TRANSPORTATION TECHNOLOGY SUPPORT
FOR DEVELOPING COUNTRIES

COMPENDIUM 15

Road and Traffic Inventories

Inventario de carreteras y tráfico

Inventaire des routes et de la circulation

prepared under contract AID/OTR-C-1591, project 931-1116,
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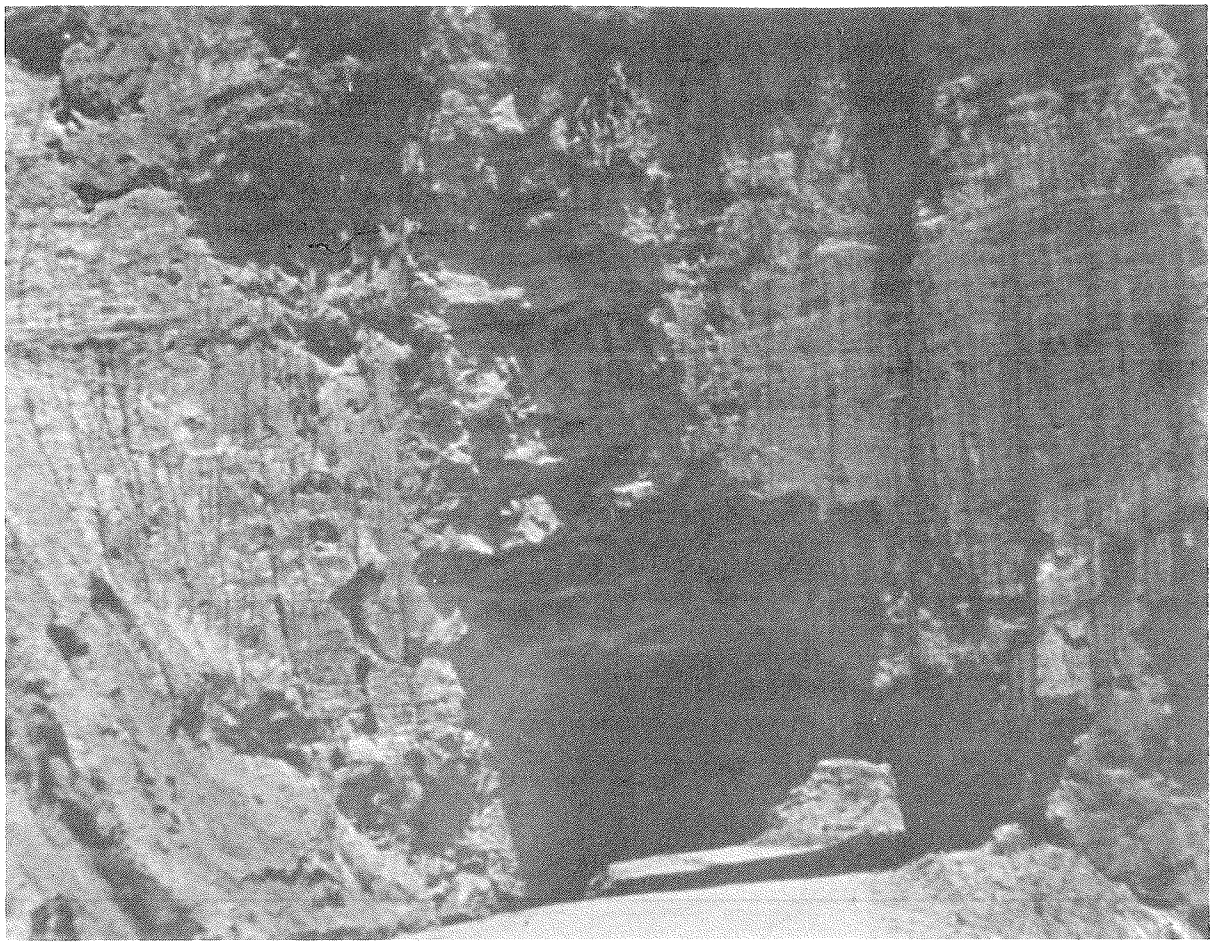
Notice

The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competence and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

Cover photo: Tunnels are important inventory items in Bolivia.



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The development of agriculture, the distribution of food, the provision of health services, and the access to information through educational services and other forms of communication in rural regions of developing countries all heavily depend on transport facilities. Although rail and water facilities may play important roles in certain areas, a dominant and universal need is for road systems that provide an assured and yet relatively inexpensive means for the movement of people and goods. The bulk of this need is for low-volume roads that generally carry only 5 to 10 vehicles a day and that seldom carry as many as 400 vehicles a day.

The planning, design, construction, and maintenance of low-volume roads for rural regions of developing countries can be greatly enhanced with respect to economics, quality, and performance by the use of low-volume road technology that is available in many parts of the world. Much of this technology has been produced during the developmental phases of what are now the more developed countries, and some is continually produced in both the less and the more developed countries. Some of the technology has been documented in papers, articles, and reports that have been written by experts in the field. But much of the technology is

Descripción del proyecto

En las regiones rurales de países en desarrollo, el desarrollo de la agricultura, la distribución de víveres, la provisión de servicios de sanidad, y el acceso a información por medio de servicios educacionales y otras formas de comunicación, dependen en gran parte de los medios de transporte. Aunque en ciertas áreas los medios de ferrocarril y agua desempeñan un papel importante, existe una necesidad universal y dominante de crear sistemas viales que provean un medio asegurado pero relativamente poco costoso para el movimiento de gente y mercancías. La mayor parte de esta necesidad se solucionaría con la construcción de caminos de bajo volúmen que generalmente moverían únicamente de 5 a 10 vehículos por día y que pocas veces moverían tanto como 400 vehículos por día.

El planeamiento, diseño, construcción y mantenimiento de caminos de bajo volúmen para regiones rurales de países en desarrollo pueden ser mejorados, con respecto al costo, calidad, y rendimiento, por el uso de la tecnología de caminos de bajo volúmen que se encuentra disponible en muchas partes del mundo. Mucha de esta tecnología ha sido producida durante las épocas de desarrollo de lo que ahora son los países más desarrollados, y alguna se produce contínuamente en estos países así como en los países menos desarrollados. Parte de la tecnología se ha documentado en disertaciones, artículos, e informes que han sido escritos por expertos en el campo. Pero mucha de la tecnología no está documentada y existe principalmente en la memoria de aquellos que han desa-

Description du projet

Dans les régions rurales des pays en voie de développement, l'exploitation agricole, la distribution des produits alimentaires, l'accès aux services médicaux, l'accès aux matériaux et aux marchandises, à l'information et aux autres services, dépendent en grande partie des moyens de transport. Bien que les transports par voie ferrée et par voie navigable jouent un rôle important dans certaines régions, un besoin dominant et universel éxiste d'un réseau routier qui puisse assurer avec certitude et d'une façon relativement bon marché, le déplacement des habitants, et le transport des marchandises. La plus grande partie de ce besoin peut être satisfaite par la construction de routes à faible capacité, capables d'accommoder un trafic de 5 a 10 véhicules par jour, ou plus rarement, jusqu'à 400 véhicules par jour.

L'utilisation des connaissances actuelles en technologie, qui sont accéssibles dans beau-

undocumented and exists mainly in the minds of those who have developed and applied the technology through necessity. In either case, existing knowledge about low-volume road technology is widely dispersed geographically, is quite varied in the language and the form of its existence, and is not readily available for application to the needs of developing countries.

In October 1977 the Transportation Research Board (TRB) began this 3-year special project under the sponsorship of the U.S. Agency for International Development (AID) to enhance rural transportation in developing countries by providing improved access to existing information on the planning, design, construction, and maintenance of low-volume roads. With advice and guidance from a project steering committee, TRB defines, produces, and transmits information products through a network of correspondents in developing countries. Broad goals for the ultimate impact of the project work are to promote effective use of existing information in the economic development of transportation infrastructure and thereby to enhance other aspects of rural development throughout the world.

In addition to the packaging and distribution of technical information, personal interactions with users are provided through field visits, con-

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rrollado y aplicado la tecnología por necesidad. En cualquier caso, los conocimientos en existencia sobre la tecnología de caminos de bajo volúmen están grandemente esparcidos geográficamente, varian bastante con respecto al idioma y su forma, y no se encuentran fácilmente disponibles para su aplicación a las necesidades de los países en desarrollo.

En octubre de 1977 el Transportation Research Board (TRB) comenzó este proyecto especial de tres años de duración bajo el patrocinio de la U.S. Agency for International Development (AID) para mejorar el transporte rural en los países en desarrollo acrecentando la disponibilidad de la información en existencia sobre el planeamiento, diseño, construcción, y mantenimiento de caminos de bajo volúmen. Con el consejo y dirección de un comité de iniciativas para el proyecto, el TRB define, produce, y transmite productos informativos a través de una red de corresponsales en países en desarrollo. Las metas generales para el impacto final del trabajo del proyecto son la promoción del uso efectivo de la información en existencia en el desarrollo económico de la infraestructura de transporte y de esta forma mejorar otros aspectos del desarrollo rural a través del mundo.

Además de la recolección y distribución de la

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coup de pays, peut faciliter l'étude des projets de construction, tracé et entretien, de routes à faible capacité dans les régions rurales des pays en voie de développement, surtout en ce qui concerne l'économie, la qualité, et la performance de ces routes. La majeure partie de cette technologie a été produite durant la phase de développement des pays que l'on appelle maintenant développés, et elle continue à être produite à la fois dans ces pays et dans les pays en voie de développement. Certains aspects de cette technologie ont été documentés dans des articles ou rapports écrits par des experts. Mais une grande partie des connaissances n'existe que dans l'esprit de ceux qui ont eu besoin de développer et appliquer cette technologie. De plus, dans ces deux cas, les écrits et connaissances sur la technologie des routes à faible capacité, sont dispersés géographiquement, sont écrits dans des langues différentes, et ne sont pas assez aisément accessibles pour être appliqués aux besoins des pays en voie de développement.

En octobre 1977, le Transportation Research Board (TRB) initia ce projet, d'une duré de 3 ans, sous le patronage de l'U.S. Agency for International Development (AID), pour améliorer le transport rural dans les pays en voie de développement, en rendant plus accessible la documentation existante sur la conception, le tracé, la construction, et l'entretien des routes à faible capacité. Avec le conseil, et sous la conduite d'un comité de direction, TRB définit, produit, et transmet cette documentation à l'aide d'un réseau de correspondants dans les pays en voie de développement. Nous espérons que le résultat final de ce projet sera de favoriser l'utilisation de cette documentation, pour aider au développement économique de l'infrastructure des transports, et de cette façon mettre en valeur d'autres aspects d'exploitation rurale à travers le monde.

ferences in the United States and abroad, and other forms of communication.

Steering Committee

The Steering Committee is composed of experts who have knowledge of the physical and social characteristics of developing countries, knowledge of the needs of developing countries for transportation, knowledge of existing transportation technology, and experience in its use.

Major functions of the Steering Committee are to assist in the definition of users and their needs, the definition of information products that match user needs, and the identification of informational and human resources for development of the information products. Through its membership the committee provides liaison with project-related activities and provides guidance for interactions with users. In general the Steering Committee gives overview advice and direction for all aspects of the project work.

The project staff has responsibility for the preparation and transmittal of information products, the development of a correspondence network throughout the user community, and interactions with users.

Information Products

Three types of information products are prepared: compendiums of documented information on relatively narrow topics, syntheses of knowledge and practice on somewhat broader

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información técnica, se provee acciones recíprocas personales con los usuarios por medio de visitas de campo, conferencias en los Estados Unidos de Norte América y en el extranjero, y otras formas de comunicación.

Comité de iniciativas

El comité de iniciativas se compone de expertos que tienen conocimiento de las características físicas y sociales de los países en desarrollo, conocimiento de las necesidades de transporte de los países en desarrollo, conocimiento de la tecnología de transporte en existencia, y experiencia en su uso.

Las funciones importantes del comité de iniciativas son las de ayudar en la definición de usuarios y sus necesidades, de productos informativos que se asemejan a las necesidades del usuario, y la identificación de recursos de conocimientos y humanos para el desarrollo de los productos informativos. A través de sus miembros el comité provee vínculos con actividades relacionadas con el proyecto y también una guía para la interacción con los usuarios. En general el comité de iniciativas proporciona consejos y dirección general para todos los aspectos del trabajo de proyecto.

El personal de proyecto es responsable de la preparación y transmisión de los productos informativos, el desarrollo de una red de corresponsales a través de la comunidad de usuarios, y la interacción con los usuarios.

Productos informativos

Se preparan tres tipos de productos informativos: los compendios de la información documentada sobre temas relativamente limitados, la síntesis del conocimiento y práctica sobre temas

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En plus de la dissémination de cette documentation technique, des visites, des conférences aux Etats Unis et à l'étranger, et d'autres formes de communication permettront une interaction constante avec les usagers.

Comité de direction

Le comité de direction est composé d'experts qui ont à la fois des connaissances sur les caractéristiques physiques et sociales des pays en voie de développement, sur leurs besoins au point de vue transports, sur la technologie actuelle des transports, et ont aussi de l'expérience quant à l'utilisation pratique de cette technologie.

Les fonctions majeures de ce comité sont d'abord d'aider à définir les usagers et leurs besoins, puis de définir leurs besoins en matière de documentation, et d'identifier les ressources documentaires et humaines nécessaires pour le développement de cette documentation. Par l'intermédiaire des ses membres, le comité pourvoit à la liaison entre les différentes fonctions relatives au projet, et dirige l'interaction avec les usagers. En général, le comité de direction conseille et dirige toutes les phases du projet.

Notre personnel est responsable de la préparation et de la dissémination des documents, du développement d'un réseau de correspondants pris dans la communauté d'usagers, et de l'interaction avec les usagers.

La documentation

Trois genres de documents sont preparés: des recueils dont le sujet est relativement limité, des

subjects, and proceedings of low-volume road conferences that are totally or partially supported by the project. Compendiums are prepared by project staff at the rate of about 6 per year; consultants are employed to prepare syntheses at the rate of 2 per year. At least one conference proceedings will be published during the 3-year period. In summary, this project aims to produce and distribute between 20 and 30 publications that cover much of what is known about low-volume road technology.

Interactions With Users

A number of mechanisms are used to provide interactions between the project and the user community. Project news is published in each issue of *Transportation Research News.* Feedback forms are transmitted with the information products so that recipients have an opportunity to say how the products are beneficial and how they may be improved. Through semiannual visits to developing countries, the project staff acquires first-hand suggestions for the project work and can assist directly in specific technical problems. Additional opportunities for interaction with users arise through international and in-country conferences in which there is project participation. Finally, annual colloquiums are held for students from developing countries who are enrolled at U.S. universities.

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un poco más amplios, y los expedientes de conferencias de caminos de bajo volúmen que están totalmente o parcialmente amparados por el proyecto. El personal de proyecto prepara los compendios a razón de unos 6 por año; se utilizan consultores para preparar las síntesis a razón de 2 por año. Se publicará por lo menos un expediente de conferencia durante el período de tres años. En breve, este proyecto pretende producir y distribuir entre 20 y 30 publicaciones que cubren mucho de lo que se conoce de la tecnología de caminos de bajo volúmen.

Interacción con los usuarios

Se utilizan varios mecanismos para proveer las interacciones entre el proyecto y la comunidad de usuarios. Se publican las noticias del proyecto en cada edición de la *Transportation Research News.* Se transmiten, con los productos informativos, formularios de retroacción para que los recipientes tengan oportunidad de decir cómo benefician los productos y cómo pueden ser mejorados. A través de visitas semianuales a los países en desarrollo, el personal del proyecto adquiere directamente de fuentes originales sugerencias para el trabajo del proyecto y puede asistir directamente en problemas técnicos específicos. Surgen oportunidades adicionales para la interacción con los usuarios a través de conferencias internacionales y nacionales en donde participa el proyecto. Finalmente, se organizan diálogos con estudiantes de países en desarrollo que están inscriptos en universidades norteamericanas.

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synthèses de connaissances et de pratique sur des sujets beaucoup plus généraux, et finalement des comptes-rendus de conférences sur les routes à faible capacité, qui seront organisées complètement ou en partie par notre projet. Environ 6 recueils par an sont preparés par notre personnel. Deux synthèses par an sont écrites par des experts pris à l'extérieur. Les comptes-rendus d'au moins une conférence seront écrits dans une période de 3 ans. En résumé, l'objet de ce projet est de produire et disséminer entre 20 et 30 documents qui couvriront l'essentiel des connaissances sur la technologie des routes à faible capacité.

Interaction avec les usagers

Un certain nombre de mécanismes sont utilisés pour assurer l'interaction entre le personnel du projet et la communauté d'usagers. Un bulletin d'information est publié dans chaque numéro de *Transportation Research News.* Des formulaires sont joints aux documents, afin que les usagers aient l'opportunité de juger de la valeur de ces documents et de donner leur avis sur les moyens de les améliorer. Au cours de visites semi-annuelles dans les pays en voie de développement notre personnel obtient de première main des suggestions sur le bon fonctionnement du projet et peut aider à résoudre sur place certains problèmes techniques spécifiques. En outre, des conférences tenues soit aux Etats Unis, soit à l'étranger, sont l'occasion d'un échange d'idées entre notre personnel et les usagers. Finalement, des colloques annuels sont organisés pour les étudiants des pays en voie de développement qui étudient dans les universités américaines.

Foreword and Acknowledgments

This book is the seventeeth product of the Transportation Research Board's project on Transportation Technology Support for Developing Countries under the sponsorship of the U.S. Agency for International Development. The objective of this book is that it provide useful and practical information for those in developing countries who have direct responsibility for road and traffic inventories.

Feedback from correspondents in developing countries will be solicited and used to assess the degree to which this objective has been attained and to influence the nature of later products.

Acknowledgment is made to the following publishers for their kind permission to reprint the selected text portions of this compendium: University of California; Federal Highway Administration; and Purdue University.

Prefacio y agradecimientos

Este libro es el décimosepto producto del proyecto del Transportation Research Board sobre Apoyo de Tecnología de Transporte para Países en Desarrollo bajo el patrocinio de la U.S. Agency for International Development. El objetivo de este libro es el de proveer información útil y práctica para aquellos en países en desarrollo quienes tienen responsabilidad directa para inventario de carreteras y tráfico.

Se pedirá a los corresponsales en los países en desarrollo información sobre los resultados, para utilizarse en el asesoramiento del grado al cual se ha obtenido ese objetivo, y para influenciar la naturaleza de productos subsequentes.

Se reconoce a los siguientes editores por el permiso dado para reimprimir las porciones de texto seleccionadas para este compendio: University of California; Federal Highway Administration; y Purdue University.

Avant-propos et remerciements

Ce livre représente le septième volume du projet du Transportation Research Board sur la Technologie des transports à l'usage des pays en voie de développement. Ce projet est placé sous le patronage de l'U.S. Agency for International Development. L'objet de ce recueil est de réunir une documentation pratique et utile qui puisse aider les personnes responsables de l'inventaire des routes et de la circulation. La réaction des correspondants des pays en voie de développement sera sollicitée et utilisée pour évaluer à quel point le but proposé de ce projet a été atteint, et pour influencer la nature des ouvrages à venir.

Nous remercions les éditeurs qui ont gracieusement donné leur permission de reproduire les textes sélectionnés pour ce recueil: University of California; Federal Highway Administration; et Purdue University.

Appreciation is also expressed to libraries and information services that provided references and documents from which final selections were made for the selected texts and bibliography of this compendium. Special acknowledgment is made to the U.S. Department of Transportation Library Services Division and to the Library and Information Service of the U.K. Transport and Road Research Laboratory (TRRL).

Finally, the Transportation Research Board acknowledges the valuable advice and direction that have been provided by the project Steering Committee and is especially grateful to W. Ronald Hudson, University of Texas at Austin; Lynne H. Irwin, Cornell University; and Melvin B. Larsen, Illinois Department of Transportation, who provided special assistance on this particular compendium.

También se reconoce a las bibliotecas y servicios de información que proveen las referencias y documentos de los cuales se hacen las selecciones finales para los textos seleccionados y la bibliografía en este compendio. Se hace un especial reconocimiento a la Library Services Division del U.S. Department of Transportation y el Library and Information Service del U.K. Transport and Road Research Laboratory (TRRL).

Finalmente, el Transportation Research Board agradece el consejo y dirección valiosos provistos por el comité de iniciativas, con especial reconocimiento a los señores W. Ronald Hudson, University of Texas at Austin, Lynne H. Irwin, Cornell University, y Melvin B. Larsen, Illinois Department of Transportation, que prestaron ayuda especial para este compendio en particular.

Nos remerciements aussi aux bibliothèques et bureaux de documentation qui nous ont fourni les documents et les références utilisés dans les textes choisis et bibliographie de ce recueil. Nous remercions spécialement la U.S. Department of Transportation Library Services Division et les Library and Information Service of the U.K. Transport and Road Research Laboratory (TRRL).

Finalement, le Transportation Research Board reconnait la grande valeur de la direction et de l'assistance des membres du comité de direction et les remercie de leur concours et de la façon dont ils dirigent le projet, spécialement W. Ronald Hudson, University of Texas at Austin, Lynne H. Irwin, Cornell University, et Melvin B. Larsen, Illinois Department of Transportation, qui ont bien voulu prêter leur assistance à la préparation de ce récueil.

Overview

Background and Scope

A road inventory is the collection and organization of a road system's physical data. Its original purpose was to obtain sufficient information to prepare maps that show all the roads and associated facilities served by the roads; together, these comprise a highway system. These maps —and the data collected to make them—are used to compile statistics about the various types of roadways in the system. Traffic counts, which may be defined as an inventory of road use, are often shown on these maps to assist officials in the evaluation of the various road types.

Today, road and traffic inventories are the basis for all advance road programming. By using these basic data, roads can be classified, road deficiencies and needs can be analyzed, and logical operational plans can be formulated to bring the road system up to acceptable standards. Road inventories may be supplemented by aerial photography, which, when available, is a less costly tool for developing road system base maps. However, once a base map is prepared, the remaining physical data must still be collected on the ground, from construction plans, and from physical traffic counts. These data may be transferred to base maps to show the classification of roads by surface types and to depict the traffic volumes throughout the sys-

Vista General

Antecedentes y alcance

Un inventario de caminos es la recolección y organización de los datos físicos de un sistema de caminos. Su propósito original fue obtener suficiente información para preparar mapas que muestren todos los caminos y los servicios afines que éstos sirven; juntos, representan un sistema de carreteras. Estos mapas—y los datos recolectados para prepararlos—son utilizados para recopilar estadísticas sobre los diversos tipos de caminos del sistema. Los conteos de tránsito, que se podrían definir como un inventario del uso del camino, aparecen a menudo en estos mapas para ayudar a los funcionarios en la evaluación de los diferentes tipos de caminos.

Hoy en día, los inventarios de caminos de tráfico, son la base de toda programación vial anticipada. Utilizando estos datos básicos se pueden clasificar los caminos, analizar las deficiencias y necesidades de las vías y formular planes operacionales lógicos para elevar el sistema de caminos a niveles aceptables. Puede suplementarse los inventarios de caminos con fotografías aéreas que, cuando están disponibles, representan una herramienta menos cos-

Exposé

Historique et description

Dresser un inventaire routier consiste à rassembler et à ordonner toutes les informations sur l'état physique du réseau routier, afin de pouvoir les utiliser pour préparer des cartes qui renseignent toutes les routes et services apparentés qu'elles desservent; ensemble, ceux-ci forment un réseau routier. On emploie ces cartes—et les informations rassemblées pour les dresser—dans le but d'obtenir des statistiques sur les différents types de routes du réseau. Les recensements de la circulation, que l'on pourrait définir comme un inventaire de l'utilisation des routes, y sont souvent indiqués afin que les administrateurs puissent juger des diverses classes de route.

De nos jours, les inventaires des routes et de la circulation sont à la base de toute programmation routière pour le futur. En utilisant ces données de base, on peut classifier les routes, analyser leur insuffisance et les améliorations à apporter, et formuler des plans d'action cohérents pour amener le réseau à un niveau accep-

tem. These data may also be recorded on charts, graphs, or tables that have been developed manually or by computer.

Advance planning activities further require (a) a functional classification of the roads, (b) an adequacy rating for each road, (c) a determination of roadway improvement needs, and (d) a priority analysis to determine in which order these roadway improvements should be undertaken. Compendium 15 provides some information about the general highway planning process so that highway engineers and administrators may understand the role of inventories in the decision-making process. However, most of this compendium addresses the actual procedure of collecting and recording road and traffic inventory data. It does not attempt to advise the professional about decision-making activities in classifying, rating, or analyzing roads. This compendium is directed to those people who must collect and record the basic inventory data input in a systematic and economic manner.

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tosa para desarrollar mapas base del sistema vial. Sin embargo, una vez que se ha preparado el mapa base, aún deben recolectarse en el terreno los demás datos físicos empleando los planos de construcción y los conteos físicos de tráfico. Pueden transferirse estos datos a mapas base para mostrar la clasificación de caminos por tipo de superficie, y para representar los volúmenes de tránsito a través del sistema. También pueden registrarse los datos en diagramas, gráficos o cuadros que han sido desarrollados manualmente o por computadoras.

Las actividades anticipadas de planeamiento, requieren además (a) una classificación funcional de los caminos, (b) una classificación de adecuación de cada camino, (c) una determinación de las necesidades de mejoramiento de las vías, y (d) un análisis de prioridad para determinar el orden en que deben ejecutar estos mejoramientos. El Compendio 15 ofrece información sobre el proceso general de planeamiento de carreteras de tal manera que los administradores y los ingenieros de carreteras puedan comprender el rol de los inventarios en el proceso de toma de decisión. Sin embargo, la mayor parte de este compendio cubre el procedimiento mismo de recolectar y anotar datos sobre inventarios de caminos y de tránsito. No trata de aconsejar al profesional sobre actividades en la toma de decisiones para clasificar, ordenar on analizar los caminos. Este compendio está dirigido a aquellas personas que deben recolectar y anotar los datos básicos del inventario de una manera sistemática y económica.

Exposición razonada para este compendio

El planeamiento de programas de conservación y mejoramiento debe empezar con una base de

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table. Les inventaires routiers peuvent être complémentés par des photographies aériennes qui, lorsqu'elles sont disponibles, représentent un outil moins coûteux pour l'élaboration des cartes de base du réseau routier. Néanmoins, une fois celles-ci préparées, certaines données physiques doivent encore être obtenues sur le terrain, des plans de construction, et des comptages du trafic. On peut transférer ces données sur des cartes de base, afin de montrer la classification des routes selon leurs différentes surfaces de roulement et afin d'indiquer le volume du trafic dans tout le réseau. On peut également les enregistrer sous la forme de tables de calcul, de graphiques ou de tableaux préparés soit manuellement soit par ordinateur.

Afin de planifier pour le futur, il faut aussi au préalable : (a) classer les routes selon leur fonction, (b) estimer si chaque route est adéquate, (c) déterminer les améliorations nécessaires, et (d) analyser les priorités pour définir dans quel ordre ces améliorations doivent être apportées. Le Recueil 15 fournit certaines informations sur le processus général de planification routière de façon à ce que les ingénieurs et administrateurs des routes puissent comprendre le rôle des inventaires dans le processus de prise de décision. Cependant, on y explique surtout comment réunir et enregistrer les données pour un inventaire des routes et de la circulation. Ce recueil ne cherche pas à conseiller le professionnel sur les activités de prise de décision lors de la classification, de l'évaluation ou de l'analyse des routes. Il s'adresse aux personnes qui doivent rassembler et enregistrer les données de base d'un inventaire d'une façon systématique et économique.

Objectif de ce recueil

Une connaissance de base de l'état du réseau routier et de son utilisation est indispensable avant de commencer la planification de pro-

Rationale for This Compendium

The planning of road maintenance and improvement programs should start with a foundation of knowledge about the physical nature and use of the existing road system. This information is obtained during the inventory process.

Both road and traffic inventories represent a major investment in time and labor. Inventory work can be slow and tedious. Therefore, it should be carefully planned and closely supervised so that (a) the information needed will be collected the first time, (b) the information collected will be in usable form, (c) the collection techniques will be as efficient as possible, (d) the information collected will be consistent and accurate, and (e) unnecessary information will not be collected.

Many publications are available both in the United States and abroad that describe the more advanced planning tools that use the data collected in the inventory process (e.g., functional classifications, adequacy ratings, improvement needs and priority analyses, and traffic projections). Very little has been published about the road inventory itself. Although the first rural road inventory program was begun in the United States in 1936, it was not until well after

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conocimientos sobre la naturaleza y el uso físico del sistema de caminos existente. Se obtiene esta información durante el proceso de inventario.

Los inventarios de caminos y de tránsito representan una inversión importante de tiempo y de personal. El trabajo de inventario puede ser lento y tedioso. Por eso, debe ser planeado y supervisado cuidadosamente de manera que (a) la información necesaria sea recolectada la primera vez, (b) la información recolectada sea utilizable directamente, (c) las técnicas de recolección sean tan eficientes como sea posible, (d) la información recolectada sea consistente y precisa, y (e) no se recolecte información innecesaria.

Hay varias publicaciones disponibles en los Estados Unidos de Norteamérica y en el extranjero que describen los métodos de planeamiento más avanzados, utilizando los datos recolectados en el proceso del inventario (por ejemplo, clasificaciones funcionales, tasas de adecuación, necesidades de mejoramiento y análisis de prioridad, y proyecciones de tránsito). Muy poco se ha publicado sobre el inventario mismo de caminos. Mientras que el primer programa de inventario de caminos rurales se inició en los Estados Unidos en 1936, no fue hasta mucho después de la Segunda Guerra Mundial que se refinaron las técnicas de recolección y recopilación de datos y se analizaron sistemáticamente los datos estadísticos. Una vez terminado el inventario preliminar, la actividad de inventario adicional puede limitarse a poner al día y a corregir los datos básicos del inventario. En consecuencia, es extremadamente importante la precisión e integridad del inventario inicial.

El primer texto seleccionado describe los usos de los datos del inventario inicial y los mé-

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grammes d'entretien et d'amélioration. On obtient ces informations au cours de l'inventaire.

Tant les inventaires des routes que ceux de la circulation représentent un investissement important de temps et de main-d'oeuvre. Dresser un inventaire est parfois un travail lent et fastidieux. C'est la raison pour laquelle il doit être soigneusement planifié et suivi, afin (a) d'obtenir en une seule fois le données nécessaires, (b) de présenter l'information réunie sous une forme utilisable, (c) d'appliquer des techniques d'obtention des données aussi efficaces que possible, (d) de réunir des données cohérentes et exactes, et (e) de ne pas inclure d'informations superflues.

Il existe de nombreuses publications, aussi bien aux Etats-Unis qu'à l'étranger, décrivant les instruments de planification les plus modernes qui utilisent les données réunies au cours des inventaires (par exemple, la classification par fonction, l'évaluation des routes selon qu'elles sont ou non adéquates, l'analyse des améliorations nécessaires et de leur ordre de priorité, et les projections de trafic). Très peu a été publié sur l'inventaire même. Bien que le premier programme d'inventaire routier en milieu rural ait débuté aux Etats-Unis en 1936, les techniques pour rassembler at enregistrer les informations n'ont été améliorées et les données statistiques systématiquement analyses que longtemps aprês la seconde guerre mondiale. Le premier inventaire doit absolument être trés compet et exact, vu qu'il sert de base aux inventaires suivants pour lesquels on se limite à le mettre à jour et à corriger certaines données.

Dans le premier texte choisi on décrit l'emploi des premiéres données de l'inventaire ainsi que certaines méthodes pour les présenter sur di-

World War II that the techniques for collecting and compiling the data were refined and the statistical data systematically analyzed. After the preliminary inventory has been completed, additional inventory activity can be limited to updating and correcting the basic inventory data. Consequently, the accuracy and completeness of the initial inventory are extremely important.

The first selected text describes the uses of early inventory data and methods of summarizing that data on various maps to aid governmental agencies and the public. The second text presents general instructions for the preparation of a road inventory. The third text describes the mechanics of making traffic counts on rural roads. The early inventories were recorded manually on forms, which were then also manually analyzed and summarized. The first three texts describe the types and amount of data to be collected. Although the recording and documentation of this information are not described in detail, either hand or machine tabulation of these data is possible.

The next three selected texts were prepared by the Foreign Projects Division, Federal Highway Administration (FHWA), U.S. Department of Transportation. These documents were prepared as a part of a basic rural highway planning system. This program was designed by using the concept of collecting the minimum basic information needed to plan and operate an efficient highway transportation program. The program was designed to minimize the manual effort and maximize the use of a computer.

The fourth selected text presents an overall outline of the highway transportation planning process. This process can be followed without the aid of a computer. However, by using the

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todos para reuniresos datos en diversos mapas a fín de ayudar los organismos gubernamentales y al público. El segundo texto presenta instrucciones generales sobre la preparación de un inventario de caminos. El tercer texto describe la mecánica para hacer conteos de tránsito en caminos rurales. Los primeros inventarios fueron anotados en formularios que eran después analizados y resumidos. Los tres primeros textos describen los tipos y cantidad de datos que deben recolectarse. Aunque la anotación y documentación de esta información no están descritos en detalle, es posible tabular estos datos sea manualmente o con calculadora.

Los tres textos seleccionados siguientes fueron preparados por la Foreign Projects Division, Federal Highway Administration, U.S. Department of Transportation (División de Proyectos Extranjeros, Administración General de Carreteras, Departamento de Transportes de los Estados Unidos de Norteamérica). Estos documentos fueron preparados como parte de un sistema básico de planeamiento de carreteras rurales. Este programa fue diseñado utilizando el concepto de recoletar la información mínima básica necesaria para planear y operar un programa eficiente de transporte por carretera. El programa fue diseñado para minimizar el esfuerzo manual y aumentar al máximo el uso de computadoras.

El cuarto texto seleccionado presenta un bosquejo general del proceso de planeamiento de

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verses cartes qui servent aux organismes gouvernementaux et au public. Le second texte donne des instructions générales pour la préparation d'un inventaire routier. Dans le troisième texte, on décrit les procédés de comptage de la circulation sur routes locales. Les premiers inventaires furent enregistrés manuellement sur des formulaires, à leur tour analysés et résumés à la main. Dans les trois premiers textes, on indique quel genre d'information réunir et en quelle quantité. La façon d'enregistrer et de présenter ces informations n'est pas décrite en détail, mais on peut le faire sous forme de tables préparées soit à la main, soit à la machine.

Les trois textes suivants sont l'oeuvre de la Foreign Project Division de la Federal Highway Administration du U.S. Department of Transportation. Ils font partie d'un système de base de planification pour les routes rurales. Ce projet fut élaboré en réunissant le minimum de données de base nécessaires pour planifier et mettre en oeuvre un programme efficace de transport routier. Il fut conçu afin de minimiser le travail manuel et d'utiliser au maximum l'ordinateur.

Le quatrième texte donne une vue générale du processus de planification du transport routier. On peut appliquer cette méthode sans l'aide d'un ordinateur. Cependant, les récents progrès techniques dans le traitement des données rendent possibles de nombreuses analyses qui autrement seraient trop coûteuses et très difficiles à réaliser à la main.

Dans les cinquième et sixième textes, on décrit comment établir un inventaire des routes et une étude de la circulation, adaptés à un systéme basé sur l'emploi de l'ordinateur. Pour les

latest technical advances in engineering and data processing, many analyses are possible that otherwise would be uneconomic and very difficult to perform manually.

The fifth and sixth texts detail the mechanics of making road inventories and traffic surveys for use in a computer-based system. The same information requirements and the same collection procedures are applicable to manual inventories. These texts describe one method of recording the information on field data forms. These are then submitted directly to keypunch operators for entry into a computer.

These three selected texts are part of a package of seven manuals of instructions and computer programs prepared and distributed by the Federal Highway Administration (see Additional Texts Nos. 10 through 15). The manuals were prepared for use in Argentina; all except the seventh — ***Computer Program User's Manual*** — are available in both English and Spanish.

At the IV African Highway Congress in Nairobi, Kenya, January 20-25, 1980, a paper on the ***Rural Highway Planning System*** was presented that describes this computer program. The paper notes that

> Should any country desire to install this system, the FHWA will send copies of the manuals, computer programs and test data. The computer programs and test data will be copied onto five computer tapes. Also available [are] the ***Computer Program Installation Guide*** and sample outputs of the key programs. This documentation and support data should make it easy for

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transporte por carretera. Puede seguirse este proceso sin necesidad de computadoras. Sin embargo, usando los últimos avances técnicos en ingeniería y procesamiento de datos, es posible hacer muchos análisis que de otra manera serían antieconómicos y difíciles de ejecutar manualmente.

El quinto y el sexto textos detallan el método para realizar inventarios viales y estudios de tránsito, empleando sistemas basados en computadoras. Los mismos requerimientos de información y los mismos procedimientos de recolección son aplicables a los i nventarios manuales. Estos textos describen un método para registrar la información en formularios de datos de campo. Estos son luego entregados directamente a los perforadores de tarjetas para su ingreso a la computadora.

Estos tres textos seleccionados forman parte de una serie de siete manuales de instrucciones y programas de computadoras preparada y distribuída por el Federal Highway Administration (ver Textos Adicionales N° 10 a 15) . Los manuales fueron preparados para su empleo en Argentina; todos, excepto el séptimo — ***Computer Program User's Manual*** (Manual para el uso de programas de computadoras) — están disponibles en inglés y en español.

En el IV Congreso Africano de Carreteras en Nairobi, Kenia, 20-25 de Enero de 1980, se presentó un trabajo sobre el ***Rural Highway Planning System*** (Sistema de planeamiento de carreteras rurales) que describe este sistema de computadoras. El trabajo indica que

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inventaires faits manuellement, on peut utiliser les mêmes informations, rassemblées de la même manière. Ces textes présentent une méthode pour enregistrer l'information sur des formulaires remplis sur le terrain et soumis directement aux perforatrices pour les faire entrer dans l'ordinateur.

Ces trois textes choisis forment partie d'un ensemble de sept manuels d'instructions et de programmes pour ordinateurs, publiés par la Federal Highway Administration (voir Textes Additionnels, Nos. 10 a 15). Ces manuels étaient destinés à l'Argentine; tous, sauf le septième — le ***Computer Program User's Manual*** (Manuel pour l'utilisation du programme d'ordinateur) — existent en anglais et en espagnol.

Ce programme a été décrit dans une communication sur le ***Rural Highway Planning System*** (Système de planification du réseau rural), présentée au IV African Highway Congress tenu à Nairobi, Kenya, du 20 au 25 janvier 1980. On y mentionne que :

> Si un pays désire installer ce système, la FHWA lui enverra un exemplaire des manuels, des logiciels et de la banque de données. Les logiciels et la banque de données seront enregistrés sur cinq bandes magnétiques. On peut également se procurer le ***Computer Program Installation Guide*** (Guide pour la mise à point du programme d'ordinateur), ainsi qu'un exemple des sorties des programmes clefs. Tant ces documents que la banque de données devraient faciliter la mise à point des programmes sur les ordinateurs de n'importe quel pays. Tou-

any country to properly install the programs upon its computers. All information will be provided free of charge. The FHWA need only be reimbursed for the cost of the computer tapes.

After any country has reviewed these manuals and support information, FHWA personnel will be available to provide a limited amount of technical assistance. This assistance would include answering any questions, explaining the program in detail and discussing the desirability and methods of initiating this program within the interested country.

The importance of accuracy and consistency in the collection of both road and traffic inventory data, cannot be overstated. Inventories should be made by as few people as possible. These people should be well trained and aware of the importance of thoroughness. Otherwise, the data collected will not be homogeneous, and the analyses of the results will lead to incorrect conclusions.

Discussion of Selected Texts

The first text, *Maintaining and Using a Rural Road Inventory,* was published in the *Proceedings of the Ninth California Street and Highway Conference* (University of California, 1957). It describes the early use of road inventories in California. The preparation of maps was a major output of the early inventories. In California, three series of maps were produced. The General Highway Map showed the highways and roads classified by surface types. The Traffic Map, by means of average daily traffic (ADT) volume groups, showed the traffic recorded on the more important roads, the traffic count sta-

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Si algún país quisiera instalar este sistema, el FHWA enviará copias de los manuales, programas de computadora y datos de las pruebas. Los programas de computadora y los datos de los ensayos serán copiados en cinco cintas de computadora. También estarán disponibles el *Computer Program Installation Guide* (Guía para la instalación de programas de computadoras) y las muestras de rendimiento de los programas claves. Esta documentación y los datos suplementarios facilitarán a cualquier país la instalación correcta de los programas en sus computadoras. Toda la información será distribuída sin costo. El FHWA debe ser reembolsado únicamente por el costo de las cintas para computadora.

Después que un país ha revisado estos manuales y la información suplementaria, el personal del FHWA estará disponible para proporcionar una cantidad limitada de asistencia técnica. Esta ayuda incluiría responder cualquier pregunta, explicar en detalle los programas y discutir la conveniencia y los métodos para iniciar este programa en el país interesado.

La importancia de la precisión y consistencia en la recolección de datos del inventario de caminos y tránsito no puede estar exagerada. Los inventarios deben ser hechos por la menor cantidad posible de personas. Estas deben estar bien entrenadas y conscientes de la importancia de efectuar un trabajo minucioso. De otra manera, los datos recolectados no serán homogéneos y los análisis de los resultados conducirán a conclusiones incorrectas.

Presentación de los textos seleccionados

El primer texto, *Maintaining and Using a Rural Road Inventory* (Manteniendo y utilizando un in-

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tes les informations seront fournies gratuitement. La FHWA n'exigera que le remboursement des bandes magnétiques.

Une fois qu'un pays a étudié cette documentation, la FHWA met son personnel à sa disposition pour lui offrir certaine assistance technique, au cours de laquelle on peut répondre aux questions qui pourraient surgir, expliquer le programme en détail et discuter de la désirabilité du programme et de la façon de l'initier dans le pays interessé.

On ne peut trop insister sur l'importance d'obtenir des données exactes et cohérentes, tant pour l'inventaire des routes que de la circulation. Le nombre de personnes participant aux inventaires doit être restreint au minimum. De plus, elles doivent être bien préparées et conscientes de l'importance d'actuer avec précision, sans quoi les données réunies manqueront d'homogénéité et les conclusions tirées de l'analyse des résultats ne seront pas correctes.

Discussion des textes choisis

Le premier texte, *Maintaining and Using a Rural Road Inventory* (Tenue à jour et utilisation d'un inventaire des routes rurales), a été publié dans *Proceedings of the Ninth California Street and Highway Conference* (Sommaire de la neuvième

tions, and the actual ADT recorded at each station. The County Road System Map, which could represent a provincial or other nonfederal governmental political subdivision in other countries, showed the local road names or numbers and their local classification type (i.e., primary, secondary, or tertiary).

These maps were prepared on a scale of 1 in to 1 mile (1:63, 360). In areas where congestion made detail impossible at that scale, the base maps were enlarged to 4 or 8 in to 1 mile (1:15, 840 or 1:7, 920) as the situation warranted. The inventory data and resulting maps were used for advanced planning purposes and for the allocation of construction and maintenance funding.

The second text is excerpted from *Guide for a Road Inventory Manual of Instructions* (Federal Highway Administration, 1974). This guide was issued by the federal government to assist the states in preparing their respective inventory manuals. The excerpt consists of the text of the publication. The Appendixes are not included because the information presented therein is included in a different format in Selected Text 5.

Selected Text 2 indicates that the road inventory organization and staff may vary considerably from one state to another because each state has its own internal inventory needs. Each state is required to gather certain data, however, to provide information for national summaries as prescribed by FHWA.

The second text, written 17 years after the first, illustrates the shift in road inventory emphasis from map making to statistical evaluation for

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ventario de caminos rurales), fue publicado en los *Proceedings of the Ninth California Street and Highway Conference* (Resúmenes de la novena conferencia de caminos y carreteras en California, University of California, 1957). Describe los primeros usos de inventarios viales en California. La preparación de mapas fue uno de los principales productos en los primeros inventarios. En California se produjeros tres series de mapas. El Mapa General de Carreteras mostraba las carreteras y caminos clasificados por tipos de superficie. El Mapa de Tráfico mostraba, mediante los grupos de volúmenes de tráfico promedio diario (TPD), el tráfico registrado en los caminos más importantes, las estaciones de conteo de tráfico y el TPD real registrado en cada estación. El Mapa del Sistema de Caminos del Condado (que puede representar una subdivisión provincial u otra subdivisión política gubernamental no federal en otros países), mostraba los nombres o números de caminos locales y su tipo de clasificación local (por ejemplo, primario, secundario o terciario).

Estos mapas fueron preparados a una escala de 1 pulgada por 1 milla (1:63,360). En áreas donde la congestión hacía imposible el detalle a esa escala, se ampliaron los mapas base a 4 u 8 pulgadas por 1 milla (1:15,840 ó 1:7,920) dependiendo de la situación. Los datos del inventario y los mapas resultantes fueron usados para propósitos de planeamiento anticipado y para la asignación de fondos para construcción y conservación.

El segundo texto viene de *Guide for a Road Inventory Manual of Instructions* (Guía para el manual de instrucciones del inventario vial, Federal Highway Administration, 1974). Esta guía fue impresa por el gobierno federal para ayudar a

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conférence sur les rues et routes en Californie, University of California, 1957). On y décrit les premières applications des inventaires routiers en Californie. L'élaboration de cartes en fut l'un des premiers résultats. En Californie, on produit trois series de cartes. La Carte Routière Générale montrait les routes et chemins classifiés selon leur type de surface de roulement. La Carte de la Circulation montrait, par groupes de volume de trafic journalier moyer (TJM), la circulation enregistrée sur les routes les plus importantes, les postes de comptage du trafic, et le TJM obtenu à chaque poste. La Carte du Réseau Routier du Comté (un comté correspond, dans d'autres pays, à une province ou autre subdivision politique) indiquait le nom ou le numéro des routes locales ainsi que leur classification locale (par exemple, primaire, secondaire ou tertiaire).

Ces cartes étaient à l'échelle de 1 pouce pour 1 mille (1:63.360). Pour les zones trop encombrées pour être détaillées à cette échelle, on agrandit les cartes de base à 4 ou 8 pouces pour 1 mille (1:15.840 ou 1:7.920) selon les cas. On utilisa les données de l'inventaire et les cartes obtenues à des fins de planification et pour l'allocation des fonds de construction et d'entretien.

Le second texte est extrait de *Guide for a Road Inventory Manual of Instructions* (Guide pour un manuel d'instructions pour inventaire routier, Federal Highway Administration, 1974). Ce guide fut préparé par le gouvernement fédéral pour aider les états à préparer leurs propres manuels d'inventaires routiers. Nous présentons ici la publication, sans inclure les annexes car

planning purposes. This shift reflects two major advancements in highway organizations in the United States. The first is physical. Various highway departments have been engaged in the inventory activity long enough so that they have amassed a well-documented dossier of maps. The second is technical. The advent of large computers has made the compilation and analyses of large quantities of statistical data fairly routine and inexpensive. However, a basic purpose of the inventory remained the development and updating of maps to show public roads and other off-the-road cultural features such as farm buildings, dwellings, schools, churches, and other important landmarks.

Selected Text 5, which deals exclusively with the road-planning aspects of road inventories, examines the collection of data on the roadway aspects of the transportation network used to determine highway needs and to prepare highway improvement programs.

The third text, ***Guidelines for Traffic Counts on County Roads*** (Purdue University, 1962), was developed to provide county highway personnel with guideline procedures for counting traffic volumes. It lists the fundamental characteristics of road use as follows: (a) traffic volumes vary by the hour of the day, by the day of the week, and by the month of the year; (b) these traffic volume variations occur in repeated cycles; and (c)

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los estados en la preparación de sus respectivos manuales de inventario. El extracto consiste del texto de la publicación. No están incluídos los anexos porque la información allí contenida está incluída en un formato diferente en el quinto texto seleccionado.

El segundo Texto Seleccionado indica que la organización y el personal para el inventario vial puede variar considerablemente de un estado a otro, porque cada uno tiene sus propias necesidades internas de inventario. Sin embargo, cada estado debe recopilar ciertos datos para proveer información para los resúmenes nacionales de acuerdo a lo prescrito por el FHWA.

El segundo texto, escrito 17 años después que el primero, demuestra el cambio de énfasis en el inventario de caminos, desde hacer mapas a evaluar las estadísticas con propósitos de planeamiento. Este cambio refleja dos avances principales en las organizaciones de carreteras en los Estados Unidos de Norteamérica. El primero es físico. Varios departamentos de carreteras han estado utilizando inventarios durante mucho tiempo, de manera que tienen un juego de mapas bien documentado. El segundo es técnico. La llegada de grandes computadoras ha hecho que la recopilación y análisis de grandes cantidades de datos estadísticos resulten rutinarios y económicos. Sin embargo, uno de los propósitos básicos del inventario sigue siendo el desarrollo y actualización de mapas para mostrar los caminos públicos y otros aspectos culturales ubicados fuera de la vía, tales como granjas, casas, colegios, iglesias y otros puntos notables importantes. El quinto Texto Seleccionado, que trata exclusivamente de los aspectos del planeamiento de caminos dentro de los inventarios viales, examina la recolección de

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les informations contenues dans celles-ci sont données, de façon différente, dans le texte choisi no. 5.

Ce second texte choisi indique que l'organisation pour un inventaire des routes, et le personnel y participant, peuvent varier considérablement d'un état à l'autre, vu que chaque état requiert un inventaire pour ses propres besoins internes. Néanmoins, comme le prescrit la FHWA, chaque état doit rassembler certaines données spécifiques afin de procurer l'information nécessaire pour les résumés nationaux.

Ce second document, écrit 17 ans après le premier texte choisi, illustre le changement d'emphase dans les inventaires routiers, de l'elaboration de cartes à l'évaluation statistique à des fins de planification. Ce changement reflète deux grands progrès des organisations routières aux Etats-Unis. Le premier est physique. Avec le temps, les départements des routes, au cours de leurs activités d'inventaire, ont amassés un dossier de cartes très complet. Le second relève de la technique. Grâce aux grands ordinateurs, la compilation et l'analyse d'un grand nombre de données statistiques est devenue une opération peu coûteuse et presque de routine. Cependant, un des objectifs principaux de l'inventaire reste l'élaboration et la mise à jour de cartes qui indiquent les routes publiques et autres aspects en-dehors du chemin, tels que les fermes, habitations, écoles, églises et autres repères importants. Dans le cinquième texte choisi, qui traite exclusivement de la planification des inventaires routiers, on examine une série de données sur les caractéristiques des routes du réseau de transport, utilisées afin de déterminer les améliorations nécessaires et de préparer un programme à cette fin.

these cyclic variations persist over long stretches of road for long periods of time. Based on these characteristics, traffic volume measurement uses three different types of traffic count stations: (a) continuous count stations, (b) monthly count stations, and (c) coverage count stations. Only at continuous count stations, which operate over a period of at least one year, can a true record of annual ADT be obtained.

Continuous count stations are used to provide long-term average trends in traffic use. Factors can also be computed for the hourly, daily, and monthly count variations that occur at a particular station. These factors are also applicable to other route locations with similar travel characteristics. Route locations with different travel characteristics must be represented by other continuous control stations.

Monthly count stations count traffic at intermittent periods of time and on a periodic schedule that divides the year into equal parts (e.g., seven consecutive days during each month of the year). These stations are used to classify or identify other major roads with the proper continuous count station. This type of station is rarely used on low-volume roads.

Coverage count stations are locations where traffic counts are taken either with portable coun-

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datos en dichos aspectos viales de la red de transporte utilizada, para determinar las necesidades de carreteras y para preparar los programas de mejoramiento vial.

El tercer texto, ***Guidelines for Traffic Counts on County Roads*** (Guías de procedimientos para conteos de tránsito en caminos de condados, Purdue University, 1962), fue desarrollado para proporcionar al personal de carreteras del condado, guías de procedimiento para contar volúmenes de tránsito. Enumera las características fundamentales del uso de caminos, de la siguiente manera: (a) los volúmenes de tránsito cambian según la hora del día, el día de la semana y el mes del año; (b) estos cambios en el volumen de tránsito ocurren en ciclos repetidos; y (c) estas variaciones cíclicas persisten en sectores estensos del camino durante largos períodos de tiempo. Basado en estas características, la medición del volumen de tránsito utiliza tres tipos diferentes de estaciones de conteo de tránsito: (a) estaciones de conteo contínuo, (b) estaciones de conteo mensual, y (c) estaciones de conteo de cobertura. Sólo en estaciones de conteo contínuo que operan por un período mínimo de un año, se puede obtener una anotación correcta del TPD anual.

Las estaciones de conteo contínuo son utilizadas para obtener tendencias promedio a largo plazo en el uso del tráfico. Los factores pueden también ser computados en variaciones de conteos horarios, diarios y mensuales que ocurren en una estación particular. Estos factores también se pueden aplicar a otras ubicaciones en el camino que tengan características similares de recorrido. Las ubicaciones en la ruta que tengan diferentes características de uso deben estar representadas por otras estaciones de conteo contínuo.

Las estaciones de conteo mensual registran el

Le troisième texte, ***Guidelines for Traffic Counts on County Roads*** (Procédés généraux de comptage de la circulation sur les routes de comté, Purdue University, 1962), fut publié afin de fournir au personnel routier des comtés un guide des procédés de recensement de la circulation. On y énumère les caractéristiques fondamentales de l'utilisation des routes : (a) le volume de trafic varie selon le moment de la journée, le jour de la semaine, et le mois de l'année; (b) ces variations de volume se répètent par cycles; et (c) ces variations cycliques persistent sur de longs tronçons de routes durant de longues périodes. Se basant sur ces observations, on emploie trois différents types de postes de comptage pour mesurer le volume de trafic : (a) des postes de comptage continu, (b) des postes de comptage mensuel, et (c) des postes de comptage temporaire. Seuls les postes de comptage continu, qui fonctionnent durant une période d'un an au moins, permettent d'obtenir une évaluation correcte du TJM annuel.

On utilise les postes de comptage continu afin de déterminer les tendances moyennes à long terme de la circulation. On peut également calculer des facteurs pour les variations enregistrées à un poste déterminé, selon l'heure, le jour et le mois. Ces facteurs sont aussi applicables à d'autres endroits qui présentent des caractéristiques similaires de circulation. Les endroits aux caractéristiques différentes doivent être représentés par d'autres postes de comptage continu.

Les postes de comptage mensuel enregistrent le trafic par périodes intermittentes et selon un programme périodique qui divise l'année en parties égales (par exemple, sept jours consécutifs au cours de chaque mois de l'année). Ces pos-

ters or manually for relatively short periods of time (8-48 hours) to estimate traffic volumes for a particular section of road. The annual ADT is then estimated by using appropriate factors derived from the proper continuous count station. This type of count is most commonly used for low-volume roads.

The text illustrates the proper methods of expanding short counts to an estimated annual ADT. It uses factors derived from continuous count stations in Indiana. The factor tables used in the examples are included in this compendium as Appendixes so that the reader can follow the examples. The factors are not transferable or directly applicable to the reader's conditions.

The text also includes detailed instructions for the operation of portable, automatic traffic counters. It emphasizes the necessity of assigning a full-time qualified technician to operate and maintain these units. The instructions and photographs describe a particular brand of automatic counter, but this should not be construed as a recommendation for, or an endorsement of, that particular brand by the Transportation Research Board.

The fourth text, *Outline of the Highway Transportation Planning Process* (Federal Highway Administration, 1976), presents an overview of highway transportation planning. It includes a description of the basic data-collection programs required to provide sufficient input to de-

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tránsito en períodos de tiempo intermitentes y con un horario periódico que divide el año en partes iguales (por ejemplo, siete días consecutivos durante cada mes del año). Se emplean estas estaciones para clasificar o identificar otros caminos principales con la estación de conteo apropiada. Este tipo de estación es utilizado muy poco en caminos de bajo volumen.

Las estaciones de conteo de cubertura son ubicaciones donde se toman conteos de tránsito con contadores portátiles o manuales por períodos de tiempo relativamente cortos (8-48 horas) para estimar volúmenes de tránsito en ciertas secciones del camino. El TPD anual es estimado entonces usando factores apropiados derivados de la estación de conteo contínuo apropiada. Este tipo de conteo es el más común en caminos de bajo volumen.

El texto muestra los métodos adecuados para expandir los conteos cortos a un TPD anual estimado. Utiliza factores derivados de estaciones de conteo contínuo en Indiana. Las tablas de factores usadas en los ejemplos están incluídas en este comendio como Anexos, para que el lector pueda seguir los ejemplos. Los factores no son transferibles o aplicables directamente a las condiciones de cualquier otro lugar.

El texto también incluye instrucciones detalladas para la operación de contadores de tránsito automáticos portátiles. Enfatiza la necesidad de asignar un técnico calificado a tiempo completo para operar y mantener estas unidades. Las ins-

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tes permettent de classifier d'autres routes importantes et de les rattacher au poste de comptage continu qui leur correspond. On utilise rarement ce genre de poste sur les routes à faible capacité.

Aux postes de comptage temporaire, les comptages de trafic s'effectuent soit au moyen de compteurs portatifs, soit manuellement, durant un temps relativement court (de 8 à 48 heures) afin d'estimer le volume de la circulation sur un tronçon de route déterminé. On évalue ensuite le TJM annuel en appliquant le facteur approprié obtenu du poste de comptage continu correspondant. Ce système de comptage s'emploie habituellement pour les routes à faible capacité.

Dans ce texte, on illustre par des exemples les méthodes correctes pour estimer un TJM annuel en se basant sur des comptages effectués sur une courte période. Les facteurs appliqués sont dérivés de postes de comptage continu en Indiana. En appendice à ce recueil, on inclut les tables de facteurs utilisés, de façon à ce que le lecteur puisse suivre les exemples. Ces facteurs ne peuvent être transférés ni appliqués directement aux conditions réelles que rencontrerait le lecteur.

Ce texte comprend également des instructions détaillées pour l'emploi de compteurs de trafic portatifs automatiques. On y met l'emphase sur la nécessité de désigner un technicien qualifié qui s'occupe à temps plein de l'opération et de l'entretien de ces appareils. Dans les instructions, ainsi que sur les photographies, on décrit un compteur automatique d'une certaine marque, ce qui ne signifie en aucune manière que le Transportation Research Board recommande ou approuve particulièrement cette marque.

termine needed highway improvements (present and future) and the order of construction. It points out that it is impossible to adequately plan a national highway system without consideration of the road and street systems of the other levels of government. Similarly, it is impossible to plan a rural highway system without consideration of the urban highway and street systems that must connect with it. This text was written for highway personnel who are not intimately familiar with the various steps or phases for effective planning of a highway program.

Inventory data represent the essential step preliminary to all other planning studies. This text describes (a) long-range plans that are based on the overall goals and objectives of a country and its financial ability to support the program and (b) short-range plans that provide a practical listing of projects to be built within a set time limit, usually five years. In the format of purpose, scope, and method, this text defines the following components of long-range planning: (a) road inventory; (b) adequacy ratings, which evaluate and record the condition of existing roadways

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trucciones y fotografías describen una marca de contador automático en particular, pero ésto no debe ser tomado como una recomendación o respaldo de esa marca en particular por parte del Transportation Research Board (TRB).

El cuarto texto, ***Outline of the Highway Transportation Planning Process*** (Esquema del proceso de planeamiento de transporte por carreteras, Federal Highway Administration, 1976), presenta una vista general del planeamiento de transporte por carreteras. Incluye una descripción de los programas básicos de recolección de datos requeridos para proporcionar información suficiente para determinar los mejoramientos de carretera necesarios (presente y futuro) y el orden de construcción. Hace notar que es imposible planear adecuadamente un sistema nacional de carreteras sin considerar los sistemas de caminos y carreteras de otros niveles gubernamentales. De manera similar, es imposible planear un sistema rural de carreteras sin considerar los sistemas urbanos de caminos y carreteras con los que se debe conectar. Este texto fue escrito para el personal de carreteras que no está íntimamente familiarizado con los diversos pasos o fases de un planeamiento efectivo para un programa de carreteras.

Los datos de inventario representan la etapa esencial, preliminar a todos los otros estudios de planeamiento. Este texto describe (a) planes a largo plazo basados en las metas y objetivos generales de un país y su habilidad financiera para apoyar el programa, y (b) planes a corto plazo que proveen una lista práctica de proyectos a ser construídos dentro de un límite establecido de tiempo, normalmente cinco años. En el formato de propósitos, alcance y método, el texto define los siguientes componentes del

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Dans le quatrième texte, ***Outline of the Highway Transportaion Planning Process*** (Aperçu du processus de planification du transport routier, Federal Highway Administration, 1976), on présente un exposé général de la planification du transport routier. On y décrit les programmes de rassemblement des données de base indispensables pour obtenir une entrée suffisante qui permette de déterminer les améliorations des routes nécessaires (actuelles et futures) ainsi que l'ordre de construction. On fait remarquer qu'il est impossible de bien planifier un réseau routier national sans tenir compte du réseau de routes et de rues aux autres niveaux administratifs. De même, on ne peut planifier un réseau routier rural sans tenir compte des réseaux de routes et voies urbaines auxquels il sera relié. Ce texte s'adresse au personnel routier qui n'est pas très familiarisé avec les différentes phases de la planification efficace d'un programme routier.

Les données de l'inventaire représentent l'étape primordiale, préalable à tout autre travail de planification. Dans ce texte, on décrit : (a) les plans à long terme basés sur les buts et objectifs généraux d'un pays et sur ses possibilités de financement du programme et (b) les plans à court terme qui fournissent une liste concrète des projets à construire dans les limites d'une période de temps déterminée, habituellement de cinq ans. D'après l'objectif du projet, son étendue et la méthode appliquée, le texte définit les composants suivants de la planification à long terme: (a) l'inventaire routier; (b) l'estimation des routes adéquates, dans laquelle on évalue et enregistre l'état actuel des routes et des ouvrages; (c) les recensements de la circulation, qui servent de base pour les prévisions de la demande future; (d) les statistiques routières, composées des données qui n'ont pas été rassemblées dans les points déjà mentionnés, telles que les kilomètres de routes par catégorie administrative, le nombre de véhicules motorisés immatriculés, et le nombre d'usagers en possession d'un permis de conduire; (e) les objectifs du système de transport, qui servent de critère pour

and structures; (c) traffic surveys, which are the basis for forecasting future travel demands; (d) highway statistics, which are data not collected above, such as road mileages by administrative classification, motor vehicle registration, and number of licensed operators; (e) transportation goals, which set the criteria for identifying and justifying highway needs; (f) highway classification study, which groups roads with similar characteristics in a functional sense into distinct systems or classes; (g) highway needs study, which determines what improvements are necessary to bring the highway transportation system up to an adequate level of condition and serviceability for current and future traffic; (h) highway fiscal study, which assembles and analyzes data concerning past, current, and possible future highway revenues; and (i) high-

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planeamiento a largo plazo: (a) inventario de caminos; (b) clasificaciones de adecuación, las que evalúan y registran la condición de los caminos y estructuras existentes; (c) encuestas de tránsito, que son la base para pronosticar las demandas de viajes futuros; (d) estadísticas de carreteras, que representan datos no recolectados con anterioridad, tales como kilometraje de caminos a través de una clasificación administrativa, registro de vehículos automotores con licencia; (e) metas de transporte, que establecen el criterio para identificar y justificar las necesidades de carreteras; (f) estudio de clasificación de carreteras, que agrupa caminos con características similares en un sentido funcional, en sistemas o clases específicos; (g) estudio de necesidades de carreteras, que determina los mejoramientos necesarios para llevar al sistema de transporte por carretera hasta un nivel adecuado de condición y servicios para el tráfico presente y futuro; (h) estudio fiscal de carreteras, que reúne y analiza los datos concernientes a los ingresos pasados, presentes y a los posibles ingresos futuros de carreteras; e (i) estudio de leyes de carreteras, que examina las leyes existentes para asegurar de que definen claramente las responsabilidades financieras y operacionales para cada nivel de gobierno y los procedimientos para distribuir equitativamente la carga de impuestos.

El quinto texto es *Guide for Manual of Instructions for Road Inventory* (Guía para el manual de

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déterminer et justifier le besoin de routes; (f) une étude de classification des routes, regroupant en classes ou catégories les routes qui présentent des caractéristiques semblables du point de vue fonctionnel; (g) une étude des améliorations nécessaires pour élever le système de transport routier à un niveau de service qui réponde aux conditions actuelles et futures de la circulation; (h) une étude du réseau du point de vue fiscal, dans laquelle on rassemble et on analyse les données sur les recettes passées et actuelles du réseau routier et leur projection dans le futur; et (i) une étude de la législation routière, permettant de vérifier si les lois en vigueur définissent clairement les responsabilités financières et opérationnelles à chaque niveau administratif, ainsi que les procédures pour distribuer équitablement la charge des impôts.

Le cinquième texte s'intitule *Guide for Manual of Instructions for Road Inventory* (Guide pour un manuel d'instructions pour un inventaire routier, Federal Highway Administration, 1976). L'inventaire routier décrit dans ce manuel a pour but d'obtenir les données pour l'élaboration de statistiques sur la quantité et les caractéristiques de différents types de routes, ouvrages, passages à niveau, tunnels, passages de cours d'eau sur un bac, et appareils de contrôle de la circulation qui composent le réseau routier physique.

Dans ce texte on présente l'organisation d'un programme d'inventaire routier, y compris une classification de tout le personnel nécessaire ainsi que la tâche correspondant à chacun. On y analyse le matériel requis, et les instructions à donner au chef de l'équipe et au conducteur du véhicule servant à l'inventaire.

Les procédures d'inventaire sont données en détail. Comme ce texte est destiné à être employé conjointement avec un programme d'ordinateur spécifique, les activités d'inventaire sont décrites dans le même ordre que sur les formulaires d'inventaire. Ceux-ci sont auto-codifiés, prêts à être perforés. Les instructions indiquent le concept de base et le code de chaque article. Les articles à inventorier — ainsi que les techniques pour les déterminer et pour les décrire — seraient semblables même si l'inventaire routier devait se faire sans l'aide d'un ordinateur qui trie et résume les données.

Ce programme d'inventaire comprend sept formulaires différents : le formulaire INV 1, Données de la route; INV 2, Données des routes à plusieurs voies séparées; INV 3, Données des ouvrages; INV 4, Données des passages à niveau; INV 5, Données des tunnels; INV 6, Don-

way laws study, which examines existing laws to be sure that they clearly define financial and operational responsibilities for each level of government and procedures to equitably distribute the tax burden.

The fifth text is *Guide for Manual of Instructions for Road Inventory* (Federal Highway Administration, 1976). The purpose of the road inventory detailed in this manual is to obtain data for compiling statistics about the amount and characteristics of the several types of roads, structures, railroad crossings, tunnels, ferries, and traffic-control devices that make up the physical highway system.

The text covers the organization of a road inventory program including the classification and duties of all personnel involved. It discusses the equipment required and instructions to the party chief and the driver of the inventory vehicle.

Inventory procedural details are detailed. Because this text was written for use in conjunction with a specific computer program, the inventory activities are described in the order in which they appear on the included inventory forms. These forms are self-coding for direct use by keypunch operators. The instructions illustrate the basic concept and the specific code for each item of data. The items to be inventoried — and the techniques of locating and describing them — would be similar, even if a road inventory were to be made without the benefit of a computer for sorting and summarizing the data.

Seven different forms are included in this inventory program: Form INV 1, Roadway Data; INV 2, Divided Roadway Data; INV 3, Structure Data; INV 4, Railroad Crossing Data; INV 5, Tunnel Data; INV 6, Ferry Data; and INV 7, Roadway Data — Urban. Examples of various identification

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instrucciones para inventario de caminos, Federal Highway Administration, 1976). El propósito del inventario de caminos descrito en este manual, es obtener datos para recopilar estadísticas sobre la cantidad y características de diversos tipos de caminos, estructuras, cruces de ferrocarril, túneles, transbordadores e instrumentos de control de tránsito, que constituyen el sistema físico de carreteras.

El texto cubre la organización de un programa de inventario vial, incluyendo la clasificación y deberes de todo el personal involucardo. Analiza el equipo requerido y las instrucciones al jefe de grupo y al conductor del vehículo usado para el inventario.

Se detallan los procedimientos del inventario. Como el texto fue escrito para utilizarse conjuntamente con un programa específico de computadora, las actividades del inventario están descritas en el orden en que aparecen en los

formularios de inventario incluídos. Estos formularios son autocodificados para ser usados directamente por los perforadores de tarjetas. Las instrucciones muestran el concepto básico y el código específico para cada partida de datos. Las partidas a inventariar — y las técnicas utilizadas para localizarlas y describirlas — serían similares aún cuando se hiciera el inventario vial sin el auxilio de una computadora que clasifique y resuma los datos.

Se incluye en este programa de inventario siete formularios diferentes: formulario INV 1, datos del camino; INV 2, datos de caminos divididos; INV 3, datos de estructuras; INV 4, datos de cruces de ferrocarril; INV 5, datos de túneles; INV 6, datos de transbordadores; e INV 7, datos de caminos urbanos. También se muestran ejemplos de varios códigos de identificación para áreas urbanas, rutas de carreteras, clases de estructuras, etc, preparados para su empleo

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nées des passages sur bac; et INV 7, Données des routes urbaines. On donne également en exemple plusieurs codes d'identification pour les zones urbaines, itinéraires routiers, types d'ouvrage, etc., à l'usage de l'Argentine mais avec les instructions permettant de les modifier pour les appliquer dans d'autres pays.

Les textes choisis 5 et 6 sont inclus dans ce recueil pour leur présentation détaillée du genre et de la quantité d'information requise pour dresser un inventaire. Il est évidemment beaucoup plus aisé de compiler et de traiter ces données au moyen d'un ordinateur, mais on peut également le faire manuellement. Dans ce cas, il n'est pas nécessaire de compiler les données sur les formulaires auto-codés renseignés dans ces textes. Néanmoins, si on utilise d'autres formulaires pour un inventaire dressé sans l'aide d'un ordinateur, toutes les informations requises sur les formulaires montrés en exemple devront également y apparaître. Tous formulaires élaborés à partir des formulaires auto-codés de ces textes, devront être présentés de façon à inclure toute l'information nécessaire.

Etant donné la grande quantité d'informations, tout inventaire manuel requiert également une codification des données (c'est-a-dire des abbréviations, chiffres ou lettres qui substituent la

codes for urban areas, highway routes, structure classes, and so forth, as prepared for use in Argentina, are also given with instructions for their modification for use in other countries.

Selected Texts 5 and 6 are included because of their detailed presentation of the type and amount of information needed for the inventory process. Compiling and processing these data are obviously facilitated if a computer is available, but manual manipulation of the same data is possible. It is not necessary to compile the data on the self-coding forms contained in these texts if the inventory is to be evaluated manually. However, any forms developed for a manual inventory process should require the same amount and type of information as are required on these sample forms. Forms for manual inventories developed from the self-coding forms in these texts will be properly organized to include all the necessary information.

Any manual inventory process will also require data coding (i.e., the substitution of abbreviations and/or numeral or letter designations for detailed descriptions of the items inventoried) because of the data volume. The use of data codes, similar to those presented in these texts,

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en Argentina, incluyendo instrucciones para facilitar su modificacion para otros países.

Se han incluído el quinto y el sexto textos seleccionados debido a su detallada presentación del tipo y cantidad de información que se requiere durante el proceso de inventario. La recopilación y procesamiento de estos datos se facilitarán obviamente si se dispusiera de una computadora, pero es también posible efectuar los cálculos manualmente. No es necesario recopilar los datos en los formularios auto codificados contenidos en dichos textos, si se fueran a evaluar manualmente los resultados del inventario. Sin embargo, cualquier formulario desarrollado para un proceso manual de inventario debe necesitar la misma cantidad y tipo de información requeridos en dichos modelos de formularios. A fin de incluir toda la información necesaria, se deberán organizar adecuadamente los formularios para inventarios manuales desarrollados en base a los formularios auto codificados.

Cualquier proceso de inventario manual requerirá también la codificación de datos (por ejemplo, la sustitución de abreviaciones, designaciones por números o letras para describir detalladamente las partidas inventariadas debido a la cantidad de datos. El uso del código de datos similares a los presentados en estos textos, facilitará las actividades del inventario manual y uniformizará el lenguaje del inventario.

El sexto texto ha sido extractado de *Guide for Manual of Instructions for Traffic Survyes* (Guía para el manual de instrucciones para estudios de tránsito, Federal Highway Administration, 1976). El propósito de los estudios de tránsito descritos en este manual es inventariar el uso de los caminos. El inventario de tráfico incluye el

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description détaillée des articles inventoriés). L'emploi de codes de données, semblables à ceux présentés dans ces textes, facilite l'élaboration manuelle d'un inventaire et permet de standardiser le langage.

Le sixième texte est extrait du *Guide for Manual of Instructions for Traffic Surveys* (Guide pour un manuel d'instruction pour les recensements de la circulation, Federal Highway Administration, 1976). Les recensements de la circulation décrits dans ce manuel sont destinés à un inventaire de l'usage des routes. L'inventaire de la circulation comprend des informations telles que le volume du trafic circulant sur la route, sa distribution par type de véhicule et ses caractéristiques de poids.

L'objectif de ce manuel est d'aider à déterminer (a) le nombre de postes de comptage et de pesage nécessaires, ainsi que leur emplacement, et (b) leur période de service. On inclut un exemple de formulaires autocodés à remplir sur le terrain, pour la classification des véhicules motorisés et du poids des camions. Ils peuvent également servir de guides pour la préparation de formulaires servant à évaluer manuellement les recensements du trafic, lorsqu'on ne dispose pas d'un ordinateur.

L'appendice C de ce texte est en soi une publication — *Guide for Traffic Volume Counting Manual* (Guide pour un manuel de comptage du volume de trafic, FHWA, 1970). Il contient des méthodes efficaces pour estimer le TFM annuel avec précision, en se basant sur le comptage d'échantillonnages. On y présente un procédé d'application de principes de statistique pour déterminer le degré de précision d'un grand nombre d'estimations de volume de trafic en termes de la probabilité de fréquence d'erreurs d'une grandeur déterminée. Les méthodes de comptage du trafic sur routes rurales sont décrites pour (a) les routes avec un volume de TJM supérieur à 500 vpj (véhicules par jour), (b) les

will expedite manual inventory activities and will standardize the inventory language.

The sixth text is excerpted from *Guide for Manual of Instructions for Traffic Surveys* (Federal Highway Administration, 1976). The purpose of the traffic surveys described in this manual is to inventory the use of roads. The traffic inventory includes the volume, distribution by type, and weight characteristics of the traffic using the roads. The manual's objective is to assist in determining (a) the number and location of counting or weighing stations needed and (b) the length of time that each should be occupied. Sample self-coding field forms are included for the classification of motor vehicles and truck-weighing studies. These forms can also serve as guides to the preparation of forms for manual evaluation of traffic surveys if computer facilities are not available.

Appendix C of this text is actually a separate publication — *Guide for Traffic Volume Counting Manual* (FHWA, 1970). The purpose of this guide is to provide efficient procedures for making accurate estimates of annual ADT volume based on sample counts. It describes a method of applying statistical principles to determine the accuracy of a large number of traffic estimates in terms of probability of frequency of errors of specific magnitude. Rural road traffic-counting procedures are described for (a) highways with ADT volumes greater than 500, (b) highways with ADT volumes of between 25 and 500, and

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volumen, la distribución por tipo y las características del peso del tráfico que utiliza los caminos. El objetivo del manual es ayudar a determinar (a) la cantidad y ubicación de las estaciones de conteo y de pasaje necesarias, y (b) el tiempo que deben estar ocupadas. Se incluyen muestras de los formularios de campo auto codificados para clasificar vehículos motorizados y efectuar estudios del peso de los camiones. Estos formularios también pueden servir como guías para la preparación de formularios de evaluación manual de estudios de tránsito si no se dispusiera de los servicios de una computadora.

El Anexo C de este texto es en realidad una publicación separada — *Guide for Traffic Volume Counting Manual* (Guía para el manual de conteo del volumen de tránsito, Federal Highway Administration, 1970). El propósito de esta guía es proporcionar procedimento efectivos para hacer estimaciones precisas del volumen del TPD anual basadas en conteos de muestra. Describe el método que aplica principios estadísticos para determinar la precisión de un gran número de estimaciones de tránsito en términos de probabilidad de frecuencia de errores de una magnitud específica. Los procedimientos de conteo del tránsito en caminos rurales están descritos para (a) carreteras con volúmenes de TPD mayores de 500, (b) carreteras con volúmenes de TPD entre 25 y 500, y (c) caminos con volúmenes de TPD menores de 25. Los factores de ajuste del volumen de tránsito pueden ser calculados por computadora o manualmente. Se describe el análisis de los informes de conteos de tránsito conjuntamente con la edición manual o mecánica, así como un proceso fluído que tiende a aumentar la precisión de las estimaciones del TPD.

Bibliografía

A final de los textos seleccionados,el lector encontrará una breve bibliografía que contiene los datos y resúmenes de 15 publicaciones. Las primeras seis describen los textos seleccionados Las otras nueve describen publicaciones relationadas con los textos seleccionados. Aun-

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routes avec un volume de TJM entre 25 et 500 vpj, et (c) les routes avec un TJM de moins de 25 vpj. Les facteurs d'ajustement peuvent être calculés par ordinateur ou manuellement. On décrit l'analyse des rapports des comptages de la circulation, ainsi que leur présentation aussi bien manuelle qu'à la machine, et un procédé de lissage qui tend à augmenter la précision des estimations du TJM.

Bibliographie

Les textes choisis sont suivis d'une brève bibliographie contenant les données de référence et les analyses de 15 publications. Les six premières s'en réfèrent aux textes choisis. Les neuf autres décrivent des publications apparentées au thème des textes choisis. Bien qu'il y ait beaucoup d'articles, rapports et livres qui pourraient être inclus, l'objectif de cette bibliographie n'est pas d'énumérer toutes les références possibles ayant rapport au sujet de ce recueil. Cette bibliographie se rapporte seulement aux publications dont nous avons choisi des extraits, ou à des textes de base que nous aurions choisis aussi s'il n'y avait pas de limite quant au nombre de pages de ce recueil.

(c) roads with ADT volumes of less than 25. Traffic volume adjustment factors may be calculated by computer or manually. The analysis of traffic count reports is described, along with both manual and machine editing and a smoothing process that tends to increase the accuracy of the ADT estimates.

Bibliography

The selected texts are followed by a brief bibliography containing reference data and abstracts for 15 publications. The first six describe the selected texts. The other nine describe publications related to the selected texts. Although there are many articles, reports, and books that could be listed, it is not the purpose of this bibliography to contain all possible references related to the subject of this compendium. The bibliography contains only those publications from which a text has been selected or basic publications that would have been selected had there been no page limit for this compendium.

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que existen muchos artículos, informes, y libros que podrían nombrarse, no es el propósito de esta bibliografía mencionar todas las posibles referencias que se relacionen con el tema de este compendio. La bibliografía contiene únicamente aquellas publicaciones de las cuales se ha seleccionado un texto o publicaciones básicas que se habrían seleccionado si no hubiera un límite al número de páginas en este compendio.

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This section of the compendium contains selected pages from each text that is listed in the table of contents. Rectangular frames are used to enclose pages that have been reproduced from the original publication. Some of the original pages have been reduced in size to fit inside the frames. No other changes have been made in the original material except for the insertion of occasional explanatory notes. Thus, any errors that existed in the selected text have been reproduced in the compendium itself.

Page numbers of the original text appear inside the frames. Page numbers for the compendium are outside the frames and appear in the middle left or middle right outside margins of the pages. Page numbers that are given in the table of contents and in the index refer to the compendium page numbers.

Each text begins with one or more pages of introductory material that was contained in the original publication. This material generally includes a title page, or a table of contents, or both. Asterisks that have been added to original tables of contents have the following meanings:

*Some pages (or parts of pages) in this part of the original document appear in the

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*Algunas páginas (o partes de página) en esta parte del documento original aparecen

Textes choisis

Cette partie du recueil contient les sections extraites des publications indiquées à la table des matières. Les pages du texte original qui sont reproduites, sont entourées d'un encadrement rectangulaire. Certaines pages ont dû être réduites pour pouvoir être placées dans l'encadrement. Le texte original n'a pas été changé sauf pour quelques explications qui ont été insérées. Donc, si le texte original contient des erreurs, elles sont reproduites dans le recueil.

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Chaque texte commence par une ou plusieurs pages d'introduction qui étaient incluses dans le texte original. Ces pages sont généralement le titre, ou la table des matières, ou les deux. Des astériques ont été ajoutés à la table des matières d'origine, pour les raisons suivantes :

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**All pages in this part of the original document appear in the selected text.

The selected texts therefore include only those parts of the original documents that are preceded by asterisks in the tables of contents of the respective publications.

Broken lines across any page of selected text indicate those places where original text has been omitted. In a number of places, the selected text contains explanatory notes that have been inserted by the project staff. Such notes are set off within dashed-line boxes and begin with the word NOTE.

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en el texto seleccionado, pero otras páginas (o partes de página) en esta parte de la publicación original han sido omitidas.

**Todas las páginas en esta parte del documento original también aparecen en el texto seleccionado.

Por lo tanto, los textos seleccionados únicamente incluyen aquellas partes de los documentos originales que están precedidas por asteriscos en el índice de las publicaciones respectivas.

Líneas de guiones cruzando cualquier página del texto seleccionado significan que en ese lugar se ha omitido texto original. En varios lugares el texto seleccionado contiene notas aclaradoras que han sido introducidas por el personal del proyecto. Tales notas están insertadas en recuadros de guiones y comienzan con la palabra NOTE.

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incluses dans les textes choisis, mais d'autres pages (ou portion de pages) de l'édition originale ont été omises.

**Toutes les pages dans cet extrait du document original sont incluses dans les textes choisis.

Les textes choisis, donc, incluent seulement ces extraits des documents originaux qui sont précédés d'un astérique dans les tables des matières des publications respectives.

Les lignes brisées sur les pages des textes choisis indiquent les endroits où le texte original a été omis. A certains endroits, les textes choisis contiennent des explications qui ont été insérées par notre personnel. Ces explications sont entourées d'un encadrement en pointillé, et commencent toujours par le mot NOTE.

PROCEEDINGS

OF THE

NINTH CALIFORNIA

STREET AND HIGHWAY CONFERENCE

Presented at

The University of California at Berkeley

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by

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UNIVERSITY OF CALIFORNIA

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Maintaining and Using a Rural Road Inventory

By H. B. LAFORGE
Engineer of Federal Aid Secondary Projects
California Division of Highways

In these days of accelerated advance in scientific and technical areas, it is somewhat difficult to "dress up" a subject as prosaic as this one. Among the exciting developments of today are the use of photogrammetric methods and electronic devices which have been ably discussed by others. In our haste to make use of these implements of engineering, and thereby advance, let us say, a date of route adoption, we must not forget that someone is going to want to know the name of a road or street associated with it. For the first time in the history of this State, we have such information for all of the counties readily at hand. Furthermore, we may now transpose our studies onto map material available for a variety of purposes. I suggest that we make maximum use of this medium.

Purpose of the Inventory

The inventory is being made for the purpose of obtaining sufficient data to permit the drafting of maps to a large scale showing thereon all public roads outside of, and principal street connections through, cities, incorporated towns, and villages, the location of important structures on the roads, buildings, and structures off the roads such as farm units, dwellings, schools, churches, and other items hereinafter enumerated. The data to be obtained will also permit the compilation of statistics on the mileage of the several types of roads, through streets, kinds of structures, and other items mentioned in the instructions below and others that may be subsequently required by special instructions supplemental to this manual. (From Bureau of Public Roads Manual of Instructions).

History of the Program

The Rural Road Inventory program was initiated by the Bureau of Public Roads in 1936, and was nationwide. Through the years there has been much criticism of the results of the inventory, particularly in the mapping. One of the weaknesses was the lack of large-scale drawings in congested areas. Another was the lack of road names or numbers. However, considering the lack of base maps, of orientation equipment, of experienced personnel, the scope of the inventory, and the short time in which the work was completed, it was a gigantic job, and well done. Not only were the roads logged in a manner similar to the recent reinventory, but culture was spotted on all rural roads. Detailed sketches were made for all the rural railroad grade crossings, and a detailed form was completed on all structures inventoried. Manual classification traffic counts were made and even a truck-weighing program was made on the county roads by means of portable loadometer scales.

This earlier inventory gave the State its first fairly complete map coverage on a uniform basis and furnished statistical data which has been an information source for numerous studies. The original tabulations and maps depicting the county maintained roads under the Collier-Burns Highway Act, by which the first of the additional 3/8 cent monies under this Act were distributed, were the results of this original inventory.

Later Reinventories of Rural Roads

In 1939, a reinventory of the rural roads in the State was started, but was terminated in 1943 due

to war problems, such as the scarcity of personnel and equipment. Ten counties were completed in this reinventory.

The present rural road inventory was started in the fall of 1949, and the field work was completed in January, 1956, with all the counties in the State being inventoried except San Francisco and the urban portion of Los Angeles. San Francisco, being also an incorporated City, has no rural roads. Due to the complexity and urban characteristics of the Los Angeles area, no full-scale inventory was attempted there.

This latter inventory had some features which, as far as we know, obtained only in California. These came about because of the careful study and discussion of the deficiencies of the 1936 inventory, and a careful consideration of the potential use of the completed material. It was decided that the most beneficial use of the material would be by the counties if the maps and data were adjusted to meet their needs. This meant an additional series of maps which would clearly indicate each county road by name and number. This series was not a requirement of the Bureau of Public Roads program. It was also decided that early and continuous official contact with the counties was necessary in order that county personnel would be familiar with the procedure and the results. Not only did the counties participate in the cost of the inventory, but county personnel took active part in all field work and also acted as advisor to the chief of the field party especially as to jurisdictional matters. In view of the requirements of the Collier-Burns Highway Act regarding the submission of the county-maintained road mileage to the Division once a year, this relationship has proved very valuable.

Three Series of Maps

The data from the rural road inventory is divided into three general classifications and is represented by the three-map series: General Highway, Traffic and County Road System maps.

The General Highway Map (Fig. 1) shows the highways and roads classified by surface types, and shows the type of facilities served in the form of the various culture symbols. No attempt is being made by the State to keep this series of maps up to date. However, some counties maintain complete records on their road surfacing jobs and, as the map symbols were devised to show progressively higher type, it would be a relatively easy matter to keep this phase of the map up to date. If desirable, the culture items could be brought up to date by referring to the county's building permit records.

The Traffic Map (Fig. 2) shows, by means of average daily traffic volume groups, the traffic recorded on the more important roads in the county plus the traffic count stations and the actual average daily traffic recorded at that station. The culture is also shown on this map. In recent years this series of maps has rapidly gained in popularity since traffice volume is one yardstick that the layman can understand. It gives the County Supervisors and Road Commissioner one means of readily comparing travel on the roads in question. More and more counties are traffic-counting. Using the small portable traffic counters, it is a relatively easy matter to set up a counting schedule which can give the Road Commissioner a good picture of the traffic pattern in his county. Also, these counters are excellent for use in studies of particular roads or intersections. Technical advice, relative to the use of counters and the results obtained, is available to the counties from the State Division of Highways. While the State, as yet, has made no attempt to maintain these traffic maps, such a program could be put into operation by the counties, with the State furnishing advisory assistance.

The County Road System Map (Fig.3) is probably the most important and most used map of the three-map series. This map was not a part of the previous road inventories, and may be unique to California. The need for such a map has been apparent for years, and with the advent of the Collier-Burns Highway Act of 1947, the need became a must. This map shows the road name and/or number, and whether the road is a county primary, county secondary, or non-county road. Once a year the counties are required by law to submit, to the Division of Highways, the changes in their county maintained road systems. By this means, it is possible to keep this series of maps reasonably up to date. Following the annual May submission by the counties of additions, deletions, or changes in the county road system, Headquarters Office of the Division of Highways corrects a duplicate copy of the autopositive film and the tabulation describing the routes. Changes involving the State highway system are also made upon the county road system series as well as changes of city limit lines.

Material Delivered to Each County

Under the inventory reporting system the following material is furnished to each county:

1. General highway map - 1 print and 1 set of autopositive films.
2. Traffic map - 1 print and 1 set of auto-

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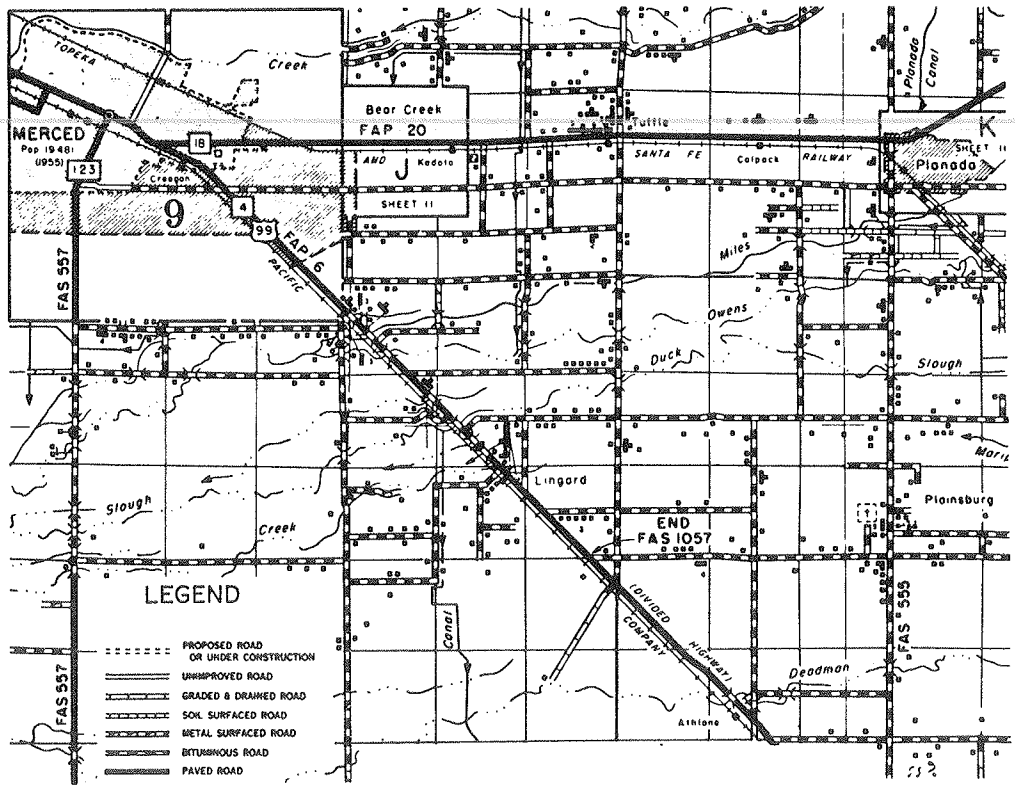

Fig. 1 - General highway map.

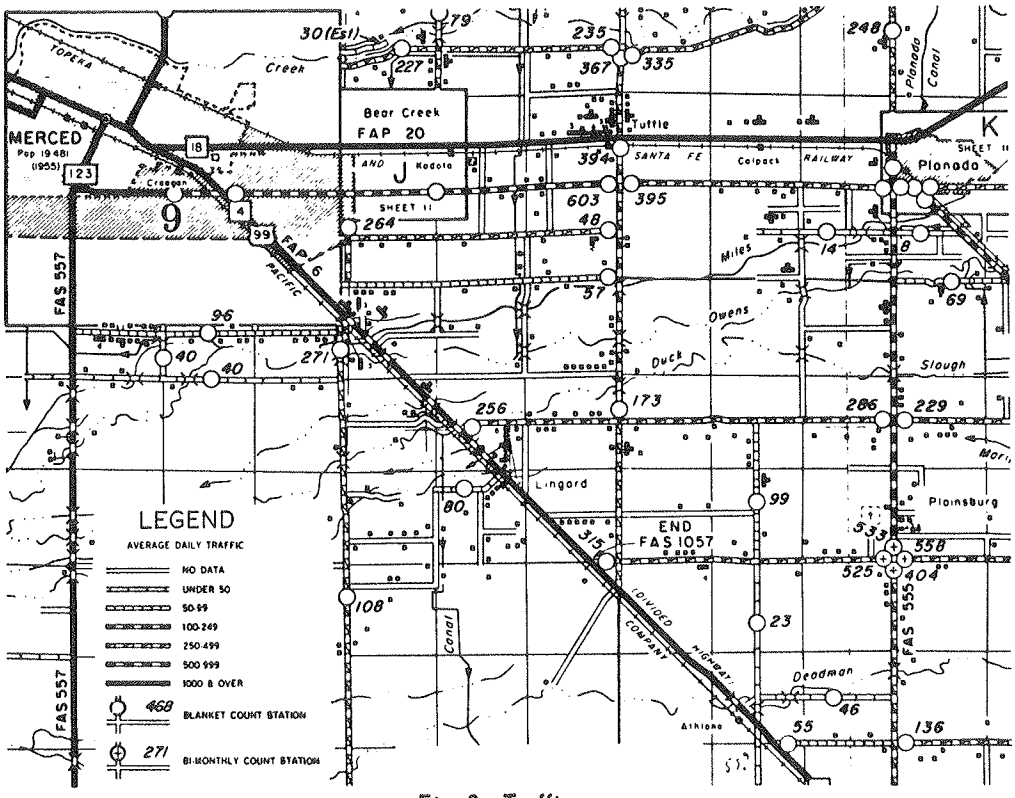

Fig. 2 - Traffic map.

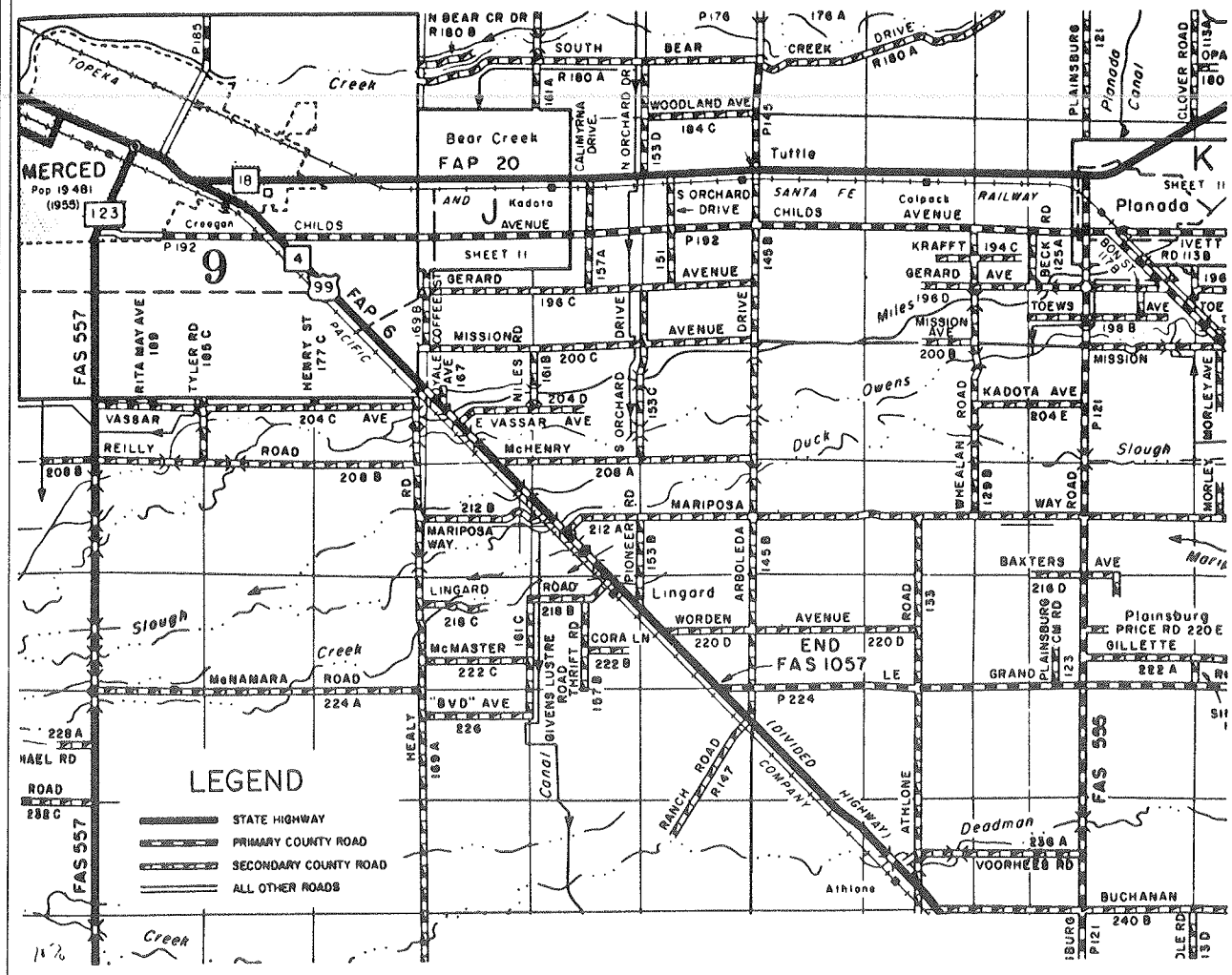

Fig. 3 - County road system.

positive films.

3. County road system map - 1 print and 1 set of autopositive films.
4. One-half scale reductions of the three county maps and reproducibles thereof.
5. Composite map of county - 1 print and one autopositive film.
6. Master tabulation of the field notes obtained in the inventory.
7. List of county roads maintained, by number, name, and length.
8. Tabulation of bridges on the county road system.
9. Tabulation of railroad grade crossings on all the rural roads in the county.

Uses of the Road Inventory Material

The uses of the road inventory material are many and widespread; ranging from Washington, D.C. to the county foreman in the road district. Using the road inventory data submitted by the various states, the U.S. Bureau of Public Roads can compile studies and reports requested by Congress. The maps are used by the Bureau for approvals of routes and projects on the several Federal-aid systems. The road inventory maps are used by many of the Federal agencies such as: Bureau of Census, Forest Service, Coast & Geodetic Survey, Geological Survey, Fish and Wildlife Service, etc.

The State Division of Highways finds many uses for the material obtained in the inventory. Material for studies and reports on rural roads off the State highways may be obtained as well as specific details on a particular road. The maps are used in advance planning for preliminary studies of proposed routes. Composites covering large areas can be obtained when necessary. The traffic department finds the maps very useful for showing traffic patterns and volumes over an area and also for spotting traffic accidents. They are also used by other departments of the Division for planning and programming.

Some of the other State agencies using these maps are: State Highway Patrol, Public Utilities Commission, Division of Forestry, Department of Fish and Game, Civil Defense, etc.

For most of the counties in the State, the rural road inventory program has furnished them with their first complete inventory of their road system and a map that adequately covers the county. It has put the counties on an equal basis for comparing sufficiencies and deficiences. Recent reports from the counties, which were used for a report to the Legislature on county needs, clearly demonstrated that for those counties which had the inventory data available, this job was not only more easily accomplished but also yielded more realistic results.

Base Map Scales and Projections

The base map for all the counties is on a scale of one inch to one mile and, with the exception of Butte, Nevada, and Sierra Counties, is on the Lambert conformal projection. The three exceptions are on a polyconic projection.

Where congestion made detail impossible on the base map, the area was enlarged to a scale of four or eight inches to the mile as the situation dictated. Where such enlargements were made, the detail on the base map was kept to a minimum. From a road standpoint, only State highways, Federal-aid routes and county primary roads are shown.

The base maps were drawn on sheets which are 36 inches square. For easier handling and reference in field and office work, the maps have been reduced to one-half scale or sheets which are 18 inches square. All of the maps are now on Eastman autopositive film which not only makes for better reproduction, but is a good material for making additions and deletions.

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Guide for a
ROAD INVENTORY
MANUAL OF INSTRUCTIONS

NOVEMBER 1974

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U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

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Guide for a Road Inventory Manual of Instructions

Section I. Purpose of a manual

The road inventory manual provides instructions in the general methods of road inventories to be conducted by the various State highway agencies in cooperation with the Federal Highway Administration. It is not intended to answer all questions that may arise in the conduct of the work, but is meant to enable employees to understand more clearly the requirements and purposes of the various inventories. The State's manual should be issued to each employee involved in the road inventory operations. Supplements covering special duties or additional work should be issued as the State sees the need.

Section II. Purpose of an inventory

An inventory is made to obtain data for compiling statistics on the mileage and characteristics of the several types of roads, streets, structures, and other pertinent items within a geographic area. There are some characteristics which can be obtained only by field examination and others which can be obtained or estimated from administrative records, aerial photos, etc. These latter sources may require periodic field checks to update and verify their accuracy. The road inventory constitutes one of
14 several phases of the highway planning process which is a function of the State highway agencies.

Among the uses of the data collected will be the development and updating of maps and computerized information systems. The maps can be used to show public roads outside of, and principal street connections through cities, incorporated towns, and villages; and to locate important structures and other off-the-road cultural features such as farm buildings, dwellings, schools, churches, and other important landmarks. Computerized information systems can lead to combined data bases which lend themselves to more efficient and comprehensive utilization by all divisions of the State highway agencies and possibly other State agencies too.

Section III. Organization and equipment

The road inventory organization and staff may vary considerably from one State to another. This is because of the many differences in geology, topography, meteorology, population, program goals, etc. among the States. Each State should, therefore, maintain its own inventory organization so as to meet not only its own internal needs, including those of local governments, but also the known requirements for national summaries as prescribed by the Federal Highway Administration or other governmental agencies.

Equipment furnished to the inventory organization should consist of such surveying and drafting tools and supplies as are determined to be necessary to meet the goals and standards of the inventory. Safety equipment must receive high priority for the inventory crew. Field parties should use safety devices complying with, and prescribed by, State law and/or administrative policy.

Section IV. Kinds of inventories included in a road inventory

As with many organizations, an inventory of existing conditions and services, along with a history of the conditions and services as provided by the transportation system, is the basis for determining forecasts of the various demands of the existing and future transportation systems. Therefore, the inventory organization should be sufficiently versatile so that it can provide accurate, comprehensive data for a multitude of periodic and special inventories related to the State's transportation system. Among the kinds of inventories that may be required are the following:

1. Rural and urban road inventory
2. Traveled-way studies
3. Highway defense bridges inventory
4. Railroad crossing hazard rating
5. Traffic control devices inventory
6. Rest area inventory
7. Land use inventory
8. Terminal and transfer facilities inventory
9. Junkyard inventory
10. Billboard inventory
11. Transit inventory
12. Bikeway inventory

In addition, there are several other inventories that are becoming more important and which should become a part of the planning process. These include measurements of sound densities, air quality levels, and other environmental effects of the transportation system. Further, more specific, information related to these and other inventories may be found by consulting the appropriate references at the end of this guide.

Section V. Procedures for data collection

During the early years of the planning surveys, the data collection procedures were such that a complete reinventory, which in effect amounted to a new inventory, was made during an established cycle. Consequently, little use was made of the data gathered during previous cycles when conducting subsequent inventories. In recent years though, these collection procedures have been updated and revised, more dramatically by taking advantage of the inherent data handling capabilities of computers and related hardware. Through application of coordinated data systems concepts, several State transportation agencies have established more efficient data gathering techniques. The result has been a reduction in field data collection efforts, a more current and comprehensive inventory data base, and a more effective road inventory activity.

All sources of information should be examined and utilized to the maximum extent practicable. This should include such sources as official city maps, construction records, aerial photographs, railroad evaluation maps, public lands maps, maps prepared by other governmental agencies, maintenance crew reports, and any others readily available. (Much of the topographical and geodetic information may be obtained from the National Cartographic Information Center.) These sources should be used routinely
16 to update the inventory records on a continual basis. Efforts should be made to establish reporting procedures from these sources, where such procedures do not presently exist, to maintain current data on a routine basis. The data obtained from these sources should be confirmed periodically. This should be done by intermittent field inspection or aerial photography, depending upon changes in local economic development and population growth, to assure that the inventory data base is reasonably current, accurate, and complete.

There are several means presently available for the collection of required data. One alternative could be to have no field crew at all, but simply to rely upon a reporting system to maintain the records. This may be the most efficient method, however, data files may be less accurate and less current than with other methods. Perhaps the other end of the data collection alternatives list would be to rely upon field crews only. This method is expensive and time consuming, but the data should be fairly accurate and complete. Other alternatives include such methods as aerial photography, orthophoto map interpretation, photologging, etc. In reality it will more than likely be more advantageous for each State to devise a combination of these procedures which will be particularly suited to the individual State. It has become increasingly important, particularly from a coordinated data systems viewpoint, to be able to locate or reference data for easy access. Therefore, in establishing data collection procedures, reference should be made to the publication "Highway Location Reference Methods."

Section VI. Inventory procedure

A. Road description

The highway system classification, surface type, width (to nearest foot), condition, etc., for each road inventoried should be recorded on the appropriate form. One column should be used for each section of road, with all descriptive items that apply checked or noted. A new section should be made where a change in road characteristics occurs; where county or zone lines, corporate limits of cities, villages, reservation boundaries, etc., are crossed. All sections should contain complete information.

Where the State has not expressed a different preference for a numbering system of roads, the roads not previously numbered should be given a series in each State. The preferred system is that EVEN numbers are assigned to roads having a general east-west direction, starting the series at the north border of the State, and ODD numbers are assigned to roads running generally in a north-south direction, starting at the west border of the State.

For unsurfaced roads and roads having improved surfaces of indefinite width, the prevailing width of the traveled-way or improved surface, as well as road width, should be noted. Sections between 17
which the road is restricted on either or both sides by any barrier such as a large drainage ditch, canal, retaining wall, railroad track, etc. should also be noted. The notes should at least include station-to-station limits of the restriction and the distance from the road shoulder to the restriction. Photographs should be taken of especially hazardous road conditions or at structures, railroad crossings, or intersections where uncommon situations are found.

B. Sidewalks

Where a sidwalk or bicycle path of 500-foot length or more exists (outside corporate limits of cities, towns, boroughs, villages, or delimited areas), its beginning, end, location on right or left, and kind should be noted.

C. Closed or abandoned roads

When a road is closed by a fence or any other obstruction which appears to be for the purpose of closing the road permanently, the inventory should stop at the barrier and the facts should be recorded in the notes. In such cases, a note should also be made to show whether or not the road beyond the fence or obstruction appears to have been used recently. It should also be noted

on the field form if the road is bordered by fences, or shows other evidence of having been a public road at one time. This does not apply to roads open to the public which have gates across them to retain livestock.

D. Impassable roads

For those roads made impassable by seasonal climatic conditions, consideration should be given to scheduling field operations at the most favorable time in the interest of safety and efficiency. When, despite best scheduling efforts, it is necessary to inventory temporarily impassable sections of roads, measurement may be made by a tape or by pacing.

E. Determination of road status

The field party should obtain all field data necessary to determine whether or not a road is legally a public road, but the actual determination will be made by staff personnel only after legal and administrative responsibilities have been established. However, where a road is not shown as a public road on the map, local inquiry should be made for facts to aid in determining its public or private status. The notes should show the information used as a basis for the inventory of such a road.

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F. Toll roads

If a road is a toll road, record in the inventory notes the name of the road, if any, and whether it is operated as a public or private facility. Identify it as a toll facility and inventory it as any other road would be inventoried.

G. Questionable Roads

Where roads appear to be public but are not shown on the maps furnished to the field party, their locations should be shown on a map by reference to aerial photos or should be determined by compass for general direction of each section. Bearings should be taken sufficiently often so that the general course may be approximated and complete notes taken in relation to other rural roads which are shown on the map. Occasional tie-in to fixed objects should be made where possible. The status of such roads (public or private) will be determined in the office at a later time--before they are included as public roads. Where the course of a road is found to be substantially different from that appearing on the map, other corrections should be made on the large scale map. With maps updated from aerial photos, field party work of this nature should be minimal.

H. Drainage

Culverts and minor structures with a clear opening from 3 feet up to and including 20 feet may be inventoried. If these culverts and minor structures are inventoried, information on the station, direction of flow, materials, type, and sizes should be obtained. Also, show roadway width when it is less than the normal width of the road. For culverts, record whether pipe, box, arch, or other.

I. Roadway structures

Structures to be inventoried are all bridges, both free and toll, that meet the AASHTO definition of a bridge as given in AASHTO Highway Definitions, adopted in June 1968. This publication defines a bridge as follows:

> A bridge is a structure including supports erected over a depression or an obstruction, as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads and having a length measured along the center of roadway of more than 20 feet between undercopings of abutments or spring lines of arches or extreme ends of opening for multiple boxes or pipes where the clear distance between openings is less than half of the smaller contiguous opening.

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All other structures crossing over or under the highway which serve public or private properties will also be inventoried. Bridges which have limitations in certain characteristics from a defense highway viewpoint should also be inventoried. Refer to Volume 4, Chapter 7, Section 2 of the Federal-Aid Highway Program Manual for further information. The inventory of these structures is described under Section VII, Structures carrying the road and ferries, and under Section VIII, Structures over the road. (Refer also to the Bridge Recording and Coding Guide.)

J. Off-highway culture

Structures and other items off the road that may be inventoried include: farm units, dwellings, schools, churches, public meeting houses, public cemeteries, hotels, resorts, tourist camps, stores, mills, factories, canneries, mines, ball parks, fairgrounds, public and private golf grounds, country clubs, railroad stations, junkyards (classified as either 1. refuse, garbage or trash dumps, 2. automobile graveyards, 3. scrap metal, 4. scrap building material, 5. sanitary fills, or 6. other), and other culture outside of cities, incorporated towns, and villages and urban

compacts served by the road being inventoried (not inventoried on another road). To avoid duplication where a feature is located at a road intersection, the feature should be inventoried on the road from which the principal entrance leads. If entrance is from both roads, the one of major importance should govern. Where this distinction cannot be made, the item should be inventoried from the road judged more important.

K. Unincorporated places

In the case of unincorporated communities, the principal routes through the village and all side roads and streets should be logged with respect to length, width, type, and condition of surface, and inventory taken of the cultural features on each road or street where such is desired by the State. The number of dwellings, stores, etc., in each block should be shown separately on each side of road if blocks are defined; if blocks are not defined, this information should be reported for each tenth of a mile; dwellings, stores, etc., should be shown separately. Inventory of bridges of greater than 20 feet clear span and of all railroad crossings should be included on the side roads and streets as well as on the through routes. Regardless of whether side streets exist, all hamlets and crossroad settlements, however small, should be recorded in the notes by local name and odometer reading. Where necessary to clarify the record in densely settled sections, a sketch should accompany the field notes.

L. Private roads

Local roads and streets in suburban subdivisions, unincorporated company-owned mill towns, etc., should be logged as described above, provided they show evidence of being legally opened to unrestricted public use. Where it is known that maintenance is actually performed by private property owners, this should be indicated.

Where it is not practicable to arrange an advance investigation, the roads should be logged. Final adjustment can be made later when the work is reviewed and private roads, which in the field work were considered open to public use, can then be placed in their proper category.

M. Delimiting compact areas

In many States, all of the urban communities are not incorporated or the corporation includes the entire township (town in New England) or an extensive area predominantly rural in character. The delimiting of such urban areas by establishing urban-rural boundary zones should be done in advance of the inventory party and a sketch map showing the limits of the area established as an urban compact. However, unknown new development may require the extension of the urban boundaries beyond those shown on office records. The inventory should identify and delimit such extensions. The inventory of cultural features can then be stopped at the urban boundary lines. Inventory of roads and streets within the compact areas should be conducted in the same manner as in rural areas except for omitting the item of culture. Stationing, surface type, and width of both through highways and local streets must be recorded so as to make possible the preparation of mileage tables for each administrative system within these areas.

Delimiting is to be done for all unincorporated urban compacts which have an estimated population of 800 or more, or in places where there are 200 or more houses spaced sufficiently close to form an urban type of development. The procedure is more fully described in Appendix 2.

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N. Reservations

Except when otherwise advised, all roads usually open for the use of the public in State and Federal reservations should be inventoried. Reservations will be designated according to standard classification as follows:

National Forest*
National Park
Military Reservations and Installations
Indian Reservations
Other Federal Reservation (indicate kind)
State Jurisdiction
Local

* Forest development roads should be distinguished from National Forest Highways. Purely timber access or other forest development roads should not be included.

The General Staff, U.S. Army, has furnished copies of "Procedures Applicable to Access of Civilian Mapping Agencies to Military Installations." These instructions cover Army, Navy, and Air Force operations and are included in Appendix 4.

O. State and county line roads

All roads on State lines should be inventoried but no off-highway culture need be noted beyond the border of the State under inventory. In the case of a road on a county line, a complete inventory should be made when the road is on the north or west boundary. When the road is on the south or the east boundary, its inventory may be left to the inventory of roads in the adjoining county.

P. Road intersections and identification in the field

At road junctions and intersections, the directions of the other road or roads in relation to the centerline of the road being traveled can be shown in the notes by single lines intersecting the ruled centerline at angles approximately agreeing with the angles formed by the intersecting roads. If each of the intersecting roads is designated by a number on the map provided, or a number has been assigned in accordance with the instructions above, these numbers should be noted on the lines representing them in the notes. If the junction or intersection is definitely identifiable by name, such as the name of a village or crossroads, the name should be recorded at the plotted point in the notes.

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Q. Railroad grade crossings

All railroad grade crossings should be inventoried. Details of information to be obtained are given in Section IX, Railroad crossings at grade.

R. Gradient, curvature, and sight distance

The inventory of grades, curves and sight distances will ordinarily require field parties who have received special training in the care and use of specially equipped vehicles. Detailed instructions are contained in Appendix 3. It must be recognized that this activity is hazardous and safety precautions should receive particular emphasis in the conduct of this work.

Section VII. Structures carrying the road and ferries

A. Bridges and culverts 1/

The location of all bridges, as covered in item I, Roadway structures, under Section VI, should be indicated on the note sheet and the direction of stream flow should also be recorded.

Structures need not be remeasured when an examination of existing records reveals no significant changes. The information for new structures, especially the large structures, should be obtained from plans. The necessary descriptive information and dimensions should be entered on the appropriate form.

Other items to be noted might include:

1. Where there is evidence that the waterway opening is inadequate, a concise description and the location should be recorded.

2. Bridges consisting of two or more spans should be briefly described where necessary to clarify the foregoing data.

3. A complete photographic record of all structures is desirable.

B. Overpasses (Highway over railroad or another highway.)

1. Name of railroad or highway crossed, structure number, if any.

2. Number of railroad tracks, or traffic lanes on road below if bridge is over highway. (Where lanes are not marked, show width of surface or traveled-way.)

3. Type of bridge, length of structure, clearances, brief descriptions, year built, condition, etc., (refer to Bridge Recording and Coding Guide).

1/ See also HPPM, Volume 2, Chapter III, for special instructions on bridge records for defense requirements.

C. Tunnels

Obtain the information including length of structure and roadway clearances, both vertical and horizontal. If toll, so note.

D. Ferries

Record in the inventory notes information as follows concerning all ferries which provide service for motor vehicles:

1. Estimates of width of stream at low water. This information need only be approximate and it is not necessary to make stadia measurements or otherwise delay the progress of the party in obtaining it.

2. Whether toll or free.

3. Type of protection for approaches. Use classifications as given in Section IX.

4. Whether publicly or privately operated.

5. Frequency of service.

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Section VIII. Structures over the road

A. High tension lines, conveyors, and similar structures

The locations where high tension lines, conveyors, or similar structures cross over the highway should be recorded on the appropriate form. The minimum overhead clearance should be noted except that all vertical clearances greater than 18 feet may be reported as 18'+. It is not necessary to note local power lines, telegraph, telephone, or guy wire crossings except where they have a minimum clearance of 18 feet or less above the road.

B. Underpasses (Highway under railroad or another road.)

Refer to item B under Section VII and to the Bridge Recording and Coding Guide. However, special handling is required when the highway underpass is incidental to the main function of the overhead bridge. An example of this might be an interstate bridge across a major river and a minor roadway along the river's edge. This underpass would be of a combined type or serve a dual function. In this case the inventory should give information on the span over the highway only.

Section IX. Railroad crossings at grade

Consideration may be given to the preparation of a separate manual of instructions for use in railroad grade crossing data collection. For the performance of this special work, the furnishing of additional instruments and surveying equipment to field parties may be warranted. As a minimum, the inventory should at least meet the requirements of the Procedures Manual, National Railroad-Highway Inventory. Of particular concern in the inventory should be sight distances. Objects restricting sight distances at points 300 feet from the crossing up to 2,000 feet, as measured along the railroad, should be located and sketched. Any buildings or other structures sufficiently close to the crossing to be affected by a future grade separation or to cause further restriction of view as the car approaches closer to the track from the 300-foot point should be noted. Approximate distances to road and track should be recorded, noting the kind of obstruction such as a barn, depot, embankment, trees, etc. If the clear view along the railroad track is 2,000 feet or more, it is not necessary to measure the length of this view. In such cases, the view can be recorded as "unlimited."

It is entirely possible that the view may be greatly restricted at a point 300 feet from the railroad, but becomes much improved or "unlimited" at a point closer to the railroad. If such a condition exists, record should be made of the distance from the centerline of the railroad to the points on either side (no closer than 15 feet to the center of the nearest main track) where greatest sight distance may be obtained; and if it becomes unlimited, show the points where this first occurs when approaching the crossing nearer than 300 feet. The view distances in both directions along the railroad from these points should be noted. In order to identify the crossing later when reports are received from the railroad covering number of trains, accidents, etc., it is important to reference the location wherever possible to the National Railroad-Highway Crossing Inventory Number which is posted at each crossing. 25

When determining the sight distance from the survey sheet to a crossing with a side track between the observer and the main track, the clear sight distance, as limited by fixed objects other than standing (or moving) railroad cars, should be obtained and reported.

In many cases, other streets intersect the survey street within 300 feet of the crossing. Often these streets are important thoroughfares and the angle of intersection may be such as to constitute a through route across the railroad. When the highway traffic crossing the railroad is distributed over two or more streets that intersect within 300 feet of the crossing, separate

sight distance records should be obtained for each street carrying a substantial share of the traffic involved. Intersecting streets that carry a small proportion of the total traffic over the crossing should not be considered.

Section X. Mail and school bus routes

One objective of the road inventory is to prepare county maps on which may be shown all roads used as mail and school bus routes. It may be found desirable to collect this information in the field, or at least have a field check of the data furnished.

Sources of information about school bus routes will vary in different States. Where field work is necessary to obtain information from local school authorities or bus drivers, interviewing should always be done with the aid of a county or local map of the area. A standard form should be used for tabulating the data concerning roads over which school buses are routed.

Section XI. Special municipal inventory procedures

A. Main routes and connections through cities

26 Federal-aid primary, Federal-aid secondary, State primary, and U.S. numbered routes through all incorporated places should be logged, and the surface type, width, condition, and the names of the streets inventoried recorded. Surface types should be designated according to the letter classifications in Appendix 5 and widths measured between curbs. Where there are no curbs, the widths to be shown should be those normally available for use by moving and parked vehicles. Any local street which provides a through connection with any of the above described routes within a city should be logged, and surface types and widths recorded. However, no roads or streets within the cities should be logged, where required data may be obtained from city records, urban planning commissions, or other local source.

B. Other streets

In addition to inventorying main routes and connections, all other streets within incorporated urban communities should be logged. This phase generally will be separately programmed and will include logging of all other streets, alleys, and public ways, in cities, villages, and other incorporated communities, with sufficient information obtained to enable a large scale map to be drawn showing the complete network of streets, major water courses, and railroad lines. All streets should be identified by name when the information is available.

It will not be necessary to take width measurements on the "other" streets. Types should be recorded as in Appendix 5. It will not be necessary to measure bridges and railroad crossings on these streets unless the State so desires.

C. Identification of major generators

Urban areas have been placing increased demands upon the States' highway agencies. Among these demands is the requirement to identify and locate major centers of activity. These centers play an important part in the overall system design for an urban area and, therefore, it is important that urban planners know as much about them as possible. Some examples of the kinds of activities to be identified and located are: civic centers, sports arenas, hospitals, universities, shopping centers, airports, etc. The information needed will at least include sufficient data to describe the type, location, and size of the activity being inventoried.

D. Information from city records

To the extent that the information called for can be obtained from city records and where the street layout is correctly shown on a current city map of adequate scale, logging and measurement of city streets may be dispensed with. Care should be taken, however, to see that mileage statistics for the city are complete and current and that maps have been brought up-to-date in respect to the street layout and other features.

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E. Identification of corporate boundaries

The location of the incorporated area boundaries should be noted. Where the inventory is to end at a county, village, township, or city line, and such line is not marked where it crosses the right-of-way or roadway being inventoried, the inventory will be continued to a street, road, or structure which will permit the boundary line to be tied in with the location of the structure or intersecting road. Where necessary, a map may be used to scale the distances from a known intersection, or structure, to the boundary in question.

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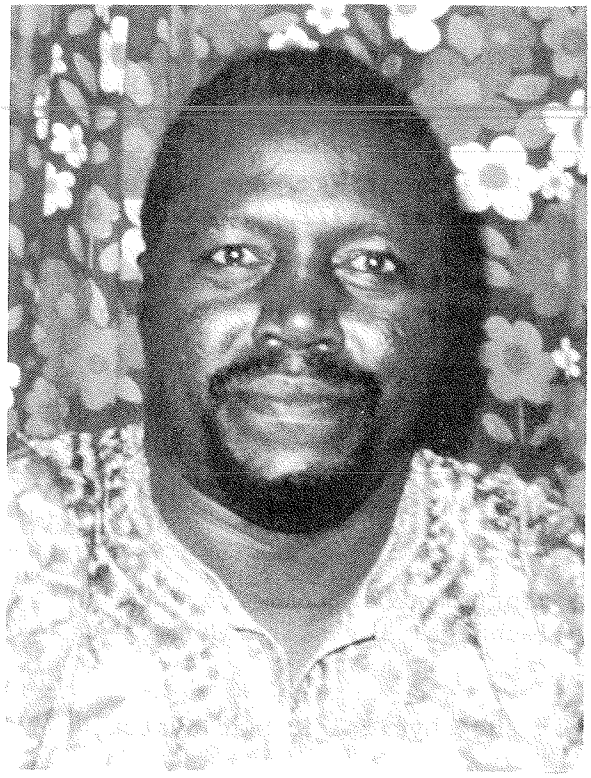

Project Correspondent R. N. Karimi, Provincial Engineer, Ministry of Transport and Communications, Kenya.

HIGHWAY EXTENSION AND RESEARCH PROJECT FOR INDIANA COUNTIES

ENGINEERING BULLETIN

Guidelines for Traffic Counts on County Roads

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PURDUE UNIVERSITY—ENGINEERING EXPERIMENT STATION

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CONTENTS

Guidelines for traffic counts on county roads

EUGENE R. RUSSELL
Research Engineer
and
JEAN E. HITTLE
Research Engineer

INTRODUCTION

1. *General:* Every county should have some sort of traffic counting program. Traffic count data, properly obtained and analysed, is essential to a sound road-planning program. It puts planning and decision-making on a realistic, factual basis. It takes much of the guesswork out of the question: "Where should funds be spent?"

Money for roads and streets must be spent in such a way that a maximum number of road-users will benefit. As road and street money always seems to be in short supply, it must be apportioned carefully. Only by having knowledge of the volume of traffic served by each road in a county can it be properly classified or grouped so that the proper apportionment of funds can be made to it or its class of road.

Obviously, all roads cannot be built to superhighway standards. Low volume roads are properly built to lower standards that are adequate for the volumes served. Usually, the classification of roads for the purpose of establishing different levels of geometric standards is done on the basis of traffic volume. The volume must be known.

Besides classification of roads for the purpose of establishing proper design standards, volume information may have additional value. Traffic volume trends or growth on a particular route or routes is one example. It may be desirable to determine peak-hour volumes at a particular location and to establish a seasonal count station to establish or verify monthly traffic variations throughout the year. It may be useful to establish a counting program to determine changes in travel patterns on routes within a county. Information in regard to vehicle-miles of travel within a county is very important and cannot be determined without information on traffic volumes.

A 1965 study (1) was conducted to estimate vehicle-miles traveled on county roads throughout the state. Information of this type is useful for good planning and should be updated periodically—5-year cycles are common—to be of continued value. As stated in the report of the above-mentioned study: "The counties, however, have little traffic volume data and a poor base on which to calculate vehicle miles of travel on county roads"—is still applicable (in 1971) to most counties. A continuing program of traffic counting and data collection is needed to keep this information current and useful.

2. *Purpose and Scope:* This manual has been developed to provide county highway personnel with guideline procedures for counting traffic volumes. While the emphasis is on county roads, the procedures are equally applicable to any highway, road or street; therefore, city street and state highway personnel may also have an interest in the guideline procedures outlined herein.

The section on "Traffic Count Planning" discusses general concepts of traffic counting and establishment of counting stations to obtain data for both immediate uses and long-range planning. The several types of traffic count stations necessary for the efficient collection of traffic count data are also discussed. Likewise, the traffic count data that is available from the Indiana State Highway Commission is reviewed.

The section on "Analysis of Data" presents specific examples for converting typical portable-counter data to an ADT value. These examples demonstrate the use and application of ISHC data. Likewise, the analysis of short count data is illustrated. This section will be of value to county personnel after they have obtained some traffic volume counts.

A section is also included which outlines the important aspects of automatic counting equipment. The operation of Streeter Amet portable counters is described in detail since the ISHC presently has only this make of portable counter in use and in stock.

The last section summarizes the organization of traffic count programs in relation to other phases of county highway planning and operation. This information should be of special interest to county commissioners and others who have a responsibility for making and shaping policy for the county highway department.

3. *Acknowledgements:* Some of the general concepts on traffic count planning have been adapted from "Traffic Volume Counting Manual," published by the U.S. Department of Commerce, Bureau of Public Roads, May 1963. The general concepts presented in this

publication have been combined with specific examples for handling traffic count data.

Special thanks are due John E. Camardy, traffic statistics supervisor, ISHC and Dwight Kay, traffic equipment technician, ISHC, for their valuable discussion of problems associated with the use of automatic counters. Much of the section, "Common Problems" is based on suggestions by Camardy and Kay on this subject.

Portions of the Streeter Amet operation manuals have been included herein with the permission of R. T. Brumbaugh, president, Streeter Amet Corporation.

TRAFFIC COUNT PLANNING

1. *General:* Planning a traffic count program for a county highway department should take into account:

(a) the size of the county and the predominate types of traffic that prevail; i.e., urban, suburban, resort, low-volume rural, etc.,
(b) the number of major traffic generators in the county,
(c) the traffic data and information already available from the ISHC that has direct use and application to the county traffic study, and
(d) the objectives and scope of the study, i.e., priority programming, capacity-standards studies, traffic control studies, classification studies, etc.

These items will, of course, relate to traffic count planning in a variety of ways, depending on needs and problems of the particular county highway department. This section reviews the types of traffic count data needed, the traffic count data available from the ISHC, and the traffic count data normally collected by the county highway department.

2. *Types of Traffic Count Stations:* Traffic count studies over the past 30 years have demonstrated repeatedly:

(a) that traffic volumes vary by the hour of the day, by the day of the week, and by the month of the year,
(b) that these traffic volume variations occur in repeated cycles—by hour of day, by day of week, and by months of year, and
(c) that these cyclic variations persist over long stretches of road and for long periods of time.

Therefore, based on these fundamental characteristics of highway

use by the traveling public, traffic volume measurement makes use of three different types of traffic count stations; these are:

Continuous Count Stations
Monthly Count Stations
Coverage Count Stations

The purpose and function of each of these types of traffic count stations is covered in the paragraphs that follow.

3. *Continuous Count Stations:* This is sometimes referred to as a "permanent" count station, since its function is to count (usually by "magnetic" probes, loops, radar, or ultrasonic devices) and record by hourly intervals, the number of vehicles passing the station for long periods of time—usually several years. Assuming proper functioning of equipment, continuous count stations provide a *true record* of annual average daily traffic (AADT) for a particular station. Likewise, the count data can be analyzed for hourly, daily, and monthly fluctuations of AADT for the particular route location.

In addition to determination of long-term average trends from such stations, factors can be computed for the hourly, daily and monthly count variations, applicable to the particular station and *to other route locations having similar travel characteristics.* Thus, to cover the full range of state-wide travel characteristics, it is necessary to maintain several continuous count stations.

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Here in Indiana the ISHC operates and maintains 28 continuous count stations. These stations and their locations are listed in Appendix A. These are strategically located over the state to cover a wide range of travel characteristics. These 28 continuous count stations are further classified into five travel groups*, each having similar monthly or seasonal factors.

These travel groups are designated as:

Travel Group I—State Roads in Most Rural Areas
Travel Group II—State Roads in Rural Resort Areas
Travel Group III—State Roads in Mining Areas
Travel Group IV—State Roads in Suburban Areas
Travel Group V—Local Roads in Rural Areas

The monthly factors for each of these five travel groups are shown in Appendix B. Examples of how these factors are used are included in the section on "Analysis of Data."

* Additional permanent count stations are currently (1971) being established in urban areas and from these, other group factors will be available in the future.

With the amount of data available from the several continuous count stations of the ISHC, it is not anticipated that county highway departments will have any immediate need to establish any continuous count stations.

4. *Monthly Count Stations:* This is a station or location where traffic counts are taken at intermittent periods of time and on a periodic schedule that divides the year into equal parts. Here in Indiana, monthly counts are taken by the ISHC at selected stations with portable traffic counters for a period of seven consecutive days during each month of the year.

Each monthly station is matched, if posible, with the travel characteristic of one of the continuous counter groups. The monthly counts are often taken on routes where a unique monthly change in the travel characteristics is known or anticipated, such as on highways serving resort area travel.

The ISHC currently operates monthly counting stations at approximately 30 locations throughout the state. Comparison of travel characteristics at these locations with specific county routes may often be helpful in establishing the type of travel on each county route (rural, rural resort, suburban, etc.). An example of the data collected and record form is shown as Appendix C.

County highway departments with predominantly low volume rural roads need not be concerned about monthly count stations. However, where there is uncertainty about the type of travel on a high volume road, then the county highway department may consider setting up a monthly count station.

5. *Coverage Count Stations:* This is a station or location where traffic counts are taken for relatively short periods of time, normally with a portable traffic counter or manually, for the purpose of estimating the traffic volume for a particular section of road. County highway departments will be primarily concerned with this type of counting station, since the bulk of the traffic volume data comes from coverage counts. Here are some general guidelines on the location and operation of coverage count stations.

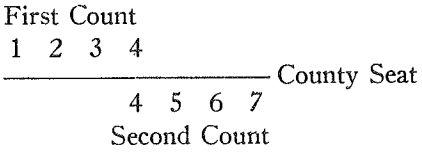
(a) *Time Periods:* Coverage count stations may be operated continuously for periods of 24 hours, 12 hours or 8 hours. However, where portable machine counters are used, an average 24-hour weekday count should be determined by operating the count station (with twice-a-day service check) for a minimum of 48 hours during the period Monday noon

through Friday noon. The 48-hour minimum duration makes it possible to spot "false" inputs or erratic counts for any given 24-hour period. Except where special weekend information is needed, the counts are normally taken on weekdays, Monday through Friday. The ISHC recommends taking them Monday noon through Friday noon. Monday morning and Friday afternoon are excluded as being not representative. Thus, the ISHC bases its average weekday on four days, designated as Monday through Thursday on ISHC records.

(b) *Count Method:* Coverage count stations on paved roads may be operated as either portable machine count stations or as manual count stations. In any case, manual counts are normally short counts of either 12-hour or 8-hour duration. Coverage counts on unpaved roads require extra precautions if portable machine counters are used. It is recommended that they be taken on bridge decks or when the ground is frozen. Counts on unpaved roads are usually manual counts (either 8-hour or 12-hour) which may be taken anytime.

(c) *Station Spacing:* The number of count stations needed along a given route will depend on the accuracy desired. For a comprehensive traffic survey, information is usually needed for each section of road between public road intersections and major traffic generators (schools, salebarns, etc.). This usually can be achieved by taking counts at every other intersection. Where traffic volumes along a route do not vary more than 10 percent, coverage count stations may be located at longer intervals. Likewise, where changes in traffic volume are evenly distributed over a series of consecutive intersections, intervening stations may be omitted and traffic volumes estimated for them by prorating the volumes of the end sections. As personnel in the county become more familiar with traffic patterns, fewer stations will need to be counted because prorating traffic between stations is often as accurate as counting; but this knowledge only comes with experience gained as the counting program progresses. It is usually a good policy to lay out stations in such a way that the data is self-checking, or at least gross errors can be spotted. One way is to lay out stations on routes working toward the county seat or other major traffic generators or collectors. As counts are made on sections on different days, an "over-

lap" station can be used for control. For example, in the layout below;



let's say we have four counters and want average weekday traffic. On the second sequence counted (during some other period than the "First Count") there should be reasonable agreement between the two counts for Station Four or there is something "wrong," e.g. an unusual day caused by a farm auction or similar unusual traffic generators. Also, traffic volume should increase as one approaches a traffic generator such as a county seat. Thus, during the routine twice-a-day checking, (see paragraph on Servicing and Maintenance) unusually low or high counts can generally be spotted. Here again, *evaluating data in this matter requires experience.*

(d) *Getting Started:* The initial effort by county highway departments in setting up coverage counts should be concentrated on the county arterial system of roads (main-line), on high-volume suburban roads not in the county arterial system, and on all other roads serving local traffic generators, such as schools, factories, resort areas, etc.

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(e) *Repeat Cycles:* Once underway, a coverage count program should be periodically repeated. In fast-growing communities it may be warranted to repeat the coverage counts annually. The coverage counts may also be repeated on three- to five-year cycles. Asuming a three-year cycle, one third of the coverage count stations in a county would be counted each year.

(f) *Priority Counts:* In planning a traffic count program, county highway officials should give emphasis and priority to the traffic counts on the higher volume roads. Routes with traffic volumes of less than 100 ADT are usually of secondary importance in road improvement planning. Therefore, such roads usually will be of secondary importance in the coverage count program.

6. *Traffic Count Data Available from ISHC:* As previously noted, the Indiana State Highway Commission's Planning Division collects

and compiles extensive data and information on traffic statistics. A considerable amount of this data has direct application to a traffic count program for county highway departments. In most cases, traffic counts are available for a portion of each county's highway system. The following categories of data and information are on file and available to county highway departments.

(a) *Continuous Count Data:* Monthly adjustment factors are compiled for 28 continuous count stations over the state. Their locations are shown in Appendix A. From counts at these stations, adjustment or expansion factors are calculated to "expand" the counts taken at coverage count stations on the county road system. New factors are computed annually and up-dated reports issued. These factors are shown in Appendix B.

(b) *Monthly Count Data:* Seven-day counts for each month of the year are taken at approximately 30 locations over the state for the purpose of identifying the travel characteristics of each route. That is, one needs to know the travel characteristics of a route in order to apply a factor appropriate to a group such as resort area, rural, suburban, etc.

(c) *Coverage Count Data:* Traffic counts are taken on all of the federal-aid routes throughout the state on about a four-year cycle, including the FAS routes under county jurisdiction. This traffic count information is compiled on county highway maps and is available to county highway departments. However, the county traffic maps are not in a reproducible form and the county highway department desiring this data for its county must provide a person to hand copy the traffic counts to another map. County highway officials are urged to make the best possible use of the coverage count data available from the ISHC.

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ANALYSIS OF DATA

1. *General:* It is only at continuous count stations and under ideal conditions that the true AADT (Annual Average Daily Traffic) can be computed with absolute certainty. Any count of less than a year's duration must be considered a sample. Samples of any duration, less than one year, adjusted to represent the AADT are an estimate of AADT, but if properly done such an estimate will be very close to the actual AADT.

Presented below is a means of estimating the AADT from a count for a 24-hour period obtained with a minimum of time and effort. If the procedure is followed with reasonable care, the results will be sufficiently accurate for application to county highway planning processes.

In order to extrapolate a 24-hour count to obtain meaningful results, appropriate factors are necessary. These factors are generally based on available continuous counts of the ISHC that are accurate.

2. *Variations of Traffic Counts:* Traffic volumes are subject to cyclic variations, such as monthly, daily and hourly. On any given route the cyclic variations reoccur over and over and are predictable with relatively high accuracy as long as the basic character of the travel on the route does not change. Likewise, all routes with similar travel characteristics will have essentially the same cyclic variations. Thus, if the pattern of variations is known on any one route, factors obtained from these variations can be applied to all other routes with similar travel. The nature of the cyclic variations and what is meant by "similar" travel, along with an example or two, will be explained further in the following paragraphs.

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3. *Monthly Variations:* The monthly variation is generally very predictable and reflects seasonal weather as well as the socioeconomic pattern of a particular region. For example, a strictly winter resort area would be expected to have its heaviest traffic in the winter months. In Indiana, the usual pattern reflects the typical national pattern of heavy traffic during the traditional summer-vacation months and low volumes during mid-winter.

4. *Variations in Cyclic Patterns, a Word of Caution:* It must be recognized that daily traffic counts can be temporarily inflated by certain local events or conditions and thus not reflect the actual AADT—for example, special events such as a state, county or local fair, a football game, etc. Volume counts taken during such activities are not average and the application of average factors is not appropriate. These conditions are best known locally, and no volume counting for calculation of AADT should be done during such unusually high volume periods. The type of area may also be unique and travel on highways in the area may not be similar to that on any other highway where monthly factors are available. If this situation exists, special monthly counts on one or more roads in the area will be necessary to obtain appropriate factors.

5. *Monthly Variations on County Roads:* Data for monthly varia-

tions on some county roads, particularly low-volume county roads, may have a different variation than on state roads.

ISHC data records, however, are available from three continuous counting stations on county roads. These three stations represent generally a high, low and intermediate traffic volume situation. A plot of these available data is shown in Figure 1. Factors can be used from the particular curve in Figure 1 which is similar to the local road for which the AADT is desired.

6. *Indiana State Highway Commission Factors:* As previously explained, factors available from the planning section of the ISHC can be used to adjust a count taken on any day of the year to an estimate of AADT.

Data are recorded at each of the ISHC permanent count stations in such a way that a count is available for each day of the year. An hourly total is also available for each day. These data from each station are put on computer cards and a computer output showing monthly totals and averages is available. An example of this output is shown in Appendix E for Station 7047-A for January 1968. Averages shown include the average for each day of the week, a four-day average (Monday through Thursday), an average weekday (five-day average—Monday through Friday), and average hourly totals for weekdays, Saturdays and Sundays. 43

7. *Calculation of Monthly Factors:* From such data, factors to convert counts made during one month to an estimate of AADT can be determined. The monthly factor is simply the ratio of the average monthly volume to the actual AADT. For example, if for a particular station AADT is 200, and the average weekday count for January is 100, then the monthly adjustment factor for January is $\frac{200}{100}$ or 2. That is, the January count of 100 must be multiplied by 2 in order to "estimate" AADT. Expressed as a "formula":

$$\text{Monthly Factor} = \frac{\text{AADT for Station}}{\text{Average 24-hr. Count for Month}}$$

$$\text{where, AADT} = \frac{\text{Total Yearly Count for Station}}{365}$$

$$= \text{Average Annual Daily Traffic}$$

An average 24-hour count for a month is for the days desired, i.e., average weekday, average Sunday, average Friday, etc. As an

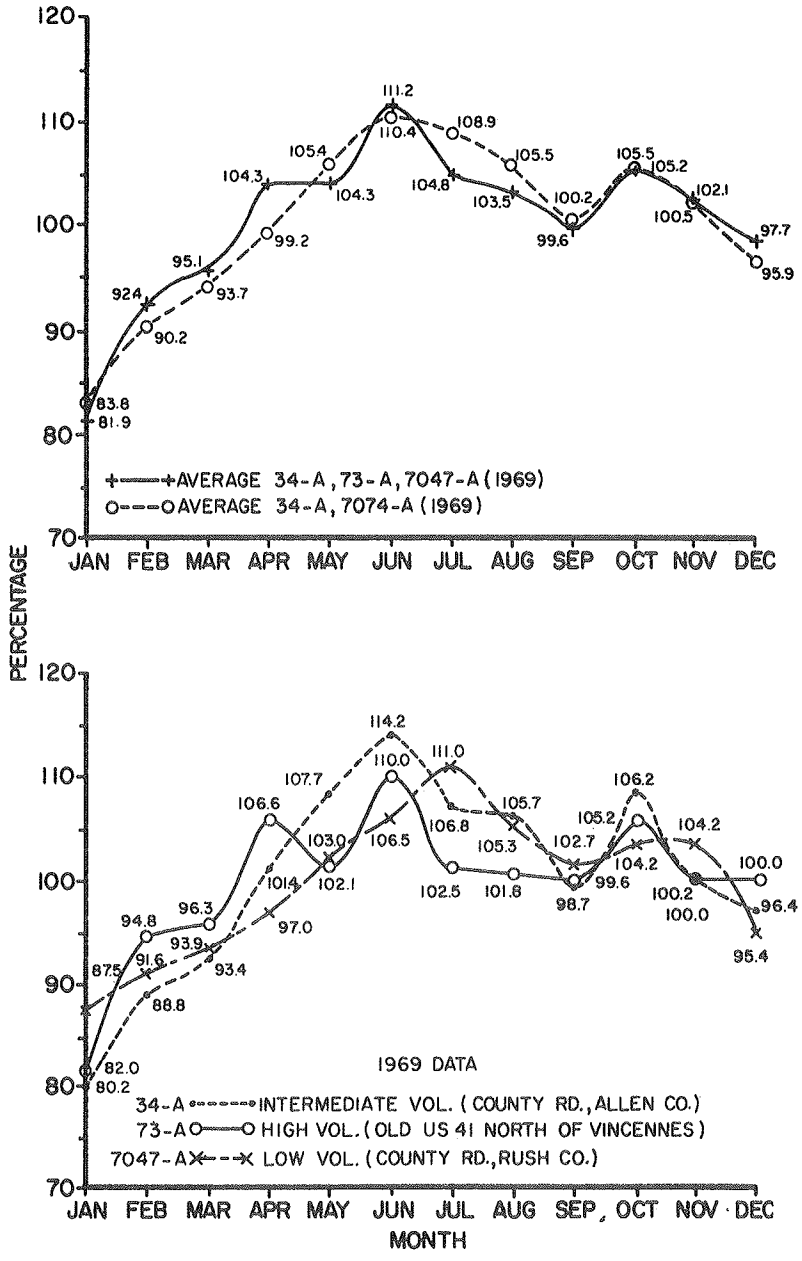

Fig. 1. Plot of Monthly Factors for Three Indiana State Highway Commission Permanent Court Stations on County Roads.

example, a portion of the worksheet used by the ISHC is presented for January for one station as follows:

EXPANSION FACTOR DATA WORK SHEET

Year: 1968 Month: January Station: 7074-A

*No. Days	Day Groups	*Total Traffic	*Average	**Ann. Ave. 24 Hr. Traffic Count	***Factor
4	Sundays	714	178	281	1.579
19	M-T-W-Th	4218	227	281	1.238
4	Fridays	1097	274	281	1.026
4	Saturdays	1047	261	281	1.077

* From output sheet for January

** Yearly total divided by 365

*** Computed as: $\text{Factor} = \frac{\text{Ann. Ave. 24-Hr. Traffic Count}}{\text{Average for month}}$

Factors for all other months are computed from comparable values taken from the record of counts compiled during that particular month.

8. Converting 24-Hour Counts to AADT

[*Different Route—Similar Travel Group*]: Now, a hypothetical example will be used to clarify the use of factors. Suppose counts are taken on another route (Route B) which is known to have the same characteristics, and therefore the same traffic variations, as the one just discussed. A 24-hour count taken on any day in January on Route B can be converted to an estimate of AADT for this route using the factors calculated above from the permanent station as follows:

Day Groups	Route B 24-Hour Count	Factor	Estimated Annual Average 24-Hour Traffic
Sundays	180	1.579	284
M-T-W-Th	220	1.238	300
Friday	300	1.026	308
Saturday	260	1.077	280

It is obvious that the estimate of AADT differs, depending on which day the count on Route B was taken. The question then is: "Which daily volume is most stable or will most often reflect a good estimate of the true AADT?" The "answer" to this question lies in

studies that have been made of "daily" variations, and it is answered in the next two sections.

9. *Daily Variations:* A second cyclic variation is the variation from day to day within a week. The traffic volume used for most purposes is the traffic volume for the average weekday. The ISHC eliminates Monday morning and Friday afternoon as not being typical and uses the four-day period from Monday noon to Friday noon, which they refer to as the Monday-thru-Thursday average. The weekday pattern reflects work and business traffic and is quite similar from week to week.

If one assumes that the average weekday traffic in any week is adequately estimated by a 24-hour count made on any weekday, then one can use the above calculation method to estimate the AADT of a particular road from a 24-hour traffic count. Such an assumption is typically adequate, for as noted in numerous studies (2) the daily traffic volume for each of the weekdays of a week is very similar.

10. *Minimum 48-Hour Count for Portable Counters:* As stated above, *any* 24-hour weekday count should be sufficiently accurate for county road volumes. However, when automatic portable machine counts are made, an average should be determined by leaving the counter with a twice-a-day check for a minimum of 48 hours during the period Monday noon—Friday noon. As noted previously, this procedure makes it possible to spot "false" inputs or erratic counts for a given 24-hour weekday period. The longer the period counted, or several periods spread throughout the month, the more reliable will be the "average weekday." Or, to coin a phrase; "the more average the average weekday is, the more reliable will be the estimate of AADT."

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11. *ISHC Factors for County Roads:* The following factors are recommended for use with volume counts taken on typical rural county roads in Indiana:

LOW VOLUME
(less than 500 ADT)
Based on Sta 7047-A on county road in Rush County (1970)

	Factor		Factor
Jan	1.10	Jul	0.86
Feb	1.01	Aug	0.94
Mar	0.96	Sept	1.00
Apr	0.99	Oct	1.01
May	0.99	Nov	1.04
June	0.94	Dec	1.21

INTERMEDIATE TO HIGH VOLUME
(greater than 500 ADT)
Based on average of Sta 34-A on county road in Allen County, Sta 73-A on old U.S. 41 North of Vincennes and Sta 7047-A on county road in Rush County (1970)

	Factor		Factor
Jan	1.31	Jul	0.96
Feb	1.18	Aug	0.94
Mar	1.08	Sept	0.97
Apr	0.93	Oct	0.93
May	0.96	Nov	0.96
June	0.92	Dec	0.99

HIGH VOLUME, COUNTY ARTERIALS
(Comparable to State Highways, 1000–10,000 ADT)
Based on average of all continuous count stations on Indiana state highways (1970)

	Factor		Factor
Jan	1.24	Jul	0.80
Feb	1.20	Aug	0.81
Mar	1.09	Sept	0.91
Apr	1.06	Oct	0.99
May	0.94	Nov	1.04
June	0.84	Dec	1.09

The factors given in Appendix B, *Factors to Expand 24-Hour Weekday (Mon., Tues., Wed., Thurs.), Volumes to AADT for "Local Roads in Rural Areas"* are averages of state count stations noted previously. Using the factors suggested above (or the "average" from Appendix B) acceptable results should be given for most county roads, although there may be cases where local characteristics are such that factors obtained by the county, either by a permanent count station or monthly count station, may be more appropriate. It should be emphasized that a county may very easily develop its own factors which may be more appropriate for any given situation. This point is discussed in the next section.

12. *Developing Local County Road Factors:* Perhaps the most practical approach for a county that wishes to develop its own monthly factors would be to do so in the same manner that monthly counts are generally taken—that is, use a portable counter, count seven consecutive days during each month, and develop factors from these data. The primary purpose of monthly count stations is to

develop factors for roads with certain traffic volume variations which fit particular routes in an area better than an average or generalized factor from a station on another type of route.

Monthly count stations sometimes provide the only way to assign, with reasonable certainty, a given route to a particular travel group or to determine that a given route stands out as being unique in its monthly travel variations. Data obtained at a monthly count station, for example, may show that a particular route's characteristics better fit other ISHC factors (from Appendix B) than those recommended above.

It should also be pointed out that another important reason for considering monthly count stations in a county is that they are valuable for determining when the "character" of a particular route is changing, e.g., a "rural" route becoming more "urban" due to subdivision growth or becoming more "resort-oriented" due to a new reservoir, etc.

SHORT COUNTS

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1. *General:* Short counts, usually taken as manual counts, are feasible only because statistical studies have shown some rather consistent relationships between 24-hour counts and counts for a given segment of the 24-hour period. Thus, short counts for a portion of a day may be "expanded" with reasonable reliability to cover the full 24-hour period. This section outlines some short count relationships that are sometimes used in traffic count programs.

2. *A Word of Caution:* Under certain conditions, short counts taken manually offer some advantages from an efficiency standpoint (time-saved); however, they are subject to the vagaries of human error and behavior and offer no safeguard against "false-inputs" such as is provided by a 48-hour machine count. For these reasons, a county should only use short counts in a planned program which includes machine counters at key locations or after an experience record and data base has been developed.

3. *Hourly Variations:* A third cyclic variation that is quite predictable on a given route, or routes with the same character, is the hourly variation, i.e., variation of hourly volume within a 24-hour period. Once again, the same note of caution applies: a local event or unusual happening can substantially alter the pattern on any given date. Based on the 1954 study by Michael (2), the pattern of hourly variation on county roads differs little from state highways or city streets,

except that county roads experience more hours (1 a.m. to 5 a.m.) of almost zero volume.

The peak hours of traffic flow are 5 a.m. to 5 p.m. and approximately 50 percent of the total daily traffic use the highways during the eight hours from 9 a.m. to 1 p.m. and 2 p.m. to 6 p.m., while less than 7.5 percent use the highways between midnight and 6 a.m. The low point of traffic movement on roads of any type is from 3 a.m. to 5 a.m. Hourly variation is plotted in Figure 2 for all three of the state's continuous counters on county roads.

4. *Twelve-Hour Counts:* Instead of 24-hour counts on all county roads, a shorter time could be counted and a factor applied to extrapolate this value to a 24-hour count. It should be noted that the reliability of the final result will depend on the length and time period of the count. With twelve-hour counts from 6 a.m. to 6 p.m., the results should be entirely acceptable. Normally, such 12-hour counts are taken by manual counting. The following procedure should be used.

One or more typical roads where 24-hour or longer counts will be taken should be selected as being representative of traffic on other roads in the county. The number needed depends on the number of areas having distinctly different traffic patterns, such as in or near a town, typical rural, resort areas, or in the vicinity of any specific traffic generator that could cause shifts in the normal pattern. Short counts would then be made on the same day as the 24-hour or longer counts are being taken at all other locations where the volume is desired.

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After the representative average 24-hour count is known, the shorter counts on the other roads of similar character can be adjusted to 24-hour counts. For the following example, on the basis of a 24-hour count, a 12-hour volume from 6 a.m. to 6 p.m. at that station includes 70 percent of the 24-hour count. (*70 percent assumed*)

EXAMPLE:

(a) Unadjusted 12-hour weekday count in July = 1000; then to extrapolate 12-hour counts, representing 70 percent of the volume to the 24-hour count, multiply by $\frac{100}{70}$ or 1.429.

To get the 24-hour count, unadjusted for monthly variation, multiply 1.429 × 1000 = 1429.

(b) The monthly adjustment factor for weekdays in July = 0.834. Now multiply the estimated 24-hour count of 1429 by the monthly factor to obtain an estimated AADT. AADT = 1429 × 0.834 = 1192.

The 70 percent figure used above was more than a guess. Based on the 1954 study (2) it was shown that on the average, during the hours between 6 a.m. and 6 p.m., county roads in Indiana carry about 70 percent of their 24-hour traffic volume.

5. *Eight-Hour Counts:* In a more recent study, eight-hour manual counts were taken (1). The traffic volumes were counted between the hours of 8 a.m. and 12 noon and from 2 p.m. to 6 p.m. An expansion factor was obtained for some counties to convert the eight-hour counts to 24-hour counts. It may be worthwhile to explain how these factors were obtained.

"Five hourly recording automatic traffic counters were set out in each county. These were generally placed on paved, low-volume, state routes in order to be more closely indicative of county highway traffic. The total recorded count for the eight hours corresponding to the eight hours of manual counting was noted. The total count for the entire 24-hour period was observed."

Greater detail on how this study was conducted can be found in HERPIC Bulletin No. 9, "Annual Travel on County Highways of Indiana."

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The 24-hour expansion Factor (F) was computed as:

$$F = \frac{A}{B}; \text{ where:}$$

A = total 24-hour count (sum of five machines)
B = total recorded count (sum of five machines) for the eight hours corresponding to the eight hours of manual counting.

The value of F obtained for some of the counties is as follows: (8 a.m. to 12 noon and 2 p.m. to 6 p.m.)

County	Factor
Adams	2.04
Brown	1.95
Clay	2.02
Dearborn	2.04
Dubois	2.09
Elkhart	1.96
Fayette	2.09

The values above are not presented herein to be used blindly, but as a guide for the factor that one should expect. It is also interesting

to note the consistency of these factors. As a rule-of-thumb, doubling an eight-hour count (the eight hours specified above) will give the 24-hour count.

6. *Variations Based on 1969 ISHC Data:* Figure 2 shows the hourly variations calculated from 1969 data on file with the State Highway Commission on the following three routes:

	Sta. No.	Location	AADT
(1)	73-A	On old US 41 no. of Vincennes	1688 (High Vol.)
(2)	34-A	On county road in Allen County	1053 (Interm. Vol.)
(3)	7047-A	On county road in Rush County	263 (Low Vol.)

Based on data taken from these stations, the following Percent Average Daily Traffic were determined. The percentage for any given time period and station is the sum of percentages taken directly from the histogram graphs shown in Figure 2.

Sta. No.	Relative Volume Class	Pct. Ave. Daily Traffic 6 a.m.-6 p.m. (12 hours)	Pct. Ave. Daily Traffic 7 a.m.-11 a.m. 2 p.m.-6.p.m. (8 hours)	Pct. Ave. Daily Traffic 8 a.m.-12 noon 1 p.m.-5 p.m. (8 hours)
73-A	High	77.5	55.2	50.3
34-A	Intermediate	71.9	51.8	47.2
7047-A	Low	75.2	54.0	54.6
Average		75.1	54.1	49.6

These values are typical of those reported in previous studies. Where more refined data is not taken locally, they can probably be used for typical rural county roads in Indiana.

7. *Use and Application of Short Counts:* Because short counts, taken manually, are subject to human error and omission, a short count program should be planned with caution. However, short counts are often expedient where traffic counts are needed on the same day for several low-volume roads. Likewise, short counts are often useful on unpaved roads were machine counts cannot be taken because of a rough or soft surface. Regardless of the purpose, short counts must be planned by an experienced person and coordinated with other traffic count data before a realistic estimate of AADT can be made for the road or station being counted.

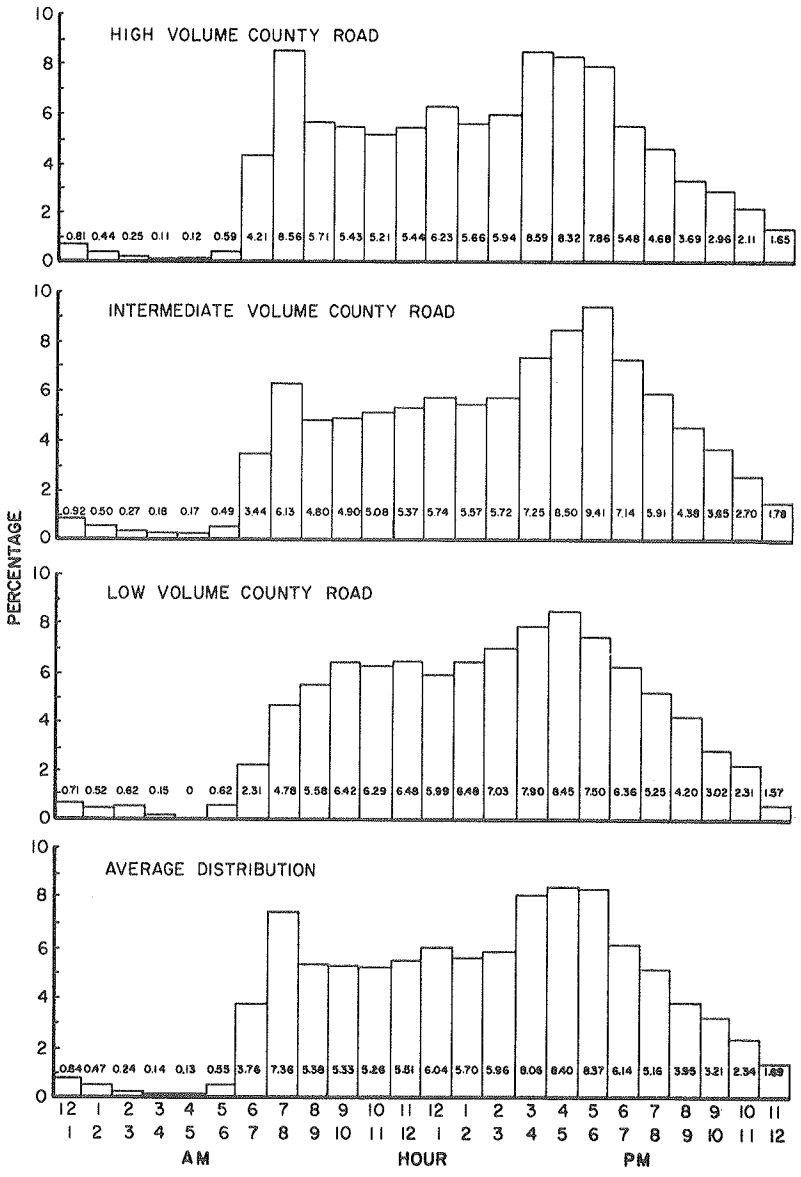

Fig. 2. Hourly Traffic Variations for Three Indiana State Highway Commission Permanent County Stations on County Roads.

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OPERATION OF PORTABLE,
AUTOMATIC TRAFFIC COUNTERS

1. *Personnel:* One point must be stressed from the beginning. The traffic counter is a precision instrument and MUST be treated as such by county highway personnel. Also, no set of instructions or list of how-to-do-it items will substitute for experience. Of course the instruction manuals should be STUDIED—as a starting point—but EXPERIENCE is going to make the difference between reliable data and poor data. A point to remember, too, is that poor data are usually worthless, since they point to incorrect conclusions.

The Indiana State Highway Commission does not consider a new employee "qualified" until after about three months of informal training. He starts out in the traffic counter repair shop watching a unit being torn down and put back together. This is followed by a period spent as an observer with an experienced fieldman. In the next phase, the new man does the field work with the experienced man watching. In the last phase the "apprentice" goes out by himself and performs the full operation, but an experienced man or supervisor later checks what has been done. The above "program" involves about a three-month period.

Most counties can justify a full-time traffic technician, by combining the traffic count program with other traffic-related functions such as records on traffic control signs, maintenance of traffic control signs, accident records on county roads and school safety programs. *In any event, it must be remembered that if the count data are to be worthwhile, some one person or a very few persons should be assigned to the operation.* Counties *should not* look upon the task of using portable counters as something one can do when there is a slack in his regular work—"Joe" one day, "John" the next, then "Bill," etc. Policies of this nature are self defeating! ONE PERSON should be assigned the task and given opportunity to become experienced in its operation.

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The following sections discuss some of the aspects of the counters themselves and highlights from the manuals of operating instructions which are available with the counters. The discussion is not intended to be a substitute for the manuals. The manufacturer's operating manuals should be studied as a starting point.

2. *Portable Automatic Counters:* The following description is an adaptation from "Installation and Operating Instructions for Traficounter"* prepared by Streeter Amet Company (3). It is intended only to acquaint the reader with the machine's components.

* Registered Trademark.

(a) *General description:* There are two types of counters:

15-MINUTE COUNTER—prints every 15 minutes and resets to zero on the hour

HOUR COUNTER —prints total each hour and resets to zero

There is only one basic difference between the two types of units. The 15-Minute Counter, prints the total units counted from the beginning of the hour to the end of each 15-minute period and resets to zero at the end of the hour. The Hour Counter, however, prints only the total number of units counted at the end of each hour and resets to zero.

The 15-Minute Counter offers certain advantages over the Hourly Counter, mainly because it records counts for a shorter time interval. The 15-Minute Counter makes it easier to spot "false-inputs," erractic machine operation and irregularities in traffic flow. Likewise, the 15-Minute Counter is better suited to peak volume studies. The 15-Minute Counter is therefore *recommended* since it will better serve the overall needs of county traffic-count programs. The ISHC uses 15-Minute Counters almost exclusively.

54 Portable, pneumatic-actuated machine counters (3) are powered by storage batteries that need charging about once a month—on the average. Hourly totals are printed on a continuous strip of paper (See Figure 5) which is removed from the machine and the figures transcribed to permanent office records.

A vehicle wheel passing over the 5/8-inch rubber tube closes a pneumatic switch which actuates the counter mechanism. The rubber tube must be placed on a hard, reasonably smooth surface at points where the traffic is moving in a straight path. The tube may be placed to count traffic in two directions, but should not cover more than three lanes. Machine counts become unreliable at volumes in excess of about 2,000 vehicles per hour per machine.

The machine records each two-actuations as one vehicle. For this reason, a correction factor may be necessary on streets and roads carrying large numbers of multi-axle trucks.

A machine counter weighs approximately 85 pounds and can be placed and maintained by one man if necessary. The placing and servicing of eight to twelve machines used for 24-hour counts represents the average amount of work that one man can accomplish in a day.

(b) *Description of Components:* The following description should help acquaint the reader with the general principles of the operation of a counter.

ROADTUBE—transmit air-impulses to diaphragm

The roadtube consists of a length of heat-resistant, gum-rubber tubing. As tires from vehicles pass over the roadtube, they create pressure waves which pass through the tubing to the diaphragm assembly located in the traffic counter. When replacements are needed, standard tubes meeting the manufacture's specifications or ISHC specifications must be used. The ISHC uses a hose with an inside diameter of about ¼", a little larger than the hose supplied with the machine; however, it meets all other specifications. (See also ISHC specifications for purchase of Rubber Traffic Tubing, page 38.)

DIAPHRAGM ASSEMBLY—converts air-impulse to electrical contract closure.

A diaphragm assembly is used to convert pressure waves of air from the roadtube to electrical pulses for operating a transistorized circuit. An indicator dial on the diaphragm assembly is used to adjust the sensitivity of the diaphragm for proper operation.

TRANSISTORIZED MODULE—advances magnetic counter when electrical impulse received.

A transistorized circuit is used to operate a magnetic counter. An electrical pulse received from the diaphragm assembly activates the transistor circuit, causing the magnetic counter to advance one half of a count (two half-counts equal one number).

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MAGNETIC COUNTER—moves numbered printwheel to record count total.

A magnetic counter is used to move the numbered print wheels according to the pulses received. Each time two electrical pulses are received from the transistorized circuit, the print wheels are advanced one full digit. The magnetic counter records traffic moving at normal highway speeds.

CLOCK and PRINTER—clock activates printer arm periodically to record total from print wheel, then to reset the printer wheel.

The clock portion of the clock-printer assembly is an eight-day mechanical clock with two main springs. The clock will turn a motor switch "ON" every fifteen minutes or each hour, depending upon the type of counter being used. The motor switch is connected to the print motor. The motor activates a print hammer producing a printed record on paper tape. As the print ham-

mer resets, the paper tape and inked ribbon are advanced. After completion of the print cycle, the print motor is turned off. The print cycle will not start again until the print motor switch is turned on by the clock.

POWER SUPPLY—a standard 6 volt, 110-amp/hour, wet-cell battery is generally used to power to counter.

(c) *General Arrangements of Components:* Figure 3 shows the counter with the lid and counting mechanism opened showing the battery housing underneath. The numbers (4, 5 and 6) and arrows on Figure 3 shows approximately the orientation of Figures 4, 5 and 6.

Figure 4 shows the battery housing and battery connections. Figure 6 shows the main components of the counting mechanism and is used herein primarily for the purpose of orientation of these components. The arrows and corresponding numbers show the location of subsequent figures showing closeups of these areas as follows:

Figure	Description
7	Transistor Module
8	Diaphragm Reset
9	Terminal Board

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3. *Preparing Counter for Operation*

(a) *Battery Installation* (Refer to Figure 4): A standard 6 volt, 110-amp/hour, wet-cell battery is used to power the counter. The battery should be fully charged with a reading of 1250 at 72°F on the hydrometer. Install the battery into the lower part of the case.

After making sure the battery terminals are clean and free of corrosion, connect a cable from the insulated negative (—) terminal of the counter to the negative (—) terminal of the battery. Also, connect a cable from the counter chassis to the positive (+) terminal of the battery. These connections are illustrated in Figure 4.

NOTE: BE SURE THAT CONNECTIONS ARE CLEAN AND TIGHT OR COUNTER MAY NOT OPERATE. NEVER LAY A COUNTER ON ITS SIDE WITH BATTERY IN HOUSING. IF BATTERY IS TIPPED, SPILLING ACID ON COUNTER MECHANISM OR CASE, WASH OFF IMMEDIATELY. BAKING SODA WILL HELP NEUTRALIZE THE ACID.

(b) *Diaphragm (Road Switch) Adjustment* (Refer to Figure 8):

(1) Turn the power switch "ON."

(2) Rotate the diaphragm dial slowly clockwise until the counting mechanism energizes.

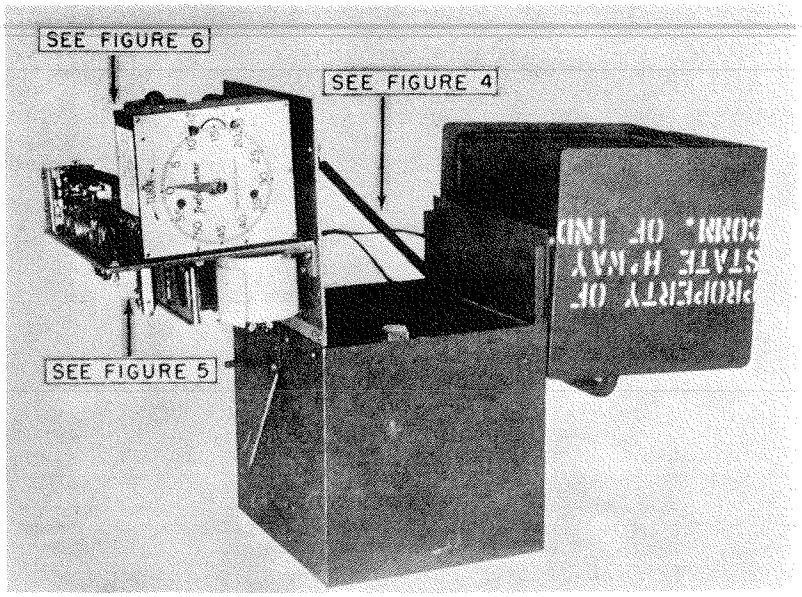


Fig. 3. General Orientation of the Main Components of the Counter.

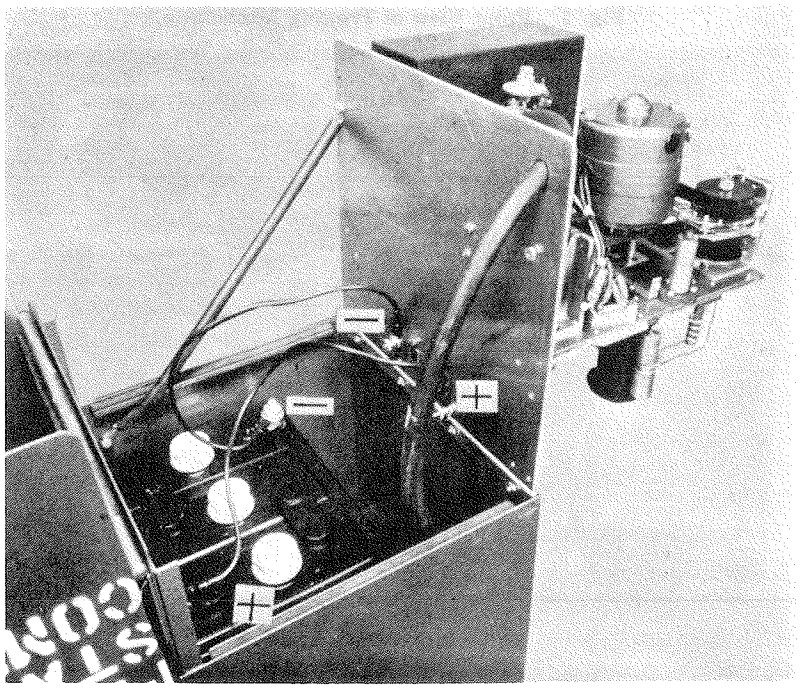
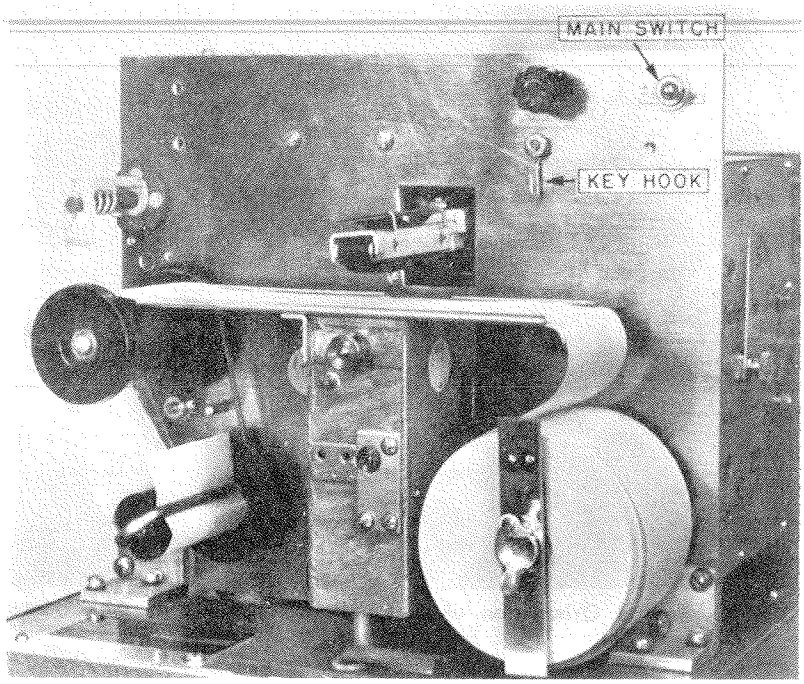


Fig. 4. Six-Volt Battery Power Source and Connections.



58 **Fig. 5. Front View of Printing Mechanism.**

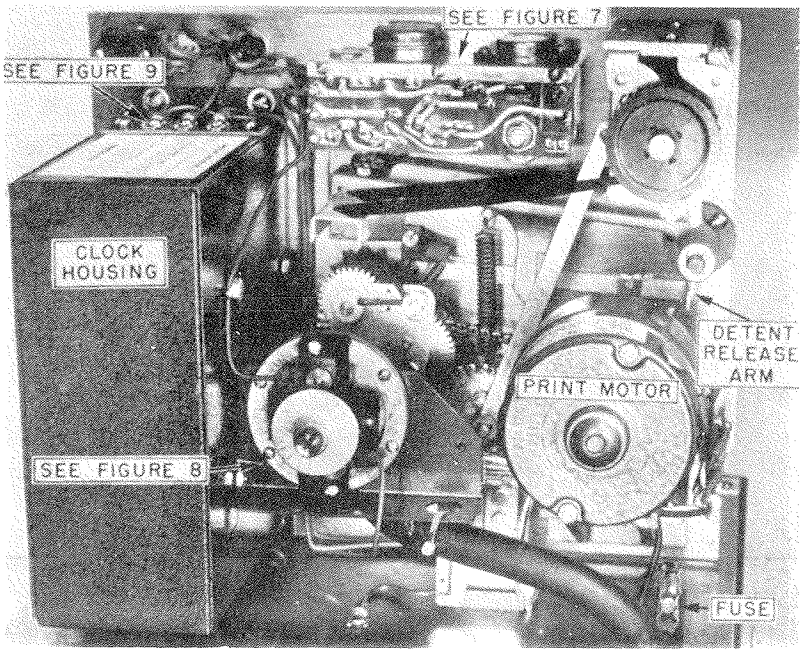


Fig. 6. Rear View of Printing Mechanism.

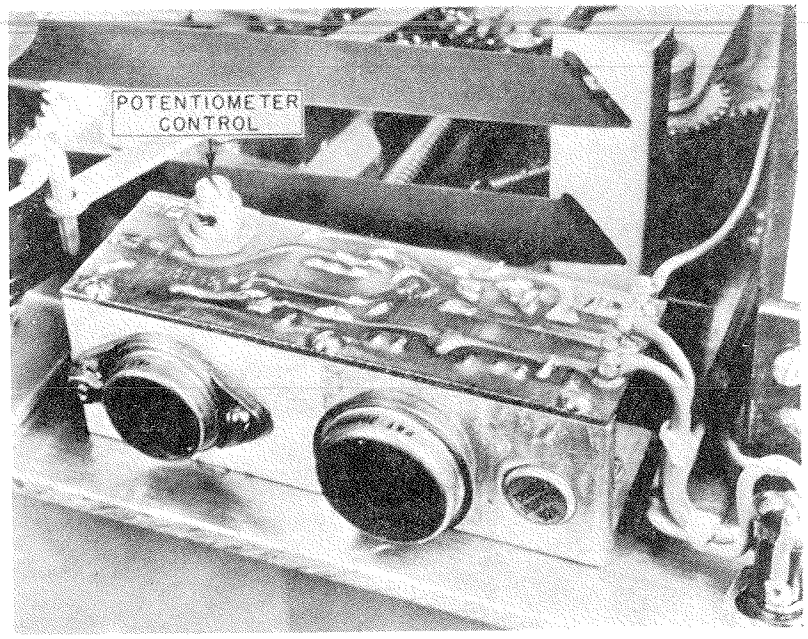


Fig. 7. Detailed View of Potentiometer.

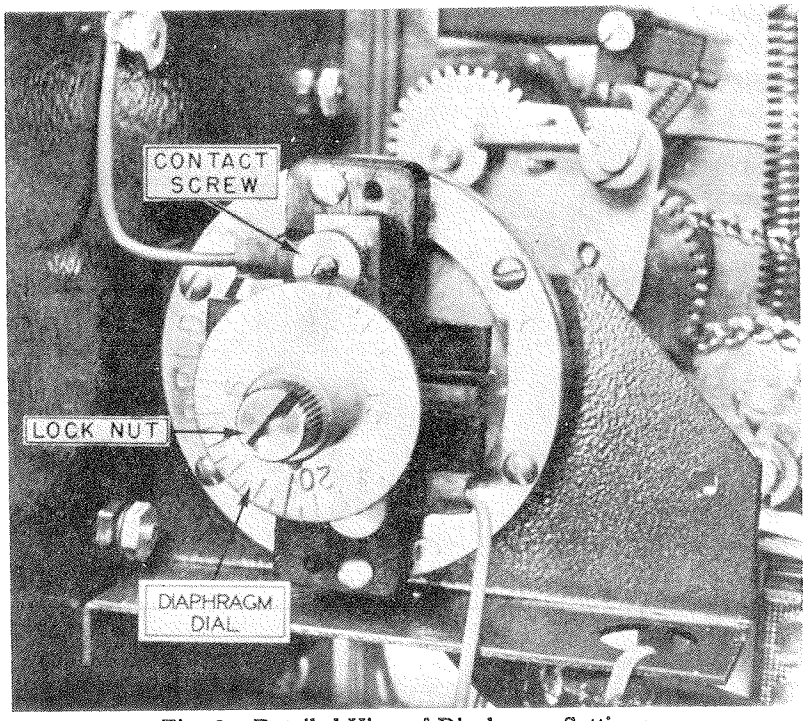


Fig. 8. Detailed View of Diaphragm Settings.

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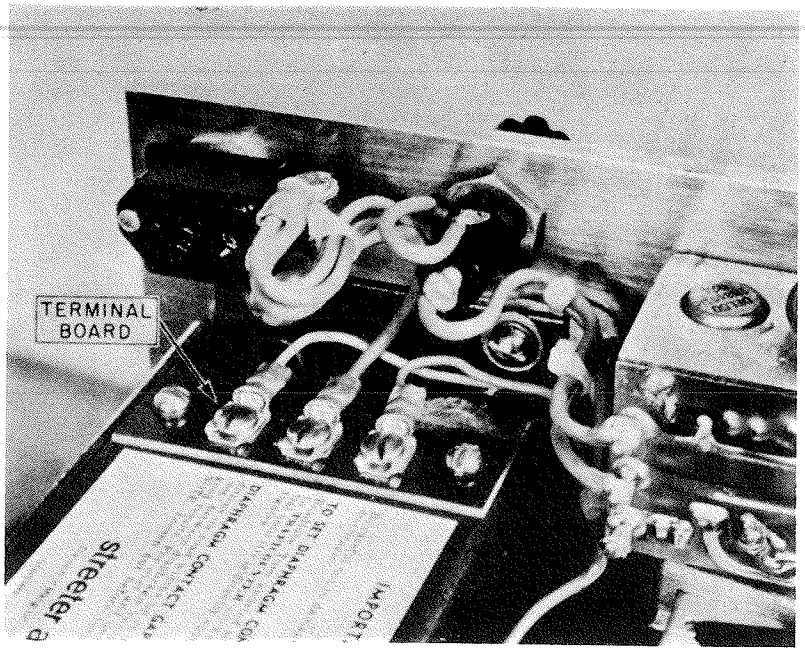

Fig. 9. Detailed View of Terminal Board.

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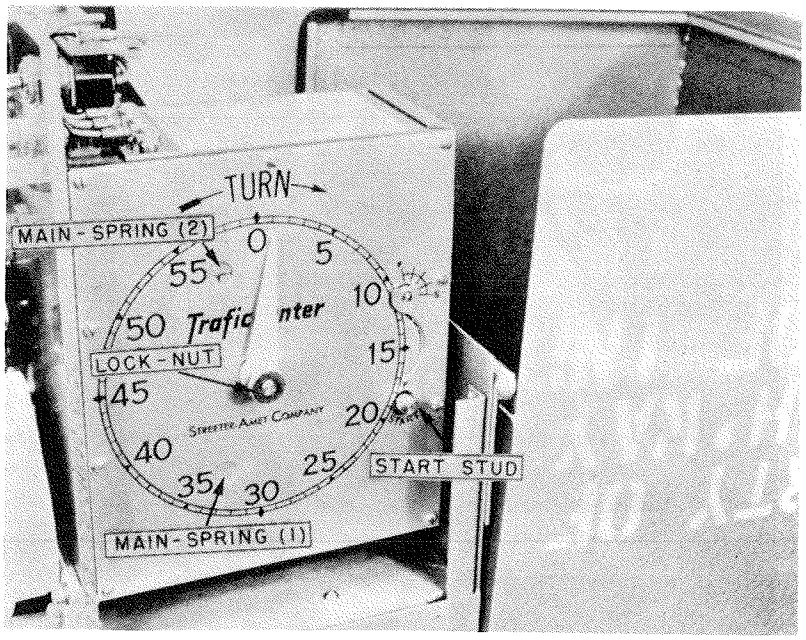

Fig. 10. Clock Details.

(3) The dial indicator should read zero. (If it does not read zero, loosen locknut about ¼ turn while holding the dial and then rotate dial [only] to zero. KEEP CONTACT SCREW FROM TURNING.) Tighten locknut with dial held in new position.

(4) Rotate dial counter-clockwise to No. 5 position.

(c) *Synchronize Clock and Printer Assembly:* This is a critical item in the calibration of a traffic counter. The step procedure outlined here was developed to serve the needs of the beginner, synchronizing the clock and printer assembly (for the first time) on a 15-Minute Counter.

A little experience will demonstrate, however, that the clock and printer assembly can be also synchronized by other procedures. The procedure set forth in the manufacturer's manual, for instance, synchronizes the clock and printer in a slightly different way.

The clock and printer may be synchronized at the county highway shop or garage or at a roadside count station. For the beginner, however, it is recommended that the calibration be carried out two or three times at the shop before an actual counter installation is made. In ths way, the installer gains self-assurance of what is required and when the clock and printer are truly synchronized. 61

(1) Turn power switch "OFF."

(2) Wind both main springs (1) and (2) in clock assembly. (See Figure 10.)
NOTE: The winding key should hang on a small hook on front of vertical face plate. *Worn keys should be replaced to prevent damage to the winding arbor.*

(3) Rotate "START" stud on the face of the clock counter-clockwise to start the clock mechanism. (See Figure 10.)

(4) Install roll of paper tape in machine. (See Figure 5.)

(5) Loosen lock-nut on clock-hand ¼ turn.

(6) Rotate clock-hand slowly (clock-wise); position clock-hand at the "0" or 60-min. position. Tighten lock-nut on clock-hand.

(7) Turn power switch "ON"; this will energize the print hammer, recording the settings of the six print wheels. Reading from left to right on the tape, print wheels 1 and 2 record time (see Figure 11); print wheels 3, 4, 5 and 6 record traffic counts. Turn power switch "OFF."

(8) Alternately turn power switch from "OFF" to "ON," until the hour wheel (No. 1—left) advances to the next higher (hour) number. The hour cycle of the clock and printer assembly are synchronized when the power

switch is "ON" and the next higher hour is showing on the tape.

(9) Keep power switch "ON" and *check* sychronization as follows:

(9-a) Loosen lock-nut on clock-hand ¼ turn.

(9-b) Turn clock-hand slowly (clockwise), pausing at the 15-min., 30-min., 45-min. and 60-min. positions to allow completion of print cycle.

(9-c) At this point, print wheels Nos. 3, 4, 5 and 6 will have re-set to zero.

(9-d) On the return to the "0" or 60-min. position, the hour wheel (No. 1—left) should again advance to the next higher number.

(9-e) If the synchronization does not check, repeat step No. 8 and re-check.

(9-f) The hour cycle of the clock and printer assembly are synchronized *only* when the clock-hand passing the "0" or 60-minute position advances the printed hour to the next higher number.

(9-g) Tighten lock-nut on clock-hand at "0" position.

62 (10) Remove paper tape from guide slot so as to expose print wheel.

(11) Pull detent release arm (see Figure 6) to free print-wheel mechanism.

(12) Rotate No. 1 (hour) print wheel to the current hour of the day; for example if the time is 8:20 a.m., set the hour wheel with 8 in the top position. (See Figure 11.)

(13) Release detent arm. (See Figure 6.)

(14) Position No. 2 print-wheel to A (a.m.) or P (p.m.) for current hour of day. (See Figure 11.)

(15) Replace paper tape in guide slot and attach to rewind spool as per Figure 5.

(16) Loosen lock-nut on clock-hand ¼ turn and *carefully* move indicator hand slowly in clock-wise direction to the current clock time and tighten lock-nut. At 8:20 a.m., as in Step 12, the hand is positioned at 20, pausing at the 15-minute position for completion of print cycle.

(17) PRECAUTIONS:

(17-a) DO NOT loosen lock-nut on clock-hand more than about ¼ turn.

(17-b) PAUSE at 15-min. (also 30-min. and 45-min.

positions if necessary) to allow for completion of print cycle.

(17-c) DO NOT move hand in counter-clockwise direction; this will upset the synchronization.

(17-d) BE SURE TO TIGHTEN LOCKNUT ON CLOCK-HAND.

(18) The traffic counter is now ready for installation. As noted before, preparing the counter for operation may be done in shop or field. For the beginner, a few "trial-runs" in the shop is advisable in order to get acquainted with the component parts and their operation.

(19) The preceding steps outline the synchronization of clock and printer for a 15-Minute Counter. The calibration of an Hour-Counter is much the same, except Steps 8 and 9 are omitted.

4. *Traffic Counter Installation:* Before installing the counter, check: (a) Roadtube for dirt and holes; (b) Batteries for proper strength.

No matter where or how many times the counter is set up, always check the roadtube for cuts, holes and dirt. Blow the inside clean with an air hose. The counter will not work if the roadtube leaks or if the roadtube is clogged.

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(a) *Ideal Roadtube Installations:* Proper installation (4) of the roadtube should, if at all possible, allow heavy, wide-tired vehicles, such as trucks, buses, etc., to strike the roadtube at a point furtherest from the counter to eliminate double counts. In addition, the roadtube should be placed at a right angle or angled slightly against traffic flow.

(b) *Location:* In all locations, the counter must be chained and locked (in an upright position) to a tree, sign post or utility pole, (See Figures 13 and 19.) Make sure the chain is sufficiently snug, so that the counter cannot tip over. The side of the road across from the counter is called the *far-side*. The side of the road that the counter is on is called the *near-side*.

(1) *Highway without center median:* Chain the counter to a tree, sign post or street lamp at the side of the road, preferably the side away from the traffic flow for added protection. Select a spot where the road is straight and at least 100 feet away from traffic lights, stop signs or intersections.

(2) *Highway with center median:* When installing on a highway with a center median, place the counter in the

median when possible. Since most heavy trucks travel on the outside lanes, this procedure will decrease the chance for overcounting. A further explanation of the effect of trucks will be given below.

(c) *Roads and Streets Without Curbs* (Refer to Figure 12):

(1) Place the counter next to a tree, sign post or lamp post. This is the near side.

(2) Lay the tube across the highway.

(3) On the far side of the road, plug the end of the roadtube with a round head screw.

(4) Slide a hose clamp over the far end of the roadtube with anchor stem projecting beyond end of the tube. (See Figure 14.) Tighten the clamp around the roadtube and plug-screw by turning the small screw on the side of the clamp.

NOTE: The ISHC prefers to use a "Chicago eye-bolt," ⅛" larger than the inside diameter of the hose. The "eye" is then anchored to the shoulder approximately 1-2 feet beyond the edge of pavement (on the far side) by means of a long bridge spike or rod driven through the "eye." This arrangement eliminates the need for a clamp as described in items 4, 5 and 6. (See Figure 15.)

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(5) If the ground is hard, drive a spike through the hole in the end of the clamp, into the ground. If the ground is too soft to hold the spike firmly, drive a stake instead. (See Figure 16.) Fasten the clamp to the stake with a screw. (Here again, the ISHC prefers using a 10"-12" bridge spike driven through the eye of the Chicago eye-bolt in lieu of a stake.)

(6) Return to the near side. Slide a second clamp over this end of the roadtube. Be sure the anchor stem of the manufacturer's standard clamp points away from the edge of the road on the near side. Attach clamp to the ground at least one foot beyond the edge of pavement on the near side. Make certain that the roadtube slides through this clamp freely. (See Figure 17.)

(7) The roadtube should be straight across the road or at a slight angle as recommended in the manufacturer's manual.

(8) Pull the roadtube through the clamp until it has stretched 10 percent. This means a stretch of: one foot if the road is 10 feet wide, two feet if the road is 20

feet wide or three feet if the road is 30 feet wide and so on.

(9) After stretching the roadtube the right amount, wrap enough tape around the roadtube next to the clamp, so that the roadtube cannot slide back through the clamp. Make certain that the clamp is anchored in such a way that the roadtube is not pinched shut, either at the clamp or at the edge of the pavement.

NOTE: On the near side, the ISHC uses a U-clamp attached (nailed) to the pavement in combination with a steel nut and tape (packing) around the roadtube. (See Figure 18.) This method is reasonably effective and trouble-free providing a heavy-duty clamp is used that is not flattened by wheel loads.

(10) When the road width is greater than the length of the roadtube, it will be necessary to extend it by using a roadtube extension sleeve. The extension sleeve should not be used on a traffic-bearing area. On narrow roads, keep any additional roadtube length coiled around the counter.

(11) Attach the free end of the roadtube over the end of the pipe on the side of the counter.

(d) *Roads and Streets With Curbs* (Refer to Figure 19):

(1) The roadtube must be held flat against the road at every point. For this reason the roadtube must be attached to the road itself and not to the ground beside the road.

(2) Follow the instructions for roads and streets without curbs except as follows: Do not drive spike or stake into the ground. Instead, find a crack, expansion joint or mortar joint in the pavement next to the curb. Drive a masonry spike through the hole in the end of the clamp into crack, expansion joint or mortar joint.

(3) Bring the free end of the roadtube up and over the curb and attach it to the pipe on the front side of the counter.

Caution: Do not put the hose across walks or paths where pedestrians may trip and be injured.

(e) *Putting Counter in Operation:* Assuming that counter has been prepared for operation and the roadtube has been properly installed, the counter installation is completed with these additional steps:

(1) Set the transistor module circuit control (potentiometer control shown in Figure 7) halfway between full clockwise and full counter-clockwise.

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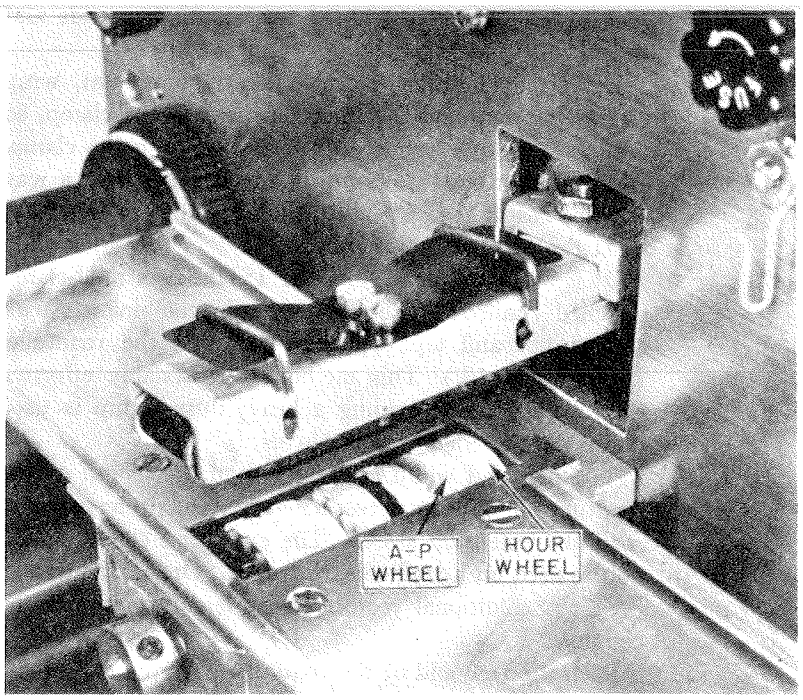

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Fig. 11. Detailed View of Print Arm and Typewheels.

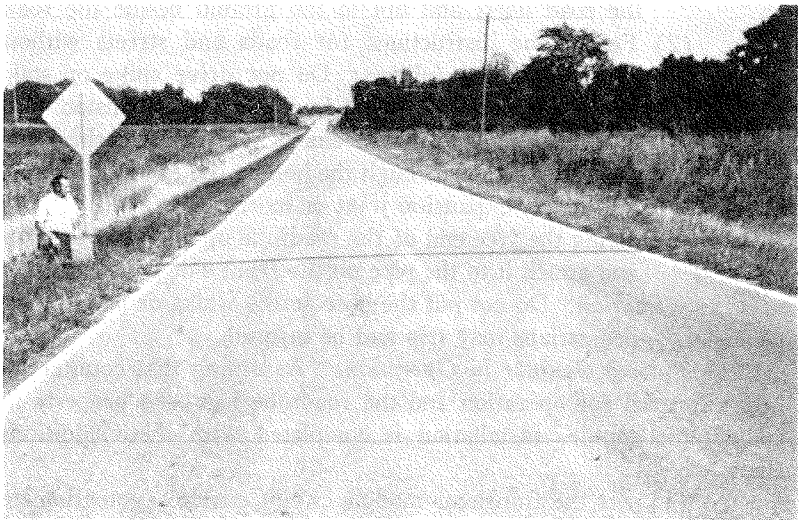

Fig. 12. Typical Arrangement for Automatic Traffic Counter on a County Road.

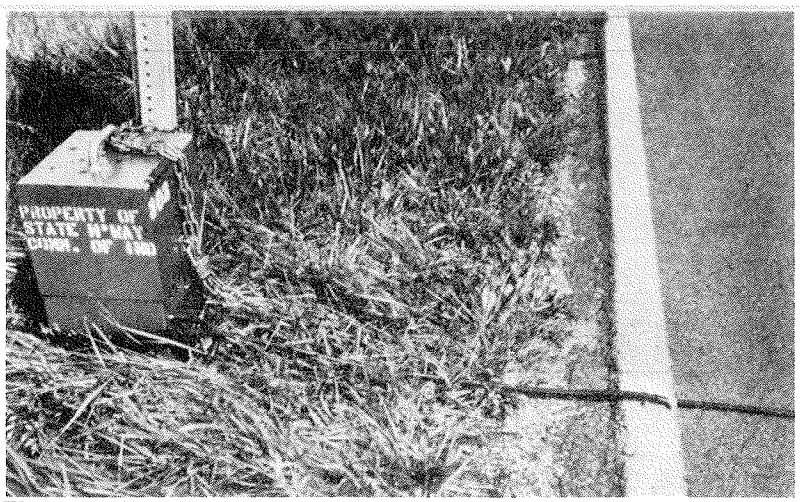

Fig. 13. Counters must be chained and locked in an upright position to a tree, sign post or utility pole. Chain must be snug so counter cannot tip over.

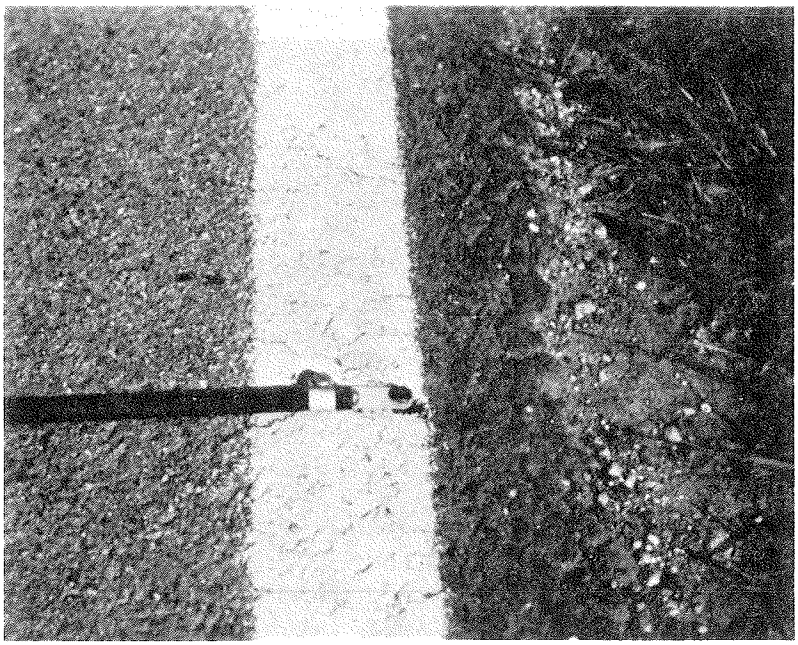

Fig. 14. Detail View Showing Hose Clamp and Roadtube Anchored With a Spike Nail at Far-side of Pavement.

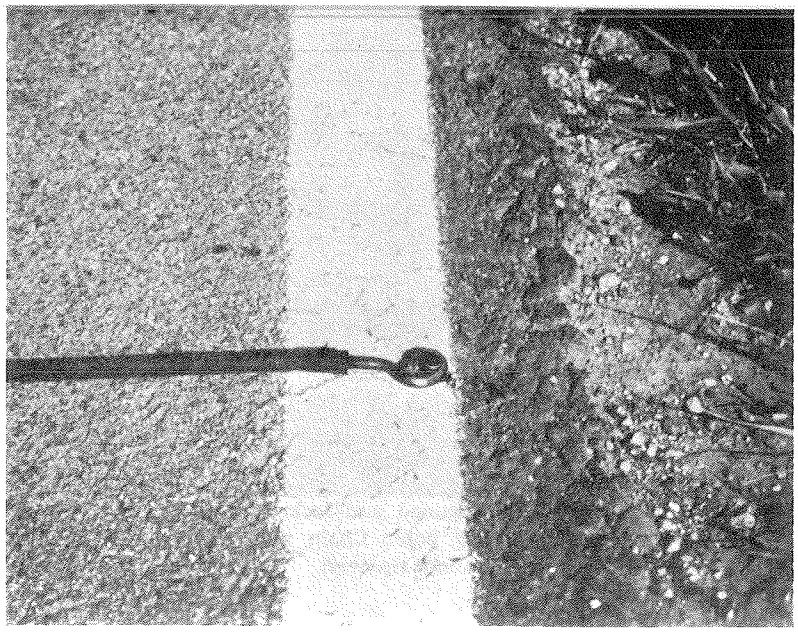

Fig. 15. Detail View Showing Chicago Eyebolt and Roadtube Anchored With Spike Nail at Far-side of Pavement.

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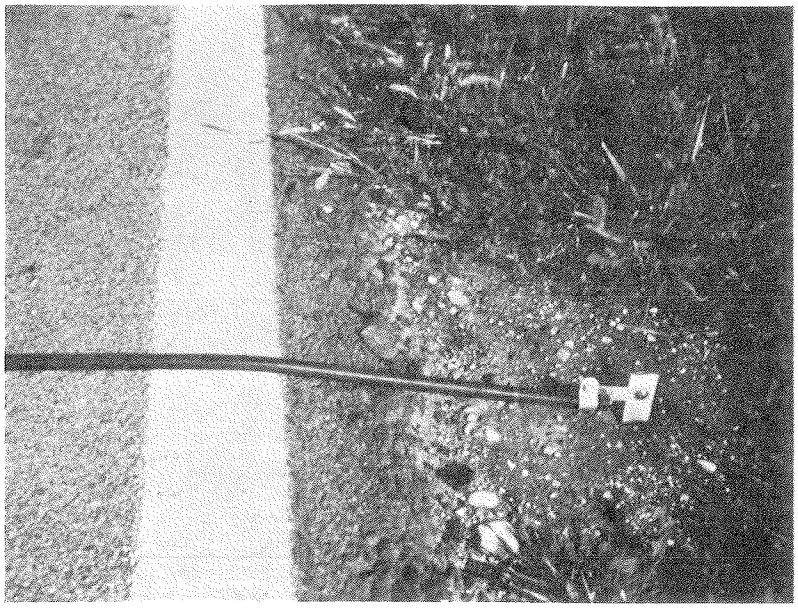

Fig. 16. Detail View Showing Hose Clamp and Roadtube Anchored to an Iron-angle Stake Driven in Shoulder at Far-side of Pavement.

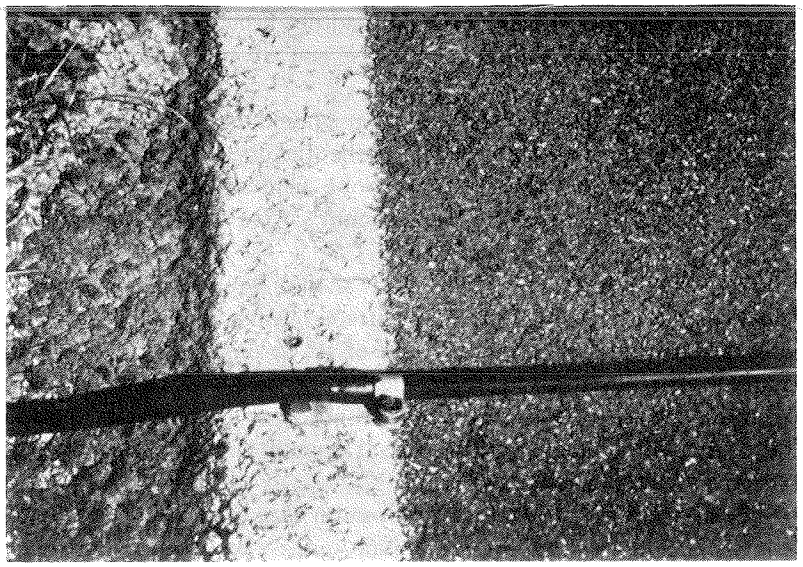

Fig. 17. Detail view of roadtube anchored to near-side of pavement by means of a hose clamp. Small washers are used as spacers to hold the clamp open so the roadtube will slide freely through the clamp. Tape wrapped around the roadtube on the near-side of the clamp holds the roadtube tight.

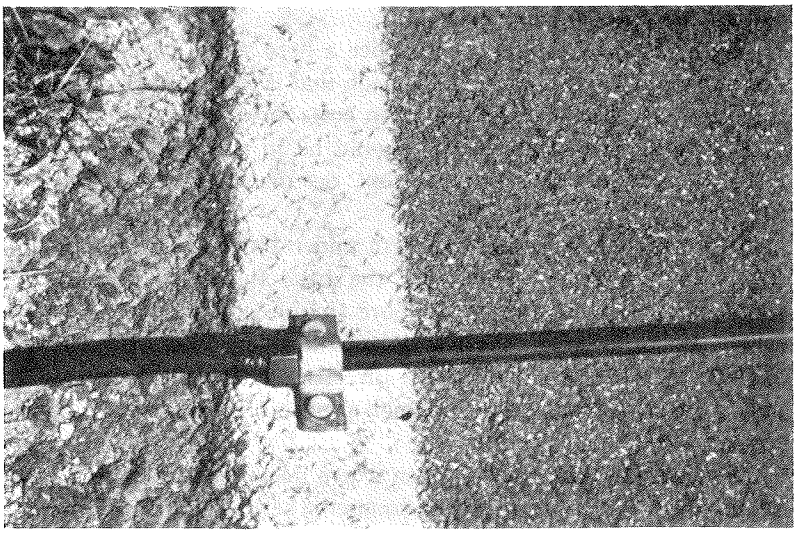

Fig. 18. Detail view of roadtube anchored to near-side of pavement by means of a heavy-duty U-Clamp and a nut slipped over the hose. Tape wrapped around the roadtube on the near-side of the nut holds the roadtube tight.

(2) Wrap excess length of roadtube around counter and connect (or re-connect) free end of roadtube to pipe on front side of counter.

(3) At this point the counter should be operational. New counters are pre-set at the factory for average conditions, but may have to be field-adjusted to eliminate over-count and under-count. [See Sensitivity Adjustment, p. 34, section (e).]

(c) *Roadtube:* The hose itself should be approximately perpendicular to the traffic flow. The Streeter Amet manual (4) recommends that the hose be at an angle of 9° against traffic flow. This angling does not appear to be critical. The hose will bow somewhat as traffic moves over it anyway. The hose can be placed in a small filled joint in concrete pavements. It should not be placed on soft gravel or rough surfaces.

Some general pointers can be given on care of the hose itself. Of course, the *hose must not leak.* One quick check can be made by blowing smoke into the hose. The hose is manufactured with a soapstone coating on the inside so that the walls of the tube will not stick together as traffic goes over it. If the hose walls should stick, even momentarily, counts will likely be lost; therefore, the soapstone is necessary. However, as the tube gets used, the soapstone tends to roll up and clog the hose.

Sometimes it is necessary to splice a hose when a longer piece is necessary. DO NOT splice the section that is in the roadway because it generally will not last. Also, when holes do show up in a tube, DO NOT patch the hose. Splicing should be in the lead-in portion or extra tube which is generally kept on the near-side around the counter.

It is best to keep the hose length under 100 feet. Longer lengths will work; however, the longer the hose the more precisely the counter has to be adjusted and more trouble is likely to occur. Another word of caution, short lengths of hose can cause trouble. For example, if the hose is extended directly out from the counter for only a short distance there is a high probability that it will "double-count."

As explained previously, when a tire goes over the hose it starts an air-pressure wave *toward* the counter where it is converted to one-half a count. An air pressure wave is also started *away* from the counter which travels toward the plugged end of the tube. If the tube is short, this wave will be reflected from the plugged end (back toward the counter), and register as a second set of tires. Thus, one

set of wheels can be "double-counted." Large, slow-moving vehicles with large tires tend to double-count especially when passing in the lane nearest the counter.

(d) *Replacing Roadtube:* Being subject to the stress and abrasive action of traffic, the roadtube often has a relatively short life. Therefore, it is recommended that each counter have four or five spare roadtubes for emergency replacement. While spare roadtubes are available through the counter manufacturer, it may be desirable and expedient to purchase replacement tubing from other vendors.

In purchasing spare roadtubes, the rubber tubing for same must be:

(1) correct size, wall thickness and length to properly operate counter,
(2) formulated to provide adequate resiliency at both high and low temperatures, and
(3) cured and processed in such a way that the inside wall surfaces do not stick together.

The following is an ISHC specification that has proven reasonably satisfactory in the purchase of roadtube replacements. It is included here as a guideline for Indiana county highway departments.

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SPECIFICATION FOR PURCHASE
OF RUBBER TRAFFIC TUBING

Rubber traffic tubing having $\frac{9}{16}$" O.D. x $\frac{1}{4}$" bore, with tolerance of $\frac{1}{64}$" for inside diam. and $\frac{1}{32}$" for wall thickness. The tubing shall be extruded in minimum lengths of 50'. The rubber tubing shall contain not less than 65 percent crude rubber by weight, with sufficient antioxident to counteract deleterious effects of sunlight, and the remainder of reclaimed rubber and other filler usually used in manufacturing such tubing. The tubing must be capable of transmitting air impulses to counter mechanisms at temperatures of 20 degrees below zero and 175 degrees above zero (Fahrenheit). The tubing must also be capable of withstanding impacts of heavy vehicles. The material must be so compounded or mixed that the tubing will not become brittle at low temperatures or stick at high temperatures.

(e) *Sensitivity Adjustment:* There are two general methods to prevent or minimize double-counting. One is to avoid using short lengths of hose by using a "leader" or extra length on the counter. The other involves proper setting of the sensitivity of the counter.

The following procedure is taken from the Streeter Amet manual (3):

If the counter overcounts, proceed as follows:

(1) Move the diaphragm dial to a maximum setting that will detect vehicles in the farthest lane.
(2) Move dial back to ½ of this maximum setting. For example, if the maximum setting is "20," set diaphragm dial to "10."
(3) Rotate controls on transistor module circuit slowly until overcounting stops.
(4) If overcounting continues, increase the diaphragm dial and transistor module control settings.

If the counter undercounts, proceed as follows:

(1) Make sure diaphragm dial is on number 5 position.
(2) Slowly turn transistor module control until undercounting is eliminated.

The following check is suggested. The counter should properly count a slow-moving large truck in the near lane and, also, a fast-moving light vehicle in the far lane. A frequent fault on the part of installers is that they do not check the machine operation for a long enough period of time to be assured that all components of the counter are working properly.

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(f) *Clock Operation:* The clock is an eight-day, spring-wound clock. A clock should be expected to keep good time for a year to 18 months. After that, if they no longer operate well, they must be returned to the clock manufacturer for reconditioning. The later models should not be wound tightly, as overwindng sometimes causes malfunction. With older models, this was no problem, but to be safe, winding should be done with care. The details of winding the clock are straight-forward and can be found in the manual; they will not be repeated here.

(g) *Ribbon Assembly:* A detailed sketch (not included here) of the ink ribbon spools, print-hammer and hammer-arm assembly is presented in the Streeter Amet manual (3). The hammer-arm assembly should be checked for cracks. The arm occasionally cracks in the vicinity of the spring-clip holders. When this occurs, the arm may not put enough pressure on the print-hammer and poor printing can result. Also, for good printing it is important that the ribbon be placed through the bridge as shown in the figure in the manual.

The ISHC uses a specially processed paper that prints without a ribbon.* Thus, if the ribbon fouls up, the data are still printed legibly. It also gives better results in extreme cold weather.

(h) *Servicing and Maintenance:* One last point must be stressed. When machines are in use TWICE-A-DAY SERVICE IS ESSENTIAL. (See Figure 22.) The main point is that to put out a counter and leave it for a long period, perhaps even 24 hours, without checking is a waste of time. Other maintenance personnel, for example, those involved with snow removal, grass cutting or grading operations must be cautioned to be careful around traffic counters.

5. *Common Problems:* This section is a discussion of problems comomnly encountered in actual field operation and some suggestions to avoid trouble. Detailed pictures and other illustrations are available in such manuals as *"Traficounter Installation and Operating Instructions,"* (3) and these should be studied. On the last page of this particular manual is a *Trouble Checklist.* This list will be presented below with some comments for clarification.

(a) *Personnel:* There is no list or manual which can be used as a substitute for experience. This fact has been stated before but one example will be given here for emphasis. The first statements made in the trouble checklist involve checking for: (a) burned out fuse, (b) dead battery, (c) loose battery connection. 73

These instructions, would seem to involve no more than common sense. However, dozens of machines are brought to the ISHC repair shop by city and county personnel every year from all over the state, for "repair" WITH NOTHING WRONG WITH THEM, except a burned out fuse, dead battery or loose connection.

The basic answer to this problem is, as stated previously, let one person gain enough experience with the counter so that checking for these minor problems becomes a standard operating procedure.

(b) *Location:* The counter should be located on a straight stretch of road away from intersections, traffic lights, and other areas where braking action or turning movements are likely to occur. There should be no large speed deviations, i.e., all vehicles, in all lanes being counted, should be moving normally.

Two illustrations which relate to the above suggestions involve a traffic signal with: (a) two lanes on one-way operation and (b) two lanes on two-way operation. In the first case, illustrated in Figure 20, there will probably be more traffic and more slow-moving vehicles

* Information on obtaining this type of paper can be obtained from various suppliers, the counter manufacturer or the ISHC.

in the right lane. Thus, if the counter is on the right there is more chance that right-lane traffic will block the hose, losing some counts from the left lane.

In the second case, illustrated in Figure 21, the reasoning is about the same. Cars stopped for the light in the right lane can block the hose so that when the light turns green, counts of the opposing left-lane traffic will be lost and also counts of turning traffic before the light changes.

6. *Trouble Checklist:* The following trouble-check list is adapted from the Streeter Amet manual (3):

(a) *Counter does not operate with power switch "ON";* check:
  (1) Fuse, if burned out, replace.
  (2) Battery leads for proper connections.
  (3) Battery potential.

(b) *Printer operates but counter does not*; check:
  (1) Roadtube for clogging or obstructions.
  (2) Transistor module for loose connections.
  (3) Diaphragm assembly for cracked or punctured membrane or possible bent contact loop assembly.

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(c) *Counter counts but does not print;* check:
  (1) Clock is fully wound and operating.
  (2) Micro-switch in clock is properly adjusted and operating.
  (3) Input leads to print motor.
  (4) Print motor for operation. This can be done by connecting the print motor directly to the battery with jumper wires.

(d) *Printer double prints:* check the print motor stop cam for adjustment.

(e) *Printer counts wrong or gaps between numbers:* check print wheels for wear.

Presented in Appendix F are troubleshooting hints from another Streeter Amet manual, *"Troubleshooting Procedures, Repair Instructions and Recommended Spare Parts List."* These may be of help, also.

For further emphasis it will be repeated here that there is no substitute for experience. Any county using counters must realize that they must make every effort to train someone to become adequately knowledgeable and then give him the opportunity to gain experience.

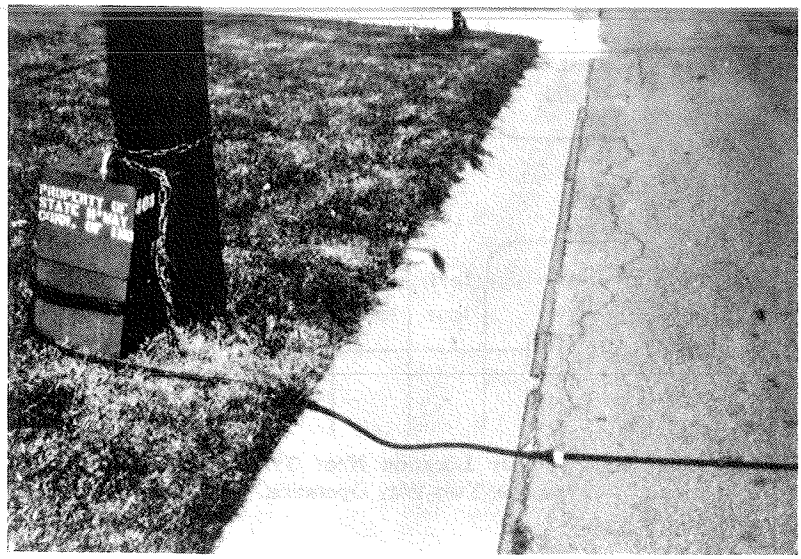

Fig. 19. Typical arrangement of counter on road or street with curbs.

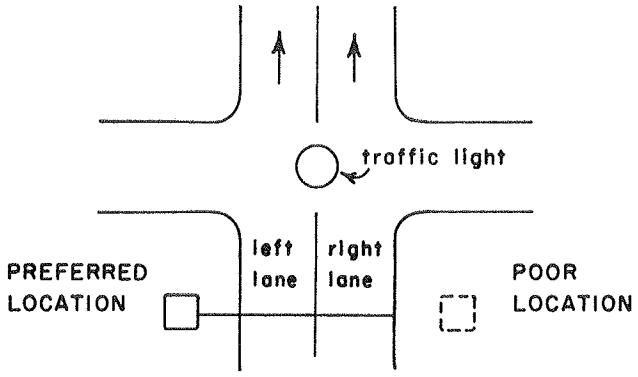

Fig. 20. Suggested Counter Location Near Traffic Signal With Two-Lane, One-Way Operation.

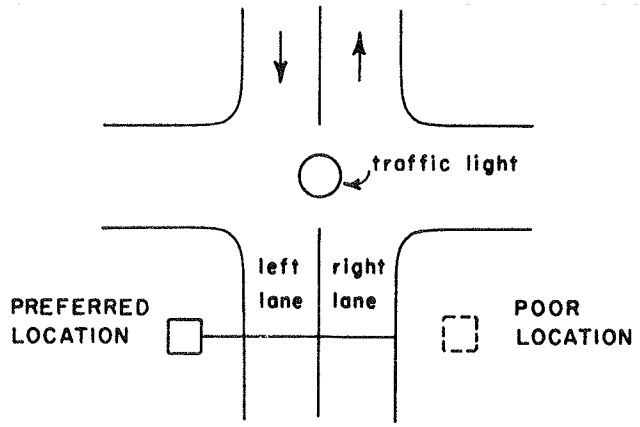

Fig. 21. Suggested Counter Location Near Traffic Signal With Two-Lane, Two-Way Operation.

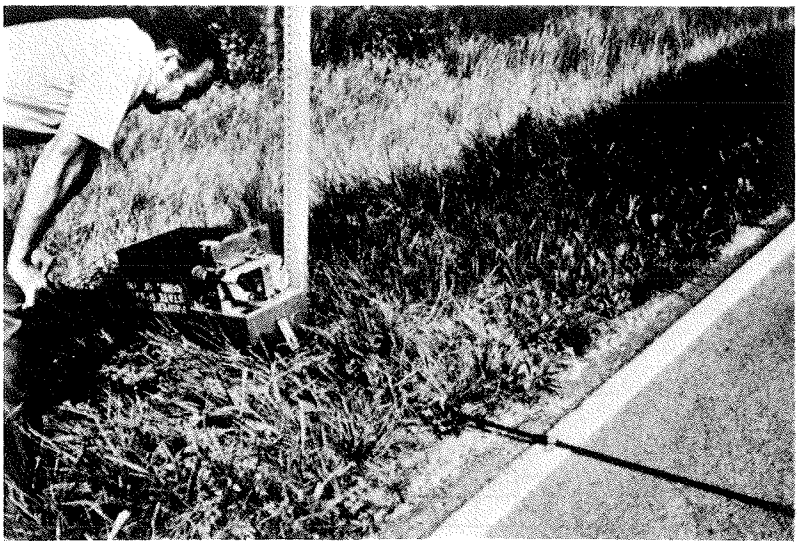

Fig. 22. Twice-a-day service is essential. A service check is an inspection of the counter mechanism to determine that the correct time and ocount are being recorded.

SUMMARY

1. *Direct Benefits of Traffic Counts:* This manual is dedicated to the proposition that every county highway department should have a continuing program of traffic counts. With minor expenditures for traffic count equipment and personnel, county road planning can proceed on a factual basis. The advantages and benefits of a traffic count program are many; here are a few that have special meaning and importance to county road officials.

(a) *Road Improvement Priorities:* The allocation of funds for road improvements involve difficult and vexing decisions for county road officials, mainly because the needs and demands for improvement always exceed available funds. Traffic count programs provide county road officials with a basic scale of comparison to establish priorities and schedules for road improvement projects. In this way, available funds can be budgeted to provide improvements that will serve the greatest number of people. However, traffic counts are not the sole basis for deciding the order of improvement; accident records and continuity of road improvements along a particular route are also important factors in deciding which projects get built first, second, third, etc.

(b) *Design of Road Improvements:* Traffic counts have always been a basic consideration of road design. Standards for the depth of base, pavement thickness, pavement width and safety features are all based on the type and amount of traffic that is expected to use the road. The object of any road improvement is to *reduce maintenance* and improve safety by the most *economical design.* This can only be accomplished with up-to-date traffic count data to eliminate the "guess-work" in the project design standards. 77

(c) *Change in Travel Patterns:* The pattern of travel on county road systems is in a constant state of change and increase. A growing and shifting population, industrial expansion, increased suburban living, new shopping centers, new schools, new recreation centers are all factors producing change in the pattern of travel on county roads. This is readily apparent to even the casual observer; yet to follow this change and measure needs in a realistic way, means that the counties must maintain a continuing program of traffic counts. After a few years experience, the patterns and trends of traffic on the county system will provide a basis for "estimating" traffic growth. This will be especially important on the county arterial road system.

2. *Organizing a Traffic Count Program:* There is no standard plan or procedure for organizing a traffic count program. It will require

of course, a certain minimum amount of equipment and personnel to get started. Populous counties with sizable cities and metropolitan centers will of necessity mount a somewhat different program than a predominantly rural county, even though the principles involved are much the same. Here are a few guidelines that will be of assistance to the county undertaking traffic counts for the first time.

(a) *Equipment and Personnel:* Most counties can make effective use of at least four (4), 15-Minute Counters. This is sufficient to count all four (4) legs of an intersection at the same time and is commonly needed to analyze the warrants for STOP signs. Four counters should be the minimum number considered for a rural county with a county seat town of 10,000 or more. The urbanized, metropolitan county will of course have greater needs for equipment. Smaller and less populous counties may want to consider a counter-sharing plan with a neighboring county.

A full-time traffic technician plus a helper should be assigned to the traffic count detail. The traffic technician should be allowed to gain the complete range of experience in the maintenance and operation of the counters, as well as the layout of the traffic count program itself. The duties of the traffic technician and helper should also include other traffic-related functions, such as maintenance of traffic control signs, county road accident records and school safety programs.

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(b) *Use of ISHC Traffic Data:* The initial effort in starting a county traffic count program should include a complete review of traffic count information available from the Indiana State Highway Commission. The traffic statistics on the state highway system are being updated constantly. Counties should therefore make use of the most current information available, especially the counts on the county federal-aid system and the expansion factors from the ISHC continuous count stations.

(c) *Getting Started:* "Which roads get counted first?" is a logical question. As with other phases of county road planning, the major emphasis initially should be on the county arterial road system, on high-volume suburban roads not on the arterial system and on all other roads serving major traffic generators, such as schools, factories, shopping centers, etc.

"Should traffic counts be taken on all roads in the county system?" is another logical question. This is mostly a matter of local preference. Generally, low-volume roads below 50 cars per day will not occupy a very high position on a priority list for improvement. How-

ever, it may be desirable for the sake of completeness or other reasons to have a traffic count for each and every road in the county system.

(d) *Annual Count Programs:* Once underway, county-wide traffic counts should be repeated periodically. Counts should be repeated annually in fast-growing communities and in populous, metropolitan counties. Counts may be repeated less frequently in predominantly rural counties, say every three years. Regardless of the county-wide repeat cycle used, roads serving new traffic generators (new schools, new factories, etc.) should be counted annually until a consistent traffic pattern has been established.

County road officials should refer to HERPIC Bulletin No. 9, *"Annual Travel on County Highways of Indiana,"* when planning county-wide traffic surveys of the total county road system. This publication has some useful guidelines on the organization of such a program, using a combination of both machine counts and manual counts.

(e) *Compiling Data and Records:* The most convenient form of presenting county-wide traffic counts is in the form of a county road map with the traffic volumes indicated at each count station. Such a traffic map will serve as a planning tool for county road officials and as a public relations instrument to explain the program of annual road improvements to the public.

A special effort should be made to maintain accurate and complete records on all traffic count data, worksheets and calculations. Such items as dates, location of stations, weather conditions should be recorded with each day's count. All pertinent information needed to verify results should be maintained in the county highway files.

3. *Traffic Growth Factors:* County highways and bridges should be planned and designed to accommodate future traffic. For this reason a factor must be applied to current traffic counts to provide for the anticipated traffic growth during the life of the completed project (normally considered as 20 years). Traffic counts on county roads for a period of say 5 to 10 years will serve as a basis for estimating future traffic growth. However, because most counties do not have an active traffic count program, it will be necessary to use the ISHC traffic growth factors based on current trends in vehicle registrations and fuel consumption.

Current forecasts by the ISHC for an average county-wide traffic growth factor (for the 20-year period ahead) varies from about 1.6

to 2.3. As with the traffic count statistics, these forecasts are being constantly updated. County road officials are therefore urged to consult the ISHC for the latest growth factor applicable to their particular county road system.

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3. Streeter Amet, "Traficounter Installation & Operating Instructions," Instructions 0-1200T, Grayslake, Illinois.

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APPENDIX A

1969-1970 ANNUAL AVERAGE 24-HOUR TRAFFIC COUNTS
For 28 Permanent Traffic Counting Stations Maintained by the Indiana State Highway Commission

Station No.	Automatic Traffic Recorder Location	Annual Average 24-Hour Traffic Counts	
	Permanent Traffic Recorders Located on Main Highways in Rural Areas		
		(1969)	(1970)
100-K (14-A)	On US 41 south of Cook	11,615	10,134
25-A	On SR 9 south of Rome City	3,103	3,245
42-A	On US 52 at the Jct. with SR 28	13,715	14,228
47-A	On SR 1 south of Farmland	1,003	1,064
59-A	On US 40 east of Greenfield	3,683	3,667
68-A	On US 50 west of Aurora	5,813	5,703
72-A	On US 31 south of Seymour	2,583	2,696
74-A	On SR 54 east of Jct. with US 41	2,405	2,459
134-A	On US 30 northwest of Fort Wayne	10,010	10,302
172-A	On I-65 south of Seymour	12,276	13,271
173-A	On US 41 north of Vincennes	8,277	8,960
200-X	On US 31 8 mi. north of Columbus	19,636	20,416
254-A	On US 31 north of Argos	6,346	6,814
256-A	On US 421 south of Medaryville	2,750	2,618
262-A	On US 24 East of Wolcott	2,414	2,571
279-A	On US 6 east of Nappanee	4,599	4,764
281-A	On SR 13 south of North Webster	3,432	3,645

APPENDIX A—Continued

1969-1970 ANNUAL AVERAGE 24-HOUR TRAFFIC COUNTS
For 28 Permanent Traffic Counting Stations Maintained by the Indiana State Highway Commission

Station No.	Automatic Traffic Recorder Location	Annual Average 24-Hour Traffic Counts (1969)	(1970)
	Permanent Traffic Recorders Located on Main Highways in Rural Areas		
301-A	On US 421 north of Versailles	3,232	3,298
313-A	On SR 67 southwest of Jct. with SR 39	5,298	5,572
319-A	On SR 56 east of Haysville	1,569	1,566
3070-A	On I-70 east of Greenfield	11,478	12,999
5420-A	On US 136 west of Crawfordsville	1,638	1,722
5474-A	On I-74 under SR 55 bridge	5,042	5,390
	Average	5,927	6,396
	Traffic Recorders Located on Main Highways in Urban and Suburban Areas		
40-A	On SR 25 south of Lafayette	5,369	5,921
45-B	On SR 67 south of Muncie	6,927	7,107
	Average	6,158	6,514
	Traffic Recorders Located on Local Roads		
34-A	On county road in Allen County	1,053	1,118
73-A	On old US 41 north of Vincennes	1,688	1,749
7047-A	On county road in Rush County	263	274
	Average	1,001	1,047

APPENDIX B

Factors to Expand 24-Hour Weekday (Mon., Tues., Wed., Thur.)
Volumes to A.D.T. 1970-1969-1968-1967

	Months of Year											
Groups	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Group I	State Roads in Most Rural Areas											
1970	1.332	1.262	1.159	1.148	1.063	0.950	0.912	0.920	1.026	1.073	1.109	1.111
1969	1.358	1.250	1.198	1.109	1.082	0.961	0.927	0.911	1.043	1.060	1.113	1.155
1968	1.297	1.266	1.212	1.108	1.078	0.978	0.925	0.914	1.040	1.075	1.124	1.176
1967	1.320	1.320	1.218	1.130	1.088	0.973	0.930	0.927	1.051	1.097	1.154	1.153
Group II	State Roads in Rural Resort Areas											
1970	1.485	1.499	1.398	1.246	1.115	0.938	0.875	0.897	1.126	1.234	1.291	1.257
1969	1.477	1.439	1.374	1.226	1.127	0.944	0.873	0.870	1.199	1.236	1.393	1.335
1968	1.462	1.444	1.373	1.212	1.125	0.949	0.845	0.864	1.127	1.212	1.298	1.345
1967	1.514	1.558	1.377	1.222	1.166	0.939	0.870	0.885	1.161	1.245	1.356	1.313
Group III	State Roads in Mining Areas											
1970	1.320	1.209	1.126	1.043	1.002	0.965	0.942	0.912	0.988	1.000	1.036	1.029
1969	1.161	1.059	1.088	1.000	0.992	0.957	0.940	0.931	0.982	1.031	1.094	1.079
1968	1.187	1.110	1.063	0.997	0.956	0.959	0.925	0.968	0.977	0.988	1.053	1.057
1967	1.119	1.123	1.033	0.986	0.973	0.963	0.964	0.956	0.942	0.991	1.079	1.058

Group IV					State Roads in Suburban Areas							
1970	1.208	1.144	1.031	1.067	0.988	0.950	0.942	0.928	0.919	0.943	0.970	0.985
1969	1.239	1.141	1.071	1.025	0.954	0.949	0.931	0.925	0.967	0.984	1.007	1.028
1968	1.204	1.148	1.109	1.061	1.017	0.988	0.989	0.983	1.015	1.008	1.008	1.030
1967	1.135	1.172	1.043	1.010	1.059	0.960	0.959	0.966	1.017	1.059	1.093	1.056
Group V					Local Roads in Rural Areas							
1970	1.199	1.112	1.074	0.971	0.973	0.900	0.928	0.936	0.943	0.999	0.965	1.017
1969	1.198	1.101	1.070	1.001	0.962	0.901	0.921	0.960	0.965	0.957	1.006	1.008
1968	1.206	1.091	1.064	0.990	0.979	0.896	0.932	0.929	1.003	0.965	0.981	1.087
1967	1.160	1.146	1.068	1.015	0.957	0.863	0.901	0.958	1.076	1.018	1.001	1.045

APPENDIX C

Route SR #446 Station #23

Indiana Automatic Traffic Recorder Record
Prepared by State-Wide Highway Planning Survey
Traffic Survey of Monroe Reservoir Area

Week Beginning 8-23-70 R.C. No. 72

Day	Sun.	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Total
Date	8-23	8-24	8-25	8-26	8-27	8-28	8-29	
Weather	Nor.	Nor.	Nor.	Nor.	Nor.	Nor.	Nor.	
Hour				A.M.				
12-1	45	14	16	15	20	25	60	
1-2	45	2	16	22	17	16	44	
2-3	21	5	2	6	2	6	17	
3-4	6	3	2	5	8	5	15	
4-5	8	4	6	3	7	7	23	
5-6	20	14	17	15	23	17	28	
6-7	37	61	72	70	71	60	80	
7-8	47	104	122	121	102	100	102	
8-9	65	93	61	63	64	62	80	
9-10	123	76	53	71	69	59	125	
10-11	206	96	88	75	98	97	168	
11-12	261	117	114	120	99	114	210	
				P.M.				
12-1	313	117	129	98	115	137	199	
1-2	308	112	147	113	124	120	224	
2-3	341	126	145	147	138	149	226	
3-4	398	140	153	160	130	161	234	
4-5	387	196	199	193	186	181	240	
5-6	396	162	175	171	164	169	235	
6-7	342	148	169	147	132	204	233	
7-8	275	117	118	131	134	201	208	
8-9	289	107	181	162	143	201	211	
9-10	215	131	157	157	156	190	204	
10-11	67	59	66	46	64	115	137	
11-12	31	43	40	40	32	69	77	
Total	4246	2047	2248	2151	2098	2465	3380	
% Aver. Wk. Day								

Remarks—Located on SR #446 0.20 mile northwest of Swartz Road
Counter Chained to: Road sign on south side of the road

Average Weekday

APPENDIX D

Sample Manual Count Form For an 8-Hour Coverage Station Count
County Highway Traffic Study

County _____ Date_____ Name_____
Counting Location _____
_____

VEHICLE CLASSIFICATION

Time	Passenger Cars	Pickup and Panel Trucks	Other Trucks	Other Vehicles
AM 8:00- 9:00				
9:00-10:00				
10:00-11:00				
11:00-12:00				
LUNCH		12:00 noon to 2:00 p.m.		
PM 2:00- 3:00				
3:00- 4:00				
4:00- 5:00				
5:00- 6:00				

APPENDIX E

Indiana State Highway Commission
Summary of Permanent Traffic Recorder Data
Month of January 1968

Station 7047-A Location on E. and W. County Road From Carthage to Mays.
Counter Located 1.4 Miles E. of CCC and St. L. RR in Carthage in Rush County.

Day	Monday					Tuesday				
Date	1	8	15	22	29	2	9	16	23	30
Weather	Snow	Snow	Snow	Cldy	Rain	Cldy	Snow	Fair	Snow	Rain
A.M.										
12- 1	4	1	1	2	1	2	0	1	0	0
1- 2	6	1	0	1	1	0	1	0	0	0
2- 3	4	0	1	1	0	2	0	0	0	0
3- 4	0	0	0	0	0	0	0	0	0	1
4- 5	3	1	0	0	0	2	0	0	0	0
5- 6	0	1	2	3	3	2	6	3	1	2
6- 7	4	3	7	9	7	14	10	9	7	8
7- 8	4	9	9	13	10	12	8	10	8	12
8- 9	6	10	10	12	7	23	11	10	9	10
9-10	8	13	12	16	12	23	15	11	12	16
10-11	11	16	15	11	13	19	13	12	10	13
11-12	14	17	19	13	16	31	15	12	10	13
P.M.										
12- 1	8	15	11	13	13	25	13	14	11	13
1- 2	6	16	12	15	13	20	14	14	12	14
2- 3	4	18	14	19	16	22	15	11	18	32
3- 4	16	19	15	19	17	22	25	16	17	34
4- 5	18	30	18	21	19	29	14	17	19	19
5- 6	7	16	13	15	17	11	13	16	16	24
6- 7	13	12	10	14	13	16	14	10	12	20
7- 8	5	9	9	8	8	8	5	5	9	6
8- 9	7	5	4	8	6	9	8	8	6	5
9-10	14	7	2	5	2	8	4	3	3	4
10-11	12	4	4	2	3	6	5	4	2	4
11-12	2	4	1	2	2	0	5	2	1	3
Totals	176	227	189	222	199	306	214	188	182	253
Pct. of No. Tot.	2.46	3.17	2.64	3.10	2.78	4.27	2.99	2.62	2.54	3.53

Average = 202 Average = 228

Four Day Average = 227

APPENDIX E

Indiana State Highway Commission
Summary of Permanent Traffic Recorder Data
Month of January 1968

Station 7047-A Location on E. and W. County Road From Carthage to Mays.
Counter Located 1.4 Miles E. of CCC and St. L. RR in Carthage in Rush County.

Day	Wednesday				Thursday				
Date	3	10	17	24	31	4	11	18	25
Weather	Cldy	Cldy	Fair	Fair	Rain	Fair	Cldy	Fair	Fair
A.M.									
12- 1	0	1	0	0	1	2	3	1	1
1- 2	1	2	1	1	0	1	1	1	4
2- 3	0	0	0	0	0	1	0	0	0
3- 4	0	0	0	0	0	0	0	0	1
4- 5	2	2	0	0	0	2	1	1	1
5- 6	5	3	4	2	1	3	3	3	1
6- 7	8	10	9	8	6	6	5	11	7
7- 8	11	12	11	10	10	13	10	13	11
8- 9	12	18	11	10	12	15	15	13	11
9-10	12	14	12	15	13	13	13	14	11
10-11	16	18	13	10	15	23	17	15	16
11-12	14	23	14	13	17	20	14	18	18
12- 1	18	16	13	14	11	17	17	14	20
P.M.									
1- 2	15	14	19	14	12	23	17	16	17
2- 3	16	20	15	21	24	23	23	15	23
3- 4	14	18	20	18	25	15	24	23	22
4- 5	16	18	16	22	24	27	24	22	23
5- 6	15	15	18	20	18	13	26	14	20
6- 7	14	12	14	14	13	18	15	13	16
7- 8	8	8	7	13	11	8	9	7	15
8- 9	5	7	6	8	10	3	8	7	8
9-10	5	6	4	5	7	5	20	4	7
10-11	3	5	4	4	3	8	6	5	5
11-12	3	4	3	3	4	4	2	1	2
Totals	213	246	214	225	237	263	273	231	260
Pct. of No. Tot.	2.97	3.43	2.99	3.14	3.31	3.67	3.81	3.22	3.63
		Average = 227					Average = 256		

Average Weekday = 235

APPENDIX E

Indiana State Highway Commission
Summary of Permanent Traffic Recorder Data
Month of January 1968

Station 7047-A Location on E. and W. County Road From Carthage to Mays. Counter Located 1.4 Miles E. of CCC and St. L. RR in Carthage in Rush County.

Day	Friday				Saturday			
Date	5	12	19	26	6	13	20	27
Weather	Fair	Cldy	Fair	Fair	Snow	Snow	Cldy	Cldy
A.M.								
12- 1	1	2	2	2	1	2	3	1
1- 2	2	1	2	3	1	0	2	0
2- 3	0	0	0	0	2	0	1	1
3- 4	1	2	1	4	0	1	0	4
4- 5	2	2	1	1	0	0	0	0
5- 6	3	2	1	0	1	1	0	0
6- 7	7	8	8	5	8	0	6	1
7- 8	12	13	9	9	9	0	5	6
8- 9	14	18	14	10	17	3	7	9
9-10	17	17	16	18	21	12	19	23
10-11	15	19	13	21	19	16	24	25
11-12	21	20	13	17	23	25	28	20
P.M.								
12- 1	21	18	13	13	26	32	26	21
1- 2	17	13	14	21	12	19	18	25
2- 3	20	18	25	16	17	14	18	21
3- 4	18	18	22	22	15	18	17	20
4- 5	31	22	29	18	17	17	16	17
5- 6	20	23	19	23	20	15	19	24
6- 7	18	13	22	20	11	13	14	20
7- 8	11	13	11	15	6	19	10	14
8- 9	9	9	7	13	7	8	7	8
9-10	6	14	10	8	6	29	4	4
10-11	12	7	5	10	4	12	7	10
11-12	5	7	3	6	6	7	3	7
Totals	283	279	260	275	249	263	254	281
Pct. of Mo. Total	3.95	3.89	3.63	3.84	3.47	3.67	3.54	3.92
		Average = 274				Average = 261		
		Number of Weekdays 23		Number of Saturdays 4		Number of Sundays 4		

REMARKS

APPENDIX E

Indiana State Highway Commission
Summary of Permanent Traffic Recorder Data
Month of January 1968

Station 7047-A Location on E. and W. County Road From Carthage to Mays. Counter Located 1.4 Miles E. of CCC and St. L. RR in Carthage in Rush County.

Day	Sunday				Average Hourly			
Date Weather	7 Snow	14 Snow	21 Cldy	28 Rain	Wkday.	Sat.	Sun.	Total
A.M.								
12- 1	1	1	11	2	1	1	3	1
1- 2	1	1	0	4	1	0	1	1
2- 3	0	0	0	2	0	1	0	0
3- 4	2	1	0	1	0	1	1	0
4- 5	2	0	2	0	0	0	1	0
5- 6	1	1	0	0	2	0	0	1
6- 7	6	5	5	0	7	3	4	6
7- 8	7	6	4	1	10	5	4	8
8- 9	6	6	4	2	12	9	4	10
9-10	10	12	10	13	14	18	11	14
10-11	11	8	9	7	14	21	8	14
11-12	12	11	18	20	16	24	15	17
P.M.								
12- 1	14	12	10	13	14	26	12	15
1- 2	13	11	12	10	15	18	11	15
2- 3	10	13	15	10	18	17	12	17
3- 4	13	14	13	16	19	17	14	18
4- 5	19	15	18	33	21	16	21	20
5- 6	19	14	16	19	17	19	17	17
6- 7	10	13	12	10	14	14	11	14
7- 8	8	12	10	10	9	12	10	9
8- 9	7	4	4	5	7	7	5	6
9-10	5	3	2	2	6	10	3	6
10-11	3	4	3	2	5	8	3	5
11-12	2	1	2	2	3	5	1	3
Totals	182	168	180	184	235	261	178	231
Pct. of Mo. Total	2.54	2.35	2.51	2.57				

Average = 178

Month	Act	Per Cent Gain or Loss	Total Traffic
January			
67	242		7490
68	230	—4.9	7176

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APPENDIX F

SUMMARY OF TROUBLE SHOOTING PROCEDURES

PROBLEM: The counter fails to record and print.

SOLUTION:
1. Check the fuse and replace, if necessary.
2. Check battery potential and polarity. The hydrometer should read approximately 1250 at 72°F.
3. Check battery terminals to insure a good connection.

PROBLEM: The counter will record but fails to print.

SOLUTION:
1. Check print start limit switch on clock to insure limit switch ON-OFF actuation.
2. Check the print motor fuse.
3. Check the print motor.

PROBLEM: The counter prints but fails to count.

SOLUTION:
1. Check to insure proper diaphragm operation.
2. Check battery polarity to insure battery + terminal is connected to chassis and battery-terminal is connected to the RC-terminal.
3. Check to insure proper counter clapper actuation.
4. If the count module is not working properly, replace.

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PROBLEM: Continue to repeat printing during the print start command of the print clock switch.

SOLUTION:
1. Check the print motor stop limit switch to insure ON-OFF actuation.
2. Check the print lockout relay to insure it is energized by the actuation of the print motor stop limit switch.
3. Check to insure the relay locks up through its own contacts to the print start switch.

PROBLEM: Duplicate printing will be caused by improper print cam dwell adjustment.

SOLUTION:
1. Check to insure the cam dwell is approximately ¼".
2. It may be necessary to loosen the screw on the motor stop cam and position it forward slightly to decrease the cam dwell.
3. Check to insure that the typewheels are in reset position. It may be necessary to loosen the set screw on the print cam and position it in relation to the print hammer cam rider.

NOTE: An overrun of the print cams will cause a loss in print-out total.

EXAMPLE: A 10:00 a.m. print command may print out a normal print of 10: A 0481, an 11:00 a.m. print may show 11: A 0000 and the 12:00 a.m. print-out may be normal. This indicates that at 10:00 a.m., a normal print-out was obtained and during the recocking of the print hammer, the print cam rider overran, dropping the hammer in print position. On the 11:00 a.m. print command, the hammer was recocked and the print typewheel reset, failing to print-out the hourly total.

PROBLEM: Replace a defective counter coil.

SOLUTION:
1. Unsolder the wires from the coil terminal.
2. Loosen and remove the three nuts and screws securing the coil to the counter frame.
3. Replace the coil in exact reverse of above procedure.
4. Before tightening screw to secure coil, place a piece of paper between coil and clapper, then pull clapper down to the end of travel. Position coil to fit flat against clapper in such a way that the paper can be moved freely. Tighten the three nuts and screws to secure coil in position.

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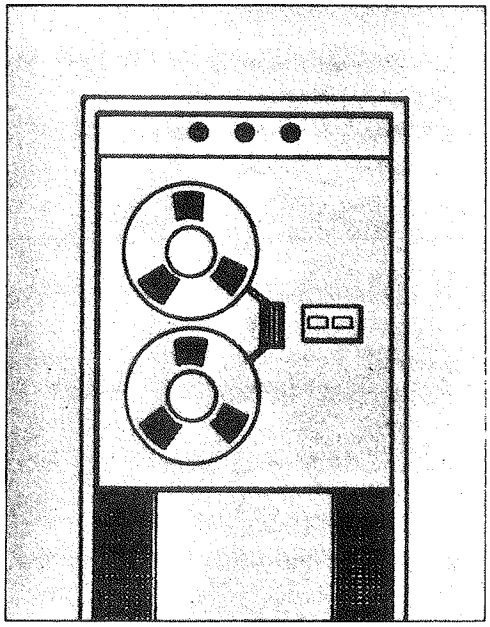
PROBLEM: The module is malfunctioning due to component failure.

SOLUTION: Replace module in counter.

PROBLEM: How to repair defective module.

SOLUTION:
1. Refer to Drawing 0203163, 1 through 5 of 5.
2. Using an oscilloscope, trace circuit, and locate defective component. Replace the defective component. Check module to insure it conforms with Drawing 0203163. (4 of 5).

outline of the highway transportation planning process



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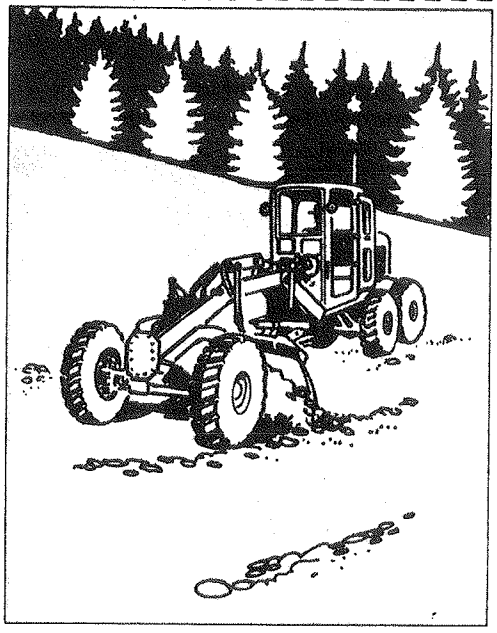
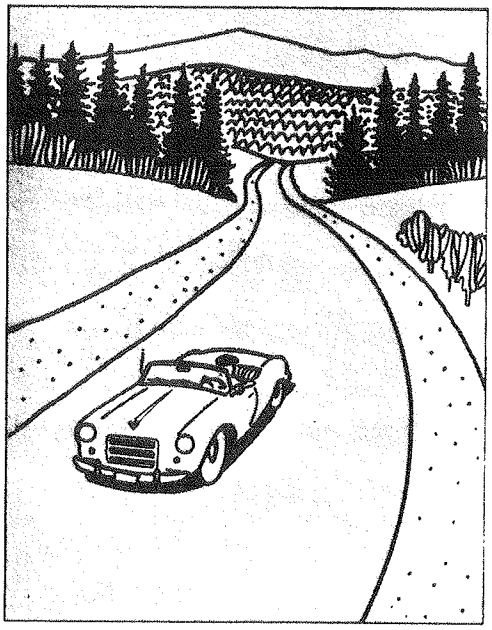


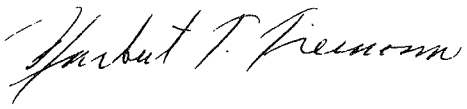


U.S. DEPARTMENT OF TRANSPORTATION
Federal Highway Administration

Beginning in 1969 the U.S. Federal Highway Administration and the Direccion Nacional de Vialidad of Argentina, have carried on a cooperative program for the development of an efficient "*Rural Highway Planning System.*" This series of manuals are a result of that work.

Upon completion of the FHWA Mission in Argentina, this "*Rural Highway Planning System*" was almost completed and in the Spanish language. It was, therefore, decided this "planning system" had the potential of being of great value for use in other countries, especially Spanish-speaking countries. Therefore, the Federal Highway Administration has reworked the manuals and computer programs to make them more adaptable and published the manuals in both English and Spanish.

This project is indebted to the members of the FHWA Division who worked in Argentina and the engineers of the Vialidad Nacional who cooperated with the development of this work. Particular credit must be given to Leon E. Litz and John D. Cutrell who were responsible for the final revisions and publication of these manuals.



Norbert T. Tiemann
Federal Highway Administrator
U.S. Department of Transportation

An effective highway transportation planning process is the basis for, and is a necessary continuous part of efficient highway transportation management. This series of manuals and accompanying computer programs were developed to provide guidelines for establishing a system and the basic data collection programs and analysis that are a necessary beginning for accomplishing such a planning process. This series includes the following manuals:

1. Outline of the Highway Transportation Planning Process
2. Guide for a Manual of Instructions for Road Inventory
3. Guide for a Manual of Instructions for Traffic Surveys
4. Guide for a Functional Classification of Highways
5. Guide for a Manual for Highway Adequacy Rating
6. Measuring Highway Improvement Needs and Priority Analysis
7. Computer Program User's Manual

It should be acknowledged that many of the procedures as described in these manuals have been taken from, or patterned after numerous published sources. Included in these sources are publications of the U.S. Federal Highway Administration, State Highway Departments and the U.S. National Association of County Engineers.

The object of this manual is to present a general overview of the Highway Transportation Planning Process. It is expected to be of special interest to highway engineers or administrators who are not intimately familiar with the various steps or phases for effective planning of a highway program.

Table of Contents

I. INTRODUCTION

Purpose:

The purpose of highway transportation planning is to aid in the development of an economical, efficient, and safe highway transportation system which is developed with careful consideration of social, environmental, and esthetic factors. It is extremely important that the highway planning process operate within the framework of well defined national goals in order that the highway transportation system will be developed and will operate in a way that will aid the nation in achieving its goals. Another way of stating the purpose of highway planning then, is to say that its purpose is to aid the nation to achieve its goals in highway transportation systems.

The primary purpose of this manual is to present a general overview of the "Highway Transportation Planning Process." It should be of assistance to those engineers or highway officials, who are not intimately familiar with the various steps or phases of effective planning of a highway program. Included will be a description of the basic data collection programs that are needed to plan and operate such a highway transportation system. It also outlines how these data are used for the determination of needed highway improvements (present and future), and the order for construction. The manual, therefore, takes you step by step through the entire process, starting with the collection of basic planning data and terminating with the plans, specifications, and estimate needed for construction.

Scope:

National highway transportation planning must be truly "national" in scope. Highway systems cover the length and breadth of the country. Trips (movements of persons and goods) begin and end with little or no consideration of the various administrative road systems which must be traversed or the various political boundaries which must be crossed. The road and street network acts as a complete system. It is not possible to adequately plan a national highway system without consideration of the road and street systems of the other levels of government. Similarly, it is not possible to plan a rural highway system without consideration of the urban highway and street systems which must connect with it.

Obviously, not all highway systems, or even all sections of the same system are subjected to the same degree of analysis, but each must be analyzed according to its function in the total highway transportation problem. Likewise, it is not normally possible to adequately plan for highway transportation without consideration of other modes of transportation such as air, rail, water, pipeline, etc. The competitive, the complimentary, and the interchange features between all modes of transportation require that planners for one mode give consideration to the abilities, needs, and plans of the other modes.

Method:

Ideally, there would be an agency with responsibility for overall comprehensive transportation planning; that is, formulation and interpretation of goals, development of transportation policies, assignment of responsibilities to the various modes, etc. The highway agency might be assigned certain planning authority and responsibility within its sphere of special knowledge and ability, which is highway transportation. Similar assignments might be made to agencies of other modes. However, in many instances there is no single transportation agency with responsibility to

plan for all modes. Therefore, each modal agency, such as a highway department, is expected to make its own plans. In such a case, extensive communication and coordination among the several agencies is required in order to assure that plans are compatible with each other.

The collection of data, preparation of analyses and formulation of plans and programs is a continuing process, one that must be soundly conceived and constantly repeated, if the plans and programs are to be responsive to changing times and at the same time capable of being implemented. The development of a stable organization of dedicated professional personnel with the ability to make the complex analyses and prepare realistic plans and programs is a vital necessity.

Use of the latest technical advances in engineering and data processing makes possible many analyses that would have been impossible only a few years ago.

II. LONG RANGE PLANS

A. INPUT:

1. ROAD INVENTORY

a. *Purpose:*

The purpose of a road inventory is to provide the highway administration with complete, accurate, and up-to-date information regarding the extent, location, and physical description of the existing road and street system. Therefore, the inventory provides a foundation of basic information about the physical characteristics of the existing road and street system.

The inventory involves the collection and organization of physical data. These data are the essential preliminary to other planning studies, which will follow. These later studies include adequacy ratings, traffic surveys, highway classification, highway needs, fiscal studies, and highway program formulation, both long and short range.

Inventory data will be published as highway statistics and in other forms for extensive use by highway and other government agencies and by private firms and individuals.

b. *Scope:*

A complete road inventory includes the physical description of all roads and streets in the nation which are open to the public. This is a large task. It is logical that an inventory of the major road and street systems should be completed first. Then, the inventory of the secondary and local roads and streets may be started. A thorough evaluation of the feasibility and need for the data should be made before an inventory of the lower systems is undertaken.

The problem of deciding what items of data to collect and the degree of refinement to use in collecting them is always difficult. If the inventory is overly complex, the time and the expense involved in the data collection and analysis can become excessive. On the other hand, the data must describe the road and street systems for statistical purposes and serve as the basis for the subsequent planning studies. It seems logical to include in the basic nationwide inventory only the data for which there is a continuing well defined and accepted need. More detailed or special information which is needed, perhaps on a "one time" basis, or perhaps on a project or route basis, can often be obtained more economically and efficiently at a later time when the need for it becomes evident.

If a highway planning process is to be effective, it must be able to respond rapidly to requests from top management for data summaries and analyses. A modest study or analysis completed "on time," when needed, is generally more useful than an overly sophisticated study which is not finished or is late.

The basic items which are essential in a road inventory are: route descriptions (termini, general corridor description, list of loops, spurs, alternates, etc.), length, surface type and width, shoulder type and width, right of way, number of lanes, median type and width, intersections, urban or rural classification, administrative classification, railroad crossing location and description, and structure location and description (including culverts, bridges, tunnels, ferries, etc.). It is necessary to gather more complete information for the major road and street sys-

tems, than for the secondary and local roads and streets.

Alignment and gradient data are normally not collected by means of detailed measurements. The alignment and grade can be evaluated through the use of engineering judgment to a sufficient degree of accuracy for use in adequacy ratings and highway needs studies. Individual curves and grades are not recorded or measured, except when needed for projects or short sections of routes as a basis for detailed corridor studies or route location studies.

c. *Method:*

There are two basically separate and distinct methods of gathering inventory data: They are: (1) by reviewing plans and other documents in the office and, (2) by actually driving over the road and recording its physical characteristics on data sheets. Most road inventories utilize a combination of the office review and the field survey methods to obtain the necessary physical data.

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It is very important that the inventory data be edited and stored in the office in such a way that both routine and special tabulations and analyses can be made promptly and efficiently. An integrated data file using automatic data processing equipment is an efficient and economical method of accomplishing this. All physical inventory data can be referenced to a route and a mile point. This makes possible the correlation of the roadway inventory data with many other data that are related to the road such as traffic volumes, vehicle accidents, maintenance costs, roadway life, etc. Therefore, *the inventory program establishes the base reference system for locating other types of data.* This is the basis for an efficient management system.

It is equally important that the road inventory data be kept up-to-date. Any changes due to construction of new roads, reconstruction of existing roads, additions, or deletions of routes, abandonments, changes of administrative jurisdiction, etc., should and can be, promptly entered into the data file. This feature allows the data file to contain complete data which is continually being updated. Changes can be recorded within a few days of the time they actually occur.

A new field inventory should be made at periodic intervals. The effectiveness of keeping the records updated from office procedures will greatly determine how often a new field inventory is desired. This period should probably not exceed 5 years. The importance of maintaining accurate road inventory data is emphasized when it forms the base for an automated informational system and highway needs are reevaluated at probably 2-year intervals. The detailed procedures for accomplishing a road inventory are described in the "Guide for Manual of Instructions for Road Inventory."

2. ADEQUACY RATINGS

a. *Purpose:*

The purpose of the adequacy rating process is to evaluate and record the condition of existing roadways and structures. This information forms much of the basis for determining highway needs (both character and cost of needs) and for developing the programs to satisfy the needs. The adequacy rating process repeated at regular intervals also provides a means of measuring the progress achieved in the continuing effort to upgrade the road and street systems.

An adequacy rating should not be used as the sole basis for determining highway construction project priority. However, it is an extremely valuable tool when used with other criteria such as: transportation and economic goals, budgets, route continuity, material and manpower availability, etc.

b. *Scope:*

Some degree of adequacy rating evaluation is necessary for all roads and streets, both rural and urban. Usually the detailed section-by-section analysis is

limited to major road and street systems. The local roads and streets are then evaluated by use of a mass analysis procedure.

Both geometrical and structural characteristics of roads and bridges are evaluated. Temporary or minor deficiencies which can be corrected by routine maintenance are not considered as cause for lowering an adequacy rating. Such "maintenance" deficiencies are ignored or overlooked in the adequacy rating process.

c. *Method:*

The adequacy of a section of road is usually rated with respect to its structural condition, the level of service it provides, and the safety it affords. The first step is to analyze the road inventory data in the office. The routes of the major road and street systems are then divided into sections of relatively uniform characteristics. This "office" selection of road and street sections must be considered to be tentative, since it is often necessary to change the limits of a section or establish additional sections in the field.

The office analysis is then followed by a field inspection, or adequacy survey of each section of each major route for the purpose of recording the roadway and structure condition. The principal items to be evaluated in the field during the adequacy survey process are: drainage, pavement and foundation condition, structural condition, sight distance, roadway alignment, and gradient. Basic physical features such as traveled way and shoulder widths, horizontal and vertical clearances, number of lanes, structure widths, surface types, etc., are evaluated by review of data obtained during the road inventory.

The condition evaluation data becomes a part of the integrated data file and is updated periodically, perhaps at 2-year intervals. The inventory data and condition evaluation data are usually combined in the adequacy rating process, and a numerical rating (between 0 and 100) is determined for each section of road. Higher ratings indicate better roads and lower ratings indicate poorer roads.

Since the condition evaluation requires the use of engineering judgment by the field man, it is important that the individual be very competent, experienced, and well trained. In order to minimize the effect of differing personal judgment, it is desirable that the condition evaluation be made by as few evaluators as is practical, preferably one or two.

The detailed procedures for accomplishing an adequacy rating study are described in the "Guide for a Manual for Highway Adequacy Rating."

3. TRAFFIC SURVEYS

a. *Purpose:*

In order to be able to plan, design, and construct an efficient highway system, it is important to have accurate estimates of the present and future traffic demand on this system. It is of primary importance in making forecasts of future travel demands to know the volumes and characteristics of the present and past travel on the highways. The needed traffic information includes traffic volumes, vehicle types, and weight characteristics of highway travel. Average annual daily traffic (ADT) is a fundamental traffic measurement needed for the determination of vehicle miles of travel on the various categories of rural and urban highway systems. ADT and the physical and weight characteristics of travel on each highway section provide the highway engineers, planners, and administrators with essential information needed for the determination of design standards, the systematic classification of highways, and the development of programs for improvement and maintenance. Vehicle mile information is important for the development of highway financing and taxation schedules, the appraisal of safety programs, and as a measure of the service provided by highway transportation. To realize the full benefits of traffic information, it must be promptly analyzed and made easily available for widespread use.

Only in this way can informed decisions be made so that highway transportation will make its maximum contribution to the economic growth of the city, province or country.

b. *Scope:*

The need for this information is nationwide. An estimate of the number and characteristics of motor vehicles using the major roads is needed as soon as possible. Eventually, it is desirable that some estimate of traffic volume and characteristics for minor roads and streets should be made.

c. *Method:*

A continuous and comprehensive traffic counting program to provide estimated volumes of traffic on each road section is needed for all of the principal and collector highways. This program will require making continuous traffic counts by mechanical means at selected locations. Short-term one or two day mechanical counts will then be needed at all locations where an estimate of ADT is desired. The estimates of ADT are then made by using factors developed at the continuous traffic counting stations to adjust these short or "coverage" counts.

A continual classification counting program to determine the vehicle type distribution of motor vehicles is needed for all the principal and collector highways. This program is normally accomplished by making manual classification counts at selected locations. The duration and number of counts needed at each location will vary depending upon the volume of traffic (ADT) and type of station. Usually, statistical methods are used to determine the number of stations that will be needed and their locations.

Weight characteristics of highway traffic are determined by a truck weighing program. This program is accomplished by the use of portable or fixed scales to weigh trucks that are sampled randomly from the traffic stream. The details on the number of stations needed, duration of operation, and sample size are explained in detail in the section of the "Guide for a Manual of Instructions for Traffic Surveys" that describes truck weighing procedures. The detailed procedures for accomplishing a mechanical and manual traffic counting program are also described in this manual.

4. HIGHWAY STATISTICS

a. *Purpose:*

Complete data on other elements of information in addition to road inventory, traffic data, and adequacy ratings are needed for highway transportation planning. These data are needed when evaluating present characteristics of travel, and safety in relation to the motor vehicle or the driver. This information is also vital when making fiscal evaluations of revenues and expenditures. Also, such data compiled over a series of years is invaluable as a tool to assist in making forecasts.

b. *Scope:*

Data to be compiled includes: motor vehicle accidents, mileages of roads and streets by type and administrative classification, motor vehicle registrations by type and age of vehicle and by location of registration, drivers' licenses by type of license and age of driver, motor fuel consumed, fiscal data (revenues and expenditures, and travel characteristics.

c. *Method:*

Procedures will have to be established for collecting each type of data. Some will be collected directly from the source in which it is available. This will require developing the necessary organization, forms, reporting procedures, and methods for the analysis of the statistical data. For example, collection of most of the data will require coordination and cooperation with other governmental agencies of the national, provincial, and municipal levels. This function will therefore re-

quire extensive planning and coordination to function efficiently.

5. TRANSPORTATION GOALS

Before highway needs can be identified, the highway transportation goals and objectives must be defined. If these are not specified there is no criterion by which to identify or justify a highway need. There are many important decisions to be made when determining and identifying highway transportation goals. Perhaps one of the most basic decisions is whether:

a. The highway program is to be used as a tool to guide, control, and encourage economic development, or

b. the highway program is to assume a more passive role and only respond to existing development by satisfying transportation needs after the need occurs.

Other important questions to consider when determining and identifying highway transportation goals and objectives are:

a. The obvious question of the total transportation need; the movement of persons and goods that is to be accomplished in some manner. What is the magnitude of the problem?

b. What are the relationships and relative economies of the different transportation modes—air, rail, water, pipeline, highway, etc.? How do these relationships and economies correlate with the development goals of the nation?

c. What are the aesthetic and social goals of the nation? How do they effect, and how are they affected by highway transportation?

d. What are the economic and physical means available, both existing and potential, for achieving the objectives?

e. What are the geographical and physical facts that must be considered—geographical size and shape of the nation, terrain features, availability of construction materials, etc.?

f. What role does the highway industry—road construction, motor vehicle manufacture and repair, fuel production, automotive insurance, etc., play in the overall economy of the country? How does the role coincide with the development goals of the nation?

From a practical point of view, it is usually helpful to differentiate between "goals" and "objectives." Goals might be defined as statements of desired conditions. These conditions may be difficult to define precisely and may be impossible to achieve completely. Highway transportation goals might be to improve highway safety, reduce vehicle operating costs, reduce highway construction, and maintenance costs, minimize travel time, improve driving comfort, or rideability of the road, etc. These types of goals inspire almost unanimous agreement and support, but they are difficult to define and to evaluate.

Goals such as listed above could be subdivided into objectives. An objective might be defined as a statement of a desired condition which is well defined and possible to achieve. An objective under the goal of highway safety might be to reduce the fatality rate by 10% within one year. Each of the other broadly stated goals could be broken down into several objectives which would be possible of achievement within a definite period of time. As soon as one objective is achieved a higher objective is set, but the goal remains unchanged.

If well defined goals and objectives are not developed by top management, then the highway planner, or the planning agency is forced to make certain assumptions about the ultimate purpose of the highway program. These, if made without the serious participation of top management, would probably not result in as realistic or effective of a highway transportation system as should be provided.

6. HIGHWAY CLASSIFICATION STUDY

a. *Purpose:*

The purpose of highway classification is to group roadways having similar

characteristics into distinct systems or classes. The term "similar characteristics" is normally considered from a functional sense.

The functional classification of roads and streets is an important aid in the establishment of realistic improvement standards, both for individual sections of road and for the highway system as a whole. The idea is to combine adequacy with economy. A road or street system improved under this principle is similar to a machine, in which each part is just the right size and strength to do its share of the job, and in which all parts fit together into an efficiently designed whole with no extra or missing pieces. This, of course, is the objective of an efficient operating machine, or an efficient highway transportation system.

Long range goals for the highway system as a whole can be more clearly expressed when roads and streets have been classified. Many countries for instance cannot afford the luxury of a high type dustless surface and a high standard of width and alignment to all roads; yet approximately such a level of ultimate development might be appropriate for the arterial roads, while a more modest goal of safe all-weather travel at moderate speeds could apply to the local and land service roads.

The conversion of long range programs into annual construction programs require the selection of more urgent projects to be built first. Here again, classification is important since the question of relative urgency involves making direct comparison between alternate projects. It is difficult, if not unrealistic, to attempt any such comparisons between roads and streets which perform different kinds of service. A much better procedure is to establish project priorities within each class of rural road, or urban street then combine priorities from each class into an overall program. Therefore, a logically developed and formally adopted classification plan is an important element of a good highway improvement program.

The system planning principles applicable to functional classification are essentially the same for both rural and urban networks. The same basic concepts apply. These are:

(1) The existence of a road or street only to serve the through movement of traffic, or to provide access to land, or a combination of both.

(2) The channelization of traffic within a network.

(3) Higher levels of service for routes on which traffic is moving over comparatively longer distances . . .

It is important, however, because of the larger traffic volumes on urban streets and different jurisdictional responsibilities that classification of rural and urban highways should be accomplished separately. The same reasoning is true when choosing project priorities for a construction program.

b. *Scope:*

Nationwide—All roads and streets.

c. *Method:*

The process of highway classification is somewhat arbitrary and requires a certain amount of personal judgment. Consequently, there are bound to be differences of opinion, as to the best division between classes. However, if a rational and objective method has been used, small differences of opinion are of no great significance. Rather, it is important that once established, the system of roadway classification be adhered to by all parties of governmental jurisdictions. See the Manual "Guide for Functional Classification of Highways" for details on accomplishing such a study.

7. EVALUATION OF ROAD IMPROVEMENTS NEEDED FOR PRESENT AND FUTURE TRAFFIC DEMANDS

a. *Purpose:*

The purpose of a highway needs study is to carefully examine and evaluate the

conditions which affect motor vehicle travel on the Nation's highways system. The objective is to determine what improvements are necessary to bring the highway transportation system up to an adequate level of condition and serviceability for present and future traffic. When properly accomplished, such studies provide a firm basis for sound financial planning, for the wise selection and orderly scheduling of improvement projects, and for achieving informed public support for the highway improvement efforts.

More specifically, a detailed study of improvement needs is the proper foundation for a planned highway improvement program. Such a study provides a realistic estimate of the improvements that will be needed over a period of years, along with their cost. A needs study, when properly carried out, will satisfy the following major objectives:

(1) Provide an estimate of the total needed improvements and their costs. It will also identify the overall size and nature of the problem and aid in determining the rate of expenditures to meet the present and future travel demands considering the overall goals and objectives of the country and its financial ability to support that program.

(2) Needed improvement projects will be individually identified as to location and type of proposed work so construction programs can be developed from the reported needs.

(3) The need for each improvement project will be documented in sufficient detail to aid in establishing priorities so that the most urgent projects can be constructed first.

(4) Provides Government agencies with useful data on the needed levels of highway revenue and on the equitable distribution of such revenues among the different governmental jurisdictions.

b. *Scope:*

Nationwide—All roads and streets.

c. *Method:*

(1) There are three related factors involved in a study of improvement needs. They are the actual physical improvements estimated to be needed, the cost of making these improvements and the period of years over which these needs are expected to arise, or in brief:

(a) Physical needs

(b) Money

(c) Time

The meaning of physical needs and their cost in dollars is fairly self-evident, but before we can approach either of these, the time element must be explained.

(2) *Time Element*

The period of years over which the future needs are expected to arise is quite general at the time of measuring needs. However, this time period becomes more specific when the needed improvements are compared with available financing and short range construction programs are being assembled.

The adoption of a planned improvement program implies the intention of bringing the Nation's highway system up to an overall level of adequacy. This takes time. Financial realities usually dictate that presently existing highway deficiencies will have to be eliminated over a period of years. But during this time other roads will also become deficient and they too will need improvement. Obviously, any long-term improvement program based only on present needs would fall short of its mark by failing to consider the new needs that would arise during the period of the program. The needs study procedure can surmount this problem by determining (1) the improvement needs that exist right now, and (2) the further needs that will arise in the foreseeable future. The intention is that a

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feasible improvement program can then be proposed to meet these needs within the time period desired, and considering the finances that will be available, so that at the end of the time period a more adequate road system will have been achieved.

At this point it should be emphasized that short range needs should be specific to establish a construction program. On the other hand, it is not practical to establish specific long range needs and expect them to become actualities. However, long range needs must be determined in a general manner in order to establish realistic cost policies for financing the improvement program. This approach permits exploration of alternative possibilities in regard to time schedules and financing plans when developing a long range improvement program. The period of time that will fit this approach will normally not exceed fifteen years. All long range plans and forecasts are made with the anticipation or knowledge that they will be periodically reviewed. If adjustments are necessary, they are far easier to cope with than is the problem of an unplanned for future which has suddenly become the present.

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(3) *Categories of Needs*

Once the time period to be covered by the needs study has been considered, the actual determination of needs can proceed. The categories into which these needs will fall are indicated below.

(a) *Present needs:* Those that exist right now and consist of:

(1) Present deficiencies on the existing road system.

(2) Present need for new facilities on new alignment.

(b) *Future needs:* Those needs that do not exist at present, but will arise in the foreseeable future. They consist of:

(1) Anticipated future deficiencies on the existing road system.

(2) Future need for new facilities on new alignment.

(4) *Establishing a Roadway Section for Analysis*

Before beginning the analysis of deficiencies, it is first necessary to identify and establish the limits of the sections of road for analysis. Sections may vary from a fraction of a mile to several miles in length depending upon the following criteria:

(a) As a primary criterion, each section to be rated should be reasonably homogeneous in character; that is, it should have reasonably the same traffic volume, surface type, width, alignment, and condition. A section should end at the point where a new characteristic appears, and a new section should be designated.

(b) As a secondary criterion, it is desirable that a section be of such length as to be capable of constituting an improvement project. However, this is not always feasible if homogeneity is to prevail. For instance, if several short critically deficient sections are interspersed on one segment of road, they should be individually sectionalized for the purpose of evaluating deficiencies. These short sections may later be combined into one improvement project during the program assembly. Normally, the roadway sections established for making the adequacy rating will be used to evaluate needed improvements.

(c) Portions of a road requiring only maintenance to elevate them to standards that are equivalent to those of adjoining sections should not be considered as separate sections.

(d) For urban roadways sometimes it is not practical to establish new sections each time a different characteristic appears. This would be especially true in business districts

where the many conditions influencing capacity would be changing at every block, i.e., parking restrictions, directional distribution, peak hour percentages of ADT and traffic signalization, etc. Therefore, practical judgments must be made to determine the fewest number of segments without jeopardizing the forthcoming priority analysis. The primary factors to be considered in this selection should be those that influence the priority rating to the greatest degree. Normally, these would be service width, traffic volume, and structural strength.

(5) *Analysis of Present Deficiencies*

The analysis of present deficiencies involves an item-by-item comparison between a road or structure as it now exists and as it should be to serve adequately the needs of present traffic. Typical roadway deficiencies would include such things as the following:

(a) Inadequate base or subgrade support

(b) Low grade line or poor drainage

(c) Inadequate type of surface

(d) Poor condition of surface

(e) Narrow surface and/or narrow shoulders

(f) Excessively sharp curves

(g) Steep grades

(h) Restricted sight distances

(i) Inadequate traffic capacity

(j) Excessive maintenance

Typical structure deficiencies would include the following:

(a) Inadequate load capacity

(b) Structural deterioration

(c) Roadway width too narrow

(d) Insufficient roadway vertical clearance

(e) Waterway opening too small

(f) Excessive maintenance cost

The definition of just how good the road or structure should be to "serve adequately the needs of traffic" is based on a predefined set of tolerable standards against which the existing conditions are compared. The tolerable standards to be determined are limited in part to the financing abilities of the government and the wishes of the people.

It is often necessary, when improvements are indicated on the existing alignment to reduce tolerable standards to the absolute minimum as far as safety and geometrics are concerned. If it is determined that the road section needs to be reconstructed, it will be designed to accommodate traffic 20 years in the future.

(6) *Analysis of Future Deficiencies*

The analysis of future deficiencies involves the process of determining the extent and costs of improvements to roads now adequate, but which will not remain so over the foreseeable future. These future deficiencies may be caused by the following two factors: (a) increased traffic demand, and (b) deterioration of the roadway structure, with the passage of time.

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Methods to evaluate these factors are:

(a) Determine future needs statistically using ages of surfaces in place, demonstrated surface lives, and averages per-mile replacement costs.

(b) Determine future needs by determining the rate of deterioration of each road section or structure in relation to the number of load applications or work that the road section serves.

Both of the above methods are based on judgment, observation, past experience, and knowledge of the age and history of the road or structure in question.

Traffic forecasts are necessary to assist in determining the design requirements for those sections of roads that are presently inadequate and need total

reconstruction. It is also necessary information when evaluating future highway deficiencies and design requirements for these deficiencies. Forecasting traffic is usually under ordinary conditions, based on projecting past traffic trends into the future. In general, annual traffic increases are greater on arterial roads than on local roads, and greater near metropolitan areas than in rural areas. In areas where considerable change is to be expected in the character or intensity of land use (suburban growth, for instance), traffic forecasts based solely on projection of past trends will not be adequate. Forecasts of future land use will be needed. Current techniques for forecasting future traffic volume from future land use data are highly complex, and for the present many engineers may have to rely on their own powers of interpretation and judgment in converting data on future land use into estimated future traffic. Frequently, in such cases the prime requirement will be the necessity for forecasting accurately enough to recognize the plan for the future need for added traffic capacity.

(7) *Determining Type of Improvement—Need and its Cost*

Whenever a need (present or future) has been determined to exist, based on the preceding analytical steps, the next step is to determine what type of improvement will be needed. This may be anything from resurfacing or minor widening to a completely new facility and will be based on the nature of the deficiency and the design standard required to serve present or future traffic. With the type of needed improvement known, the cost of this proposed improvement can then be estimated. The cost is based generally on historical contract prices for the type of work and modified according to quantities of materials involved, availability of materials, or unusual conditions related to a specific proposal. The price is frequently computed on a cost per mile basis for roads and a cost per square foot basis for structures. An allowance for preliminary and construction engineering should be included. The engineering allowance is often determined as a percentage of the construction cost. Right of way cost, if applicable, may be similarly determined.

8. HIGHWAY FISCAL STUDY

(a) *Purpose:*

The purpose of a highway fiscal study is to assemble and analyze data concerning past, present, and possible future revenues for highways. The sources and the distribution of revenues are analyzed to determine if the financial burden and revenues are distributed equitably. The study provides top management with data on which to base decisions concerning the size of the highway program, distribution of funds, and sources of revenue.

(b) *Scope:*

Just as a road and street system is thoroughly linked together at all levels of governmental jurisdiction, it is necessary to study the highway finances of all levels of government in order to fully define the fiscal problems and to determine possible solutions. The sources of financing of the total highway program, i.e., administration, planning, design, construction, maintenance, policing, etc., should be included.

(c) *Method:*

The methods of obtaining existing highway revenues are reviewed. Statistical data showing past and present revenue collections and distributions are collected and tabulated. The revenue receipts from different sectors of the economy (users and non-users) and from different classes of users (automobiles, buses, trucks, etc.) are compared to the benefits and costs due to each to determine if each is paying a fair share. Other methods of revenue sharing may, also, be evaluated.

Forecasts are made of future revenue that might be expected if existing revenue laws are continued, and from new sources if the revenue laws were to be changed. Forecast revenues are compared with estimated present and future highway needs and several alternate possibilities of financing the highway program are developed. Specific recommended solutions are usually included.

9. STUDY OF HIGHWAY LAWS

(a) *Purpose:*

Efficient highway management requires adequate legislative authority which clearly designates responsibilities at each government level. Most of the existing highway legislation has probably been accumulating, piece by piece, over many years. Much of it is probably out-moded and seriously handicaps highway progress. There are usually duplications, conflicts, ambiguities, and serious omissions.

A highway laws study is for the purpose of examining existing laws, identifying problems, and suggesting solutions with the end result being a modern, efficient body of highway law. For example, these laws should clearly define financial and operational responsibilities for each level of government, and procedures to equitably distribute the tax burden.

(b) *Scope:*

The study should consider the adequacy and interrelationship of highway laws at all levels of government. This does not mean that it should include a detailed review of the existing laws of every lower level of government, but clearly designated levels of authority should be provided for each level of government. Model codes and ordinances could be prepared in order to assist local governments in their efforts to update their laws.

(c) *Method:*

A thorough search of existing laws, decrees, and regulation is made. Each provision of law is examined to determine its validity and adequacy. Specific recommendations for repeal, modification, or addition are made when the existing laws do not meet the tests or provide the necessary needs of the transportation system.

B. OUTPUT:

1. THE LONG RANGE HIGHWAY PLAN

a. *Purpose:*

The highway needs study has determined what highway improvements will be needed over a period of years considering the overall goals and objectives of the country and its financial ability to support the program. Now the process of long and short range programming is to take the data from the needs, financing, and priorities studies, and convert these data, using practical considerations into an actual construction time table.

Among the projects the needs study has shown to be eligible for the long range program, many will warrant immediate construction. However, financing realities may require that the backlog of present needs be accomplished over a period of years. Since some of these needs will be more critical than others, it is essential to sort out the needed projects in priority sequence, so the more urgent ones can be scheduled for earliest construction. Before establishing priorities, all roads must be functionally classified. Therefore, separate priority lists can be drawn up for each class of road.

While the short range program is primarily concerned with construction to be accomplished during the next three, four, or five years in the future, the long range program includes all work proposed to be accomplished by the long range highway needs and financial plans. These projects which are listed by the approximate year for construction (probably 5th to 20th) are not as firm and more subject to change from projects in the short range program. However, it does provide as accurately as possible, using available information, the

construction time-table to be accomplished within the period of the long range financial plan.

Showing the approximate year for construction will serve two purposes. First, it gives the taxpayers evidence that worthy projects have received individual consideration. It will, also, give them an idea of when they can hope to see the projects, in which they are interested, built. Second, it accomplishes a preliminary sorting which will simplify the annual task of selecting projects to add each year to the short range program.

b. *Scope:*

The long range highway plan should be nationwide and include the general road plans for all levels of government.

c. *Method:*

As indicated above, the highway needs study has determined what highway improvements will be needed over a period of years. Subsequently, these needed improvements will need to be placed into a construction time-table, using a priority procedure. These projects should first be subjected to a priority analysis from a pure engineering point of view. This method of priority analysis contains three features as outlined below:

(1) *Service Rating:* The service rating attempts to evaluate the importance of a road in relation to other roads of the same classification, assuming two roads of the same class have the same degree of physical inadequacy, the road having the greater service rating would warrant earlier improvement. Traffic volume is one measure of the importance of any road. (a) In establishing the service rating for all urban roadways and for rural arterials and collectors traffic volume criterion alone should be sufficient, as other measures of road importance have already been given consideration in the classification process. (b) For rural local roads where traffic counts may not be accurate or comprehensive enough to indicate the total importance of the road, other factors may need to be considered. These factors include such as dwellings served, service to mail, or bus routes, etc.

(2) *Condition Rating:* The condition rating expresses the extent to which the road (or structure) is deficient, in terms of a numerical index. This numerical rating is usually taken from the highway adequacy study. If two roads are equally important, that is they have equal service ratings, it seems logical that the road having the lower condition rating should be improved first. The extent of the individual deficiencies that have been determined during the adequacy rating process provides the basis for the condition rating. A perfect roadway or structure would have a condition rating of 100. Point values for deficiencies are deducted from this score. For example, a road with a condition rating of 60 is in better condition than a road with a rating of 40. Individual deficiencies of different kinds are measured and added together into one rating for each road section.

(3) *Priority Analysis:* The Manual "Measuring Improvement Needs and Priority Analysis" presents a method for mechanically making a priority rating for each section of highway based upon "service" and "condition." It should be pointed out, however, that the priority array though essential, cannot by itself determine a construction program. There are always practical considerations involved which cannot be evaluated by any type of rating formula, and which *must* be taken into account. These considerations may include such things as desire to concentrate construction along a route, better geographical distribution of work, etc.

III. SHORT RANGE PLANS

A. INPUT

1. CORRIDOR STUDIES

a. *Purpose:*

These types of studies are for the purpose of answering specific questions as to the location of a highway within a corridor, the number of lanes, degree of access control, etc. These studies are normally made to determine the highway location and general design features immediately before starting to prepare the detailed project plans, specifications, and estimate for projects within the corridor.

b. *Scope:*

These types of studies are usually limited to a corridor which is connecting major traffic generators, or to a relatively small geographic area sometimes containing several routes with similar problems. Typical studies (in addition to the normal national planning studies) that may be needed for short range planning include:

(1) Special O & D studies for small areas for specific purposes.

(2) Special economic studies.

(3) Aerial surveys, etc.

c. *Method:*

The nationwide highway planning operations such as road inventory, adequacy ratings, traffic studies, highway classification, and need studies, etc., form the basis for the preparation of long range plans. As was pointed out previously in the long range planning section of this report, highway improvement planned for 10, 15, or 20 years into the future is very general. It would not be possible, or even desirable, to develop detailed information for every project in a 20 year plan. The projects that are included in a short range plan, of five years or less, however, should be described in more detail in order to allow the right of way studies and preliminary engineering to proceed sufficiently in advance of construction.

The different phases of planning might be categorized as follows:

- Long range plans—nationwide
- Short range plans—route or route section
- Construction plans—single project

For example, a long range plan might show that a high type facility is needed between two large cities. As the time for construction approaches, say within five years or less, it is necessary to make some decisions about the precise details of location and design. Examples of questions that may have to be resolved are:

(1) Should the route follow the present alignment or another location?

(2) Should the design be a freeway with complete control of access, or an expressway with partial control of access and with intersections at grade?

(3) Should the new road pass through intervening towns or bypass them?

(4) Can the existing roadbed and pavement of the route serve as two lanes of a new four lane divided road?

These kind of questions cannot be answered on a project by project basis. They must be answered for long sections of road at one time. To answer these questions, it is usually necessary to collect more detailed data than was collected in the nationwide surveys. It is very probable at this time that additional traffic origin and destination data are needed as well as

more specific detailed roadway inventory data. Additional aerial surveys, economic studies, etc., of the corridor being analyzed may also be needed.

In most instances it is not feasible to gather such detailed information as is needed for a corridor study on a nationwide basis because:

(1) To do so would greatly delay the date of completion and increase the complexity and expense of the national surveys.

(2) The data may not be needed at all in many cases. In other cases it will not be needed for 10, 15, or 20 years in the future, and it is quite possible that analysis needs will have changed by then, and the data may be obsolete and of little, or no value.

(3) Collection of the special data individually for each corridor study permits the design of each study to be made exactly to the needs of that particular corridor.

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Once the corridor study has been completed and answers to the above types of questions have been found, it is possible to begin the preparation of construction plans, specifications, and estimates, and the acquisition of rights of way on a project basis. This process is described in the following section IV—*Construction Plans.*

2. BUDGET ANALYSIS

a. *Purpose:*

The purpose of the budget analysis is to make a fairly precise analysis of the current financial status and the expected income and expenditures of the next five years period. This analysis is necessary to permit realistic short range planning for new construction, roadway maintenance, and the other operations of the highway agency.

The fiscal study described under Section II, *Long Range Plans* dealt with a long period of time and cannot be as precise as is necessary for the short range plan for the immediate future.

b. *Scope:*

Normally, this type of analysis is made by each highway agency for its own operations. The analysis should include all types of income and expenditures incurred by the agency.

c. *Method:*

The first operation would be a complete accounting of the present financial status of the highway agency. This includes studying the assets, liabilities, (unpaid contract obligations, unreceived income, etc.). The second step would be to make estimates of income and expenditure for the short range program period. This period may be for two, three, four, or five years in the future, as desired. Estimates of income should include all sources of all anticipated income such as taxes, tolls, bonds, loans, etc. Estimates of expenditure should include all anticipated expenditures for all purposes such as construction, maintenance, administration, engineering, right of way, policing, debt retirement, etc.

The results of the analysis described above should give a fairly precise estimate of the types and amounts of funds that will be available each year (or even by quarters of each year) of the short range program period. The available funds and the highway needs can then be evaluated, compared, and balanced.

B. OUTPUT

1. FIVE YEAR PROGRAMS

a. *Purpose:*

The purpose of the five year program is to provide as firm of a listing as is practical, of the projects to be built within the next five years. This will provide sufficient lead time for establishing an orderly flow of survey, design, right of way acquisition, and construction activity.

b. *Scope:*

Nationwide—The analysis should include the general road plans for all levels of Government.

c. *Method:*

The method of establishing priority analysis for short range programs is much the same as for long range programming. However, the short range program is primarily concerned with the projects in which construction is to be initiated within the next five years in the future. Each year the short range program will be reviewed and projects moved up according to plan, subject of course, to any adjustments that may be necessary due to modified circumstances. Also, as these projects move ahead in schedule, a new group of projects must be selected and advanced to the short range program. This will be a continuing process to continually keep a list of projects to be constructed during each of the next five years in the future.

IV. CONSTRUCTION PLANS

A. INPUT

1. PRELIMINARY ENGINEERING

a. *Purpose:*

Preliminary engineering determines the precise location of the road and the structural and geometric design features.

b. *Scope:*

Preliminary engineering is normally done on a project basis. The length of a project may vary greatly. For example, some projects may be less than a kilometer in length where others may be many kilometers in length depending on the available funds, complexity of the work, nature of the work, etc. Typical types of studies that are needed to accomplish preliminary engineering include:

(1) Location Surveys
(2) Soil sampling
(3) Material investigation
(4) Bid price statistics

c. *Method:*

After the long range and the short range planning processes have established the highway functional classifications, set construction priorities, established general design criteria for each road section, determined fairly precise highway locations within the corridor, and set the project limits, the work then enters the preliminary engineering phase. The preliminary engineering work will establish the exact geometric and physical design features of each project. This includes such work as:

(1) Determining exact line and grades

(2) Determining intersection and interchange design and locate points of access.

(3) Determining design features of roadway and structures.

(4) Determine the necessary public utility adjustments.

(5) Test and determine location of construction materials.

(6) Estimate quantities of materials needed.

(7) Prepare average unit prices of materials to enable estimating the cost of the work.

2. RIGHT OF WAY

a. *Purpose:*

The purpose of this work is to study the right of way aspects of the project, make recommendations for the solution of right of way problems, and to acquire the rights of way necessary for the project.

b. *Scope:*

The right of way phase is normally conducted on a project basis although occasionally it is advisable to acquire right of way in advance on sections which are longer than individual construction projects. Some right of way studies which are more broad and general in scope are necessary during both the long and short range planning processes. These broad studies are made to ensure that adequate right of way will be obtainable and that the planned general criteria and highway locations are feasible from a right of way point of view.

c. *Method:*

At the same time that the preliminary engineering studies are underway the right of way department can be preparing maps showing the ownership of the property along the general highway location.

Studies can be made of recent land transactions in the area. These will aid in establishing a fair price for the land to be taken for the highway right of way. As the final location of the highway is being established, it is necessary to have close cooperation between the preliminary engineering department and the right of way department in order to avoid conflict between design and right of way considerations. After the location of the road is firmly established and the necessary right of way adequately determined, the right of way department can begin appraisal, negotiation, and acquisition of the right of way.

B. OUTPUT

1. PLANS SPECIFICATIONS AND ESTIMATES

a. *Purpose:*

The purpose of the plans, specifications, and estimates is to serve as a basis for soliciting bids and to describe the work so that the contractor can construct the road in accordance with its design.

b. *Scope:*

Plans, specifications, and estimates are prepared on a project basis and in sufficient detail to accurately describe and control the work.

c. *Method:*

Construction plans normally consist of plan and profile sheet and detail drawings for the roadway, structures, intersections, signs, etc. Sometimes two or three, or more sets of plans are prepared at different stages during the design process. These might be called route location plans, preliminary design plans, right of way plans, final design plans, and as-constructed plans after the work is completed.

Standard specifications normally control most of the work but it is usually necessary to prepare supplemental specifications and special provisions to cover the specific details of each project.

Estimates of materials prepared during preliminary engineering are used by the contractors in preparing bids. Estimates of cost prepared during preliminary engineering aid the agency in evaluating the bids received from contractors.

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FIGURE 1

Outline of the

Highway Transportation Planning Process

	INPUT:	*OUTPUT:*
Phase I	Road Inventory Traffic Surveys Highway Classification Adequacy Ratings Highway Statistics Transportation Goals Evaluation of Road Improvements Needed (Present and Future) Highway Fiscal Study Study of Highway Laws	The Long Range Highway Plan
Phase II	Corridor Studies Budget Analysis	5 Year Programs
Phase III	Preliminary Engineering Right of Way	Plans, Specifications, and Estimates

Guide for

MANUAL OF INSTRUCTIONS

for

ROAD INVENTORY

1976

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An effective highway transportation planning process is the basis for, and is a necessary continuous part of efficient highway transportation management. This series of manuals and accompanying computer programs were developed to provide guidelines for establishing a system and the basic data collection programs and analysis that are a necessary beginning for accomplishing such a planning process. This series of manuals includes:

1. Outline of the Highway Transportation Planning Process
2. Guide for a Manual of Instructions for Road Inventory
3. Guide for a Manual of Instructions for Traffic Surveys
4. Guide for a Functional Classification of Highways
5. Guide for a Manual for Highway Adequacy Rating
6. Measuring Highway Improvement Needs and Priority Analysis
7. Computer Program User's Manual

It should be acknowledged that many of the procedures as described in these manuals have been taken from, or patterned after numerous published sources. Included in these sources are publications of the U.S. Federal Highway Administration, State Highway Departments and the U.S. National Association of County Engineers.

The planning of a highway improvement program should start with a foundation of knowledge about the physical nature and use of the existing road system. This information is obtained during the inventory process. This manual describes in detail the process for collecting the physical details of the highways. This information will subsequently be used to classify the highways and to analyze the needs and deficiencies, and to formulate the improvement program.

The highway inventory also provides vital information that is needed for the coordinated data system. Any physical object that is permanent and easy to identify along the road may be used as a reference point to locate all roadway oriented data. The location of these reference points are determined during the highway inventory.

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CHAPTER 1—GENERAL CONSIDERATIONS

A. OBJECT OF THE MANUAL

The object of this manual is to instruct the personnel working on the inventory of the highway system and to provide uniform criteria for accomplishing the task in a systematic and economic manner.

A copy will be given to each employee working on the inventory, and he will be expected to study the manual in order that he will be aware of the work he has to do.

When additional information or instructions are needed, the employee should ask his immediate supervisor for assistance. The supervisor is responsible to see that all of his employees have received all of the necessary additional information.

Changed circumstances, requirements of the work, or new policies, may make revision of, or addition to the manual necessary. In case of revision, the new procedures supersede and replace the old procedures.

In order to assure that all users of the manual receive all revisions, the inventory section of the central office should maintain a distribution list containing the names of all persons who have received the manual.

It should be emphasized that the information being collected as described in this manual was designed for a particular country. The Field Inventory Forms may be changed to reflect the data requirements of any country. However, such changes will accordingly require modification of the computer programs that were developed to analze these data.

B. PURPOSE OF THE ROAD INVENTORY

The purpose of the road inventory is to obtain data for compiling statistics and solving problems regarding the amount and the characteristics of the several types of roads, streets, structures, and other items discussed in this manual. The data obtained will be used in the determination of highway needs and in the preparation of highway improvement programs. These data can also be used to make accurate delineation of the road surface systems, surface types, and special information on maps.

C. ORGANIZATION

Management of the road inventory program is normally in the central office of the highway department. This results in more uniformity, efficiency, and better coordination.

1. CHIEF OF ROAD INVENTORY SECTION

He is in responsible charge of the road inventory and is assisted by staff members in charge of various phases of the work.

2. DEPUTY CHIEF OF ROAD INVENTORY SECTION

He acts as deputy or senior assistant to the Section Chief and acts for the Section Chief in his absence. It is probable that this man may also serve as assistant chief for Office Operations, or as assistant chief for Field Operations.

3. ASSISTANT CHIEF FOR OFFICE OPERATIONS

He has charge of the office operations of the road inventory program. He supervises the draftsman and office analysts. He prepares and supervises the analysis and inspections of field data sent in by inventory parties, and secures and accounts for office supplies.

He coordinates the flow of work to and from the automatic data processing division. He answers requests for information regarding road inventory data.

4. ASSISTANT CHIEF FOR FIELD OPERATIONS

He is in charge of field inventory operations. He assigns the work for each field party and provides them with the necessary equipment, supplies, and maps. During the progress of the work he will prepare a weekly progress report. He is responsible for the progress of the field work. He maintains equipment records and is responsible for the nonexpendable property used during the field inventory.

He assigns personnel, making changes and replacements in assignments and schedules when necessary. He keeps in close contact with the field operations, follows the progress of the work, notes the location of the crews, and makes (or causes to be made) regular inspections in the field. The results of the inspections are reported to his supervisor, the Chief of the Road Inventory Section.

5. INSPECTOR

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One or more inspectors may be appointed to inspect the work of the field parties. The Inspector closely follows the progress and the location of the work so that he can contact each party in the field without delay. He inspects the work as to rate of progress, completeness, accuracy, and is responsible for other tasks as assigned by his supervisor, the Assistant Chief for field operations.

6. PARTY CHIEF

He is responsible for the field work performed by his party, the notes recorded in the field and the equipment assigned to him. The other members of the field party work under his direction. His immediate supervisor is the Assistant Chief for Field Operations. He will report the progress of his work weekly.

7. ASSISTANT PARTY CHIEF

He acts as the Assistant Party Chief and assists the Party Chief in making measurements and in defining or determining the location of the routes being inventoried. Normally he will be an employee of the District or Field Office (in order to be more familiar with the immediate area).

8. DATA ANALYSTS

They are in charge, under the supervision of the Assistant Chief for Office Operations, of preparing field maps and data forms for inventory parties, checking the field data forms when received in the office, and making such special reviews, analyses, or reports as assigned by their supervisors.

9. DRAFTSMAN

He drafts such forms, tables, graphs, charts, and reports as assigned by his supervisor. He also, when not doing drafting work, may assist in the checking and analysis of data. He prepares maps for use by field inventory teams and also drafts of maps showing graphically the progress of the field inventory.

10. DRIVER

Under the direction of the Chief of Party he drives the car and performs other duties such as cleaning and servicing the vehicle and checking the tire pressure. (In some cases the Assistant Party Chief may drive the vehicle.)

11. HOURS OF WORK

The hours of work and the working conditions for field parties are established by the central office. The weekly report, to be submitted by the Party Chief, will report the hours worked.

12. SAFETY

Road inventory involves operation of a vehicle at low speed including frequent stopping and starting with personnel getting in and out of the vehicle, making measurements, and crossing traffic lanes. These actions can be extremely hazardous. In the interest of their own safety, and that of the motoring public, field parties must comply with all traffic regulations. Safety devices and practices will be prescribed by the central office.

Safety devices include:

a. Flashing lights mounted on top of the vehicle.

b. Flasher unit to operate the 4 directional turn signals on the vehicle simultaneously.

c. Two red flags for use by the field crew in controlling traffic.

G. THE INVENTORY VEHICLE

1. THE VEHICLE AND ITS EQUIPMENT

The vehicle should be a station wagon or other type with seating capacity at least equal to a sedan. It will have a closed body and four doors. It will be identified as an official government vehicle.

In addition to the usual odometer, the vehicle will be equipped with an odometer which will register trip length accurately, reading to 0.01 of a kilometer. The tires which control the odometer readings should be virtually new tires. Radial cord tires incorporating layers of steel cords are often used to improve the accuracy of the odometer. Tests have shown these tires are far superior to regular tires for improving the accuracy of the odometer for measuring distance.

2. ODOMETER TEST AND TOLERANCE

All field inventory personnel should be thoroughly acquainted with the factors which affect accuracy of odometers. Before starting an inventory, the supervisor shall see that the odometer readings can be relied upon to register accurate road distance. It shall be the duty of the inspector, or the assistant chief for field operations, to personally supervise the test of the odometer.

The tire pressure is to be checked by the same gauge that has been furnished to the party for use in the daily checks of tire pressure. With the tires thus inflated, he will have the car driven over a measured distance of five kilometers or more, and the error noted. If the test shows the odometer to be inaccurate (variation in excess of 2%) and the error cannot be eliminated by a change in the tire pressure, change of tires, or adjustment of the odometer, a new odometer should be installed in the vehicle.

The odometer check should be repeated approximately once each month during the inventory. A record of the odometer tests will be kept in the central office showing the percent error. This record may be used later in applying correction factors to distances obtained from field notes.

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CHAPTER II—INVENTORY PROCEDURES

A. GENERAL

This chapter describes in detail each item of the field data forms. Many examples are provided to illustrate the intent of the instructions. The instructions are provided in this form in order to be easily understood and to illustrate both the basic concept and the specific code for each item of data. Each item of data will be recorded by its code. The field forms will be given to the key punchers directly, after only a cursory manual review in the office.

In order to minimize errors the writing of coded data and notes must be very clear. Additional information written in the "comments" section can be very useful for solving problems or interpreting unusual situations encountered in the field.

Form INV 1 is used for recording data on undivided roadways (without center medians). Short sections of median, such as are found at channelized intersections, are not measured or recorded, and Form INV 1 may be used to inventory these sections. In other words, it is not necessary to change to Form INV 2 for such short sections of road with median.

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Form INV 2 is used for recording data on divided roadways, such as freeways, expressways, or toll roads, with center medians.

Form INV 3 is used primarily for recording data on bridges and culverts. It is also used for recording pertinent items of data for other structures or events such as: high tension lines, overhead pipe lines, overhead conveyors, sign bridges, pedestrian overpasses or underpasses, dips (sudden sag), and toll collection booths. For major structures all columns on Form INV 3 should be completed if possible. See Sample Form INV 3 in the "computer program users manual," which identifies the data fields usually completed for the different types of structures.

Form INV 4 is used for recording data on railroad grade crossings. If the intersection of the railroad and the road has been separated by a bridge then Form INV 4 is not used but Form INV 3 is used to record the data for the bridge.

Form INV 5 is used for recording data on tunnels.

Form INV 6 is used for recording data on ferry crossings which form an essential link in the road network.

Form INV 7 is used to record supplemental data on extensions of national and provincial highways in urban areas. (It is not intended that this form be used to record data for an inventory of local city streets.) Form INV 1 or 2, depending upon the form that is being used when entering the urban area and whether it is an undivided or a divided road, will be used to record the basic roadway data within the urban areas. For this inventory an urban area is defined as any city with a metropolitan population of 2,000 inhabitants or more.

The first and last line entries on Form INV 7 for an urban area will be used to record the location of entering and leaving the urban area. It should be noted that at both of these points the first 44 columns should be completed. Completion of columns 45 through 71 will depend if such events exist at these points.

See appendices A through G for examples of the INV forms.

Whenever data are hand coded for keypunching (such as the field coding of the above mentioned forms) many times the following letters and numbers are misinterpreted: O, S, Z, 0, 5, 2. Generally, this confusion is avoided by some distinguishing mark superimposed upon the character. In this publication, the following have been used:

d. Safety vests in bright red or orange to be worn by all members of the field party.

13. EQUIPMENT

The basic equipment for each field crew shall include:

a. A vehicle equipped with a trip odometer which will record to 0.01 of a kilometer.

b. Measuring tapes of 25 and 50 meters each.

c. Tire pressure gauge.

d. Collapsible level rod (or other device to measure vertical clearance).

e. Four clipboards for note sheets.

f. Camera (with case and built-in light meter).

g. Chalkboard.

h. Drafting triangles (2).

i. Drafting pencils and pencil pointer.

j. Engineer's scale.

k. Protractor (180°).

l. Survey Pins (5).

m. Hammer.

n. Shovel.

o. Tow chain.

p. Wood stakes (25).

q. Maps and aerial photographs of area being inventoried.

r. Data forms.

s. Chalk.

t. Envelopes.

u. File folders.

v. Spare tires (2).

w. Electric bulbs.

x. Vehicle tool box.

D. INSTRUCTIONS TO PARTY CHIEF

1. PARTY CHIEF

He is responsible for recording all notes of the inventory. Data for roadways, structures, railroad crossings, tunnels, and ferries will be coded on special forms. Additional information can be included in the comments section or on the maps as necessary to provide a clear interpretation of the data. A carbon copy will be prepared of each data sheet (to insure against possible loss of the original in the mail). He will prepare a weekly report of work performed, and he will include a tentative itinerary for the following week.

He will schedule each day's work, following in general the broad itinerary prepared for his team in the central office. Location of towns, weather conditions, progress of the work, etc., all must be considered when scheduling each day's work.

When unfavorable weather prevents field inventory, he can do other things, for example:

a. Procure necessary office data from local authorities.

b. Review notes on work to be done and/or completed.

c. Service the vehicle and make any necessary repairs.

In case of serious problems of any kind, he will contact the central office for instructions.

2. MAPS

He will use the latest available editions of highway maps. Supplemental maps showing some areas in enlarged form will be included. Aerial photos should also be used when available.

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3. NUMBERING OF ROADS

The existing system of route numbers for the national and provincial primary roads will be used. Routes which have names will be assigned identification codes for use in the road inventory data system.

The central office will devise a system and assign numbers to those routes which do not presently have numbers.

4. ZONES

For the purpose of planning the work, zones may be established to define the areas of work for each field team. Limits of work zones will be defined by provincial or district boundaries, major highways, railroads, rivers, or other prominent features readily identifiable on the ground.

5. FIELD NOTES

Field data are to be recorded in a neat and orderly fashion. The field data sheet

is a "self-coding" form which will be used by key punch operators. For this reason it is very important that the data be entered neatly and legibly in the field. The data should be completely and accurately recorded at the moment they are obtained. "Putting off until later" the completion of the field notes is an unacceptable practice.

There should be no erasures or "writing over" errors on the data sheets. Errors should be "lined out" and the data written in correct form on the next line.

Each day's work is to be started on a separate data sheet, and also a new sheet must be used when inventorying a different route or in a different province or district. The identification data in the heading of each form should be filled in completely before proceeding to record the inventory data.

6. NUMBERING OF PAGES

The sheets will be numbered consecutively to show the number of sheets used each day. Each type of form and each route will be numbered separately. After the field sheets for a complete route have been assembled in the office, they will be numbered consecutively from the beginning to the end of the route, with separate numbering for each type of form.

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7. DISPOSITION OF FIELD NOTES

The Party Chief will send by registered mail, the original copy of the field data sheets to the central office at the end of each week. The carbon copies of the field data sheets will be retained by the party chief and brought to the central office on his next visit.

Exposed film will not normally be sent through the mail but will be picked up by the inspector or brought in to the central office by the party chief on his next visit.

E. INSTRUCTIONS TO ASSISTANT PARTY CHIEF

He will assist the Party Chief in taking measurements and photographs and such other tasks as the Party Chief may request. As he is well acquainted with the roads and communities in his district, he will be expected to advise the Party Chief as to the correct routing or location of the road. He will be expected to assist in choosing locations for overnight stops, making hotel reservations, etc.

F. INSTRUCTIONS TO THE DRIVER

He will see that the vehicle is maintained in good running order and at all times supplied with fuel, oil, and water. Tire pressure will be checked at least once each day, using the tire gauge furnished to the field party, in order that the odometer measurements may be as accurate as possible. Lubrication, oil changes, and other service is to be done in accordance with the vehicle manufacturer's recommendations.

The driver will keep to the right within the traveled way, driving parallel to the right edge of the road. *DO NOT STOP IN THE TRAVELED WAY.* When it is necessary to stop in order to take measurements, or for any other reason, move the car to the right shoulder out of the traveled way. On a bridge, for example, the odometer reading can be noted as the vehicle passes the beginning point of the structure. The vehicle can continue moving over the bridge to a point where it can move out of the traveled way before stopping. If necessary stops are very frequent, the vehicle can be driven slowly on the shoulder, thus avoiding excessive turning on and off the road. The amount of error introduced into the odometer readings by moving to the shoulder for each stop is negligible during a normal rural road inventory. *Do not forget the safety of the crew and the traveling public comes first.* Look carefully forward and to the rear before slowing, stopping, or entering the traffic stream. For example, do not leave the vehicle standing with the doors open when taking measurements. This is a safety precaution. See that the vehicle is locked when it is left unattended. Keep all instruments in their cases or boxes and out of sight as much as possible.

Ø=alphabetic O
$=alphabetic S
Ƶ=alphabetic Z
Ø=numeric zero
5=numeric five
2=numeric two

The user should apply whichever system is customarily used in the data processing work in that locality.

Numeric fields such as odometer reading, pavement width, kilometer post, shoulder width, etc., must be completely filled when making an entry. This means that zeros must be coded if there are unoccupied columns to the left of the highest order digit of the number.

Examples:

Odometer reading 7.93 is coded 00793
Kilometer Post 15 is coded 0015
Pavement width 7.3 is coded 073

B. ROADWAY DATA (FORM INV 1)

PARTY CHIEF: Write the full name of the Party Chief on the line in the box.

ASSISTANT: Write the full name of the Assistant Party Chief on the line in the box.

VEHICLE NUMBER: Write the vehicle license plate number on the line in the box.

SHEET OF SHEETS TODAY: Number consecutively the sheets used each day. Use a different series of numbers for each route and for each different type of form (INV 1, INV 2, etc.).

FIELD DATE: Write the day and the month on the line and the last two digits of the year in Columns 3 and 4.

Example: Field Date 21 May|7|4

TIME START: Write the time that work is started on that sheet.

TIME FINISH: Write the time that work is finished on that sheet.

SHEET OF SHEETS FOR THIS ROUTE: This space is for use in the central office. When all sheets have been assembled for an entire route, the sheets will be numbered consecutively.

TYPE OF CARD—COLUMNS 1 AND 2: The code for the card type is preprinted on each form. For the undivided roadway data form the card type is 01.

ROUTE—COLUMNS 5 THROUGH 8: Enter the route number code. Codes should be developed for all routes. An example is shown in Appendix J.

Example: Route 5 is coded 0|0|0|5
Route 40S is coded 0|S|4|0

See instructions for Column 17 (equations) and Columns 30 and 31 (intersection type) for guidance when inventorying a one-way pair constituting the route being inventoried. When inventorying in the direction of the inventory, the route designation (Columns 5 through 8) will not change; however, when inventorying the segment of the road carrying the traffic in the direction opposite to the inventory, the alternate loop or route number will be coded under Columns 5 through 8.

JURISDICTION—COLUMN 9: Record the administrative jurisdiction of the road being inventoried:

Example:

1 National
2 Provincial
3 Departmental
4 Municipal
5 Military
6 National Parks
7 Port Authority
8 Airport Authority
9 Other

If other is used then indicate the jurisdiction in the comments.

DISTRICT—COLUMNS 10 and 11:

Example:

01 Bs. As. (except south)
02 Cordoba
03 Tucuman
04 Mendoza
05 Salta
06 Jujuy
07 Santa Fe
08 La Rioja
09 San Juan
10 Corrientes
11 Catamarca
12 Neuquen
13 Chubut
14 San Luis
15 Misiones
16 Santiago del Estero
17 Entre Rios
18 Chaco
19 Bs. As. (South zone)
20 Rio Negro
21 La Pampa
22 Formosa
23 Santa Cruz
24 Tierra del Fuego

PROVINCE: Write the name of the province in which the inventory is being conducted.

ODOMETER READING—COLUMNS 12 THROUGH 16: Enter the odometer reading to the nearest 0.01 kilometer. The odometer reading will be recorded at the beginning and at the end of each route, at each event (structure, sign, intersection, etc.) and at each location where there is change in a continuous item such as pavement width, shoulder type, etc. An entry in any column from columns 17 through 74 will require that the odometer reading be recorded in columns 12 through 16 to identify the physical location of the event on the route. Normally, the survey odometer will be set at 000.00 at the beginning of the route and at the point where the route crosses a provincial border, but this is not mandatory since all odometer readings will be adjusted in the office to represent progressive reference points.

For structures and tunnels record the odometer reading at the point of beginning of the structure or the entry to the tunnel when proceeding in the direction of the inventory. For intersections record the odometer reading at the point where the center line (or theoretical center lines) of the roads intersect. At railroad crossings record the odometer reading of the intersection of the roadway and the first railroad track.

In the heading of this field a space is provided for recording the final odometer reading from the previous sheet. This is intended to aid in keeping the data sheets in proper sequence during the office review and key punching operations.

EQUATIONS—COLUMN 17: Data are recorded in this column to indicate simple equations in odometer reading and also to indicate other critical points encountered during the field inventory.

1 Back
2 Ahead
3 Begin Gap
4 End Gap
5 Begin Superimposition of Routes
6 End Superimposition of Routes
7 Begin Construction
8 End Construction
9 Begin Route
0 End Route
A Begin one way pair
B End one way pair

Codes 1 and 2 are used where it is necessary to introduce a simple equation in the odometer reading series. For example, if the odometer reaches 999.99 and begins again at 000.00, or if the work is temporarily interrupted and then started again at the same point with a different value on the survey odometer.

Codes 3 and 4 are used where there is a gap in a numbered route. The route may be designated on maps, but in actuality in the field there may be sections that do not, as yet, exist. In this case, code 3, in column 17, where the gap is encountered. Code 4 where the road inventory is resumed on the other side of the gap. When such a situation is encountered the normal odometer reading at the point where the gap begins, is recorded under Columns 12 to 16, and a 3 is coded under Column 17. When the inventory is resumed at the point where the route continues, the odometer should be reset to zero and so recorded under Columns 12 to 16. The code 4 is then entered under Column 17. The estimated length of the gap should also be noted under comments.

Codes 5 and 6 are used where there is a superimposition of two or more route numbers on one road. A decision must be made as to which numbered route takes precedence, that is, which is the most important. When this "more important" route is being inventoried, there are no special codes to indicate the existence of the superimposition. All physical data on the section of road in which a superimposition exists are recorded as usual when inventorying the more important route. When inventorying the less important route involved in a superimposition the beginning of the superimposition is indicated by coding a 5 under Column 17. The taking of inventory data is then suspended until the end of the superimposition is reached where code 6 is entered under Column 17 and the inventory is resumed. The superimposed section is con-

sidered to constitute a gap in the less important route for statistical data analysis purposes.

Codes 7 and 8 are used where there is road construction in progress, which may prevent the taking of road inventory data. Code 7 is entered in Column 17 at the point where a construction project begins. Code 8 in Column 17 indicates the end of the construction project and the resumption of the normal inventory.

Code 9 in Column 17 indicates the point of beginning of a numbered route and code 0 indicates the end.

Code A indicates the beginning of a one-way pair constituting the route being inventoried. Code B indicates the end of a one-way pair. The section of road between Code A and B carries one-way traffic. The segment of road carrying traffic in the direction opposite to the inventory direction will be assigned a route number, similar to a loop or an alternate of the basic route, and inventoried as a separate route, in the direction of the traffic flow. Code A at the beginning of the segment and Code B at the end will indicate that it carries one-way traffic.

All entries in Column 17 must have corresponding odometer readings entered in Columns 12 through 16. Each odometer reading (with the exception of the 999.99 to 000.00 equation) must be referenced to an identifiable physical feature on the roadway; such as an intersection, structure, kilometer post, sign, construction survey stake, etc. See Appendix M for special instructions for coding equations.

KILOMETER POST—COLUMNS 18 THROUGH 21: Enter the number from each kilometer or reference post, as it is encountered in either rural or urban areas. When a kilometer or reference post is coded in Columns 18 through 21, and there are more than one line of coded information with the same odometer reading, the kilometers or reference posts must be coded on the first line.

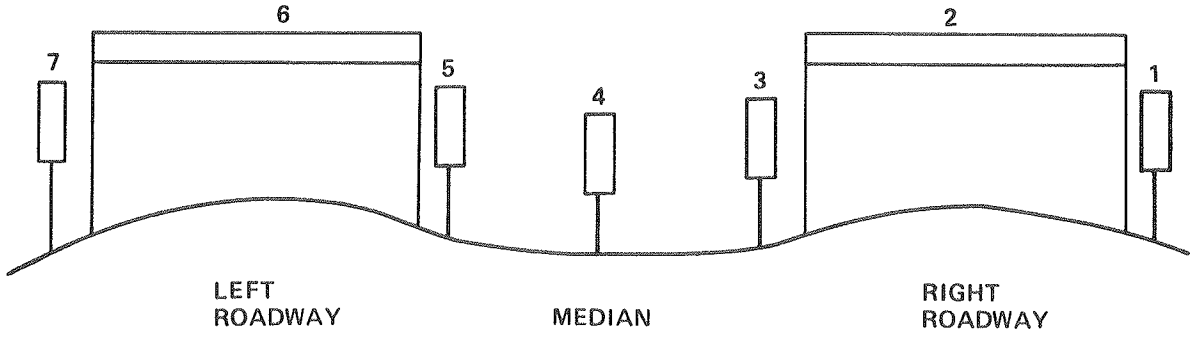
SIGNS—COLUMNS 22 THROUGH 26: The location and the type of all of official traffic signs will be recorded. Temporary signs, such as "Men Working" will not be recorded. It is helpful to indicate the sign legend in the comments section, especially when working in remote areas where signs are not numerous. In urban areas traffic signs will not be recorded.

Including an inventory of signs in the road inventory will normally slow the progress 20 to 30 percent. Therefore, the need for this information should be thoroughly evaluated before deciding whether or not to include this information in the inventory. 129

SIGN TYPE—COLUMNS 22 THROUGH 25: In these columns enter the correct code to indicate the type of sign and its legend. A complete list of codes for signs is included in Appendix K.

A special code (CØ99) is included to provide for recording the location of permanent traffic counter stations.

SIGN LOCATION—COLUMN 26: Indicate the location of the sign with respect to the roadway as follows:



Normally only Codes 1 through 3 would be used on Form INV 1, however, at channelized intersections the remaining codes (4 through 7) may be used on Form INV 1.

STRUCTURE—COLUMNS 27 THROUGH 29: In this field enter the codes to indicate type of structure (or other event). Column 29 is used, on Form INV 2 only, to indicate whether the structure is on the left or the right roadway. Each entry in Columns 27 and 28 requires a corresponding entry on Form INV 3 (for all structures, except types 12, 18, 19, and 23 through 33. Form INV 5 is completed for tunnels (structure type 18). Form INV 6 is completed for ferries (structure type 19). Codes 12 and 23 through 33, are exceptions requiring no corresponding entries on other forms. (Note that at any point where a structure is being recorded and other events are being logged at the same location which requires the use of two or more lines, it is important that the structure be shown on the first line.)

130 *STRUCTURE TYPE—COLUMNS 27 AND 28:* Record the structure type (or other event) according to the following codes. Structures of 7.0 meters or, more in total length are considered to be major structures.

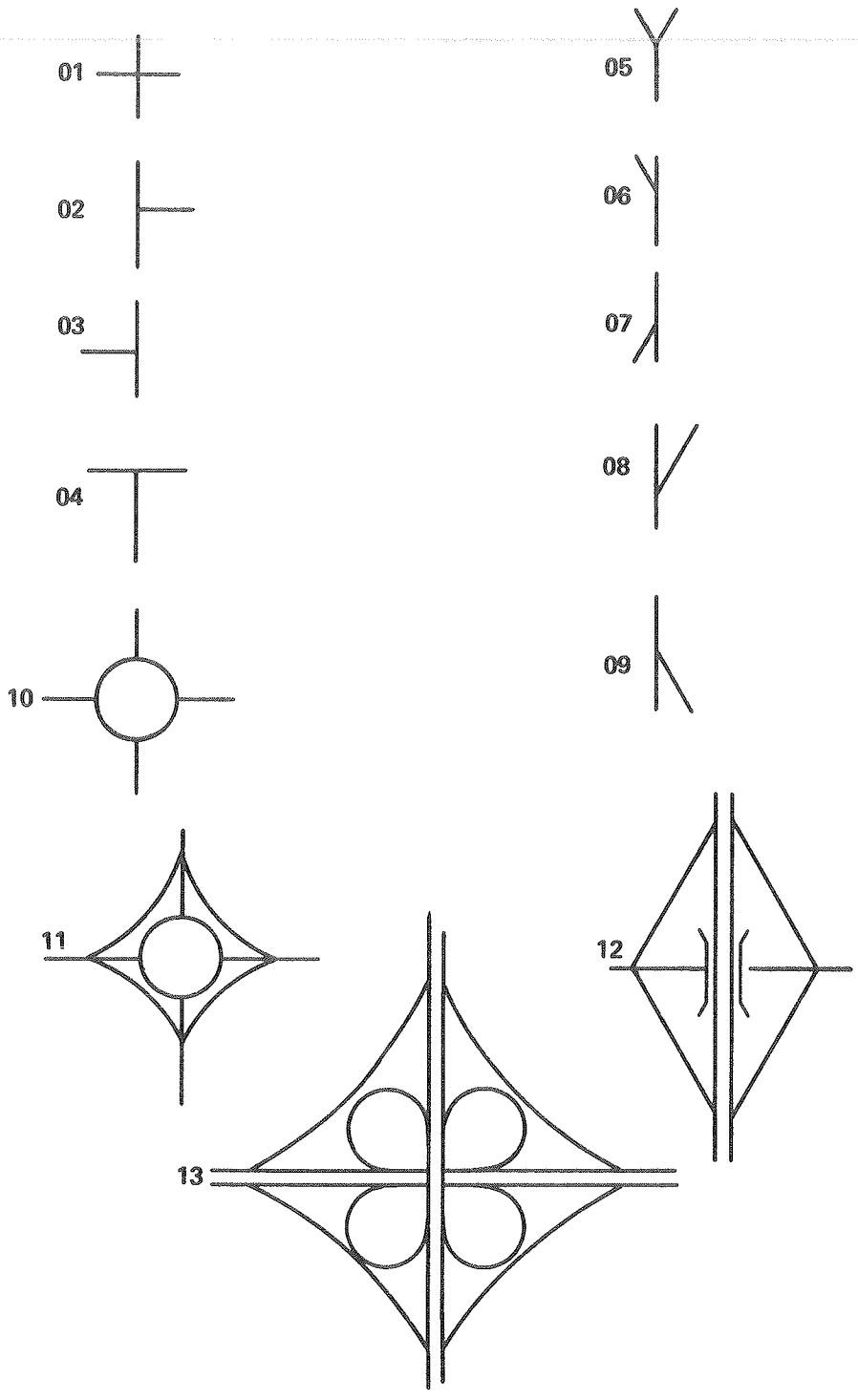
01 Minor structure—road over waterway
02 Major structure—road over waterway
03 Major structure—road over other road
04 Major structure—road over railroad
05 Major structure—road over waterway and other road
06 Major structure—road over waterway and railroad
07 Major structure—road over railroad and other road
08 Major structure—road over waterway, railroad and other road
09 Underpass—road under other road
10 Underpass—road under railroad
11 Underpass—road under railroad and other road
12 Cattleguard
13 Cattleguard—culvert combination
14 High tension electric power line
15 Overhead pipeline
16 Overhead conveyor (ore, grain, sand, etc.)
17 Sign bridge
18 Tunnel
19 Ferry
20 Pedestrian overpass
21 Pedestrian underpass
22 Dip (sudden sag)
23 Approach road culvert—right side
24 Approach road culvert—left side
25 Approach road culvert—both sides
26 Rest area—right side only
27 Rest area—left side
28 Rest area—both sides
29 Rest area—Median
30 Service area—median
31 Median crossover—paved
32 Median crossover—unpaved
33 Toll collection booth
34 Roadway over dam
ØØ Other

(Structure types 23, 24, and 25 will not be recorded for urban areas.)

STRUCTURE LOCATION—COLUMN 29: This column does not appear on Form INV 1.

ROAD INTERSECTIONS—COLUMN 30 THROUGH 37: In this field indicate the intersection type, the route number and jurisdiction of the crossroad and its surface type.

INTERSECTION TYPE - COLUMNS 30 AND 31:



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OO = OTHER
BP = BEGINNING OF A ONE-WAY PAIR CONSTITUTING THE ROUTE BEING INVENTORIED
EP = END OF A ONE-WAY PAIR CONSTITUTING THE ROUTE BEING INVENTORIED

Intersection types 12 and 13 are intended to represent interchanges where the intersecting roads are separated by a bridge. One, or both of the roads would have a center median which prevents left turns. If the Code 00 (for other) is used a sketch showing the intersection form should be included in the comments space. Codes BP and EP will be used when inventorying a one-way pair constituting the route being inventoried. This procedure will be necessary when it is not convenient or possible to inventory the roadways carrying both directions of travel in the direction of the inventory. Therefore, when a code "A" is used under Column 17 (equations), a code of BP must be coded in Columns 30 and 31. Also when Code B is coded in Column 17, a code of EP must be shown in Columns 30 and 31. When inventorying the section of road in the direction opposite to the inventory code A in Column 17 and BP in Columns 30 and 31 will show the beginning of the segment and Code B in Column 17 and BP in Columns 30 and 31 will show the end of the segment.

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CROSSROAD ROUTE NUMBER—COLUMNS 32 THROUGH 35: Enter the route number of the crossroad, if it is available. If the crossroad has no number, or if the number is unknown, leave the field blank.

CROSSROAD JURISDICTION—COLUMN 36:

Example:

1 National
2 Provincial
3 Departmental
4 Municipal
5 Military
6 National Park
7 Port Authority
8 Airport Authority
Ø Other

If the jurisdiction of the crossroad (or road not being inventoried) is unknown, leave a blank.

CROSSROAD SURFACE TYPE—COLUMN 37: Report the surface type of the crossroad.

H Portland cement concrete
A Asphalt—high type
T Asphalt—surface treatment
P Cobblestone
R Gravel
S Soil
Ø Other

HORIZONTAL CURVES—COLUMN 38: Record the occurrence of horizontal curves by use of the following codes in Column 38:

1 Begin curve to the right
2 Begin curve to the left
3 End curve
4 Right angle (90°) turn to the right
5 Right angle (90°) turn to the left
6 Begin winding road
7 End winding road
8 Begin curvilinear alignment
9 End curvilinear alignment

These data will be useful in evaluating the general alignment characteristics of the existing road. If the alignment is of a winding character such as found in mountainous areas the recording of each curve becomes laborious, and at the same time, unnecessary since the knowledge that the road is "winding" is sufficient. The same is true of the newer type of gentle, sweeping roadway alignment classed as curvilinear. On this type of alignment the beginning and end points of each curve are almost impossible to define accurately, and each individual curve becomes unimportant since none are sharp or sudden and the knowledge that the road is curvilinear is sufficient. The alignment classed as curvilinear will normally be encountered on the higher type designs or freeways.

FENCE—COLUMNS 39 THROUGH 44: Record in this field the type of fence and its location. In urban areas data on fences will not be recorded.

FENCE TYPES—COLUMNS 39 AND 40: Record the type of fence separately for the left and right sides of the road.

1 Smooth wire
2 Barbed wire
3 Barbed and smooth wire combination
4 Woven wire
5 Woven and barbed wire combination
6 Wood
7 Stone or masonry
8 Irregular
0 Other
N None

Code 8, for irregular fencing, is to be used when there are frequent small plots of land

with different types of fencing, or some with no fencing, and at variable distances from the road. This situation is common near developed areas. In this initial inventory these data are not of sufficient value to justify the large expenditure of time necessary to measure and classify each change in fence type and location. The primary purpose of these data is to indicate, in the vast open rural areas, whether the roadway is fenced. More detailed data can be collected at a later date if it is found desirable to do so. If there are no fences, use Code N. Under Column 39 record the type of fence for the left side of the road. Use Column 40 to show the type of fence on the right side of the road.

DISTANCE TO THE FENCE—COLUMNS 41 THROUGH 44: Enter the distance to the fence measured from the center of the median (for divided roadways) or the center line of the road. Record the measurement to the nearest whole meter, separately for the right and left fences. All measurements should be at right angles to the center line of the road. Code NN, if there is no fence. Columns 41 and 42 are used to code the distance left of the centerline, and columns 43 and 44 to code the distance right of the centerline.

COLUMNS 45 THROUGH 58: These columns contain data for divided roadways; therefore, they do not appear on Form INV I.

ROADWAY—COLUMNS 59 THROUGH 68: These columns contain the shoulder and pavement data for the roadway when inventorying an undivided road. The surface type classifications are general, and limited in number, because of the difficulty of making precise determinations in the field, regarding surface thickness, placement methods, etc. As the inventory data file is updated in the future, from construction plan data, more descriptive surface type data can be recorded. If a roadway or shoulder contains more than one type of surface, the predominate type should determine the code to be used. Include in the comments a description of the combination surfaces.

On a gravel or earth surfaced roadway where there is no demarcation of the shoulders, the entire width of the roadway usable by traffic should be measured and recorded as being the traveled way. In this case the shoulder type and widths would be coded NNN, "None."

On roadways where shoulders are evident the measured width should include the total usable shoulder width, even though perhaps a part of a shoulder will have a surface treatment and the remainder will be sod, earth, or gravel. In such cases record the total usable shoulder width and the predominate surface type. Explain in the comments the combinations of surface types and the widths of each.

When any entry is made in columns 59 through 68 to record a change in shoulder or traveled way data, it will be necessary to make new observations and fill all columns 59 through 68. In addition, a new entry should be made in column 69.

LEFT SHOULDER—COLUMNS 59 THROUGH 61: Record the type and width of the left shoulder (the shoulder which is on the left-hand side when facing in the direction of the inventory).

SHOULDER TYPE—COLUMN 59:

H Portland cement concrete	P Cobblestone
A Asphalt—high type	R Gravel
T Asphalt—surface treatment	S Soil
	C Sod
	Ø Other
	N No shoulder

SHOULDER WIDTH—COLUMNS 60 AND 61: Record the average width of the shoulder to the nearest one-half meter. Code NN, if there is no shoulder.

TRAVELED WAY—COLUMNS 62 THROUGH 65: Record the surface type and width of the traveled way (the portion of the roadway used for moving traffic exclusive of the shoulders).

TRAVELED WAY SURFACE TYPE—COLUMN 62:

H Portland cement concrete	P Cobblestone
A Asphalt—high type	R Gravel
T Asphalt—surface treatment	S Soil
	Ø Other

TRAVELED WAY WIDTH—COLUMNS 63 THROUGH 65: Record the width of the traveled way to the nearest 0.1 meter.

RIGHT SHOULDER — COLUMNS 66 THROUGH 68: Record the type and width of the right shoulder (the shoulder which is on the right hand side when facing in the direction of the inventory).

SHOULDER TYPE—COLUMN 66:

H Portland cement concrete	P Cobblestone
A Asphalt—high type	R Gravel
T Asphalt—surface treatment	S Soil
	C Sod
	Ø Other
	N No shoulder

SHOULDER WIDTH—COLUMNS 67 AND 68: Record the average width of the shoulder to the nearest one-half meter. Code NN, if there is no shoulder.

NUMBER OF LANES—COLUMN 69: Record the total number of lanes used for moving traffic under normal operating conditions (not congested peak hours). If the traffic lanes are not marked, then estimate the number of lanes normally used by traffic.

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ACCESS CONTROL—COLUMN 70: Record the access characteristics of the roadway. It is the type of access control over a substantial section of the road that is to be inventoried. Individual access points and/or violations, or exceptions to the general type of access control are not to be recorded. Such violations or exceptions should be noted in the comments.

T=Complete Control of Access
P=Partial Control of Access
N=No control of access

(Note that an undivided highway should not have full control of access, therefore, this column does not appear on Form INV 1.)

RAILROAD CROSSING—COLUMN 71: Enter the name of the railroad according to the following codes. In addition, if the crossing is "at grade," then complete Form INV 4; if separated by a structure, then complete Form INV 3.

Example:

1 Gral. Bartolome Mitre
2 Gral. Manuel Belerano
3 Gral. Julio A. Roca
4 Gral. Justo Jose de Urquiza
5 Gral. Jose de San Martin
6 Domingo F. Sarmiento
Ø Other

If "other" is used, specify the name in the comments.

Note that at any point where a railroad crossing at grade is being inventoried and other events are being logged at this same location, which require the use of two or more lines, it is important that the railroad crossing be shown on the first line.

RURAL OR URBAN—COLUMN 72: In this column classify the character of the area through which the road is passing. Refer to Appendix H for additional instructions.

R Rural U Urban

Note that at any point of entry into an urban area and when other events being logged at this same location which require the use of two or more lines, it is important that the urban area code be shown on the first line.

ADMINISTRATIVE BOUNDARY—COLUMN 73: Record the existence of administrative boundaries by use of the following code:

Example:

1 National	7 Port Authorities
2 Provincial	8 Airport Authorities
3 Departmental	9 Partido
4 Municipal	Ø Other
5 Military	
6 National Park	

Always indicate in the comments the name of the administrative boundary being recorded, such as: Rio Negro—Chubut provincial border; Los Alerces National Park boundary; Lujan municipal limits; etc. If "other" is used, explain the type of boundary being recorded.

TOPOGRAPHY—COLUMN 74: Record the general type of terrain through which the road is constructed (and which affects the alignment and grade of the road) as follows:

L Level
O Rolling
M Mountainous

Care should be taken to classify the terrain which affects the design (and cost of construction) of the road. It is possible, for example, to have a road on "level" terrain within a

mountainous area. This could happen if the road were in a flat river valley, or on a bench or shelf, or on a flat mesa or table land, even though the surrounding region were mountainous.

ILLUMINATION—COLUMN 75: Record the existence of roadway illumination. Do not record short intervals of spot illumination "such as bus stops, intersections, or interchanges, etc."

1 Begin illumination
2 End illumination

COMMENTS: Make comments brief, but clear. If additional space is needed, use the reverse side of the form. Remember to identify each comment by odometer reading where necessary.

Do not use other sheets of paper for notes or sketches unless absolutely necessary because of the difficulty of preventing their loss.

C. DIVIDED ROADWAY DATA—FORM INV 2

PARTY CHIEF: Write the full name of the Party Chief on the line in the box.

ASSISTANT: Write the full name of the Assistant Party Chief on the line in the box.

VEHICLE NUMBER: Write the vehicle license plate (or other identification) number on the line in the box.

SHEET __ OF __ SHEETS TODAY: Number consecutively the sheets used each day. Use a separate series of numbers, for each route and for each different type of form (INV 1, INV 2, etc.).

FIELD DATE—COLUMNS 3 AND 4: Write the day and the month on the line and the last two digits of the year in columns 3 and 4.

Example: Field date 21 May|74|

TIME START: Write the time that work is started on that sheet.

Example: Time start 8:00 a.m.

TIME FINISH: Write the time that work is finished on that sheet.

Example: Time finish 2:15 p.m.

SHEET __ OF __ SHEETS FOR THIS ROUTE: This space is for use in the central office. When all sheets have been assembled for an entire route, the sheets will be numbered consecutively.

TYPE OF CARD—COLUMNS 1 AND 2: The code for the card type is preprinted on each form. For the divided roadway data form the card type code is 02.

ROUTE—COLUMNS 5 THROUGH 8: Enter the route number code. Codes should be developed for all routes. An example is shown in Appendix J.

Example: Route 5 is coded 0|0|0|5
Route 40S is coded 0|S|4|0

See instruction for Columns 17 (equations) and Columns 30 & 31 (intersection type) for guidance when inventorying a one-way pair, constituting the route being inventoried. When inventorying in the direction of the inventory, the route designation (Columns 5 through 8) will not change. However, when inventorying the segment of the road carrying the traffic in the direction opposite to the inventory the alternate loop or route number will be coded under Columns 5 through 8.

JURISDICTION—COLUMN 9: Record the administrative jurisdiction of the road being inventoried.

Example:

1 National
2 Provincial
3 Departmental
4 Municipal
5 Military
6 National Park
7 Port Authority
8 Airport Authority
Ø Other

If "other" is used, then indicate the administrative jurisdiction in the comments.

DISTRICT—COLUMNS 10 AND 11: Record the highway department district code.

Example:

01 Bs. As. (north zone)
02 Cordoba
03 Tucuman
04 Mendoza
05 Salta
06 Jujuy
07 Santa Fe
08 La Rioja
09 San Juan
10 Corrientes
11 Catamarca
12 Neuquen
13 Chubut
14 San Luis
15 Misiones
16 Santiago del Estero
17 Entre Rios
18 Chaco
19 Bs. As. (south zone)
20 Rio Negro
21 La Pampa
22 Formosa
23 Santa Cruz
24 Tierra del Fuego

PROVINCE: Write the name of the province in which the inventory is being conducted.

ODOMETER READING—COLUMNS 12 THROUGH 16: Enter the odometer reading to *the nearest 0.01 kilometer.* The odometer reading will be recorded at the beginning and at the end of each route, at each event (structure, intersection, etc.) and at each location where there is a change in a continuous item such as pavement width, shoulder type, etc. An entry in any column from columns number 17 through 75 will require that the odometer reading be recorded in columns 12 through 16 to identify the physical location of the event on the route.

Normally the survey odometer will be set at zero (000.00) at the beginning of the route and at the point where the route crosses a provincial border, but this is not mandatory since all odometer readings will be adjusted in the office to represent progressive reference points.

For structures and tunnels record the odometer reading at the point of beginning of the structure or the entry to the tunnel when proceeding in the direction of the inventory. For intersections record the odometer reading at the point where the center lines (or the theoretical center lines) intersect. At railroad crossings record the odometer reading of the intersection of the roadway and the first railroad track.

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In the heading of this field a space is provided for recording the final odometer reading from the previous sheet. This is intended to aid in keeping the data sheets in proper sequence during the office review and key punching operations.

EQUATIONS—COLUMN 17: Data are recorded in this column to indicate simple equations in odometer readings and also to indicate other critical points encountered during the field inventory.

1 Back	7 Begin construction
2 Ahead	8 End construction
3 Begin gap	9 Begin route
4 End gap	Ø End route
5 Begin superimposition	A Begin one way pair
6 End superimposition	B End one way pair

Codes 1 and 2 are used where it is necessary to introduce a simple equation in the odometer reading series. For example, if the odometer reaches 999.99 and begins again at 000.00, or if the work is temporarily interrupted and then started again at the same point with a different value on the survey odometer.

Codes 3 and 4 are used where there is a gap in a numbered route. The route may be designated on maps, but in actuality, in the field there may be sections that do not as yet exist. In this case Code 3, in Column 17, where the gap is encountered. Code 4, where the road inventory is resumed on the other side of the gap. When such a situation is encountered, the normal odometer reading at the point where the gap begins, is recorded under Columns 12 to 16, and a 3 is coded under Column 17. When the inventory is resumed at the point where the route continues, the odometer should be reset to zero and so recorded under Columns 12 to 16. The Code 4 is then entered under Column 17. The estimated length of the gap should also be noted under comments.

Codes 5 and 6 are used where there is a superimposition of two or more route numbers on one road. A decision must be made as to which numbered route takes precedence, that is which is the most important. (The route having the higher functional classification is normally considered the "more important route." If the routes have the same functional classification, the route having the higher average traffic volume may be considered the more important.)

When this more important route is being inventoried, there are no special codes to indicate the existence of the superimposition. All physical data on the superimposed section are recorded as usual when inventorying the more important route. When inventorying the less important route involved in a superimposition, the beginning of the superimposition is indicated by coding a 5 in Column 17. The taking of inventory data is then suspended until the end of the superimposition is reached where code 6 is entered in Column 17, and the inventory is resumed. The superimposed section is considered to be a gap in the less important route for statistical data analysis purposes.

Codes 7 and 8 are used where there is road construction in progress which prevents the taking of road inventory data. Code 7 is entered in Column 17 at the point where a construction project forces suspension of the inventory. Code 8 in Column 17 indicates the end of the construction project and the resumption of the normal inventory.

Code 9 in Column 17 indicates the point of beginning of a numbered route and Code 0 indicates the end.

Code A indicates the beginning of a one-way pair constituting the route being inventoried. Code B indicates the end of a one-way pair. The section of road between Codes A and B carries one-way traffic. The segment of road carrying traffic in the direction opposite to the inventory will be assigned a route number, similar to a loop or an alternate of the basic route, and inventoried as a separate route in the direction of the traffic flow. Code A at the beginning of the segment and Code B at the end will indicate that it carries one-way traffic.

All entries in Column 17 must have corresponding odometer readings entered in Columns 12 through 16. Each odometer reading (with the exception of the 999.99 to 000.00 equation) must be referenced to an identifiable physical feature on the roadway; such as an intersection, structure, kilometer post, sign, construction survey stake, etc. (See Appendix M for special instructions for coding equations.)

KILOMETER POST — COLUMNS 18 THROUGH 21: Enter the number from each kilometer or reference post as it is encountered in either rural or urban areas. When a kilometer reference post is coded in Columns 18 through 21 and there is more than one line of coded information with the same odometer reading, the kilometer or reference post must be coded on the first line.

SIGNS—COLUMNS 22 THROUGH 26: The location and the type of all official traffic signs may be recorded. Temporary signs, such as "Men Working" will not be recorded. It is helpful to indicate the sign legend in the comments section, especially when working in remote areas where signs are not numerous. The decision as to whether signs should be inventoried or not will depend upon each country and the use it intends to make of this information. Sign data should not be collected unless a definite use for the information is planned. Sign data should not be collected in urban areas.

SIGN TYPE—COLUMNS 22 THROUGH 25: In these columns enter the correct code to indicate the type of sign and its legend. An example list of codes for signs is included in Appendix K. A special code (C099) should be used to provide for recording the location of permanent traffic counter stations.

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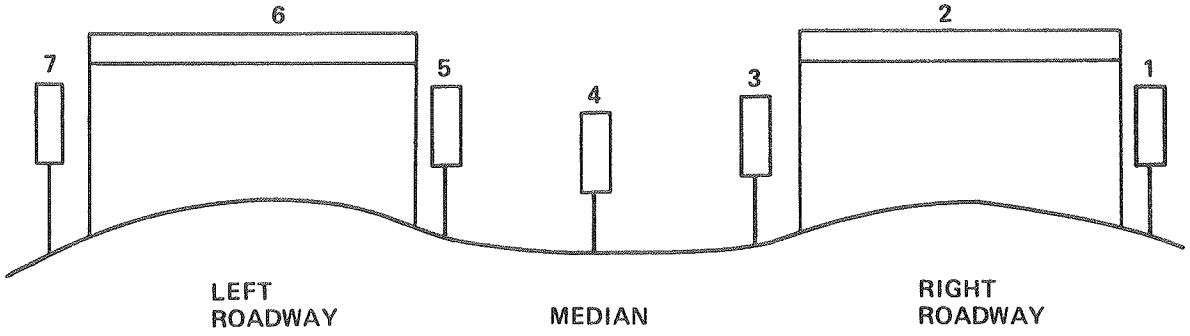
SIGN LOCATION—COLUMN 26: Indicate the location of the sign with respect to the roadway as follows:



STRUCTURE—COLUMNS 27 THROUGH 29: In this field enter the codes to indicate type of structure (or other event). Column 29 is used, on Form INV 2, to indicate whether the structure is on the left or the right roadway. Note that at any point where a structure is being recorded and other events are being logged at the same location, which require the

use of two or more lines with the same odometer reading, it is important that the structure be shown on the first line.

Each entry in Columns 27 and 28 requires a corresponding entry on Form INV 3 (for all structures, except types 12, 18, 19, and 23 through 33) or Form INV 5 for tunnels, or Form INV 6 for ferries.

Codes 12 and 23 through 33 are exceptions requiring no corresponding entries on other forms.

STRUCTURE TYPE—COLUMNS 27 AND 28: Record the structure type (or other event) according to the following codes. Structures of 7.0 meters or more in total length are considered to be major structures.

01 Minor structure—road over waterway
02 Major structure—road over waterway
03 Major structure—road over other road
04 Major structure—road over railroad
05 Major structure—road over waterway and other road
06 Major structure—road over waterway and railroad
07 Major structure—road over railroad and other road
08 Major structure—road over waterway, railroad, and other road
09 Underpass—road under other road
10 Underpass—road under railroad
11 Underpass—road under railroad and other road
12 Cattleguard
13 Cattleguard—culvert combination
14 High tension electric power line
15 Overhead pipeline
16 Overhead conveyor (ore, grain, sand, etc.)
17 Sign bridge
18 Tunnel
19 Ferry
20 Pedestrian overpass
21 Pedestrian underpass
22 Dip (sudden sag)
23 Approach road culvert—right side
24 Approach road culvert—left side
25 Approach road culvert—both sides
26 Rest area—right side only
27 Rest area—left side
28 Rest area—both sides
29 Rest area—median
30 Service area—median
31 Median crossover—paved
32 Median crossover—unpaved
33 Toll collection booth
34 Roadway over dam
ØØ Other

Structure types 23, 24, and 25 will not be recorded in urban areas.

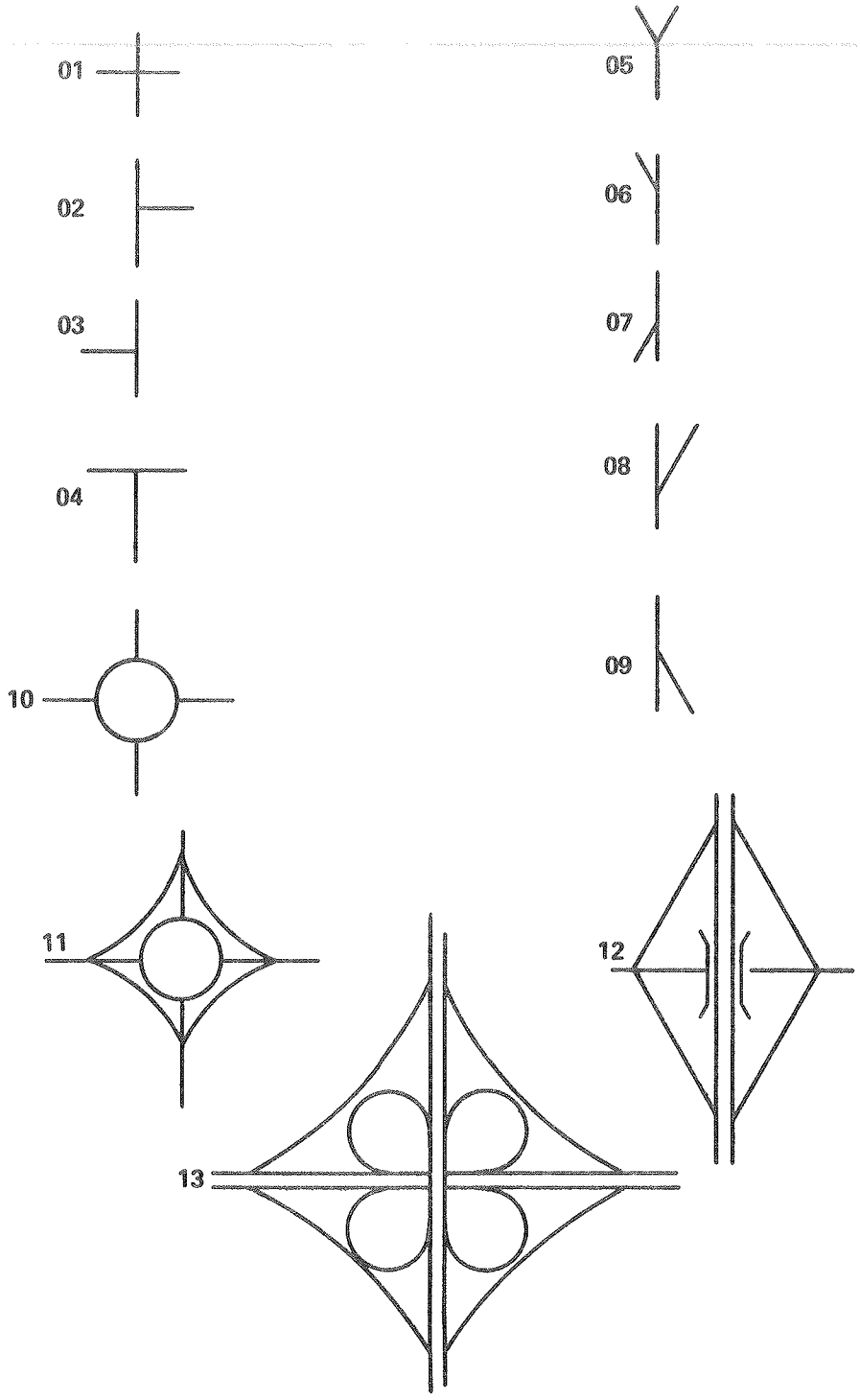
STRUCTURE LOCATION—COLUMN 29: The data in this item will indicate if the structure pertains to the roadway carrying traffic in the direction of the inventory, or to the opposing roadway, or to both. The codes will differentiate between structures carrying or spanning one roadway and those carrying or spanning both roadways.

A structure pertains to forward roadway
Ø structure pertains to opposite roadway
B structure pertains to both roadways

If there are twin structures (one on the forward roadway and one on the opposing roadway) at the same odometer reading it will be necessary to use two lines on Form INV 2 repeating the same odometer reading on each coding one structure as "A" in Column 29 and the other as "0" in Column 29.

ROAD INTERSECTIONS—COLUMNS 30 THROUGH 37: In this field indicate the intersection type, the route number of the crossroad and its surface type.

INTERSECTION TYPE - COLUMNS 30 AND 31:



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OO = OTHER
BP = BEGINNING OF A ONE-WAY PAIR CONSTITUTING THE ROUTE BEING INVENTORIED
EP = END OF A ONE-WAY PAIR CONSTITUTING THE ROUTE BEING INVENTORIED

Intersection types 12 and 13 are intended to represent interchanges where the intersecting roads are separated by a bridge. One, or both, of the roads would have a center median which prevents left turns. If the code 00 (for other) is used a sketch showing the intersection form should be included in the comments space. Codes BP and EP will be used when inventorying divided highways or freeways, where it is not convenient or practical to inventory, both roadways in the direction of inventory. Therefore, when a code "A" is used under Column 17 (equations), a code of BP must be coded in Columns 30 and 31. Also, when code B is coded in Column 17, a code of EP must be shown in Columns 30 and 31. When inventorying the section of road in the direction opposite to the inventory, code A in Column 17 and BP in Columns 30 and 31. This will show the beginning of the segment. Code B in Column 17 and EP in Columns 30 and 31 will show the end of the segment.

CROSSROAD ROUTE NUMBER—COLUMNS 32 THROUGH 35: Enter the route
140 number of the crossroad, if it is available. If the crossroad has no number or if the number is unknown, leave the field blank.

CROSSROAD JURISDICTION — COLUMN 36:

Example:

1 National	6 National Park
2 Provincial	7 Port Authority
3 Departmental	8 Airport Authority
4 Municipal	Ø Other
5 Military	

If the jurisdiction of the crossroad (road not being inventoried) is unknown, leave a blank.

CROSSROAD SURFACE TYPE—COLUMN 37: Record the surface type of the crossroad.

H Portland cement concrete	P Cobblestone
A Asphalt—high type	R Gravel
T Asphalt—surface treatment	S Soil
	Ø Other

HORIZONTAL CURVES—COLUMN 38: Record the occurrence of horizontal curves by use of one of the following codes in Column 38:

1 Begin curve to the right
2 Begin curve to the left
3 End curve
4 Right angle (90°) turn to the right
5 Right angle (90°) turn to the left
6 Begin winding road
7 End winding road
8 Begin curvilinear alignment
9 End curvilinear alignment

These data will be useful in evaluating the general alignment characteristics of the existing road. If the alignment is of a winding characteristic, such as found in mountainous areas the recording of each curve becomes laborious, and at the same time, unnecessary since the knowledge that the road is "winding" is sufficient. The same is true of the newer type of gentle, sweeping roadway alignment classed as "curvilinear." On this type of alignment the beginning and end points of each curve are almost impossible to define accurately, and each individual curve becomes unimportant since none are sharp or sudden and the knowledge that the road is curvilinear is sufficient. The alignment classed as curvilinear will normally be encountered on the higher type designs or freeways.

FENCE—COLUMNS 39 THROUGH 44: Record in this field the type of fence and its location. Data on fences will not be collected in urban areas.

FENCE TYPE—COLUMNS 39 AND 40: Record the type of fence separately for the left and right sides of the road.

1 Smooth wire
2 Barbed wire
3 Barbed and smooth wire combination
4 Woven wire
5 Woven and barbed wire combination
6 Wood
7 Stone or masonry
8 Irregular
Ø Other
N None

Code 8, for irregular fencing, is to be used when there are frequent small plots of land with different types of fencing, or some with no fencing, and at variable distances from the

road. This situation is common near developed areas. In this initial inventory these data are not of sufficient value to justify the large expenditure of time necessary to measure and classify each change in fence type and location. The primary purpose of these data is to indicate, in the vast open rural areas, whether the roadway is fenced. More detailed data can be collected at a later date, if it is found desirable to do so. If there are no fences use code N. Under Column 39 record the type of fence for the left side of the road. Use Column 40 to show the type of fence for the right side of the road.

DISTANCE TO THE FENCE—COLUMNS 41 THROUGH 44: Enter the distance to the fence measured from the center of the median (on divided roadways) or the centerline of the road. Record the measurement to the nearest whole meter, separately for the right and left fences. All measurements should be at right angles to the center line of the road. Code NN if there is no fence. Columns 41 and 42 are used to code the distances left of the median and Columns 43 and 44 to code the distance right of the median.

LEFT ROADWAY—COLUMNS 45 THROUGH 54: These columns contain the data for the left roadway (which is carrying traffic in the direction opposite to the direction of the inventory). The surface type classifications are general and are limited in number because of the difficulty of making precise determinations in the field regarding surface thickness, placement methods, etc. As the inventory data file is updated in the future, from construction plan data, more descriptive surface type data may be recorded. If a roadway contains more than one type of surface, the predominate type should dictate the code to be used. Include in the comments a description of the combination surface.

On a gravel or earth surfaced roadway where there is no demarcation of the shoulders the entire width of the roadway usable by traffic should be measured and recorded as being the traveled way. In this case the shoulder type and widths would be coded NNN, "None."

On roadways where shoulders are evident the measured width should include the total usable shoulder width, even though perhaps a part of a shoulder will have a surface treatment and the remainder will be sod, earth, or gravel. In such cases record the total usable shoulder width and its predominate surface type. Explain in the comments the combinations of surface types and the widths of each.

When any entry is made in Columns 45 through 68 to record a change in shoulder, traveled way, or median data, it will be necessary to make new observations and fill all Columns 45 through 68. In addition, a new entry should be made in Column 69.

OUTSIDE SHOULDER—COLUMNS 45 THROUGH 47: Record the type and width of the outside shoulder.

SHOULDER TYPE—COLUMN 45:

H Portland cement concrete	P Cobblestone
A Asphalt—high type	R Gravel
T Asphalt—surface treatment	S Soil
	C Sod
	Ø Other
	N No shoulder

SHOULDER WIDTH COLUMNS 46 AND 47: Record the average width of the shoulder to the nearest 0.5 meter. Code "NN," if there is no shoulder.

TRAVELED WAY—COLUMNS 48 THROUGH 51: Record the surface type and width of the traveled way (the portion of the roadway used for moving traffic exclusive of the shoulders).

TRAVELED WAY SURFACE TYPE—COLUMN 48:

H Portland cement concrete	surface treatment
A Asphalt—high type	P Cobblestone
T Asphalt—	R Gravel
	S Soil
	Ø Other

TRAVELED WAY WIDTH—COLUMNS 49 THROUGH 51: Record the width of the traveled way to the nearest 0.1 meter.

MEDIAN SHOULDER—COLUMNS 52 THROUGH 54: Record the type and width of the median shoulder.

SHOULDER TYPE—COLUMN 52:

H Portland cement concrete	P Cobblestone
A Asphalt—high type	R Gravel
T Asphalt—surface treatment	S Soil
	C Sod
	Ø Other
	N No shoulder

SHOULDER WIDTH—COLUMNS 53 AND 54: Record the average width of the shoulder to the nearest ½ meter. Code "N" if there is no shoulder.

MEDIAN—COLUMNS 55 THROUGH 58: Record the type and width of the median. Ignore short sections of median divider, or channelization, at intersections on roads which are basically undivided roads. Form INV 2 is not to be used for recording channelized intersection data.

MEDIAN TYPE—COLUMN 55:

1 Depressed—sod or earth	4 Flush—paved
2 Depressed—paved	5 Raised—sod or earth
3 Flush—sod or earth	6 Raised—paved
	Ø Other

MEDIAN WIDTH—COLUMNS 56 THROUGH 58: Record the width of the median to the nearest 0.1 meter. The median width is measured from the edge of the traveled way and includes the width of the shoulder (if there is a shoulder). If the median width is variable (not constant), then code: 999 Variable median width.

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RIGHT ROADWAY—COLUMNS 59 THROUGH 68: These columns contain the data for the right roadway (which is carrying traffic in the direction of the inventory).

MEDIAN SHOULDER—COLUMNS 59 THROUGH 61: Record the type and width of the median shoulder.

SHOULDER TYPE—COLUMN 59:

H Portland cement concrete	P Cobblestone
	R Gravel
A Asphalt—high type	S Soil
	C Sod
T Asphalt—surface treatment	Ø Other
	N No shoulder

SHOULDER WIDTH—COLUMNS 60 AND 61: Record the average width of the shoulder to the nearest ½ meter. Code "NN" if there is no shoulder.

TRAVELED WAY—COLUMNS 62 THROUGH 65: Record the surface type and width of the traveled way (the portion of the roadway used for moving traffic exclusive of the shoulders).

SURFACE TYPE—COLUMN 62:

H Portland cement concrete	P Cobblestone
	R Gravel
A Asphalt—high type	S Soil
	Ø Other
T Asphalt—surface treatment	

TRAVELED WAY WIDTH—COLUMNS 63 THROUGH 65: Record the width of the traveled way to the nearest 0.1 meter.

OUTSIDE SHOULDER—COLUMN 66 THROUGH 68: Record the type and width of the outside shoulder.

SHOULDER TYPE—COLUMN 66:

H Portland cement concrete	P Cobblestone
	R Gravel
A Asphalt—high type	S Soil
	C Sod
T Asphalt—surface treatment	Ø Other
	N No shoulder

SHOULDER WIDTH—COLUMNS 67 AND 68: Record the average width of the shoulder to the nearest ½ meter, Code "NN" if there is no shoulder.

NUMBER OF LANES—COLUMN 69: When inventorying a divided roadway enter in this column the total number of lanes carrying traffic on both roadways. Record the number of lanes used for moving traffic under normal operating conditions (not congested peak hours). If the traffic lanes are not marked, then estimate the number of lanes normally used by traffic.

ACCESS CONTROL—COLUMN 70: Record the access control characteristics of the roadway. It is the type of access control over a substantial section of road that is to be recorded. Individual access points and/or violations or exceptions to the general type of access control are not to be recorded. Such violations or exceptions should be noted in the comments.

T Complete control of access
P Partial control of access
N No control of access

RAILROAD CROSSING—COLUMN 71: Enter the name of the railroad according to

the following codes. In addition, if the crossing is "at grade" then complete Form INV 4; if separated by a structure, then complete Form INV 3.

Example:

1 Gral. Bartolome Mitre
2 Gral. Manuel Belgrano
3 Gral. Julio A. Roca
4 Gral. Justo Jose de Urquiza
5 Gral. Jose de San Martin
6 Domingo F. Sarmiento
Ø Other

If "other" is coded, specify the name of the railroad in the comments, if known.

Note that at any point where a railroad crossing at grade is being recorded and other events are being logged at this same location, which require the use of two or more lines, it is important that the railroad crossing be shown on the first line.

RURAL OR URBAN—COLUMN 72: In this column classify the character of the area through which the road is passing. Refer to Appendix H for additional instructions.

R Rural
U Urban

Note that at any point of entry into an urban area and when other events being logged at this same location which require the use of two or more lines, it is important that the urban area code be shown on the first line.

ADMINISTRATIVE BOUNDARY—COLUMN 73: Record the existence of administrative boundaries by use of the following code:

Example:

1 National
2 Provincial
3 Departmental
4 Municipal
5 Military
6 National Parks
7 Port Authorities
8 Airport Authorities
9 Partido
Ø Other

Always indicate in the comments the name of the administrative boundary being recorded, such as: Rio Negro-Chubut provincial border, Los Alerces National Park boundary, Lujan municipal limits, etc. If "other" is used, explain the type of boundary being recorded.

TOPOGRAPHY—COLUMN 74: Record the general type of terrain through which the road is constructed (and which affects the alignment and grade of the road) as follows:

L Level
Ø Rolling
M Mountainous

Care should be taken to classify the terrain which affects the design (and cost of construction) of the road. It is possible, for example, to have a road on "level" terrain within a mountainous area. This could happen if the road were in a flat river valley, or on a bench or shelf, or on a flat mesa or table land, even though the surrounding region were mountainous.

ILLUMINATION—COLUMN 75: Record the existence of roadway illumination. Do not record short intervals of "spot illumination" such as bus stops, intersections, or interchanges.

1 Begin illumination
2 End illumination

COMMENTS: Make comments brief, but clear. If additional space is needed, use the reverse side of the form. Remember to identify each comment by odometer reading where necessary. Do not use other sheets of paper for notes or sketches unless absolutely necessary because of the difficulty of preventing their loss. Include information regarding toll rates, provision of walkways or bicycle paths, bus stop turnouts, emergency telephones, etc.

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D. STRUCTURE DATA (Form INV 3)

Reference should be made to the "Computer Program Users Manual" before beginning to inventory structures and completing Form INV 3. This manual shows the columns of this form that "must be coded," "may optionally be coded," and "must be left blank" for the different conditions.

PARTY CHIEF: Write the full name of the Party Chief on the line in the box.

ASSISTANT: Write the full name of the Assistant Party Chief on the line in the box.

VEHICLE NUMBER: Write the vehicle license plate (or other identification) number on the line in the box.

SHEET __ OF __ SHEETS TODAY: Number consecutively the sheets used each day. Use a separate series of numbers, for each route and for each different type of form (INV 1, INV 2, etc.).

FIELD DATE—COLUMNS 3 AND 4: Write the day and the month on the line and the last two digits of the year in Columns 3 and 4.

Example: Field Date 21 May|7|5

TIME START: Write the time that work is started on that sheet.

Example: Time Start 8:00 a.m.

TIME FINISH: Write the time that work is finished on that sheet.

Example: Time Finish 2:15 p.m.

144 SHEET __ OF __ SHEETS FOR THIS ROUTE: This space will be completed in the central office. When all sheets have been assembled for an entire route, the sheets will be numbered consecutively.

TYPE OF CARD—COLUMNS 1 AND 2: The code for the card type is preprinted on each form. For the structure data form the card type code is 03.

ROUTE—COLUMNS 5 THROUGH 8: Enter the route number code. This code should agree with the route entry made on Form INV 1 or 2, when the structure was being entered on one of these forms.

JURISDICTION—COLUMN 9: Record the administrative jurisdiction of the road being inventoried.

Example:

1 National
2 Provincial
3 Departmental
4 Municipal
5 Military
6 National Park
7 Port Authority
8 Airport Authority
Ø Other

If "other" is used, then indicate the administrative jurisdiction in the comments.

DISTRICT—COLUMNS 10 AND 11: Record the highway department district code.

Example:

01 Bs. As. (north zone)
02 Cordoba
03 Tucuman
04 Mendoza
05 Salta
06 Jujuy
07 Santa Fe
08 La Rioja
09 San Juan
10 Corrientes
11 Catamarca
12 Neuquen
13 Chubut
14 San Luis
15 Misiones
16 Santiago del Estero
17 Entre Rios
18 Chaco
19 Bs. As. (south zone)
20 Rio Negro
21 La Pampa
22 Formosa
23 Santa Cruz
24 Tierra del Fuego

ODOMETER READING—COLUMNS 12 THROUGH 16: Record the odometer reading at the point of beginning of the structure. On bridges the point of beginning is assumed to be the expansion joint at the beginning of the deck floor, or the beginning of the first span, if there is no deck expansion joint. If it is necessary to use more than one line on the form to record the data for one structure, the same odometer reading should be repeated on each line.

Each entry in Columns 12 through 19 on Form INV 3 must have a corresponding entry on Form INV 1 (Columns 12 through 16, and Columns 27 and 28) or on Form INV 2 (Columns 12 through 16 and Columns 27 through 29).

STRUCTURE—COLUMNS 17 THROUGH 19: In this field enter the codes to indicate the location and type of structure (or other event).

STRUCTURE TYPE—COLUMNS 17 AND 18: Record the structure type (or other event) according to the following codes. Structures of 7.0 meters or more in total length are considered to be major structures.

01 Minor structure—road over waterway
02 Major structure—road over waterway
03 Major structure—road over other road
04 Major structure—road over railroad
05 Major structure—road over waterway and other road

06 Major structure—road over waterway and railroad
07 Major structure—road over railroad and other road
08 Major structure—road over waterway, railroad, and other road
09 Underpass—road under other road
10 Underpass—road under railroad
11 Underpass—road under railroad and other road
13 Cattleguard—culvert combination
14 High tension electric power line
15 Overhead pipeline
16 Overhead conveyor (ore, grain, sand, etc.)
17 Sign bridge
20 Pedestrian overpass
21 Pedestrian underpass
22 Dip (sudden sag)
34 Roadway over dam
ØØ Other

Form INV 3 not used for structure type codes 12, 18, 19 and 23 through 33. All structures that are recorded on Form INV 3 will require including codes for at least Columns 1 through 19.

STRUCTURE LOCATION—COLUMN 19: When inventorying structures on undivided roadways put code "A" in Column 19. When inventorying structures on divided roadways the code in this column will indicate if the data pertain to the roadway carrying traffic in the direction of the inventory or to the opposing roadway. It will also indicate if there are separate structures spanning or carrying each roadway or if one structure spans or carries both roadways. Separate structures are identified by Codes A and Ø while the data from one structure carrying or spanning both roadways are identified by Codes B and C.

A Structure pertains to forward roadway
Ø Structure pertains to opposite roadway
B Single Structure—data pertains to forward roadway
C Single Structure—data pertains to opposite roadway

Sometimes it may be necessary to use additional lines on Form INV 3 for a structure because of multiple spans of different lengths. If there are separate structures pertaining to the opposing roadways then identify each line of data by Code A or Ø, as appropriate. If a single structure spans, or carries both roadways, then list the number of spans, and their lengths, on one or more lines using Code B in Column 19 on each line. The line containing Code C in Column 19 with data pertaining to the opposing roadway, should not contain data in Columns 38 through 43, referring to spans.

NAME OF THE CROSSING—COLUMNS 20 THROUGH 34: Enter the name that will help to identify the structure, such as: Rio Lujan, Gral. Roca RR., Jct. Nat. Rt. 7, etc. Use abbreviations as much as possible. Leave a blank space between each word. Write in capital letters. If there is no name, leave the data field blank. If the structure is a culvert, which serves minor cross drainage and less than seven meters in length, enter the name "Culvert."

MATERIAL—COLUMNS 35 THROUGH 37: The material of the structure is recorded separately for the substructure, superstructure, and the road surface. If there is more than one type of material, use the code for the predominant type. Use Ø, or other, no more than necessary. If Ø is used, then specify in the comments the type of material.

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SUBSTRUCTURE—COLUMN 35: The substructure includes abutments, piers, foundations, retaining walls, wing walls, etc. On pipe or box culverts, the material surrounding the ends of the culvert barrel is defined as substructure. Use one of the following codes:

H Concrete
F Steel
M Wood
P Stone or masonry
L Brick
S Earth
Ø Other

SUPERSTRUCTURE—COLUMN 36: The superstructure includes girders, beams, trusses, etc. On pipe or box culverts the culvert barrel is defined as superstructure. Use one of the following codes:

H Concrete
F Steel
M Wood
P Stone or masonry
L Brick
Ø Other

ROAD SURFACE—COLUMN 37: The road surface is the deck floor or other surface which carries the traffic. On underpasses (structure types 09, 10, and 11), report the surface type of the road being inventoried, not the one being carried overhead by the structure. Use one of the following codes:

H Concrete	M Wood
A Asphalt	L Brick
P Cobblestone	Y Steel Plate
R Gravel	E Steel Grate
S Earth	Ø Other

SPANS—COLUMNS 38 THROUGH 43: Record the number and length of spans. When a multiple span structure has spans of different lengths use as many lines as necessary on Form INV 3 to record the span data. Repeat the same odometer reading and structure type with the appropriate structure location code on each additional line used but leave the other columns (20–37 and 44–75) blank.

NUMBER—COLUMNS 38 AND 39: Record on one line the number of spans that are of equal length. Use additional lines as necessary for spans of different lengths or culverts of different sizes.

SIZE—COLUMNS 40 THROUGH 43: Record the length of span or width of box from abutment face to center of pier. For round culverts record the barrel diameter. Measure, in general, to the nearest 0.1 meter but disregard minor variations in span measurements when grouping spans for recording on Form INV 3. Record an approximate length to represent the size of the grouped spans. For example:

(bridge at odometer reading 481.25)

Span number	*Measured length*
1	20.1 m
2	19.8 m
3	20.0 m
4	20.2 m
5	22.0 m

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Odometer Reading					Structure			Name of Crossing																Material			Spans					
					Type	Location																		Substructure	Superstructure	Road Surface	Number		Size			
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
4	8	1	2	5	0	2	A	R	I	O		N	E	G	R	O							H	H	A	0	4	0	2	0	0
4	8	1	2	5	0	2	A																			0	1	0	2	2	0

HEIGHT ABOVE WATER—COLUMN 44: Measure the distance from the stream or other surface such as road, track, etc., to the bottom of the structure. Do this for structure types 02 through 08 only. Record to the nearest meter. If the distance is more than nine meters, then Code "U" for unlimited, but be sure to indicate the actual height, or estimate thereof, in the comments.

U Unlimited

BRIDGE RAIL—COLUMNS 45 THROUGH 47: Record the predominant construction material and the height of the bridge rail. When inventorying underpasses, ignore bridge rail on the overhead structure, but record any bridge rail on the road being inventoried.

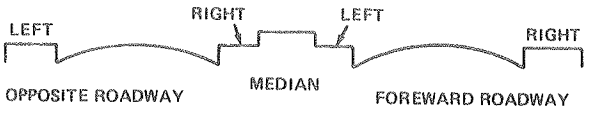
HEIGHT—COLUMNS 45 AND 46: Measure the height of the bridge rail to the nearest 0.1 meter. Measure from the roadway surface to the top of the posts, if they extend above the

rail. It is not necessary to measure curb height. Likewise a bridge rail with a height of less than 30 cm above the roadway surface may be ignored. Use Code "NN" to indicate there is no bridge rail.

MATERIAL—COLUMN 47:

H Concrete	P Stone
F Steel	L Brick
M Wood	Ø Other

SIDEWALKS—COLUMNS 48 THROUGH 51: Record the existence of sidewalks by entering in these columns the widths of the sidewalks separately for the left and right sides of the roadway. The widths should be recorded to the nearest 0.1 meter. Sometimes a structure will have a curb with a wide flat top which looks much like a sidewalk. Such curbs should not be recorded as sidewalks unless the flat top usable by pedestrians is more than 0.7 meters in width. When recording sidewalk on structures on divided roadways, use the following convention to define "left" and "right."



If there is no sidewalk, then code:
NN No sidewalk

NOTE: The left and right are determined facing the direction of the inventory.

CLASS OF STRUCTURE—COLUMNS 52 AND 53: Record in these columns the class of the structure using the following general classifications. A structure not fitting into one of these classifications should be coded "other" and explained in the comments. See Appendix L for diagrams of typical structure classifications.

10 Beam or girder
20 Slab
30 Arch
40 Truss
50 Frame
60 Suspension
81 Box Culvert
82 Pipe Culvert
83 Elliptical pipe culvert
84 Arched box culvert
85 Box culvert with deck slab road surface
ØØ Other

DECK—COLUMNS 54 AND 55: Record in these columns the description of the deck as to whether it is fixed or movable (to allow ships to pass through). If it is movable, then indicate the type of protection to prevent vehicles from driving into an open bridge.

FIXED OR MOVABLE—COLUMN 54:

F Fixed	M Movable

PROTECTION—COLUMN 55: Indicate the type of protection by the following codes. Describe the protection in the comments.

1 No protection	Ø Other
2 Watchman	

TOTAL LENGTH—COLUMNS 56 THROUGH 60: Record the total length of the structure to the nearest 0.1 meter. The total length of a bridge is the distance between the faces of the abutments. It is equal to the sum of the span lengths. Total length is recorded only for structure types 02 through 08 (Columns 17 and 18), and for type 22, sudden sag. For sudden sags measure the length of the sagged section that is paved or, if unpaved, the sagged section.

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TRAVELED WAY WIDTH—COLUMNS 61 THROUGH 63: Record the traveled way width between curbs, sidewalks, or bridge rails on bridge decks, underpasses, and sudden sags (structure types 02 through 11 and type 22). Record the width to the nearest 0.1 meter. If it is a minor structure (type 01) with headwalls, the width between headwalls should be recorded. If there are no headwalls and the width of the traveled way and shoulders are not restricted by the structure record "UUU" to indicate no change in the traveled way width.

HORIZONTAL CLEARANCE—COLUMNS 64 THROUGH 66: Record the distance between bridge rail or other barriers at the point of minimum clearance. Record to the nearest 0.1 meter. Disregard barriers or obstacles of 30 cm or less in height. If there is a barrier

on one side only or no barrier on either side record:

UUU Unlimited horizontal clearance

VERTICAL CLEARANCE—COLUMNS 67 AND 68: Record the vertical clearance over the roadway being inventoried. Record to the nearest 0.1 meter. If the clearance is greater than six meters, record:

UU Unlimited vertical clearance

POSTED LOAD LIMIT—COLUMNS 69 THROUGH 71: Record the maximum safe load limit, if it is posted on the bridge. Record the load limit to the nearest whole ton.

NUMBER OF TRACKS CROSSED—COLUMNS 72 and 73: Record the number of tracks crossed if a railroad passes either under or over the highway being inventoried.

ILLUMINATION—COLUMN 74: Record the existence of illumination of the structure by:

S Yes
N No

148 TOLL OR FREE—COLUMN 75: Indicate whether the bridge is free or toll by:

L Free
C Toll

E. FORM INV 4—RAILROAD CROSSING

PARTY CHIEF: Write the full name of the Party Chief on the line in the box.

ASSISTANT: Write the full name of the Assistant Party Chief on the line in the box.

VEHICLE NUMBER: Write the vehicle license plate (or other identification) number on the line in the box.

SHEET __ OF __ SHEETS TODAY: Number consecutively the sheets used each day. Use a separate series of numbers, for each route and for each different type of Form (INV 1, INV 2, etc.).

FIELD DATE—COLUMNS 3 AND 4: Write the day and the month on the line and the last two digits of the year in Columns 3 and 4.

Example: Field Date 21 May|7|5|

TIME START: Write the time that work is started on that sheet.

Example: Time Start 8:00 a.m.

TIME FINISH: Write the time that work is finished on that sheet.

Example: Time Finish 2:15 p.m.

SHEET __ OF __ SHEETS FOR THIS ROUTE: This space is for use in the central office. When all sheets have been assembled for an entire route, the sheets will be numbered consecutively.

TYPE OF CARD—COLUMNS 1 AND 2: The code for the card type is preprinted on each form. For the railroad crossing data from the card type is 04.

ROUTE—COLUMNS 5 THROUGH 8: Enter the route number code. The code should agree with the route entry made on Form INV 1 or 2, for this railroad crossing.

JURISDICTION—COLUMN 9: Record the administrative jurisdiction of the road being inventoried.

Example:

1 National
2 Provincial
3 Departmental
4 Municipal
5 Military
6 National Park
7 Port Authority
8 Airport Authority
Ø Other

If "other" is used, then indicate the administrative jurisdiction in the comments.

DISTRICT—COLUMNS 10 AND 11: Record the highway department district code.

Example:

01 Bs. As. (north zone)
02 Cordoba
03 Tucuman
04 Mendoza
05 Salta
06 Jujuy
07 Santa Fe
08 La Rioja
09 San Juan
10 Corrientes
11 Catamarca
12 Neuquen
13 Chubut
14 San Luis
15 Misiones
16 Santiago del Estero
17 Entre Rios
18 Chaco
19 Bs. As. (south zone)
20 Rio Negro
21 La Pampa
22 Formosa
23 Santa Cruz
24 Tierra del Fuego

ODOMETER READING—COLUMNS 12 THROUGH 16: Enter the odometer reading to the nearest 0.01 kilometer, at the point where the first rail of the crossing is encountered.

NAME OF RAILROAD—COLUMN 17: Record the name of the railroad:

Example:

1 Gral. Bartolome Mitre
2 Gral. Manuel Belgrano
3 Gral. Julio A. Roca
4 Justo Jose de Urquiza
5 Gral. Jose de San Martin
6 Domingo F. Sarmiento
Ø Other

NUMBER OF TRACKS—COLUMNS 18 THROUGH 20: Record the number of tracks separately for main and auxiliary tracks.

TYPE OF WARNING—COLUMNS 21 THROUGH 34: Record the type of warning existing at the crossing. If the crossing has a watchman record the time of day in hours and minutes (from and to) that the watchman is on duty. Use the following code in Columns 21 through 26 to indicate the type or types of existing protection.

S Yes
N No

SIGNS—COLUMN 21
FLASHING LIGHTS—COLUMN 22
BELLS—COLUMN 23
GATES (MANUAL)—COLUMN 24
GATES (AUTOMATIC)—COLUMN 25
WATCHMAN—COLUMN 26

TIME—COLUMNS 27 THROUGH 34: Record the time that the crossing is under the surveillance of a watchman. For example: suppose that from midnight to 6:00 a.m. there is no watchman on duty. Then at 6:00 a.m. a watchman begins his tour of duty which is terminated at 12:00 noon. He is relieved by another watchman from noon to 6:00 p.m. A third watchman is on duty from 6:00 p.m. to midnight. This situation would be coded as follows:

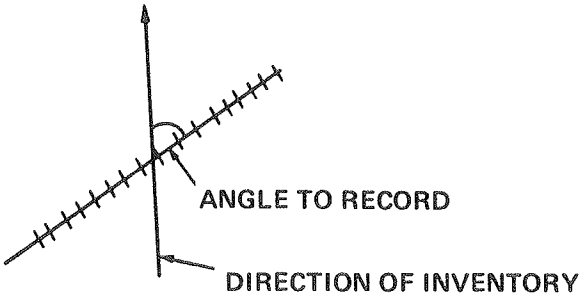
TYPE OF WARNING													
					WATCHMAN								
						TIME							
Signs	Flashing Lights	Bells	Gates - Manual	Gates - Automatic	Yes - No	FROM				TO			
21	22	23	24	25	26	27	28	29	30	31	32	33	34
					S	0	6	0	0	2	4	0	0

NOTE: If Column 26 is coded "No", then Columns 27 through 34 should be left blank.

ANGLE OF CROSSING—COLUMN 35: Estimate the acute angle made by the intersection of the road and the railroad. Record the angle to the nearest 10 degrees according to the following code:

Example:

1 0° to 9°
2 10° to 19°
3 20° to 29°
4 30° to 39°
5 40° to 49°
6 50° to 59°
7 60° to 69°
8 70° to 79°
9 80° to 90°



SIGHT DISTANCE—COLUMNS 36 THROUGH 59: Sight distances are recorded for each quadrant of the intersection formed by the road and the railroad. The diagram on the bottom of Form INV 4 identifies by letter codes the points to and from which sight distances are to be measured. The object is to measure and record the distance along the tracks from the crossing to the point

where a train would become visible to a motorist who is on the road at a point 100 meters from the crossing. Points N and P on the diagram represent the positions of a vehicle at points 100 meters from the crossing. If the train becomes visible at a distance less than 600 meters from Points N and P, it is also required to know the distance from the crossing that the motorist will see the train when the train is 600 meters from the crossing.

SIGHT DISTANCE—COLUMNS 36 THROUGH 47: The distances OA and OB on the diagram represent the sight distances measured from point 0, parallel to the railroad tracks, to points A and B, respectively, where a train would become visible to a motorist at point N. The measured distances from Point 0 to points A, B, C, and D are to be recorded, in meters, in the corresponding data fields labelled OA, OB, OC, and OD. If a sight distance greater than 600 meters exists for any quadrant of the intersection the corresponding data field should be coded:

150 UUU Unlimited sight distance

SIGHT DISTANCE—COLUMNS 48 THROUGH 59: The distances ON′, ON″, OP′ and OP″ on the diagram refer to distance from point 0 measured along the road. These distances will be recorded on Form INV 4 only when the sight distance along the railroad track (distance OA, OB, OC, or OD) is less than 600 meters. If the sight distance in a quadrant is 600 meters or more then the corresponding field (ON', ON", OP', or OP") is left blank. For example, suppose the sight distances along the railroad tracks measure as follows:

OA More than 600 meters
OB More than 600 meters
OC 600 meters
OD 426 meters

Since OD measures less than 600 meters, it is necessary to determine the location of point P″, from which a train could be seen at point F, which is 600 meters from the crossing, and to measure and record the distance OP″.

F. FORM INV 5—TUNNEL

PARTY CHIEF: Write the full name of the Party Chief on the line in the box.

ASSISTANT: Write the full name of the Assistant Party Chief on the line in the box.

VEHICLE NUMBER: Write the vehicle license plate (or other identification) number on the line in the box.

SHEET __ OF __ SHEETS TODAY: Number consecutively the sheets used each day. Use a separate series of numbers, for each route and for each different type of form (INV 1, INV 2, etc.).

FIELD DATE—COLUMNS 3 AND 4: Write the day and the month on the line and the last two digits of the year in Columns 3 and 4.

Example: Field date 21 May|7|5|

TIME START: Write the time that work is started on that sheet.

Example: Time Start 8:00 a.m.

TIME FINISH: Write the time that work is finished on that sheet.

Example: Time Finish 2:15 a.m.

SHEET __ OF __ SHEETS FOR THIS ROUTE: This space is for use in the central office. When all sheets have been assembled for an entire route the sheets will be numbered consecutively.

TYPE OF CARD—COLUMNS 1 AND 2: The code for the card type is preprinted on each form. For the tunnel data form the card type code is 05.

ROUTE—COLUMNS 5 THROUGH 8: Enter the route number code. This code should agree with the route entry made on Form INV 1 or 2 for this tunnel.

JURISDICTION—COLUMN 9: Record the administrative jurisdiction of the road being inventoried.

Example:

1 National
2 Provincial
3 Departmental
4 Municipal
5 Military
6 National Park
7 Port Authority
8 Airport Authority
Ø Other

If "other" is used then indicate the administrative jurisdiction in the comments.

DISTRICT—COLUMNS 10 AND 11: Record the highway department district code.

Example:

01 Bs. As. (north zone)	14 San Luis
02 Cordoba	15 Misiones
03 Tucuman	16 Santiago del Estero
04 Mendoza	17 Entre Rios
05 Salta	18 Chaco
06 Jujuy	19 Bs. As. (south zone)
07 Santa Fe	20 Rio Negro
08 La Rioja	21 La Pampa
09 San Juan	22 Formosa
10 Corrientes	23 Santa Cruz
11 Catamarca	24 Tierra del Fuego
12 Neuquen	
13 Chubut	

ODOMETER READING—COLUMNS 12 THROUGH 16: Record the odometer reading, to the nearest 0.01 kilometer, at the beginning of the tunnel. Do not record the beginning of entrance sheds, approach ramps, or similar structures. The odometer reading is to be recorded at the point where the "tunnel proper" begins. If there are separate tunnels for the opposing traffic directions, inventory each separately, and use two lines on Form INV 5 to record the basic data pertinent to each. Pertinent information for each tunnel will be collected in the direction of the traffic flow for each bore. The odometer readings for both bores will be the reading recorded for each bore in the direction being inventoried. In addition, it may be necessary to use more lines for recording sign type and location.

ALIGNMENT—COLUMN 17: Record a description of the roadway alignment within the tunnel. If the entire tunnel has a tangential alignment consider the tunnel to be straight. If any portion of the roadway within the tunnel is built on a curve, consider the tunnel to be curved. Use the following codes:

R Straight
C Curved

LENGTH—COLUMNS 18 THROUGH 20: Record the length of the tunnel from portal to portal. Do not include any entrance sheds, approach ramps, etc., in the tunnel length. The length may be measured by the survey odometer in the vehicle. Record the length to the nearest 0.01 kilometer.

STATUS—COLUMN 21: Record whether the tunnel has international status—that is, connects two countries.

N National
I International

TOLL OR FREE—COLUMN 22: Indicate if the tunnel is toll or free. If toll, then indicate the amount of toll in the comments.

L Free
C Toll

TRAFFIC OPERATION—COLUMN 23: Indicate if the tunnel carries one-way traffic (alternating flow direction by use of signals or other control), two-way traffic, or is a multiple bore with separate tunnels for each direction.

1 One-way traffic—one bore
2 Two-way traffic—one bore
3 Multiple bore tunnel

NUMBER OF LANES—COLUMN 24: Record the number of lanes used for moving traffic. If the tunnel has multiple bores with more than one line being used on Form INV 5, then record the number of traffic lanes separately for each bore.

SIDEWALKS—COLUMNS 25 THROUGH 32: Sidewalk data are recorded separately for the right and left sides of the tunnel bore.

MATERIAL—COLUMNS 25 AND 29: Record the sidewalk material according to the following code:

H Concrete	R Gravel
A Asphalt	S Earth
T Bituminous surface treatment	B Tile
	N None
P Cobblestone or rock	Ø Other

WIDTH—COLUMNS 26-27 AND 30-31: Record the sidewalk width to the nearest 0.1 meter. If there is no sidewalk code:

NN None

HAND RAIL—COLUMNS 28 AND 32: Record the existence or absence of hand rails.

S There are handrails
N There are no handrails

TRAVELED WAY—COLUMNS 33 THROUGH 36: The roadway surface type and the traveled way width within the tunnel are recorded in this field.

TYPE—COLUMN 33:

H Concrete	P Cobblestone
A Asphalt	R Gravel
T Bituminous surface treatment	S Earth
	Ø Other

WIDTH—COLUMNS 34 THROUGH 36: Record the traveled way width to the nearest 0.1 meter.

ILLUMINATION—COLUMNS 37 AND 38: TYPE—COLUMN 37: Record the type of illumination as follows:

M Mercury	Ø Other
S Sodium	X Mixed
F Incandescent	

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If codes Ø or X are used, then explain in the comments.

LOCATION—COLUMN 38: Record the location of the lamps as follows:

1 Overhead center	3 Side lamps (high)
2 Side lamps (low)	X Mixed

If Code X is used, then explain in the comments.

VENTILATION—COLUMN 39: Indicate the type of tunnel ventilation.

N Natural	A Mechanical

POWER SOURCE—COLUMN 40: Indicate the electric power source for lighting, equipment operation, etc.

1 Public power source	2 Generators
	3 Both

PHYSICAL CHARACTERISTICS—COLUMNS 41 THROUGH 62: Indicate in this field the physical characteristics of the tunnel portals, walls, and ceilings.

ENTRANCE PORTAL—COLUMNS 41 THROUGH 49:

WIDTH—COLUMNS 41 THROUGH 43: Measure the width of the tunnel entrance at a point 1:5 meters above the roadway surface. Record the width to the nearest 0.1 meter.

VERTICAL CLEARANCE—COLUMNS 44 THROUGH 47: Record the vertical clearance to the nearest 0.1 meter.

AT EDGE—COLUMNS 44 AND 45: Measure the vertical clearance at both the right and the left edges of the traveled way. If the clearances are not equal record the lesser of the two.

AT CENTERLINE—COLUMNS 46 AND 47: Measure the vertical clearance at the centerline of the traveled way, on an undivided roadway, or at the centerline of the median on a divided roadway.

FORM—COLUMN 48: Describe the shape of the tunnel portal as:

A Arch	Ø Other
D Rectangular	

NOTE: If "other" describe in the comments.

MATERIAL—COLUMN 49: Record the material of which the tunnel portal is constructed. In case more than one material has been used, code the predominant type. If code Ø, other, is used, then explain in the comments.

P Stone	M Wood
H Concrete	Ø Other

EXIT PORTAL—COLUMNS 50 THRU 58: This field contains the same items as found in the entrance portal field, columns 41 through 49. Refer to that field for detailed instructions.

WALL MATERIAL—COLUMNS 59 AND 60: This field refers to the type of material found in the walls of the tunnel. If more than one material is present, code the predominant type. Explain and describe in the comments any combinations or variations of material type.

LINING—COLUMN 59:

A Tile	Ø Other
H Concrete	N None
P Masonry	

NOTE: If Code N is used in Column 59, some type of natural material must be coded under Column 60.

NATURAL—COLUMN 60:

R Rock	N None (use when
T Earth	tunnel is 100%
Ø Other	lined)

NOTE: If Code N is used under Column 60, some type of lining material must be coded under Column 59.

CEILING MATERIAL — COLUMNS 61 AND 62: This field refers to the type of material found in the ceiling of the tunnel. If more than one material is present, then code the predominant type. Explain and describe in the comments any combinations or variations of material type.

LINING—COLUMN 61:

A Tile	F Steel
H Concrete	Ø Other
P Masonry	N None

NOTE: If Code N is used in Column 61, some type of natural material must be coded under Column 62.

NATURAL—COLUMN 62:

R Rock
T Earth
Ø Other
N None (use when tunnel 100% lined)

NOTE: If Code N is used under Column 62, some type of lining material must be coded under Column 61.

SAFETY—COLUMNS 63 THROUGH 66: Indicate the existence or absence of the following safety elements by coding:

S Yes
N No

FIREHOSE—COLUMN 63:

SAND CONTAINERS—COLUMN 64:

FIRE EXTINGUISHERS — COLUMN 65:

TELEPHONES—COLUMN 66:

Include in comments any additional data believed pertinent to safety.

TRAFFIC CONTROL — COLUMNS 67 THROUGH 72: In Columns 67 through 70 indicate the existence or absence of the following traffic control elements by coding:

S Yes
N No

TELEVISION CIRCUIT—COLUMN 67:

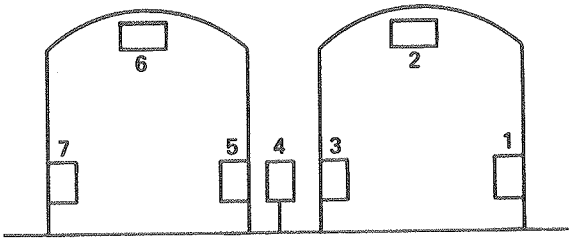
TRAFFIC SIGNALS—COLUMN 68:

SIRENS OR HORNS—COLUMN 69:

PUBLIC ADDRESS SYSTEM—COLUMN 70:

POSTED VERTICAL CLEARANCE—COLUMNS 71 AND 72: Record the posted maximum allowable height, or posted vertical clearance to the nearest 0.1 meter. Code NN, if no regulations are posted.

SIGNS—COLUMNS 73 TO 77: Record in this field, data on signs which are at the portals or within the tunnel. Use as many lines as necessary to record the sign data putting the appropriate odometer reading for each sign in Columns 12 through 16. Use the sign codes from Appendix K, to indicate the type of sign. The sign location codes are:



WATCHMAN—COLUMN 78: Record the presence or absence of of tunnel watchman (toll collectors, police, gatemen, etc.) by coding:

S Yes N No

COMMENTS: Include any observations that may help to clarify or describe the tunnel and its use.

G. FORM INV 6—FERRY DATA

Two data cards are required for recording information on ferries. Columns 3 through 16 are identical on the two cards, and these

columns appear only once in the heading of the data form. The first card is for the purpose of recording the physical characteristics, while the second card is for listing operational characteristics of the ferry.

PARTY CHIEF: Write the full name of the Party Chief on the line in the box.

ASSISTANT: Write the full name of the Assistant Party Chief on the line in the box.

VEHICLE NUMBER: Write the vehicle license plate (or other identification) number on the line in the box.

SHEET __ OF __ SHEETS TODAY: Number consecutively the sheets used each day. Use a separate series of numbers, for each route and for each different type of Form (INV 1, INV 2, etc.).

FIELD DATE: COLUMNS 3 AND 4: Write the day and the month on the line and the last two digits of the year in Columns 3 and 4.

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Example: Field Date 21 May|7|5|

ROUTE—COLUMNS 5 THROUGH 8: Enter the route number code. This code should agree with the route entry made on Form INV 1 or 2 for this ferry crossing.

SHEET __ OF __ SHEETS FOR THIS ROUTE: This space is for use in the central office. When all sheets have been assembled for an entire route the sheets will be numbered consecutively.

JURISDICTION—COLUMN 9: Record the administrative jurisdiction of the road being inventoried.

Example:

1 National	6 National Park
2 Provincial	7 Port Authority
3 Departmental	8 Airport Authority
4 Municipal	Ø Other
5 Military	

If "other" is used, then indicate the administrative jurisdiction in the comments.

DISTRIST—COLUMNS 10 AND 11: Record the highway department district code.

Example:

01 Bs. As. (north zone)	14 San Luis
02 Cordoba	15 Misiones
03 Tucuman	16 Santiago del Estero
04 Mendoza	17 Entre Rios
05 Salta	18 Chaco
06 Jujuy	19 Bs. As. (south zone)
07 Santa Fe	20 Rio Negro
08 La Rioja	21 La Pampa
09 San Juan	22 Formosa
10 Corrientes	23 Santa Cruz
11 Catamarca	24 Tierra del Fuego
12 Neuquen	
13 Chubut	

ODOMETER READING—COLUMNS 12 THROUGH 16: Record the odometer reading where the loading dock, or ramp to board the ferry begins. Disconnect the odometer at this point. At the opposite end of the crossing start the odometer at the point where the inventory vehicle leaves the dock or loading ramp.

Card 06:

TYPE OF CARD—COLUMNS 1 AND 2: The code for the card type is printed on the form. For the ferry physical characteristics data the card type code is 06.

NAME OF LAKE OR RIVER—COLUMNS 17 THROUGH 31: Record the name of the waterway being crossed. Use abbreviations when necessary. Leave a blank space between words.

PROPRIETOR—COLUMN 32: Indicate the ownership, or jurisdiction, of the ferry.

Example:

1 National	3 Private
2 Provincial	Ø Other

NAME OF PROPRIETOR—COLUMNS 33 THROUGH 47: Record the name of the proprietor.

YEAR ESTABLISHED—COLUMNS 48 THROUGH 51: Code the year in which the first ferry crossing service was established at

that location. If the year is not known then leave the field blank.

LENGTH OF CROSSING—COLUMNS 52 THROUGH 55: Record the length of the crossing (the route followed by the ferry) to the nearest 0.01 kilometer. If the trips in opposing directions are of different lengths then record the longer of the two and explain in the comments the basis for the estimate.

CHARACTERISTICS OF EACH FERRY BOAT—COLUMNS 56 THROUGH 72: Use as many lines as necessary to adequately describe the physical characteristics of the ferry boats.

NUMBER OF BOATS—COLUMNS 56 AND 57: Record on each line the number of boats of similar characteristics. Use additional lines to show ferries with different characteristics.

TYPE OF BOAT—COLUMNS 58 AND 59: Record in this field the method of propulsion and the material of construction.

Propulsion—Column 58

D Diesel	E Electric
S Steam	Ø Other
G Gasoline	

Material—Column 59

F Steel	Ø Other
M Wood	

CAPACITY—COLUMNS 60 THROUGH 72
VEHICLES—COLUMNS 60 AND 61: Record the number of vehicles (passenger cars) that the ferry can accommodate.

PERSONS—COLUMNS 62 THROUGH 64: Record the number of persons that can be accommodated, not including those in motor vehicles. The number of persons to be accommodated might be determined by the number of available seats, or by the number of life jackets, or other safety devices.

WEIGHT LIMIT—COLUMNS 65 THRU 67: Record the load carrying capacity of the ferry in tons.

MAXIMUM HEIGHT—COLUMNS 68 AND 69: Record the maximum height permitted for vehicles boarding the ferry. Code to the nearest 0.1 meter. If the maximum is more than 9.9 m, Code UU for unlimited.

MAXIMUM LENGTH—COLUMNS 70 THROUGH 72: Record the maximum length permitted for a single unit vehicle, or a combination unit boarding without disconnecting trailer. Code to the nearest 0.1 meter.

Card 07

TYPE OF CARD—COLUMNS 1 AND 2: The code for the card type is printed on the form. For the ferry operational characteristics data the card type code is 07.

TIME REQUIRED FOR CROSSING—COLUMNS 17 THROUGH 19: In this field code the hours and minutes required for a one-way trip by the ferry. If times vary by boat type, use more than one line. Explain other variations, such as, by direction, time of year, water level, etc. in the comments.

OPERATIONS SCHEDULE—COLUMNS 20 THROUGH 33

MONTHS IN SERVICE—COLUMNS 20 AND 21: Indicate by code, the month that service begins and the month that it is terminated each year. If the service is 12 months per year, then code E for January in column 20 and D for December in column 21. Use the following codes:

E January	L July
F February	G August
M March	S September
A April	Ø October
Y May	N November
J June	D December

DAYS OF THE WEEK IN SERVICE—COLUMNS 22 AND 23: Indicate by code the day that service begins and the day that it is terminated each week. If the service is for all days of the week, then Code L for Monday in Column 22 and D for Sunday in Column 23. If the ferry only operates on certain days,

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additional lines may be needed to describe the schedule. Use the following codes:

L Monday	V Friday
M Tuesday	S Saturday
W Wednesday	D Sunday
J Thursday	

HOURS IN SERVICE PER DAY—COLUMNS 24 AND 25: Record the number of hours per day that the ferry is in service. Record the total number of hours regardless of whether there is more than one time period of service each day.

TIME BEGINNING AND CLOSING—COLUMNS 26 THROUGH 33: Record the time of day, in hours and minutes, that the ferry begins and stops its operation each day. If there is more than one period of operation each day, explain in comments.

FARES—COLUMNS 34 TO 80: Indicate in this field if the ferry is free or toll, and if it is toll, then indicate the fare. Columns are provided for recording the one-way fares and round-trip fares for persons and for various vehicle types, as follows:

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FREE OR TOLL—COLUMN 34:

C Toll	L Free

ONE WAY—COLUMNS 35 THROUGH 58

PERSONS—COLUMNS 35 THROUGH 38

AUTOMOBILES—COLUMNS 39 THRU 42

BUSES—COLUMNS 43 THROUGH 46

TRUCK (SINGLE UNIT)—COLUMNS 47 THROUGH 50

TRUCK (COMBINATION)—COLUMNS 51 THROUGH 54

OTHER—COLUMNS 55 THROUGH 58

ROUND TRIP—COLUMNS 59 THRU 80

PERSONS—COLUMNS 59 THROUGH 62

AUTOMOBILES—COLUMNS 63 THRU 66

BUSES—COLUMNS 67 THROUGH 70

TRUCK (SINGLE UNIT)—COLUMNS 71 THROUGH 74

TRUCK (COMBINATION)—COLUMNS 75 THROUGH 78

OTHER—COLUMNS 79 THROUGH 80

COMMENTS: Usually, it will be necessary to include many observations and clarifications in the comments in order to adequately describe the characteristics of a ferry. Be sure to take photos of each boat and of the loading and unloading facilities at each end of the ferry run.

H. FORM INV 7—ROADWAY DATA (URBAN)

Reference should be made to the "Computer Program Users Manual" before beginning an inventory of urban areas and completing Form INV 7. This manual shows the columns of this form that "must be coded," "may optionally be coded," and "must be left blank" for the different conditions.

PARTY CHIEF: Write the full name of the Party Chief on the line in the box.

ASSISTANT: Write the full name of the Assistant Party Chief on the line in the box.

VEHICLE NUMBER: Write the vehicle license plate (or other identification) number on the line in the box.

SHEET __ OF __ SHEETS TODAY: Number consecutively the sheets used each day. Use a separate series of numbers, for each route and for each different type of form (INV 1, INV 2, etc.).

FIELD DATE—COLUMNS 3 AND 4: Write the day and the month on the line and the last two digits of the year in Columns 3 and 4.

Example: Field Date: 21 May|7|5|

TIME START: Write the time that work is started on that sheet.

Example: Time Start 8:00 a.m.

TIME FINISH: Write the time that work is finished on that sheet.

Example: Time Finish 2:15 p.m.

SHEET __ OF __ SHEETS FOR THIS ROUTE: This space is for use in the central office. When all sheets have been assembled for an entire route, the sheets will be numbered consecutively.

TYPE OF CARD—COLUMNS 1 AND 2: The code for the card type is preprinted on each form. For the urban roadway data form the card type is 14.

ROUTE—COLUMNS 5 THROUGH 8: Enter the route number code. This code should agree with the route entry codes made on Form INV 1 or 2 for this urban area.

JURISDICTION—COLUMN 9: Record the administrative jurisdiction of the road being inventoried:

Example:

1 National
2 Provincial
3 Departmental
4 Municipal
5 Military
6 National Parks
7 Port Authority
8 Airport Authority
Ø Other

If "other" is used, then indicate the jurisdiction in the comments.

DISTRICT—COLUMNS 10 AND 11:

Example:

01 Bs, As, (except south)
02 Cordoba
03 Tucuman
04 Mendoza
05 Salta
06 Jujuy
07 Santa Fe
08 La Rioja
09 San Juan
10 Corrientes
11 Catamarca
12 Neuquen
13 Chubut
14 San Luis
15 Misiones
16 Santiago del Estero
17 Entre Rios
18 Chaco
19 Bs. As. (south zone)
20 Rio Negro
21 La Pampa
22 Formosa
23 Santa Cruz
24 Tierra del Fuego

URBAN AREA—COLUMNS 12 THROUGH 14: Write the name of the urban area (see Appendix I for urban area codes).

ODOMETER READING—COLUMNS 15 THROUGH 19: Enter the odometer reading to the nearest 0.01 kilometer for each event recorded. The first entry will be to record the beginning of an urban area. Columns 1 through 44 must be coded on the first entry. The other columns 45 through 71 may or may not be completed depending on whether the R/W width can be determined and if an intersection or traffic signal is at the same location as the urban boundary. The last entry will be at the point leaving the urban area. Again, it is necessary to complete Columns 1 through 44, and possibly Columns 45 through 71, as described above.

NAME OF STREET BEING INVENTORIED—COLUMNS 20 THROUGH 39: Write the name of the street which is being inventoried. If the street is not named, then write "no name." For additional entries on the same street, it is not necessary to continue entering the street name. If the name of street changes, the new name should be coded.

CURBS—COLUMN 40: Indicate the type of roadway cross section on the street being inventoried by:

C Curbs N No curbs

NOTE: Anytime a new line is used to record any change of street characteristics, as coded under Columns 40 through 48, all of these columns should be coded. For example, if an entry was made to record the beginning of curbs (col. 40), all Columns 40 through 48 should be completed.

PARKING—COLUMNS 41 AND 42: Indicate the parking conditions by use of the following codes separately for the left and right sides of the road:

B Shoulders—could be used for parking not presently prohibited or regulated.
C Curbs—there is space for parking not presently prohibited or regulated.
P Parking prohibited.
R Parking regulated.
N Parking impossible because of lack of space may or may not be prohibited.

SIDEWALKS—COLUMNS 43 AND 44: Indicate the existence of sidewalks or foot-

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paths by use of the following codes separately for the left and right sides of the road:

H Concrete	B Tile
A Asphalt	T Earth
M Wood	N No sidewalks or footpaths
L Brick	

RIGHT OF WAY WIDTH—COLUMNS 45 THROUGH 48: If the right of way width can be determined in the field, from survey monuments or other means, it should be measured and recorded to the nearest 0.1 meter. The fronts of buildings, or fence lines, are not to be accepted as right of way limits, unless they are definitely known to be on the right of way line. Frequently, the right of way widths will have to be obtained from construction plans or from municipal records.

NAME OF INTERSECTING STREET—COLUMNS 49 THROUGH 68: Write the name of the street which intersects the highway which is being inventoried. If the intersecting street has no name, then write "no name." If there are different names for the streets going away from an intersection, identify them by using additional lines and repeating the odometer reading. Indicate the direction of the street by preceding the name with "LEFT," "RIGHT," "1st LEFT," "2nd LEFT," etc.

TRAFFIC SIGNALS—COLUMNS 69 THROUGH 71: Indicate in Column 69 whether the intersection has traffic lights to control traffic by coding:

S Yes	N No

Indicate in Columns 70 and 71 the number of signal heads which are in place. If there are no signals, code NN. If a signal is located between intersections, it should be logged and so noted in the comments.

COMMENTS: Include sketches of channelized intersections. Make explanatory notes to aid in the interpretation of the coded data whenever needed.

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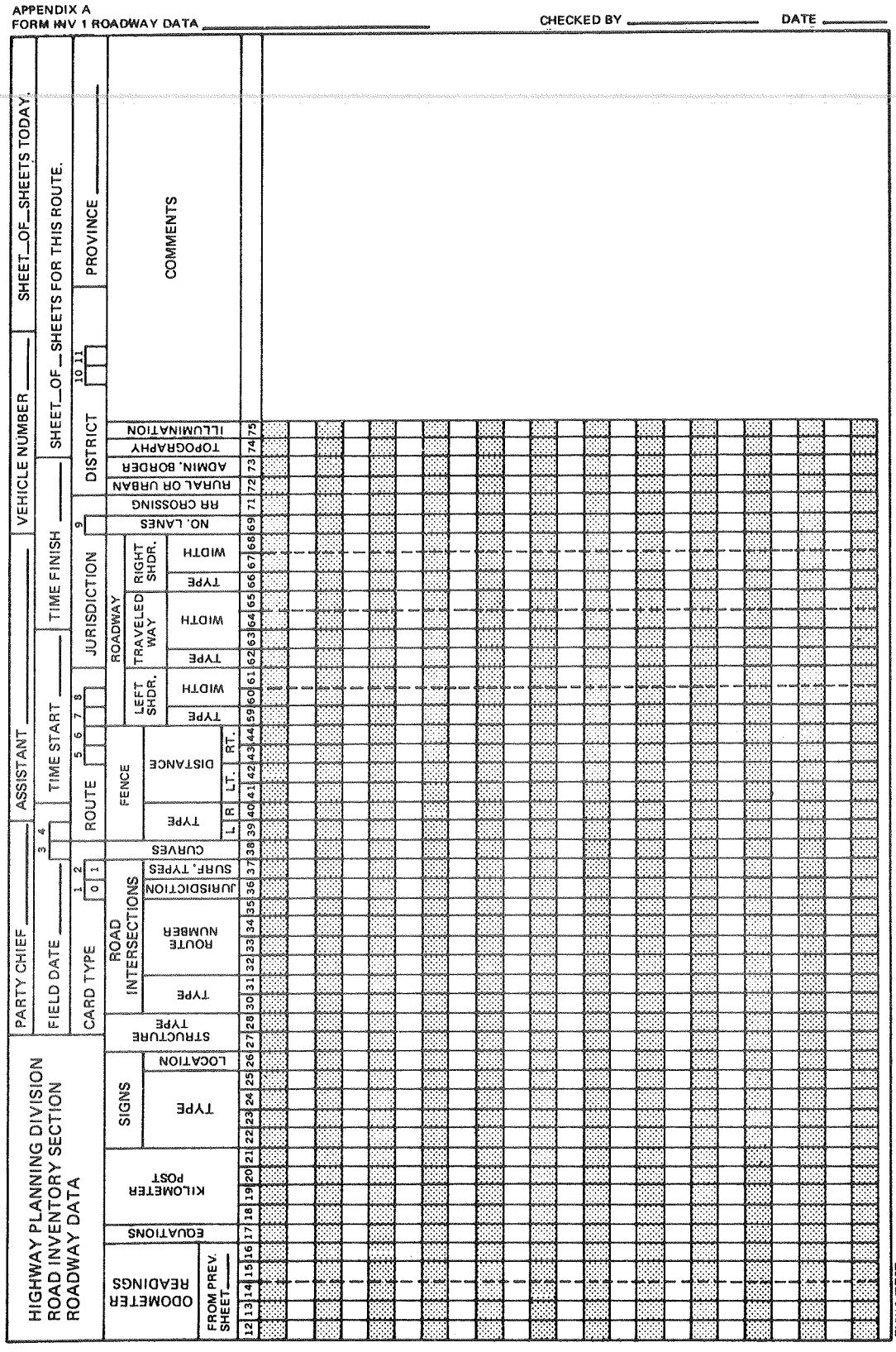
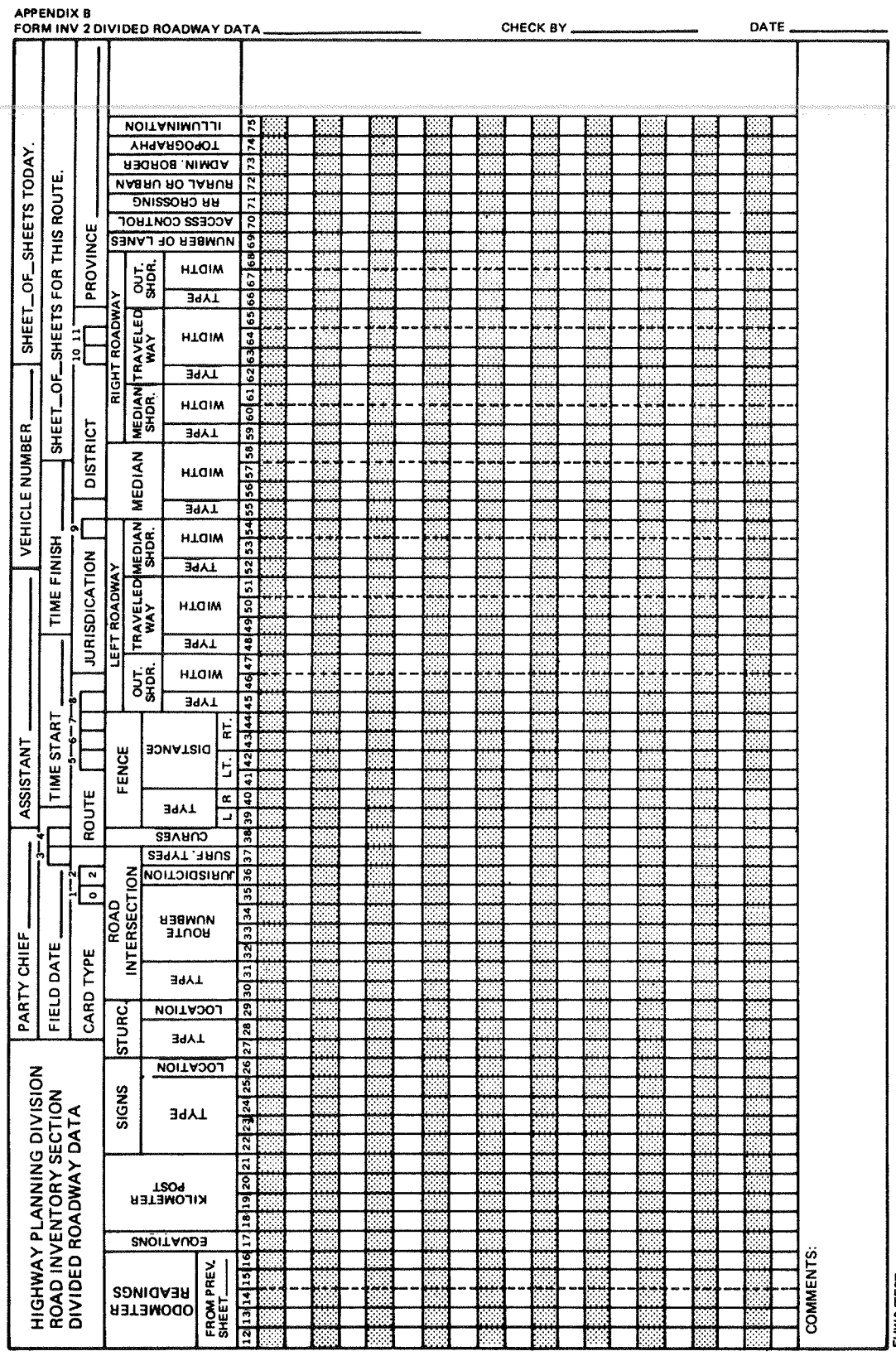

APPENDIX A
FORM INV 1 ROADWAY DATA
CHECKED BY
DATE
HIGHWAY PLANNING DIVISION
ROAD INVENTORY SECTION
ROADWAY DATA
PARTY CHIEF
ASSISTANT
VEHICLE NUMBER
SHEET OF SHEETS TODAY
FIELD DATE
TIME START
TIME FINISH
SHEET OF SHEETS FOR THIS ROUTE
CARD TYPE
ROUTE
JURISDICTION
DISTRICT
PROVINCE
ODOMETER READINGS
FROM PREV. SHEET
EQUATIONS
KILOMETER POST
SIGNS
TYPE
LOCATION
STRUCTURE TYPE
ROAD INTERSECTIONS
TYPE
ROUTE NUMBER
JURISDICTION
SURF. TYPES
CURVES
FENCE
TYPE
DISTANCE
LT.
RT.
L
R
ROADWAY
LEFT SHDR.
TRAVELED WAY
RIGHT SHDR.
WIDTH
TYPE
NO. LANES
RR CROSSING
RURAL OR URBAN
ADMIN. BORDER
TOPOGRAPHY
ILLUMINATION
COMMENTS
FHWA/TEST


APPENDIX B
FORM INV 2 DIVIDED ROADWAY DATA
CHECK BY
DATE
HIGHWAY PLANNING DIVISION
ROAD INVENTORY SECTION
DIVIDED ROADWAY DATA
PARTY CHIEF
ASSISTANT
VEHICLE NUMBER
SHEET_OF_SHEETS TODAY.
FIELD DATE
TIME START
TIME FINISH
SHEET_OF_SHEETS FOR THIS ROUTE.
CARD TYPE
ROUTE
JURISDICATION
DISTRICT
PROVINCE
ODOMETER READINGS
FROM PREV. SHEET
EQUATIONS
KILOMETER POST
SIGNS
TYPE
LOCATION
STURC
ROAD INTERSECTION
FENCE
CURVES
LEFT ROADWAY
RIGHT ROADWAY
OUT. SHDR.
TRAVELED WAY
MEDIAN SHDR.
MEDIAN
NUMBER OF LANES
ACCESS CONTROL
RR CROSSING
RURAL OR URBAN
ADMIN. BORDER
TOPOGRAPHY
ILLUMINATION
COMMENTS:
FHWA/TEST

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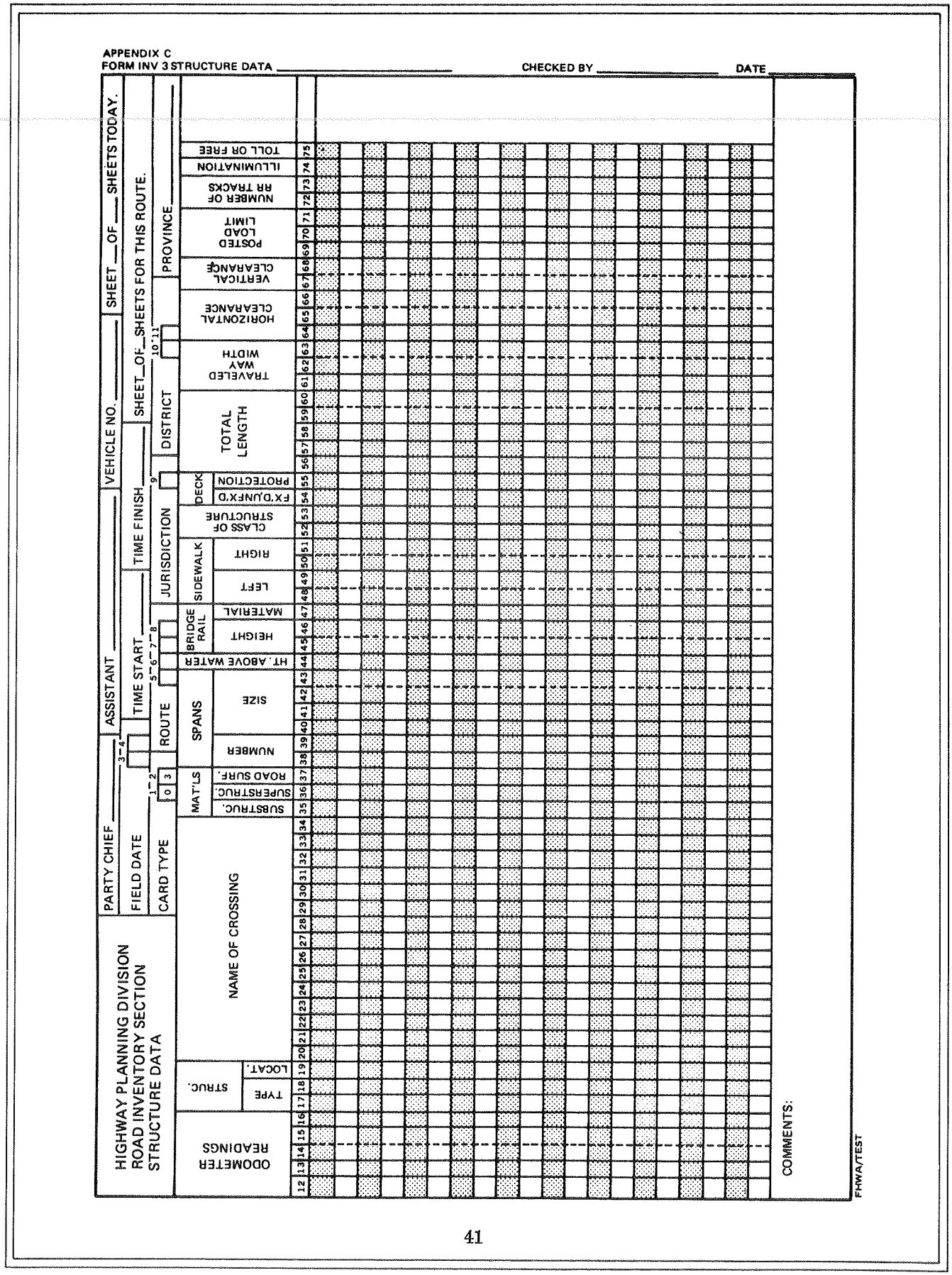
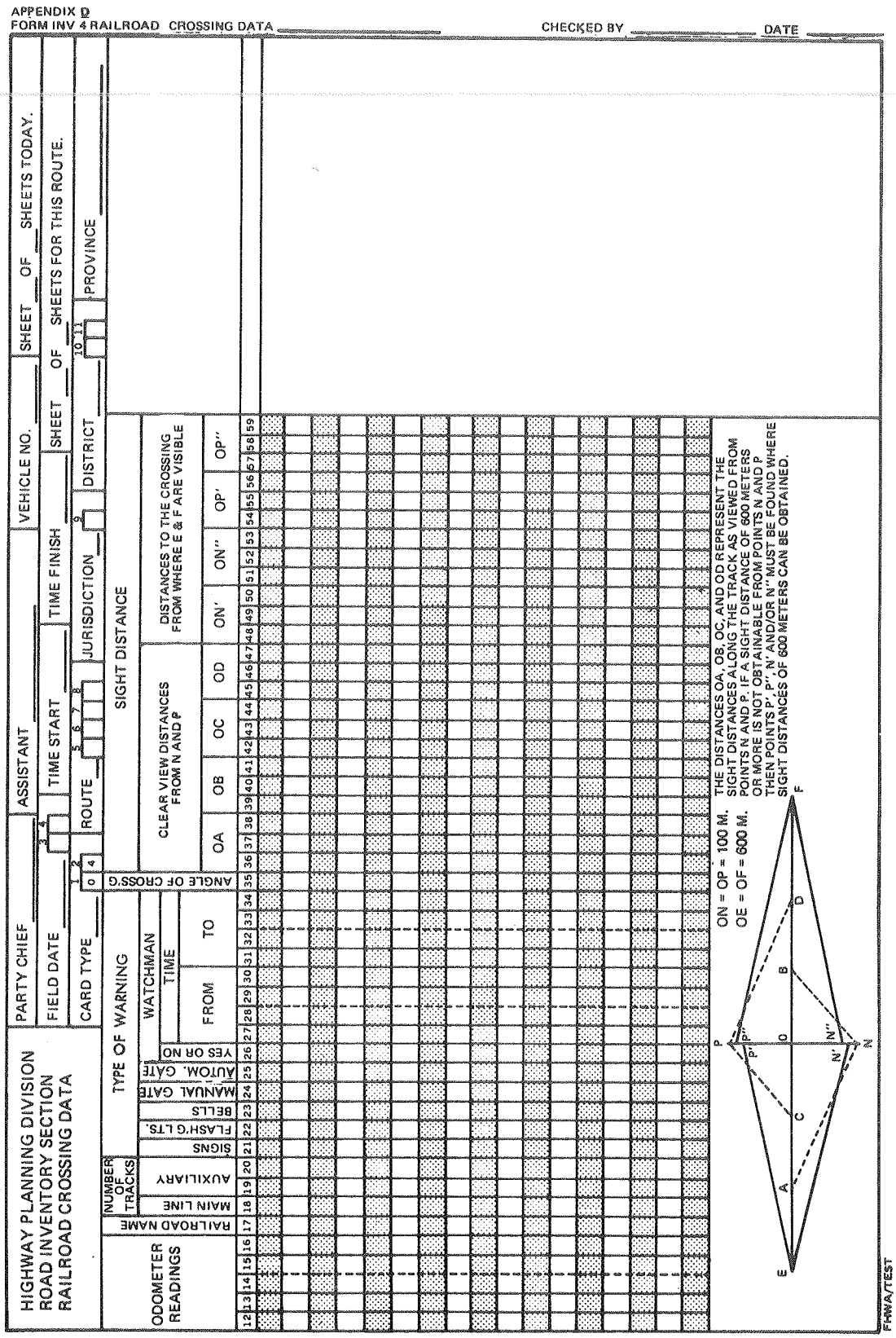
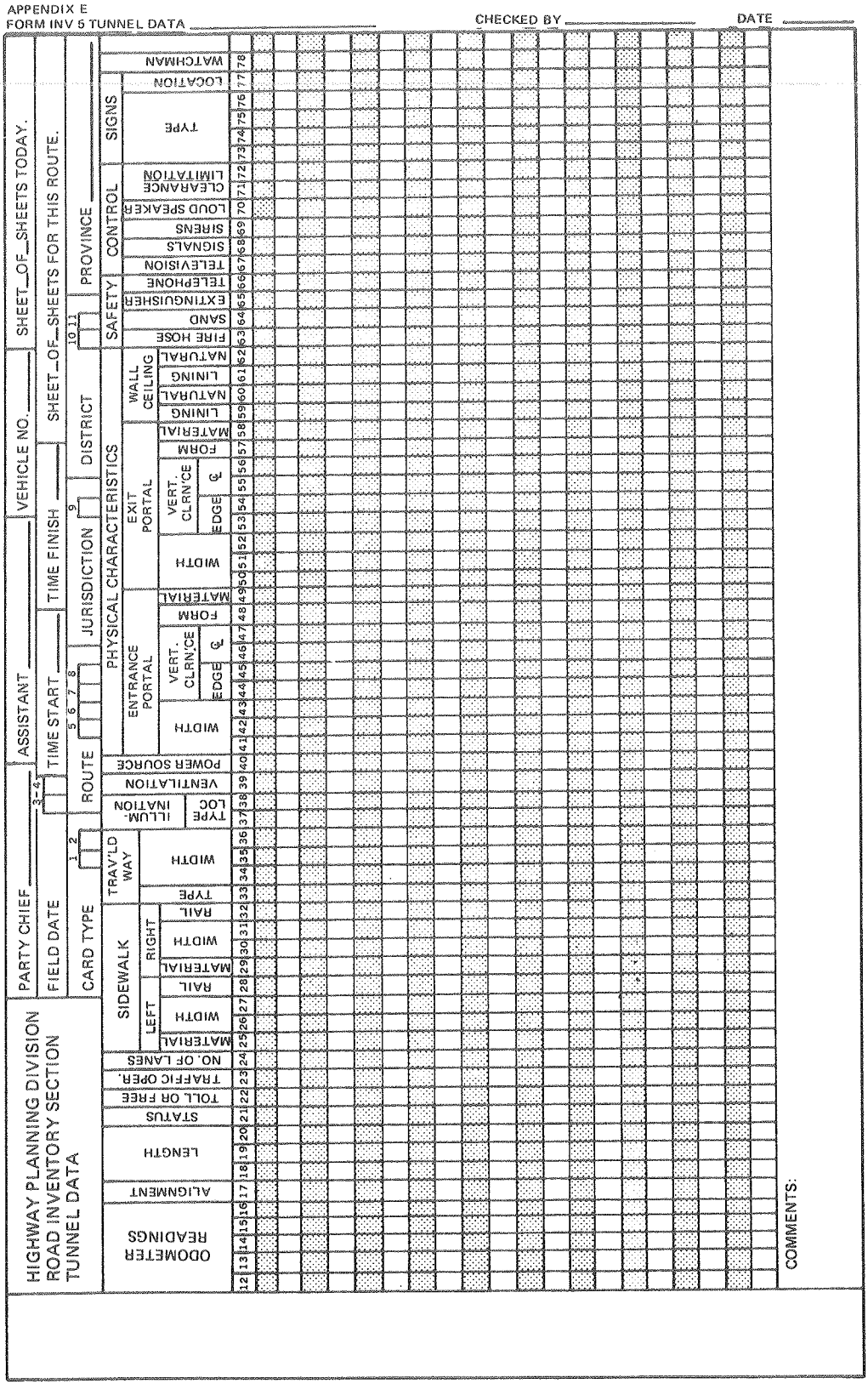
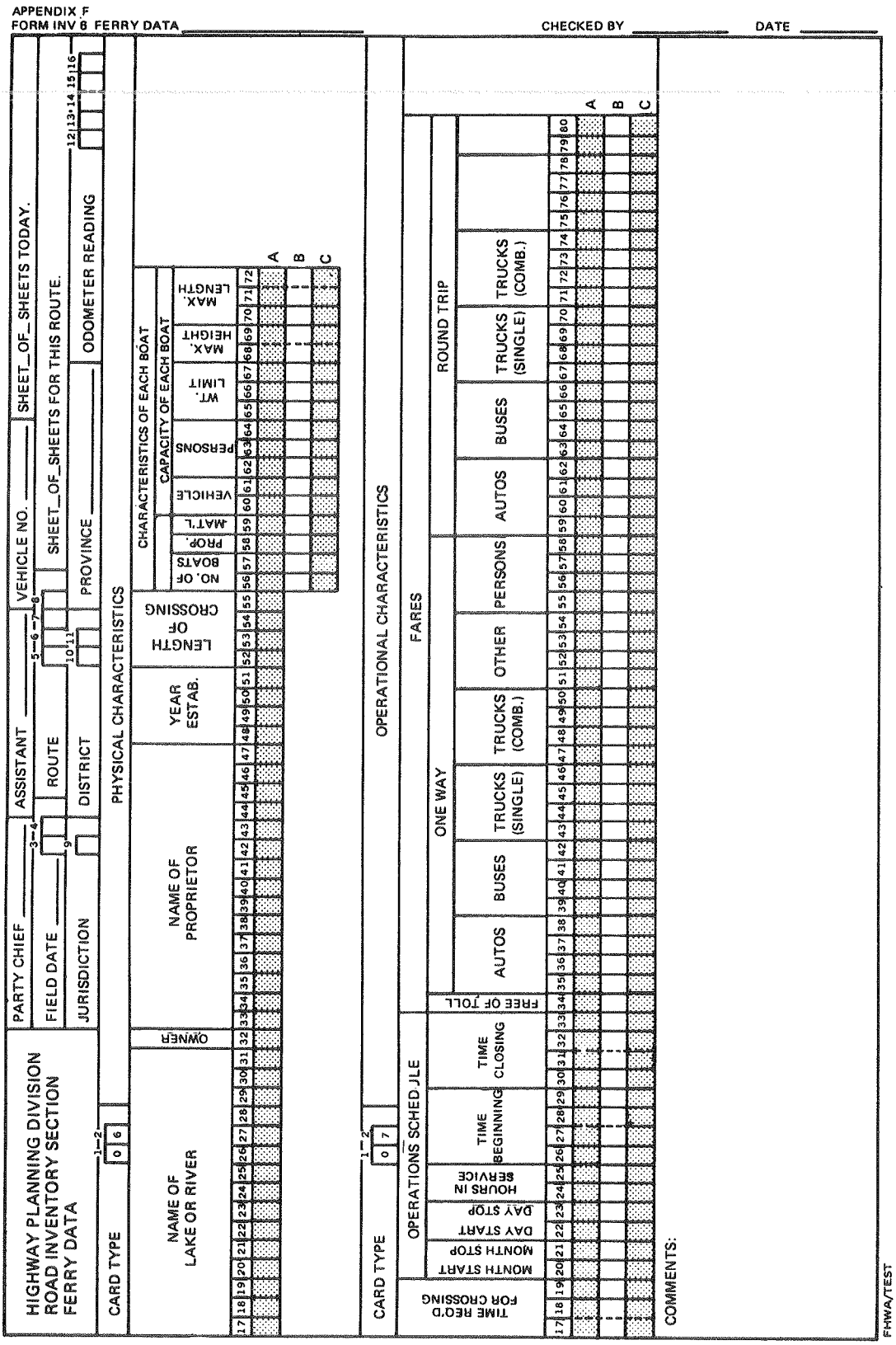
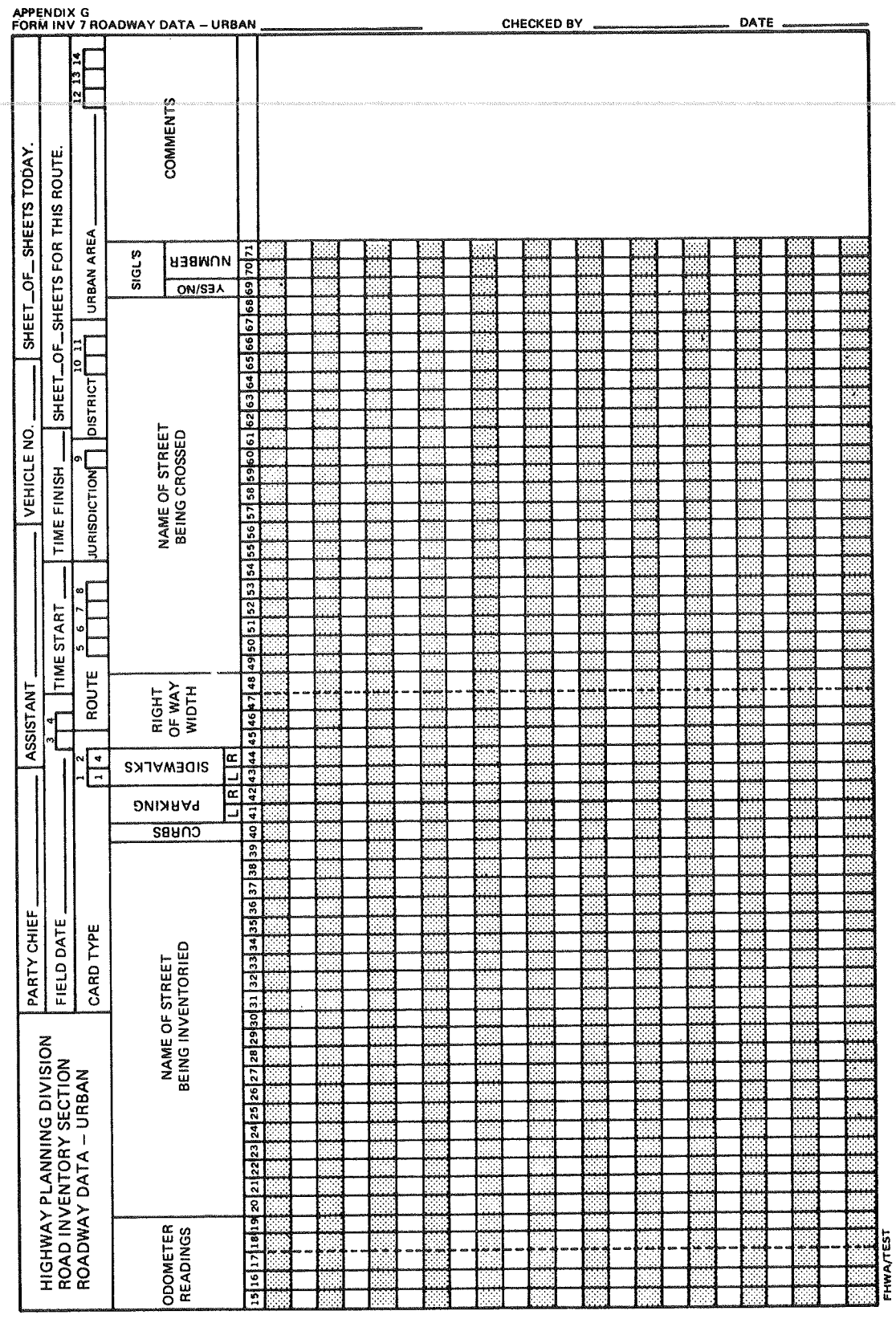

APPENDIX C
FORM INV 3 STRUCTURE DATA
CHECKED BY
DATE
HIGHWAY PLANNING DIVISION
ROAD INVENTORY SECTION
STRUCTURE DATA
PARTY CHIEF
ASSISTANT
VEHICLE NO.
SHEET OF SHEETS TODAY.
FIELD DATE
TIME START
TIME FINISH
SHEET OF SHEETS FOR THIS ROUTE.
CARD TYPE
ROUTE
JURISDICTION
DISTRICT
PROVINCE
ODOMETER READINGS
STRUC. TYPE
STRUC. LOCAT.
NAME OF CROSSING
MAT'LS SUBSTRUC.
SUPERSTRUC.
ROAD SURF.
SPANS NUMBER
SIZE
HT. ABOVE WATER
BRIDGE RAIL HEIGHT
MATERIAL
SIDEWALK LEFT
RIGHT
CLASS OF STRUCTURE
DECK FX'D.JUNFX'D
PROTECTION
TOTAL LENGTH
TRAVELED WAY WIDTH
HORIZONTAL CLEARANCE
VERTICAL CLEARANCE
POSTED LOAD LIMIT
NUMBER OF RR TRACKS
ILLUMINATION
TOLL OR FREE
COMMENTS:
FHWA/TEST


APPENDIX D
FORM INV 4 RAILROAD CROSSING DATA
CHECKED BY
DATE
HIGHWAY PLANNING DIVISION
ROAD INVENTORY SECTION
RAILROAD CROSSING DATA
PARTY CHIEF
ASSISTANT
VEHICLE NO.
SHEET OF SHEETS TODAY.
FIELD DATE
TIME START
TIME FINISH
SHEET OF SHEETS FOR THIS ROUTE.
CARD TYPE
ROUTE
JURISDICTION
DISTRICT
PROVINCE
SIGHT DISTANCE
ANGLE OF CROSSG.
CLEAR VIEW DISTANCES FROM N AND P
DISTANCES TO THE CROSSING FROM WHERE E & F ARE VISIBLE
OA
OB
OC
OD
ON'
ON''
OP'
OP''
TYPE OF WARNING
WATCHMAN
TIME
FROM
TO
YES OR NO
AUTOM. GATE
MANUAL GATE
BELLS
FLASH'G LTS.
SIGNS
AUXILIARY
MAIN LINE
NUMBER OF TRACKS
RAILROAD NAME
ODOMETER READINGS
ON = OP = 100 M.
OE = OF = 600 M.
THE DISTANCES OA, OB, OC, AND OD REPRESENT THE SIGHT DISTANCES ALONG THE TRACK AS VIEWED FROM POINTS N AND P. IF A SIGHT DISTANCE OF 600 METERS OR MORE IS NOT OBTAINABLE FROM POINTS N AND P THEN POINTS P', P'', N' AND/OR N'' MUST BE FOUND WHERE SIGHT DISTANCES OF 600 METERS CAN BE OBTAINED.
E
A
C
P
P''
P'
O
B
D
N''
N'
N
F
FHWA/TEST


APPENDIX E
FORM INV 5 TUNNEL DATA
CHECKED BY
DATE
HIGHWAY PLANNING DIVISION
ROAD INVENTORY SECTION
TUNNEL DATA
PARTY CHIEF
ASSISTANT
VEHICLE NO.
SHEET OF SHEETS TODAY.
FIELD DATE
TIME START
TIME FINISH
SHEET OF SHEETS FOR THIS ROUTE.
CARD TYPE
ROUTE
JURISDICTION
DISTRICT
PROVINCE
ODOMETER READINGS
ALIGNMENT
LENGTH
STATUS
TOLL OR FREE
TRAFFIC OPER.
NO. OF LANES
SIDEWALK
LEFT
RIGHT
MATERIAL
WIDTH
RAIL
TRAV'LD WAY
TYPE
WIDTH
ILLUMINATION
TYPE LOC
VENTILATION
POWER SOURCE
PHYSICAL CHARACTERISTICS
ENTRANCE PORTAL
EXIT PORTAL
WIDTH
EDGE
VERT. CLR'NCE
℄
FORM
MATERIAL
WALL CEILING
NATURAL
LINING
SAFETY
FIRE HOSE
SAND
EXTINGUISHER
TELEPHONE
TELEVISION
CONTROL
SIGNALS
SIRENS
LOUD SPEAKER
CLEARANCE LIMITATION
SIGNS
TYPE
LOCATION
WATCHMAN
COMMENTS:
FHWA/TEST


APPENDIX F
FORM INV 6 FERRY DATA
CHECKED BY
DATE
HIGHWAY PLANNING DIVISION
ROAD INVENTORY SECTION
FERRY DATA
PARTY CHIEF
ASSISTANT
VEHICLE NO.
SHEET_OF_SHEETS TODAY.
FIELD DATE
ROUTE
SHEET_OF_SHEETS FOR THIS ROUTE.
JURISDICTION
DISTRICT
PROVINCE
ODOMETER READING
CARD TYPE
PHYSICAL CHARACTERISTICS
NAME OF LAKE OR RIVER
OWNER
NAME OF PROPRIETOR
YEAR ESTAB.
LENGTH OF CROSSING
CHARACTERISTICS OF EACH BOAT
NO. OF BOATS
PROP.
MAT'L
CAPACITY OF EACH BOAT
VEHICLE
PERSONS
WT. LIMIT
MAX. HEIGHT
MAX. LENGTH
A
B
C
CARD TYPE
OPERATIONAL CHARACTERISTICS
OPERATIONS SCHED JLE
TIME REC'D FOR CROSSING
MONTH START
MONTH STOP
DAY START
DAY STOP
HOURS IN SERVICE
TIME BEGINNING
TIME CLOSING
FARES
FREE OF TOLL
ONE WAY
ROUND TRIP
AUTOS
BUSES
TRUCKS (SINGLE)
TRUCKS (COMB.)
OTHER
PERSONS
AUTOS
BUSES
TRUCKS (SINGLE)
TRUCKS (COMB.)
COMMENTS:
FHWA/TEST


APPENDIX G
FORM INV 7 ROADWAY DATA – URBAN
CHECKED BY
DATE
HIGHWAY PLANNING DIVISION
ROAD INVENTORY SECTION
ROADWAY DATA – URBAN
PARTY CHIEF
ASSISTANT
VEHICLE NO.
SHEET__OF__SHEETS TODAY.
FIELD DATE
TIME START
TIME FINISH
SHEET__OF__SHEETS FOR THIS ROUTE.
CARD TYPE
ROUTE
JURISDICTION
DISTRICT
URBAN AREA
ODOMETER READINGS
NAME OF STREET BEING INVENTORIED
CURBS
PARKING
SIDEWALKS
RIGHT OF WAY WIDTH
NAME OF STREET BEING CROSSED
SIGL'S
YES/NO
NUMBER
COMMENTS
FHWA/TEST

Appendix H—Special Instructions For Urban Areas

Urban and rural areas have different characteristics of land use and road and street networks. For this reason the road inventory process should include a determination of the location of the boundary between urban and rural areas.

The boundary is to be located at the point where the character of land use changes from rural to urban, and vice versa, without regard to municipal or other jurisdictional boundaries. (Municipal and other jurisdictional boundaries are to be recorded in column 73 on Forms INV 1 and 2). This urban-rural classification will be especially important when making the present and future highway functional classification and when projecting urban growth for the highway needs study.

It is recognized that the transition from a rural area to an urban area is not always a definite clear cut demarcation. Frequently the transition is gradual and difficult to locate exactly. The party chief must use judgment in determining where the land use and the road and street networks change from rural to urban in characteristics. The occurrence of residences closely grouped together, commercial or industrial land uses, street lighting, sidewalks, frequent cross streets, etc., are indications of urban land use. Large tracts of land such as railroad yards, factories, parks, airports, schools, cemeteries, etc., which are in or adjacent to an urban area should be included in the urban area.

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As soon as the location of the urban boundary has been determined, it should be recorded "U" in Column 72, on Form INV 1 or 2, depending on the form being used at the time. The location of the urban boundary will also be logged on Form INV 7. The inventory of the urban area will then continue using two Forms, (INV 1 or 2 and 7), upon which to record the basic roadway data in urban areas.

At the boundary where the inventory is leaving the urban area and returning to rural, the location is logged on both Forms INV 1 or 2 and 7. The inventory is then continued on Form INV 1 or 2, as appropriate. It should be noted that when entering or leaving an urban area the entries on Form INV 1 or 2, and 7, to note these locations should be complete. That is all types of appropriate information that is available for these locations should be recorded. For example, as a minimum, the type and widths of pavements and shoulders should be recorded at these locations.

If it is desirable in order to expedite the inventory of the rural highways, or if detailed information in urban areas is not wanted, the initial work in the urban areas may be limited to driving the inventory car over the route noting the distance traversed in the urban area and also noting only kilometer posts and junctions with other national routes. Then, if detailed information is desired, a specially trained inventory crew can collect more complete data on the highways within urban areas at a later date. However, if detailed inventory information for urban areas *is* desired, it is recommended that this information should be collected while conducting the rural inventory as it will ultimately save much travel and time.

The party chief who is doing the highway inventory in the urban areas, should first contact the local municipal officials to inform them of the work he intends to do. He will ask them for maps or other data which will aid him in verifying the location of the routes through the urban area and the names of streets. Copies of maps should be obtained and kept for the road inventory files, where possible, to supplement the field data sheets.

Form INV 7 is used to record supplemental data on extensions of national and provincial

highways in urban areas. (It is not intended that this form be used to record data in an inventory of local city streets.) Form INV 2 will be used to record the basic roadway data within the urban areas. It will be completed in the same manner as in a rural area, except that the data fields for signs (Columns 22 through 26) and for fences (Columns 39 through 44) will be left blank. Likewise, structure types 23, 24, and 25 (Columns 27 through 29) will not be recorded. For divided roadways, Columns 45 through 68 will be used to record roadway cross section data. For undivided roadways Columns 45 through 58 will be left blank and the data field from Columns 59 through 68 will be used to record roadway cross section data. The fields entitled "Traveled Way" (Columns 48 through 51 and 62 through 65) are intended for describing the portion of roadway which is used for moving traffic. The fields entitled "Shoulder" (Columns 45 through 47, 52–54, 59–61, and 66–68) are intended for describing the portion of the roadway which is available for emergency stopping and/or parking. The sum of the widths reported for traveled way and shoulders is the total roadway width. For a curbed street section the sum of the traveled way width plus the parking lane widths (the parking lane widths will be reported in the data fields normally used for shoulder widths) is equal to the curb-to-curb width. If there are no shoulders or parking lanes delineated, or clearly marked by use, then the total roadway width can be reported as "traveled way," in the same manner as was done in rural areas.

Forms INV 3, 4, 5, and 6 will be used to collect complete data on structures, railroad crossings, tunnels, and ferries, using the same procedures as in rural areas.

Small urban areas or population centers where the land use and road characteristics change very little should be considered rural. When preparing to undertake an inventory, a minimum population should be established as constituting an urban area—urban areas with less than 2,000 population have been considered rural in several studies.

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Appendix I—Urban Area Identification Codes

(This appendix should be prepared by the agency using the manual. It would contain 3-digit codes to be used to identify the urban areas.) The lists of urban areas should only include those cities over a minimum population and should be listed by district, province, or state. The minimum population used in several studies was 2,000.

EXAMPLE OF APPENDIX I

URBAN AREA IDENTIFICATION CODES

CITY	*POPULATION*	*DISTRICT*	*CODE*
Almirante Brown	137,000	Buenos Aires	001
Arrecifes	10,000	Buenos Aires	002
Bolivar	16,000	Buenos Aires	003
Capilla Del Senor	4,000	Buenos Aires	004
Colon	10,000	Buenos Aires	005
Arroyito	4,000	Cordoba	001
Bell Ville	19,000	Cordoba	002
Cordoba	586,000	Cordoba	003
Cosquin	9,000	Cordoba	004
Dean Fumes	16,000	Cordoba	005
Devoto	3,000	Cordoba	006

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Appendix J—Highway Route Identification Codes

(This appendix should be prepared by the agency using the manual. It would contain the necessary four digit codes to identify the highway routes which are to be inventoried.)

EXAMPLE OF APPENDIX J

HIGHWAY ROUTE IDENTIFICATION CODES

Route No.	*Code*
1	0001
2	0002
3	0003
4	0004
5	0005
6	0006
7	0007

ROUTES WITHOUT NUMBER

Province	*Section*	*Code*
Buenos Aires	Campo de Mayo—Moron	SN01
Buenos Aires	El Palomar—Haedo	SN02
Chubut	Jct National Route 3 to access to Puerto Lobos	SN17
Chubut	Jct. National Route 3 to access to Puerto Madryn	SN18

Appendix K—Traffic Sign Identification Codes

(This appendix should be prepared by the agency using the manual. It would contain the necessary four digit codes to identify the highway signs which are to be recorded in the inventory.)

EXAMPLE OF APPENDIX K

TRAFFIC SIGN IDENTIFICATION CODES

WARNING SIGNS

Changes in horizontal alignment	WA01
Intersections	WA02
Advance Warning of Control Devices	WA03
Converging Traffic Lanes	WA04
Narrow highways or bridges	WA05
Changes in highway design	WA06
Grades	WA07
Roadway surface conditions	WA08
Railroad crossings	WA09
Entrances and crossings	WA10

REGULATORY SIGNS

(1) *Right of way Series*	
Stop sign	RE01
Yield Sign	RE02
(2) *Signs controlling speed*	RE03
(3) *Movement Series*	
Turning	
Alignment	RE04
Exclusion	RE05
One-way	RE06
(4) *Parking Series*	RE07
(5) *Pedestrian Series*	RE08
(6) *Miscallaneous Series*	RE09

GUIDE SIGNS

(1) Giving directions to destinations, or to streets, or highway routes at intersections or interchanges	GU01
(2) Furnishing advance notice of the approach to intersections or interchanges	GU02
(3) Directing drivers of vehicles into appropriate lanes in advance of diverging or merging movements	GU03
(4) Identifying routes and directions on those routes	GU04
(5) Showing Distances to destinations	GU05
(6) Indicating access to general motorist services, rest, scenic, and recreational areas	GU06
(7) Providing other information of value to the driver	GU07

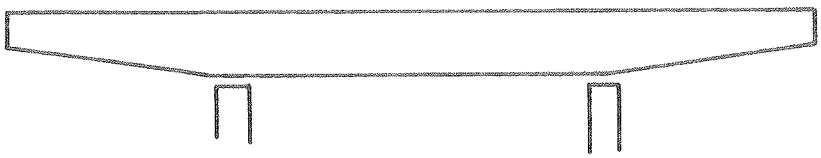
Appendix L—Identification of Structure Class

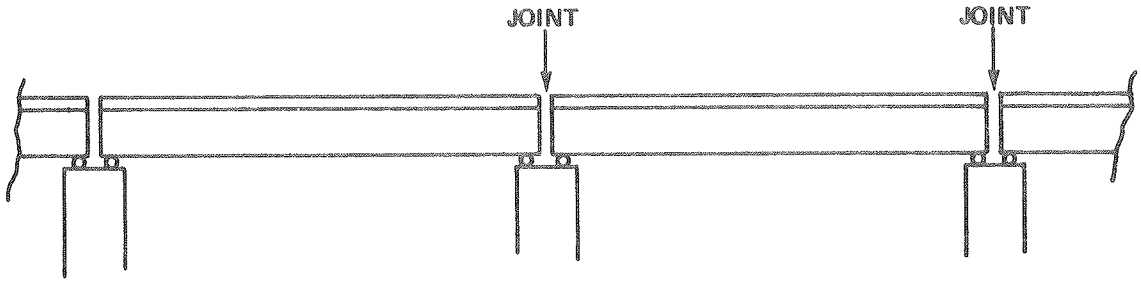
(This appendix should be prepared by the agency using the manual. It would contain drawings of typical structure types in common use and show the codes to be used to identify the structures on the inventory forms.)

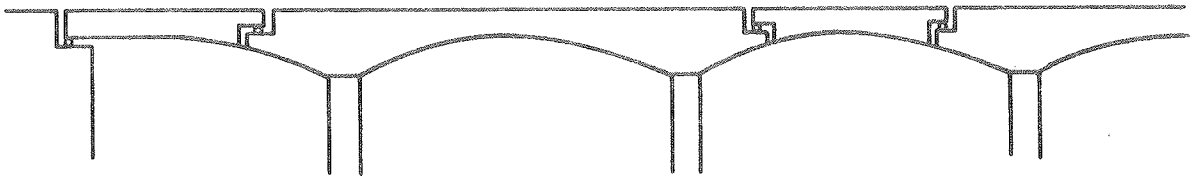
EXAMPLE OF APPENDIX L

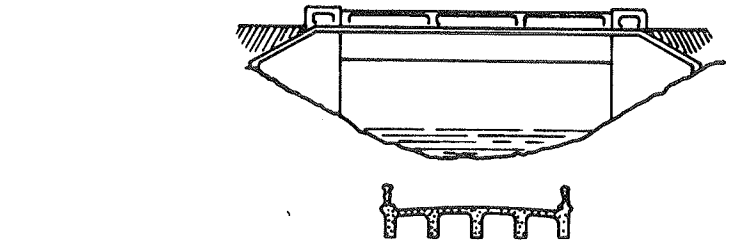
CLASS OF STRUCTURE

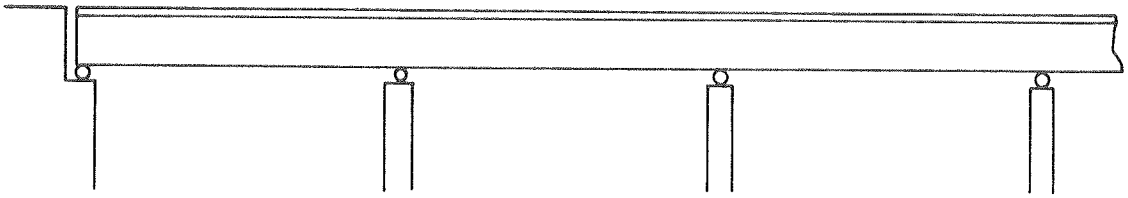
10 - BEAM OR GIRDER











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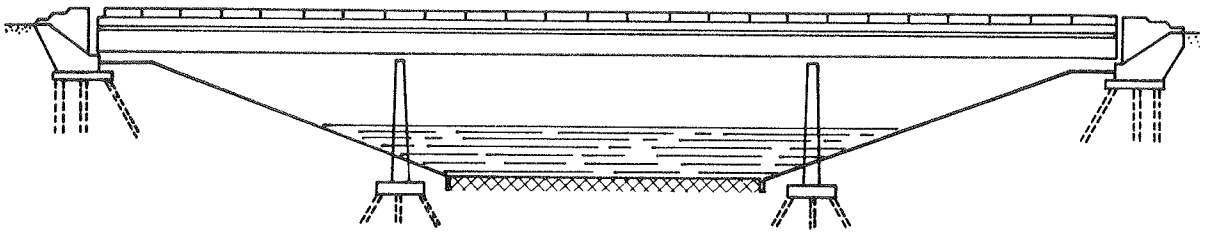

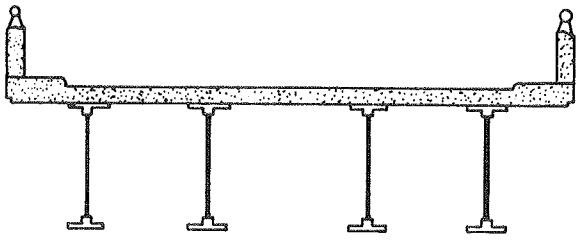

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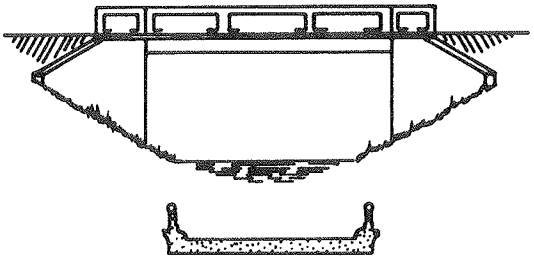

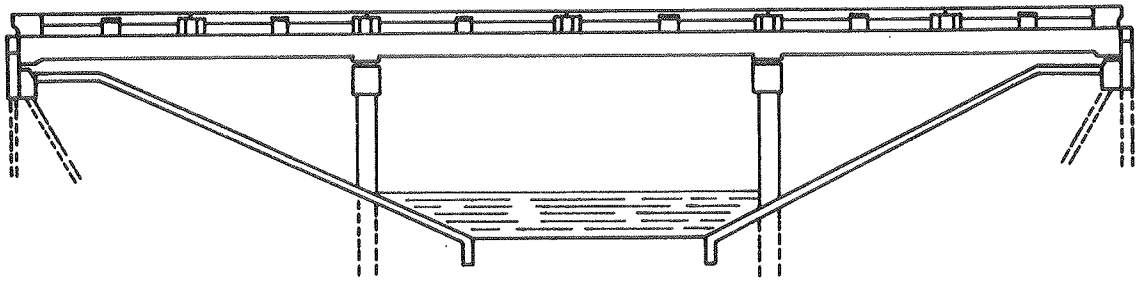

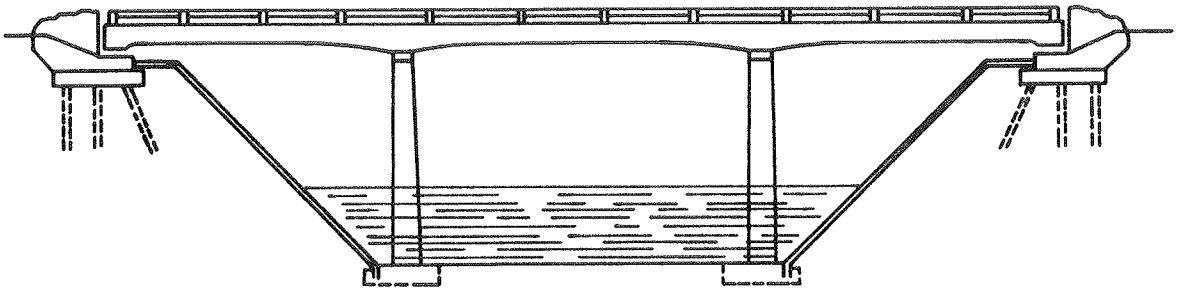

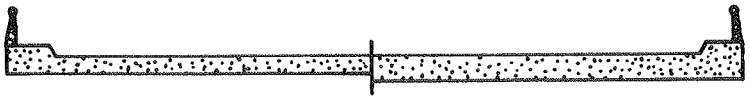

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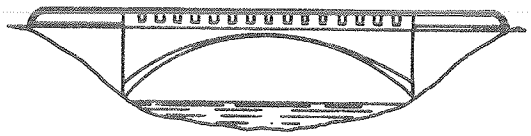

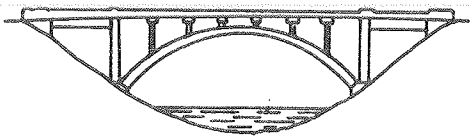

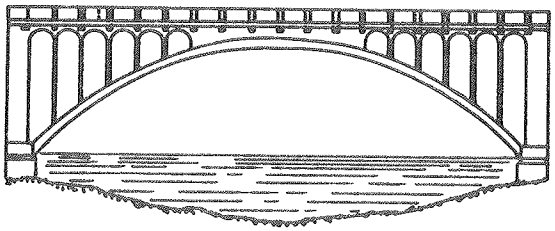

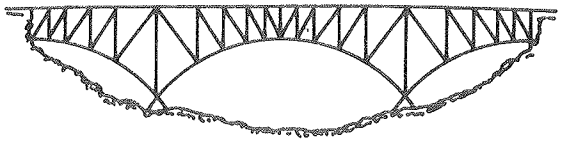

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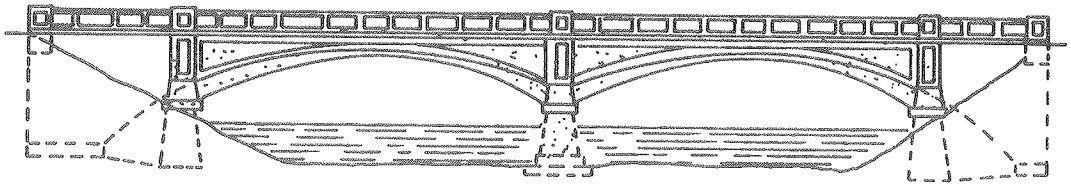

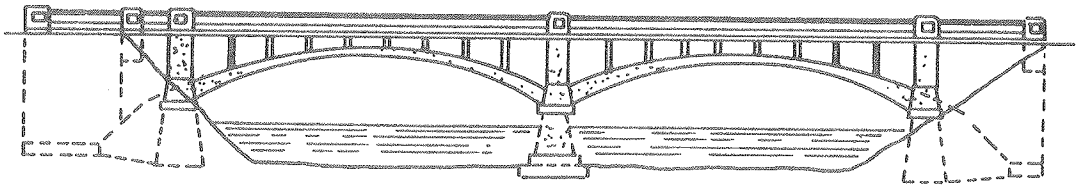

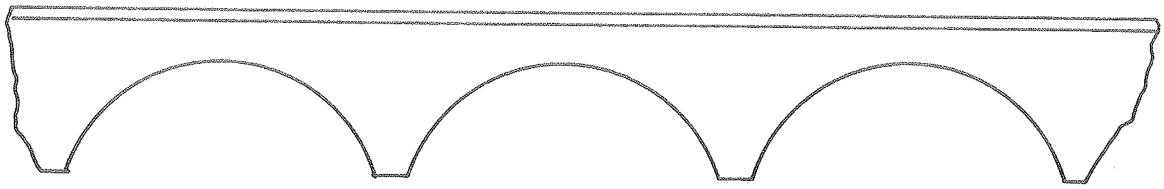

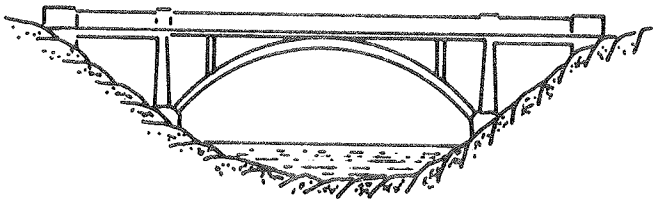

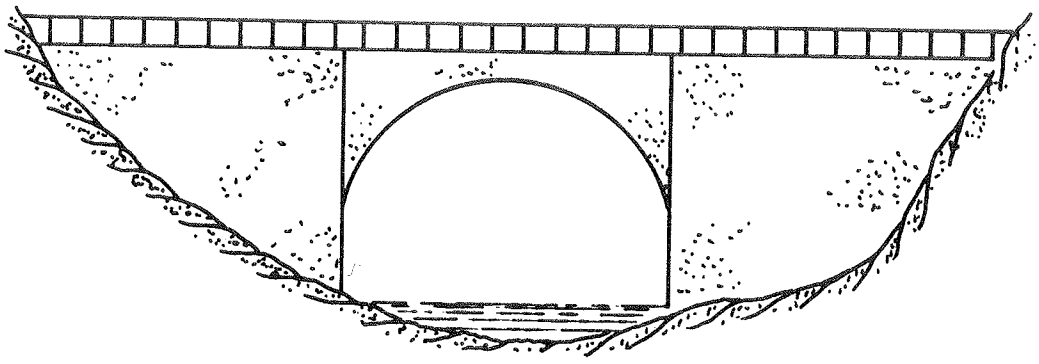

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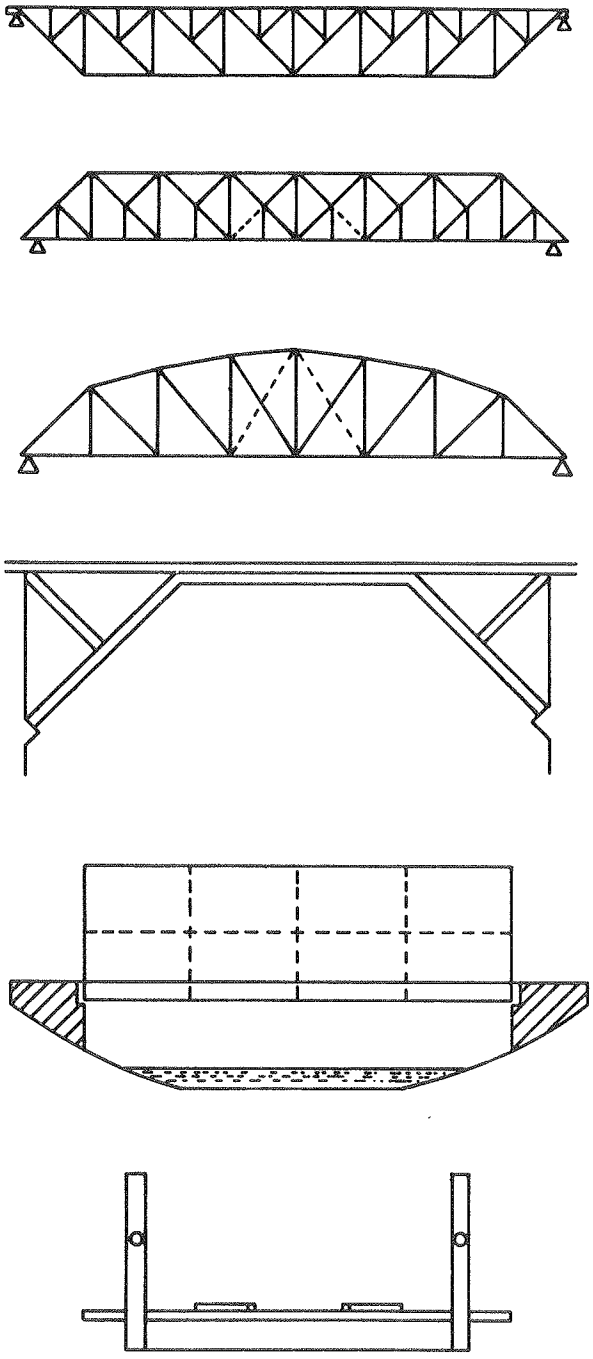

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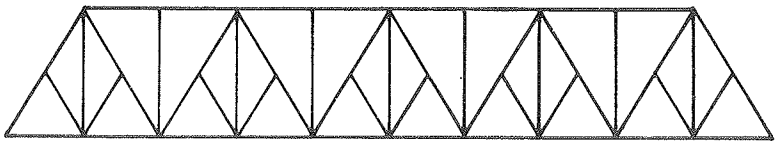

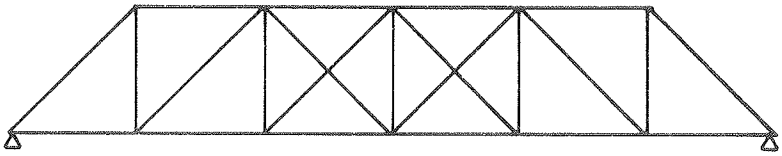

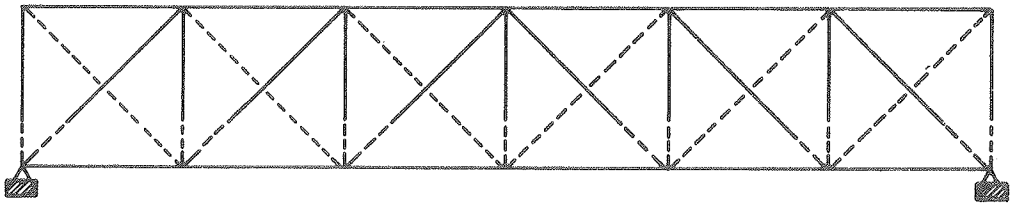

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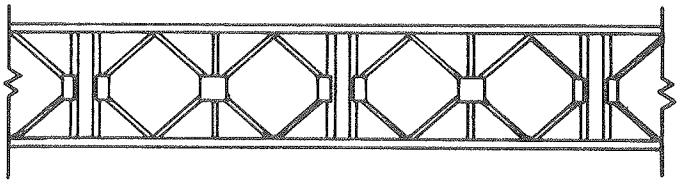

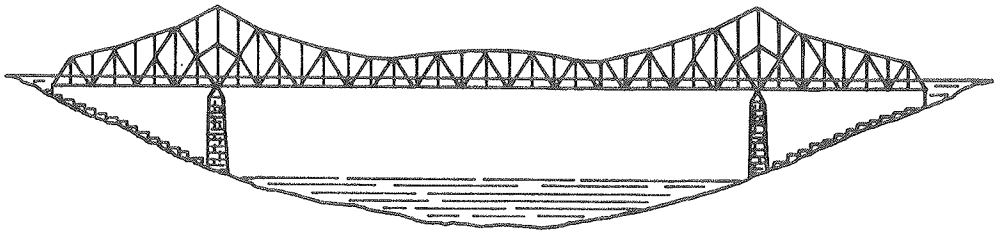

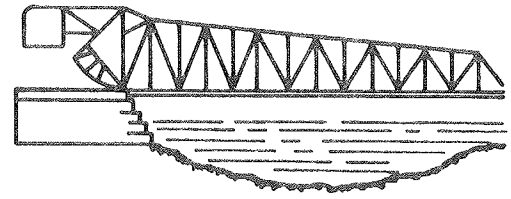

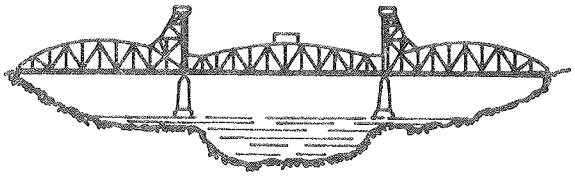

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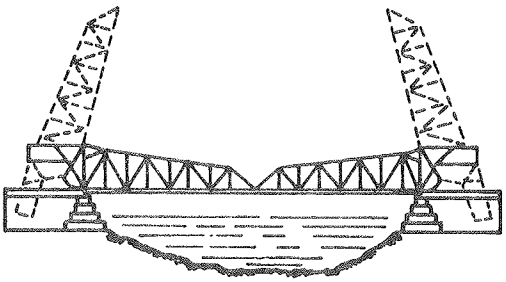

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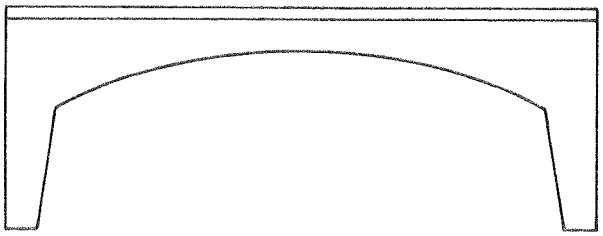

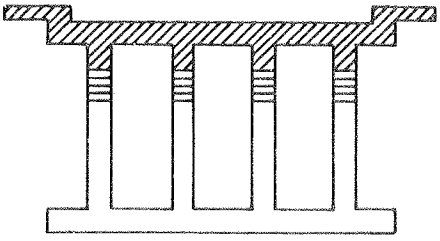

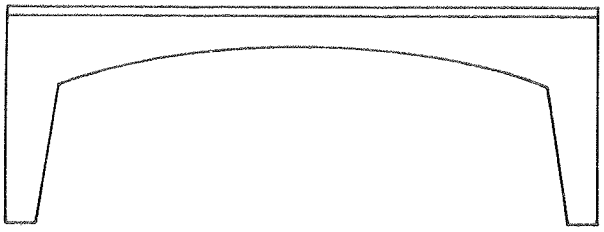

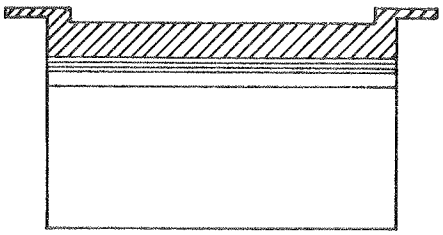

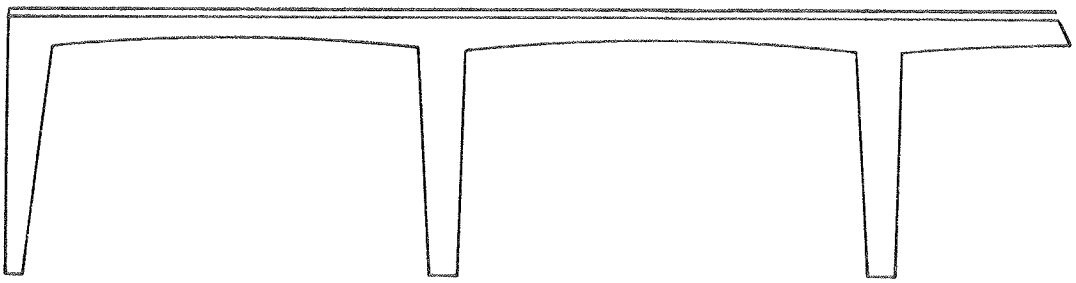

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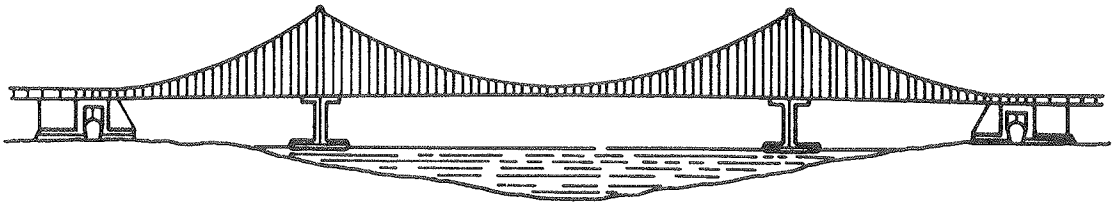
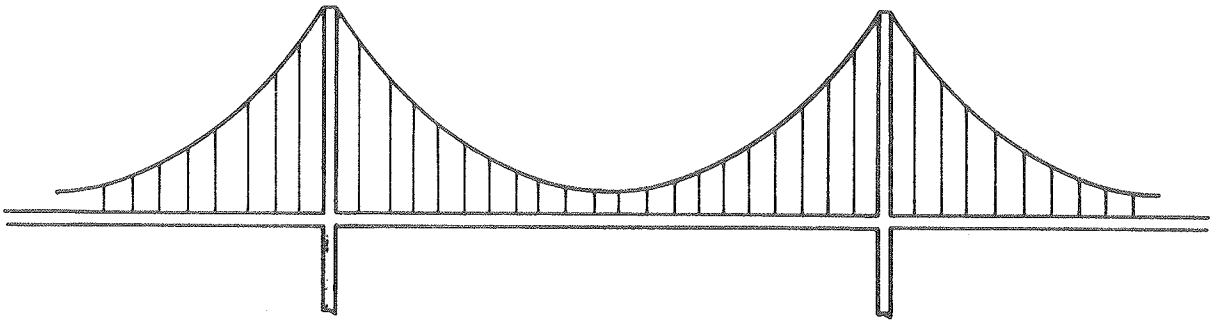
60 -- SUSPENSION





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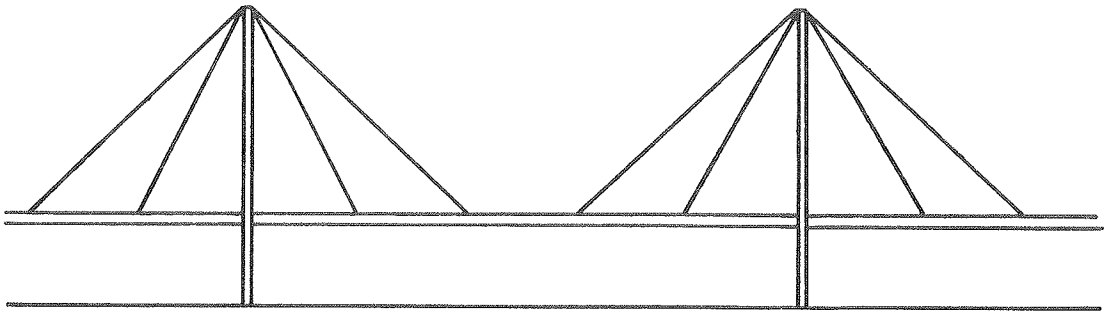
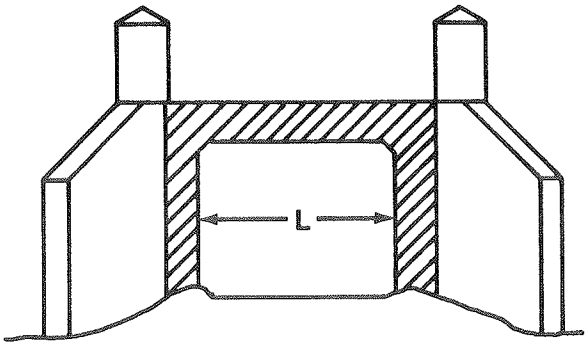


CULVERTS

81 – BOX CULVERTS



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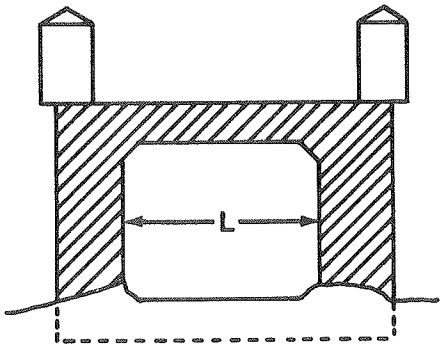
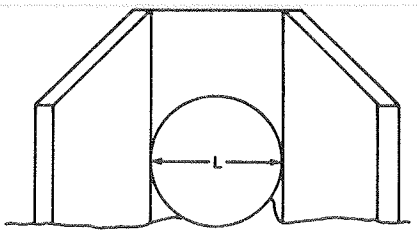
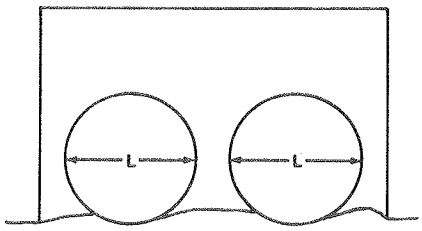
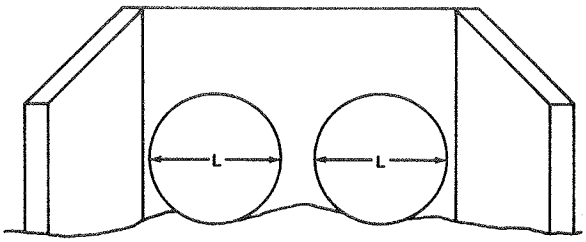


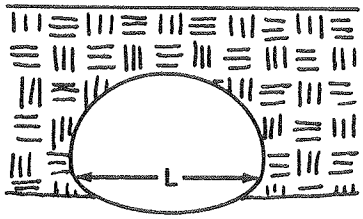
82—CIRCULAR PIPE CULVERT

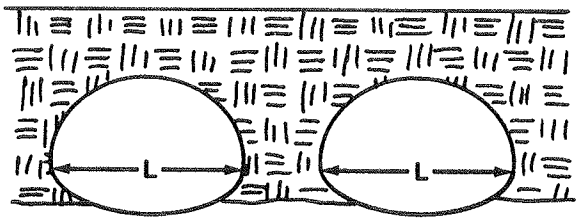






83—ELLIPTICAL PIPE CULVERT





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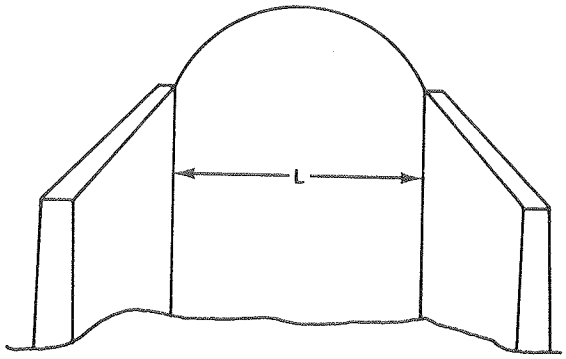
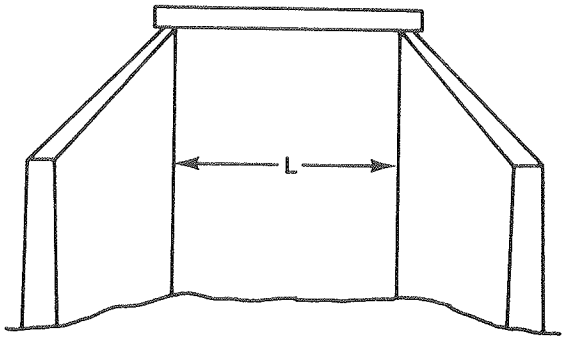
84—ARCHED BOX CULVERT



85—BOX CULVERT WITH DECK SLAB



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Appendix M—Special Instructions for Coding Equations (Col. 17)

(Forms INV 1 & 2)

Codes 7 & 8 will be used to show road construction in progress. When such construction is encountered, there will be two possibilities:

1. It will be possible to drive over the final location of the section of road under construction, or;

2. It will not be possible to drive over the final location of the section of road under construction. Therefore, a detour will have to be used.

In case number 1, where the section of road under construction can be driven over, the exact locations of the beginning and end of construction should be located, if possible. This information may be determined from the construction stakes, or from the project engineer, or some responsible person working on the project. If the exact location of the beginning and end of construction *cannot* be determined, it should be estimated as nearly as possible and noted in the comments that the location is an estimate. The section of road under construction should then be inventoried in the usual fashion logging all information that will be permanent. For example, the location and description should be recorded for all structures that are completed, or that will serve the road after the construction is accomplished. If available, information on fences, right-of-way widths, types and widths of pavements, and shoulders may, also, be included. Care should be taken to log only that information that will be valid after the construction is completed and explain in the comments any pertinent information. For example, when information on a structure is being recorded, it should be noted if it is a new structure or an old one that will continue to be used.

In case No. 2, if it is *not* possible to drive over the road section under construction, then one of the following procedures should be used:

1. If the exact location of the beginning and end of construction *can* be determined, as outlined above, the location of the beginning will be recorded using a code 7 under Column 17. The inventory will then continue from the end of construction. The odometer should be reset to zero at this point to continue the inventory. All types of information that are available will be recorded at this point including a code of 8, under Column 17.

2. If the exact location of the beginning and end of construction *cannot* be exactly determined, then the location of the last permanent reference point before the construction begins, will be used to stop the inventory. A note to this effect should be made in the comments. The entry locating this last permanent reference should also include a code of 7 under Column 17. The inventory will then continue from the first permanent reference beyond the end of construction. At this point the odometer should be reset to zero, and all types of information that are available at this point should be recorded including a code of 8 under Column 17.

It should be noted that anytime a code of 4, 6, or 8 is coded under Column 17, indicating an end of gap, end of superimposition, or end of construction, at this point, the odometer should be reset to zero, and all types of information that are available at this point of continuing the inventory should be recorded.

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Guide for

MANUAL OF INSTRUCTIONS

for

TRAFFIC SURVEYS

1976

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An effective highway transportation planning process is the basis for, and is a necessary continuous part of efficient highway transportation management. This series of manuals and accompanying computer programs were developed to provide guidelines for establishing a system and the basic data collection programs and analysis that are a necessary beginning for accomplishing such a planning process. This series of manuals includes:

1. Outline of the Highway Transportation Planning Process
2. Guide for a Manual of Instructions for Road Inventory
3. Guide for a Manual of Instructions for Traffic Surveys
4. Guide for a Functional Classification of Highways
5. Guide for a Manual for Highway Adequacy Rating
6. Measuring Highway Improvement Needs and Priority Analysis
7. Computer Program User's Manual

It should be acknowledged that many of the procedures as described in these manuals have been taken from, or patterned after numerous published sources. Included in these sources are publications of the U.S. Federal Highway Administration, State Highway Departments and the U.S. National Association of County Engineers.

This manual describes in detail the process for inventorying the use of highways. Included in the inventory is the volume, distribution of type, and weight characteristics of the traffic using the highways. This information is needed during the process of planning, designing, and operation of an efficient highway program.

Table of Contents

THE TRAFFIC INVENTORY

A. INTRODUCTION

The planning of a highway improvement program should start with a foundation of knowledge about the physical nature and use of the existing highway system. This information is collected during the inventory process. This includes the inventory of the physical features and condition of the highways, as well as the use to which each section of highway is put. The inventory of the physical features and conditions are subjects of other manuals. This manual will outline the procedures to inventory highway use. The manual will be in three parts as follows:

1. *Mechanical Counting*—This section includes instructions for making traffic volume counts.

2. *Classification Counting*—This section includes instructions for making the necessary counts to determine the distribution of motor vehicles by type using the highways.

3. *Truck Weighing*—This section includes instructions for undertaking a truck weighing program to determine the weight characteristics of the different types of motor vehicles using the highways.

The inventory programs as described above will provide the minimum basic information needed to plan and operate an efficient highway transportation program.

B. METHOD

This manual will not make recommendations regarding the organization that will be needed to undertake the detailed operational procedures for accomplishing a traffic inventory. These are normally problems that have to consider local conditions and organizational practices for solution. It is the objective of this manual to assist in determining the number and location of counting or weighing stations that will be needed, and the length of time that each should be occupied. Also, included are examples of field forms upon which the traffic data should be recorded, and the instructions for completing these forms. These formats must be used in order to utilize the package of computer programs that have been developed to analyze the data. See the "Users Manual for Computer Programs" for examples of the outputs that will be produced by these programs.

The traffic surveys as described in this manual are comprehensive in scope and are recommended when a new territory or country is being studied for the first time. Such an extensive program may also be considered, if a resurvey is being made after a lapse of counting for several years, or because of a major change in economic conditions, etc. After the comprehensive traffic survey has been underway for three or four years, under normal conditions, it can be substantially reduced.

The Highway Planning Department should continually evaluate the costs of collecting and analyzing different types of data. These costs should then be compared to the value of the uses to which the data are put. If the costs of collecting a certain type of data exceeds the value of its use, one of the following solutions should probably be considered.

1. The program should be reduced in proportion to its need, and or,

2. A cheaper method for collecting the information should be explored, using latest technological advances.

I. MECHANICAL COUNTING

A. INTRODUCTION

The volume of traffic that is using each section of highway is basic information that is needed in the planning, design, maintenance, traffic control, programming, and general administration of a highway program. Therefore, the objective of a mechanical traffic counting program is to obtain, at a minimum of cost, the data that is needed to make estimates of traffic volumes which are within acceptable tolerances of accuracy.

Absolute accuracy in measuring traffic volumes on every section of highway would require counting vehicles continuously on those sections. Such a program would be prohibitively expensive. With the recurring pattern of traffic flows, daily, weekly, and seasonally, it is possible to utilize recognized statistical techniques which will provide volume figures for a minimum expenditure of manpower and money with the desired degree of accuracy.

Estimates of traffic volumes utilizing these techniques can be made by correlation of information obtained at selected locations representative of many kilometers of highways where traffic is counted. The three types of mechanical traffic counts are:

1. *Continuous Counts*—These counts are obtained, as the name implies, at locations where an automatic vehicle detector or sensor, recorder, and sometimes memory device are installed to count and record the number of vehicles passing a location during each hour (or some lesser period if desired) for each day throughout the year and normally over a number of years.

2. *Seasonal Counts*—These counts are made on sections of highways to determine which seasonal traffic pattern or group the section belongs to. Normally, after the determination has been established, the count is discontinued. These counts are made using automatic traffic detectors and recorders, usually for seven consecutive days and repeated on a predetermined schedule of *six, or twelve times each year.*

3. *Coverage Counts* — These counts are needed at each location that an estimate of ADT is desired. Traffic volume information is needed at sufficient locations to be representative of each significant section of each system of highways. Automatic traffic detectors and recorders may also be used at these locations, installed for a period of 24 or 48 consecutive hours, usually once each year. It should be noted, however, that the smaller, accumulative (non-recording) type mechanical counters are usually used to make coverage counts of short duration. These accumulative counters are much cheaper, easier to haul, and require less time to put into operation and to pick up. The disadvantage is that the counts are not mechanically recorded at periodic intervals. It is, therefore, more difficult to get counts of exactly 24 or 48 hours. It is also more difficult to detect if there has been an error in the count.

The number of counting locations that any country will need for comprehensive coverage will depend primarily upon the diversity of travel patterns within the country. An efficient and accurate method for determining the traffic patterns and guidance on the number and location of count stations are described in the "Guide for Traffic Volume Counting Manual." This guide which was prepared by the U.S. Federal Highway Administration, includes detailed guidelines on procedures to follow for developing an efficient mechanical traffic counting program.

B. METHOD

A copy of the "Guide for Traffic Volume Counting Manual" is included as Appendix C.

II. CLASSIFICATION COUNTING

A. INTRODUCTION

In order to be able to plan, design, construct, and operate an efficient system of highways, it is important to have accurate estimates of the present and future traffic demand on this system. This needed traffic information includes traffic volumes, physical characteristics, and weight characteristics of the highway travel. This section of the traffic inventory manual concerns determining the distribution of vehicles by type that are using each section of highway.

Vehicles of different sizes and weights have different operating characteristics which must be considered in highway design. Besides being heavier, trucks generally are slower and occupy more road space; and consequently, impose a greater traffic load on the highway than do passenger vehicles. The overall effect on traffic operations of one truck is often equivalent to several passenger vehicles. Thus, the larger proportion of trucks in a traffic steam, the greater the traffic load, and the more highway capacity is required. Therefore, this information is of particular importance when determining the geometric and structural design of the highway facility and in determining its economic values. It is also basic to the determination of ton-miles of commodity movement by highway, and is necessary information for the solution of most all highway economic and design problems.

B. METHOD

At the present time the primary method used for motor vehicle classification is by observation. Manually counting the distribution of vehicles is generally considered expensive, and more efficient machine methods have been developed. However, most existing classification counting programs are still being accomplished using manual methods.

The program outlined below may be considered as a maximum practical scope. It is recommended only when a new territory or country is being studied for the first time. The recommended number of stations and duration of counts for a comprehensive program are as follows:

1. At continuous count and seasonal control stations located on roads having an average volume of 2,000 or more vehicles per day, 24-hour counts on two weekdays; one Saturday, and one Sunday, are made four times a year seasonally spaced. This would total 16 full days count each year.

2. At the remaining continuous count stations, 16-hour, ordinarily at 6 a.m. to 10 p.m., counts should be made on one weekday, one Saturday and one Sunday, four times during the year, seasonally spaced.

3. At the remaining seasonal control stations, 8-hour counts, ordinarily 10 a.m. to 6 p.m., should be made on one weekday four times during the year, seasonally spaced.

4. Classification data may also be collected for special requirements as needs of the highway department. Such special studies are usually to provide information on a one-time basis rather than continuing basis.

5. Vehicle classification counts should, also, be made in conjunction with the truck weight study. As a minimum, classification counts should be made during the same period as the weighing operations. It is desirable, however, that the classification counts should be made for a 24-hour period encompassing the period in which weighing operations are conducted.

6. After 2 or 3 years data are available using the above schedule it should be statistically analyzed to determine how much the program may be reduced without significantly reducing the accuracy of the data.

The data collected for this study should be coded on Form CVT 1. See Appendix A for a copy of this form. (See page 13.) The instructions for completing this form follow.

C. FORM CVT 1 CLASSIFICATION OF MOTOR VEHICLES

Form CVT 1 is the field form upon which motor vehicle classification count data are coded. Detailed instructions for completing this form follow.

NOTE: Code a zero under any column where a number is not needed.

CARD TYPE—COLUMNS 1 & 2:

The code 40 will be preprinted on the forms. It identifies the type of card to be used for recording motor vehicle classification data.

DATE—COLUMNS 3 THROUGH 8: The day, month and year that the classification counts are taken are shown in these columns.

DAY OF THE WEEK—COLUMN 9: This column is to show the day of the week that the survey is made using the following code:

Monday	=L	Friday	=V
Tuesday	=M	Saturday	=S
Wednesday	=W	Sunday	=D
Thursday	=J		

DURATION OF THE COUNT IN DAYS—COLUMN 10: This column is to show the number of consecutive days that the classification count is taken. For example, if the count is made for only one day, or fraction thereof, a 1 would be coded, if a count is made for two consecutive days, or fractions thereof, a 2 would be coded, etc.

DISTRICT—COLUMNS 11 & 12: Enter the District or State Code:

Example:

01 Buenos Aires (North Zone)	14 San Luis
02 Cordoba	15 Misiones
03 Tucuman	16 Santiago del Estero
04 Mendoza	17 Entre Rios
05 Salta	18 Chaco
06 Jujuy	19 Buenos Aires (South Zone)
07 Santa Fe	20 Rio Negro
08 La Rioja	21 La Pampa
09 San Juan	22 Formosa
10 Corrientes	23 Santa Cruz
11 Catamarca	24 Tierra del Fuego
12 Neuquen	
13 Chubut	

STATION NUMBER—COLUMNS 13 THROUGH 15: After the vehicle classification program has been developed, the location of each station is usually plotted upon a map and given a number. The station number is then coded under these columns.

JURISDICTION—COLUMN 16: Jurisdiction (or level of government which has responsibility for the road) is coded in this column.

Example:

1 National	6 National Park
2 Provincial	7 Port Authority
3 Departmental	8 Airport Authority
4 Municipal	Ø Other
5 Military	

ROUTE—COLUMNS 17 THROUGH 20: Enter the route number. Use the route codes which have been developed for the road inventory.

REFERENCE POINT — COLUMNS 21 THROUGH 24: Record in these columns the reference point or milepoint at which the classification count station is located. When it is determined in the field of the exact location that a count will be made, the reference or milepoint of this location can be determined by measuring its distance from the nearest fixed reference which was located during the field inventory.

DIRECTION—COLUMN 25: This column will show the direction of travel of the traffic. When codes 1 and 2 are used, two Forms CVT 1 are completed, one for each direction of travel. When code 3 is used only one Form CVT 1 is used. Code one of the following:

1. Distribution of vehicles for one direction only (ascending mileage—The general direction used when making the road inventory).

2. Distribution of vehicles for one direction only (descending mileage—The opposite general direction used when making the field inventory).

3. Distribution of vehicles for both directions of travel.

HOUR—COLUMNS 26 & 27: Under these columns are coded the hours of the day. Therefore, the number of vehicles that passed the station between midnight and 1 a.m. will be recorded on the first line. The vehicles that passed between 1 a.m. and 2 a.m. will be recorded on the second line, etc.

PASSENGER CARS—COLUMNS 28 THROUGH 31: The number of passenger cars are coded under these columns.

PANELS, PICKUPS & LIGHT TRUCK (4-TIRE)—COLUMNS 32 THROUGH 35: The number of panels, pickups and light trucks (4-tired) are coded under these columns.

BUSES—COLUMNS 36 THROUGH 39: The number of buses are coded under these columns.

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(2 AXLE 6 TIRE)—COLUMNS 40 THRU 42: The number of 2 axle 6 tire trucks are coded under these columns.

(3 AXLE SINGLE UNIT TRUCK)—COLUMNS 43 THROUGH 45: The number of 3 axle single unit trucks are coded under these columns.

(2 AXLE TRUCK—2 AXLE TRAILER—COLUMNS 46 THROUGH 48: The number of 2 axle trucks pulling 2 axle trailers are coded under these columns (2–2).

(2 AXLE TRUCK—3 AXLE TRAILER—COLUMNS 49 THROUGH 51: The number of 2axle trucks pulling 3 axle trailers are coded under these columns (2–3).

(3 AXLE TRUCK—2 AXLE TRAILER—COLUMNS 52 THROUGH 54: The number of 3 axle trucks pulling 2 axle trailers are coded under these columns (3–2).

(3 AXLE TRUCKS--3 AXLE TRAILER—COLUMNS 55 THROUGH 57: The number of 3 axle trucks pulling 3 axle trailers are coded under these columns (3–3).

(2 AXLE TRACTOR PULLING 1 AXLE TRAILER—COLUMNS 58 THROUGH 60: The number of 2 axle tractors pulling 1 axle trailers are coded under these columns (2S1).

(2 AXLE TRACTOR PULLING 2 AXLE TRAILER—COLUMNS 61 THROUGH 63: The number of 2 axle tractors pulling 2 axle trailers are coded under these columns (2S2).

(3 AXLE TRACTOR PULLING 2 AXLE TRAILER)—COLUMNS 64 THROUGH 66: The number of 3 axle tractors pulling 2 axle trailers are coded under these columns (3S2).

OTHER VEHICLE TYPES—COLUMNS 67 & 68: The other types of vehicles that cannot be coded under any of the previous columns should be coded under these columns.

CLIMATIC CONDITION—COLUMN 69: The climatic condition that exists during each hour of counting operation should be coded as follows:

1 Good	4 Snow
2 Cloudy	5 Fog
3 Rain	

COMMENTS

Describe under comments anything that may effect or be significant to consider when evaluating the counts. For example, an accident or a nearby section of the road under construction may affect the distribution or volume of vehicles and should be noted.

III. TRUCK WEIGHING

A. INTRODUCTION

As previously indicated, accurate estimates of present and future traffic demand is basic information that is needed to properly administer a highway program. Such an administration requires making decisions on such matters as design criteria, equitable tax bases, regulation of vehicle operation, and the determination of the relative position of highway transportation in the national economy. Vital information that is needed during the evaluation of these decisions is to know the intensities and frequencies of loads being applied to the highways, the dimensions of the vehicle, and the commodities carried.

Truck weight studies provide basic information needed for estimating ton-miles of cargo hauled via highway, year to year changes in axle and gross weight frequencies, and comparison of the characteristics of actual usage with administrative policies. These policies include allocations of highway costs and revenue, size and weight evaluations, establishment of geometric design criteria as related to the size and weight of vehicles. The collection of weight data over time, also, provides important indications of changing patterns in transportation by highway in comparison to other modes of transportation.

B. METHOD

The two general methods that are currently used for obtaining weight data are permanent platform scales and portable scales. In countries which are initiating truck weighing programs it is probable that light weight portable scales will be initially used for their truck weighing program for planning purposes. Portable scales may be easily hauled in pickup trucks or other light vehicles. They can be easily moved and require only one man to operate each scale. Most portable scales can only weigh one end of an axle. In order to weigh both ends of an axle, or all axles of a truck or truck combination simultaneously, two or more portable scales must be used in combination. Scales generally may be placed on the roadway or shoulder, and the truck wheels are positioned on the scale platform. For best results, scale sites should be prepared so that scale platforms are level with the roadway.

Platform scales are generally used at permanent locations and primarily for the purpose of enforcing weight and revenue laws. These permanent stations are generally located at points selected to intercept the greatest percentage of truck traffic. These scales may have platforms large enough to weigh the full truck at one time or just single or tandem axles. If these scales are used to collect planning data then enforcement of the weight laws should be discontinued during this period of weighing for planning purposes. This is to ensure obtaining an unbiased sample of the loading practices of trucks using the highway.

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1. *Locating Truck Weight Stations*

Selecting a suitable site and proper installation of a truck scale are crucial factors in obtaining reliable truck weight data. For all types of installations, permanent and temporary there are certain basic requirements for obtaining true weights.

The weighing site should be located on a generally straight and level section of road to provide the safety and ease of operation that is necessary. The site should be perfectly level for a minimum of 75 feet upstream and downstream from the center of the scale. This will enable most all vehicles to be on a level plane when being weighed. The centerline of the approaches entering and leaving the scale must also be straight

for at least the same distance to assure straight alignment of the longer vehicles while crossing the scale.

Locating weight stations at the end of a long downgrade should be discouraged in order to avoid excessive braking to stop. Brakes will sometimes catch fire on a heavy vehicle that is required to stop near the bottom of a long steep downgrade. Placing the weight stations at the crest of a vertical curve may be satisfactory if proper sight distance, alignment, and level approaches can be provided. The design and placement of prepared sites should be consistent with traffic engineering practices based on traffic volume and speed.

Normally truck weight data for planning purposes is obtained by operating portable scales at various locations for short periods of time during each year. Portable truck weight stations should be located so as to provide data representative of different classes or systems of highways. Other considerations in selecting station locations include traffic volumes, geographic distribution, functional classification of highways, adjacent land use, and distances between stations. Stations should be located so as to minimize bias due to high truck volumes or due to specialized usage or other causes, and should represent different vehicle type mixes within a system to the extent practicable. Care should be taken to locate stations so it is difficult to bypass the stations.

2. *Number of Weighing Stations Needed for Planning Purposes and Operating Schedule*

The following may be used as a guide in determining the minimum number of rural stations required to provide sufficient weight data for planning purposes.

Classification of Highway	*Kilometers (Rural)*	*No. of Stations*
Principal Arterial	Under 800	3
	800–2,000	5
	over 2,000	7
Primary Arterial	Under 2,000	3
	2,000–8,000	5
	over 8,000	7
Secondary Arterial	Under 4,000	3
	4,000–10,000	5
	over 10,000	7
Collectors	Under 8,000	3
	8,000–20,000	5
	over 20,000	7

Additional stations may be added where it is believed the above stations are not sufficient to provide data representative of the loading practices on the different classes or systems of rural roads.

3. *Station Layout*

The following activities should be considered when laying out a truck weight station for planning purposes both permanent and portable:

a—Sampling of trucks
b—Interviewing the truck drivers
c—Measuring activities
d—Weighing activities

Vehicle classification counting is generally accomplished independently of the other truck weighing activities.

When weighing trucks at night, *it is absolutely essential to have adequate lighting.* This is necessary to enable the station personnel to obtain and record the data correctly and efficiently, as well as for the safety of the entire operation.

Roadside signing is important for both permanent and temporary weighing stations. The signing should indicate that the weighing is for planning purposes only and that all trucks are subject to weighing, not just the heavier trucks and no penalties will be levied. As a minimum, signs should instruct truckers to reduce speed, advise that weighing operations for planning purposes only are in progress, and indicate turnoff points.

A flagman will be needed to direct traffic. Signs should be appropriately spaced for the operating speed of the highway.

4. *Period of Operation*

If there has been no previous comprehensive weighing program for planning pur-

poses, the following guideline should be followed:

a. Each station should be operated 16 hours, 8 hours during the period 6 a.m. to 6 p.m., and 8 hours during the period 6 p.m. to 6 a.m., four times a year seasonally spaced on a weekday, except that the night operations may be limited to those roads carrying an important amount of commercial traffic during the night hours. Additional weighing may also be made on Saturday and Sunday if it is believed that the loading characteristics of trucks are substantially different on weekends than on weekdays.

b. After 2 or 3 years data have been collected using the above schedule, it should be statistically analyzed to determine if there is a significant difference in loading practices between hours of the day, seasons of the year, and road systems. If there is not a significant variation in the loading practices the above schedule of operation can be substantially reduced.

5. *Weighing Procedure*

A properly installed and adjusted platform scale is probably the most accurate and dependable method for obtaining static weights of trucks. Prior to commencing weighing operations the weighman should check the zero load balance with no load on the platform; this check should also be made frequently during weighing operations. The total vehicle weight and weights for each axle should be obtained. It is important to obtain weights of each axle of a tandem pair. Research has shown that the total weight carried by a tandem pair is not evenly distributed between the two axles. Weights for individual axles of a tandem pair are obtained by splitting the tandem—weighing the truck with one axle of the tandem on the scale and one off. For large combinations, this procedure will require positioning the truck several times on the scale and taking scale readings for each position. Brakes should be released before taking a weight reading.

Weighing trucks with portable scales presents a number of problems not encountered in platform scale operations. There are several variations in portable scale set-ups that could affect accuracy due to weight transfer even though all factors are favorable. The different methods of setting up portable scales are:

a. Two scales set in a pit so the platform of each scale is level with the approaches. The pit extends the full width of the roadway lane or approach and the scales are so placed that the outside wheels of an axle when resting on the scale platforms will carry the entire weight bearing on that axle. By adding the weight readings for each scale the total weight of the axle is obtained. Each axle of a truck or combination is weighed separately and when added together will give the total weight of the truck or combination.

b. Two scales set on a hard level surface with short ramps on each side of each scale. When a truck or combination is weighed on this set-up, each axle while being weighed would be elevated several inches above the other axles. Obviously there would be an undesirable weight transfer, especially with liquid or fluid loads.

c. Two scales set on a hard level surface with long ramped planks on each side of each scale so that both axles of tandems would be at the same elevation while each is being weighed. This method is an improvement over method "b" but there may still be considerable weight transfer as each axle is moved. There are many types of springs, rubber bumpers and axle suspensions that further complicate efforts to secure true weights on scale set-ups using planks or short ramps.

d. The preferred method is to have four or more scales, one for each wheel, set on a hard, level surface with planks and ramps to keep all axles level and on the same plane while all axles are being weighed simultaneously. Of all the planked set-ups (b, c, or d) this method is probably the most accurate.

The reliability and usefulness of truck weight data depend on the care with which

vehicles are weighed. Available data show that for the greatest consistency all wheels of the truck or combination should be on the same horizontal plane with brakes released at the time of weighing. If brakes must be set when weighing with portable scales, they should be released after the vehicle has been stopped on the scales and then reset. To provide reliable data for all axles, the weight of each axle of a tandem axle group should be determined separately since available design and weight information indicate that a large proportion of these assemblies places an appreciably greater load on one of the two axles.

Normally only one weighman is required on a platform scale. With portable scales, one man is required for each scale. Although two men can handle four scales, this practice is not recommended due to the inefficient and slow operation that results.

6. *Measurements*

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The distance between axles for each truck weighed should be measured to permit more accurate calculation of pavement and bridge loadings. Axle spacings should be measured with the vehicle components drawn out in a straight line.

7. *Sampling the traffic stream*

It is important that a representative sample of each vehicle type be weighed at each station. The distributions of axle and gross weights by weight intervals and the percentages of loaded vehicles of each type are determined solely from the sample of vehicles selected for weighing. If possible all trucks should be weighed.

A procedure which has been used successfully to assure unbiased probability sampling at locations where volumes are so great that all passing trucks cannot be weighed is suggested. Using this procedure, each shift of operation is subdivided into short intervals. Intervals of 10 or 15 minutes have been used. The frequently occurring vehicles are assigned one or more intervals each hour on a systematic probability sampling basis. During the assigned period every passing vehicle of the designated type is stopped and weighed. Vehicle types for which periods have been designated are not stopped during undesignated periods. Usually the infrequent vehicle types are stopped and weighed during all periods so that 100 percent samples of these types are obtained. Sampling rates which have been practicable at typical locations provide for weighing of 2-axle, 4-tire trucks (both panels and pickup trucks and other 4-tire) during every fourth interval; 2-axle, 6-tire trucks every third interval; weighing of tractor semi-trailer or truck and trailer combinations during three intervals out of every four; and weighing of all other vehicle types during all intervals. Thus, more than one of the vehicle type categories designated for sampling may be designated for a given interval. At lower volume locations it may be desirable to sample 100 percent of all semi-trailer or truck and trailer combinations. Where volumes are extremely high it may be necessary to reduce sampling rates. When a single vehicle or a fleet of similar trucks passes a station several times a day no vehicle need be weighed more than twice, once loaded and once empty, and a sample of three empty and three loaded truck weighings is adequate for the fleet. All passing vehicles should be counted.

When weighing both directions of a highway, three alternate procedures are available. The preferred method is to weigh each direction independently of the other in separate operations; i.e., one or more 8-hour shifts in one direction and one or more 8-hour shifts in the other direction. This procedure is normally used on divided highways. For example, on Monday trucks may be weighed from 6 a.m. to 2 p.m. in one direction. This same operation would be repeated on Tuesday for traffic in the opposite direction. On Wednesday weighing operations may continue in this original direction from 6 p.m. to 2 a.m. This operation would be repeated on Thursday for the opposing traffic. Therefore, a 16 hour weekday sample would be obtained for each direction of travel.

The second method is to weigh two hours in one direction, then weigh two hours in the other direction, etc., until the 8-hour shift is complete. When using this method it is desirable to have two sets of equipment available to minimize change-over time.

The third method is to weigh both directions of traffic at the same time using scales located on one side of the road. If this method is used, extreme care must be taken to provide adequate safety to the traffic. This will require adequate signing and flagmen. This method can be used only on undivided two-lane highways.

8. *Vehicle Classification Counts at Weight Stations*

Manual vehicle classification counts should be made at all truck weighing stations for planning purposes. Counts should be made for both directions of travel and at least during the period that weighing operations are underway. Part II of this manual outlines the procedures and forms to be used for making these manual counts.

C. FIELD FORM AND INSTRUCTIONS FOR CODING

The data collected for this study should be coded on Form PC-1. (See Appendix "B" for a copy of this form.) Instructions for completion of this form follow:

PARTY CHIEF: Write the name of the party chief.

SHEET __ OF __ SHEETS FOR THE HOUR: A new sheet is started when the weighing operations begin for each shift, and, also, for each hour. The sheets are then numbered to show the number of sheets upon which data are recorded for each hour. At the end of each hour the total number of sheets that have been used during the hour can be recorded on each sheet.

CARD TYPE—COLUMN 1: This information will be preprinted on the forms. It identifies that it is the card type that is used upon which truck weight data for planning purposes will be coded.

DATE—COLUMN 2 THROUGH 6: These columns are used to record the date of the survey. Where a number is not needed in any box, a zero should be recorded rather than leaving it blank.

HOUR—COLUMNS 7 AND 8: These columns are used to record the hour during which the data were collected. Again during the first 9 hours of the day a zero will be recorded in column 7 rather than leaving it blank.

DISTRICT—COLUMNS 9 AND 10: Enter the District Code.

Example:

01 Bs. As. (north zone)	14 San Luis
02 Cordoba	15 Misiones
03 Tucuman	16 Santiago del Estero
04 Mendoza	17 Entre Rios
05 Salta	18 Chaco
06 Jujuy	19 Bs. As. (south zone)
07 Santa Fe	20 Rio Negro
08 La Rioja	21 La Pampa
09 San Juan	22 Formosa
10 Corrientes	23 Santa Cruz
11 Catamarca	24 Tierra del Fuego
12 Neuquen	
13 Chubut	

JURISDICTION—COLUMN 11: Enter the route jurisdiction code.

Example:

1 National	6 National Park
2 Provincial	7 Port Authority
3 Departmental	8 Airport Authority
4 Municipal	Ø Other
5 Military	

ROUTE—COLUMNS 12 THROUGH 15: Enter the route number. Use the route codes which have been developed for the road inventory. The route code is the same as the one used for road inventory.

MILE POINT—COLUMNS 16 THROUGH 19: These columns are used to record the location of the weighing station. The location can be determined by using table 9 of the inventory outputs. This table shows the mile point for all primary reference points. The location of the weighing station can be deter-

mined by measuring its distance from the nearest reference point.

VEHICLE TYPE—COLUMN 20: The vehicle type should be coded in these columns using the following codes:

Code	*Vehicle Type*
0	Automobiles and jeeps
1	Panels and pickup (4-tire)
2	Single unit truck (2-axle)
3	Single unit truck (3-axle)
4	Single unit truck plus trailer
5	Tractor with semi-trailer
6	Other types of trucks
7	Buses

BODY TYPE—COLUMNS 21 AND 22: These columns are used to record the type of body. The following codes should be used:

Code *Body Type*

11 *Panel*—A fully enclosed body of limited capacity which includes drivers compartment.

12 *Pickup*—A small open box or express box.

13 *Light utility*—A body designed to carry readily accessible tools, equipment, and supplies in integrally constructed compartments, with or without other cargo spaces.

15 *Carryall or Minibus*—An enclosed utility body with side windows and one or more removable seats designed for transporting either passengers, light cargo, or both. (Station wagons are considered to be passenger cars and are not included in this category.)

GENERAL TRUCK AND SEMI-TRAILER

21 *Platform, Flat, or Stake*—A body having a floor without sides or roof.

22 *Lowbed Trailer*—A truck trailer with a platform body constructed to provide a low loading height and designed for the transportation of extremely heavy or bulky property.

23 *Rack*—A body with fixed slatted sides and headboard.

24 *Livestock Rack*—A rack body with or without roof designed primarily for transportation of livestock.

32 *Open Top Box or Van*—A body with high closed sides and ends and a movable top, which usually is a tarpaulin cover.

33 *Grain*—A low side open box, designed primarily to transport grains or other dry fluid commodities in bulk.

34 *Dump*—A low side open box, designed primarily to transport dry fluid commodities in bulk, which can be tilted to discharge its load.

35 *Hopper*—A body which is capable of discharging its load by gravity or mechanical power through means other than tilting and usually loaded from the top.

41 *Van*—A fully enclosed body designed primarily for transportation of packaged commodities, household goods, etc.

51 *Tank*—A body designed to haul bulk liquid commodities.

91 *Bus*—A body designed for carrying passengers.

99 *Other*—All vehicles which are weighed and the body type cannot be coded using one of the above codes may be coded other.

PLACE OF REGISTRATION—COLUMNS 23 AND 24: The province or State where the vehicle was registered should be coded in this column.

Example:

01 Bs. As. (north zone)
02 Cordoba
03 Tucuman
04 Mendoza
05 Salta
06 Jujuy
07 Santa Fe
08 La Rioja
09 San Juan
10 Corrientes
11 Catamarca
12 Neuquen
13 Chubut
14 San Luis
15 Misiones
16 Santiago del Estero
17 Entre Rios
18 Chaco
19 Bs. As. (south zone)
20 Rio Negro
21 La Pampa
22 Formosa
23 Santa Cruz
24 Tierra del Fuego

FUEL TYPE—COLUMN 25: The type of fuel that the engine uses should be coded under this column using one of the following codes:

Code	*Engine Type*
1	Gas
2	Diesel
3	Other

AGE—COLUMNS 26 AND 27: Record the age of the vehicle to the nearest year.

EMPTY WEIGHT—COLUMNS 28 THRU 30: Record the registered empty weight of the truck. This will usually include the weight of the body. The weight is coded in tons and tenths thereof.

Example:

Kilograms	*Code*
1,030	010
3,240	032
11,310	113

TYPE OF COMMODITY CARRIED—COLUMNS 31 THROUGH 33: The type of commodity being carried should be written in the space provided. The code for this commodity will then be entered in the office.

FORM OF CARGO—COLUMNS 34 AND 35: Code the form in which the cargo is being carried under these columns.

Example:

01 Bulk
02 Boxes of Cartons
03 Bottles
04 Barrels or Drums
05 Sacks or Bags
06 Bundled, Banded, Baled, etc.
07 Coiled
08 Planks, Layers, etc.
09 Blocks
10 Tanks
00 Other not specified above

ORIGIN OF CARGO—COLUMNS 36 THROUGH 39: The origin of the cargo should be specified. This origin, province, and city, or (State and city) should be written in the space provided. The code for this place will be entered in the office.

DESTINATION OF CARGO—COLUMNS 40 THROUGH 43: The destination of the cargo should be specified. The destination, province, and city or (State and City) should be written in the space provided. The code for this place will be entered in the office.

NOTE: If the origin and destination of the cargo has many locations, such as a local delivery, freight truck, it should be so noted.

WEIGHT OF AXLES—COLUMNS 44 THROUGH 61: The weight of each axle should be recorded in the respective columns. The weight should be recorded in thousands of kilograms, expressed to the first decimal.

Example:

	Kilograms	*Code*
Axle Weight	470	005
Axle Weight	1,270	013
Axle Weight	11,480	115

HEIGHT—COLUMNS 62 AND 63: The height of the truck or load, whichever is higher, the coding should be recorded in meters and tenths.

Example:

	Meters	*Code*
Measured Height is	2.6	26
Measured Height is	3.14	31
Measured Height is	4.37	44

DISTANCE BETWEEN AXLES—COLUMNS 64 THROUGH 77: These columns are used to record the distance between axles. These columns should be recorded in meters and coded to the nearest tenth of a meter.

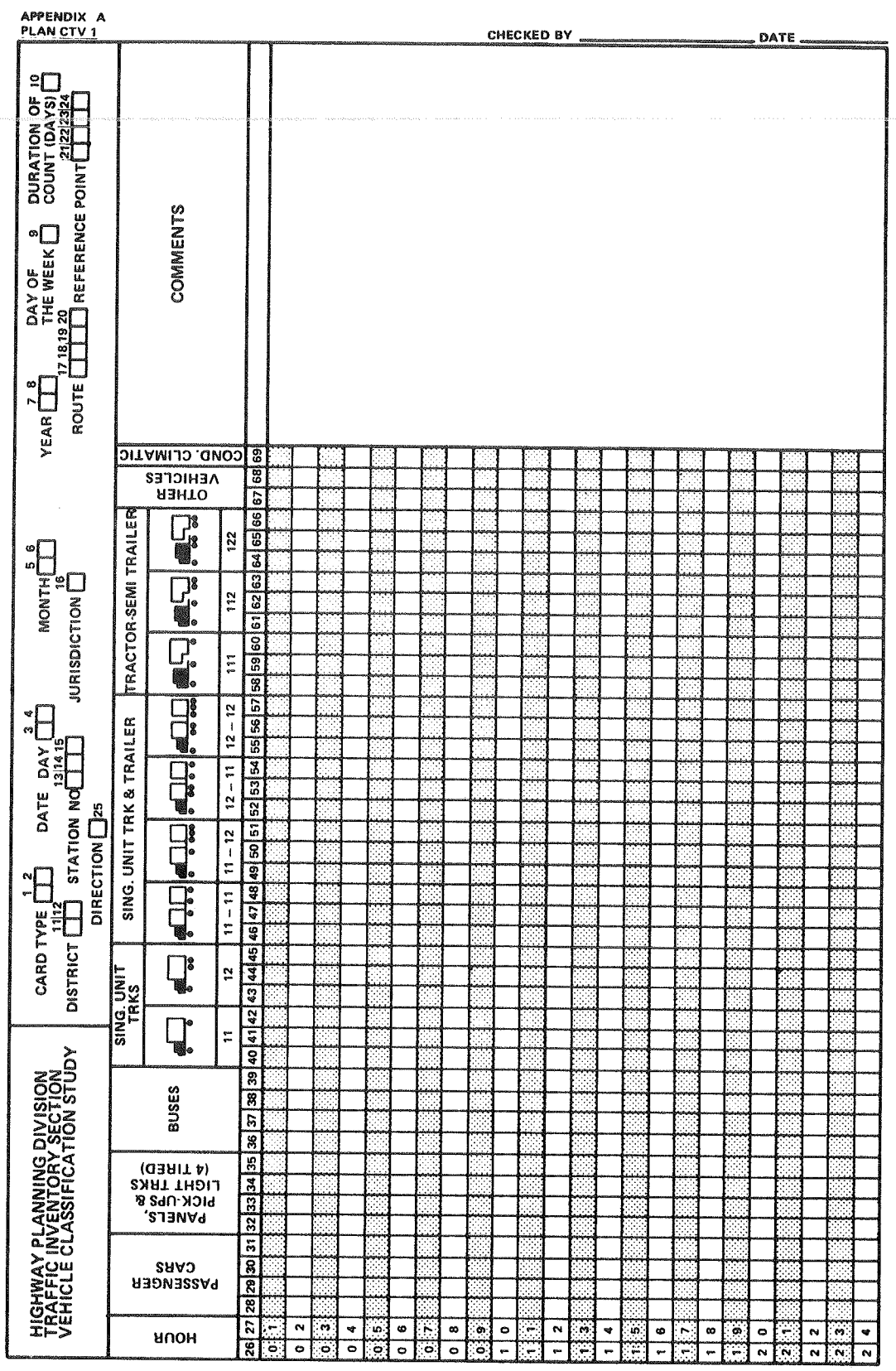
Example:

	Meters	*Code*
Measured Length is	2.52	025
Measured Length is	6.72	067
Measured Length is	14.30	143

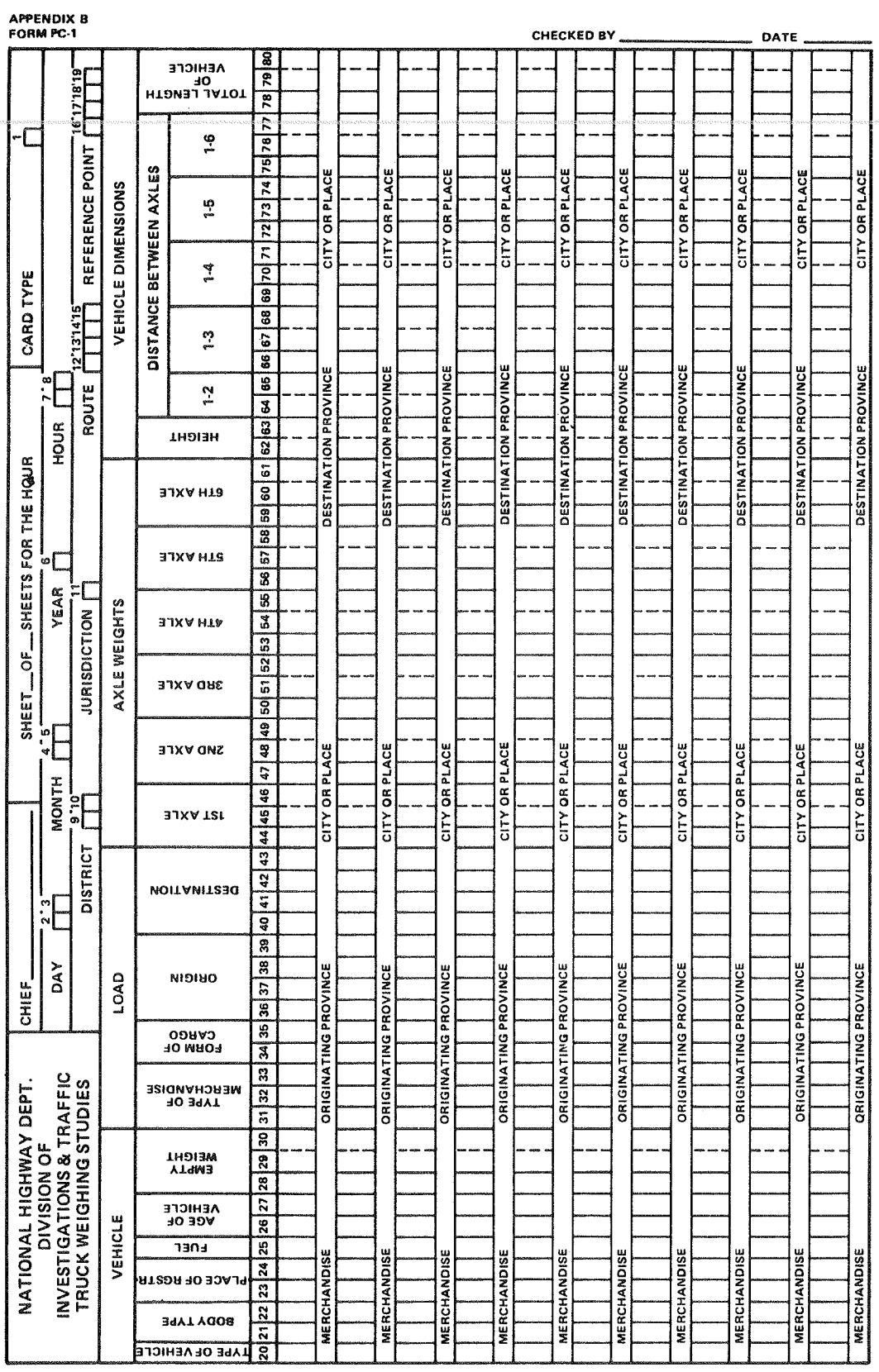
TOTAL LENGTH OF VEHICLE—COLUMNS 78 THROUGH 80: The total length of the vehicle should be shown in these columns. Measurements should be made from the extremities on each end of the vehicle or combination.

Example:

	Meters	*Code*
Measured Length is	5.00	050
Measured Length is	9.83	098
Measured Length is	18.73	187


APPENDIX A
PLAN CTV 1
CHECKED BY
DATE
HIGHWAY PLANNING DIVISION
TRAFFIC INVENTORY SECTION
VEHICLE CLASSIFICATION STUDY
CARD TYPE 1 2
DISTRICT 11 12
DIRECTION 25
STATION NO 13 14 15
DATE DAY 3 4
JURISDICTION 16
MONTH 5 6
YEAR 7 8
ROUTE 17 18 19 20
DAY OF THE WEEK 9
DURATION OF COUNT (DAYS) 10 21 22 23 24
REFERENCE POINT
HOUR
PASSENGER CARS
PANELS, PICK-UPS & LIGHT TRKS (4 TIRED)
BUSES
SING. UNIT TRKS
SING. UNIT TRK & TRAILER
TRACTOR-SEMI TRAILER
OTHER VEHICLES
COND. CLIMATIC
COMMENTS
11
12
11 – 11
11 – 12
12 – 11
12 – 12
111
112
122

200


APPENDIX B
FORM PC-1
CHECKED BY
DATE
NATIONAL HIGHWAY DEPT.
DIVISION OF
INVESTIGATIONS & TRAFFIC
TRUCK WEIGHING STUDIES
CHIEF
DAY
MONTH
SHEET OF SHEETS FOR THE HOUR
YEAR
HOUR
CARD TYPE
DISTRICT
JURISDICTION
ROUTE
REFERENCE POINT
VEHICLE
LOAD
AXLE WEIGHTS
VEHICLE DIMENSIONS
TYPE OF VEHICLE
BODY TYPE
PLACE OF RGSTR.
FUEL
AGE OF VEHICLE
EMPTY WEIGHT
TYPE OF MERCHANDISE
FORM OF CARGO
ORIGIN
DESTINATION
1ST AXLE
2ND AXLE
3RD AXLE
4TH AXLE
5TH AXLE
6TH AXLE
HEIGHT
DISTANCE BETWEEN AXLES
1-2
1-3
1-4
1-5
1-6
TOTAL LENGTH OF VEHICLE
MERCHANDISE
ORIGINATING PROVINCE
CITY OR PLACE
DESTINATION PROVINCE
CITY OR PLACE

APPENDIX "C"

U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

Bureau of Public Roads

GUIDE

FOR

TRAFFIC VOLUME COUNTING MANUAL

3rd Edition

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Glossary of Terms

VPD—(Vehicles per day). Number of vehicles that pass a particular point on the road during a period of 24 consecutive hours.

ADT—(Annual average daily traffic). Annual average number of vehicles during 24 consecutive hours that pass a particular point on the road over the period of 365 days.

Annual average daily traffic is calculated by averaging the average daily traffic for each of the 12 months. The average daily traffic for the month is calculated using the equation:

$$\text{Average day of month} = \frac{5\ \text{Av. Weekday} + \text{Av. Saturday} + \text{Av. Sunday}}{7}$$

Where Av. weekday = average daily volume for all weekdays of month
Av. Saturday = average daily volume for all Saturdays of month
Av. Sunday = average daily volume for all Sundays of month

This procedure is considered the simplest feasible method for providing comparable values when counts for certain days are unusable.

Vehicle miles—Normally obtained by multiplying the ADT by 365 and by multiplying the mileage of road to which the ADT is applicable.

Error of estimate—The difference between the estimated value and the true value. The true value is generally unknown.

Estimate of ADT $= y_i$. This is an estimate produced by any estimating procedure. 205

True ADT $= Y$. This is known exactly at points where machine counts are made continuously all during the year.

Best estimate of true ADT $= Y'$. This is the estimate that is obtained at points that are counted for repeated but intermittent periods of time during the year.

Error of estimate $= y_i - Y$ or $y_i - Y'$. This is the difference between the estimated value of ADT based upon one observation and the "true" value. The "true" value either is known or the best combination estimate based upon several periods of observation.

$$\text{Relative error} = \frac{(y_i - Y)}{Y}\ 100 = x_i \quad \text{or} \quad \frac{(y_i - Y')}{Y'}\ 100 = x_i$$

Number of estimates of ADT $= n$

$$\text{Average relative error of estimates of ADT} = \bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

(Studies indicate that, in a large sample of relative differences, the value of $\bar{x}$ is sufficiently close to zero as to be treated as a negligible quantity.)

Standard deviation $=\sigma=\sqrt{\frac{\sum_{i=1}^{n}(x_i-\bar{x})^2}{n-1}}$ (This is the ordinary statistical formula for the standard deviation applicable to any random sample of observations. When the observations are relative errors of estimates of ADT and x is equated to zero the formula can be simplified as follows:

$$\sigma=\sqrt{\frac{\sum_{i=1}^{n}(x_i)^2}{n-1}}$$

If a zero value is adopted $\pm\sigma$ is approximately equal to ⅔ of the area under the normal distribution curve which is the familiar bell shaped curve.)

Standard error of estimate $=SE=\frac{\sigma}{\sqrt{n}}$ (Since x_i is a percent, both σ and SE are in percent)

Σ = the sum of the quantities within the expression.

Continuous count station—A place along a road where a traffic counting machine is installed for the purpose of counting and recording by periods not longer than one hour, the number of vehicles passing this location for continuous long periods of time, usually several years.

Seasonal control station—A place along a road where a traffic counting machine is installed for the purpose of counting and recording (usually by the hour) the number of vehicles passing this location for repeated intermittent periods of time. These periods, usually of consecutive seven days duration, are repeated on a predetermined schedule which divides the year into four, six or twelve equal periods.

Coverage count station—A place along a road where a traffic counting machine is installed for the purpose of counting the number of vehicles passing this location usually during a period of consecutive 48 or 24 hours. Sometimes coverage counts are extended to 5 consecutive weekdays or 7 consecutive days on primary highways under 2000 ADT. Manual counts are also used for coverage count purposes.

Random selection—Every combination of samples of a given size from a population, no matter how small or how large, has an equal chance of being selected.

68 percent confidence limit—In a non-technical sense, it is meant that the mean value of a particular sample has a chance of being one of 68 in a hundred of being different from the population mean by not more than the value of one standard deviation. A more technical description is as follows:

The purpose for sampling is to estimate some value, (parameter), of the population. A sample mean is an estimate of the mean of the population. As such, it differs from the population value by some unknown amount, which may be as small as zero or very large. Using the sample data, and on the basis of statistical theory, an interval can be calculated around the sample estimate, in which the unknown population value lies. The truth or falsity of that statement for any given sample is unknown. However, theory indicates that if this *process* is repeated many times, then a definite propor-

tion of the interval statements will be true. The confidence that we have in the statement for any one sample is the confidence we have in the proportion resulting from the process. An interval calculated by a process that would yield interval statements that were true 68 percent of the time is a 68 percent confidence interval. The upper and lower bounds of a confidence interval are the confidence limits. The size of the interval is a function of the standard error of estimate calculated from the sample data.

Weekday traffic—The number of vehicles that passes a given point on the road during a consecutive 24-hour period from Monday to Friday inclusive.

Road or highway section—A section of road or highway between two intersections or junctions with other roads or highways. The section may include all lanes for traffic in both directions or the lanes assigned to traffic going in only one direction.

Chapter I.—INTRODUCTION

The purpose of this guide is to provide efficient procedures for making accurate estimates of annual average daily traffic (ADT) volumes based on sample counts.

ADT is a fundamental traffic measurement for the determination of vehicle-miles of travel on the various categories of rural and urban highway systems. ADT values for specific road sections provide the highway engineer, planner, and administrator with essential information needed for the determination of design standards, the systematic classification of highways, and the development of programs for improvement and maintenance. Vehicle-mile values are important for the development of highway financing and taxation schedules, the appraisal of safety programs, and as a measure of the service provided by highway transportation. To realize the full benefits of the efforts involved in obtaining and analyzing traffic data, they must be summarized and promptly made available for widespread use. Only in this way can informed decisions be made so that highway transportation will make its maximum contribution to the economic growth of the State and Nation.

Statistical analysis and experiences in the application of statistically controlled procedures in over 30 States form the foundation upon which this guide has been developed. Measurements of the error of estimate made in these States have indicated that the procedures they had been using, as a rule, resulted in errors as great or greater than those determined by the procedure set forth in this guide. In the majority of these States, the cost of obtaining traffic volumes by using the procedure presented in this guide was less than by the use of their earlier traffic counting methods, particularly when the old procedure involved the use of extensive seasonal machine counts for control purposes.

This guide sets forth methods which can be used to produce traffic volume estimates with the accuracy indicated necessary for design purposes and economic analyses at a minimum of cost and effort.

Only at continuous count stations and under perfect conditions can true ADT be determined with absolute accuracy, assuming no mechanical failures and correct vehicle classification data are available when axle counts must be converted to vehicles. Any count of less than one-year duration must be regarded as a sample. The sample then can be interpreted to bear a certain relation to the ADT or to some other needed measure, and adjustments can be made accordingly.

When a sample is adjusted to represent the ADT, it becomes an estimate of ADT. The measure of accuracy of the estimate is the difference between the estimate and the true average volume of traffic, if known. This difference is the error of estimate.

At coverage stations the true ADT is never known. However by simulating sample coverage counts at continuous count stations where the true ADT is known, the error of estimate of ADT at coverage stations can be approximated by the application of statistical methods. Ordinarily there are no means of knowing the accuracy of an individual estimate. But by using certain statistical principles, the accuracy of a large number of estimates can be determined in terms of probability of frequency of errors of specific magnitude. These magnitudes of errors are attributable to the method of sampling and estimating. Errors due to any imperfections or malfunctioning of traffic counting equipment are not considered in these guidelines.

The effect of these errors remains the same irrespective of the methods used in estimating. Thus, there are objective means of establishing the superiority of one method of estimating over another as far as accuracy of sample estimates of traffic volume is concerned.

Every State has its own problems concerning traffic volume information. There is no single procedure that would solve all these problems. There is, however, a method of attack which, when properly applied, will produce appropriate answers to questions as to the number of stations, length and frequency of counts, and the accuracy of the results. A working knowledge of basic statistical principles and formulas is necessary to develop the most efficient procedures and to extract the maximum accuracy from the data.

Observations indicate that there are substantial differences in the urban and rural variations of traffic volume within specified time periods. Therefore, it is necessary to consider separately counting and estimating of traffic volumes on rural roads and on urban roads and streets.

Chapter II.—RURAL HIGHWAYS

A. Highways with ADT Volumes Greater Than 500

The traffic counting procedure established as a part of the original statewide highway planning surveys, and later modified by the various States to suit individual needs, invariably have produced useful results. In the more than 30 States where the errors of estimates of the ADT have been measured, it was found that the standard deviations of these errors were usually in the ±12 to ±17 percent range for roads carrying approximately 500 ADT or more. As a result of theoretical study, research, and extensive field applications, a basic procedure has been developed which generally reduces the standard deviation of the errors of estimate to ±10 percent for these higher volume roads, always at a reduced cost as compared with previous methods. The procedure that is presented for high volume roads can be divided into three major steps:

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1. Grouping continuous count stations into similar patterns of monthly traffic volume variation,
2. Assigning road sections to groups of similar patterns of monthly variation, and
3. Locating and operating traffic counting stations.

These three steps in succession are discussed in this section.

1. *Grouping Continuous Count Stations Into Similar Patterns of Monthly Traffic Volume Variation*

The major premise of the suggested procedure for high-volume roads is that it is possible to establish a series of consecutive road sections having similar patterns of monthly traffic volume variation. Route sections displaying similar patterns may be concentrated in a particular area of a State; other patterns may be found statewide. Road sections which are determined to have similar patterns of monthly traffic volume variation provide the basis for the adjustment of coverage counts made at points within these routes. These coverage counts are adjusted to ADT by means of a group mean factor determined for all the road sections within the group.

A simple way of searching for continuous traffic counting stations with similar patterns of monthly traffic volume variation is the "array method" and is described and illustrated as follows:[1]

a. In Table 1, the monthly adjustment factors (that is, the ratio of ADT to the average weekday traffic of the month), are shown assuming 12 permanent locations of automatic traffic recorders for stations A through L, which represent road sections carrying ADT of 500 vehicles or more. These permanent continuous counting stations are not listed in any particular order.

b. Arrange the factors by months in ascending order, as shown on Table 2.

c. For each month determine a group of stations such that the difference between the smallest and the largest monthly factor does not exceed the range of 0.20 in the values of factors. This is based on

[1] In the illustrative example, coverage counts are made only during the period of April through November. Therefore, adjustment factors for coverage counts are needed for these eight months and only for that period. The similarity of patterns of adjustment factors for a full year is required for grouping of road sections if factors for 12 months are used.

the criterion of ±0.10[1] from the assumed mean. There are several possible groupings in each month. Determine for each month that group having the largest number of stations within this 0.20 range and designate the separation of these stations by horizontal lines, as shown on Table 2. For instance, for April a group from 1.00 through 1.19 includes 10 stations; whereas, if the groupings were made from 1.19 through 1.38, only three stations would have been included. (Stations outside the horizontal lines often form independent groups with a smaller number of components.)

d. The final grouping should be such that all or as many as possible of the same stations would fall into the same group for each of the months. With this prerequisite in mind, it is found that although stations C, D, and E are within the 0.20 range, between 1.00 and 1.19 in April, they do not fall into the group defined for some other months. For instance, station E with 0.93 is outside the limits of the range 0.64–0.76 in August; also, it is outside the range in July. (Table 3 illustrates the groups finally defined.)

It should be noted that in November station L has a factor 1.36 which is outside of the range 1.10–1.30. Investigation disclosed that in November there was construction which caused a reduction of traffic volume at station L. Also, it was found that in the previous year the factor was 1.19 which would have kept station L well within the range of this group. For these reasons station L was included in group I.

It is also noted that in group I for the month of June the range is 0.21 which indicates that strictly speaking, either station H or station J is outside the range. However, investigation of field records and data from previous years did not disclose any abnormalities of the counts at these two stations. Since the excess over the 0.20 criterion is only .01, obviously it could not have any significant effect on the group mean factor. Therefore, it was decided to keep both stations H and J in group I.

e. For each group compute the average of the factors for each month to arrive at the month group mean factor as shown in Table 4.[1]

The reasons why station L was included have been previously discussed. However, because of the highly localized nature of the construction work which affected the November factor at station "L," the value of 1.36 was not included in the computation of the mean factor of 1.16 for November for group I. For the month of June all seven values were used computing the group mean factor of 0.88. The exclusion of either station H or station J would have affected the value of the mean only by 0.01 which is negligible.

In exceptional cases such as noted in stations H, J, and L, of the example, the .20 range may be slightly deviated from if the condition warrants.

When a computer is available, groupings may be done separately for every month during which vehicle coverage count stations are operated. This would mean that the number of groups would most likely vary from month to month. For instance, from Table 2 it can be seen that there would be only one group in October; only two groups in April, May, June, September, and November; and by rearranging the grouping procedure, July and August can also be placed into two groups.

[1] This ±.10 value should not be confused with the design standard deviation of ±10 percent in the error of estimate of ADT. The criterion of ±0.10 is designed to produce a part of the standard deviation of ±10 percent. The remaining part of this standard deviation of ±10 percent is attributable to the sampling error.

[1] It should be noted that adjustment factors are in terms of average weekday traffic. Coverage counts are usually made on weekdays; when Saturday and Sunday are included, only the weekday counts should be used for estimating ADT. As a rule, the variations of Saturday and Sunday volumes within a month are greater than that of the weekdays, thus the ADT estimates based on counts which include weekends tend to be less accurate than those based on weekdays.

2. *Assigning Road Sections to Groups of Similar Patterns of Monthly Variation*

Assign a certain color to each group and mark on a map the location of each continuous count station with the appropriate color for its group. This is illustrated on Figure 1. Stations of the same group usually fall along a continuous route or routes. Connect the road sections on these continuous routes designating them by the color of the stations which fall upon it. When grouping is done separately for each month, there should be a map for each month on which the groupings are thus designated.

The number of continuous count recorders is not ordinarily sufficient to assign to pattern groups all road sections in the State with an ADT volume greater than 500. In the majority of the States there are seasonal control stations. These are stations at which traffic counts are made at equally spaced intervals of time during the year. Some road sections which cannot be grouped by continuous count recorders may be classified by seasonal control stations. This is accomplished in the following manner:

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a. For each seasonal control station, compute the ratios of the ADT to the average weekday of the month, excluding all holidays during which the count was made. (This is illustrated in Table 5. Note that this is exactly the same procedure illustrated in Table 1 for continuous count stations.)

b. The stations are then arrayed as shown in Table 6. (This is the same procedure illustrated in Table 2 for continuous count stations.)

c. Compare each of the resulting ratios with the corresponding mean determined from continuous count stations. Using the criterion of ±.15[1] difference from the mean ratio of continuous count stations, allocate all seasonal control stations to the groups determined by the analysis of continuous count stations. The resulting allocation is shown in Table 7. An example of assigning a seasonal control station to a group follows:

Station 5 is shown in group I in Table 7. By reference to Table 5 the ratio for the month of April is .97. As shown in Table 4 the mean April factor for group I is 1.11. Thus the difference between the factors is .14. This same procedure was followed for the remaining months and the difference between the factors for station 5 and the mean factors for the corresponding months for group I were not greater than .15. Therefore, station 5 could belong to group I.

A more objective method of allocating a seasonal control station to a group may be used. This method is based on the principlie of "least squares." (See Table 8, page 48.)

d. Indicate on the map the location of each seasonal control station, using the color of the group to which the station belongs. Many of the seasonal control stations will fall into patterns which were determined by continuous count stations and thus verify the allocation of these road sections. Others may provide information to allocate the road sections for which no information is available from the continuous count stations. The patterns for some seasonal control stations may not fall into any predetermined group as noted in Table 7.

e. If the State does not have seasonal control stations to make necessary assignments of road sections to groups, it is important to establish seasonal control stations for one year to make these assignments. Best results will be obtained by counting seven consecutive days in each month. Stations counted less frequently than once each month may be difficult to assign to groups.

The seasonal control stations that do not fall into any predetermined group should be carefully examined. For example, it may

[1] Since seasonal control stations are samples rather than complete months, the group may be extended to the range of ±.15 rather than ±.10 used for the continuous count stations.

be found that the majority of the months agree with a previously determined pattern. In such cases records for several preceding years should be examined and compared in order to determine if the disagreement in some of the months is a matter of repetition rather than being peculiar to one particular year. This was illustrated by the study of the records for stations L and H.

If records are available, the process of grouping continuous count stations and, if necessary, seasonal control stations as described above should be repeated for two or three preceding years. Because of the persistence of the monthly ratios over a period of years, it may be expected that the great majority of the road sections will fall into the same monthly pattern groups year after year. In one State, after studying four years counts, it was found that about 94 percent of the road sections retained their groupings and only about 6 percent needed to be changed. It is recommended that groupings of continuous recorders and seasonal control stations be checked every year.

Ordinarily the changes in the group patterns can be visually determined when the control stations have been plotted on a map by means of the color-coded group symbols. However, there may be situations when the exact point of change is not easily ascertained. This may occur near urban areas. In such situations it is desirable to establish additional control to define this point of change. An illustration of this condition in a rural area is shown at the bottom of Figure 1. This route was assigned to group I, based on the data from continuous count stations B and G. However, there was no certainty that all of the sections of this route so assigned actually belong to that group. In the long-range program of assignment of road sections to a group, it is necessary to verify the assumed road section designation by establishing necessary seasonal control stations. This was accomplished in this instance by establishing seasonal control stations 32, 33, 34, 37, and 39, which substantiated the original assumption that all sections between major intersections on this route belong to group I.

Experience substantiates the applicability of the theory of configurations which indicate that in the majority of cases the seasonal control stations fall into the groups previously determined by the continuous count station data.

For the purpose of illustration, another example of where a change in grouping is indicated is shown on Figure 1 for seasonal control stations 19 and 21. There are two questions arising from this situation. One is the assignment of the road sections between Richardsville and Frazer, and the other is the assignment of the road west of Richardsville as indicated by the pattern of station 19. The data from station 31 indicate that previous assignment of the road between Richardsville and Frazer to group I was correct. On the other hand, it is observed from the data obtained at stations 16, 17, and 18 that the road sections west of Richardsville belong to the same group as station 19.

After accomplishing the above described procedures, the ungrouped road sections with an ADT exceeding 500 as noted on Figure 1, are road sections with unusual or extreme patterns of monthly variations of traffic volume. Normally these are roads leading into resort or recreational areas. The road sections exhibiting such patterns usually are limited in extent and a single continuous or suitable seasonal control count station is ordinarily sufficient to obtain the necessary adjustment factors for each such section.

The planning of traffic volume measurement is based on two fundamental characteristics which have been established by many studies.[1] These characteristics are:

(1) The pattern of monthly variations of traffic volume persists over long stretches of highway.

(2) The pattern of monthly variations of traffic volume persists over long periods of time.

[1] Refer to bibliography items 1 and 2.

It can be expected that at intermediate points along each rural route, the monthly variations will be similar to those established by the continuous count stations along the route of its group. Therefore, each group mean factor should be applied to the coverage count stations which are located on road sections of this group. For example, in Figure 1 all coverage count stations operated during May on road sections of group I would use a factor of 0.97 (see Table 4). This method should result in estimates of ADT with a standard deviation of estimates not exceeding ±10 percent.

3. *Locating and Operating Traffic Counting Stations*

a. Continuous Traffic Counters

After all road sections have been allocated to groups of similar monthly patterns of traffic variation, it may be possible to eliminate or relocate some of the continuous count stations. This decision, however, should be made only after careful determination of all purposes served by these stations. These considerations should include:

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(1) Continuous count stations, in addition to providing adjustment factors for expansion of coverage counts, may be needed for long-range determination of traffic trends at a particular point.

(2) It may be desirable to determine accurate peak hour counts at a particular station.

(3) Other local information may be used.

(4) The road sections for which records are not available should be studies. Either permanent or seasonal control stations should be located on these sections in future years so as to enable the proper classification of these road sections by groups. If seasonal count stations are operated, each count should be for one-week duration.

(5) It may be desirable to retain continuous count station locations to determine the rates of change or travel.

(6) In general, a minimum of six continuous counting stations should be located in each group of road sections with an independent set of monthly factors.

b. Seasonal Control Stations

After all road sections have been grouped as described above, the number of seasonal control stations can be significantly reduced. When there is reason to believe that a seasonal pattern on a particular road section is changing or has changed, seasonal control or continuous count stations should be used to determine this change.

c. Coverage Count Stations

(1) The bulk of the ADT data comes from coverage count stations since they are located wherever specific traffic volume information is desired. In a comprehensive traffic volume survey, information is needed for each section of road between intersections. To achieve this it is theoretically necessary to have traffic counts at every other intersection. However, data collected at coverage count stations represent samples in time. Estimates of ADT based on these samples are subject to sufficient sampling error as to justify the following rule:

"Locate coverage count stations at alternate intersections. However, it may not be necessary to locate a coverage count station at alternate intersections providing the traffic volumes do not vary by more than 10 percent between road sections under consideration. Also coverage stations may be omitted when changes of traffic volume are evenly distributed over a series of consecutive road intersections. Traffic volumes for the intervening sections can be estimated by prorating the volumes at the end sections."

(2) The following may be used as a guide to determine the coverage count stations that are needed:

(a) Make coverage counts at every other intersection or as needed as de-

scribed above. This coverage counting program may be made in one year or in several year cycles up to five years. A maximum cycle of three years is recommended. Assuming a three-year cycle, one-third of the coverage counts would be made each year.

(b) If only vehicle mileage information is needed then a much smaller coverage than described under (a) would be required. For example, the rural vehicle mileage by counties was needed within 5 percent standard error of the mean. This was accomplished by locating coverage count stations at an average of 10 miles apart.

(c) In general, approximately 25 coverage count stations will be required for each 100 miles of rural roads. Depending on the topography and the pattern of location of roads, variations from this coverage may be encountered in some of the States.

B. Highways with ADT Volumes Between 25 and 500

Roads carrying less than 500 ADT must be treated differently than roads with higher traffic volumes, since past studies have shown that the standard error of estimate increases at a much greater rate than the traffic volume is less than 500 ADT.[1] This relation can be illustrated graphically by the following figure.

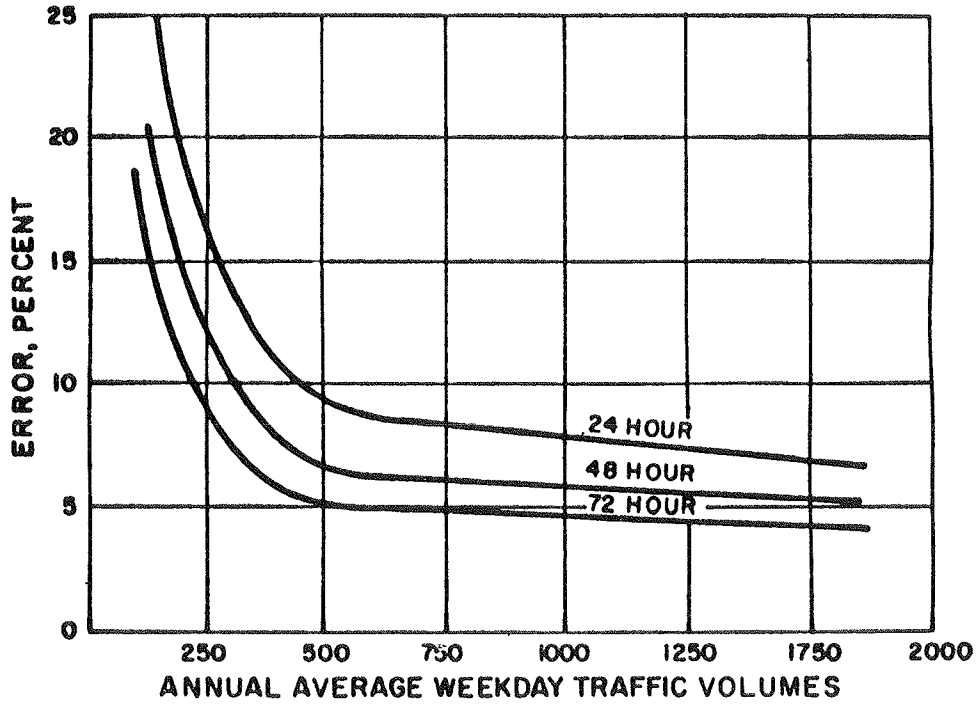
1. *Control Station Operations*

It has been determined from past experience that all rural road sections regardless of the administrative system with volumes between 25 and 500 ADT can generally be represented by one group, for the purpose of computing monthly adjustment factors to obtain estimates of ADT.[1] On this basis, the following steps should be undertaken:

a. Continuous count station locations on lower volume roads may be chosen arbitrarily to provide adequate geographical representation. Analysis of one or two year's data will help determine if any of

[1] Refer to bibliography item No. 3.

[1] Refer to bibliography item No. 4.



the locations should be changed, or if additional stations are required. Five or six such stations will be adequate in most States to compute the average adjustment factors for estimating the ADT at the coverage count stations.

b. Seasonal control stations may be used instead of continuous counting stations. If continuous count stations are used, a minimum of 5 or 6 is required. If seasonal control stations are used and a count is taken in every month, 5 or 6 seasonal control stations are also sufficient. If counts are taken every other month at seasonal control stations, then the number of stations should be doubled. Therefore, 10 or 12 stations may be required. Moreover, the schedule should be so arranged that an equal number of counts are taken in each month, statewide. Similarly, if counts are taken every third month, 3 times the number of continuous counts are required.

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Providing a State has a sufficient number of existing continuous count stations on State highways carrying less than 500 ADT or on low-volume roads on other administrative systems, these stations could be used to provide the necessary average adjustment factors for low-volume roads.

Continuous count stations and seasonal control stations normally should not be located on roads carrying less than 100 ADT. The factors obtained on sections having 100 to 500 ADT can be applied to all roads carrying ADT of 25–500.

2. *Coverage Count Stations*

Procedures for locating coverage count stations on roads carrying in excess of 500 ADT also apply to low-volume roads. An exception to this policy is that coverage count stations are not usually located on roads carrying an ADT of 25 or less. Locate coverage count stations at alternate intersections. However, it may not be necessary to locate a coverage count station at alternate intersections providing the traffic volumes do not vary by more than 25 percent between road sections under consideration. Note the similarity to the procedure for roads carrying an ADT of 500 or more. (Chapter II, A–3 (C) page 27.)

When the adjustment factors obtained from these control stations are applied to coverage count stations on a low-volume system, it may be expected that 68 percent of the estimates of ADT will have an error within 20–25 percent. More precise estimates may be expected for the higher volume roads within this traffic volume range.

C. Roads with ADT Volumes Less Than 25

Other sources of information should be used for the estimation of traffic volumes on the extremely low-volume roads. Such sources may include culture, previous records, and the application of the overall rate of change in traffic volume over a period of years. However, there may be roads within a State or an area that have such economic importance that fewer than 25 vehicles may represent an appreciable measure of service and that service should be more accurately measured. In such cases, traffic counts of longer than 48-hour duration are usually necessary to achieve any practical degree of accuracy, and five- or seven-day counts may be necessary. The control stations which were used for the computation of the average adjustment factors needed to compute ADT volumes for roads in the 25–500 ADT group can be utilized to determine ADT for roads with ADT volumes less than 25. When greater accuracy is desired, a repeat coverage count may be justified. In some cases a continuous count recorder may be necessary to produce the desired degree of accuracy.

D. Adjustment Factors

1. The group mean ratio of the ADT to the average weekday traffic volumes of the month is an adjustment factor that would be applicable to samples of 24-hour averages of 48-hour counts on weekdays, and 24-hour averages of five consecutive weekdays.

If computers are used then weekly adjustment factors may be applied. These factors are the group mean ratios of ADT to the

average weekday of the week during which the coverage counts are made. Even factors for individual weekdays of the year can be used. However, these individual weekday factors in a few States where they have been used, do not produce a significant increase in the accuracy of ADT estimates.

For all coverage counts taken on road sections that have been assigned to groups of similar monthly variations, a group mean factor should be applied. These group mean adjustment factors are computed separately for each group from continuous count or control count station data. This procedure has been discussed previously, (either monthly or weekly). For example, the use of a monthly factor would be as follows:

A coverage count of 48-hour duration on weekdays was made on a road section of group I in September, the count showed 4,286 vehicles. The 24-hour mean, therefore, equals 2,143 vehicles. From Table 4 the adjustment factor is 0.89. The estimate of ADT for this coverage station is $2,143 \times 0.89 = 1,907$.

2. When coverage counts are made for a period of seven consecutive days a suitable adjustment factor must be applied. If hourly recording counters are used, the factor should be representative of the average *weekday* of the month or week. When cumulative counters are used the factors must be representative of the average *day* of the month or week. A major consideration in selecting a coverage count period is the strong possibility of lost data when rubber tube detectors are left in place for extended periods. Little, if any, accuracy can be gained by including Saturdays and Sundays in the coverage period.[1]

There is a period of about four weeks in the spring and another in the fall when the 24-hour weekday rural traffic volume differs from the ADT for that same station by a standard deviation of less than ±10 percent. Therefore, this count could be considered an estimate of the ADT without any further treatment. However, it is considered impractical to recruit sufficient help only for these short periods of time. If this procedure is used, caution should be exercised in the selection of these 4-week periods as the representative traffic volumes vary somewhat from year to year and from station to station. The usual practice is to conduct traffic coverage counting for a period of seven or more consecutive months and in some States the year-round.

Adjustment factors determined from control stations in rural areas should be applied to all rural roads. For the suburban sections, it is desirable to determine the adjustment factors from data obtained either from continuous count recorders or from a few seasonal count stations located in these areas. Until data are available from these recorders, it is usually adequate to average the factors obtained in the rural areas with those in the particular city and apply these average values to suburban areas. Generally, the monthly variations of traffic volumes in suburban areas approach those of the cities. It has also been observed that monthly traffic volume fluctuations in the cities are much smaller than they are on the rural road sections, so that the urban factors tend to approach unity for each month. This implies that the monthly variations in the suburban areas are usually smaller than those observed in the rural sections of the same route.

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E. Analysis

1. *Editing*

a. Manual Editing

Every field report must be carefully examined in the office and all notations thereon must be carefully read. This will eliminate all counts that are obviously unsatisfactory. All counts for which there are indications that they were taken under abnormal circumstances should not be used. Each count should be compared with the record of the same station for the previous year. If the two differ by

[1] Refer to bibliography item No. 8 for the effect on ADT estimate accuracy of varying the coverage count duration.

30 percent or more for roads carrying greater than 500 ADT, such counts should ordinarily not be used unless justified by known changes in the area. Counts which differ by more than 20 but less than 30 percent may be used, but all sections in this range must be subjected to very careful scrutiny.

On roads carrying less than 500 ADT, the counts differing by 60 percent or more from the previous year should ordinarily not be used. However, if the difference is between 20 and 60 percent, such counts may be used with caution upon evidence that they may be satisfactory.

b. Machine Editing

In States where computers and qualified personnel trained in statistical methods are available, machine editing procedures can be used.[1] The principle of this editing procedure is as follows:

(1) Using available historical data of traffic counts at a particular location, compute a relationship between ADT and the year by means of linear regression techniques. Five to ten years of historical data are desirable for the purpose.

(2) Extend the function of the year of the current count and determine the difference between the value yielded by the function and the current value.

(3) If this difference is smaller than twice the standard error of estimate about the regression line, the count can be accepted without further investigation. If the difference is larger than twice the standard error of estimate about the regression line, then the current count is subject to investigation. Its final acceptance or rejection will be made upon the results of this investigation.

The first two steps outlined above can be accomplished by use of computers. The only phase of the procedure outlined under (3) above that cannot be accomplished by the use of a computer is the analysis of the rejected count. This analysis may require both field and office checking, either a recount or an investigation, to determine the cause of the exceptional change in traffic volume counts.

2. *Mechanical Data Processing*

The use of electronic data processing equipment is most desirable for further analysis subsequent to editing. The selection of the adjustment factor and the factoring of the field count can be accomplished by using this equipment. Computers may also be used to improve somewhat the accuracy of the results—instead of using monthly adjustment factors, weekly or daily adjustment factors can be produced without appreciable additional costs.

3. *Smoothing Out*

After all the coverage counts have been converted into estimates of ADT, it may be expected that about 68 percent of the estimates will have errors not greater than 10 percent for the high-volume roads and not greater than 20 percent for the low-volume roads.

After all ADT volumes have been estimated, a smoothing out process will usually be necessary for adjacent road sections. This process can be accomplished as follows:

a. Post all ADT estimates on a map.

b. Each successive road section should now be studied in comparison with the adjacent road sections, keeping in mind the influence of traffic from the location of the cities and intersecting roads.

c. If the difference between traffic volumes on two successive sections of road appear to be too large to be justified by the circumstances, the traffic volumes should be adjusted to give a more logical distribution based on the evidence. This is accomplished by increasing or decreasing the volume at one or both stations.

d. This smoothing out process can also be guided by the traffic volumes on road

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[1] Refer to bibliography item No. 5.

sections beyond the section immediately under study.

This smoothing process tends to increase the accuracy of the estimates of ADT. In the final evaluation of the errors involved, it is believed by those concerned with highway traffic that ⅔ of the final estimates will usually not be greater than 5 percent in error for high-volume roads and not greater than 10 percent in error for low-volume roads; and that 95 percent of the estimates will not be more than 10 percent in error for high-volume roads and not more than 20 percent in error for low-volume roads. Some of the reasoning which supports this opinion is as follows:

(1) In the examination of successive road sections a sudden large unexplainable change in traffic volume is easily observed and eliminated.

(2) Comparison with historical data may indicate an unexplainable large change in traffic volume which is easily observed and eliminated.

(3) The elimination of the obviously large errors of estimate will, by itself, reduce the average error of the remaining estimate.

4. *Improvement in Accuracy*

A greater degree of accuracy in estimating ADT can be accomplished as follows:

a. Using weekly factors instead of monthly factors. This procedure is presented on page 31, under "Mechanical Data Processing."

b. Use of repeat counts as noted on page 29, under "Roads with ADT Volumes Less Than 25."

c. Taking five- or seven-day coverage counts as noted on page 29, under "Roads with ADT Volumes of Less Than 25." See also bibliography item No. 8.

The above are procedures in which improvement in accuracy in the estimate of ADT can be obtained. However, when considering methods to improve accuracy the cost should be kept in mind. A fairly accurate rule that can be used in attempting to improve precision by increasing the sample size is that "to reduce the error by one-half using the same sampling procedures would require increasing the effort and probably the cost by four times."

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NOTE: Chapter III of Appendix "C" is not included because it deals with urban roads.

Chapter IV.—GENERAL NOTE

The greater the familiarity with local conditions the better judgment can be exercised in the final decisions in estimating traffic volumes. The probability principles built into the procedures suggested in this guide will eliminate major errors of judgment and reduce the errors to chance alone. Further research can somewhat improve and refine the procedures. However, because the inherent properties of chance variations have already been accounted for in this guide only minor or primarily local improvements can be expected.

When making an estimate of traffic volumes all available information should be utilized including counts for special purposes. These may include special counts for such purposes as:

Manual classification counts
Capacity counts
Ramp and turning movement counts
Special counts for construction, etc.
Screenline counts

There are several methods under investigation whereby the data collected by the traffic counting mechanisms are automatically transferred into the central headquarters. Also under consideration is complete automation of most office analyses, including editing of field data, preparation of arrays (such as shown in Tables 2 and 6) and grouping of continuous count and seasonal control stations (as shown in Tables 3 and 7); as well as statistical tests of significance of differences, analysis of variance, chi square tests, and others as needed. Computers may be utilized for such routine mass operations as factoring coverage counts into estimates of ADT and regrouping control stations separately for each month. However, regardless of the automation that is used expert judgment must always be applied.

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Table 1.-- ADT ÷ Average weekday traffic volume of the month at continuous count stations

Station number	April	May	June	July	August	September	October	November
(A)	1.08	0.99	0.91	0.73	0.71	0.86	1.00	1.13
(B)	1.19	1.03	.90	.66	.64	.90	1.09	1.15
(C)	1.00	.93	.91	.83	.85	.99	1.05	1.02
(D)	1.03	.92	.88	.86	.86	.89	.95	1.10
(E)	1.07	.90	.79	.90	.93	1.00	1.08	1.15
(F)	1.05	.98	.91	.68	.67	.92	1.03	1.10
(G)	1.16	.97	.83	.70	.74	.81	1.04	1.22
(H)	1.09	.87	.76	.69	.72	.85	.95	1.18
(I)	1.44	1.15	.90	.57	.51	.75	1.15	1.32
(J)	1.04	.95	.97	.77	.75	.95	1.07	1.16
(K)	1.38	1.14	.98	.70	.65	.82	.98	1.07
(L)	1.19	.99	.85	.71	.76	.97	1.00	1.36

Table 2.-- The array of factors for continuous count stations

April	May	June	July	August	September	October	November
(C) 1.00	(H) 0.87	(H) 0.76	(I) 0.57	(I) 0.51	(I) 0.75	(H) 0.95	(C) 1.02
(D) 1.03	(E) .90	(E) .79	(B) .66	(B) .64	(G) .81	(D) .95	(K) 1.07
(J) 1.04	(D) .92	(G) .83	(F) .68	(K) .65	(K) .82	(K) .98	(D) 1.10
(F) 1.05	(C) .93	(L) .85	(H) .69	(F) .67	(H) .85	(A) 1.00	(F) 1.10
(E) 1.07	(J) .95	(D) .88	(K) .70	(A) .71	(A) .86	(L) 1.00	(A) 1.13
(A) 1.08	(G) .97	(B) .90	(G) .70	(H) .72	(D) .89	(F) 1.03	(B) 1.15
(H) 1.09	(F) .98	(I) .90	(L) .71	(G) .74	(B) .90	(G) 1.04	(E) 1.15
(G) 1.16	(A) .99	(C) .91	(A) .73	(J) .75	(F) .92	(C) 1.05	(J) 1.16
(B) 1.19	(L) .99	(A) .91	(J) .77	(L) .76	(J) .95	(J) 1.07	(H) 1.18
(L) 1.19	(B) 1.03	(F) .91	(C) .83	(C) .85	(L) .97	(E) 1.08	(G) 1.22
(K) 1.38	(K) 1.14	(J) .97	(D) .86	(D) .86	(C) .99	(B) 1.09	(I) 1.32
(I) 1.44	(I) 1.15	(K) .98	(E) .90	(E) .93	(E) 1.00	(I) 1.15	(L) 1.36

Table 3.-- Groups of stations within .20 range

April	May	June	July	August	September	October	November
Group I - (A), (B), (F), (G), (L), (H), and (J)							
(J) 1.04	(H) 0.87	(H) 0.76	(B) 0.66	(B) 0.64	(G) 0.81	(H) 0.95	(F) 1.10
(F) 1.05	(J) .95	(G) .83	(F) .68	(F) .67	(H) .85	(A) 1.00	(A) 1.13
(A) 1.08	(G) .97	(L) .85	(H) .69	(A) .71	(A) .86	(L) 1.00	(B) 1.15
(H) 1.09	(F) .98	(B) .90	(G) .70	(H) .72	(B) .90	(F) 1.03	(J) 1.16
(G) 1.16	(A) .99	(A) .91	(L) .71	(G) .74	(F) .92	(G) 1.04	(H) 1.18
(B) 1.19	(L) .99	(F) .91	(A) .73	(J) .75	(J) .95	(J) 1.07	(G) 1.22
(L) 1.19	(B) 1.03	(J) .97	(J) .77	(L) .76	(L) .97	(B) 1.09	(L) 1.36
Group II - (I) and (K)							
(K) 1.38	(K) 1.14	(I) .90	(I) .57	(I) .51	(I) .75	(K) .98	(K) 1.07
(I) 1.44	(I) 1.15	(K) .98	(K) .70	(K) .65	(K) .82	(I) 1.15	(I) 1.32
Group III - (C), (D), and (E)							
(C) 1.00	(E) .90	(E) .79	(C) .83	(C) .85	(D) .89	(D) .95	(C) 1.02
(D) 1.03	(D) .92	(D) .88	(D) .86	(D) .86	(C) .99	(C) 1.05	(D) 1.10
(E) 1.07	(C) .93	(C) .91	(E) .90	(E) .93	(E) 1.00	(E) 1.08	(E) 1.15

Table 4.-- Monthly group mean factors

Group	April	May	June	July	August	September	October	November
Group I	1.11	0.97	0.88	0.71	0.71	0.89	1.03	1.16
Group II	1.41	1.14	.94	.64	.58	.78	1.06	1.20
Group III	1.03	.92	.86	.86	.88	.96	1.03	1.09

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Table 5.-- ADT ÷ average weekday traffic volume of the month at seasonal control stations

Station number	April	May	June	July	August	September	October	November
1	1.25	1.29	1.09	.78	.60	.67	1.00	1.20
2	1.19	1.06	.90	.91	.83	.82	.99	1.23
3	1.03	.96	.80	.80	.88	.92	1.02	1.18
4	1.31	1.27	1.00	.78	.65	.58	.88	1.30
5	.97	.89	.88	.71	.69	.76	1.00	1.12
6	1.08	.91	.87	.73	.69	.81	.99	1.11
7	.99	.82	.80	.74	.70	.79	.98	1.15
8	1.12	.93	.79	.80	.73	1.00	1.10	1.14
9	1.20	1.10	.76	.79	.78	.93	1.03	1.21
10	.96	.88	.87	.69	.72	.83	1.05	1.20
11	1.60	1.39	.47	.50	.36	.34	1.00	1.63
12	1.13	1.11	.99	.68	.68	.76	1.11	1.18
13	1.15	1.09	1.02	.69	.68	.86	1.16	1.16
14	1.00	.82	.90	.67	.73	.90	.95	1.17
15	1.20	1.08	1.00	.59	.79	1.01	1.07	1.09
16	1.16	.87	.72	.75	.80	1.00	1.04	1.20
17	.99	.78	.75	.76	.90	1.03	1.09	1.09
18	.98	.80	.87	1.00	1.00	.90	.90	1.00
19	1.03	1.03	.91	.82	1.00	.98	1.17	1.00
20	1.25	1.02	.99	.69	.61	.81	1.05	1.08
21	1.22	1.03	.98	.68	.63	.79	1.03	1.05
22	1.07	1.00	1.01	.70	.68	.92	1.09	1.11
23	1.47	1.16	.95	.50	.55	.59	1.00	1.33
24	1.13	.97	.75	.58	.61	.91	1.02	1.21
25	1.09	.85	.78	.66	.71	.89	1.01	1.09
26	1.18	.97	1.00	.84	.69	.95	1.06	1.17
27	1.05	.85	.87	.81	.72	.79	1.00	1.23
28	1.01	1.00	.92	.85	1.01	.89	.89	.89
29	3.07	3.07	.29	.38	.29	2.00	2.50	2.78
30	1.12	1.00	.86	.84	.90	.95	.94	.99
31	1.19	.99	.92	.68	.74	1.05	1.06	1.20
32	1.04	.94	.89	.78	.64	1.01	1.09	1.01
33	1.26	1.00	.75	.55	.55	1.05	1.10	1.30
34	1.10	.98	.88	.67	.70	.98	1.02	1.25
35	1.53	1.14	.93	.50	.49	.91	1.20	1.09
36	1.49	1.02	.80	.63	.57	.92	1.10	1.07
37	1.19	1.05	.90	.60	.75	.90	1.09	1.24
38	1.00	1.11	1.00	.73	.80	.89	1.00	1.20
39	1.26	.95	.74	.59	.65	1.03	1.11	1.30

Table 6.-- The array of factors for seasonal control stations

Sheet 1 of 2

April		May		June		July		August		September		October		November	
Station	Factor	Station	Factor	Station	Factor	Station	Factor	Station	Factor	Station	Factor	Station	Factor	Station	Factor
10	.96	17	.78	29	.29	29	.38	29	.29	11	.34	4	.88	28	.89
5	.97	18	.80	11	.47	11	.50	11	.36	4	.58	28	.89	30	.99
18	.98	7	.82	16	.72	23	.50	35	.49	23	.59	18	.90	18	1.00
7	.99	14	.82	39	.74	35	.50	23	.55	1	.67	30	.94	19	1.00
17	.99	25	.85	17	.75	33	.55	33	.55	5	.76	14	.95	32	1.01
14	1.00	27	.85	24	.75	24	.58	36	.57	12	.76	7	.98	21	1.05
38	1.00	16	.87	33	.75	15	.59	1	.60	7	.79	2	.99	36	1.07
28	1.01	10	.88	9	.76	39	.59	20	.61	21	.79	6	.99	20	1.08
3	1.03	5	.89	25	.78	37	.60	24	.61	27	.79	1	1.00	15	1.09
19	1.03	6	.91	8	.79	36	.63	21	.63	6	.81	5	1.00	17	1.09
32	1.04	8	.93	3	.80	25	.66	32	.64	20	.81	11	1.00	25	1.09
27	1.05	32	.94	7	.80	14	.67	4	.65	2	.82	23	1.00	35	1.09
22	1.07	39	.95	36	.80	34	.67	39	.65	10	.83	27	1.00	6	1.11
6	1.08	3	.96	30	.86	12	.68	12	.68	13	.86	38	1.00	22	1.11
25	1.09	24	.97	6	.87	21	.68	13	.68	25	.89	25	1.01	5	1.12
34	1.10	26	.97	10	.87	31	.68	22	.68	28	.89	3	1.02	8	1.14
8	1.12	34	.98	18	.87	10	.69	5	.69	38	.89	24	1.02	7	1.15
30	1.12	31	.99	27	.87	13	.69	6	.69	14	.90	34	1.02	13	1.16
12	1.13	22	1.00	5	.88	20	.69	26	.69	18	.90	9	1.03	14	1.17
24	1.13	28	1.00	34	.88	22	.70	7	.70	37	.90	21	1.03	26	1.17

Table 6.-- The array of factors for seasonal control stations (cont.)

April		May		June		July		August		September		October		November	
Station	Factor	Station	Factor	Station	Factor	Station	Factor	Station	Factor	Station	Factor	Station	Factor	Station	Factor
13	1.15	30	1.00	32	.89	5	.71	34	.70	24	.91	16	1.04	3	1.18
16	1.16	33	1.00	2	.90	6	.73	25	.71	35	.91	10	1.05	12	1.18
26	1.18	20	1.02	14	.90	38	.73	10	.72	3	.92	20	1.05	1	1.20
2	1.19	36	1.02	37	.90	7	.74	27	.72	22	.92	26	1.06	10	1.20
31	1.19	19	1.03	19	.91	16	.75	8	.73	36	.92	31	1.06	16	1.20
37	1.19	21	1.03	28	.92	17	.76	14	.73	9	.93	15	1.07	31	1.20
9	1.20	37	1.05	31	.92	1	.78	31	.74	26	.95	17	1.09	38	1.20
15	1.20	2	1.06	35	.93	4	.78	37	.75	30	.95	22	1.09	9	1.21
21	1.22	15	1.08	23	.95	32	.78	9	.78	19	.98	32	1.09	24	1.21
1	1.25	13	1.09	21	.98	9	.79	15	.79	34	.98	37	1.09	2	1.23
20	1.25	9	1.10	12	.99	3	.80	16	.80	8	1.00	8	1.10	27	1.23
33	1.26	12	1.11	20	.99	8	.80	38	.80	16	1.00	33	1.10	34	1.25
39	1.26	38	1.11	4	1.00	27	.81	2	.83	15	1.01	36	1.10	37	1.24
4	1.31	35	1.14	15	1.00	19	.82	3	.88	32	1.01	12	1.11	4	1.30
23	1.47	23	1.16	26	1.00	26	.84	17	.90	17	1.03	39	1.11	33	1.30
36	1.49	4	1.27	38	1.00	30	.84	30	.90	39	1.03	13	1.16	39	1.30
35	1.53	1	1.29	22	1.01	28	.85	18	1.00	31	1.05	19	1.17	23	1.33
11	1.60	11	1.39	13	1.02	2	.91	19	1.00	33	1.05	35	1.20	11	1.63
29	3.07	29	3.07	1	1.09	18	1.00	28	1.01	29	2.00	29	2.50	29	2.78

Table 7.-- Distribution of seasonal control stations by groups of similar monthly variations as determined from the mean factors in Table 4

April		May		June		July		August		September		October		November	
Group I - Stations 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 20, 21, 22, 24, 25, 26, 27, 31, 32, 33, 34, 37, 38, and 39															
(10)	.96	(7)	.82	(39)	.74	(33)	.55	(33)	.55	(5)	.76	(14)	.95	(32)	1.01
(5)	.97	(14)	.82	(24)	.75	(24)	.58	(20)	.61	(12)	.76	(7)	.98	(21)	1.05
(7)	.99	(25)	.85	(33)	.75	(15)	.59	(24)	.61	(7)	.79	(6)	.99	(20)	1.08
(14)	1.00	(27)	.85	(9)	.76	(39)	.59	(21)	.63	(21)	.79	(5)	1.00	(15)	1.09
(38)	1.00	(10)	.88	(25)	.78	(37)	.60	(32)	.64	(27)	.79	(27)	1.00	(25)	1.09
(32)	1.04	(5)	.89	(8)	.79	(25)	.66	(39)	.65	(6)	.81	(38)	1.00	(6)	1.11
(27)	1.05	(6)	.91	(7)	.80	(14)	.67	(12)	.68	(20)	.81	(25)	1.01	(22)	1.11
(22)	1.07	(8)	.93	(6)	.87	(34)	.67	(13)	.68	(10)	.83	(24)	1.02	(5)	1.12
(6)	1.08	(32)	.94	(10)	.87	(12)	.68	(22)	.68	(13)	.86	(34)	1.02	(8)	1.14
(25)	1.09	(39)	.95	(27)	.87	(21)	.68	(5)	.69	(25)	.89	(9)	1.03	(7)	1.15
(34)	1.10	(24)	.97	(5)	.88	(31)	.68	(6)	.69	(38)	.89	(21)	1.03	(13)	1.16
(8)	1.12	(26)	.97	(34)	.88	(10)	.69	(26)	.69	(14)	.90	(10)	1.05	(14)	1.17
(12)	1.13	(34)	.98	(32)	.89	(13)	.69	(7)	.70	(37)	.90	(20)	1.05	(26)	1.17
(24)	1.13	(31)	.99	(14)	.90	(20)	.69	(34)	.70	(24)	.91	(26)	1.06	(12)	1.18
(13)	1.15	(22)	1.00	(37)	.90	(22)	.70	(25)	.71	(22)	.92	(31)	1.06	(10)	1.20
(26)	1.18	(33)	1.00	(31)	.92	(5)	.71	(10)	.72	(9)	.93	(15)	1.07	(31)	1.20
(31)	1.19	(20)	1.02	(21)	.98	(6)	.73	(27)	.72	(26)	.95	(22)	1.09	(38)	1.20
(37)	1.19	(21)	1.03	(12)	.99	(38)	.73	(8)	.73	(34)	.98	(32)	1.09	(9)	1.21
(9)	1.20	(37)	1.05	(20)	.99	(7)	.74	(14)	.73	(8)	1.00	(37)	1.09	(24)	1.21
(15)	1.20	(15)	1.08	(15)	1.00	(32)	.78	(31)	.74	(15)	1.01	(8)	1.10	(27)	1.23
(21)	1.22	(13)	1.09	(26)	1.00	(9)	.79	(37)	.75	(32)	1.01	(33)	1.10	(37)	1.24
(20)	1.25	(9)	1.10	(38)	1.00	(8)	.80	(9)	.78	(39)	1.03	(12)	1.11	(34)	1.25
(33)	1.26	(12)	1.11	(22)	1.01	(27)	.81	(15)	.79	(31)	1.05	(39)	1.11	(33)	1.30
(39)	1.26	(38)	1.11	(13)	1.02	(26)	.84	(38)	.80	(33)	1.05	(13)	1.16	(39)	1.30

Table 7.-- Distribution of seasonal control stations by groups of similar monthly variations as determined from the mean factors in Table 4 (cont.)

Sheet 2 of 2

April	May	June	July	August	September	October	November
Group II - Stations 1, 4, 23, 35, and 36							
(1) 1.25	(36) 1.02	(36) .80	(23) .50	(35) .49	(4) .58	(4) .88	(36) 1.07
(4) 1.31	(35) 1.14	(35) .93	(35) .50	(23) .55	(23) .59	(1) 1.00	(35) 1.09
(23) 1.47	(23) 1.16	(23) .95	(36) .63	(36) .57	(1) .67	(23) 1.00	(1) 1.20
(36) 1.49	(4) 1.27	(4) 1.00	(1) .78	(1) .60	(35) .91	(36) 1.10	(4) 1.30
(35) 1.53	(1) 1.29	(1) 1.09	(4) .78	(4) .65	(36) .92	(35) 1.20	(23) 1.33
Group III - Stations 2, 3, 16, 17, 18, 19, 28, and 30							
(18) .98	(17) .78	(16) .72	(16) .75	(16) .80	(2) .82	(28) .89	(28) .89
(17) .99	(18) .80	(17) .75	(17) .76	(2) .83	(28) .89	(18) .90	(30) .99
(28) 1.01	(16) .87	(3) .80	(3) .80	(3) .88	(18) .90	(30) .94	(18) 1.00
(3) 1.03	(3) .96	(30) .86	(19) .82	(17) .90	(3) .92	(2) .99	(19) 1.00
(19) 1.03	(28) 1.00	(18) .87	(30) .84	(30) .90	(30) .95	(3) 1.02	(17) 1.09
(30) 1.12	(30) 1.00	(2) .90	(28) .85	(18) 1.00	(19) .98	(16) 1.04	(3) 1.18
(16) 1.16	(19) 1.03	(19) .91	(2) .91	(19) 1.00	(16) 1.00	(17) 1.09	(16) 1.20
(2) 1.19	(2) 1.06	(28) .92	(18) 1.00	(28) 1.01	(17) 1.03	(19) 1.17	(2) 1.23

It is noted that in group II for the months of September and October; and in group III for the month of November the ranges are slightly over .30. The reasoning for the inclusion and treatment of stations which fell outside the .30 range is similar to that used in connection with grouping of continuous count stations within .20 range, as described on pages 5 and 6 in items (c) and (d).

The seasonal control stations which did not fall into any of the groups predetermined by continuous count stations are numbers: 11 and 29. The reasons why these stations did not fall into any of the predetermined groups is not always obvious. Some of them may indicate additional pattern groups. Others may reflect local and/or temporary situation such as resort areas, football games, or activities that will cause unique traffic movements. However, these types of movements are generally very limited in extent. The stations noted above which did not fall into any predetermined group were of strictly local significance and do not represent any appreciable mileage.

Table 8.--Example illustrating the application of the principle of least squares for allocating a seasonal control station to a group. (The data for station No. 8 come from table 5. The monthly group mean factors come from table 4).

	Factors Station No. 8	Mean Factors Group I	Difference between factors at Station No. 8 and Group I, d_1	d_1^2	Mean factors Group III	Difference between factors at Station #8 & Group III, d_3	d_3^2
April	1.12	1.11	.01	.0001	1.03	.09	.0081
May	.93	.97	-.04	.0016	.92	.01	.0001
June	.79	.88	-.09	.0081	.86	-.07	.0049
July	.80	.71	.09	.0081	.86	-.06	.0036
August	.73	.71	.02	.0004	.88	-.15	.0225
September	1.00	.89	.11	.0121	.96	.04	.0016
October	1.10	1.03	.07	.0049	1.03	.07	.0049
November	1.14	1.19	-.05	.0025	1.09	.05	.0025
				$\Sigma d_1^2 = .0378$			$\Sigma d_3^2 = .0482$

It should be noted that in the above example in the columns marked d_1 and d_3 the difference between the factors of station 8 and the group mean factors of group 1 and the group mean factors of group 3 are within the criterion of permissible variation of $\pm .15$. Therefore, station 8 could have been allocated to either group 1 or group 3. However, the summation of the squared values of d_1 is equal to .0378 whereas the summation of squared values of d_3 is equal to .0482. Because the summation of the squared values of d_1 is less than the summation of squared values of d_3 station No. 8 is assigned to group 1. This method of allocating seasonal control stations to the various groups is particularly useful when the data are processed on the computer.

However, the final decision as to the allocation of a seasonal control station that could fall into more than one group should be made after examining the location of the station on the map. The contiguity of the road sections belonging to the same group determines the grouping of such a station. In such a situation, groupings of similar road sections should be maintained as much as possible.

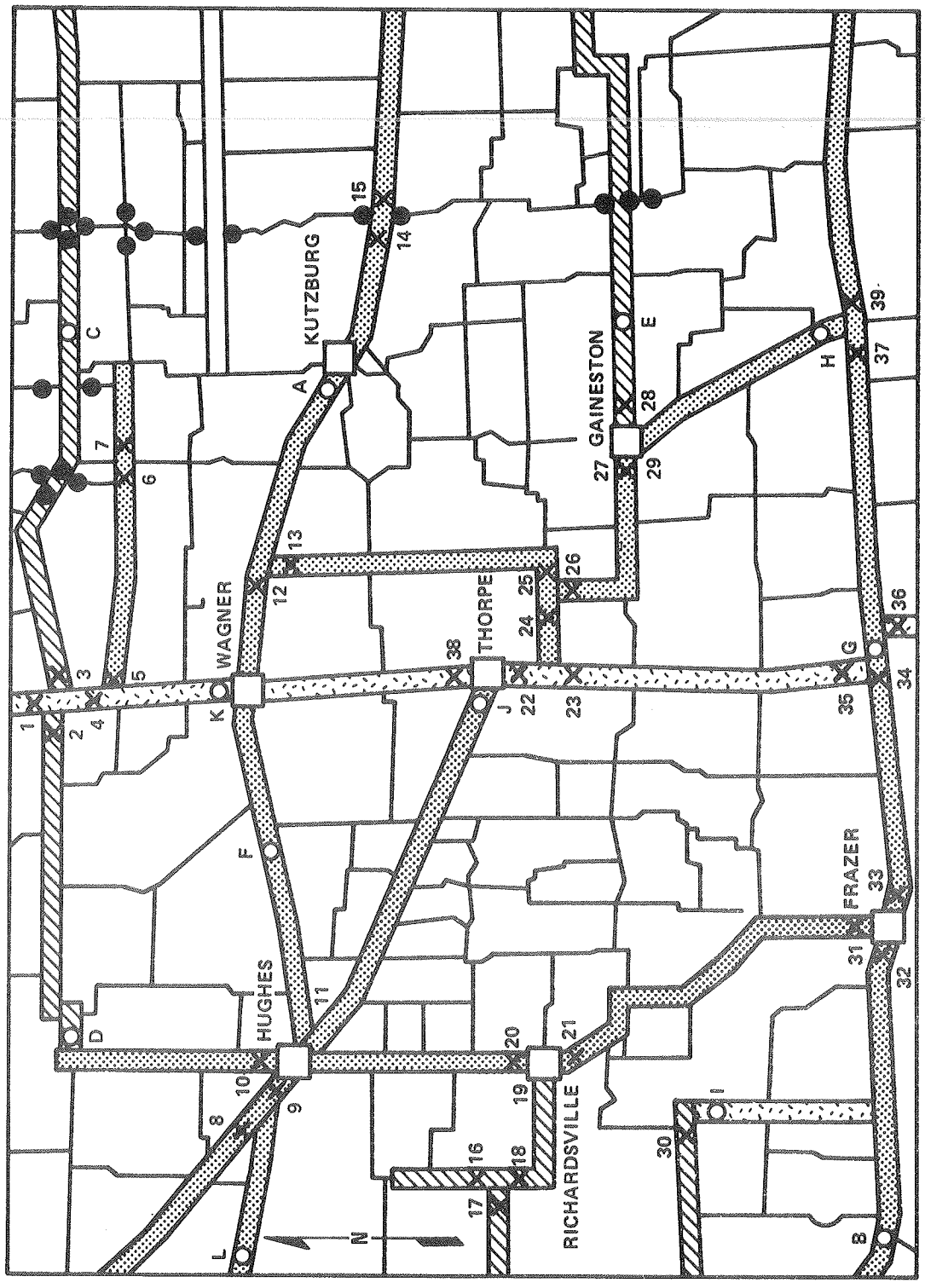

FIGURE I – GROUPING OF ROAD SECTIONS FROM CONTINUOUS AND SEASONAL CONTROL STATIONS.

Project Correspondent M. Marumo, Chief Roads Engineer, Ministry of Works, Lesotho.

Bibliography

The following bibliography contains two sets of references. The first set consists of a reference for each selected text that appeared in the preceding part of this compendium. The second set consists of references to additional publications that either were cited in the selected texts or are closely associated with material that was presented in the overview and selected texts. Each reference has five parts that are explained and illustrated below.

(a) Reference number: This number gives the position of the reference within this particular bibliography. It is used in the compendium index but should ***not*** be used when ordering publications.

(b) Title: This is either the title of the complete publication or the title of an article or section within a journal, report, or book.

(c) Bibliographic data: This paragraph gives names of personal or organizational authors (if any), the publisher's name and location, the date of publication, and the number of pages represented by the title as given above. In some references, the paragraph ends with an order number for the publication in parentheses.

Bibliografía

La siguiente bibliografía contiene dos series de referencias. La primera serie consiste en una referencia para cada texto seleccionado que apareció en la parte anterior de este compendio. La segunda serie consiste en referencias a publicaciones adicionales que fueron mencionadas en los textos seleccionados o que se asocian íntimamente con el material que se presentó en la vista general y los textos seleccionados. Cada referencia tiene cinco partes que se explican y se ilustran abajo.

(a) Número de referencia: este número indica la posición de la referencia dentro de esta bibliografía en particular. Se utiliza en el índice del compendio pero ***no*** deberá utilizarse al pedir publicaciones.

(b) Título: el título de la publicación completa o el título de un artículo o sección dentro de una revista, informe, o libro.

(c) Datos bibliográficos: este párrafo da los nombres de autores personales u organizacionales (si hay alguno), el nombre del editor y su dirección, la fecha de publicación, y el número de páginas representadas por el título en la parte (b). En algunas referencias el párrafo termina con un número de pedido para la publicación en paréntesis.

Bibliographie

La bibliographie qui suit contient deux catégories de références. La première catégorie consiste en une référence pour chaque texte choisi qui est inclus dans la partie précédente de ce recueil. La deuxième catégorie contient des références pour des documents qui ont soit été cités dans les textes choisis, ou soit sont étroitement associés avec des écrits qui sont présentés dans l'exposé ou les textes choisis, Chaque référence est composée de cinq parties qui sont expliquées et illustrées ci-dessous:

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(b) Titre : cela indique ou le titre du livre entier, ou le titre d'un article ou d'une section d'une revue, un rapport, ou un livre.

(c) Données bibliographiques: ce paragraphe indique les noms des auteurs personnels (quand il y en a) ou des auteurs collectifs (organisation), le nom de l'éditeur et son adresse, la date de l'édition, et le nombre de pages qui sont incluses sous le titre dans (b). Certaines références se terminent par un numéro entre parenthèses qui indique le numéro de commande.

(d) Availability information: This paragraph tells how the referenced publication is available to the reader. If the publication is out-of-print but may be consulted at a particular library, the name of the library is given. If the publication can be ordered, the name and address of the organization from which it is available are given. *The order should include all information given in parts (b) and (c) above.*

(e) Abstract: This paragraph contains an abstract of the publication whose title was given in part (b).

(d) Disponibilidad de la información: este párrafo indica la disponibilidad al lector de la publicación referenciada de una de dos formas como sigue. (1) La publicación está agotada pero puede ser consultada en la biblioteca indicada, donde se sabe que se posee una copia, o (2) la publicación puede ser pedida de la organización cuyo nombre y dirección están indicados. *El pedido deberá incluir toda la información dada en las partes (b) y (c).*

(e) Resumen: este párrafo es un resumen de la publicación cuyo título se dió en la parte (b).

(d) Disponibilité des documents: ce paragraphe indique les deux façons dont le lecteur peut acquérir les documents: (1) L'édition est épuisée, mais une certaine bibliothéque détient ce document et il peut être consulté. (2) Le document peut être commandé à l'organisation dont le nom et l'adresse sont indiqués ici. *L'ordre de commande doit inclure toutes les informations données dans les parties (b) et (c).*

(e) Analyse : ce paragraphe est une analyse du texte dont le titre est cité dans la partie (b).

Illustration (from Comp. 1) **Ilustración** (del Comp. 1) **Illustration** (du Recueil 1)

(a) Reference number
(a) Número de referencia
(a) Numéro de la référence

(b) Title
(b) Título
(b) Titre

(c) Bibliographic data
(c) Datos bibliográficos
(c) Données bibliographiques

(d) Availability information
(d) Disponibilidad de la información
(d) Disponibilité des documents

(e) Abstract
(e) Resumen
(e) Analyse

The order should include all information given in parts (b) and (c) above.
El pedido deberá incluir toda la información dada en las partes (b) y (c).
L'ordre de commande doit inclure toutes les informations données dans les parties (b) et (c).

Reference 5
A REVIEW OF HIGHWAY DESIGN PRACTICES IN DEVELOPING COUNTRIES

Cron, Frederick W. Washington, DC: International Bank for Reconstruction and Development; 1975 May. 57 p.

Order from: International Bank for Reconstruction and Development, 1818 H Street, N.W., Washington, DC 20433.

The design standards of some 150 highway projects financed by the International Bank for Reconstruction and Development between 1960 and 1970 are reviewed, and areas of agreement between the standards of the 63 countries studied are identified; practical highway standards based on these areas of agreement are sketched for the guidance of planners in developing countries. The roads discussed here, fall into three functional categories: a small group of expressways, freeways and toll roads carrying large volumes of traffic; a very large group of 2-lane highways carrying a wide range of traffic volumes serving both local and long distance traffic; and a smaller group of low-traffic tertiary or special purpose roads existing primarily for land service. Comments are made on the problem of classifying highway standards, and on the comparison of standards. Conclusions regarding standards for the capacity- related elements of design and standards for the velocity-related elements of design (radius of curvature, stopping sight distance, passing sight distance) are discussed, as well as the horizontal and vertical clearances for bridges. The standard live loadings for bridges, the structural capacity of pavements and legal load limits are covered, and conclusions relating to pavement design, design standards for 2-lane highways, incremental development of highways, and levels of service are presented.

Reference 1
MAINTAINING AND USING A RURAL ROAD INVENTORY

Laforge, H.B. Proceedings of the Ninth California Street and Highway Conference; Presented at the University of California at Berkeley, January 23–25, 1957, by the Institute of Transportation and Traffic Engineering and University Extension, University of California. Berkeley, California: The Institute of Transportation and Traffic Engineering, University of California; 1957; pp. 58–62. (Photocopies available).

Order from: University of California, Institute of Transportation Studies, 109 McLaughlin Hall, Berkeley, California 94720.

This paper describes the inventory of data that would permit the drafting of large-scale maps to show all public roads; cities, principal street connections through cities, incorporated towns, and villages; important structures on the road; and buildings and structures off the road such as farm units, dwellings, schools, churches, etc. The data inventoried will also permit the compilation of statistics on the mileage of the several types of roads, through streets, kinds of structures, and other items. Inventoried data are of three types and are represented by three map series: general highway, traffic, and county roads. The general highway map shows the highways and roads classified by surface types. The traffic map shows, by means of average daily traffic volume groups, the traffic recorded on the more important roads, the traffic count stations, and the actual average daily traffic recorded at the station. The county road map shows the road name and/or number and whether the road is a county primary, county secondary, or noncounty road.

Reference 2
GUIDE FOR A ROAD INVENTORY MANUAL OF INSTRUCTIONS

United States Department of Transportation, Federal Highway Administration. Washington, DC: November 1974; 50 p.

Order from: United States Department of Transportation, Federal Highway Administration, HHP–10, 400 Seventh Street, N.W., Washington, DC 20590.

This guide provides instruction in the methods of road inventories and is designed to help employees understand the requirements and purposes of the various inventories. The guide covers such aspects as staffing and organization for inventorying purposes, the equipment, kinds of inventories included in a road inventory, procedures for data collection, inventory procedure, structures carrying the road, ferries, and structures over the road, railroad crossings at grade, and special and municipal inventory procedures. Appendixes give further information on the delimitation of unincorporated places, gradient, curvature and sight distance, procedures applicable to the access of civilian mapping agencies to military installations, and the classification of road types. A glossary of terms and a list of references are included. A Spanish translation of this guide is available.

Reference 3
GUIDELINES FOR TRAFFIC COUNTS ON COUNTY ROADS

Russel, Eugene R.; Hittle, Jean E. Lafayette, Indiana: Purdue University, Engineering Experiment Station; June 1971. 60 p. (Highway Extension and Research Project for Indiana Counties; Engineering Bulletin; County Highway Series—No. 12).

Order from: The director, Highway Extension and Research Project for Indiana Counties, Engineering Experiment Station, Purdue University. West Lafayette, Indiana 47907.

These guidelines for counting traffic volumes are presented in several sections. The section on traffic count planning discusses general concepts of traffic counting and the establishment of counting stations to obtain data for both immediate use and long-range planning. Continuous count stations, monthly count stations, and coverage count stations are discussed. Traffic count data from the Indiana State Highway Commission (ISHC) are reviewed. Specific examples for converting typical portable-counter data to an ADT (average daily traffic) value are presented in the section on the analysis of data. Monthly variations, variations in cyclic patterns, monthly variations on county roads, calculation of monthly factors, converting 24-hour counts to AADT (annual average daily traffic), daily variations, minimum 48-hour count for portable counters, and developing local county road factors are covered. The use and application of ISHC data is illustrated. One section covers special aspects of short counts. The operation of portable automatic counters is outlined, and the operation of the Streeter Amet portable counter is detailed. The organization of traffic counting programs is summarized in relation to other phases of county highway planning and operation.

Reference 4
OUTLINE OF THE HIGHWAY TRANSPORTATION PLANNING PROCESS

United States Department of Transportation, Federal Highway Administration. Washington, DC: 1976; 20 p. (Record # PB 80–196389).

Order from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

This manual describes the collection of basic planning data, the planning, the establishment of specifications, and the estimation of construction needs related to the highway transportation planning process. The data needed for the planning and operation of such a system are described, and the use of the data for the determination of needed highway improvements is outlined. Long range plans that are based on the country's overall goals and objectives and short-range plans (usually five years) are described. The long-range plan inputs include the road inventory, adequacy ratings, traffic surveys, highway statistics, transportation goals, highway classification study, highway improvement needs, highway fiscal study, and study of highway laws. The inputs to the short-range plans—namely, corridor studies, budget analyses, preliminary engineering plans, and right-of-way plans related to construction planning—are examined. The outputs—namely, the long-range highway plan, the five year programs, and construction plans, specifications, and estimates—are also covered. A Spanish translation of this book is available (Record # PB 80–196405).

Reference 5
GUIDE FOR MANUAL OF INSTRUCTIONS FOR ROAD INVENTORY

United States Department of Transportation, Federal Highway Administration. Washington, DC: 1976; 64 p. (Record # PB 80-196389).

Order from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

This guide describes the organization and management of the road inventory program, including the classification and duties of personnel, equipment for the field crews, and the duties of the party chief and driver, and the inventory vehicle and its equipment. Inventory procedures are described in detail including each item in seven different field data forms. These self-coding forms for direct use by keypunch operators record data on undivided roadways, divided roadways, bridges and culverts, railroad grade crossings, tunnels, ferry crossings, and supplemental data on extensions of national and provincial highways in urban areas. Examples of various identification codes as prepared for use in Argentina are given with instructions for their modification in other countries. A Spanish translation of this guide is available (Record # PB 80-196405).

Reference 6
GUIDE FOR MANUAL OF INSTRUCTIONS FOR TRAFFIC SURVEYS

United States Department of Transportation, Federal Highway Administration. Washington, DC: 1976; 49 p. (Record # PB 80-196389).

Order from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

This outline of procedures to inventory highway use is in three sections. The section on mechanical counting includes instructions for making traffic volume counts. The section on classification counting includes instructions for making counts to determine the distribution of different types of motor vehicles. The section on truck weighing gives instructions for a weighing program to determine the weight characteristics of different types of motor vehicles. The manual provides guidance on determining the number and location of counting or weighing stations and the length of time that each should be occupied. Appendixes include examples of forms for recording vehicle classification data, truck weight data, and a guide for a traffic volume counting manual. The latter describes procedures for estimating annual ADT (average daily traffic) volume based on sample counts. It describes a method of applying statistical principles to determine the accuracy of traffic estimates in terms of frequency of errors of specific magnitudes. Rural road traffic counting procedures are described for highways with ADT volumes greater than 500, highways with ADT between 25 and 500, and roads with ADT less than 25. A Spanish translation of this guide is available (Record # PB 80-196405).

ADDITIONAL REFERENCES

Reference 7
ANNUAL TRAVEL ON COUNTY HIGHWAYS OF INDIANA

Vodrazka, Walter C.; Michael, Harold L. Lafayette, Indiana: Purdue University, Engineering Experiment Station; March 1967; 22 p. (Highway Extension and Research Project for Indiana Counties; Engineering Bulletin; County Highway Series—No. 9).

Order from: The director, Highway Extension and Research Project for Indiana Counties, Engineering Experiment Station, Purdue University. West Lafayette, Indiana 47907.

A study to determine the annual vehicle miles of travel on county highways in Indiana is reported. An estimate was made of the average AADT (annual average daily traffic) for all miles of road in the county highway system. This average when multiplied by the total length of the system, provided the estimate of the vehicle miles of travel. The method employed was to place each road section in 25 counties selected randomly from seven county-size strata into its appropriate volume stratum and select a random sample of these sections from each stratum. One volume count was then made on each sample selected to obtain an estimate of the system AADT. The AADT was then multiplied by the system length to obtain the vehicle miles of travel in the system. The data collection procedure is briefly outlined. The results of the study are tabulated and discussed. The conclusions drawn from the study are presented.

Reference 8
HIGHWAY PLANNING MANUAL

Jorgensen (Roy) Associates, Incorporated. Gaithersburg, Maryland: September 1975; 180 p. (Prepared by Roy Jorgensen Associates Incorporated, Engineering and Management Consultants for U.S. Agency for International Development; Project Number—Highway Manual AID/OTr C-1420). (Available in microfiche).

Order from: United States Agency for International Development, AID Resources Center, Office of Development Information Utilization, Bureau of Development Support, Washington, DC 20523.

This manual, which is intended for use by highway agency personnel responsible for supervision and control of planning activities, provides basic orientation and an understanding of planning organization, policies, practices and responsibilities, provides guidelines for judgements and decisions by planning personnel, and describes the most effective techniques and procedures for highway planning in developing nations. The highway planning categories considered are system planning, route and project planning, programming and scheduling, budgeting, and support functions. In system planning, long-range objectives must be defined. Factors to be considered in such planning are travel desire lines, traffic data, economic data, road classes, and the assignment of responsibilities to regional and local governments. Existing road facilities must be reviewed and priorities for needed improvements must be established. Route planning is usually guided by economic analyses. Project planning is guided by defining the precise beginning and ending of individual projects and by setting the geometric characteristics. The programming and scheduling process includes consideration of improvement priorities, project development time, available funds, and constraints on funding. The budgeting process consists of the allocation of resources and the commitment of funds

for specific purposes during specific time periods. Supporting functions include the collection of data related to road and bridge inventories, traffic data, traffic projections, and origin and destination studies. Organizational practices and procedures for carrying out planning functions are discussed.

Reference 9
ADVANCE ROAD PROGRAMS

National Association of County Engineers, Research Foundation. Washington, DC: July 1972; 72 p. (National Association of County Engineers Action Guide Series Volume III).

Order from: National Association of Counties, 1735 New York Avenue, N.W., Washington, DC 20006.

Authoritative information on all phases of county road management is provided. Advance road programming is the planning of improvements well in advance of actual work. The first step in the process of setting up a system for such programming is the inventory that involves the collection and organization of physical data and road use data that will be used afterwards to classify the roads, analyze needs and deficiencies, and formulate a plan of operations to bring the county's road system up to acceptable standards. Classification sorts out the rural roads and urban streets and applies the proper functional name tag to each. Improvement projects that are necessary to bring the roadway system to an adequate level of condition and serviceability need to be determined. Reported improvement needs are translated into a firm plan of action consistent with the financial capability of the county. A methodical and impartial procedure, termed priority analysis, ranks needed improvement projects in order of relative urgency. Program assembly takes up the data on needs, financing and priorities, seasons it with legitimate practical considerations, and converts it to an actual construction timetable.

Reference 10
GUIDE FOR FUNCTIONAL CLASSIFICATION OF HIGHWAYS

United States Department of Transportation, Federal Highway Administration. Washington, DC: 1976; 23 p. (Record # PB 80-196389).

Order from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22157.

Functional classification is the process by which streets and highways are grouped into classes or sytems that serve similar functions. Such classification provides information important in establishing realistic improvement standards, both for individual highway sections and for the whole highway system. It also provides information that will be of assistance in making an equitable and viable distribution of responsibility between the different levels of government for the public highways. Functional classification defines the nature of channelization of travel by defining the part that any particular road or trip should play in serving the flow of trips through a highway network. The specific objectives of application of highway system classification are planning of highway system development, assignment of jurisdiction, and fiscal planning. Classification criteria that relate to rural arterials, rural collectors, rural local roads, urban network, urban arterials, urban collectors, and urban local streets are described. A technical procedure of rural highway classification with particular reference to a technique for laying out a rural arterial network is described in detail. A Spanish translation of this guide is available (Record # PB 80-196405).

Reference 11
GUIDE FOR MANUAL FOR HIGHWAY ADEQUACY RATING

United States Department of Transportation, Federal Highway Administration. Washington, DC: 1976; 31 p. (Record # PB 80-196389).

Order from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

The adequacy-rating process provides an evaluation of the existing structural adequacy, safety, and level of service provided by each section of highway as compared with a tolerable standard. The tolerable standard describes a road that would be considered satisfactory to accommodate current traffic volumes at a minimum acceptable level of service related to the function of the road. The highway-adequacy study is designed to provide separate ratings for surface type, traveled way width, shoulder width, surface condition, foundation condition, drainage, alignment, stopping sight distance, passing sight distance, major structure (bridge) condition, and major structure clearances. The staff requirements for making an adequacy study are discussed. Details are given of work procedures that relate to roadway and bridge evaluation in the field (including the use of data forms to record observations) and the evaluation of roadway bridges from inventory data. Special instructions are provided with regard to hazardous locations, topography, tentative functional classification, and procedures for evaluating divided highways. The appendix includes examples of tolerable standards for major and minor rural highways, forms for recording data, and listings for adequacy rating control sections and inventory data by reference point. A Spanish translation of this guide is available (Record # PB 80-196405).

Reference 12
MEASURING HIGHWAY IMPROVEMENT NEEDS AND PRIORITY ANALYSIS

United States Department of Transportation, Federal Highway Administration. Washington, DC: 1976; 22 p. (Record # PB 80-196389).

Order from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

Detailed instructions are given for making a careful evaluation of conditions that affect motor vehicle travel on the rural arterial and collector highway systems. The evaluation will determine what improvements are necessary to bring the highway system up to an acceptable level of condition and serviceability and will provide a basis for financial planning, for the rational selection and orderly scheduling of improvement projects, and for achieving informed public support. The appraisal process consists of identification of study sections, description of existing conditions, determination of

the character and degree of the deficiencies, estimation of improvements needed to overcome deficiencies, and estimation of costs of needed improvements. Improvement analysis guides for rural arterials and collectors, for bridges on rural arterials and collectors, and for railroad grade crossing criteria are outlined. Priority analysis for ranking needed improvement projects is discussed. Tables of tolerable standards for major and minor rural highways and railroad grade crossing criteria are included, as well as figures that show improvement analysis guides for rural arterials and collectors, for bridges on rural arterials and collectors, and for railroad grade-crossing criteria. Appendixes include guides for calculating roadway cost data for rural arterial and collector highways and for estimating costs for improvements to major structures. The appraisal process described in this manual is dependent on the availability of road inventory and adequacy data in the format outlined in the Guide for Manual of Instructions for Road Inventory (see Reference 5) and the Guide for Manual for Highway Adequacy Rating (see Reference 11). A Spanish translation of this guide is available (Record # PB 80-196405).

Reference 13
COMPUTER PROGRAM USERS' MANUAL, VOLUME 1

United States Department of Transportation, Federal Highway Administration. Washington, DC: 1977; variable paging. (Record # PB 80-196355).

Order from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

Designed to assist with the development of efficient procedures for analyzing the data from completed field forms, this manual also suggests organization for office operations and documentation to assist with the installation and use of the computer programs developed for the system. This volume, which includes data-analysis procedures for the highway inventory, describes and documents 19 computer programs required to edit, store, and report the data. All of the computer programs are written in American National Standard COBOL programming language. The manual covers control and storage of data, data processing steps, validation master file coding, processing of data in lots, route compilation procedures, reference data listings, and highway log publications. This volume is one of a series of three volumes. The three volumes are also available in one set (Record # PB 80-196348).

Reference 14
COMPUTER PROGRAM USERS' MANUAL, VOLUME 2

United States Department of Transportation, Federal Highway Administration. Washington, DC: 1978; variable paging. (Record # PB 80-196363).

Order from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

Procedures for analyzing highway adequacy rating data including the description and documentation for seven computer programs required to edit, store, and report the highway adequacy data, are presented in this volume. Highway adequacy data are used to determine the need for improvements necessary to bring the highway transportation system to an adequate level of condition and serviceability for current and future traffic. These data are also used for the selection and scheduling of improvement projects. All of the computer programs are written in American National Standard COBOL programming language. This manual (Volume 2) should be used as a supplement to Computer Program Users' Manual, Volume 1 (see Reference 13), and is one of a series of three volumes. The three volumes are also available in one set (Record # PB 80-196348).

Reference 15
COMPUTER PROGRAM USERS' MANUAL, VOLUME 3

United States Department of Transportation, Federal Highway Administration. Washington, DC: 1979; variable paging. (Record # PB 80-196371).

Order from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

This volume, which deals with rural highway traffic subsystems, covers the procedures for analyzing highway traffic data and includes the descriptions and documentation for 12 computer programs for editing, sorting and reporting highway traffic data. All of the computer programs are written in American National Standard COBOL programming language. This manual covers data preparation, the validation master file, editing, traffic reports, vehicle classification reports, and truck weight reports. The complete data processing documentation package for the entire rural highway planning system includes the Computer Program Users' Manual, Volume 1, relating to highway inventory (see Reference 13), and Volume 2, relating to highway adequacy (see Reference 14). The three volumes are also available in one set (Record # PB 80-196348).

Index

The following index is an alphabetical list of subject terms, names of people, and names of organizations that appear in one or another of the previous parts of this compendium, i.e., in the overview, selected texts, or bibliography. The subject terms listed are those that are most basic to the understanding of the topic of the compendium.

Subject terms that are not proper nouns are shown in lower case. Personal names that are listed generally represent the authors of selected texts and other references given in the bibliography, but they also represent people who are otherwise identified with the compendium subjects. Personal names are listed as surname followed by initials. Organizations listed are those that have produced information on the topic of the compendium and that continue to be a source of information on the topic. For this reason, postal addresses are given for each organization listed.

Numbers that follow a subject term, personal name, or organization name are the page numbers of this compendium on which the term

Indice

El siguiente índice es una lista alfabética del vocablo del tema, nombres de personas, y nombres de organizaciones que aparecen en una u otra de las partes previas de este compendio, es decir, en la vista general, textos seleccionados, o bibliografía. Los vocablos del tema que aparecen en el índice son aquellos que son necesarios para el entendimiento de la materia del compendio.

Los vocablos del tema que no son nombres propios aparecen en letras minúsculas. Los nombres personales que aparecen representan los autores de los textos seleccionados y otras referencias dadas en la bibliografía, pero también pueden representar a personas que de otra manera están conectadas a los temas del compendio. Los nombres personales aparecen con el apellido seguido por las iniciales. Las organizaciones nombradas son las que han producido información sobre la materia del compendio y que siguen siendo fuentes de información sobre la materia. Por esta razón se dan las direcciones postales de cada organización que aparece en el índice.

Los números que siguen a un vocablo del tema, nombre personal, o nombre de organización son los números de página del compendio donde el vocablo o nombre aparecen. Los números romanos se refieren a las páginas en la vista general, los números arábigos se refieren a páginas en los textos seleccionados, y los números de referencia (por ejemplo, Ref. 5) indican referencias en la bibliografía.

Algunos vocablos del tema y nombres de organizaciones están seguidos por la palabra ***see.*** En tales casos los números de página del com-

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Cet index se compose d'une liste alphabétique de mots-clés, noms d'auteurs, et noms d'organisations qui paraissent dans une section ou une autre de ce recueil, c'est à dire dans l'exposé, les textes choisis, ou la bibliographie. Les mots-clés sont ceux qui sont le plus élémentaires à la compréhension de ce recueil.

Les mots-clés qui ne sont pas des noms propres sont imprimés en minuscules. Les noms propres cités sont les noms des auteurs des textes choisis ou de textes de référence cités dans la bibliographie, ou alors les noms d'experts en la matière de ce recueil. Le nom de famille est suivi des initiales des prénoms. Les organisations citées sont celles qui ont fait des recherches sur le sujet de ce recueil et qui continueront à être une source de documentation. Les adresses de toutes ces organisations sont incluses.

Le numéro qui suit chaque mot-clé, nom d'auteur, ou nom d'organisation est le numéro de la page où ce nom ou mot-clé parait. Les numéros

or name appears. Roman numerals refer to pages in the overview, Arabic numerals refer to pages in the selected texts, and reference numbers (e.g., Ref. 5) refer to references in the bibliography.

Some subject terms and organization names are followed by the word ***see.*** In such cases, the compendium page numbers should be sought under the alternative term or name that follows the word ***see.*** Some subject terms and organization names are followed by the words ***see also.*** In such cases, relevant references should be sought among the page numbers listed under the terms that follow the words ***see also.***

The foregoing explanation is illustrated below.

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pendio se encontrarán bajo el término o nombre alternativo que sigue a la palabra ***see.*** Algunos vocablos del tema y nombres de organizaciones están seguidos por las palabras ***see also.*** En tales casos las referencias pertinentes se encontrarán entre los números de página indicados bajo los términos que siguen a las palabras ***see also.***

La explicación anterior está subsiguientemente ilustrada.

écrits en chiffres romains se rapportent aux pages de l'exposé et les numéros écrits en chiffres arabes se rapportent aux pages des textes choisis. Les numéros de référence (par exemple, Ref. 5) indiquent les numéros des références de la bibliographie.

Certains mots-clés et noms d'organisations sont suivis du terme ***see.*** Dans ces cas, le numéro des pages du recueil se trouvera après le mot-clé ou le nom d'organisation qui suit le terme ***see.*** D'autres mots-clés ou noms d'organisations sont suivis des mots ***see also.*** Dans ce cas, leurs références se trouveront citées après les mots-clés qui suivent la notation ***see also.***

Ces explications sont illustrées ci-dessous.