

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
SYNTHESIS OF HIGHWAY PRACTICE

34

**POLICIES FOR
ACCOMMODATION OF UTILITIES ON
HIGHWAY RIGHTS-OF-WAY**

TRANSPORTATION RESEARCH BOARD 1976

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ACCOMMODATION OF UTILITIES ON
HIGHWAY RIGHTS-OF-WAY**

RESEARCH SPONSORED BY THE AMERICAN
ASSOCIATION OF STATE HIGHWAY AND
TRANSPORTATION OFFICIALS IN COOPERATION
WITH THE FEDERAL HIGHWAY ADMINISTRATION

AREAS OF INTEREST:
TRANSPORTATION ADMINISTRATION
LAND ACQUISITION
HIGHWAY DESIGN

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL
WASHINGTON, D.C. 1976

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

In recognition of these needs, the highway administrators of the American Association of State Highway and Transportation Officials initiated in 1962 an objective national highway research program employing modern scientific techniques. This program is supported on a continuing basis by funds from participating member states of the Association and it receives the full cooperation and support of the Federal Highway Administration, United States Department of Transportation.

The Transportation Research Board of the National Research Council was requested by the Association to administer the research program because of the Board's recognized objectivity and understanding of modern research practices. The Board is uniquely suited for this purpose as: it maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; it possesses avenues of communications and cooperation with federal, state, and local governmental agencies, universities, and industry; its relationship to its parent organization, the National Academy of Sciences, a private, nonprofit institution, is an insurance of objectivity; it maintains a full-time research correlation staff of specialists in highway transportation matters to bring the findings of research directly to those who are in a position to use them.

The program is developed on the basis of research needs identified by chief administrators of the highway and transportation departments and by committees of AASHTO. Each year, specific areas of research needs to be included in the program are proposed to the Academy and the Board by the American Association of State Highway and Transportation Officials. Research projects to fulfill these needs are defined by the Board, and qualified research agencies are selected from those that have submitted proposals. Administration and surveillance of research contracts are responsibilities of the Academy and its Transportation Research Board.

The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

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PREFACE

There exists a vast storehouse of information relating to nearly every subject of concern to highway administrators and engineers. Much of it resulted from research and much from successful application of the engineering ideas of men faced with problems in their day-to-day work. Because there has been a lack of systematic means for bringing such useful information together and making it available to the entire highway fraternity, the American Association of State Highway and Transportation Officials has, through the mechanism of the National Cooperative Highway Research Program, authorized the Transportation Research Board to undertake a continuing project to search out and synthesize the useful knowledge from all possible sources and to prepare documented reports on current practices in the subject areas of concern.

This synthesis series attempts to report on the various practices without in fact making specific recommendations as would be found in handbooks or design manuals. Nonetheless, these documents can serve similar purposes, for each is a compendium of the best knowledge available concerning those measures found to be the most successful in resolving specific problems. The extent to which they are utilized in this fashion will quite logically be tempered by the breadth of the user's knowledge in the particular problem area.

FOREWORD

*By Staff
Transportation
Research Board*

This synthesis will be of special interest and usefulness to representatives of state highway and transportation agencies and of public and private utilities who are concerned with policies that govern the accommodation of utilities on highway rights-of-way. Information is presented on current policies of highway and transportation agencies in accommodating pipelines, power lines, communication lines, and other utilities on highway rights-of-way. Among matters of discussion are location, bury, encasement, and installation of underground utilities; location, clearances, and nature of installation of overhead utilities; positioning and method of attachment to highway structures; scenic enhancement; and permits and fees. Recommendations for the improvement of accommodation policies are made where believed warranted.

Administrators, engineers and researchers are faced continually with many

highway problems on which much information already exists either in documented form or in terms of undocumented experience and practice. Unfortunately, this information often is fragmented, scattered, and unevaluated. As a consequence, full information on what has been learned about a problem frequently is not assembled in seeking a solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem. In an effort to resolve this situation, a continuing NCHRP project, carried out by the Transportation Research Board as the research agency, has the objective of synthesizing and reporting on common highway problems—a synthesis being identified as a composition or combination of separate parts or elements so as to form a whole greater than the sum of the separate parts. Reports from this endeavor constitute an NCHRP report series that collects and assembles the various forms of information into single concise documents pertaining to specific highway problems or sets of closely related problems.

It is often in the best public interest in terms of efficiency, economy, and the preservation of an acceptable environment for power lines, communication lines, pipelines, water mains, sewers, and other facilities of publicly and privately owned utilities to follow, cross, and be accommodated within highway rights-of-way. In these situations, care must be exercised in having each of the facilities occupy the same space without serious detriment to the other. The dual interest of highway and transportation agencies and utilities in acting harmoniously in matters of the joint occupancy of highway rights-of-way is recognized by the American Association of State Highway and Transportation Officials in the publication of its *Guide for Accommodating Utilities on Highway Rights-of-Way*. Similarly, most states and the Federal Highway Administration have adopted specific policies and procedures for the use of highway rights-of-way by utilities. This report of the Transportation Research Board explores and interprets the provisions of the AASHTO Guide and the state policies on utility accommodation. Recommendations are made for improvement and areas of needed research are pointed out.

To develop this synthesis in a comprehensive manner and to ensure inclusion of significant knowledge, the Board analyzed available information assembled from numerous sources, principally state highway and transportation departments and the Federal Highway Administration. A topic advisory panel of experts in the subject area was established to guide the researchers in organizing and evaluating the collected data, and to review the final synthesis report.

This synthesis is an immediately useful document that records practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As the processes of advancement continue, new knowledge can be expected to be added to that which is now at hand.

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POLICIES FOR ACCOMMODATION OF UTILITIES ON HIGHWAY RIGHTS-OF-WAY

SUMMARY

Highways are planned, designed, and constructed to serve the public by carrying people and goods from place to place. Public- and private-owned utilities also have a similar public-serving function, often between the same points served by the highway systems. It is inevitable, in many cases, that utilities follow and cross highways and seek to be accommodated within highway rights-of-way.

This dual interest in the use of highway rights-of-way is recognized by the American Association of State Highway and Transportation Officials (AASHTO) in *A Guide for Accommodating Utilities on Highway Rights-of-Way*, including guidelines for meeting the needs of both highways and utilities. Each state highway or transportation agency has adopted its own utility accommodation policy, generally following the criteria contained in the AASHTO *Guide*. This report explores the requirements of state policies with respect to the various facets of utility accommodation: pipelines, power and communication lines, installation on structures, scenic enhancement, permits and fees, utility accommodation coordination, and others.

Findings of the synthesis include:

- Most agencies have used the AASHTO *Guide* as the model for their policies on utility accommodation. Some have used the exact language of the *Guide*; others have added to or revised the suggestions of the *Guide* to meet local needs.
- There are policy variations from state to state in such items as: location, bury, encasement, and installation of underground utilities; location and clearance of overhead facilities; and position and method of attachment of utilities to highway structures. Location requirements are often oriented to different baselines, such as right-of-way line, pavement edge, or curb line.
- Differences in location, alignment, bury, clearance, encasement, etc., are not always attributable to differences in geographic area, climate, terrain, or other factors.
- All policies reflect a desire to locate utilities as far as possible from the traveled way. Another common denominator is the almost complete banning of longitudinal placement of facilities under pavements, except in urban areas. The policies are also in agreement that attachment of utilities to highway structures should be discouraged whenever possible and, when permitted, should be regulated rigidly.
- Some policies relate location, bury, and encasement requirements with relative hazards involved, such as power or communication lines, voltages, pressures, and the nature of material transmitted in a pipeline.
- Most agencies are aware of the need for scenic enhancement of roadsides, particularly areas such as overlooks, rest areas, and parks, and thus have adopted the exact or similar wording of the AASHTO *Guide* on scenic enhancement for utility installations.

- The need for coordination of the practices and procedures of all utilities that use the right-of-way is not adequately covered by the AASHTO *Guide*, nor do individual state policies make specific references to utility accommodation coordination.

Recommendations for the improvement of policies on accommodation of utilities have been made, as follows:

- Periodic conferences should be conducted for the purpose of developing possible concurrences between state policies and for examining the views of the utilities.

- Efforts should be made to foster dual and multiple use of utility facilities where such uses are compatible, safe, and workable.

- The AASHTO *Guide* has been helpful to state agencies in preparing their policies. However, it provides only minimal guidance for accommodating utilities in urban areas or sections of road with narrow rights-of-way. Some agencies have included additional material and established procedures beyond those in the *Guide*. An appropriate AASHTO group should undertake revision of the *Guide*. Similarly, each agency should periodically review its policy to ascertain the need for revisions.

- Agencies that do not now have sections in their policies covering permits, inspections, fees, and bonding requirements should consider adding these.

- The formation of local-regional utility coordination committees with the participation of highway agencies is encouraged.

- Standard color markings should be adopted for stakes used to mark the location of underground utilities.

- Some responsibilities for certain facets of utility accommodation belong to highway agencies, others belong to the utilities, and some belong to both.

Areas where specific research is needed include:

- New and improved methods for placing, repairing, and replacing utilities within highway rights-of-way.

- Optimization of standards for location, alignment, bury, encasement, structure attachments, etc.

- Determination of: the nature and extent of the problems of accommodating utilities on highways, the effects that adoption of policies have had on these problems, and the cost/benefit of the policy requirements.

INTRODUCTION

THE DUALITY OF INTERESTS AND RIGHTS

Highway systems in the United States have been planned, designed, and constructed to expedite vehicular traffic with the utmost safety and with a minimum impedance of movement. Any conditions that limit the free movement of traffic, affect the structural integrity of road systems, or interfere with roadway construction, operation, maintenance, and life expectancy must be controlled. Yet, highways do not exist in a vacuum. They are a part of the areas they traverse and of the communities they serve.

Privately and publicly owned utilities have a public-serving function similar to that of highways. The needs of utilities (power lines, communication lines, gas and other pipelines, water mains and sewers) to go from place to place in the public interest—often to or from the same points served by the highway system—should be recognized.

The franchise rights and responsibilities of private and public utilities are often based on their ability and legal rights to use the best and most economical routes. In many cases, then, these utilities follow and cross highways and seek accommodation within highway rights-of-way (R.O.W.).

This dual interest in highway and utility routing need not become a duel of interests. It can be resolved to the mutual benefit of all concerned through careful planning by highway agencies and through acceptance of space allocations and procedures by the utilities that occupy highway rights-of-way. Agreements between the two interests can provide utilities with reasonable accommodations without impairing the serviceability of highway systems.

Any accommodation of utility plant on, in, under, over, or along highway rights-of-way must be accomplished with a minimum of detrimental effect on, or interference with, the purposes of the road system. The challenge is to develop techniques that will permit two facilities to occupy the same space without adverse effects on either. The answer is cooperation and participation.

To foster this duality of right-of-way use by utilities and highways, the Federal Highway Administration (FHWA) has established policies and procedures for accommodating utilities on federal and federal-aid highway projects (1). In addition, most states have adopted policies for the use of rights-of-way by utilities.

The AASHTO *Guide for Accommodating Utilities on Highway Rights-of-Way* (2)* recognizes the dual interest of highways and utilities and suggests equitable guidelines

for meeting the needs of both. The policies adopted by state transportation agencies are intended to supplement and implement these guidelines to preserve their inherent right to regulate the use of their rights-of-way in order to satisfy transportation needs. This synthesis explores and interprets the provisions of the AASHTO *Guide* and the state policies on utility accommodation.

ACCOMMODATION OF UTILITIES ON FREEWAYS

AASHTO has published *A Policy on the Accommodation of Utilities on Freeway Rights-of-Way* (3). This policy was adopted for use by all state highway agencies and has been officially adopted by the Federal Highway Administration as a highway design policy applicable to all federal-aid freeways. Basically, this policy does not permit the longitudinal installation of utilities on freeway rights-of-way, except in extreme cases and under strictly controlled conditions. Other specific criteria are included in the policy. For example, supporting poles (a) are to be located at least 30 ft (9.1 m) beyond the edge of the shoulder of through-traffic lanes; (b) must be at least 20 ft (6.1 m) from edge-of-ramp shoulders; and (c) shall not be placed in medians 80 ft (24 m) or less in width.

The FHWA policy on accommodation of utilities (1) is contained in the *Federal-Aid Highway Program Manual* (PPM 30-4.1). The policy provides a practical method for applying both the AASHTO policy and joint development and multiple use concepts to freeways and utilities, especially for locations within and approaching metropolitan areas where land is scarce and right-of-way is expensive. This preserves the access control feature of freeways but recognizes the merit and need for accommodating trunk-line and transmission-type utilities under strictly controlled conditions.

UTILITY ACCOMMODATION IN URBAN AREAS

The AASHTO *Guide* is directed toward the accommodation of utilities on highway rights-of-way in rural areas and provides minimal guidance for urban areas or highways with narrow rights-of-way. Two reports have recently been prepared for FHWA by the American Public Works Association (APWA) that address this problem: a *Manual of Improved Practice* (4) and a *State of the Art* (5). Both reports have been reproduced and distributed by the FHWA. Much of the information on construction techniques in these reports is also applicable to utility work on rural highway rights-of-way.

* Referred to hereafter as AASHTO *Guide* or, simply, *Guide*.

PIPELINES AND APPURTENANCES

Of all the utilities that can affect the performance and permanence of highway pavements and structures, those occupying underground space (including pipelines and appurtenances) are the most critical. Their physical size and strength, life expectancy, and maintenance characteristics, as well as the substances they carry, dictate their accommodation in the highway right-of-way. Occupation of space under traffic lanes and along right-of-way lands can have a marked effect on the highway.

The location, burial, encasement, protection, and installation of utilities within rights-of-way must be regulated by highway agencies. With such regulations, highway systems can provide safe, dependable and economical traffic flow conditions and, at the same time, utilities occupying the right-of-way can realize comparable benefits. When both highways and pipelines achieve joint use of the right-of-way, the public interest is best served.

Pipeline transmission of gases and hazardous liquids (including petroleum) is subject to regulations issued by the U.S. Department of Transportation, Office of Pipeline Safety. These regulations outline minimum safety standards that must be met by virtually all pipeline operators.

LOCATION AND ALIGNMENT

Despite variations in policies from state to state, one basic principle of pipeline location and alignment is recurring: Utilities preferably should not be installed longitudinally under any rural traveled way. Utilities are permitted under a traveled way for crossing purposes. However, such crossings must be made in the shortest possible distance (at, or approximating, a right angle to the roadway). In urban areas it is often necessary to place utilities longitudinally beneath the traveled way (4, 5). Some states make a distinction between transmission and distribution lines in longitudinal installations, allowing the former and prohibiting the latter.

The AASHTO *Guide* states that longitudinal installations preferably should be located at or adjacent to the right-of-way line, and that crossings should be as near perpendicular to the highway as is practical. All state policies cover the location and alignment of pipelines in general conformity with the *Guide*. Twenty-one agencies have adopted policies that either use exact AASHTO language or slight modifications thereof. However, many policies do not follow the same format as the AASHTO *Guide*, making it difficult to determine that the policy is, in fact, essentially the same as the *Guide*.

In many agencies, the general principles set forth in the AASHTO *Guide* have been supplemented by specific dimensions for location and alignment. It should be noted that these specific dimensions are often qualified by certain

exceptions. Offset distances vary from state to state. The use of different baselines for measuring offsets further clouds the issue. It is difficult to explain the differences in terms of local conditions such as geographical, topographical, or geological factors, or to attribute them to the personal or professional opinions of the drafters of the policies.

Discussion of Pipeline Location Policies

A review of the pipeline policies discloses no significant offset location policy that could serve as a model in making more uniform requirements. Those states that do not have specific dimensional policies could clarify their requirements by not only limiting alignments to as close to the R.O.W. line as possible, but by also giving preferred locations.

TABLE 1
PIPELINE LOCATION POLICIES

State	Baseline	Offset from Baseline ^a
Colo.	Edge of traveled lane	30 ft min.
Ga.	Slope line, curb line, or ditchline	3 ft min.
Ill.	R. O. W. ^b	8 ft max.
Kans.	R. O. W.	3 ft min., 5 ft max.
La.	R.O.W.	2 ft max.
Minn.	R. O. W.	10 ft max.
Mo.	R. O. W.	6 ft max.
Nev.	Slope or curb line	6 ft min.
N. M.	R. O. W.	5 ft max.
Wash.	Slope line, curb line, or ditchline	6 ft min.

^a Preferred offsets, exceptions permitted

^b Right-of-way

Examples of Pipeline Location Policies

Location policies of longitudinal pipelines for several states that have specific dimensions are given in Table 1. A number of other states use the AASHTO wording without specific dimensions. In Hawaii, longitudinal pipelines may be located within the shoulder or median if approved by the Highway Utility Encroachment Committee. Tennessee permits longitudinal installations of lines carrying flammable, corrosive, or expansive transmittants only in cases of extreme hardship. In North Dakota, crossings must be as close to 90 degrees as practicable but in no case less than 30 degrees.

BURY OF PIPELINES

The depth of bury of longitudinal pipelines and crossings varies from state to state and region to region. In general, it is more dependent on local geological, meteorological, and hydrological conditions, and on roadway traffic loadings than on longitudinal position and alignment.

The AASHTO *Guide* recognizes this situation by reference to lateral drainage and frost penetration as factors in specifying minimum depth of bury. The relationship between bury, encasement and mechanical protection is treated in general terms by the *Guide* with the provision that lines with less than minimum bury should have encasement or slab cover protection to ensure the safety of crossings, particularly those crossings in the vicinity of ditches. However, cover for lines carrying hazardous transmittants that are flammable, corrosive, expansive, or pressure-energized must not be reduced below acceptable safety limits.

In most cases the rules in the *Guide* are made more definitive in state policy documents. Bury requirements vary from state to state and are not always explainable in terms of differences in local conditions. As in the case of location and alignment requirements, different baselines for determining depth of bury are used, adding to the lack of uniformity.

Discussion of Pipeline Bury Policies

In most states, there is an effort to protect pipelines against damage and to safeguard maintenance personnel against injury. In addition, highway pavements, slopes, shoulders, curbs, drainage ditches, and other right-of-way features must be maintained. Policy variations among states are basically variations of data for depth preference rather than actual ultimate depth of bury. Any effort to standardize burial depth requirements on a national basis must recognize the legal authority of state and federal agencies to regulate pipeline utility practices. There must also be a recognition of differences in climate, foundation conditions, and traffic loadings.

Examples of Pipeline Bury Policies

Requirements for depth of bury for a number of states are given in Table 2. Generally, pipelines located at depths less than the minimums must have encasement or mechanical protection. Other state requirements include:

- Additional cover over flexible pipes (Georgia, Nevada, and some other states).
- Minimum depths that vary depending on type of pipeline and location within the R.O.W. (Massachusetts and Ohio). Several other states specify different cover for different types of pipelines.
- Depths of cover that are different for cased and uncased pipelines (Tennessee).

ENCASEMENT OF PIPELINES

The encasement of underground pipeline crossings is a common practice, motivated by the desire to provide added protection to utilities, to minimize any damage to the highway system, and to facilitate maintenance, replacement, or enlargement of the utilities involved. Most states have adopted policies that follow the AASHTO *Guide*, with variations in the types of pipelines requiring encasement and the means of encasement. These policies translate the general principles of AASHTO into specific criteria.

The AASHTO *Guide* establishes general rules for encasement of pipeline crossings of highways including the following:

- Encasement should be considered for structural protection from external loads or shock.
- Encasement protection may be needed for pressurized lines and lines used for conveyance of flammable, corrosive, and other potentially hazardous substances.
- Encasement should be considered for lines with less than minimum bury, lines close to hazardous locations, and lines that require protection from damage due to jacking or boring.
- Where used, encasement should be extended beyond the slope line or ditchline.
- Where appropriate, encasement should extend to the access control lines or to a line that allows for future widening.

Discussion of Encasement Policies

Lack of uniformity on encasement practices is evident in terms of type of pipe, nature of transmittants, depth of cover and other pertinent factors. Variance among states is less a matter of language and baseline dimensioning (as in the case of location and depth of burial) and more one of differences in engineering opinion and local engineering experience. It may be difficult to rationalize differences in policies for the same type of pipeline carrying the same substances, such as water and sewers, but the only way such variances could be standardized would be to undertake unified research on individual pipeline applications, or to achieve a meeting of the minds by means of seminars and group explorations.

Examples of Encasement Policies

Most of the states have followed the AASHTO *Guide* for encasement requirements, with additional provisions outlining the conditions under which these protective measures are required for pipeline crossings.

Examples of state encasement policies follow.

TABLE 2
PIPELINE BURY POLICIES

State	Minimum Depths (a)			
	Below Ditches	Below Road Grade	Below Subgrade	Within R.O.W.
Ala.	30 in.	4 ft (b)		
Ark.	2.5 ft		3.5 ft	2.0 ft
Conn.		36 in.	18 in.	
Del.	24 in.			18 in.
Fla.	30 in.	36 in.		30 in.
Ga.	2 ft	4 ft		3 ft
Hawaii	2 ft (c)	3 ft		3 ft
Idaho	3 ft (d)	4 ft		3 ft
Ind.	3 ft	4 ft		
Iowa		48 in.		36 in.
Kans.	3 ft	5 ft		3 ft
La.	24 in.	4 ft		24 in.
Maine		24 in.		12 in. (e)
N. H.		24 in.	6 in.	24 in.
N. J.				30 in. (e)
N. M.				36 in.
Ore.	24 in.	30 in.		30 in.
Pa.	3 ft (d)	3 ft	6 in.	36 in.
P.R.	0.5 m			1.2 m
R.I.	3 ft	5 ft		
S.C.		4 ft		3 ft
Utah	2 ft (f)	3 ft		2 ft
Wash.	3 ft, 6 in.	5 ft		

(a) Preferred minimums, exceptions permitted in most states.

(b) For curb and gutter sections.

(c) 1 ft below paved ditch.

(d) 2 ft below paved ditch.

(e) Depth of frost penetration should be considered.

(f) 1.5 feet below paved ditch.

- Alabama requires encasements to extend beyond the toe of slope or beyond the ditchline. A minimum distance of 6 ft (1.8 m) behind the face of the curb is stipulated.

- California prefers sleeves 4 in. (100 mm) larger than the pipeline outside diameter, with concrete jacketing of lines larger than 24 in. (610 mm). Encasement must extend to access control lines of freeways, with a minimum of 5 ft (1.5 m) beyond slope limits, or curb or shoulder lines. Pipelines for flammables and other hazardous transmittants must be encased or provided with protective coatings and cathodic protection.* Water and sewers must be encased, but gravity irrigation lines are exempted.

- Connecticut relates pipeline size and pressure to encasement. Pressurized lines less than 30 in. (760 mm) in diameter crossing major highways, and all high-pressure gas lines must be encased.

- Georgia requires encasement for all installations over 10 in. (250 mm) diameter that are jacked or bored unless there is positive assurance against damage to roadbed. Pipes over 4 in. (100 mm) in diameter carrying hazardous transmittants are to be encased.

- Hawaii requires encasement of all pipelines under free-

ways but offers leeway for other highways unless protective provisions are deemed necessary by the director.

- Illinois exempts continuous welded ductile water mains from encasement if they can be jacked into place.

- Iowa allows uncased natural gas lines if casing-size carrier pipe and higher safety factors are provided; however, encasement is required for pressure sewers, water mains and carriers of hazardous substances. Casings must be two pipe sizes larger than the carrier pipe.

- Kansas requires sewer lines of fiber, asbestos-cement and clay to be encased from right-of-way line to right-of-way line.

- Louisiana relates encasement to size and pressure of pipelines. Encasement is not required for lines 6 in. (150 mm) or smaller with less than 200 psig (1400 kPa). Gravity lines are exempted.

- Minnesota requires crossings to be made by boring inside a casing or carrier pipe, or by jacking, unless modified by special permit.

- Missouri requires encasement except for adequately coated and cathodically protected welded steel pipe carrying gaseous or liquid petroleum materials; gas service connections of steel or copper; water lines of copper, if less than 2 in. (50 mm) in diameter; and new sanitary trunk sewer crossings.

* Cathodic protection is required for virtually all pipelines subject to regulation by the U.S. Dept. of Transportation, Office of Pipeline Safety.

- New Mexico requires that all crossing lines be steel, cast iron or reinforced concrete and/or be encased. Each question of carrier material and/or encasement is considered on an individual basis.

- North Carolina permits uncased lines where open cut is allowed. Bores of greater than 6 in. (150 mm) must be encased.

- North Dakota requires pressurized pipelines of 100 psig (690 kPa) or greater to be encased. Encasement must extend at least 2 ft (0.6 m) beyond the toe of slopes.

- Ohio does not require encasement of water and sewer lines. Nonplastic pipes carrying petroleum or gas must be encased if stresses produced by internal pressures are greater than 30 percent of minimum yield. Plastic pipe must be encased if pressure exceeds 100 psig (690 kPa).

- Pennsylvania offers exemption from encasement on free-access highways in urban areas. Exemption is also made whenever the utility can justify non-encasement and also agrees to carry out all pipe replacement work by boring.

- Puerto Rico exempts gravity irrigation lines, but requires encasement or protection of water and sewer lines.

- South Dakota requires encasement or use of extra-heavy pipe for lines greater than 6 in. (150 mm) diameter with over 80 psig (550 kPa). Encasement must extend to 5 ft (1.5 m) beyond the ditchline.

- Tennessee (and other states) distinguishes between utilities laid across highways during construction and those installed under existing roadways. It stipulates that lines other than water or sewer, laid in trench during construction, can be unencased if the pipe wall thickness, coating and wrapping, welds, and cathodic protection are in accordance with applicable ANSI (American National Standards Institute) standards.

- In Utah, water and sewer lines may be unencased if extra-heavy pipe is used.

- Vermont stipulates that all pressure pipe, including water and sewer lines, must be laid in conduit.

- Wisconsin requires encasement if depth of cover is less than specified.

MECHANICAL PROTECTION AND APPURTENANCES

The AASHTO *Guide* links encasement requirements with alternative protective measures such as added strength of pipe structures, wrapping, coating, and cathodic protection. The *Guide* stipulates certain parameters, including the following:

- Use of encasement or higher safety factors.
- Unencased crossings by open trench construction.
- Bridging or other means of protection for vulnerable pipe installations.
- Venting at ends of encasements.
- Markers at right-of-way line.
- Drain for leaking liquids or liquified gaseous transmittants.
- Manholes not located in roadway of major highways, but permissible in urban roads with ADT (average daily traffic) of less than 750.
- Shut-off valves at or near ends of structures.

Discussion of Mechanical Protection and Appurtenance Policies

In general, most state policies conform to the provisions of the AASHTO *Guide*. Mechanical protection and appurtenances are aspects of utility right-of-way facilities that should, and do, reflect the consolidated experiences of highway and utility officials.

Examples of Mechanical Protection and Appurtenance Policies

A few examples of policies that have requirements in addition to the AASHTO *Guide* include:

- Connecticut stipulates that markers located within 30 ft (9 m) of any travelway shall give on impact.

- Hawaii requires protective measures for lines carrying explosive or flammable transmittants at pressures of over 65 psig (450 kPa), as deemed necessary by the Highway Utility Encroachment Committee.

- North Dakota augments its encasement and protective requirements with a stipulation that vents must be at least 2 in. (50 mm) in diameter and extend at least 3 ft (0.9 m) above grade.

- Puerto Rico requires the venting of casings longer than 40 m (130 ft).

INSTALLATION OF PIPELINES

The importance of underground pipeline utilities makes it necessary to regulate their installation methods. No utility in the highway right-of-way is better, safer, or more dependable than the case used in placing it under or adjacent to the traveled way. Although most agencies have based their utility accommodation policies on the AASHTO *Guide*, many have supplemented it with their own concepts of what constitutes the best engineering construction practice for this situation.

For trenched construction, AASHTO recognizes the adequacy of highway agencies' standard specifications. The *Guide* considers:

- Width of trenches and vertical faces.
- Use of bedding.
- Backfill layers and compaction.
- Driving of small pipe with pilot shoes, including use of casings or corrosion-resistant pipe.
- Coring-drilling for small casings.
- Boring for larger pipe jacked through oversized bores.
- Wet-boring sluiced by slurry, with the pipe pushed through the slurry.
- Suggested controls for untrenched construction and grouting.

Discussion of Installation Policies

Although highway agencies generally follow the AASHTO *Guide* for controlling trenching work, they often use their own bedding and backfill specifications. It does not appear practical to develop a uniform procedure because of differences in soil and foundation conditions. Because highway agencies have had relatively little experience with bor-

ing and grouting techniques, instructions and controls could be prepared jointly by AASHTO, and utilities companies and equipment manufacturers.

Examples of Installation Policies

Open cuts are permitted in New York only with adequate justification. Kentucky prefers augering, jacking, boring, pushing or tunnelling. Open trenching is permitted only with departmental approval. North Carolina permits no cuts on roads with more than 2,000 ADT, except in unusual cases. Pennsylvania permits trenching when it can be justified for economic and engineering reasons. Tennessee stipulates that cuts are permitted only in extreme hardship cases. Texas allows trenching on low-traffic roads or non-controlled access urban roads where conditions justify. West Virginia requires jacking or boring under existing roads except where unusual conditions are encountered.

Colorado limits trenching to situations where boring or pushing are impractical. Delaware requires that in trenching work, only one-half of the travelway can be open at any one time, and Florida stipulates that one-way traffic must be maintained during daylight hours and two-way traffic at night.

Alabama requires certification of backfill compaction by a registered professional engineer or certified testing laboratory. Wet-boring is prohibited in Georgia, Indiana, Louisiana, New Mexico, North Dakota, Ohio, Pennsylvania, Rhode Island and South Carolina. Wet-boring is not permitted under major highways in Massachusetts, New Jersey and Vermont. Tennessee does not permit wet-boring without prior written approval. Wet-boring is allowed by special approval in South Dakota and for lines less than 2 in. (50 mm) diameter in Illinois. Alabama permits wet-boring, but includes a detailed specification on this method in its policy.

CHAPTER THREE

OVERHEAD POWER AND COMMUNICATION LINES

The need for electrical and communication organizations to occupy fair and reasonable space in, on, and over highway right-of-way lands, in keeping with their franchise requirements to serve the public need, cannot be considered as a "blank check" for accommodation of their facilities. The type of plant they install, where and how construction will be permitted, and how they must maintain, repair and enlarge their structures are decisions that highway authorities must regulate to protect the primary purpose of the highway systems (i.e., the safe and expeditious movement of traffic).

Technological, legal, aesthetic, and economic considerations dictate whether power and communication lines are located underground or overhead. Overhead lines affect road systems and their right-of-way lands in different ways than underground utility structures. Overhead lines may involve less effect on other utilities and the road structure, and cause less disturbance to the roadway in case of line failures or utility relocation or augmentation. However, their exposed location may represent a safety hazard to highway users, or may interfere with highway maintenance operations.

Overhead line facilities use the right-of-way for the installation of poles and supports (guys and other stabilizing facilities). Problems include avoidance of physical interference with other overhead lines and their appurtenances, as well as interference with highway structures; prevention of electrical or telecommunication interferences; and the

problem of overhang in the airspace over roads, interchanges or other roadway system features.

To avoid these problems, AASHTO has suggested guidelines of a general nature, and state highway agencies have established specific policies relating to location, vertical clearance, and type of construction.

LOCATION OF OVERHEAD LINES

The AASHTO *Guide* offers criteria for the location of overhead power and communication utilities in highway rights-of-way, subject to translation of these suggestions into policy parameters that suit conditions in individual states. As with all types of utilities occupying space of any type in the right-of-way, overhead lines should be as far from the traveled way as possible, and contain as few physical structures as possible. The AASHTO *Guide* includes the following provisions on location:

—For rural areas, overhead lines should be located at or near the right-of-way line, and at least outside the clear roadside area [30 ft (9 m)] where there is sufficient space.*

—For urban areas, overhead lines should be located at or near the right-of-way line.

—In curbed sections, overhead lines should be as far as practical behind the face of the curb, and where feasible, behind the sidewalk.

* The 1974 AASHTO "Yellow Book" (6) indicates (p. 38) that the "30-ft distance is not a magic number . . . the application of engineering judgment is still required in providing a safe roadside."

TABLE 3
OVERHEAD POWER AND COMMUNICATION LINE LOCATION POLICIES

State	Maximum Distance from R.O.W. Line	Minimum Distance from			
		Pavement Edge	Shoulder	Curb Face	Guardrail
Ala.	5 ft	30 ft \geq 50 mph 20 ft < 50 mph		6 ft	
Cal.	Close as possible			2 ft	
Conn.		12 ft or +	8 ft		Cable 13 ft Beam (weak post) 9 ft Beam (strong post) 5 ft
Fla.	6-1/2 ft	30 ft \geq 50 mph 18 ft < 50 mph		4 ft	
Hawaii	5 ft	30 ft rural 20 ft urban		6 ft	
Kans.	2 ft	30 ft			
La.	1/2 crossarm, plus 1 ft				
N.M.	1 ft				
P.R.		12 m			
S.D.		30 ft \geq 750 ADT ^a 15 ft < 750 ADT		6 ft	
Tex.	1 to 3 ft				
Vt.		30 ft			

NOTE: In most states exceptions are permitted if space is not available or if poles are behind walls, guardrails, etc., or on top of cut slopes.

^aADT (Average daily traffic)

—On narrow rights-of-way, self-supporting, single armless poles should be considered before relaxing the right-of-way line requirement. As an alternative, poles should be located behind guardrails, beyond open ditches, slopes or retaining walls, or similarly protected locations.

—In irregular rights-of-way, location variances can be permitted to provide reasonable alignment patterns.

—Longitudinal installations should not be permitted in medians.

—For crossings, poles are not permissible in medians of less than 80 ft (24 m) in width.

These suggestions are so clear-cut that many states have adopted them as official policy in total, and others have accepted them with a minimum amount of additions and specifics to meet their own concepts and conditions.

Discussion of Overhead Line Location Policies

Among the variations in location requirements, the intent to keep overhead lines and their supporting structures as far

as possible from traffic remains. The repetitive references to the 30-foot criterion is evidence that highway agencies tend to agree with the AASHTO *Guide*.

Examples of Overhead Line Location Policies

Location requirements for overhead power and communication lines for a number of states are given in Table 3. Several other agencies use the exact language of the AASHTO *Guide* as their policy.

Some other policy requirements include:

- Maine ties its utility location on rural highways to right-of-way width. For 100-ft (30-m) rights-of-way without curbs, poles must be set not less than 30 ft (9 m) from the edge of the traveled way; on narrower rights-of-way without curbs, the location is established as not less than 10 ft (3 m) beyond the edge of the shoulder. Minimum distance beyond curbs is 10 ft, and not less than 8 ft (2.4 m) behind beam-type guardrails. On urban roads with curbs, poles shall be not less than 6 ft (1.8 m) from

the face of the curb when the right-of-way is from 10 to 14 ft (3.0 to 4.3 m) behind the curb. For R.O.W. greater than 14 ft, locations shall approach standards for rural highways. No poles are permitted less than 1 ft (0.3 m) from a curb face.

- Missouri requires poles to be within 2 ft (0.6 m) of the R.O.W. line except in the relocation of existing poles. These may be within 5 ft (1.5 m) of the R.O.W. line.

- New Hampshire has a minimum distance of 30 ft (9 m) from the pavement edge or 5 ft (1.5 m) behind the ditch bottom. However, there are exceptions. Poles may be located 14 ft (4.3 m) behind the guardrail. On a rural road when there is insufficient right-of-way width, poles should be located within one-half the crossarm width from the right-of-way line but not closer than 8 ft (2.4 m) from the pavement edge, shoulder, or face of the guardrail.

- New York requires that for speeds over 35 mph (56 km/hr), nonfrangible structural members must be located not less than 30 ft (9 m) from the pavement edge; for speeds of under 35 mph, location shall be at the right-of-way line. If this is not feasible, poles may be set behind the sidewalk or a minimum distance of 2 ft (0.6 m) behind the face of the curb.

- Oregon draws a correlation between location of poles and the number of lanes in the roadway. For two-lane roads, poles must be located within 1 ft (0.3 m) of the right-of-way line when the land width on the side of the highway occupied by utility supports is up to 50 ft (15 m); for four-lane roads, location must be within 1 ft when right-of-way widths are up to 62 ft (19 m) on the pole side. For wider rights-of-way, poles must be located within 5 ft (1.5 m) of the R.O.W. line. Subject to right-of-way width, no pole must be within 30 ft (3 m) of the edge of a traveled way unless protected by a wall, guardrail, slope, etc. Poles must be located at least 5 ft behind guardrails.

VERTICAL CLEARANCE BENEATH OVERHEAD LINES

States add vertical clearance requirements to their horizontal location stipulations to assure that highway traffic will not be affected by overhead electrical power and communication lines and, conversely, that the safety of these utilities will be protected. AASHTO has offered the simple guideline that clearances should conform to National Electrical Safety Code requirements (7), or subject to greater heights required by each state's own laws, regulations, or policy.

Discussion of Vertical Clearance Policies

Vertical clearance of electrical and communication lines is one area in which there is substantial agreement among the states. Almost all policies require conformance to the National Electrical Safety Code as suggested by the AASHTO *Guide*, although some require slightly greater minimum

clearances than the Code. The few states with minimums considerably in excess of those in the Code might want to re-evaluate their requirements to determine if they are compatible with the requirements of adjacent states.

Examples of Vertical Clearance Policies

Almost all state policies follow the AASHTO *Guide* in referring to the National Electrical Safety Code for vertical clearance requirements. However, about half of the policies also specify an absolute minimum clearance over pavements. The most common of these is 18 ft (5.5 m) or 20 ft (6.1 m), but a few states specify considerably higher clearances.

Of the few states that make no reference to the Code, one simply uses an abbreviated form of the Code's minimum clearance table. The others refer to the state public utility commission as the arbiter of clearance requirements.

Some examples of policies on vertical clearance follow.

- Minimum vertical clearance for overhead power and communication lines . . . shall conform with the National Electrical Safety Code. However, in no instance should an aerial crossing have less vertical clearance over the roadway than eighteen (18) feet. (states with a specific minimum in addition to the Code.)

- Some states have different minimums for freeways and other roads: typically, 20 or 24 ft (6.1 or 7.3 m) for freeways and 18 ft (5.5 m) for other highways.

- A number of policies differentiate between communication and electrical lines in specifying the minimum clearance: typically, 18 ft (5.5 m) for communication and 20 or 22 ft (6.1 or 6.7 m) for electrical lines.

TYPES OF POLE CONSTRUCTION

The types of poles are regulated by states in order to control the use of their rights-of-way and to provide optimum use of the supports allowed within the right-of-way.

The AASHTO *Guide* recommends single-pole construction for longitudinal lines. Joint use of poles is encouraged in accordance with Rule 222 of Part 2 of the National Electrical Safety Code.

Discussion of Pole Construction Policies

Of all the facets of overhead line installations on highway rights-of-way, the policies covering types of poles and the use thereof show the greatest consensus.

Most policies use the language of the AASHTO *Guide* without addition or exception. A few states have added requirements that permit only one pole line on each side of the road. One state requires cable television lines to use existing poles. Although the joint use of poles along roadsides is encouraged in most states, it is not required by policy. The AASHTO *Guide* has served to produce a general unanimity regarding type of pole construction.

UNDERGROUND ELECTRIC POWER AND COMMUNICATION LINES

The policy outlining under what circumstances underground electric power and communication facilities are accommodated may influence a utility company's choice of overhead or underground locations, their method of construction and safety, or the choice of a highway or private right-of-way. In any event, highway routes are still the most economical and efficient path that allows electric power and communication facilities to reach their consumers. The joint use of rights-of-way by highways and utilities reduces the added impact on the environment that would otherwise occur with single-use rights-of-way.

Technological, legal, economic, and other considerations dictate whether power and communication lines are located overhead or underground. Included in these considerations are highway policies, public utility commission requirements, environmental impacts, native soil conditions, climate, groundwater table, comparative construction and maintenance costs, proximity to other utilities, and other local conditions. Recent public efforts to replace overhead lines with underground facilities to enhance scenic quality add another dimension to the decision-making problems facing power and communication utility officials.

When underground routes are used for these utilities, the highway agency policies for location and alignment, encasement, and installation dictate how and where they are permitted to occupy the right-of-way.

LOCATION AND ALIGNMENT

The *AASHTO Guide* is framed in terms of general practices that state highway policies can translate into specific requirements to meet local conditions and engineering standards. To this end, AASHTO criteria suggest that longitudinal power and communication lines be installed as close to the right-of-way line as possible, that crossings be as near normal to the highway alignment as possible, and that crossings avoid deep cuts, footings, intersections, drains, and wet or rocky terrain.

Discussion of Location and Alignment Policies

Location and alignment policies for underground electric power and communication lines are less varied than for pipelines; however, there is still a tendency to use slightly different distances and varying baseline points for specifying location of longitudinal facilities. Concurrence with the *AASHTO Guide* predominates in all policies, and the mix of distances for locations does not detract from the general policy of keeping lines as far from the roadway as possible. If all of the distance requirements were expressed in comparable terms, it is probable that the variations would be small. However, it is recognized that road prism and right-of-way dimensions vary and that some flexibility is required

to obtain the best accommodation of utility facilities and the best protection of highway systems to meet indigenous conditions.

Examples of Location and Alignment Policies

Most policies use wording identical or similar to that of the *AASHTO Guide* without adding any specific location requirements. Other policies have recommended or required locations for underground power and communication lines:

- Georgia and Indiana use the slope, ditch or curb as a baseline and require a minimum distance of 3 ft (0.9 m) and 5 ft (1.5 m), respectively, to underground lines.
- Hawaii, Pennsylvania, and Washington have requirements for location of underground power and communication lines that are the same as those for pipelines.
- Illinois, Minnesota, and New Mexico require that the underground lines be within 5 ft (1.5 m) of the right-of-way line. In Missouri, this distance is 6 ft (1.8 m), and in Kansas the maximum distance from the R.O.W. line is 5 ft, with a 3-ft (0.9-m) minimum.
- South Dakota recommends that underground power lines be located about 5 ft (1.5 m) from the R.O.W. line and communication lines at about 10 ft (3.0 m).

ENCASEMENT

Protection of power and communication lines against impacts and loadings from highway traffic, and against action by soils, groundwater and other sub-surface hazards is achieved with conduits, ducts, or other encasements. In addition, these measures provide a means for repair and maintenance of lines and may allow for future growth or expansion of utility lines.

This means of protection is aimed more at the needs of the buried utilities than at preserving the integrity of the highway structure itself. Failure of cables under a roadway does not threaten the foundation of the highway in the same manner as failure of a pipeline does. However, any under-road damage to uncased electrical power or communication lines could involve the highway structure and cause interference with traffic whenever repairs or replacements must be undertaken.

The *AASHTO Guide* suggests that:

—Electric power and communication lines may be installed under highways without protective conduit or duct if installation is limited to open trench construction or to small bores for wire or cable facilities.

—Where crossings are encased in protective conduit or duct, the encasement should extend a suitable distance beyond slope line or ditchline and, where appropriate, to access control lines.

—Consideration should be given to encasement or other protection of facilities with less than minimum bury, near bridge footings, or other hazardous locations.

Discussion of Encasement Policies

Despite variations in encasement policies from state to state, all policies adhere to the general criteria contained in the *AASHTO Guide*. The major differences in policies relate to the actual details of crossing protection. Nearly all agencies seek the greatest protection under local conditions in conformity with local engineering opinion and experience.

Although some encasement policies do not differentiate between electrical lines and communication lines, a sizable number diminish requirements for communication lines. Perceived hazard (or lack thereof) can play a part in establishing protective policies.

Many states still require the encasement of crossings of underground distribution power cables (5 to 15 kV) even when they are equipped with circuit-interrupting devices that operate to clear cable failure or accidental damage because of excavations. Some states fail to draw any distinction between the greater hazard in pipeline crossings and the lesser effects of failure of electrical and communication lines, but others show a trend toward relating encasement policies to actual hazards. Any attempt to standardize these two aspects of encasement would be fruitless unless it is possible to gain acceptance of a statement which recognizes that potential hazards and protective measures are inter-related.

Examples of Encasement Policies

Some examples of policies for encasement of underground power and communication lines follow.

- Alabama requires encasement of power lines within the highway prism, but communication lines need not be encased if the utility agrees not to open cut for maintenance purposes.
- Colorado allows service connections or crossings to be made without conduit if the utility company believes they do not need reinforcement; other crossings require conduits of sufficient strength to carry the weight of construction equipment and highway traffic, and of sufficient capacity to meet anticipated future needs of the utility.
- Connecticut requires crossings to be installed with protective conduit or duct.
- Georgia specifies encasement in protective conduit extending a minimum of 3 ft (0.9 m) beyond slope lines or ditchlines.
- Illinois requires crossings of power lines operating above 600 V to be encased for the full length of the crossing.
- Iowa allows communication cables to be unencased, provided that a casing is placed alongside the facility when installed. Electrical cables must be encased with rigid steel or concrete conduit.
- Missouri requires encasement of lines crossing highways, except for telephone and electric cables installed in ducts.

- Nebraska requires encasement to extend from toe to toe of fill slopes. When multicell ducts are used, they should be placed in large casings or tunnels.

- North Carolina requires freeway crossings to be encased, but no encasement is required for nonfreeway systems if open-cut construction or bores of 6 in. (150 mm) or less are used.

- Utah requires underground lines to be suitably encased in protective conduit extending 30 ft (9 m) beyond the edge of the traveled way, or curb line, whichever is greater.

- West Virginia requires cable placed under paved roads to have a casing with a minimum diameter of 2 in. (50 mm) and to extend 5 ft (1.5 m) beyond the edge of pavement, shoulder, ditchline or curb line.

GENERAL INSTALLATION REQUIREMENTS

General provisions covering installation and construction of underground electric power and communication lines vary from state to state because of differences in local conditions and long-established engineering specifications of highway agencies.

The *AASHTO Guide* can only suggest that each agency establish its own criteria to best serve its own needs, its own particular highway right-of-way conditions, and its own engineering judgment. The *Guide* suggests that:

—Each agency should establish a minimum depth of bury.

—Consideration should be given to installation of spare conduit or ducts for future expansion.

—Proposed locations should be reviewed to prevent conflicts with existing or planned highways or with operation and maintenance.

—The general controls for pipelines as related to markers, installation, trenched and untrenched construction, and adjustment should be followed, as applicable.

Discussion of General Installation Policies

There is no consensus among states on installation policies. Perhaps there can be none, but a survey of national practices points out the feasibility of relating depth of bury and protection of electrical and communication lines to potential hazard and failure experiences. Distinctions between requirements for electrical and communication lines in many states are motivated by differences in apparent line failure hazards. However, a number of states regulate these lines in the same manner as more hazardous pipeline structures, without recognition of obvious hazard variances.

Examples of General Installation Policies

A number of state policies use the wording of the *AASHTO Guide*, but most supplement it with at least minimum requirements for depth of bury.

- Alabama permits cable installation by plowing outside of the roadway prism and within 1 ft (0.3 m) of the approved horizontal location. Minimum depths of bury for power lines are 42 in. (1.07 m) under R.O.W., 48 in. (1.22 m) under pavement; minimums for communication

lines are 30 in. (0.76 m) under nonfreeway R.O.W., 36 in. (0.91 m) under freeway rights-of-way, and 48 in. under pavement.

- Arkansas specifies minimum crossing depths as 2.5 ft (0.76 m) below the lowest point of the highway, or 3.5 ft (1.07 m) below the bottom of the road surfacing, whichever is greater. Longitudinal lines must be buried at least 2 ft (0.61 m).

- California stipulates a minimum cover of 30 in. (0.76 m), but increases the minimum to 60 in. (1.52 m) for clay ducts under roadbeds. Crossings must be made by boring or jacking under existing roads.

- Colorado requires a depth of 30 in. (0.76 m) for power lines carrying voltages up to 750 V, and a depth of 42 in. (1.07 m) for 750 V and greater.

- Connecticut requires conduits to have a minimum depth of 36 in. (0.91 m) within paved areas. Buried cable must have a minimum depth of 24 in. (0.61 m), with 36 in. preferred.

- Georgia uses its pipeline policy as a general control for cable installations. Plowed-in cable must have a minimum bury of 24 in. (0.61 m).

- Idaho sets a minimum depth of 2½ ft (0.76 m) but will allow 2 ft (0.61 m) if necessary to clear drainage facilities and other critical features. Depths less than 2 ft require encasement.

- Illinois requires longitudinal lines to have markers every 300 ft (91 m) and a minimum cover of 30 in. (0.76 m). Minimum cover for crossings is 30 in. below bottom of ditch. Power cables of 600 V or greater require

an outer metallic ground shield plane consisting of concentric wire stranding or a lead sheath.

- Iowa requires a minimum bury of 48 in. (1.22 m) under roadways and 36 in. (0.91 m) elsewhere for communication lines. The policy requires 48 in. in all locations for electrical lines.

- Kansas stipulates that longitudinal communication lines must be buried 24 in. (0.61 m), but requires 3-ft (0.91-m) cover for power lines.

- Maine has a minimum cover requirement of 24 in. (0.61 m) under pavement and shoulders and 12 in. (0.30 m) elsewhere.

- Missouri requires a minimum cover of 30 in. (0.76 m). However, parallel direct burial cable has a minimum of 24 in. (0.61 m).

- New Jersey recognizes that cased lines should require less cover than uncased facilities [30 in. (0.76 m) and 42 in. (1.07 m), respectively].

- North Carolina specifies minimum bury for the following conditions: crossings under roadways, 3 ft (0.91 m); crossings under ditches and sidewalks, 2 ft (0.61 m); longitudinal electric primary, 3 ft; electric power secondary and trenched communication, 2 ft; and plowed-in communication lines, 18 in. (0.46 m).

- Texas stipulates that underground power and communication lines must meet the requirements for water pipelines.

- Washington applies the general controls for pipelines to underground power and communication lines with a minimum cover of 3 ft 6 in. (1.07 m) below ditches and 5 ft (1.5 m) from the surface of the roadway.

CHAPTER FIVE

INSTALLATION OF UTILITIES ON HIGHWAY STRUCTURES

Under certain conditions, it may become necessary, and even desirable, to use highway structures to carry utility facilities. Circumstances can arise when it would be more expeditious, economical and aesthetically favorable to attach private and public utility plant to bridges, viaducts, overpass structures, etc., rather than installing independent support facilities to effectuate utility crossings. This arrangement involves a special use of right-of-way space in state highway systems and special provisions must be made to accommodate the needs of utilities without impairing the usefulness, safety and life of the structures. Although the scenic effect of utility accommodation in the highway right-of-way may be enhanced by such piggyback arrangements, the hazards must be evaluated and balanced against the benefits derived.

The attachment of utilities to highway structures exposes pipelines and electric power and communication lines to

the elements and to a different set of impact and contact conditions than those involved in underground crossings. Careful engineering is necessary to care for the effects of expansion and contraction. The hazards of utility defects, breaks, leakages, explosion and fire can affect the highway structures involved and expose vehicles and people to hazards.

These factors have been recognized by the AASHTO *Guide*, and general suggestions on how to cope with the practices and problems involved in attachment of utilities to structures are recommended:

- Such attachments should be permitted when the public interest will be served thereby, and then should conform to logical engineering considerations.

- Attachment locations should occupy a position beneath the structure's floor, between outer beams, or within a cell, and located above the lowest steel or masonry members.

—The general controls for providing encasement of pipelines crossing highways should be followed for pipelines attached to bridges.

—Electric power and communication lines should be suitably insulated, grounded, and preferably carried in conduits or pipes that are insulated from power line attachments.

DISCUSSION OF STRUCTURE ATTACHMENT POLICIES

Expressed or implied in all policy statements covering the attachment of utilities to highway structures is a consensus that the AASHTO *Guide* contains the best principles for this facet of right-of-way use. The basic preference is that no such accommodations be provided; however, the needs of utility location can require attachment in many cases. The goal, then, is to permit attachments of certain facilities under certain conditions that will preserve and protect supporting structures, prevent utility damage and interferences, and assure the safety of highway users.

Although most states adhere to the AASHTO *Guide*, variances in permitted attachments and prohibited facilities are found from state to state. These differences may be based on local concepts of safety and equitable use of structures to facilitate the location of utility plant. Whether such variables as gas line pressure, pipe sizes, encasement, locations and types of attachments, types of transmittants permitted, insulations and other protective measures can be standardized nationally is debatable. However, an engineering consensus may be achievable by means of an exchange of opinions and explanations of why certain special requirements have been used by some states and not others.

EXAMPLES OF STRUCTURE ATTACHMENT POLICIES

Most policies on structure attachments follow the spirit of the AASHTO *Guide* although many add specific requirements or restrictions.

- Alabama stipulates that pipelines must not be attached to bridges over highways or railroads except under extreme conditions, and then only if properly encased. Gas lines with pressures exceeding 80 psig (550 kPa) must be encased. Attachment of high-pressure pipelines more than 600 psig (4100 kPa) is prohibited.

- Arkansas suggests that attachment of pipelines carrying hazardous transmittants be avoided wherever possible; when permitted, such lines must be given 24-hour hydrostatic tests at pressures of 1.4 times the maximum to be carried. Bridge attachments are permitted only when the structure is deemed capable of supporting the added load. Utility mountings must be nonrattling. Open-wire transmission lines with 35-kV ratings or higher are not permitted. Owners of utility attachments are charged an annual rental fee. However, there is no fee for telephone or electric utility lines.

- Colorado may charge utilities an equitable share of any additional cost of design and construction to accommodate their attachments.

- Hawaii permits attachment of fuel oil lines but prohibits other liquid fuel lines. The maximum size of gas lines

in box girders is 6 in. (150 mm). Maximum pressure in gas lines on any bridge is 65 psig (450 kPa).

- Illinois prohibits welding of structural steel members for attachment of utilities. Gas pipelines more than 4 in. (100 mm) in size or carrying more than over 75 psig (520 kPa) are not permitted. Utility companies are assessed a portion of the cost of the bridge, under most circumstances.

- Indiana discourages attachment of utilities on structures. Lines carrying flammable, corrosive or explosive transmittants are completely prohibited. Pipelines are not permitted on overpasses of highways or railroads.

- Iowa permits attachment of water and steam lines serving a municipality. Natural gas lines can be attached to bridges longer than 200 ft (61 m), with a fee charge; no other pipelines are permitted. A fee is also charged for attached telephone or electric power lines.

- Kentucky requires cushioned supports for attached utilities when they are permitted. A charge is made for the cost of additional supports to permit attachments if the cost is more than nominal.

- Massachusetts will not permit facilities carrying volatile liquids or gases. Gas lines rated for 100 psig (690 kPa) are not permitted.

- Minnesota limits pipeline attachments to water, sewer and natural gas lines.

- Missouri bans attachment of any utilities on structures carrying freeways. The only utilities permitted on grade separation structures are wires, and these are authorized only when no other practicable crossing means is available. A charge is made for attachments to cover increased maintenance expenses.

- New York has an extensive list of detailed requirements regarding utility attachments to structures. Support of utilities from the bottom of concrete structural slab is not permitted; electrical conduits must be placed in sidewalks whenever possible and be of galvanized steel or fiber covered by a steel plate. Lines of 115 V or less may be carried beneath slabs in fiber conduit, but lines of greater than 115 V must be carried in galvanized steel conduit. Power lines of more than 440 V, gas mains, and sewers are permitted only in extraordinary circumstances; carrier lines must have shut-offs at the ends of structures; and the cost of any additional structural items due to the added load of the utility shall be paid by the utility.

- North Carolina requires cathodic protection where stray currents may be experienced.

- Ohio specifies that gas lines must not be stressed in excess of 30 percent of the minimum yield strength. Water mains must be protected with insulated wrappings against freezing.

- Oregon permits structure attachments where utility poles or other areas have been provided. If not previously provided, utilities may be carried on hangers affixed between outside beams. Locations below parapets on structures over freeways are banned, but attachments to the outside of other structures may be made if interior locations are not feasible. All pipe exposed to view must be painted to blend with the supporting structure.

- Puerto Rico requires that high-pressure pipeline, over

200 psig (1400 kPa), cannot be stressed to more than 40 percent of the minimum yield strength, and that radiographic inspections must be made of all field welds. The system must be tested for a 24-hour period with the pressure maintained at 150 percent of the maximum operating pressure or greater. Pipelines carrying water, sewage and low-volatile fluids must be encased when they cross freeways or primary highways. Encasement is required for all pipelines carrying volatile fluids or gas.

- South Dakota normally installs utilities under bridge curbs or sidewalks by means of hangers or brackets. Encasement is required for all utilities, including power and communication lines, except where conditions permit cradling or hanger-type construction. Shut-offs for flammable or corrosive transmittant lines must be provided within

300 ft (91 m) of the structure. For structures less than 75 ft (23 m) long, some restrictions may be eliminated and other alternatives considered.

- Tennessee will not allow attachment of pipes or conduits over 12 in. (300 mm) in diameter. Also prohibited are pipelines or transmission lines, as defined in ANSI-B31 series, transmitting flammable liquids or gases. Pipelines transmitting liquids must be encased or otherwise protected.

- West Virginia does not permit drilling of concrete or steel members on existing bridges for the attachment of utilities. Pipelines carrying combustible materials are prohibited.

- Wisconsin requires that pressure in pipelines on structures not exceed 150 psig (1000 kPa).

CHAPTER SIX

ADDITIONAL POLICY REQUIREMENTS

SCENIC ENHANCEMENT

The effects of utilities on the scenic quality of highways are recognized by the AASHTO *Guide*. The *Guide* suggests additional controls for scenic areas such as overlooks, rest and recreation areas, scenic strips, and parks and historic sites through which highways pass. The *Guide* states that new underground installations in scenic areas should be allowed only where extensive removal of trees or other visible features is not required. New aerial installations should be avoided in scenic areas if there is a feasible alternative. If not, they should be considered only (a) where other locations are unusually difficult and unreasonably costly or less desirable visually, (b) where undergrounding is not technically feasible or is unreasonably costly, or (c) where the proposed installation uses designs and materials that give adequate attention to the visual qualities of the area traversed.

Discussion of Scenic Enhancement Policies

The scenic enhancement policies of almost all agencies contain wording identical or similar to that of the *Guide*. A few policies have no section on scenic enhancement; in one case, an explanatory note accompanying the policy indicates that the state has no legal authority in this area but encourages utility owners to voluntarily achieve an aesthetic environment.

IRRIGATION AND DRAINAGE FACILITIES

Irrigation and drainage facilities are utilities that are not found as frequently as other utility types. Because of the similarity to highway drainage, the AASHTO *Guide* states that irrigation and drainage facilities crossing highways

should be designed and constructed in accordance with highway culvert specifications. Ditches and canals paralleling the highway should be discouraged and special consideration given to ditch rider roads.

Discussion of Irrigation and Drainage Facility Policies

About half of the state policies make no mention of requirements for irrigation and drainage facilities. In most instances, there are probably few or no such facilities in these states.

Most of the policies with requirements follow the AASHTO *Guide*, although a few have additional requirements.

- Arkansas requires encasement across controlled-access highways for water siphons, flumes, or pressure lines from irrigation pumps. Other irrigation pipes must be smooth- or spiral-welded steel, cast or ductile iron, corrugated metal with watertight bands and asphaltic coating, or concrete pressure pipe.

- California prohibits longitudinal canals and ditches unless no other alternative is available.

- Idaho requires irrigation line and pipe siphon crossings to be buried from R.O.W. line to R.O.W. line. Crossings of canals and ditches may be made through culverts or bridges. Parallel open canals or ditches are not permitted within the right-of-way.

MISCELLANEOUS REQUIREMENTS

Whereas the major sections of the AASHTO *Guide* are directed toward the regulation of specific utility installations on, in, and over the highway right-of-way, the miscellaneous provisions provide general controls for construction and

maintenance. In the category of preservation, restoration and cleanup, the AASHTO *Guide* recommends:

- That disturbed areas be kept to a minimum.
- That restoration be in accord with agency specifications.
- That existing drainage should not be disturbed and adequate drainage provided for the utility facility.
- That jetting or puddling under the highway not be permitted.
- That spraying, cutting or trimming of trees be prohibited without written permission.

For safety and convenience, traffic control should conform to the *Manual on Uniform Traffic Control Devices* (8). The *Manual* recommends that operations should be planned to keep traffic interference to a minimum, that all facilities should be kept in a good state of repair, and that the permits held by utility companies should identify permitted maintenance operations and notification procedures.

Discussion of Miscellaneous Requirements

Approximately half of the states have incorporated the *Guide* wording in their own utility accommodation policies, either completely or in a slightly modified form. A few have added other requirements:

- For sod or cover disturbed and replaced by the utility, Alabama requires maintenance for a sufficient time to assure that the turf is alive and growing.
- Louisiana and North Carolina include detailed regulations covering the removal or trimming of trees or other vegetation in the right-of-way.
- Washington has specific regulations relating to the use of chemicals for roadside spraying operations.
- West Virginia has details for traffic control in addition to the *Manual on Uniform Traffic Control Devices* and the department's traffic control manual.

CHAPTER SEVEN

PERMITS, INSPECTIONS, FEES, AND BONDS

No utility is given carte blanche to locate its plant in, on, or over highway rights-of-way. It must be authorized to do so, at designated locations, and with the required quality of physical plant and workmanship. Knowledge and control of utility installations is made possible by: instituting and administering a system of applications; careful review of proposals; issuance of permits to place, modify or maintain a plant in a required manner and location; inspection of utility work for compliance with permit requirements; and imposition of adequate and equitable fees, bonds or deposits to assure proper performance. Without these regulatory steps, the requirements for utility placement outlined in the foregoing chapters would be unfulfilled.

The state of the art report prepared for the Federal Highway Administration by APWA (5) addresses this subject. The FHWA *Manual of Improved Practice* (4) proposes systems of applications and permits, inspections, and fee and bonding practices to improve local government control over the accommodation of utilities in urban streets and highways.

This Report characterizes application-permit systems as effective in: registering utilities' intentions to carry out work within the right-of-way, stipulating the nature and extent of the work, providing information necessary for the coordination of utility accommodation plans, assuring the effectiveness of utility compliance with regulations, and protecting governmental agencies against improper work. In addition, the Report stresses the importance of inspection

procedures and fee, bonding, and deposit provisions in protecting roadways and their users against unforeseen difficulties.

The *Manual of Improved Practice* lists 15 application, permit, inspection, fee, and bonding practices that improve operations, improve public and utility relations, and protect the public interest.

The AASHTO *Guide* is limited in this phase of utility accommodation. It places the responsibility for plant design on the utility owner and stipulates that "the highway authority should be responsible for review and approval of the utility's proposal with respect to the location of the utility facilities to be installed and the manner of attachment" (2). AASHTO has a more specific policy for accommodation of utilities in the rights-of-way of freeway systems: "The public agency which constructs or maintains freeways shall reserve the right to review and approve the location and design of all utility installations, adjustments or relocations affecting the highway and issue permits for the contemplated work" (3).

DISCUSSION OF POLICIES FOR PERMITS, FEES, AND BONDS

A review of utility accommodation policies indicates that procedures are not uniform with respect to receipt of applications for utility work, issuance of permits, imposition of fee charges and/or bonding and escrow deposit procedures, and agency inspection of utility installation work.

Policies vary on whether local, district, or regional offices handle these procedures, and on whether or not the authority is retained in the highway agency's central headquarters.

The issuance of permits for utility work without follow-up inspections by qualified personnel leaves the responsibility for work quality and compliance with standards unresolved. Most highway agencies probably do perform inspections of utility construction and reconstruction in their highway rights-of-way, but in many states no explicit references are made to this control procedure in policy statements. Inclusion of specific references to job inspections should be included in such statements, if only by reference.

Imposition of fees for issuance of permits and inspections varies from state to state; uniformity of policies covering utility or contractor performance bonding does not exist, nor should a general consensus be expected. Each state may have different reasons for fee-bonding-deposit policies; they should be based on past experiences, fiscal requirements, the nature of the utilities or contractors involved in installation projects, and other indigenous conditions. There need be no apology for the imposition of fees or for bonding-escrow policies. Costs for administering a regulatory program should be recaptured and additional costs for structures that support utility attachments are a rational reason for rental, fee or other monetary recompense. Services that require some payment therefor achieve greater recognition and dignity when charges are made for them on a rational and equitable basis. Bonding to guarantee performance and deposits held in escrow to assure proper performance must be based on the individual experiences and policies of each agency.

EXAMPLES OF POLICIES FOR PERMITS, FEES, AND BONDS

Permit Applications

A number of policies make no specific reference to the filing of applications for utility work, although there must be some procedure because all have some requirement for obtaining a permit.

- Arkansas and New Jersey require filing of applications with the "department"; and New Mexico has a similar requirement with a post office box number given. Hawaii requires filing with the director of transportation; Nebraska to the "appropriate governmental subdivision"; Rhode Island to the permit supervisor; and Puerto Rico to the Department of Public Works, with plans submitted to the Highway Authority.

- A large percentage of states requires the filing of applications with district offices, district engineers, or division engineers of maintenance or utilities.

- Illinois distinguishes between "general permits" and "working permits." For the former, applications are processed through the Bureau of Maintenance at the department headquarters; applications for the latter are filed with district engineers.

- Indiana has a different filing procedure for construction of transmission or distribution lines, and for installation and repair of service connections. Applications for transmission or distribution lines are handled by the district

permit engineer, while those of the latter category are filed with the superintendent of the highway subdistricts.

- New Hampshire distinguishes between interstate, turnpike, and other highways. Applications for work in the interstate network are sent to the utilities engineer, for turnpikes to the director of turnpikes, and for other roads to the division engineer.

In most cases, permits for work are issued by district offices when applications are filed with them.

Ten state policy statements contain no reference to application procedures, but define the office that approves permits for proposed utility work. On the other hand, six policies designate the recipients of applications, but make no reference to the approval of permits.

Fees and Charges

About one-third of the policies have some provision for a fee or other charge for accommodation of utilities.

- Arkansas charges an annual rental for attachments to highway structures, except for telephone and electrical lines.

- Colorado, Illinois, and Kentucky charge for the added cost of design and construction of structures upon which utility facilities are attached.

- Connecticut charges inspection costs if more than two hours of inspection per day are required.

- Hawaii has a fee based on the number of linear feet or square yards that are occupied by the utility.

- Iowa bases its structure attachment charges on the type of utilities, and lists a fee schedule for each type.

- Missouri imposes a maintenance charge for utilities attached to structures.

- Maine and Rhode Island charge a fee equal to the cost of repairing pavement cuts. A similar fee is charged by Ohio and Vermont if the repair is to be done by the department.

- Oklahoma imposes a flat fee of \$5 per permit.

- Washington's fees range from \$20 to \$150, depending on whether the project application entails a new franchise, a renewal, an assignment, etc.

Bonds and Deposits

Bonding practices and requirements for deposits are no more uniform than those relating to permit fees. About half of the policies make reference to bonds, either required, or subject to being required, at the decision of the issuer of permits.

Most agencies do not list the amount of bond coverage, but some are more specific. Arkansas requires bonds in an amount to cover the cost of right-of-way restoration if the utility fails to perform this work; Massachusetts sets bond limits from \$2,000 to \$10,000; Missouri specifies a minimum bond of \$1,000; Oklahoma stipulates a maximum bond limit of \$10,000; and Washington requires bonding, with a minimum of \$1,000.

Deposits to guarantee proper consummation of right-of-way utility plant projects are required by some agencies: Kansas requires a deposit of \$25 to \$500, depending on the type of work; Louisiana's ranges from \$10 to \$1,000 per mile, depending on the nature of the project.

UTILITY ACCOMMODATION COORDINATION

The rights-of-way of state highways are used by utilities as convenient pathways to utility consumers. As complex and multitudinous as this accommodation is today, it will be even more demanding in the future. Highways will face increased problems in accommodating utilities in right-of-way space. The only way to provide each utility with its own space requirements and to fit them all into an orderly composite is to establish policies and to adhere to them through cooperation, coordination, compromise, and compulsion. Compulsion implies strict enforcement of regulations to minimize competition for right-of-way space.

Without planned coordination of utility accommodations, the public usefulness of highways could be diminished. In addition, each utility using right-of-way space could be affected by the work and plant of other users and threatened by excavation and installation operations.

The upshot of the problem is that competition for right-of-way space will become more acute in the future and that a coordinated effort is the only rational solution. This cooperation and coordination is two-phased, that is, cooperation between highway agencies and the utilities that depend on them for right-of-way accommodations, and coordination of practices among the utilities themselves in the allocation and use of space for their physical plant.

The practices suggested for utility installations by AASHTO are examples of a rational compromise between the needs of utilities and the responsibility of highway agencies to protect the public investment in their systems. The relationship among the utilities themselves, as exemplified by the recent development of voluntary utility location and coordination committees, is symbolic of the second facet of cooperation and partnership.

Such coordination groups are often motivated by the need to protect utilities against physical plant damage. These groups tend to operate within restricted local areas, but the trend is toward the broadening of their operations into regional areas. Their purpose is to coordinate utility placement, to establish liaison with governmental regulatory agencies, to place utility locations and details on record, and to sponsor alert systems that will prevent digging damage to their facilities.

Many local committees are engaged in coordination programs. A recent bulletin issued by the New York-New Jersey Metropolitan Chapter of APWA, entitled "Stop Before You Plan, Design, Dig or Blast," is an example of the efforts of a regional group which represents an area served by approximately forty public and private utilities. The bulletin appeals for a "call-before-you-dig" program that will minimize utility damage.

The need for utility coordination efforts is admittedly more acute in urban areas where rights-of-way are more restricted, where more space is required by utilities, con-

tractors, city services, drainlayers, and others. But, there is a need for the same spirit and practice of utility location coordination for rural highways.

APWA UTILITY COORDINATION STUDY

Utility coordination was explored in FHWA's *State of the Art (5)* and *Manual of Improved Practice (4)* for utilities in urban streets and highways. Both reports outline the benefits of coordination programs, how they can be achieved, and how present practices and experiences are being used in cooperative groups in widespread parts of the United States.

The *Manual of Improved Practice* lists seven basic precepts of coordination and recommends: the establishment of utility coordination committees, preferably authorized, recognized, and financed by local legislative actions and participant support; the widening of scope of such agencies to serve total regions; the keying of "call-before-you-dig" programs to centralized one-call systems; the use of joint trenching and supporting facilities for compatible utilities; and the maintenance of key maps and other utility records under the aegis of a single agency.

These urban coordination practices cannot be provincial; they must be cosmopolitan, not only in terms of area of coverage but in the composition of the agencies and interests represented. They must include government representatives from the central community and from surrounding areas. They should also include representatives of highway agencies. Such a membership base ensures that utilities that serve wide regions are guided and regulated by integrated rights-of-way policies.

PLEASE NOTE!

Don't Dig Up Trouble . . . Call Before You Dig!

When underground telephone cable is accidentally dug up or cut by power shovels, trenching or earth boring machines, bulldozers, pipe-pushers, or even by picks or shovels — telephone, television and radio services may be disrupted for the whole neighborhood.

... For

BURIED CABLE LOCATION

before digging, call REPAIR SERVICE (see "Service Calls", right) We'll quickly locate and mark the location of the cable for you.



DISCUSSION OF POLICIES ON UTILITY COORDINATION

The AASHTO *Guide* and the AASHTO *Policy on the Accommodation of Utilities on Freeway Rights-of-Way* (3) make no specific references to utility coordination and the role of highway agencies in this program. However, AASHTO's participation in the new national utility coordination council program (see below) is proof of the relationship between AASHTO and effective location coordination programs.

Examination of the highway utility accommodation policies has disclosed no specific references to, nor participation in, utility coordination efforts. The absence of such references in policy statements cannot be taken as a lack of interest in, or cooperation with, existing utility coordination groups. Some agencies may consider this subject to be unrelated to their policy statements. However, such statements would be an effective means of asserting interest in coordinated programs and in the spirit of joint action to resolve joint problems.

UTILITY LOCATION AND COORDINATION COUNCIL

Evidence of the current interest in utility location and coordination is found in the fact that the APWA studies for FHWA have led to the formation of a National Utility Location and Coordination Council within the past year,

under the sponsorship of APWA. Organization meetings have been held, subgroups have been formed to develop guidelines for the creation of local and regional coordinating committees and for establishing unified programs of action, and an Advisory Panel of over twenty organizations has been set up to guide the growth of the Council. It is significant that AASHTO is a member of the Panel.

AASHTO's participation in the work of the Utility Location and Coordination Council is important. It can act as the catalyst for participation of all highway agencies in regional coordination programs, wherever they now exist, and in helping form groups where utility coordination is not now in effect. Participation by highway officials is essential to the functioning of such groups. With this participation, these utility groups can have a full impact, and can convert segregated local coordination programs into unified regional policies and practices.

Just how the *Guide*, the *Utilities on Freeways Policy*, and individual agency utility accommodation policies can be cognizant of the trend toward coordination group actions cannot be defined in this report. The means for adequate recognition for this worthwhile movement may become clear through AASHTO's involvement in the work of the Advisory Panel of the new Council. It is sufficient, here, to point out the need for active participation of highway agencies in the principle and practice of utility location coordination.

CHAPTER NINE

FINDINGS AND RECOMMENDATIONS

This synthesis examines procedural regulations covering highway utility impacts referred to in the AASHTO *Guide* (2). The findings from the exploration of individual agency policy statements have been evaluated and interpreted in various chapters of this synthesis. Each chapter of the synthesis describes how policies have been stated, vis-a-vis the AASHTO *Guide*, and how these policies compare with the policies of other agencies.

It is the purpose of this chapter to extract a few highlights from the findings on highway utility accommodation policies and to offer selected recommendations for improved procedures.

FINDINGS

- Most agencies have used AASHTO criteria as the model in drafting their policies on what utilities will be accommodated in highway rights-of-way, where they are to be located, how they must be constructed and protected, and the manner in which they are to be controlled.

- The duality of interest in the rights-of-way by highway authorities and utilities is broadly recognized, but this is not taken to mean that these utilities are free to install their plant in manners determined by them alone. Every agency has established policies to regulate accommodation.

- Some agencies have established policies for all facets of highway utility accommodation, which others have included policies for some facets and left others unstated. Many agencies have followed the AASHTO *Guide* by using direct phrasing or slight modifications thereof. Others have written into their policy statements specific variations or clarifications of the general suggestions in the *Guide*. The agencies that have bolstered or augmented the AASHTO language have been guided by the need to translate the generalities of some suggestions into the specifics of individual state needs.

- Most of the accommodation policies show variances from state to state in: location, bury, encasement, and installation of underground utilities; the location, clearances, and nature of installation of overhead facilities; and the

position and method of attachment of utilities to highway structures. Further variances result because of location requirements oriented to different base points, such as right-of-way outer limits, highway shoulders, pavement edges and curb lines.

- The basic reasons for variations in location, alignment, bury, overhead utility clearances, encasement and protection of underground plant, and other accommodation criteria are not always attributable to geographical areas, climatic conditions or other factors. In many cases, the stated policies can be rationalized only on the basis of the opinions, experiences, and decisions of individual state highway authorities. Dimensional differences are of the character of hairsplitting in some instances, and could be readily standardized.

- One common trust is present in all policies: The desire to keep utilities as far as possible from the traveled way and in the remotest points of the right-of-way. Other common denominators are the almost complete banning of longitudinal placement of utility facilities under pavements, except in urban areas, and the requirement that utility crossings be made by the most direct path under highway traffic lanes.

- Minimizing the number of pole lines for overhead utilities and limiting their location in the right-of-way are desirable according to all states. Although joint use of poles is encouraged, it is not required by the policies.

- Some policies correlate location, depth of bury, protection, and encasement requirements with the relative hazards involved in specific utilities such as electrical power or communication lines, the nature of materials transmitted by pipelines, electrical power voltages, pipeline pressure, and other factors of a rational nature. Others take no cognizance of the relationship between hazards and their accommodation regulations.

- Agency policies are in general agreement that attachment of utilities to highway structures should be discouraged whenever possible, but when permitted, it should be rigidly regulated as to effective support, proper isolation, and payment of adequate charges or fees to compensate for added costs of design, construction, and maintenance of the supporting members.

- Many agencies do not cover irrigation and drainage facilities in their policy documents, presumably because they are not involved in irrigation-drainage utility problems or services.

- Most agencies are aware of the need for scenic enhancement of roadsides, particularly in scenic areas such as overlooks, rest areas, and parks, and thus have adopted either the exact AASHTO language on scenic enhancement for utility installations, or similar wording.

- There is a need for coordination of the practices and protective procedures of all utilities that use the right-of-way to avoid accidental dig-ups and to promote the most efficient use of available space within the right-of-way. This is not adequately covered by the AASHTO *Guide* nor do state policies make specific references to these matters.

These findings do not detract from the excellence of the AASHTO *Guide* and *Utilities on Freeways Policy*. Similarly, the lack of uniformity of highway utility policies is

not necessarily a fault. The individuality of some policies is often a reflection of specific experiences in the design, construction, operation, and protection of rights-of-way and highways built thereon, and of engineering opinions based on such experiences. However, differences in details just for the sake of differences merit elimination or modification whenever standardization can be achieved. The above findings should be interpreted in this spirit.

RECOMMENDATIONS

The recommendations for the improvement of accommodation of utilities that follow are over and above the commentaries offered in each chapter on each phase of accommodation policies.

- Many variances in utility accommodation in highway rights-of-way are often explainable in terms of differences in climate, terrain, and local needs and experiences. However, some differences in practice are not readily understandable, particularly between states in the same geographical parts of the nation. Such differences might be resolved by an exchange of ideas and technical opinions through the medium of seminars, workshops, or other means. It is recommended that periodic conferences be conducted for the purpose of developing new ideas, making improvements, modernizing and updating policies, and coordinating these matters between states. Such conferences could also include the views of utilities on their location, alignment, construction, protection and encasement, attachment to structures and other needs in highway rights-of-way.

- Consolidation of utility space requirements, such as joint use of trenches, poles and other facilities, would mitigate future demands for accommodation of utility plant in highway rights-of-way. It is recommended that efforts be made to foster dual and multiple use of such facilities whenever such consolidated uses are compatible, safe, and workable.

- The 1969 AASHTO *Guide* has been most helpful to state agencies as they prepared their policies. However, it provides only minimal guidance for accommodating utilities in urban areas or sections of roads with narrow rights-of-way. In the course of developing policy statements some agencies have been able to include additional material, provide examples, or establish procedures that are beyond those given in the *Guide*. It is recommended that an appropriate AASHTO group revise and update the present *Guide*.

- It is recommended that all states review their policy documents at periodic intervals to ascertain the need for clarification and revision of their policies in the light of ever-changing practices, products, and protective measures. The utility industry should be consulted on this review.

- Erosion control for construction projects has received considerable attention by highway agencies in recent years. However, few agencies have regulations on erosion control in their utility accommodation policies. It is recommended that this phase of right-of-way protection and preservation be incorporated in policy documents.

- A number of agencies make no reference to regulations

covering formal applications for utility work in their rights-of-way, the issuance of permits, the recording of utility location and construction details, the inspection of utility work for compliance with permit provisions, and the imposition of fees or bonding-insurance requirements to assure proper utility work performance and highway protection. Although such stipulations may be provided in other rules and regulations issued by highway agencies, the appropriate place for them, if they are in effect, is in the policy statements. It is recommended that agencies that do not now cover this regulatory phase in their policy statements do so, and that they adhere to these procedures in authorizing utility use of right-of-way space. Records will be enhanced and greater respect for regulations will result. Imposition of fees needs no defense, but the purpose of such charges should be improved control and greater respect for the privilege of right-of-way use, and not the mere raising of revenues.

- The value of utility accommodation coordination is indisputable. The creation of the new National Utility Location and Coordination Council by the American Public Works Association attests to current interest in this area. AASHTO's membership on the Advisory Panel of this Council demonstrates its importance in the proper control of utility accommodation in highway rights-of-way. It is recommended that all highway agencies encourage the formation of local-regional utility coordination committees and participate in their efforts to improve plant location and protection through "call-before-you-dig" programs, record-keeping procedures and other cooperative practices. The need for a central depository for plans and records is recognized; however, the specific agency to assume this responsibility will vary.

- Although concern has been expressed over high costs and the infeasibility of extending scenic enhancement of utility installations to include total highway networks, consideration of this extension is warranted by the present interest in aesthetics of highways. Within the limitations of costs and feasibility, new utility installations should be planned, designed, and constructed to blend with the highway and the environment.

- Those agencies without requirements covering removal, trimming and spraying of trees should consider appropriate additions to their policies.

- Standard color markings should be adopted for stakes used to mark the location of underground utility plant within highway rights-of-way. The APWA Utility Location and Coordination Council has adopted the following standard color markings: yellow for gas, oil, petroleum, and other hazardous liquid or gaseous materials; red for electric power; orange for communication; blue for water; and green for storm and sanitary sewers.

- Many agency policies do not consider the three different types of utility accommodation. Policies should provide for (a) accommodation of utilities on existing highway rights-of-way, (b) adjustment of utilities for highway re-

construction, and (c) concurrent construction on new highways and utilities.

- It is recommended that some responsibilities for certain facets of utility accommodation belong to highway agencies, others belong to the utilities, and some belong to both. Examples of areas where the highway agency should be responsible include:

- Establishment of minimum horizontal and vertical clearances.

- Minimum clearance to highway appurtenances such as drainage, structure footings, traffic signals, and lighting.

- Locations where trenching is not permitted.

- Backfill procedures.

- Pavement replacement.

- Work hours on high-volume facilities.

- Attachments to structures.

Examples of areas where the utilities should have responsibility include:

- Clearances for safety and utility system protection.

- Installations for future expansion.

- Development of industry standard procedures.

Responsibility should be shared in such areas as:

- Utility location coordination.

- Bury policies.

- Encasement.

- Pipe weights, classes, and strengths.

Research

Some areas where specific research is needed include:

- New and improved methods for placing, repairing, and replacing utilities on highway rights-of-way should be investigated.

- Requirements for high-strength pipe, encasement, and other protection methods should be evaluated.

- Optimization of standards for location, alignment, bury, encasement, structure attachments, etc., warrants study.

- Various techniques have been used for identification and location of utilities on maps, plans, etc. These should be studied and some direction developed to ensure accuracy, speed and uniformity in entering and disseminating information.

- The literature does not provide a basis for the various utility accommodation policies. A study should be undertaken to determine: (a) the nature and extent of the problems of accommodating utilities on highways, (b) the effects that adoption of policies has had on these problems, and (c) the cost/benefits of the policy requirements.

- The effect of utility cuts on pavement life and pavement restoration standards should be measured.

- Simplification and standardization of permit forms, formats, systems, and processing should be explored.

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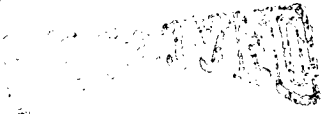
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