A PROGRAM FOR REDUCING SKIDDING ACCIDENTS DURING WET WEATHER

Kenneth D. Hankins, Texas Department of Highways and Public Transportation

This paper is specifically directed toward one of the categories in the statewide highway safety improvement programs in Texas. The program for reducing skidding accidents during wet weather includes obtaining and reporting skid resistance information; obtaining and reporting wet weather accident information; selecting and prioritizing locations for treatment and providing skid resistant surfaces. A discussion of each part of the program is included.

Even though attempts were made to provide skid resistant surfaces early in the history of highways in Texas, the first skid resistance measurements were made in 1962. Since then, much time and considerable funds have been expended in the study of skid resistance and in developing methods of reducing wet-weather accidents.

The program for reducing wet weather skidding accidents may be explained in four parts:

1. Development of skid resistance information.
2. Treatment of accident information.
3. Safety improvement program for skid-prone locations.
4. Providing skid resistant surfaces.

Development of Skid Resistance Information

In the past, pavement skid resistance measurements have been obtained using a stopping distance vehicle, skid test trailers, a British Portable Tester and a Penn State Drag Tester. The stopping distance vehicle was used initially and the Penn State Drag Tester was used experimentally. At present, the British Portable Tester is used in connection with laboratory tests. The skid test trailer is used exclusively in the field for inventory work. A history of the development of the unit follows:

1963 - First skid test unit fabricated in the Departmental shops. Used in research studies.

1968 - Three additional test trailers fabricated. Used for statewide skid resistance inventory.

1974 - Four new second-generation skid test units fabricated in the Departmental shops. Texas Transportation Institute assists in the automation of the units. One unit is used for research studies and three units are used in a statewide inventory.

In 1974, a system was devised wherein skid resistance data could be collected in an automated manner (1). This system was developed around a scheme for numbering construction jobs. Each construction job in each district (field) was assigned a unique number, which was termed a Construction Section Number (CSN). Materials, traffic, location and past skid resistance information were collected for each construction job and stored in a (computer) automated file using the CSN number as the file location key. Each skid test unit was fabricated with equipment that resulted in a machine processable punched teletype tape.

The location key punched on the paper tape is the CSN. In other words, the beginning of each construction job is visually located from the truck cab by the unit observer and "dialed in" on the instrumentation provided. As the unit passes the beginning of the construction job, a button is activated which automatically punches the CSN which was dialed, along with temperature and direction of travel. Skid number, velocity, distance from CSN initiation, lane tested and selected comments are punched on the paper tape at each lock-up. Figure 1 is a general view of one of the skid test units. Figure 2 shows several items of equipment on the trailer in addition to part of the watering system. A torque ring is used as the force transducer. Figure 3 shows both the operator console (left) and the observer console (right). The view is from the rear seat facing toward the front of the truck. The center divider contains four digital displays indicating the skid number, water pressure (assures correct water discharge), the distance in miles from the initiation of the CSN, and a distance readout in feet which is used to determine the mileage readout. The frequency at which the test tire is braked may be preprogrammed by dialing a number on a thumbwheel switch. This frequency or lockup interval may be selected from 0.161 km (0.1 mile) to 1.448 km (0.9 mile) at 0.161 km (0.1 mile) intervals. The divider also contains a strip chart recorder. The digital display for the velocity is shown just below the gear shift in the vehicle dash panel. The observers console in the upper left contains thumbwheel switches by which the CSN, temperature, lane and direction of travel may be dialed. The light-colored push butoons are activated to denote standard comments such as "test obtained on a horizontal curve" and "test obtained on a flushed area." Figure 4 shows the teletype and timing or strobing hardware which is located in the rear seat area.

Figures 5 through 11 are examples of seven types of reports that are available to the user. Report 1 on Figure 5 automatically is submitted to the field district when the teletype punched paper tape is processed. The other reports may be obtained whenever needed. It may be noted that field data have been combined with previously stored data for reporting purposes. This is accomplished by using the CSN which is available on both field and computer stored data. Also the low, average and high skid numbers of a given CSN are stored, as the paper tape is processed, eventually forming a history or skid resistance performance of various pavement types and materials. The location information is compatible with accident location information.

Treatment of Accident Information

Historically, the statewide reporting of vehicular accidents in Texas has been a combined effort of the Department of Public Safety (DPS) and the Texas Department of Highways and Public Transportation (DHT) (2). The DPS investigated each accident and filed an accident report. The DHT processed the accident report and stored the information. Originally, this process was limited to rural areas.. Recently, urban areas were added with city police units forwarding accident reports to a central processing group.

To assist DHT personnel in selecting and studying wet weather accident sites, several reports have been developed. Figure 12 is an example of a report indicating both total (all or wet and dry weather) and wet weather accidents, and accident rates (3). The rates are based on 160.9 million vehicular kilometers (100 million vehicle miles) of travel. It may be noted that wet weather accident rates are generally 2 to 3 times higher as compared to the total accident rates. Some wet weather accident rates have been noted which are 10 times greater than the total accident rate. The report shown in Figure 12 is available annually for every state-maintained rural highway and is subdivided by political subdivision (county). The "Cont and Sec" (Control and Section) represent certain lengths or sections along given highways but do not represent construction job limits. Figure 13 is a list of skid-prone control-sections selected by a method to be explained later in this paper. The number of wet weather accidents and the wet weather accident rates are available for perusal.

The example in Figure 14 is also a list of skid-prone locations. The difference between the information in Figures 13 and 14 is that Figure 13 concerns longer lengths of roadway, whereas Figure 14 is for spot (0.161 km or 0.1 mile) locations. Figure 15 is an example of a summary of each individual accident occurring within the skid-prone locations selected as shown in Figures 13 and 14. The control section is shown in the upper left; however, the milepost is shown along the top of the sheet. Each vertical column represents an accident event. The locations are shown to the closest 0.161 km (0.1 mile) and the first location was at milepost 0.6. The last location was at milepost 17.9. The symbol "W" represents an accident in wet weather conditions and of course "D" is for dry conditions. On many occasions a quick glance will indicate certain events that would reduce the probability that the site should be considered as skid-prone, such as the vehicle in collision with an animal. On the other hand, it is believed that greater consideration should be given to those sites with large numbers of single vehicle accidents while wet, and especially those in which the investigating officer recorded, "lost control and skidded."

Safety Improvement Program for Skid Prone Locations

The present Statewide Highway Safety Improvement Program was initiated in December 1974 (4). The program was subdivided into four categories as follows:

1. High Accident Locations.
2. High Hazard Locations.
3. Roadside Fixed Objects.
4. Skid-Prone Locations.

The concern in this paper is the category entitled "Skid Prone Locations." This category contains a method of selecting the locations and then establishing a statewide priority rating. Skid-prone locations are selected using the following criteria:

A. For Spot Locations - Any 0.161 km (0.1 mile) section exhibiting 3 or more wet weather accidents in a one-year period. (See Figure 14)

B. For Long Sections - (1) Any control-section exhibiting 2 or less wet weather accidents annually should not be considered. (2) All control-sections exhibiting 20 or more wet weather accidents annually should be considered without restriction. (3) Control-sections having 3 to 19 wet weather accidents annually should be considered if:

a. $$\frac{DVM}{WWA} \leq 3{,}000$$

DVM = daily vehicle miles
WWA = number of wet weather accidents

b. The control section length is 0.483 km (0.3 mile) or more.

Figure 13 is an example of a list of control-section locations within one of the twenty-five districts in Texas.

The statewide priority rating is established by the following method:

$$SPI = BCR \times (ADT/1000) \times SNF$$

SPI = Skid-Prone Index
BCR = Benefit Cost Ratio
ADT = Average Daily Traffic (Annual)
SNF = Skid Number Factor

The SNF is determined from:

SN_{40} =	<30	30-40	> 40
SNF =	1/30,	1/35,	1/40

The BCR is determined as follows:

$$BCR = \frac{ABAC - AAAC}{AIC}$$

ABAC = Annual Before Accident Cost
AAAC = Annual After Accident Cost
AIC = Annual Improvement Cost

$$ABAC = \frac{BAC}{\text{Number of Years of Accidents}}$$

BAC = Total Accident Cost During the Before Study Period

AAAC = ABAC X (1.00 - RF)

RF = Percent reduction by type of improvement (expressed as a decimal)

AIC = Total Project (Improvements) Cost X CRF

CRF = Capital recovery factor for project service life at 8 percent interest rate.

The annual before accident costs are to be based on:

$82,000 for each fatality.
3,400 for each injury.
480 for each property damage accident.

The project with the largest SPI has first priority. Subsequent projects are ranked in order of decreasing SPI.

It should be noted that both the selection of locations and the statewide priority rating schemes were established arbitrarily and are based on judgement.

Providing Skid Resistant Surfaces

Providing a skid resistant surface in Texas is synonymous with providing a surface with optimum texture, both macrotexture and microtexture. To maintain a skid resistant surface it is necessary to maintain optimum surface texture.

When hydroplaning is considered in providing skid resistant surfaces, the water layer between the tire and the pavement must be reduced, and at times drastically reduced. The water layer on the pavement surface may be reduced through adequate geometric design and through adequate cross-slope or superelevation consideration. The water layer between the tire and the pavement may be reduced by proper pavement mix design and construction procedures. Adequate mix design and construction procedures will provide (1) dynamic water drainage around the macrotexture projections as the tire passes; (2) dynamic internal water drainage into and through the pavement surfaces; or (3) a combination of (1) and (2). A discussion of providing skid resistance for each major pavement type follows.

Portland Cement Concrete

The skid resistance experience in Texas for portland cement concrete paving has been good. In general, the SN40 values will be around 50 or above soon after construction and rarely below 35 in the "as polished" condition. However, there are many exceptions to this.

Texas has little studded tire traffic and therefore, the coarse aggregate is rarely exposed. For this reason, when considering skid resistance, considerable emphasis is given to the fine aggregate and very little to the coarse aggregate.

Microtexture is developed from the fine aggregate and mortar. To obtain adequate microtexture, it is necessary to use a fine aggregate that is sharp and angular. To maintain the microtexture, a hard aggregate that will continue to exhibit sharp, angular edges is needed. A durable concrete with an excellent surface strength will hold the fine aggregate in place. Because of this the 1972 Standard Specifications require the fine aggregate to meet a value of not less than 28% by weight when subjected to an acid insoluble residue test (Test Method Tex-612-J) (5, 6) The same requirement exists at the present time. Most of the fine aggregate used since 1972 in both paving and bridge decks has been from a source with silicious origin. Silicious fine aggregate generally has sharp, angular faces in Texas. However, some test is needed which would assure an aggregate with sufficient angular faces. Such a test is not used; however, some postulation has been given to a dry bulking test proposed by Rose and Havens (7).

Macrotexture is developed from the surface finishing process. Surface strength is particularly important in maintaining mactrotexture. In the past several years there has been a trend toward finishing processes that provide greater macrotexture. The trend has advanced from a belted finish to a tine finish. For several years a burlap drag was used and wooden floats, a broom and several types of plastic grooving have been used experimentally. The 1972 Standard Specifications included the first texture values as measured by the "sand patch" method. Basically, these values required 0.635 mm (0.025 inch) on pavement surfaces and 0.889 mm (0.035 inch) on bridge decks at the time of construction. At present a special provision to the standard specifications is being used which requires 1.27 mm (0.050 inch) on both pavement and bridge decks to be developed by use of metal tines at approximately 1.27 cm (1/2 inch) spacings. Transverse tines are required on paving and the direction of the tine application is left to the discretion of the district engineer in the case of bridges.

To assist construction personnel in obtaining texture, lightweight plastic or styrofoam specimens that have four examples of texture depths have been distributed to project engineers and construction inspectors. Being light in weight, the specimens can be carried to the construction job and used as examples to judge the texture of fresh concrete.

Asphaltic Concrete

A large percentage of pavement surfaces in Texas are composed of asphaltic concrete. The vast majority are dense-graded, generally a Type D mix which has a 9.53 mm (3/8 inch) top size aggregate with around 60% to 70% by weight retained on the 10-mesh screen. Asphalt contents vary from about 5% to 7% by weight. At the present time, approximately 160 lane km (100 lane miles) of open-graded asphaltic concrete exist in the State. Most of the open-graded asphaltic concrete is of recent construction. Sand asphalts are rarely exposed to the surface; however, this type of material is used frequently in base courses.

Skid resistance on the usual asphaltic concrete mix is basically derived from the coarse aggregate. Discounting the layer of fines on the coarse aggregate at or soon after construction, the tire is in contact with the coarse aggregate during passage. With age, traffic, and weathering, the fine aggregate-asphalt mortar is generally dislodged, leaving the coarse aggregate in even more intimate contact with the tire.

Microtexture is available from the fine aggregate in the mix, but because of the dominate role of the coarse aggregate, microtexture on the surface of the coarse aggregate particles is essential. Sharp angular facets on the surface of the aggregate particles are also necessary for the coarse aggregate to have good skid resistance properties. If a coarse aggregate can be found which will maintain good microtexture and angular facets under traffic, an asphaltic concrete surface can be constructed which will maintain good skid resistance, provided sufficient water drainage is available.

Macrotexture for the usual dense-graded mix stems from the protrusion of the coarse aggregate particles from the pavement surfaces. The extent of the macrotexture depends on several factors such as void content of the mix, asphalt content, traffic, weather, abrasion resistance of the aggregates, construction techniques. It would be helpful to have available a procedure to assure adequate macrotexture in a dense-graded mix, but at present no method is used in Texas.

The British Wheel Test is presently used to specify coarse aggregate with durable skid resistance characteristics and the test does a good job of predicting the skid resistance performance of aggregate (8). This test has been in use since 1971. The test is not included in the standard specifications, but it is used through special provision clauses. The test procedure has been slightly modified from the parent British BSS-812 test procedure; therefore, the term "polish value" is used to describe the "terminal" polished condition of aggregate rather than the British term polished stone value. The following polish values are specified at the present time:

Minimum Polish Value	Present Average Daily Traffic Grouping
None	0-749
30	750-1999
33	2000-4999
35	5000-Over
35	All Interstate Highways

A British Portable Tester is used in the test to determine polish values. However, an auxiliary scale such as that used by the British is not used to determine the polish value. Therefore, the values indicated above may seem low to some readers. An approximation of values using an auxiliary scale would result if the above values were multiplied by a factor of 1.67. Thus, a polish value of 35 would be about equivalent to a polished stone value of 51.

A small number of jobs have been constructed in the State using an open-graded mix. As compared to a dense-graded mix, the open-graded mix should be mixed, transported and placed in a relatively cool condition. Attempts should be made to reduce the time of transport. The surface to receive the mix should be waterproof and in good condition. An aggregate with good skid resistance characteristics should be used in the mix.

The initial SN_{40} values on the open-graded mixes which have been placed are usually relatively low or around 35 to 40. These values improve with time and are maximum within several hundred thousand traffic applications. When using the same coarse aggregate, the SN_{40} values are lower than that of a penetration seal and about the same or slightly lower than a dense-graded mix. Even though open-graded mixes have not been tested in heavy rainfall conditions, it is believed that the reverse would be revealed or the skid resistance of open-graded mixes would be higher as compared to dense-graded mixes. The reasoning is related to the excellent drainage properties of the open-graded mix. Water is drained into and around the aggregate particles. Because of the large void content, excellent macrotexture is also available.

Because the coarse aggregate again provides the major role in providing skid resistance in the open-graded mix, the British Wheel Test is used in the specifications. The polish values specified are the same as those used in the dense-graded mixes.

Penetration Seals or Surface Treatments

A penetration seal and a surface treatment have similar construction techniques. The term "surface treatment" is used in conjunction with newly constructed sections of roadway. They may be singles, doubles or triples, depending on the number of layers. Multiple courses conform to a "macadam" construction method. The term penetration seal is used in referring to maintaining or upgrading an existing surface. Surface treatments are used extensively in the State as the surface on newly constructed pavements, particularly secondary roads. There is a tendency not to use seals or surface treatments on high-volume highways. Intersections and other geometric locations where high friction is needed show poor results when seals have been used. It is believed that the friction developed between the tire and the rock causes the rock to dislodge. The most used specification requires a Grade 4 in which the majority of the aggregate is retained on the 6.35 mm (1/4 inch) sieve and passes the 9.53 mm (3/8 inch) sieve. The aggregate size ranges from Grade 1, which has a top size of 19.05 mm (3/4 inch) with the majority on the 15.88 mm (5/8 inch) sieve, to a Grade 5, which has a top size of 6.35 mm (1/4 inch) with the majority retained on a number 10 sieve.

The recurring problem with this type of construction is the flushing that occurs from consolidation or aggregate stripping. It is believed that more stripping occurs than consolidation. Recently an attempt was made to use a "one-size" aggregate in surface treatment and seals. With the "one-size" aggregate, more asphalt is generally used. Also, less aggregate is needed and there is a tendency to reduce the aggregate application rate. The "one-size" aggregate change has apparently improved the structural durability of the surfaces and, therefore, the friction.

A skid resistant aggregate with good microtexture and shape should be used in seal coats. The British Wheel Test is used with surface treatments and seals with the same "polish values" as specified with the dense-graded asphaltic concrete.

Sprinkle Treatment

In the sprinkle treatment construction technique, a small quantity of skid resistant aggregate is placed (sprinkled) on the surface of a newly placed asphaltic concrete or portland cement concrete and bound by rolling, vibrating, or tamping. Sprinkled aggregate on portland cement concrete has not been used in Texas. Therefore, the experience with asphaltic concrete will be treated. Sprinkle treatment construction is considered in the State because of the economic benefit. It is possible to use the low-cost local materials in the asphaltic concrete and only a small amount of high-cost skid resistant aggregate as the sprinkled material.

Sprinkle treatment construction was first noted in British publications. Later, specifications and construction procedures were obtained from the Virginia Department of Highways and Transportation. Because of the lack of funds to upgrade our highways for both structural and skid resistance reasons, this type of construction is becoming popular. However, sprinkle treatment construction in Texas should be considered experimental at the present time. In the majority of the jobs to date the sprinkled aggregate has been placed on the usual Type D dense-graded mix previously described. The sprinkled aggregate has usually been precoated to assure adhesion to the asphaltic concrete mat. Various aggregate types have been used as the sprinkled material and various types and quantities of precoating material have been used. There has also been experimentation with aggregate application rates and rock spreading equipment.

The skid resistance history of sprinkle treatment pavement sections has been understandably varied because of the experimental nature. However, the skid resistance level appears highly dependent on the type of sprinkled aggregate, the amount of sprinkled aggregate in place in terms of surface area, and the extent the sprinkled aggregate protrudes from the asphaltic concrete mat.

Rehabilitation of Surfaces

Rehabilitation practices to renew skid resistance generally have been some form of overlay procedure. Dense-graded mixes, open-graded mixes, sprinkle treatments and penetration seals have been used as rehabilitation methods. The procedures in obtaining skid resistance for rehabilitation are not different from those involved in initial construction.

Other methods of improving the skid resistance of existing surfaces have been attempted. These have been pavement grooving (sawed), acid etching, hydra broom (high-pressure water jet), reheating (treating flushed areas with aggregate after reheating), and heater planing (trimming the surface with blades after heating). With the exception of pavement grooving, the methods are considered as only temporary emergency measures until treatments with longer skid resistance life can be applied.

Summary

This paper has described the equipment, information and methods used in a planned program for reducing accidents. The use of pavement skid resistance and accident information in the reduction of accidents is very illusive. It is believed that the illusiveness is due primarily to the time delay in obtaining information, particularly the accident information. In the large reporting network described in the paper, statewide reports have a lag time for initially collected information that is as much as fifteen months. In many cases, rapid treatment is needed at accident sites and long lag times are harmful.

Present efforts involve developing more frequent automated reporting. Many field personnel receive a copy of the reports of the accidents occurring in their area on the day following the occurrence. Using this information, small or spot accident sites can be located early and, at times, treated with small funding.

There are, therefore, two methods for corrective action to be considered. First, with frequent reporting and in local areas, corrective treatment is needed at the locations that can be treated at low cost. Temporary corrective treatment may be considered. Second, the annual information may be used for the more costly long-term corrective treatment methods.

In summary, advancement has been made toward the reduction of wet weather skidding accidents and we are proud of this advancement. However, much continued effort is needed.

Figure 1. The 1974 Skid Test Unit.

Figure 2. Trailer Components.

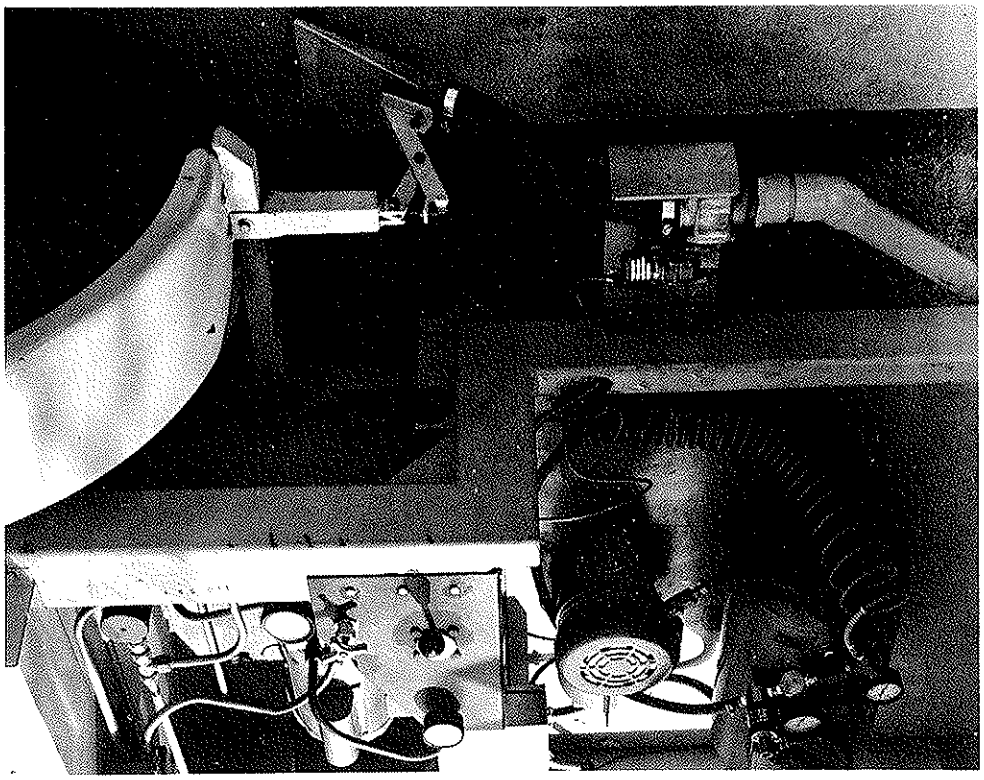

Figure 3. Control Consoles.

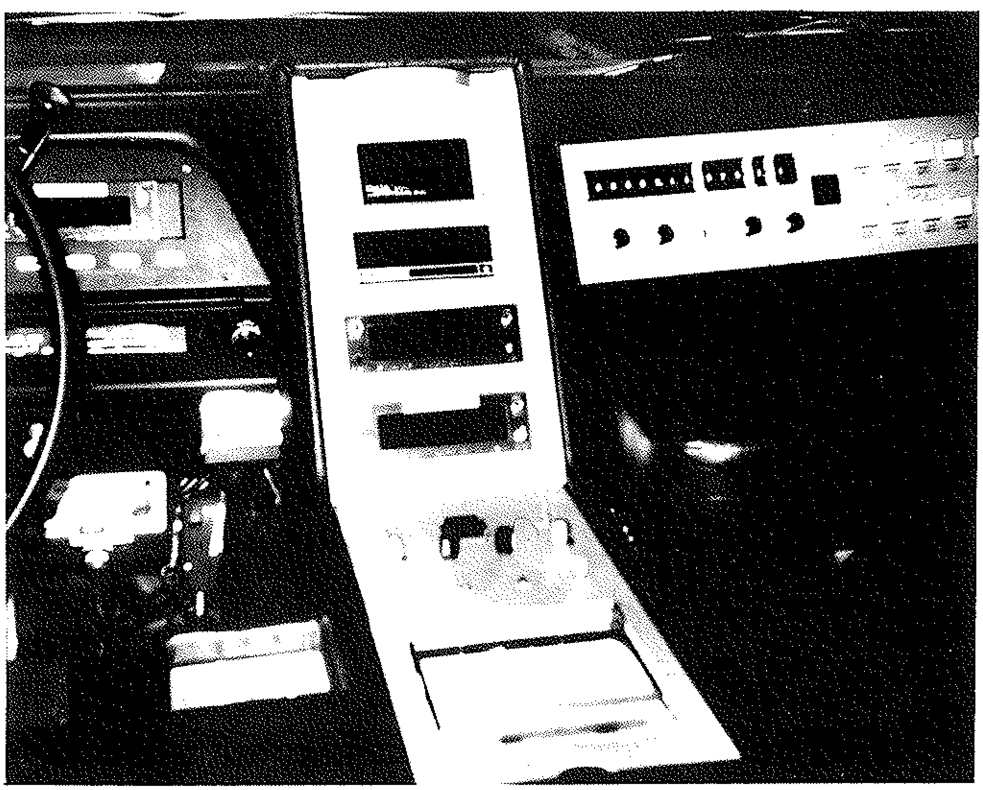

Figure 4. Teletype and Strobing Units.

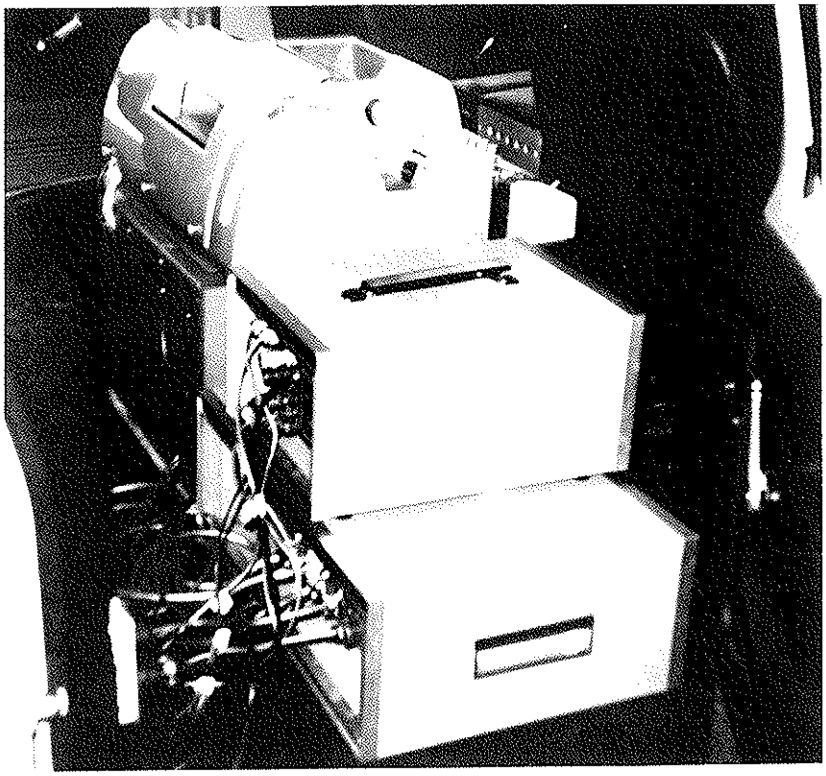

Figure 5. Skid Resistance Report 1.

```
DISTRICT..0 . CSN..0000271 - DETAIL TEST LISTING          SKID RESISTANCE REPORT 1          DATE 02/19/74          PAGE   1

+-- CONSTRUCTION SECTION INFORMATION ---+----- PAVEMENT, MATERIAL, & ------+-- CONTROL-SECTION INFO. --+------- SKID HISTORY -------+
+                                       +       SOURCE INFORMATION         +                          +        TVL   SN     TRAFFIC+
+                                       +                                  + CO.   C-S    BMP    EMP  + MO/YR -LN LO/AV/HI  (000) +
+---------------------------------------+----------------------------------+--------------------------+----------------------------+
HIGHWAY... IH   5  ADT............18,700 + PAVEMENT. HHAC                   +  4    5-_4 25.600 22.939 +
CSN LENGTH  2.661  TRAFFIC....3,459,500 + PLACED... 08/73    BINDER... 9.50 +                          +
FROM..        NO C/L                    + PRI AGG.. TYPE D      LIGHTWEIGHT+                          +
TO.... 01 MI NO SH 3  OP                + 2ND AGG..                        +                          +
CODE COL-....5...10...15...20...25...30-+- SOURCE NUMBERS & NAMES FOLLOW --+                          +
COMMENT1                                + PRI 316-EAGLELIGHT-WACO,TX       +                          +
COMMENT2                                + 2ND                              +                          +
---------------------------------------------------------------------------------------------------------+
CONSTANTS THIS TEST -  (1) TESTED ON  2/13/74      (3) AIR TEMPERATURE AT TEST WAS  62 DEGREES F.        +
                       (2) USING TRUCK NO. 40      (4) TRAVELING ***WITH*** THE FROM/TO DESCRIPTION      +
                                                                                                         +
WARNING - THIS TEST ALONE IS INSUFFICIENT TO ESTABLISH THE SAFE FRICTION VALUE FOR A HIGHWAY             +
---------------------------------------------------------------------------------------------------------+------------------------

-- GENERAL SKID TEST DATA ---***-- SN BREAKDOWN BY LANE --***---------------------- SN BREAKDOWN BY COMMENT ---------------------
 TEST & +       + CUMM. +    ***    +    +    +    + E &  ***          +       + INTER- + STRUC- + R.R.  +       + CITY  + DIST.
  LANE  + SPEED + MILES + SN ***  A +  B +  C +  D + OVER *** FLUSH   + PATCH + SECT.  +  TURE  + XING  + CURVE + LIMIT + SELECT
--------+-------+-------+----***----+----+----+----+------***---------+-------+--------+--------+-------+-------+-------+--------
   1-A  +   38  +  0.0  + 57 *** 57 +    +    +    +      ***         +       +        +        +       +       +       +
   2-B  +   44  +  0.3  + ** ***    + ** +    +    +      ***         +       +        +        +       +  **   +       +
   3-B  +   43  +  0.3  + 50 ***    + 50 +    +    +      ***         +       +        +        +       +       +       +
   4-A  +   41  +  0.6  + 57 *** 57 +    +    +    +      ***         +       +        +        +       +  57   +       +
   5-B  +   43  +  0.8  + ** ***    + ** +    +    +      ***         +       +        +        +  **   +       +       +
   6-B  +   39  +  0.9  + 51 ***    + 51 +    +    +      ***         +       +        +        +       +       +       +
   7-A  +   40  +  1.2  + 56 *** 56 +    +    +    +      ***         +       +        +        +       +  56   +       +
   8-B  +   43  +  1.5  + 48 ***    + 48 +    +    +      ***         +       +        +        +       +  48   +       +
   9-A  +   41  +  1.8  + 58 *** 58 +    +    +    +      ***         +       +        +        +       +       +       +
  10-B  +   43  +  2.0  + ** ***    + ** +    +    +      ***         +       +        +   **   +       +       +       +
  11-B  +   41  +  2.1  + 50 ***    + 50 +    +    +      ***         +       +        +        +       +       +       +
  12-A  +   42  +  2.4  + 52 *** 52 +    +    +    +      ***         +       +        +        +       +       +       +
  13-B  +   41  +  2.7  + 51 ***    + 51 +    +    +      ***         +       +        +        +       +       +       +
--------+-------+-------+----***----+----+----+----+------***---------+-------+--------+--------+-------+-------+-------+--------
      NUMBER OF TESTS....+ 10 ***  5 +  5 +    +    +      ***         +       +        +        +       +   3   +       +
      SKID NUMBER - LO...+ 48 *** 52 + 48 +    +    +      ***         +       +        +        +       +  48   +       +
      SKID NUMBER - AVG..+ 53 *** 56 + 50 +    +    +      ***         +       +        +        +       +  54   +       +
      SKID NUMBER - HI...+ 58 *** 58 + 51 +    +    +      ***         +       +        +        +       +  57   +       +
--------+-------+-------+----***----+----+----+----+------***---------+-------+--------+--------+-------+-------+-------+--------
```

Figure 6. Summary, Sorted by Control Section.

```
CONTROL-SECTION LISTING FOR DISTRICT 0                  SKID RESISTANCE REPORT 3                       DATE 06/06/75     PAGE   1
+- CONTROL SECTION INFO --+--- GENERAL CONSTRUCTION SECTION (CSN --+-------- MATERIAL AND SOURCE ------+- SKID HISTORY(MAX. OF 6) -+
+                         +              INFORMATION                +              INFORMATION             + DATE  TVL   CO     TRAFFIC+
+  C-S   BEGIN MP  END MP +                                         +                                      + MO/YR -LN LO/AV/HI  (000) +
--------------------------+-----------------------------------------+--------------------------------------+---------------------------
  36- 3     0.000   1.092 + PVT... HMAC               PLACED.. 05/62 + BINDER..  4.80 PERCENT              +  8/74 O-A 38/39/40  10,862
---- --    ------  ------ + FROM.. HUN  CO LINE                     + PRI AGG. TYPE D       SILICEOUS      +  7/74 W-A 39/40/41  10,789
SH  24. D             CO. + TO.... 1.09 MI NE HUN  CO LINE          + 2ND AGG. LIMESTONE                   +  4/71 W-A 40/42/44   9,373
MI IN CSN-1702401.. 1.092 +-CODE COL-....5...10...15...20...25...30-+- SOURCE NUMBERS & NAMES FOLLOW --+  4/71 O-A 36/38/41   9,373
ADT................2.670 + COMMENT1                                + PRI   9-BRIG    SEG-MOR    PRPTY.+
TRAFFIC.........11.661.150 + COMMENT2                               + 2ND  36-TEXAS INDUS.-ARC SPUR     +
--------------------------+-----------------------------------------+--------------------------------------+---------------------------
  36- 3     1.092   4.982 + PVT... HMAC               PLACED.. 11/56 + BINDER..  5.20 PERCENT              +  8/74 O-A 38/40/43  15,422
---- --    ------  ------ + FROM.. 1.09 MI NE HUN  CO LINE          + PRI AGG. TYPE D       SILICEOUS      +  7/74 W-A 36/39/43  15,351
SH  24. DEL           CO. + TO.... 1.6 MI W JCT FM 152  SE          + 2ND AGG. LIMESTONE                   +  4/71 W-A 36/40/44  11,950
MI IN CSN-1702402.. 3.890 +-CODE COL-....5...10...15...20...25...30-+- SOURCE NUMBERS & NAMES FOLLOW --+  4/71 O-A 33/35/38  11,950
ADT................2.660 + COMMENT1                                + PRI  41-GIFFORD      -ROF     PIT  +
TRAFFIC.........16.216.700 + COMMENT2                               + 2ND  26-DOLE   BROS-DUPANT.OKLA   +
--------------------------+-----------------------------------------+--------------------------------------+---------------------------
     - 3    4.982  10.317 + PVT... HMAC               PLACED.. 04/67 + BINDER..  4.80 PERCENT              +  8/74 O-A 33/35/42   6,446
--   --    ------  ------ + FROM.. 1.6 MI W JCT FM 152  E           + PRI AGG. TYPE D       LIMESTONE      +  7/74 W-A 30/33/45   6,374
SH  24. DEL           CO. + TO.... JCT LP 45  COOPER                + 2ND AGG. SILICEOUS                   +  4/71 W-A 31/33/35   6,460
MI IN CSN-1702403.. 5.335 +-CODE COL-....5...10...15...20...25...30-+- SOURCE NUMBERS & NAMES FOLLOW --+  4/71 O-A 30/31/32   6,460
ADT................2.540 + COMMENT1                                + PRI 305-GIFFORD       SEAGO        +
TRAFFIC..........7.213.600 + COMMENT2                               + 2ND 402-MCK SEG GRAY     CO.      +
--------------------------+-----------------------------------------+--------------------------------------+---------------------------
  36- 3    10.317  11.590 + PVT... HMAC               PLACED.. 11/72 + BINDER..  5.90 PERCENT              +  7/74 W-B 48/52/55   1,043
---- --    ------  ------ + FROM.. JCT LP 45  W COOPER              + PRI AGG. TYPE D       LIMESTONE      +  7/74 W-A 52/56/60   1,043
SH  24. DEL           CO. + TO.... BEG CONC PVT                     + 2ND AGG. SILICEOUS                   +
MI IN CSN-1702404.. 1.273 +-CODE COL-....5...10...15...20...25...30-+- SOURCE NUMBERS & NAMES FOLLOW --+
ADT................1.860 + COMMENT1 S LANE                         + PRI 413-WOODMAN     PIT GRAY     CO+
TRAFFIC..........1.652.700 + COMMENT2                               + 2ND 407-TXI BRIDGEPORT, TX         +
--------------------------+-----------------------------------------+--------------------------------------+---------------------------
  36- 3    11.590  11.867 + PVT... CRCP               PLACED.. 07/67 + BINDER..  5.00 SACKS/CY             +  7/74 W-B 50/51/51   4,420
---- --    ------  ------ + FROM.. BEG CONC PVT                     + PRI AGG. GRD UNKNOWN SILICEOUS      +  4/71 W-A   /49/     2,190
SH  24. DEL           CO. + TO.... END CONC PVT                     + 2ND AGG. SILICEOUS                   +
MI IN CSN-1702405.. 0.277 +-CODE COL-....5...10...15...20...25...30-+- SOURCE NUMBERS & NAMES FOLLOW --+
ADT................1.890 + COMMENT1                                + PRI 344-CHOC    MATLS-  CO,OKLA   +
TRAFFIC..........5.038.850 + COMMENT2                               + 2ND 405-SKE   SEG PAR      MAR CO.+
--------------------------+-----------------------------------------+--------------------------------------+---------------------------
     - 3   11.590  10.317 + PVT... HMAC               PLACED.. 11/72 + BINDER..  5.90 PERCENT              +  8/74 W-B 49/50/52   1,094
-    --    ------  ------ + FROM.. BEG CONC PVT                     + PRI AGG. TYPE D       LIMESTONE      +  8/74 W-A 56/63/69   1,094
SH  24. DEL           CO. + TO.... JCT LP 45  W COOPER              + 2ND AGG. SILICEOUS                   +
MI IN CSN-1702409.. 1.273 +-CODE COL-....5...10...15...20...25...30-+- SOURCE NUMBERS & NAMES FOLLOW --+
ADT................1.860 + COMMENT1 N LANE                         + PRI 413-WOODMAN     PIT GRAY     CO+
TRAFFIC..........1.652.700 + COMMENT2                               + 2ND 407-TXI BRIDGEPORT, TX         +
--------------------------+-----------------------------------------+--------------------------------------+---------------------------
  36- 3    11.867  12.050 + PVT... HMAC               PLACED.. 11/72 + BINDER..  5.90 PERCENT              +  7/74 W-A 43/48/53   1,055
---- --    ------  ------ + FROM.. END CONC PVT                     + PRI AGG. TYPE D       LIMESTONE      +
SH  24. DEL           CO. + TO.... JCT LP 45  E                     + 2ND AGG. SILICEOUS                   +
MI IN CSN-1702406.. 0.183 +-CODE COL-....5...10...15...20...25...30-+- SOURCE NUMBERS & NAMES FOLLOW --+
ADT................1.890 + COMMENT1                                + PRI 413-WOODMAN     PIT GRAY     CO+
TRAFFIC..........1.674.050 + COMMENT2                               + 2ND 407-TXI BRIDGEPORT, TX         +
--------------------------+-----------------------------------------+--------------------------------------+---------------------------
```

Figure 7. Summary, Sorted by CSN.

```
CONSTRUCTION SECTION LISTING FOR DISTRICT C                SKID RESISTANCE REPORT 4                  DATE 06/06/75          PAGE   1

-- CONSTRUCTION SECTION INFORMATION -----+------ PAVEMENT, MATERIAL, --------+-- CONTROL-SECTION INFO. --+- SKID HISTORY(MAX. OF 6) -+
+                                         +       & SOURCE INFORMATION        +                           +          TVL           TRAFFIC+
+ CSN                                     +                                   + CO.    C-S    BMP    EMP  + MO/YR -LN LO/AV/HI  (000) +
------------------------------------------+-----------------------------------+---------------------------+---------------------------
1003801  HWY...FM  3   LENGTH...  1.520 + PAVEMENT. SURF. TRT./SEAL         +  6    49-03  0.000  1.520 +  8/74 O-A 22/25/26    1,670
-------  ADT......384  TRF....1,787,480 + PLACED... 09/62   BINDER... 0.31 +                           +
FROM..   MAR CO LINE                     + PRI AGG.. GRADE 2     LIMESTONE  +                           +
TO.... JCT FM 12                         + 2ND AGG.. PRECOAT AGG            +                           +
CODE COL-....5...10...15...20...25...30-+- SOURCE NUMBERS & NAMES FOLLOW --+                           +
COMMENT1                                 + PRI  43-GIFFORD      -PERCH      +                           +
COMMENT2                                 + 2ND    -2ND AGG. SOURCE UNKNOWN  +                           +
------------------------------------------+-----------------------------------+---------------------------+---------------------------
1006401  HWY...FM  6   LENGTH...  2.586 + PAVEMENT. SURF. TRT./SEAL         +  6    99-03  1.931  4.517 +  8/74 W-A 33/43/60    1,130
-------  ADT......202  TRF....1,191,750 + PLACED... 04/59   BINDER... 0.29 +                           +
FROM.. JCT FM 12                         + PRI AGG.. GRADE 6     SILICEOUS  +                           +
TO.... S 2.586 MI                        + 2ND AGG..                        +                           +
CODE COL-....5...10...15...20...25...30-+- SOURCE NUMBERS & NAMES FOLLOW --+                           +
COMMENT1                                 + PRI 406-STN.  CONST MTLS BOB     +                           +
COMMENT2                                 + 2ND                              +                           +
------------------------------------------+-----------------------------------+---------------------------+---------------------------
1006402  HWY...FM  6   LENGTH...  5.417 + PAVEMENT. SURF. TRT./SEAL         +  6    99-03  4.517  9.934 +  8/74 W-A 33/50/61    1,391
-------  ADT......242  TRF....1,465,250 + PLACED... 11/58   BINDER... 0.29 +                           +
FROM.. 4.5 MI S JCT FM 12                + PRI AGG.. GRADE 6     SILICEOUS  +                           +
TO.... CO RD.1.49 MI E JCT FM 152        + 2ND AGG..                        +                           +
CODE COL-....5...10...15...20...25...30-+- SOURCE NUMBERS & NAMES FOLLOW --+                           +
COMMENT1                                 + PRI 305-GIFFORD        SOVILLE   +                           +
COMMENT2                                 + 2ND                              +                           +
------------------------------------------+-----------------------------------+---------------------------+---------------------------
1006403  HWY...FM  6   LENGTH...  4.186 + PAVEMENT. SURF. TRT./SEAL         +  6    99-03  9.934 14.120 +  8/74 W-A 22/26/28    1,682
-------  ADT......559  TRF....1,853,055 + PLACED... 05/65   BINDER... 0.30 +                           +
FROM.. 4.18 MI W NL SH 2                 + PRI AGG.. GRADE 2     LIMESTONE  +                           +
TO.... NL SH 2                           + 2ND AGG.. PRECOAT AGG            +                           +
CODE COL-....5...10...15...20...25...30-+- SOURCE NUMBERS & NAMES FOLLOW --+                           +
COMMENT1                                 + PRI  43-GIFFORD      -PERCH      +                           +
COMMENT2                                 + 2ND    -2ND AGG. SOURCE UNKNOWN  +                           +
------------------------------------------+-----------------------------------+---------------------------+---------------------------
1007101  HWY...FM  7   LENGTH...  2.797 + PAVEMENT. SURF. TRT./SEAL         +  6    66-02  0.000  2.797 +
-------  ADT......324  TRF....2,719,580 + PLACED... 06/52   BINDER... 0.20 +                           +
FR   - HUN  CO LINE                      + PRI AGG.. GRADE 6     SILICEOUS  +                           +
TO.... JCT FM 153                        + 2ND AGG..                        +                           +
CODE COL-....5...10...15...20...25...30-+- SOURCE NUMBERS & NAMES FOLLOW --+                           +
COMMENT1                                 + PRI 406-STN   CONST MTLS         +                           +
COMMENT2                                 + 2ND                              +                           +
------------------------------------------+-----------------------------------+---------------------------+---------------------------
1007102  HWY...FM  7   LENGTH...  1.570 + PAVEMENT. SURF. TRT./SEAL         +  6    56-02  2.797  4.367 +
-------  ADT......241  TRF....1,062,745 + PLACED... 05/63   BINDER... 0.30 +                           +
FROM.. JCT FM 153                        + PRI AGG.. GRADE 5     LIMESTONE  +                           +
TO.... HOP    CO LINE                    + 2ND AGG.. PRECOAT AGG            +                           +
CODE COL-....5...10...15...20...25...30-+- SOURCE NUMBERS & NAMES FOLLOW --+                           +
COMMENT1                                 + PRI  43-GIFFORD      -PERCH      +                           +
COMMENT2                                 + 2ND    -2ND AGG. SOURCE UNKNOWN  +                           +
------------------------------------------+-----------------------------------+---------------------------+---------------------------
```

Figure 8. Statewide Frequency Distribution.

DISTRICT 99 - SKID RESISTANCE REPORT 5 DATE 05/16/75 PAGE
TABLE OF MILEAGE FOR SKID NUMBER RANGES

SN RANGE	NUMBER OF MILES	CUMMULATIVE NO. OF MILES	PERCENT OF TOTAL	CUMMULATIVE PERCENT
01-05	0.000	0.000	0.0	0.0
06-10	20.240	20.240	0.0	0.0
11-15	343.089	363.329	0.7	0.7
16-20	1,345.679	1,709.008	3.0	3.7
21-25	3,828.589	5,537.597	8.6	12.3
26-30	5,917.068	11,454.665	13.3	25.6
31-35	7,218.594	18,673.259	16.2	41.8
36-40	6,548.778	25,222.037	14.7	56.5
41-45	6,559.233	31,781.270	14.8	71.3
46-50	5,166.002	36,947.272	11.6	82.9
51-55	3,427.501	40,374.773	7.7	90.6
5[illegible]0	2,271.227	42,646.000	5.1	95.7
61-65	1,181.739	43,827.739	2.6	98.3
66-70	328.111	44,155.850	0.7	99.0
71-75	114.731	44,270.581	0.2	99.2
76-80	28.742	44,299.323	0.0	100.0
81-85	0.000	44,299.323	0.0	100.0
86-90	0.000	44,299.323	0.0	100.0
91-95	0.000	44,299.323	0.0	100.0
96-99	0.000	44,299.323	0.0	100.0

NOTE -- PROBABLE PERCENT ERROR DUE TO ROUNDING. ''PERCENT OF TOTAL'' INDICAT[illegible] TRUE PERCENTAGE TO NEAREST TENTH. ''CUMMULATIVE PERCENT'' IS FORCED [illegible]

Figure 9. Location of Sections in Frequency Distribution.

DISTRICT [illegible] - SKID RESISTANCE REPORT 5 DATE 06/06/75 PAGE 2
TABLE OF CONTROL-SECTION (OR C-S PORTION) SURFACES FOR SKID NUMBER RANGES

SN RANGE	C-S	BMP	EMP	LENGTH	HWY.	TVL-LN	FROM	TO
01-05	NONE							
06-10	NONE							
11-15	36-06	14.097	14.628	0.531	LP 90	O-A	CLEMENT RD	AT SF RR
11-15	26-01	3.840	5.979	2.139	FM 8	W-A	SH 24	FM 49
16-20	72-03	12.132	14.535	2.407	SH 7	W-A	1.5 MI N LP 3 W	FM 90
16-20	88-02	18.973	19.435	0.462	FM ?	O-A	CO RD RD W PI CK	0.462 MI E
16-20	49-01	10.135	10.637	0.502	FM 7	W-A	.1 MI E FM 118	.3 MI W FM 118
16-20	88-02	18.973	19.435	0.462	FM 9	W-A	CO RD RD W PI CK	0.462 MI E
16-20	30-02	0.000	1.694	1.694	FM 5	W-A	JCT LOOP 46	1.694 MI NORTH
16-20	9-08	11.588	12.223	0.635	FM 9	W-A	SH 5	FM 51
16-20	17-04	4.634	6.130	1.496	FM 1	W-A	JCT FM 42	VAN ZANDT CO LINE
16-20	39-01	0.000	1.937	1.937	FM 1	O-A	PARK BOUNDARY	FM 157
16-20	36-07	3.407	3.896	0.489	LP 0	O-B	LOOP 28	CLEM ST
16-20	30-02	7.733	13.388	5.655	FM 5	O-A	1.0 MI WEST OF FAU	JCT FM 90 AT VICE
16-20	30-02	7.145	7.733	0.588	FM 5	O-A	1.6 MI WEST OF FAU	1.0 MI WEST OF FAUG
16-20	35-04	19.084	19.942	0.858	FM 5	W-A	SH 1	SH 15
16-20	72-03	12.132	14.535	2.407	SH 37	O-A	1.5 MI N LP 3 W	FM 90
16-20	97-01	4.289	10.611	6.322	FM 15	O-A	0.3 MI S MILEPOST 4	JCT FM 300
16-20	38-01	0.000	2.941	2.941	FM 15	W-A	JCT FM 279	JCT FM 294 S
16-20	25-01	6.257	14.117	7.860	FM 75	W-A	IH 3	FM 156 E
16-20	81-10	0.000	4.173	4.173	US 77	O-A	WILLIS FERRY S END BR	4.1 MI S
16-20	9-09	4.257	3.224	0.933	IH 30	W-B	1.0 MI E JCT FM 49	JCT FM 49
16-20	36-07	3.407	3.896	0.489	LP 30	O-A	LOOP 28	CLEMENT ST
16-20	36-07	3.407	3.896	0.489	LP 30	W-B	LOOP 28	CLEMENT ST
16-20	9-09	10.816	8.463	2.353	IH 30	W-B	0.2 MI W LOO 31	0.1 MI W MILE POST 6
16-20	41-02	0.048	5.121	5.073	FM 67	O-A	US 6	HOPKINS CO LINE
16-20	41-04	9.939	18.457	8.518	FM 67	O-A	SH 1	SH 15

Figure 10. Materials Report.

SURFACE TYPE COMPARISON FOR DISTRICT C — SKID RESISTANCE REPORT 6 — DATE 06/06/75 — PAGE 7

PAVEMENT TYPE..........C-HMAC — PRIMARY AGGREGATE TYPE..B-LIMESTONE

TIME IN PLACE YR-MO	C-S	BMP	EMP	HWY	FROM	TO	TVL-LN	AVG SN	TRAFFIC (000)
8	9- 3	0.000	15.376	IH 3.	ROCK CO LINE	LOOP 31	W-B	26	78,389
							W-A	28	78,389
8	9- 3	15.379	C.CCC	IH 3.	LOOP 31	ROCK CO LINE	W-B	24	78,389
							W-A	28	78,389
8	3-04	0.000	8.517	US 6.	SH 1	WO CO LINE	W-A	42	272
10	1-01	4.300	14.560	SH 15	SH 1	WO CO LINE	W-A	26	11,451
11	3-11	0.0C0	7.373	SH 1.	FM 279.	VAN CO LINE	O-A	45	1
							W-A	42	1
11	21-01	1.035	1.566	LP 48	1 STREET	2 STREET	O-A	31	2,075
11	690-01	20.260	23.533	LP 28	END CONC PVT W SH 1	JCT US 8 W	O-A	38	5,019
11	690-01	16.709	20.031	LP 28	.74 MI S JCT US 27	BEG CONC PVT	O-A	38	9,757
1- 4	5-18	6.296	17.722	US 8	C.4 MI E JCT FM 90	JCT FM 141	W-A	59	***,***
							W-B	49	***,***
1- 4	5-18	17.722	6.296	US 8	JCT FM 141	0.4 MI E JCT FM 90	W-A	58	***,***
							W-B	50	***,***
2- 2	5-08	0.000	2.228	US 8	FANN CO LINE	2.2 MI E TO FAP HKR	O-A	45	1,296
							W-A	48	1,296
2- 3	5-06	16.258	15.204	US 8	NEY GROVE	MAR CO LINE	W-A	43	1,488
							O-A	42	1,488
2- 7	36-03	11.590	10.317	SH 2	BEG CONC PVT	JCT LP 45 W COOP	W-B	50	1,094
							W-A	63	1,094
2- 7	36-03	11.867	12.050	SH 2	END CCNC PVT	JCT LP 45 E	W-A	48	1,C55
2- 7	36-03	12.050	11.867	SH 2	JCT LP 45 E	END CONC PVT	W-B	50	1,107
2- 7	36-03	10.317	11.590	SH 2	JCT LP 45 W COOPER	BEG CONC PVT	W-B	52	1,043
							W-A	56	1,043
2- 9	9- 6	8.496	10.501	SH 5	FM 45.	IH 3	O-A	44	2,800
							W-A	44	2,800
2- 9	36-02	0.000	1.885	SH 2	LOOP 21 W OF COMMERCE	LOOP 21 NE OF COMMERCE	O-A	41	1,849
							W-A	35	1,849
2- 9	68-01	0.000	1.163	SH 5	SH 2	LOOP 17	W-B	39	4
							W-A	40	4
2- 9	68-01	1.163	0.0CC	SH 5	LOOP 17	SH 2	W-B	39	4
							W-A	46	4
2- 9	690-01	0.000	3.163	US 8	JCT LOOP 26 N AND E	BEG CONC PVT W US 27	W-A	42	2,747
							W-B	35	2,747
							O-A	37	2,747
							O-B	34	2,747
2- 9	321-01	7.129	8.486	SH 5	FM 51	FM 49	O-A	45	2,432
							W-B	45	2,432
2-11	5-18	6.296	C.000	US 8	C.4 MI E JCT FM 90	COOK CO LINE	W-A	63	3,358

* 01 * C-HMAC * B-LIMESTONE *

Figure 11. Materials Report, Sorted by Pavement Type, Aggregate Type and Source.

C-HMAC — A-SILICEOUS

CONSTRUCTION SECTION	BINDER CONTENT	TRAFFIC AT SKID TESTS	DATE OF TESTS	W-A	W-B	W-C	W-D	W-E	O-A	O-B	O-C	O-D	O-E
9-BRIG SEG- TEN PRPTY. 12-TYPE D													
1701901	4.80	14,518,CCC	C7/74	42	38								
1701903	4.80	8,416,00C	C4/71	39					44				
		13,857,CCC	C7/74	39					40				
1702401	4.80	9,373,CCC	04/71	42					38				
		10,862,CCC	08/74	40					39				
1702410	4.80	8,829,4CC	04/71	41					40				
		10,102,CCC	C8/74	40					42				
41-GIFFORD -BCB PIT 12-TYPE D													
1702402	5.20	31,950,0CC	C4/71	40					35				
		15,422,CC0	08/74	39					40				
6631502	4.50	2,133,CC0	C4/71	51					46				
		5,CCC,CC0	C8/74	32	31				30	30			
6702401	4.90	14,299,CCC	C8/74	33	31				33	33			
6806905	4.50	5,765,5CC	04/71	35					32				
		6,163,2C0	C8/74	33					33				
6806906	4.50	7,977	04/71	32					38				
		8,471	C8/74	30					31				
6806907	5.20	6,709,5C0	04/71	29					34				
		7,154,CC0	08/74	30					34				
44-GIFFORD -K PLANT 12-TYPE D													
9827102	5.80	7,475,CCC	C4/71	41					39				
		8,198,0C0	07/74	37					36				
45-GIFFORD -TEX 12-TYPE D													
7808208	4.60	***,***,***	04/71	34					34				
		10,288,CC0	07/74	34					34				
9808201	4.70	***,***,***	04/71	35					38				
		,,***	C7/74	35					35				
304-TEXAS INDUS- GOVILLE,TX 12-TYPE D													
8004701	4.80	88,505	C3/75						40				
305-GIFFORD GOVILLE 12-TYPE D													
6838002	5.20	6,916,300	C4/71	32					33				
		7,574,4CC	C7/74	33					31				

* 01 * C-HMAC * A-SILICEOUS * BRIGGLE SEG-MORTEN PRPTY. THRU GIFFORD HILL-HODY PIT *

Figure 12. Wet Weather Accident Rate Report.

COUNTY - GRAY AVG ANNUAL RAINFALL =38. INCHES DISTRICT PAGE 5

HIGHWAY	CONT	SEC	LENGTH IN MILES	DAILY VEHICLE MILES	FATAL-ITIES	FAT. ACC.	FAT.+ INJ ACC.	TOTAL ACC.	FATALITY RATE	FATAL ACC RATE	FATAL + INJURY RATE	TOTAL RATE	TOT WET ACC	% WET TIME	WET ACCIDENT RATE	RATIO WET RATE TO TOTAL RATE
US 8	4	2	10.64	54402	1	1	9	43	5.0	5.0	45.3	216.6	7	7.9	446.2	2.06
US 8	4	3	6.78	37609	0	0	4	15	0.0	0.0	29.1	109.3	3	7.9	276.6	2.53
US 8	4	4	11.95	46450	1	1	6	29	5.9	5.9	35.4	171.0	3	7.9	224.0	1.31
US 8	4	18	17.74	1739	1	1	10	30	157.5	157.5	1575.5	4726.4	7	7.9	13959.8	2.95
US 8	4	19	0.39		0	0	0	1					0	7.9		
US 6	4	1	3.92	42610	3	2	27	40	19.3	12.9	173.6	257.2	9	7.9	732.5	2.85
SH	4	3	9.74													
US 7	4	3	0.67													
			10.41	33156	0	0	3	23	0.0	0.0	24.8	190.1	0	7.9	0.0	0.0
US 7	4	13	9.41	93131	3	1	9	23	8.8	2.9	26.5	67.7	5	7.9	186.2	2.75
LP 38	4	16	0.34	762	0	0	1	5	0.0	0.0	359.5	1797.7	0	7.9	0.0	0.0
US 37	8	7	16.84	28679	0	0	6	17	0.0	0.0	57.3	162.4	5	7.9	604.6	3.72
LP 44	8	8	4.89	8430	0	0	3	12	0.0	0.0	97.5	390.0	1	7.9	411.4	1.05
US 37	8	10	15.84	30825	1	1	12	28	8.9	8.9	106.7	248.9	6	7.9	675.0	2.71
LP 47	8	15	0.76	84	0	0	0	1	0.0	0.0	0.0	3261.6	0	7.9	0.0	0.0
LP 47	8	16	1.10	572	0	0	1	3	0.0	0.0	479.0	1436.9	0	7.9	0.0	0.0
SH 28	9	1	15.89	19688	1	1	7	20	13.9	13.9	97.4	278.3	9	7.9	1585.3	5.70
FM 15	20	1	1.10	1774	0	0	0	2	0.0	0.0	0.0	308.9	0	7.9	0.0	0.0
FM 12	20	8	7.21													
FM 99	20	8	2.02													
FM141	20	8	2.96													
FM 13	20	8	2.52													
			14.71	30994	0	0	13	44	0.0	0.0	114.9	388.9	11	7.9	1230.8	3.16
FM 69	20	9	14.77	3958	0	0	1	4	0.0	0.0	69.2	276.9	0	7.9	0.0	0.0
US 6	20	13	1.31	2773	0	0	3	6	0.0	0.0	296.4	592.8	0	7.9	0.0	0.0
FM 8	31	2	6.83	5840	0	0	3	4	0.0	0.0	140.7	187.7	0	7.9	0.0	0.0
FM175	31	3	9.16	8766	0	0	4	11	0.0	0.0	125.0	343.8	0	7.9	0.0	0.0
US 6	41	1	11.07	27786	0	0	7	15	0.0	0.0	69.0	147.9	4	7.9	499.2	3.38
US 6	41	2	7.37													
SH 16	41	2	7.37													
			14.74	23687	0	0	7	16	0.0	0.0	81.0	185.1	5	7.9	732.0	3.95
FM 90	51	1	20.27	8331	5	1	2	10	164.4	32.9	65.8	328.9	1	7.9	416.3	1.27
FM 90	51	2	7.98													
SH 1	51	2	5.28													
			13.26	15607	0	0	5	19	0.0	0.0	87.8	333.5	2	7.9	444.4	1.33
FM 89	51	3	2.02	2367	0	0	1	8	0.0	0.0	115.7	926.0	1	7.9	1465.2	1.58
FM 69	66	1	5.30	13054	0	0	6	20	0.0	0.0	125.9	419.8	10	7.9	2656.7	6.33
SH 7	70	1	3.60	13561	0	0	7	15	0.0	0.0	141.4	303.0	3	7.9	767.2	2.53
FM 12	72	1	5.23	15303	0	0	8	20	0.0	0.0	143.2	358.1	2	7.9	453.2	1.27
FM 12	72	2	6.49	6678	1	1	6	19	41.0	41.0	246.2	779.5	4	7.9	2077.3	2.66
FM189	72	3	5.58	4458	0	0	0	1	0.0	0.0	0.0	61.5	0	7.9	0.0	0.0
FM 12	72	1	22.23	9826	0	0	2	9	0.0	0.0	55.8	250.9	2	7.9	705.9	2.81
FM 12	72	2	10.86	6929	1	1	5	9	39.5	39.5	197.7	316.3	0	7.9	0.0	0.0
FM 81	72	3	1.08	239										7.9		

Figure 13. Control Sections Selected for Priority Ranking.

SELECTED CONTROL SECTIONS

DIST	COUNTY	CONT-SEC	NUMBER WET ACCIDENTS	WET ACCIDENT RATE
0	3	18- 5	4	1547.0
0	3	98- 7	5	1609.1
0	3	06- 4	7	1340.2
0	3	65- 1	3	1792.0
0	9	38-15	3	3128.1
0	9	77- 1	11	1317.8
0	9	93- 1	22	1448.0
0	9	24- 2	14	1625.1
0	10	64- 2	10	1192.1
0	10	20- 7	6	1458.9
0	10	89- 1	3	1840.3
0	20	23- 6	5	2170.0
0	20	06- 6	6	1888.0
0	20	45- 3	4	1523.2
0	21	45- 6	19	1144.8
0	21	78- 2	6	1605.6
0	21	92- 1	9	1105.4
0	21	92- 5	5	1922.7
0	21	95- 4	26	589.8
0	21	95- 5	21	503.9
0	21	05- 2	10	1762.2
0	21	20- 6	20	1141.2
0	21	33- 1	3	1764.5
0	23	89- 1	3	1243.0
0	25	95- 9	8	1132.0
0	25	90- 3	22	1459.6
0	25	92- 3	7	1162.2
0	25	47- 1	3	1836.5

Figure 14. Spot Locations Selected for Priority Rating.

1973 1/10 MILE SECTIONS WITH 3 OR MORE WET ACCIDENTS PAGE 10

DIST	COUNTY	HIGHWAY	CONT-SEC	MILE POST	INTERSECTION	NO. OF FATAL-ITIES	NO. OF PERSONS INJURED	TOTAL NO. OF ACCIDENTS 1973	NO. OF WET ACCIDENTS 1973
0	GRE	US 25	38- 1	6.8			1	3	3
0	HEN	SH 3	63- 4	0.6	FM 9		1	11	3
0	RUS	US 8	23- 6	18.7	US 25		4	10	3
0	RUS	US 25	38- 3	0.8			1	3	3
0	RUS	SH 4	07- 3	0.3	SH 14		1	5	3
0	SMI	SH 3	24- 1	14.3	FM 85	1	5	6	4
0	SMI	FM 1	92- 1	15.4	LP 32	2	6	9	4
0	SMI	IH 2	95- 4	12.4	US 6			8	4
0	SMI	IH 2	95- 5	18.6	FM 1		1	4	3
0	SMI	SH 15	20- 6	12.2				3	3
0	SMI	SH 15	20- 6	12.3	LP 32		6	18	6
0	WOO	US 8	96- 2	32.6	FM 1			6	4
0	WOO	US 6	90- 3	3.4	US 8		3	16	4

Figure 15. Summary of Accidents in a Control Section.

```
TOTAL ACCIDENTS= 40     WET ACCIDENTS= 12
DIST.      PG. 55 +H 0 0 0 0 0 0 0 0 0 0 + 0 0 0 0 0 0 0 0 0 1 + 1 1 1 1 1 1 1 1 1 1 + 1 1 1 1 1 1 1 1 1 1 + T
CO. RED           +. 0 0 0 1 1 1 2 4 5 5 + 6 7 7 7 7 7 7 7 9 0 + 1 1 2 3 4 4 6 6 7 7 + 7 7 7 7 7 7 7 7 7 7 + 0
CS   89- 2        +P . . . . . . . . . . + . . . . . . . . . . + . . . . . . . . . . + . . . . . . . . . . + T
+++++++++++++++++++. 6 6 9 4 5 5 7 0 4 8 + 9 3 4 4 4 5 6 7 7 2 + 1 7 2 5 3 9 6 8 5 6 + 6 6 6 6 6 6 6 8 8 9 + .
VEHICLE 1 - TYPE---+---------------------+---------------------+---------------------+---------------------+++
  AUTOMOBILE........ W D D D D D D   W   + D D D D D D W W W W + W D     D   D   D D +   D D     W W D D W =31
  TRUCK OR BUS......               D   W +                     +     W D   D   D     + D     D D           = 9
  OTHER.............                     +                     +                     +                     *
VEH1-DIR. OF TRAVEL+---------------------+---------------------+---------------------+---------------------+++
  WITH MILEPOSTS.... W       D       W   +     D     D     W   +   D W D         D   +     D       W       =12
  AGAINST MILEPOSTS.   D D D   D D D   W + D D   D D   W W   W + W       D D D D   D + D     D   W     D   =24
  LT. OF MILEPOSTS..                     +                     +                     +         D     D     = 2
  RT. OF MILEPOSTS..                     +                     +                     +   D               W = 2
DATE OF ACCIDENT---+---------------------+---------------------+---------------------+---------------------+++
  MONTH-M1.......... 0 0 0 0 0 0 0 1 1 0 + 0 0 0 0 0 0 0 0 0 0 + 0 0 0 0 0 0 0 0 0 0 + 0 0 0 0 0 0 1 0 0 0 *
  MONTH-M2.......... 4 6 8 7 5 5 8 2 1 7 + 7 6 3 3 3 7 9 7 6 5 + 1 2 7 6 7 8 4 7 1 1 + 2 3 5 5 6 9 1 6 8 7 *
  DAY-D1............ 1 2 0 2 1 2 2 0 2 2 + 0 1 1 1 1 0 0 1 0 1 + 2 1 2 0 2 3 2 1 1 0 + 2 1 1 2 1 0 2 2 0 1 *
  DAY-D2............ 5 2 7 2 6 9 4 6 4 8 + 1 7 0 0 0 9 5 5 3 1 + 0 4 9 3 4 1 6 4 1 1 + 1 6 2 1 9 2 3 8 3 5 *
  YEAR-Y1........... 7 7 7 7 7 7 7 7 7 7 + 7 7 7 7 7 7 7 7 7 7 + 7 7 7 7 7 7 7 7 7 7 + 7 7 7 7 7 7 7 7 7 7 *
  YEAR-Y2........... 3 3 3 3 3 3 3 3 3 3 + 3 3 3 3 3 3 3 3 3 3 + 3 3 3 3 3 3 3 3 3 3 + 3 3 3 3 3 3 3 3 3 3 *
VEH1-CONT.FACTORS-+ ---------------------+---------------------+---------------------+---------------------+++
  SPEEDING..........           D     W   +         D     W   W +             D     D +   D         W       = 9
  DISREGARD SIGN/ROW                     +                     +                     +                   W = 1
  IMPROPER TURN.....                     +                     +                     +         D           = 1
  WRONG SIDE OF ROAD                     +                     +           D         +                     = 1
  WRONG WAY ON 1 WAY                     +                     +                     +                     *
  FOLLOW TOO CLOSE..                     +                     +                     +                     *
  ILLEGAL PASSING...             D       +                     +                   D +                     = 2
  ALCOHOL OR DRUGS..                     +                 W   + W                   +                     = 2
  VEHICLE DEFECTS...               D     +                     +   D                 +                     = 2
  OTHER.............                     +                     +                     +                     *
VEHICLE 2 - TYPE---+---------------------+---------------------+---------------------+---------------------+++
  NO SECOND VEHICLE.   D           D W W +   D D D D D W W W W + W D   D     D D   D +   D     D W         =22
  AUTOMOBILE........     D     D         + D                   +         D D         +     D D       D D W =10
  TRUCK OR BUS...... W     D D   D       +                     +     W           D   + D           W       = 8
  OTHER.............                     +                     +                     +                     *
VEH2-DIR. OF TRAVEL+---------------------+---------------------+---------------------+---------------------+++
  WITH MILEPOSTS.... W     D   D         +                     +     W     D     D   +                     = 6
  AGAINST MILEPOSTS.     D       D       + D                   +         D           +                   W = 5
  LT. OF MILEPOSTS..         D           +                     +                     + D   D       W D D   = 6
  RT. OF MILEPOSTS..                     +                     +                     +       D             = 1
PART OF HIGHWAY----+---------------------+---------------------+---------------------+---------------------+++
  MAIN LANE......... W D D D D D D D W W + D D D D D D W W W W + W D W D D D D D D D + D D D D D W W D D W =40
  FRONTAGE ROAD.....                     +                     +                     +                     *
  RAMP..............                     +                     +                     +                     *
  DETOUR............                     +                     +                     +                     *
  OTHER.............                     +                     +                     +                     *
  UNKNOWN...........                     +                     +                     +                     *
VEH2-CONT.FACTORS-+ ---------------------+---------------------+---------------------+---------------------+++
  SPEEDING.......... W                   + D                   +     W               +       D             = 4
  DISREGARD SIGN/ROW       D   D         +                     +                     + D   D       W   D   = 6
  IMPROPER TURN.....         D           +                     +                     +                     = 1
  WRONG SIDE OF ROAD                     +                     +                     +                     *
  WRONG WAY ON 1 WAY                     +                     +                     +                     *
  FOLLOW TOO CLOSE..                     +                     +         D           +                     = 1
  ILLEGAL PASSING...                     +                     +                     +                     *
  ALCOHOL OR DRUGS.. W     D             + D                   +                     +                     = 3
  VEHICLE DEFECTS...                     +                     +                     +                     *
  OTHER.............                     +                     +                     +                     *
+++++++++++++++++++++--------------------+---------------------+---------------------+---------------------+++
```

Figure 15. (Continued)

DIST. ' PG. 56 +M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	T
CO. RED +.	0	0	0	1	1	1	2	4	5	5	6	7	7	7	7	7	7	7	9	0	1	1	2	3	4	4	6	6	7	7	7	7	7	7	7	7	7	7	7	7	O
CS 89- 2 +P	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T
+++++++++++++++++.	6	6	9	4	5	5	7	0	4	8	9	3	4	4	4	5	6	7	7	2	1	7	2	5	3	9	6	8	5	6	6	6	6	6	6	6	6	8	8	9	.
PAVEMENT CONDITION																																									
WET	W								W	W							W	W	W	W	W		W													W	W			W	=12
DRY		D	D	D	D	D	D	D			D	D	D	D	D	D						D		D	D	D	D	D		D	D	D	D	D	D			D	D		=27
OTHER																													D												= 1
LIGHT CONDITION																																									
DAYLIGHT			D		D	D	D			W	D						W	W	W		W		W		D	D	D	D	D		D		D	D	D		W	D	D	W	=24
DAWN OR DUSK																																									*
DARKNESS	W	D		D				D	W			D	D	D	D	D				W		D		D						D		D									=15
INTERSECTION																																									
NONE		D					D	D	W	W	D	D	D	D	D	D	W	W	W	W	W	D	W	D	D	D	D	D													=23
PVT.CO.RD.CITY ST.	W		D		D	D																							D	D	D	D	D	D	D	W	W	D	D	W	=16
MAJOR				D																																					= 1
CURVATURE																																									
NONE	W	D	D		D	D	D	D	W		D	D	D	D	D	D		W	W	W	W	D	W	D	D	D	D	D	D		D	D	D	D	D	W	W	D	D	W	=36
0.1-1.9 DEGREES																	W																								= 1
2.0-3.9 DEGREES				D						W																															= 2
4.0-5.9 DEGREES																																									*
6.0-7.9 DEGREES																																									*
8.0-9.9 DEGREES																																									*
10.0-11.9 DEGREES																																									*
12.0-13.9 DEGREES																																									*
14.0-15.9 DEGREES																																									*
16.0-17.9 DEGREES																																									*
18.0 DEG AND OVER																																									*
TYPE OF ACCIDENT																																									
NONCOLL. ON ROAD																																D									= 1
VEH W/ VEH-IN REAR	W						D				D												W		D				D												= 6
VEH W/ VEH-LT TURN			D	D		D																																			= 3
VEH W/ VEH-RT TURN																																									*
VEH W/ VEH-HEAD ON																										D															= 1
VEH W/ VEH-ANGLE					D																										D		D	D				W	D	W	= 7
VEH W/ PEDESTRIAN																																									*
VEH W/ TRAIN																																									*
VEH W/ PARKED VEH.																	W																		D	W					= 3
VEH W/ BICYCLIST																																									*
VEH W/ ANIMAL		D											D	D		D																									= 4
VEH W/ FIXED OBJ.								D										W		W				D			D	D		D											= 7
VEH W/ OTHER OBJ.															D																										= 1
VEH WENT OFF ROAD.									W	W		D							W		W	D																			= 6
OTHER FACTORS																																									
LOST CONTROL/SKID.										W																															= 1
PASSNGR INTERFERED																																									*
ATTENTION DIVERTED																																									*
PROJECTING OBJECT.																																									*
FT SLIP(CLUTCH/BR)																																									*
GUSTY WINDS																																									*
VEH PASSING(LEFT).			D				D											W												D											= 4
VEH PASSING(RIGHT)																																									*
VISION OBSTRUCTED.																																									*
VEH SWERVED/VEERED															D		W																								= 2
VEH SLOWING/STOPED	W																												D									D			= 3
ACCIDENT DAMAGE																																									
1 OR MORE FATAL																		W																							= 1
1 OR MORE INJURY				D					W	W	D	D		D	D			W	W			D		D		D						D									=13
PROPERTY ONLY	W	D	D		D	D	D	D					D			D	W			W	W		W		D		D	D	D	D	D		D	D	D	W	W	D	D	W	=27
TRAFFIC CONTROL																																									
SIGNAL																													D												= 1
SIGN					D	D																								D	D		D	D		W	W	D		W	=10
STRIPE VIDER	W	D	D	D				D	W	W	D	D	D	D	D	D	W	W	W	W		D	W	D	D	D	D	D				D			D				D		=28

References

1. System SKIDR - Manual for the Automated Skid Resistance Survey. 1974, 262 pp. Texas State Department of Highways and Public Transportation.
2. Highway Traffic Accident Analysis - Accident Detail Listing. Yearly. Texas State Department of Highways and Public Transportation.
3. K. D. Hankins. The Use of Rainfall Characteristics in Developing Methods for Reducing Wet Weather Accidents in Texas. DHT Research Report No. 135-4, 1975, 41 pp. Texas State Department of Highways and Public Transportation.
4. Statewide Highway Safety Improvement Program - 1975. Administrative Order No. 32-74, 1974. Texas State Department of Highways and Public Transportation.
5. 1972 Standard Specifications for Construction of Highways, Streets, and Bridges. 807 pp. Texas State Department of Highways and Public Transportation.
6. Manual of Testing Procedures. Volume 2, 160 pp. Texas State Department of Highways and Public Transportation.
7. J. G. Rose and J. H. Havens. Aggregate Shape and Skid Resistance. Research Report No. 312, 1971. Kentucky Department of Highways.
8. Manual of Testing Procedures. Volume 2, Test Method Tex-438-A, 8 pp. Texas State Department of Highways and Public Transportation.
9. J. A. Epps and C. H. Hughes. Sprinkle Treatment-How, Why and Where. DHT Research Report 214-4, 1975, 33 pp. Texas Transportation Institute and Texas State Department of Highways and Public Transportation.