

BACKGROUND AND DEVELOPMENT OF THE FEDERAL HIGHWAY ADMINISTRATION'S SKID-ACCIDENT REDUCTION PROGRAM

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Review is made of Federal Highway Administration actions related to pavement skid-control qualities of federal-aid highway projects since the Highway Safety Act of 1966. Emphasis is on measuring skid resistance; obtaining and correlating accident data, material properties, and practices in design, construction, and maintenance for better skid resistance; and determining priorities for current projects. A coordinated research program was expanded in 1970 to include study on all phases of skidding accidents and the engineering factors and actions for their reduction, including 3 field test centers to calibrate skid measurement equipment. It is FHWA policy that pavement surfaces on all projects be designed, constructed, and maintained with the best practical skid resistance properties and that highway sections that are inadequate be identified and corrected. Since 1968, project work to improve pavement skid resistance has been eligible for federal aid. Concern of the state highway departments for the legal implications of use of minimum skid numbers is recognized. The present program uses guidelines set by each state for their specific conditions to establish priorities for correction.

•THE TOPIC of skid resistance has been around for a long time. As far back as the 1930s Ralph A. Moyer, formerly of the Highway Research Board, and others were expressing concern about safety problems and were presenting research reports on conditions and early measurement details. The 1958 International Skid Conference in Virginia was the first major effort to bring together the many engineering and research aspects of the subject. House Report 1700 (1966 accompanying H. R. 13290) identified skidding on wet pavements as 1 of the principal contributing factors in many accidents. The resultant Highway Safety Act of 1966 renewed emphasis at the federal level to improve pavement skid resistance. This continuing emphasis has resulted in what has been termed the federal skid-accident reduction program.

Do not be misled by the word "program," which has a wide variety of meanings. A Federal Highway Administration skid-accident reduction program exists not as a separately funded, specific set of projects but rather as actions toward a general goal. Better skid resistance is 1 of several safety features being emphasized in the federal program for construction and reconstruction of highways in the federal-aid system. It is also a significant part of the general highway safety program that applies to the many thousands of miles of streets and highways not in the federal-aid systems.

The stated policy of the FHWA is that pavement surfaces should be constructed and maintained for the best possible skid resistance and that inadequate pavements be identified and corrected. This calls for attention to materials, design, construction, operations, maintenance, research, development, and administrative controls on vehicles and drivers. On April 21, 1967, the FHWA issued a Circular Memorandum (CM),

Pavement Skid Resistance, to field personnel emphasizing the importance of providing good skid resistance on federal-aid roadways and stressing the need to include provisions for high skid resistance during the design and construction of federal-aid projects. In addition, the memorandum transmitted 2 documents. One dealt with the present state of the art on the causes and nature of skidding and skid resistance, and the other gave information on applying skid-resistant surfaces to new and existing pavements. At that time, minimum standards for pavement surface skid resistance had not been firmly established but obviously were needed.

In June 1967 the FHWA's National Highway Safety Bureau issued 13 highway safety program standards. These are uniform performance standards that each state must implement as part of its comprehensive highway safety program. It should be noted that these standards are not specific design details such as those developed by AASHTO on geometric items but rather broad goals and objectives to be attained through the program. The Standard on Highway Design, Construction and Maintenance included 2 important provisions on skid resistance that apply to all streets and highways.

- (1) Every State, in cooperation with county and local governments, shall have a program of highway design, construction and maintenance to improve highway safety.
- (2) The program shall provide as a minimum that: ...
 - D. There are standards for pavement design and construction with specific provisions for high skid resistance qualities.
 - E. There is a program for resurfacing or other surface treatment with emphasis on correction of locations or sections of streets and highways with low skid resistance and high or potentially high accident rates susceptible to reduction by providing improved surfaces.

In April 1968 the FHWA issued Instructional Memorandum (IM) 21-3-68, Construction of Pavement Surfacing to Provide Safer Coefficient of Skid Resistance, which pointed out the benefits of good skid resistance and encouraged improvement projects. More importantly, it informed the states that in the interests of safety, there would be federal-aid eligibility for work to resurface pavements with skid numbers (SNs) of less than 35. Up to this time, it had been a policy to view any of the several forms of thin overlays as a maintenance step to restore pavement and, therefore, there was no eligibility for federal funds. With this memorandum, surface courses provided primarily to improve skid resistance were accepted as needed safety improvements that could be funded. The SN criterion was based on data included in NCHRP Report 37 (1). This report is a good summary of the state of the art on pavement skid resistance. It presents tentative minimum SNs for main highways.

On May 13, 1968, the FHWA issued a followup CM, Plant Mix Seal Coats, to better describe plant mix seal coats and encourage states to use them to provide high skid resistance on existing pavements.

Since early 1969 there has been an FHWA Highway Safety Improvement Program as outlined in Policy and Procedure Memorandum (PPM) 21-16, which was last revised on May 3, 1972. This is a program of projects to detect and correct hazardous or potentially hazardous locations, elements, or sections of the federal-aid highway system. Accident data are used to identify hazardous spots. Continuing systematic corrections and evaluations are required for skid-prone locations.

During the summers of 1967 and 1968 the FHWA conducted a program of pavement skid testing with the cooperation of 17 states using a BPR skid-test trailer. The 2 main objectives of the program were to illustrate the ease, efficiency, safety, and reliability of a standard skid trailer to conduct rapidly a large number of skid tests in various environments and to obtain widespread technical data on existing pavement skid resistance. Two reports, 1 to AASHTO and 1 to the HRB, were given in 1968 on the data collected in 14 of the states.

By 1970 it became evident that there was a need to develop a comprehensive approach to the skid-accident problem. A number of state studies indicated a dramatic reduction in skidding accidents after overlaying or grooving of existing pavements with low SNs. Also, increasing evidence showed that many highway sections had less than desirable

skid characteristics and that high speeds and high traffic volumes were polishing pavements at a rapid rate. Formulation of a major research program was started. A series of regional workshops on skid-resistant surface courses was begun. A number of meetings were held among the affected safety, operating, and research offices within FHWA to develop a broad approach to aid all states. A special ad hoc committee was formed to obtain and analyze all known information on skid resistance and to develop a comprehensive program to reduce skidding accidents.

Through the efforts of this special committee, a proposal for a skid-accident reduction program was developed in July 1971. This was commonly referred to as the "white paper" on skid resistance. Although the white paper was not used directly as FHWA policy, it was the basic resource used to develop the current control memorandum on skid-accident reduction. With the data then available the committee felt that enough information was available for the states to develop an initial program that included 3 main action features:

1. Countrywide detection of pavements with low skid resistance through inventories and accident analyses;
2. Systematic correction of existing pavements that have become low on the skid resistance scale; and
3. Development of better design criteria to both provide and retain better skid resistance in new highway construction.

To support this program, the committee also identified areas in which further research was needed. For example, different correlation studies indicated that skid trailers owned by different states were not producing similar SNs. Wide studies on related research needs led to a major FHWA-correlated research activity with a goal to reduce the frequency and severity of skidding accidents. The project was divided into 8 sections:

1. Materials and techniques for durable skid-resistant surfaces;
2. Mechanics of pavement-vehicle interactions, skidding, and loss of control;
3. Measurement systems for pavement friction, roughness, and hydroplaning potential;
4. Friction requirements for highway sites with high skid-accident potential;
5. Skid-accident analyses and identification of highway sites with high skid-accident potential;
6. Driver awareness of highway sites with high skid-accident potential;
7. Cost effectiveness of alternate solutions for highway sites with high skid-accident potential; and
8. Procedures, equipment, and test centers for standardizing skid measurements.

Progress has been made on all of the tasks and 3 centers have been established for calibrating and certifying measurement equipment.

In March 1971 the National Highway Safety Bureau of FHWA issued Volume 12 of the Highway Safety Program Manual, which supplements Standard 12, Highway Design, Construction and Maintenance, and suggests guidelines for implementing the various features of the standard. The manual calls for a program under which any pavement that cannot meet the "recommended minimum interim skid numbers" [values from NCHRP Report 37 (1)] should be considered for corrective action. It also states that specific consideration be given to skid resistance qualities in the materials, design, and construction of new pavements.

Meanwhile, the Subcommittee on Investigations and Oversight of the House Public Works Committee expressed disappointment at the slow progress being made in skid resistance and scheduled hearings in May 1971. A film used during these hearings showed highly disturbing skidding incidents on Interstate segments in the Washington, D.C., area. The subcommittee charged the FHWA to give the states leadership in the prevention of skidding accidents. They urged that we encourage better state response on testing, reporting, and improving pavement skid resistance. The subcommittee also indicated that future hearings on our progress would be held. The subcommittee scheduled a hearing for the spring of 1973, but it was postponed.

In 1972 the FHWA ad hoc committee was reassembled to give policy instruction to our field offices and the states. After much deliberation a draft memorandum was prepared and distributed to all affected units within the FHWA. The nature and extent of specific FHWA requirements for state actions were heavily debated. Some felt that we should call for correction of all highway sections with SNs below a named value. Others, who reflected the states' concerns about widely varying conditions, lack of widespread inventory data, and legal implications, believed that only something less definite would be workable. We resolved these divergent views in a few months and issued a revised draft that we hoped would be acceptable to all factions of the highway community. This draft contained a table of minimum SNs, below which corrective work would be required. These minimum SNs were based on those from NCHRP Report 37 (1). The memorandum also included a guide that contained a table of desirable SNs and speed gradient characteristics for new constructions.

To ensure acceptance of this controversial IM we furnished copies to the AASHTO "Red Tape" committee for comments. During this time, all of the states received copies and replies were received from 20 of them, which indicates the great interest in this problem. Comments ranged from complete endorsement of the proposed IM to complete rejection with the suggestion that we avoid all program requirements and leave the matter entirely to the states. One consistent comment on the SN guidelines related to the possible legal liability of a state if highways did not meet the minimum SNs. Because some states had lost suits on unsafe highway conditions they were reluctant to officially collect data such as skid inventories and listings of hazardous locations that could be used in the courts against them. In response to the states, we once more revised the IM and eliminated all direct references to minimum SNs. We also asked that each state set up its own general guidelines based on specific conditions. These guides are expected to help establish program priorities for skid reduction projects.

The current FHWA program is described in the July 19, 1973, IM, Skid Accident Reduction Program. Its main contents are: (a) a policy statement; (b) the essence of Highway Safety Program Standard 12 restated as a call for state programs for evaluation of current pavement design, construction, and maintenance practices and for systematic identification and corrections; (c) a reference to PPM 21-16, May 1972, Highway Safety Improvement Program, to amplify accident data studies with pavement-friction data; (d) requests for more complete state skid measurement data and appraisals of present practices; (e) a request for engineering evaluation of skid, geometric, traffic, weather, and other factors for corrective action; (f) a statement about federal-aid fund eligibility; (g) a request for progress reports; and (h) guidelines on the technical details of evaluation, design, and construction for skid resistance.

We believe that the inventory work required by the Highway Safety Program Standard 12 can be used for the general skid reduction program. Initial measurements should be made on selected samples of surfaces representative of the various combinations of mix designs, aggregates, and construction procedures to appraise skid resistance. This information can then be used to estimate the condition of similar pavements and to determine probable critical locations. A location in need of a thorough engineering evaluation for corrective action may be identified by a high frequency of wet weather accidents, by a low SN, or by a combination of the 2.

The FHWA has determined that federal-aid funding can be made available to programs to provide new or reconstructed pavements with desirable skid resistance qualities. Work that is justified solely by skid resistance measurements is limited to corrective treatment of the pavement surface. This work may consist of grooving the surface or applying a thin overlay of bituminous material specifically designed to provide the desired skid resistance.

Our division engineer is expected to monitor the states' skid resistance improvement program on a continuing basis, review it for reasonableness and consistency, and see that it is implemented at the earliest possible date. The engineer is not to approve future project plans involving surface courses unless these surfaces will satisfy the objectives of the IM. In short, we insist that future projects be done so that better skid-resistant surfaces will be provided for the traveling public.

The FHWA skid-accident reduction program described in the July 19, 1973, IM 21-2-73 is an expansion of the ongoing highway safety improvement program (PPM 21-16) for spot improvement projects, which has been under way for about 4 years. It is also concerned with better skid quality design and construction of new highway projects. It is not a separately funded program, but rather an integral part of the overall federal-aid highway program. The program required some time to develop and represents a compromise between the high safety desires and practical limitations that exist today.

The nature of the program is a compromise and it recognizes several deterrents against more rapid or more widespread pavement skid betterment. These include:

1. Priority scrambles for use of available highway funds for the most cost-effective returns;
2. Incomplete development and acquisition of rapid, reliable skid measurement equipment, and a resultant lack of pavement condition data;
3. Inertia in agencies making changes in materials, design, and construction practices;
4. Limited supply of high-quality aggregates and incomplete technical testing knowledge of those available; and
5. Highway agency concern about liability to lawsuits for accidents caused by skidding.

Obviously, the legal implications of highway skid resistance are and will continue to be significant factors in highway safety programs. But, there are others too. The FHWA will continue to press for adequate and up-to-date programs that will reduce skidding hazards.

REFERENCE

1. Kummer, H. W., and Meyer, W. E. Tentative Skid Resistance Requirements for Main Rural Highways. NCHRP Rept. 37, 1967.