

# SKID RESISTANCE EVALUATION PROGRAM

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## HISTORY

Indiana started skidding roads in 1968 with a towed-trailer type skid system. In 1974, a 1974 Ford pick-up was purchased to replace the original 1968 pick-up. The skid trailer measures skid resistance of pavement surfaces. The standard speed is 40 mph. The electronic data reduction system presently being used can produce a skid number in about 7 seconds. (See Figure 1.)



Figure 1. The Indiana State Highway Commission Skid Testing System

A second skid trailer, which will produce the skid number on board, is being fabricated and should be ready for skid testing in about 60 days. It will be calibrated in Ohio to national standards prior to being used.

## PURPOSE

- To maintain a state-wide inventory of all primary highways with speed limits of 40 mph or higher.
- To perform special tests on selected sites.
- To aid in future planning and design of antiskid and durable construction (by evaluation of special surfaces).
- To do special skidding at 30, 40, and 50 mph.
- To provide skid information for counties and cities upon special request.
- To evaluate high-accident locations.

## SPECIFIC ACTION TO SATISFY ABOVE OBJECTIVES

The Indiana State Highway Commission Research and Training Center is working closely with the following departments on this skidding program under the direction of M. L. Hayes, assistant highway engineer.

- Materials and Tests Division
- Traffic Division
- Design Division
- Maintenance Division
- Construction Division
- The six districts

### *1975 Skid Inventory*

Robert Reusser was the engineer in charge of the skidding program in 1975. He has just finished the reports on all of the miles tested and sent them out to the districts and the other departments involved. Between June 1 and December 31, 1975, the skid system traveled 18,654 miles and tested 7,314 miles. They did a good job.

It is the intent of the Research and Training Center to get the inventory results out to all departments involved as soon as possible after the skidding is done.

William Balensiefer, Jr., has been responsible for maintaining the skidding machine and keeping it going. He also is responsible for the electronic equipment and its maintenance. In late 1975 he designed and completed an electronic interface that changed the time of getting a skid number from  $\pm 7$  minutes to  $\pm 7$  seconds. He is our electronics specialist.

### COMPARISON OF SKID NUMBERS ON DIFFERENT SURFACES SKIDDED IN 1975:

The highest average number was for HE IV surface—48.2. (See Figure 2.) The lowest average is for Portland cement concrete surfaces which was 37.4. It is to be noted that many of the concrete surfaces were from 19 to 30 years old. None of the Type IV surfaces were over six years old. See data on later special skidding.

### COMPARISON OF HIGHEST AND LOWEST SKID NUMBERS FOR ALL SURFACES SKIDDED IN 1975:

The lowest number was 17.3 and was on Type B surface. The highest number was 74.1, and it was on newly paved, tined concrete pavement. HAE Type IV surface seemed to be the most consistent. Most of these surfaces were rather new.

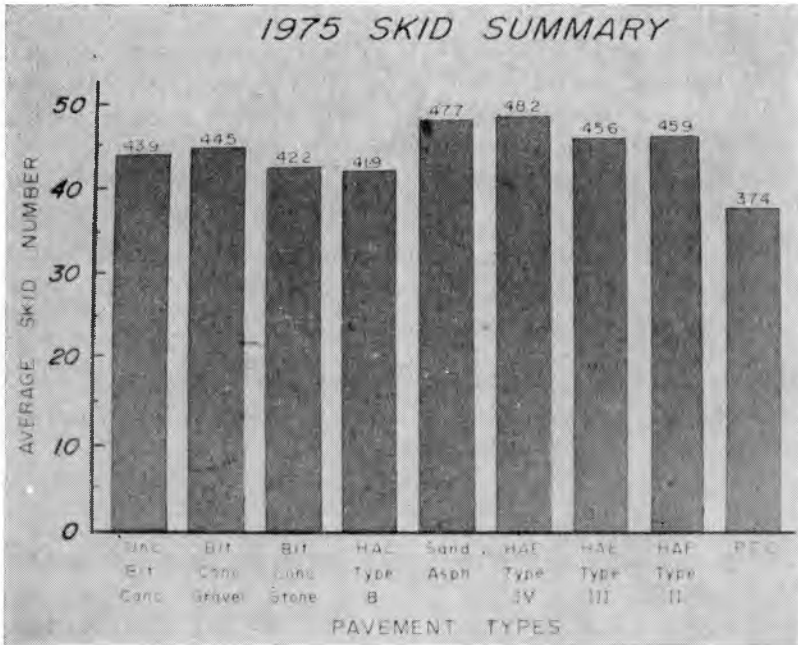


Figure 2. A Comparison of Skid Numbers on Different Surfaces Skid Tested in 1975

COMPARISON OF SKID NUMBER IN PERCENTAGE BELOW NUMBER 35 FOR ALL SURFACES SKIDDED IN 1975:

HAE Type IV had the least percentage—1.5—and concrete had the highest percentage—41.3. Again consider the ages of the surfaces.

*Special Test Evaluation on Pavements 23 and 25 Years Old on S.R. 37*

- From Lawrence-Orange County line to JCT US 50W, concrete pavement with stone coarse aggregate was paved in 1950 to 1952, giving it an age from 23 to 25 years old. The 1972 skid number was 31.6. The 1975 skid number was 30.3—a loss of 1.3 in three years.
- From U.S. 150 in Paoli to Lawrence-Orange county line, the pavement is approximately 25 years old and had a skid number of 40.3 in 1972 and 36.8 in 1975—a loss of 3.5 in three years.

SKIDDING ON 30-YEAR OLD CONCRETE, 13-YEAR OLD TYPE B, AND TWO-WEEK OLD TYPE IV SURFACES ON U.S. 41:

- NBL—concrete—30 years old—tested July 1975—had a skid number of 34.7. Type HAE IV surface was constructed and in October the skid number was 42.0.

- SBL—concrete—30 years old—tested July 1975—had a skid number of 15.3. Type HAE IV surface was constructed, and in October the skid number was 39.9. The low numbers for both surfaces were less than expected, probably due to underseal coming up through joints and being spread by traffic.
- NBL—concrete—30 years old—tested in 1972—showed a skid number of 38.7; in 1975—a number of 34.8.
- SBL—Type B—13 years old—tested in 1972—showed a skid number of 39.1; in 1975—a number of 24.0.
- Same reason as above for low number.

#### SKIDDING ON CONCRETE AND BITUMINOUS SURFACES ON S.R. 62:

- Concrete pavement 19 years old had the following skid number in 1972—43.8; in 1975—47.5.
- Concrete pavement five years old with 1972 skid number of 41.4 and 1975 skid number of 51.4.
- Bituminous pavement five years old with 1975 skid number of 43.7.
- Concrete pavement one year old with a 1975 skid number of 43.7.
- EBL is concrete 13 years old in 1972—skid number 38.3.  
WBL is concrete two years old in 1975—skid number 42.9.

#### *Information for Design of Durable Skid Resistant Pavement Surface*

On September 16, 1975, Mr. Hallock, chief highway engineer, sent the Research and Training Center a letter stating that we were a part of a steering committee of which Robert Eskew was chairman, and the purpose of the committee was to come up with a more skid resistant and durable surface. The center, working with the Divisions of Materials and Tests and Traffic, has begun the search for a more safe and durable surface.

#### S.R. 43 SPECIAL SKIDDING, TINED CONCRETE:

The location is at the intersection of I-65 and S.R. 43 near West Lafayette, contract R-10101. The concrete tined surface had an average skid number of 62.4.

#### I-64 SPECIAL SKIDDING, TINED CONCRETE, CONTRACT R-9875:

The location is 0.7 miles west to 5 miles east of N. Jct. S.R. 66. The average skid number was 70.5. The skidding was done one day before the road was opened to traffic. Figure 3 shows a close-up of the surface skidded. Some of the tining was variable. On February 11, 1976, an average skid number was 69.5.

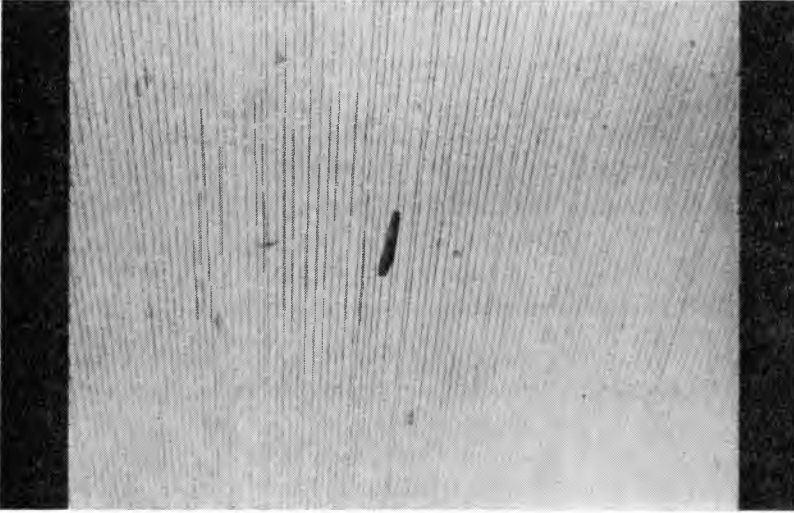


Figure 3. Tined Concrete on I-64, Contract R-9875

I-64 SPECIAL SKIDDING, OPEN-GRADED SURFACE 75#/Sys. USING 100 PERCENT CRUSHED GRAVEL AND AE 60 ASPHALT:

This was a 3½ mile section of I-64, contract R-9967 (See Figure 4.) The skid number was 41.0. The skid number on February 11, 1976, was 47.8. It is to be noted that its skid resistance became higher after three months of traffic. This was expected.

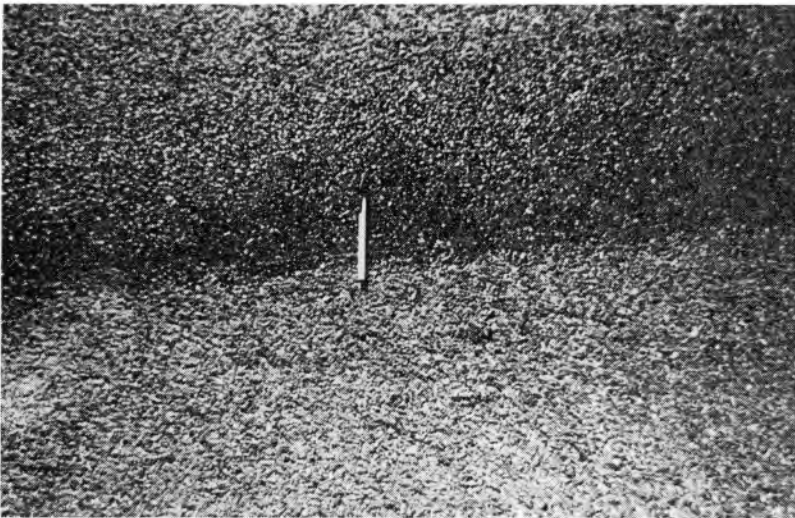


Figure 4. Open Graded Surface, 75 #/sys, I-64, Contract R-9967

#### I-64 SPECIAL SKIDDING, TYPE B SURFACE :

The skidding was done on the ramps of contract R-9967. The average skid number was 49.7. The ramps were not skidded February 11, 1976.

#### I-64 SPECIAL SKIDDING, TYPE IV SURFACE :

This includes 3½ miles of dual-lane pavement on contract R-9967. The average skid number was 49.1 on November 18, 1975. The skid number on February 11, 1976, was 56.0. It is to be noted that the skid number became higher after three months of traffic.

#### I-64 SPECIAL SKIDDING, CONCRETE BROOMED PAVEMENT :

This includes 8.4 miles of dual-lane pavement in Seymour District from Corydon to five miles east of N. S.R. 66, contract R-9617. The skid number on November 18, 1975, was 64.6. The skid number on February 11, 1976, was 65.6. It is to be noted that this 20.2 miles of I-64 was skidded at 30, 40, and 50 mph. The range for the bituminous surfaces was much closer together than the range for the concrete pavements at the different speeds.

### OTHER SPECIAL TESTING

#### *Skidding Bridge Decks Overlaid with Dow Latex*

Figure 5 shows a close-up of the textures of bridge deck overlays with Dow that were laid in 1974 and 1975. The locations are 11 bridges

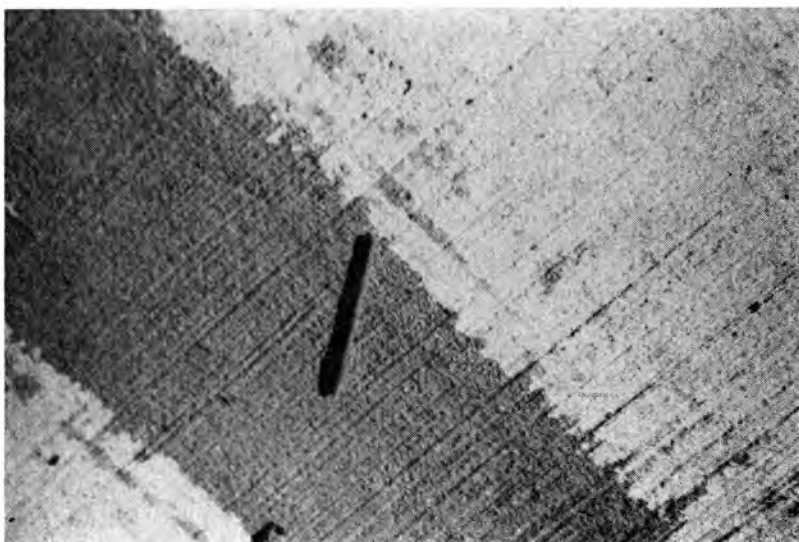


Figure 5. Dow Latex Overlay on Old Bridges in Vincennes District

from 10 miles south of Vincennes to one mile south of Princeton on U.S. 41.

B-9741	Str. 41-26-4573	Skid No. 56.7
B-9718	Str. 64-26-4616-A	Skid No. 38.6
B-9911	Str. 41-26-4078	Skid No. 38.0
B-9911	Str. 41-26-4079	Skid No. 35.1
B-9911	Str. 41-26-2214-A	Skid No. 35.9
B-9912	Str. 41-42-3917-B	Skid No. 39.0

Two bridges on S.R. 57, 2½ to 3 mile North of Oakland City, were overlaid over a new deck with Dow latex in 1974.

B-9717	Str. 57-63-3005	Skid No. 43.2
B-9827	Str. 57-26-3004-A	Skid No. 36.2

*S.R. 45 Skidding, 11-Year-Old Type B and Two-Week-Old Type IV Surfaces*

Location is from U.S. 50 in Loogootee to Jct 58E. Eleven-year-old Type B surface skidded on June 24, 1975, had a skid number of 27.0. Under contract R-10123, a HAE Type IV surface was constructed, and it had a skid number of 47.2.

*S.R. 67 Skidding of Eight-Year-Old Type B Surface and HAE Type IV Surface*

From Jct 157 in Worthington to Freedom. The Type B surface was constructed in 1967 under contract R-7059. On June 12, 1975, it had a skid number of 35.6. Under contract R-10124 a Type IV HAE surface was constructed, and it had a skid number of 48.7 after being opened to traffic four weeks.

*I-65 Skidding of Grooved and Tined Concrete*

Location is in Indianapolis. Skidding was done prior to opening road to traffic, contract R-9876. The average skid number on the grooved section was 56.6; on the tined section—73.0.

**PROPOSED PROGRAM FOR 1976**

There will be no problem keeping two skid machines busy in 1976. One machine will skid the primary roads, the other machine will perform the special skidding. We have asked the Materials and Tests Division to give us 21 different surface textured pavements at three locations, each to be skidded for the special project. (See Table 1.) These locations will be for contracts done in 1976 preferably with some finished in 1974 and 1975. We believe the newer the pavement the

quicker we can come up with reliable data. We will be skidding many of the locations monthly and at speeds of 30, 40, and 50 mph. We will be working closely with all departments on the steering committee and the districts.

TABLE 1—21 Textured Surfaces To Be Tested in 1976

<i>Type Surface</i>	<i>Aggregates to Be Used</i>		
1. HAC Type A	Stone	Gravel	
2. HAC Type B	Stone	Gravel	Slag Modified
3. HAC Type D	Sand		
4. HAE Type II	Stone	Gravel	
5. HAE Type III	Stone	Gravel	Slag
6. HAE Type IV	Sand		Slag Modified
7. Open Graded		Crushed Gravel	Slag
8. Portland Cement Concrete	Stone	Gravel	
	Broomed	Tined	
	Tined	Tined	
	Grooved	Grooved	

The center will be putting out weekly reports on all inventory testing. It is hoped that this will help all concerned. Test results for the special studies will be available as progress warrants.

We will be putting our lab to use to determine asphalt contents and aggregate gradation of cores from special skid sites. We will also be checking wear depth of surfaces at these test sites. We will be depending on the Traffic Division to provide traffic counts at the special locations. We also hope to get wear test information from the Testing Division. We hope to skid about 20,000 miles of pavement in 1976. In 1975 testing efficiency was 39.2 percent. We hope to increase that to 50 to 55 percent.



**CLOSURE**

Our intent at the Research and Training Center is to work with all Indiana state highway departments and Purdue University through research and training and to make all highways in Indiana safer, more pleasant, and more economical for the traveling public.

OVERALL SUMMARY  
SKID RESISTANCE OF INDIANA PAVEMENTS  
1975 Readings

Districts	Bit.	Bit.	Bit.	Sand	HAE	HAE	HAE	HAE	HAC	P.C.C.
	Conc.	Conc.	Conc.	Asph.	Type IV	Type III	Type II	Type B		
C-ville	43.9	42.0	39.7	42.1	46.2	44.8	47.1	38.2	36.7	
Ft. Wayne	45.9	46.5	46.3	43.5	48.6	45.5	48.5	43.0	33.2	
Greenfield	42.8	40.9	42.4	46.0	47.2	43.1	43.7	40.7	35.7	
LaPorte	42.5	41.3	41.1	50.9	48.6	44.7	44.7	41.5	38.2	
Seymour	44.7	47.8	44.0	58.5	53.7	48.5	50.3	44.2	37.5	
Vincennes	45.3	35.9	39.8	47.8	47.1	46.0	—	39.1	41.7	
Average	43.9	44.5	42.2	47.7	48.2	45.6	45.9	41.9	37.4	
% Below 35	10.8	15.0	12.5	6.9	1.5	5.7	0.0	20.7	41.3	
Minimum	23.2	32.9	27.2	28.9	33.5	26.1	37.0	17.3	21.0	
Maximum	61.1	59.5	63.2	60.8	60.8	56.0	53.2	61.2	74.1	

## Range of Numbers

15-20									1-1.2	
20-25	1-0.4									7-2.0
25-30	8-3.3								1-1.2	35-10.1
30-35	17-7.1	3-15.0	2-3.1	1-3.5	1-1.5	2-2.8			15-18.3	101-29.2
35-40	43-17.9	2-10.0	6-9.4	1-3.4	4-5.9	2-2.9			16-19.5	114-32.9
40-45	58-24.2	5-25.0	13-20.3	2-6.9	12-17.6	8-11.4	2-10.0		21-25.6	43-12.4
45-50	67-27.9	3-15.0	24-37.5	10-34.5	28-41.2	15-21.4	5-25.0		18-22.0	19-5.5
50-55	34-14.2	5-25.0	15-23.4	2-6.9	15-22.1	28-40.0	10-50.0		8-9.8	10-2.9
55-60	10-4.2	2-10.0	2-3.1	7-24.1	6-8.8	12-17.2	3-15.0		1-1.2	8-2.3
			1-1.6	5-17.2		3-4.3				



OVERALL SUMMARY COMPARISONS  
SKID RESISTANCE  
1973 and 1975 Readings

Districts		Bituminous Concrete				Bituminous Concrete		Sand Asphalt	HAE			HAC		P.C.C.
		Concrete	Gravel	Concrete	Gravel	Concrete	Stone		Type III	Type II	Type IV	Type B		
Crawfordsville	-1973	43.7	37.8	46.9	45.9	46.8				50.9	41.4	32.7		
	-1975	43.9	42.0	39.7	42.1	44.8			47.1	46.2	38.2	36.7		
Fort Wayne	-1973	+ 0.2	+ 4.2	- 7.2	- 3.8	- 2.0				- 4.7	- 3.2	+ 4.0		
	-1975	48.6	48.6	47.2	50.2	49.7			48.5	48.9	38.5	37.1		
Greenfield	-1973	45.9	46.5	46.3	43.5	45.5				48.6	43.0	33.2		
	-1975	- 2.7	- 2.1	- 0.9	- 6.7	- 4.2				- 0.3	+ 5.5	- 3.9		
LaPorte	-1973	40.3	48.8	35.2	46.0	45.2				44.7	33.2	31.3		
	-1975	42.8	40.9	42.4	46.0	43.1			43.7	47.2	40.7	35.7		
Seymour	-1973	+ 2.5	- 7.9	+ 7.2	0.0	- 2.1				+ 2.5	+ 7.5	+ 4.4		
	-1975	43.1	37.7	40.2	50.1	46.7			44.7	50.7	41.5	37.6		
Vincennes	-1973	42.5	41.3	41.1	50.9	44.7				48.6	41.5	38.2		
	-1975	- 0.6	+ 3.6	+ 0.9	+ 0.8	- 2.0				- 2.1	0.0	+ 0.6		
Average	-1973	44.7	50.3	42.2	50.4	48.1				56.4	49.9	39.5		
	-1975	44.7	47.8	44.0	58.5	48.5			30.3	53.7	44.2	37.5		
Average	-1973		- 2.5	+ 1.8	+ 8.1	+ 0.4				- 2.7	- 5.7	- 2.0		
	-1975	45.3	45.4	39.3	48.0	49.5				48.4	42.7	42.8		
% Below 35	-1973		35.9	39.8	47.8	46.0				47.1	39.1	41.7		
	-1975		- 9.5	+ 0.5	- 0.2	- 3.5				- 1.3	- 3.6	- 1.1		
% Below 35	-1973	43.5	46.3	41.5	48.3	48.0				48.2	41.9	36.6		
	-1975	43.9	44.5	42.2	47.7	45.6			45.9	48.2	41.9	37.4		
Average	1973	19.0	10.9	13.4	5.4	0.0				4.4	23.3	41.1		
	1975	10.8	15.0	12.5	6.9	5.7			0.0	1.5	20.7	41.3		

1975 PRIMARY SKID TESTING  
EFFICIENCY SUMMARY

Dates of Testing—June 1, 1975, to December 31, 1975

Month	Days Avail. for Tests	Act. Days Testing	Number of Tests	Miles Traveled	Miles Tested	
					Number	% Traveled
6	21	7* 4†	343	1,517	402	26.5
7	22	3 13	1,031	3,181	1,299	40.8
8	21	6 12	1,009	2,915	1,038	35.6
9	21	3 10	861	2,402	1,018	42.4
10	22	1 19	2,059	4,783	2,278	47.6
11	16	3 10	808	2,844	921	32.4
12	19	1 4	319	1,012	358	35.4
Totals	142	24 72	6,430	18,654	7,314	39.2
'76 Est. Skid Inven. Testing	175	120	13,600	27,500	15,125	55.0

\* Number of calibration days—top number.

† Number of inventory testing days—lower number.