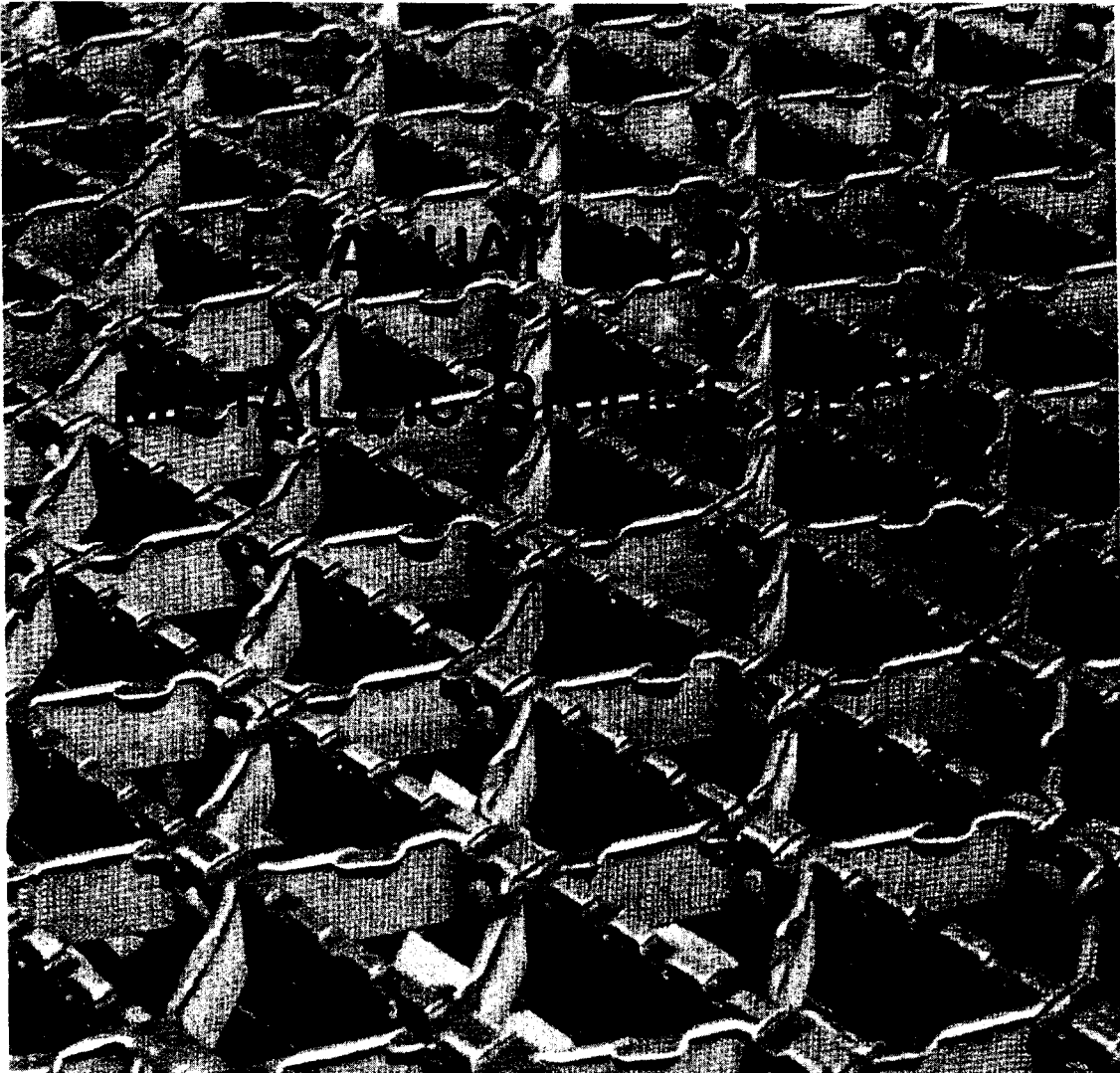


NEW JERSEY DEPARTMENT OF TRANSPORTATION



DIVISION OF RESEARCH AND EVALUATION
BUREAU OF STRUCTURES AND MATERIALS

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ABSTRACT

The objective of this report is to evaluate and compare the many characteristics of various metallic bridge deck configurations throughout the state of New Jersey.

A summary of the basic properties is presented at the end of the report, and recommendations are offered in an attempt to relieve some of the hazards of metallic bridge decks.

EVALUATION OF METALLIC BRIDGE DECKSINDEX

<u>Sections</u>	<u>Pages</u>
A. Introduction	1
B. Accident Analysis for all State Highway Draw Bridges -- <u>Table 1</u>	3
C. Comparison and Evaluation of 18 Bridge Deck Configurations -- <u>Data Sheet Series</u>	12
D. Summary and Recommendations -- <u>Table 2</u>	39

A. INTRODUCTION

The following report stems from a request by Mr. I. Oliver Doll, Assistant State Highway Engineer, to study the effective skid resistance of bridge steel grid decks in wet weather; it represents a summary of data for eighteen (18) bridges containing sections of steel grid decks.

No quantitative data of virtually any source concerning this specific characteristic of skid resistance are available. All known prior works at improving the skid resistance of steel grid decks were on the basis of before and after traffic accident analysis and did not consider the actual measurements made on the grid deck itself. The specific elements utilized in this evaluation include an accident analysis and comparative skid testing of the various steel grid deck types and the paved approaches on either side of the grid deck. Testing was achieved by the use of a 1966 Plymouth passenger vehicle with regular tires in obtaining decelerometer readings and snow tires in evaluating vehicle control.

Accident summaries for these bridges were obtained from a broad analysis of accidents for 42 draw bridges containing grid decks, [REDACTED]. This analysis is enclosed as Section B. The summary represents accident data for a 5 year 8 month period beginning January 1, 1960 and ending August 31, 1965. Since the

steel grid deck represents a very small portion of the total bridge deck, no specific means of isolating accidents on the grid deck was available.

Traffic data as far back as the initial period of bridge construction are virtually impossible to obtain; and no estimate of total traffic volume at the date of writing was attempted. Instead, 1966 AADT'S were used for these structures.

In establishing parameters for the traffic volumes and decelerometer readings for these structures, the following criteria were used:

Traffic Volumes - AADT

	0 - 5,000	low
	5,000 - 15,000	medium
	15,000 - 25,000	high
Above	25,000 -	very high

James Brake Inspection Decelerometer Readings

Excellent	- 16 - 17 ft.	at 20 mph.
Good	- 18 - 19 ft.	at 20 mph.
Fair	- 20 - 24 ft.	at 20 mph.
Poor	- 25 - 50 ft.	at 20 mph.
Unsafe	Above - 50 ft.	at 20 mph.

Drivers comments regarding vehicle control indicate the degree of stability of the test vehicle while travelling in a straight line at the posted speed limit;

they are, of course, subjective and would vary with the individual:

Poor control - considerable side sway or wandering sensation;

Fair control - some side sway or wandering sensation;

Good control - no side sway or wandering sensation.

B. ACCIDENT ANALYSIS OF ALL STATE-MAINTAINED DRAW BRIDGES

In order to gain further insight as to accident types and frequencies on State maintained draw bridges, the following discussion is presented. Accident data are analyzed by types, (rear end, head-on, etc.) and also classified as skidding on wet or dry pavement. Fourteen of the eighteen bridges studied in detail in part C of this report are indicated by an asterisk. The other four bridges studied were county bridges and were not included in this list.

1. Analysis one (1) shows bridges that had no reported accidents for the period studied.

2. The second analysis deals with total accidents and analyzes the bridges with 20 or more accidents for the period studied. It was felt that an analysis of total accidents would be a better indicator of the accident experiences on the bridges than an accident rate.

3. The third analysis deals with head-on accidents. Bridges with 5 or more head-on accidents were studied, since head-on accidents are normally the most severe due

to the high relative speeds involved.

No detailed analysis is made of the "skidding" accidents since it cannot be determined in all cases from the accident report whether the skidding occurred on the metallic grid portion of the bridge or on the paved roadway portion. Where it can be determined, it will be noted in the analysis of total accidents.

Analysis

1. The following 16 bridges had no reported accidents during the study period:

1. Nacote Creek Draw Bridge
2. Shrewsbury River Draw Bridge
3. Mantua Creek Draw Bridge
4. Hackensack River Draw Bridge
5. Big Timber Creek
6. Salem River Draw Bridge
7. Alloways Creek Draw Bridge
8. Maurice River Draw Bridge
9. Brigantine Inlet Draw Bridge
10. Oldmans Creek Draw Bridge
11. Raccoon Creek Draw Bridge
12. Rancocas Creek
13. Grassy Sound Draw Bridge
14. Manantico Creek Draw Bridge
15. Farmer's Access Road

2. The following 5 bridges had 20 or more reported accidents during the study period:

1. Passaic River Draw Bridge
2. Wittpen Bridge, Hackensack River
3. Victory Bridge, Raritan River
4. Finger Channel Beach Therofare
5. Stickle Bridge, Passaic River

TOTAL ACCIDENT ANALYSIS BY BRIDGE

A. Passaic River Draw Bridge - Rt. 3

No. Lanes	6
Lane width	12'
Length	702'
Total Accidents	24
Fatalities	0
Injuries	20
Injury Accidents	12

The skidding accidents compose 42% of all accidents. Seven of these skidding accidents (out of ten) specifically mention that the skidding took place on the grid portions of the bridge.

B. Wittpen Bridge - Hackensack River - Rt. 7

No. Lanes	4
Lane width	10'
Length	2169'
Total Accidents	50
Fatalities	0
Injuries	55
Injury Accidents	26

The 15 skidding accidents represent 30% of the total accidents and 5 specifically mention that the skidding was on the grid section. A large number (30, i.e. 60%) of these total accidents were rear-end accidents which occurred when the bridge was open.

C. Victory Bridge - Rt. 35

No. Lanes	4
Lane width	10'
Length	2960'
Total Accidents	121
Fatalities	5
Fatal Accidents	4
Injuries	109
Injury Accidents	64

The 30 skidding accidents represent 25% of the total accidents. Six reports specifically mention that the skidding was on the grid section. A large portion (71) of the total accidents were rear-end and 16 specifically mentioned that the bridge was open at the time of the accident. It is suspected that a good many more of these accidents occurred when the bridge was open, although they were not specifically mentioned as such.

D. Finger Channel Beach Thorofare - Rt. 52

No. Lanes	4
Lane width	10'
Length	1025'
Total Accidents	90
Fatalities	0

Injuries	90
Injury Accidents	47

The 20 skidding accidents represent 22% of the total accidents. No mention is made of the location of the skidding. Forty-four of the total accidents were rear-end accidents, eight of the reports specifically mentioned that the bridge was open at the time. However, again, it is suspected that many more resulted from vehicles stopping suddenly while the bridge was opening.

E. Stickle Bridge - Rt. 280

No. Lanes	6
Lane width	12'
Length	--
Total Accidents	54
Fatalities	0
Injuries	27
Injury Accidents	20

The 16 skidding accidents represent 30% of the total accidents. No mention is made as to location of skidding. Here again there was a considerable number of rear-end accidents (31) and it is suspected that a large percentage occurred when the bridge was open.

3. The following 3 bridges had 5 or more reported head-on accidents during the study period:

1. Wittpen Bridge, Hackensack River, Rt. 7
2. Victory Bridge, Rt. 35
3. Finger Channel Beach Thorofare, Rt. 52

A total accident summary is presented in Table (1).

SKIDDING

ROUTE	NAME OF BRIDGE	TYPE ACCIDENT					MET					DRY				
		REAR END	SIDE SWIPE	HEAD ON	FIXED OBJECT	TOTAL	REAR END	SIDE SWIPE	HEAD ON	FIXED OBJECT	TOTAL	REAR END	SIDE SWIPE	HEAD ON	FIXED OBJECT	TOTAL
49	Haurtice River Draw Bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
450	Tuckahoe River Draw Bridge	5	0	0	1	6	1	0	0	0	0	0	0	1	2	2
452	Ship Channel	5	0	0	6	11	0	0	0	0	0	0	0	1	1	1
462	Finger Channel Beach Thorofare	44	6	9	31	90	3	0	2	6	6	0	1	2	20	20
470	Manasquan River Draw Bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
471	Shark River Draw Bridge	9	1	0	0	10	0	0	0	0	0	0	0	0	0	0
87	Bridgwater Inlet Draw Bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
488	Inland Waterway Canal Draw	10	0	0	3	13	0	0	0	0	0	0	0	0	0	0
130	Oldmans Creek Draw Bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	Raccoon Creek Draw Bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	Rancocas Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	Big Timber Creek	0	1	0	2	3	0	0	0	0	0	0	0	0	0	0
162	Cape May Canal Draw Bridge	4	1	3	5	9	0	0	0	1	1	0	0	0	1	1

COMPARISON AND EVALUATION OF THE VARIOUS BRIDGE
DECK CONFIGURATIONS

Grid deck configurations were studied with respect to automobile control using a 1966 Plymouth sedan with snow tires, and stopping distances under wet conditions with regular tires. The eighteen grid decks studied fell into one of the seven different configurations shown in the data sheet series (pages 21 through 38).

CONFIGURATION 1

Configuration number 1 consists of members serrated in the longitudinal direction, crossed with unserrated members.

Decelerometer readings taken on 5 decks of this type ranged from 28 to 40. (Average 34). All of these readings were considered as poor. The reading of 40 was the highest recorded for any configuration.

The grid surface on all longitudinally serrated decks were worn and polished. The drivers comments on vehicle stability, handling and control ranged from fair to poor. Decelerometer readings on the paved approaches to these bridges ranged from 18-29, with an average of 22, which is considered fair.

It may be noted that the average decelerometer of 22 on the paved approaches is less than the average reading of 34 on the metallic grid deck. A breakdown of the characteristics of each of the 5 bridge decks

falling into this group follows:

1. Route 47 Manantico Creek. The driver experienced poor directional stability at the posted speed limit of 50 mph. The deck surface was found to be worn and polished but otherwise clean. Traffic data showed no accidents for the period studied. The 1966 AADT of 5,200 was considered medium.

The average James Brake Decelerometer value of 28.5 is rated as poor.

2. Route 40, Atlantic City Inside Thorofare. At 25 mph., the driver experienced fair vehicle control. The grid surface was noted to be worn and polished. A total of six (6) accidents were recorded for the period studied. An AADT of 19,960 was considered to be high. The average skid test value of 28 was considered poor.

3. Route 88, Point Pleasant, Inland Waterway. Here, the driver experienced poor control at 35 mph. The deck surface was worn and polished. A total of thirteen (13) accidents was recorded for the period studied. The traffic volume was high with an AADT of 19,430. A decelerometer reading of 40 was recorded, and was the poorest of all the grid decks studied.

4. Route 71, Shark River Belmar. On this bridge, fair vehicle control was observed at 35 mph. The surface condition of the deck was worn and polished. The average decelerometer reading of 29.5 was considered to be poor. A total of 10 accidents occurred on the structure for the

period studied, with a medium AADT of 13,700.

5. Route 52, Finger Channel Ocean City. The driver noted fair vehicle control at 35 mph. The grid surface was very worn and polished and an average decelerometer reading of 32.5 was considered poor. The AADT for this bridge is 13,450 (medium). A total of 90 accidents was recorded and was the highest amount recorded for any of the structures studied.

CONFIGURATION 2 (Biaxially serrated with serrated cross members)

1. Route 52, Ships Channel Sommers Point. Configuration number 2 is biaxially serrated box-type grid. The sole example of this grid being the Route 52 Ships Channel Bridge. The deck surface was worn and polished and the driver noted good control at the posted speed of 50 mph. A decelerometer reading average of 32.5 was considered poor. A total of 12 accidents was recorded, with a medium traffic volume of 13,450.

CONFIGURATION 3 (Longitudinal and Curved Serrations)

Configuration number 3 consists of longitudinal serrations, crossed with curved serrated members. Decks of this configuration had the highest average decelerometer readings (Average 35). Pictures of these decks show that the grid is worn and polished and the serrated edges are

well rounded. The decelerometer readings on the approaches ranged from 20-25, which is fair. All of the decelerometer readings taken on the approaches were generally less than those obtained on the deck. The two bridges in this category are:

1. Route 35 Manasquan River. The driver noted fair control and some side sway at 40 mph. The grid deck surface was very worn and polished and an average James Brake decelerometer value of 36 was considered to be poor. The structure had a total of 22 accidents for the period studied; AADT of 18,600, is high.

2. Route 30, Atlantic City Beach Thorofare. The driver commented that control was fair. The grid deck surface was worn and polished. The traffic and accident data showed the AADT to be 19,500 (high), and (6) accidents were recorded. The average decelerometer value of 34 is poor, the approaches averaged 22 (Fair).

CONFIGURATION 4 (Concrete filled grid)

1. Route 70, Riviera Beach. Configuration number 4 is a concrete filled grid with reinforced steel members protruding through. The average decelerometer reading of 30 is considered poor. Vehicle control was similar to control on other concrete roadways. The deck was in fair condition i.e. not worn. The decelerometer readings on the concrete approaches to the bridge ranged

from 20-24 which is considered fair but not unusual for concrete pavements. It may be noted that although the deck was concrete filled it possessed poorer anti-skid properties than the paved approaches. This may be due to the fact that steel grid is exposed through the concrete thereby allowing contact between the steel grid and the vehicle tires. No accidents were reported, AADT was estimated at 15,400 (high).

CONFIGURATION 5 (Curved Serrations)

1. Ocean Avenue, Belmar. Configuration number 5 consists of longitudinal bars with curved serrated cross members. The one bridge in this group is the Ocean Avenue Bridge, Belmar.

Decelerometer reading of 28 for this grid deck is considered poor. The grid edges were sharp and clean. This configuration allowed good vehicle control at the posted speed limit of 25 mph. No accident data was available for this bridge. The AADT was estimated at 5,960 (medium).

CONFIGURATION 6 (Studded grid deck)

Configuration number 6 consists of studded grid deck, and are of two types.

Configuration 6A consists of transverse unserrated members crossed by unserrated curved members. The studs are usually at the junction points.

The second type (Configuration 6B) is a longitudinally serrated member crossed by unserrated curved members with studs at the junction points.

On all four of the studded bridges fair to good vehicle control was observed. However, in some instances side skid was noticed on braking. The decelerometer readings ranged from 20 to 33; the average of 27 is considered poor, but was the lowest of all configurations. In general, the bridge decks were found to be worn, in some instances polished and in all cases studs were damaged or missing. Curiously enough, the best decelerometer readings were recorded for the bridge (Route 1 & 9A ^{PASSAIC RIVER} Configuration 6B) with the highest traffic volume and greatest grid wear.

[REDACTED]

The four bridges in this group are:

1. Corsons Inlet Ocean Drive (Configuration 6A).

The drivers noted good vehicle control and stability. The grid deck was worn and the wheel paths polished. A few studs were missing from the deck, but the remaining

seemed to be in fair condition. The 1966 AADT was 1,150 vehicles, which is a low volume. The studs were installed in 1960. The grid deck is located just south of a toll booth, therefore, the northbound traffic must brake on the grid, causing greater wear and polishing. The average decelerometer reading was 33. (poor). Southbound, the grid appears upon leaving the toll booth. The average decelerometer reading was found to be 24, which is fair.

2. County Route 531, Passaic River Gillette (Configuration 8A). Good vehicle control was noted at 35 mph. However, during the decelerometer tests, the vehicle was found to side skid. The average decelerometer reading (grid) was 31, which is poor; the approaches averaged 21 (Fair). The studs and the deck were worn and a few studs were missing. The approximate 1966 AADT was 1,500 vehicles. No accident data were available.

3. County Route 50 (Jaqui Pond), Morristown (Configuration 6A). Good vehicle control was noted at 35 mph. However, during the decelerometer tests some side skid was noticed. The bridge deck was very worn and several studs were missing. This deck unlike the others was not polished. The approximate 1966 AADT was 3,200, which is low, and no accident data was available. An average decelerometer reading (grid) of 32 was rated as poor, whereas the approaches averaged 21 (Fair).

4. Route 7 & 9 (truck) Passaic River (Configuration 6B). The portion of the deck studied was studded and longitudinally serrated. The deck surface was extremely worn.

polished and dirty. The AADT of 46,000 was considered as very high traffic volume. An average decelerometer reading of 20 was considered good, and was the lowest ^{OR BEST} reading of all studded decks.

CONFIGURATION 7 (Biaxially serrated)

Configuration number 7 is a box-type grid, biaxially serrated. The average decelerometer reading for this group was 30, which is rated poor. On all the bridges the drivers noted poor directional stability and control. All decks of this type were worn and grid edges were rounded and polished.

Decelerometer readings taken on the approaches ranged from 24-35 (fair to poor). Readings on the grid deck ranged from 25-37 all of which are poor. The bridges falling into this configuration are:

1. Route 35, Shark River Belmar. The driver noted poor directional stability and control. The deck surface was polished and slightly worn. The 1966 AADT of 22,670 was high. Ten (10) accidents were reported for the period studied. The average decelerometer reading (grid) of 34 was considered poor, whereas, the approaches averaged 29.

2. Route 9, Nacote Creek, Port Republic. Poor vehicle control and a very worn and polished deck were observed. The AADT for this deck was 2,570 which is low. No accidents were reported for the period studied. The average

decelerometer reading of 25 was considered poor.

3. Route 9, Bass River New Gretna. The driver noted poor vehicle control. The grid was worn and polished and the average decelerometer reading (grid and approaches) was 31 (poor). The 1966 AADT of 4,100 was low.

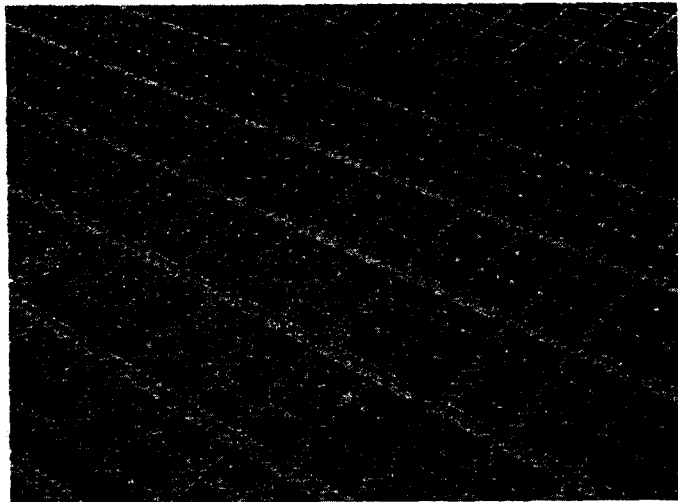
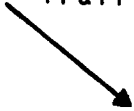
4. Route 50, Tuckahoe River. The driver noted poor vehicle control and the grid was found to be worn and polished. The 1966 AADT of 4,600 was low. Six (6) accidents were reported for the period studied. The average decelerometer reading of 31 was considered poor.

DATA SHEET SERIES

CONFIGURATION 1

ROUTE 47 MANANTICO CREEK

Direction of
Traffic



Description: Bridge 146' long, grid deck 97' long, 2-15' wide lanes; 2"x3" rectangular grid, longitudinal serration $\frac{1}{4}$ " deep.

Geometrics: Flat grade, no sight problem.

Approach: Bituminous with dolomite aggregate.

Built: 1925

AADT: 5,200

Speed limit: 50 mph.

Grid conditions: worn and polished.

Drivers comments: Poor stability and control at 50 mph.

James Brake Decelerometer Readings (wet)

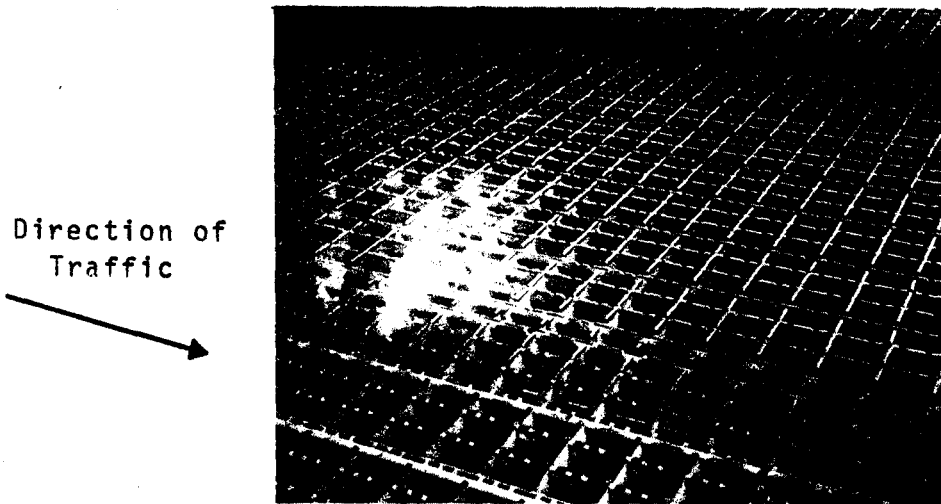
Grid - Range 26 - 33 (Average 28.5)

Approach - 29 - 29

Accident: none reported

CONFIGURATION 1

ROUTE 40 - ATLANTIC CITY, INSIDE THOROFARE



Description: Bridge 421' long, grid deck 72' long, 4-15.5' lanes; 2"x3" rectangular grid, longitudinal serration 1/16" deep.

Geometrics: Slight grade, no sight problem.

Approach: Bituminous surface treatment.

Built: 1928

AADT: 19,960

Speed limit: 25 mph.

Grid conditions: worn and polished.

Drivers comments: Fair control at 25 mph.

James Brake Decelerometer Readings (wet)

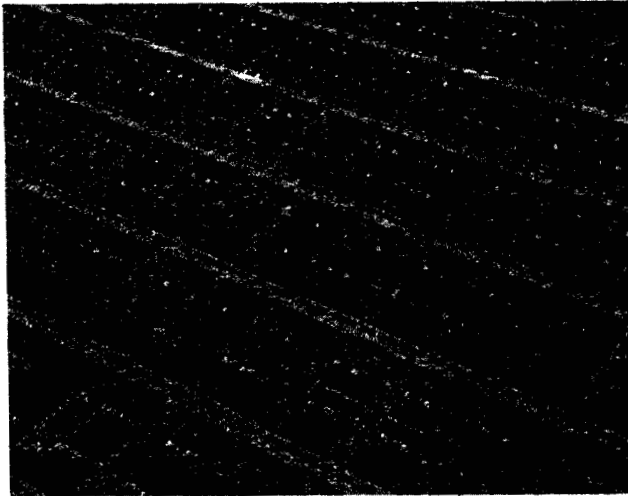
Grid - 28 (only one taken)

Approach - none taken

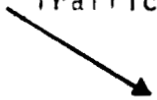
Accidents: Six, (no skidding).

CONFIGURATION 1

ROUTE 88 - POINT PLEASANT INLAND WATERWAY



Direction of
Traffic



Description: Bridge 148' long, grid deck 56.2' long, 2-15' lanes; 2"x3" rectangular grid, longitudinal serrations 1/8" deep.

Geometrics: Straight alignment, flat grade.

Approach: Resurfacing

Built: 1924

AADT: 19,430

Speed limit: 35 mph.

Grid conditions: worn and polished.

Drivers comments: Poor control at 35 mph.

James Brake Decelerometer Readings (wet)

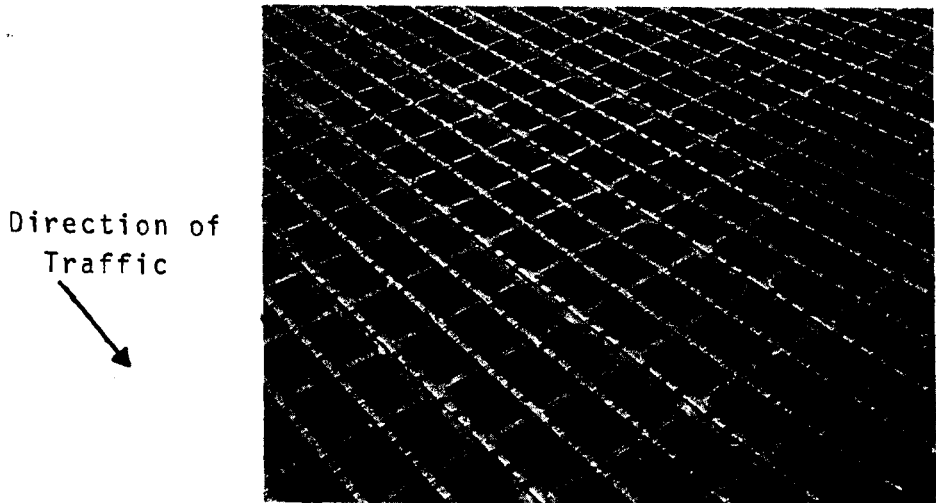
Grid - 40 (only one taken)

Approach - none taken

Accidents: Thirteen, (no skidding).

CONFIGURATION 1

ROUTE 71 - SHARK RIVER, BELMAR



Description: Bridge 858' long, grid deck 75.8' long, 4-12.5' lanes; 2"x3" rectangular grid, longitudinal serration 1/8" deep.

Geometrics: Straight alignment, slight grade.

Approach: Asphalt blocks

Built: 1932

AADT: 13,700

Speed limit: 35 mph.

Grid conditions: worn and polished.

Drivers comments: Fair control at 35 mph.

James Brake Decelerometer Readings (wet)

Grid - 29 - 30 (Average 29.5)

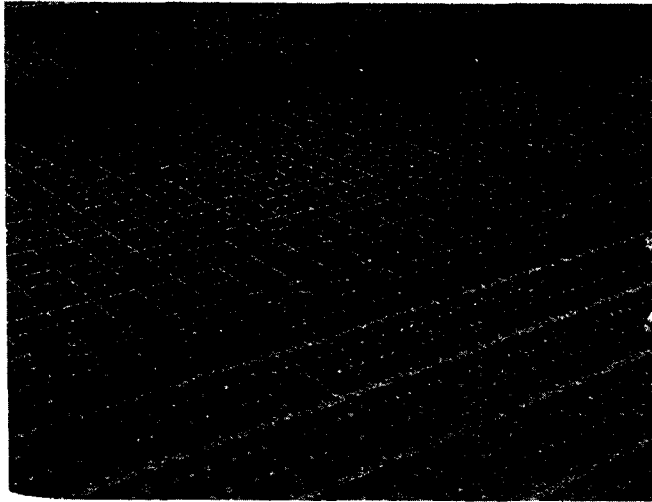
Approach 22 - 25 (Average 23.5)

Accidents: Ten, no skidding.

CONFIGURATION 1

ROUTE 52 - FINGER CHANNEL, OCEAN CITY

Direction of
Traffic



Description: Bridge 1,025' long, grid deck 91' long 4-10' lanes, grid 2"x3" longitudinally serrated 1/16" deep.

Geometrics: Poor sight distances at both approaches, steep grade and sharp curves on either side.

Approach: Concrete with exposed gravel aggregate.

Built: 1932

AADT: 13,450

Speed limit: 35 mph.

Grid conditions: worn and polished.

Drivers comments: Fair control at 35 mph.

James Brake Decelerometer Readings (wet)

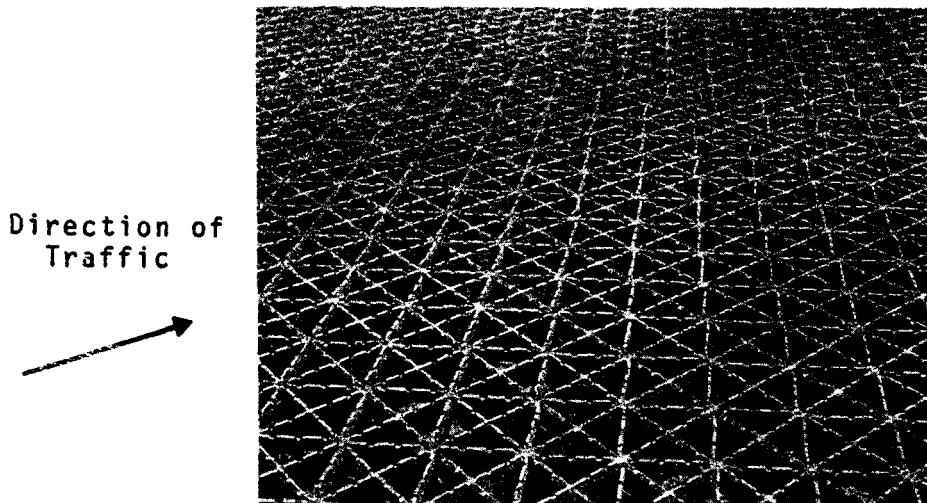
Grid - 31 - 34 (Average 32.5)

Approach - 18- 23 (Average 20.5)

Accidents: 90, (20 skidding accidents).

CONFIGURATION 2

ROUTE 52 - SHIPS CHANNEL, SOMERS POINT



Description: Bridge 1,444' long, grid 61' long, (4) 12.5' lanes; all edges serrated 3/16" deep.

Geometrics: Good sight distance both sides.

Approach: Concrete

Built: 1932

AADT: 13,450

Speed limit: 50 mph.

Grid conditions: worn and polished.

Drivers comments: Good control at 50 mph.

James Brake Decelerometer Readings (wet)

Grid - 32 - 33 (Average 32.5)

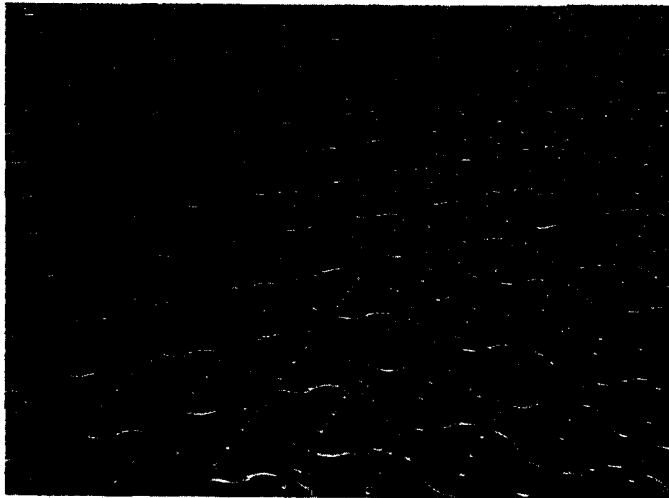
Approach - 19 - 20 (Average 19.5)

Accidents: Eleven + one skidding.

CONFIGURATION 3

ROUTE 35 - MANASQUAN RIVER BRIDGE

Direction of
Traffic



Description: Bridge 556' long, grid deck 112.8' long,
(4) 12.5' lanes + shoulder, total 68.2' wide; grid 2 3/4"
x 2 3/4" curved-serration 1/8" deep.

Geometrics: Straight alignment flat grade good sight
distance.

Approach: Medium size aggregate - exposed.

Built: 1950

AADT: 18,600

Speed limit: 40 mph.

Grid conditions: worn and polished.

Drivers comments: Fair control at 40 mph.

James Brake Decelerometer Readings (wet)

Grid - 36 - 36 (Average 36)

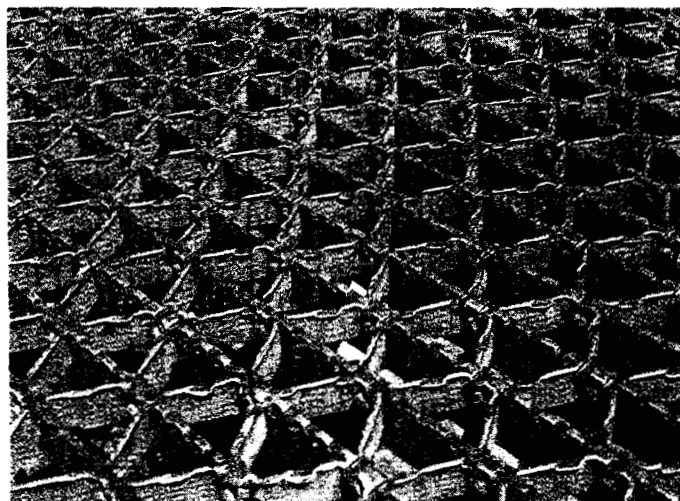
Approach - 22 - 25 (Average 24)

Accidents: Seventeen, (5 were skidding accidents).

CONFIGURATION 3

ROUTE 30 - BEACH THOROFARE, ATLANTIC CITY

Direction of
Traffic



Description: Bridge 492' long, grid deck 69' long, (6) 12.5' lanes: grid 2 3/4"x2 1/2" serrated cross grid, serrated longitudinally 1/8" deep.

Geometrics: Sloping center, barrier curb.

Approach: Concrete with exposed gravel aggregate.

Built: 1946

AADT: 19,500

Speed limit: 50 mph.

Grid conditions: worn and polished.

Drivers comments: Fair control.

James Brake Decelerometer Readings (wet)

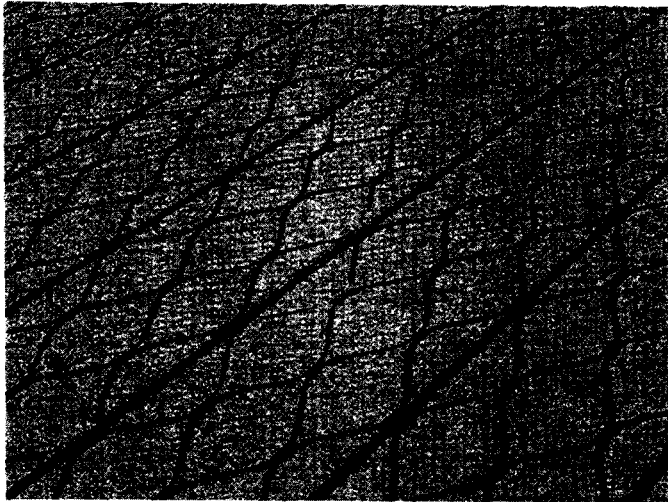
Grid - 33 - 35 (Average 34)

Approach - 20 - 24 (Average 22)

Accidents: Six, no skidding accidents.

CONFIGURATION 4

ROUTE 70 - RIVIERA BEACH



Description: Bridge 625' long, grid deck 64' long 2-24' lanes; grid concrete filled.

Geometrics: Straight alignment flat grade, good sight distance.

Approach: Gravel aggregate - exposed.

Built: 1936

AAIT: 15,400

Speed limit: 50 mph.

Grid conditions: Fair condition.

Drivers comments: Good control, same as paved roadway.

James Brake Decelerometer Reading (wet)

Grid - 30 - 30 (Average 30)

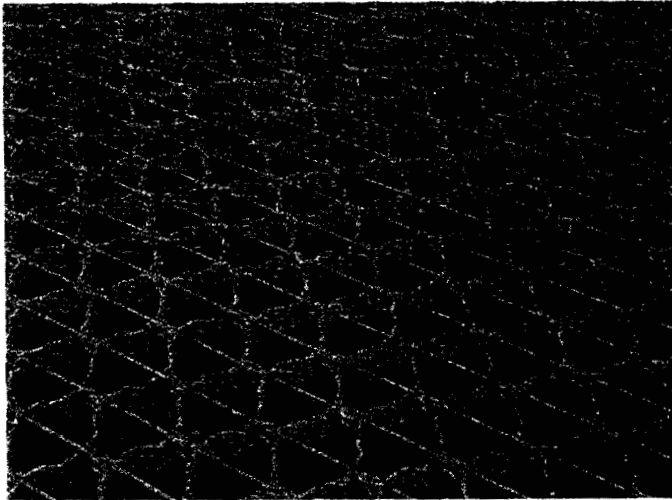
Approach - 20 - 24 (Average 22.25)

Accidents: no accidents reported.

CONFIGURATION 5

OCEAN AVENUE - SHARK RIVER INLET, BELMAR

Direction of
Traffic



Description: Bridge 123' long, grid deck 93' long, 4-10' lanes; grid 2 3/4"x2 3/4" curved grid, curved serrations.

Geometrics: Upgrade on north, downgrade south.

Approach: Bituminous surfacing

Built: 1936

AADT: 5,960

Speed limit: 25 mph.

Grid conditions: Good condition, not polished.

Drivers comments: Good control.

James Brake Decelerometer Readings (wet)

Grid - 28 (1 reading taken)

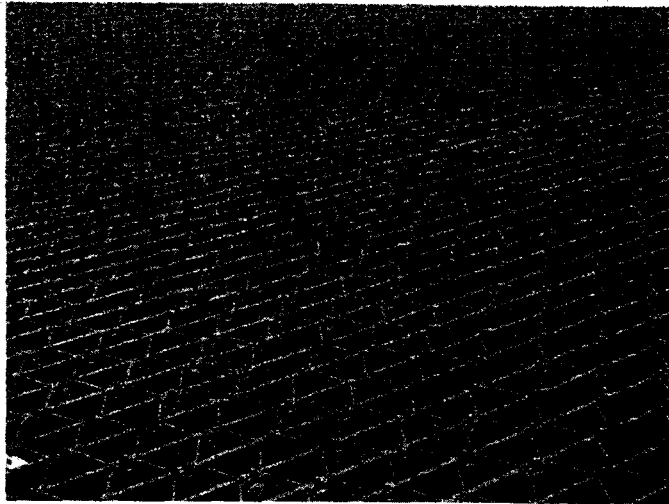
Approach - no data

Accidents: no data.

CONFIGURATION 6A

OCEAN DRIVE - CORSON'S INLET

Direction of
Traffic



Description: Bridge 0.3 miles long, grid 56' long 2-12' lanes; grid - studded no serrations.

Geometrics: South end road curves to west, 3% grade on bridge approach.

Approach: Concrete with good mortar cover.

Built: 1948 (studs 1960)

AADT: 1,150

Speed limit: 25 mph.

Grid conditions: worn and wheel path polished, studs missing.

Drivers comments: Good control and stability.

James Brake Decelerometer Readings (wet)

Grid - Southbound 23 - 25 (Average 24) Northbound 32 - 34 (Average 33)

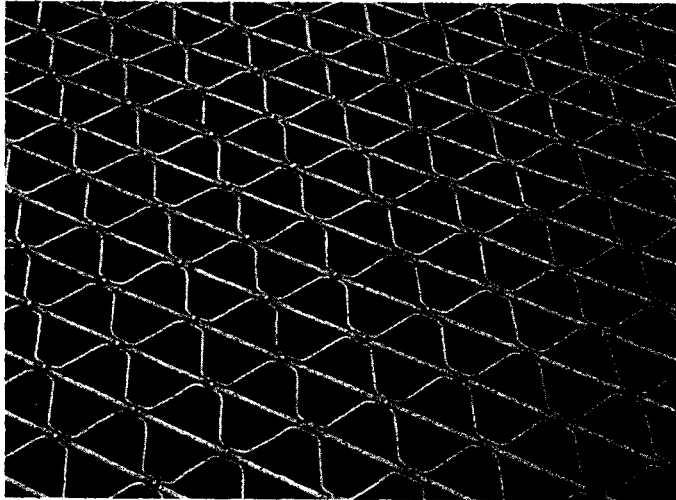
Approach - 19 - 21 (Average 19.75)

Accidents: no data.

CONFIGURATION 6A

ROUTE 531 - PASSAIC RIVER, GILLETTE

Direction of
Traffic



Description: Bridge 87' long, grid deck 87' long, 2-10' lanes; grid - studded, (non serrated) transverse members.

Geometrics: Good sight and alignment north, curve and down grade on south approach.

Approach: Resurfacing

Built: no date

AAIT: approximate 1,500

Speed limit: 35 mph.

Grid conditions: Studs and deck worn, studs missing.

Drivers comments: Good control; during decelerometer tests car skidded to the right.

James Brake Decelerometer Readings (wet)

Grid - 29 - 32 (Average 30.7)

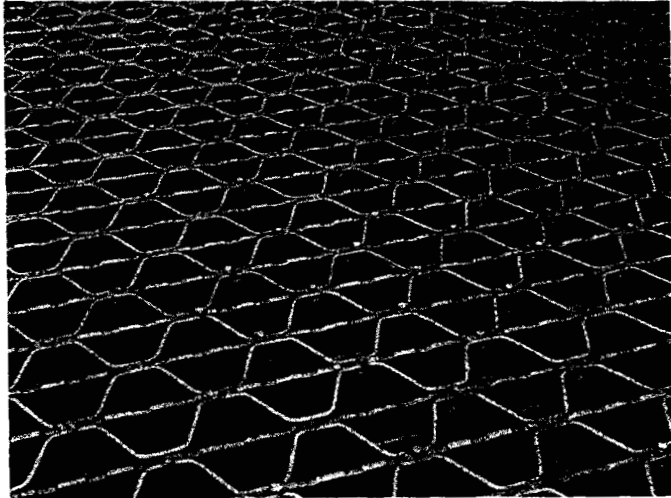
Approach - 21 - 21 (Average 21)

Accidents: no data.

CONFIGURATION 6A

COUNTY ROAD - JAQUI CREEK, MORRISTOWN

Direction of
Traffic



Description: Bridge 53' long, grid deck 53' long 2-10' lanes; grid serrated transversely studs at joints.

Geometrics: Poor sight distance both approaches poor alignment both approaches.

Approach: Resurfacing

Built: no date

AADT: Approximate 3,200

Speed limit: 35 mph.

Grid conditions: Very poor condition of studs and deck.

Drivers comments: Good control.

James Brake Decelerometer Readings (wet)

Grid - 32 - 32 (Average 32)

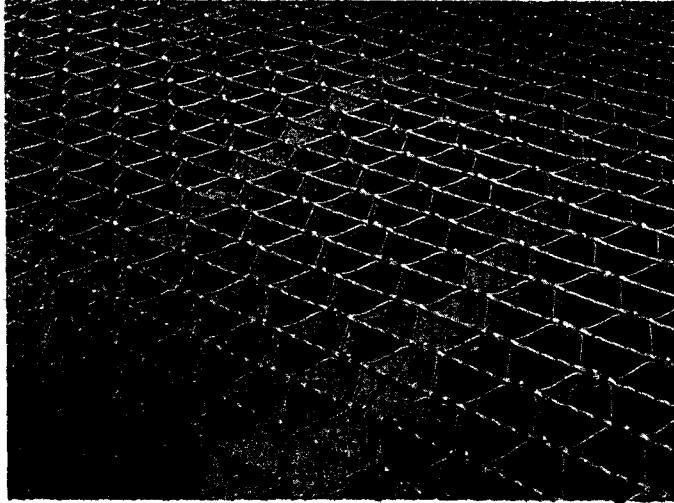
Approach - 21 - 21 (Average 21)

Accidents: no data.

CONFIGURATION 6B

ROUTE 1 & 9 (truck) PASSAIC RIVER

Direction of
Traffic



Description: Bridge - serration on longitudinal members, studs at junction points of cross grids, 1 lane studded.

Geometrics: Good sight distance, no center barrier.

Approach: Concrete, large aggregate - exposed.

Built: no date

AADT: 46,000

Speed limit: 45 mph.

Grid conditions: Very poor condition of stud and decks, deck very worn and polished.

Drivers comments: Fair control.

James Brake Decelerometer Readings (wet)

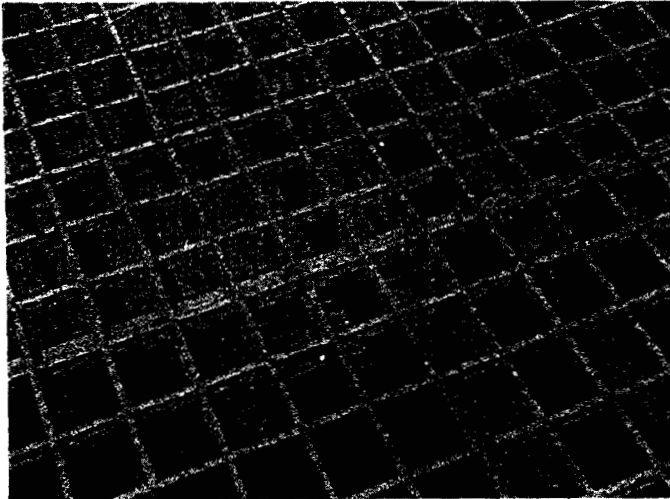
Grid - (studded) 20 - 20 (Average 20) - rated as fair
(unstudded) 28 - 31 (Average 29.5) - rated as poor
Approach - 26 (Average 26) - rated as poor

Accidents: Seven, (4) skidding accidents.

CONFIGURATION 7

ROUTE 35 - SHARK RIVER, BELMAR

Direction of
Traffic



Description: Bridge 478' long, grid deck 82' long, 4-10' lanes; grid 3"x2 1/4" serrated box-type grid.

Geometrics: Straight alignment, flat grade.

Approach: Bituminous concrete surface.

Built: 1927 (1960)

AADT: 22,670

Speed limit: 35 mph.

Grid conditions: worn and polished.

Drivers comments: Poor directional stability.

James Brake Decelerometer Readings (wet)

Grid - 31 - 37 (Average 34)

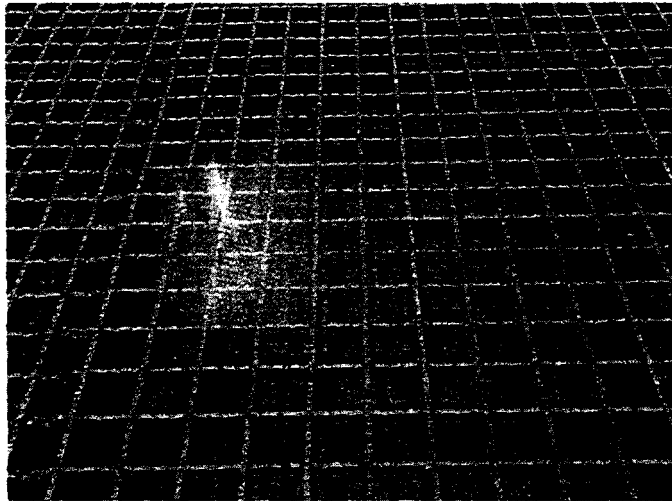
Approach - 24 - 32 (Average 29)

Accidents: Ten, 3 skidding accidents.

CONFIGURATION 7

ROUTE 9 - NACOTE CREEK, PORT REPUBLIC

Direction of
Traffic



Description: Bridge 250' long, grid deck 37' long, 2-15' lanes; grid 2 1/2"x2" serrated grid serration 1/16" deep.

Geometrics: Flat grade, sight limitations on North approach.

Approach: Wooden plank and deck approaches, patched.

Built: 1922

AADT: 2,570

Speed limit: 50 mph.

Grid conditions: very worn and polished.

Drivers comments: Poor control.

James Brake Decelerometer Readings (wet)

Grid - 25 (Average 25)

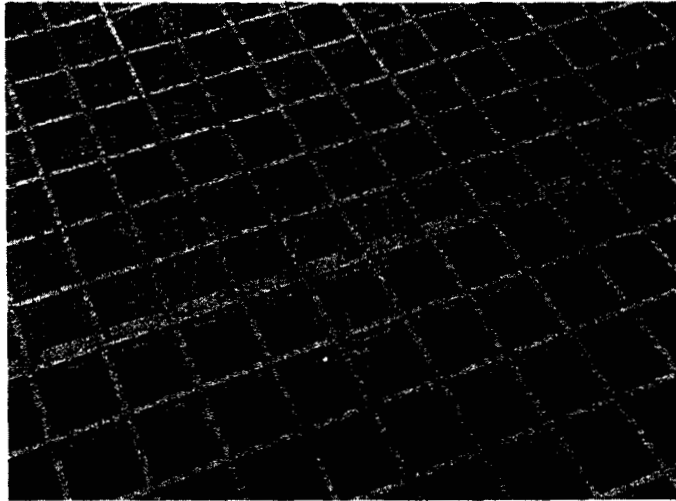
Approach - no data

Accidents: none reported.

CONFIGURATION 7

ROUTE 9 - BASS RIVER, NEW GRENA

Direction of
Traffic



Description: Bridge 342' long, grid deck 38' long, 2-15' lanes; grid 2 1/2"x2" box-type serrated grid, serrations 1/16" deep.

Geometrics: Flat grade south approach, slight grade and sight limitation on north approach.

Approach: Wooden blocks with asphalt overlay.

Built: 1924

AADT: 4,100

Speed limit: 40 mph.

Grid conditions: worn and polished.

Drivers comments: Poor control.

James Brake Decelerometer Readings (wet)

Grid - 30 - 33 (Average 31.5)

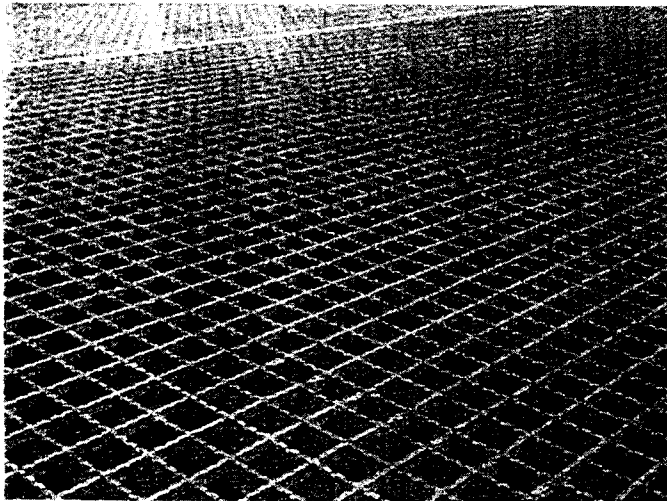
Approach - 28 - 35 (Average 30.75)

Accidents: One, no(skidding accidents).

CONFIGURATION 7

ROUTE 50 - TUCKAHOE RIVER, TUCKAHOE

Direction of
Traffic



Description: Bridge 175' long, grid deck 38' long, 2-15' lanes; grid 2 1/2"x2 1/2" serrated box-type grid, serrations 1/16" deep.

Geometrics: No sight problem, slight grade.

Approach: Bituminous overlay over blocks.

Built: 1926

AADT: 4,600

Speed limit: 50 mph.

Grid conditions: worn and polished.

Drivers comments: Poor control.

James Brake Decelerometer Readings (wet)

Grid - 30 - 32 (Average 31)

Approach - no data.

Accidents: Six, (2 skidding accidents).

D. SUMMARY AND RECOMMENDATIONS

The findings of this study may be summarized as follows:

1. Metallic grid decks in general were found to possess poorer anti-skid properties than paved roadway surfaces.

James Brake Decelerometer readings indicated that the paved approaches to the bridges had better skid resistance than the metallic grid decks. Sixteen of the metallic grid decks were rated poor and two fair; whereas, only two of the paved approaches to the bridges were rated poor, and all others were rated from fair to good.

2. Serrated grid decks seemed to possess poorer anti-skid properties than the studded decks. The serrations when worn and polished became extremely slippery when wet; whereas, the studded decks even when worn and polished seemed to retain some skid resistance as evidenced by skid tests on the Route 1 & 9 Passaic River Draw Bridge. Further examination of this bridge deck showed better skid resistance on the studded portion of the deck than the serrated section.

3. Concrete filled grid decks as evidenced by the Route 70 Riviera Beach deck ^{WERE} found to possess poor anti-skid properties. This may have been due to the fact that the concrete did not completely cover the steel members. The protruding steel members would offer a lower coefficient of friction to the tire than would concrete to the tire.

In conclusion, the following recommendations are offered in an attempt to relieve some of the hazards arising from slippery conditions encountered on grid deck surfaces:

1. The installation of non-mountable center barriers be considered in preventing head-on collisions, which are considered the most serious type of accident. The barrier would be installed on all bridges having an AADT volume of 5,000 or more, and on bridges having a history of high accident rates.

2. In instances where it is desirable to fill the grid deck with concrete (eg. Route 70 Riviera Beach), it is recommended that the deck be covered completely to approximately one (1) inch above the metallic grid work, thereby allowing no contact between the tire and the metal.

3. Currently, the State of New Jersey is responsible for the maintenance of some forty (40) bridges with serrated and studded metallic grid decks. At this time, relatively little is known about the effects of various grid configurations on skid resistance and vehicle control. It is felt that further studies should be conducted examining the relationship of existing and other types of grid configurations with respect to the vehicle tire under both wet and dry conditions.

The use of a movie camera to observe the interplay between the tire and the deck was found to be a useful tool. Additional work along these lines may yield useful data.

4. It may be interesting to note from the skid test data and also Table 2 that the studded decks seemed to possess slightly better anti-skid characteristics under wet conditions, than the serrated decks. It may be desirable in the future to create other experimental studded deck configurations and conduct comparative skid studies between the studded and serrated grids. Existing metallic bridge decks throughout the State could be studded, and effectively used in these experiments. The desirable effects of studding a serrated grid may be noted by the relatively good skid resistance value of twenty (20) for the Route 1 & 9 bridge deck, Passaic River.

Deteriorating concrete bridge decks may be also used in these experiments by converting them into studded metallic grid decks. This may be accomplished by overlaying the damaged concrete decks with a steel grid.

Each grid section would have a metal strip welded to the bottom of the grid on three-foot centers drilled with a 3/4 inch opening, to serve as a template for drilling the anchor bolt holes inserted in the decks to prevent movement of the section.

Anchoring would be accomplished by drilling a 3/4 inch hole into the firm concrete deck at each template location. A 1/2 inch lag bolt, fitted with an expander would be inserted into each drilled hole so that the grid would be brought into intimate contact with the slab and drawn up firmly in a manner to prevent any future movement. The metallic deck could then be studded in the conventional manner.

This method of restoring damaged concrete grid decks has been used by the Connecticut Highway Department. They, however, elected to fill the grid spaces with a bituminous mixture and then hot-mixed the entire surface.

It was reported by the State of Connecticut, that this type of restoration would take about a day to accomplish, while structures being repaired in the normal manner were partially closed to traffic for about one month. The experimental technique was expected to yield a cost reduction of about 20%.

TABLE 2
 AVERAGE DECELEROMETER READINGS
 ON
 GRID DECK AND APPROACHES

