BRIDGE LOADINGS ROUND THE WORLD

NEW DELHI
1966

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BRIDGE LOADINGS
ROUND THE WORLD

The Indian Roads Congress issued a questionnaire to various countries in the world about the bridge loadings applied for design purposes.

The following countries very kindly sent the replies:

(1) America (U.S. Bureau of Public Roads)
(2) Austria
(3) Belgium—see pp. 128-129
(4) Canada (Toronto and Ontario)
(5) Finland
(6) Germany (Federal Republic)
(7) Great Britain
(8) India
(9) Italy
(10) Japan
(11) Malaysia
(12) New South Wales (Australia)
(13) New Zealand
(14) Norway
(15) Philippines
(16) Rhodesia
(17) Sweden
(18) Switzerland
(19) Turkey

The ensuing Tables have been prepared from the information received.

The Indian Roads Congress is very grateful to the above mentioned countries for the information supplied.
## QUESTIONS

### AMERICA

(U.S. Bureau of Public Roads)

#### Article 1.2.5*

(i) Truck loading and lane loading H10-44, H15-44, H20-44, H15-S12-44, H20-S16-44 and Military loading. (See Figs. 1, 2, 3 & 4 in Plate 1).

For trunk highways or other highways which carry heavy truck traffic, minimum loading H15-S12-44.

For Inter-state highway system, Military loading (see Fig. 4 in Plate I) wherever it causes moments or shear greater than those caused by H20-S16 truck or the standard lane loading.

(ii) Distance between successive trains or loads

(a) Kerb

(b) Central line of the bridge

(c) Lateral disposition of train loading or other types of loadings with respect to:

(d) No particular lateral disposition.

#### Article 1.2.9*

(i) 100 per cent of either 2-lane loading or one standard H or H.S. truck per each lane.

(ii) 75 per cent of either 4 lane loading or one standard H or H.S. truck per each lane.

(iii) 73 per cent of either 6 lane loading or one standard H or H.S. truck per each lane.

### AUSTRIA

#### Bridge Classes

See Fig. 6 in Plate I

<table>
<thead>
<tr>
<th>Total weight</th>
<th>25</th>
<th>16</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Truck</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fore wheel</td>
<td>4</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Back wheel</td>
<td>8.5</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Equivalent</td>
<td>tonnes/m²</td>
<td>1.67</td>
<td>1.07</td>
</tr>
</tbody>
</table>

| (b) Uniform load | tonnes/m² | 0.50 | 0.40 |

| (c) Caterpillar |    |    |    |
| Car            |    |    |    |
| Total weight   | 60 | -  | -  |
| Caterpillar load | tonnes/m² | 17.14 | -  |
| Equivalent weight | tonnes/m² | 3.33 | -  |

For spans more than 30 m, calculations may be made with the "Equivalent weight" (total weight, referred to the track area) instead of the different wheel loads.

---

*Articles referred to relate to the A.A.S. H.O. Standard Specifications for Highway Bridges (1961).
**TORONTO**

Truck loading is based on the H20-S16-44 or the heavier H25-S20 loading in the A.A.S.H.O. Standard Specifications for Highway Bridges (1961).

**ONTARIO**

All H20-S16-44

Article 1.2.4 to 1.2.9*

---

**TORONTO**

(a) For trucks, wheel is placed 2 ft away.

(b) No relationship for trucks.

**ONTARIO**

Article 1.2.6.*

---

**ONTARIO**

(i) 2 train loads.

(ii) (a) 2 train loads.

(b) 3 train loads with 10 per cent reduction.

(c) 4 train loads with 25 per cent reduction whichever gives the most critical stress.

(iii) As in (i) above except that (c) becomes 4 lanes or more with 25 per cent reduction.

---

**ONTARIO**

Article 1.2.9*

*Articles referred to relate to the A.A.S.H.O. Standard Specifications for Highway Bridges (1961).
### FEDERAL REPUBLIC OF GERMANY

<table>
<thead>
<tr>
<th>0.3 t/m²</th>
<th>0.6 t/m²</th>
<th>0.9 t/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3 t/m²</td>
<td>0.6 t/m²</td>
<td>0.9 t/m²</td>
</tr>
<tr>
<td>0.3 t/m²</td>
<td>0.6 t/m²</td>
<td>0.9 t/m²</td>
</tr>
</tbody>
</table>

(i) For Federal Autobahns, Federal Highways and Rural Highways of 1st order, Bridge Class 60 = 6 × 10 t

For Rural Highways of 2nd order and District Roads, Bridge Class 30 = 6 × 5 t

For Minor Roads, Bridge Class 16 & 6, see Fig. 7 in Plate II.

---

### GREAT BRITAIN

Bridges carrying public roads are designed for HA loading (British Standard 153-Part 3-Section A—see Fig. 8 in Plate II consisting of a uniformly distributed load plus a single knife edge load. The U.D. load varies with the span but between 20 and 75 ft it is constant at 2200 lb per linear foot of 10 ft wide lane. The knife edge load is placed parallel to the supports of the member under consideration and has a value of 27,000 lb for a 10 ft wide lane.

Bridges carrying important roads are checked for 45 units of HB loading to British Standard 153.

#### UNIT - TON Loading

- 3 ft = 1 t
- 5 ft = 1 t

(a) Any part of the bridge deck between kerbs, including the hard shoulder, if any, is deemed to be subject to HA or HB loading.

#### (a) For main carriageway, the load should be so placed as to cause worst effects. Laterally it can be placed up to the kerb.

(b) Outside the carriageway, uniformly distributed load of 0·3 t per m² for bridges of class 60 and 30.

(i) & (ii) The portion of train loading according relieving effect will not be considered.

(i) Two lanes of HA loading or one lane of HB loading together with one lane of 1/3 HA loading.

(ii) Two lanes of 1/2 HA loading and two lanes of 1/3 HA loading or one lane of HB loading and the adjacent lane with 1/3 HA loading. The two lanes in the other carriageway each with HA loading.

(iii) Two lanes of HA loading and four lanes of 1/3 HA loading or one lane of HB loading and the two adjacent lanes with 1/3 HA loading. In the other carriageway, two lanes with HA loading and the other lane with 1/3 HA loading.
## Indira

**Clauses 201* and 207*:**

(i) Class "AA" tracked vehicle and Class "AA" wheeled vehicle.  
Class "A" train of vehicles.  
Class "B" train of vehicles.  
See Figs. 9, 10 & 11 in Plate III.  
(a) For every 2-lane width of bridge Class "AA" one tracked or wheeled vehicle or two lanes of Class "A" loading whichever creates worst effects, to be used for road bridges in municipal limits, industrial and other specified areas and on specified highways.  
(b) Class "A" to be used for all roads on which permanent bridges and culverts are constructed.  
(c) Class "B" for temporary bridges, etc.  

(ii) See Figs. 9, 10 & 11 in Plate III.  
For Class "AA" tracked vehicles—300 ft min.  
For Class "A" train of vehicles—65 ft min.  
For Class "B" train of vehicles—65 ft min.  

**Clause 207* (See Figs. 9 to 11, Plate III):**

(a) Class "AA" clear distance between kerb and outer edge of wheel or track=1ft for single lane bridge with 12 ft carriageway; 2 ft for multi-lane bridge with less than 18 ft carriageway; 4 ft for 18 ft or above carriageway: In case of Class "A"—clear distance 6 in. between kerb and wheel having 20 in. width for all carriageway widths. Class "B" 6 in. for wheel having 15 in. width.  
(b) Not given.

**Clauses 113* and 208.2*:**

(i) One train of Class "AA" tracked or wheeled vehicles or two lanes of Class "A" train of vehicles for National Highways and State Highways.  
(ii) 80 per cent of two trains of Class "AA" tracked or wheeled vehicles or of four lanes of Class "A" train of vehicles.  
(iii) This type of bridge construction is not permitted.

---

## Italy

For the purpose of loading, highways are divided into the following two categories:

(I) Highways for civil and military use, and  
(II) Highways for civil use only (local and minor roads).

**Loading system:**

Type 1. a continuous train of 12 t truck  
,, 2. a single 18 t steam roller  
,, 3. a crowd load of 400 kg per sq. m.  
,, 4. a continuous train of military loads of 61.5 t  
,, 5. a continuous train of military loads of 32 t  
,, 6. a single military load of 74.5 t  

(See Fig. 13 in Plate—IV)  
Loading system to be adopted in the design of highway bridges.

**Category (I)—One military type—the heaviest of types 4, 5 or 6 flanked by one or more trains of truck (Type I) with crowd loading of 400 kg/m² (Type 3) on the footpaths.**

**Category (II)—The most unfavourable of the following conditions:**

(a) one or more lanes loaded with continuous trains of trucks (Type 1) with crowd loading on the footpaths (Type 3)  
(b) one or more steam rollers (Type 2) side by side with crowd loading on footpaths (Type 3).

---

*Clauses referred to relate to the Indian Roads Congress Standard Specifications & Code of Practice for Road Bridges-Sections I & II (1964).
## Transport-Communications Monthly Review

### JAPAN

**T-LOADING**

**L-LOADING**

T-loading for design of floor system:

<table>
<thead>
<tr>
<th>Class of bridge</th>
<th>Load</th>
<th>Weight W(t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>T-20</td>
<td>20</td>
</tr>
<tr>
<td>2nd</td>
<td>T-14</td>
<td>14</td>
</tr>
</tbody>
</table>

One vehicle longitudinally and as many as possible transversely.

**Note:** For spans exceeding 150 m, specifications are otherwise considered.

### Loading for the Design of Main Girders

<table>
<thead>
<tr>
<th>Class of bridge</th>
<th>Load</th>
<th>Main-lane loading (width of 5.5 m)</th>
<th>Other lanes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>U.D.L. (kg/m)</td>
<td>U.D.L. (kg/m²)</td>
</tr>
<tr>
<td>1st</td>
<td>L-20</td>
<td>5000</td>
<td>350 430 120 300</td>
</tr>
<tr>
<td>2nd</td>
<td>L-14</td>
<td>70 per cent of L-20</td>
<td></td>
</tr>
</tbody>
</table>

### MALAYSIA

B.S. 153-Part 3A: 1954 (see Fig. 8 in Plate II.)

Type HA (British) loading represents approximately effect of 3 vehicles, each 22 tons in weight, closely spaced, in each of two carriageway lanes, followed by 10-ton and 5-ton vehicles. For short span members, the effects of two 9-ton wheels 3 ft apart have been considered (i.e., approximately two 11-ton wheels with 25 per cent overstress).

- **(a)** Nil.
- **(b)** Nil.

B.S. 153-Part 3A—1954—Clause 4-A (a), (b) and (c).

(i) Occupied by full type HA loading.

(ii) Occupied by full type HA loading.

(iii) Two lanes occupied by full type HA loading and one lane occupied by one-third the full lane loading.
**NEW SOUTH WALES**

<table>
<thead>
<tr>
<th>Clauses 2.5* and 2.7*</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Truck loading and lane loading H10-44, H15-44, H 20-44 and H15-S12-44 and H20-S16-44.</td>
</tr>
<tr>
<td>Minimum loading:</td>
</tr>
<tr>
<td>(a) Metropolitan bridges H20-S16-44.</td>
</tr>
<tr>
<td>(b) Bridges on Main roads and Highways: H20-S16 44.</td>
</tr>
<tr>
<td>(c) Other bridges: Through roads—H20-S16-44 unless H15-S12-44 is considered desirable. Other than Through Roads (such as those serving small group of settlers) lower classes of loading, if desirable.</td>
</tr>
</tbody>
</table>

(ii) No successive trains or loads.

---

**NEW ZEALAND**

| Design loading for new bridges for all National Board Roads or Govt. Subsidiary Roads as per A.A.S.H.O. |
| H20-S16-44 Truck and Lane loading and H20-S16-T16 truck loading, whichever gives the worst effects. |

---

** Clause 2.6* **

(a) For deck slab design (concrete, steel grid or timber deck), the distance of the wheel to the kerb face may be only 1 ft (see Figs. 1, 2 and 3 in Plate I).

(b) No particular lateral disposition.

---

** Clause 2.9* **

(i) 100 per cent of 2 lane loading or of one standard H or HS truck per each lane.

(ii) 75 per cent of 4 lane loading or of one standard H or HS truck per each lane.

(iii) 75 per cent of 6 lane loading or of one standard H or HS truck per each lane. Where continuous spans are designed, for the truck loading, only one standard H or HS truck per each lane shall be considered on the structure.

---

*Clauses referred to relate to Highway Bridge Design Specifications of N.A. of A.S. Road Authorities (1965).
NORWAY

Equivalent loading per lane:

\[
\frac{A}{L} = 12 + 8x/L \text{ tons (Class I & II)}
\]

Class I: \( p = 0.5 + \frac{25}{L+5} \)

Class II: \( p = 0.35 + \frac{24}{L+7} \)

to 0.5 tonnes per linear metre of lane. Impact included in A and p. L = actual loaded length of lane.

Class I and II mainly refer to lane widths for two lane bridges usually used for roadway widths more or less than 6·5 metre respectively.

The above lane loadings are normally considered uniformly distributed over lane widths from 3·0 to 3·75 metre. Besides, the structure is designed for a local loading of two axles of each 18 t (13 t allowable + 5 t impact) with lateral position shown in the sketch below:

Furthermore, the structure is controlled for one up to 30 metre long span.

Class II lane load laterally distributed as the above two right wheel loads for a corresponding other position, if more unfavourable.

(i) The equivalent loading in each lane.
(ii) -do- -do-
(iii) The full equivalent loading in two lanes, 50 per cent in the third lane.

PHILIPPINES

Class of bridge loading:

AA—H20 or H20-S16 See Figs. A—H15 or H15-S12 Plate I & B—H10 Fig. 14 in Plate IV.

Class “AA” bridges for specially heavy traffic units in locations where the passage of such loads is frequent or located in large cities and industrial centres.

Class “A” bridges for normally heavy traffic units and the occasional passage of specially heavy loads.

Class “B” bridges for light traffic units and the occasional passage of normally heavy loads.

Class “C” bridges shall be considered as temporary or semi-temporary structures.

There is also loading H-10-35 as shown in Fig. 14 in Plate IV.

Similar to A.A.S.H.O. Article 1.2.4.

Figs. 1 and 3 in Plate I.

(i) Two headed in the same direction
(ii) Two each way
(iii) Three each way (load intensity reduced to 90 per cent)

RHODESIA

HA loading, supplemented with 30 units HB loading allowing 25 per cent increase in permissible working stresses.

See Fig. 8 in Plate II for HA loading. For HB loading, see sketch under Great Britain, p. 98.

All in accordance with B.S. 153/1954—Part 3—Section A.

(a) 18” from kerb line in any analysis not incorporating a lateral distribution analysis.

Accidental loading of a 4 ton wheel is investigated at edge of parapet, allowing 25% increase in permissible working stresses.

(b) Symmetrical, unless a lateral distribution analysis is undertaken.

(i) Full HA loading in each lane.
(ii) As above.
(iii) N/A.
(iv) Three lanes, Full HA loading in two adjacent lanes; 1/3 HA in the third lane.
(a) Lane loading consisting of one 14 t axle load + distributed "p" t/m, when p = 2.4 t/m for loaded length less than 10 m, and 1.1 t/m for loaded length over 90 m.

For loaded length between 10 m and 90 m, "p" varies according to formula

\[ p = 2.4 - 1.3 \times (\ell - 10) \]

where \( \ell \) is the loaded length in metres (distance between the zero points of influence curve) or by interrupted loading, the sum of loaded lengths and length of the unloaded parts between.

(b) Single truck loading of 100 t. This single truck loading may be assumed as exceptional loading without concurrent loading stress increased by 15 per cent.

On special roads, it can be prescribed that the above mentioned single truck shall be considered as normal traffic loading.

(i) Main roads:
- Distributed load of 360 kg per m² and one axle load of 15 t for each lane.
- Secondary roads:
  - The same with 240 kg per m² and 10 t.

(ii) Instead of distributed loading with one axle load, all parts should be checked also for the following train load:
- 3 axle loads for each lane with 1.5 m distance behind each other of 15 t for main roads, 10 t for secondary roads.

(iii) Two lane loading or single truck loading.

Each side of the divided highway shall essentially be regarded as belonging to a separate bridge. However, in some cases on long bridges, certain deduction in the loading is often allowed.

(iii) Not more as two lanes are loaded with axle or train loads.

(ii) & (iii) Not more as two lanes each way have to be loaded with axle or train loads.

### SWEDEN

See Fig. 15 in Plate IV.

### SWITZERLAND

<table>
<thead>
<tr>
<th>State Roads</th>
<th>Provincial Roads H15-S12</th>
<th>Village Roads H10</th>
</tr>
</thead>
<tbody>
<tr>
<td>H20-S16</td>
<td>2 8 8 51</td>
<td></td>
</tr>
<tr>
<td>H15-S12</td>
<td>1.5 6 6 38</td>
<td></td>
</tr>
<tr>
<td>H10</td>
<td>1 4 0 25</td>
<td></td>
</tr>
</tbody>
</table>

The distributed load goes all over the bridge. The train and axle loads in the position which gives the maximum stress.

One truck for each lane.

### TURKEY

(i) Not more as two lanes are loaded with axle or train loads.

(ii) & (iii) Not more as two lanes each way have to be loaded with axle or train loads.
## QUESTIONS

4. Area of the train of vehicle assumed in elevation for calculating the effective wind pressure.

<table>
<thead>
<tr>
<th>AMERICA (U.S. Bureau of Public Roads)</th>
<th>AUSTRIA</th>
<th>CANADA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article 1.2.14*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Wind pressure at the rate of 100 lb per linear ft on moving live load acting at 6 ft above deck. This is to be taken only for group loading combination as explained in Article 1.4.1*.

The Austrian standards adopt a 2.5 m high rectangular traffic area in correspondence with the position of live load.

**TORONTO**

A simplified procedure is used for spans 125 ft and under.

- 100 lb per linear ft transversely.
- 40 lb per linear ft longitudinally.

Both forces applied simultaneously 6 ft above deck.

**ONTARIO**

Article 1.2.14*

---

5. Impact factor due to live loads assumed for different types of loads on:

<table>
<thead>
<tr>
<th>Concrete bridges</th>
<th>Article 1.2.12*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact fraction</td>
<td>I = \frac{50}{L+125} (maximum impact factor 30 per cent)</td>
</tr>
<tr>
<td>L = length in ft of the portion of the span which is loaded to produce the maximum stress in the member. This is applicable only for structural members of group (A).</td>
<td></td>
</tr>
</tbody>
</table>

For further explanation, see Article 1.2.12*.

<table>
<thead>
<tr>
<th>Impact Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Concrete bridges :</td>
</tr>
<tr>
<td>L = span of the structural part (metre)</td>
</tr>
<tr>
<td>Platform girder, direct loaded main girder</td>
</tr>
<tr>
<td>1.40 1.30 1.20 1.10 1.00</td>
</tr>
<tr>
<td>Indirect loaded main girder</td>
</tr>
<tr>
<td>1.40 1.25 1.10 1.00 1.00</td>
</tr>
<tr>
<td>Floor slab 1.40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Steel bridges</th>
</tr>
</thead>
<tbody>
<tr>
<td>No distinction has been made in impact factor for different types of loads or bridges of different materials.</td>
</tr>
</tbody>
</table>

(iii) Prestressed concrete bridges

Variation of impact according to span length.

<table>
<thead>
<tr>
<th>Impact Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ii) Steel bridges :</td>
</tr>
<tr>
<td>L in metres</td>
</tr>
<tr>
<td>2 4 6 8 10 20</td>
</tr>
<tr>
<td>Impact factor</td>
</tr>
<tr>
<td>Lane I 1.64 1.50 1.41 1.35 1.30 1.18</td>
</tr>
<tr>
<td>Lane II 1.32 1.25 1.20 1.17 1.15 1.09</td>
</tr>
<tr>
<td>L in metres</td>
</tr>
<tr>
<td>40 60 80 100</td>
</tr>
<tr>
<td>Impact factor</td>
</tr>
<tr>
<td>Lane I 1.1 1.07 1.05 1.04</td>
</tr>
<tr>
<td>Lane II 1.05 1.03 1.02 1.02</td>
</tr>
</tbody>
</table>

For all following lanes: Impact factor = 1

---

*Articles referred to relate to the A.A.S.H.O. Standard Specifications for Highway Bridges (1961).
<table>
<thead>
<tr>
<th>FINLAND</th>
<th>FEDERAL REPUBLIC OF GERMANY</th>
<th>GREAT BRITAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height 2 m for the length of loading.</td>
<td>For bridges without load—250 kg/m²</td>
<td>A plane with a continuous height of 8 ft above the carriageway for highway bridges or 4 ft above the footway for footbridges. Allowance may be made for the screening effect of the structure on the plane, based on projected areas.</td>
</tr>
<tr>
<td></td>
<td>For bridges under construction—125 kg/m²</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For bridges with load—125 kg/m²</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For pedestrian &amp; cycle bridges—75 kg/m²</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The above loading acting in case of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) road bridges at 2.0 m height</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) pedestrian bridges at 1.8 m height.</td>
<td></td>
</tr>
<tr>
<td>I=40 per cent when filling h(m) ≥3 m</td>
<td>Impact Factor ( \varphi = 1.4 - 0.008 \times \text{l}_\varphi \geq 1.0 )</td>
<td></td>
</tr>
<tr>
<td>I=16 ((3.0 - h)) per cent for height of fill varying from 0.5—3.0 m</td>
<td>( \text{l}_\varphi = \text{governing length in metres} )</td>
<td></td>
</tr>
<tr>
<td>For timber bridges always I=20 per cent.</td>
<td>(See D.I.N. 1073, 1074, 1075 and 1078 for the determination of the value of ( \text{l}_\varphi )).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HB loading has no impact factor.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HA loading incorporates an impact factor of 25 per cent on the heaviest axle in the train of vehicles from which HA loading is derived. It is constant for all forms of construction.</td>
<td></td>
</tr>
</tbody>
</table>
Clause 212.4*—Also see Figs. 9, 10 and 11 in Plate III.

The lateral wind force against any exposed moving load shall be considered as acting at 5 ft above the roadway and shall be assumed to have the following values:

Highway bridges, ordinary—200 lb per linear ft
Highway bridges carrying tramway—300 lb per linear ft

While calculating the wind pressure on live load, the clear distance between the trailers of a train of vehicles should not be omitted.

Clause 211*

(i) (a) Class “A” or “B” loading—Impact fraction

\[ I = \frac{15}{20+L} \]

(b) Class “AA” loading—Impact percentage:

For spans less than 30 ft:
- For tracked vehicles: 25 per cent for spans up to 15 ft, linearly reducing to 10 per cent for spans of 30 ft.
- For wheeled vehicles—25 per cent.

For spans of 30 ft or more:
- Tracked vehicles: 10 per cent up to 130 ft span and according to the curve in Fig. 12 in Plate III for more than 130 ft span.
- Wheeled vehicles:
  - 25 per cent for spans up to 40 ft, for more than 40 ft span in accordance with the curve in Fig. 12 in Plate III.

(ii) (a) Class “A” or “B” loading

\[ I = \frac{30}{45+L} \]

(b) Class AA loading

Tracked vehicles—10 per cent for all spans.

Wheeled vehicles—25 per cent for spans up to 75 ft and for over 75 ft spans as per curve in Fig. 12 in Plate III.

*Clauses referred to relate to the Indian Roads Congress Standard Specifications and Code of Practice for Road Bridges—Sections I and II (1964).
Exposed to wind

\[ \frac{1 \text{ em}}{\text{a-th \, ft}} \]

\[ \frac{1 \text{ em}}{\text{a-th \, ft}} \]

\[ \frac{1 \text{ em}}{\text{a-th \, ft}} \]

JAPAN

MADELSIA

B.S. 153-Part 3A-1954, Clause 12 (a)-(d)

A plane with a continuous height of 8 ft above the carriageway for highway bridges and 5 ft above the footway for footway loading. Allowance may be made for the screening effect of the structure on the plane based on projected areas.

B.S. 153-Part 3A : 1954

Where type HA loadings are not adopted, the allowance for impact on highway bridges are as follows:

(i) Concrete bridges—

\[ i = \frac{7}{20+L} \]

for main girder

\[ i = \frac{20}{50+L} \]

for floor system.

(L = span in metres)

(ii) Steel bridges—

\[ i = \frac{20}{50+L} \]

(iii) Prestressed concrete bridges—same as for concrete bridges.

(i) Concrete bridges—

\[ 25 \text{ per cent} \]

(ii) Steel bridges—

\[ 25 \text{ per cent} \]

(iii) Prestressed concrete bridges—

\[ 25 \text{ per cent} \]
### NEW SOUTH WALES

Clause 2.15*

Lateral wind force at 100 lb per linear ft acting at a height of 6 ft above the deck.

Alternatively, 66 lb per linear foot laterally plus 33 lb per linear foot longitudinally acting simultaneously.

### NEW ZEALAND

Wind loads as per A.A.S.H.O. Specifications for longitudinal elevation.

See Fig. 3 in Plate I and sketch in Q., 1, p. 101.

### NORWAY

Normally no wind pressure is considered on loaded bridge.

On bridge without load, wind pressure is assumed equal to 250 kg per m² of exposed area.

### PHILIPPINES

Normally no wind pressure is considered on loaded bridge.

For all kinds of bridges,

$$I = \frac{50}{L+125} \text{ per cent}$$

$(L=\text{length in feet of the portion of the span which is loaded to produce the maximum stress in the member})$

- **Clause 2.13**

(a) Impact = 10 per cent for steel or concrete substructure above the foundations but not rigidly connected to the superstructure and structures carrying 1½ to 3 ft of fill.

(b) Steel or concrete superstructures and those parts of steel or concrete substructure above the foundations which are rigidly connected to the superstructure as in the rigid frames or continuous designs and structures carrying less than 1½ ft of fill. The impact shall be

$$I = \frac{5000}{L+125} \text{ per cent}$$

- (max. 30 per cent)
- (min. 10 per cent)

Impact factor not dependent on bridge type. Impact factor in use:

$$I = \left(\frac{50}{L+125}\right) \times 100 \text{ per cent}$$

Impact is included under Q., 1—equivalent loading.

The local loading (Q., 2) assumes 5 ft impact for an allowable 13t axle load (38½ per cent)

Allowable gross weights of vehicles are established by comparing their effect with the effect of the class II equivalent loading.

By this, the above 38½ per cent impact is added to the heaviest axle, but it is so far considered unnecessary to add impact to the remaining axles.
RHODESIA

As under Section 12—B.S. 153/1954—Part 3, Section "A".

SWEDEN

The wind pressure area of traffic load shall supposed to be a rectangle 2 metre higher from the deck and length equal to loaded length.

SWITZERLAND

For road bridges, 3 metre high band is assumed.

TURKEY

Effective wind pressure is calculated as follows:

(a) for unloaded bridge: 1.5 times the height of the full area of the bridge deck including the hand-rails. Load 250 kg per m².

(b) for loaded bridges: height of the area of the bridge deck elevation + 2.0 m for live load.

Wind load 125 kg per m².

(i) & (ii) Concrete and steel bridges—Included in HA loading. See B.S. 153/1954.

(iii) For Prestressed concrete bridges:

As above, but for dynamic stability the following apply:

(a) The vertical acceleration of the superstructure under HA loading, travelling at 40 m.p.h. shall not exceed 0.5 ft per sec^2.

(b) The natural frequency of the superstructure under a live load of 100 lb per sq. ft. shall not be less than 3 cycles/sec., where the natural frequency equals

\[ 0.75 \sqrt{\frac{EI}{wL^4}} \text{ cycles/sec.} \]

where

"E" is Young's Modulus for the superstructure in lb per sq. in.,
"I" moment of inertia of superstructure (in.⁴),
"w" = B×100+ weight of superstructure in lb/ft run,
"B" = breadth of superstructure,
"L" = span of superstructure in feet.

40 per cent for lane loading and only for the wheel loads, and not for the uniform load p.

When wheel is in contact with railing or another limitation (kerb, etc.) of the roadway, no impact allowance has to be considered.

No impact for single truck loading.

Impact = \[ 5 \times \frac{100+L}{10+L} \]

where

L is the length of span in m.

\[ \Phi = 1 + \frac{15}{L+37} \]

where

\[ L = \text{span length in metres.} \]

\[ \Phi_{max.} = 1.3 \]
<table>
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<th>QUESTIONS</th>
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<th>AUSTRIA</th>
<th>CANADA</th>
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<tbody>
<tr>
<td>6. Ground Contact Area &lt;br&gt;The shape of contact area for design calculations and formula adopted for dispersion of the wheel loads through the wearing coat and the slab for designing.</td>
<td>Article 1.2.6 and 1.3.2 (c) &lt;br&gt;As per Figs. 1 and 3 in Plate I. &lt;br&gt;For further details, see Article 1.3.2 (c).</td>
<td>For the shape of the contact area, see Q. 1, Loadings. If there is a load distributing layer, concentrated loads may be dispersed under an angle of 45 degrees. The dispersion may be extended to the centroidal axis of the considered structural part only.</td>
<td>&lt;br&gt; <strong>TORONTO</strong> &lt;br&gt;Shape is circular for slabs on soil. Otherwise dispersion is in accordance with “Standard Specifications for Highway Bridges” (A.A.S.H.O.—1961). &lt;br&gt;<strong>ONTARIO</strong> &lt;br&gt;Article 1.3.2*</td>
</tr>
<tr>
<td>7. Equivalent UDL or knife edge loading, if adopted for working out: &lt;br&gt;(i) Bending moment. &lt;br&gt;(ii) Shear.</td>
<td>Articles 1.2.7 and 1.2.8* &lt;br&gt;See Fig. 2 in Plate 1.</td>
<td></td>
<td>&lt;br&gt;<strong>TORONTO</strong> &lt;br&gt;(i) For bending moment 640 lb per linear ft UDL + 18000 lb (in lieu of H20—S16 truck) &lt;br&gt;(ii) For shear 640 lb per linear ft UDL + 26000 lb (in lieu of H20—S16 truck)</td>
</tr>
<tr>
<td>8. The percentage of the live load on the bridge taken for calculating the braking force in the design of substructure of the bridge.</td>
<td>Article 1.2.13* &lt;br&gt;5 per cent of L.L. without impact in all lanes carrying traffic headed in the same direction acting at 6 ft above deck. The load shall be lane-load plus knife edge load without impact and reduction as per Q. 3 applied. Longitudinal forces due to friction of beams shall also be provided for in the design.</td>
<td>30 per cent of the weight of the heaviest vehicle (caterpillars excluded).</td>
<td>&lt;br&gt;<strong>ONTARIO</strong> &lt;br&gt;None</td>
</tr>
</tbody>
</table>

*Articles referred to relate to the A.A.S.H.O. Standard Specifications for Highway Bridges (1961).
<table>
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<th>FEDERAL REPUBLIC OF GERMANY</th>
<th>GREAT BRITAIN</th>
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</thead>
<tbody>
<tr>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="Diagram" /></td>
<td>The contact area for a heavy wheel of 11.5 tons in the HB loading is taken as 15 in. x 3 in. with the 3 in. in the direction of travel. This load may be dispersed through the wearing course and slab at an angle of 45 degrees longitudinally and transversely. For structural distribution in a slab, normal structural theory may be used, e.g., Pigeaud or Westergaard.</td>
</tr>
</tbody>
</table>

For ground contact area of wheel load, see Fig. 7 in Plate II.

Generally the dispersion of wheel load be taken at 45 degrees. In the case of massive slabs, the dispersion as above will be up to the middle of the slab.

See Q. 1

20 per cent

100 per cent

The longitudinal force for HA loading is 10 Tons for spans up to 10 ft, plus 0.5 Ton per foot of span over 10 ft with a maximum of 25 Tons. The longitudinal force for 45 units of HB loading is 45 Tons for all spans.

See Q. 1. 

20 per cent

100 per cent
<table>
<thead>
<tr>
<th>Questions</th>
<th>India</th>
<th>Italy</th>
</tr>
</thead>
</table>
| 6. Ground Contact Area | Clauses 207 and 207-2.* See Figs. 9, 10 and 11 in Plate III, for shape of contact areas. For one way slab dispersion = effective width measured parallel to the supported edges: 
\[
e = kx \left( 1 - \frac{x}{l} \right) + W \text{ and } e = 1.2x + W \text{ for cantilever.}
\]
| Equivalent UDL or knife edge loading, if adopted for working out:  
(i) Bending moment. 
(ii) Shear. | Nil | In slab calculations, the weight of a rear wheel (64t) of the roller is distributed over a rectangle, one side of which is equal to the sum of the width of the roller wheel plus twice the depth of slab and wearing coat; the other side is equal to 10 cm plus twice the depth of slab and wearing coat. |
| 7. The percentage of the live load on the bridge taken for calculating the braking force in the design of substructure of the bridge. | Clause 214-2*  
(a) 20 per cent of the first train load plus 10 per cent of the loads of succeeding trains or part thereof, the train loads in one lane only being considered for this purpose. When only part of the first train is on the full span, the braking force shall be only 20 per cent of portion of load on the span.  
(b) For bridges having more than two lanes: as in (a) above for the first two lanes plus 5 per cent of the loads on the lanes in excess of two. (Effect of impact is not taken into consideration). | See Table 2 page 131 | Braking force shall be equal to 1/10 of the load superimposed by a continuous train of trucks (Type 1). This force, however, shall not be less than 0.3 of the heaviest axle of the load system being considered. |

*Articles referred to relate to the Indian Roads Congress Standard Specifications and Code of Practice for Road Bridges—Sections I and II (1964).
JAPAN

Front Wheel
12.5 cm
20 cm

Rear Wheel
150 cm
20 cm

MALAYSIA

Appendix A 1(c) and 3(f)

Contact area of 15 in. x 3 in.,
the smaller dimension being in
the direction of travel.

Dispersal under the wheel load
shall be taken at 45 degrees.

For bridges with span length
less than 150 m,
it is not adopted.
For longer spans,
equivalent U.D.L
may be specified.

Appendix A.

See Fig. 8 in Plate II.

10 per cent of T loading.

Clause 10

Span upto 10 ft = 10 Tons

Span above 10 ft = 10 Tons +
\( \frac{1}{2} \) Ton for each ft of span over
10 ft, but not exceeding 25 Tons.
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<th>NEW ZEALAND</th>
<th>NORWAY</th>
<th>PHILIPPINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clause 2-5*</td>
<td>See Figs. 1 &amp; 3 in Plate 1.</td>
<td>The contact area for the wheel load given under Q. 2 is 50 cm lateral, by 20 cm in driving direction.</td>
<td></td>
</tr>
<tr>
<td>Contact width of each rear tyre equals 1 inch per every 2000 lb of total weight of loaded truck.</td>
<td>Distribution according to the A.A.S.H.O. Specification based on Westergaard method.</td>
<td>For moment calculation, the above area is increased by thickness of wearing coat+50 per cent of slab thickness in each direction.</td>
<td></td>
</tr>
<tr>
<td>As per A.A.S.H.O H20-S16-44 Lane Loading.</td>
<td>See Q. 2 above.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Similar to A.A.S., H.O., Bridge Specifications (1961).</td>
<td>For shear, the actual knife edge load &quot;A&quot; reaches the max. value of 16 tonnes according to formula</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clause 2-14*</td>
<td>None in the case of road bridges.</td>
<td>[ x = \frac{L}{2} ]</td>
<td>Fig. 2 in Plate I.</td>
</tr>
<tr>
<td>5 per cent of total live load (without impact) on the bridge loaded to give maximum effect. This shall be taken as acting 6ft above road level.</td>
<td>So far braking force of 3 t for lane lengths upto 5 m increasing to 12 t for 25 m length or more has been adopted. At present the question of increasing braking forces is being considered.</td>
<td>5 per cent of the total lane loading for moment without impact and traffic headed in the same direction subject to reduction in the load intensity as follows:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>One or two lanes 100 per cent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Three lanes 90 per cent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Four lanes or more 75 per cent</td>
<td></td>
</tr>
</tbody>
</table>

*Clauses referred to relate to Highway Bridge Design Specifications of N. A. of A. S. Road Authorities (1965).
<table>
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<th>RHODESIA</th>
<th>SWEDEN</th>
<th>SWITZERLAND</th>
<th>TURKEY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elliptical, major axis 21 in., minor 9 in. Pigeaud's general dispersion, i.e., 45 degrees from contact area to main reinforcement in structural member.</td>
<td>Shape of contact area—See Fig. 15 in Plate IV.</td>
<td>Main reinforcement perpendicular to traffic: Slab span (S) from 0'6 to 2'0 m [ E = 0.6S + 0.76 ] Bigger than 2 m [ E = 0.4S + 1.14 ] Main reinforcement parallel to traffic [ E = 0.175S + 0.98 ]</td>
<td></td>
</tr>
<tr>
<td>(i) N/A</td>
<td></td>
<td>For each lane:</td>
<td></td>
</tr>
</tbody>
</table>
| (ii) N/A | | \[
| \begin{array}{|c|c|c|}
| \hline
| (q) & (t/m) & Q(t) \\
| \hline
| H20-S16 & 1.00 & 9.00 13.00 \\
| H15-S12 & 0.75 & 6.75 9.75 \\
| H-10 & 0.50 & 4.50 6.50 \\
| \end{array}
| |
| 15 per cent of one standard truck for the whole width of the bridge applied on the surface of the deck. |
| |
| See para 10 B. S. 153 (1954) Part 3 Section “A”. |
| See Fig. 15 in Plate IV. |
| |
| |

Irrespective of the clear width of the roadway, the braking force shall be 7 tonnes for 20 m length & 12 tonnes per 30 m length or more uniformly distributed over the clear width of roadway. For intermediate lengths, linear interpolation is applied.
<table>
<thead>
<tr>
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</tr>
</thead>
</table>
| 9. The surcharge effect considered in the design of abutments of the bridge due to the live load on the approach fill. | Article 1.2.19*  
Surcharge effect on the abutment due to the live load on approach fill = 2 ft.  
No surcharge, if adequately designed R.C.C. approach slab is provided. | No special standards. | TORONTO  
Equivalent to an additional 2 ft of backfill.  
ONTARIO  
2 ft surcharge without approach slab.  
None if approach slab is used. |
| 10. Footpath loading (state) min. width of footpath acceptable. | Article 1.2.11 (c)*  
No minimum width of footpath.  
(i) 85 lb per sq. ft. for slab, stringers and immediate supports.  
(ii) For girders, trusses, arches, etc.  
0—25 ft span  
—85 lb/sq. ft.  
26—100 ft span  
—60 lb/sq. ft.  
Over 100 ft span,  
P = \( \frac{32 + \frac{3000}{L}}{50} \) \( \frac{5.5 - W}{L} \)  
where  
P = L.L. per sq. ft. (max.  
60 lb per sq. ft.)  
L = loaded length of side-walk in feet,  
W = width of side-walk in ft  
(iii) Any special loading specified for the accidental mounting of vehicles on the footpath and in that case overstressing, if any, allowed. | Minimum width = 1.50 m  
Bridge Class I  
= 0.5 t per m²  
Bridge Class II  
= 0.4 t per m² | TORONTO  
Normal use—100 lb per sq. ft.  
ONTARIO  
Nil  
Nil |
| (iii) Any special loading specified for the accidental mounting of vehicles on the footpath and in that case overstressing, if any, allowed. | (iii) No such loading.  
One truck of 25 tonnes (16 tonnes) placed to produce maximum stress, No overstressing allowed. | Not definite. | ONTARIO  
Article 1.2.11* |

<table>
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<tr>
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<th>GREAT BRITAIN</th>
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<tbody>
<tr>
<td>( q = \frac{1}{12} F + \frac{2}{3} P )</td>
<td>Earth surcharge and earth pressure are determined from the characteristic value of the soil at site. The traffic load considered in the design of bridge should be placed at the unfavourable positions. Individual loads can be substituted by uniformly distributed loading.</td>
<td>The surcharge effect is taken as being equivalent to two feet height of fill.</td>
</tr>
<tr>
<td>( q ) in kg per m(^2)</td>
<td>( F ) in kg</td>
<td>80 lb per sq. ft.; minimum width normally accepted is 6 ft.</td>
</tr>
<tr>
<td>( P ) in kg per m</td>
<td>100 lb per sq. ft.</td>
<td></td>
</tr>
<tr>
<td>See Q. 1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum width = 1.5 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) 400 kg per m(^2)</td>
<td>(i) 0.5 t per m(^2) in case of spans less than 10 m</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) ( 0.550 - 0.005L \geq 0.4 ) t per m(^2)</td>
<td>These loadings may be reduced in the same proportion as the uniformly distributed load in HA loading, for spans above 75 feet.</td>
</tr>
<tr>
<td></td>
<td>( L = ) span in metre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discrete wheel load ( F ) (See Q. 1)</td>
<td>(iii) No</td>
<td>A four ton wheel load occupying a 12-in. diameter circle, 50 per cent over-stress is permitted.</td>
</tr>
<tr>
<td>Stressing: Concrete &amp; reinf. 65 per cent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel ( \leq ) Yield point</td>
<td></td>
<td></td>
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</table>

\( L = \) span in metre

Discrete wheel load \( F \) (See Q. 1) Stressing: Concrete & reinf. 65 per cent Steel \( \leq \) Yield point

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<tr>
<td>9. The surcharge effect considered in the design of abutments of the bridge due to the live load on the approach fill.</td>
<td>Clause 217*&lt;br&gt;(a) When adequately designed R,C,G approach slab covering the entire width of roadway, with one end resting on the abutment, and extending for a length of not less than 12 ft into the approach is provided, no live load surcharge need be taken.&lt;br&gt;(b) Otherwise surcharge load should be taken as per Table 1-p. 130.</td>
<td>No details given.</td>
</tr>
</tbody>
</table>
| 10. Footpath loading (state) min. width of footpath acceptable. | Clause 209*<br>5 ft minimum width.<br>The peak crowd load<br>(i) Normal 58 lb per sq. ft.<br>In case of bridges located near town of pilgrimage or large congregational fairs, 100 lb per sq. ft.<br>(ii) The main girders, trusses, arches or other members supporting the footways shall be designed for the following live loads per sq. ft. of footway area,<br>(a) for effective spans of 25 ft or less—85 lb or 100 lb as the case may be:<br>(b) 25–100 ft spans<br>\[ P = P' - \frac{(L - 25)}{3} \]
(c) over 100 ft spans<br>\[ P = \left( P' - 55 + 3000 \frac{W}{L} \right) \left( \frac{55 - W}{50} \right) \]
where \( P' = 85 \text{ lb/sq. ft.} \) or 100 lb/sq. ft. as the case may be, \( P = \text{L.L. in lb per sq. ft}; L = \text{Eff. span of main girder, truss or arch in ft}; W = \text{width of footway in feet.} \) | Uniformly distributed load including impact effects 500 kg per sq. m.<br>The above should be checked for the effect of a 5 t including impact wheel load. |
| (i) Crowd load assumed per sq. ft. | If the foot-path is carried on a cantilever slab, then the load can be distributed along the root of the cantilever for a length equal to twice the distance of the centre of the load to the root or a constant moment per metre of root can be applied of:<br>\[ \frac{PL}{L^2} = \frac{P}{2} \text{ t per m} \]
At the free ends of the slab, such moment shall be doubled. |
| (ii) Any variation in the above load for change in the span length. | *(Articles referred to relate to)*<br>**Transport-Communications Monthly Review**<br>December 1965<br>**Transport-Communications More**<br>*Clauses referred to the Indian Roads Congress Standard Specifications and Code of Practice for Road Bridges—Sections I and II (1964).*

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<th>MALAYSIA</th>
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</table>
| It is not specified, but considered as the case may be. | 2 ft surcharge of earth is assumed in abutment design. | Clause 2.19*  
Surcharge effect on the abutment due to the live load approach fill shall be equal to not less than 4 ft of earth.  
No surcharge effect to be taken if adequately designed R.C.C. approach slab is provided. |
| B.S. 153: Part 3A; 1954 Clause 4G | | Clause 2.12*  
5 ft minimum width  
(i) 80 lb per sq. ft. of footway area for design of footway, stringers and their immediate supports. For metropolitan areas, it should be 100 lb per sq. ft.  
(ii) Girders, trusses, arches and members of main structure shall be designed for the following L.L. per sq. ft. of footway area:  
Span 0—25 ft—80 lb  
" 26—100 ft—60 lb  
" Over 100 ft—40 lb |
| (i) 500 kg per m² | (i) 100 lb per sq. ft. upto 75 ft | |
| (ii) No | (ii) Over 75 ft length, the standard uniformly distributed loads given in type HA loading multiplied by a reduction factor of 80/2200. | (ii) An isolated concentrated extra load of 4,000 lb |
| (iii) No | (iii) A wheel load of 4 Tons, distributed over a contact area of 12 in. in diameter. The working stress shall be increased by 25 per cent to meet this provision. | |

* Clauses referred to relate to Highway Bridge Design Specifications of N.A. of A.S. Road Authorities (1965).
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<th>NORWAY</th>
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<tbody>
<tr>
<td>When highway traffic can come within a distance from the top of the structure equal to one half the height, the pressure shall have added to it a surcharge pressure equal to not less than 2 ft of filling.</td>
<td>Usually a surcharge of 2 t per sq. metre has been considered for abutment design. A differentiation between low and high abutments ought to be introduced.</td>
<td>2 ft L.L. surcharge to be added to earth pressure.</td>
</tr>
<tr>
<td><strong>Minimum width 4 ft</strong></td>
<td><strong>For design of footpath structures</strong>: 400 kg per m²</td>
<td><strong>Minimum width—2 ft 6 in. clear.</strong></td>
</tr>
<tr>
<td>(i) 60 lb per sq. ft. (50 per cent of this when combined with main traffic live loads).</td>
<td>(i) Contemporary footpath loading and local load according to Q. 2 200 kg per m² footpath.</td>
<td>(i) 85 lb per sq. ft.</td>
</tr>
</tbody>
</table>
| (ii) No | (ii) Contemporary footpath loading and equivalent loading according to Q. 1: 0.1 × P per sq. metre foot-path and not more than 200 kg per m². | (ii) Spans upto 0—25 ft 85 lb per sq. ft. Spans from 26 ft to 100 ft—60 lb per sq. ft. Over 100 ft spans—  
\[ P = (30 + \frac{3000}{L}) \times \frac{(55-W)}{50} \]  
P = L.L. per sq. ft. (maximum 60 lb per sq. ft.)  
L = loaded length of sidewalk in ft  
W = width of sidewalk. |
| (iii) No allowance | (iii) Control for a "runway" wheel of 6'5t (without impact) placed with its contact area close to railing. 50 per cent overstressing permitted. | (iii) Concentrated wheel load of 15600 lb applied one foot from the face of rail.  
\[ \text{Stress } f_s = 30000 \text{ p.s.i.} \]  
\[ f_c = 1670 \text{ p.s.i.} \]  
\[ N = 10 \] |
<table>
<thead>
<tr>
<th>RHODESIA</th>
<th>SWEDEN</th>
<th>SWITZERLAND</th>
<th>TURKEY</th>
</tr>
</thead>
<tbody>
<tr>
<td>See clause 1.4 B.S. 153/1954 Part 3</td>
<td>1.5 t per m² each lane of 3 m width. For more than 2 lanes, the surcharge may be reduced in the same proportion as the loading, i.e., for more than two lanes, only 50 per cent extra lanes is to be added. This surcharge may be considered uniformly distributed over the width of abutment.</td>
<td>2 tonnes per m²</td>
<td>0.80 m extra height of earth fill.</td>
</tr>
<tr>
<td>Minimum width 2 ft 6 in. Minimum width—1.5 m. Separate footpath</td>
<td></td>
<td></td>
<td>Minimum width—0.75 m</td>
</tr>
<tr>
<td>(i) 80 lb per sq. ft.</td>
<td>(i) 400 kg per m² uniformly distributed when loaded length exceeds 10 m. The above mentioned load be reduced for main girders and arches to 1/6 pt. per m² P=uniform lane loading as per Fig. 15 in Plate IV.</td>
<td>(i) Main roads.... 360 kg per m² Secondary roads... 240 kg per m²</td>
<td>(i) 300 kg per m² (for spans upto 30 m)</td>
</tr>
<tr>
<td>(ii) Clause 4C, B.S. 153/1954 Part 3 Section A</td>
<td>(ii) No</td>
<td>(ii) p=(0.3 + 0.9L)/(5.5 - W/3)</td>
<td>(w per m²) for spans bigger than 30 m L=span length in m, W=footpath width in m</td>
</tr>
<tr>
<td>(iii) Accidental loading of a 4 Ton wheel is investigated at edge of parapet, allowing 25 per cent increase in permissible working stresses.</td>
<td>(iii) Single axle load of 14 t (without impact) placed near the railing. For dead load plus single axle load of 14 t the stresses allowed may not exceed lower yield point of steel and 1/2 cube strength of concrete respectively.</td>
<td>(iii) Single wheel load of 6 tonnes</td>
<td>(No over stressing)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QUESTIONS</td>
<td>AMERICA (U.S. Bureau of Public Roads)</td>
<td>AUSTRIA</td>
<td>CANADA</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------------------------</td>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td>11. Foot bridges.</td>
<td>Article 1.2.11*</td>
<td>(i) No such minimum widths specified.</td>
<td>(i) No standard dimensions.</td>
</tr>
<tr>
<td>(i) The minimum width of foot bridge acceptable.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii) The loading specified in the design of the deck in</td>
<td>(ii) No distinction made.</td>
<td>(ii) Austrian standards assume no different loads for rural and urban areas.</td>
<td></td>
</tr>
<tr>
<td>(a) Urban areas</td>
<td></td>
<td>Bridge class I—uniform load of 0.5 t per m²</td>
<td></td>
</tr>
<tr>
<td>(b) Rural areas</td>
<td></td>
<td>Bridge class II—uniform load of 0.4 t per m²</td>
<td></td>
</tr>
<tr>
<td>(iii) Loading stipulated for the design of hand-rails.</td>
<td>(iii) See Fig. 5 in Plate I.</td>
<td>(iii) 0.08 t per m on the upper edge of the hand-rail in horizontal and vertical direction.</td>
<td></td>
</tr>
<tr>
<td>12. Any formulae stipulated for calculating the impact on piers and abutments due to floating objects in the river</td>
<td>Article 1.2.17*</td>
<td>(i) No details given.</td>
<td></td>
</tr>
<tr>
<td>(i) floating timber</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii) vessels and small river craft</td>
<td>(ii) No details given.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(iii) ice</td>
<td>(iii) No details for impact of ice are given.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>However ice pressure on piers to be taken at 400 lb per sq. in. The thickness and height of ice to be determined by site investigation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Any other information supplied.</td>
<td>Clearance. For structures over Interstate Highway System—16 ft clear over the entire width of roadway including shoulders.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Articles referred to relate to the A.A.S.H.O. Standard Specifications for Highway Bridges (1961).
<table>
<thead>
<tr>
<th>FINLAND</th>
<th>FEDERAL REPUBLIC OF GERMANY</th>
<th>GREAT BRITAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) 4-0 m</td>
<td>(i) —</td>
<td>(i) 6 ft</td>
</tr>
<tr>
<td>(ii)</td>
<td>(ii) No special specification</td>
<td>(ii)</td>
</tr>
<tr>
<td>(a) 400 kg per m² or 7 ton axle</td>
<td>(a) 100 lb per sq. ft.</td>
<td></td>
</tr>
<tr>
<td>(b) — do —</td>
<td>(b) 80 lb per sq. ft.</td>
<td></td>
</tr>
<tr>
<td>(iii) Uniformly distributed load 80 kg per m concentrated load 100 kg (vertical or horizontal).</td>
<td>(iii) Between 50 lb and 100 lb per linear foot according to situation. The force to be applied 3 ft above the footway.</td>
<td>No specification.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>FINLAND</th>
<th>FEDERAL REPUBLIC OF GERMANY</th>
<th>GREAT BRITAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(i) protection required</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) 1-0......3-0 t per m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iii) 10......20 t per m solid</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10......50 t per m floating</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Minimum headroom provided:
(a) overall roads-16 ft 6 in.
(b) In pedestrian subways-7 ft.
(c) In cycle or combined cycle and pedestrian subways-7 ft 6 in.
(d) In cattle creeps-8 ft.

For detailed information refer B.S. 153—Girder Bridges Part 3 loads-stresses, Section—A loads, and Ministry of Transport Memorandum No. 771.

123
<table>
<thead>
<tr>
<th></th>
<th>QUESTIONS</th>
<th>INDIA</th>
<th>ITALY</th>
<th>JAPAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Foot bridges.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(i) The minimum width of foot bridge acceptable.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) The loading specified in the design of the deck in</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Urban areas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) Rural areas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iii) Loading stipulated for the design of hand-rails.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Any formulae stipulated for calculating the impact on piers and abutments due to floating objects in the river</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(i) floating timber</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) vessels and small river craft</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iii) ice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Any other information supplied.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Articles referred to relate to the Indian Roads Congress Standard Specifications and Code of Practice for Road Bridges-Sections I & II (1964).

*Clause referred to relates to the Indian Roads Congress Standard Specifications and Code of Practice for Road Bridges-Sections I & II (1964).
<table>
<thead>
<tr>
<th>MALAYSIA</th>
<th>NEW SOUTH WALES</th>
<th>NEW ZEALAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) 6 ft</td>
<td>Clause 2.12*</td>
<td>(i) Minimum width between rails to be 6 ft.</td>
</tr>
<tr>
<td>(ii)</td>
<td>(i) not given</td>
<td>(ii)</td>
</tr>
<tr>
<td>(a) 100 lb per ft</td>
<td></td>
<td>(a) Live load 100 lb per sq. ft.</td>
</tr>
<tr>
<td>(b) —do—</td>
<td></td>
<td>(b) Live load 60 lb per sq. ft. (except over motorways)</td>
</tr>
<tr>
<td>(iii) 25-100 lb per linear ft</td>
<td>(iii) Top members of railings Lateral horizontal force of 150 lb per linear ft and simultaneous vertical force of 100 lb per linear foot applied at top of railing. Lower railing: Lateral horizontal level force for 150 lb per linear ft.</td>
<td>(iii) Lateral load of 60 lb per linear ft applied at top rail level.</td>
</tr>
<tr>
<td>Clause 15, B.S. 153—Part 3A:1954</td>
<td></td>
<td>Nil</td>
</tr>
<tr>
<td>Nil</td>
<td>Clause 2.17*</td>
<td>Not taken into account.</td>
</tr>
<tr>
<td>(i) Force to be calculated on the assumptions that the log weighs 2 Tons and travels at normal stream velocity. The log shall be stopped in a distance of 1 foot for timber piers, 6 in. for column type piers and 3 in. for solid type concrete piers. Should fender piles or timber sheathing be placed upstream from the pier to absorb the energy of the blow, distances may be increased.</td>
<td>(ii) No details given.</td>
<td></td>
</tr>
<tr>
<td>(iii) —do—</td>
<td>(iii)</td>
<td></td>
</tr>
</tbody>
</table>

*Clauses referred to relate to Highway Bridge Design Specifications of N.A. of A.S. Road Authorities (1965).
<table>
<thead>
<tr>
<th>NORWAY</th>
<th>PHILIPPINES</th>
<th>RHODESIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>So far no specifications adopted.</td>
<td>(i) 5 ft (clear roadway)</td>
<td>(i) 2 ft 6 in. 8 ft, if combined with cycle track bridge.</td>
</tr>
<tr>
<td>(ii)</td>
<td>(ii) Section 4 C, B. S. 153/1954 Part 3 Section A</td>
<td></td>
</tr>
<tr>
<td>(a) 100 lb per sq. ft.</td>
<td>(a) 50 lb per sq. ft.</td>
<td></td>
</tr>
<tr>
<td>(b) —do—</td>
<td>(b) —do—</td>
<td></td>
</tr>
<tr>
<td>(iii) 150 lb per sq. ft. horizontal force with simultaneous vertical force of 150 lb per sq. ft. applied at the top of railing.</td>
<td>(iii) 500 lb horizontal force at 2 ft 6 in. above surface level.</td>
<td></td>
</tr>
</tbody>
</table>

So far no specifications adopted. Velocity of flowing water only considered.

\[ P = KV^2 \]

where

\[ V = \text{Velocity of water in ft per sec.} \]

\[ K = \text{a constant which is } \frac{1}{4} \text{ for square ends, } \frac{1}{2} \text{ for angle end where the angle is 30 degrees or less and } \frac{2}{3} \text{ for circular pier.} \]

\[ P = \text{pressure in lb per sq. ft.} \]

(i) No particular formulae adopted. Each structure treated according to the vegetation types predominant in its catchment area, e.g. heavy large trees, excessive bush, etc.

(ii) N/A

(iii) N/A
<table>
<thead>
<tr>
<th>SWEDEN</th>
<th>SWITZERLAND</th>
<th>TURKEY</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) 2.5 m</td>
<td>(i) Not prescribed.</td>
<td>(i) 2.5 m</td>
</tr>
<tr>
<td>(ii) 400 kg per m². In special case, the load may be reduced to 250 kg per m².</td>
<td>(ii) 360 kg per m² and one over load of one t.</td>
<td>(ii)</td>
</tr>
<tr>
<td>(iii) Transverse live load of 100 kg per m applied at the top of railing.</td>
<td>(iii) 120 kg per m in towns 80 kg per m outside the towns.</td>
<td>(iii) 100 kg per m</td>
</tr>
<tr>
<td>(i) Nil</td>
<td>Not prescribed</td>
<td>(i) — —</td>
</tr>
<tr>
<td>(ii) Nil</td>
<td></td>
<td>(ii) — —</td>
</tr>
<tr>
<td>(iii) Between 10 and 20 t per m of abutment or pier in question. In flowing water with ice, block pressure parallel to the stream may be assumed between 0.5 to 1.5 t per m of span length and 1/5th thereof perpendicular to the stream.</td>
<td></td>
<td>(iii) 30 kg per cm² multiplied by the area consisting of the width of the pier and the thickness of ice.</td>
</tr>
<tr>
<td>Vertical clearance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Roadway 4.6 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii) Cycle track 2.5 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(iii) Foot-path 2.2 m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
BELGIUM

1. Normal train loading

Over traffic lane 2.50 m² minimum wide to 4 m maximum wide and simultaneously a load of 400 kg per m² uniformly distributed on the carriageways and footpaths.

2. Lateral disposition of train loading

3. Number of train loadings

One train loading over traffic lane plus a load of 400 kg per m².

4. Effective wind pressure

The area of the train of vehicles assumed in elevation is a rectangular screen 2 m high with a length equal to the length of the train.

5. Impact factor

The impact factor due to live loads is the same for in question No. 1—i, ii, iii; and is given by the following formula:

\[ \varphi = 1 + 0.377 \frac{v}{\sqrt{l \alpha}} \sqrt{1 + \frac{2Q}{P}} \]

where

- \( v \) = speed in kilometre per hour, always greater than 60
- \( l \) = distance between supports, in metre
- \( \alpha \) = \( \frac{l}{f_s} \)
- \( f_s \) = static deflection, in metre, due to dead weight
- \( Q \) = moving loads on the bridge deck, in tonnes
- \( P \) = deadweight of the bridge, in tonnes
The nose-to-tail spacing between two such vehicles shall not be less than 300 ft.

For dual-lane bridges and tunnels, one train of Class AA tracked or wheeled vehicles, whichever creates conditions shall be considered for every two-traffic-lane width. No other live load shall be considered on any part of the said 2-lane width carriageway of the bridge when the above mentioned train of vehicles is crossing the bridge.

For the wheeled vehicle, 40 tons for a bogie spaced not more than 12 ft centres.

The minimum clearance between the road face of the kerb and the outer edge of the wheel or track, CL shall be as under:

<table>
<thead>
<tr>
<th>Carriageway Width</th>
<th>Minimum Value of C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 12 ft</td>
<td>1.5 m</td>
</tr>
<tr>
<td>12 ft and above</td>
<td>1.6 m</td>
</tr>
</tbody>
</table>

No other live load shall cover any part of the carriageway when a train of vehicles or trains of vehicles in a multiple-lane bridge is crossing the bridge.

The ground contact area of the wheels shall be as under:

<table>
<thead>
<tr>
<th>Axle Load</th>
<th>Ground Contact Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>15,000 lb</td>
<td>9.0 sq ft</td>
</tr>
<tr>
<td>25,000 lb</td>
<td>15.0 sq ft</td>
</tr>
</tbody>
</table>

The minimum clearance, g. between the outer edge of the wheel and the shoulder of the road, and the minimum clearance, f. between the outer edge of passing or crossing vehicles on tracks, shall be as given below:

<table>
<thead>
<tr>
<th>Span Feet (F)</th>
<th>Clearance, g. (G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 to 20 ft</td>
<td>Uniformly increas-</td>
</tr>
<tr>
<td>21 to 25 ft</td>
<td>ing from 6 in. to 3</td>
</tr>
<tr>
<td>26 to 30 ft</td>
<td>in.</td>
</tr>
<tr>
<td>31 to 35 ft</td>
<td>8 in.</td>
</tr>
<tr>
<td>36 to 40 ft</td>
<td>10 in.</td>
</tr>
<tr>
<td>41 to 45 ft</td>
<td>12 in.</td>
</tr>
</tbody>
</table>

The maximum clearance, f., between the outer edge of the wheel and the shoulder of the road, and the maximum clearance, g., between the outer edge of passing or crossing vehicles on tracks, shall be as given below:

<table>
<thead>
<tr>
<th>Span Feet (F)</th>
<th>Clearance, g. (G)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>21 to 25 ft</td>
<td>ing from 6 in. to 3</td>
</tr>
<tr>
<td>26 to 30 ft</td>
<td>in.</td>
</tr>
<tr>
<td>31 to 35 ft</td>
<td>8 in.</td>
</tr>
<tr>
<td>36 to 40 ft</td>
<td>10 in.</td>
</tr>
<tr>
<td>41 to 45 ft</td>
<td>12 in.</td>
</tr>
<tr>
<td>46 to 50 ft</td>
<td>14 in.</td>
</tr>
</tbody>
</table>

The minimum clearances between successive trains shall be 60 ft.

No other live load shall cover any part of the carriageway when a train of vehicles on a multiple-lane bridge is crossing the bridge.

The ground contact area of the wheels shall be as under:

<table>
<thead>
<tr>
<th>Axle Load</th>
<th>Ground Contact Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>15,000 lb</td>
<td>9.0 sq ft</td>
</tr>
<tr>
<td>25,000 lb</td>
<td>15.0 sq ft</td>
</tr>
</tbody>
</table>

The minimum clearances, g., between the outer edge of the wheel and the shoulder of the road, and the minimum clearances, f., between the outer edge of passing or crossing vehicles on tracks, shall be as given below:

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<tr>
<th>Span Feet (F)</th>
<th>Clearance, g. (G)</th>
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<tbody>
<tr>
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</tr>
<tr>
<td>21 to 25 ft</td>
<td>ing from 6 in. to 3</td>
</tr>
<tr>
<td>26 to 30 ft</td>
<td>in.</td>
</tr>
<tr>
<td>31 to 35 ft</td>
<td>8 in.</td>
</tr>
<tr>
<td>36 to 40 ft</td>
<td>10 in.</td>
</tr>
<tr>
<td>41 to 45 ft</td>
<td>12 in.</td>
</tr>
</tbody>
</table>

The maximum clearances, f., between the outer edge of the wheel and the shoulder of the road, and the maximum clearances, g., between the outer edge of passing or crossing vehicles on tracks, shall be as given below:

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<tr>
<th>Span Feet (F)</th>
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<td>ing from 6 in. to 3</td>
</tr>
<tr>
<td>26 to 30 ft</td>
<td>in.</td>
</tr>
<tr>
<td>31 to 35 ft</td>
<td>8 in.</td>
</tr>
<tr>
<td>36 to 40 ft</td>
<td>10 in.</td>
</tr>
<tr>
<td>41 to 45 ft</td>
<td>12 in.</td>
</tr>
</tbody>
</table>
ITALY
CIVIL LOADING

**Type 1**
CONTINUOUS TRAIN OF 12 TRUCKS
SINGLE 18 T STEAM ROLLER

**Type 2**

**Type 3**
CONTINUOUS TRAIN OF MILITARY LOAD OF 45 T

**Type 4**
CONTINUOUS TRAIN OF MILITARY LOAD OF 32 T

**Type 5**
SINGLE MILITARY LOAD OF 76.5 T

---

**PHILIPPINES**

**SWEDEN**

**TRAFFIC LOADING FOR BRIDGES**

**CL. Lane Loading**

1. **One-14 T Axle-Load Plus Distributed Load p t/m.**

   \[ P = 14t \]

   \[ L < 10 \]

   \[ p = 24 \]

   \[ L = 10 - 90 \]

   \[ p = 24 \]

   \[ \frac{13(L - 10)}{10} \]

   \[ L > 90 \]

   \[ p = 11 \]

---

**Fig. 14.**

**Fig. 15.**

---

**December 1965**
BARAK BRIDGE

When completed this bridge will have the largest prestressed span of any bridge so far built in India.

The bridge will be 924 ft. long with deckings of 77 ft.—185 ft.—400 ft.—185 ft.—77 ft. span, providing a 24 ft. wide roadway. This "Cantilever" in-situ construction was done without staging, which ensured navigation during construction.

Prestressing has been done by the Freyssinet method.

Designed and constructed to the orders of the Chief Engineer (Roads) P.W.D., Shillong, Assam.

By

GAMMON INDIA LIMITED
Civil Engineers & Contractors
Gammon House, Prabhadevi, Cadell Road,
BOMBAY - 28 DD.

Telephones : \{ 454261 (5 lines) 452214 - 452215 \}

Telegrams : \{ "Gammon", Bombay Dadar. \}
S. B. JOSHI & CO. LTD.
STRUCTURAL ENGINEERS & CONTRACTORS,
Registered Office:
Examiner Press Building,
35, Dalal Street,
Fort, BOMBAY-1.

We undertake design and construction of major Civil Engineering works including R. C. C. and Prestressed Bridges, Factories, Tunnels, Dams and Marine Works.

KOSI BRIDGE AT RAMPUR (U.P.)
Supported on 81' Deep Well Foundations R.C.C. Box Girder Balanced Cantilever Type Bridge over River Kosi at Rampur on National Highway No. 24 was Completed in July 1965 in Just 15 Working Months—Length: 1055'-0" Span: 135'-0"

Regional Offices: Cuttack (Orissa), Lucknow (U.P.) and Patna (Bihar).
ALLWYN

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An artist’s impression of the Thana Creek Bridge

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