STANDARD PLANS FOR HIGHWAY BRIDGES
PRESTRESSED CONCRETE BEAMS & R.C.C. SLAB TYPE SUPERSTRUCTURE

VOLUME - II
ONE END STRESSING
PART 1 : STRAND SYSTEM
PART 2 : MULTI WIRE SYSTEM

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PREFACE

In 1991, Ministry had issued standard T-beam and slab prestressed concrete superstructure plans for 2-lane carriageway having spans 30 m (with and without footpaths) 35 m (with footpaths) and 40 m (without footpaths). These drawings envisage strand prestressing from both ends. In such method, it is essential that prestressing force at both ends should be applied simultaneously and of equal magnitude. This requirement can be achieved only if there is proper coordination/control between the technical staff at both the ends.

To overcome these difficulties and to maintain pace with the developed countries, it was decided to review the designs and drawings which envisage imparting prestressing force from one end only so that technical site staff can have better control during cable extensions.

Further, since high capacity multi-wire cables are available in the market, it was decided to evolve prestressed concrete superstructure drawings using such multi-wire cables.

Accordingly, suitability of already evolved prestressed concrete superstructure plans has been reviewed for adoption of one end prestressing strand system. It is observed that all other details except cable extensions will be identical to the details finalised for two end prestressing system issued earlier. The minor modifications have been carried out in drawings bearing Nos. SD/031 (Sheets 1 & 2), 312, 322, 332 and 342 for respective spans and new drawings bearing Nos. SD/401 (Sheets 1 & 2), 412, 422, 432 and 442 have been presented in part 1 of this volume. Other drawings pertaining to respective spans are available in earlier drawing folders and should be used without modification.

For adoption of multi wire cables (42 wires of 7 mm dia each), while concrete sections finalised earlier have been kept unaltered, slight modification in the cable profile has been found necessary. While reviewing the design, zero and 6 mm slip has been considered at one end only. Accordingly, drawings indicating general notes, anchorage details, cable profile and reinforcement in each end cross girder have been evolved afresh and presented in Part 2 of this volume.

For each type of system, a statement showing bill of quantities of various items has been appended to facilitate preparation of estimate for bridge superstructure based on these drawings.

It is hoped that the new drawings shall be of great use for adoption in the field. While every care has been taken to eliminate any error, error/omission that may come to notice while using these drawings for execution, may please be communicated to the Ministry.

The work of preparing the design and drawings has been carried out by Ms. Tandon Consultants Pvt. Ltd., New Delhi, and has been finalised by the officers of the Ministry. Their efforts deserve appreciation.

Dated: 6th June, 1995

M.V. Sastry
Director General (Road Development)
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PART 1. STRAND SYSTEM
(A) GENERAL

1. These notes are applicable for the Standard Drawings for Prestressed Concrete Girders and RC Slab Type Composite Superstructure with and without footpaths.

2. The drawings are applicable only for right bridges.

3. The design is according to the following Codes:

   I IRC: 5-1985
   II IRC: 6-1966 (1981 Print)
   III IRC: 18-1985
   IV IRC: 21-1987
   V IRC: 22-1966
   VI IRC: 83-1982 (Part 1)
   VII IRC: SP: 33-1989

4. All dimensions are in mm. Only written dimensions shall be followed. No drawing shall be scaled.

5. Public utility services (except water supply and sewerage), if required, shall be carried over the bridge through 150 mm dia ducts provided in the footpaths. Total load of such services shall not be more than 1.0 kN/m on each footpath.

6. Bituminous wearing coat shall comprise the following:

   (i) A layer of mastic asphalt, 6mm thick (12 mm for high rainfall area) after applying a prime coat over the top of the deck, before the wearing coat is laid.
   (ii) 50 mm thick asphaltic concrete wearing coat in two layers of 25 mm each.

   Note 1. For high traffic density, an alternative specification for wearing course comprising 40 mm bituminous concrete overlaid with 25 mm thick bitumen mastic layer can be adopted.

   Note 2. All the work of wearing coat may be done as per Section 500 of MOST’s Specification.

7. The following loads have been considered in the design:

   (i) One lane of IRC Class 70R or two lanes of IRC Class A on carriageway, whichever governs.
   (ii) Footpath load of 5 kN/sq.m. for superstructure having footpaths.
   (iii) Wearing Coat load of 2 kN/sq.m.

8. The designs are applicable for “moderate” and “severe” conditions of exposure. In case of “severe” conditions suitable anti-corrosion treatment as approved by Engineer-in-Charge may be provided to reinforcement bars and exposed concrete surface.

(B) MATERIAL SPECIFICATIONS

Concrete

1. Concrete shall be design mix and have minimum 28 days characteristic strength of 40 MPa on 150 mm cubes for all elements of superstructure.

2. Ordinary Portland Cement conforming to IS: 269 or High strength Ordinary Portland Cement conforming to IS: 8112 capable of achieving the required design concrete strength shall only be used.

3. To improve workability of concrete and cement grout, admixtures conforming to IS: 6925 and IS: 9103 could be permitted subject to satisfactory proven use. Admixtures generating hydrogen, nitrogen, chlorides, etc., should not be used.

4. Cement content in concrete shall not be less than 400 kg/m³ nor more than 540 kg/m³ of concrete.

5. Maximum water cement ratio shall be as follows:
   - Deck Slab 0.40
   - Procast Girdor 0.40

Reinforcement

6. Reinforcing Steel shall be of HYSD bars (Grade designation S:415) conforming to IS: 1796.

Prestressing Steel and Accessories

7. Cable consisting of 12 nos. of 12.7 mm dia. 7-wire Class 2 Strand as per IS: 6006-1963 shall be used for main prestressing.

8. For future prestressing, single 12.7 mm dia. 7-wire Class 2 Strand as per IS: 6006-1963 shall be used.

9. The prestressing steel and accessories shall be subjected to an acceptance test prior to their actual use on the works (Guidance may be taken from BS: 4447). Only multi-strand jacks shall be used for tensioning of cables. Direct and indirect force measurement device (e.g. Pressure Gauge) to be attached in consultation with system manufacturer.

10. Anchorages at dead end shall be used similar to those used at the “live end”. The use of buried type of anchorages at “dead end” are not permitted.

11. The strands at dead end anchorage shall be pre-blocked prior to tensioning from the live end. During tensioning of cable if there is any slip at the “dead end” the same shall be added to the extension required at the stressing end.

Sheathing

12. Sheathing shall be of “Drossbach” type 75 mm ID manufactured from minimum 0.4 mm thick bright metal strip. It shall be tested as per IRC: 18-1985, Appendix: f.

Water

13. Water to be used in concreting, grouting and curing shall conform to Clause 5.1 (ii) of IRC: SP: 33-1989.

Expansion Joints

14. Expansion joints must be robust, durable, watertight and replaceable. It must be provided over the full width of deck and follow the profile including kerb, footpath (where relevant) and facia. Expansion joints shall be obtained only from approved manufacturers and be of proven type. Details of expansion joints may be got approved before commencement of construction. Site fabricated expansion joints shall be prohibited.

15. Expansion joints shall have the following additional essential features:
   (a) It shall cater for a total movement of ± 40 mm
   (b) It shall be provided with a waterproof membrane to ensure against leakage below the joint.
   (c) It shall have a cushion of elastomer to enable absorption of shock transmitted by vehicles.

16. Fabricated steel parts shall be positioned accurately before concreting the portion of deck slab beyond the end faces of the main girders.

17. Presence of manufacturer’s representative at the time of positioning of embedded parts and installation of expansion joints is mandatory.

GOVERNMENT OF INDIA
MINISTRY OF SURFACE TRANSPORT
(ROADS Wing), NEW DELHI

STANDARD DRAWINGS FOR ROAD BRIDGES

PSC GIRDER AND RC SLAB COMPOSITE SUPERSTRUCTURE WITH AND WITHOUT FOOTPATHS

GENERAL NOTES

ONE END STRESSING

RECOMMENDED BY: S/P: (D.K. RASTOGI) S.E. APPROVED BY: S/P: (M.K. MUKHERJEE) C.E.

1992

DRG NO. SD/601 SHEET NO. 1
18. The initial gap between the adjacent movable concrete faces shall be fixed in consultation with the manufacturer of the expansion joint. However, the initial gap shall not be less than 30mm at the time of concreting.

(C) CONSTRUCTION

Sequence

Day   Activity
14    Stressing of 1st stage cables
21    Casting of cross girders and deck slab except its portion beyond the end faces of main girders
49    Casting of portion of the deck slab beyond the end faces of main girders and casting of superimposed dead loads other than wearing coat
56    Stressing of 2nd stage cables
After  Laying of wearing coat

Stressing of 1st stage cables can be done earlier on achieving a strength of 35 MPa. Subsequent activities can also be advanced keeping the same time intervals.

2nd stage cables shall be stressed progressively one at a time in the three girders.

Launching Truss

The design is based on cast-in-situ construction. However, launching of girders may be permitted for which the load from leg of launching truss should not exceed the value given in relevant drawing.

(D) WORKMANSHIP/DETAILING

1. Minimum cover to any reinforcement shall be 50 mm unless shown otherwise in the drawing.

2. For ensuring proper cover of concrete to reinforcement bars, specially made polymer cover blocks shall only be used.

3. Construction joints shall be provided at locations shown in drawings.

4. Welding of reinforcement bars shall not be permitted.

5. Bonding of reinforcement bars to be as per IS: 2502-1963.

6. Minimum lap length shall be kept as 63 d where “d” is the diameter of bar.

7. Supporting chairs of 12 mm dia. shall be provided at suitable intervals, as per IS: 2502.

8. Sharp edges of concrete shall be chamfered (10 mm x 10 mm)

9. Shuttering plates shall suitably be stiffened to enable the compaction by form vibrators.

10. Full width screed vibrator shall be used for compaction of concrete in deck slab.

11. The jacking force in each cable is 1543 kN to be imparted at stressing end only by using multi strand jack.

12. The following properties have been considered in the design:

(i) Area of 1 strand = 98.7 mm²
(ii) Wobble coefficient k = 0.0046/m
(iii) Friction coefficient µ = 0.25
(iv) Modulus of elasticity of steel in strand = 1.95 x 10⁵ MPa
(v) Average slip = 6 mm

13. Minimum strength of concrete at the time of tensioning of cables shall be 35 MPa or as recommended by system manufacturer, whichever is higher.


15. For future prestressing in case of bridge distress, single 12.7 mm dia. 7-ply Class 2 strands as per IS: 6006-1983 shall be used. The tensioning force per strand shall be 128.6 kN. Mono strand jacks shall be used for tensioning of strands utilising approved prestressing system only. The externally placed strands shall be protected by polyethylene sheathing and grouted.

16. The location of jacks for lifting up the superstructure to replace bearing etc., is shown thus. This shall be distinctly etched on end cross-girders and pier/abutment caps.

(E) REFERENCE TO DRAWINGS

Drawing No. | Title
---|---
SD/302 | General Arrangement
SD/303 | Details of wearing coat and drainage system
SD/304 | Details of RCC Railing for Superstructure without footpaths
SD/305 | Details of RCC Railing for Superstructure with footpaths
SD/306 | Details of Bearings

(Sheets 1, 2 & 3)

In case any other type of railing is used, prior approval shall be obtained.

(F) SPECIAL NOTE FOR PRESTRESSING

If the calculated elongation is reached before the calculated gauge pressure is obtained, continue tensioning till attaining the calculated gauge pressure, provided the elongation does not exceed 1.05 times the calculated elongation. If this elongation is achieved before the calculated gauge pressure is attained, stop stressing and inform the engineer.

If the calculated elongation has not been reached continue tensioning by intervals of 5 kg/sq. cm. until the calculated elongation is reached provided the gauge pressure does not exceed 1.05 times the calculated gauge pressure.

If the elongation at 1.05 times the calculated gauge pressure is less than 0.95 times the calculated elongation, the following measures must be taken, in succession, to define the cause of this lack of elongation:

- Recalibrate the pressure gauge.
- Check the correct functioning of the jack, pump and leads.
- De-tension the cable. Slide it in its duct to check that it is not blocked by mortar which has entered through holes in the sheath. Retension the cable, if free.

If the required elongation is not obtained, further finishing operations such as cutting or sealing, should not be undertaken without the approval of the engineer.
### BILL OF QUANTITIES (PER SPAN)
FOR STANDARD PLANS FOR HIGHWAY BRIDGES
PRESSTRESSED GIRDER & RCC SLAB SUPERSTRUCTURE
(WITH PRESSTRESSING CABLES COMPRISING OF STRANDS)

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Note: Quantities mentioned above are applicable to Drawings issued in Vol. I as well as Vol. II Part 1.
NOTES:

1. The stressing or live anchorages of all the cables will be located at some end of the girder.
2. The length of cables indicated are measured along profile between end faces of prestressing girder. Additional length required for attaching jack of live end is to be added in consultation with system manufacturer.
3. The extensions indicated are for portion of cables lying between end faces of prestressing girder. Additional extension for portion lying between end face and gripping point of jack at stressing end is to be added (approx. 7mm/1m).
4. The extensions are based on the following data:
   i) Webbing coefficient \( k = 0.0046 \)
   ii) Friction coefficient \( \alpha = 0.25 \)
   iii) Modulus of Elasticity of steel in strand \( E_s = 1.95 \times 10^6 \text{MPa} \)
5. The sequence of stressing of prestressing cables shall be as follows:
   Stage 1. Nos. 1, 2, 3 and 4 (14th day after casting of girder).
   Stage 2. Nos. 5 (15th day after casting of girder) or 8th day after casting deck slab whichever is later. Superimposed dead loads will be placed immediately after stage 2 prestressing.
6. All cables are to be smooth profile (without kinks) passing through given ordnates and firmly supported at every 1.0m interval as shown.
7. For other details refer following drawings:
   i) General Notes
   Drg. No. SD/440 (sheet 1 & 2)
   ii) Distant Columns & Anchorages Details
   Drg. No. SD/311
   iii) Reinforcement in Deck slabs & Kerbs
   Drg. No. SD/313
   iv) Reinforcement in Main Girders
   Drg. No. SD/314
   v) Reinforcement in End Cross Girders
   Drg. No. SD/315
   vi) Reinforcement in Intermediate Cross Girders
   Drg. No. SD/316
   vii) Schedule of Reinforcement
   Drg. No. SD/317 (sheet 1, 2 & 3)
NOTES:
1. The stressing or live anchorages of all the cables will be located at same end of the girder.
2. The length of cables indicated are measured along profiles between end faces of precast girder. Additional length required for attaching jack at live end is to be added in consultation with system manufacturer.
3. The extensions indicated are for portion of cables lying between end faces of precast girder. Additional extension for portion lying between end face and gripping point of jack of stressing end is to be added (approx: 7mm/ft).
4. The extensions are based on the following data:
   i) Wobble coefficient $k = 0.20$ gi/ft
   ii) Friction coefficient $j = 0.25$
   iii) Modulus of Elasticity of steel in strand, $E_s = 295$ x 10^6 psi
5. The sequence of stressing of prestressing cables shall be as follows:
   Stage 1: Nos. 1, 2, 3, 4 and 5 (4th day after casting of girder)
   Stage 2: Nos. 7, 8, 9, 10 and 11 (5th day after casting of girder or 9th day after casting of deck slab whichever is later). Superimposed dead loads will be placed immediately after stage 2 prestressing.
6. All cables are to have smooth profile without kinks passing through given ordinates and firmly supported at every 1m interval as shown.
7. For other details refer following drawings:
   i) General Notes
      Org. No. SD/401/Sheet 182
   ii) Dimension & Anchorage Details
      Org. No. SD/330
   iii) Reinforcement in Deck Slab, Kerbs and Footpaths
      Org. No. SD/323
   iv) Reinforcement in main Girders
      Org. No. SD/265
   v) Reinforcement in End Cross Girders
      Org. No. SD/325
   vi) Reinforcement in Intermediate Cross Girders
      Org. No. SD/325
   vii) Schedule of Reinforcement
      Org. No. SD/327 Sheets 1-2, E33

**LEGEND**
- Indicates start of curve in Elevation
- Indicates end of curve in Elevation
- Indicates start of curve in Plan
- Indicates end of curve in Plan
- Indicates end of cable
- Indicates cable number

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<td>36</td>
<td>65</td>
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<td>65</td>
</tr>
</tbody>
</table>

END VIEW OF BEAM
TYPICAL DETAIL OF SUPPORTING
ARRANGEMENT FOR CABLES
1. The stressing or live anchorages of all the cables will be located at some end of the girder.

2. The length of cables indicated are measured along profile between end faces of precast girder. Additional length required for attaching jack of live end is to be added in consultation with system manufacturer.

3. The extensions indicated are for portion of cables lying between end faces of precast girder. Additional extension for portion lying outside gripping point of jack at stressing end is to be added (approx. 10% of.)

4. The extensions are based on the following data:
   i) Wobble coefficient \( k = 0.0046/m \)
   ii) Friction coefficient \( \mu = 0.25 \)
   iii) Modulus of Elasticity of steel in strand, \( E_s = 195 \times 10^6 \) MPa

5. The sequence of stressing of prestressing cables shall be as follows:
   Stage 1: Nos. 5, 3, 2, 3A, and 8 (11th day after casting of girder.)
   Stage 2: Nos. 6 and 7 (15th day after casting of girder or 30th day after casting of deck slab whichever is later).
   Superimposed dead load will be applied immediately after stage 2 prestressing.

6. All cables are to have smooth profile (without knots) passing through gripping points and finally supported at every 10 m interval as shown.

7. For other details refer following drawings:
   i) General Notes: Drg No. SD/40 (sheet 1 & 2)
   ii) Dimensions & Shave Details: Drg No. SD/731
   iii) Reinforcement in Deck Slab, Kerbs and Footpaths: Drg No. SD/333
   iv) Reinforcement in Main Girders: Drg No. SD/335
   v) Reinforcement in End Cross Girders: Drg No. SD/336
   vi) Reinforcement in Intermediate Cross Girders: Drg No. SD/336
   vii) Schedule of Reinforcement: Drg No. SD/337 (sheet 1, 2 & 3)

8. All cables are to be stressed from the same side of the girder. If necessary, the cables are to be stressed from both sides of the girder.

9. The above details are subject to change as per the client's requirements.

LEGEND:
- Indicates start of curve in elevation.
- Indicates end of curve in elevation.
- Indicates start of curve in plan.
- Indicates end of curve in plan.
- Indicates end of cable.
- Indicates cable number.
PART 2. MULTI-WIRE SYSTEM
(A) GENERAL

1. These notes are applicable for Standard Drawings for Prestressed Concrete Girders and RC Slab Type Composite Superstructure with and without footpaths.

2. The drawings are applicable only for right bridges.

3. The design is according to the following Codes:
   - I IRC: 5-1985
   - II IRC: 6-1966 (1981 Print)
   - III IRC: 18-1985
   - IV IRC: 21-1987
   - V IRC: 22-1986
   - VI IRC: 83-1982 (Part I)
   - VII IRC: SP: 33-1989

4. All dimensions are in mm. Only written dimensions shall be followed. No drawing shall be scaled.

5. Public utility services (except water supply and sewerage), if required, shall be carried over the bridge through 150 mm dia ducts provided in the footpaths. Total load of such services shall not be more than 1.0 kN/m on each footpath.

6. Bituminous wearing coat shall comprise the following:
   - A layer of mastic asphalt, 6 mm thick (12 mm for high rainfall area) after applying a prime coat over the top of the deck before the wearing coat is laid.
   - 50 mm thick asphaltic concrete wearing coat in two layers of 25 mm each.

Note 1. For high traffic density, an alternative specification for wearing course comprising 40 mm bituminous concrete overlaid with 25 mm thick bitumen mastic layer can be adopted.

Note 2. All the work of wearing coat may be done as per Section 500 of M.O.S.T.'s Specification.

7. The following loads have been considered in the design:
   - One lane of IRC Class 70R or two lanes of IRC Class A on carriageway, whichever governs.
   - Footpath load of 5 kN/sq.m. for superstructure having footpaths.
   - Wearing Coat load of 2 kN/sq.m.

8. The designs are applicable for "moderate" and "severe" conditions of exposure. In case of "severe" conditions suitable anti-corrosion treatment as approved by Engineer-in-Charge may be provided to reinforcement bars and exposed concrete surface.

(B) MATERIALS SPECIFICATIONS

Concrete

1. Concrete shall be design mix and have minimum 26 days characteristic strength of 40 MPa on 150 mm cubes for all elements of superstructure.

2. Ordinary Portland Cement conforming to IS: 269 or High strength Ordinary Portland cement conforming to IS: 8112 capable of achieving the required design concrete strength shall only be used.

3. To improve workability of concrete and cement grout, admixtures conforming to IS: 6925 and IS: 9103 could be permitted subject to satisfactory proven use. Admixtures generating hydrogen, nitrogen, chlorides, etc., should not be used.

4. Cement content in concrete shall neither be less than 400 kg/cu. m nor more than 540 kg/cu. m of concrete.

5. Maximum water cement ratio shall be as follows:
   - Deck Slab 0.40;
   - Precast Girder 0.40

Reinforcement

6. Reinforcing Steel shall be of HYSB bars (Grade designation S:415) conforming to IS: 1786.

Prestressing Steel and Accessories

7. Cable consisting of 42 nos. of 7.0 mm dia wire as per IS: 1786-1983 (Part I) shall be used for main prestressing.

8. For future prestressing, single 12.7 mm dia 7-pley Class 2 Strand as per IS: 6006-1983 shall be used.

9. The prestressing steel and accessories shall be subjected to an acceptance test prior to their actual use on the works (Guidance may be taken from BS: 4447). Direct and indirect force measurement device (e.g. Pressure Gauge) to be attached in consultation with system manufacturer.

Sheathing

10. Sheathing shall be of "Drossbach" type 75 mm ID manufactured from minimum 0.4 mm thick bright metal strip. It shall be tested as per IRC: 18-1965, Appendix-1.

Water

11. Water to be used in concrete, grouting and curing shall conform to Clause 5.1 (ii) of IRC: SP: 33-1989.

Expansion Joints

12. Expansion joints must be robust, durable, watertight and replaceable. It must be provided over the full width of the deck and follow the profile including kerb, footpath (where relevant) and facia. Expansion joints shall be obtained only from approved manufacturers and be of proven type. Details of expansion joints may be got approved before commencement of construction. Site fabricated expansion joints shall be prohibited.

13. Expansion joints shall have the following additional essential features:
   - (a) It shall cater for a total movement of ± 40 mm.
   - (b) It shall be provided with a waterproof membrane to ensure against leakage below the joint.
   - (c) It shall have a cushion of elastomer to enable absorption of shock transmitted by vehicles.

14. Fabricated steel parts shall be positioned accurately before concreting the portion of deck slab beyond the end faces of the main girders.

15. Presence of manufacturer's representative at the time of positioning of embedded parts and installation of expansion joints is mandatory.

16. The initial gap between the adjacent movable concrete faces shall be fixed in consultation with the manufacturer of the expansion joint. However, the initial gap shall not be less than 38 mm at the time of concreting.
(C) CONSTRUCTION

Sequence

<table>
<thead>
<tr>
<th>Day</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Stressing of 1st stage cables (After casting of main girders)</td>
</tr>
<tr>
<td>21</td>
<td>Casting of cross girders and deck slab except its portion beyond the end faces of main girders</td>
</tr>
<tr>
<td>49</td>
<td>Casting of portion of the deck slab beyond the end faces of main girders and casting of superimposed dead loads other than wearing coat</td>
</tr>
<tr>
<td>56</td>
<td>Stressing of 2nd stage cables</td>
</tr>
<tr>
<td></td>
<td>After</td>
</tr>
<tr>
<td>56</td>
<td>Laying of wearing coat</td>
</tr>
</tbody>
</table>

Stressing of 1st stage cables can be done earlier on achieving a strength of 35 MPa. Subsequent activities can also be advanced keeping the same time intervals. 2nd stage cables shall be stressed progressively one at a time in the three girders.

Launching Truss

The design is based on cast-in-situ construction. However, launching of girders may be permitted for which the load from leg of launching truss should not exceed the value given in relevant drawing.

(D) WORKMANSHIP/DETAILING

1. Minimum cover to any reinforcement shall be 50 mm unless shown otherwise in the drawing.

2. For ensuring proper cover of concrete to reinforcement bars, specially made polymer cover blocks shall only be used.

3. Construction joints shall be provided at locations shown in drawings.

4. Welding of reinforcement bars shall not be permitted.

5. Bending of reinforcement bars to be as per IS: 2502-1963.

6. Minimum lap length shall be kept as 63 d where “d” is the diameter of bar.

7. Supporting chairs of 12 mm dia. shall be provided at suitable intervals, as per IS: 2502.

8. Sharp edges of concrete shall be chamfered (10 mm x 10 mm).

9. Shuttering plates shall suitably be stiffened to enable the compaction by form vibrators.

10. Full width screed vibrator shall be used for compaction of concrete in deck slab.

11. The jacking force in each cable is 1776.3 kN, to be imparted at one end of the girder using multi-pull jack.

12. The following properties have been considered in the design:

   (i) Area of one wire = 38.46 mm²
   (ii) Area of one cable = 1616.3 mm²
   (iii) Wobble coefficient, k = 0.0091 rad/m
   (iv) Friction coefficient, μ = 0.25
   (v) Modulus of elasticity of steel in wires = 2.1*10⁵ MPa
   (vi) Slip = 0 to 6 mm.

13. Minimum strength of concrete at the time of stressing of cables shall be 35 MPa or as recommended by system manufacturer, whichever is higher.


15. For future prestressing in case of bridge distress, single 12.7 mm dia 7-ply Class 2 strand as per IS: 6006-1993 shall be used. The tensioning force per strand shall not exceed 128.6 kN. Mono strand jack shall be used for tensioning of strand utilising approved prestressing system only. The externally placed strands shall be protected by polyethylene sheathing and grouted.

16. The location of jacks for lifting up the superstructure to replace bearing etc., is shown thus. This shall be distinctly etched on end cross-girders and pier/abutment caps.

(E) REFERENCE TO DRAWINGS

<table>
<thead>
<tr>
<th>Drawing No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD/302</td>
<td>General Arrangement</td>
</tr>
<tr>
<td>SD/303</td>
<td>Details of wearing coat and drainage system</td>
</tr>
<tr>
<td>SD/304</td>
<td>Details of RCC Railing for Superstructure without footpaths</td>
</tr>
<tr>
<td>SD/305</td>
<td>Details of RCC Railing for Superstructure with footpaths</td>
</tr>
<tr>
<td>SD/306</td>
<td>Details of Bearings (Sheets 1, 2 &amp; 3)</td>
</tr>
</tbody>
</table>

In case any other type of railing is used, prior approval shall be obtained.

(F) SPECIAL NOTE FOR PRESTRESSING

If the calculated elongation is reached before the calculated gauge pressure is obtained, continue tensioning till attaining the calculated gauge pressure, provided the elongation does not exceed 1.05 times the calculated elongation. If this elongation is achieved before the calculated gauge pressure is attained, stop stressing and inform the engineer.

If the calculated elongation has not been reached continue tensioning by intervals of 5 kg/cm², until the calculated elongation is reached provided the gauge pressure does not exceed 1.05 times the calculated gauge pressure.

If the elongation at 1.05 times the calculated gauge pressure is less than 0.95 times the calculated elongation, the following measures must be taken, in succession, to define the cause of this lack of elongation:

- Recalibrate the pressure gauge
- Check the correct functioning of the jack, pump and leads
- De-tension the cable. Slide it in its duct to check that it is not blocked by mortar which has entered through holes in the sheath. Re-tension the cable, if free.

If the required elongation is not obtained, further finishing operations such as cutting or sealing, should not be undertaken without the approval of the engineer.

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**GOVERNMENT OF INDIA**
**MINISTRY OF SURFACE TRANSPORT**
**(ROADS WING), NEW DELHI**

**STANDARD DRAWINGS FOR ROAD BRIDGES**

| PSC GIRDER AND RC SLAB COMPOSITE SUPERSTRUCTURE WITH AND WITHOUT FOOTPATHS |
| GENERAL NOTES |
| MULTI-WIRE SYSTEM (ONE END STRESSING) |

**RECOMMENDED BY**

**APPROVED BY**

**DEC. 1993**

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**MR. K. RASTOGI**

**MR. K. KACHHWA**

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**SD/301 SHEET NO. 2**
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
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<td>30 m span without footpath</td>
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<td>7.</td>
<td>Drainage Spouts</td>
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<td>8.</td>
<td>Steel Bearing (i) Rocker Bearing (ii) Roller-cum-Roller Bearings</td>
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<td>3</td>
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</table>
NOTES:
1. The location of jacks for lifting up the superstructure to replace bearings etc. is shown below. These should be distinctly marked on the end cross girders and pier abutment caps.
2. Anchorages recesses to be sealed with epoxy cement mortar. The end faces of girders to be coated with 2 coats of epoxide with a total dry film thickness of not less than 150 microns.
3. Maximum reaction to any jack under lifting condition is 1810 kN.
4. During jacking operation, both jacks placed under one end cross girder should be operated simultaneously using stress control system so as to ensure that the reaction on both the jacks is equal at all times.
5. The prestressing is safe for a maximum reaction of 150 kN from leg of moving launching truss.
6. Holes in end cross girders and intermediate cross girders at places shown in this drawing shall be left for bending moments for inserting strands for future prestressing if any.
7. For other details, refer following drawings:
   i) General notes:
      Dwg. no. SD/501 (Sheets 1 & 2)
   ii) Prestressing cables:
       Dwg. no. SD/522
   iii) Reinforcement in deck slab, kerb and footpaths:
       Dwg. no. SD/323
   iv) Reinforcement in main girders:
       Dwg. no. SD/324
   v) Reinforcement in end cross girders:
       Dwg. no. SD/325
   vi) Reinforcement in intermediate cross girders:
       Dwg. no. SD/326
   vii) Schedule of reinforcement:
       Dwg. no. SD/327 (Sheets 1, 2 & 3).
### NOTES

1. The length of cables indicated are measured along profile between the outer faces of anchorage bearing plates. The actual cutting length of wires shall be calculated in consultation with the manufacturer of the prestressing system.

2. The extensions indicated are for portion of cables lying between the outer faces of anchorage bearing plates.

3. The extensions are based on the following data:
   - Elastic modulus of steel, \( E = 2.1 \times 10^{11} \) MPa
   - Friction coefficient, \( J_0 = 0.25 \)
   - Effective area of strand, \( A_{eff} \)
   - Weight of strand, \( G \)

4. The sequence of stressing of prestressing cables shall be as follows:
   - Stage 1: Cable No. 3, 4, 1, 2 (1/4 th day after casting of girders)
   - Stage 2: Cable No. 6, 5 (1/4 th day after casting of girders or 3/4th day after casting of deck slab whichever is later)

5. All the cables shall be stressed from one end of the girder.

6. All cables are to have smooth profile (without kinks) passing through given ordinates and firmly supported at each 1.0 m interval as shown.

7. For other details refer following drawings:
   - General Notes: Drg No. S10/51 (Sheet 1 & 2)
   - Dimensions, anchorages details: Drg No. S10/52
   - Reinforcement in deck slab, kerbs and footpaths: Drg No. S10/323
   - Reinforcement in main girders: Drg No. S10/324
   - Reinforcement in end girders: Drg No. S10/325
   - Schedule of reinforcement: Drg No. S10/327 (Sheets 1 & 2 & 3)

### ORDINATES AT DISTANCE `X` (mm) FROM MID SPAN

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</table>

### LEGEND

- **Cables**: Designated by Cable No.
- **Length**: Designated by Length (m)
- **Extension**: Designated by Extension (m)
- **Emergence angle**: Designated by Emergence angle (deg)

<table>
<thead>
<tr>
<th>Cable No.</th>
<th>Length (m)</th>
<th>Extension (m)</th>
<th>Emergence angle (deg)</th>
</tr>
</thead>
<tbody>
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<td>119.2</td>
<td>5.3</td>
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<tr>
<td>7</td>
<td>30580</td>
<td>134.6</td>
<td>9.61</td>
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</tbody>
</table>
1. The location of jacks for lifting up the superstructure to replace bearings etc. is shown such that these should be distinctly watched on the end cross girder and pier abutment cap.

2. Anchorage recesses to be sealed with prepreg non-shrink mortar. The end faces of girders to be coated with 2 coats of epoxy with a total dry film thickness of at not less than 100 microns.

3. Maximum reaction to any jack under lifting condition is 2220 kN.

4. During jacking operation both jacks placed under one end cross girder shall be operated simultaneously using stress control system so as to ensure that the reaction on both the jacks is equal at all times.

5. The precast girder is safe for a maximum reaction at 100 kN from leg of moving launching jack.

6. Holes in end cross girder and intermediate cross girders at places shown in this drawing shall be left during construction for inserting strand for future prestressing if any.

For other details refer following drawings:

i. General notes:
   - Drg. No. 50/501 (Sheets 1 & 2)
ii. Prestressing cables:
    - Drg. No. 50/532
iii. Reinforcement in deck slab, kerb and footpaths:
    - Drg. No. 50/333
iv. Reinforcement in main girders:
    - Drg. No. 50/334
v. Reinforcement in end cross girders:
    - Drg. No. 50/335
vi. Reinforcement in intermediate cross girders:
    - Drg. No. 50/336
vii. Schedule of reinforcement:
     - Drg. No. 50/371 (Sheets 1 & 2)
NOTES...

1. The length of cables indicated are measured along profile between the outer faces of anchorage bearing plates. The actual cutting length of wires shall be calculated in consultation with the manufacturer of the prestressing system.

2. The extensions indicated are for portion of cables lying between the outer faces of anchorage bearing plates.

3. The extensions are based on the following data:
   i) Wobble coefficient, k = 0.0091 rad/m
   ii) Friction coefficient, µ = 0.25
   iii) Modulus of Elasticity of steel (1Kt wires) = 21 x 10^5 MPa

4. The sequence of stressing of prestressing cables shall be as follows:
   Stage 1: Cable No. 3, 4, 5, 6 after casting of girder.
   Stage 2: Cable No. 7, 8 after casting of girder or 35 day after casting of deck slab whichever is later.

5. All the cables shall be stressed from one end of the girder.

6. All cables are to have smooth profile (without kinks) passing through given ordinates and firmly supported at every 1.0m interval as shown.

7. For further details refer following drawings:
   i) General Notes: Drg. No. SD/1101 sheets 1 & 2
   ii) Dimensions & anchorage details: Drg. No. SD/537
   iii) Reinforcement in deck slab, huts and footpaths: Drg. No. SD/333
   iv) Reinforcement in main girders: Drg. No. SD/334
   v) Reinforcement in end cross girders: Drg. No. SD/535
   vi) Reinforcement in intermediate cross girders: Drg. No. SD/336
   vii) Schedule of reinforcement: Drg. No. SD/537 (Sheets 1, 2 & 3)

GOVERNMENT OF INDIA
MINISTRY OF SURFACE TRANSPORT
ROADS WINDS
NEW DELHI

STANDARD DRAWINGS FOR ROAD BRIDGES

P S C GIRDERS AND RC SLAB
COMPOSITE SUPERSTRUCTURE
35m, span with footings
PRESTRESSING CABLES

MULTI-WIRE SYSTEM (ONE END STRESSING)

RECOMMENDED BY

APPROVED BY

SD/532
NOTES:

1. The location of jacks for lifting up the superstructure to replace bearings etc. is shown on the cross girders and pier/abutment caps.

2. For other details refer following drawings:
   a) General Notes
      Org. no. SD/531 (sheets 1 & 2)
   b) Dimensions & anchorage details
      Org. no. SD/531
   c) Reinforcement in deck slab & footpaths
      Org. no. SD/533
   d) Reinforcement in main girders
      Org. no. SD/534
   e) Reinforcement in intermediate cross girders
      Org. no. SD/535
   f) Schedule of reinforcement
      Org. no. SD/337 (sheets 1, 2 & 3)

PLAN C C
DETAIL OF END CROSS GIRDER

CROSS SECTION 2.2

CROSS SECTION 1.1

FACE A
FACE B
ELEVATION

FACE A
FACE B

32@8 MESH REINF.

GOVERNMENT OF INDIA
MINISTRY OF SURFACE TRANSPORT
(ROADS WING), NEW DELHI

STANDARD DRAWINGS FOR ROAD BRIDGES

P S C GIRDER AND RC SLAB
COMPOSITE SUPERSTRUCTURE
30m SPAN WITH FOOTPATHS
REINFORCEMENT IN END CROSS GIRDER
MUL T I - WIRE SYSTEM (ONE END STRESSING)

RECOMMENDED BY
APPROVED BY
MARCH 1990

SD/535

SD/531

SD/533

SD/534

SD/535

SD/337 (sheets 1, 2 & 3)
NOTES:

1. The location of jacks for lifting up the superstructure to replace bearing etc is shown thus. These should be distinctly etched on the end cross girders and pier/abutment cap.
2. Anchorage recesses to be sealed with prepackaged non-shrink mortar. The end faces of girders to be coated with 2 coats of epoxy with a total dry film thickness not less than 0.6 millimeters.
3. Maximum reaction to any jack under lifting condition is 2205 kN.
4. During stressing operation both jacks placed under one end cross girder shall be operated simultaneously using stress control system so as to ensure that the reaction on both the jacks is equal at all times.
5. The precast girder is safe for a maximum reaction of 990 kN from leg of moving launching truss.
6. Holes in end cross girders and intermediate cross girders at places shown in this drawing shall be left during construction for inserting strands for future prestressing, if any.
7. For other details refer following drawings:
   i. General notes: Drg no SD/501 (Sheets 1 & 2)
   ii. Prestressing cables: Drg no SD/542
   iii. Reinforcement in deck slab and kerb: Drg no SD/543
   iv. Reinforcement in main girders: Drg no SD/544
   v. Reinforcement in end cross girders: Drg no SD/545
   vi. Reinforcement in intermediate cross girders: Drg no SD/546
   vii. Schedule of reinforcement: Drg no SD/547 (Sheets 1, 2 & 3)
1. The length of cables indicated are measured along profile between the outer faces of anchorage bearing plates. The actual cutting length of wires shall be calculated in consultation with the manufacturer of the prestressing system.

2. The extensions indicated are for portion of cables lying between the outer faces of anchorage bearing plates.

3. The extensions are based on the following data:
   i. Wobble coefficient, $k = 0.0001$ rad/m
   ii. Friction coefficient, $k_a = 0.25$
   iii. Modulus of Elasticity of steel (11 wires) $E = 210 \times 10^6$ kN/m²

4. The sequence of stressing of prestressing cables shall be as follows:
   Stage 1: Cable no. 3, 4, 5, 6 (14th day after casting of girder)
   Stage 2: Cable no. 6, 7, 8, 9 (26th day after casting of girder or 30th day after casting of deck slab whichever is later)

5. All the cables shall be stressed from one end of the girder.

6. All cables are to have smooth profile (without lumps) passing through gusset plates and firmly supported at every 1 m interval as shown.

7. For other details refer following drawings:
   i. General Notes:
      Dwg. No. SD/1 S01/Sheet 1 & 2
   ii. Dimensions & anchorage details:
      Dwg. No. SD/1 S04
   iii. Reinforcement in deck slab and kerb:
      Dwg. No. SD/1 S03
   iv. Reinforcement in main girders:
      Dwg. No. SD/1 S05
   v. Reinforcement in end cross girders:
      Dwg. No. SD/1 S06
   vi. Reinforcement in intermediate cross girders:
      Dwg. No. SD/1 S07
   vii. Schedule of reinforcement:
      Dwg. No. SD/1 S07 (Sheet 2 & 3)

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**NOTES:**

1. The length of cables indicated are measured along profile between the outer faces of anchorage bearing plates. The actual cutting length of wires shall be calculated in consultation with the manufacturer of the prestressing system.

2. The extensions indicated are for portion of cables lying between the outer faces of anchorage bearing plates.

3. The extensions are based on the following data:
   - Wobble coefficient, $k = 0.0001$ rad/m
   - Friction coefficient, $k_a = 0.25$
   - Modulus of Elasticity of steel (11 wires) $E = 210 \times 10^6$ kN/m²

4. The sequence of stressing of prestressing cables shall be as follows:
   - Stage 1: Cable no. 3, 4, 5, 6 (14th day after casting of girder)
   - Stage 2: Cable no. 6, 7, 8, 9 (26th day after casting of girder or 30th day after casting of deck slab whichever is later)

5. All the cables shall be stressed from one end of the girder.

6. All cables are to have smooth profile (without lumps) passing through gusset plates and firmly supported at every 1 m interval as shown.

7. For other details refer following drawings:
   - General Notes: Dwg. No. SD/1 S01/Sheet 1 & 2
   - Dimensions & anchorage details: Dwg. No. SD/1 S04
   - Reinforcement in deck slab and kerb: Dwg. No. SD/1 S03
   - Reinforcement in main girders: Dwg. No. SD/1 S05
   - Reinforcement in end cross girders: Dwg. No. SD/1 S06
   - Reinforcement in intermediate cross girders: Dwg. No. SD/1 S07
   - Schedule of reinforcement: Dwg. No. SD/1 S07 (Sheet 2 & 3)
NOTE S:

1. The location of jacks for lifting up the superstructure to replace bearing etc. is shown in the cross girders and pier/adjustment cups.

2. For other details refer following drawings:
   i. General Notes
      Drg. No. SD/541 (sheets 1 & 2)
   ii. Dimension & anchorage details
      Drg. No. SD/541
   iii. Reinforcement in main slab and kerb
      Drg. No. SD/343
   iv. Reinforcement in main girders
      Drg. No. SD/344
   v. Reinforcement in intermediate cross girders
      Drg. No. SD/346
   vi. Schedule of reinforcement
      Drg. No. SD/340 (sheets 1, 2 & 3)

3. Detail of End Cross Girder

4. 8 Mesh Reinforcement