

JIS

JAPANESE INDUSTRIAL STANDARD

Prestressed concrete beams for slab bridges

Ⓒ JIS A 5313—1991

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In the event of any doubt arising,
the original Standard in Japanese is to be final authority.



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J I S

Prestressed concrete beams
for slab bridges

A 5313-1991

1. Scope

This Japanese Industrial Standard specifies the prestressed concrete bridge beams (hereafter referred to as the "bridge beams") manufactured by pretensioning and to be used for slab type road bridges.

Remarks 1. The following Standards are cited in this Standard :

JIS A 1108	Method of Test for Compressive Strength of Concrete
JIS A 1132	Method of Making and Curing Concrete Specimens
JIS A 5011	Air-Cooled Iron-Blast-Furnace Slag Aggregate for Concrete
JIS A 5012	Granulated Blast Furnace Slag Fine Aggregate for Concrete
JIS A 5308	Ready-Mixed Concrete
JIS A 6204	Chemical Admixtures for Concrete
JIS G 3112	Steel Bars for Concrete Reinforcement
JIS G 3536	Uncoated Stress-Relieved Steel Wires and Strands for Prestressed Concrete
JIS R 5210	Portland Cement

2. The units and numerical values given in { } in this Standard are in accordance with the International System of Units (SI) and are appended for informative reference.

The units and values in this Standard will be converted to SI units and values on April 1, 1995.

2. Definition of Terms

The definitions of the main terms used in this Standard are as follows:

- (1) bondless section The section near the end of a bridge beam where the adherence of the concrete to the PC steel is cut.
- (2) bondless steel PC steel in the bondless section.

- (3) bond control beam A beam which partly contains bondless steel.
- (4) ordinary beam A beam in which the PC steel is adhered to the concrete throughout and is arranged in a straight line.

3. Types

The bridge beams shall be classified into the types given in Table 1 and Table 2.

Table 1

Type designation	Grade of bridge	Type of bridge beam	Standard span m	Beam height mm	7-wire strand PC steel wire SWPR 7B, 12.7 mm and 15.2 mm		Remarks
					Number of wires required	Standard diameter	
1S05	Grade 1 bridge	Ordinary beam	5	325	9	12.7	1. The interval of the beam centers shall not exceed 0.77 m.
1S06			6	325	12		
1S07			7	350	13		
1S08			8	375	16		
1S09			9	400	17		
1S10		Bond control beam	10	425	10	15.2	2. When used for bridges, this table is applicable to oblique angles of not less than 60°. 3. The span may be longer than the standard span by a maximum of 0.2 m, and may be shorter by a maximum of 1 m. 4. A snow load of 100 kgf/m ² {981 N/m ² } is taken into account for these beams.
1S11			11	450	11		
1S12			12	475	11		
1S13			13	500	13		
1S14			14	525	15		
1S15			15	550	15		
1S16			16	575	17		
1S17			17	600	17		
1S18			18	650	17		
1S19			19	700	19		
1S20			20	750	19		
1S21			21	800	19		

Table 2

Type designation	Grade of bridge	Type of bridge beam	Standard span m	Beam height mm	7-wire strand PC steel wire SWPR 7B, 12.7 mm and 15.2 mm		Remarks
					Number of wires required	Standard diameter	
2S05	Grade 2 bridge	Ordinary beam	5	275	9	12.7	1. The interval of the beam centers shall not exceed 0.77 m. 2. When used for bridges, this table is applicable to oblique angles of not less than 60°. 3. The span may be longer than the standard span by a maximum of 0.2 m, and may be shorter by a maximum of 1 m. 4. A snow load of 100 kgf/m ² {981 N/m ² } is taken into account for these beams.
2S06			6	300	9		
2S07			7	325	10		
2S08			8	350	11		
2S09			9	375	15		
2S10			10	400	16		
2S11		Bond control beam	11	425	10	15.2	
2S12			12	450	10		
2S13			13	475	11		
2S14			14	475	13		
2S15			15	500	15		
2S16			16	525	15		
2S17			17	575	15		
2S18			18	600	17		
2S19			19	650	17		
2S20			20	700	17		
2S21			21	750	17		

4. Quality

4.1 Appearance The bridge beams shall have a fine external appearance, and shall be free from harmful defects such as flaws, cracks and twists.

4.2 Bending Strength The bending strength of the bridge beam shall be such that the bridge beam will not produce crackings when it is subjected to the bending strength test specified in 8. with a cracking test moment as shown in Table 3 or Table 4, and in Table 5 or Table 6.

Table 3 (Applicable until March 31, 1995)

Unit: $\text{tf} \cdot \text{m}$ { $\text{N} \cdot \text{m}$ }

Type designation	Cracking test moment	Reference ⁽¹⁾ Weight per unit length (tf/m { kN/m })
1S05	13.2 { 129×10^3 }	0.533 {5.23}
1S06	16.5 { 162×10^3 }	0.533 {5.23}
1S07	19.3 { 189×10^3 }	0.573 {5.62}
1S08	23.7 { 232×10^3 }	0.613 {6.01}
1S09	27.2 { 267×10^3 }	0.653 {6.40}
1S10	30.8 { 302×10^3 }	0.551 {5.40}
1S11	36.6 { 359×10^3 }	0.563 {5.52}
1S12	40.0 { 392×10^3 }	0.576 {5.65}
1S13	48.1 { 472×10^3 }	0.588 {5.77}
1S14	56.7 { 556×10^3 }	0.601 {5.89}
1S15	61.2 { 600×10^3 }	0.613 {6.01}
1S16	71.1 { 697×10^3 }	0.648 {6.35}
1S17	76.5 { 750×10^3 }	0.682 {6.69}
1S18	86.5 { 848×10^3 }	0.707 {6.93}
1S19	102 { $1\,000 \times 10^3$ }	0.732 {7.18}
1S20	113 { $1\,110 \times 10^3$ }	0.757 {7.42}
1S21	125 { $1\,230 \times 10^3$ }	0.782 {7.67}

Note ⁽¹⁾ For simplicity, these values assume the mass per unit volume of concrete, including the steel, to be $2.5 \text{ t}/\text{m}^3$, and the load of a unit length of bridge beam acts as the force, these do not form a part of this Standard.

Table 4 (Applicable from April 1, 1995)

Unit: N · m

Type designation	Cracking test moment	Reference ⁽¹⁾ Weight per unit length (kN/m)
1S05	129×10^3	5.23
1S06	162×10^3	5.23
1S07	189×10^3	5.62
1S08	232×10^3	6.01
1S09	267×10^3	6.40
1S10	302×10^3	5.40
1S11	359×10^3	5.52
1S12	392×10^3	5.65
1S13	472×10^3	5.77
1S14	556×10^3	5.89
1S15	600×10^3	6.01
1S16	697×10^3	6.35
1S17	750×10^3	6.69
1S18	848×10^3	6.93
1S19	1000×10^3	7.18
1S20	1110×10^3	7.42
1S21	1230×10^3	7.67

Note ⁽¹⁾ For simplicity, these values assume the mass per unit volume of concrete, including the steel, to be 2.5 t/m^3 , and the load of a unit length of bridge beam acts as the force, these do not form a part of this Standard.

Table 5 (Applicable until March 31, 1995)

Unit: tf · m {N · m}

Type designation	Cracking test moment	Reference ⁽¹⁾ Weight per unit length (tf/m {kN/m})
2S05	9.95 {97.6 × 10 ³ }	0.453 {4.44}
2S06	11.6 { 114 × 10 ³ }	0.493 {4.83}
2S07	14.8 { 145 × 10 ³ }	0.533 {5.23}
2S08	17.3 { 170 × 10 ³ }	0.573 {5.62}
2S09	22.2 { 218 × 10 ³ }	0.613 {6.01}
2S10	26.6 { 261 × 10 ³ }	0.653 {6.40}
2S11	31.1 { 305 × 10 ³ }	0.551 {5.40}
2S12	34.1 { 334 × 10 ³ }	0.563 {5.52}
2S13	40.4 { 396 × 10 ³ }	0.576 {5.65}
2S14	45.0 { 441 × 10 ³ }	0.576 {5.65}
2S15	53.5 { 525 × 10 ³ }	0.610 {5.98}
2S16	58.1 { 570 × 10 ³ }	0.645 {6.33}
2S17	66.9 { 656 × 10 ³ }	0.670 {6.57}
2S18	77.4 { 759 × 10 ³ }	0.682 {6.69}
2S19	87.5 { 858 × 10 ³ }	0.707 {6.93}
2S20	97.8 { 959 × 10 ³ }	0.732 {7.18}
2S21	108 {1 059 × 10 ³ }	0.757 {7.42}

Note ⁽¹⁾ For simplicity, these values assume the mass per unit volume of concrete, including the steel, to be 2.5 t/m³, and the load of a unit length of bridge beam acts as the force, these do not form a part of this Standard.

Table 6 (Applicable from April 1, 1995)

Unit: N · m

Type designation	Cracking test moment	Reference ⁽¹⁾ Weight per unit length (kN/m)
2S05	97.6×10^3	4.44
2S06	114×10^3	4.83
2S07	145×10^3	5.23
2S08	170×10^3	5.62
2S09	218×10^3	6.01
2S10	261×10^3	6.40
2S11	305×10^3	5.40
2S12	334×10^3	5.52
2S13	396×10^3	5.65
2S14	441×10^3	5.65
2S15	525×10^3	5.98
2S16	570×10^3	6.33
2S17	656×10^3	6.57
2S18	759×10^3	6.69
2S19	858×10^3	6.93
2S20	959×10^3	7.18
2S21	$1\,059 \times 10^3$	7.42

Note ⁽¹⁾ For simplicity, these values assume the mass per unit volume of concrete, including the steel, to be 2.5 t/m^3 , and the load of a unit length of bridge beam acts as the force, these do not form a part of this Standard.

5. Shapes, Dimensions, and Dimensional Tolerances

The shapes ⁽²⁾ and dimensions of the bridge beams shall be as specified in Attached Figs. 1 to 34, and the dimensional tolerances shall be as specified in Table 7.

Note ⁽²⁾ Bridge beams may be provided with accessories necessary for the beams or may be worked appropriately by agreement of the parties concerned with delivery.

Suspending metal fittings, if attached, shall be located within $\frac{l}{10}$ (l =span) apart from the beam end.

Table 7

Unit: mm

Item	Tolerances	
	When $L \leq 10$ m	± 10
Beam length L	When $L > 10$ m	$\pm \frac{L^{(3)}}{1000}$
External dimensions of the cross section	± 5	
Warp of beam ⁽⁴⁾	± 8 ⁽⁵⁾	
Lateral bend	± 10	

Notes ⁽³⁾ The beam length L shall be expressed in mm.

⁽⁴⁾ The warp of a beam shall be the value in the middle of the span.

⁽⁵⁾ These shall be the deviations from the mean value which has been obtained from a number of beams to be used as a set in one span.

6. Materials

6.1 Cement The cement to serve shall be Portland cement complying with JIS R 5210 excluding the super rapid hardening Portland cement.

6.2 Aggregates The aggregates shall be clean, tough and durable, and shall have appropriate grain sizes. They shall not contain injurious amounts of dust, mud, chloride, organic substances, etc. The maximum dimension of the coarse aggregates shall be 20 mm.

Further, the aggregates shall be subjected to the alkali-silica reactivity test specified in Annex 7 or Annex 8 to JIS A 5308. This requirement does not apply to aggregates specified in JIS A 5011 or JIS A 5012.

6.3 Water The water shall not contain harmful amounts of substances which may affect the quality of the beams, such as oils, acids, salts, or organic substances.

6.4 PC Steel PC steel to be used for bridge beams shall be 12.7 mm 7-wire strand or 15.2 mm 7-wire strand of SWPR 7B, both specified in JIS G 3536.

6.5 Reinforcing Steel The reinforcing steel shall be SD295 A or SD295 B specified in JIS G 3112.

6.6 Admixtures Admixtures shall not affect the quality of the beams adversely, and shall be in compliance with the specifications of JIS A 6204.

7. Manufacture

7.1 Concrete Concrete shall comply with the following:

- (1) Chlorides contained in the concrete not yet set shall be within 0.30 kg/m^3 as chloride ion.
- (2) The quality of the concrete shall be of 500 kgf/cm^2 { 49.0 N/mm^2 } or more in compressive strength at 28-day age, and shall be durable and uniform in quality.

The compression test shall follow the method specified in JIS A 1132 and JIS A 1108.

- (3) The mix-design shall contain the minimum unit water content required to achieve the required strength and durability.

When using aggregate judged not to be innocuous in the alkali-silica reactivity test, measures to suppress alkali aggregate reaction must be taken in accordance with as stipulated in Annex 6 to JIS A 5308.

- (4) A batch mixer shall be used to mix the concrete and mixing shall be performed thoroughly until the mixed concrete becomes plastic and homogeneous.
- (5) The concrete, when placed, shall be compacted thoroughly with a high frequency vibrator.
- (6) The concrete after the completion of placing shall be cured under sufficient humidity. Steam or hot water curing, when used, shall attain a satisfactory result for the quality of the concrete and the product.

7.2 Method of Imparting Prestress The method of imparting prestress shall comply with the following:

- (1) PC steels arranged in their correct positions shall be stressed and fixed completely at both ends on the reaction supporters so as not to loosen before subjected to prestressing.
- (2) The bondless section of PC steel shall be treated in a manner not giving rise to adhesion of the concrete.
- (3) PC steels, immediately after fixed to the reaction supporters, shall sustain, for each stranded wire constituting PC steel, a force of 13430 kgf { 131.7 kN } for 7-wire strand of 12.7 mm in diameter and 18870 kgf { 185.1 kN } for 7-wire strand of 15.2 mm in diameter.

- (4) In conducting prestressing, the fixing device for the steels shall be loosened gradually after the side formworks are removed. The compressive strength of the concrete at the time of prestressing shall be not less than 350 kgf/cm² {34.3 N/mm²}. In this case, the compressive strength test shall be made in accordance with JIS A 1108 for the test specimen having been cured in the same way as that for the products.
- (5) PC steels shall be trimmed in a manner so as not to protrude from the end faces of the member, and shall be protected with water proof, adhesive, and alkali resistant materials.

7.3 Shipment Shipment shall be made if the compressive strength of specimens cured simultaneously with the products attain 500 kgf/cm² {49.0 N/mm²} or where it is confirmed that the specification of 7.1 (2) is satisfied.

8. Test

The bending test for the bridge beam shall follow the loading method shown in Fig. 1.

The test shall be carried out after the compressive strength of the test specimen cured in the same way as that for the products has reached 500 kgf/cm² {49.0 N/mm²} or after confirming that the specification in 7.1 (2) is satisfied.

The calculation of the bending moment shall be given by the following equation:

$$M = \frac{wl^2}{8} + \frac{(P+W)}{4} (l-2a)$$

where, M : bending moment (tf·m) {N·m}

P : load (tf) {N}

W : weight of loading device (tf) {N}

l : span = beam length (L) - 2 d (m)

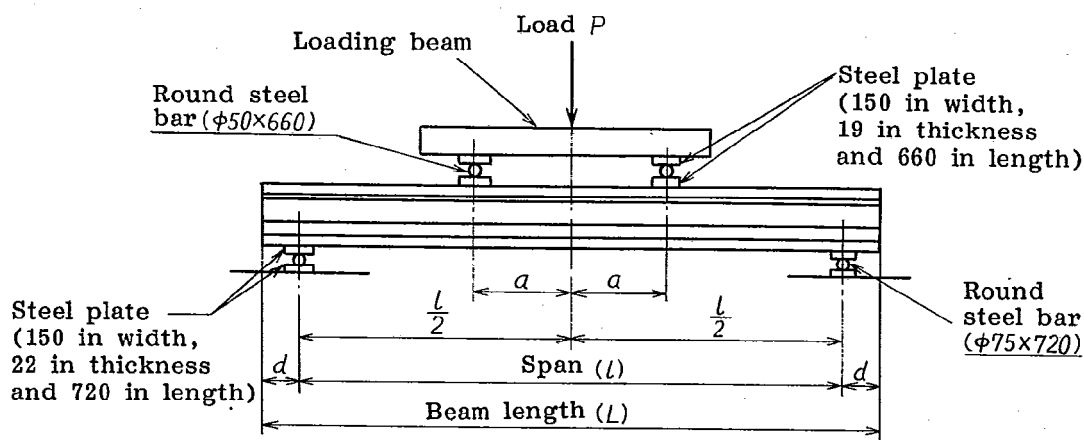
w : weight per unit length of beam (tf/m) {N/m}
(see Table 3 or Table 4 and Table 5 or Table 6)

a : $a = 0.5$ (m) when $l < 10$ m

$a = 0.75$ (m) when $l \geq 10$ m

Fig. 1. Loading Method

Unit: mm



Remark: The following values shall be taken as the value d .

$l \leq 7$ m	$d = 0.15$ m
$7 \text{ m} < l \leq 9$ m	$d = 0.20$ m
$9 \text{ m} < l \leq 14$ m	$d = 0.25$ m
$14 \text{ m} < l \leq 19$ m	$d = 0.30$ m
$19 \text{ m} < l \leq 21$ m	$d = 0.35$ m

9. Inspection

9.1 Appearance, Shapes and Dimensions The inspections on the external appearance, shapes and dimensions shall be made on a 100 % basis, and the products which meet the requirements of 4.1 and 5. shall be judged as acceptable.

9.2 Cracking Strength The cracking test shall be carried out in accordance with 8. for two beams sampled from each lot of bridge beams; if both beams meet the requirements of 4.2, all beams of the lot shall be judged as acceptable, and if both do not meet the requirements, the entire lot shall be judged as unacceptable. If one of the beams fails to meet the requirement of 4.2, each of the beams in the lot shall be tested individually.

Generally the number of beams constituting one lot shall be 400 of the same type.

10. Marking

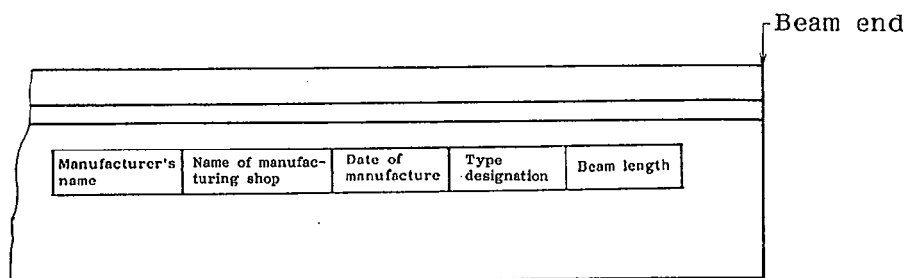
The bridge beams shall bear the following details marked clearly as shown in Fig. 2.

- (1) Type designation
- (2) Beam length

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- (3) Manufacturer's name or its abbreviation
- (4) Name of manufacturing shop or its abbreviation
- (5) Date of manufacture

Fig. 2. Example of Marking



Attached Fig. 1. IS05

Side View of a Bridge Beam

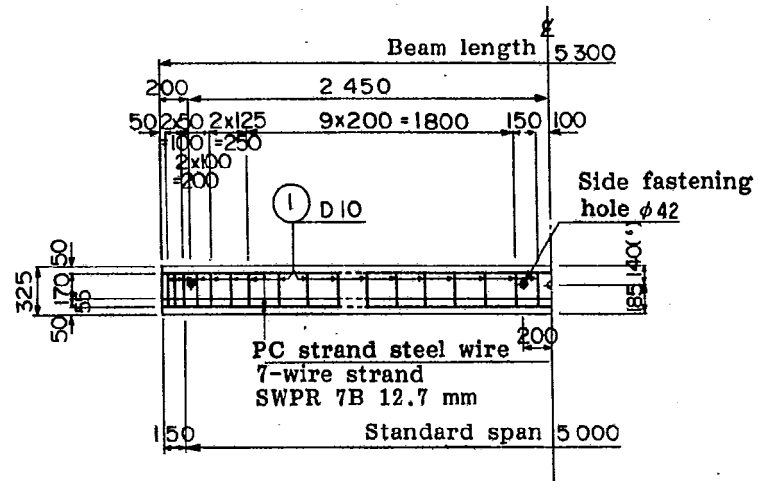
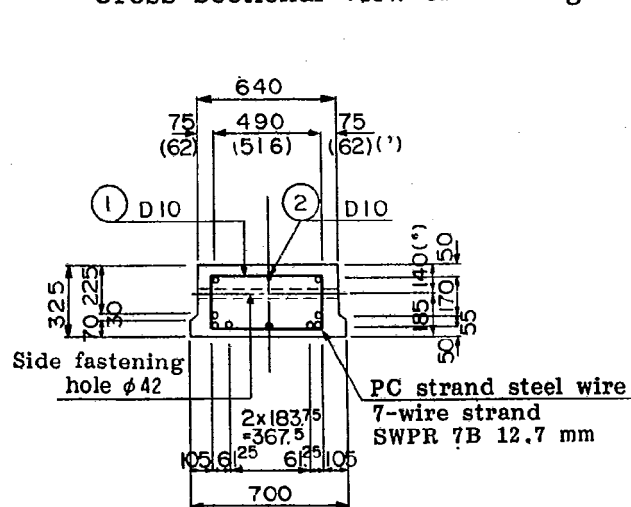


Diagram Sh

Cross Sectional View of a Bridge Beam



① D10 x 18

Legend

- PC steel
- Reinforcement

Notes (6) The values shown in the Diagram Showing Reinforcement W the interval of the side fastening locations are reference v

(7) Horizontal distance of the PC strand steel wire, excluding

Attached Fig. 1. IS05

View of a Bridge Beam

Unit: mm

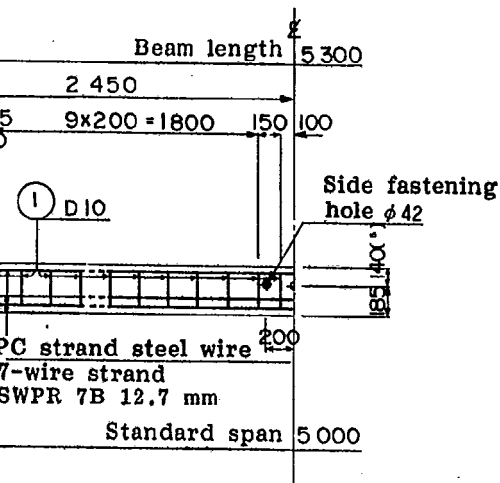


Diagram Showing Details of Side Fastening Position

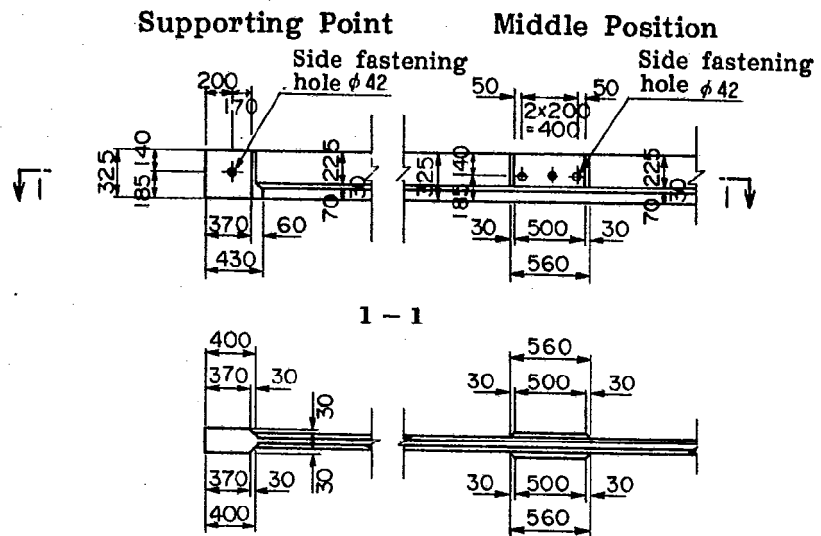
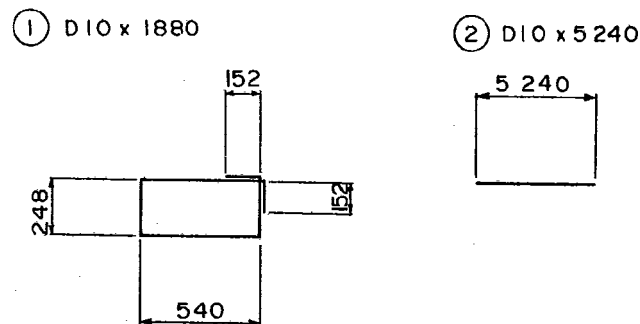


Diagram Showing Reinforcement Working (6)

View of a Bridge Beam



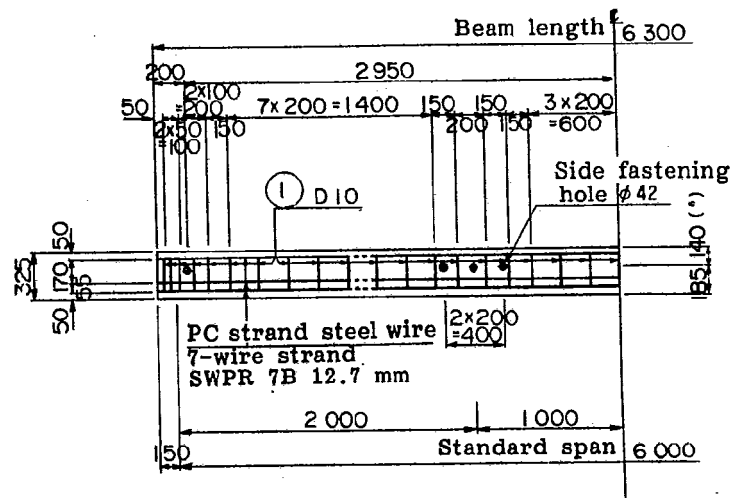
Legend

- PC steel
- Reinforcement

shown in the Diagram Showing Reinforcement Working and those indicating the side fastening locations are reference values.

distance of the PC strand steel wire, excluding the lowest and highest steps.

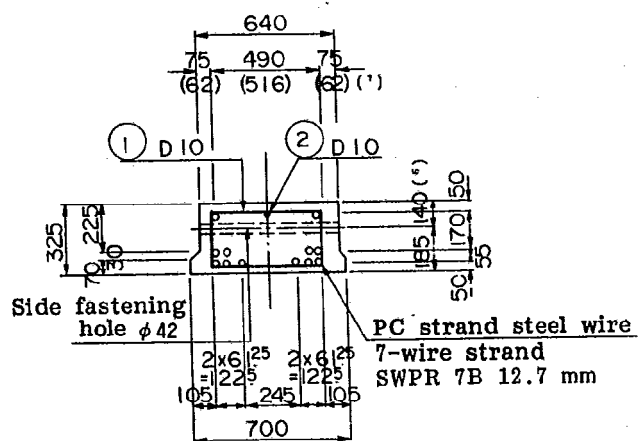
Side View of a Bridge Beam



St
325
185
140

Diagram

Cross Sectional View of a Bridge Beam



① D 10 x 1

248
5

Legend

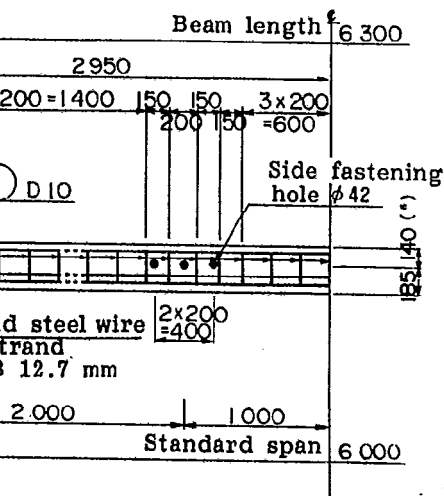
- PC steel
- Reinforcement

Notes (6) The values shown in the Diagram Showing Reinforcement Working the interval of the side fastening locations are reference values.

(7) Horizontal distance of the PC strand steel wire, excluding the k

Attached Fig. 2. IS06

View of a Bridge Beam



Unit: mm

Diagram Showing Details of Side Fastening Position

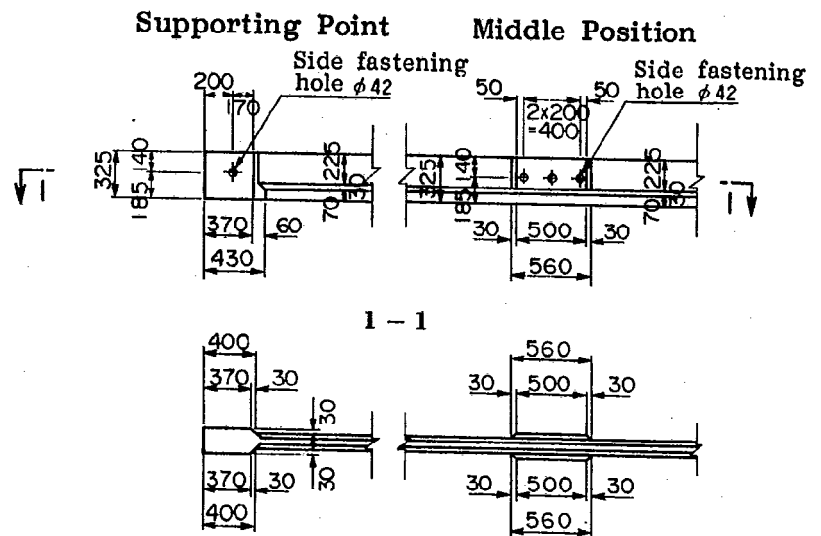
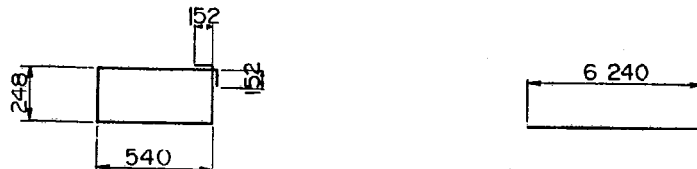


Diagram Showing reinforcement Working (6)

Bridge Beam

① D10×1880

② D10×6 240



and steel wire
strand
12.7 mm

Legend

- PC steel
- Reinforcement

shown in the Diagram Showing Reinforcement Working and those indicating of the side fastening locations are reference values.

distance of the PC strand steel wire, excluding the lowest and highest steps.

Attached Fig. 3. IS07

Unit: mm

View of a Bridge Beam

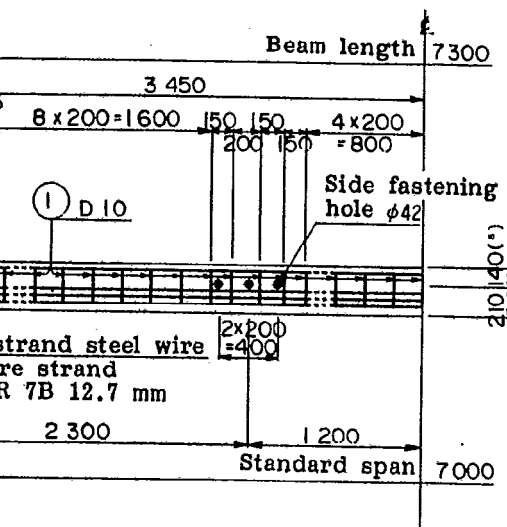
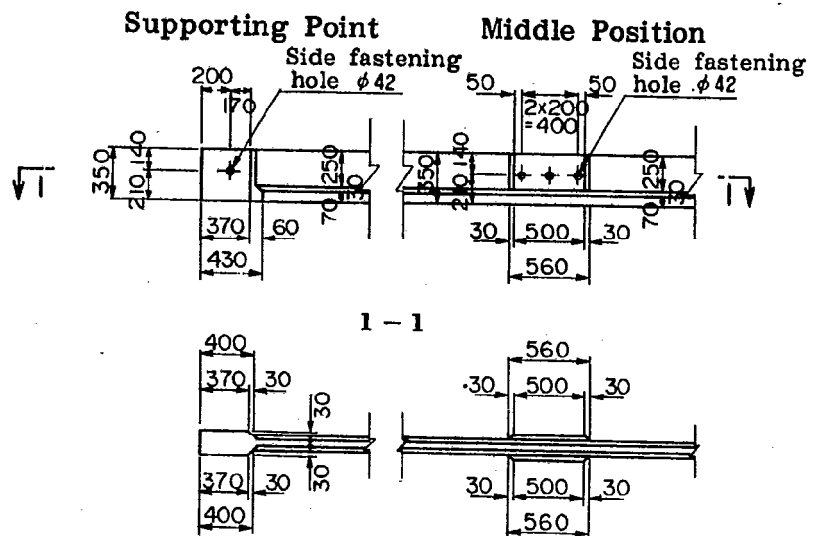
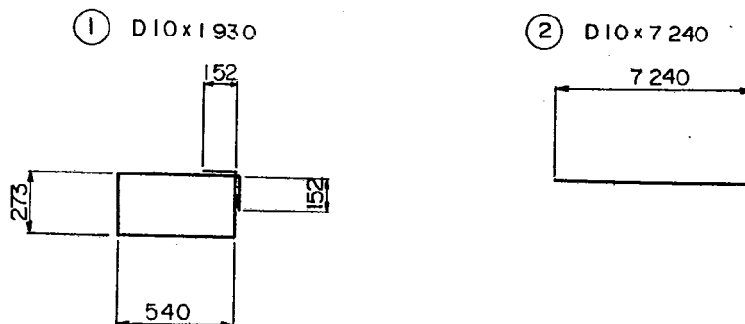


Diagram Showing Details of Side Fastening Position



Bridge Beam

Diagram Showing Reinforcement Working (6)



Legend

- PC steel
- Reinforcement

own in the Diagram Showing Reinforcement Working and those indicating the side fastening locations are reference values.

ance of the PC strand steel wire, excluding the lowest and highest steps.

Attached Fig. 4. IS08

Unit: mm

View of a Bridge Beam

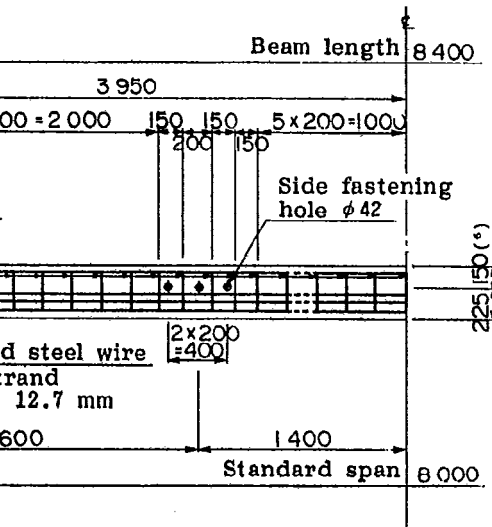


Diagram Showing Details of Side Fastening Position

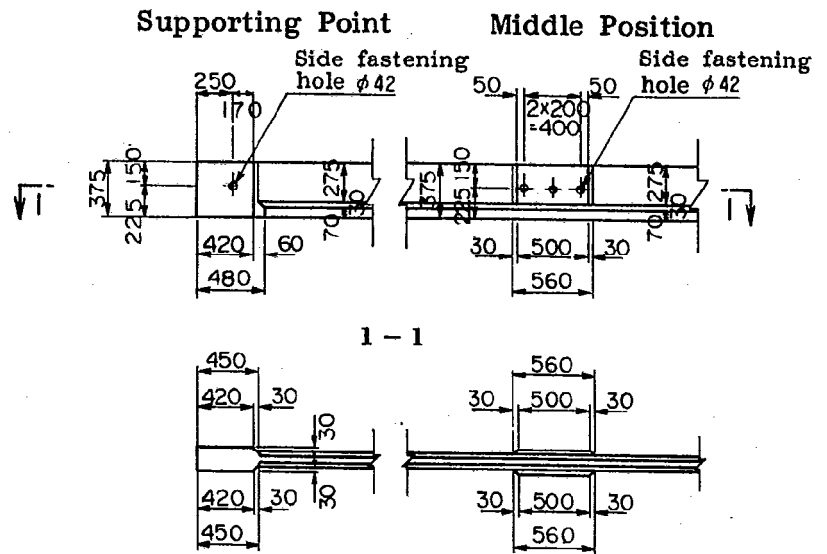
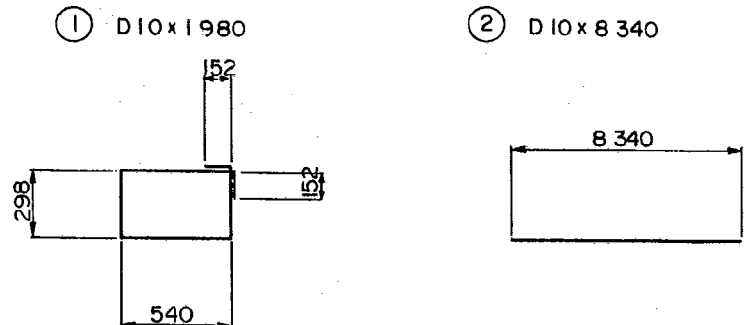


Diagram Showing Reinforcement Working (6)



ridge Beam

2x55
=110and steel wire
strand
7B 12.7 mm

Legend

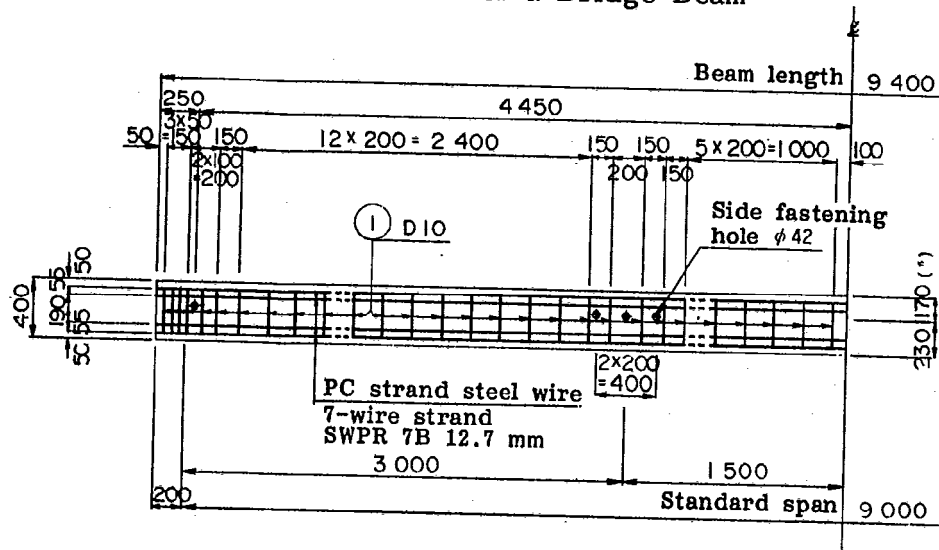
- PC steel
- Reinforcement

own in the Diagram Showing Reinforcement Working and those indicating the side fastening locations are reference values.

ance of the PC strand steel wire, excluding the lowest and highest steps.

Attached Fig. 5. IS09

Side View of a Bridge Beam



Supp

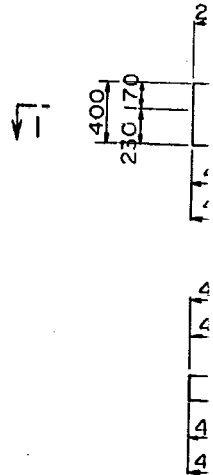
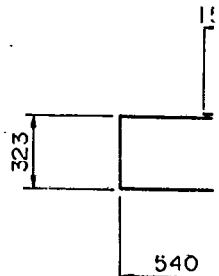
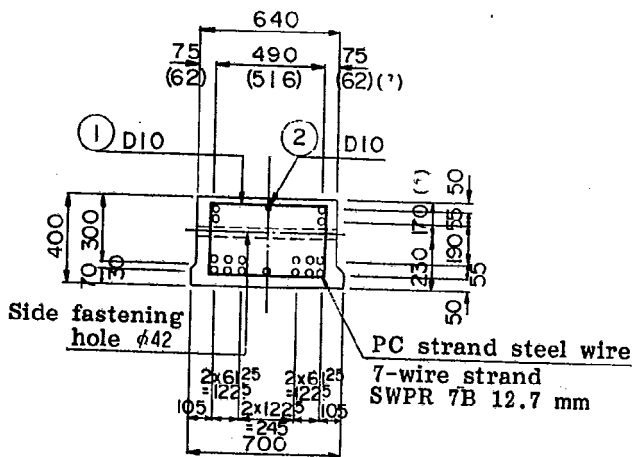


Diagram Show

① D10 x 2 030



Legend

- PC steel
- Reinforcement

Notes (6) The values shown in the Diagram Showing Reinforcement Working and those the interval of the side fastening locations are reference values.

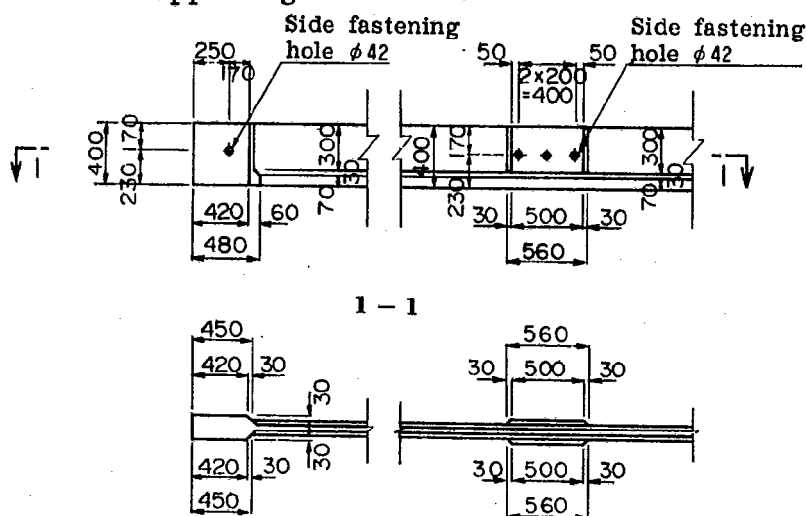
(7) Horizontal distance of the PC strand steel wire, excluding the lowest and 1

Unit: mm

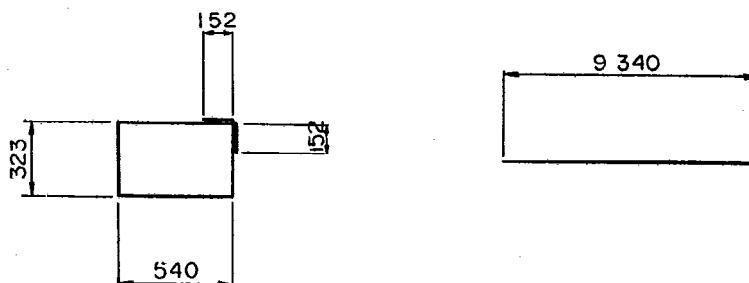
Technical drawing of a beam cross-section showing dimensions and fastening details. The drawing includes the following labels and dimensions:

- Beam length**: 9 400
- Side fastening hole**: $\phi 42$
- Standard span**: 9 000
- Dimensions**:
 - 60
 - 50
 - $5 \times 200 = 1\,000$
 - 100
 - 330
 - 170 (*)
 - 1 500

Supporting Point	Middle Position
1. The first supporting point is the introduction, which sets the stage for the argument. 2. The second supporting point is the main body, where the argument is developed and supported by evidence. 3. The third supporting point is the conclusion, which summarizes the argument and provides a final statement.	1. The first middle position is the introduction, which sets the stage for the argument. 2. The second middle position is the main body, where the argument is developed and supported by evidence. 3. The third middle position is the conclusion, which summarizes the argument and provides a final statement.



① D10 x 2030 ② D10 x 9340

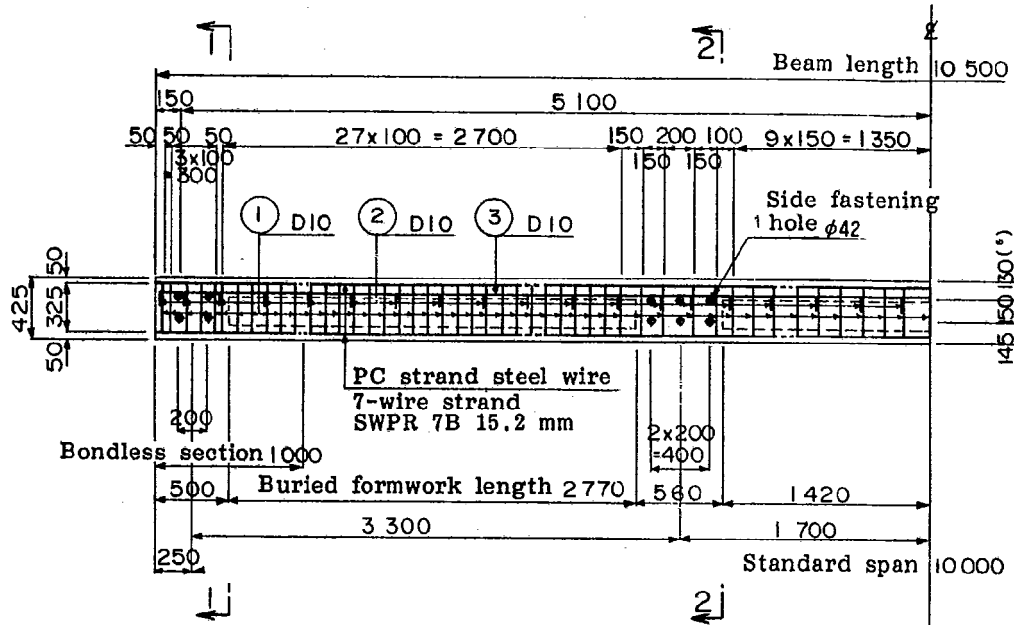


- PC steel
- Reinforcement

gram Showing Reinforcement Working and those indicating
 ning locations are reference values.

strand steel wire, excluding the lowest and highest steps.

Side View of a Bridge Beam

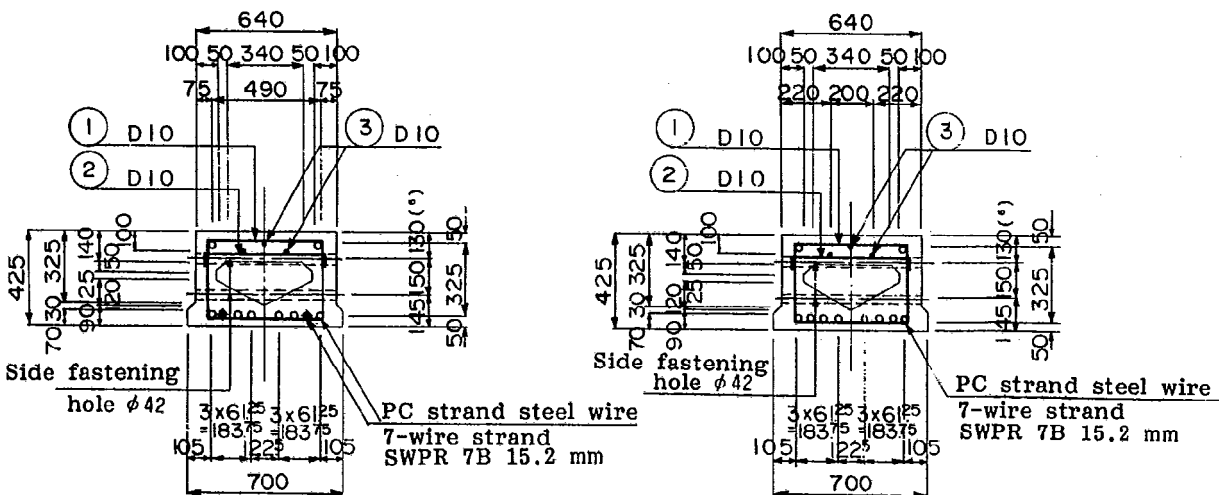


Cross Sectional View of a Bridge Beam

Diagram S1

1 - 1

2 - 2



Legend

- PC steel
- ◆ Bondless steel
- Reinforcement

Notes (6) The values shown in the Diagram Showing Reinforcement Working and those in the interval of the side fastening locations are reference values.