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Precast prestressed concrete products

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Foreward

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Precast prestressed concrete products

1 Scope This Japanese Industrial Standard specifies precast-concrete products (hereafter referred to as “PC products”) made from prestressed concrete. This Standard does not apply to concrete products for buildings.

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS A 0203 *Concrete terminology*

JIS A 1108 *Method of test for compressive strength of concrete*

JIS A 1132 *Method of making and curing concrete specimens*

JIS A 1136 *Method of test for compressive strength of spun concrete*

JIS A 5361 *Precast concrete products—General rules for classification, designation and marking*

JIS A 5362 *Precast concrete products—Required performance and methods of verification*

JIS A 5363 *Precast concrete products—General rules for methods of performance test*

JIS A 5364 *Precast concrete products—General rules of materials and product methods*

JIS A 5365 *Precast concrete products—General rules for method of inspection*

JIS B 7505 *Bourdon tube pressure gauges*

JIS B 7721 *Verification and calibration of the force measuring system of the tension/compression testing machines*

3 Definitions For purpose of this Standard, the definitions given in JIS A 0203 and the following definitions apply.

Group I : PC products whose conformity with the stated performance is confirmed by actual results, which are manufactured based on such specification, and whose recommended specifications are indicated in the annex.

Group II : PC products whose performance and specifications are defined by the agreement between the parties concerned with delivery and which are manufactured based on such specifications.

4 Classification PC products shall be classified as indicated in table 1 by the application.

In addition, products shall be classified into Group I and Group II depending on the way how the performance and specifications are defined.

Table 1 Classification of PC products

Classification	Application
Poles	See clause 2 of the annex 1.
Bridges	See clause 2 of the annex 2.
Retaining walls	See clause 2 of the annex 3.
Closed conduits	See clause 2 of the annex 4.
Piles	See clause 2 of the annex 5.
Other products Example Disaster prevention facilities	It shall be subject to the agreement between the parties concerned with delivery.

Remarks : The annexes include Group I having the recommended specifications and Group II having no recommended specifications.

5 Quality

5.1 Appearance Appearance shall be tested by 9.1 and it shall be free from any flaw, crack, chip, curvature, torsion (in the case of a board-like product), etc. which are detrimental to application. Moreover, the water-contact surface of PC products for water channels shall be as smooth as practically acceptable.

5.2 Performance The performance shall conform to the provisions of table 2.

Table 2 Performance of PC product

Classification	Application
Poles	See clause 3 of the annex 1.
Bridges	See clause 3 of the annex 2.
Retaining walls	See clause 3 of the annex 3.
Closed conduits	See clause 3 of the annex 4.
Piles	See clause 3 of the annex 5.
Other products Example Disaster prevention facilities	<p>a) Performance Concrete items of performance shall be selected and designated according to JIS A 5362 and subject to the agreement between the parties concerned with delivery.</p> <p>When performance is clearly correlated with product specifications (dimensions, materials, structure, etc.), the agreement may be replaced by designation of product specifications indicated in b).</p> <p>b) Specifications representing performance</p> <ol style="list-style-type: none"> 1) Dimensions 2) Compressive strength of concrete 3) Bar arrangement 4) Effective prestress

6 Shape, dimensions and dimensional tolerance The shape, dimensions and dimensional tolerance shall be as specified in table 3.

Table 3 Shape, dimensions and dimensional tolerance of PC products

Classification	Application
Poles	See clause 4 of the annex 1.
Bridges	See clause 4 of the annex 2.
Retaining walls	See clause 4 of the annex 3.
Closed conduits	See clause 4 of the annex 4.
Piles	See clause 4 of the annex 5.
Other products Example Disaster prevention facilities	It shall be subject to the agreement between the parties concerned with delivery.

7 Bar arrangement (reinforcement and PC steel) and tolerance of bar arrangement
As to the bar arrangement and tolerance of bar arrangement, the bar arrangement shall be measured by 9.3, and it shall conform to the provisions of 7.1 and 7.2.

7.1 Bar arrangement Bar arrangement (the minimum covering of reinforcement is included) shall be as specified in table 4. However, when the method is subject to the agreement between the parties concerned with delivery, and it falls within the range which does not damage the performance of PC products (including provisions of 5.2), the method may be outside of table 4. Manufacturers shall prepare the bar arrangement drawing for each product and shall present it to purchasers upon request.

Table 4 Bar arrangement of PC products

Classification	Application
Poles	See clause 5 of the annex 1.
Bridges	See clause 5 of the annex 2.
Retaining walls	See clause 5 of the annex 3.
Closed conduits	See clause 5 of the annex 4.
Piles	See clause 5 of the annex 5.
Other products Example Disaster prevention facilities	It shall be specified by manufacturers.

Information : The general precaution in the case of planning bar arrangement is shown below.

- a) The minimum gap of reinforcement and PC steel shall exceed $5/4$ of the maximum dimension of coarse aggregate.
- b) The necessary cross section area of reinforcement and PC steel is decided from structural calculation or structural details. But, a combination of diameter and numbers of reinforcement and PC steel which can satisfy the cross section area is not limited to one. The diameter and numbers of reinforcement and PC steel shall be selected and arranged in consideration of thickness of members of framework and the maximum dimensions of coarse aggregate. They shall also be selected to ensure complete adhesion between reinforcement/PC steel and concrete and to distribute cracking possibility uniformly.

7.2 Tolerance of bar arrangement Manufactures shall specify the tolerance ⁽¹⁾ of bar arrangement for each class of products, within the range where the dynamic characteristics and durability of members of framework satisfy the predetermined performance.

Note⁽¹⁾ : The limit of deviation between the reinforcement position indicated on the bar arrangement drawing and the reinforcement position of products.

8 Materials and manufacture method Materials used for PC products and manufacture methods shall be as specified in **JIS A 5364**.

9 Test methods

9.1 Appearance test An appearance test shall be performed by a visual observation to check for any flaw, crack, chip, curvature, torsion (in the case of a board-like product), etc. which are detrimental to application.

9.2 Performance test The test method of performance shall be as specified in **JIS A 5363** and table 5.

Table 5 The performance-test method of PC products

Classification	Application
Poles	See clause 6 of the annex 1.
Bridges	See clause 6 of the annex 2.
Retaining walls	See clause 6 of the annex 3.
Closed conduits	See clause 6 of the annex 4.
Piles	See clause 6 of the annex 5.
Other products Example Disaster prevention facilities	It shall be subject to the agreement between the parties concerned with delivery.

9.3 Measurement of bar arrangement Measurement of bar arrangement shall be performed about reinforcement and PC steel in terms of diameter/quantity and minimum covering. The method shall be either of the following.

- a) **Measuring method by a non-destructive test** The measurement by a nondestructive test shall use the electromagnetic induction method, the radar method, etc. According to the respective designated measurement manuals, measurement shall be made of the diameter/ quantity and the minimum covering of reinforcement and PC steel.
- b) **Measuring method by a destructive sample** The measurement by a destructive sample shall be performed after finishing performance tests, such as bending strength. The concrete part of the sample shall be chipped; reinforcement shall be exposed; and measurement shall be made of the diameter/quantity and the minimum covering of reinforcement and PC steel.
- c) **Measuring method by bar arrangement before placing** If the reinforcement and PC steel position before and after placing of concrete is not affected by assembly of reinforcement and PC steel, fixing of the reinforcement and PC steel to a frame, and securing of covering, then the reinforcement and PC steel position of finished product may be presumed by measuring the diameter/quantity and the minimum covering before placing concrete.

10 Inspections

10.1 Inspection items The inspection items of the final inspection carried out by manufacturers and the delivery inspection carried out for confirmation at the time of delivery shall be as follows.

- a) **Final inspection items**
 - 1) Appearance
 - 2) Performance
 - 3) Shape and dimension
- b) **Delivery inspection items**
 - 1) Appearance
 - 2) Shape and dimension

Remarks : The delivery inspection items shall be subject to the agreement between the parties concerned with delivery, and they may be omitted based on the result of final inspection.

10.2 Inspection method The inspection method shall be as specified in JIS A 5365 and table 6.

Table 6 The inspection method of PC products

Classification	Application
Poles	See clause 8 of the annex 1.
Bridges	See clause 8 of the annex 2.
Retaining walls	See clause 8 of the annex 3.
Closed conduits	See clause 8 of the annex 4.
Piles	See clause 8 of the annex 5.
Other products Example Disaster prevention facilities	It shall be subject to the agreement between the parties concerned with delivery.

11 Designation of products The designation of products shall be as specified in **JIS A 5361**.

12 Marking The marking shall be as specified in **JIS A 5361**. However, if the marking is specified particularly in the annexes of this Standard, the annexes shall prevail. Moreover, about the Group II products, the following shall be marked on products.

- a) Characters "II"
- b) Classification (designation specified by manufacturers), or its abbreviation
- c) Other necessary matters, or its abbreviation

13 Report Manufacturers shall submit the report about the appearance, performance, shape, dimension, etc. of products, when they are so requested by purchasers.

Annex 1 (normative)

Poles

1 Scope This annex specifies Group I and Group II of poles which are mainly used for utility poles among the precast prestressed concrete products specified in JIS A 5373.

2 Classification The classification of poles shall be as specified in annex 1 table 1.

In addition, Group I shall be as specified in annex 1 table 2.

Annex 1 table 1 The classification of poles

Major division	Minor division
Poles	Prestressed concrete poles
	Decorative poles for lighting
	Others

Annex 1 table 2 The classification of Group I of poles

Classification	Classification by application	Classification by a check	Detail
Class 1	Power transmission, power distribution, communication, signal, etc.	Crack test load	See the Recommended specification 1-1.
Class 2	The line in a railroad and a track (a trolley coach is included), etc.	Crack test bending moment	

3 Performance The performance of poles shall conform to the provisions of annex 1 table 3.

Annex 1 table 3 Performance of poles

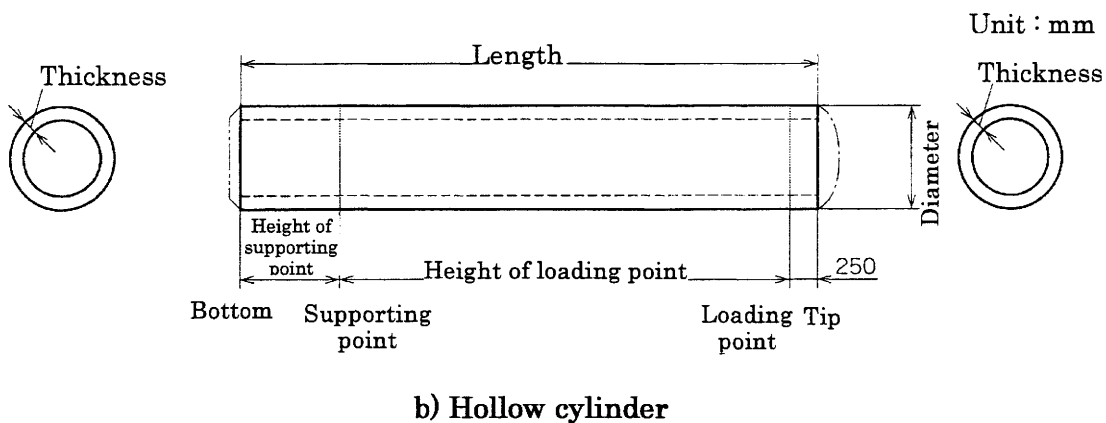
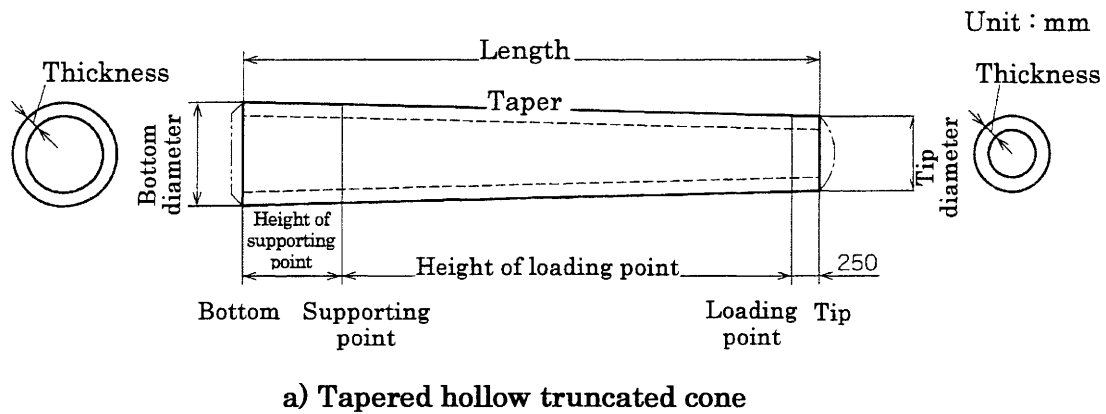
Performance item	Performance	Performance check method
Service performance	It shall be safe to the regular load assumed at the time of use, and crack width shall be within the allowance.	See a design document or clause 6 of the annex 1.
End stage performance ⁽¹⁾	It shall not break for the load assumed at the time of end stage.	See a design document or clause 6 of the annex 1.
Deflection	A deflection shall be within the allowance to the regular load assumed at the time of use.	See a design document or clause 6 of the annex 1.
Durability ⁽²⁾	Durability shall be secured against deterioration assumed.	See a design document or results.
Procedure performance	Workability for transport, installation, assembly, etc. shall be secured.	See a design document or results.

- Notes (1) Confirmation of the end stage performance shall be made when so requested by purchasers.
- (2) Durability may be confirmed by the actual results of such similar products as are equivalent in terms of water-cement ratio and reinforcement covering.

Remarks : The performance items of Group II shall be subject to the agreement between the parties concerned with delivery.

4 Shape, dimension and dimensional tolerance As to poles, the shape, dimension and dimensional tolerance shall be specified as follows. As to Group I, if the design concept is not different, and if the performance (quality) and performance (quality) check method are the same, the reference dimension may be changed within 10 % in response to purchaser's demand, provided that the necessary performance is satisfied.

4.1 Shape The shape of poles is shown in annex 1 informative figure 1.



Annex 1 informative figure 1 Example of shape of poles

4.2 Dimension and dimensional tolerance The dimension and dimensional tolerance of the Group I products shall be as specified in annex 1 table 4. However, a cap and a bottom cover are not included in the length. The dimension and dimensional tolerance of the Group II products shall be subject to the agreement between the parties concerned with delivery.

Annex 1 table 4 The dimension and dimensional tolerance

Classification		Length	Thickness	Tip diameter	Bottom diameter	Diameter
Prestressed concrete poles	Dimension	7 to 17 m	See a design document.	120 to 220 mm	230 to 450 mm	300 to 400 mm
	Tolerance	+ 50 mm - 10 mm	+ Not specified - 0 mm		+4 mm -2 mm	

Remarks 1 The tip diameter, bottom diameter and diameter shall be the average of two values measured along the orthoaxis.

2 The thickness shall be the average of four values measured along the orthoaxis in one cross section of end face of main body.

5 Bar arrangement (positions of PC steel and reinforcement) The bar arrangement of poles is based on JIS A 5364 and a design document.

In addition, a manufacturer shall define the bar arrangement which satisfies clause 3 for every product.

6 Test method

6.1 Compressive-strength test A compressive-strength test is based on JIS A 1132 and JIS A 1108, or JIS A 1136.

6.2 Bending strength test A bending strength test is based on JIS A 5363.

Remarks : A tester shall be Grade one or higher specified in JIS B 7721, or shall have the allowance which is equivalent to or better than this.

7 Quality of concrete

7.1 Material and manufacture method The material for concrete and manufacture method are based on JIS A 5364.

7.2 Compressive strength The compressive strength of concrete shall be verified by the compressive strength of a specimen which was processed by the same cure as the product, or the compressive strength which was controlled properly. When the predetermined cure has been finished, the strength shall be 50 N/mm² or more. Moreover, the compressive strengths at the time of prestress introduction shall be 1.7 or more times the prestress given at a supporting point, and 1.3 or more times the prestress given at a load point, and at the same time 25 N/mm² or more.

In addition, products of Group II shall be subject to the agreement between the parties concerned with delivery.

Remarks : The compressive strength of concrete may refer to JIS A 5364 annex (informative).

8 Inspection Inspection is based on JIS A 5365 and the following.

8.1 Final inspection The final inspection shall be conducted about appearance, performance, shape, and dimension.

- a) **Appearance** About appearance, the characteristics of a product, manufacture method, manufacture quantity, etc. shall be considered, and a total inspection or a sampling inspection shall be performed.
- b) **Performance, shape and dimension** About performance, shape and dimension, a sampling inspection shall be performed.

When the performance is inspected by a specimen as alternative characteristic, correlation shall be established between the specimen and the product.

- c) **Size of inspection lot** The size of inspection lot shall be specified by a manufacturer by considering the characteristics of a product, a manufacture method, manufacture quantity, manufacture period, ordered quantity, etc.

Within one inspection lot, the characteristics, the materials used, concrete mixing ratio, and the manufacturing method shall be the same.

8.2 Delivery inspection The delivery inspection of poles shall be made about appearance, shape and dimension. The size of inspection lot and the sampling method shall be subject to the agreement between the parties concerned with delivery. However, the delivery inspection shall be subject to the agreement between the parties concerned with delivery, and it may be omitted based on the result of final inspection.

9 Marking The marking of poles shall be marked the following according to JIS A 5361.

- a) Classification or its abbreviation
- b) Manufacturer's name or its abbreviation
- c) Date of manufacture or its abbreviation

10 Others Group I of poles is shown in annex 1 table 5.

Annex 1 table 5 Recommended specification

Structure-specific product group standard		Recommended specification
JIS A 5373	annex 1 (normative) Poles	Recommended specification 1-1 Prestressed concrete poles

Recommended specification 1-1

Prestressed concrete poles

1 Scope This recommended specification specifies the group I prestressed concrete poles (hereafter referred to as “poles”) among the annex 1 of JIS A 5373.

Remarks 1 Poles which are based on the details of this recommended specification 1-1 and which are manufactured by proper quality control shall be deemed to conform to clause 3 of the annex 1 of JIS A 5373.

2 If the reference dimension has been changed within the range shown in clause 4 of the annex 1 of JIS A 5373, a manufacturer must present the following data to a purchaser, when so requested. The data must state conformity of the pole to clause 3 of the annex 1 of JIS A 5373 which has been demonstrated by the design document or performance test.

2 Classification The classification of poles shall be Class 1 and Class 2.

a) Class 1 shall be classified according to a dimension and a crack test load as shown in recommended specification 1-1 table 1.

b) Class 2 shall be classified according to a dimension and a crack test bending moment as shown in recommended specification 1-1 table 2.

3 Performance

3.1 Bending strength The bending strength of body of class 1 poles shall be specified as follows. When it is subjected to the bending strength test specified in clause 6 and to the crack test load specified in recommended specification 1-1 table 1, it shall not generate the crack which is wider than 0.25 mm. When this crack test load is removed, the crack wider than 0.05 mm shall not be present. Moreover, the destructive load shall be at least twice the crack test load specified in recommended specification 1-1 table 1.

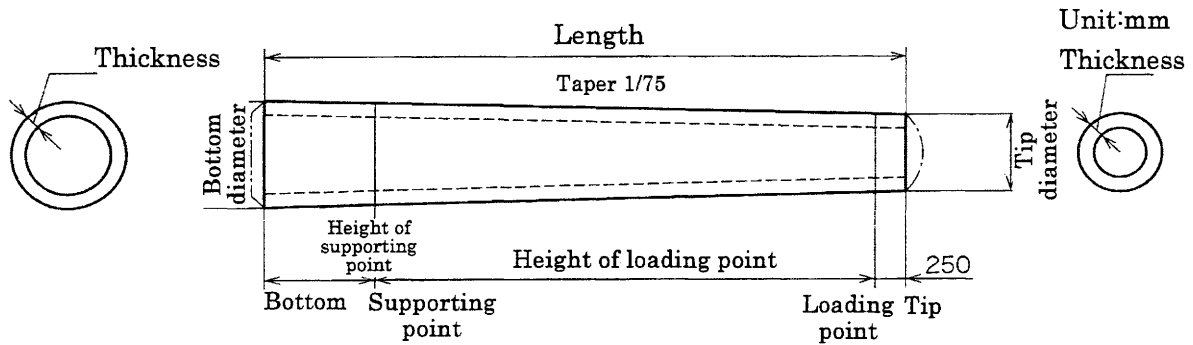
The bending strength of body of Class 2 poles shall be specified as follows. When it is subjected to the bending strength test specified in clause 6 and to the crack test bending moment specified in recommended specification 1-1 table 2, it shall not generate the crack which is wider than 0.25 mm. When this crack test bending moment is removed, the crack wider than 0.05 mm shall not be present. Moreover, the destructive bending moment shall be at least twice the crack test bending moment specified in Recommended specification 1-1 table 2.

3.2 Deformation The deformation of class 2 poles shall be specified as follows. When it is subjected to the bending strength test specified in clause 6 and to 2/3 of the crack test bending moment specified in recommended specification 1-1 table 2, the deflection of a 8 m pole at 6 m from the supporting point and the deflection of a 9 m or longer pole at 7 m from the supporting point shall not exceed 75 mm.

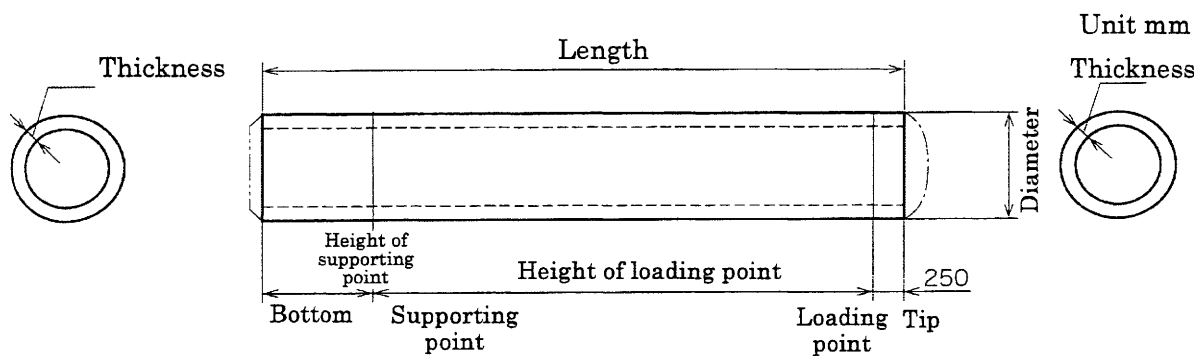
4 Shape, dimension and dimensional tolerance

4.1 Shape The shape of a pole is based on the following.

- a) Class 1 shall be a tapered truncated cone as shown in recommended specification 1-1 figure 1.
- b) Class 2 shall be a hollow cylinder as shown in recommended specification 1-1 figure 2.



Recommended specification 1-1 figure 1 Shape of class 1



Recommended specification 1-1 figure 2 Shape of class 2

4.2 Dimension and dimensional tolerance The dimension of poles shall be as specified in recommended specification 1-1 table 1 and recommended specification 1-1 table 2. The dimensional tolerance shall be as specified in recommended specification 1-1 table 3.

Recommended specification 1-1 table 1 Dimension and crack test load (class 1)

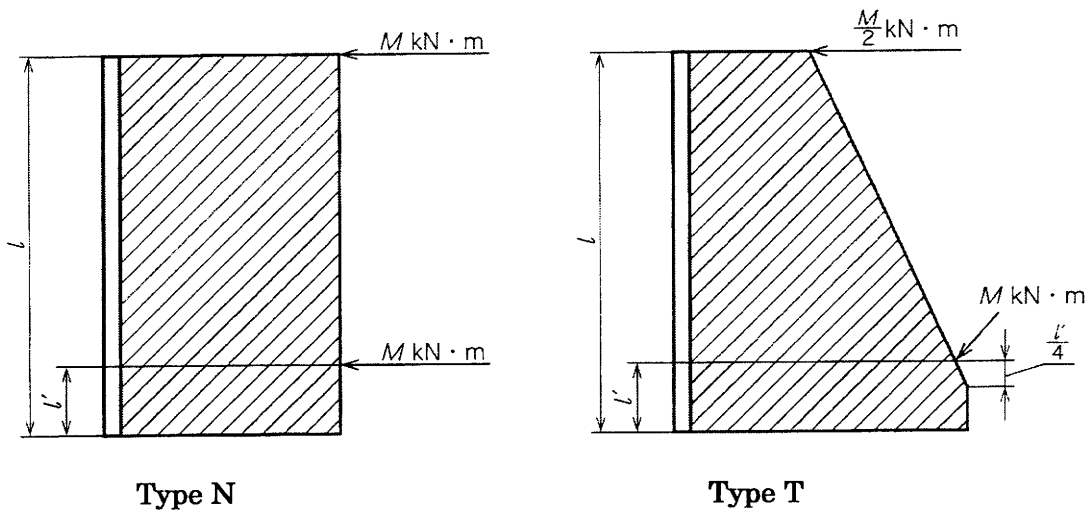
Length l m	Height of load point m	Height of supporting point l' m	Crack test load kN			
			Tip diameter mm			
			120	140	190	220
7	5.55	1.2	—	1.5	—	—
8	6.35	1.4	—	1.5 2.0	4.3	—
9	7.25	1.5	2.0	2.5	3.5 4.3 5.0	—
10	8.05	1.7	2.0	2.5	3.5 5.0	—
11	8.85	1.9	2.0	—	3.5 5.0	—
12	9.75	2.0	—	—	3.5 5.0 7.0	—
13	10.55	2.2	—	—	3.5 5.0 7.0	—
14	11.35	2.4	—	—	3.5 5.0 7.0	—
15	12.25	2.5	—	—	5.0 7.0 10	—
16	13.25	2.5	—	—	5.0 7.0 10	10 15
17	14.25	2.5	—	—	5.0 7.0 10	10 15

Remarks : A taper shall be 1/75.

Recommended specification 1-1 table 2
Dimension and crack test bending moment (class 2)

Length <i>l</i> m	Height of load point m	Height of supporting point <i>l'</i> m	Crack test bending moment at supporting point kN·m			
			Type N			Type T
			Diameter mm			Diameter mm
			300	350	400	350
8	6.35	1.4	65	50 65	—	—
9	7.25	1.5	65	50 65	—	—
10	8.05	1.7	65	50 65 75	—	—
11	8.85	1.9	65	50 65 75	110	90 110
12	9.75	2.0	65	50 65 75	110	90 110
13	10.55	2.2	—	65 75	110	90 110
14	11.35	2.4	—	75	—	—

Remarks : Type N and Type T in the table are the type symbol classified by distribution of the bending moment. The magnitude and the distribution map of the bending moment according to type are shown below.



l : Length of a pole

l' : Height of a supporting point

M : Crack test bending moment shown in recommended specification 1-1 table 2

Recommended specification 1-1 table 3 Dimensional tolerance

Unit : mm

Classification		Length	Thickness	Tip diameter	Bottom diameter	Diameter
Prestressed concrete poles	Dimension	7 to 17 (m)	See design document.	120 to 220	230 to 450	300 to 400
	Dimensional tolerance	+ 50 - 10	+ Not specified - 0	+ 4 - 2		

Remarks 1 The tip diameter, bottom diameter and diameter shall be the average of two values measured along the orthoaxis.

2 The thickness shall be the average of four values measured along the orthoaxis in one cross section of end face of main body.

5 Bar arrangement The bar arrangement of pole is based on the following.

- a) PC steel and a longitudinal reinforcement shall be arranged as uniformly as possible over the cross section of a pole.
- b) The gap of PC steel and a longitudinal reinforcement shall be one or more times their diameter, and shall be 5/4 or more times the maximum dimension of a coarse aggregate. However, when the gap of PC steel and a longitudinal reinforcement decreased below the specified value by attaching the accessory, etc., it shall be checked that concrete is compacted enough by the centrifugal compaction.

- c) An additional bar shall be spirally arranged on the outside of PC steel and a longitudinal reinforcement. An additional bar shall be 2.7 mm or more in diameter. The pitch shall be 150 mm or less.
- d) The covering shall be 9 mm or more and 1 or more times the diameter of PC steel and a longitudinal reinforcement.
- e) When welding an additional bar with PC steel or a longitudinal reinforcement, it shall be guaranteed that welding does not decrease their mechanical characteristics below each specified value.

6 Strength test

6.1 Compressive-strength test A compressive-strength test of concrete is based on 6.1 of the annex 1 of JIS A 5373.

6.2 Bending-strength test A bending-strength test is based on 6.2 of the annex 1 of JIS A 5373.

Remarks : A tester shall be Grade one or higher specified in JIS B 7721, or shall have the allowance which is equivalent to or better than this.

7 Quality of concrete The compressive strength of concrete is based on 7.2 of the annex 1 of JIS A 5373.

8 Inspections

8.1 Inspection items The inspection items of poles are based on the following.

a) **Final inspection**

- 1) Appearance
- 2) Performance
- 3) Shape and dimension

b) **Delivery inspection**

- 1) Appearance
- 2) Shape and dimension

Remarks : The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and it may be omitted based on the result of final inspection.

8.2 Inspection lot The size of inspection lot of pole shall be decided by a manufacturer who considers the characteristics of products, manufacture methods, manufacture quantity, manufacture period, ordered quantity, etc. The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and shall be decided by a purchaser. However, one lot may be 3 000 pieces or its fraction.

8.3 Inspection method The inspection method of a pole is based on the following.

a) Final inspection

- 1) **Appearance** Appearance shall be subjected to visual 100 % inspection. If the products conform to the provision of 5.1 of JIS A 5373, they shall be accepted.
- 2) **Performance** The bending crack strength shall be inspected as follows. Take two arbitrary samples from one lot and test them by 6.2. When both samples conform to provision of 3.1, the lot shall be accepted. When they fail, the lot shall be rejected. When only one of them fails, take other four samples from the lot. If all samples conform to the provision, the lot shall be accepted after eliminating nonconforming sample(s). If even one sample does not conform to it, the lot shall be rejected.

The bending destructive strength shall be inspected as follows. Take each of the first two samples inspected at the bending crack strength test and test it by 6.2. When both samples conform to provision of 3.1, the lot shall be accepted. When they fail, take other two samples from the lot. If all samples conform to the provision, the lot shall be accepted after eliminating nonconforming sample(s). If even one sample does not conform to it, the lot shall be rejected. Moreover, PC steel and bar arrangement shall be inspected about the reinforcement which was assembled before placing concrete, or about a pole whose destructive strength was inspected. If it conforms to the provision of clause 5, the lot shall be accepted.

- 3) **Shape and dimension** For inspection of shape and dimension, take arbitrary samples from one lot. If they conform to the provision of clause 4, the lot shall be accepted. If even one sample does not conform, the lot shall be inspected 100 %. If the lot conforms to the provision, it shall be accepted.

b) Delivery inspection

- 1) **Appearance** Inspection of appearance shall be made like a).

For sampling inspection, take two arbitrary samples. If they conform to 5.1 of JIS A 5373, the lot shall be accepted. If even one sample does not conform, the lot shall be inspected 100 %. If the lot conforms to the provision, it shall be accepted.

- 2) **Shape and dimension** Inspection of shape and dimension shall be made like a).

9 Marking The marking on pole is based on JIS A 5361 and JIS A 5373.

In addition, Class 1 shall indicate the length (m), a tip diameter (cm), and a crack test load (kN), and Class 2 shall indicate the length (m), a diameter (cm), a type symbol, and the crack test bending moment (kN·m).

Annex 2 (normative)

Bridges

1 Scope This annex specifies Group I and Group II of bridges which are mainly used for highway bridges among the precast prestressed concrete products specified in JIS A 5373.

2 Classification The classification of bridges shall be as specified in annex 2 table 1. In addition, Group I shall be as specified in annex 2 table 2.

Annex 2 table 1 Classification of bridges

Major division	Minor division	
Bridges	Bridge beam	The bridge beams for highway bridges
		The bridge beam for light load slab bridges
		The segment of bridge beam for highway bridge
	Deck slab	The precast plate for composite deck slab
		Precast deck slab for highway bridges
Others		

Annex 2 table 2 Classification of Group I bridges

Classification by application/shape		Detail
Bridge beams	The bridge beams for highway bridges (a slab bridge beam, a beam bridge beam, light-load slab bridge beam)	See the Recommended specification 2-1.
	The segment ⁽¹⁾ of bridge beam for highway bridge	See the Recommended specification 2-2.
Deck slabs	The precast plate for composite deck slab	See the Recommended specification 2-3.
	Precast deck slab for highway bridges	See the Recommended specification 2-4.

Note ⁽¹⁾ : The precast PC product which becomes one bridge beam by assembling a set of several segments of PC steel.

3 Performance The performance of bridges shall conform to the provisions of annex 2 table 3.

Annex 2 table 3 Performance of bridges

Performance item	Performance	The performance check method
Service performance	It shall be safe to the regular load assumed at the time of use, and crack width shall be within an allowance.	See a design document or clause 6 of the annex 2.
End stage performance ⁽²⁾	It shall not break for the load assumed at the time of end stage.	See a design document.
Durability ⁽³⁾	Durability shall be secured against deterioration assumed.	See a design document or a record.
Workability	Workability for transport, installation, assembly, etc. shall be secured.	See a design document or a record.

Notes ⁽²⁾ Confirmation of the end stage performance shall be made when so requested by purchasers.

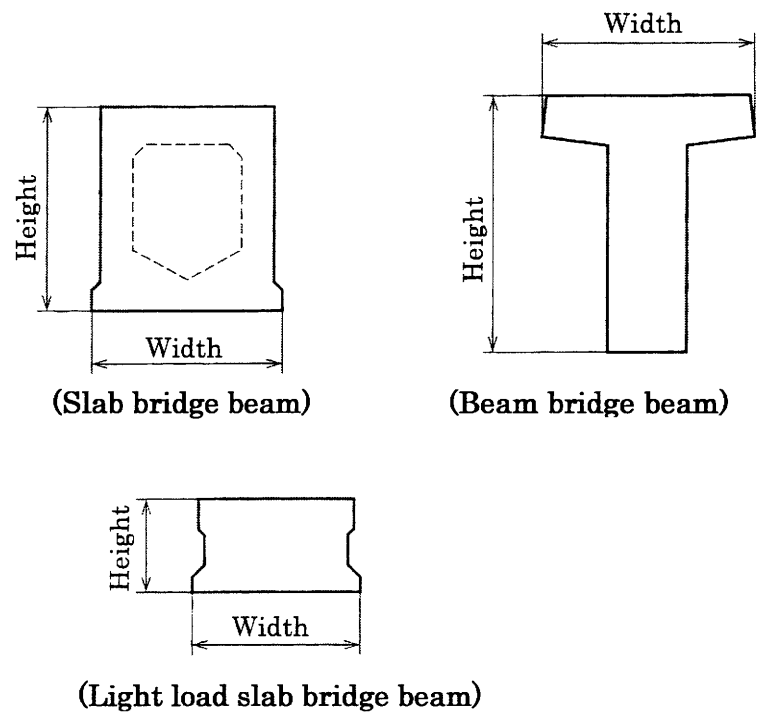
⁽³⁾ Durability may be confirmed by the actual results of such similar products as are equivalent in terms of water – cement ratio and reinforcement covering.

Remarks : The performance items of Group II shall be subject to the agreement between the parties concerned with delivery.

4 Shape, dimension and dimensional tolerance As to bridges, the shape, dimension, and dimensional tolerance shall be as specified as follows. As to Group I, if the design concept is not different, and if the performance (quality) and performance (quality) check method are the same, the reference dimension may be changed within 10 % in response to purchaser's demand, provided that the necessary performance is satisfied. The changing range of reference dimension for bridge beams for highway bridges and precast deck slabs for highway bridges shall be subject to the recommended specification.

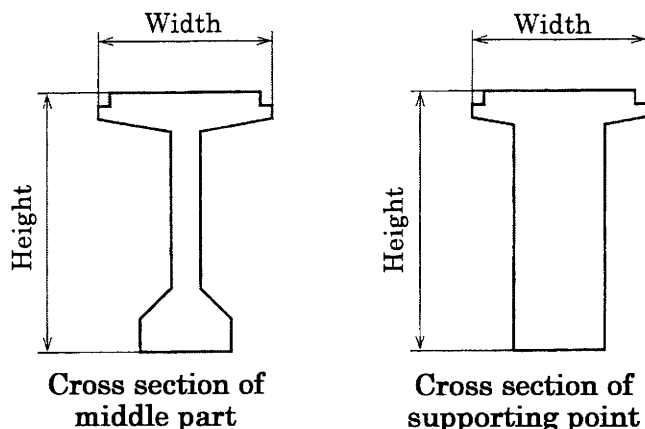
4.1 Shape The shape of bridges is shown in annex 2 informative figures 1 to 4.

a) **Bridge beams for highway bridges** The shape of the bridge beams for highway bridges is shown in annex 2 informative figure 1.



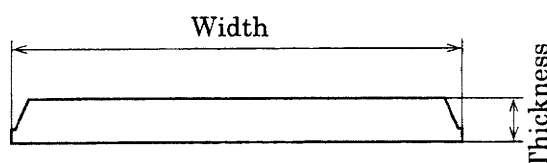
Annex 2 informative figure 1
Example of shape of the bridge beams for highway bridges

- b) **Segments for bridge beams** The shape of the segment for bridge beams is shown in annex 2 informative figure 2.



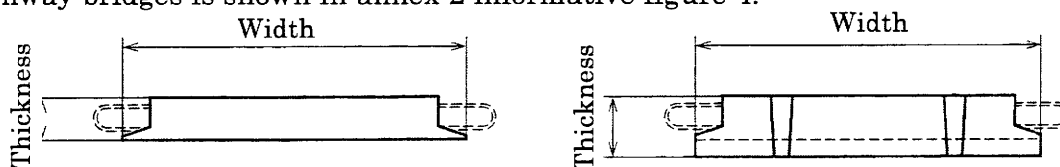
Annex 2 informative figure 2 Example of shape of the segments for bridge beams

- c) **Precast plates for composite deck slabs** The shape of the precast plates for composite deck slabs is shown in annex 2 informative figure 3.



Annex 2 informative figure 3
Example of shape of the precast plates for composite deck slabs

- d) **Precast deck slabs for highway bridges** The shape of the precast deck slab for highway bridges is shown in annex 2 informative figure 4.



Deck direction middle part cross section Deck direction support part cross section

Annex 2 informative figure 4
Example of shape of the precast deck slabs for highway bridges

4.2 Dimension and dimensional tolerance The dimension and dimensional tolerance of the Group I products shall be as specified in annex 2 table 4 and table 5. The dimension and dimensional tolerance of the Group II products shall be subject to the agreement between the parties concerned with delivery.

- a) **Bridge beam** The dimension and dimensional tolerance of a bridge beam shall be as specified in annex 2 table 4.

Annex 2 table 4 The dimension and dimensional tolerance of a bridge beam

Unit : mm

Classification		Height or thickness	Width (perpendicular to bridge axis)	Length (along bridge axis)	
Slab bridge beam	Dimension	350 to 1 000	700	Span length L (m) 5.3 to 24	
	Tolerance	± 5	± 5	In the case of $L \leq 10$ m	± 10
				In the case of $L > 10$ m	$\pm L/1\ 000$ (4)
Light-load slab bridge beam	Dimension	225 to 400	700	Span length L (m) 5.3 to 13.5	
	Tolerance	± 5	± 5	In the case of $L \leq 10$ m	± 10
				In the case of $L > 10$ m	$\pm L/1\ 000$ (4)
Beam bridge beam	Dimension	900 to 1 300	800	Beam length L (m) 18.6 to 24.7	
	Tolerance	± 5	± 5	$\pm L/1\ 000$ (4)	
Segment for bridge beams	Dimension	1 400 to 3 300	1 300	Segment length L (m) 4.05 to 11.5	
	Tolerance	+10 - 5	Upper width +10 -5 Lower width ± 5	± 10	

Note(4) : The beam length L is expressed with mm.

- b) **Deck slabs** The dimension and dimensional tolerance of deck slabs shall be as specified in annex 2 table 5.

Annex 2 table 5 The dimension and dimensional tolerance of deck slab

Unit : mm

Classification		Thickness		Width (along bridge direction)	Length (perpendicular to bridge axis)
The precast plate for composite deck slab	Dimension	70 to 120		998	PC plate span length L (m) 1.45 to 3.00
	Tolerance	+5 -2		+5 -3	+10 -5
Precast deck slab for highway bridges	Dimension	H_1	240 to 320	1 990	Deck length L (m) 7.9 to 18.5
		H_2	340 to 420		
	Tolerance	+10 0		+5 -10	+20 0

5 Bar arrangement (position of PC steel and reinforcement) Bar arrangement (position of PC steel and reinforcement) shall be as specified in JIS A 5364 and a design document. However, when the method is subject to the agreement between the parties concerned with delivery, and it falls within the range which does not damage the performance of products (including provisions of clause 3), the method may be outside the bar arrangement (position of PC steel and reinforcement) of recommended specification.

6 Test method

6.1 Compressive-strength test A compressive-strength test is based on JIS A 1132 and JIS A 1108.

6.2 Bending test A bending test is based on JIS A 5363. As shown in annex 2 figure 1 and figure 2, apply the load F which is equivalent to the crack test bending moment, and check for any cracks.

In addition, perform the test after confirming that the compressive strength of a test piece is equal to or more than the specified value.

Remarks : A tester shall be Grade one or higher specified in JIS B 7721, or shall have the allowance which is equivalent to or better than this.

Load F is computed by the following formula.

$$F = \left\{ (M - M_{d0}) \times \frac{4}{(1 - 2a)} \right\} - m \cdot g$$

Where, F : Loading load (kN)

M : Crack test bending moment (kN·m)

M_{d0} : Bending moment by product tare (kN·m)

m : Mass of loading equipment (kg)

l : Span (m)

a : Loading position

In the case of a bridge beam

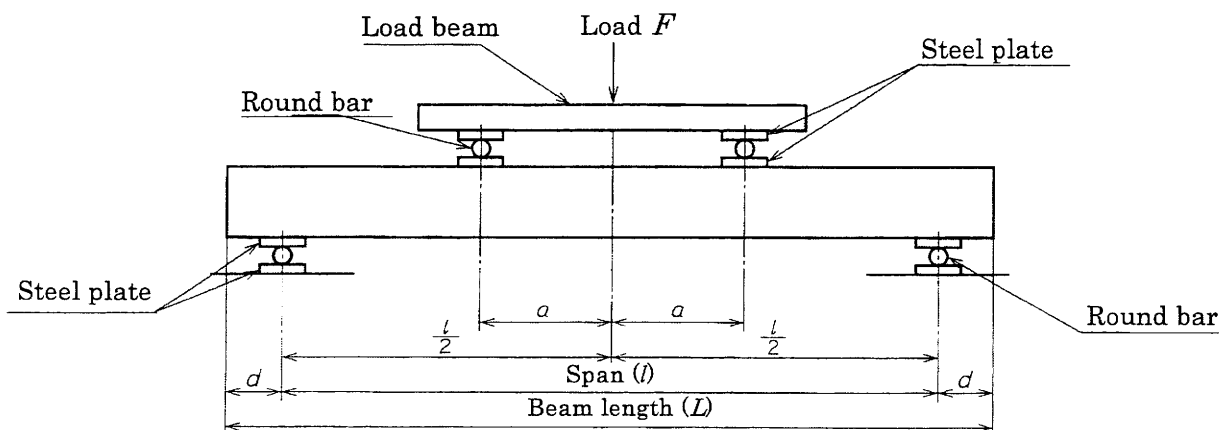
In the case of $l < 10$ m 0.50 (m)

In the case of $l \geq 10$ m 0.75 (m)

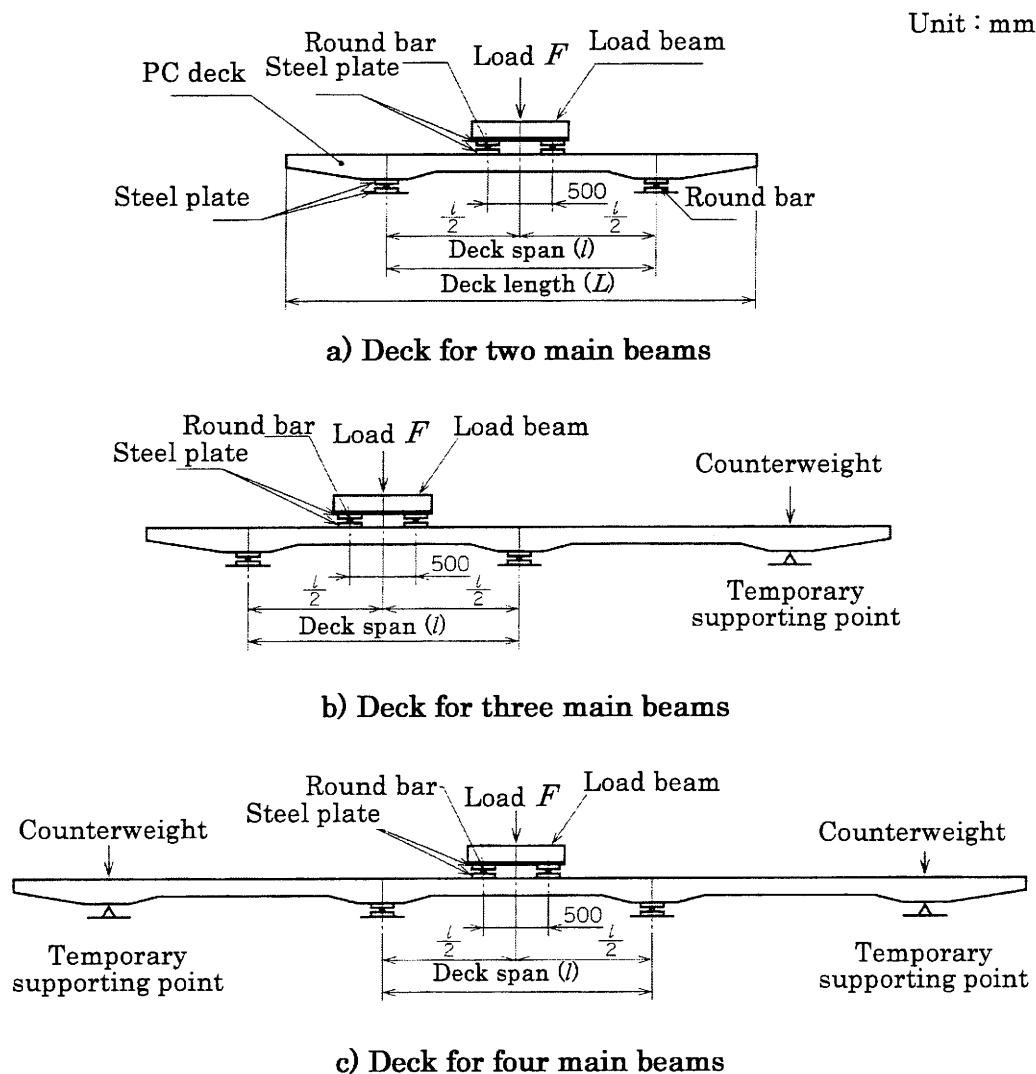
In the case of the precast deck slab for highway bridges 0.25 (m)

In the case of the precast plate for composite deck slab 0.20 (m)

g : Standard gravitational acceleration (9.81 m/s²)



Annex 2 figure 1 The loading method (in the case of the bridge beams for highway bridges, and the precast plates for composite deck slabs)



Annex 2 figure 2 The loading method
(in the case of the precast deck slabs for highway bridges)

7 Quality of concrete

7.1 Material and manufacture method The material and manufacture method for concrete are based on JIS A 5364.

7.2 Compressive strength The compressive strength of concrete shall be verified by the compressive strength of sample which was processed by the same cure as the product, or the compressive strength which was controlled properly. When the predetermined cure is finished, the strength shall satisfy the value specified in annex 2 table 6.

In addition, products of Group II shall be subject to the agreement between the parties concerned with delivery.

Annex 2 table 6 The compressive strength of concrete

Unit : N/mm²

Classification		The compressive strength of concrete	
		At the time of prestress introduction	At the time of quality assurance
Bridge beams	Slab bridge beams	35 or more	50 or more
	Light-load slab bridge beams	42 or more	70 or more
	Beam bridge beams	35 or more	50 or more
	Segments for bridge beams	35 or more	50 or more
Deck slabs	Precast plates for composite deck slabs	30 or more	50 or more
	Precast deck slabs for highway bridges	35 or more	50 or more

Remarks : The compressive strength of concrete may refer to JIS A 5364 annex(informative).

8 Inspection Inspection is based on JIS A 5365 and the following.

8.1 The final inspection The final inspection of bridges is conducted about appearance, performance, shape, and dimension.

- a) **Appearance** About appearance, the characteristic of a product, the manufacture method, manufacture quantity, etc. shall be considered, and a 100 % inspection shall be performed.
- b) **Performance, shape, and dimension** About the performance, shape, and dimension, a 100 % inspection or a sampling inspection shall be performed.

When the performance is inspected by a sample as alternative characteristic, correlation shall be established between the sample and the product.

- c) **Size of inspection lot** The size of inspection lot shall be specified by a manufacturer by considering the characteristics of a product, a manufacture method, manufacture quantity, manufacture period, ordered quantity, etc.

Within one inspection lot, the characteristics, the materials used, concrete mixing ratio, and the manufacturing method shall be the same.

8.2 Delivery inspection The delivery inspection of bridges shall be made about appearance, shape, and dimension. The size of inspection lot and the sampling method shall be subject to the agreement between the parties concerned with delivery, and shall be determined by a purchaser. However, the delivery inspection shall be subject to the agreement between the parties concerned with delivery, and it may be omitted based on the result of final inspection.

9 Marking The marking on bridges shall indicate the following according to JIS A 5361.

- a) Classification or its abbreviation
- b) A manufacturer's name or its abbreviation
- c) A date of manufacture or its abbreviation

10 Others The Group I of bridges is shown in annex 2 table 7.

Annex 2 table 7 Recommended specification

Structure-specific product group standard		Recommended specification	
JIS A 5373	annex 2 (normative) Bridges	Bridge beams	Recommended specification 2-1 Bridge beams for highway bridges
			Recommended specification 2-2 Segments for bridge beams for highway bridge
		Deck plates	Recommended specification 2-3 Precast plates for composite deck slabs
			Recommended specification 2-4 Precast deck slabs for highway bridges

Recommended specification 2-1

Bridge beams for highway bridges

1 Scope This recommended specification specifies the Group I bridge beams for highway bridges (hereafter referred to as “bridge beams”) among the annex 2 of JIS A 5373.

Remarks 1 A bridge beam which was based on the details of this recommended specification 2-1 and which was manufactured by proper quality control shall be deemed to conform to clause 3 of the annex 2 of JIS A 5373.

2 If the informative dimension has been changed within the range shown in clause 4 of the annex 2 of JIS A 5373, a manufacturer must present the following data to a purchaser, when so requested. The data must state conformity of the bridge beam to clause 3 of the annex 2 of JIS A 5373 which has been demonstrated by the design document or performance test.

2 Classification Bridge beams are classified into the ordinary bridge beam and the light-load bridge beam. They are classified by their standard span as shown in recommended specification 2-1 tables 1 to 3.

2.1 Ordinary bridge beams

a) Slab bridge beams

Recommended specification 2-1 table 1

The classification and crack test bending moment of slab bridge beams

Standard span m	Live load A			Live load B		
	Classification	Beam height mm	Crack test bending-moment kN·m	Classification	Beam height mm	Crack test bending-moment kN·m
5	AS05	350	148	BS05	350	153
6	AS06	350	170	BS06	350	182
7	AS07	400	211	BS07	400	227
8	AS08	400	253	BS08	400	271
9	AS09	450	294	BS09	450	314
10	AS10	450	338	BS10	450	370
11	AS11	450	370	BS11	500	433
12	AS12	450	405	BS12	500	475
13	AS13	500	478	BS13	500	526
14	AS14	500	532	BS14	550	610
15	AS15	550	616	BS15	600	696
16	AS16	600	702	BS16	600	764
17	AS17	650	862	BS17	650	863
18	AS18	700	962	BS18	700	960
19	AS19	750	1 050	BS19	750	1 140
20	AS20	750	1 150	BS20	800	1 260
21	AS21	800	1 270	BS21	850	1 440
22	AS22	850	1 470	BS22	900	1 640
23	AS23	900	1 630	BS23	950	1 780
24	AS24	950	1 830	BS24	1 000	2 020

- Remarks 1 **Ordinary bridge beam** Bridge beams used for the national expressway, national highway, prefectural road and important municipal road, or other important roads specified by Road Traffic Law.
- 2 **Live load A** Live load which assumes the comparatively low situation of the run frequency of a large-size vehicle among the design vehicle loading of Road Structure Order.
- 3 **Live load B** Live load which assumes the comparatively high situation of the run frequency of a large-size vehicle among the design vehicle loading of Road Structure Order.
- 4 The center-to-center spacing of bridge beam as a bridge shall not exceed 0.77 m.
- 5 When used for a bridge, a bridge beam shall have the angle of skew of 60 degrees or more.
- 6 The span used may be longer than the standard span by 0.2 m or less, and shorter, by 1 m or less.
- b) **Beam bridge beams**

Recommended specification 2-1 table 2

The classification and crack test bending moment of beam bridge beams

Standard span m	Live load A			Live load B		
	Classification	Beam height mm	Crack test bending moment kN·m	Classification	Beam height mm	Crack test bending moment kN·m
18	AG18	900	1 270	BG18	1 000	1 450
19	AG19	1 000	1 490	BG19	1 000	1 500
20	AG20	1 000	1 560	BG20	1 100	1 790
21	AG21	1 100	1 890	BG21	1 100	1 910
22	AG22	1 100	1 920	BG22	1 200	2 270
23	AG23	1 200	2 280	BG23	1 200	2 300
24	AG24	1 200	2 310	BG24	1 300	2 690

- Remarks 1 The center-to-center spacing of bridge beam as a bridge shall not exceed 1.08 m.
- 2 When used for a bridge, a bridge beam shall have the angle of skew of 70 degrees or more.
- 3 The span used may be longer than the standard span by 0.2 m or less, and shorter, by 1 m or less.

2.2 Light-load bridge beams

Recommended specification 2-1 table 3**Classification and crack test bending moment of light-load slab bridge beams**

Standard span m	Classification	Beam height mm	Crack test bending-moment kN·m
5	LS05	225	76.1
6	LS06	225	93.7
7	LS07	225	108
8	LS08	250	132
9	LS09	275	168
10	LS10	300	207
11	LS11	350	258
12	LS12	375	320
13	LS13	400	376

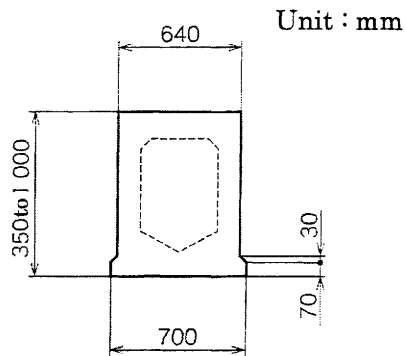
Remark 1 **Light-load bridge beams** Bridge beam used for the road which is not specified in Road Traffic Law, and where a design load is smaller than the ordinary bridge beam.

- 2 The center-to-center spacing of bridge beam as a bridge shall not exceed 0.77 m.
- 3 When used for a bridge, a bridge beam shall have the angle of skew of 60 degrees or more.
- 4 The span used may be longer than the standard span by 0.2 m or less, and shorter, by 1 m or less.

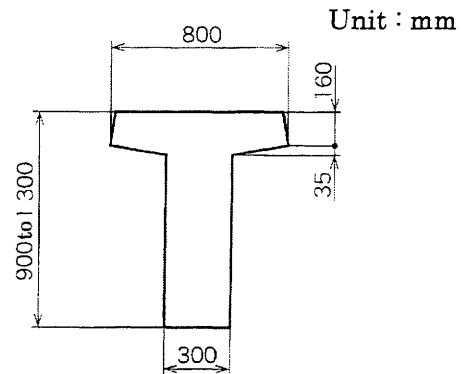
3 Performance

3.1 Bending strength The bending strength of bridge beams shall be specified as follows. When it is subjected to the bending strength test specified in clause 6 and to the crack test bending-moment specified in recommended specification 2-1 tables 1 to 3, it shall not generate any crack.

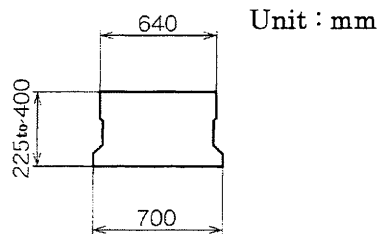
4 Dimension and dimensional tolerance The dimension and dimensional tolerance of bridge beams shall be as specified in annex 2-1 figures 1 to 3 and table 4.



Recommended specification 2-1 figure 1
Shape and dimension of a slab
bridge beam (ordinary bridge beam)



Recommended specification 2-1 figure 2
Shape and dimension of a beam
bridge beam (ordinary bridge beam)



Recommended specification 2-1 figure 3
The shape and dimension of a slab
bridge beam (light-load bridge beam)

Recommended specification 2-1 table 4 Dimensional tolerance
Unit : mm

Classification	Tolerance	
Beam length L	In the case of $L \leq 10$ m	± 10
	In the case of $L > 10$ m	$\pm \frac{L}{1\ 000}$ (1)
The outside dimension of cross section	± 5	
Camber (2) of bridge beams	± 8 (3)	
Deflection of the transverse direction	10	

Notes (1) The beam length L is expressed with mm.

(2) This shall be the value of the center of a span.

(3) Make one set of number of the bridge beams used for one span, and this shall be tolerance of the average of camber.

5 Bar arrangement The bar arrangement of bridge beams is based on a design document and the following.

- a) The covering of reinforcement and PC steel shall be 25 mm or more.
- b) The gap of reinforcement and PC steel shall be 20 mm or more. As to PC steel, the gap shall be three times or more a diameter, and at the same time $4/3$ or more times the maximum dimension of a coarse aggregate.
- c) A reinforcement and PC steel shall be free from loose scale, oil, etc. which damage adhesion of concrete, and shall be assembled and fixed to the accurate position.

6 Strength test

6.1 Compressive-strength test The compressive-strength test of bridge beams is based on 6.1 of the annex 2 of JIS A 5373.

6.2 Bending test The bending test of bridge beams is based on 6.2 of the annex 2 of JIS A 5373.

Remarks : A tester shall be Grade one or higher specified in JIS B 7721, or shall have the allowance which is equivalent to or better than this.

7 Quality of concrete The compressive strength of concrete is based on 7.2 of the annex 2 of JIS A 5373.

8 Inspections

8.1 Inspection items The inspection items of bridge beams are based on the following.

- a) **Final inspection**
 - 1) Appearance
 - 2) Performance
 - 3) Shape and dimension
- b) **Delivery inspection**
 - 1) Appearance
 - 2) Shape and dimension

Remarks : The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and it may be omitted based on the result of final test.

8.2 Inspection lot The size of inspection lot of bridge beams shall be decided by a manufacturer who considers the characteristics of products, manufacture methods, manufacture quantity, manufacture period, ordered quantity, etc. The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and shall be decided by a purchaser. However, one lot may be 400 pieces or its fraction.

8.3 Inspection method The inspection method of bridge beams is based on the following.

a) **Final inspection**

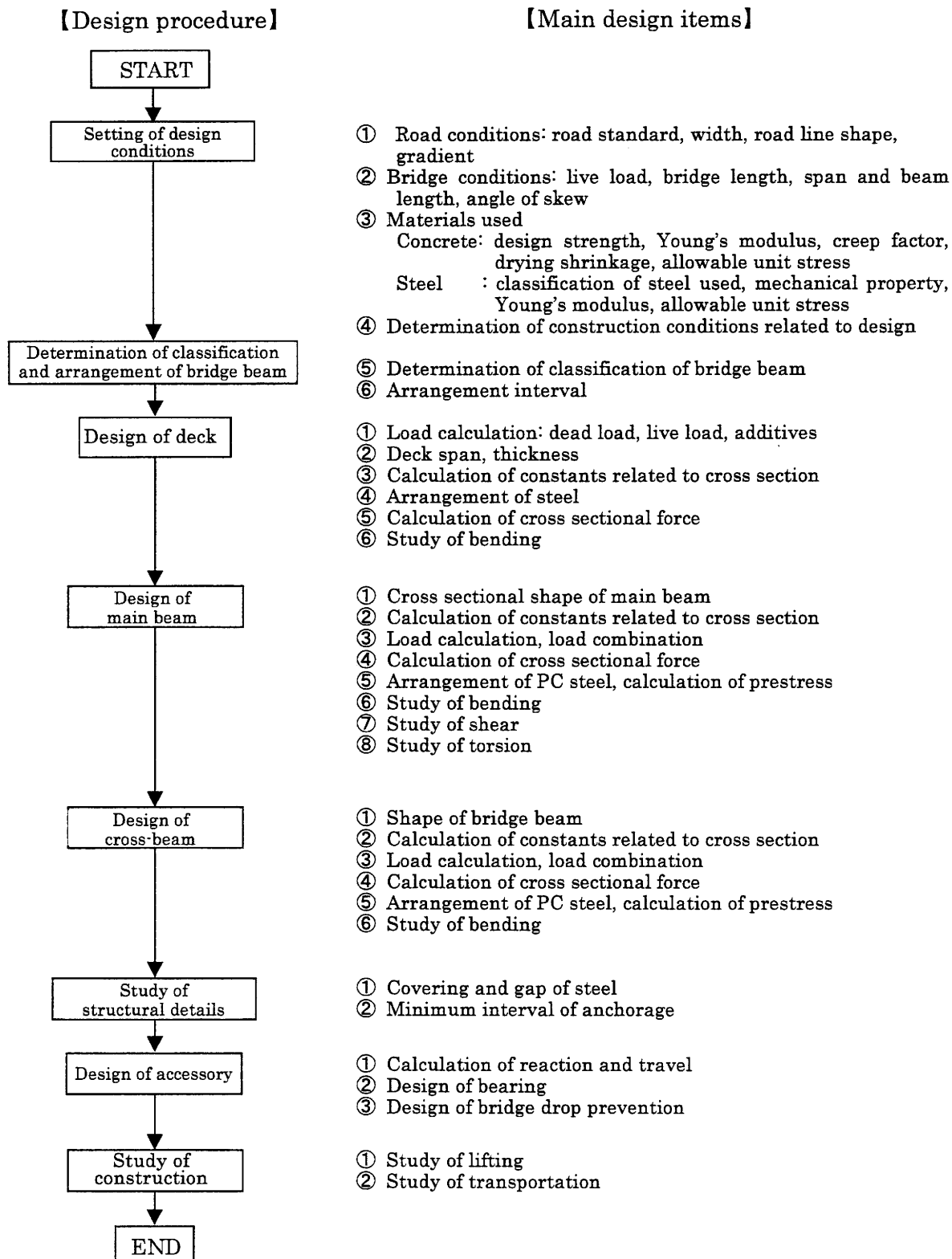
- 1) **Appearance** Appearance shall be subjected to visual 100 % inspection. If the products conform to the provision of 5.1 of JIS A 5373, they shall be accepted.
- 2) **Performance** For inspection of performance, take two bridge beams from one lot of bridge beams, and inspect them by 6.2. If both of the two conform to 3.1, the lot shall be accepted. If both of the two fail, the whole lot shall be rejected. If one of the two fails, the rest of the lot shall be tested. If it conforms to the provision, it shall be accepted.
- 3) **Shape and dimension** For inspection of shape and dimension, a 100 % inspection shall be performed. If they conform to the provision of clause 4, they shall be accepted.

b) **Delivery inspection**

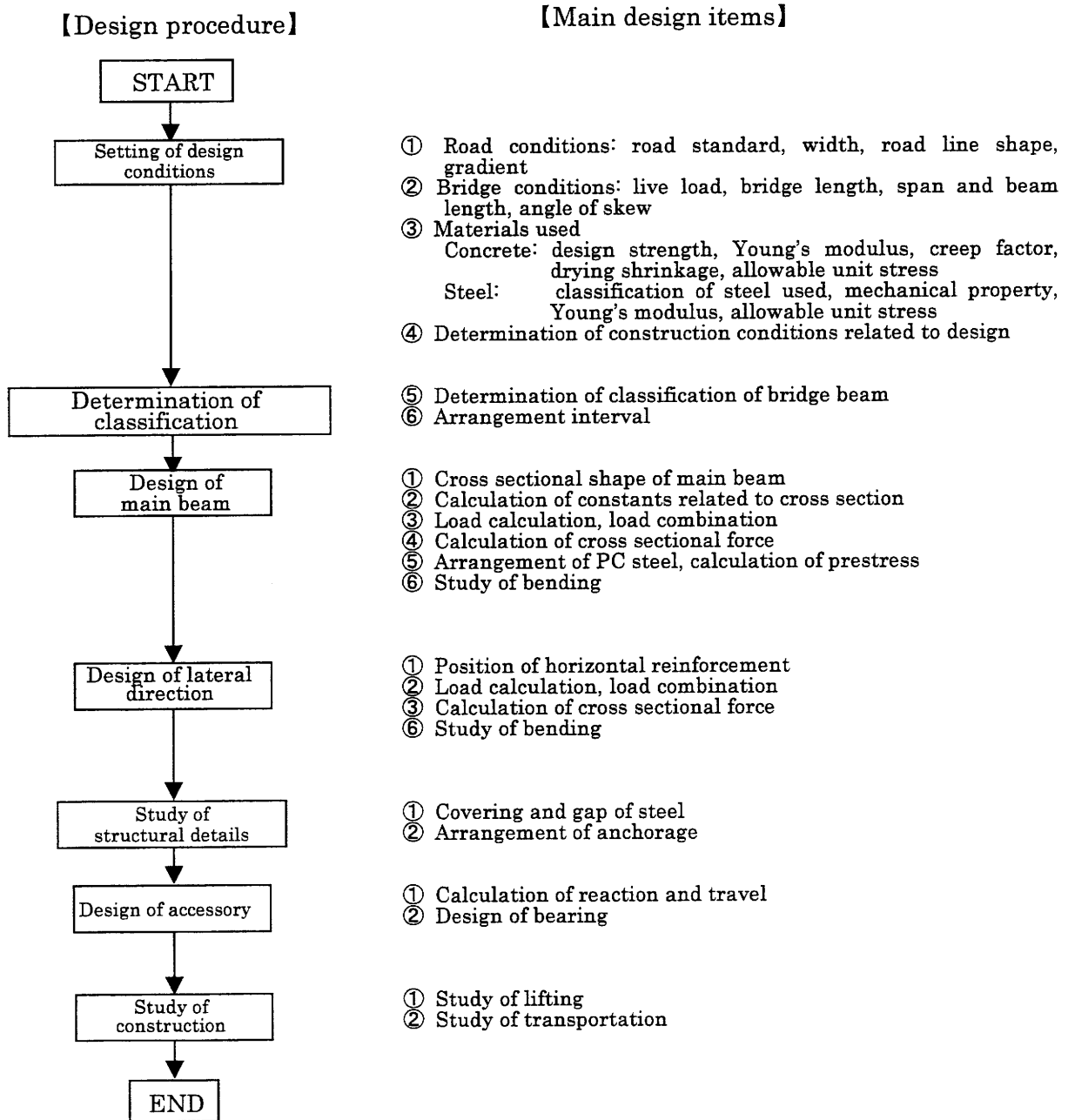
- 1) **Appearance** Inspection of appearance shall be made like a).
- 2) **Shape and dimension** Inspection of shape and dimension shall be made like a).

9 Marking The marking on bridge beams is based on JIS A 5361 and JIS A 5373.

The general design procedure and the main design items of the bridge beam for roads are shown below.



The general design procedure and the main design items of the bridge beam for light load slab bridges are shown below.



Recommended specification 2-1 informative figure 2

Design procedure of the bridge beams for light-load slab bridges

Recommended specification 2-2

Segments for bridge beams of highway bridge

1 Scope This recommended specification specifies the segment for Group I bridge beams of highway bridge (hereafter referred to as “segment for bridge beams”) among the annex 2 of JIS A 5373.

Remarks 1 A segment for bridge beam which was based on the details of this recommended specification 2-2 and which was manufactured by proper quality control shall be deemed to conform to clause 3 of the annex 2 of JIS A 5373.

2 If the reference dimension has been changed within the range shown in clause 4 of the annex 2 of JIS A 5373, a manufacturer must present the following data to a purchaser, when so requested. The data must state conformity of the bridge beam to clause 3 of the annex 2 of JIS A 5373 which has been demonstrated by the design document or performance test.

2 Classification Segments for bridge beams are classified by the length of a bridge beam as shown in Recommended specification 2-2 table 1. Moreover, the segment for bridge beams consists of an edge, middle, and central segments. At the time of manufacture, it is a reinforced-concrete product (RC). At the time of use, several components are combined into a single body with PC steel to form prestressed concrete structure.

The classification shown here indicates the highway bridge of the main beam spacing of 2.6 m to 3.8 m.

Recommended specification 2-2 table 1

The classification and segment composition of segment for bridge beams

Standard span of bridge beam	Classification and number of edge segments	Classification and number of middle segments	Classification and number of central segments	Standard span of bridge beam	Classification and number of edge segments	Classification and number of middle segments	Classification and number of central segments
25 m	They are two pieces about T25-a.	—	It is one piece about MD25-a.	36 m	They are two pieces about T36-a.	They are two pieces about M36-a.	It is one piece about MD36-a.
	They are two pieces about T25-b.	—	It is one piece about MD25-b.		They are two pieces about T36-b.	They are two pieces about M36-b.	It is one piece about MD36-b.
	They are two pieces about T25-c.	—	It is one piece about MD25-c.		They are two pieces about T36-c.	They are two pieces about M36-c.	It is one piece about MD36-c.
26 m	They are two pieces about T26-a.	—	It is one piece about MD26-a.	37 m	They are two pieces about T37-a.	They are two pieces about M37-a.	It is one piece about MD37-a.
	They are two pieces about T26-b.	—	It is one piece about MD26-b.		They are two pieces about T37-b.	They are two pieces about M37-b.	It is one piece about MD37-b.
	They are two pieces about T26-c.	—	It is one piece about MD26-c.		They are two pieces about T37-c.	They are two pieces about M37-c.	It is one piece about MD37-c.
27 m	They are two pieces about T27-a.	—	It is one piece about MD27-a.	38 m	They are two pieces about T38-a.	They are two pieces about M38-a.	It is one piece about MD38-a.
	They are two pieces about T27-b.	—	It is one piece about MD27-b.		They are two pieces about T38-b.	They are two pieces about M38-b.	It is one piece about MD38-b.
	They are two pieces about T27-c.	—	It is one piece about MD27-c.		They are two pieces about T38-c.	They are two pieces about M38-c.	It is one piece about MD38-c.
28 m	They are two pieces about T28-a.	—	It is one piece about MD28-a.	39 m	They are two pieces about T39-a.	They are two pieces about M39-a.	It is one piece about MD39-a.
	They are two pieces about T28-b.	—	It is one piece about MD28-b.		They are two pieces about T39-b.	They are two pieces about M39-b.	It is one piece about MD39-b.
	They are two pieces about T28-c.	—	It is one piece about MD28-c.		They are two pieces about T39-c.	They are two pieces about M39-c.	It is one piece about MD39-c.
29 m	They are two pieces about T29-a.	—	It is one piece about MD29-a.	40 m	They are two pieces about T40-a.	They are two pieces about M40-a.	It is one piece about MD40-a.
	They are two pieces about T29-b.	—	It is one piece about MD29-b.		They are two pieces about T40-b.	They are two pieces about M40-b.	It is one piece about MD40-b.
	They are two pieces about T29-c.	They are two pieces about M29-c.	It is one piece about MD29-c.		They are two pieces about T40-c.	They are four pieces about M40-c.	It is one piece about MD40-c.
30 m	They are two pieces about T30-a.	—	It is one piece about MD30-a.	41 m	They are two pieces about T41-a.	They are two pieces about M41-a.	It is one piece about MD41-a.
	They are two pieces about T30-b.	They are two pieces about M30-b.	It is one piece about MD30-b.		They are two pieces about T41-b.	They are four pieces about M41-b.	It is one piece about MD41-b.
	They are two pieces about T30-c.	They are two pieces about M30-c.	It is one piece about MD30-c.		They are two pieces about T41-c.	They are four pieces about M41-c.	It is one piece about MD41-c.
31 m	They are two pieces about T31-a.	They are two pieces about M31-a.	It is one piece about MD31-a.	42 m	They are two pieces about T42-a.	They are two pieces about M42-a.	It is one piece about MD42-a.
	They are two pieces about T31-b.	They are two pieces about M31-b.	It is one piece about MD31-b.		They are two pieces about T42-b.	They are four pieces about M42-b.	It is one piece about MD42-b.
	They are two pieces about T31-c.	They are two pieces about M31-c.	It is one piece about MD31-c.		They are two pieces about T42-c.	They are four pieces about M42-c.	It is one piece about MD42-c.
32 m	They are two pieces about T32-a.	They are two pieces about M32-a.	It is one piece about MD32-a.	43 m	They are two pieces about T43-a.	They are two pieces about M43-a.	It is one piece about MD43-a.
	They are two pieces about T32-b.	They are two pieces about M32-b.	It is one piece about MD32-b.		They are two pieces about T43-b.	They are six pieces about M43-b.	It is one piece about MD43-b.
	They are two pieces about T32-c.	They are two pieces about M32-c.	It is one piece about MD32-c.		They are two pieces about T43-c.	They are six pieces about M43-c.	It is one piece about MD43-c.

Recommended specification 2-2 table 1 (concluded)

Standard span of bridge beam	Classification and number of edge segments	Classification and number of middle segments	Classification and number of central segments	Standard span of bridge beam	Classification and number of edge segments	Classification and number of middle segments	Classification and number of central segments
33 m	They are two pieces about T33-a.	They are two pieces about M33-a.	It is one piece about MD33-a.	44 m	They are two pieces about T44-a.	They are two pieces about M44-a.	It is one piece about MD44-a.
	They are two pieces about T33-b.	They are two pieces about M33-b.	It is one piece about MD33-b.		They are two pieces about T44-b.	They are six pieces about M44-b.	It is one piece about MD44-b.
	They are two pieces about T33-c.	They are two pieces about M33-c.	It is one piece about MD33-c.		They are two pieces about T44-c.	They are six pieces about M44-c.	It is one piece about MD44-c.
34 m	They are two pieces about T34-a.	They are two pieces about M34-a.	It is one piece about MD34-a.	45 m	They are two pieces about T45-a.	They are two pieces about M45-a.	It is one piece about MD45-a.
	They are two pieces about T34-b.	They are two pieces about M34-b.	It is one piece about MD34-b.		They are two pieces about T45-b.	They are six pieces about M45-b.	It is one piece about MD45-b.
	They are two pieces about T34-c.	They are two pieces about M34-c.	It is one piece about MD34-c.		They are two pieces about T45-c.	They are six pieces about M45-c.	It is one piece about MD45-c.
35 m	They are two pieces about T35-a.	They are two pieces about M35-a.	It is one piece about MD35-a.				
	They are two pieces about T35-b.	They are two pieces about M35-b.	It is one piece about MD35-b.				
	They are two pieces about T35-c.	They are two pieces about M35-c.	It is one piece about MD35-c.				

Remarks 1 The segment for bridge beams should be easy for transportation and construction. The weight of one piece of segment shall be 300 kN or less. The weight difference from segment to segment shall be as small as possible.

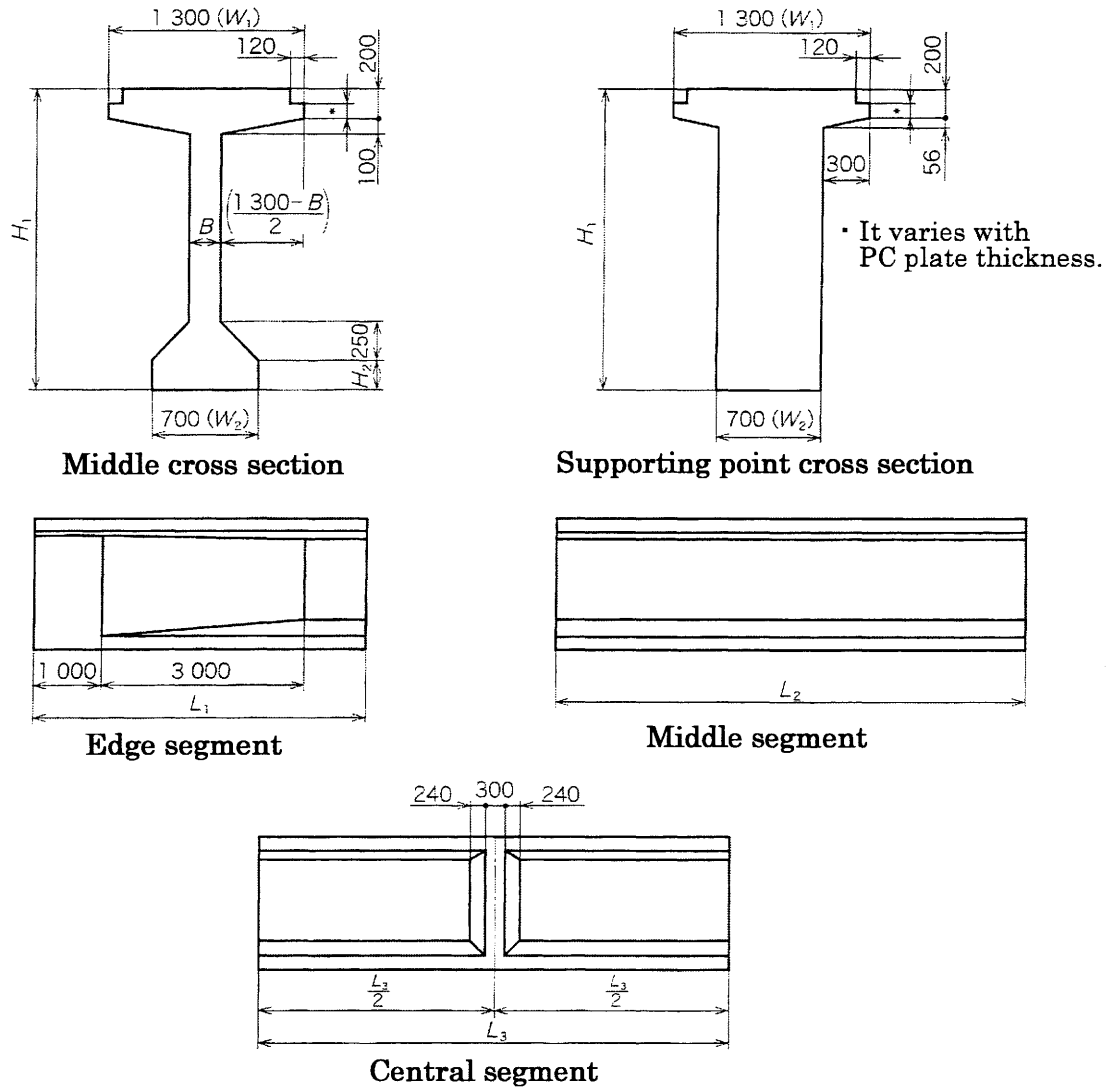
2 When used for a bridge, bridge beams shall have the angle of skew of 70 degrees or more.

3 Performance

3.1 Compressive strength The segment for bridge beams shall be subjected to the compressive-strength test specified in clause 6. The compressive strength for quality assurance shall be 50 N/mm² or more. The compressive strength at the time of prestress introduction shall be 35 N/mm² or more.

4 Shape, dimension and dimensional tolerance The shape, dimension and dimensional tolerance shall be as specified in recommended specification 2-2 figure 1, tables 2 to 4 and table 5.

Unit : mm



Recommended specification 2-2 figure 1 Shape of the segments for bridge beams

Recommended specification 2-2 table 2 Dimension of edge segments

Unit : mm

Classification		L_1	H_1	H_2	B	Classification		L_1	H_1	H_2	B
T25-	a	8 100	1 400	200	220	T36-	a	6 400	2 000	200	220
	b	8 100	1 600	200	220		b	6 400	2 300	200	220
	c	8 100	1 900	200	220		c	4 900	2 700	200	220
T26-	a	8 600	1 400	200	220	T37-	a	6 900	2 000	200	220
	b	8 100	1 700	200	220		b	6 900	2 300	200	220
	c	8 100	2 000	200	220		c	5 400	2 700	200	220
T27-	a	8 600	1 400	200	220	T38-	a	5 900	2 100	200	220
	b	8 600	1 700	200	220		b	5 900	2 400	200	220
	c	8 600	2 000	200	220		c	5 900	2 800	200	220
T28-	a	9 100	1 500	200	220	T39-	a	6 400	2 100	250	230
	b	9 100	1 800	200	220		b	6 400	2 500	250	230
	c	9 100	2 100	200	220		c	6 400	2 900	250	230
T29-	a	9 100	1 600	200	220	T40-	a	6 200	2 100	250	230
	b	9 100	1 900	200	220		b	6 950	2 500	250	230
	c	4 350	2 300	200	220		c	4 700	3 000	250	230
T30-	a	9 900	1 700	200	220	T41-	a	6 700	2 200	250	230
	b	4 900	2 000	200	220		b	4 700	2 600	250	230
	c	4 900	2 400	200	220		c	5 200	3 000	250	230
T31-	a	4 100	1 700	200	220	T42-	a	7 200	2 200	250	230
	b	5 400	2 000	200	220		b	5 200	2 600	250	230
	c	4 100	2 400	200	220		c	5 700	3 100	250	230
T32-	a	4 400	1 800	200	220	T43-	a	7 700	2 300	250	230
	b	4 400	2 100	200	220		b	4 450	2 700	250	230
	c	4 400	2 500	200	220		c	4 100	3 200	250	230
T33-	a	4 900	1 800	200	220	T44-	a	8 200	2 300	250	230
	b	4 900	2 100	200	220		b	4 600	2 700	250	230
	c	4 900	2 500	200	220		c	4 250	3 200	250	230
T34-	a	5 400	1 900	200	220	T45-	a	7 800	2 400	250	230
	b	5 400	2 200	200	220		b	4 400	2 800	250	230
	c	5 400	2 600	200	220		c	4 050	3 300	250	230
T35-	a	5 900	2 000	200	220						
	b	5 900	2 300	200	220						
	c	4 400	2 600	200	220						

Recommended specification 2-2 table 3 Dimension (1) of middle segments

Unit : mm

Classification		L_2	H_1	H_2	B	Classification		L_2	H_1	H_2	B
M29-	a	-	-	-	-	M38-	a	9 000	2 100	200	220
	b	-	-	-	-		b	9 000	2 400	200	220
	c	7 000	2 300	200	220		c	9 000	2 800	200	220
M30-	a	-	-	-	-	M39-	a	9 000	2 100	250	230
	b	7 000	2 000	200	220		b	9 000	2 500	250	230
	c	7 000	2 400	200	220		c	9 000	2 900	250	230
M31-	a	7 800	1 700	200	220	M40-	a	9 500	2 100	250	230
	b	7 000	2 000	200	220		b	9 000	2 500	250	230
	c	7 800	2 400	200	220		c	6 300	3 000	250	230
M32-	a	8 000	1 800	200	220	M41-	a	9 500	2 200	250	230
	b	8 000	2 100	200	220		b	6 500	2 600	250	230
	c	8 000	2 500	200	220		c	6 300	3 000	250	230
M33-	a	8 000	1 800	200	220	M42-	a	9 500	2 200	250	230
	b	8 000	2 100	200	220		b	6 500	2 600	250	230
	c	8 000	2 500	200	220		c	6 300	3 100	250	230
M34-	a	8 000	1 900	200	220	M43-	a	9 500	2 300	250	230
	b	8 000	2 200	200	220		b	5 000	2 700	250	230
	c	8 000	2 600	200	220		c	5 100	3 200	250	230
M35-	a	8 000	2 000	200	220	M44-	a	9 500	2 300	250	230
	b	8 000	2 300	200	220		b	5 100	2 700	250	230
	c	9 000	2 600	200	220		c	5 200	3 200	250	230
M36-	a	8 000	2 000	200	220	M45-	a	10 100	2 400	250	230
	b	8 000	2 300	200	220		b	5 300	2 800	250	230
	c	9 000	2 700	200	220		c	5 400	3 300	250	230
M37-	a	8 000	2 000	200	220						
	b	8 000	2 300	200	220						
	c	9 000	2 700	200	220						

Note⁽¹⁾ A middle segment becomes unnecessary when a bridge beam consists of three segments (edge segment $\times 2$, central segment). Therefore, middle segments of standard span of 25 m to 28 m (M25 to M28) and some of standard span of 29 m and 30 m (M29-a, M29-b, M30-a) do not exist.

Recommended specification 2-2 table 4 Dimension of central segments

Unit : mm

Classification		L_3	H_1	H_2	B	Classification		L_3	H_1	H_2	B
MD25	a	9 500	1 400	200	220	MD36	a	8 000	2 000	200	220
	b	9 500	1 600	200	220		b	8 000	2 300	200	220
	c	9 500	1 900	200	220		c	9 000	2 700	200	220
MD26	a	9 500	1 400	200	220	MD37	a	8 000	2 000	200	220
	b	10 500	1 700	200	220		b	8 000	2 300	200	220
	c	10 500	2 000	200	220		c	9 000	2 700	200	220
MD27	a	10 500	1 400	200	220	MD38	a	9 000	2 100	200	220
	b	10 500	1 700	200	220		b	9 000	2 400	200	220
	c	10 500	2 000	200	220		c	9 000	2 800	200	220
MD28	a	10 500	1 500	200	220	MD39	a	9 000	2 100	250	230
	b	10 500	1 800	200	220		b	9 000	2 500	250	230
	c	10 500	2 100	200	220		c	9 000	2 900	250	230
MD29	a	11 500	1 600	200	220	MD40	a	9 500	2 100	250	230
	b	11 500	1 900	200	220		b	9 000	2 500	250	230
	c	7 000	2 300	200	220		c	6 300	3 000	250	230
MD30	a	11 000	1 700	200	220	MD41	a	9 500	2 200	250	230
	b	7 000	2 000	200	220		b	6 500	2 600	250	230
	c	7 000	2 400	200	220		c	6 300	3 000	250	230
MD31	a	8 000	1 700	200	220	MD42	a	9 500	2 200	250	230
	b	7 000	2 000	200	220		b	6 500	2 600	250	230
	c	8 000	2 400	200	220		c	6 300	3 100	250	230
MD32	a	8 000	1 800	200	220	MD43	a	9 500	2 300	250	230
	b	8 000	2 100	200	220		b	5 000	2 700	250	230
	c	8 000	2 500	200	220		c	5 100	3 200	250	230
MD33	a	8 000	1 800	200	220	MD44	a	9 500	2 300	250	230
	b	8 000	2 100	200	220		b	5 100	2 700	250	230
	c	8 000	2 500	200	220		c	5 200	3 200	250	230
MD34	a	8 000	1 900	200	220	MD45	a	10 100	2 400	250	230
	b	8 000	2 200	200	220		b	5 300	2 800	250	230
	c	8 000	2 600	200	220		c	5 400	3 300	250	230
MD35	a	8 000	2 000	200	220						
	b	8 000	2 300	200	220						
	c	9 000	2 600	200	220						

Recommended specification 2-2 table 5 Dimensional tolerance

Classification	Tolerance
Length L_1 to L_3	± 10
Upper width W_1	+10 -5
Lower width W_2	± 5
Height H_1	+10 -5

Remarks : Plural segments are joined to be used as a bridge beam. The tolerance of beam length (L) at the time of manufacture shall be the sum of those of segments used, and it shall be $\pm (L-5)$ and within -30 mm. The unit of beam length (L) shall be m, and the unit of tolerance, mm.

5 Bar arrangement The bar arrangement of segment for bridge beam is based on a design document and the following.

- a) The covering of reinforcement and PC steel shall be 30 mm or more for upper flange, and 35 mm or more for the rest.
- b) The gap of reinforcement shall be 20 mm or more, and at the same time $4/3$ times or more the maximum dimension of a coarse aggregate.
- c) A reinforcement and PC steel shall be free from loose scale, oil, etc. which damage adhesion of concrete, and shall be assembled and fixed to the accurate position.

6 Strength test

6.1 Compressive-strength test The compressive-strength test of segment for bridge beam is based on 6.1 of the annex 2 of JIS A 5373.

Remarks : A tester shall be Grade one or higher specified in JIS B 7721, or shall have the allowance which is equivalent to or better than this.

7 Quality of concrete The compressive strength of concrete is based on 7.2 of the annex 2 of JIS A 5373.

8 Inspections

8.1 Inspection items The inspection items of segments for bridge beams are based on the following.

- a) **Final inspection**
 - 1) Appearance
 - 2) Performance
 - 3) Shape and dimension
- b) **Delivery inspection**
 - 1) Appearance
 - 2) Shape and dimension

Remarks : The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and it may be omitted based on the result of final test.

8.2 Inspection lot The size of inspection lot of segment for bridge beam shall be decided by a manufacturer who considers the characteristics of products, manufacture methods, manufacture quantity, manufacture period, ordered quantity, etc. The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and shall be decided by a purchaser. However, one lot may be one bridge beam.

8.3 Inspection method The inspection method of segment for bridge beam is based on the following.

a) **Final inspection**

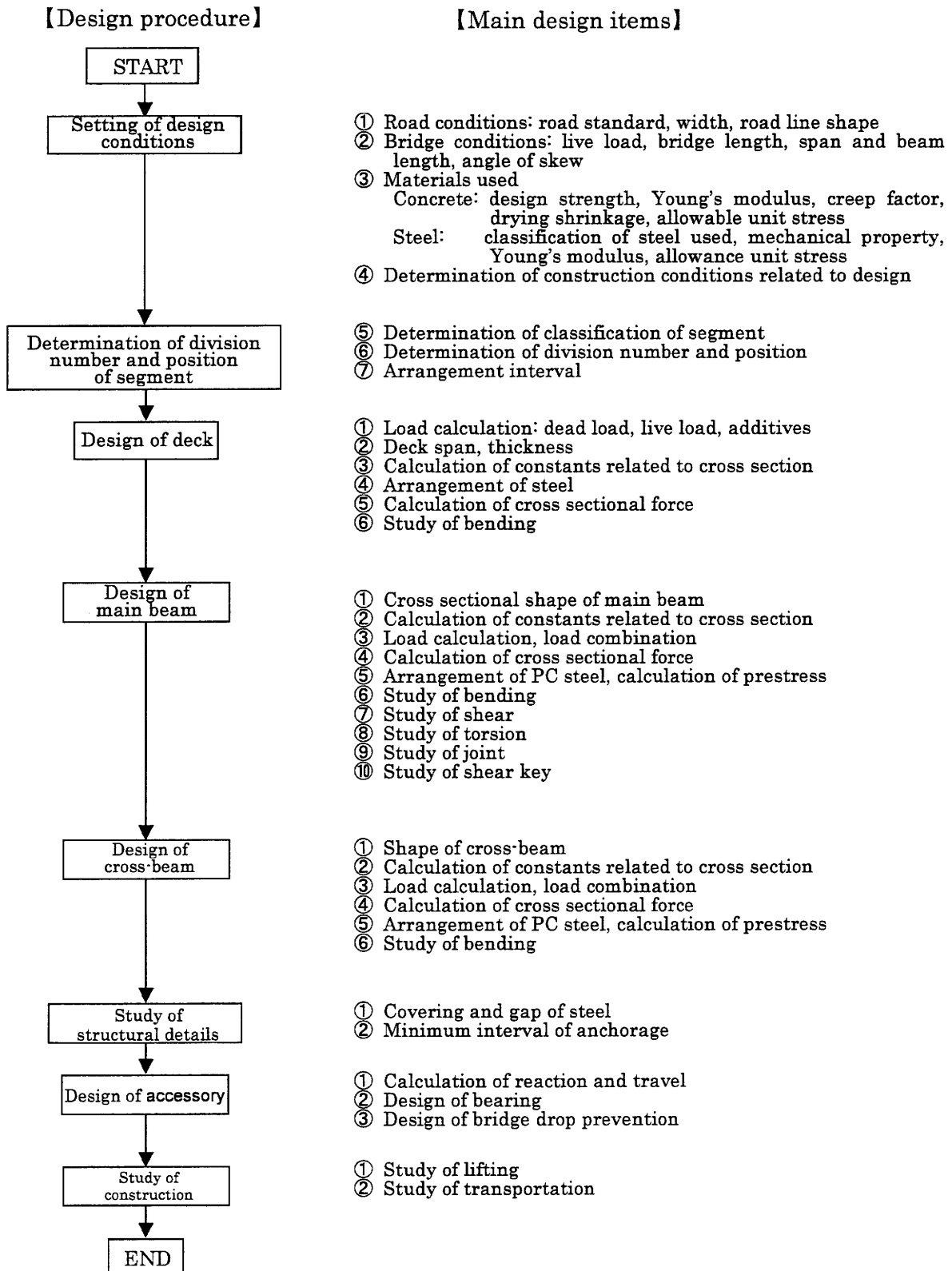
- 1) **Appearance** Appearance shall be subjected to visual 100 % inspection. If the products conform to the provision of 5.1 of JIS A 5373, they shall be accepted.
- 2) **Performance** For inspection of performance, take one bridge beam, and inspect it by 6.1. If it conforms to 3.1, it shall be accepted.
- 3) **Shape and dimension** For inspection of shape and dimension, a 100 % inspection shall be performed. If they conform to the provision of clause 4, they shall be accepted.

b) **Delivery inspection**

- 1) **Appearance** Inspection of appearance shall be made like a).
- 2) **Shape and dimension** Inspection of shape and dimension shall be made like a).

9 Marking The marking on segments for bridge beams is based on JIS A5361 and JIS A5373.

The general design procedure and design items of the segments for road bridge beams are shown below.



Recommended specification 2-2 informative figure 1

Design procedure of the segments for bridge beams for highway bridge

Recommended specification 2-3

Precast plates for composite deck slabs

1 Scope This recommended specification specifies the precast plate for composite deck slab of Group I bridge (hereafter referred to as “precast plate for composite deck slab”) among the annex 2 of JIS A 5373.

Remarks 1 Precast plates for composite deck slabs which were based on the details of this recommended specification 2-3 and which was manufactured by proper quality control shall be deemed to conform to clause 3 of the annex 2 of JIS A 5373.

2 If the reference dimension has been changed within the range shown in clause 4 of the annex 2 of JIS A 5373, a manufacturer must present the following data to a purchaser, when so requested. The data must state conformity of the precast plates for composite deck slabs to clause 3 of the annex 2 of JIS A 5373 which has been demonstrated by the design document or performance test.

2 Classification The precast plates for composite deck slab are classified by the span as shown in recommended specification 2-3 table 1.

Recommended specification 2-3 table 1 Classification and crack test bending moment of the precast plates for composite deck slabs

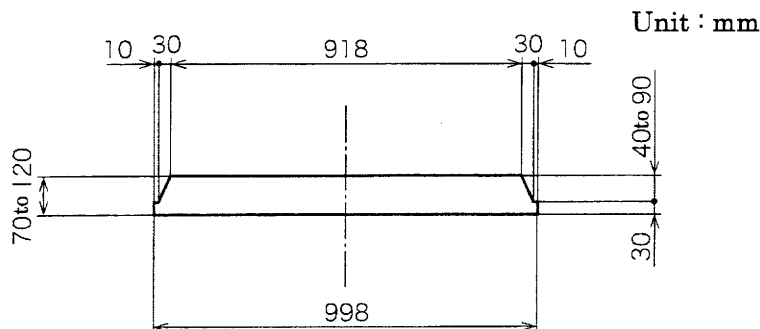
Classification	The span of precast plate mm	Plate thickness mm	Crack test ⁽¹⁾ bending-moment kN·m
PCC-70-1	1 450	70	6.8
PCC-70-2	1 750	70	7.8
PCC-80	2 050	80	10.1
PCC-90	2 200	90	13.0
PCC-100	2 600	100	16.3
PCC-110	2 800	110	19.9
PCC-120	3 000	120	22.3

Note⁽¹⁾ The crack test bending moment shall be the value which applies the guarantee tensile stress of 1.8 N/mm² on the lower edge of a precast plate.

3 Performance

3.1 Bending strength The bending strength of precast plate for composite deck slab shall be specified as follows. When it is subjected to the bending strength test specified in clause 6 and to the crack test bending moment specified in recommended specification 2-3 table 1, it shall not generate any crack.

4 Shape, dimension and dimensional tolerance The shape, dimension, and dimensional tolerance of precast plate for composite deck slab shall be as specified in recommended specification 2-3 figure 1 and table 2. The top face of precast plate shall have a suitable inequality to combine cast-in place concrete with the precast plate, the thickness of plate shall be intermediate of the inequality.



Recommended specification 2-3 figure 1

The shape and dimension of the precast plates for composite deck slabs

Recommended specification 2-3 table 2 Dimensional tolerance

Unit : mm

Classification	Tolerance
Length (perpendicular to bridge axis)	+10 - 5
Width (along bridge axis)	+5 -3
Thickness (at protrusive part)	+5 -2
Linearity of the side face of plate	±3
Perpendicularity of the end face of plate	±10

5 Bar arrangement The bar arrangement of the precast plate for composite deck slab is based on a design document and the following.

- The covering of reinforcement and PC steel shall be 25 mm or more.
- The gap of reinforcement and PC steel shall be 20 mm or more. The gap of PC steel shall be three times or more the diameter, and at the same time 4/3 times or more the maximum dimension of a coarse aggregate.
- A reinforcement and PC steel shall be free from loose scale, oil, etc. which damage adhesion of concrete, and shall be assembled and fixed to the accurate position.

6 Strength test

6.1 Compressive-strength test The compressive-strength test of the precast plate for composite deck slab is based on 6.1 of the annex 2 of JIS A 5373.

6.2 Bending test The bending test of the precast plate for composite deck slab is based on 6.2 of the annex 2 of JIS A 5373.

Remarks : A tester shall be Grade one or higher specified in JIS B 7721, or shall have the allowance which is equivalent to or better than this.

7 Quality of concrete The compressive strength of concrete is based on 7.2 of the annex 2 of JIS A 5373.

8 Inspections

8.1 Inspection items The inspection items of the precast plate for composite deck slab are based on the following.

a) Final inspection

- 1) Appearance
- 2) Performance
- 3) Shape and dimension

b) Delivery inspection

- 1) Appearance
- 2) Shape and dimension

Remarks : The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and it may be omitted based on the result of final test.

8.2 Inspection lot The size of inspection lot of the precast plate for composite deck slab shall be decided by a manufacturer who considers the characteristics of products, manufacture methods, manufacture quantity, manufacture period, ordered quantity, etc. The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and shall be decided by a purchaser. However, one lot may be 20 manufacture lines or its fraction.

8.3 Inspection method The inspection method of the precast plate for composite deck slab is based on the following.

a) Final inspection

- 1) **Appearance** Appearance shall be subjected to visual 100 % inspection. If the products conform to the provision of 5.1 of JIS A 5373, they shall be accepted.
- 2) **Performance** For inspection of performance, take two plates from one lot of precast plate for composite deck slab, and inspect them by 6.2. If both of the two conform to 3.1, the lot shall be accepted. If both of the two fail, the lot shall be

rejected. If one of the two fails, the rest of the lot shall be tested. If it conforms to the provision, it shall be accepted.

- 3) **Shape and dimension** For inspection of shape and dimension, use one lot of precast plate for composite deck slab, and take one sample each from two arbitrary manufacture lines, i.e. two samples in total. If both of the two conform to provision of clause 4, the whole lot shall be accepted. If even one sample fails, take one sample each from four other manufacture lines, i.e. four samples in total. If all the four samples conform to the provision, all the lines shall be accepted, excluding the lines which produced nonconforming products. If even one of the four fails, the rest of the lot shall be subjected to a 100 % inspection.

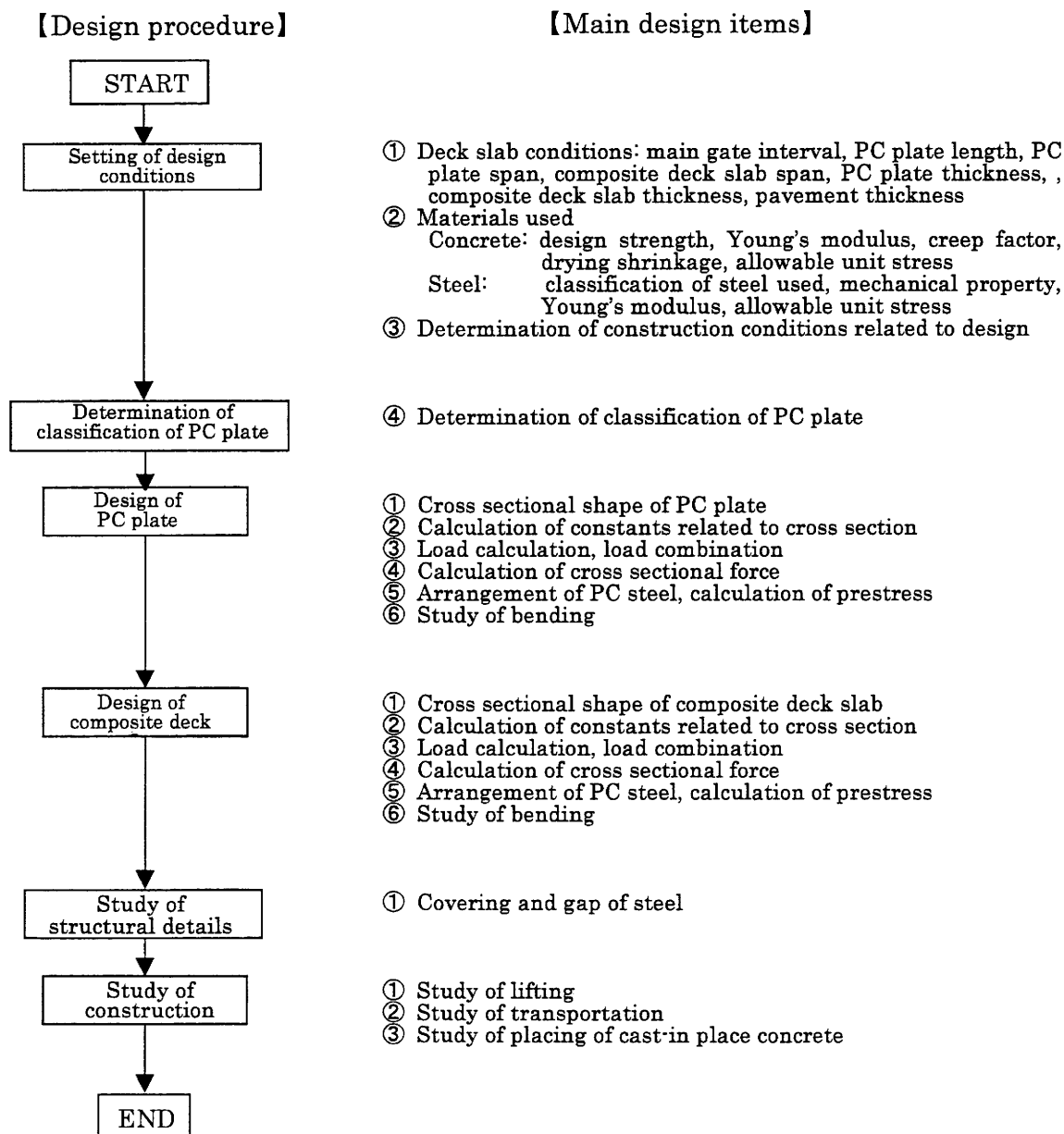
In addition, about the manufacture line(s) which produced nonconforming product(s), take two further samples and inspect them. If both of the two conform, the rest shall be all accepted, excluding the manufacture lines which produced nonconforming products. If even one fails, the manufacture line shall be subjected to a 100 % inspection.

b) **Delivery inspection**

- 1) **Appearance** Inspection of appearance shall be made like a).
- 2) **Shape and dimension** Inspection of shape and dimension shall be made like a).

9 Marking The marking on precast plates for composite deck slabs are based on JIS A 5361 and JIS A 5373.

The general design procedure and design items of the precast plate for composite deck slab are shown below.



Recommended specification 2-3 informative figure 1

Design procedure of the precast plates for composite deck slabs

Recommended specification 2-4

Precast deck slabs for highway bridges

1 Scope This recommended specification specifies the precast deck slab for highway bridges of Group I bridge (hereafter referred to as “precast deck slab”) among the annex 2 of JIS A 5373.

Remarks 1 The precast deck slab which was based on the details of this recommended specification 2-4 and which was manufactured by proper quality control shall be deemed to conform to clause 3 of the annex 2 of JIS A 5373.

2 If the reference dimension has been changed within the range shown in clause 4 of the annex 2 of JIS A 5373, a manufacturer must present the following data to a purchaser, when so requested. The data must state conformity of the precast deck slab to clause 3 of the annex 2 of JIS A 5373 which has been demonstrated by the design document or performance test.

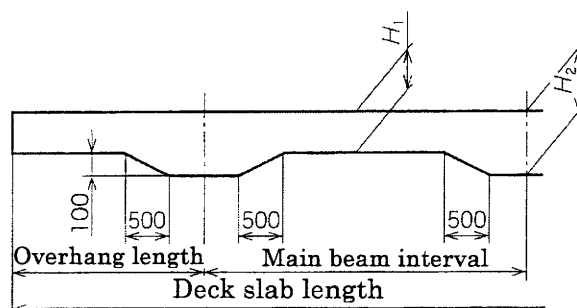
2 Classification The precast deck slabs shall be classified by the length of deck slab as indicated in recommended specification 2-4 table 1.

Recommended specification 2-4 table 1 The classification and crack test bending moment of precast deck slab

Classification	The length of deck slab mm	The number of main beams	Main beam interval mm	Standard overhang length mm	Thickness of deck slab mm		Crack test bending moment kN·m
					Span (H_1)	Fulcrum (H_2)	
PDS2-7.9	7 900	2	4 000	1 950	250	350	142
PDS2-8.9	8 900		4 100	2 400	250	350	127
PDS2-9.4	9 400		4 400	2 500	260	360	137
PDS2-9.9	9 900		4 700	2 600	270	370	152
PDS2-10.4	10 400		5 000	2 700	280	380	161
PDS2-11.2	11 200		5 600	2 800	310	410	198
PDS2-11.7	11 700		6 000	2 850	320	420	219
PDS3-12.2	12 200	3	4 700	1 400	240	340	185
PDS3-12.7	12 700		4 900	1 450	240	340	185
PDS3-13.2	13 200		5 100	1 500	240	340	198
PDS3-13.5	13 500		5 200	1 550	240	340	198
PDS3-13.7	13 700		5 300	1 550	250	350	206
PDS3-14.0	14 000		5 400	1 600	250	350	206
PDS3-14.5	14 500		5 600	1 650	260	360	215
PDS3-14.7	14 700		5 700	1 650	260	360	215
PDS3-15.0	15 000		5 800	1 700	260	360	229
PDS3-15.2	15 200		5 900	1 700	260	360	229
PDS3-15.5	15 500	6 000	1 750	270	370	238	
PDS4-16.0	16 000	4	4 400	1 400	240	340	162
PDS4-16.5	16 500		4 500	1 500	240	340	162
PDS4-17.0	17 000		4 600	1 600	240	340	162
PDS4-17.5	17 500		4 700	1 700	240	340	174
PDS4-18.5	18 500		5 000	1 750	240	340	187

- Remarks : When applying to a curved bridge, etc., the following may be applied.
- The overhang length used may be distributed to right and left within 0.3 m from the standard overhang length.
 - The deck slab width may be changed within 0.1 m.

Unit : mm



Recommended specification 2-4 figure 1

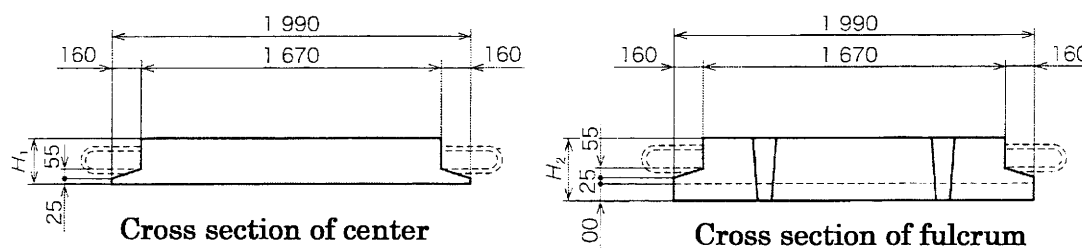
The shape and dimension of precast deck slab
(the deck slab span right angled direction)

3 Performance

3.1 Bending strength The bending strength of precast deck slab shall be specified as follows. When it is subjected to the bending strength test specified in clause 6 and to the crack test bending moment specified in recommended specification 2-4 table 1, it shall not generate any crack.

4 Shape, dimension and dimensional tolerance The shape, dimension and dimensional tolerance of the precast deck slab shall be as specified in recommended specification 2-4 figure 2 and table 2.

Unit : mm



Recommended specification 2-4 figure 2

The shape and dimension of precast deck slab (deck slab fulcrum direction)

Recommended specification 2-4 table 2 Dimensional tolerance

Unit : mm

Item	Tolerance
The length of deck slab	+20 0
Width of deck slab	+ 5 -10
Thickness of deck slab	+10 0

5 Bar arrangement The bar arrangement of the precast deck slabs is based on a design document and the following.

- a) The covering of reinforcement and PC steel shall be 25 mm or more.
- b) The gap of reinforcement and PC steel shall be 20 mm or more. The gap of PC steel shall be three times or more the diameter, and at the same time $4/3$ times or more the maximum dimension of a coarse aggregate.
- c) A reinforcement and PC steel shall be free from loose scale, oil, etc. which damage adhesion of concrete, and shall be assembled and fixed to the accurate position.

Remarks : The covering of reinforcement and PC steel on the top face of deck slab shall be 30 mm or more, considering the interfilling.

6 Strength test

6.1 Compressive-strength test The compressive-strength test of the precast deck slab is based on 6.1 of the annex 2 of JIS A 5373.

6.2 Bending test The bending test of the precast deck slab is based on 6.2 of the annex 2 of JIS A 5373.

Remarks : A tester shall be Grade one or higher specified in JIS B 7721, or shall have the allowance which is equivalent to or better than this.

7 Quality of concrete The compressive strength of concrete is based on 7.2 of the annex 2 of JIS A 5373.

8 Inspections

8.1 Inspection items The inspection items of the precast deck slabs are based on the following.

a) Final inspection

- 1) Appearance
- 2) Performance
- 3) Shape and dimension

b) Delivery inspection

- 1) Appearance

2) **Shape and dimension**

Remarks : The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and it may be omitted based on the result of final inspection.

8.2 Inspection lot The size of inspection lot of the precast deck slab shall be decided by a manufacturer who considers the characteristics of products, manufacture methods, manufacture quantity, manufacture period, ordered quantity, etc. The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and shall be decided by a purchaser. However, one lot may be 400 plates or its fraction.

8.3 Inspection method The inspection method of precast deck slab is based on the following.

a) **Final inspection**

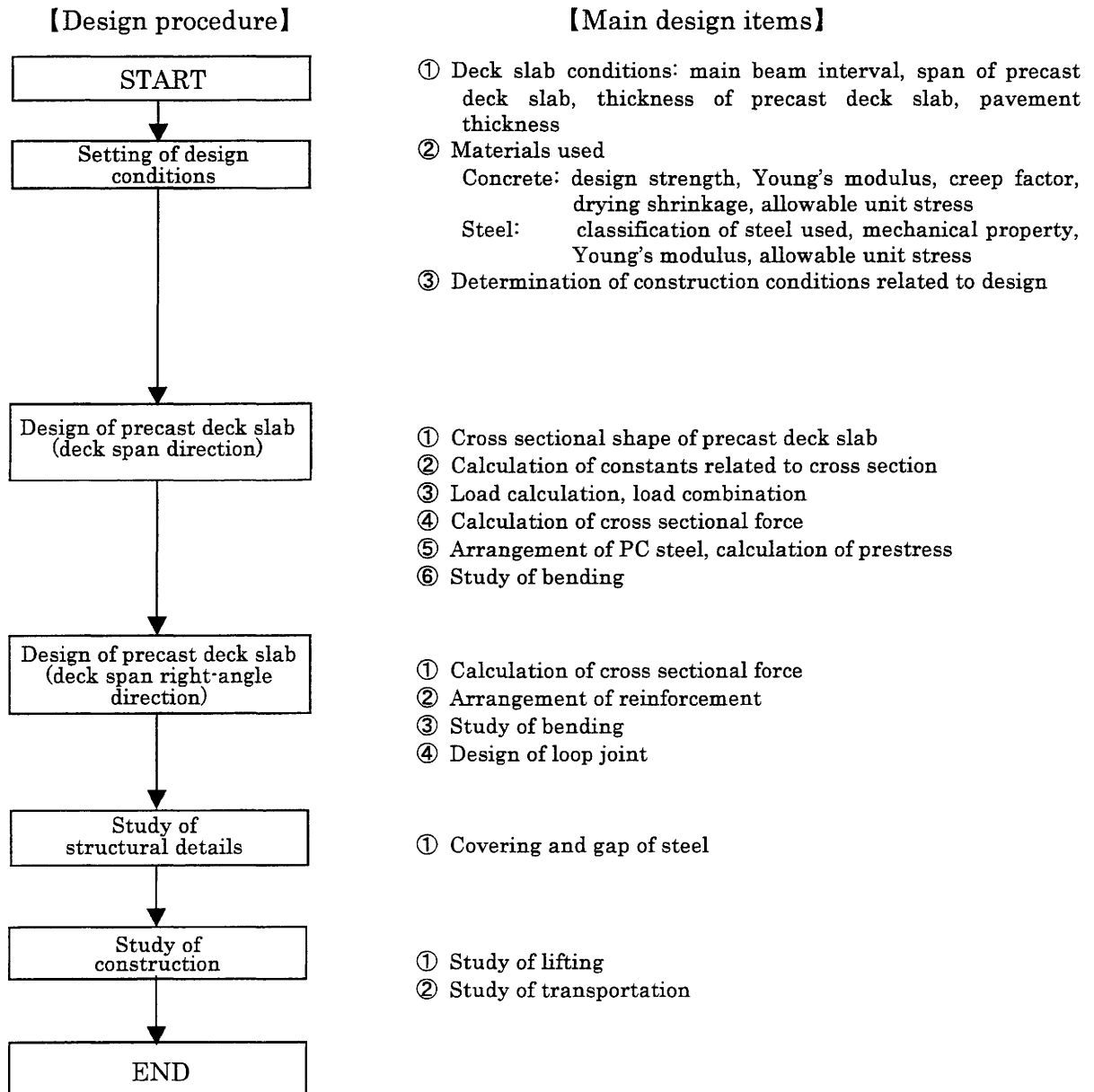
- 1) **Appearance** Appearance shall be subjected to visual 100 % inspection. If the products conforms to the provision of 5.1 of JIS A 5373, they shall be accepted.
- 2) **Performance** For inspection of performance, take two plates from one lot of precast deck slab, and inspect them by 6.2. If both of the two conform to 3.1, the lot shall be accepted. If both of the two fail, the lot shall be rejected. If one of the two fails, the rest of the lot shall be tested. If it conforms to the provision, it shall be accepted.
- 3) **Shape and dimension** For inspection of shape and dimension, a 100 % inspection shall be performed. If they conform to the provision of clause 4, they shall be accepted.

b) **Delivery inspection**

- 1) **Appearance** Inspection of appearance shall be made like a).
- 2) **Shape and dimension** Inspection of shape and dimension shall be made like a).

9 Marking The marking of precast deck slabs is based on JIS A 5361 and JIS A 5373.

The general design procedure and the main design items of the precast deck slab for highway bridges are shown below.



Recommended specification 2-4 informative figure 1
Design procedure of the precast deck slabs for highway bridges

Annex 3 (normative)

Retaining walls

1 Scope This annex specifies Group I and Group II of retaining walls which are mainly used for revetment and earth retaining walls among the precast prestressed concrete products specified in JIS A 5373.

In addition, the prestressed concrete sheet pile made from precast prestressed concrete (hereafter referred to as “sheet pile”) specified herein is applicable also to drainage canals.

2 Classification The classification of the retaining walls shall be as specified in annex 3 table 1.

In addition, Group I shall be specified in annex 3 table 2.

Annex 3 table 1 Classification of retaining walls

Major division	Minor division
Retaining walls	PC walls
	Sheet piles
	Others

Annex 3 table 2 Classification of retaining-walls Group I

	Classification	Detail
	Classification by shape	
Sheet piles	Flat piles	See the recommended specification 3-1.
	Slot piles	
	Wavy piles	

3 Performance The performance of retaining walls shall conform to provisions of annex 3 table 3.

Annex 3 table 3 Performance of retaining walls

Performance item	Performance	The performance check method
Service performance	It shall be safe to the regular load assumed at the time of use, and crack width shall be within an allowance.	See a design document or clause 6 of the annex 3.
End stage performance ⁽¹⁾	It shall not break for the load assumed at the time of end stage.	See a design document or clause 6 of the annex 3.
Durability ⁽²⁾	Durability shall be secured against deterioration assumed.	See a design document or a record.
Workability	Workability for transport, installation, assembly, etc. shall be secured.	See a design document or a record.

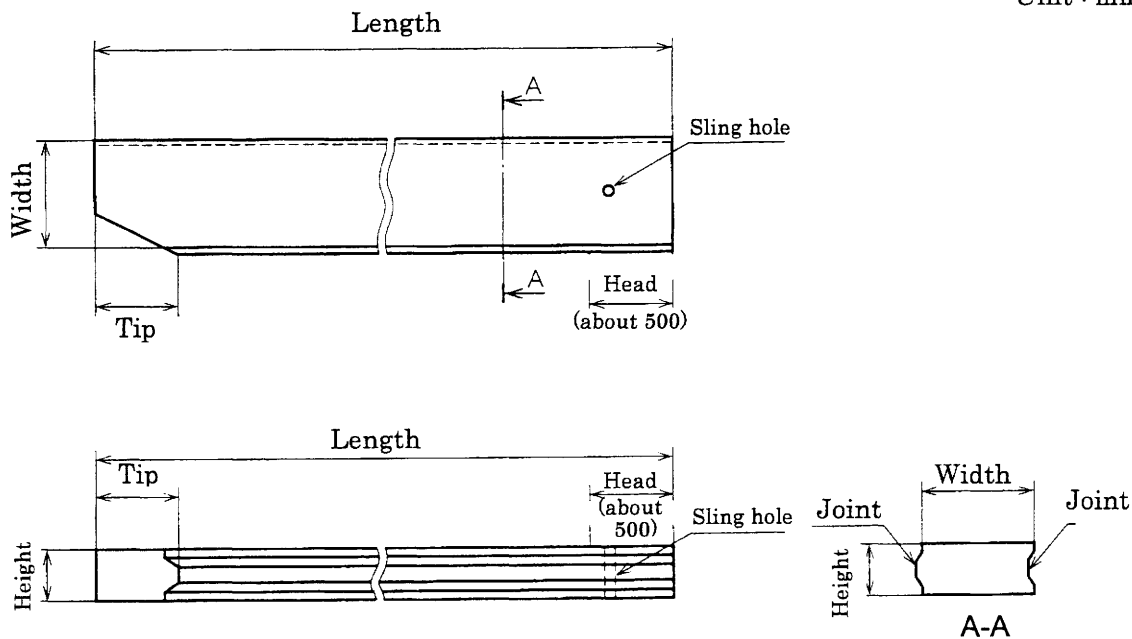
- Notes (1) Confirmation of the end stage performance shall be made when so requested by purchasers.
- (2) Durability may be confirmed by the actual results of such similar products as are equivalent in terms of water-cement ratio and reinforcement covering.

Remarks : The performance items of Group II shall be subject to the agreement between the parties concerned with delivery.

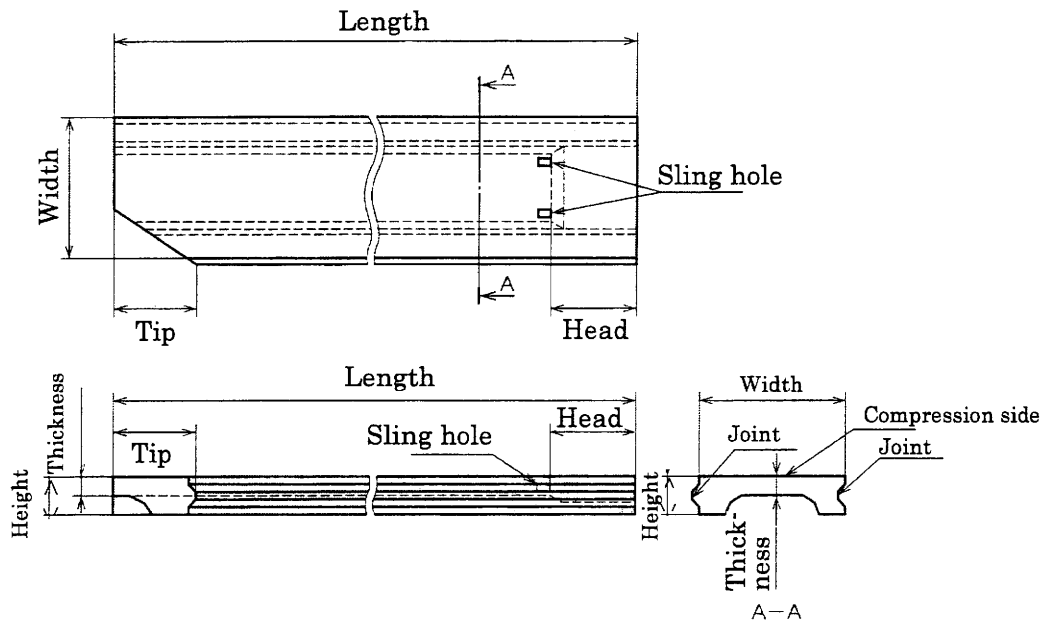
4 Shape, dimension and dimensional tolerance As to the retaining walls, the shape, dimension, and dimensional tolerance shall be specified as follows. As to Group I, if the design concept is not different, and if the performance (quality) and performance (quality) check method are the same, the reference dimension may be changed within 10 % in response to purchaser's demand, provided that the necessary performance is satisfied.

4.1 Shape The shape of the sheet pile is shown in annex 3 informative figures 1 to 3.

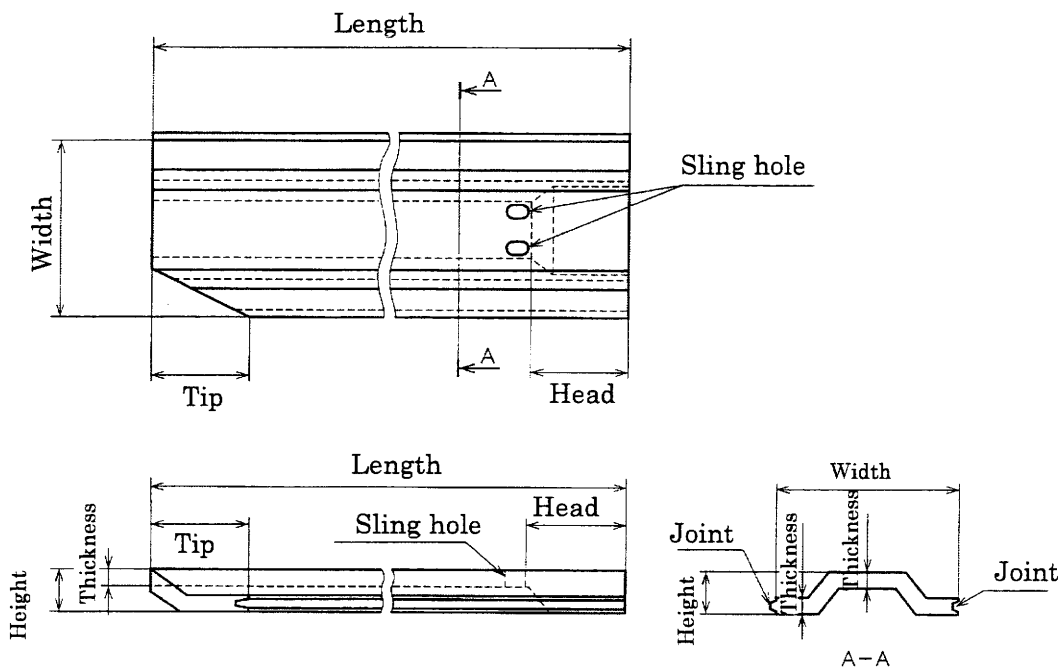
Unit : mm



Annex 3 informative figure 1 Example of shape of sheet pile (flat)



Annex 3 informative figure 2 Example of shape of sheet pile (slot)



Annex 3 informative figure 3 Example of shape of sheet pile (wavy)

4.2 Dimension and dimensional tolerance The dimension and dimensional tolerance of products classified as Group I shall be as specified in annex 3 table 4. The dimension and dimensional tolerance of products classified as Group II shall be subject to the agreement between the parties concerned with delivery.

In addition, the dimension of a tip is not specified.

Annex 3 table 4 Dimension and dimensional tolerance of sheet piles

Unit : mm

Classification		Width	Height	Thickness	Length	
Sheet piles	Flat piles	Dimension	500	50 to 220	—	2 000 to 14 000
		Tolerance	+5 -2	+5 -2	—	±30
		Dimension	996	50 to 220	—	2 000 to 14 000
		Tolerance	+7 -2	+7 -2	—	±30
	Slot piles	Dimension	996	90 to 350	45 to 100	2 000 to 14 000
		Tolerance	+7 -2	+7 -2	+7 -2	±30
	Wavy piles	Dimension	996	120 to 600	60 to 120	3 000 to 21 000
		Tolerance	+7 -2	+7 -2	+7 -2	±30

- Remarks
- 1 The surface may be chamfered.
 - 2 The shape of head, tip and joint as well as position of sling hole may be subject to the agreement between the parties concerned with delivery, and they may be changed as necessary.
 - 3 Depending on the agreement between the parties concerned with delivery, necessary accessories may be attached or necessary processing may be made, provided that it does not damage the performance of sheet pile.
 - 4 The detail of tolerance shall be subject to the recommended specification.

5 Bar arrangement (position of PC steel and reinforcement) The bar arrangement shall be as specified in JIS A 5364 and a design document. However, when the method is subject to the agreement between the parties concerned with delivery, and it falls within the range which does not damage the performance of products (including provisions of clause 3), the method may be outside the bar arrangement (position of PC steel and reinforcement) of recommended specification. Moreover, a manufacturer may specify, for each product, the bar arrangement (position of PC steel and reinforcement) which satisfies clause 3.

6 Test method

6.1 Compressive-strength test A compressive-strength test is based on JIS A 1132 and JIS A 1108.

6.2 Bending test A bending test is based on **JIS A 5363**.

Remarks : A tester shall be Grade one or higher specified in **JIS B 7721**, or shall have the allowance which is equivalent to or better than this.

7 Quality of concrete

7.1 Material and manufacture method The material and manufacture method for concrete are based on **JIS A 5364**.

7.2 Compressive strength The compressive strength of concrete shall be verified by the compressive strength of sample which was processed by the same cure as the product, or the compressive strength which was controlled properly. When the predetermined cure is finished, and when the prestress is introduced, the strength shall satisfy the value specified in annex 3 table 5.

In addition, products of Group II shall be subject to the agreement between the parties concerned with delivery.

Annex 3 table 5 Compressive strength of concrete

Classification	Unit : N/mm ²	
	When the predetermined cure is finished	When the prestress is introduced
Sheet pile	70 or more	35 or more

Remarks : The compressive strength of concrete may refer to **JIS A 5364** annex (informative).

8 Inspections Inspections are based on **JIS A 5365** and the following.

8.1 Final inspection The final inspection of the retaining walls shall be conducted about appearance, performance, shape, and dimension.

- a) **Appearance** About appearance, the characteristics of a product, manufacture method, manufacture quantity, etc. shall be considered, and a 100 % inspection or a sampling inspection shall be performed.
- b) **Performance, shape, and dimension** About performance, shape, and dimension, a sampling inspection shall be performed.

When the performance is inspected by a sample as alternative characteristic, correlation shall be established between the sample and the product.

- c) **Size of inspection lot** The size of inspection lot shall be specified by a manufacturer by considering the characteristics of a product, a manufacture method, manufacture quantity, manufacture period, ordered quantity, etc.

Within one inspection lot, the characteristics, the materials used, concrete mixing ratio, and the manufacture method shall be the same.

8.2 Delivery inspection The delivery inspection of the retaining walls shall be made about appearance, shape, and dimension. The size of inspection lot and the sampling method shall be subject to the agreement between the parties concerned with delivery, and decided by purchasers. However, the delivery inspection shall be subject to the agreement between the parties concerned with delivery, and it may be omitted based on the result of final inspection.

9 Marking The marking on the retaining walls shall indicate the following according to JIS A 5361.

- a) Classification or its abbreviation
- b) A manufacturer's name or its abbreviation
- c) A date of manufacture or its abbreviation

10 Others Group I of the retaining walls is shown in annex 3 table 6.

Annex 3 table 6 Recommended specification

Structure-specific product group standard		Recommended specification
JIS A 5373	annex 3 (normative) Retaining walls	Recommended specification 3-1 Prestressed concrete sheet pile

Recommended specification 3-1 Prestressed concrete sheet pile

1 Scope This recommended specification specifies the prestressed concrete sheet pile of Group I of the retaining walls (hereafter referred to as “sheet pile”) among the annex 3 of JIS A 5373.

Remarks 1 A sheet pile which was based on the details of this recommended specification 3-1 and which was manufactured by proper quality control shall be deemed to conform to clause 3 of the annex 3 of JIS A 5373.

2 If the reference dimension has been changed within the range shown in clause 4 of the annex 3 of JIS A 5373, a manufacturer must present the following data to a purchaser, when so requested. The data must state conformity of the sheet pile to clause 3 of the annex 3 of JIS A 5373 which has been demonstrated by the design document or performance test.

2 Classification Sheet piles shall be classified, by the shape, the dimension, and a crack moment, as shown in recommended specification 3-1 tables 1 to 4.

Recommended specification 3-1 table 2 Flat type (nominal width 1 000 mm)

Classifi- cation	Height <i>H</i> mm	Product width <i>B</i> mm	Crack moment kN-m	Length(<i>L</i>)																	
				m																	
				2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	9.0	10.0	11.0	12.0	13.0
SF 50	50	996	5.4	0	0	0	0	0													
SF 60	60		8.0		0	0	0	0	0	0											
SF 70	70		11		0	0	0	0	0	0	0										
SF 80	80		15			0	0	0	0	0	0										
SF 90	90		20				0	0	0	0	0	0	0	0	0						
SF100	100		22				0	0	0	0	0	0	0	0	0						
SF110	110		30					0	0	0	0	0	0	0	0						
SF120	120		36						0	0	0	0	0	0	0	0					
SF130	130		44							0	0	0	0	0	0	0					
SF140	140		50								0	0	0	0	0	0					
SF150	150		58									0	0	0	0	0	0				
SF160	160		68										0	0	0	0	0	0			
SF180	180		84												0	0	0	0	0		
SF190	190		90													0	0	0	0	0	
SF200	200		102														0	0	0	0	0
SF220	220		130															0	0	0	0

Remarks : As far as the sheet pile of this shape is concerned, there is no distinction of a cross section between the compression side and the tension side.

Recommended specification 3-1 table 4 Wavy type (nominal width 1 000 mm)

Classifi- cation	Height <i>H</i> mm	Thick- ness <i>T</i> mm	Prod- uct width <i>B</i> mm	Crack mo- ment kN- m	Length(L) m																									
					3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0
SW120	120	60	996	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
SW160	160	80		20			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
SW180	180			31			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
SW225	225	100		42					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SW250	250			55						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SW275	275			73							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SW300	300	110		94							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SW325 A	325			120								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SW325 B				130								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SW350 A	350	120		160										0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SW350 B			170												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SW400 A	400		200												0	0	0	0	0	0	0	0	0	0	0	0	0	0		
SW400 B			230														0	0	0	0	0	0	0	0	0	0	0	0	0	
SW450 A	450		270														0	0	0	0	0	0	0	0	0	0	0	0		
SW450 B			310															0	0	0	0	0	0	0	0	0	0	0	0	
SW500 A	500		350															0	0	0	0	0	0	0	0	0	0	0		
SW500 B			400																0	0	0	0	0	0	0	0	0	0	0	
SW600 A	600		500																0	0	0	0	0	0	0	0	0	0		
SW600 B			590																		0	0	0	0	0	0	0	0	0	

Remarks : As far as the sheet pile of this shape is concerned, there is no distinction of a cross section between the compression side and the tension side.

3 Performance

3.1 Bending strength Sheet piles shall be subjected to the bending strength test specified in clause 6, and to the load equivalent to the crack moment specified in recommended specification 3-1 tables 1 to 4. Then, sheet piles shall not generate any crack exceeding the width of 0.05 mm. Moreover, a bending rupture moment shall be at least twice the crack moment specified in recommended specification 3-1 tables 1 to 4.

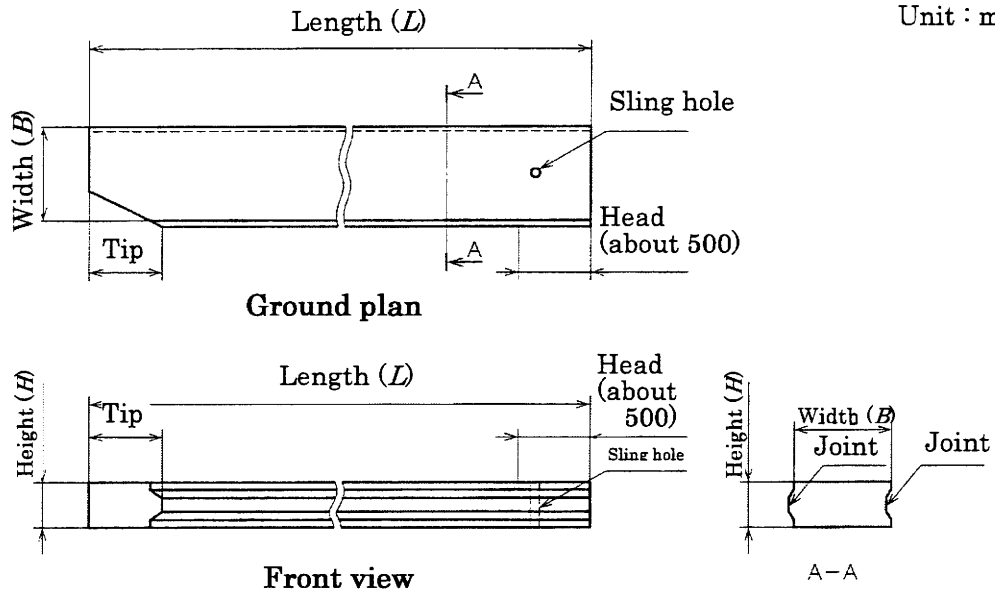
A load is computed by the following formula.

$$F = \frac{6M}{l} - Wg$$

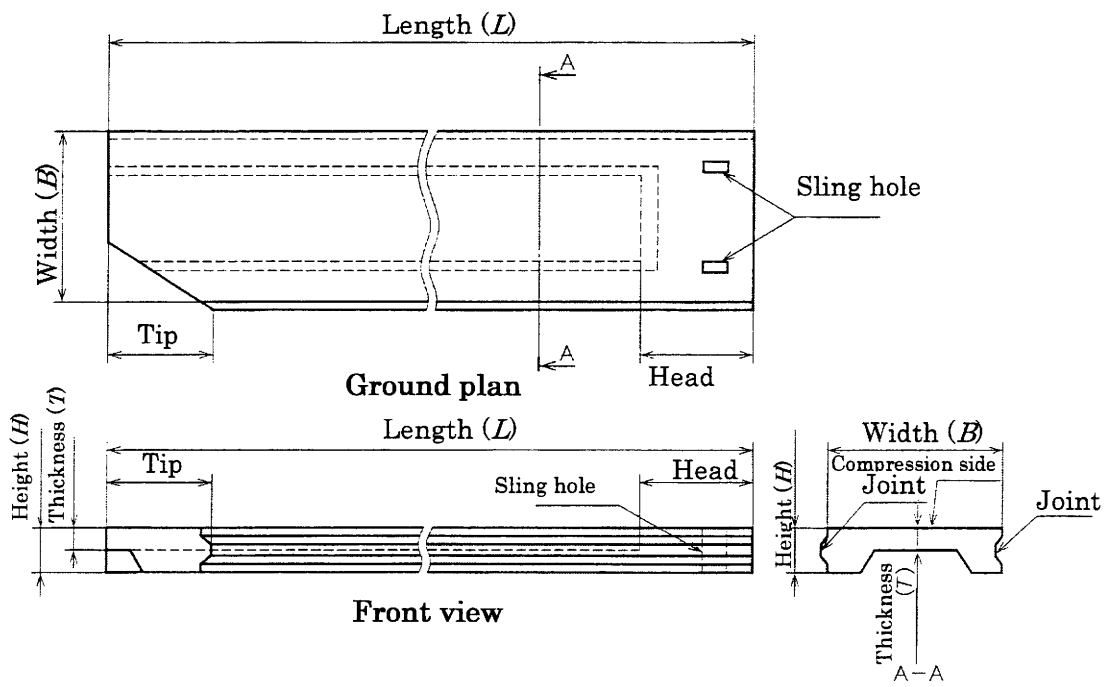
- Where,
- F : Loading load (kN)
 - M : Crack moment (value specified in recommended specification 3-1 tables 1 to 4) (kN·m)
 - l : Span (m) which is specified by $l = L/2$, and $b = l/3$.
However, when l is smaller than $10H$, it shall be $l = 10H$
 - H : Height (m) of sheet pile
 - W : Gross mass of a loading beam, a round steel as a load and a sheet steel as a load. However, when a loading beam is incorporated into a bending strength tester, the mass of a loading beam is not included. (t)
 - g : Standard gravitational acceleration (9.81 m/s²)

4 Shape, dimension and dimensional tolerance The Shape, dimension and dimensional tolerance of the sheet pile shall be as specified in recommended specification 3-1 figures 1 to 4, recommended specification 3-1 tables 1 to 4, and recommended specification 3-1 table 5.

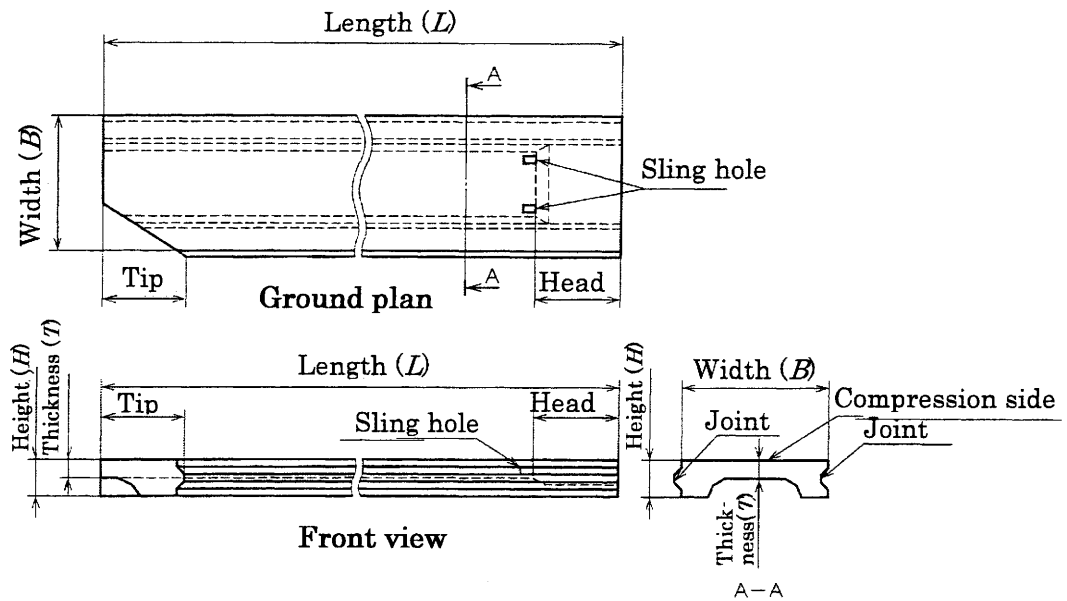
In addition, the tolerance of camber shall be as specified in recommended specification 3-1 table 6.



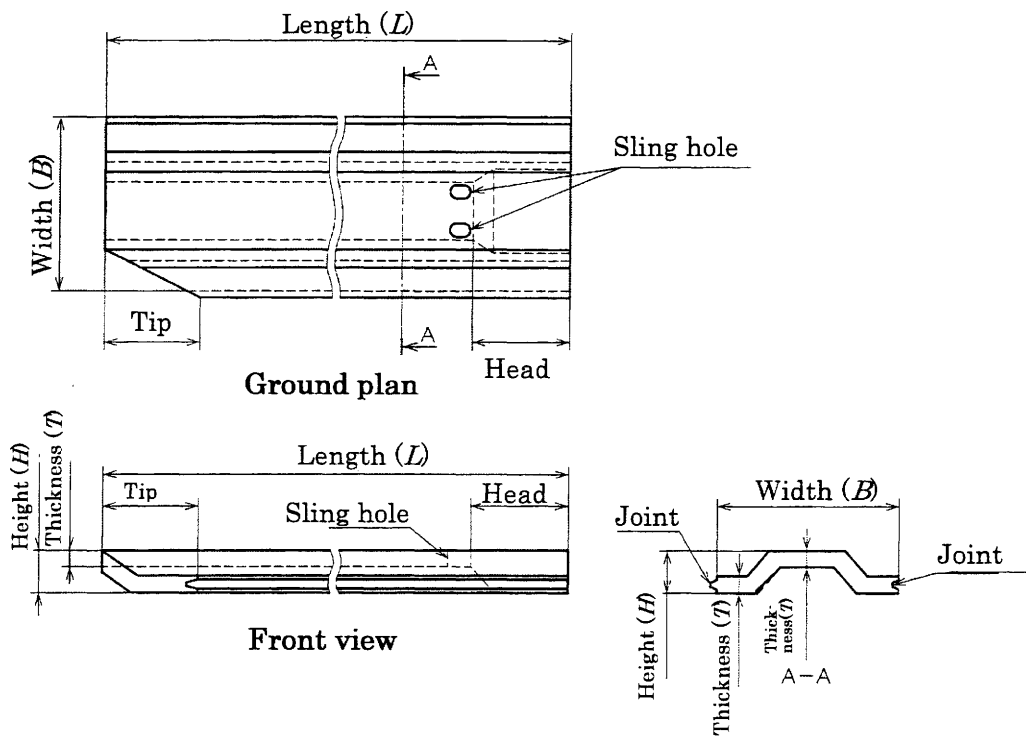
Recommended specification 3-1 figure 1 Shape of a flat type



Recommended specification 3-1 figure 2 Shape of a slot type (height 90 mm to 120 mm)



Recommended specification 3-1 figure 3 Shape of a slot type
(height 150 mm to 350 mm)



Recommended specification 3-1 figure 4 Shape of wavy type

Recommended specification 3-1 table 5 Dimension and dimensional tolerance

Unit : mm

Classification		Width	Height	Thickness	Length
Flat type	Dimension	500	50 to 220	—	2 000 to 14 000
	Tolerance	+5 -2	+5 -2	—	±30
Flat type	Dimension	996	50 to 220	—	2 000 to 14 000
	Tolerance	+7 -2	+7 -2	—	±30
Slot type	Dimension	996	90 to 350	45 to 100	2 000 to 14 000
	Tolerance	+7 -2	+7 -2	+7 -2	±30
Wavy type	Dimension	996	120 to 600	60 to 120	3 000 to 21 000
	Tolerance	+7 -2	+7 -2	+7 -2	±30

Recommended specification 3-1 table 6 Tolerance of camber

Unit : mm

Camber	$L \leq 7\ 000$	10
	$L > 7\ 000$	15

5 Bar arrangement The bar arrangement of sheet pile is based on the following.

- a) The covering of reinforcement shall be 12 mm or more.
- b) The covering of PC steel shall be 15 mm or more.

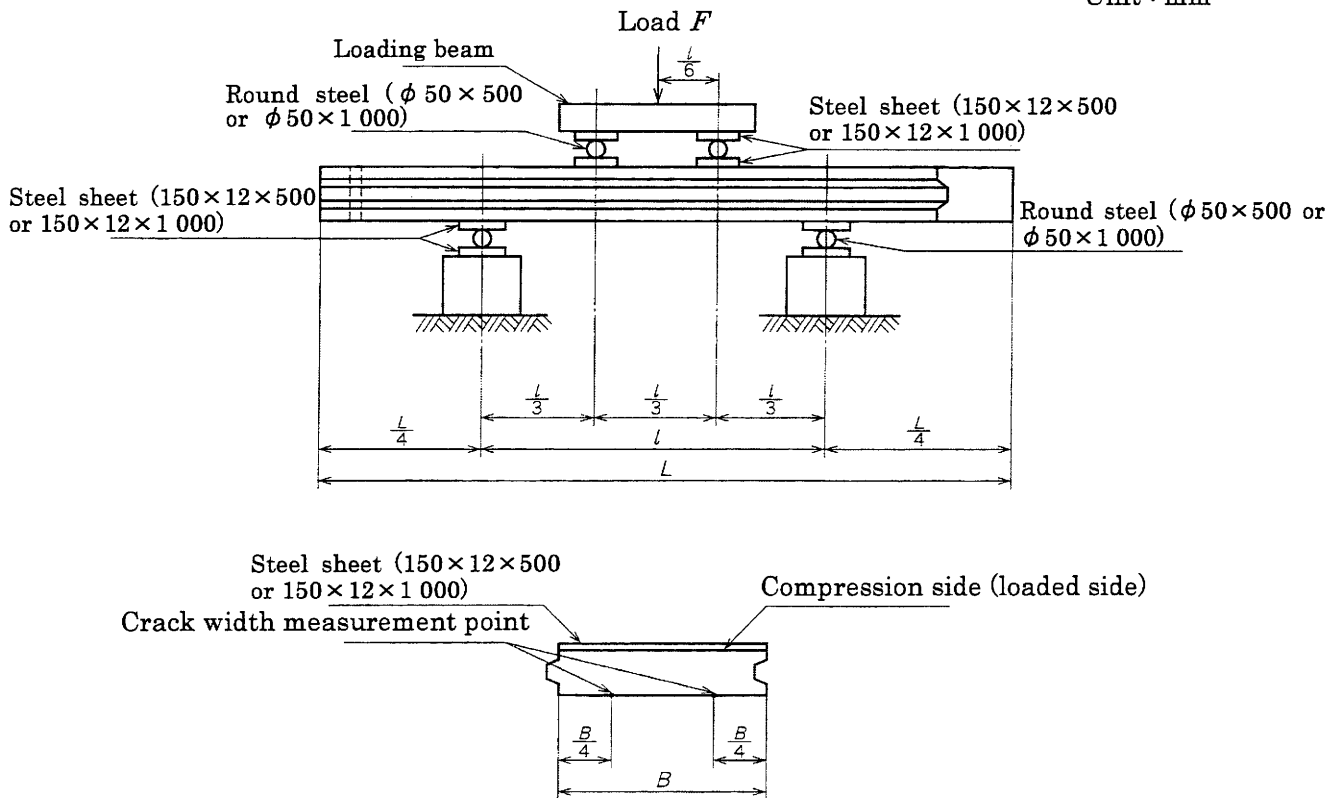
6 Strength test

6.1 Compressive strength test The compressive strength test of sheet pile is based on 6.1 of the annex 3 of JIS A 5373.

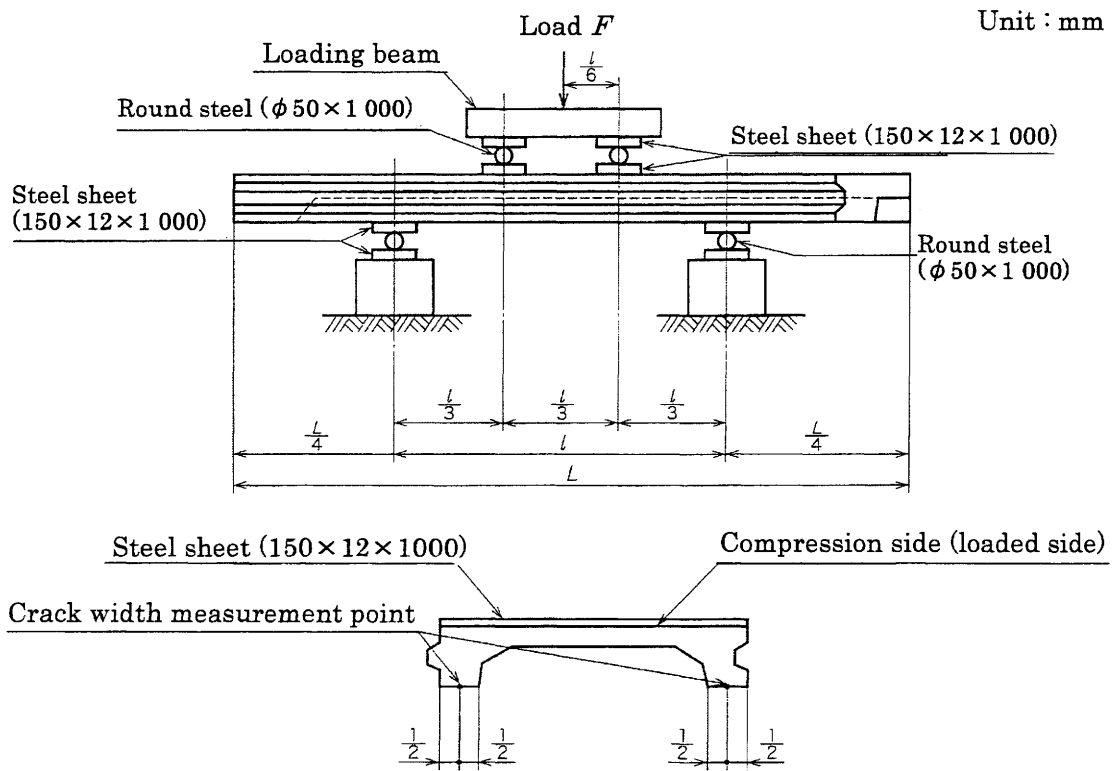
6.2 Bending strength test The bending strength test of sheet pile shall be performed by the loading method shown in the recommended specification 3-1 figures 5 to 7. When the load equivalent to the crack moment specified in recommended specification 3-1 tables 1 to 4 is applied, check for any cracks in the crack width measurement point shown in the recommended specification 3-1 figures 5 to 7.

Remarks : A tester shall be Grade 1 or higher specified in JIS B 7721, or shall have the allowance which is equivalent to or better than this.

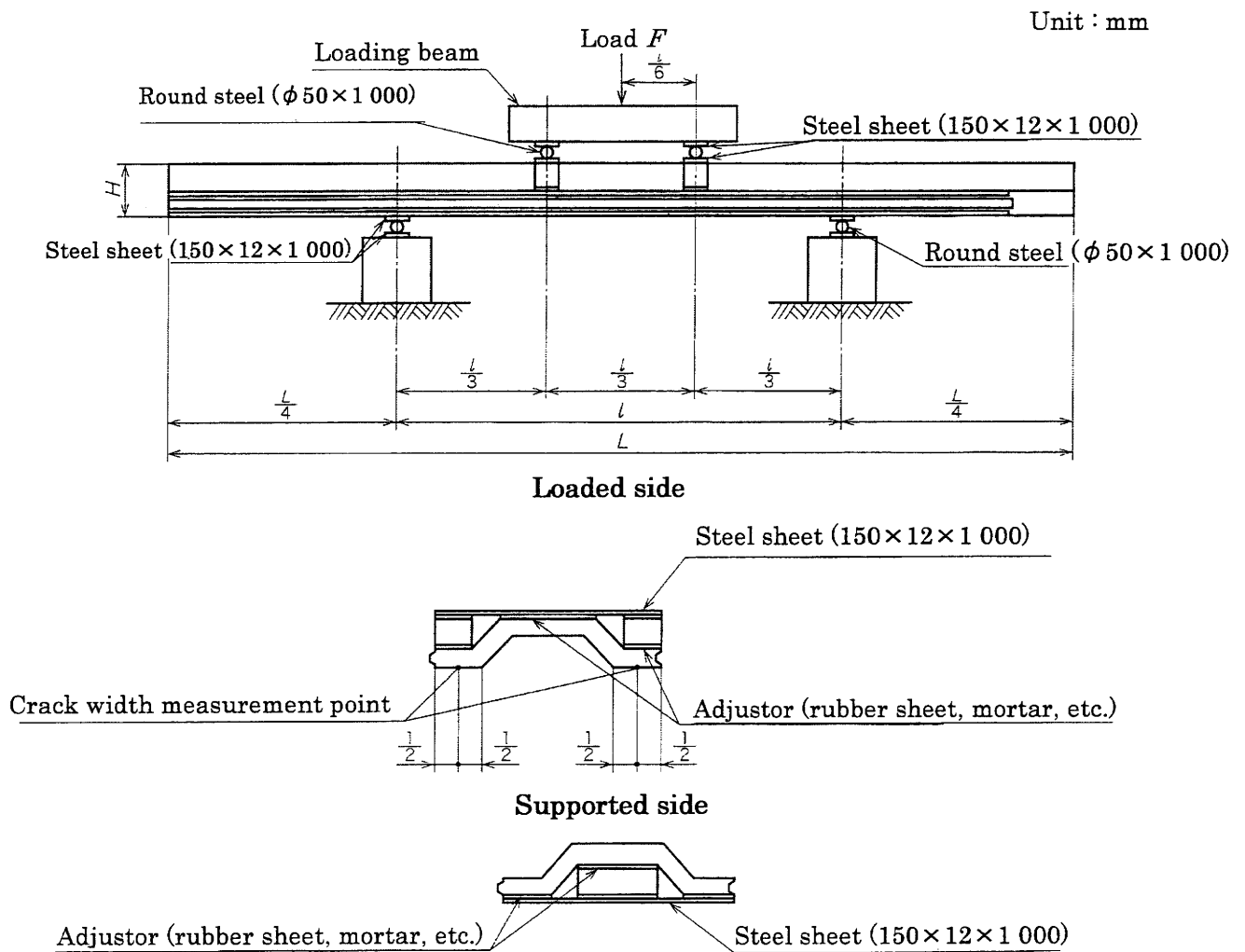
Unit : mm



Recommended specification 3-1 figure 5
The bending strength test method (flat type)



Recommended specification 3-1 figure 6
The bending strength test method (slot type)



Recommended specification 3-1 figure 7 Bending strength test (wavy type)

7 Quality of concrete The compressive strength of concrete is based on 7.2 of the annex 3 of JIS A 5373.

8 Inspections

8.1 Inspection items The inspection items of sheet pile are based on the following.

a) **Final inspection**

- 1) Appearance
- 2) Performance
- 3) Shape and dimension

b) **Delivery inspection**

- 1) Appearance

2) **Shape and dimension**

Remarks : The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and it may be omitted based on the result of final inspection.

8.2 Inspection lot The size of inspection lot of sheet pile shall be decided by a manufacturer who considers the characteristics of products, manufacture methods, manufacture quantity, manufacture period, ordered quantity, etc. The final inspection shall be decided by a manufacturer. The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and shall be decided by a purchaser. However, one lot may be 1 000 sheets or its fraction.

8.3 Inspection method The inspection method of sheet pile is based on the following.

a) **Final inspection**

- 1) **Appearance** For inspection of appearance, take samples from one lot at random and inspect them. If they conform to the provision of 5.1 of JIS A 5373 they shall be accepted. If even one sample fails, perform a 100 % inspection of the lot. If it conforms to the provision, it shall be accepted.
- 2) **Performance** For inspection of performance, take two sheets at random from one lot and inspect them according to 6.2. If both sheets conform to the provision of 3.1, the lot shall be accepted. If both fail, the lot shall be rejected. If one of the two fails, take four further sheets. If all the four sheets conform to the provision, the lot shall be accepted, excluding the first nonconforming product. If even one of the four fails, the lot shall be rejected.
- 3) **Shape and dimension** For inspection of shape and dimension, take two sheets at random from one lot. If both sheets conform to the provision of clause 4, the lot shall be accepted. If even one of the two fails in this inspection, the lot shall be subjected to a 100 % inspection. If it conforms to the provision, it shall be accepted.

b) **Delivery inspection**

- 1) **Appearance** Inspection of appearance shall be performed like a).

When adopting a sampling inspection, take two sheets at random. If they conform to the provision of 5.1 of JIS A 5373, the lot shall be accepted. If even one of the two fails in this inspection, the lot shall be subjected to a 100 % inspection. If it conforms to the provision, it shall be accepted.

- 2) **Shape and dimension** Inspection of shape and dimension shall be performed like a).

9 Marking The marking of sheet pile is based on JIS A 5361 and JIS A 5373.

In addition, the following matters shall be marked.

- a) Length or its abbreviation
- b) When there is distinction of the compression side and the tension side, the symbol or its abbreviation indicating the compression side or tension side.

Annex 4 (normative)

Closed conduits

1 Scope This annex specifies Group I and Group II of closed conduits which are mainly used for a channel, a passage, etc. among the precast prestressed concrete products specified in JIS A 5373.

2 Classification The classification of closed conduits shall be as specified in annex 4 table 1.

In addition, Group I shall be as specified in annex 4 table 2.

Annex 4 table 1 Classification of closed conduits

Major division	Minor division
Closed conduits	Prestressed concrete tubing
	Prestressed concrete box culvert
	Others

Annex 4 table 2 Classification of closed-conduits Group I

Classification by shape and type	Classification by earth covering	Classification by application	Classification by strength	Detail
Prestressed concrete tubing	—	Internal-pressure tubing, external-pressure tubing	High pressure class 1 to class 5	See recommended specification 4-1.
Prestressed concrete box culvert	0.5 m to 1.5 m	External pressure	—	See recommended specification 4-2.
	1.51 m to 3.0 m			
	3.01 m to 6.0 m			

Remarks 1 Prestressed concrete tubing is available in two kinds. One is an internal tubing where both internal and external pressures are applied. The other is an external tubing where only the external pressure is applied.

2 The prestressed concrete box culvert is generally used when only the external pressure is applied.

3 Performance The performance of closed conduits shall conform to the provision of annex 4 table 3.

Annex 4 table 3 Performance of closed conduits

Performance item	Performance	The performance check method
Service performance	It shall be safe to the regular load ⁽¹⁾ assumed at the time of use, and crack width shall be within the allowance.	See a design document or clause 6 of the annex 4
End stage performance ⁽²⁾	It shall not break for the load assumed at the time of end stage.	See a design document or clause 6 of the annex 4
Durability ⁽³⁾	Durability shall be secured against deterioration assumed.	See a design document or a record.
Workability	Workability for transport, installation, assembly, etc. shall be secured.	See a design document or a record.

Notes ⁽¹⁾ When the strength for internal water pressure is required, the internal water pressure shall be checked, too.

⁽²⁾ Confirmation of the end stage performance shall be made when so requested by purchasers.

⁽³⁾ Durability may be confirmed by the actual results of such similar products as are equivalent in terms of water-cement ratio and steel covering.

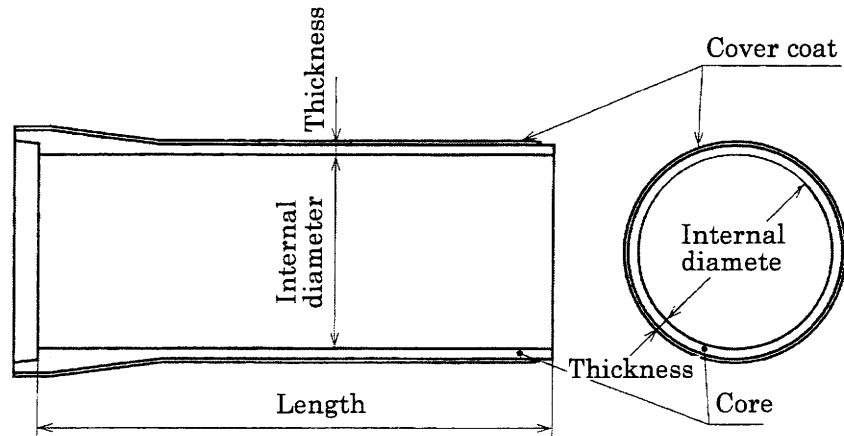
Remarks : The performance items of Group II shall be subject to the agreement between the parties concerned with delivery.

4 Shape, dimension, and dimensional tolerance The shape, dimension, and dimensional tolerance of closed conduits shall be based on the following.

As to Group I, if the design concept is not different, and if the performance (quality) and performance (quality) check method are the same, the reference dimension may be changed within 10 % in response to purchaser's demand, provided that the necessary performance is satisfied.

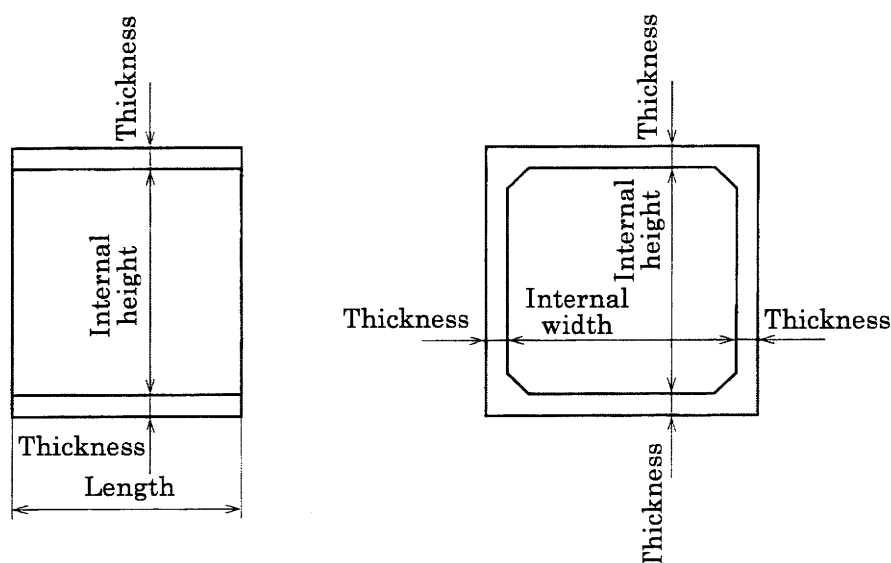
4.1 **Shape** The shape of closed conduits is shown in annex 4 informative figure 1.

a) **Prestressed concrete tubing**



Annex 4 informative figure 1 Example of shape of prestressed concrete tubing

b) Prestressed concrete box culvert



Annex 4 informative figure 2 Example of shape of prestressed concrete box culvert

4.2 Dimension and dimensional tolerance The dimension and dimensional tolerance of the products classified into Group I shall be as specified in annex 4 tables 4 and 5. The dimension and dimensional tolerance of the products classified into Group II shall be subject to the agreement between the parties concerned with delivery.

a) **Prestressed concrete tubing** The dimension and dimensional tolerance of prestressed concrete tubing shall be as specified in annex 4 table 4.

Annex 4 table 4 Dimension and dimensional tolerance of prestressed concrete tubing

Unit : mm

Classification		Internal diameter	Length	Thickness
Prestressed concrete tubing	Dimension	500 to 3 000	2 000 to 5 000	40 to 250
	Tolerance	± 3 to ± 12	+10 - 5	+4 to +12 -2 to -6

- Remarks 1 The thickness shall be specified at the core.
- 2 Products may have chamfer, reinforced tubing end or other processing which does not affect the shape and damage the strength of tubing. The inside and outside circumference of cross section of tubing shall be practically concentric. The tubing end shall be practically perpendicular to the tubing axis.
- 3 For details of tolerance, refer to the recommended specification.

- b) **Prestressed concrete box culvert** The dimension and dimensional tolerance of prestressed concrete box culvert shall be as specified in annex 4 table 5.

**Annex 4 table 5 Dimension and dimensional tolerance
of prestressed concrete box culvert**

Unit : mm

Classification		Internal width × internal height	Length	Thickness
Prestressed concrete box culvert	Dimension	600 × 600 to 5 000 × 2 500	1 000 to 2 000	125 to 530
	Tolerance	± 4 to ± 10	+ 10 - 5	+ 4 to + 8 - 2 to - 4

- Remarks 1 Products may have chamfer, reinforced tubing end or other processing which does not affect the shape and damage the strength of tubing.
2 For details of tolerance, refer to the recommended specification.

5 Bar arrangement (position of PC steel and reinforcement) The bar arrangement is based on JIS A 5364 and a design document. Moreover, a manufacturer shall decide, for each product, the bar arrangement of prestressed concrete tubing and prestressed concrete box culvert so that it satisfies clause 3.

6 Test method

6.1 Compressive strength test The compressive strength test is based on JIS A 1132 and JIS A 1108.

6.2 Bending strength test and internal pressure strength test The bending strength test and internal pressure strength test are based on JIS A 5363.

Remarks : A tester shall be Grade 1 or higher specified in JIS B 7721, or shall have the allowance which is equivalent to or better than this. An internal pressure test shall use the pressure gauge of Grade 1.6 or better specified in JIS B 7505.

7 Quality of concrete

7.1 Material and manufacture method The material for concrete and manufacture method are based on JIS A 5364.

7.2 Compressive strength The compressive strength of concrete shall be verified by the compressive strength of sample which was processed by the same cure as the product, or the compressive strength which was controlled properly. When the predetermined cure is finished, the strength shall satisfy the values specified in annex 4 table 6.

In addition, products of Group II shall be subject to the agreement between the parties concerned with delivery.

Annex 4 table 6 Compressive strength of concreteUnit : N/mm²

Classification		Compressive strength	
		At the time of prestress introduction	At the time of quality assurance
Prestressed concrete tubing	Concrete	30 or more	50 or more
	Mortar	—	(4) 35 or more
Prestressed concrete box culvert	Concrete	30 or more	(5) 40 or more

Notes (4) Cover-coat mortar for PC steel protection.

(5) The time of quality assurance in prestressed concrete box culvert shows the design reference strength of concrete.

Remarks : The compressive strength of concrete may refer to JIS A 5364 annex (informative).

8 Inspections Inspections are based on JIS A 5365 and the following.

8.1 The final inspection The final inspection of closed conduits shall be performed about appearance, performance, shape, and dimension.

- a) **Appearance** About appearance, it shall be a 100 % inspection or a sampling inspection in consideration of the characteristics of a product, a manufacture method, manufacture quantity, etc.
- b) **Performance, shape, and dimension** About performance, shape, and dimension, it shall be a sampling inspection.

When the performance is inspected by a sample as alternative characteristic, correlation shall be established between the sample and the product.

- c) **Size of inspection lot** The size of inspection lot shall be specified by a manufacturer by considering the characteristics of a product, a manufacture method, manufacture quantity, manufacture period, ordered quantity, etc.

Within one inspection lot, the characteristics of products, the materials used, concrete mixing ratio, and the manufacture method shall be the same.

8.2 Delivery inspection The delivery inspection of closed conduits shall be made about appearance, shape, and dimension. The size of inspection lot and the sampling method shall be subject to the agreement between the parties concerned with delivery, and shall be specified by a purchaser. However, the delivery inspection shall be subject to the agreement between the parties concerned with delivery, and it may be omitted based on the result of final inspection.

9 Marking The marking on closed conduits shall indicate the following matters according to JIS A 5361.

- a) Classification or its abbreviation
- b) Manufacturer's name or its abbreviation
- c) Date of manufacture or its abbreviation

10 Others Group I of closed conduits is shown in annex 4 table 7.

Annex 4 table 7 Recommended specification

Structure-specific product group standard		Recommended specification	
JIS A 5373	annex 4 (normative) Closed conduits	Recommended specification 4-1	Prestressed concrete tubing
		Recommended specification 4-2	Prestressed concrete box culvert

Recommended specification 4-1 Prestressed concrete tubing

1 Scope This recommended specification specifies the prestressed concrete tubing of closed conduits Group I (hereafter referred to as “PC tubing”) among the annex 4 of **JIS A 5373**.

- Remarks
- 1 The closed conduit which was based on the details of this recommended specification 4-1 and which was manufactured by proper quality control shall be deemed to conform to clause 3 of the annex 4 of **JIS A 5373**.
 - 2 If the reference dimension has been changed within the range shown in clause 4 of the annex 4 of **JIS A 5373**, a manufacturer must present the following data to a purchaser, when so requested. The data must state conformity of the PC tubing to clause 3 of the annex 4 of **JIS A 5373** which has been demonstrated by the design document or performance test.
 - 3 The PC tubing specified by this recommended specification is manufactured by introducing the prestress into the core which was formed by a centrifugal force or rolling pressure. Cover-coat mortar coating is applied to protect the PC steel arranged in the core perimeter.

2 Classification The PC tubings are classified into internal-pressure tubing and external-pressure tubing, and further classified by shape and nominal diameter range as shown in recommended specification 4-1 table 1.

Recommended specification 4-1 table 1 Classification of PC tubing

Classification by type		Classification by shape and nominal diameter range			Information	
		Type S	Type C	Type NC		
Internal-pressure tubing	Class 1	500 to 1 650	—	—	This is designed to the internal pressure and the external pressure.	
	Class 2	500 to 2 000	—	—		
	Class 3					
	Class 4					
	Class 5					
External-pressure tubing	High pressure Class 1	—			900 to 1 350	1 500 to 2 200
	High pressure Class 2		900 to 2 200	2 400 to 2 600		
	High pressure Class 3		900 to 2 600	2 800 to 3 000		
	Class 1	500 to 1 650	900 to 3 000	—		
	Class 2				500 to 2 000	
	Class 3					
	Class 4					
	Class 5					

3 Performance

3.1 Bending strength A PC tubing shall be subjected to the bending strength test specified in clause 6. When a tubing receives the crack load specified in recommended specification 4-1 table 2, it shall not produce any crack. A tubing shall not be destroyed when the breaking load indicated in recommended specification 4-1 table 2 is applied.

Recommended specification 4-1 table 2 Bending strength of PC tubing

Unit : kN/m

Nominal designation	Classification															
	Internal-pressure tubing and external-pressure tubing															
	Cracking load					Breaking load										
	High pressure Class 1	High pressure Class 2	High pressure Class 3	Class 1	Class 2	Class 3	Class 4	Class 5	High pressure Class 1	High pressure Class 2	High pressure Class 3	Class 1	Class 2	Class 3	Class 4	Class 5
500	-			112	97	80	64	56	-			224	194	160	128	112
600	-			110	95	78	61	52	-			220	190	156	122	104
700	-			113	96	79	61	52	-			226	192	158	122	104
800	-			120	102	84	64	55	-			240	204	168	128	110
900	240	200	170	130	110	88	67	56	480	400	340	260	220	176	134	112
1 000				138	117	94	73	61				276	234	188	146	122
1 100				144	121	100	76	61				288	242	200	152	122
1 200				151	128	105	81	69				302	256	210	162	138
1 350				157	133	108	82	69				314	266	216	164	138
1 500	300	240	200	169	143	118	90	75	600	480	400	338	286	236	180	150
1 650				180	155	127	97	80				360	310	254	194	160
1 800				190	161	129	98	82				380	322	258	196	164
2 000		250	230	200	165	137	103	85		500	460	400	330	274	206	170
2 200				210	177	143	108	89				420	354	286	216	178
2 400	-	300	250	220	185	149	112	93	-	600	500	440	370	298	224	186
2 600				230	193	155	118	97				460	386	310	236	194
2 800		-	300	240	201	161	123	101		-	600	480	402	322	246	202
3 000				250	209	167	128	105				500	418	334	256	210

3.2 Internal-pressure strength When the internal-pressure tubing is subjected to the internal-pressure strength test specified in clause 6, and subjected to the test internal pressure specified in recommended specification 4-1 table 3 it shall not generate any leakage of water. Moreover, when it is subjected to the crack internal pressure shown in recommended specification 4-1 table 3 it shall not generate any crack.

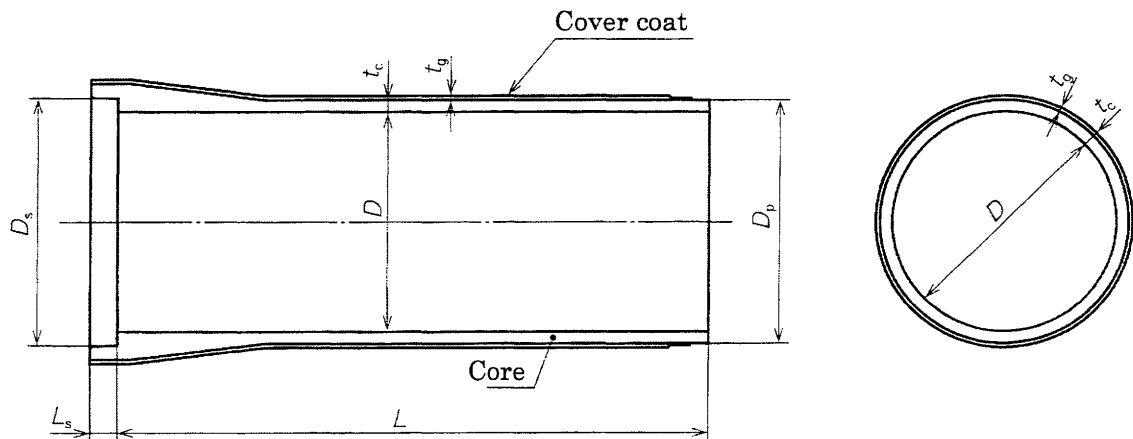
**Recommended specification 4-1 table 3 Test internal pressure and
crack internal pressure of PC tubing**

Unit : MPa

Classification		Test internal pressure	Crack internal pressure	Range of nominal designation
Internal-pressure tubing	Class 1	1.8	2.0	500 to 1 650
	Class 2	1.4	1.6	500 to 2 000
	Class 3	1.0	1.2	
	Class 4	0.6	0.8	
	Class 5	0.4	0.6	

4 Shape, dimension and dimensional tolerance The shape⁽¹⁾, dimension and dimensional tolerance of the PC tubing shall be as specified in recommended specification 4-1 figure 1 and table 4.

Note (1) : The shape of PC tubing may be processed, as necessary, to the extent that it does not affect the shape and damage the strength. The inside and outside circumference of cross section shall be practically concentric. The tubing end shall be practically perpendicular to the tubing axis. The inner surface of tubing shall be smooth against the flowing water.



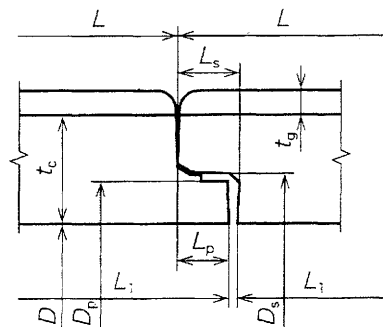
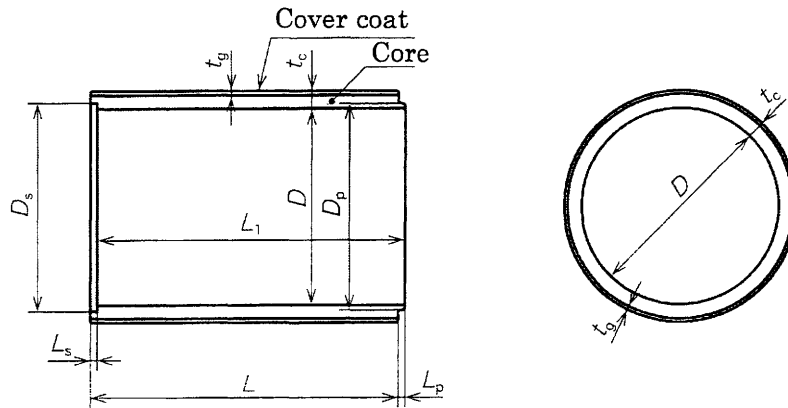
Unit : mm

Nominal designation	Internal diameter		Thickness of core		External diameter of insertion port		Internal diameter of receiving port		Depth of receiving window L_s	Thickness of cover coat t_g	(2) Effective length L	Mass (informative) (kg/m)	
	D		t_c		D_p		D_s					I	II
	I	II	I	II	I	II	I	II					
500	500	500	42	40	572	575	592	595	115	25 or more	4 000	320	320
600	612	600	44	44	684	687	708	711	140			410	390
700	724	700	46	46	800	781	824	805	140			480	460
800	828	800	52	50	916	894	940	918	140			610	560
900	932	900	59	55	1 034	1 004	1 058	1 028	140			740	700
1 000	1 034	1 000	65	60	1 144	1 112	1 172	1 140	165			870	800
1 100	1 134	1 100	71	65	1 258	1 222	1 286	1 250	165			970	930
1 200	1 234	1 200	78	70	1 372	1 332	1 400	1 360	165			1 210	1 110
1 350	1 382	1 350	87	75	1 538	1 492	1 566	1 520	165			1 460	1 320
1 500	1 532	1 500	96	85	1 702	1 680	1 734	1 712	190			1 770	1 680
1 650	1 680	1 650	105	95	1 868	1 830	1 900	1 862	190	2 080	1 930		
1 800	1 824	1 800	115	100	2 032	1 988	2 064	2 020	190	2 480	2 240		
2 000	2 040	2 000	125	110	2 268	2 210	2 300	2 242	190	2 940	2 730		

Note (2) : The effective length L may be 2 000, 3 000 or 5 000.

Remarks : The symbol I refers to the tubing manufactured by centrifugal force, and the symbol II, the tube manufactured by rolling pressure.

Recommended specification 4-1 figure 1
Shape and dimension of PC tubing, type S

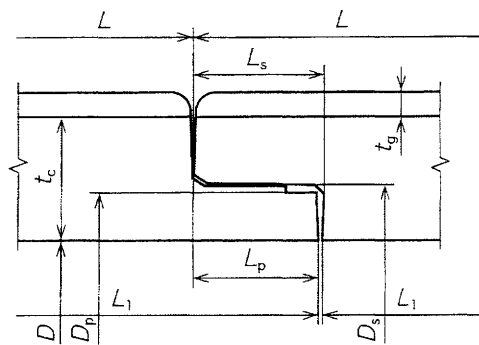
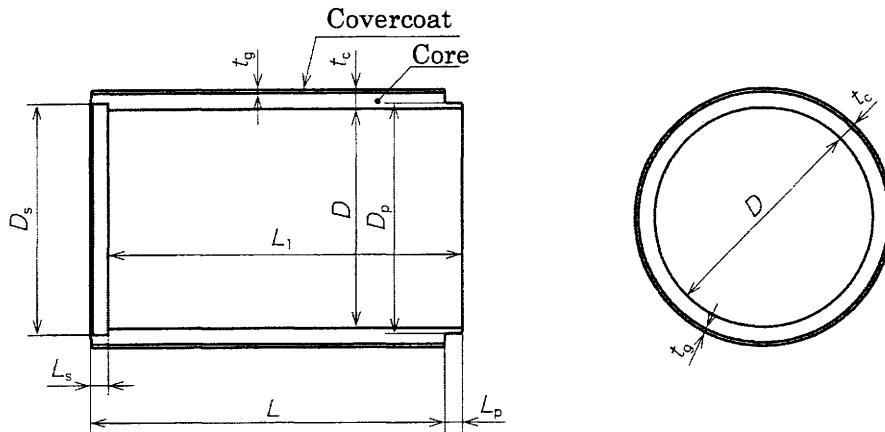


Details of joint

Unit : mm

Nominal designation	Internal diameter D	Thickness of core t_c	External diameter of insertion port D_p	Internal diameter of receiving port D_s	Length of insertion port L_p	Depth of receiving window L_s	Thickness of cover coat t_g	Effective length L	Inside length L_i	Mass (informative) (kg/m)
900	900	75	960	976	47	57	25 or more	2 360	2 352	770
1 000	1 000	82	1 064	1 080						910
1 100	1 100	88	1 168	1 184						1 050
1 200	1 200	95	1 274	1 290						1 220
1 350	1 350	103	1 432	1 448	52	62				1 450
1 500	1 500	112	1 588	1 604						1 720
1 650	1 650	120	1 744	1 760						2 000
1 800	1 800	127	1 898	1 914						2 280
2 000	2 000	145	2 116	2 132	57	67				2 830
2 200	2 200	160	2 326	2 342						3 390
2 400	2 400	175	2 536	2 556	62	72				4 000
2 600	2 600	190	2 746	2 766						4 650
2 800	2 800	205	2 956	2 976	67	77	5 350			
3 000	3 000	220	3 166	3 186			6 090			

Recommended specification 4-1 figure 1 Shape and dimension of PC tubing (continued), type C



Details of joint

Unit : mm

Nominal designation	Internal diameter D	Thickness of core t_c	External diameter of insertion port D_p	Internal diameter of receiving port D_s	Length of insertion port L_p	Depth of receiving window L_e	Thickness of cover coat t_g	Effective length L	Inside length L_1	Mass (informative) (kg/m)
1 500	1 500	140	1 598	1 632	115	120	25 or more	2 300	2 295	2 110
1 650	1 650	150	1 758	1 792						2 450
1 800	1 800	160	1 916	1 950						2 820
2 000	2 000	175	2 130	2 164						3 380
2 200	2 200	190	2 344	2 378						3 990
2 400	2 400	205	2 550	2 594	130	135				4 640
2 600	2 600	220	2 764	2 808						5 330
2 800	2 800	235	2 978	3 022						6 120
3 000	3 000	250	3 192	3 236						6 900

Recommended specification 4-1 figure 1

Shape and dimension of PC tubing (concluded), type NC

Recommended specification 4-1 table 4 Dimensional tolerance

Unit : mm

Range of nominal designation	Internal diameter D	⁽³⁾ Thickness of core t_c	External diameter of insertion port D_p	Internal diameter of receiving port D_s	Depth of insertion port and receiving port L_p, L_s	Effective length	Inner length
						Type S, Type C, Type NC	Type C, Type NC
						L	L_1
500	± 3	+4 -2	+2 -1	+1 -2	± 5	+10 - 5	
600 to 900	± 4						
1 000 to 1 350	± 6	+6 -3	± 2	± 2			
1 500 to 2 000	± 8	+8 -4					
2 200 to 2 400	± 10	+10 -5		± 3			
2 600 to 3 000	± 12	+12 -6	+3 -2	± 4			

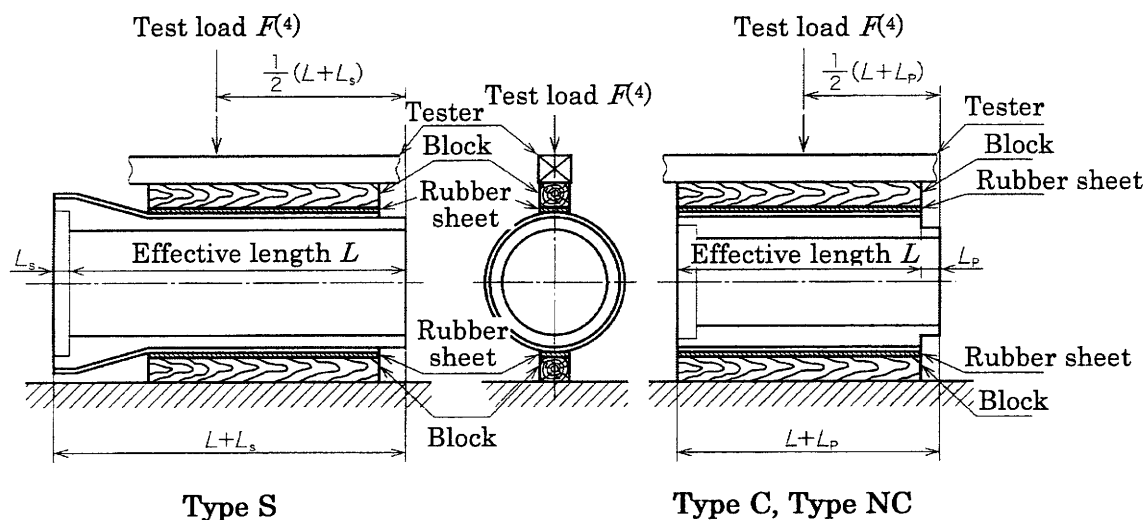
Note ⁽³⁾ : Measure the thickness t_c of a core before prestressing in the direction of a periphery of a core.

5 Bar arrangement A manufacturer shall specify, for each product, the bar arrangement which satisfies the performance specified in clause 3.

6 Strength test

6.1 Bending strength test For a bending strength test, install PC tubing as shown in recommended specification 4-1 figure 2, and apply a load in the center of a span. Set the test load to the cracking load specified in recommended specification 4-1 table 2 and check for any crack. Moreover, check for a breaking strength to investigate whether it satisfies the test load equivalent to the breaking load specified in recommended specification 4-1 table 2

When performing a bending strength test, insert a rubber plate to the pressurization surface and supporting surface of PC tubing, and distribute a load uniformly.



Type S

Type C, Type NC

Recommended specification 4-1 figure 2

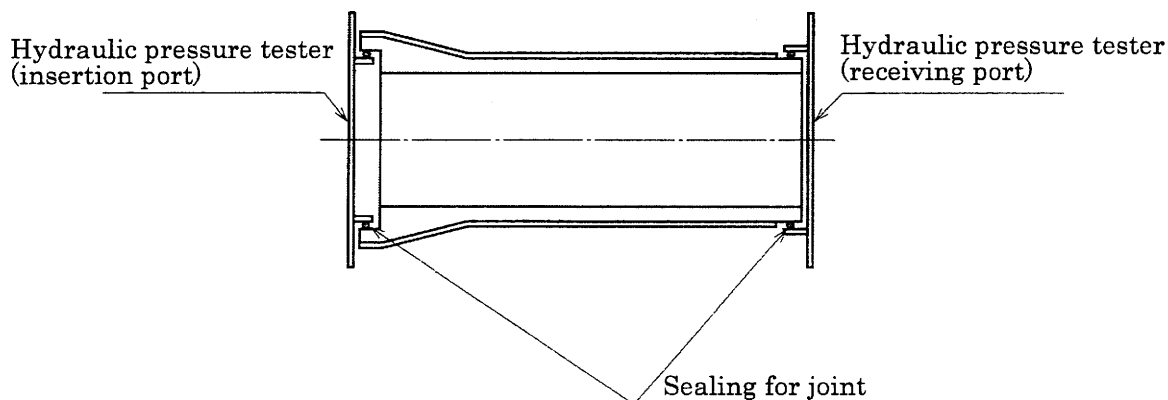
The bending strength test method of PC tubing

Note⁽⁴⁾ : The value of test load F is the product obtained by multiplying the cracking load specified in recommended specification 4-1 table 2 by the effective length L .

Remarks : A tester shall be Grade 1 or higher specified in JIS B 7721, or shall have the allowance which is equivalent to or better than this.

6.2 Internal pressure strength test For the internal pressure strength test, install a PC tubing as shown in recommended specification 4-1 figure 3, and apply the test internal pressure specified in recommended specification 4-1 table 3. Maintain that pressure for 3 minutes and check for leakage of water. However, spots or water drops oozed on the surface of the tubing shall not be deemed as leakage of water. When the crack internal pressure reaches the value shown in recommended specification 4-1 table 3, check for any crack.

Remarks : The internal pressure test shall be performed using the pressure gauge of grade 1.6 or better specified in JIS B 7505.



Recommended specification 4-1 figure 3

The internal-pressure strength test method of PC tubing

7 Quality of concrete The compressive strength of concrete is based on 7.2 of the annex 4 of JIS A 5373.

Remarks : To verify quality of cover coat mortar, an alternative characteristic (e.g. density) may be used, provided that it is sufficiently correlated with strength.

8 Inspections

8.1 Inspection items The inspection items of PC tubing are based on the following.

a) Final inspection

- 1) Appearance
- 2) Performance
- 3) Shape and dimension

b) Delivery inspection

- 1) Appearance
- 2) Shape and dimension

Remarks : The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and it may be omitted based on the result of final inspection.

8.2 Inspection lot The size of inspection lot of PC tubing shall be decided by a manufacturer who considers the characteristics of products, manufacture methods, manufacture quantity, manufacture period, ordered quantity, etc. The final inspection shall be decided by a manufacturer. The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and shall be decided by a purchaser. However, one lot may be 50 tubings or its fraction.

8.3 Inspection method The inspection method of PC tubing is based on the following.

a) Final inspection

- 1) **Appearance** The appearance shall be subjected to visual 100 % inspection. If the products conform to the provision of 5.1 of JIS A 5373, they shall be accepted.
- 2) **Performance** The performance shall be inspected as follows. Take one tubing at random from one lot. In case of the external-pressure tubing, inspect it by 6.1. In the case of the internal-pressure tubing, inspect it by 6.1 and 6.2. If it conforms to the provision of 3.1 or 3.2, the lot shall be accepted. If it fails, inspect all of the rest of the lot. If it conforms to the provision, it shall be accepted.
- 3) **Shape and dimension** For inspection of shape and dimension, take one tubing at random from one lot. If it conforms to the provision of clause 4, the lot shall be accepted. If it fails, inspect all of the rest of the lot. If it conforms to the provision, it shall be accepted.

b) Delivery inspection

- 1) **Appearance** Inspection of appearance shall be made like a).
- 2) **Shape and dimension** Inspection of shape and dimension shall be made like a).

9 Marking The marking of PC tubing is based on **JIS A 5361** and **JIS A 5373**.

Recommended specification 4-2

Prestressed concrete box culvert

1 Scope This recommended specification specifies the prestressed concrete box culvert of Group I of the closed conduits (hereafter referred to as “PC box culvert”) among the annex 4 of JIS A 5373.

Remarks 1 The PC box culvert which was based on the details of this recommended specification 4-2 and which was manufactured by proper quality control shall be deemed to conform to clause 3 of the annex 4 of JIS A 5373.

2 If the reference dimension has been changed within the range shown in clause 4 of the annex 4 of JIS A 5373, a manufacturer must present the following data to a purchaser, when so requested. The data must state conformity of the box culvert to clause 3 of the annex 4 of JIS A 5373 which has been demonstrated by the design document or performance test.

2 Classification The PC box culvert is classified by the nominal dimension and applicable earth covering as shown in recommended specification 4-2 table 1.

Recommended specification 4-2 table 1 Classification of PC box culvert

Classification	Classification by nominal dimension mm	Classification by applicable earth covering m ⁽¹⁾
Type 150	600×600	0.50 to 1.50
Type 300	to	1.51 to 3.00
Type 600	5 000×2 500	3.01 to 6.00

Note (1) : Although the range of applicable earth covering is indicated above, it is possible to correspond to the minimum earth covering (0.2 m).

3 Performance

3.1 Bending strength The PC box culvert shall be subjected to the bending strength test specified in clause 6, and to the bending strength load specified in recommended specification 4-2 table 2. Then, it shall not generate the crack exceeding width of 0.05 mm. Moreover, when the check of the performance against breaking is carried out based on the agreement between the parties concerned with delivery, it shall be based on the provision of clause 3 of the annex 4.

Recommended specification 4-2 table 2 Bending strength load of PC box culvert

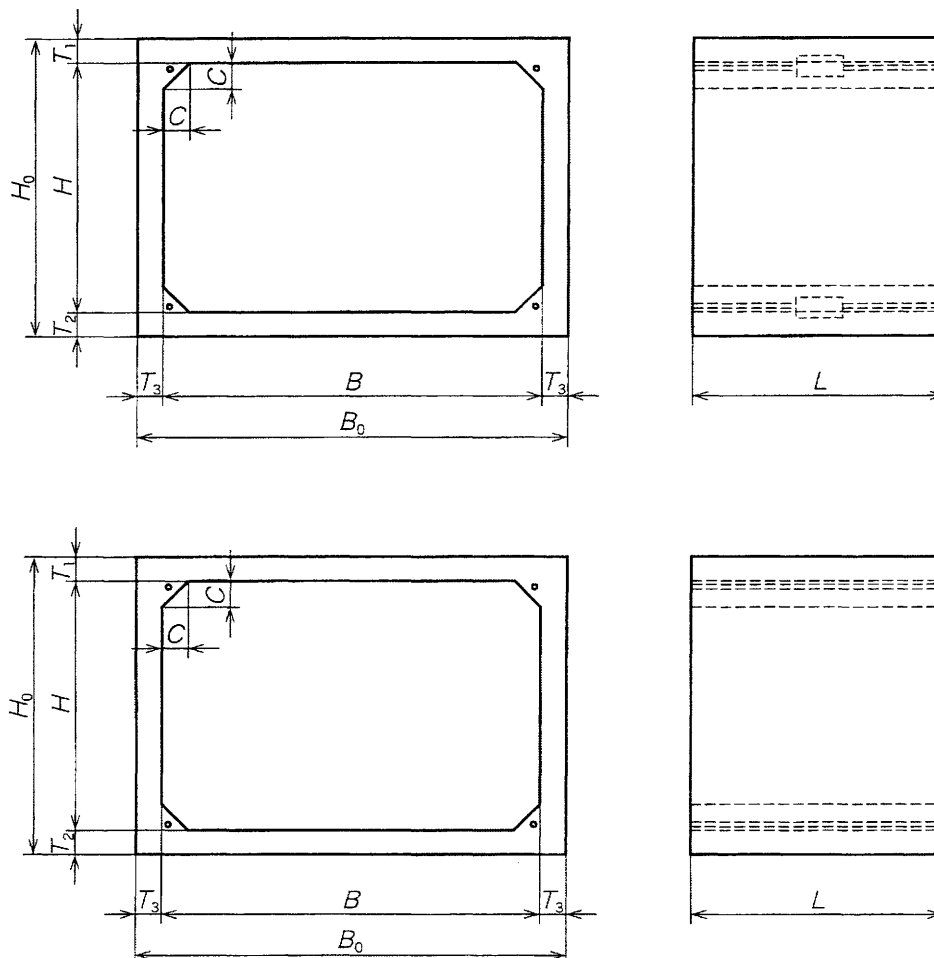
Nominal dimension $B \times H$ (mm)	Bending strength load (kN/m)		
	Type 150	Type 300	Type 600
600×600	30.5	21.4	34.7
700×700	34.1	23.9	38.9
800×800	37.8	26.5	43.1
900×600	41.6	32.7	55.8
900×900	41.5	29.0	45.7
1 000×800	45.5	34.3	58.5
1 000×1 000	45.2	31.5	52.6
1 000×1 500	41.3	19.5	28.6
1 100×1 100	48.6	34.0	56.8
1 200×800	51.9	41.4	71.1
1 200×1 000	52.0	39.5	66.9
1 200×1 200	51.5	36.4	60.9
1 200×1 500	49.6	29.8	48.3
1 300×1 300	54.1	38.9	65.0
1 400×1 400	57.2	42.1	69.1
1 500×1 000	60.4	51.0	85.9
1 500×1 200	60.3	49.1	82.0
1 500×1 500	59.2	44.5	73.2
1 800×1 200	66.3	59.7	103
1 800×1 500	65.8	56.6	96.1
1 800×1 800	64.2	51.6	86.7
2 000×1 500	69.4	64.0	111
2 000×1 800	68.2	59.9	103
2 000×2 000	66.9	56.2	95.7
2 200×1 800	72.3	68.8	118
2 200×2 200	69.6	61.9	106
2 300×1 500	74.7	75.5	131
2 300×1 800	73.8	72.5	125
2 300×2 000	72.8	69.7	120
2 300×2 300	70.5	64.1	110
2 400×2 000	74.4	73.6	128
2 400×2 400	71.4	66.4	115
2 500×1 500	77.3	82.0	145
2 500×1 800	76.7	79.7	140
2 500×2 000	75.8	77.4	135
2 500×2 500	72.5	69.3	118
2 800×1 500	81.2	92.4	162

Recommended specification 4-2 table 2 (concluded)

Nominal dimension $B \times H$ (mm)	Bending strength load (kN/m)		
	Type 150	Type 300	Type 600
2 800 × 2 000	80.3	89.1	155
2 800 × 2 500	77.3	82.0	142
2 800 × 2 800	74.4	75.9	132
3 000 × 1 500	86.9	105	181
3 000 × 2 000	84.8	99.4	172
3 000 × 2 500	80.6	90.3	157
3 000 × 3 000	76.3	82.1	137
3 500 × 2 000	96.7	120	205
3 500 × 2 500	92.5	114	194
4 000 × 2 000	109	138	232
4 000 × 2 500	107	133	227
4 500 × 2 000	123	159	268
4 500 × 2 500	120	155	263
5 000 × 2 000	130	174	302
5 000 × 2 500	129	171	296

- Remarks 1 A tester shall be Grade 1 or higher specified in JIS B 7721, or shall have the allowance which is equivalent to or better than this.
- 2 The above-mentioned values assume the vehicle load of total weight of 245 kN as the design live load. This bending strength load of PC box culvert is designed under the following applicable earth covering: for type 150, 0.50 to 1.50 m; for type 300, 1.51 to 3.00 m; and for type 600, 3.01 to 6.00 m.

4 Shape, dimension and dimensional tolerance The shape, dimension, and dimensional tolerance of PC box culvert shall be as specified in recommended specification 4-2 figure 1, table 3 and table 4.



- Remarks 1** The shape of a product has a standard type and an inverted type. The shape of joint has a butting type, a fitting type, and a receiving port, insertion port type.
- 2 Products may have chamfer, packing window, sling hole or other processing which does not affect the shape and damage the strength of box culvert.
 - 3 Products can be installed in several ways. Product may be simply laid down, joined with PC steel, or joined with bolts. Recommended specification 4-2 figure 1 shows the joint using PC steel.

Recommended specification 4-2 figure 1 Figure of shape of PC box-culvert

Recommended specification 4-2 table 3 Dimension table of PC box culvert

Unit : mm

Covering classification dimension Nominal dimension	Type 150, type 300					Type 600				
	T_1	T_2	T_3	C	L	T_1	T_2	T_3	C	L
600 × 600	125	125	125	100	2 000	125	125	125	100	2 000
700 × 700	125	125	125	100	2 000	125	125	125	100	2 000
800 × 800	125	125	125	100	2 000	125	125	125	100	2 000
900 × 600	125	125	125	150	2 000	150	150	125	150	2 000
900 × 900	125	125	125	150	2 000	150	150	125	150	2 000
1 000 × 800	125	125	125	150	2 000	150	150	150	150	2 000
1 000 × 1 000	125	125	125	150	2 000	150	150	150	150	2 000
1 000 × 1 500	125	125	125	150	2 000	150	150	150	150	2 000
1 100 × 1 100	125	125	125	150	2 000	150	150	150	150	2 000
1 200 × 800	125	125	125	150	2 000	150	150	150	150	2 000
1 200 × 1 000	125	125	125	150	2 000	150	150	150	150	2 000
1 200 × 1 200	125	125	125	150	2 000	150	150	150	150	2 000
1 200 × 1 500	125	125	125	150	2 000	150	150	150	150	2 000
1 300 × 1 300	125	125	125	150	2 000	150	150	150	150	2 000
1 400 × 1 400	150	150	150	150	2 000	150	150	150	150	2 000
1 500 × 1 000	150	150	150	150	2 000	150	150	150	150	2 000
1 500 × 1 200	150	150	150	150	2 000	150	150	150	150	2 000
1 500 × 1 500	150	150	150	150	2 000	150	150	150	150	2 000
1 800 × 1 200	150	150	150	150	2 000	180	180	180	150	2 000
1 800 × 1 500	150	150	150	150	2 000	180	180	180	150	2 000
1 800 × 1 800	150	150	150	150	2 000	180	180	180	150	2 000
2 000 × 1 500	150	150	150	150	2 000	200	200	200	150	2 000
2 000 × 1 800	150	150	150	150	2 000	200	200	200	150	2 000
2 000 × 2 000	150	150	150	150	2 000	200	200	200	150	2 000
2 200 × 1 800	180	180	180	150	2 000	230	230	230	150	2 000
2 200 × 2 200	180	180	180	150	2 000	230	230	230	150	2 000
2 300 × 1 500	180	180	180	150	2 000	230	230	230	150	2 000
2 300 × 1 800	180	180	180	150	2 000	230	230	230	150	2 000
2 300 × 2 000	180	180	180	150	2 000	230	230	230	150	2 000
2 300 × 2 300	180	180	180	150	2 000	230	230	230	150	2 000
2 400 × 2 000	180	180	180	150	2 000	250	250	250	150	2 000
2 400 × 2 400	180	180	180	150	2 000	250	250	250	150	2 000
2 500 × 1 500	180	180	180	150	2 000	260	260	250	150	2 000
2 500 × 1 800	180	180	180	150	2 000	260	260	250	150	2 000
2 500 × 2 000	180	180	180	150	2 000	260	260	250	150	2 000
2 500 × 2 500	200	200	200	150	2 000	260	260	250	150	2 000
2 800 × 1 500	200	200	200	200	2 000	280	280	280	200	2 000
2 800 × 2 000	200	200	200	200	2 000	280	280	280	200	2 000
2 800 × 2 500	200	200	200	200	2 000	280	280	280	200	2 000
2 800 × 2 800	200	200	200	200	2 000	280	280	280	200	2 000
3 000 × 1 500	250	250	200	200	2 000	350	350	300	200	2 000
3 000 × 2 000	250	250	200	200	2 000	350	350	300	200	2 000
3 000 × 2 500	250	250	200	200	2 000	350	350	300	200	1 500

Recommended specification 4-2 table 3 (concluded)

Unit : mm

Covering classification dimension Nominal dimension	Type 150, type 300					Type 600				
	T_1	T_2	T_3	C	L	T_1	T_2	T_3	C	L
3 000 × 3 000	250	250	250	200	2 000	350	350	300	200	1 500
3 500 × 2 000	300	300	250	300	2 000	350	350	300	300	1 500
3 500 × 2 500	300	300	250	300	2 000	380	380	300	300	1 500
4 000 × 2 000	300	300	250	300	1 500	400	400	400	300	1 000
4 000 × 2 500	300	300	250	300	1 500	400	400	400	300	1 000
4 500 × 2 000	380	380	300	300	1 000	450	450	400	300	1 000
4 500 × 2 500	380	380	300	300	1 000	450	450	400	300	1 000
5 000 × 2 000	380	380	330	300	1 000	500	530	400	300	1 000
5 000 × 2 500	380	380	330	300	1 000	500	530	400	300	1 000

Remarks : The effective length (L) may be 1 500 mm or 1 000 mm.**Recommended specification 4-2 table 4 Dimensional tolerance of PC box culvert**

Unit : mm

Nominal dimension	Dimensional tolerance		
	Inner width and inner height	Thick-ness	Effective length
600 × 600 to 900 × 900	±4	+4 -2	+10 -5
1 000 × 800 to 2 500 × 2 500	±6	+6 -3	
2 800 × 2 000 to 3 000 × 3 000	±7	+6 -4	
3 500 × 2 000 to 5 000 × 2 500	±10	+8 -4	

5 Bar arrangement A manufacturer shall specify the bar arrangement which satisfies the provision specified in clause 3.

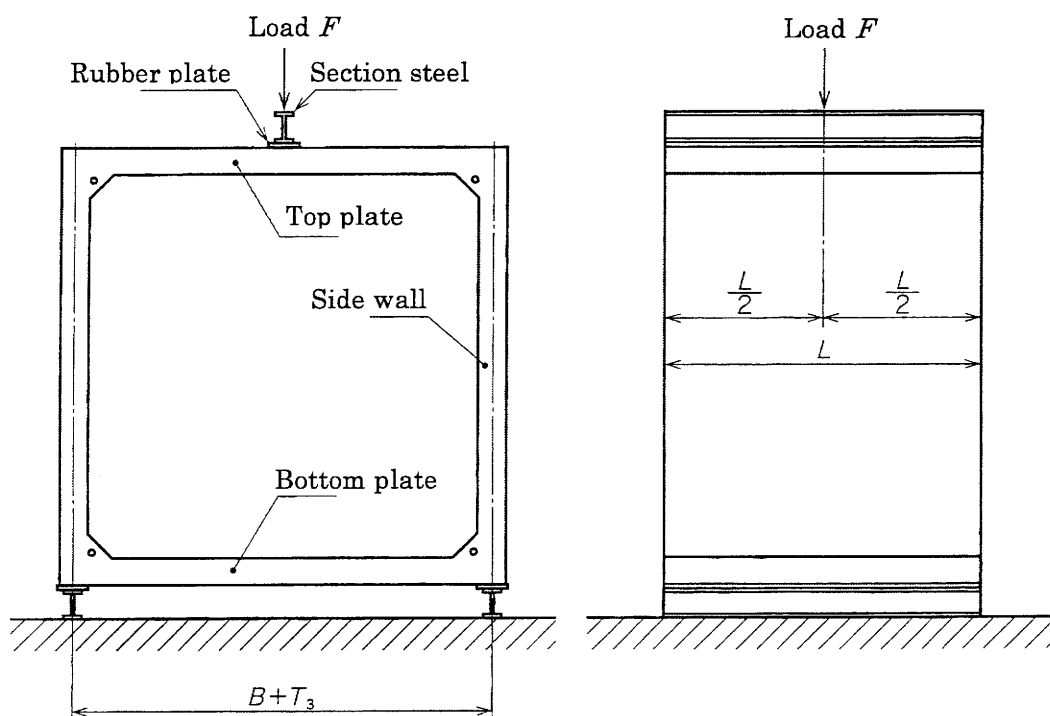
The covering of steel shall be equal to or more than the diameter of steel and 20 mm or more. The gap of steel shall be $\frac{5}{4}$ times or more the maximum dimension of a coarse aggregate.

6 Strength test

6.1 Compressive strength test The compressive strength test of concrete is based on JIS A 1132 and JIS A 1108.

6.2 Bending strength test For the bending strength test, install a PC box culvert as shown in recommended specification 4-2 figure 2. When it is subjected to the load specified in recommended specification 4-2 table 2, check for any crack exceeding the width of 0.05 mm.

When performing a bending strength test, insert a rubber plate to the pressurization surface and supporting surface of PC box culvert, and distribute a load uniformly.



Recommended specification 4-2 figure 2
The bending strength test method of PC box culvert

7 Quality of concrete The compressive strength of concrete is based on 7.2 of the annex 4 of JIS A 5373.

8 Inspections

8.1 Inspection items The inspection items of PC box culvert are based on the following.

a) Final inspection

- 1) Appearance
- 2) Performance
- 3) Shape and dimension

b) Delivery inspection

- 1) Appearance
- 2) Shape and dimension

Remarks : The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and it may be omitted based on the result of final inspection.

8.2 Inspection lot The size of inspection lot of PC box culvert shall be decided by a manufacturer who considers the characteristics of products, manufacture methods, manufacture quantity, manufacture period, ordered quantity, etc. The final inspection shall be decided by a manufacturer. The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and shall be decided by a purchaser. However, one lot may be 100 pieces or its fraction for each classification.

8.3 Inspection method The inspection method of PC box culvert is based on the following.

a) Final inspection

- 1) **Appearance** The appearance shall be subjected to visual 100 % inspection. If the products conform to the provision of 5.1 of JIS A 5373, they shall be accepted.
- 2) **Performance** The performance shall be inspected as follows. Take one piece at random from one lot and inspect it by 6.2. If it conforms to the provision of 3.1 the whole lot shall be accepted. If it fails, take two further pieces from the lot, and re-inspect them. If both of the two conform, the whole lot shall be accepted, excluding the first nonconforming product. If even one piece fails in re-inspection, the whole lot shall be rejected.
- 3) **Shape and dimension** For inspection of shape and dimension, take one piece at random from one lot. If it conforms to recommended specification 4-2, the whole lot shall be accepted. If it fails, take two further pieces from the lot, and re-inspect them. If both of the two conform, the whole lot shall be accepted, excluding the first nonconforming product. If even one piece fails in re-inspection, the whole lot shall be inspected. If it conforms to the provision, it will be accepted.

b) Delivery inspection

- 1) **Appearance** The appearance shall be inspected like a).

When a sampling inspection is adopted, take two pieces at random. If both of the two conform to the provision of 5.1 of JIS A 5373, the lot shall be accepted. If even one piece fails, the whole lot shall be inspected. If it conforms to the provision, it will be accepted.

- 2) **Shape and dimension** Shape and dimension shall be inspected like a).

9 Marking The marking on PC box culvert is based on JIS A 5361 and JIS A 5373.

Annex 5 (normative)

Piles

1 Scope This annex specifies Group I and Group II of piles which are mainly used for a foundation pile among the precast prestressed concrete products specified in JIS A 5373.

2 Classification Piles shall be classified according to annex 5 table 1.

In addition, Group I shall be classified according to annex 5 table 2.

Annex 5 table 1 Classification of piles

Major division	Minor division
Piles	Prestressed concrete pile (PC pile, ST pile, knot pile)
	Prestressed reinforced-concrete pile (PRC pile, PRC knot pile)
	Others

Annex 5 table 2 Classification of Group I of piles

Classification	Classification by external diameter mm	Classification by effective prestress N/mm ²	Detail
Prestressed concrete pile (PC pile, ST pile)	300 to 1 200	4.0 to 10.0	See recommended specification 5-1.

Remarks 1 The effective prestress shall be calculated. The calculated value shall be in the range of $\pm 5\%$ of each value.

2 It is allowable to adopt the external diameter exceeding 1 200 mm. In that case, performance values shall be decided subject to the agreement between the parties concerned with delivery.

3 PC piles have the same cross section over the entire length. ST piles have the cross section which enlarges toward on end.

3 Performance

3.1 Performance of the body of pile The performance of the body of pile shall conform to the provision specified in annex 5 table 3.

Annex 5 table 3 Performance of body of pile

Performance item	Performance	Performance check method
Service performance	It shall be safe to the regular load assumed at the time of use, and crack width shall be within an allowance.	See a design document or clause 6 of the annex 5.
End stage performance ⁽¹⁾	It shall not break for the load assumed at the time of end stage.	See a design document or clause 6 of the annex 5.
Durability ⁽²⁾	Durability shall be secured against deterioration assumed.	See a design document or a record.
Workability	Workability for transport, installation, assembly, etc. shall be secured.	See a design document or a record.

Notes⁽¹⁾ Confirmation of the end stage performance shall be made when so requested by purchasers.

⁽²⁾ Durability may be confirmed by the actual results of such similar products as are equivalent in terms of water-cement ratio and reinforcement covering.

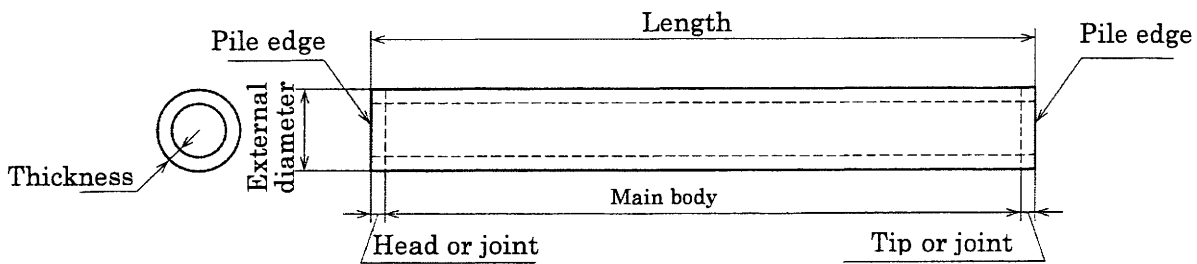
Remarks : The performance items of Group II shall be subject to the agreement between the parties concerned with delivery.

3.2 Performance of joint The performance of joint is based on the following.

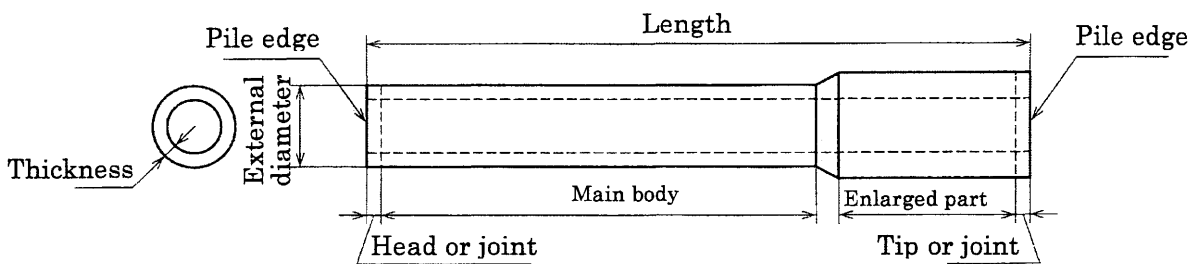
- a) **Bending strength of joint** The bending strength of joint shall exceed the destructive bending moment among the end stage performance of the body specified in 3.1.
- b) **Connectability (squareness of joint edge)** The gradient of joint edge shall be within 1 mm per 300 mm against the right angle of the axis of a pile.

4 Shape, dimension, and dimensional tolerance The shape, dimension, and dimensional tolerance of piles shall be based on the following. As to Group I, however, if the design concept is not different, and if the performance (quality) and performance (quality) check method are the same, the reference dimension may be changed within 10 % in response to purchaser's demand, provided that the necessary performance is satisfied.

a) **Shape** The shape of piles is shown in annex 5 informative figure 1.



a) PC pile, PRC pile



b) ST pile

Remarks 1 A PC pile and a PRC pile has a hollow cylinder body, having a suitable tip, a joint or a head, if needed.

2 An ST pile has a part at its edge which is enlarged in diameter. The maximum length of the enlarged part shall be twice the external diameter of the enlarge part. An ST pile has a suitable tip, a joint or a head, if needed.

Annex 5 informative figure 1 Example of shape of a pile

4.1 Dimension and dimensional tolerance The dimension and dimensional tolerance of the products classified into Group I shall be as specified in annex 5 table 4.

The dimension and dimensional tolerance of the products classified into Group II shall be subject to the agreement between the parties concerned with delivery.

Annex 5 table 4 Dimension and dimensional tolerance

Classification		External diameter mm		Thickness mm	Length m
Prestressed concrete pile (PC pile, ST pile)	Dimension	300 to less than 700	700 to 1 200	60 to 230	7 to 15
	Dimensional tolerance	+5 -2	+7 -4	+ not specified -0	±0.3 (%) of length

- Remarks 1 The unit of length of a pile shall be 1 m unit. Piles are available in 4 m, 5 m, and 6 m according to the agreement between the parties concerned with delivery.
- 2 The external diameter of pile shall be the average of two values measured along the orthoaxis at a cross section of body.
 - 3 The thickness of pile shall be the average of four values measured along the orthoaxis on a cross section of edge of body.

5 Bar arrangement (positions of PC steel and reinforcement) The bar arrangement of piles is based on JIS A 5364 and a design document.

In addition, a manufacturer shall define the bar arrangement, for every product, which satisfies clause 3.

6 Test method

6.1 Compressive-strength test A compressive-strength test is based on JIS A 1132 and JIS A 1108, or JIS A 1136.

6.2 Bending strength test A bending strength test is based on JIS A 5363.

Remarks : A tester shall be Grade 1 or higher specified in JIS B 7721, or shall have the allowance which is equivalent to or better than this.

- a) For the bending strength test of the body, as shown in figure 1 of JIS A 5363, support the span part of 3/5 of the pile length and apply the load (F) at the center of span. According to the following formula, calculate the loading load from the bending moment.

In addition, if the loading point or the supporting point is likely to break locally before rupture of bending of pile occurs, then, take appropriate countermeasures.

$$F = \frac{40M - mGL}{6L - 10A}$$

- Where, M : Bending moment (kN·m)
 m : Mass of a pile (t)
 G : Standard gravitational acceleration (9.81 m/s²)
 L : Length of a pile (m)
 F : Loading load (kN)
 A : Bending span (m) It is referred to as $A = 1.0$ m.

- b) For the breaking bending moment, obtain the maximum of the load (F) shown by a pile until it breaks, and calculate it according to the formula specified in a).
- c) For the bending strength test of joint, coincide the seam of joint at the center of span. Then, follow the procedure specified in a).

6.3 Axial-tension bending strength test (positive/negative alternating repetition axial-tension bending strength test) An axial-tension bending strength test is based on the following.

Remarks : A tester shall be Grade 1 or higher specified in JIS B 7721, or shall have the allowance which is equivalent to or better than this.

- a) For the axial-tension bending strength test, as shown in annex 5 figure 1, support the span part of B of the pile with the axial tension (N) applied, and apply the load (F) at the center of span. According to the following formula, calculate the loading load from the bending moment.

In addition, if the loading point or the supporting point is likely to break locally before rupture of bending of pile occurs, then, take appropriate countermeasures.

In the case of a positive load

$$F = \frac{8M - mG(2B - L) - 8\delta N}{2(B - A)}$$

In the case of a negative load

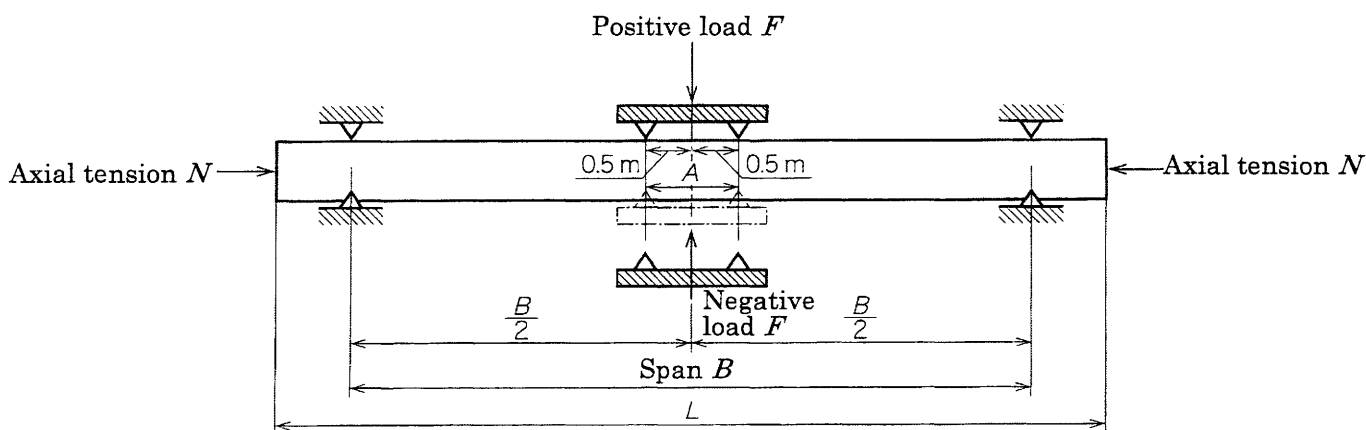
$$-F = \frac{-8M - mG(2A - L) + 8\delta N}{2(B - A)} - mG$$

- Where, M : Bending moment (kN·m)
- m : Mass of a pile (see the value in recommended specification 5-1 table 5) (t)
- G : Standard gravitational acceleration (9.81 m/s²)
- L : Length of a pile (m)
- B : Span (m) It is referred to as $B \geq 7.0$.
- F : Loading load (kN)
- δ : Relative deflections of a center section (m)
- N : Axial tension (kN)
- A : Bending span (m) It is referred to as $A = 1.0$ m.

- b) The axial tension N , load F , and positive/negative alternating number of cycles must satisfy the following conditions.
- 1) The axial tension N must be secured uniformly till the completion of test.
 - 2) The axial tension N shall be either of three steps, N_1 , N_2 , and N_3 which are shown in recommended specification.
 - 3) While the axial tension N is applied, the repeated load F shall produce the moment of 1/1.2 each of the crack bending moment and the destructive bending moment. The number of cycles shall be 10 or more.

One cycle is defined as one positive/negative sequence.

- c) For the breaking bending moment, complete the positive/negative alternating repetition, apply the load (F), obtain the maximum of the load (F) shown until it breaks, and calculate it according to the formula specified in a).



Annex 5 figure 1 The loading method of an axial-tension bending strength test

6.4 Shear strength test The shear strength test of a main body is based on JIS A 5363 and the following.

Remarks : A tester shall be Grade 1 or higher specified in JIS B 7721, or shall have the allowance which is equivalent to or better than this.

Perform the test using the method shown in JIS A 5363 figure 6 or figure 7. When using the method shown in figure 6, calculate a loading load from shear strength according to the following formula.

In addition, if the loading point or the supporting point is likely to break locally before rupture of shear of PC pile occurs, then, take appropriate countermeasures.

$$F = 2Q$$

Where, Q : Shear strength (kN)
 F : Loading load (kN)
 L : Length (m)
 A : Bending span (loading span) (m) $A= 1.0$
 a : Shear span (m) $a=1.0D$

In addition, the specimen ejection length (m) shall be about $1.25D$ to $2.0D$.

Especially when performing a shear-fracture test, it shall be based on JIS A 5363 figure 7, and a loading load shall be calculated from shear strength according to the following formula.

$$F = \frac{Q(B+C)}{B}$$

Where, Q : Shear strength (kN)
 F : Loading load (kN)
 L : Length (m)
 B : Distance between a loading point and an outside supporting point (m)
 $C/2$: Shear span (m) $C/2=1.0D$

6.5 Measuring method of squareness of a connector end face For measurement of squareness of a connector end face, use a square, set it in line with the axis of external diameter of a pile, and measure and obtain the amount of inclinations about external diameter of a pile.

7 Quality of concrete

7.1 Material and manufacture method The material for concrete and manufacture method are based on JIS A 5364.

7.2 Compressive strength The compressive strength of concrete shall be verified by the compressive strength of sample which was processed by the same cure as the product, or the compressive strength which was controlled properly. When the predetermined cure is finished, the strength shall be 80 N/mm^2 or more for the effective prestress below 4.0 N/mm^2 , and the strength shall be 85 N/mm^2 or more for the effective prestress over 4.0 N/mm^2 . Moreover, the compressive strength at the time of prestress introduction shall be 40 N/mm^2 or more.

In addition, products of Group II shall be subject to the agreement between the parties concerned with delivery.

Remarks : The compressive strength of concrete may refer to JIS A 5364 annex (informative).

8 Inspections Inspections are based on **JIS A 5365** and the following.

8.1 The final inspection The final inspection of piles shall be performed about appearance, performance, shape, and dimension.

- a) **Appearance** About appearance, it shall be a 100 % inspection or a sampling inspection in consideration of the characteristics of a product, a manufacture method, manufacture quantity, etc.
- b) **Performance, shape, and dimension** About performance, shape, and dimension, it shall be a sampling inspection.

When the performance is inspected by a sample as alternative characteristic, correlation shall be established between the sample and the product.

- c) **Size of inspection lot** The size of inspection lot shall be specified by a manufacturer by considering the characteristics of a product, a manufacture method, manufacture quantity, manufacture period, ordered quantity, etc.

Within one inspection lot, the characteristics of products, the materials used, concrete mixing ratio, and the manufacture method shall be the same.

8.2 Delivery inspection The delivery inspection of piles shall be made about appearance, shape, and dimension. However, the delivery inspection shall be subject to the agreement between the parties concerned with delivery, and it may be omitted based on the result of final inspection.

9 Marking The marking on piles shall indicate the following matters according to **JIS A 5361**.

- a) Classification or its abbreviation
- b) Manufacturer's name or its abbreviation
- c) Date of manufacture or its abbreviation

10 Others Group I of piles is shown in annex 5 table 5.

Annex 5 table 5 Recommended specification

Structure-specific product group standard		Recommended specification
JIS A 5373	annex 5 (normative) Piles	Recommended specification 5-1 Prestressed concrete pile

Recommended specification 5-1

Prestressed concrete pile

1 Scope This recommended specification specifies the prestressed concrete pile of Group I of piles (hereafter referred to as “PC pile”) among the annex 5 of JIS A 5373. It shall include the pile with enlarged edge (ST pile).

Remarks 1 The PC pile which was based on the details of this recommended specification 5-1 and which was manufactured by proper quality control shall be deemed to conform to clause 3 of the annex 5 of JIS A 5373.

2 If the reference dimension has been changed within the range shown in clause 4 of the annex 5 of JIS A 5373, a manufacturer must present the following data to a purchaser, when so requested. The data must state conformity of the pile to clause 3 of the annex 5 of JIS A 5373 which has been demonstrated by the design document or performance test.

2 Classification PC piles shall be classified, by the external diameter, into 300 mm, 350 mm, 400 mm, 450 mm, 500 mm, 600 mm, 700 mm, 800 mm, 900 mm, 1 000 mm, 1 100 mm and 1 200 mm. Moreover, they shall be classified, by the magnitude of effective prestress, into Class A, Class B, and Class C (hereafter referred to as “A, B, and C”, respectively).

In addition, the effective prestress of A, B, and C of PC pile shall be 4.0 N/mm², 8.0 N/mm² and 10.0 N/mm², respectively.

3 Performance

3.1 Bending strength The bending strength of the pile body and the pile joint is based on the following.

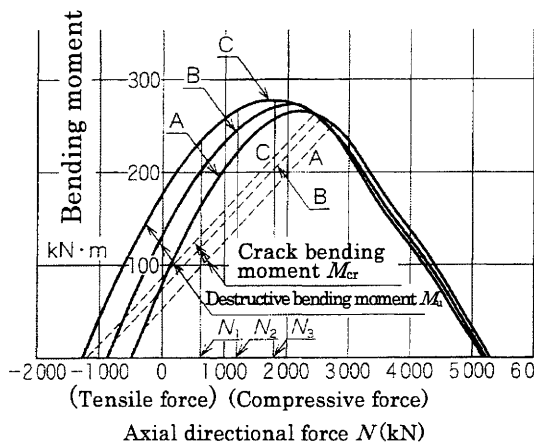
- a) **Pile body** The PC pile body shall be subjected to the bending strength test specified in clause 6, and to the crack bending moment specified in recommended specification 5-1 table 1 and table 2. Then, it shall not generate any crack. Moreover, the destructive bending moment shall exceed the value specified in recommended specification 5-1 table 1 and table 2.
- b) **Pile joint** The PC pile joint shall be subjected to the bending strength test specified in clause 6. Then, it shall exceed the destructive bending moment specified in recommended specification 5-1 table 1.

3.2 Shear strength The PC pile body shall be subjected to the shear strength test specified in clause 6, and to the shear crack strength specified in recommended specification 5-1 table 3. Then, it shall not generate any crack. Moreover, the shear destructive strength shall exceed the value specified in recommended specification 5-1 table 3.

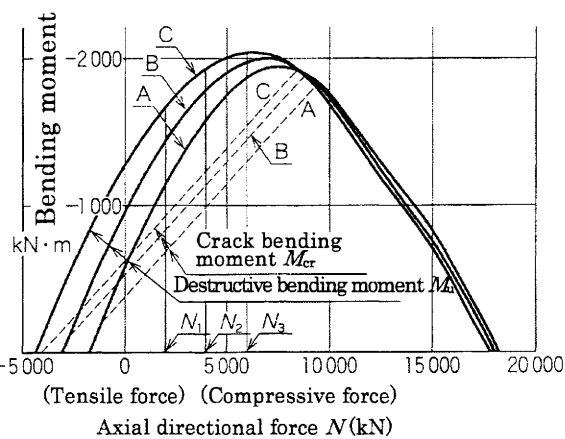
3.3 Connectability (squareness of joint edge) The gradient of joint edge shall be within 1 mm per 300 mm against the right angle of the axis of a pile.

Recommended specification 5-1 table 1 Dimension and bending strength
(at the time of application of axial tension $N=0$ kN)

External diameter mm	Classification	Thickness mm	Length m	Crack bending-moment kN·m	Destructive bending-moment kN·m	External diameter mm	Classification	Thickness mm	Length m	Crack bending-moment kN·m	Destructive bending-moment kN·m
300	A	60	7 to 13	24.5	37.3	700	A	100	7 to 15	264.9	397.3
	B		7 to 15	34.3	61.8		372.8			671.0	
	C		7 to 15	39.2	78.5		441.4			882.9	
350	A	60	7 to 13	34.3	52.0	800	A	110	7 to 15	392.4	588.6
	B		7 to 15	49.0	88.3		539.6			971.2	
	C		7 to 15	58.9	117.7		637.6			1 275	
400	A	65	7 to 15	54.0	81.4	900	A	120	7 to 15	539.6	809.3
	B			73.6	132.4		735.8			1 324	
	C			88.3	176.6		833.8			1 668	
450	A	70	7 to 15	73.6	110.8	1 000	A	130	7 to 15	735.8	1 104
	B			107.9	194.2		1 030			1 854	
	C			122.6	245.2		1 177			2 354	
500	A	80	7 to 15	103.0	155.0	1 100	A	140	7 to 15	932.0	1 398
	B			147.2	264.9		1 324			2 384	
	C			166.8	333.5		1 521			3 041	
600	A	90	7 to 15	166.8	250.2	1 200	A	150	7 to 15	1 177	1 766
	B			245.2	441.4		1 668			3 002	
	C			284.5	569.0		1 962			3 924	



External diameter 400 mm axial force, bending moment relation figure



External diameter 800 mm axial force, bending moment relation figure

Recommended specification 5-1 table 2 Axial-tension bending strength

External diameter mm	Classification	Bending strength at the time of application of axial tension N_1			Bending strength at the time of application of axial tension N_2			Bending strength at the time of application of axial tension N_3		
		Axial-tension N_1 kN	Crack bending-moment M_{cr} kN-m	Destructive bending-moment M_u kN-m	Axial-tension N_2 kN	Crack bending-moment M_{cr} kN-m	Destructive bending-moment M_u kN-m	Axial-tension N_3 kN	Crack bending-moment M_{cr} kN-m	Destructive bending-moment M_u kN-m
300	A	392.4	44.1	77.5	784.8	64.7	105.9	1 177	84.4	122.6
	B		54.0	95.2		74.6	117.7		94.2	127.5
	C		58.9	106.9		79.5	123.6		99.1	130.5
350	A	490.5	64.7	111.8	981.0	96.1	156.0	1 472	126.5	181.5
	B		79.5	140.3		109.9	173.6		141.3	188.4
	C		89.3	159.9		119.7	184.4		151.1	192.3
400	A	588.6	97.1	163.8	1 177	139.3	223.7	1 776	182.5	259.0
	B		116.7	201.1		158.9	249.2		202.1	269.8
	C		130.5	234.5		173.6	266.8		215.8	277.6
450	A	735.8	134.4	228.6	1 472	195.2	312.9	2 207	256.0	361.0
	B		168.7	291.4		229.6	353.2		290.4	379.6
	C		183.4	329.6		244.3	375.7		305.1	389.5
500	A	882.9	183.4	304.1	1 766	263.9	421.8	2 649	345.3	496.4
	B		227.6	392.4		309.0	483.6		389.5	527.8
	C		247.2	447.3		328.6	518.0		409.1	543.5
600	A	1 275	309.0	522.9	2 551	452.2	723.0	3 826	594.5	839.7
	B		388.5	671.0		530.7	823.1		673.9	886.8
	C		427.7	765.2		570.9	877.0		713.2	909.4
700	A	1 766	498.3	832.9	3 532	731.8	1 151	5 297	965.3	1 312
	B		606.3	1 034		840.7	1 282		1 074	1 366
	C		673.9	1 185		906.4	1 355		1 139	1 387
800	A	1 962	692.6	1 143	3 294	991.8	1 579	5 886	1 292	1 855
	B		839.7	1 446		1 140	1 796		1 440	1 967
	C		935.9	1 679		1 235	1 936		1 534	2 027
900	A	2 452	966.3	1 598	4 905	1 394	2 226	7 358	1 821	2 601
	B		1 165	2 009		1 595	2 516		2 024	2 748
	C		1 264	2 277		1 696	2 679		2 127	2 827
1 000	A	2 943	1 306	2 159	5 886	1 876	3 004	8 829	2 446	3 502
	B		1 598	2 750		2 167	3 403		2 736	3 697
	C		1 745	3 143		2 314	3 633		2 882	3 810
1 100	A	3 434	1 652	2 821	6 867	2 372	3 943	10 300	3 092	4 597
	B		2 030	3 646		2 735	4 538		3 440	4 907
	C		2 218	4 163		2 916	4 846		3 612	5 041
1 200	A	3 924	2 080	3 555	7 848	2 982	4 983	11 770	3 885	5 852
	B		2 552	4 598		3 435	5 754		4 319	6 272
	C		1 834	5 331		3 706	6 208		4 578	6 471

Remarks : The performance check of the PC pile body involves the axial-tension bending strength test and the positive/negative alternating repetition axial-tension bending strength test. The representation external diameter in this case shall be middle class diameter of piles which are usually manufactured. Moreover, the axial tension at this time shall be N_3 .

In addition, the length of PC pile used in this case shall be 8 m or more.

Symbol	Explanation
N_4	The axial tension which equates each destructive bending moment of A, B, and C in a bending-moment relation figure
N_3	The axial tension of $N_4 \times 3/4$
N_2	The axial tension of $N_4 \times 2/4$
N_1	The axial tension of $N_4 \times 1/4$

Symbol	Explanation
M_{cr}	Crack bending moment
M_u	Destructive bending moment

Recommended specification 5-1 table 3 Shear strength

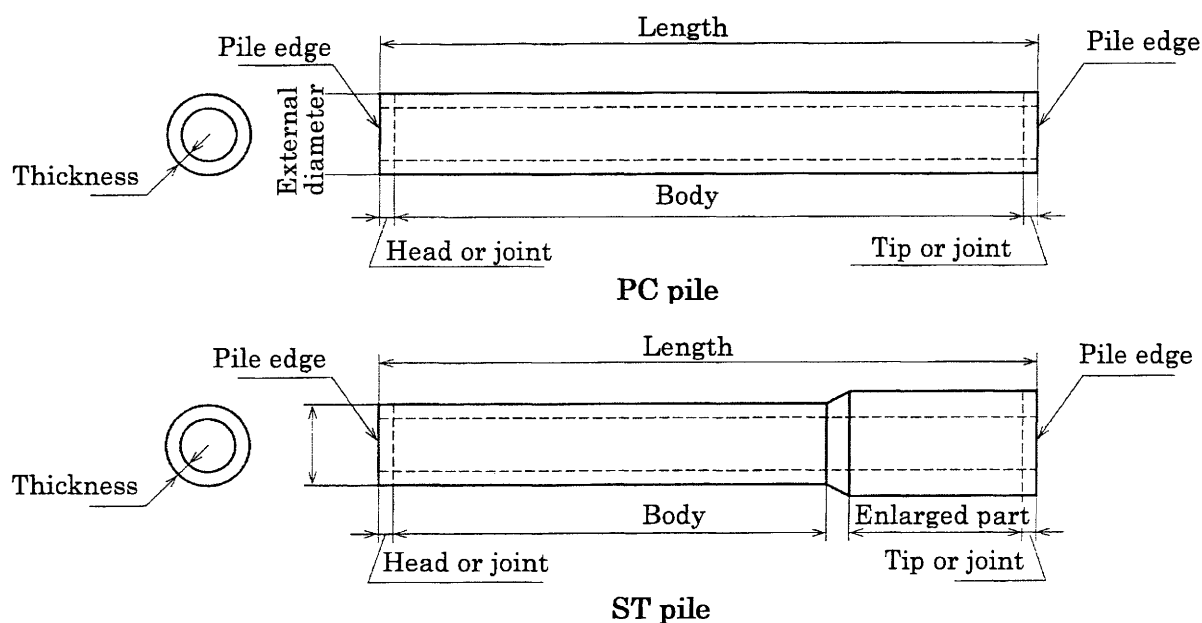
External diameter mm	Thickness mm	Classifi- cation	Shear strength kN	
			Shear crack	Shear fracture
300	60	A	99.1	125
		B	126	160
		C	136	175
350	60	A	119	149
		B	150	190
		C	163	209
400	65	A	148	187
		B	187	234
		C	204	259
450	70	A	181	225
		B	228	293
		C	248	316
500	80	A	229	276
		B	288	359
		C	314	395
600	90	A	311	388
		B	392	506
		C	428	554
700	100	A	406	514
		B	512	677
		C	557	739
800	110	A	512	661
		B	647	863
		C	704	936
900	120	A	631	820
		B	797	1 063
		C	867	1 153
1000	130	A	762	990
		B	961	1 289
		C	1 047	1 400
1100	140	A	905	1 202
		B	1 142	1 561
		C	1 244	1 687
1200	150	A	1 059	1 413
		B	1 337	1 823
		C	1 457	1 979

Remarks : The performance check of the PC pile body involves the shear test. The representative external diameter in this case shall be middle class diameter of piles which are usually manufactured.

4 Shape, dimension, and dimensional tolerance The shape, dimension, and dimensional tolerance of PC piles shall be based on recommended specification 5-1 figure 1, table 1 and table 4.

A PC pile has mainly a hollow cylinder body, having a suitable tip, a joint or a head, if needed.

An ST pile has a part at an edge of PC pile which is enlarged in diameter. The maximum length of the enlarged part shall be twice the external diameter of the enlarge part.



- Remarks
- 1 A tip, a joint and a head are included in the length of pile.
 - 2 A metallic fixture, which is attached to the tip after manufacture, is not included in the length of pile.
 - 3 There are a closed edge and an open edge.
 - 4 A tip may be attached to a pile or a middle tip to make a lower pile.

Recommended specification 5-1 figure 1 Shape of piles

Recommended specification 5-1 table 4 Dimension and dimensional tolerance

Classification		External diameter mm		Thickness mm	Length m
Prestressed concrete pile (PC pile, ST pile)	Dimension	300 to 600	700 to 1 200	60 to 150	7 to 15
	Dimensional tolerance	+5 -2	+7 -4	+ Not specified -0	±0.3(%) of length

Remarks 1 The unit of length of a pile shall be 1 m unit. Piles are available in 4 m, 5 m, and 6 m.

2 The external diameter of pile shall be the average of two values measured along the orthoaxis at a cross section of body.

3 The thickness of pile shall be the average of four values measured along the orthoaxis on a cross section of edge of body.

5 Bar arrangement The bar arrangement of PC pile is based on the following.

a) As to the PC steel and reinforcement arranged axially, the ratio of reinforcement in terms of total cross-sectional area shall be 0.4 % or more, and the number shall be six or more. On each cross section of pile, they shall be arranged as uniformly as possible along the circumference of concentric circles. This is intended to decrease directionality of the bending strength of a pile. The gap of PC steel and reinforcement shall be one or more times their diameters, and more than 4/3 of the maximum dimension of a coarse aggregate.

b) A spiral reinforcement shall be arranged on the outside of axial PC steel and axial reinforcement. The wire diameter of spiral reinforcements shall be 3 mm or more for the external diameter of pile of 500 mm or less, 4 mm or more for the diameter of 600 to 1 000 mm and 5 mm or more for the diameter of 1 100 mm and 1 200 mm. The pitch shall be 110 mm or less.

In order to improve the shear resistance and the deformation performance, the required spiral reinforcement quantity shall be determined by the parties concerned with delivery.

c) The covering of PC steel and spiral reinforcement shall be more than 15 mm.

d) The reinforcement and PC steel shall be cleared of loose scale, oil, etc. which damage adhesion of concrete, and shall be assembled and fixed to the accurate position.

6 Strength test

6.1 Compressive strength test The compressive strength test of concrete is based on 6.1 of annex 5 of JIS A 5373.

6.2 Bending strength test The bending strength test is based on 6.2 of the annex 5 of JIS A 5373.

In addition, the mass of the body of PC pile used for calculation of a loading load is based on recommended specification 5-1 table 5.

6.3 Axial-tension bending strength test The axial-tension bending strength test is based on 6.3 of the annex 5 of JIS A 5373.

In addition, the mass of the body of PC pile used for calculation of a loading load is based on recommended specification 5-1 table 5.

6.4 Shear strength test The shear strength test is based on 6.4 of the annex 5 of JIS A 5373 .

6.5 Measurement test of squareness of joint edge The measurement test of the squareness of a joint edge is based on 6.5 of the annex 5 of JIS A 5373.

7 Quality of concrete The compressive strength of concrete is based on 7.2 of the annex 5 of JIS A 5373.

In addition, Class A shall be more than 80 N/mm², and Classes B and C shall be more than 85 N/mm².

8 Inspections

8.1 Inspection items The inspection items of PC pile are based on the following.

a) Final inspection

- 1) Appearance
- 2) Performance
- 3) Shape and dimension

b) Delivery inspection

- 1) Appearance
- 2) Shape and dimension

Remarks : The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and it may be omitted based on the result of final inspection.

8.2 Inspection lot The size of inspection lot of PC pile shall be decided by a manufacturer who considers the characteristics of products, manufacture methods, manufacture quantity, manufacture period, ordered quantity, etc. The delivery inspection shall be subject to the agreement between the parties concerned with delivery, and shall be decided by a purchaser. However, one lot may be 3 000 pieces or its fraction.

8.3 Inspection method The inspection method of PC pile is based on the following.

a) Final inspection

- 1) **Appearance** For inspection of appearance, take samples at random from one lot. If they conform to the provision of 5.1 of JIS A 5372, they shall be accepted. If even one sample fails, the whole lot shall be subjected to a 100 % inspection. If it conforms to the provision, it shall be accepted.
- 2) **Performance** For inspection of bending crack strength of the body, take two samples at random from one lot and inspect them by 6.2. If both of the two conform to 3.1, the lot shall be accepted. If both fail, the lot shall be rejected. If one of them fails, take four further samples from the lot. If all the four conform, the lot shall be accepted, excluding the first nonconforming product. Even one of them fails, the lot shall be rejected.

For inspection of the bending breaking strength of a body, inspect one of the two samples used for inspection of the bending crack strength of a body by 6.2. If both of the two conform to the provision of 3.1, the lot shall be accepted. If they fail, take two further samples from the lot. If both of the two conform to the provision, the lot shall be accepted, excluding the first nonconforming product. If even one of them fails, the lot shall be rejected. Moreover, PC steel and bar arrangement shall be inspected as follows. Inspect the reinforcement which was assembled before placing of concrete, or the PC piles which were subjected to the breaking strength inspection. If they conform to the provision of clause 5, the lot shall be accepted.

- 3) **Shape and dimension** For inspection of shape and dimension, take samples at random from one lot of PC piles. If they conform to the provision of clause 4, the lot shall be accepted. Even one sample fails in this inspection. The lot shall be subjected to a 100 % inspection. If it conforms to the provision, it shall be accepted.

b) Delivery inspection

- 1) **Appearance** The appearance shall be inspected like a).

When adopting a sampling inspection, take two samples at random. If they conform to the provision of 5.1 of JIS A 5372, they shall be accepted. Even one sample fails in this inspection, the lot shall be subjected to a 100 % inspection. If it conforms to the provision, it shall be accepted.

- 2) **Shape and dimension** The shape and dimension shall be inspected like a).

9 Marking The marking on PC pile is based on JIS A 5361 and JIS A 5373.

In addition, the pile manufactured by the centrifugal compaction shall be marked with PHC.

Recommended specification 5-1 table 5 Mass of PC pile

External diameter mm	Mass (t)										
	Length (m)										
	5m	6 m	7 m	8 m	9 m	10 m	11 m	12 m	13 m	14 m	15 m
300	0.588	0.705	0.823	0.940	1.058	1.176	1.293	1.411	1.528	1.646	1.763
350	0.710	0.852	0.994	1.136	1.278	1.421	1.563	1.705	1.847	1.989	2.131
400	0.889	1.067	1.244	1.422	1.600	1.778	1.955	2.133	2.311	2.489	2.667
450	1.086	1.303	1.520	1.737	1.954	2.172	2.389	2.606	2.823	3.040	3.257
500	1.372	1.646	1.920	2.194	2.469	2.743	3.017	3.292	3.566	3.840	4.115
600	1.874	2.248	2.623	2.998	3.373	3.747	4.122	4.497	4.871	5.246	5.621
700	2.449	2.939	3.429	3.919	4.409	4.898	5.388	5.878	6.368	6.858	7.348
800	3.098	3.718	4.338	4.957	5.577	6.196	6.816	7.436	8.055	8.675	9.295
900	3.821	4.585	5.349	6.113	6.877	7.642	8.406	9.170	9.934	10.698	11.462
1 000	4.617	5.540	6.463	7.387	8.310	9.233	10.157	11.080	12.004	12.927	13.850
1 100	5.486	6.583	7.681	8.778	9.875	10.972	12.070	13.167	14.264	15.361	16.459
1 200	6.429	7.715	9.001	10.287	11.572	12.858	14.144	15.430	16.716	18.002	19.287

Note(1) : For ease of handling, the mass was calculated as follows. The bulk density of reinforced concrete was assumed to be 2.60 t/m³. π was approximated to be 3.14. Then, the following formula was used to calculate the mass to three places of decimals according to JIS Z 8401.

$$m = \omega \pi L (D - t)$$

Where, m : Mass of PC pile (t)
 ω : Bulk density of reinforced concrete (t/m³)
 t : Thickness (m)
 L : Length (m)
 D : External diameter (m)

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Errata will be provided upon request, please contact:
Standardization Promotion Department, Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN
TEL. 03-3583-8002 FAX. 03-3583-0462

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