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(JPCC/JSA)

**Precast reinforced concrete  
products**

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## Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Precast Concrete Standard Committee (JPCC)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS A 5372:2004** is replaced with this Standard.

However, **JIS A 5372:2004** may be applied in the JIS mark certification based on the relevant provisions of Article 19 Clause 1, etc. of the Industrial Standardization Law until 22nd September, 2010.

This **JIS** document is protected by the Copyright Law.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

# Precast reinforced concrete products

## 1 Scope

This Japanese Industrial Standard specifies the precast reinforced concrete products (hereafter referred to as “RC products”). However, this Standard shall not be applied to individual concrete products for buildings and the tactile ground surface indicators for blind persons which are specified in separate Japanese Industrial Standards.

This Standard shall not be applied to products which use the reinforcing steel, etc. for the purpose of securing safety in construction without intending to use the reinforced concrete structure.

The comparison table between previous and current editions of this Standard on technically significant revisions is listed in Annex H.

## 2 Normative references

The following standards contain provisions which, through reference in this text, 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 1107 *Method of sampling and testing for compressive strength of drilled cores of concrete*

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

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

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 7505-1 *Aneroid pressure gauges—Part 1: Bourdon tube pressure gauges*

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

JIS Z 8401 *Guide to the rounding of numbers*

## 3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in **JIS A 0203** and the following terms and definitions apply.

### 3.1 Group I

RC 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 Annexes

### 3.2 Group II

RC 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

RC products shall be classified as specified in table 1 by the application. Products shall be classified into Group I and Group II according to the determination method of performance and specifications.

**Table 1 Classification of RC products**

| Classification                                                                                                                                           | Applicable clause in Annex                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Piles                                                                                                                                                    | See <b>A.2.</b>                                                                  |
| Retaining walls                                                                                                                                          | See <b>B.2.</b>                                                                  |
| Covered conduits                                                                                                                                         | See <b>C.2.</b>                                                                  |
| Manholes                                                                                                                                                 | See <b>D.2.</b>                                                                  |
| Surface-drainage ditches                                                                                                                                 | See <b>E.2.</b>                                                                  |
| Drainage canals                                                                                                                                          | See <b>F.2.</b>                                                                  |
| Utility conduits                                                                                                                                         | See <b>G.2.</b>                                                                  |
| Other products<br>Example 1 Bridges<br>Example 2 Water storage facilities<br>Example 3 Disaster prevention facilities<br>Example 4 Sowed concrete blocks | Shall be subjected to the agreement between the parties concerned with delivery. |
| NOTE : Group I is listed in the recommended specifications of Annexes; however, Group II has no recommended specifications.                              |                                                                                  |

## 5 Quality

### 5.1 Appearance

The appearance shall be tested as specified in **9.1** and it shall be free from any flaw, crack, chip, camber, torsion (in the case of a board-like product), etc. which are detrimental practically. Moreover, the water-contact surface of RC products for water-channel shall be as smooth as practically acceptable.

### 5.2 Performance

The performance shall conform to the provisions of table 2 when tested as specified in clause **9**.

**Table 2 Performance of RC products**

| Classification                                                                                                                                           | Applicable clause in Annex                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Piles                                                                                                                                                    | See <b>A.3.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Retaining walls                                                                                                                                          | See <b>B.3.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Covered conduits                                                                                                                                         | See <b>C.3.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Manholes                                                                                                                                                 | See <b>D.3.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Surface-drainage ditches                                                                                                                                 | See <b>E.3.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Drainage canals                                                                                                                                          | See <b>F.3.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Utility conduits                                                                                                                                         | See <b>G.3.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Other products<br>Example 1 Bridges<br>Example 2 Water storage facilities<br>Example 3 Disaster prevention facilities<br>Example 4 Sowed concrete blocks | <p>a) <b>Performance</b> Specific items of performance shall be selected and designated subjected to the agreement between the parties concerned with delivery as specified in <b>JIS A 5362</b>.</p> <p>When performance is clearly correlated with product specifications (dimensions, materials, constructions, etc.), the agreement may be substituted by designation of product specifications indicated in <b>b</b>).</p> <p>b) <b>Specification of alternative characteristics</b> The specification of alternative characteristics shall be as follows.</p> <ol style="list-style-type: none"> <li>1) Dimensions</li> <li>2) Compressive strength of concrete</li> <li>3) Bar arrangement</li> </ol> |

## 6 Shape, dimensions and dimensional tolerances

The shape, dimensions and dimensional tolerances shall be as specified in table 3.

**Table 3 Shape, dimensions and dimensional tolerances of RC products**

| Classification                                                                                                                                           | Applicable clause in Annex                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Piles                                                                                                                                                    | See <b>A.4.</b>                                                                  |
| Retaining walls                                                                                                                                          | See <b>B.4.</b>                                                                  |
| Covered conduits                                                                                                                                         | See <b>C.4.</b>                                                                  |
| Manholes                                                                                                                                                 | See <b>D.4.</b>                                                                  |
| Surface-drainage ditches                                                                                                                                 | See <b>E.4.</b>                                                                  |
| Drainage canals                                                                                                                                          | See <b>F.4.</b>                                                                  |
| Utility conduits                                                                                                                                         | See <b>G.4.</b>                                                                  |
| Other products<br>Example 1 Bridges<br>Example 2 Water storage facilities<br>Example 3 Disaster prevention facilities<br>Example 4 Sowed concrete blocks | Shall be subjected to the agreement between the parties concerned with delivery. |

## 7 Bar arrangement and tolerances of bar arrangement

The bar arrangement and its tolerances shall be measured as specified in 9.3, and they shall conform to the provisions of the following a) and b).

- a) **Bar arrangement** The bar arrangement (the minimum cover of reinforcing bar is included) shall be as specified in table 4. However, the bar arrangement other than that specified in table 4 may be adopted as far as it does not compromise the performance of RC products (including provisions of 5.2) subjected to the agreement between the parties concerned with delivery. Manufacturers shall prepare the bar arrangement drawing for each product and shall present it to purchasers upon request.

**Table 4 Bar arrangement of RC products**

| Classification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Applicable clause in Annex                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| Piles                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | See A.5.                                                   |
| Retaining walls                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | See B.5.                                                   |
| Covered conduits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | See C.5.                                                   |
| Manholes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | See D.5.                                                   |
| Surface-drainage ditches                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | See E.5.                                                   |
| Drainage canals                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | See F.5.                                                   |
| Utility conduits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | See G.5.                                                   |
| Other products<br>Example 1 Bridges<br>Example 2 Water storage facilities<br>Example 3 Disaster prevention facilities<br>Example 4 Sowed concrete blocks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Shall be subjected to the designation of the manufacturer. |
| <p>NOTE : General precautions for designing bar arrangement should preferably be as follows.</p> <ul style="list-style-type: none"> <li>— The minimum clearance of reinforcing bars is 5/4 of the maximum dimension of coarse aggregate or more.</li> <li>— The necessary cross section of reinforcing bar is determined from structural calculation or structural details, and a combination of diameter and number of reinforcing bars that can satisfy the cross section is more than one. The diameter and number of reinforcing bars shall be selected and arranged in consideration of thickness of members of formwork and the maximum dimensions of coarse aggregate. They shall also be selected to ensure complete adhesion between reinforcing bar and concrete and smeared crack heterogeneity index.</li> </ul> |                                                            |

- b) **Tolerances on bar arrangement** The tolerances <sup>1)</sup> on bar arrangement shall be specified, within the range where the dynamic characteristics and durability of members of formwork satisfy the predetermined performance, for each class of products, by manufacturers.

Note <sup>1)</sup> The limits of deviation between the position of reinforcing bar indicated on the bar arrangement drawing and the position of reinforcing bar of products.

## 8 Material and production method

The material used for RC products and the production method shall be as specified in **JIS A 5364**.

## 9 Test methods

### 9.1 Appearance test

The appearance test shall be conducted by a visual observation to check for any flaw, crack, chip, camber, torsion (in the case of a board-like product), etc. which are detrimental practically.

### 9.2 Performance test

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

**Table 5 Performance test method of RC products**

| Classification                                                                                                                                           | Applicable clause in Annex                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Piles                                                                                                                                                    | See <b>A.6</b> .                                                                 |
| Retaining walls                                                                                                                                          | See <b>B.6</b> .                                                                 |
| Covered conduits                                                                                                                                         | See <b>C.6</b> .                                                                 |
| Manholes                                                                                                                                                 | See <b>D.6</b> .                                                                 |
| Surface-drainage ditches                                                                                                                                 | See <b>E.6</b> .                                                                 |
| Drainage canals                                                                                                                                          | See <b>F.6</b> .                                                                 |
| Utility conduits                                                                                                                                         | See <b>G.6</b> .                                                                 |
| Other products<br>Example 1 Bridges<br>Example 2 Water storage facilities<br>Example 3 Disaster prevention facilities<br>Example 4 Sowed concrete blocks | Shall be subjected to the agreement between the parties concerned with delivery. |

### 9.3 Measurement of bar arrangement

Measurement of bar arrangement shall be conducted about the diameter, number and minimum cover of reinforcing bars. The method shall be either of the following.

- Method by non-destructive test** The measurement by the non-destructive test shall use the electromagnetic induction method, the radar method, etc. According to the designated measurement manual, measurement shall be made on the diameter, number, and the minimum cover of reinforcing bars.
- Method by destructive sample** The measurement by the destructive sample shall be conducted after finishing performance tests, such as bending strength. The concrete part of the sample shall be chipped; reinforcing bar shall be exposed; and measurement shall be made on the diameter, number, and the minimum cover of reinforcing bars.
- Method by reinforcing bar before placing** If the position of reinforcing bar before and after placing of concrete is not affected by assembly method, fixing

method to a formwork, and securing method of cover of reinforcing bar, then this position can be regarded as the position of finished product by measuring the diameter, number, and the minimum cover of reinforcing bars before placing concrete.

## 10 Inspections

### 10.1 Inspection items

The inspection items of the final inspection conducted by the manufacturer and the delivery inspection conducted for confirmation at the time of acceptance shall be as follows.

- a) **Final inspection items** The final inspection items shall be as follows.
- 1) Appearance
  - 2) Performance
  - 3) Shape and dimensions
- b) **Delivery inspection items** The delivery inspection items shall be as follows. However, the delivery inspection may be omitted subjected to the agreement between the parties concerned with delivery.
- 1) Appearance
  - 2) Shape and dimensions

### 10.2 Inspection method

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

**Table 6 Inspection method of RC products**

| Classification                                                                                                                                           | Applicable clause in Annex                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Piles                                                                                                                                                    | See <b>A.8</b> .                                                                 |
| Retaining walls                                                                                                                                          | See <b>B.8</b> .                                                                 |
| Covered conduits                                                                                                                                         | See <b>C.8</b> .                                                                 |
| Manholes                                                                                                                                                 | See <b>D.8</b> .                                                                 |
| Surface-drainage ditches                                                                                                                                 | See <b>E.8</b> .                                                                 |
| Drainage canals                                                                                                                                          | See <b>F.8</b> .                                                                 |
| Utility conduits                                                                                                                                         | See <b>G.8</b> .                                                                 |
| Other products<br>Example 1 Bridges<br>Example 2 Water storage facilities<br>Example 3 Disaster prevention facilities<br>Example 4 Sowed concrete blocks | Shall be subjected 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

For RC products, items specified in **JIS A 5361** shall be marked. If the marking is particularly specified in Annex of this Standard, Annex shall prevail. For the Group II products, the following items shall be marked on products.

- a) Characters “Group II”
- b) Classification (nominal designation determined by the manufacturer) or its abbreviation
- c) Other necessary item or its abbreviation

## 13 Report

The manufacturer shall present the report about the appearance, performance, shape, dimensions, etc., when requested by the purchaser.

## **Annex A (normative)**

### **Piles**

#### **A.1 Outline**

This Annex specifies Group I and Group II of piles which are used mainly for the foundations among the RC products specified in this Standard.

#### **A.2 Classification**

The classification of piles shall be as specified in table A.1.

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

**Table A.1 Classification of piles**

| Major division | Minor division                          |
|----------------|-----------------------------------------|
| Piles          | Reinforced concrete pile (RC pile)      |
|                | Steel concrete composite pile (SC pile) |
|                | Others                                  |

**Table A.2 Classification of Group I of piles**

| Classification                             | Division by<br>outside diameter<br>(mm) | Division by load           | Reinforcing bar ratio               | Detail                                |
|--------------------------------------------|-----------------------------------------|----------------------------|-------------------------------------|---------------------------------------|
| Reinforced<br>concrete piles<br>(RC piles) | 200 to 600                              | Class 1: vertical force    | Class 1: not to be<br>distinguished | See recommended<br>specification A-1. |
|                                            | 300 to 600                              | Class 2: bending<br>moment | Class 2: to be<br>distinguished     |                                       |

#### **A.3 Performance**

##### **A.3.1 Performance of body of piles**

The performance of body of piles shall conform to the provisions of table A.3.

In addition, the performance items of Group II shall be subjected to the agreement between the parties concerned with delivery.

**Table A.3 Performance of body of piles**

| Performance item                                                                                                                                                                                                                                                                                         | Performance                                                                                                                                                                                | Performance check method               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| Service stage performance                                                                                                                                                                                                                                                                                | Shall be safe to be subjected to the regular load assumed at the time of use, and crack width (for the SC pile, strain at upper and bottom ends) shall be less than the permissible value. | See design document or <b>A.6</b> .    |
| End stage performance <sup>a)</sup>                                                                                                                                                                                                                                                                      | Shall not break due to the load assumed at the time of end stage.                                                                                                                          | See design document or <b>A.6</b> .    |
| Durability <sup>b)</sup>                                                                                                                                                                                                                                                                                 | Durability shall be secured against deterioration assumed.                                                                                                                                 | See design document or actual results. |
| Workability                                                                                                                                                                                                                                                                                              | Workability for transportation, installation, assembly, etc. shall be secured.                                                                                                             | See design document or actual results. |
| Notes <sup>a)</sup> Confirmation of the end stage performance shall be made when requested by the purchaser.<br><sup>b)</sup> Durability may be confirmed by the actual results of such similar products as are equivalent in terms of water-cement ratio and/or air content, and reinforcing bar cover. |                                                                                                                                                                                            |                                        |

**A.3.2 Performance of joint part**

- a) **Bending strength of joint part** The joint part of Class 2 of Group I shall not break when it is subjected to twice the cracking moment of the body.

In addition, the bending strength of joint of Group II shall be subjected to the agreement between the parties concerned with delivery.

- b) **Connectivity (squareness of joint end face)** The joint end face shall be at right angles with the pile axis line within the deviation of 1 mm per 300 mm.

**A.4 Shape, dimensions and dimensional tolerances**

The shape, dimensions and dimensional tolerances of piles shall be as follows. As to Group I, if the design concept is not different, and if the performance (quality) and the performance (quality) check method are the same, the reference dimension may be changed within  $\pm 10\%$  in response to the purchaser's demand, provided that the necessary performance (quality) is satisfied.

- a) **Shape** The shape of piles is shown in figure A.1.

A tip, joint part and head are included in the length of a pile. Attachment after manufacture such as metallic fixture to a tip, if any, is not included in the length of a pile. The tip shall be blocked end, open end or the like, and it may be attached to the upper pile or middle pile to be used as a lower pile.

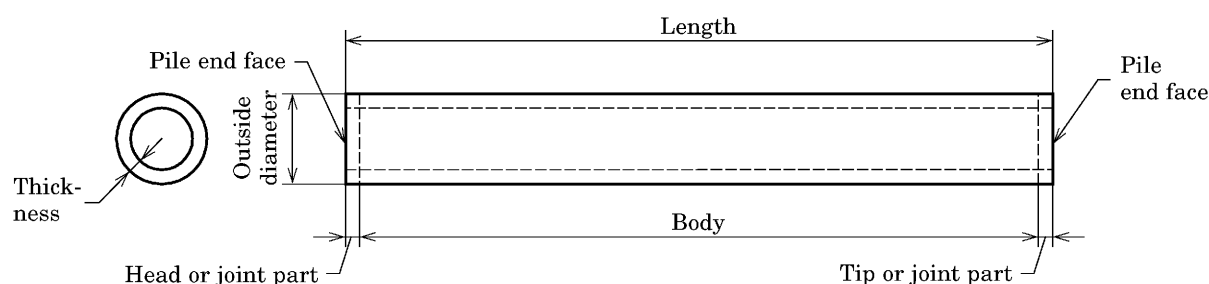


**Figure A.1 Example of shape of pile**

- b) **Dimensions and dimensional tolerances** The dimensions and dimensional tolerances of the products classified into Group I shall be as specified in table A.4. The dimensions and dimensional tolerances of the products classified into Group II shall be subjected to the agreement between the parties concerned with delivery.

**Table A.4 Dimensions and dimensional tolerances of piles**

| Classification                                                                                                                                                                                                                                                                                                                                                          |            | Outside diameter<br>mm | Thickness<br>mm       | Length<br>m        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------|-----------------------|--------------------|
| Reinforced concrete piles                                                                                                                                                                                                                                                                                                                                               | Dimensions | 200 to 600             | 50 to 150             | 3 to 15            |
|                                                                                                                                                                                                                                                                                                                                                                         | Tolerances | +5<br>-2               | + Not specified<br>-0 | ±0.3 (%) of length |
| <p>— The length of a pile shall be designated in increments of 1 m.</p> <p>— The outside diameter of a pile shall be the average of two values measured along the axis perpendicular to a cross section of body.</p> <p>— The thickness of a pile shall be the average of four values measured along the axis perpendicular to a cross section of end face of body.</p> |            |                        |                       |                    |

## A.5 Bar arrangement

The bar arrangement shall be as specified in **JIS A 5364** and a design document. However, subjected to the agreement between the parties concerned with delivery, the bar arrangement other than that of the recommended specification may be adopted in the range in which the product performance (including the provisions of **A.3**) is not compromised.

The bar arrangement of piles that satisfies **A.3** shall be defined for every product by the manufacturer. The SC pile has steel pipes instead of reinforcing bars, which are arranged at the outer shell of a pile. Therefore, it is not necessary to consider the cover and clearance of reinforcing bars. At the time of use, the corrosion allowance of a steel pipe shall be considered, or rust-proofing shall be provided.

## A.6 Test methods

### A.6.1 Compressive strength test

The compressive strength test shall be as specified in **JIS A 1132** and **JIS A 1108**.

### A.6.2 Bending strength test

The bending strength test shall be as specified in **JIS A 5363** and as follows.

The tester shall be of Class 1 or superior specified in **JIS B 7721**, or shall be at least equivalent in allowance thereto.

- a) The bending strength of body shall be tested as shown in figure A.2. The length of 3/5 of pile length ( $L$ ) shall be supported as a span ( $B$ ), the force ( $F$ ) shall be applied at the centre of the span, and the loading force shall be calculated from the bending moment according to the following formula.

If there is a possibility that a local fracture is likely to occur at the loading point or the fulcrum before the bending fracture occurs on a pile, countermeasures shall be taken.

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

where,  $F$  : force (kN)

$M$  : bending moment (kN · m)

$m$  : mass of a pile (t)

$g$  : standard acceleration of gravity (9.81 m/s<sup>2</sup>)

$L$  : length of a pile (m)

$A$  : bending span 0.6 m (in the case of  $L = 3$  m and 4 m)  
bending span 1.0 m (in the case of  $L = 5$  m or longer)

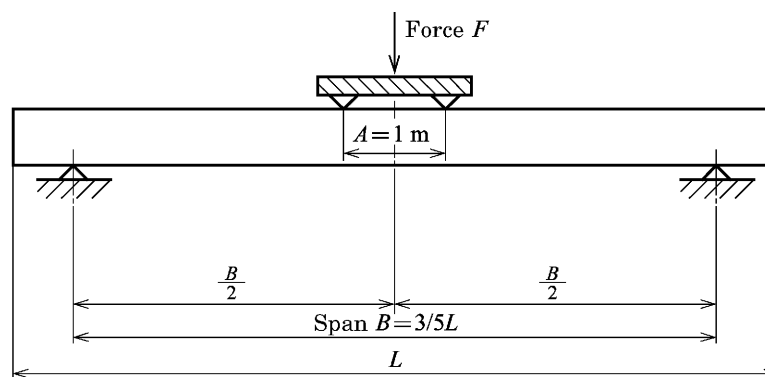


**Figure A.2 Loading method of bending strength test**

In addition, for the SC pile, the length of 9/10 of pile length ( $L$ ) shall be supported as a span ( $B$ ), and  $A = 1$  m shall be set as a bending span. In this case, the loading force shall be calculated according to the following formula by ignoring the bending moment due to its own mass.

$$F = \frac{40M}{9L - 10}$$

- b) The pile of Class 2 of Group I shall be confirmed that it does not fracture when the force ( $F$ ) equivalent to twice the cracking moment is applied.

In addition, the bending strength of piles of Group II shall be subjected to the agreement between the parties concerned with delivery.

- c) The bending strength of the joint part shall be tested according to the following procedures of **a)** and **b)** by putting the joint line to the centre of span.

#### **A.6.3 Method to measure squareness of joint end face**

The squareness of joint end face shall be obtained by using a right-angle gauge, setting it in alignment with the axis line of pile outside diameter, and measuring the amount of gradients in respect to the pile outside diameter.

### **A.7 Quality of concrete**

#### **A.7.1 Material and production method**

The material for concrete and the production method shall be as specified in **JIS A 5364**.

#### **A.7.2 Compressive strength**

The compressive strength of concrete shall be verified by the compressive strength of the sample which has been processed by the same curing as the product or the compressive strength which has been controlled properly. When the predetermined material aging is finished, the compressive strength shall be 40 N/mm<sup>2</sup> or more.

In addition, products of Group II shall be subjected to the agreement between the parties concerned with delivery, and Annex A of **JIS A 5364** may be referred to.

### **A.8 Inspections**

Inspections shall be as specified in **JIS A 5365** and the following.

- a) **Final inspection** The final inspection of piles shall be conducted for the appearance, performance, shape and dimensions, and shall be as follows.
- 1) **Appearance** For the appearance, it shall be a 100 % inspection or a sampling inspection in consideration of the characteristics of product, production method, production quantity, etc.
  - 2) **Performance, shape and dimensions** For the performance, shape and dimensions, the inspection shall be a sampling inspection.  
  
When the performance is inspected by a sample as alternative characteristics, the correlation between the sample and the product shall be established.
  - 3) **Size of inspection lot** The size of inspection lot shall be determined by the manufacturer in consideration of the characteristics of product, manufacturing method, production quantity, production period, ordered quantity, etc.  
  
Any product in the inspection lot shall have the same characteristics, and shall be manufactured using the same materials, concrete mix proportion and manufacturing process, etc.
- b) **Delivery inspection** The delivery inspection of piles shall be conducted for the appearance, shape and dimensions. The size of inspection lot and the sampling method shall be subjected to the agreement between the parties concerned with delivery, and shall be specified by the purchaser. The delivery inspection may be omitted subjected to the agreement between the parties concerned with delivery.

### A.9 Marking

The marking items on piles shall be the following as specified in **JIS A 5361**.

- a) Classification or its abbreviation
- b) Manufacturer's name or its abbreviation
- c) Date of manufacture or its abbreviation
- d) When recycle material is used, the statement to that effect

### A.10 Others (recommended specification)

Group I of piles is shown in table A.5.

**Table A.5 Recommended specification**

| Structure-specific product group standard |               | Recommended specification                                  |
|-------------------------------------------|---------------|------------------------------------------------------------|
| <b>JIS A 5372</b>                         | Annex A Piles | Recommended specification A-1<br>Reinforced concrete piles |

## Recommended specification A-1

### Reinforced concrete piles

#### A-1.1 Outline

This recommended specification describes the reinforced concrete piles in Group I of piles (hereafter referred to as “RC piles”) in Annex A.

#### A-1.2 Classification

RC piles are classified by an outside diameter for Class 1, and also classified into Class A, Class B, and Class C (hereafter referred to as “A”, “B”, and “C,” respectively) by an outside diameter and reinforcing bar ratio of longitudinal reinforcing bar for Class 2. The division shall be as shown in recommended specification A-1 table 1.

In addition, the reinforcing bar ratios of Class 2 RC piles, A, B, and C shall be under 3.0 %, 3.0 % or over to and excluding 5.0 %, and 5.0 % or over, respectively.

**Recommended specification A-1 Table 1 Classification of RC piles**

Unit: mm

| Classification | Division of cracking moment | Outside diameter |     |     |     |     |     |     |     |
|----------------|-----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|
| 1              | —                           | 200              | 250 | 300 | 350 | 400 | 450 | 500 | 600 |
| 2              | Class A                     | —                | —   | 300 | 350 | 400 | 450 | 500 | 600 |
|                | Class B                     | —                | —   | 300 | 350 | 400 | 450 | 500 | 600 |
|                | Class C                     | —                | —   | 300 | 350 | 400 | 450 | 500 | 600 |

#### A-1.3 Performance

##### A-1.3.1 Bending strength

The bending strength shall be as follows.

- Body of pile** The body of RC pile shall be subjected to the bending strength test as specified in **A-1.6**. When it receives the cracking moment specified in recommended specification A-1 tables 2 and 3, it shall not produce the crack of 0.2 mm in width or wider. Moreover, Class 2 shall not break when it is subjected to twice the cracking moment specified in recommended specification A-1 table 3.
- Pile joint part** The pile joint part of Class 2 shall be subjected to the bending strength test as specified in **A-1.6**. It shall not break when it is subjected to twice the cracking moment specified in recommended specification A-1 table 3.

##### A-1.3.2 Connectability (squareness of joint part)

The joint end face shall be at right angles with the pile axis line within the deviation of 1 mm per 300 mm.

**Recommended specification A-1 Table 2 Cracking moment (Class 1)**

| Outside diameter<br>mm                                                                                              | Cracking moment kN·m |     |     |      |      |      |      |      |      |      |      |      |      |
|---------------------------------------------------------------------------------------------------------------------|----------------------|-----|-----|------|------|------|------|------|------|------|------|------|------|
|                                                                                                                     | Length m             |     |     |      |      |      |      |      |      |      |      |      |      |
|                                                                                                                     | 3                    | 4   | 5   | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   | 15   |
| 200                                                                                                                 | 2.9                  | 2.9 |     |      |      |      |      |      |      |      |      |      |      |
| 250                                                                                                                 |                      | 5.9 | 5.9 | 5.9  | 7.8  |      |      |      |      |      |      |      |      |
| 300                                                                                                                 |                      | 9.8 | 9.8 | 9.8  | 9.8  | 9.8  | 9.8  | 12.8 | 15.7 | 18.6 |      |      |      |
| 350                                                                                                                 |                      |     |     | 10.8 | 10.8 | 10.8 | 10.8 | 16.7 | 20.6 | 24.5 | 28.4 | 32.4 |      |
| 400                                                                                                                 |                      |     |     |      | 15.7 | 15.7 | 15.7 | 20.6 | 25.5 | 30.4 | 35.3 | 41.2 | 47.1 |
| 450                                                                                                                 |                      |     |     |      |      | 20.6 | 20.6 | 25.5 | 30.4 | 36.3 | 43.2 | 50.0 | 56.9 |
| 500                                                                                                                 |                      |     |     |      |      |      | 27.5 | 32.4 | 40.2 | 44.1 | 51.0 | 59.8 | 68.7 |
| 600                                                                                                                 |                      |     |     |      |      |      | 47.1 | 53.0 | 61.8 |      |      |      |      |
| NOTE : An example of the longitudinal reinforcing bar of Class 1 is shown in recommended specification A-1 table 6. |                      |     |     |      |      |      |      |      |      |      |      |      |      |

**Recommended specification A-1 Table 3 Cracking moment (Class 2)**

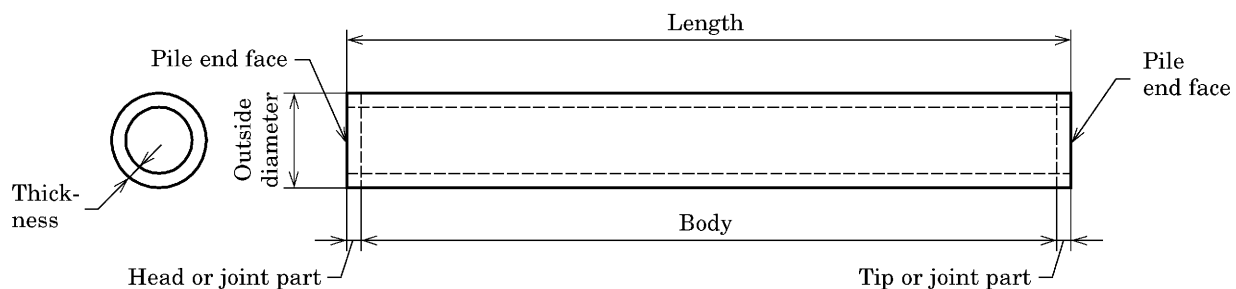
| Outside diameter<br>mm                                                                                              | Classification | Cracking moment<br>kN·m |
|---------------------------------------------------------------------------------------------------------------------|----------------|-------------------------|
| 300                                                                                                                 | A              | 24.5                    |
|                                                                                                                     | B              | 34.3                    |
|                                                                                                                     | C              | 39.2                    |
| 350                                                                                                                 | A              | 34.3                    |
|                                                                                                                     | B              | 49.1                    |
|                                                                                                                     | C              | 63.7                    |
| 400                                                                                                                 | A              | 53.9                    |
|                                                                                                                     | B              | 73.5                    |
|                                                                                                                     | C              | 88.2                    |
| 450                                                                                                                 | A              | 73.5                    |
|                                                                                                                     | B              | 102.9                   |
|                                                                                                                     | C              | 117.6                   |
| 500                                                                                                                 | A              | 88.2                    |
|                                                                                                                     | B              | 122.5                   |
|                                                                                                                     | C              | 166.6                   |
| 600                                                                                                                 | A              | 98.1                    |
|                                                                                                                     | B              | 176.4                   |
|                                                                                                                     | C              | 264.6                   |
| NOTE : An example of the longitudinal reinforcing bar of Class 2 is shown in recommended specification A-1 table 7. |                |                         |

#### A-1.4 Shape, dimensions and dimensional tolerances

The shape, dimensions and dimensional tolerances shall be as follows.

- a) **Shape** The shape of RC pile shall be a hollow-cylinder body as shown in recommended specification A-1 figure 1. As necessary, the body shall be provided with a tip, joint parts, or a head properly.

A tip, joint part and head are included in the length of a pile. Attachment after manufacture such as metallic fixture to a tip, if any, is not included in the length of a pile. The tip shall be blocked end, open end or the like. A tip may be attached to the upper pile or middle pile to be used as a lower pile.



**Recommended specification A-1 Figure 1 Shape of RC pile**

- b) **Dimensions and dimensional tolerances** The dimensions and dimensional tolerances of RC pile shall be as specified in recommended specification A-1 tables 4 and 5.

**Recommended specification A-1 Table 4  
Dimensions and dimensional tolerances (Class 1)**

| Classification         | Outside diameter<br>mm | Thickness<br>mm        | Length m         |   |   |   |   |   |   |    |    |    |    |    |    |
|------------------------|------------------------|------------------------|------------------|---|---|---|---|---|---|----|----|----|----|----|----|
|                        |                        |                        | 3                | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| Class 1                | 200                    | 50                     | ○                | ○ |   |   |   |   |   |    |    |    |    |    |    |
|                        | 250                    | 50                     |                  | ○ | ○ | ○ | ○ |   |   |    |    |    |    |    |    |
|                        | 300                    | 60                     |                  | ○ | ○ | ○ | ○ | ○ | ○ | ○  | ○  | ○  |    |    |    |
|                        | 350                    | 65                     |                  |   |   | ○ | ○ | ○ | ○ | ○  | ○  | ○  | ○  | ○  |    |
|                        | 400                    | 70                     |                  |   |   |   | ○ | ○ | ○ | ○  | ○  | ○  | ○  | ○  | ○  |
|                        | 450                    | 75                     |                  |   |   |   |   | ○ | ○ | ○  | ○  | ○  | ○  | ○  | ○  |
|                        | 500                    | 80                     |                  |   |   |   |   |   | ○ | ○  | ○  | ○  | ○  | ○  | ○  |
|                        | 600                    | 90                     |                  |   |   |   |   |   | ○ | ○  | ○  |    |    |    |    |
| Dimensional tolerances | +5<br>-2               | + Not specified<br>- 0 | ±0.3 % of length |   |   |   |   |   |   |    |    |    |    |    |    |

**Recommended specification A-1 Table 5**  
**Dimensions and dimensional tolerances (Class 2)**

| Classification            | Outside<br>diameter<br>mm | Thickness<br>mm      | Class       | Length m         |   |   |    |    |    |    |    |    |  |
|---------------------------|---------------------------|----------------------|-------------|------------------|---|---|----|----|----|----|----|----|--|
|                           |                           |                      |             | 7                | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |  |
| Class 2                   | 300                       | 60                   | A<br>B<br>C | ○                | ○ | ○ | ○  | ○  | ○  |    |    |    |  |
|                           | 350                       | 65                   | A<br>B<br>C | ○                | ○ | ○ | ○  | ○  | ○  | ○  | ○  |    |  |
|                           | 400                       | 70                   | A<br>B<br>C | ○                | ○ | ○ | ○  | ○  | ○  | ○  | ○  |    |  |
|                           | 450                       | 75                   | A<br>B<br>C |                  | ○ | ○ | ○  | ○  | ○  | ○  | ○  | ○  |  |
|                           | 500                       | 80                   | A<br>B<br>C |                  |   | ○ | ○  | ○  | ○  | ○  | ○  | ○  |  |
|                           | 600                       | 90                   | A<br>B<br>C |                  |   | ○ | ○  | ○  |    |    |    |    |  |
| Dimensional<br>tolerances | +5<br>-2                  | +Not specified<br>-0 | —           | ±0.3 % of length |   |   |    |    |    |    |    |    |  |

### A-1.5 Bar arrangement

The bar arrangement of RC piles shall be as follows.

- A longitudinal reinforcing bar shall be six or more and the reinforcing bar ratio thereof shall be 0.8 % or more. For each cross section of RC pile, bars shall be arranged uniformly along the circumference of the concentric circle. The clearance of reinforcing bars shall be one or more times the diameter of reinforcing bar, and shall be 4/3 or more of the maximum dimension of coarse aggregate.
- Spiral reinforcing bar shall be arranged on the outside of a longitudinal reinforcing bar. The wire diameter of a spiral reinforcing bar shall be 2.5 mm or more for outside diameter of pile of 200 mm or 250 mm; 3 mm or more for outside diameter of 300 mm to 500 mm; and 4 mm or more for outside diameter of 600 mm.

The pitch shall be 110 mm or less.

The amount of spiral reinforcing bar required to improve the shearing resistance and the transformation performance shall be determined by the parties concerned with delivery.

- The cover of a longitudinal reinforcing bar and a spiral reinforcing bar shall be 10 mm or more for RC pile of outside diameter of 200 mm and 15 mm or more for outside diameter of 250 mm to 600 mm.

- d) The edge of a longitudinal reinforcing bar shall be arranged to lie on the same plane which is at right angles to the axis of RC pile. When joints are provided to a longitudinal reinforcing bar, they shall be the joint whose stress transmissibility of reinforcing bar is 100 %. Joints shall not be collected to one cross section.
- e) The reinforcing bar shall be cleared of any rust or oil which is detrimental to adhesion of concrete, and assembled to be secured at the right position.

### **A-1.6 Strength test**

#### **A-1.6.1 Compressive strength test**

The compressive strength test of concrete shall be as specified in **A.6.1**.

#### **A-1.6.2 Bending strength test**

The bending strength test of concrete shall be as specified in **A.6.2**.

The mass of the body of RC pile used for the calculation of loading force may be as specified in recommended specification A-1 tables 6 and 7.

The tester shall be of Class 1 or superior specified in **JIS B 7721**, or shall be at least equivalent in allowance thereto.

#### **A-1.6.3 Measurement test of squareness of joint end face**

The measurement test of the squareness of a joint end face shall be as specified in **A.6.3**.

**Recommended specification A-1 Table 6 Mass of Class 1 of RC pile**

| Out-side<br>diameter<br>mm | Mass <sup>a)</sup> t |       |       |       |       |       |       |       |       |       |       |       |       |                                                                          | Example of<br>longitudinal<br>reinforcing bar <sup>b)</sup> |  |
|----------------------------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------------------------------------------------------------------------|-------------------------------------------------------------|--|
|                            | Length m             |       |       |       |       |       |       |       |       |       |       |       |       |                                                                          |                                                             |  |
|                            | 3 m                  | 4 m   | 5 m   | 6 m   | 7 m   | 8 m   | 9 m   | 10 m  | 11 m  | 12 m  | 13 m  | 14 m  | 15 m  | Reinforcing cross<br>sectional<br>area A <sub>s</sub><br>mm <sup>2</sup> | Diameter mm<br>×<br>number                                  |  |
| 200                        | 0.184                | 0.245 |       |       |       |       |       |       |       |       |       |       |       | 198                                                                      | 6 × 7                                                       |  |
| 250                        |                      | 0.327 | 0.408 | 0.490 |       |       |       |       |       |       |       |       |       | 255                                                                      | 6 × 9                                                       |  |
|                            |                      |       |       |       | 0.571 |       |       |       |       |       |       |       |       | 283                                                                      | 6 × 10                                                      |  |
| 300                        |                      | 0.470 | 0.588 | 0.705 | 0.823 |       |       |       |       |       |       |       |       | 382                                                                      | 9 × 6                                                       |  |
|                            |                      |       |       |       |       | 0.940 |       |       |       |       |       |       |       | 509                                                                      | 9 × 8                                                       |  |
|                            |                      |       |       |       |       |       | 1.058 |       |       |       |       |       |       | 636                                                                      | 9 × 10                                                      |  |
|                            |                      |       |       |       |       |       |       | 1.176 |       |       |       |       |       | 763                                                                      | 9 × 12                                                      |  |
|                            |                      |       |       |       |       |       |       |       | 1.293 |       |       |       |       | 929                                                                      | 13 × 7                                                      |  |
|                            |                      |       |       |       |       |       |       |       |       | 1.411 |       |       |       | 1 194                                                                    | 13 × 9                                                      |  |
| 350                        |                      |       |       | 0.907 | 1.059 | 1.210 |       |       |       |       |       |       |       | 509                                                                      | 9 × 8                                                       |  |
|                            |                      |       |       |       |       |       | 1.361 |       |       |       |       |       |       | 700                                                                      | 9 × 11                                                      |  |
|                            |                      |       |       |       |       |       |       | 1.512 |       |       |       |       |       | 827                                                                      | 9 × 13                                                      |  |
|                            |                      |       |       |       |       |       |       |       | 1.664 |       |       |       |       | 1 062                                                                    | 13 × 8                                                      |  |
|                            |                      |       |       |       |       |       |       |       |       | 1.815 |       |       |       | 1 194                                                                    | 13 × 9                                                      |  |
|                            |                      |       |       |       |       |       |       |       |       |       | 1.966 |       |       | 1 592                                                                    | 13 × 12                                                     |  |
| 400                        |                      |       |       |       |       |       |       |       |       |       |       | 2.117 |       | 1 725                                                                    | 13 × 13                                                     |  |
|                            |                      |       |       |       | 1.320 | 1.509 |       |       |       |       |       |       |       | 636                                                                      | 9 × 10                                                      |  |
|                            |                      |       |       |       |       |       | 1.697 |       |       |       |       |       |       | 763                                                                      | 9 × 12                                                      |  |
|                            |                      |       |       |       |       |       |       | 1.886 |       |       |       |       |       | 890                                                                      | 9 × 14                                                      |  |
|                            |                      |       |       |       |       |       |       |       | 2.074 |       |       |       |       | 1 062                                                                    | 13 × 8                                                      |  |
|                            |                      |       |       |       |       |       |       |       |       | 2.263 |       |       |       | 1 327                                                                    | 13 × 10                                                     |  |
| 450                        |                      |       |       |       |       |       |       |       |       |       |       |       |       | 1 592                                                                    | 13 × 12                                                     |  |
|                            |                      |       |       |       |       |       |       |       |       |       |       | 2.452 |       | 1 592                                                                    | 13 × 12                                                     |  |
|                            |                      |       |       |       |       |       |       |       |       |       |       |       | 2.640 | 1 858                                                                    | 13 × 14                                                     |  |
|                            |                      |       |       |       |       |       |       |       |       |       |       |       | 2.829 | 2 123                                                                    | 13 × 16                                                     |  |
|                            |                      |       |       |       |       | 1.837 | 2.067 |       |       |       |       |       |       | 763                                                                      | 9 × 12                                                      |  |
|                            |                      |       |       |       |       |       |       | 2.296 |       |       |       |       |       | 1 062                                                                    | 13 × 8                                                      |  |
| 500                        |                      |       |       |       |       |       |       |       | 2.526 |       |       |       |       | 1 194                                                                    | 13 × 9                                                      |  |
|                            |                      |       |       |       |       |       |       |       |       | 2.755 |       |       |       | 1 460                                                                    | 13 × 11                                                     |  |
|                            |                      |       |       |       |       |       |       |       |       |       | 2.985 |       |       | 1 725                                                                    | 13 × 13                                                     |  |
|                            |                      |       |       |       |       |       |       |       |       |       |       | 3.215 |       | 1 991                                                                    | 13 × 15                                                     |  |
|                            |                      |       |       |       |       |       |       |       |       |       |       |       | 3.444 | 2 256                                                                    | 13 × 17                                                     |  |
|                            |                      |       |       |       |       |       | 2.469 |       |       |       |       |       |       | 890                                                                      | 9 × 14                                                      |  |
| 600                        |                      |       |       |       |       |       |       | 2.743 |       |       |       |       |       | 1 062                                                                    | 13 × 8                                                      |  |
|                            |                      |       |       |       |       |       |       |       | 3.017 |       |       |       |       | 1 327                                                                    | 13 × 10                                                     |  |
|                            |                      |       |       |       |       |       |       |       |       | 3.292 |       |       |       | 1 460                                                                    | 13 × 11                                                     |  |
|                            |                      |       |       |       |       |       |       |       |       |       | 3.566 |       |       | 1 858                                                                    | 13 × 14                                                     |  |
|                            |                      |       |       |       |       |       |       |       |       |       |       | 3.840 |       | 2 123                                                                    | 13 × 16                                                     |  |
|                            |                      |       |       |       |       |       |       |       |       |       |       |       | 4.115 | 2 389                                                                    | 13 × 18                                                     |  |
| 600                        |                      |       |       |       |       |       | 3.373 |       |       |       |       |       |       | 1 194                                                                    | 13 × 9                                                      |  |
|                            |                      |       |       |       |       |       |       | 3.747 |       |       |       |       |       | 1 327                                                                    | 13 × 10                                                     |  |
|                            |                      |       |       |       |       |       |       |       | 4.122 |       |       |       |       | 1 592                                                                    | 13 × 12                                                     |  |

### Recommended specification A-1 Table 6 (concluded)

|       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | <p><sup>a)</sup> For the purpose of convenience, the mass is calculated by the following formula assuming that the unit volume mass of reinforced concrete is 2.60 t/m<sup>3</sup>, and the value of <math>\pi</math> is 3.14. The value of mass is rounded off to the third decimal place as specified in <b>JIS Z 8401</b>.</p> $m = \omega \pi t L (D - t)$ <p>where, <math>m</math> : mass of RC pile (t)<br/> <math>\omega</math> : unit volume mass of reinforced concrete (t/m<sup>3</sup>)<br/> <math>t</math> : thickness (m)<br/> <math>L</math> : length (m), assuming that it is tubular over entire length<br/> <math>D</math> : outside diameter (m)</p> <p><sup>b)</sup> An example of a longitudinal reinforcing bar is calculated from SR235 specified in <b>JIS G 3112</b>. It is indicated for informative purpose only and not to constitute the provisions of this Standard.</p> |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Recommended specification A-1 Table 7 Mass of Class 2 of RC piles

| Out-side diameter mm | Classification | Mass <sup>a)</sup> t |       |       |       |       |       |       |       |       | Example of longitudinal reinforcing bar <sup>b)</sup> |                      |                                                     |
|----------------------|----------------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------------------------------------------------------|----------------------|-----------------------------------------------------|
|                      |                | Length m             |       |       |       |       |       |       |       |       | SD295A                                                |                      | Radius to centre of longitudinal reinforcing bar mm |
|                      |                | 7 m                  | 8 m   | 9 m   | 10 m  | 11 m  | 12 m  | 13 m  | 14 m  | 15 m  | Reinforcing bar cross section $A_s$ mm <sup>2</sup>   | Diameter mm × number |                                                     |
| 300                  | A              | 0.839                | 0.959 | 1.078 | 1.198 | 1.318 | 1.438 |       |       |       | 1 267                                                 | 13 × 10              | 120                                                 |
|                      | B              | 0.867                | 0.991 | 1.115 | 1.239 | 1.363 | 1.487 |       |       |       | 2 027                                                 | 13 × 16              |                                                     |
|                      | C              | 0.895                | 1.023 | 1.151 | 1.279 | 1.407 | 1.535 |       |       |       | 2 780                                                 | 16 × 14              |                                                     |
| 350                  | A              | 1.070                | 1.223 | 1.376 | 1.529 | 1.682 | 1.835 | 1.987 | 2.140 |       | 1 394                                                 | 13 × 11              | 145                                                 |
|                      | B              | 1.099                | 1.256 | 1.413 | 1.569 | 1.726 | 1.883 | 2.040 | 2.197 |       | 2 154                                                 | 13 × 17              |                                                     |
|                      | C              | 1.152                | 1.316 | 1.481 | 1.645 | 1.810 | 1.975 | 2.139 | 2.304 |       | 3 575                                                 | 16 × 18              |                                                     |
| 400                  | A              | 1.336                | 1.527 | 1.717 | 1.908 | 2.099 | 2.290 | 2.481 | 2.672 |       | 1 774                                                 | 13 × 14              | 165                                                 |
|                      | B              | 1.381                | 1.578 | 1.775 | 1.973 | 2.170 | 2.367 | 2.565 | 2.762 |       | 2 979                                                 | 16 × 15              |                                                     |
|                      | C              | 1.433                | 1.638 | 1.842 | 2.047 | 2.252 | 2.457 | 2.661 | 2.866 |       | 4 369                                                 | 16 × 22              |                                                     |
| 450                  | A              |                      | 1.868 | 2.102 | 2.335 | 2.569 | 2.802 | 3.036 | 3.269 | 3.503 | 2 383                                                 | 16 × 12              | 190                                                 |
|                      | B              |                      | 1.919 | 2.159 | 2.399 | 2.639 | 2.879 | 3.119 | 3.359 | 3.599 | 3 575                                                 | 16 × 18              |                                                     |
|                      | C              |                      | 1.970 | 2.217 | 2.463 | 2.709 | 2.955 | 3.202 | 3.448 | 3.694 | 4 766                                                 | 16 × 24              |                                                     |
| 500                  | A              |                      |       | 2.489 | 2.765 | 3.042 | 3.318 | 3.595 | 3.871 | 4.148 | 2 383                                                 | 16 × 12              | 210                                                 |
|                      | B              |                      |       | 2.553 | 2.837 | 3.121 | 3.404 | 3.688 | 3.972 | 4.255 | 3 724                                                 | 19 × 13              |                                                     |
|                      | C              |                      |       | 2.677 | 2.975 | 3.272 | 3.570 | 3.867 | 4.165 | 4.462 | 6 303                                                 | 19 × 22              |                                                     |
| 600                  | A              |                      |       | 3.366 | 3.740 | 4.114 |       |       |       |       | 2 552                                                 | 16 × 13              | 255                                                 |
|                      | B              |                      |       | 3.466 | 3.852 | 4.237 |       |       |       |       | 4 645                                                 | 22 × 12              |                                                     |
|                      | C              |                      |       | 3.616 | 4.017 | 4.419 |       |       |       |       | 7 742                                                 | 22 × 20              |                                                     |

### Recommended specification A-1 Table 7 (concluded)

Notes <sup>a)</sup> The mass is calculated by the following formula assuming that the unit volume mass of reinforced concrete is 2.50 t/m<sup>3</sup>, the value of  $\pi$  is 3.14 and the mass of reinforcing bar is 7.85 t/m<sup>3</sup>. The value of mass is rounded off to the third decimal place as specified in **JIS Z 8401**.

$$m = \{ \omega_1 [\pi t (D - t) - A_s] + \omega_2 A_s \} L$$

where,  $m$  : mass of RC pile (t)

$\omega_1$  : unit volume mass of concrete (t/m<sup>3</sup>)

$\omega_2$  : unit volume mass of reinforcing bar (t/m<sup>3</sup>)

$t$  : thickness (m),

$D$  : outside diameter (m),

$A_s$  : cross sectional area of reinforcing bar (m<sup>2</sup>),

$L$  : Length (m)

<sup>b)</sup> An example of a longitudinal reinforcing bar is calculated from SR235 and SD295A specified in **JIS G 3112**. It is indicated for informative purpose only and not to constitute the provisions of this Standard.

#### A-1.7 Quality of concrete

The compressive strength of concrete shall be as specified in **A.7.2**.

#### A-1.8 Inspections

##### A-1.8.1 Inspection items

The inspection items of RC piles shall be as follows.

a) **Final inspection** The final inspection items shall be as follows.

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

b) **Delivery inspection** The delivery inspection items shall be as follows. However, the delivery inspection may be omitted subjected to the agreement between the parties concerned with delivery.

- 1) Appearance
- 2) Shape and dimensions

##### A-1.8.2 Inspection lot

The size of inspection lot of RC piles shall be decided by the manufacturer for final inspection, and by the purchaser for delivery inspection subjected to the agreement between the parties concerned with delivery by considering characteristics of the product, production method, production quantity, production period, ordered quantity, etc. One inspection lot may consist of 3 000 units or fraction thereof.

##### A-1.8.3 Inspection method

The inspection method of RC piles shall be as follows.

a) **Final inspection** The final inspection method shall be as follows.

- 1) **Appearance** For the inspection of appearance, the lot shall be 100 % inspected by visual observation, and those conform to the provisions of **5.1** shall be accepted.
- 2) **Performance** For the inspection of the cracking strength of the body, two arbitrary RC piles per one lot shall be taken and inspected as specified in **A-1.6.2**. If both of the two conform to **A-1.3.1**, the lot shall be accepted. If neither of the two conforms, the lot shall be rejected. If only one of the two does not conform, the lot shall be re-inspected. In the re-inspection, four more RC piles shall be taken from the lot, and if all the four conform to the provisions, the lot shall be accepted after the first non-conforming product is eliminated. If one or more of them do not conform in the re-inspection, the lot shall be rejected.

The bending fracture strength of the body of Class 2 shall be inspected as follows. One of the first two RC piles for cracking strength inspection shall be inspected as specified in **A-1.6.2**. When it conforms to the provisions of **A-1.3.1**, the lot shall be accepted. If it does not conform, two more RC piles shall be taken from the lot for re-inspection, and if both of them conform to the provisions, the lot shall be accepted after the first non-conforming product is eliminated. If one or more of them do not conform in the re-inspection, the lot shall be rejected.

- 3) **Shape and dimensions** For the inspection of shape and dimensions, arbitrary RC piles per one lot shall be taken. If they conform to **A-1.4**, the lot shall be accepted. If one or more of them do not conform, the lot shall be inspected 100 % of remainder, and accepted when the provisions are conformed.

b) **Delivery inspection** The delivery inspection method shall be as follows.

- 1) **Appearance** The appearance shall be inspected in the same way as a).  
When adopting the sampling inspection, if two arbitrary RC piles are inspected and conformed to the provisions of **5.1**, the lot shall be accepted. If one or more of them do not conform, the lot shall be inspected 100 % of remainder, and accepted when the provisions are conformed.
- 2) **Shape and dimensions** The shape and dimensions shall be inspected in the same way as a).

### **A-1.9 Marking**

The RC piles which conform to all the requirements of this Standard shall be marked as specified in **A.9**.

## Annex B (normative)

### Retaining walls

#### B.1 Outline

This Annex specifies Group I and Group II of retaining walls which are used mainly for revetment and sheathing among the RC products specified in this Standard.

In addition, the reinforced concrete sheet piles made of precast reinforced concrete (hereafter referred to as “sheet pile”) specified in this Annex may apply also to drain-ages.

#### B.2 Classification

The classification of retaining walls shall be as specified in table B.1.

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

**Table B.1 Classification of retaining walls**

| Major division  | Minor division                         |
|-----------------|----------------------------------------|
| Retaining walls | L-shape retaining wall                 |
|                 | Inverted T-shape retaining wall        |
|                 | Buttress retaining wall                |
|                 | PC wall                                |
|                 | Sheet pile                             |
|                 | Built-up retaining wall                |
|                 | Curbed retaining wall                  |
|                 | Reinforced earth wall                  |
|                 | Block for retaining wall and revetment |
|                 | Others                                 |

**Table B.2 Classification of Group I of retaining walls**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                         | Detail                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|------------------------------------|
| Classification                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Classification by shape |                                    |
| Block for retaining wall and revetment                                                                                                                                                                                                                                                                                                                                                                                                                               | Rectangle               | See recommended specification B-1. |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Square                  |                                    |
| Sheet pile                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Flat                    | See recommended specification B-2. |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Channel                 |                                    |
| <div><div>—</div><div>The size of block for retaining wall and revetment (width × height) shall be 0.5 m<sup>2</sup> or more.</div></div> <div><div>—</div><div>The block for retaining wall and revetment shall be that having the larger face while the brace length of 35 cm is left unchanged or that whose brace length is also lengthened. That having a thin-walled structure which requires bar arrangement during the construction is excluded.</div></div> |                         |                                    |

### B.3 Performance

The performance of retaining walls shall conform to the provisions of table B.3.

In addition, the performance items of Group II shall be subjected to the agreement between the parties concerned with delivery.

**Table B.3 Performance of retaining walls**

| Performance item                                                                                                                                                                                                                                                                                         | Performance                                                                                                                             | Performance check method               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| Service stage performance                                                                                                                                                                                                                                                                                | Shall be safe to be subjected to the regular load assumed at the time of use, and crack width shall be less than the permissible value. | See design document or <b>B.6</b> .    |
| End stage performance <sup>a)</sup>                                                                                                                                                                                                                                                                      | Shall not break due to the load assumed at the time of end stage.                                                                       | See design document or <b>B.6</b> .    |
| Durability <sup>b)</sup>                                                                                                                                                                                                                                                                                 | Durability shall be secured against deterioration assumed.                                                                              | See design document or actual results. |
| Workability                                                                                                                                                                                                                                                                                              | Workability for transportation, installation, assembly, etc. shall be secured.                                                          | See design document or actual results. |
| Notes <sup>a)</sup> Confirmation of the end stage performance shall be made when requested by the purchaser.<br><sup>b)</sup> Durability may be confirmed by the actual results of such similar products as are equivalent in terms of water-cement ratio and/or air content, and reinforcing bar cover. |                                                                                                                                         |                                        |

### B.4 Shape, dimensions and dimensional tolerances

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

a) **Shape** The shapes of retaining walls are shown in figure B.1 to figure B.3.

- 1) **Block for retaining wall and revetment** The shape of block for retaining wall and revetment is shown in figure B.1.

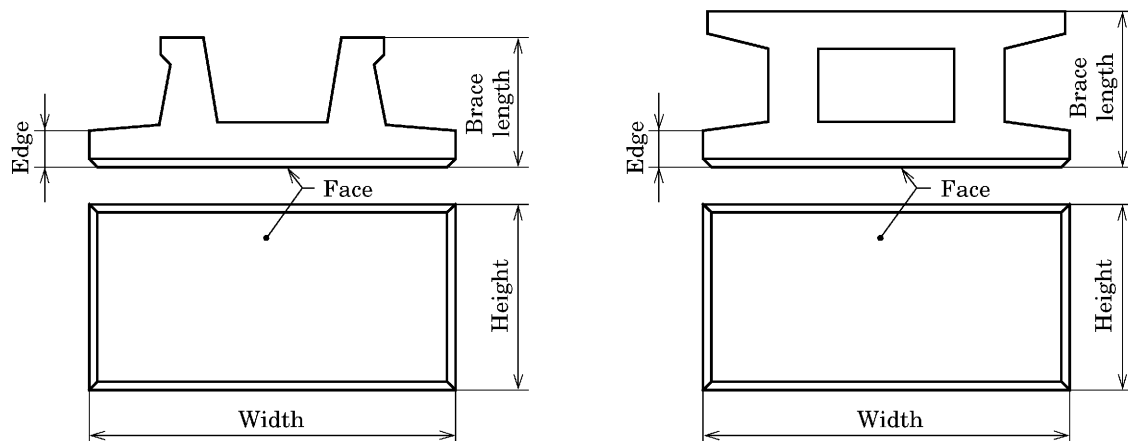


**Figure B.1 Example of shape of block for retaining wall and revetment**

- 2) **Sheet pile** The shapes of sheet pile are shown in figure B.2 and figure B.3.

Unit: mm

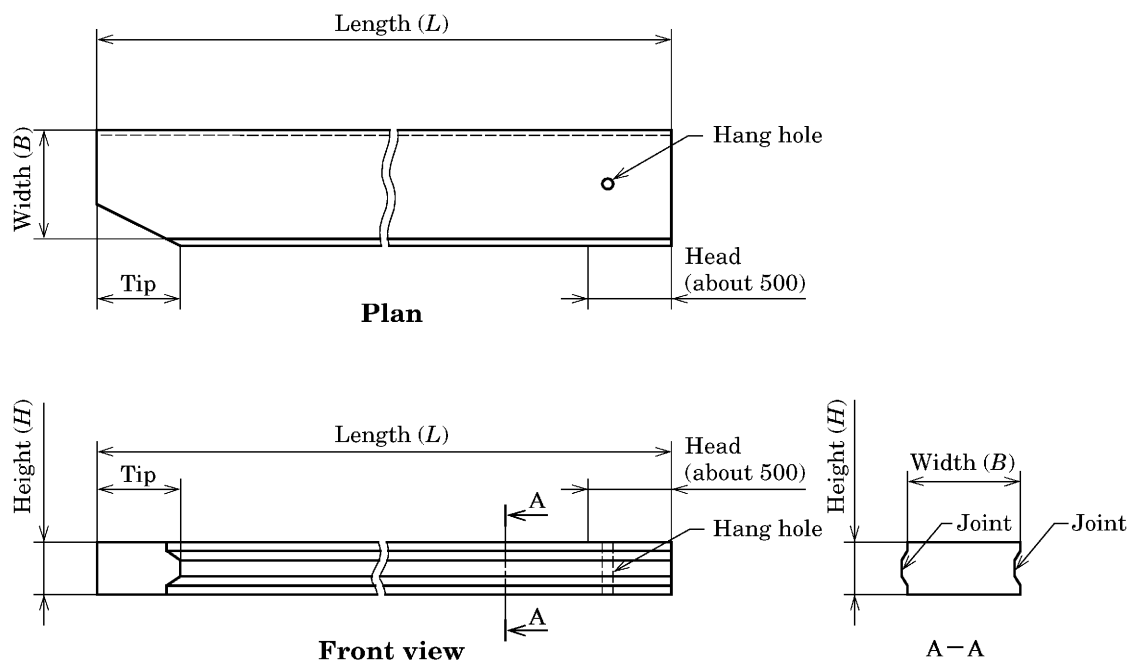


**Figure B.2 Example of shape of sheet pile (flat)**

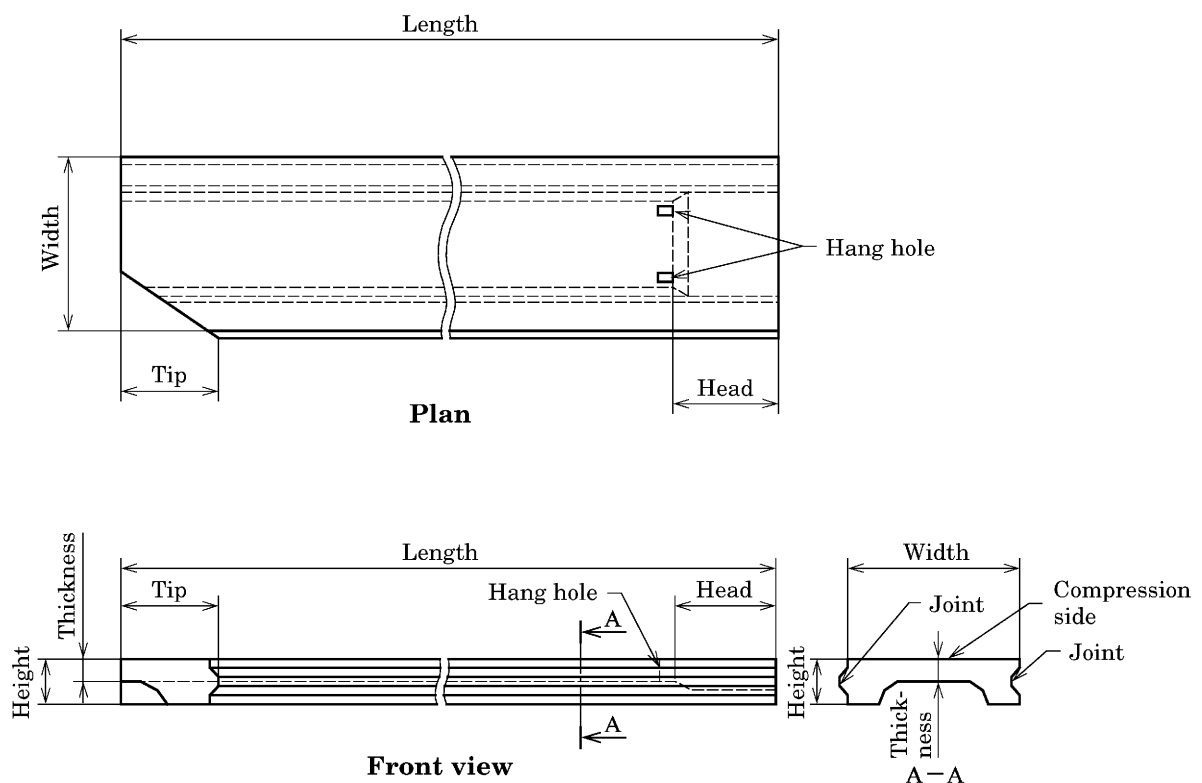


**Figure B.3 Example of shape of sheet pile (channel)**

- b) **Dimensions and dimensional tolerances** The dimensions and dimensional tolerances of the products classified into Group I shall be as specified in table B.4 and table B.5. The dimensions and dimensional tolerances of the products classified into Group II shall be subjected to the agreement between the parties concerned with delivery.
- 1) **Block for retaining wall and revetment** The dimensions and dimensional tolerances of block for retaining wall and revetment shall be as specified in table B.4.

**Table B.4 Dimensions and dimensional tolerances of blocks for retaining wall and revetment**

Unit: mm

| Classification                                                                                  |           |            | Width          | Height         | Brace length |
|-------------------------------------------------------------------------------------------------|-----------|------------|----------------|----------------|--------------|
| Blocks for retaining wall and revetment                                                         | Rectangle | Dimensions | 1 000 to 2 000 | 500 to 1 200   | 350 to 1 500 |
|                                                                                                 |           | Tolerances | ±5             | ±5             | + 10<br>- 5  |
|                                                                                                 | Square    | Dimensions | 1 000 to 1 500 | 1 000 to 1 500 | 350 to 1 500 |
|                                                                                                 |           | Tolerances | ±5             | ±5             | + 10<br>- 5  |
| NOTE 1 A face may be rough provided that it is not detrimental to use practically.              |           |            |                |                |              |
| NOTE 2 A face may be chamfered.                                                                 |           |            |                |                |              |
| NOTE 3 The chamfered part may be included in the brace length.                                  |           |            |                |                |              |
| NOTE 4 Blocks with face dimensions which consider the construction joint, etc. may be included. |           |            |                |                |              |

- 2) **Sheet pile** The dimensions and dimensional tolerances of sheet pile shall be as specified in table B.5.
- The dimensions of a tip are not specified.

**Table B.5 Dimensions and dimensional tolerances of sheet piles**

Unit: mm

| Classification                                                                                                                                                                                     |         |            | Width    | Height    | Thickness | Length          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------------|----------|-----------|-----------|-----------------|
| Sheet piles                                                                                                                                                                                        | Flat    | Dimensions | 500      | 50 to 220 | —         | 2 000 to 14 000 |
|                                                                                                                                                                                                    |         | Tolerances | +5<br>-2 | +5<br>-2  | —         | ±30             |
|                                                                                                                                                                                                    |         | Dimensions | 996      | 50 to 220 | —         | 2 000 to 14 000 |
|                                                                                                                                                                                                    |         | Tolerances | +7<br>-2 | +7<br>-2  | —         | ±30             |
|                                                                                                                                                                                                    | Channel | Dimensions | 996      | 90 to 350 | 45 to 100 | 2 000 to 14 000 |
|                                                                                                                                                                                                    |         | Tolerances | +7<br>-2 | +7<br>-2  | +7<br>-2  | ±30             |
| NOTE 1 A face may be chamfered.                                                                                                                                                                    |         |            |          |           |           |                 |
| NOTE 2 The shape of head, tip and joint and the presence and position of hang holes may be appropriately changed subjected to the agreement between the parties concerned with delivery.           |         |            |          |           |           |                 |
| NOTE 3 Necessary attachments or processing may be provided as long as they do not compromise the performance of sheet pile subjected to the agreement between the parties concerned with delivery. |         |            |          |           |           |                 |

**B.5 Bar arrangement**

The bar arrangement shall be as specified in **JIS A 5364** and a design document. However, subjected to the agreement between the parties concerned with delivery, the bar arrangement other than that of the recommended specification may be adopted in the range in which the product performance (including the provisions of **B.3**) is not compromised. Moreover, as to the bar arrangement of the block for retaining wall and revetment and the sheet pile, a manufacturer shall specify the bar arrangement for each product so as to satisfy **B.3**.

**B.6 Test methods****B.6.1 Compressive strength test**

The compressive strength test shall be as specified in **JIS A 1132** and **JIS A 1108**, or **JIS A 1107**.

**B.6.2 Bending strength test**

The bending strength test shall be as specified in **JIS A 5363**.

The tester shall be of Class 1 or superior specified in **JIS B 7721**, or shall be at least equivalent in allowance thereto.

**B.7 Quality of concrete****B.7.1 Material and production method**

The material for concrete and the production method shall be as specified in **JIS A 5364**.

### B.7.2 Compressive strength

The compressive strength of concrete shall be verified by the compressive strength of the sample which has been processed by the same curing as the product or the compressive strength which has been controlled properly. When the predetermined material aging is finished, the compressive strength shall satisfy the value specified in table B.6.

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

**Table B.6 Compressive strength of concrete**

Unit: N/mm<sup>2</sup>

| Classification                                                                          | Compressive strength of concrete |
|-----------------------------------------------------------------------------------------|----------------------------------|
| Blocks for retaining wall and revetment                                                 | 24 min.                          |
| Sheet pile                                                                              | 60 min.                          |
| NOTE : The compressive strength of concrete may refer to Annex A of <b>JIS A 5364</b> . |                                  |

### B.8 Inspections

Inspections shall be as specified in **JIS A 5365** and the following.

a) **Final inspection** The final inspection of retaining walls shall be conducted for the appearance, performance, shape and dimensions, and shall be as follows.

- 1) **Appearance** For the appearance, it shall be a 100 % inspection or a sampling inspection in consideration of the characteristics of product, production method, production quantity, etc.
- 2) **Performance, shape and dimensions** For the performance, shape and dimensions, the inspection shall be a sampling inspection.

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

- 3) **Size of inspection lot** The size of inspection lot shall be determined by the manufacturer in consideration of the characteristics of product, production method, production quantity, production period, ordered quantity, etc.

Any product in the inspection lot shall have the same characteristics, and shall be manufactured using the same materials, concrete mix proportion and production method, etc.

b) **Delivery inspection** The delivery inspection of retaining walls shall be conducted for the appearance, shape and dimensions. The size of inspection lot and the sampling method shall be subjected to the agreement between the parties concerned with delivery, and shall be specified by the purchaser. The delivery inspection may be omitted subjected to the agreement between the parties concerned with delivery.

## B.9 Marking

The marking items on retaining walls shall be the following as specified in **JIS A 5361**.

- a) Classification or its abbreviation
- b) Manufacturer's name or its abbreviation
- c) Date of manufacture or its abbreviation
- d) When recycle material is used, the statement to that effect

## B.10 Others (recommended specification)

Group I of retaining walls is shown in table B.7.

**Table B.7 Recommended specification**

| Structure-specific product group standard |                         | Recommended specification                                                |
|-------------------------------------------|-------------------------|--------------------------------------------------------------------------|
| <b>JIS A 5372</b>                         | Annex B Retaining walls | Recommended specification B-1<br>Blocks for retaining wall and revetment |
|                                           |                         | Recommended specification B-2<br>Reinforced concrete sheet pile          |

## Recommended specification B-1

### Blocks for retaining wall and revetment

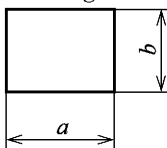
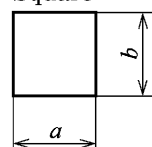
#### B-1.1 Outline

This recommended specification describes the blocks for retaining wall and revetment in Group I of retaining walls in Annex B.

#### B-1.2 Classification

The blocks for retaining wall and revetment are classified by the mass division and the shape of face as shown in recommended specification B-1 table 1.

**Recommended specification B-1 Table 1**  
**Classification of blocks for retaining wall and revetment**

| Classification                                                                                                                                                                                                                                                                                                                |                             |               | Abstract                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------|--------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                               | Mass division <sup>a)</sup> | Shape of face |                                                                                      |
| 1                                                                                                                                                                                                                                                                                                                             | A                           | Rectangle     | Shape of face                                                                        |
| 2                                                                                                                                                                                                                                                                                                                             |                             |               | Rectangle                                                                            |
| 3                                                                                                                                                                                                                                                                                                                             |                             |               |   |
| 4                                                                                                                                                                                                                                                                                                                             |                             |               |                                                                                      |
| 5                                                                                                                                                                                                                                                                                                                             |                             |               |                                                                                      |
| 6                                                                                                                                                                                                                                                                                                                             |                             |               |                                                                                      |
| 7                                                                                                                                                                                                                                                                                                                             |                             |               |  |
| 8                                                                                                                                                                                                                                                                                                                             |                             |               |                                                                                      |
| 9                                                                                                                                                                                                                                                                                                                             | Square                      |               |                                                                                      |
| <p>Blocks for retaining wall and revetment shall be the blocks whose face dimension is made larger or the blocks whose brace length is also made longer.</p> <p>Note <sup>a)</sup> The division by mass shall be based on the block mass in construction area of 1 m<sup>2</sup>; and Division A shall be 350 kg or more.</p> |                             |               |                                                                                      |

#### B-1.3 Performance

The blocks for retaining wall and revetment shall be subjected to the compressive strength test as specified in **B-1.6**. The compressive strength as the product warranty shall be 24 N/mm<sup>2</sup> or more when the predetermined material aging is finished.

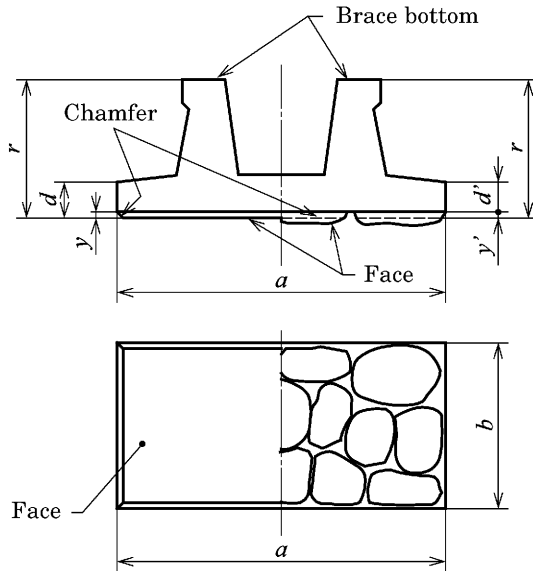
#### B-1.4 Shape, dimensions and dimensional tolerances

The shape, dimensions and dimensional tolerances of blocks for retaining wall and revetment shall be as specified in recommended specification B-1 table 2.

If the reference dimension is changed within the range as specified in **B.4**, the manufacturer shall present the data indicating that blocks for retaining wall and revetment

conform to **B.3** by the design document or the performance test when requested by the purchaser.

**Recommended specification B-1 Table 2**  
**Shape, dimensions and dimensional tolerances of**  
**blocks for retaining wall and revetment**



| Notation | Meaning of notation         |
|----------|-----------------------------|
| $a$      | Width of face               |
| $b$      | Height of face              |
| $r$      | Brace length                |
| $y$      | Chamfer width               |
| $y'$     | Width equivalent to chamfer |
| $d, d'$  | Edge                        |

Unit: mm

| Classification         |               |               | Dimensions         |                     |                           |
|------------------------|---------------|---------------|--------------------|---------------------|---------------------------|
|                        | Mass division | Shape of face | Width ( <i>a</i> ) | Height ( <i>b</i> ) | Brace length ( <i>r</i> ) |
| 1                      | A             | Rectangle     | 1 000              | 500                 | 350 to 1 500              |
| 2                      |               |               | 1 250              | 800                 |                           |
| 3                      |               |               | 1 250              | 894                 |                           |
| 4                      |               |               | 1 500              | 666                 |                           |
| 5                      |               |               | 1 500              | 1 000               |                           |
| 6                      |               |               | 1 500              | 1 118               |                           |
| 7                      |               |               | 2 000              | 1 000               |                           |
| 8                      |               |               | 2 000              | 1 118               |                           |
| 9                      |               | Square        | 1 000              | 1 000               |                           |
| Dimensional tolerances |               |               | ±5                 | ±5                  | +10<br>-5                 |

NOTE 1 A face may be rough provided that it is not detrimental to use practically.

NOTE 2 A face may be chamfered.

NOTE 3 The chamfered part may be included in the brace length.

NOTE 4 Blocks with face dimensions which consider construction joint, etc. may be included.

### B-1.5 Bar arrangement

The bar arrangement of blocks for retaining wall and revetment shall be as follows.

- a) **Reinforcing bar clearance** The clearance of reinforcing bars shall be one or more times the diameter of reinforcing bar, and shall be 5/4 or more of the maximum dimension of coarse aggregate.
- b) **Spacing of assembled reinforcing bars** Spacing of assembled reinforcing bars shall be 300 mm or less.
- c) **Cover of reinforcing bars** Cover of reinforcing bars shall be one time or more its diameter.

This does not apply when the end of reinforcing bars is covered with rust proofing sheath such as cap spacer.

### **B-1.6 Strength test**

The strength test of blocks for retaining wall and revetment shall be as specified in **B.6.1**. Moreover, the preparation of the sample according to **JIS A 1108** shall be as specified in **JIS A 1132**. In this case, the sample shall be cured under the same conditions as the block.

The tester shall be of Class 1 or superior specified in **JIS B 7721**, or shall be at least equivalent in allowance thereto.

### **B-1.7 Quality of concrete**

The compressive strength of concrete shall be as specified in **B.7.2**.

### **B-1.8 Inspections**

#### **B-1.8.1 Inspection items**

The inspection items of blocks for retaining wall and revetment shall be as follows.

- a) **Final inspection** The final inspection items shall be as follows.
  - 1) Appearance
  - 2) Performance
  - 3) Shape and dimensions
- b) **Delivery inspection** The delivery inspection items shall be as follows. However, the delivery inspection may be omitted subjected to the agreement between the parties concerned with delivery.
  - 1) Appearance
  - 2) Shape and dimensions

#### **B-1.8.2 Inspection lot**

The size of inspection lot of blocks for retaining wall and revetment shall be decided by the manufacturer for final inspection, and by the purchaser for delivery inspection subjected to the agreement between the parties concerned with delivery by considering characteristics of the product, production method, production quantity, production period, ordered quantity, etc. One inspection lot may consist of 500 units or fraction thereof.

### **B-1.8.3 Inspection method**

The inspection method of blocks for retaining wall and revetment shall be as follows.

a) **Final inspection** The final inspection method shall be as follows.

- 1) **Appearance** The inspection of appearance shall be conducted by taking two arbitrary samples per one lot. When both of the two conform to the provisions of **5.1**, the lot shall be accepted. If one or more of them do not conform, the lot shall be inspected 100 %, and accepted when the provisions are conformed.
- 2) **Performance** For the inspection of performance, two arbitrary samples per one lot shall be taken and inspected as specified in **B-1.6**. If both of the two conform to **B-1.3**, the lot shall be accepted. If neither of the two conforms, the lot shall be rejected.

In this inspection, if one of the two does not conform to the provisions, four more samples shall be taken from the lot. If all the four conform to the provisions, the lot shall be accepted after the first non-conforming product is eliminated. If one or more of them do not conform, the lot shall be rejected.

- 3) **Shape and dimensions** For the inspection of shape and dimensions, two arbitrary samples per one lot shall be taken. If both of the two conform to the provisions of **B-1.4**, the lot shall be accepted. If one or more of them do not conform, the lot shall be inspected 100 %, and accepted when the provisions are conformed.

b) **Delivery inspection** The delivery inspection method shall be as follows.

- 1) **Appearance** The appearance shall be inspected in the same way as **a)**.
- 2) **Shape and dimensions** The shape and dimensions shall be inspected in the same way as **a)**.

### **B-1.9 Marking**

The blocks for retaining wall and revetment which conform to all the requirements of this Standard shall be marked as specified in **B.9**.

## Recommended specification B-2

### Reinforced concrete sheet piles

#### B-2.1 Outline

This recommended specification describes the reinforced concrete sheet piles in Group I of retaining walls (hereafter referred to as “sheet piles”) in Annex B.

#### B-2.2 Classification

The sheet piles are classified by the shape, dimensions and cracking moment as shown in recommended specification B-2 tables 1 to 3.

**Recommended specification B-2 Table 1**  
**Flat sheet pile (nominal designation width 500 mm)**

| Classification           | Height<br><i>H</i> | Product<br>width<br><i>B</i> | Cracking<br>moment<br>kN • m |            | Length ( <i>L</i> ) |     |     |     |     |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
|--------------------------|--------------------|------------------------------|------------------------------|------------|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
|                          |                    |                              |                              |            | m                   |     |     |     |     |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
| Pressed<br>sheet<br>pile | mm                 | mm                           | Per<br>sheet                 | Per<br>1 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 | 14.0 |
| KF 50H                   | 50                 | 500                          | 2.7                          | 5.4        | ○                   | ○   | ○   | ○   | ○   |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
| KF 60H                   | 60                 |                              | 4.0                          | 8.0        |                     | ○   | ○   | ○   | ○   | ○   | ○   |     |     |     |     |     |     |     |      |      |      |      |      |
| KF 70H                   | 70                 |                              | 5.5                          | 11         |                     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   |     |     |     |     |     |      |      |      |      |      |
| KF 80H                   | 80                 |                              | 7.5                          | 15         |                     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   |     |     |     |     |      |      |      |      |      |
| KF 90H                   | 90                 |                              | 10                           | 20         |                     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   |     |      |      |      |      |      |
| KF100H                   | 100                |                              | 11                           | 22         |                     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   |     |      |      |      |      |      |
| KF110H                   | 110                |                              | 15                           | 30         |                     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   |     |      |      |      |      |      |
| KF120H                   | 120                |                              | 18                           | 36         |                     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   |      |      |      |      |      |
| KF130H                   | 130                |                              | 22                           | 44         |                     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   |      |      |      |      |      |
| KF140H                   | 140                |                              | 25                           | 50         |                     |     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   |      |      |      |      |      |
| KF150H                   | 150                |                              | 29                           | 58         |                     |     |     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○    |      |      |      |      |
| KF160H                   | 160                |                              | 34                           | 68         |                     |     |     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○    |      |      |      |      |
| KF180H                   | 180                |                              | 42                           | 84         |                     |     |     |     |     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○    | ○    |      |      |      |
| KF190H                   | 190                |                              | 45                           | 90         |                     |     |     |     |     |     |     |     |     |     |     | ○   | ○   | ○   | ○    | ○    | ○    |      |      |
| KF200H                   | 200                |                              | 51                           | 102        |                     |     |     |     |     |     |     |     |     |     |     |     | ○   | ○   | ○    | ○    | ○    | ○    |      |
| KF220H                   | 220                |                              | 65                           | 130        |                     |     |     |     |     |     |     |     |     |     |     |     |     | ○   | ○    | ○    | ○    | ○    | ○    |

NOTE : The pressed sheet pile of this shape has a face subjected to tension and another face subjected to compression.

**Recommended specification B-2 Table 2**  
**Flat sheet pile (nominal designation width 1 000 mm)**

| Classifi-<br>cation   | Height<br>$H$<br>mm | Product<br>width $B$<br>mm | Cracking<br>moment<br>kN · m | Length ( $L$ )<br>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 | 14.0 |
| Pressed<br>sheet pile |                     |                            |                              |                     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
| KF 50                 | 50                  | 996                        | 5.4                          | ○                   | ○   | ○   | ○   | ○   |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
| KF 60                 | 60                  |                            | 8.0                          |                     | ○   | ○   | ○   | ○   | ○   | ○   |     |     |     |     |     |     |     |      |      |      |      |      |
| KF 70                 | 70                  |                            | 11                           |                     | ○   | ○   | ○   | ○   | ○   | ○   | ○   |     |     |     |     |     |     |      |      |      |      |      |
| KF 80                 | 80                  |                            | 15                           |                     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   |     |     |     |     |     |      |      |      |      |      |
| KF 90                 | 90                  |                            | 20                           |                     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   |     |      |      |      |      |      |
| KF100                 | 100                 |                            | 22                           |                     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   |     |      |      |      |      |      |
| KF110                 | 110                 |                            | 30                           |                     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   |     |      |      |      |      |      |
| KF120                 | 120                 |                            | 36                           |                     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   |      |      |      |      |      |
| KF130                 | 130                 |                            | 44                           |                     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   |      |      |      |      |      |
| KF140                 | 140                 |                            | 50                           |                     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○   |      |      |      |      |      |
| KF150                 | 150                 |                            | 58                           |                     |     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○    |      |      |      |      |
| KF160                 | 160                 |                            | 68                           |                     |     |     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○    |      |      |      |      |
| KF180                 | 180                 |                            | 84                           |                     |     |     |     |     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○    | ○    |      |      |      |
| KF190                 | 190                 |                            | 90                           |                     |     |     |     |     |     |     |     |     |     |     | ○   | ○   | ○   | ○    | ○    |      |      |      |
| KF200                 | 200                 |                            | 102                          |                     |     |     |     |     |     |     |     |     |     |     |     |     | ○   | ○    | ○    | ○    | ○    | ○    |
| KF220                 | 220                 |                            | 130                          |                     |     |     |     |     |     |     |     |     |     |     |     |     |     | ○    | ○    | ○    | ○    | ○    |

NOTE : The pressed sheet pile of this shape has a face subjected to tension and another face subjected to compression.

**Recommended specification B-2 Table 3**  
**Channel sheet pile (nominal designation width 1 000 mm)**

| Classifi-<br>cation   | Height<br><i>H</i> | Thick-<br>ness<br><i>T</i> | Prod-<br>uct<br>width<br><i>B</i> | Crack-<br>ing<br>moment<br><br>kN • m | Length ( <i>L</i> )<br>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 | 8.5 | 9.0 | 9.5 | 10.0 | 11.0 | 12.0 | 13.0 | 14.0 |
| Pressed<br>sheet pile | mm                 | mm                         | <i>B</i><br>mm                    |                                       |                          |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
| KC 90A                | 90                 | 45                         | 996                               | 5.9                                   | ○                        | ○   | ○   | ○   | ○   | ○   |     |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
| KC 90B                |                    |                            |                                   | 8.9                                   |                          | ○   | ○   | ○   | ○   | ○   | ○   |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
| KC 90C                |                    |                            |                                   | 12                                    |                          | ○   | ○   | ○   | ○   | ○   | ○   |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
| KC120                 | 120                | 50                         |                                   | 15                                    |                          |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   |     |     |     |     |     |     |      |      |      |      |      |
| KC150A                | 150                | 60                         |                                   | 21                                    |                          |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   |     |     |     |     |     |     |      |      |      |      |      |
| KC150B                |                    |                            |                                   | 28                                    |                          |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   |     |     |     |     |     |     |      |      |      |      |      |
| KC175                 |                    |                            |                                   | 175                                   | 35                       |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   |     |     |     |     |      |      |      |      |      |
| KC200A                | 200                | 75                         |                                   | 41                                    |                          |     |     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   |     |     |      |      |      |      |      |
| KC200B                |                    |                            |                                   | 53                                    |                          |     |     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   |     |      |      |      |      |      |
| KC230                 | 230                |                            |                                   | 63                                    |                          |     |     |     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   |     |      |      |      |      |      |
| KC255A                | 255                |                            | 83                                |                                       |                          |     |     |     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○   | ○    |      |      |      |      |
| KC255B                |                    |                            | 100                               |                                       |                          |     |     |     |     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○   | ○    | ○    |      |      |      |
| KC275A                | 275                |                            | 120                               |                                       |                          |     |     |     |     |     |     |     |     |     |     | ○   | ○   | ○   | ○   | ○   | ○    | ○    | ○    |      |      |
| KC275B                |                    |                            | 140                               |                                       |                          |     |     |     |     |     |     |     |     |     |     |     |     | ○   | ○   | ○   | ○    | ○    | ○    |      |      |
| KC300                 | 300                | 100                        | 160                               |                                       |                          |     |     |     |     |     |     |     |     |     |     |     |     |     | ○   | ○   | ○    | ○    | ○    |      |      |
| KC350                 | 350                |                            | 190                               |                                       |                          |     |     |     |     |     |     |     |     |     |     |     |     |     |     | ○   | ○    | ○    | ○    |      |      |

NOTE : The pressed sheet pile of this shape has a face subjected to tension and another face subjected to compression.

## B-2.3 Performance

### B-2.3.1 Bending strength

The sheet pile shall be subjected to the bending strength test as specified in **B-2.6**. When it receives the cracking moment specified in recommended specification B-2 tables 1 to 3, it shall not produce the crack of 0.2 mm in width or wider. Moreover, it shall not break when it is subjected to twice the cracking moment specified in recommended specification B-2 tables 1 to 3.

The force shall be calculated as follows.

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

where,  $F$  : force (kN)

$M$  : cracking moment (value specified in recommended specification B-2 tables 1 to 3) (kN·m)

$l$  : span (m)  $l = L/2$ , and  $b = l/3$

However, when  $l$  is smaller than  $10H$ ,  $l = 10H$ .

$H$  : height of sheet pile (m)

$W$  : beam for load, total mass of round steel and steel sheet applied as force (t)

However, when beam for load and bending tester are integrated, mass of beam for load is not included.

$g$  : standard acceleration of gravity (9.81 m/s<sup>2</sup>)

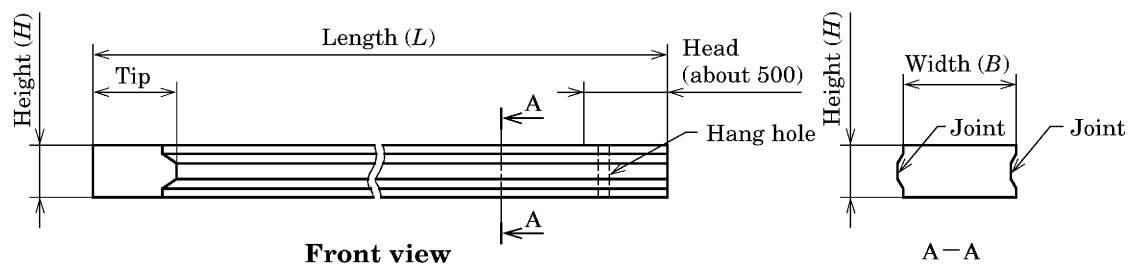
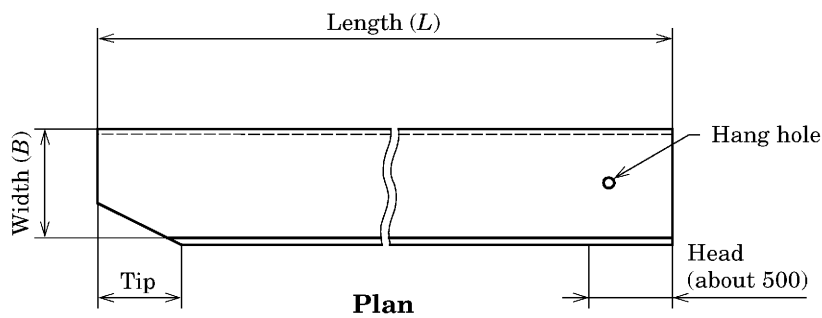
### B-2.4 Shape, dimensions and dimensional tolerances

The shape, dimensions and dimensional tolerances of sheet piles shall be as specified in recommended specification B-2 figures 1 to 3, recommended specification B-2 tables 1 to 3 and recommended specification B-2 table 4.

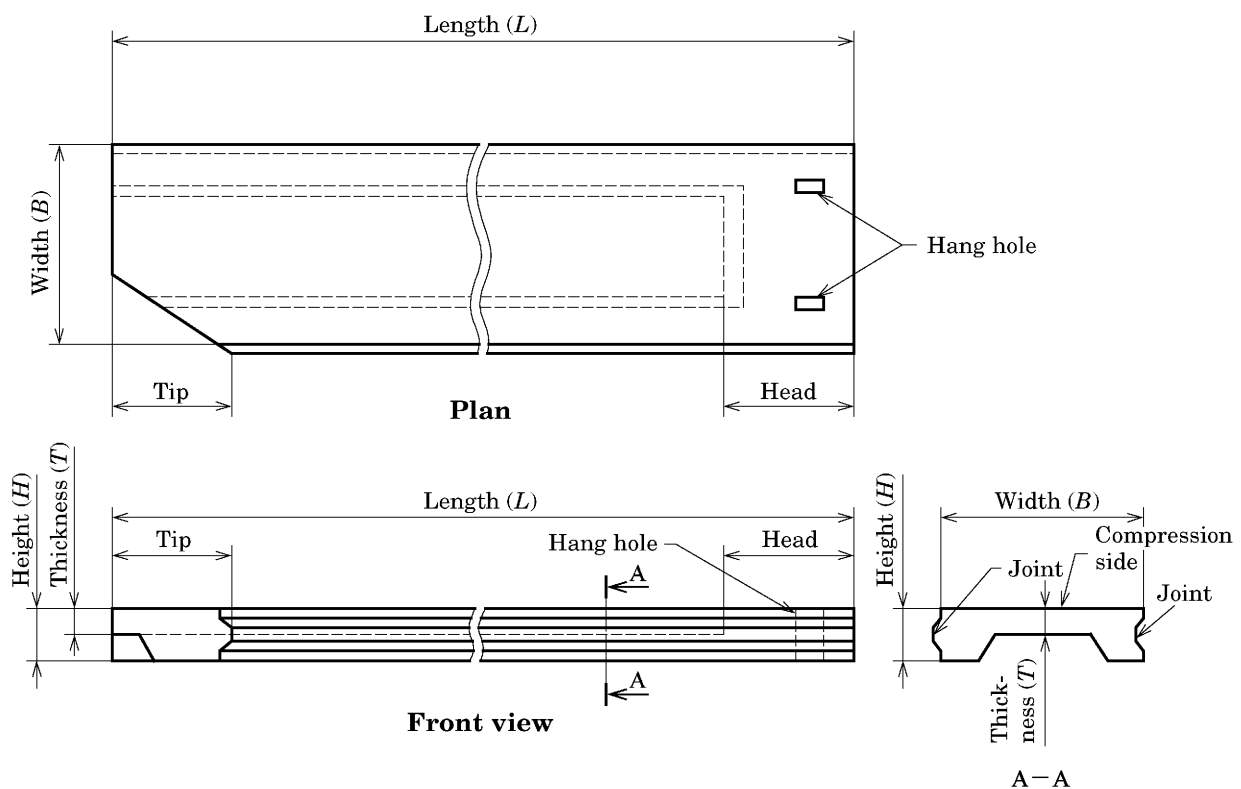
The tolerances on curvature shall be as specified in recommended specification B-2 table 5.

If the reference dimension is changed within the range as specified in **B.4**, the manufacturer shall present the data indicating that sheet piles conform to **B.3** by the design document or the performance test when requested by the purchaser.

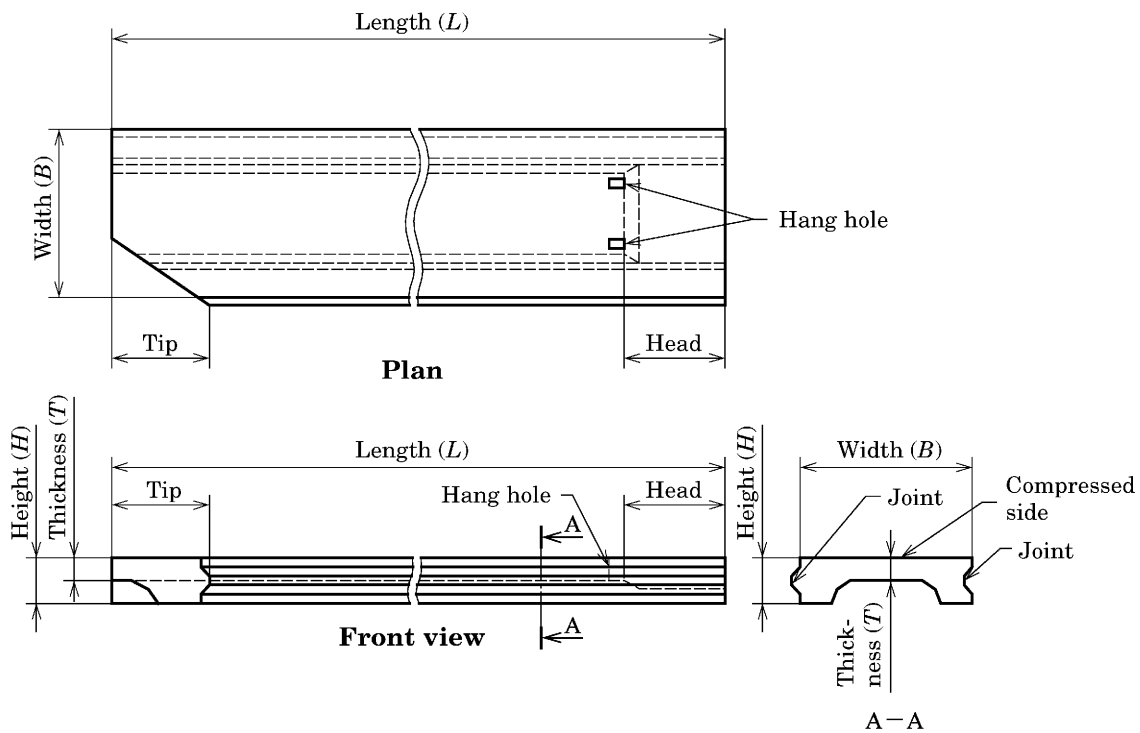
Unit: mm



**Recommended specification B-2 Figure 1 Flat sheet pile**



**Recommended specification B-2 Figure 2  
Channel sheet pile (height 90 mm to 120 mm)**



**Recommended specification B-2 Figure 3**  
**Channel sheet pile (height 150 mm to 350 mm)**

**Recommended specification B-2 Table 4**  
**Dimensions and dimensional tolerances**

Unit: mm

| Classification |            | Width    | Height    | Thickness | Length          |
|----------------|------------|----------|-----------|-----------|-----------------|
| Flat           | Dimensions | 500      | 50 to 220 | —         | 2 000 to 14 000 |
|                | Tolerances | +5<br>-2 | +5<br>-2  | —         | ±30             |
| Flat           | Dimensions | 996      | 50 to 220 | —         | 2 000 to 14 000 |
|                | Tolerances | +7<br>-2 | +7<br>-2  | —         | ±30             |
| Channel        | Dimensions | 996      | 90 to 350 | 45 to 100 | 2 000 to 14 000 |
|                | Tolerances | +7<br>-2 | +7<br>-2  | +7<br>-2  | ±30             |

**Recommended specification B-2 Table 5**  
**Tolerances on curvature**

Unit: mm

|           |                 |    |
|-----------|-----------------|----|
| Curvature | $L \leq 7\,000$ | 10 |
|           | $L > 7\,000$    | 15 |

### **B-2.5 Bar arrangement**

The bar arrangement of sheet piles shall be as follows.

- a) The clearance of reinforcing bars shall be one or more times the diameter of reinforcing bar, and shall be  $5/4$  or more of the maximum dimension of coarse aggregate.
- b) In the case of pressurized compaction, cover of reinforcing bars shall be 7 mm or more.
- c) Spacing of assembled reinforcing bars shall be 300 mm or less.

### **B-2.6 Strength test**

#### **B-2.6.1 Compressive strength test**

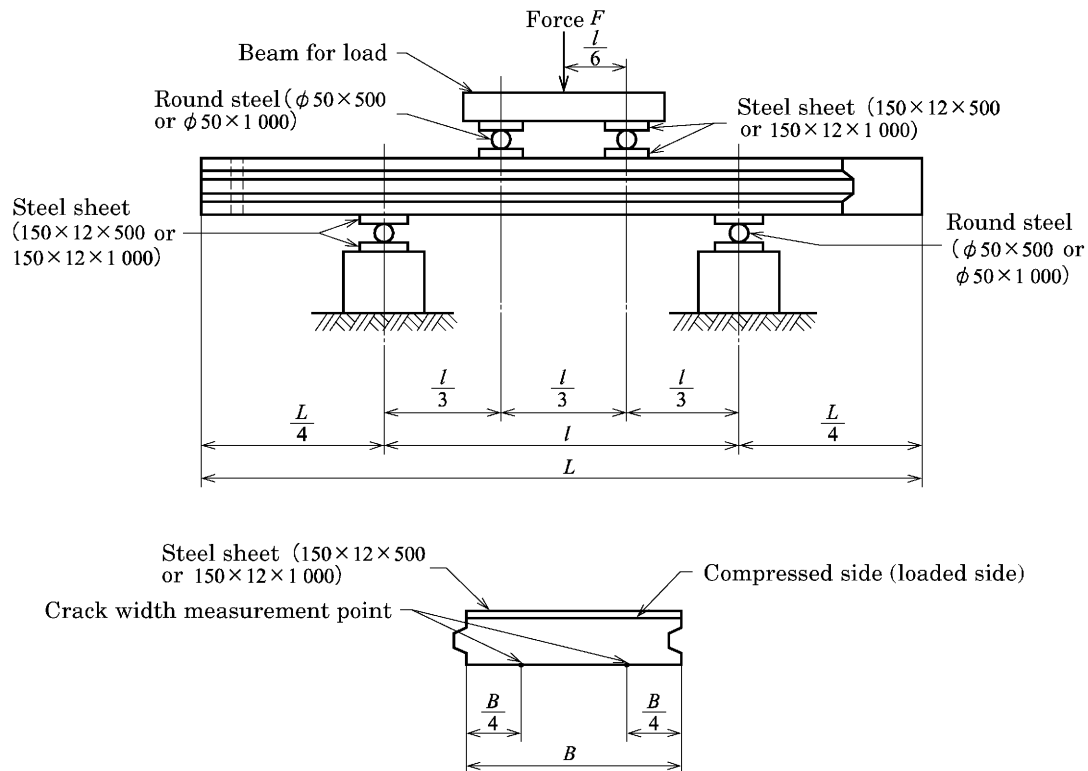
The compressive strength test of sheet piles shall be as specified in **B.6.1**.

#### **B-2.6.2 Bending strength test**

The bending strength test of sheet piles shall be conducted by the loading method shown in recommended specification B-2 figures 4 and 5. When the sheet pile receives the force  $F$  equivalent to the cracking moment specified in recommended specification B-2 tables 1 to 3, the crack situation shall be investigated at the crack width measurement point shown in recommended specification B-2 figures 4 and 5. Moreover, the sheet pile shall be confirmed that it does not break when the force equivalent to twice the cracking moment is applied.

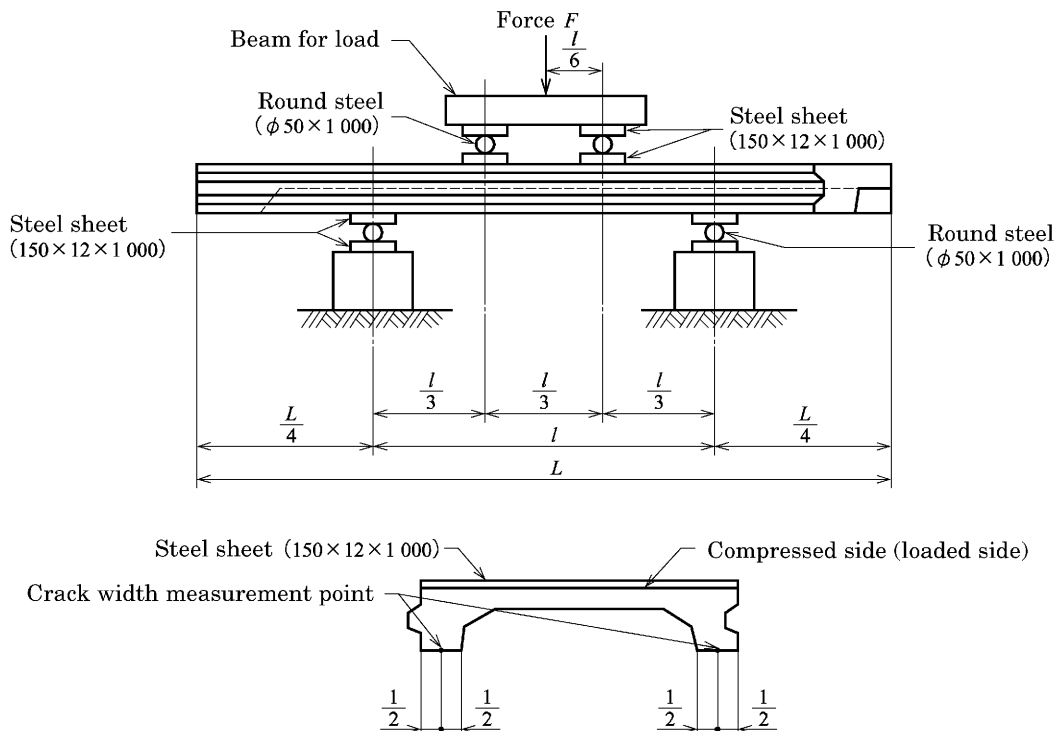
The tester shall be of Class 1 or superior specified in **JIS B 7721**, or shall be at least equivalent in allowance thereto.

Unit: mm



**Recommended specification B-2 Figure 4**  
**Bending strength test method (flat)**

Unit: mm



**Recommended specification B-2 Figure 5**  
**Bending strength test method (channel)**

### **B-2.7 Quality of concrete**

The compressive strength of concrete shall be as specified in **B.7.2**. However, in the case of pressurized compaction, the sample shall be formed and cured in the same way as the sheet pile.

### **B-2.8 Inspections**

#### **B-2.8.1 Inspection items**

The inspection items of sheet piles shall be as follows.

- a) **Final inspection** The final inspection items shall be as follows.
  - 1) Appearance
  - 2) Performance
  - 3) Shape and dimensions
- b) **Delivery inspection** The delivery inspection items shall be as follows. However, the delivery inspection may be omitted subjected to the agreement between the parties concerned with delivery.
  - 1) Appearance
  - 2) Shape and dimensions

#### **B-2.8.2 Inspection lot**

The size of inspection lot of sheet piles shall be decided by the manufacturer for final inspection, and by the purchaser for delivery inspection subjected to the agreement between the parties concerned with delivery by considering characteristics of the product, production method, production quantity, production period, ordered quantity, etc. One inspection lot may consist of 1 000 units or fraction thereof.

#### **B-2.8.3 Inspection method**

The inspection method of sheet piles shall be as follows.

- a) **Final inspection** The final inspection method shall be as follows.
  - 1) **Appearance** The inspection of appearance shall be conducted by taking arbitrary number of samples per one lot. When they conform to the provisions of **5.1**, the lot shall be accepted. If one or more of them do not conform, the lot shall be inspected 100 %, and accepted when the provisions are conformed.
  - 2) **Performance** For the inspection of performance, two arbitrary samples per one lot shall be taken and inspected as specified in **B-2.6.2**. If both of the two conform to **B-2.3.1**, the lot shall be accepted. If neither of the two conforms, the lot shall be rejected. In this inspection, if one of the two does not conform to the provisions, four more samples shall be taken from the lot. If all the four conform to the provisions, the lot shall be accepted after the first non-conforming product is eliminated. If one or more of them do not conform, the lot shall be rejected.

- 3) **Shape and dimensions** For the inspection of shape and dimensions, two arbitrary samples per one lot shall be taken. If both of the two conform to the provisions of **B-2.4**, the lot shall be accepted. If one or more of them do not conform, the lot shall be inspected 100 %, and accepted when the provisions are conformed.
- b) **Delivery inspection** The delivery inspection method shall be as follows.
- 1) **Appearance** The appearance shall be inspected in the same way as **a**).
- When adopting the sampling inspection, if two arbitrary sheet piles are inspected and conformed to the provisions of **5.1**, the lot shall be accepted. If one or more of them do not conform, the lot shall be inspected 100 % of reminder, and accepted when the provisions are conformed.
- 2) **Shape and dimensions** The shape and dimensions shall be inspected in the same way as **a**).

### **B-2.9 Marking**

The sheet piles which conform to all the requirements of this Standard shall be marked as specified in **B.9**.

In addition, the marking shall also include the following matters.

- a) Length or its abbreviation
- b) When having a face subjected to tension and another face subjected to compression, the symbol or abbreviation indicating the compressed side or tensed side.

## Annex C (normative)

### Covered conduits

#### C.1 Outline

This Annex specifies Group I and Group II of covered conduits which are used mainly for the sewerage and drainages among the RC products specified in this Standard.

#### C.2 Classification

The classification of covered conduits shall be as specified in table C.1.

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

**Table C.1 Classification of covered conduits**

| Major division   | Minor division                             |
|------------------|--------------------------------------------|
| Covered conduits | Reinforced concrete pipe                   |
|                  | Centrifugal reinforced concrete pipe       |
|                  | Reinforced concrete built-up culvert block |
|                  | Reinforced concrete box culvert            |
|                  | Arch culvert                               |
|                  | Jacking pipe                               |
|                  | Segment for shielding                      |
|                  | Prefabricated arch culvert                 |
|                  | Others                                     |

**Table C.2 Classification of Group I of covered conduits**

| Division by shape                                                                                                                                             | Classification                             | Division by application          | Division by strength      | Detail                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|----------------------------------|---------------------------|------------------------------------|
| Cylindrical shape                                                                                                                                             | Reinforced concrete pipe                   | Channel (external pressure pipe) | Class 1, Class 2          | See recommended specification C-1. |
|                                                                                                                                                               | Centrifugal reinforced concrete pipe       | Channel (external pressure pipe) | Class 1, Class 2, Class 3 | See recommended specification C-2. |
|                                                                                                                                                               |                                            | Channel (internal pressure pipe) | 2K, 4K, 6K                |                                    |
| Box shape                                                                                                                                                     | Reinforced concrete built-up culvert block | Channel (for external pressures) | —                         | See recommended specification C-3. |
|                                                                                                                                                               | Reinforced concrete box culvert            | Channel (for external pressures) | Class 1, Class 2          | See recommended specification C-4. |
| NOTE 1 Class 1, Class 2 and Class 3 of external pressure pipes show the division classified by the bending strength of covered conduits.                      |                                            |                                  |                           |                                    |
| NOTE 2 2K, 4K, and 6K of internal pressure pipes show the division classified by the internal pressure strength and the bending strength of covered conduits. |                                            |                                  |                           |                                    |
| NOTE 3 Class 1 and Class 2 of reinforced-concrete box culvert show the division classified by the tensile strength of concrete.                               |                                            |                                  |                           |                                    |

### C.3 Performance

The performance of covered conduits shall conform to the provisions of table C.3.

In addition, the performance items of Group II shall be subjected to the agreement between the parties concerned with delivery.

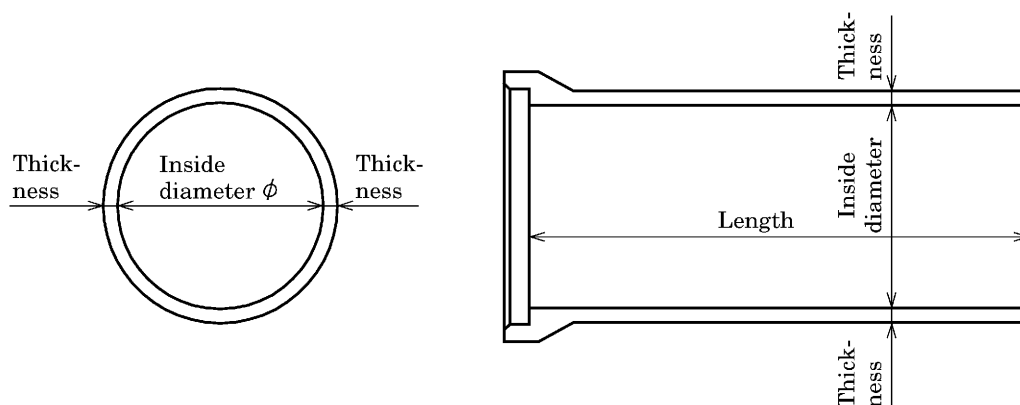
**Table C.3 Performance of covered conduits**

| Performance item                                                                                                                                                                                                                                                                                                                                                                                                                                       | Performance                                                                                                                                           | Performance check method               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| Service stage performance                                                                                                                                                                                                                                                                                                                                                                                                                              | Shall be safe to be subjected to the regular load <sup>a)</sup> assumed at the time of use, and crack width shall be less than the permissible value. | See design document or <b>C.6</b> .    |
| End stage performance <sup>b)</sup>                                                                                                                                                                                                                                                                                                                                                                                                                    | Shall not break due to the load <sup>a)</sup> assumed at the time of end stage.                                                                       | See design document or <b>C.6</b> .    |
| Durability <sup>c)</sup>                                                                                                                                                                                                                                                                                                                                                                                                                               | Durability shall be secured against deterioration assumed.                                                                                            | See design document or actual results. |
| Workability                                                                                                                                                                                                                                                                                                                                                                                                                                            | Workability for transportation, installation, assembly, etc. shall be secured.                                                                        | See design document or actual results. |
| <p>Notes <sup>a)</sup> When the strength for internal water pressure is required, the internal water pressure shall also be checked.</p> <p><sup>b)</sup> Confirmation of the end stage performance shall be made when requested by the purchaser.</p> <p><sup>c)</sup> Durability may be confirmed by the actual results of such similar products as are equivalent in terms of water-cement ratio and/or air content, and reinforcing bar cover.</p> |                                                                                                                                                       |                                        |

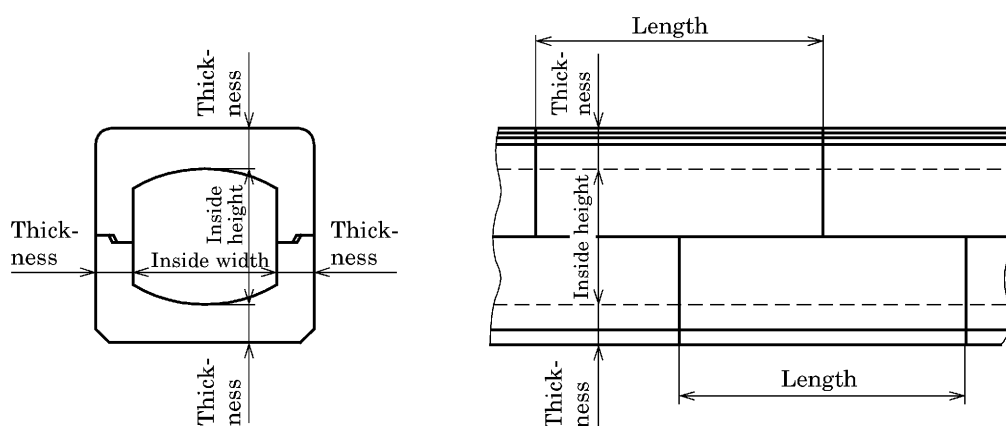
### C.4 Shape, dimensions and dimensional tolerances

The shape, dimensions and dimensional tolerances of covered conduits shall be 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  $\pm 10\%$  in response to the purchaser's demand, provided that the necessary performance (quality) is satisfied.

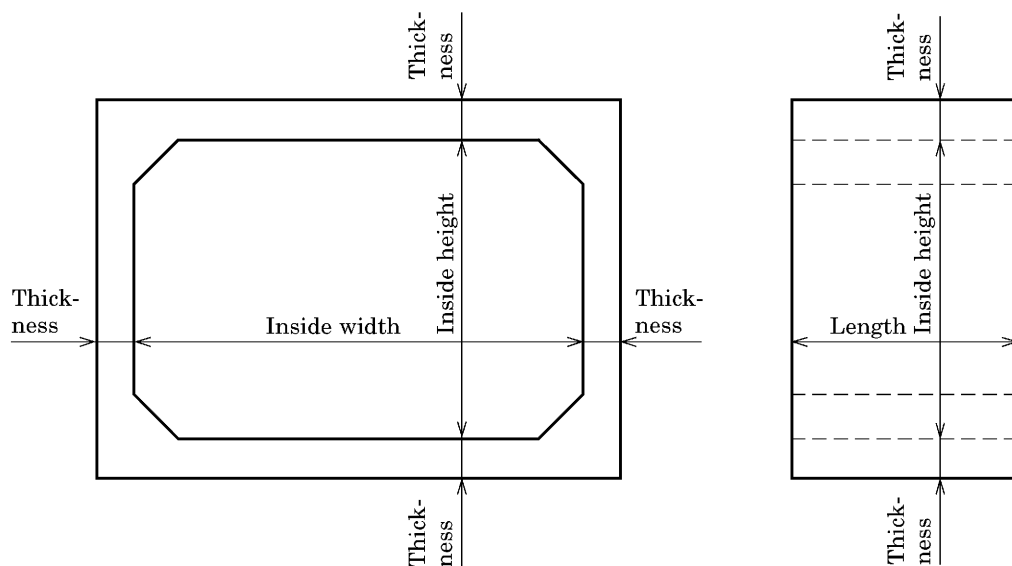
a) **Shape** The shape of covered conduits is shown in figure C.1.



a) Cylindrical shape



b) Built-up box shape



c) Box shape

Figure C.1 Example of shape of covered conduits