

## Recycled aggregate concrete-Class L

### 1. Scope

This Japanese Industrial Standard specifies the recycled aggregate concrete-Class L<sup>1)</sup>. However this standard is not applied to the transportation after delivery and pouring and curing.

Note<sup>1)</sup> : The recycled aggregate concrete-Class L shall be applied the recycled concrete using recycled aggregate Class L (hereafter referred to as “recycled aggregate L”) conform to Annex A.

### 2. Normative references

The following standards contain provisions which, through references 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 1101 *Method of test for slump of concrete*
- JIS A 1102 *Method of test for sieve analysis of aggregates*
- JIS A 1103 *Method of test for amount of material passing test sieve 75  $\mu\text{m}$  in aggregate*
- JIS A 1104 *Methods of test for bulk density of aggregate and solid content in aggregate*
- JIS A 1108 *Method of test for compressive strength of concrete*
- JIS A 1109 *Methods of test for density and water absorption of fine aggregates*
- JIS A 1110 *Methods of test for density and water absorption of coarse aggregates*
- JIS A 1115 *Method of sampling fresh concrete*
- JIS A 1116 *Method of test for unit mass and air content of fresh concrete by mass method*
- JIS A 1119 *Method of test for variability of freshly mixed concrete by measuring mortar and coarse aggregate contents*
- JIS A 1128 *Method of test for air content of fresh concrete by pressure method*
- JIS A 1132 *Method of making and curing concrete specimens*
- JIS A 1144 *Method of test for chloride concentration in water of fresh concrete*
- JIS A 1145 *Method of test for alkali-silica reactivity of aggregate by chemical method*
- JIS A 1146 *Method of test for alkali-silica reactivity of aggregate by mortar-bar method*
- JIS A 1154 *Methods of test for chloride ion content in hardened concrete*
- JIS A 1158 *Method for reducing samples of aggregate to testing size*
- JIS A 1801 *Methods of test for production control of concrete-. Method of test for sand*

*equivalent value of fine aggregates for concrete*

- JIS A 5002 *Lightweight aggregate for structural concrete*
- JIS A 5021 *Recycled aggregate for concrete –class H*
- JIS A 5022 *Recycled concrete using recycled aggregate class M*
- JIS A 5308 *Ready-mixed concrete*
- JIS A 6201 *Fly ash for use in concrete*
- JIS A 6202 *Expansive additive for concrete*
- JIS A 6204 *Chemical admixture for concrete*
- JIS A 6205 *Corrosion inhibitor for reinforcing steel in concrete*
- JIS A 6206 *Ground granulated blast-furnace slag for concrete*
- JIS A 6207 *Silica fume for use in concrete*
- JIS A 8603-2 *Concrete mixers-Part 2: Procedure for examination of mixing efficiency*
- JIS A 9607 *Household electric refrigerators, refrigerator-freezers and freezers*
- JIS R 5210 *Portland cement*
- JIS R 5211 *Portland blast-furnace slag cement*
- JIS R 5213 *Portland fly-ash cement*
- JIS R 5214 *Ecocement*
- JIS Z 8801-1 *Test sieves---Part 1 : Test sieves of metal wire cloth*

### **3. Terms and definitions**

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

#### **3.1 original concrete**

Concrete lump to be a raw material for manufacturing the recycled aggregate

#### **3.2 original aggregate**

Aggregate contained in the original concrete

#### **3.3 original coarse aggregate**

Coarse aggregate contained in the original aggregate

#### **3.4 original fine aggregate**

Fine aggregate contained in the original aggregate

#### **3.5 Volume mixing ratio**

Absolute volume ratio of recycled fine aggregate against absolute volume of whole fine aggregate and absolute volume ratio of recycled coarse aggregate against absolute volume of whole coarse aggregate

### **4. Classification**

The recycled aggregate concrete L is classified by the conditions shown by marked “ ” in Table 1 for maximum size of coarse aggregate, slump and nominal strength.

**Table 1 - Classification of recycled aggregate concrete L**

	Maximum size	Slump	Nominal strength		
	of coarse aggregate		18	21	24
	mm	cm			
Recycled aggregate concrete L	20, 25, 40	8, 10, 12, 15, 18 a)			

NOTE The recycled aggregate concrete L shall be used as the member or the part which is not required for high strength or high durability such as for backfilling concrete, filling concrete, leveling concrete or blinding concrete. Moreover the recycled aggregate concrete shall be used for a member or a part which is not effected by freeze thaw due to to secure high freeze thaw resistance is normally difficult.

The unit water amount shall not be excessive by using chemical admixture.

Note<sup>a)</sup> When the maximum size of coarse aggregate is 40mm, the slump excludes 18cm.

For purchasing of recycled aggregate concrete L, following requirements a) to h) shall be agreed with manufacturer. a) and b) shall be designated while c) to h) shall be designated by agreement if necessary. However a) to h) shall be regarding in the scope of this standard.

- a) Class of cement
- b) Maximum size of coarse aggregate
- c) Class and consumption of admixture
- d) Upper limit value of chloride content given in 5.4
- e) Material age which certified nominal strength
- f) Air content
- g) If using mixture with the aggregate conform to Annex A of JIS A 5308<sup>2)</sup>, volume mixing ratio of recycled fine aggregate L and recycled coarse aggregate L
- h) Other requirements

Note <sup>2)</sup>: The artificial lightweight aggregate is excluded among the aggregate conform to Annex A of JIS A 5308 (c.f. 8.2).

## 5. Quality

The recycled aggregate concrete L shall satisfy the following requirements at unloading site.

### 5.1 Compressive strength

The compressive strength shall be satisfied the following requirements if the test given in 10.2 is performed. The material age of the specimens for the test shall be 28 days. However if specified as Clause 4 e), the material age shall be designated by the purchaser.

- a) The result in one test shall be 85% or greater for the value<sup>3)</sup> of nominal strength specified by the purchaser.
- b) The mean value of the results in three times tests shall be greater than the value of nominal strength<sup>3)</sup> specified by the purchaser.

Note<sup>3)</sup> The value is shown as N/mm<sup>2</sup> which using decimal point for nominal strength and the first digits after the decimal point is zero

## 5.2 Slump

When the test given in 10.3 is performed, the tolerance of the value of slump specified in Clause 4 shall be  $\pm 3$  cm. However in the case of considering the decrease of amount for slump during delivery, it shall be provided as the value at the time of shipment<sup>4)</sup> from the factory by agreement between the manufacturer and the purchaser. The tolerance shall be also  $\pm 3$  cm.

Note<sup>4)</sup> In case of using truck-mixer for transportation, the value after mixing shall be used.

## 5.3 Air content

When the air contents are designated according to Clause 4, the specified air contents shall be satisfied in the test given in 10.4. Moreover the tolerance of the specified value shall be  $\pm 2.0\%$ . However in the case of considering the decrease of air content during delivery, it shall be provided as the value at the time of shipment<sup>4)</sup> from the factory by agreement between the manufacturer and the purchaser. The tolerance shall be also  $\pm 2.0\%$ .

## 5.4 Chloride content

When the chloride contents are designated according to Clause 4, and if required by the method given in 10.5 at unloading site, it shall be satisfied the value  $0.30\text{kg/m}^3$  as amount of chloride ion ( $\text{Cl}^-$ ). However if agreement by the purchaser, it shall be  $0.60\text{kg/m}^3$  or under..

## 6. Volume

The volume of recycled aggregate concrete L shall not below the volume in the statement of delivery calculated by the method given in 10.6 at unloading site.

## 7. Mix proportion

The mix proportion of recycled aggregate concrete L shall be as follows.

- a) The mix proportion shall be determined by the test to satisfy the quality specified in clause 5, and to certify the inspection given in clause 11 by the manufacturer. The maximum value of water-cement ratio shall be 65 %.
- b) If requested by the purchaser, the manufacturer shall present the designing mix proportion for recycled aggregate concrete L shown in table 3. It shall be presented prior to delivery of recycled aggregate concrete L.
- c) If requested by the purchaser, the manufacturer shall present the designing mix proportion, the calculation for the chloride content in recycled aggregate concrete L and the material so as to the base for the method of countermeasures for restraint alkali-silica reactivity.

## 8. Materials

### 8.1 Cement

The cement shall be as follows.

- a) For the cement, portland cement conform to JIS R 5210, portland blast-furnace slag cement conform to JIS R 5211, fly-ash cement conform to JIS R 5213 or ordinary ecocement conform to JIS R 5214 shall be used.
- b) When using the recycled aggregate L which division of alkali-silica reactivity is "B" according to Annex A, for the cement, portland cement conform to JIS R 5210, portland blast-furnace slag cement which amount of blast-furnace slug (mass fraction) is 40 % or over conform to JIS R 5211, fly-ash cement which amount of fly-ash (mass fraction) is 15 % or over conform to JIS R 5213 or ordinary ecocement conform to JIS R 5214 shall be used. When using portland cement or ordinary ecocement, the fly-ash given in 8.4 a)1) shall be used 15 % or over of the total sum of portland cement or the ordinary ecocement and fly-ash for mixing, or the ground granulated blast-furnace slag given in 8.4 a)5) shall be used 40 % or over of the total sum of portland cement or ordinary ecocement and ground granulated blast-furnace slag for mixing.

### 8.2 Aggregate

The aggregates shall be as follows.

- a) For coarse aggregate, either the recycled coarse aggregate L<sup>5)</sup> conform to Annex A shall be used independently or the mixture of the recycled coarse aggregate L with the coarse aggregate conform to Annex A of JIS A 5308 or with the recycled coarse aggregate M conform to Annex A of JIS A 5022 shall be used. However among the aggregate conform to Annex A of JIS A 5308, the artificial light-weight aggregate shall be excluded.
- b) For fine aggregate, either the recycled fine aggregate L<sup>5)</sup> conform to Annex A shall be used independently or the mixture of the recycled fine aggregate L with the fine aggregate conform to Annex A of JIS A 5308 or with the recycled fine aggregate M conform to Annex A of JIS A 5022 shall be used. However among the aggregate conform to Annex A of JIS A 5308, the artificial light-weight aggregate shall be excluded.
- c) By agreement between the manufacturer and the purchaser, the aggregate conform to Annex A of JIS A 5308 or the recycled aggregate M conform to Annex A of JIS A 5022 may be used for the whole of either fine or coarse aggregate. However among the aggregate conform to Annex A of JIS A 5308, the artificial light-weight aggregate shall be excluded.

Note<sup>5)</sup> The recycled aggregate L shall be normally in division "B" for alkali-silica reactivity, however the recycled aggregate L in division "A" for alkali-silica reactivity also may be used.

### 8.3 Water

The water shall be used conform to Annex C of JIS A 5308.

## **8.4 Admixture**

The admixture shall be as follows.

- a) The fly ash, expansive additive, chemical admixture, corrosion inhibitor, ground granulated blast-furnace slag and silica fume shall be used conform to the following standards.
  - 1) JIS A 6201
  - 2) JIS A 6202
  - 3) JIS A 6204
  - 4) JIS A 6205
  - 5) JIS A 6206
  - 6) JIS A 6207
- b) When using admixture other than a), the designation agents by agreement between the manufacturer and the purchaser, of which judged as harmless to concrete or steel materials and also confirmed the specified quality and soundness shall be used.

## **9. Method of manufacture**

The method of manufacture shall be in accordance with Annex B.

## **10. Test method**

### **10.1 Method of sampling specimen**

The method of sampling specimen shall be in accordance with JIS A 1115.

### **10.2 Compressive strength**

The compressive strength test shall be performed in accordance with JIS A 1108, JIS A 1132 and Annex E of JIS A 5308. However for the diameter of specimen, nominal dimensions may be used. Moreover when using the unbonded-capping given in Annex A of JIS A 1108, it may be provided for the both side of the specimen.

The specimen shall be preserved at a normal temperature<sup>6)</sup> after preparation until removal of the framework.

Note<sup>6)</sup> : Preferably the specimen shall be prepared under the environment of normal temperature. If it's impossible, the specimen shall be moved into the environment of normal temperature as soon as possible after preparation. The specimen shall be preserved for preventing evaporation of moisture in storage.

### **10.3 Slump**

The slump test shall be performed in accordance with JIS A 1101.

### **10.4 Air content**

The test for air content shall be performed in accordance with either JIS A 1128 or JIS A 1116.

### 10.5 Chloride content

The chloride content shall be calculated by the following formula (1). However in the case of  $C_0$  is calculated as minus, formula (2) shall be used instead.

$$C_0 = 4 \times \frac{C_1 W_1 - (0.75 - \alpha) C_2 W_2}{100} \dots\dots\dots (1)$$

$$C_0 = 4 \times \frac{C_1 W_1}{100} \dots\dots\dots (2)$$

- where,  $C_0$  : chloride content of recycled aggregate concrete L (kg/m<sup>3</sup>)  
 $C_1$  : concentration of a chloride ion of water in fresh concrete(%)  
 $W_1$  : unit water amount used for designing mix proportion<sup>7)</sup> ( kg/m<sup>3</sup>)  
 $C_2$  : concentration of chloride ion in cement (%)  
 $W_2$  : unit cement amount used for designing mix proportion<sup>7)</sup> ( kg/m<sup>3</sup>)  
 $\alpha$  : persistence ratio of chloride ion<sup>8)</sup>

The test of concentration of a chloride ion for water in fresh concrete shall be performed in accordance with JIS A 1144. However the test may be performed by measuring instrument of chloride content with confirmation of accuracy by agreement of the purchaser.

NOTE : For the test of concentration of a chloride ion for water in fresh concrete, the amount of chloride ion in recycled aggregate L which eluted into mixing water immediately is only 1/4 of whole composition. Assuming that 1/4 of total amount of chloride ion in both cement and recycled aggregate L shall be eluted into the water in fresh concrete, the chloride content of recycled aggregate concrete L shall be calculated

Note<sup>7)</sup> The value shall be shown in designing mix proportion in Table 3.

<sup>8)</sup> The ratio of chloride ion which persist in cement without elution into water in fresh concrete among whole amount of chloride ion in cement. When using cement other than ordinary ecocement,  $\alpha=0$ . When using ordinary ecocement, the value  $\alpha$  shall be in accordance with JIS R 5214.

### 10.6 Volume

The volume shall be obtained to divide one total amount of load capacity of transportation vehicle by density of fresh concrete. The total volume loaded in one vehicle shall be calculated either total amount of the materials using this load or the difference of weight for transportation vehicle before and after unloading. However the test of density of fresh concrete shall be in accordance with JIS A 1116.

When the volume of container given in JIS A 1128 shall be accurately determined, the container may be used.

## **11. Inspection**

### **11.1 Inspection items**

The inspection shall be performed for compressive strength and slump.

If air content and/or chloride content shall be designated by clause 4, the inspection for them also shall be performed.

### **11.2 Compressive strength**

The compressive strength shall be tested in accordance with 10.2 and those which conform to the requirements given in 5.1 shall be accepted.

The frequency of the test shall be once per 150 m<sup>3</sup> as a standard.

The specimens sampled at the time of shipment from the factory<sup>4)</sup> shall be tested in accordance with 10.2 by agreement with the purchaser.

The result of each test shall be calculated as the mean value of test value for three sample pieces made by specimen taking from one of any carrier.

Each sample pieces of three times tests may be judged as a same lot of concrete, when the relation of water-cement ratio and strength is same and the same nominal strength even though the slump is not same.

### **11.3 Slump**

The slump shall be tested in accordance with 10.3 and those which conform to the requirements given in 5.2 shall be accepted.

The frequency of the test shall be once per 150 m<sup>3</sup> as a standard.

By agreement with the purchaser, in the case of the value of slump is determined at the time of shipment from the factory<sup>4)</sup>, the test of slump may be performed at the time of shipment from the factory<sup>4)</sup>.

In the case of the slump is not conformed to the tolerance range, a new specimen may be taken in accordance with 10.1, and retested in accordance with 10.3 only once. The result conform to the requirements given in 5.2 shall be accepted.

### **11.4 Air content**

The air content shall be tested in accordance with 10.4 and those which conform to the requirements given in 5.3 shall be accepted.

The frequency of the test shall be once per 150 m<sup>3</sup> as a standard.

By agreement with the purchaser, in the case of the value of air content is determined at the time of shipment from the factory<sup>4)</sup>, the test of air content may be performed at the time of shipment from the factory<sup>4)</sup>.

In the case of the air content is not conformed to the tolerance range, a new specimen may be taken in accordance with 10.1, and it may be retested in accordance with 10.4 only once. The result conform to the requirements given in 5.3 shall be accepted.

### **11.5 Chloride content**

The inspection of chloride content shall be tested in accordance with 10.5 and those which



conform to the requirements given in 5.4 shall be accepted.

The frequency of the test shall be once per 150 m<sup>3</sup> as a standard.

Moreover the inspection for the chloride content may be performed at a time of shipment from the factory<sup>4)</sup> due to the specified condition at unloading site is satisfied even at a time of shipment from the factory<sup>4)</sup>.

### 11.6 Designated matters

For the designated matters given in clause 4 by the purchaser, the method of inspection shall be determined by agreement between the manufacturer and the purchaser for inspection.

## 12. Designation

The recycled aggregate concrete L shall be designated by the sign according to class of concrete, nominal strength, slump, maximum size of coarse aggregate and types of cement.

The signs according to the class of concrete shall be indicated as “recycled L”. The sign according to types of cement shall be given in Table 2.

### Example

<u>recycled L</u>	---- Indicates according to class of recycled aggregate concrete L
<u>18</u>	----- nominal strength
<u>8</u>	----- slump (cm)
<u>20</u>	----- the maximum size of coarse aggregate(mm)
<u>BB</u>	----- Indicates according to types of cement

Class	Symbol
Ordinary portland cement	N
Ordinary portland cement (low alkali type)	NL
High-early-strength portland cement	H
High-early-strength portland cement (low alkali type)	HL
Ultra-high-early-strength portland cement	UH
Ultra-high-early-strength portland cement (low alkali type)	UHL
Moderate-heat portland cement	M
Moderate-heat portland cement (low alkali type)	ML
Low-heat portland cement	L
Low-heat portland cement (Low alkali type)	LL
Sulfate-resistant portland cement	SR
Sulfate-resistant portland cement (low alkali type)	SRL
Portland blast-furnace slag cement A	BA
Portland blast-furnace slag cement B	BB
Portland blast-furnace slag cement C	BC
Portland fly-ash cement A	FA
Portland fly-ash cement B	FB
Portland fly-ash cement C	FC
Standard ecocement	E

### **13. Report**

#### **13.1 Designing mix proportion and basic materials of recycled aggregate concrete**

The manufacturer shall present the designing mix proportion of recycled aggregate concrete L shown in Clause 7 b) to the purchaser if requested prior to delivery. The format shall be given in Table3, the contents may be changed by agreement between the manufacturer and the purchaser. However if the volume mixture ratio is designated by the purchaser, it shall be included. Moreover according to the request by the purchaser, the manufacturer shall present the materials which shall be the base for the designing mix proportion shown in Clause 7 c).

#### **13.2 Statement of delivery for recycled aggregate concrete L**

The manufacturer shall present the statement of delivery for recycled aggregate concrete L to the purchaser for each carrier at each delivery. The format of the statement of delivery shall be shown in Table 4. However the document which has as same or more information shall be accepted.