हमारा संदेश  : सीईडी 2:2/टी-92  
25 10 2016  
तकनीकी समिति  : सीमेंट और कंक्रीट विषय समिति, सीईडी, 2  
प्राप्तकर्ता  :  
सिविल इंजीनियरिंग विभाग परिषद के रूप में रचनात्मक रूप से रचनाकार  
सीईडी 2 के सभी सदस्य  
रूप रचनाकर्ता व अन्य निर्देश

महंदय(यो),  

निम्नलिखित मानकों के मसौदे संलगन हैं:  

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| सीईडी CED 2 (10896)WC | IS 1199: कंक्रीट के नमूने एवं विश्लेषण पद्धतियाँ  
ताजा सेटिंग कंक्रीट का परीक्षण - भाग 6 |

कृपया इस मानक के मसौदे का अवलोकन करें और अपनी सम्मतियों यह बताते हुए भेजें कि यदि ये मानक के रूप में प्रकाशित हो तो इन पर अमल करने में आपके व्यवसाय अथवा कारोबार में क्या असर पड़ेगा आ सकती हैं।

सम्मतिया भेजने की अंतिम तिथि 25 दिसम्बर 2016

सम्मति यदि कोई हो तो कृपया divya.s@bis.org.in, ced2@bis.gov.in पर ईमेल करें।

यदि कोई सम्मति प्राप्त नहीं होती है अथवा सम्मति में केवल भाषा सम्बन्धी वित्त प्राप्त करने की यथायोग्य अंतिम रूप दिया जाएगा। यदि सम्मिलित तकनीकी प्रकृति की हुई तो विषय समिति के अध्यक्ष के प्रारंभिक से अथवा उनकी इच्छा पर आगे की कार्रवाही के लिए विषय समिति को भेजे जाने के बाद प्रलेख को अंतिम रूप दे दिया जाएगा।

यह प्रलेख भारतीय मानक ब्यूरो की वेबसाइट पर भी है।

धन्यवाद । 

भवदीय,  
(बी के सिन्हा)  

प्रमुख (सिविल इंजीनियरी)
ADDRESS TO:
1. All Members of Civil Engineering Division Council, CEDC
2. All Members of CED 2,
3. All others interested

Dear Sir (s),

Please find enclosed the following documents:

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<td>Part 6 Tests on fresh Self Compacting Concrete</td>
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Kindly examine the draft and forward your views stating any difficulties which you are likely to experience in your business or profession, if this is finally adopted as National Standard.

Last Date for comments: **25 December 2016**

Comments if any, may please be made in the format as given overleaf and mailed to divya.s@bis.org.in or ced2@bis.gov.in.

In case no comments are received or comments received are of editorial nature, you will kindly permit us to presume your approval for the above document as finalized. However, in case comments of technical in nature are received then it may be finalized either in consultation with the Chairman, Sectional Committee or referred to the Sectional Committee for further necessary action if so desired by the Chairman, Sectional Committee.

The documents are also hosted on BIS website [www.bis.org.in](http://www.bis.org.in).

Thanking you,

Yours faithfully,

(B K Sinha)
Head (Civil Engg.)

Encl: as above
FORMAT FOR SENDING COMMENTS ON THE DOCUMENT

[Please use A4 size sheet of paper only and type within fields indicated. Comments on each clause/sub-clause/ table/figure, etc, be stated on a fresh row. Information/comments should include reasons for comments, technical references and suggestions for modified wordings of the clause. **Comments through e-mail to divya.s@bis.org.in** shall be appreciated.]

**Doc. No.:** CED 2(10896)WC  **BIS Letter Ref:** CED 2:2/T-92  **Dated:** 25 October 2016

**Title:** *Draft for Methods of Sampling and Analysis of Concrete: Part 6: Tests on Fresh Self Compacting Concrete (IS 1199 (Part 6))*

**Name of the Commentator/Organization:** ________________________________

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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Cement and Concrete Sectional Committee had been approved by the Civil Engineering Division Council. Testing plays an important role in controlling the quality of cement concrete work. Systematic testing of the raw materials, the fresh concrete and the hardened concrete, is an inseparable part of any quality control programme for concrete. This helps achieve a higher efficiency of the materials used and greater assurance of the performance of the concrete, in regard to workability, strength and durability. The test methods used should be simple, direct and convenient to apply. This standard was prepared with this object in view.

This standard was first published in 1959. In this first revision, it was decided to review and update the various existing test methods of fresh concrete taking into consideration the latest international practices and developments in this field in the country, and also introduced certain new test methods wherever required. In the process, the various existing test methods covered in IS 1199:1959 ‘Method of Sampling and Analysis of Concrete’ have been revised taking into consideration primarily the corresponding ISO standards while also examining the other best practices world over and in the country. In addition, test methods for determination of properties of new types of concrete like self compacting concrete have been included, covering tests such as consistency, viscosity, passing ability and segregation resistance. Also, for better understanding and implementation, some of the other test methods which were spread over in other Indian standards have been brought together under the fold of IS 1199 as its various parts, such as the setting time of concrete by penetration method and, water soluble and acid soluble
chlorides in mortar and concrete. This is with a view to making the standard complete in all respects, and rendering it a comprehensive source of provisions for testing of concrete and reference in other Indian Standards.

In this revision, the standard is being brought out in the following parts:
Part 1 Sampling of fresh concrete
Part 2 Determination of consistency of fresh concrete
Part 3 Determination of Density of Fresh Concrete
Part 4 Determination of Air Content of Fresh Concrete
Part 5 Making and curing of test specimens
Part 6 Tests on fresh Self Compacting Concrete
Part 7 Determination of setting time of concrete by penetration resistance
Part 8 Determination of water soluble and acid soluble chlorides in mortar and concrete
Part 9 Analysis of freshly mixed concrete

This Standard (Part 6) covers the procedures for testing of fresh self-compacting concrete.

This revision has been taken up to incorporate the modifications found necessary in the light of experience gained in its use and also to bring it in line with the latest development on the subject. Significant provisions in this revision are highlighted below:

- These are newly introduced test methods for self compacting concrete (SCC).
- These test procedures are based on the latest literature on this topic as well as latest research data.
- The test methods for the determination of consistency, viscosity, passing ability and segregation resistance have been included.
- For consistency determination of SCC, the flowability is evaluated by measuring the maximum spreading diameter ($d_{\text{max}}$) and the time the concrete takes to reach the spreading diameter of 500 mm ($t_{500}$).
- For viscosity determination, the V funnel test for determining the flow time of SCC has been included. This test also gives the filling ability of the concrete.
- For passing ability determination of SCC, the L box test is specified, which measures the passing ability of self-compacting concrete to flow through tight openings including spaces between reinforcing bars and other obstructions without segregation or blocking.
- For assessing the segregation resistance of SCC, the sieve segregation resistance test is specified. A known weight of the sample, kept stagnant for 15 minutes, is poured into a sieve, and the segregation ratio is then calculated as the proportion of the sample passing through the sieve.
For the purpose of deciding whether a particular requirement of this standard is compiled with, the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2:1960 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that specified value in this standard.

BUREAU OF INDIAN STANDARDS

Cement and Concrete Sectional Committee, CED 2

Last Date for Comments: 25 December 2016

[ICS 91.100.30]

Draft Indian Standard

METHODS OF SAMPLING AND ANALYSIS OF CONCRETE:
PART 6: TESTS ON FRESH SELF COMPACTING CONCRETE

WARNING: When carrying out this test, prevent skin contact with wet cement or concrete by wearing suitable protective clothing (gloves, safety glasses). If wet cement or concrete enter the eye, immediately wash it out thoroughly with clean water and seek medical treatment without delay. Wash wet concrete off skin immediately.

1. Scope

This part of the standard specifies procedures for testing of fresh self-compacting concrete. It specifies the following test methods: determination of consistency (slump flow test), V funnel test, L box test, Sieve segregation test and J ring test

2. References

The Indian Standards listed in Annex A contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A. Whenever a reference to any standard mentioned in Annex A appears in this standard, it shall be taken as a reference to the latest version of the standard.
3. Terminology

3.1 Self Compacting Concrete (SCC) — SCC is an innovative concrete that does not normally require vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, without segregation, even in the presence of congested reinforcement.

3.2 Passing ability

Ability of fresh concrete to flow through tight openings such as spaces between steel reinforcing bars.

3.3 Segregation resistance

The ability of concrete to remain homogeneous in composition while in its fresh state.

3.4 Slump flow

The mean diameter of the spread of fresh concrete using conventional slump cone.

Section 1: Slump-flow Test and T<sub>500mm</sub> Test

This test specifies the procedure for determining the slump-flow and t<sub>500</sub> time for self-compacting concrete. The test is not suitable when the maximum size of the aggregate exceeds 40 mm.

4. Principle

The slump-flow test is an indication of the flowability of self-compacting concrete in the absence of obstructions. It is based on the slump test described in IS 1199 (Part 2). The flowability is evaluated by measuring the maximum spreading diameter (d<sub>max</sub>) and the time it reaches the spreading diameter of 500 mm (t<sub>500</sub>). The d<sub>max</sub> of spreading is a measure of the self-compacting concrete flow range when subjected to load from its own weight. It is an indication of the yield stress of the self-compacting concrete. The t<sub>500</sub> time is a measure of the speed of flow and an indication of the relative viscosity of the self-compacting concrete. The result is an indication of the filling ability of self-compacting concrete.

The fresh concrete is poured into a cone as used for the IS 1199 (Part 2) slump test. When the cone is withdrawn upwards the time from commencing upward movement of the cone to when the concrete has flowed to a diameter of 500 mm is measured; this is the t<sub>500</sub> time. The largest diameter of the flow spread of the
concrete and the diameter of the spread at right angles to it are then measured and the mean is the slump-flow.

5. Apparatus

The apparatus shall be in accordance with IS 1199 (Part 2) except as detailed below.

5.1 Base plate, made from a flat steel plate, with a plan area of at least 900 mm × 900 mm on which concrete can be placed.

The plate shall have a flat, smooth surface. The surface shall not be readily attacked by cement paste or be liable to rusting. The construction of the plate shall be such as to prevent distortion. The deviation from flatness shall not exceed 3 mm at any point when a straight edge is placed between opposing sides and corners.

The center of the plate shall be scribed with a cross, the lines of which run parallel to the edges of the plate and with circles of (210 ± 1) mm diameter and (500 ± 1) mm diameter having their centers coincident with the center point of the plate. See Figure 1. All lines to be a maximum of 2.0 mm wide and 1.0 mm deep.

Fig. 1 – Baseplate

5.2 Rule or measuring tape, of minimum length 1000 mm and having subdivisions not greater than 5 mm along its entire length.
5.3 **Stop watch**, capable of measuring to 0.1 s.

5.4 **Spirit level**, for checking horizontality of base plate prior to commencing the test.

5.5 **Container**, to hold the test sample and having a volume of at least 10 l.

6. **Test sample**

About 6 litres of concrete is needed to perform the test. The sample shall be obtained in accordance with IS 1199 (Part 1)

7. **Procedure**

Place the base plate on a flat and horizontal surface free from external vibration or shock. Check the top surface for horizontality using the spirit level. Clean the table and the cone and dampen immediately prior to testing, but keep free from excess moisture.

Place the cone centrally within the 210 mm circle on the base plate and hold in position by standing on the foot pieces, ensuring that no concrete can leak from under the cone.

Fill the cone in one operation without any agitation or mechanical compaction, and strike off surplus from the top of the cone. Allow the filled cone to stand for not more than 30s; during this time remove any spilled concrete from the base plate.

Lift the cone vertically in 1s to 3s in one movement without interfering with the flow of concrete. If the $t_{500}$ time has been requested, start the stop watch immediately the cone ceases to be in contact with the base plate and record the time taken to the nearest 0.1 s for the concrete to first touch the 500 mm circle.

After the flow of concrete has stabilized without disturbing the base plate or concrete, measure the largest diameter of the flow spread and record as $d_1$ to the nearest 10 mm. Then measure the diameter of the flow spread at right angles to $d_1$ to the nearest 10 mm and record as $d_2$ to the nearest 10 mm. If the difference between $d_1$ and $d_2$ is greater than 50 mm another sample shall be taken and the procedure repeated.

If two consecutive tests show the difference between $d_1$ and $d_2$ to be greater than 50 mm, the concrete lacks the necessary flowability for the slump-flow test to be suitable.

Check the concrete spread for signs of segregation and report under cl. 9g in a
qualitative way, e.g. no indication of segregation, strong indication of segregation.

NOTE: Signs of segregation include a ring of cement paste/mortar and segregated coarse aggregate in the central area.

8. Test result

The slump-flow SF is the mean of d1 and d2, expressed to the nearest 10 mm, given by the following equation.

\[ SF = \frac{(d1 + d2)}{2}, \]

Where,

- SF is the slump-flow, in millimeters;
- d1 is the largest diameter of flow spread, in millimeters;
- d2 is the flow spread at 90° to d1, in millimeters.

The \( t_{500} \) time is reported to the nearest 0.1 s.

9. Test report

The test report shall include:

- Identification of the test sample;
- Location where the test was performed;
- Date and time of test;
- Ambient temperature,
- Slump-flow, SF, to the nearest 10 mm;
- \( t_{500} \) time, to the nearest 0.1 s (when requested);
- Any indication of segregation of the concrete, no indication of segregation or strong indication of segregation; (see NOTE under 7)
- Any deviation from the standard test method;
- Declaration by the person technically responsible for the test that it was carried out in accordance with this standard, except as noted in item h).

The report may include:

- Temperature of the concrete at the time of test;
- Time between completion of mixing and performance of the tests.

Section 2: V-Funnel Test

10. Introduction

This test specifies the procedure for determining the V-funnel flow time for self-
compacting concrete. The test is not suitable when the maximum size of the aggregate exceeds 20 mm. The V-funnel test is used to assess the viscosity and filling ability of self-compacting concrete.

11. Principle

A V shaped funnel is filled with fresh concrete and the time taken for the concrete to flow out of the funnel is measured and recorded as the V-funnel flow time.

12. Apparatus

12.1 V-funnel, made to the internal dimensions and tolerances in Figure 2, fitted with a quick release, watertight hinged or sliding gate at its base and supported by a frame so that the top of the funnel is horizontal with sufficient clearance beneath the gate to place the container underneath. The V-funnel shall be made from metal or fibre glass; the surfaces shall be smooth, and not be readily attacked by cement paste or be liable to rusting.

12.2 Container, to hold the test sample and having a volume larger than the volume of the funnel and not less than 12 liters.

12.3 Stop watch, capable of measuring to 0.1 s.

12.4 Straight edge, for striking off concrete level with the top of the funnel.

13. Test sample

A sample of at least 12 litres shall be obtained in accordance with IS 1199 (Part 1).
14. Procedure

Clean the funnel and bottom gate, then dampen all the inside surface including the gate. Close the gate and pour the sample of concrete into the funnel in one operation, without any agitation or mechanical compaction, then strike off the top with the straight edge so that the concrete is level with the top of the funnel. Place the container under the funnel in order to collect the concrete. After a delay of $(10 \pm 2)$ s from filling the funnel, open the gate quickly and measure the time $t_v$, to 0.1 s, from opening the gate to when it is possible to see vertically through the funnel into the container below for the first time. The time $t_v$ is the V-funnel flow time. The flow of concrete from the funnel shall be continuous. If a blockage occurs the test shall be repeated. If a second blockage occurs the concrete lacks the necessary viscosity. Report if a blockage has occurred.

15. Test report

The test report shall include:

a) identification of the test sample;
b) location where the test was performed;
c) date when test performed;
d) Ambient temperature;
e) V-funnel flow time ($t_v$) to the nearest 0.1s;
f) Any deviation from the standard test method;
g) Declaration by the person technically responsible for the test that it was carried out in accordance with this standard, except as noted in item g).

The report may include:
h) Temperature of the concrete at the time of test;
j) Time between completion of mixing and performance of the tests.

Section 3  L Box Test

16. Introduction

The L-box test is used to assess the passing ability of self-compacting concrete to flow through tight openings including spaces between reinforcing bars and other obstructions without segregation or blocking.

17. Principle

The L box test is used to assess the passing ability of self-compacting concrete to flow through tight openings including spaces between reinforcing bars and other obstructions without segregation or blocking. There are two variations; the two bar test and the three bar test. The three bar test simulates more congested reinforcement.

A measured volume of fresh concrete is allowed to flow horizontally through the gaps between vertical, smooth reinforcing bars. The heights of the concrete in the vertical section (H1) and at the end of the horizontal section (H2), see Figure 3, are measured and the ratio $H2/H1$ determined. This ratio is a measure of the passing or blocking behaviour of self-compacting concrete.

18. Apparatus
18.1 **L box**, having the general arrangement and internal dimensions as shown in Fig. 3.

The L box shall be of rigid construction with surfaces that are smooth, flat and not readily attacked by cement paste or be liable to rusting. The vertical hopper may be removable for ease of cleaning.

The bar positioning system shall be such that two smooth steel bars of \((12 \pm 0,2)\) mm diameter will provide a gap of \((59 \pm 1)\) mm for the two bar test and three smooth steel bars of \((12 \pm 0,2)\) mm diameter will provide a gap of \((41 \pm 1)\) mm for the three bar test. The system shall locate the bars in the L box so that they are vertical and equidistant across the width of the box, as shown in Figure 4.

**Figure 3 – Typical general assembly of L box showing required dimensions**
Figure 4 – Bar positions in L box

The surface of any material used in the assemblies shall not be readily attacked by cement paste or be liable to rusting.

18.2 Rule or measuring tape, of minimum length 500 mm and graduated at intervals not exceeding 1 mm, the zero mark being at the extreme end of the rule or measuring tape.

18.3 Containers, to hold the sample and having a total volume not less than 14 l.

18.4 Spirit level, for checking horizontality of base of L box base prior to commencing the test.

18.5 Straight edge, for striking off concrete level with the top of the L box.

19. Test sample
A sample of at least 12 litres shall be obtained in accordance with IS 1199Part 1.

20. Test procedure
Support the L box on a level base and check for horizontality using the spirit level. Clean the L box and dampen immediately prior to testing, but keep free from excess moisture. Close the gate between the vertical and horizontal sections. Pour the concrete from the container(s) into the filling hopper of the L box, without any agitation or mechanical compaction, then strike off the top with the straight edge so that the concrete is level with the top of the vertical section of the L box and allow to stand for (60 ± 10) s. Check the concrete for signs of segregation before and after
filling of the L box and report under cl. 22d) in a qualitative way, e.g. no indication of segregation, strong indication of segregation.

NOTE: Signs of segregation include a layer of cement paste/mortar and segregated coarse aggregate at the top.

Fully open the sliding gate in a smooth continuous action to allow the concrete to flow into the horizontal section. When movement has ceased, measure the drop in height of the level of concrete $\Delta H_1$ to the nearest 1 mm in the vertical section on the gate side of the box at three positions equally spaced across the width of the box. The mean depth of the concrete $H_1$ is the difference between the height of vertical section and the average of the three readings of $\Delta H_1$. Record $H_1$ to the nearest 1 mm. The same procedure is used to calculate the mean depth of the concrete at the end of the horizontal section of the L box $H_2$ from the difference with the height of the horizontal section and the average of the three readings of $\Delta H_2$. Record $H_2$ to the nearest 1 mm.

21. Test result

The passing ability ratio $P_L$, as measured by the L box test, is calculated to the nearest 0.01 from the following equation:

$$ PL = \frac{H_2}{H_1} $$

Where,

$P_L$ is the passing ability ratio measured by the L box test;

$H_1$ is the mean depth of concrete in the vertical section of the box, in millimetres;

$H_2$ is the mean depth of concrete at the end of the horizontal section of the box, in millimetres.

22. Test report

The test report shall include:

a) Identification of the test sample;

b) Location where the test was performed;

c) Date and time of test;

d) Ambient temperature,

e) Whether two bar or three bar test was carried out;

f) Passing ability ratio, $P_L$, to the nearest 0.05;

g) Any segregation or bleeding observed during filling of the L box, no indication of segregation/bleeding or strong indication of segregation/bleeding; (see NOTE under 20)
h) Any deviation from the standard test method;
j) Declaration by the person technically responsible for the test that it was carried out in accordance with this standard, except as noted in item h).

The report may include:
k) Temperature of the concrete at the time of test;
m) Time between completion of mixing and performance of the tests

Section 4 Sieve Segregation Resistance Test

23. Introduction

This test specifies the procedure for determining the sieve segregation resistance of self-compacting concrete.

24. Principle

The sieve segregation resistance test is used to assess the resistance of self-compacting concrete to segregation. After sampling, the fresh concrete is allowed to stand for 15 min and any separation of bleed water is noted. A known weight of the sample is then poured into a sieve with 4.75 mm square apertures. After 2 min the weight of material which has passed through the sieve is recorded. The segregation ratio is then calculated as the proportion of the sample passing through the sieve.

25. Apparatus

25.1 Perforated plate sieve, having 4.75 mm square apertures, frame diameter 300 mm and height 40 mm, conforming to IS: 460 (Part 2) complete with a receiver from which the sieve can be easily removed by lifting vertically.

25.2 Weighing machine, having a flat platform which can accommodate the sieve receiver and having a capacity of at least 10 kg, calibrated in increments of ≤ 20 g.

25.3 Sample container, a rigid container made from a non-absorbent material and having a minimum internal diameter of 200 mm and a capacity of at least 11 l with a 10 l point indicated on the inside of the container.
25.4 **Timer**, capable of measuring to 1 s.

25.5 **Thermometer**, capable of measuring to 1 °C.

26. **Test sample**
A sample which fills the sample container to be obtained in accordance with *IS 1199-1*.

27. **Procedure**

Take and record the temperature of the concrete to the nearest 1 °C by using the thermometer. Place (10 ± 0.5) litres of concrete in the sample container and cover to prevent evaporation (see Fig. 5).

![Figure 5 – Sample container and cover](image)

**Key**
1. Cover
2. Concrete
3. Sample container

Allow to stand in a level position, without disturbance, for (15 ± 0.5) min.

Ensure the balance is level and free from vibration. Place the sieve receiver on the balance and record its mass, $m_p$ in gm. Then place the dry sieve on the receiver and again record the mass or zero the balance.

At the end of the standing period remove the cover from the sample container and record whether any bleed water has appeared on the surface of the concrete.

With the sieve and receiver still on the balance, and with the top of the sample container (500 ± 50) mm above the sieve, steadily and carefully pour (4.8 ± 0.2) kg
of concrete (including any bleed water) onto the center of the sieve (see Figure 6) in one operation. Record the actual mass of concrete \( m_c \) in gm on the sieve.

![Figure 6 – Measurement of segregated portion](image)

Allow the concrete to stand in the sieve for \((120 \pm 5)s\) and then remove the sieve vertically without agitation.

Record the mass of the receiver, including the material that has passed through the sieve, \( m_{ps} \) in grams.

### 28. Test result

The segregated portion \( SR \) is calculated from the following equation and reported to the nearest 1 percent.

\[
SR = \frac{(m_{ps} - m_p) \times 100}{m_c}
\]

Where,

- \( SR \) is the segregated portion in percent;
- \( m_{ps} \) is the mass of sieve receiver plus passed material, in grams;
\( m_p \)  is the mass of the sieve receiver, in grams;
\( m_c \)  is the initial mass of concrete placed onto the sieve, in grams

29. Test report

The test report shall include:

a) Identification of the test sample;
b) Location where the test was performed;
c) Date and time of test;
d) Ambient temperature;
e) Segregated portion SR, to the nearest 1 \%;
f) Presence of bleed water, if any, after standing for 15 min;
g) Any deviation from the standard test method;
h) Declaration by the person technically responsible for the test that it was carried out in accordance with this standard, except as noted in item g).

The report may include:

j) Temperature of the concrete at the time of test;
k) Time between completion of mixing and performance of the tests.
Annex A
(Clause 2)
List of Indian Standards

1. IS 1199 (Part 1) : 20xx, Methods of Sampling and Analysis of Concrete – Part 1: Sampling of fresh concrete. *(under preparation)*

2. IS 1199 (Part 2) : 20xx, Methods of Sampling and Analysis of Concrete – Part 2: Properties of fresh concrete. *(under preparation)*