SELF COMPACTING CONCRETE
Contents:

- Introduction
- Materials used for SCC
- Requirements of SCC
- Different Tests On SCC
- Mix Proportioning Of SCC
- Advantages and Dis-advantages of SCC
- How Economical is SCC...?
- Places where it is used
1. INTRODUCTION:

- Self Compacting Concrete was first developed in Japan in the year 1980.
- Prof. H. Okamura of University of Tokyo, Japan; is mainly responsible for initiating and initial development of this concrete and is now regarded as the Father of SCC.
- The need for the development of SCC arose from the skilled labor and man power in Japan during 1980’s.
- It is a greatest technological advancement and the most revolutionary development in concrete technology over the years, at least from 1980 till date.
Growth and development:

- Though SCC was first developed to overcome the deficiency of the skilled man power, subsequently it is observed that SCC not only reduces the requirement of man power, but it also results in more durable concrete with the excellent user friendly characteristics.

- It has a big role to play because of the sustainable benefits in construction both quantitatively and qualitatively.

- It is now used in many countries such as Canada, Sweden, Netherlands, USA, Austria, Korea etc.
Mechanism of achieving self compaction

- Reduction of water:binder ratio
- Limitation of CA and it’s maximum size
- Addition of mineral Admixtures
- Use of super Plasticizers and VMA

High segregation resistance of mortar and concrete.

High deformability of mortar and concrete.

SELF COMPACTING CONCRETE.
Comparison Of SCC Over NC

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>NORMAL CONCRETE</th>
<th>SELF COMPACTING CONCRETE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FINES</td>
<td>12%</td>
<td>18%</td>
</tr>
<tr>
<td>SAND</td>
<td>24%</td>
<td>34%</td>
</tr>
<tr>
<td>COARSE AGGREGATES</td>
<td>46%</td>
<td>28%</td>
</tr>
<tr>
<td>WATER</td>
<td>18%</td>
<td>20%</td>
</tr>
<tr>
<td>ADMIXTURE</td>
<td>-</td>
<td>0.01%</td>
</tr>
</tbody>
</table>
2. MATERIALS USED FOR SCC:

- **Cement:** OPC of 43 or 53 grade can be used.
- **Aggregates:** Agg. Of size ltd. to 20mm.
  - Congested Reinforcement: 10 to 12mm
  - Well graded cubical or rounded aggregates.
  - FA can be either natural or manufactured and of uniform grade.
  - Particle sizes <0.125mm are considered as fines
- **Water:** It must be of the same quality used for that of RC or Pre stressed concrete.
2. MATERIALS USED FOR SCC:

• **Chemical Admixtures:** The new generation super plasticizers termed as poly carboxylated ethers is particularly used.
  - **VMA:** For stability
  - **Air Entraining Agents:** To improve Freeze-Thaw resistance
  - **Retarders:** To control setting time

• **Mineral Admixtures:**
  - **GGBS:** To improve Rheological Properties.
  - **Fly ash:** To improve the quality and durability.
  - **Silica Fumes:** To improve Mechanical Properties.
  - **Stone Powder:** To increase the powder content.
3. REQUIREMENTS OF SCC:

The main characteristics of SCC are the properties in the Fresh state. The mixed design is focused on the ability to flow under its own weight without vibration (FILLING ABILITY), and to retain homogeneity (PASSING ABILITY) without segregation (SEGREGATION RESISTANCE). A concrete mix can only be classified as SCC if it has the above mentioned characteristics.
4. DIFFERENT TESTS ON SCC:

<table>
<thead>
<tr>
<th>Filling Ability Tests</th>
<th>Passing ability Tests</th>
<th>Segregation resistance Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slump Flow Test</td>
<td>J-Ring Test</td>
<td>V-funnel At $T_{5\text{minutes}}$</td>
</tr>
<tr>
<td>$T_{50\text{cm}}$ Slump Flow</td>
<td>L-Box Test</td>
<td>GTM Screen stability Test</td>
</tr>
<tr>
<td>V-Funnel Test</td>
<td>U-Box Test</td>
<td></td>
</tr>
<tr>
<td>Orimet</td>
<td>Fill-Box Test</td>
<td></td>
</tr>
</tbody>
</table>
Slump Flow Test
T50 Slump Flow Test
V-Funnel Test
Orimet Test
J-Ring Test
L-box Test

Fig. 3. L-box test
U-Box Test
Fill Box Test
V-Funnel Test At T5minutes
## Limits Of Various Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slump Flow Test</td>
<td>650mm to 800mm</td>
</tr>
<tr>
<td>$T_{50}$ slump flow</td>
<td>2sec to 5sec</td>
</tr>
<tr>
<td>J-ring Test</td>
<td>0 to 10mm</td>
</tr>
<tr>
<td>V-Funnel Test</td>
<td>8sec to 12sec</td>
</tr>
<tr>
<td>V-funnel at $T_{5\text{minutes}}$</td>
<td>+3 seconds</td>
</tr>
<tr>
<td>L-box Test</td>
<td>$H_1/H_2=0.80$ to $1.0$</td>
</tr>
<tr>
<td>U- Box Test</td>
<td>$H_2-H_1=30$mm max.</td>
</tr>
<tr>
<td>Fill Box Test</td>
<td>90% to 100%</td>
</tr>
<tr>
<td>GTM Screen Stability Test</td>
<td>0 to 15%</td>
</tr>
<tr>
<td>Orimet Test</td>
<td>0 to 5%</td>
</tr>
</tbody>
</table>
## 5. MIX PROPORTIONING OF SCC

<table>
<thead>
<tr>
<th>CA</th>
<th>&lt;50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water: Powder</td>
<td>0.8 to 1.0</td>
</tr>
<tr>
<td>Total Paste</td>
<td>400 to 600 kg/m³</td>
</tr>
<tr>
<td>Sand Content</td>
<td>&gt;40% of mortar</td>
</tr>
<tr>
<td>Sand</td>
<td>&lt;50% of paste volume</td>
</tr>
<tr>
<td>Sand</td>
<td>&gt;50% by weight of total aggregates</td>
</tr>
<tr>
<td>Free Water</td>
<td>&lt;200 liters.</td>
</tr>
<tr>
<td>Paste</td>
<td>&gt;40% of the volume of the mix</td>
</tr>
</tbody>
</table>
Mix Design Procedure

1. Determine The Desired Water Content
2. Determine The Coarse Aggregate Volume
3. Determine The Sand Content
4. Determine The Paste Content
5. Determine The Optimum Water to Powder Ratio and super plasticizer dosage in mortar
6. Finally the concrete properties are assessed by the standard tests.
## Limiting Proportions of Ingredients by Weight

<table>
<thead>
<tr>
<th>Ingredients In Kg/m³</th>
<th>Self Compacting Concrete</th>
<th>Normal Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Aggregates</td>
<td>750-920</td>
<td>880</td>
</tr>
<tr>
<td>Fine Aggregates</td>
<td>710-900</td>
<td>930</td>
</tr>
<tr>
<td>Powder Binder</td>
<td>400-600</td>
<td>310 (cement)</td>
</tr>
<tr>
<td>Water</td>
<td>150-200</td>
<td>190</td>
</tr>
</tbody>
</table>
6. ADVANTAGES OF SCC

- Reduced Permeability

- Improves Quality, durability, and reliability of concrete structure due to better compaction and homogeneity of concrete.

- Ease of placement results in cost savings through reduced equipment and labor requirement.

- Less noise from vibrators and reduced danger from Hand Arm Vibration Syndrome

- Greater Freedom In Design

- Improves working condition and productivity in construction industry

- Faster construction

- Elimination of problems associated with vibration
6. DIS-ADVANTAGES OF SCC

- More Stringent Requirement on the selection of materials.
- Lack of globally accepted test standard and mix design
- Costlier than conventional concrete based on concrete material cost (exception to placement cost)
- Requires more Trial batches at lab as well as at RMC plants
- More precise measurement and monitoring of constituent materials.
7. How Economical Is SCC...?

- There is a feeling that cost of SCC is much higher than that of corresponding normal or high strength concrete.
- It is seen that the materials of SCC is about 10-15% higher than NC.
- If one takes the other components of costs such as cost of compaction, finishing, etc. then one would realize that SCC is certainly not a costly concrete for comparable strength.
8. USES OF SCC

- Complicated reinforcement
- Raft Foundation
- Retaining Walls
- Pile foundation
- Repairs, Restoration and renewal.
9. Major constructions Using SCC

Bandra-Worli sea link project
9. Major constructions Using SCC

Delhi metro project
9. Major constructions Using SCC

Shin-Kiba Ohashi Bridge
9. Major constructions Using SCC

Anchorage 4A of Akashi-Kaikyo Bridge
9. Major constructions Using SCC

Tarpur nuclear Power plant
Heavily Reinforced section
Seating Benches Constructed Using SCC