Smart Dynamic Concrete and its Applications

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Sustainability in Concrete Technology and Construction
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The two extremes……

Normal or Traditional Vibrated Concrete (TVC)
- High stability (+)
- Difficult to place (-)
- Dependent on human skill for compaction (-)

Self-Consolidating Concrete (SCC)
- Highly flowable (+)
- Easy to place (+)
- Increased binder (-)
- High strengths (+/-)
Everyday Concrete = Grades C20 to C35
What is Smart Dynamic Concrete (SDC)?

- Fits between TVC and SCC
- Contains less binder but exhibits SCC properties
- Everyday concrete made Extraordinary
- Flowable for grades M20 – M40
- Placed with no vibration
- Faster completion of projects
- Overall savings in Construction
Comparison between SCC & SDC

SCC
450Kg/m³ of cementitious content

SDC 1
380Kg/m³ of cementitious content

SDC 2
350Kg/m³ of cementitious content
Shanghai Tower, China

World’s Second Tallest Building

- Architectural height: 632 m
- Occupied height: 556.7 m
- Floors above ground: 121
- Floors below ground: 5
- Number of elevators: 106
- World’s fastest elevator: 1080 m/min

Sustainability
- LEED Gold certification
- China Green Building Three Star rating
Shanghai Tower

- Ambient temperature: 8~15 °C
- Raft foundation diameter = 120 m & depth = 6 m
- 450 agitator trucks, 18 pumps, 6 + 1 RMC plants
- Mix design C50 grade concrete

<table>
<thead>
<tr>
<th>Water Kg/m³</th>
<th>Cement Kg/m³</th>
<th>Slag Kg/m³</th>
<th>Fly ash Kg/m³</th>
<th>Sand Kg/m³</th>
<th>Stone Kg/m³</th>
<th>Dosage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>240</td>
<td>120</td>
<td>80</td>
<td>760</td>
<td>1000</td>
<td>0.9%</td>
</tr>
</tbody>
</table>

- Admixture: Rheoplus 325 SDC
- Mixing time: 45s
- Fresh concrete properties
  - Initial slump (flow): 220mm/550mm
  - Flow on site after 2hours: >500mm
SDC - WALLS
Slums in India, housing shortages
Modular formwork prepared for SDC
SDC – no plastering before painting
Slum Clearance Board project, Bangalore
Mix Design for SDC in Bangalore
M20 grade concrete

<table>
<thead>
<tr>
<th>Binder Content</th>
<th>Agg. Content</th>
<th>Admixture</th>
<th>Admix %</th>
<th>Slump flow</th>
<th>Comp Strengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>360 Kgs</td>
<td>1700</td>
<td>MasterGlenium SKY 6100</td>
<td>0.8%</td>
<td>600 mm</td>
<td>15 20 35</td>
</tr>
</tbody>
</table>

Binder = Portland Cement with 50% GGBFS
Water/Binder ratio = 0.47
Rajiv Gandhi Rural Housing project, India

Completed in 6 days !!!
Long Distance Pumping

Chuzachen in Sikkim, Hydro Power Project

Pumping distance = 2.4 km and down hill (gradient 1: 32)
Precast Concrete

Box Culverts

Septic Tanks
Benefits of SDC

1. Reduction in construction time by 50%
2. Reduction in machinery & fuel costs for vibration
3. Reduction in cost due to repairs
4. Easy placement with no compaction
5. Good surface finish / plastering avoided
6. Reduction in labour costs
7. Overall reduction in cost of the structure
8. Enhanced durability and service life of structure
Summary of the Innovation

**Smart**

Technology
- Robust mix design
- Tailor-made HRWR
- Unique VMA

**Dynamic**

Features
- Uses less Binder
- 20 - 40 MPa strength
- 50-70 cm slump flow

**Concrete**

Benefits
- Economics
- Ecology
- Ergonomics
THANK YOU