Self compacting concrete

EX³ Performance special concrete range

Technical data sheet
Holcim Romania, is the company which constantly raised the standards in the constructions domains, proposing permanently innovative products and solutions to respond to the most various needs.

Holcim’s concretes were always appreciated for their quality and performance. The offer of Holcim Romania is however ready to meet the future buildings with the EX3 special concrete range. The constructions of the future will be increasingly high. Slimmer. More unconventional. The architects and the designers are increasingly daring and the buildings are increasingly challenged.

Holcim Romania is however ready to meet the future buildings with the EX3 special concrete range. EX3 special concrete range has emerged from the desire to always exceed our limits and to offer you the most progressive and efficient solutions to the challenges imposed by the projects where you are involved in.

EX3 represents „Excellence at cube”. It is a promise made to our partners that the performance and the quality of the products from the new special concrete range are at the highest level. EX3 comprises:

• EX3 Performance – special performance concretes
• EX3 Estetica – decorative special concretes
• EX3 Concept – special concretes adapted to some special needs

Self compacting concrete

General information

Self compacting concrete is a special concrete, capable to flow under its own weight, filling completely the framework and insuring an appropriate compaction, without vibration, even in the case of the existence of a vertical cladding variant.

The concrete’s consistency is modified by using special additives.

The self compacting concrete’s composition insures the homogeneity, without presenting segregation phenomena.

The hardened concrete is compact, presenting characteristics and durability similar to those of the traditional concrete (vibrated).

The conditions of the self compacting concrete’s composition, according to the European Guide for self compacting concrete (EFNARC), are the following:

• the volume of coarse aggregate varies between 28-38% of the concrete’s volume
• the volume of paste is comprised between 30-42% of the concrete’s volume
• the volume of powder is inscribe in the area 15-21% of the concrete’s volume
• the volume of fine aggregate (sand) represents 25-40% of the concrete’s volume
• the maximum diameter of the aggregate’s granule is 50 mm.

Areas of use

• Reinforced concrete civil, industrial and agricultural constructions: monolith structures made by usual technologies (foundations, floors, pillars, walls, slabs, beams, straps, etc.) or by special technologies (e.g. technology for the execution of diaphragm walls).
• Art works: bridges, viaducts, reinforced concrete tunnels, etc.
• Reinforced concrete precast elements: sleeve foundations, pillars, wall panels, beams, dales/ tiles, wedges, columns for the electricity network, special supporting/ retaining elements (inclinations, mine walls, etc.)

Exposure range/classes (according to CP 012-1:2007)

<table>
<thead>
<tr>
<th>Without risk of corrosion attack</th>
<th>Corrosion due to carbonation</th>
<th>Corrosion due to chlorides having other origin than marine</th>
<th>Corrosion due to chlorides of the sea water</th>
<th>Attack for frost-thaw in saturated status with water and thawing agents</th>
<th>Chemical attack</th>
</tr>
</thead>
<tbody>
<tr>
<td>XD</td>
<td>XC1, XC2, XC3, XC4</td>
<td>XD1, XD2, XD3</td>
<td>XS1</td>
<td>XF1, XF2, XF3, XF4</td>
<td>XA1, XA2, XA3</td>
</tr>
</tbody>
</table>

* Vertical surfaces of the concrete exposed to frost and directly subject to splashing with thawing agents.
** In case the chemical attack is not of sulphate type.

Note: According to tables F1.1 F1.2 of Code of practice for the concrete production CP012-1:2007, the requirements regarding the concrete class, the cement minimum dosage and related to the driven air shall be complied with.
Advantages of self compacting concrete

**Execution safety**
- High compaction and homogeneity of the concrete, which insure the durability of the construction
- Insurance of the quality of the works by reducing the risks due to human errors

**Flexibility**
- Execution of complex architectural works, by the correct and complete filling capacity of the formworks, no matter their shape
- Execution of the thin sections elements
- Possibility to remain expose concrete (simple or ornamental)

**Protection of humans and of the environment**
- Safe working environment
- Improved conditions of work on site
- Reduced noise level during the work placing

**Reduction of cost by**
- Reduction of the labor force
- Shortening the work placing time
- Decreasing the concrete’s pumping pressure and, as a consequence, the reduction of the pumps’ wear
- Elimination of vibration equipments
- Reduction or elimination of the repairing costs (surface flaws)

Characteristics of the self compacting concrete

Self compacting concrete is characterized, in fresh condition, by the following features:

- Capacity to spread / flow under its own weight;
- Viscosity;
- Passing through ability (evaluated through the capacity of passing through narrow spaces, without the tendency to segregation or blocking);
- Resistance to segregation (property to remain homogeneous during transportation and work placing).

The specific requirements of self compacting concrete depend on the application manner, especially of:

- Geometry of the concrete elements, quantity, type and position of the cladding;
- The manner of work placing (e.g.: pumping, directly from the self blender, ladle, etc.);
- Number and position of the pouring/casting points;
- Finishing method.

In order to cover these requirements, there are various methods to establish the concrete’s consistency.
Consistency includes the characteristics related to the flowing capacity, viscosity, ability of passing through and the resistance to segregation.

The flowing capacity is measured by establishing the concrete’s spreading by settling (SR EN 12350-8).

<table>
<thead>
<tr>
<th>Examples of applications</th>
<th>Class SF1 (550-650mm)</th>
<th>Class SF2 (660-750mm)</th>
<th>Class SF3 (760-850mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structures of simple or plain concrete</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Concrete pumped into the lining works (e.g.: tunnels)</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Reduced sections works (piles, high depth foundations, etc.)</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Majority of the applications (e.g.: walls, pilars, etc.)</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Vertical elements with conglobated reinforcement</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Elements with complicated geometry</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Grouting</td>
<td>★</td>
<td>★</td>
<td>★</td>
</tr>
</tbody>
</table>

*Note: The applications specified in the table above are only informative.*

Viscosity may be assessed by the flowing time, T500 during the spreading test or by the flowing time through J’-tunnel test (SR EN 12350-9).

<table>
<thead>
<tr>
<th>Class</th>
<th>T500 (s)</th>
<th>Tolerance according SR EN 206-9</th>
</tr>
</thead>
<tbody>
<tr>
<td>VF1</td>
<td>≤ 2</td>
<td>± 1</td>
</tr>
<tr>
<td>VF2</td>
<td>≥ 2</td>
<td>± 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class</th>
<th>Flowing time V-tunnel (s)</th>
<th>Tolerance according SR EN 206-9</th>
</tr>
</thead>
<tbody>
<tr>
<td>VF1</td>
<td>≤ 9</td>
<td>± 3</td>
</tr>
<tr>
<td>VF2</td>
<td>≥ 9</td>
<td>± 5</td>
</tr>
</tbody>
</table>
The low viscosity concrete will initially have a very rapid flow, and then will suddenly stop. The high viscosity concrete may continue to spread over for a longer time period.

The viscosity conditions must be specified only in special cases.

### Examples of special cases requirements

<table>
<thead>
<tr>
<th>VS1/F1</th>
<th>VS2/F2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very thick cladding network and flat surface requirement, with limited number of alveoli (e.g. exposed concrete)</td>
<td>–</td>
</tr>
<tr>
<td>Limitation of the pressure at the basis of the formwork in case of vertical elements (the increase of the spreading time leads to the enhancement of the thixotropic effects)</td>
<td>–</td>
</tr>
</tbody>
</table>

Note: The applications specified in the table above are only informative.

The passing through capacity is established with the L-box device (SR EN 12350-10) or J-ring device (SR EN 12350-12), existing the following classes:

<table>
<thead>
<tr>
<th>L-box class</th>
<th>Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA1</td>
<td>≥ 80% with 2 bars</td>
</tr>
<tr>
<td>PA2</td>
<td>≥ 80% with 3 bars</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>J-ring class</th>
<th>Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PJ1</td>
<td>≤ 10 with 12 bars</td>
</tr>
<tr>
<td>PJ2</td>
<td>≤ 10 with 16 bars</td>
</tr>
</tbody>
</table>

Examples of choosing the passing class depending on the application:

- **PA1**
  - Distance between the cladding bigger than 100 mm
  - Distance between the cladding between 80 mm and 100 mm
  - Distance between the cladding between 60 mm and 80 mm
  - Distance between the cladding under 60 mm

- **PA2**
  - Not necessary a special demand for the passing capacity.
  - There will be made special tests for the simulation of the working conditions.

### Resistance to segregation

Resistance to segregation is one of the fundamental characteristics of the self compacting concrete. In case of the concretes with high flowing capacity (SF2; SF3) and/or low viscosity class (VS1/VF1).

If for the self compacting concrete are specified the spreading class SF1 and/or the viscosity class VS2/ VF2, it is no longer need to mention the segregation class.

The concrete may present dynamic segregation (during the work placing) or static segregation (after pouring, but before setting).

Both types of segregations are dangerous, may be causing flaws into the concrete’s mass or surface flows (cracks, delamination of the surface, etc.).

Depending on the resistance to segregation, established according to SR EN 12350-11 are delimited two classes of segregation for the self compacting concrete, thus:

<table>
<thead>
<tr>
<th>Class</th>
<th>Resistance to segregation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR1</td>
<td>≤ 20%</td>
</tr>
<tr>
<td>SR2</td>
<td>≤ 15%</td>
</tr>
</tbody>
</table>

### Recommendations

In the situation where, in the project, are not mentioned the self compacting concrete’s characteristics, the consistency classes must be selected carefully, on the basis of the site conditions, by all factors involved in (designer, builder, concrete station).

#### Classes of self compacting concrete delivered by Holcim Romania

<table>
<thead>
<tr>
<th>Class of the concrete</th>
<th>Spreading by setting</th>
<th>Viscosity</th>
<th>Passing through capacity (through the cladding bars)</th>
<th>Resistance to segregation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>SF2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>SF3</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>VS1/VF1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>VS2/VF2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>PA1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>PA2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>PA3</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>PA4</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>SR1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>SR2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Note: In case the the consistency class SF3 is desired (special constructions), it will be made a special request for that project.

For a better use of the self compacting concrete, please consult „Self-compacting concrete – Mini-guide for the work placing“.

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