Chapter 04

Self-Compacting or self-consolidating concrete (2 weeks)

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Content

Chapter III: Self-Consoldating concrete

In French

Chapitre III: 1- Béton auto-plaçant

1. Definition

WHAT IS :

SELF-COMPACTING OR SELF-CONSOLIDATING CONCRETE?

Self-Compacting Concrete (SCC) is defined as concrete that has an ability to flow under its own weight, to fill the required space or formwork completely and to produce a dense and adequately homogenous material without a need for vibrating compaction.

INTRODUCTION:

- Self-Compacting Concrete (SCC), also known as Self-Consolidating Concrete, is a highly flowable type of concrete that can spread and fill mold forms under its own weight without the need for mechanical vibration.
- This type of concrete is designed to achieve optimal consolidation by using a combination of specially engineered materials such as high-range water reducers, fine aggregates, and superplasticizers.

2. Principle of self-compacting concrete

WHAT IS THE

PRINCIPLE OF SELF-COMPACTING CONCRETE ?

The principle of self-compacting concrete (SCC) revolves around achieving a concrete mixture that can flow and consolidate under its own weight, without the need for external energy such as vibration, while maintaining its homogeneity, stability, and resistance to segregation.

Le principe du béton autoplaçant (BAP) consiste à obtenir un mélange de béton qui peut s'écouler et se consolider sous son propre poids, sans nécessiter d'énergie extérieure telle que la vibration, tout en conservant son homogénéité, sa stabilité et sa résistance à la ségrégation.

3. Formulation of self-compacting concrete

3-1. Basic Ingredients of self-compacting concrete

a. **Cement**: Types used in SCC

a. Ordinary Portland Cement (OPC)

b. Portland Pozzolana Cement (PPC)

c. Blended Cements (with Fly Ash, Slag, Silica Fume, etc.)

d. High-Performance Cement

e. Sulphate-Resistant Cement

b. Fine Aggregates:

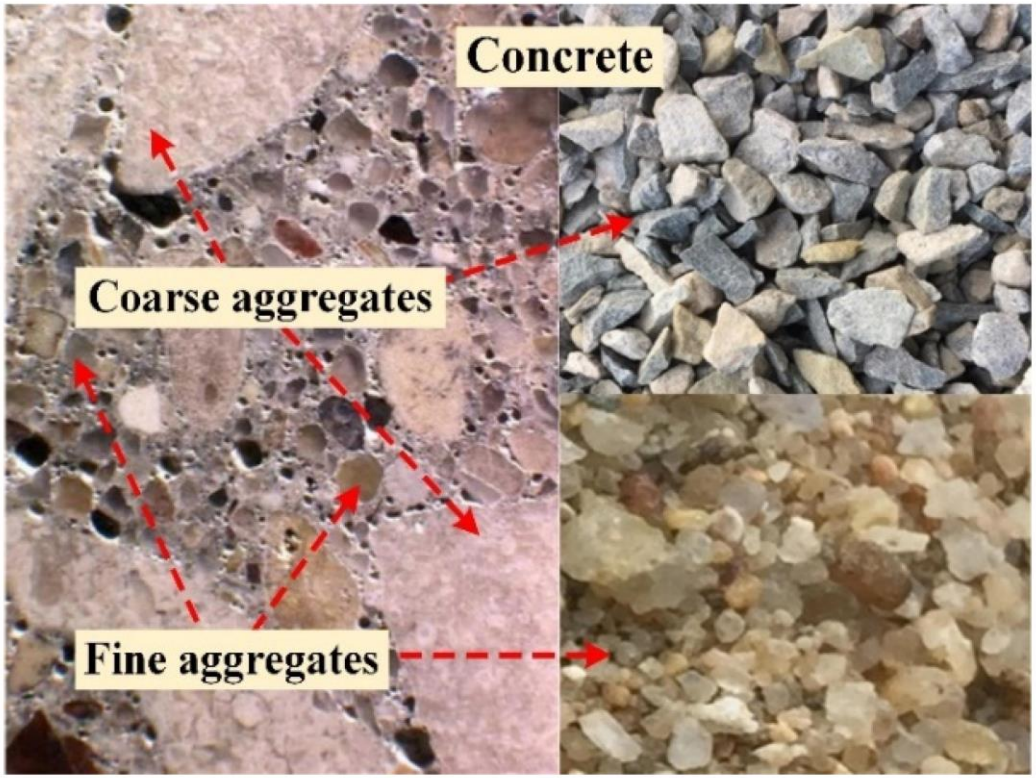
1. Role in SCC:

- **Flowability:**
- **Segregation Resistance:.**
- **Stability:.**

Open Access Article

A Numerical Study of ITZ Percolation in Polyphase Concrete Systems Considering the Synergetic Effect of Aggregate Shape- and Size-Diversities

by Jianjun Lin [1,2,3,*], Qingxin Zhao [1,3], Huisu Chen [2,*], Mingqi Li [4] and Lili Yuan [5]



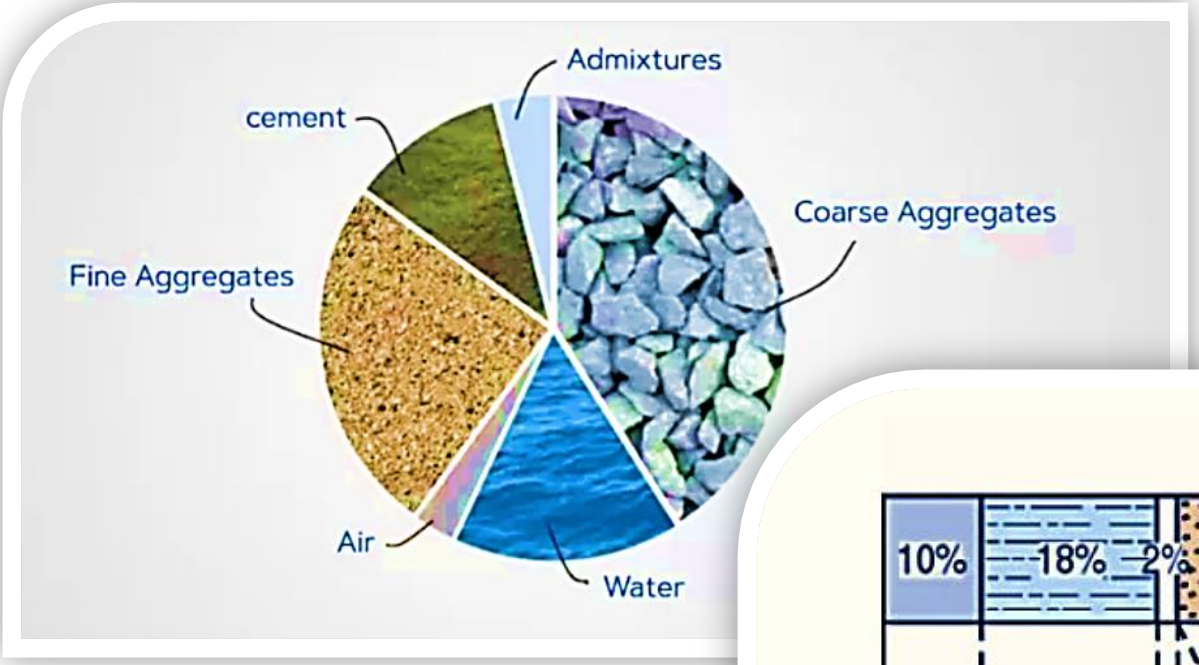
2. Characteristics:

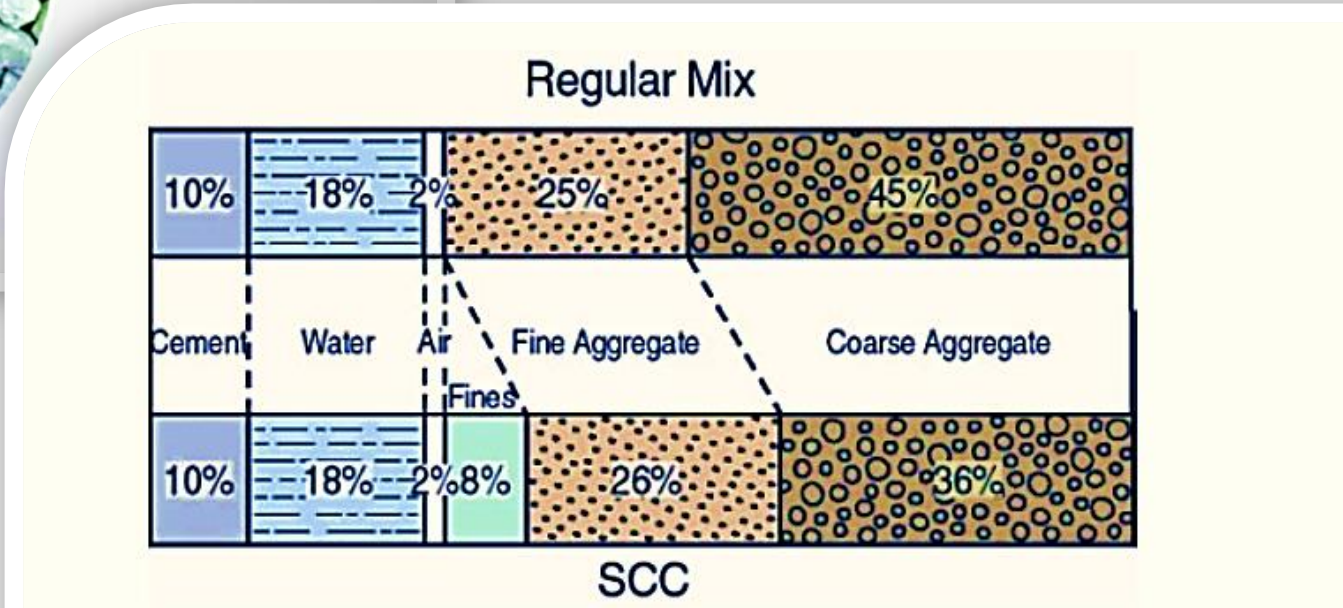
- **Particle Size Distribution**:.
- **Shape**: **Round or smooth particles**
- **Fineness Modulus**
- **Moisture Content (humidité)**
- **Impurities**.

3. Proportioning:

- The quantity of fine aggregates depends on the **cement content** and **water-cement ratio (W/C)**. Higher cement content and lower W/C ratio require careful adjustment of fine aggregate amounts to ensure optimal workability (*maniabilité*) and prevent segregation (segregation, الفصل).

- The use of **superplasticizers** (*superplastifiants*) and **viscosity-modifying agents (VMAs)** may allow for a reduction in the required fine aggregate content while maintaining the desired flow and stability.





SCC: A high-performance concrete innovation.

c. Coarse Aggregates (*Agrégat grossier*):

1. Role in SCC:

- **Strength**: Coarse aggregates provide the bulk and contribute to the compressive strength of SCC.
- **Flowability**: While fine aggregates mainly affect flow, coarse aggregates influence the ease with which SCC passes through reinforcement without blocking.
- **Segregation Resistance**: Well-graded coarse aggregates help maintain the mix's cohesiveness, preventing the separation of coarse particles from the cement paste.

2. Key Characteristics:

- **Particle Size**
- **Gradation**.
- **Shape**
- **Surface Texture**: **Smooth-textured aggregates**

3. Proportioning

The amount of coarse aggregates should be balanced with the cement and fine aggregate content to ensure a mix that flows easily while maintaining strength and resisting segregation.

In summary, coarse aggregates in SCC must be carefully selected for their size, shape, and gradation to optimize **flowability**, **strength**, and **segregation resistance**.

d.**Water**:

1. **Influence on Workability**:

- **Increased Water Content**: More water improves flowability, making it easier for SCC to pass through reinforcement and formwork. However, excessive water can lead to **segregation** and **reduced strength**.
- **Superplasticizers**: These are used to improve flowability without adding excess water, helping maintain stability and cohesiveness in SCC.

2. **Water-Cement Ratio (W/C)**:

- **Lower W/C Ratio**: Increases strength and durability but may reduce flowability, requiring the use of admixtures like superplasticizers.
- **Higher W/C Ratio**: Improves workability but reduces strength and durability.
- **Typical W/C Ratio**: For SCC, the ratio usually ranges from **0.30 to 0.45** to achieve the right balance between strength and flow.

3. **Excessive Water**:

- Too much water leads to **lower strength**, **higher porosity**, and **increased segregation** and **bleeding**.

  Water content in SCC must be optimized to ensure **sufficient flowability** without compromising **strength** and **stability**. Superplasticizers are typically used to maintain high workability with a lower water-cement ratio.

e. **Chemical Admixtures**:

i. **Superplasticizers**: Role in achieving high fluidity without excess water
ii. **Viscosity-Modifying Agents (VMA)**: Ensuring segregation resistance and stability
iii. **Air-Entraining Agents**: In cases where freeze-thaw resistance is needed

4. Key features of self-compacting concrete

Key features of self-compacting concrete include(**Les principales caractéristiques du béton autoplaçant sont les suivantes**):

1. **High Flowability**
2. **Deformability**:
3. **Resistance to Segregation** *(Résistance à la ségrégation)*
4. **Self-Consolidating**
5. **High Strength and Durability**
6. **Improved Surface Finish (Amélioration de l'état de surface)**

5. Application of self-compacting concrete

1. **High-Rise Buildings**
2. **Bridges and Overpasses**
3. **Precast Concrete**
4. **Repair and Rehabilitation**
5. **Complex Architectural Designs**
6. **Mass Concrete Structures**
7. **Tunnels and Underground Construction**
8. **Special Concrete Applications**

Self-Compacting Concrete is used in applications requiring superior workability, reduced labor, faster construction times, and higher-quality finishes, particularly in **complex**, **high-rise**, **precast**, and **repair projects**.