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Concrete

Strength:

Strength, a predominant aspect, primarily focuses on the material's ability to withstand compression, meaning to support loads that tend to compress it. However, it also encompasses its tensile strength, which measures its ability to resist pulling forces that seek to deform it by pulling it in opposite directions. Regarding tests and measurements to assess these properties, a key focal point is compressive strength, measured using various standardized methods and specialized instruments.

Concrete

Non-destructive testing:

Standardized methods used to assess the quality of concrete in buildings or structures only consider destructive tests on specimens cast at the same time. The main disadvantages of these methods are as follows: results are not obtained immediately, the concrete in the specimens may differ from that in the structure because the curing or compaction may be different, and the strengths of the specimens also depend on their dimensions and shapes. Several non-destructive evaluation methods have been developed.

Concrete

Non-destructive testing:

These methods are based on the fact that certain physical properties of concrete can be related to strength and can be measured by non-destructive methods. These physical properties of concrete include hardness (rebound capacity), the ability to transmit ultrasonics, and resistance to pull-off, among others. Here, two tests are mentioned:

1. **NFP 18-417 Sieve test,**

2. **2. NFP 18-418 Sonic auscultation test.**

Concrete

Transport of prepared concrete:

Transporting prepared concrete to the site of its implementation must ensure the preservation of its homogeneity and fluidity level. During prolonged transport, the concrete paste thickens due to cement hydration, water absorption by aggregates, and evaporation. However, the concrete's fluidity at the time of implementation must remain consistent with that established by the project. The choice of transport mode depends

1 -on the distance to be traveled,

2-transport speed,

3-the fluidity degree of the mixture,

4-and the cost of the chosen transport mode.

Concrete

Transport of prepared concrete:

At the plant, fresh concrete transport is facilitated by distributors, self-propelled carts, and conveyor belts. In medium and low-flow plants, it is carried out using electric hoists and electric carts. Fluid mixtures can be transported over long distances in concrete pipelines using compressed air installations.

On the construction site, fresh concrete is delivered by tipper trucks or concrete mixer trucks, where the concrete is mixed approximately 5 minutes before reaching its destination.

Concrete

Transport of prepared concrete:

For each quantity produced, the concrete plant issues a **matrix sheet containing information** such as **the company name and address, sheet number and date of issue, mixture quantity, cement consumption per cubic meter of fresh mixture, particle size of crushed stones and gravel, fluidity and rigidity, concrete class, and results of concrete strength tests on control samples. In recent years, fully automated high-flow concrete.**

plants have experienced significant development, producing commercial concrete and mortar with an average worker efficiency 2.5 times higher than that of mechanized enterprises. This expansion is also accompanied by improved product quality and reduced production costs. In these automated concrete plants, all equipment is technological.

Concrete

Placement of prepared concrete:

Use of concrete mixers or concrete distributors for placement in a mold or formwork.

Objective:

Fill the mold without leaving voids, especially in corners and restricted areas. Concrete compaction:

Compaction methods:

vibration, vibro-stamping, rolling, centrifugal force treatment, or vacuum. Vibration: the most common method. Factors influencing the degree of compaction: frequency, amplitude, and duration of oscillations. Types of vibrators: electromechanical, electromagnetic, pneumatic. Surface vibrators for large open surfaces. Internal vibrators for massive constructions of great depth: Needle vibrators. High-frequency vibrators.

Concrete

Improving concrete quality through vacuum treatment:

- Aspiration of excess water and air from the mixture.
- Increase in atmospheric pressure for better compactness.
- Advantage of vibrating the mixture a second time after vacuum treatment to close pores and improve compactness.

REINFORCED CONCRETE

Summary

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1-Definition:

Concrete is a pre-established mixture of binder (cement), aggregates (sand, gravel, crushed stones), and water, blended in defined proportions. Reinforced concrete is characterized by the embedding of carefully arranged steel within concrete. These steel reinforcements, called rebars, are categorized into longitudinal reinforcements, aligned with the axis of the component, and transverse reinforcements, arranged perpendicular to this axis.

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2-Challenges faced by the constructor:

The challenge lies in ensuring the structural equilibrium against various forces:

- Permanent loads, such as the dead weight of the construction (walls, columns, beams, floors, etc.), the weight of adjacent elements (roof, partitions, cladding), soil pressure, etc.
- Variable loads, including live loads (furniture, occupants), climatic loads, and the effect of temperature.
- Accidental loads, such as earthquakes, vehicle impacts, and falling objects. Additionally, consideration must be given to the upward forces exerted by the soil on the foundations.

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3-Structural components:

These include the following elements:

- **Horizontal:**

For example, floors can be constructed with: Pre-stressed precast beams; Thick slabs (with a thickness of 18 to 25 cm); Slabs with ribs; Slabs with ribs and beams.

- **Vertical or inclined, such as:**

Reinforced concrete columns; Medium-thickness walls (from 18 cm to 20 cm); Walls.

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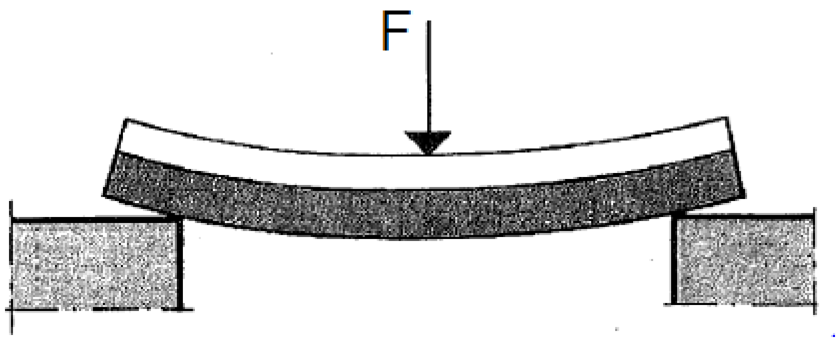
4-The distribution of forces in load-bearing elements:

Let's consider a beam as an example. Material tends to compress on one of its faces (for example, the upper face) and to stretch on another (for example, the lower face). Thus, in the beam, there is an area subjected to compression (in our case, the upper part) and another subjected to tension (in our case, the lower part).



Beam on supports

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5- Properties:

Reinforced concrete is so named due to the combined use of steel and cement concrete. Reinforced concrete is primarily used for components subjected to bending. Indeed, in the phenomenon of bending of components, tensile forces occur on one face of the beam, while compressive forces occur on the other face. On one side, the compressive strength of concrete can reach a value of 450 kg/cm^2, allowing, for an average mix, a practical permanent strength of 50 kg/cm^2. On the other hand, steel is a metal that performs very well under tension, as it can safely withstand a load of 12 to 16 kg/mm^2.

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5- Properties:

Hence the idea of associating the two materials and obtaining the strength of a beam, under bending, by a sufficient mass of concrete to withstand compression and incorporating metal into the parts of this beam subjected to tension. To achieve practical results in such a combination, it is necessary for the metal to bond with the mass of concrete. The bond between steel and concrete is considerable and reaches 40 to 47 kg/cm^2 of contact surface. It has often been observed that steel undergoes no alteration in cement.

REINFORCED CONCRETE

5- Properties:

Therefore, walls and pillars are not exposed to being overturned as in metal constructions. Moreover, from experiments that have been conducted, it has been found that the coefficient of expansion of concrete is substantially the same as that of steel, so that, under the action of fire, the two elements expand equally without causing any disintegration in the mass. As special properties of reinforced concrete, it is not frost-resistant, it poorly conducts heat, sound, and electricity, it has high hardness, and it can be easily molded. Dead loads are low, and it provides economical constructions, especially in large-scale projects.

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6- Materials Used.

6-1- Cement Concrete:

Four mixtures are recommended according to the usage:

1-For concrete used in heavy masses, with the use of large aggregates and a low percentage of reinforcements... 250 kg/m3

2-For standard concrete, controlled and not exposed to weather or aggressive actions... 300 kg/m3

3-For concrete with less controlled manufacturing or for unprotected elements (framework, exposed structure, etc.)... 350 kg/m3

REINFORCED CONCRETE

6- Materials Used.

6-1- Cement Concrete:

Four mixtures are recommended according to the usage:

4-For concrete intended for structures in aggressive atmospheres... 400 kg/m3

The French ministerial circular of 1934 limits the dimensions of sand to a maximum of 5 mm and those of gravel to 25 mm.

Metal: The N.B.N. 179 standard provides the following table summarizing the required characteristics of steel used in the form of smooth reinforcements.

REINFORCED CONCRETE

6- Materials Used.

6-2- STEEL:

The N.B.N. 179 standard provides the following table summarizing the required characteristics of steel used in the form of smooth reinforcements.

	R kg/mm²	R_e minimum en kg/mm²			Coefficient de qualité $R + 2{,}5\,A'$ ou $R + 2{,}2\,A''$ minimum	Simple pliage à froid		
		$d \leqslant 12$	$12 < d \leqslant 16$	$d > 16$		Épais. de la cale $d \leqslant 20$	Épais. de la cale $d > 20$	Angle de pliage
	mm	mm	mm					
A00	$\leqslant 50$	—	—	—	—	4d	4d	180°
A37	37-45	24	22	22	100	0,5d	d	180°

R_e : limite d'élasticité.
A' : allongement sur éprouvette : $L_0 = 8{,}16\sqrt{S_0}$.
A'' : allongement sur éprouvette : $L_0 = 5{,}65\sqrt{S_0}$.

Re: Yield limit.
A': Elongation on test piece
A'': Elongation on test piece

REINFORCED CONCRETE

6- Materials Used.

6-2- STEEL

6-2-1- Mechanical Characteristics of Steel

The steels commonly used for reinforced concrete are classified into three categories:

- Smooth bars of soft, medium, and hard grades (natural hardness).
- High-adhesion bars of medium or hard grade obtained through cold work by twisting or pulling.
- Welded meshes.

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6- Materials Used.

6-2-STEEL

6-2-1-Mechanical Characteristics of Steel

Smooth Round Bars

The diameters of the reinforcement bars, expressed in millimeters, are selected from the following series of standardized diameters: 5, 6, 8, 10, 12, 14, 16,

Welded Meshes

Welded meshes are grids made of smooth drawn wires, assembled at the crossing points by electric welding.

REINFORCED CONCRETE

6- Materials Used.

6-2- STEEL

6-2-1- Mechanical Characteristics of Steel

Welded Meshes

Characteristics:

Nominal yield strength:

— for Ø<6mm . ∂= 5,200 bars (5,300 kgf/cm^2),

— for Ø >6mm . ∂ = 4,410 bars (4,500 kgf/cm^2).

Cracking coefficient: n = 1.

Diameters of wires used for both load-bearing and distribution wires (in mm): 3 3.5 4 4.5 5 6 7 8 9 10 12. Spacing between wire axes:

— load-bearing (in mm): 75, 100, 125, 150, 200

— distribution (in mm): 50, 100, 150, 200, 250, 300.

REINFORCED CONCRETE

7- Comparison between steel and concrete

- Concrete
- Concrete can withstand considerable compressive forces, ranging from 20 to 60 MPa.
- However, it poorly resists tensile forces, only 1.5 to 3.5 MPa.
- In tensile zones, it is prone to failure, so the rule is to disregard tensile concrete in calculations.

- Steel
- Steel is equally strong in compression as it is in tension.
- The ultimate tensile strength of the steel used, even the weakest, ranges from about 400 to 500 MPa.
- Note: In the case of compression, concrete remains more economical than steel. Steel is placed in tension zones.