Basics of Concrete

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Components of Concrete

Cement $\neq$ Concrete
Reasons for using Ready-Mixed Concrete

- Strong
- Pleasing
- Versatile
- Durable
- Natural
- Inexpensive
- Recyclable
- Easy
Most widely used construction material

- More than one cubic meter per person per year
  
  OR

- 2.5 ton per person per Year
Some Examples

The tallest

The deepest
Ready-Mixed Concrete
Concrete components

Concrete components include:

**CONCRETE**
- COARSE AGG.
- FINE AGG.
- CEMENT. MATERIAL
- WATER

**HUMAN BODY**
- SKELETON
- FAT
- MUSCLE
- BLOOD
## Composition of concrete

### Materials (volume %)

<table>
<thead>
<tr>
<th>Material</th>
<th>Volume %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>34</td>
</tr>
<tr>
<td>Sand</td>
<td>30</td>
</tr>
<tr>
<td>Air</td>
<td>3</td>
</tr>
<tr>
<td>Water</td>
<td>18</td>
</tr>
<tr>
<td>Cement</td>
<td>15</td>
</tr>
</tbody>
</table>

### Cost (%)

<table>
<thead>
<tr>
<th>Material</th>
<th>Cost %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>20</td>
</tr>
<tr>
<td>Sand</td>
<td>21</td>
</tr>
<tr>
<td>Cement</td>
<td>59</td>
</tr>
</tbody>
</table>
Properties of fresh concrete

- Workability
- Segregation
- Bleeding
- Heat of Hydration
Properties of fresh concrete

- **Workability**
  - resistance to segregation
  - ease of placement
  - homogeneous mass

- **Consistency** - Ability to flow (measured by Slump cone or Vebe apparatus)

- Cohesiveness – describes the tendency to bleed or segregate
Slump Test

- Inverted cone
- fill it up with three layers of equal volume
- rod each layer 25 times
- scrape off the surface
Execution of Slump Test
Hardened Concrete

- Concrete is normally sold by its Compressive Strength
- This is measured in MPa (N/mm$^2$)
- Typical strength range 10 to 60N/mm$^2$
- Sold by volume (m$^3$), produced by weight (Kg)
Strength of Concrete

COMPRESSIVE
Flexural Strength of Concrete

TENSILE
Split Tensile Strength

Load

0.18 m x 0.3 m specimen

Failure plane
Concrete under various loads

- Concrete very rarely undergoes a crushing or compression failure. Typically, tensile strains generated in the lateral direction (perpendicular to the loading direction) due to Poisson effect are responsible for cracking leading to failure of concrete.
Uniaxial compression
Biaxial compression
Compression and tension
Biaxial tension
Triaxial compression
Uniaxial loading

- Failure planes in uniaxial compression are the planes of principal tensile strains, which are parallel to the direction of the applied load.

- In the case of uniaxial tensile loading, the failure plane is again the plane of maximum principal strain, which in this case is perpendicular to the applied load.