Introduction to Infrastructural Engineering

Construction Materials2

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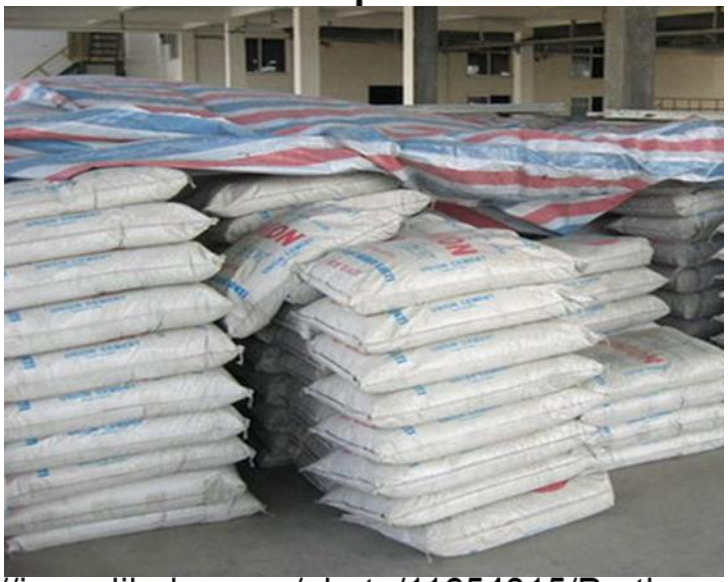
Reinforcement

- Strong in compression, as the aggregate efficiently carries the compression load.
- Weak in tension as the cement holding the aggregate in place can crack, allowing the structure to fail.
- Reinforced concrete solves these problems by adding either metal reinforcing bars, steel fibers, glass fiber, or plastic fiber to carry tensile loads.

Cement

- Crystalline compound of calcium silicates and other calcium compounds having hydraulic properties.
- Considered hydraulic because of their ability to set and harden under or with excess water through the hydration of the cement's chemical compounds or minerals



http://img.alibaba.com/photo/11654315/Portland_Cement_42_5_N_R.jpg

Cement (Cont)

- **Uses**

  Main use is in the fabrication of concrete and mortars

- **Modern uses**

  -Building (floors, beams, columns, roofing, piles, bricks, mortar, panels, plaster)

  -Transport (roads, pathways, crossings, bridges, viaducts, tunnels, parking, etc.)

  -Water (pipes, drains, canals, dams, tanks, pools, etc.)

  -Civil (piers, docks, retaining walls, silos, warehousing, poles, pylons, fencing)

  -Agriculture (buildings, processing, housing, irrigation)

Cement (Cont)

- **HYDRAULIC CEMENTS:**
- **Hydraulic lime**: Only used in specialized mortars. Made from calcination of clay-rich limestones.

- **Natural cements:** Misleadingly called Roman. It is made from argillaceous limestones or interbedded limestone and clay or shale, with few raw materials. Because they were found to be inferior to portland, most plants switched.
- **Portland cement:** Artificial cement. Made by the mixing clinker with gypsum in a 95:5 ratio.

Cement (Cont)

- **Portland-limestone cements:** Large amounts (6% to 35%) of ground limestone have been added as a filler to a portland cement base.

- **Blended cements:** Mix of portland cement with one or more SCM (supplementary cemetitious materials) like pozzolanic additives.

- **Pozzolan-lime cements:** Original Roman cements. Only a small quantity is manufactured in the U.S. Mix of pozzolans with lime.

Cement (Cont)

- **Masonry cements:** Portland cement where other materials have been added primarily to impart plasticity.

- **Aluminous cements:** Limestones and bauxite are the main raw materials. Used for refractory applications (such as cementing furnace bricks) and certain applications where rapid hardening is required. It is more expensive than portland. There is only one producing facility in the U.S.

Portland cement

- Most active component of concrete
- The greatest unit cost in concrete,
- Its selection and proper use are important in obtaining most economically the balance of properties desired for any particular concrete mixture.

Portland cement (Cont)

- The production process for portland cement first involves grinding limestone or chalk and alumina and silica from shale or clay.
- Type I/II portland cements are the most popular cements used by concrete producers

  -Type *I* cement is the general purpose cement and most common type. Unless an alternative is specified, Type I is usually used.

  -Type *II* cement releases less heat during hardening. It is more suitable for projects involving large masses of concrete--heavy retaining walls

Types of Portland cement

Cement type	Use
I[1]	General purpose cement, when there are no extenuating conditions
II[2]	Aids in providing moderate resistance to sulfate attack
III	When high-early strength is required
IV[3]	When a low heat cof hydration is desired (in massive structures)
V[4]	When high sulfate resistance is required
IA[4]	A type I cement containing an integral air-entraining agent
IIA[4]	A type II cement containing an integral air-entraining agent
IIIA[4]	A type III cement containing an integral air-entraining agent