Types of Cement :-

* Ordinary portland Cement :-

* Ordinary portland cement (OPC) is by far the most important type of Cement
* It has been possible to upgrade the qualities of cement by using high quality limestone modern equipment, maintaining better particle size distribution, finer grinding and better packing.
* Generally use of high grade cements offers many advantages for making stronger concrete.
* Although they are little costlier than low-grade cement.
* One of the most important benefits is the faster rate of development of strength.
* In the modern construction activities, becomes so popular that 33 grade cement is almost out of the market.

* Rapid Hardening Cement (IS 8041-1990).

* This Cement is similar to Ordinary portland cement.
* The rapid rate of development of strength is attributed to the higher fineness of grinding and higher C_3S and lower C_2S content.
* Consequently, rapid hardening cement gives out much greater heat of hydration during the early period.
* The use of rapid heading cement is recommended in the following situations;-
  - → In pre-fabricated concrete construction.
  - → Where formwork is required to be removed early for re-use elsewhere.
  - → Road repair works.
  - → In cold weather concrete where the rapid rate of development of strength reduces the vulnerability of concrete to the frost damage.

* Extra Rapid Hardening Cement :-

* Extra rapid hardening cement is obtained by intergrinding calcium chloride with rapid hardening portland cement.
* It should be transported, placed and compacted and finished within about 30 minutes. This cement should not be stored for more than a month.
* A large quantity of heat is evolved in a very short time after placing.
* The gains of strength will disappear with age and at 90 days.
* The strength of extra rapid hardening cement or the ordinary portland cement may be nearly the same.

* Sulphate Resisting Cement (IS 12330-1988).

* Ordinary portland cement is susceptible to the attack of sulphates.
* Their expansion within the frame works of hardened cement paste results in cracks and subsequent disruption.
* Solid sulphate do not attack the cement compound.
* To remedy the sulphate attack, the use of cement with low C_3A content is found to be effective.
* Such cement with low C_3A and comparatively low C_4AF content is known as sulphate Resisting cement.
* The use of sulphate resisting cement is recommended under the following conditions:

→ Concrete to be used in marine condition

→ concrete to be used in foundation and basement, where soil is infested with sulphates;

→ concrete to be used in the construction of sewage treatment works.

* portland Slag Cement (PSC) (IS 455-1989).

* portland Slag cement is obtained by mixing portland cement clinker, gypsum and granulated blast furnace slag in suitable proportions.
* It has low heat of hydration and is relatively better resistant to chlorides, soils etc... this can be used for marine works with advantages.
* The quantity of granulated slag mixed with portland clinker will range from 85-70 percent.
* In cold weather the low heat of hydration of portland blast furnace cement coupled with moderately low rate of strength development, can lead to frost damage.
* The major advantages currently recognised are:-
  - → Reduced heat of hydration,
  - → Refinement of pore structure;
  - → Reduced permeability.
  - → Increased resistance to chemical attack.

* Quick Setting Cement :-

* This cement as the name indicates sets very early.
* It is used mostly in under water construction where pumping is involved.
* Quick setting cement may also find its use in some typical grouting operations.

* Super Sulphated Cement (IS 6909-1990).

* Super Sulphated cement is manufactured by grinding together a mixture of 80-85 percent granulated slag, 10-15 percent hard burnt gypsum, and about 5 percent portland cement clinker.
* This cement is rather more sensitive to deterioration during storage than portland cement
* This cement has high sulphate resistance, it is also used in the marine works.
* Super-Sulphated cement, like high alumina cement, combines with more water on hydration than portland cement.

* Low Heat Cement (IS 12600 - 1989).

* It is well-known that hydration of cement is an exothermic action which produces large quantity of heat during hydration.
* where temperature rise by the heat of hydration can become excessively large.
* The rate of evolution of heat will, therefore, be less and evolution of heat will extend over a longer period.
* But the ultimate Strength of low-heat cement is the same as that of ordinary portland cement.

* The heat of hydration of low-heat portland cement shall be as follows:

7 days — not more than 65 calories per gm.

28 days — not more than 75 calories per gm.

* Such as Setting time and Soundness are Same as that of ordinary portland cement.

* portland pozzolana Cement (IS 1489 - 1991)

* A pozzolanic material is essentially a silicious or aluminous material which while in itself possessing no cementitious properties,
* portland pozzolana cement (PPC) is manufactured by the intergrinding of opc clinker with 10 to 25 percent of pozzolanic material.
* The pozzolanaic materials generally used for manufacture of ppc are calcined clay or fly ash.
* Fly ash is a waste material, generated in the thermal power Station, when powdered coal is used as a fuel.
* The use of fly ash performs such a role. The pozzolanic action is shown below:

Calcium hydroxide + pozzolana + water → C - S - H (gel).

portland pozzolana cement produces less heat of hydration and offers greater resistance to the attack of aggressive waters than ordinary portland cement.

* Advantages of ppc:-

→ In ppc, costly clinker is replaced by cheaper pozzolanic material - Hence economical.

→ ppc consumes calcium hydroxide and does not produce calcium hydroxide as much as that of opc.

→ It generates reduced heat of hydration and the too at a low rate.

→ Reduction in permeability of ppc offers many other alsoundadvant-ages.

* Applications of ppc:-

The use of ppc would be particularly suitable for the following situations.

*→ For hydraulic structures;

*→ For mass concrete structures like dam, bridge piers and thick foundation

*→ for marine structures;

*→ For sewers and sewage disposal works etc....

* Air- Entraining Cement :-

* This cement is made by mixing a small amount of an air-entraining agent with ordinary portland cement clinker at the time of grinding.

* The following types of air-entraining agents could be used:

→ Alkali salt of wood resins.

→ Synthetic detergents of the alkyl- aryl sulphonate type.

→ Calcium lignosulphate derived from the sulphite process in paper making

→ Calcium salts of glues and other proteins obtained in the treatment of animal hides.

* There are ~~add~~ other additives including ~~and~~ animal and vegetable fats, oil and there acids could be used.

* Wetting agents, aluminium powder, hydrogen peroxide could also be used.

* Coloured Cement (White Cement IS 8042-1989).

* For manufacturing various coloured cements either white cement or grey portland cement is used as a base.

* The use of white cement as a base is costly.

* Coloured cement consists of portland cement with 5-10% of pigment. It is usual to grind the cement and pigment together.

* A chemical composition such that the pigment is neither effected by the cement nor detrimental to it, and the absence of soluble salts.

* The two famous brands of white cement namely Birla white and J.K white cements are manufactured near Jodhpur.

* The raw materials used are high purity limestone.

* Sea shells and coral can also be used as raw materials for production of white cement.

* Hydrophobic Cement (IS 8043-1991)

* Hydrophobic cement is obtained by grinding ordinary portland cement clinker with water.

* The water-repellant film formed around each grain of cement, reduces the rate of deterioration of the cement during long storage, transport, or under unfavourable conditions.

* The transportation and storage of cement in such places causes deterioration in the quality of cement.

* The hydrophobic cement is made actually from Ordinary portland cement clinker.

* The cost of this cement is normal nominally higher than ordinary portland cement.

* Masonry Cement (IS 3466 : 1988).

* Ordinary cement mortar through good when compared to lime mortar with respect to strength and setting properties.
* Masonary cement is a type of cement which is particularly made with such combination of materials.
* This kind of cement is mostly used, as the name indicates, for masonry construction.
* It contains certains amount of air-entraining agent and mineral admixtures to improve the plasticity and water retentivity.

* Expansive Cement :-

* Concrete made with ordinary portland cement shrinks while setting due to loss of free water. This is known as drying shrinkage.
* This type of cement which suffers no overall change in volume on drying is known as expansive cement.
* Since expansion takes place only so long as concrete is moist, curing must be carefully controlled.
* Another similar type of cement is known as Self-Stressing Cement.

* Opc 53 Cgrade S - Earlier it was called IRS T40 :-

* Opc 53 grade S cement is manufactured as per specification laid down by ministry of Railway under IRS-T40: 1985.
* This cement can also be used with advantage for other applications where high early strength concrete is required.
* This cement can be used for prestressed concrete elements, high rise buildings, high strength concrete.

* Oil-well Cement (IS 8229-1986).

* Oil-wells are drilled through stratified Sedimentary rocks through a great depth in search of oil.
* The pressure required may go upto 1300 kg/cm^2.
* It may also have to resist corrosive conditions from Sulphur gases or waters containing dissolved salts.
* The desired properties of oil-well cement can be obtained in two ways;
  → By adjusting the compound composition of cement or by adding retarder to ordinary portland cement
  → Many admixtures have been patented as retarders.
* Sometimes workability agents are also added to this cement to increase the mobility.

* Rediset Cement :-

* Calcium chloride, lignosulfonates and cellulose products form the base of some of admixtures.
* High alumina cement, through good for early strengths, shows retrogression of strength when exposed to hot and humid conditions.
* Associated cement company of india have developed an equivalent cement by name "REDISET" cement.

Applications :- "REDISET" can be used for:

* Very-high-early strength concrete and mortar.
* patch repairs and emergency repairs.
* Quick release of forms in the precast concrete products industry.
* palletisation of iron ore dust.
* Slip-formed concrete construction,
* construction between tides.

* **High Alumina Cement (IS 6452:1989).**

* The raw materials used for the manufacture of high alumi alumina cement are limestone and bauxite.
* These raw materials with the required proportion of coke were charged into the furnace.
* The fusion take place at a temperature of about 1550-1600°c.
* The cement is maintained in a liquid state in the furnace.
* These castings are known as pigs.
* The hydration and conversion can be shown as follows:

$$CA + 10H \longrightarrow CAH_{10};$$

$$3CAH_{10} \longrightarrow C_3AH_6 + 2AH_3 + 18H.$$

* **Refractory Concrete :-**

* High alumina cement concrete loses considerable strength only when subjected to humid condition and high temperature.
* At a very high temperature alumina cement concrete exhibits good ceramic bond instead of hydraulic bond as usual with other cement concrete.
* Crushed firebrick is one of the most commonly used aggregates for making refractory concrete with high alumina cement.
* Concrete can withstand temperature upto about 1350°c.
* It is also used in fire pits, construction of electric furnaces, Ordinary furnaces and Kilns.
* High alumina cement can be used for making refractory mortars.

* Very High Strength Cement :-

* MDF refers to the absence of relatively large voids or defects which are usually present in conventional mixed cement pastes because of entrapped air and inadequate dispersion.
  [MDF refers to Macro- defect-free].
* Densely packed System (DSP).
* The size of cement particles may very from 0.5 to 100μ and that of Silica fume varies from 0.005 to 0.5μ.
* Silica fume is generally added from 5 to 25%.
* A new approach has been developed for achieving very high strength by a method called "Warm pressing." to cement paste.
* Super high early strength and durable cement called by trade name "pyrament cement."
* Lithium Salts have been effectively used as accelerators in high alumina cement.