THERMAL PROPERTIES OF CONCRETE

The three important thermal properties of concrete are, Thermal conductivity of concrete. Co-efficient of thermal expansion and Fire resistance.

Thermal character of concrete: The process of hydration of cements materials releases heat which raises the temperature of concrete. This heat mush eventually be lost to the atmosphere and the cone temperature has to reach equilibrium with a long term atmosphere Conditions. The atmospheric gradients may occur or develop in the concrete as the internal temperature is raised above the surface temperature of the concrete member. This surface temperature is dependent on the material in contract. The resulting temperature will produce tensions in the surface and may be stiffness to cause cracking. The second effect operates as the mean temperature of the member is remaining move that of connecting members and the subsequent cooling will induce tensions.

Thermal conductivity of concrete: Thermal conductivity of heat is the ability o the materials to conduct heat. Heat is defined as the ratio of the ratio of the flow of heat to the atmospheric gradient and this thermal conductivity is measured in Jules per second per square meter. The thermal conductivity of heat depend the composition with respect to the type of aggregate amount of ass and moisture continent. When the concrete is saturated the conductivity ranges from 1.4 and 3.6 m/sec. The thermal conductivity various more rapidly in light wt one than heavy or normal weight concrete.

Thermal expansion of concrete: Coefficient of thermal expansion of cone is an important property which affects the stability and durability at different temperature conditions. As the con is made up of two phases material namely paste and aggregate paste which has dissimilar thermal con efficient but the coefficient of cone is a resultant of these two phases. In general form the coefficient of thermal expansion of cone is a function of the quantity of aggregate in the mix and the coefficient of thermal expansion of aggregate by itself.

Fire resistance:

Even cone is not a refractory material but a good combustible and has a good fire resisting properties. Fire resistance of concrete is determined by three factors. The capacity of cone itself to with stand heat. The subsequent action of water without losing strength unduly without cracking or spelling. And the conductivity of the concrete to heat and coefficient of thermal expansion of concrete.

Action of fire on (concrete) steel: The fire introduces high temperature gradients and as a result of it, the surface layers extent to separate and spall off from the cooler interior. The heating of reinforcement aggravates the expansion both laterally and longitudinally of the reinforcement base resulting in loss of bond and loss of strength of reinforcement.

Fire resistance on concrete: Fire on cone building damages the cone as well as steel reinforcement, causing disintegration of the cone and buckling of steel. The temperature gradient is extreme 30 to 40oc on the outer face and above 800oC on the interface (near the source of fire). In the initial stage (half an hour) as the heat inside builds up, some aggregate. Expand suddenly, spelling the adjacent concrete. Moisture in concrete rapidly changes to steam, causing localized bursting of small pieces of cone. Extreme heat near the sources of fire causes spalling rapidly expanding cone surfaces. In the next 30 minutes a temperature inside reaches 400oC, the cement matrix converts to QuickTime causing disintegration of concrete. The reinforcing steel loses the ensile capacity at such temperature. Deflection of beams and slab increases beyond this limit. Beyond one hour of fire, as the concrete disintegrates, the exposed steel expands, more rapidly than the surrounding concrete causing buckling, loss of bond to adjacent concrete. The thermal conductivity of any concrete can be calculated from

$K = Km\ (2m\text{-}m^2) + km\ k^2\ (1\text{-}m)^2 / K2M + Km\ (1\text{-}m)$

K = conductivity of aggregate

Km = conductivity of motor

Thermal effects on concrete: Effect of temperature on concrete. Similar to other materials, cone expands with increase in temperature and contract with decrease in temperature. The range of variation in temperature varies from localities to localities, season to season and day to day. The objectionable cracks may occur in cone due to contraction combined with the effect of shrinkage. Occasionally large and harmful stress may develop due to deformation because temperature changes. The coefficient of thermal expansion of contraction depends on the type and quantity of cement, aggregate, relative humidity and sizes of section. Excess water in concrete evaporates due to heat and setting of cone occurs. The loss of moisture to evaporation causes the cement paste matrix to contract, leading to shrinkage stress and shrine erecting. A 6m long slab may shrink 3mm to 5mm along its length called “drying shrinkage”. If the slab is supported at both its ends stress build up due to shrinkage drying may exceed the tensile strength of concrete, resulting in a 3mm to 5mm wide crack. However, if the cone is properly reinforced at regular intervals, the shrinkage stress are distributed along the length of slab, resulting uniformly spaced fine cracks.