B. ARCHITECTURE

CONSTRUCTION TECHNOLOGY (AR6013)

CONTRUCTION PRACTICE

Lecture – 3

Durable Concrete & High Performance Concrete:

Durable Concrete

Concrete durability can be achieved in a very holistic way. In this context, there are a large number of materials in the market which facilitate durability in concrete. Apart from the materials, the construction processes have also undergone changes with a view of improving the durability of the finished concrete. The durability of concrete is defined as its ability to resist weathering action, chemical attack, abrasion, or any other process of deterioration.

Durable concrete will retain its original form, quality and serviceability when exposed to environment. The concrete ingredients the proportioning interactions between them placing and curing practices and the service environment all determine the durability and life of concrete. For example sulphates and chlorides in sea water require the use of low permeability concrete to minimize steal corrosion and sulfur attack.

A cement resistant to sulphate exposure is helpful, proper concrete cover over reinforce steal by provided and the water cement ratio should not exceed 0.40. So what happens is we can put this at mixtures in the concrete and we can increase the durability of the concrete. So when we put at mixtures that we do not react we put at mixtures with kind of concrete we are going to use in various circumstances for example if you are using concrete in an atmospheric condition which is more prone to salt which is more humid in nature, which is more dry in nature which is more prone to acidic contact so in all this cases we use some at mixtures, some minerals and some chemicals probably sulphates, chlorides all this minerals when we

add with concrete during its preparation it increases the durability of the concrete.

High Performance Concrete

So in response to widespread cracking of concrete structures the construction process moved towards the use of high performance concrete that we also called as HPC mixes. High performance concrete is a concrete mixture which possess high durability and high strength when compared to conventional concrete. This concrete contains one or more of cementious materials such as fly ash, silica fume or ground granulated blast furnace slag and usually a super plasticizer. High performance concrete is introduced in India initially for the reconstruction of the pre-stressed concrete dome of Kaiga atomic power plant followed for the parts of the reactors at Tarapur and Rajasthan. Subsequently a number of bridges and flyovers have been introduced with a high performance concrete up to m 75 grade different parts of India.

Self Compacting Concrete & Concrete with Mineral Admixtures:

Self Compacting Concrete

Self-Compacting Concrete that is called SCC which leaves the batching plant is in a semi fluid and is placed into the formwork without the use of vibrators. Due to its fluidity SCC is able to find its way into the formwork and in between the reinforcement and gets self-compacted in the process. SCC is particularly useful for components of structures which are heavily reinforced. The fluidity is realized by modifying the normal mix components. In addition to cement, coarse and fine aggregates water, special new generation polymer based admixtures are used to increase the fluidity of the concrete without increasing the water content. So it is not necessary that into the fluidity of concrete we have to put a lot of water what we do is we maintain the quantity of water but we put other admixtures like polymer based admixtures to increase the fluidity of the concrete that we can do without increasing the water content.

Concrete with Mineral Admixtures

From being a product made of three or four materials (cement, aggregates, water) today a typical durable concrete consists of six or more materials.

The use of low water cement ratio enables a reduction in the volume and size of capillary voids in concrete this concrete which is the source of micro cracking from thermal shrinkage and drying shrinkage. So another reason why we do not prefer using more water is because when the what happens when concrete dries up it causes when concrete with more water it wise up it causes cracks so why this crack happen is because the water vapor tend to evaporate from this concrete and thus it causes cracks in the concrete. So we reduce that we use admixtures may be mineral admixtures, may be synthetic based admixtures, may be polycarbonate based admixtures and this is how the concrete the durability of the concrete is increased, so in this section the concrete were mineral admixtures so when we add the mineral admixtures so the concrete mix the durability increases. To reduce the cement based content both the water content and the cement content must be reduced as much as possible. The concrete mixes with fewer micro cracks can be produced by blending the cement with mineral admixtures either in the batching plant or in the cement plant. This enhances the service life of concrete structures in a cost effective manner.

Fly Ash:

Fly Ash Brick is a building material specifically masonry units containing classy fly ash in water. The fly ash is obtained from the thermal plants it's a byproduct of the thermal power plant that we reuse as fly ash bricks for building constructions. So in this case we use fly ash bricks we are also using a product that we are recycling in the building construction industry. Compressed at 28 MPa and cured for 24 hours in a 66 degree C steam bath then toughened with an air entrainment agent the bricks last for more than 100 freeze thaw cycles. The finished product is a lighter block less than 40% the weight of conventional bricks while providing the similar strengths. You can see in these pictures these are fly ash bricks and these are highly compacted building units, they are used in replacement of conventional bricks but they provide the same strength. Now the fly ash bricks have much important property we can fast track the construction process with fly ash bricks because they were available in various dimension even in the bigger dimension. Now they have equal strength as compared to equal brick as earlier and most importantly they made up of fly ash and not of earth so that is why we are actually using recycle product.

The Advantages of Fly Ash Blocks

- It reduces dead load on structures due to its lightweight the dimensions which are available are 230mm×110mm×70mm
- The same number of bricks will cover more area than clay bricks. So that's why I said due to its increasing size we need less number of fly ash bricks then the clay bricks we need more clay bricks to cover an area but the fly ash the necessity number of fly ash brick modules will be lesser
- Now it as high fire insulation
- Due to high strength, there is practically no breakage during transport and use
- Due to uniform size of bricks mortar require for joints and plaster also reduces by almost 50% thus its main cost 7 point
- Due to lower water penetration seepage of ware through bricks is considerably reduced
- Gypsum plaster can be directly applied on these bricks without a blacking coat of lime plaster because this bricks have a plain texture so gypsum plaster can be easily applied on top of it we do not need a lime plaster to make it smooth again
- These bricks do not require soaking in water for 24 hours so it's just a sprinkling of water before use is enough so that saves lot of man power.

The Disadvantages of Fly ash Blocks:

- The mechanical strength of fly ash blocks are low but his can be rectified by adding marble waist or mortar between the blocks.
- The limitation of size. Only modular size can be produced. Large size will have more breakages. So these are the disadvantages of fly ash bricks.

Concrete Masonry Units & Glass:

Concrete Masonry Units

A concrete masonry unit is a standard size rectangular block used in building construction. Concrete blocks are made from cast concrete for example Portland cement and aggregate usually sand and fine gravel for high density blocks. Lower density blocks may use industrial wastes, such as fly ash or bottom ash as an aggregate. Lightweight block can also be produced using autoclaved aerated concrete. Now this concrete masonry units are available

in the market in various forms one are normal dense concrete masonry units are solid blocks, another typology are the concrete block which have cavity inside and another typology and another type of concrete masonry units available are called AAC blocks that are autoclaved aerated concrete. Now when we are intending to do a cavity wall construction are in general wall construction, if we were using concrete masonry units with cavity inside it produces it gives as thermal benefit, it gives as thermal resistance, it gives as acoustic resistance so its win win situation for us, you know it can be replacement or conventional bricks. The second thing is when we are using the autoclaved aerated concrete blocks that are AAC blocks. So these are very porous in nature but the strength wise is good but if you see the concrete block that are very porous, so due to the porousness of the block we get a very good thermal benefit as well as acoustic benefit also so this are the new building modules that can be used for building construction.

Glass

Now glass has become very important material which is used in construction as we have seen more and more buildings having glass facades. It is generally made from mixtures of sand and silicates and is very brittle. Glass finds major usage in beautification of the structure and keeping temperatures regularized. Now glass can be used in constructions in various forms. One is Insulated glazing

Insulated glazing more commonly known as double glazing consists of two glass window panes separated by a vacuum or gas filled space to reduce heat transfer across a part of the building envelope. So an insulated glazing is nothing but two panels of glass with an air gap between. Now insulated glazing glasses can also come up with coating various materials from the internal side of the glass paints to regulate the temperature inside, it also regulates the U value that in turn reduces the temperature of the ambient temperature inside and also it gives as various good shedding coefficient to regulate the temperature and it also gives us a lot of respite from the glare of the sun.

Laminated glass is the type of safety glass that holds together when shattered. In the event of breaking, it is held in place by interlayer, typically of polyvinyl butyral (PVB) or ethylene-vinyl acetate between its two or more layers of glass. So laminated glass is nothing but two glass paints which have a layer of poly carbonate sheet its either PVB or EVA sand which in

between two of those glass paints. So what happens when glass breaks it does not get shattered it does not harm an individual

Toughened or Tempered Glass

Toughened or Tempered glass is a type of safety glass processed by controlled thermal or chemical treatments to increase its strength compared with normal glass. Tempering puts the outer surfaces into compression and the inner surfaces into tension. Such stresses cause the glass, when broken; to crumble into small granular chunks instead of splintering into jagged shards as plate glass that is annealed glass creates. The granular chunks are less likely to cause injury. What happens when we break a tempered glass it breaks into pieces but it become very small pieces that are very safe but not very sharp and irregular large pieces that can cause injury to a person

Annealed glass is the most common glass used in windows. Annealed glass is also known as a standard sheet of float glass. Annealing is actually a process of slowly cooling glass to relieve internal stresses after it is formed. Now how are these glasses paints to at site. Glass is generally stored vertically on its edge in dry conditions with the storage of the short side or long side that depends on the available space we have at site.

The factors to consider when storing glass on its edge

The glass should not be in contact with any hard substances that is concrete, stone, ferrous metals or broken glasses. If we do this, this will minimize the risk of damage and breakage, and can be implemented by cladding all supporting structures with timber, felt, rubber or plastic material. Care should be taken to ensure that all nails and screws are countersunk below the surface likely to come into contact with the glass which they are properly covered with timber, felt or any other soft t materials so that they do not happen the glass or they do not break the glass. So that’s why we should always ensure that the supporting bearers are smooth and clean.

Angle of inclination of the glass:

Transportable racks, barrows, trolleys and still age’s can be kept as at 5° - 6° maximum. If the angle is increased above the 6° it will tend to put extra weight on the back sheets and make sheet separation more difficult to achieve and in turn while using the glass in construction site you can break the glass it’s more proven to breakage.

The following is a list of recommended practices for the storage of glass on sites:

Glass delivers should be coordinated to minimize on site storage duration. Subcontractors should work with the general contractor or builder to select on site under roof storage locations that avoid direct rain and water runoff work areas of other trades, areas of high traffic, and to minimize material movement should be ensured and handling of the materials in activities near the glass where the glass storage is should be reduced. Individual sheets or cases of glass and pre glazed materials should be secured, blocked and braced to prevent falls. Blocks are support should ensure that the bottom edge of materials will be kept well above potential sources of water. Storage of glass against walls should be avoided unless can be determined that the wall is suitably sound for the task for example the single sheet of glass is still can be suitably secured. Storage area should be provide secure temporary covering that prevents direct water flow but ensure ventilation and stops condensation build up on the glass that may calls sleep edge when you try to lift the glass and the glass may fall and break. We should ensured the stored materials are not exposed to activities of other trades such as welding, painting and insulating etc. that happens on site and we should daily inspect that's an important point we should daily inspect the place where the glass is stored.

Metal & Plastic:

Metal

Next material is Metal, Metal such as steel and aluminum alloys are used in taller structures and are used as structural frameworks for these skyscrapers. Its advantages are strength and flexibility while its prime enemy is we all know corrosion. Now how is metal used in the construction industry.

Steel Grids

Incorporation of steel frames made construction of skyscrapers possible. Here, vertical columns and horizontal I-beams form a grid. This supports other elements of the building that are attached to the grid. It is used to better withstand stress of the structure. Bolts and fasteners are used to connect beams to the columns. I-beams in the Centre are usually wider and so more resistant to bending moments. Wide sheet of steel is used to cover

the top of the frame. As for the floor surface precast concrete is a popular option. Due to steel softening with high temperatures, file resistant elements are usually incorporated.

So steel is very widely used in construction industry we get steel I sections we get from structural elements like columns and beams we also get we also use interior elements like balusters view steel doors, so steel is an important element now for the construction industry used fixtures used fixing, all fixing materials we use joinery hardware's, windows steel is an important material in the construction industry as of now

Metal Roofs

Metal roofs can be fabricated from galvanized steel or a maximum of zinc, aluminum and silicon coated steel. Stainless steel, lead and copper can also used. The main advantage of such roofs is their durability. Metal usually gets epoxy or ceramic coated in order to prevent the roof from rust and damage caused by water. So metal roofs are common site now

Reinforce Concrete:

Steel is used in Reinforced Cement Concrete. Rebars are usually made from twisted strands with anchoring ridges.

Fixing and Fasteners

Fixing and Fasteners are often made from stainless steel. They are widely used in automotive, aerospace and other manufacturing industries; one more area where this is very critical is the glazing industry where steel fasteners provide require strength for the glass façade. They are crucial for stability and safety of construction and civil engineering in general. They are many different types of fixings and fasteners for specific types of constructions.

Aluminium

Aluminium is used for a cladding on façade. Aluminium can be cladded on the façade as Aluminum composite panels that we call as ACP or sheet Aluminium cladding with required framework/supports that can be of steel or aluminum. So aluminium can be used as façade material in various ways. We can use sheet aluminium cladding with powder coating on it with various textures on it with various prints on it or we can sue it as aluminium

composite panels. Now what are aluminium composite panels, these are two sheets of aluminium with the polycarbonate base substance in between two aluminium panels. So these provides excellent cladding material on façade that we can turn it into any shape and form we want with these aluminium composite panels ACP are cladded on substructure or great structure are support structure of which are either of steel or aluminium or frame work. Now aluminium is used as a part of structural glazing. The Mullions and transoms everything are widely made up of Aluminium. The Doors and windows, aluminium joinery are a common side along with steel doors today. They are specially used for fire protection, durability and sound proof doors etc.

Plastics

Plastics are widely used substance, it is a synthetic or semi-synthetic organic condensation or polymerization product that can be molded in various forms and differs in heat tolerance, hardness and resiliency. It is cost effective and owing to qualities like ease of manufacturing, versatility, and imperviousness to water, it is extensively used as a building material.

Following at the area of application

- Façade Cladding – The Plastics can be used as the polycarbonate sheet on the façade cladding and as the replacement of glass
- Indoor usage – wall cladding, electrical and lighting fixtures are all made up of plastics nowadays
- Furniture – Since it is a property of molding the shape we want. Plastics are widely used as furniture
- Storage Spaces – We get cabinets, we get closets, we get everything what we can think of from plastic
- Polycarbonate sheets can also be used in roofing materials

Ceramics, Foam & Composite Wood:

Ceramics

It is a tile or fixture made up of clay-pottery firing in kilns and mainly used for flooring, ceiling, walls, counter tops and other coverings in the building. Not only that ceramics can also be used as a cladding material may be in the interior or in the exterior because the ceramic tiles is used in the exterior do

not fade away with the sun or do not fade away with time, they keep the shin intact and they available in market with various textures and various colors and also it can be used as a replacement of stone cladding on the façade or even metal cladding yes

Foam

Foam are mainly used for insulation purposes owing to its properties of maintaining temperatures, being flexible and light in weight it is compressed between wood and cement to give the desired effect. So foam is a product that can be used as insulation material on the service pipes and also it can be used as insulation material between two physical components before example if we are using two physical components, one is concrete one is metal, two metal side by side there is a fine joint between that we wanted to be insulated so that the two components are against each other we can use foam.

Composite Wood

Now we all know that we cannot use wood on the exterior we won't prevent on the exterior it loses its it create more prom to whapping and then if we do polishing on it, it loses its polishing in no time

Engineered wood are also called man-made wood, or manufactured board, includes a range of derivative wood products which are manufactured by binding or fixing the strands, particles, fibers or veneers or boards of wood, together with adhesives, or other methods of fixation to form composite materials. So these composite woods can be used as external façade material not only that it can be used as flooring material, it can be used as cladding material and it resembles wood.