B. ARCHITECTURE

CONSTRUCTION TECHNOLOGY (AR6013)

CONTRUCTION SYSTEMS

Lecture – 1

Built Environment:

Environment can be manmade and natural will start with a surroundings that is surroundings can be natural man made or combination of this. A built environment is the environment that is created by man or with the aid of natural environment. Here in this illustration we can see the elements of natural environment we can see the trees we can see the crops we can see the waterways we can see all this constitutes of natural environment whereas the built environment consists of daylight ventilation mechanism, artificial lights, textures and envelope which know the human beings the man resides in, a circulation space furniture for people to sit, so all this consists of the built environment. Now the surrounding is the composition of this natural and built environment you can see in this illustration there is the building here that is a man made environment this are the paved areas that is again the manmade environment this are the walls that is again component of a manmade environment these are the retaining walls here then these are the plantation, then these are the lakes all this are the components of the natural environment then these are the grease, shrubs and vegetation. So all this together are called as surroundings, so all these together you know defined the space around as so this is what the environment.

Structure & Its Types:

What is the Structure?

A Structure is an arrangement and organization of interrelated elements in a material object or system or a built environment. A structure is nothing a structure is an arrangement of small composites, so the structural system and these composites are also called structural system. To go through the

definition of structural system, the 4 structural system refers to load resisting sub system of the structure, the structural system transfer the loads through interconnected structural components or members. So these structural systems and the structures can be classified into various types, if you see the illustrations in the slide this is the simply supported beam so this consists of beam and two supporting walls. For design purposes ends a resume to be free that is this are not fixed so this structure a small example of structure is called simply supported beam structure.

The next built-in Beam in this what we do this is the Beam there are supporting walls. For design purposes ends to resume walls some degree or fixity. The next composition cantilever beam in which we have a beam which is supported or fixed one end only. So this become Cantilever Beam, this is also another kind of the structure, then the propped cantilever structure we have supported fixed beam at one end and the other end the Propped at the free end, so this become the Propped Cantilever structure. As the structure consist of various member so this member at the structural members which do an important task from transferring the load from one member to other member it's basically how it transfer the forces from one member to the other member.

So here we can see the example of a strut, A strut is the structural member which is subjected mainly to the compression forces here we see a column and this column can be called as Vertical Strut here we see there are forces applied by this slab and the forces applied by the bottom slab and this column doing a work of strut of transferring the forces from one place to the other place. So this vertical strut is also called the column extension or pier. This arrangement of structure is actually rafter and tie structure we see we have two rafters and this is the tie, so the tie is the structural member which is subjected mainly to the tension forces, Here we see arches now the arches the transmit load is transmitted around the arches to the apartments, so here we see the load is applied here and the load is further brought down from two sides like this, so this are the abutments and the load is applied here and the load is further transfer to the ground by these along the curves, so arches are awaiting partner structural component. So next is Post and Lintel system in this we see there is the lintel system, in this we see there is the lintel that can be simply supported can be that can also be called as simply supported beam and there are two posts what happens is when the load is applied here and these are further transfer to the vertical

members that is the those vertical members are post or also we call it columns. In this frame this is the frame structure in this frame we see a combination or rafter, a tie and a strut. We see will come across more rafter how the load is distributed in the subsequence slides but what we see is these are the rafters this is the tie and this are the struts. So it's the combination of the structural members that we have gone through previously. Now the classification of structure can also be term in the types of construction here I bring to you example of solid construction and a framed or skeleton construction. In solid construction what happens is the load of the roof is brought is transferred to the ground to load bearing walls. So in the solid construction is generally done in closed areas where the buildings I can find low height and very short spans and this is the framed or skeleton construction. In this construction comprises of main beams, secondary beams, edge beams, tie beams etc., so it's basically frame works of beams and columns by which thus the load of the roof is brought down to the foundation. There again two other type of construction one is panel or box construction and the other one is a folded or plate construction here we see the panel or box construction. This structure consists of series of interconnecting frames forming structural forms and floors. In the flooded plate constructions the flat slab its folded so that the roof will behave as a beam spanning along field and then we have a diaphragm introduce in to the folds and there you see here the columns under the diaphragm so that those columns can take load down in to the foundation. Other structures like the shell roof or found by a structural curved skin covering a given plan shape and area. Here is as an example there is the dome or rotational shell this is the double curvature shell which is formed by rotating a plain curved shape about a vertical axis and this is the pendentive dome. In this dome as we can see there is a inscribed polygon, this dome looks like the dome a normal dome is intersected is cut vertically through all the four side of inside polygon. So you can see here this arch looks like vertical plane along the edge of the inscribed polygon has cut a simple dome. So this is how the pendentive dome is formed. This is the example of the translational dome which is formed by a curved line moving over another curved line, this is the Barrel Vault, a barrel vault is it resembles a cylinder cut through the longer axis of the cylinder, this are the combination of the domes and other forms of structure, this is called the Conoid shell and this is Hyperbolic Paraboloid these are basically the combination of shells and other forms of structures put together and we can make all this give rise to interesting shapes and

forms and different kinds of structures, this is the space deck it is a series of interconnected inverted pyramids and this is the Space Frame and this is the series of interconnected grids all this members in the space frame that it went important work of bring the low from the top to the foundation. Here in this figure is the tension cable structure, here we see there are two compression hearts systems and in between there are tension cables to support the covering on top, so this kind of structure is called tension cable structure, this is the tension membrane structure or also called tensile structure. What happens in the structure is we generally have the network of cables forming tension membrane and there is an covering on top like a canvas which can be used covering on the top of the this tension membranes. So it forms the tensile structures or a tension membrane structure.

Elements of Substructure & Superstructure:

Moving to the another kind of classification. The structure can also be classified as sub structures and super structures

Substructure

The structure can be defined as all structure below the superstructure which in general terms is considered to include all structure below ground level but including the ground floor bed. What it means is anything below the ground level can be termed as the substructures. So for example what comes below the ground level, below the ground level or the foundation the load bearing walls that lead to the foundation, the columns that lead to the foundation? So all this below the ground floor bed or called the substructures. Here there are some more examples of substructures, here we can see the example of pile foundation so the pile foundation the ground beam and the wall that leads to the pile foundation or all members in our all components of the substructure system, on the right hand side we see the service duct below the ground floor level so all this also part of the substructure system. Here we see the retaining wall the ground level is at the top the retaining wall and this is the paved area and this is the basement wall and this is the ground floor slab and this is the basement raft foundation. So all this components which are coming under the ground level are called the substructure.

Superstructure

A Superstructure can defined as all structure above substructure both internally and externally. So superstructure is nothing but all the components of the structure which are coming above the ground level for example the walls, the columns above the ground level, the beams, the roof, the ceiling the finishes everything come above the ground level can be considered as the part of superstructure. Now there are various elements of a superstructure this are basically components of the building carcass above the substructure excluding the secondary elements that is finishes, services and fittings. So these are the primary elements of the superstructure, so the elements of the superstructure can be classified into primary elements and secondary elements, so the primary elements would be the basic carcass for example the walls, the beams, the columns, the floor slabs and the secondary elements would be the finishers or the ornamental part of the building that comes over the primary elements. So this are the various components in this illustrations in this illustration describe the various components of the superstructure, coming from the top this is the roof, this are the external walls this is the partition, this are the framing members, this are the beams, this are the columns, this are the galleries, this is the upper floor slab all this parts are the superstructure, this are the stairs and ramps, this are the internal walls and all this you see from the ground floor level from the top of the ground floor to the roof the Para per all this part of the super structure

Secondary Elements

Secondary Elements are nothing but the completion of the structure including completion around and within opening second primary elements. What I meant to say is this secondary elements are nothing but the finish product what we see we have a wall, the wall is a primary element on top of it we do plaster, the plaster is again a primary element but in top of it we do painting, for example we do POP we do painting that becomes the part that we finish is can be called as secondary elements, for example there are few examples that I brought here, for example floating floors we see this floor slab this is a primary element and we see this floor finish that is coming above the floor slab that is called as the secondary elements, this is the roof this is the another example of the floating floor, so this is the primary element and this is the secondary element, this is the RC slab of the floor so we call it is a primary element and this is the finish of the floor including the framing members of the finish so this collectively are called as the secondary

element we come to the Roof lights. The roof as we discussed earlier is the primary element as the roof lights come as the secondary elements. Here we see in the door jams what happens, the door openings the openings in the walls, the walls are basically in the primary elements but the door enter is the secondary elements, here we see the ceiling slab is the primary element but the suspended ceiling is the secondary element. In the case of staircase, the staircases is such a primary element but the balustrade and the finish on the trade risers are all secondary elements here we see the external walls and the internal walls what we see here is the walls basically at the primary element like the walls can made up of bricks, the walls can be made up of concrete all this are primary element but in top of it when we do paneling when we do windows all this are called secondary elements we do door linings we put lights on it all this part of the secondary elements.

Finish

The final surface which can be self-finished as with a trowelled concrete surface or an applied finish such as floor tiles is called finish. Finish is nothing but the final surface what we see after the construction we can leave it as travelled concrete or plaster surface or we can apply a finish on it discussed earlier like a plain finished we can apply a floor tiles on it, we can apply different kinds of floating on it so whatever we put on the wall and we leave it as such the appearance of such any element of structure can be termed as a finish here we have few examples this is the external wall and here we have a tile hanging weather boarding or painting or painted surface or texted painted surface so all those can be called as finishers. In the internal walls we night have wallpapers, we might leave at just plaster but the wall is the primary element but all the finishers are secondary elements we can have a dry cleaning on the walls we can have wet clining on the walls we can have trims on various materials on the walls. So all those are secondary elements and all those can be termed as finishers. In case of floors here example you see the floor slab is the primary element but the screed with the tiles or corporate is termed as secondary elements we see here again in terms of wooden floors another example the RC slab the structural slab of the floor is the primary element whereas the wooden blocks kept on it or secondary element or the quarry tiles kept on it or secondary elements and this are the finishers. Some more examples of finishers are stairs, you know the stairs just now we discussed that the nosing trims and tread risers what we see after the construction we can do

stone, we can do wood, we can leave it as concrete as such but whatever we leave whatever we see after the construction the appear of every structure is called finishers. Here we see in the ceilings it's a plasterboard and plaster ceilings and then we here the ceiling at the roof covering, these are the tiles or slates here we see in this example this is the roof and then we have do nothing but we are just putting as fault and metal covering over it so everything will come as part as finishers.

Component Parts & Functions:

This is the typical domestic structural system that consist of roof that consist of walls and that consist of foundation as discussed the trust at the top as discussed the structure from top to bottom the work of every member of the structure is transfer the load from top to the foundation, from the top of the structure to the foundation that is the substructure below the ground here we see the load of the roof coverings plus any snow and the wind loads at transferred to the roof members, this loads are accepted by roof members which are in turn transferred to the walls we see the diagram we see the arrow that depicts the transfer of forces. Here the ceiling loads plus any loads in roof transferred to the jaists. So this include we can see a dead load kept here there can be dead loads there can be live loads also, so all this loads at transferred in to the walls the loads over openings via a lintel to the jambs on either side. After that total floor load are transferred to the wall dead and live loads are flooring are transferred to the floor jaists further these wall loads are transferred to the foundation the total floor loads transferred to the internal load bearing wall or further transferred to the foundation, the ground floor loads which are transferred directly to the ground and here at the foundation these aerostatic the total wall loads which are transferred to the foundations. Coming to the second example this is the example of the typical framed structure here also the principal is the same the work of every member in a structure is transferred the loads from top to bottom here we will start from the top. The load at roof coverings plus any snow and wind loads at transferred to the roof slabs. The roof loads are accepted by the beams which are further transfer to the columns. The loads at infill panel are transferred at the edge beam at the base that is here the total roof loads are further transmitted down the column to the other frame the live and dead loads of floor are transferred to the main and the secondary beams further down, the main and the edge beam loads are transferred to the columns so all this loads further transferred to the

columns, the secondary beam loads are transferred to the main beams and the main beams are further transferred to the beams to the columns, so the total column loads are further transferred to the foundation so here we see this is the description of the total forces that are transfer to the foundation, the work of the foundation is transfer those loads further in to the other sides.

External Envelope

Any man-made built environments also have an external envelope, so this external envelope consists of the material and component which form the external shell or enclosure of the building. This may be the load bearing or non-load bearing, according to the structural form of the building. Here we see in the illustration the external envelope protects as from the natural adversities it also protects as from sound it protects as for excessive heat by providing as heat insulation it gives as a comfort into our build space. Here we see in this illustration we see that the certiphical envelope protects as from the rain from the snow from harsh atmospheric conditions, it also protects as from sound here we can see heat loss from here we can see thermal insulation this is the envelope the envelope provides as the acceptable appearance. The openings and the envelope provide ventilation from the bell space so that the bell space properly ventilated and there is in flow and out flow of air. The envelope also needs to have an adequate strength the stability and the durability and also fire existence. The openings also provide the visual contact with outside and the door important part of the opening of the external envelope, the provide an access and aggress from the built environment from the envelope to outside further down the walls at the down level the envelope walls that leads to the foundation that resist moisture penetration rising through the walls from the ground.

Internal Separation & Compartmentation:

Classifications the Internal Separation and Compartmentation. The Internal Separation and Compartmentation is the important part of the structure, here we would like the internal separation and Compartmentation with two examples one will be dwelling houses and other one will be flats. Now what is Compartmentation? A Compartmentation is nothing but a segregation of space in the built environment for example in a built environment in a room we have bedroom in a space square we have two rooms a bedroom and the drawing room both have different functions so both this rooms are both this

space are separated by physical barriers like the walls so the space after the physical barrier that is left is called compartment. So the entire process is called Compartmentation. In this case the example of dwelling houses what we see is we see walls , we see a roof void we see ridge and apex of roofs and we see separate buildings its complete example where we see found floor we have an upper floor we have the walls that that continuing at the roof, so this space is aggregated to different functions like as I said dining space or a living space but the entire space is one dwelling unit, there is another part of Compartmentation in which we make compartments based on the collection of functional spaces. For example flats what do we do in flats is we aggregate collection of this dwelling unit each flat is combination of dwelling units like here we see we have a staircase this one as one flat which is compartmentalized by the walls and since when compartmentalized the walls this space as provides as a resistance as fire and also proves an caustic values by not letting the sound coming come out of the space or not letting the outside coming to the space, here we see this is the collection of dwelling units that is called a flats

Point to Be Noted

For non-residential buildings, compartment size is limited by floor area depending on the building function (purpose unit) and height. Compartment a building or part of a building with walls to floors constructed to contain fire and to prevent it spreading to spreading to another part of the same during or to an adjoining building.

Separating floor/wall = element of sound resisting construction between individual living units. So what compartmentalization does is it provides a town resistance between individual living units and to the adjusting living units