INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

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Housing Policy & Planning

Lecture – 13
Technology Systems in Housing Delivery-2

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Hello, last day we discuss the technology systems and it is role to deliver mass housing in India, we have discussed that the conversational technology is unable to deliver housing for the mass in quicker time. So there are alternative options faster technologies are available, which can deliver housing in a quicker time and we also attempted to see the it is characteristics typologies of the technology systems and what are the options for India.

So today we will see the examples and how it can fixable for Indian system like before I go to the example and the case study to understand the applicability for the Indian condition briefly touch up on the points, which we discuss last day like firstly we discussed that for conversational technology, conversational construction methods, the construction is fully onsite and due to onsite activities for the construction sometimes due to the weather affect or the extreme weather affect the construction is not possible.

For example during rainy season, during extreme winter, the construction is not possible. So as the result the construction become delayed and because of the delayed construction the time escalation and the cost escalation is obvious reason and the cost escalation is there then the affordability or the affordable housing within the cheaper cost will not possible. So how we can tackle this problem, now there are options, there are technologies, which actually involves the lot of manufacturing of the count building compounds of site that is in the factory or it is manufactured and in a suitable time it is transported from the factory and just assembled using either manual and the industrialized mode of assembling in the site.

So site based activities are minimized so as result the time is minimized so these kind of technology, which involves lot of activities in the factories and less activity in the site it is

called industrialized building system sometimes we call it as modular construction, sometime we call it as pre-fabricated construction, but this is viable option, which other countries are also tried. Next we discussed that two there are three type of industrialized building system, one is box system, which is nothing, but to contextualizes a building in terms of various cubes of the box as building units, second we discuss the panel system, panels are the low barring walls, which takes the load of the upper floors.

So panels are very big load bearing and also there are compound based linear system, frame system, which is contextualizes the load bearing members like say column and also beams as individual compound and as a pre-fabricated compound and we have discussed last day that for Indian context apart from the box system and the panel system, the frame system is suitable because of the load condition because of the high availability of the manual labour, all this factors are involve.

So compound based frame construction and also amount of in contextual bases, the panel construction also can be thought of if possible and then also we discuss that as process of the industrialization, it has specific stages India is currently in the stages just before the close system, so closed is nothing but where only selective few developers, develops the package the building as a package and delivers it.

No other contractors or manufactures are allow to monitor or allow to alter the design or the constructions where the open system is a system where many contractors, many developers, many manufactures take part. It is more open to the various stay holders. So open system invites open economy, open and it discourages the monopoly, and close system basically ensure the quality because it is driven by only one unit, one suppliers but sometimes it encourages monopoly.

So this two are the obvious close system is come first then it follows the open system. So Indian system right now there are various companies or various manufactures who are basically manufacturing building compound and government also is trying to co-op with the trained and the need for the day. So, with this background today we will see that how industrialized building system for India can be applicable for mass housing.

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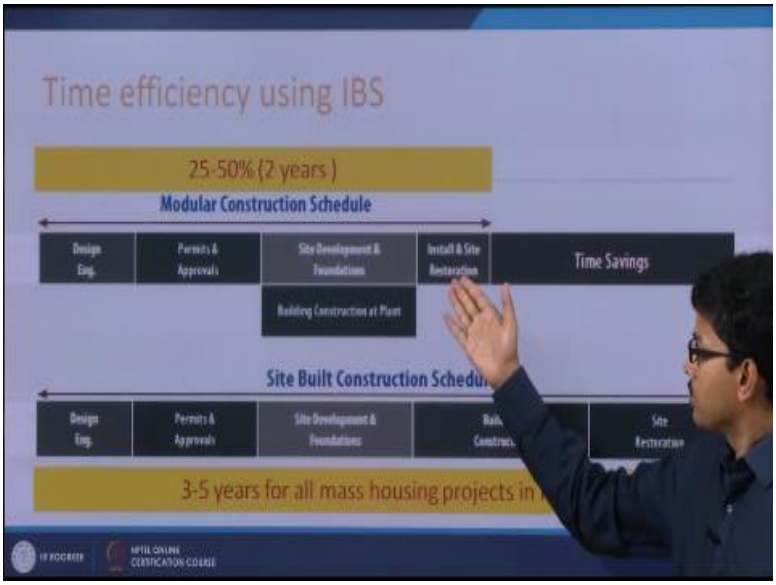

So this picture we saw last day also that in typical modular construction schedule this is time saving because of the offsite construction activity, the site based construction activity is reduced and the site based construction activity actually done at the construction at the plan. So now we will see the case study how industrialized building system in India is available how much it can be applicable now before I show this example and the case study let me tell you that government labour rate like say CBIR or BMPTC or HUDCO lot of experiments where there.

They have developed and Hindustan Private Limited they have developed very innovative building compounds and very building materials as such and those are tested also and those worked very nicely in some of the context, but here the examples we have taken it will show that how in a mass scale in a 1000 of unit can be developed generated using the building compounds in India context that will see in the next example.

So the examples we have taken is the Maharashtra housing area and develop an authority and they have tired with another private company or the manufactures of the very innovative building materials.

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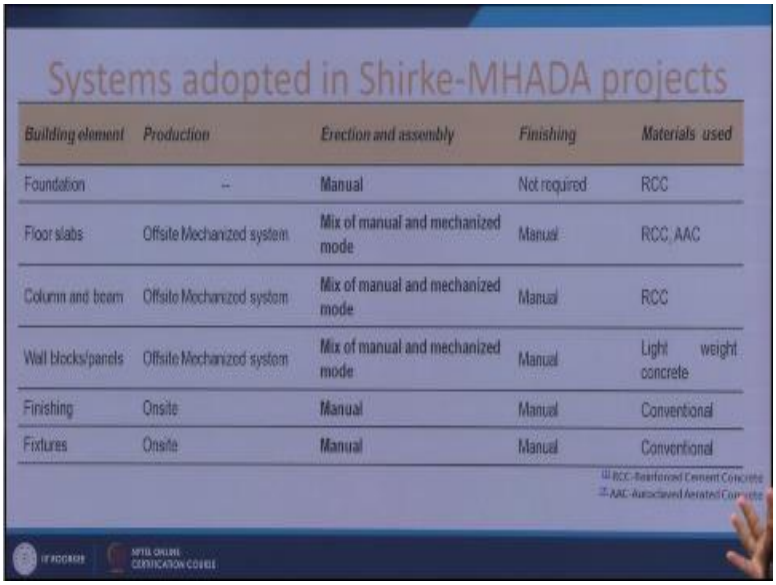

Which is called Shirke so the combination the partnership between the MHADA they take up all the most of the affordable housing and the housing for the poor in the whole state of the Maharashtra especially in the Mumbai major cities, so the materials they use for every component of the house like foundation floor slap, columns and beams, wall blocks, finishing and fixture, they take the floor slab to the wall blocks, they take the offsite mechanism system.

They use the blocks like rain force concrete block or autoclaved aerated concrete block, similarly for this they take the light weight concrete or AC block. Whereas the foundation is done manually and RCC it is done onsite, similarly the finishing and fixtures these are done also onsite. So apart from this stages floor slabs, column and beam and the wall blocks the foundation and the finishing and fixtures are done on site and mostly they use mix on manual and they in foundation in column and beam and the wall blocks.

Where the foundation and finishing and fixture say this three activities are taken place in the site, these are essentially buy and enlarge manual process. So to illustrate the example we have taken three different example, different cases, different projects at different locations like MHADA Shirke and Mazgaon in city of Mumbai and one project will be there for okay one project will be showing that under construction another project will be showing that it is

completed last few years like 5 years and another project will be showing which is completed more than 20 years or before.

So that we can understand its quality, its durability and its performances as building as the housing typology this is ongoing project on Mazgaon so basically it is redevelop of transit accommodations done by the Mankhurd .

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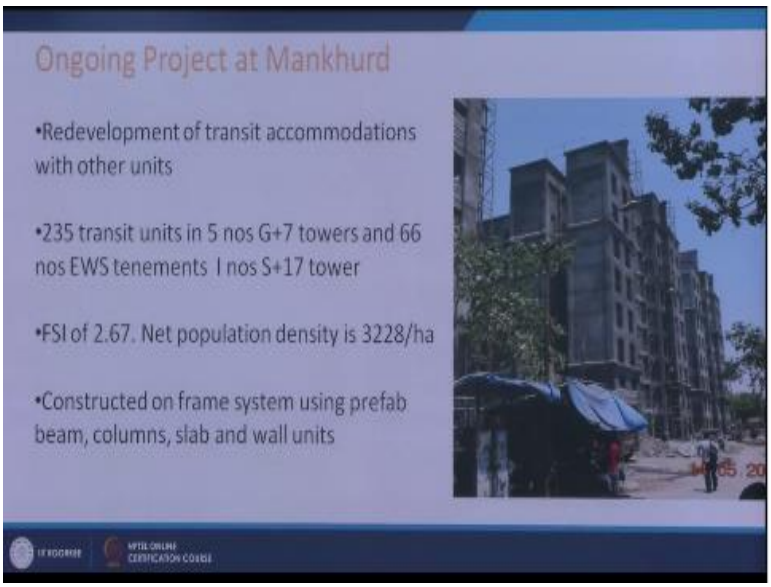

So it consist of 235 transit units in 5 numbers of G+7 and 66 number of EWS units with still 17 sorted high. They have used a FSI of 2.67 and the densities above 3000 per hector those who are coming from planning or architecture background you can understand that this density is quite very high in terms of Indian context like in major cities you can see the net density, which is calculated in particular plot is like 1000 or 1500 maximum, but here they could achieve more than 3000.

And they have constructed on frame system using preferred beam, column, slab and wall units. I will show how they have constructed.

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So you can see the columns, beams are joint here this is typical joint of a column you can see the shortage of column where a particular beam will be placed suitably and fixed suitably these are pictures showing column units have whole throughout the column length and it is inserted vertically like this so that this sockets are available for placing of these beams and these are some of the beam element you can see and over the beam you can see some of the hankering element where these slab element will be put and hankered.

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I will show the pictures so that you can understand well. So after placement of the columns and the beams like this, they place the slab element like this so all the slab elements are independent treated as the independent pre-fabricated element some are consisting of the RCC elements some are consisting of the cellular concretes block, which is aerated auto concrete element, which is completely manufactured in their own factory of Shirke and they transport all this materials and put in this manner.

After placement of this slab component like this what they do they just fill up this slab over this concrete of three to four inch and they put the concrete in the wholes of the column. So whole column beam and the slab become fixed and it becomes more stable and all the individual compounds become one isolated strong compounds as whole. So after putting this screed concrete over the slab it becomes a complete strong floor as such and the whole process of placing column, beam, slaps and the screed concretes it takes not more than 8 to 10 days as I have learned from the flied visit, which we conducted in last one or two years in the various site of the Mahada housing projects.

So the floor to floor cycle not more than 8 to 10 days, but at times it can take little more depending on whether, but technically it should not take 8 to 10 days. So here you can see that how manual labour is used to.

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Find tuning of the slab component and hankering the slab component with the hankers and the Shirke left over the main component after this fine tuning of the slap component then the screed concrete will be put and it will be used.

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You can see the typical pictures of the slap component, every slab component have the grooves like that so that after placement of the slab component it can be acted like silage one unified component as slab and so that it also bind well. It is locked well with each other like this. This is the picture of the whole floor. It typical floor, this is how their lifting any pre-fabricated component using quinces and this is the typical picture of a wall component where their using the AC block, which we call as light weight block as the wall component also they use the binder concrete binder to so that it becomes strong, it become unified and this blocks are very light weight.

This blocks are very light weight single person can carry and it is also very soft so that some person can make groove or can break it and use it like a common brick, but it is manufactured in such dimension which is standardized dimension and practically u do not need to cut AC block too many times so that you reduce the time requirement for the project construction. Now in this picture you can see the some of the AC blocks tacit in the site.

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these are the window block, this blocks are also pre-fabricated, it is sometime pre-fabricated at the factory, sometimes pre-fabricated at the site and place like that and these are the AC block was how it looks from the outside and you can see the slab component, photography is taken at the floor level so that you can understand how the joinery and the arrangement for ceiling fan is kept here.

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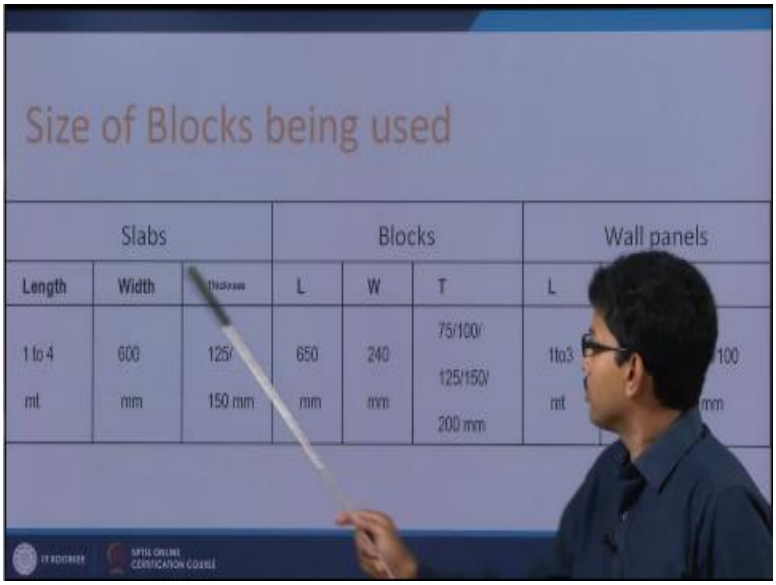

So they use the slab blocks and wall panel in this size, you can see that these 600 millimetre almost 600 millimetre is the standard modern size what they use and for the blocks they use 4 inch, 3 inch or 6 inch module and the length can be one to four meter for this slabs, Len can be 650 for the blocks for the wall blocks and for wall panels it is one to three meters so keeping the thickness as 3 to 5 inch and width as 2 feet they can for the one to two meters and 3 meter.

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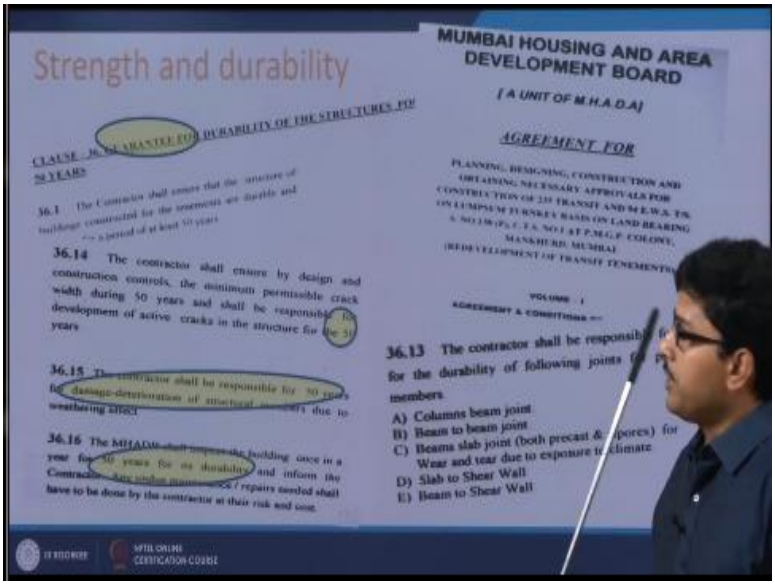

Now lets us talk about its strength and durability, the whole structure is designed in such way that it will give a life cycle of at least 50 years against its durability, its strength against all the possible load component in the building and they have waited the design with help of IIT Bombay and this is the clause some of the clauses in the contractor between the developer or the manufacture and the government housing authority, housing board authority where you can see that 50 years they have given guarantee against the durability and strength for 50 years at least so 50 years.

So that is there and it is still working for more than 20 years, some of the projects, this particular project was under construction. Now this are the arrangement how they put the convicts for the electrical pipelines usually in the normal RCC construction, with we place electrical concretes floor in this slabs, I mean roof slab during the costing,

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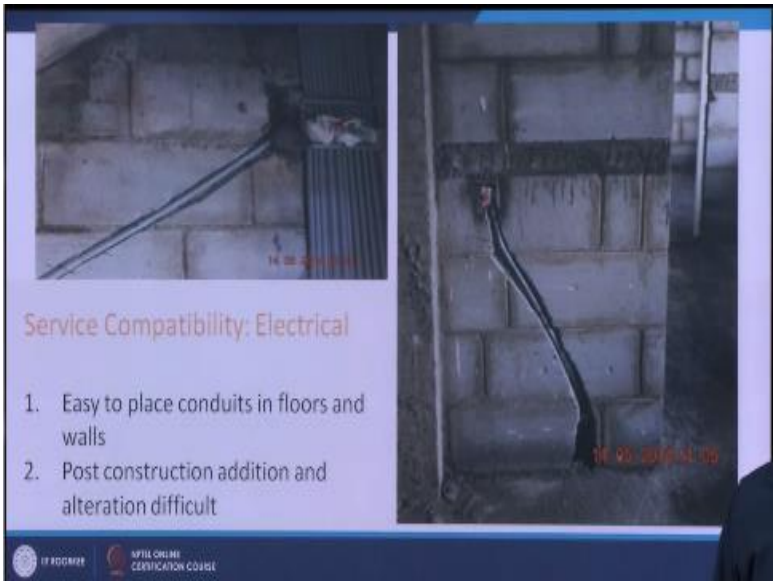

But here what they do during the secrete concreting, which I discussed little before over the pre-fabricated slab component on the screed concrete they take the conflict like that and from the screed concrete they take up to the switch board level, but in the conventional construction it is taken from the ceiling. So that is difference and another point is you can see that it is very easily cut by common even semi-scale labour so that they can put this place for concrete like this also.

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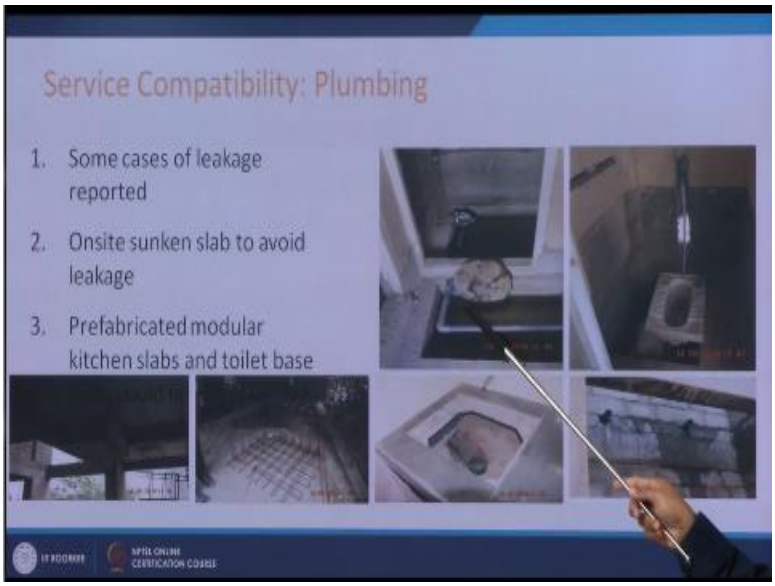

This is exposed conflicts these are some of the pictures showing how the plumbing arrangements are done. The outlets and some of the drops slabs, which is done incite to those could be kind of a next stage of improvement, but these are the areas where it is working very nicely as a product as design, these are the pictures which is under construction. Now we will see some of the project, which is already constructed to apprise or to assess their efficacy against the performances.

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Now this project the new Hindu Mills project is in Mazgaon, now in Mumbai you now that there are many mills, and land so the authority or the government of Maharashtra they took a policy to use that Mill lands for the affordable housing projects. So this is one of the biggest Mill land housing called New Hindu Mills basically it is combination of few Mill land and housing where Mill land where they have placed also the original staff of the Mills some transit accommodation and few EWS and LIG population.

You can see the adjoining area is full of kind slum like situation and this is the housing project which we are discussing. So far 18 housing projects in the Mill land was already executed more than 10000 units till 2014 when we took the study that time was done.

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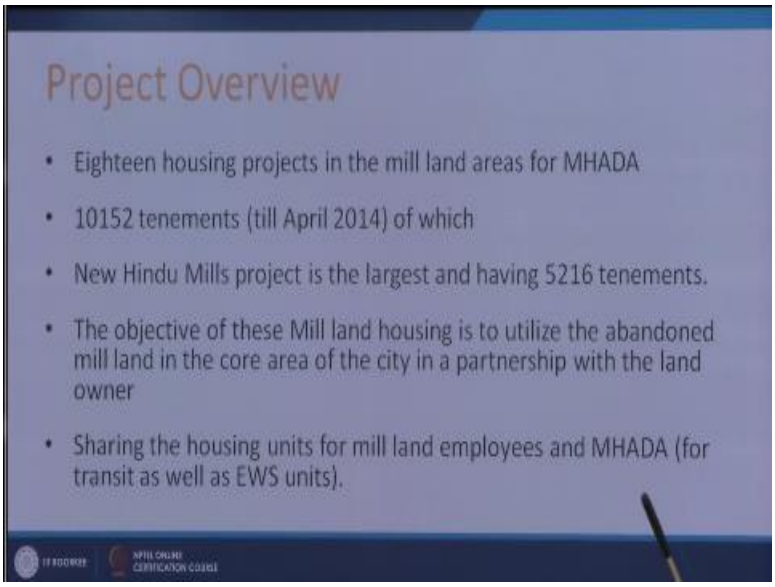

So new Hindu Mill project is the largest and having more than 5000 units, it is one of the biggest projects. So objective of this Mill land housing is to utilize the abundant mill, land in the core area of the city in partnership with the land owner and sharing of the housing unit for Mill land employers and the MHADA for transit as well as EWS unit that I told. For development of the other projects, other slums some of the transit house will be required so those transit houses will be accommodate in this project that was one of the objective.

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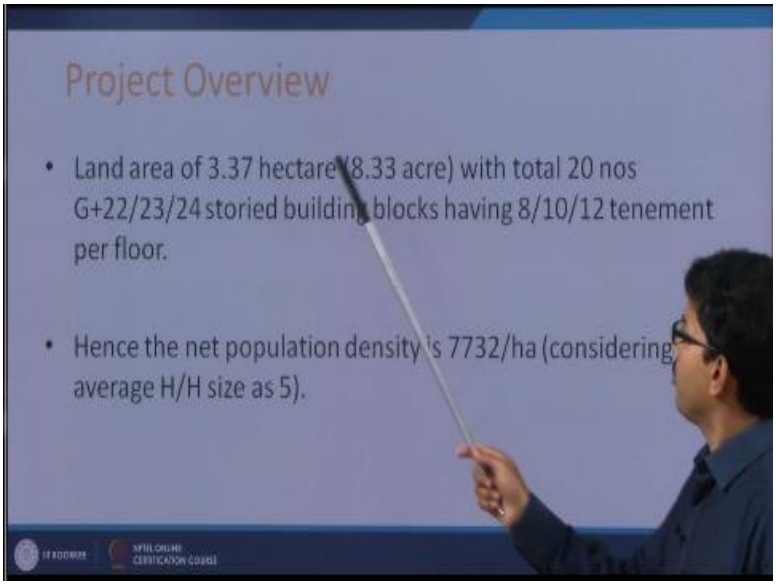

So you can see the land area was more than 3 hector, 3.7 hector and it was full G+22/23/24 storied block having 8 to 12 tenements per floor and you can see the density. It is very, very high density and dense project with the compact development, which is very high, but with this density at least the housing units are affordable for the poor and the lower middle income group or the lower income group for economical weaker session at this density otherwise it is not affordable.

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You can see the layout plan, the layout plan each building blocks are joint together in such way so that it makes internal cote here for enough light ventilation and you can see the typical building units is repetitive because we talked last day also that the whole industrialized process or pre-fabricated process runs on the standardized design, standardized module, so each housing unit is consisting of standardized module so we will see one such module in detail in the next day.

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So this is standardized module of a typical building block it consist 12 unit this is the one unit consisting one multipurpose room or living room, one bedroom, one WUC, and one bus area and one kitchenette with some storage area and this is the common core with staircase and live block where this are the common lobby to provide the access to each and every unit. So this is the standardized module, which they use out of this module this component like this lift core and the staircase core this is done in using the RCC basically and some of the element like bigger columns these are also RCC.

But apart from that most of the elements are done by the pre-fabricated wall blocks and pre-fabricated components.

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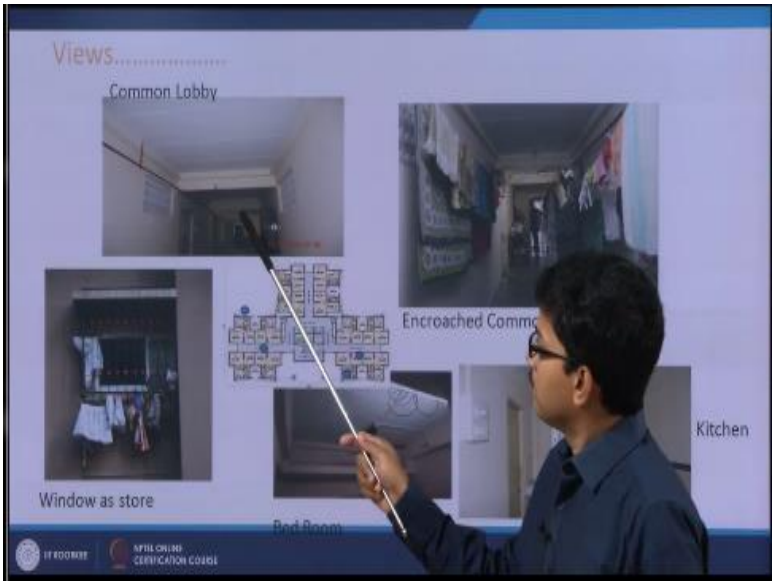

This is finished picture of floor where you can see the placement of the lobby component from bottom it is painted in colours and this is the picture of the typical kitchen where you can see the kitchen slab and the slab component only one thing that since this particular design does not have any balcony as such, so their using the windows for today the storage purpose or in few cases we have also found that in lobby areas they have used the lobbies for keep their today think and this is the picture taken from inside where you can see that the internal arrangement of the slabs and how they taken the electrical pipe lines, which is basically exposed.

So these are the variation and outcome of the project. This is typical unit plan, having one living room, one bedroom, kitchen and the WBC and one bath now only one path.

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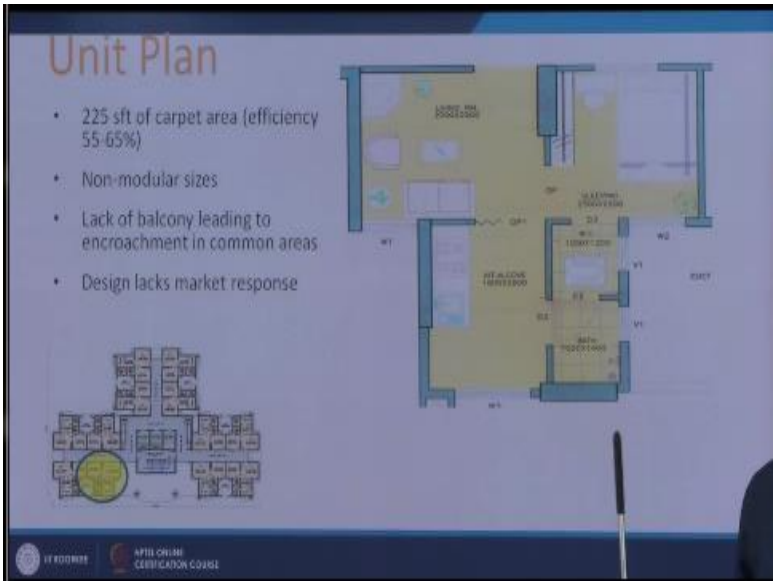

This is very compact design, very compact design within this much of 225 sq feet of corporate area. So only think that it could be accommodated another very small balconies so that people could use it in multipurpose way other than that it is very nice design to accommodate and to generate affordable house within this price and within this much of time. So this is general views of the project you can see it is huge project.

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This is the view from inside of the project.

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Some other views.

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Now we come to one project which is completed long back more than 20 years to see its quality it is projection and other housing project, you can see the project like this, some of

surface tax is missing during the investigation, during our visit, but those are tax developed due to poor maintained physically, it is not structural track as such because structure is durable enough giving 50 years of the durability and the strength as per the design.

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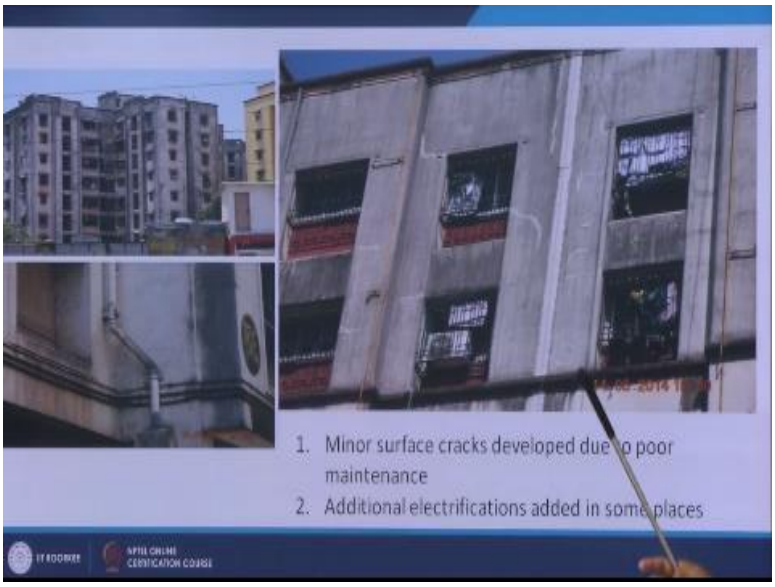

So because of the low maintenances, poor maintenances of the projects it is showing little bit of cracks and some different colours, but otherwise the structure is good enough. So overall influences from our this particular set of projects is that super structure has been found say structurally against whether effects and all kind of load features like say live loaded, loads and load everything, the pre-fabricated elements like wall slab blocks.

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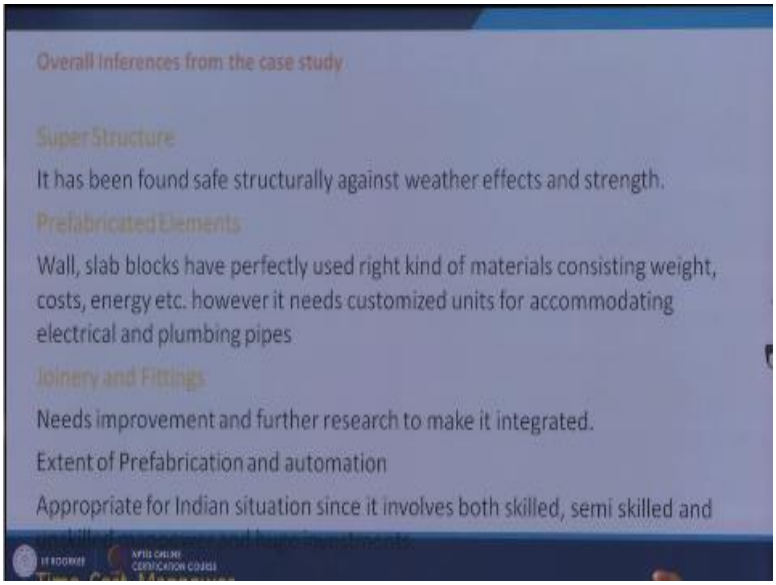

Have perfects used right kind of materials consisting weight, cost, energy, however it needs to be customized unit for the accommodating electrical and plumbing pipe that when we discussed in the fight we understood that some of the units could be integrated to have to the plumbing and electrical installation so that during the construction somebody does not have to make grooves separately.

Joinery and fittings are the areas where further improvement can be done, but as if now the projects are functioning absolutely in the good condition it is very viable and visible option using frame construction in Indian context what we discussed.

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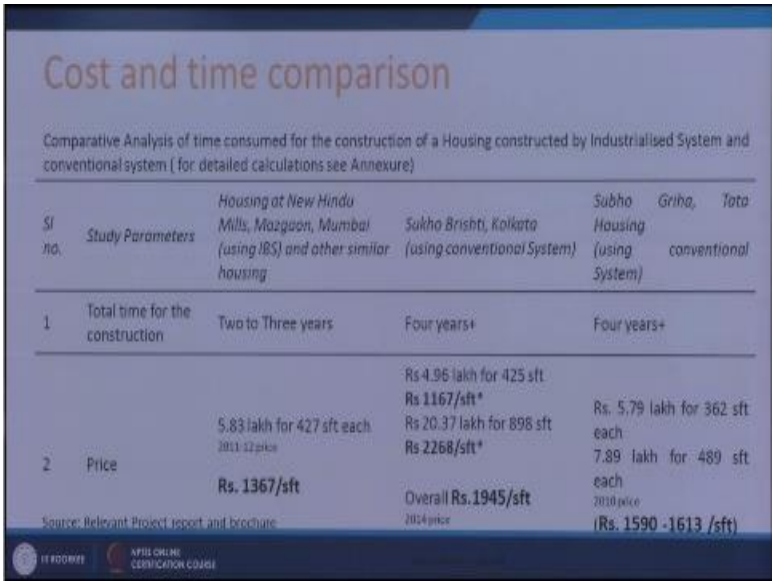

Now let us see a comparative cost of the two projects to compare we have taken two other projects so that we can have comparison, we took we took which is basically being developed by in Kolkata is lower income group housing and we have taken sukaho housing which is develop by TATA housing and also we have taken new Hindu Mills housing, we have taken the cost compound from their website.

So you can see the cost compound it is much lower than the other conventionally constructed projects almost 30 to 40% cost saving as their and if you see the time in this project sukaho and we should go they are taking more than 4 years, but in this case the new Hindu Mills housing they have taken two to three years because this project is very large project otherwise in other projects they have taken one and half years or two years or even less than that.

So median duration of the project is one and a half year for a mid 500 units or so, but here the project was so big that 5000 units it took two to three years still it is less than other conversational projects. So now we come to the present status of India. In India now we have the pradhan mantri mudra yojana by the government of India next we will discuss the pradhan mantri mudra yojana in detail and under the pradhan mantri mudra yojana want technology submission is contextualized.

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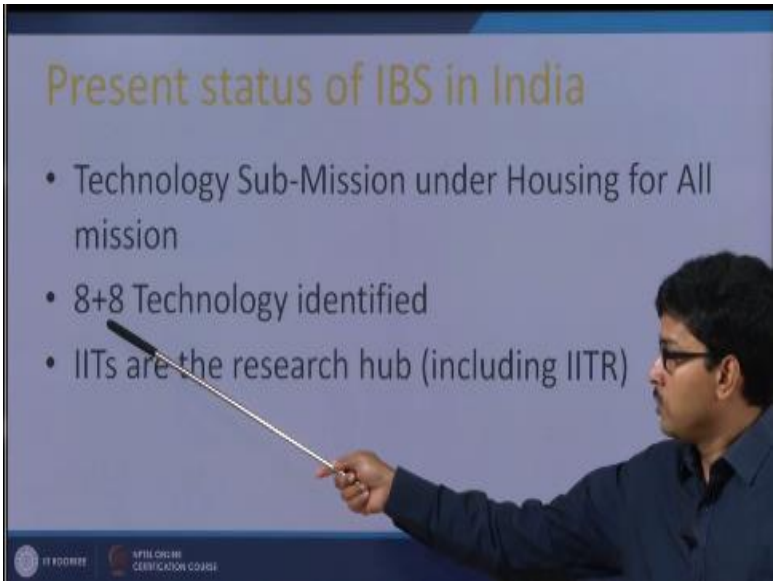

In this technology submission they have identified total 16 technologies NITS their actually basically delivering are offering the research for the technology submission because not all the technology whatever the identified are tested in the field except one or two which I showed today that is why it is under experimentations so let us summarized the discussion what we had today before I conclude so today we discussed the some of the example of industrialized building system in Indian condition.

We told that in India after the independences there are lot of experimentation in material and the systems of the buildings by the government organization NGO, but those who have are basically focused on a particular building component or material, but today we showed another examples where a particular agency government agency is delivering with the partnership with another private developer a complete project using total pre-fabricated units using pre-fabricated columns, beams, slab component and wall block component.

So that the project is being completed within the two years for mid sage mass housing project, which is comparable to other projects conventionally constructed, other projects are taking four to five years, but here they are taking two years median and also the project cost is also less than other project so the learning point in this discussion is that for India the mass housing project using pre-fabricated building components or pre-fabricated building

technology or industrialized building system is fusible and probably this is future and considering this essence government of India they have contextualized the technology submission under Pradhan Mantri Mudra Yojana which we discussed tomorrow or next lecture in greater details so thank you.

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