Disaster Recovery and Build Back Better
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Lecture - 21
Temporary Shelter Construction in India

Welcome to the course disaster recovery and build back better. My name is Ram Sateesh. I am an assistant professor in Department of Architecture and Planning, IIT Roorkee. Today, I am going to talk about temporary shelter construction in India. So, in this lecture, I am going to cover a wide variety of examples and my own personal interaction with all these 3 case studies which I am going to discuss about the Gujarat earthquake starting in 2002 and to this one, two.

And then the Tsunami recovery programs in 2004 Tsunami and as well as 2005 earthquake in Kashmir in the Pewaukee Pakistan Occupied Kashmir. So, these are all my, some of my personal interactions with these or various other various aspects of my work and as well as my study.

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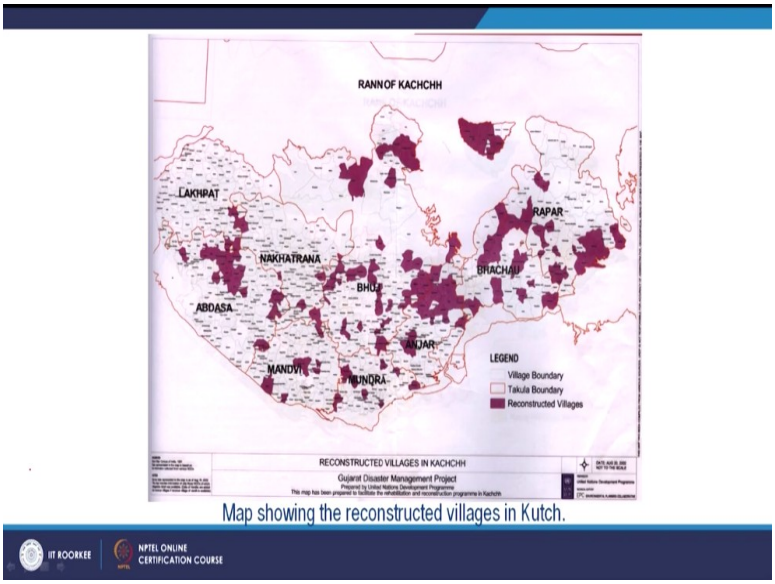

Map showing the reconstructed villages in Kutch.

And in the early 2000 like 2002 when the whole disaster has been struck in Gujarat earthquake. So Kutch is the district which has been majorly affected and that is one of the major 7.5 major earthquake and it has a huge vast devastation both at an urban level as well as the rural level and this is one of the you know the layout of reconstructed villages, the map

of the reconstructed villages in the Kutch district, which has been developed by the Gujarat disaster management project we call GSDMP.

And this is a time Gujarat state has actually taken a very active initiative of the community participation and as well as developing certain guidelines. The GSDMA regulatory aspects, the retrofitting process, so it has looked at providing them guidance in how to reconstruct and how to retrofit these buildings. So, that is where the technical aspects also come into the picture and many NGOs have shown interest in looking at the participatory approaches advocacy.

For example, Hunnarshala an NGO and Catholic Relief Services. So, there are many NGOs who have actually advocated participatory approaches in Gujarat earthquake. So, today what I am going to discuss with you is it is about the immediately after a disaster before coming into the permanent reconstruction stage and just immediately after relief stage, this is where the transition shelter.

You know there is a temporary shelter which they have been provided for them and how they gradually shaped into or progressed into a permanent shelter process. So, this is the stage which I will be talking about it and from this map you can see the amount of damage which has occurred in the Kutch and the amount of reconstruction activities from many NGOs, Catholic Relief Services, Hunnarshala, Caritas.

It was many NGOs which came to Gujarat to give their helping hand. So, these are all some of my primary case study you know evidences.

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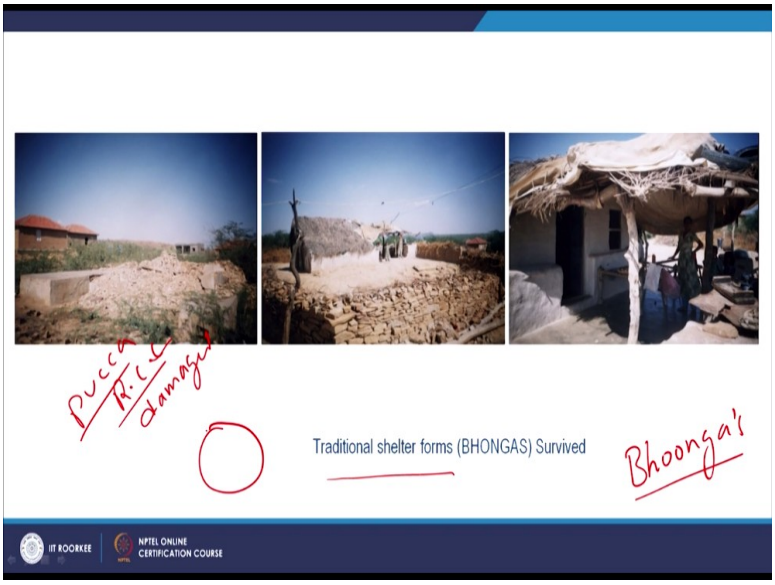

Like in this what you can see is the modern house which has RCC construction and which is a brick and concrete construction has completely damaged and this is a pucca house and which has completely damaged. Whereas, you can see these traditional shelter forms in local language they call also the Bhongas which is normally there in circular shape and in some cases they are in a kind of rectangular shape.

So, here what you see, these have resisted, these are some of immediate I am talking about within a span of one year, the evidences which you are seeing is that these houses with traditional shelter forms have resisted the earthquakes and why they have resisted because that is where the structural form within.

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You can see that there is a wattle and daub constructions, it has you can see that these weeds the wattle has been embedded like a mesh, it acts like a reinforcement, is a binding element and then the cover with the mud and this is a circular shape because they believe that the circular shape is the best earthquake resisted form because all the forces are not coming at the corner because most of the damages which we see is at the corners of a house you know that is where the load aspects also play an important role.

But and also this is how when the moment from the circular form, they believe that this is smaller circular shapes, they resist earthquakes and this wattle and daub which acts as the vertical and the horizontal bands and which can protect the houses from the severe earthquakes and this Kutch zone, Kutch area this falls in the fifth zone, zone 5 in the earthquake zoning.

And what you can see here this is called otla in Gujarati language, so, here you can see that there is a small just exposed platform which is informally has been raised. So, this defines some a kind of semi-living space because, for them, they can cook, some people have some outdoor kitchens to it, some people can have a washing area, some people and if it is and they also believe in kind of family clusters you know like 2, 3 people live in a cluster.

And they raise the whole platform as the otla has been raised and that demarcates that family belonging from the ground and this is how the traditional patterns and in many of the Bhongas we have the low eaves you know because of the desert climate and also the windy aspects of it, so it can protect from the wind as well.

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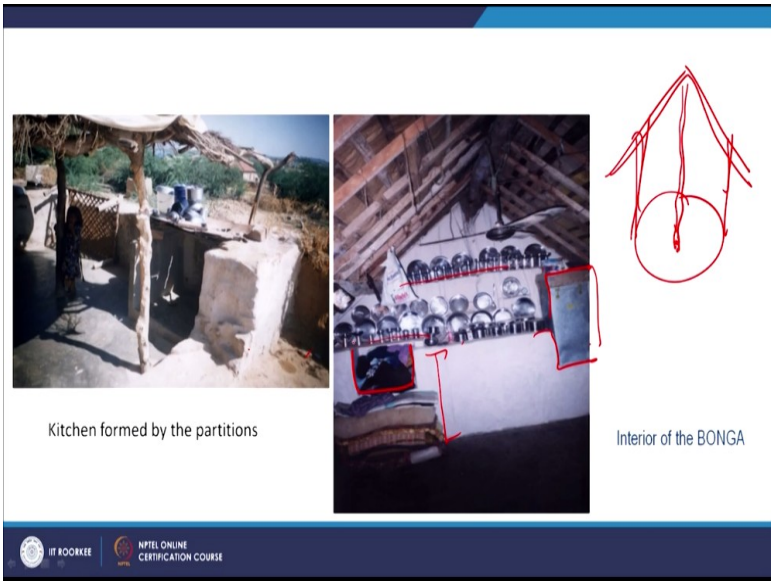

And you can see this kind of veranda and where they have the kitchen has been made a small partition and there is a stone wall you can see and how the inside of the Bhongas you know it has all, it has a very low height wall and then what they do is if it is a conical shape, so, in some of the Bhongas it will have also the central post. You know to support this kind of low eaved roof which can protect from the harsh climatic aspect.

And here, this obviously forms as a kind of racks which they can display, they can keep their functional aspects like you can see that the storage boxes are embedded within it and then they can I mean the indigenous ideas of how a small space could be functional enough for the family, you know for everyday activities. So, even a small wall makeup itself frames everything that their whole products can fit within it.

You can see that the clothes, their utensils you know and this everything has been managed within that small space.

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Also, the typical bath, they have a kind of outdoor bathing areas like we have a semi-open bath spaces and also this is in Pakai village near Bhuj and this is a kind of again a raised platform about one feet six inches and then there is a wooden construction which has been made for a small commercial entity which is scattered to the local needs of that village or nearby villages.

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That is how the pattern looks like and in this particular disaster many of the communal buildings also have been damaged, not only the communal buildings, the historic buildings have been damaged, public buildings have been damaged. So, this is one example it has been partly damaged to the old community hall of the village. So, it is very unsafe to live and the mosque which has been repaired.

Because that is the religious entity where they feel so that is how they immediately retrofitted this and they immediately made a mosque here and in Bhuj, I visited to many places of these damaged areas. I will just show you a glimpse of what all things have happened immediately after an earthquake and how what are the destructions and what kind of property has been damaged, what kind of built environment has been damaged.

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So, now this is a kind of industrial godown which has been damaged. So, when we talk about the industrial godowns and which has to do with the livelihood of certain sector of the people, obviously they will lose their employment for some months, maybe years. So, it has not only the godown or not only the built form which has been collapsed or damaged but it will indirectly affect the livelihoods of the poor people who are working in that godown, so all the industrial segment.

There is also the historic building which has been damaged and the brackets have been fallen down and the railing have fallen down. So, it has become very unsafe, you know it has to talk with the heritage and we also discuss about heritage in disaster context and many aspects like Ayutthaya 9:45 will be discussing on and we also discussed on Kiruna aspect.

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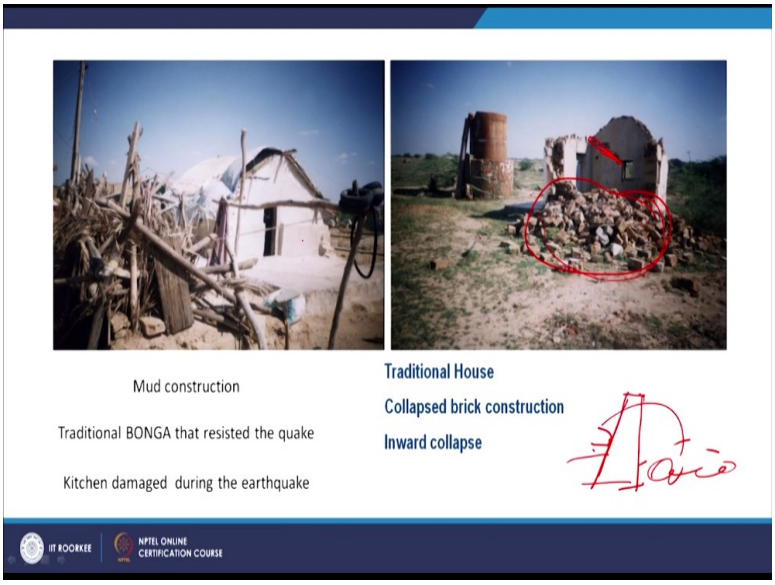

And as I said to you if you see this was a traditional house with a brick and concrete house. The wall has actually collapsed inside, the inward collapse, so that actually talks about you know the wall makeup and bonding and even how we can actually make a slant. Imagine if you are making a roof like if you are making a wall like this, obviously the pressure acts this way and as things might tend to fall down here.

But if it is and also the corners most of the corners during the openings, at the walls, the junctions these are the most crucial places, you know where the damage occurs and also the water tanks which has because this is where they used to store the water and obviously it got damaged. So, because these are some basic needs one a community relies upon, so these are and whereas brick and concrete house has fallen but as the Bonga have resisted. This is one of the important example, surviving examples.

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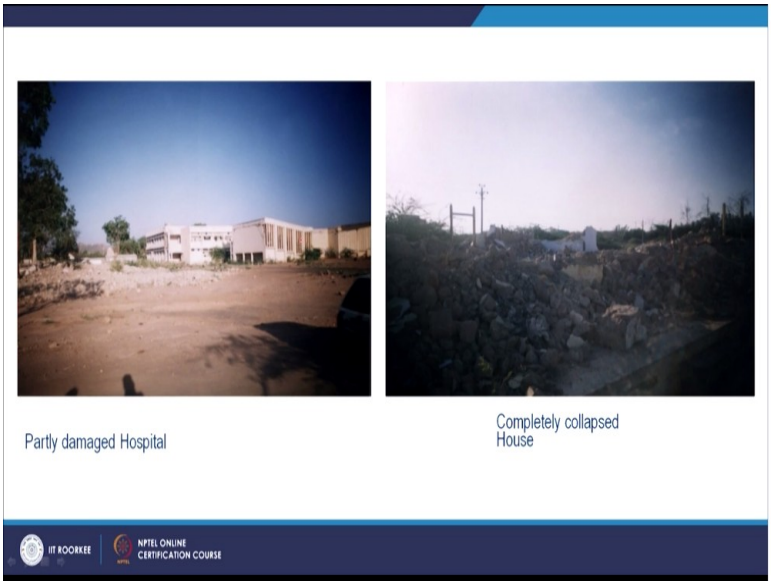

And similarly in Bhuj, where a large infrastructure has been damaged like roads also, some of the bridges, some of the hospitals, some of the schools which has been and now some in the urban areas, huge house, many houses have been damaged, some apartments have been damaged and this is one good example of how it has partially been damaged.

So, being a hospital do you think now how it will affect the whole health sector and which is serving the community. When we say hospital has been obvious, it is very difficult to carry on the regular activities and how it has to serve the local community's health conditions and what about the employment of those people who are working. For Government Hospital, if it is servants were working, government servants who are working, for them at least they have some benefit that they will be supported.

But what about the temporary workers, who are depending on their daily labor or daily wages, so for them if there is no work what happens to the livelihood, these are some of the important questions and due to the hot summers you can see the whole lake in Bhuj has been dried, many rivers have been dried out. So, it has become even the water scarcity is the issue in that particular region.

This is a house nearby a village where they have different class societies. There is a mukhiyas, there is chauhans and there is a Muslim community. So, different caste hierarchies existed in the Kutch area and this is one of the rich class and which has been destructed during the earthquake. Now there is one single house which is having like two or three families together they made one single house having different partitions.

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And this whole house has been damaged but then if you look at the sociological and psychological aspects why these houses are located here, on the top of the ridge or the top of a in a slightly higher area, it's not a mountain area but slightly but if you ever looked from the rich houses villages, you will see the whole entire village. So, this is where the traditional, the landlords or the rich people who used to settle down on the top.

So, it shows the significance of the status of that particular community and who try to look at the whole village and including in some villages even the entry point of a different community also from the external side, it depends on the untouchable. So, this is the condition, social systems which has been prevalent in these areas and now what happened to these houses.

So, people who were not having any house to live there, so when these people have migrated to a different place because they could able to afford somewhere and they could able to live somewhere else. So, that is where this unsafe houses has become a shelter for the corridor between these two families has become a shelter for the homeless people, but the question is, is it really safe to live there?

Because aftershocks might keep coming on and there might be a possibility that you can see that whole damage has been occurred. So, there is a great possibility that this may also collapse and the wash areas has been damaged behind and the toilets.

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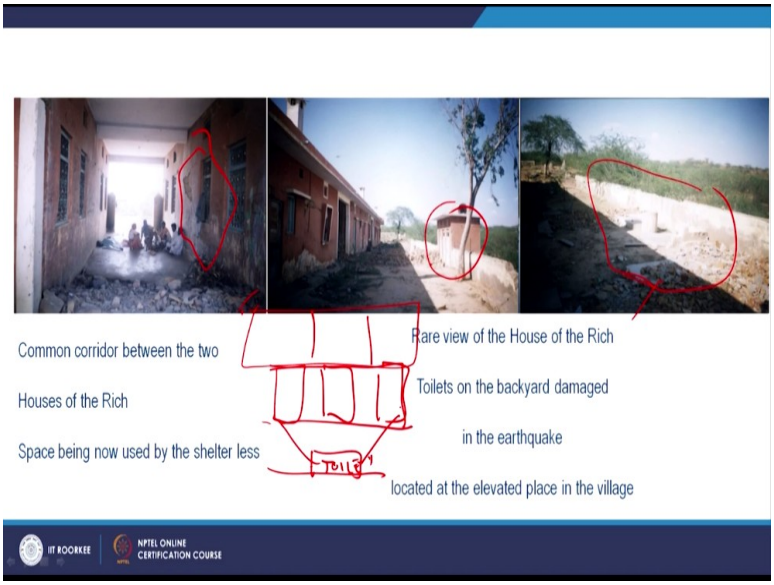

But you look at it the wealthy class of the village, they have a detached toilet system and detached washing systems towards the rear side so which means though the independent families are segregated by wall and the common corridors at the end like you have the 3 families living like this but they have a common toilet. So, they gather at the rear space and at the same time they have their personal demarcation of their space.

So, this is how the whole and this is completely treated as one unit to represent one family belonging.

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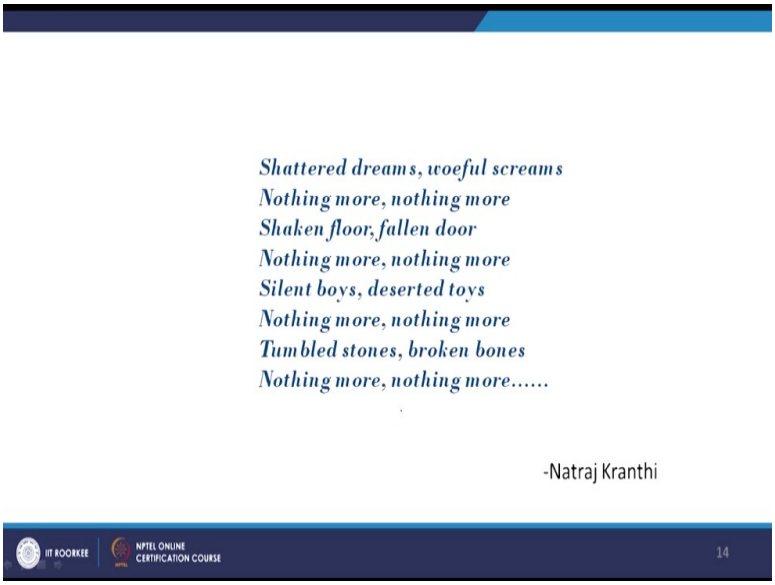

So, this is the story of immediately after the earthquake but now I will just read out a poem which has been written by Natraj Kranthi and it was at the moment of the earthquake impacts. He talks shattered dreams, woeful screams, nothing more, nothing more, shaken

floor, fallen door, nothing more, nothing more, silent boys, deserted toys, nothing more, nothing more, tumbled stones, broken bones, nothing more, nothing more.

So, this was on the wake of this disaster, one of my friend Natraj, he has written this kind of narrative of explain the pain and agony of the families and what happens to their dreams, what happened to their flows, what happened to their belongings, you know how they are, how the people, the children can become orphans when the parents die and you know how people die, what kind of panic situation it was, that is the.

And in such kind of situations, obviously one of the important aspect is the schools like as I showed you some community hall infrastructure; even these kind of infrastructure has been affected. So, many of these schools were damaged and many of the community halls, community centers have been damaged. So, this actually says that you know they are afraid to go to school.

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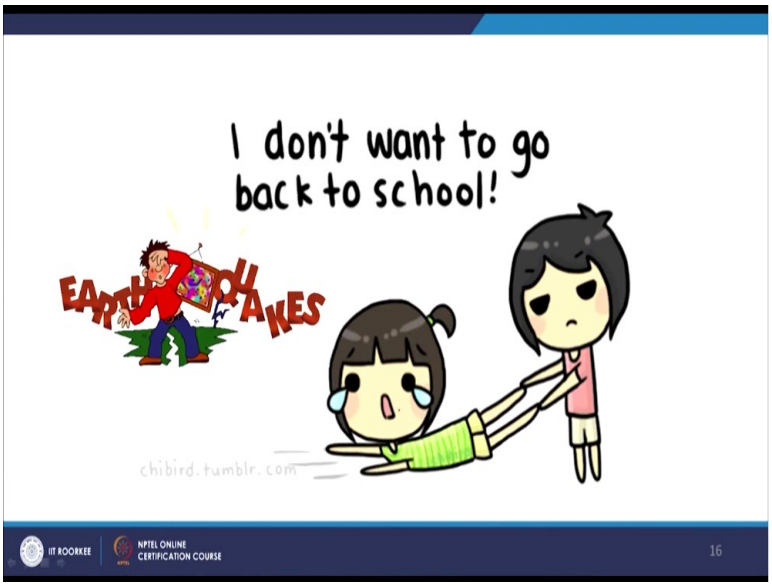

So, that is where the schools have been stopped for about one year, nearly one year. So, how about education, you know what to do, how we can engage the community and the children because you know that is also needed, what happens to the school education and where do we provide the school facilities and this is where many NGOs have came forward, many development agencies have came, they collaborated in different forms as I am not going in detail about how differently they have collaborated.

But at least some of them they sponsored it, some of them they worked independently, some of them they collaborated with partnerships. So, these are some of the examples you can see that the weave of the classrooms.

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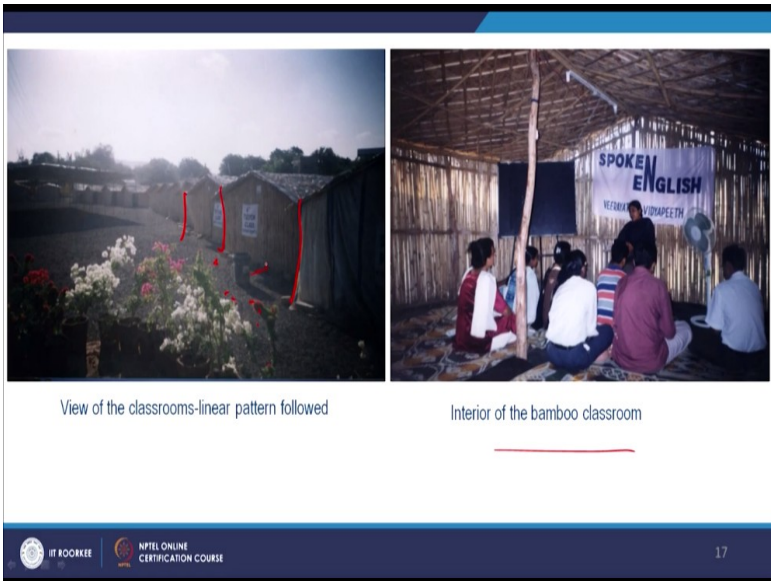

This is a school, a temporary school, which has been constructed to provide some education facilities for the people who does not have school, I mean at least from the neighborhood areas and you can see that the kind of linear pattern has been organized to organize the school and this is the interior of a bamboo classroom but now the question is, yes they are good at least bamboo has been supplied.

And it has quickly erected to make assemble because it is very easy to build bamboo, you just have to make kind of panel-based and make some studs, make the structure with the poles and then tie up and then what you see here is this is a gravel you know the gravel, they put the gravel on the top so that even if the rain comes it does not become dirty and because there is hardly any level difference.

It is hardly 5 centimeters to 10 centimeters level difference and even in case when rain happens, so that is where they put the gravel so that the water can percolate and this whole school has been established. So, here then people, the local teachers or the local educated graduates, they started volunteering themselves to teach to the children.

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And similarly, some the school office, some of the office buildings and they have also developed in the laminated paper pipes, you know you will also see that from the Tadao Ando's work and the temporary shelters which will actually provide with the laminated paper pipes and this was about in those days I am talking about 2002 which has costed about 27,000 rupees per unit.

So, which was very reasonable amount of cost. whereas, the dining hall which is completely built with the canvas material, so that itself has costed about 18,000 material but then if you talk about the durability or if there is any kind of rain occurs then obviously this may not so better and but this is little better than the canvas aspect of it. What they do is, they have this walled structure and they put a mat on it, the tarpaulin sheets or some kind of waterproof materials so that it can actually protect as a roof.

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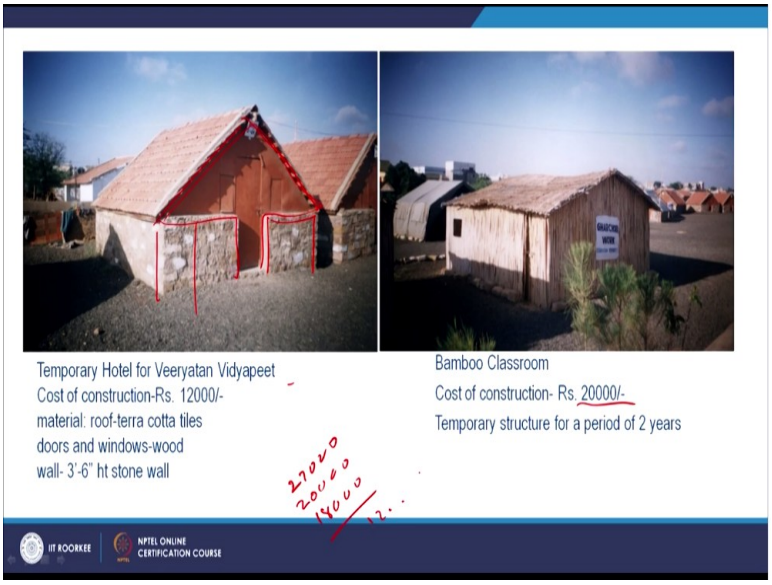

And some of the hotels because a lot of NGOs coming forward, so where do they stay, you know there is many offices coming here and going and doing lot of reconstruction work. So, there is lot of movement is going on in this work and this is where they also developed some kind of residential aspects of it that is where they built till the sill level with the stone wall with a random, rubble masonries.

And then, this is a kind of wooden material or a tin material and then this is the traditional tile pattern roof where the terracotta tiles and the doors and windows are made with the plywood, the plywood material which is made about 3 feet 6 inches stone wall and this bamboo construction was about 20,000 rupees. So, if you compare the cost the terracotta was 27,000 and this one was bamboo was 20,000 and the canvas was about 18,000.

So, the more the material we are improving obviously and this is about 12,000 you know because that is where you are using the stone and as well as the plywood material into it and this all temporary structure for a period of 2 years and because for 1 year they completely abandoned the school education.

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And many NGOs came forward how we can actually generate some alternative livelihood items, you know like the woman how they can be educated the unemployed youth, how they could be provided with some kind of alternative skills because like tailoring, sewing, embroidery or any craft making, so this is one of the so what they did was they had a stone wall and they made a vault and they have a truss, the metal truss.

And in some places they have also had this asbestos and the tin sheet, the tin sheets as well and the galvanized sheets and they put it on the top and that way because being a hot place they also have kind of some places they had some little insulation sheets, you know the materials which can make and the flooring it has again a kind of mats which has been laid out, in classrooms there is a normal mats and as well as and this is a computer lab you know it's an air-conditioned computer labs which has a semi-circular trussed roof.

And this is again a prefabricated trussed roof and here they have actually established a training center even computer training center as well.

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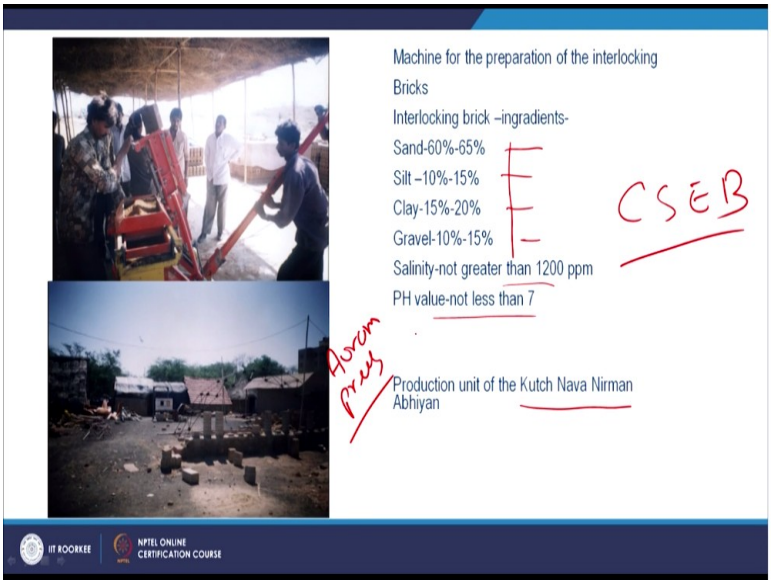

And this is all about the temporary housing but then when we moved on how in these 2 years, how we have to invest for the permanent housing because the land allocation issues, way to relocate and how to find the land, how to get the money, how to get the collaborations, all these becomes big questions you know and these are challenging issues and this is where the technology transfer also has been adopted in Gujarat case.

So, where center for earth unit in the Auroville Center has actually transferred some rammed earth and as well the compressed stabilized, here we call it as CSEB, compressed stabilized earth block. So, these are basically a kind of interlocking bricks and this is the workshop in that name. Earlier, the present Hunnarshala, it's called Kutch Nava Nirman Abhiyan and now it is called Hunnarshala Foundation.

But this was the workshop of, so, where they used to make these interlocking bricks or they used to make these kind of pre-fabrications, making these live models of the houses, demonstration units and the here, based on the silt content and the clay content is 60 to 65% of sand, 10 to 15%, clay is 15 to 20%, gravel is about aggregates are about 10 to 15% and salinity should not be greater than the 1200 ppm and pH value not less than 7.

So, that is a kind of composition through which they developed these stabilized earth blocks which are about in a square shape and this is called Aurum press.

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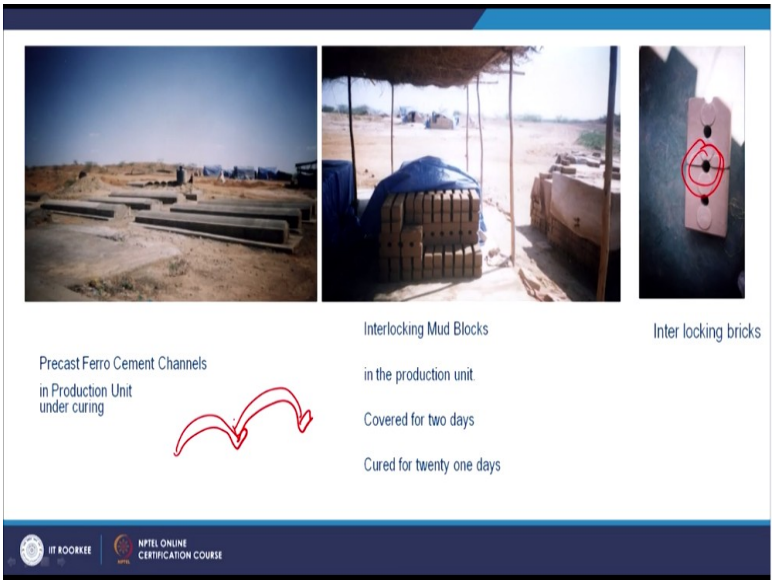

And basically what they do is they actually prepare the mixture of this, mixing with the cement 5% to 7% of the cement and to stabilize it and then they actually this is a mould process. So, they keep that and then they press it and then these moulds will come out of it and this is where the interlocking bricks because these are very helpful for having a vertical reinforcement at the corners or the junctions.

So, they can have some vertical reinforcement, there is a male and female coupling of it. So, how these two things has to match and then the reinforcement is kept whether it is a pipe inserted or 8 mm rod has been inserted into it. So, what they do is once they prepare these bricks, they do not fire these bricks, what they do is they cover with a kind of plastic sheet for two days and then they leave it for about, they cure it for 21 days in the hot sun and then they directly use it to the building material.

Also, there has been some prefab units such as Ferro-Cement Channels. So, you have the Ferro-Cement Channels which are moulds and similarly these are mostly used for toilets as well so this is how the roof structure is like. So, it couples one over the another and then it forms as a kind of roof.

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And not only in terms of this earthquake but also the previous past earthquakes, there has been some efforts by different agencies by development alternatives in Delhi, Nirmithi Kendra's in Hyderabad. This is one another model where they talk about you know the pre-cast frames you know. These are all the precast technologies in housing. So, this is a frame which has been developed by Nirmithi Kendra like a door frame.

But then this is a hollow brick model of roofs, what they do is these things will embedded into this frame and that becomes into the roof, you know so each panel is fitted with these kind of blocks and then it composed as one panel. So, this is one technology and also they developed one more technology of having a diagonal bracing and the concrete balls you know. So, they roll over even if earthquake comes and shakes.

Obviously, the building can only you know tilt a bit, so that it will not affect much damage. So, this is also one of the technology, which Nirmithi Kendra have developed.

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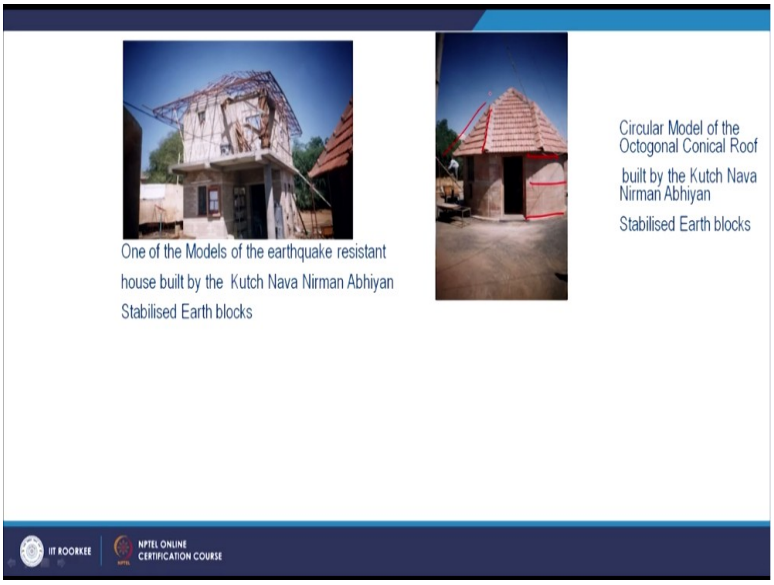

And following various guidelines which we showed by the GSDMA and all others IS codes, Kutch Nava Nirman Abhiyan of that time has developed many of the models earthquake resistant, one is G+1 model, one is the imitation of the Bonga, what you can see is the plinth band, sill band on the roof band. So, following these codes as well as the guidelines which has been issued by the authorities, so they also demonstrated that how the transfer of this technology can be implemented like the upgradation of the Bonga roof.

So that is where they are talking about the octagonal conical roof with the help of truss, fabricated truss.

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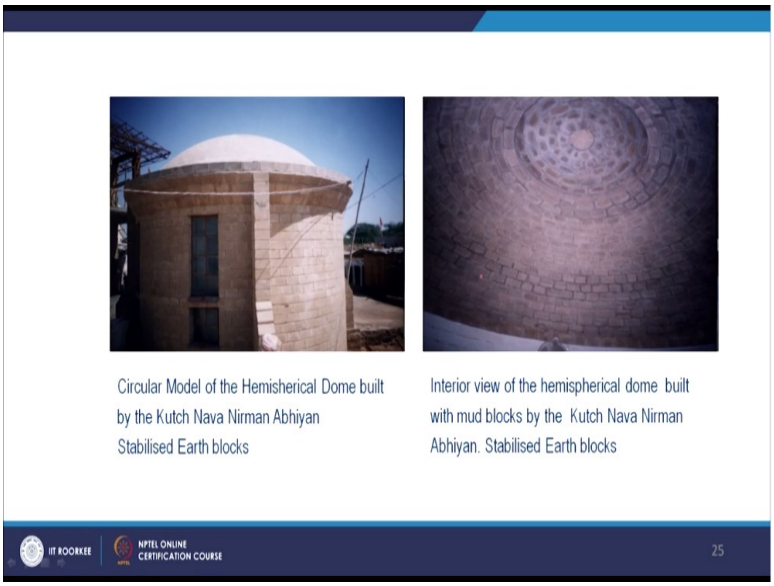

Also, some of the circular models which is a hemispherical dome. This is completely done with the bricks, you know with the mud blocks.

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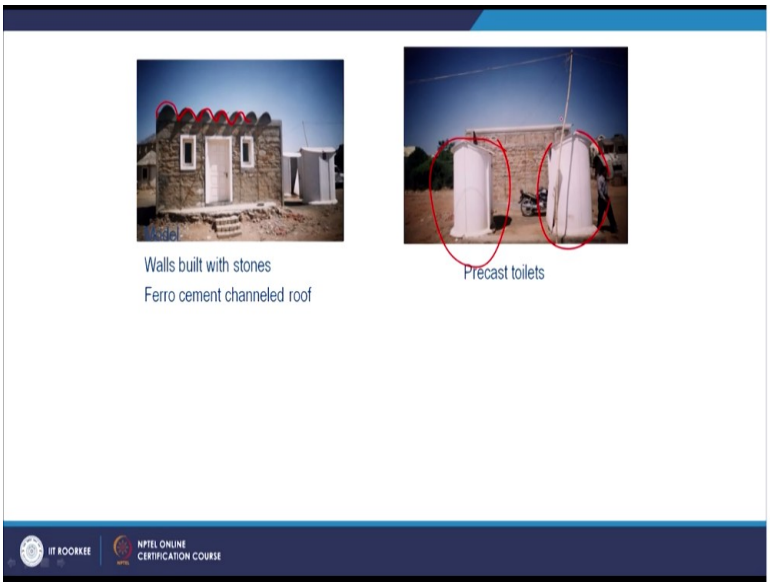

And the Ferro-Cement Channels which I have showed you just now how they are fabricated and some of the houses were also constructed on that and as well as some toilets, you can see that these are the precast toilets, toilet units so these are some of the interventions, some ideas because this whole disaster becomes the follow-up of this becomes a kind of place a laboratory of different ideas and experiments.

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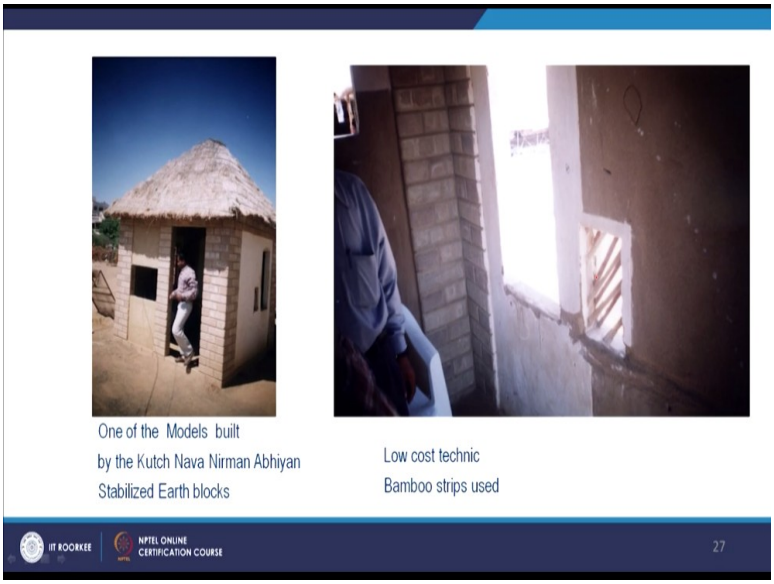

So, even some incorporation of traditional technology like bamboo how we can make use of bamboo and embed that in the shelter forms and thatch. So, there is a combination of both these CSEB blocks, rammed earth as well as thatched roofs, so there is different works.

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And similarly, in the hospital what you can see is that they are building some units of the geodesic domes which has known for its earthquake-resistant structure and which will have less area and more volume. So, this is the earthquake resistant model built by Nirmithi Kendra as I said to you the diagonal bracing in the foundation with these circular balls where the building can bear the forces, the earthquake forces as well.

And the same community hall, the Catholic Relief Services has taken the reconstruction activity of the Paika village and here you can see that this whole community hall which has been damaged has been reconstructed and using the CSEB blocks and the Mangalore tiles.

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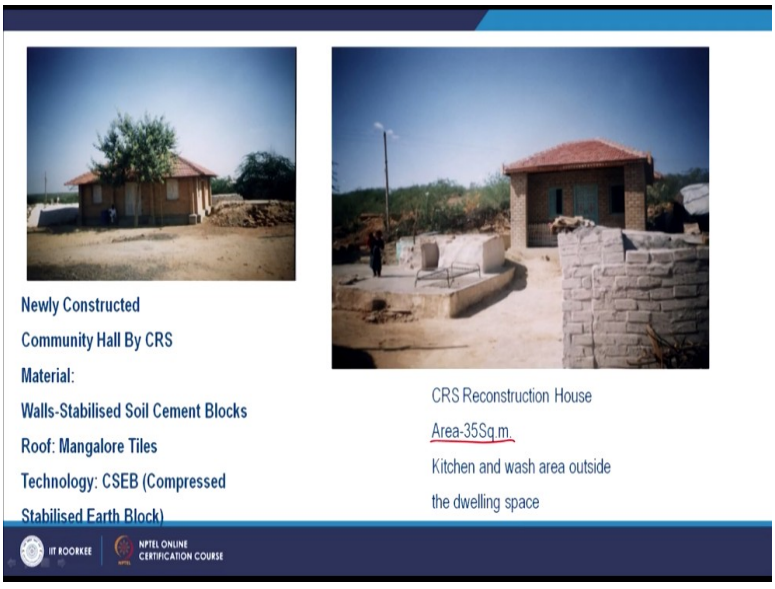

And similarly, you can see that houses they are giving about 35 square meter area of a house, where they have a small open space and sometimes using the previous doors if they have.

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And here, in this village what they did was they have not designed any layout but what they did was just adjacent to the house where they already have an existing house just adjacent to it they have like imagine you have a house here, so adjacent to it they have built it. So, that the structure remained, the structure of that layout remained as it is and like now today, you see that the crossroad is like this where the community center in the center and gradually things have developed later on.

But now, what you are seeing is a view of the village which has been reconstructed at the same places like you can see a small Bhongas next to it where they were living temporarily.

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And there is also some earthquake-resistant models which were developed by Caritas-KVT but these are very not even relevant to this area but they are very uniform and standardized forms of the concrete models where people showed their reluctance in not to stay in these houses. When I started interviewing them, they said no we cannot stay in these houses and some of the, there is a 100 crore hospital projects which can at least resist to 9 Richter scale.

So, in that way, they try to progress to resistance aspect of it and what are the responses of this community. So, now you can see a community has been given this house by an NGO, next to it the community themselves have built this house by using the stone.

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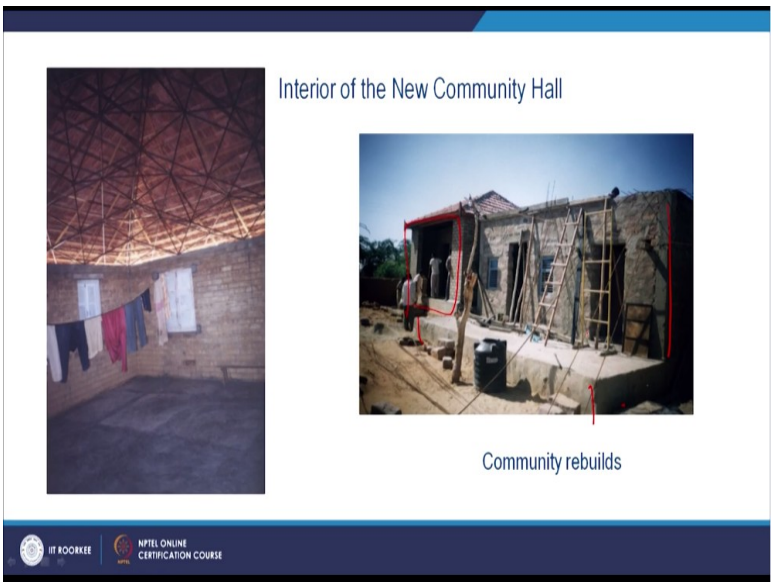

They know that they have, a stone is an unsafe material but they have built with their own for their own needs, for their own. So, this is where we have to learn that what community needs and what community demands and now to give them some guidance even if they are wishing to go with the stone how safe it is but what are the better ways to construct and what are the rightful ways to construct using these materials.

You know, what are the codes we have to follow; this is where the technicality has to be addressed in some support system for the community to build themselves. So, these are some of the examples from the Gujarat earthquake whereas in following the Gujarat we have Tsunami and immediately after Tsunami the Kashmir earthquake and in the Kashmir earthquake, I was working in a company in UK.

And I was immediately, after the post Kashmir earthquake, a lot of agencies were working towards it and they were looking for a quick technologies, quickly build houses that is why at that time UNWTO has also approached our company and I was actually designing some kind of prefab houses from Britain and where setting for frame houses where we can do a flat-pack approach, what you can see is the panels here.

And there all, this is not the house exactly built-in the POK but built elsewhere but I do not have the photographs, so I am trying to show some similar models of it. So, here the trusses, the roofs everything is a flat-pack approach. So, in a uniform and standardized format, so that we can reduce the waste by design and we pack it from the factory, we ship it to the POK and as well as then we send to few labours there and they erect it on spot.

So, here that is where I say that I realized a villain's role as a designer sitting in my desk. I have never been to the site, I never been to the context, I never introduced to the context. I am not knowing who are the beneficiaries, what do they need, what was the livelihood and this is where I was playing a villain role and that is where I looked at my further research of how we can actually take the research, what are the gaps, how to reconcile in between the gaps between the development groups and the beneficiary groups.

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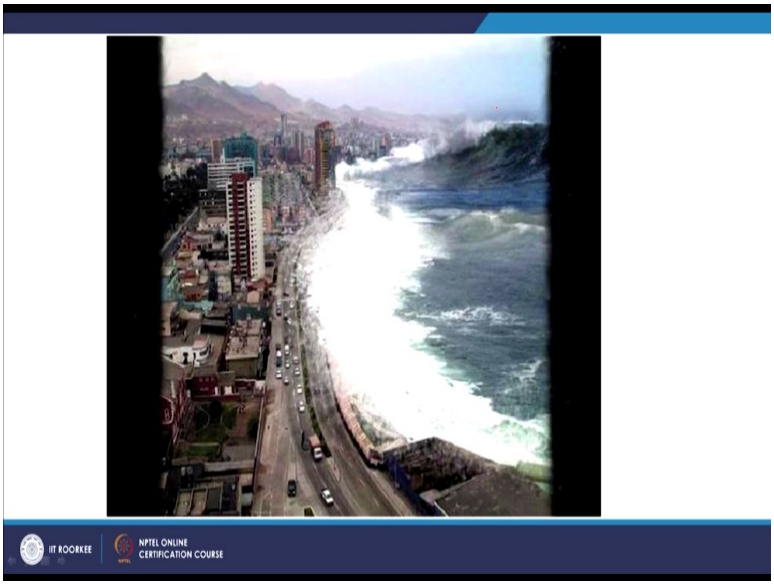

Then, before that Kashmir earthquake, we have the Tsunami.

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And what you can see is a Giant Tsunami which has been destructed the Banda Aceh and the Indian Ocean Tsunami in 2004, the Boxing Day Tsunami.

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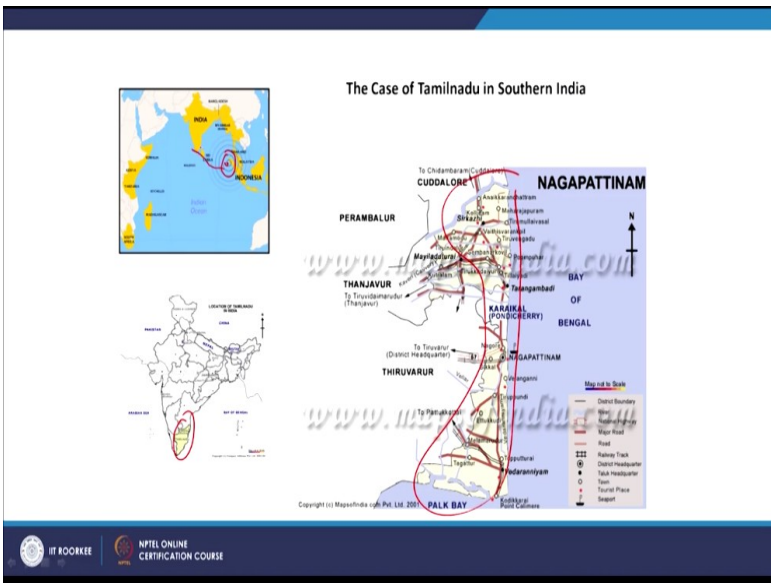

And it has affected the Tamil Nadu, the southern state of Tamil Nadu especially in the Nagapattinam and of course the Cuddalore and the East Coast of the Tamil Nadu but the epicenter was somewhere near Sumatra and waves have traveled almost in this direction.

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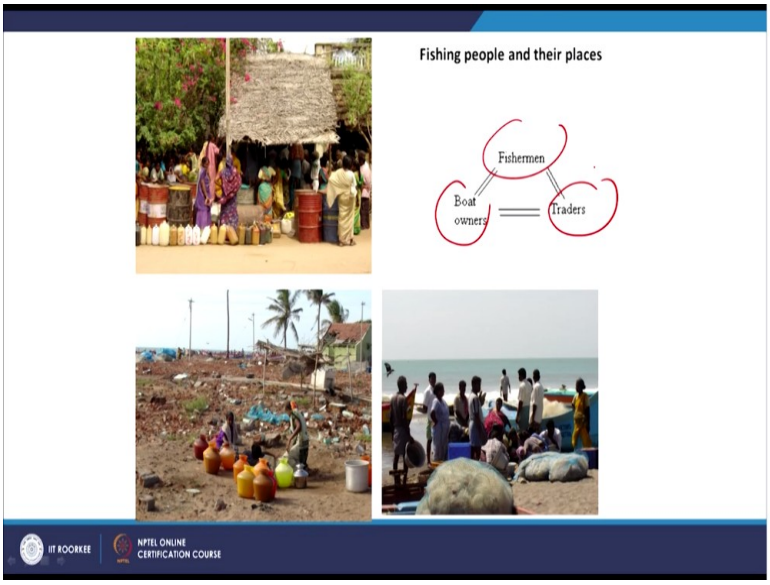

So, now immediately after the post-Tsunami when I visited the place, the important issues are the food security, you know how to get their rations because they are all after the relief stage when they settle somewhere, so their daily needs, this is where every ration shop is full of queues, every water facility because their infrastructure has been damaged because of the Tsunami, where do they get the drinking water you know and their livelihood is in threat.

So, this is where in the fishermen set up, you have the boat owners, you have the fishermen, you have the traders and everything used to cooperate with each other and they use to work.

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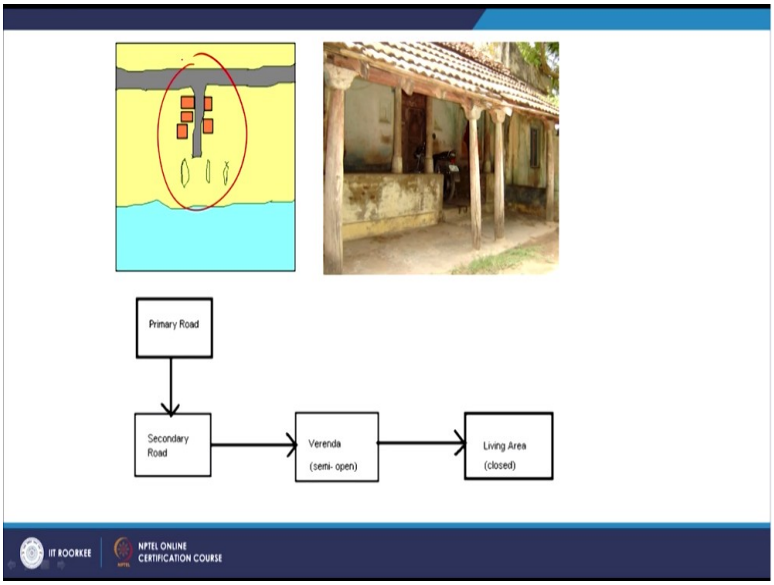

And the traditional houses you know and their indigenous knowledge how they oriented their houses, they are climatically efficient, how it suits their livelihood needs.

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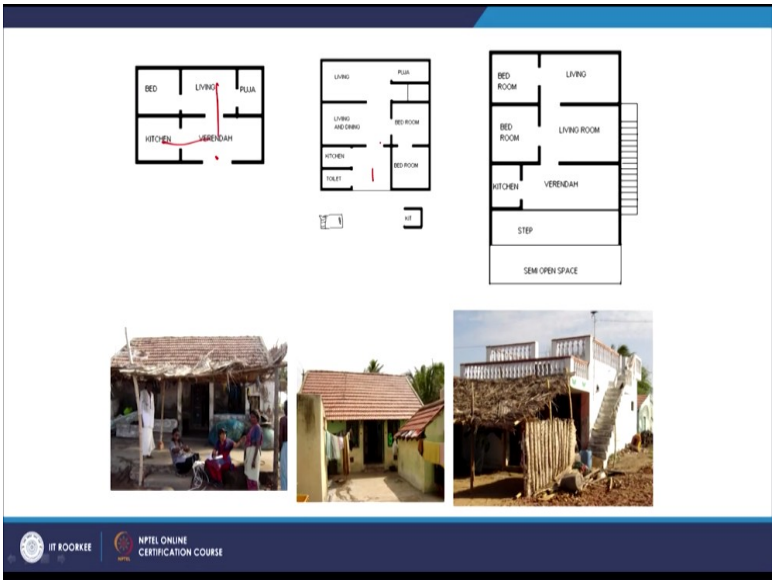

And different typologies of houses, this is in Tharangambadi and how different layouts of these houses like a joint family house, a nuclear family house.

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And their public places, how they were damaged. This is a huge infrastructure has been damaged.

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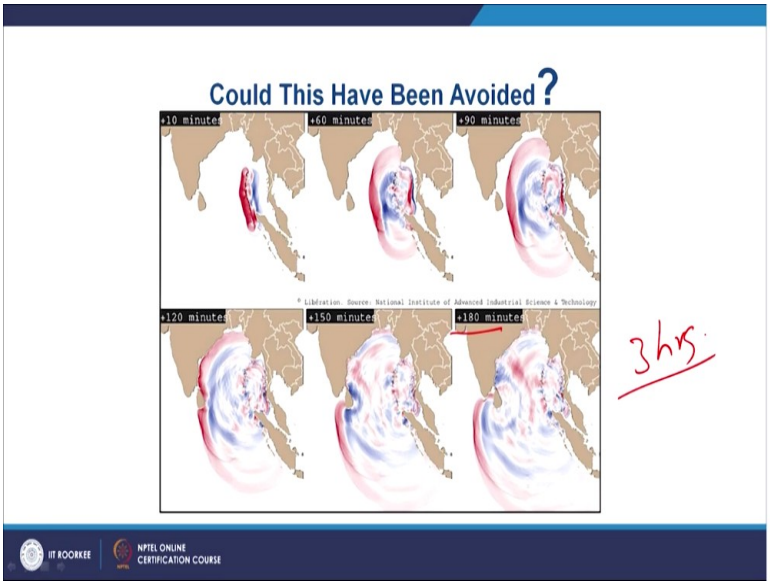

But one has to look at it but if you look at the evidences if a correct information has been passed down to these places, it took 180 minutes which is about 3 hours to reach to get these waves into the mainstream, you know to the mainland, so if that information has been passed on the right way, we would have saved many lives, we would have at least saved some important assets.

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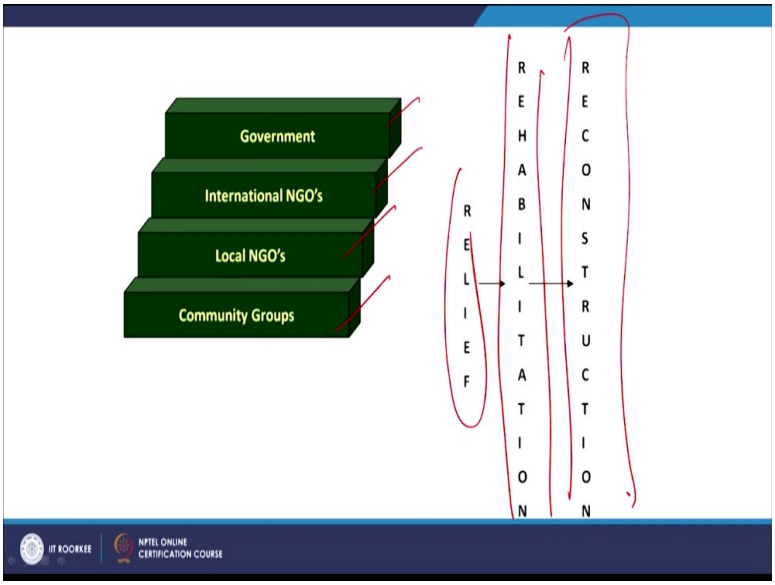

There is always a relief stage, there is a rehabilitation stage which goes for a few months and the final is the reconstruction stage. There is a lot of actors working from the government, international NGOs, local NGOs and the community groups which work on these aspects.

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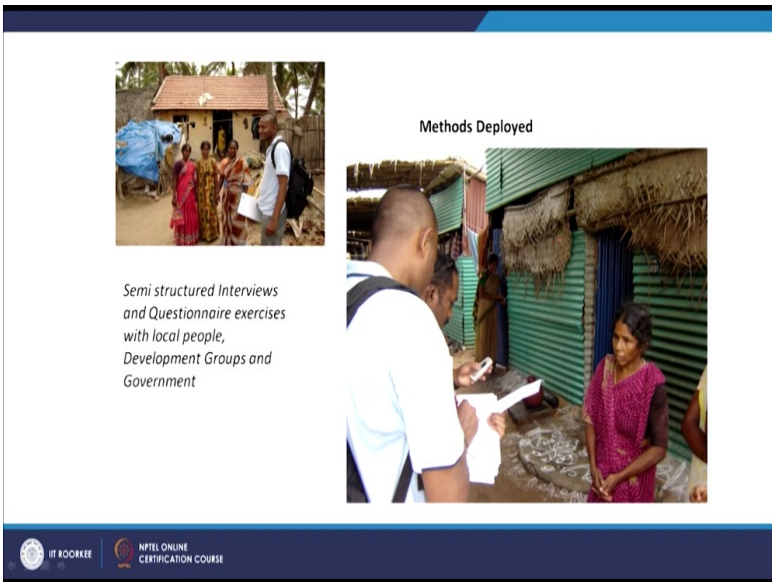

So, I am talking about the transitional shelter. So what they did was an immediate requirement for them as where to live, many of them lost their houses, so many I was visiting Devanampattinam village, the longest fisherman village and you can see that I have taken lot of questionnaires and a lot of semi-structured interviews. They got the tin sheets immediately and they have lived here for about two years.

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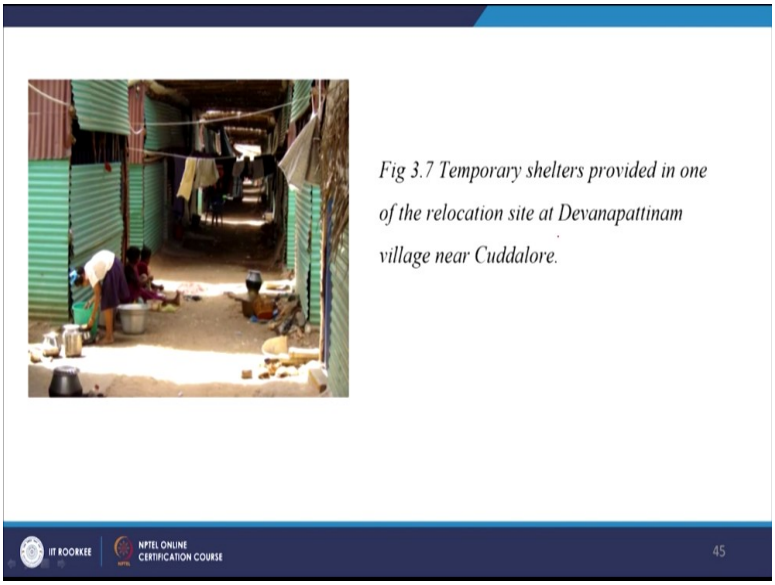

And what you can see is a barracks of the tin sheets, in fact, the similar kind of housing has been provided in the Andaman and Nicobar ice islands and the tribal communities they rejected these houses, they have boycotted these houses. So, this is where material also plays an important, of course, it was very quick to deliver but one has to understand that they have to stay here for a few more months and how to work on it.

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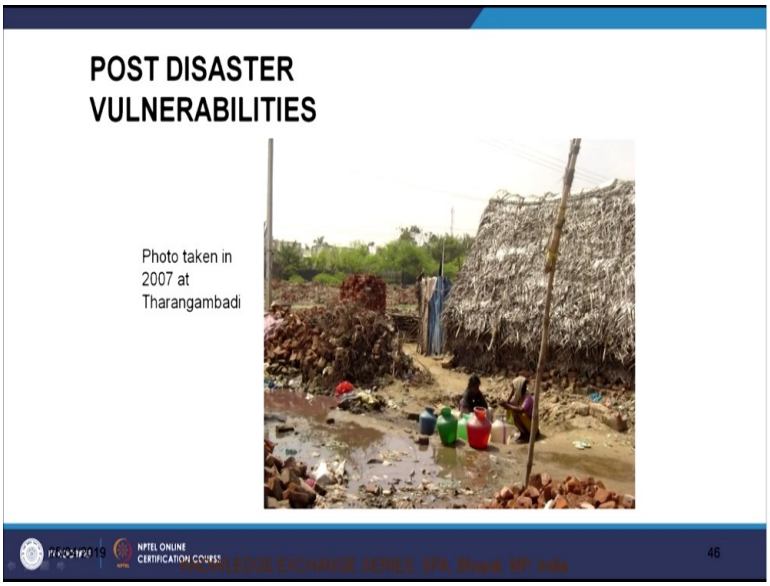

And after the following disaster, the basic infrastructure, the toilets, where do they go for the toilets, where do they get the water services.

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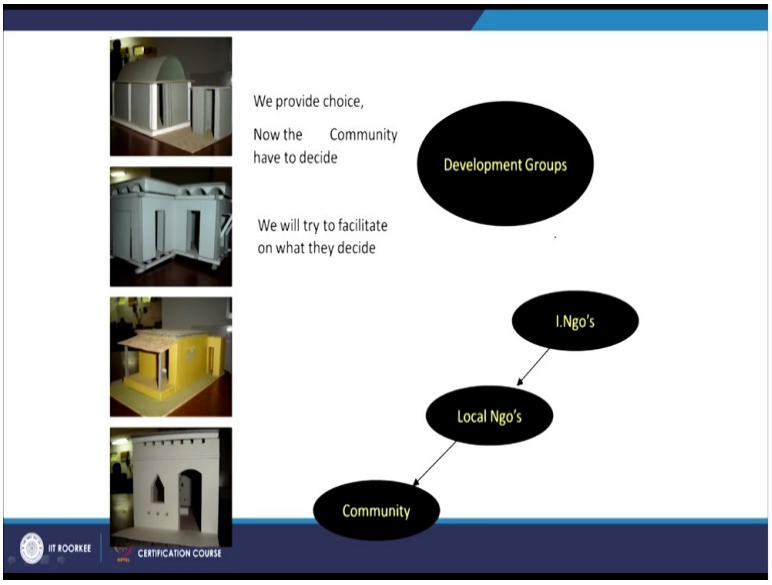

And this is where the time where people have some professional minds come together, they started showing some choices, yes, we provide this option, now you can decide, we try to facilitate you know what they decide. So, different process which starts actually following the transition stage but the most important challenge is not only about it should not be narrowed them only at the built form but one has to look at how this transition stage has to gradually go into the permanent stage.

And there are issues like how this material could be reused in these two years, what are the things we have to address, children schooling, the community's health facilities, community's livelihood, how they can regenerate and all these, okay. So, these are some of the evidences which I want to bring to the students notice that yes, there are some challenges in the transition phase as well, okay. I hope you understand better. Thank you very much.