Disaster Recovery and Build Back Better
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Lecture – 07
Ayutthaya at Risk

Welcome to the course Disaster Recovery and Build Back Better. My name is Ram Sateesh, I am Assistant professor, Department of Architecture and planning, IIT Roorkee. Today I am going to discuss on a topic of heritage at risk, especially with the case of Ayutthaya which is the ancient capital of kingdom of Thailand. So I will go through a brief of various reports and very different kinds of analysis, the flood risk analysis and what kind of measures they have taken.So this is a very brief overview of how the heritage context comes under risk.

Before coming into the heritage context, let us also brief you about a kind of historical understanding of Thailand.

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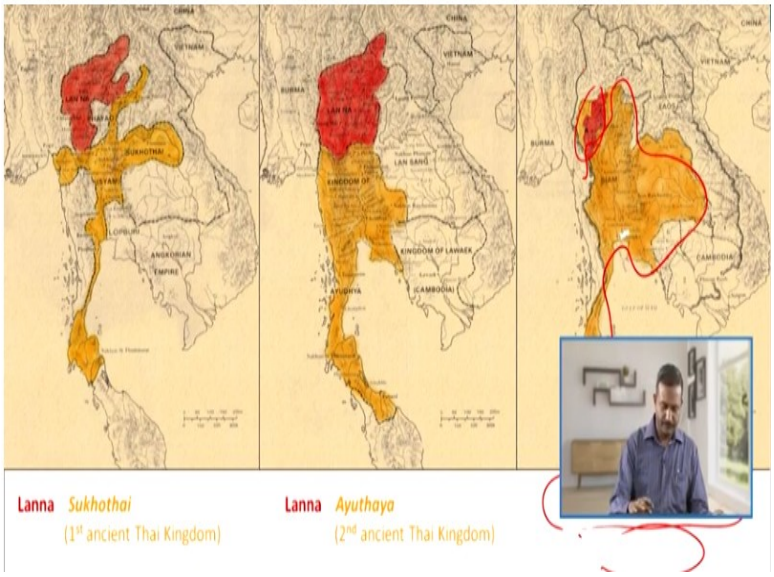

Much of the literature of Thailand goes back to 13th century which we found more evident that is where the Lanna Kingdom where you can see the Lanna Kingdom and this is the data for of the first ancient kingdom which is Sukhothai. So the Lanna Kingdom is in a northern part of the Thailand. And Chiang Mai actually comes from here and the Bangkok, the today's Bangkok comes from here and Ayutthaya some somewhere here.

So now from the 13th century if we go back to the 14th century, this is where the Ayuthaya, Lanna and you can see this Ayuthaya, Ayodhya when you heard this name Ayutthaya or Ayodhya it actually reflects the mythological stories of Ramayana, the epics of Ramayana from Indian subcontinent. There are many similarities between the Indian culture and the Thai culture, in fact, when you say even Indonesian cultures to Thai cultures, we have some similarities which shared this particular epic.

Have you heard about Jatayu which is a kind of bird which protected tried to fight with Ravana when he was carrying Sita to Lanka? So, in fact, the national symbol of Thailand is actually Jatayu. So they share a similar epics of what we shared and it also reflects to the birthplace of Rama. I mean there has been various studies like there is a document on locating Lanka. Where they discussed about different understandings of the how Ayutthaya has been positioned both in Thailand and as well as in the Indian continent.

And there might have been a lot of geomorphological issues from that generation or that time to this time. So maybe we never know how was the situation at that time but the story has been reflected and has been continued for generations and generations even today, and Ayutthaya also reflects back to Rama.

And this is a friend of mine Burin Tharavichitkun from Thailand, he actually worked on the Thai identity. And I could able to see that you know gathered some information from his work basically on the historical aspects of it. So now this Sukhothai have gradually becomes the Ayutthaya you know this is the Ayutthaya Kingdom and which is about a century after 13th and 14th century.

And now the Chiang Mai plus Siam which is the Siamese on the 20th century. So now this whole thing has been now into the Chiang. And now the Lanna part has been very limited, and that is where the Chiang Mai which is still reflecting its traditional identity and the cultural resources. So this is how the overall understanding of how the historical layers have been framing Thailand.

And the Bangkok becomes a capital city of the Thailand and Chiang Mai becomes a kind of cultural capital.

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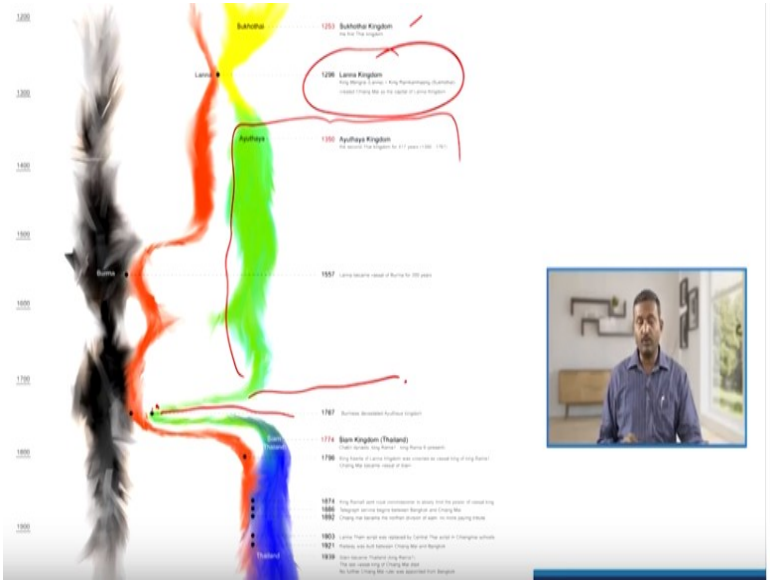

So Burin also works out the kind of timeline especially in 12th century or 13th century where the Sukhothai has frames the Lanna Kingdom and about Ayutthaya which is the 1350 to almost 17th century where the Burmese have devastated the Ayutthaya Kingdom in the war. And that is where the Siam which is the Siam kingdom has been started from 17th century, and you can see that king Rama 5.

So many of their king names is actually named of king Rama 1 Rama 2 Rama 3, and that is how the Burmesian envision also has an impact on, so this is the time we are talking about Ayutthaya and which has been the capital as well. In terms of the houses in terms of the architecture it also varies from different historical influences, and different belief systems have also made some significant differences in the architecture.

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For instance, many of the traditional houses they were designed for this hot and humid climate, and you know, therefore the ventilation is very much essential for this kind of climate. And that is the climate, and the geography is one aspect, and also there is religious aspect there is a seniority plus Buddhism which frames the form of the building and a steep roof and a long use for heat production and fast drainage for heavy rain because it has been a very flood-prone areas.

And there is a supporting stilts, a buffer area, provide air circulation to cool living spaces and avoid seasonal flooding because that is one aspect all the houses are raised in a stilt.

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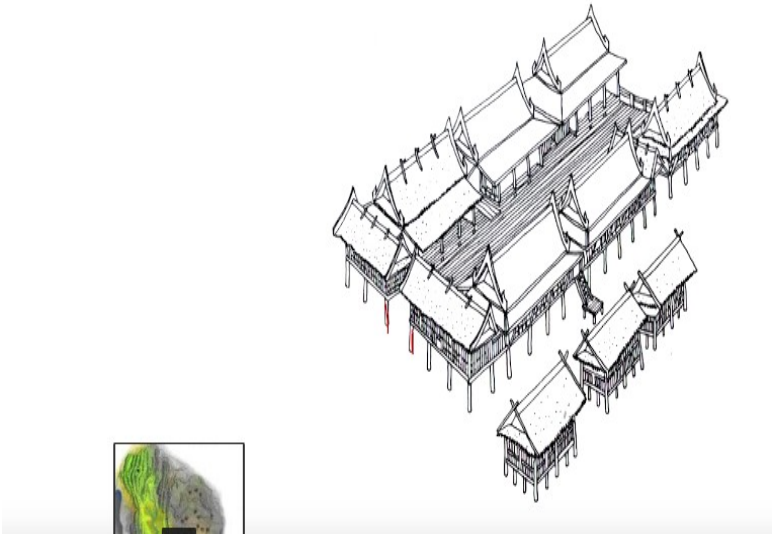

So this is how a traditional houses in the central parts of Thailand which you see like you have the whole house is raised in stilts, and that is how the whole program.

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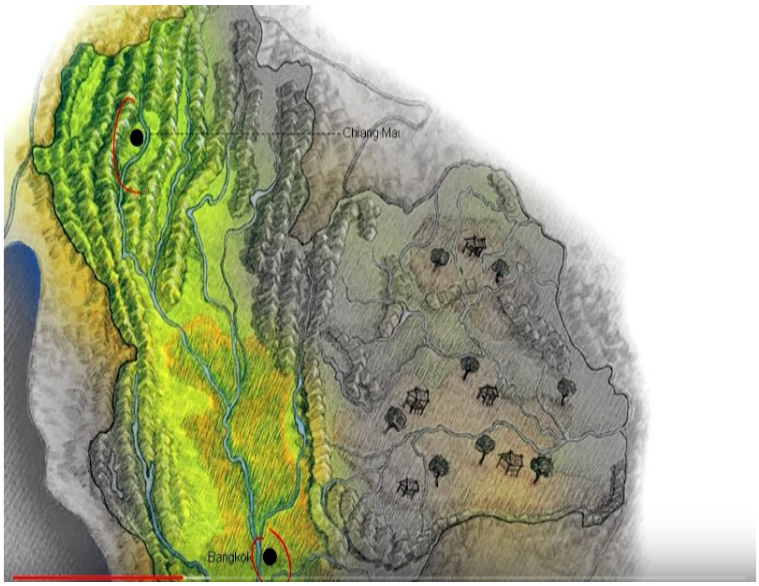

And in Chiang Mai and Bangkok these are the two important places one has to look at it because this is more of a kind of metropolitan, so capital city and this is more of a cultural capital.

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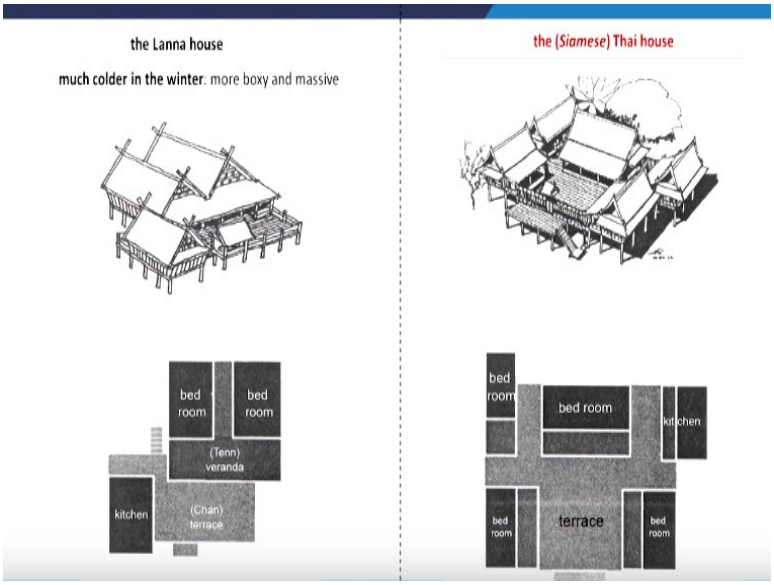

And the Lanna house and the Siamese house how they differ you know in terms of their orientation, and in terms of their organizers, like you have the Chan they call it is the terrace the Tenn veranda and the kitchen has been little isolated from it and that is how this is a kitchen and this is a Chan where they do even some kind of agricultural activities like taking out the seeds

and other things, and this is how the common terrace so this is a very slight difference in there in terms of the layout.

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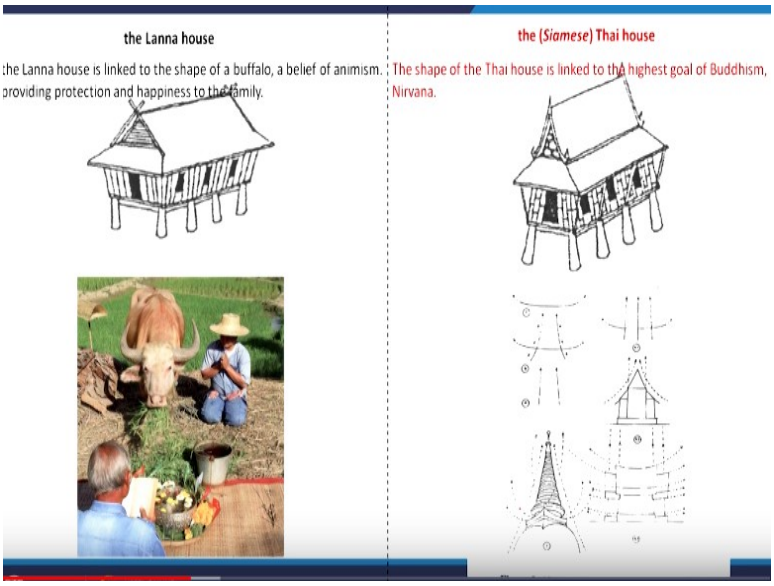

And the Lanna house is very much linked to the animist approach you know the animist beliefs systems that is where they tried to portray that in the shape of a buffalo because they believe in animism which is providing the protection and happiness to the family. Whereas the Siamese house or the Thai house it reflects to the spiritual aspects of the highest goal you know of the Buddhism which is talking about the Nirvana.

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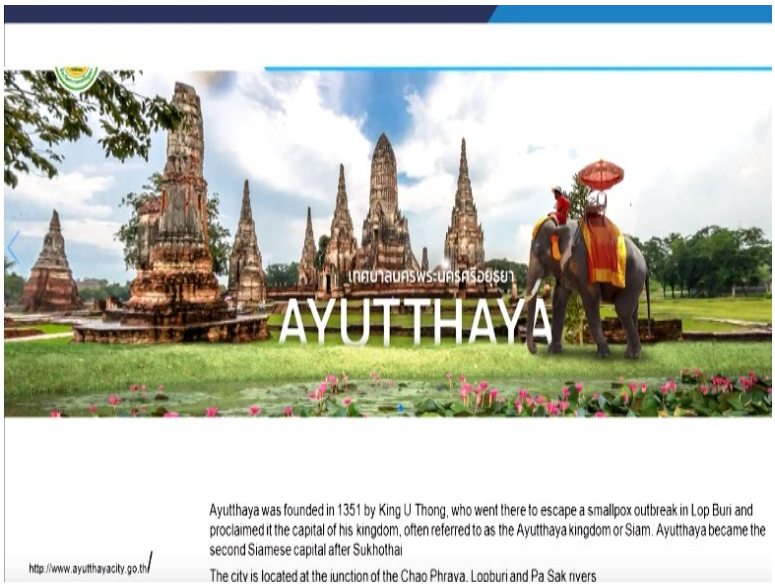

And then we come to the Ayutthaya which is has been an ancient kingdom as I said to you it also reflects some stories about the Rama the birthplace of Rama and Ayutthaya. But in Thai it has been founded in 1351 by King U Thong who went there to escape a smallpox outbreak in Lop Buri and proclaimed it the capital of his kingdom, and this is often referred as Ayutthaya kingdom or Siam.

So that is where the Ayutthaya has became the second Siamese capital of the Sukhothai, Sukhothai which I showed you earlier. So this has become more of the second capital, and this city is located at the junction of Chao Phraya and Lopburi and Pasak rivers, so it is almost a kind of delta kind of thing.

So this particular historic city has some religious meanings and the historical understanding to it. And there is a cultural significance and cultural integrity and as a cultural context which actually frames this historical city. And this has been 17th century it has been destroyed by the Burmese military and then later on it has been converted as a Ayutthaya historical park when it has been recognized as in a school world heritage site, and this is where it has reflected with its outstanding universal value where we talk about OUV.

I am going to refer about mainly two to three important documents and this particular paper Which talks about the disaster aspect of it where the flood risk assessment in the areas of cultural heritage and how it has been applied in the Ayutthaya.

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ORIGINAL PAPER

Holistic approach to flood risk assessment in areas with cultural heritage: a practical application in Ayutthaya, Thailand

Zoran Vojinovic[1,2,3] · Michael Hammond[1] · Daria Golub[1] · Sianee Hirunsalee[4] · Sutat Weesakul[5] · Vorawit Meesuk[1] · Neiler Medina[1] · Arlex Sanchez[1] · Sisira Kumara[6] · Michael Abbott[7]

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So this is a group of authors which worked that has been published in natural hazards and Zoran Vojinnovic, and Michael Hammond, Daria Golub, Sianee Hirunsalee, and others you know they have actually published is a very recent document.

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Flood risk assessment (FRA) is a key tool in the traditional approach to understanding and managing flood risk.

However, FRAs commonly focus on those impacts that can be quantified in financial terms, such as the cost of damage to property and business disruption. These readily quantifiable impacts do not reflect the entire effects of flooding, and those impacts that are difficult (or impossible) to express in non-monetary terms, such as the loss of life or the loss of cultural heritage, are often neglected

So first they talk about what is a flood risk assessment you know because that is FRA, we call it as flood risk assessment that is a very basic key tool as a traditional approach in the traditional approach to understand and managing the flood risk. So and if you look at FRA techniques much of the work has been mostly focused on the quantitative aspects or the target based on how much has been impacted or the cause of them.

And the cost of damage to the property and the business description and you know either it may be quantified in financial terms. And when it talks about these quantifiable impacts, do not reflect the entire effects of flooding you know that like, for instance, there is not only about the monetary aspects, there is a physical aspect, and there is also to do with the non-monetary aspects of the intangible aspects of it. So this is where the loss and life, loss of cultural heritage which has been often neglected in the FRA tools.

So when we say about the hazard assessment of any floods that is where the hydrologist they talk about many hydrological models when it is a 1d model the 2d models and which actually talks about the represent the process by which rainfall is converted into the surface runoff. So you know so how much water volume of water and how much surface runoff is carried out, so this is all about the quantitative aspect of it and the modeling and the simulation aspect of it.

Whereas in the vulnerability assessment it actually has to it is often assessed using the site-specific indicators or measurements, and this is where the multiple aspects which has to be combined by multi-criteria methods.

There is also the qualitative aspects, there is also the financial aspect, there is a livestock, there is livelihood, there is human loss, there is a property damage, there is a infrastructural damage. So it is a different sets of impact situations which we considered varies from site to site but in this kind of conditions we need to look at the culture as an important cultural vulnerability. So there is two approaches when the authors they try to relate with the traditional approach.

Where we call about R=risk=hazard when vulnerability adds on to it that is where the risk component comes to it and this is the risk perception approach how people how the communities percept this approach you know the risk.

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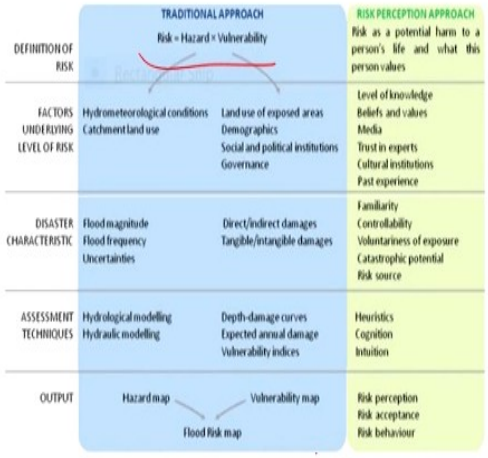

Fig. 1 Comparison of the two approaches to flood risk assessment (traditional or quantitative, and risk perception or qualitative, approach)

Like, that is where they try to compare, like in the factors underlying the level of risk here the Hydrometeorological conditions and the catchment the land use areas and what are the land use of exposed demographic social and political institutions and the governance. Whereas here when we talk about the perception aspects of it the level of knowledge the beliefs and values the media and the trust in the expert's cultural institutions, and the past experience what they have understood what they have experienced.

Disaster characteristics: this is where the flood magnitude, flood frequency, and uncertainties. Whereas the direct and indirect damages the tangible and as well as intangible damages so this is where again the perception brings about the familiarity, controllability, voluntariness of exposure, catastrophic potential.

And assessment techniques: Maximum they might narrow down to hydrological and hydraulic modeling. And depth-damage curves except inundation maps and all this. Whereas here they talk about the heuristics, cognition, and intuitions. And what is the output out of it it takes us a hazard map, and the vulnerability map, and that is how a flood tisk map regeneration. But there is also the risk perception, risk acceptance as risk to whom then how do they prepare for it how do they accept it risk behaviour so this is again this whole thing comes from the social and community.

It is very community-specific, it is also society specific how they look at it how they see it how they behave to it.

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Fig. 2 Ayutthaya Island is located in Thailand and represents an urban area. Approximately one-third of the island is protected by UNESCO as a World Heritage Site (WHS)

So now when you look at the Ayutthaya island which is located in the urban area. So almost one-third of this island is under the world heritage site. So and you can see that the river process the kind of the whole island is set up in the river bases.

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A 1D model of a 52-km stretch of the Chao Phraya River is developed, which consists of the channel data for the Chao Phraya River and a number of tributaries that include the Lopburi and Pasak Rivers which meet at Ayutthaya.

Rainfall data from four raingauges and observed river stages are used as initial conditions. Second, a shorter section of this 1D model is coupled with a 2D model of the urban area, to investigate the propagation of excess floodwater from the 1D river system of the Pasak, Lopburi, and Chao Phraya Rivers into the urban area, using the DHI MIKE FLOOD software.

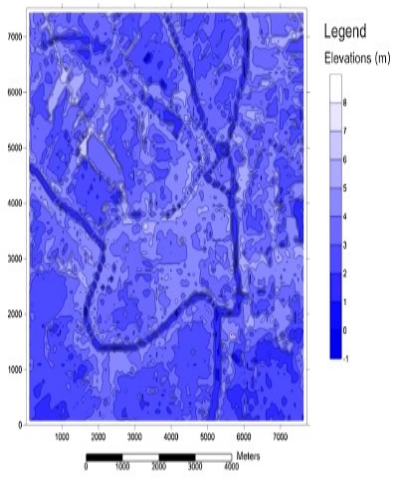

Fig. 3 Contour topography of Ayutthaya Island derived from 2-m grid scale resolution data

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The two lands coming and what this authors have tried to do they tried to club both the methods of both, one is the scientific approach of it, and second is the social approach to it, and the perception of it. And see how they are actually relating to it. Like it is about a 1D model this is a

1D model of 52 kilometer stretch of Chao Phraya river and which has a number of tributaries that include Lopburi, Pasak rivers which actually meet at Ayutthaya.

But they also collected lot of rainfall data and 4 rain gauges and then this 1D model is coupled with a 2D model of the urban area to investigate the propagation of excess flood offered that is where how much an inundation is created. And from the 1d river system of Pasak, Lopburi and Chao Phraya rivers into the using and they use the software of DHI MIKE flood software.

So here is what you can see is that the intensities, this is you know about they develop this contour topography of Ayutthaya land derived from 2 meter grid-scale resolution from the satellite data and how it can actually create the inundated areas.

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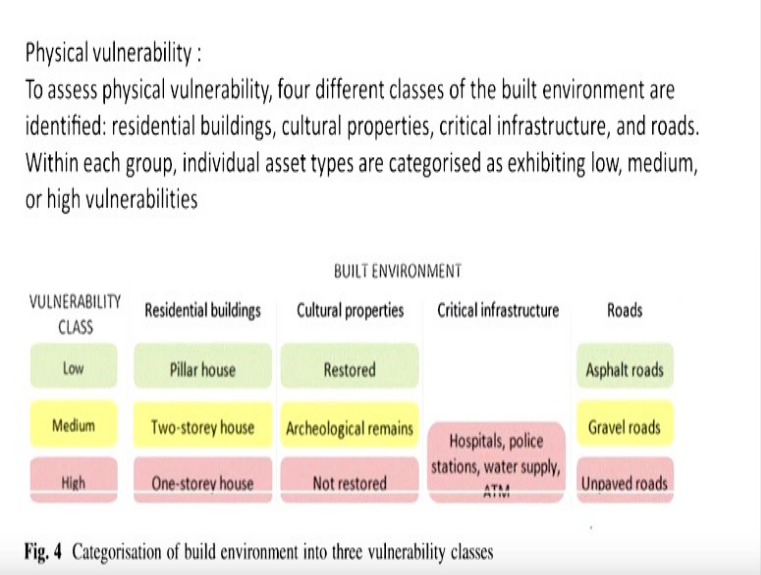

Fig. 4 Categorisation of build environment into three vulnerability classes

Then the physical vulnerability so there is a for assessing the physical vulnerability 4 different classes of the built environment or identified. Residential buildings, cultural properties, and the critical infrastructure, and the roads and the connectivity. And within each group they also categorize the vulnerability part of it low, medium, and high. So if you look at it the pillared house in the residential buildings there a subjected the medium.

But whereas in the high, which is a one-storey house which is based on and they are subjected mostly to the high risk. Similarly, in the cultural properties which has been submerged they are

not restored. And whereas the archaeological remains you know and whereas some of these properties which are restored back. Critical infrastructure includes hospitals, police stations, and ATMs, water supply and they are all subjected to the high risk.

And the roads which is asphalt roads which having the low risk and gravel roads and unpaved roads which are more into the high risk. That is how the categorization of the built environment into 3 vulnerable classes.

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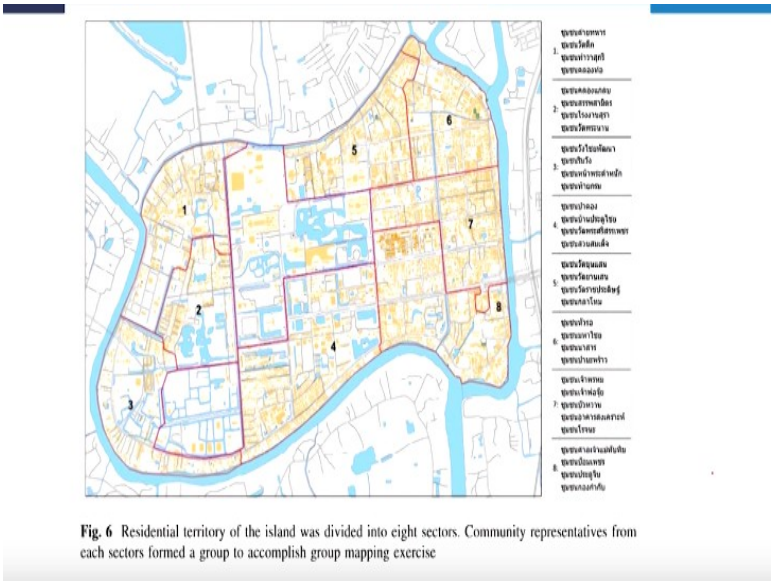

Fig. 6 Residential territory of the island was divided into eight sectors. Community representatives from each sectors formed a group to accomplish group mapping exercise

And then coming to the social approach, what they did was they divided into 8 sectors the whole region into the eight sectors like you can see the River Delta which is forming out and the whole heritage properties about here. And that what they did was they divided this whole territory residential territory into 8 sectors and the community representatives from each sector formed the group to accomplish the group mapping exercise. So there is a huge exercise what they did developed in each sector.

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A difficulty arises in comparing the two maps because of their spatial data format. The traditional flood risk map uses 1-m raster grid cells, while the risk perception map is based upon polygons of varying sizes.

And collected a lot of inventories and the data. So the biggest difficulty here is comparing the two maps because of the spatial data format one is the traditional flood risk map uses the one-meter raster grid cells, whereas the risk perception map is based on the polygons of varying sizes. So that is where a difficult to compare the same set of spatial data.

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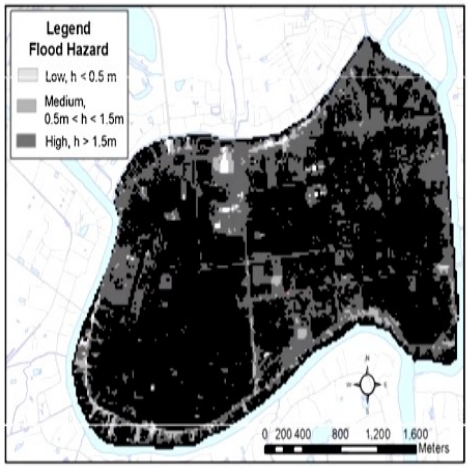

Fig. 7 Flood hazard map of the extreme flood event in 2011. The levels of hazard are identified based on threshold values of 0.5, and 1.5 m depth of inundation

When this is the flood hazard map of the extreme and there is given the threshold values of 0.5 to 1.5 meter depth of inundation there is inundation map and if you can see that this whole region is completely flooded right about 1.5 meter height of inundation. And on the banks at least you can see that the whole thing is in the inundation.

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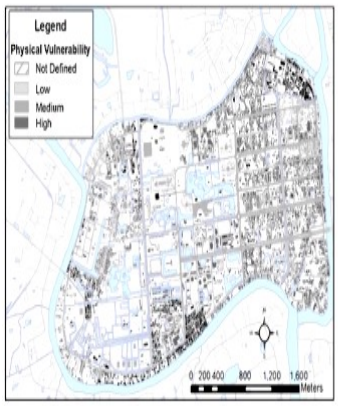

8 Physical vulnerability

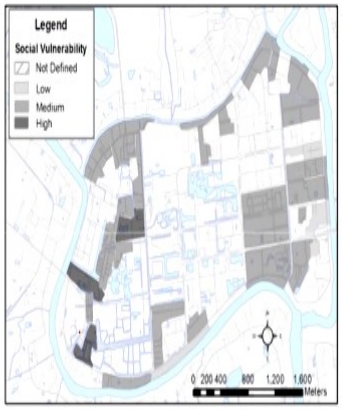

Fig. 9 Social vulnerability

So that is how what they did was they tried to classify different layers of it and like physical vulnerability now when you talk about the physical vulnerability what are the places which has been in highly damaged, medium damaged, and the low damaged and which has been not defined. Similarly, the social the target groups which are actually which are the most of these communities which are often affected and this is the social vulnerability map. **(Refer Slide Time: 19:56)**

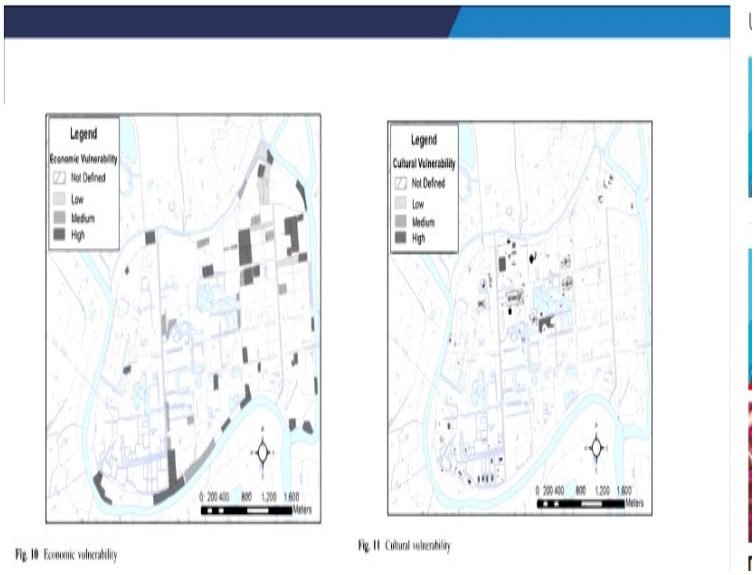

Fig. 10 Economic vulnerability

Fig. 11 Cultural vulnerability

And the economic vulnerability: When we say economic vulnerability, when the flood happens obviously what kind of business sector often closes down, shuts down for a period of some time and or how their livestock gets damaged so this is all about the economical. Mostly you can see that on the edges you can see that most of the commercial aspect has been damaged.

The cultural vulnerability: and you can see that you know much of the cultural properties are under the high risk.

And this is where one has to understand that the heritage which is UNESCO world heritage it is subject to the high risk and tomorrow if these things get collapsed and they get damaged then we are actually closing the history we are actually bringing an intense damage to the history the where the next generations has to learn about their own country their own ancestors.

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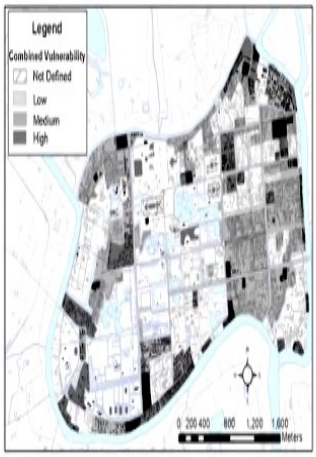

Fig. 12 Combined vulnerability

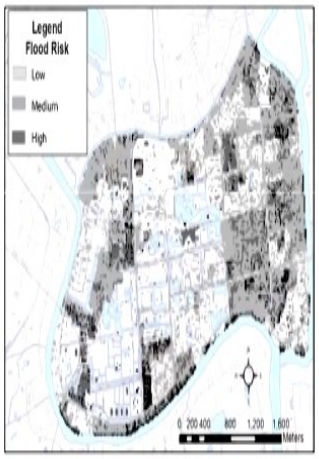

Fig. 13 Combined flood risk map by traditional approach

Now what they did was they tried to combine this map and one is using all the digital tools how they combined and this is again a combined flood risk map by a traditional approach. So by both by the social approaches and as perception approach and by their scientific approaches how they have able to get a similar set of data but of course they could able to identify. There are some possibilities which were more possible in the scientific approach.

But in certain perception approach they have lacking some kind of data. So that is then authors they have articulated very well in that report that what aspects they could able to get from these and what aspects they could not able to get in these. I think one can go through that report but here what we have to see is what we have to learn from is that how even the satellite imagery and the social understanding, how they are able to correlate with each other, and also they in parts they also contrast with each other.

I mean till now I talked about the flood analysis part of it and how different techniques have been used by various authors. But then from the conservation point of it how the ICOMOS.

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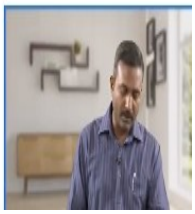
ICOMOS

Report on the ICOMOS Advisory Mission to Historic City of Ayutthaya (C 576)

28th April to 2nd May 2014



Or what kind of report they have produced on the historic city of Ayutthaya.

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1. Direct Impact of the Major Flooding in 2011 and Emergency Measures for Conservation

2. Mid- and Long-term Impact of the Flood Water

So one is there is a direct impact of the major flooding in 2011which, and there has been lack of some emergency measures for conservation as well because there is a also some rush process indicated. And this flood water will have both the mid-term and the long-term impacts. You know on the heritage sites. So what kind of conclusions they have come up with now when we say about the conclusions.

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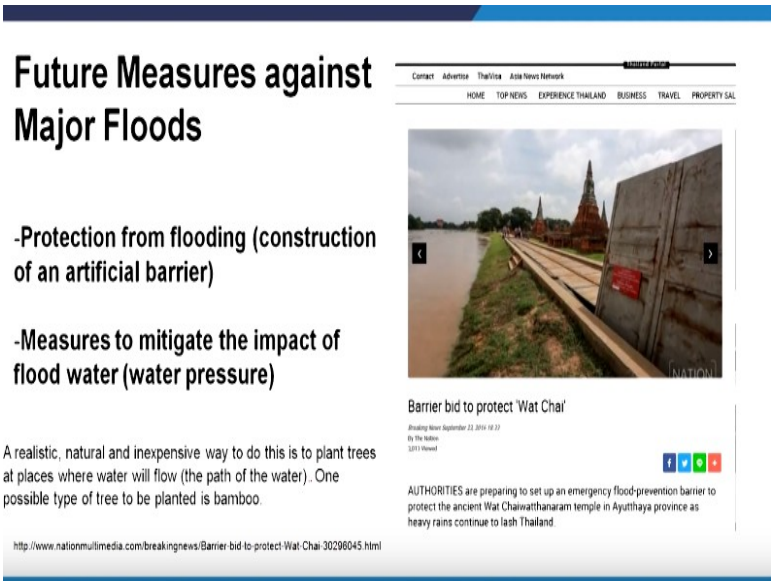

The future measures against major floods. One is the protection from flooding, how we can protect this sites but if you look at this existing site if the river is just these temples have this Wat Chai place is just near to the so it all the whole thing gets flooded. So the authorities are actually preparing to set up an emergency flood prevention barrier, and they want to make an artificial barrier using the concrete and metal barrier.

So that at least it can obstruct the flood water penetrating into the historic sites. So this is one aspect. The other aspect is the measures to mitigate the impact of floodwater. So when we say about what kind of measures we can adopt so one easiest expensive method is planting the trees. So imagine if people start planting the trees and especially bamboo is one aspect one because it can densely grow and as well as it was very quick in growing so there are some species one can identify, and plantation could be possible in this kind of flood-affected areas.

So because being a historic context one has to look at the learning from history.

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So reproduction of a city wall; so historians think that how this geography was existing even before this has become a heritage site even in 13thcentury how the ancient I mean those days how people have survived. Obviously they might have built a wall before in order to protect this particular kingdom. So why not we can think of reproducing of the city wall. So there might be possibility that when the kingdom has moved.

So they might have taken all these bricks and taken out, and probably this area might have got abandoned. So these are some various theories which has also thought about so how in what ways we can reproduce a city wall.

And when we talk about the looking back about how man has lived and have survived these floods this is where the traditional measures we can even identifying from the rediscovering the traditional wisdom. The traditional knowledge systems which of that days man have implemented so there is a need that we can relook into it rediscover into these kinds of practices and then try to implement in our contemporary practice situations so at least some learning could help us should show some direction.

And the third aspect is the comprehensive plan for conservation and utilization. So how you know the arts department have developed a comprehensive plan for both the conservation and the living heritage.

Then they also talked about the international symposium of Ayutthaya symposium where we can learn from the global experts of flood resilience you know how we can learn from each other so that is a kind of international symposium.

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So some of the photographs I will go through it and then so there is a new square bases which has been constructed using some concrete tie-beams and what they tried to do is they made the bases with the tie-beams to raise the plinth, and then they covered with the brick part of it. So in many places that is one thing the authentic question you know why is there any particular scientific study which says that why we have to cover the tie-beam? why not a tradition of how they come to that kind of conclusion and the question of authenticity also comes into the picture and is it the right way of conservation practice. So there are many questions in this particular practice which comes.

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And these are all again the new constructed plinths and whether is it the only method we have going aback with the structural understanding or how the traditional understanding has been overlooked, these are some aspects we can look at.

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And conservation philosophy and execution should ideally converge because on one side we are talking about the authentic heritage on the other side we have to talk about how to protect it or so they has to really come together.

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Reconstructed base - undulating brick layers not the best of workmanship

Now, these undulating bricklayers not the best of the workmanship, for instance, if you ever look at this kind of circular mounds, even in Andhra you can see in Ghantasala where this similar kind of structures Stupas have been brick Stupas have been constructed where the brick sizes were very different the brick component is very different and even the bonding you can see that you know how the bonding could be also worked out so that the load could be transferred easily.

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In the new brick laying work there is a lot of room for improvement

And you can see that a lot of improvement could be done because whatever they have done it still one can see that you know the bonding has not been appropriately taken care of even the material component on the bricks sizes.

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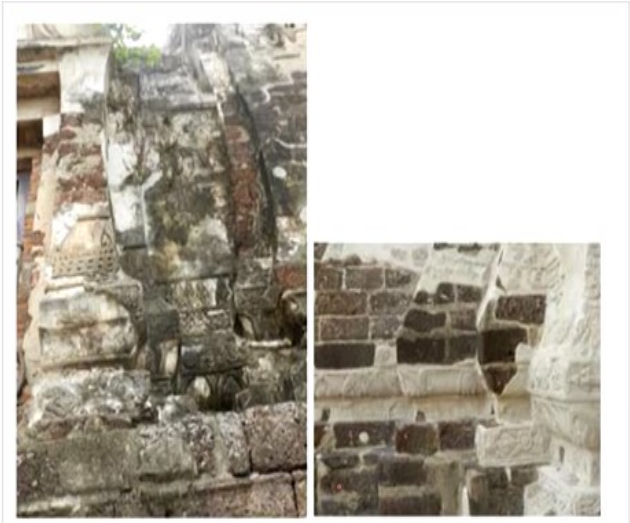

And also the material the composition of mortar the lime and the old and new lime mortar so one can see that the basic fundamental difference of it. Of course in conservation, we also have to make sure that what has been added later it has to reflect because it all varies about the context where we are applying and what context, what we want to show and what we need to show, that is how the whole conservation and management plan has to talk about.

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And re-plastering in patches you know like see that these many of the things have been re-plastered and different patchwork has been done but is it the only way to do it because this is the one of the common practice you find in many of the conservation projects. Where they try to put

this either lime plaster or but the nearest composition we should take back at least the nearest composition that will make some difference.

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And the new tiles: Where they have raised for the tourism purpose you know that have actually raised and challenge to the authenticity of the monument. So they need to be removed and replaced with the brick paving so in that way that authenticity has to be maintained.

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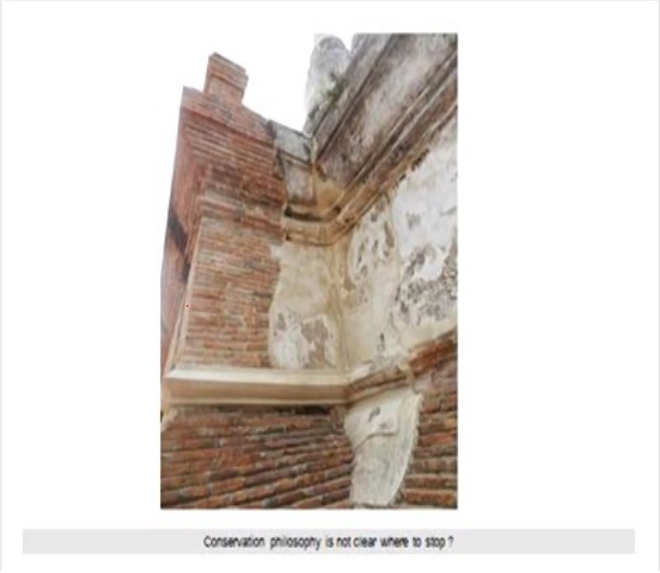

And here, what you can see is that conservation philosophy of restoring and the reconstruction, but where to stop it, How to stop it, that is one aspect one has to really think about it.

As we see the straight joints, you know so how this reflects the poor workmanship. The problem is the workmanship in the conservation projects is very moderate at cases it is poor in such a situation.

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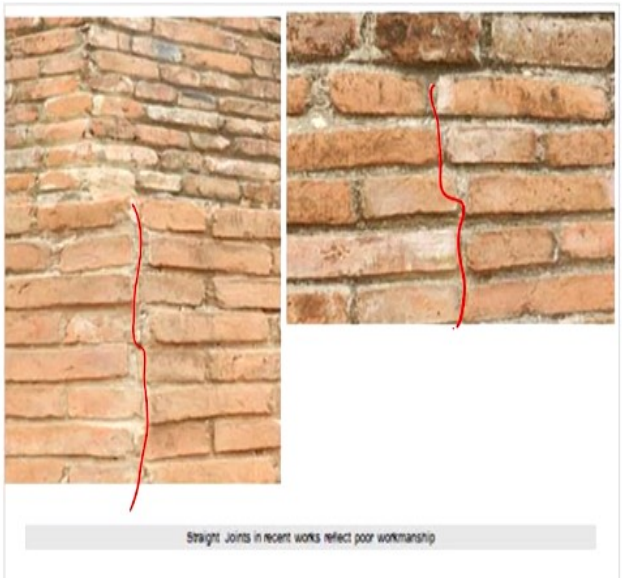

So I hope you got an idea of one of the heritage site of Ayutthaya how the analysis has been carried out and with that what kind of implications has been framed out and still what are the challenges we have in conservation and the development this will give you an idea.

Thank you very much.