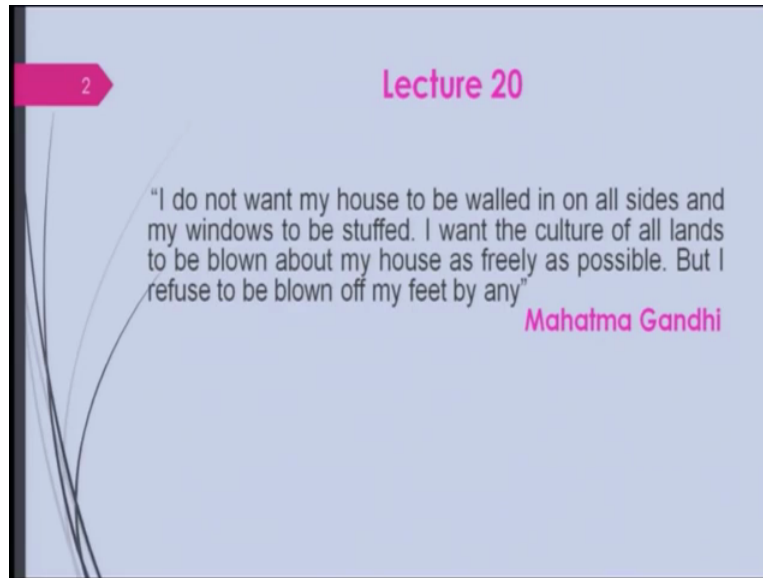


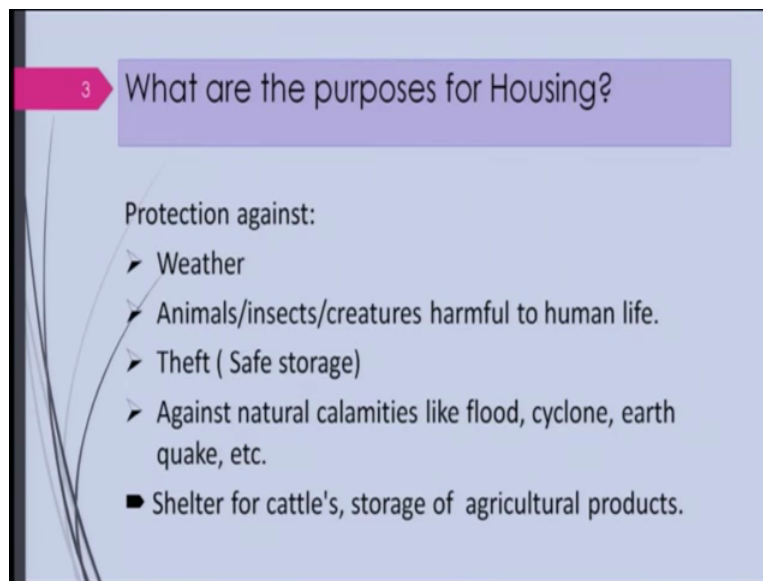
**Introduction to Ancient Indian Technology**  
**Professor D. P. Mishra**  
**Department of Aerospace Engineering**  
**Indian Institute of Technology Kanpur**  
**Module 4**  
**Lecture No 20**

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Let us start discussion on ancient Indian rural housing, and if you recall that in earlier lectures we had discussed about basic needs that is your agriculture and also textile. And let us start this lecture with a thought process from Mahatma Ghandi, who says I do not want my house to be walled on all sides and my windows to be stuffed. I want the culture of all lands to be blown about my house as freely as possible, but I refused to be blown off my feet by any. It is very important that we should learn from others as our Veda says but at the same time we must retain the fundamentals of our culture heritage and scientific tradition. And let us look at, about housing in ancient India.

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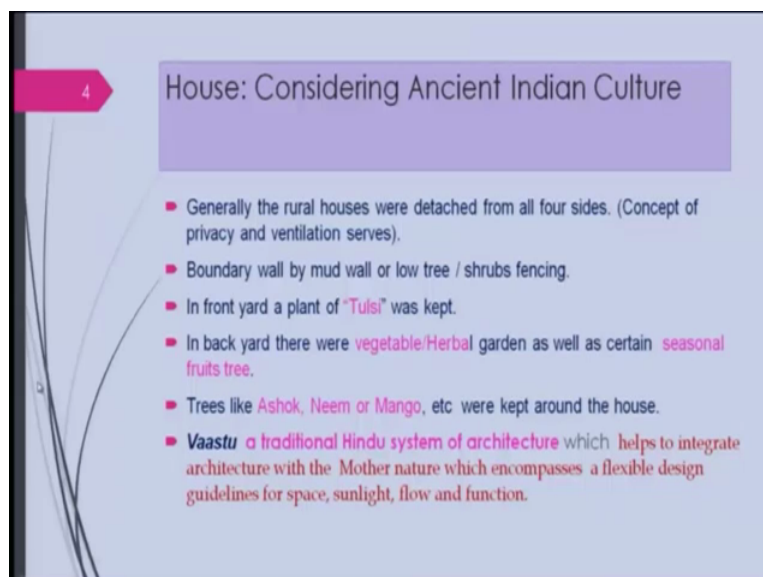
3 What are the purposes for Housing?

Protection against:

- Weather
- Animals/insects/creatures harmful to human life.
- Theft ( Safe storage)
- Against natural calamities like flood, cyclone, earth quake, etc.
- Shelter for cattle's, storage of agricultural products.

Some of the questions might be arising in your mind, what are the purpose of house. Of course most of you know that it is basically protection against the weather and in recent time there is a lot of climate changes so we will have to look at this. And besides these animals, insects, creatures and you know, which are harmful for human life and property we will have to protect also, and the theft of course safe storage is very important and that is the characteristics of modern human being if you recall that or if you go back to our history the theft was almost not there in this country. Even today in some villages are without any door and lock, particularly in Maharashtra region and besides these we will have to also protect ourselves against the natural calamities like flood, cyclone, earth quakes and other things.

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4 House: Considering Ancient Indian Culture

- Generally the rural houses were detached from all four sides. (Concept of privacy and ventilation serves).
- Boundary wall by mud wall or low tree / shrubs fencing.
- In front yard a plant of "Tulsi" was kept.
- In back yard there were vegetable/Herbal garden as well as certain seasonal fruits tree.
- Trees like Ashok, Neem or Mango, etc were kept around the house.
- **Vaastu** a traditional Hindu system of architecture which helps to integrate architecture with the Mother nature which encompasses a flexible design guidelines for space, sunlight, flow and function.

So apart from that people do rear the cattle and other animals and we need to also store there, not only the agricultural products but also other accessories or items of day to day uses. And considering you know, ancient Indian culture we need to look at what are the houses what we are having, generally the rural houses are detached from all four sides. And not always true but if you see at least in 50 years back or maybe earlier that most of the houses were having separated out due to several reason, one of them of course privacy other is ventilation, but privacy is a new concept it was not there earlier in our culture. But what I feel that it might be, that people were having lot of lands, that is one and other thing is that they were using thatched house.

So for higher safety they might have kept the house separated little bit and beside this they will be having a lot of land around for cultivation and boundary wall were made earlier days by mud wall or a low tree or shrub fences what we call hedge and even some house you may find that it is not without any boundary because there will be land where they will be cultivating, so in front of the yard a plant of Tulsi was kept particularly in Hindu tradition and because we revere the Tulsi plant. And in the backwards even in front also sometimes there are vegetable and herbal garden as well as seasonal fruit trees which are a part of rural housing earlier days and trees like Asoka, neem, mango etc are kept around the house and there are various reasons.

It can also help to thwart the wind particularly in cyclone time and of course it can maybe sometimes fall on the house itself, but it will give resistance and Vaastu, in traditional Hindu system of architecture which was very much there and today it had evolved in, rather it has rejuvenated in a different form. Although it is attached with lot of superstitious, but if you look at the scientific part it is quite interesting. One can look at it, which I will not be covering but I am just mentioning it here for you people to explore it and find out what are the right thing with that. And this Vaastu which is a Hindu system of architecture helps to intricate the architecture with the mother nature and which encompasses a flexible design guidelines, not only for the space, sun light, flow and also its functionality. So therefore it is important to look at, but I am not going to cover that here.

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And as I told Tulsi is very important and it is being placed in the front and also the backyard of the house. And I have just shown you they do revere and make a lot of pujas and other things. Besides it creates a positive energy what people say because we are having belief system and Ayurveda's best herb after Amrit and it has been proven scientifically Tulsi is you know, medicinal very great medicinal plant and it is a sure solution for cough and cold in human body. I have tried because last 3-4 years I am experimenting with myself and I have not taken any anti biotic medicine and whenever I am having cough and cold due to the seasonal variation I just resort to the Tulsi and it is a cure for several other diseases as I learned from the Ayurvedic book so one has to look at it, so it is very important that should be a part of our house.

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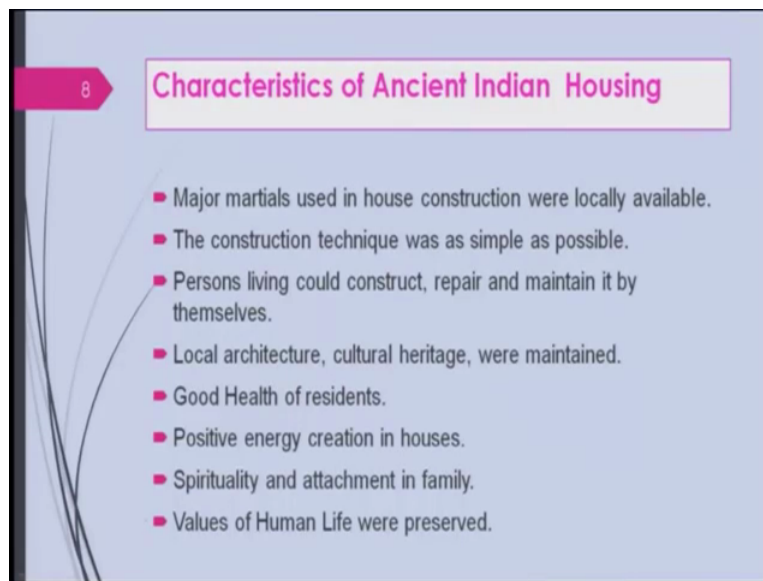


Besides this you know, Indian tradition is to welcome the guest, Athithi Devo bhava. And we always welcome the people of outside and then thing, and if you look at, you will find there are several signatures of our civilization. I have just shown here, which is some of them you place in your home, like Athithi devo or Shub labh. Labh means basically profit, Subh is auspicious, then only profit will be, this is the signature of Indus valley civilisation. It is Not that we will get away by the profit alone, it must be beneficial for the man kind then the profit is good, so besides this there is a 'Yantra' which is shown here in this place and which is having a lot of importance related to our culture and heritage particularly in tantric systems it is a lot of importance is there I am not going to discuss about it. So these two are basically the feet impression of the newly married bride who enters the house, because we consider them Lakshmi and that is the symbol, we welcome the bride to our house and we also keep it in our mind.

There is another important symbol what we keep in front of our house is the swastika chihn, and it is having a lot of importance, not only psychologically but also the religiously therefore that is the things one has to keep it and of course there are several ways people are having. There will be painting, various paintings we keep and tradition, because this brings happiness and pleasant environment in the house and this kind of symbols what we use as a part of you know our culture and some of the goddesses and other things that brings positive energy inside the house which is very important, so why we need to look at and rethink about ancient Indian housing.



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### Characteristics of Ancient Indian Housing

- Major materials used in house construction were locally available.
- The construction technique was as simple as possible.
- Persons living could construct, repair and maintain it by themselves.
- Local architecture, cultural heritage, were maintained.
- Good Health of residents.
- Positive energy creation in houses.
- Spirituality and attachment in family.
- Values of Human Life were preserved.

If you look at today due to the cultural invasion and globalisation and marketization of our life what we are losing the cultural heritage of across our country and particularly in the, as a result the local housing is not there, all are replaced with the same concrete and mortar building structure. Earlier days if you look at from Kashmir to the Kanyakumari, each state or each place will be having their own tradition of making houses which are depending on their weather condition, depending on their culture and other thing today it is not the case. So as I told modernisation is really throwing all our cultural way of designing and developing the house from our life and we are just copying and pasting and just forgetting about our traditional knowledge which was there for together and it is just going to dust bin.

And we do not have a documentation for that, that is very important and I must ask people, whoever is having some interest in this, they should document the way of making, not only the house, but also the other tradition so that at least it will be retained. And besides this, most of the houses today are not ventilated properly, they are all sandwiched between two houses and not many thing, and it is not hygienic to a larger extend let me tell you. Particularly in rural areas where people are not that educated and not that wealthy to afford to that, for a better construction of house. Unhygienic and less or non-ventilated house a I told and various problems related to the house they are facing today in rural areas for example privacy, neighbourhood feeling that is being receding in rural area which was the hall mark of our rural life rather Indian life.

And there is very low mentality of the people nowadays not sharing and then caring of the people and cost of land is increasing and so also encroachment and local land policies is in doldrums is in trouble. So therefore they are facing serious problems and Indian native architecture is almost on the verge of extinction. So that is very important we need to and those are developed over the years by our forefathers and we need to re look at it.

I am not saying we should copy and use that today, but the fundamentals or the basics should be retained. And the other characteristics of ancient Indian housing are major material used in house construction in rural areas were locally available, so then transportation cost and then other cost will be reduced and it is they are aware about it. And today people are not aware about whatever things are available in their areas but they are, they may be getting from outside that is the fallacy of the present system. And construction technique was as simple as possible so that the knowledge was with the local people and they were also learning from generation to generation passing that knowledge to others.

Person living could construct, repair, maintain it by themselves they feel good about it. They feel that they have built the house not the workers and local architecture cultural heritage were maintained and good health of the resident which was considered the prime important for making a house, but today it is not. And positive energy creation in the house were also a part of this thing which was emphasised in Vaastu system and spirituality and attachment in the family because when you do together and you own that house, own means literally owning, not owning only from investing money and then making a house. But you feel that I have made this and that part attachment is important and which is important that values of human life were preserved which is at stake today. So that is the things we need to, therefore we need to look at our ancient Indian way of making house and maintaining house.




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### Major Components of Ancient Indian House

- Floor
- Wall
- Roof



### Rural materials for House

- Stones/Bricks
- Mud
- Wood/Bamboo/Agricultural Wastes


So if you look at major components of ancient Indian house, are basically floor wall and roof of course here I have shown you something about that. This is your roof, and these are the walls of course the floor is here, which is you can say veranda kind of thing. So rural materials, house, basically metal stone and bricks, of course bricks you can make yourself not to buy. I remember that when I was a kid that local people were knowing how to make brick, but today if I go back to the same place where I had learned how to make brick in my childhood today they do not know how to make and they buy that from factories and mud which is plenty in available and wood bamboo and agricultural waste were being used for making houses, and which was basically suitable even the brick to some extend sustainable.

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**What do you mean Mud ?**  
Mud is a mixture of different kinds of soil (loam, silt, and clay), and water.

**What is Mud brick ?**  
Mud brick/adobe is made by mixing mud with water, placing the mixture into mould and then allowing it to dry in open air.



Straw is used as a binder within the bricks, as it adds a support lattice. When the brick is subjected to force, the straw will redistribute the force throughout the brick, decreasing the chance of breakage.

**Mud House in Punjab**



**Why to use Mud for construction of Houses?**

- ◆ Easily available raw materials for community participation and use by unskilled labour.
- ◆ Ease of cutting, turning or adjusting dimension of mud brick
- ◆ No energy requirements for making mud brick as solar energy is used drying.
- ◆ Cost savings in energy as the "burning" of the brick red clay represents 40% of the cost.
- ◆ The use of mud in building a good acoustic and insulation.
- ◆ Thermal insulation in areas and acts as a natural domestic air conditioning. Hence suitable for tropical & sub-tropical area.
- ◆ Self sustainable and eco-friendly.

Of course stone is not sustainable and so today what we use are not sustainable and earlier days house were sustainable. Let us see that, you know like what do we mean by mud, because today we are not aware about the mud, earlier days mud was a part of life not only agriculture for making housing and having pond and then several other things. It is a part and parcel of our life. So mud is a, basically a mixture of different kinds of soil. It can be Loam, it can be silt, it can be clay, of course you will have to add some water kind of things and when you say it is a mud brick basically we call mud brick which is not baked of course, today we are using baked mud brick and when it is not baked it is known as adobe, and it can be made by mixing mud with water and placing this mixture into a mould. Like for example here this is the mould and in which this will be, the mud will be packed and then it will be getting the shape of the mould particular shape and then allowing it to dry in open air with the help of , of course sun drying.

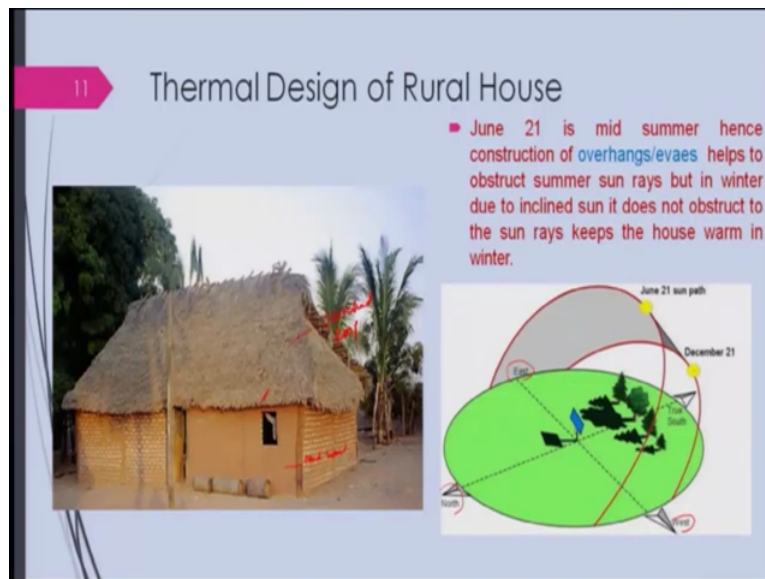
And people do add the straw and some kind of rice husk and other things, and straw is used as a binder within the brick as it also supports to the lattice because whenever a brick is subjected to a force the straw will redistribute the force throughout the brick and decreasing the chance of breakage. And these are traditionally being used, and that also similarly saw dust and other agricultural waste being added to the mud also for making brick. So this is a house which is made out of mud, not only the wall also the roof in Punjab even still in some places it is being used.

And of course this is a 'pakka' house and there is a 'kacha' house also. Like this is basically a mud wall and this is a thatched, basically thatched roof but here the roof is flat and also it is made of mud kind of thing, so we will be discussing about it. Why do we use mud for construction of house because it is easily available for community participation and used by unskilled labour. If you look at earlier days in the rural areas we are having ponds, for maintaining ponds you need to sometimes remove them what you call mud from the pond and those mud generally were taken by people who wants to construct the house. And it is a very, total system, cycle was there and it is beautifully narrated in several places, kind of things. But unfortunately today the pond is not there, and even the mud from the bottom of the pond is used for the field for agriculture purposes.

And it is this adobe or the sun dried bricked are easy for cutting and turning or adjusting the dimension of mud brick like the other one which is little difficult but you can use also, that is the baked mud, and no energy is required for making the mud brick, mud brick means, I am

talking about the adobe, right. As the solar energy is used for drying and cost wise it is you know, like a lot of saving almost 40% cost as compared to the brick. And the use of mud in building a good acoustic and insulation, it is basically gives a very good insulation, so the temperature will be lowered down unlike the concrete, which will absorb the heat and then (()) (19.00) And thermal insulation area and act as a domestic air conditioner kind of thing and hence suitable for tropical and sub-tropical like areas like in India.

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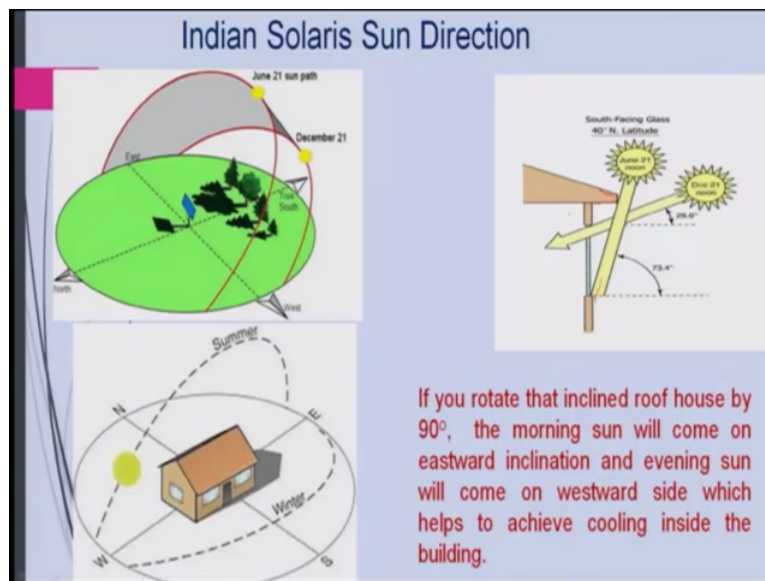
India today people are using glasses for the window pane and then other brick and of course the mortars and cement they are using. Earlier days we were using lime or the mud which is a better material as compared to mortar and cement today and self-sustainable and eco-friendly, because it is eco-friendly, you need not make anything to you know burn the fuel or something to do that. So therefore it is very important to use mud and mud is a part of our culture and we always revere it as a part of our rituals. So if you look at the thermal design of a rural house and you can think of like this is a roof of course this is made of mud right, mud wall, and the roof is thatched house, that is roof and there is a overhang here.

This is a wall and this is a overhang, now why this overhang is there, why not it will just end wherever the wall is getting ended. And it is having because it will protect the wall and other regions from the heating of the thermal particularly in summer. Not only that, when you are using the mud wall and you are using adobe the sun dried mud brick then you will have to take care that water should not fall, it will damage it, so that is another reason. So let us look at thermal side and when you look at let's say we will talk about summer which is June 21,

the sun path will be from east this side it will be going. Of course this is the middle of the day and then it will be coming down.

And in December it will be just in the, the angle will be different and it will be here somewhere and if you look at shadow wise, it will be changing. Of course this is the east side keep in mind. This is your east side and this is your west. Similarly this is your north and this is your south. Now if you look at June 21 is the mid-summer hence construction of the overhangs or the eaves what I told this is the overhangs helps to obstruct the summer sun rays but in winter due to inclined sun, the sun is at a different, smaller angle, it does not obstruct the Sun rays to keep the house warm. That means in the summer it will protect the house, from the sun rays, so that it will not really heat it up. But in the winter it will allow the sun rays to enter into the house and keep it warm, what a beautiful design it is, right. But today we are making house, we are not thinking about it, right.

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This is the same figure I am just doing, if you just rotate that inclined roof if I will put house by 90 degree like this, if I say this is your east here right and this is your west my house will be you know doors are to the south right and of course the windows and other things will be north side and the east and west side. If you do that morning sun will come in eastward inclination right and evening sun will come to the west side, it will come morning here you know, and more in from the east and then it will go to the west that is the normal thing in the summer and winter will be like that way. So that what will happen, if you look at you know the of course this is taken for the 40 degree latitude right, that is corresponding to Indian condition of course it will vary from, you know region to region, the angle. But let us

consider this angle, so June 21<sup>st</sup> the sun ray will come directly here and it will heat the plinth area.

Then you know your wall is not affected by the sun rays provided these overhangs are here, right. But suppose it could not have been there then it would have fallen here, whole building, it could have. But in the winter what happens, this rays is having different angles that is 26.6 degree kind of thing, so then it will enter inside and it will warm. See that is the beauty of the design, right.

And this of course depends on what is the length you will have to give, this length. And this length is very important and they have developed that thing over the years of course it will be varying from region to region. It is not that they know that precisely at that time I guess, but they know what is to be done. That is the beauty of the thing, traditional knowledge but we do not know in modern time.

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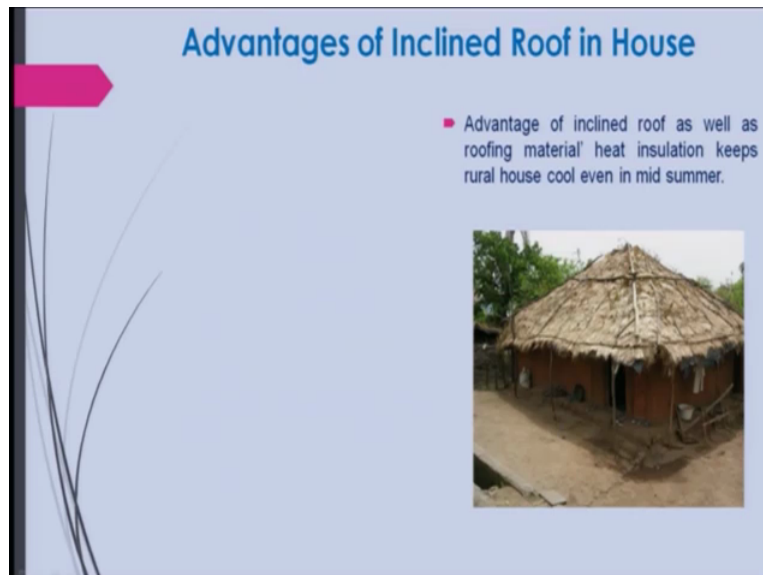


Whenever we make a house, we will not overhang right, and say o it is hot, of course it is due to global warming there is a rise in temperature, but we need to re look at this traditional wisdom of making houses, right. Let us look at another things of course there is one way of putting this overhang here but there is a thick wall and having this angle also like you know, so that this again, the summer sun cannot can be avoided, whereas the winter sun can enter into the house so that is the thing what you need to look at it.

There are various designs you can think of across the country, but unfortunately, we have not kept track of it and we do not have documented at least I am not aware of it of course with

me limited resources and then time I am spending for this work, this is not my usual work. So of course I had a talk with several civil engineering people and they say that they are not having any information you know. I have talked with various faculty members. So and also if you look at the, there is, what are the other advantages of inclined roofs.

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I used to wonder, why they are making inclined. So keep in mind, these are the inclined house and these of course strips are there, this bamboos or the strips and it is to protect it from getting blown away by the wind ok. Now if you look at, now what happens to the solar? Like if the solar rays are coming in and then what will happen, some of this thing will be reflected.

If I had been the flat one, what it could have happened? Suppose if it I a flat house, like this is like a flat house, what will happen? The sun will come and directly hot right but here it is reflected back and some of the of course heat will be entering into here and some of the heat will also go back so that the less amount of heat will be retained in the house and that is the beauty of putting this inclined roof and we are not doing it ok. And of course the question arises, what will be you know, angle will be making, this angle what would it be, and let me just mention again thing that relative ability of the roof surface to radiate absorbed heat you know because it will emit lot of radiations also the same time and it is a bad insulation.


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**Aerodynamic Design of House**

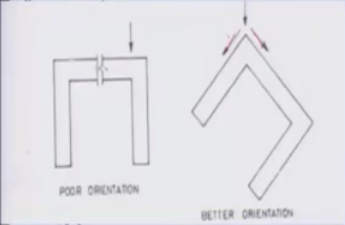
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In ancient India, Natural wide barriers such as trees/hedges are used to reduce impact of prevailing winds. Trees like **Neem, Peepal, mango, etc** are planted for reducing the impact of prevailing winds with certain distance from the house.

**Building shape** : For withstanding wind load, rectangular shape house (Length: Width = 1.5; Height:Width = 1.0) are used. But square houses are safest for wind force.



**Building Orientation** : It is to be fixed with respect to the direction from which wind/tidal force. An oblique angle makes the force to dissipate. Traditional Vastu shastra advocates for it.



This is also insulating materials and it will not absorb the heat like concrete building, concrete building like you know and they will be absorbing lot of heat. But here it is not this thing that is also another important point we can think of. So let us look at aerodynamic of a house, like of course earlier days people were putting the house near the trees and there might be hillocks and that is the reason why also people plant trees like neem, Peepal and mango etc around the house and, so that it will act as a barrier you know for the wind and at the same time it allow the wind to enter, Are you getting?

You are putting some barrier but the wind will come, but if it is cyclone then there will be a problem, because if they are uprooted the big trees can fall on the house and it will be damaged. So that is also one of the things (28.09) but there are ways of doing, people I remember used to you know tie the tree, old trees they will make it you know, identify it and tie it also. That they do but that is a maintenance work we need to take care. And it also affects your air quality will be improved by these trees ok particularly neem and even mangos right. So the shape of the building is very important. The building shape for withstanding wind load generally rectangular shaped house is being used width will be around 1.5 length to width if you look at right 1.5 and this is basically height to width, this height will be here right.

You can talk about this is your width, this will be height. And height width 1 for use basically if it is 1, it is a square house, so square houses are safest for the wind, if you look at most of the houses, numbers will be similar if you just look at, except few, baring few they do not know how to build a house and in modern day we do not do. And pyramid shaped deep steep

roof is best for avoiding wind force damage right and building orientation is very important right because it to be fixed with respect to direction from which wind or the tidal force is coming. Therefore generally angle it will put it, that is a very important point which is there in Vaastu right. And traditional Vaastu Shastra we look at for example if the wind is coming over here right then it will impact the wall, but it will come over then it will be diverted and then you know load will be less and that is being reflected in the Vaastu itself.

So therefore we will be discussing more about the design of house in traditional wisdom and in ancient days what people were using there is a lot of science involved in them, they were practicing not talking about it. So with this I will stop over and we will be discussing more about rural housing and its scientific aspect in the next lecture, Thank you very much.