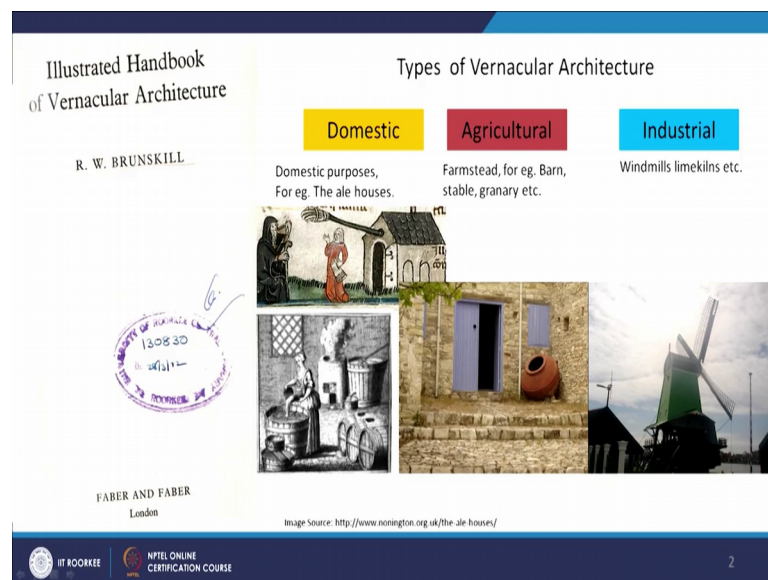


Culturally Responsive Built Environments
Dr. Ram Sateesh Pasupuleti
Department of Architecture and Planning
Indian Institute of Technology, Roorkee

Lecture – 31
Stone- as a Vernacular Building Material

Welcome to the course Culturally Responsive Built Environments. Today, we are going to talk about Stone as a Vernacular Building Material and what kind of techniques are used in the stone laying and closing and rendering.

(Refer Slide Time: 00:42)



When we talk about stone in fact, especially in connection with the vernacular architecture studies I would like to bring an important contribution. Especially, not only on stone in terms of the materials; especially, the Vernacular resources and technology and this is where the Brunskills work on illustrated handbook of vernacular architecture and his observations throughout England and United Kingdom.

How the countryside houses and how these and how he classified the vernacular architecture in his way, most report has classified vernacular architecture and how material as a subject to classify a material on the size, as a subject to classify vernacular architecture. Especially, if one could take a region point of view or a country point of view or a national understanding. So, initially he classifies the types of vernacular architecture into 3 categories, number 1 which is domestic, number 2 agricultural and

number 3 industrial. So, here domestic purposes the places the buildings which are used for eating, sleeping, doing all kinds of kitchen cooking all kinds of domestic work.

And it also acts as not only as dwellings, but it also can extend to the small homemade breweries or any kind of cheese making of I mean cheese making building. So, this is basically a small cottage level buildings as well or included within the domestic. For example, if you talk about the ale houses of nonington and how the breweries and how the women or especially employed in particular sections of you know this brewery and how they are, it is a kind of family business or it kind of a kind of a set, who are involved in this particular local economist. So, that is where we refer with the domestic architecture.

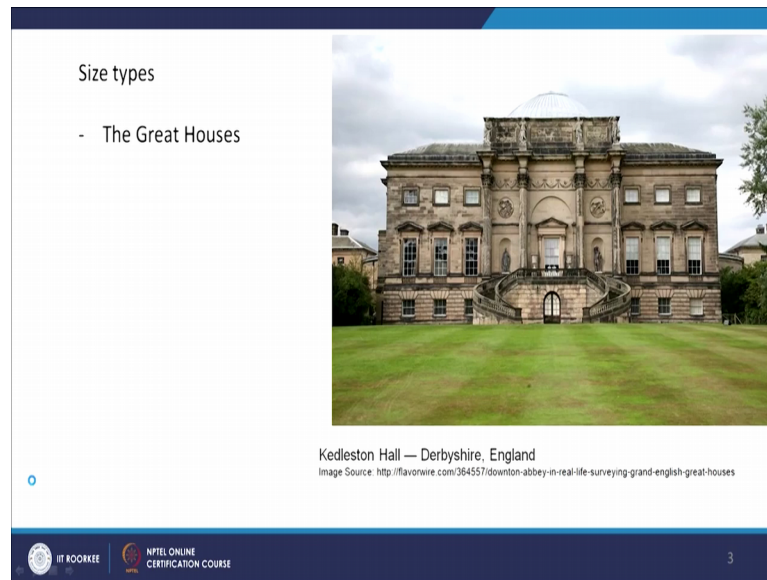
And the second category refers to the agricultural so for instance, the farm states which are associated with the farm buildings, you know it is not only about there is a difference between the farm house and these farm building which are actually associated buildings such as barn, stable, the granary you know. So, even if you are talking about in the (Refer Time: 02:29) you have this kind of long houses. Where, you have a part of it is a stable and part of it is for animals and part of it is so, the living cottage so; obviously, there are a barns these granaries which are used for storing grains in the harsh winter seasons. So, there are associated purposes.

So, that is where which are mostly relevant with the agricultural aspects and the third aspect which he talks about for example, which are to do a with the production aspect of it production of it could be a limekilns it could be a windmills which can generate power or which can pump water supplies. So basically if you go to Amsterdam or in the Netherlands a lot of windmills even today their kind of heritage orientation so, even certain limekilns, certain [FL] making processes in all these things you know they are industrial production oriented.

So, that is how we classified into the way the domestic purposes are manage the way the agricultural purposes. And associated activities that are related to agriculture managed that there are a linked with the production oriented, it could be industrial oriented, it could be windmills, it could be kilns or anything like that and his understanding takes not only in a broader terms, but it also talks he also talks about the size types.

So, till now our discussion was about vernacular architecture use to do with the kind of tribal dwellings or a community level, but Brunskill when he refers with the material aspect of it. So, he classifies into 4 categories one is the great houses.

(Refer Slide Time: 05:21)



In fact, the great houses is often referred with the people of the national, you know status, you know who are well known in the nation it could be royal family, it could be you know someone who is our national repute, who used to live there are chancellors 16 17 century in the or in the medieval times.

So, how these people have lived and where they have spend their times. So, that is where all these properties which has a notion of an identity you know which carries an identity and to that place and even to that region. So, that is where he talks about the great houses for example, the condition Kedleston hall in derby in England. And so, even that which is referred as a kind of the place of where the royals stayed in the so it is referred as a great house.

And then slightly I mean if you look at the way he categories comes from the wealth and the status of it from a very broad from the national level to the societal and the regional level and to the community level and not only in the societal hierarchies, but also the by wealth, and by the scale, and by the building sizes.

(Refer Slide Time: 06:49)

- The Large House
For eg. People of some local importance - Manor Houses




Image Source: <http://www.dailymail.co.uk/travel/article-3192965/The-Glories-Secret-Britain-20-unsung-fabulous-historic-houses-know-simply-visit.html>


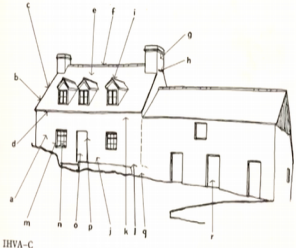
IIT ROORKEE | NFTEL ONLINE CERTIFICATION COURSE

4

So, the other thing he talks about the large houses the large houses which are referred with the kind of people of some local importance. He might be the governor or in the local minor house houses which, we see in each nearby each county areas. So, some of these historical areas now, especially in Britain they have been conserved and they have been protected and they also form a kind of landmarks, because certain feudal lords might have stayed there and you know that is how someone with a local importance have and; obviously, it comes to the again the peizons dwellings and the normal cottages with the small house and the cottage.

(Refer Slide Time: 07:35)

- The Small House
- And the Cottage



IHVA-C

33

a. Walling material, shape, coursing, jointing finish.
b. Roofing shape, c. details at verge, d. detail at eaves, e. material, method of laying, f. ridge, g. chimney position, h. water tabling, etc. i. dormers, position, shape, roofing walling material, j. Plan form, k. sectional form, l. staircase provision, m. window shape, n. window frames, o. door shape, p. door details, q. relationship between farm buildings and farm house, r. use of farm buildings.

IIT ROORKEE | NFTEL ONLINE CERTIFICATION COURSE

5

So but when you look at an vernacular understanding because for vernacular architecture one needs a great observation. Because, the material might be the same in all these categories it could be stone taking from a great house to a small cottage or a small house, but the kind of detailing it went into the kind of understanding of the material and the kind of local understanding and the local resource.

And how they tap the local resources that is one thing one has to give emphasis and that is where you can understand the vernacular architecture. The domestication of how the local materials are produced and how they have been brought here and then how the skills have built.

For example, on the right hand side, this is a small house when I was visiting that more. So, you can if you could see that even the whole roof was with the slates so it is not any tiles or anything. The stones slates because all these houses which were constructed this slates. So, if you look back how, why, they have constructed, because that is where in the nearby queries and the moves, how they get this slate as an abundance material.

So, here is a small diagram Brunskill points of what one has to notice for instance he talks about the first thing he prefers with the on the façade. What is the waling material and what are it is shape and what is it is course and what is it is jointing and what is it is edge the quoins? So, basically the quoins, the jointing, the coursing will actually give the whole talks about his whole skin.

Then, what kind of roofing sheet and the details of verge is it a gable roof, is it a hip roof, is it a mansard roof so, what kind of detailing? And how the details of the verge you know, how at the ends you know, how the details have been brought. And not only that the details at the eaves, how the soffit and the eaves actually been detailed out.

What kind of materials, what kind of method laying? Not only that the ridge. So, what kind of ridge if you consider in a framed constructions; obviously, an attic tress; obviously, the whole thing the wall and the roof everything comes in one package. So in that case how the ridge is made and how the difference in the ridges the chimney position now, if you take in the context of England.

Now, there are many historical houses which have the chimney's. But in today's generation, how many of them are useful? And still why in certain, why they still have

the chimney? In order to maintain the character of that historicity, that is one thing that goes back from not only the vernacular act. It goes back to the urban design and the understanding of the whole locality and its context and what kind of water tabling and domers?

So, what you see here is, a kind of domer; domer window in the construction of a dormer window varies by in terms of its roof type. Imagine, what kind of angle, what kind of height? It is getting at the sea level. So, where the domer is coming, and how the domer is functioning, what is the width of the domer?

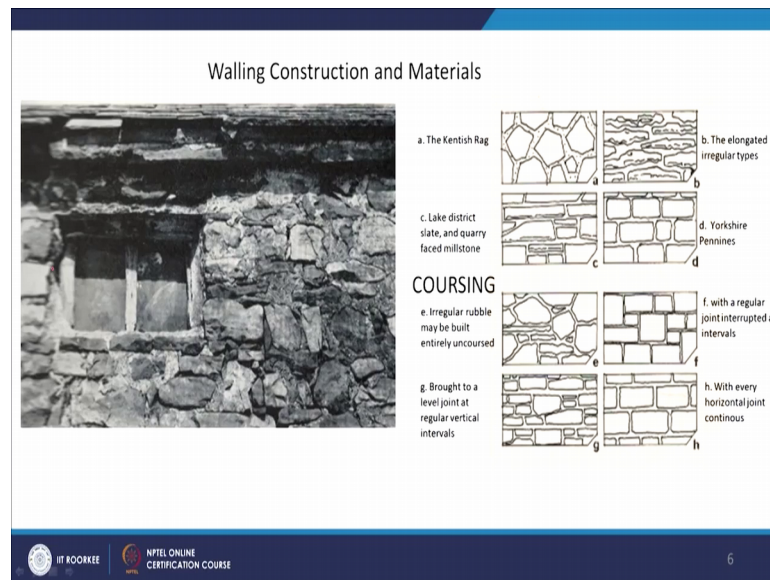
Position shape roofing walling material and the plan form like in a long house you have the part is a living and this part is for animals and it is all tilted. So that, that water is gets drained out. So similarly, what plan forms like in Japanese minka building minka dwellings we discussed about how they lived with animals, as well as how they categorize the workspace as well as, the sleeping spaces sectional form staircase provision, window shape, window frames right. In recently and at the end of this presentation, I will be talking about, how in the Chanderi even the window frames and door frames everything is made of stone.

Door details relationship between farm buildings and farm houses and the use of farm buildings. What is the purpose they are using it? So, I think this is a very basic understanding of how one has to study a building and what we will be talking about is. Today, about a brief techniques you know this is; obviously, any student of Architecture.

He might be learning about this techniques. In his first year, and in the introduction to building materials and construction subjects, but still it is a I am just trying to relate with the kind of study of vernacular architecture. So, the moment it is not just only an broader thinking of it the more if you are going into the study of buildings and how they could be retrofitted how they could be conserved in some cases you need to know the details of the construction.

You need to know the understanding how the bonding how the coursing how the jointing how the rendering how the quoins have been placed. So, for instance if you look at this photograph you can see that even the window material is all with the stone and there are few I just brief you out, how different arrangements of stone and how what are the technicalities inside.

(Refer Slide Time: 12:58)



So, the first one we refer is a kind of regular arrangement of stones that, is where we call the Kentish Rag and the second one, you see the elongated regular types because, they all coming from the kind of sandstone and they come in a kind of regular formats.

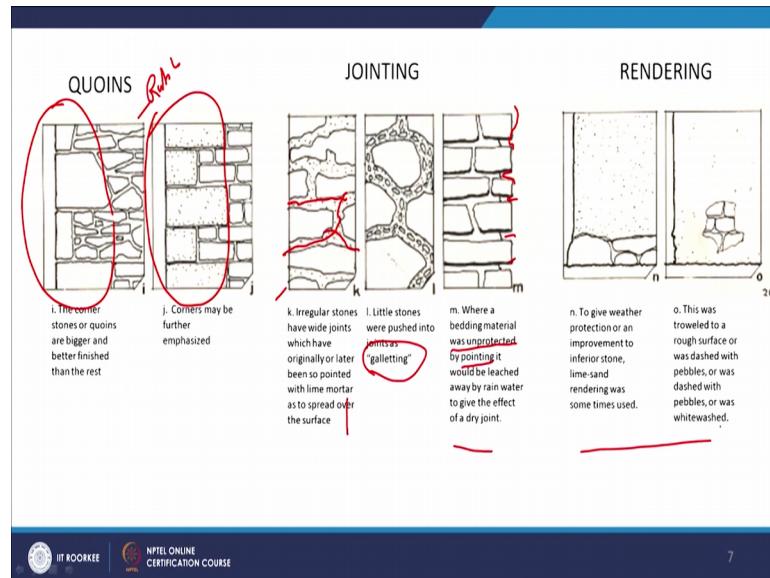
And how they little elongated in shape and this is one format I was in Lake District in England and Lake District is famous for it is slate and as well as the kind of stone buildings it has so. In fact, if you refer to many of the literature on the stone buildings lake district you cannot escape the Lake District examples. So, how the quarry faced millstone, how this is a kind of how certain constructions have been very famous because, slate is abundantly available there. And similarly, in the Yorkshire you see this is also referred as a kind of Yorkshire pennines style.

Because, the style is also denoted by it is region where, it is particularly used and particularly represent because, that is giving a neat character for that particular town or a village or a settlement or even a region. So, when it comes to the coursing like a you see that it is an irregular rubble irregular rubble, but it is entirely uncoursed. You know there is no proper I mean a proper order, but they are all it is a kind of there is between you have the kind of flat slab which is giving a kind of bonding sort of thing. Whereas, in this picture what you see is it is regular joint interrupted at intervals.

So you can see here it is a regular joint, but in between it is interrupted. So, you keep a big stone and then that breaks. So, that kind of gives a kind of bonding whereas, in this

model we see the brought to a level joint at regular vertical level. So, for instance you can see here this part you are getting. So, it is a kind of working as a sealed band or a plane band or you know it is breaking up till the sealed level you are getting to sets of times and with every horizontal joint continuous. So basically this again a model of continuous so, it is slightly if you scheme it so this is a model you are getting on.

(Refer Slide Time: 15:44)



And in the quoins, especially the corner stones are usually bigger in nature and they are better finished and the rest. So here, if you see the rubble and then you can see at the end you have the bigger stones which are giving a great finish.

And here, if you if you look in the second model of where the corners have been emphasized with a huge stones. So, there is an emphasis which has been laid out especially you might see in the if a great houses as well where the royals has lived so, these are clear emphasis of this particular edges.

I have been shown because that gives the whole elegant picture of the wall and it can also symbolize certain status as well. And in terms of jointing, if you see this model you have the irregular stones have white joints which have originally or later been. So, pointed with lime mortar or to spread over the surface. So, basically the irregular stores have a white joints because you are not an uniform nature.

So, but later on it can be pointed with a kind of lime mortar. So, basically you have the lime mortar finish or it can just be spread over. So, that I think in the rural villages of India also you find this thing very common this is another technique called galleting little stones are pushed into joint such galleting.

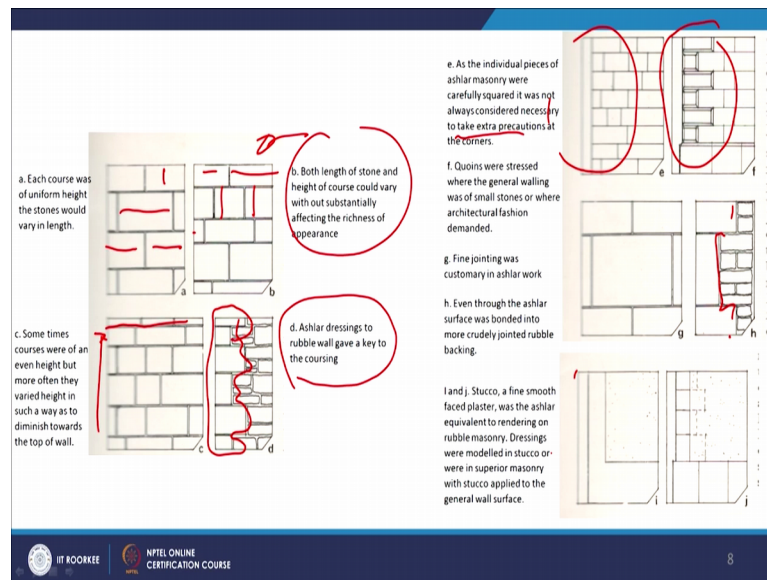
So, basically what they do is this you will find in Chanderi as well in the Indian context which we will come across. So, what they do is they push the small rubbles inside these bonding. So, that creates a bonding and here in this model, you can see where a bedding material was unprotected by pointing it would be leached away by rain water to give effect of a dry joint.

So, you can see that you know so, it should get a kind of effect of a dry joint there is a dry stone masonry. Where, we do not use any mortar or anything which is again relevant in Chanderi in the parts of Chanderi. So here what they do is they do a kind of pointing work unprotected by pointing it would be leached away by rainwater.

So but there are some issues like how the rain water can percolate and stay. Whereas, in rendering you know the lime sand the renders were used and this was trowel to a rough surface or was dashed with pebbles or was dashed pebbles were white washed. So, here the lime sand and rendering has been applied and as well as sometimes a rough surface will be created. So, basically some kind of renders will also be applied.

Now, coming to the ashlar we should which is not very common from the vernacular architecture because till now what we talked about the kind of very rough textured, but this is much more finished quality what you get, but still if you look at you need to understand the kind of a techniques.

(Refer Slide Time: 18:33)



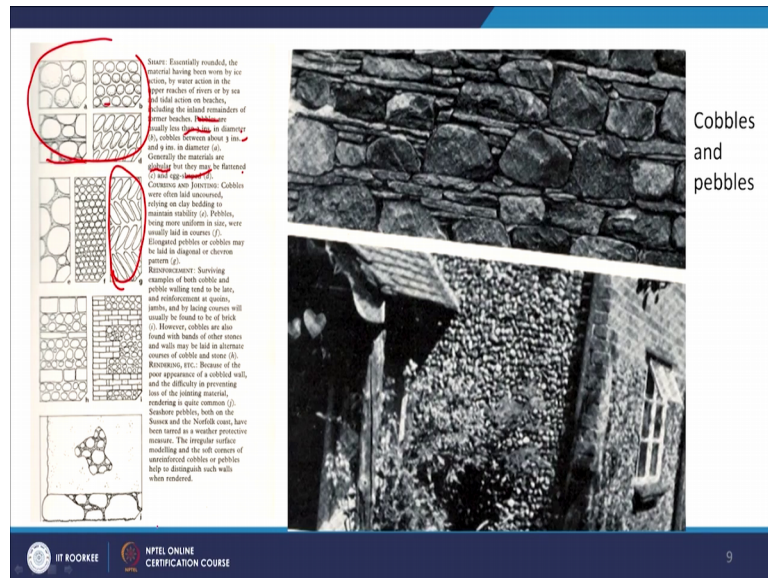
Like you see here the each course was uniform height and the stones would vary in length. So, you can see they vary in length and in this case if you say the both length of stone and height of stain could vary without substantially effect in the richness of appearance. So, that is the second case and but here if you look at it sometimes the courses were often even height, but more often they varied height in such a way as would. So, by the time you go the top the diminishes to the top of the height diminishes to the top of the wall.

So, that you know you have on the top you have a little projection out and that is how it is laid. And the other way of it is also the Ashlar dressings to rubble wall gave a key of the coursing, that the way I talked about in the corners. You have the Ashlar the front and then how the rubble is filled within at in different courses.

And similarly, if you look at it here you have the similar techniques of how the edges have been thought. And here, if you look at it the quoins were stressed where there is a demand of an architectural fashion so; obviously, they are drust and they are stressed you know. So, that it can create a particular fashion and the main important part is the Ashlar work is the fine jointed and you can see because a most of it is a kind of uniform layered. And here, though it is an Ashlar work, but still they are all crudely jointed rubble you know work has been backed up into it.

So whereas, again the stucco which has a smooth faced plaster and also these are various techniques in the Ashlar constructions then, coming to cobbles and pebbles. So, cobbles where we actually get the kind of round stones near the river beds. So, that is where we use the cobbles and the pebbles which are actually or again a very smaller ones of a pebbles which we collect from the shore as well.

(Refer Slide Time: 20:49)



So, this is how the cobbles and pebbles. So, you can see here so these are all basically the pebbles are usually less than 3 inches in diameter and cobbles between about 3 inches and 9 inches in diameter.

So, you have the different techniques, how they have like the you have various things called the materials of globular and they may be flattened and here you can see the egg shaped and in terms of. So, there was various ways how this pebbles are organized sometimes in a particular region, a particular because of this sedimental flows. You know the whole rock surface get smoothen and they might collect, they might segregate them into different batches and they might use it for different purposes and cobbles unusual are usually like uncoursed.

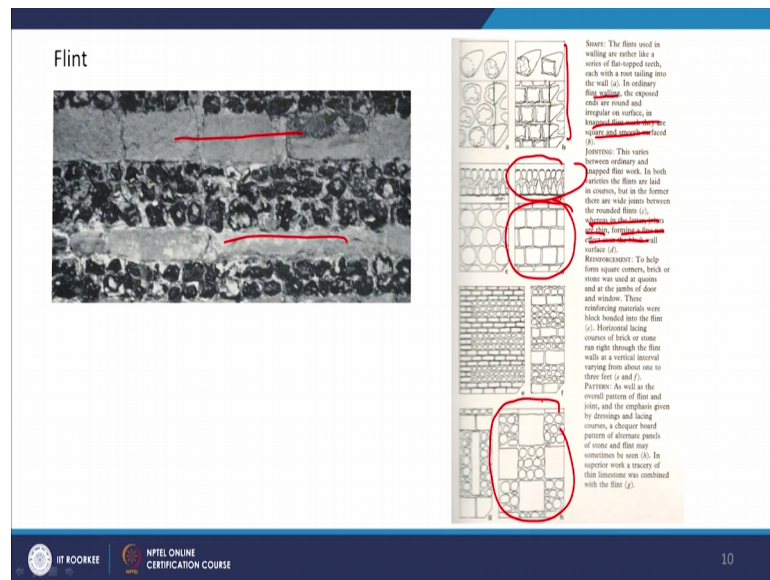
And relying on clay bedding to maintain stability and pebbles being more uniform in size were usually laid in courses. So, when the cobbles because they are of not in a uniform nature. So, they are normally laid in a uncoursed and whereas, the pebbles they are in courses. So, the elongated pebbles you see here the elongated pebbles or the cobbles may

be diagonal or chevron pattern. So, basically you have a diagonal pattern one on this side one on this side. So, that creates a pattern as well and so like that there are few examples.

So, you have a mixture of both the kind of Ashlar work and the cobbles fitting in and you have the stone beds coming in a flat surfaces and intermediate they act like a bands in the wall which supports the strength.

At the same time, you also works with the renders as well, but the main important part of this cobbles and pebbles is basically, how it needs it. It is a very difficult work because, they are each peak is unique of it is kind each to put it in the a wall and how you actually create a good bonding is a very difficult task and I am coming to the flint.

(Refer Slide Time: 22:55)



So, this is also a kind of walling material which actually you get in the kind of more or less get in the kind of pebble sort of thing. In the and here, there is again a different techniques which they have mentioned. Especially the flint walling the exposed ends are round and irregular on surface in knapped flint work they are squared. And so, basically there are different ways how they can actually arrange these flint works the one you can see here.

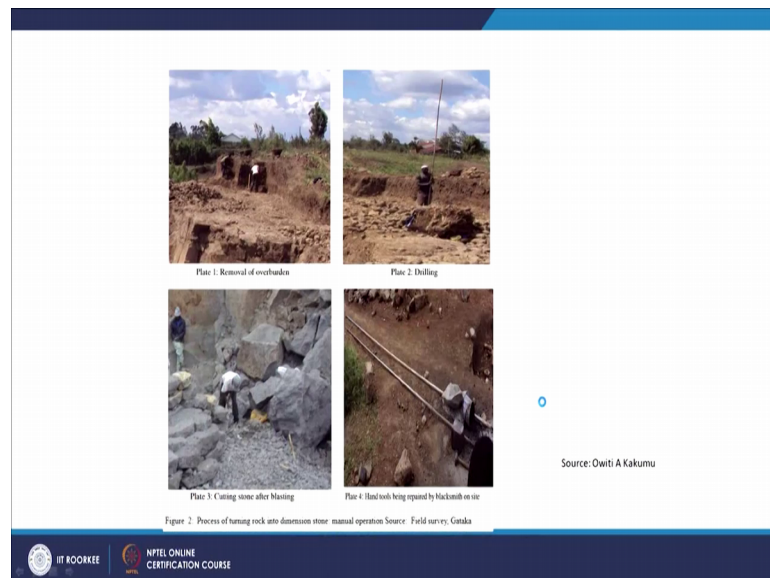
So, there is a different bands so basically, this is a the flint becomes a kind of filling material in between these bands and also on the tops. How you actually create a kind of coping sort of things and so, similar add to the cobbles and pebbles you can look at you

know the all the details were given here like for example, joints are thin forming a fine net effect over the black wall surface. So, basically you see the plan here and you see the elevation right.

So, basically these flints they are actually put it like this and intermediate they have it they themselves get a kind of bonding over there sometimes the limestone is also combined with the flint. So, here this is basically what you got an understanding is various techniques using cobs and pebbles cobbles and pebbles, using flint, using Ashlar, using random rubble masonry the Kentish stacks.

So now, looking at the process, you know one person I would like to refer is Owiti K Akumu from you know Nigeria Nairobi, who was in University of Nairobi. He was also a colleague of mine who worked on the stone quarrying.

(Refer Slide Time: 24:46)




So in fact, he actually worked on the he is a building economist and he was working on how to stream line the artisanal dimension stone. In fact, he looked at the kind of processes one is the removal of the overburdens in the quarry.

Then the drilling of the stone and the cutting stone after blasting and the final part, how you chisel them out. How this is where the hand tools and this is where, how you want it to deliver it to the site. So, that is where the whole process is about turning rock into a dimension stone.

(Refer Slide Time: 25:23)

2. Ashlar masonry: This built of stones carefully dressed and has narrow joints

Dry Stone Stacking
The earliest form of stone construction is known as dry stone, or dry stacking. These are freestanding structures such as field walls, bridges and buildings that use irregularly shaped stones carefully selected and placed so that they fit closely together without slipping.



IIT ROORKEE | NPTEL ONLINE CERTIFICATION COURSE

And again, we discussed about Ashlar masonry and this is also one of the form of dry stone stacking when, with this photograph what you see there is no mortar used.

Usually if when I was working in school of planning and Architecture Bhopal we used to take our students to document various vernacular building typology sometimes completely based on mud sometime the whole villages are built with stones. So, these are some few examples from the Chanderi district where even the staircases. You can see the cantilever staircases and the sills, how they used developed windows. Everything is built of stone and not only because the whole quarries do exist there and then that is the most abundantly available material.

So, you also have to understand the few technical terms like kind of bed surface. Corbels cramps is a kind of connections between these stone works, it could be a metal plate a kind of cramp which connects usually you find in the historic temples sort of thing.

(Refer Slide Time: 26:29)



Here, you see there even the roofing material is a very thin slabs if you look at the girder the stone girder, here and then these stone slabs have been and then they filled with a kind of lime mortar or something like that.

So, that it does not leak out, but the just without using any kind of mortar or anything. Simply, with the way the mass constructions are happened because there are 2 types of a construction. If you understand broadly, the one is the mass construction system and other is framed construction system. So, here the load you know the transfers from in the frame it distributes with the skeleton over and. And in the frame, you will see in the next class, we will talk about the timber and that is where we see we talk about the timber framed constructions.

(Refer Slide Time: 27:19)



And here we can see even the entrance is the door, jams how they are all made completely without using any mortar. And you can see repetitive courses here there is a thin stone there is. So, this is of one layer and then you have a thin layer horizontal layer and then this is another layer. So, in like that within that informality there is a formal arrangement.

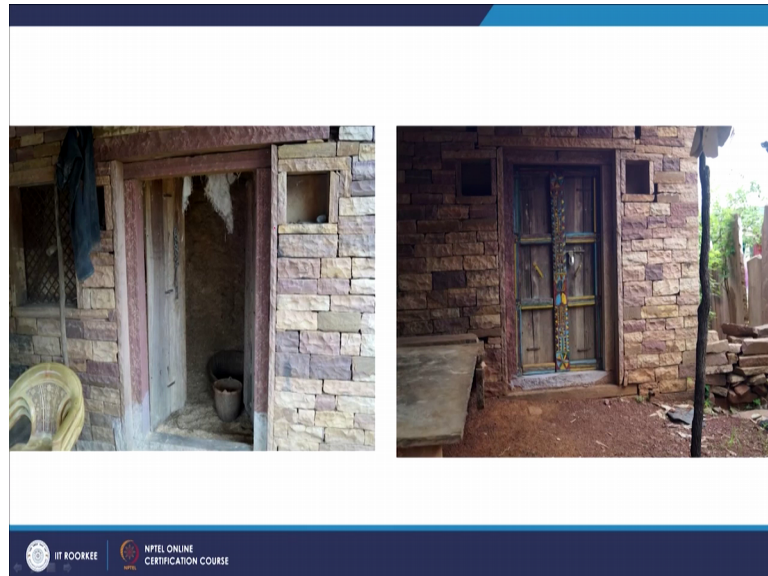
(Refer Slide Time: 27:50)



And again this is one thing of a render example. So, people use to put a kind of slurry and the cow dung and then they try to cover these walls a kind of give a render. And this

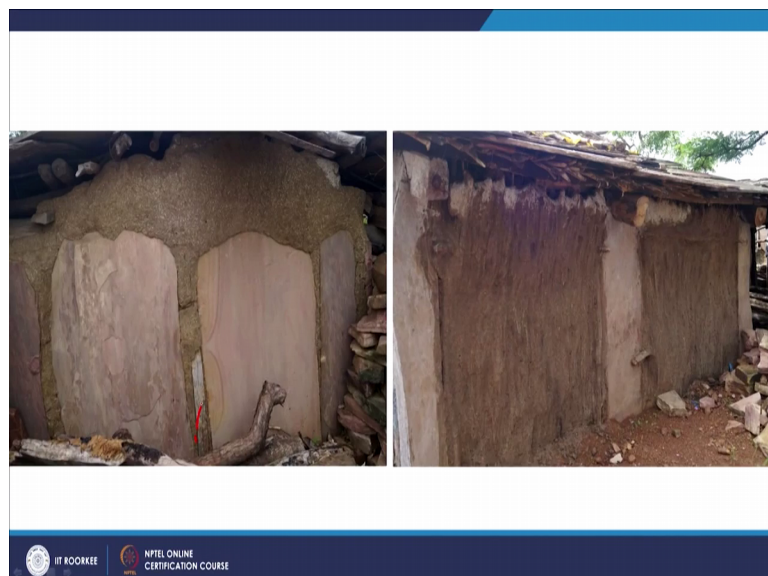
is all again a render this is all the stone constructions, even the cow sheds how everything is built with stone and the intricate work.

(Refer Slide Time: 28:09)



If you look at the way, the detail is worked out and the look at the jamb detail. So, very thin slate here and here normally what they do is they keep lamps in the evenings. So, that you know it is a auspicious thing and a Lausell windows. So, this is all meant for it is climatic reasons as well as the local reasons also and; obviously, this is very unique kind of thing.

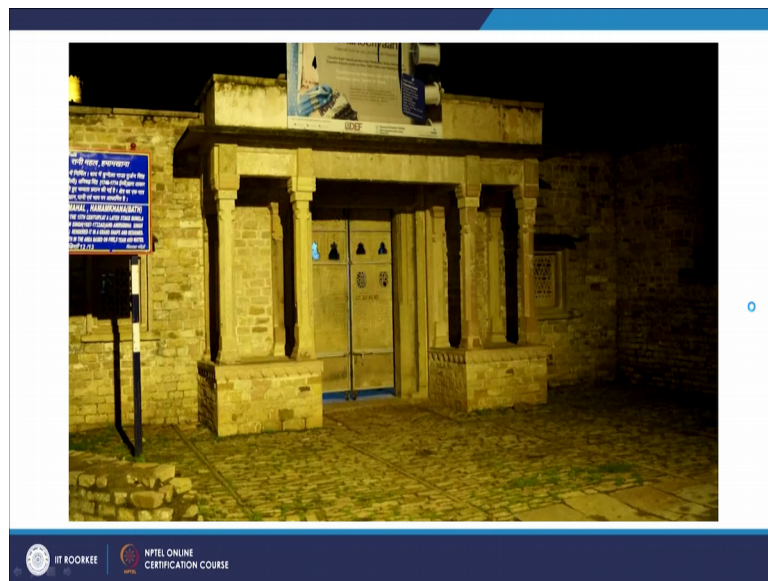
(Refer Slide Time: 28:38)



And you can see the finishes, how they are joining with this cow dung and the kind of slurry. What they get? And the finishes it is almost like a kind of wattle and daub construction.

But here, they are embedding with the stones and I would like to end this lecture of the stone the good example of Raja Rani Mahal restoration done by (Refer Time: 29:00) one of my colleague Professor Ramesh Bolay was involved in it.

(Refer Slide Time: 28:57)



And if you look at this whole reconstruction everything, even the doors this all the metal frame and these all the stone slabs which are, intricately worked out under stored back.

And now, they have started a kind of digital centre for the saree prints and as well as you know. So, to empower the local economist this is a good example of the stone. How it is very much useful, if you understand the stone construction techniques and especially is very important the construction and conservation areas.

Thank you very much.