**Introduction to Remote Sensing**
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**Lecture 07**
**Principles of Image Interpretation**

Hello everyone! Welcome to this 7th lecture in this course that is Introduction to remote sensing and in this particular topic we will be discussing image interpretation and what are the principles of image interpretation. So, what we have seen that there are different channels are there different satellites are there. We acquire the data ultimately the images are generated by the satellites and once the images are with us then the application part, interpretation part will start how to use those images that is very important thing.

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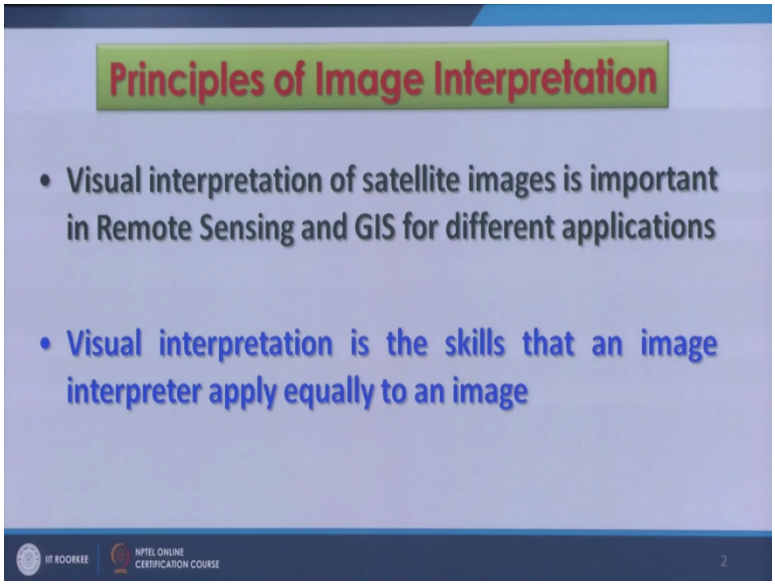


So, in this we will be discussing about principles of image interpretation especially visual one and then of course digital nowadays are also possible to some extent. So, in most of the cases visual interpretation of satellite images is important specially in remote sensing applications as well as nowadays we use in GIS remote sensing images extensively and therefore before they go into the GIS database we make certain interpretations, make certain maps or classify these images for different types of applications in GIS.

Visual interpretation starts... basically visual interpretation will come once we understand how

images are acquired? How different objects on surface of the earth behaves in different part of image spectrum and once we have as we have discussed in previous lectures that once we have understood all those spectral curves behavioral of different objects in different parts of EM spectrum absorption is scattering other phenomena then interpretation of such images, visual interpretation of such images becomes much easy and reliable. So, this is basically a skill visual interpretation is a skill that an image interpreter apply equally to an image.

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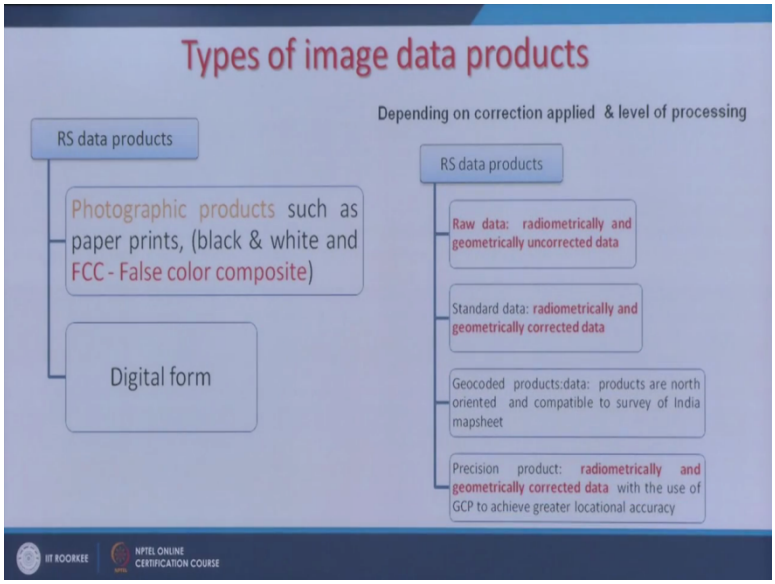


And as you know once the data has been acquired and then this is RS for the remote sensing data products we may go for photographic products or nowadays we use screens and directly display images make the interpretation on the screens make the output map and so and so. That is also possible so, maybe in the paper form or maybe in the digital form. This false color composite I will come little later so we may make color images we make black and white images depending on our applications once the data is acquired then certain corrections are done by the organization which acquire the data especially the readymade corrections but some corrections one has to perform on the raw data that is geometric correction atmospheric corrections on the data and finally then geo referencing or geometric correction are also done so that we can directly use on to the GIS platform.

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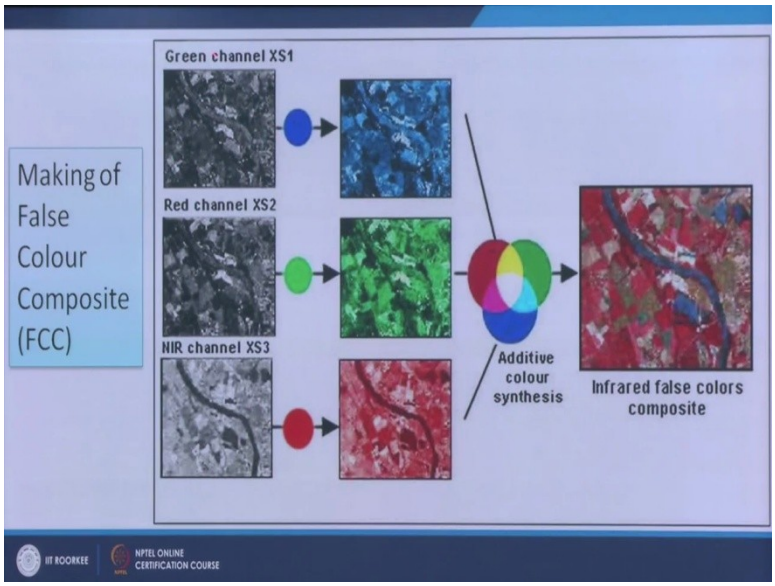


Now about the false color composite this is very very important and this is very standard practice of creating colored images of satellite data. So, what we will see like in different part of visible spectrum the green and red channels are blue... blue is not involved here so, green channel is assigned, blue color in a standard false color composite. Red channel is assigned the green color and now near infrared channel is assigned red color and because of this everything is becoming false like green channel is assigned blue color, red channel is assigned green color near infrared is assigned red color. And therefore the color composite which is created through this additive color scheme this kind of color composite or color images can be created using satellite images but because we are not putting the corresponding color like green we are putting blue, for red we are putting green and for infrared we are putting red and therefore we call as false color composites.

This became essential because we want we know by spectral curves that the vegetation reflects maximum in the infrared or near infrared part of EM spectrum. We want that vegetation should be discriminated very easily with vegetation of bare soil or rocks or any other objects which are present on the surface of the earth and therefore that channel has to be involved. So now which color one will assign so, in a standard false color composite generally the red color is assigned for this infrared channel and then remaining two colors are assigned for remaining two channels

and therefore that mix. Now as you can see in false color composite in a standard false color composite vegetation will always appear red more healthy vegetation more dense vegetation you will see will have more red color and whereas your water bodies or bare soils will have different colors in standard false color composite.

This is very standard practice of creating false color composite specially when we have limited number of bands but after having more bands of part of EM spectrum in like Landsat, TM or ETM Plus and it is possible to create a near true color images as well. But in case of Landsat MSS we had only four channels and therefore this was a very standard practice which is still being followed. The main purpose here to put bands in such a color combination that different objects can be discriminated very easily that's the main purpose that is why such schemes have been developed.

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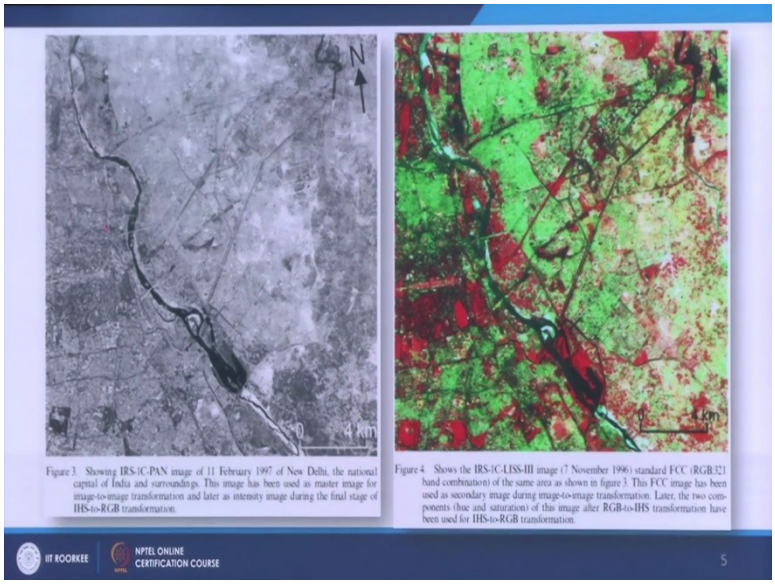


One example of a Delhi area is shown here that what we are seeing here is an image of Delhi area with shape panchromatic from our own Indian remote sensing satellite which was acquired in 1997. Almost of the same year not in just few months before in 1996 least three image of same area was also acquired. Now we can use these images and these color combination to create some new products which are which will show the vegetation water bodies and built up areas very easily, very distinctly and this is the purpose of creating such color composite.

Here one more extra thing has been done using this image fuse and technique the high special resolution data which was available for pen image has been merged with relatively low special resolution of least 3 that is 23.5 meter and using the same color combo combination and new product at high resolution has been created and which is false color. So, but our interpretation becomes much more easier and reliable that is why such approaches are followed. So, false color composites creating them interpreting is very important in remote sensing.

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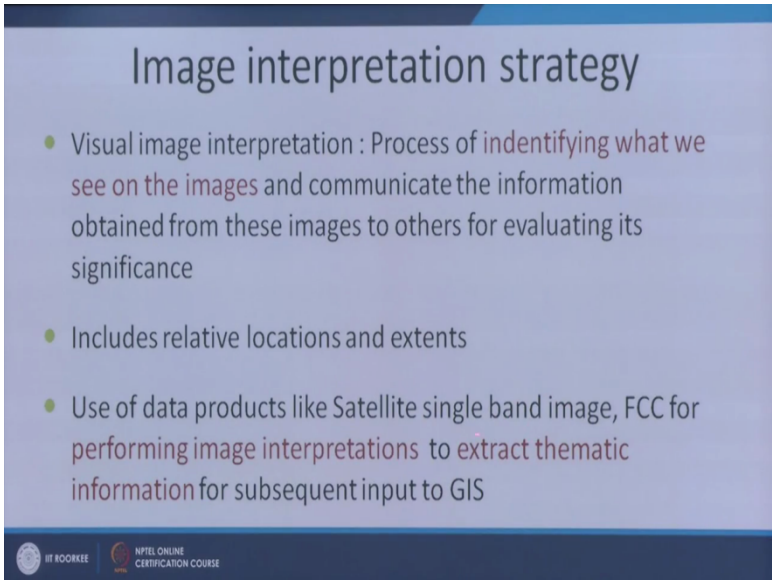


Now visual interpretation basically the process of identifying what we see on the images and the communicate the information obtained from these images to other for evaluating its significance. And manually earlier we used to put a transparent sheet and mark different areas but nowadays with digital images one can assign different colors and then can create output maps for example using a false color composite image we can create a land used map, land covered map forest density maps, maybe ethological map and so on and so forth. Such images can be used, their color combination can be used to create a new outputs for different application.

This also includes the relative locations and extent of the area and use of such satellite products of either single band I have shown the example of Delhi area that is this panchromatic or you can involve multiple bands so this single band false color composite, true color composite, extract the information which is present for subsequent input to the GIS. The main purpose of creating

these color composites and other things is to discriminate between different objects. Even if throw out in area where vegetation is there. One would in sudden application one would like to see the differentiation within the vegetation. Might be differentiation due to species might be the health of vegetation so that is why image interpretations are required.

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There are certain keys, certain standards which are followed while making image interpretation specially the visual interpretation or we say criteria for identification of an object with interpretation or key elements interpretation keys we call them.

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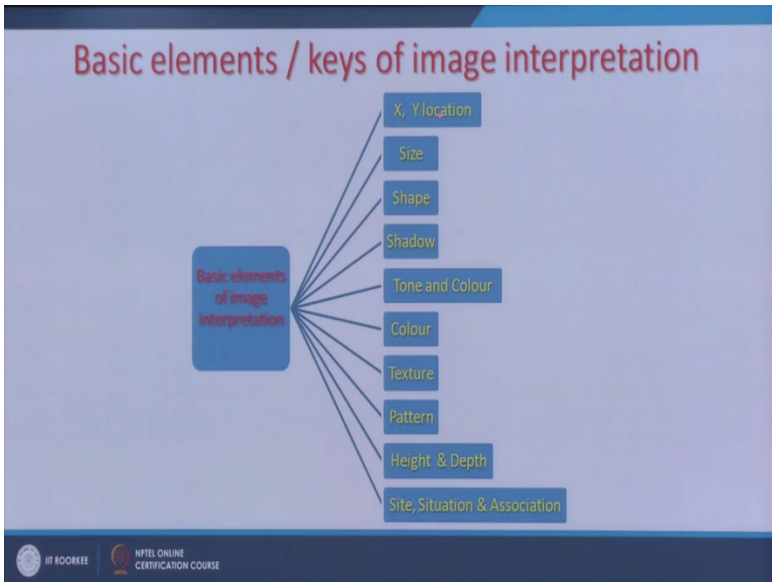


These are basically first the location whether it is we are on the land or in the sea or under water body or in a hilly mountain so, the location is very important then the size of an object that help us to make interpretation about an object which are present then the shape of object. Like for built up area which generally you will find them either they are square or rectangular. You may not find many built up areas which are in circular or having some other shapes so that is why it becomes easier of understanding objects which are present on the earth and with their shapes. Shadow also gives us lot of information about an object.

Specially in the hilly terrain it gives you the feeling about the depth or depth perception whether its valley or ridge or whatever or in plain areas you may not have shadows but if there are some objects which are present which will have shadows like tall building will always have shadow in day time images. Tone and color plays a very very important role and then texture is also there whether it is fine texture, coarse texture depending on the type of objects which is present within a forest area you may find certain vegetation, certain areas which are showing fine texture and in the same forest area you may find showing coarse texture. Pattern also... pattern help while making image interpretation, height and depth is also connected and also shadow and then where it is located.

Site location and association like beach generally are associated either with the sea or large lakes

so there is that kind of association is mentioned here. Where things are situated because in normally in large land area you may not find beach and other things are. Same might be with sand dunes deserts and their association so that is very important while making interpretation whether in reality these things can be found at that location or not that has to be understood. That is why site situation and association is also very important key one of the keys of image interpretations.

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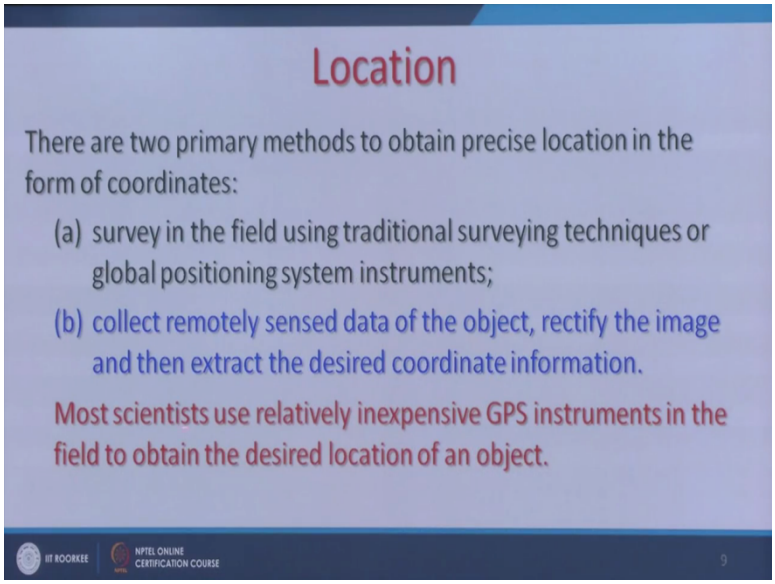


We will go one by one first location, there are two primary methods to obtain precise location in the form of coordinates. One is using the survey in the field using traditional survey techniques or nowadays some navigation systems like GPS instruments or collect remote sensing data of the object rectify the image, rectify means here making geometrically corrected or doing the geo referencing and then extract the desired coordinate information so, location is very much required for as one of the keys of image interpretation.

Most of the users or scientist use relatively in expensive GPS instrument in field to obtain desired location or an object. When we go for some mapping maybe geological mapping or some mineral exploitation maybe for water or for some civil purposes we might carry our GPS and can get the location of that particular object and that makes very useful input for image interpretation.

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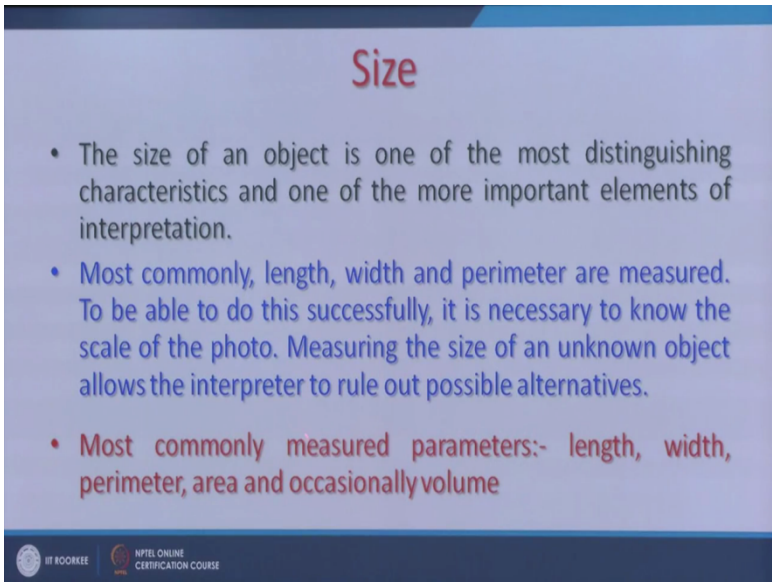


Then next is the size the size of an object is one of the most distinguish characteristics and one of the more important elements of interpretation. Now this size has to be understood because depends it will influence as per the special resolution of your satellite image if a object which is very small and you are having satellite image which are having coarse or special resolution like no AVHRR which is having 1 kilometer special resolution then these objects will not be visible at all. Whereas you go very high special resolution which is having say 2 meter or 30 centimeter special resolution then all these details of the objects are present.

So size is really depending on the special resolution and object of course object itself. So, most commonly the length, width and perimeters are measured to be able to do this successfully it is necessary to know the scale of the photograph if you are using a printouts of a satellite image or special resolution in case of a digital image and measuring the size of an unknown object and that will allow is to make correct interpretations and may provide possible alternatives as well. And the most commonly parameters as mentioned length, width and perimeter area and maybe occasionally maybe for related with water or other things maybe the volume of the water.

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The third one in the series of keys of image interpretation is the shape that is the shape of an object is described in geometric form represented on image. Again shape may remain in little different depending on again special resolution so, one has to be before making interpretation one must know what is the special resolution of that image on which interpretation is been made, specially on the digital images. Regular shapes and signs of manmade objects like buildings, maybe roads maybe some track another things whereas irregular shapes with no distinct geometrical pattern are signs of natural environments like a water body, shape of a water body maybe fluvial system like a river or a mountain so on and so forth.

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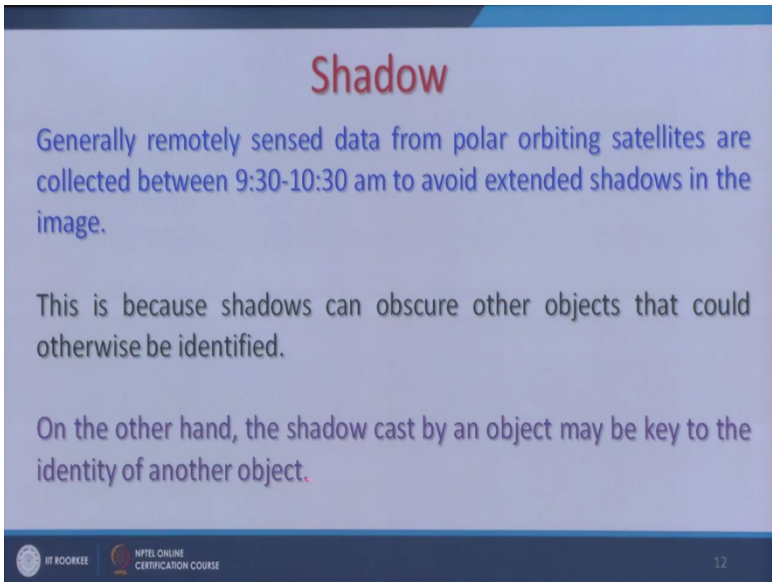


Now shadow this is the forth keys of image interpretation, the shadow and generally remote sensing data from polar orbiting satellite or sun synchronous satellites are collected between 9:30 to 10:30 in morning hours that is why they are called sun synchronous and to avoid this basically it is not too early in the morning, not too late in the afternoon and to avoid the extended shadows in the images that is how these are designed. But shadow can obscure other objects that course otherwise be identified.

So, especially in hilly terrain like Himalaya where you are having one ruggedness so, there is a mountain peak and suddenly there is a valley and then in your satellite images you would find large shadows and these shadows will may give you wrong interpretations one has to be very careful. The shadow cast by an object maybe the key to identifying by the another object so the shadow generally helps but sometimes it can also creates problems.

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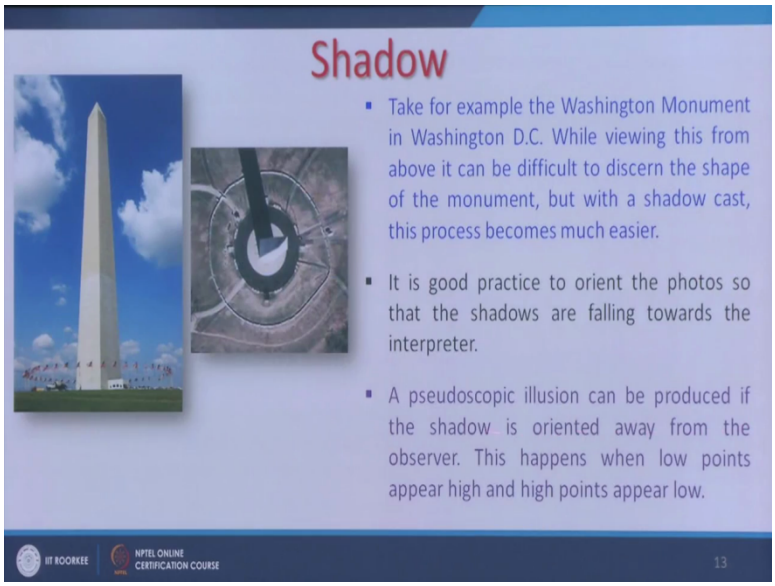


Examples are here this is Washington monument which is very high as you can see through a photograph taken from the ground but the same Washington monument is not looking as tall. From top or from satellite image but if you see the shadow so this is taken in the morning hour that means the sun was in the south east quadrant and therefore shadow is in the north west and even the measuring the length of shadow and the elevation angle of sun you can one can estimate the height of a this tower as well based on the satellite images. So, this kind of applications of shadow are possible, take example as I have already mentioned about the Washington monument while be in this from above it is difficult to design the shape of the monument but the shadow cast this process becomes much easier.

And as it is good practice to orient photos or satellite images in that way shadows are falling towards the interpreter and pseduscopic can be produced if the shadows oriented away from the observers this happens low point appear high and high appear low. So, what does it mean basically here generally the data is acquired between 9:30 to 10:30 but our brain have things that illumination is coming from opposite direction and therefore if we keep like this then there might be wrong interpretation. So, one has to be very careful while using shadow to interpret certain objects which are present on the earth.

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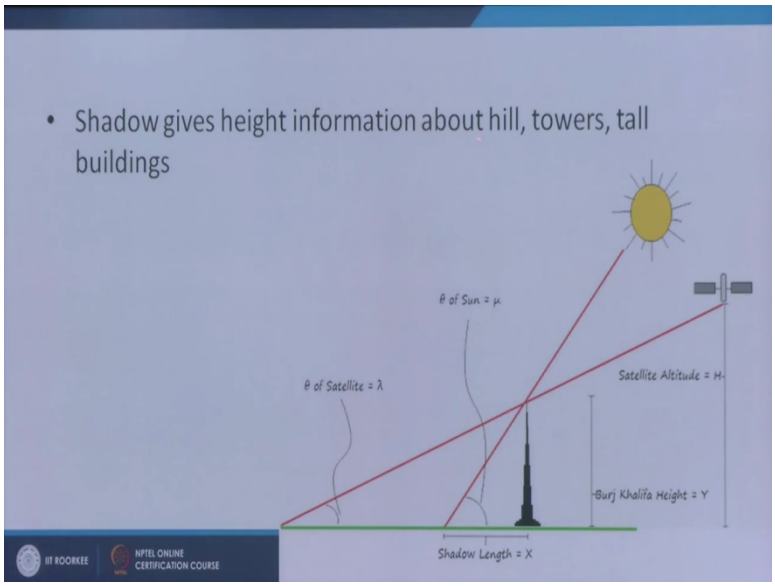


As I have mentioned that shadow gives height information about hills, towers, tall buildings etc, and we know the altitude of the satellite and the angle then probably the shadow can give you the estimations of the height as the demonstrated here.

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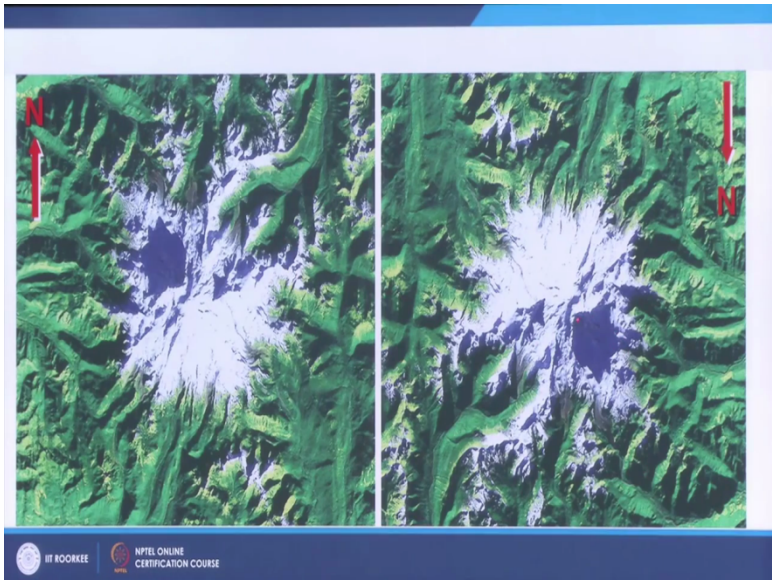


One example of that point which was just mentioned is that when satellite images are acquired by this solar... polar orbiting satellite, sun synchronous satellites that time sun is in the south east

quadrant and therefore if I say this is a snow covered mountain peak but you might see it is showing a form of depression. Because what happens when the sun is here the satellite has taken the image from the top the shadow will be in the opposite direction of the interpreter and if this situation comes then we will see a inverted phenomena or false topographic phenomena but if I rotate this image by 180 degree like this then we see incorrect perception that means the illumination source in this first image on the left image was in the south east quadrant has been put back in the north west quadrant on the right image and therefore the shadows are towards the interpreter and once this situation comes then you see topography in correct perception.

So we call as false topographic phenomena of hills terrain it is present in all satellite images all parts of the earth even on moon surface, even on mars, so while using shadows during interpretation one has to be very very careful that in which direction shadow is falling and keep in direction or keep in the same hemisphere where the interpreter is present. That means you keep the illumination source in the north west quadrant rather than in the south east quadrant as really happens in case of this sun synchronous satellite images, so one has to be very very careful while using shadows in the interpretation and especially in the hills terrain where shadows are very common and gives you the depth perception as well.

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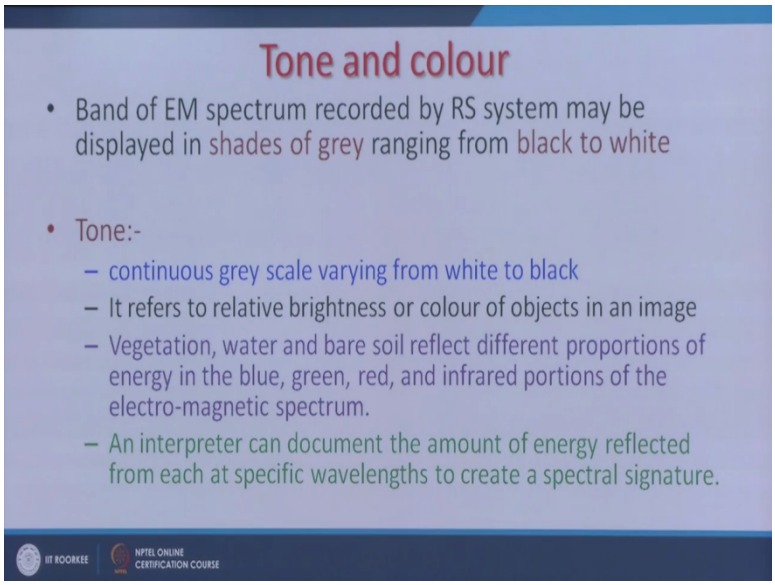


Another few more keys of a image interpretation important one the tone and color the like a

different parts of EM spectrum are used to create for different bands and they record the remote sensing system displayed in shades of grey ranging from black to white, so when only the colors when you combined three channels use the additive color scheme then you create the color images otherwise what you will see in the grey shade and there the tone will play important role.

So continuous grey scale varying from white to black refers to the relatively brightness or color of the object like for example in the visible channels the vegetation may appear very dark whereas in infrared channels vegetation will appear very bright. And different objects like water and bare soils will be different in different part of EM spectrum and therefore an interpreter should have the knowledge of which band he is interpreting. Which band of remote sensing data he is interpreting and accordingly the tone he might expect and the colors are when you combined three channels and make color composites.

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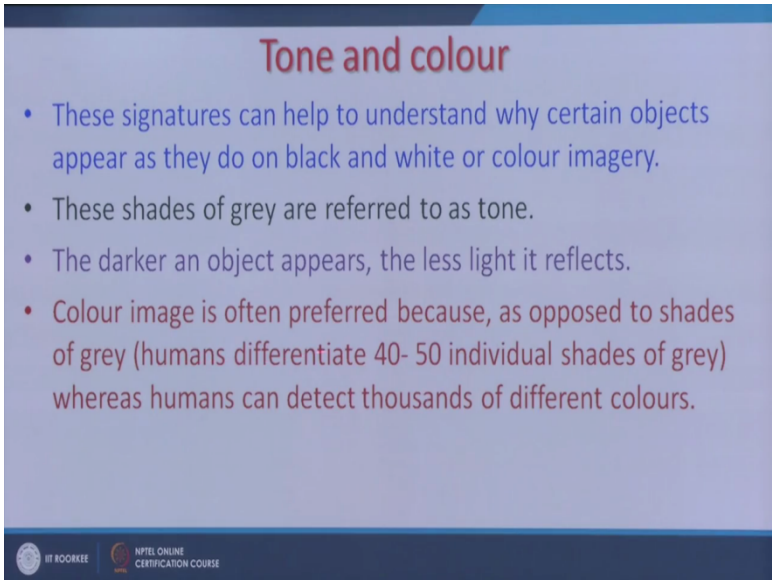

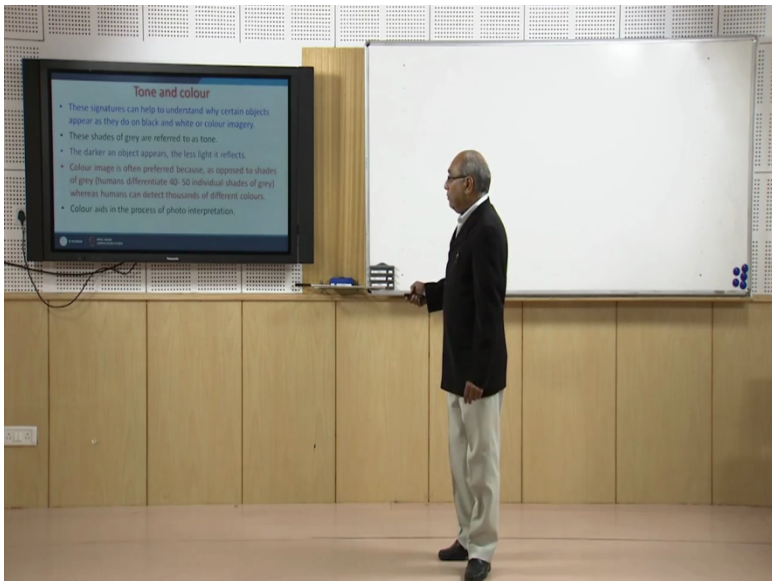


And these signatures of tone on color can help to understand why certain objects appears as they do black and white or color images. And these shades of grey are referred as tone. Darker of an object appears that means it is reflecting less in that particular channel, color images often preferred as oppose to the shades of grey the human can differentiate maximum 40 to 50 individual shades of grey whereas in case of colors we can detect 1000 of colors so that is why colored images are most liked and used in image interpretation. Color it is in process of photo interpretation it helps us and make this photo interpretation much easier as compared to grey images that is why we always create color composite that even might be a false color composite but it is great help while making interpretations.

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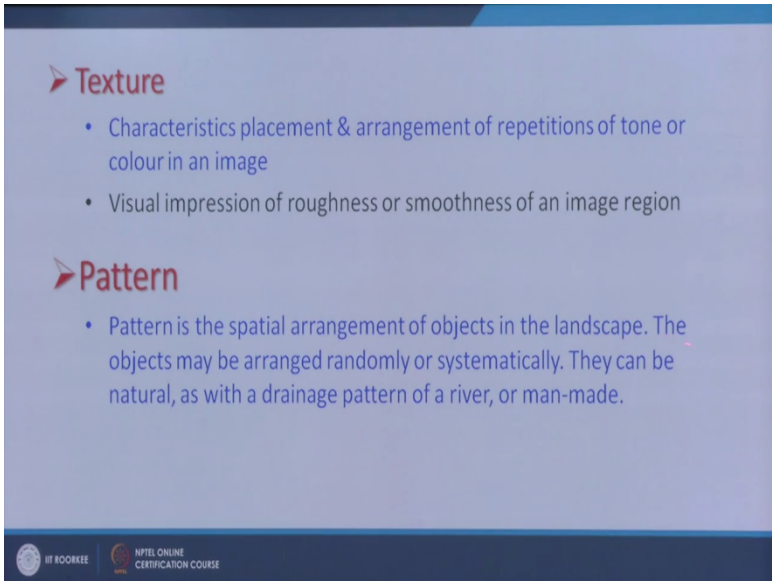


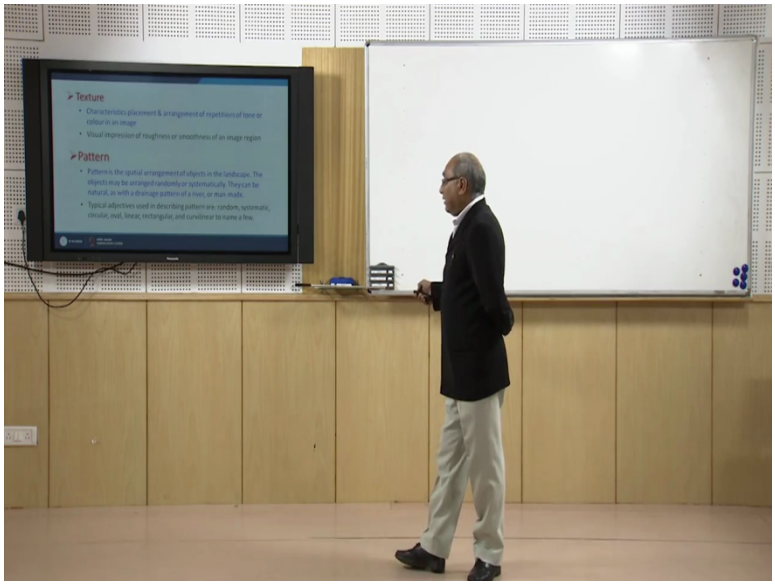

Texture another important characteristics or another important key of image interpretation that the characteristic placement and arrangement of repetition of tone or color and image. And visual impression of roughness or smoothness of image in a particular region and other key is the pattern in the special arrangements of the objects and the landscape, the objects maybe arranged randomly or systematically, generally natural objects are not arranged systematically and whereas man made might be arranged systematically and they can be natural with drainage pattern or wherever or manmade. Typical objectives used in describing pattern are like random,

systematic, circular, oval, linear, rectangular, (())(26:01). Mainly we use for different types of lines specially like drainage lines maybe some other networks for example road and others.

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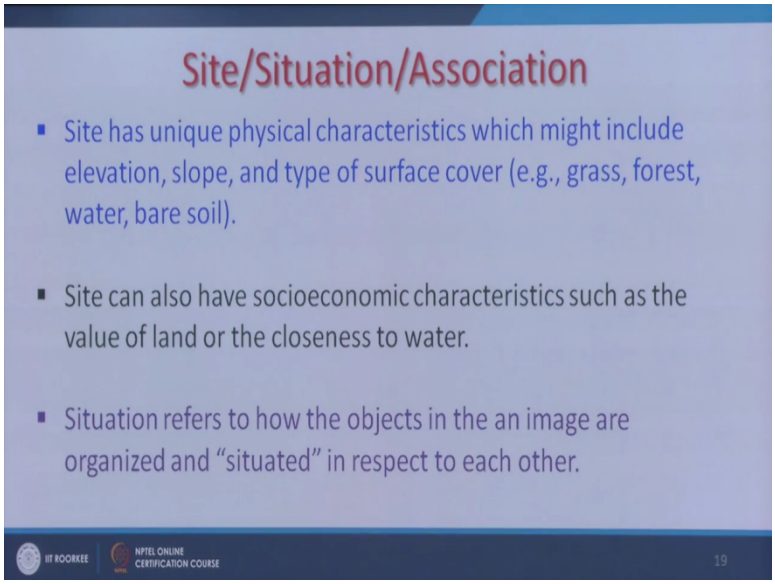


Now where such objects are located that is the site situation or association that will also decide what kind of object it is and it will help in the image interpretation. So side has unique physical characteristics which might include elevation, slope, type of surface covered etc. For example grass, forest, water bare soil and other things. Site can also have socio economic characteristics such as value of land or closeness to the water. Closeness maybe to road and so on and so forth.

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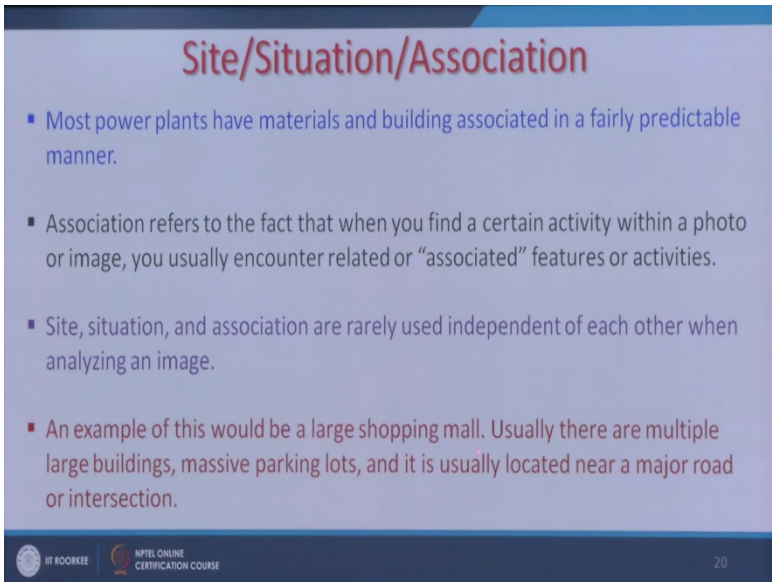


Situation refers to how the objects and an image are organized and situated with respect to each other. So there association is very very important I gave the example like beach are associated generally along the sea or along the large lakes so, the most power like manmade structure most power plant have materials and buildings associated fairly predictable manner and this is how you make interpretation that this might be a power plant, might be a cement factory because if it is power plant, it will have some thermal power plant, it will have some cold dump. It will have some fly as dump.

It might have storage for water and then power lines might be coming out of that a power house might be there so all these association of different objects will make your interpretation easy and you will be able to identify that probably this is a thermal power plant. So, association refers to the fact when you find certain activity within a photo or an image and you usually encounter related to associated feature or activities. Site situations association are rarely used independent of each other when realizing an image.

There can be like a railway station so, if railway station you will find a track you might find a platform, shadow and there might be a more number of lines in a few kilometers within the range of railway station and then maybe less. So, based on these associations you can interpret very easily about a particular object which might be present on your image. So, an example is this

would be large shopping mall usually there are multiple large buildings massive parking plots and usually located near a major road intersection so association is another very important key of image interpretations.

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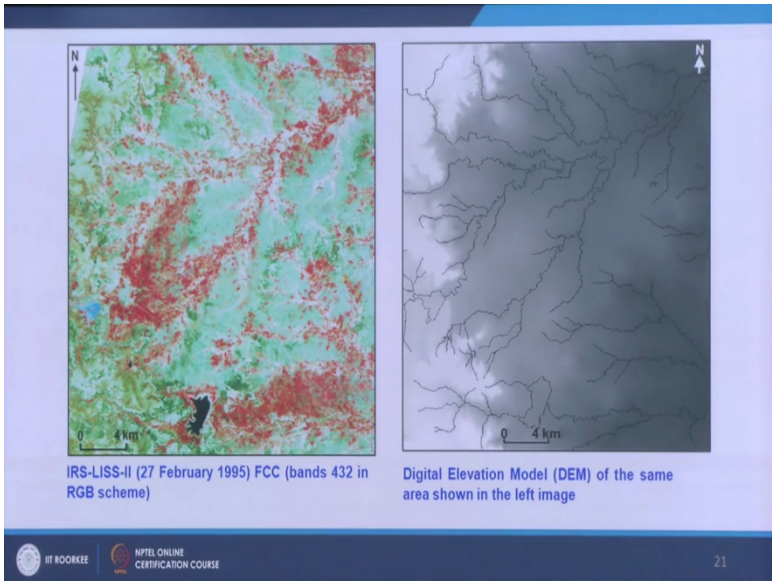


Here like I am showing that a there are water bodies and there is association of vegetation along with a water bodies in the downstream area so, that clearly tells that probably these are the agricultural lands and which are getting feeding or getting water from these small reservoirs and whereas you don't have much water bodies here or reservoirs and therefore you don't have much growth of vegetation or agriculture land, so this association is making this kind of image interpretation in a much easier manner.

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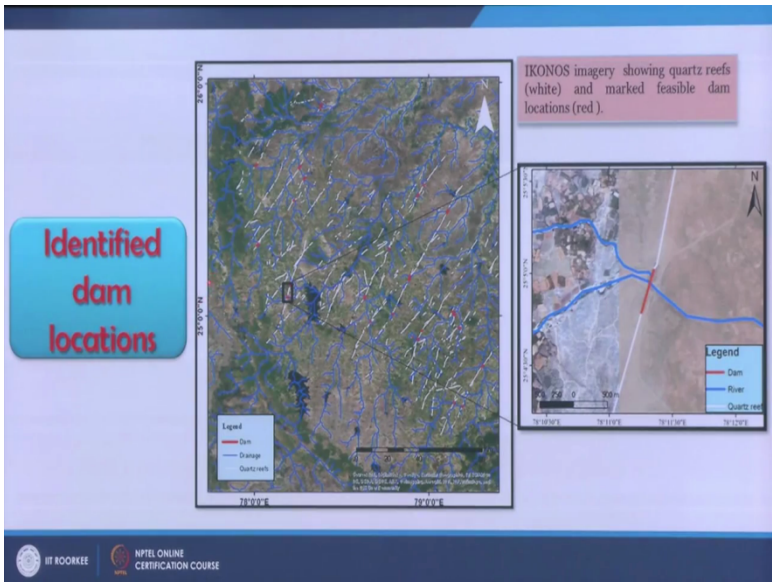


Similarly one more example I am showing from Bundelkhand region where there are lot of quartz reefs are there so while studying such images or making interpretation of images we can even identify a location for a future dam because we know there are quartz reefs natural kind of dam are there is no blocking of a drainage line or what our river a river led which is going through this quartz reefs so if it is blocked then it can become a reservoir.

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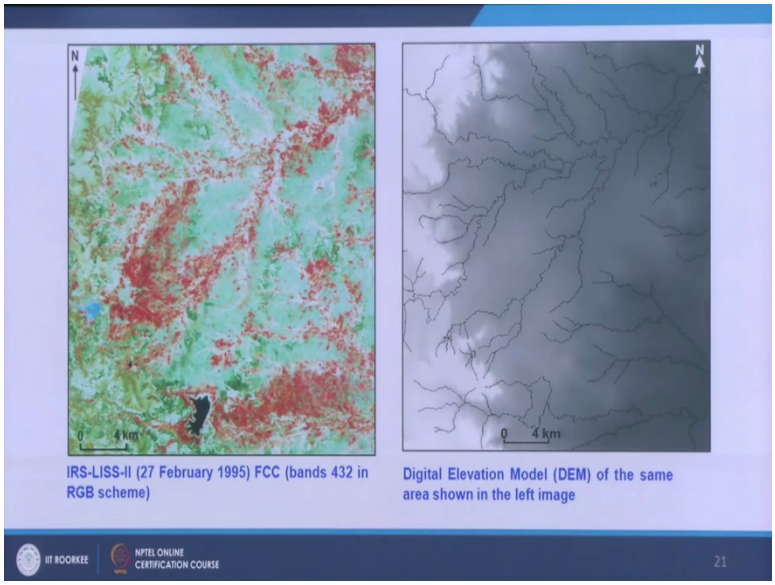

While learning from here and making interpretation in this image probably in the same almost in the same area or nearby areas we can do some futuristic work as well. Using this concept of association or image interpretation overall image interpretation, so that is the advantage of making good interpretation of satellite images.

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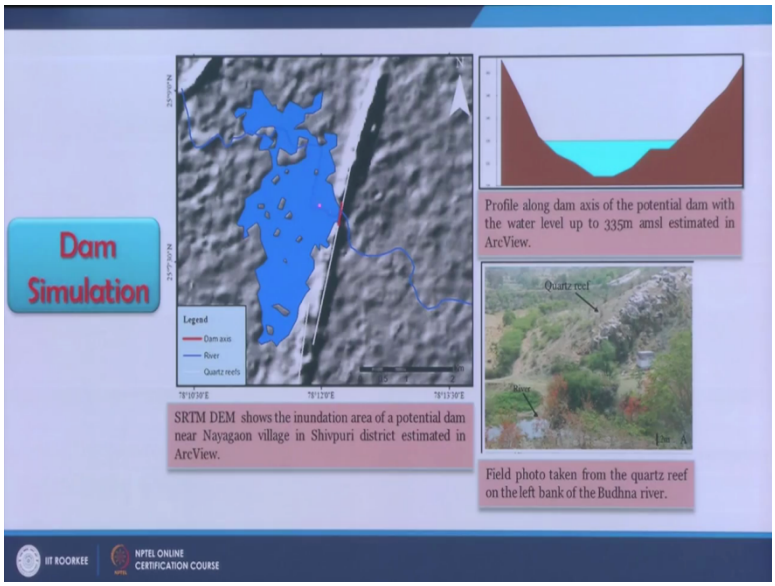


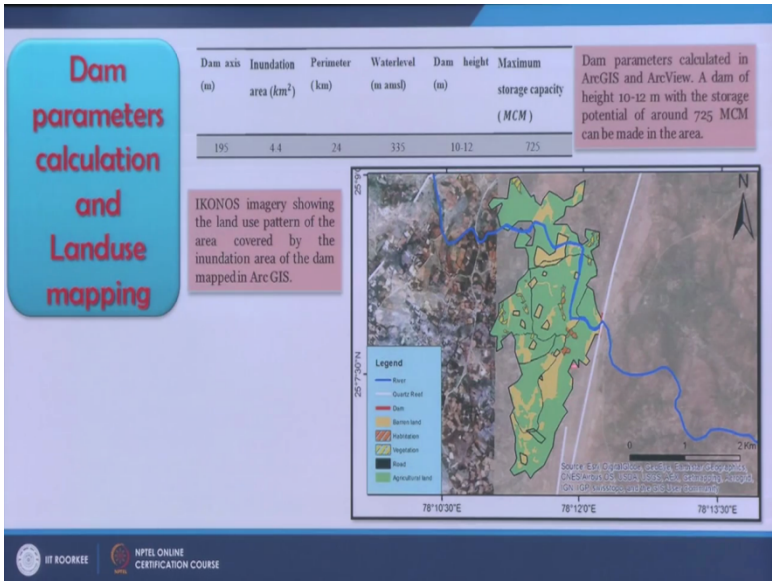


So, this is the quartz reef if a stream is going if it is blocked then a dam can be constructed and the simulation of dam has been done in GIS platform it shows that how much area if this much height of dam is created how much area will be inundated and so which land use will submerge

that can also be estimated so that kind of work can be done starting from satellite image interpretations. So, thank you very much.