Photogeology In Terrain Evaluation (Part-1)
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Lecture – 10
Relief Displacement on Aerial Photographs

So, let us look at the relief displacement on aerial photographs.

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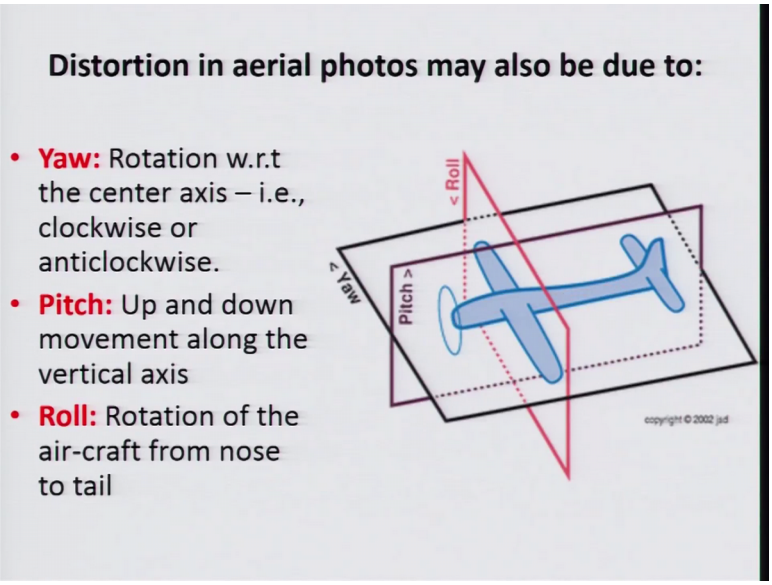

Now, on aerial photographs whatever the data has been collected will show some distortion, and distortion may be due to many reasons, but few reasons which are added on because of the problems, we face in flight either it is because of the rotation, because of the flight moving up and down, and either they are if the flight is moving anti-clock or clockwise direction. So, these are the reasons because of which the scale of the photograph will not be a same throughout.

So, to look at this is what we have that is the yaw rotation with respect to this inter axis, where there is an clockwise or anticlockwise rotation of the of the flight. So, either the flight is for example, if you look at the flight is moving either like this or and this direction. So, either the moment is clockwise or anticlockwise.

Then comes the pitch, which will be along the vertical axis, where you will have the up and down movement of the flight. So, here we add in the variation like in terms of the

height, then role of the aircraft from nose to tail. So, this is again will add slight tilting on the photographs. So, if you are having roll along the axis here. So, that will also add to the distortion.

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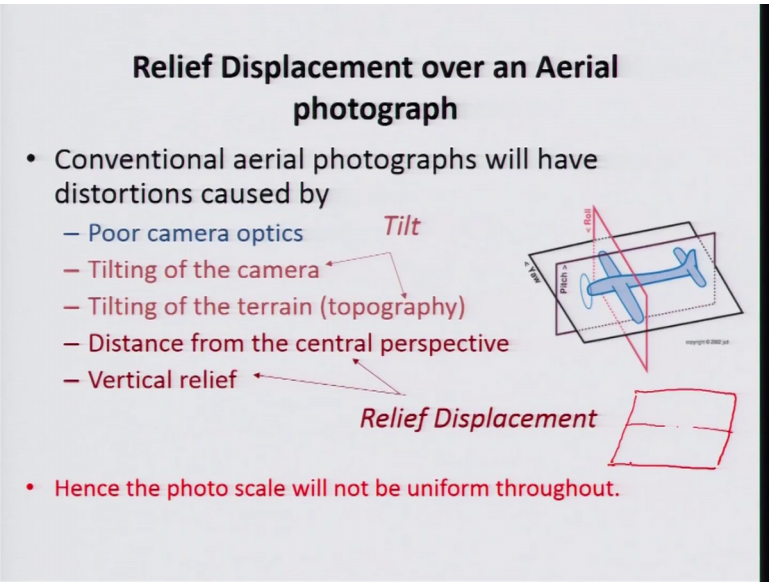

So, these are a few things, which are we cannot help it out while taking the other mission or flying over the terrain. So, relief displacement over an aerial photos conventional aerial photographs, will have distortion caused by poor camera optics, these are add on distortions which can be added, because of the poor camera optics tilting of the camera, now tilting of the camera can also be added because of the rotation of the aircraft.

Then tilting of terrain, because terrain will not be flat all through it will have undulations. So, that will also result into some distortion. So, this will result into tilt, then we have distance from these central prospective. So, we have we have talked about the central perspective. If we are having many vertical we will have exactly the same point p that is principal point and nadir point.

So, distance from the central prospective vertical relief will also play an role. So, that 2 the last 2 will result into the relief displacement, and this is what we are going to talk today. Hence, the photograph scale will not be uniform throughout. So, you will have some distortions, which will be seen for example, you are having a photograph here it is the photograph here. So, this will be your centre here and on the either side you will have the distortion. So, this should be kept in mind while interpreting the photographs.

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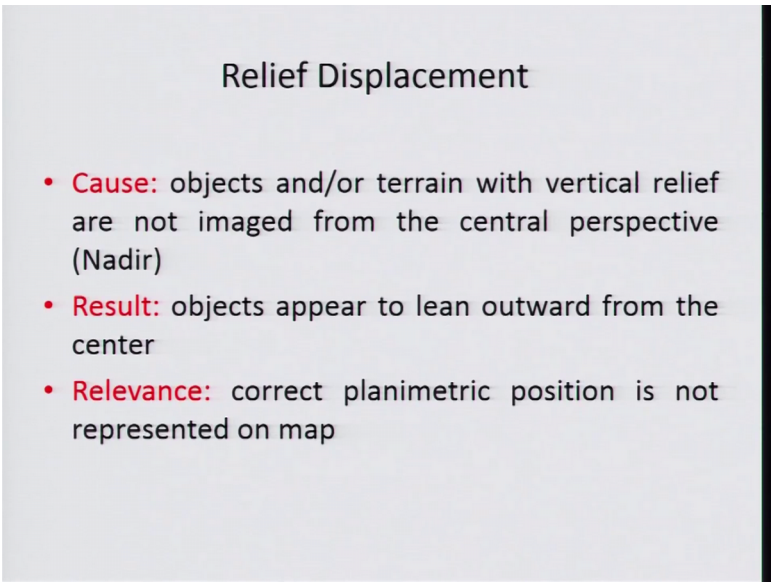

Now, relief displacement when can cause when the object or the terrain with vertical relief are not imaged from the central prospective, that is nadir and this was absolutely not possible every time. So, you will not be able to do that this results into the objects will appear to lean outward from the center, the relevance correct planimetric position is not represented on the map.

So, these are the problems, which usually we face when we are using the aerial photos, but then also having the height of the aircraft or the (Refer Time: 04:47) with respect to your the exposure point, and the focal length you can easily work out the relief displacement, and that what we are going to look at today how we can do that.

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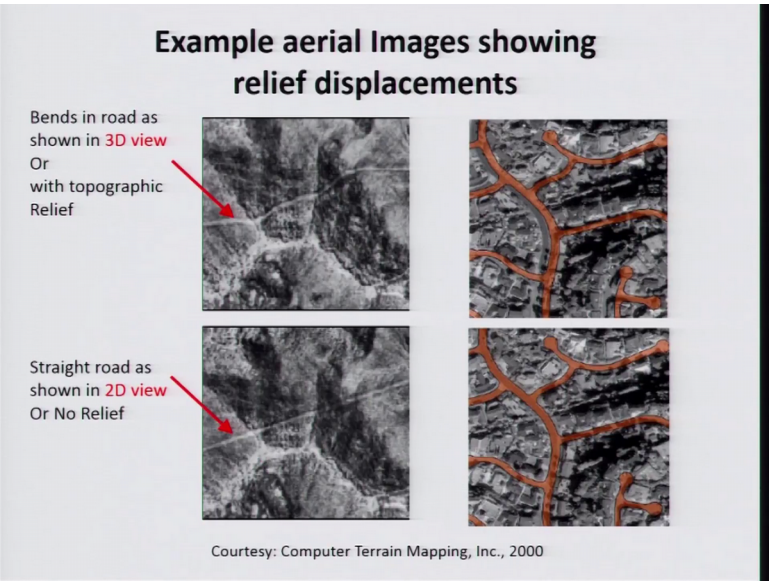

So, for example, if you view any image on 2D, which is on the lower part here, then everything will appear very linear or even for example, the road here looks very linear here, but you add up in 3Division then you will find that there is an undulation here, then through 2D you would not be able to identify any relief or you will not be able to pinpoint any relief on this photograph, if we are doing the photograph in 2D whereas, in 3D you will be able to understand the relief of the terrain.

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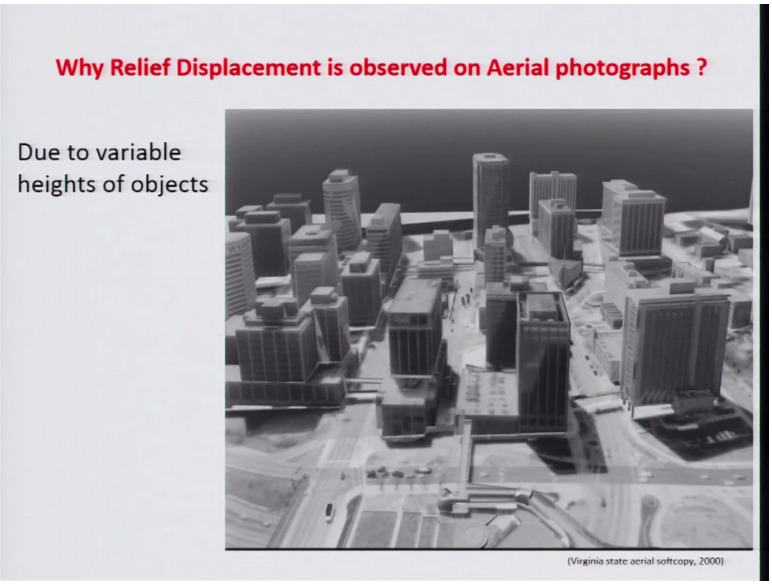

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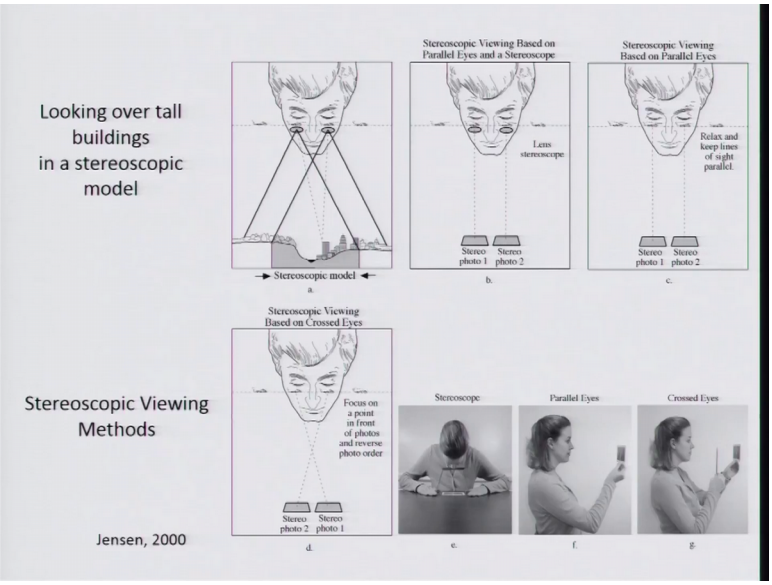

Now, for this is another view of the different buildings with variable heights, and these are most commonly used ways to view the terrain and in stereographic projection, mostly what you are looking is that you are looking the same object for example, this one here with the left eye as well as the with the right eye for example, this one here if you look at, then we are looking at the with the right eye and then we are looking with the left eye and that will give you the relief displacement, because we are not able to see the exact point eye with respect to nadir here.

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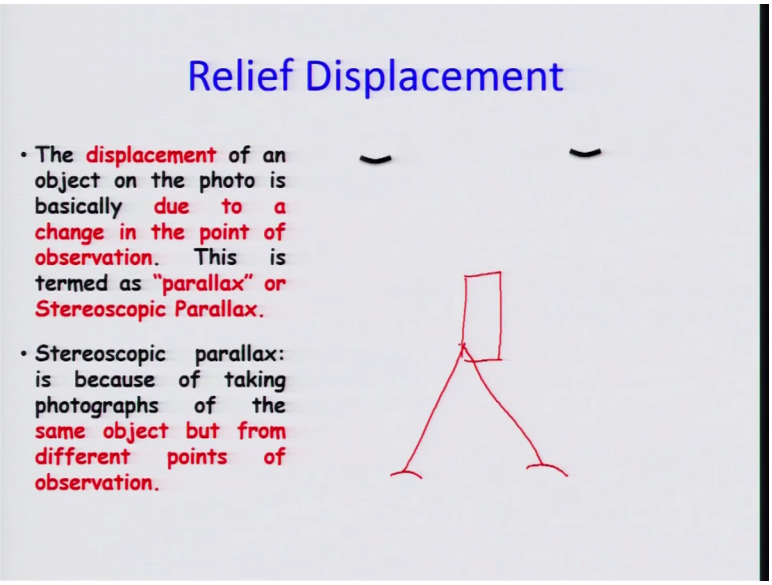

Now, let us look at this example here, the relief displacement the displacement of an object on the photo is basically due to a change in the point of observation, because you

are not observing the photograph from the same point as has been shown here for example, this point is different from which you are viewing that is where, if suppose you are having this this is your right eye and this is your left eye.

Then this point is different at the point where, we are viewing the building whereas, this point is. So, observation point changes. So, there is change in the point of observation, this is what we call parallax and if you are viewing the photographs with the having this stereographic vision, then we term this as an stereographic parallax.

So, stereographic parallax is because of taking photographs of the same object, but from different point of observation. So, for example, you are having you are trying to view, suppose there is an building here and then you are trying to view these are your 2 eyes and from here you are reviewing this one and from here you are viewing this one. So, if you are viewing the building from the different point of observation. So, that will give you the relief displacement.

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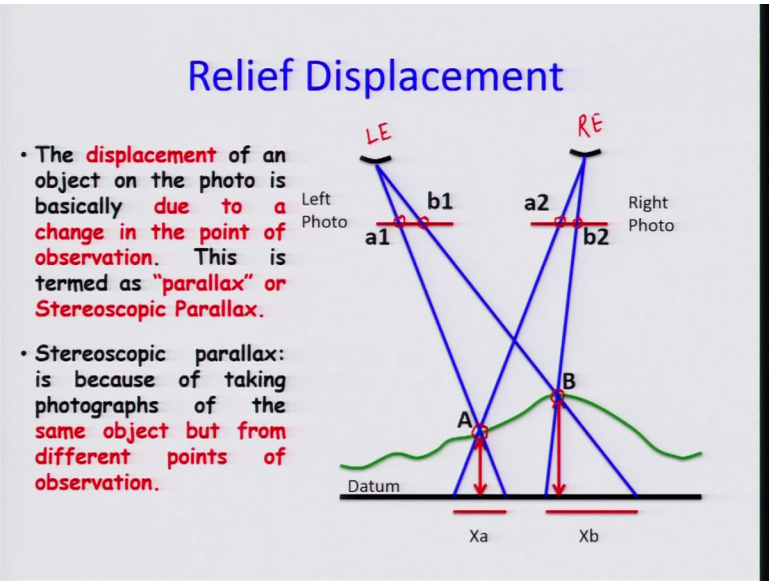

Now, if you look at this sketch here these are your 2 eyes maybe, you can say this is your left eye and this is your sorry right eye and this is your left eye, and you have a terrain which is undulating the height is not same with respect to datum, here and the height here like this is the left photo and right photo. So, this is what you are recording on the your photographs. So, you are having 2 photographs that these are the stereo photographs.

So, this is the height here with respect to datum, and this is the another height of the object say A and B, and then same points are been reflected here, now I have put her A1 and A2, B1 and B2, because you are viewing the same object with different eyes, left eye and right eye that will give you the 2 points. So, you are observing the same object or the same point, but the observation point is different. So, for this point which is marked here has been reflected on this photograph here. And so, this is the respective point of your A object similarly you have this here. So, you are having this point has been shown here and here on both the photographs.

Hence, if you look at there is some relief displacement that what we can see here is your which is given by x1 and x p, this will help you also in identifying the height of the object. So, this part has to be kept in mind while viewing the stereo photographs.

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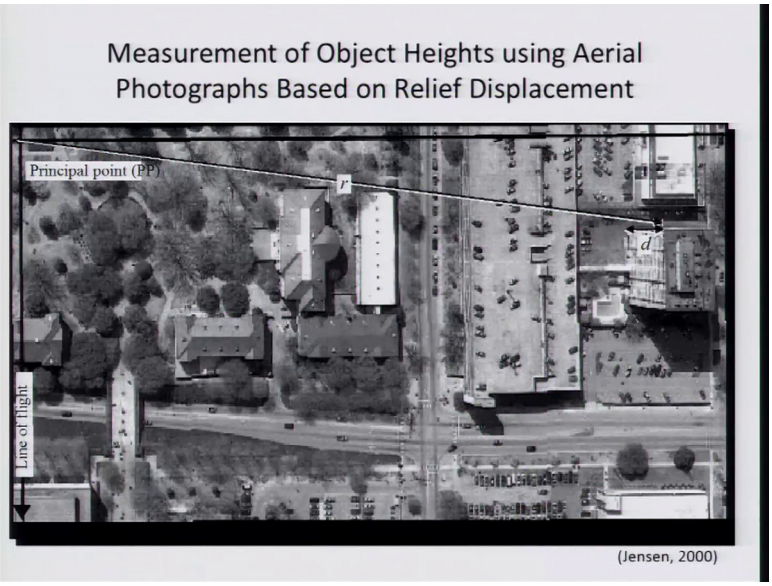

Let us move ahead. So, for example, if you take single photograph, that what we can say either left or we can say right photograph or forward or you are having the after photograph. So, with the help of one single photograph, even then you can calculate the relief displacement again.

So, how you can do that is very simple because you are having very high-resolution photograph, you will be able to look at the structures or the civil structures or trees or maybe the valleys also. And so, you know here this is the top of the building and this is the base of the building here. So, this will give you the d and then there is another

measurements, which you have to take up is they are now r has to be taken with respect to your principal point.

So, you have principal point. So, this is a radial distance between the principal point of the respective photograph, and the top of the building. So, you have r you have d you can calculate the height of the object, this can be done very easily and very simple exercise can be done.

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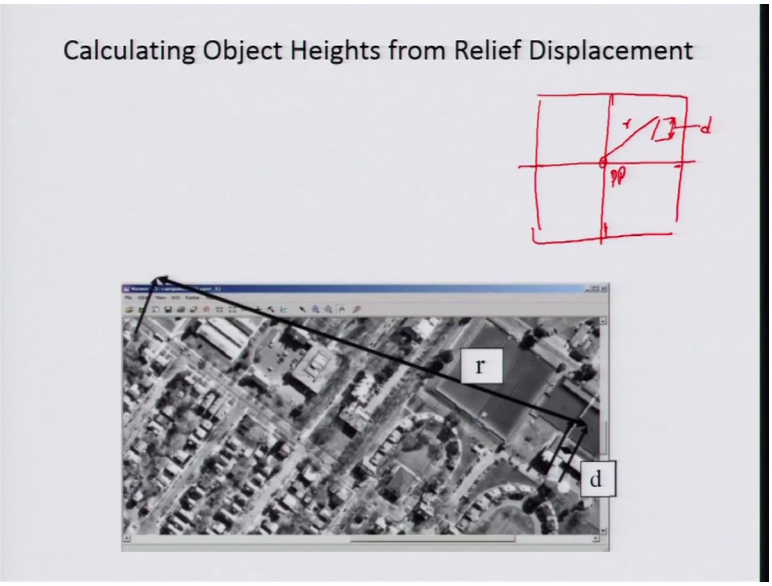

So, again the similar one. So, you have for here it has been given this is the top of the conical building or this structure, and this is the base of that and the distance difference of that is your d and this is your principal point. So, if you remember, we can have the principal points suppose we are having the photograph here and if you are having the fiducial marks on either side you can draw the principal point.

And suppose your building is somewhere here, then you can take this at the top this will be your r and the difference between this will be your d. So, this you can you can do easily, now considering this measurements what best you can do of course, you need to have the height of the flight also here.

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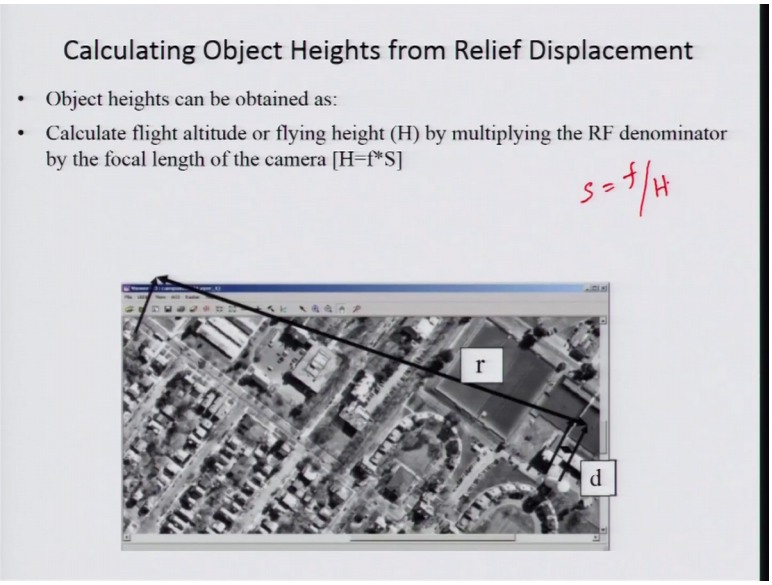

So, object height can be obtained as one calculate flight altitude or flying height by multiplying the this is your ratio fraction by local length of the camera. So, simple we lost in one of the lecture we talked about the scale of the photograph. So, scale of the photograph if you take is S is equal to the focal length of the camera lens by H here. So, with this simple equation, you can calculate the even the height of the flying height and H is your height of the object if you take.

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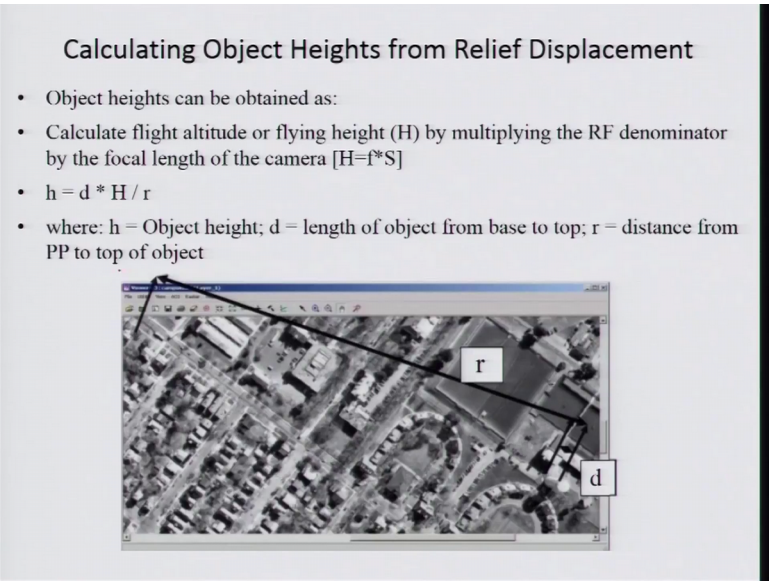

So, you are having d that is the displacement, here that or you can say the displacement of relief from the top of the building and at the base of the building you can take.

Then H is your flying height and R is your radial distance from the PP to the top of the object. So, if you do this it will be easily able to calculate the height of the object.

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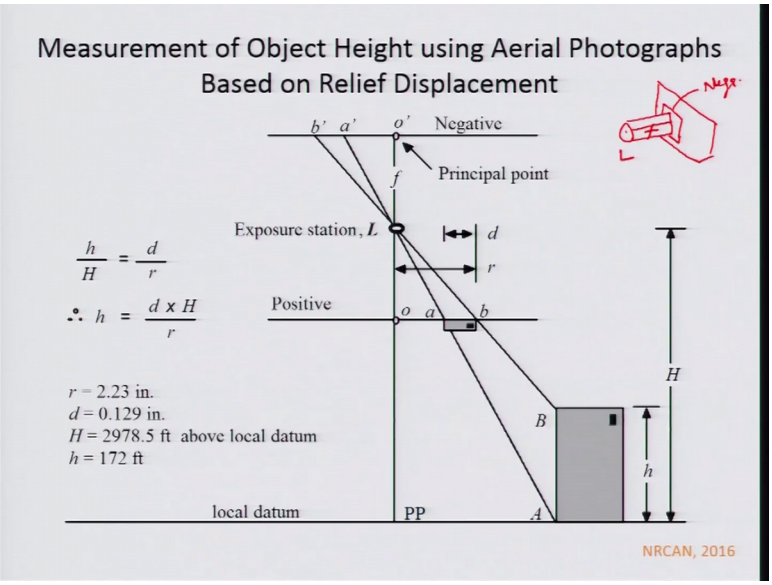

And this is another simplified way, which has been given here. So, d either you call the displacement or the relief displacement, which you will encounter in aerial photographs and can be obtained from the measurement of the top of the object and the bottom of the object.

Now, here if you see, we have first what let us look at the complete sketch here it is a local datum here, we have the positive of the photograph and this is your exposure station and this part will be your focal length and this is your negative. So, in a simple camera if you look at then you have a lens here and then this is the camera body. So, this part you put the negative here usually. So, this is your negative and this will be your f and this will be your exposure point actually, now this will be your exposure station either you would say L for example.

So, if you understand all this. So, for example, o dash on the negative is the point o on the positive and then PP on the ground actually, and if on the ground if you are having an object here which is represented by P is the top of the object, a is the base of the object

and same will be represented on the positive as a b, and similarly on the negative a dash and b dash, and we usually look at because you are viewing this on for with respect to negative this has to look at and drawn through the exposure station.

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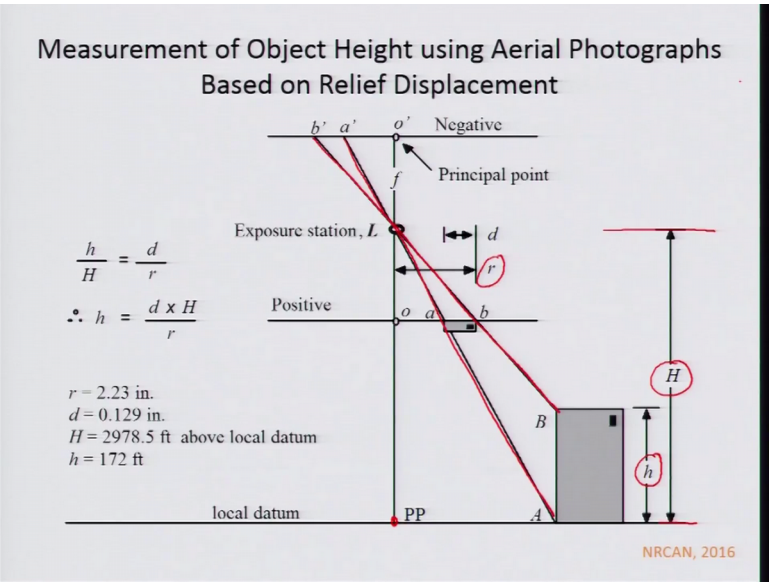

Hence, this is because we need to consider the focal length also. So, this will be projected over here and this will be projected over here, and this gives you the height of the object, that is your small h, now as we were talking about that we need to have the height of the or the flying height that is your H with respect to datum. And so, that will be from the point of exposure up to the datum. So, you have H, here you have smaller h that is the height of the object with respect to datum capital H is the flying height with respect to datum.

Further, we need r which can be calculated based on the principal point, and the top of the object, this you will get and then relief displacement is your this one which you can look at that is d. So, if you are having all this and if you look at this it that h by H or the smaller h in the capital H is equal to the relief displacement in the radial displacement. So, H will be given as a relief displacement flying height and the radial distance

So, for example, this is your observation that r is 2.23 inches, d is point 1.9 inches, height of the flight is 2978.5 above local datum and height of the object with respect to datum is your 172 feet, with this you can calculate the height of the object sorry, this is this is the height you will obtain from this one.

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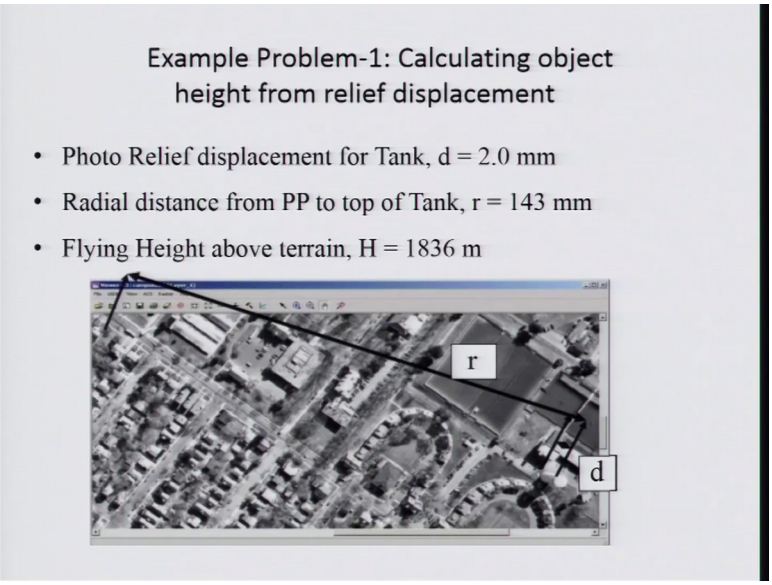

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So, another example if you look at the relieve displacement of a tank the similar one for example, you are having 2 millimeter a displacement that is your d radial distance with respect to PP to the top of the tank is 143 millimeter and the flying height is this one. So, you can calculate based on this which will give you the height around 26 meters.

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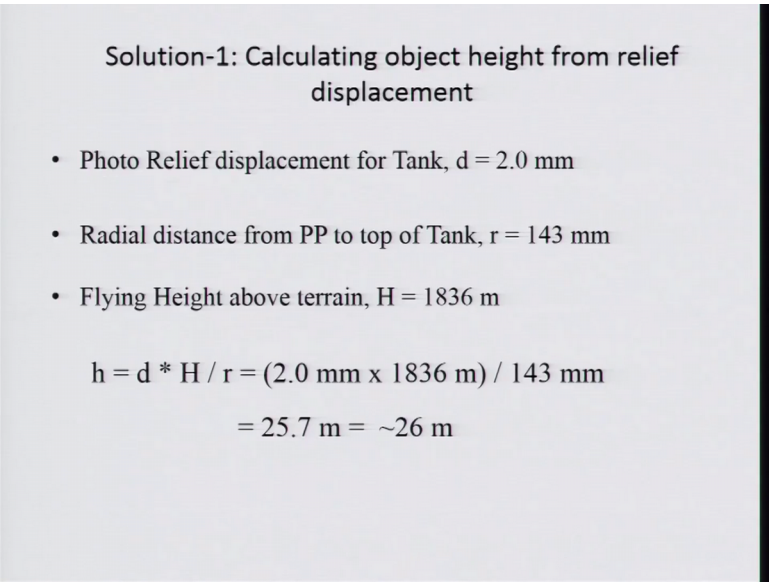

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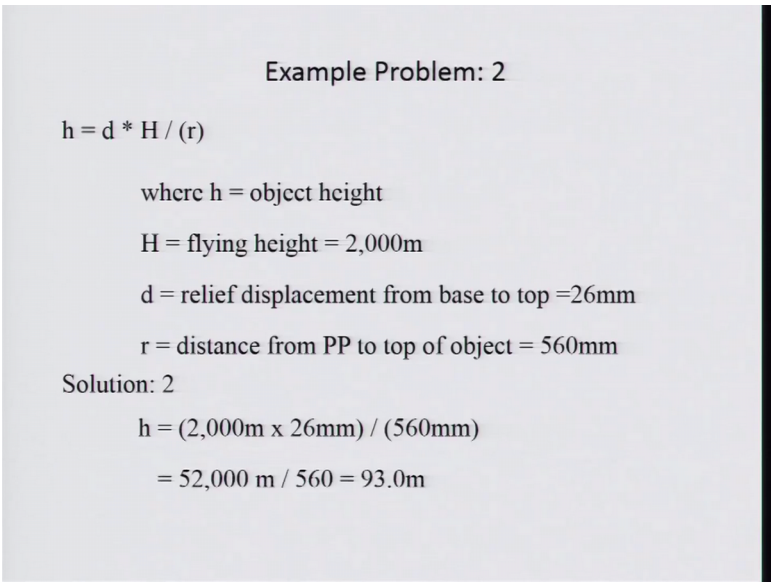

So, similarly you can do this exercise also it is very easy and you can extract a lot of information out of this.

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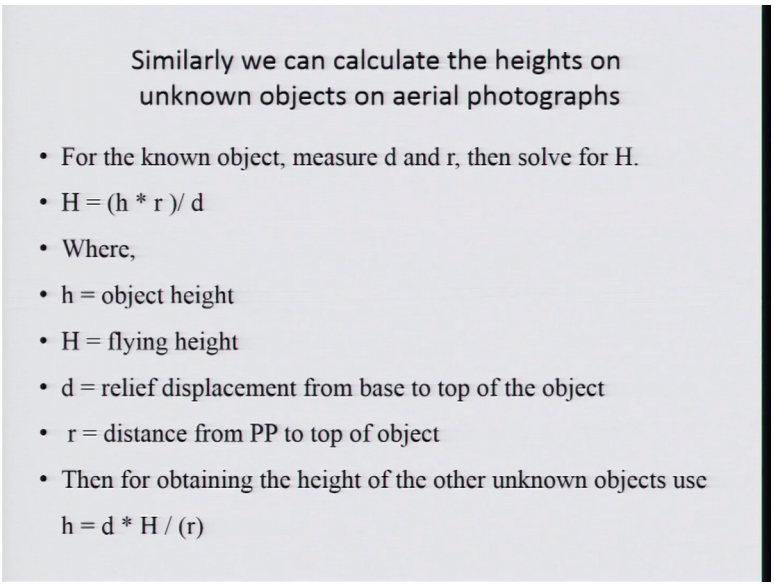

Similarly, you can calculate the height of unknown object on the aerial photographs. So, for the known object measure d and r then small h where, h is the object height as a flying height this you know this is the relief displacement from the base on top of the building r is the radial distance from PP to top of the building or the object then you can have this one obtained.

So, we will stop here and we will also have the calculation or we can do the exercise of relief displacement using parallax that we will be covering in the lab part. So, this was with the 2D image or a single a photograph, but that we will do with the stereo photographs where, we have to take into consideration the average distance of the base of the photograph, then we have to take into consideration the relief displacement on both the photographs of the object and of course, we will have that radial distance and all that. So, that we will do in the lab part, I hope you enjoyed you continue in the next lecture.

Thank you so much.