Technical Arts 101
Prof. Anupam Saxena
Department of Mechanical Engineering
Indian Institute of Technology, Kanpur

Lecture -22
Think and Analyze

Student: ((Refer Time: 00:17))

Louder.

Student: ((Refer Time: 00:20))

Once again.

Student: ((Refer Time: 00:27))

I read that as loads of practice, loads of practice, space geometry solve about practice, if you do not practice then things will be a little difficult for you to comprehend.

Read this.

Student: ((Refer Time: 00.43))

Once again.

Student: ((Refer Time: 00:45))

Read this.

Student: ((Refer Time: 00:49))

Loads of practice, once again.

Student: ((Refer Time: 00:55))

Come on, so one to one map lines and planes loads of practice, once again what is this?

Student: ((Refer Time: 01:09))

Louder.

Student: ((Refer Time: 01:10))

Still not with me, lines and planes to me means loads of practice, what does it mean to you, lines and planes you do not need practice fine, planes and planes to me would mean practice and practice and practice.

Unless, you practice things will be a difficult for you to understand, so Tuesday I was here, I was sleepy, you were here, you were sleepy, I did not know what I said, I did not know what I explained and then I went back and I was like did I explain things right. The answer that question to myself was perhaps not, so maybe I will give another shot and then I thought, what would I do, if I were you, leaving the stage sitting down over there and trying to understand thoroughly space geometry.

Then I said well, if I were you, I would rewind my life some 15, 20 years back to 1991 which is how many years from now, 21 no kidding really, I was just thinking 15 anyhow. So, I would rewind my life back and assume that I was you first year and I will try to understand the intersection between a line and a plane that I am going to talking about today.

So, these are some very nice hanging models that would help you understand the concept better, if you have gadgets, if you have cameras on your cell phones feel free not now, but after the classes over feel free to take a picture at these two models, you know if I were you, I would look at the frontal plane take a picture, look at the top plane take a picture, look at the edge view of this take a picture.

Go back to home or to my hostel room or to my lab and try to work out the example with these pictures, likewise frontal plane take a picture, top plane take a picture, edge view take a picture and do the same thing that will help you understand this better, so feel free after the class.

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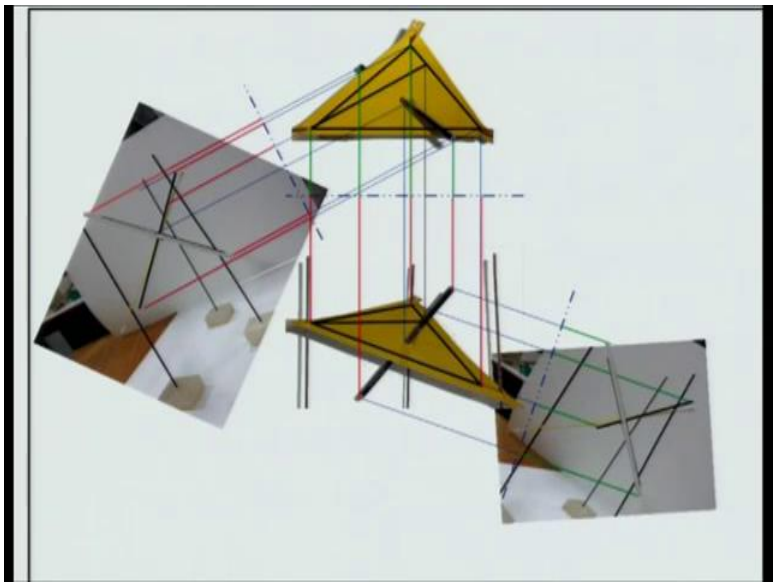

So, lines and planes, so this is what I did so on Tuesday, I was there on the lab was it Tuesday, was it Wednesday, Wednesday I was there in the lab and I asked Ashwin ji to make a little model for myself, so he made a little cardboard model which is a little different, so in fact, he painted red and green, so very nice of him. So, he made a card board model like so a plane and a line passing through that plane, so this is a front view top view and then I also got the two edge views in my camera, an my thought maybe I can explain this little better with these pictures.

Now, realize one thing one Tuesday, I said if this part of the pencil would be visible or this part of the line would be visible, most likely this part of the line will be in visible, just said as on Tuesday, yes or no, this is an example that neglects my statement. So, it is not necessarily true that if this part of the line is invisible, this part would be visible, so this is a counter example and pretty nice one, so it is also a alright.

So, I had these pictures let me start with the front and top view, so a triangle, a triangle, same basic thing projectors just to make sure that the pictures are okay, so note that note two things, these pictures are not accurate because, there are actually in prospective they are not purely orthographic. So, these are pointers they actually spread out, when I take a picture, when I take a photograph, so note that, so there would be certain errors, but if you discount them if you just ignore them and just follow the example here it is,

horizontal line, true length, hinge perpendicular true length, projectors out, distances measured and transferred.

This is the edge view of that yellow plane that you see and if I do the same thing for the pencil, this is what my pencil looks like and if I look at the edge view of this, so this is what my pencil looks like of course, this is the point on my intersection, if I project this thing back on to the top view and the front view. So, this matches pretty well with the pictures that I have over here and then if I look at the edge view and I super pose almost like accurate.

So, as I said the errors because, this plane is also walled, so almost like accurate and then if you figure out or if you recall the logic behind visibility that I gave you, if you see this part of the pencil, this part of the pencil is lying in front of this plane closer to this hinge line and if you look at that part and if you compare if you know that this part is going to be visible, you realize that this is in deprecates and hold the pencil which is behind this plane or away from this hinge line, that part is actually concealed behind this plane.

Is the edge view going to be unique from where I look, yes or no, perhaps, perhaps not, well if I take the edge view using the vertical plane or the front view as reference. Do the same mechanical stuff, edge view the pencil and if I compare this with the picture that I have again, quite accurate not very, but quite accurate, this is the pencil you have, this is the plane and this is the edge we have the plane, little angular difference.

And if you compare, if you think about the visibility this part is closer to the hinge line is in front of the plane and if you go here that corresponds to this part and you realize that this part is actually visible and the pencil the part of this line which is behind the plane, if you look at the corresponding line here, this part is not visible, so are you with me on this example, everybody.

Student: Yes Sir.

Who’s not, good.

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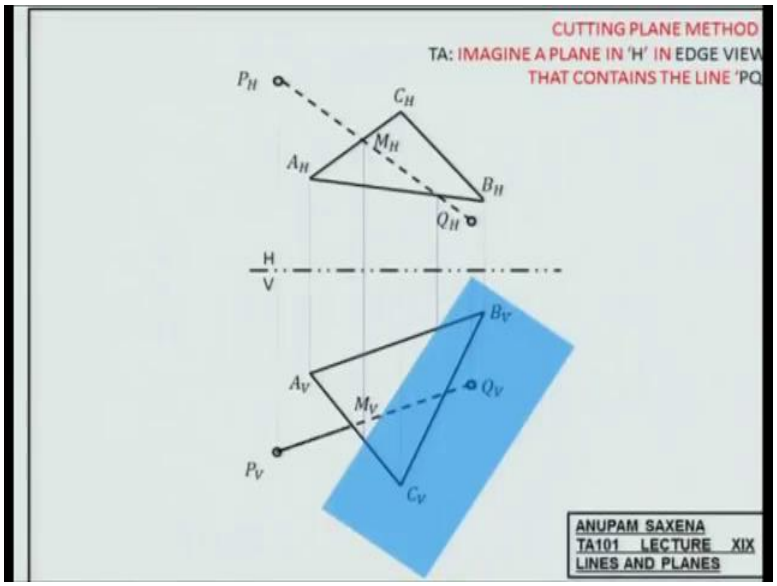

So on Tuesday, I introduced the concept of the cutting plane method, probably I did not explain, I did not get time to explain that pretty well, but hopefully I will do that better today. So, imagine a plane, imagine and imaginary plane in the top view, in the edge view which is in the edge view here, so just imagine that, this plane is this projection of the line and it is kind of vertical to this top view plane, it is going straighten just imagine that.

Question 1, would this plane contain the actual line, would it, would it not, it would, so this plane is going to be intersecting with this tri angle ABC at this point and at this point. So, this point is on AC, this point is on AB, so if I project these points down get to the corresponding point on AC here, if I project this point down get to AB here, what would this line correspond to, this line would correspond to the line of intersection between ABC and the imaginary plane in the edge view here, would it, would not it, yes, how would you find the point of intersection.

So, this line has to be intersecting with the corresponding projection of this line PQ and of course, this would be the point of intersection, now the second thing that you would want to imagine and this could be a little difficult. So, imagine that this is the plane and if you flip this entire figure, if you flip this entire figure which part of ABC would you see towards you or more clearly which part of ABC would you see in front of this imaginary plane, would be this part or would be this part.

Student: ((Refer Time: 11:30))

Vertices A, so it is this part of the tri angle which will be in front of this imaginary plane in edge view here and this part of the tri angle ABC will be behind that imaginary plane. So, once you understand this and realizing that this imaginary plane is containing the actual line, the projection which is here in the front view, if you look at the visibility. Of course, this part of the line will be visible, how about this part, would this be visible because, ABC is in front of that imaginary plane which is containing the line, so this part is visible this part is not visible, but this part will it be visible.

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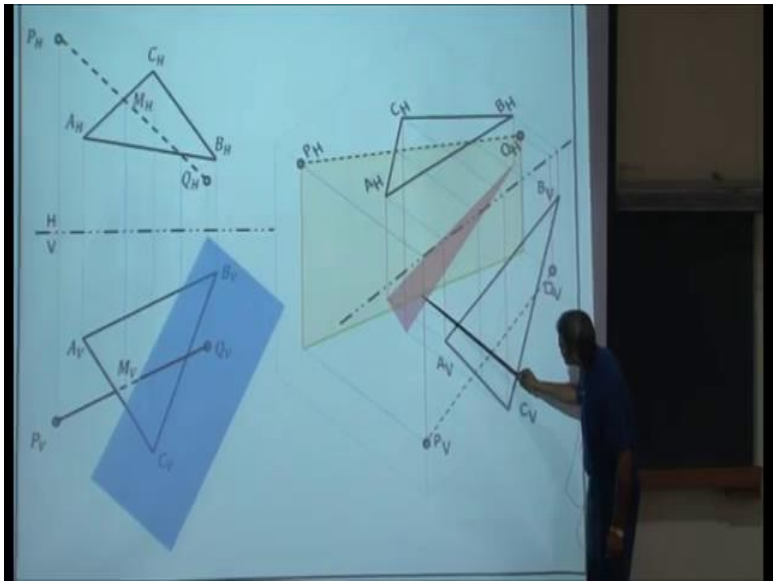

So, if you are having a hard time understanding my second shot, back to the cube example, so the top view on the horizontal plane, the front view on the vertical plane, this the actual three dimension plane and if you look at the imaginary plane that is in edge view, in the top view or horizontal plane, that is the actual line PQ. That imaginary plane is going to be looking like that the yellow plane, of course, it going to be containing the line.

So, this tells the point that I was trying to make using the cube example and if you would further want to work out this example, you would see that this imaginary plane is going to be intersecting here and this would be the actual point of intersection. If, you project this point of intersection over here, in three dimensions this would be the point of intersection, so nothing much to say, but going back to the board example.

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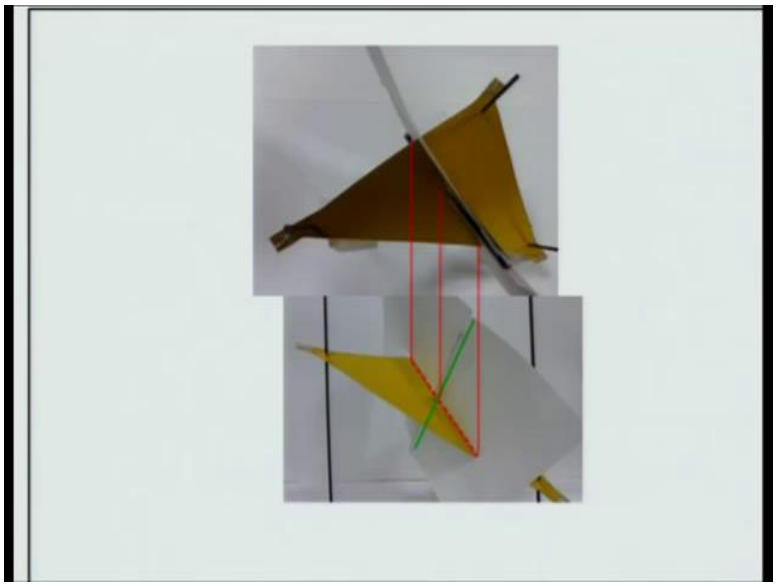

So, imagine that the plane is in edge view that is containing this projection of the line in top view and if I flip this and look at the front view, this is how my front view is going to look like, are you there, sleepy, stay with me, have some water, if I take this projection down from here to here, I take this projection down from here to here, this is where my imaginary plane is going to be intersecting with the real plane ABC. This is where my actual line on the pencil is and clearly the intersection between the red dotted and green solid is the actual point of intersection between the line and the plane, fine.

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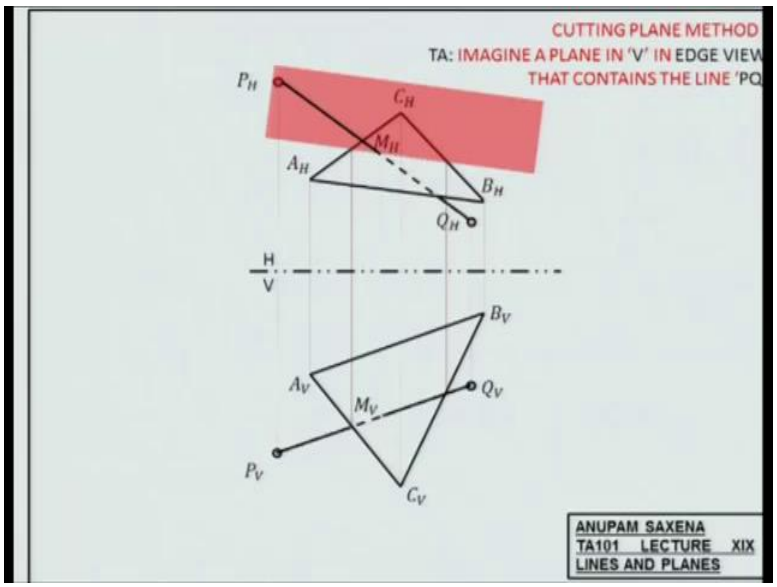

What I did with the top view, you could do the same thing with the front view, so imagine a line, rather imagine a plane, that is piercing the front view along this line and the plane is in the edge view, so it is just kind of piercing this thing over here. And if you flip this over and look at the top view, same thing if you project these points up that imaginary plane is going to be intersecting ABC at this line and this line is going to be intersecting the projection of PQ at this point, so this is the point of intersection that you have.

And of course, if this is your plane and if you flip it over to look at the top view which part of the triangle will be in front of the plane in top view, so this part will be in front of that imaginary plane and this part of the tri angle, that will be behind that imaginary plane and realize that the actual line is contained within that imaginary plane. So, which part of this line is going to be visible here?

Student: ((Refer Time: 16:40))

Would be this part which is visible or would be this part which is visible, the actual line is on the imaginary plane, so would be that part that is going to be visible, because this part of the triangle ABC is going to be in front of the imaginary plane. It is a little difficult for you to appreciate that at this time, but with practice I guess you'll be better.

So, planes and planes .

Student: ((Refer Time: 17:26))

Change the angle between…

Student: ((Refer Time: 17:33))

The planes if I change the angle, when you say if I change the angle what do you mean.

Student: ((Refer Time: 17:57))

So, now focus on this the plane is in V number 1 and in edge view, what is it mean, so I am actually restricting my plane to be in edge view here, so I do not have the freedom to change the angle of the plane here. So, this is probably I kind of got it wrong yesterday, so my plane is going straight in vertical to this and that is the reason, that is how it is going to be in the edge view, otherwise it would not be in the edge view.

Student: ((Refer Time: 18:39))

Can I repeat, how?

Student: ((Refer Time: 19:02))

My triangular plane ABC, imaginary plane that is containing the line, now what is you see in the front view is this, maybe a projection of this, do you, do not you, this imaginary plane is in the edge view, this is my tri angle that is what you see in the front view. Now, if I want to look at the top view of this what would I do, so should I go this way, should I go this way, should I go this way, now if I go this way, are you sure, should I go this way or should I go this way.

Student: ((Refer Time: 19:49))

So, what you see in the front view and what you see in the top view, a part of ABC is going to be in front of this imaginary plane the other part of the A, B, and C is going to be behind the imaginary plane and this

Student: ((Refer Time: 20:07))

Well direction of flip, they comes with of practice and visualization, so I cannot

Student: ((Refer Time: 20:20))

Maybe I will, I will go back.

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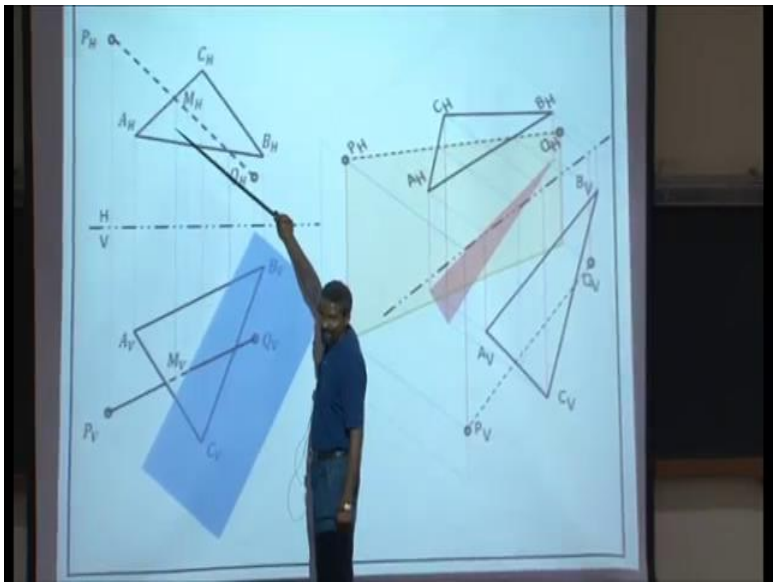

So, let us let us take a look at the this case, now this plane is going in, if you want to take a look at the front view of this, how would you flip, you think how do you flip your assembly, you going to flip it this way, now if you want to go back from front to top, how would you want to flip, you flip this way simple.

Student: ((Refer Time: 21:08))

How am I figuring that out?

Student: ((Refer Time: 21:15))

That what visualization in this, a visualization how am I figuring that out, so anybody have an answer to this, what is your name?

Student: ((Refer Time: 21:44)) Vinay.

So, Vinay says well fine sir, you have your imaginary plane going in intersecting with the plane and then you flip, when you flip, how do you figure which part of the tri angle is in front of the plane and which part of the triangle is behind the plane, that is what the question,

Student: ((Refer Time: 22:15))

You want to come.

Student: ((Refer Time: 22:16))

You can imagine it.

Student: ((Refer Time: 22:20))

How many of you can imagine this, raise your hand, not very many, not very many that is what visualization is so makes things difficult.

Student: ((Refer Time: 22:37))

This is my model, I will take it out, so your green plane ABC and let us say that this is your imaginary plane, let us say this is in the top view, in the top view, you should be looking at the edge view of this, do you see that this is the line, do you see that this is the plane, if you want to look at the front view of this what you do or maybe perhaps this would be a better example, edge view triangle ABC, if you want to look at the front view flip it up which part of the triangle is in front.

So, it is always a good idea to make these models, physical models and later on we will practice mental models, otherwise it becomes a little difficult for anybody to explain this, anyhow I was never a big fan of the cutting plane method. So, if you ask me, I would say well if I were given a chance, I would probably not want to use the cutting plane method, instead I would want go with the edge view method which I am lot more comfortable with it, is not so easy to imagine this, but anyhow, so comes with practice.

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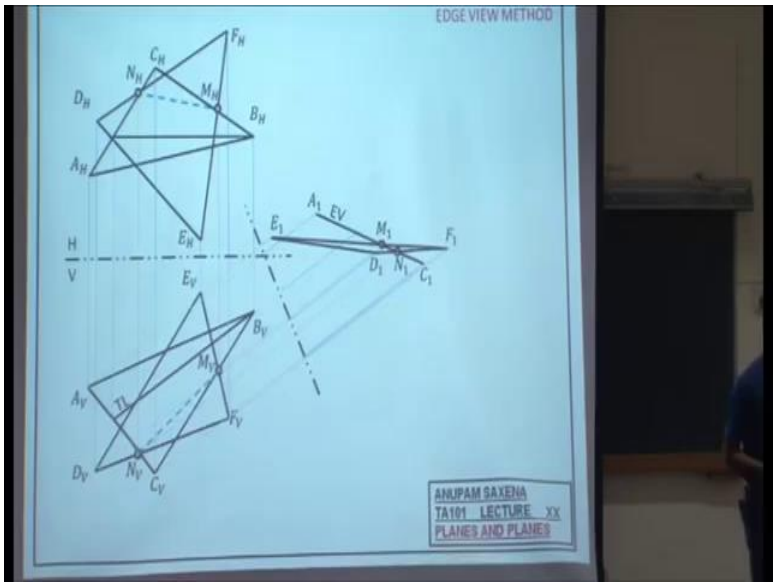

So, let me go forward planes and planes everybody ready for this, same stuff, if you want to figure out the intersection between planes and planes, so given two cases, well not two cases, same case two projections, the frontal projection like the front view and the top view two planes ABC and DEF you want to find the point of section or other line on the section between these two planes. Two planes intersect give you what, line how would you do that, how would you do that planes and planes how do you find the intersection the line of intersection between these two look at the edge view of one of the planes.

So, you should look at the edge view of the one of the planes I have take it out, if you look at the edge view of one of the planes, then your line of intersection will be on this, back project and you should be able to get the two points. Let see how, horizontal line this is very mechanical exercise from now on, I guess true length should projections what are we looking at we are looking at the edge, we have which plane ABC great, so you understand as little bit.

So, this is the edge view of ABC and then you would want to do the same thing to plane DEF would that DEF be are triangle in this observing plane it will, same thing pretty straight forward can you look at the point of intersection now, one would be this, the other one would be this, pretty straight forward, those points of intersections are going to be lying where, look at this guy here EF, one of them is going to be lying on F, the other one is going to be lying on that project.

These intersection points 1 lies on B well, 1 lies at EF and the other 1 lies on D, so this is 1 MV and MH and the other 1 lies on DF there, so this is the line of intersection between two planes in the front view, line of intersection between two planes in the top view, do you agree that this is a actually the line of intersection between two planes, yes or no, yes, why do you say that, does this line belong to both planes or rather projections of both planes in both views.

So, if these projections of the intersection line or contained within the respective views of the two planes in both views facing to intersect, you can do the same thing so this was with the front view as reference to get the edge view of ABC you can do the same thing with the top view as reference to get the edge view.

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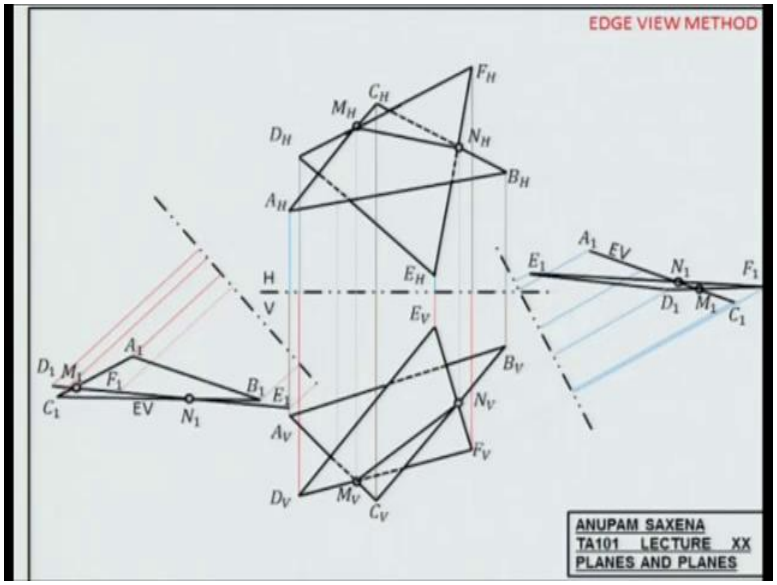

Real quick, no rocket science, points of intersections where this is the intersecting tri angle ABC at this point and at this point, so this point is actually on AC and this point is on BC, project these intersection points back. So, irrespective of whether you are looking at the edge view of ABC, plane ABC or DEF you should be getting the identical result, same thing not comes interesting part visibility, I want you guys to pay attention to this, do you think that all of these lines are going to be solid for both planes, both views, some will be hidden, some will be solid, some will be behind get the plane, some will be in front of other plane.

How do you figure that out, if you stay with me this is something which is really interesting so the same concept, here DEF is in my edge view, now there would be a little part of ABC that will be in front of DEF in edge view, that would be closer to this hinge line, there would be the other part of ABC which would be behind the edge view of DEF which would be away from this hinge line.

So, from here and here, from here you can figure out the visibility of ABC for this, from here the same thing there would be a part of DEF which would be in front of the edge view of ABC and then there would be a part of DEF which would be behind ABC. So, look at this edge view and whichever part is in front go back over here, mark that part solid, whichever part is behind mark that hidden,

Now, let us take it look wise find the loop of the plane DEF above or rather in front of the plane ABC in edge view, when I say in front, I would rather mean that the part of ABC which is closer to the hinge line flipping, now which loop is in front of DEF which loop of ABC is in front DEF, A 1, M 1 stay with me, stay with me N 1, B 1 in front I should have been looking at that.

Anyhow, so which part of DEF is in front of ABC that is E 1, D 1, M 1 and N 1, EDM and N that is in front, so there will be visible therefore, that would be solid, the other part of DEF will be behind ABC, DEF the rest of this guy will be behind ABC, but not all of it will be behind ABC, only the part which is covered by this plane ABC will be behind it.

So, would this part be solid hidden, the rest of the plane DEF will be below the plane ABC in edge view, now just solve a counter example, if this part of DEF is behind ABC of course, that corresponding part of ABC has to be in front. So, this part would it be solid or hidden of ABC, this part of the loop DMNE is solid and that is kind of hiding a part of ABC, what you say of this edge of ABC, how about this edge and the rest of ABC will be solid, can you do the same thing from the other side help me out here.

So, I will first figure out the visibility ABC with respective DEF, because DEF in the edge view and then I will figure out the visibility of DEF with respect to that, so which part of which loop of ABC is visible A, MNB, because this is relatively closer to the hinge line. And the other part of ABC is behind, it has to be behind, but only a part of that would be visible, the other part is going to be hidden. So, which part of ABC is

going to be hidden behind DEF this guy here, so this would be hidden this little part will be solid.

Now, go backwards if this part of ABC is hidden, the corresponding part of DEF has to be hiding it, so this part of DEF will be and if this part of ABC is in front of DEF what you have to say about this, about this and the other straight forward. This is one of the reasons why I like edge view a lot better everybody with me, everybody with me clear enough.

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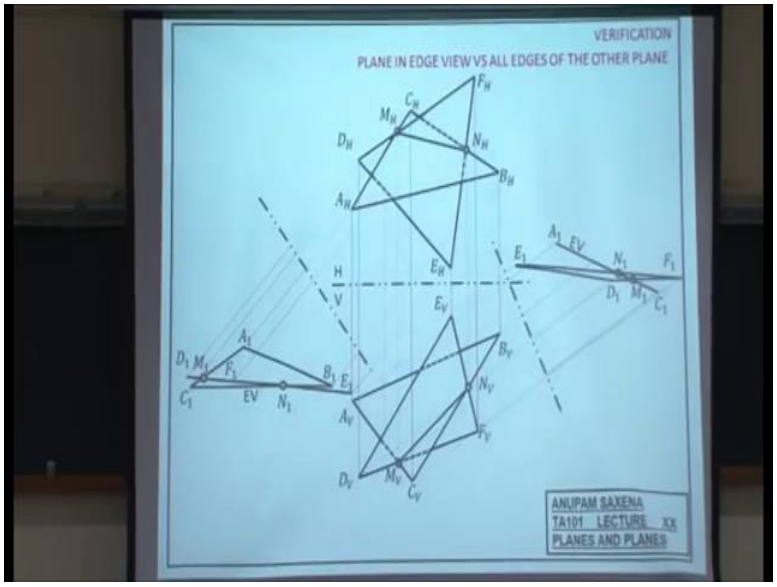

If you remember I had discussed the projection method some time with regard to lines and planes, you can use that to verify the visibility and the trick to using that is consider one plane at a time and see the other plane as the set of three lines, so you will actually break the problem in to a lines and planes problem, once again one plane at a time, so take ABC as a plane for example, and DEF as a set of three lines DE, EF and the third one.

And then apply projection method, well what I said about the projection method holds through, but this is a little, so instead of a treating or instead of seeing planes as loops, you can actually see planes as lines and figure out the visibility of a line with respect to the edge view of the plane. So, this was just an example of that, so but that is that is something which should be straight forward.

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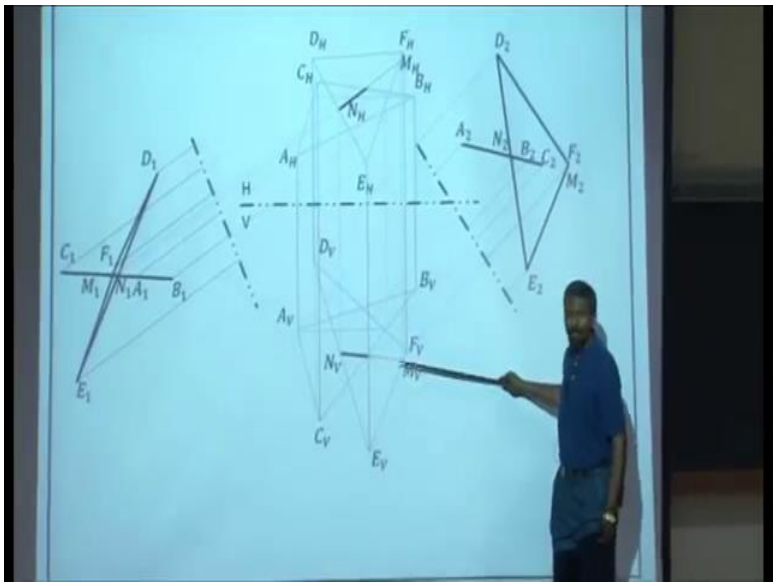

So, this is another example two planes ABC and DEF little animation same staff, but just for practice, whose not with me so far…

Student: ((Refer Time: 37:46))

You are not with me…

Student: ((Refer Time: 37:51))

So, come close to me anybody else not with me, anybody else not with me, should I take it as a sign that you understand what I discussed today or you know your feedback is important. So, if I see smiles and sparkling eyes, I am like everybody understand, if I see heavy eyes, droopy eyes, I am like, I were just still thinking about the quiz at 3 o'clock what is it, what is the feedback, what is the feedback.

Student: ((Refer Time: 38:49))

Quiz, so another example you see the two edge views and this corresponds to ABC in the edge view and this corresponds to again ABC in the edge view, a point to note I wanted to actually discuss quite a bit, but maybe I will just leave you here, wait, but before I leave you here you see only a part of ABC is intersecting with DEF, but here a complete part of ABC is intersecting with DEF, how do you find the line of intersection? so maybe I will just take M and N over here, I will project them back.

This is what my line intersection will be I will project these guys down this is what my line intersection will be M and N, but is it the true line of intersection why not, why not because the entire line M, N is not common to both the planes. Only a part of that line segment is common both planes which part is it, which part is it, it is going to be this part and that part, so the entire line is not common to both the planes, so keep that in mind, so maybe I will just leave you here, all the best for your quiz.