Lab – 9

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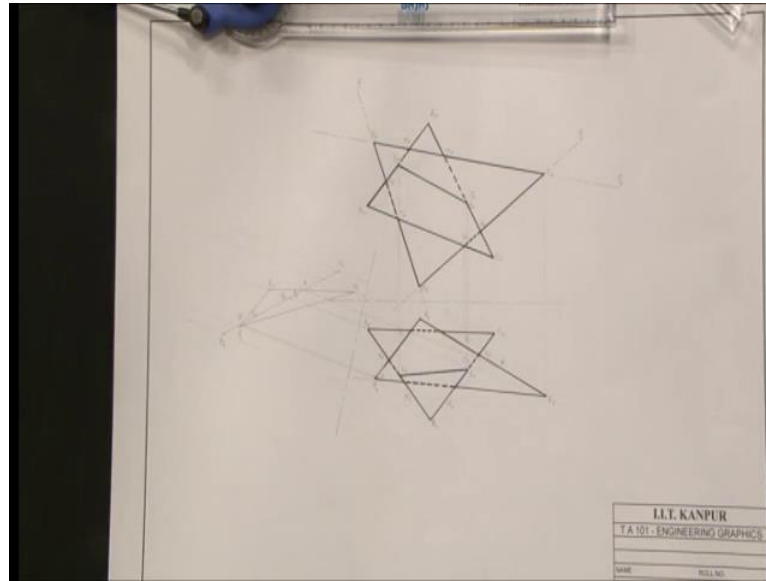
This is a drawing example; that demonstrates the intersection between 2 planes A B C, and D E F. So, both these planes are lay down or depicted or shown in the front view, or the vertical plane, and the top view, or the horizontal plane. The front view, the top view vertical plane horizontal plane again, we need to determine number one. Now, this time the line of intersection between these 2 planes A B C and D E F. If there exists such a line, and if you are able to find that line of intersection, then the second task that; we need to accomplish is to determine the visibility of the planes. Which part of the plane will be visible, and for example; the front view and the top view, and which part of the plane will be hidden behind the other plane in both these views.

Again, to determine the line of intersection and visibility of these planes; we can use either the edge view method or the cutting plane method. So, what I will do is; I will try to demonstrate both these methods using the same diagram. And, this time trying I am not sure about that, but trying to get the line of intersection to be the same using both the auxiliary plane method, or the edge view method and the cutting plane method. So, first the cutting plane; now for that what I would do is; I would think about the plane A B C

being intact, and then I would see plane D E F has composed of a set of 3 lines. Now, when I say that; what I primarily imply is that I would treat in fact I would see this problem as intersection between plane A B C, and each of these 3 lines.

Now, to do that let me first imagine D F to be such a line, and let me pass an imaginary vertical plane passing through that line D F, very similar to what we did in the previous lab example. And, of course; this plane will be containing the actual line D F in 3 dimensions. So, having said that; let me consider this as one of the cutting planes, and to differentiate this edge with the other 2 edges, let me draw these inch lines. Now, this cutting plane now, imaginary vertical cutting plane is going to be intersecting with A B over here and, A C over here. Let me take these intersection points down, on to the corresponding edges over here. Now, this point to A B which is right, there I will have to make sure that; I am using 2 H pencil at this point 2 A C which is right here.

Now, what I would do is; I would join these 2 points it is important for me to label, but I would join these 2 points and perhaps represent it using, represents this line using very dim line of results come back, and label this. So, let me call this point as S H, this point as T H. The corresponding point here on A B as S of V and this would be T of V. Let me consider another imaginary plane passing through now, the edge E F. So, this the vertical plane that passes through edge E F. Of course; this plane is going to be intersecting with this triangle, so the corresponding intersection points in the top view are these 2. So, this would be on A B this is on B C now.

So, let me project this point down; so this lies on A B very gently using dim line. Let me call this point M H, so that the corresponding point on A B would become M V likewise. Let call this point N H project it down on to B C, B C is here. Once again 2 H dim line, and let me call this point N V. And, let me join just so that this represents the line of the intersection between the vertical plane passing through E F and A B C and the projection of that in the front. Now, since this is a cutting plane now. Let me represent that using the convention of inch lines or the section planes that is same, long followed by too short followed by one long and here also long followed by too short followed by one long. Well, let me name this as plane P 1, let me name this as plane P 2.

While, this is not necessary what I did was; I considered a vertical plane to be passing through T H E H, so that plane I name it as p 3. And, this plane intersects at U H V H

intersects A B C. If I project these down U H lies on A H C H correspondingly U V will be lying on A V C V. Likewise, B H lies on B H C H, so correspondingly B V will be lying on B V C V. And, of course; this line of intersection would represent the line of intersection between the vertical plane p 3, and the triangle A B C, and the projection of that in the front view. Now, in the cutting plane method that you have seen in the previous drawing example; if there is a vertical plane that passes through one of the edges in the top view. If I come down the corresponding line for example; in this case S H T H, so the corresponding line S V T V has to be intersecting with the corresponding projection D V F V.

So, looks like this point of projection is very close to the index, or this vertex F V. Likewise, if I consider plane p 2;, so the corresponding intersection segment was M H N H that is M V N V over here. Now, this is to be intersecting with the image of the line E H F H in the front view which is E V F V. So, if I extend this line little, and let M V N V intersect with that; I would be getting a second intersection point over here. So, the first intersection point is there, the second intersection point is here. And, if I extend a line join these 2 points, it would probably look somewhat like this again very dim line, once again this one here.

Now, just for sanity check, let me also consider the cutting plane p 3; this would help me verify this is indeed the line of intersection, or this is indeed the line or which the actual line of intersection between these 2 planes would lay. So, p 3 cuts A B at U H V H going down to the front view, it is U V V V. And, this line segment has to be intersecting with the corresponding image T V E V T V E V over here. So, looks like I have this intersection point. Now, in first go this is seem right because these 3 points I expect them to be collinear. They quite close to be in collinear, but they are not exactly collinear. So, I will have to verify if there is any mistake that I have made. Looks like there is I will not passing right through U V, so perhaps if I make little change in the angle; that may make a huge difference. If I change this slightly; my intersection point would come over here somewhere, still close but not vary.

Now, if I look at these 2 points this seem all right, if extend E V F V this seems ok, so this point seems ok. And, if I verify if this projection is accurate may be a little shift may be perhaps. If I change the angle of this slightly, I would see that this is intersecting somewhere over here. Seems kind of just little error, but ideally they should be lying on

the same line. Anyhow; so this looks like this would be the line of intersection, and possibly not this, so I will erase that. I think I will be able to verify this better in the edge view method. And, the actual line of intersection between these 2 planes would be the one; that would be common to both the planes. So, it would actually be this line here.

So, this is the segment that would be lying within A B C and D E F. Let me remind myself by nomenclating these 2 points or naming these 2 points as; for example, let say I of V and J of V. Now, I of V is lying on A B, the frontal projection of that, so if I project this thing upward; should be lying on A B straight there. And, I will call this I of H and likewise; if I project J V up J V is lying on B V C V of B C in the front view this would come to this point. Let me call this J H and my line of intersection would be the one that; joins I H and J H and that would be the line intersection between these 2 planes in the top view, thus that. Now, before I start with the projection method to figure out the visibility may be it is perhaps a nice idea for me to consider the edge view of one of the planes. And, verify this is indeed the line intersection that I am looking for.

Now, for that better that I draw horizontal from here. Let me verify of these lines well with the margin looks like it does and I will try to make this little faster. So this is the horizontal. Let me mark this is O H, corresponding projection down O H lays on B H C H the corresponding projection down there, so this point here is O V. Now A V O V would be in true length because this thing is horizontal, and this thing also parallel to the inch line that separates the 2 views, the front view and the top view. So I will come back to the inch line. But first let me align my drafter the longer side of the ruler along A O and shoot a projection out, it is the one way and the other way is to should projection the other way or the other side because, perhaps this box over here would be interfering with the edge view right there.

Now what I will do is, I will show the projections parallel to that one from all the vertices. This is one not so nice thing about the edge view that could be quite tedious. From C from D from A from F from B and from E; maybe I will have to draw another projection, and that projection is going to be very close to the one that starts from A. I can see that there is a little problem over here. I will probably have to be little more careful perhaps that is the one. Now having done that, I will realign the longer ruler of my drafter. Draw inch line that will separate the front view with the top view and this going to be a complicated figure. I will align my drafter to be parallel to one of these

projections. This would correspond to the inch that would separate the front view from the auxiliary plane. What I will do is I will take a pause; measure the distances from all the vertices from this inch line; transfer those distances over here and draw the edge view of A B C which is what I am aiming at. And also draw the corresponding projection of the triangle or triangle of plane D E F.

So, when I do that maybe it is a nice idea for my friend asutosh who is on the camera to take a pause. Ok, back from the break; anyhow so welcome back. In the mean time what I done was; I had made this figure of this assembly of 2 planes in the auxiliary plane A 1 where my plane A B C it happens to be in the edge view. And of course, T E F it is not supposed to be in the edge view but supposed to still look like a triangle. Now the idea behind drawing this edge view was, to confirm whether I cut the intersection points or not or correctly or not using the cutting plane method. So let us do that; so A B C is in the edge view and this is intersecting. Let me take my 2 H pencil so this is intersecting triangle D E F at this point here and at this point here. So of course, the intersection points are going to be lying over here and over here on the on the A B C plane.

So let me try to realign my drafter along this projector, and let me go very close I am not sure if this is, yeah; so let me [glow/go] let me go very close to this intersection point and of course, this intersection point is lying on E F so I need to project this point back on E F E F by there, so I have to figure my drafter is all right looks like this. So, if I project this point on to E F this will probably be intersecting E F over here somewhere. So, let me draw this line and let me keeps point mind on the other intersection point between A B C in the edge view and D E F is over here. And, that intersection point lies on D E H D E. So I need to project this intersection point back on D E. So, let me do that and if I do that correctly I expect that point to be lying somewhere over here.

So let me draw this projector let me darken it. And if I get to my thirty degree friend thirty sixty subscribe friend which I call, and if I try to align these points it is looks like I am very close to the intersection line. Intersection I J very closes little deviation which I guess I can expect because of certain errors in these instruments. But I am verify close, let me go back again and see if I can do anything with this, yeah; possibly I can. So I just need to make sure that my instruments are free of errors. Anyhow so this confirms pretty much that my line intersection will be very very close to this line I guess. Let me draw this line in blue I J, and this is going to be a solid line I know and it is going to be visible

line in both views. Because this is the common line of intersection between 2 planes you know of course, we will come back visibility in a while and if I back project the points, I will have to realign my drafter. If I back project my points then more slightly my point I would be somewhere over here and J would be somewhere over here.

And let me join I H and J H as I have mentioned again using a dim line. Just to highlight that this is the common line segment intersection. This is much better after having gotten the intersection, line of intersection between the planes D E F and A B C in both views. We are now ready to determine the visibility. I will have to be very careful because I tend to make many mistakes. So first I would like to consider the projection method. So, the logic behind the projection method to determine the visibility or different you know; Planes a lines is not very difficult. Now imagine that I have got 2 lines here. This is my 2 H pencil representing one line this is my H pencil representing the second line. Now imagine that you are seeing the projections of both these lines in top view, and imagine that, this point of this pencil and this point of this pencil or the 2 lines they are common here in the top view, so one would be just above the other.

Now if you flip this view over like this of course, these 2 lines are not intersecting. But one point will be on top of the other. Once again one point will be on top of the other. So primarily what means is that; if I take a projection from this common point in the top view and drop it on the front view, I would see that this line will be getting hit by that projection before actually the green line gets hit by the projection. Let me rotate it and therefore, I would conclude that the brown line is going to be visible, and this this part is going to be hidden behind the brown line in the top of view. Once again quite straightforward of course, you could clearly see that this line is in front of this line. The top view the vertical projector is going to be hitting this part first and then later this part.

So we will be using this straight to determine the visibility of the 2 planes, and the front view as well as in the top view. And I am going to work on this quite slowly because I do not want to make much mistake or rather any mistake here. All right; so you would see that both the planes are represented using dark lines. So it is going to be a little difficult for me to work but I have these 2 markers here, 2 friends; my black sketch pen or marker in my blue sketch pen marker. What I will do is I will kind of work on these 2 planes by these markers and try to depict visibility and invisibility can clearly. Now let us look at this point S H and S H happens to be common to T H F H and A H B H in the top view.

And if I project this point down, if I project this point down from here I would be hitting A V B V first once again. So if I come down from here I will be hitting A V B V first that means that this part happens to be above this part in the top view. Now before I come back to that notice that these edges which are not. So these edges they are all lying outside the other planes region or let me let me try to repeat this better.

So for example, if you look at this part this part of A B and A C both these parts are not lying within D F. So they have to be visible likewise these 2 parts. They have to be visible because, they are not lying within this within this projector D E F and likewise these parts are going to be visible. So let me go back take may be another pause and work with my marker to darken these lines. And then come back and reinitiate my discussion on visibility. All right; so I am back now and I have darkened draw these edges which are going to be visible anyway. So it is these edges that we need to figure the visibility for and these are quite a few ok. So coming back to this point S H, so if I project this point down and this of course, in the top view is intersection between D F and A B. If I project this down D F seems to be hit after A B. So looks like A B will be visible and from here to here, so this part is going to be visible. So what I will do is, I will take my drafter off once again, just make sure that what I determined seemed to make sense. So if I go from here down A B seems to be intersected by this projector or intersected by this projector before D F. Thus so this part is going to be visible yeah.

So using my blue pencil, I will just mark this thing in solid. All right; may be perhaps little darker, because I am going to be overwriting this by black sketch pen that I have. All right; I am back, so if this comes down from here A B is visible and if A B is visible then of course, D F will be hidden behind it. So, D F will be hidden behind that. So looks like this would be a hidden line therefore, will be shown by dashed.

Now to confirm if that is really the case, this edge of A B is lying above D F. Now for that I need to shoot a projector very good projector from here. So this is the intersection between A C and D F. So I take my drafter and shoot a projector over here. Very good projector down and let me try to figure which is hit first. So looks like A C is hit first and before D F yeah ok. Once again so looks like this is intersected first or this intersect or projector first and then this. So looks like this part of the line is going to be visible and therefore, is going to be shown by a solid line, and that seems to make sense, because if this part is solid, this part is solid then differently this part of the edge E F will be hidden.

That seems to be working all right for us for now, and let me show this using again a solid true line.

Now let us come to this point of intersection between A C and D E. So before I shoot a projector down from there I already have one I guess. And let me locate the corresponding edges A C and D E here. So apparently if I go down from here I will encounter A C before I will counter D E. So this part of the line is going to be visible which is quite all right. This has to be a solid line and this is the solid line then definitely this part of D E will be behind the plane A B C. So this part of D E will have to be hidden, which again kind of make sense. So this is we will use 2 H pencil for that. All right, so if this is hidden. Let me look at this point here, point of intersection between D E and B C. I have a vertical projector down, once again D E here B C here.

And if I go down from here D E B C looks like I am going to be hitting B C before I hit D E. So does this part is going to be visible so this part is going to be visible. So let me draw a solid line here, all right. Now if I go to this point, for example; now before that we notice the loop I A C J is going to solid and this loop belongs to the plane A B C, and this loop that is lying above the corresponding plane D E F. And that is the reasons why these 2 lines are hidden that that have not make sense physically as well. Now coming back to this point of intersection between A B and E F, so let me locate A B E F by there all right now, if I project this point down here. Looks like I am going to be getting to see E F before I get to see A B. So, E F will be visible and when I say E F is going to be visible, then this part of the A B this part of the edge A B will be hidden.

So, maybe I will just without using the ruler this time, I will just kind of you know make a few dashes, all right. So, when this part is hidden, this part has to be solid, once again if I take this projector down, I tend to be hitting E F before I hit a B right. So, this part is going to be solid. When I say this part is going to be solid of course; is to shown using a solid line. Now, what remains is to figure the visibility for this part of the edge B C, so for that I need to go to this intersection point that; is intersection point between B C and E F. Let me locate where B C is, where E F is, and if I shoot a projector down from there again, I am going to be hitting or encountering E F before I encounter B C. So, looks like E F is going to be or this is part of the plane E F, this part of the plane D E F is going to be visible. And, of course this part of B C will be hidden, and therefore; I am going to be using dashed, I need to show this.

So, notice what these intersection point have done;, so this is where, there is a change of state of this part of A B, and this part of A B. So, before I edge this part of A B was visible, and after I edge this part of A B is hidden behind D E F. And, likewise before J of H intersection point this part of B C was visible. and, after J H this part of B C is hidden behind D E F., so it looks like A B C is phrasing D E F right, to their this where the intersection is happening, and after this your actually see; a part of D E F before A B C cannot make sense.

So, before I quite a figure the visibility of the respective portions of the edges of these planes these 2 planes, in the front view. Let me take a little pause, and finalize this drawing using the black sketch pen, so that a lot of things become clear. So, this is how the final top view showing the 2 plane, or showing the 2 planes looks. Now, let us try to figure out the visibility of the corresponding edges of these planes in the front view. Now, for that I will use the identical method. Now, it is easier for me to figure the visibility of this edge first; because the intersection point is not there. And, likewise for this edge and of course; we are going to worrying about these 2 parts later, because that is where the intersection point happens to be there, all right.

So, let me focus on this intersection point between D F and A B. Let me get my drafter over here, D F A B, all right. So, I have located these 2 edges; I go up and I try to figure what to I encounter first is a D F or A B. So, looks like I encounter D F first, therefore; mean that in this view D F will be visible. And, when I say that; I will have to be using a solid line representation, and this time let me use my blue pencil, you know of course; I will finalize this drawing later. Now, when this guy or this edge D F is visible of course; then this part of the edge A B will be hidden behind this corresponding portion of the plane D E F. So, I going to expect this portion of A B to be hidden, make sense that we seems more logical that way maybe, I will it is kind of you know mark this part as a hidden line, and of course; visit that later.

Let me make this little more solid little more clear, all right. Well, I have said I will come back to this later. So, I will do that let me focus on this intersection point between A C and D E that is why get my vertical ruler here, I identify A C which is here and, D E which is here. So, I go up and clearly; I will encounter D E for I meet A C, so D E would be visible. So, I have to have a solid line here, so notice that I am not using any information from the edge view with regard to determine the visibility of these portions

of edges, I will fly come in a hurry. So, I should not do that; so maybe I will go up again D E, D E, A C, A C. So, I hit D E before I hit A C, so D E is going to be visible and if D E is going to be visible. This part of A C will be hidden, you know confirm, let us do that ok.

So, this is the point of intersection between D F and A C takes it up, D F I hit D F before I hit A C right. So, D F is visible good, and if I take a look at this point of intersection between A C and D E again, I get to see D E before I get to see A C in the top view. So, of course this part is visible, so when this part is visible, this part is visible of the plane D E F. Naturally, this part of the plane A B C has to lie behind D E F, and logically this will be represented by a hidden line segment, so just ok. Now, back to this part of A B and this part of B C, if I locate this intersection point between A B and E F, I go up. Well, this is where A B is, this is where E F is, so I will probably have to go further up. So, I get to be seeing A B before I get to see E F so A B here and E F right there. So, looks like I hit A B before I hit E F, for that matter A B will be visible here, and this again seems to be ok, because this intersection point I V would tend to change the nature of this line segment.

So, if this line segment is visible solid, then this part has to be invisible hidden. So, this part has to be solid, all right. Now, to this intersection point between E F and E C, E F right there, B C here, take it up I get to see B C before I hit E F. So, this part of B C will be solid, B C before E F, so this part is solid, all right. And, now what you expect this part of B C to be hidden, or solid. Notice that there is an intersection point that expected to change this state of the line segment. So, it is solid over here, you know I would expect this segment to be dotted, or dashed, or hidden behind T E F.

Now, for that to confirm that; let me locate this intersection point between D C and D E. So, I bring my drafter over here, D E is where, I have over here, and B C is this. So, if I take my projector up I get to be hitting D E before I get to hit B C. So, D E would be visible that means; B C would be hidden, which is what is expected. So, maybe I will just represent these using dotted lines, ok. Let me finalize this on line; try to ensure that I do not make any mistake, because if I do, then I am done well, so this is solid. So, this part is solid, and this part is hidden, this part is going to be solid. Anyways, this part is solid, this part of D E is again solid, and this part of A C is hidden. So, shown using dashed lines, all right.

So, did I leave out any edge looks like I left out this edge here, this part have to be solid, and it looks like I left out this part of E F. Now, what you expect; this part to be should this be a hidden segment, or should this be a solid segment. Well, it is not very easy to well it is rather very easy to determine that. Because if you look at the corresponding portion of A B C; this part is solid, this part is solid. So, of course; in the front view this part of A B C has to be lying in front of this part of D E F, and you would expect this line to be hidden. So, maybe I will just go ahead, and draw this hidden line. If I am not sure maybe I use a pencil, there is a point I would like to make after this. Why do not I go ahead, and draw dashed line segment, I cut of sure myself at some point of time, all right.

So, this is how the planes will look; the intersection line, and different portion of the 3 edges of 3, or rather 2 planes. And, then visible or hidden state; I should have marked this also as a dashed segment better. Now, what we can do is; we can confirm if we got the visibility right and, the front view by comparing this drawing with the edge view over here. Now, look at this loop D A, and if I call this point; let us say a kind of a, and perhaps this point has b. So, this point b is going to be lying on D E perhaps here and this point is going to be lying somewhere here.

Now, D b a F D, so I am looking at this loop, this loop is closer to the inch line that means; that relative to the edge view A B C, this part of T F will be visible. And, let us see if that is really the case, so T b, so far so good solid line, this part is not a part of the intersection line. So, I ignore this part from B to perhaps J V would be interesting for m e to plot J V over here, let us do that. So, J V would be lying on B C, maybe they will give us a better perspective B C by there. So, let me mark this as J 1, let me also go ahead and mark I 1; I 1 is going to be lying on A B, so here perhaps.

Coming back to the point D B J 1, I 1, F D this is lying in front of the edge view of A B C, or closer to this inch line. So, it should be visible let us verify so D b from J V D I V solid line from I V to a perhaps again, this part is something that is not of our concern from A to F. It is visible from F to D it is visible so all these guys, or all the edges happen to be represented using solid edges. And of course; B E A 1 so this part of D E F lies behind the edge view of A B C. Or, away from the edge view of A B C with respect to this inch line, so let us verify that is the case.

So, if I look at E 1; if I go from E 1 towards F. So, this part is lying behind A B C. So, perhaps I was laboring so maybe let me get back and take a look at this loop D F all together. If I go from E 1 to A 1, that is behind the edge view of A B C, or away. From the edge view of A B C with respected this inch line. So, if I go from E 1 to A 1 or E 1 to A E 1 towards A, a part of E F has to be hidden behind A B C, so that is ok. So, if I am standing at A from A till F all right. So, this is where D F will be lying in front of the edge view of A B C. So, this is solid all right, and F E rather D E, so from here to here from T to P. I expect the edge to be solid and from here to here, there is nothing on the plane O B C that kind of heights, this part of D E F. So, this has to be sudden, so it looks like it is ok.

So, you can find the visibility of plane using either the projection method; that we had discussed in detail, or directly is in the auxiliary plane, or the edge view method, which in a way again is projection method. If you are comparing these 2 views for visibility, all right. You know, you could do this as an exercise; you might want to draw an edge view corresponding to this figure of the plane. And, I am using the edge view try to verify if the visibility over here is correct or not I hope I am correct, but I would still have.