**Technical Arts 101**
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**Lab 01**

Hello, let me introduce my drawing friends to you. What I have here is a mini drafter, this is a stencil of circles that are used to draw a smaller circles, it is easier for me to draw them. This is on 90, 30, 60 set square, this is a 90, 45, 45 degrees set square, let me ask these friends to go away from here for a while. I use two different kinds of graphite grades to draw my drawings; this one over here uses the H grade, I use this to draw the final lines in my drawing.

And this one uses the 2 H graphite grade, this helps me draw construction lines or lighter lines in a drawing. To have some fun I also have a colored pencil, I will try to figure if I would be using this after, I use 3 different kinds of pencils for my drawing, this one uses the H grade of graphite, it helps me draw final drawings, this is of grade 2 H, it helps me draw construction lines and along with me I also have a colored pencil, I will try to figure, if I will be using this today.

And then I have this pen of mine a compass, it helps me draw circles which are bigger than the diameter of the circles I have on this stencil, I make a lot of mistakes in drawings and in general. So, I have with me not 1, but 2 erasers, but ideally I should not be using them in my drawing, I should try to avoid using them, this is a piece of cloth I keep handy just in case I am using my friend that is going to correct me to clean up my sheet every time I use this friend.

Coming back to my main friend of drawing, this is something really interesting, mini drafter of course, this is having 2 sets of parallelogram linkages, two parallel links over here. At this end one parallelogram linkage is fixed, here I have a coupler that is coupling two linkages and the end point of this parallelogram linkage has 2 scales, one horizontal the other one vertical. Most often in my drawings, I have to draw horizontal lines and vertical lines and the beauty of this linkage, this mechanical linkage is this that wherever I move this end point of my mini drafter.

The vertical scale always remains vertical and the horizontal scale always remains horizontal. I have set my friend in such a way that the horizontal scale aligns very nicely with the horizontal margin of my sheet and the vertical scale aligns with the vertical margin of the sheet. So, the goal today is to draw the third angle autographic projection of the solid, I have not yet introduced to you a very important friend of mine, the sketch sheet before I transfer my drawings to the final sheet, it is always a nice idea to prepare myself with the sketches in this case for the solid.

So, that if I am very well prepared I will not be using this friend of mine is going to help me with 2 things, one I will be saving time and two I will prevent my sheet from getting spoiled, camera 2. So, before I start let me prepare myself well with the sketch of the solid, what I have here is a pictorial view of the solid.

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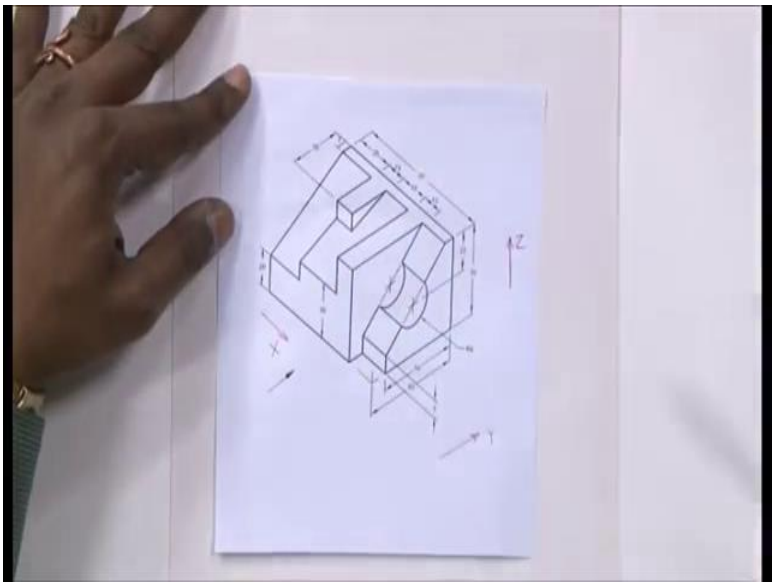

So, I have the pictorial view of the object with me here, let me call this is the X axis, let me call the axis parallel to this line as a Y axis and the vertical axis as the Z axis. So, many of this features in the object, they are parallel to the principle planes, this is the X Z principle plane, X Y principle plane and Y Z principle plane. This arrow indicates that we are viewing the object along this direction, so this plane here shows as the front view of the object, the top view is given by the X Y plane and the profile view is given by the Y Z plane.

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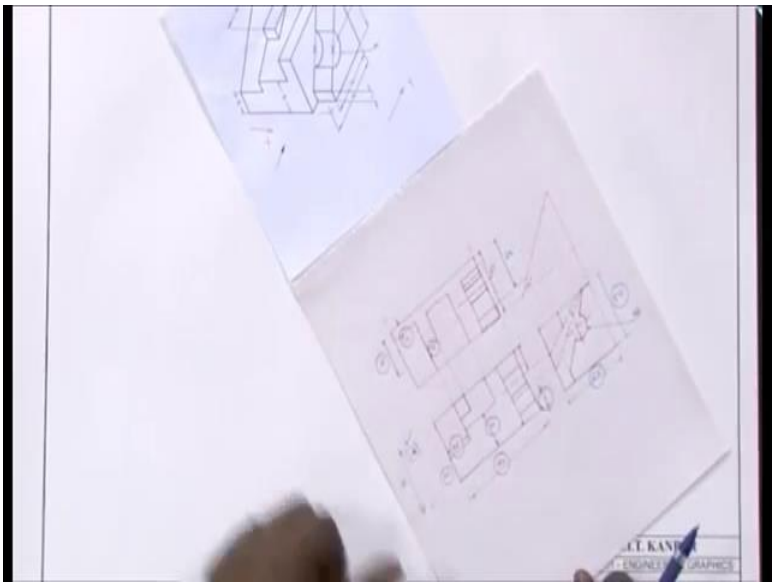

Let me now start sketching the object, remember that I am drawing this in the third angle autographic projection. So, if I view the object along this direction, what will I be seeing, I will be seeing the bottom edge, so if I look at this object in the frontal plane, which features of the object will I be seeing. So, I will be seeing this line all the way through from here to here and then from here to here, now this entire dimension from this point up till this point is 90 millimeters.

So, all the numbers over here are in millimeters, so this is 90, so let me start from the left part of the object. So, I will have a vertical line which is of length 20, I will go horizontal from this point to this point and this is about 25 and then I will go vertical from here to here. So, this height of this edge from the bottom is about 30 and then I will have a horizontal line here, so this is 30 and this is 25 I am mixing my dimensions here, but not to worry at this point.

And then from this point to this point, there is a vertical line and then a horizontal line and then a vertical line going down. Now, in the front view this point and this point they essentially will be the same, I will be seeing a horizontal line from here and then a vertical line that vertical line is the projection of this slant line in the front view. And then a vertical line corresponding to the projection of this arc and then all the way down and then I will see a horizontal line this height is 7.

Notice that, I have not marked this feature why because this feature happens to up here on a slant surface. And I am not really sure about the height of this feature as yet, I will probably have to take this height from the projections emanating from other views. Likewise for the position of the center line of this arc, well may be not I know that this line is 22 millimeters below this line, so maybe I can mark 22 millimeters from the horizontal line at the top and perhaps mark the axis of this arc.

And of course, I will have a horizontal line corresponding to this and a horizontal line corresponding to this. Let me go back and focus on the left part of the object, look at this line, this line belongs to the slant surface of the object, but in the frontal plane it is projection will be a vertical line, going all the way from here up till here. So, this is this vertical line and then I will go from here to here and essentially this line is also going to be visible in the front plane, rather this entire line will be a horizontal line in the front plane.

Now, look at this edge and this edge, now corresponding to this edge there will be a point here in the front view and this edge will go down a little bit. I am not really sure toward height I will go down, I will get this height from the projections coming from the other views. How about this line, this line again will be a vertical line in the front plane and in fact, it is going to be coinciding with this line, so I will probably have to go all the way down.

Now, let us look at the top view of the object how would the object look, if I am looking at from the top. In the third angle projection, the top view is above the front view, so on the top view I will essentially be seeing this horizontal line at the base and then from the left a vertical line. Now, there is a discontinuity in surface, so this line essentially signifies a meeting of a horizontal surface and a slant surface, so there will be a line here.

Once again there is a little discontinuity here and this is affiliated with the projection coming out from the front view, I will be drawing this line is going to come down. So, this length is 35, so I will make we mark this length here, this is about 7, this horizontal line is going to go all the way up to this projection line. This length is 13 and then I am going to go up from here and then horizontal up to the point, where these two edges make a right angle, which is here then I will go all the way down to the base line in the top view.

And then stop here, there would be a vertical line in the top view and then there would be horizontal line. Once again this would be projected as a planer surface in the top view, so I would see this line, the projection of this output again be a line and this line, did I miss anything out in the top view pertaining to the feature changes in this region of the object. Perhaps I did there would be a vertical line corresponding to this feature change, in the object in the top view.

Will I be able to locate the axis of this cylindrical feature in the top view possibly or may be not; however, notice that this overall length is 90, which is not here, the distance from this vertex to this vertex, rather the distance here is about 65. So, let me note it down here, this will help me prepare the bounding box for the object for the top view of the object rather am I missing anything out, perhaps I should not have gone all the way from this point to this point.

If I look at the object from the top again I would be seeing this edge I would be seeing this edge, but this edge would fall short, may be up to this point and then I would be seeing this horizontal line here. So, in the top view you will not be seeing lines corresponding to this region of the object, just to remind myself I let go of these lines, anything else that I may have missed when drawing the top view. Let us see later I will make a sketch note for myself that I am missing a feature here and of course, one of the projections for this feature is it is vertical line.

I will come back to this later, but for now let me continue by trying to draw the view of the object on the plane on the right hand side. As if I am visualizing the object along this direction, I am going to be leaving out some space here of course, this height is the same as this height and this length is the same as this length. I take some projections out, let this intersect draw a 45 degree line and then take a vertical projection from here take a horizontal projection here.

So, my profile view will be within this box, on the let I will be seeing this edge, I will be seeing this entire base line. And then at some distance, which I get through projection from the top view, I will see a vertical line, this horizontal line is something that I will be getting from the projection from the top view again. And then I will have a slant line, I just draw that line is dotted at this time, it meets in the axis it will be easier for me to

draw the circular arc in the profile view, let me sketch that and then join the rest of these lines.

So, this part of the object is taken care of our of course, c afford with tangle corresponding to this feature here. And then of course, this edge leads to this point, this edge leads to this point in the profile view. And now let us come back to this feature, let me draw a horizontal projection from the top view take it down, I still do not have this height, but what I know is that this slant surface starts from a height of 30.

So, in the profile view I have this height, so the slant surface starts from here and it ends over here somewhere of course, this slant surface will be behind this little block here, so it will be hidden. So, I have this hidden line here that corresponds to this slant surface over which this feature lies and I also have a projection emanating from the top view for this feature. So, this projection comes here hits the 45 degree line comes down and it intersects this hidden line.

So, if I project this intersection point horizontally on to the front view I would get this line in the front view and this block will be visible as a solid block. So, I have taken care of this mental note that I made for myself some time ago, one needs to be a little careful in particular when trying to figure if one has missed a few lines or added unnecessary lines. For example, in this case I had added these lines before I have made this correction for myself, but I may have missed a few lines I will have to go over this object again and over these three autographic projections.

So, this slants of assumes alright, this part seems alright, this part here would be this part the block. This slant surface seems alright this slant surface seems I would not be seeing this in the front view it is alright I will be seeing this part of course, but very second about this line, in the top view it is alright, in the front view I have this feature. So, I am ok here not to worry, look at this slant surface how I captured this in my profile view of course, I have captured this surface, so this hidden line, but probably not this.

So, this would be a slant line in the profile view starts at a height of 20 I have this marked here and then it goes all the way up to this point, this point here of course, it is hidden. So, I will draw dotted lines, now I need to be a little careful I focus my attention on this circular feature or cylindrical feature I have a line corresponding to this point, which is an edge in the front view. Would I be seeing an edge corresponding to the

bottom part of this cylindrical arc, looks like I will be and again of course, it is not going to be visible therefore, it will be hidden.

Likewise, if I take a projection of this part up on to the top view I just realized that I have not drawn this part here. So, I will do that, so I take the axis, take this projection on the top view and then I draw the center line, I will take the projection of this point on the top view this would be visible. So, I will have a solid line, likewise this point this projection up and on to the left again be visible, so I will have a solid line and coming back to this region of the circular arc, if I take the projection up to the left I will see a hidden line.

Let me mark it using a blue colored pen, so would I be missing anything, you know thinking aloud could be, so difficult, which is what I have been doing over the pass half an hour 45 minutes. I may have missed out on a hidden vertical line here, let us revisit that. So, if I look at this feature traverse along the horizontal projection come down here and if I look at the corresponding vertical line for this feature I would see that there would be a line of course, but this line, which is here will be behind this part of the object and therefore, it would be a hidden line.

So, this is 65, this is 90 this height is 50, so therefore, this is 50 I just want to make sure that when I am dimensioning my final drawing I do not repeat these dimensions. So, let me encircle the main dimensions, let me encircle the main dimensions 90, 65, 50, I have a 20 here, I have a 25 this side is 30, this is about 7, this is about 7, this distance is 35, this distance is 13. Of course, this 65 did I missed out on any dimension yes of course, this arc is of radius 6, this dimension here from here to here is 54 and I can keep going on.

So, I will not worry about that I will worry about these dimensions when I start drawing, the main thing on the sheet. So, we will now draw the autographic projection of the solid or which the sketches we drawn previously, so I have my pictorial view of the solid here, I have my sketches here, I am kind of prepared and ready to transfer the autographic views in the third angle projection of the solid. Throughout my intension will be to not use these friends of mine, I will be a little slow and I will try to be careful for now let me take this piece away and focus on the sketch.

Once again to draw the construction lines and projection lines I am going to be using the light to which graded pencil and to draw my solid lines I will be using the dark H graded

pencil. I will start by drawing the bounding boxes of these views, the front view, the top view and the profile view. So, that I have an idea about how much space I will be requiring on this worksheet, so this is about 90 millimeters and this is about 65 millimeters let me focus on the bounding boxes for these two views.

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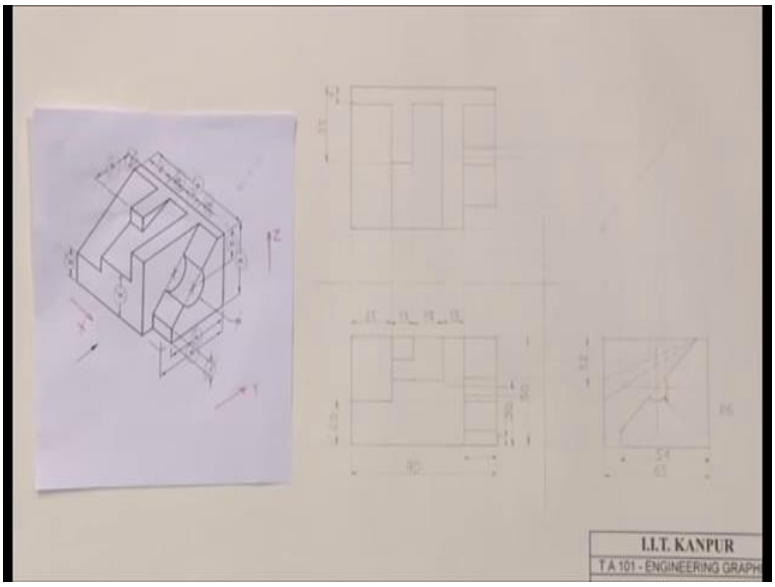


So, I have my scale here goes from 0 to 25 this is about 155 millimeters, so looks like I have space think here, I will try to start from the base of the sheet. Let me first draw the hinged line using in H graded pencil by convention it is represented by a long dash followed by two short dashes. So, I have my hinged line here, I will leave some space on the left of the hinged line and on the right of the hinged line, so that my figure does not look flatter I leaved few centimeters left all I need is 90 millimeters, which I have right here.

May be I will leave some more space, this is a dim line intentionally made it will not be clear, now or maybe it is anyways, this is 65 millimeters I will leave some space here. I have this projection line and then perhaps from here, I will make a line of length 65 this height is 50 millimeters for both the boxes here and then here, you know how interesting this drafter is the horizontal lines they remain horizontal and the vertical lines they remain vertical.

Let me now complete these boxes, let me verify these dimensions are it will look like they are and perhaps the same height from base of course, let me join these two lines, via

a projection line, so far, so good. Now, let me look at the top view this length is 90 and this height is 65, let me take the projections upwards, once again let me leave some space between the front view and the top view. And I will do that by drawing a hinged line again, a long dash followed by two short dashes I will take vertical projections now may be up till this point.

And then I will draw a horizontal line of 90 millimeters I will extend this projection and I will extend the vertical line from here, this is about 65, this is 90 again and this is 65. Let me extend the vertical line from here and the horizontal line from here and then let me use my drafter for this. And if I join these two points I would reckoned that this would be 45 degrees precisely it has to happen because this dimension is the same as this dimension.

So, we have the bounding boxes ready, so this is for the front view, the top view, the profile view. So, while we are drawing it may be a good idea for us to also start dimensioning the object, so for this example I will be using the aligned dimension key of the length of the object, I got the height of the object. And perhaps in the profile view I can get the width of the object, to make sure the lines are different let me use arrow heads.

Notice that this dimension line and this dimension line I have tried for them to be on the same horizontal line for the figure to look better, with this preparation ready. Let me slightly dark on this line, so with this preparation ready I can now think about starting to draw the main solid lines. I look at my sketch and I am kind of almost sure which ones of these lines will be solid, where they are going to be and which ones of these lines will be hidden, where they are going to be.

I will be careful of course, I will not be using these although I keep them handy, I will not be using these although I keep them handy. But, still the vertical edge on the front view, this will appear as total solid, so I will darken this line, this entire horizontal line at the top and at the bottom they will appear solid. So, I will darken these two lines, this line for dark lines realize that I am using the H grade pencil and then I will be seeing this entire vertical line as solid, so I will darken this as well.

This is the benefit of preparing the sketches a priory, for the top view I will have this horizontal line, this vertical line and a part of this horizontal line as solid lines, this part

is something that I would not see. So, remember I had cut these portions of the lines, well I am drawing the solid lines may be I will draw these in the top view, the full vertical line single stroke no multiple strokes, the full horizontal line. And then vertical line in part I will not worry about that and a little length of horizontal line over here I will not worry about that either.

Coming back to the front view this height is at 20, so I will mark this height and then I will make a projection this may be a line throughout I might meet this line in the profile view as well. And let me also dimension this use the arrow heads to differentiate this line from other solid or projection or construction lines from here to here is 25 and this is a solid line. So, I will make the solid from here to here is a line throughout up till this vertical line and then of course, this feature gets extended in the top view.

May be what I could do is I could draw a solid line from here up till this horizontal line and then perhaps use a different pencil the 2 H pencil to extend this to the top view in the top view this distance is 7. So, maybe I will mark 7 here and I will draw a light line may be a little darker line, now this vertical line extends up to this horizontal line, so I can use the solid pencil directly and then this line is also solid. So, I will mark this as solid, now coming back to the front view, this is this horizontal line is at a height 30 from the base.

So, I will mark this dimension 30 use the different pencil and take this construction line a long, rather all across to the profile view. Now, let us focus on the object on the dimensions given in this picture, this entire thing is 90, 25, 13, 19, 13, so this dimension would be 90 minus 25 plus 13 is 38 plus 19 is 57, 57 plus 13 is 70, 20. Once again 25 and 13 38 and 19 57, 57 and 13, 70, so this dimension here is about 20.

So, I should have noted this down while I was making the sketch, this is 20 I can draw this vertical line, I know that this is solid line throughout at a distance 20 from the right vertical line in the front view. And I can switch my pencil use the different grade pencil, use lighter line take a projection in the top view and the top view this line is again solid up till this height. So, maybe I can draw a solid line and then I see this line I still I am not sure about this, but that is coming back to this picture this dimension is 13.

So, this is 13 we will come back to that later, but for now let us not forget to dimension this part here. Again switching pencils using a lighter pencil, using the arrow heads, coming back to this view, this is 13, let me measure this and draw a vertical light line.

Let us also not forget to mark this dimension, switching pencils using a lighter pencil, using arrow heads, let us try to focus on this distance.

If I look at this figure this line in the front view corresponds to this line and the length of this line is 19 plus 13, which is about 32. So, let me have this dimension over here 32 and mark this dimension, this line is at a height of 30, this is about 32 it is, so your fine. So, this line is solid I switch pencils I will draw a solid line and then this line is also solid I will draw a solid line here, now this feature is a dimension 25, so I can mark this dimension here I switch pencils use arrow heads.

So, well I am marking these dimensions I will also cross them in this picture, so I have got 90, I have got 50, I have got 65, I have got 20, may be this dimension I have not marked alright, so I will do that. Now, this is marked and I got 13 here, so this is done I got 13 and 19 here let us worry about that a little later I got 25, so this is marked, let me not lose focus come back to the main drawing. So, I have got this vertical line, this feature here, this block here, this block is something that I will be worrying a little later these lines, so far, so good.

I am kind of I am missing a few lines here, but I will worry about them later, let us focus on the profile view, this vertical line is solid. So, I am going to draw this as a solid line, this horizontal line is solid again and this vertical line is solid, I am going to draw both as solid lines. I am not supposed to be drawing a line over another line, I am not supposed to be over lapping the lines, but any how I am permitting myself to that, still I have taken a above that I am not going to be using an eraser although I have made a mistake here.

So, this vertical line is solid and in fact, this line will also be a solid line, so let me finish this line. I am switching pencils, this distance is about 54 from here to here, let me mark this I should have done that while I was sketching this and this height is 7, which is alright I have marked this. So, from here I measure 7 draw horizontal projection, all the way down to the front view and then in the front view this is a solid line, so maybe I will switch pencils and draw this as a solid line and I will also dimension this I should be using a different pencil.

Now, this length is 54, I measure 54 make a little mark and draw a vertical line, this vertical line will be solid and from here this distance is also 7. So, I measure that distance, so whenever I am drawing a line which is other than a horizontal line or vertical

line I am not using a drafter, I am rather preferring to use in edge in my set square. So, once I have this slant line in the profile view, let me try to locate the center of the circular feature a cylindrical feature.

So, this is at a height of 22 millimeters from the top edge, so what I will do is the best thing for me is to locate a line at a height, rather at a distance 22 from the top edge. Here somewhere and may be draw an edge draw a projection line. And let me extend this projection line up till this point slight line and where this horizontal line intersects with this slant line I will have the center let me mark, this center using center lines, a dash followed by a short dash followed by a long dash followed by a short one like so.

And then in a similar manner the horizontal center line and let me extend the center line up to the front view. Once I have located the center, I am going to be using this friend here, a stencil I know that this is of radius 6, so I will have to locate a circle of diameter 12 right here. You know this really helps when drawing smaller circles adjust the center and then draw this arc, once I have this arc maybe I can make the rest of this inclined line solid here we go.

So, let me dimension this use a different pencil make sure the dimension lines are also lined, you will see arrow heads. And wait for the numbers come later, looking at the sketch I have this box ready, I have this feature ready, I have to worry about these two hidden lines. So, I already have this vertex here, I need to locate this vertex in this vertex, this is at a height of 20 and this one is at a height of 30, I think I already have these heights one here and the other one here.

So, maybe I can go ahead and draw these hidden lines using an H pencil, hidden lines are to be shown by dashed lines, this one is at a height of 20 and this one is at a height of 30. Here we go I am trying to be careful, I am trying to not let the lines over shoot the lines of the bounding box, here may be it over shot by little, but so looking at the profile view and comparing I got this feature this entire box 2 hidden lines and yet to draw this line and this is something that I will be getting from the top view.

So, let me draw this horizontal line, which is at a distance of 35 from this top line, so I measure 35, somewhere here and this dimension is 13. So, maybe I will measure 13 here this line is a solid line, so that is a solid line for me, here I will use a different pencil and I will project this line on to this 45 degree line. I will take a vertical projection come

down and complete this line, this would be culminating on the top inclined hidden line right there, now, this part is done.

Let us look at the front view, so I got this feature ready I still have to worry about this box. So, maybe I will do a question mark here on my sketch, this rectangular feature is done, so you would realize that I have left a small plot here well sorry about that, this part is done. And then I have to capture these three lines I have already captured this line and these three lines are going to come from this circular feature, so I will take the projections I use a 2 H pencil.

And then an H pencil to draw the solid line, I gone to use a 2 H to get the projection and then the H to get the solid line. And there would be a hidden line corresponding to this lower part of the circular void, so I will draw a hidden line here, so except for this part my front view looks like it is done. Now, switching to the top view, let me start from here this line is solid draw a solid line, now this part is a solid line and this part is a solid line. So, I will complete both I still have an gotten this line that is for now let me focus on this part of the figure.

So, this again corresponds to this circular void here, circular feature I take these projections, first I take the projection of the axis. The center switch pencils, light lines go up go left from this 45 degree line possibly stop here, switch pencils and draw a center line dash dot, dash dot, dash dot. I project these two points upward, I already have this may be I will project this thing also upward well I am added and then project this thing to the left at the top view and then both these lines are solid lines.

So, I will switch to an H pencil and draw a solid line here and here I still have to worry about this hidden line. And for that I will take the projection from this part of the profile view, take this to the left and draw a hidden line now I still have not may this line solid because I was not sure of this dimensions may be I am. So, if I look at this feature I have this feature ready over here, may be I can take the rather projection go up to the 45 degree line take it on to the left and then make a solid line, looking at my sketch now maybe I can cover this part.

Let me verify, if I have missed out on anything, so this part is fine I have got center lines, I have got hidden lines, I have got this hidden line this part seems. And then I have got in my front view, this part, this part I may have missed on this I still have to come back to

this, good idea that I question marked it. Otherwise I have this part, I have this part, I have all the lines kind of pre-match laid down over here, now coming back to this part I will have to use the projection from my top view and I will have to use this projection from my profile view.

So, maybe I will do that first use this projection and then maybe I can get up till here and then switch pencils and then draw solid lines. So, this part is also taken care of may be this line is not as thick as it should be, so maybe I will thick in it little more, I may have forgotten to draw this any how I am not supposed to be drawing a line over another line. But, for the first example I am permitting myself to do, so looks like I have all the features here now in all the three views.

So, maybe I can focus on the dimensions I have many of these dimensions cover, but a few may have been left, let me try to cover those. So, this one here for instance is not cover, so maybe I can show this in the top view, so I have to leave some gap here to write that dimension out. So, this dimension is cover, this dimension is covered alright 13, this length maybe I can mention it over here, so this is done 19 may be I can mention it over here.

This is taken care of now this height 22, which is used to look at this axis, maybe I can dimension that in the profile view I am just trying to make sure that I do not repeat these dimensions. So, this is taken care of 54 I can also think about dimensioning that in the profile view, I have to leave some space for the bottom dimension. So, this 54 is taken care of this height 7 may be I capture that over here ideally I should have made a dimension line in the profile view. So, this is taken care of and finally, I think it is this radius then I need to worry about.

So, for that I need to draw a 45 degree leader, so maybe I will use a combination of my mini drafter and set square. Let one of the edges pass to the center of the arc, may be draw a little line here and there after draw a horizontal line, so this is taken care of I will quickly chart down these dimensions. I will use a little bit of hip from my sketch and from this figure, the work of the drafter it seems to be done, so this is 90 I am using the aligned dimensioning, this is 65, this is 54 I am trying to print the letters.

And also I am trying to keep them big let me have my sketch here and my dimension sheet here. So, this 90 is taken care of let me circle that, 54 taken care of let me circle

that, 65 taken care of let me circle that, this 7 I have to rotate a number and align that with the dimension line 7 is here taken care of may be this number is too close to the front view. But, let us not worry about that 20 done, the site 30 done, 25, 13, 19, 13 perhaps I am not very good at lettering I need to go back and practice, but for now.

So, this is 22, so this dimension is taken care of this height is 50 appears over here, the stun 35 and 7. So, maybe I will start with 7 and then I will go 35 and finally, r 6 which is here and I have to point an arrow towards center of this arc, let me take away my sketch, let me take away the object place a drafter here or may be take it out of site. And this is how the final third angle autographic view of this object would look like, I hope that I have not missed any line hidden or solid construction hinges.