Engineering/Architectural Graphics - Part 1
Orthographic Projection
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Lecture - 34
Orthographic Projections
Sections of Cylinders

Good morning, welcome to the 4th lecture of this week of this online ongoing course on engineering or architectural graphics. And in this particular subject, we have been discussing about orthographic projections. In this week of this course, we have looked at how to draw orthographic projections for sections of various solids and in different conditions? So, when I introduced in the first lecture when I introduced you to the sections of solids.

After that we learned to draw sections of prisms. And then we learn to draw sections of pyramids. Today, we are going to learn how to draw the sections of cylinders circular cylinders and right angled cylinders. We are not looking at oblique cylinders here. Now, before we go on to drawing how what will the section of a cylinder look like? We must again revisit the basics.

So, as I introduced in the first lecture of this week, if the section plane the plane cutting the cylinder is parallel to its base or perpendicular to its axis, we will still see a true circle the same shape as that of the base which is what goes with any prism or cylinder. So, that will remain the same. That is one. If we have a plane which is parallel to the axis or perpendicular to the base, in that case, we will be seeing a rectangle which is again similar to what we had seen in the case of prism.

If you cut the cylinder inclined such that the plane is inclined to its base, in that case, we will be seeing an ellipse. And sometimes, if the base is also being cut, if it is not just the height of the cylinder, if it is also the base being cut, then we will have a distorted ellipse or an ellipse which will be cut at its ends. So, these are the 3 different conditions. And then if the plane is inclined to the surface of the cylinder and not the bases. In that case also, we will see a different shape. Let us see, how do we arrive at these different shapes? And then we will

draw them. So, I will start with the simplest one which is if the cylinder is being cut by a section plane parallel to its base. So, let us draw. So, in the first case, let us assume that the cylinder is kept in HP. It is perpendicular to HP and parallel to VP. **(Video Starts: 03:02)** So, let us assume in all these cases today.

Let us assume that we have a cylinder with a base radius of 3 centimeters. So, I am drawing this original position. So, we are assuming that the cylinder is kept perpendicular to HP. And it has its base in HP. So, this is what we going to see in the plan. In the elevation, if you remember, we will see just a rectangle. So, assuming the height of the cylinder to be 8 centimeters, we will get a rectangle there.

Now, we are assuming that the cylinder is getting cut by a plane which is parallel to its base. I am drawing the axis also here. This is the axis. So, I am just drawing it continuously. However, the axis in this case is just a perpendicular line. So, we will just be seeing a point. So, if I cut this plane, if I cut the cylinder by a plane which is parallel to its base which means it is parallel to HP here. I will see a true cylinder in the top view.

And that will also be the true shape of the section. So, what we have here is if I draw the final shape of the left over solid. So, this is what we are going to see in the elevation. And in the plan, we will be seeing the same circle just that this circle is actually a section a plane which has been cut. It is not the original base. So, if I just hatch it, it will be evident that this is actually the section. So, you have to remember to hatch the section surface every time.

Only then will the drawing be complete. So, this is what the final drawing will be. This is also the true shape of the section because the plane is parallel to the base. In case, we keep our cylinder in such a manner that it is resting on one of its generators in HP and it is perpendicular to VP, we will be seeing a circle here. And if it is cut by a plane which is parallel to its base and in the second case it will be parallel to VP.

We will see a section circle here in VP and a cut rectangle here in HP. So, that is the first case. Now, for the same case exactly the same position, let us assume that this same cylinder is now being cut by a plane which is perpendicular to HP. So, if this is the same cylinder

which we had in the first case, this is our cylinder. And now, let us assume that this cylinder is being cut by a plane which is parallel to VP but perpendicular to HP.

For example, this is the plane which is cutting this circle here. This plane is parallel to VP perpendicular to HP. What would we see? So, what we seeing? That this surface of the cylinder is actually getting cut here. So, we will take the projections upwards. This is where it is getting cut here. And the rest of the surfaces they remain intact. So, we will still see the edge here which is at the tangent position.

And the rest of this circle and the rest of the cylinder it remains intact. So, what we are seeing? This is the true shape. This is the true length of the rectangle. The rectangular face which is going to be made once this cylinder is cut by a plane perpendicular. So, we will just darken the remaining portion. So, this is the leftover portion here. This is the section line. And in the front view, the height of the cylinder remains intact because the height is not being cut.

This is the external edge. This is where the cylinder is being cut by the section plane one of the edges. This is the second edge. And this is the base line. Now, the only thing that we still need to do is hatch it to tell where the section is being seen. So, this is where this is the surface which is actually the cut surface. In this case, we really do not need to divide the circle in equal number of parts say 25, 12 or 8.

We will be able to arrive at the section of this circle of the cylinder very conveniently. So, these are the 2 conditions where the section plane is parallel to one of the reference planes and perpendicular to the other reference planes. This is a very simple condition. Now, just imagine then that in this case in this condition what if the section plane was perpendicular to both the planes? So, the same circle, we will still draw the same circle.

So, I am keeping the same cylinder as the base. And we will be seeing all these different conditions on the same cylinder these simple conditions. So, in this case, we are assuming that the section plane is perpendicular to both the planes. So, this is how the section plane is

going to come. Now, where will you see the true shape of the section? Because, if you look at it in the front view. We will still have the same line being projected up.

And, what will we see in the front view? We will only be seeing this part of the rectangle. In the plan, we will be seeing this remaining part of the circle. But, if we have to look at the true shape, we will have to draw it on a plane which is parallel to the section plane. So, very simple, we will take it on to the side plane because a plane which is perpendicular to both HP and VP is going to be the side plane.

So, we will just take it as we did for all previous problems. So, we have just projected the same section onto the side plane. And this is what we are going to get. So, let me quickly darken it for you. So, this is the true shape of the section which we will be seeing simply in the side plane. We do not have to make a separate auxiliary plane. This is the remaining portion of the cylinder after it has been cut. This is the section plane.

This is the side view the front view and the leftover of the top view. The only thing that you have to do is to hatch. Because unless we hatch it is very difficult for us to know that which surface is what? This is what the third condition is. So, in this case, the plane is parallel to HP perpendicular to VP. In this case, it is perpendicular to HP parallel to VP. And in this case, the section plane is perpendicular to both VP and HP.

So, the true shape of the section is visible in the side view. Now, let us look at the third case where the plane is be the cylinder is being cut by a plane which is perpendicular to VP and inclined to HP. And I am continuing with the same condition here assuming the same cylinder. So, that the case is clear to you that how the difference is being brought.

So, this is the cylinder the original cylinder that we have been considering for all these sections. So, we start by drawing the true shape always. This is what it is. Now, let us assume that this cylinder is cut by a plane which is passing through the center of its axis. And it is inclined at 60 degrees to the HP. So, what would you see? You would and it is since it is perpendicular to the VP.

So, this is the plane which is there. Now, how would we get it back is what the question is. So, what happens when this section plane cuts along this line? So, there are several points along this line. When it is cutting the periphery we know very clearly that this is where the base is getting cut the bottom base. And this is where the top base is getting cut. So, we would have these 2 very distinct lines coming. But, what happens in between?

So, what we will have to do? We will have to again project the points. So, we divide the circle again in 12 equal parts like we did for other problems earlier in case of planes if you remember. So, divide the circle into 12 equal parts. Now, we have to take the projections up for all these points. In any case, this part is cut. So, let us take the 2 points here upwards. These are the 2 points here. These are the 2 points here. So, now, what happens?

When this plane intersects this line which is this and this, so, what we are doing? We are again measuring assuming that there was a plane which was cutting the sphere here. So, what would happen? We would actually be getting the projection back onto these lines. So, this is where the periphery is. And when we cut it onto the top view, then we will just take the projections back from these points. And we will project it onto the same.

So, if it is getting cut here which is these 2 lines right at the middle. So, we know that this projection even from the top is getting cut here in the middle. So, we will be projecting the same projection points back onto the top view. So, now, when we see it from the top, what we will see? That this top surface is actually getting cut here in this line which is here, the bottom is cut getting cut. And after that the base is actually totally taken off.

So, if I start to draw the remaining portion of the top view, we will actually be seeing this entire thing like this where the lower part of the base has actually been taken off. So, if you see I have not darkened this. This is the remaining portion of the circle the cylinder which will be hatched here. And since it is perpendicular to VP, we will actually be seeing only the section plane as a line here.

So, that is what we will see in elevation. Now, we have to arrive at the true shape of the section here which is where these 12 points will now come handy. So, let us draw an

auxiliary plane parallel to the section plane. And now, we have these distances for all these points which is what we are going to mark first. So, we will just take the projections further up. This is for these 2 points which are here.

For these 2 points, this is where it is going to come. For the next 2 points, this is what it is, the next 2 and on the top. And now, what we have to do? We have to measure the distances and trace the same distances onto the points here the projections here. So, this is for the base. So, this is the straight line that you get as the base. So, it is the same process exactly the same process as we followed for the other sections.

It is just that in this case since there are no straight edges; we will have to follow the same procedure as we do for circle. So, marking those 12 points and then measuring the distances for each of the points there. And this is for the top of the base. Now, let us join this. And you would be able to see the kind of shape which emerges. So, what we have? We have a straight line at the end of this which is the top of the base.

And we have another straight line in the bottom base. For the rest of the points, we will use the French curves. So, we will have to fit the French curves. So, if you look at this, this is the part of the ellipse that we are going to see, as I said earlier, because in this case, the base is getting cut, the top base as well as the bottom base. Both are getting cut. That is why. So, this is the kind of shape which is the true shape of the section here.

And in top view, we will see this part as the section which when we hatch will represent the section surface in top view. And I will just quickly sparsely hatch even this one so that it is evident that this surface is actually a section surface. And this is how you arrive at the true shape of the section. While in front view and the top view, it is a very distorted view of the section that is possibly seen here.

So, that is when the section plane is inclined to HP and it is perpendicular to VP. Now, there is one more condition where the section plane is inclined to VP and it is perpendicular to HP. So, in that case, let us assume a different position of the circle. So, instead of the circle being

perpendicular to HP, let us assume that the cylinder is kept with its axis parallel to both the reference planes.

So, what I am assuming here that this is the cylinder which is kept with its axis parallel to both HP and VP. And we are assuming that it is kept in HP. It is resting on HP. So, the same height as the diameter will be seen here. So, this is what we will see as the original position. And now, we are assuming that there is a section plane which cuts this cylinder in such a manner that the section plane is inclined to VP and it is perpendicular to HP.

So, I am just drawing a section plane. So, this is the section plane which is going to be cutting the cylinder. Now, we are assuming that the cylinder is actually perpendicular to the side plane. So, what we will do? We will actually draw the side view the circle here. So, I will just draw the same size of the circle which is the base of the cylinder here in the side view. So, from there, we will actually get the 12 points which we will have on the circle.

In which we will divide the circle. We will divide the circle again in 12 equal parts. Now, let us bring them back onto the front view as well as the top view. So, if you see, the procedure remains the same. And we just keep repeating the procedure. There is no change in the procedure. If you follow the same procedure every time, there is hardly any chance that you will be going wrong. So, I am just getting those 12 points back onto the top view.

So, these are the lines representing these 12 divisions. And, why would we need them? It is simply because we have to know where each of these lines is getting cut. And then we will take the projections of these points in VP also. Now, if you can remember fine if not then number them, so, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12. These are the points which we have cut. So, now, we will take the projections of all the points and gradually keep moving.

So, this is for 1. This is where 1 is coming. So, we take it to the top. This is 1. This is for 2 and 12. So, this line is for 2 and 12. So, that is where 2 and 12 come. Now, this one is for 3 and 11. We take it up again, 3 and 11. This is for 10 and 4, so, 4 and 10. Next, we have 5 and 9, 5 and 9, 6 and 8 and the last one here is 7. So, if you see, it is not a perfect circle. It is slightly distorted. So, this is what we are going to see. And this is not the true shape.

So, the true shape of this is actually going to come here. This will probably be a circle because the horizontal projection and the vertical projections are all going to be the same. So, if I keep it here in the front view, we will probably be seeing more or less a circle here. So, that is what we see. And only the remaining portion of the cylinder will be visible. So, what we have is this.

And in the top view, we only have this portion as the remaining portion of the cylinder. Now, we have to arrive at the true shape of the section. So, we will just draw the projections of all these points. So, we have to get the projections of all these points here. So, the same projections and now let us again start marking the same points. So, what we have here? This is 1. So, the distance of 1 onto this. This is our point 1. Now, 12 and 2. So, this is your 12.

This is our 2. So, we have 2 and 12 here. Then, we have 11 and 3. So, this is for, so, this was actually 3. We forgot to draw the projection line for this one. I am just drawing it here. So, this was our point 2 and 12. This is 3. And this is 11. 10 is here. And your 4 is the same height as that of the diameter of this circle. So, that is what we get here. And since it is symmetric, if I extend these points I will be getting the same points for the remaining part of the ellipse.

So, this is this point. This is this point. This is corresponding to this one here, this one here and this one here. So, if I can draw roughly freehand, this is the ellipse that we are going to get. So, now if you see since the base was not getting cut in between, it was only the length of the cylinder the height of the cylinder we were actually able to get a perfect ellipse here. Let us try to fix the French curves which is the tricky part but we have to do it anyways.

So, this is the ellipse that we are finally getting. And please remember in regular ellipse it will always be having 2 axis of symmetry. So, whatever curve you choose, it should be fitting the other side of the ellipse as well. So, it becomes easier if you are able to fit any one quarter of the curve onto it. And then you will be able to get the rest of the ellipse. So, this is approximately the ellipse that you are going to get.

And then you will have to shade it. You will have to hatch it to indicate that this is the section. So, this by this we get the true shape of the section here. And this is the front view where we will see a skewed view of the same section for which we have drawn the true shape. So, these are the 5 different conditions in which we will get views for a cylinder. First one, the section plane is parallel to HP perpendicular to VP.

This one, which is parallel to VP perpendicular to HP perpendicular to both HP and VP, this one is inclined to HP perpendicular to VP. This is the true shape of the section parallel to the on an auxiliary plane parallel to the section plane. And in this one, the plane is inclined to VP and perpendicular to HP. And we see the true shape of the section coming as the true full yield.

Now, this totally depends upon where the section plane is cutting? How much the section plane is cutting? So, depending upon whether the base is getting cut or not or how it is coming? You will be determining the shapes which are not predetermined. You will always get it from the projections orthographic projections. So, whatever you do just follow the process the procedure the step-by-step method.

And you will be able to arrive at the orthographic projections. **(Video Ends: 42:28)** So, I hope the orthographic projections of sections of cylinders are fairly clear to you. Thank you very much for being with me in this lecture today. See you again tomorrow for sections of another solid. Thank you and bye, bye.