Engineering/Architectural Graphics – Part 1
Orthographic Projection
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Lecture – 36
Orthographic Projections
Sections of Spheres

Good morning, welcome to the last week of this ongoing online course on architectural or engineering graphics. And in this week, we are going to continue from the previous week. So, we still are left with learning how to draw orthographic projections of spheres. So, before I start, I will quickly brush you up with the introductory discussion that we had in the last week first lecture, which was that from wherever you cut the sphere, you will always be seeing a circle as the true shape of the section.

So, with that in mind, we will draw the sections of spheres. We will assume the planes to be parallel to HP; perpendicular to HP; inclined to HP and inclined to VP. Just as we did for all other types of solids and let us see how do we draw them. So, the drawing for sections of spheres particularly is very easy simply because of this fact that the true shape of the section, we know already is always going to be a circle.

So, let us start with that understanding in our mind and we will draw the sections of circles today.

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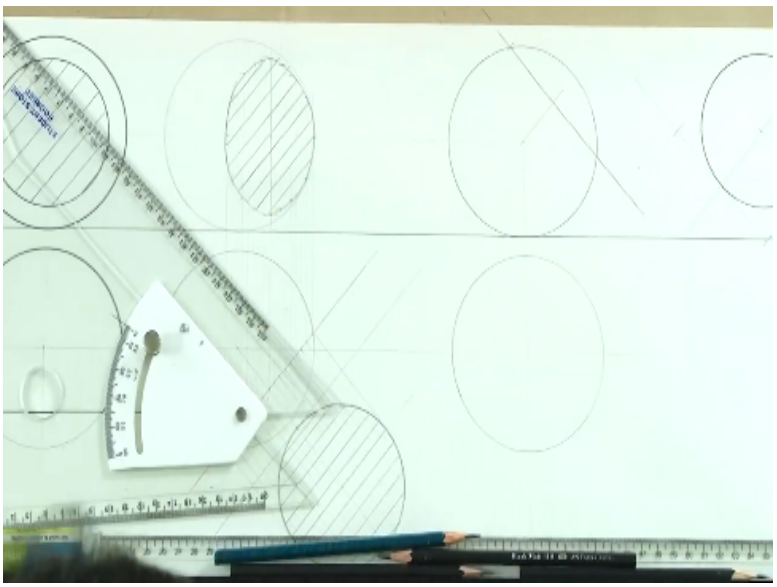

So, here, I am assuming that we have a circle, we have a sphere. So, we are assuming that we have a sphere of 5 centimetre radius here. Just to make things little easy for us. So, we will just be assuming different conditions of section for the same circle. So, this is the centre which we will take up. So, we have assumed that this sphere is kept on HP. Now, let us take our first case where the section plane is going to be parallel to HP.

So, I am assuming that this section plane is going to be cut from here, which is parallel to HP. Now, what we know clearly is that we are going to be seeing a true circle here. So, the only thing here we know is that if I am looking at this curve as semi-circle at this midpoint, at this diameter, this is where the reduction is going to happen. So, what will I get? I will get a true circle here, which is slightly reduced in size.

So, this is what I am going to get in the plane. And this circle, which was the original of the sphere, simply because the section plane is cutting it slightly above the diameter, the hemispherical position of the sphere will also remain. So, in the front view, what we are going to see is this section line and the rest of the sphere. So, this is what our front view is going to be and it will make more sense if I just hatch it for our convenience.

So, this is what is going to come when we have a plane or section plane parallel to HP. The shape of the section will be seen in the top view because we know that the plane is parallel

and in the front view, we will only be seeing this. Now, we take another condition again simple. So, we are again assuming that we have the sphere which is kept on ground.

We have to take the line for the centre of the sphere. So, we will just draw this sphere. This is the original position. And now, in this case, what I am assuming is that a plane, a section plane is parallel to VP and perpendicular to HP. It is cutting the sphere somewhere here. As a simple procedure for drawing the section of the circle, what we have is that the circle is again diminish along the horizontal plane, which we are assuming to be here, which is where we are assuming that this sphere is actually seen.

So, what we have is: we have a circle slightly reduced in size and passing through this. So, that is what we are going to be seeing in the front view. If this is how the sphere was getting cut, we will still see this plane interact this circle intact, which is the original circle of the sphere. And in the top view, we will have the rest of this sphere intact and we will be seeing the section line. So, what you see in the elevation is actually the true shape of the section, which we know is a circle again.

So, this is again the section of this sphere when it is being cut by a plane which is parallel to VP and perpendicular to HP. What if we had a plane which was perpendicular to both HP and VP, in that case, we would have seen the true shape of the circle in the side view. The process exactly remains the same as we have seen for the previous examples.

Now, we will look at the next case where this sphere which we are considering is going to be cut by a plane which is inclined to one of the reference planes. So, this is the original of the sphere here. And now, let us assume that there is a plane which is cutting this sphere at and this plane the section plane is inclined to VP and perpendicular to HP. Now, how do we see it? So, what we actually have is; we will be seeing the true shape of this section here.

We will be seeing the true shape of the section here in the auxiliary plane which is going to be parallel to the section plane and the line passing through this centre of the sphere is going to be the line where the centre of the circle because we know for sure that this is the true shape

of the section is going to be a circle that is confirmed. So, we will start by drawing the true shape of the circle only.

So, what I know is that this is the true shape of the circle that I am going to get. Okay. Now, what I will do is; I will mark equidistant points onto this circle. So, what I am doing here is I am drawing points, I am drawing lines which are parallel. So, I am just drawing them right now, at certain equal distance. So, you could take this distance as for convenience, there is no hard and fast rule about it.

So, we will just draw parallel lines. So, what we are doing here is: we are reversing the process, okay. So, we have just reversed the process and now, we are going to get the distances onto these lines in the front view. So, what we know that these lines are being intersected at this and this distance, so, what we know; this is the reference line. So, this is the distance which we are taking for each of these lines.

Now, we will take it up. So, we will project each one of these upwards and the distance that we are going to get is the distance from the centre line that we will be seeing. So, I have just marked these lines, which are here. So, what we have now? Just see; this is the total distance which is equal to the diameter of the circle, which we are going to get here and if I just project this line upwards, so, this is the point where the centre is going to lie and this distance is the distance on this line.

So, what we actually have is, we have these 2 points coming on these, on this line, which is the centre line. Next. So, next, we have these points. So, I am just noting these points, the distance of these points from the centre. So, it will be the same for both the sides and also this. So, what we are eventually doing is that this trace of this line is now reduced, but the height of this remains the same.

So, this is what we are going to be doing here. So, maybe it is too close; we will just reduce and we will take the alternate lines. We just have to remember that we are taking the correct lines for the projections that is it. So, I will just darken this line, which is the centre line

slightly so, that we do not confuse. So, I will take alternate points. And then the second last one and then this point, which is right on this.

And this is the point, which is here. So, what we have now is a kind of an elliptical surface, which is what we get when we connect all of these points together. So, we just have to connect all these points together. So, we finally arrive at an elliptical shape. So, I will try to fit a curve to it. So, it is quite close. It is not exactly fitting. This would require a lot of time. However, when you are doing it, please do it with a lot of patience.

So, that we get smooth curves here all the time. So, that is what we get. So, this is an approximate shape that we are getting when the sphere is being cut. And now, we just have to hatch it. So, the true shape of the section of a sphere will always remain to be a circle, but diminished in size depending upon where the section plane is going to pass through. So, this is what we see when we see this sphere being cut.

In this case, this is a plane, which is inclined to VP and it is perpendicular to HP. So, we are seeing the true shape of the section here. And instead of taking the distance because we did not know where this point which is, what is the distance of this point from x, y. So, we just took a hypothetical line x, y, but we surely know where the centre line is going to be, which is there and then when we cut it, this is how it is going to be now.

Why would the centre line come here? Because the centre of this circle will always lie on a line joining the centre of the sphere that is the rule. We always know it. So, when it was perpendicular to HP and parallel, so, we still know that this centre is going to lie on the same line which is connecting the perpendicular of the plane to the centre of the sphere. So, that is what we know that the centre is definitely going to lie here and this is the diameter.

So, we know that the centre is going to lie here and if this is the diameter, we can just make a circle and the relative position of all these points which we have taken as parallel circles on the sphere. And then since it is inclined, what you see in the elevation is slightly skewed. So, this dimension has reduced while this dimension remains the same. Simply because this plane is perpendicular to HP, it is inclined to VP.

What happens if in this case? We have a plane which is inclined to VP and perpendicular to, so it is inclined to HP and perpendicular to VP. We will get the same condition. So, I will just start to draw this but you take it as an exercise which you need to complete by yourself. So, we will just start it. I will show you the initial steps and then we can take it forward. So, what we do is; we are again starting to draw the original position of the sphere, which is this.

And now we will make. So, I am just assuming that this plane is inclined to HP and it is perpendicular to VP. So, what will we see? We will actually be seeing the true shape of this section in a plane auxiliary plane, which is parallel to the section plane. So, we will always start by drawing it. So, I am slightly shifting it here. Because we do not have as much space on the sheets to demonstrate.

So, I am just taking it here and what we know is that this centre is going to lie here. So, we will just. So, if I have to take now, we will have to measure all of these. So, we are just assuming that this line is what we are going to get here. And the centre of this circle, which is the true shape of the section here, the centre is going to lie here and this is the diameter. So, if this is the diameter, this is where the centre is going to come. So, this is the diameter.

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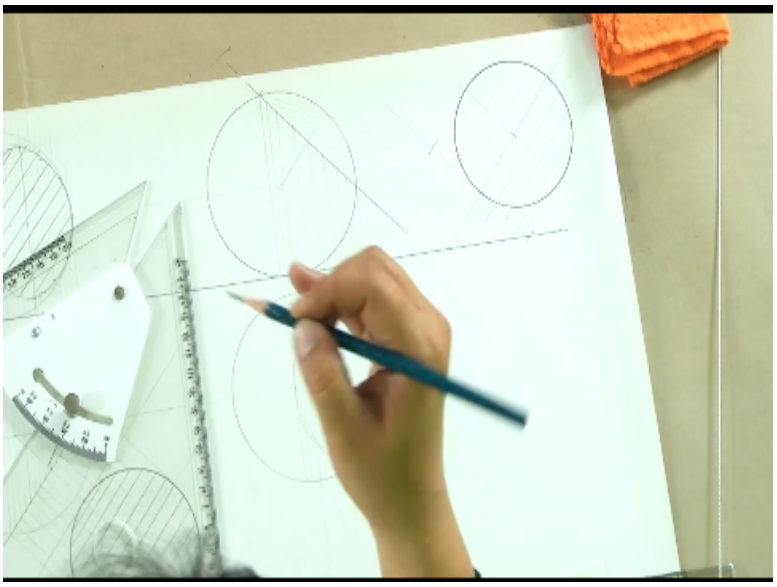

This is where the centre of the circle is going to be. And this is the true shape of the section which we will get. What will we do? What is the next step? The next step is that we will draw

lines on this diameter, which are perpendicular to the diameter. So, I am randomly drawing certain lines. It does not matter. Try to keep them equidistant as it becomes easier for us to locate points. And now, the distance that you are getting here is the distance that we are going to get back here.

So, we just have to project these projectors. We just have to take these projectors back onto the slide, which was the section plane, the line of the section plane. So, we trace exactly the same projectors here. If it was right here, you could have just projected them here. But right now, so what we can do in this case is we can always have a line which is inclined, such that we connect. So, it is not the best way.

But you can always do that. That is the interesting part of drawing using T-Pulleys. So, if you keep the parallel lines, the distances, they remain the same that is what I am doing here that is the same concept. So, I am just taking these projectors back on to the section plane. So, what I have now is this and all we going to do is we are going to project it back onto the top view and the distances from the centre of this circle or the diameter which is passing through which is parallel to section plane and passing through the centre is what we are going to take here.

So, what we will take? This is the diameter. So, I am just taking the radius. So, we will first locate the centre. This is the point. This is the line where the centre is going to come. So, we know that this is the centre. This is where your 2 points are going to come and these are the 2 points where your other 2 end of the circle. This circle are going to be projected. Rest of the points will be diminished and you will find them represented here at similar distance from the centre line, which will be represented here.

And finally when you join, you will get some skewed shape which will be an ellipse. I am drawing it roughly. You have to arrive at those points and you will finally be arriving at this ellipse scientifically. So, that is how it is going to be. So, I hope with this you are also familiar with how to draw orthographic projections for sections of spheres. Now, it could be anything.

The next step after this once we have completed the sections of all the solids is if you put together certain solids, so, what if a sphere is intersecting a cylinder. So, the surface of the cylinder is actually cutting the sphere. What kind of an image would you get? So, this is intersection of surfaces and that we can get only once we are thorough with the concept of drawing sections of solids.

Once you are thorough with that, you will be able to draw intersection of surfaces. One more thing which we are going to cover in this week is development of surfaces. So, we have already discussed about different types of solids. So, regular solids, we have already talked about. Then we have discussed about platonic solids and Archimedean solids. How to develop those surfaces?

How to draw them is what we are going to cover in this week too? So, thank you very much for being with me in this lecture today. In tomorrow's lecture, we will be discussing about development of surfaces for drawing the solids. Thank you very much for being with me here. See you again tomorrow. Bye, bye.