Engineering/Architectural Graphics - Part 1
Orthographic Projection
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Lecture - 32
Orthographic Projections
Sections of Prisms

Good morning, welcome to the 2nd lecture of this week for this ongoing online course on architectural or engineering graphics. And in this week, we are going to learn about orthographic projections of sections of solids. So, in the first lecture of this week, I have already introduced you to sections of various solids depending upon how the section plane is cutting these solids.

So, in this lecture today, we are going to learn how to draw orthographic projections of sections of prisms? And we will take various examples where the section plane is going to be positioned differently. And then we will see how do we draw the sections? And we also have to arrive at the true shape of the section. So, I will start with the very simple positions and you can simultaneously follow it up.

So, let us assume that we have a hexagonal prism and that hexagonal prism is kept perpendicular to HP and in such a manner that none of its faces is parallel to VP rather 2 of its faces are going to be parallel perpendicular to VP. That is how we will position our hexagonal prism. **(Video Starts: 01:53)** So, let us first start by drawing the hexagonal prism.

So, assuming that this hexagonal prism is of 3 centimeter side each, so, we will draw a hexagon. I hope you have already picked up the geometrical construction fairly well. So, every time I say we have to draw a hexagonal prism, I am not even repeating the method of drawing a hexagon. I am assuming that you already remember it. So, have your fundamentals in place whether we are drawing hexagon or a pentagon. They all will remain the same.

So, this is our hexagon. Since this prism is kept perpendicular to HP which means that its base is going to be parallel to HP which is what we are seeing here. So, we draw a solid prism. I am not darkening it because this is not the final thing. And in front view, we will be seeing the projections of this hexagonal prism. Assuming the height of the prism to be say 8 centimeters, we now have the front view of the prism as well.

So, we now have the plan and the front view of the prism. Now, let us assume that this hexagonal prism is cut by a section plane which is perpendicular to HP and parallel to VP. And it is cutting the hexagon 2 centimeter away from the center or the axis. So, if we say 2 centimeter from the axis. So, what do we get? We get a section plane passing through this point. And this section plane is parallel to VP and perpendicular to HP.

So, what are we going to see? We going to see a simple straight line here. This is the section line. Now, what do we see there? So, what are we seeing? This line, suppose I start numbering them if it was A, B, C, D, E and F and beneath it we may be having P, Q, R, S, T, U. So, EF is being cut at a point which is this. So, I draw a line to meet this EF here and in the base the lower one here.

And similarly, we get another line which is intersecting the top base and the bottom base here. And, what is this going to be seen? This is going to be seen as a rectangle. So, if you remember our initial introductory lecture, we said that if the plane is going to be parallel to the axis or perpendicular to the bases, we will always be seeing a rectangle. And now, in this case, so, I will quickly darken it. So, what do we have finally left?

We have this section plane. This is the nomenclature that we use for marking the section plane. So, this is the section plane. The left over portion of this hexagonal prism as seen from the top is only the one which is not cut. So, we are assuming that this portion the bottom portion is taken off. So, we will not darken the portion which has been cut. So, what I am doing? I am only darkening the portion which we are keeping or which is still there.

So, this is the leftover part of the hexagon. And in the top, what do we see? We see these 2 edges which are here. We see these 2 edges which are here. And this portion which is this

part of the rectangle which is seen here is actually a section. So, it is the cut portion. And on top, since the top remains, we will still be seeing the line intact the bottom line remains intact. Now, the middle edge which we were originally seeing initially when the prism was assumed to be kept.

This edge which is F starting from F that edge has totally gone. So, we do not see any edge like that there anymore. And what we have to do is to mark that this is a cut edge because this is what we are seeing. We will hatch it. What does hatching means? We have to draw. We have to fill this entire surface to represent that this surface is cut. So, we will draw equidistant parallel lines.

And whenever we are drawing on a piece of sheet on one sheet we will retain the angle of hatch preferably. So, if we are choosing a particular angle, for example, I am choosing 45 degree here. Preferably, we should be keeping the same angle. This is not mandatory but then it makes our sheets look better. So, while we have to work on technicalities, we also have to look at the aesthetics. So, this is the section. This is the actual object which is left.

So, we will only darken number this remaining portion. This is and this is the cut portion. Now, we will mark it here again. We have we do not see the C here. We see E and D. And this is the cut portion. You could number it. So, we could also number it 1, 2, 3 and 4. And the same thing will be seen here which will be 1 and 4 and 2 and 3 here. And similarly, in the bottom, we could also have P, Q, R, S. And similarly, you could number it.

Now, also, as we see this is the true shape of the section, so, whatever is being seen here because the plane is parallel to VP will also be the true shape of this section. Now, assume that this there is another plane let us another solid let us assume a triangular prism. In this lecture, we are only looking at the prisms. So, let us assume that we have an equilateral triangular prism which is kept on one of its faces.

It is resting in HP on one of its faces and the axis is inclined to VP. So, let us, in case, we have an object like that a prism like that. So, what would we see? We will be actually seeing a rectangle from top and a rectangle from front with 2 triangles being visible. So, that is what

we will draw here. Let us quickly take the equilateral triangle. So, assuming the triangle to be of 4 centimeter side, I am just drawing it for reference here of 5 centimeter side.

So, this is the true shape of the triangle which will be there. However, we will not be seeing it here. So, you could also assume it to be the original position which you will be seeing in the side view or you could directly make it. Now, when we see this triangle in the front view, this will be the line which will be the height of the prism. Now, we are assuming that this triangular prism is kept. And it is inclined at certain angle say 30 degrees to VP.

So, what do we do? What will we actually get is we get a prism which is inclined like this. So, we get a rectangle assuming the height of the prism to be say 10 centimeters. This is the height of the prism. The triangle is 5 centimeter side and it is kept on HP. So, we see complete 5 centimeters here. And since it is kept on in HP on one of its faces, we actually see the top edge right in the middle of this rectangle which is here.

So, in the original position, this is the top view. And now, if we take it to the front, this is the top edge. So, this is where you going to see. And another triangle will actually be hidden behind this rectangular face. So, let us roughly draw this front view. So, we will be seeing this edge. However, this edge will remain to be hidden. So, I am making very thin lines not very dark here because this is not the final picture. And here we have.

So, this is the front view of the original prism. Now, we are assuming that this prism is being cut by a section plane which is parallel to HP and perpendicular to VP. And it is passing through the middle. So, we are assuming that it is passing through the middle of the triangular prism. So, this is the point where we will assume that the plane is passing through the section plane is passing through.

Now, so, the top portion is going to be cut off but where will these be? Where will this section line will come in the top view is what we have to ascertain. So, let me number it again. So, if this is A, B, C and P, Q, R and in the bottom also let us number it, so, A, B, C and P, Q, R. Now, what is happening? This A and B, this line AB is being cut here. And this line BC is cut here. So, what is this line AB in the top view? It is here.

So, let us take the projections back. So, this is where AB is cut. And this is where BC is cut. Similarly, this is the point where PQ is cut. And this is the point where QR is cut. And since the plane is parallel to HP, we will actually be getting the straight line here. Ideally, we should be getting. So, if your construction is right if there is no problem no flaw with your construction here, you should actually be getting the parallel lines.

So, again what we are seeing? That we are getting a rectangular section here, it is a prism. And since the plane is parallel to its axis, we will always be seeing this rectangle here which is exactly what we are seeing. So, let me darken it for you so that you understand the shapes better. We will be seeing this entire line because that is what we will be seeing in the base. It is not getting cut. This is completely dark. Now, this line PQ is not there anymore.

This is an edge not PQ but BQ. So, BQ is not there it is totally chopped off. So, we will not see it anymore. And this surface I am again numbering it. So, if it is 1, 2 this is 1, 2, 3 and 4, so, 3 and 4. This 1, 2, 3, 4 is the section which is what we will see. Let us draw the front elevation as well. This is the section plane. Do not get confused by axis because when we draw axis we draw a long dash and a dot.

While when we draw this section plane, we draw a long dash and a small dash. So, this is the section plane. This is the final view of the section solid. And, where do we see the section? So, this is the section plane. So, we will just hatch this entire portion which is seen in section. The finer are your hatch lines they do not have to be as dark as the final object. You can make them using an HB pencil which will be lighter than the 2B which we are using to darken the final object.

So, this is what you see as the final projection of this solid. Now, this is also the true shape of the section which is 1, 2, 3 and 4. And this is the front view. This is the top view of the solid. Now, we could get it in one single step simply because in both these cases the section plane was parallel to one of the reference planes. Now, what happens if we have a section plane which is inclined to one of the planes and perpendicular to the other?

So, here again I will take the example of a simple rectangular prism. So, we will draw a central rectangular prism where the base is rectangle. And it is kept perpendicular to HP but it is inclined the side of the base is inclined to VP. So, let us draw a rectangular prism in the simple position. So, assuming that this rectangular prism is of 7 centimeters by 5 centimeters in base, so, this is the rectangular prism.

How it is assumed to be kept in the original position? And we will take the projections up. Assuming the height of the prism to be say 10 centimeters, this is what our the original position of the rectangular prism is going to be. Now, let us assume that this rectangular prism is cut by a section plane which is perpendicular to HP but it is making an angle with VP. So, let us assume that it is cut by a plane which is making an angle of 15 degrees with VP and it is perpendicular to HP.

So, when it is perpendicular to HP, what do we see? (()) (22:56) one of its the lines of the plane is actually going to be parallel to HP which is what we will see in the true shape here. Now, assuming that this plane passes through the center of the rectangular prism and it is inclined at 15 degrees to VP, this is how the section plane is going to be. So, this is our section plane here. So, what we are assuming? That this portion is now cut out of this solid.

Let us take the projections back where this section line is cutting. So, let us number it for our convenience, if this is A, B, C, D, I am only marking the top face and this is A, B, C and D. Now, this AB is cut in this point. So, we are taking it back. This is this point and DC is getting cut in this point which is here. This is another point. Now, what do we see? This base is ABCD.

And if there is another one beneath it PQR and S, so, AP DS and this entire surface is going to go and what we see here is 1, 2, 3 and 4. So, what will be the final shape? That we will see in the front view, I will darken it directly. So, we still have CR in place. So, that is going to remain intact. It is not getting cut. It is still there. We have another edge here which is 2, 3. So, I will label it here 2, 3 which we will see in the front view. This is 2 3.

Then, we have this 1 and 4 which we see here, 1 and 4. And this D is not there and this surface this edge BQ is at the back. So, it will be actually seen as a hidden line. So, what we have here is this is a hidden line which we see at the back. This is the final front view front elevation of this rectangular prism. And this is the top view of the remaining part of this rectangular prism. So, it is not the original one. It is the remaining one.

Now, one thing which you can see clearly is that the true shape of section is not visible here. Now, where do we see the true shape of the section? As we have already understood in auxiliary planes if we draw an auxiliary plane which is parallel to the section plane we will actually be seeing the true shape of section. So, let us draw an auxiliary plane to represent the true shape of the section which is parallel to this.

So, let us draw. This was inclined at 15 degrees to the VP. So, let us draw a reference line XY which is parallel to this section plane. So, assuming this is our reference line X dash Y dash. Now, since it is parallel to this, if we take the projections of this section plane onto this, it is going to be the actual dimension of the section. Now, what we need is another dimension which is the height.

Now, since this plane is perpendicular to HP, what we will be seeing in VP will actually be the true height. So, the only thing which changes is since it is making an angle with VP, the horizontal trace is going to be slightly different. But in height, it is actually the vertical trace is going to remain the same. So, what we will do? We will actually be drawing the true shape of the section here on this auxiliary plane.

And the heights are going to be taken from the elevation. So, the distance of 2 3 is here. And it is the same distance 1 4. Now, this is the XY. And this is our original XY reference line here. So, the distance of 4 from the XY is 0. So, this is point 4. The distance of 3 from XY is 0. This is 3. This is our point 2. And this is our point 1. So, if I join this, this is the true shape of the section. And what do we get here?

We get 1, 2, 3 and 4 as the true shape of the section. And before we finalize this drawing, we have to hatch it. So, we are going to hatch it in the same orientation which is this. I am doing

it at a greater spacing. But, when you make your sheets, you should try to make this hatch as closely spaced hatch which will look much better. So, do not make a hatch which is as far spaced as I am drawing here. Try to make it closer.

And the true shape of the section will also be hatched here. So, what we have here is this true shape of the section. So, if you see again we had the section as a rectangle because in this case also this section plane is actually parallel to the axis. And that is why we are going to be seeing the section as a rectangle. And the true shape of the section will be drawn on a plane parallel to the section plane.

So, we will draw a new auxiliary plane and a new reference line X dash Y dash and project the true shape of the section onto this. Now, assume that this particular problem which we had taken earlier. Now, instead of this, suppose this section plane was actually inclined to HP and perpendicular to VP. So, what if I have a section plane which cuts this prism? This is the axis here. I will draw an axis here first.

So, if this axis is cut at the midpoint by a plane which is inclined to HP and perpendicular to VP then what do we see? And, where do we see? So, what happens? Ignore the section that I have drawn? Assume that this is a complete prism which is available for us. So, what happens? We will have this line which is F. So, we had an F here. And in the bottom, if we had P, Q, R, S, T, U, so, if we had this line FU being cut here, now, the next line is FE.

So, FE is not being cut anywhere. So, we do not see any this there is no section on this line FE. There is this line DE which is actually being cut DE. We have this line AB which is also cut completely. And we have this BC which will be at the back which will be cut again FC. So, in the top view, if you look at this in the top view, we will actually be seeing a complete hexagon.

So, what do we see in the top view is actually a complete hexagon which will be the section. So, I will then hatch this entire hexagon which is seen from the top. So, this is going to be the top view of the prism. The rest of the portion the remaining portion on the top of this section

plane to this side is going to be taken off. So, this will all become light and we will only darken the portion which is below.

So, there will not be this line. These 2 lines are not there. The sectional hatch is not going to be there. And we will only be seeing the edges intact. And there will be a section line assuming the top portion is cut. Now, how do we see the true shape of the section is required. So, what we have? Say, this is again we have to draw an auxiliary plane parallel to the section plane. So, I am drawing this XY here.

Now, similar to what we had, here we have the same things. This distance is going to remain intact. That is the distance which is actually coming intact and from these planes. So, we will just draw. This is where D and E are going to come. This is the point where F and C are going to come. And this is the point where A and B are going to come. That is how we are getting.

So, these lengths will actually be the true lengths that are seen because the plane is actually going to be perpendicular. Now, the distance of these points remains the same from this XY which is what we are going to mark here. So, let us mark these distances from XY on these respective lines. So, what I have here is on this line I get this C. This is the F, D, E. Same distance for A. And, this is B here. So, I will now join these points that I have got.

This will give me the true shape of the section. So, what we see here is that when the section plane is not parallel to the axis, we see the shape of the base in section. That is what we are seeing here. Here, we are seeing section because we are still seeing it from the top but it is not the true shape. The true shape is actually this. So, it is a distorted hexagon. So, if you remember the introductory lecture again.

This was exactly what we were saying that we will still be getting the same shape as that of base but in a slightly distorted manner. That is what we have got here. And we do not need to measure anything. It is automatically represented. It is automatically coming. And that is what we see here when we cut the prism by a plane which is inclined to HP. And in this case, it is cutting the axis. It is not parallel to the axis. We see a shape of the section like this.

So, with this I have explained to you the 4 cases of how prisms can be cut by a plane which is perpendicular to HP parallel to VP parallel to HP perpendicular to VP inclined to VP and perpendicular to HP inclined to HP and perpendicular to VP. In these 4 different given conditions, we have seen how to draw the sections of the prisms? With this, I will close my lecture today. **(Video Ends: 39:18)**

And tomorrow, we will take up the sections of another type of solids. And I am just hoping that you are continuing to follow it up with me. So, thank you for being there with me today in this lecture. See you again tomorrow, bye, bye.