Engineering/Architectural Graphics – Part 1 Orthographic Projection

Prof. Avlokita Agrawal
Department of Architecture and Planning
Indian Institute of Technology – Roorkee

Lecture – 18
Projection of Lines Inclined to One Plane

Good morning. Welcome to this lecture for the ongoing online course on architectural graphics or engineering graphics and we are discussing orthographic projections. In the past few lectures, we have seen how to draw the projections of lines which are either parallel to both the planes or perpendicular to one of the planes. Today, we are going to learn about the projections of lines which are inclined to one of the planes, but parallel to the other plane.

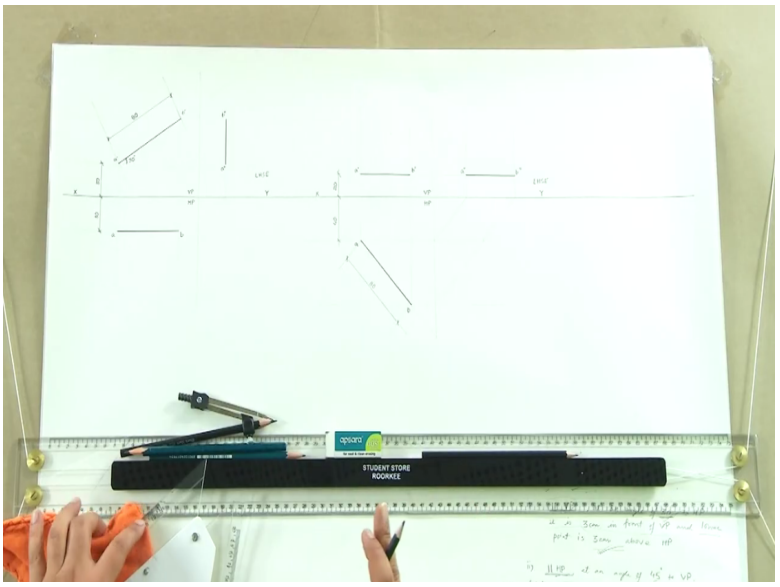
So, let us first visualize how this line would look like which is inclined to one of the planes and parallel to the other plane. So, the moment we say that it is parallel to one of the planes. So, for example which is parallel to VP which means that the line is contained in a plane which is parallel to the vertical plane. It could be in front, it could be right in the VP, but it will remain parallel and then it makes an angle with the horizontal plane.

So, for example, if you will see it from the front it will be like this. So, it is parallel to VP and it is inclined to HP. Now this could be here, here anywhere and also the angle could change between HP the angle which the line makes with HP that angle may vary, but it will still remain parallel to VP. So, this is how the line could be front or in VP that is what we mean. The other position could be when the line is parallel to HP, but it makes an angle with VP.

So, in this case it is parallel to HP or a plane which is parallel to HP and it makes an angle with VP. Now, in this case either of the two cases we see that the line is parallel to one of the plane. So, if it is parallel to VP what do we see? We see the true length of the line and also the true inclination in VP because that is how it is. If it is parallel to HP then we would see the true length of the line in HP.

And also the true angle that it makes with VP in top view. So, that is what we are going to make and we will see how do we demonstrated, how do we put it on the sheet of paper.

(Refer Slide Time: 03:01)



So, let us assume another line just like we did for the previous lecture and set certain conditions for ourselves. So, for example, we again take a line which has a length of 8 centimeters or 80 mm that is one condition. In case 1 we say that it is parallel to VP and makes at an angle of 30 degree to HP that is what the condition is. And then we can also say that it is 3 centimeter in front of VP and lower point is 3 centimeter above HP.

Now, let us start drawing step by step. So, the first thing that we do is to decide where our axis is coming. So, we would draw an axis. Now, we have a line which is 8 centimeter and it is parallel to VP. It is making an angle of 30 degree to HP. So, what are we going to see? We are going to see the true length in VP.

And also the true angle in VP. It is at 3 centimeter in front of VP and lower point is 3 centimeter above HP. So, let us first start drawing 3 centimeter the lower point is 3 centimeter above HP which is what we are going to be seeing in VP in the front elevation. So, this is what we have made. Now it is making an angle of 30 degree to HP. So, let us set our set square to 30-60 you could use 30-60.

Now it is making an angle of 30 degree to HP. So, we draw a line at an angle of 30 degree and we mark 8 centimeters that is the length of the line. So, we mark 8 centimeters here which is the actual length of the line and also the projection as would be seeing. So, we just

darken this line here and we draw the projections. So, we draw the projections here. Now it says so what we have done?

We have drawn 30 degree to HP, we have drawn it parallel to VP that is how the true length is seen. Now the only thing which is remaining is 3 centimeter in front of VP. So, which means that we will mark another line 3 centimeter in front of VP. Now since it is parallel to VP, we are going to have a line which is parallel. So, we have the top view as this. Now, this is what the entire drawing is.

And suppose we also have to make the side view of this given condition. So, we have taken the projection of the top view on to the side plane and then we just match the projections for both the given points. Let us start labeling them. Now, since it is parallel to VP let us start labeling the VP first. So, we have an a dash b dash here. In the top view, we will have an a b here.

If we project a this is the point that we get as a double dash and if you look at this projection of b it meets up here which is going to be your b double dash and this a double dash and b double dash is the projection of the line on side plane. This is the overall projection now we have to dimension it what all are we going to dimension? We are going to dimension the true length of the line.

Now where is the true length of the line seen? It is seen parallel to the line in elevation. So, we will have an inclined dimension here. We cannot write it straight. So, we will do we will mark a dimension which is parallel to the line in elevation. This is how the dimension will be marked. So, this is the true length of the line which is seen here so we are marking it here. The other thing that we had was this angle to HP.

So, we will mark this angle to HP and we write 30 degree. So, it marks that there is an angle which this line makes to HP as 30 degrees. When it says it is 3 centimeters in front of VP and lower point is 3 centimeter above HP for this we will have to draw a dimension line on the side to represent both these conditions. So, what we have is 30 in front of VP and 30 above HP.

This is the final drawing. Now, we will not dimension this line because this is not the true length of the line. This is a projection which is definitely shorter than the actual dimension of the line which is shown here in VP. In the side view also, we will not have the true dimension seen. Now another thing that you can visualize here is that this line which is parallel to VP is in a plane which is perpendicular to the side plane.

And hence we will see a vertical line. Whenever, the line is contained by a plane which is perpendicular to a plane we will only see a straight line of a dimension the trace of that line will depend upon the angle it makes with the other plane that is how we will be doing it. Now we quickly finished the labeling this is our reference line. This is VP, this is HP here and this one is left hand side elevation here.

This is what our drawing is. This was very simple case another case we will take where the line is now inclined to HP. So, the case 2 here is where the length of the line remains 8 centimeters it is parallel to HP at an angle of 45 degree to VP. It is 4 centimeter in front of VP or we should say the nearer point is 4 centimeter in front of VP and it is 2 centimeter above HP.

Now, we have the XY line so where do we start from? We will start from HP that is the top view because it is parallel to HP and it is 4 centimeter in front of VP the nearer point is 4 centimeter in front of VP. So, in this case we are starting with the top view now. We will draw the line starting from a point which is 4 centimeters in front of VP. It is inclined at an angle of 45 degree to VP which means this.

So, there is a line on this inclined we will measure 8 centimeter which is the true length of the line and this is what will be seen. So, we have this actual length the true length of the line as seen here and then we will draw the projections to be taken to the elevation and also if we wish to draw on the side planes. So, we have represented this condition 4 centimeter the nearer point is 4 centimeter in front of VP.

The length of the line is 8 centimeters it is parallel to HP at an angle of 45 degrees here and it is 2 centimeter above HP. So, we just draw this last dimension, this last information which is 2 centimeter above HP and then we get a line here which is the projection of this inclined line which is making an angle of 45 degrees with VP. This is the projection. Now let us label this one.

So, we start from the plane where it is parallel to HP a b now as it goes up it becomes a dash b dash and now we will take this projection on to the side plane and now we will match up the projection. So, this is the projection coming for point a so this becomes a double dash this is the projection for point b and also the projection of point b which is b double dash and so what we have here is this projection in the side plane which is a double dash b double dash.

Now, this is absolutely scientific because what we are seeing here is totally unambiguous. The projection of a in plan will always meet up with projection of a in the elevation to result in the side elevation there is no ambiguity about it. In vertical also we can see that the projection of a will not result in a point b. The projection of b will not result in a point a so that is how we will always draw unambiguous very clear.

And it is a standard format in which we are going to be doing things. Now, we will write the dimension of this line which will be shown parallel to this inclined line. So, we draw this dimension line. Now, there is a slight change in how we represent dimensions. If you remember correctly I had told you that we should always draw dimensions and write the unit, the actual dimension measurement on it away from the line.

So, what we are doing here now is since the drawing will be seen from this side it will become opposite. We will not be able to see it clearly. So, that is why in this case we will be mentioning the dimensions here in between the dimension line and the actual object which is a rare thing to do, but in certain cases like this we might be needed to do that. So, if we write 80 below it that is not the correct.

If we invert it then it will be very difficult to read. So, the whole point is about the clarity of the drawing, its readability and for which sometimes these exceptions may occur. The other

dimension we will mention the other two dimensions. So, it was 2 centimeter above HP. So, we have 2 centimeter above HP and the nearer point is 4 centimeters in front of VP. So, we have 4 centimeters in front of VP.

This is our XY which is the reference line, this is VP here, this is HP here and this one is left hand side elevation. I am writing all these without guidelines, but ideally you should never be writing without guidelines until and unless your hand is very firm and you are well versed with how to draw things and how to write. So, until then you should not be doing and write up without the guidelines. Always have guidelines.

So, these are the two cases which we will get if the lines are inclined to one of the plane and parallel to the other plane. The only change in this could be where the line is in a plane. So, for example, in the first case suppose the line was not just parallel to VP, but it was in the VP. In that case if the line was in VP then we will have this line which is in the top view merging with XY.

So, it will be in VP at a height of say 3 centimeter above HP, but the moment it is contained in VP this line this projection will shift to XY and we will have a darker line here as this vanishes that is the only change. Similarly, if we have this line which is not just parallel to HP, but it is contained in HP in that case this trace which is the front elevation will then merge with the XY line the reference line everything else remains the same.

It is 4 centimeter in front of VP. The only thing that changed was it is 2 centimeter above HP. So, instead of 2 centimeter above HP it is now contained in HP which means it is at zero distance from HP. And hence this become zero and the line mergers here. In this case, even the side view changes and the side view line also merges with the reference line because it is in HP.

So, that is how we would be drawing the projections of inclined lines. Now, one thing which I should emphasize and you should be very careful about this is as you see when I draw all these drawings there is a distinct thickness to each type of line. Always I will repeat and your sheets look very good when you vary the thickness. Even if you go ahead and start working

on CAD, you will be required to select the correct thickness and that is the essence of a good drawing.

So, we do not color our sheets in engineering drawing. We do not make them fancy, we do not decorate them, ornament them. This variation of thickness, proportions of the font is the beauty of these sheets. So, you have to pay attention to that always the darkest lines will be the ones which are the projections of the actual object. Then next one comes the reference line then the dimension line.

And the last and the thinnest of them all are these projection lines which are just the guidelines and nothing else and in case you are drawing these guidelines for writing the text then those guidelines are also as thin as projection lines or even thinner than them. They should not be seen they are just to guide us. Another thing that you have to keep in mind is the font size of these.

So, the labeling of the sheet has to be appropriate it has to be appropriate size. If you make too big letter if the font size is too big then that will dominate. If the font size is too small then it will not be readable. So, we have to have a balance between what size of font will be used. It has to be just proportionate to make your drawing look good and then the drawing has to be distinct.

Here I have made it continuous. However, if you have say 4 problems to be drawn on one sheet you should first see that how much space would each problem approximately require and then divide the sheet in four equal parts or unequal also in case one problem requires a bigger solution. And then you should center your drawing in that space available. So, preferably the XY line for problems the solutions should be almost in the same line.

And then the rest could vary. It would make your sheets look good and also more readable. So, the point is not just about the technical correctness, but it is also about how do you make your sheets look better? Another word of option is I am familiar with how to draw. So, I can directly darken the lines here, do not copy me here you should always make the entire drawing in very light almost as dark as the projection lines.

And then gradually start darkening it from light to dark. The darkest line should be drawn in the last so that they do not smudge. To come up to this level where we can directly darken it you have to have a lot of practice and after practice of course you can work that it will be much faster, but until then draw it all in light and then gradually darken it and the last thing that should be darkened on your sheet is the border.

I am not making the borders here, but if you are to make the complete sheet for say submission in your class you need to make a border right everything which should be the last thing that you should be doing. Darkening of the border light border you could do dark borders you should do it later. So, that is all in the class today. I am hoping that you are following all that we are teaching in the class here with drawing at your end.

So, you could be drawing using anything it could be T-pulley as I repeatedly say, it could be a mini drafter anything, but just get familiarize with the process of these projections. So, with that I will end my lecture today. See you again in the next lecture. Thank you.