Engineering/Architectural Graphics – Part 1 Orthographic Projection

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

Lecture – 14
Orthographic Projections: Introduction to Projection of Lines

Good morning. Welcome to this 4th lecture of week 3 for this ongoing online course on architectural graphics or engineering graphics. And we are discussing orthographic projections. In the last lecture, we saw about the orthographic projections of points in different quadrants.

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Now for the past couple of lectures I have been explaining to you the concept of quadrants using this quadrant system. And I got a few queries from some of you saying this is little confusing. Now, I should clarify it right here. What I have been explaining so far is that this is first quadrant, second, third and fourth while I was looking at this quadrant system from my side.

So, my right if I look at the quadrant system my right top is the first quadrant. If you look at it from your angle you should always hold the quadrant system like this. The top right to you would be the first quadrant and if you go in anti-clockwise direction first, second, third and fourth that is how it is. So, whatever we have been explaining please do not get confused as you see it like this then this becomes your top left.

While the first quadrant is actually the top right and then we go anti-clockwise first, second, third and fourth. And it still folds the same way everything else remains the same. This is just to clarify that the top right of the quadrant is your first quadrant.

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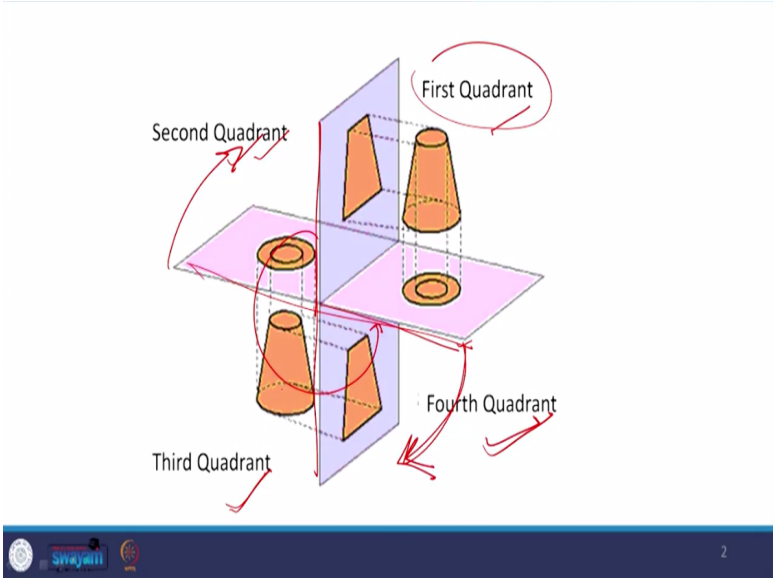

If you look at it on the screen also then the top right. So, this is the quadrant system and your top right becomes the first quadrant and as you go in the anti-clockwise direction the second, third and fourth come and we fold it in such a manner that the elevation and plan both come together above reference line in the second elevation and elevation and plan both come together below the reference line in the fourth quadrant.

And for the first and third it just reverses. So, I just hope that this idea of quadrants is clear to all of you now before we move on to the more complicated problems. So, now that we have this idea of projection system, these different quadrants clear. We will now move on to projection of lines. So, today I am just going to introduce the projection of lines to you. So, the points they make up a line and the lines would come together to make up planes.

And all these planes would come together to make up different solids as we have been seeing. So, if you see cube I take example of cube because it is the easiest to understand. So, if you look at this cube it is made up of 6 flat surfaces. These are planes. Each flat surface is a plane,

but at a different angle placed together. This is the simple solid if you look at say a hexagonal pyramid, a cone with a base of hexagon in that case we will see triangular planes.

So, each of the plane surface is triangle and a hexagon in the base. Now, these are all arranged at different angles. These are planes the edges where they meet are lines. The apex of the cone or the vertex of the cube is a point. So, ultimately we are talking about projections of points and lines and planes which when put together appear to be solid that is what we are doing here.

So, understanding the projection of points and lines is fundamental and absolutely important. So, now these lines could be placed in the first quadrant, this is what we are considering in multiple ways. So, let us look at some of these ways in which these lines could be placed.

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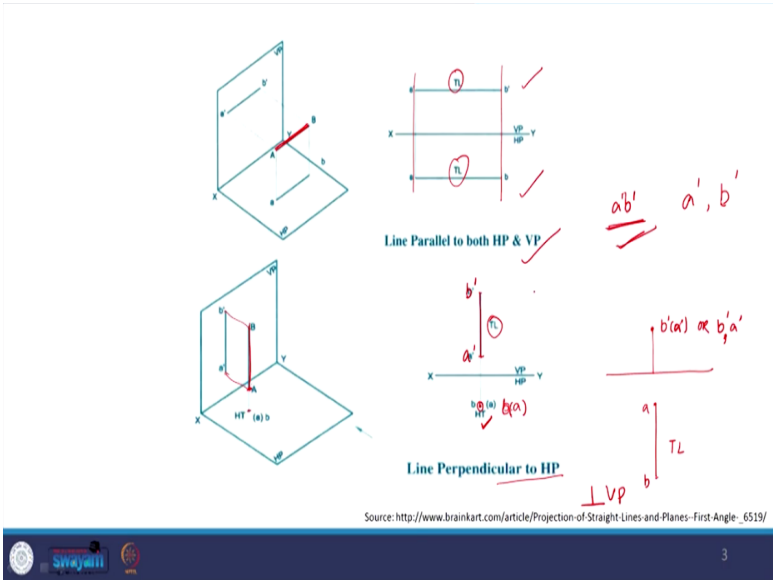

The first one which is very simple is when the line is parallel to both HP and VP horizontal plane and vertical plane. So, when the line is parallel to both HP and VP in the first quadrant the line is parallel to both HP as well as VP this is the line. It could be anywhere again we could see that the line is 5 centimeter in front of the VP, 5 centimeter above HP whatever it is it is parallel.

And the principle is that anything which is parallel to a plane will be seen in its true dimension on that plane. So, now in this case this line is parallel to both VP and HP. So, we

will be seeing the true dimension in the line in both HP as well as VP. So, if you look at the screen this is the line that we are talking about it is parallel to both VP as well as HP and if you look at the projections.

These projections will match which is the fundamental of orthographic projection always and we will see the true length in both VP as well as HP. This is what we will be seeing if the line is parallel to both HP and VP. Suppose, the line is perpendicular to one of the planes. The moment the line is perpendicular to one of the planes we will be seeing a point that is in case of a line.

So, just imagine that there is this line which is perpendicular to HP. As you see it from the top in the front since it is parallel to VP it is perpendicular to HP, but parallel to VP we will be seeing the true length in vertical plane, but when we look at this from top. If we look at this from top we will only be seeing a point because the line does not have any thickness. So, what we are seeing here is this is a line which is at some distance from VP which is what is seen.

And it is at some height from the horizontal plane. So, what we will see in the projections. In elevation we will actually be seeing the true length because it was parallel to VP while in the horizontal plane we will only be seeing a point which is the horizontal trace it is called the trace. So, in horizontal plane the trace of the line is just a point. Here, if you look at this in the plan if you see both point A and B are coming together.

So, if you look at this line again. Suppose, I say that this line is AB where the tip of the pencil is A and top of the pencil is B. So, if I see it in plan I will actually be seeing only point B and there is an point A which is below B. So, I may write here B, A or I could write B and A in bracket which means that B is visible and A is not seen it is beneath B. However, in elevation as the nomenclature is we will see B dash and A dash that is when the line is perpendicular to HP.

Suppose, the line is perpendicular to VP and parallel to HP. So, what we would be seeing it is perpendicular to VP and parallel to HP. Since it is parallel to HP where would we see the true

length of the line? We will be seeing it in the HP because it is parallel here. And in VP, we will only be seeing a vertical trace which is a point in this case. So, if the line was perpendicular to VP what would we see and parallel to HP we would see the true length of the line here say a line a b.

So ‘a b’ and in elevation at whatever distance whatever height it is from horizontal plane we would be seeing B dash in bracket A’ or B‘A’. The moment we place a comma between two points being represented it means they are two distinct points. However, if we write A dash B dash it implies it is one single line if we have a comma in between if we write A dash, B dash it means these are two distinct points A dash and B dash.

While if we write A dash B dash it means that this is one single line. So, if the line is perpendicular to VP here we will see this while if it is perpendicular to HP we will see like this very similar, but just flipped.

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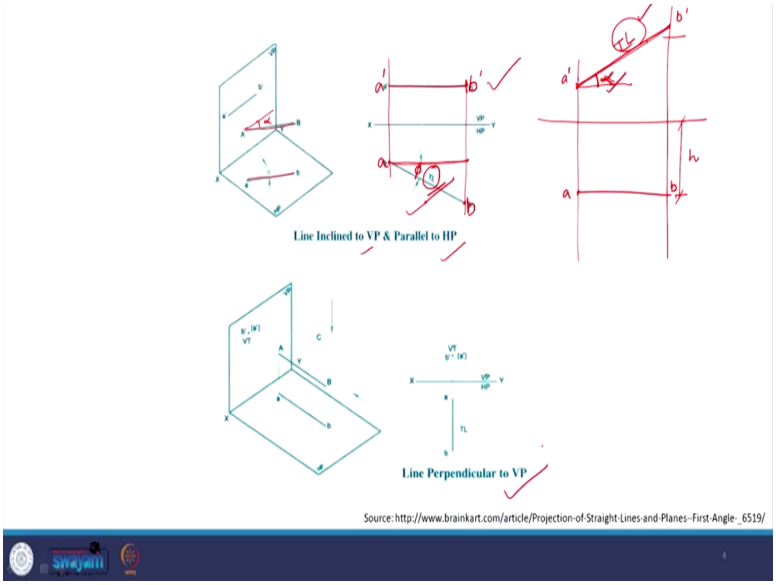

The lines could also be making a certain angle with one of the planes. So, what we can have? We can have a line which is parallel to HP, but it makes a certain angle with VP. Now it could be in HP, it could be anywhere, but the plane in which the line is it is parallel to HP and it make certain angle with the VP which is what we see here. So, it is making a certain angle say alpha with VP and it is parallel to HP.

Now, if it is parallel to HP what are we seeing? We are going to be seeing the true length of the line in horizontal plane and we will see exactly the same angle okay this was theta here. So, the same angle which it makes with VP being represented here and what will we see in vertical plane. We will see a reduced version of this line. So, we will see a b here so we have a and b here.

And in elevation we will see a dash b dash, but while a b is the true length we will not be getting the true length in a dash and b dash. So, what do we do? We will always start with drawing the true length first wherever we are seeing the true length first that is what we will be drawing. So, we draw the horizontal plane. First the plan and then we will draw the trace the elevation in the vertical plane that is what we will do.

So, wherever true length comes that will be drawn first, what if the line is parallel to VP, but it makes an angle with HP. So, if say the line is like this slightly projected to the front what would we see? It would just be a reverse. So, we would actually be seeing the line in its true length. So a dash b dash making an angle alpha which is the angle that the line makes with the horizontal plane and then we just project.

And at the distance which the line has from the VP say h this is what we get as the plan. It is going to be a reduced length while here we would be seeing the true length. So, when we define this problem any problem for that matter what we would say a line of say 10 centimeters is parallel to VP and makes an angle of 45 degree with HP. So, there are three conditions.

We know that the line is 10 centimeters which is the length here. It is parallel to VP which means that the true length be seen here and makes an angle of alpha degrees with HP which is what we are going to see. So, whenever a problem will be given to you a question will be given to you a condition all the conditions stated in the statement of the problem shall be clearly indicated here.

So, the length of the line, the angle it makes and that it is parallel. So, somewhere the true length is seen. All these three are now seen here in this particular picture. So, this is when the

line is inclined to one of the planes and is parallel to one of the plane. We have already discussed about this condition when the line is perpendicular to VP.

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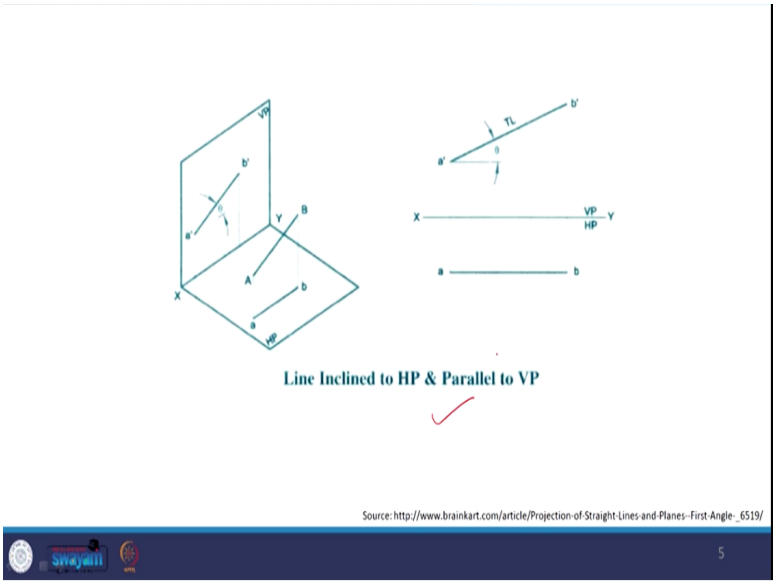

And we have also seen if the line is inclined to HP and parallel to VP.

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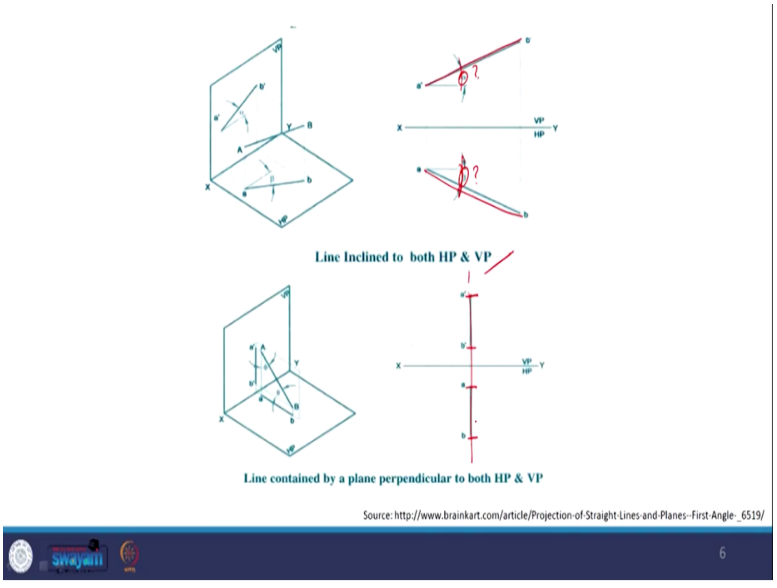

Now, what if the line is in inclined to both the planes. So, what we have we might be having a line which is say like this. So, it makes a certain angle with HP and it also makes an angle with VP. Now it will be making certain angles say alpha and beta with the horizontal plane and vertical plane, but in reality what we will be seeing here as a projection will not be these angles alpha and beta.

These angles would change, but what would actually appear is a line a dash b dash or a b at certain angles to both vertical plane as well as horizontal plane. Now, in this case we cannot be seeing the true length of the line anywhere in the final figure. So, to start with we will have to assume that the line is say parallel to one of the planes or perpendicular to another or say parallel to both.

And then we progress by revolving it inclining it to one plane and then inclining it to another plane, but in this case we will not be seeing the true length anywhere in the drawing that is when the line is inclined to both HP as well as VP. The other case where the line is inclined to both HP and VP is when the line is contained in a plane which is perpendicular to both the planes.

So, maybe if I have a line like this which is in a plane perpendicular to both VP as well as HP. So, the line is not perpendicular, but the plane is perpendicular and then we have a line. Now this line makes an angle certain angle with VP and it also make certain angle with HP. In this case which is a special case we will be seeing only two straight lines in one single line there will be just one projection because the plane in which the line is perpendicular to the HP as well as VP.

So, we will be seeing diminished length greatly reduced and we will not be seeing any angle or any true length of the line in the final picture. Again here we will be seeing, we will be assuming the line to be parallel to either of the planes and then start by rotating it. Now the moment we say that the line is inclined to both the planes we are basically looking at a solid angle.

So, it is not just an angle in one plane if it was we would be seeing it in true length and the true angle in one of the planes, but the moment it is inclined to both it is actually making a solid angle. We will see when we come to lines which are inclined to both the planes how the projections will be drawn, but keep in mind that we are talking about a solid angle ultimately a solid angle is formed when the line is being inclined to both the planes.

So, that is about the projection of lines all the varieties which we are going to cover in subsequent lectures. So, I hope you are familiar with what we are going to cover in the upcoming lectures about projection of lines and we will be starting with the lines parallel to both the planes and how to draw them. So, thank you very much for attending this lecture. See you again in the next lecture on projection of parallel lines to both the planes. Thank you.