Indian Institute of Technology Kanpur
National Programme on Technology Enhanced Learning (NPTEL)
Course Title
Engineering Graphics

Lecture-30
Intersection of Solids

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So last class I have started with this intersection of the solids, there is a pipe, pipeline, two pipelines, so intersection of the two pipelines how the surface looks like. Now we will go in details particularly in this case what we have finished till now.

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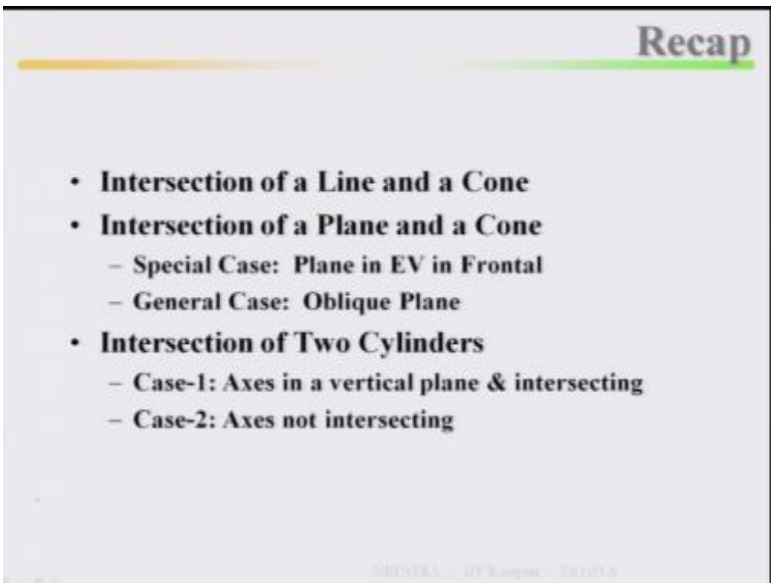

Intersection of a line and a cone, intersection of a plane and a cone, special case plane in edge view in frontal, general case, oblique plane, intersection of two cylinders, axes in a vertical plane and intersecting, axes not intersecting.

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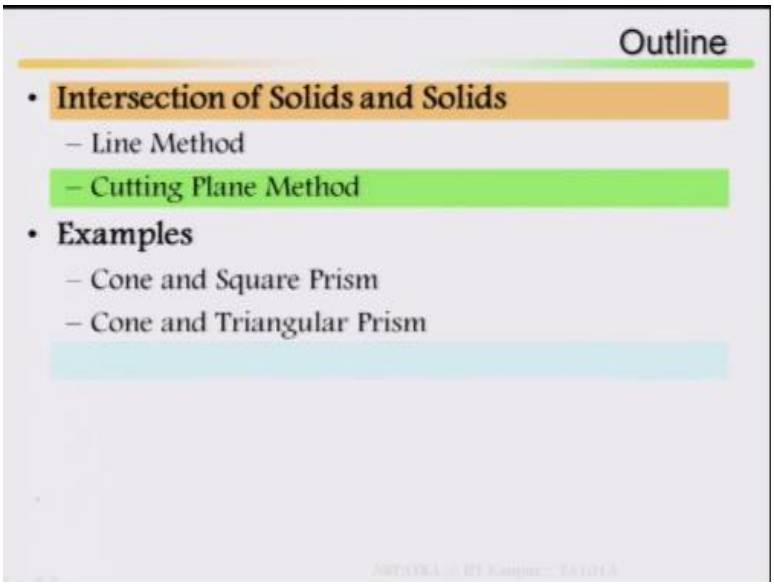

Now in this we are going to discuss intersection of solid and solids by means of line method, by means of cutting plane methods and few examples, cone and square prism, cone and triangular prism.

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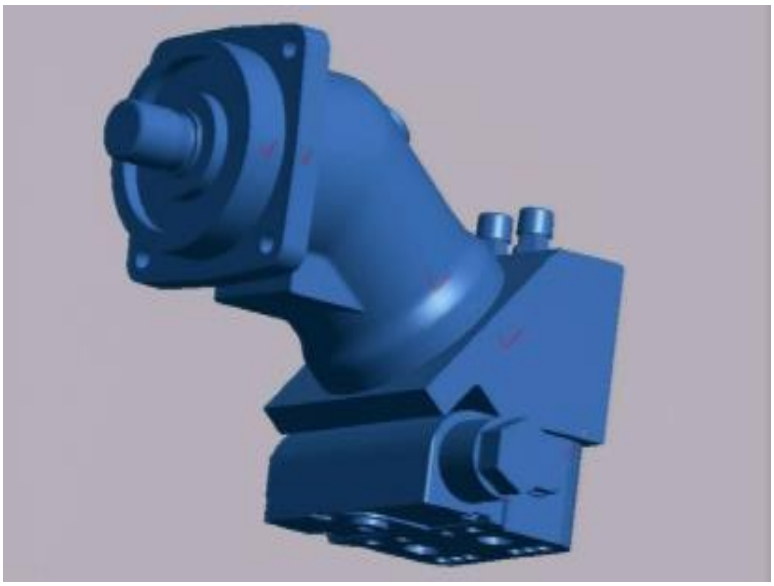

Look at here this is a machine assembly, means if you look at here from this part to this part, this part to this part, this part, these are all intersected. These are all merging, if you look at here there is a cylindrical shape, then there is a rectangular shape, this is where your intersection will come into picture.

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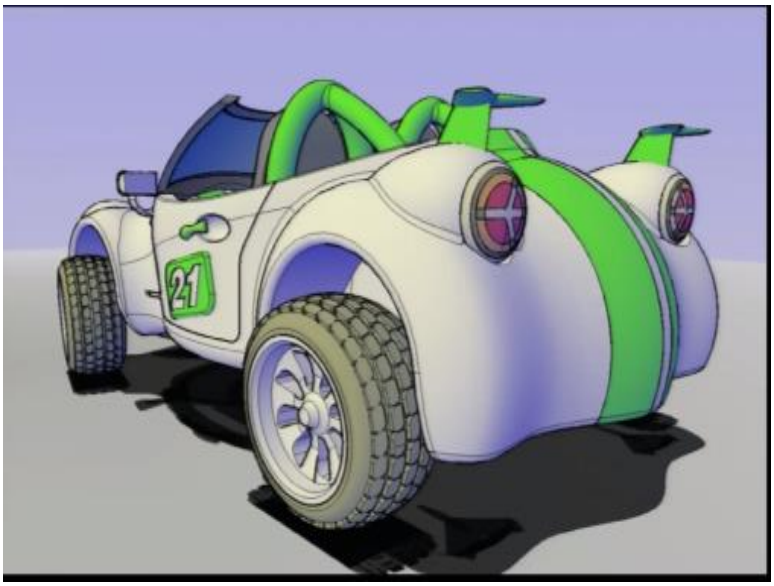

Now there is a vehicle also.

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Now let us start with solids and solids.

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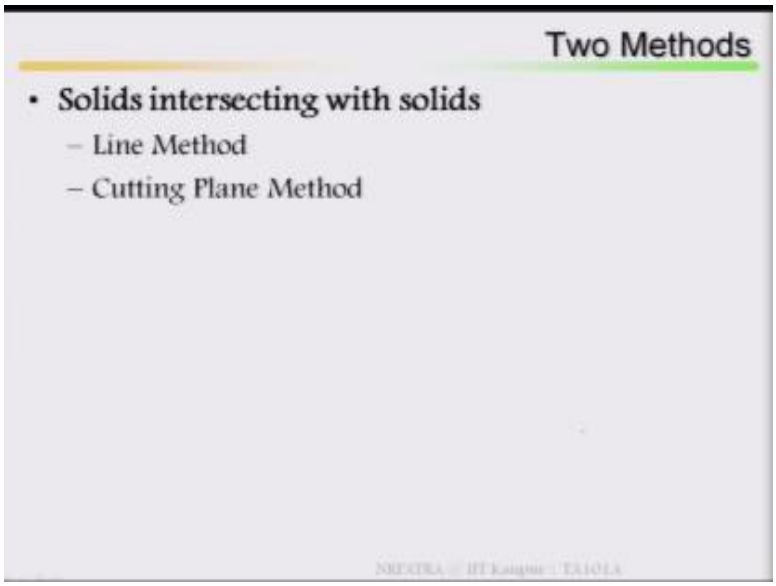

Solids intersecting with solids. There are two methods; one is by line methods, line methods we have covered. By cutting plane methods, cutting plane methods also we have covered, we discussed it, now these applications are -- will be applicable here, intersection of the solids.

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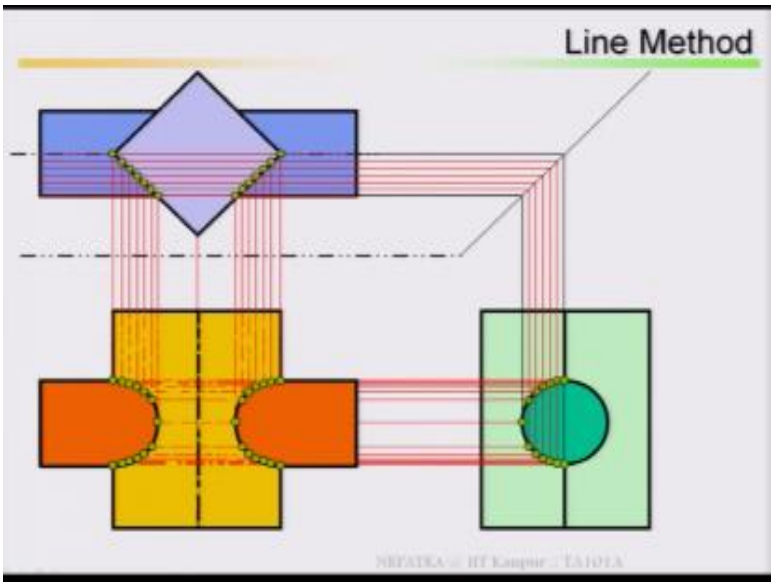

Now look at this by means of the line method, by means of line method look at here. Now by means of line methods this your top view, this is your top view, this is your front view, this is your side view. It has been projected back taking into this, if I take this circular feature with number of, number of points inside the circular feature and I project it back, from there it has been projected back, from here it has been projected back, how your intersection looks like? At the interface your intersections how the surface looks like.

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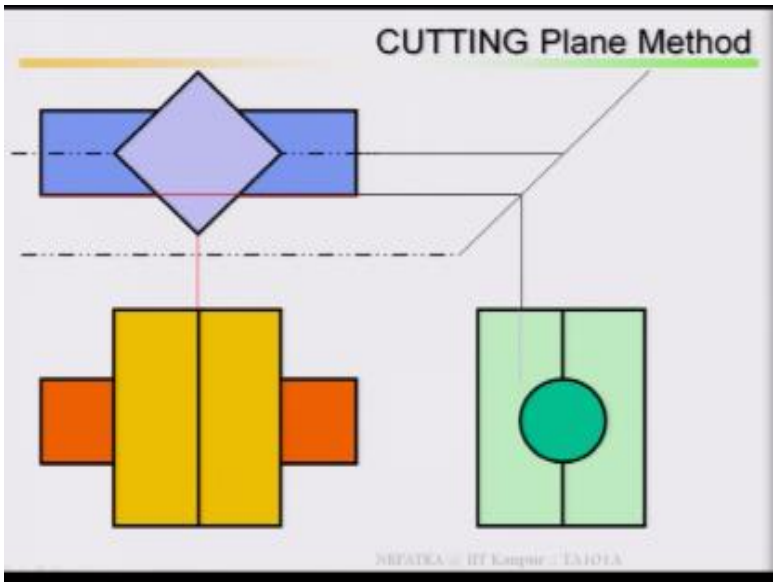

Look at here how the surface looks like.

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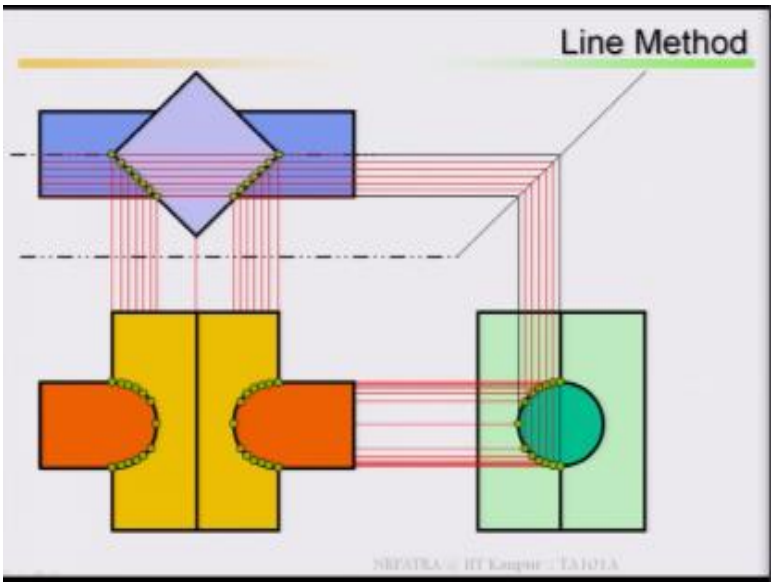

Now this is by means of line method, this is by means of line method, that means you take a line from your side view, project it back your top view, from top view you project it back front view, from here side view you project it back to front view, intersections and you mark it and draw, this is the surface, this is the surface at the interface, that means this solid and this solid at the intersections, interface, how your surface looks like? This is called by means of line method.

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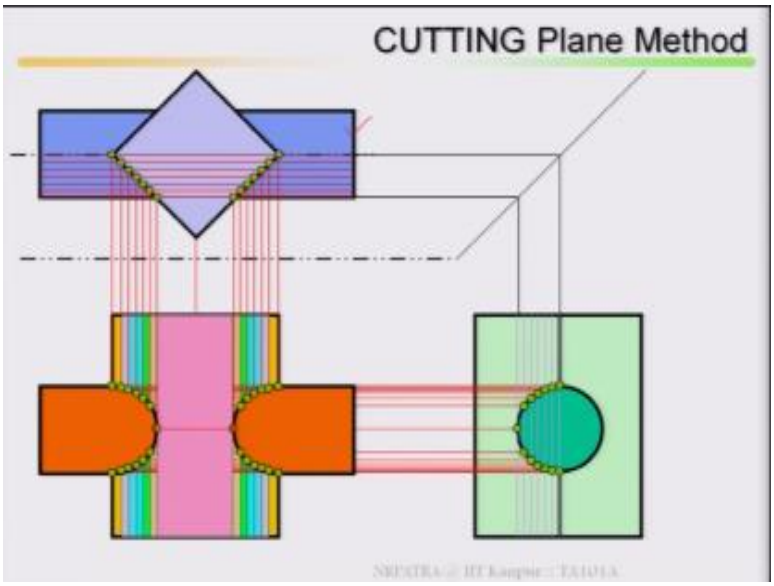

Now cutting plane method, cutting by plane method you take cutting plane, suppose this is one solid, this is another solid is going, there is a solid here one solid is going, take the cutting plane in between the intersection of the solids and I have taken one cutting plane here, then project it back how it cuts in your side view. Then you mark the point of intersection, from there you mark and you extend it to your front view, then mark your point of intersection in the front view.

And from there top view at this two point, this is your point of intersection project it back, where this intersect, from the side view, from the top view? At your front where it intersects you mark this two points, it has been marked. Then take another cutting plane then same procedure you follow, mark it then take another cutting plane, same procedure you follow and continue.

By doing this if you continue one by one then you see at interface how your surface looks like. This is at the interface particularly intersection of two solids at the interface how your surface looks like.

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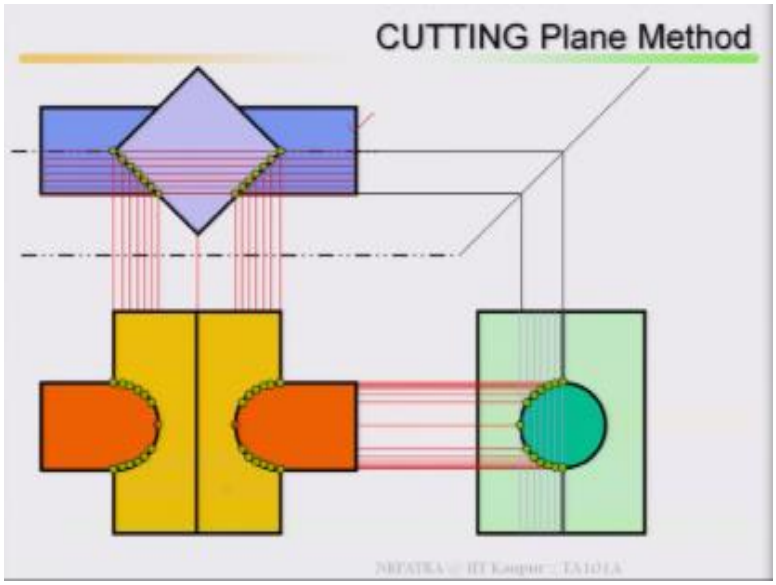

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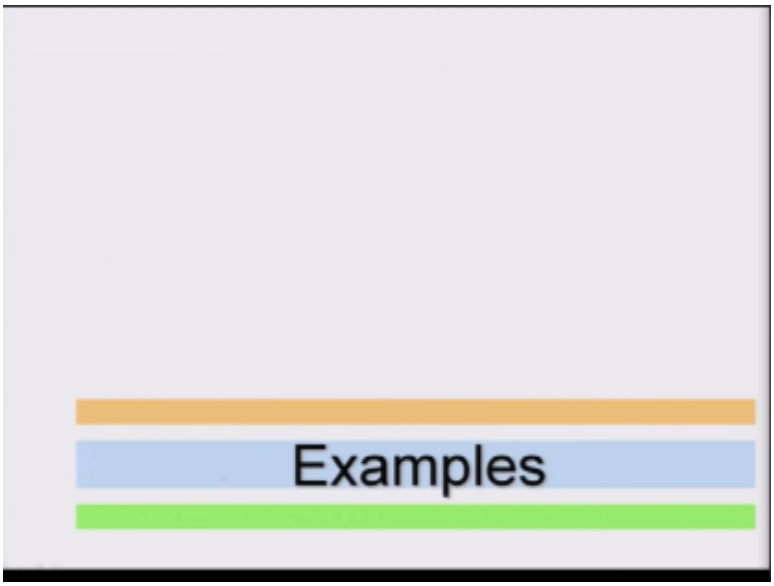

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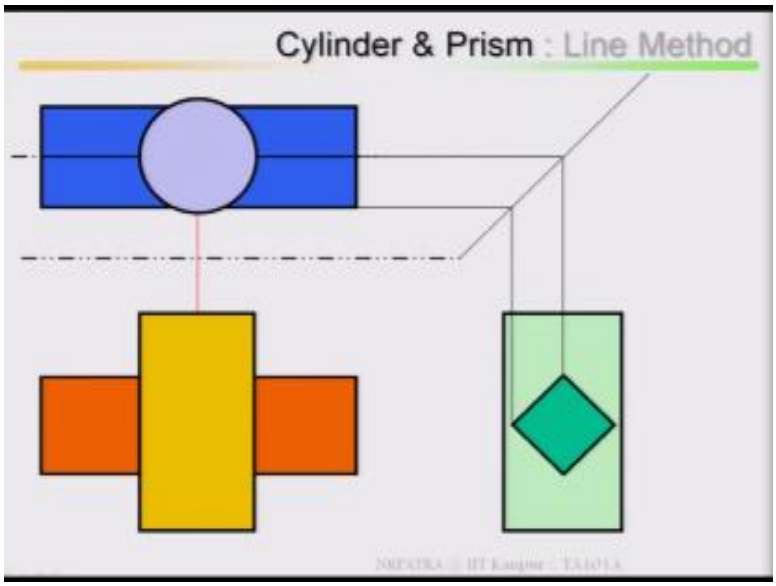

Now let us start with example cylinder and prism by means of lines method. Cylinder and prism, there is a prism, there is a cylinder, intersection between cylinder and prism.

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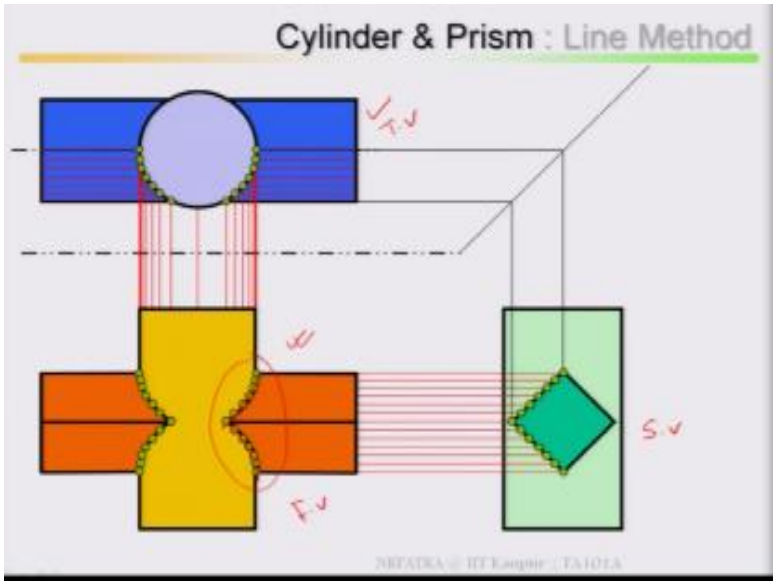

Draw the top view, this top view, draw the top view, draw the front view, this is your front view, this is your top view and draw the side view, draw the side view and from there with the side view take the lines, mark the points top and bottom, then project it back to your front view, project it back to your top view and this intersections points you mark it.

Take additional points, here take many of points, 1, 2, 3, 4, 5, 6, 7, 8, because this is, this is one side, this is other side, this is symmetry, you can take also symmetry, then mark it, point of intersection mark it, one by one you mark it, mark it, mark it, mark it, look at how it looks. At the interface, at the interface intersection between solid and solid how your curves looks, it looks this way and this way. How it looks, now look at here.

This is -- unless if you do not provide at the interface what is the intersections, how the surface looks like, then it will not be going to helpful for the designer to the design.

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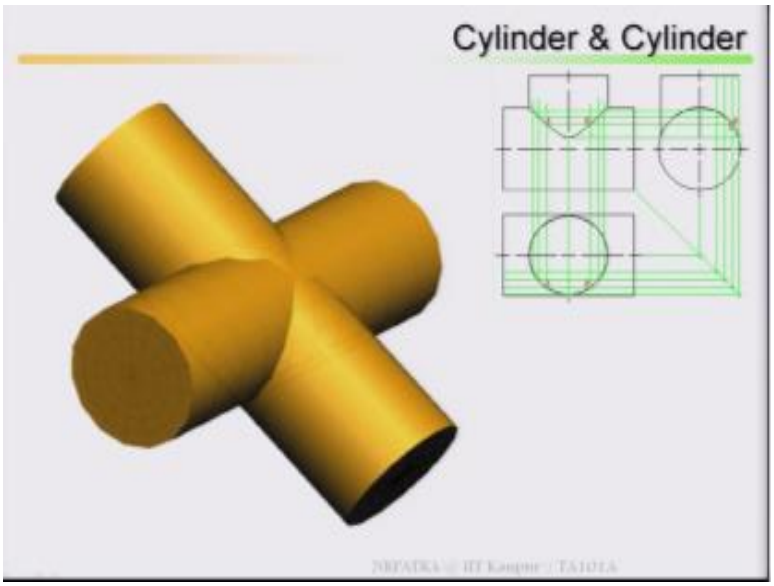

Now look at here, cylinder and cylinder, one cylinder is passing, other cylinder is passing, how it looks at your surface look at here, in color how in your surface it looks like.

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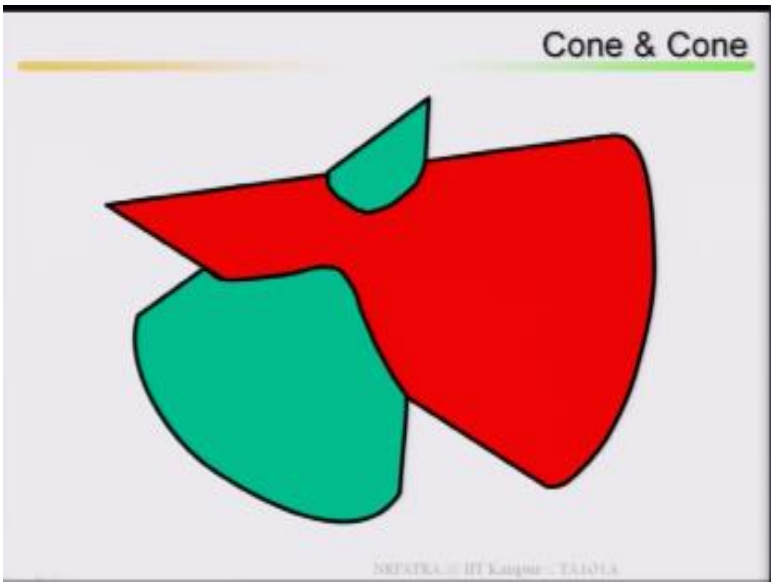

Now how it looks? Cone and cone, both the cones intersecting, it is a solid and solid.

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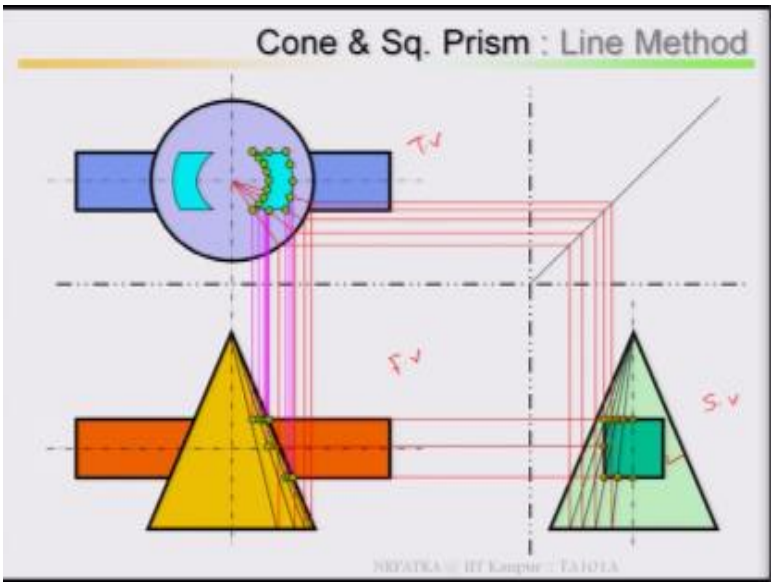

Then let us start with this, cone and square prism, cone and square prism by means of line method. Take your front view, take your top view, take your side view, in the side view mark the points, here, here, here, here, because inside this cone the square prism is there. This is your cone, inside the square prism is going. Now I divide this cone this half to this half into number of equal parts.

Now where is your intersection parts? This point has to be marked, if you look at here, one point at the center, second point, third point, fourth point, fifth point, sixth point, seventh point, eight point, there are points of intersection it has been marked in the side view. Then once you get this point of intersection from there you project it back. As this is a cone look at the difference, particularly the cone you draw and these are the lines, you project it back, it should be in the cone not in the square prism.

I project it back and mark it in the line of the cone; this is your cone in the top view. Then similarly once it is intersecting in the cone at the same, same points has been projected back to your front view and mark these points then extend it. Then from there look at here, once you

locate these cones first you look the different, if you look at here first I locate the cones, this cone different parts has been projected back your top view as well as side view.

Then go to your prism, square prism, then mark the point, from these points take out, this your external 1, 2, 3, you take out, then where it intersect, it intersect here, here. Then from there you project it back and respective lines, this line where it has been projected. If you look at this line has been projected with this line, from here to here, that means from this point you extend it where it got it exactly same line of the cone it has to intersect.

You mark it, continue, continue, continue, continue. Once you get one side then as it is symmetry, square prism that will be same as the both.

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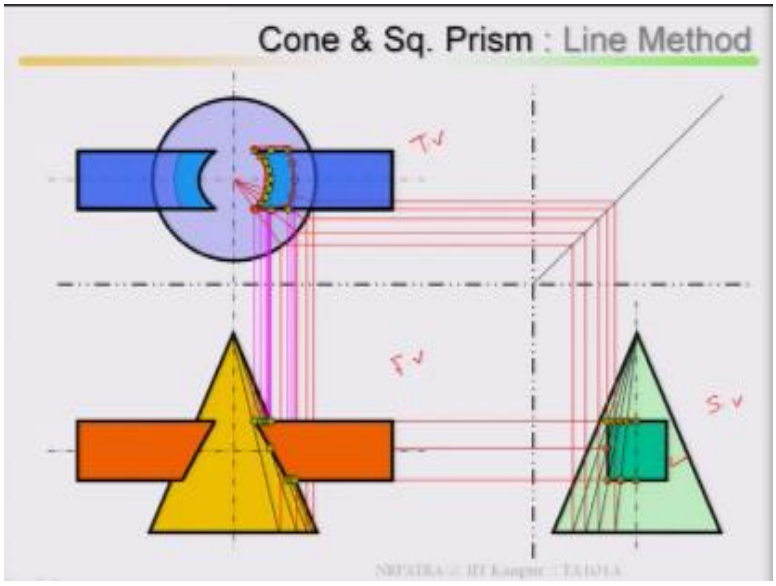

How it looks, look at here how it looks. It looks a curve of at the interface this, this, and this. It is symmetry, because the -- square prism is throughout this cone and it will be same.

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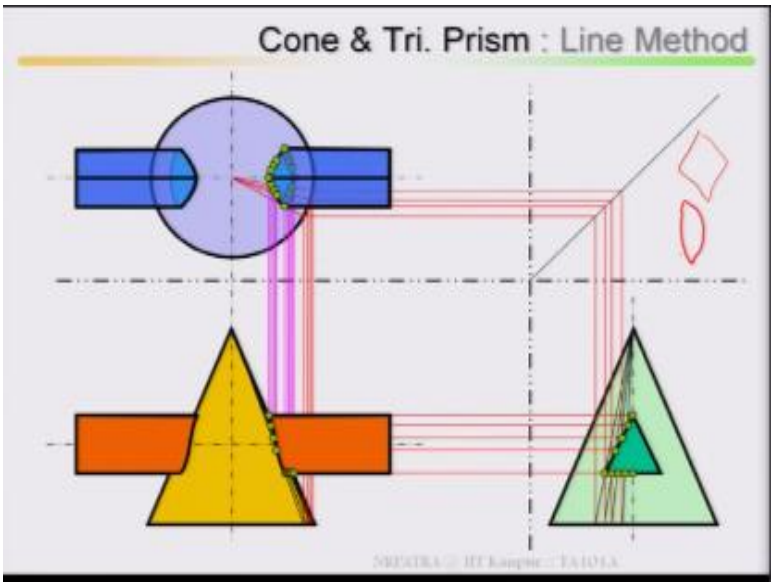

Now same intersection between cone and square prism by means of, intersection between cone and triangular prism. Earlier it was a square prism, intersection between cone and triangular prism example by means of line method, same way this cone has to be divided from there you project it back. Mark the points where is your intersections and from this projections you take out the cone and join it.

From there you put it, mark it, then project it back your point, line of intersections in the front view, in the front view and respective point of intersection has to be located in the top view. It has been taken and located in the top view and do it, as you have done it one side you can finish it other side also, do it how it looks. This is how you are supposed to get it. More number of points you are going to take it you should get a smooth surface like this.

Less number of points you will get it, you may get approximately this kind of things, but more number of points you are going to take it you will get a smooth curve here as well as here. So this is how in the interface the surface looks like, in the front view it looks like, in the top view it looks like.

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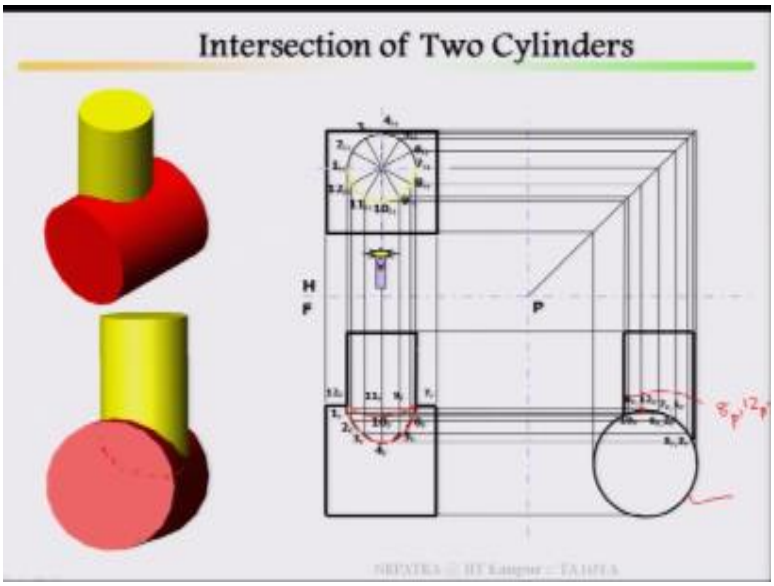

Next example is your intersection of two cylinders. Look at here there is one cylinder, then another cylinder is going inside. I rotate it, rotate it, then how it looks, then take it, finish it top view, this is your top view, this is your front view, this your side view, front view I have not drawn so what happened in the top view? Once you finish the top view outer cylinder mark, inner cylinder how it intersect you mark it.

Then inner cylinder you divide into number of equal parts so it has been marked 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12. 12 equal parts, then divide it, then you project it back to your side view, side view you project it back, inner cylinder has been projected back where? Look at here, inner cylinder has been projected back to your inner cylinder. This is your inner cylinder, if I take it side view out how it looks? This is your outer cylinder; this is your inner cylinder intersections so once I have the top view inner cylinder this has to be projected back to your inner cylinder.

Then mark this point, respective points so this is the ten point, this ten point will come, here it will be marked ten, so this is now 8 and 12, 8 and 12 will be here, here it will be this point will be 8 name it this way, 8 P′ 12 P′, what does it mean? 8.12. in the top view, project it back to your

profile view that is why it has been P for profile, 8P′, 12P′. Here 12H, 12 in horizontal view. Now once it is over then from there project it back to your front view.

How your front view looks like here, then from there, here it is a point of intersection of one point, one point here, here one point. Both you project it back here and here then you get the line of projections. Then similarly locate your 12^{th} point, because this is a 12 point 12 and 2 will be equidistance from here to here, so this will be 12 and 2, we will see. Then now similarly 3 we are talking about at the top 4, now similarly 5, now similarly 6, here and here it has been projected back.

Now similarly 7, now similarly 8, 9; 8, 9, 10, 11, 12 in the front view. Now look at here how it looks, look the animation, this surface is representing this surface. Look at how this animation looks like and because this is at here in the front view this will look as a dotted line, you cannot see inside how it is passing, inside how it is passing. That is why you cannot see it that is why it is a dotted line.

Here you are seeing it so this is your -- particularly if you look at here this is the surface at the interface between two cylinders. If you go it at step by step it is very easy. Number it, name it, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, same way you name it 1, 2, 3, 4, 5, 6, 7, 8, 9, 8, 10, 11, 12, then if you are projecting back one point here you have to project back one point here, similarly you can locate it all the points.

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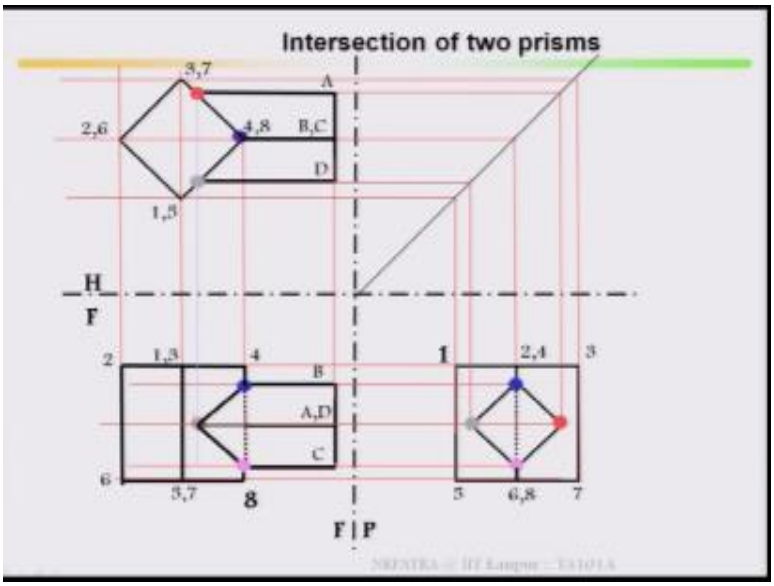

Now let us look at another example intersection of two prisms. This is your top view, I name it 1, 2, 3, 4, 5, 6, 7, 8, this is your front view 1, 2, 3, 4, 5, 6, 7, 8, now this is your side view. Now inner prism, outer prism, outer prism you mark it A, B, C, D, similarly you can mark it A, B, C, D, in the front view. Similarly you can mark it in the side view what is your A, B, C, D, then start with one by one point.

Point of intersection start it and locate it. This point you have taken, it is your inner prism, you take it inner prism, project it back, this is your inner prism. Then similarly both the outer line of the inner prism - you one by one point you mark it.

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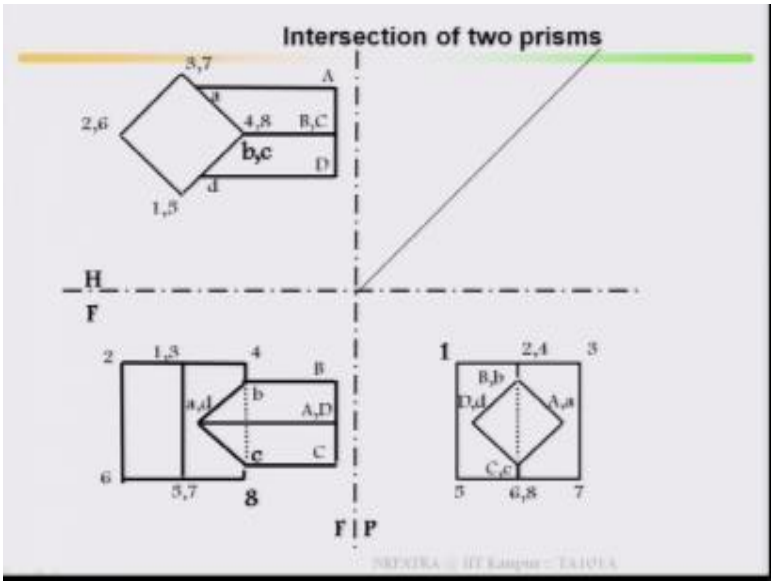

Look at how it looks, this is how your interface, how your surface looks like.

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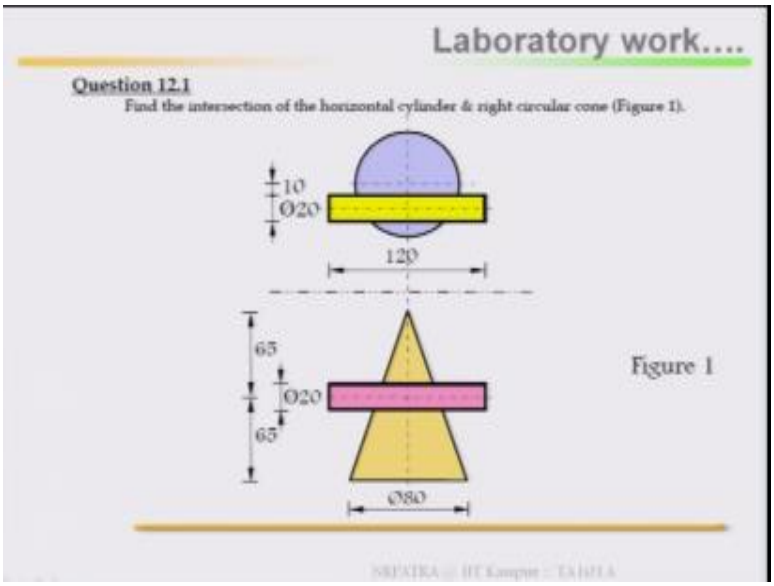

There are a few laboratory examples I have given, you can try in your hostels and solve yourself then you have your answers.

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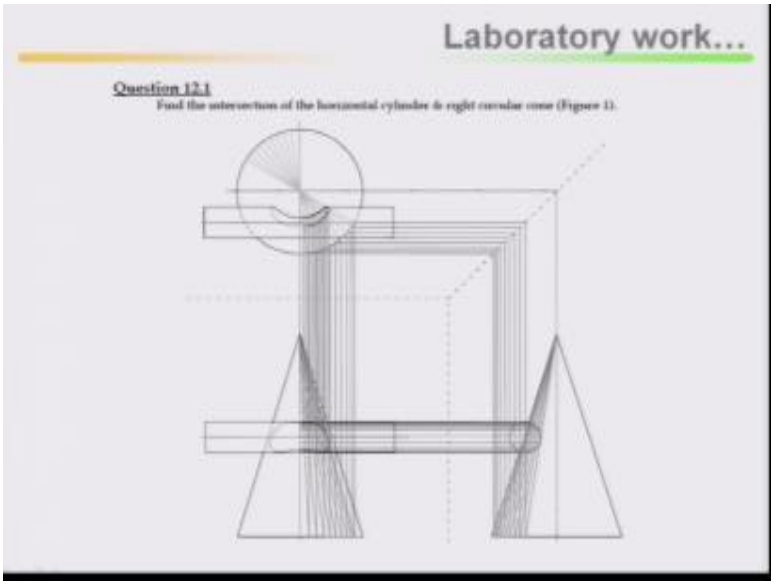

This is your 12.1 from how, what is the solution.

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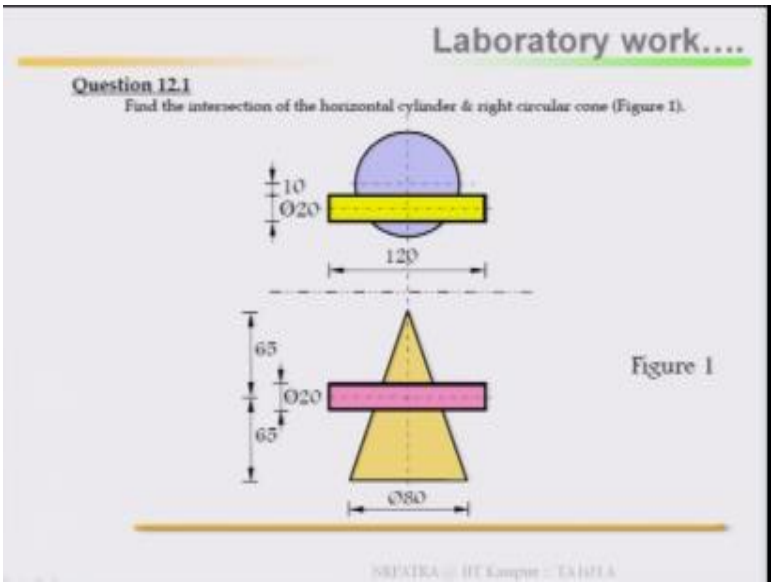

This is your questions.

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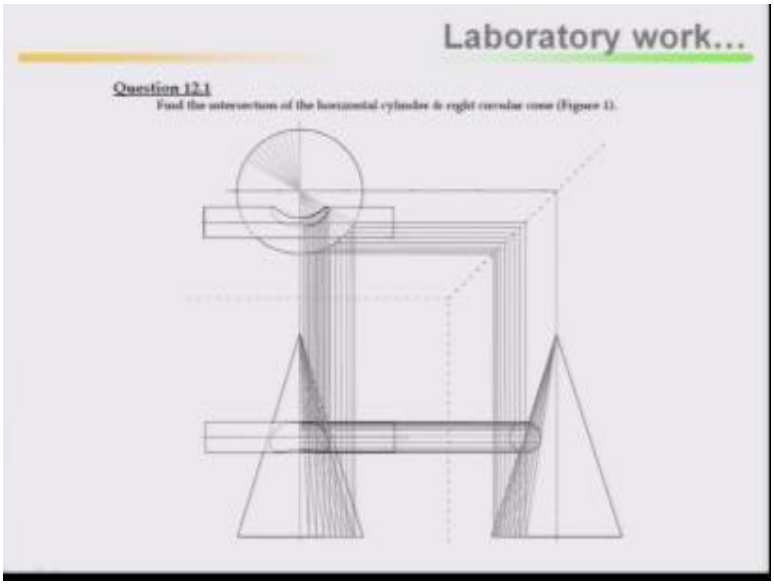

How your solution comes out.

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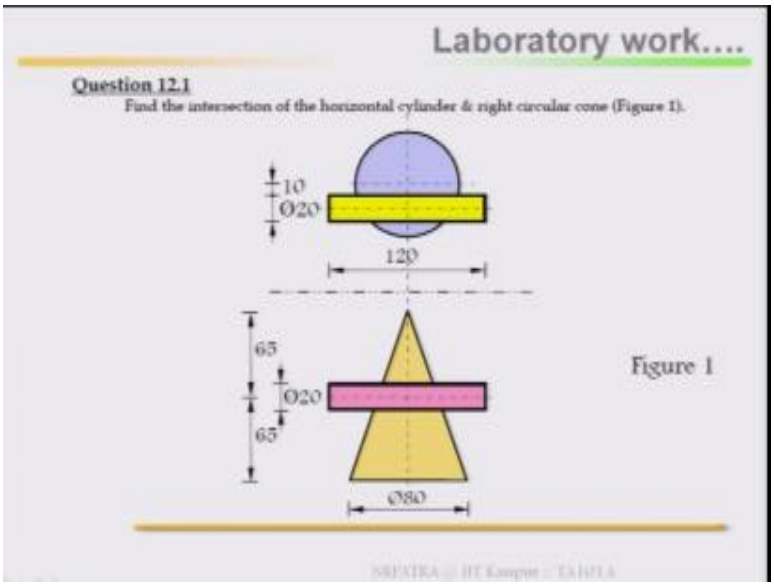

Look at here this is the questions, top view and front view has been given.

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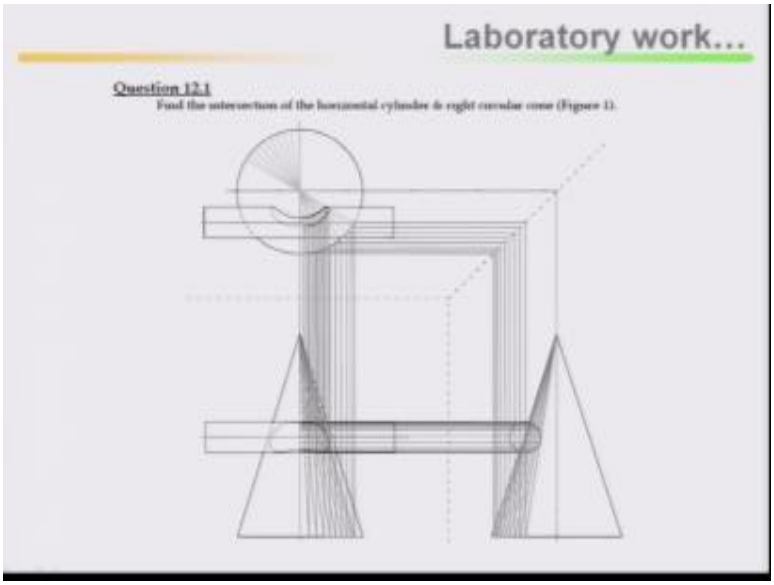

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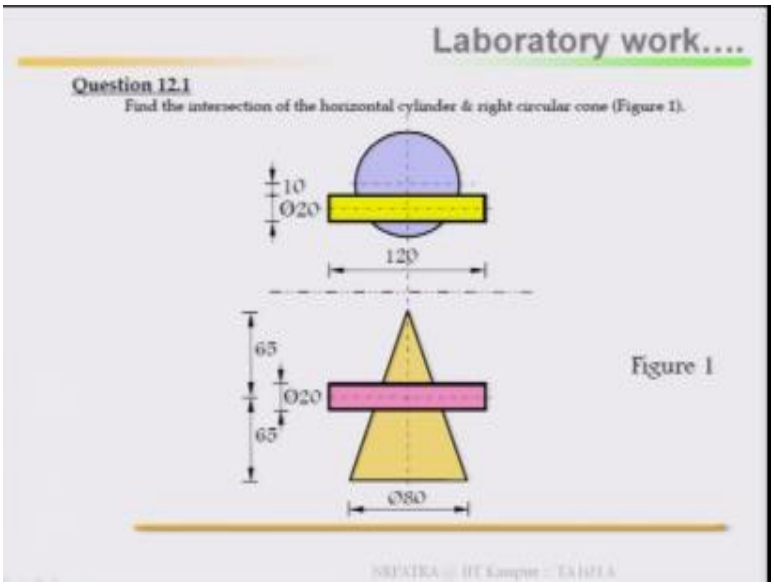

So you take it.

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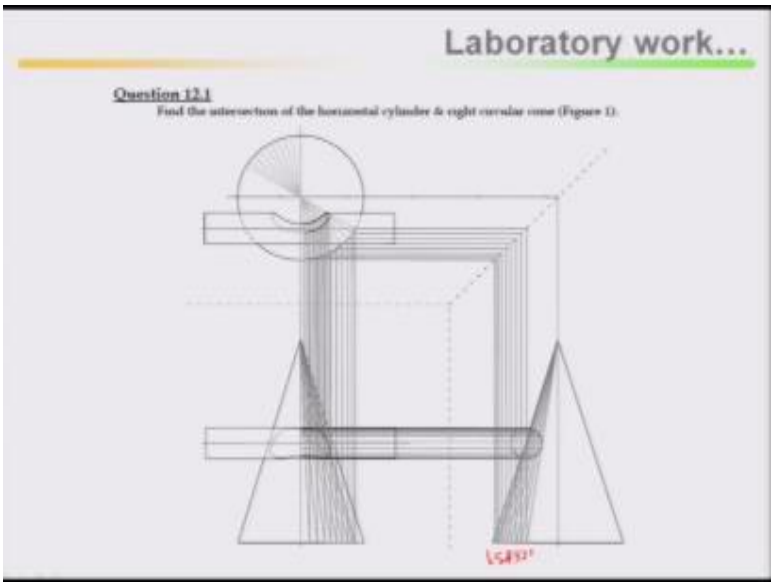

Top view front view and side view draw the side view same way find it out point of intersection draw the lines project it back then project it back, how in the top view interface looks like the surface. How in the front view it looks like. We have taken many number of points to get this smooth surface you name it, 1, 2, 3, 4, 5, 6, like this continue and you will get it.

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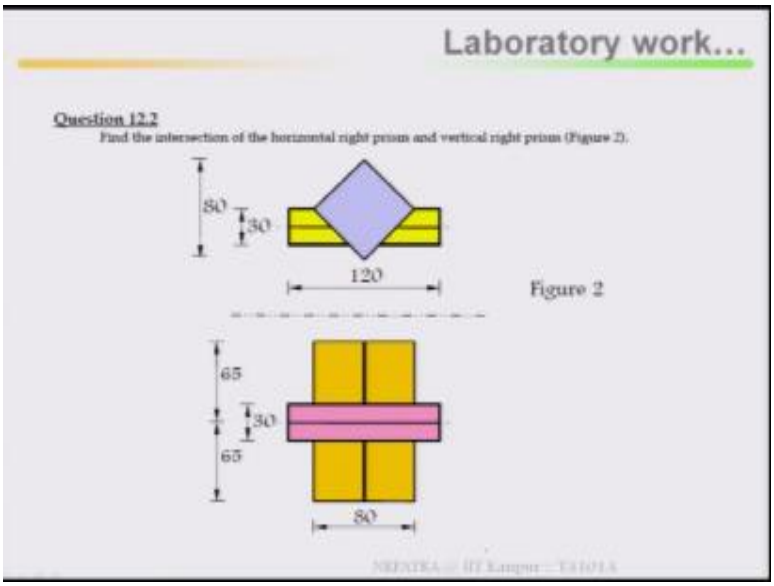

Same questions I have given find the intersection of horizontal right prism and vertical right prism.

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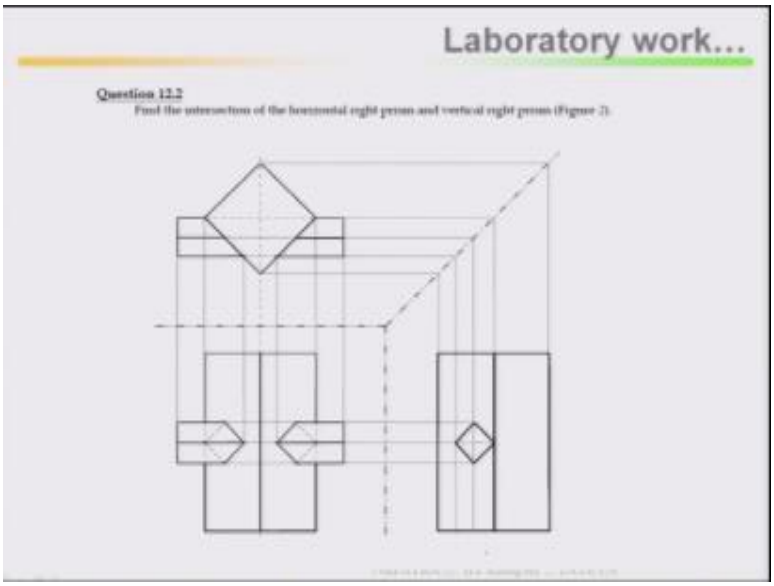

This is the solutions you are suppose to get it.

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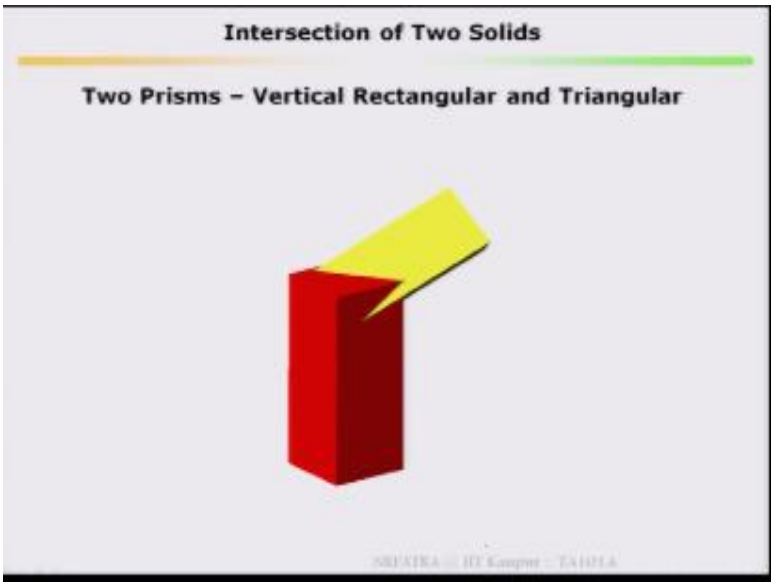

Two prisms slightly complicated, vertical one prism is vertical rectangular and other prism is triangular, vertical rectangular other prism is your triangular how it looks two colors. How this surface looks in the interface in the top view in the front view.

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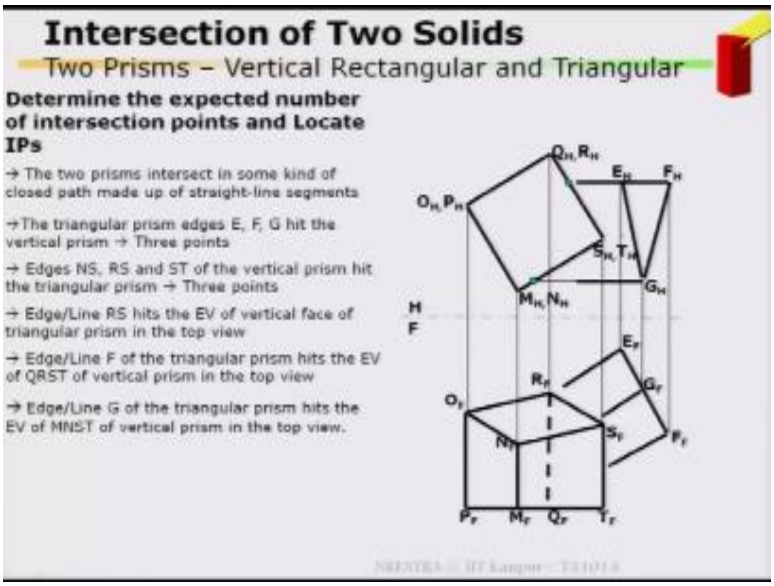

Draw the top view name it, draw the front view name the – name it then from there mark the point, determine the expected number of intersection points locate IPs. The two prism intersection in some kind of closed part made of these straight line segment. The triangular prism HEFG, EFG hit the vertical prism, hit the vertical prism at three points, H, NS, RS, ST, ST of the vertical prism hit the triangular prism at three points H line RS hit the edge view of vertical face of the triangular prism in the top view.

Edge line of front of the triangular prism hit the edge view of QRST, QRST, T of the vertical prism in the top view. Edge line G of the triangular prism hit the edge view of MNST, MNST of vertical prism, MNST of the vertical prism in the top view. These are all write-ups, the methodology I have said, if you go by naming one by one it will be very easy. We make it numbering or by putting it ABCDEF same way you follow you will get it.

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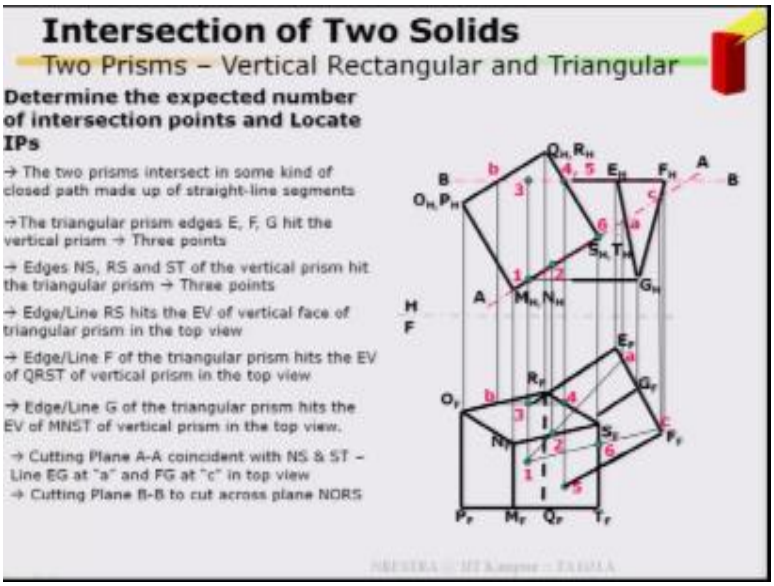
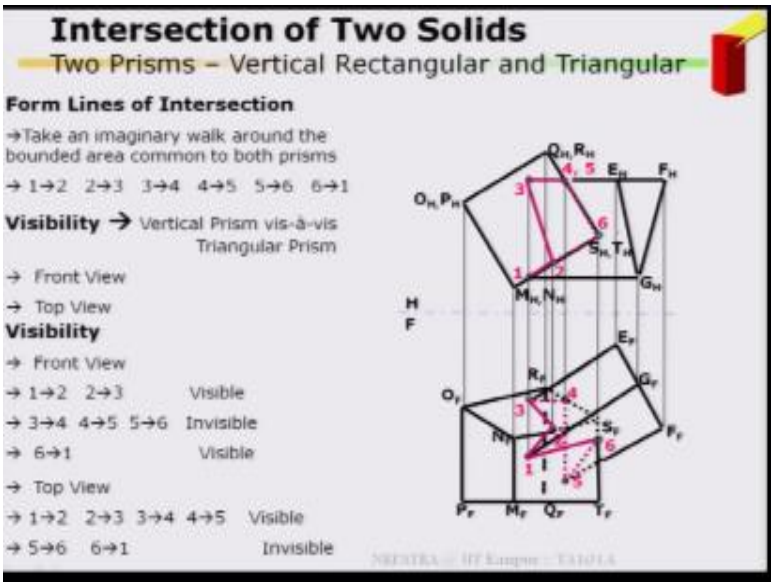


Look at here, just I am leaving for you to think how it has been drawn rather than maybe next class I will explain more detail about this, you just think how it goes like this I am just going one by one. This is a slightly complicated.

(Refer Slide Time: 20:48)



This is your interface surface.

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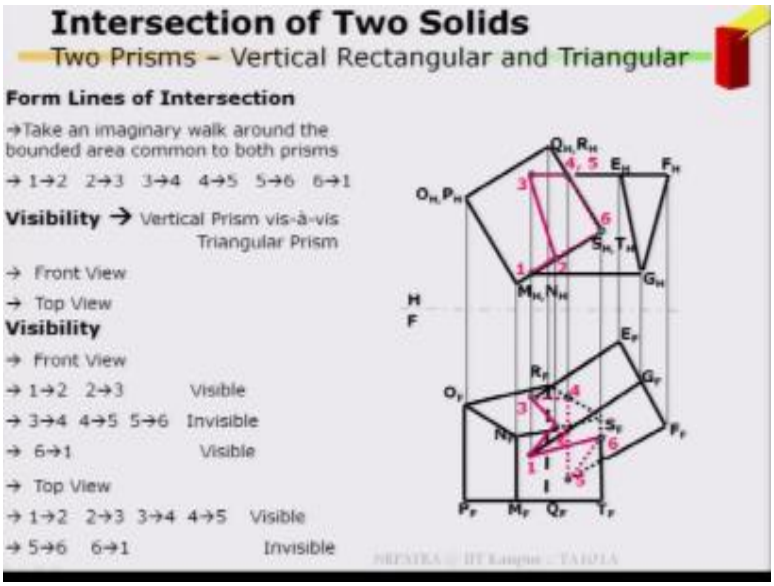

Once you get the interface surface I got the interface surface. Now you have to find it out the visibility, visibility means which is inside, which is outside. Which piers first which does not pier. So same method the visibility, take the two views, front view and top view, you do this visibility and find it out where is your visible, where is your not visible. Here 1, 2, 3, 4, is visible, visibility.

4, 5, 6, 2 in top view it is not visible that is why it is dotted line. Here in the front view 1, 2, 3, 3, 2, 1, 6 it is on the front that is why it is visible, 4, 5, 6, 3, 4, 5, 6 it is in the back it is not visible. Try it do it yourself, this is a questionnaire I am putting you, I will explain more in the next class, thank you.

Acknowledgement
Ministry of Human Resource & Development

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Badal Pradhan
Tapobrata Das
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Sanjay Mishra
Shubham Rawat
Shikha Gupta
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Aradhana Singh
Sweta
Ashutosh Gairola
Dilip Katiyar
Sharwan
Hari Ram
Bhadra Rao
Puneet Kumar Bajpai
Lalty Dutta
Ajay Kanaujia
Shivendra Kumar Tiwari

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