Technical Arts 101
Prof. Anupam Saxena
Department of Mechanical Engineering
Indian Institute of Technology, Kanpur

Lecture - 11
Think and Analyze

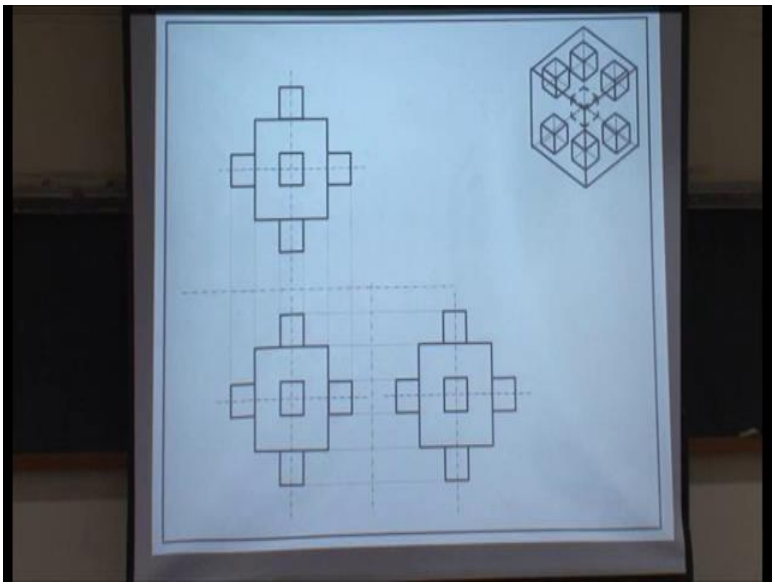
You know he did a wonderful job on 2 counts, number one I think he talk you well, because I learnt a lot along with you and number two teaching for three hours and a stretch is no joke, you try it out. Teaching for three hours and a stretch is absolutely no joke and then doing that consecutively on Friday and on Saturday, so he deserves another round of applause please. Thank you. So, he is see you again on this Friday and this Saturday, can you hear me, can you hear me?

Student: Yes sir.

So, he be seeing you again on this Friday and this Saturday with the problems that you are going be solving with or a based on the experience that you a had the previous week. So, you know I was looking at certain documents and I dug this thing out, do you know what this is, do you know what this is, what? Identity card, it says Indian institute of technology, Bombay and incidentally it has my name here and this is some kind that you are going be getting four years down the line, when you are graduating. So, this my graduating degree B. Tech IIT Bombay.

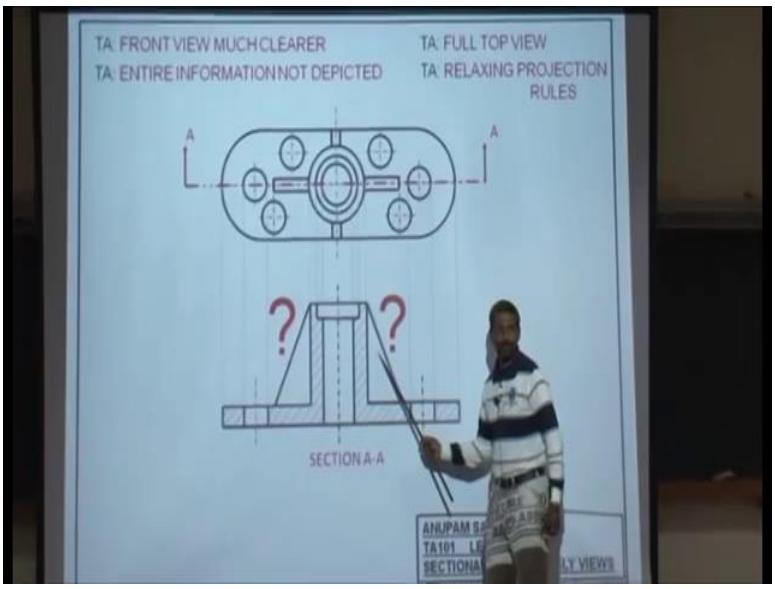
Well, somebody told me that I need this to get my passport renewed tomorrow, so I am going take it along with me. Anyhow let us get started if you recall quite a few lectures ago we had at this problem. So, we had this cube which was FCC on all sides six sides and there was a BCC void will the cube, we recall that.

(Refer Slide Time: 03:12)



So, the front top and profile use were identical and in none of the views you could realize any information or you could know or you could learn any information about the void that was within the cube within the big cube. So, there a ways to come around it and we are going to be discussing more these ways today, section and assembly views.

(Refer Slide Time: 03:41)



So, that was one of the motivations this is second motivation that I am going to be talking about. So, let us draw a problem which is very similar to question one of your both homework. So, let me start with a top view so you have two lines two semi circles

on the left on the right in the top view a bunch of circles with center lines. I am going to talk about this feature in a while, and then you have some supporting structures called ribs which I am going to talk about today. So, let me start drawing the front view of this, you see a rectangle take the projections of these cylindrical feature down, this is the cylindrical feature, take the projections down.

So, if you realize, you have this hole which is a through hole, it is going from top to bottom of the object, and then you have some like this feature and I want your attention here because this is something that I am going to be asking you in the exam. This feature is called a count sunk countersunk c o u n t e r s u n k counter sunk, what I will give you as information as this counter sunk file something, something deep comma file something through. Once again counter sunk diameter something, some distance deep, d e e p, and then space or comma file something through.

So, this describes this entire feature, we will continue with the projections I will start drawing hidden lines pertaining to the circle voids in the top view, something that should be familiar to you because you have drawn this in your homework problem. I am going to go slow so that you realize what is going on, so this time you see these hidden lines pertaining to the circle of voids here hidden lines pertaining these circle of voids. Then, the corresponding center lines the same on the right hand side hidden lines pertaining to these voids. Then, the center lines and then this is a triangular RIB, r i b this a triangular RIB the corresponding projection here on the top view. Likewise you will see something very similar on the right hand side.

So, there are ribs on top and bottom the top view and correspondingly you will be seeing those structures in the front view of course, the third angle projection, question mark is this technically correct yes or no, ha no, yes. Maybe, assuming that I have not made a mistake if you assume that I have not made a mistake is this technically correct yes or no.

Student: Yes sir.

No, yeah for that upper part will there be three circles or four circle, this one yeah looks like there would be three, looks like there will be three fine. So, ignore this circle for the for the time being ignore this part for the time being. There should not be one more circle, there should be or should not be, there should be one more circle there should be

one more circle. There should not be one more circle projection 1, projection 2, projection 3, you had me there for a while in isometric.

Student: yes sir.

You drawn it right, so in the top view you will see three of these, so the innermost part corresponds to this through hole folks, can I have your eyes on the screen please. So, the innermost circle corresponds to this the middle circle corresponds to this and the outer circle corresponds to this technically correct no.

Student: Yes sir.

Yes. questions 2 are you happy with the front view why is that it is difficult to distinguish which hidden line corresponds to which feature in the top view, so too many hidden lines yes, no?

Student: Yes sir.

Too many center lines the front view is confusing, yeah can you do something better perhaps, so we discuss all these reasons and of course, hidden lines center lines all those lines projection lines many lines they create lot of confusion, what do we do about this? Very simple trick, very simple trick divide and conquer works everywhere yeah divide and conquer, so what we here going to do is we are going to take a knife section the object so that the top view sectioned. This is your section line, this is how the section is depicted by convention take the bottom part out and view the object in this direction.

Once again, take a knife cut the object into two different pieces by convention; this is how we represent the cutting operation. We let go off the bottom part of the top view and we look at the object from this direction of course, there will be certain changes in the front view and we will try to figure what projection lines back, I want you guys to be very careful and follow me. Now that we have done this, there is one thing that I would actually want you guys to keep in mind.

I would not want to show in my front view any hidden feature so long is you keep this rule in mind it is I would not want you guys or me for that matter to show any hidden feature, have we said that is continued, what you see? Do you see this line? It is a solid line.

Student: yes sir.

It is basically we have what you done is you have cut these cylindrical void into half, so essentially this would represent one of the boundaries of that cylindrical void of this one in particular do you see this line yeah. As I said, I am going to be ignoring this cylindrical void because it is essentially hidden I do not want to be showing the hidden features. Likewise, I am going to be ignoring this cylindrical void, I would actually want it show what I see what I see? Do I see this line is solid line? Yes, this thing is cut, do I see this line? This thing is cut, do i see this line? Yes or no.

Student: Yes sir.

Good, do I see this line?

Student: yes sir do I see this line?

Student: Yes sir.

Do I see you? I do, I see this rib, now because that part is gone that part is gone with the part of the top view that was here again. I am going to be letting go these hidden lines because they correspond to the cylindrical void at the back here stay with me would I see this line?

Student: Yes sir.

This line?

Student: Yes sir.

These guys gone?

Student: Yes sir.

The corresponding center lines are gone how about this line, how about this line, would I see this, or would I not see this? I would not see what is the difference what is the difference the front view is lot more clearer. Now, is it is it yeah vertical you mean this line this thing I will come to that, I am so glad you guys are thinking so far so good to show that you have actually taken a section of the object. Once again, to show that you have actually taken the section of an object, this is the only part of shading that is

permitted in technical drawing hatching by convention this is the only part of shading that is permitted in technical drawing.

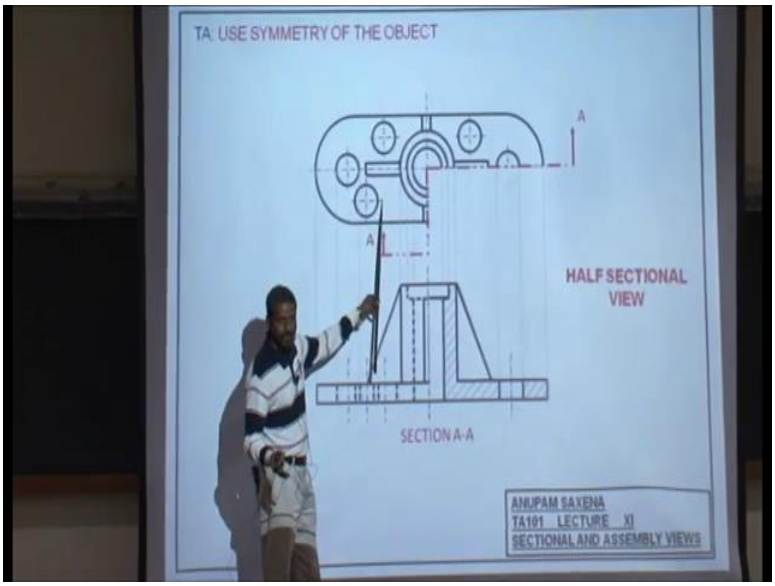
This essentially means that you have material here. no material here on section plane material here, material here, no material here and till here the triangles I will come to that I will come to that. I will come to that for now for now of course, you would agree that front view is much clearer you would also realize that the entire information is not depicted. So, I am going to be making a statement here, I am going to making a statement here be careful section views are nothing but a trade of between clarity and information, it is a compromise between clarity and information.

If you want more clarity, let us go certain information if you want less clarity include as much information as you want something to keep in mind. However, it will be nice idea for you to show the full top view, so that much of information not all, but much of information is something that you are able to retain section views is about relaxing once again relaxing rules of projection in favor of clarity. So, this is how the section plane is shown top view this is like the edge of knife and looking at these two directions and the bottom view in the front view you say section a why did I not sectioned the triangular ribs? You have no idea and I expect that not a problem, I will come back to it later, but to give you a clue by convention.

They are certain elements in the object, which are supposed to be for support. For example, these triangular ribs they are essentially meant to support the cylindrical feature over this platform this need not be there in the object, but since this is there it is kind of ensuring that the cylindrical feature stays perpendicular to the base of the object. So, it is a supporting elements not the machine part, but supporting element it is called a RIB and later I will tell you that there are certain supporting elements that you do not section you just ignore that the section plane is passing through those supporting elements.

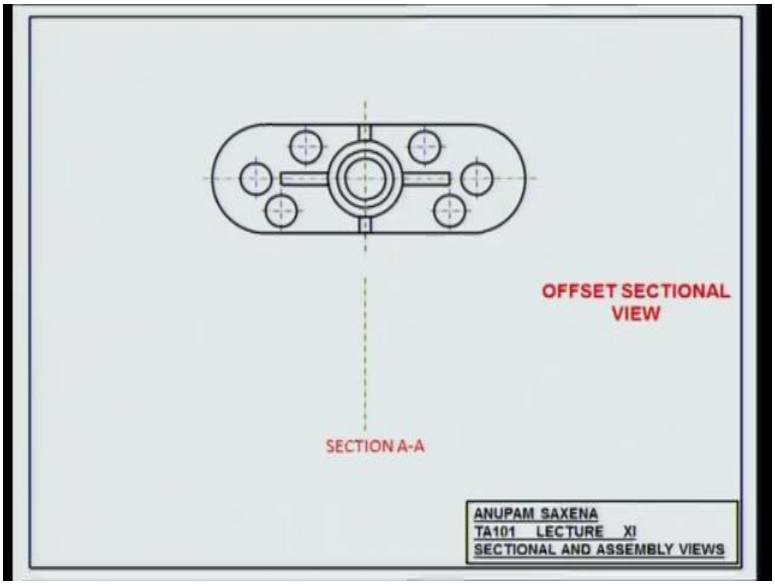
It is called the full sectional view full sectional view you are taking the entire section they are different kinds of section to use. The second one is the half section view and for this example you can take advantage of the symmetry in the object, again it is a tradeoff between clarity and information, you do not take the entire section, but you just cut one quarter of the object, take it off.

(Refer Slide Time: 21:41)



The part on the left in these in the front view stays the same as if you are taking the front view of the entire object on the left the part on the right is sectioned from the top view. You realize that the object is symmetric this is where you depict the entire information this is where you depict the information. After you have sectioned the object or the interior of the object right your top view will always remain full look at the way I have drawn the section line here dash dot, dot, dash, dot, dot finish line.

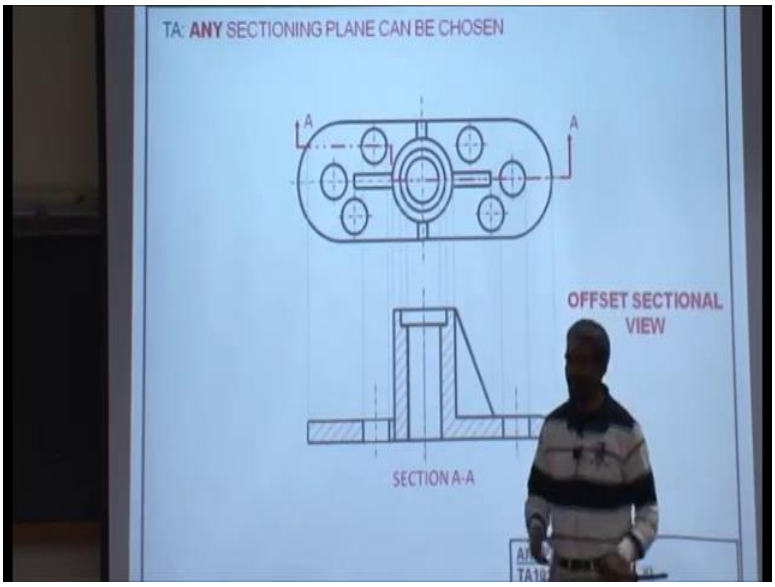
(Refer Slide Time: 22:51)



You are the boss, you can choose the cutting plane in whichever way you want it need not be straight, it can go zigzag depending on the details of information that you want to depict. For example, I can choose the cutting plane to be like this starts from here and till here goes back starts from here and till here. So, the right part is actually showing the center part of the object and the left part is also covering the features which are the back of the RIB. So, you can choose the section plane you want take this part off and start drawing the front view this is something that you have seen before.

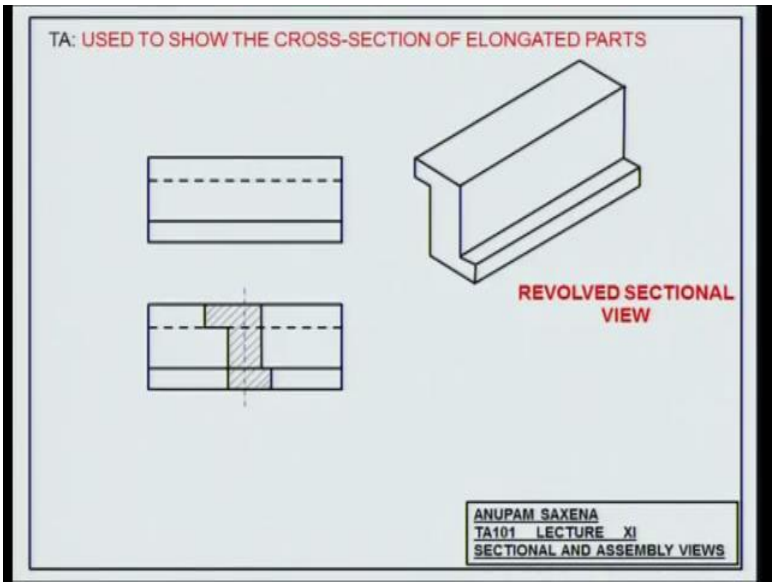
Let us start drawing the left hand side the projection lines you would see this would you see the edge fine you see this edge of course, no, yes, no what is wrong? These guys should be and should not be hatched solid this part should not be hatched, yeah it is called a RIB, it is called a RIB.

(Refer Slide Time: 25:26)



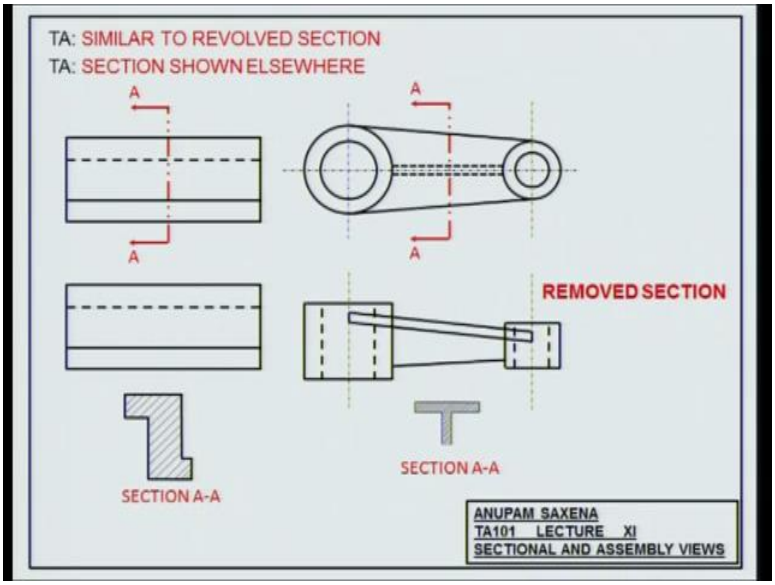
So, this line and this line would not be visible, assuming that this is not there would be visible then. So, when you are sectioning just assume that supporting elements are not there section, and then add the supporting elements later by convention I will talk about that little more.

(Refer Slide Time: 25:56)



Discussion time full section half section offset section, the fourth one is the revolved section use to show the cross section of elongated parts, let us say if you have an object like this. If you want to show the cross section this is an object, where the front view and the top view, they are the same cut the object anywhere, and show the cross section within either the top view the front view.

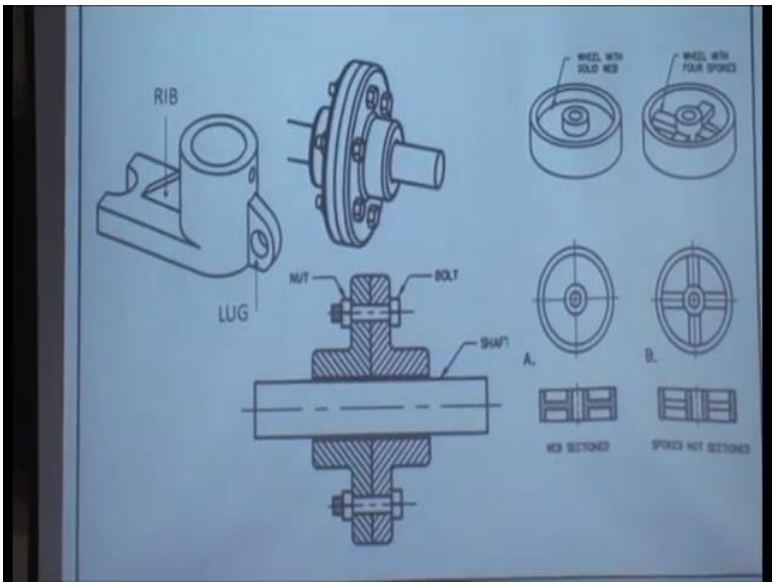
(Refer Slide Time: 26:44)



Likewise, the second example this like a t section if you cut the object over here this like a t section and the t section is going to look like this. So, just to show some more details

in the object revolved section removed section, it is very similar to the revolved section. Just that if you want to show the cross section at any point of the object show that section elsewhere cut the object go down, do not show the section with the front view itself, but slightly down around.

(Refer Slide Time: 27:49)



Likewise, for this also this important and this something that all of us follow or try to follow diligently for clarity standard parts are not sectioned even when cutting planes pass through them, parts like shafts, nuts, bolts, ribs, spokes. I am going to talk about webs and lugs different examples this is an object with a rib and a lug if you not cut this object in two pieces like. So, you do not section the rib, you do not section the rib and you do not section the lug. If you look at this carefully, if you let go off this object, you will lose much, sorry if you let go off this part, you would not lose much. If you let go this part, you would not lose much either, so they are not the main also its defining features in this machine part, they are just supporting elements.

They are just there for example, this thing is to help or this thing is to in a way ensure perpendicularity between the cylindrical feature and this platform, so it is just there and let go this. So, more matter match look at this example and look at the section view of this, so much like take the bolts out listen to me very carefully, take the bolts out take the shaft out what you are going to be left with is this flinch. This flinch takes the full section, so these are two parts, so this is the corresponding section for this plank. This is

corresponding section for this plank since they are two parts; they hatched differently 45 degrees from the right and 45 degrees from the left. Once we have shown that section then bring in the bolts back and shaft back?

Student: yeah sir.

How do you will decide that the think and analyze cannot say that we are correcting this with a just take an example. In that coupler, we are connecting two couplers with the elbow of that which coupler second this one. Well, this is different from this, no this is different from this, but instead of that cutting bolts by pressing them or just by locking them with the ribs, then how can you say that it is not a with the ribs. You cannot lock them with the ribs, you cannot pass in them with the ribs can you? Yes, we can with the ribs yeah. Well, by convention elements which happen to be of supporting nature elements, which happen to be of fastening nature, they are not sectioned by convention.

So, two kinds of pulleys are shown over here, one is a pulley with solid web and one a pulley with spokes so the one with solid web is sectioned the web is sectioned and in this case these spokes are not sectioned. So, it is not so very easy to appreciate this when you are learning this for the first time, so you need some practice and on my web page have also uploaded a supporting document for you to kind of go through. So, this lecture along with another supporting document.

(Refer Slide Time: 32:42)

First examples, so you have fastness over here, so if your section plane is not passing through this, do not worry about that just section it and show what you see.

So, this part is getting sectioned this part is getting sectioned, so the black part, and so it is hatched in your drawing the red part is not sectioned. So, remains white let me come to this example full section half section offset section what full section, one slice, do you know what a rib is a triangular, he is on time he is dot on time. Thank you.

(Refer Slide Time: 34:00)

Part one, part two, they are suppose to be perpendicular, this part is called a rib, it is a triangular feature, it is called a rib. So, if I take a section I just take the rib off take the section hatch this platform and this platform, and then put this back I cannot force see how you can fasten two flinches with this width or may be on Thursday, you make a model like you did last time. So, this is what a RIB is essentially is there to maintain perpendicularity between these two parts of the object.

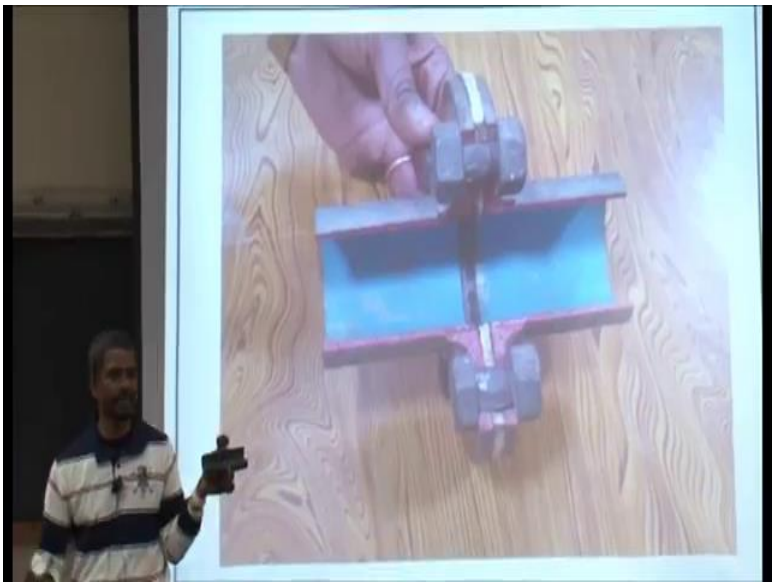
(Refer Slide Time: 35:03)

Full section, half section, quarter section, what full, half, quarter, this would be the full section half of that is half what this would be the full section half of that is half. So, even though I have taken the quarter of this object out, it is actually a half section.

(Refer Slide Time: 35:47)

Now, realize what I have done, I have taken the bolts out I have taken away the bolts attach, these guys together sectioned this part section, this part.

(Refer Slide Time: 00:31)



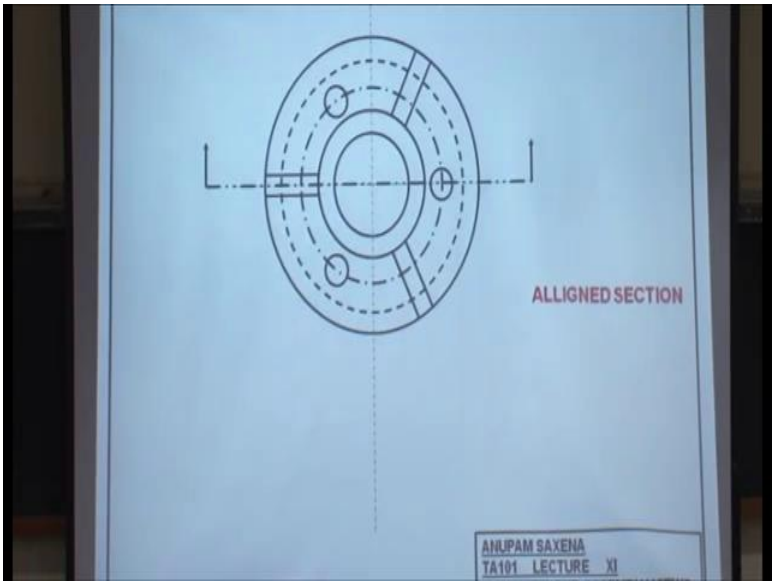
You can see the section lines red and white and then I have placed both back this is just for the sake of depiction because see if you start sectioning everything, it becomes very difficult to follow you have to be clear in your drawings. That is one the reasons why their own section standard objects, this is another part what is this. Well in layman's language what have done is have taken a quarter of the object on the right out or retain the object on left. I have not sectioned it the bolt stays there the shaft comes out. Maybe, it stays there shaft comes out I sectioned this part and then place the shaft back this is how you are going to be sectioning your drawings right section the main parts section.

The main parts ignore the supporting elements ignore the fastening elements the elements like webs spokes lugs section the rest of the object and then bring those supporting elements back yeah a love to scratch my head. I would say is the half section of the right part of the object half section of the right part of the object the left part is intact. Is there anything I would actually call it is still a half section, but I would add some more information to differentiate between the fact that I am taking the section of the entire thing or just one part.

I will still call it a half section alright, so align section, so if you realize what we are doing is we are relaxing the projection rules, we are going more into clarity and we are letting go of certain information. So, we are tracking a tradeoff between clarity

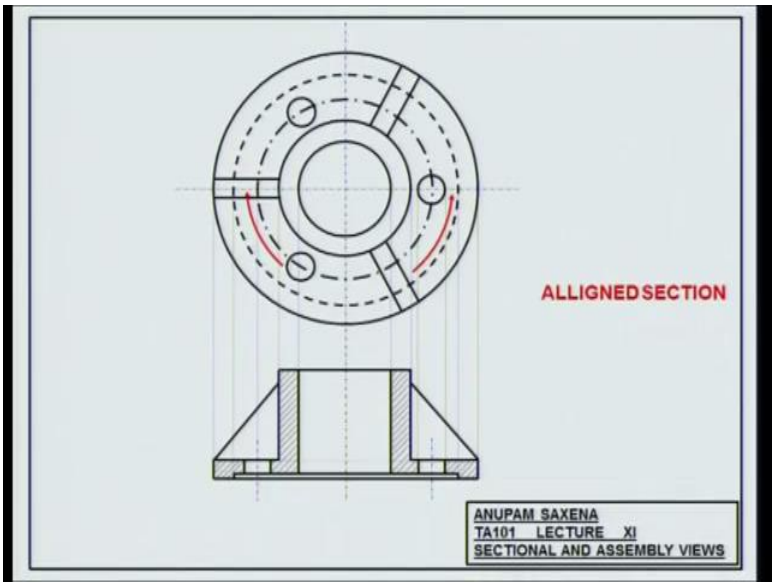
information, so this is another example where your projection rules are relaxed for better clarity.

(Refer Slide Time: 00:31)



Features which are odd in number are rotated to align with the sectioning plane, let us say you have the top view of an object its circular. You have got three ribs you got three ribs 1 2 and 3 at 120 degrees and you got three circles through voids again at 120 degrees this the cylindrical feature let me try to draw the front view so if I section this object.

(Refer Slide Time: 40:43)



So, if I try to look at what the front view looks like I will see a rectangle, so there's this hollow feature over here at the bottom of the desk, I will take the projections I give the cylindrical feature I get this rib and I will get this hole. Now, look at the object what is your first impression what is your first impression, certain part of the second part of the second rib is also going be visible. You mean this one this one well one of this one the other one will be kind of hidden behind the front one what the section. So, this this part is off of course, this one certain parts of a slight part of this. So, what you are saying is whatever information that is left you are trying to retrieve it now using projection rules yeah.

So, you are going for that you are going for that so you are saying, I mean this rib is something that we have not shown. So, let us use projections and try to show the rib yeah how about this hole what about the section yeah the certain part of that would be visible in this section well how by projection by projection. So, essentially you are going to be taking the guys whole down, so what Kevin is saying is essentially you are going to be taking the projection lines over here and you are going to be trying to show the rib. Likewise for the holes also for this hole, the hole would not be visible rib will be the rib will be visible.

You will be a wonderful teacher one day without the mike of course, do you sing do you sing, alright do you see some symmetry in the top view symmetry in some sense in top view in some sense. If you take the projection of the rib, this will be in a way unsymmetric, yes or no yeah alright. So, this is the trick that keep attend to follow follow way carefully I am going to be aligning. Once I do that i get to show this section plane over here, this hole over here folks I align this guy over here and I get to see this corresponding feature here which is in symmetry with this one thing I do the same thing with the rib I align it and I get to see this part.

So, I am relaxing my projection rules significantly over here, while in a way not compromising much on the information in a way not compromising much on the information with this alignment. I am able to show the true dimensions of a feature once I do that, I get to section one more time so far so good here so far so good. Imagine that the hole travels up to the section plane and participates in the sectioning correspondingly you will see this hole over here. Likewise, imagine that the rib rotates itself to align with

the section plane, you will see this part, and then you section the rest my projection rules are relaxed, now in favor of information this is how you show the aligned section alright.