

Computer Aided Engineering Design
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Lecture -2

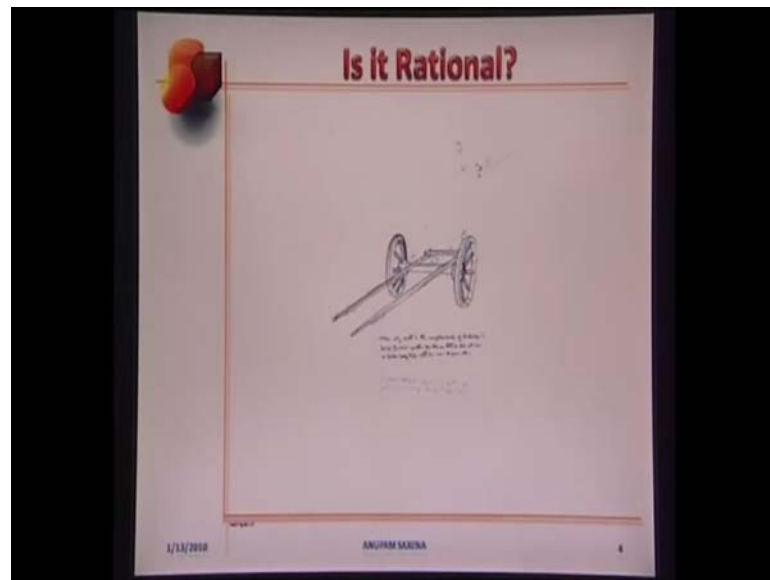
Hello, this is lecturer 2 of the NPTEL video scenes. There is a reason, why the term design is highlighted in the slide. Design is the significant and a broad term and it is only appropriate for us to proceed with the cad course after we understand the term design very well. We will try to understand design through this lecture, while a single lecture does not justify the purpose. There are many dedicated courses and programs on design itself.

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The basic question, what is design? Is that art? This is the very famous painting by Leonardo da Vinci people who know his work well consider him to be both an artist and an engineer, was he more of an artist or less of an engineer or vice versa is open to speculation Of course, the term engineer was possible not coined them it eliminated much later but, in his time Leonardo was able to classify a different shape, different mechanical or machine elements like gears, links (()) arrangements and more. His designs related to engineering were a complicated calculations are suppose to be made or it is rational.

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For example, a wheel we all know that the wheel is one of the proud inventions of mankind, in the best way for efficient motion transfer.

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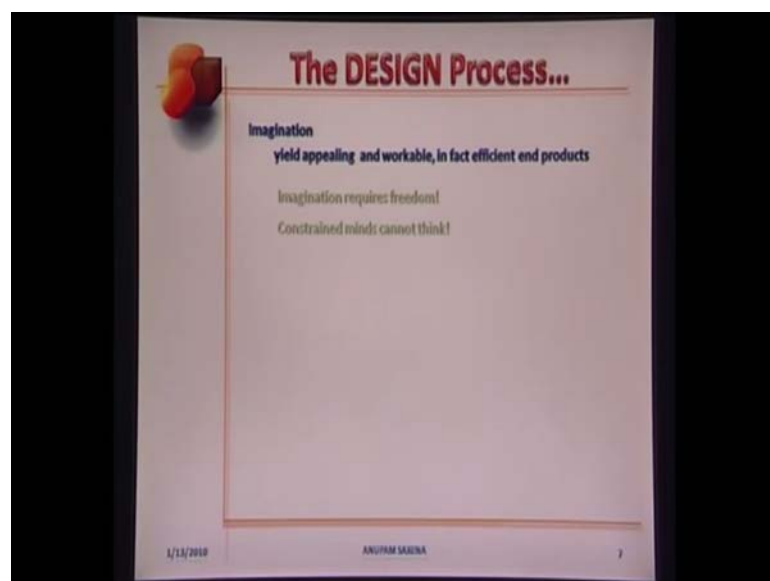
Do all agree about our engineering a rational design culminate into product design. Well, many are looking at the television set on the slide, I am looking at the cabinet and the music system and the other perponalia. Off course, we see verity of products now a day's which are so at these we have witnessed many in the first lecture.

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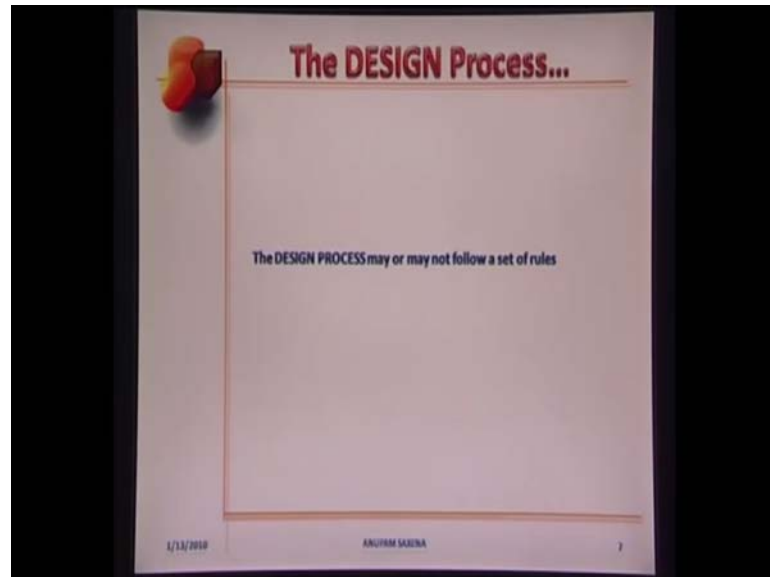
Maybe product design involves all we are our engineering a rational component may be more or less depending on the product being designed. For example, a car in engineering aspect seems more compare with the astetic, though the asthetic component is very much present or pronounced a person's comfort and economy a man's pocket are important as well. Our design process should involve imagination and should yield appealing and workable rather efficient design, appealing here has implications in terms of economic, aspetics and organamics.

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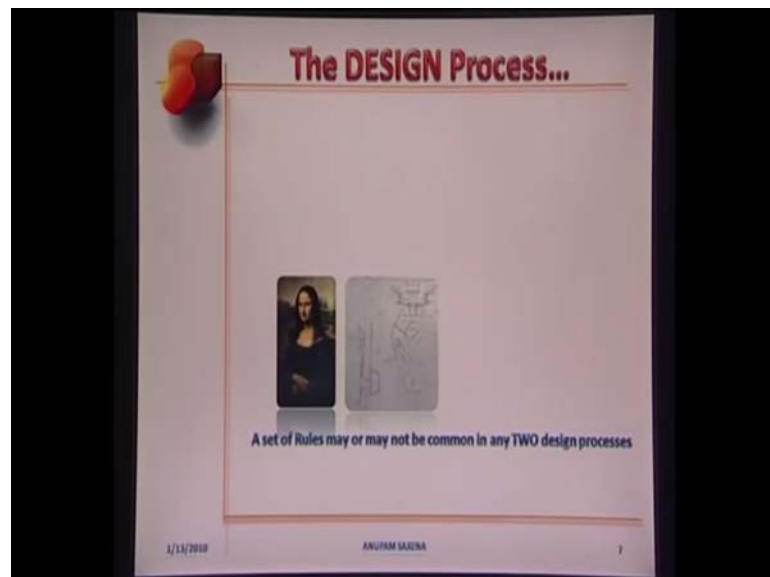


Economic means the product should be affordable. Aspetics implies the product should be pleased and Oraganimic means the human should be comfortable using it. Imagination requires freedom and constrained minds cannot think. A designed process may or may not follow a set of rules.

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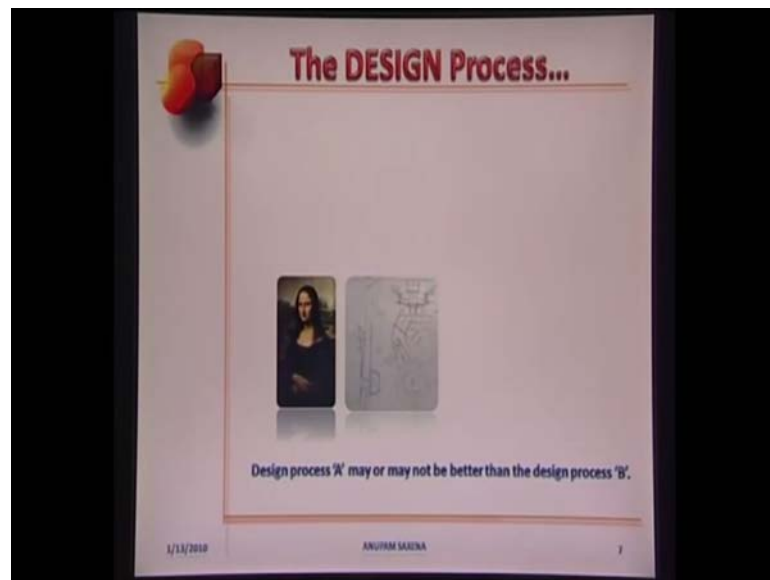
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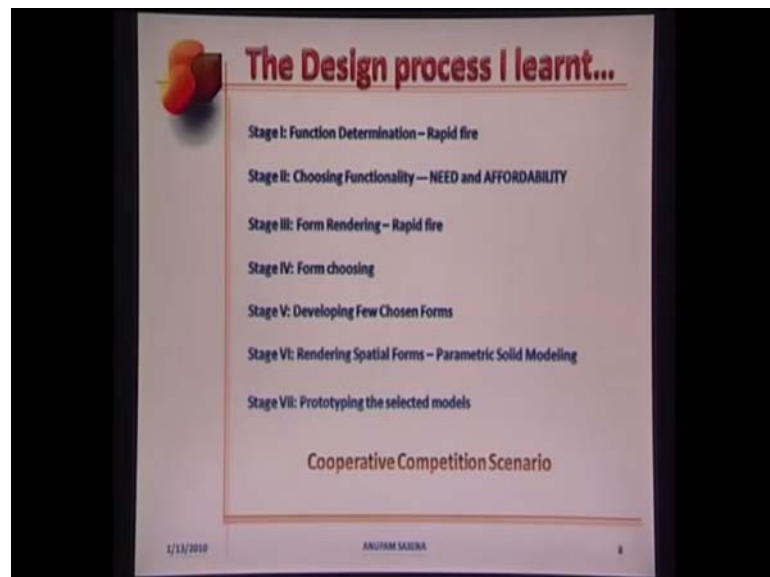
In our design, rules may be conceived. For example, the ratio of facial leniamance are features are possibly worked on before the final rendering in the form of portrait sketch

or painting is provided. In engineering design certain rules. For example, those related to failure should be applied and calmly agreed upon, one cannot apply different failure criteria for a design. A set of rules may or may not be common between any 2 design processes.

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A design processes A, may or may not be better than any other design process B. My personal opinion the design processes may not be comparable. Since, many evaluation

criteria based on aspetics, economics and others are possibly subjected and cannot be fortified easily.I am going to be deniyating the design process when I learnt in an undergraduate at iit, Bombay back in 1991 to 1995. It follows about 7 stages, stage 1 is function determination or the rapid fire. Stage 2 is choosing functionality, which is based on need and affordability. Stage 3, is form rendering which is again rapid fire. Stage 4, is to choose a form. Stage 5, is developing a few chosen forms. Stage 6, is rendering spatial forms, this involves parametric solid modeling. Stage 7 is prototyping of the chosen points of the chosen model.

We will demonstrate each step through a small workshop, example of the design of a table lamp in this lecture. We will work in the cooperative competitive scenario. We have about 10 students participating in the workshop, I divide them into 5 groups of 2 each. 2 students in a group will collaborate, while the 5 group will be completing at notes stage in the design process will be groups interacting or sharing any information.

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As you know, we are going to be working on a mini design workshop, first what I will do is, I will introduce you all.

This is group 1 Dinesh Sharma, mechanical engineering, m tech first year.

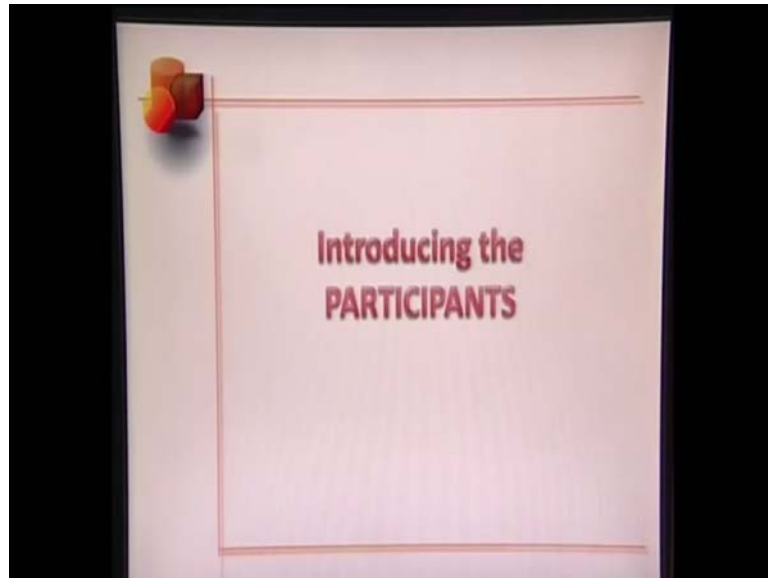
I am Abhijith Sarkar, passed with p h d from mechanical engineering department.

Prathik Jayanth, mechanical department m tech first year.

I am Sharath Sindhaniya, mechanical department m tech first year.

You 3.

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Myself Swetha Singh mechanical engineering m.tech first year.

I am Indra Barathi, m tech student mechanical department.

And this is group 4.

I am Arun, m tech first year mechanical department.

And I am Ravishankar, mechanical department m tech first year.

So, let me explain you guys, the basic rule for this workshop.

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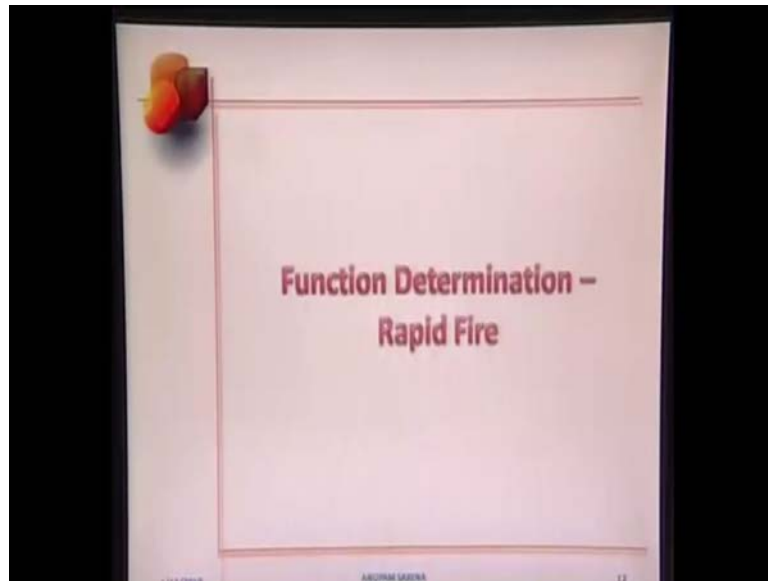
This is going to be in the cooperative competition mode that means none of the groups are going to be interacting with each other for the next half an hour to 45 minutes. You are going to be keeping your design philosophies to yourself. You work to yourself.

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This is the design objective today. You are going to be designing a table lamp together. You are going to be following a bunch of steps. I will tell you each step one by one. I will explain each step and then we are going to be working towards designing a table lamp.

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This is the first stage of the workshop, it is called function determination.

So, we are going to be following 3 or 4 basic rules.

Rule number 1: try to get as many functions of the table lamp as you can.

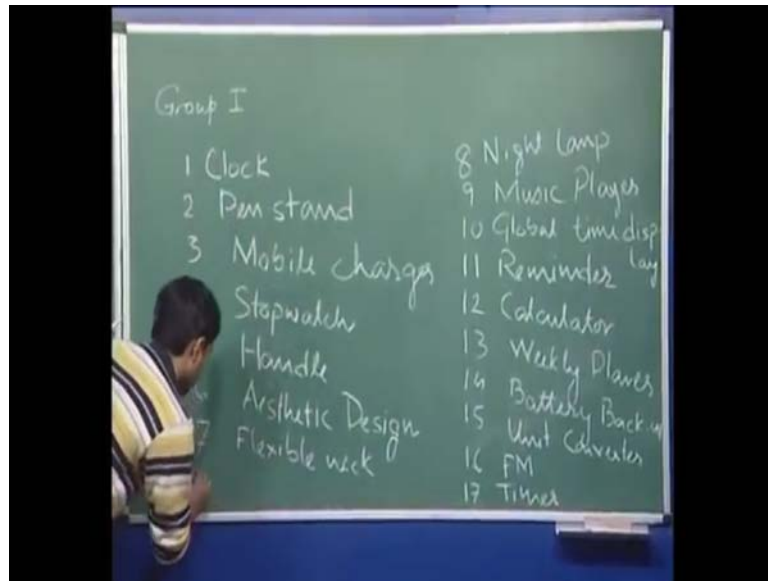
Number 2: you all know what a table lamp looks like, this is going to be a rapid fire section.

So, we are going to be having 3 minutes, in 3 minutes, try to get as many functions as possible for the table lamp.

Welcome all crazy ideas that come to you, do not block your imaginations. So, in about 3 minutes, try to get at least 20 possible components. For example, your lamp can walk, it can be on wheels, it can dance. Try to entertain any crazy ideas as you can.

So, these are all the ideas from group 1.

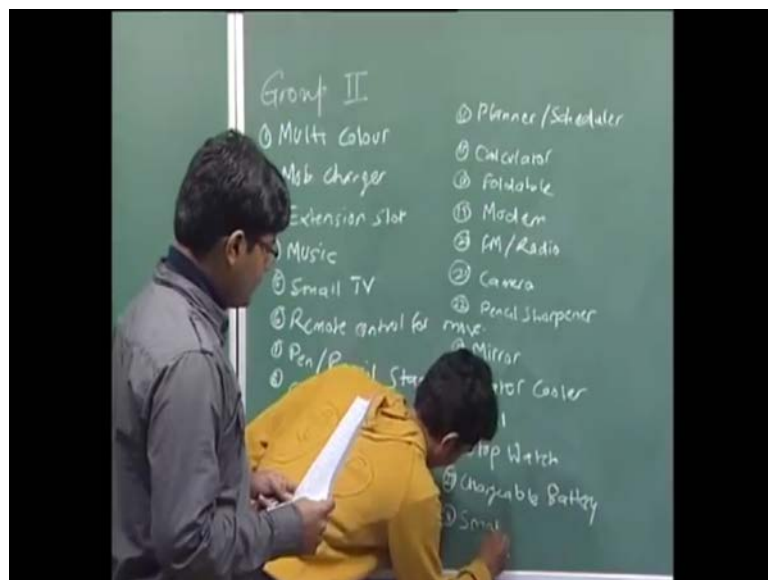
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It should have a clock, a pen stand, Mobile charger, Stopwatch, Handle, Aesthetic design, Flexible neck, Night lamp, Music player, Global time display.

So, these are the ideas from group 2.

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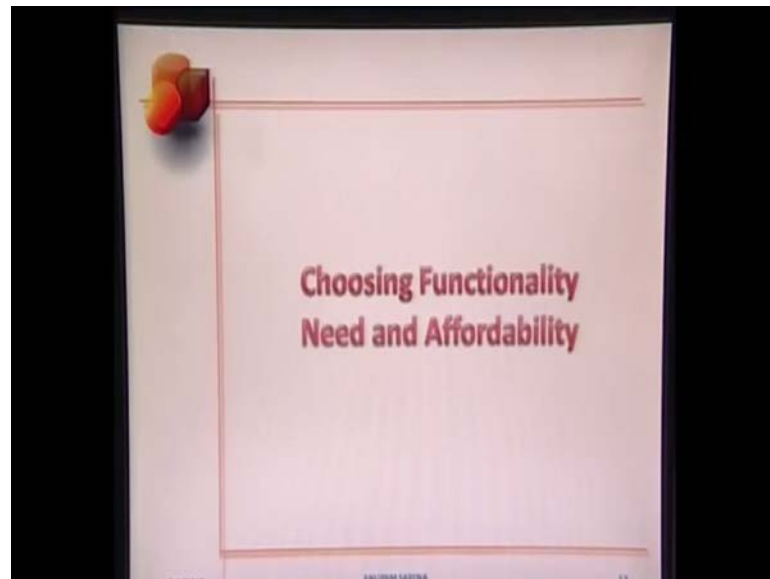


Number 1: light with multiple color, Second one mobile charger, Third extension slot, Music system, Small TV, Remote control for movement, Pen and pencil stand, Clock, Thermometer, GPS, Stock update, Reminder, Alarm, Planner and scheduler, Calculator,

Automotive switch on and off, Movable Fixed frame, Fixed, Adjusting high and low intensity of light, adjusting high and low intensity of light, Rotating, Enlarging, Twisting, Self charging, Automatic light balance, Light concentration on a single point, Alarm, Stopwatch, Music system with headphone, Voice sensor for on and off, Slot for mobile charger, Fixed on the wall with air pressure, yes completed.

So, well I will not share any information with the group members here. I can tell you in summary is, you are very much impressed with the gadgets that you seen. I could see one of the groups still sticking to next, that wanna that I would not tell. Now, this is the second stage.

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From the wish list that you have created in stage one, all I want to do is, choose 8 plus, minus pre functions. Depending on what you need and depending on what you can approach?

I will not give you an upper bound of the cost of the lamp, you decide what the tented cost of the lamp can be and accordingly choose the functions from the list that you have created. Your time starts now, you may want to take about a couple of minutes here and after that I will be asking, what you have chosen and why? I will be asking each group, same the question. Take about 30, 35 seconds now.

So, remember in stage 1 we did not block our imagination. But, now we are trying to judge each and every idea that we were have jotted down. So, this is what I am asking from each of the groups. What is it that you have in mind for a table lamp and why? And what would be the tentative cost of the table lamp?

If I would were you I would have designed a break dancing lamp. Automatic self charging, Automatic light balance,

(())

Yes, you are going to be focusing on light on a single point.

Alarm (())

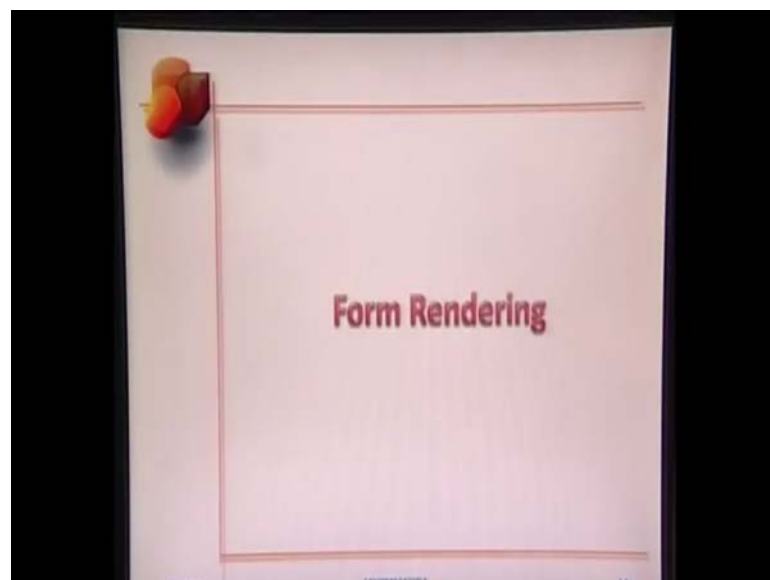
Is it going to be wireless head phones or head phones with wired?

Wireless

Did you say your cost was about 1000 rupees? Maybe you did not mention the cost I think.

(()) Mobile charger

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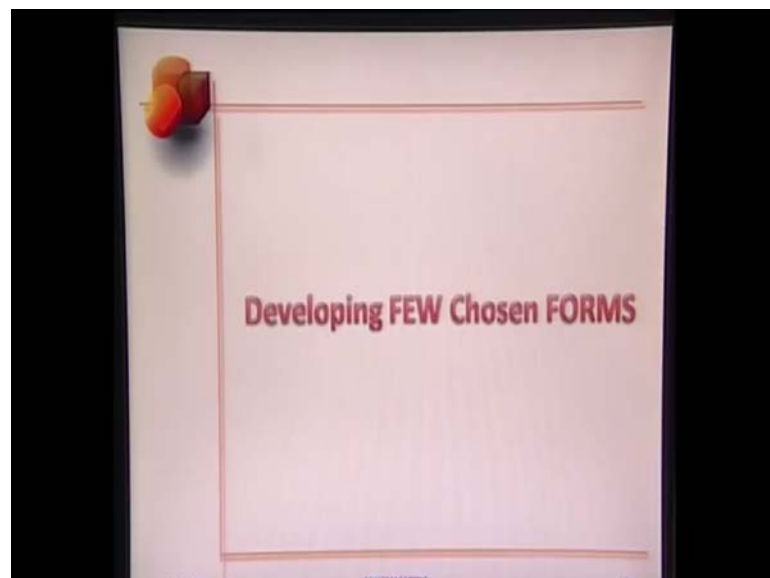


So, you want to control the intensity of light as and when you require. And we can also reserve they were left with 2 lengthy ball with 2 different titles. But, did you have this in your functionality list before or may be it is an new idea that good. So, this is the third stage of the design process.

We call it as form rendering. So, what we are going to be doing here is that, based on the shortened the function list that you have in stage 2. You are going to be sketching different forms of your design, again the time that will be provided to you will be very limited. So, say about you have to sketch about 20 to 25 designs and let us say 5 minutes. So, you have to be very fast, so my suggestion is that you adjust time, stick to character wise, they would convey the design intend or they convey the intend behind the form.

So, do not work on your sketches in detail, stick to skeletal designed you will have about 5 minutes and you have to draw about 25 draw about 25 designs of the table lamp that you have in mind. The partners can collaborate definitely, keep your sheets ready, keep your pencils ready, your time would start about now. So, after you have sketched out about 20 to 25 forms, what we require you to do in the fourth stage of this design process is to develop a few chosen forms.

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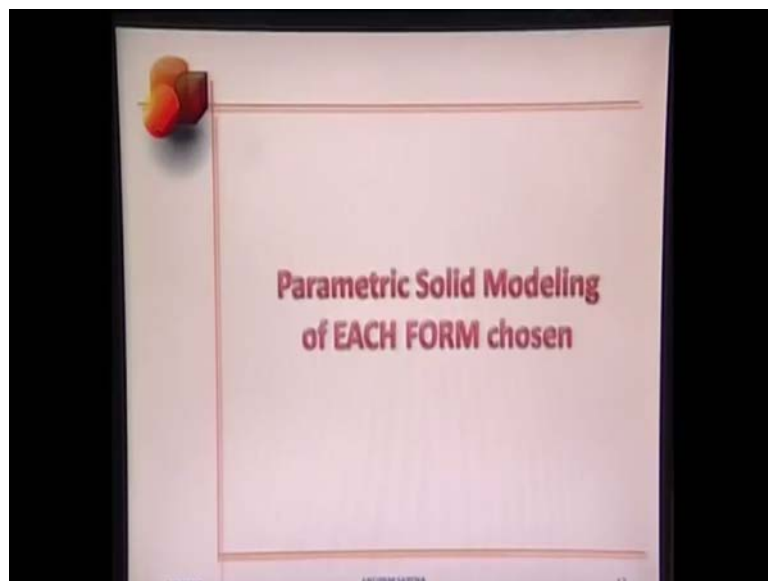
So, What we are going to do is, we are going to be choosing, may be 2 of the best possible forms that we have and will be asking you as to why you have chosen those forms. This is the fifth stage of form designing.

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So, what we are going to be doing in this stage and this is something that you are going to be doing now, you would probably go to your hostel rooms and work on the 2 designs that you have chosen, form develop.

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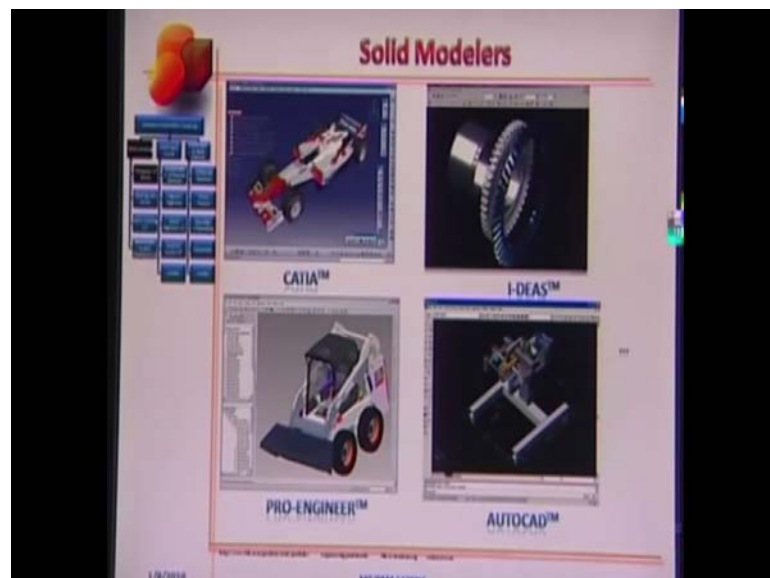


So, Based on the sketched designs you have chosen, you will go to your hostel rooms, develop your 2 forms really nice. So, keep in mind that you are going to be working without paper, pen approach, you are going to sketching it. You can take some experts help, you can have a sketch a person, a friend, who can do sketching for you. Develop the 2 designs really nice. Keep in mind that, this is going to be 2 dimensional rendering of your form.

In the six stage what I would like to do is, I would like you to chose any solid modeler of your choice and give your form, a 3 dimensional rendering have the words, your going to be designing these 2 forms in 3 dimensions, using computer aided solid modeling, once you have done, you are going to be sharing the design with all of us and we are going to be evaluating the designs.

So, remember while you are working, you all going to be working in groups. But, you will not be communicating with each other with regarding your ideas concepts. So, remember your competing skills. We have seen now, how design works on paper. Now, you will learn how different products, different components are designed using a computer.

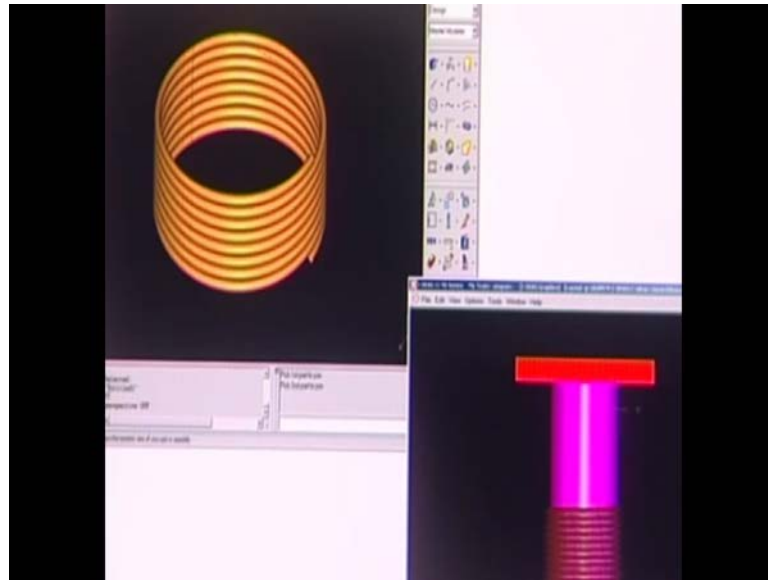
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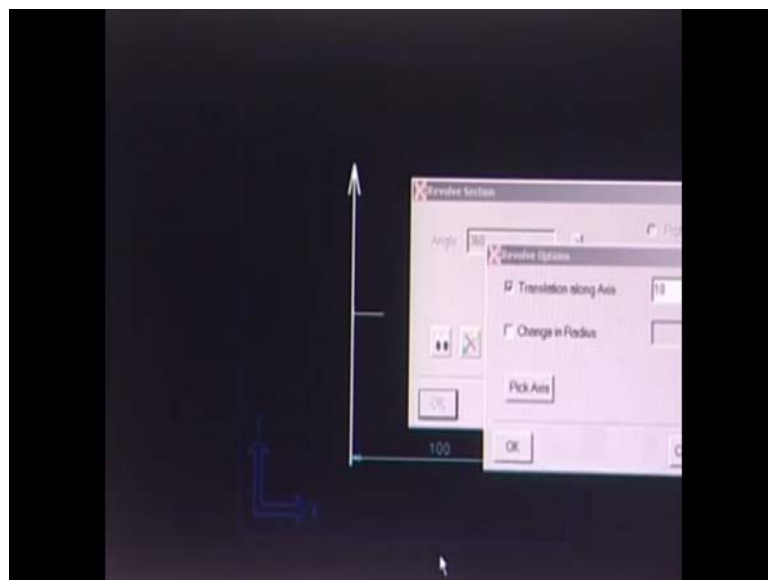
There are different solid modelers available commercially in the market Catia, I-deas, Pro-engineer, Autocad and many others. A few are also freely available on the net, the

idea is not to patronize any single software in particular. But, we use just one as an example, to show how solid modeling works. I am going to be illustrating solid modeling through design of 2 mechanical components, the spring and the book.

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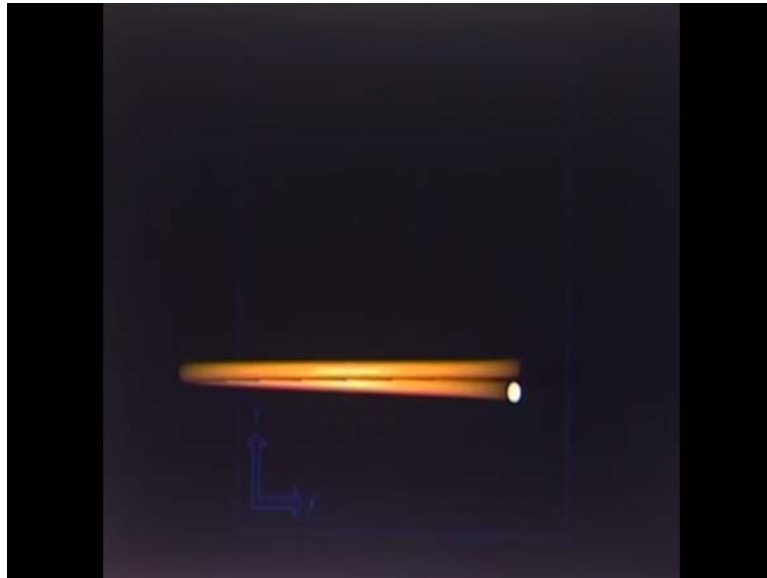
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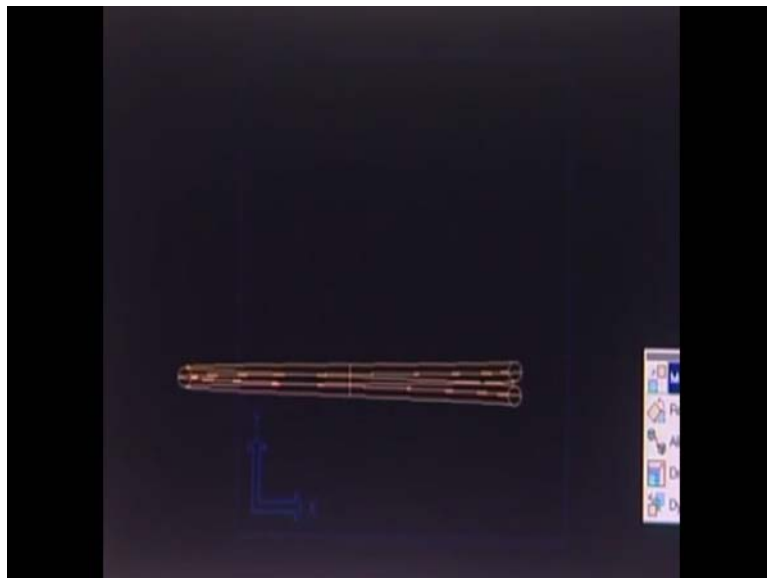
First, the spring design, using the poly lines option, you draw a straight line and using this centre edge option, to sketch the circle, the next dimension, the distance between the circle and the straight line and also the diameter of the circle. Now, we modify major

diameter for the spring, next to evolve the circle around the axis by 360 degrees. We also take care of the fact that we translate the circle vertically by 10 units when revolving it.

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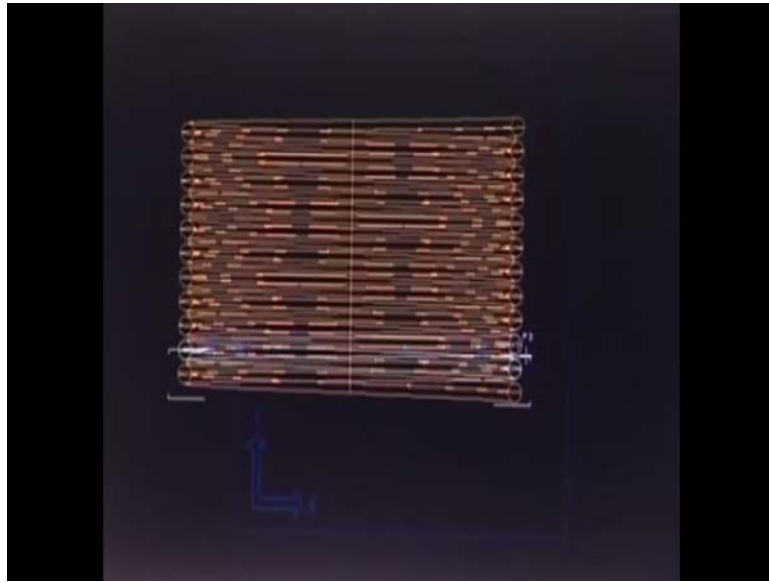


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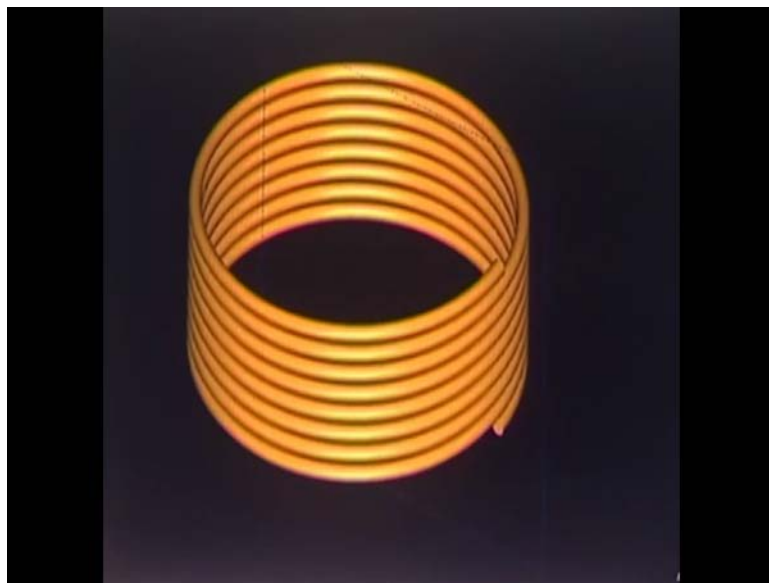


We get 1 part of the spring. To change the display to wire frame mode. And then, we use boolean options to make copies of this part and join one part with the other. We join 2 different parts of the spring now. We finally, have a spring.

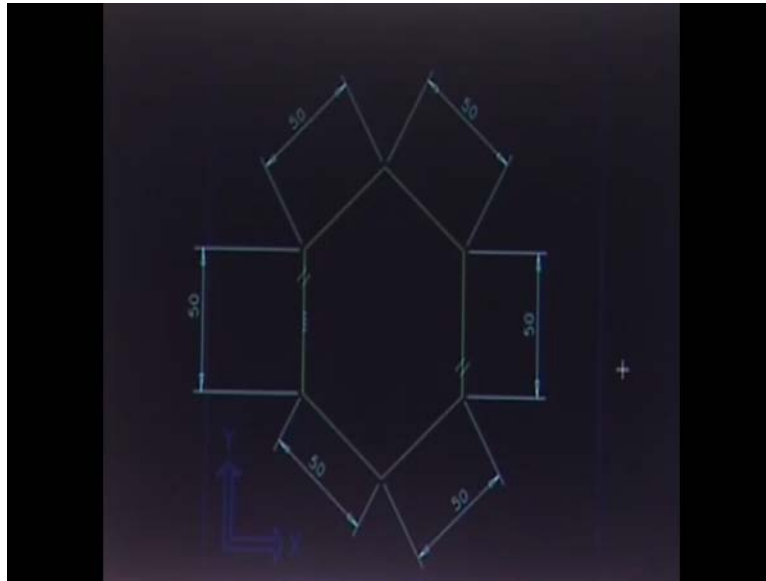
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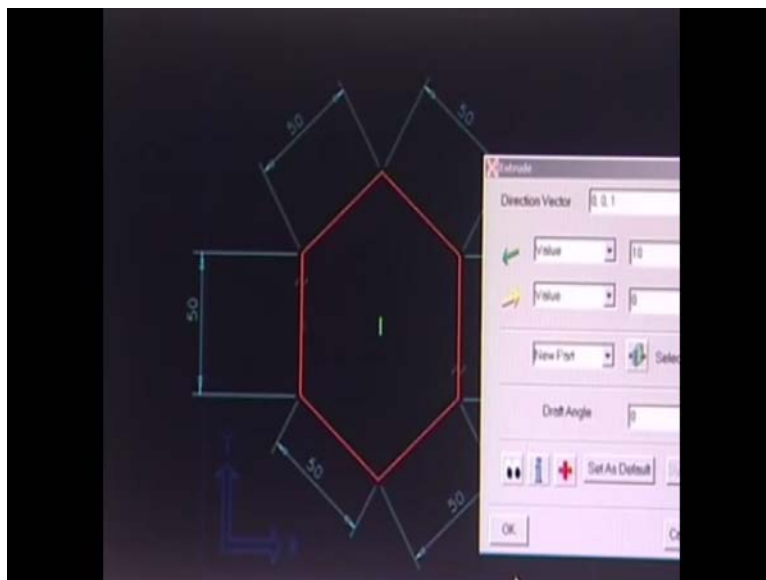


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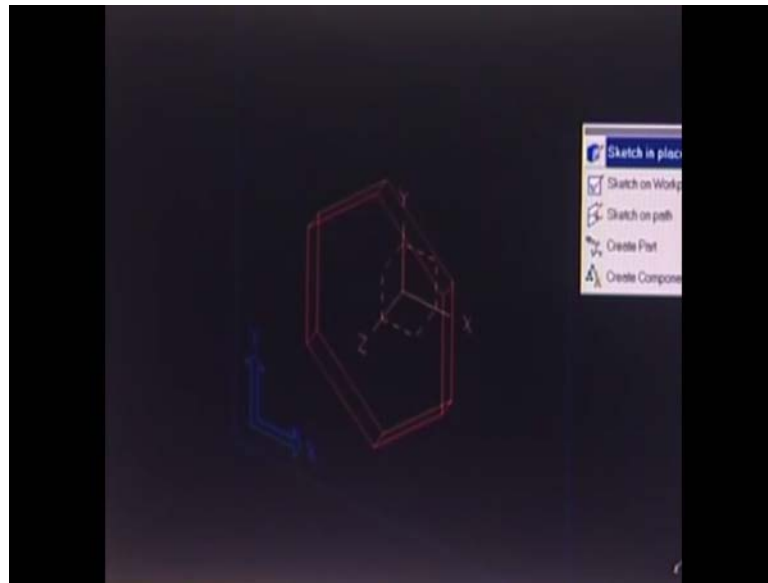


Next, the board design for this will start with curve lines option and draw an irregular hexagon. We see the dimension each edge is different, we modify these dimensions to get regular hexagon. Next, we use this tool command to generate the prismatic hexagonal head. The height of the edge is 10 units.

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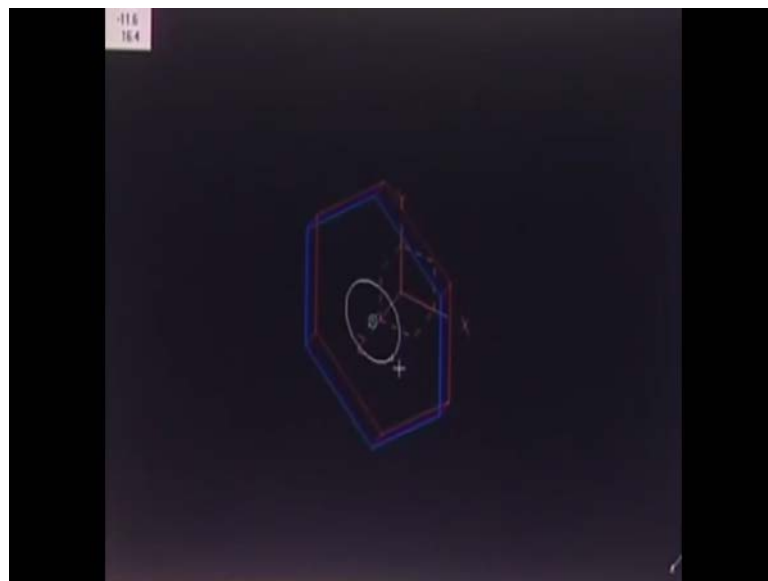


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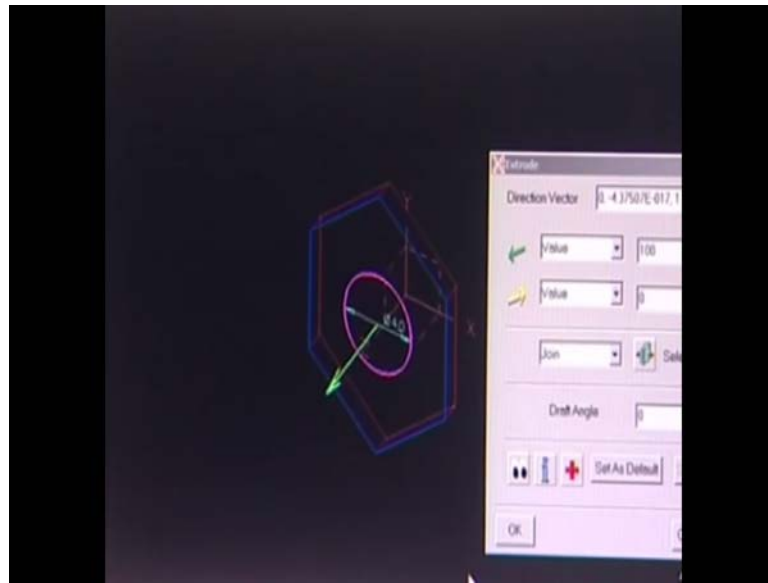
We choose one of the hexagonal planes to sketch the circles which would be cross-section of the board.

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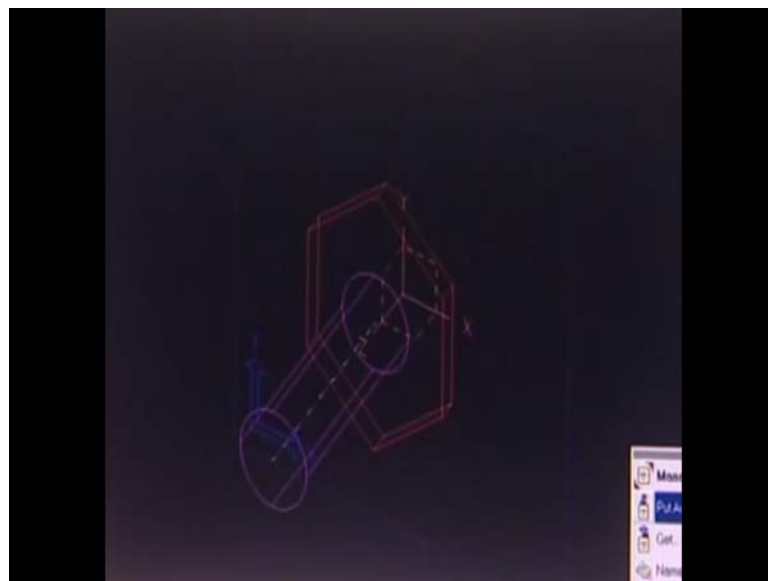
To sketch the circle and in a similar way the hexagonal head excluded to be exclude the circle as well.

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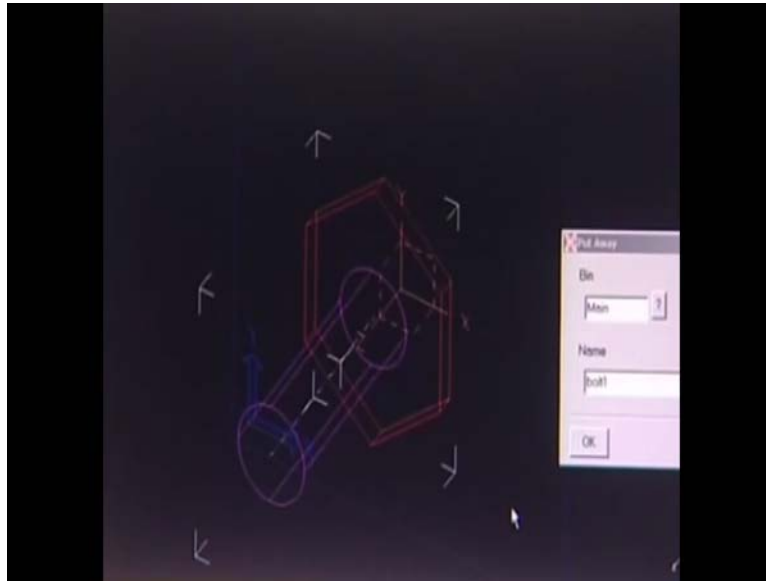


We exclude the circle by 100 units. We put this part away and concentrate now on modeling the threads.

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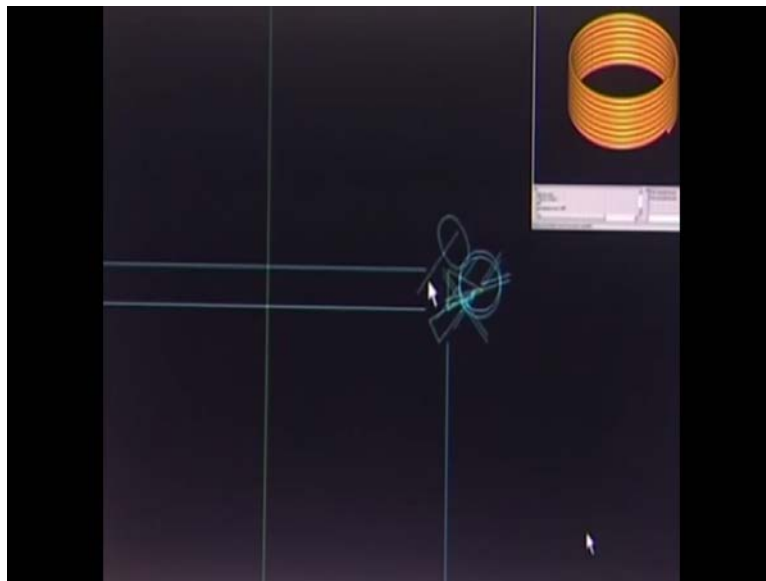


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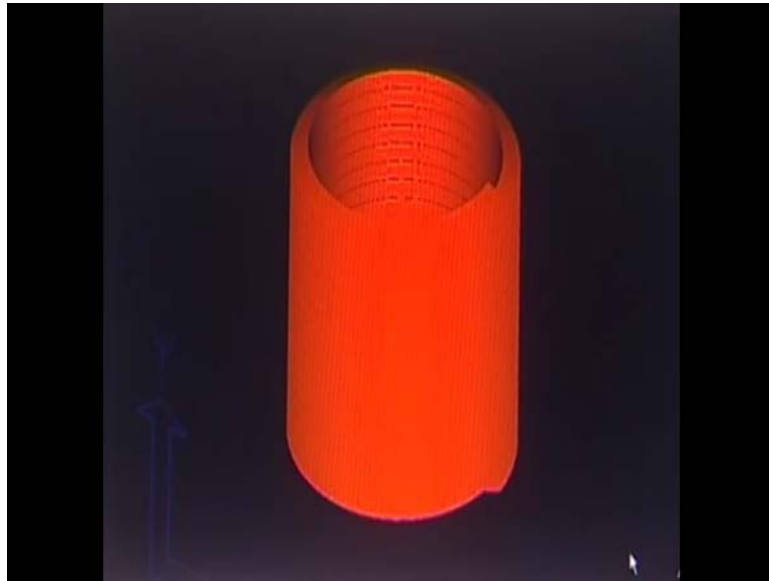
Thread design is very similar to spring design.

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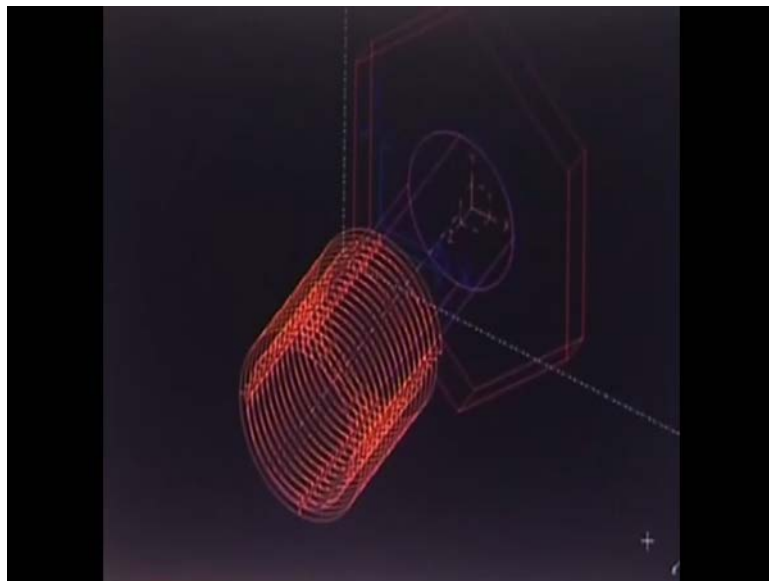
We have a vertical axis and a triangular cross-section which is going to be revolved around the axis.

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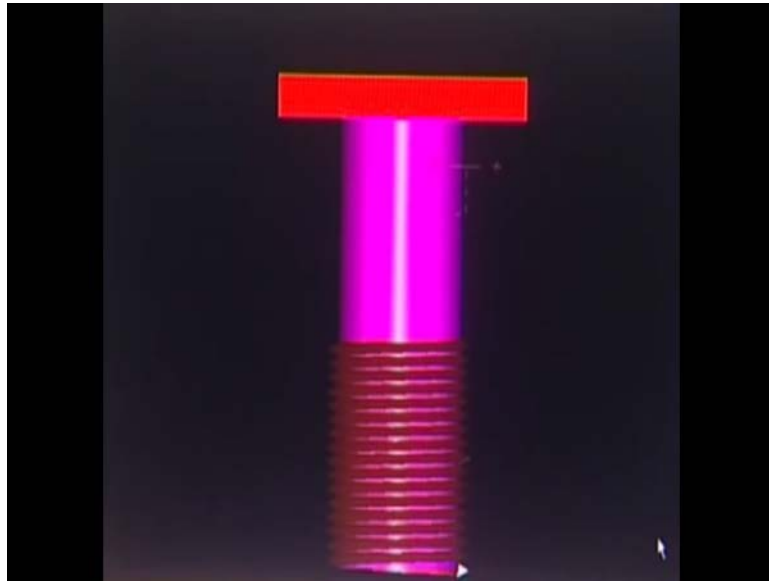
We sketch all the intermediate procedures and finally, get the threads. We now get the main part back.

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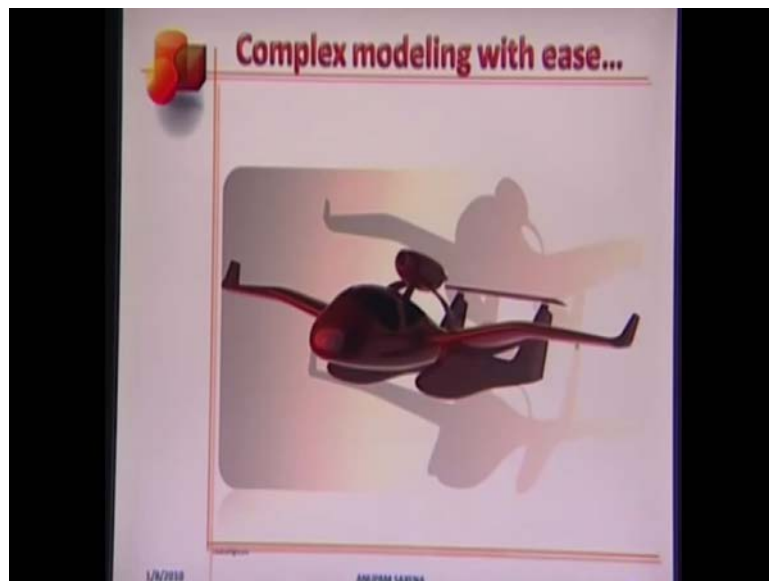
Position the thread appropriately over the shank and join the threads with the shank.

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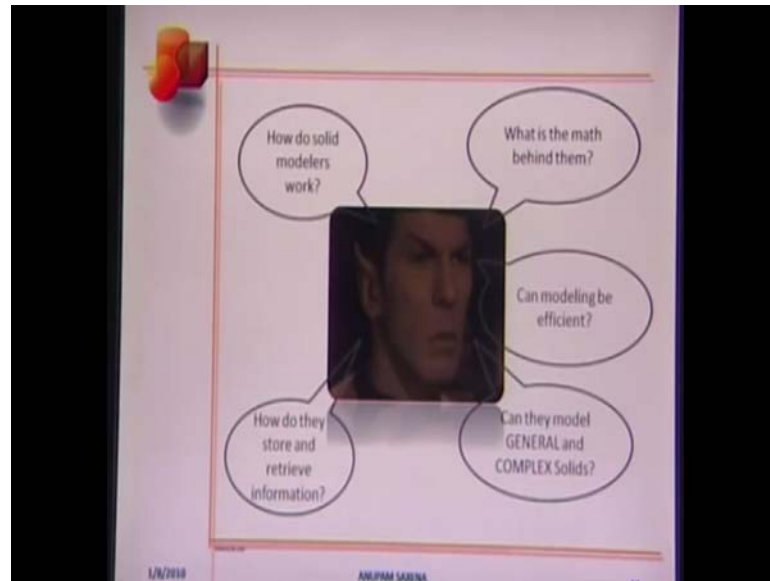
We have a bolt design.

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Although we have seen before, that we can design very simple mechanical components which are also feasible for us to design very complex structures, like this one.

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This is a picture of Misess Park, one of the characters in the first generation started. He is working and I am using this picture to represent an implicated mind. He would ask how would solid modelers work? What is the mathematics behind them? How do they store and retrieve information? Can they model general and complex solids at a same time? Can modeling be efficient? These are the questions that were formed the jist for the rest of the course.