Engineering Drawing and Computer Graphics

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Module – 01

Lecture 01: Introduction to engineering drawing

Hello everyone, welcome to our NPTEL online registration course on Engineering Drawing and Computer Graphics. I am Rajaram Lakkaraju from the Department of Mechanical Engineering, IIT Kharagpur.

In this course, we will learn about the technical way of looking at a drawing and comparing it with artistic drawing. In the 1st lecture, we are going to cover the introduction to engineering drawing.
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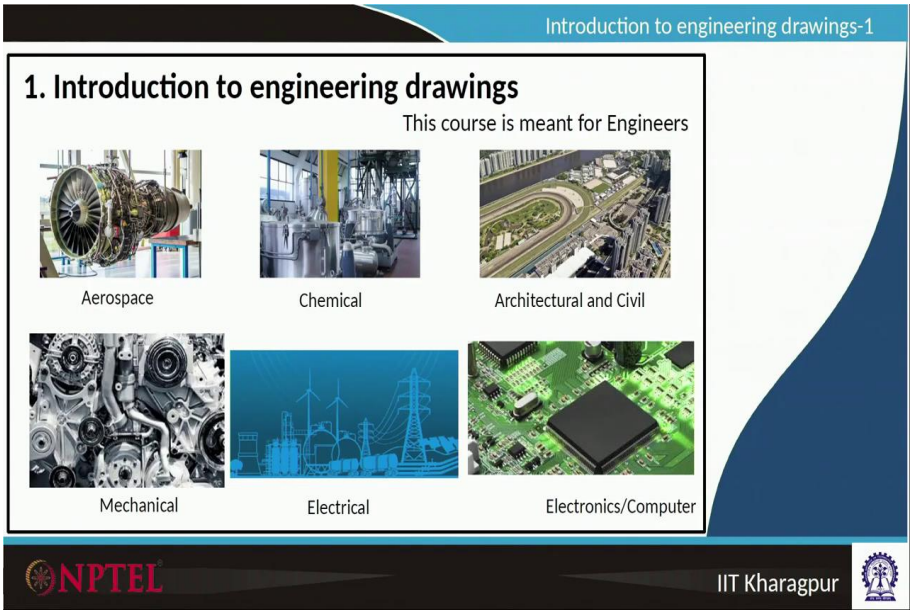

Engineering drawing is an essential component for engineers. Whatever the ideas you have, you express it through drawings and sketches. It involves many engineering aspects like design, production techniques, and many things that cover engineering drawing. For example, if you are looking at aerospace engineering, there will be gas turbine blades, and airplane's wings, many aspects.

These have to be in mass production. And for that, we require technical drawings for process repetitions.

Further purpose engineering drawing helps create proper construction of drawings that will be delivered to production lines.

Similarly, in chemical engineering processes, there will be many heat and mass transfer equipment, which have to be reproduced correctly. Every design always has tolerances, but that can be minimized through these engineering drawings. Similarly, for civil and architectural engineers, constructing building's patterns is an essential component.

And engineering drawing helps in achieving such kinds of drawings. Even for mechanical engineering, electrical engineering, and electronics, and computer science, engineering drawing is essential. Many chips, resistors, integrated circuits have to be properly produced in industries that require a careful way of drawing sketches, representing ideas. And our course is meant for such technical engineers who would like to learn this art of expressing their ideas.

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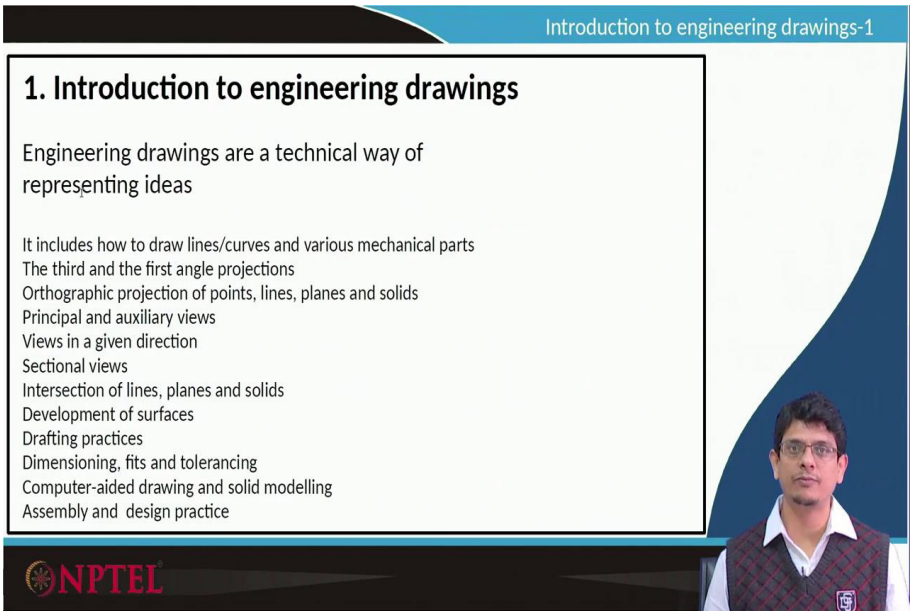

In this course, we will learn how to draw lines, curves, and various mechanical parts. We will also try to look at orthographic points, lines, planes, projections, principle, and auxiliary views, views in a given direction, sectional views, the intersection of lines, planes, and solids. We will also try to look at the development of surfaces, how to give dimensions, how to represent fits and tolerances, and how to use computers to draw these computer graphics. And we will also cover a little elementary hands-on in terms of assembly and design practice.

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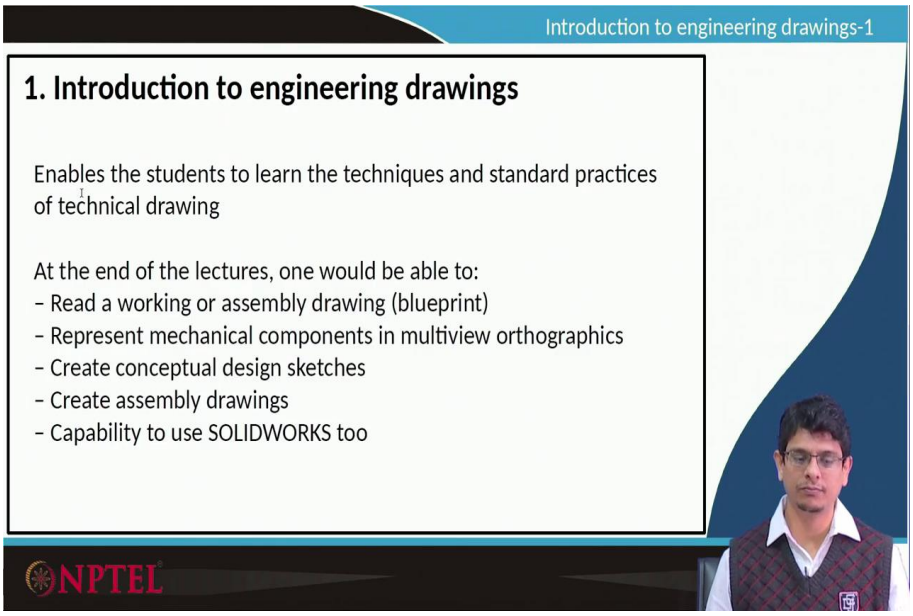

Engineering drawings enables the students to learn the techniques and standard practice of technical drawing. At the end of the lectures, one would be able to read a working assembly drawing, represent mechanical components in multiview orthographic drawings, create conceptual design sketches, and also create assembly drawings. The mission is to learn technical drawing skills and use computers, such as SOLIDWORKS software, to represent drawings.

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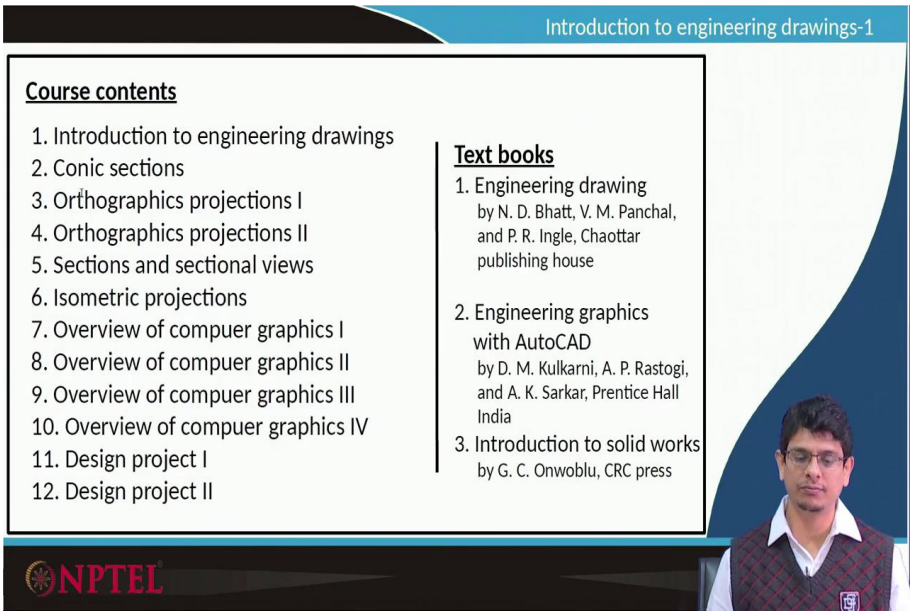

In this course, we cover 12 modules, 1 - introduction to engineering drawings; 2 modules on how to understand conic sections and represent them; 2 modules on orthographic projections which include sections and sectional views as a separate module and how to represent isometric projections; And 4 modules on overview of computer graphics i.e., knowing about computer graphics and drawing them using computer software; and 2 modules on picking up a specific problem and doing design project.

The standard textbooks that we have followed are Engineering drawing by N. D. Bhatt and others; Engineering graphics with AutoCAD by D. M. Kulkarni and others; Introduction to solid works by Onwoblu, CRC press. And over that, we have used many online resources to cover it in an extensive way.

Wherever we have used these references and materials, we have suitably represented, and some also acknowledged them. Engineering practices cover from the past few hundred years. So, we have acknowledged these sources suitably, and if there are any omissions in terms of acknowledgment, please excuse us.

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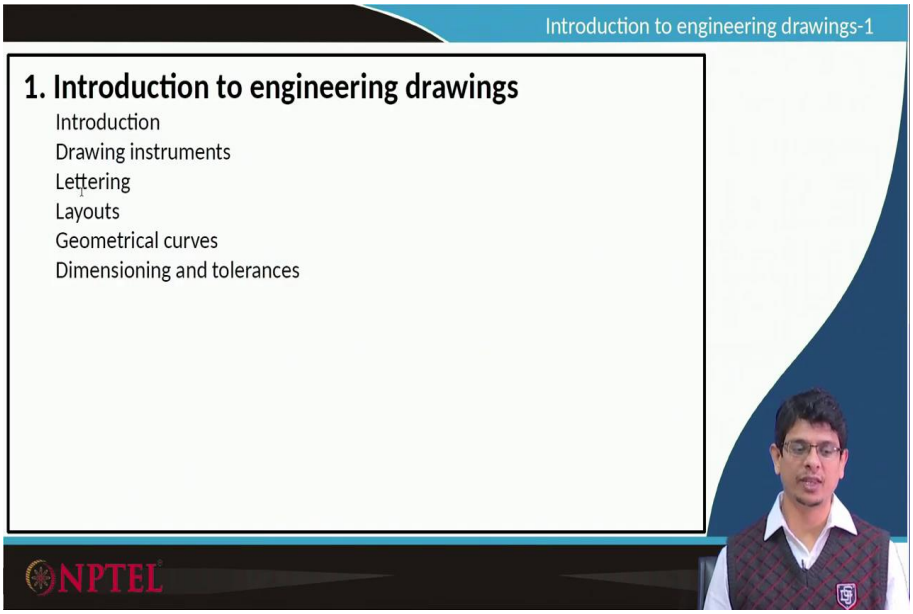

The first module covers the introduction to engineering drawings. In that we know about drawing instruments, how to use lettering, and what kind of papers, layouts we have to apply for engineering drawing, and representing geometrical curves dimensioning and tolerances we will cover.

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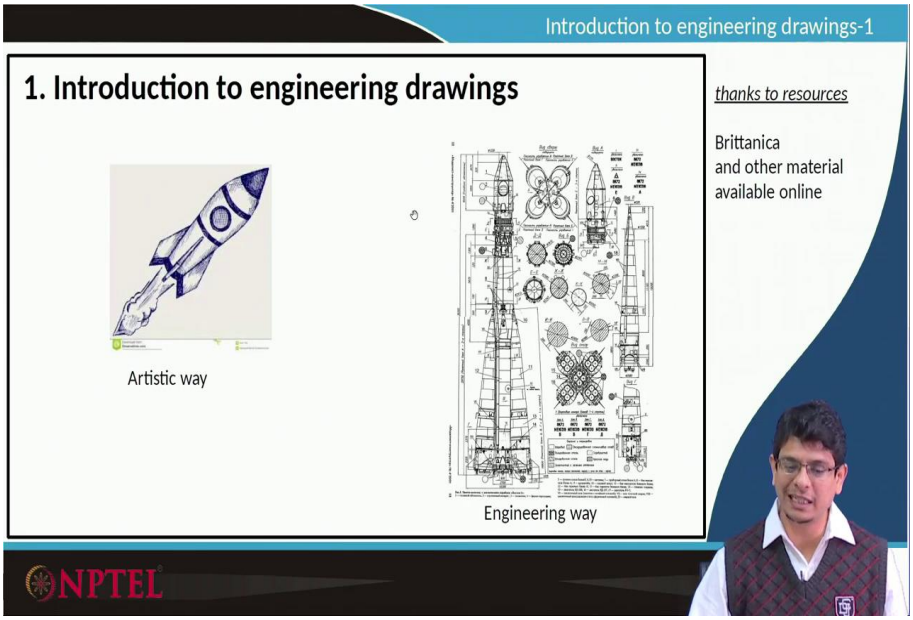

In an artistic way, we draw sketches. For example, here I am showing you a rocket drawn by an artist there will be exhaust gas coming out of that rocket, and thus giving momentum because of Newton's 3rd law, the rocket flies upward. Here the rocket shape is arbitrary; whether this might be efficient design or not, we may not know. But engineering drawing involves efficient designs, at least in terms of aerodynamical models, stability, structural strength, and many representations.

To design anything, we first use principles like Newton mechanics, and from there, we represent object size and cross-sectional areas that can withhold the stresses and forces. And from there, try to draw the realistic representation; from there, we submit to production lines, and manufacturing and production lines create that kind of object. And repetition is very much required for the engineering design.

For example, the engineering way of looking at the rocket is entirely different from the artistic way of representing drawing. Here a simple rocket consists of many parts. Here the hub, the re-entry shape, perhaps the wing, and the integrated components and many components will be involved to design this rocket.

The sectional view of this rocket is also important. Some of them have thrusters, some of them have body supports, some of them having cores, some of them have conical kind of shapes, and so on. Even the cut sectional consists of many engineering equipments. All these things supposed to be represented and reproduce if one would like to rebuild a rocket. So, the artistic way always is nice and simple. The engineering way is very complicated drawings involved. We need to understand what exactly each component is performing and doing, and what are the dimensions of that and how does that cut sectional looks.

Here, for example, for engineering way, there are certain lines arrows something like nimbus representing dimensions, and some of them like titles, components, the sectional views, who made that, what are the key components of that, and so on. And our engineering drawing is knowing about this basic plan of drawing the things and representing drawings.

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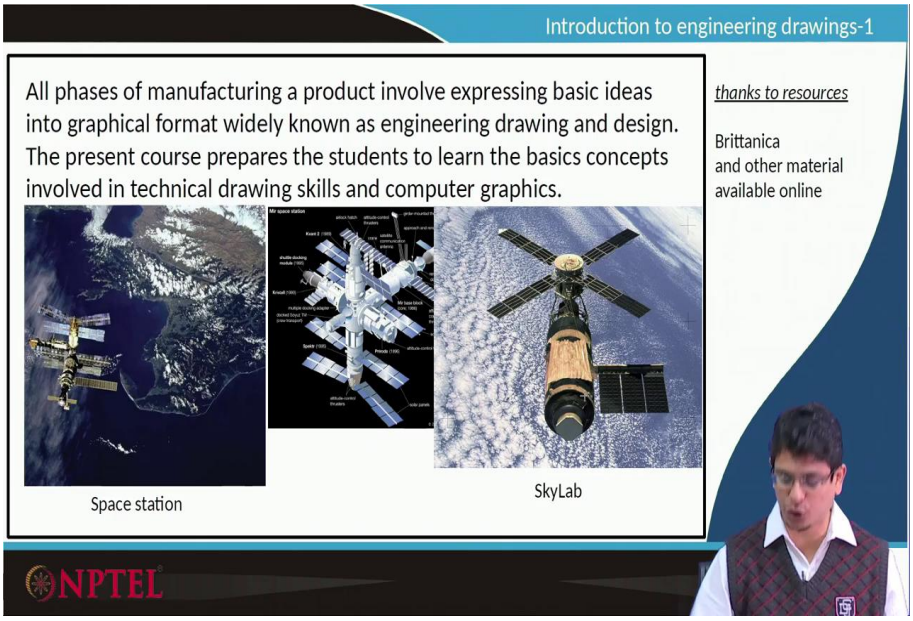

To recap, all phases of product manufacturing involve the expression of the basic idea of product in graphical format, widely known as engineering drawing and further design. The present course prepares the students to learn the basic concepts involved in technical drawing skills and computer graphics.

For example, let us pick a space station. This is the actual image of a space station that is above 100 kilometers from the earth at an altitude. It contains many components like solar panels, thrusters, and many other things. If we look at that in an abstract sense, it is an assembly of many parts; for example, the SkyLab the 1950s, 1960s famous space station contains many solar panels, gyroscopes, and instruments.

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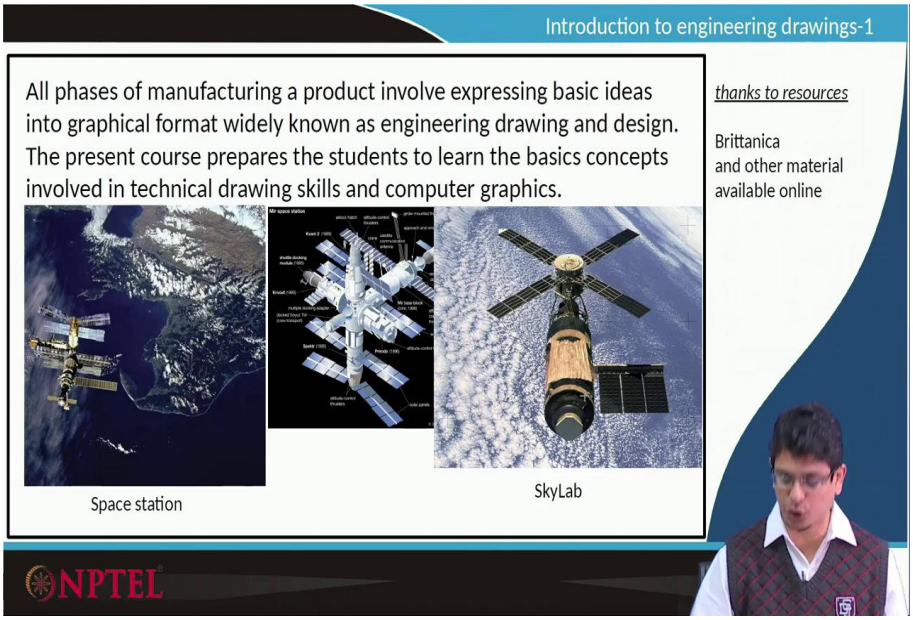

For example, it might be containing micrometeoroid shields, sleep compartments, wardrooms, waste compartments, airlock modules, multiple adapters, command and service modules, telescope units, and workshop units. So, each component, one has to draw it carefully, which follows certain design practices and is supplied to the fabrication unit or manufacturing guys. Based on that technical drawing with the dimensions, one will be able to produce each component.

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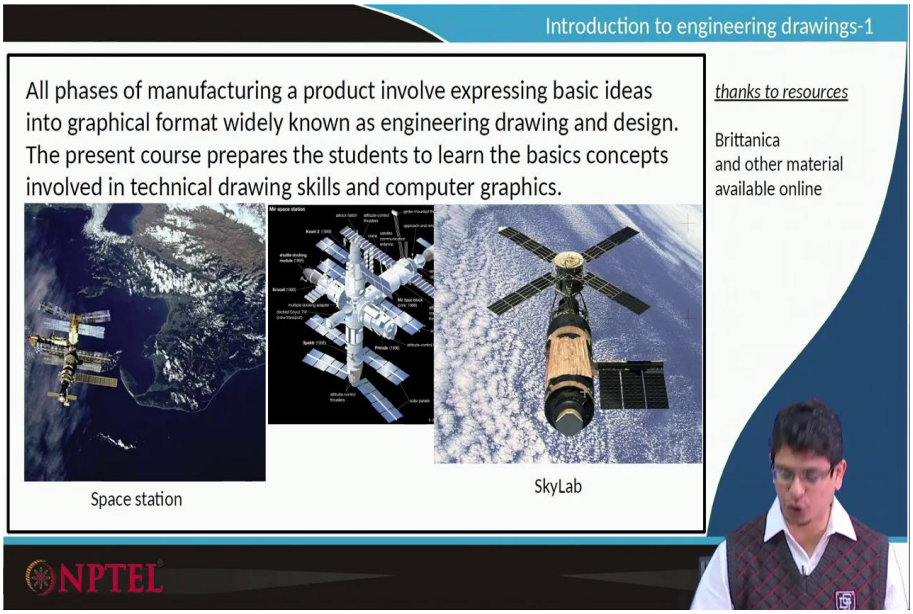

And they know which component has to assemble to what. Typically these engineering drawings may contain a huge number of individual components. For example, for this Skylab, the space station

contains nearly 10 Lakh components. It is not easy for any human being to remember which component is supposed to be assembled where.

And these components were also not made by one single person or one single unit. These drawings are distributed to a variety of manufacturing units, and individual components will be made. So, synchronization issues always exist between these industries and are communicated through engineering drawings.

For example, on this left-hand side, we show such kind of engineering drawing where all these individual components are represented. And this will have many sub drawing sheets having thrusters separately, having gyroscope separately, compartmental space, even nuts and bolts separately supplied to these industries. And based on those drawings, they repeat the pattern and reproduce the configurations.

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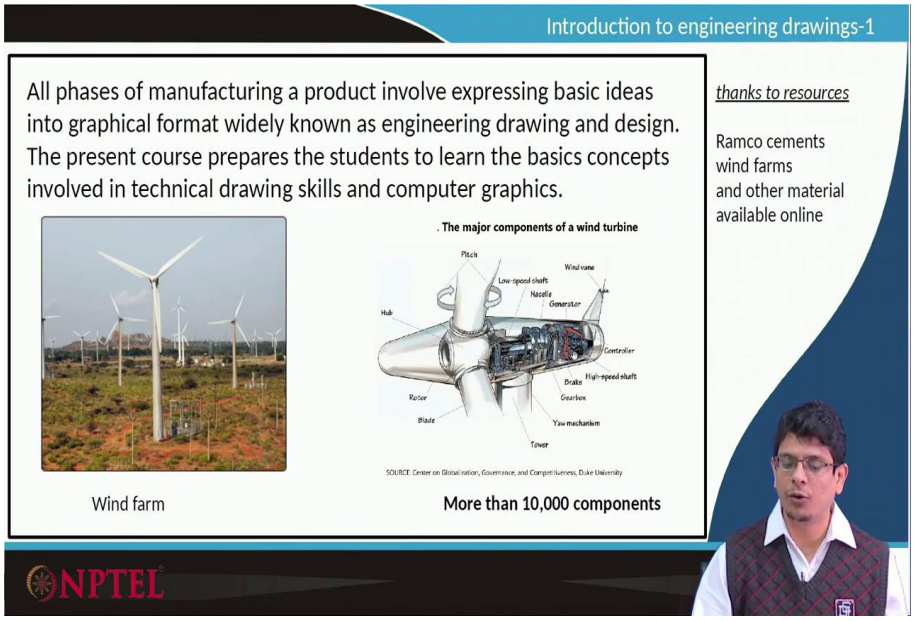

For example, if we are taking a wind farm, it contains wind turbine blades and a post massive post, which might be some 50 meters height, some 20 meters diameter of these wind turbine blades, and a wind farm consists of many wind turbines. And each wind turbines is supposed to be re-represented and manufactured unless a drawing sheet is there for this wind turbine blades, post and dimensions tolerances clearly mentioned, and materials used for production.

It might not be easy for any manufacturing unit to reproduce such kinds of repeated patterns. It contains very complicated details even for the turbine, something like a generator, wind vanes, low-speed shafts, nacelle, towers, yaw mechanism, gearbox, and many units. Each unit has to be assembled properly also.

And this engineering drawing course teaches you how to do this assembly things and also how to represent necessary drawings. By the end of this course, you will be in a position to understand engineering drawings, the dimensions, tolerances, boxes, and sectional views.

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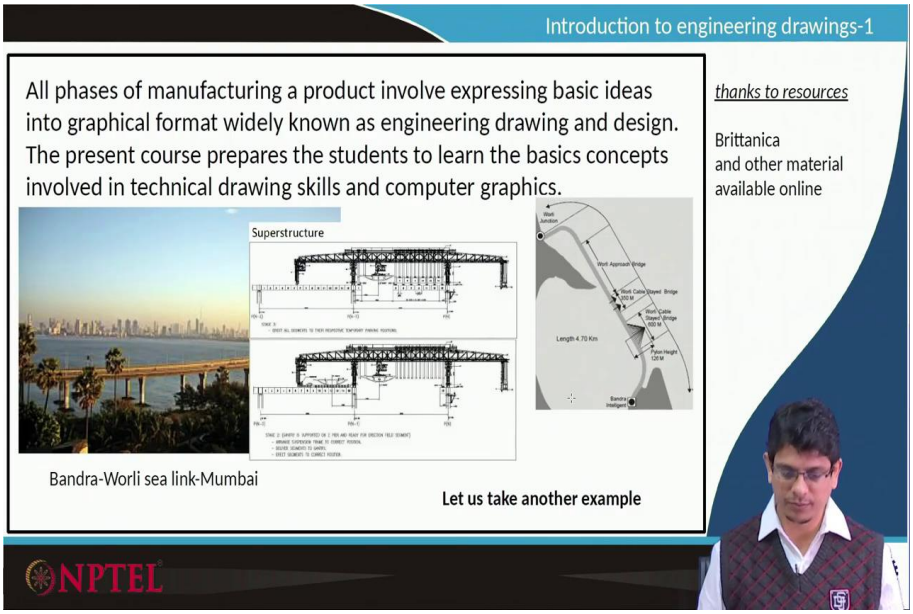

As I mentioned earlier, it is not just for mechanical and aerospace engineering, even for civil engineering and construction drawing plays an important role. Here, on the left-hand side a simple example like Bandra-Worli sea link from Mumbai is shown. It contains a very long bridge and many beams and columns are there.

And the distance between Bandra and Worli is also mentioned in the right-side plot; it is around 4.7 kilometers. And everything is represented in a schematic way like where these suspensions have to be created, where pylon has to be created, how this bridge has to be constructed. This is one part of an engineering drawing. The complicated thing though having many more inner details shown in the middle; it contains mass, pose, the dimensions, pillar to pillar locations, and many things.

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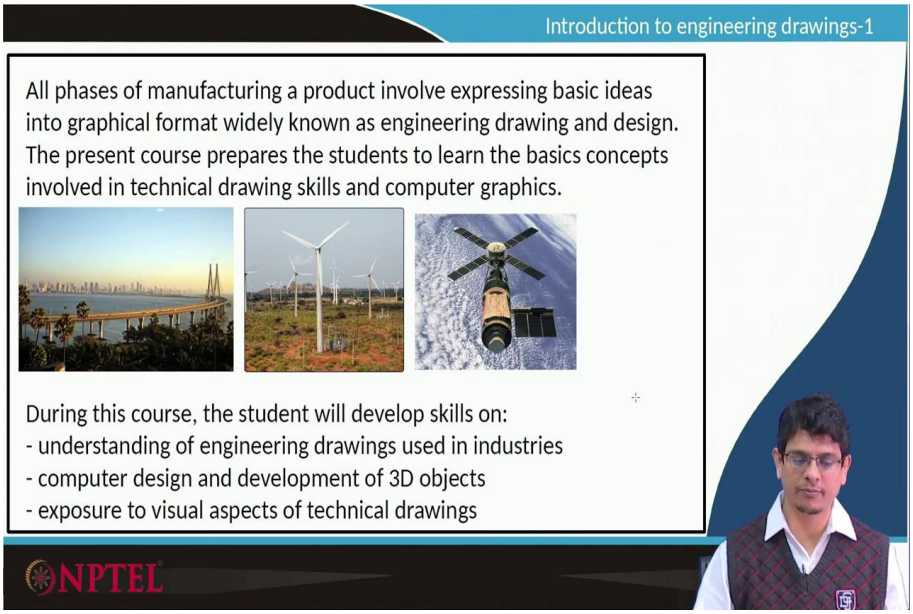

During this course, the student will develop skills in understanding engineering drawings used in industries, design them using computers, develop 3D objects, and have visual aspects of technical drawings. These are the objectives of our course.

Thank you.