Engineering/Architectural Graphics – Part 1 Orthographic Projection

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Lecture – 01
Introduction to Engineering Graphics

Good morning. I am Dr. Avlokita Agrawal, I am an associate professor at department of architecture and planning, IIT, Roorkee and this course which I am going to take now is on architectural graphics or engineering graphics. So, the content mainly remains pretty much the same as far as we are talking about orthographic projection. So, in this course we will start from the fundamentals of graphics not just orthographic projection.

We would know about what are the different instruments, tools which are used for hand drawing the orthographic projection and then we will gradually move on to understanding what orthographic projection is and how should we draw various objects. So, in this first lecture which is just an introductory lecture I will take you through the basic understanding of what is architectural graphics?

What is drawing, what is graphical communication and why at all is it needed? In the next lecture onwards, we will understand about the different tools and the equipments. So, to start with if we look at any design so anything that is designed around us it could be a piece of furniture, it could be a toy, it could be a building which is what we are ultimately aiming here to design.

So, if we look at anything that has been designed we can see that there are different stages through which this final product of design has passed. So, it was conceived by somebody I want a toy which is a spherical toy. So, there is a design which is conceived in the minds of the designer. Once it has been conceived after that it is further designed and analyzed that how will it be manufactured.

So, the third stage goes on to manufacturing and then once it is manufactures it is verified whether it will work the way it is it was intended to be designed or not and once it has been

verify it is out as a product used by people and finally we dispose it off. At each one of these stages, we require to communicate our ideas. So, at the conception stage we require to communicate what is conceived as an idea.

At the design stage and the analysis we need to communicate how exactly what are the dimensions, how exactly it is being designed, so what our initial idea was how will it be designed and analyzed and then to manufacture if we have to cast a dye or whatever. So, at each one of these stages we need to have a precise communication of this idea for the next stage to progress.

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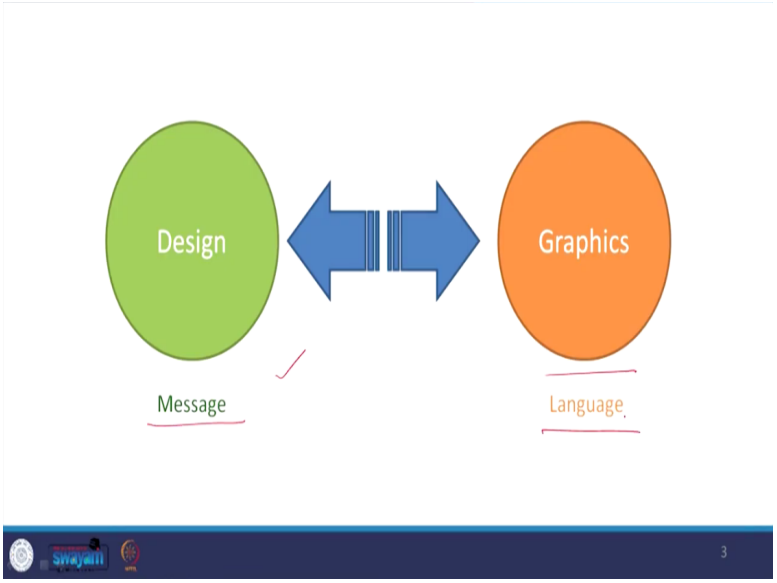

So, if we look at this design the final design is actually the message. It is only the message and the language in which this message is conveyed is graphics. So, basically graphics is actually a language. So, when I am talking to you when I am communicating all of this just imagine if there was not the screen if there was not a graphics which is on the screen in the presentation and if I was only talking through words I was still communicating.

So, we are communicating, I am conveying my idea of graphics through a language which is being heard, which is composed of words, sentences and I am communicating. I could do the same thing or maybe mix both of these with the help of this. So, I have a circle drawn here and I tell you that design is a message and graphics is actually the language to communicate that message.

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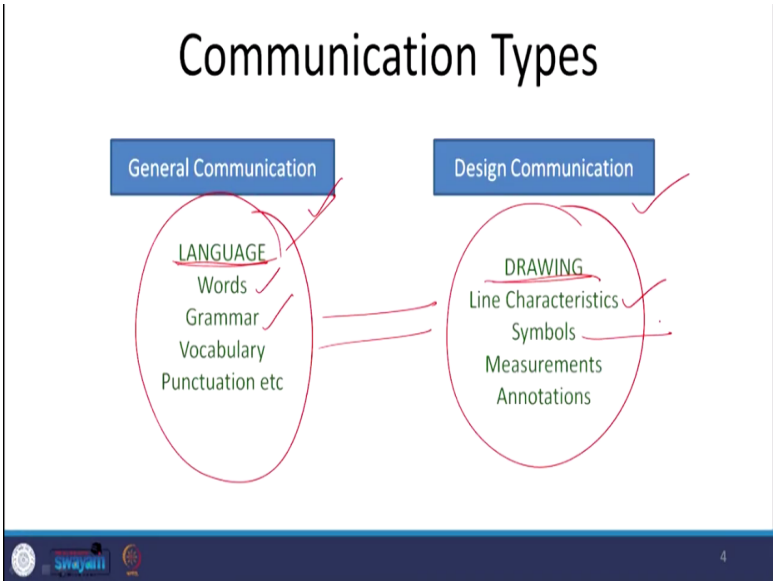

So, it is basically language and it is used to communicate. So, if we look at communication types which is what I have just said. We basically have two types of communications. We have a general communication and we have a design communication. If we look at general communication so all the languages that we read, that we study, for example, Hindi, English whatever language you might be talking about it is a way of communicating in general.

We could speak or we could write through this language and what this language is comprised of it has words, it has its own grammar, it has vocabulary, it has punctuation etcetera. Exactly all the same components which are part of the general communication they can be equated with design communication. So, if we talk about language here in general communication it is the drawing.

So, what you understand as a language is what you understand through a drawing and drawing is the language of engineers and architects and in fact not really just engineers and architects primitive people used to communicate through drawings and we have seen that. We have seen those old cave paintings through which they were actually communicating about the lifestyle that they had.

So, sociologist and historians have been able to deduce a lot of things from the drawings that the prehistoric people the primitive in prehistoric times were able to make. So, language can

be compared with drawing for engineers and architects like we have words we have these different line characteristics. So for example we have these different words as I am speaking so I use these words speak and draw and communicate these are all words.

Similarly, we have line characteristics as we go forward in this course we would see there is a continuous thick line there is a continuous thin line, there is a dotted line, there is a dash line and each one of this has a different meaning just as we have these different words which have different meanings. For example speak to say continuous line is a solid object, it is a continuous edge being represented and likewise.

Just like we have grammar we have these symbols here. So, how do you represent a fan which is going to be place in a sealing there is a symbol for it and it is kind of standard, how do you represent a tap, how do you represent a staircase, how do you represent a cut out in the roof. Each one of these they have standardized symbol and we use the same symbol. So, just as you understand grammar how to put these words together we use symbols.

How to put all these different lines together to represent meaning, communicate meaningful things and it is all standard. So, grammar is just like grammar and standard similarly symbols are standard. Next, we have vocabulary. So, we have so many different words for different things. Similarly, we have measurements not exactly equating to vocabulary, but we have measurements to actually communicate the sense of scale how big or how small is this going to be.

We have punctuations and all other things. Similarly, here we have annotations and a lot of these things. Overall, even if you were to read a drawing without somebody explaining to you, one should be able to understand what is being said through a drawing just like we understand a language composition. So, you read a poem, you read newspapers where this communication is happening, magazine, articles, books anything just like we read them and we understand what the author has been wanting to say.

Similarly, we read a drawing and we understand what the architect or the engineer has been wanting to communicate. So, when we talk about communication through graphics we are

essentially talking about the communication of an idea. A design through this medium which is graphics. So, it is the language using projections and there are different types of projections and just like they are using these abbreviations and different words.

We are using these symbols as a standardized thing and overall it comprises of this language. However, we have to be very particular that just like in general communication we have a bad language. So, sometimes if we do not use choose our words carefully it might communicate a wrong thing it might communicate a wrong message. Similarly, in drawing also if we do not choose our lines, our symbols carefully it might communicate something wrong and we might ahead with a wrong design.

We might just go ahead with something completely different being designed and constructed. So, similar to communication we have to be very careful of this language of design communication and how to standardize this. So, when I say that fan is represented in this fashion. So this is a standard symbol for fan, this is a standard symbol for ventilator, this is a standard symbol for window.

These standards they have been maintained through various national and international codes of practice and this is quite old. So, it started around the time when industrial revolution was happening and after that especially during the world war times this language of graphics, this communication through graphics it flourished, but initially it remained confined as a military language.

So, it was not used commonly, but after world war 2 especially it came out and it was used more and more by engineers and architects.

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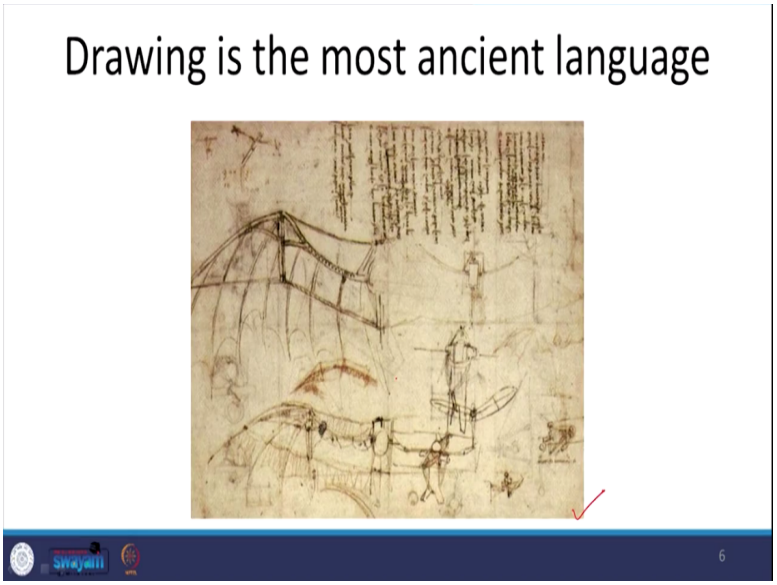

So, if you look at this is one of the drawings by Leonardo da Vinci and it is one of the most ancient languages of course Leonardo da Vinci is not a very olden times person, but he if you ever get a chance to see how he drew. So, this is his idea, his representation of the idea that he conceived, conceptualize for a flying machine basically and air plane. So, based on the wings of a bat so he was inspired by the wings of a bat.

And he was trying to convert all of this design in a workable thing. So, basically there is a very I should say a notational idea of what I want and then how will it work out, it will it really work. So, there is a fine balance between the creative aspect of an idea and the analytical, the scientific aspect of the idea for it to work. So, unlike sketching and painting it is little different because it is not just creative side.

It is not just fancy idea that I can paint and I do not really need to materialize it in a physical form, but when we are talking about engineering graphics or architectural graphics we are really looking at conceptualizing this idea, materializing this idea in a physical form. So, if we look at the need for graphics in engineering and design we see that design process will always include the graphics skill.

It has to without understanding this language of graphics we will not be able to communicate our idea to the other person. So, we cannot always tell and even if we are communicating the

language of general communication we cannot communicate to the other person what we really want to design.

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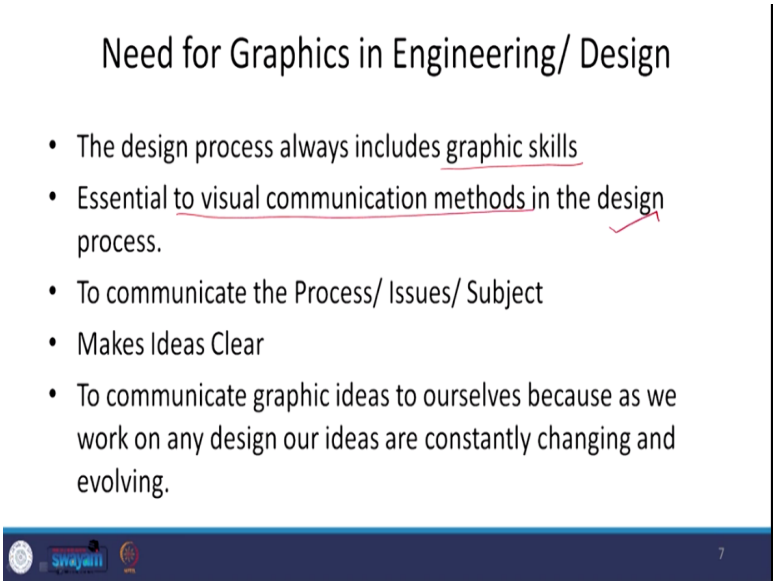

So, it is essential to visual communication methods in the design process. So, engineering graphics or architectural graphics is used to communicate the process or issue or subject whatever is being discussed and to make that idea very clear and not just for the other person, but also to ourselves as we go on to design as we go on to draw it makes things even clearer to us who is drawing that how it is going to progress, how the idea is going to progress.

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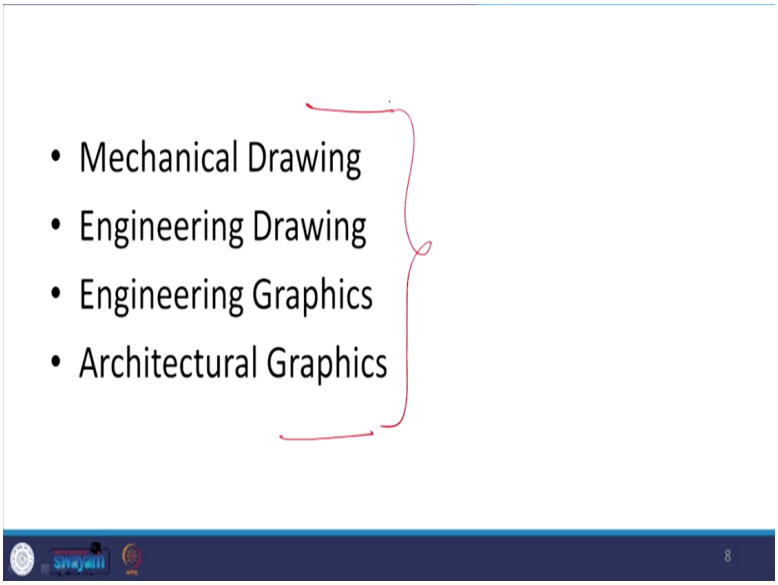

So, what I call as engineering graphics or architectural graphics is also known as mechanical drawing or engineering drawing or you could also find it in the name of engineering graphics.

All of these they mean the same thing and they have more or less similar content if you talk about architectural graphics. So, you might be dealing more with the symbols which are used to represent different parts of the building.

For example the wall looks like that, sealing would be represented like that, a window would be represented like that. However, if I am talking about engineering graphics where an engineer is using it to design dye or nuts or bolts or different machines the graphical language will remain the same. It is just that the symbols which are being used mostly popularly for communicating that particular idea will be slightly different though they are standard.

So, if a nut is represented as something in engineering graphics it will be represented as exactly the same in architectural graphics as well it is just that it is not being used enough. So, in a sense what I mean to say is all these are the same things, it is the same subject. You could pick up any book for mechanical drawing or engineering drawing or engineering graphics or architectural graphics.

And you would find the same fundamentals being discussed especially when we are talking about orthographic projection. So, what is the difference between a sketch versus a drawing and I think I have somehow someway discussed this, but a sketch is basically just representation of an idea which is in our mind. So, if we looked at the drawing which was made by Leonardo da Vinci which I just showed.

So, it had a sketch like thing and then by the side it although also had a drawing with some little dimensions on it. So, a sketch is a representation of an idea, but it is quite ambiguous, a different person any different person can understand it in a different way. However, the drawing is absolutely unambiguous. It will convey only one thing and that is what is supposed to convey.

So, sketch one could be conceived, perceived as different by different people drawing cannot be. Drawing will only convey one meaning.

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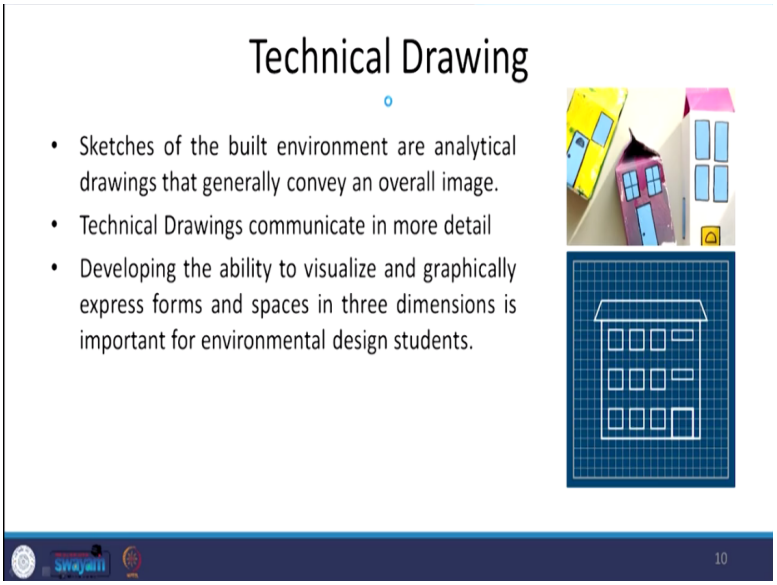

So, within drawing when we come to this technical drawing especially when we are talking about this architectural drawing it is the sketch of a built environment which along with the analytical drawings that can very clearly convey the overall image of this building, the build environment which is in question, which is in discussion, which is being designed to be constructed tomorrow.

So, they have all the details, the dimensions, the measurements, the different types of materials which are going to be used it has utmost detail which will be required to design it tomorrow.

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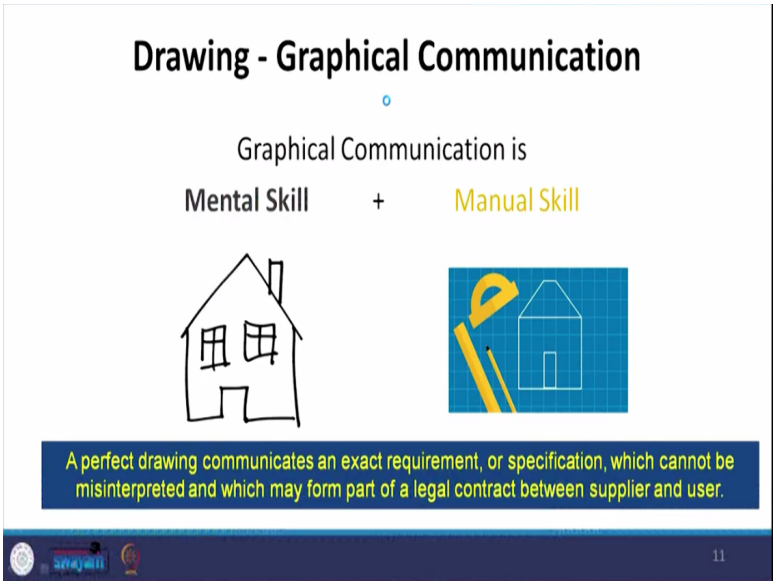

So, when we are talking about this graphical communication we are basically looking at both the mental skills. So, you have to perceive things, you have to be able to visualize, imagine what is going to happen and then manual skill to translate all that imagination on to the paper.

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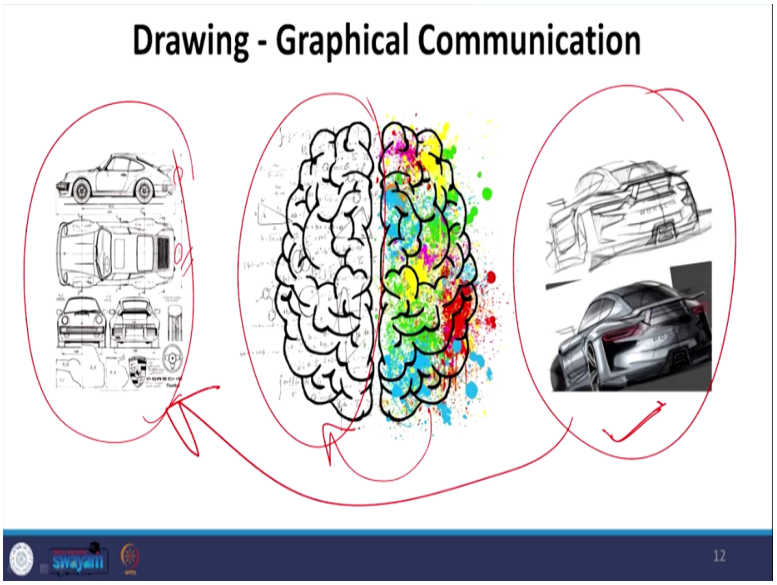

So, it is putting both of these things together, it is using both sides of your brain basically. So, on one hand we are imaging what we are wanting to design say building a house in mountains is what we are designing. So, I just visualize that this house is going to have a lavish big balcony and it will have a sloping roof and it will have a wooden column and it will have very huge vast windows.

As I say all these things I have a certain picture of this house in my mind. I know what I am imagining is this, this kind of house. While you are listening to what I am saying, you are also imagining what this house could be. The moment I start I have to get it constructed, I will have to convert this creative idea into a design a drawing which is analytical. So, it is not just that okay I can have any slope I would have to know what size of the rafter would be needed, what size of the column would be needed to hold this beam and this rafter.

What kind of material would go for the flooring, what kind of foundation would go and I have to talk about all those analytical aspects of this design for it to actually. So this was my idea for example of the home here it is a car and I have to actually make it like this where I

have all these individual dimensions, I have the materials and everything so that this idea which I had in my mind be converted into a reality through with the help of these drawings.

So, that is what is the sole purpose of this graphical communication. Now when I say that it is a very standard drawing it would also mean this and that. No, there is no scope further. So there are certain very rigid rules when we make these drawings, when we go ahead with the graphical communication, graphics.

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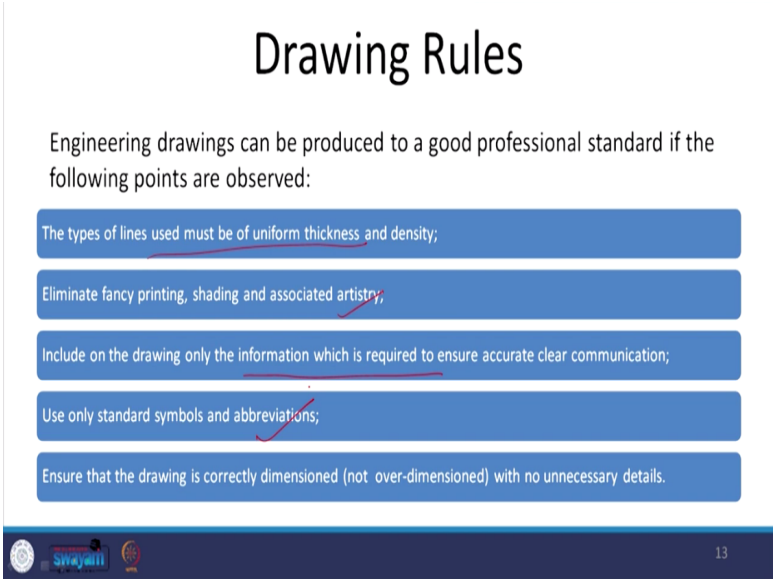

So, one that the lines that will be used they have to be of uniform thickness and density. When we move the pencil so things have been made much simpler with the help of these CAD software, computer aided drawing software for example this AutoCAD is there, you have many other software which are used to draw these drawings. So, it is much easier, you select a line thickness and you draw a line of a certain dimensions, certain measurement.

And it will be absolutely uniform, but when the drawing was mainly done by hand and by the way in this particular lecture, in this particular course all together we are going to draw it by hand and you will learn how to draw it by hand. So that is why I am emphasizing that the lines have to be of uniform thickness. In graphics, the variation in line thickness also has different connotation is that it has different meaning.

If I have to show a line which is being seen and plan I will make it thicker. If I have to show another beam which is in the sealing right above this I will make it lighter. So, there is a difference that is why when we use these lines any line it has to be of uniform thickness. We cannot use fancy printing and coloring and shading and associated artistry because a drawing will be reproduced multiple times.

For example, I have to design a space, a room, a hall and there are multiple things which are going to be fitted in this room. One there will be these brick walls. So, civil works will be there walls, columns, beams, sealing, flooring everything. The same set of drawing with slight variations will be given to the civil contractor then we have to get all these electricity works done.

So, there will be light, there will be fans, there will be conduits running the same set of drawing with of course additional information related to electrical will be going to the electrical contractors. There will be another set probably the mechanical one the plumbing with this, that furniture guy. So, everybody will be using this drawing and it has to be reproduced.

So, we cannot put colors it will produce shades and it can be perceived wrongly. So we cannot have any color, printing, shading or any artistic representation on engineering drawings. The next we have to include only the information which is required so that the communication is absolutely clear. So, we cannot have we should not include anything which is not needed in the drawing.

So, only the necessary ones we cannot have unnecessary, irrelevant information added on the sheets. It is very simple and it is very clear and we use only standard symbols and abbreviations. So, the standards as I said for representing fan or light or any plumbing accessory everything has a standard symbol and there are abbreviations which will be used and it will only be read that way.

So, we have to know what those standards abbreviations and standard symbols are and the same be used. The next we have to ensure that the drawing is correctly dimensioned with no

unnecessary details. So, a drawing is almost meaningless if it does not carry a dimension along. I might make a room, but if I do not know what will be the size of this room 3 meter / 6 meter or whatever.

It will have no meaning, it cannot be constructed. So, it always will come, should come along with dimensions and of course the scale to read it. So, we come to almost the conclusion of this introductory lecture.

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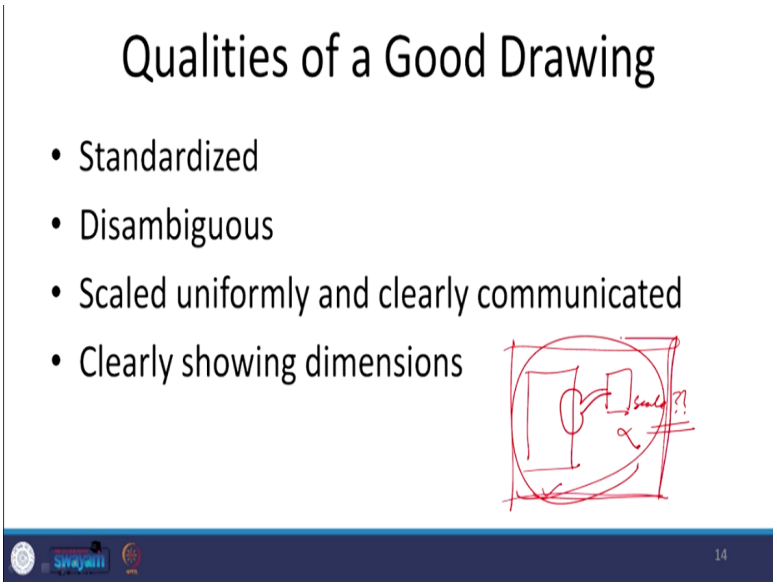

I will conclude it by narrating, by telling you the qualities of a good drawing. When do you know that the drawing is a good drawing when it is a standardized drawing and we are talking about architectural drawing, engineering drawing. So, it has to be standardized the symbols, the representations used in the drawing have to be the standard ones. Second, the moment it is standardized it will automatically become (()) (24:51), but still we have to try to maintain that the drawing is not ambiguous at all.

It should convey what I meant to convey and not something else. Third thing, it has to be scaled uniformly and the scale has to be clearly communicated along with the dimensions. So, it has to clearly show the dimensions. Now when I say scaled uniformly what I mean is we could have a huge big drawing. Now, if I have one piece of the drawing here and another piece of the drawing here it should not have some other scale here and some other scale there.

This entire thing has to have the same scale in case it is like a blow up of this you know smaller part then in that case the scale has to be specifically mentioned. A different scale will be specifically mentioned here otherwise for this entire drawing the same scale will be maintained and it will be used.

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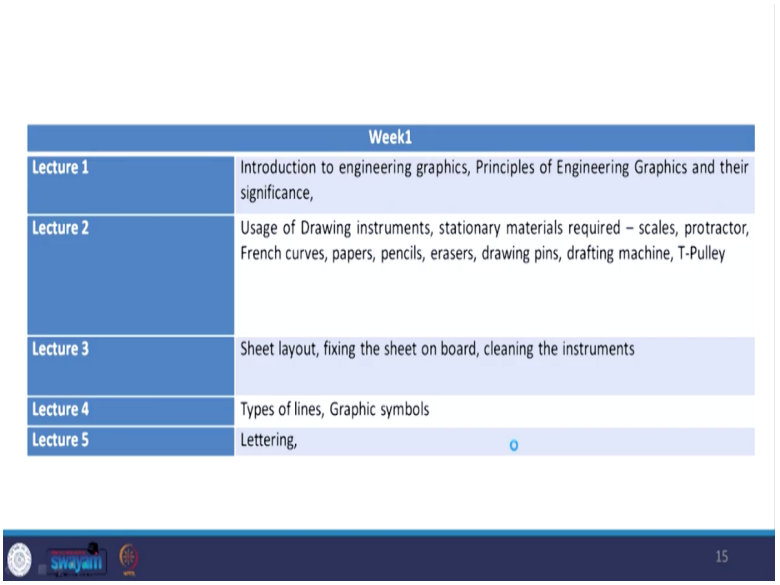

So, before I close this lecture here I will quickly take you through what we are going to read in the coming weeks. So, the week 1 will actually be the introduction. So, we will understand about the principles of engineering graphics which we have covered in today's lecture. Different drawing instruments, how different stationary materials will be used, what are the purposes, different sheet layouts, how do we fix the sheet, cleaning the instruments.

Different types of lines and graphics symbol, lettering. So, basically the introductory stuff which you say the vocabulary building or I should not even vocabulary building, but in language like the understanding, knowing the alphabets and some basic words how to put words together something like that.

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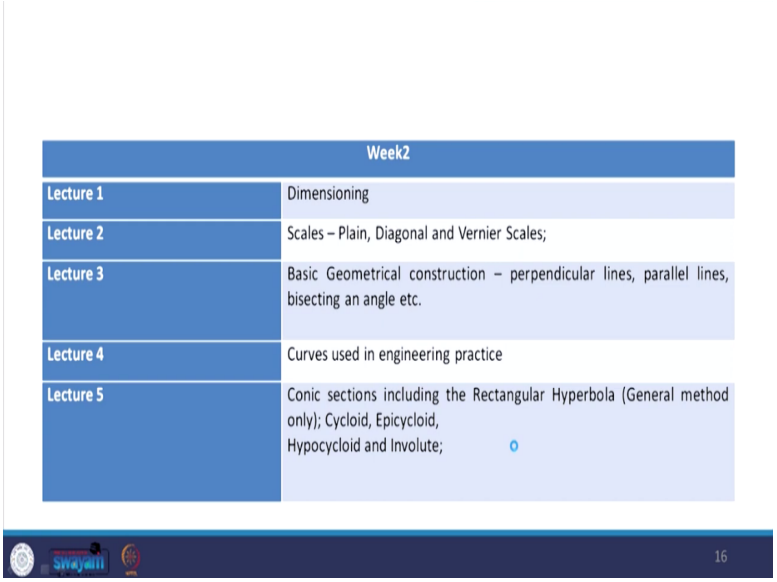

In week 2, we will start with dimensioning and scales because scales are very important. So, we will understand about scales and then we will start about basic geometrical construction using these equipments and then we will go on to understand how the curves in engineering practice will be used and different conic sections.

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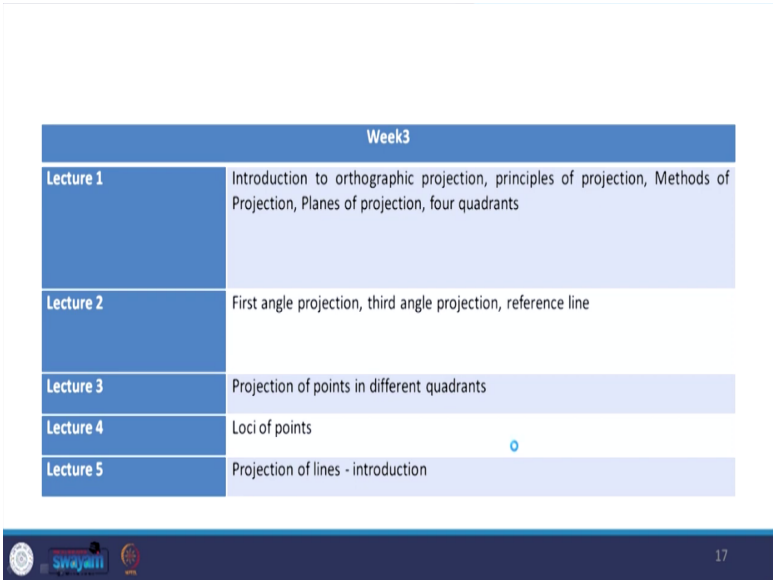

Week three, we will start with orthographic projections. So, we will understand the orthographic projection, the principles and then we will majorly work in first angle projection. Though, we will understand about first angle, third angle both and then we will go on to start with projection of lines.

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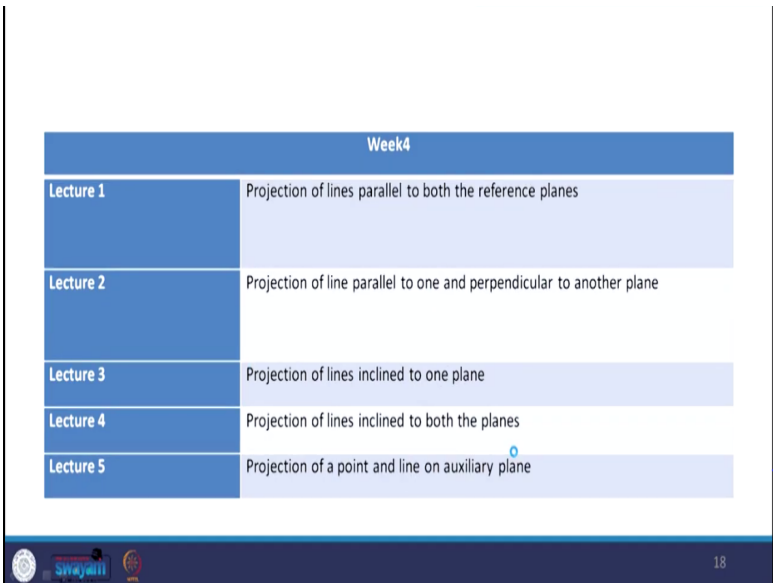

So, then week 4 we will go with projection of lines.

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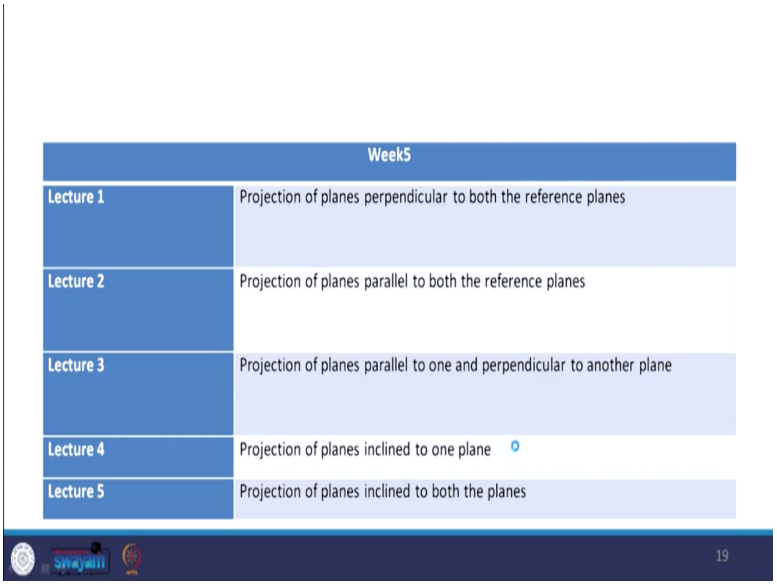

Week 5, we will move on to projection of planes and the complexity of these different projections will continue to increase.

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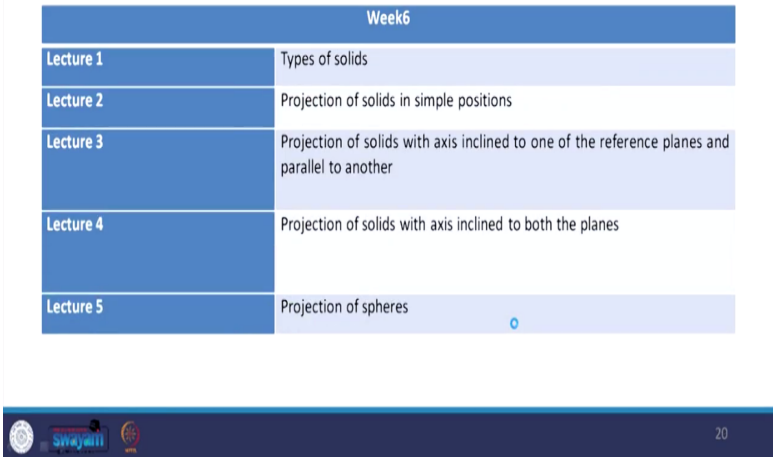

Week 6, we will move on to solids from planes we will move on to the whole solids.

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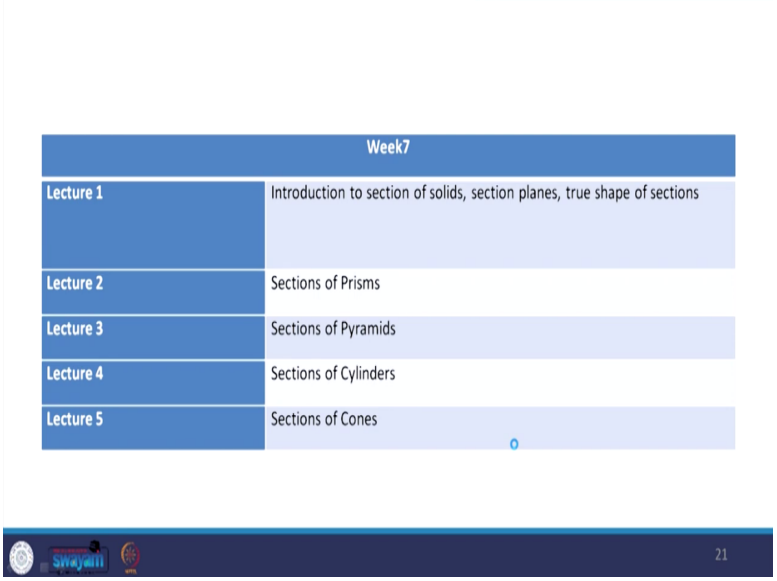

Week 7, we will look at sections of these solids. So, if the solids are being cut then what do we see? Week 8, we will move on to spherical surfaces, how do we develop different surfaces and then intersection of these different solids. So, that is all for today I will meet in the next lecture where we will be seeing what are the different equipments and instruments, tools which we will be needing stationary items to carry on with this course on engineering drawing.

So, after the second lecture I would request all of you to kindly procure these tools so that you can go ahead with your drawing as we move ahead with the lectures. So, thank you and have a nice day.