Interior Design
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Lecture - 16
Interior Design: Materials - Timber

Namaste. Hello everyone. Welcome again to my NPTEL course on interior design. We are at lecture number 16 today and we are starting our discussions on materials when we talk about interior design projects and we are beginning with wood or timber and this is the broad content for today. We will focus on the factors affecting wood finish.

Starting with understanding, you know, the type of wood first, types of wood finishes, color of wood, wood grain, texture, performance of wood, different types of woods, some examples from Uttarakhand and prices to give some idea of how the pricing of wood is done and of course a list of references. So, let us see the factors affecting the wood finishes. So, we have to first understand what type of wood it is. So, we have hardwood and softwood as two broad categories when we talk about wood or timber and you know it is important to understand the anatomy of wood to understand what is the you know composition what are its constituent parts and then how it impacts the selection of wood for application also.

So, if we look at this drawing over here, we can see this is the central part which is the pith and you know there is a portion of wood which is around this center, this over here that is the heartwood. And the one away from that and between this portion and the bark is the sapwood. So and this is the outermost skin which is the bark. We also see these rays and these rings that you see actually determine the age of the wood. So it's very important to understand anatomy, whether we are taking the heart wood or the sap wood or a cross section, which is a combination of both.

And how many rings, how old is the wood? If it is too old, it is a bit dry, you know, and compared to the younger wood. So those kinds of implications will also show on selection and design. And here this is for softwood and this is for hardwood and we can try to see the anatomy over here. You know there is some difference in the anatomy when we talk about hardwood and softwoods.

So we will see also what are hardwoods and softwoods slightly in detail. but yeah these are the rays that you see over here this over here is again ray and here if we look at the hardwood this is the ray so the anatomy is different there are typological variations over here these are the cells these are the fibers these are the vessels the longish ones so This is to understand the anatomy and then of course the wood finish also depends on the quality of wood. Whether it is a commercial wood or it is taken from the jungle or forest. Which portion like I was talking about whether it is sap inclusive or heart inclusive or heart exclusive or sap exclusive and so on.

We also have to understand the types of cut you know that a wood can take. So the popular ones are you know the quarter cut, the rift one, the tangential and the slab and the section of the cut whether we are cutting along the grains of the wood or across the grains of the wood. There are also some anatomical peculiarities which we find in some woods. So there may be a cross grain, something like this that we see over here. There may be knots, there may be pits, there may be some peculiarities in every kind of timber.

So these are the types of cuts that we see, and these are the most popular ones. These sectional drawings actually help us understand, when we cut it in a plain-sawn manner, what the direction of the cut is and how it appears. So you can see the appearance over here versus here. This is a quarter-sawn, of course. This is the quarter on which the cut is happening, the direction of the cut, the portion of the cut, and then how it will appear. So you can see the grains and the appearances.

This one is a rift-sawn. This is the detail over here in the drawing, and then how it will appear. This is the live-sawn, and this is the appearance. So, based on how we are cutting, there will be a certain appearance that you will get in your surfaces or sections, depending on how you are utilizing timber for your project. Now, there are technical specifications and implications of what you will achieve in plain-sawn versus rift-sawn, which has more wastage and which has more strength. So, those are highly technical terms.

I am not able to cover everything in one lecture where we are focusing on timber. So, I have left those details out, but if you are interested to know more, you can either write to me or look at the references. I will give you a broad overview. I will explain which kind of timber can be used in which kind of projects, and I will give you some examples. The wood finishes also depend on the presence of chemicals, whether there is a waxy

or resinous substance or an aliphatic compound present in the timber. It depends on the environmental conditions where it is grown or from where it is procured.

And the type of the field that you require for the project or for the application. So what is the texture that you can achieve, the grain or the pattern and the economics? So what is the cost and what are the additional maintenance costs which are sort of, you know, liable to occur? And of course, what is the time available for processing the timber that is being used? It also depends on the tools and technology available, what is the age of the wood like I was telling in the beginning, the moisture content of the wood, whether it is seasoned or not.

So, seasoned wood is where we try to remove the moisture and make the wood more suitable for the applications and what is the intended use for which the timber is used whether we are going with a highly structural application or it is not that structurally intact which is required so what is the intention.Types of wood finishes of course there are also different types of wood finishes so there is a the bark stripped one, the chopped one, sanded one and broadly speaking we can categorize the wood finishes into rough finishes and smooth finishes So rough finishes are cheaper compared to the wood finishes. They need less time to prepare. We can work with them you know using simple tools and techniques.

And the advantage is that they give better bondage to preservatives and coatings. They are good for moisture movement. So I was telling you that we need to season the wood and we need to minimize the moisture content. But nonetheless some moisture movement happens. So rough finishes help actually in that movement rather than locking that moisture.

Then the rough finishes also you know they hide the local defects such as knots and cracks etc. So now it depends on an individual whether you see them as defect or you want to utilize them as part of your design vocabulary and play around them. But yes technically speaking timber does have some defects like what are mentioned on the screen and the rough finish can aid in hiding those. They are vulnerable to insect and bacterial growth. That's another disadvantage.

So these are some of the examples that you see here on the screen which are rough finishes when we talk about timber. Then the smooth finishes, they are smooth as the

name suggests. They are expensive. They require finer tools and techniques to work with them. They give poor bondage to preservatives and coatings compared to what we saw in the case of rough finishes.

They do not collect dirt and they discourage the bacterial growth. That's an advantage here. These are some of the examples that you see for the smooth finishes in wood. And also, you know, when we talk about smooth finishes, the timber should have a fine grain pattern and therefore it will result in smooth finish. And we talked about the heart portion and the sap portion in the beginning.

So the heart portion of the wood is preferred to the sap portions if we require smooth finishes. And the sap portion may, however, be finished smoothly provided it is immediately covered with a moisture-proof coating. So we can do that, but we have to do some treatment. So hardwoods usually provide smoother finishes compared to softwoods. So these are some of the important details that one has to keep in mind when talking about finishes.

So we are talking about smooth finishes. So woods with resinous or oily substances generally have a natural smooth feel. So for example, teak and rosewoods have an oily or waxy surface. So they appear smooth, but they do not allow oil paints or varnish to adhere well, so they don't take the stain very well. Then, if the timber surfaces are flame-charred or singed, they also provide a slightly darker to black tone for selected areas.

So that can also be a way of playing with the finish by charring or singeing the timber. The flame is either cool, capable of depositing carbon, or hot, which is used to singe the surface. Now, the color of the wood. So, we find a very wide range of naturally occurring colors within the family of woods. But the color changes depending on whether it is freshly cut or has been exposed for a longer time.

And both the sapwood and the hardwood change color due to slight oxidation on exposure. The sapwood is generally lighter in color. We did talk about the pith, and we talked about the bark. And the heartwood section and the sapwood. So, sapwood is generally lighter in color than the heartwood.

For example, the colors in chir, sissoo, and kokko are less well-defined than in the case of sal. And then some timbers like spruce and fir show color distinction between heartwood and sapwood. The color of wood may be uniform, non-uniform, or streaked,

etc. And there is a huge variety available, from creamy white, for example, in the case of birch and deodar, to jet black, for example, in the case of mahogany, or varying shades of grey, such as in the case of oak, or yellow, pink, red in the case of walnut, sisam, brown in the case of teak, and purple as in rosewood, etc. In general, a darker color in wood indicates greater durability because of the presence of natural toxic substances.

So, these are some kinds of thumb rules that maybe this lecture can help us understand. This is the huge variety of colors available in naturally occurring woods, and there are plenty more. I have just put some popular ones over here, and we can utilize them to our advantage while working on projects. Then, wood grain—I was talking about it also in the beginning. So, it refers to the general direction or alignment of wood cells.

We saw, you know, on drawings, cells, vessels, rays. So, the grains may be straight, spiral, interlocked, wavy, irregular. And they sort of give a certain character to each timber, you know, depending on what their cell alignment and what their grains are like. So, the nature of grain considerably affects the strength, seasoning and other properties of timber. So grain if not straight is generally or technically termed as a defect in timber.

So a straight grain is preferred. So straight grains usually occur in normally grown or like planned you know tree plantations. We also see some cases of interlocked grains like in the example of sal which is very very unique. So, you know, we have different kinds of grains if you look at the anatomy again. You know, the straight and very pronounced grain in this case that you see over here, which means that, you know, the fibers in the board run roughly parallel with the vertical axis of the log.

That is one case. Here in this second one, you see irregular grain, you know, very, very irregular, not pronounced, not straight This is the third case where we see the diagonal grains over here. So, you know the otherwise straight grained log if it is not sawn along its vertical axis we get this kind of a pattern. So, also the type of cut sometimes determines you know how the grain structure looks like.

Then this is the fourth one where you know A tree that somehow grow twisted, it produces a log and subsequent boards which has some kind of a spiral grain that you

see over here. So, this is another kind. Then there is also you know this interlocked grain. We talked about the case of saal.

So, here we have this interlocked grain which comes from trees whose fibers in each growth layer tended to align in opposite directions. So, this kind of a grain is also possible in naturally occurring timber. And this is a wavy grain you know. When the direction of the wood fibers constantly changes, the board has this kind of a wavy grain. So, we have these, broadly speaking, six types of grains that we see in timber.

And they are very, very crucial to be understood while deciding, you know, how we are cutting them, what kind of grain structure do we want to use for our advantage in naturally occurring timber. Do we use it as part of our design vocabulary? While cutting the log, how do we retain their grain structure, minimize the waste stage, etc. So, it is a part of design to understand the anatomy of the material. Here in this case, we are talking about timber.

So, spiral grain is actually considered a natural defect. And you know, it has irregularities; it may make conversion difficult, reduce the strength of timber, and in timbers where the grain changes direction left and right more or less regularly, they have erratic grains. When radially cut, this may produce beautiful figures, you know, so sometimes we can use this defect as an advantage. Then there is wavy grain, which we talked about, and it is produced by undulations in wood. It also weakens the timber.

Texture of the wood. Now, the texture of the wood depends on the size and variation of cells, dimensions of the vessels—that long section we saw in the drawing—the width and abundance of the rays that we saw again in the anatomical drawings. So, timbers with large vessels and broad rays have a coarse texture. Again, just to understand it in an overview manner rather than going into too many details, this is something that will be useful for you to understand. Softwoods have marked variation in rings due to severe seasonal climatic alterations, and consequently, on drying, they show uneven texture.

Softwoods generally have a fine feel due to the presence of resinous substances. So, uneven texture generally, resinous substances, and because of that, a fine feel. These are characteristics of softwoods. Moist wood has a coarse texture due to the rise or uprooting of fibers. Similarly, old timber, which is very dry, tends to be brittle at the edges.

So more rings, more age, older the timber, it tends to be dry and hence it is brittle at the edges. A fresh wood may provide smooth feel due to the presence of oils, waxes, moisture etc. These are some of the images. Now we talk about the performance of the timber and it is measured in terms of strength, durability, stiffness, also color, texture and feel, size, availability, moisture characteristics, its weight, all of these properties. The size of timber is limited to the width of a tree trunk.

Again, something which can be easily understood and taken as a thumb rule. And quality is rarely uniform even within a section. It is susceptible to decay, of course, and a substantial part of a tree is lost in making timber for appropriate use. Yes, so whenever we are talking about environment, you know, concerns for environment, there are forest laws, whether or not we can cut timber. So there are a lot of byproducts, alternate materials that are coming up and we are trying to, you know, rely less and less on natural trees, but have more and more alternate and sustainable materials.

Its greatest strength lies in the longitudinal direction that is along the grain. We just saw six kinds of grains and we tried to understand the direction and the alignment of cells and hence a certain structure of grains. So the greatest strength lies in the longitudinal direction that is along the grain whereas it is comparatively weak across the grain. This the interior designers need to really understand well. And some would show excellent shear resistance across the grain.

So even though it is comparatively weak across the grain, some timbers show excellent shear across the grain. So there are always exceptions in some cases. Now, fast-growing trees or ecologically grown trees, which can provide an easily renewable source of supply, result in timber of poor structure or aesthetic qualities. So, the plantation has to be planned for good quality. The types of woods we broadly started this discussion with, focusing on hardwood and softwood, we are now going to talk a bit about these different kinds of woods.

So when we talk about softwood, we see examples like cedar, fir, pine, and redwood. And when we talk about the family of hardwoods, very popular and commonly found in the market and seen in applications during interior design projects and their execution are ashwood, birchwood, mahogany, cherry, and maple. We see timber like walnut, teak, oak, all of these. And I was just talking about byproducts and less reliance on natural timber. And hence, we find in the market products like MDF board, HDF board,

veneers, laminates, particle board, lumber board, all of these different products that you would find in the market.

So when we talk about softwoods, as the name goes, softwoods, it doesn't mean that they are weaker than hardwoods. They come from coniferous trees such as cedar, fir, and pine, and they tend to be somewhat yellow or reddish. So we find them usually in these color palettes. Most coniferous trees grow fast and straight. Softwoods are generally less expensive than hardwoods, so this is one reason why they are selected for projects if the budget is a concern. The important thing is that it's also relatively easy to find sustainably grown softwoods. They can replenish easily and grow within a few years, so therefore a lot of designers and projects actually use them.

They tend to focus on the softwoods for that reason. Some of the images and some examples are over here. Now, when we talk about solid wood, the wood cut into boards from the trunk of the tree makes up most of the wooden furniture and architectural building components. So, solid wood is used in a lot of furniture, in a lot of architectural building components, and interior architecture projects. The type of wood we choose determines the beauty and strength of the finished piece.

So, of course, it will depend on the type of wood, whether it is a hardwood or a softwood, and what is the age, what is the grain structure like, what is the color like, all of that. Many varieties of wood are available, and each has its own properties. We can try to understand which properties work to our best advantage, which wood can be used for interior purposes versus exterior purposes, and so on. So, we can understand that from a plethora of varieties which are available. So now, the following section is going to introduce the most common types of softwoods and hardwoods, and let us try to understand their applications within interior design projects. So, starting with the softwoods, I'll focus on cedar, and the most common type of cedar is the western red variety.

This is one image that can help you understand what cedar looks like. The western red cedar, as its name implies, has a reddish color. It's, of course, a softwood; it has a straight grain and is slightly aromatic, which can be used for very specific projects capitalizing on this quality and property of the aromatic smell of cedar. So, the western red cedar is mostly used for outdoor projects such as furniture. So, this is to be

understood, and of course, it will come with a lot of experience—getting to know the material, touching it, and working with it on-site.

But I have just tried to put things in an overview manner so that you can get some insights on how to use timber in interior architecture projects. So, the western red cedar, as we are talking about, is mostly used for outdoor projects such as furniture, decks, and building exteriors because it can handle moist environments very well. So, that's an interesting property, and also, it is moderately priced. So, that comes as an advantage for designers, and we can use it for projects. So, like I talked about, it's one of the most aromatic woods.

It's moderately priced. It's soft. It can resist moisture, and it can be used for exterior elements. So, it is used quite often in interior architecture projects. Then another softwood, which is fir, is often referred to as Douglas fir.

And this also has a straight, pronounced grain, as you can see here in this image—quite straight and very pronounced. It has a reddish-brown tint again if you see over here, and it's most often used in constructing buildings. It's not so expensive, and it can also be used for furniture making, so there is an all-round use for fir, and it comes quite handy. And it doesn't have the most interesting grain pattern. It doesn't take stain very well. And, you know, we can intend to paint the finished product. And it is moderately strong and is considered a hardwood, you know, within the overarching umbrella of softwoods.

So this is accordingly chosen and you can use it for construction of buildings. Then there is pine wood. Pine wood is getting used very extensively in interior architecture projects and in the industry we see a lot of use of pine these days. It comes in several varieties. There is sugar, there is white, there is yellow.

It is easy to work with. And because it is soft, we can also do carving in it if there is some kind of a detail which we want to achieve for our projects. It takes the stain very well. But of course we need to seal the wood first. So we see the use in furniture.

It can be easily shaped and it can also be used for building construction. We see a lot of use of pine in homestays and retreat projects and hospitality projects, residential projects. Then there is redwood. So, just like cedar, redwood is also very commonly used for outdoor projects, again because of its resistance to moisture. It is very

important because when we use timber as a material, there is a threat from moisture, from termites and a lot of issues that one has to take care of on ground while working with this material on the projects.

It is soft. It also has a straight grain as you can see over here. And the color is very very interesting. So reddish tint as I was talking about. Again this is also easy to work with and it is moderately priced.

So this is also a good choice for our projects. Now let's talk a bit about hardwoods and there is a huge variety that is available you know when we talk about hardwoods. So of course there is a popular oak, there is walnut which is very very hardwood and not so easy to work with in that sense. There is cherry, there is maple and pine we saw in the category of softwood but it's also available in a version which is the hardwood. So we see a lot of variety of colors, textures, grain patterns, and there is a like a plethora from which we can pick and choose.

So there is a lot of diversity for us to, you know, look at and then do the selection for our projects. And the issue is that they are very expensive. And if for our clientele, the budget is not a problem, then, of course, we can go selecting the hardwoods. So some of the more exotic species can be like very, very expensive, even for the hardwoods. So then that totally depends, you know, on the pricing and the budget and the clientele.

Some hardwoods are very hard to find and are being harvested without concern for their eventual extinction. Now, this is my concern. This is the biggest concern. How to replenish hardwoods? How to prevent them from going extinct?

How to prevent harm to the environment? How do we keep in mind the environmental impact assessment? And we do not just employ and use these words irresponsibly without talking about climate change. So, of course, that is why we are trying to look for alternative materials. So, when I talk about timber in this course during this lecture, I am, of course, talking about a classic material called

which is very, very interesting, timeless, and still used a lot and highly sought after. But I'm also constantly talking about circularity, sustainability, less harm to the environment, and being responsible designers. So let's also keep that in mind and try to achieve a balance. So when we talk about hardwood, ash is a very popular kind of hardwood, and you know we find it in white to pale brown varieties.

It's easy to work with. It takes the stain quite nicely. It's a good substitute for white oak. If you don't want to use oak, you can go for ash. Here, if you see within this, we find a plain figure, a medium figure, and a highly figured wood.

So, as we also talk about in the case of stone, you will see. There could be grade A, B, C, ranging from highly finished and sophisticated to a version where you see a lot of grains and stains. So, accordingly, you pick which one is budget-friendly and which one you would want to use for your project. Then there is birch wood, which comes in two varieties: yellow and white. It's a very interesting timber.

It's also used for furniture. And, you know, yellow birch is a pale yellow to white wood with reddish-brown hardwood. Whereas the white birch has a whiter color that resembles maple. It is readily available, and importantly, for the category of hardwoods, it is slightly less expensive. So, we could use that.

It comes in this kind of tint, and it's not so expensive compared to other hardwoods. It is used for making fine furniture, as I mentioned on the previous slide. It is quite stable, and we can work with it easily. But the problem is that it is hard to stain because it can get blotchy. So, you know, one may prefer to paint anything made out of birch.

Cherry. Cherry is a very popular kind of timber, and it's like an all-round wood with great performance, highly recommended for interior architecture projects. It's easy to work with, stains well, and finishes nicely. It ages beautifully. That's a very interesting aspect of this kind of timber.

And cherry's heartwood has a reddish-brown color. The sapwood is almost white. So, it's very interesting. There is diversity within the section, you know, when we move from heartwood to sapwood, and it could be used as part of a design vocabulary. It has moderate hardness.

These are some of the images that show the application of cherry. It is very common for furniture making. Also, it is available from sustainably grown forests. That makes cherry, again, an excellent choice for projects. Then there is mahogany, one of the great furniture woods, also known as Honduran mahogany.

It has these attributes: reddish-brown to deep red tint, straight grain, medium texture, and moderate hardness. And it also stains very well. It looks great with just a coat of

oil if you apply it. The drawback is that it is not grown in sustainable forests. So if we are truly concerned about the impact on the environment, we have to think about our choices.

Then there is maple. Maple comes in both hard and softwood varieties. And both varieties are harder than many other woods. Hard maple is extremely hard and therefore difficult to work with. Soft maple, on the other hand, is relatively easy to work with.

So this is a better choice in that sense. And maple, because of its fine straight grain, both varieties are more stable than many other woods. So again, that's the reason why this is chosen for the projects. And also, compared to other hardwoods, it is less expensive. So this also goes in the pros, you know, of selecting this.

Oak is one of the most used woods for furniture. It's available in the two popular varieties: red and white oak. Quite strong and easy to work with. White oak is preferred for furniture making because it has a more attractive figure than red oak. So sometimes the grain structure, figure, and appearance based on that, of course, we decide whether we are going to use it for furniture making or for other purposes.

White oak is also resistant to moisture. And therefore, it can be used for outdoor furniture also. So it's again an excellent choice. So this is one wood that can be found quarter-sawn. We saw in the beginning plain-sawn, quarter-sawn, rift-sawn.

So, in fact, quarter-sawn white oak is less expensive than some other hardwoods like cherry. So, this is an advantage. The grain has a beautiful ray flake pattern to it, and therefore, that is also capitalized while designing. So, it's used for both flooring and furniture. And a lot of people—designers, clientele—love this kind of timber because of its grain structure and appearance.

Then there is poplar, which is not a very popular wood, even though it is less expensive. And for a hardwood, it is soft and easy to work with. But because it has, you know, some kind of streaks of green or brown that you see over here, sometimes it is less popular among designers and clients. So, it is not considered one of the most beautiful woods; therefore, it is rarely used in fine furniture, and if it is used, it is usually always painted.

But I would just like to put a disclaimer that it also depends on individual choices. If any designer would like to use this as an interesting attribute and not look at it as a defect or, you know, non-aesthetic. So, it depends. But going by the market value, it's not much of a popular wood because of these streaks that you see. So, it can be a good choice, rather, for, you know, the inside of the drawers, for storage, and other applications.

It is also good for making toys, bowls, and woodworking crafts. It takes paint better than stain. Then there is teak, of course, very popular, but it is becoming rarer, you know. Because we are talking about forest laws and environmental concerns. But it's quite suitable for fine furniture, both interior and outdoor.

Highly weather-resistant, very beautiful to look at. It has an oily feel. It has a very, very beautiful color pigment also, which is natural, golden brown. Wooden entrance doors are often made from the top-quality Burma teak wood, very popular, quite exquisite, and very expensive also. Then walnut—it's one of the hardest woods.

If I have to talk about hardness on a scale, you know, one to five, walnut is somewhere around four. So very hard, rich brown color, and it's expensive. It's difficult to find large boards of walnut for big projects. So all these things have to be thought about before selecting this. Despite this, walnut is still a great wood to work with and lends itself nicely for use as accents and inlays.

So, very interesting and intricate details can be achieved in this, and for that, skills are required, and not everybody can work with walnut. Some of the images. Now, because we are talking about byproducts and looking at alternatives and relying less on natural wood, you will come across these byproducts in the industry, starting with plywood. So, plywood is used a lot in interior design projects. So, plywood and other manufactured wood cores, you will find them in woodworking projects.

They come in a variety of styles and a variety of finishes. And we can use them for different purposes in different projects. Plywood comes with several different types of cores. So, there are outer layers and there are sandwich layers, and that's how you prepare a core, and it could be used for different purposes. So, when we talk about veneer core, it has alternating wood plies, which means layers.

This type of plywood is very common, and you know it is used quite a lot. But if one uses it, it is important to be aware of voids or holes in the inner layers, which are generally not visible to the naked eye. And because of those voids, there could be a problem. They pose a problem when the panel is cut into smaller pieces. So, one has to check that out.

There could be a varying number of plies in a veneer core, from 3 all the way up to 11. And for the most part, the number of plies relates to the thickness of the board. And it is used for drawers, storage, and, you know, a lot of purposes. And we could just finish it with some oil or PU, which is polyurethane. Then there is lumber core.

So, you know, the core plywood consists of narrow strips of wood, and they run parallel to one another. So we see those examples over here. These strips are sandwiched between two outer layers, which, like the veneer core plywood, have their grains running perpendicular to one another, and it's a strong and stable core. Then MDF, a very popular option, which is available in the market: medium-density fiberboard. Technically, it is not plywood; it is created from sawdust, which is just put together through resins and

Like plywood, MDF is stable, but it is not very strong because it's just sawdust as such and not chunks or pieces of wood. It is heavy, and it can be hard to work with, but within MDF, you also get different sections. So it may not be hard to work on a thinner section. It depends on the intended purpose and where it is to be utilized. And, you know, cabinet makers often use MDF.

And, you know, if they do use MDF in an area where it is visible, it's always painted because it takes paint very well. The drawback is that it produces a ton of dust. That is a problem with MDF. There is also HDF, you know, like medium-density fiberboard (MDF). There is HDF, which is also used and found in the market—high-density fiberboard.

It is stronger than the MDF board. Then there is flakeboard, which is also a popular product. It is constructed from small pieces of wood and resins, not just sawdust, and therefore it doesn't have the voids and is stronger than MDF. It produces a lot less dust, so this is also a product that can be used. Then we have the veneers on wood cores.

So, you know, aside from having a variety of inner cores—plywood and sheet goods—they also come with a variety of outer skins. So, when we saw the anatomy of timber, we saw the bark, which is the outermost skin. Now, that can be used to produce veneers, which is like the skin of the timber, and it can be used as the top finish on our product. It is natural—it comes from the tree itself. And generally, these include hardwoods and plastic laminates.

So they are the most popular styles. We can find many varieties of hardwood veneer plywoods, including oak, cherry, birch, maple, and mahogany. And you know, these hardwood veneer plywoods are great for building cabinets, shelves, and other woodworking projects where large pieces of wood may be required. The disadvantage of using hardwood veneer plywoods is that one must dress up the edges of the board. Because the hardwood veneer is only available on two faces, here and here, not the edges.

So that has to be addressed. Now I have just listed some woods that are commonly found in Uttarakhand. I tend to include many examples and case studies from Uttarakhand because IIT Roorkee is based in Uttarakhand, and I have been focusing on this Himalayan state for 12 years now. I just like to include some examples from here. There is axle wood, which is quite strong, hard, and tough.

It has a smooth finish. It is prone to cracking, though. There is another one, which is babool. It is also very strong, hard, and tough. It takes a good polish.

It is used for the bodies and wheels of bullock carts, as well as agricultural instruments, some kind of hardware, tools, etc. Bamboo, of course, is known as ringal in Uttarakhand. It is not so much timber but more of a grass, like a woody grass. Quite flexible and durable, it is used very extensively as a building construction material. Also, for interiors, we use a lot of bamboo these days.

It is used for scaffolding as well, such as roofs, rafters, etc. Also for furniture. Then there is banyan, which is strong and durable. And, you know, it is also used for several items, such as tent poles, well curbs, etc. There is bija sal.

It has a coarse grain. It is durable. It is strong, but it is difficult to work with, and termites do not easily attack it. That is the advantage. And it is used for building construction as well as other purposes.

Then there is deodar, which is a very popular wood. And you know, moderately strong, quite interesting, and beautiful in appearance. But again, due to forest laws and environmental concerns, we are trying to reduce our reliance on deodar. It is otherwise quite good for structural work. There is sheesham, which is hard and durable.

This is also difficult to work with, and it is used, interestingly, for furniture. Another one is sissoo, which is also known as shisham or tali. It's a strong and tough local wood, an indigenous variety. Quite handsome, maintains its shape well, and is easily seasoned. So, a lot of advantages, actually.

And it is difficult to work with, but it takes a fine polish. It is used for high-quality furniture. That's an interesting advantage again. It is a very good material for decorative work and carvings as well. Then we have simul, which is loose-grained in structure.

Slightly inferior quality wood, technically speaking. Light in weight, and it is used for, you know, making cheap furniture. Then there is palm. It contains ripe wood in the outer crust. The color of this ripened wood is dark brown, strong, durable, and fibrous.

And it is used for furniture, as well as construction purposes, such as roof covering, rafters, and joists. We also have mango wood—easy to work with and maintains its shape well. It is moderately strong. It is also used for cheap furniture, toys, packaging, doors, windows, cabinet works, panels, etc. Then there is a variety called Indian Elm.

It is moderately hard, strong, and used for door and window frames, as well as for carts. Just to give some idea of wood prices, I have tried to procure this from some sources, and it will give you a broad idea. This is in US dollars per meter cube, and you can find the range—you know, different ranges for different kinds of woods over here. These are some more varieties. So this is Myanmar teak we were talking about.

It's quite exquisite. So we see the export grade over here—expensive. This is INR per cubic foot. And this is dynamic and liable to actually increase further, you know, on the higher side. Import price list again—INR per cubic foot—and here also we see a huge range: 340 to 350, even 1300 plus, and so on.

Some Indian plywood price lists—so these are just for, you know, understanding purposes—what is available in the market. So, if we talk about plywood, as we also saw a few slides ago, there are sections available in the market: standard sizes—4 mm,

6 mm, all the way to 18 mm—and then there is the per-square-foot cost over here, which has a different range—30 all the way to 85 or 90. And then, if we talk about, you know, other grades—we talk about rubberwood and hardwood—and then these plywood commercial grades, they are also available in different standard sizes, and there are per-square-foot costs that you see on the screen. So, this was an overview. It's really very difficult to do justice, you know, to finish wood or timber in one lecture.

But since I'm trying to cover the most important details about interior design, pedagogy, and practice, I've just tried to... put this together in an overview manner. And, as FLW says, wood is universally beautiful to man. It is the most humanly intimate of all materials. So, like I said: classic, timeless, beautiful.

And a lot of designers and architects, you know, are fans of wood as a material. So, in the next lecture, I am going to focus on another material, which is stone, and I have just put some references here, you know, focusing on all that we discussed. Thank you so much. I will see you next time.