Sustainable Materials and Green Buildings
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Lecture 43
Design Strategies and the Green Design Process

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Welcome, and if you recollect, we have discussed all the features of green building, a number of them also related to sustainable materials. Now, in this lecture or set of lectures we should discuss the design strategies and the green design process.

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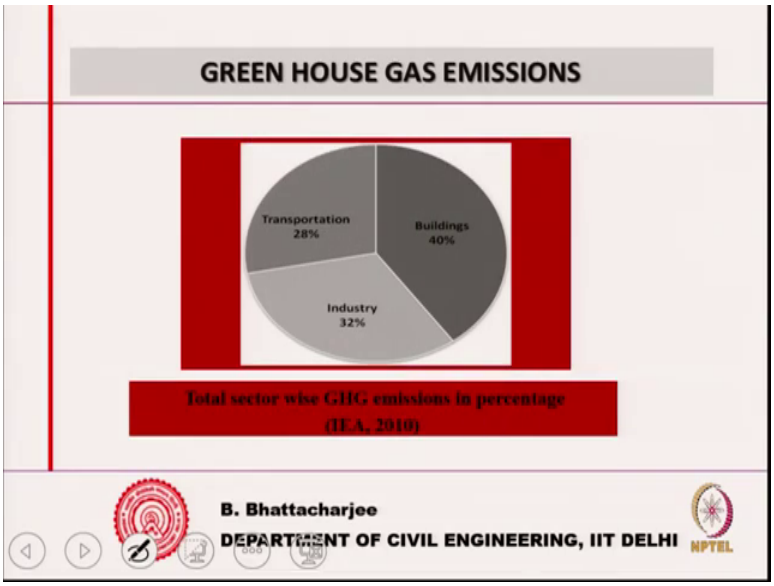

So, let us look at greenhouse gas emission, recollect some of them. We have seen that if you look at this one, you know basically transportation sector around 28 percent, buildings around 40 percent and industry around 32 percent. So, building sector is one of the major source for emission of greenhouse gases.

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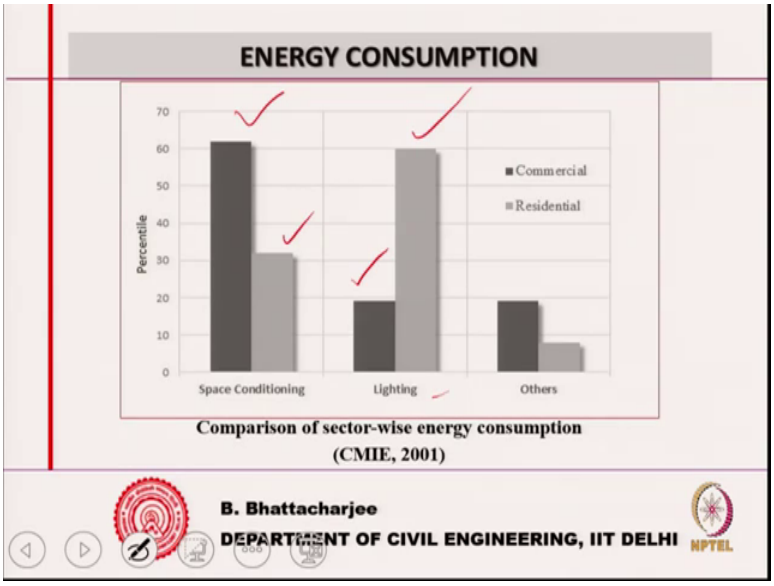

And if you look at the other feature that is energy consumption, you will see that in the building themselves, commercial buildings, space conditioning that is very high, while in

case of residential space conditioning is relatively low, but lighting, you see that for residential lighting is relatively high and space conditioning is less, this is an Indian scenario and obviously others is something like this.

So, energy we have seen greenhouse gas emission and the energy consumption and if you recollect that these are major features related to green concepts. We like to minimize the energy consumption and obviously, the greenhouse gas emission as well.

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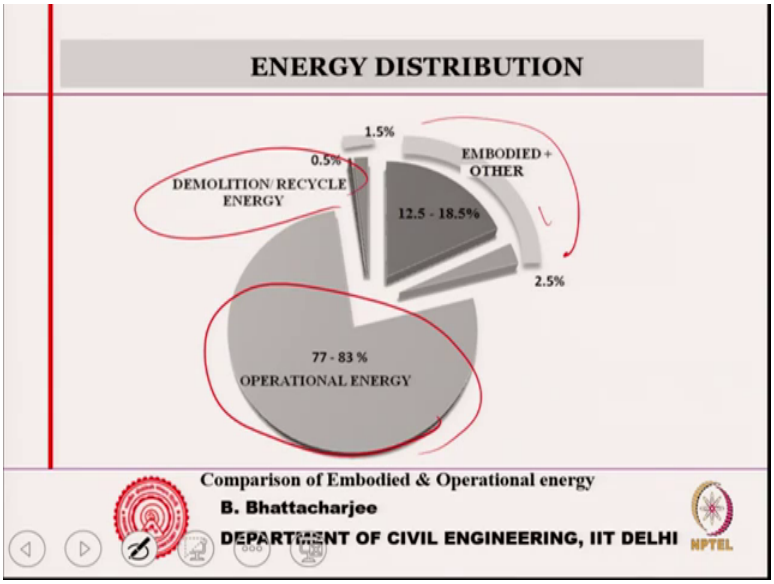

Then, if you see the distribution in a building which we have seen earlier in a different form of a graph, you will find during the lifecycle operational energy is maximum, embodied energy and other grey energy etcetera etcetera is something of this order 2.5 to 12.5 to 18.5 percent and this is about 77 to 83 percent. And demolition and recycle energy that will be coming somewhere they are small percentage. So, this we had given in a different form of (())(2:53).

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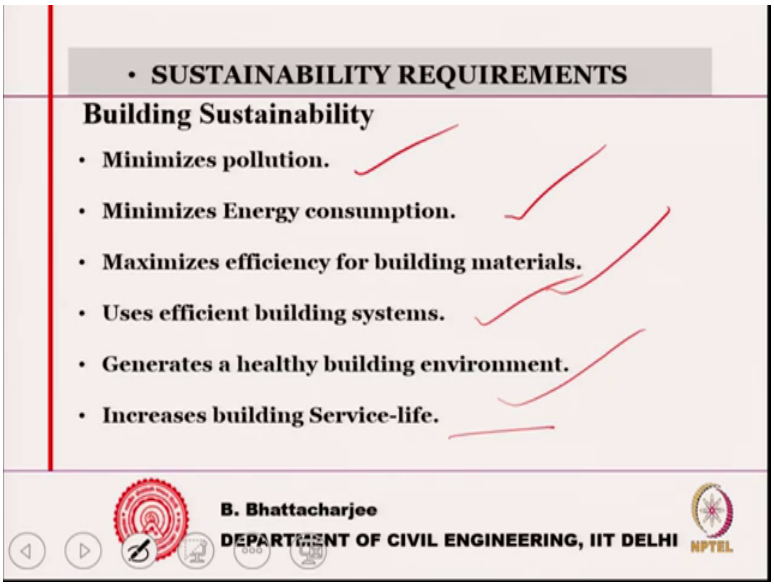

So, based on these issues and the other we have discussed earlier sustainability requirements are, these are the sustainability requirements. Minimize pollution obviously this is one of them. Energy consumption, minimize that. Maximize the efficiency of building materials. Efficient building system of course that will make it. And healthy building environment. And obviously, lifecycle should be as high as you know service life should be as high as possible.

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So, these features are actually to see the performance of the building, green performance of the building, tools have been, some tools have been are available, which we will discuss later on. These tools, these tools looks into several criteria, like site selection, many of them there are different tools some of them I will mention today, some maybe later. Energy efficiency. Water efficiency because minimization of the resource consumption. Material efficiency that is what I was talking of you know, minimization of the resources actually again. And indoor air quality, we discussed it earlier. And waste and pollution. Economics. Operation and management, etcetera, these are the features.

So, some of the tools actually looks into this one. Now, let us denote them as C1, C2, C3, etcetera, etcetera. These are the criteria, criterion C1, criterion C2, etcetera, etcetera. So, there are different criteria that could be there, alright by you know, various, you know, this criteria could be there and yes, this is actually 8 of them, not this is 5, 6, 7, 8, so 8 of them are there. So, this could be various or there could be more of them, there could be more of them or less of them depending upon the tool that you are using.

So, all these tools that we will discuss a little bit later name them, some of them there are a number of them available in it now. For example, LEED is one of them, in India GRIHA is used, there are several others, which different countries uses different tools. All of them what they do is, they try to judge the building according to these criteria.

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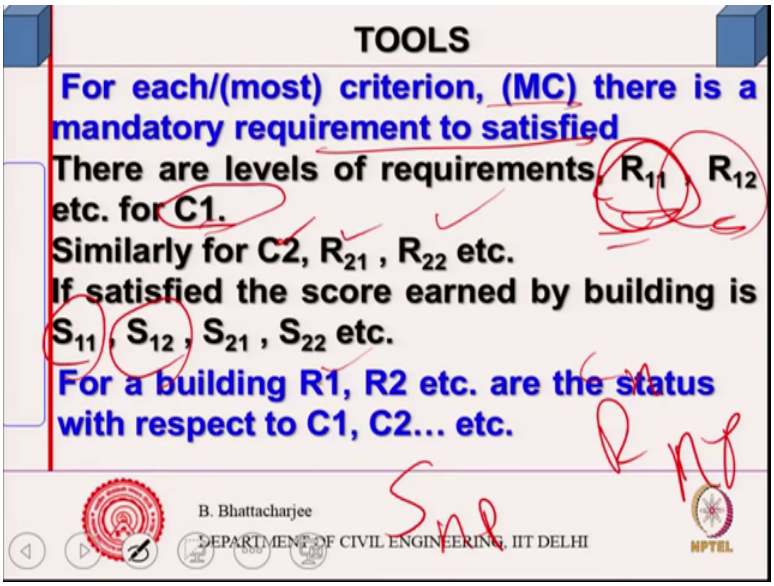

And most of them this, there is a mandatory requirement, there is a minimum level, if that is not satisfied, the performance is not rated at all because rating is not worthwhile. So, minimum criteria, minimum mandatory certain requirements are to be satisfied. Then for let us say a given criteria, levels of requirements are given in each of these tools, each of these tools and these requirements are R11, R12 let us say requirements for criteria 1 is R1 and R2, there are several requirements are stated.

And similarly for criteria 2 it could be R21 or R22, etcetera, that is for the purpose of our understanding, if one building satisfies the R11 requirement, it gets a score of S11, if it satisfies R12, then it gets the score of S12. Similarly, if it satisfies let us say Cn, some nth criteria Cn and it is correspondingly we will have R1, you know Rn, let us say np it satisfies, right satisfies, then it gets score corresponding to np, scores corresponding to np.

So, requirements are specified, they are given and a building is judged on those basis of these requirements so it will get clear when we look later on into anyone of these examples, let us say we have an example for LEED, when we look into that, this will get clear. So, for criteria 1 if it satisfies R1j, let us say, then the score will be S1j so, scores are corresponding to each requirements, so scores are specified, scores are specified.

And so, for a given building if the status is let us say R1, R2 etcetera with respect to criteria C1, C2, etcetera. So, the status so R1 should satisfy R11, R12, R13 etcetera some one of those values, correspondingly it will get S you know S value, as the scores values it will get. Similarly R you know like something like a Rn should satisfy, Rn should satisfy Rn1 or Rn2, etcetera, etcetera somewhere it should satisfy, supposing it satisfy Rnp then its score is S1p so, scores are given depending upon what it satisfied, which requirement range it satisfies.

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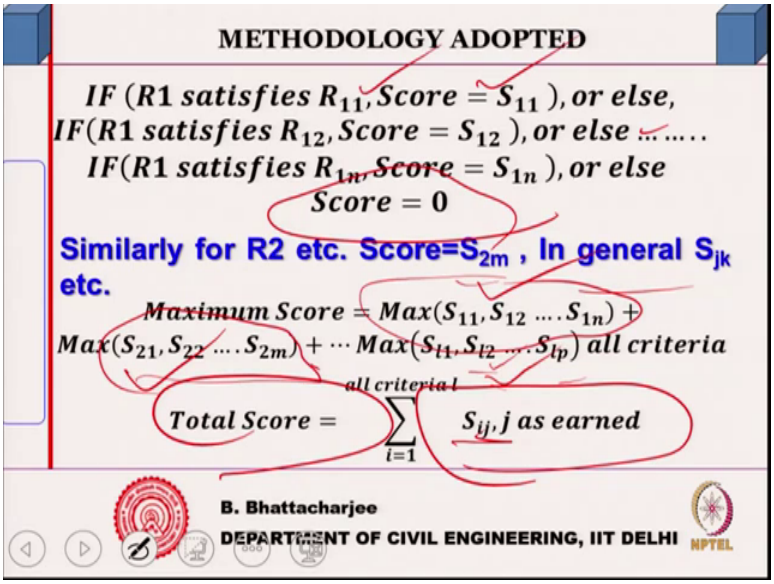

So, this is the methodology in general adopted by most of the tools. If R1 satisfy R11 score is S11 or else if R1 satisfies R12 score is S12, or else etcetera etcetera. So it goes on and if it does not satisfy even the minimum requirement the score is going to be 0, mandatory requirement if it does not satisfy, then we should have not consider even the same thing.

So, similarly for R2, S2m let us say in general Sjk, I can say in general, where j stands for the jth criteria, k is the satisfaction of the requirement level, so, score comes like this and maximum score, first of all maximum score possible is given by max of S 11, 12 etcetera 1n, max of 21, 2m, etcetera, etcetera. So, all the C you know this is corresponding to C1, this is corresponding criteria C2, this corresponding to C, for all criteria so Cn you know if nth, total n criteria is there, so up to Cn.

So, all the maximum values that when I sum up, maximum value when I sum up that is the maximum score possible. Now, the (())(10:00) score, total score would be some of Sij value that is that I have accumulated. For example, for the criteria 1, I might have got S1 sum j, for this one let us say S2l and you know, S3q and so on. So sum all of them up as (())(10:25) and for all criteria and that is your total score for the building itself, total score.

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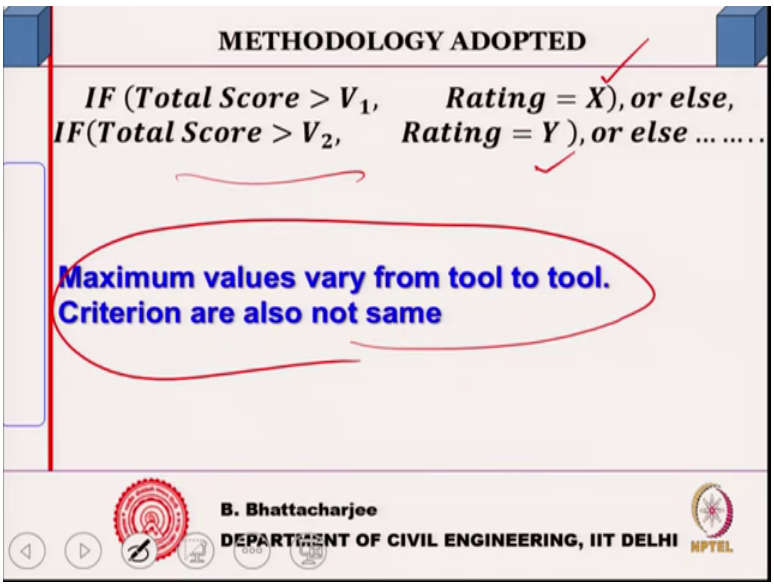

Now, given the total score, given the total score, if the total score is greater than some value V1 let us say, score is greater than V1 let us say, then rating will be X, the rating is given in terms of some quantitative or qualitative values like some sort of rating in terms of gold rating, platinum rating, etc so silver rating or some, some qualitative terms or else.

So, if it is greater than V1 rating is X or else the rating is greater than V2, the rating is Y or else etcetera etcetera. So, basically, if or else kind of thing if you satisfy a particular type of rating value, then total score is greater than a particular value, then you get a rating, this will be in qualitative terms may be qualitative terms, etcetera etcetera and this is also in qualitative terms you get quantitative rating so, that is how most of the tool works, that is how most of this tool works. Maximum values vary from tool to tool,

criterion also are not same. So, if I compare all the tools, values are not same, criteria is also not same.

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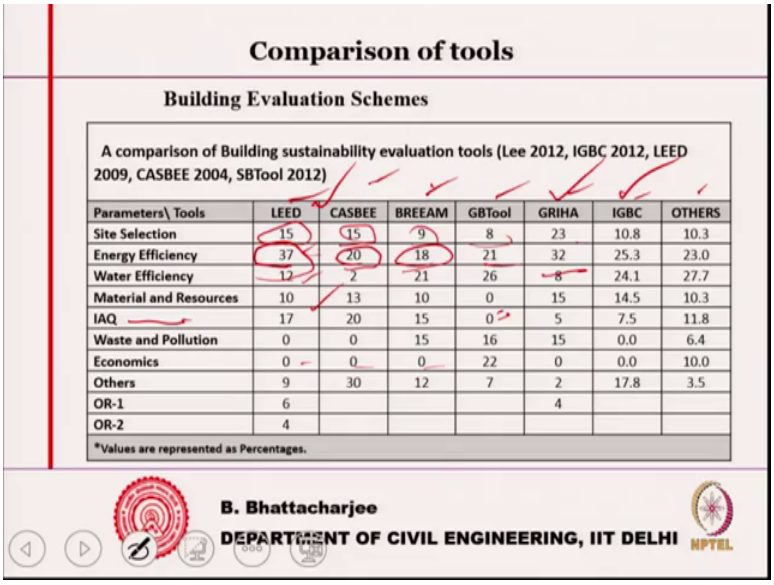

So, let us say different evaluation schemes or these tools. So, there are various tools for example, something called LEED leadership in energy and environmental design some of them will be talking about this, so, IGBC is Indian green building council, GRIHA is from the Tata Energy Research TERI. There are several other tools which we will be talking about BREEAM and this we will mention later on somewhere.

And if you see this there are these are each one of them is a different tool. And the points is a (())(12:38) if you see this, for example, weightages this gives maximum to 37 to energy efficiency. While this gives 20 to energy efficiency, 18, 21, 32, 25 so it varies. While site selection this is 15, this 15, this is 9, 8, 23, 10, etcetera, etcetera and you go to water efficiency, material and resources.

So, you know criteria of course, criteria themselves vary, in some cases this criteria may not be there the 0, this is simply not there, this one for example, you know indoor air quality, this GB tool does not consider itself and so on. But, at the same time the weightage or importance given to it is also different which is this importance is given by this codes, you know by these values which are given here, right.

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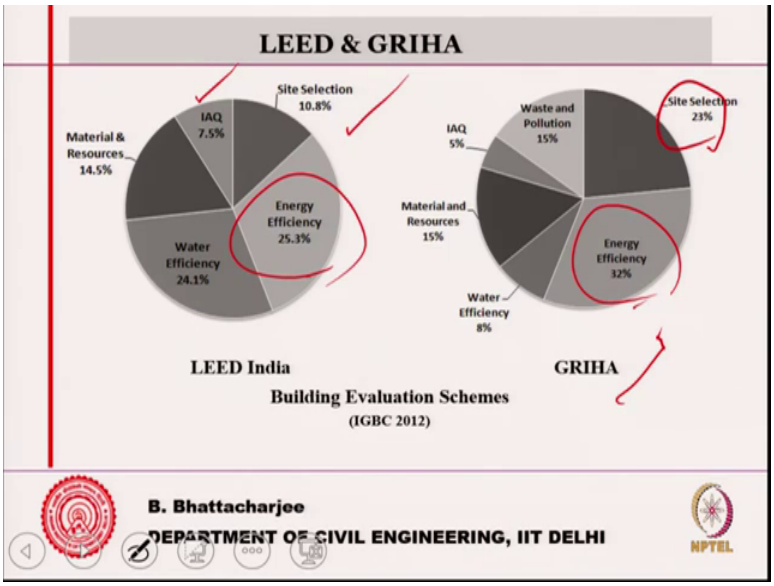

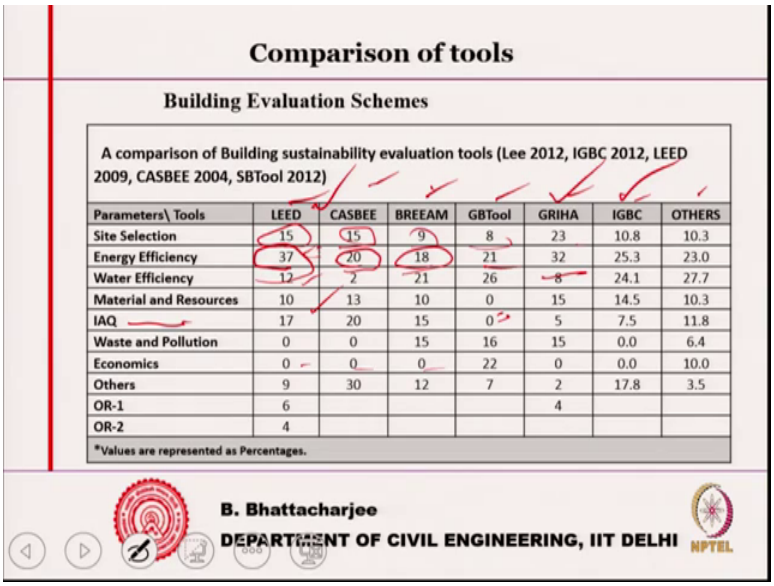

So, they various from, so, for example, if you look LEED and GRIHA, LEED we will discuss this again later on, you know LEED we will discuss one example of one specific case of LEED. Of course, it keeps on changing, but the basic structure would be explained by our, by the next lecture when we talk about, so, indoor air quality LEED has got 7.5 percent, site selection 10.8 percent, energy efficiency 25.3.

Now, this percentage is calculated from this, because 37 out of the total that you get would give us the percentage. So, when we work it out in this percentage, I get 25.3

percent water efficiency and so on so forth. Whereas, if you go to GRIHA site selection is pretty high, energy efficiency is 32 percent you know, its energy efficiency is somewhat is different. So, the point that I am trying to make is it varies from tool to tool, the importance given to this criteria and also criteria themselves vary. So, if I see number of them, if I compare about 6, 7 of them, which are used worldwide various places, as we shall mention in the some other lecture.

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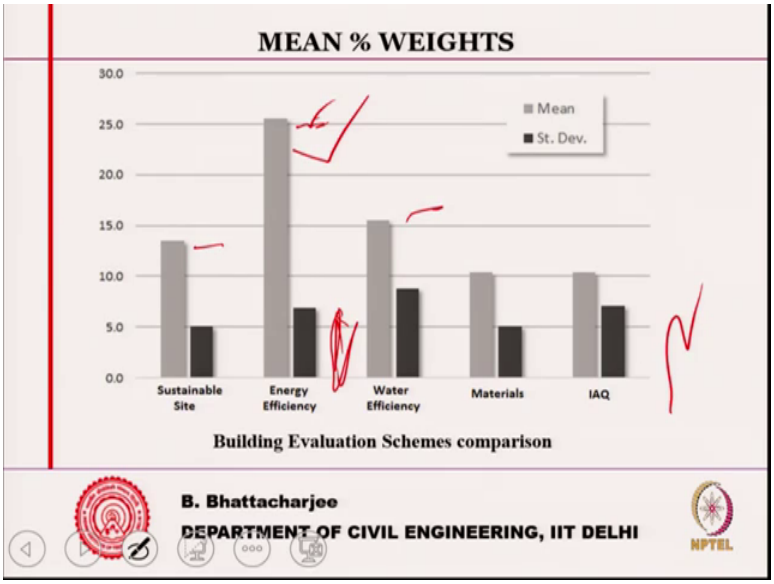

The mean percentage variation, in case of energy efficiency it is around 25, while a standard deviation is also calculated out it comes out to be somewhat there around 5 percent. Sustainable site average is around 12, 13 percent. And water efficiency is around 15 percent and so on. So, there is a variation, this shows us the variation. Indoor air quality, so while majority gives energy efficiency major, major importance, right.

But there is a variation, not everyone looks at the, every tool looks in a similar manner, because therefore, different countries and they are based on subjective decision of, you know in kind of I mean subjective decisions are also converted into in objective form using various kind of managerial tools like analytical hierarchy tool and similar sort of thing, HP as it is called analytical hierarchy process.

So, using this kind of tool, so, experts view have been taken into account in this ones and that varies from each of the tool to another tool, one tool to the another, and that is how it is. So, this gives us some idea.

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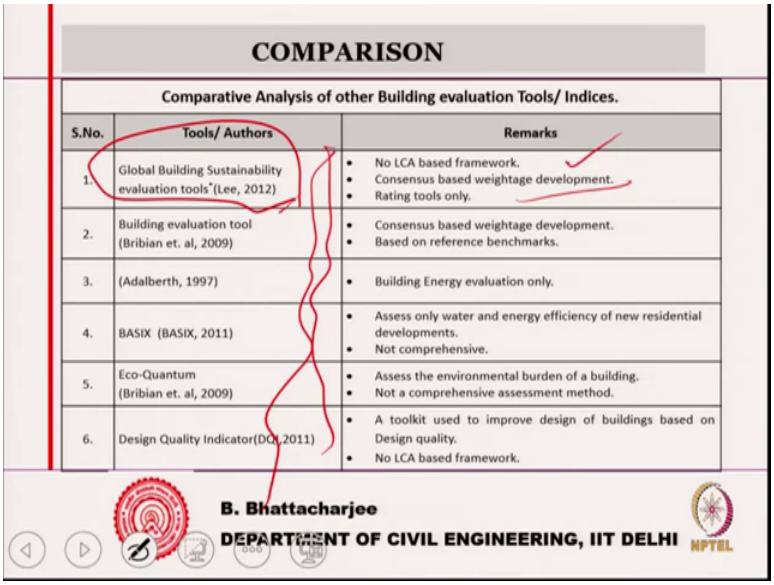

So if you see comparison, global building sustainability evaluation tools, the references are also mentioned there, none of them deals with lifecycle based work, most of them do not work with lifecycle based work and all of them are consensus based weightages. Building evaluation tool, consensus based weightage and several of them basically most of them are, you know, these are the people who, you know, they suggest the literature would tell you that nobody looks at LCA life cycle scenario. And also, most of the people there is the difference in tools and all so this is the summary of finding, you know, various authors, their comments, essentially.

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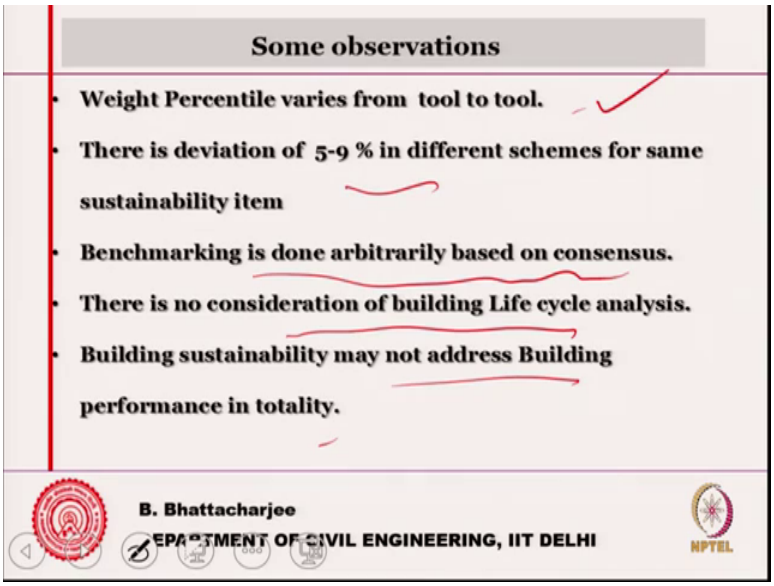

So that is it, so weight percentage is a summary of what is the observations you can find by looking at all the tools together, weight percentile varies from tool to tool, there is a deviation 5 to 9 percent, and benchmarking is done arbitrarily based on consensus of people, well you may say its arbitrary but not exactly, you know, somewhat it is based on subjective decision making.

Building life analyzes is relatively most of the people do not consider and totality of building performance everything cannot be considered and that is not considered. So these are the summary of different tools that would be there. And we will look into the tools in the next lecture, but let us look into some other strategies.

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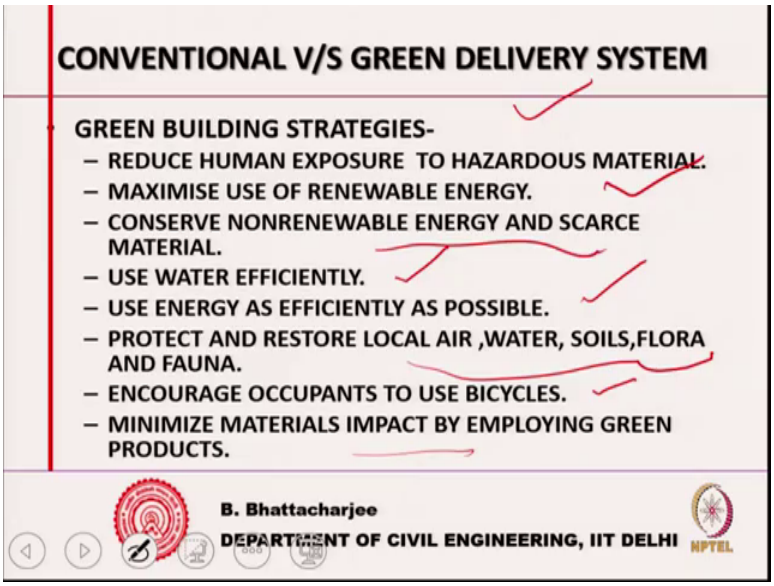

Conventional and green building delivery system. So this is what the various tools which we will discuss sometime later on at least one of them in some manner you know, because this may change and there are changes possible from time to time. So, one of the typical example of a tool, rating, calculations or procedure we will look into in one of the lectures, LEED rating for example, calculation will take into one of the lectures later.

But general green building strategy, we can look into, basically, essentially the strategy should be reduce human exposure to hazardous material. Maximize the use of renewable energy. Nonrenewable energy and scarce materials should be conserved. Water should be use efficiently. Energy efficiency. Local air, water, soils, flora and fauna should be they should be protected. And transportation less energy. So, bicycles use could be maximized. Minimize material impact on employing green products.

So, these are the strategies as you can understand through our discussions for example, you know, we looked into the volatile organic compound emissions in buildings, renewable energy, so, use of solar energy for example and minimize the energy so, maximize the energy efficiency and so on which you have looked into earlier sometimes.

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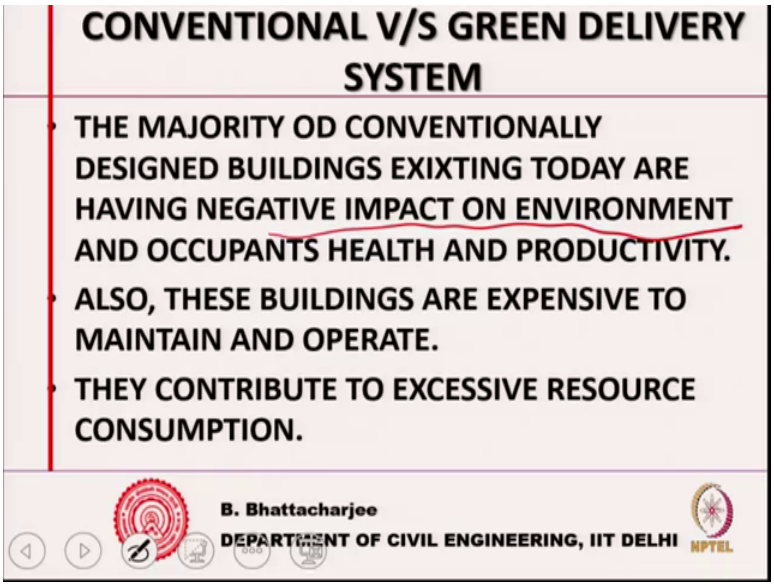

Majority of the conventionally designed buildings have negative impact on environment majorly because this was not a concern. So, obviously we will have some sort of negative impact towards occupants health and productivity, this thermal comfort, acoustic comforts that is not been looked in you know, as much as importance they should be getting including health issues.

Also, these buildings are expensive to maintain and operate because if it is energy efficiency if it is not, if the envelope is not designed optimally you will always end up consuming more energy than actually required, consuming more energy than actually required, so to operate and maintain. The contribute excessive and obviously, resource consumption will be high, resource consumption to be high, so since if it is optimally designed, you can minimize the resource consumption.

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Clear design objectives are critical to any project success yet to achieve maximum benefit, the project goals must be identified and held in proper balance during the design process. So, first in the beginning of this lecture, we looked into how we judged the performance and how to achieve this performance, this is the strategy that we are looking of.

So, you know the clear design objectives, first I must clearly state my objective, what is my objective? Design objective should be stated and get the maximum benefit to attain this project goals, if I identify them early and basically hold on during the project execution and design process, then it can be successful.

Another feature of course is smart growth what is called. It relates to ability to control sprawl, reuse existing infrastructure and create walkable neighborhoods. So, basically control is important and reuse as much as possible if you are changing anything and it also relates to neighborhoods which will actually promote less use of mechanized vehicle which consumes energy. Obviously, fossil fuel energy will be avoided much.

Now, neighborhoods are basically in planning and neighborhoods are basic units of urban plan, urban residential plans and if it goes back to early development where primary school was actually put into the focal point of neighborhoods and children are expected to

travel from their home to the neighborhood, no thorough traffic, through the neighborhood traffic, major traffic or arteries would be in the boundaries of the neighborhood.

And internal roads will be meant for light vehicle or traffic, which only the local vehicles in the neighborhood they will be using this, normally supposed to be matching with the topography and thereby giving a good look and other issues of neighborhood planning is definitely there, possibility of firefighting vehicle coming in and taking easy turn and things like that so, those issues are there. So basically they should promote those concepts and that would be smart growth essentially, so controlling the whole thing.

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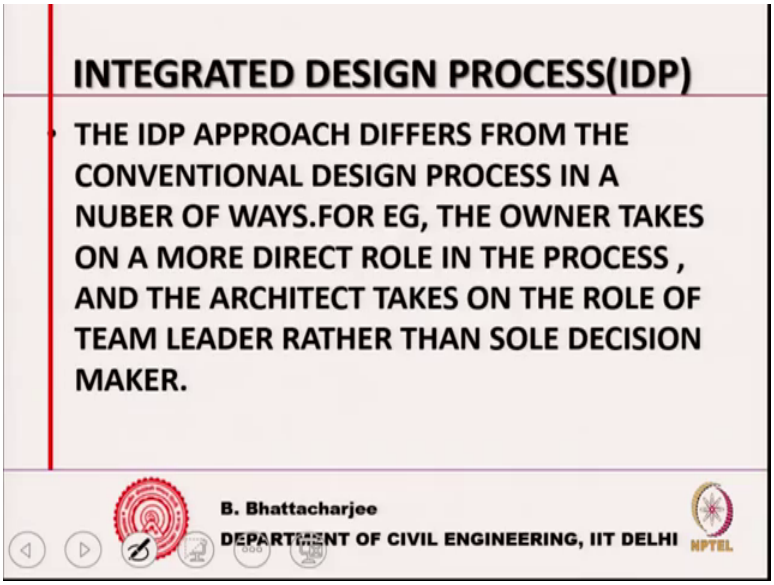

Then integrated design approach, so this differs from basically conventional design process on a number of ways. For example, the owner takes on more direct role in the process, an architect takes on the role of team leader rather than sole decision maker. So, it is a group of people who should be taking design decisions, not individuals. And the role of the owner is very important here.

So, basically the group should be taking the planner or the architect might take a lead role, but they are not, should not be the sole decision maker of the whole thing. So these are the kind of process in integrated design process.

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So, if you want to ensure success of any of such design, then strategies that would be important is establish a vision that looks into or that you know essentially embraces sustainability, principles, sustainability principles are taken care of, so such as they can be applied and integrated in the design process themselves. Clear statement of requirement of the project, objective of the design and criteria and priorities in the design. So, obviously, it has to be economic and therefore, the budget is to be looked into and performance goals for energy, water, material, siting, indoor environment quality along with other sustainable design goals should be established so this should be established.

So, this is an integrated design process can actually is a good strategy for green design system, it must take care of all those things and your sustainability goals should be specified in the beginning and the team should be working on to it and followed by vision, establishing vision and then stating them clearly, develop them and obviously has to be economical.

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So, this integrated design process actually can incorporate building information modeling, which is there is software available for this and virtual model one can create through using software one can create virtual models so also beam actually helps in sustainable design because you can see the virtual model, three dimensional models and as with time variants scenario, you can see visualize different possibilities.

Form a design and construction team that is committed to the project vision, obviously that has to be there and the contract document should actually follow the project schedule and all this can be done to building information modeling. So, develop contract plans and specifications and such specification should ensure that the building design is at appropriate level of the given building performance, you know whatever you want so, according to that performance, it should be there.

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Implement a building management plan that ensures that operating decision and tenants education and implemented in a satisfactory manner. So, first is the construction in a building normally it starts from the owner and then owners prepares requirement before whatever it is, then actually the design, then actual realization of this design drawing board thing you know comes on to actual physical realization, but then after that is the maintenance and operation of the building and must this management the maintenance, building management plan, maintenance plus everything else operation and management, maintenance and overall management of the building that plan should come right in the beginning.

So, right in the beginning this operating decisions and if required the people who will be living or using that facility they should be educated and they should be (())(29:05) down in the beginning in a satisfactory manner, that provision should be there. So, all stages of building lifecycle into including demolition or deconstruction that should be also taken into consideration.

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So, let us see the green building project delivery process, once these all aspects are taken care of in terms of the design drawing and things like that and realization of the physical system. The concept of integration is very important in green building designs. So, green building design uses integrated design process IDP as I mentioned and the essence of integrating design is that building consists of interconnected or interdependent system.

Now that we know very well building is the most complex of infrastructure and it will have several interconnected system including traits of civil engineering, electrical services of various kinds, mechanical and so on so forth. And therefore, integrated design is important, an interconnected and interdependent system that is there so, it is critical and consistent component in design and construction of the building.

So, in green building this becomes even more, because there are several features which may not be there in conventional building. So, in case of green building design, the use of this kind of interconnected as integrating the various interconnected, interdependent system that becomes very, very important and it is critical in case of green building design system.

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So, the owner's representative or the person who represents the owner that is number one is in the team. Then obviously construction (management) manager obviously, they will be hired construction management or the construction team. Then you have architect, typically leads the design team and coordinates the activities. Then obviously, all the engineers, civil engineers, soil, land and all regulatory aspect of construction project, these are the team that will do, so it should actually a team not piecemeal.

For example, what happens is normally the architect is solely responsible, the owner is nowhere there, is given to the architect, they make the plan and then possibly appoint a civil engineer or somebody structural engineer who does design then a civil construction. But, if the whole thing is put together in one go right in the beginning in a larger team handles the whole situation that actually make a success.

So the team, it is a team effort of all those people including owner or user, owner or user, and this whole team, maybe the leadership might remain with the architect, but the whole team should be taken into right in the beginning taken into confidence in order to make this kind of a project success.

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So it is basically multidisciplinary project team, like consulting for example, structural, mechanical, electricals and on larger more complex project directly by the owner depending upon the situation. So management of green building design or strategies that should include should involve this kind of strategies, which is slightly deviated from the conventional design processes.

Because this is more, more complex and you are trying to optimize everything, minimization of resource usage, natural resources usage, minimization of energy usage, minimization you know best indoor air quality and so on so forth. So therefore, this is more complex than just doing an ordinary building when you are trying to do a green building designs.

Specialized consultants are adopted into the design as needed in the requirements for the project, if required. For example, a fire consultant as normally they would be there and part of the thing but you might have to involve them depending upon the situation if it is a green building, functional group building and let us say hospital building, then you might need some specialist, specific purposes because (cross quantum avoid) to avoid cross contamination, supply of various kind of life support system and so on so that would be that kind of scenario will be needed.

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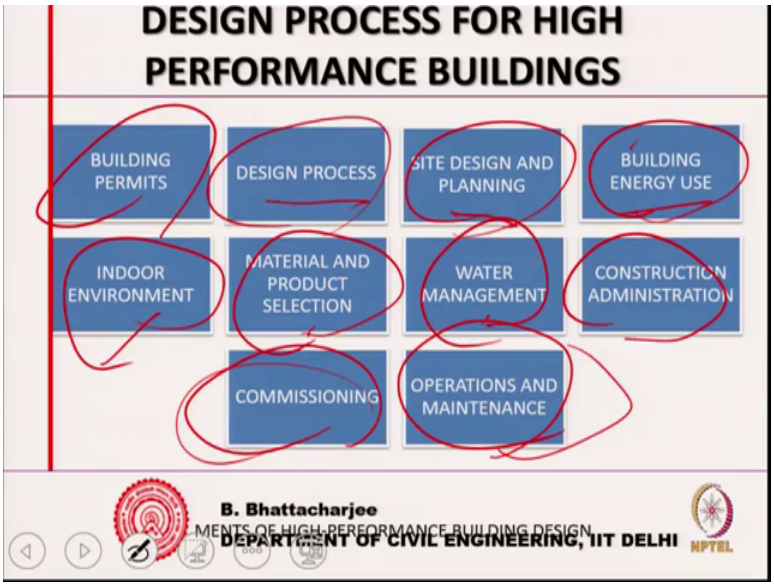

So, usually such green buildings are high performance building and basically the design process, site and design planning, these are the kind of stages building energy use, indoor environment, material and product, water management, construction administration, operation and maintenance and then commissioning. These are the features of design process for high performance building.

So you can see that first is obviously all the legal aspects, then the process of design, then site planning, building, look at the building energy used, indoor air quality, material product, water management, then of course, the construction administration and commissioning and finally operational maintenance during the life of the structure, during the life of the structure or the life of the building, life of the building.

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So, high performance outcome necessitate a far more integrated team effort, team approach, then the design process and market departure from traditional practices, in which emerging designs are handed sequentially from architect to engineer and sub consultants. So that is the sequential thing is not there it has to be whole team.

So, traditionally what you do, we actually architect to engineer and then to sub (contract) consultants and so on so forth, that should not be approached all should sit together and possibly make the design so that high performance of the building can be achieved. Performance in terms of not only the structural performance we are talking of, we are talking of performance functional, performance related to energy efficiency, thermal comfort, acoustic comfort and fire protection, services and possibly visual comfort and any other functional requirement, movement of people and so on so forth, everything put together.

And optimal use of resources, optimal use of resources, minimization of the, minimization of waste, least embodied energy, least operational energy requirement and maintenance requirement and so on. So, that is what, that can be ensured only through team operation. Such integrated design process that means you do all design in one go integrated, inclusion of even contractors and operating staff and everything to improve the likelihood of success.

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So, a team driven approach is considered to be a front loading of expertise. The process should start typically begins with the consultant and owner leading a green design charter you can say with all stakeholders brainstorming session pertaining to approach that encourages collaboration in achieving high performance green goals for the new building while breaking down traditional adversarial roles. No adversaries, no fight, right? No competition so essentially all should work together that is the idea.

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If you look at sustainable sites selection, minimize the development of open space though selection of disturbed land, already existing, already disturbed land, you see like that, that is Brownfield development, rather than all Greenfield development, that is the site selection or take a building retrofit it to the current requirement of vendors or you know, it is that that would be green, new green areas you do not try to occupy best is, if you can change retrofitted to the current requirement (())(38:08).

Energy implication of sites selection and then of course, shape orientation of building and all those these are important as we have looked into energy efficiency, envelope design that will be very important. We did not look into envelope design in this course, but these are the issues orientation, shape they play a big role in energy efficiency. So therefore, this relate to the site selection.

No erosion, soil erosion should be avoided, right kind of landscaping practices and if required stabilize the soil. No erosion should be there, heat island effect should be minimized which we have discussed from time to time, I know there are several of them we discussed actually and minimal area around the building parameter, minimize habitat disturbances, you do not disturb the others around all kinds of habitats.

Restore the health of degraded areas, if there is a degraded area put them back. Increasing and improving the presence of healthy habitat for indigenous species, whatever is there around. Transportation solution should be integrated to the site plan that means how people should be moving possibly, if it has to be done with minimum energy so, they should be either walking or bicycle or similar sort of things, so this should be integrated right in the planning stages during the site selection itself when you are doing green building.

Because as usual see in the tools, site selection was one of the points where you have number of you had some weightages given we have seen in many of the ratings or tools that is there for judgment of performance or green performance judgment, they have site selection as one of the things and this is (())(40:16) this.

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So, the general intent of selecting a sustainable site is essentially to reduce environmental impacts, how do you do it? By avoiding, you know, inappropriate site and by selecting an appropriate location of the building, location, orientation everything put together. There should be, it should not be in the sensitive, you know, it should not be any sensitive element should not be included in it and it should not be on restrictive land types. For example, do not encroach into a green area or anything of that kind or anything of that sort.

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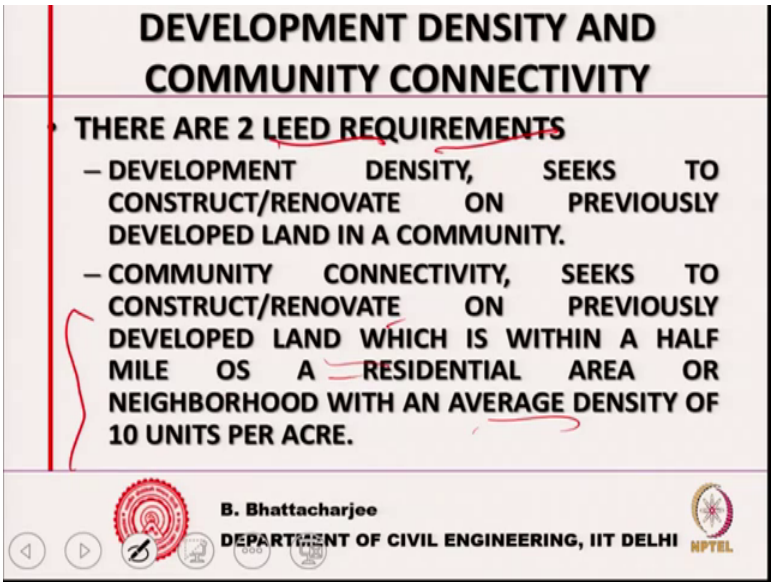

Connectivity, density and community connectivity when we will when you see the LEED, we will see these requirements development of density seeks to construct, renovate on previously development land and community. Community connectivity seeks to construct or renovate on previously developed land which is within the half mile of a residential area or neighborhood with an average density of 10 units per acre, well, this will be an American sort of thing.

In India of course, the densities, population density is higher and as I said, the half mile area concept comes from the original concepts of neighborhood actually proposed universally in 1920s and half a mile, so, which is within half a mile of a residential area or neighborhood. So, densities are also given, perhaps density could be different in Indian scenario.

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So, essentially Brownfield development it should be looking into. Basic intent is to protect green fields by developing an environmentally contaminated or damaged site, because I mean environmentally contaminated or damaged sites. What it means is that already there is a development then that is considered as damaged or you, so green areas should or green fields should remain as Greenfield as much as possible that is idea.

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Transport, bicycle, impact of pollution and land development on the environment of reducing automobiles use, bicycle storage and if required a changing room low emitting and fuel efficient vehicles, sufficient parking capacity.

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Protect and restore habitat, maximize open space. Open space maximization is required for various purposes, one is the flow of your lighting, fire protection and built up areas should be less so that your microclimate changes are minimal. It does not store a lot of heat, because built up or constructed areas building tend to store the heat and in as you have seen in our urban heat island scenario so, this has to be there.

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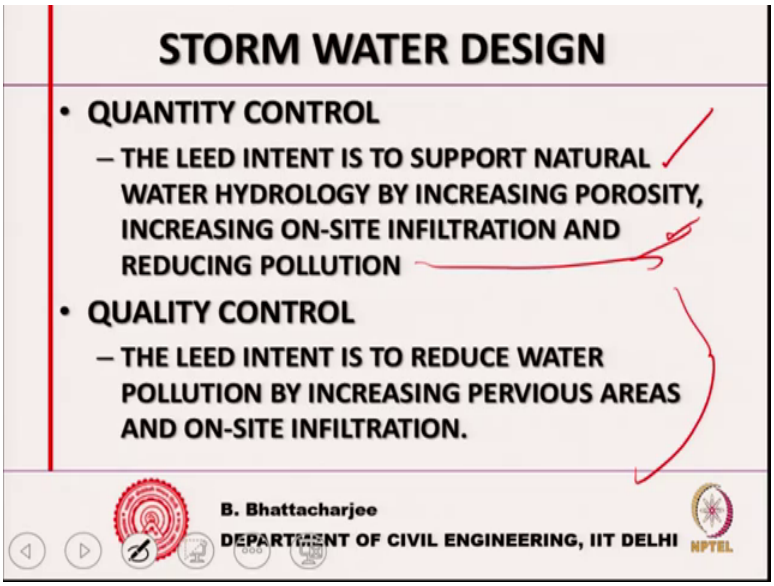

Then design for storm water, support natural water hydrology by increasing porosity of the soil, on site infiltration and reducing pollution, that means water harvesting or something allow water to percolate to the ground and the quality control, water pollution, minimize water pollution by increasing pervious area so that water, there is no surface ran off rather it recharges the ground and so on so, as much as possible that is sort a good idea of green building design. Now the LEED name is coming because they are the ones who originally they thought of and we will discuss some of this as I said an example will be taken up later.

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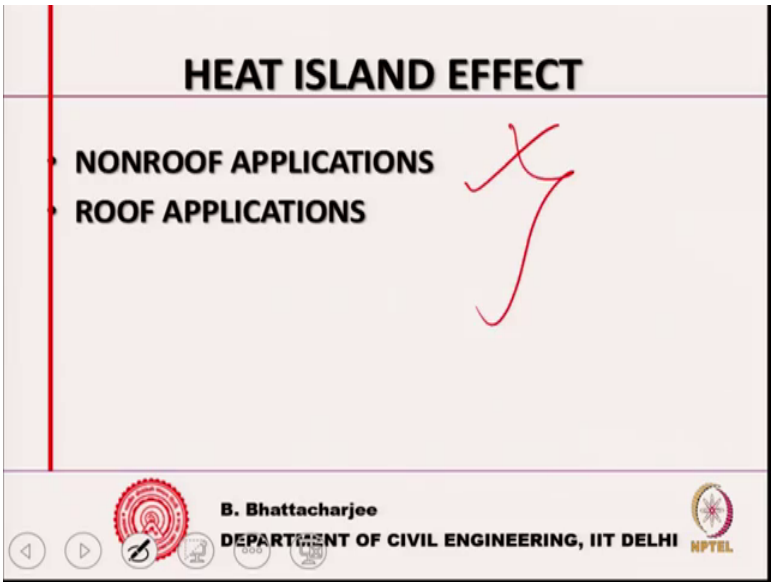

So, heat island effect we have already discussed something, non-roof and roof applications we have seen.

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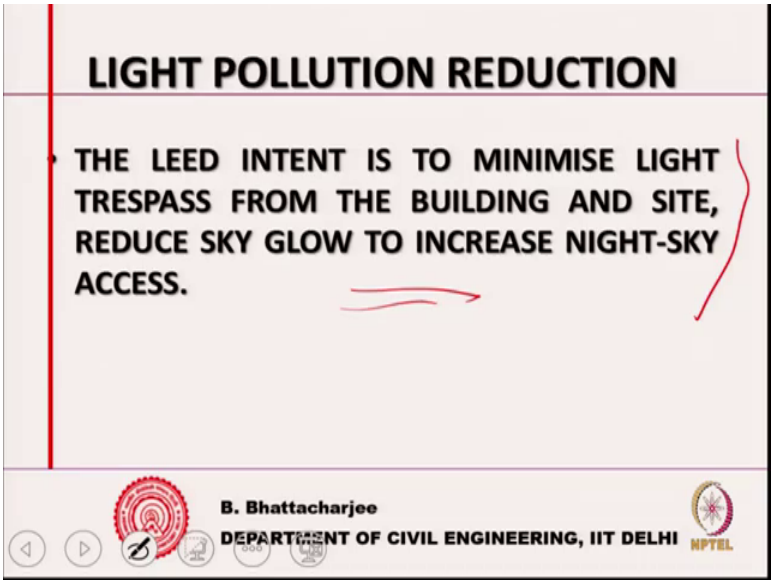

Minimize, you know light passes from building site, reduce sky glow and increase night sky access. So essentially, such that the light can pass into the building available of the daylight and night sky access and so on should be there.

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Then in a commissioning process all buildings system should perform interactively, according to the design intent, and owners, operational requirements. So, that is you know, it is synergistic approach to everything and right from the project inception it will start and it is a synergistic approach. So, all building systems should perform interactively and according to the requirement of the design.

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Basically installation, calibration, performance of energy system, calibration of the energy system and their installation, they must meet the project requirement, basis of design and constructional document so, that during the time of commissioning, these are to be seen.

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And, if there is later than, you know, after commissioning it is the commissioning of, if it is existing building, then what you do? Green situation this is becoming increasingly prominent as an cost effective strategy for improving energy performance particularly, so retrofit the building to the new energy requirement. That means, you might change some of the envelope parameters, the orientation you cannot change, shape you may not be able to change, but the envelope, some of the envelope parameters you might be able to change, envelope you know quality material and things like that various other strategies could be there, new more efficient HVSC system and so on those could be done.

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And start the process of commissioning right in the beginning together with the design process, together straight away, during design process I mean think of commissioning right the design stage itself and additional activities on completion of the system performance verification. So, you verify the system and then once that is over, then additional activities would be. So commissioning first you start, look at that and once you have checked the design performance compliance with the design performance, then you start once it is verified, then you start with the additional activities.

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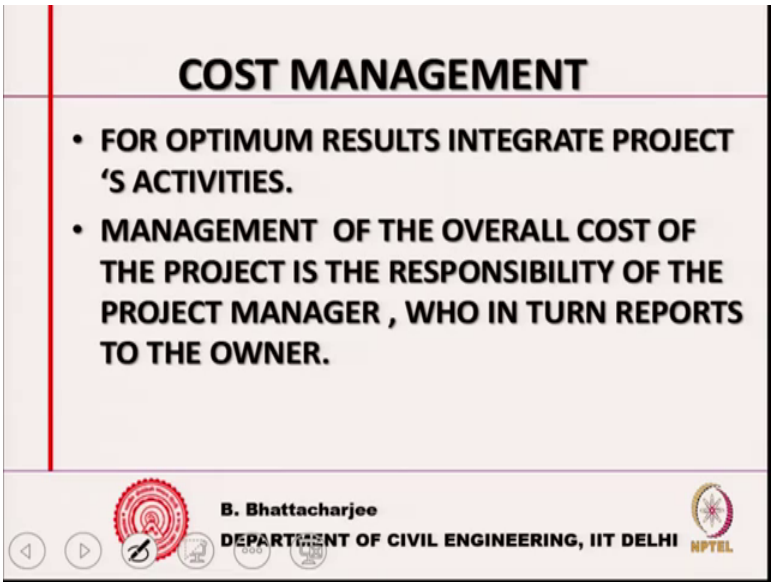

Then of course, the cost management for optimum results integrate all projects activities, integrate the all projects all activities of the project, management of the overall cost of the project. That is of course, the responsibility of project manager but, it is finally the owner because cost is to the owner and obviously that has to be cost has to be looked into. So you do not want to the minimization of the cost is an important feature so, that has to be done.

So we do, we get the best, we get the best performance, but at the same time the cost has to a minimum, it is a big challenge and therefore, you need all people to come together and integrate and design the system together rather than piecemeal, with one being at loggerhead with the other or something of that kind.

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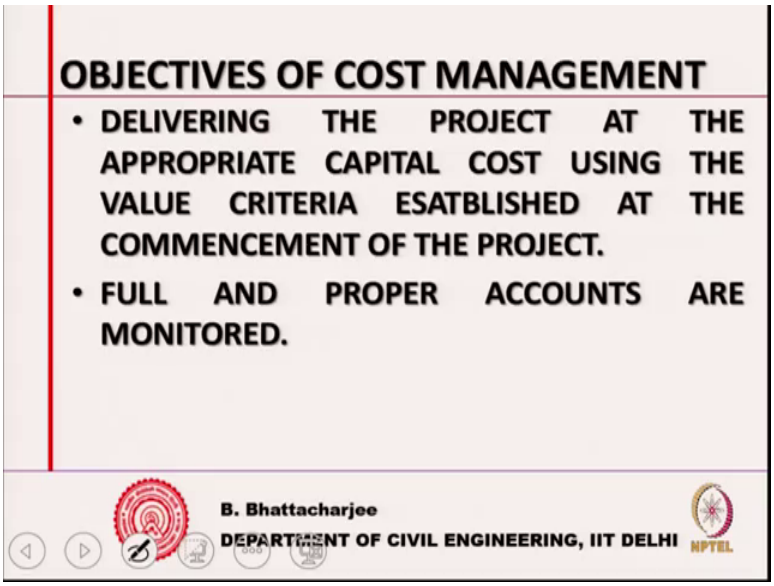

So therefore, you know, cost and value criteria that has to be established right in the beginning and that has to be maintained. And basically, maintain the accounts, cash flow pattern, how it was supposed to be and how it is actually monitoring the cash flow pattern and so on, capital costs that has gone to the building, and so on, that has to be done.

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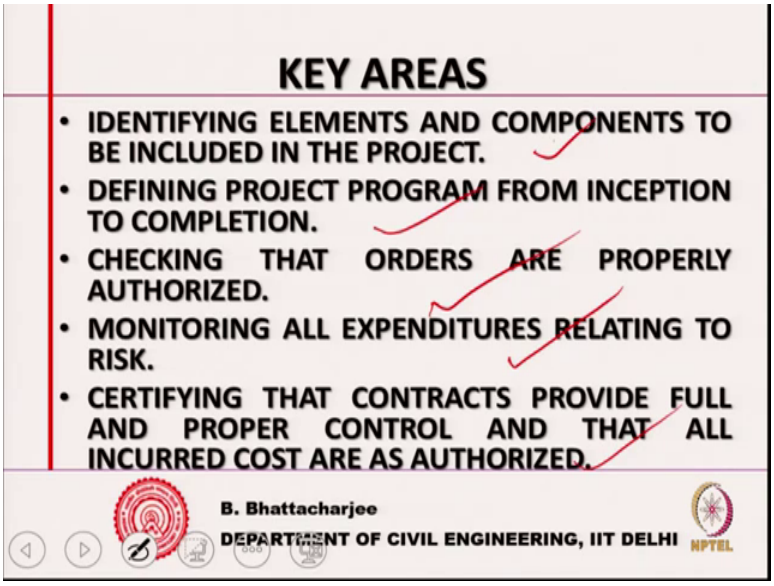

So, in this context, identifying key elements and components to be included in the project that is important, defining project program from inception to completion. Checking the

orders and properly authorized, monitoring all expenditures if the cost is to be control and full and proper control and that all in cut costs are authorized.

These are the kind of control that has to be looked into in case of cost control, key areas associated with cost control and that is how you can achieve the green building design. So that is the overall strategy of green building design. I think with this we conclude our discussion. Thank you very much.