Strategies for Sustainable Design
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Lecture 27
Guidelines for Building Design By SA Methods: GRIHA

Hello everyone, in today's lecture, we will discuss about guidelines for building design by sustainability assessment method, such as GRIHA.

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So, we will talk about green rating for integrated habitat assessment, GRIHA, which was framed by a theory the Energy and Resources Institute in collaboration with the Ministry of New and Renewable Energy Resources Government of India.

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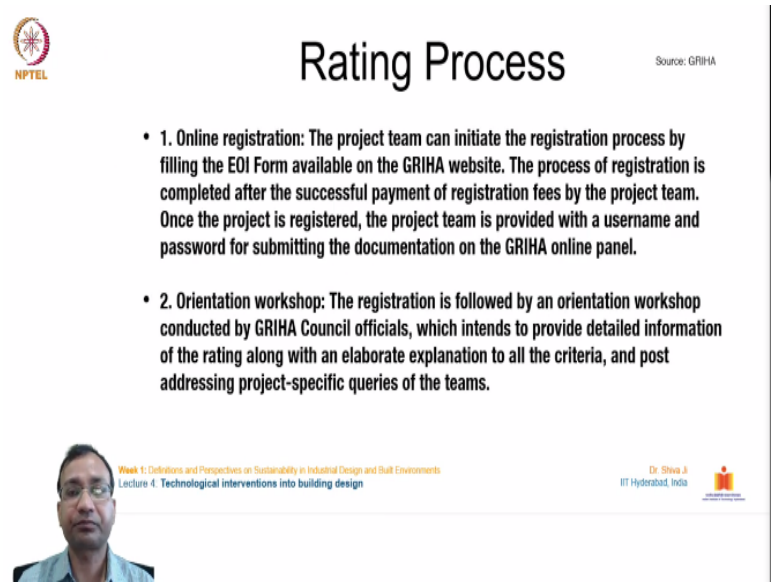

So, what is the rating process over here? They start with the online registration; the project team can initiate the registration process by filling the expression of interest form available on the GRIHA website. The process of registration is completed after the successful payment of registration fee by the project team. Once the project is registered, the project team is provided with a username and password for submitting the documentation on the GRIHA online portal.

The second stage is orientation workshop. The registration is followed by an orientation workshop conducted by GRIHA council officials, which intends to provide detailed information of the rating system along with an elaborate explanation to all the criteria and post addressing project specific queries of the teams.

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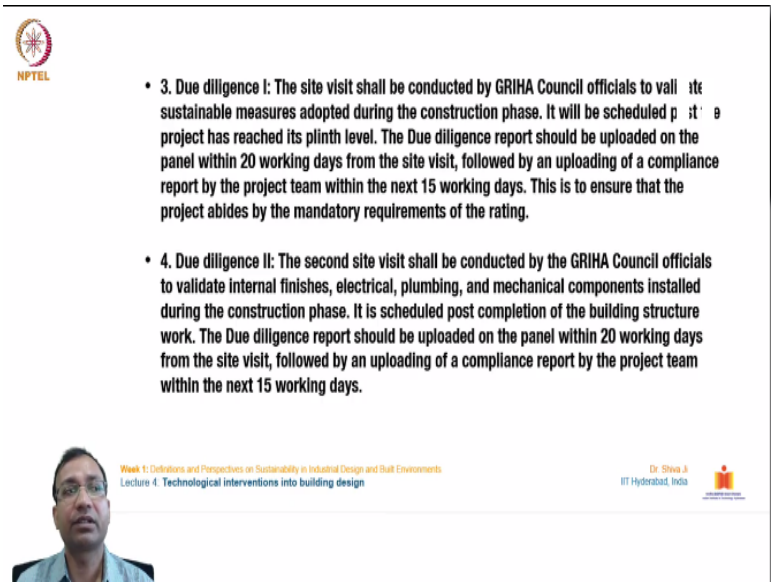

Well, after this, they carry out our due diligence. Stage One, the site visit shall be conducted by GRIHA council officials to validate sustainable measures adopted during the construction phase, it will be scheduled post the project has reached this plinth level. The due diligence report should be uploaded on the panel within 20 working days from the site visit followed by an uploading of a compliance report by the project team within the next 15 working days. This is to ensure that the project abides by the mandatory requirements of the rating.

Next comes our due diligence two, the second visit shall be conducted by the GRIHA council officials to validate internal finishes, electrical plumbing and mechanical components installed during the construction phase. It is scheduled post completion of the building structure work. The due diligence report should be uploaded on the panel within 20 working days from the site visit, followed by an uploading of a compliance report by the project team within the next working 15 days.

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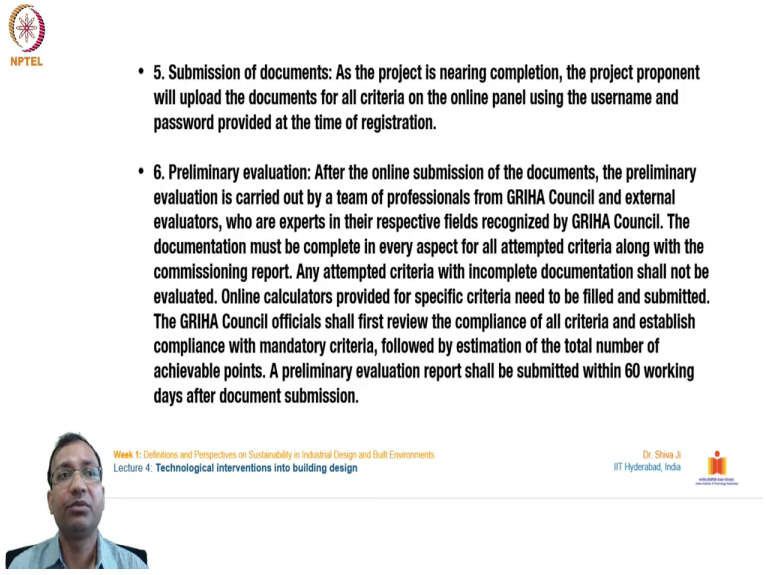

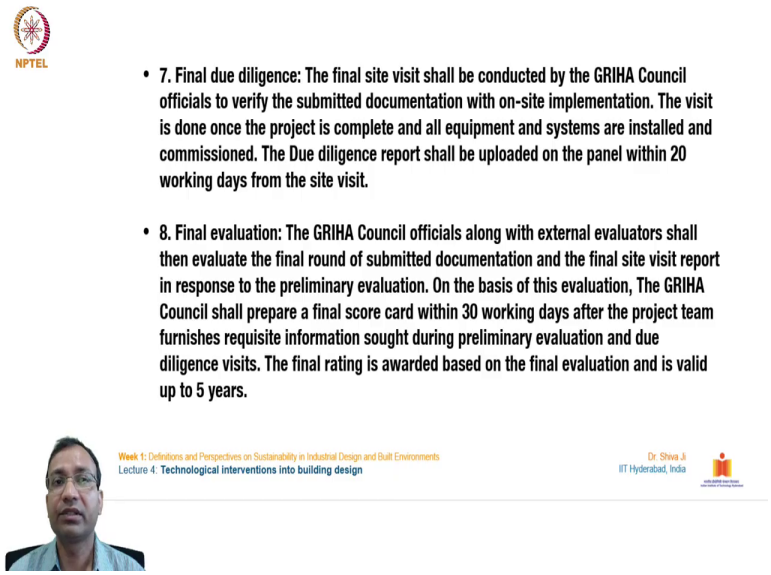

Further comes submission of documents as the project is nearing completion, the project proponent will upload the documents for all criteria on the online panel using the username and password provided at the time of registration. Further comes up preliminary the evaluation, after the online submission of the documents, the preliminary evaluation is carried out by a team of professionals from GRIHA Council and external evaluators who are experts in their respective fields recognized by GRIHA counsel.

The documentation must be complete in every aspect of all attempted criteria along with the commissioning report. Any attempted criteria with incomplete documentation shall not be evaluated. Online calculators provided for specific criteria need to be filled and submitted. The GRIHA council official shall first interview, shall first review the compliance of all criteria and established compliance with mandatory criteria followed by estimation of the total number of achievable points.

A preliminary evaluation report shall be submitted within 60 working days after document submission. Further comes final due diligence, the final site visit shall be conducted by the GRIHA council officials to verify the submitted documentation with on site implementation. The visit is done once the project is complete and all equipment and systems are installed and commissioned. The due diligence report shall be uploaded on the panel within 20 working days from the site visit. The final evaluation comes in the last, the GRIHA council officials along with external evaluators shall then evaluate the final round of submitted documentation and the final site visit report in response to the preliminary evaluation.

On the basis of this evaluation the GRIHA council shall prepare a final scorecard within 30 working days after the project team furnishes requisite information sought during preliminary evaluation and due diligence visits. The final rating is awarded based on the final evaluation and it is very late rallied up to five years.

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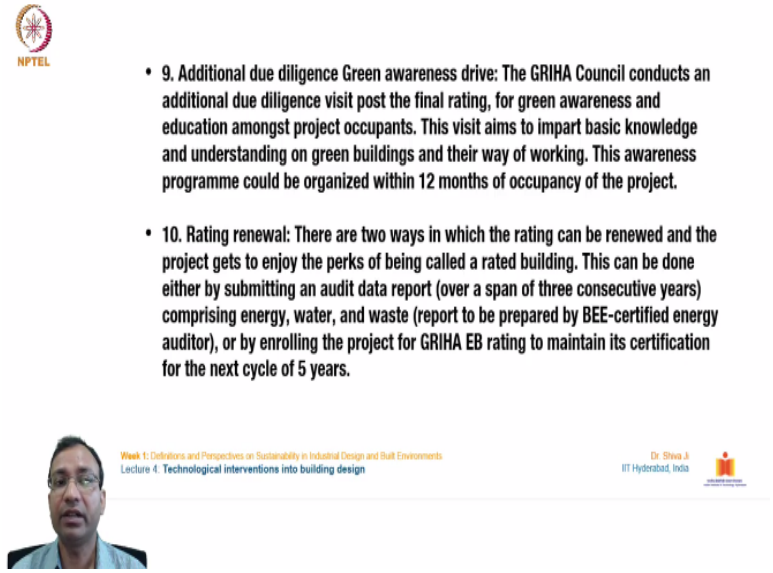

Further comes additional due diligence, green awareness drive, the GRIHA council conducts an additional due diligence visit post the final rating, for green awareness and education among project occupants. This visit aims to impart basic knowledge and understanding on green buildings and their way of working. This awareness program could be organized within 12 months of occupancy under project.

Then comes rating renewal. There are two ways in which the rating can be renewed and the project gets to enjoy the perks of being called a rated building. This can be done either by submitting an audit data report over a span of three consecutive years comprising energy, water and waste report to be prepared by BEE certified energy auditor and by enrolling the project for GRIHA EB rating to maintain its certification for the next cycle of five years.

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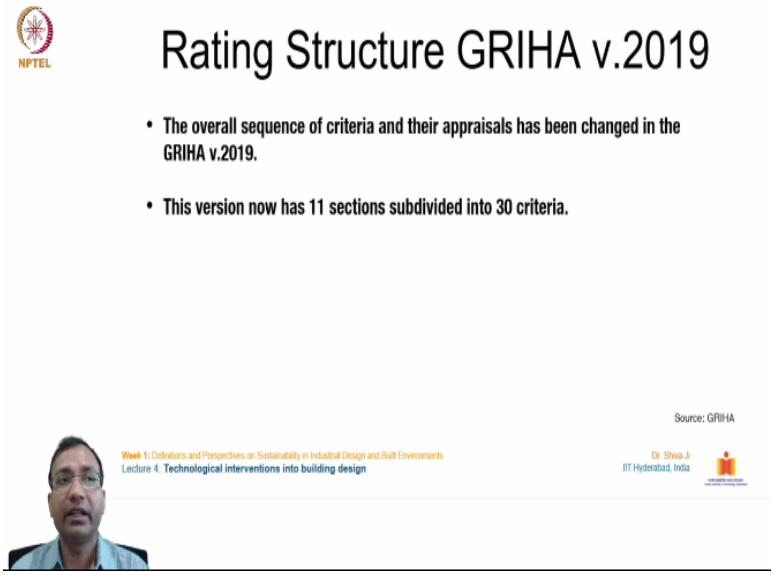

So, we have actually currently green rating structure of GRIHA version 2019, the overall sequence of criteria and their appraisals have been changed in GRIHA 2019 from the previous editions, this version now has 11 sections subdivided into 30 criteria. So, we will see one by one.

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So, this is actually the entire criteria set of GRIHA actually present a structure version 2019 including this page. So, it has like a sections then criteria numbers, then criteria name and then the maximum points allocated to that particular criteria. So, it starts from the sustainable site planning, it has like a three number of criterias then it goes to the construction management then it has energy optimization section, then it goes to occupant comfort, then water management, then solid waste management, then sustainable building materials, then lifecycle costing.

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Then it goes to socio economic strategies and finally, performance metering and monitoring. Further there is one more point of innovation added to this entire actually criteria set and as a total it has a one or five points in totality, including five dedicated only for innovations.

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So, we will see the GRIHA version 2019 and it structure. So, if you see like starting from this green, green actually circle over here sustainable site planning, so, it has like a 12 percent share given to this section, then construction management has received 4 percent share and the energy optimization has received 18 percent share.

So, you see, this is the largest actually share is actually hold by this energy optimization section, which clearly shows how important it is to conjure and preserve energy, then risk gets attention, the next is occupant comfort, it has like a 12 percent share, then water management 16 percent, so with 16 percent water management is the second highest share receiving section.

So, this shows about the criticality of saving water, then we have solid waste management with the 6 percent share, then we have 12 percent for sustainable building materials. So, this also you can say there are like a three-part section who have 12 percent share.

So, this system of building materials section also comes at the third level in terms of like the percentage share what it has, and then it goes to lifecycle costing with 5 percent, then it comes to socio economic strategies, it has like 8 percent share and finally performance

metering and monitoring with 7 percent share. So, we will see a finally the breakup in the upcoming slides.

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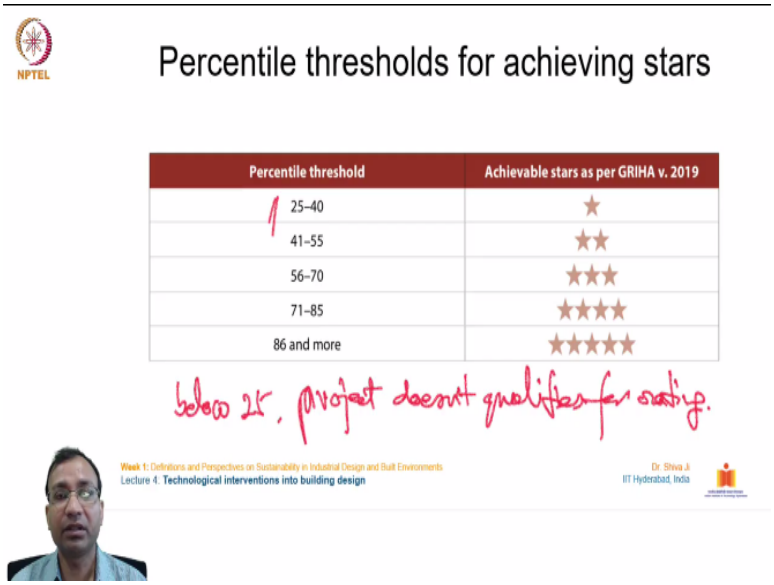

Well, the percentile of awarding star varies with this point threshold you can see over here, a project which receives the points within a range of 25 to 40 is rated as a single star GRIHA rating and the projects which are actually falling short of 25 percent on their project, they may not be given any star rating and they may not be given any GRIHA rating.

Then in the next slab, the point range between 41 to 55 which receives a two-star rating then 56 to 70 three stars, 71 to 85 four star and 86 points and above that project receives GRIHA five-star rating which is the highest rating available currently from GRIHA.

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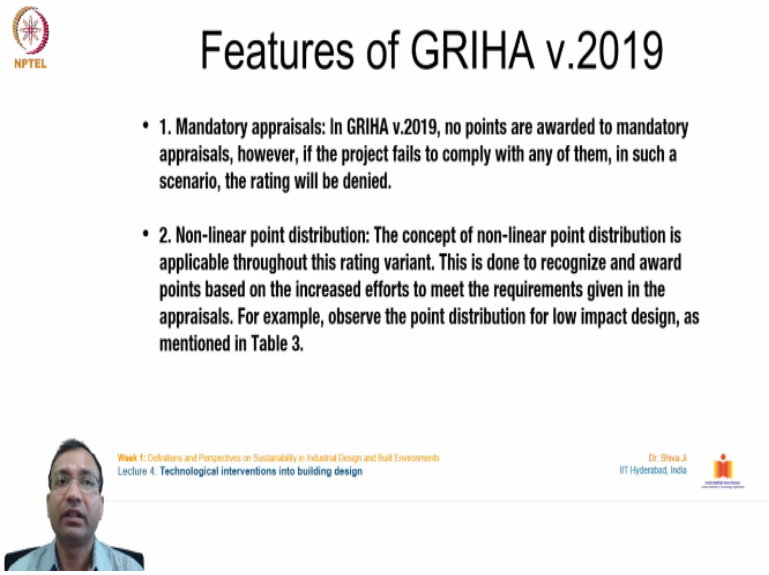

Features of version 2019 GRIHA. Let us see, there are some mandatory appraisals. So these are mandatory and a project must comply on these mandatory parameters to be considered for GRIHA rating systems. So this is very important for the project to have these criteria fulfilled and satisfied to the fullest.

So in GRIHA our version 2019 no points are awarded to mandatory appraisals. However, if the project fails to comply with any of them in such a scenario the rating will be denied. So, as it is stated over here, these mandatory points actually do not carry any points, but they are mandatory in nature and a project must comply with these criteria sets and only after successful satisfaction, after successful meeting the criteria of these mandatory appraisals the project can be rated.

So the rest of the criteria which are optional, they are have found place in the rating structure but what we saw in the previous slides. So a nonlinear point distribution system, this is one of the features of present version of GRIHA, it talks about the concept of nonlinear point distribution is applicable throughout this rating variant. This is done to recognize and award points based on the increased efforts to meet the requirements given in the appraisals. For example, observe the point distribution for low impact design, as mentioned in table three, we will see it later.

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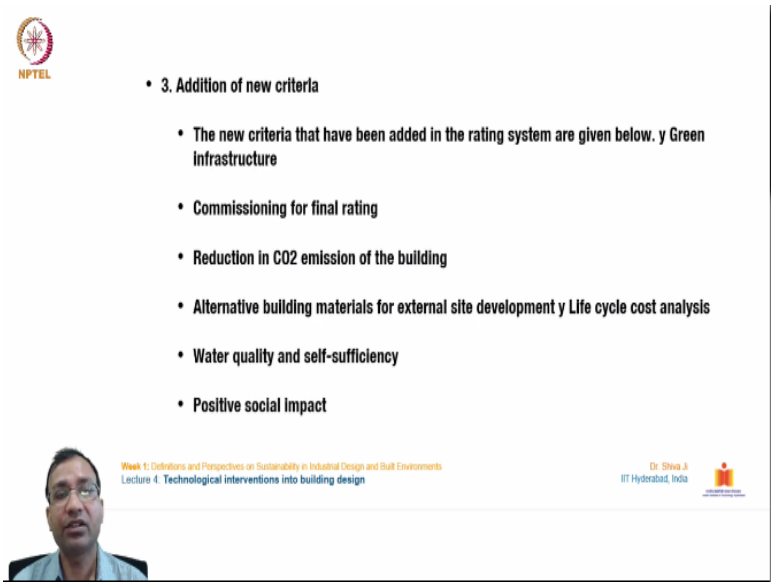

So, the table three is here, addition of new criteria, the new criteria that have been added in the rating system are given below, for example, like a green infrastructure is the new criteria added in this present version of the year 2019. Commissioning for final rating, reduction in the CO2 emission of the building, alternative building materials for external site development for example, like lifecycle cost analysis, water quality and self sufficiency and finally, positive social impact.

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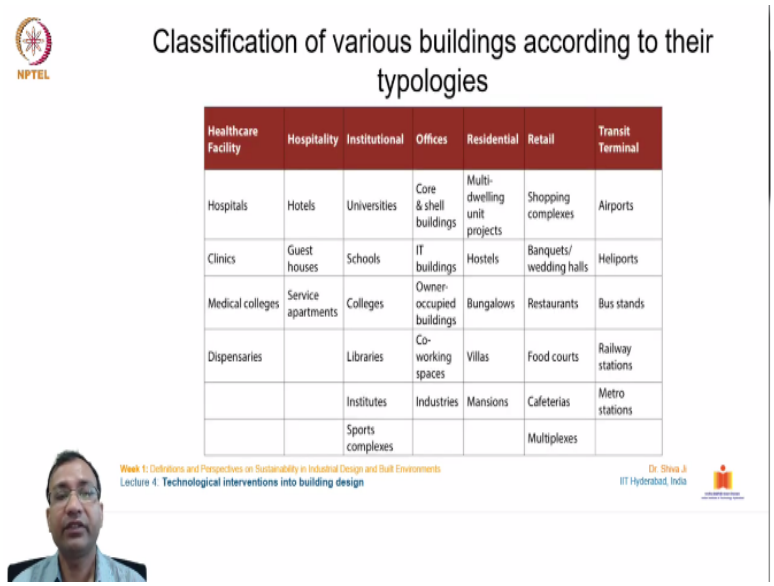

So, this is the classification of various buildings according to their topology. So, these are healthcare, hospitality, institutional, offices, residential, retail and transit terminal types of topologies of different buildings under which there are some variations in these buildings. So, these are currently buildings topologies which are rated with the help of like GRIHA.

So, in this healthcare facility you can see over the hospital, clinics, medical colleges and dispensaries they fall under this topology and hotels, guest houses, service apartments, they fall under hospitality topology and nurseries, schools, colleges, libraries, institutes, you know, sports complexes, they fall under like institutional topology of the building and similarly like these many.

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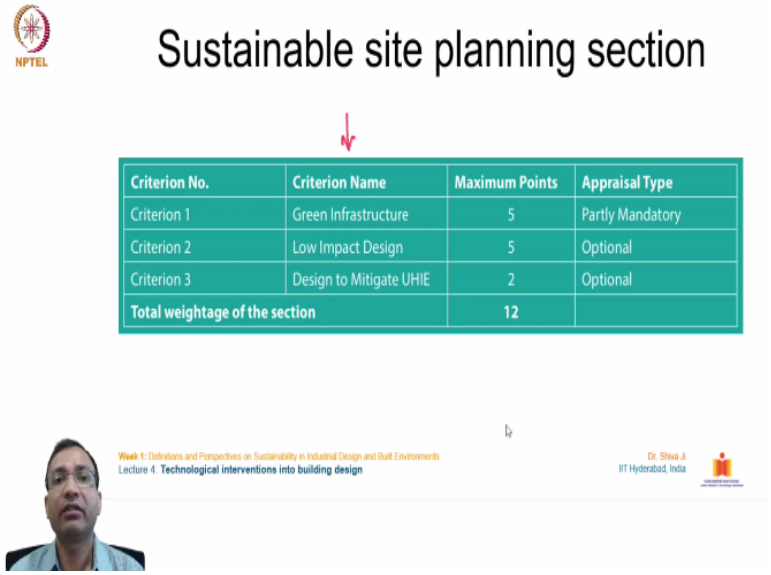

So, we will move further to the for checking each and every section for the criteria sets what they have and the kind of points which are given to them. So, one by one starting from the first one, which is sustainable site planning section. So, this has, you can see there are three criteria vis-à-vis green infrastructure which carries five points, it has low impact design, it has designed to mitigate urban heat island effect, this receives two points together this section a holds 12 points for this section.

So, we can see from here it starts from the site planning. So, site plan comes in the preliminary, at the beginning of the design or any conceptualization, so we must take a consideration of the site situations, site location and natural features and the presence of elements on that particular site and how the design can come up in and around those concerns. So, this is one of the major and the preliminary sections and criteria sets were the design and conceptualization begins for taking ship.

This talks about establishing green infrastructure, green infrastructure means energy harvesting units, means energy conserving procedures and methodologies plus following the (())(13:03) saving and the (())(13:03) material and resources part, then it talks about using low impact designs, we have discussed in detail what are the impacts caused by this growth and development scenario in the present world, post industrial period.

So, the designs which are causing lesser impacts are the preferred ones in the today's time and they have found place over here. So, this is one of the most important criteria as far as sustainability aspects on environmental concerns are concern. Further it talks about reducing the urban heat added effect, we have discussed in detail in our previous lectures.

So, the urban heat island effect is the collective a catchment of heat factor, heat component of the sunlight and creating a heat bubble over the cities in the, so this is a recent phenomena which has been taking shape by the extensive use of heat absorbing material such as metal, such as concrete, bricks etcetera, because these are the materials which absorb heat, heat component and this heat component is released in the air, in the nighttime and even in the rest of the time of the entire day and night durations.

So, the designs which try mitigating or try minimizing this UHIE effect this point has also found place in this actually particular section.

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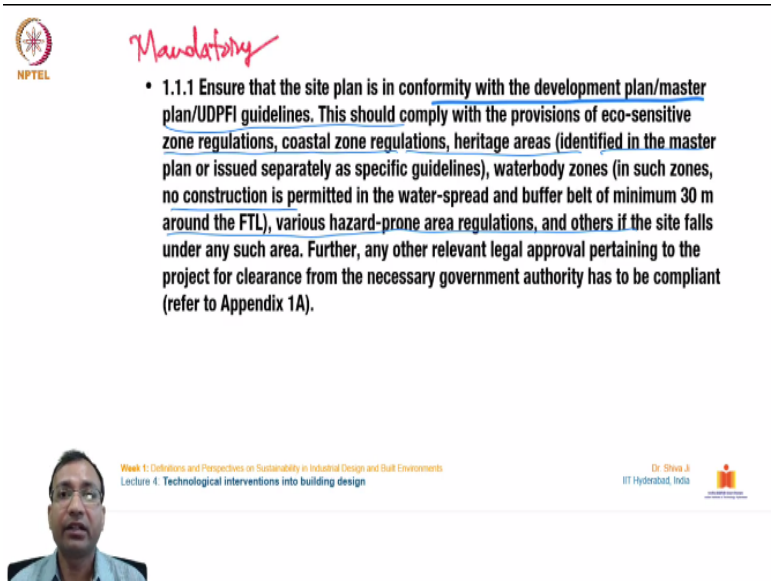

So, if you see that the mandatory point in this particular section is the to ensure that the site plan is in conformity with the development plan, master plan or UDPFI guidelines. This should comply with the provisions of eco sensitive zone regulations, coastal zone regulations, heritage areas identified in the master plan or received separately as specific

guidelines, water body zones such as, in such zones no construction is permitted in the water spread or buffer built minimum 30 meters from the full tank level.

Various hazard prone area regulations and others if the site falls under such area, further any other relevant legal approval pertaining to the project fall clearance from the necessity government authority has to be compliant, for that there is a appendix also. So as you can see over here the project must comply with the city planning, the master plan of that particular place and it must comply to the regulations, if there are any eco sensitive regulations such as forest areas or maybe coastal zone regulations or maybe heritage zone regulations etcetera.

So, unless a project which will complies completely on these mandatory parameters, one cannot actually proceed for the GRIHA certifications.

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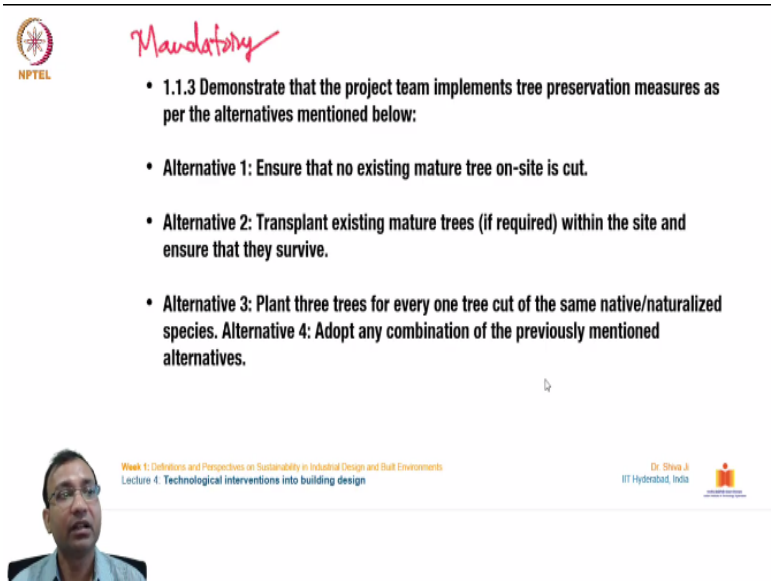

Next comes in the mandatory criteria over here, this talks about demonstrate that the project team implements three preservation measures as per the alternative mentioned below. Alternative one ensures that no existing mature tree on site is cut. So, this is one of the very important and I think lovable point from the environmentalists that we must actually take care of, we must actually preserve the mature trees on the ground at any cost, if a project has to come up at the location of the tree. So, there should be there must

be actually alternative arrangements to relocate that tree from that location to some other location, but we must not cut any tree. So, this is one of the mandatory criteria under the framework of GRIHA.

Alternative two, it talks about transplant existing mature trees if required within the site and ensure that they survive, alternative three, plant three trees for every one tree cut of the same native or naturalized species, alternative four, adopt any combination of the previously mentioned alternatives. So, in a nutshell, if you see preserving the trees or preserving the existing flora from that particular site is a mandatory parameter.

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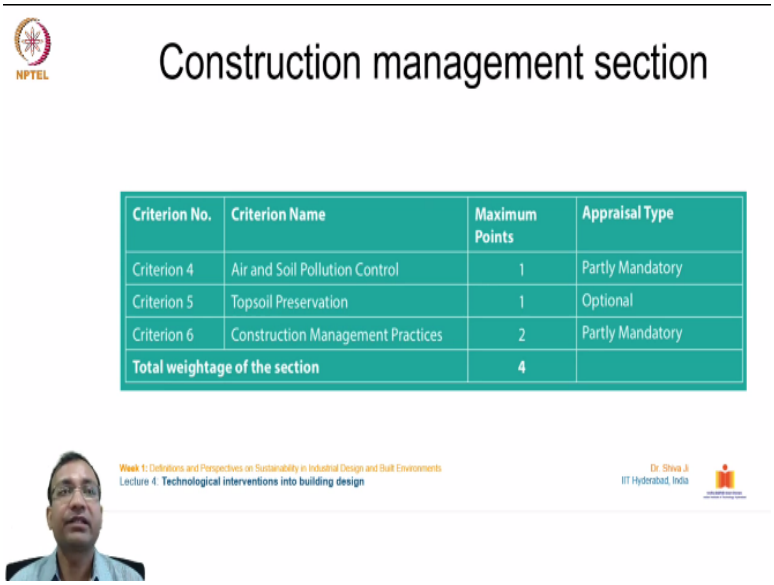

Further we are moving into the next section that is construction management section. So, we can see over here the pollution gets the importance over here. So, the air and soil pollution control, water pollution control, all sorts of pollutions must be controlled and for that there is allocation of one point, then comes topsoil preservation, so with the construction activities, the topsoil gets degraded by the falling of the debris, the falling of the cement and other components and even like oil, grease etcetera and that topsoil is very important for the growth of the vegetation and green and other plants and trees etcetera.

So, we must protect actually this topsoil, this topsoil houses the several types of microbes and other organisms also, so we must actually protect this topsoil. Finally, it has the third point of construction management practices. So a responsible construction management practices which takes care of its employees and the manpower who are employed on that project. So this actually receives two points, so overall, this section has got four points.

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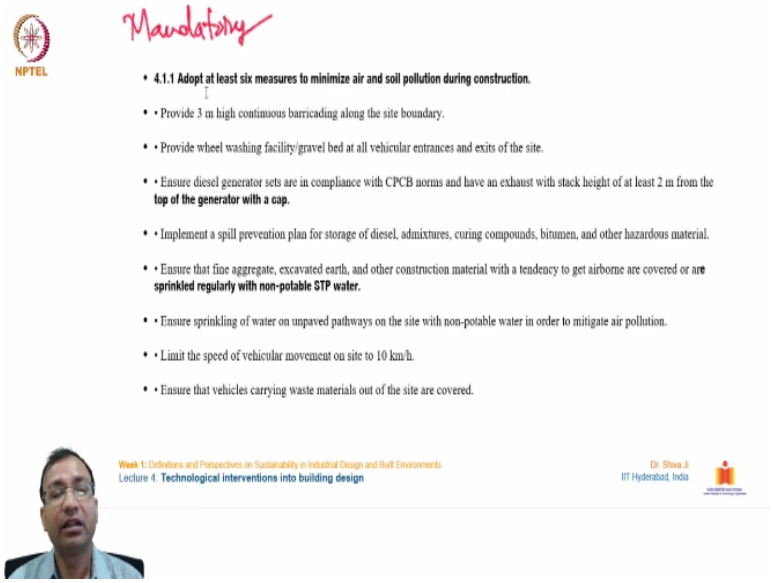

The mandatory points here are like adopt at least six measures to minimize air and soil pollution during construction, provide three-meter-high continuous barricading around the side boundary, so that the pollution of the spillover like dust and debris should not actually go out of the project area, provide wheel washing facility gravel bed at all vehicular entrance and exit of the site. So there are no footprints of soil and mud on the external roads, on the arterial roads outside the project area.

Ensure diesel generation sets are in compliance with the CPCB norms and have an exhaust with the stack height of at least two meters from the top of the generator with the cap, implement a spill prevention plan for storage of diesel, admixtures, curing compounds, bitumen and other hazardous material. Ensure that fine aggregate excavated earth and other construction material over a tendency to get airborne are covered or are sprinkled regularly with non portable STP water. STP water is Sewage treatment plant water.

Next to that is ensure sprinkling of water on unpaved pathways on the site with non portable water in order to mitigate air pollution, limit the speed of regular moment on site to 10 kmph, ensure that vehicles carrying waste material out of the site are covered. So, if you see all of these points talk about preventing pollution in this way or the other in this form or the other, whether it is for air pollution, for soil pollution, so there are, these are mandatory points which your project actually must take care of, while under the construction.

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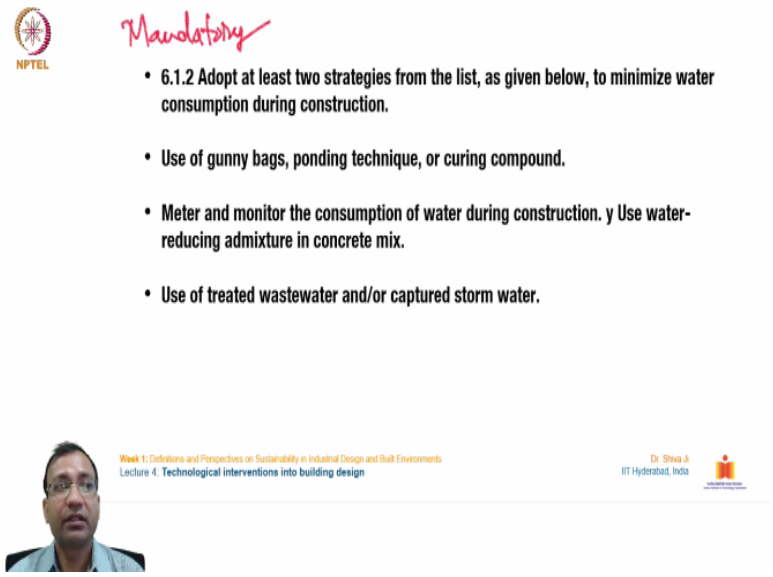

Next to this, there are some points such as adopt, at least two strategies from the list as given below to minimize water consumption during construction for use of gunny bags, ponding techniques or curing compound. Meter and monitor the consumption of water during construction, use water reducing admixture in concrete mix, use of treated wastewater and or captured storm water.

Water related points are also mandatory points on this construction management this section over here. So, we can see clearly over here it talks about like minimizing the consumption of the water, starting from that concept which we have discussed in the previous lectures and then conserving the water so, the water should not get evaporated, so quickly, so of the gunny bags and other like a ponding technique and curing

compounds should also be used on the site for reducing the wastage of water. So, these are actually points which are related with the water conservation on the site.

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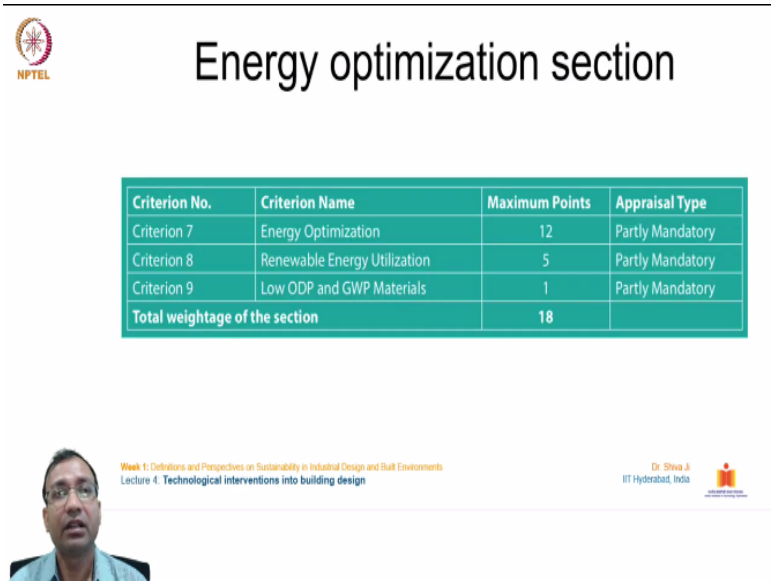

Further to this if, energy optimization section. So, in this section also there are three criteria points, energy optimization, renewable energy utilization and low ODP and GWP material. So, if you see these points have found lot of weightages over here. So, energy optimization in itself is a single criterion with 12 points located only for this credit or so, we can understand the intensity and the kind of criticality of this energy optimization in the recent times and the kind of weightage it has received over a year in the GRIHA framework.

Further, renewable energy utilization is also increased with the award of five points and then like ozone depleting potential materials and other greenhouse gas kind of global warming potential materials and compounds should also be discouraged and even if they have to be used, then must be in a very low quantity. So, this has also found a place over here and with the total 18 maximum points of 18 this criterion is the top post criteria with the highest weightage.

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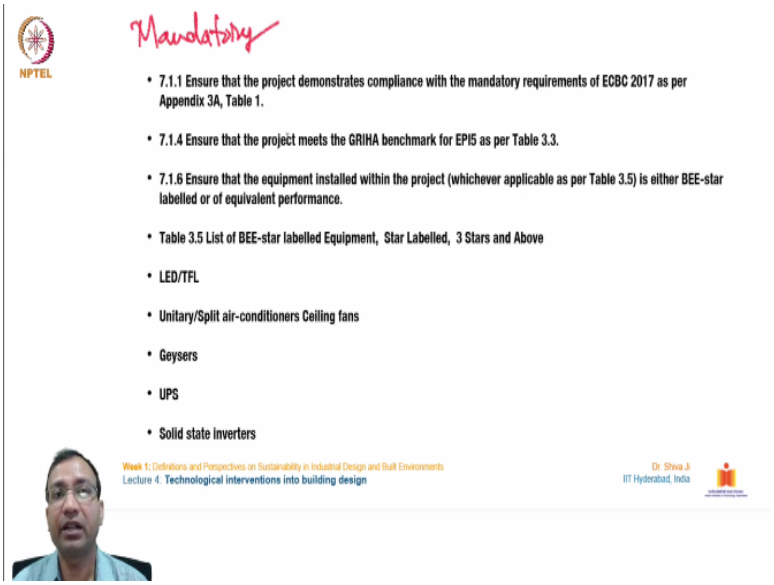

The mandatory points over here are like ensure that the project demonstrates compliance with the mandatory requirements of ECBC 2017 as per appendix, there is a table given in the annexure, ensured that the project meets the GRIHA benchmark of EPI5 as per the table 3.3, ensure that the equipment installed within the project whichever applicable as per the given table is either BEE star labeled or of equivalent performance. So, there are these standard BEE star rating system is there. So, the equipment must actually comply to these star rating system, and the table 3.3 list of BEE star labeled equipment.

So these are the LED and TFL based like equipment, unitary and split air conditioner, ceiling fans, geysers, UPS, so these are list of the equipment which must comply to the BEE star rating system.

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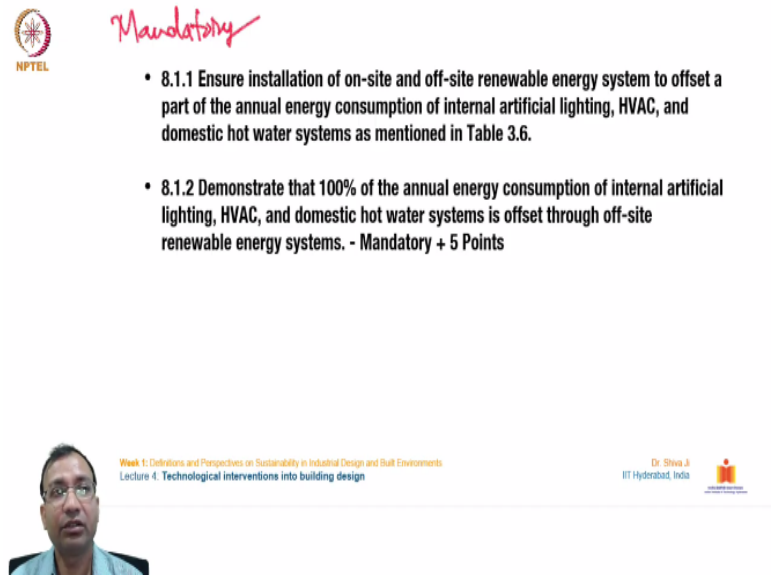

Further to that if we see ensure installation of onsite and offsite renewable energy system to offset a part of the annual energy consumption of internal artificial lighting, HVAC and domestic hot water systems as mentioned in the table, demonstrate that 100 percent of the annual energy consumption of internal artificial lighting, HVAC and domestic hot water systems is offset through offset renewable energy systems. So these are mandatory points. So a hardcore promotion of renewable energy resources.

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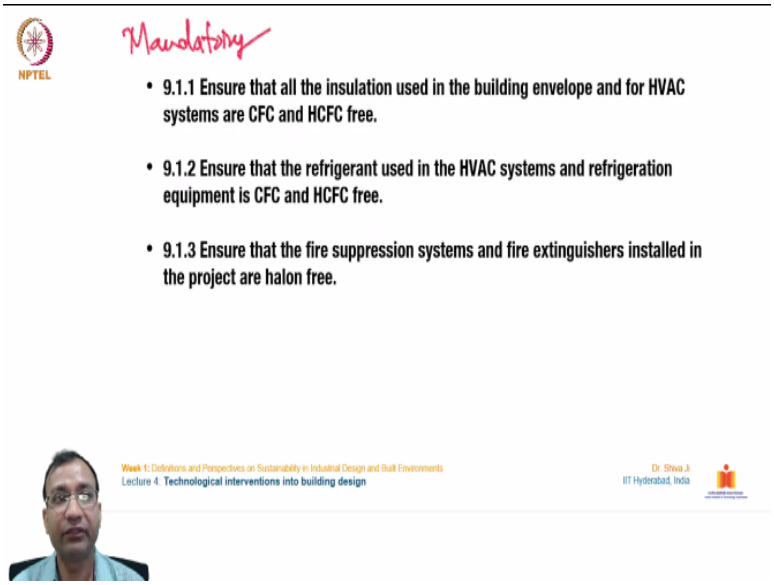

Further to this section, ensure that all the insulation used in the building envelope and for HVAC systems are CFC and HCFC free. We have discussed in one of our previous lectures the importance of insulation and sealing in the buildings to conserve energy, ensure that the refrigerant used in HVAC systems and refrigeration equipment is CFC HCFC free, ensure that the fire suppression systems and the fire extinguishers installed in the project are halon free. So, there is very critical focus on the protection of the ozone layer by using non-CFC products and articles.

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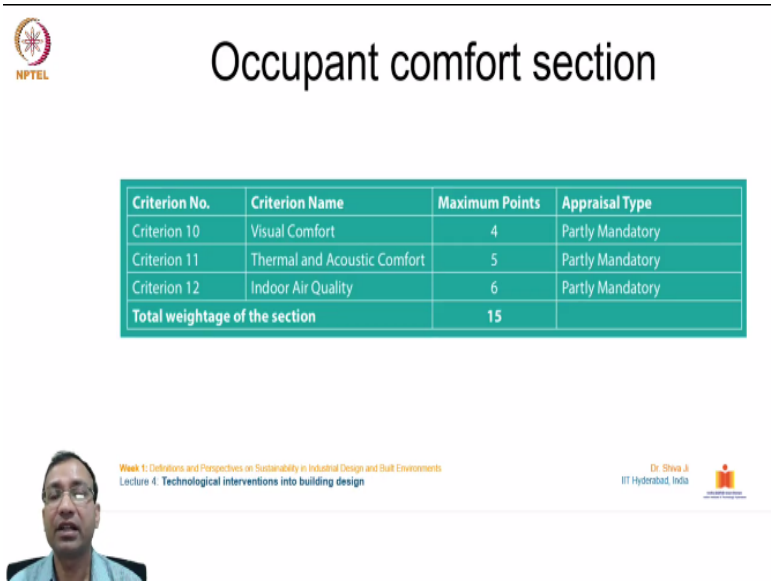

In the next section this belongs to occupant comfort section. So, this has three criteria sets visual comfort, thermal and acoustic comfort and indoor air quality. Well these are the most basic comfort conditions desired for human, uses to be undertaken for any occupied atmosphere. So, these have found a place, so visual comfort you may be surprised to see over here even like a having look up, beautiful views outside whether it is a green area, whether it is the activity area, whether it is a marketplace or any such activity where one can see greenery or maybe the movement or the activity of the other human beings or the other life forms.

It is considered one of the important comforting points for the humanity on keeping in mind the psychological effects which can happen if the person is kind of locked inside, closed room where there is no opening or there is no visible or available for the outside world. So, this has actually found a place apart from the regular thermal and acoustic and indoor air quality considerations.

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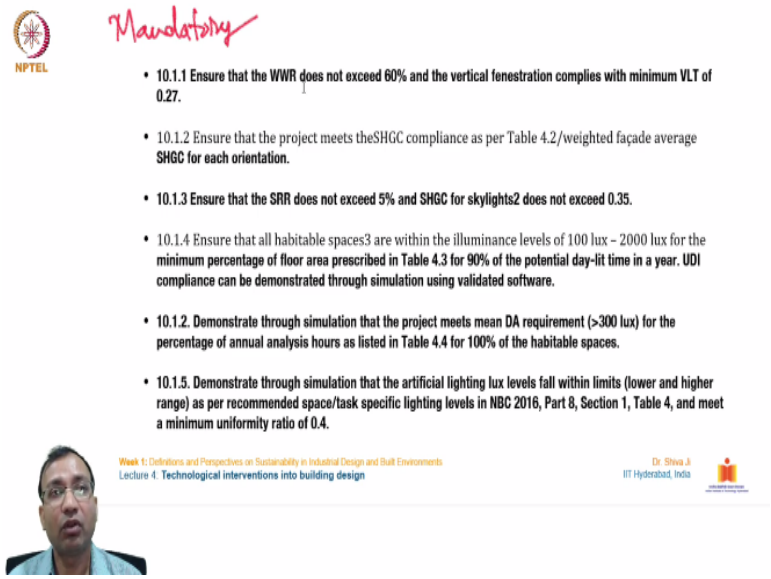

In this section if you see ensure that window to wall ratio does not exceed 60 percent and the vertical fenestration complies with minimum VLT of 0.27, ensure that the project meets SHGC compliance as per table 4.2 weighted facade average SHGC for each orientation, ensure that the SSR does not exceed 5 percent and SHGC for skylight2 does not exceed 0.35. Ensure that all the habitable spaces are within the illuminance level of 100 lux to 2000 lux for the minimum percentage of floor area prescribed in the table.

For 90 percent of the potential day lit time in a year. UDI compliance can be demonstrated through simulation using validated software. So, you can see how much of the emphasis is given on even the, like in LeNS level inside our spaces. So depending upon the utility and activity, in the particular areas this illuminance should vary from 100 to 2000 lux.

Further demonstrate through simulation that the project meets mean DA requirement more than likely 300 lux for the percentage of annual analysis hours as listed in the table for 100 percent of the habitable spaces. Demonstrate through simulation that the artificial lighting lux level fall within limits lower and higher range as per recommended space or task specific lighting levels in NBC 2016 Part 8, Section One, Table 4 and meet a minimum uniformity ratio of 0.4. So, these are mandatory points as far as the lighting levels are concerned, the lighting comfort is concerned inside the spaces.

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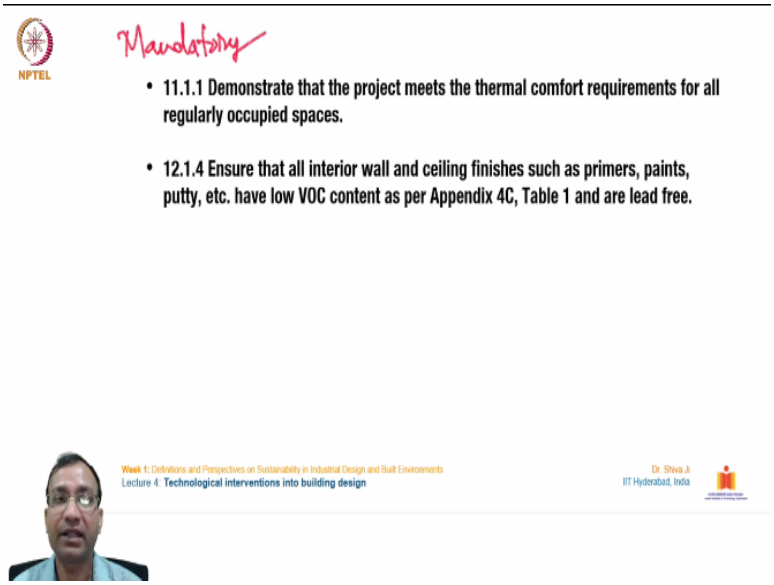

Demonstrate that the project needs the thermal comfort requirements of all regularly occupied spaces, ensure that all interior wall and ceiling finishes such as primers, paints, putty etcetera have like a low volatile organic compound in lower percentage content as per the appendix 4C, Table 1 and are lead free. So, lead is one of the most toxic substances which was conventionally used in the construction material. But once it was discovered, then afterwards this lead is completely banned to be used in the any materials which are going to be used in the habitable spaces of buildings.

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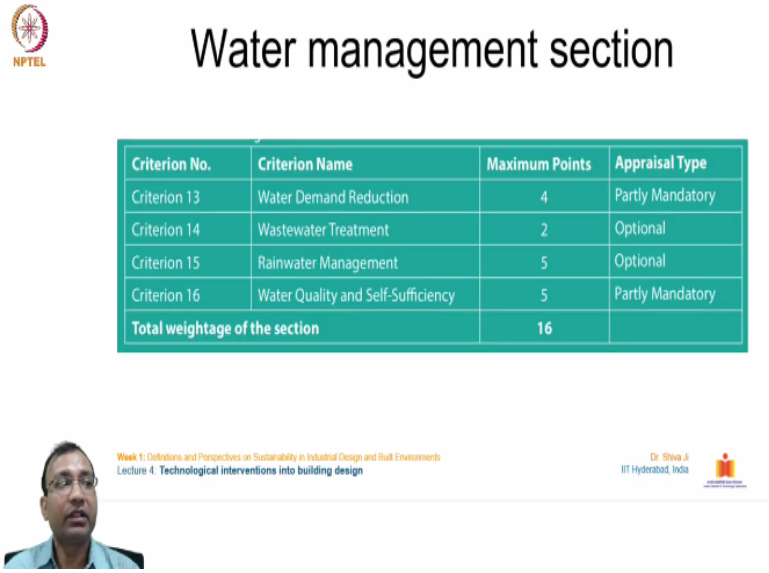

Further coming down to the next section of water management, here we see there are four criteria sets, water demand reduction, four points, wastewater treatment, two points, rainwater management, five points, water quality and self sufficiency, five points. So in total 16 points.

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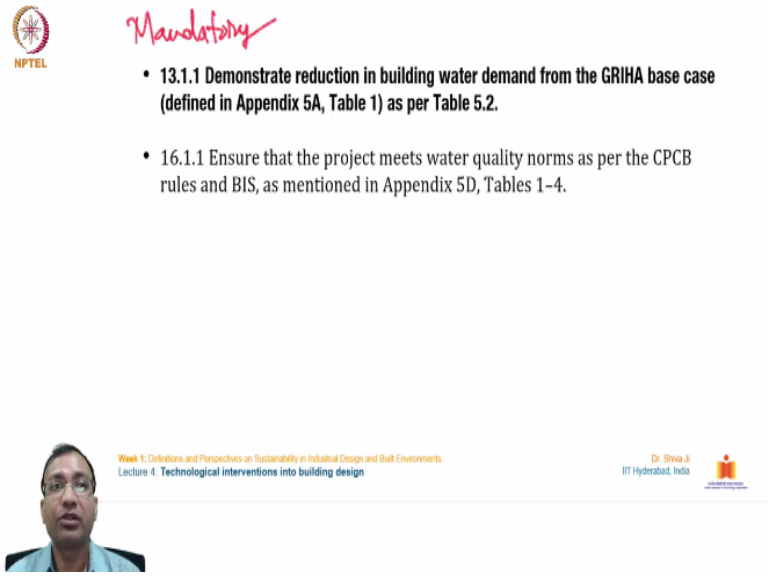

Further in this the mandatory points are demonstrating reduction in building water demand from GRIHA base case. So, there is a base case given for several criteria sets. So, GRIHA project, GRIHA rated project must comply at least at the level of that base case or even higher. Ensure that the project meets water quality norms as per the CPCB rules and BIS as mentioned in the appendix.

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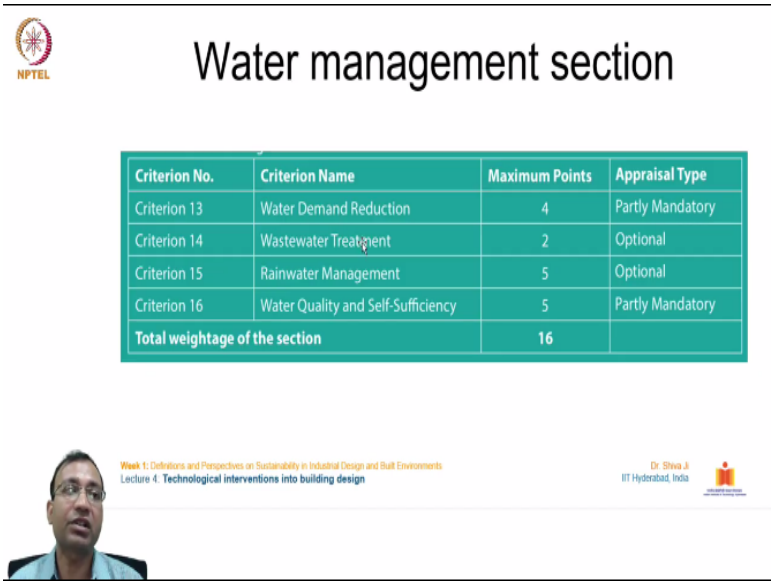

So, we can see over here in this one. So, it talks about this water management section, talks about reducing the demand first of all, so that there is a less consumption of water, less amount of this resource is required in the building. And then there are treatment facilities are also considered over here. So that the use water or the maybe some other forms of water can be reused on the site for non portable activities and requirements.

Rainwater management, so that the rains supply the fresh water, pure water unless it gets polluted through the lake or passing through the atmosphere, through poisonous gases and other particulate matter, otherwise rainwater is considered to be one of the safest one for drinking and other utilization purposes. So storing this water for onsite uses or even rainwater harvesting, so this is one of the important criteria given, it has received five points, so you can see the importance of it.

Water quality and in self sufficiency, so this is water maintaining the water quality to maintaining the hygiene and maintaining the quality for the human consumption and self sufficiency. So that the site itself is has the self sufficiency in meeting the requirement of the water on site.

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Further after this section we have the solid waste management section, here we are having two criteria sets. For example, waste management post occupancy and organic waste treatment on site. So, both of them have respectively received 4 and 2 points. So, this talks about post occupancy there must be waste management system on the site to whether it is related with the segregation, whether it is related to sending it to the responsible agency or the recycling unit for recycling or reusing or that further disposal. So, a responsible disposal system must be in the place by having waste management system on the site.

Well organic waste treatment on site is important because of the organic waste formula for example, like a kitchen waste and other like organic stuff, which we generally like created in the kitchen and then elsewhere from pruning of the trees and plants and etcetera. So, this kind of waste must not go outside the site and should be recycled on site itself. The various forms, various techniques and the uses are given are being run from several NGOs and other agencies to have on site composting systems, on site dissolving

system, on site disposal system for this organic waste or maybe it can be reused for other maybe on-site purposes.

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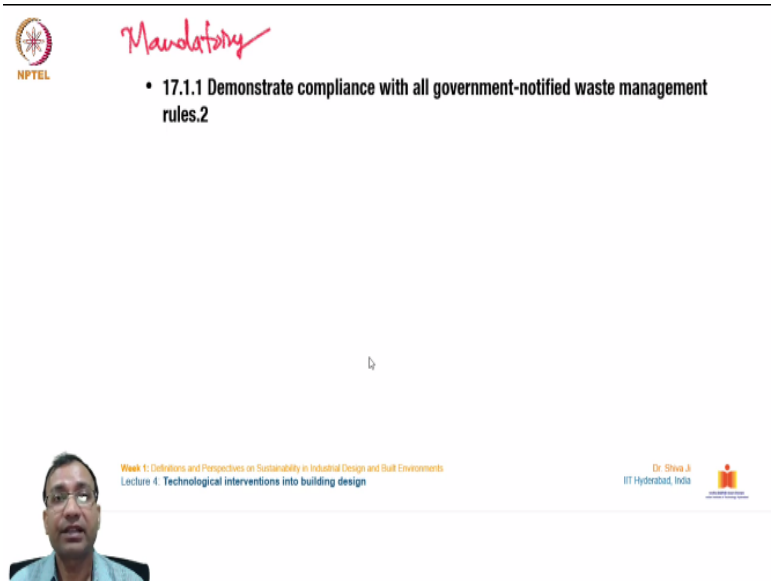

Mandatory criteria under this section are to demonstrate compliance with all government notified waste management rules. So, it is very important for the project to comply the waste management rules and guidelines from the local authorities.

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Next to and line with this new section, we have sustainable building materials section. So, here we have utilization of alternative materials in the building, here we have a reduction in the greenhouse potential reduction through lifecycle assessment, the LCA method the EIA method, what we discussed in the previous methods, so such kind of potential materials must be discouraged on the site and finally, the alternative materials for external site development, so the site development works also can be handled by using alternate materials. And of course, the first one if you see, it has received five points, this talks about the utilization of alternative materials in the buildings.

So, the idea itself is to use less impacted materials by going ahead with the alternative material for example, we studied in the previous lecture of the sustainable materials that the fly ash is one of the materials, a byproduct for certain industry, which the construction industry has adopted, the fly ash comes from the coal plants. So, it is an byproduct of the coal based industries and power generation unit.

So, a huge quantity of this fly ash gets accumulated and earlier fly ash is one of the very less productive material, it does not have any moisture content or any organic content. So, it becomes a very bad for, if it is thrown in the agricultural fields. So, earlier it used to create a lot of problem in the agricultural field, it used to fly away from these sites through the wind and air.

So, as the provisions were made and this discovery was made how this material can be utilized by designing other alternative materials. So, this fly ash-based bricks and construction blocks were designed, so such kind of alternative materials must be used on the site.

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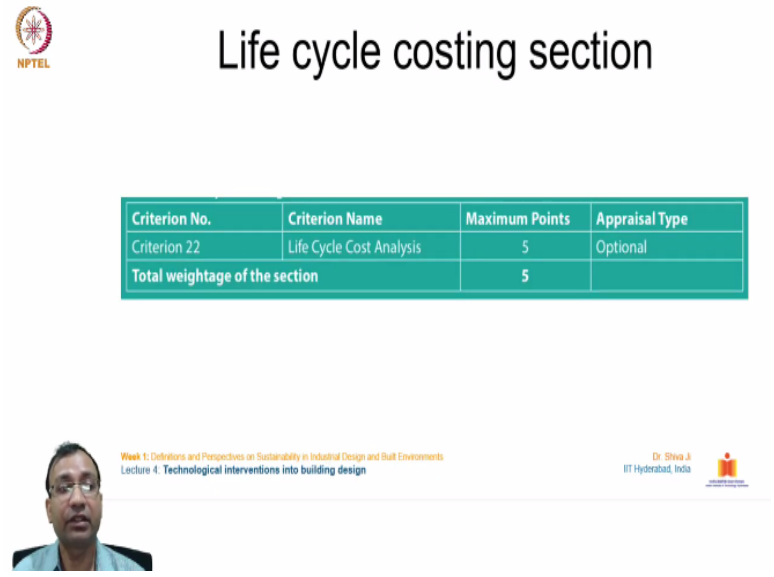

Further to this in this section, we are having lifecycle costing section, this session talks about this LCA analysis, which we have studied in the previous lectures. So, there is a lot of emphasis given on to assessing the lifecycle of any product or any component which is going to be used in the building industry. So, the impact, the high impacting material must be discouraged through this analytical tool for being used at the sites. So, that is why this tool is important to understand the embodied energy to understand overall impact a product can exert on the environment.

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Further to this we have our socio-economic strategies section where there are four criteria points given. So the first one is safety and sanitation for construction workers, further universal accessibility, dedicated facilities for service staff and finally, positive social impact. So all of these criteria have received 1, 2, 2, and 4 points respectively.

So, I will talk about the first one the safety and sanitation for construction workers, traditionally or the earlier the construction workers who are employed on the sites, they were not taken care of, they used to live in a very bad situations for their habitation, they were not provided with the portable luxury of water and sanitation facilities also used to be not existing on those sites.

In the recent years, we have seen this development of taking care of our workforce on the site, so that the gents and the ladies along with their kids who reside on the site for the construction activity must be taken care of. So, their basic necessities and the other requirement must be fulfilled such as water and sanitation activities. Universal accessibility talks about the inclusive growth and development models.

So, it talks about actually taking care of the other specially abled person also of the society who are having some kind of difficulty in there motion or a visual or auditory or any other sort of, so the design of the building, the design of the premises should be in compliance to take care of such all respected persons also on the site, so that they do not face any difficulty while accessing the building.

Dedicated facilities for service staff, so that they can take care of themselves on the site, so there is no worry to go out of the site for attending other unnecessary activities. Finally, positive social impact. So, this is one of the very important points which have evolved in the recent years, it has to do a lot with the social sustainability angle, which we have discussed earlier.

So, a building must have some connection, some relationship with the local, with the community, with the place with the culture of that place. So, how this building is going to have some positive social impact must also be encouraged through the design, through its operation, through its usage and that is why this point is over there. So, this enhances the presence of a building, this bounds this building, binds this project, binds these occupants of this building with the local society and the local community.

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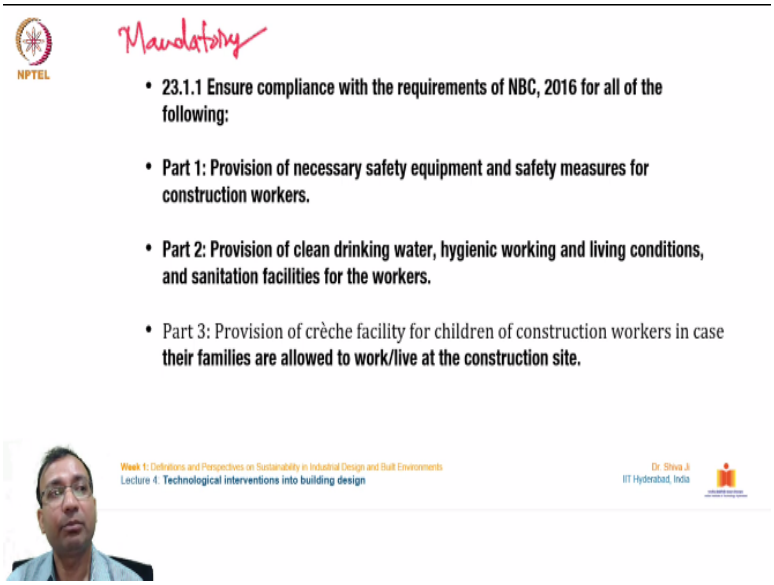

In the mandatory points if we see there are a few points given, ensure compliance with the requirements of NBC National Building Code 2016 for all the following, these are parts. Part one, provision of necessary safety equipment and safety major for the construction workers, part two, provision of clean drinking water, hygienic working and living conditions and sanitation facilities for the workers. Part three, provision of creche facility for the children of construction worker in case their families are allowed to work or live at the construction site.

So, you can see these three points these are very, very humane considerations very, very humanely attitude is shown from these construction projects because earlier most of these points are not taken care of and our workforce used to receive not so healthy or like supporting environments while working or while staying on the site. So a basic necessities such as water, sanitation and the living facility and the taking care facility for the children of the people who are employed, who are working on these sites, and finally, the safety of the workers who are working on the site.

So, the safety comes first any activity or anything, whatever is going on the construction project. So, a project must comply on the safety standards and safety measures to take care of all of the workers, all of the workforce who are employed on the site and there must be adequate arrangements to not to have any accidents or any casualties on any project.

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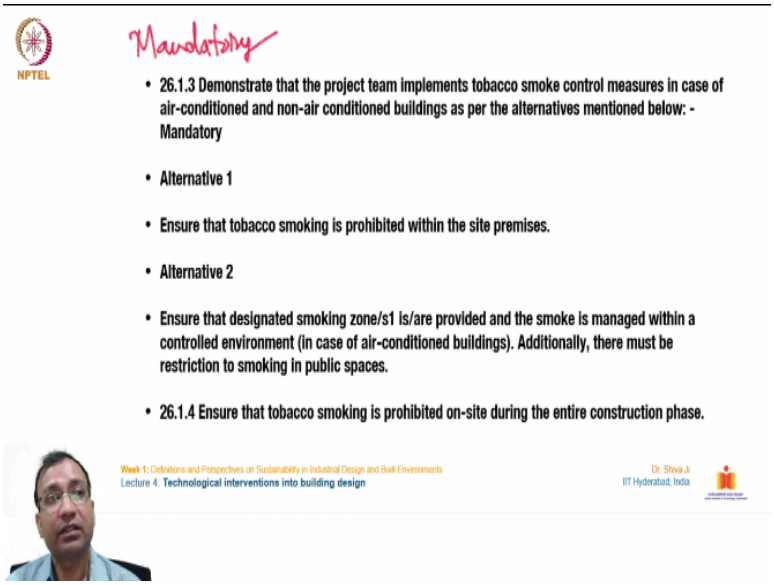

Next to this, the mandatory points to demonstrate that the project team implements tobacco smoke control measures in case of air condition and non-air-conditioned buildings as per the alternatives mentioned below. These are the mandatory measures alternative one, ensure that tobacco smoking is completely prohibited within site premises, alternative two, ensure that designated smoking zones or areas are provided and the smoke is managed within the control environment in case of air-conditioned buildings. Additionally, there must be restriction to smoking in public spaces.

Well, smoking in public places is already banned by the Government of India and now it is a public law that one cannot smoke in the public spaces. So construction site being a public space where there are n number of people working together. So this is smoking cannot be allowed in any form on the construction site. So this must be taken care of. Additionally, if there is any air-conditioned space where there is demarcated area, then a demarcated area can be constructed for smokers, clearly marked where the exhaust system can work more efficiently to take out the exhaust out the fumes of that smoke separately without disturbing the activity other people on the location.

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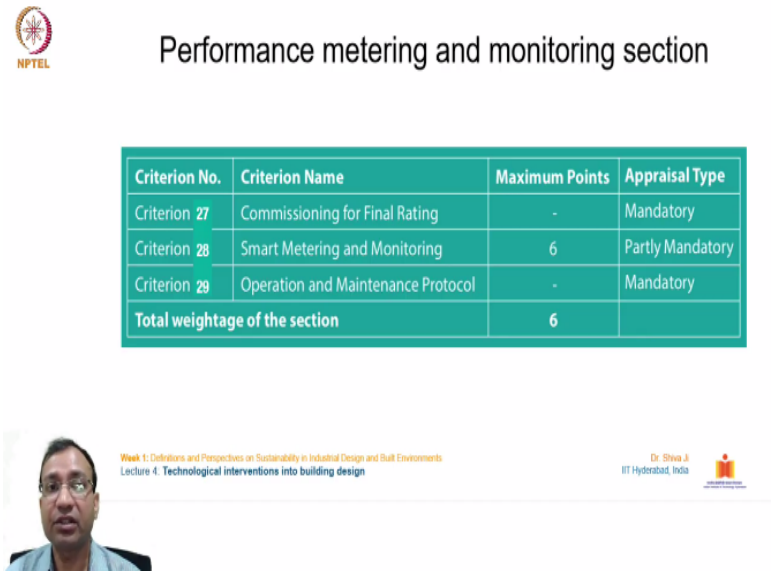

Further to this, we have next section of a performance metering and monitoring section. So, this section is dedicated mainly for the evaluation and the performance monitoring of the building how the building fairing over the time, how much of consumption it is doing for the other resources and energy particularly. So, this section takes care of such responsibility. So, it has three dedicated points of commissioning for final rating, smart metering and monitoring and operation and maintenance protocol.

So, the first and the third criteria are not given any point, but the middle point has like the six points. So, this talks about smart metering and monitoring, so that the constant monitoring and resource consumption can be taken care of, so in case of any fluctuation if it is the consumption is going very high. So, the leakage or that tentative area can be addressed and rectified on given time.

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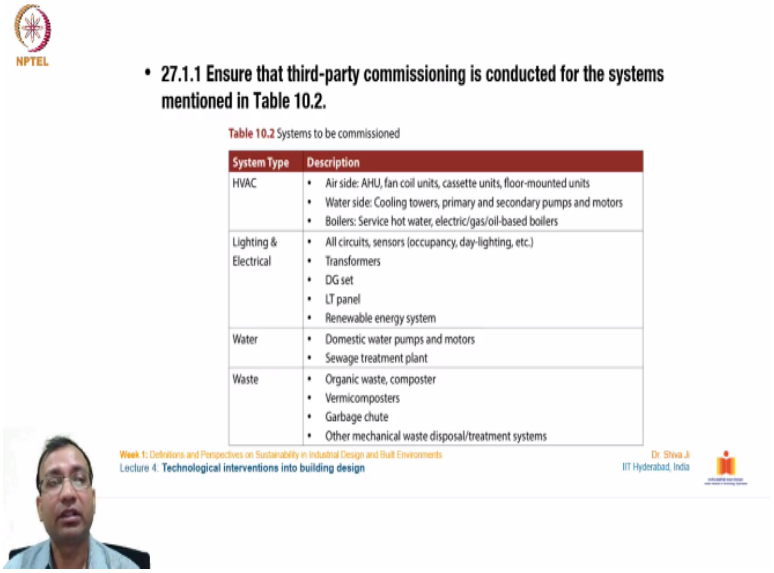

Here if you see this table talks about the points of ensuring that the third-party commissioning is conducted for the systems mentioned in that table. So, the system types for example, other very important building services such as like HVAC, lighting and electrical, water and waste, so the descriptions if you see on the commissioning part air side, AHU, fan coil unit, cassettes units and floor mounted units and the waterside a cooling towers, chillers, primary and secondary pumps and motors, boiler service hot water, electric gas or oil-based boilers.

For the electrical and lighting sites all circuits sensors occupancy or day lighting evaluations also transformers DG set, LT panel, renewable energy systems for the water system, the domestic water pumps and motors sewage treatment plants for the waste, organic waste, composters, vermicompost, garbage chutes and other mechanical waste disposal and treatment systems should be placed. So, these are systems which must be monitored and should be evaluated regularly for the overall upkeep, safe upkeep of the site.

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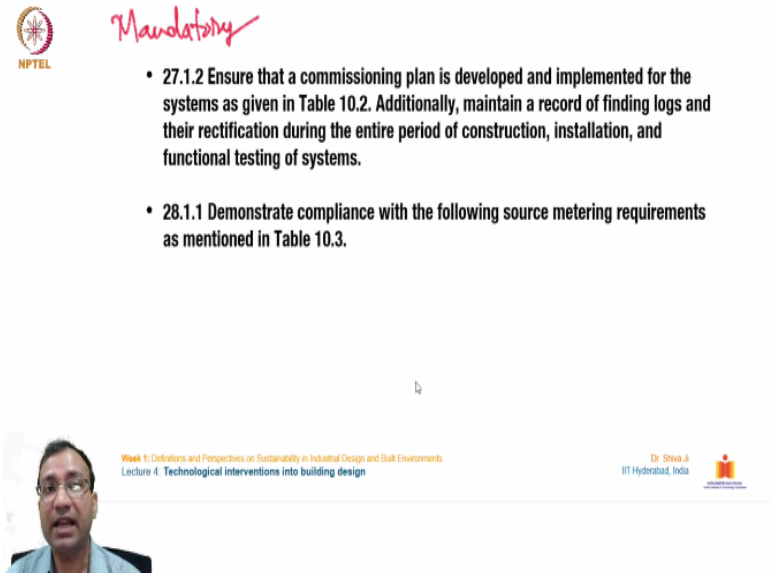

The mandatory points over here ensure that a commissioning plan is developed and implemented for the system as given in the table. Additionally, maintain a record of finding logs and the risk rectifications during the entire period of construction, installation and functional testing of systems, further demonstrate compliance with the following source metering requirements as mentioned in the table.

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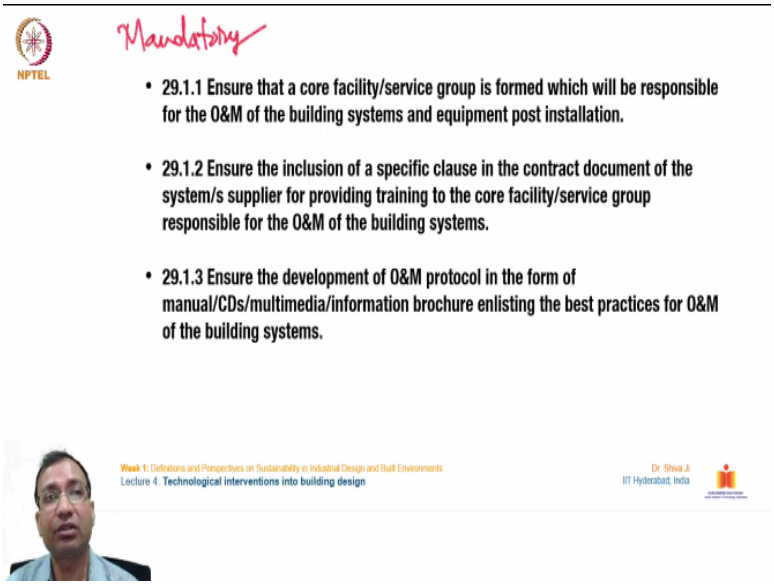

Further to this, there are some more mandatory points ensure that a core facility or service group is formed within which will be responsible for operations and management of the building systems and equipment post installation. So, there must be team on site present all the time to check and measure these systems, ensure the inclusion of a specific clause in the contract document of the systems supplied for providing training to the core facility of service group, responsible for the operation and maintenance of the building system.

So, the supplier or the manufacturer of that particular equipment for example, like HVAC must give training to the team with the maintenance team which is present on the site for the better upkeep of the equipment. Further to this ensure the development of operational management protocol in the form of manual series, multimedia information brokers, enlisting the best practices for O and M of the building systems. So, the information dissipation is also important, this kind of knowledge resources should be prepared for dissemination and easy referencing for the team deputed on the site.

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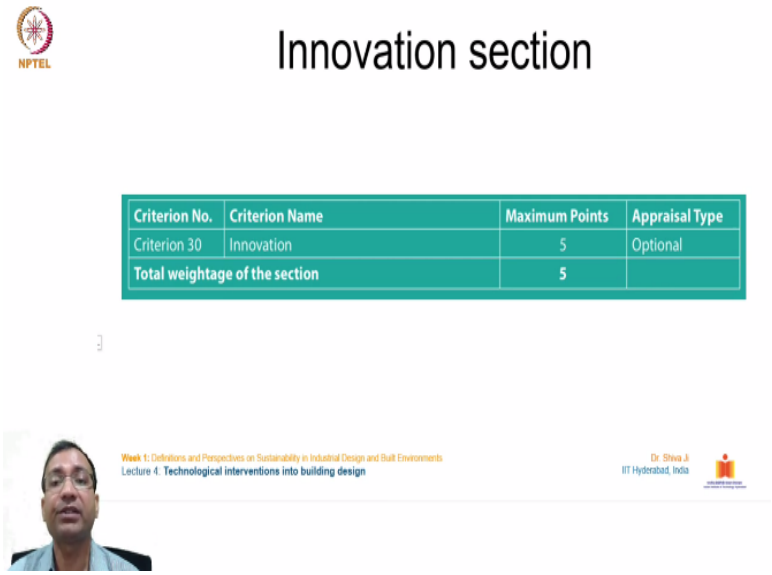

Finally, we have this innovation section. So this innovation section has received five criteria points, so five criteria points means it is an important criteria set over here with innovation can happen into any segment, any lifecycle stage or any process or techniques or technology or the material or the approach.

So innovation is a barrier free that is why there is no particularly final criteria or final consideration given for this to the criteria set over here, rather it is open for experimentation from the designer, from the architect, engineers, manufacturers from the construction management team, or even the owner or the leader of that particular place, a project, or even the occupants, so anybody, any stakeholder of a project can go for adopting innovative measures, and that is why this criteria is given to promote idea of information to be implemented on the construction site of the construction projects on the site.

That is why it is important for us to pay some attention to the innovative ideas creative ideas, which can be applied on design project, so sustainability being the major concern in the recent times, it has become very critical, very important to be addressed. So, in what ways we can deal with the overall objective of such rating systems, with the innovative ideas, innovative our technology, adaptations of the materials, or maybe using

some alternative methods or alternative mechanisms to come up with some energy saving or material saving ways.

So this criteria is dedicated for serving all of those innovative ideas and approaches which are adopted or particular site. So we must give some attention to this as well. So with this we have come to the end of all the sections, so we have discussed and learned how these criteria which are given in this rating systems are very important, and some of the criteria which are falling under the mandatory category, even though they do not carry any points, but they are mandatory in the nature if project feels to satisfy those criteria, which are mandatory that project cannot actually proceed with the GRIHA certification.

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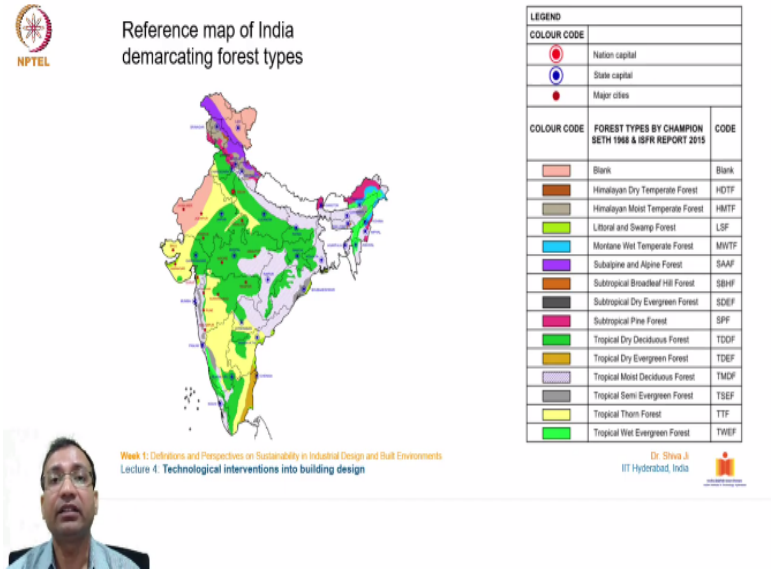

In addition to this GRIHA has considered and has laid these maps which I would like to share with you over here. So this maps talks about demarcating forest types which are prevalent across the length and breadth of our country India. So you can see starting from the Jammu Kashmir, this Baltistan regions from the Ladakh region, directly from Kerala and Tamil Nadu region and ranging from the Kachh of Gujarat till Arunachal Pradesh till the corner of this Mizoram and Tripura, Manipur Nagaland and Sikkim, so we can see over here, the types of the forest types which are given over here with the color code the legend is given over here.

So it has like Himalayan Dry temperate forest, we have like a Himalayan moist temperate forest, littorals swamp forest, we have like a montane wet temperate forest, we have subalpine and Alpine forest, we have subtropical broadleaf hill forest, we have subtropical dry evergreen forest, we have subtropical pine forest, we have tropical dry deciduous forests, we have tropical dry evergreen forest, we have tropical moist deciduous forests, we have tropical semi evergreen forest, we have tropical thorn forest, we have tropical evergreen forest.

So, these are the number of varieties in the forest which gives an idea of the biodiversity in the fluoride, the vegetation, in the trees, in the forest, what kind of diversity with India actually has.

So why is it important over here is to discuss this green rating lecture over here, because whenever we are designing a project, whenever we are conceptualizing a project, when we are when we are detailing a project we must take care of the local condition, the local soil, the local geography, the local climatology, the local topography, the local demographics, the local vegetation, the flora and fauna and the biodiversity of that place because the design must be routed to that particular place, and we must undertake such studies before starting the project, to understand what kind of biodiversity, what kind of the forest system, what kind of other like life forms living species are existing in those areas.

Because in one of the lectures we discuss a strong push is given to the Northeastern, like the states of Arunachal, this is like Nagaland, then we have Manipur, we have Assam, Meghalaya, Tripura and Mizoram and the Sikkim, so along with this we have like eight states are falling in region, so these regions are one of the most biodiverse region, one of the hotspots of half the biodiversity recognized by the United Nations, recognized by the several other agencies from across the world. So while undertaking such growth and development works, we must pay attention to what kind of vegetation, what kind of forest are there in those particular.

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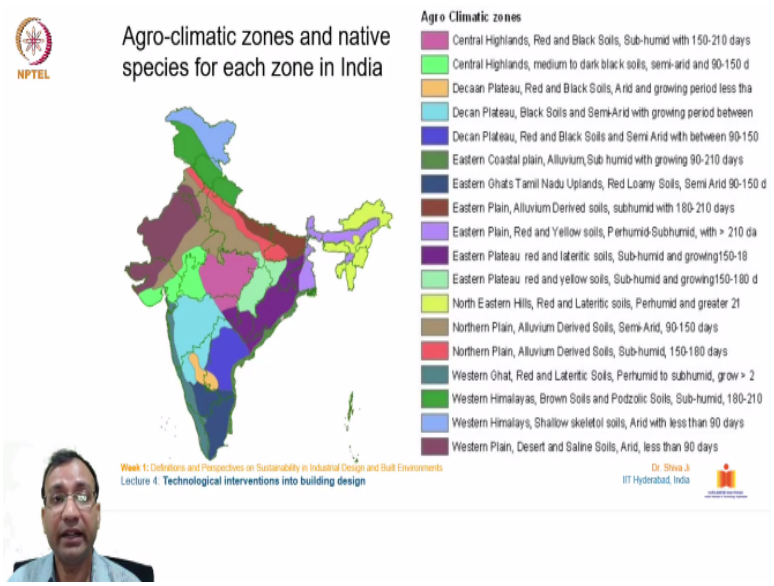

Moving on to the next slide. Here we have like a agro climatic zones and native species of fall each zone of the India, so you can see over here the different varieties what sorts of agro climatic zones are there, so this list is also given over here, for example, we can see the location of Delhi, so this falls under northern plane alluvial derived soils, semi arid between 90 to 150 days a year. And for example, if you see, currently if you see the city of Hyderabad, so this is lying under Deccan Plateau, red and black soil and semi arid with between 90 to 150 days per year.

So this is the kind of diversity which India has, so we must conform our designs, we must route our designs to these local situations and that is why I kept these maps also here in this discussion in this lecture for our understanding.

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Further, so with this we are coming to the end of this lecture. So, you can always go to the GRIHA website, they have kept all of your rating manuals and other supporting documents for download for referencing free of the cost. So you can see what kind of additions, they have in the GRIHA, the kind of literature, the kind of reading material they provide along with these rating specification tools.

So, apart from the basic GRIHA they have several other types of GRIHA. There is this SWAGRIHA, so SWAGRIHA is made for the smaller projects for example, a smaller residential house, so an owner can himself or herself do some evaluation, they do not actually require, they do not need GRIHA certified assessors and assessment team. So that is a very simple and comprehensive approach it has, so one can actually assess a smaller project on their own.

So this is to promote self awareness or kind of self initiative which we as an individual can take without taking technical help, if our project is not big enough, so how still we can manage because why this is important, because if we count the number of projects from across India. So, the institutional or industry or any like especially like recreational or like a hospitality or like hospitals. So these number of buildings are still far lesser if we compared to the residential buildings what we have, so almost like every household, if

even if they own, like a one single house, so just imagine the number of houses, what we have in like our country.

So beginning from independent a site based houses to the flats, to the row houses, to the houses on the remote locations or houses of vernacular types, so all sorts of houses, so how in this latest times of the concrete and brick and steel and glass construction systems, how we can take care of minimizing the impact. So that is purpose of SWAGRIHA, it helps us very nicely, very efficiently so I think you must refer this literature on your own for your better understanding.

Further there is GRIHA large development format. So this important for the bigger infrastructure projects for example, I would like to mention the name of IIT Gandhi Nagar over here, so IIT Gandhi Nagar is one of the recently GRIHA five star rated project, which is brought attracted a (())(53:26) from all quarters, and it has become a kind of role model building, design scheme building planning scheme, which can utilize a form like a public sector at any given place.

So IIT Gandhi Nagar the design of the Gandhi Nagar campus has taking care of a very nice (())(53:47), whether it is a selection on the construction material, whether it is selection on the construction techniques. For example, the incumbent director of IIT Gandhi Nagar Professor Sudhir Jain he himself is civil engineer, and he has put up a lot of effort and a lot of attention, he has a paid personal attention to this project to execute this project.

So starting from the concentration to the design to the detailing and in the execution, he has been always involved, even like they have the team of the designers, team of the architects they have followed the local neighborhood concept of the older city of the Ahmadabad were in the vicinity this campus is located, so they have followed the concept of this (())(54:33) these are local names of the residential neighborhoods and commercial markets.

So this is how they have designed this IIT Gandhi Nagar using traditional value system also. This actually place falls under a very hot and arid regions so they have designed

several shading mechanisms in the campus, they have utilized the local materials, they have used, these are confined machinery technique to minimize the uses of the material. Plus, increase the strength in the structure, and there are several means and things they have adopted in this project we will talk about this design and planning of IIT Gandhi Nagar in one of the upcoming lectures, after this lecture, we will discuss more about this project in detail.

So with this we have come to the end of this lecture, I wish you all the best, and you can go and refer this website and you should download some of this literature, and you should actually read it in your leisure time for your understanding. So this will help you in visualizing how a rating activity takes place in any project, and should be beneficial for increasing your capacity. So, thank you all.