System Design for Sustainability
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Week - 10
Lecture - 2
Other Design for Sustainability Tools and Approaches – Architecture

Hello everyone, today we will discuss about certain sustainability tools and approaches from the field of architecture. The aim of this lecture is to introduce you to these tools. We are not going to go into details of these tools because it is a completely different all together huge topic to deal with, but when we discuss all these tools it is gives you an idea, say you want to design something in that particular field what all can be your starting points.

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So we will discuss about LEED, GRIHA, IGBC Rating and Sustainable Building -Proposed Principles.

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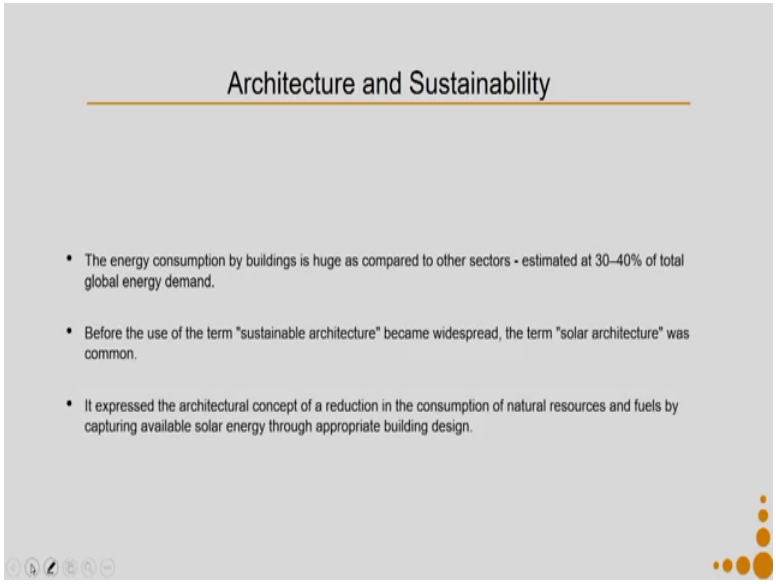

So, architecture and sustainability, why did we take up this particular topic of sustainability in the domain of architecture? So, the energy consumptions by buildings is huge as compared to other sectors. It has been estimated that on an average and a global scale 30 to 40 percent of the total global energy demand comes from the building itself. It is required for lighting, for heating, for cooling and so on. Hence the foot print of architecture is pretty large in the domain of sustainability.

Before the use of the term sustainable architecture became wide spread, the term solar architecture was a commonly used terminology. It express the architectural concept of a reduction in the consumption of natural resources and fuels by capturing available solar energy through appropriate building design.

Say for example, if the building was supposed to be coming up in a region which is a cold place, the building design would incorporate features into it so that a part of the solar energy falling onto the building surfaces can be trapped in the building to bring in heating. Or say for example, during day time designing the building in the manner that we do not need to use artificial lighting or if the building is coming up in a hot and dry climate, how do I design the ventilation in the building in order to ensure greater thermal comfort inside the building without much use of fan or air conditioner which requires external energy sources and so, on.

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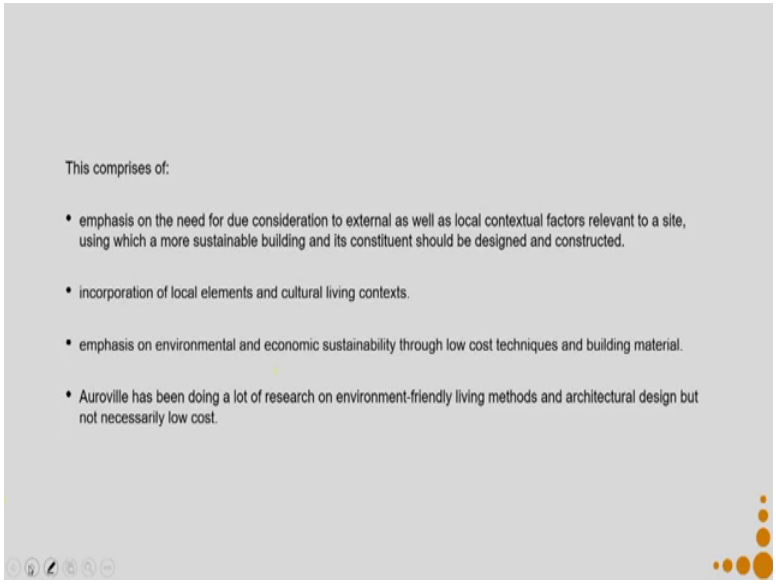

So currently architecture and sustainability how we understand it? This comprises of emphasis on the need for due consideration to external as well as local contextual factors relevant to a site, for the context of a building each and every building might be very different, because the impact of local contextual factors. Even in a building which is to be build up in the same regions in geographical region, the orientation of the building might vary, the height of the building might vary, as the result of which the contextual factors like wind direction the sun direction to which the building is expose to we will keep on changing.

Hence, there is an emphasis on the need for due consideration to external as well as local contextual factors relevant to a particular site on which the building is supposed to come. External factors might involve say the presence of other buildings or say the presence of certain surrounding features like lakes or a airport and so on, using which a more sustainable building and it is constituent should be designed and constructed.

Incorporation of local elements and cultural living context, why they are important because as we saw in the definition of sustainability, the social dimension is the very important part of sustainability and buildings because they are supposed to house people, people live in buildings, people work in buildings and hence it is very important to bring in local elements, cultural living context. Say for example, in certain areas where the

house doubles up as the space which is also living space as well as the space which from where people conduct their livelihood generation activities.

Now say this is a particular community in which the house doubles up as a living place as well as a place from which livelihood generation happens. In that particular context if you build a house which removes a livelihood generation capacity from the house. Say for example, a craft sector house the craftsman mostly they work from their home, now you build them a house which is a bare minimum house this of course, happens through many aid related housing scheme which are present in the current scenario, where a house is given to such people because they live below the poverty line, where in the house consists of one room with a kitchen space and may be or may not be a bearing space inside the house.

Now because this house does not have any space for the craftsman to do their activity this cannot fit into their way of living, also say this craftsman they are used to cooking using firewood, they do not have the capacity neither does the area have access to say LPG connection.

So again cooking inside the house is not possible because when you burn firewood there is lot of smoke generated. So, now, presence of the kitchen inside the house it is present, but it does not come to any use, also in many context people do not prefer to have the washing room or the bathing room inside their house because it is considered inappropriate. They even if they have such kind of a space they would prefer to have that space outside their house just beside their house may be.

So, if you provide them with a such kind a space they will not end up using that space that space many a times when such spaces have been provided inside the house they tend to use that space as a storage room and so on and they do not use it as a washing or a bathing room or a toilet. So, we need to incorporate local elements and cultural living context in the housing system as well.

Emphasis on environmental and economic sustainability through low lost techniques and building materials it is always important that we should have a environmental and economical sustainability involved into it, but there are many times when not necessarily these also employ that we bring in low cost techniques and building material, but if we can bring in way much better.

So, say for example, Auroville has been doing a lot of research in environment friendly living methods an architectural design, but not necessarily all of them are low cost. So, you can look up Auroville on the internet and you can try to find out all their different kinds of research and experimentation around environmental friendly living methods, some of them are low cost, some of the are not necessarily low cost.

Now coming to how do we do building assessment like we saw in the context of our products and services we need to have assessment methods, we need to have design methods. So, in the context of buildings there are couple of methods available.

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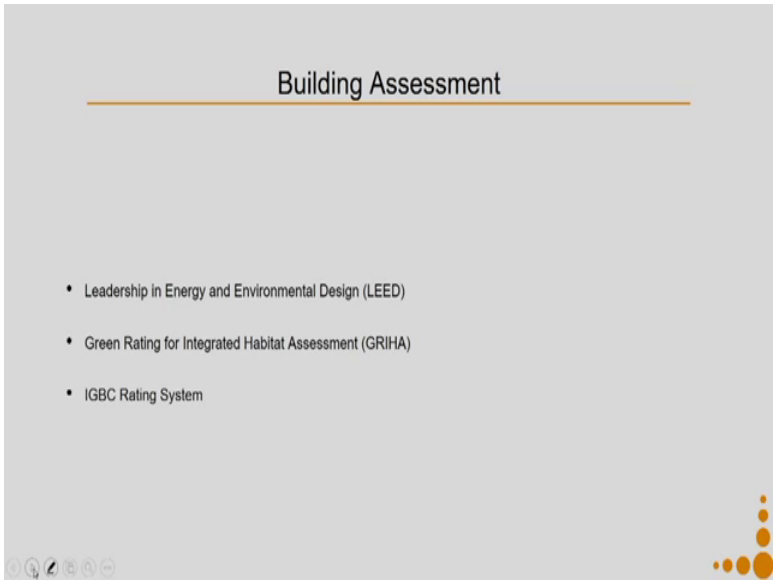

So, the first one it is called as Leadership in Energy and Environmental Design abbreviated as LEED. The second that we will discuss in this lecture is called Green Rating for Integrated Habitat Assessment GRIHA this is. So, the first rating system is originated from us and then it has been adopted to suit the look local context in many different countries. So, it has been also lead as also been adopted to suit to the Indian context.

Whereas the second one the GRIHA it has been developed specially for the Indian context. Then is the IGBC rating system is which is another rating system which has been specifically designed for the Indian context.

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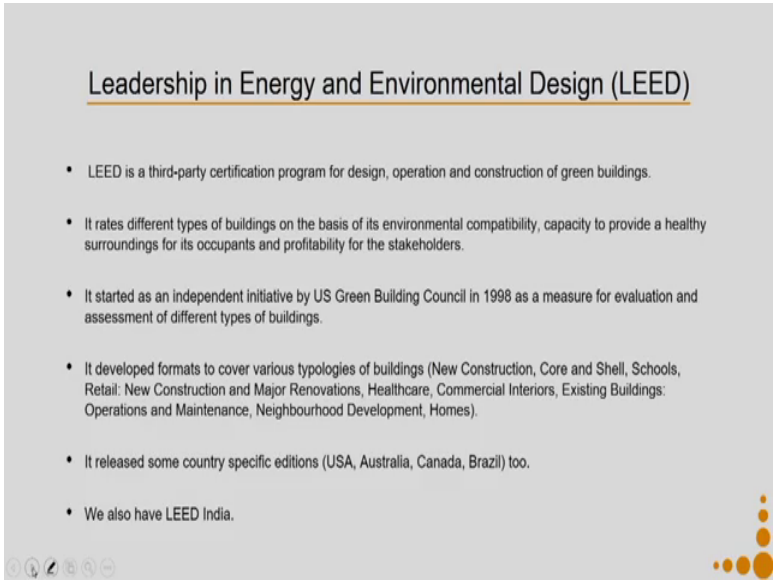

So let us see what leadership in energy in an environmental design LEED tells us. So, LEED is a third party certification program for design, operation and construction of green buildings so, all the 3 that we spoke about, LEED, GRIHA and IGBC rating system they are all third party certification programs.

So, there are the organizations or there are LEED certified or GRIHA certified professionals who are more who can give certification to various buildings, various building typologies and give them different ratings on the LEED parameter or GRIHA parameter or IGBC parameter. There are many other parameters so many countries have their own parameters say for example, UK has a rating system that is called as (Refer Time: 10:03). So different countries do like we have GRIHA and IGBC rating, similarly many different countries also have their own customized rating systems.

So, LEED it rates different types of buildings on the basis of it is environmental compatibility capacity to provide a healthy surroundings for it is occupants and profitability for the stake holders.

It started as an independent initiative by us green building council in 1998 as a measure for evaluation and assessment for different types of building, depending on what type of building it is the criteria the evaluation criteria varies. Say for example, if it is a individual home, if it is a commercial complex, if it is a new construction which is coming up or if it is a renovation and so on.

It is it developed formats to cover various typologies of buildings like new constructions, core and shell, schools, retail, new construction and major renovations, health care, commercial interiors, existing buildings, operations and maintenance, neighborhood development homes.

Why different formats are required for different typologies of building, because you cannot compare a home versus a school. The number of people using a home is very different from the number of people using a school the scale of a home is very different than that of a school. So, different rating measures are required for each of these typologies, there after it came up for the context of US County specific additions were released. So, we have USA, Australia, Canada, Brazil and we also have LEED India.

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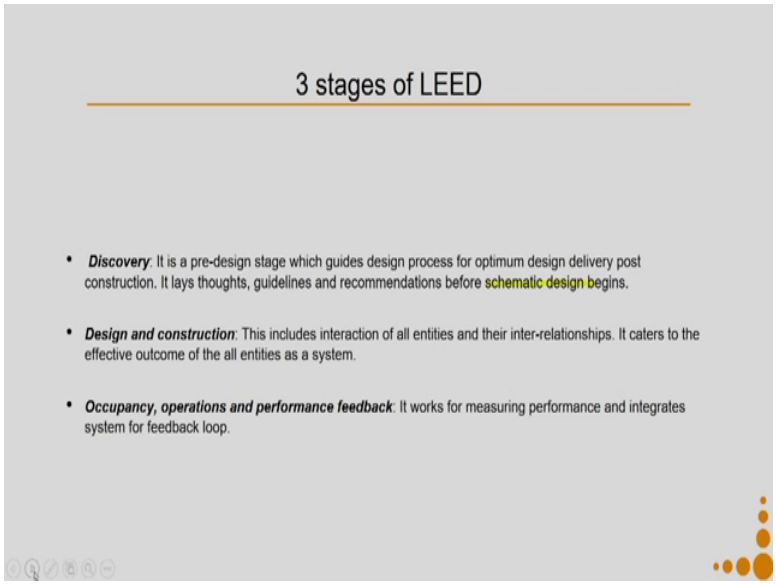

So, there are 3 stages of LEED. So, the first stage is called the Discovery, it is a predesigned stage which guides design process for optimum design delivery post construction. It lays thoughts, guidelines and recommendations before schematic design begins. So, before somebody can start with the design process the discovery guidelines they help you to lay your thoughts, guidelines and recommendations and then on the basis of that you come up with schematic design for the building.

Then next phase is called the design and construction, this includes interaction of all entities and their interrelationships. It caters to the effective outcome of all the entities as a system during the design and the construction face.

Then comes the third stage, which is the occupancy operation and performance feedback. So, once the building has been occupied the building will be designed with certain parameters not necessarily the occupants will use the building to the most optimal extent. So, it is also very essential that we do measurements at the occupation after the occupancy has happened. So, occupancy operations and performance feedback, it works for measuring performance and integrate system for feedback loop.

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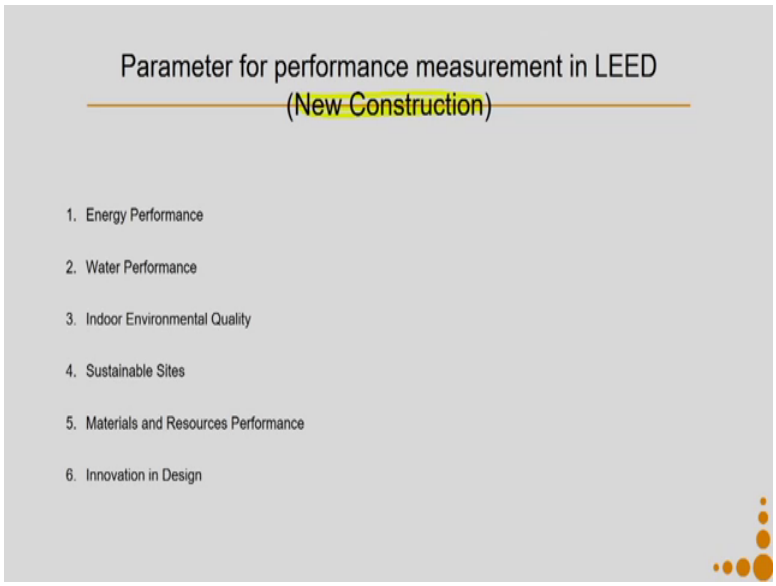

So, say for example, I take the context of new construction. So, for the context of new construction the parameter of performance measurement in LEED are first parameter is the energy performance, there are many sub parameters within them as well. The main parameters are energy performance then water related performance, indoor environmental quality, sustainable sites. So, the site at which the building is build sustainability of that particular site.

Materials and resources performance; so, all the materials which are used in the building and all the resources which the building consumes it is performance on those parameters. And then there is always a criteria which is called as innovation in design. So, this allows this gives the architect or the builders the freedom to innovate and get points on these innovations. This also allows that certain sites allow you to bring in certain features where as other sites do not allow certain features. So, in this parameter innovation in design particular builder or a designer or an architect can exploit the possibilities

afforded by a particular site and bring in innovation in design which helps to improve the performance of the building in terms of sustainability.

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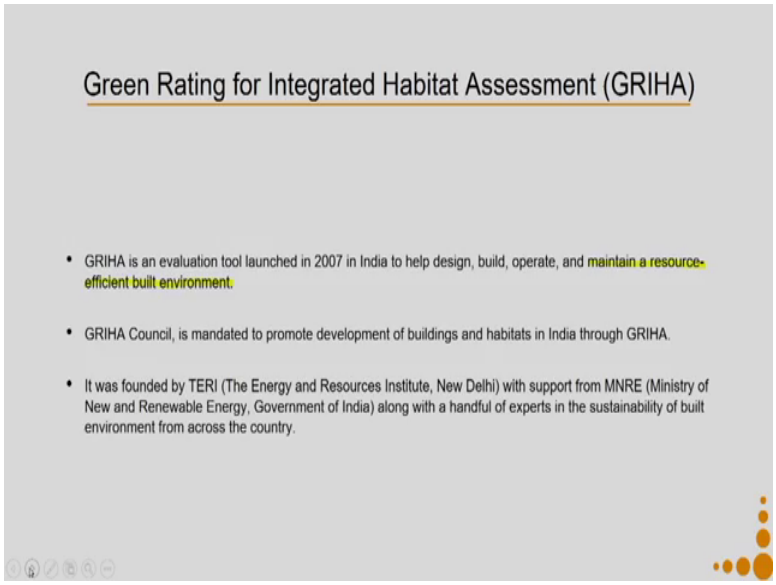

Now let us come to the green rating for integrating habitat assessment GRIHA. So, GRIHA is an evaluation tool launched in 2007 in India to help design, build, operate and maintain a resource efficient built environment. As you can see from this definition it talks about resource efficient built environment. So, we will in towards the end of this particular lecture we will show you comparison between LEED and GRIHA. So, LEED because of it is definition which said it rates different types of building on the basis of it is environmental compatibility, capacity to provide a healthy surroundings for it is occupants and profitability for the stake holders.

So you can see the scope of LEED is very wide as a result LEED has parameters which have economic environmental as well as social aspects built into it. Whereas if you see the definition of GRIHA it talks about maintain a resource efficient built environment. Hence the number of parameters which focus on the environmental and the economic aspects are way much higher than the parameters which focus on the socio cultural aspect. So, we will discuss more when we compare LEED and GRIHA in the later part of the lecture.

So, the GRIHA council is mandated to promote development of buildings and habitat in India through GRIHA. The GRIHA council was founded by TERI, TERI stands for The

Energy and Resource Institute it is in New Delhi with the support from MNRE ministry of new and renewable energy government of India along with a handful experts in the sustainability of built environment from across the country.

So, they together form the GRIHA council and they came up with this rating system, all the rating system that we are discussing today they are continuously evolving. So, if you go to the GRIHA 2015 version that will be way much more advanced version than say the previous versions of GRIHA. So, is the case with LEED and IGBC guidelines again GRIHA also has 3 stages.

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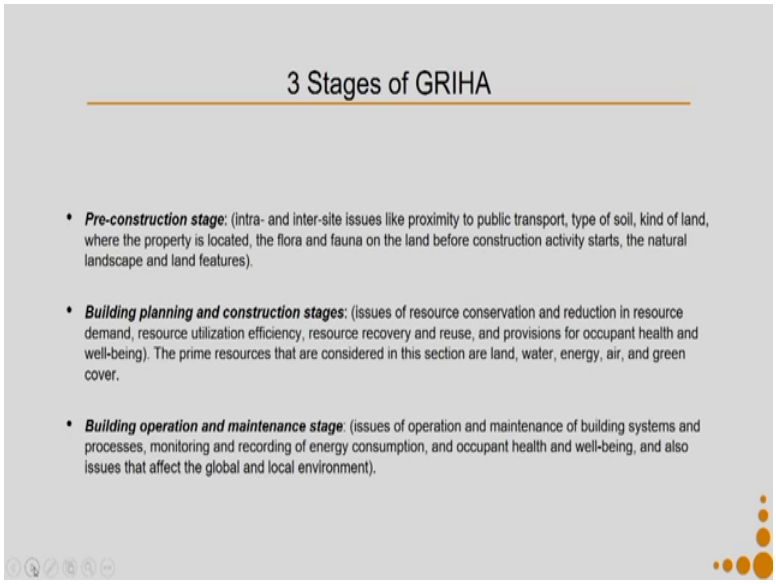

So, the first stage is called as the pre construction stage, where intra and inter site issues like proximity to public transport type of soil, kind of land, where the property is located the flora and fauna on the land before construction activities starts, the natural landscape and land features are considered.

Then there is building planning and construction stage, where issues of resource conservation and reduction in resource demand, resource utilization efficiency, resource recovery and reuse and provisions for occupant health and well being is considered. The prime resources that are considered in this section are land, water, energy, air and green cover.

Then comes building operation and maintenance stage so, you can see if the stage are almost similar to that of LEED just the name of the stages have been coined differently. In building operation and maintenance stage issues of operation and maintenance of building systems and processes, monitoring and recording of energy consumption and occupant health and well being and also issues that affect the local and global environment are considered.

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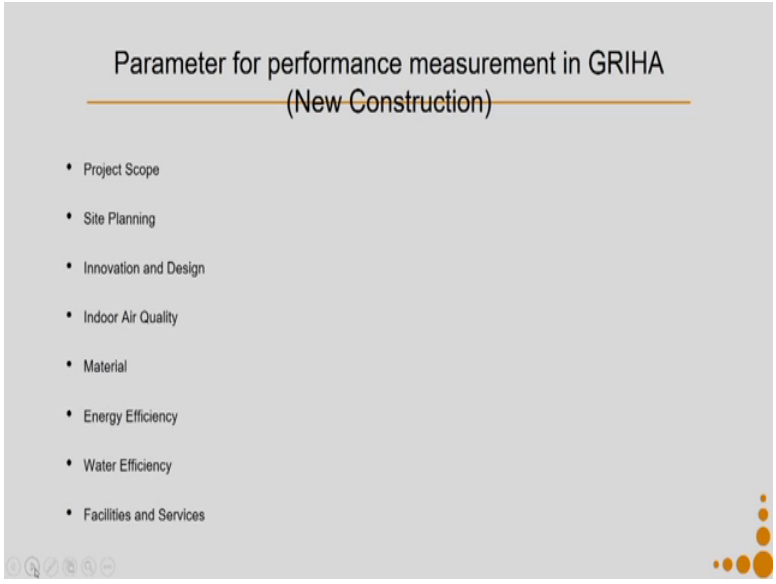

Now, coming to parameters for performance measurement in GRIHA so, again we took an example of new construction like for LEED we took the example of new construction we take the same for GRIHA. Why we are comparing both on the same, because we cannot compare showroom versus a new construction in both the rating systems and the performance parameters are very different on each of those building typologies. So, the parameters for performance measurement in GRIHA they start from project scope, site planning, innovation and design, indoor air quality, material, energy efficiency, water efficiency, facilities and services.

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Say for example, if we go to the GRIHA website. So, this is the GRIHA website for us these are the different categories of different building typologies on which you can do an evaluation. Say for example, I can do an evaluation on GRIHA Precertification there is a SVA GRIHA which is for your own house, there is a GRIHA rating there is GRIHA for large developments, GRIHA for existing buildings, GRIHA for affordable housing and self- evaluation checklist.

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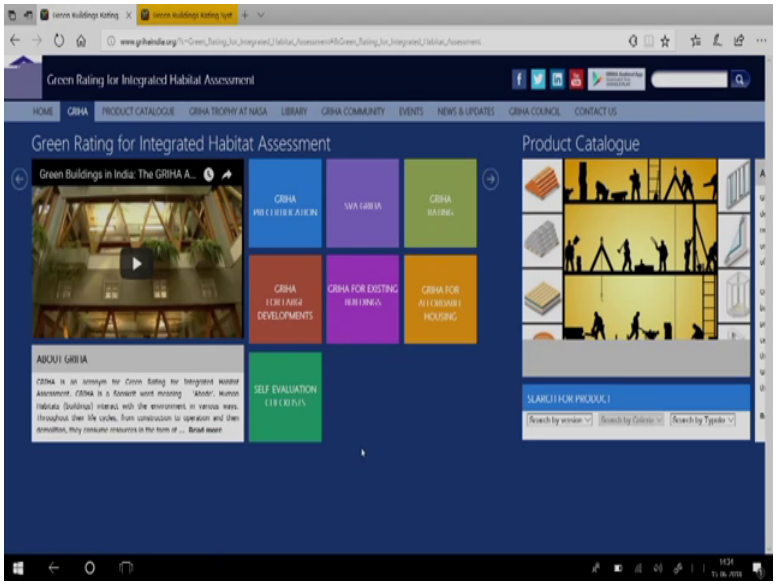

So, this is our website. So, you can see the GRIHA website it has all this different areas on which I can go and understand more about each of this.

Let us say here you can see our link which calls as product catalog, see you can check onto each of these a links and they give you good tools which can be used for your self evaluation. Say for example, I will show you the GRIHA self evaluation tool kit which I downloaded from that particular website.

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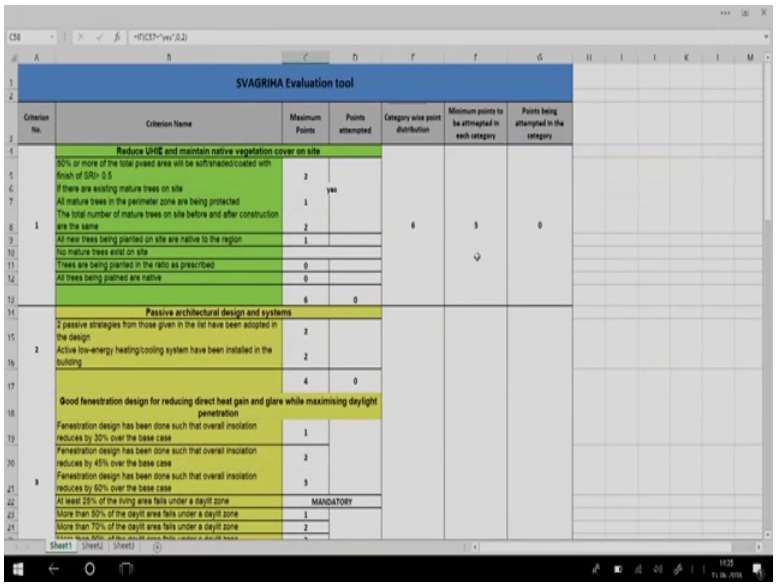

So, this tool kit is nothing, but an excel sheet if you remember our ICS tool kit, which was an excel base tool kit which we could use for designing a product which has better environmental performance. So, this is similar kind of a tool kit which has been programmed.

So you can give certain point ratings. So, there are certain criteria names so, like my criteria name is Reduce UHIE and maintain native vegetation cover on site. So, my first sub criteria over there is 50 percent or more of the total paved area will be soft shaded or coated with finish of SRI which is greater than 0.5. So, if this is available so, the maximum point that one can get over here is to. So, say I attempted for 2 points. So, I can put 2 say I could not go for 50 percent I could only go for 25 percent, then I would say I attempted for only 1 point over here.

So we will go through the whole evaluation process and once my whole evaluation because this is a self evaluation process which I can use while I am in the design phase or in the planning phase itself, then I know that how good my design can come out of it and then I can go for rating. The self evaluation does not give you the right to say that my building is complained to GRIHA certification. You have to go for a certification only when you get a GRIHA certification then you can claim for the same the self evaluation only helps you to evaluate your plan or design.

Another important aspect in the GRIHA website is the GRIHA product catalog.

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How can we use this particular catalog? So, here you can see this is the catalog, when I click on the product catalog I will get a list of all kinds of products which can be used in a green building. So, say for example, here I can.

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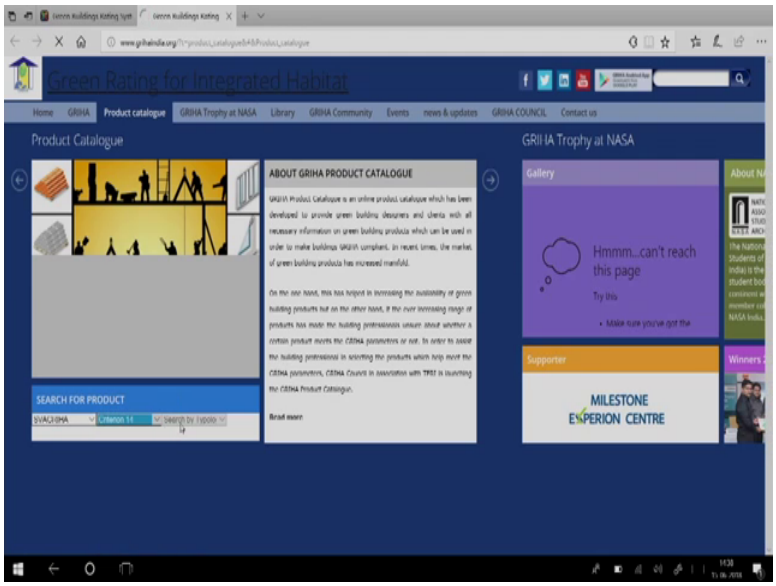

So, in this product catalog that you can see you can search by version. So, say I am looking for SVA GRIHA. So, for my own house I am looking for it. So, I will select SVA GRIHA then I will select a particular criteria. These criteria are linked to the excel sheet in a criteria that I showed you, let us select any criteria let us select criteria 14. So, let us so, we will have to wait for some time for this page to load.

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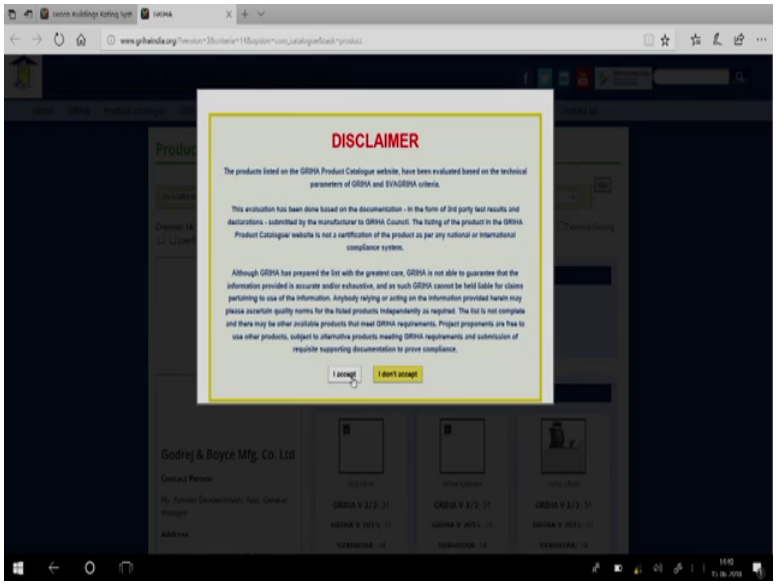

So, when the page has loaded you will get a disclaimer and you can the disclaimer says that the product listed on the GRIHA product catalog website has been evaluated based

on the technical parameters of GRIHA and SVA GRIHA criteria and so on and you can say that you accept that.

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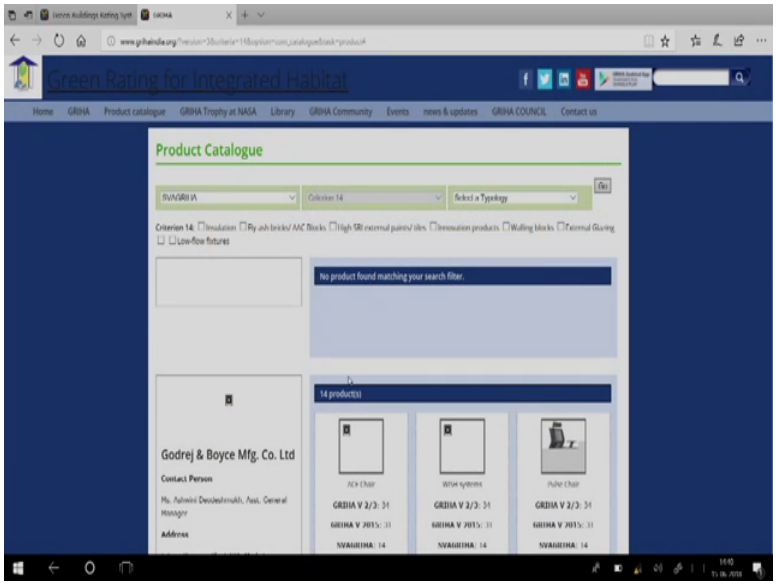

Then you have all this list of products. Here you can also select what in criteria 14 you have insulation, fly ash breaks, you have high SRI external paints or tiles these are all these components which you can use in your building in your own home. So, that you can satisfy the requirements of SVA GRIHA you can also change the criteria over here and you can select a particular typologies.

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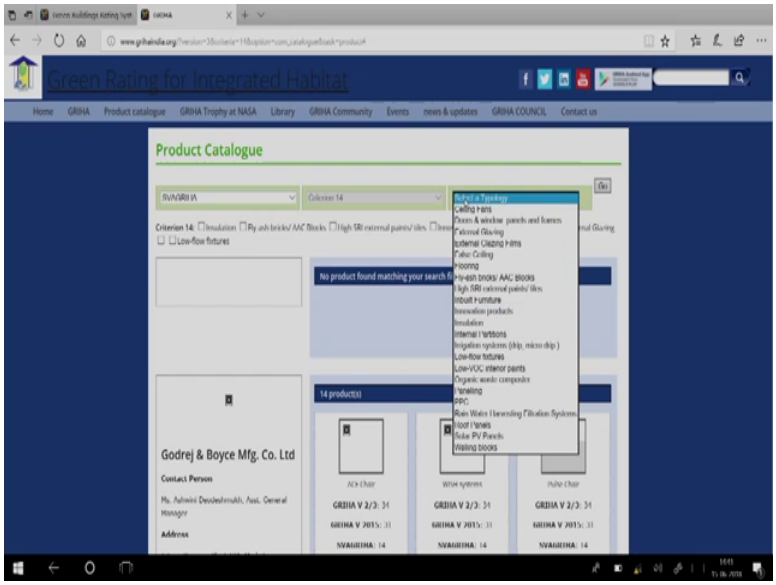

So there are many so, there are SVA GRIHA certified SVA GRIHA or GRIHA certified, ceiling fans available and when you select one of them you get the products.

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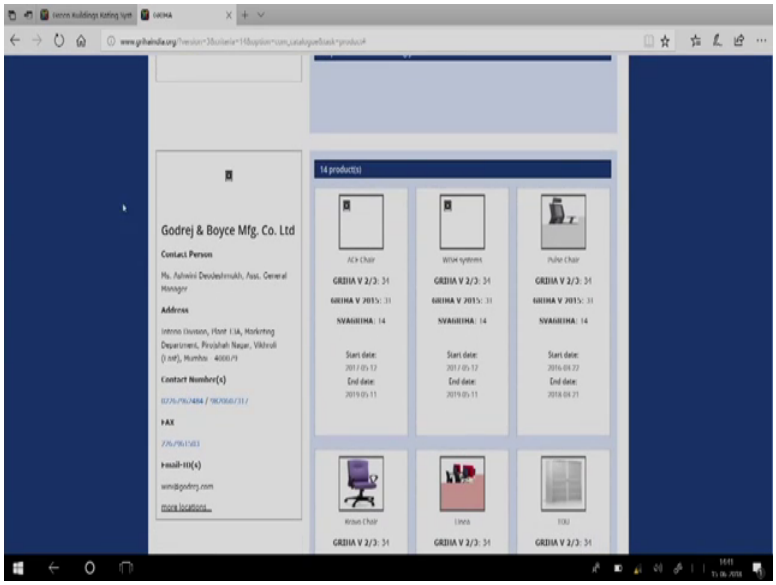

So, say for example, this one is a chair, this one is wish system, this is a pulse chair, and so on, they all can be used and they have been certified.

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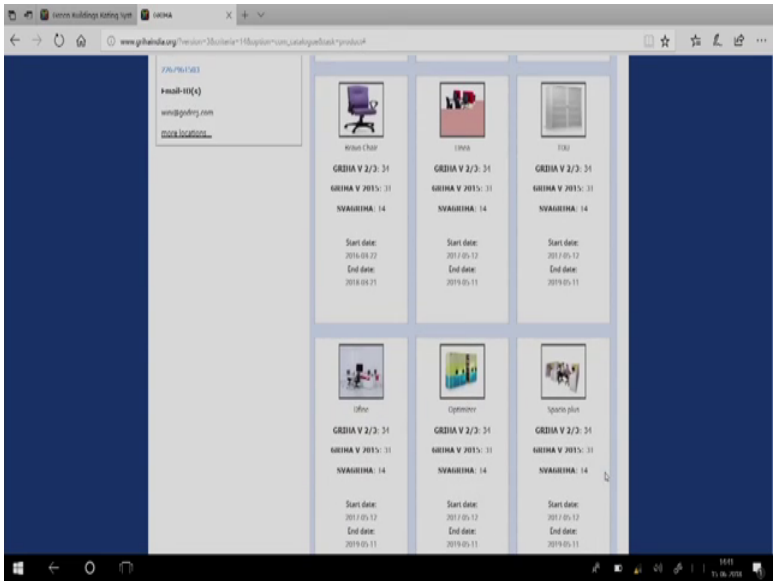

So, you can see what rating they have got under the different certifications systems.

And you all also have the contact person from whom or the email ids from whom you can purchase those products.

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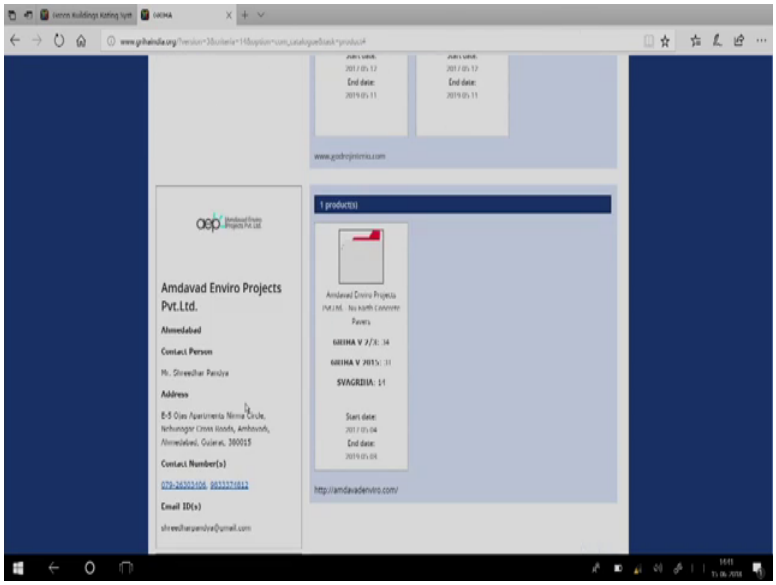

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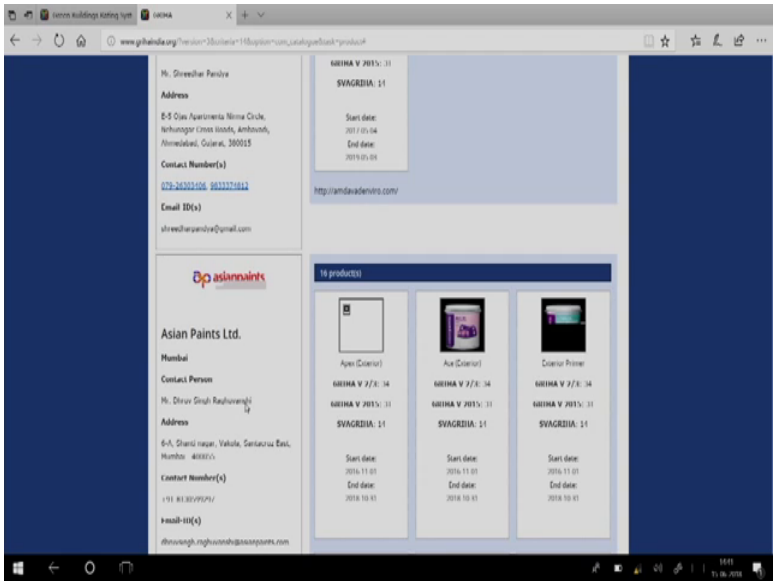

So, you can see there are lots of products into it they are in the category of furniture's, paints and a lot of similar products which are required to furnish a complete house.

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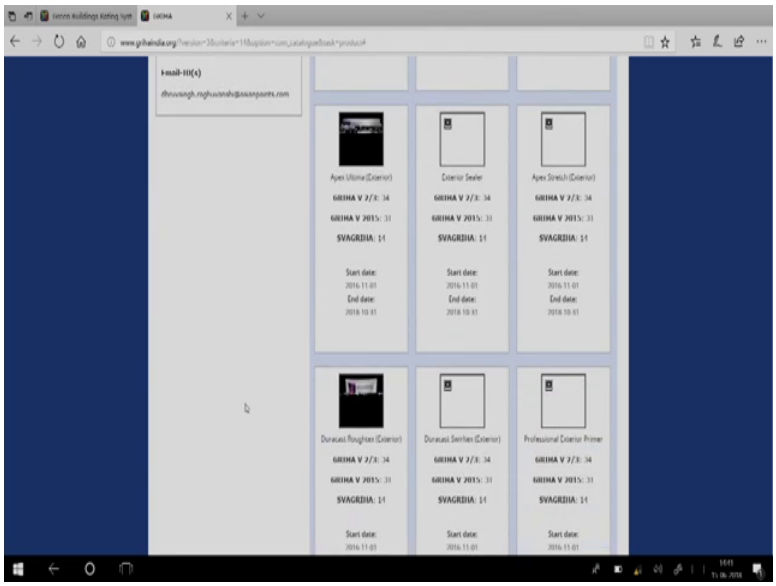

So now let us go to the IGBC rating it is tends for Indian Green Building Council.

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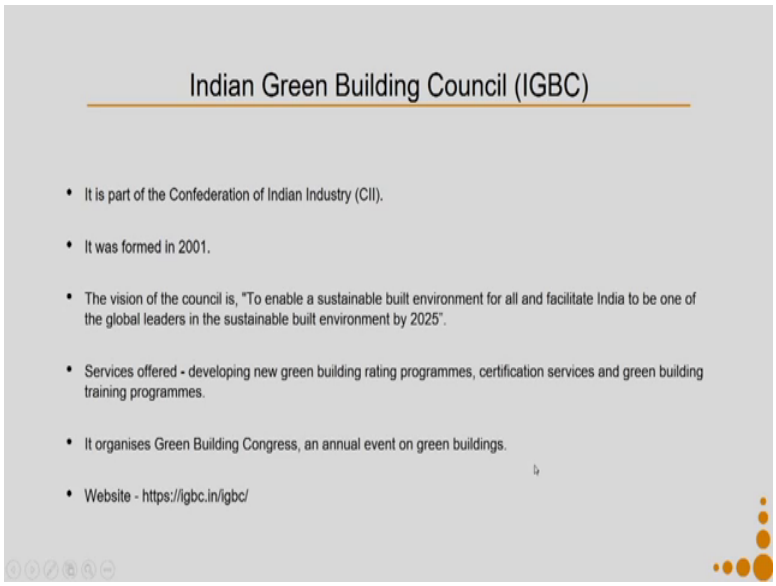

So, it is part of the Confederation of Indian industries CII it was formed in 2001, the vision of the council is to enable a sustainable built environment for all and facilitate India to be one of the global leaders in the sustainable built environment by 2025.

The services offered by IGBC are developing new green building rating program, certification services and green building training programs. It organizes green building congress and annual event on green buildings as well.

This is the website and you can go to the website for more details.

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So, from the website I picked up so IGBC rating systems, as we said different building typologies have different rating systems. So, IGBC has for new building, existing buildings, green homes, green affordable housing, green residential societies, green schools, green factory buildings, green health care rating, health and wellness being rating, green data center.

They also have LEED in into it, green interiors, green campus, green town ships, green cities, green villages, green landscapes, green SEZs, see you can see the width of this spectrum covered by the IGBC rating system is really large. So, if you go to each of those these ratings say for example, IGBC green township you can go and see all that in a details about the same.

So let us pickup IGBC Green Villages.

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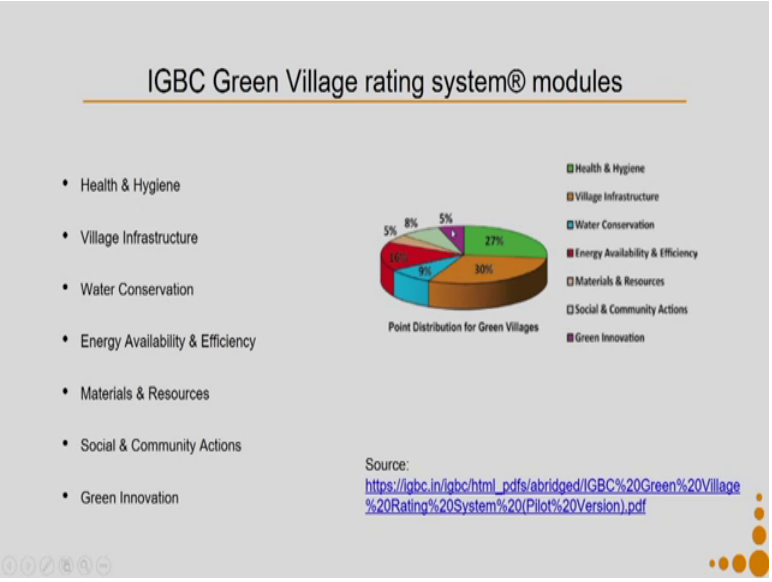

What does it have got to say? So, this is the PDF which details out the whole module. We would just discuss the main parameters of this module. So, for the village rating system module it starts with health and hygiene, village infrastructure, water conservation, energy availability and efficiency, materials and resources, social and community actions, green innovations and you can see each of this criteria have different point distribution for green villages. So, say for example, health and hygiene has 27 percent, village infrastructure has 30 percent whereas, green innovation it has only 5 percent weightages. So, not necessarily all the parameters will have equal weightage, they have different weightages.

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So here is the IGBC Green Villages PDF which you can download from the link that is provided on the page.

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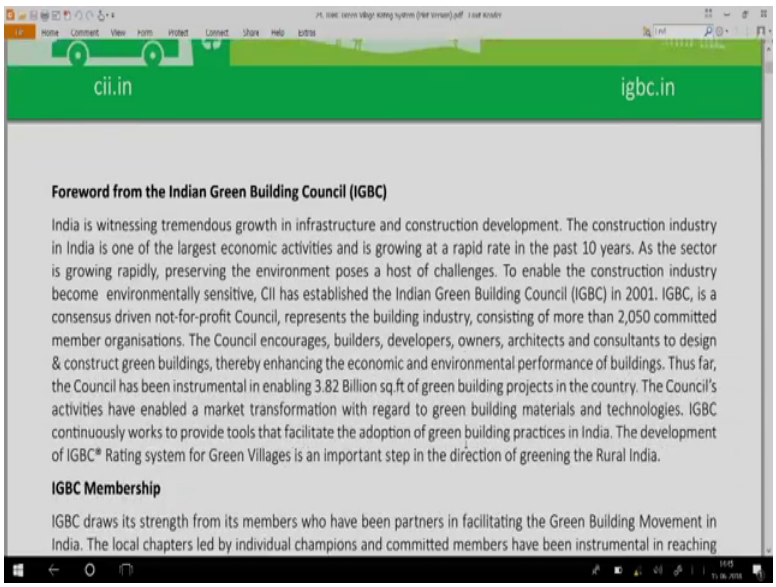

This is a pilot version released in June 2016.

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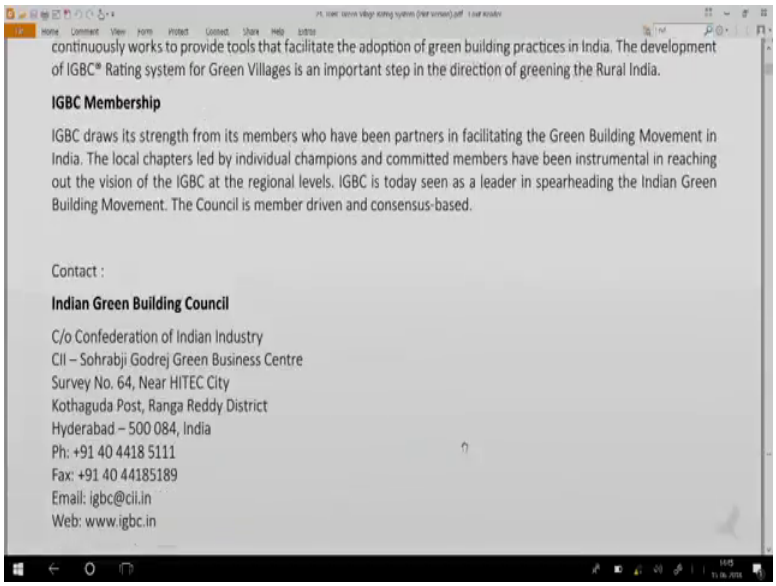

And it first helps you with what it is meant for, whom you can contact the various acknowledgements.

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Then we go into each of those criteria say for example, health and hygiene, sub criteria's over there are solid waste collection and disposal, clean village, drinking water availability, sanitation facility, health care facilitied, indoor air quality in house hold, organic waste management. So, you by using these criteria it can help you in design and then further going for evaluation.

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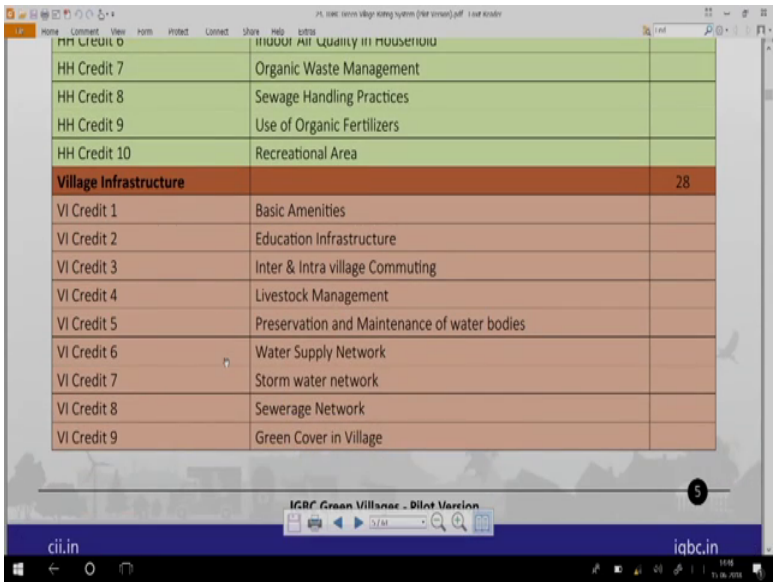

So, is all other criteria elaborated in this particular PDF document, it also explains the criteria and why those criteria are used as they are used.

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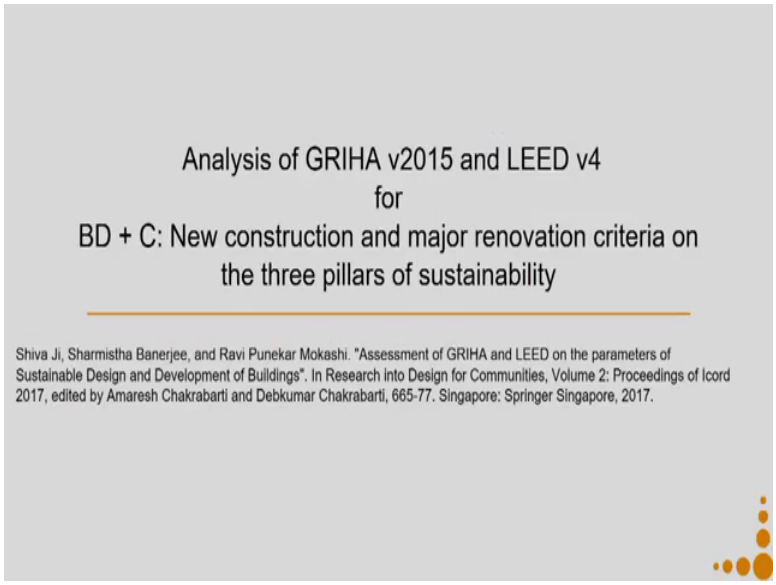

Now, let us do an analysis of it is a comparative study of GRIHA version 2015 and LEED version 4 for new construction and major renovation criteria on 3 pillars of sustainability. So, to read in detail this is the paper and you can read in detail about the analysis.

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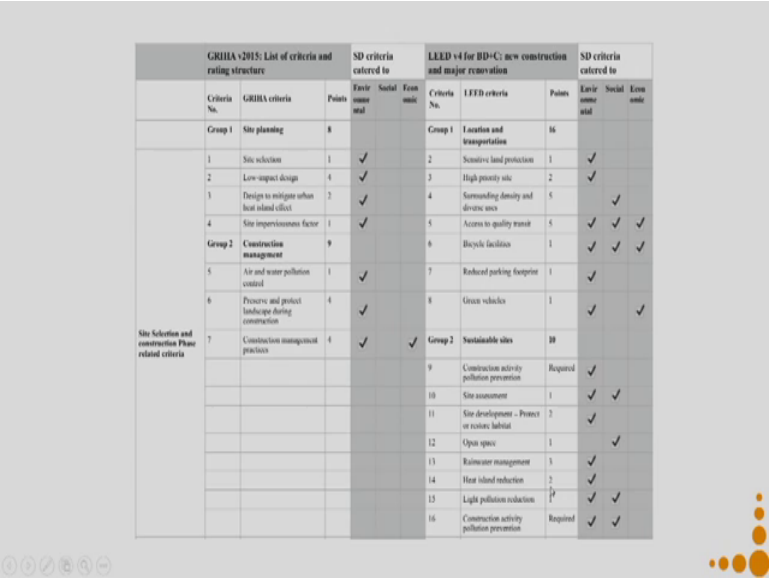

	GRIHA v2015: List of criteria and rating structure			SD criteria catered to			LEED v4 for BD+C: new construction and major renovation			SD criteria catered to		
	Criteria No.	GRIHA criteria	Points	Environmental	Social	Economic	Criteria No.	LEED criteria	Points	Environmental	Social	Economic
	Group 1	Site planning	8				Group 1	Location and transportation	16			
Site Selection and construction Phase related criteria	1	Site selection	1	✓			2	Sensitive land protection	1	✓		
	2	Low-impact design	4	✓			3	High priority site	2	✓		
	3	Design to mitigate urban heat island effect	2	✓			4	Surrounding density and diverse uses	5		✓	
	4	Site imperviousness factor	1	✓			5	Access to quality transit	5	✓	✓	✓
	Group 2	Construction management	9				6	Bicycle facilities	1	✓	✓	✓
	5	Air and water pollution control	1	✓			7	Reduced parking footprint	1	✓		
	6	Preserve and protect landscape during construction	4	✓			8	Green vehicles	1	✓		✓
	7	Construction management practices	4	✓		✓	Group 2	Sustainable sites	10			
							9	Construction activity pollution prevention	Required	✓		
							10	Site assessment	1	✓	✓	
							11	Site development – Protect or restore habitat	2	✓		
							12	Open space	1		✓	
							13	Rainwater management	3	✓		
							14	Heat island reduction	2	✓		
							15	Light pollution reduction	1	✓	✓	
							16	Construction activity pollution prevention	Required	✓	✓	

Here I will show you some of the parameters how we tried to compare it.

So on this side you have your list of criteria and retain rating structure and here I have it for LEED and here for GRIHA. So, for GRIHA you can see ok, the first one is site planning that is the main criteria it has sub criteria's like site selection, low impact design, design to mitigate urban heat island effect, site imperviousness factors. So, we can rate this. So, I have my sustainable development criteria catered to. So, all of them are catering to the environmental dimension, they do not touch upon the social or the economical dimension.

But if I see something similar over here which is about in LEED location and transportation. So, it talks about sensitive land protection, high priority site, surrounding density and diverse uses and access to quality transit, bicycle facilities, reduce parking footprint, green vehicles. So, here you can see I can say like surrounding density and diverse uses that is the kind of a it is catering to the social criteria of sustainable development, where as access to quality transit it talks about caters to environmental, social, as well as economic dimension.

So, on this small snapshot that I have picked up you can see at least in this snapshot there is nothing which caters to the social criteria where as in the LEED it is there is all though the focus on the environmental aspect is very strong, but there is also some focus on the social and economic parameters, let us check out the full list.

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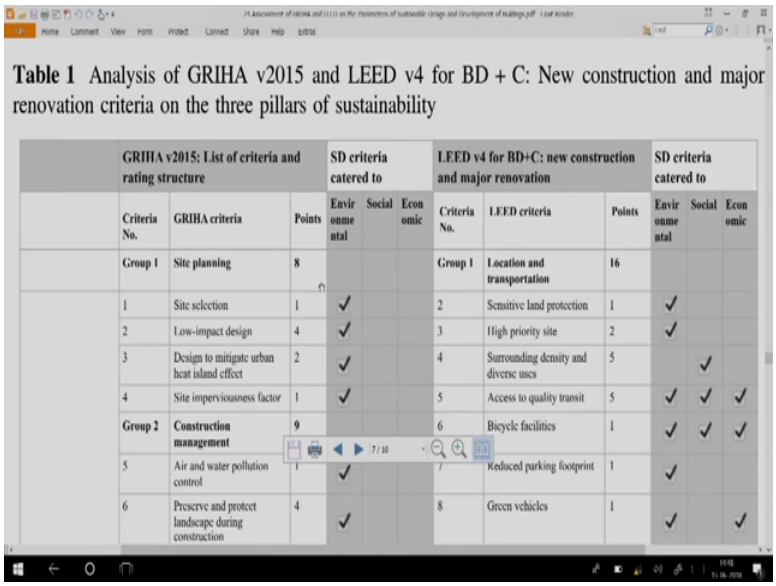

Table 1 Analysis of GRIHA v2015 and LEED v4 for BD + C: New construction and major renovation criteria on the three pillars of sustainability

	GRIHA v2015: List of criteria and rating structure			SD criteria catered to			LEED v4 for BD+C: new construction and major renovation			SD criteria catered to		
	Criteria No.	GRIHA criteria	Points	Environmental	Social	Economic	Criteria No.	LEED criteria	Points	Environmental	Social	Economic
	Group 1	Site planning	8				Group 1	Location and transportation	16			
	1	Site selection	1	✓			2	Sensitive land protection	1	✓		
	2	Low-impact design	4	✓			3	High priority site	2	✓		
	3	Design to mitigate urban heat island effect	2	✓			4	Surrounding density and diverse uses	5		✓	
	4	Site imperviousness factor	1	✓			5	Access to quality transit	5	✓	✓	✓
	Group 2	Construction management	9				6	Bicycle facilities	1	✓	✓	✓
	5	Air and water pollution control	1	✓			7	Reduced parking footprint	1	✓		
	6	Preserve and protect landscape during construction	4	✓			8	Green vehicles	1	✓		✓

So, this is the full list.

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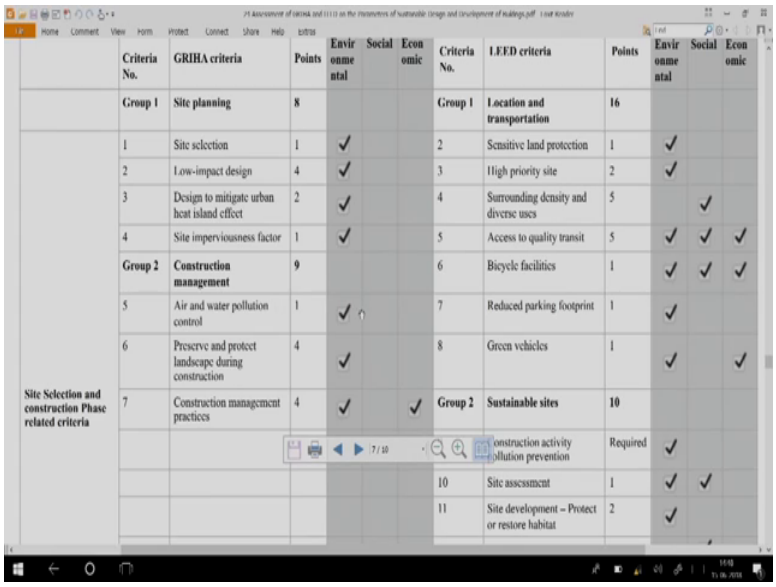

	Criteria No.	GRIHA criteria	Points	Environmental	Social	Economic	Criteria No.	LEED criteria	Points	Environmental	Social	Economic
	Group 1	Site planning	8				Group 1	Location and transportation	16			
	1	Site selection	1	✓			2	Sensitive land protection	1	✓		
	2	Low-impact design	4	✓			3	High priority site	2	✓		
	3	Design to mitigate urban heat island effect	2	✓			4	Surrounding density and diverse uses	5		✓	
	4	Site imperviousness factor	1	✓			5	Access to quality transit	5	✓	✓	✓
	Group 2	Construction management	9				6	Bicycle facilities	1	✓	✓	✓
	5	Air and water pollution control	1	✓			7	Reduced parking footprint	1	✓		
	6	Preserve and protect landscape during construction	4	✓			8	Green vehicles	1	✓		✓
Site Selection and construction Phase related criteria	7	Construction management practices	4	✓		✓	Group 2	Sustainable sites	10			
								onstruction activity ollution prevention	Required	✓		
							10	Site assessment	1	✓	✓	
							11	Site development – Protect or restore habitat	2	✓		

So, you can see again on the left hand side we have the GRIHA criteria and sub criteria, on the right we have the LEED criteria and sub criteria.

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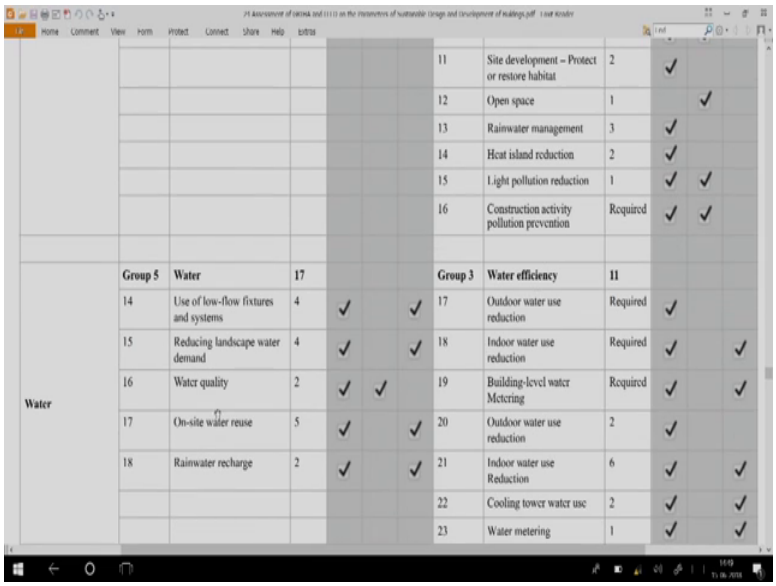

						11	Site development – Protect or restore habitat	2	✓	
						12	Open space	1		✓
						13	Rainwater management	3	✓	
						14	Heat island reduction	2	✓	
						15	Light pollution reduction	1	✓	✓
						16	Construction activity pollution prevention	Required	✓	✓
	Group 5	**Water**	**17**			**Group 3**	**Water efficiency**	**11**		
Water	14	Use of low-flow fixtures and systems	4	✓	✓	17	Outdoor water use reduction	Required	✓	
	15	Reducing landscape water demand	4	✓	✓	18	Indoor water use reduction	Required	✓	✓
	16	Water quality	2	✓	✓	19	Building-level water Metering	Required	✓	✓
	17	On-site water reuse	5	✓	✓	20	Outdoor water use reduction	2	✓	
	18	Rainwater recharge	2	✓	✓	21	Indoor water use Reduction	6	✓	✓
						22	Cooling tower water use	2	✓	✓
						23	Water metering	1	✓	✓

So, when we come to the water aspect of it in water quality, the way it was defined it seemed that it also caters to the social aspect as well as the environmental aspect.

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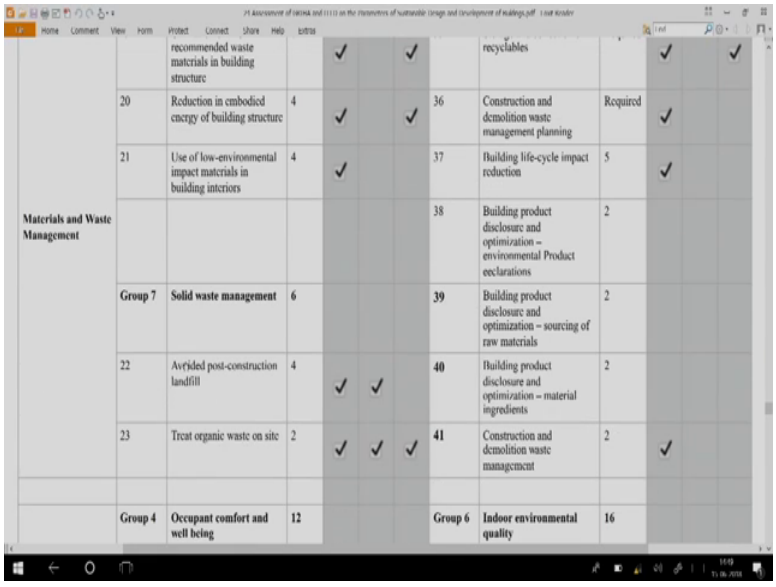

		recommended waste materials in building structure		✓		✓		recyclables		✓		✓
	20	Reduction in embodied energy of building structure	4	✓		✓	36	Construction and demolition waste management planning	Required	✓		
	21	Use of low-environmental impact materials in building interiors	4	✓			37	Building life-cycle impact reduction	5	✓		
Materials and Waste Management							38	Building product disclosure and optimization – environmental Product declarations	2			
	Group 7	**Solid waste management**	**6**				**39**	Building product disclosure and optimization – sourcing of raw materials	2			
	22	Avoided post-construction landfill	4	✓	✓		**40**	Building product disclosure and optimization – material ingredients	2			
	23	Treat organic waste on site	2	✓	✓	✓	**41**	Construction and demolition waste management	2	✓		
	Group 4	**Occupant comfort and well being**	**12**				**Group 6**	**Indoor environmental quality**	**16**			

So, if I go through this entire list again when it comes to avoided post construction land fill, you can see there is certain social aspect involved in it. How do we define whether there was a social aspect involved into it or not? We went into the definition of what how are the defining avoided post construction land fill.

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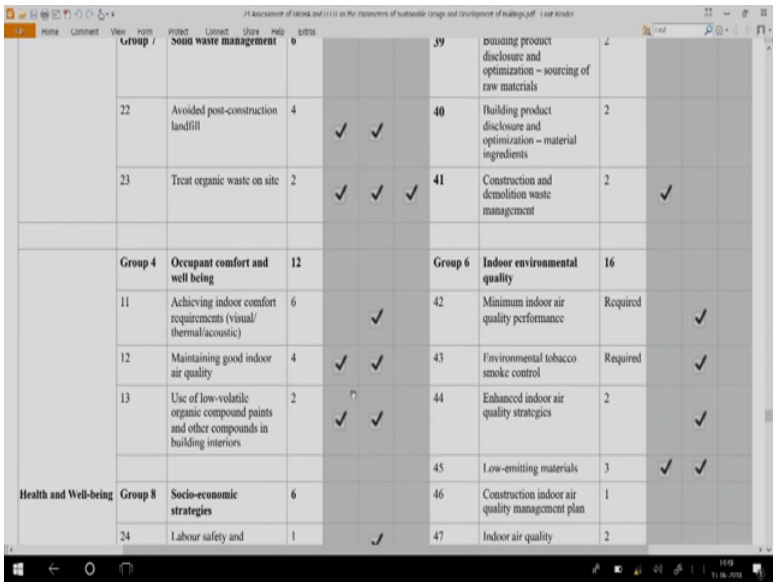

	Group 7	Solid waste management	6				39	Building product disclosure and optimization – sourcing of raw materials	2	
	22	Avoided post-construction landfill	4	✓	✓		40	Building product disclosure and optimization – material ingredients	2	
	23	Treat organic waste on site	2	✓	✓	✓	41	Construction and demolition waste management	2	✓
	Group 4	Occupant comfort and well being	12				Group 6	Indoor environmental quality	16	
	11	Achieving indoor comfort requirements (visual/ thermal/acoustic)	6		✓		42	Minimum indoor air quality performance	Required	✓
	12	Maintaining good indoor air quality	4	✓	✓		43	Environmental tobacco smoke control	Required	✓
	13	Use of low-volatile organic compound paints and other compounds in building interiors	2	✓	✓		44	Enhanced indoor air quality strategies	2	✓
							45	Low-emitting materials	3	✓ ✓
Health and Well-being	Group 8	Socio-economic strategies	6				46	Construction indoor air quality management plan	1	
	24	Labour safety and	1		✓		47	Indoor air quality	2	

So, after doing this comparison we found that GRIHA touches to a very small extent on the social sustainability aspect of it, hence there is a requirement to improve on that particular parameter. So, how do we give sustainability orientation on the 3 pillars?

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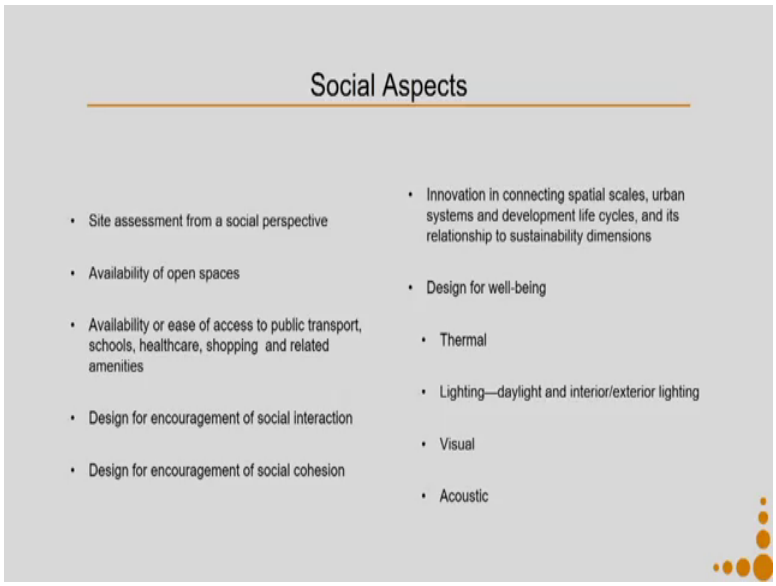

So, say for example, we can include these criteria into it say the social aspects related to site assessment from a social perspective. So, not only site assessment from an environmental perspective, but also from social perspective.

Availability of open spaces because open spaces can give children the space to play, it can also act as a place where the people living in the surroundings can come together involve into certain activities together, creating better social living spaces.

Then, availability or ease of access to, public transport, schools, health care, shopping and related amenities, because these things actually make a habited more sustainable more livable.

Designed for encouragement of a social interaction, how do I design my house in a manner that it design encourages people to come together and interact more with each other.

Design for encouragement of social cohesion, innovation in connecting spatial scales, urban systems and development life cycle and it is relationship to sustainability dimensions.

Then, design for well being how can we incorporate it say for example, is my housing designed in a manner that it ensures optimal lighting conditions for good performance of people or optimal sound barriers so, as to give enough privacy as well as comfort and so on.

So, design for well being can be defined in many different ways; am I using the right kind of interior material, so that the indoor environment is good for well being of the occupants. So, design for well being in terms of thermal, lighting which is day light, interior and exterior lighting, visual well being, acoustic the sound related well being.

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Then inclusion of aspects like cultural aspects, influence of architectural design on cultural aspects of the region or population on aspects like history, geography, heritage, symbols, art, cultural practices or beliefs etcetera. Not necessarily all these aspects can be covered, but we can see how can we cover all these aspects as well; so, that we can claim that we are catering to all the 3 dimensions of sustainability.

Then socio economic aspects like surrounding density and diverse use based assessment.

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So, how dense the place is in terms of, people living in terms of the different kind is it only if we are in residential place or is it a residential plus commercial place and so on. Then life cycle analysis, performance costing and cost to the people on their livelihood, health, recreation and education. Say for example, my office is located in so far away from my housing that I have to travel 2 hours in the morning and 2 hours in the evening to reach it. So, that is a cost to the people because of their livelihood and it is also cost to the people who are living because the health is suffering their recreation, it is suffering same for the education nearby if good education is not available that is again a cost to the people. So, how do we do all these analysis because they are in the boundary region they involve both the social dimension as well as the economic dimension.

So, that was small introduction on how to think in terms of sustainability and built environment the target of this lecture was not at all to cover everything about built environment, but just to give a food for thought if we are trying to design something for the built environment what all different things can be considered. Of course, many of these different things are part of the product design, but many of these aspects are very divergent and are at a much larger scale than individual products.

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Next we will be talking in our next lecture we will be talking about sustainability tools and approaches to agriculture, why agriculture? Agriculture is of course, one of the most important activity without agriculture we cannot have food and we do not survive.

Secondly, in our countries context in India's context still majority of the population lives in rural areas and their major occupation is agriculture. Hence the largest part of our population are involved in this particular sector and there are lots of unsustainability cropping up into this sector.

Say for example, excessive use of pesticides fertilizers is rendering the land less fertile more prone to diseases when the pesticides and the fertilizer they flow from the land into the water resources, they also pollute our water resources, due to excessive use of water for farming activities and not allowing enough time for the land to recuperate. We are causing other kinds of problems about to our land, our water bodies, when we eat the same kind of food which is lays with too much of chemicals, we also cause damage to our body.

So, in order to avoid these things in order to have a development in the agriculture sector which is more sustainable on all the 3 criteria it is very important to have a introduction to this particular topic and to understand what are the unsustainabilities over there and what are the existing tools which has been designed and are being used by various people involved in the sector to bring in sustainability in this domain.

Thank you.