Sustainable Architecture
Prof. Avlokita Agrawal
Department of Architecture and Planning
Indian Institute of Technology, Roorkee

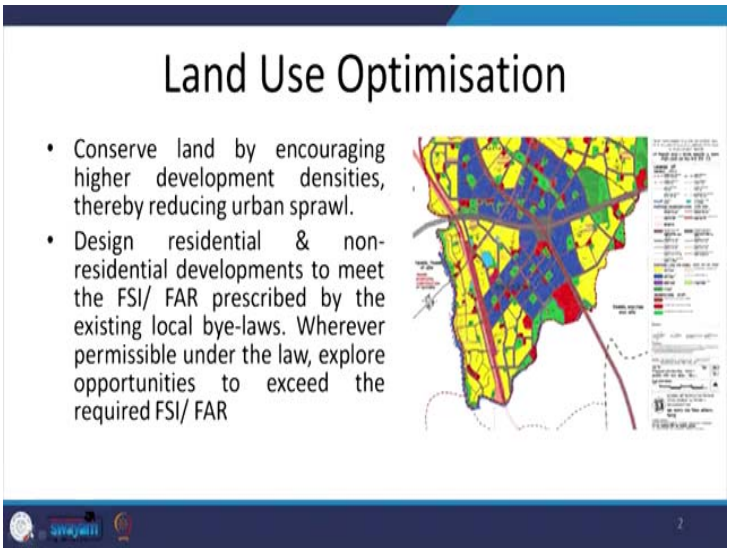
Lecture – 25
Sustainable Sites - V

Good morning. Welcome back to this new lecture for the online ongoing course on Sustainable Architecture and in this week, we have been discussing about how to develop site for sustainable architecture. So, we were largely talking about the selection of site, we were talking about the design and construction parameters and issues which should be considered while we are developing these sites.

Now, we have discussed about the urban heat island and we have also discussed about the stormwater drainage and stormwater management on sites for sustainable site development. We also looked at the calculations which are required the scientific and technological aspects of these two issues. Here today, we will be discussing about some of the parameters which are applicable when it is a large development.

So, usually when it is a single building or a small site such issues would not even appear, would not even come into picture. Why? When it is a large development, there is a scope of it and there is also a possibility of incorporating some of these parameters into site development. So, let us go over some of these parameters today.

(Refer Slide Time: 01:51)

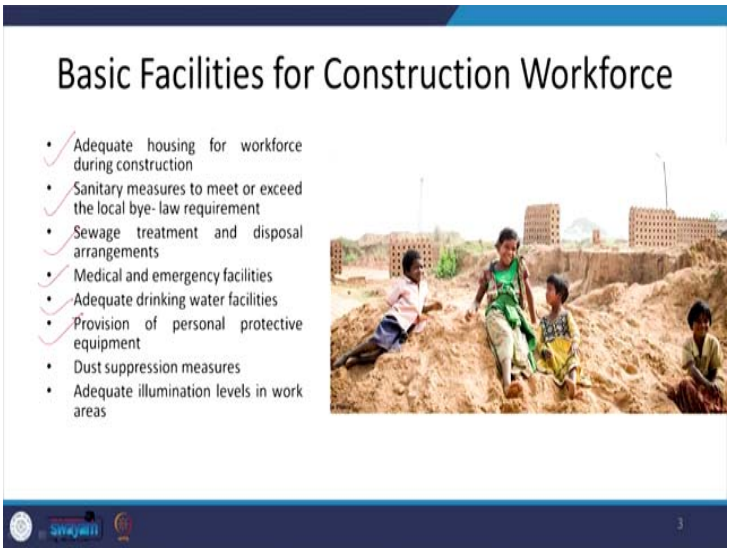


So, the first one is land use optimization. Now, when we are talking about land use optimization, we are talking about ensuring that the development densities are higher. Now, this is slightly different from what we have been looking when we discussed about the development densities from site selection point of view. So there, we selected a site if there is a possibility in dense areas of the city so as to control urban sprawl.

The intent here is the same, where we want to limit the urban sprawl, but here what we intend doing is the site which have been taken up that will be developed for high development densities. That is possible when we are going ahead with large development. Now, of course, all these densities will be controlled with the help of local bylaws and other governing laws.

So, the heights would be restricted, the densities the ground coverage would be restricted; but the intent is to have the maximum development densities as possible as governed by the local bylaws.

(Refer Slide Time: 03:01)



The next is basic facilities for construction workforce. Now, when there is a small building coming up usually the construction workforce does not stay on the site. While, when it is a large development, often the construction workforce is forced to stay on this site throughout. So, they have children, they have their own requirements. With the help of this parameter it is ensured that the basic amenities, the basic facilities for construction workforce are provided.

These basic facilities include adequate housing, for workforce during construction; sanitary measures for example, toilets, washrooms, bathrooms. The sewage, distreatment and disposal arrangements for the construction workforce and the housing and sanitation measures which are provided for them. Also, the medical and emergency facilities have to be provided on site while the work is going on. Adequate clean drinking water facilities; so, it is not just any water which should be made available to them. It is portable water which should be provided.

Then, provision of personal protective equipment. Unfortunately, still in our country the construction sector and especially, this workforce is a very unorganized kind of sector. I am not talking about construction sector as a whole, it is quite organized; but when it comes to the labour, the workforce, then it is unorganized. Hence, this becomes very-very important that all the construction workers be provided with personal protective equipment like helmets, boots, gloves, maybe even an apron or something like that.

The next is the measures for dust suppression need to be implemented even while the construction of the project is on because these people are going to stay on site and they will be exposed to all these suspended particles, this dust. Adequate illumination levels in work areas, so for ensuring the safety of these construction workers, adequate illumination levels must be provided in the work areas.

Besides these, the crash for children, school for children, for taking care of the children of these construction workforces, they have to be provided on site itself. The next parameter is mixed use development. Wherever there is a large development coming up if it is for example, say a housing scheme. It is advisable that other uses and other areas for example, commercial, retail areas, office areas, institutional areas, hospitals, recreational areas be provided along. Now, this has become a common practice. So, we do not think that this is something unusual or extra because this is also the demand from the people the society and hence, it is driven by the demand.

However, wherever, there is not enough demand there also, a mixed use development is always a good idea because it limits the people from travelling for their needs, for fulfilling their needs of shopping, for groceries, for all other things, for school, education of children too far off places to distant places. The next parameter is varying the housing typologies. So, it is not that a housing scheme should have only one kind of housing

typology. For example, only the high end or only the middle income group housing. It should ideally have a mix of these housing topologies.

Now, this is also being ensured through some of the government schemes, where government is ensuring that even when you are going in for a high end residential development, you also allocate some area, some portion for the low income group housing and like that. So, this mix ensures that the economically weaker group the underprivileged of the society are not marginalized; they are not put to the margins. So, they also get an access to get good amenities, good facilities like the others who can afford it.

(Refer Slide Time: 07:33)

The next parameter is employment opportunities which is a post occupancy parameter, which comes into picture when the construction of the building is over. So, here we are extending on the mixed use development; where the retail areas, the office areas, office buildings and institutional buildings come up.

So, that people find employment within the vicinity and they will reduce the long distance travel in search of employment opportunities. So, the closer the employment opportunities are which will be ensured by providing mixed used development, it will be better from a sustainable point of view.

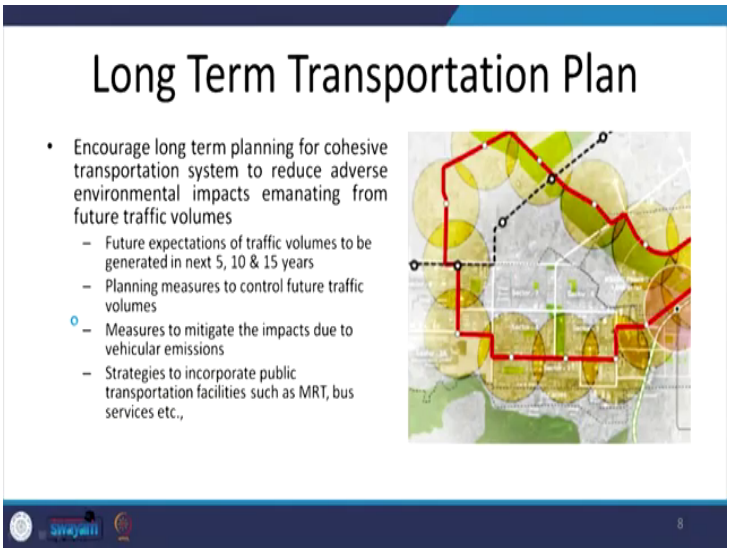
(Refer Slide Time: 08:19)

The next parameter is social and cultural initiatives. So, all these parameters are largely interlinked and whenever we talking about sustainability, as we have been seeing and we have been discussing through in this course. We see that only the environmental dimension is not the one which is important. It is also the social cultural and economic dimension which is equally important.

Often, we take care of the environmental dimension and the economic dimension and forget about the sociocultural dimension. Here, when we are looking at a large development, we have to look at the sociocultural initiatives which can be incorporated right from the beginning, through the design and development of the project. For example, providing for open areas where people can gather and celebrate as a community. For example, provisions for amenities like dispensaries, banks etcetera. So, that is also ensured by providing mixed use development.

Then, other facilities, amenities for example, vocational training institutes may be clubbed within the large development. For example, the conservation and restoration of buildings of historical importance, if there is a part of the site which has some such monument. Then conservation and restoration of such buildings as part of the site development is a good strategy and besides these, any other social initiative which can be incorporated and provided for right at the design stage itself.

(Refer Slide Time: 10:03)



The next parameter which is very important is a long term transportation plan. So, how this development of the site will impact the transportation and how people will be commuting? So, keeping that in mind. For example, if there is a metro station close by; so how the site should be developed where the entry and exit should be? So, that people travel lesser distance to reach the metro station.

For example, there is a bus terminus. So, where should the entry and exits be provided. Also, where should the entry and exits be provided so that there is no traffic jam happening on the main routes, on the main roads which are surrounding the site. So, all that has to be developed with a long term vision in mind. So, the transportation plan has to be developed for a longer duration.

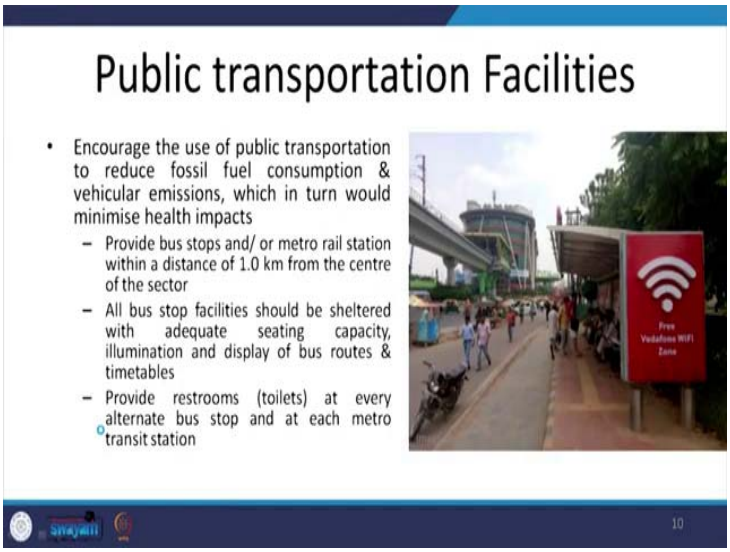
(Refer Slide Time: 10:59)

Next very important parameter is designed for differently abled. When we are talking about buildings often, we take care of this universal design. This design for differently abled which is also mandated through NBC. So, when we are talking about buildings, we often take care of it. So, we provide for ramps, we provided we provide for lifts, we provide for other options so that differently abled people are able to move freely.

However, when it comes to large developments often, we ignore the design for differently abled. For example, footpaths. So, the differently abled people are not able to access footpaths, where it becomes extremely important that this parameter be considered. Now, specifically we are talking about this safe and comfortable and easy access, uniformity in flooring level or ramps, it should not change abruptly, preferred car parking spaces which are closer to the building for differently abled people.

There should be special restrooms which should be designed for differently abled people when we are talking about the public buildings, commercial buildings, offices and other institutional buildings and Braille supported lifts. So, some of these measures when I am discussing about all these parameters may be present in different green building rating programs, may not be present; but they form essential part of sustainable buildings, sustainable architecture.

(Refer Slide Time: 12:31)

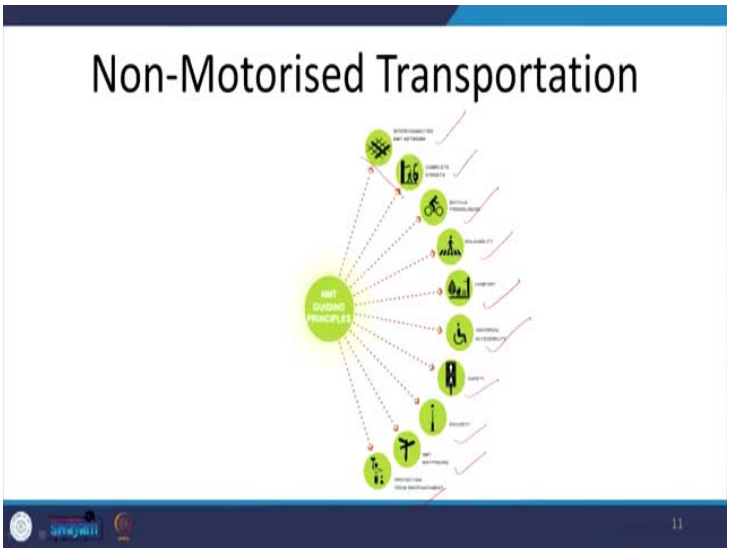


The next is public transportation facilities. Here, we are talking about the provision on site and design of site in order to access transportation facilities which are available in the vicinity. For example, if we do not have a bus stop in the vicinity, then providing for a bus stop within a distance of 1 kilometer from the center of the sector. Now, this is at a policy level; this is at a sector development level or a city development level.

When we are talking about the large development within the site itself, we may be needing to provide for public transportation. So, provision of bus stops on the site itself. In addition to that the bus stop facilities wherever the queue shelters are, they should be adequately sheltered to provide for or sheltered space with adequate seating capacity illumination and also the display of bus routes and the timetables for the ease and comfort of the users.

Also providing for restrooms at every alternate bus stop and at each metro transit station. Now, some of these may not appear feature in majority of the projects. But in very large development projects some of these features may also need to be provided for.

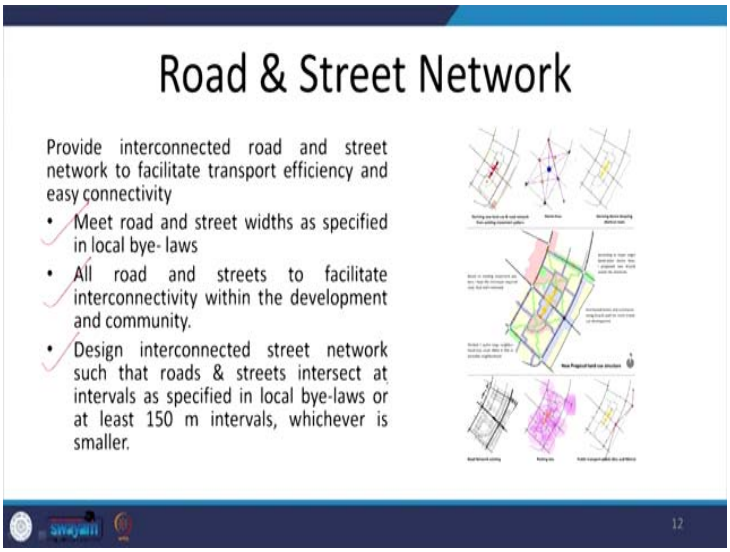
(Refer Slide Time: 13:59)



We also have to have provisions for non motorized transportation. For example, the bicycles and how people walk. So, what are the different parameters within non motorized transportation, all those parameters; for example, safety, security, wayfinding, protection from encroachment which is often a major problem, universal accessibility, comfort, walkability, bicycle friendliness, complete streets, an interconnected network, all of that forms part of the non-motorized transportation.

Whenever, any one of these goes missing that is where the non motorized transportation is hampered and people immediately shift to motorized transportation. So, for making non motorized transportation popular, all these points they have to be adequately addressed.

(Refer Slide Time: 14:57)



So, within this we are talking about the road and street network, first of all we have to provide for the road widths, a street widths as prescribed specified in local bylaws; minimum of that. The next is to facilitate interconnectivity within the development and community. So, the streets and roads have to connect to the higher level in hierarchy of the roads and streets for facilitating this interconnectivity.

The next is that the intersection; this is achieved through providing the intersections at least 100 at every 100-150 meter interval. So, or if lesser is prescribed within the bylaws that is to ensure that the streets, all the streets and roads are interconnected.

(Refer Slide Time: 15:55)

Next within non motorized transportation facilities is bicycle friendliness. So, we have to ensure in the large development, the public bicycle sharing. A lot of campuses educational campuses are opting for this. This particular picture is from GNDU, Amritsar, where a bikes, bicycle sharing facility has been implemented. Now, this practice is going on in many of the campuses across the country and it is a very good, very healthy practice. More and more campuses are opting for it.

(Refer Slide Time: 16:37)

But besides the facility for public bicycle sharing, we also require dedicated cycle lanes, where the bicyclists, the cyclists, they can ride bicycles safely. So, these have to be dedicated bicycle lanes and as per the guidelines from MOUD 2011 dedicated and physically segregated bicycle tracks with the width of 2 meter or more; one in each direction they have to be provided.

So, all large developments, if they are opting, if they are considering the non motorized transportation facilities have to look at provision of such lanes. Our cities also are encouraging the use of bicycles and hence, providing for bicycle lanes.

(Refer Slide Time: 17:29)

For example, Noida and many other cities are doing that. Other than cycle lanes, dedicated cycle lanes, we also have to provide for cycle parking's; specially near the transit transport transit stations for example, bus stops. So, this is ensuring the last mile connectivity. So, people can cycle from their homes to the transport hubs, the bus stands, the bus stations, metro stations; park their bicycles properly. So, adequate cycle parking spaces near the crowded locations have to be provided.

(Refer Slide Time: 17:59)

This will help in the last mile connectivity or the public transit integration. Often we see that people do not want to use the public transportation; for example, metro simply the last mile connectivity, their home to metro station transfer, the travel becomes very difficult. If such facilities for example, the bicycle parking or the cycle rickshaw parking bays are provided adequately, then the public transit integration becomes smoother.

(Refer Slide Time: 18:33)

Next very important within non motorized transportation is pedestrian network. While we are providing for the dedicated cycle lanes, we have to ensure that adequate footpaths

with the kind of facilities which are required by the pedestrians while moving are provided adequately. For example, appropriate signage, adequate seating, the drop curve which will make it universally accessible so that differently abled people are able to use it.

The barriers, which restrict the mood use of this walkway pedestrian walkway by motorized vehicles, motorcyclists and others. Zebra crossing where the pedestrians can cross the motorable roads along with the pedestrian signal so that the crossing becomes safe. So, all this has to be adequately designed and provided for the pedestrians, if you want to encourage the use of pedestrian walkways.

(Refer Slide Time: 19:41)

The next parameter after non motorized transport is light pollution reduction. As our cities are growing and they becoming dense, we see that the nature, the greenery, vegetation and along with that several birds and animal species are disappearing from our cities.

There are many cities in the world which do not have birds there because not just because they do not have enough trees or flora and fauna, simply because the light pollution is so much in the cities that the birds cannot sleep, they cannot survive in the city environments. And that is why all these birds have fled away the cities which is an alarming situation because this is a grave serious change in the ecosystem, when one

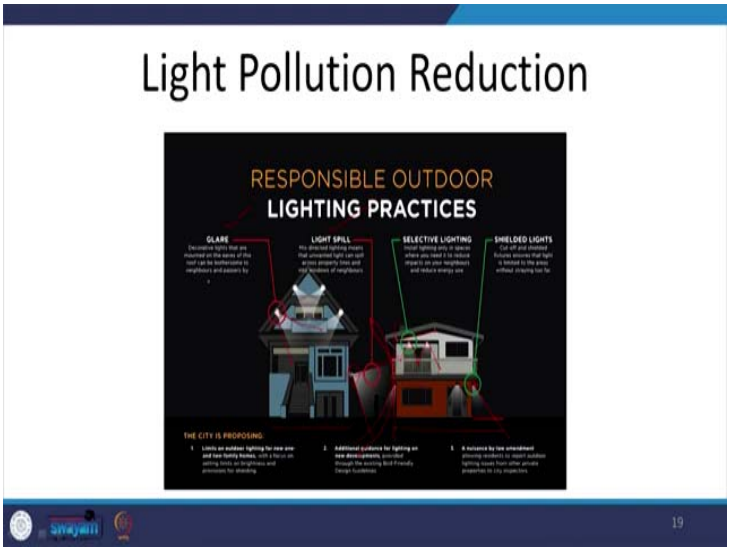
species suddenly disappears it leads to the growth of several other species which is unwanted. So, it leads to an imbalance in the ecosystem.

To reduce that we have to reduce the light pollution in the cities. So, at a large scale level large development scale level and also at individual building level, we have to curb, we have to limit the light pollution. In this, we have to minimize the light trespass from the building and site, reduce this sky glow that is to increase the night sky access and improve the nighttime visibility through glare reduction and reduce development impact from lighting on nocturnal environments.

Here we are talking about the lighting strategies. It is not that we have to suddenly reduce the amount of lighting, thereby leading to unsafe environments. No, we are talking about provision of light in such a manner that it does not light up the night sky like in this case which is a very bad example where the luminary is totally exposed.

So, it is lighting up the area; but at the same time, it is lighting up the night sky which is absolutely not required. So, what we need to do is we need to cut off this light. So, they have partially cut it off. They have cut it, in this case it is reasonably good it is better than the previous two cases; but the best is this where the cut off is full and the light is available only on the ground. So, the night sky visibility is full.

(Refer Slide Time: 22:29)

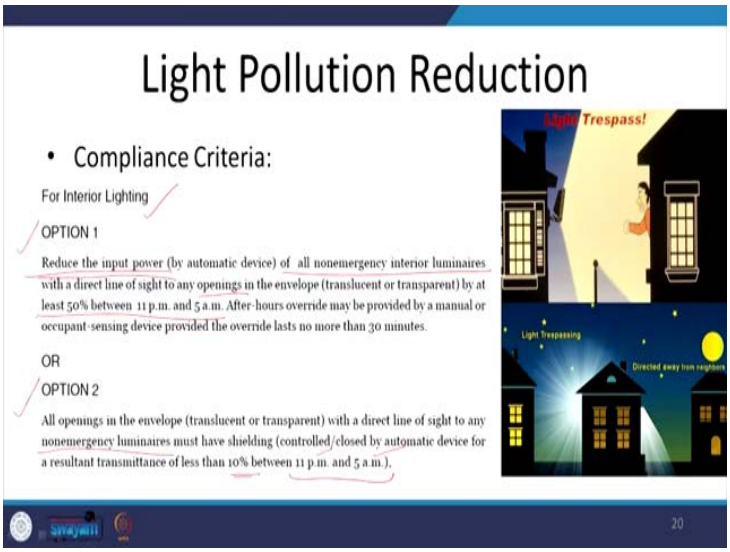


For this, we have to incorporate some of the responsible outdoor lighting practices within the design. Now, this largely implies how the lighting fixture is installed on the outdoors of the buildings and also indoors. So, the light has to be designed. This image shows very clearly a comparison of two cases.

Now, this is the same lighting fixture which is installed outside for lighting up the outdoors and here, we have another one, where the reflector is installed in such a way that it only lights up the ground and not the other part of the environment, not describe all and also not disturbing the adjacent buildings.

Similarly, the lights which are installed on the eaves of the roof, they are provided with a down lighting. While in this case they are inclined and that disturbs that creates glare for the adjacent building. So, we have to reduce the glare, reduce the light spill and install the lighting fixture, select a lighting fixture and its reflector in such a manner that glare and light spill is controlled and limited.

(Refer Slide Time: 23:53)



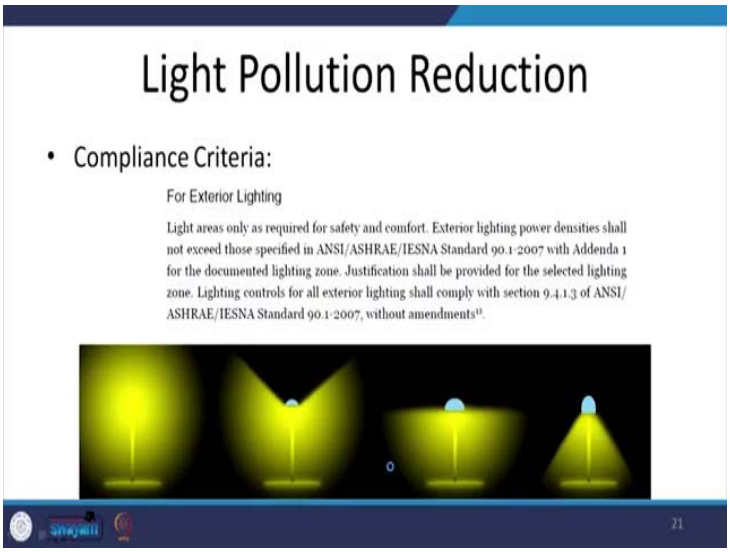
If you look at the green building rating systems, light pollution reduction has been incorporated as an essential parameter and there are compliance criteria. So, there are different options. There are two options; first one, now this is for two cases. One is for interior lighting and the other one is for exterior lighting. So, we there is compliance criteria for both. The first one is for interior lighting. There are two ways, two options in which this can be complied with.

First one is to reduce the input power for all nonemergency interior luminaries which are in the direct line of sight to any opening. So, which are closer to the openings in such a manner that it is reduced by at least 50 percent between 11 P.M. to 5 A.M. Now, that is the time when the maximum trouble is caused, maximum trouble is created.

So, we will reduce the input power to all the non-emergency interior luminaries, that is option 1 or the option 2 is that all the openings in the envelope whether they are translucent or transparent with a direct line of sight to any nonemergency luminary as in the first case, they must have the shielding which is either controlled or closed by automatic device for a resultant transmittance of less than 10 percent during the same duration.

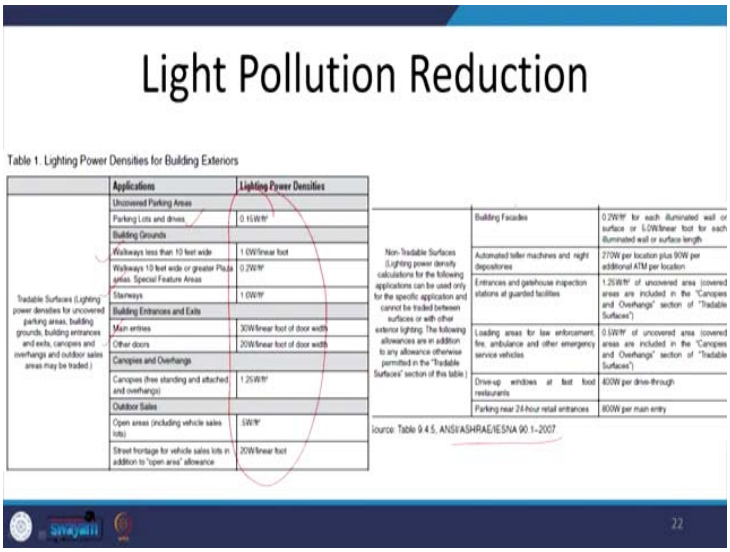
So, this is either we treat our luminaries, reduce the input power or we treat the windows, the fenestration which is adjacent and which is close to the luminary. So, these are two compliance options for the same criteria.

(Refer Slide Time: 25:43)



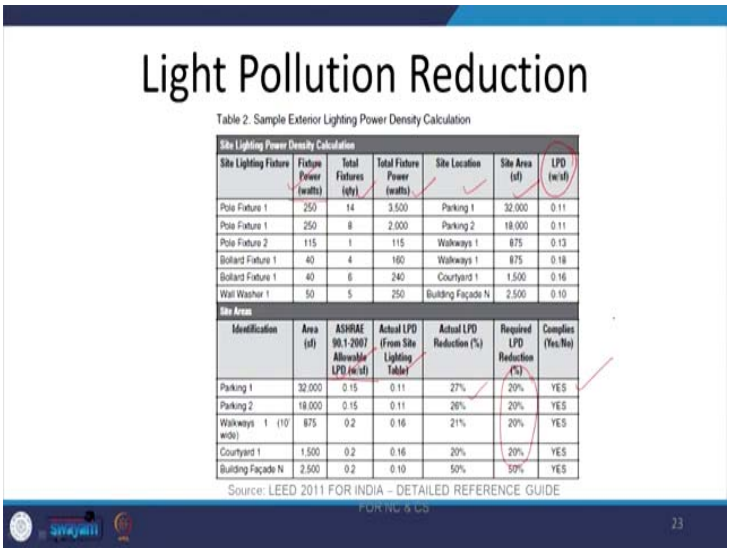
The next one is for exterior lighting. Now, here it directly refers to the codes. We have Indian codes also in practice, ECBC also mentions the lighting power density. So, ensuring that the minimum lighting power density is provided for. So, no extra lighting power density has to be provided.

(Refer Slide Time: 26:05)



Now, this is the kind of table which you would find in ASHRAE 90.1-2007 version, where the lighting power densities for different areas of the site are given. For example, parking lots and drives. For example, the walkway, stairways, the entries and other doors. So, the lighting minimum, maximum lighting power densities are provided for here.

(Refer Slide Time: 26:31)

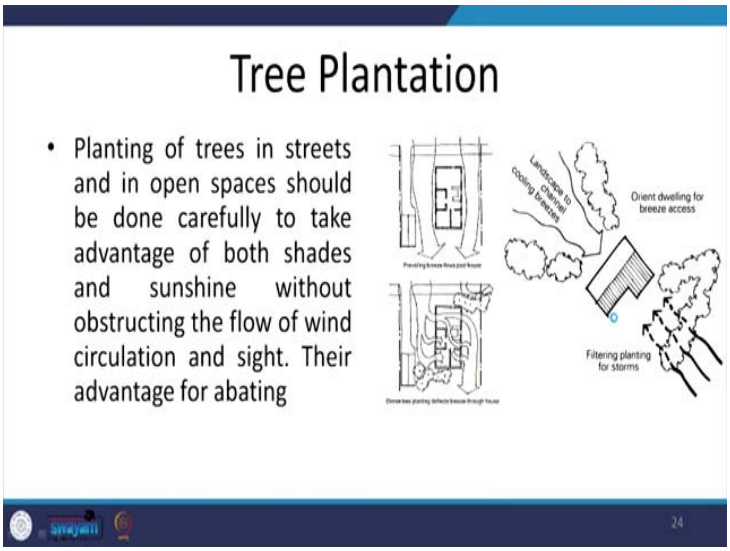


When we are going for a compliance, we would see that the kind of fixture which has been installed, it's a power in Watts; the total number of fixtures which are provided, so

the total fixture power, the site location, the total area that it covers. Hence, the lighting power density in Watts per square feet will be calculated. That the actual lighting power density will then be compared with the ASHRAE provisions which we just saw in the previous slide.

So, if there the actual provided for lighting power density is less than ASHRAE, then it complies and as per the compliance approach, it has to be reduced by certain percentage and hence, we see here that it has been reduced by say around 27 percent while they required was 20 percent. So, it complies. So, the intent is to reduce this lighting power density for exterior lighting and for interior lighting, cut off the glare and any light spill.

(Refer Slide Time: 27:39)



The next parameter is tree plantation. So, the plantation of tree in streets and open spaces, it shall be done carefully because trees, greenery, vegetation not only provides for shading in summers, but it also directs and diverts the winds. So, the plantation has to be designed in such a manner that it improves the ventilation, if it is required. For example, in extremely cold areas, the winds are not required, they are not welcome. So, the plantation may be required to block the winds. While in hot areas, in warm areas we may be required to force the winds into indoors through the plantation like this.

(Refer Slide Time: 28:31)

Another increasingly popular strategy is local food production. Unfortunately, food production and the provision of food to the communities is not even counted as a measure, as a parameter which we need to think about in sustainable architecture sustainable built environment. However, it is a very crucial parameter because it consumes a lot of energy not just for production, but for transportation of food. So, if in large developments local food production can be incorporated.

So, where there are large campuses, the community may be involved in their own food production like this one where in Bengaluru one of the tech parks; Manyata Tech Park, the employees grow their own food. It is not that adequate amount of food will be produced. So, the total volume of food which is required will not be produced on the premises of this tech park itself. But it will reduce the burden on the food which is going to be procured from outside.

However, in case of very large developments like small townships, which are getting developed on the in the suburbs of large cities, there the provisions may be made right in the beginning to grow local food, to grow the food locally.

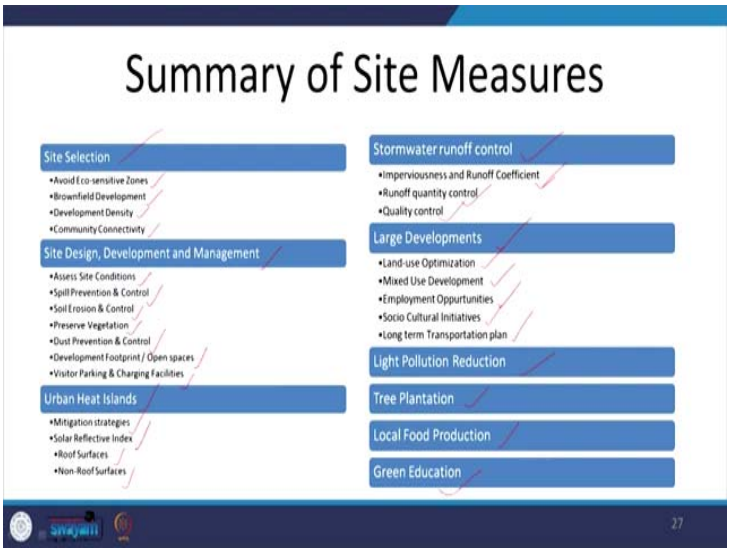
(Refer Slide Time: 30:09)

Next very important parameter is green education and guidelines. Often the architects and developers design the township or the built environment in such a manner that it complies with all the parameters which are required for a green building for a sustainable built environment. Unfortunately, the performance of these strategies, these parameters largely depend upon how the users, the occupants of these buildings and these developments behave and use. For example, if we have provided for bicycle lanes, but the people do not use bicycles.

Then, the entire parameter is a wastage of resources. There was no need for providing for bicycle lanes when people were not sensitized enough. So, while we are talking about the development of sustainable sites, sustainable projects it is important very important to invest in green education and guidelines. So, the users have to be educated about implementing sustainable design and construction features in the spaces. There have to be sufficient signage and information based on green education and people have to be sensitized enough so that they help in maintaining the green features of the project for the lifetime of the project.

So, to conclude and consolidate all that we have discussed in this week, we can summarize on this slide, where all the parameters and measures for sustainable site development are listed here.

(Refer Slide Time: 31:41)



First of all, we talked about the site selection, where we talked about eco sensitive zones, the brownfield development, development density and community connectivity. Some of these form part of the green building rating systems, some of these are mandatory. For example, avoiding eco sensitive zones. The next was site design development and management.

Here, we talked about the assessment of site conditions which includes climate, topography, storm water all those conditions. Then, spill prevention and control, soil erosion and control. We looked at the measures, we looked at these strategies. Preserving the vegetation on site. We looked at the dust prevention and control strategies. We talked about development footprint and open spaces and visitor parking and charging facilities.

The next very important head was urban heat islands. So, we looked at the mitigation strategies, solar reflective index, the non roof and roof surfaces for reduction of urban heat island. Next we discussed about stormwater runoff control, where we talked about imperviousness and runoff coefficients, the runoff quantity control and also the quality control. We looked at strategies for each one of these and we also looked at the calculations and the quantification of all these measures.

Lastly, we talked about the large developments and the parameters and strategies. So, we talked about the land use optimization, mixed use development, employment opportunities, sociocultural initiatives, long term transportation plan. Beside this, we also

talked about the light pollution reduction, tree plantation, local food production and most importantly the green education. So, we will close the discussion on sustainable site development here and from the next week onwards, we would start with the water and related measures and parameters for sustainable architecture.

Thank you for being with me see you again in the next week.

Thank you.