Sustainable Architecture
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Lecture – 48
Codes and Standards

Good morning. Welcome to this lecture for the ongoing course on Sustainable Architecture. Where, today we will be discussing about the relevant codes and standards for implementing sustainable buildings sustainable architecture.

So, if we talk about the codes and standards which are prevalent in India, we see that there are different types of standards and codes which are available. However, all of them are not mandatory codes; there are several codes which are voluntary code there are some which are mandatory some which are partly mandatory. So, some codes are prepared and they are available at the central level while the implementation is held the powers of implementation are resting with the state governments.

So, some states have mandated it. Some states have not mandated it. So, the codes they vary and there are different types of codes. So, in this lecture I will very quickly take you through what are those different kinds of codes and what is the content which is there in these codes. We will not go in detail over the content of these codes because some of the content. We have already taken in part of our lectures and some is still untouched, but you can go over and look at these codes because these are huge codes and volumes. So, the first and most important code that we will consider today is National Building Code.

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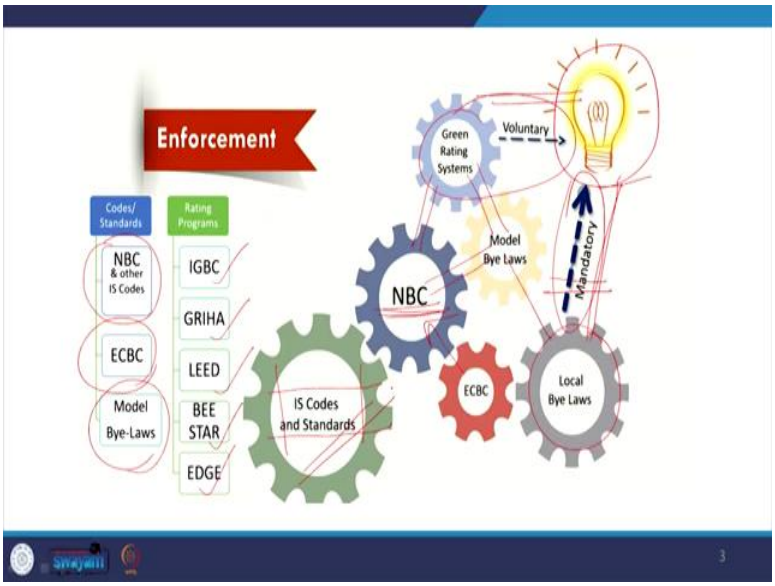

All of you who are taking this code and our architects are already familiar with National Building Code. So, when we are talking about National Building Code and before I go on detailing about what NBC National Building Code of India is.

As I was just mentioning that there are some codes and standards which are voluntary. So, NBC is a voluntary code. Part of it some sections of it are mandatory, while most of it remains a voluntary code. There is ECBC at the central level. The ECBC is a voluntary code and ECBC has been taken up by different states it has been modified to suit the specific requirement of the state and it has been mandated in some of the states for some types of the buildings.

Then they also have Model Bye-Laws which are again not mandatory laws. These are not mandatory, but these are also voluntary codes and they help the states to formulate their own Model Bye-Laws model set of laws. So, these are the main codes which are available at the central level. In addition to these codes and standards we also have rating programs.

So, we have also seen that several of these rating programs are applicable in our country. We have IGBC, we have GRIHA, we have LEED, BEE STAR rating for buildings and we have EDGE which is being practiced implemented in our country. These are also voluntary codes. So, when we are talking about the enforcement with the help of these codes and standards and how green buildings or sustainable buildings are being made using these rating programs all these have a role to play. So, we have these IS codes and standards

which are mandatory in nature. So, all the building owners, facility managers they are mandated to follow the IS codes and standards. Now these IS codes and standards have been referred to in NBC which we as architects often refer to and while we are making green buildings and sustainable buildings we are also referring to NBC now.

NBC is also substantiated with ECBC. There are local Bye-Laws which are taking clues from the model bye laws which is again connected with how NBC handles and then there are green building rating systems which are taking clues for from NBC, ECBC, Model Bye-Laws and the building whatever the building project is partly it is governed by the mandatory laws and sets of standards and partly it is governed by the voluntary set of laws.

In case of green buildings and sustainable buildings, the green features are largely voluntary in nature as of now as far as the standards are concerned while the rest of the requirements for example, as far as structure is concerned as far as the building height and habitable spaces and minimum dimensions and all of these things are.They are all governed by the mandatory codes which are the IS codes and standards. So, if you look at all these NBC, ECBC and lot of these others they form the voluntary set of codes yet they are very very important in driving the agenda of green buildings and sustainable buildings. So, here we are talking about National Building Code as the first code.

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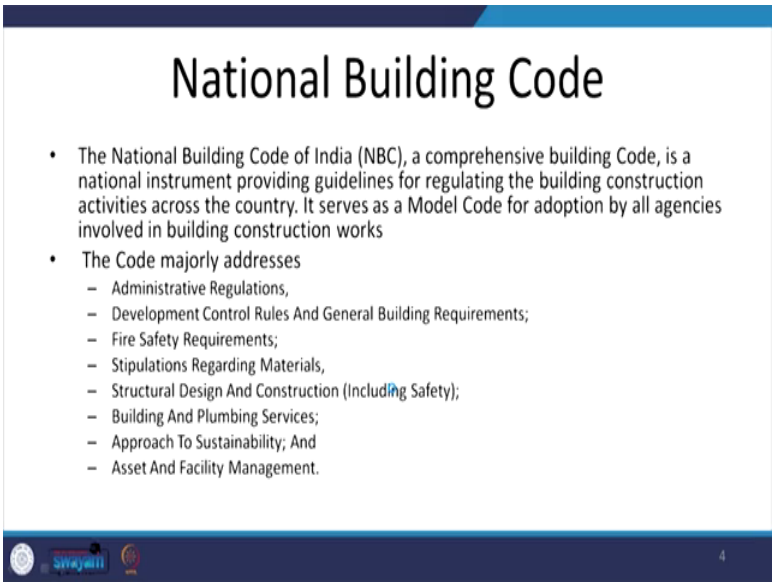

National building code is a comprehensive building code and it talks about almost all the features and parameters which are related to the building sustainable building and buildings in general.

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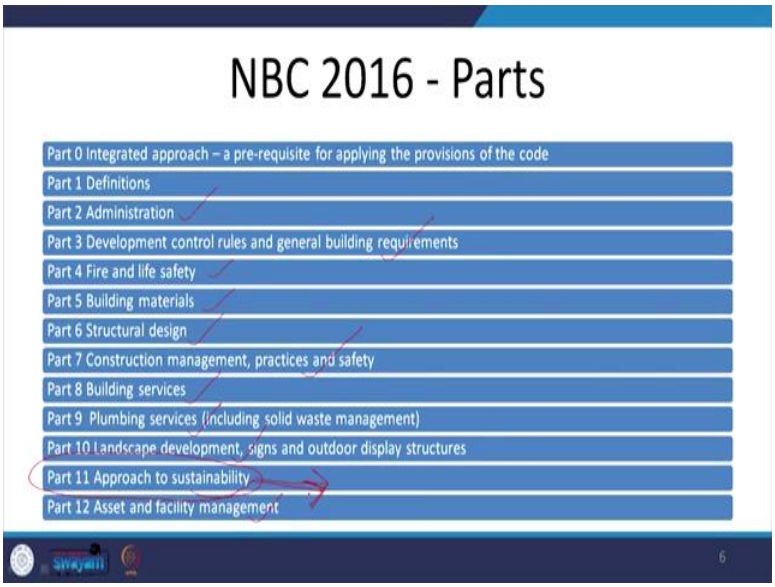

And it addresses a lot of these different issues right from the right from the administration to developmental controls to fire safety, building materials, structural design, construction management practices and safety building services, plumping services, landscape development and we also have a certain facility management.

And in the latest version of NBC which was released in 2016 we also saw addition of a chapter which is part 11 which is approach to sustainability. In the earlier versions of NBC 2016 this approach to sustainability was not there now with the addition of this part 11 approach to sustainability the sustainable features in green buildings or in buildings become an integral part officially.

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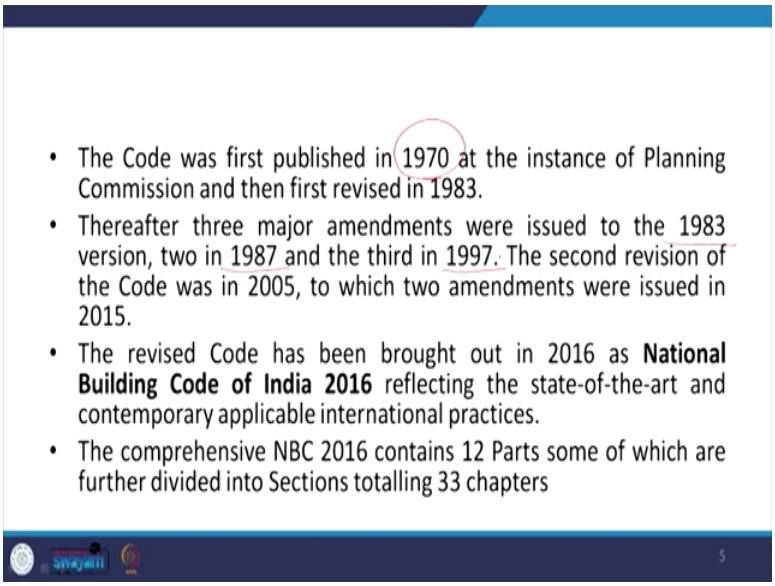

Prior to this when the National Building Code was first published in 1970 and then it was revised in 1983 and 1987 and 1997 subsequently none of those had any reference or any discussion about the green feature or sustainable features in buildings.

So, the new chapter part 11 which was added to National Building Code of India brought sustainability to the main stream. And now it is not only the green buildings which need to follow these features all other buildings and constructions which are going to happen will have to take care of these sustainable aspects. However, this entire code remains voluntary in nature. It is more of a guidebook it is more for guiding the design and construction of buildings.

So, when we when the discussion around approach to sustainability and inclusion of a chapter on approach to sustainability was happening we realized that the world at large is discussing about green buildings and there is a green movement green building movement of sort happening and India is witnessing that already through the rating programs, voluntary rating programs and codes like ECBC had already come into picture by the time part 11 approach to sustainability was added.

And given the kind of heritage that we have inherited the sustainable constructions, design of buildings that we have inherited it is imperative for a country like ours to lead this green building movement from our country and that is what collectively the growing voices led to the inclusion of part 11 approach to sustainability.

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So, if you look at this approach to sustainability we can broadly divide the contents given in this part 11 approach to sustainability in 8 distinct parts. These are not as they appear in the code, but this is what they largely cover. So, in part 11 we talk about siting, form and design. We talk about external development and landscape, envelope optimization, materials, water and waste management both at the building level and site level.

Building services optimization, constructional practices and commissioning, operation, maintenance and building performance tracking. So, all these broad parts cover the entire content of chapter 11 approach to sustainability and if we look at all these contents.

We can also see that the first two are largely related to the site planning. The next two are related to building design, the next two are largely talking about building services and the last two are discussing about the construction, operation and maintenance of building. So, right from the conception of the building design till the construction and occupancy of the building all aspects of buildings life cycle have been covered through discussions and different sections in this part 11 which is approach to sustainability.

Which is the essence of sustainable buildings, that we are not only focusing on one phase of the buildings life, but it starts from the early discussions about how the building should be design till the final delivery of the building and even post occupancy. All of that has been comprehensively covered in this part 11 approach to sustainability.

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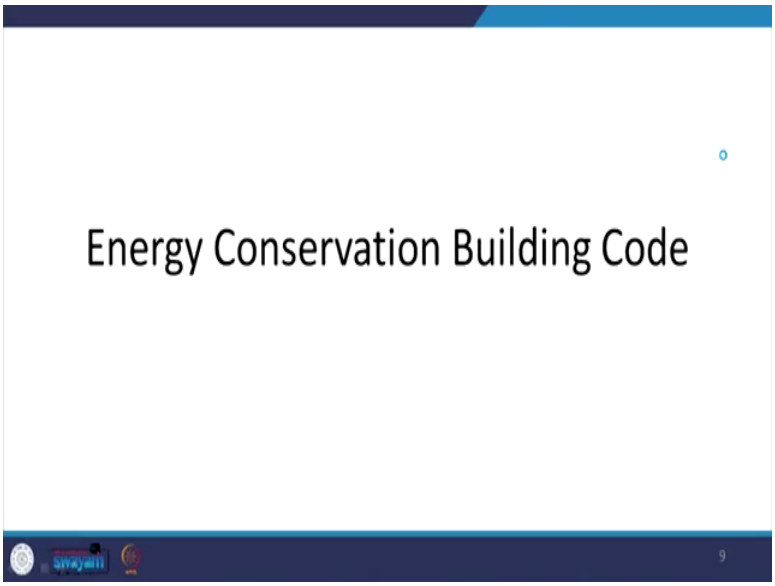

The next code which is very relevant for a sustainable building design in India is Energy Conservation Building Code.

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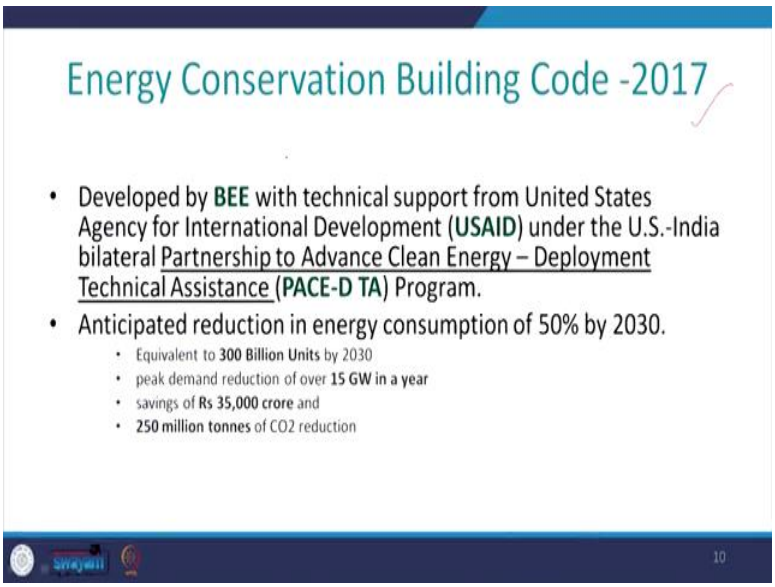

This code and we are here referring to Energy Conservation Building Code 2017. So, ECBC was first developed and published in 2007 with the help of USAID which is the United States Agency for International Development.

And later in 2017 it was further revised with the help of USAID only under this bilateral partnership program called PACE-D TA. ECBC largely talks about the energy

conservation in buildings. So, it is not discussing about any other aspect of sustainable buildings, but only energy. However, when it talks about energy it talks about all the aspects of energy which goes into a building.

So, it talks about building envelope where the envelope affects the performance of a building in terms of its energy performance here. It talks about the consumption of energy through different types of usages for example, lighting, HVAC service hot water, pumping. So, all these systems which affect the energy usage consumption of a building are covered as part of ECBC. And besides that the addition of renewable energy to it is very briefly handled, but not in detail. So, this is what this entire code covers. It talks about the energy conservation in building.

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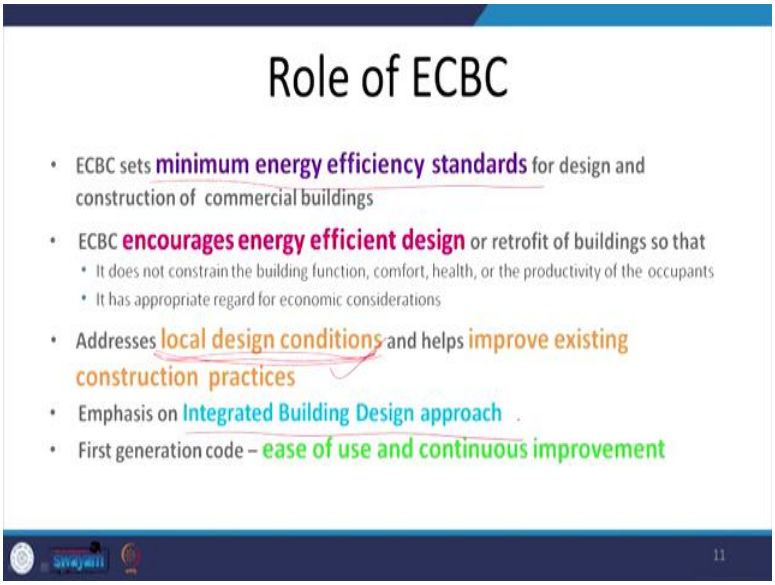

So, if we look at the role of ECBC here in a country it sets the minimum energy efficiency standards for design and construction of commercial buildings and it encourages the energy efficient design or retrofit of buildings in order to not constrain the building function, comfort, health or productivity of the environment yet reduce or optimize the energy consumption. Through ECBC we have tried to address the local design conditions and help in improving the existing construction practices. So, when we talk about the local design conditions they have been addressed by taking into account the different climatic zones.

So, the country has been divided into different climatic zones as we have already seen in our previous lectures. So, the same classification of climate has been used in ECBC and that is what it incorporates in terms of the local design conditions. And there is an emphasis on integrated building design approach where the design, the construction, materials and the active systems. So, both the passive system and active system along with the design has been taken care of in ECBC and that is what it emphasizes on. So, that is a integrated building design approach which it talks about.

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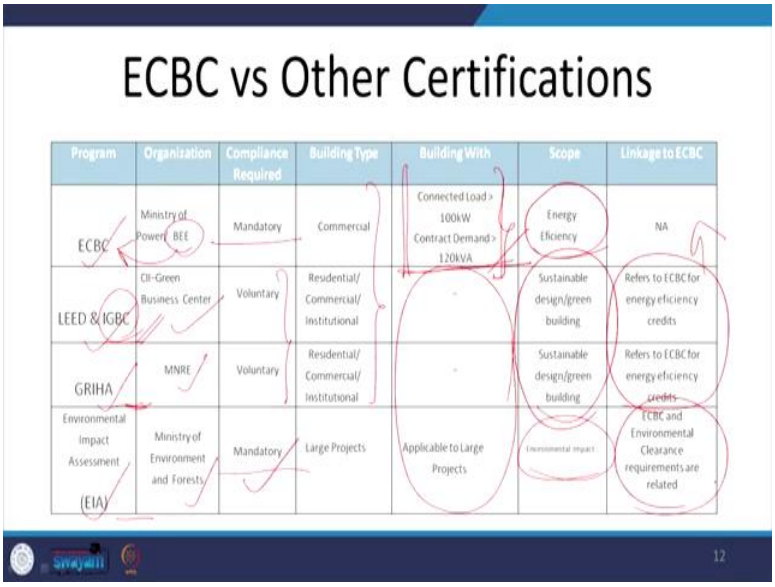

So, if we look at ECBC and other certification programs. So, here we are talking about the voluntary programs again and ECBC is voluntary at the central level while it has been mandated by some of the states at the state government level where the implementation authority lies.

So, if you look at these compare these certifications programs. So, we have ECBC, we have LEED and IGBC, we have GRIHA and we also have Environmental Impact Assessment. There are different organizations which are driving these certifications. So, ECBC is mainly governed and driven by Ministry of Power under which Bureau of Energy Efficiency was formed and Bureau of Energy Efficiency largely looks after the operations related to ECBC.

LEED and IGBC are they were initially looked after by CII, Green Business Centre. Now only IGBC is being looked after by CII. GRIHA is directly under Ministry of Non-

Renewable Energy resources MNRE and we have Environmental Impact Assessment where Ministry of Environment and Forests MOEF is largely looking after the Environmental Impact Assessment.

Out of all these ECBC is partly mandatory because it is mandated in some of the states and not in the others. The other 2 are voluntary. So, these green building rating programs are in a sense voluntary in nature still in our country. While Environmental Impact Assessment is mandatory, but it is applicable only for large projects very large projects where EIA is mandatory.

For ECBC, LEED and IGBC GRIHA almost all they directly cover the commercial buildings. However, LEED and IGBC and GRIHA have also diversified and they take care of residential buildings institutional buildings and many other different types of building buildings as well. Here LEED IGBC and GRIHA which are the green building rating programs and EIA they do not have any minimum mandatory requirement for the connected load or the demand of the building in terms of energy.

While ECBC gives that requirement where at least a connected load of 100 kilo Watt is required or a contract demand of 120 kilo volt amp kVA is required. However, this condition changes from state to state. So, depending upon the size of the buildings which are commonly present in the states. This range has been varied. So, hill states. For example, Uttarakhand has a very small requirement of this connected load while the states for example, Rajasthan they have a higher connected load requirement.

If you look at the scope of these ECBC is only talking about the energy efficiency and energy conservation while the green building rating programs like LEED IGBC and GRIHA are talking about sustainable design and green building where they cover all the aspects of green buildings as we have discussed so far water, site environment energy everything and Environmental Impact Assessment talks about the environmental impact which is directly governed by the international standards.

So, if we are talking about the linkage of all these with ECBC we see that the green building rating programs in India and also NBC in its chapter part 11 approach to sustainability they directly refer ECBC for energy efficiency credits and the discussion on energy efficiency. So, mostly all the prescriptive requirements, mandatory requirements

also the simulation approach whole building simulation approach and trade off approach all of this is directly referred to from ECBC.

And here Environmental Impact Assessment is not related to energy performance of performance of buildings individually, but it is linked or it is related only to the large site development. So, there is no direct relevance connection.

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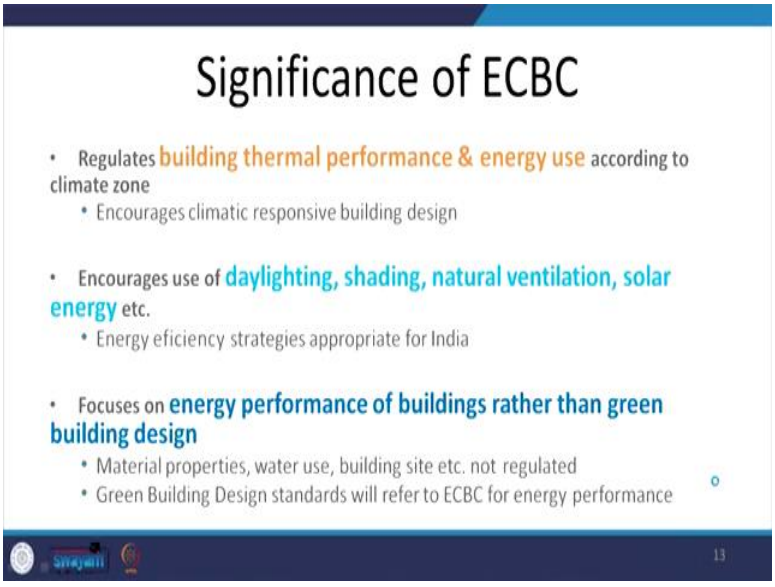

So,, if you talk about the significance of ECBC we see that ECBC is instrumental in regulating the buildings thermal performance and energy use depending upon the climatic zones.

So, ECBC mainly encourages the climate responsive building design through it is passive design approach through the design of building envelope and selection of right kind of building materials. It also encourages the use of passive features in design such as day lighting, shading, natural ventilation, incorporation of solar energy into the design which should as we have already seen through the past few lectures it should be the first step towards designing a sustainable building.

So, we must take care of the passive design features and address them first before moving on to the active systems. And then lastly it mainly focuses on energy performance of buildings rather than the green building design as we have already seen.

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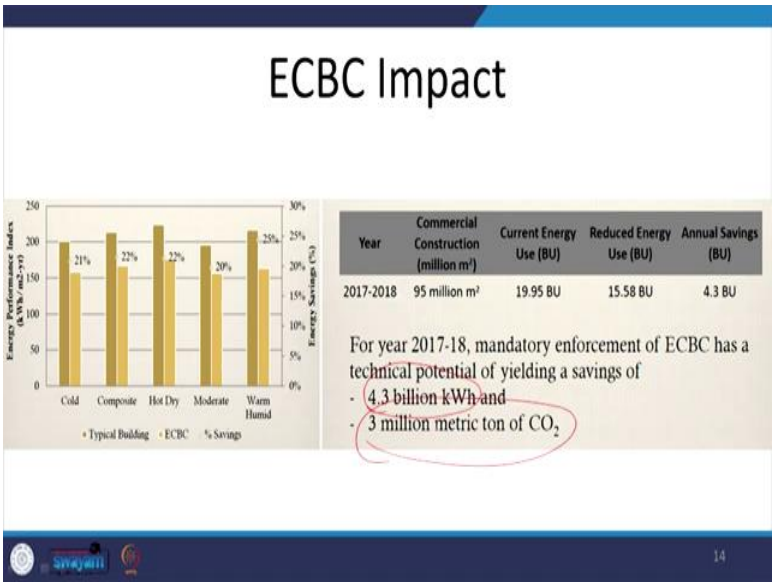

And when ECBC 2017 was published brought out the impact of ECBC possible impact of ECBC was estimated and it was seen that if all the buildings in constructed in the year 2017-18 which is the year when ECBC was launched the latest version of ECBC.

If all the buildings were ECBC compliant what to be made ECBC compliant it would yield in a potential saving of around 4.3 billion units of energy consumption and would save around 3 million metric tons of CO 2. It will it would offset that much of emissions. So, there is a huge potential of savings energy savings and emissions reduction if ECBC is implemented and mandated in the entire country.

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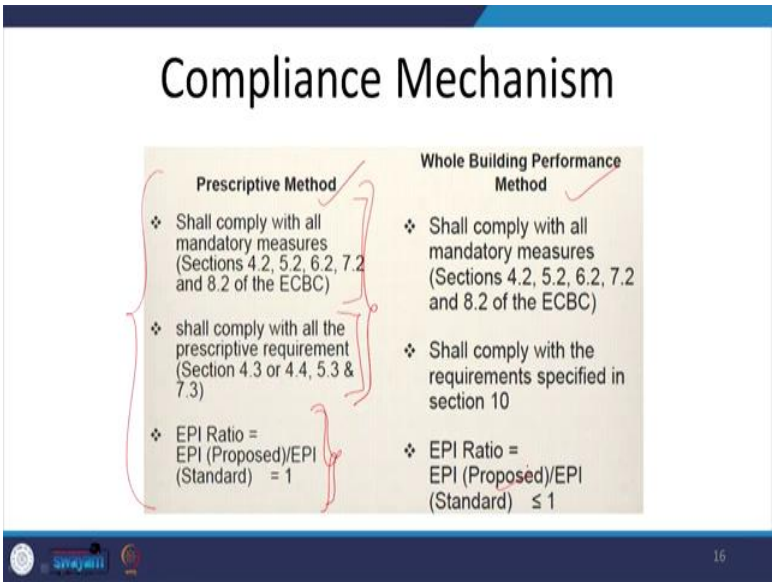

So, if we look at these Compliance Mechanism. We have briefly touched upon this compliance mechanism while we were discussing about sustainable buildings in previous lectures. So, there are 2 distinct methods of compliance. One is the prescriptive method where the building complies with all the sections and prescriptive requirements mandatory measures and prescriptive requirements given in the chapters from 4 to 7.

In case prescriptive method is not used then we have 2 options. One partly we can trade off where the envelope can be designed and there can be a trade off within the different features of envelope only. So, we can trade off between the performance of wall with that of fenestration or we can trade off between the performance of roof with that of wall or like that, but the overall energy performance index remains the same.

So, the proposed energy performance index for the proposed building should be better than that of the base case, but all of that is largely the prescriptive compliance approach where at least all the active systems they have to follow the prescriptive method while the second method is whole building performance method.

Here, the entire building could have various performance parameters. We could change both the active systems as well as passive systems and internally we could do all those changes in the proposed building, but in the end the EPI Energy Performance Index of the proposed building should be better than that of the base case or the standard building. So,

in the end whether through an enhanced investment in passive design features or in active features.

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Overall the building performance has to be better than that of the base case as specified through ECBC. So, for whole building performance method the system that we have to use is that of simulation. So, we have to use the simulation tools where we make a computerized model of the building in terms of its energy used, the kind of materials which are going to be used it is orientation and all the parameters which affect the energy performance of the building.

We simulate and estimate the amount of energy which is going to be consumed by the building or we may also estimate the thermal comfort which will be achieved throughout the year and we compare that with that of the base case or the standard building. So, two cases will be simulated and they will be compared for their performances. This is what we will be talking about in detail in our subsequent lectures and we will look at one of the whole building simulation tools and see learn the process of whole building simulation.

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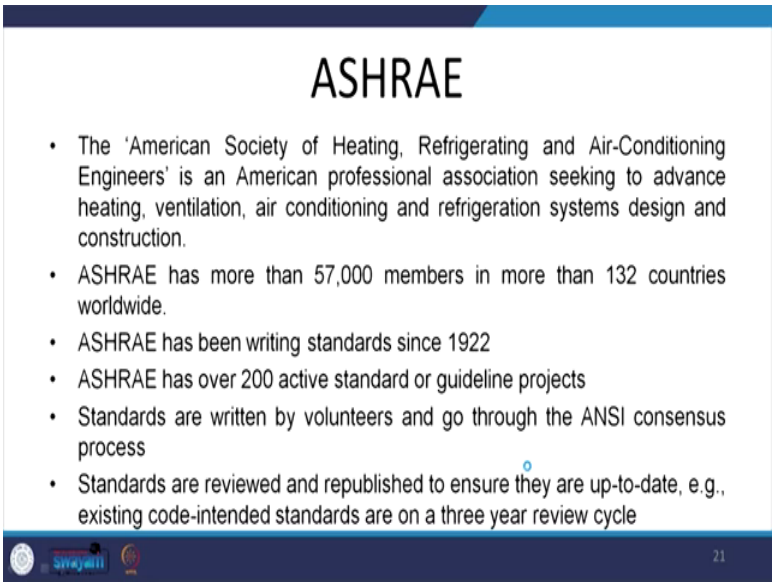

So, another set of standards that we have here is ASHRAE standards. As far as the sustainable buildings or green buildings are concerned we have few standards, which are published by ASHRAE which are of use. None of the standards as per ASHRAE is a mandatory standard, but many of the organizations across the world refer to these ASHRAE standards and they use it for guiding setting the standards or guidelines in their projects. So, ASHRAE is the American Society of Heating Refrigerating and Air-conditioning Engineers and it has a huge member base and it is active in more than 132 countries.

So, that makes it evident that it is quite a popular organization and ASHRAE has published more than 200 standards and they are also active. So, these standards are used to establish the guideline or the base line for several of these green building rating programs. When we are talking about these ASHRAE standard. So, LEED for example, uses ASHRAE to set the standard the baseline of the building the base case.

Well when we are talking about the IGBC and we are talking about the GRIHA rating program for setting the energy benchmark we use we refer to ECBC. While almost in many other rating programs green building rating programs ASHRAE is the one which is used and here we very quickly discuss about what are the different types of standards which are available through ASHRAE which are of relevance to us.

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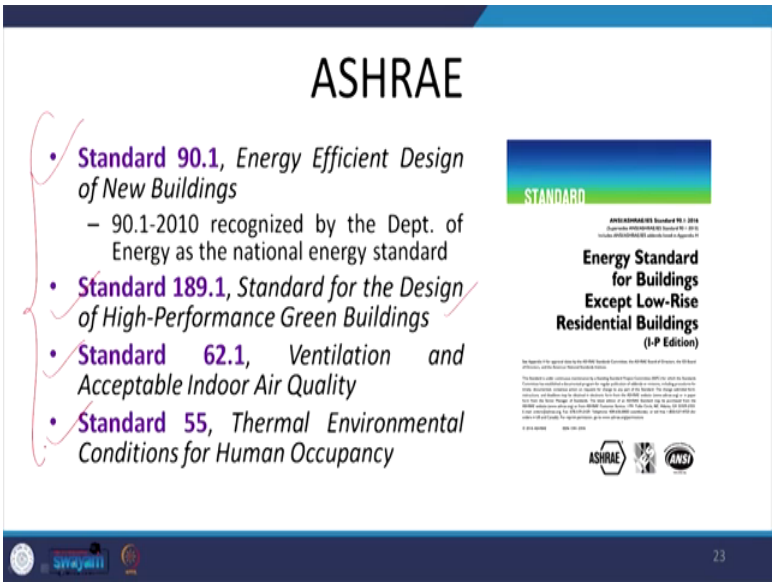

So, we have the first one which is most important which is ASHRAE standard 90.1 which is on Energy Efficient Design of New Buildings and LEED directly refers to ASHRAE 90.1 to define the base case and all the prescriptive measures for the base case. The next is Standard 189.1, which is the Standard for Design of High Performance Green Buildings.

Standard 62.1 is for Ventilation and Acceptable Indoor Air Quality and this is used to determine and define the air exchange rates and the leakages from the building. ASHRAE Standard 55 is for Thermal Environmental Conditions for Human Occupancy which defines how the comfort hours unmet hours and met hours should be calculated. So, all these 4 standards together they largely drive the whole building simulation approach which is used in the green building rating programs.

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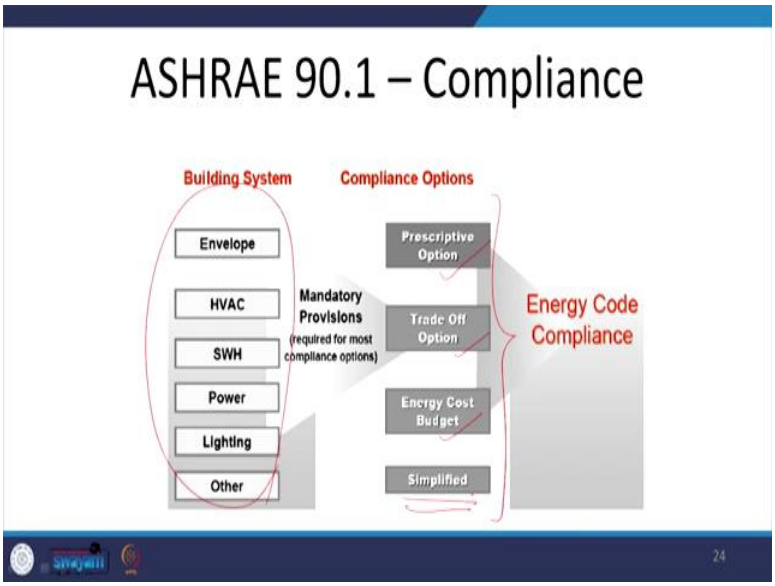

And the compliance in ASHRAE 90.1 is exactly the same as we have for ECBC where we have all these building systems envelope, HVAC hot water systems, power lighting and others. And there are different options where we have prescriptive option, trade off option, energy cost budget and there is a simplified method, which is exactly the same as we use in ECBC.

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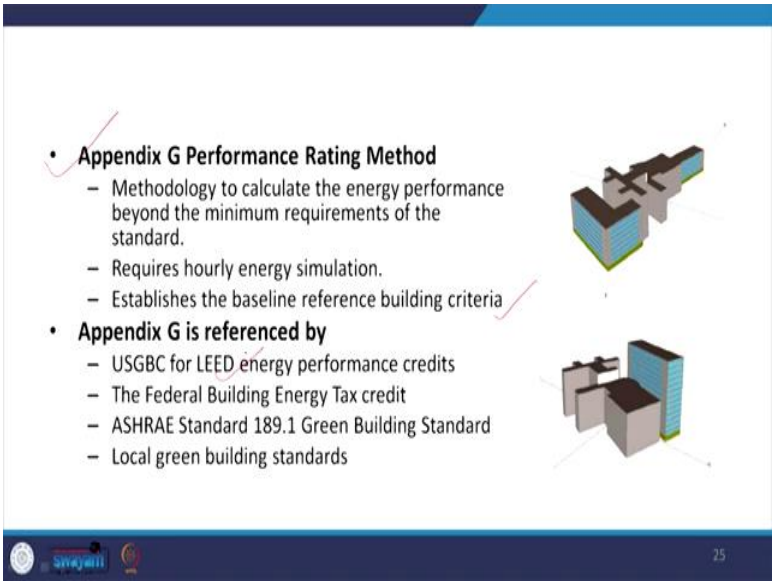

So, this part the compliance approach is absolutely the same. Now when we are talking about the whole building performance method we have this appendix G performance rating

method which is which largely drives the whole building simulation approach method and this is a methodology to calculate the energy performance beyond the minimum requirements of the standards.

It mandatorily requires an hourly energy simulation and it helps to establish the baseline reference building criteria. This baseline building criteria that I very often refer to we will be discussing it in detail in the subsequent lecture. So, appendix G is referred by USGBC for LEED energy performance credit. So, it is only for energy performance that ASHRAE Standard 90.1 and then appendix G is referred to.

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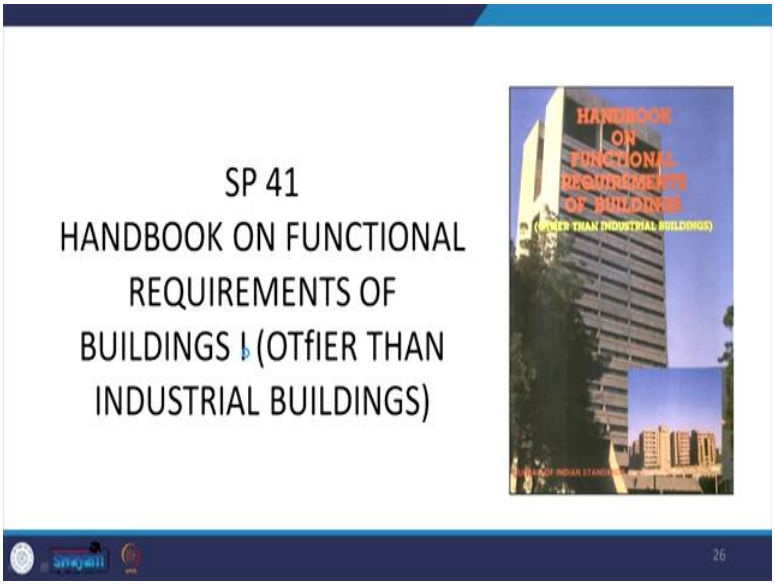

The last here which I want to discuss as part of this codes and standards is SP 41 which is the handbook on functional requirements of buildings other than industrial buildings and SP 41 largely covers which is relevant to sustainable buildings. It covers heat transmission through building sections.

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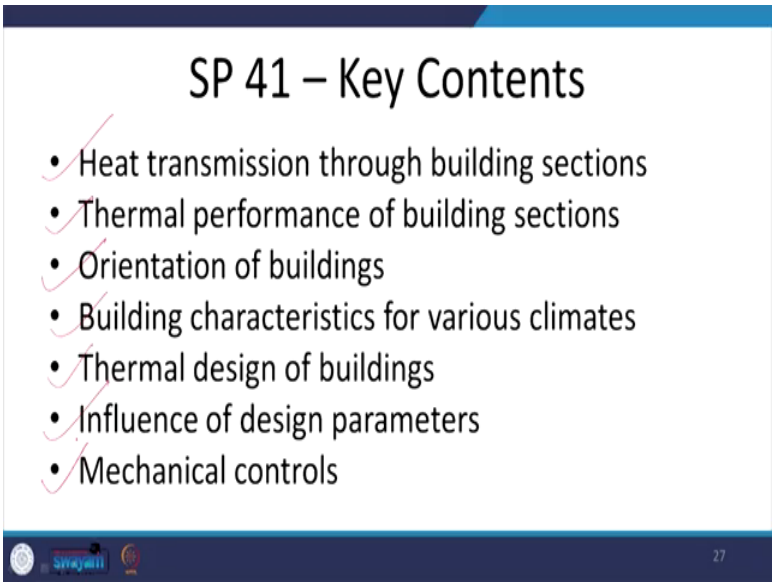

So, there are detailed calculation procedures and thumb rules given to calculate and to understand all these concepts. One which is heat transmission, the second which is thermal performance of building sections then orientation of buildings building characteristics for various climates thermal design of buildings, influence of design parameters and mechanical controls.

So, all these topics have been discussed in detail in SP 41. And it has detailed calculations formula available, where even before designing the building a reference to all these sections would definitely help us in designing the elements in sustainable buildings correctly and in an optimized manner.

So, we were stop here with this discussion on codes and standards. And we will move on to discussion related to whole building performance approach in our subsequent lectures.

Thank you very much for being with. See you in the next lecture.