

Glass in buildings : Design and Application
Prof. Murali
Department of Civil Engineering
Indian Institute of Technology, Madras

Lecture - 48
National Building Code 2016

(Refer Slide Time: 00:22)



So, let us take the first step towards Safety because we have been designing energy efficient buildings for quite long, traditionally the passive architecture or currently the modern architecture. There are a lot of features that have been added to address sustainability. Yeah, we know we do a building more for aesthetic too. But an important criteria which has been lost in the entire building process is the safety, that even glass buildings or glass facades as part of building safety come as a first criteria.

So, what does NBC mean for safety?

(Refer Slide Time: 00:51)

GLASS ACADEMY

What is a safety glass

- ✓ Glass which does **not break under most likely forms of human impact**
- ✓ Even if it breaks, likelihood of cutting or piercing will be **minimized**
- ✓ Does **not include protection** from vandalism, burglary, explosion, fire arms, natural disasters
- ✓ Does not classify for **security glazing**
- ✓ Safety Glass- **Toughened Safety Glass and Laminated Safety Glass**
- ✓ Other types like heat strengthened glass, coated glass etc can be a part of the Laminated Safety Glass

NBC has very clear definition for what is called safety glass. As per NBC the glass which does not break under most likely form of human impact. So, it mean even as it is a general is an accidental procedure, somebody is going to fall on the class even it can be in internal partition the glass should have the ability to with stand the human impact low that is called safety glass. As this case worst case scenario even if it breaks the likelihood of cutting or making any kind of physical damage will has to be has to be the minimized does not include protection. So, here is safety glass the word safety here does not mean it is not for vandalism, burglary, explosion or for fire arms or any kind of natural disaster.

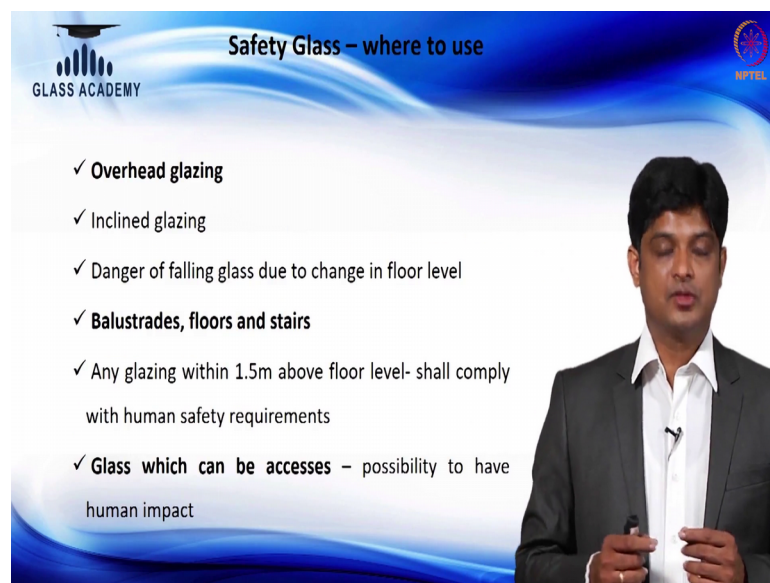
Here the definitions very clearly that, safety glass means; it is safety against human impact because in case if I wanted to make my building safe against vandalism or for explosion or for fire or for kind of a natural disaster, the design procedures has to be slightly different and there are different standards it has to pass through different design consideration I have to take into part during the design. So, the safety glass does not been classified as a security glazing. So, even if I wanted to save my property building or my house from burglary or any other external impact, this safety glass does not going to solve the purpose.

This product which is the safety glass as per NBC which is very clearly defines the toughened safety glass or laminated safety glass. Here it means a glass which has a ability to win higher resistance against human, which is toughened glass which is four

times stronger than an annealed glass or a laminated glass where I use polyvinyl butyl p v b which bonds two portion of a glass two slice of a glass. So, that even as an impact heavy impact happened the first glass break even a second glass will have a tendency to hold the glass one or even at this condition of both the glasses break there is an p v b which holding the class together. So, the glass will not come out of the frame.

So, it can still hold the resistance, only this two types of glass been named as safety glass toughened safety glass or laminated safety glass. If I have to use a coated glass as a part of this, then I have to use the coated glass in the format of toughened or I have to laminated before using it in a building or it can be of a heat strengthened glass for us argument, which is between the impact resistance of heat resistance glasses which lies between annealed and toughened. In that case if I have to use heat strengthened glass, then it has to be used in the laminated format.

(Refer Slide Time: 03:43)

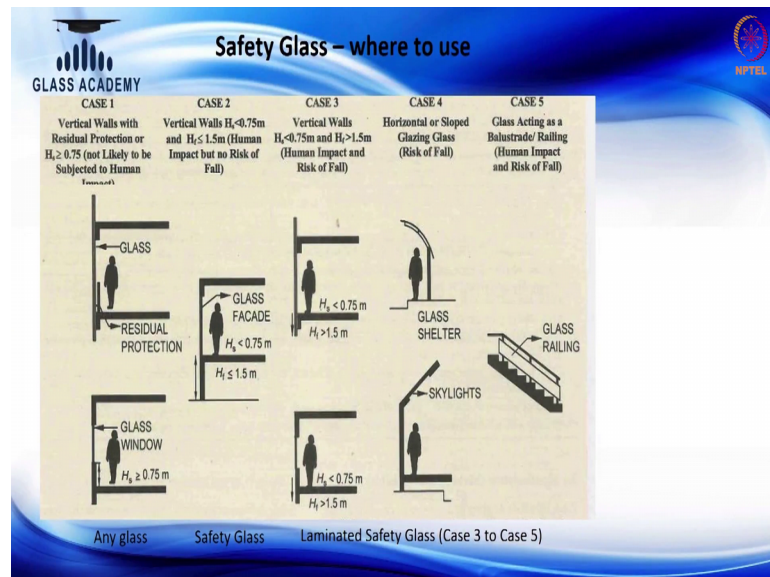


So, where we can where to use this safety glass based on the different locations or access. So, for example, there is a glass overhead, which has you can called as skylight or it can be a horizontal skylight or it can be an inclined skylight or even in case of in any other format even as a architecture or a part of a aesthetics, the facade is going to be a stoked façade. The stoke can be towards inside or it can be an outside. So, is there is a possibility of the glass can fall on somebody then ideally the glass has to be safety glass as per the definition. Where as we use the glass were we are accessible, we use a glass

balustrades, we use glasses floor sometime, we use glasses stairs for the staircase application.

So, in that case where are the human beings or directly accessing or transferring the load over the glass? So, the glasses supposed to take very high resistance against human impact this is what we call human impact. In that case these applications has to be precisely a laminated glass laminated safety glass for an example, the balustrades or the handrails, which has used in your shopping malls which has an access or it has a possibility to fall on during a any kind of human impact. So, it has to be very clearly laminated safety glass.

(Refer Slide Time: 05:05)



So, in fact, to make it very clear the NBC 20 session has a pictorial communication, I would say. So, based on the height of the building, so, the buildings at a ground floor level which even the glass breaks going to just shutter on the floor, you have not still has an provision as an access to go with the basic kind of a class, but moment the glass is going to be above 2.1 meter or you have a provision to touch the glass or you have a provision or the glasses in an inclined format inclined format or in a sloped format or in a handrail the glasses has to be safety glass. Again the safety you can divided based on the application in case of vertical facades still you can go with a toughened glasses, where as there is no compromise when it goes to be an incline or handrail purpose or for

balustrade or for glass application glass floor application or staircase application it has to be laminated safety glass.

(Refer Slide Time: 06:04)

Requirements against	Laminated Safety Glass	Toughened Safety Glass
Impact / Resistance to shock (Ball Drop test)	-	Yes
Fragmentation Test	-	Yes
Warp Test	Yes	Yes
Boil Test	Yes	-
Fracture and Adhesion test (Ball Drop Test)	Yes	-
UV Light Test	Yes	-
Shot Bag (Human Impact)	Yes	Yes
Light stability test	Yes	-

▪ Bake test, humidity test (for laminated glass) and surface compression, four point bending test, waviness (for Toughened glass) are optional

So, moment I mean safety glass, it does not mean that any process glass can be named as safety glass as a definition safety glass means we know it has to take human impact. So, how to quantify it? So, there is a kind of or a list of test available as per a different standards including a n or the current I S which is get to getting launched. So, there is a list of test like whether impact or resistance to shock which is ideally called Ball Drop test or Fragmentation Test, Wrap Test, Boil Test for laminated glasses, fracture and adhesion test again for laminated UV light test, Short bag which is ideally for the human impact. So, that you can understand or create an impact like human and then understand what happens to the glass Light stability test.

So, these are the list of test which is identified in NBC 2016 as a procedure to go through any processed glass before getting installed in the building, there should be a set of samples has to be taken during the processing, it is ideally like how we do cube testing for concrete. So, you have to take a list of set of samples send it to laboratories available which can do the testing currently IIT, Madras has this kind of a testing which can do this. So, that you will make ensure that the processing procedures are follow.

And the testing over the processed glass has passed or followed the methodology as per the standers requirement. So, based on whether it is laminated safety or toughened safety

there are few tests which are mandatory few tests are kept as optional based on the functionality, which is very clearly detailed out in your NBC 2016. For an example, the bake test and humidity test it is specifically for laminated glass, where as safaris compression as four point bending or the waviness which very precisely has to be done for toughened laminated glass toughened glass soft and safety glass.

(Refer Slide Time: 08:06)



Summary:

By the end of this video, you have learnt about the:

- Definitions of safety glass
- Usage of safety glass
- Test requirements