Structural Reliability
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Lecture –247
Target Reliabilities (Part - 10)

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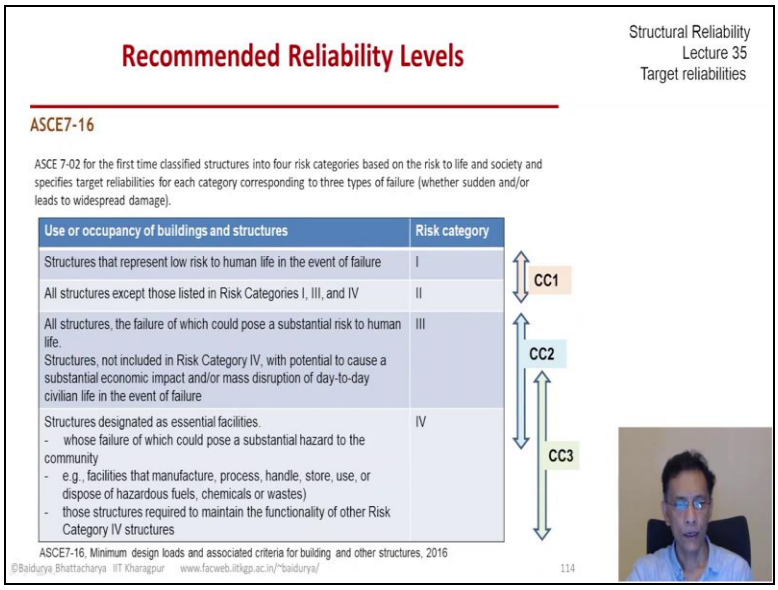

AACE-7 the minimum design loads standard the 2002 revision was the first one that classified structure's into four risk categories depending on the risk to life and society and then specify target reliabilities for each of these categories corresponding to three types of failure. Let us first take a look at the four risk categories. So, the risk category one is those structures that represent low risk to human life in the event of failure.

Then let us define risk category 4 these are on the other end of the spectrum structures that are essential facilities whose failure could posed a substantial hazard to the community many lives at risk including those structures that store hazardous and toxic materials and also those structures which have an essential role in supporting other category four structures. Then let us define category three it is those structures that pose a substantial risk to human life and structures that are similar to category 4 in terms of hazards and toxic substances.

And then category 2 are those that are not in 1 or 3 or 4. Now it would be obviously an interesting question and a logical question to see how these four risk categories compare to the PN 1990 Euro codes consequence classes. So, it would seem based on the definitions that AAC's risk categories 1 and 2 would very closely match the CC1 of the euro codes it would seem there that CC2 would not only cover risk category 3 completely but a part of this category 4.

And there would be likewise an overlap of for CC3 which would cover all of category 4 and parts of category 3.

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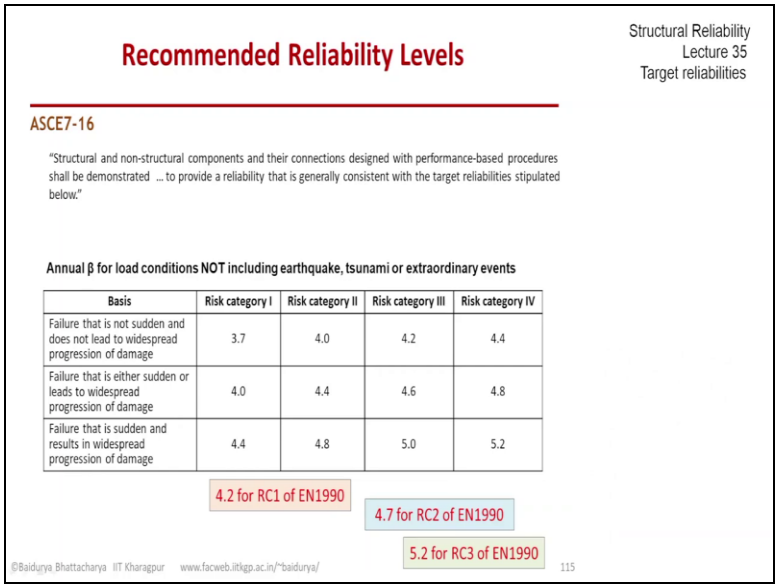

Now let us look at what the proposed target reliabilities are AC7 of 2016 is very explicit that these that structures have to demonstrate that a certain reliability or the specified reliabilities have been achieved and. So, there are three types of failure. So, the first one is failure that is not sudden and does not lead to widespread progression of damage and for that we have target beta values per year gently rising from 3.7 all the way to 4.4.

And then we come to the next one failure that is either sudden or leads to widespread progression of damage but not both. So, basically we are partitioning the entire sample space into a and b either a or b but not both and neither a and nor b. So, this is the second class that either sudden or leads to wise spread progression damage and then you see the beta values are slightly higher than the row above in each column.

So, they rise from 4.0 all the way to 4.8 and then finally we have the and operator and failure that is sudden and results in widespread progression of damage that has the highest target reliabilities. So, they increase from 4.4 all the way to 5.2 for this category 4. So, 5.2 is the most severe case and has the highest target reliability. Now how would these compare with the RC1, RC2 and RC3 from euro codes it would seem that 4.2 which is the target for RC1 per year of year 1990 it kind of is in the same range as what you see in AC7 for failure that is sudden.

And results in widespread damage that is those reliabilities in AC7 are higher than that in EN 1990 and then if we look at RC2 which is 4.7 and if you now compare with price category three and part of this category four it would seem that the EN1990 is quite in the middle of the range of AC7 and then finally if we look at RC3 which is 5.2 then obviously that is that is at the extreme operand of the range for AC7.

So, it would appear that euro codes provide the highest level of target reliability for those with the highest risk and in this case failure is sudden. So, not much warning and widespread damage. So, these target reliabilities where for those load conditions that did not include earthquake tsunami or extraordinary events.

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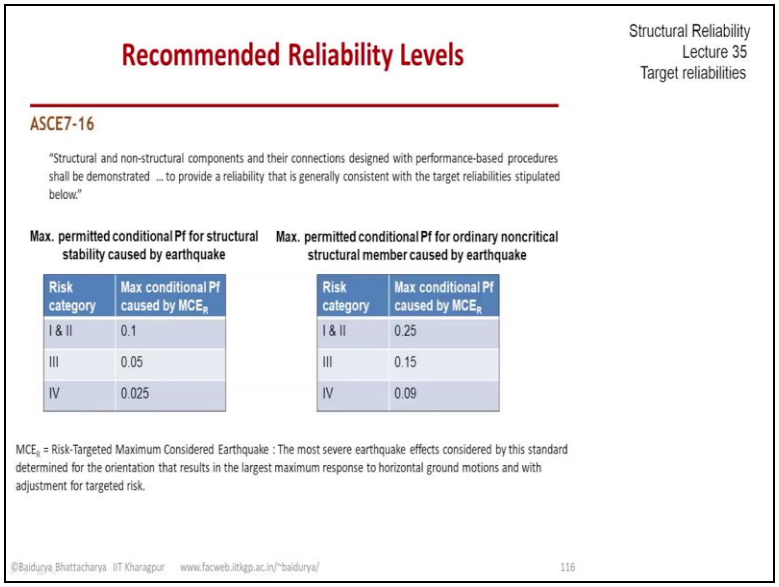

AC7 also provides target reliabilities for those situations. So, here are two of those under risk

categories one and two or three or four there are maximum permitted conditional probability failures. So, they are not with respect to any time horizon but against loss of stability under earthquake and especially the MCER. So, the Maximum Considered Earthquake which is risk targeted.

And likewise we also find the maximum permitted conditional Pf for ordinary non-critical structural members also under MCER. Now let us just take a look at an example. So, suppose we are looking at risk category 3 which is very common for most structures and we see that the conditional failure probability is five percent. So, if we say that the probability of a MCER in 50 years which is say the lifetime is two percent. So, then the unconditional Pf at the unconditional failure probability will be 0.05 times 0.02. So, this is 0.001.