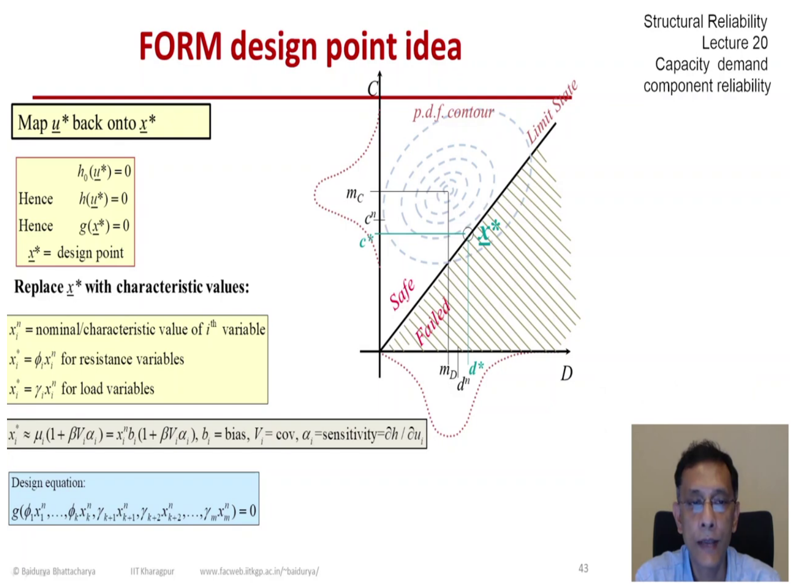
Structural Reliability
Prof. Baidurya Bhattacharya
Department of Civil Engineering
Indian Institute of Technology, Kharagpur

Lecture –166
Capacity Demand Component Reliability (Part 14)

(Refer Slide Time: 00:27)



We end this lecture with some ideas on form design point I have used the word idea because you know this is a bit too premature and one should not take this slide as conclusive it is just to give an idea of how form might be used. So what you see on the right is the space of basic variables. So, C and D are capacity and demand and we are taking a very simple approach that it is a linear function. So, the limit state is C minus D and what you see here is we have x star.

So, x star is the map back the inverse map from the u star that we obtained in form in the independent standard normal space. So, if we can go from x to u we can always come back from u to x. So, u star can be mapped back to x star and just like u star is a point on h equals zero x star will be a point on g equals 0. So, you will find a point on the limit state equation the limit state line now what do we do with that there are we can actually expand this idea that g of x star equals 0 and see if we can describe that in terms of more familiar quantities.

So, x star are some very special values of the basic variables obtained from a form analysis the form u star happened to be the most likely point because it was closest to the origin and the pdf contours are such that they are circular in nature. So, in any direction the further you go from the origin you are going to decrease in probability density. So, the closest point to the origin has the highest probability density.

So, that is why we call the maximum likelihood point on the limit state surface. So, by that logic x star is a maximum likely combination on the limit state surface even in the basic variable space. So, can that give us something can that x star be interpreted in a manner that has a practical value it turns out we could we could represent x star in terms of the characteristic values of these basic variables if you have them and here are certain steps which we will look at towards the end of this course in more detail.

So, this is this is how it goes. So, x i superscript n is the nominal of the characteristic value of x i and we can say that okay it is relation to the design point value is in terms of a factor phi. So, x i star could be x i n times a factor phi this phi will turn out to be a very important factor likewise for we could for load type variables phi was for resistant type variables for low type variables we could call another factor gamma.

We could give it a different name gamma and that is actually helpful because we like to give different symbols for strength type versus load type variables the factors that is and now we know that the x's can be expressed in terms of what we saw in the standard normal space the independence and normal space u if we make certain substitutions for example if you remember u was beta times alpha. So, and if now we factor the mean out we can express x star in terms of mu times 1 plus beta v times a where v is the coefficient of variation.

So, mu times coefficient of variation is sigma. So, and then we can substitute the mean in terms of the nominal by bringing in the bias factor. So, bias is mean over nominal. So, thereby we are actually reaching of an equation which involves the nominal values the last one in this line in this box is alpha we described that was the sensitivity also the cosine of the angle that the minimum distance line makes with the axis of u.

So, going back to what we started with we can write g of x star equals 0 in terms of all these expanded versions of x in terms of x n of x star in terms of x n and now we are point by point if we express this. So, we are left with a function which involves all the nominal values of the basic variables multiplied by a certain factor these factors later on we are going to call them partial safety factors load and resistance factors but that we will come back to towards the end of the course this was just a preview.