Structural Reliability
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Lecture –159
Capacity Demand Component Reliability (Part 07)

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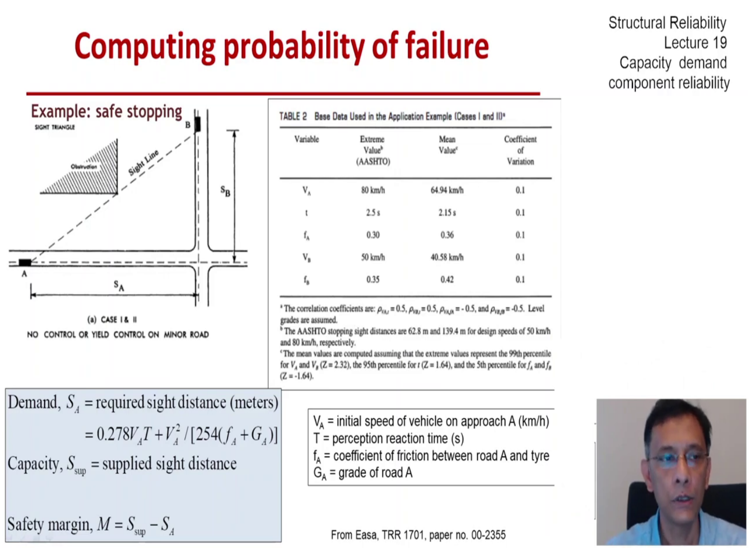

We have already seen this problem when we discussed how to formulate a reliability problem this involves a design of an intersection from transportation engineering. So, we have to make sure that the required side distance is less than the supplied side distance but there are random variables involved. So let us solve this problem with some typical numerical values.

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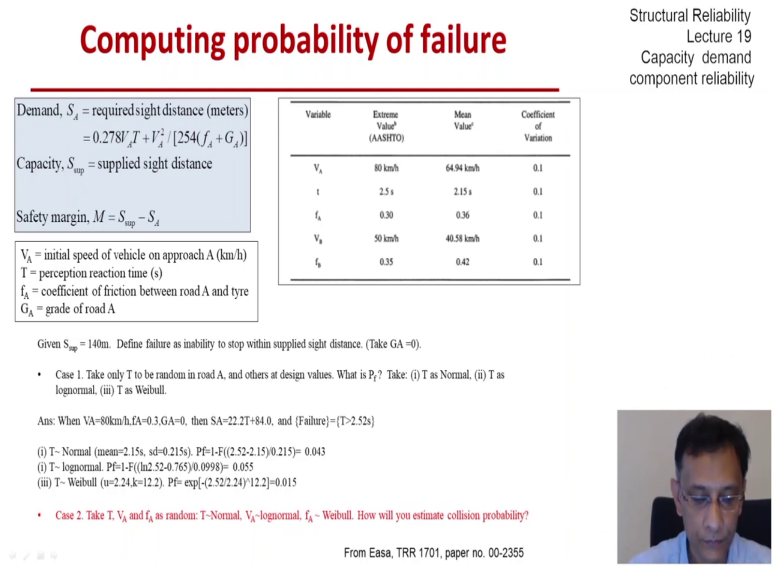

So, on the top left you see the limit state which is M the S supplied minus S required all the random variables are defined and all the other constants are defined. So, we and it is also stated that the supplied side distance is known to be deterministically 140 meters. So, suppose only T the time of the perception reaction time is the only random variable and all other parameters are fixed non-random at their design values.

So, we can solve this problem under various assumptions that this T random variable T is normal or log normal or viable and it would be a simple exercise you have done solve these problems already several times. So, if you want to work through them please pause the video otherwise let me present the answers. So, when we fix the non-random parameters at their design values we get a limit state failure as T greater than 2.52.

So, here failure is written in an inverse form typically we have g less than 0 but here T is greater than 2.52. So, you can think of it as 2.5 to minus T would be our limit state function anyway. So, when T is normal we can solve it and the answer comes to something like 4.3% when T is log normal we can solve it and the answer is a little different when T is viable we can also solve it the answer is again smaller.

So, clearly and we know by now that the distribution of the random variables can significantly affect the answer in terms of P_f or reliability. But we have a more interesting question here is that what if T is not the only random variable which is what we should expect and what if V_A the initial speed and f_A the friction coefficient they are also random variables and we can define their properties either from data or from the literature or from some reasonable assumptions in either case how will we estimate the collision probability.

It is not a simple cdf calculation anymore there are three random variables involved and there is no way that we can combine all of them into a nice analytical closed form answer. So, what we are hinting at here is that there are situations and which are more common than the otherwise is that we have to resort to approximations we have to come up with estimation techniques for failure probability where an exact solution is not readily available. So, we need approximations and we are going to present them very soon but let us go through one more example.