Structural Reliability
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Lecture –90
Reliability Problem Formulation (Part - 02)

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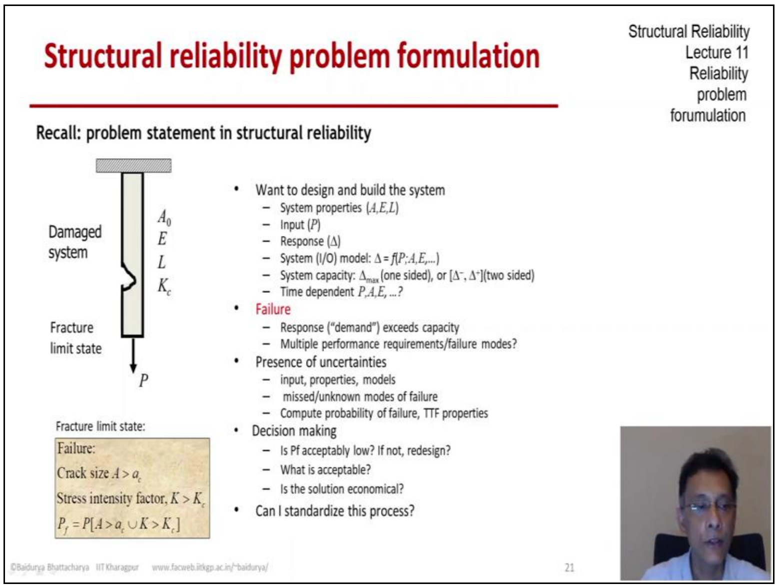

So let us take a look at how this fits in with the overall scheme of things. This slide we have seen in the past in the first lecture where we tried to give an overview of things to come. So, this was our problem statement. We want to design or build a system and we know its properties its input its response its input output model system capacity and we have knowledge we have definition of failure in terms of response exceeding capacity.

And then we know the uncertainties involved and we are able to make computations estimate failure probability then we can take decisions and hopefully standardize the process. So, the point to note here and what we are trying to do in todays lecture is what I have in red how to define failure. So, that would be one of the key steps in setting up the reliability problem. Instead of an intact system that you see on the slide if I had a damaged system I would probably have a different interest in failure a different definition of failure instead of an elongation.

And excessive elongation limit state I would probably have a fracture limit state. And the fracture limit state I could describe in terms of crack size meaning that the crack size exceeds a limiting value a critical crack size or the stress intensity factor exceeds the fracture toughness I could be interested in both of them and failure would be defined in terms of either or. So, a series event as you see on the on the screen.

So, what would be the key steps in that that red marked item that definition of failure because that is the physics-based definition of failure that is the physics-based reliability problem and that is a key step in setting up a problem in reliability and structural reliability in particular.

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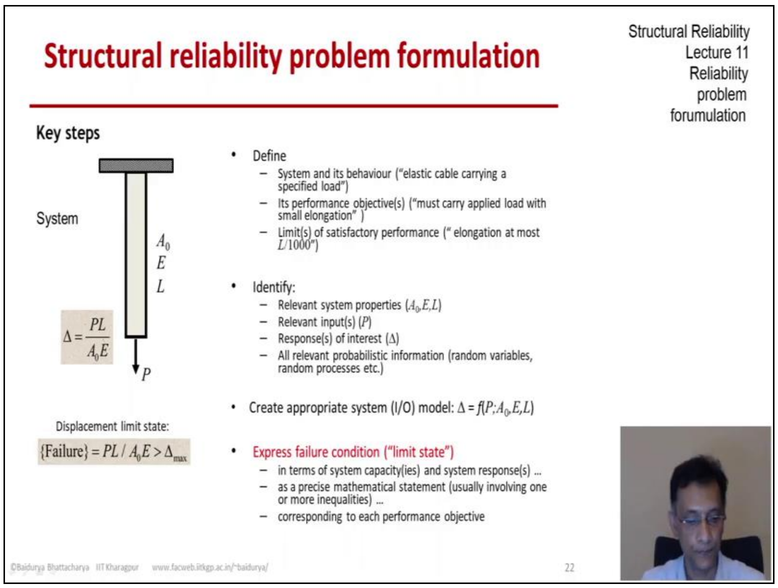

So here are the key steps. First I need to be able to define the system and its behaviour. So, in this particular case the example that we have been talking about that you see on the on the screen on the left is an elastic cable that needs to carry a specified load. Then I need to define its performance objective or objectives; which in this case is that the cable must carry the applied load with small elongation.

So, it must not suffer a large elongation. So, that is my performance objective. So, the cable must carry the load and it should elongate within limits. So, the next thing to define would be the limits of satisfactory performance in this case it is one-sided that elongation just an example that elongation is at most L by 1000. Once I am able to define those then I need to identify the relevant system properties that would let me impose that condition of satisfactory performance.

So, the system properties are the inputs the response or responses of interest and how to connect them together see all probability information and how to connect them together through the input output model. So, that would be my finite element model for a larger structure. Then the next important step that would be express failure condition making use of all the things that I have done above.

So, express failure in terms of system capacity or capacities and system responses as a precise mathematical statement which involves one or more inequalities in this case just one for each performance objective. So, these would be the key steps in setting up a reliability problem solving it, estimating probability taking decisions etcetera they come later. In today's lecture or objective is to understand these key steps and go through some examples of how to set up such a problem.