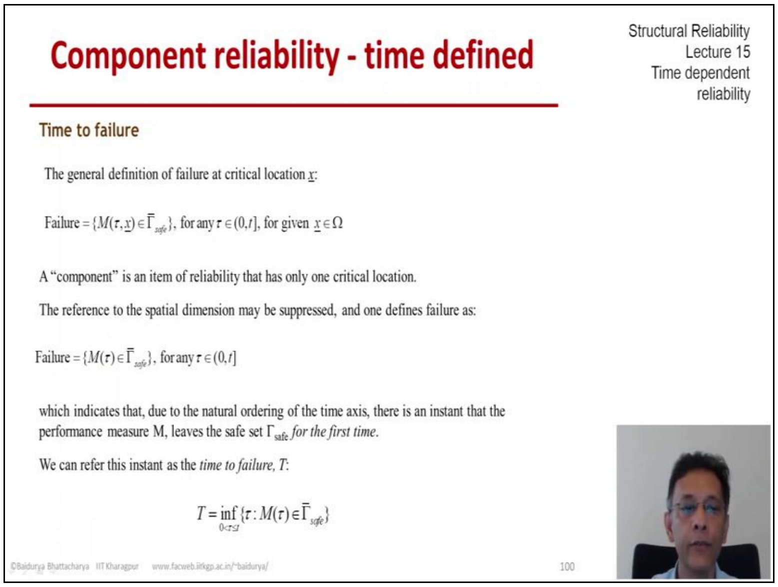
Structural Reliability

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

Lecture –121
Time Dependent Component Reliability (Part - 02)

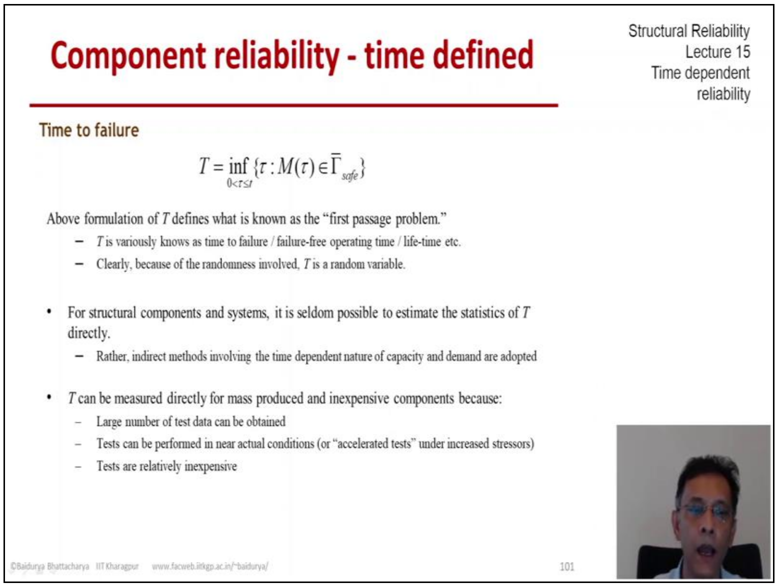
(Refer Slide Time: 00:33)



The random variable describing the time to failure; the general definition of failure at a critical location is we have looked at this type of approach several times in the last couple of weeks is that there is a safety margin there is a performance function that exceeds that goes out of a safe set which is gamma safe here. And the over bar indicates the complement. So, if this happens at that location x any time tau during the lifetime between 0 and t then we would have a failure.

Now, since we are talking about components in this lecture we will suppress the reference to the location and simplify the definition of failure as the safety margin m which is time dependent that goes into the unsafe set at any tau between 0 and t. So, since the time axis is ordered such an excursion into the unsafe set would happen for the first time and because of all the randomness involved this the first time that such a thing would happen such an excursion into the unsafe set would happen would be the random time to failure. So, that is how we formally define the random time to failure.

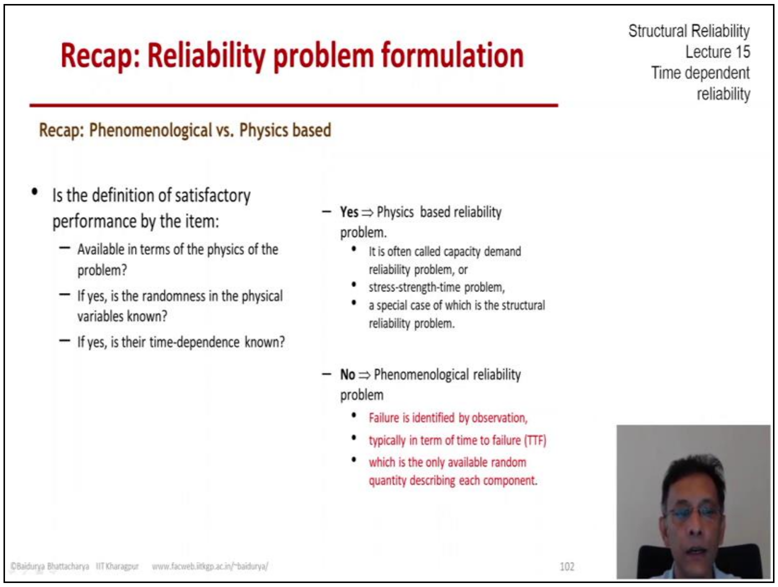
(Refer Slide Time: 02:04)



And in general this comes under the class of problems known as first passage problem and this T this first passage time is variously known as time to failure, failure free operating time lifetime etcetera. And for reasons that we have discussed several times t is a random variable. Now for structural components and systems we do not have the ability to observe directly this time to failure for in most situations rather we have to take recourse to the capacity demand time approach to solving to formulating and solving the reliability problem.

However if we have access to a large number of mass-produced identical and relatively inexpensive components then we could test them under near actual conditions or under accelerated tests under increased stresses. But we would get a large number of test data time to failure data and then we could use them to estimate various metrics of this random variable T.

(Refer Slide Time: 03:30)



So, to recap we do not have a physics-based definition of failure in such situations. So, we do not have a capacity demand time sort of formulation. What we have is a phenomenological approach and we are going to define time to failure by observation. And then we can estimate various metrics from this time to failure including reliability hazard function etc which we are going to see later in this lecture.