**Structural Reliability**
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**Lecture –98**
**Representation of Systems (Part -02)**

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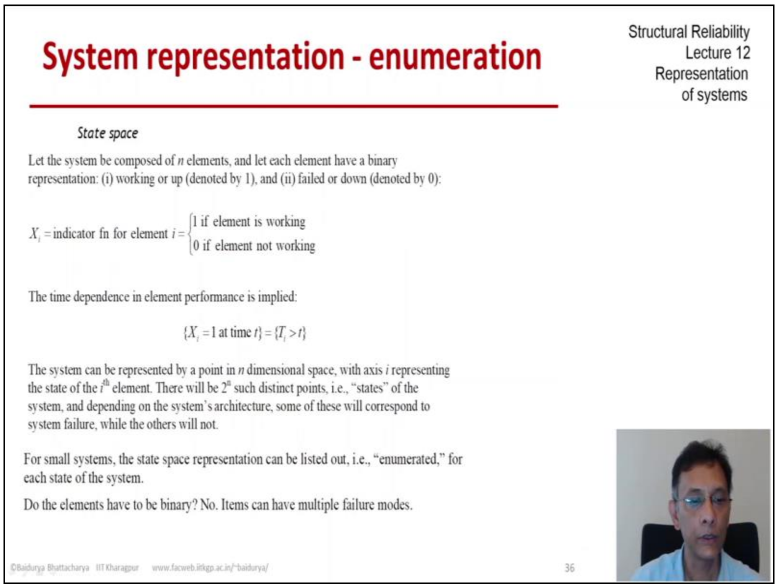


System representation through the method of enumeration: So, what we will talk about is the state space. The systems are composed of n elements and let us say; each element is binary in nature. So, let the state one be that it is working or in an upstate and let the state zero be for its faith or it is in the; So, I can have the performance indicated for each element X i. So, that is equal to one if the element is working and zero every element is not the if time was an important aspect here which it often is so that is implied.

So, if X i is one at time t that means the time to failure which we have not discussed we will in a week or two from now that is greater than small t. So, random time to failure of element i exceeds small t it is the same thing as saying X i is equal to 1 at time T. So this we could do for all such elements of the system. So, if the elements are binary in nature then we would have 2 to the power and the entire power set of such states and that would each of those points each of those two power n points would give me a state for the system itself.

So, if the system is up or system is down we would be able to indicate that provided we know how the system is composed of in terms of its elements. And this works and we are going to look at an example in the next slide for small systems this works in fact later on we are going to look at also a three-state system through enumeration.

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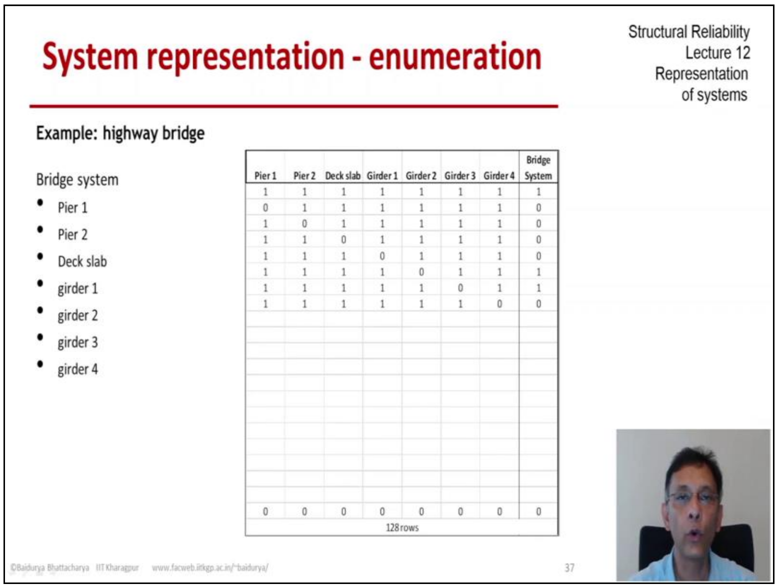


So, let us look at the example it is a simple structure let is say we have we have a bridge system the bridge system is composed of seven elements two pairs one deck slab and four girders and which means there are 128 possible states of those elements and each of those would give rise to an up or down state for the bridge system. So, let us look at a few of them and that would give us an idea how this method works and obviously in creating this enumeration one needs a good structure knowledge or good knowledge for the system.

So, let us look at the first row. So, all the elements are up. So, from here one all the way up to go to four. So, obviously the bridge system is up the next one let's said the clear one is it has failed. So regardless of the state of the other elements it's an essential component of the bridge system. So, obviously the bridge system has fit that is the second row. The third row is likewise what happens if the two fails while all the others are up then also the bridge system fails.

Obviously both pier fail that would be another row down the row then also the bridge system would have failed. If we look at row number four if the next slot fails the bridge has failed even if all the others are up. Likewise the next row, row number five if girder one has failed that means failure of the system the girders are numbered from left to right or end to end. So, if it's one of the end girders and it has failed then the bridge has failed for all practical purposes.

So, that is row number five but it could be and that is what I think is happening to the bridge here that is that is our understanding is if in row number six if girder two has failed and everything else is up then the bridge is able to take that loss and still function. So, even if girder 2 has failed but the others are up the bridge is up that is that is what we find here. Obviously it will depend on the bridge's behaviour on its design and construction but that is one of the things that will come out only from our understanding and analysis of the mechanics of the system.

The next row likewise we make the same argument that if girder three fails another interior girder and the others are all functioning then the bridge will still be okay again. The next row if the other four fails then the bridge has failed because it is one of the end curves. This way we could enumerate all the states of the system and if the number of states is small it is actually a feasible method until we have exhausted all the 128 possibilities. The last row being all of them is down and the bridge system is down as a result.