Structural Reliability

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Lecture –102
Representation of Systems (Part -06)

We continue with our discussion on system representation in terms of the system's constituent elements. Today I would like to cover reliability block diagrams and cut sets. So, let us start with reliability block diagrams.

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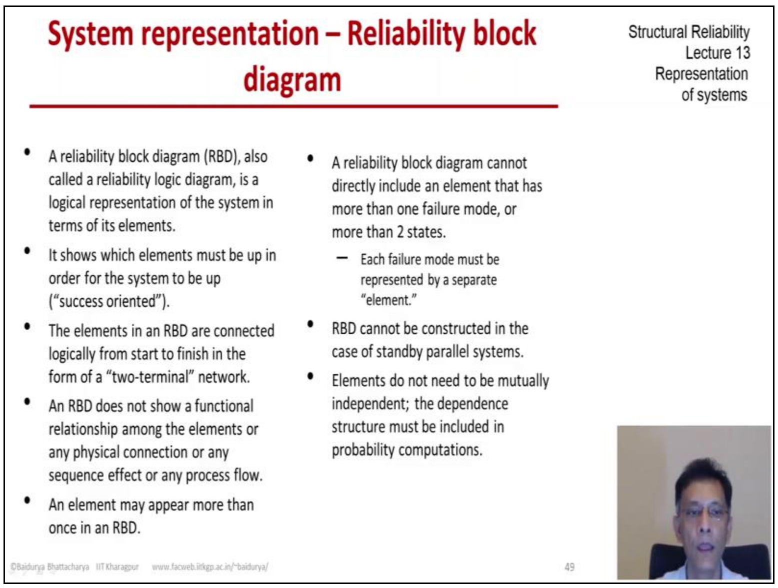

And RBD also called a reliability logic diagram is a logical description of the system in terms of its elements and we have seen some examples obviously in the last few weeks. It shows which elements must be up in order for the system to be up. So, it is a success oriented approach the elements in a RBD are connected logically from start to finish. So, we have a start terminal and an end terminal.

So, it is kind of a two-terminal network it is important to note and keep in mind that an RBD does not show any functional relation among the elements or any physical connection among the elements or any sequence effect or any process flow is just a logical construct. An element may appear more than once in an RBD and we will see one example. An RBD cannot directly include an element that has more than two states or more than one failure mode.

So, if you have a multi-state element then each failure mode or each success mode must be represented by a separate element logically. We are going to talk about standby systems standby parallel systems later uh. So, just as a heads up and RBD cannot be constructed for such systems and elements in the RBD do not need to be mutually independent but when we do probability computations we must keep that dependent structure in mind.

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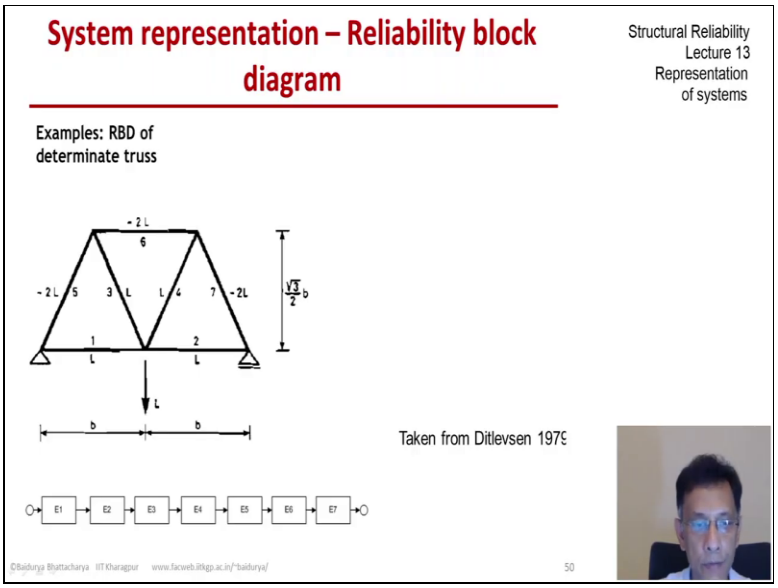

Let us start with a very simple example this is a determinate truss taken from Ditleven's 1979 book since this is a determinant truss any element failing is tantamount to system failure. So, the system is in effect a series system and the reliability block diagram for this system would be just the 7 elements of the 7 truss elements connected in series. So, as I said this RBD that you see at the bottom of the page it does not in any way mean that that's how the elements are connected.

So, that is the logical representation of the system. Let us move on to one example that we looked in the previous lecture.

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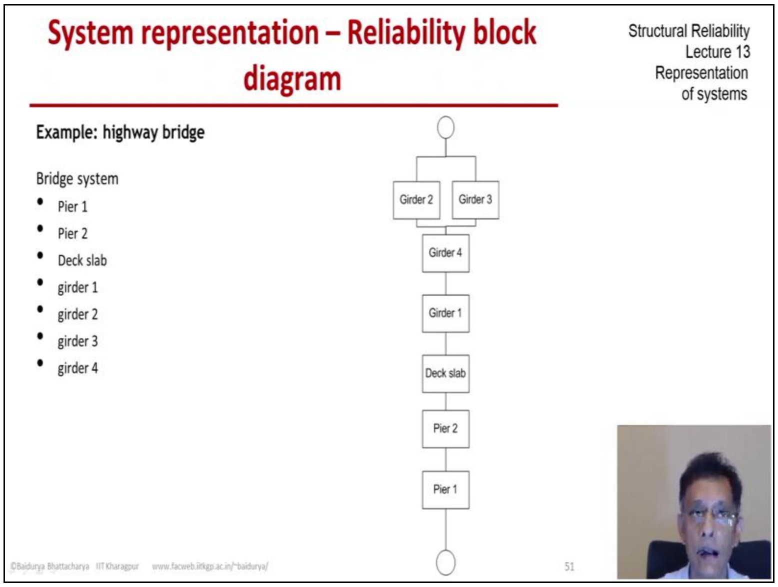

This is a little more complicated than this 7 member determinant truss. We if you remember we had a bridge system that involved two peers 1 deck slab and 4 girders and the logic that we agreed upon for the bridge was that each of the peers is essential for the functioning of the bridge as is the deck slab. But for the girders the end girders on either end girder one and girder four are essential but if two fails or three fails separately then the bridge is still okay.

So, with this understanding of the mechanics of the bridge let us continue let us build up the RBD for this bridge. So, we start block by block pier one is the first element let us say pier 2 would be in series with that the deck slab also in series with that girder 1 the left girder is essential. So, it is also in series girder 4 is essential the other end girder and it is also in series but girder 2 and girder 3 are in parallel.

So, at least if one of them works then the bridge would be okay. So, both of them need to fail if the bridge has to be declared in a failed state.