Structural Reliability
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Lecture –02
Introduction (Part - 02)

Let us start with looking at some of the joys and challenges faced by engineers and civil engineers in particular.

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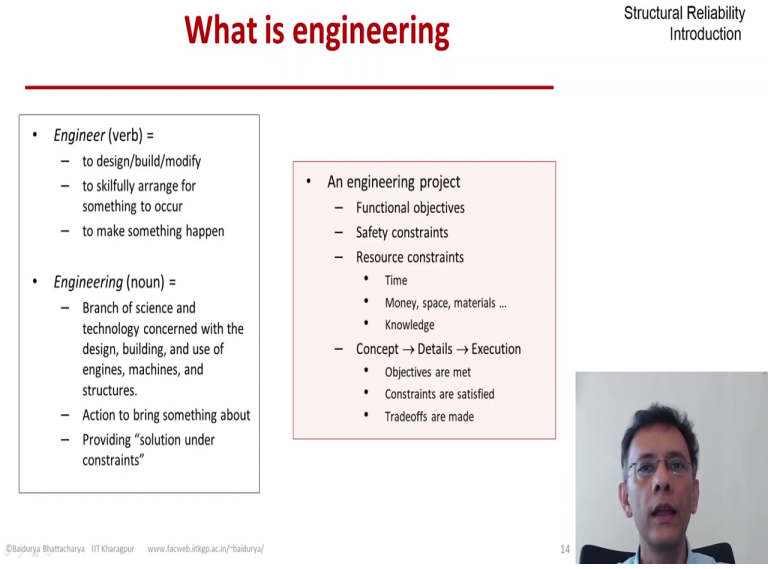

If you look up the word engineer or engineering in the dictionary you get the usual answers but I would like to add one here engineering is providing solutions under constraints I think it captures beautifully the essentially creative nature of engineering. So where does this notion of solution under constraints come from? Let us take an engineering project it always starts with functional objectives that the product the system must satisfy and there are constraints of safety.

There are constraints of resources the available time the space the materials funding and so on but very importantly there is also the constraint in knowledge about the state of the art. How the system behaves its mechanics, its environment, its future service conditions. So an iterative process starts until the solution is reached that meets the objectives and satisfies the constraints and invariably in this process trade-offs are made.

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So over the millennia civil engineers and structural engineers have created many marvelous achievements. We have a sample here the Sanchi Stupa constructed during the third to the first century BC. The pyramid of the Sun during the first and second century AD, the Hagia Sophia in the sixth century the Notre-Dame in the 12th through the 14th century our Taj Mahal completed in 1648 the Golden Gate Bridge in 1937.

The Majestic Bhakra Dam completed in 1963, The World Trade Center buildings in 1973. So these are examples of great structural engineering achievements over the ages some damaged but being brought back some whose time have passed some made to fall down and some that are still serving very well. Now obviously buildings are not the only kind of structures as I said in the introductory slides that some structures move, some float or even fly.

And some structures are large some are tiny and the common thread going through all of them is that structures do fail.

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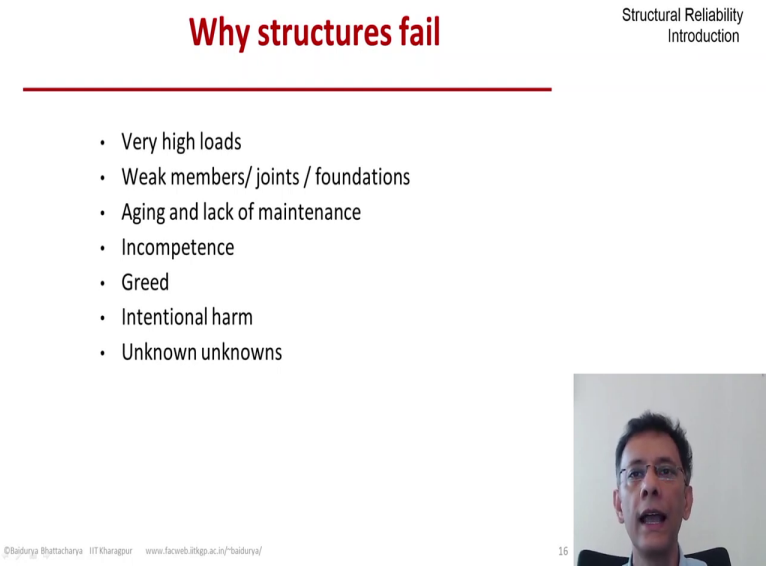

Now why do structures fail there are many reasons there could be very high loads, loads that are outside the design envelope. Some key elements that are weaker than they should be, aging and lack of maintenance, sometimes plain incompetence, bad design, and bad construction. Greed deliberately using low quality material and workmanship, intentional harm sometimes and sometimes as a famous person once said the unknown unknowns.

So the previously unknown failure modes not understanding accurately how the structure may behave particularly under unusual conditions. So this point can happen when there is new material, new construction techniques or new applications involved. So we will see a few examples next and also see how the engineering community came together and learned the lesson from the unfortunate failures and made the future systems better.

And this way they lived up to an increased the expectation of high structural safety and performance in the public mind which can be seen from the outrage that invariably follows actual or even thought of structural failures.