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NPTEL ONLINE
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Failure Analysis & Prevention

Introduction: Engineering Disasters

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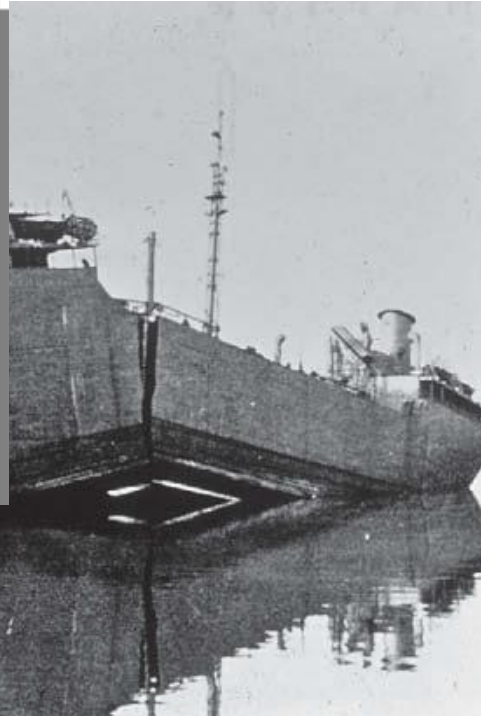
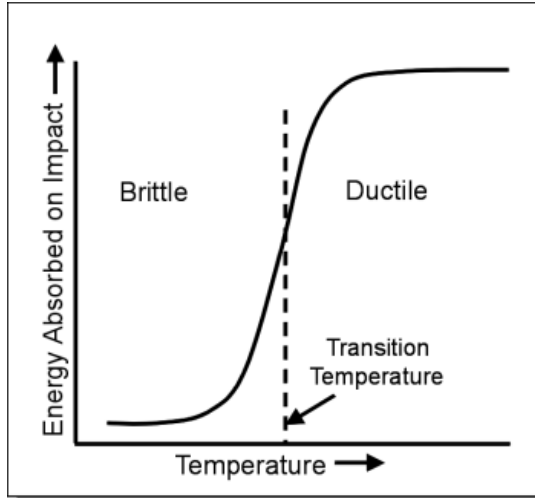


Engineering disasters

- A disaster is referred to as an engineering disaster when it's caused by an **engineering failure**:
 - design flaws or
 - materials failures
 - insufficient knowledge,
 - different underestimations,
 - even carelessness or negligence.



Titanic Ship, 1912



- RMS Titanic was a British passenger ship that sank after hitting an iceberg on her maiden voyage from Southampton (UK) to New York City, in April 1912. The tragedy claimed the lives of over 1,500 people.
- Several rivets of the 3 million rivets that held the Titanic together were recently recovered and tested, and found to be made of low quality iron, which on impact caused them to fall apart.
- Another engineering fault was that the 16 watertight compartments that kept the boat afloat, were not individually sealed, but rather connected near the ceiling. This enabled the water to spill from one compartment to another and sink the boat.

St. Francis Dam flooding (1928)

- The St. Francis Dam was a concrete dam built between the years 1924 and 1926, to create a water reservoir for Los Angeles.

The dam was located in a canyon around 40 miles (64 km) from the city.

On March 12, 1928, just hours after being inspected by the Chief Engineer William Mulholland, the dam failed, sending a massive water wave 120 ft tall, and killing as many as 600 people in one of the worst American civil engineering disasters



Tacoma Narrows Bridge collapse (1940)



The first Tacoma Narrows Bridge was a suspension bridge in Washington state that opened in 1940 and collapsed at the same year. At the time of its construction, the bridge was the world's third longest suspension bridge, by main span length.

The bridge was known to move vertically in windy conditions, and in November 7, 1940, under 40 mph (64 km/h) winds it collapsed. The collapse was caught on video and made an impact on science and engineering, especially bridge designing till today.

The cause of failure was aeroelastic flutter – a dynamic instability of an elastic structure.

Kadalundi Train Disaster

- There was a structural failure. The railway bridge was around 140 years old and it definitely needed repair.
- What happened was one of the pier had settled down causing internal stresses to grow in rails.
- As soon as a train came near it, the track snapped and the train derailed which eventually landed into river.
- So lesson one, never ever use a structure of high importance without testing it. Always, keep an eye on it and test it.



The Bhopal Disaster: Union Carbide

The 1984 Bhopal gas disaster

The human cost (estimates)

- ▶ Up to 10,000 deaths in first three days
- ▶ Additional 25,000 people died of related injuries by 1994



Rafiganj rail bridge



- Blamed to poor design and construction as well as low maintenance.
- It is said that the plate girder deteriorated over time and was losing its **strength in fatigue due to vibrations** from trains.
- Nobody paid attention to it. Also the **bridge was rusty** to a great extent.
- When the train was passing by, the plate girder gave up leading to this fatal crash.
- Lesson two, make sure your design is checked against fatigue and steel is coated with anti-corrosion paints.

Need of Failure Analysis

- The failure of engineering components frequently leads to disruption in services.
- To establish primary factor and other important factors that led to failure
- Make recommendations to avoid failure in future.
- To avoid reoccurrence of the failure of engineering component during service

