AALBORG UNIVERSITY

Fatigue

some famous accidents

and some less famous

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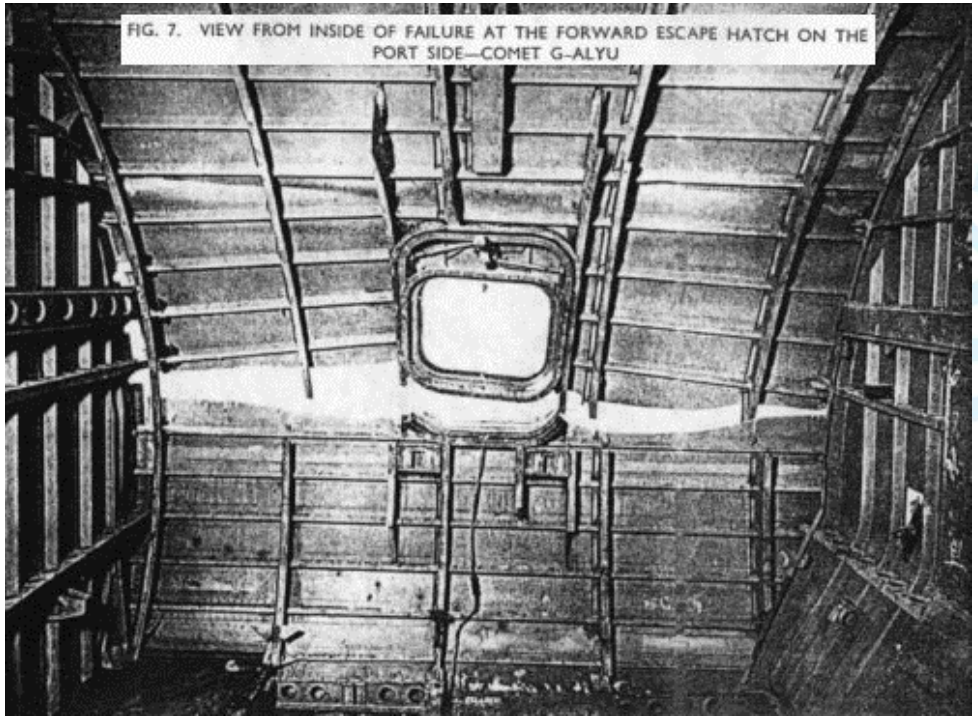
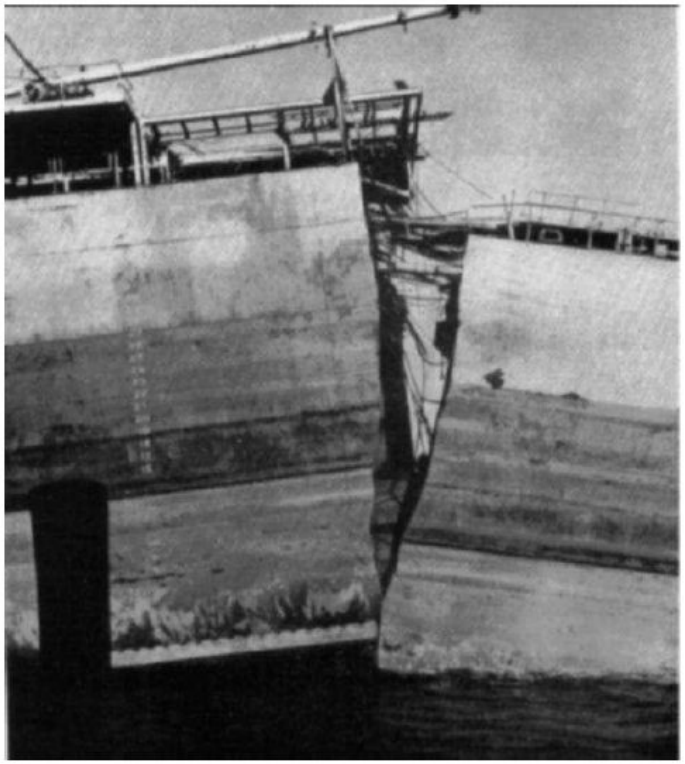
Comet – a new design of window holes was catastrohic

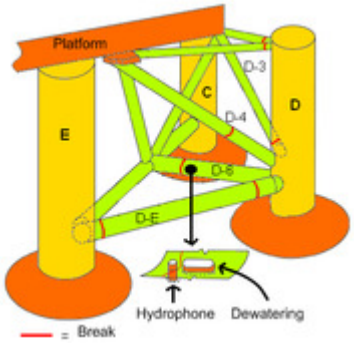


Liberty ships – new design and cold water



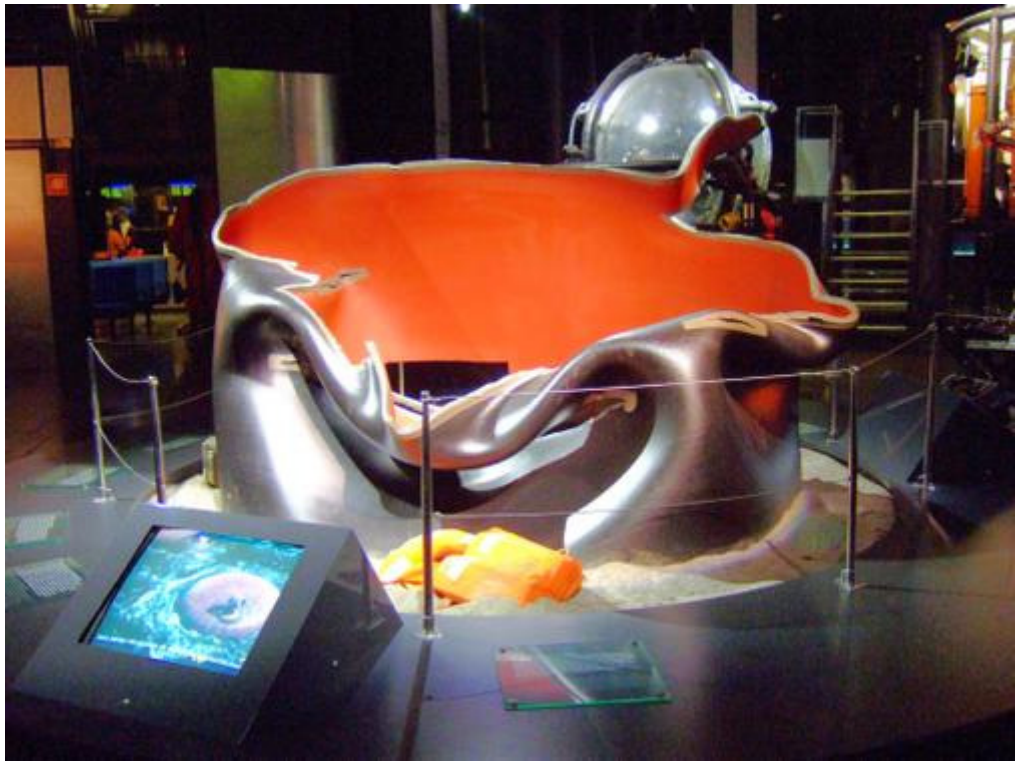
Low temperatures can severely embrittle steels. The Liberty ships were the first all-welded ships, and a significant number of ships failed by catastrophic fracture. Fatigue cracks nucleated at the corners of square hatches and propagated rapidly by brittle fracture. In earlier ships, the riveted plates acted as natural crack arresters. These were absent in the all-welded Liberty ships. The problem was solved by improvements in ship design and steel quality.

Alexander Kielland – bad design



A year later in March 1981, the investigative report concluded that the rig collapsed owing to a fatigue crack in one of its six bracings (bracing D-6), which connected the collapsed D-leg to the rest of the rig. This was traced to a small 6mm fillet weld which joined a non-load-bearing flange plate to this D-6 bracing. This flange plate held a sonar device used during drilling operations. The poor profile of the fillet weld contributed to a reduction in its fatigue strength. Further, the investigation found considerable amounts of lamellar tearing in the flange plate and cold cracks in the butt weld. Cold cracks in the welds, increased stress concentrations due to the weakened flange plate, the poor weld profile, and cyclical stresses (which would be common in the North Sea), seemed to collectively play a role in the rig's collapse.

Alexander Kielland - catastrophic failure



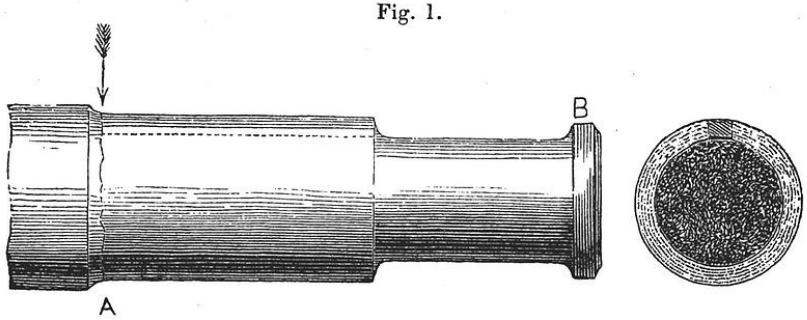
Part of the bracing that failed during the accident. On display in the Norwegian Petroleum Museum

Alexander Kielland - wreck

Wind turbine wings - failure due to bolts

Train accidents – start of fatigue design criteria

Fig. 1.



Aluminium – fatigue is of major concern

Other materials - asphalt

Repeated traffic loads is the cause