

## List of Some Engineering Successes and Failures

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Here is a list of some successes and failures for possible use for students in an engineering course:

*Note that the veracity of these events and the details of the failures/successes have not been checked. Also, only a few references, internet or otherwise, are provided here. Internet search engines will provide a wealth of useful information and analysis on many failures - use imaginative search terms and omit word conjunctions (and, of etc) to optimise the results.*

#### **Structure : Event : Notes : Date**



#### **Antiquity**

Great Sphinx of Egypt 4th dynasty : ancient success 240 feet in length

Colosseum of Rome 80 AD : concrete vaults and stone piers. Successfully seated 40 000-50 000 spectators

Pyramids of Egypt circa BC 2800 : 450 feet tall, base sides of 755 feet. 2,300,000 blocks, average weight of each is 2.5 tons

Parthenon of Greece BC 438



**Airline accidents** : See Disasters in World Almanac, Aircraft Accident Reports in NTIS <http://www.airsafe.com> <http://aviation-safety.net/reports/index.html>

Examples

Aloha Airlines 737 1989 : 1 person killed

Eastern Airlines Lockheed L-1011 : crashed in Everglades with 103 people killed : autopilot too easily disengaged

KLM 747 Pan American 747 collided in Tenerife Canary Islands 1977 : 582 people killed

United DC-10 crash in Sioux City, Iowa 1989 : faulty hydraulic system, 111 people killed

Turkish DC-10 crash in Paris 1974 : defective fuselage cargo doors, 346 people killed



#### **Bridge Failures**

Examples

Dryburgh Abbey Bridge, Scotland 1818 suspension bridge : severe wind damage

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Union Suspension Bridge, England 1821 : severe wind damage

Thomas Telford's Menai Straits Bridge : Wales 1826 suspension bridge : blown down in hurricane in 1839, celebrated wrought iron

Nassau Bridge, Germany 1834 : suspension bridge, wind damage

Brighton Chain Pier, England 1836 : suspension, severe wind damage

Montrose Bridge, Scotland 1838 : suspension, severe wind damage

Britannia Bridge, Menai Straits, Wales : tubular iron bridge 1839 : suspension, severe wind damage

Dee Bridge, England 1847 : Trussed girder bridge : torsional instability

Britannia Tubular Bridge, Menai Straits, Wales 1850 : design problems of carrying trains through wrought iron tube

Roche-Bernard Bridge, France 1852 : suspension, severe wind damage

Niagara-Lewiston Bridge, USA - Canada 1864 : suspension, severe wind damage

Wheeling Bridge, USA 1864 : suspension, severe wind damage

Iron truss bridge collapse, Ashtabula, Ohio 1876 : killed 100 people

Tay Bridge, Scotland 1879 : Truss bridge, unstable in wind : see DRH Jones, The Tay bridge disaster - faulty materials or faulty design, *Engineering Failure Analysis* Vol. 1 No. 3 1994 pp243-253

Brooklyn Bridge, New York 1883 : successful bridge design

Niagara-Clifton Bridge, USA - Canada 1889 : suspension, severe wind damage

Firth of Forth Bridge, Scotland 1890 : successful bridge design

Quebec, Canada 1907 : Cantilever bridge, compressive buckling

Fykesesund Bridge, Norway 1937 : Modern bridge oscillated in wind, stiffened by rolled I-beam

Golden Gate Bridge, USA 1937 : oscillated in wind, stiffened by truss

Thousand Islands Bridge, USA Canada 1938 : oscillated in wind, stiffened by plate girder

Bronx-Whitestone Bridge, USA 1939 : oscillated in wind, stiffened by plate girder

Bronx-Whitestone, New York 1939 : sister design to the Tacoma Narrows bridge, stiffened by plate girder in 1943 due to wind oscillation problems

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Deer Isle Bridge, USA 1939 :oscillated in wind, stiffened by plate girder

Tacoma Narrows Bridge, Washington State 1940 : Suspension bridge, aerodynamic instability : see <http://www.tech.plym.ac.uk/sme/FailureCases/Failure.htm>

Point Pleasant Bridge collapse, Ohio River 1967 : 46 people killed : see <http://www.tech.plym.ac.uk/sme/FailureCases/Failure.htm>

Milford Haven Bridge, Wales 1970 : Box girder bridge, plate buckling

Mianus River Bridge, Greenwich, CT : Interstate 95 collapse 1983 3 people killed



### **Buildings**

#### Examples

Leaning Tower of Pisa 1067-1173 : Tower is 179 feet high and leans 16 feet out of perpendicular : Builders did not reach bedrock for firm footing (also have problems with water table level)

[http://torre.duomo.pisa.it/index\\_eng.html](http://torre.duomo.pisa.it/index_eng.html)

<http://www.endex.com/gf/buildings/ltpisa/ltpisa.html>

<http://www.pisaonline.it/pisa/town/pagine/torre2.htm>

<http://www.humnet.unipi.it/~pierotti/Torre/index-en.html>

<http://www.uoguelph.ca/~mosers/>

Beauvais cathedral collapse : France 1284

Saint Paul's Cathedral 1710 : successful cathedral

Crystal Palace, London's Hyde Park 1851 : Successful design of enormous building for International World's Fair

John Hancock Building 1970 : High rise, window panes popped out due to unexpected torsional flexibility

Sears Tower 1974 : successful tallest building

Hartford Civil Center Roof collapsed 1978 : collapsed under heavy snow. Too much reliance on computer modelling : American Heritage Inven & Techn, Winter 1993

Kansas City Hyatt Regency Walkway Collapse 1981 : Short rods used instead of long ones. NBSIR 82-2465. 113 dead, 186 injured

<http://www.cen.bris.ac.uk/civil/staff/dib/casehist99/hyattlinks.htm>

<http://lowery.tamu.edu/ethics/ethics/hyatt/hyatt1.htm>

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<http://www.people.virginia.edu/~jtt3e/hyatt/paper.htm>

Ronan Point Apartment collapse, East London 1968 : insufficiently supported room; gas explosion caused many apartments to topple in high rise



### Civil Engineering

Examples

Eric Canal 1817-1825 : links Lake Erie and Hudson River

Panama Canal 1914 : successfully connects Caribbean Sea and Pacific Ocean

Idaho Teton Dam collapse 1976 : 11 people killed

Channel Tunnel : under English Channel/La Manche linking England to France 1987-1993 31 miles long. Contractors started in 1880s, 1974 and again in 1987, finally achieving success

Eiffel Tower, Paris 1889 : Successful structure

Scaffold collapse in Water Tank on Long Island 1981 : 2 people overcome by paint fumes



### Cars

Examples

Ford Pinto : see <http://www.uoguelph.ca/~sharoon/a1/a1disate.htm>



**Ships** : see web sites like [http://www.shipstructure.org/case\\_studies.shtml](http://www.shipstructure.org/case_studies.shtml)

Examples

Vasa Swedish ship 1628 : ship so large it was top heavy : Built 1627, sunk in Stockholm harbour 1628

Mary Rose English ship : capsized whilst sailing to engage the French

Titanic ship 1912 : huge size contributed to failure, plus rivet popping theory (poor rivet steel), and too few lifeboats : Ice berg collided with ship : see J Lancaster *Engineering Catastrophes: causes and effects of major accidents*, Abington Publishing, Cambridge, England. Library accession number 363.34 LAN

<http://www.reseau-medias.ca/eng/med/class/teamed2/titan10.htm>

<http://titanic.gov.ns.ca/>

<http://www.encyclopedia-titanica.org>

Liberty ship cracking problems 1942-44

Estonia ferry sinking : see [http://muhu.www.ee/ms\\_estonia](http://muhu.www.ee/ms_estonia)

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Derbyshire bulk carrier sinking 1980 : see <http://www.shipstructure.org/derby.shtml>

USS Thresher : nuclear submarine that broke up and sank in 1963

HM submarine M1 : fitted with a 12" gun - sank in 1925 off Devon



### **Nuclear Disasters**

#### Examples

Three Mile Island Nuclear Reactor, Harrisburg, PA 1979 : loss of coolant and partial core meltdown due to equipment failure and human mistakes

<http://www.pbs.org/wgbh/amex/three/>

<http://www.nrc.gov/OPA/gmo/tip/tmi.htm>

<http://www.uilondon.org/safety/tmi.htm>

<http://www.enviroweb.org/tmia/>

<http://www.uoguelph.ca/~rkapadia/tmipage.html>

Chernobyl Nuclear Power plant explosion, Kiev, Russia 1986 : explosion and fire, 31 people dead, thousands more affected by radiation :

<http://www.tech.plym.ac.uk/sme//FailureCases/Failure.htm>



### **Environmental Disasters**

#### Examples

Bhopal, India 1984 : toxic gas explosion at Union Carbide plant killed 2000 : see

<http://www.bhopal.net>

Exxon Valdez oil spill, Prince William Sound, Alaska 1989 : grounding, 10 million gallons spilled : see <http://www.oilspill.state.ak.us>

<http://response.restoration.noaa.gov/photos/exxon/exxon.html>

<http://www.bbc.co.uk/horizon/oilspillenvironment.shtml>

<http://www.ceos.noaa.gov/progress/reports/oilspill.html>

Torrey Canyon oil tanker grounding 1967 : see

<http://www.lboro.ac.uk/departments/hu/ergsinhu/aboutergs/torrey.html>

[http://www.lawschool.cornell.edu/library/Student\\_Services/advanced/eurydice.html](http://www.lawschool.cornell.edu/library/Student_Services/advanced/eurydice.html)

<http://www.amsa.gov.au/me/pn324.HTM>

<http://www.bbc.co.uk/horizon/oilspillenvironment.shtml>

<http://www.ceos.noaa.gov/progress/reports/oilspill.html>

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MV Kurdistan oil spill, Cape Breton, Canada 1979 : 7000 tonnes of oil spilled : see [http://www.twi.co.uk/industry/oilgas/oilgas\\_caseup33.html](http://www.twi.co.uk/industry/oilgas/oilgas_caseup33.html)

[http://www.collegetermpapers.com/TermPapers/Environmental\\_Science/Kurdistan\\_oil\\_spill.s](http://www.collegetermpapers.com/TermPapers/Environmental_Science/Kurdistan_oil_spill.s)

[http://www.ns.ec.gc.ca/emergencies/studies\\_kurdistan.html](http://www.ns.ec.gc.ca/emergencies/studies_kurdistan.html)

For information on oil tanker routes around Canada and the effect on birds of oil spills, see :

<http://www.britishcolumbia.com/WildLife/wildlife/information/Oil%20Pollution%20and%20Birds>



### Space Disasters

Examples

Apollo 13 1970 : rupture of service module oxygen tank aborted moon landing. Crew rescued

<http://www.lpi.usra.edu/expmoon/Apollo13/Apollo13.html>

<http://liftoff.msfc.nasa.gov/Academy/History/APOLLO-13/mission-report.html>

<http://nssdc.gsfc.nasa.gov/planetary/lunar/ap13acc.html>

<http://science.ksc.nasa.gov/history/apollo/apollo-13/apollo-13.html>

Challenger Space Shuttle explosion 1986 : failure of o-rings to seal in low temperatures, all astronauts perished : see <http://www.tech.plym.ac.uk/sme//FailureCases/Failure.htm>

Loss of Mars polar lander : <http://www.nasa.gov/newsinfo/marsreports.html>

<http://marslander.jpl.nasa.gov/news/news71.html>