# Analysis Of The Engineering Failures Of The Space Shuttle Columbia Disaster

On February 1st, 2003, the Space Shuttle Columbia re-entered Earth's atmosphere after a 16-day research mission conducting microgravity experiments. As it descended into the atmosphere, it gradually broke apart over a period of approximately five minutes from 8:55 am to 9:00 am EST, killing all seven astronauts on board. Their names were Commander Rick Husband, Pilot William McCool, Payload Commander Michael Anderson, Mission Specialists David Brown, Kalpana Chawla, and Laurel Blair Salton Clark, and Payload Specialist Ilan Ramon.

The Columbia disaster has become a widely known engineering case study into engineering ethics and failure analysis and led to widely revamped protocols concerning Space Shuttle launches. There were many contributing factors that resulted in the eventual destruction of Columbia, namely the culture of the human space flight program of NASA as well as an inherent tendency of said program to prioritize political and public relations concerns over that of the lives of astronauts.

The primary failure, however, was a physical one: a 1. 7 pound piece of insulating foam broke off of the left bipod ramp, which connected the external fuel tank to the orbiter, and struck the orbiter's left wing 81. 9 seconds after launch. The crew of Columbia completed their two-week mission in orbit while unaware of the significance of the damage, and on February 1st they attempted reentry. The hole created during ascent by the insulating foam allowed superheated gases to enter the superstructure of the orbiter, melting the metal interior and causing structural failure. This was confirmed because of the evidence of overheating and slumping on three of the shuttle's lower left carrier panel 9 tiles on the left wing's leading edg. This led to the wing breaking apart and subsequently caused the remainder of the orbiter to be subjected to intense aerodynamic forces, leading to its total disintegration. The foam shedding itself was caused by a rapid temperature change of the material surrounding the foam. At 81. 9 seconds after launch, the cryogenic fuel in the fuel tank would have decreased to a level below the left bipod ramp.

This would have caused the local conditions to quickly change from the subzero temperatures of the fuel to the temperatures of the warm atmospheric air, causing a rapid expansion of the gases trapped within the foam. This would have provided enough force to dislodge the material from the ramp and send it tumbling down via aerodynamic slipstream.