Structural Design Practices

- Payload interfaces to launch vehicles
- Examples of structural design approaches from past space vehicle structural designs
Shuttle Payload Restraint Configurations

3-POINT ATTACH

PRIMARY FITTINGS;
REACT LONGITUDINAL AND
VERTICAL LOADS ($F_x$ & $F_z$)

5-POINT ATTACH

PRIMARY FITTINGS;
REACT LONGITUDINAL AND
VERTICAL LOADS ($F_x$ & $F_z$)

KEEL FITTING;
REACTS SIDE AND LONGITUDINAL
LOADS ($F_y$ & $F_x$)

STABILIZING FITTINGS;
REACT VERTICAL LOAD ($F_z$)
Orbiter Active Latches

Structural Practices
Principles of Space Systems Design
Orbiter Passive Latches
Atlas V Payload Fairing Configuration
Delta IV Bolted Payload Attach Fitting
Delta IV Pyro Payload Attach Fitting

Diagram showing dimensions and features of the Delta IV Pyro Payload Attach Fitting.
Delta IV Marmon Band PAF

Structural Practices
Principles of Space Systems Design
Saturn V First Stage (S-IC) Cutaway
Saturn V S-IC Intertank Fairing
Saturn V S-IC Intertank Assembly
Saturn V S-IC Ground Handling
Buran Ground Handling
Saturn V S-II Stage Stacking
Saturn V S-II LOX Tank Cutaway
Saturn V S-II Stage Engine Cluster
Saturn V S-II Thrust Structure Detail
Saturn V S-II Interstage Jettison
N-1 Launch Vehicle Interstages
Saturn V S-IVB/J-2 Thrust Structure
Mercury Spacecraft Layout

- VENT
- Peroxide Tank
- Window
- Instrument Panel
- Hatch
- Main and reserve parachute
- Drogue parachute
- Couch and restraints
- Periscope
Mercury Spacecraft Assembly
Gemini Spacecraft Equipment Arrangement
Apollo Spacecraft Components

Apollo Command and Service Modules

- Docking probe leading to forward access tunnel
- Forward boost protective cover (landing parachutes underneath)
- Pressurized crew compartment
- Pitch engines
- Roll engines
- Reaction control engines (4)
- Cryogenic oxygen & hydrogen tanks
- Environmental control system space radiation panel
- Stillwell & quantity measurement system
- Service Propulsion Engine nozzle
- Yaw engines

Apollo Lunar Module

- VHF antennas (2)
- Docking hatch (cabin entrance)
- LM/CM docking hatch
- Reaction-control oxidizer
- Ruby box
- Water tank
- Reaction-control pressurant (helium)
- Reaction-control fuel (Aerozine 50)
- Ascent fuel tank (Aerozine 50)
- Steerable S-band antenna
- Rendezvous radar
- S-band in-flight antenna
- LM Pilot’s console
- Tracking light
- Cabin air recirculation fan
- Exhaust deflectors
- Portable Life Support System
- Ascent engine (3,500 lbs thrust)
- Egress/Egress platform and rails
- Thermal insulation
- Ladder
- Descent structure
- Descent fuel tank (2) (Aerozine 50)
- Descent oxidizer tank (2)
- S-band erectable antenna storage
- Secondary shock absorber strut
- Radiocope thermal generator
- Primary shock absorber strut
- Foot pad

Apollo CSM Facts

The Apollo Command Module was 10.6 ft tall and 12.6 ft at its maximum diameter, and typically weighed 13,090 lbs. with astronauts. The Service Module was 34.3 ft tall and 12.9 ft in diameter and weighed 94,074 lbs. The Service Propulsion System engine delivered a thrust of 20,500 lbs.

The lunar module was 23 ft tall and had a launch weight of 33,205 lbs.

The Apollo 17 lunar module weighed 74,000 lbs.
Soyuz Spacecraft Design
Lunar Module Overall Configuration
Lunar Module Ascent Stage Structure
Lunar Module Ascent Stage Structure
Lunar Module Descent Stage Structure
Lunar Module Descent Stage Structures
Soviet Lunar Lander Concepts
LK Lunar Landing Vehicle

LK Russian Lunar Landing Vehicle

Front

Side
LK Spacecraft on Moon