

SPACE SHUTTLE DISCOVERY

A2 Final Project



Introduction

Why the space shuttle?

- Launched 39 missions (184 crewmen)
- Carried the Hubble Space Telescope
- Reusability (Cost per flight)

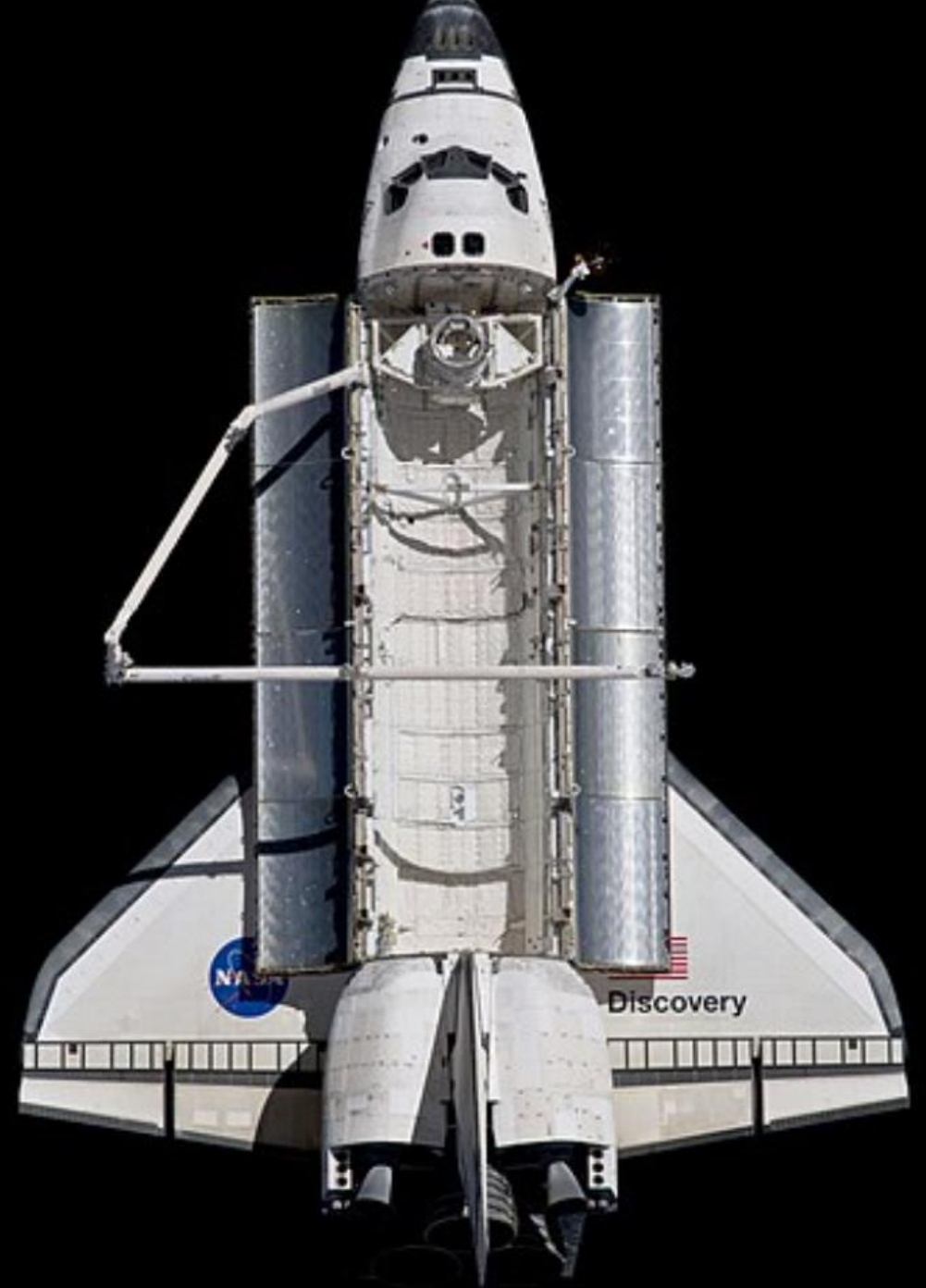
Roles:

- Becca: Fuselage
- Hope: Vertical Fin Stabilizer
- Daniel: Wings & Assembly
- Sal: Orbiter engines & External tank
- Jake: SRB

MODELING INDIVIDUAL PARTS



FUSELAGE



Fuselage Modeling Process

Sources:

- NASA

Part breakdown:

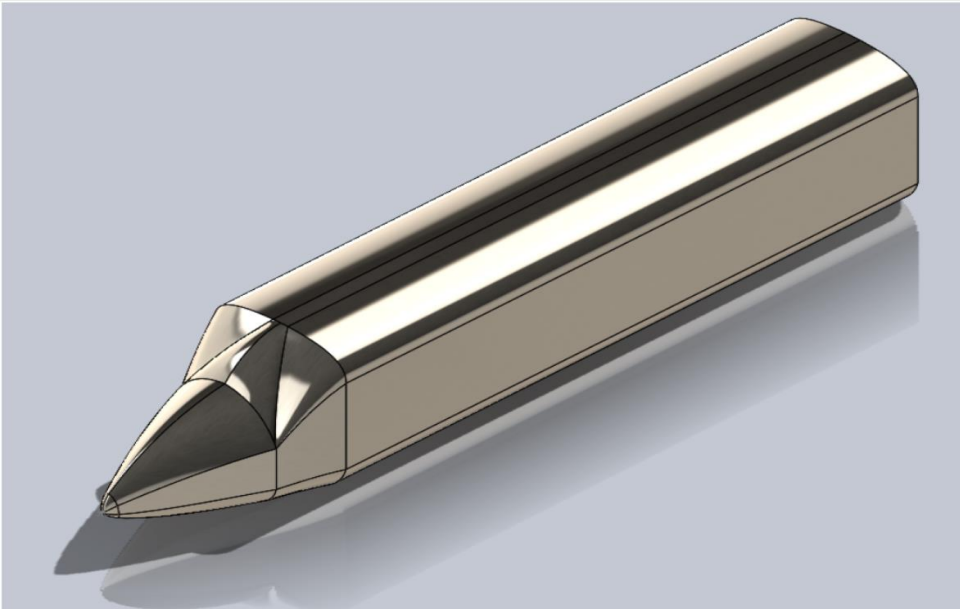
- Forward Fuselage: Nose & Crew Compartment
- Mid-fuselage & Aft fuselage

Modeling challenges:

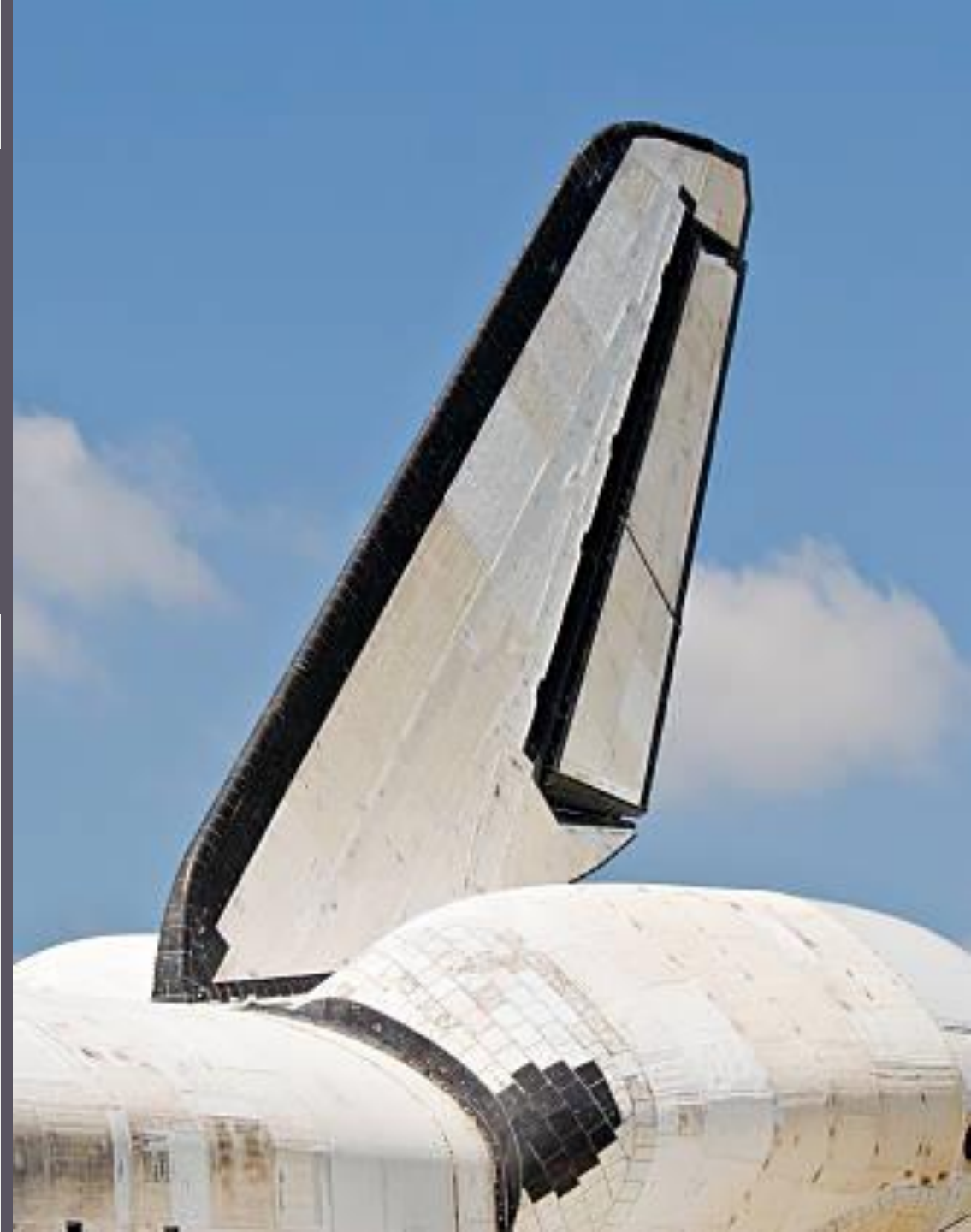
- Struggles with the lines in the lofts not working

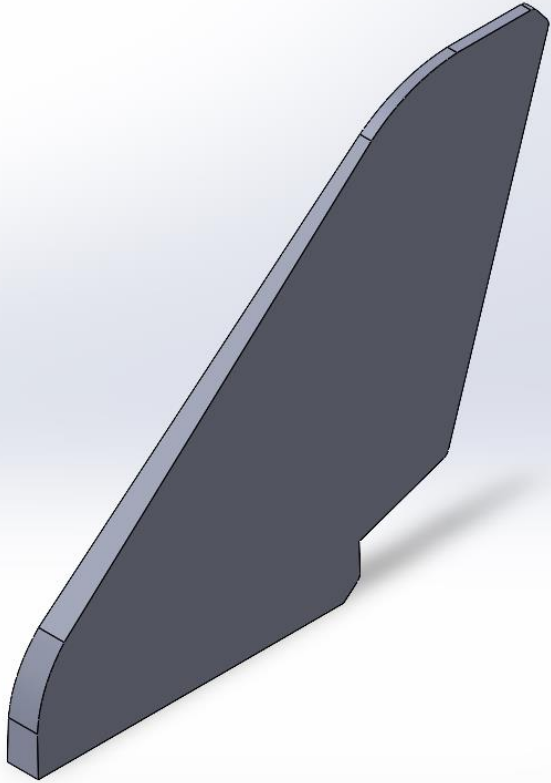
Assumptions Made:

- Dimensions: Error on sketching over the blueprints



VERTICAL "FIN" STABILIZER





Vertical "Fin" Stabilizer

Sources:

- NASA

Assembly breakdown:

- Three main "sections"

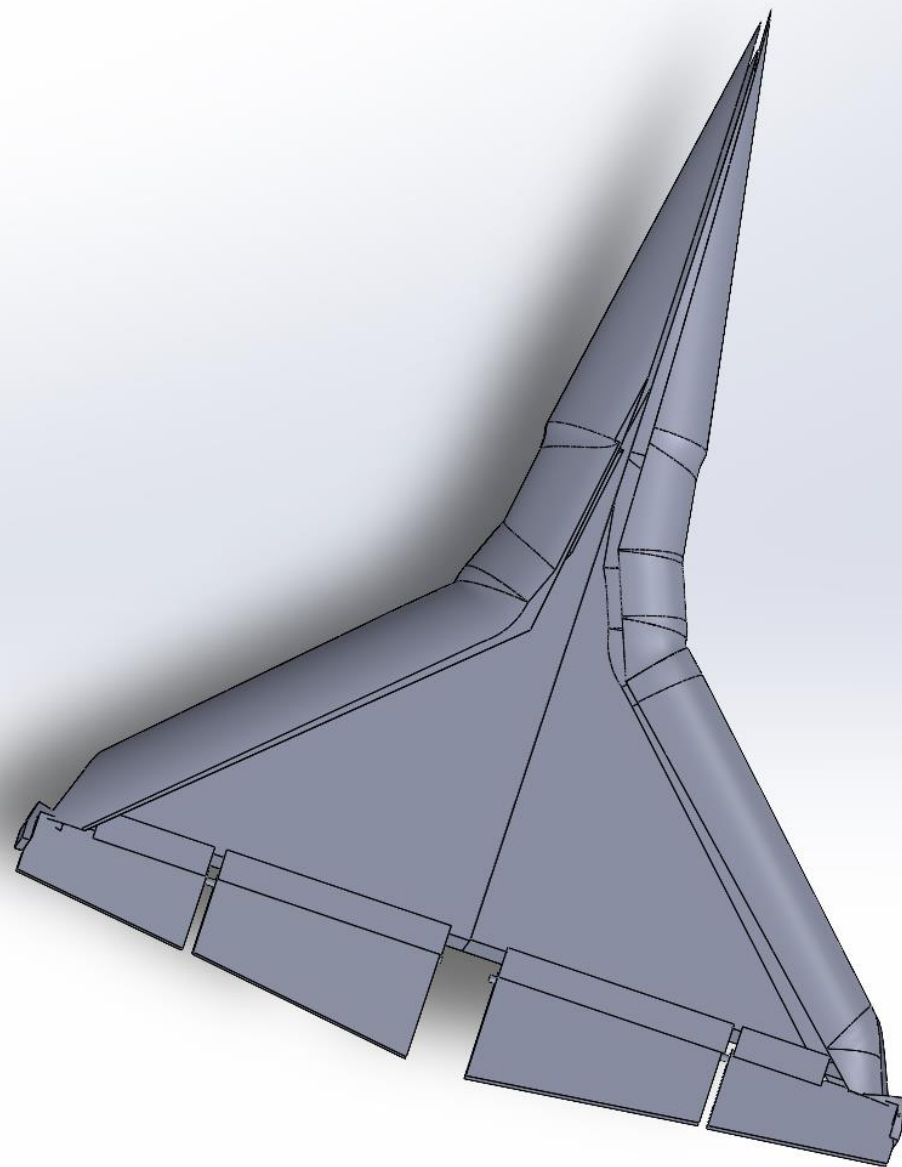
Modeling challenges:

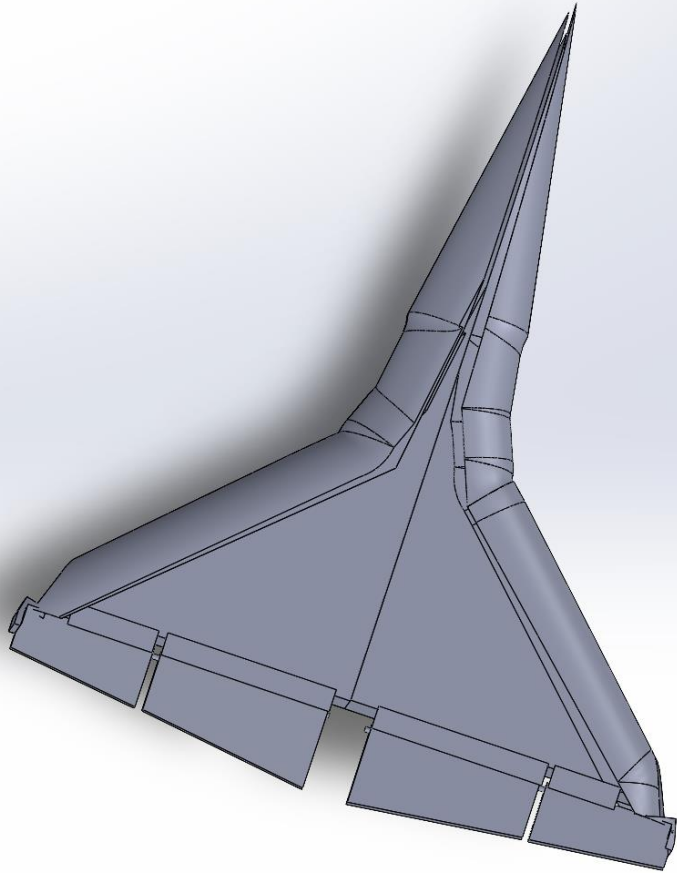
- Using the spline tool and extruding the part

Assumptions made:

- Dimensions

WING





Wing Modeling Process

Sources:

- NASA

Part breakdown:

- The double-delta wing shape
- The reinforced carbon-carbon (RCC) panels along the leading edge
- The elevons/flaps on the trailing edge
- Elevon connection cylinder (spar)
- Hinges

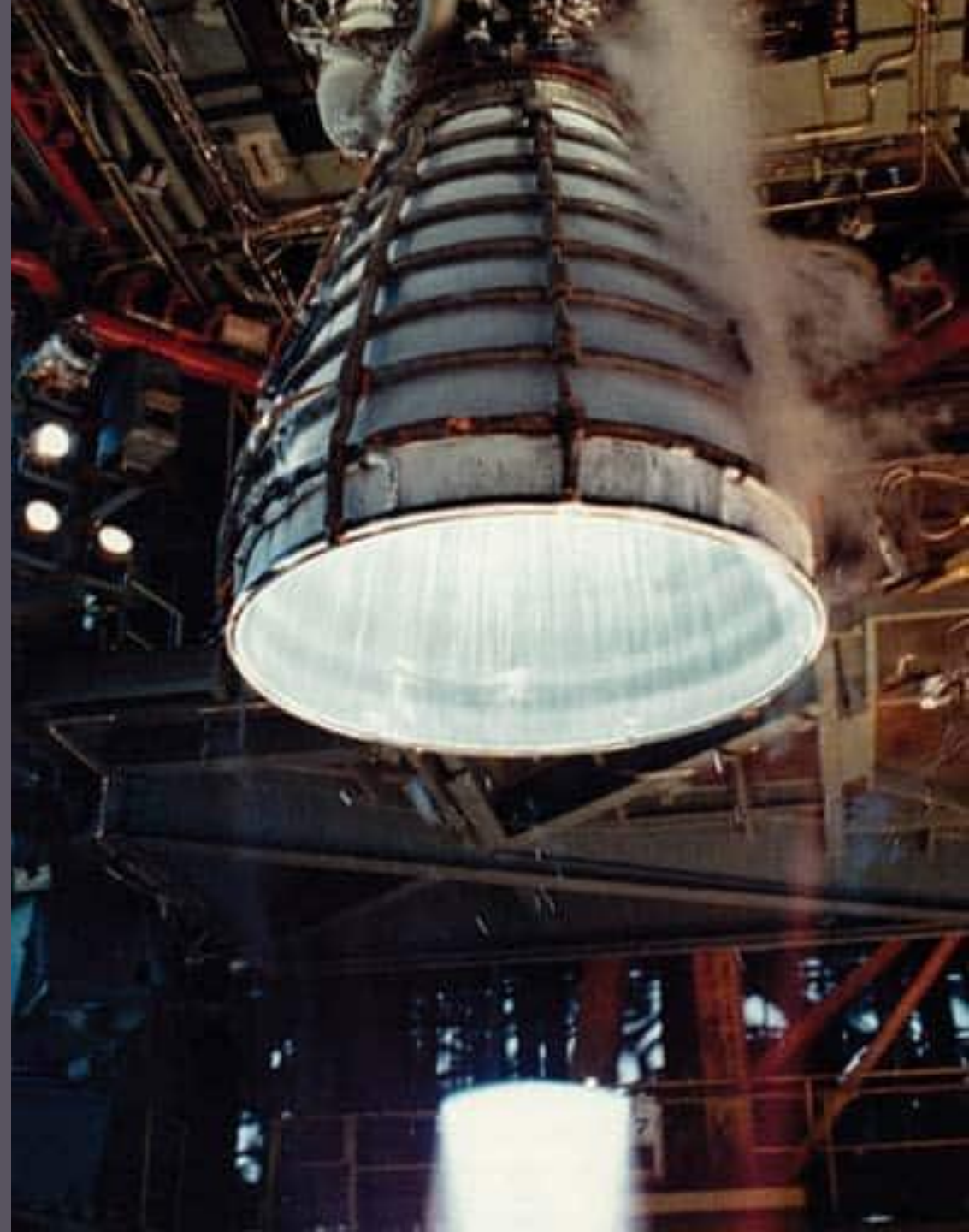
Modeling challenges:

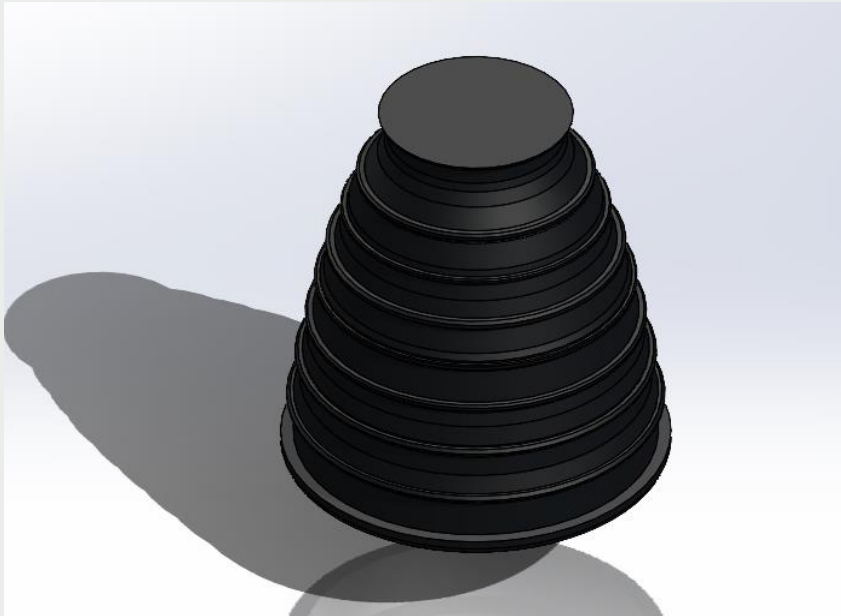
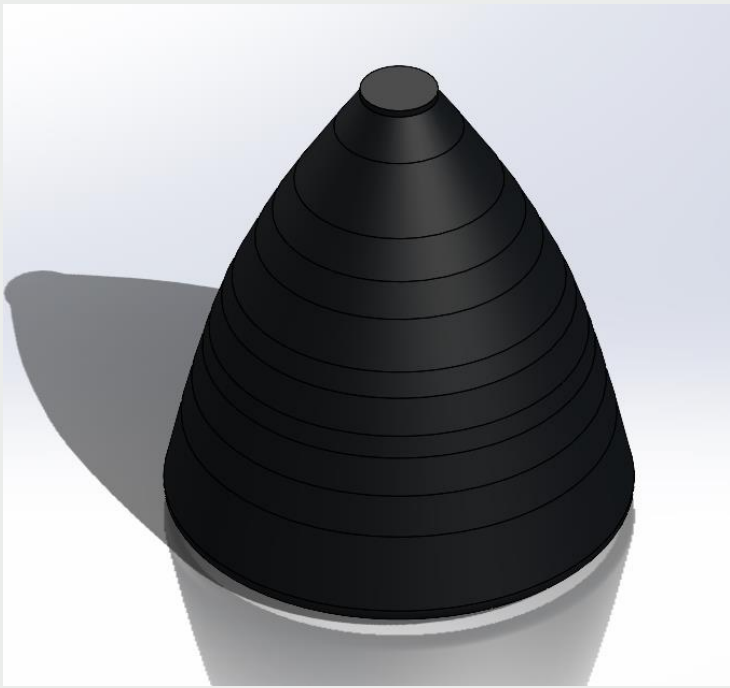
- The delta wing shape does not employ conventional airfoils.

Assumptions made:

- The base profile was sketched on the wing planform
- The elevons were arbitrarily chosen to be 11 inches thick, slightly less than 1/5th the wing maximum thickness

ORBITER ENGINES





Orbiter Engines Modeling Process

Sources:

- NASA

Part breakdown:

- Modeling via external shape 'function' and application of calculus II solid rotation.

Modeling challenges:

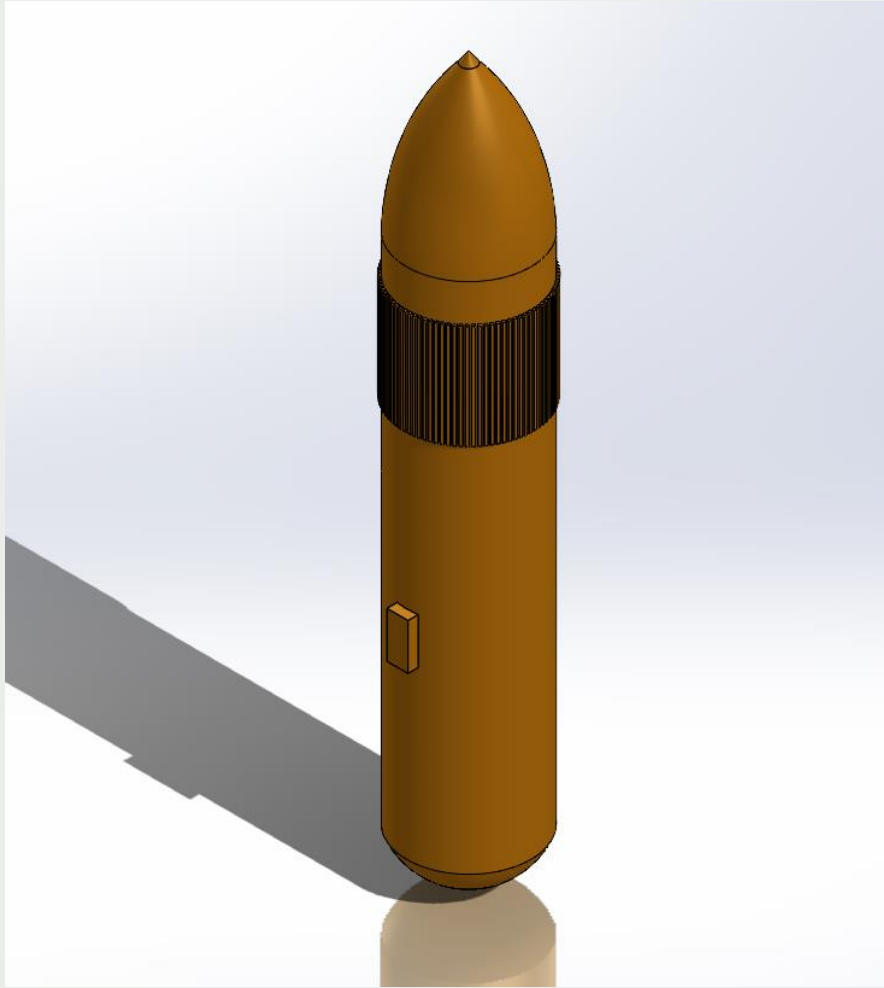
- Random fixed points kept the solid from being fully defined.

Assumptions made:

- Diameter of the main engine rings.

EXTERNAL TANK





External Tank (ET) Modeling Process

Sources:

- NASA

Part breakdown:

- Mid-tank section.
- Parabolic Nose cone.
- Elliptical Aft dome.
- Inter-tank "ring" section.
- Orbiter-ET attachment point.

Modeling challenges:

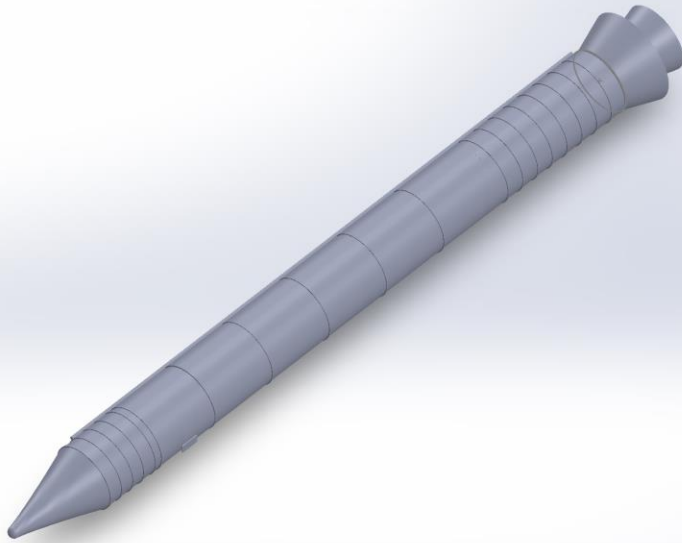
- Aligning the nose and aft dome curves so that the solid remained fully defined.

Assumptions made:

- Orbiter-ET attachment point; inter-tank "ring" section.

SOLID ROCKET BOOSTER (SRB)





SRB Modeling Process

Sources:

- United space alliance (USA) illustrated design schematics
- NASA

Part breakdown:

- Motor Stack (mid, forward)
- Nose cone
- Engine Stack and Nozzle

Modeling challenges

- Lost work

Assumptions made:

- Access runway, nozzle, rear engine segment, Support rings

ASSEMBLY PROCESS



THE ORBITER

Sources:

- NASA

Part breakdown:

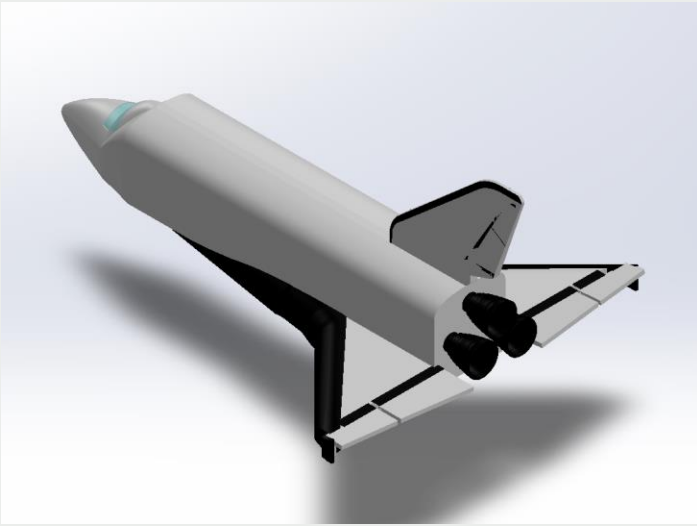
- The Orbiter
- Wings
- Fuselage
- Main Engines
- Vertical Stabilizer/ tail fin

Modeling challenges:

- N/A

Assumptions made:

- The positioning of the main engines was not done according to specific units. They were arranged in a triangle



ORBITER, EXTERNAL TANKS & SOLID ROCKET BOOSTERS

Sources:
NASA

Part breakdown:

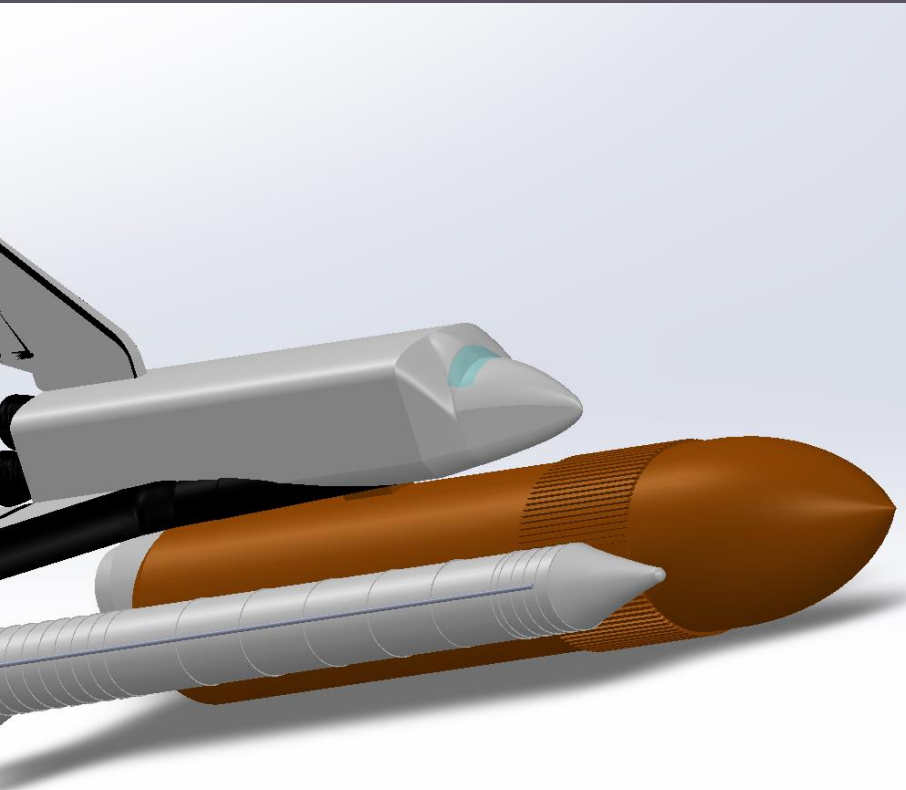
- The Orbiter – Wings, Fuselage, Main Engines, Vertical Stabilizer/ tail fin
- The external tank
- The Solid Rocket boosters

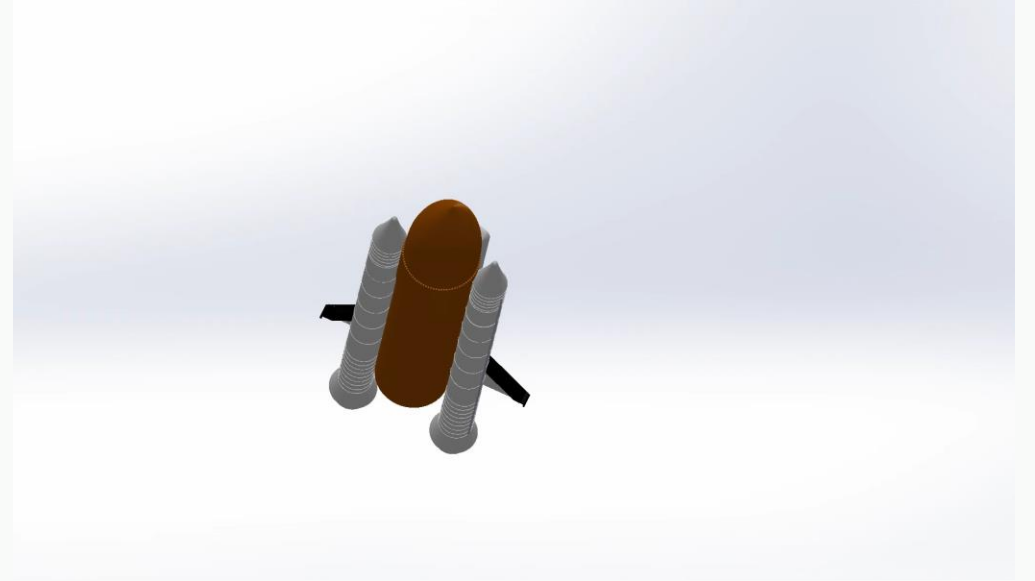
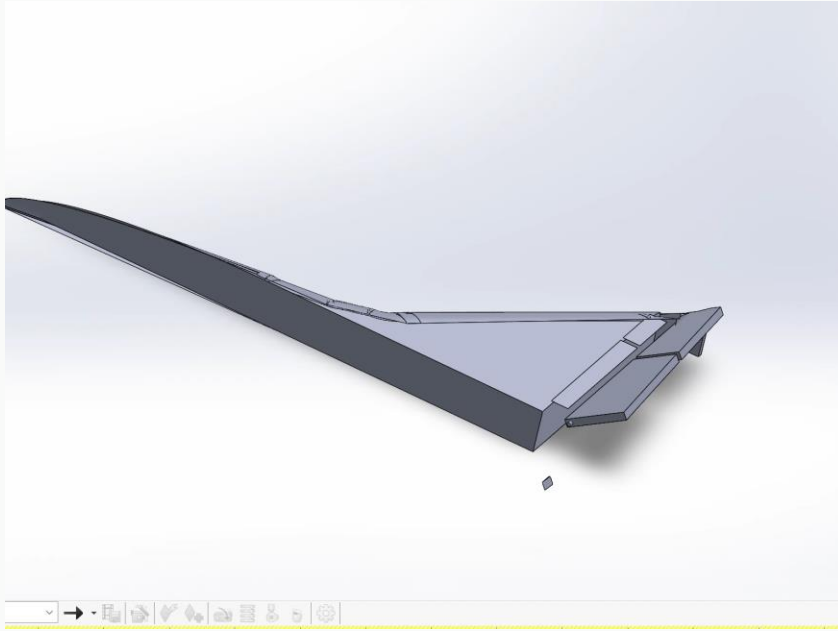
Modeling challenges:

- N/A

Assumptions made:

- The connection systems for the SRB-External tank and Orbiter-External tank are adaptations of the real thing





MOTION STUDIES



SIDE BY SIDE
COMPARISON

Questions

Picture Sources

- <https://spaceref.com/science-and-exploration/stacked-shuttle-solid-rocket-boosters-on-the-move-2/>
<https://www.launchphotography.com/STS-133.html>
- <https://www.istockphoto.com/photo/space-shuttle-vertical-stabilizer-gm176979187-20037915>
- https://th.bing.com/th/id/R.da59702cef477b0ef487ed9638e3200f?rik=yPmEx1TQ1jj3ag&riu=http%3a%2f%2fupload.wikimedia.org%2fwikipedia%2fcommons%2fthumb%2fa%2fa5%2fExternal_tank_No._1_24.jpg%2f300px-External_tank_No._124.jpg&ehk=XhUu1XpsII0CrHzFtTqDQLT0wprIMpXM0FgaZ4nMSNM%3d&risl=&pid=ImgRaw&r=0
- https://en.wikipedia.org/wiki/Space_Shuttle_Discovery
- <https://exploredspace.com/wp-content/uploads/2015/08/SSME-Space-Shuttle-Main-Engine-Stennis-Space-Center-RS-25-NASA-image-posted-on-SpaceFlight-Insider.jpg>