

Lightweight Bracket Redesign

Difficulty Advanced	Time 2-3 class periods	Type Aerospace Mission
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Background

An aerospace bracket meets the required shape but is heavier than necessary. Every gram matters in flight hardware.

Engineering Problem

Redesign an instructor-provided bracket to reduce modeled mass by at least 20% while preserving interfaces and basic load capability.

Learning Objectives

- Apply design-for-lightweighting strategies
- Use CAD mass properties
- Preserve functional interfaces
- Document design tradeoffs

Materials

- Starter bracket file or drawing
- Fusion 360
- Material property assignment
- Engineering notebook
- Optional 3D printer

Procedure

1. Open the baseline bracket and record material, mass, envelope dimensions, and interface locations.
2. Highlight no-change zones such as mounting holes and contact surfaces.
3. Sketch two lightweighting concepts using ribs, pockets, tapered walls, or pattern changes.
4. Select one concept and predict the mass reduction.
5. Create the redesigned model using parameters.
6. Assign the same material and measure final mass.
7. Inspect minimum wall thickness, sharp internal corners, and print orientation.
8. Create a before/after comparison and explain how load could travel through the redesigned part.

Engineering Requirements

- Reduce modeled mass by at least 20%
- Preserve all mounting hole locations and interface dimensions
- Maintain minimum 2 mm wall thickness unless approved
- Avoid unsupported features that make printing impractical
- Use at least one rib or load-path feature

Constraints & Safety

- Use the same assigned material for both mass calculations
- Do not simply scale the entire part
- Part must remain printable on classroom equipment
- No formal claim of structural safety without testing or analysis

Deliverables

- Two concept sketches
- Baseline and final mass-property screenshots
- Fusion file
- Before/after visual comparison
- Manufacturability check
- Design justification

Reflection Questions

1. Where did you remove the most material?
2. How did you preserve the load path?
3. What new failure risk did the redesign create?
4. What physical test would you perform next?

Engineering Tip

Keep material along likely load paths and remove it from large low-stress areas.

Common Mistake

Cutting random holes may reduce mass but can create stress concentrations and weak connections.

Stretch Goal

Print both versions and compare mass, print time, and a simple non-destructive stiffness test.

Career Connection

Aerospace mechanical engineers use topology, ribs, pockets, and material selection to reduce mass while maintaining function.