Section 1: Case Studies

1. Automotive Lightweight Frame Design

Introduction:
Engineering project to reduce vehicle frame weight without compromising structural integrity, improving fuel efficiency and performance.

Design Process:

- Created initial sketches for frame dimensions and structural elements.
- Developed full frame assembly in SolidWorks (part modeling, assembly, weldments).
- Conducted stress and strain simulations under various load cases.
- Iterated to achieve optimal balance of weight reduction and strength.

Outcome:

- Frame weight reduced by 15% with safety factor ≥ 2.5.
- Improved fuel economy, handling, and reduced material usage.

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2. Consumer Electronics Housing Design

Introduction:
Design of a lightweight housing for a portable electronic device, ensuring thermal efficiency and durability.

Design Process:

- Initial housing designed using SolidWorks sheet metal tools.
- Thermal simulations performed for airflow optimization.

Outcome:

- Housing minimized thermal build-up, improving device lifespan.

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3. Industrial Pump Assembly

Introduction:
Redesign of an industrial pump to improve efficiency and reduce maintenance.

Design Process:

- Analyzed existing design for improvement areas.
- Created detailed 3D models of all components.
- Performed flow simulations to optimize fluid dynamics.

Outcome:

- Pump efficiency increased by 22%.
- Maintenance frequency reduced by 35%.

Section 2: Specifications

1. Automotive Lightweight Frame Design

Key Specifications:

- Target Mass: — kg (± —%)
- Achieved Mass: — kg
- Weight Reduction: 15%
- Safety Factor: ≥ 2.5
- Max Stress: — MPa
- Global Stiffness: — Nm/deg
- Modal Frequency: — Hz
- Corrosion Protection: E-coat + powder

Materials:

Subsystem	Material Grade	Yield (MPa)	UTS (MPa)	Notes
Main rails	6061-T6	—	—	
Cross members	—	—	—	
Brackets/Gussets	—	—	—	

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2. Consumer Electronics Housing Design

Key Specifications:

- Material: Sheet metal (—)
- Thermal Resistance: — °C/W
- Mass: — g
- Thickness: — mm
- Cooling Ventilation: —

Notes:

- Folded sheet metal design for lightweight structure.
- Optimized airflow openings.

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3. Industrial Pump Assembly

Key Specifications:

- Pump Type: —
- Max Flow Rate: — L/min
- Max Pressure: — bar
- Efficiency Improvement: 22%
- Maintenance Interval Reduction: 35%
- Material: Cast iron + stainless steel components

Notes:

- Flow-optimized impeller design.
- Critical components reinforced for durability.