Parametric Chassis Design

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Outline

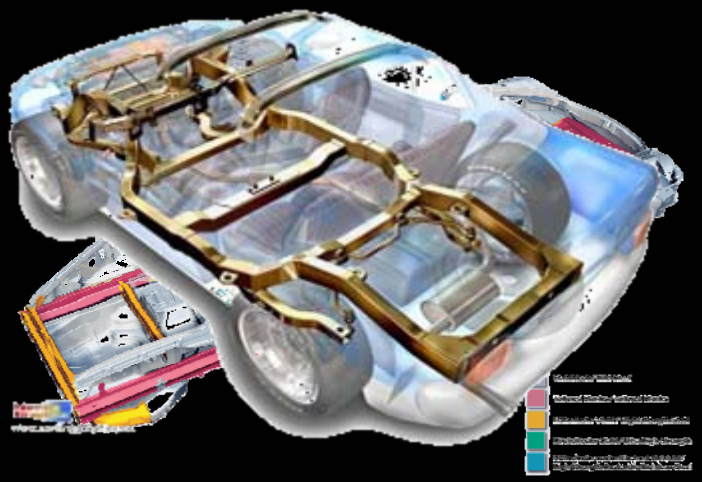
- Objective
- Concepts
- Modeling
- Analysis
- Application

Objective

- Design, model, and analyze a parametric chassis based on sound engineering principles with the ability to:
  - Interface with all other components
  - Adapt to fit all Industrial Design bodies

Concepts

- Solid/space frame
  - Body mounted on later
- Unibody
  - Integrated body parts



- Challenges
  - Choosing design to fit project scope and time frame
  - Ensuring structural integrity
  - Aesthetic appeal

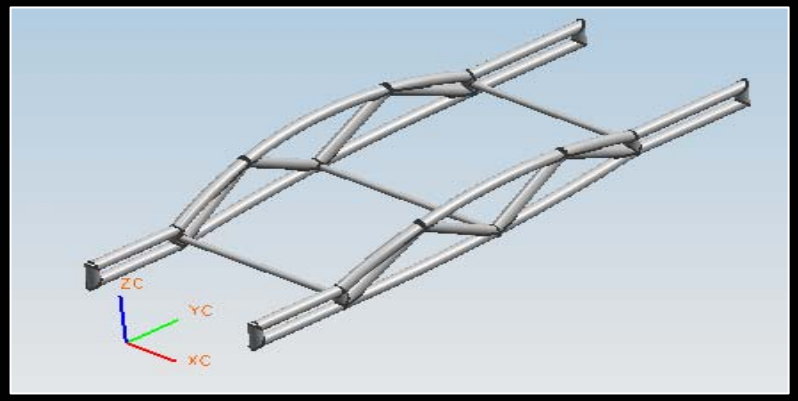
Concepts

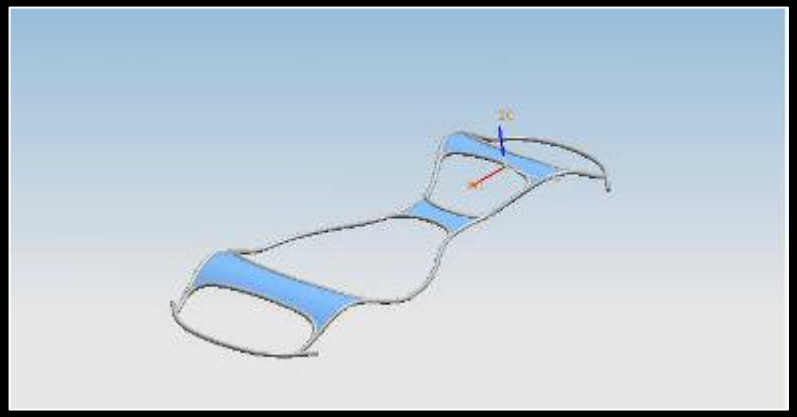
- Tubular
  - Simple tube design, similar to Solid frame

Modeling

- Various initial design concepts

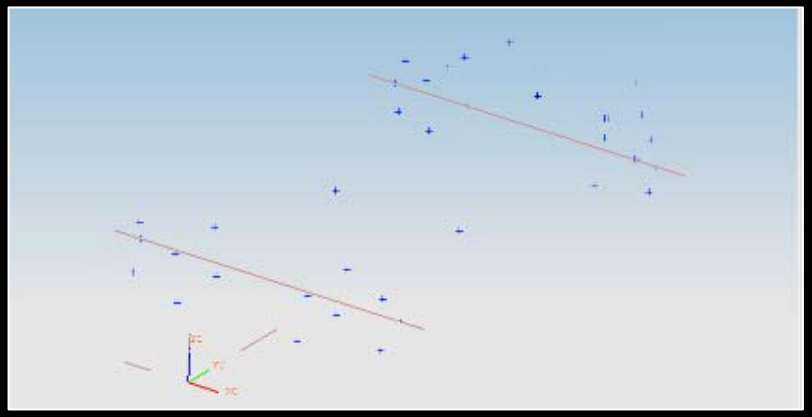
- Challenges:
  - Deciding upon both aesthetic and sound engineering design
  - Defining parametrics robustly
  - Establishing naming conventions
  - Waiting to build solid models

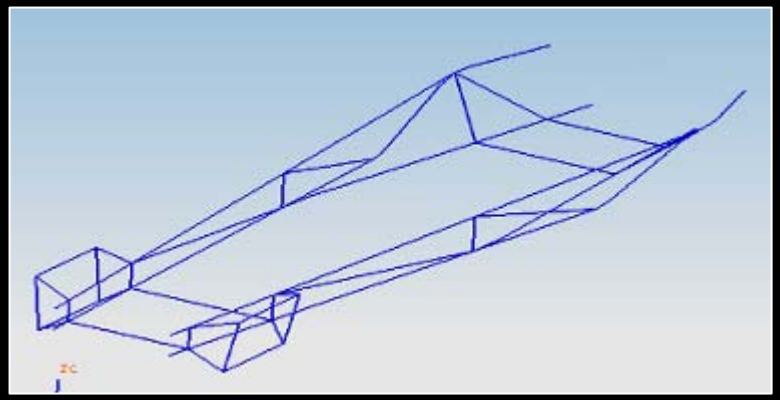




Modeling

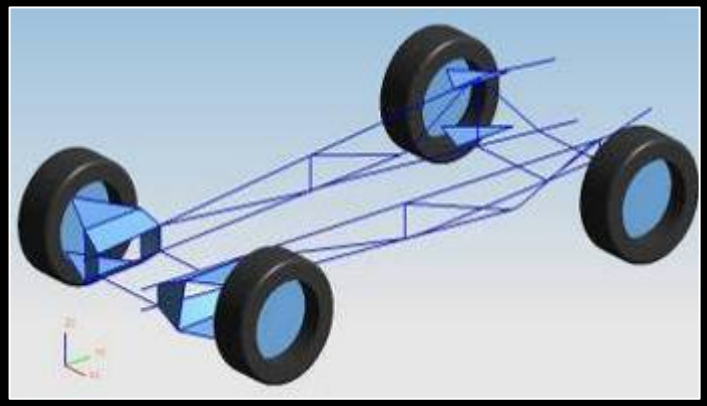
- Various initial design concepts
- Chassis hard points defined
- Wireframe geometry created

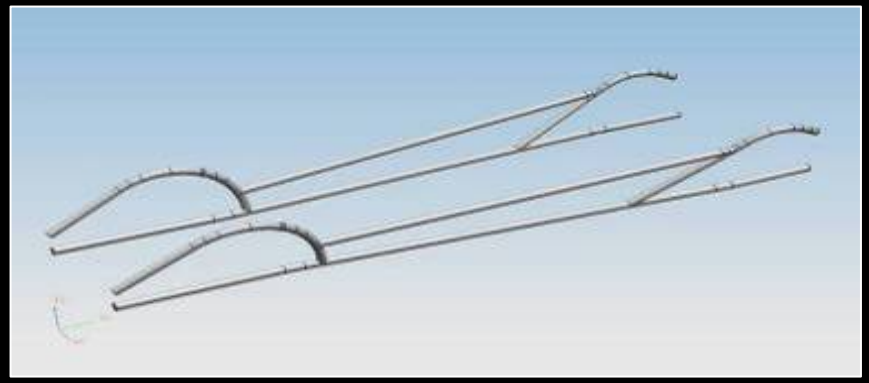




Modeling

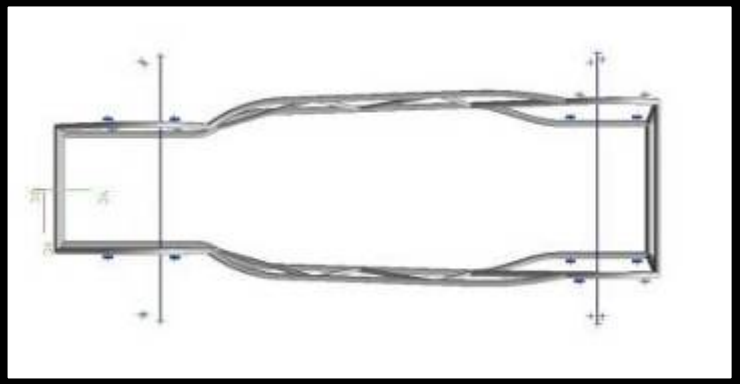
- Various initial design concepts
- Chassis hard points defined
- Wireframe geometry created
- Suspension hard points defined and linked
- Guideline model developed

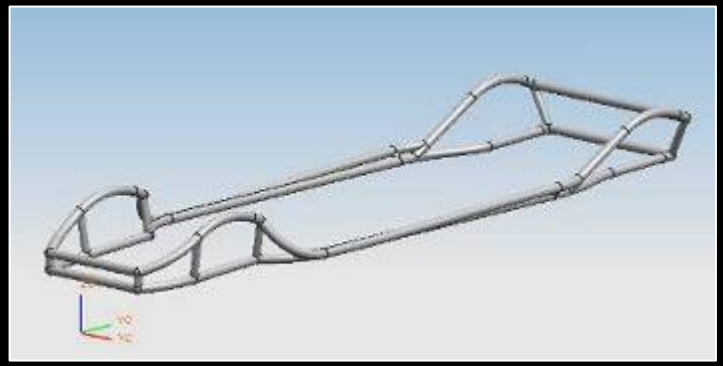




Modeling

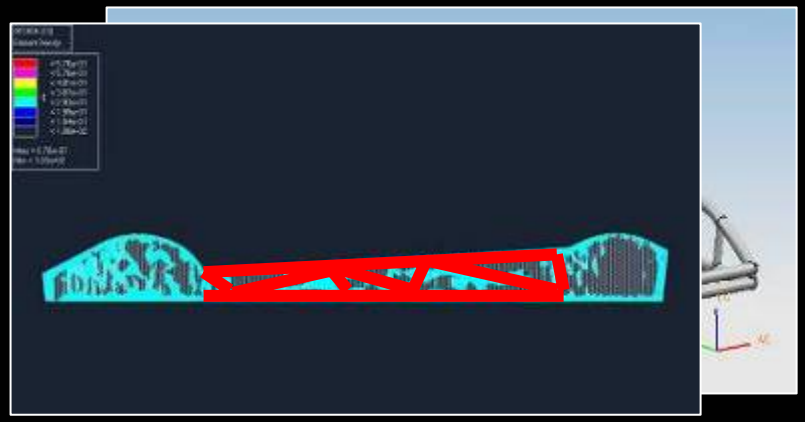
- Embedded spreadsheet created

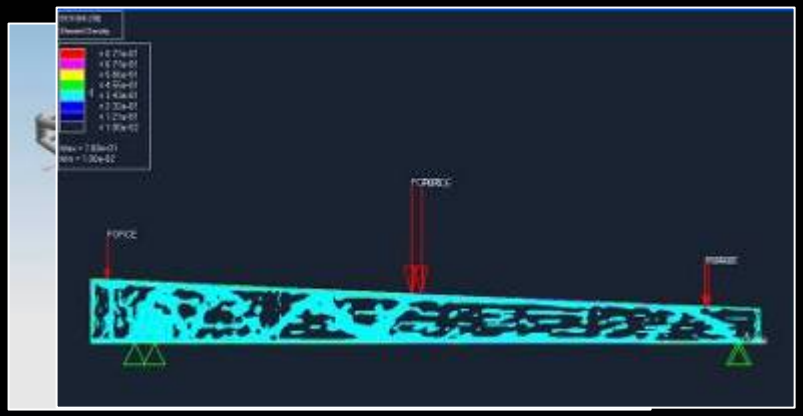




Modeling

- Embedded spreadsheet created
- Side lattice structure and cross-bars approximated using Optistruct results

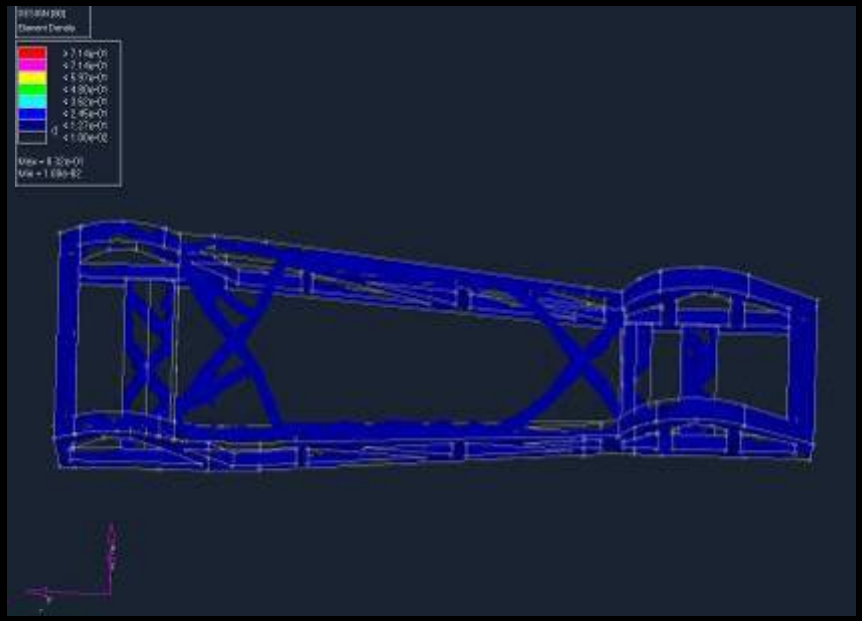




- Challenges
  - Properly defining static loads
  - Interpreting results

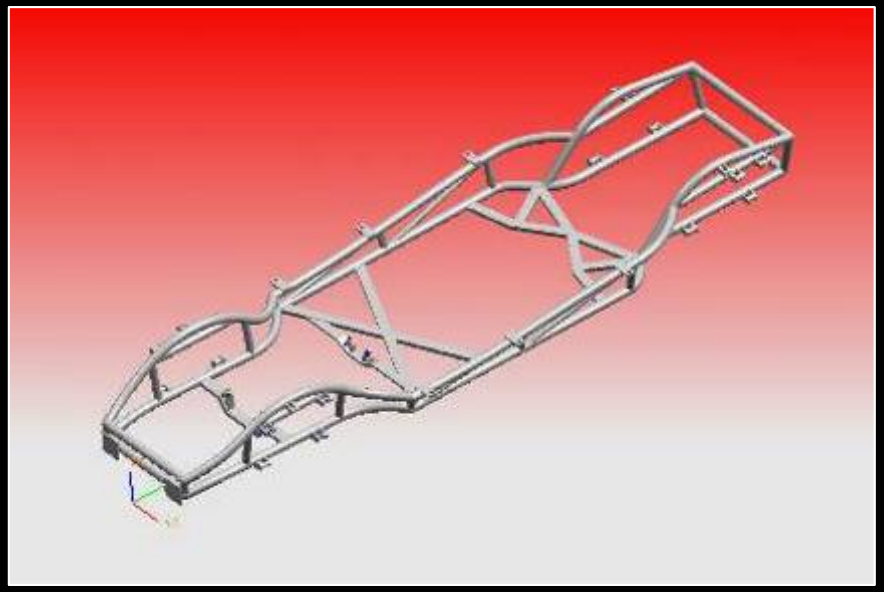
Modeling

- Embedded spreadsheet created
- Side lattice structure and cross-bars defined using Optistruct results



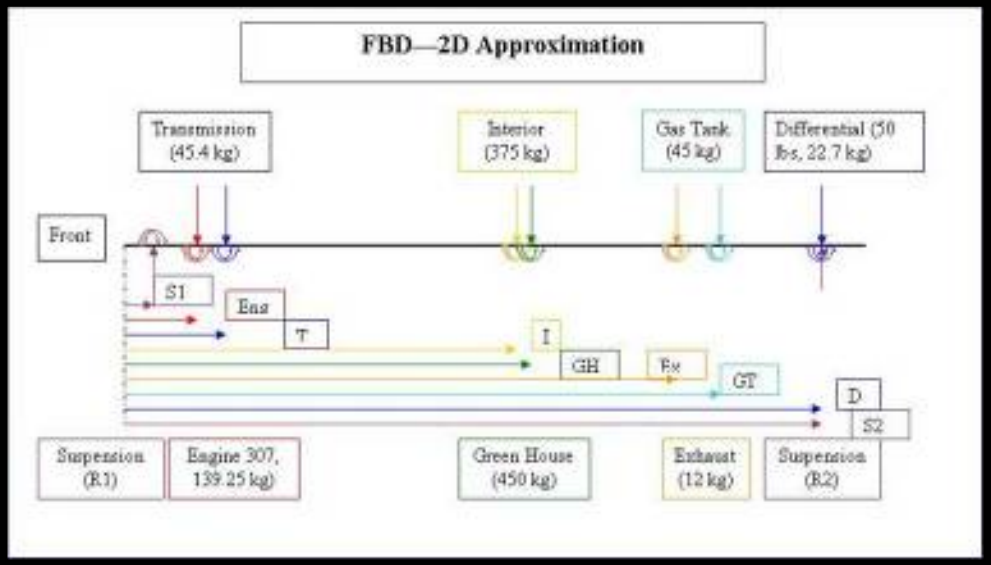
Modeling

- Embedded spreadsheet created
- Side lattice structure and cross-bars defined using Optistruct results
- Mounting brackets for engine, suspension, transmission, bumper
- Roof pillars created



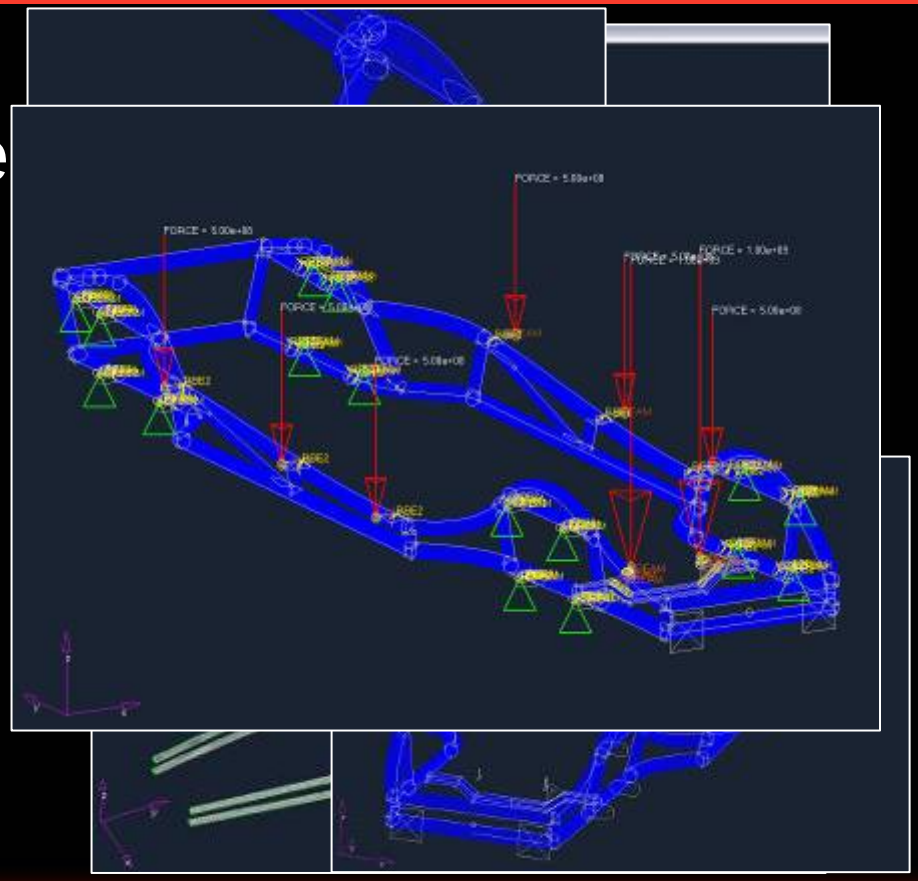
Analysis

- Model approximation



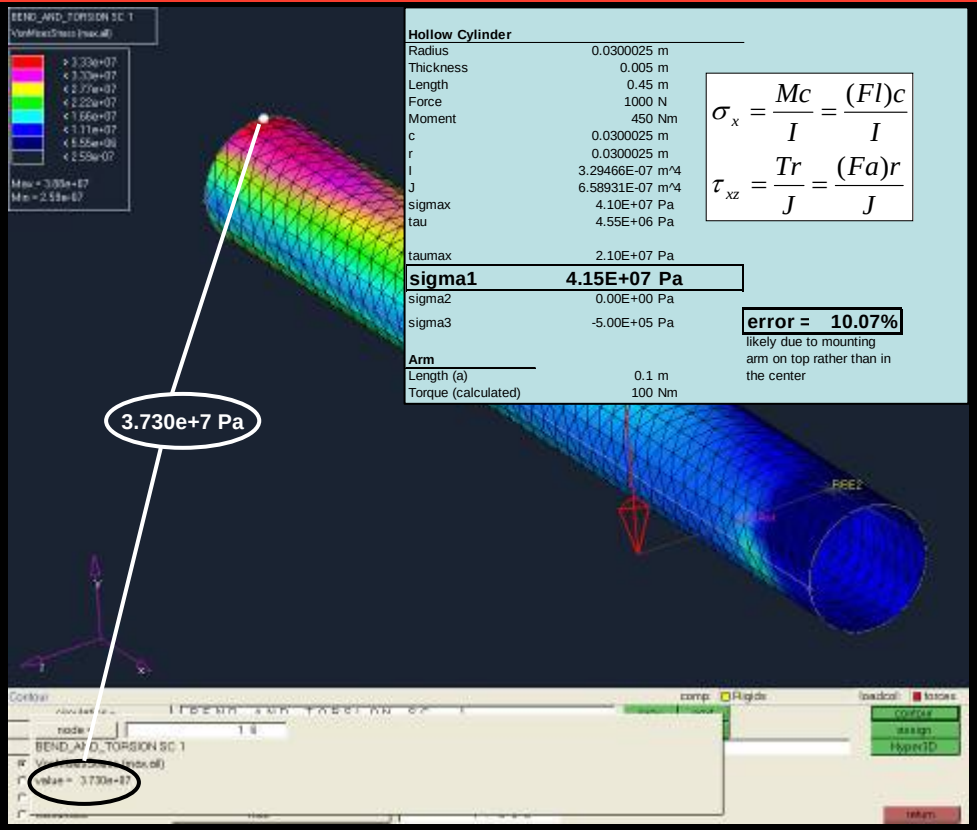
Analysis: HyperMesh

- Primary mesher for other analyses (collage this)
- Creates loads and boundary conditions



Analysis: NASTRAN

- Stress analysis
- Validation of results



Hollow Cylinder

Radius	0.0300025	m
Thickness	0.005	m
Length	0.45	m
Force	1000	N
Moment	450	Nm
c	0.0300025	m
r	0.0300025	m
I	3.29466E-07	m^4
J	6.58931E-07	m^4
sigmax	4.10E+07	Pa
tau	4.55E+06	Pa
taumax	2.10E+07	Pa
sigma1	**4.15E+07**	**Pa**
sigma2	0.00E+00	Pa
sigma3	-5.00E+05	Pa

Arm

Length (a)	0.1	m
Torque (calculated)	100	Nm

$$\sigma_x = \frac{Mc}{I} = \frac{(Fl)c}{I}$$

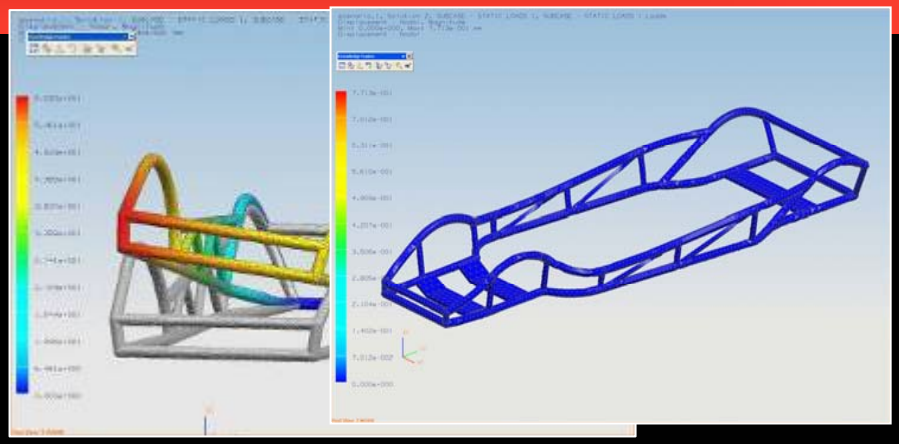
$$\tau_{xz} = \frac{Tr}{J} = \frac{(Fa)r}{J}$$

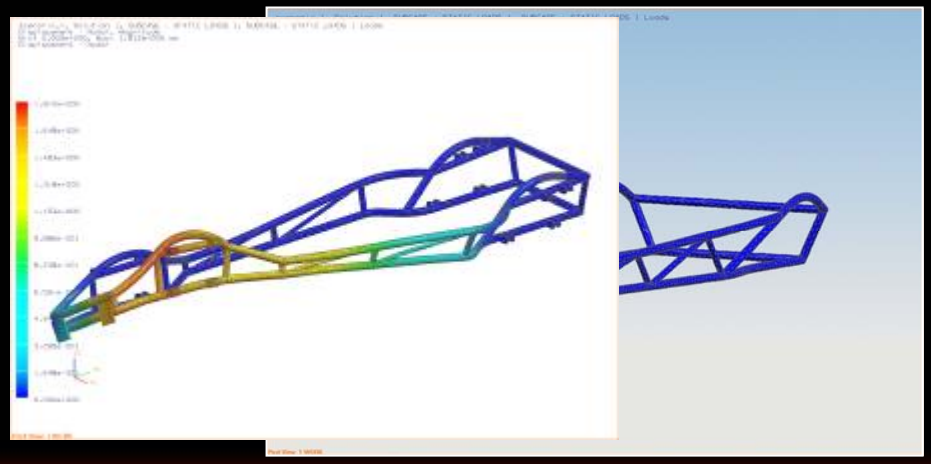
error = 10.07%

likely due to mounting arm on top rather than in the center

Analysis: NX FEA

- Alternate method to validate FEA results
- Torsional analysis without crossbars
- Validating cross-bars and floorpan



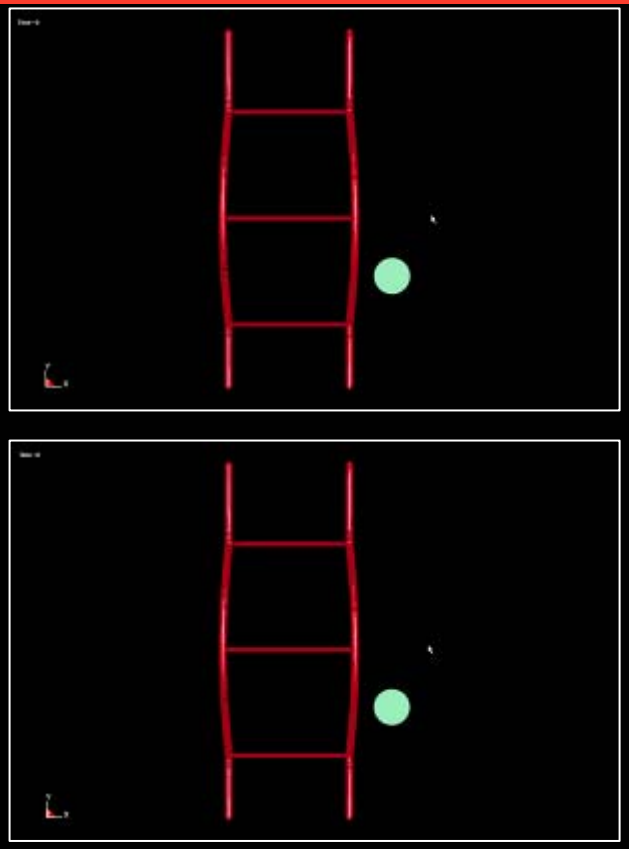


Analysis: LS-DYNA

- Crash analysis
- Challenges
  - Determining units
  - Defining material properties
  - Analyzing more complex geometry

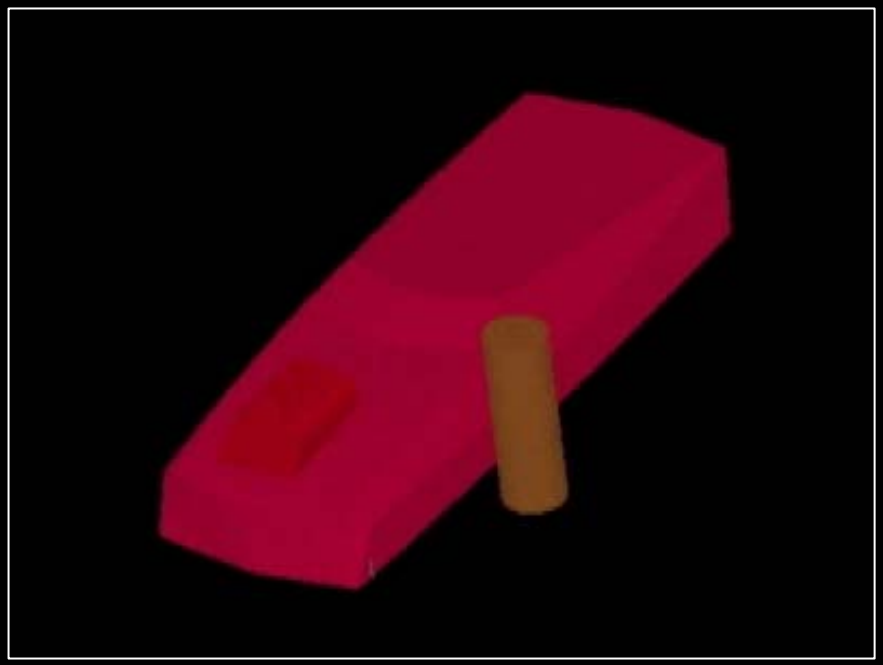
Analysis: LS-DYNA

- Crash analysis
- Challenges
  - Determining units
  - Defining material properties
  - Analyzing more complex geometry
  - Defining circular crash surfaces



Analysis: LS-DYNA

- Crash analysis
- Challenges
  - Determining units
  - Defining material properties
  - Analyzing more complex geometry
  - Defining circular crash surfaces
  - Establishing connectors between parts



Application

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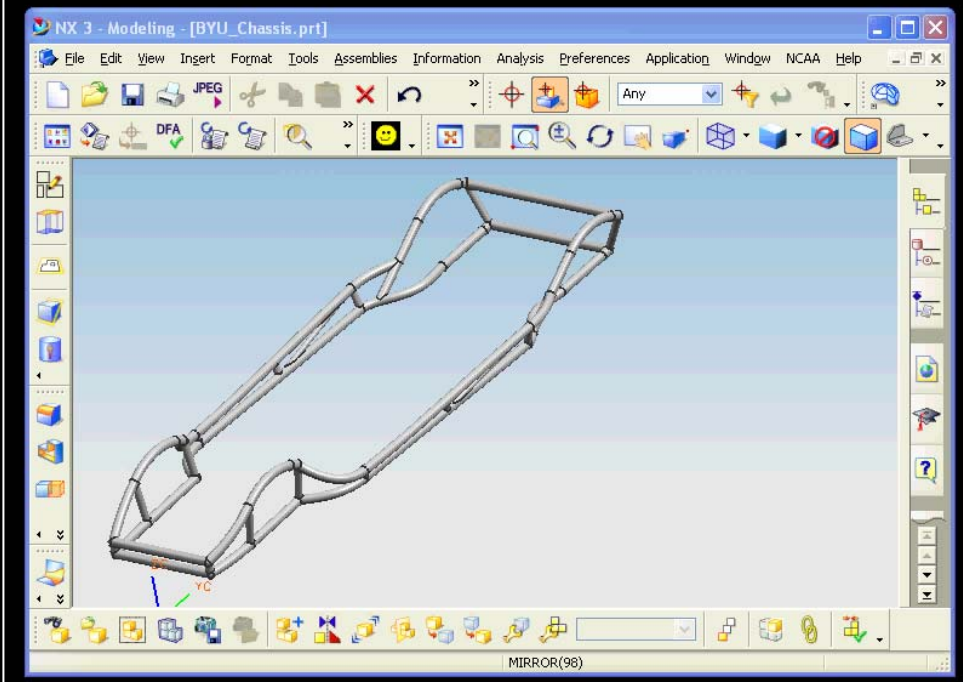

Questions?