Summary for ME599 Automotive Body Structures

I Nomenclature for primary body beams and panels

II Body Requirements

- Sources of Requirements
  - Locate and Retain
    - Bending Moments
    - Twist Ditch
    - Suspension Loads
    - Other Subsystems (powertrain, seat...)
  - Enable Vehicle Functions
    - Safety
    - Ride and Handling
    - Noise and Vibration

- Classification of Structural Requirements
  - Stiffness, Strength, Energy Absorbing
  - Global to Local

III Global Bending

- Moment Diagram and Equivalent Single Load

- Planar model and relationship to actual body

- Free-body analysis to show basic side frame loads

- FEM model of side frame (initially with rigid joints)
  - Importance of Including flexible joints
  - Relation of strain energy to deformation

IV Global Torsion

- Load cases for torsion- a) twist ditch, b) stiff relative to suspension rate

- Importance of panels for torsional stiffness, Analysis of box
  - Non-redundancy of shear-box

- Windshield / adhesive effectivness

- Torsional stiffness via lower load path-ladder frame, tube, x frame

V Body Topology

Efficiency measures: body mass relative to gross vehicle mass
body mass relative to plan view area

Major load cases defining topology
- Global bending, Global torsion
- Front Barrier, Rear Barrier, Side Barrier
- Suspension lateral, vertical

Constraints on topology
- packaging
- manufacturing
- secondary load cases

Body Structure Elements

VI Thin Walled beams

Used because of efficiency in providing high stiffness

Deflection and Stress distribution when loaded at angle to principle axis

Compressive Buckling of walls of beams
- Basic Buckling Equation
- Use of effective width
- Use of “CARS” for effective section calculations
- Axial Collapse of Beam/Columns
- Means to inhibit buckling

VII Joints

Desirable geometry for joints
Free-body analysis of joints
Section / beam model for transverse section stiffness
Distortion in curved sections

VIII Panels

Panel Requirements
Oil Canning and Dent Resistance
Panel Vibration
- Effect of Ribs and Crown on natural frequency
- Effective Rib Patterns

Membrane model for panels
- Loads define panel shape

IX Local Stiffness

Section / beam model for transverse section stiffness
Examples of effective local stiffness designs

X Barrier Modeling using Plastic hinge / limit analysis

XI Spot weld

Shear vs peel loading
Stress concentration at weld
Between weld buckling of flange
Deflection of weld flange under shear loads and effect on section stiffness

XII Vehicle Vibration

Source-Path-Receiver Model
Modeling a body mode with a modal model
Effect of mass placement on body frequency