



Let the evidence speak[®]

Theory 301: Multibody Model

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Multibody model



- Elastically-deformable “rigid” bodies
- Kinematically-constrained joints or spring/dampers connect bodies
- Linear deformation-based contact forces with friction

Multibody model

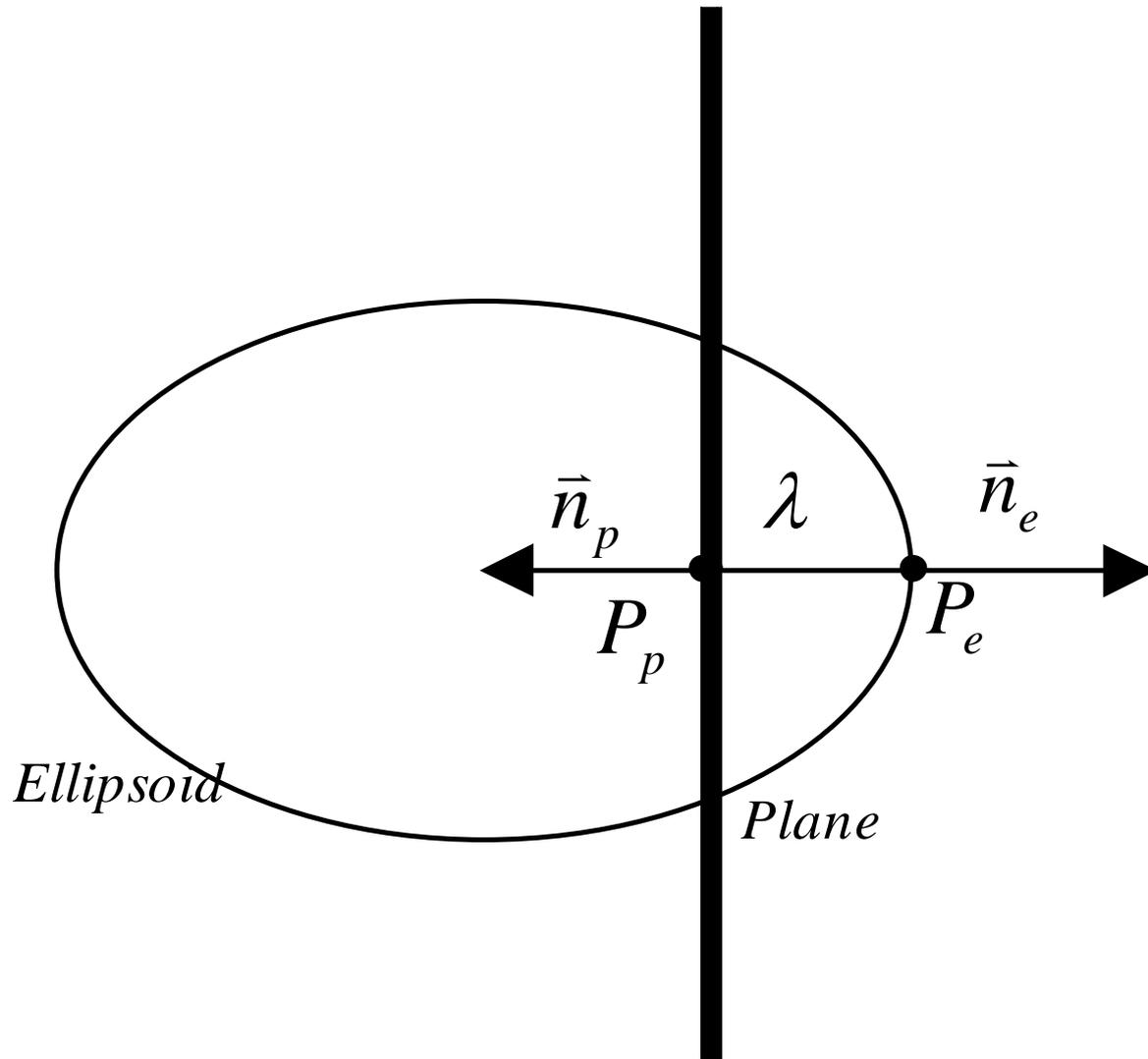


$$\begin{pmatrix} x \\ - \\ a \end{pmatrix}^n + \begin{pmatrix} y \\ - \\ b \end{pmatrix}^n + \begin{pmatrix} z \\ - \\ c \end{pmatrix}^n = 1$$

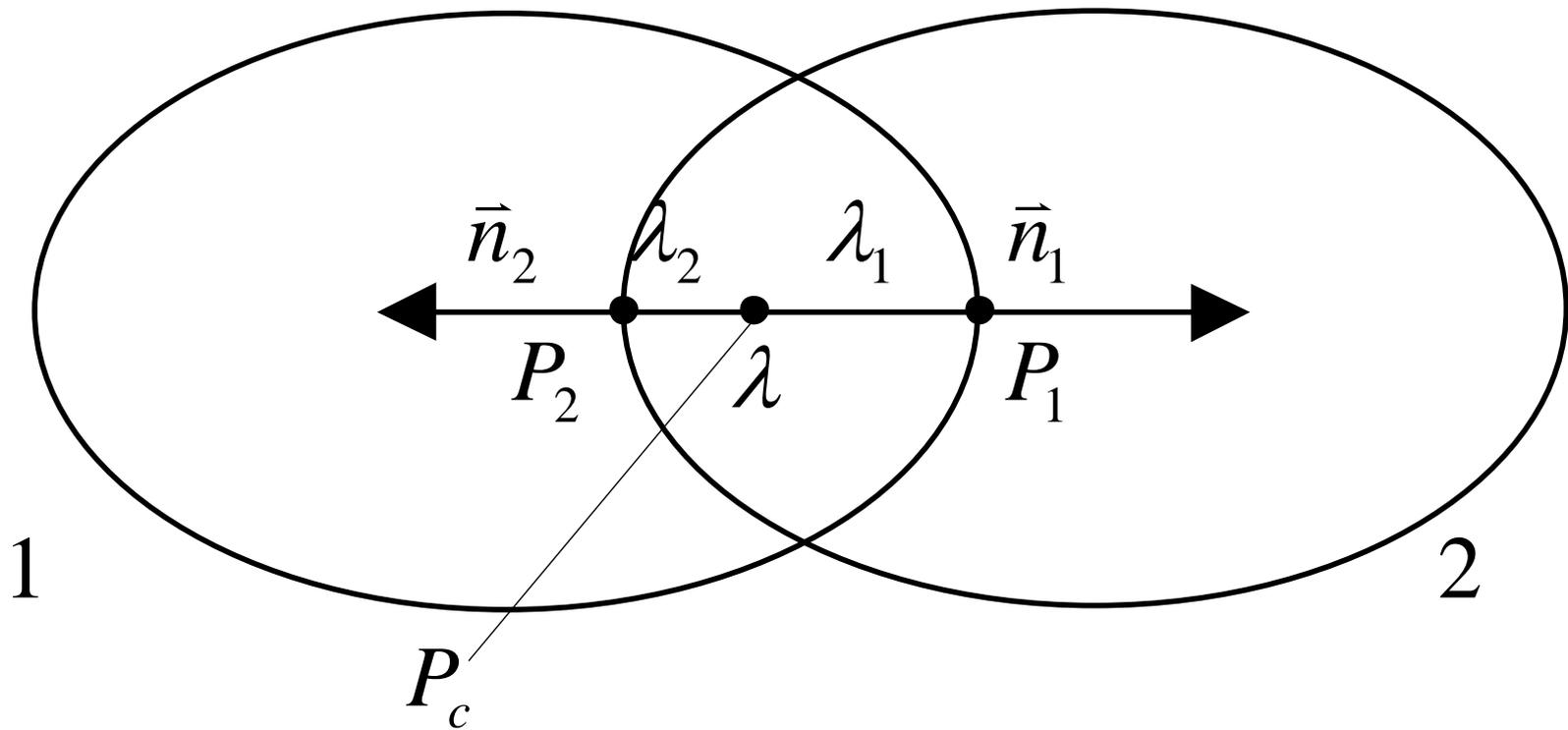
Ellipsoid contact model

- Based on a linear stiffness function
- A coefficient of restitution is specified to define the amount of elasticity during the contact
- Once the contact normal force is calculated friction forces are calculated, using the specified contact friction between two bodies or a body and the ground surface

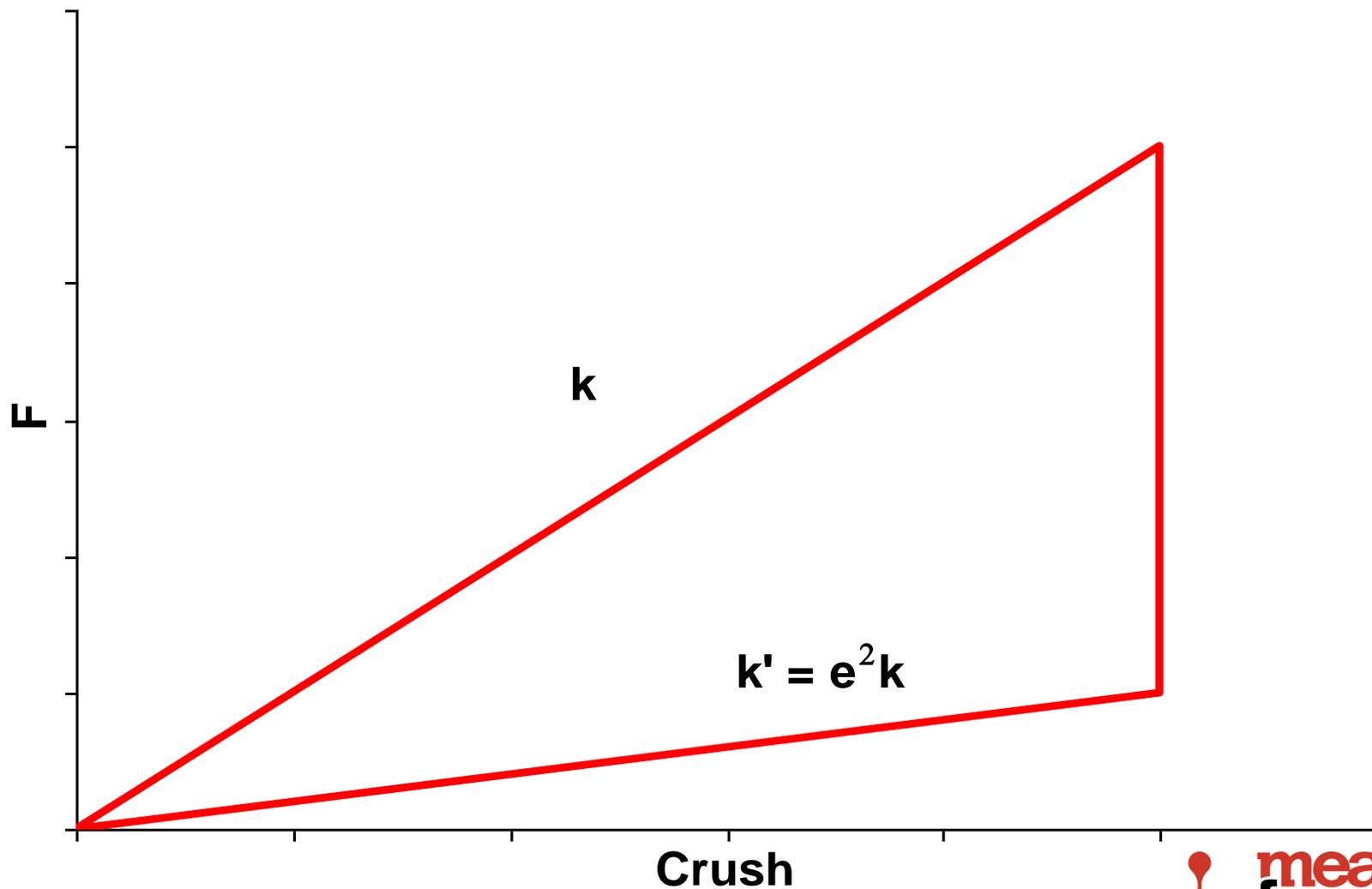
Ellipsoid-ground plane contact



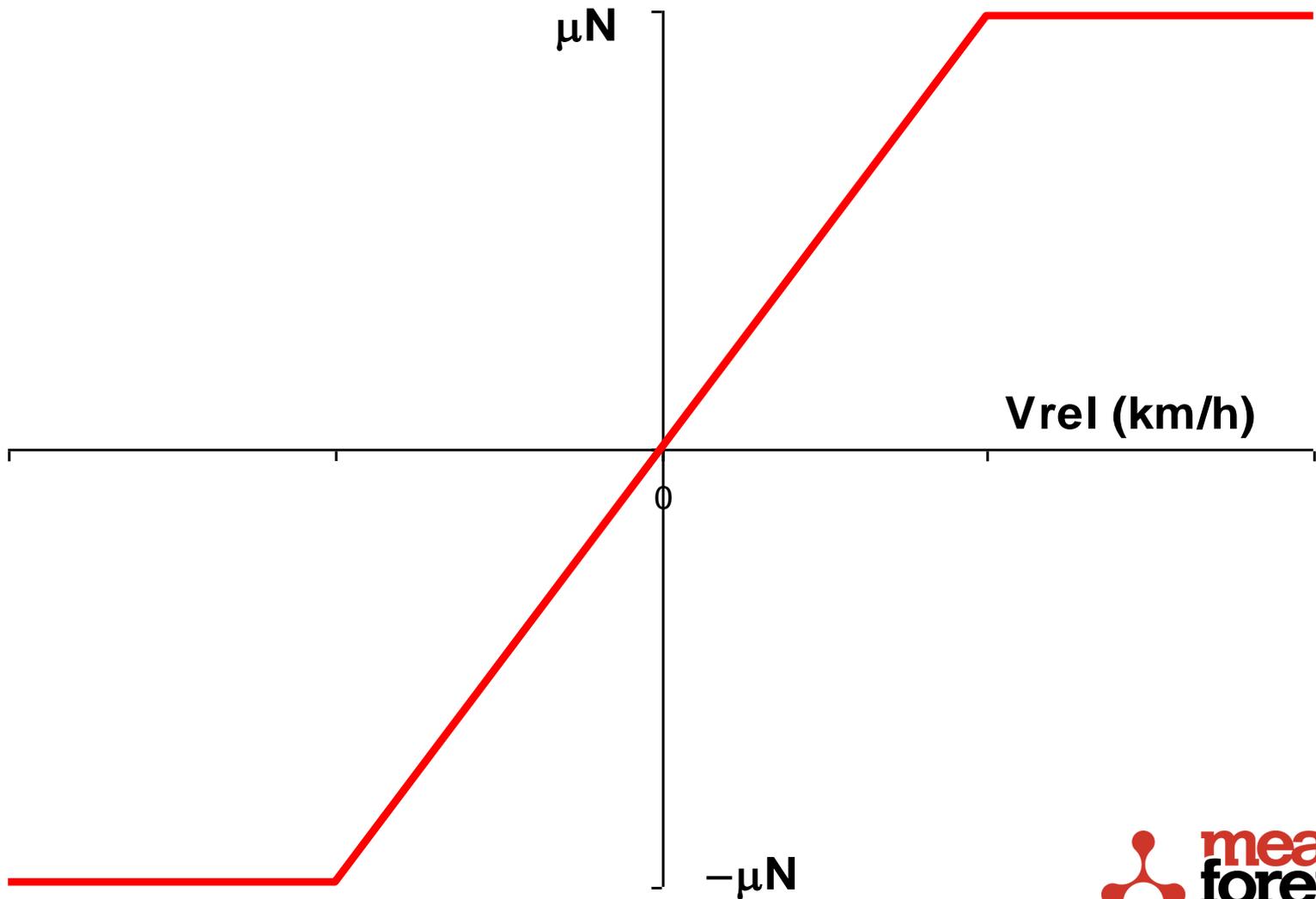
Ellipsoid-ellipsoid contact model



Force-deflection / restitution model



Ellipsoid friction model

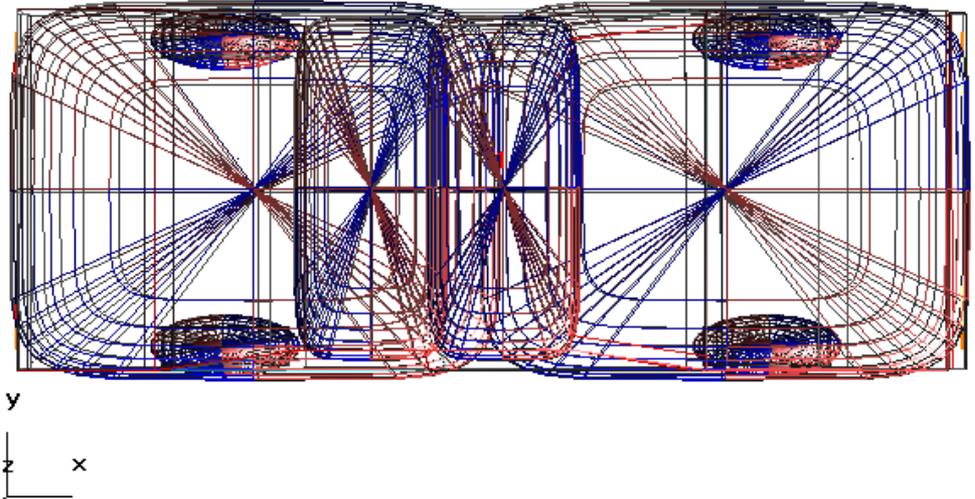


Typical Vehicular Uses

- Rollovers (on flat and 3D ground profiles)
 - Roof stiffness set to 25% of lower body stiffness
 - Wheel stiffness set to 50% of lower body stiffness
 - Wheel to ground friction the minimum of 0.80 or as specified for the scene
- Low speed impacts
- Sustained contact impacts

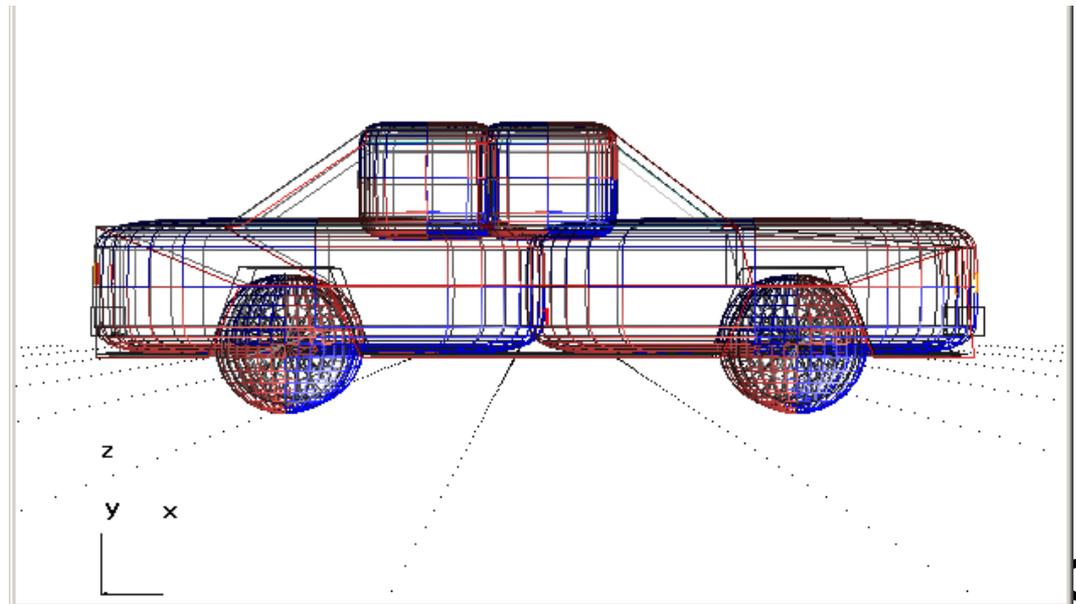
Typical Ellipsoidal Vehicle Model

Top view



Present car model
has 8 ellipsoids:
4 for body
4 for wheels

Side view



Ellipsoid model

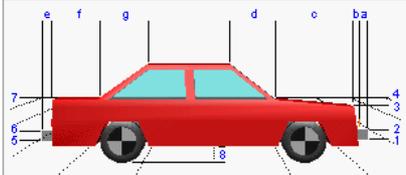


Vehicle Shape editor

Vehicle data

Vehicle Geometry: FORD TRUCKS-EXP Sedan

| | |
|------------|------------|
| a: 0.050 m | 1: 0.350 m |
| b: 0.058 m | 2: 0.500 m |
| c: 1.022 m | 3: 1 m |
| d: 0.584 m | 4: 1.100 m |
| e: 0.030 m | 5: 0.350 m |
| f: 0.000 m | 6: 0.500 m |
| g: 0.400 m | 7: 1.1 m |
| | 8: 0.267 m |

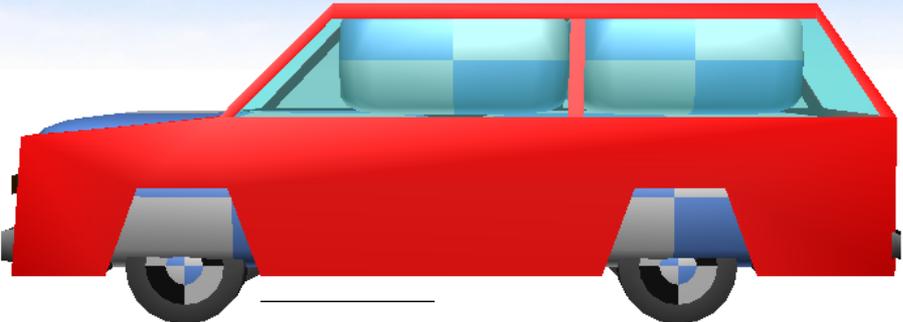


OK Cancel Apply

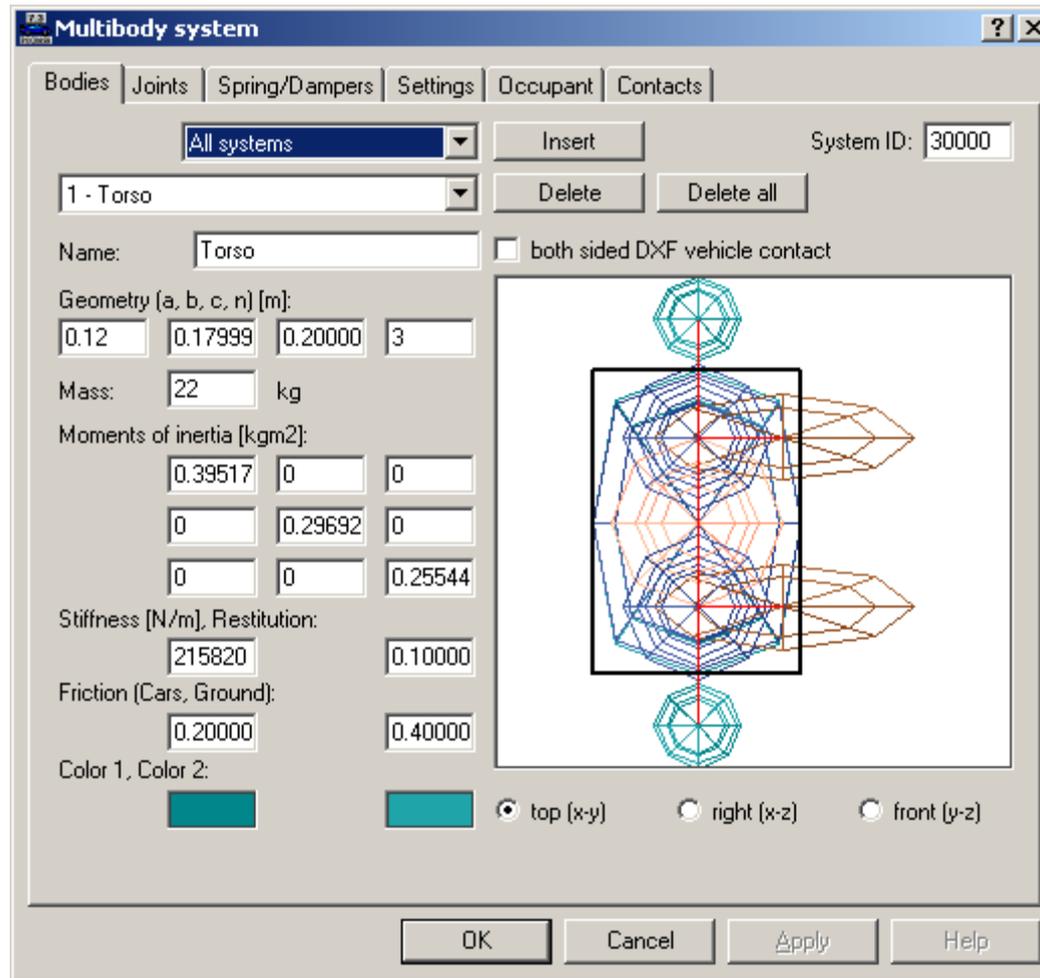
3D Visualization

Style Background Animation Print

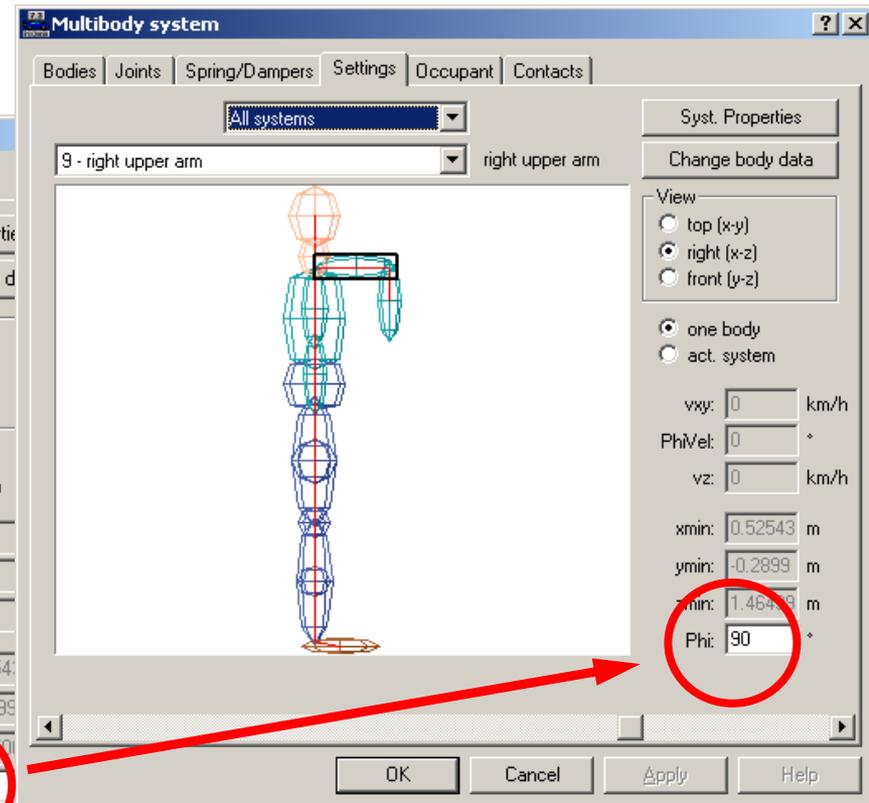
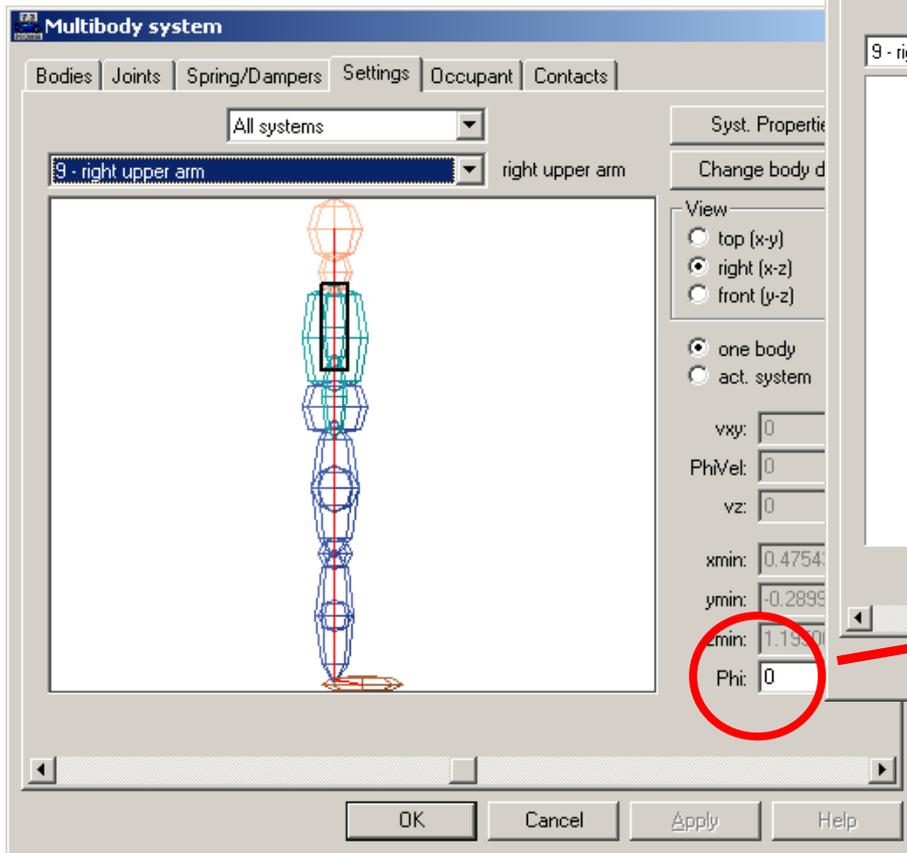
Strains (l)



Multibody Editor



Multibody editor - Posing



Multibody editor - Posing



The image displays two screenshots of the Multibody system software interface, illustrating the 'Posing' process.

Left Screenshot: The 'Multibody system' window shows the 'right upper arm' selected. The 'View' panel has 'right (x-z)' selected. The 'one body' radio button is circled in red. The 'zmin' value is 1.31169 m.

Right Screenshot: The 'Multibody system' window shows the 'right upper arm' selected. The 'View' panel has 'act. system' selected, which is circled in red. The 'zmin' value is 0.61419 m, which is also circled in red.

Multibody editor



- Numbers displayed in aEb notation
- Angles applied in order Roll-Pitch-Yaw (X-Y-Z) in global frame
- Editor display snaps to first body with respect to Yaw
- Act. System adjusts properties for all bodies as a unit

Multibody editor – Adding bodies



- Click Insert on Bodies tab
 - Adjust geometry and inertia
- Click Insert on Joint tab
 - Select bodies to link
 - Edit joint locations relative to each body
- Click Settings tab
 - Adjust body orientation