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Front Suspension

Baseline Optimization of Bump/Roll Steer

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- The Steering Knuckle in an SLA (Short/Long Arm) Independent Front Suspension has three pivot point attachments. These are at the Upper Control Arm, the Lower Control Arm, and the Tie Rod end.
- Bump/Roll Steer (change in toe) occurs due to the Tie Rod pivot at the Knuckle swinging through a different arc than the Control Arms.
- The baseline for this arc can be optimized using CATIA DMU Kinematics.

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- Certain parameters were set in this particular design.
  - Track: Front/Rear = 1490/1510mm
  - Wheelbase = 2489.2mm
  - Tire Size:
    - Front = P245/45ZR-17
      (Static Rolling Radius = 302mm)
    - Rear = P275/40ZR-18
      (Static Rolling Radius = 314mm)
  - Wheel Size:
    - Front = 17 x 8.5 in, Offset = 56mm
    - Rear = 18 x 9.5 in, Offset = 63mm

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- Parameters (cont'd).
  - Scrub Radius = +10mm
  - Steering Axis Inclination = 8.8^{o}
  - Caster Angle = 6.5^{o}
  - SLA Ratio = 1.43:1
  - Brake Rotor Offset (Hub face to Rear Rotor face) = 38mm
  - Ackermann Steering = 82.5%
  - Shock Extension/Compression = 48.7/36.1mm
- All of these parameters affect the three pivot points on the Steering Knuckle.

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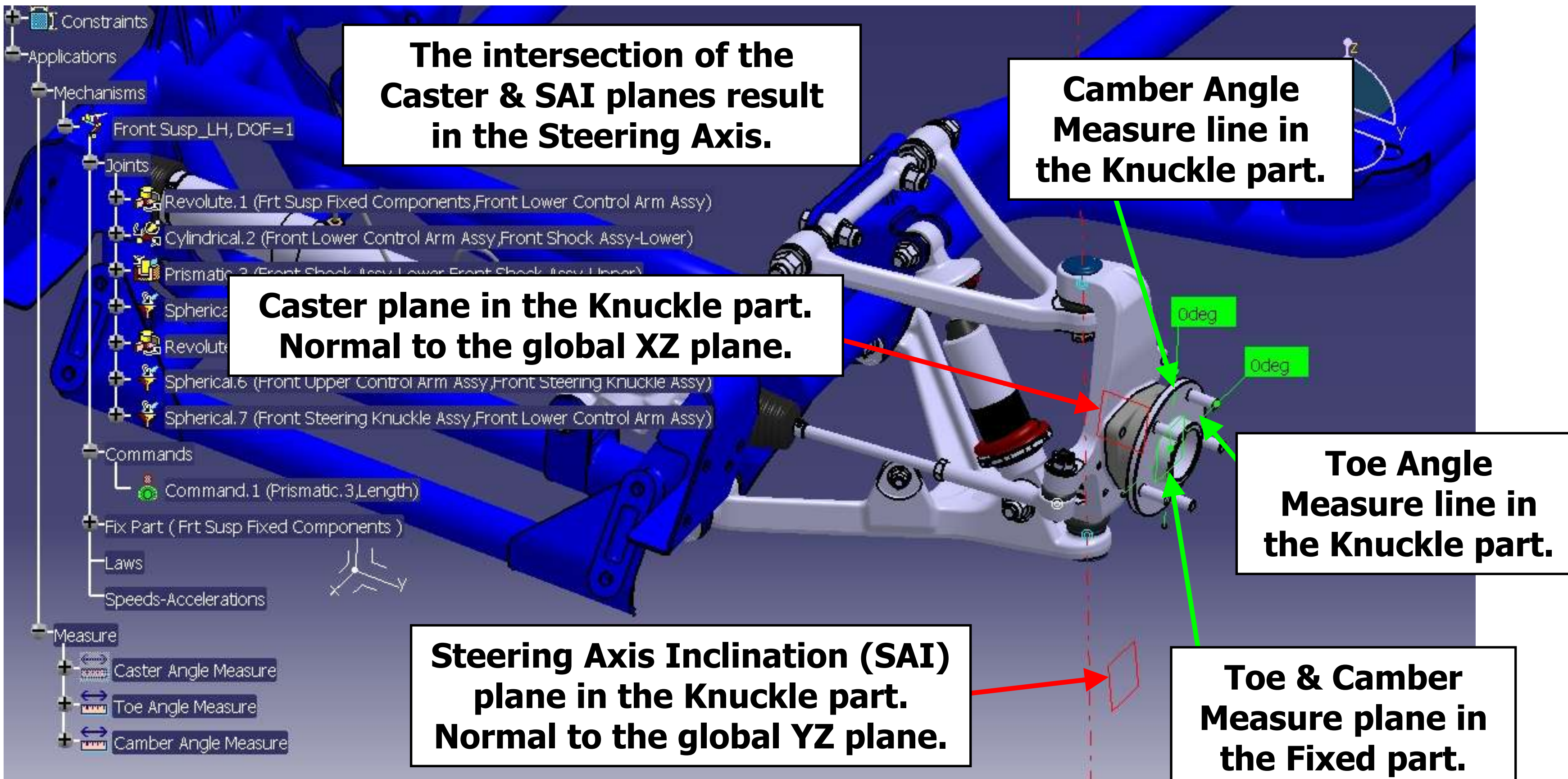
- In design position, the Toe and Camber Angles measure zero degrees.



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- To optimize the Toe Angle delta as the suspension moves through jounce and rebound, the Tie Rod pivot arc must first be determined.

- The method shown in this example is an expedient way to get the optimized plane to swing the Tie Rod pivot arc.

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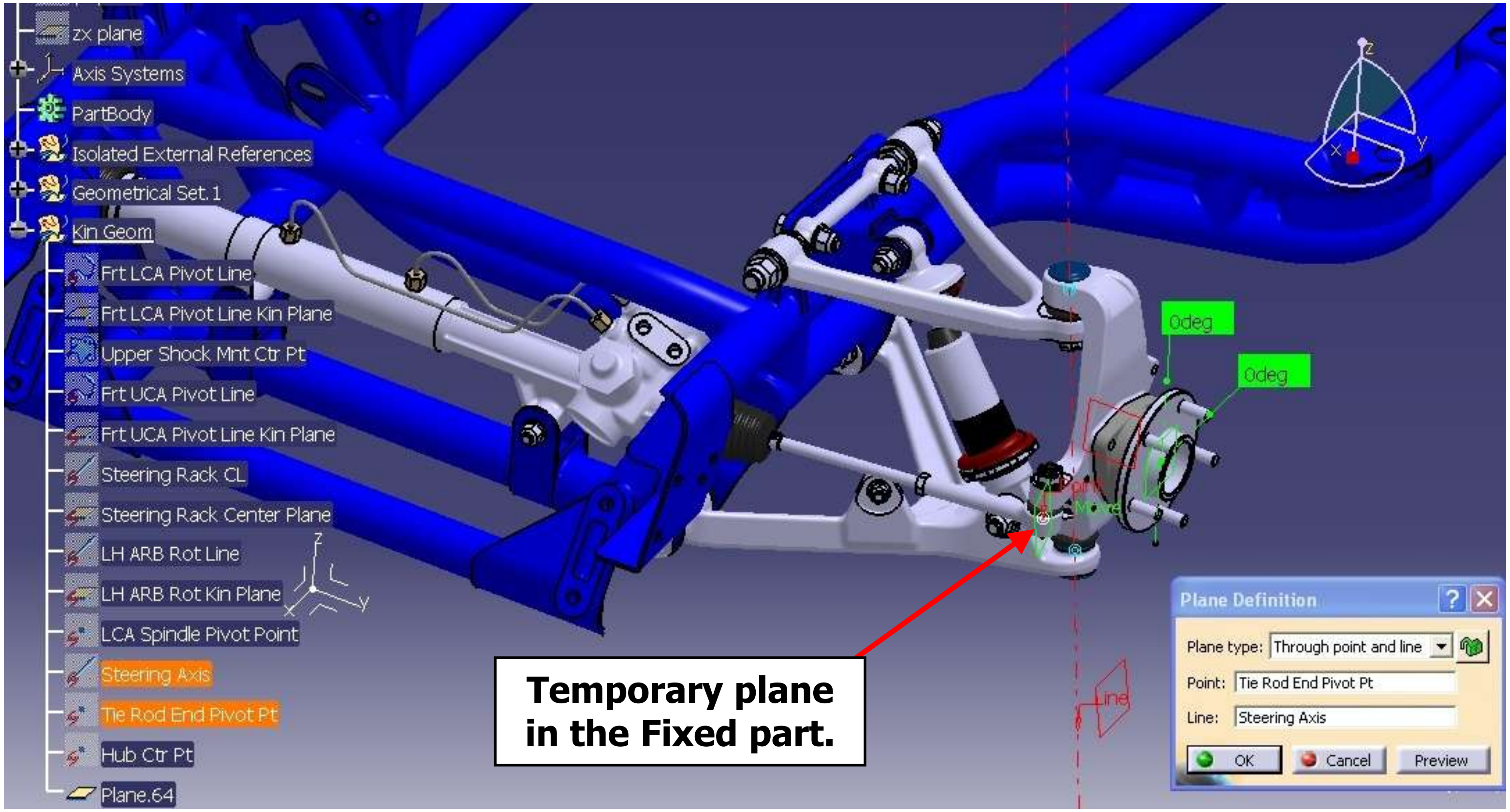
- Step 1: In the Fixed Part, create a temporary plane through the Steering Axis and the Tie Rod pivot point.



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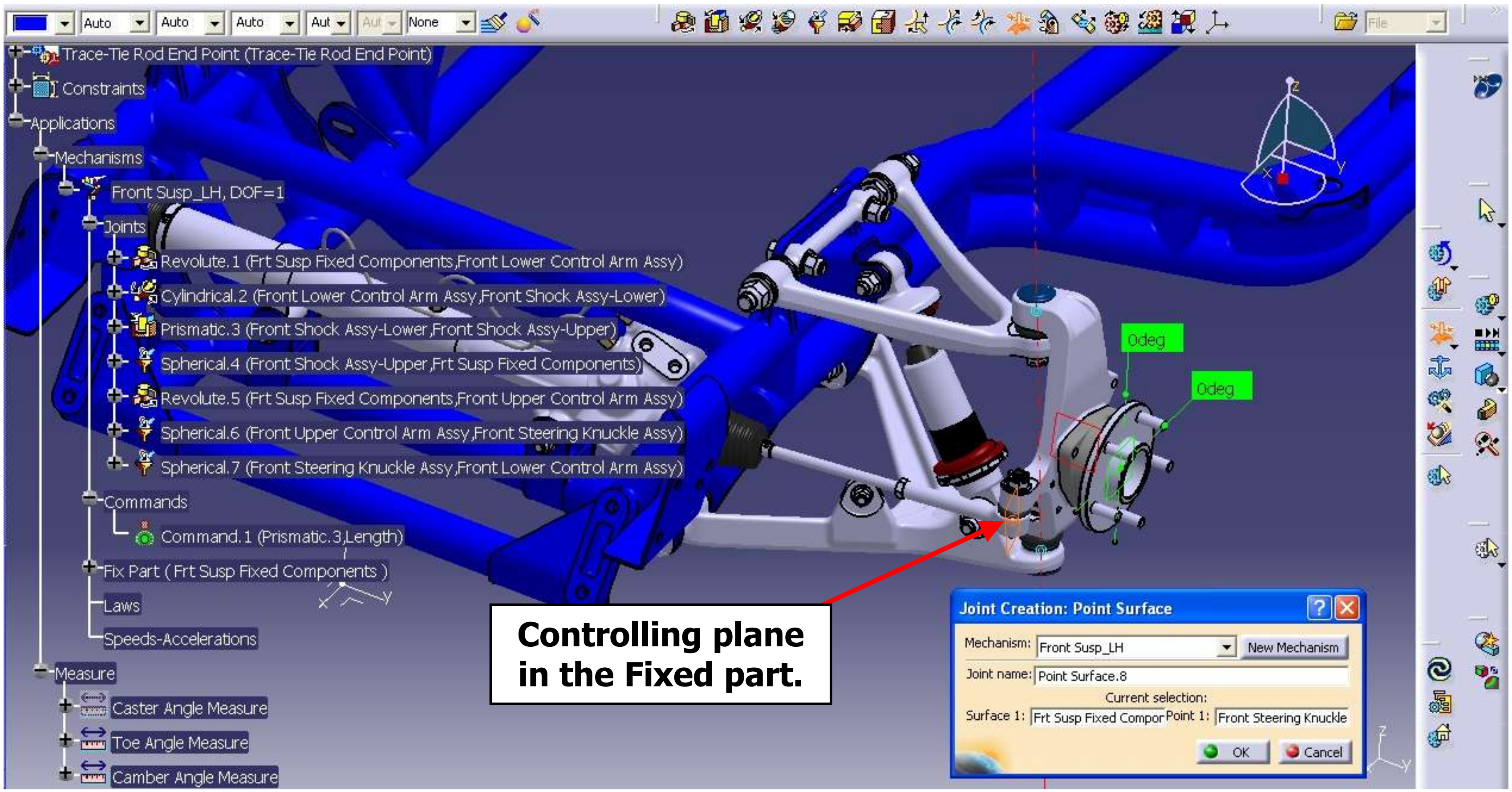
- Step 2: Use the temporary plane as the controlling surface in a Point-Surface joint to complete the suspension Kinematic.



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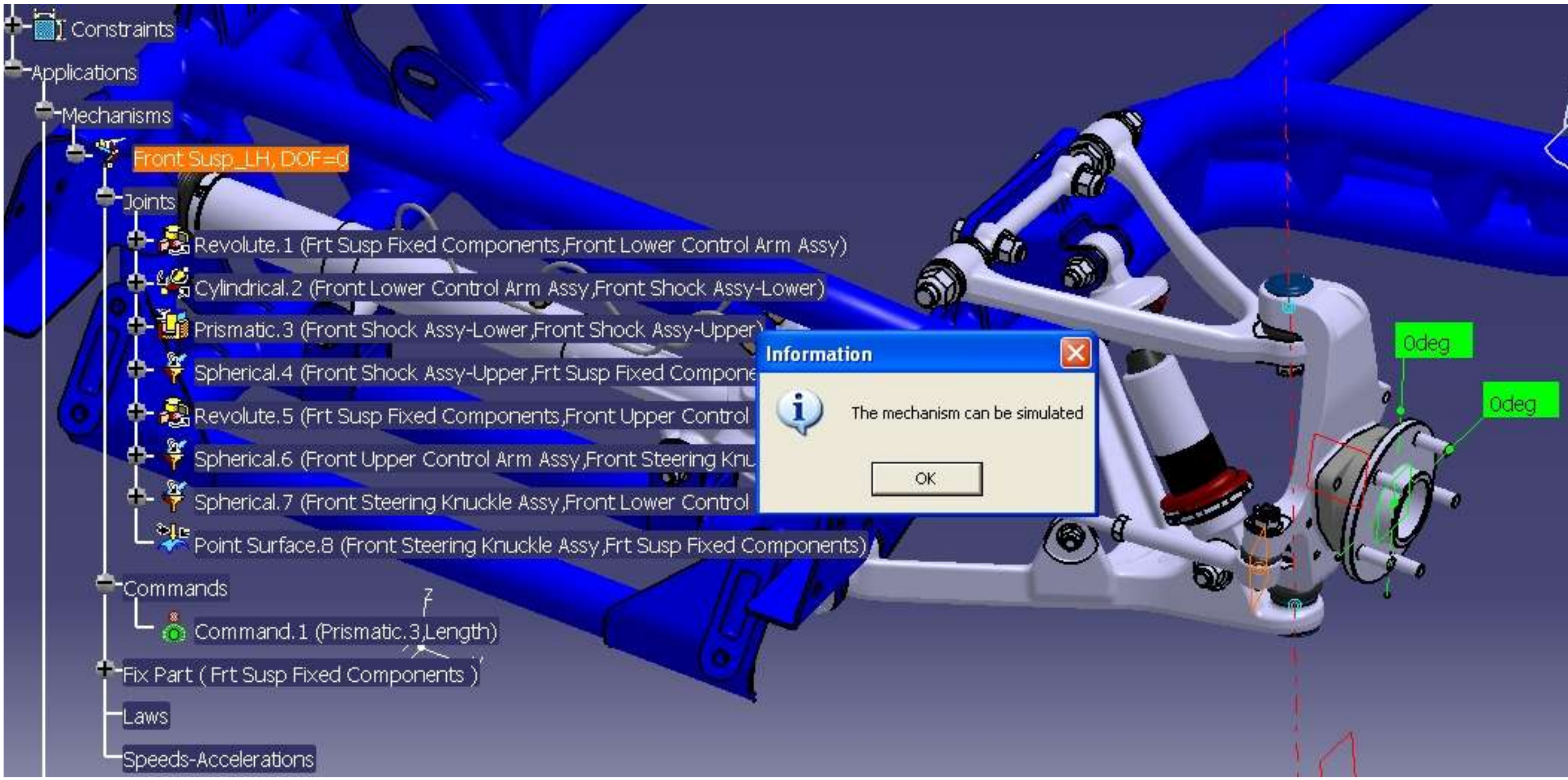
- Step 2: The completed Kinematic.



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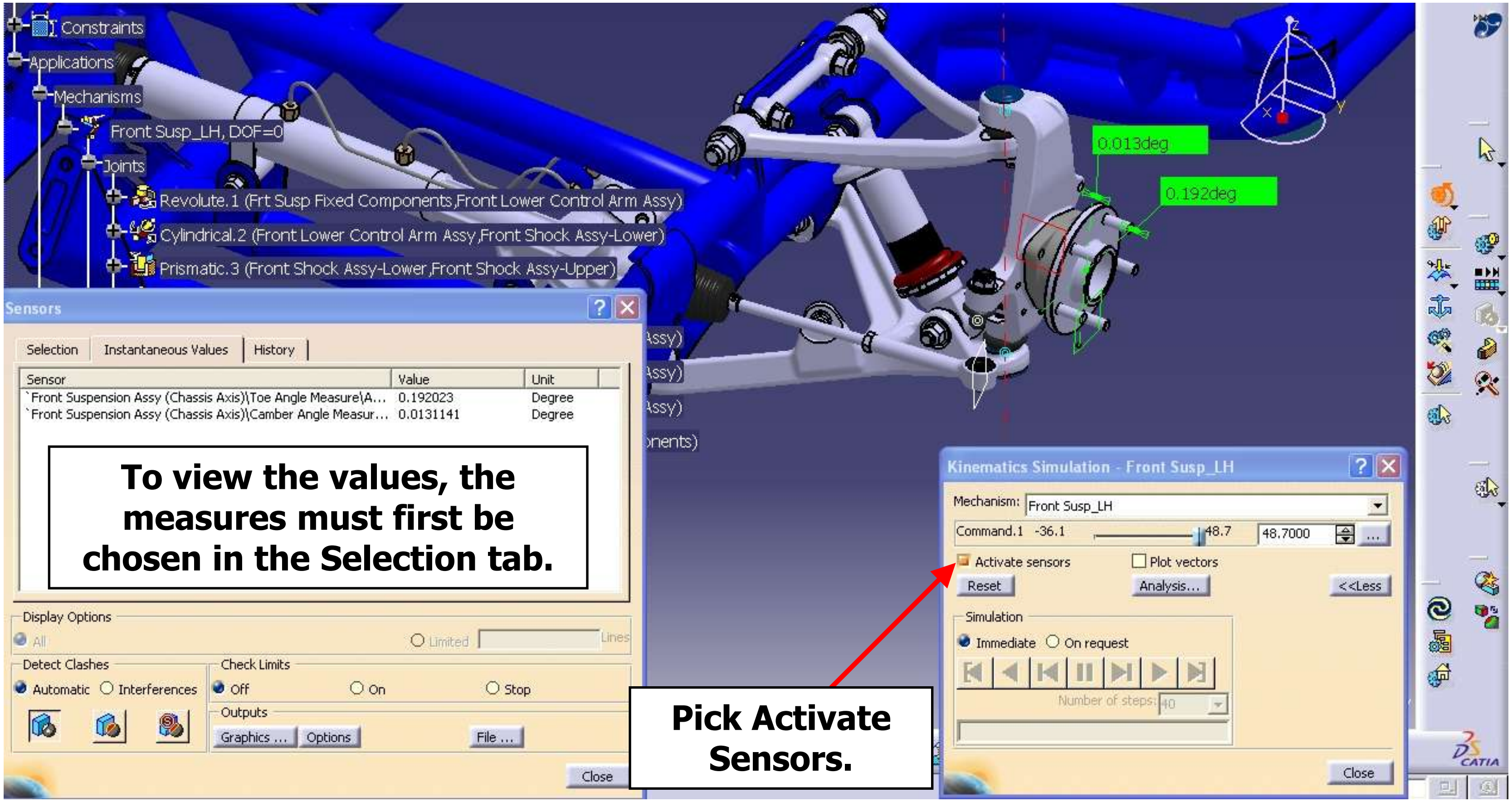
- Step 3: Run the Kinematic to full jounce position.



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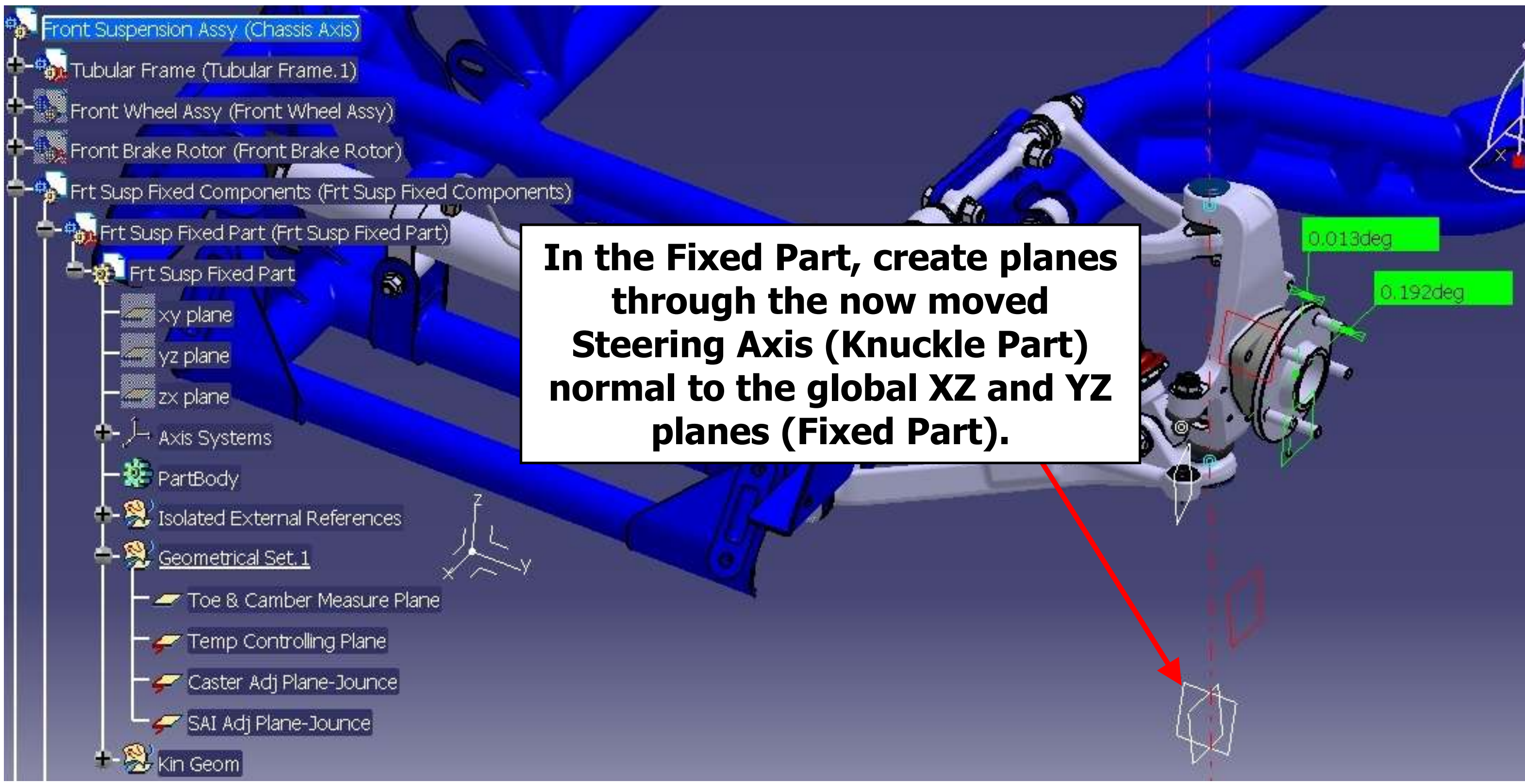
- Step 4a: Adjust the Knuckle to Optimized position.



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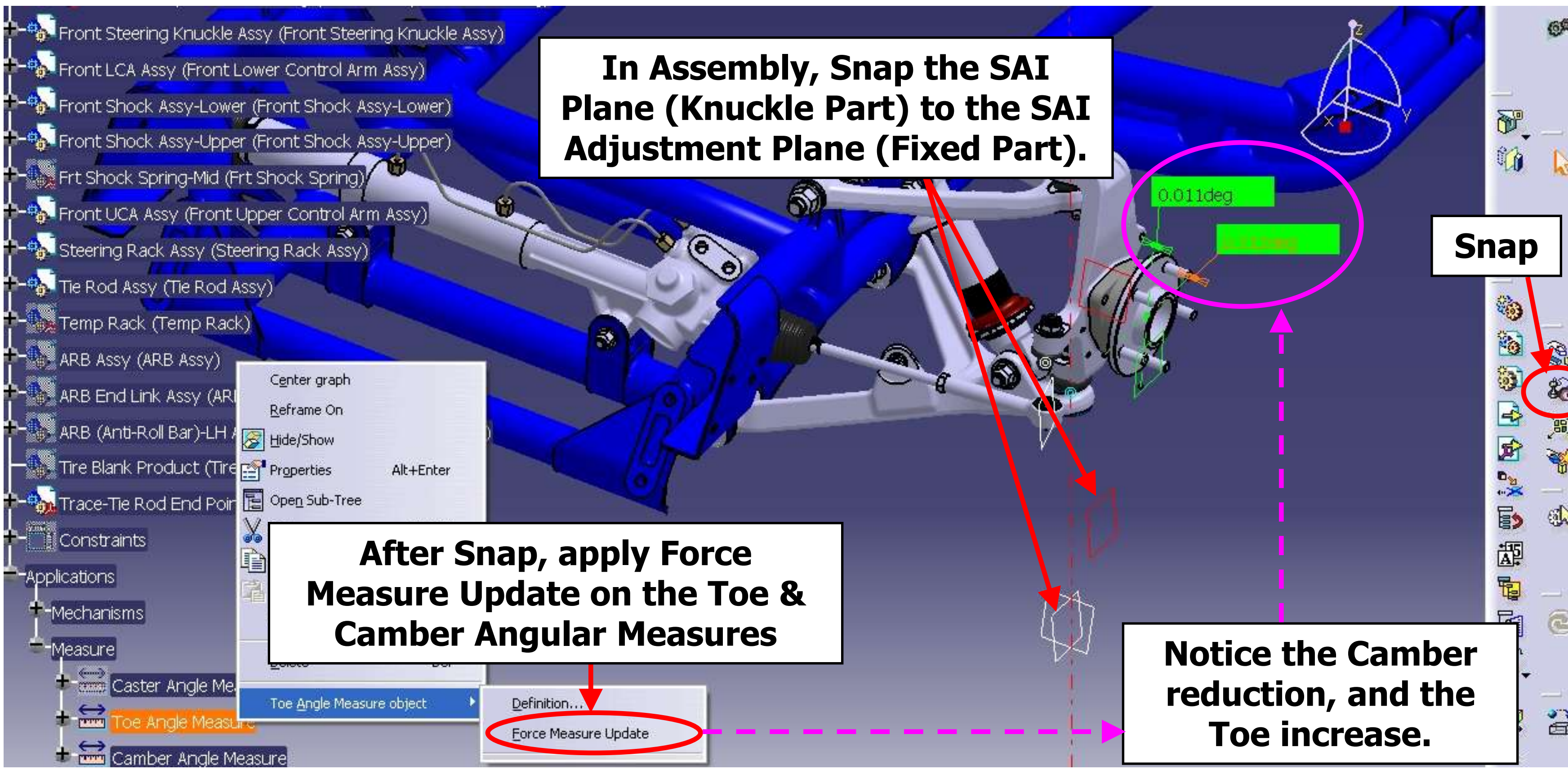
- Step 4b: Adjust the Camber to Optimized position using Snap.



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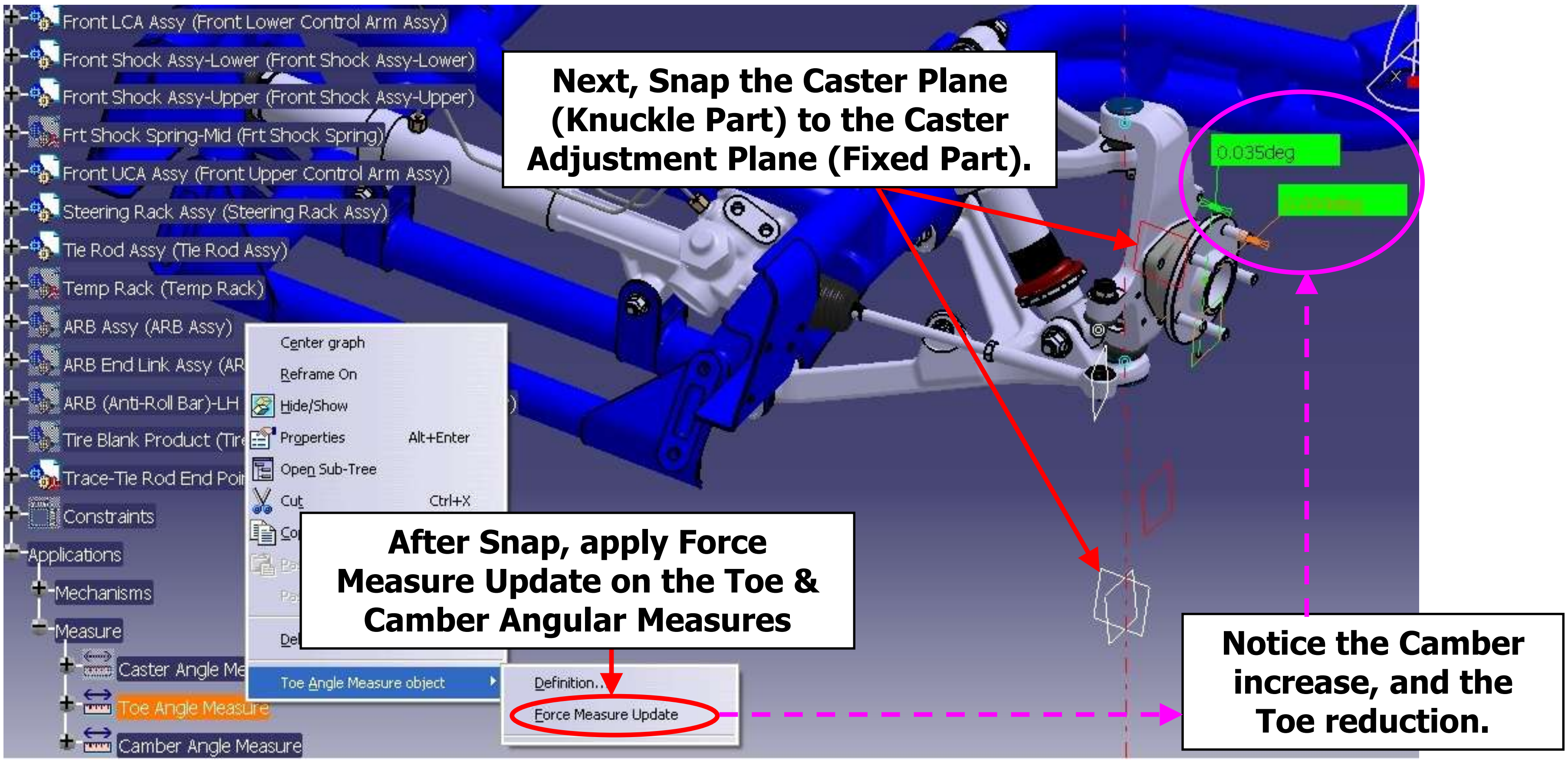
- Step 4c: Adjust the Toe to Optimized position using Snap.



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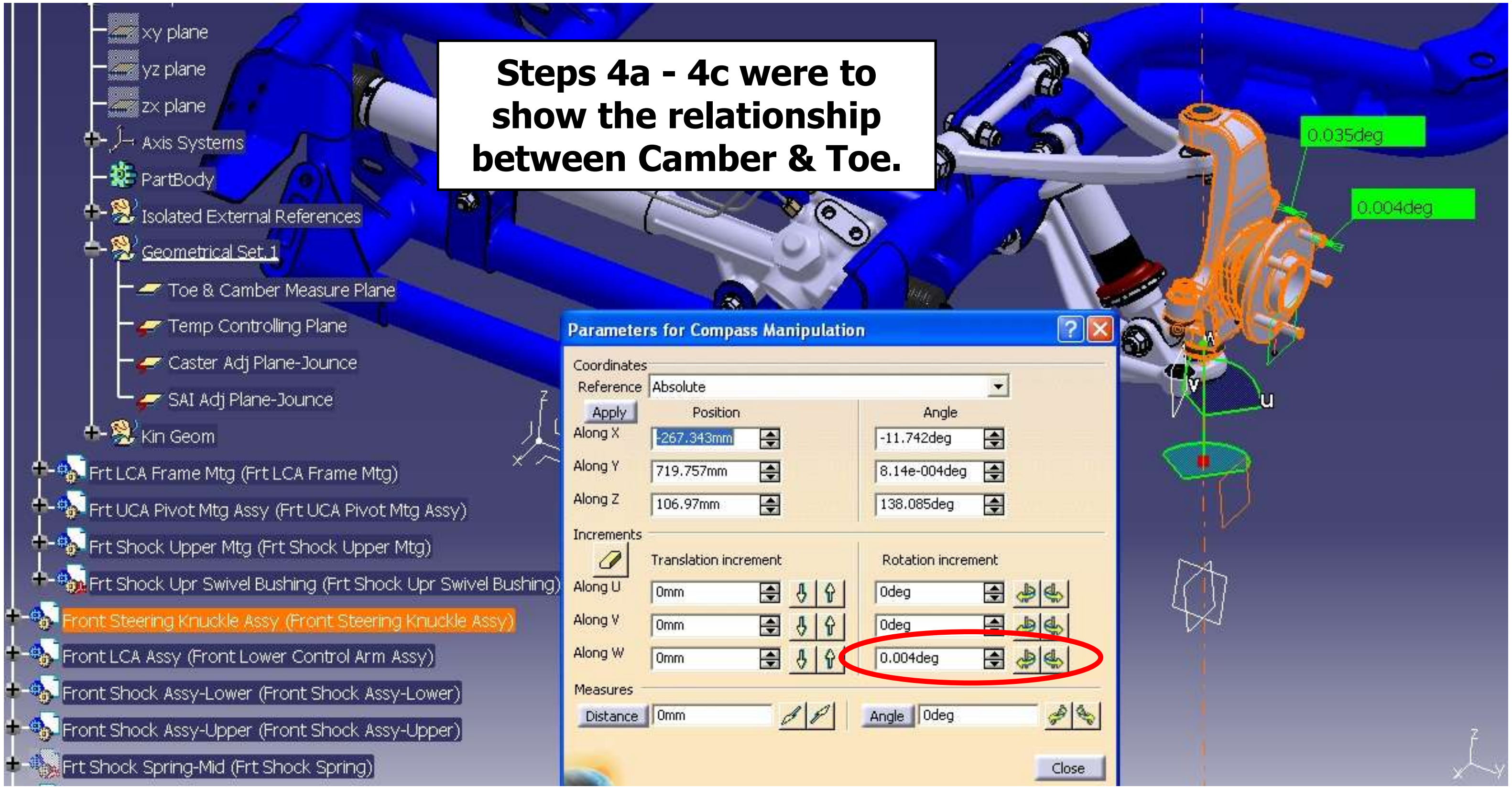
- Step 4d: Adjust the Toe to Optimized position using Compass on the Steering Axis. This method could be used in lieu of steps 4a – 4c.



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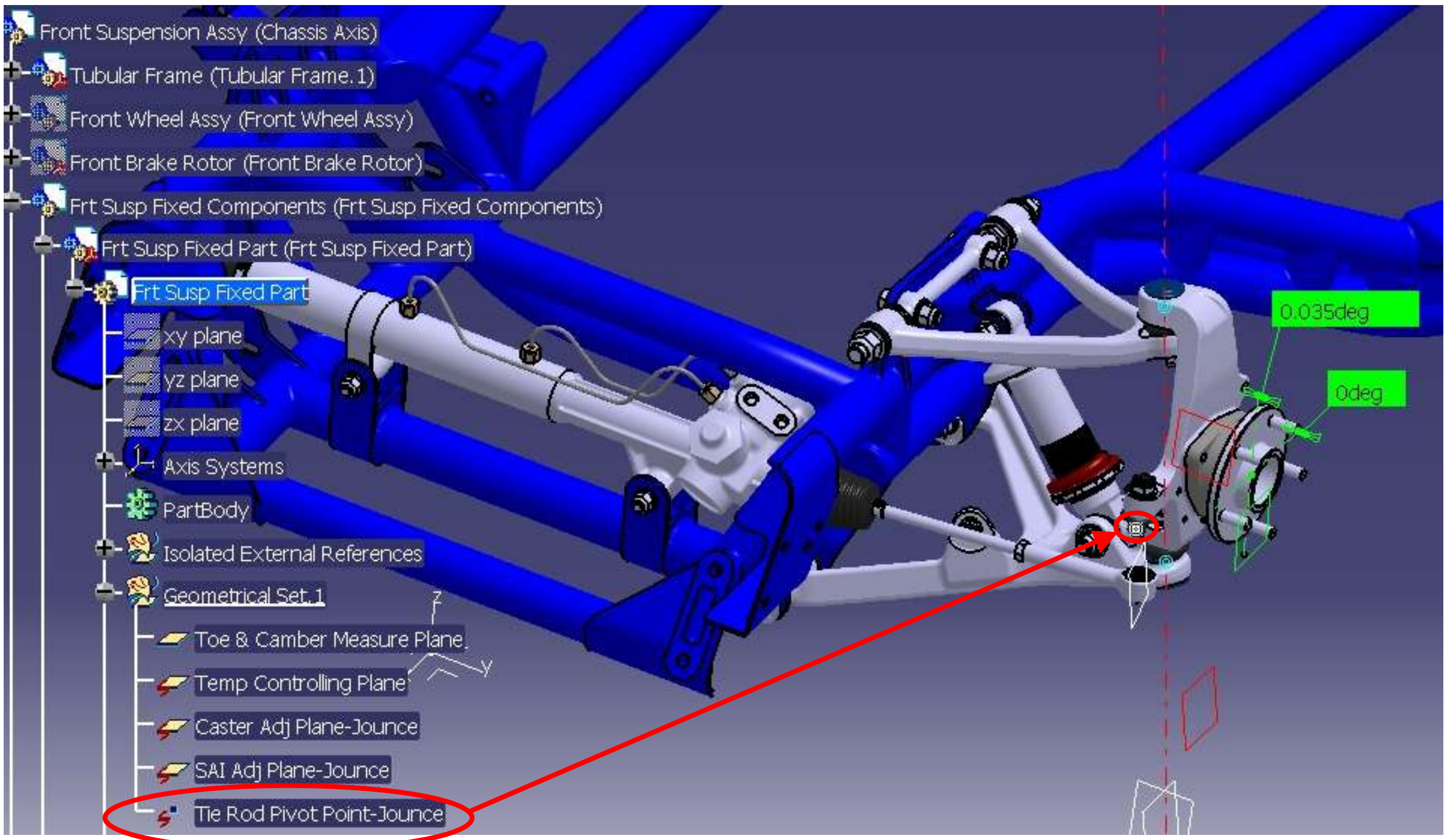
- Step 4e: In the Fixed Part, create a point at the now moved Tie Rod pivot.



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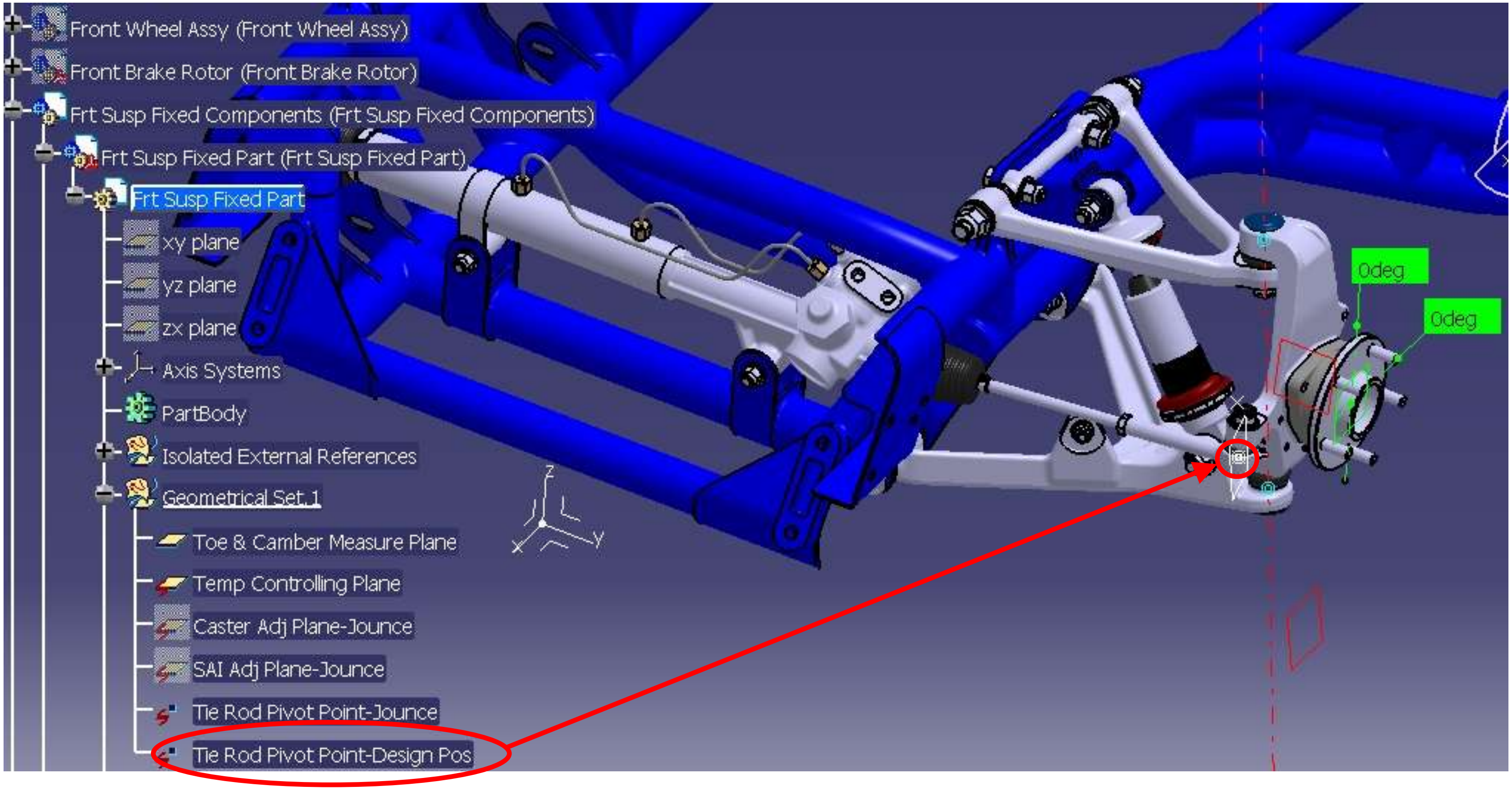
- Step 5: Return the Kinematic to design position. In the Fixed Part, create a point at the now moved Tie Rod pivot.



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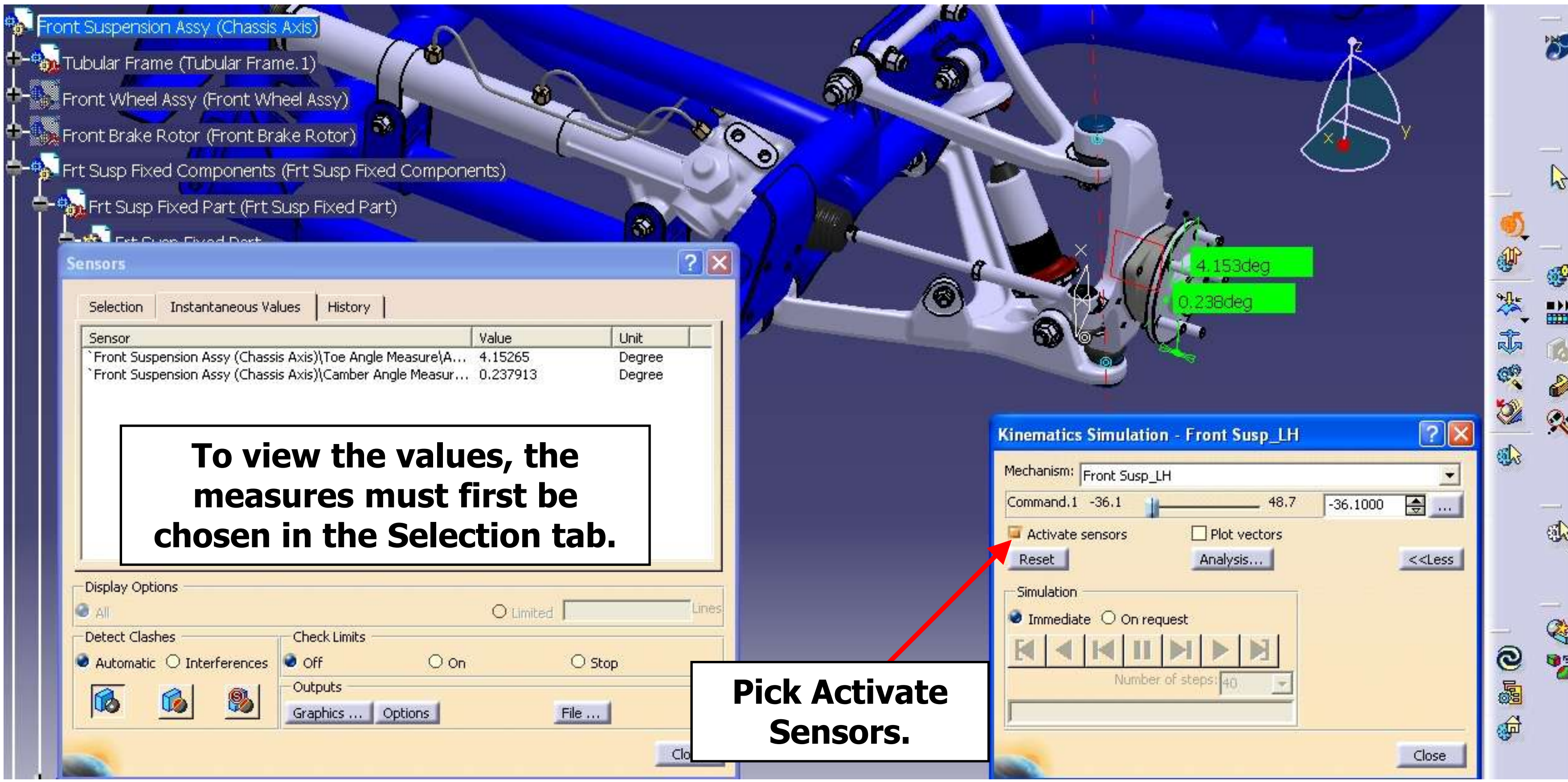
- Step 6: Run the Kinematic to full rebound position.



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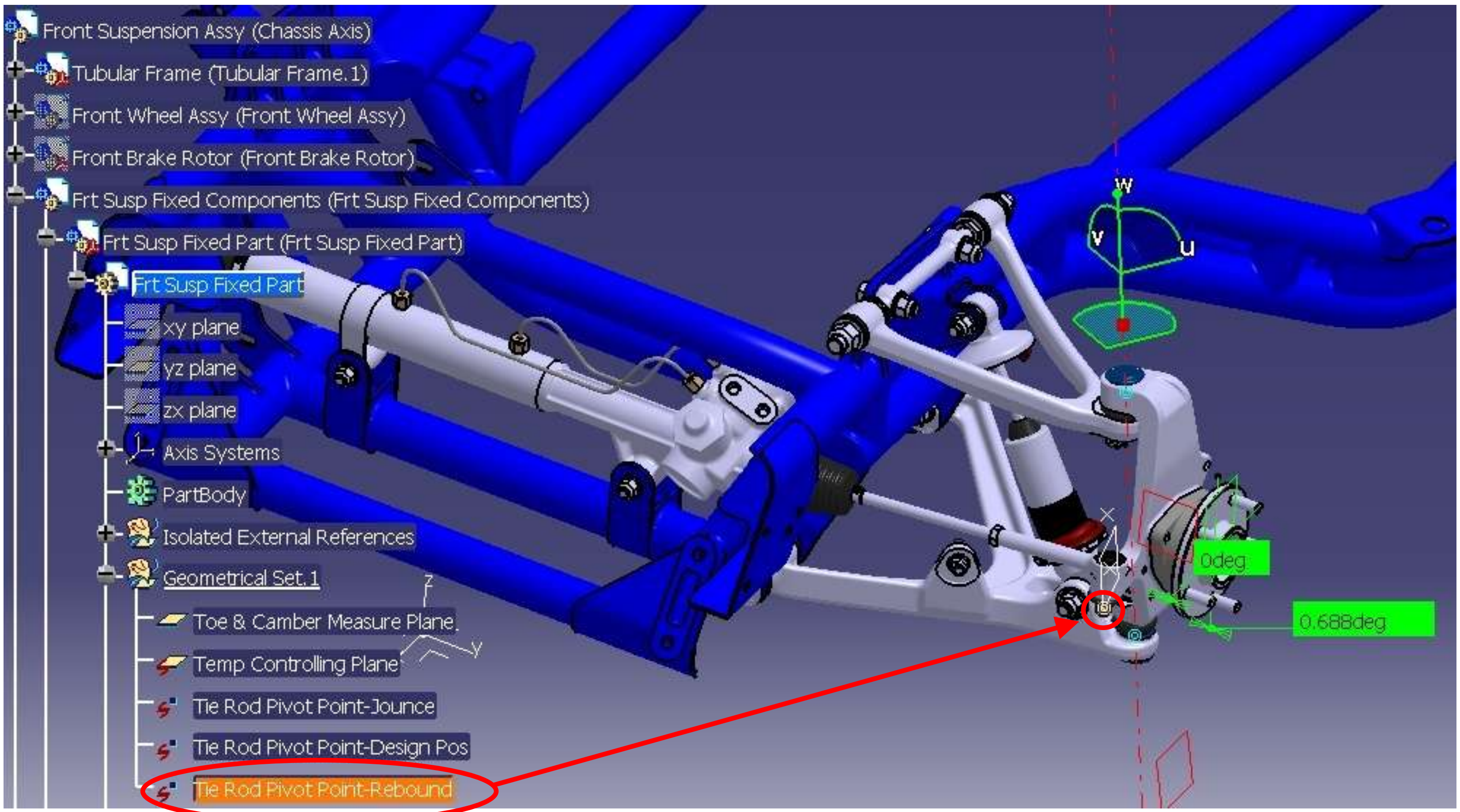
- Step 7: Repeat Steps 4d & 4e in rebound position.



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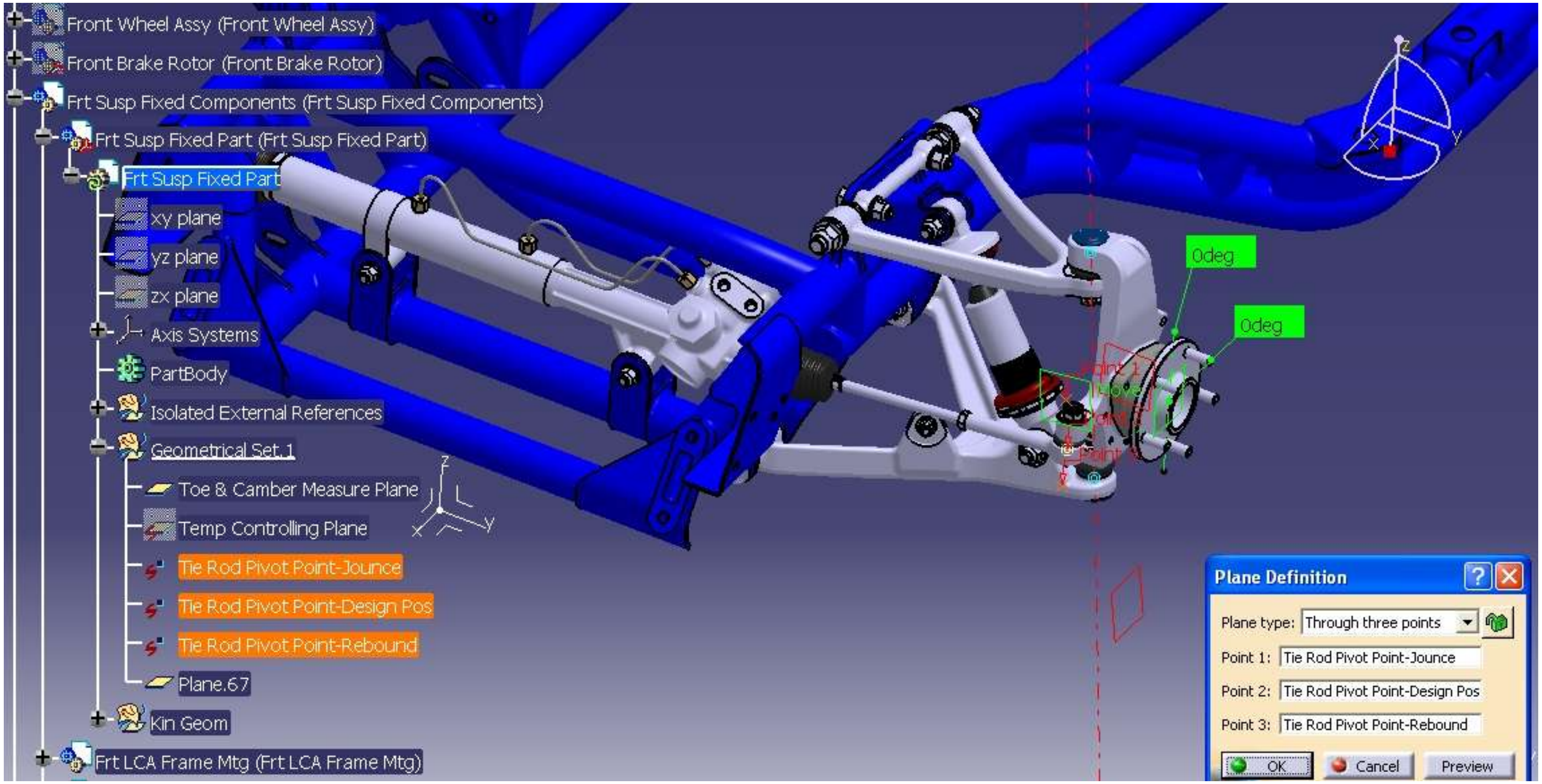
- Step 8: Return the Kinematic to design position. In the Fixed Part, create a plane through the three Tie Rod Pivot points.



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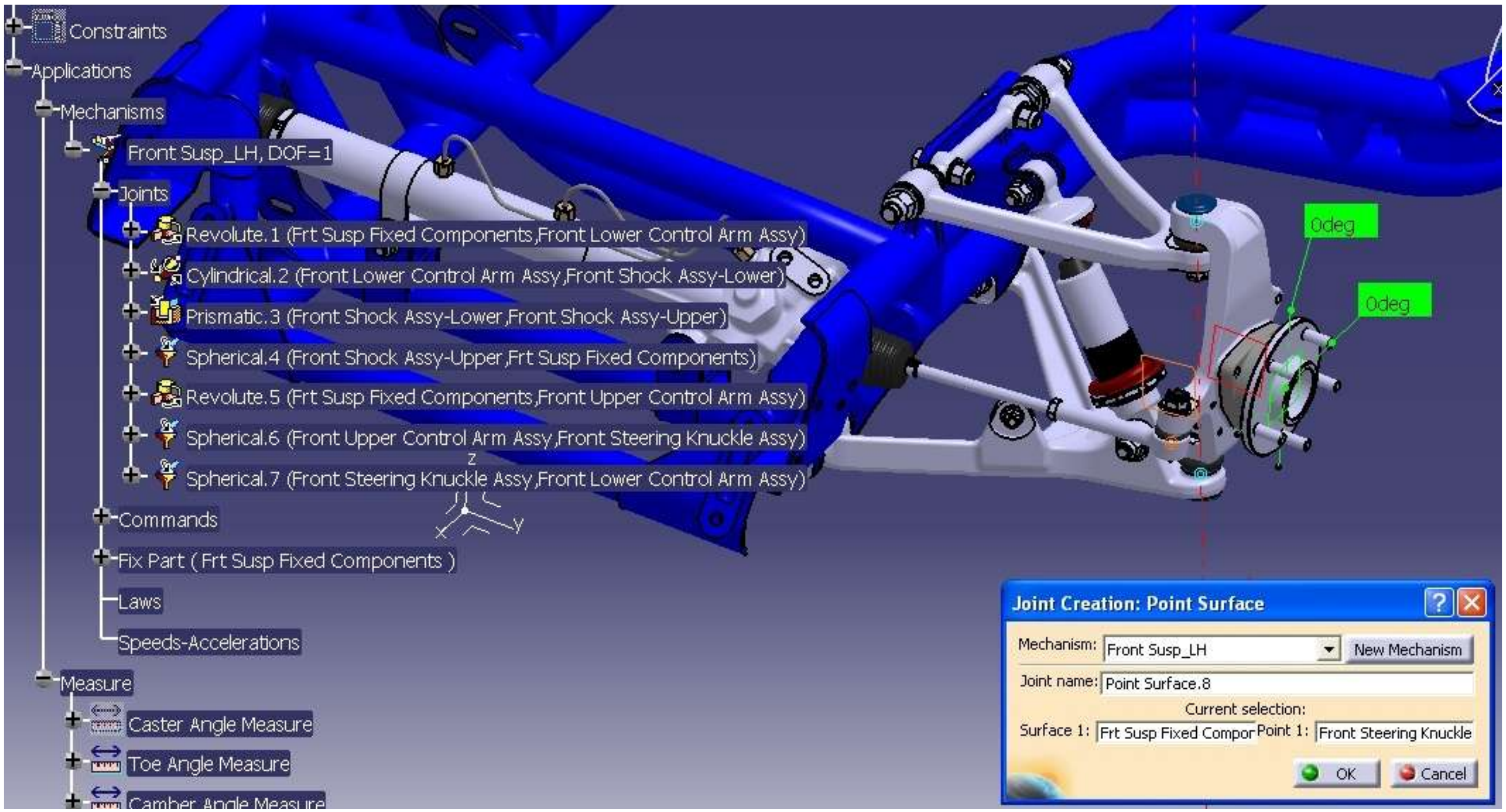
- Step 9: Replace the Temporary Controlling Plane in the Kinematic with the Optimized Controlling plane.



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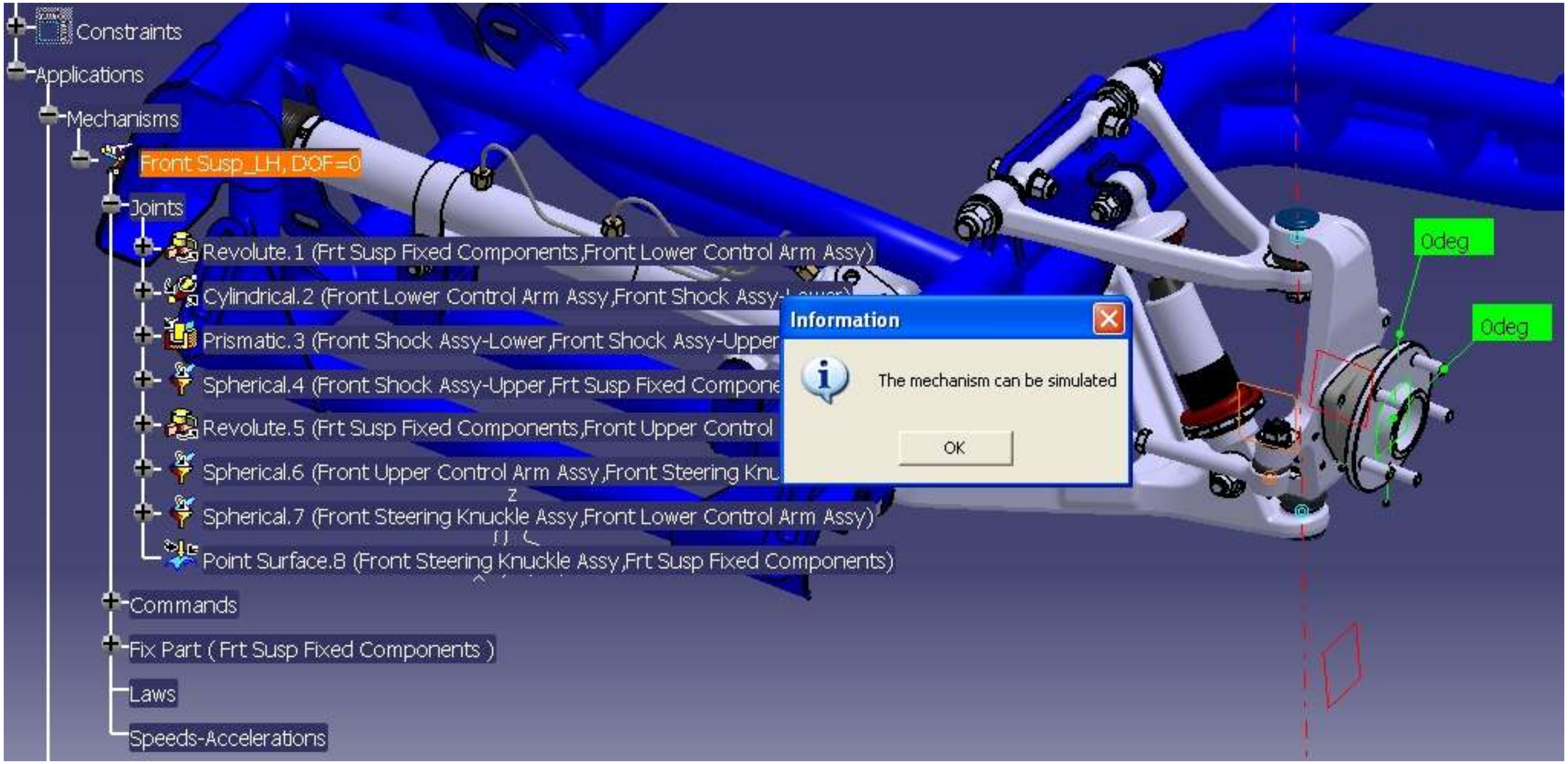
- Step 9: The completed Kinematic.



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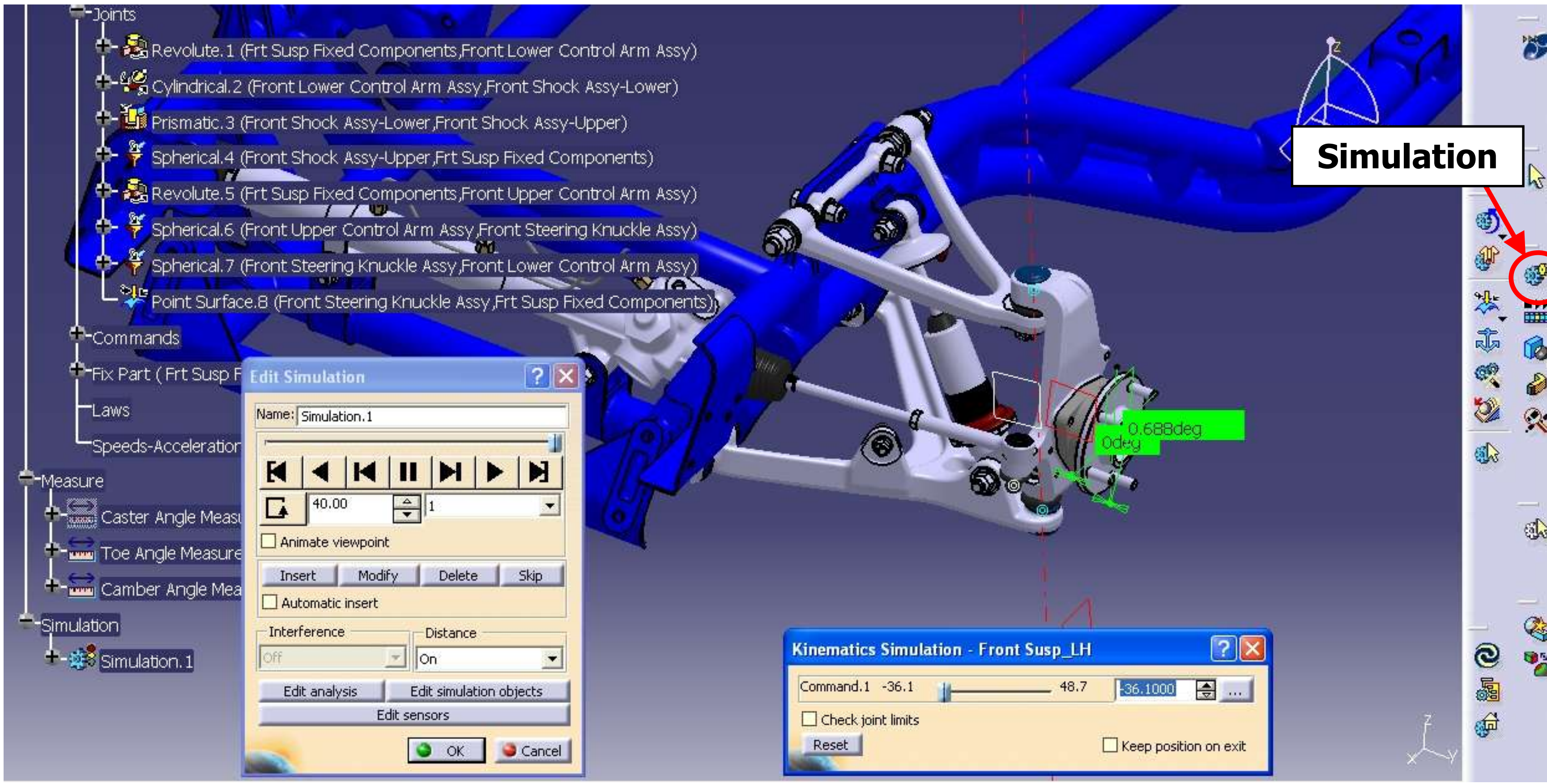
- Step 10a: Create a Kinematic Simulation (for the Trace).



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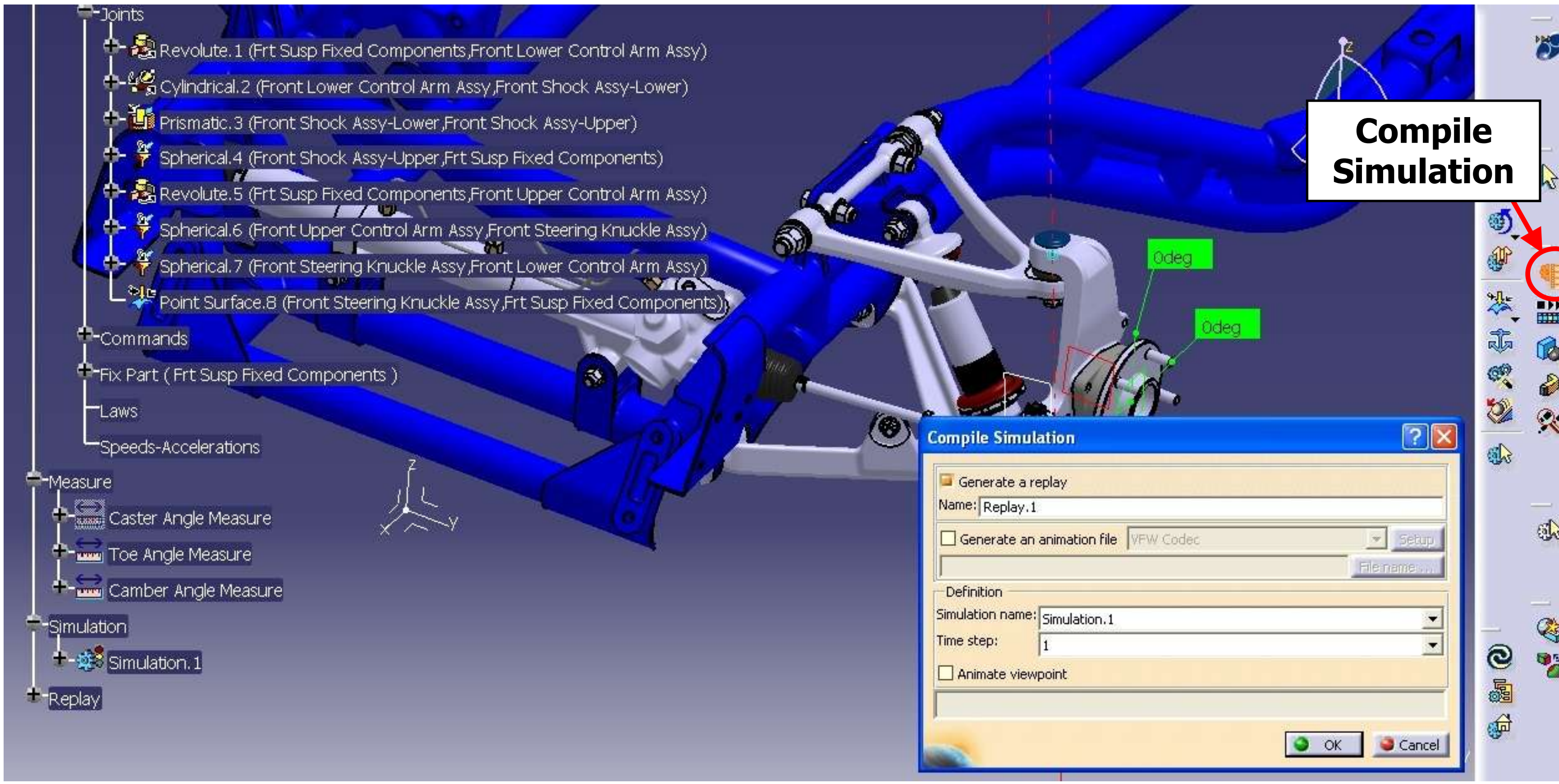
- Step 10b: Compile the Kinematic Simulation (for the Trace).



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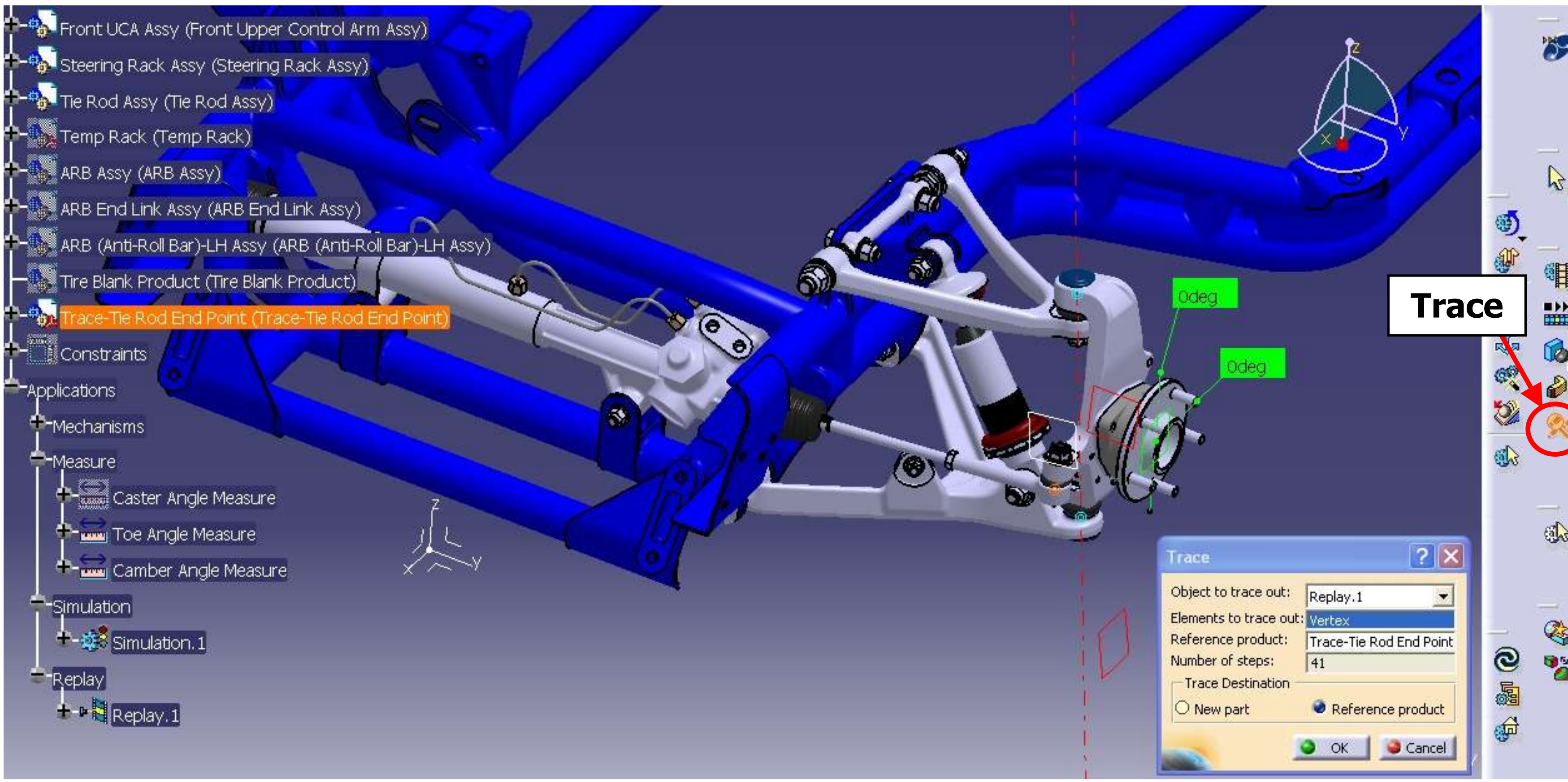
- Step 10c: Create a Kinematic Trace of the Optimized Arc for the Tie Rod Pivot Points.



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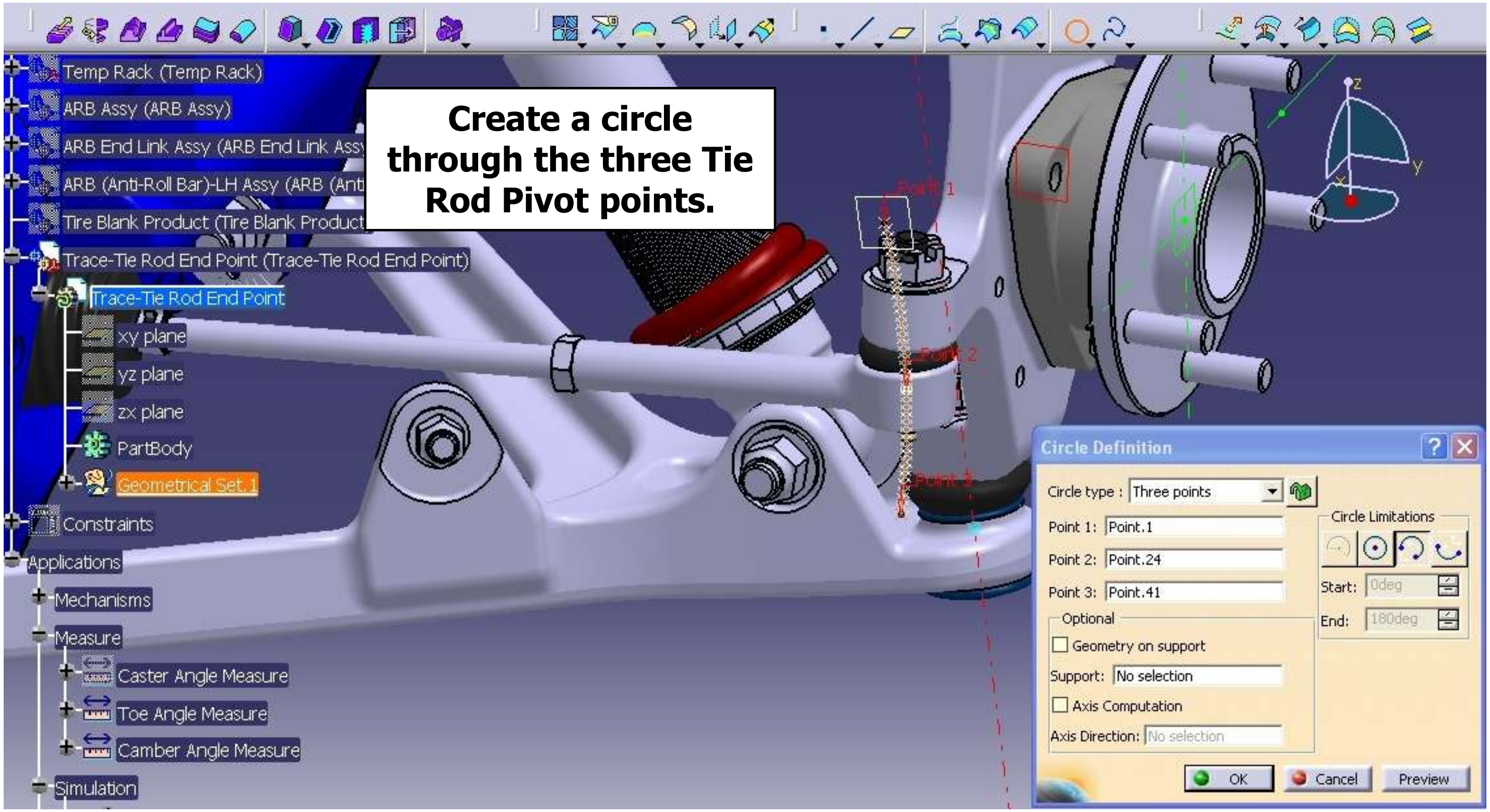
- Step 11a: Use the Kinematic Trace of the Optimized Arc to determine the optimized Steering Rack attachment point.



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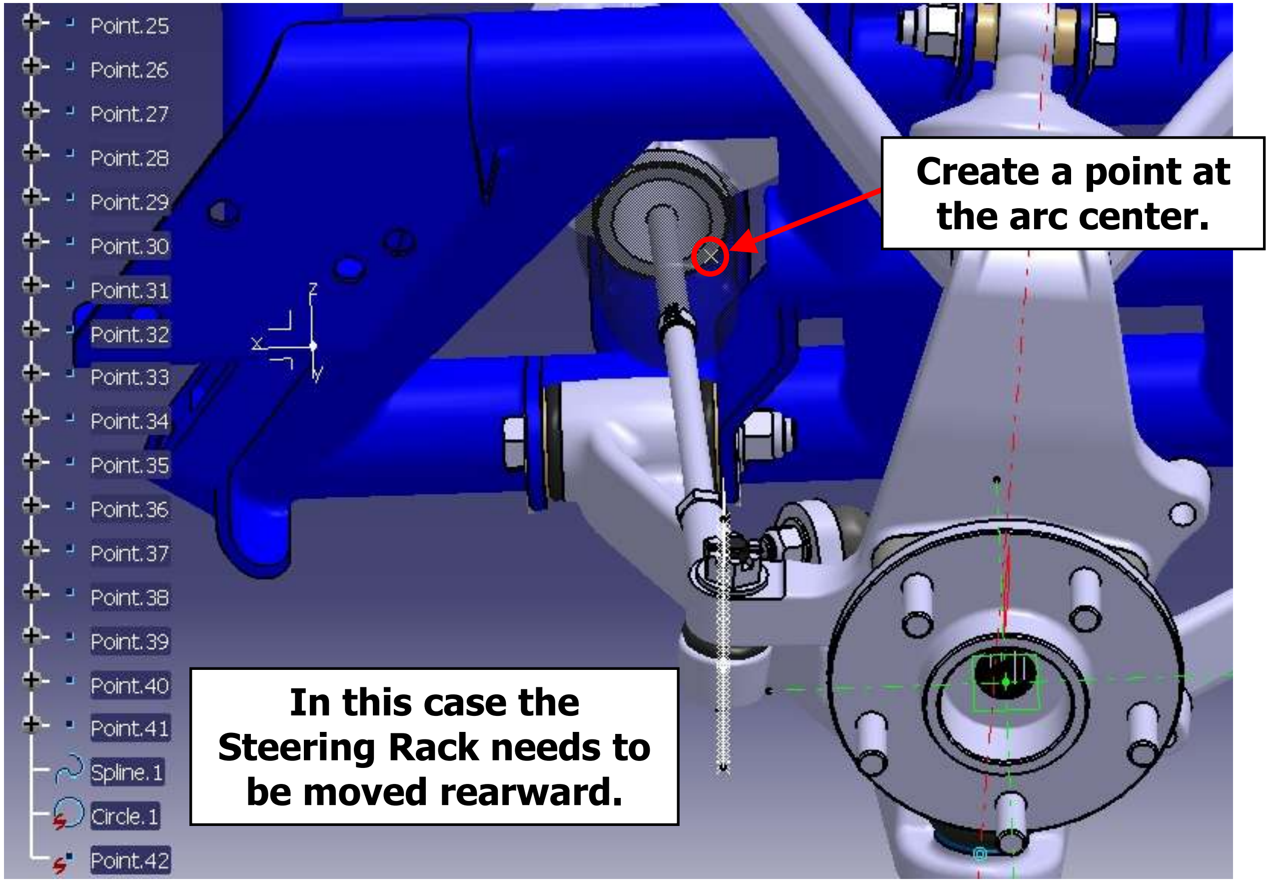
- Step 11b: Use the Optimized Arc to determine the optimized Steering Rack attachment point.



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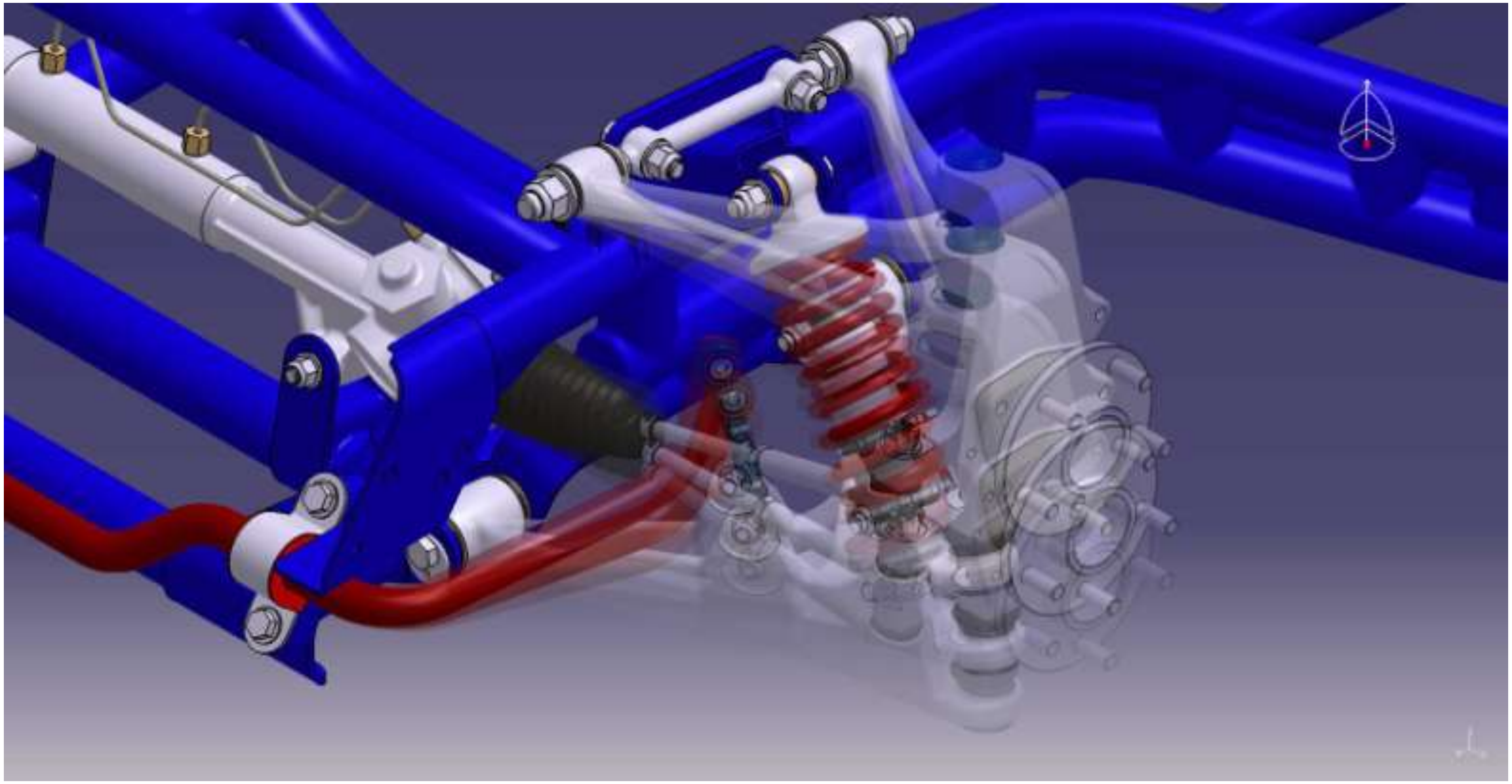
- Step 12: Reposition the Steering Rack to the Optimized Arc Center Point and complete the Kinematic with the proper Tie Rod joints in place of the Point-Surface joint.



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- Step 12: Run the Kinematic with Sensors Activated and Output the data into an Excel Spreadsheet.