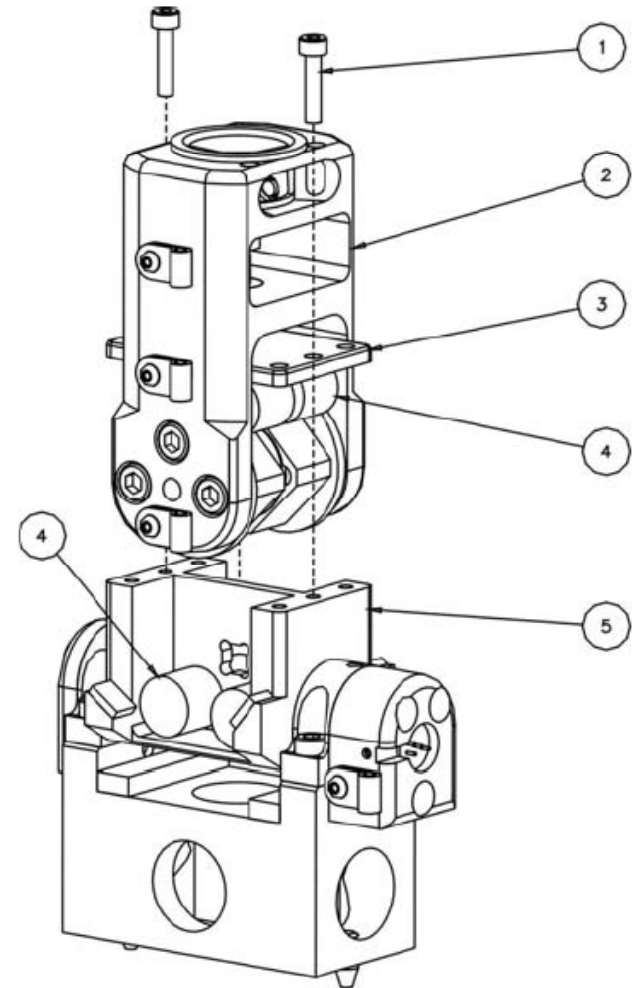

WorldSID 5th Female Ankle Design Review

GTR WorldSID Informal Group Meeting
SAE Headquarter, Troy, Michigan
12 April 2010

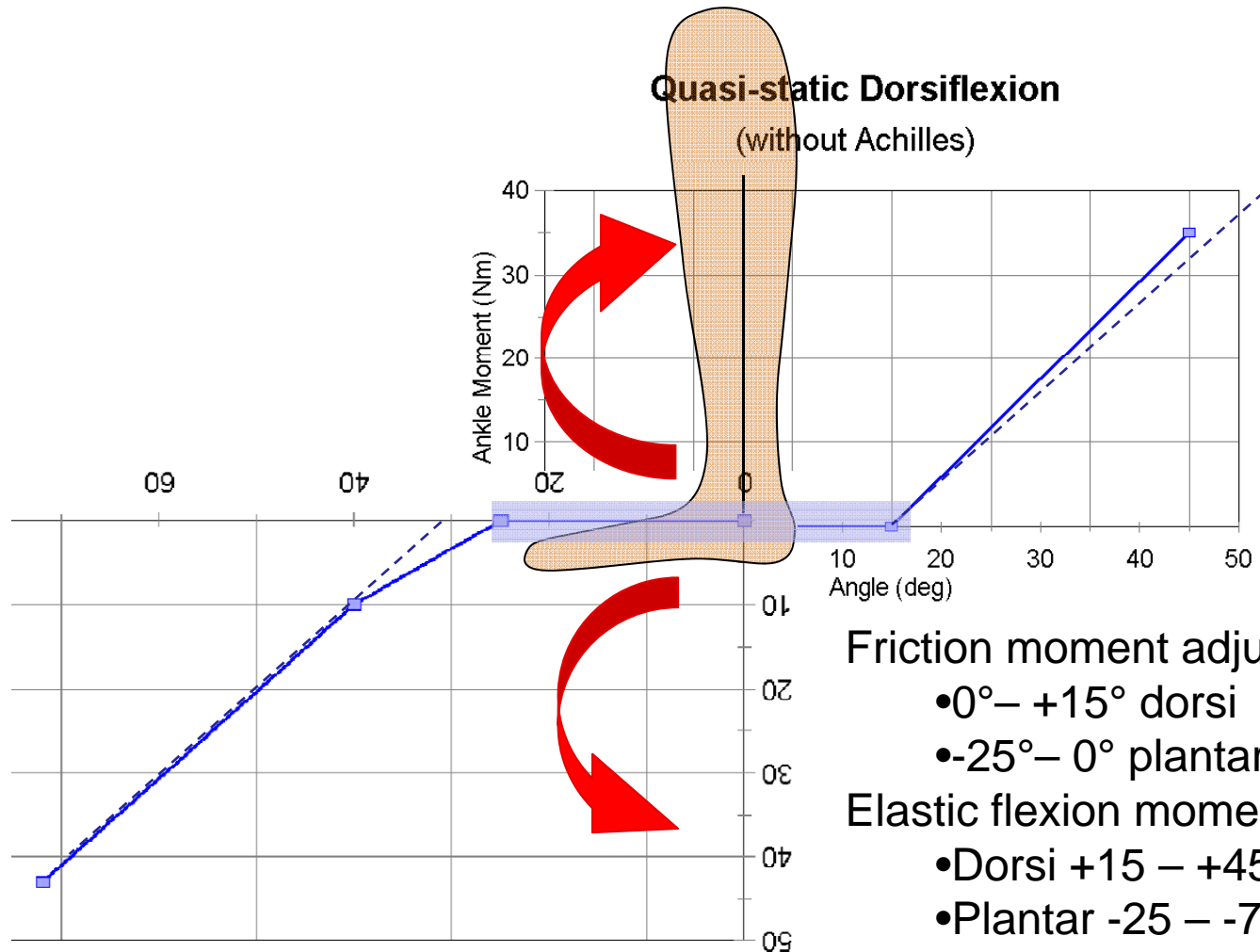
Bernard Been, Chandler Yao and Jerry Wang
First Technology Safety Systems, Inc.

Issue current WS50M ankle design

- WorldSID adjustment of foot position to vehicle interior is difficult
- Increasing moment of ankle joint from mid position
- Desire friction setting in mid position and free range for adjustment
- WorldSID 50M has highest priority
- In Tokyo it was decided to first try concept in the 5F WorldSID



FTSS proposal moment vs. angle WorldSID 50%Male (based on LX)



Quasi-static Plantarflexion

Friction moment adjustable between

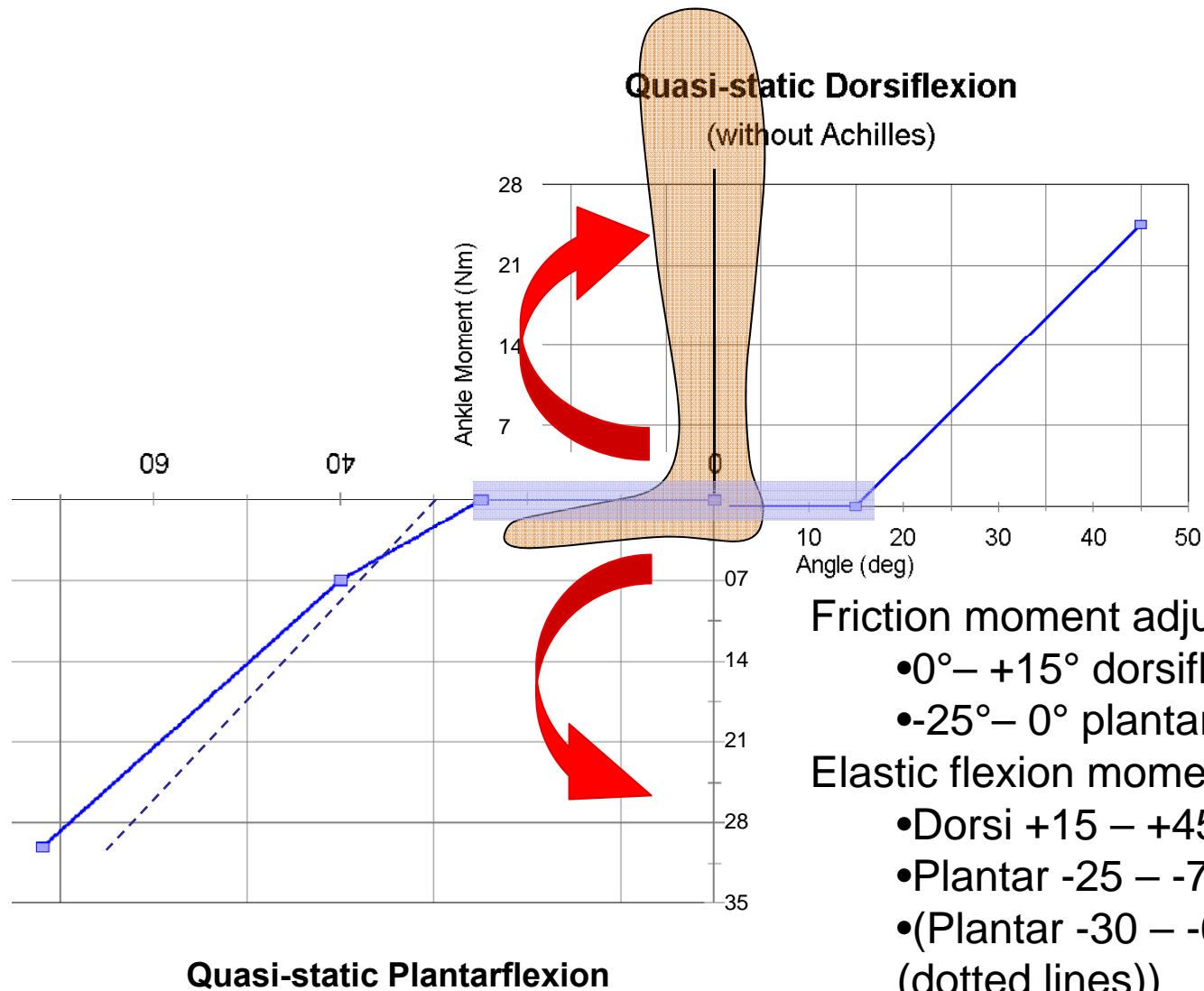
- 0° – +15° dorsi
- -25° – 0° plantar

Elastic flexion moment

- Dorsi +15 – +45°, 0 to 35Nm: 1.2Nm/°
- Plantar -25 – -70°, 0 to 42Nm: 0.93Nm/°
- Dotted lines 0 to 40Nm: 1.1Nm/°

FTSS proposal moment vs. angle

WorldSID5F 70%scaled THOR-LX



Friction moment adjustable between

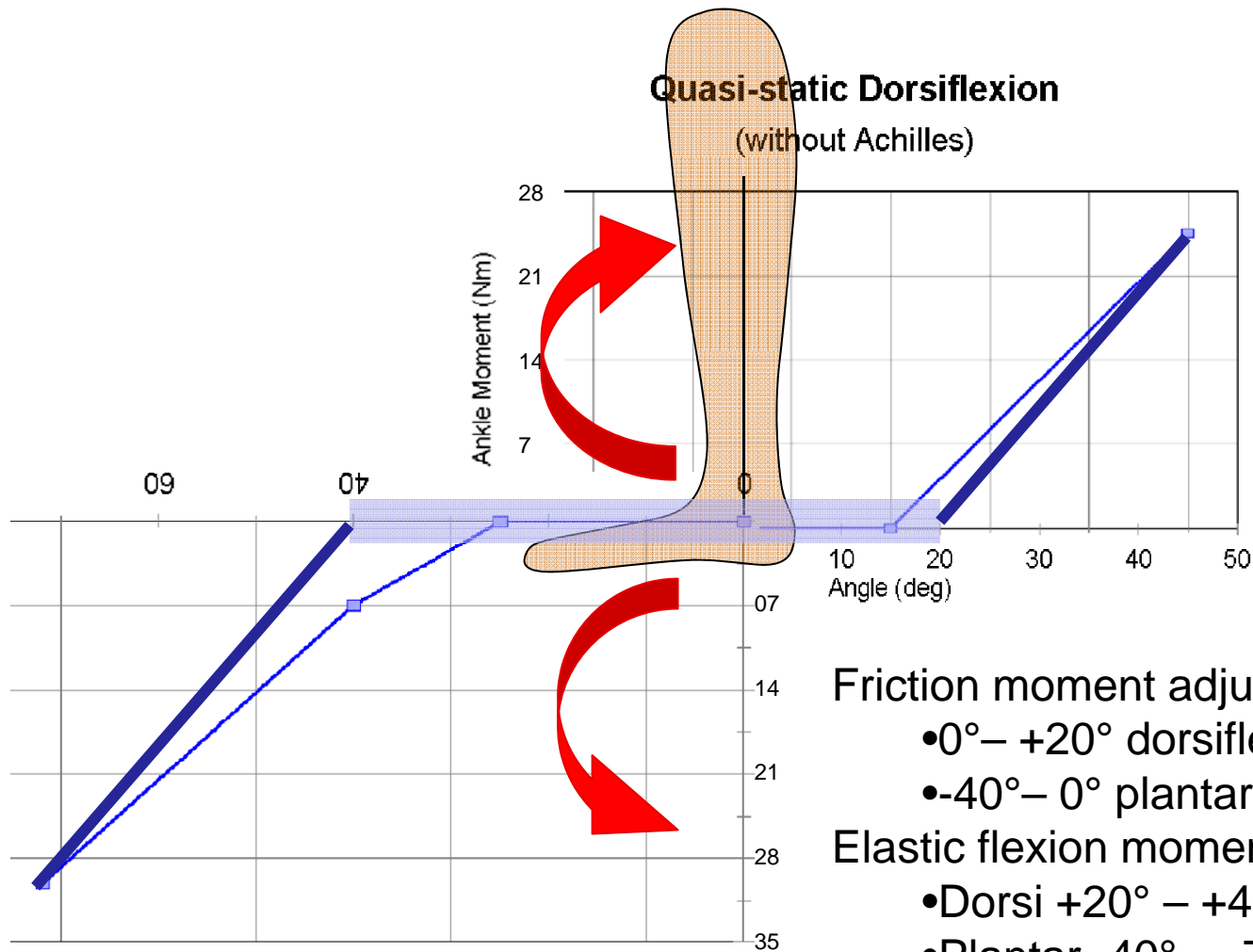
- 0° – +15° dorsiflexion
- -25° – 0° plantarflexion

Elastic flexion moment

- Dorsi +15 – +45°, 0 – 25Nm: 0.83 Nm/°
- Plantar -25 – -70°, 0 – 30Nm: 0.67Nm/°
- (Plantar -30 – -66°, 0 – 30Nm: 0.83 Nm/° (dotted lines))

PDB proposal

WorldSID5%F moment vs. angle



	PDB recommendation
Dorsiflexion	0° until +20°
Plantarflexion	-40° until 0°

Friction moment adjustable between

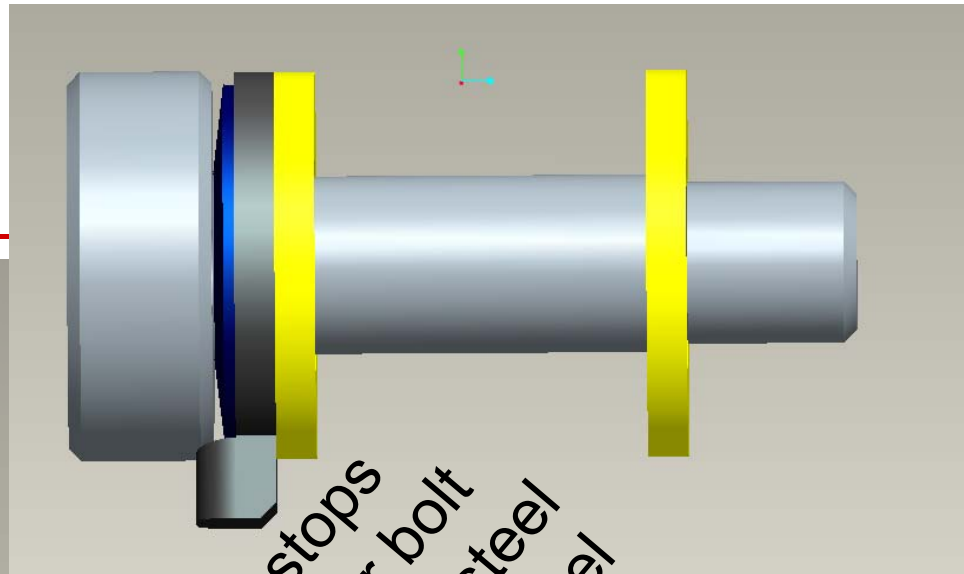
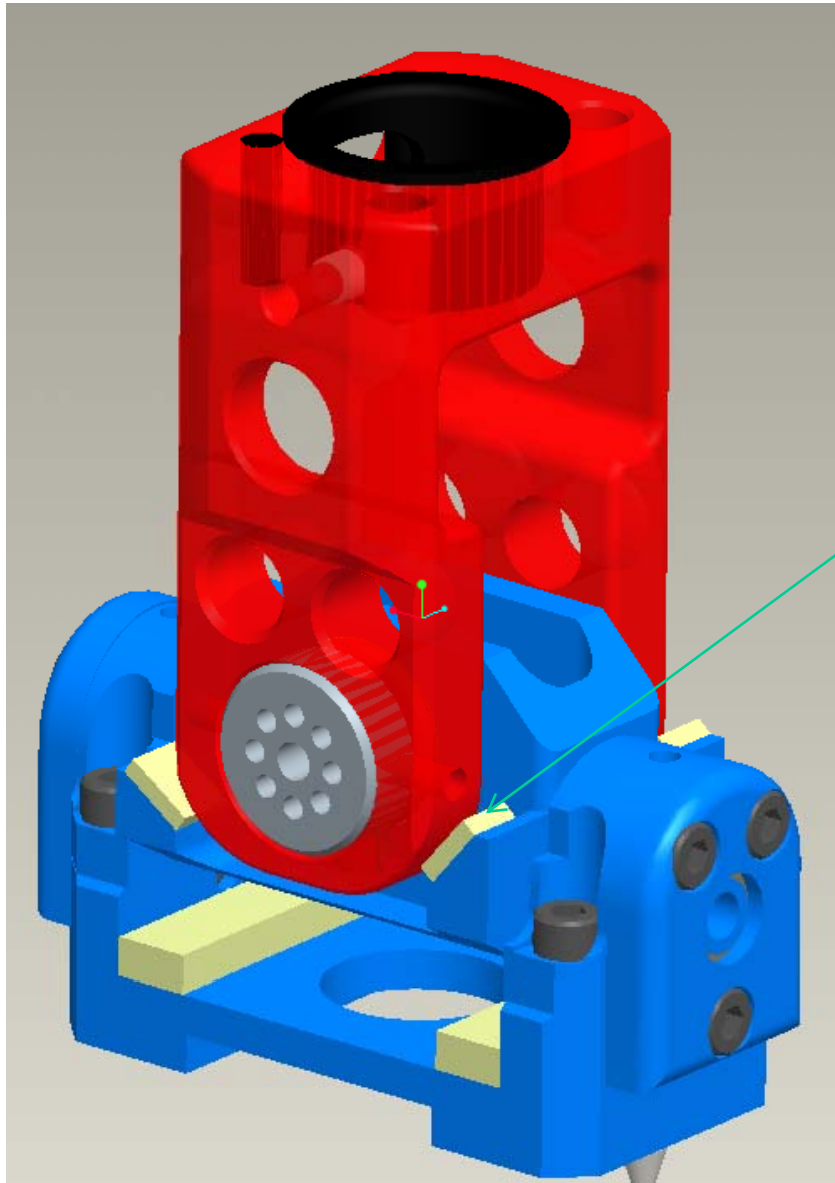
- 0° – +20° dorsiflexion
- -40° – 0° plantarflexion

Elastic flexion moment

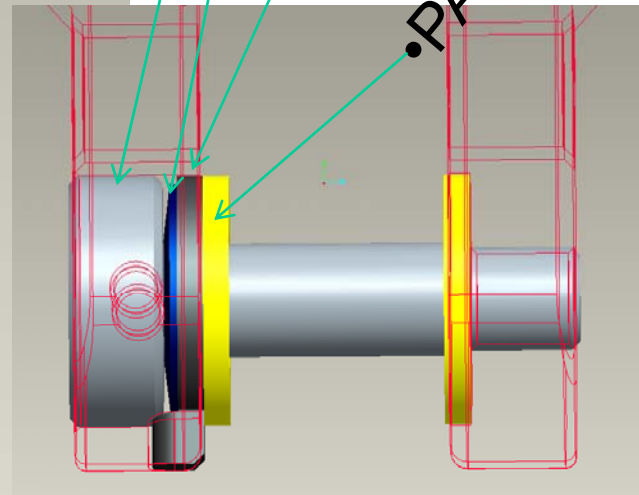
- Dorsi +20° – +45°, 0 – 25Nm: 1.0 Nm/°
- Plantar -40° – -70°, 0 – 30Nm: 1.0 Nm/°

Quasi-static Plantarflexion

Concept 1

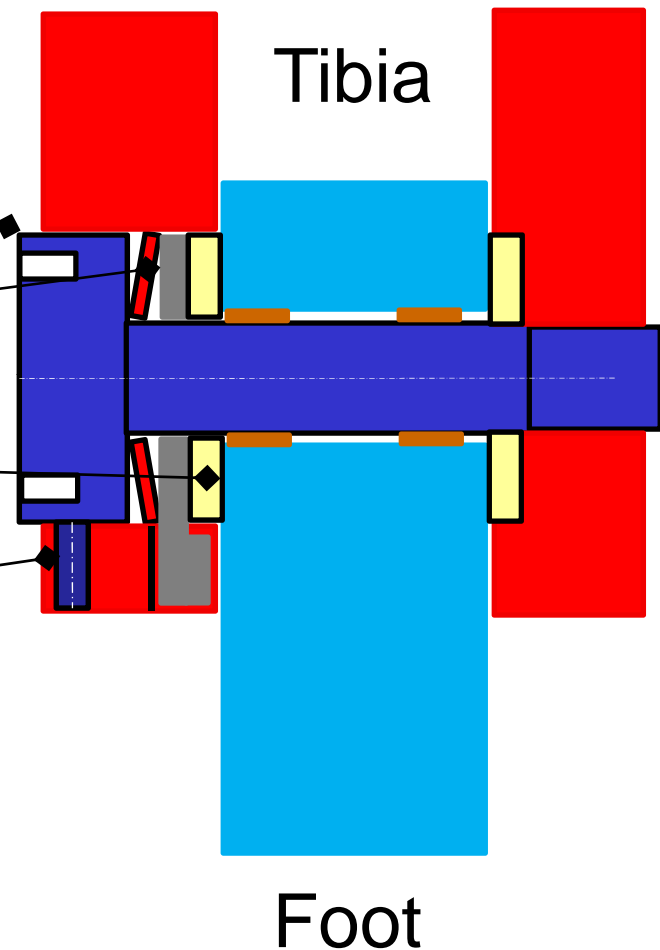


- End stops
- Shoulder bolt
- Disc spring steel
- Keyed ring steel stainless
- PA friction rings

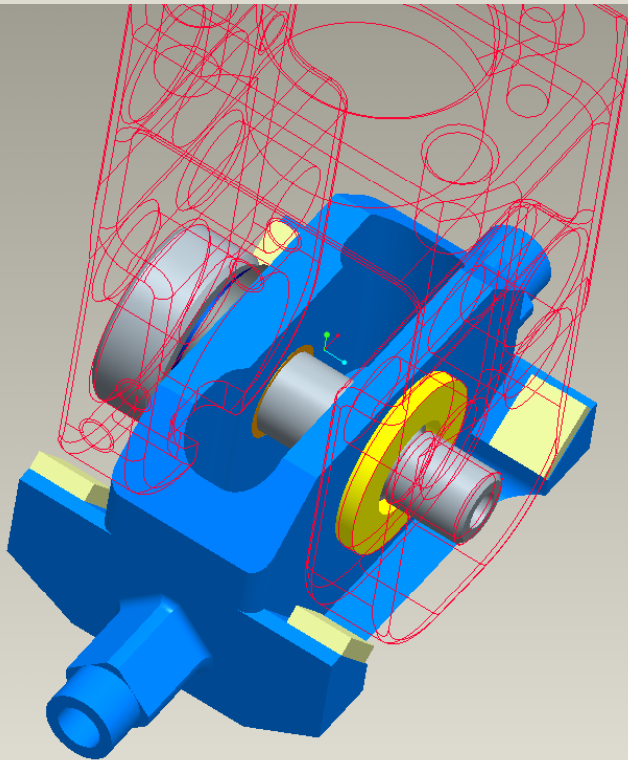
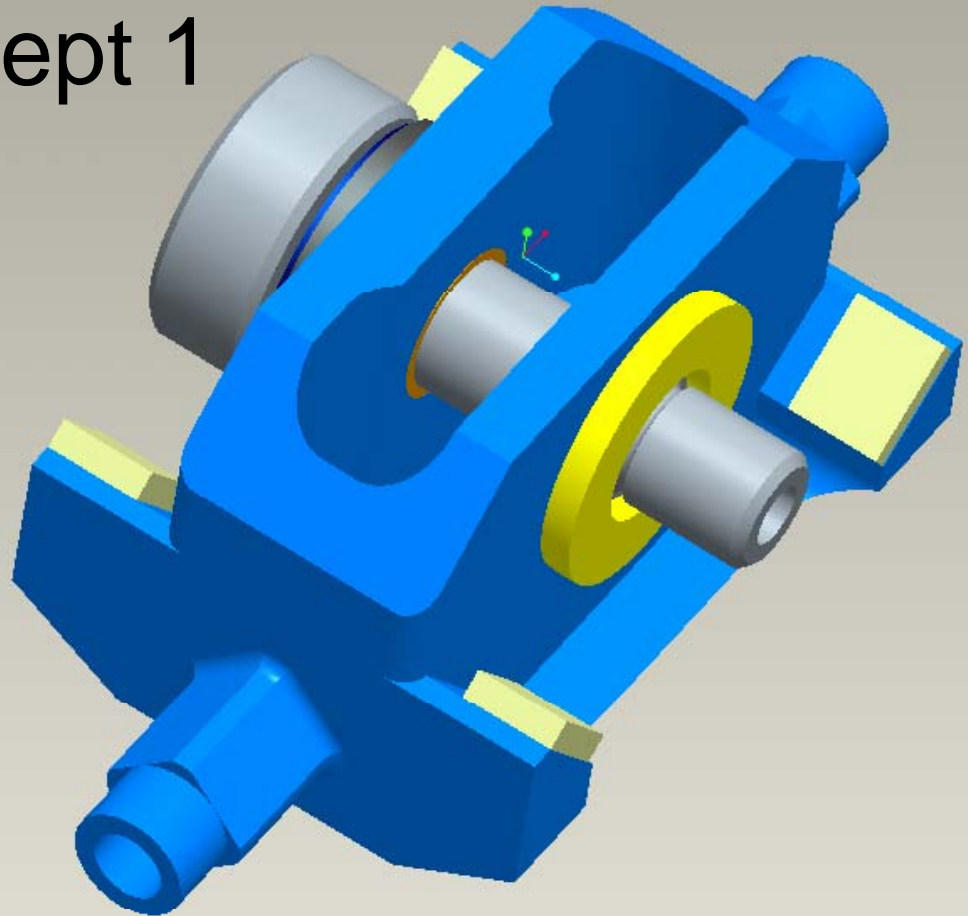
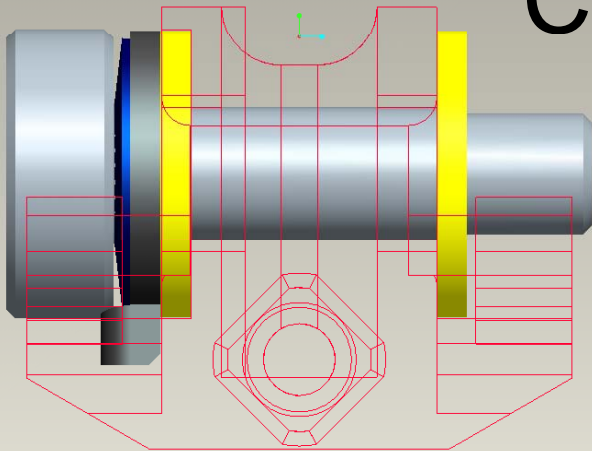


Concept 1

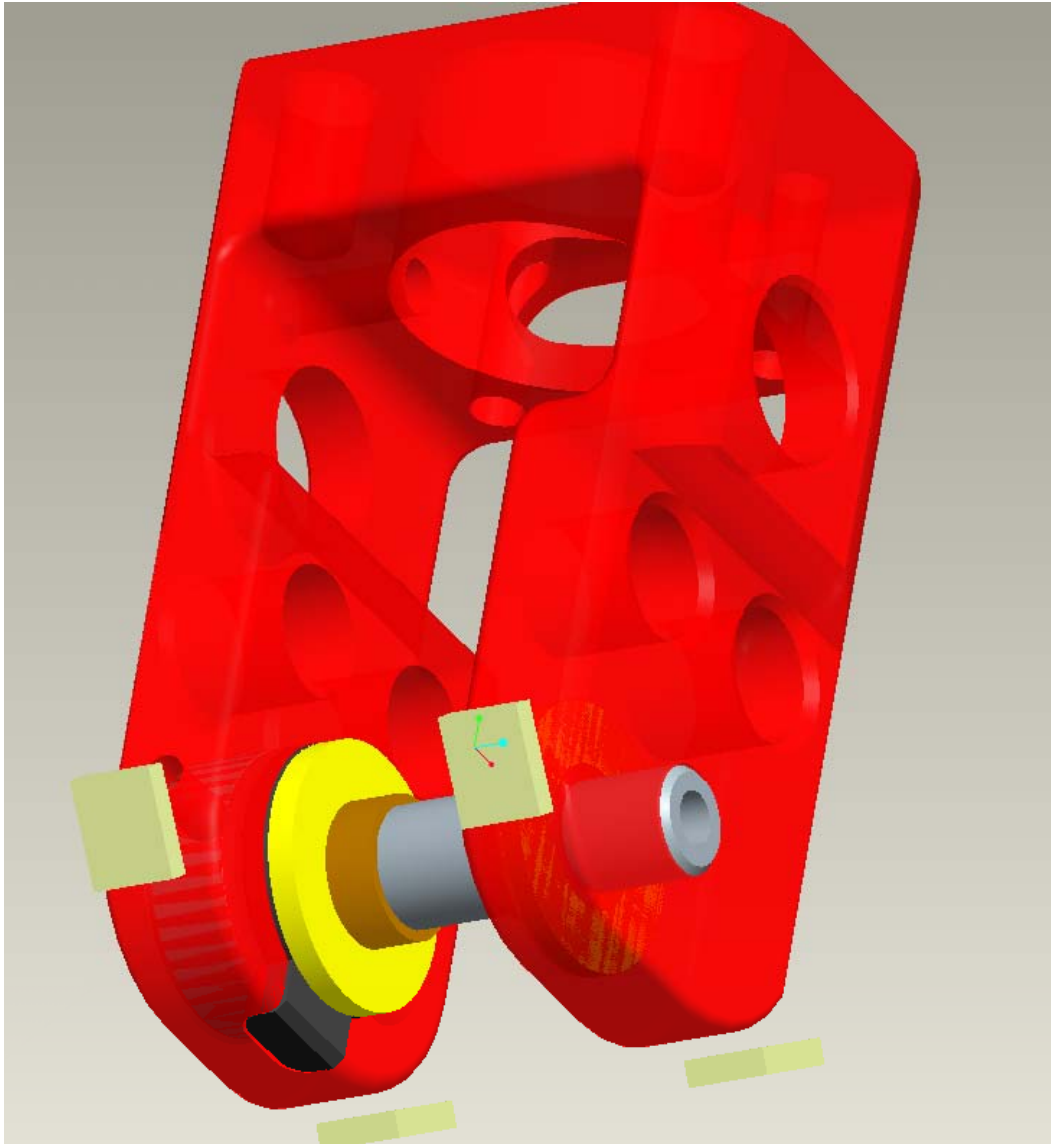
- Shoulder bolt
- Adjust compression on disc spring
- Nylon friction rings
- Set screw to maintain adjustment
- Friction adjustable between 0 and 10Nm



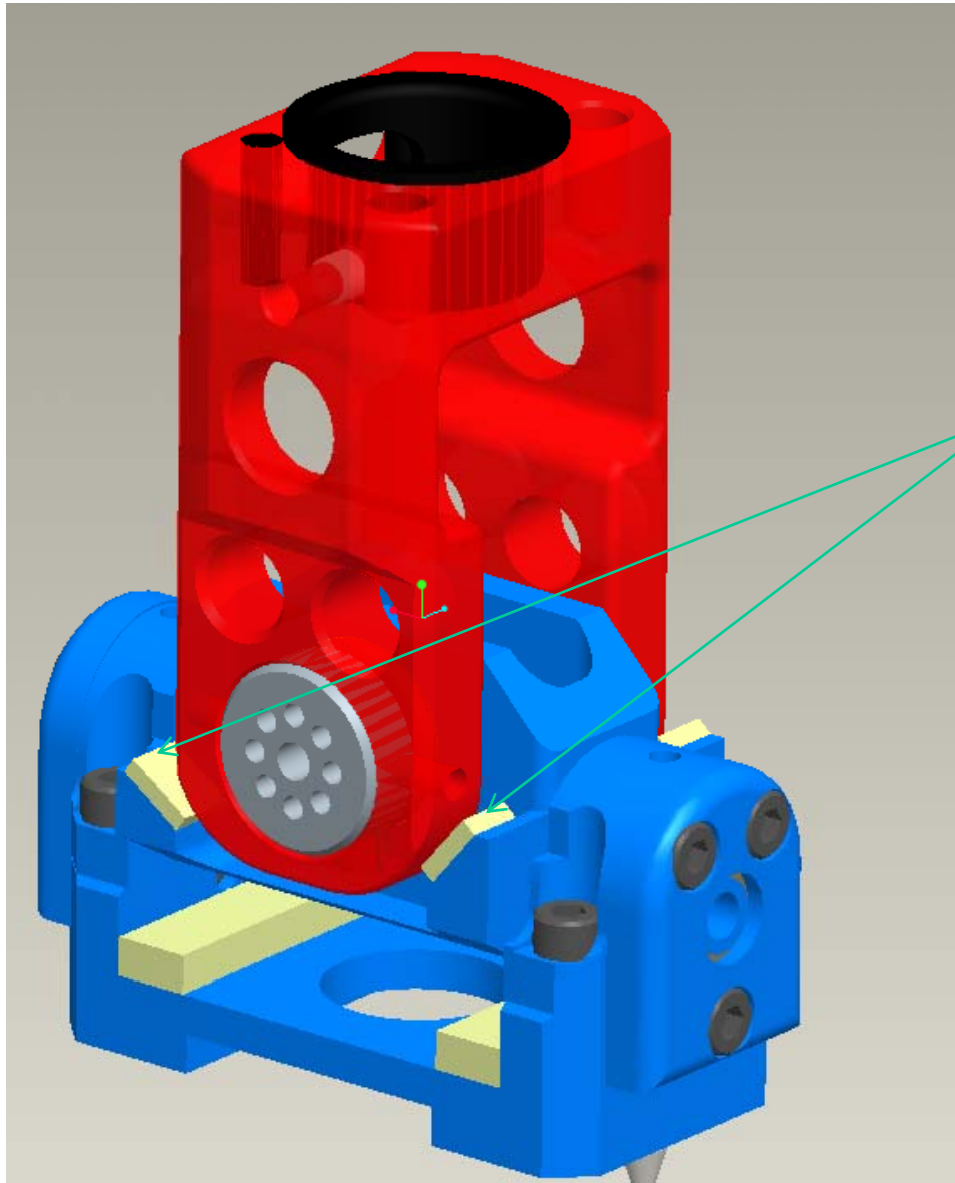
Concept 1



Concept 1



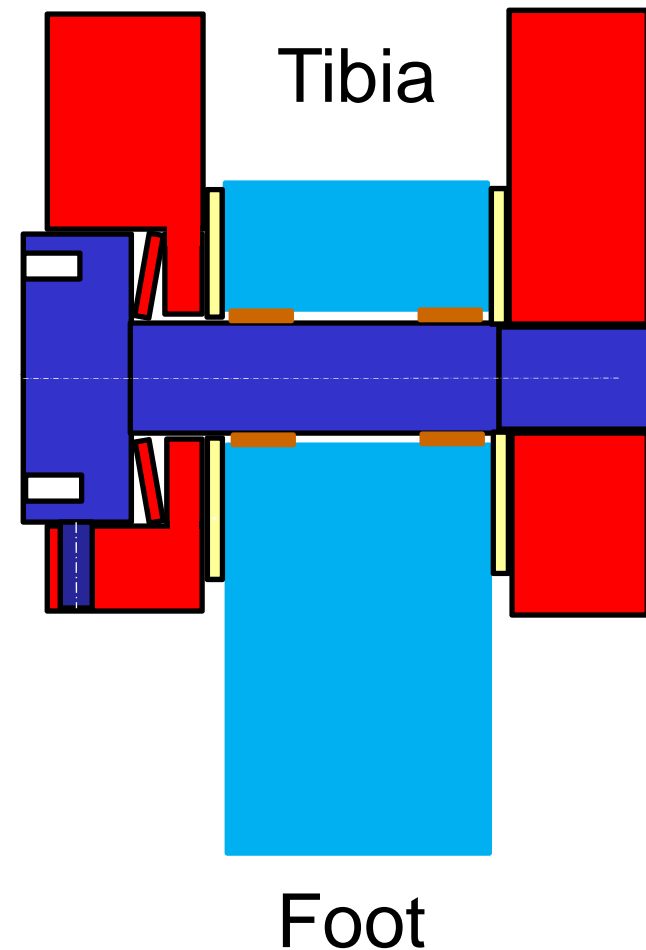
Concept 1



- Progressive end stops to get desired moment angle response

Alternative: Concept 2

- Based on elasticity of the ankle clevice
- Less parts, simpler machining
- Need tighter machining tolerances
- Cost trade off



Alternative: Concept 3

- Rubber buffers located closer to the shaft
- Located in the centre
- Better matches the rubber buffer dimensions to achieve desired ROM

