

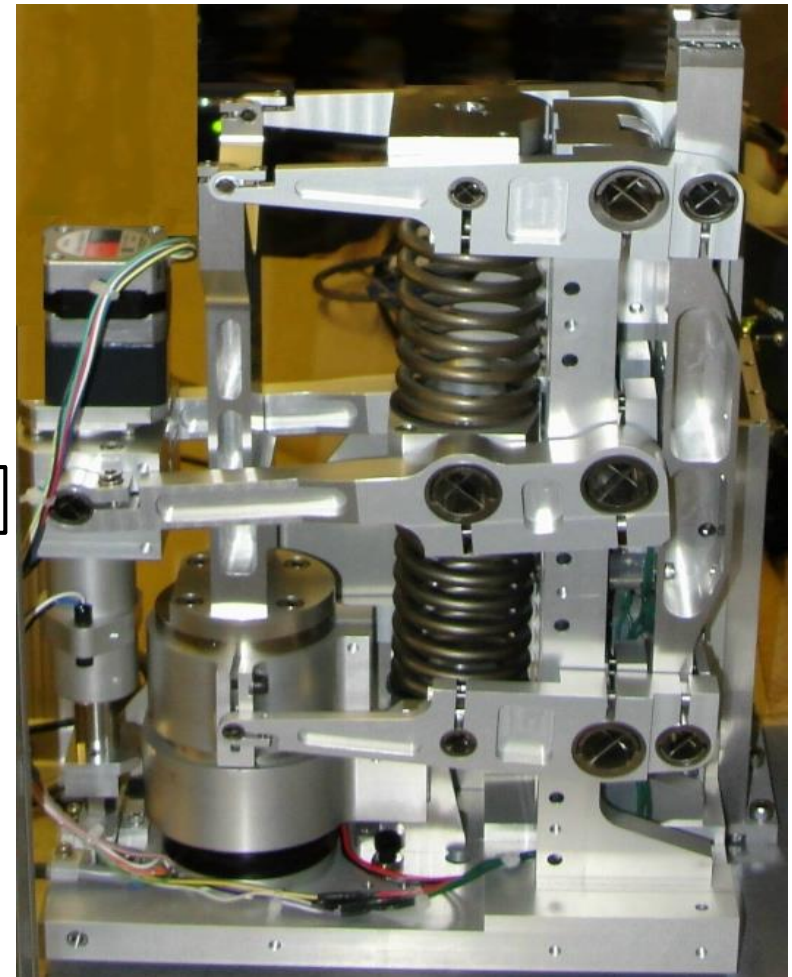
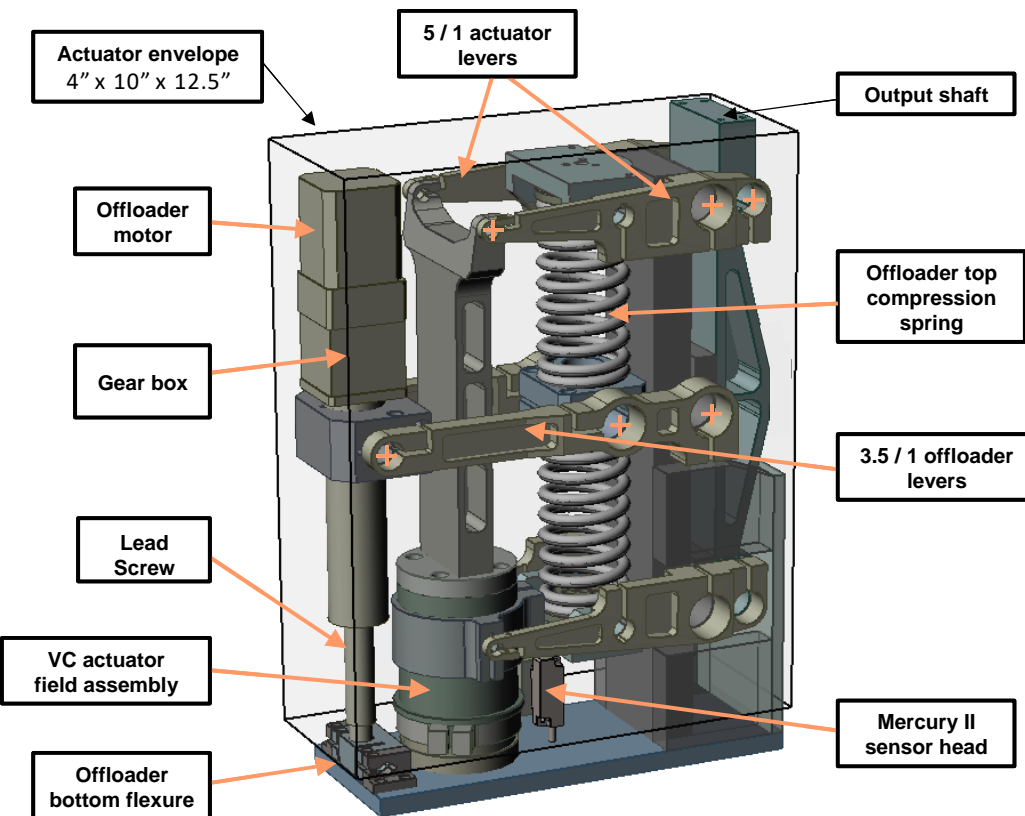
# P2 Actuator Introduction

6/4/2010

# Intro

- P2 design goals
  - Use proven working principles of the P2 Proof-of-Concept (POC) soft actuator developed by Marjan Research for TMT
  - Increase damping over the full range
  - Incorporate integral SSA mounting
  - Accommodate earthquake loads
  - Improve collocation of the encoder
  - Reduce the cost where practical

# P2 Proof-of-Concept (POC) Actuator developed by Marjan Research



## Summary of new design

- Maintain 4-bar-linkage drive, closely following POC, but use duplex bearings where feasible to reduce cost
- Replace large voice coil (voltage drive) with small voice coil (current drive) & magnetic damper
- Offloader uses same mechanism & ~ratio as POC, but puts springs at output and drives directly, simplifying the design and leaving room for the damper
- Incorporates a conservative earthquake protection mechanism
- Designed for straightforward mounting to the SSA

## P2 approach to drive and damping

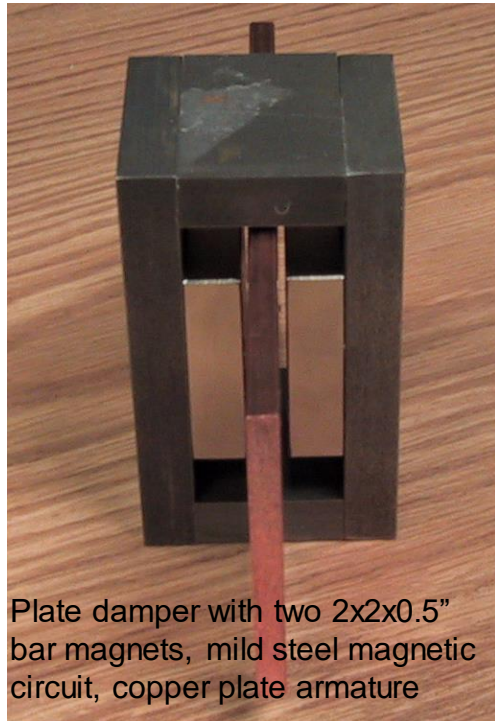


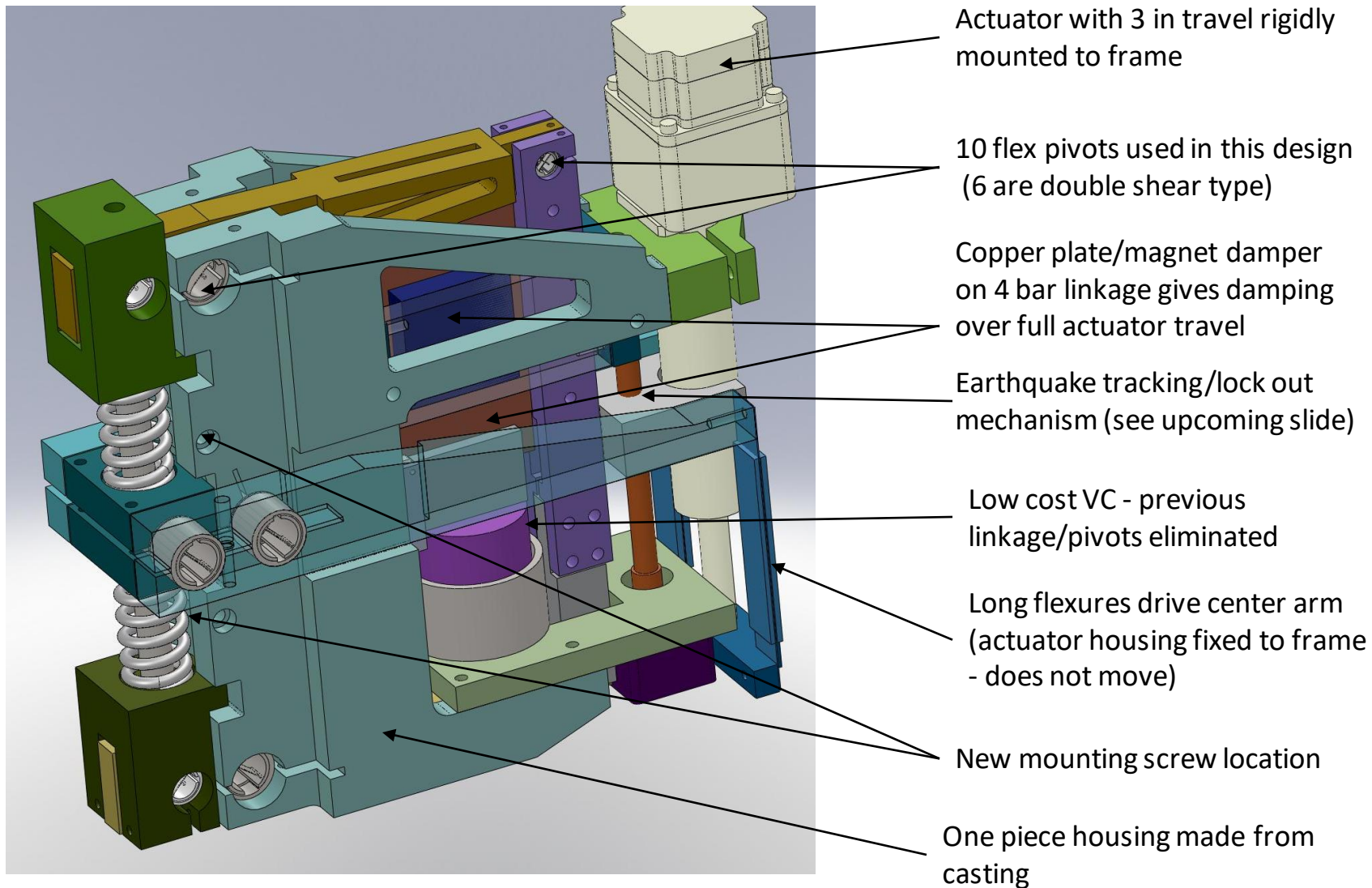
Plate damper with two 2x2x0.5" bar magnets, mild steel magnetic circuit, copper plate armature

- P2 design uses a plate damper (aka magnetic brake) to provide internal damping in series with a simple current-drive voice coil
- These two relatively-inexpensive elements replace the large voltage-drive voice coil in the POC
  - Provides uniform damping over the range of travel without a negative impedance circuit
  - Reduces cost
  - Loosens alignment tolerances
  - But slightly heavier overall

## P2 mechanical walkthrough

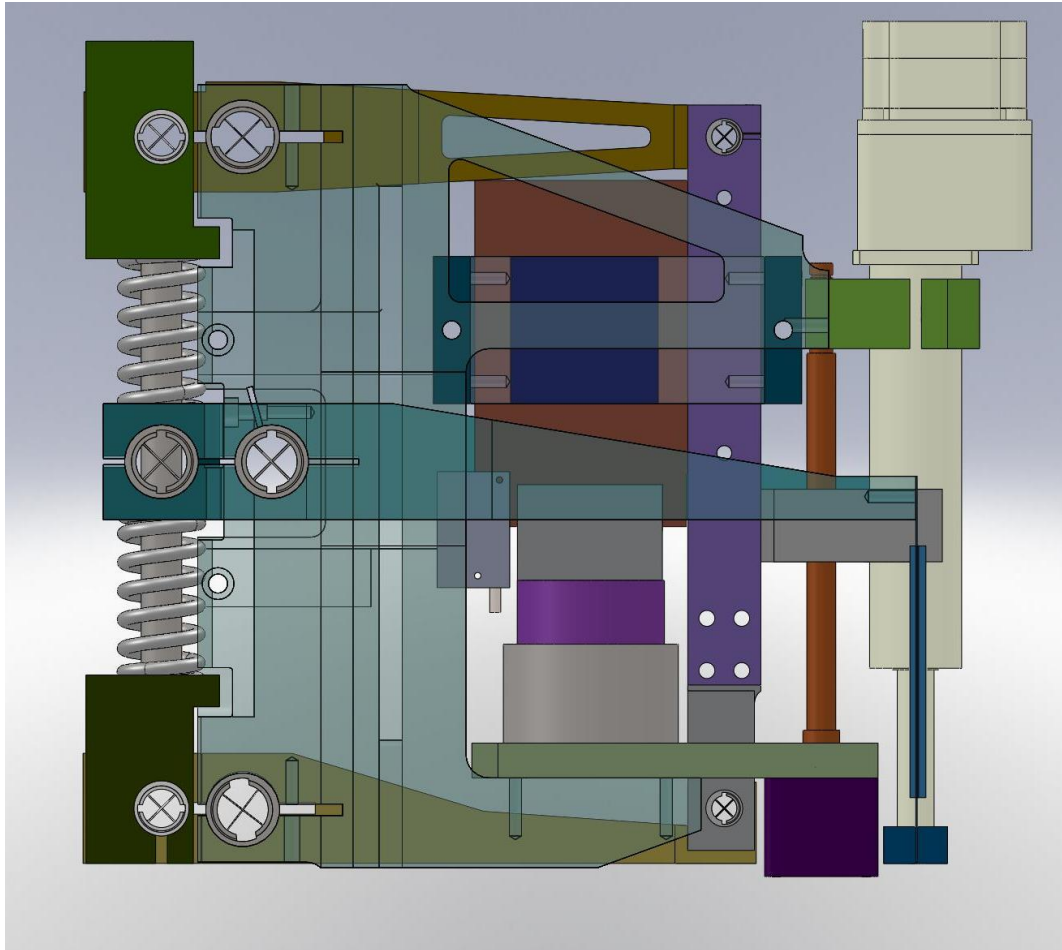
## New design primary changes

(Machining fillets and fasteners not shown)



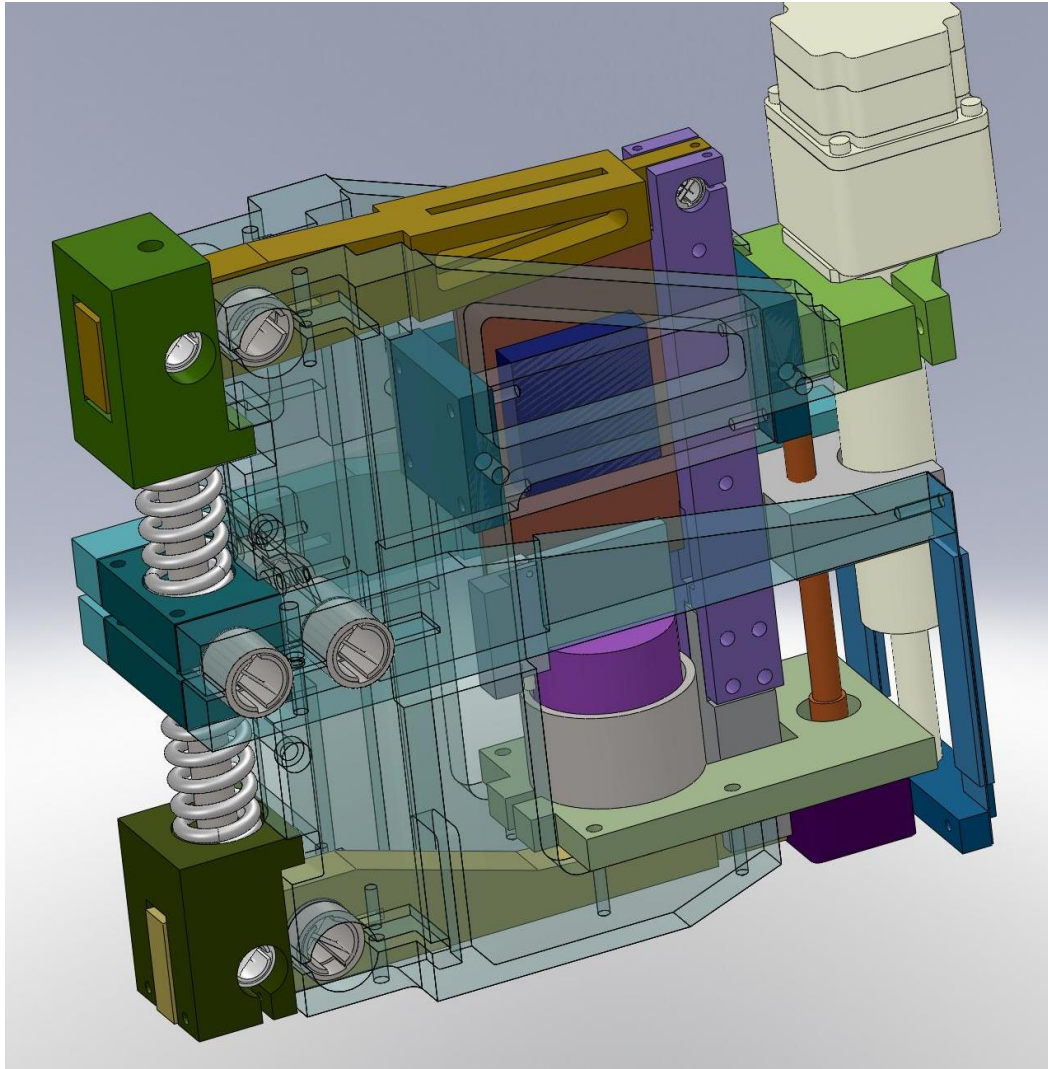


Side view with  
transparent housing

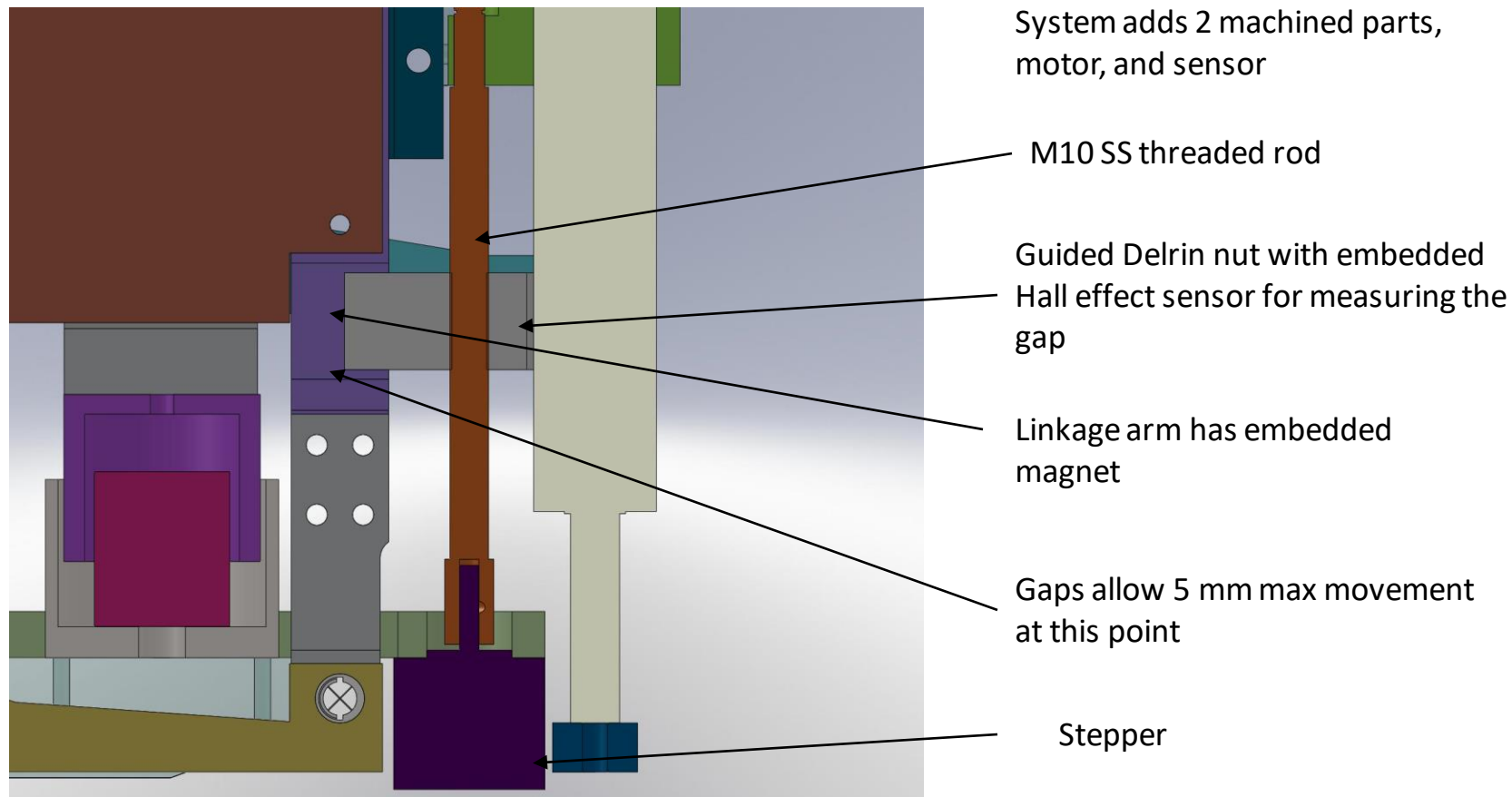




Another view with housing transparent

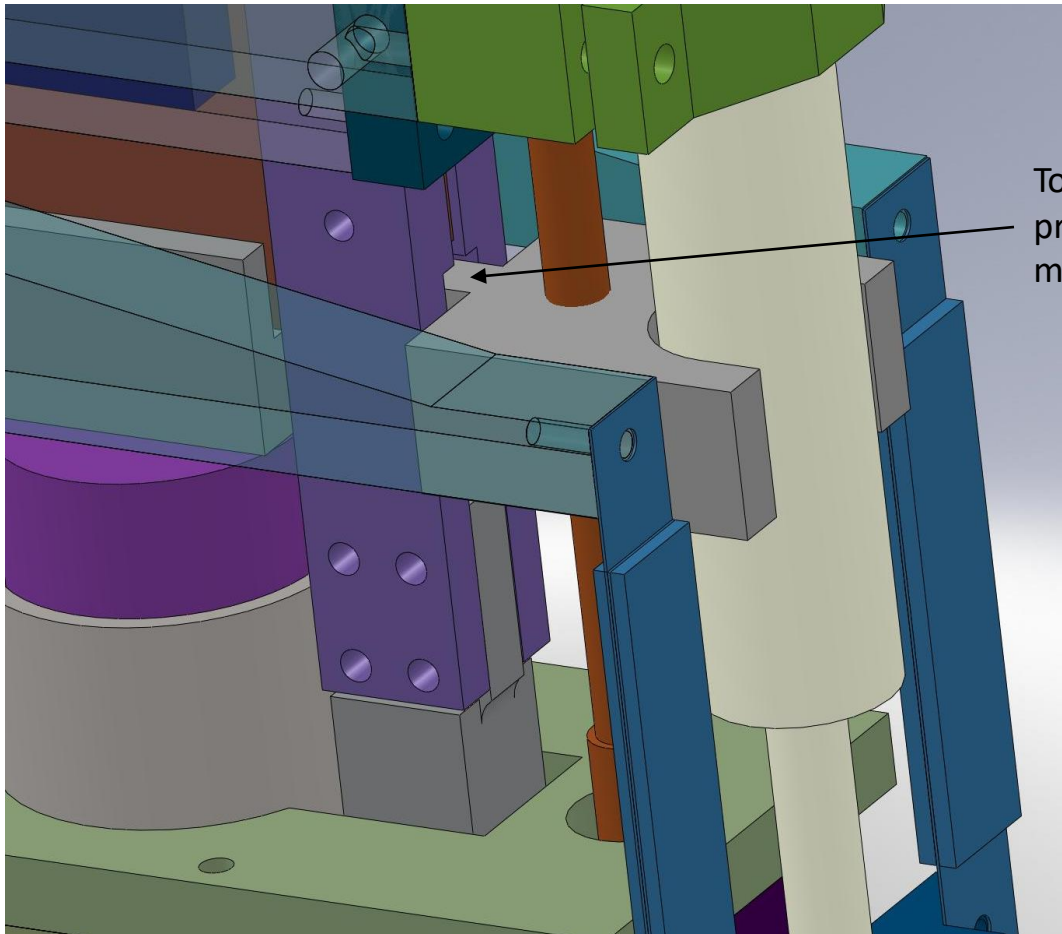


## Earthquake safety mechanism, section view (this and next slide)



Note: earthquake loads go into the upper green clamp and into the frame, not into the motor bearings

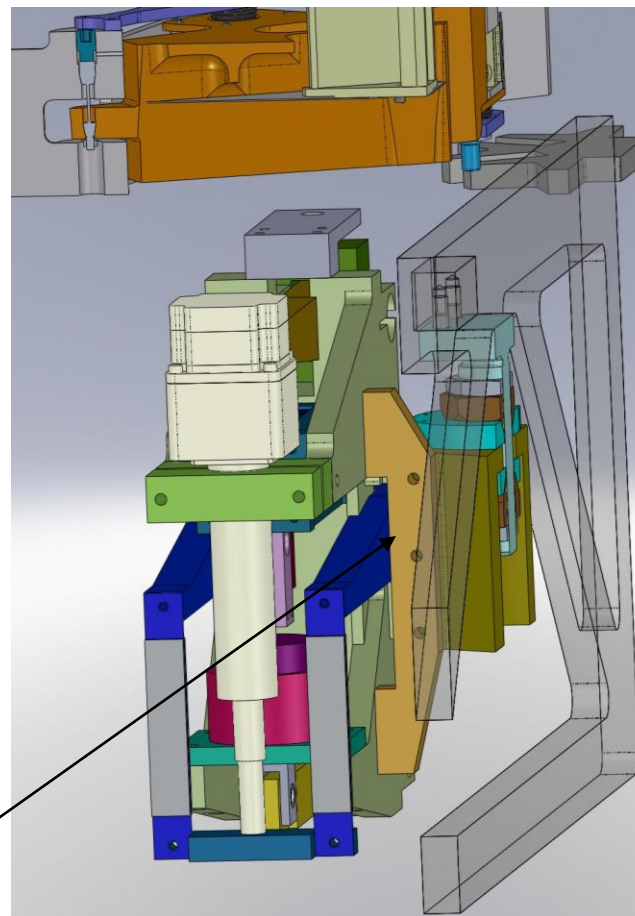
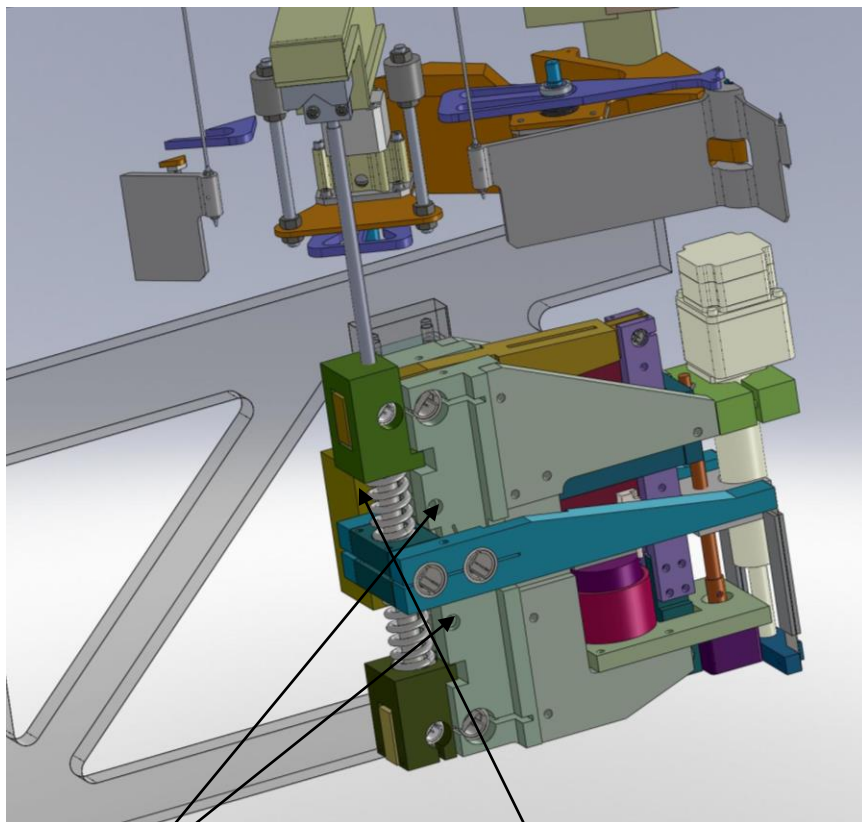
## Earthquake limit close-up



Tongue of traveling nut  
prevents large motions of  
mechanism

# Installed in SSA

## Minor mod to present SSA interface improves stiffness



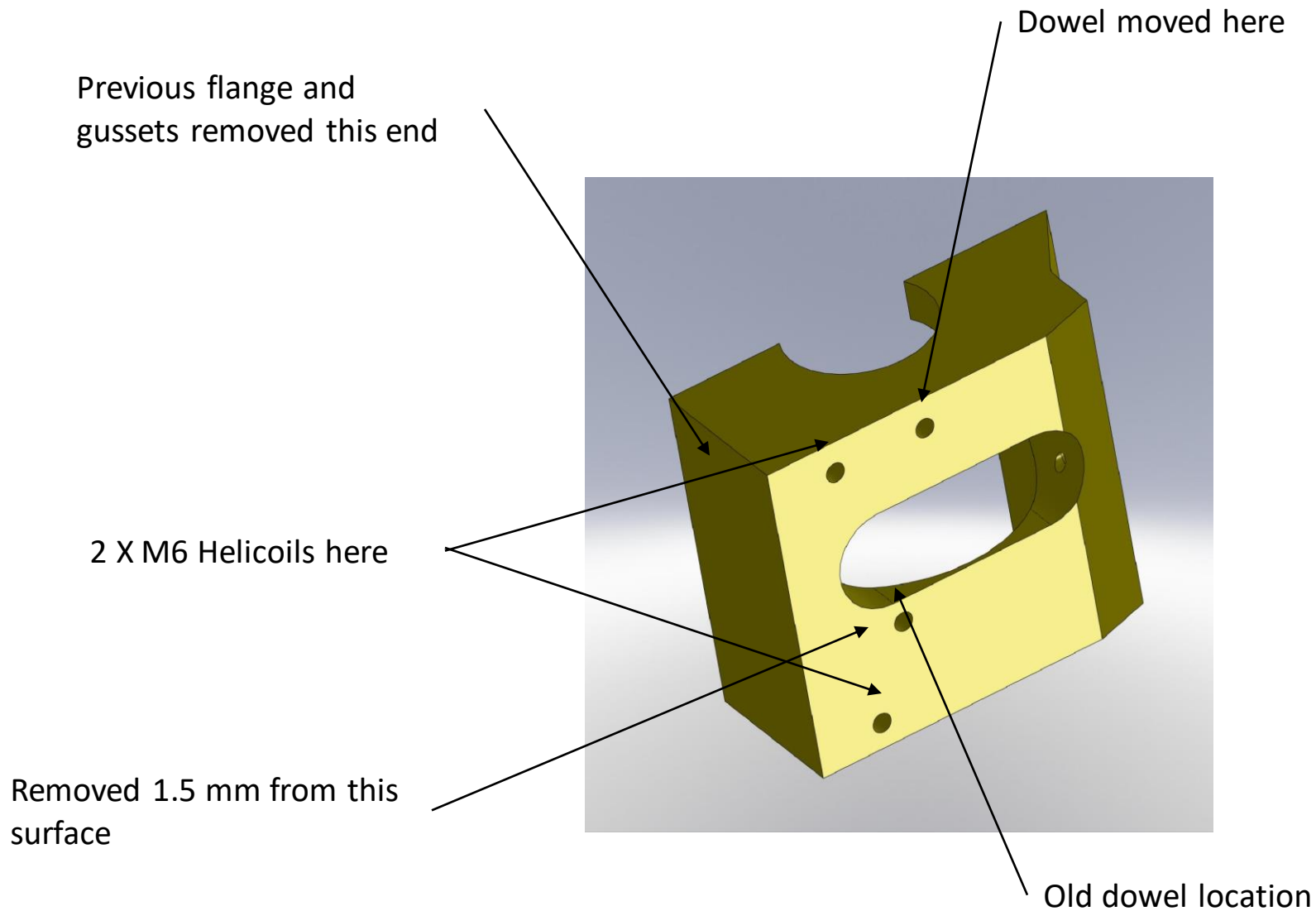
New mounting screw location

Interfaces

See slide showing mod to interface block

BACK VIEW

## Modified interface block



## Documentation summary

- This represents a snapshot of the P2 actuator documentation
  - Minor changes would be expected as we assemble and test the prototype over the next few months – large changes are not anticipated

Fabricated parts	
TMT-101	SAT_MACHINED_HOUSING_RH
TMT-103	LOWER_ARM
TMT-104	UPPER_ARM
TMT-105	CONNECTING_LINK_RH_REV_B
TMT-106	ACTUATOR_ARM_RH
TMT-108	UPPER_CONNECT_BLOCK
TMT-109	LOWER_CONNECT_BLOCK
TMT-110	VERT_LINK_CONNECT_BLOCK
TMT-111	VC_MOUNTING_PLATE_REV_B
TMT-112	COPPER_PLATE
TMT-113	SPRING_BLOCK
TMT-114	CLAMP_BASE
TMT-115	ACTUATOR_CLAMP
TMT-116	TRACKING_SCREW
TMT-117	DELFIN_GUIDE
TMT-118	CONNECTING_LINK_LH
TMT-119	SLEEVE
TMT-120	ACTUATOR_END_BLOCK
TMT-121	STEEL_END_BAR
TMT-122	STEEL_SIDE_BAR
TMT-123	FLEXURE
TMT-124	FLEXURE_STIFFENER
TMT-125	CONNECTING_ROD
TMT-126	ACTUATOR_ARM_LH
TMT-127	VC_CONNECT_CLEVIS
TMT-128	ENCODER_MTG_BRKT
TMT-129	SSA_ADAPTER_BAR
TMT-130	TRACKING_SCREW_SLEEVE

## Drawing List

Not yet released: TMT-XXX: Rod Flexure



# Parts List

<b>Procured mechanical parts</b>		
TMT201	4	1" flex pivot C-Flex J-20
TMT202	2	0.75" flex pivot C-Flex ID-20
TMT203	2	1" flex pivot C-Flex JD-20
TMT204	2	0.5" flex pivot C-Flex GD-20
TMT210	2	Compression spring, TBD
TMT220	1	Assorted fasteners
TMT230	2	2" x 2" x 1/2" N52 NdFeB magnet
<b>Procured active parts</b>		
TMT301	1	UltraMotion Digit linear actuator D-A.083-HT17-3.5 (final model may change slightly)
TMT310	1	Micro-E Systems MII linear encoder, MII5850
TMT311	1	Micro-E Systems MII scale, 303-R3683-01
TMT320	1	Voice-coil actuator, H2W NCC15-24-050-1R
TMT330	1	Stepper motor NEMA17, Anaheim Automation 15Y202D-LW4 or similar
TMT340	1	Limit switches, Hall sensor IC, indicator magnet