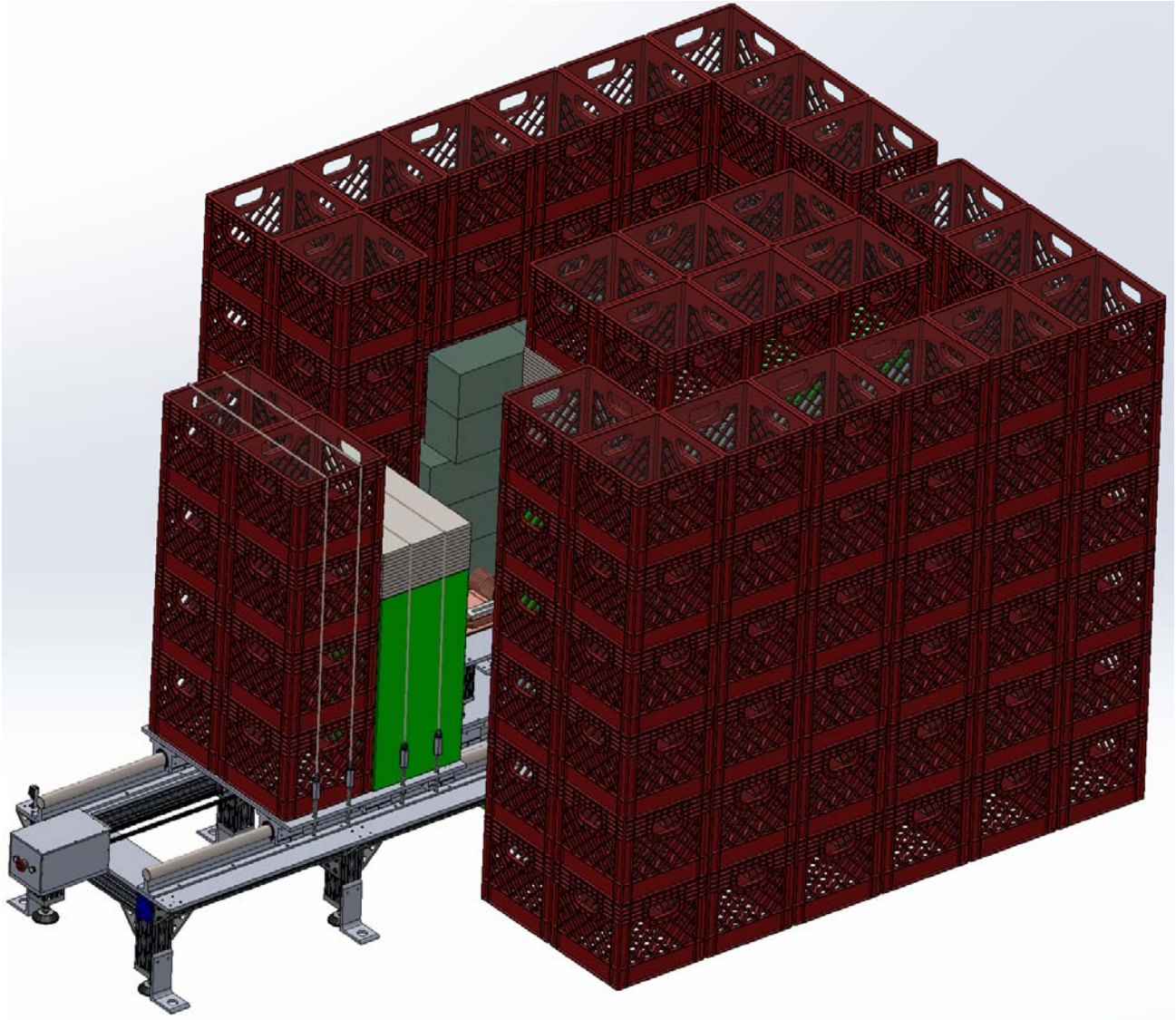
ISOTOPE SHIELDING MECHANICAL REVIEW

JFG 05-09-2019

5kW @ 40 MeV RADIATION SHIELDING REQUIREMENTS

- 13” OF STEEL - INTERIOR
- 8” OF WATER - EXTERIOR
- RELATIVE QUICK ACCESS TO TARGET
- MAINTAIN RADIATOR BEHIND AS MUCH SHIELDING AS POSSIBLE

DESIGN

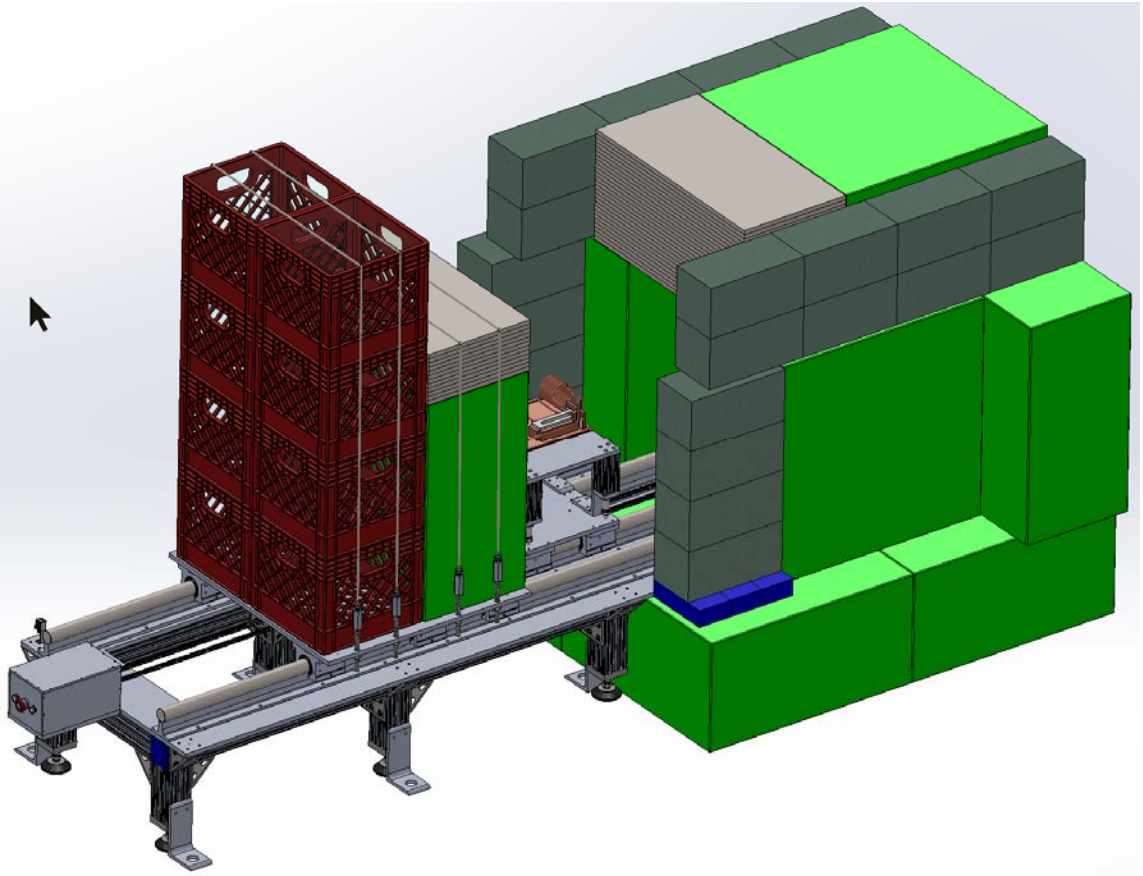


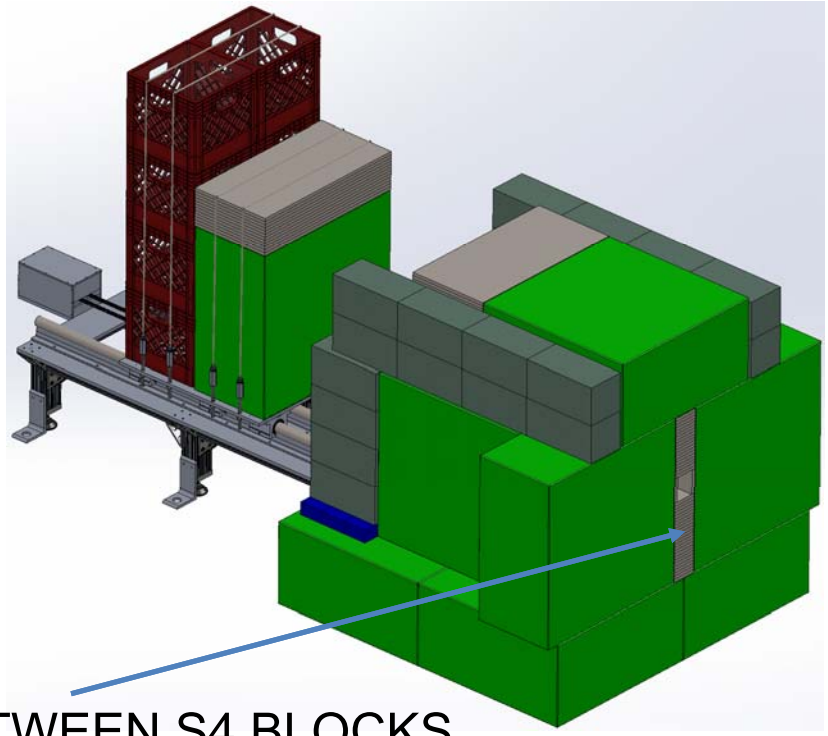
USED (10) S4 SHIELDING BLOCKS, STEEL PLATES, CONCRETE BLOCKS AND WATER FILLED MILK CRATES TO CREATE ≥13” OF STEEL AND 12” OF WATER.

BACK WALL, TARGET AND RADIATOR ON LINEAR RAILS

DESIGN CONT.

LIGHT GREEN – S4 STEEL BLOCK
DARK GREEN – CONCRETE BLOCK
TAN – STEEL PLATE
GREY – ALUMINUM
RED – WATER FILLED PLASTIC CRATE



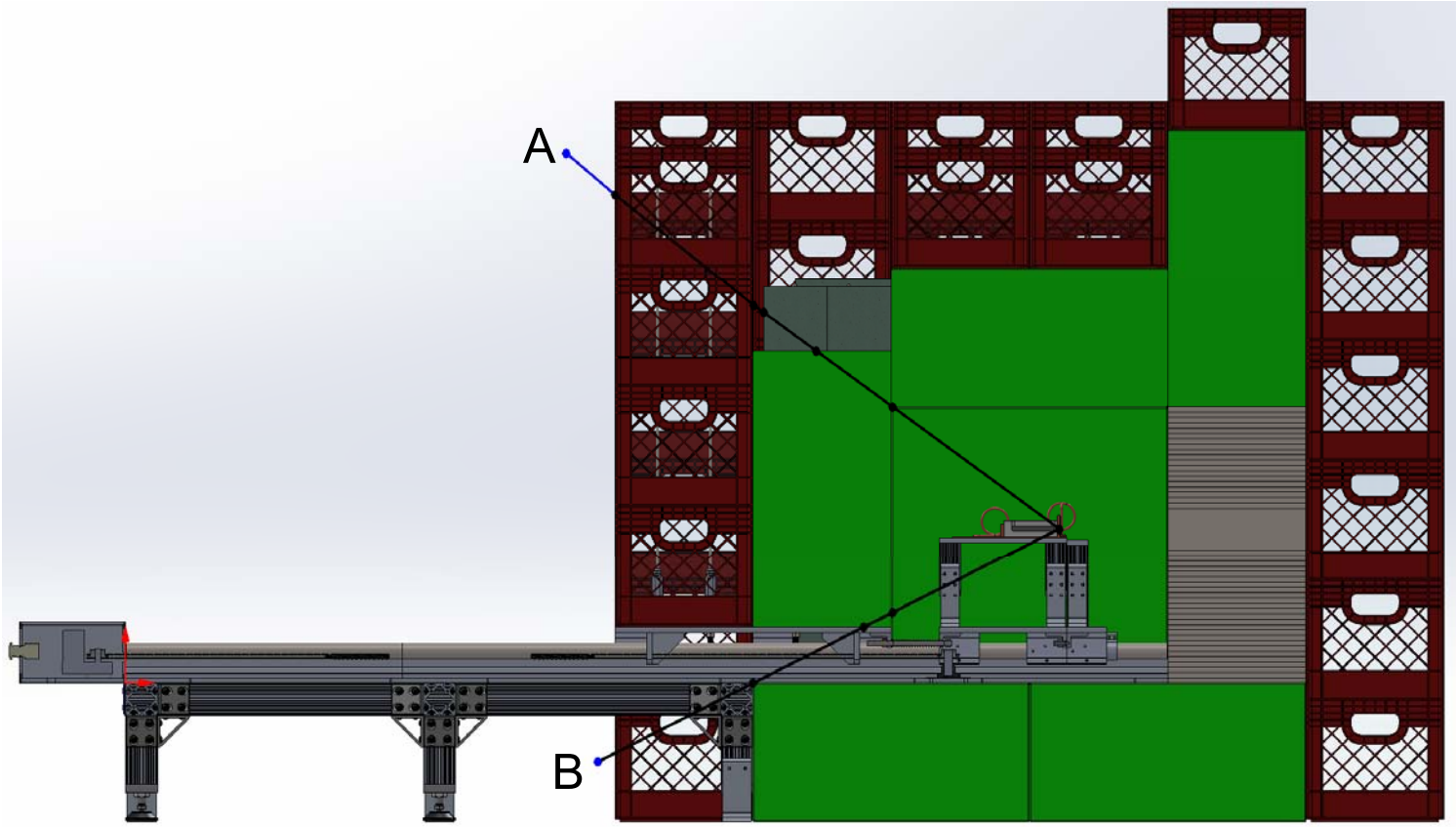


4 ¼” GAP BETWEEN S4 BLOCKS

SHIELDING CONCERNS

A - 8.9” STEEL
6.1” CONCRETE
16.7” WATER

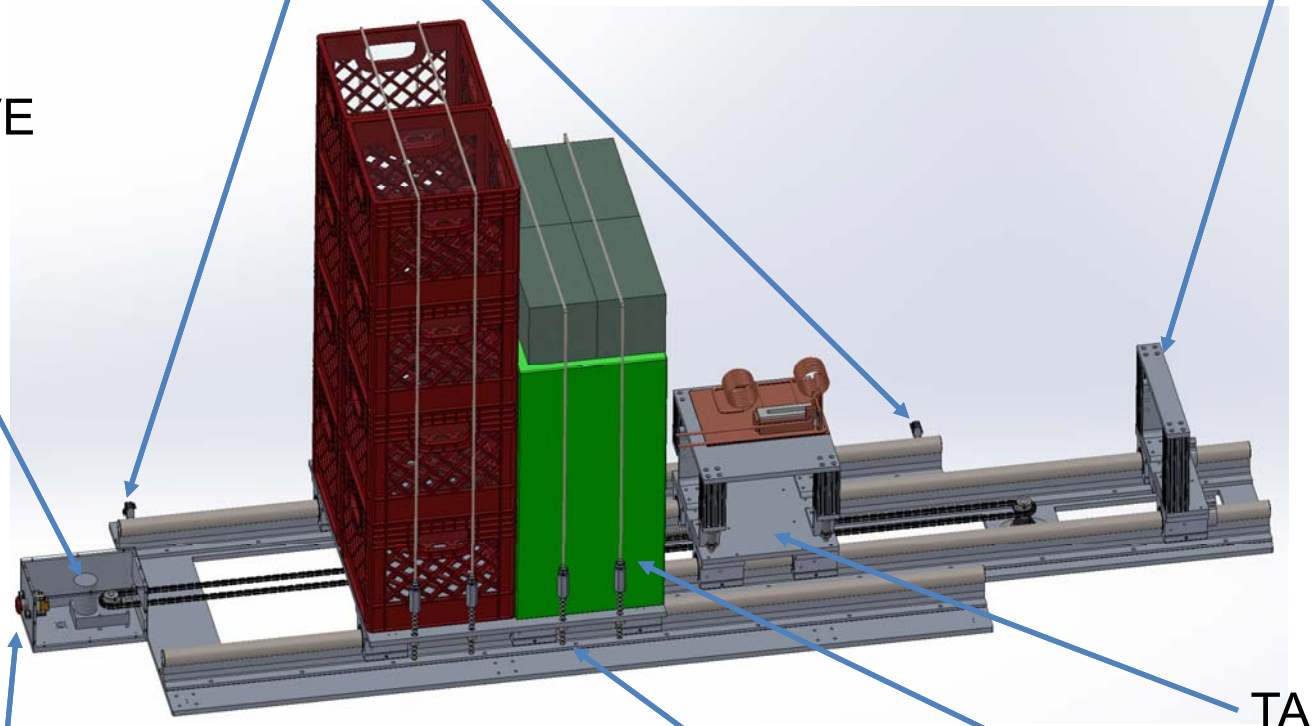
SHIELDING OK



B – 3.1” STEEL
0” CONCRETE
0” WATER

SHIELDING NEEDED UNDER STAND?

SLIDE ASSEMBLY

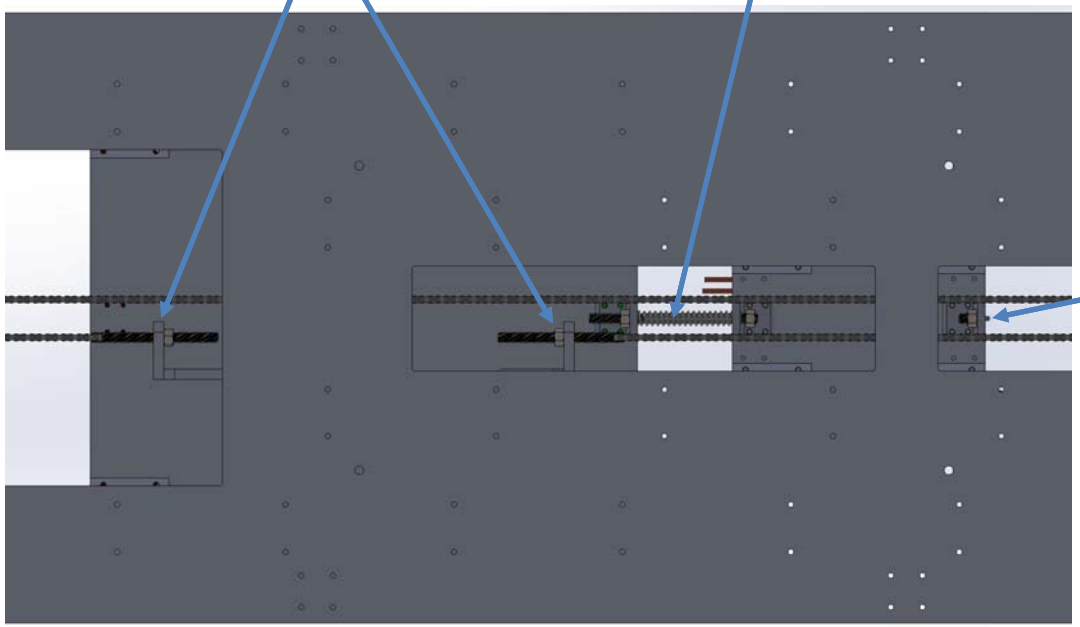


SLIDE ASSEMBLY

SPRING/SHAFT
ALLOWS TARGET ASSEMBLY TO RETRACT W/ SHIELDING AND PRESSES TARGET ASSEMBLY TO RADIATOR ASSEMBLY WHEN INSERTED

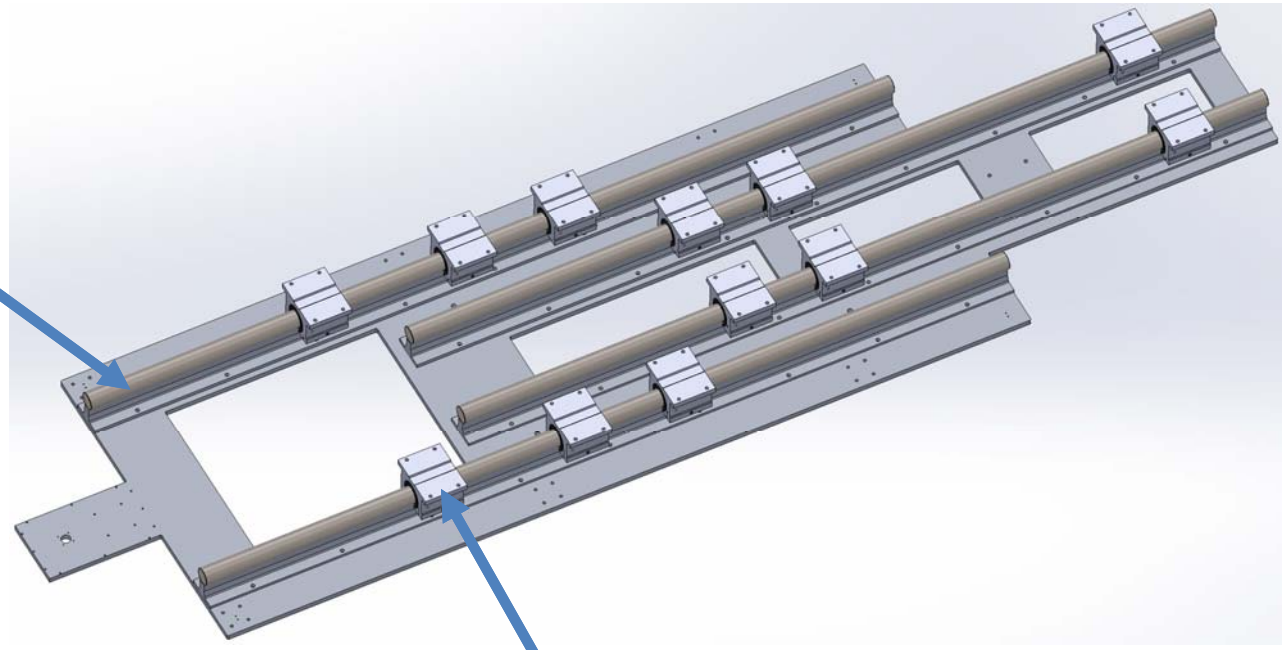
CHAIN TENSIONER

SPRING PLUNGER KEEPS RADIATOR ASSEMBLY FROM RETRACTING WITH TARGET ASSEMBLY



LINEAR SLIDE ASSY

1.5” RAILS

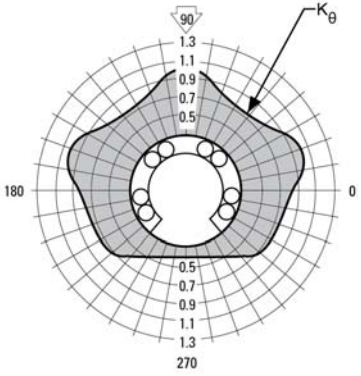


SSUPBO-24

BEARING DYNAMIC LOAD CAPACITY – 3880 lb
COEFF. STATIC FRICTION - 0.001 to 0.004
SHIELDING LOAD ~ 3000 lb
FORCE TO MOVE SHIELDING (0.004) ~ 12 lb

~LOAD PER BEARING (6 BEARINGS) – 500 lb EA.

Load Correction Factor, K_θ



The actual dynamic load capacity of a Ball Bushing Bearing is determined by the direction of the applied load relative to the bearing circuits. The load correction factor K_θ is found by referring to the polar graph. To determine the actual dynamic load capacity, multiply the proper correction factor (K_θ) by the dynamic load capacity.

SLIDE GEARED MOTOR

MOTOR LOAD WHILE MOVING
- SHIELDING SLIDE (~3000 lb) – 12 lb
- TARGET SLIDE (~30 lb) – 0.12 lb

- ~12 lb TOTAL OR 10.8 in-lb

MOTOR LOAD AT FULL INSERTION
- SHIELDING SLIDE (~3000 lb) – 12 lb
- TARGET SLIDE (~30 lb) – 0.12 lb
- SPRING (24.31 lb/in)@1/2 in – 12 lb
- SPRING PLUNGER – 9 lb

- ~33 lb TOTAL or 29.7 in-lb

MOTOR RATED AT 200 in-lb

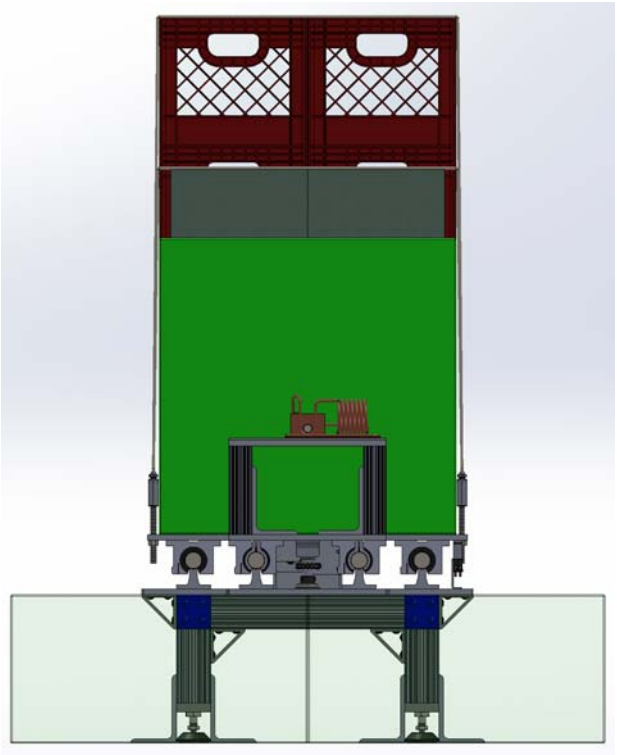
ALUMINUM TOP PLATE ANALYSIS

PLACING THE SHIELDING LOAD CENTEREND ON THE PLATE

Maximum Stress $\sigma(y, F, L, I) := \frac{y \cdot F \cdot L}{4 \cdot I}$

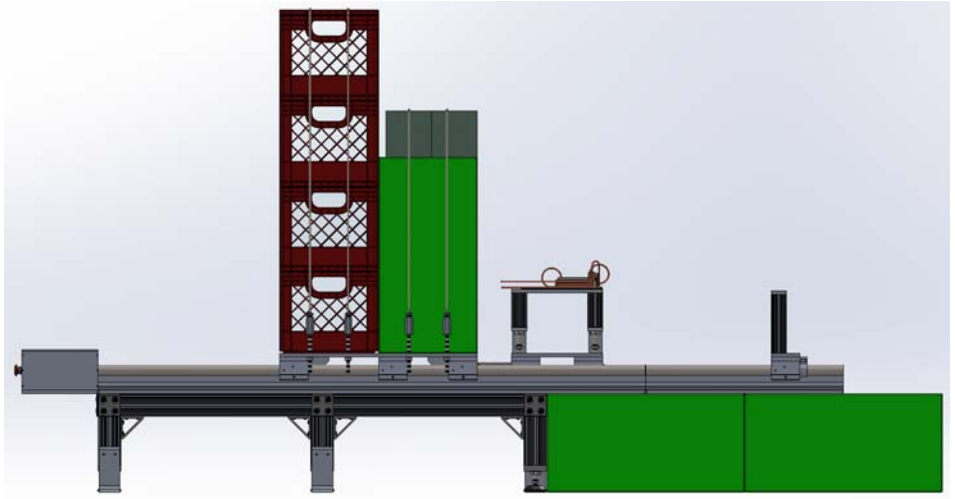
Maximum Deflection $\mu(F, L, E, I) := \frac{F \cdot L^3}{48 \cdot E \cdot I}$

Maximum Stress = 18029 psi
Maximum Deflection = 0.24 in
Safety Factor = 2.2



		½" THICK ALUMINUM PLATE
y(in)	DISTANCE FROM AXIS	.25
F(lb)	LOAD	3000
L(in)	SPAN LENGTH	20
I(in^4)	MOMENT OF INERTIA	.208
E(psi)	MODULUS OF ELASTICITY	10000000
Y(psi)	YIELD STRENGTH	40000

IN REALITY THE S4 BLOCK (& SOME OF THE WATER) SPANS THE PLATE SUPPORTS AND HAS LITTLE CONTRIBUTION TO THE ANALYSIS DECREASING THE STRESS BY 10x



SUPPORT STAND ANALYSIS

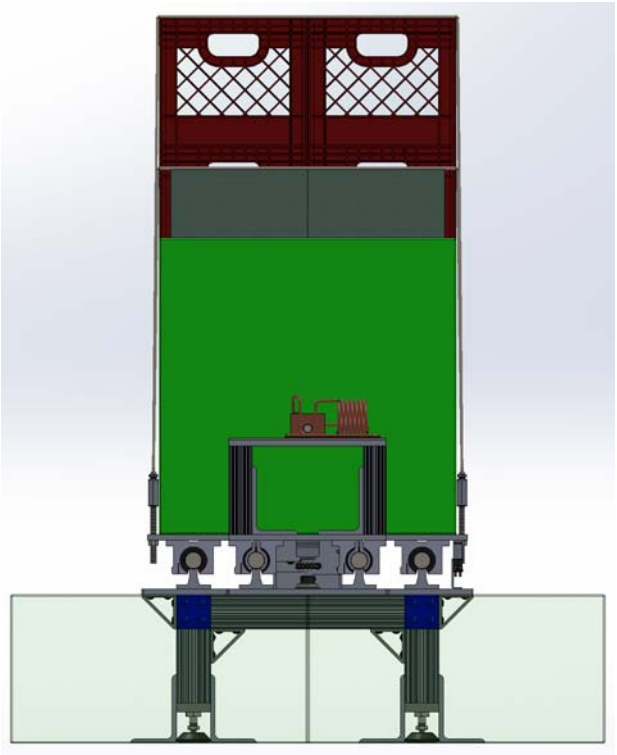
PLACING HALF SHIELDING LOAD CENTEREND 0N THE 8020 25” SPAN

Maximum Stress $\sigma(y, F, L, I) := \frac{y \cdot F \cdot L}{4 \cdot I}$

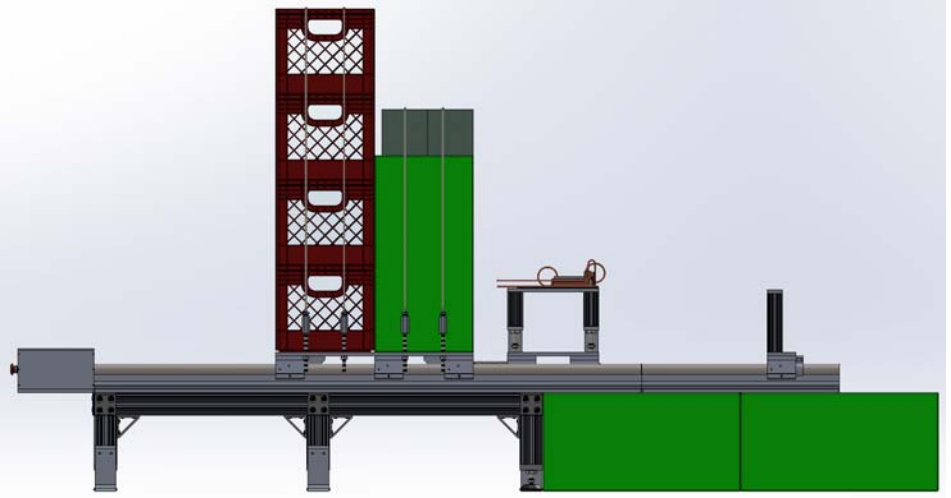
Maximum Deflection $\mu(F, L, E, I) := \frac{F \cdot L^3}{48 \cdot E \cdot I}$

Maximum Stress = 4120 psi
Maximum Deflection = 0.014 in
Safety Factor = 8.5

		8020 – 3030 PROFILE
y(in)	DISTANCE FROM AXIS	1.5
F(lb)	LOAD	1500
L(in)	SPAN LENGTH	25
I(in^4)	MOMENT OF INERTIA	3.4133
E(psi)	MODULUS OF ELASTICITY	10200000
Y(psi)	YIELD STRENGTH	35000

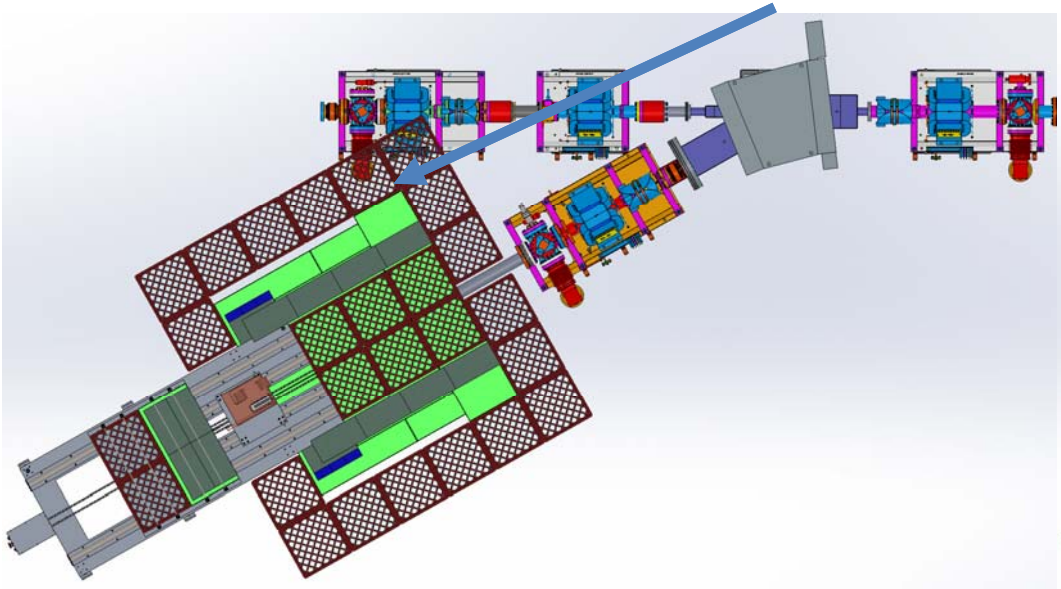


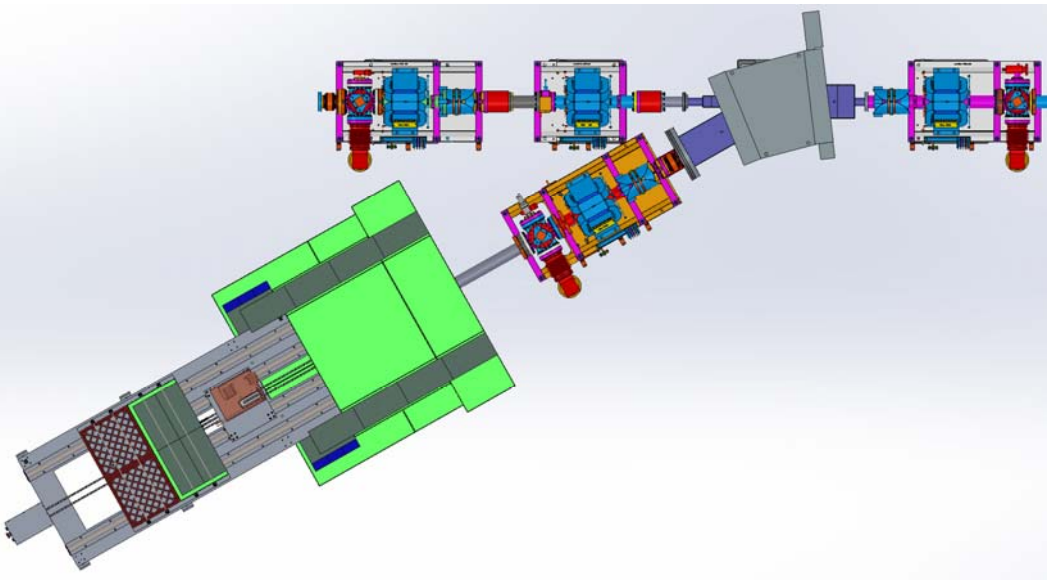
300 lb Lateral load on vertical post
Maximum Stress = 659/6 psi
Safety Factor = 53*6

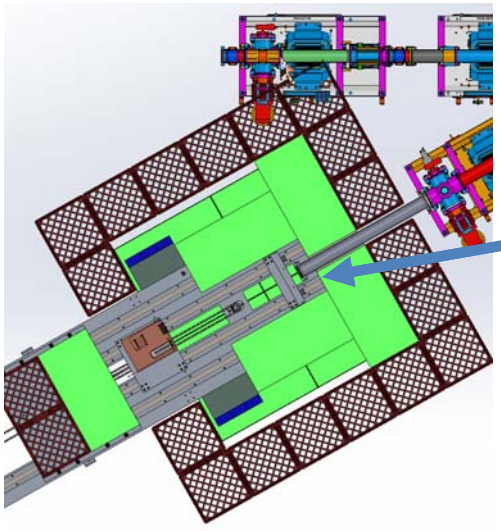


2F

THESE SETS OF WATER CRATES WILL NEED TO BE REPLACED

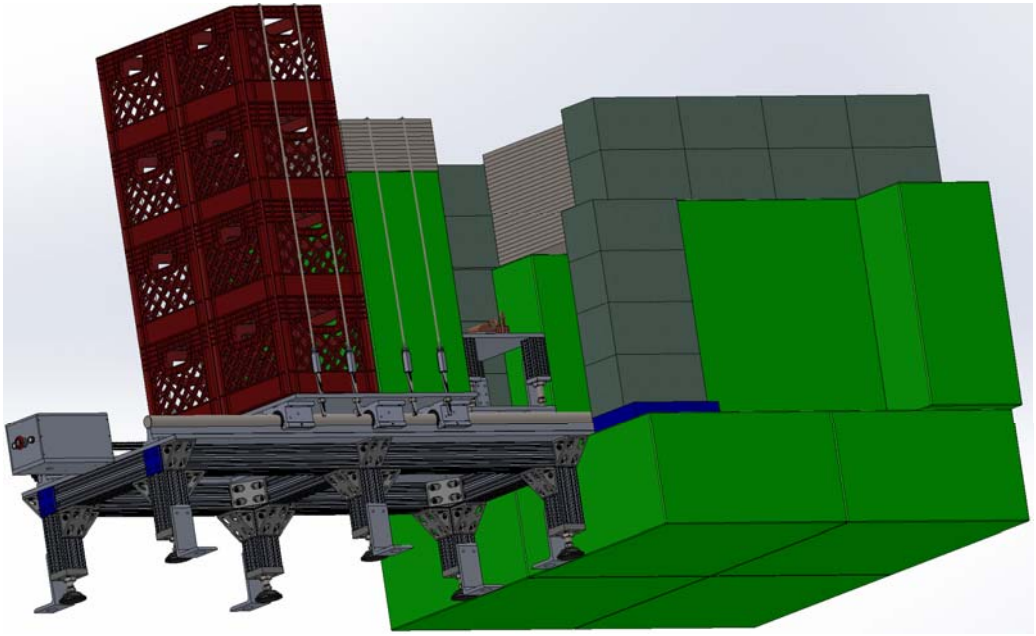


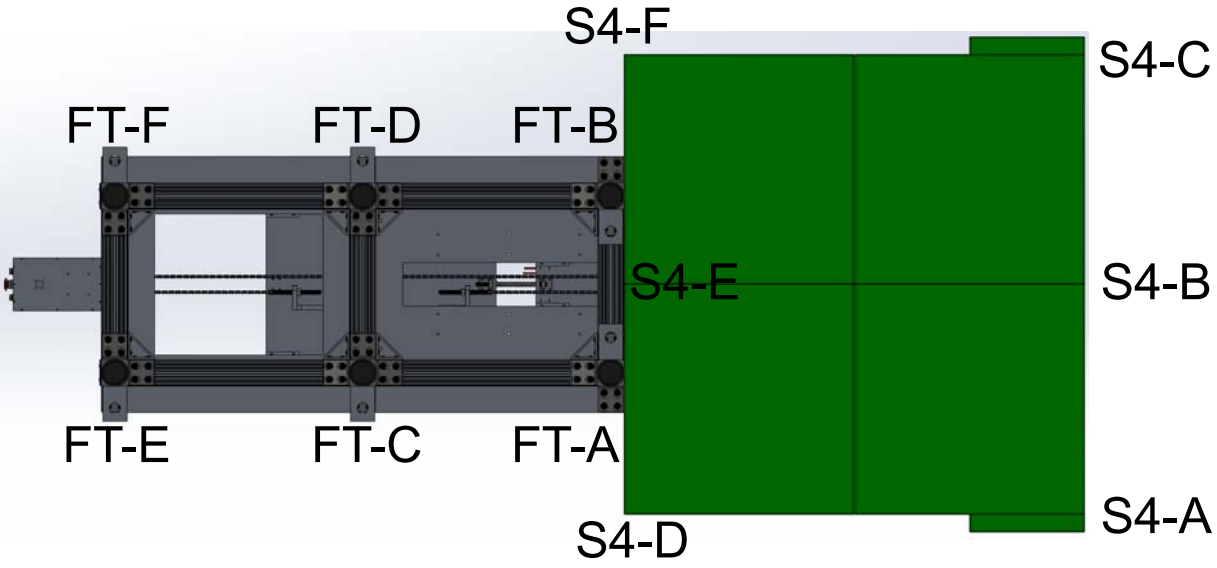




INSIDE FLANGE FACE IS
2-1/2” FROM S4 BLOCK

SURVEY POINTS





NAME	X(m)	Z(m)
S4-A	19.48662	38.76396
S4-B	18.91118	39.08800
S4-C	18.33575	39.41205
S4-D	18.83853	37.61309
S4-E	18.26309	37.93714
S4-F	17.68766	38.26118
FT-A	18.46572	37.77931
FT-B	18.02308	38.02897
FT-C	18.11675	37.15961
FT-D	17.67411	37.40887
FT-E	17.76778	36.53991
FT-F	17.32514	36.78918

OFFSETS BASED ON “AS FOUND” 03-29-2019 ALIGNED POSITION OF MQX101