



**YOUNGSTOWN
STATE
UNIVERSITY**

PEELER TABLE DESIGN

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MECH 3762L

OUTLINE

- **Purpose**
- **Project Criteria**
- **Initial Design**
- **Final Design**
- **Room for Improvements**

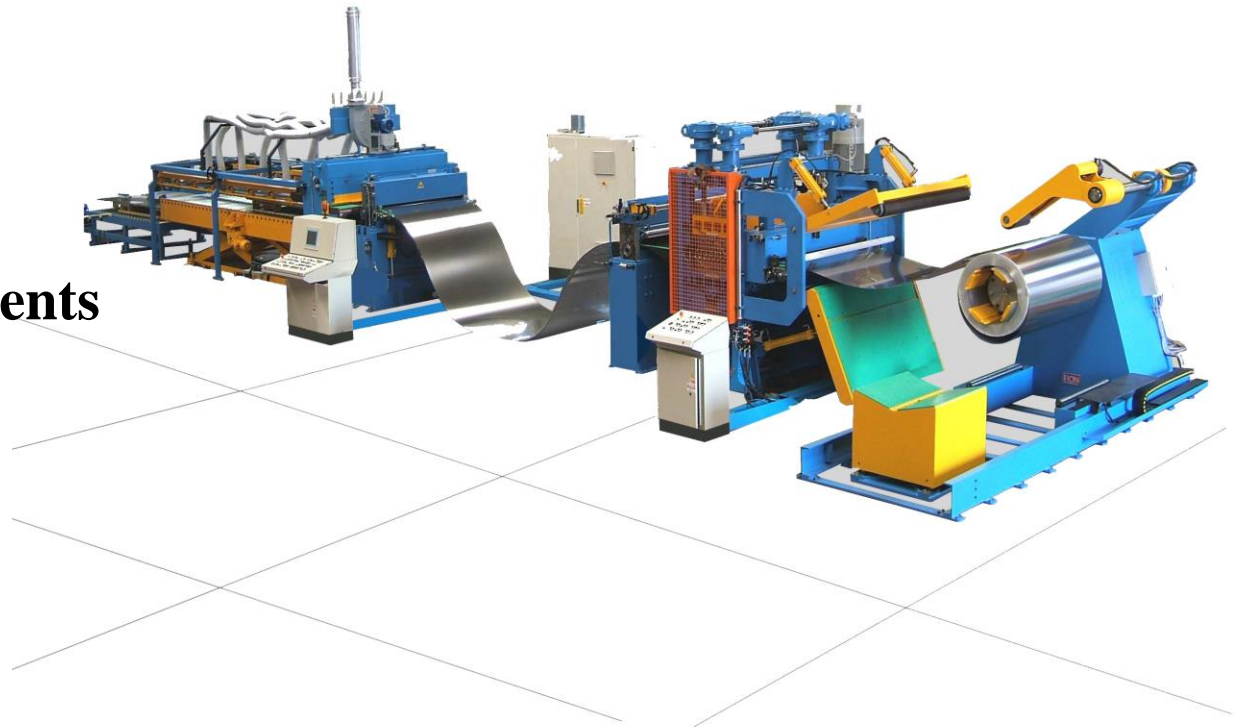
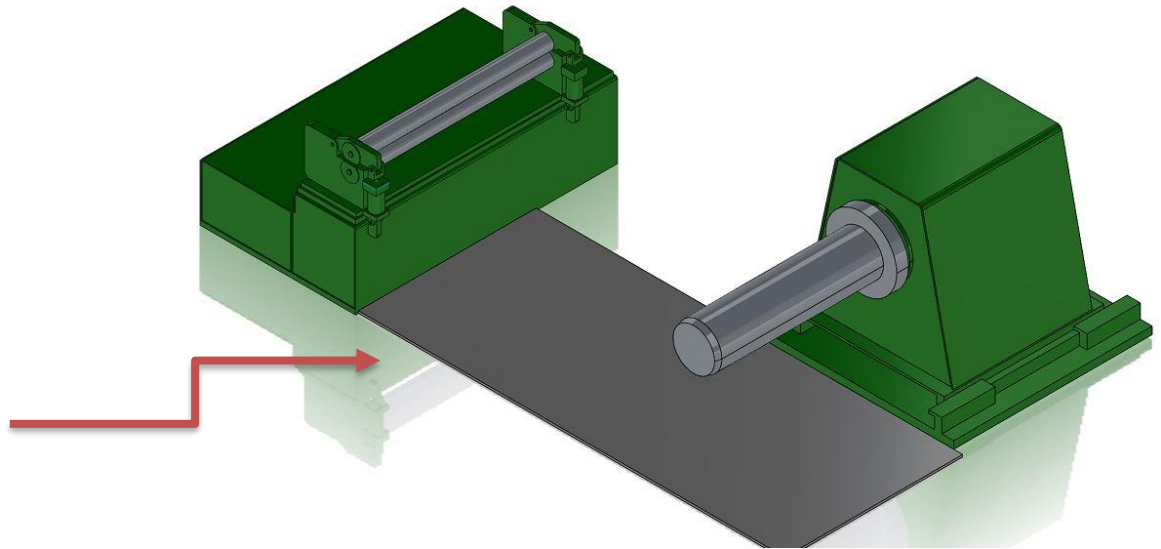


Image Credit : Chicago Slitter.

Purpose

- Design 2 main Parts of Slitter Line.
 - Hold down Arm
 - To hold and uncoil the leading edge of Strip.
 - Peeler table
 - To guide the sheet to the pinch roll of slitter .

Design to fit in a given footprint .



Project Criteria

- Arm with powered roller.
- Power supplied by existing hydraulics.
 - $P_{sys}=1500$ psi.
- Accommodates coil dimension.
 - Strip width:
 - Max: **52 inch**
 - Min: **15 inch**
 - Strip Gauge: **10-gauge** max
 - Coil Diameter: **68-inch** diameter max

Customer Request manual control of Peeler table and hold down arm.

Initial Design: Peeler Table

Entire moment due to the table is acted on two of these vertical support. Adding support on the front will help.



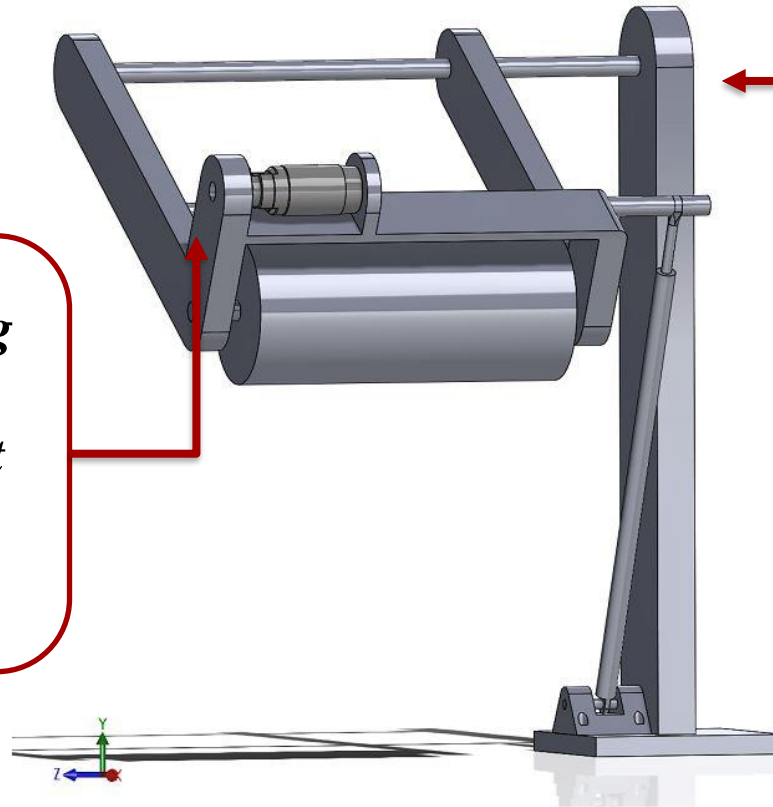
Difficult to machine the designed shape. (Not Practical)

Mounted to the ground. Mount on the frame would be better.



Initial design: Hold down arm

Thought of using belt for power transmission but decided chain would be better.



Entire load is supported by this support, thus subjected to large moment.



Final design

*McMaster-Carr
Press-Fit Bushing*

*Additional member
decreases the
moment on vertical
member*

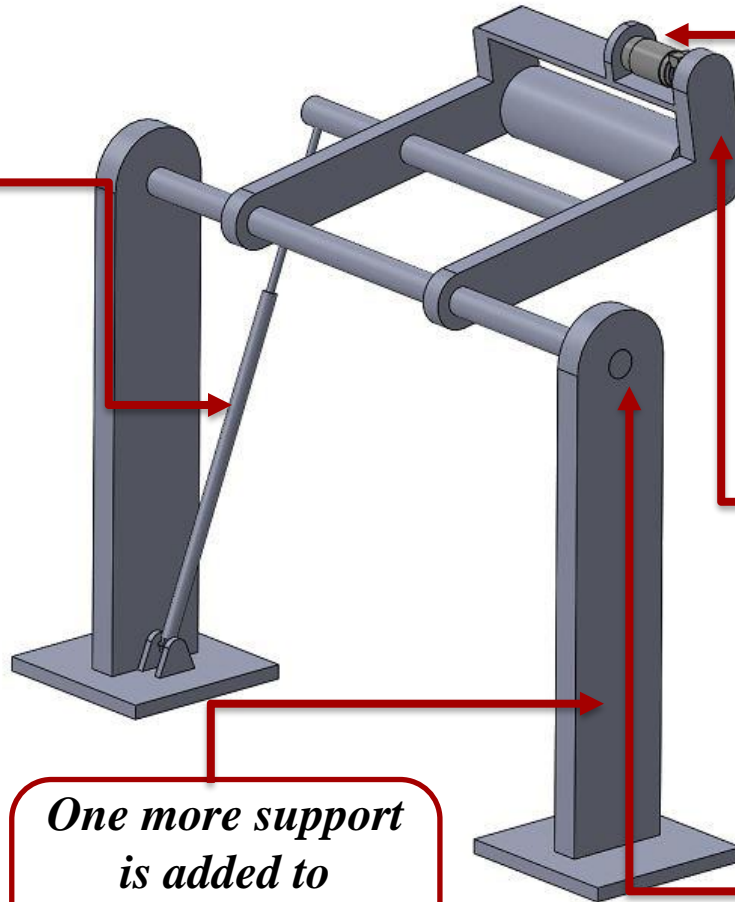
*Hydraulics
mounted on the
frame*

*Hydraulic Cylinder
(Heavy duty
Roundline Welded-
Series RDH)*



Final design

*Hydraulic
Cylinder (Heavy
duty Roundline
Welded-Series
RDH)*



*Medium Duty
Motor- Torqmotor
TL Series*

*Sprocket to
torque from
motor to roller*

*One more support
is added to
decrease stress on
other arm*

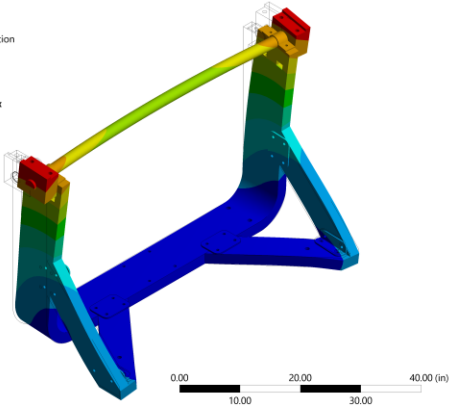
*Angular contact
ball bearing*



FEA

A: Static Structural
Total Deformation
Type: Total Deformation
Unit: in
Time: 1
4/30/2020 2:00 AM

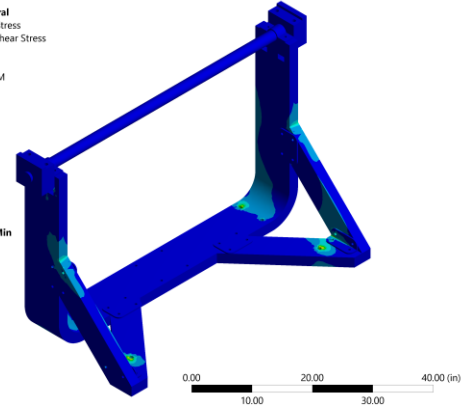
0.0040187 Max
0.0035722
0.0031257
0.0026791
0.0022326
0.0017861
0.0013396
0.00089304
0.00044652
0 Min



Total Deformation

A: Static Structural
Maximum Shear Stress
Type: Maximum Shear Stress
Unit: psi
Time: 1
4/30/2020 2:01 AM

1891.2 Max
1681.1
1470.9
1260.8
1050.7
840.53
630.4
420.27
210.14
0.0048491 Min



Max Shear Stress

Max Principal Stress

A: Static Structural
Maximum Principal Stress
Type: Maximum Principal Stress
Unit: psi
Time: 1
4/30/2020 2:01 AM

4010.8 Max
3471.5
2932.1
2392.8
1853.4
1314
774.69
235.33
-304.03
-843.39 Min

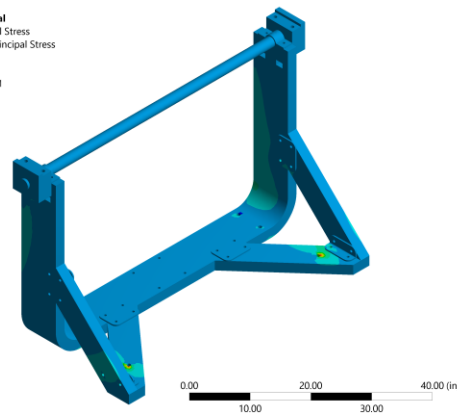


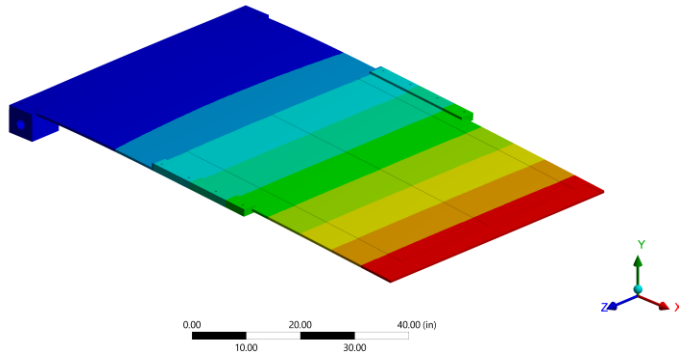
Table Support FEA



FEA

A: Static Structural
Total Deformation
Type: Total Deformation
Unit: in
Time: 1
4/22/2020 2:33 AM

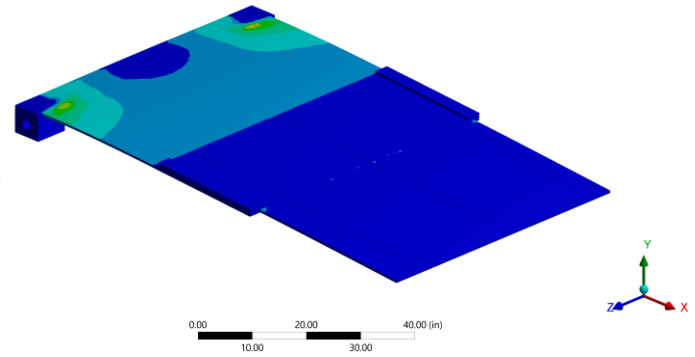
1.7282 Max
1.5362
1.3442
1.1521
0.96012
0.7681
0.57607
0.38405
0.19202
0 Min



Total Deformation

A: Static Structural
Maximum Shear Stress
Type: Maximum Shear Stress
Unit: psi
Time: 1
4/22/2020 2:33 AM

10373 Max
9220.6
8068
6915.5
5762.9
4610.3
3457.8
2305.2
1152.7
0.086298 Min

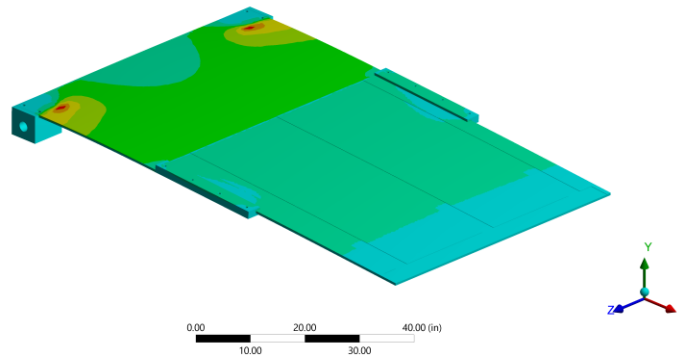


Max Shear Stress

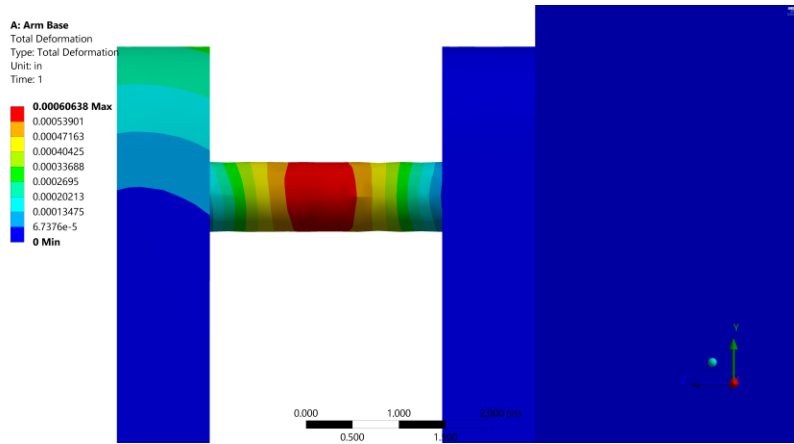
Max Principal Stress

A: Static Structural
Maximum Principal Stress
Type: Maximum Principal Stress
Unit: psi
Time: 1
4/22/2020 2:33 AM

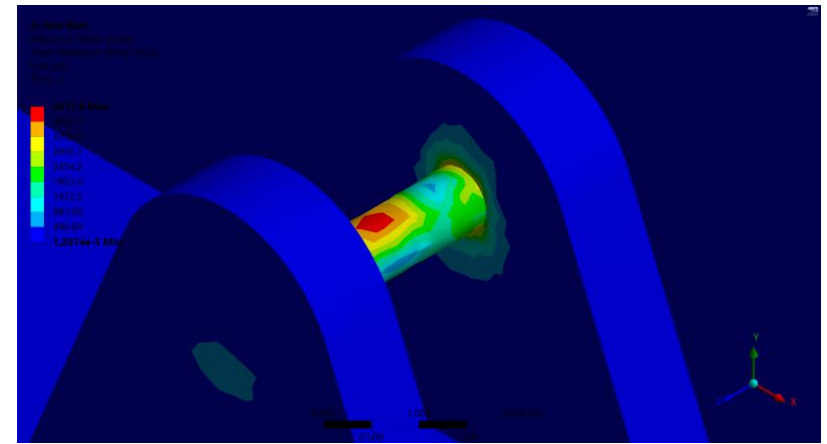
14977 Max
12540
10104
7666.7
5229.9
2793.1
356.22
-2080.6
-4517.4
-6954.3 Min



FEA

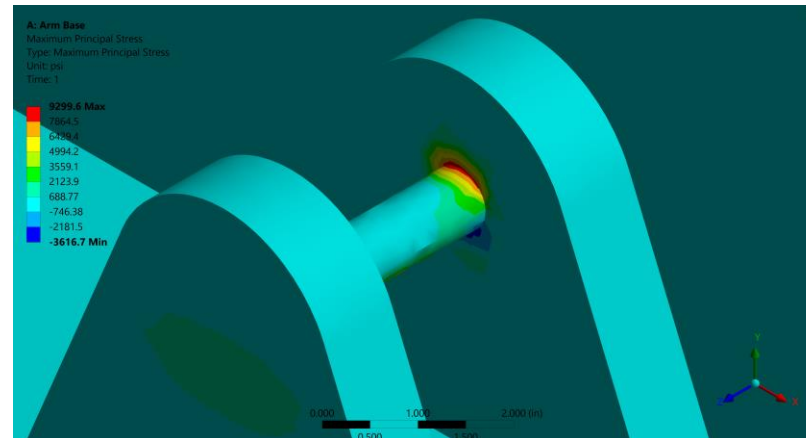


Total Deformation



Max Shear Stress

Max Principal Stress

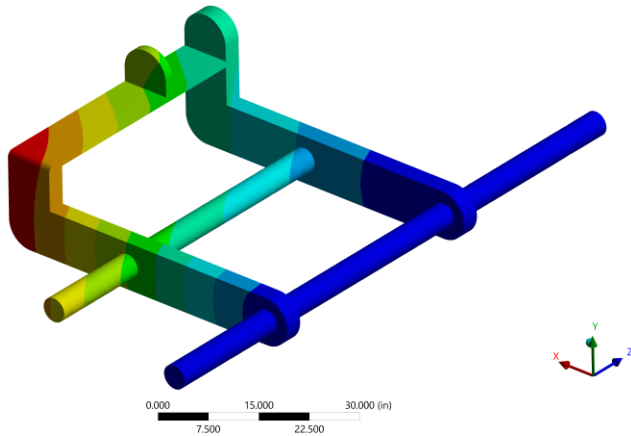
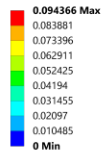


Pin Support FEA



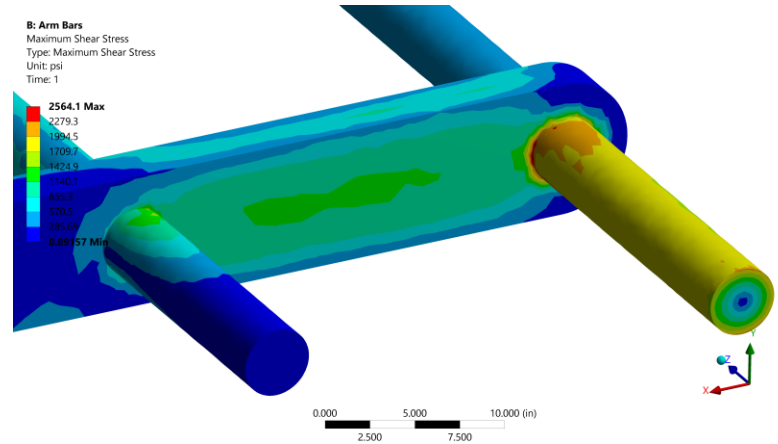
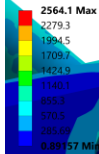
FEA

B: Arm Bars
Total Deformation
Type: Total Deformation
Unit: in
Time: 1



Total Deformation

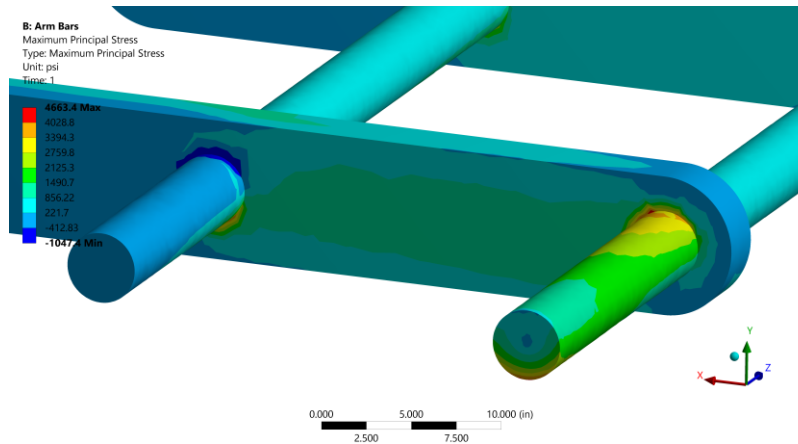
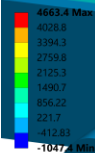
B: Arm Bars
Maximum Shear Stress
Type: Maximum Shear Stress
Unit: psi
Time: 1



Max Shear Stress

Max Principal Stress

B: Arm Bars
Maximum Principal Stress
Type: Maximum Principal Stress
Unit: psi
Time: 1



Basic Calculation results

Hydraulic Cylinder

- **Fext**(Table): 1634 lbf
 - **P**(needed): 520 psi
- **Fext**(Arm): 3042.26 lbf
 - **P**(needed): 969 psi

Hydraulic motor

- Torque required : 8311 lb-in
(Assuming strip velocity to be 3 in/s.)

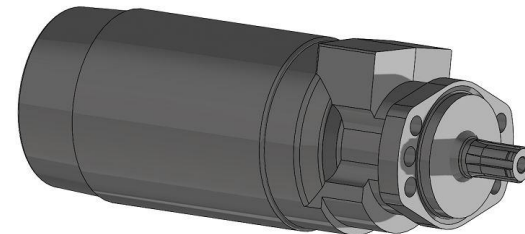
Bearings and bushing

- **Fr**(hinge): 950 lbf
- **Fr**(Arms support): 701.83 lbf
- **Fr**(Roller): 412.64 lbf

Hydraulics Cylinder and Motor

- Hydraulic Cylinder (Heavy duty Roundline Welded-Series RDH)
 - **Fluid type:** Filtered hydraulic oil
 - **Bore Diameter:** 2 inch
 - **Rod Diameter:** 1 inch
 - **Mounting type:** Pivot mounting
 - **Configuration:** Welded cap

- Hydraulic Motor (Medium Duty Motor- Torqmotor TL Series)
 - **Max Output Torque:** 10,300 lb.-in
 - **Shaft Diameter:** 1.25-inch nominal



Bearings

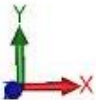
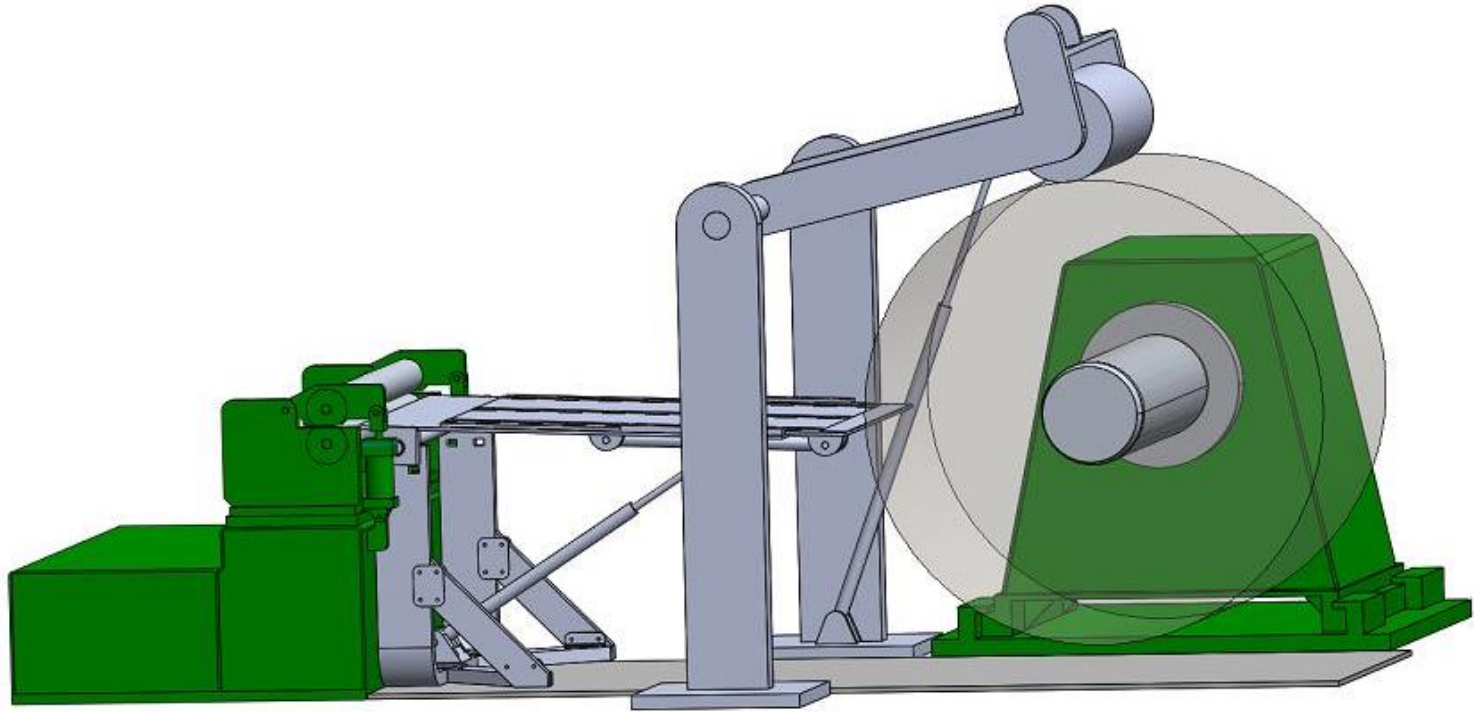


- Ball Bearing
 - From McMASTER
- Radial Load Capacity
 - Dynamic: 3750 lbs.
 - Static: 2700 lbs.
- Material
 - Steel
- Maximum Speed
 - 10,000 rpm
- Bore Diameter
 - $D=1''$

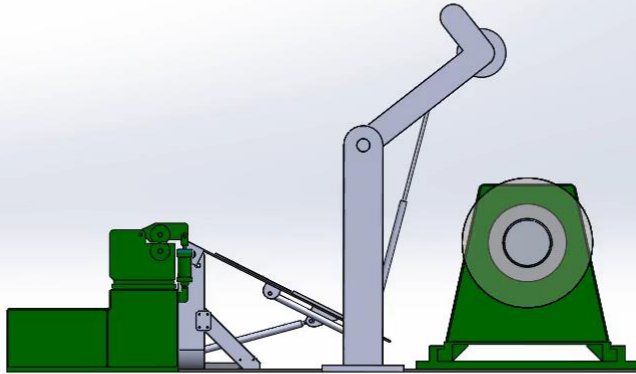
From Manufacturer



Full Assembly



Animation



Stroke Velocity

- $V(\text{Table})$: **1 in/sec**
- $V(\text{Extended table})$: **2.1 in/s**
- $V(\text{Hold-down arm})$: **1.2 in/sec**

Room for improvements

- Pin Calculations.
- Run fatigue analysis.
- Attach hold-down arm to table frame.
- Modify table to further increase factor of safety.

Thank You !!