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Carpet Rollup System

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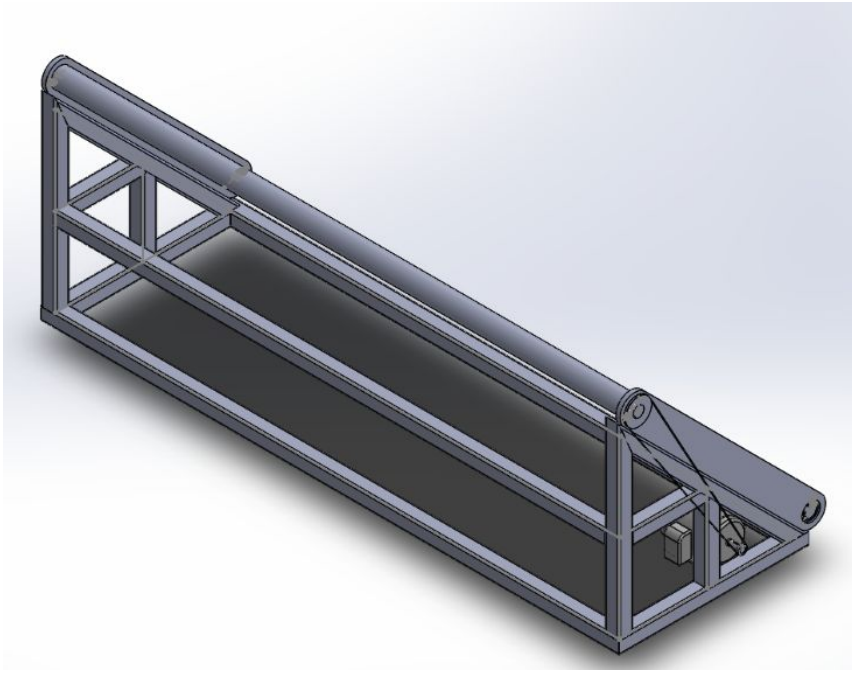
Team - A15



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Objectives

- Design a carpet feeding mechanism so that the overall system stays at height of 4 ft
- Select an appropriate motor to accommodate both the feeder and roller
- Design the system to accommodate all standard size carpets
- Design a frame to house the mechanism and mechanical parts
- Design the system to completely protect the carpet from both surrounding and machine elements

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Constraints

- The height of the system is should to be 4’
- Frame should be statically stable.
- The system should not affect the original condition of the carpet.
- Most of the machine components have to be built in-house.

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Codes

- SEMA Conveyor Design Manual
- Northern American American Classification system(NAICS): Industry 2273- Carpets & Rugs
- ASME Safety Standards for Conveyor and related Equipments
  - B20.1
- National Institute for Occupational Safety and Health(NIOSH)
  - Recommended lifting weight limit: 50 lbm

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System Components

Carpet

Parameter	Specification	Selected/Calculated
Sample Material	Rhapsody Kent Cerulean Oversize Area Rug Density: 16.7 lbm/ft^3 Width : 13 ft Height: 0.03ft (0.31”)	Selected
Allowable length(250 lbm)	Mass/(Density*Cross sectional Area) = 38.4 ft ≈ 38 ft	Calculated
Weight Per unit Length	211.8 lbf ft	Calculated

Fig: Sample Carpet

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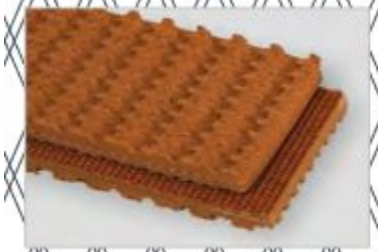
System Components

Conveyor Belt Material



SPEC#	PART#	TEMP.	THICKNESS	WEIGHT (PIW)	MIN. PULLEY	RECOMMENDED LACING
2-PLY 150# POLYESTER TAN SBR ROUGHTOP X BARE						
4303	20104303	0°F to 250°F	0.25"	0.092	2"	UX1 Clipper®, #7 Alligator®, RS125 Staple

Tan non-marking roughtop surface. Soft durometer compound provides extra gripping power.

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System Components

Conveyor Belt Design

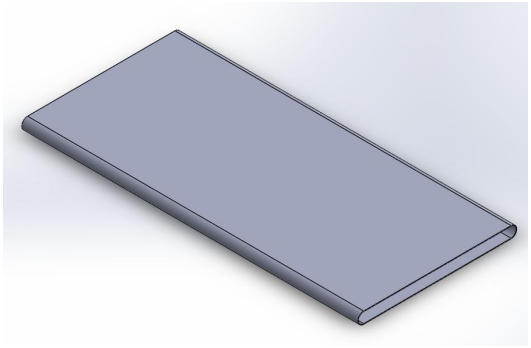

Fig: Solidworks Design of Conveyor Belt

Parameter	Specification	Selected/Calculated
Length	5.7 ft	Calculated
Width	13 ft	Selected
Angle of Inclination	45^0	Calculated
Force of Conveyor	8646 lbf	Calculated
acceleration	a = 0.3 ft/s^2	Selected

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System Components

Main Shaft

Fig: Exploded view of the Main Shaft

Parameter	Specification	Selected/Calculated
Min Diameter	D = 0.2 ft (actual 3”)	Selected
Ultimate Yield Strength	S_{ys} = 44.1 ksi(FOS: 1.02)	Calculated
Material	Hot Rolled High Strength low alloy ASTm A1011 S_{ys} = 45 Ksi	Selected

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System Components

Main Shaft

- Keys

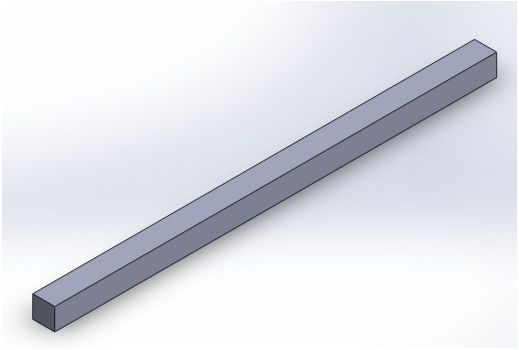

Fig: Isometric View of Key

Parameter	Specification	Selected/Calculated
length	Calculated: 0.7”(12 “ used)	Both
Width	0.6”	Table 7-6(Shigley’s)
Height	0.6”	Table 7-6(Shigley’s)

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System Components

- Bottom Shaft

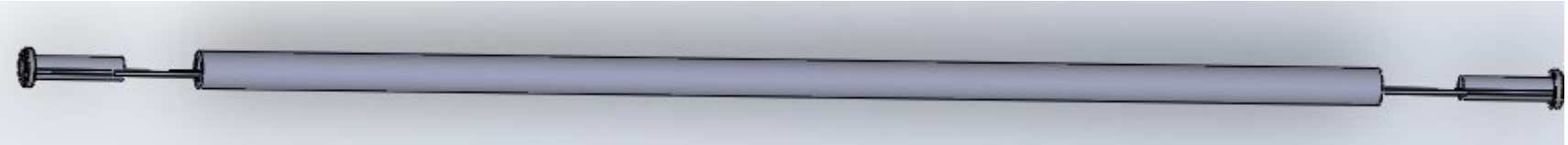

Fig: Exploded view of the Bottom Shaft

- Middle shaft & key dimensions same as main shaft
- Left & right shaft same as the right shaft of the main shaft

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System Components

Conveyor Arm

- Support both conveyor shafts
- House Bearings
- Attach with the truss frame

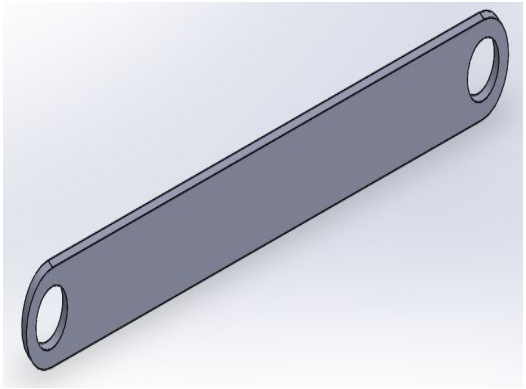

Fig: Isometric View of Conveyor Arm

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System Components

Bearings

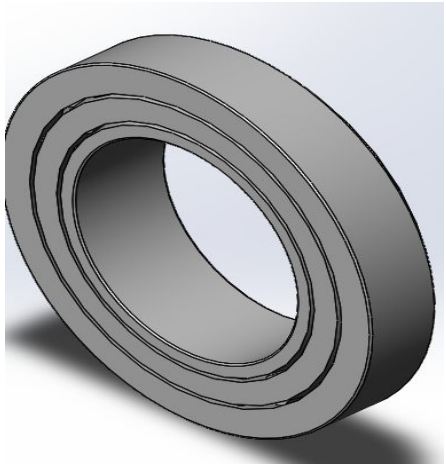

Fig: Isometric View of Tapered Bearing

- Shaft Diameter 3”
- Withstand the reaction forces of the shaft

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System Components

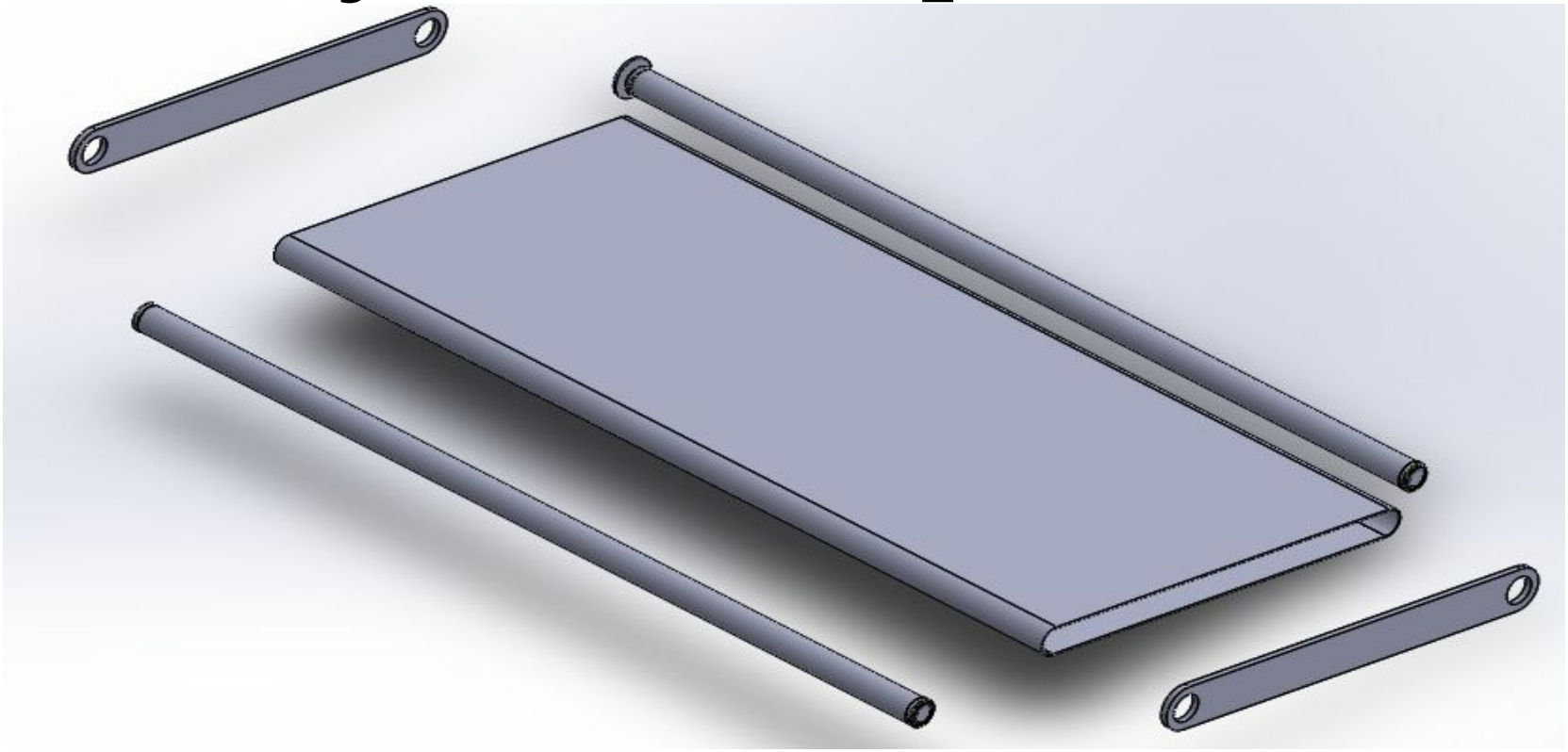

Fig: Brust View of Conveyor Assembly

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System Components

Truss

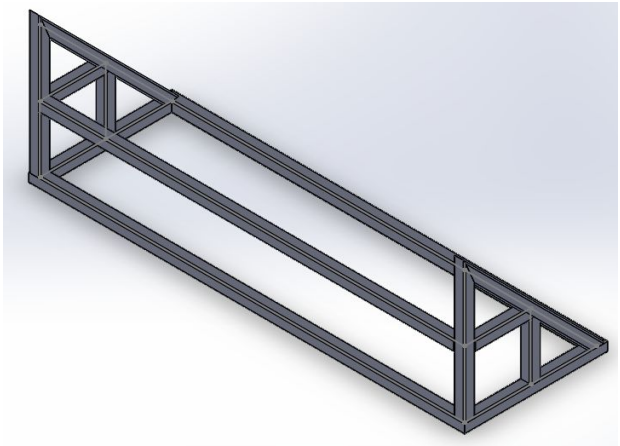

Fig: Isometric View of Truss Frame

Parameter	**Specification**	**Selected/Calculated**
Frame Type	Triangular	Selected
Dimension of Tubes	4” X 4” X 0.25”	Selected
Material Selection	Hot Rolled High Strength low alloy ASTm A1011 S_{ys} = 45 Ksi	Selected (Same material as conveyor for welding)

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System Components

Power Transmission Pulley

- Pulley with key
- Welded onto the main shaft

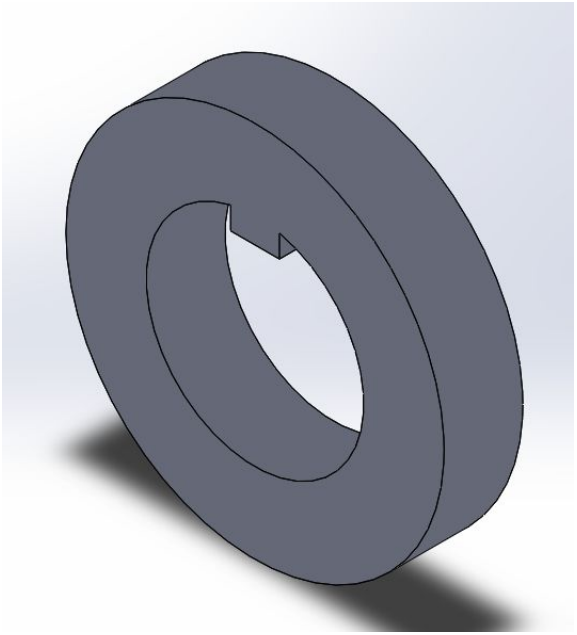

Fig: Transmission pulley for main shaft

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System Components

Power Transmission Belt

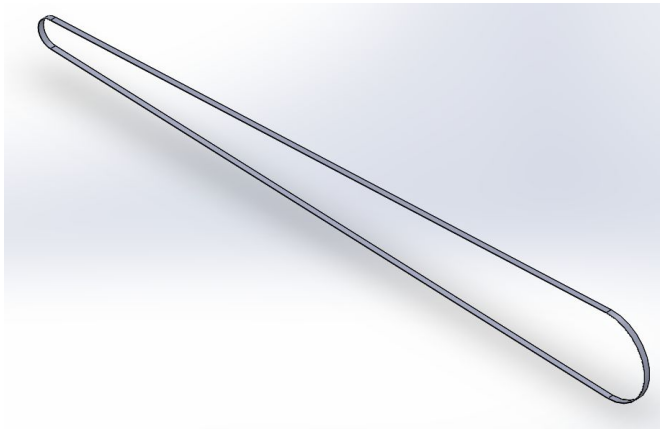

Fig: Isometric View of Transmission Belt

Parameter	Specification	Selected/Calculated
Angle of Wrap	$\Theta_D = 185.1^0$ $\Theta_d = 175^0$	Calculated
Transmitted Torque	0.048 lbf ft	Calculated
Center Distance	4.6 ft	Selected
FOS	1.02	Calculated
Material	Polyamide F-0^c	Selected

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System Components

Motor Pulley

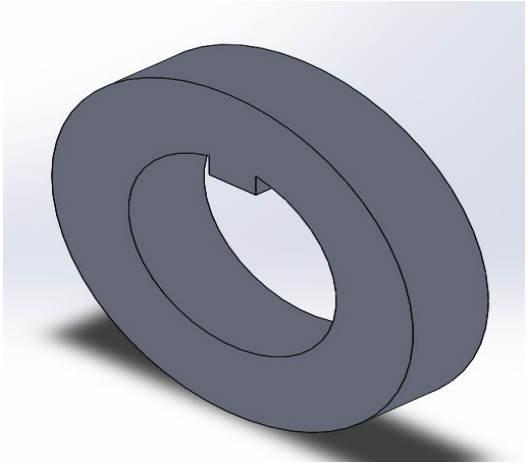

Fig: Isometric view of Motor Pulley

- Diameter = 0.2 ft (selected)
- Hole and Key designed to fit in the motor shaft.

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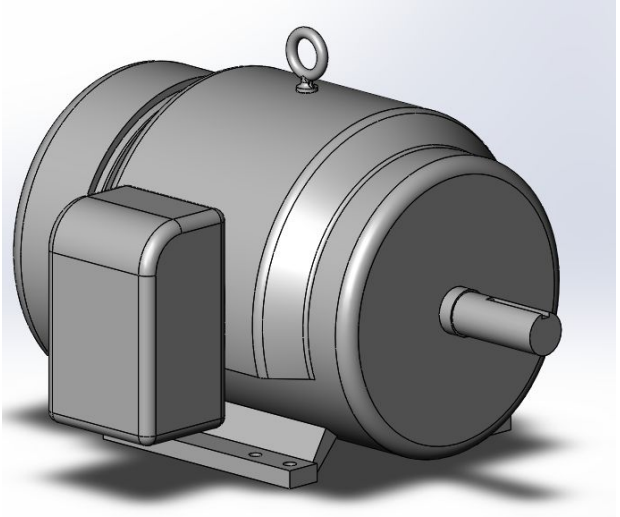
System Components

Motor



Parameter	Specification	Selected/Calculated
Angular speed	1760 rpm (max)	Selected
Placement Location	L = 2.3 ft from base	Calculated
Power	10 HP	Calculated

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System Components

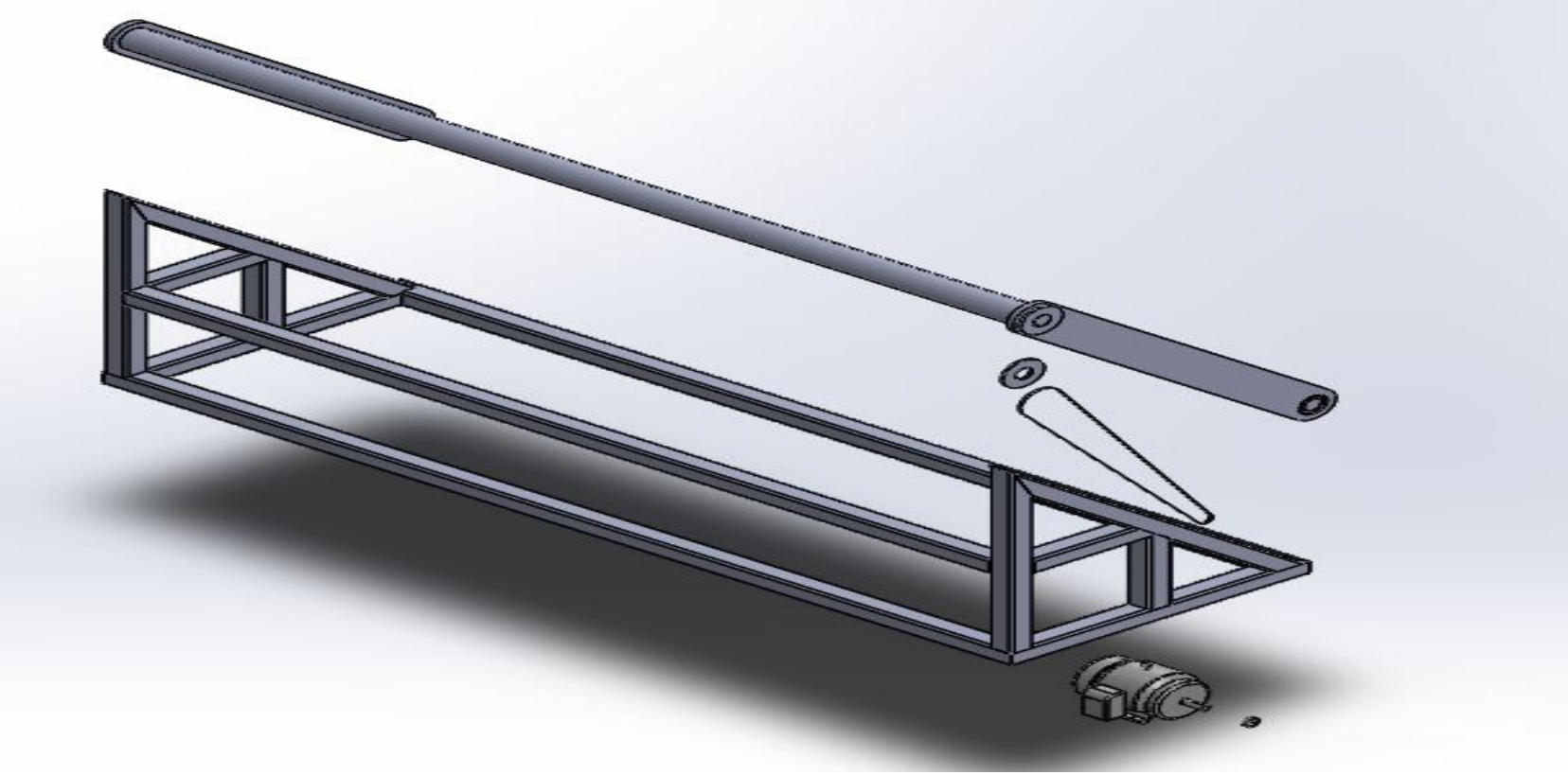

Fig: Exploded view of the Carpet Feeder system

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System Components

Item	Specification	Market Spec	Cost($)
Motor	1	-	1430.69
Bearings	4	-	683.32
Conveyor Belt	5.7 ft X 13 ft		476.45
Transmission Belt	126” X 0.5“		120
Hot Rolled ASTM A1011			
Tube(4” X 4” X .25”)	887.11”(74 ft)		1276.5
Rod (3”)	54 “(4.5 ft)	8 ft	334.96
Rod (4.8”)	312” (26 ft)	20ft(*2)	1170
Keys (.6” X .6” X 12”)	4	(Machine from 4.8 “)	-
Conveyor Arm (76.4” X 8” X 1.14”) + 2 Pulleys	2	84 * 16 “ *1.25”	13.05
		Total	$5504.97

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Actual cost of Steel

$2/cwt

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Fabrication

- Truss Frame is welded
- Conveyor & Truss are welded
- Pulleys are milled
- Holes in the Conveyor drums are milled
- Key bores are milled
- Parts are also sanded and cut

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Possible Updates

- Proper Quote from Manufacturers for Materials
- Shorten power transmission belt
  - Add Tensioner

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