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Design, Fabrication and Analysis of a Paver Machine Push Bar Mechanism

by

Mahendra Palnati

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Science in Mechanical Engineering
Department of Mechanical Engineering
College of Engineering
University of South Florida

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Date of Approval:
October 21, 2015

Keywords: Concrete block pavers, Pavers manufacturing, Concrete mixture, Hydraulic press paver production, Cleaning mechanism, Waste management

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DEDICATION

I dedicate this study to my parents and brother for their support and teachers for their guidance and friends for their encouragement and to all the people who made this work possible.

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ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to Dr. Alex Volinsky for providing me his guidance and support to accomplish this work. I would like to thank my committee members Dr. Kaw and Dr. Lusk for their time and valuable advice. I am very grateful to Mr. Luc Girard and Mr. John Gallagher for giving me the opportunity to do my research work at Tremron Lakeland. I would like to thank Mr. Joe Lebiedz and Mr. Clinton Cunningham for providing valuable suggestions in my research work and thesis writing. I would also like to thank Mr. Alan Whipp, Mr. Sean Phelps, Mr. Darold Jones, and all the people at Tremron for their help in various ways. Special thanks to TREMRON for funding my project.

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ABSTRACT

Now-a-days, the major challenge that's being faced by the concrete industry is the cleaning of concrete handling equipment. Concrete consists of aggregates, which harden with time, and the transportation of concrete mixture within the plant is a significant problem. This will not only increase the overall maintenance cost, but will lead to loss of raw materials, affect the rate of production, and reduce the lifetime of concrete handling equipment.

The present study focuses on the design and implementation of an adaptive cleaning mechanism in the concrete industry and its importance in achieving efficient cleaning, which is tested to verify its performance in the Paver production plant. The goal of this study is to provide practical evidence about the importance of adaptive cleaning mechanisms for industrial applications.

The first chapter gives a detailed introduction about pavers and the production process, the cause of material loss that occurs during transportation of wet concrete mixture inside a paver plant, and its effect on handling equipment and work environment. The second chapter explains design and working of the paver machine push bar mechanism, which can be implemented in a hydraulic press production process of pavers. The third chapter includes analysis and results of the mechanism obtained using Solidworks and Autodesk Inventor followed by observations that are achieved based on practical application of this mechanism in a paver production plant.

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CHAPTER 1

INTRODUCTION TO CONCRETE BLOCK PAVERS

1.1 Pavers (Blocks)

Pavers are being widely used as construction materials for home, industrial, and commercial projects. A few major applications are pathways, driveways, patios, courtyards, garden paths, streetscapes, plazas and pedestrian malls. Pavers are available in a wide range of surface texture, colors, finishes, shapes and other special features making concrete block pavers suitable for endless design possibilities. Pavers are not only preferred for their unique looks or easy installation techniques, but more importantly for their superior load distribution characteristics. These properties make pavers suitable for construction materials in industrial surfaces and low speed roads [1]. Pavers can be classified in to two types, Concrete block pavers and kiln fired clay bricks [5]. This paper mainly focuses on the production of concrete block pavers.

1.2 Historical Development

Until 1918, stone blocks, composite wood, bricks and tar units were the commonly used construction materials. After this time, increase in construction costs provided a need for a far more economical and simpler alternative. This led to introduction of high strength concrete blocks. Concrete blocks were first produced in the United States in the 1960's, using German equipment and designs. Today's annual production of concrete blocks raised to millions of square meters in many countries, shown in Figure 1. The reason for this growth is manufacturing technology that allows mass production of accurately dimensioned, high strength concrete blocks [1]. Today's growing demand for the use of

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these blocks signifies the importance of this study, which focuses on improving the efficiency of paver production in a plant.

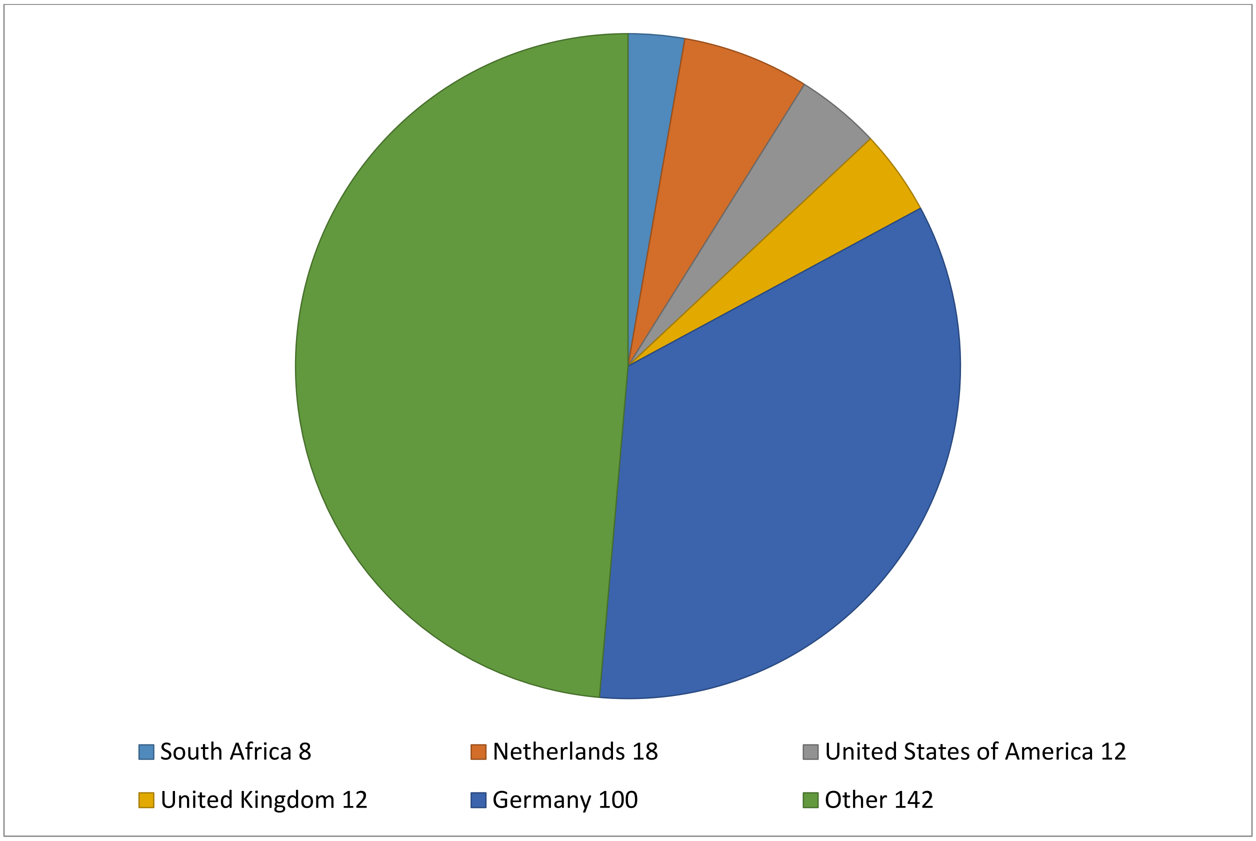

Figure 1: Use of pavers worldwide in millions of square meters per annum (values for the above chart are taken from [2])

1.3 Applications of Concrete Block Pavers

Properties of pavers like high strength, resistance to environmental damage and capability of supporting heavy loads makes them suitable for a wide verity of applications.

1.3.1 Roads

Pavers offer great skid resistance even in wet weather [2]. Also different color pavers can be used to create awareness among drivers and helps to guide them properly (Figure 2). Maintenance required for these types of roads is very less.

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Figure 2: Change in texture at an intersection (from [32] in public domain)

1.3.2 Commercial Projects

Applications of pavers provide an attractive and ideal look for golf courses and country clubs. Different color pavers can also be used to create attractive pictures and patterns, shown in Figure 3.

Figure 3: Pattern created using different colored pavers (from [30] in public domain)

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1.3.3 Industrial Areas

Pavers are capable of withstanding concentrated heavy loads, making them suitable for off-road vehicles like cranes and forklifts. These characteristics make them recommended in airports, harbors and container depots where long term static loading is experienced [2] .

1.3.4 Domestic Paving

Pavers make a good choice for attractive pool surroundings and can be both attractive and functional along with enhancing the value of property [2] (Figure 4).

Figure 4: Hardscape project (from [31] in public domain)

1.4 Standards and Specifications

Fixed Designation C936 provides physical requirements that should be achieved during manufacturing of concrete paving units. The unit should have an exposed face area ≤ 0.065 m^2 (101 in^2), and the overall length divided by thickness shall be ≤ 4. Minimum thickness of pavers shall be

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60 mm (2.36 in) [15]. The color of block pavers is achieved by using concrete dyes, which are commonly metallic oxides, and the quality of the dye has a huge effect on block pricing.

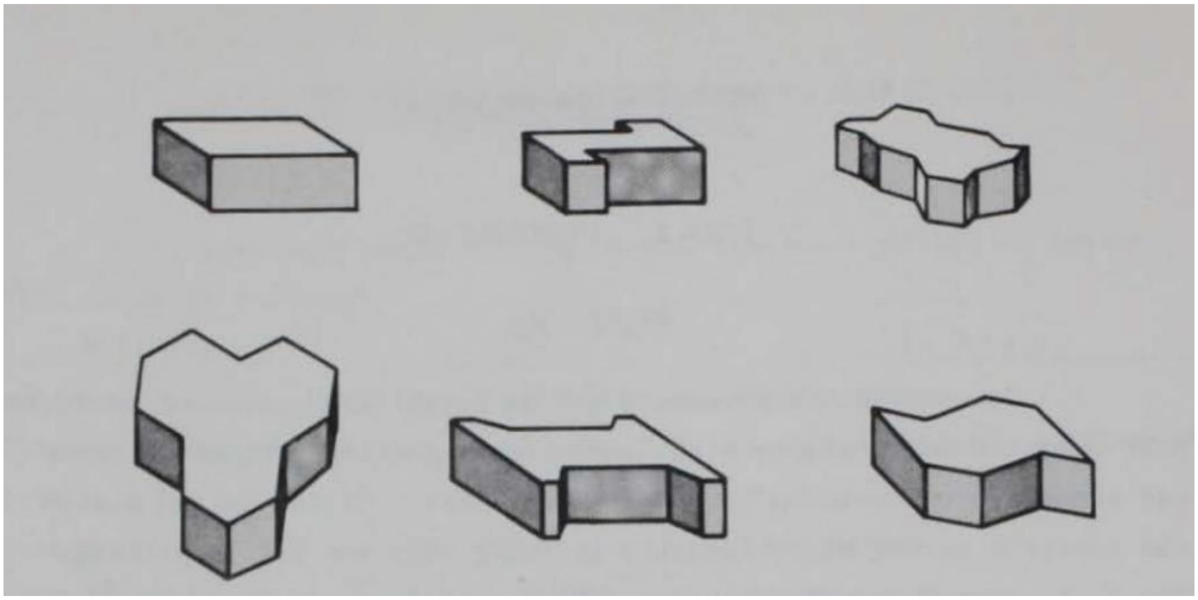

Figure 5: Example of paving block shapes (from [1] in public domain)

1.5 Paver Plant Layout

Plant layout may vary depending on the manufacturer. Paver plant generally has six phases of production. (Figure 6)

- Receiving and storing raw materials
- Batching and mixing
- Molding unit
- Curing
- Cubing and storage
- Delivery

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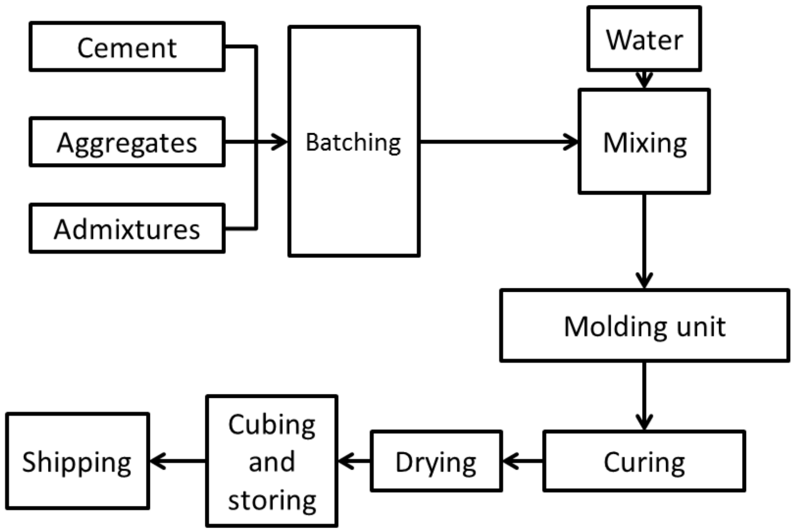

Figure 6: The paver production process flow chart

1.5.1 Receiving and Storing Raw Materials

Different required materials like aggregate and concrete used in block production are delivered in bulk by trucks or rails and stored separately in silos [3]. Loading is controlled manually to make sure that hoppers hold the required quantity to finish the batch. Conveyor belt delivers concrete sand into a weigh belt that weighs the coarse sand as it falls onto it and the weigh belt carrying this sand forward, while another conveyor belt unloads stone chips (aggregates) to be weighed. These chips are no larger than an eighth of an inch in size. The ratio of sand and stone chips varies depending on the type of paver being made. The weigh belt transports the stone chips forward along with the coarse sand both are in route to the dosing and mixing plant [6]. High quality concrete is produced by carefully regulating the supply of ingredients to maintain consistency in texture, color, strength and physical properties.

1.5.2 Batching and Mixing

The batching process is more commonly measured in weight rather than in volume. Batching is done prior to production, and is based on properties of final product. It is a process of measuring and

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mixing ingredients like sand, screening, cement, admix, color and water according to the recipe [3]. This is done in a large concrete mixer, where the sand and stone chips are dumped. Six large steel paddles mix and rotate while cement is added automatically through several nozzles on the side of this enormous mixing bowl. Water is added until the consistency is just right. Nozzles also shoot a pigment into the mix to achieve required color. The mixture comes out dry and crumbly, but the recipe has just enough moisture to make quality pavers [6].

1.5.3 Molding Unit

Early block production involves hand tamping concrete mixture into wooden molds. A team of two people would turn out about 80 blocks per day. By the mid 1920's, automatic machines could produce around 3,000 blocks per day. Today, in a modern paver plant molding is done by a combination of hydraulic pressure and mechanical vibrations, with production of around 1,000 blocks per hour [3]. Concrete in this process is conveyed to the hydraulic press machine (Figure 8), where a filling wagon (feed box) spreads the mix over a steel mold containing up to 50 paver shaped cavities (Figure 9). The mold press then applies the required vibrating pressure. This pulsating force compact the mixture in the mold and removes any air pockets which could weaken the pavers. Hydraulic cylinders lift the mold and the press board (pallet) slides out. The mold once again gets filled in and makes another 50 pavers. It only takes about 20 seconds to mold, compact and release a batch of pavers [6].

1.5.4 Curing

The press board filled with pavers slide onto a rack and a hydraulic chain hoist lifts each board into a large holding rack where a special moving wagon called a Finger Wagon (Figure 7) picks up all the boards from the rack in just one move. The electrical wagon moves along the rail to a curing room where temperatures reach almost 100 °F. The pavers actually generate the heat due to a chemical reaction from the combination of cement and water. 12 hours later the Finger Wagon carts the pavers from the kiln, which are now 70% cured as a result of the chemical process [6]. The process binds the

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cement, sand and gravel, causing the pavers to harden. The rest of the curing will happen over the next 28 days. The pavers are now sturdy enough to handle, as they pass through a quality assurance system to check for any damages.

1.5.5 Cubing and Storing

A hydraulic clamp lifts the pavers off the board and begins to stack them, making a cube. This machine is called a cuber (Figure 7). The cuber packs nine to ten layers on top of one another to make a cube, and further packaging is done by wrapping and strapping the cubes. Wrapping and strapping provide safer handling wile transporting to the job site.

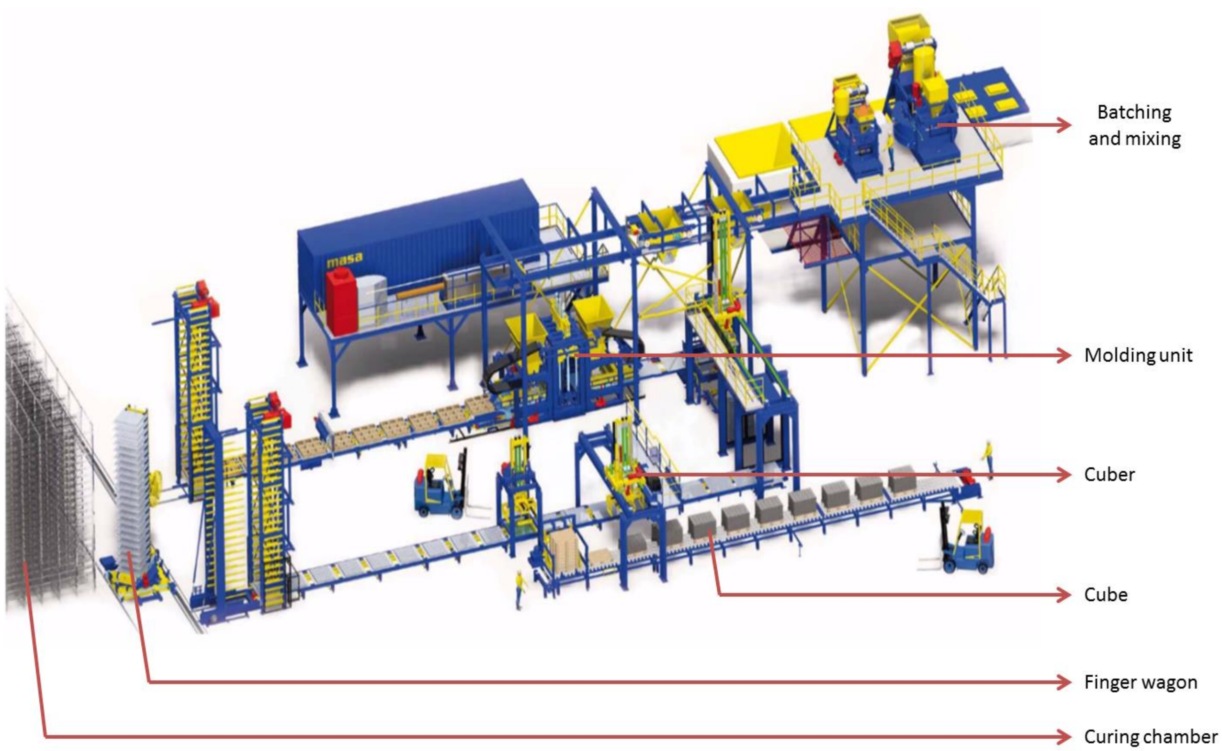

Figure 7: Concrete block pavers plant layout [7] (Reprinted from "Concrete Block Production Reliable, First Class and Solid" by MASA)

1.6 Manufacturing

Paver manufacturing is mainly done by the two processes:

- Wet casting
- Hydraulic press production

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Large scale production of pavers is generally done using a hydraulic press paver machine. Working of a hydraulic press paver machine is explained in detail below:

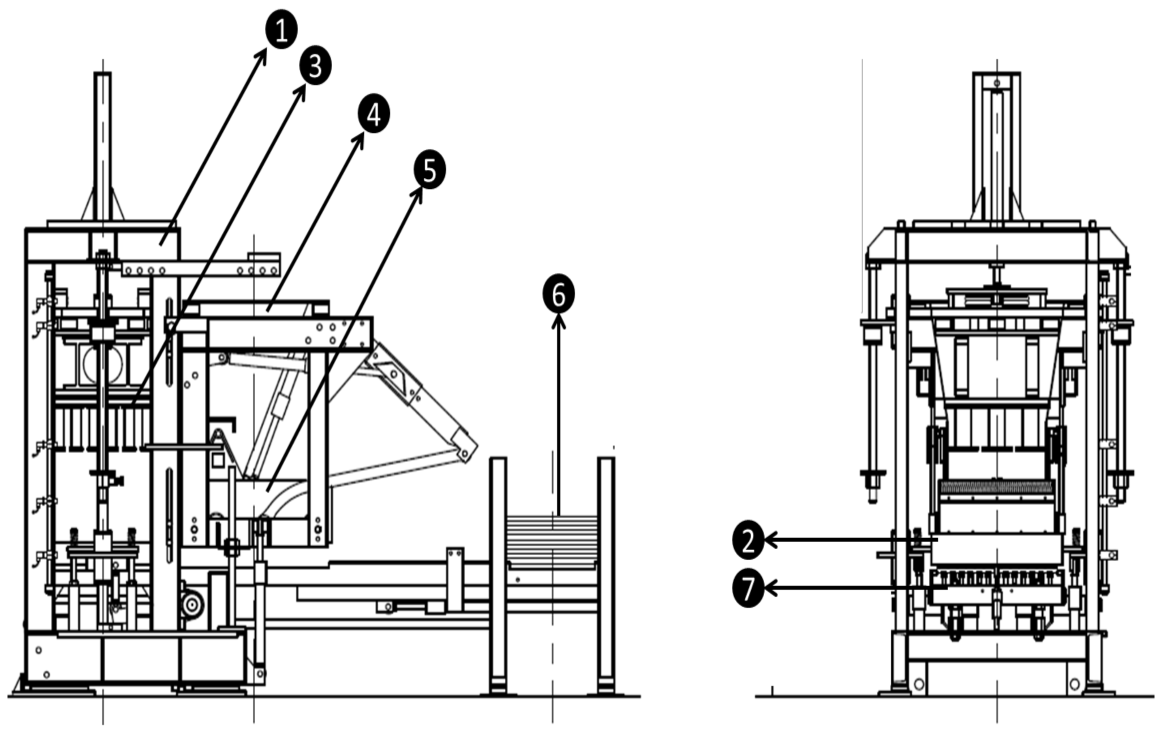

Figure 8: Hydraulic press paver machine [24]. (List of parts in a paver machine: (1) Machine frame, (2) Mold, (3) Compacting head, (4) Concrete hopper, (5) Feed box, (6) Pallet feeder, (7) Vibrating table) (Reprinted from “Block machine series 750 Type 62/62” by KVM INTERNATIONAL A/S)

1.6.1 Machine Frame

The machine frame has a very strong base plate holding four hard chrome plated ground columns (Figure 8) to withstand the vibrations that occur during the process of paver’s production [8]. The frame also provides support to all components of a paver machine.

1.6.2 Mold

Pavers get their shape depending on the mold fitted, which is generally made of iron. Other metals are also used occasionally. Mold brackets and airbag arms hold the mold in its designated position and hydraulic cylinders located on either sides of the mold lift the mold before the press board with paver’s slides out [8].

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1.6.3 Compacting Head

Compacting head helps in holding the top part of a mold (Mold head) secured in place, such that it is centered and is exactly aligned with the mold. This arrangement can be seem in Figurer 11. It also provides enough compressing force when forming pavers.

1.6.4 Concrete Hopper

The mixture is stored in a hopper and the hopper gate discharges the required amount of material for one pressing cycle (Figure 9) into the feed box.

1.6.5 Feed Box

The feed box is filled with concrete mixture moves forward into the mold, filling all the cavities evenly, as shown in Figure 9. To ensure proper distribution of mixture without any air gaps mold is vibrated by the vibrating table that is located below. The feed box is also fitted with an adjustable scraper and a rotating brush on its front. The scraper helps in leveling the mold surface and the rotating brush helps in maintaining a clean mold head.

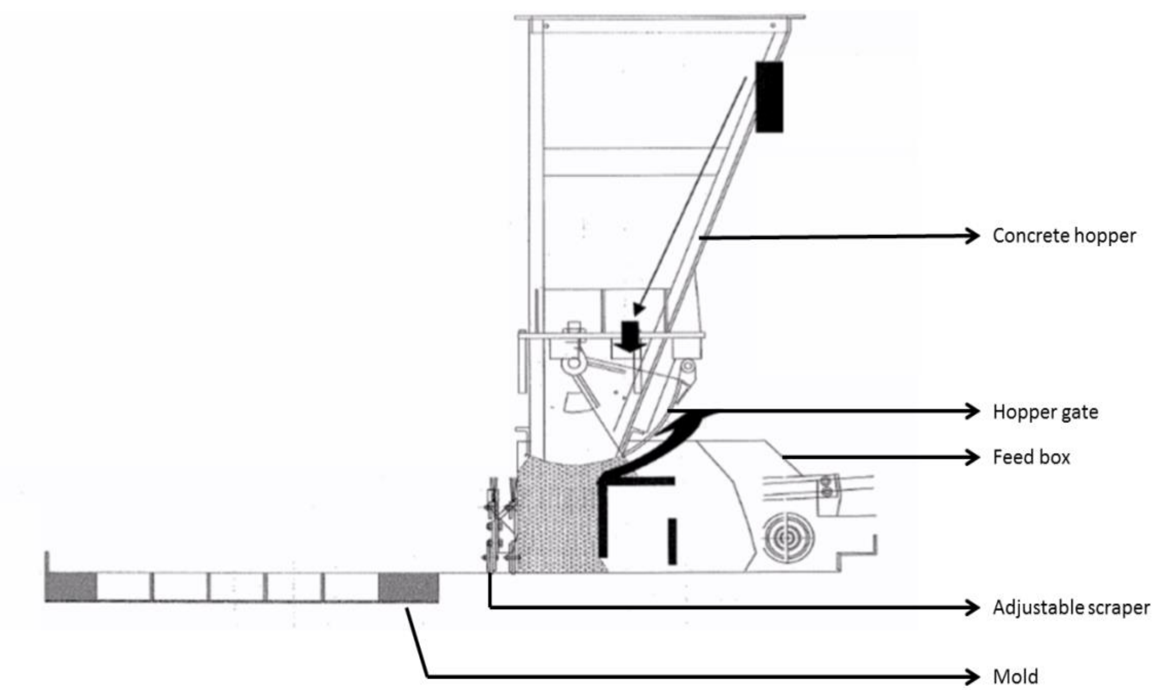

Figure 9: Feed box filling sequence 1 [8] (Reprinted from “Block machine operation manual” by KVM Industrimaskiner)

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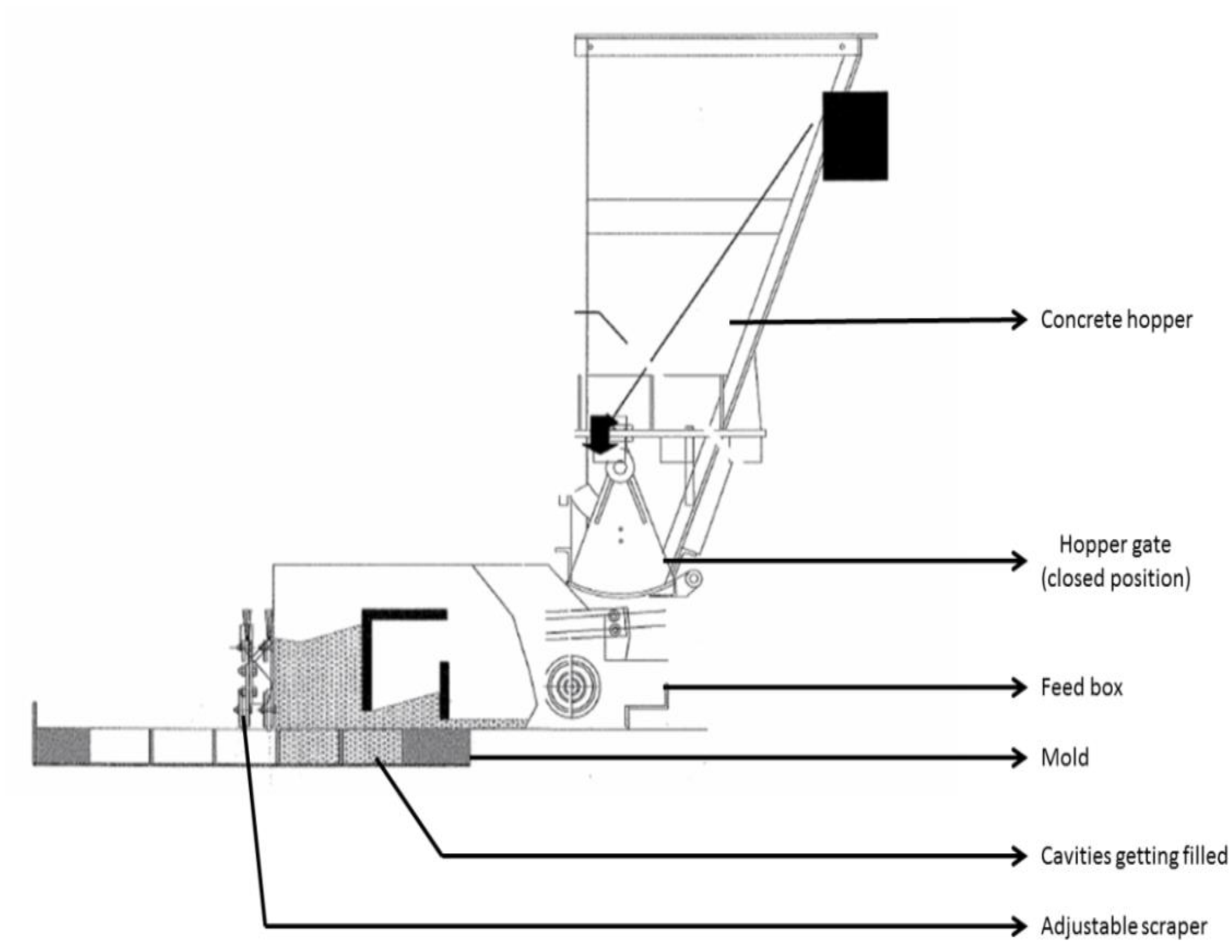

Figure 10: Feed box filling sequence 2 [8] (Reprinted from “Block machine operation manual” by KVM Industrimaskiner)

1.6.6 Pallet Feeder

Pallet feeder provides continued supply of press boards to the paver machine.

1.6.7 Vibration Table

Once the feed box moves back to its home position, the compacting head presses down on the mold and high frequency vibrations are induced by the vibrating table (Figure 11), providing required pressure to compress the concrete mixture to achieve quality shape and strength in the blocks.

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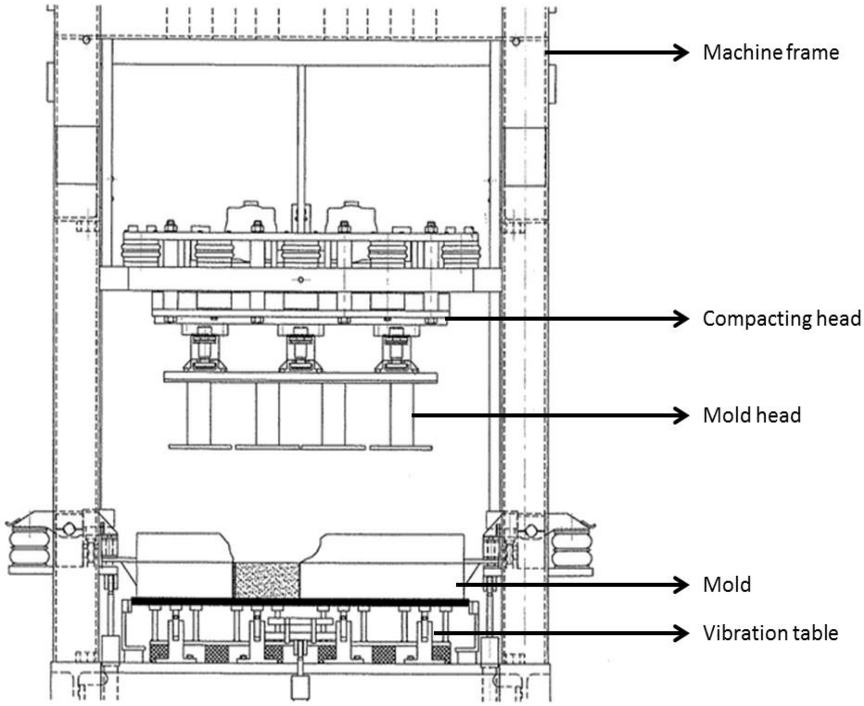

Figure 11: Vibration table [8] (Reprinted from “Block machine operation manual” by KVM Industrimaskiner)

1.7 Manufacturing Cycle

A manufacturing cycle includes:

- Feed box carrying concrete mixture moves forward filling the mold cavities shown in Figure 12.

Figure 12: First step of paver manufacturing cycle

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- Feed box moves back to its home position providing clearance for the compacting head to move down (Figure 13).

Figure 13: Second step of paver manufacturing cycle

- Compacting head moves down compressing the mixture in to the mold cavities providing enough force to shape the pavers (Figure 14).

Figure 14: Third step of paver manufacturing cycle

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- Mold head lifts up along with the compacting head providing enough clearance for the press board to leave the paver machine with shaped pavers (Figure 15).

Figure 15: Fourth step of paver manufacturing cycle

- Both the mold and the compacting head moves back to their home position and the above steps are repeated.

Figure 16: Fifth step of paver manufacturing cycle

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1.8 Material Waste and Its Effects

Material loss can occur at any stage in a production process. Efficiently transporting raw is a major problem in the concrete industry. Managing waste is necessary to achieve a clean work environment and also, improve the efficiency of production, which can be done using simple adaptive cleaning mechanisms.

The concrete industry consumes around 1.5 billion tons of cement, 9 billion tons of aggregate (sand & rock) and one billion tons of mixing water every year. This makes the concrete industry the largest consumer of natural resources [10]. Preventing waste of these natural resources must be given the top priority in a viable concrete industry.

Table 1: Typical concrete mix (values taken from [])

Component	Percent by weight
Portland Cement	12%
Sand	34%
Crushed stone	48%
Water	6%

1.9 Health Concerns

A number of chemicals are commonly added to concrete to control strength, color, freeze-thaw resistance, control setting time, pumpability and water content. Admixtures added to the mixture contain various types of inorganic salts along with more chemicals such as alkyl benzene sulphonates and methyl-ester-derived cocamide diethanolamine. These chemicals could sometimes release small quantities of formaldehydes and other chemicals into the air. Rubber gloves and boots are required when dealing with wet concrete to protect the skin from its high alkalinity. Also improper protective clothing occasionally leads to cement dermatitis [12].

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CHAPTER 2

PAVER MACHINE PUSH BAR MECHANISM

2.1 Problem Statement

After the feed box moves forward and fills the mold cavities, an adjustable scraper attached on its front end helps in achieving a level surface by scraping off the excess material during the backward motion of feed box. The level surface of the mold, after the filling sequence, can be seen in Figure 13. The mixture has highly abrasive materials, so obtaining efficient cleaning is an issue. Because of heavy vibrations induced on the mold during compression, the mixture from the cavities gets spilled out. Figure 15 shows the excess mixture that's left on the mold after a cycle is completed. During the next cycle, the excess gets pushed to the front end of the mold which starts accumulating. The amount of excess mixture increases with every cycle, and after few cycles, the forward motion of the feed box starts pushing the excess material onto the floor, which repeats every cycle, shown in Figure 17. It generally takes 30-40 minutes for waste material to harden. However stopping the production once every 30 minutes just for the purpose of cleaning results in great loss for the manufacturer. Once the material hardens, cleaning it is difficult and time consuming. Extra man power is needed to break the hardened concrete and shovel it in to a container. The excess material also creates debris on the mold surface, which needs to be cleaned before reusing it (Figure 19). The aim of this study is to eliminate, if not reduce spillage, at the paver machine. A push bar mechanism has been designed using SolidWorks software, and the design specifications and working of this mechanism are explained in detail below.

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Figure 17: Material spilling out

Figure 18: A cleaned mold surface

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Figure 19: Debris formed on mold surface due to material accumulation

The material spilling in the front has been collected and weighed and represented graphically in Figure 20 taking X axis as number of cycles and Y axis as weight of material wastage in pounds. A mean material loss of 8 pounds has been noticed for every 50 cycles.

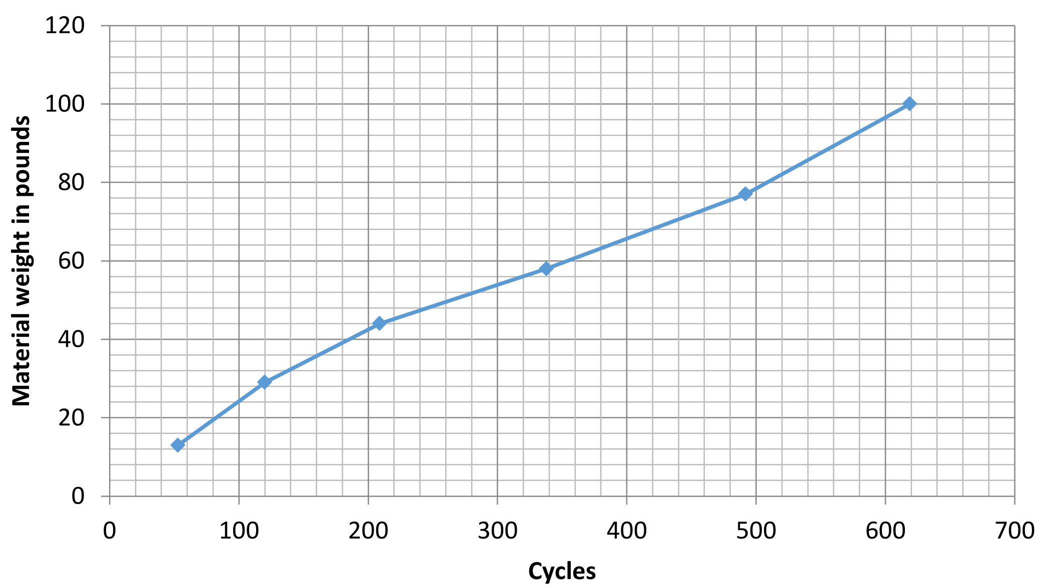

Figure 20: Material waste

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2.2 Design Methodology

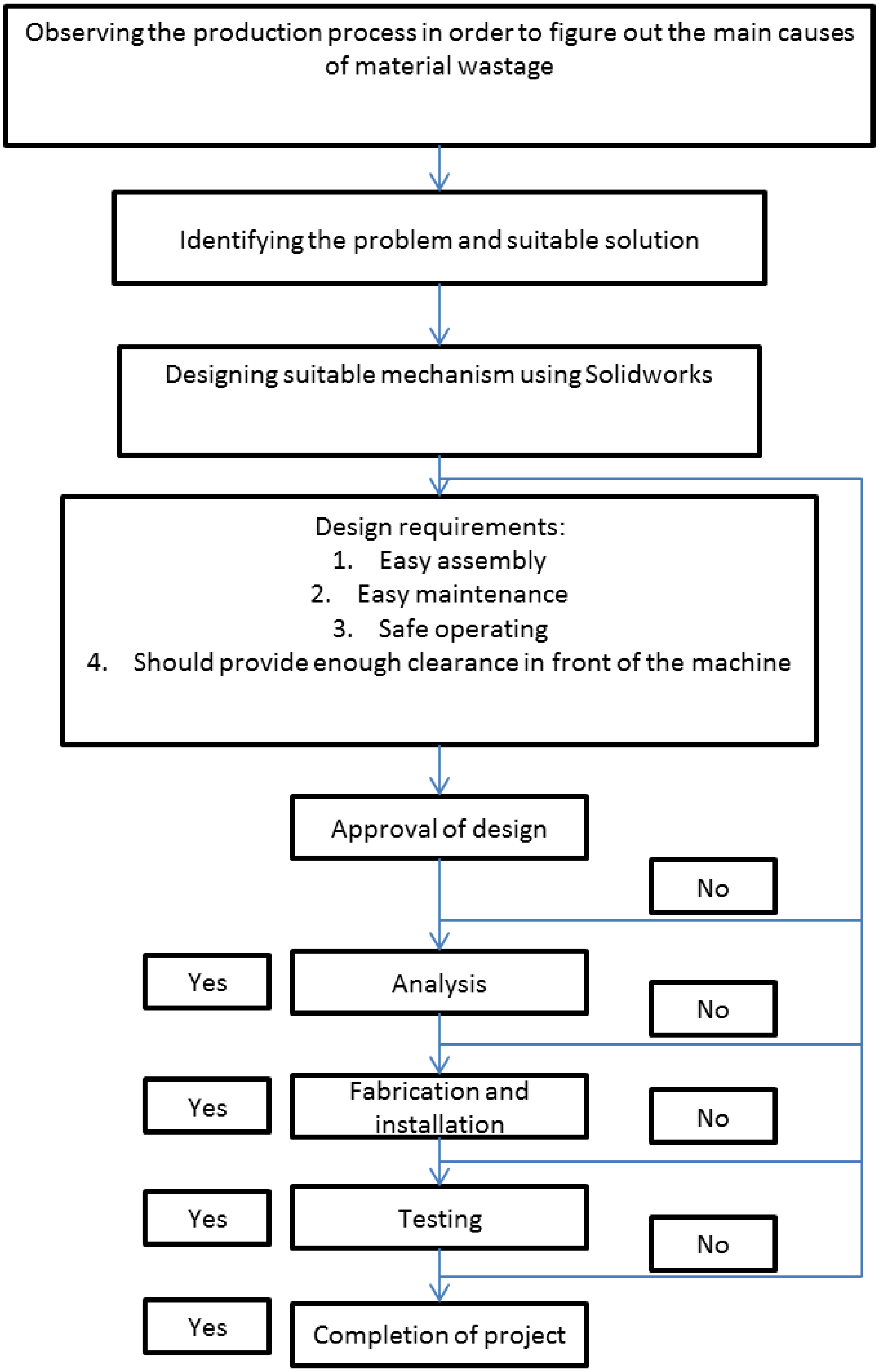

Figure 21: Flowchart of design methodology

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2.3 Design and Fabrication

The push bar mechanism is explained in detail below:

- Support beam
- Guide tubes
- Brass bushings
- Guide rods and Scraper support bar
- Pneumatic cylinder
- Scraper
- Linear Guide rails and Roller carriages

2.3.1 Support Beam (Material – ASTM A36 Steel)

The support beam bears the total loading caused by different parts of this mechanism as they are either anchored or supported on this structure. One inch thick ASTM A36 steel is used for fabrication to provide sufficient strength. A detailed geometry can be seen in Figure 22. This unique design reduces the distance between the mold and the cleaning mechanism. The flat surface seen on both ends on the beam gets attached to the pillars while the shaped part moves into the frame close to the mold. Two 3 inch diameter holes are machined into the structure to hold the guide tubes in place. Two extensions are located on the front side (Figure 22), whose task is to establish contact between the support beam and the mold. It is essential to achieve proper contact so that the up and down motion of the mold can be transferred to the whole cleaning mechanism through the support beam.

During the mold change process the front of the paver machine needs to be clear of the whole cleaning mechanism. Dismantling and reassembling components for a mold change is a time consuming process. This extra work can be eliminated by providing hinges (Figure 22), which can be hooked with ropes. To be lifted up along the machine pillars, providing enough clearance for the mold change.

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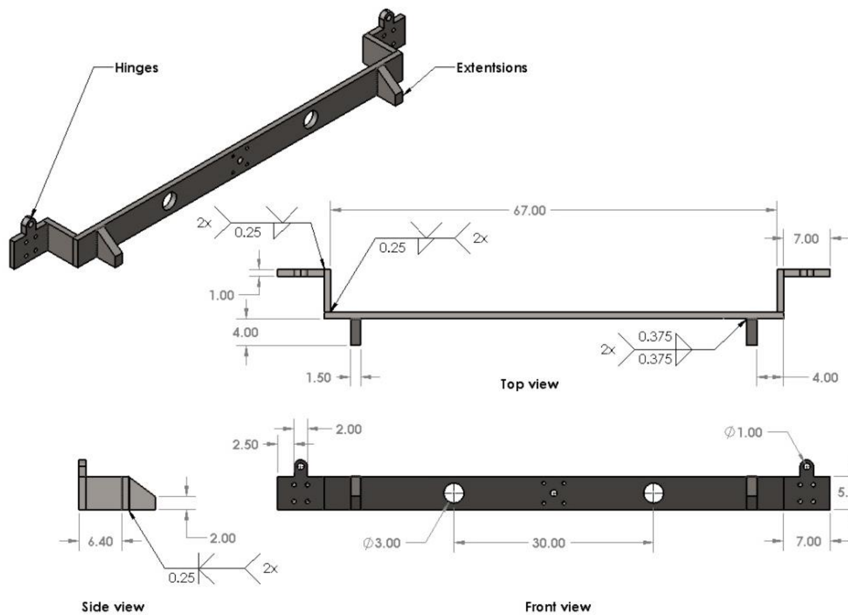

Figure 22: Support beam (Weld symbols represented in AWS format)

2.3.2 Guide Tubes (Material – ASTM A36 Steel)

Two guide tubes with inner and outer diameters 2 inches and 3 inches respectively, and 12 ½ inches long are welded in position on the support beam. The function of the guide tubes are to support and guide scraper support bar over the mold surface.

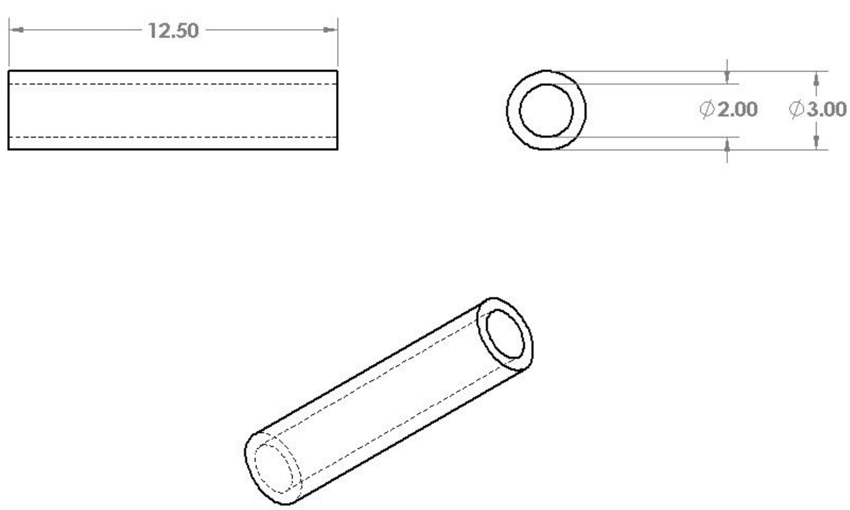

Figure 23: Guide tubes

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2.3.3 Brass Bushings (Material – Brass)

Bushings are installed into the guide tubes, one at each end. They are shrink fitted to hold them tightly in place, and provide smooth movement between the guide tubes and guide rods and help prevent any wear caused by friction, which reduces the service life of parts.

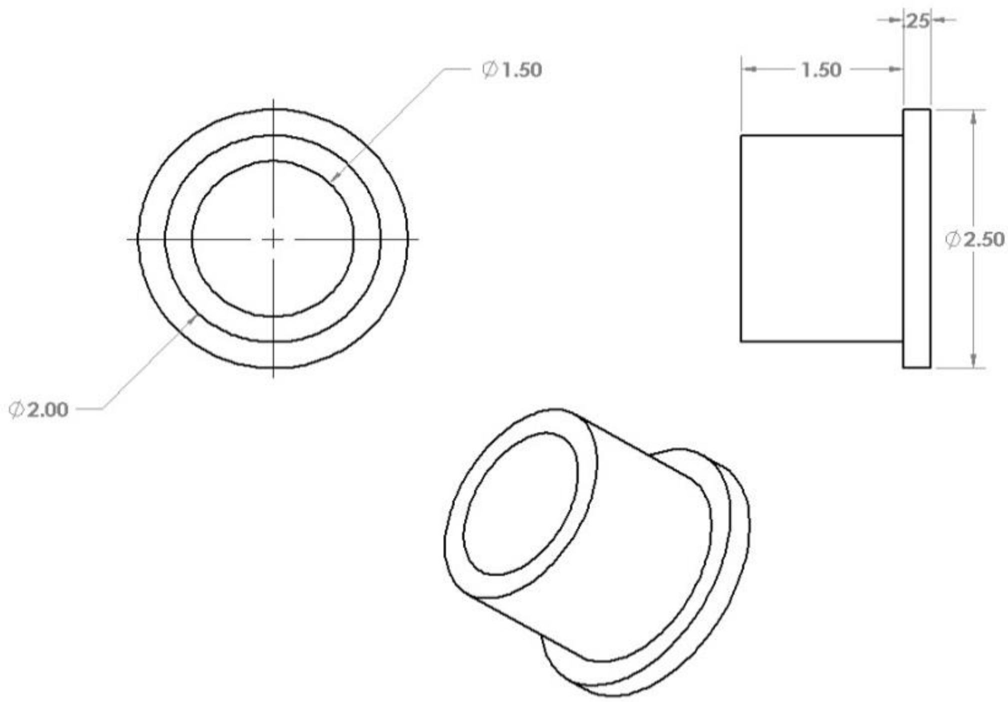

Figure 24: Brass bushings

2.3.4 Guide Rods and Scraper Support Bar (Material – ASTM A36 Steel)

Two guide rods are welded to the scraper support bar, which is made from ½ inch thick ASTM A36 steel (Figure 25), which provides enough support to the rubber scraper while pushing the excess material into the mold cavities. It also helps to prevent any deformities in the rubber scraper due to contact. The guide rods are made of cold, rolled steel. Which increases there yield strength and tensile strength and helps prevent any surface imperfections. All these properties help achieve smooth, aligned movement of components and improve service life.

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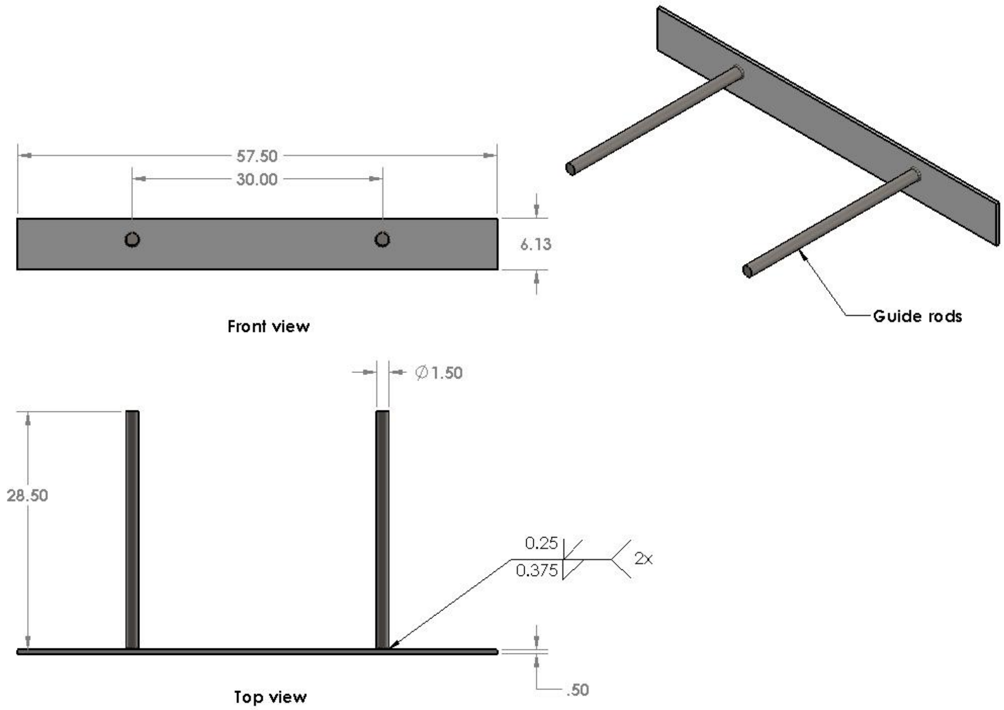

Figure 25: Guide rods and scraper support bar (Weld symbols represented in AWS format)

2.3.5 Adjustable Scraper (Material - Rubber)

The scraper is attached on the front surface of the support bar using three bolts, and the height can be adjusted to maintain perfect contact with various mold surfaces.

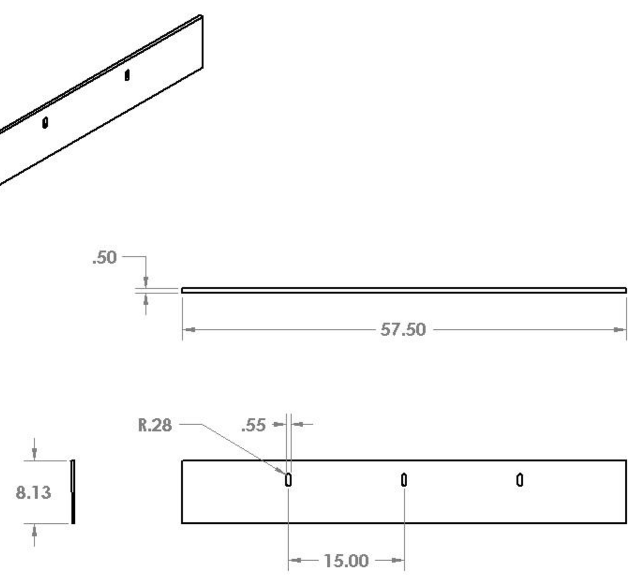

Figure 26: Adjustable scraper

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2.3.6 Pneumatic Cylinder

A 14 inch pneumatic cylinder is anchored on the support beam and is connected to the scraper support bar with a horse shoe clamp. This setup prevents the occurrence of any tilts in the support bar while returning, which may damage the cylinder. This setup can be seen in Figure 27.

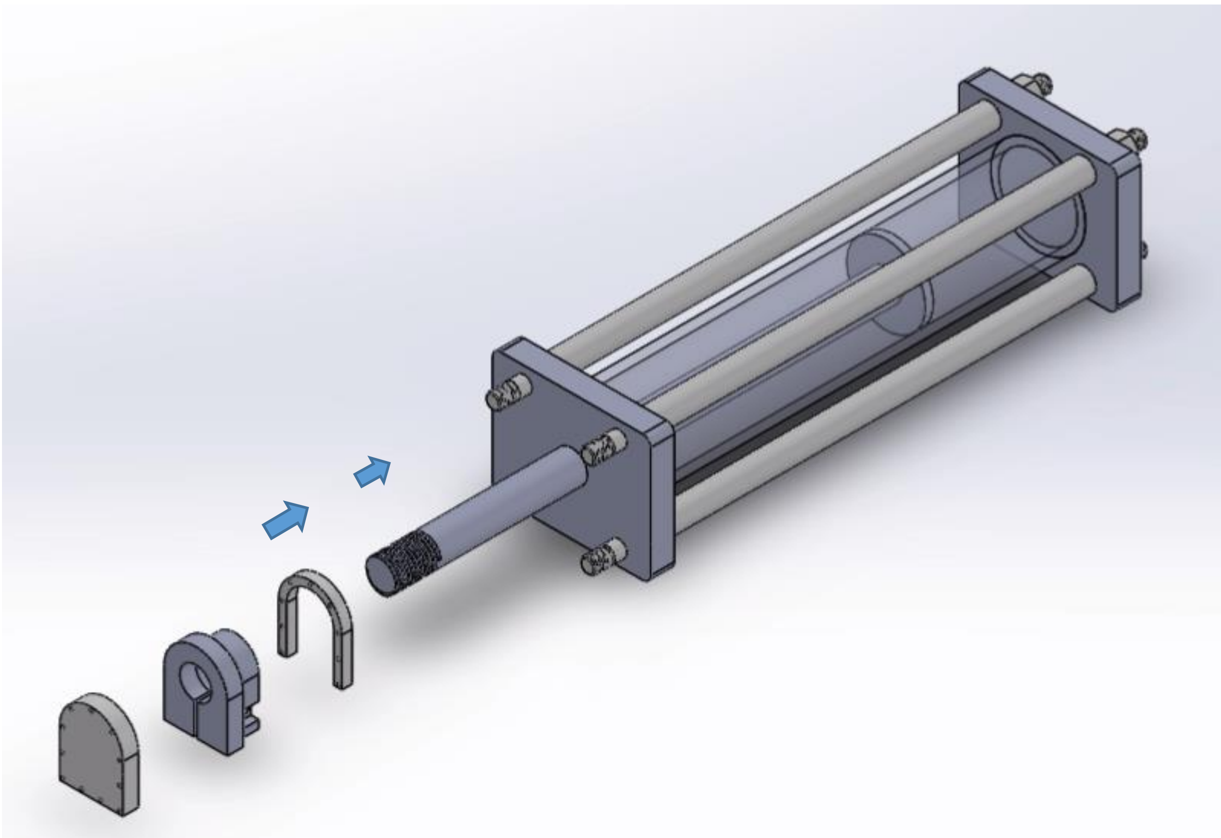

Figure 27: Pneumatic cylinder

2.3.7 Linear Guide Rails and Roller Carriages

Rails of required length are welded on both the machine pillars at specified position, and provide a straight path for roller carriages, which are attached on both ends of support beam shown in Figure 30. Guide rails are made of hardened steel (Figure 28) and carriages are made of aluminum with steel rollers (Figure 28) [27].

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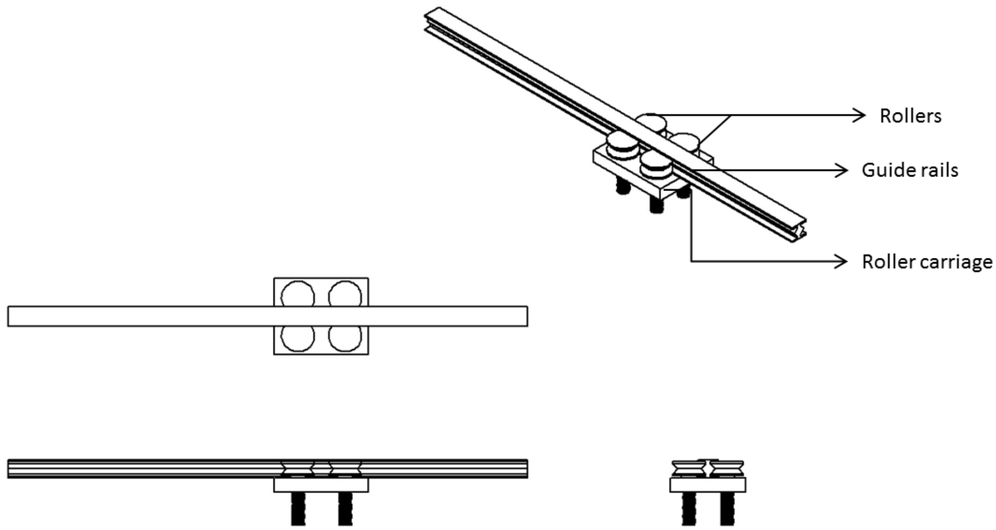

Figure 28: Linear guide rail and roller carriage assembly

2.4 Working

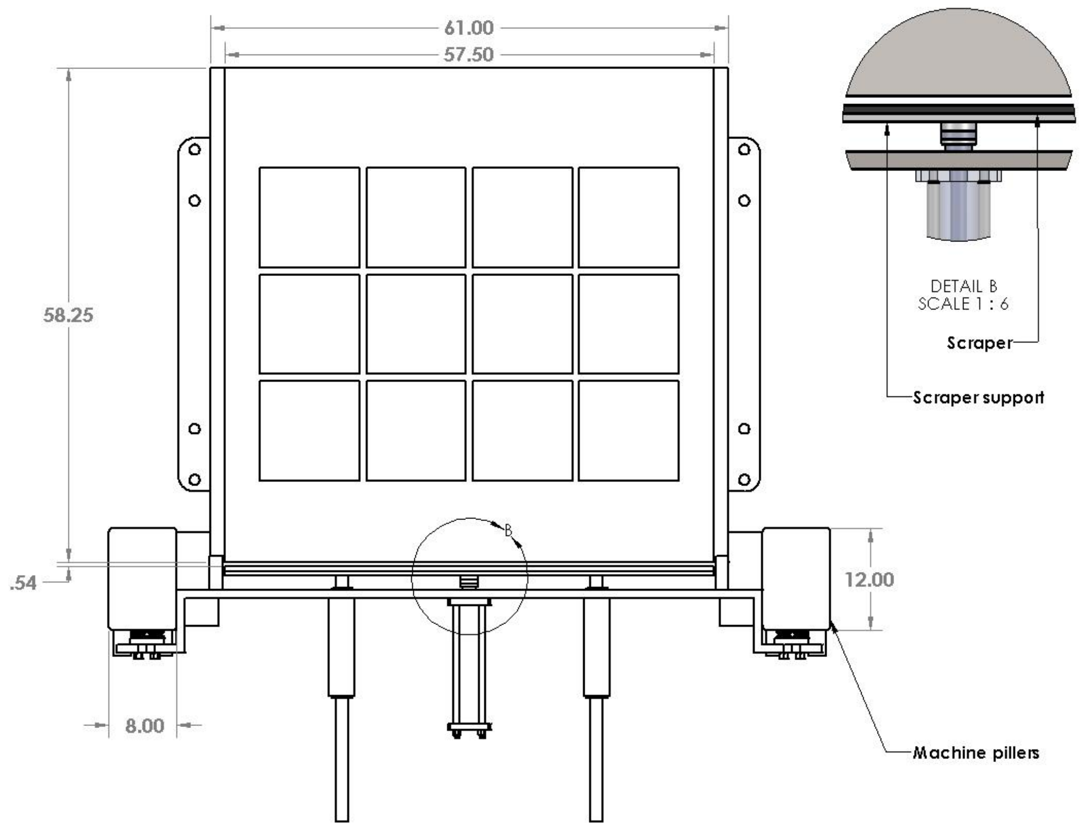

Figure 29: Push bar setup top view

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The simplest way of reducing the material waste is to prevent it from accumulating at the front end of the mold. The mechanism setup is shown in the above Figure 29. The pneumatic cylinder with a stroke length of 14” is anchored to the support beam, which controls the movement of the scraper over the mold surface.

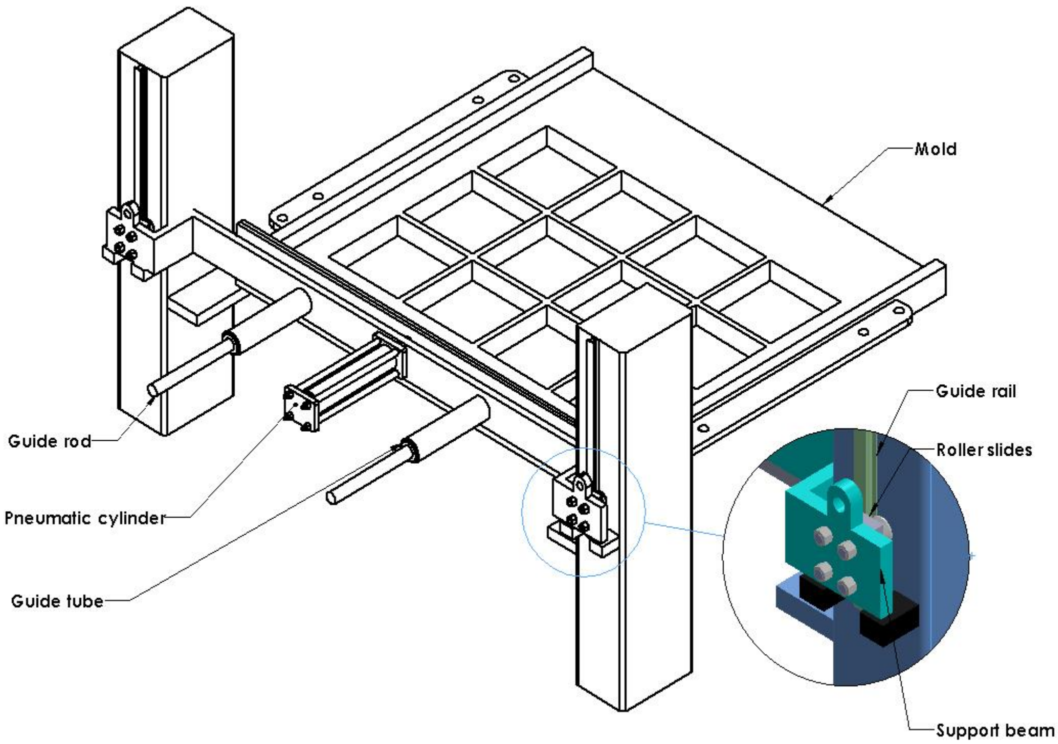

Figure 30: Push bar setup isometric view

When the compacting head comes down and the product is made, the mold lifts up to provide enough clearance to let the product move out in the front. When the mold lifts, it makes contact with the extensions on support bar and lifts the whole mechanism along with it, which prevents contact between the scraper on the push bar with the pavers. The upward motion of the push bar mechanism is supported by the linear guide rails. An empty press board is moved into position by the pallet feeder and the mold moves back to its initial position. During the downward movement of the mold, the support beam gets in contact with stoppers on the machine pillars and comes to rest. The pneumatic cylinder is

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activated and pushes the scraper over the mold surface, cleaning off excess material and pushing it back into the empty mold cavities. Next the feed box moves forward, filling the rest of the mold cavities. Once the feed box is back to its initial position, the compacting head moves down pressing the mixture and forms the pavers. This process keeps repeating every cycle.

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CHAPTER 3

ANALYSIS AND RESULTS

3.1 Motion Analysis

Design software's helps in reducing the required design time, design cost and provides with functions such as three dimensions virtual modeling design of components, three dimensions virtual assembly (Figure 31), motion simulation and etc. [14]

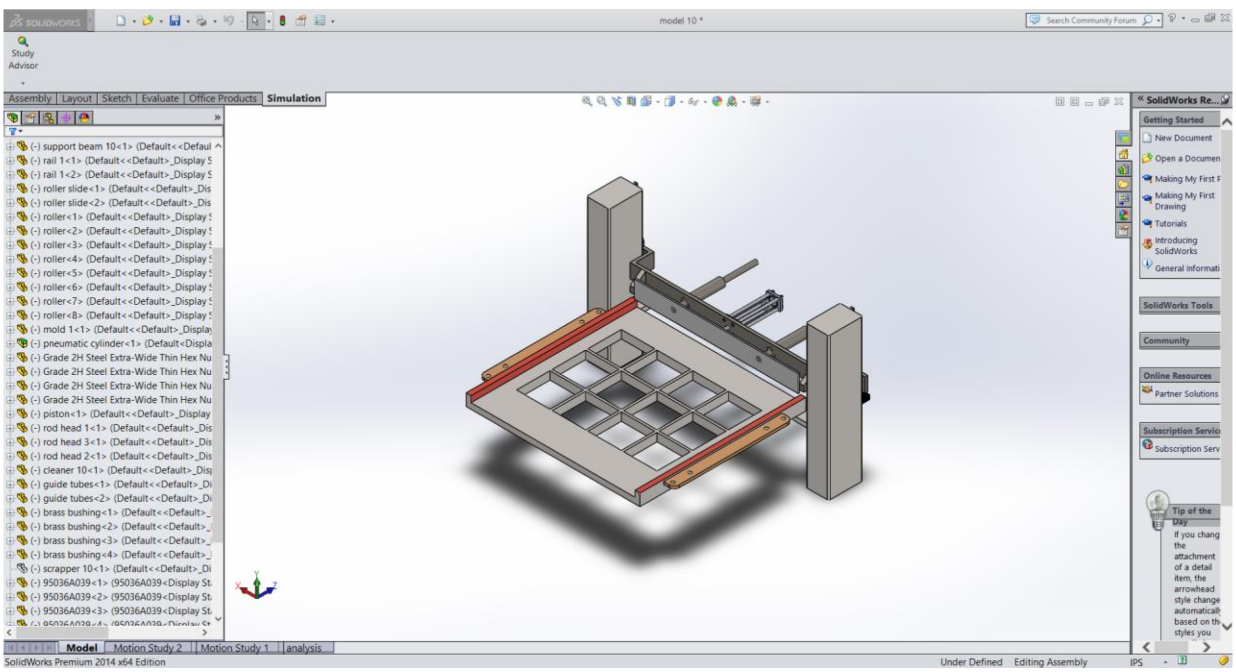

Figure 31: Three dimensional virtual assembly in Solidworks

Mechanical performance of the design can be evaluated using motion analysis in Solidworks. Solidworks motion analysis uses the assembly mates along with part contacts and a robust physics-based solver to accurately determine the physical movements of an assembly under load. With the assembly motion and forces calculated, a structural analysis of the components can be performed to ensure product performance [14]. Support beam (Figure 22) of the push bar mechanism is the critical

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part that experiences huge loads, the reaction forces between the mold and support beam during their motion is calculated using motion analysis. Figure 32 shows graphical representation of reaction force (lbf) along Y axis and Time along X axis. The maximum value 563 lbf was noted during the first contact between the mold and support beam.

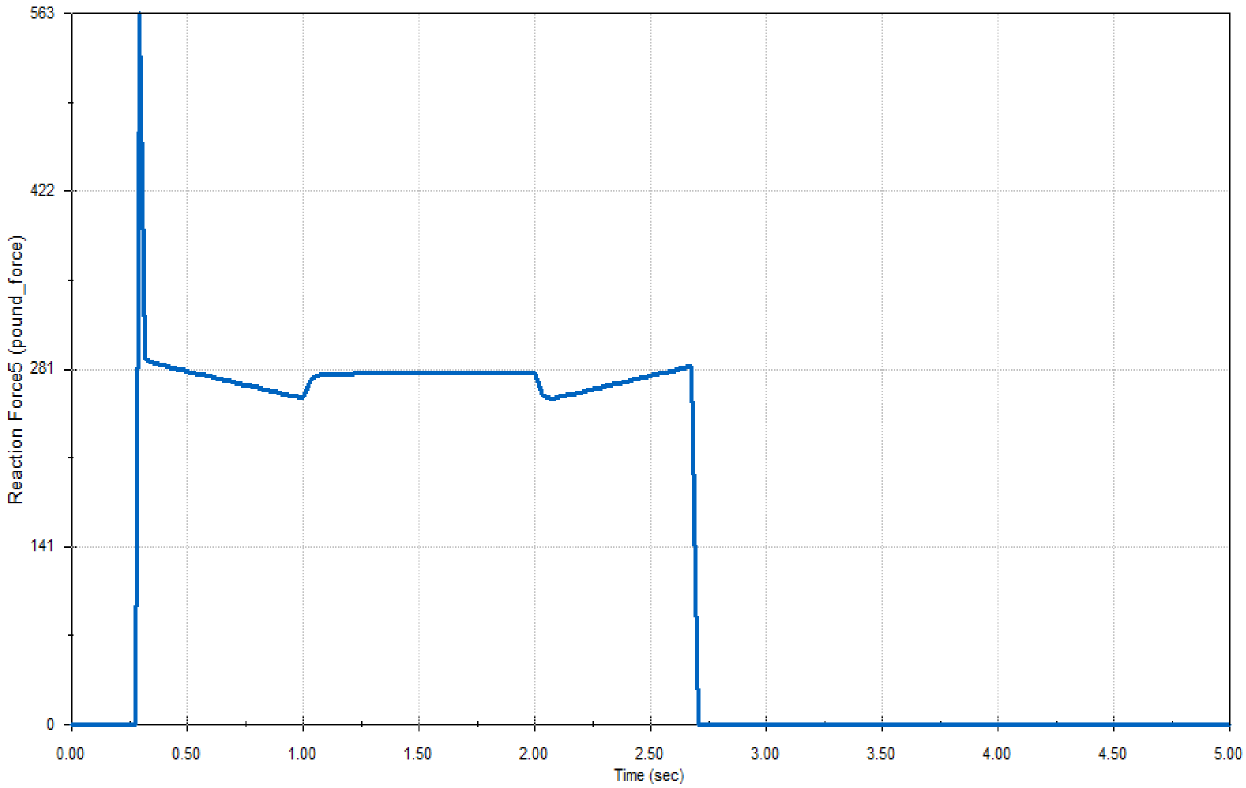

Figure 32: Reaction forces

3.2 Stress Analysis

In this process, one should define the material, the boundary conditions such as loads and constraints, and specify contact conditions. Once these criteria are entered, you can run the simulation and view the behavior relative to the conditions you defined [28]. Autodesk Inventor was used to preform stress analysis.

3.2.1 Physical Properties

Physical properties of the whole mechanism obtained in stress analysis can be seen in Table 2.

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Table 2: Physical properties

Mass	288.6 lbmass
Area	4182.79 in^2
Volume	1033.98 in^3
Center of gravity	X=-57.1 in Y=34.3 in Z=90.5 in

3.2.2 Mesh Settings

Mesh settings used during stress analysis is Autodesk Inventor can be seen in below Table 3. Average element size between mesh element nodes, minimum distance between two nodes and max turn angle can be applied to get finer mesh over a curved area [28]

Table 3: Mesh Settings

Avg. Element Size (fraction of model diameter)	0.06
Min. Element Size (fraction of avg. size)	0.2
Grading Factor	1.5
Max. Turn Angle	60 deg

3.2.3 Material Properties

Name of the material used for each part of the mechanism and their properties like yield strength, ultimate tensile strength, young's modules, poisons ratio and shear modules are listed in detail below (Table 4).

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Table 4: Material properties

Name	Steel ASTM A36	
General	Mass Density	0.283 lbmass/in^3
	Yield Strength	36001.9 psi
	Ultimate Tensile Strength	58000.6 psi
Stress	Young's Modulus	29001.6 ksi
	Poisson's Ratio	0.3 ul
	Shear Modulus	11154.5 ksi
Part Name(s)	Guide tube Guide tube Support beam Scraper support bar Guide rod Guide rod	
Name	Brass, Soft Yellow	
General	Mass Density	0.305 lbmass/in^3
	Yield Strength	14996.9 psi
	Ultimate Tensile Strength	39885.4 psi
Stress	Young's Modulus	15896.1 ksi
	Poisson's Ratio	0.331 ul
	Shear Modulus	5971.5 ksi
Part Name(s)	Brass bushings	
Name	Steel, Carbon	

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Table 4 (continuation)

General	Mass Density	0.28 lbmass/in^3
	Yield Strength	50763.2 psi
	Ultimate Tensile Strength	60915.8 psi
Stress	Young's Modulus	29007.5 ksi
	Poisson's Ratio	0.29 ul
	Shear Modulus	11243.2 ksi
Part Name(s)	Rails	
Name	Aluminum 6061	
General	Mass Density	0.097lbmass/in^3
	Yield Strength	39885.4 psi
	Ultimate Tensile Strength	44961.7 psi
Stress	Young's Modulus	9993.1 ksi
	Poisson's Ratio	0.33 ul
	Shear Modulus	3756.8 ksi
Part Name(s)	Roller Carriages	
Name	Stainless Steel	
General	Mass Density	0.289 lbmass/in^3
	Yield Strength	36259.4 psi
	Ultimate Tensile Strength	78320.4 psi
Stress	Young's Modulus	27992.3 ksi
	Poisson's Ratio	0.3 ul
	Shear Modulus	10766.3 ksi

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Table 4 (continuation)

Part Name(s)	Rollers

3.2.4 Operating Conditions

- Gravity

The direction along which the gravitational field is applied can be seen in Figure 33, and its magnitude is listed in Table 5.

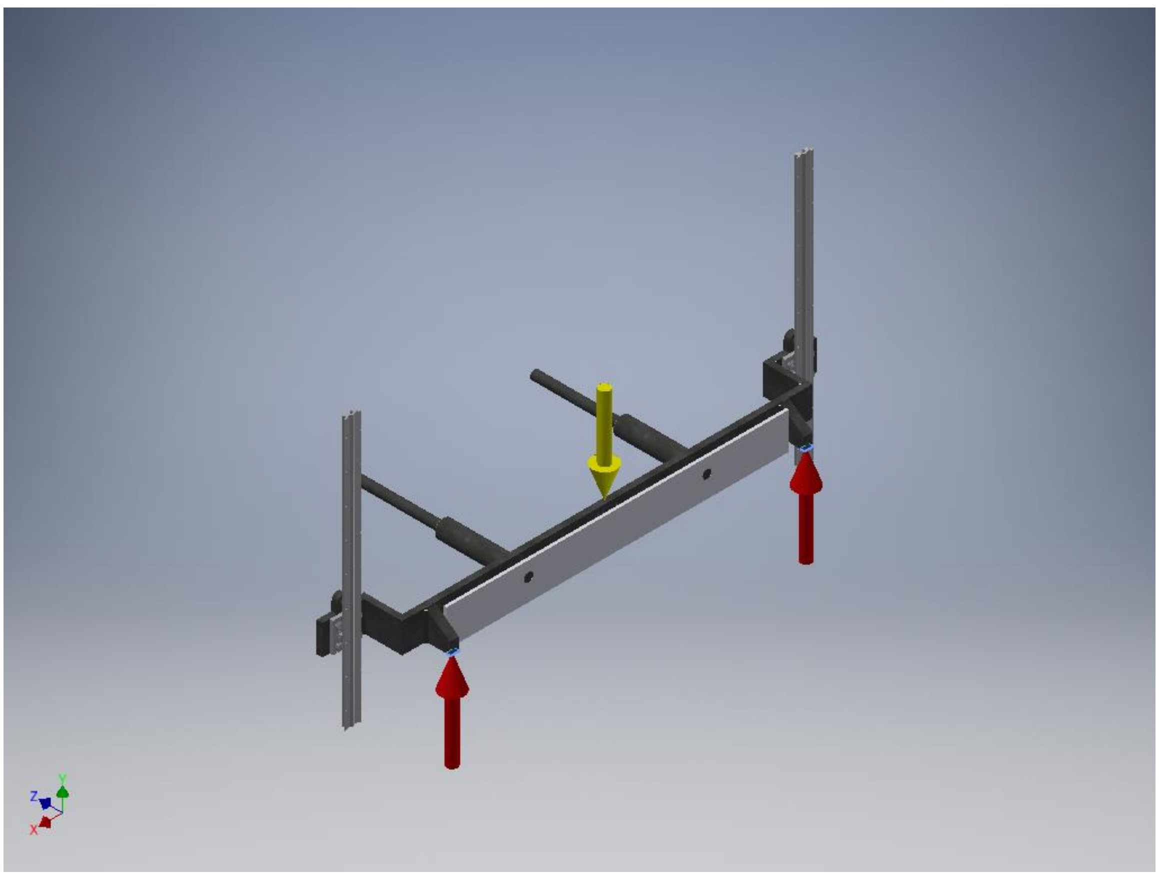

Figure 33: Operating conditions

Table 5: Operating conditions

Load Type	Gravity	Force
Magnitude	386.2 in/s^2	560 lbforce

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- Force applied

Reaction force calculated in motion analysis was applied during stress analysis. Split solid command was used to accurately mark the area on which forces are applied. Direction of applied can be seen in Figure 33 represented by red arrows.

3.2.5 Fixed Constraint

Fixed constraint is used to resemble welded joints between rails and the machine pillars. The area along which these constraints are applied can be seen in Figure 34.

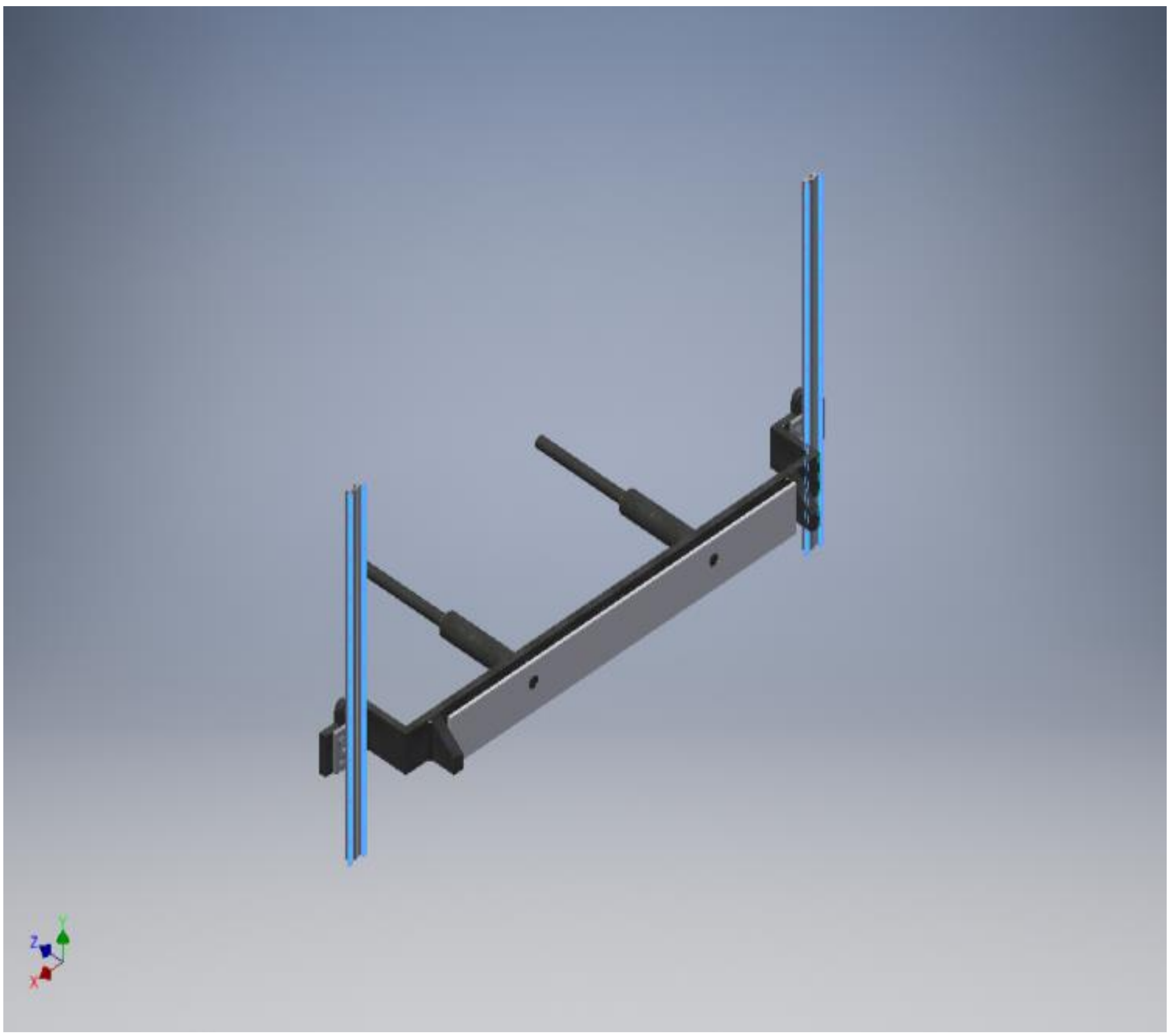

Figure 34: Fixed constraint

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3.3 Results

Resulting reaction force and moment acting on the constraints shown in Figure 34 are listed in the below Table 6.

Table 6: Reaction force and moment on constraints

Constraint Name	Reaction Force		Reaction Moment	
	Magnitude	Component (X,Y,Z)	Magnitude	Component (X,Y,Z)
Fixed Constraint:2	46.94 lbforce	0 lbforce	263.31 lbforce ft	-263 lbforce ft
		31.94 lbforce		0 lbforce ft
		-34.40 lbforce		-11.36 lbforce ft

3.3.1 Results Summary

The maximum and minimum values of all the results obtained in this stress analysis are listed in the below Table 7.

Table 7: Stress analysis results

Name	**Minimum**	**Maximum**
Volume	1033.98 in^3	
Mass	288.67 lbmass	
Von Mises Stress	0.0000036 ksi	1629.75 ksi
1st Principal Stress	-205.05 ksi	971.1 ksi
3rd Principal Stress	-1018.48 ksi	74.17 ksi
Displacement	0 in	9.13 in
Safety Factor	0.022 ul	15 ul
Stress XX	-482.10 ksi	438.30 ksi

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Table 7 (continuation)

Stress XY	-856.03 ksi	882.77 ksi
Stress XZ	-114.39 ksi	139.88 ksi
Stress YY	-276.60 ksi	234.39 ksi
Stress YZ	-529.61 ksi	360.68 ksi
Stress ZZ	-207.81 ksi	145.28 ksi
X Displacement	-0.00073 in	0.00047 in
Y Displacement	-0.000032 in	9.13 in
Z Displacement	-0.0022 in	0.0025 in
Equivalent Strain	0.00000000011 ul	0.0504 ul
1st Principal Strain	-0.000051 ul	0.045 ul
3rd Principal Strain	-0.044 ul	0.000039 ul
Strain XX	-0.012 ul	0.014 ul
Strain XY	-0.0397 ul	0.040 ul
Strain XZ	-0.0053 ul	0.0064 ul
Strain YY	-0.00819 ul	0.0076 ul
Strain YZ	-0.0245 ul	0.0167 ul
Strain ZZ	-0.00468 ul	0.00609 ul
Contact Pressure	0 ksi	115.83 ksi
Contact Pressure X	-66.26 ksi	73.70 ksi
Contact Pressure Y	-107.31 ksi	64.20 ksi
Contact Pressure Z	-66.26 ksi	73.70 ksi

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3.3.2 Von Mises Stress (σ_v)

Maximum stress distribution is noticed near welded joints and on roller carriages, which can be clearly seen in below Figures 35 and 38. The color scales maximum had to be adjusted to 1 ksi to generate a visible plot of stress distribution.

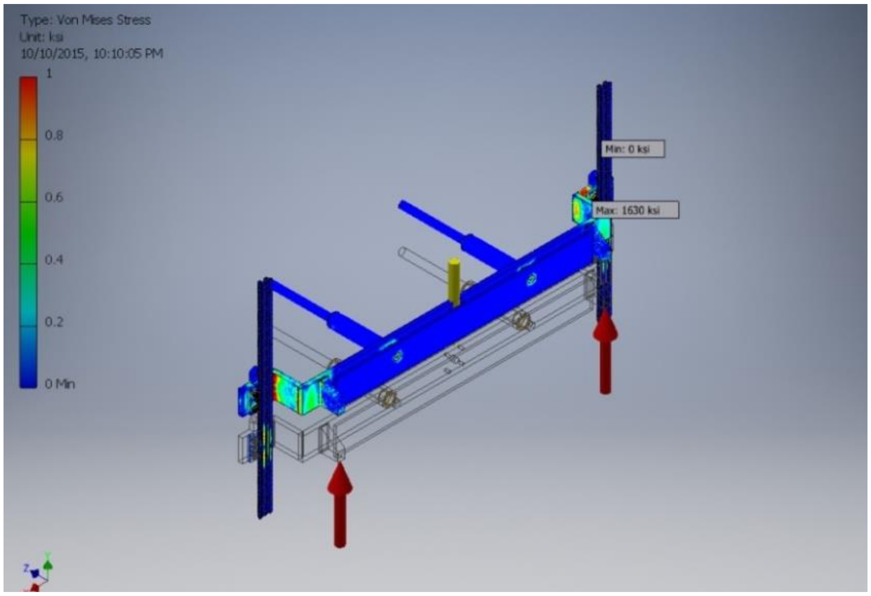

Figure 35: Von mises stress 1st view

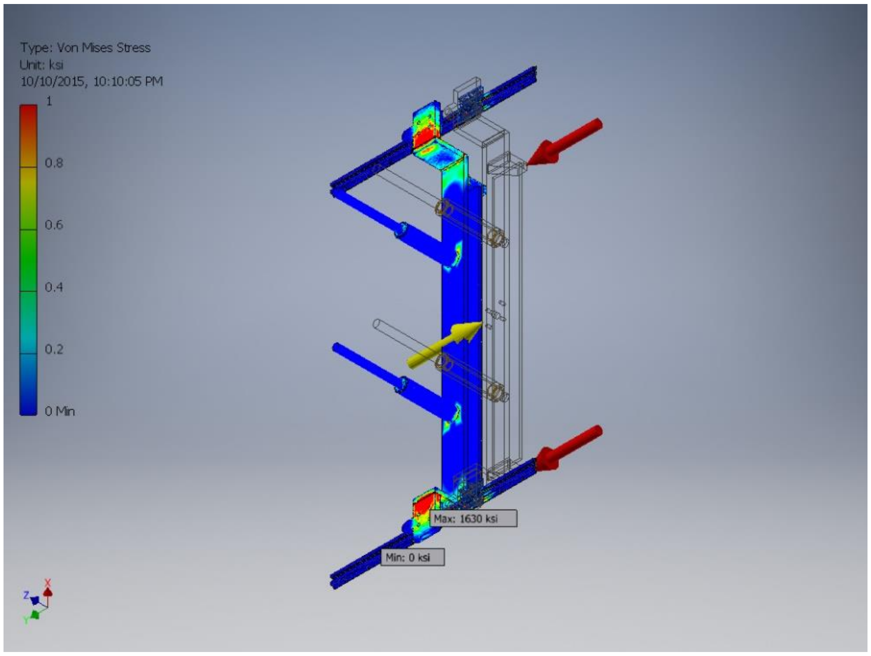

Figure 36: Von mises stress 2nd view

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3.3.3 1st Principal Stress

1st principal stress provides the stress value normal to the plane where shear stress is zero, which gives maximum tensile stress [25]. Maximum value noted during analysis is 971 ksi and its location can be seen in below Figure 37. Maximum 1st principal stress concentrations are noted at welded joints on support beam and on roller carriers.

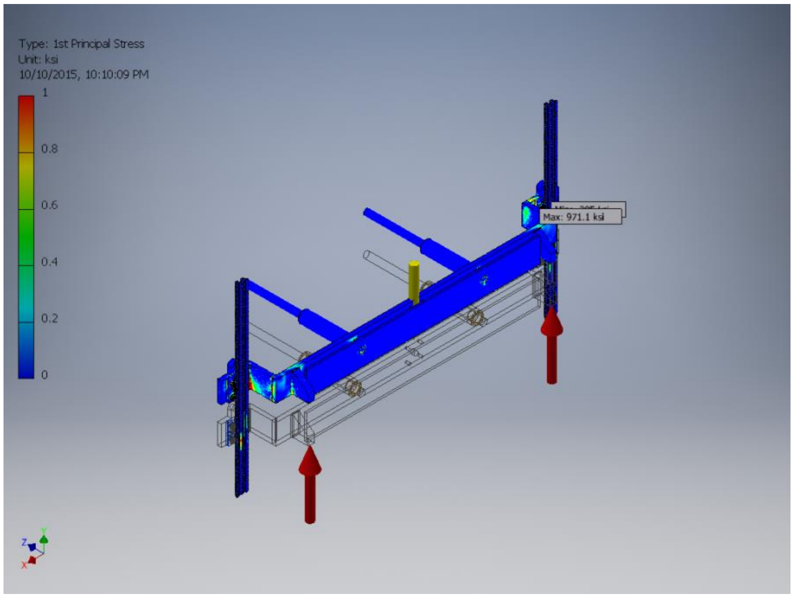

Figure 37: 1st Principal stress 1st view

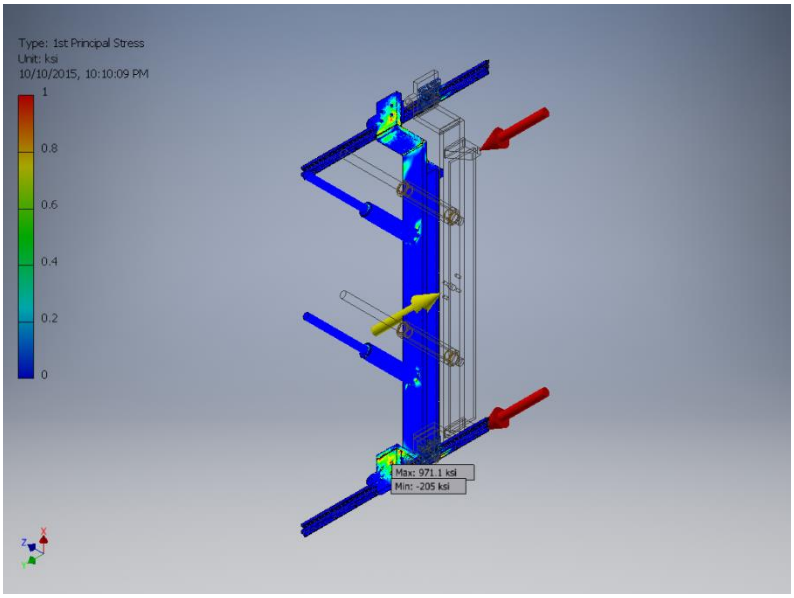

Figure 38: 1st Principal stress 2nd view

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3.3.4 3rd Principal Stress

Maximum 3rd principal stress value observed is 74 ksi. Its location can be seen in Figure 39. 3rd principal stress is always lower than 1st principal stress [25].

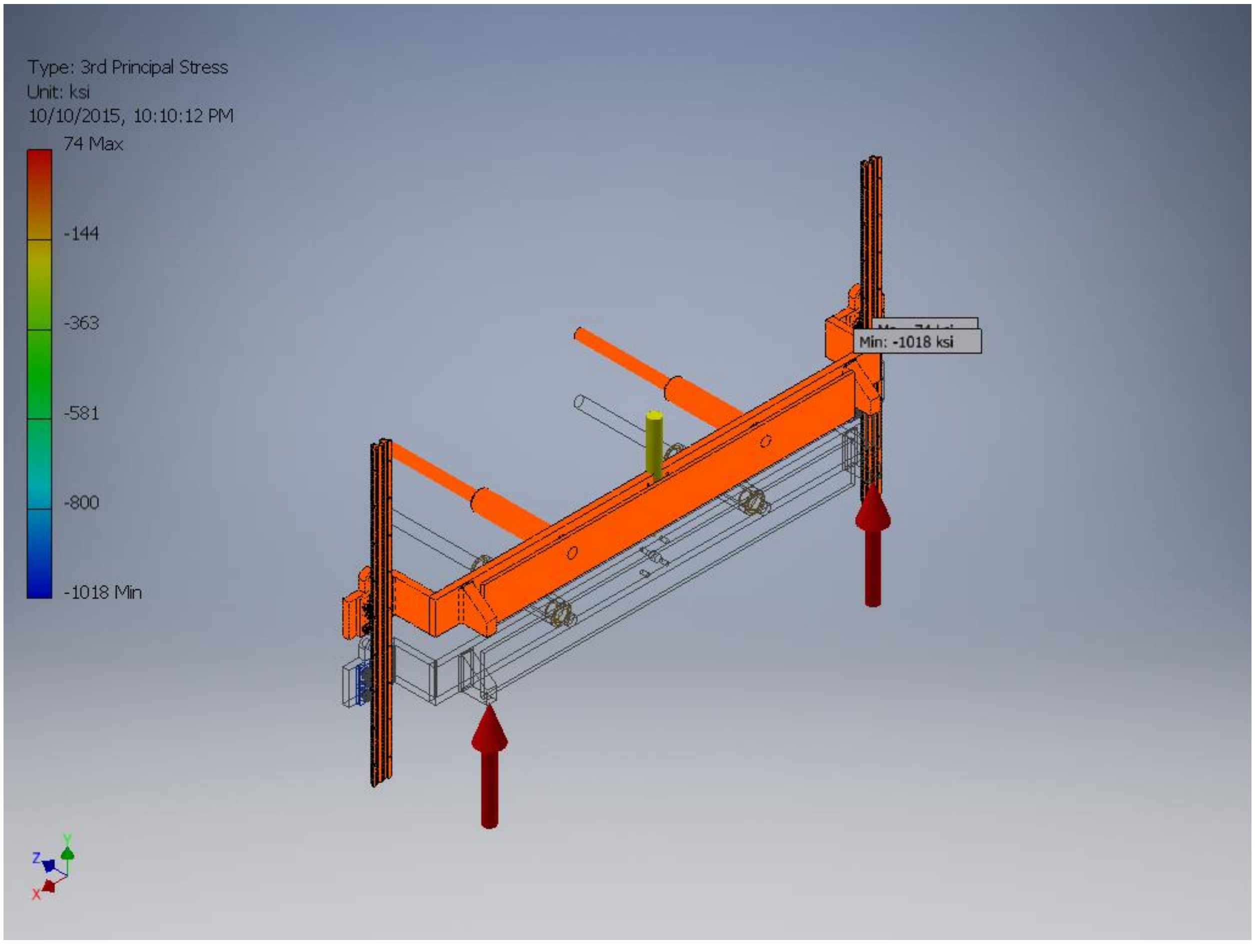

Figure 39: 3rd Principal stress

3.3.5 Safety Factor

Factor of safety maximum value is noted as 15ul and its location can be seen in Figure 40, and the minimum value is noted on the stoppers provided on the roller carriers, whose purpose was cleaning the rails. Permanent deformation was observed on these stoppers.

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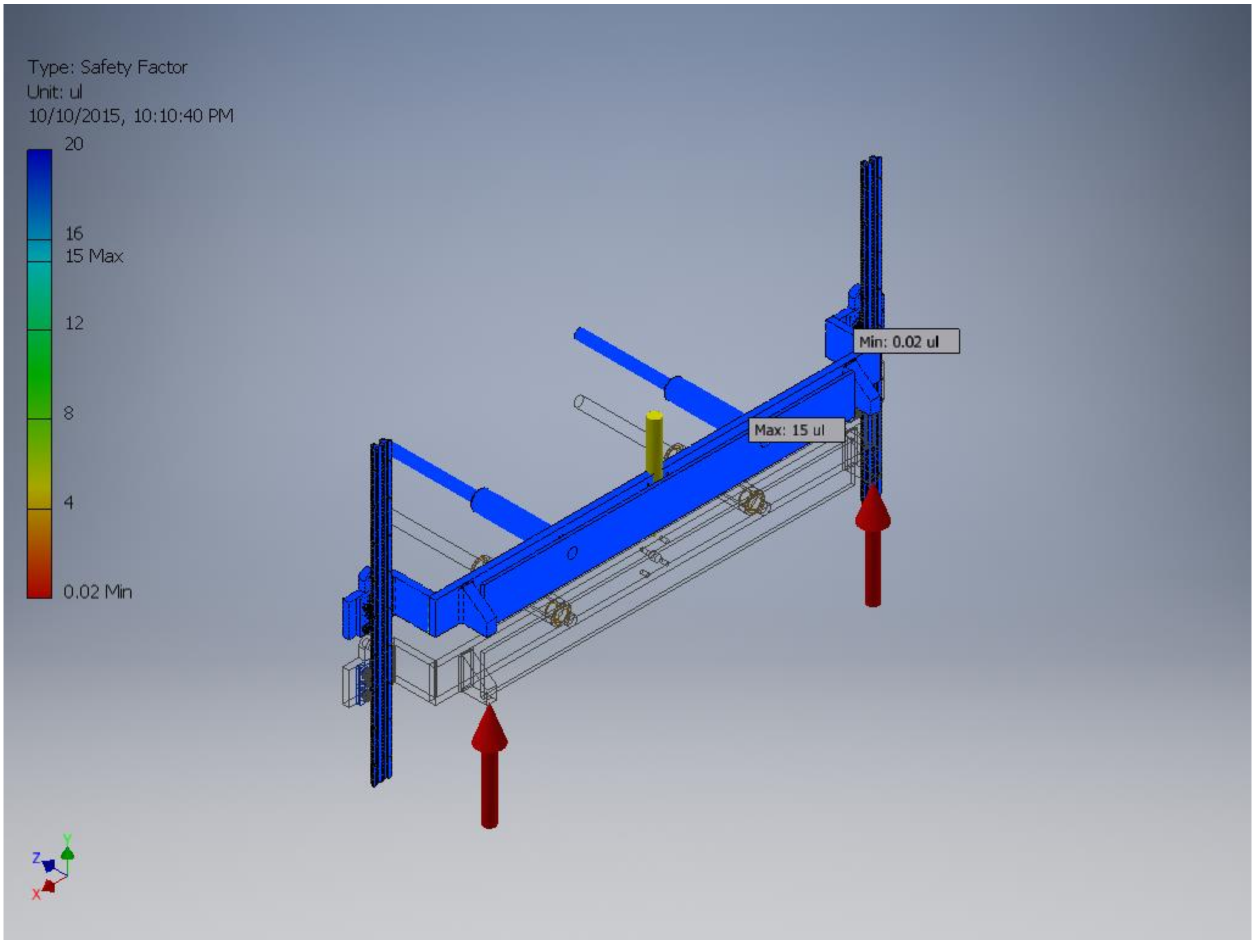

Figure 40: Safety factor

3.3.6 Stress (XX, XY, XZ, YY, YZ & ZZ)

Stress XX, Stress YY and Stress ZZ are normal stresses, and Stress XY, Stress YZ, and Stress XZ are three shear stresses which define the stress state in the analysis. Tensile normal stresses are considered positive whereas compressive normal stresses are considered negative. Shear stresses are positive when their two defining positive axes rotate toward each other which can be determined using right-hand rule [28]. All these stress distributions there maximum and minimum values locations are shown in detail below.

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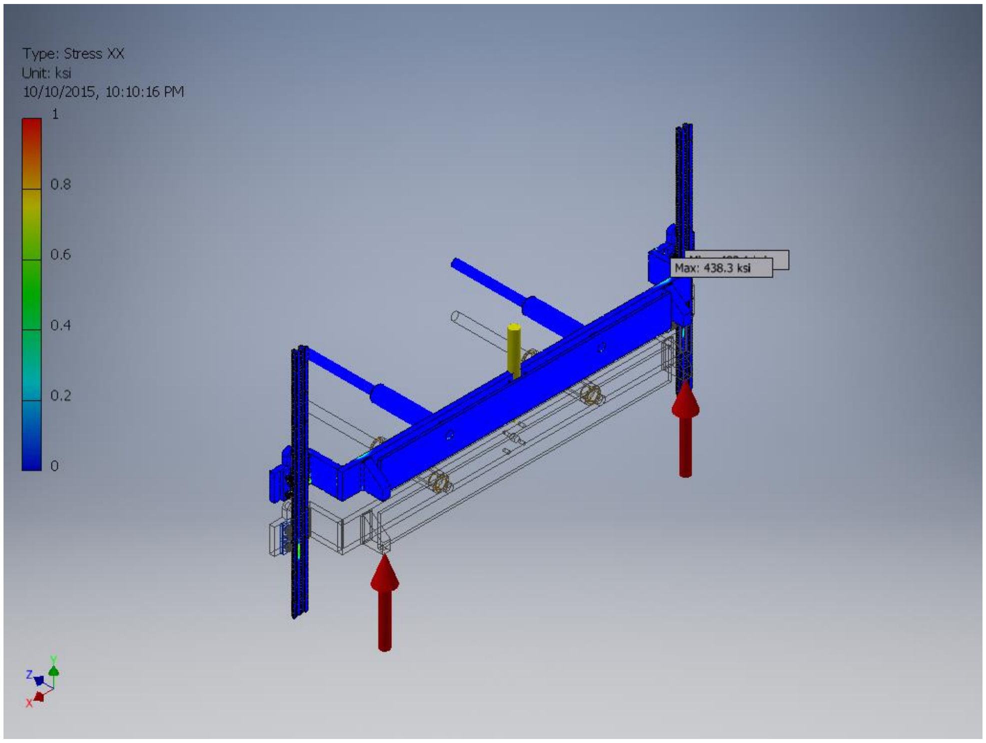

Figure 41: Stress XX 1st view

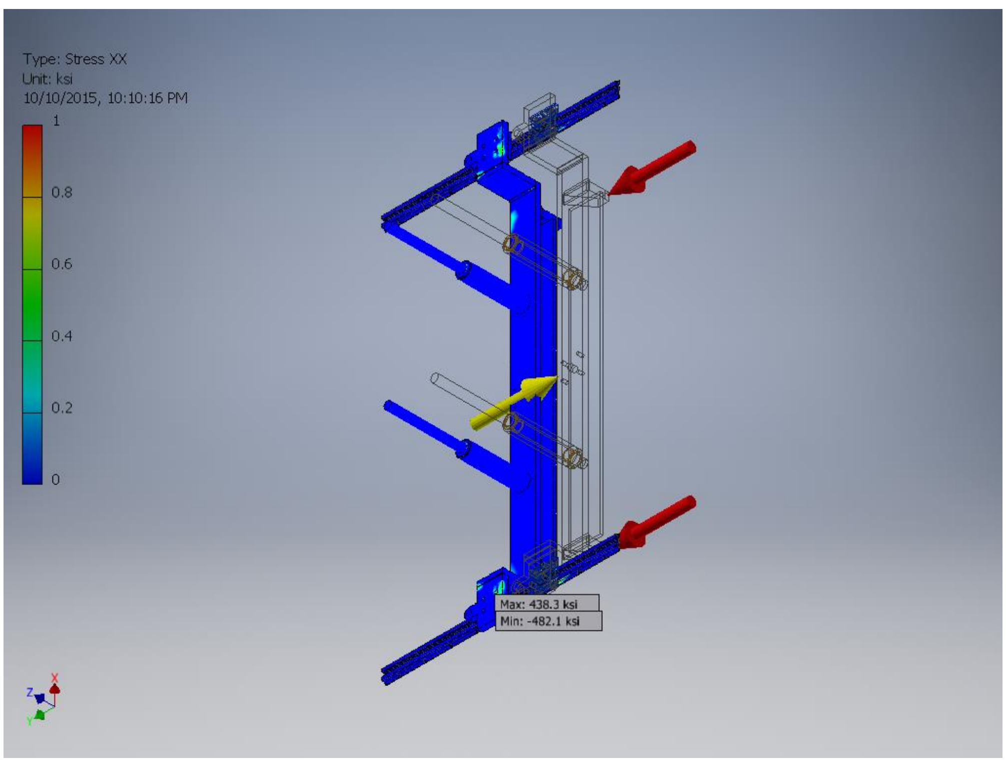

Figure 42: Stress XX 2nd view

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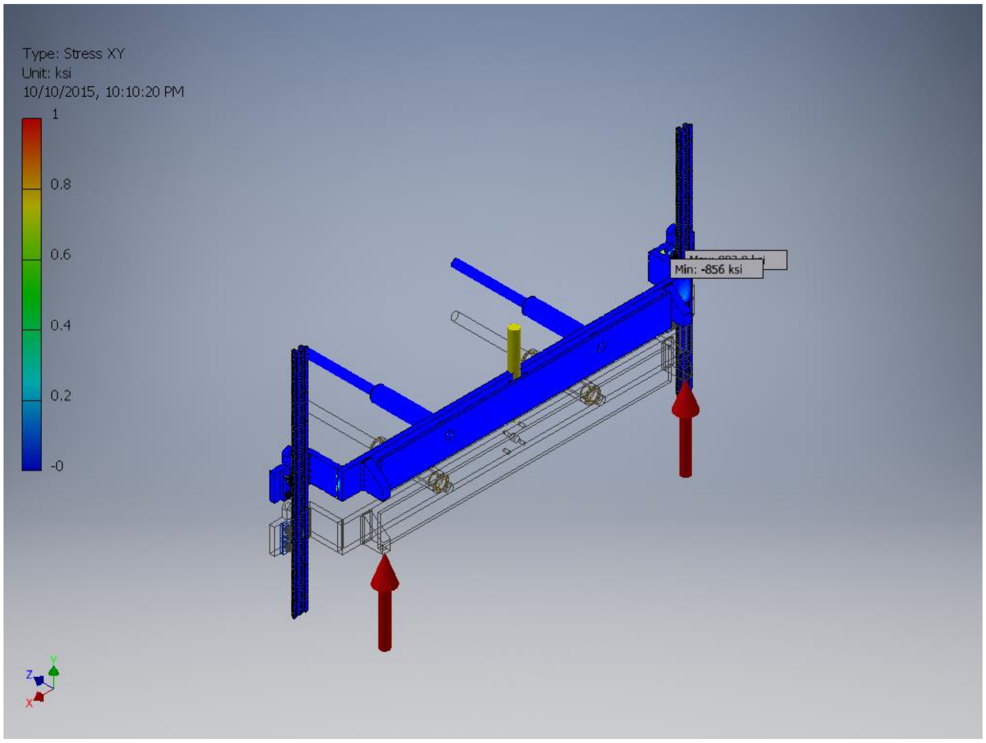

Figure 43: Stress XY 1st view

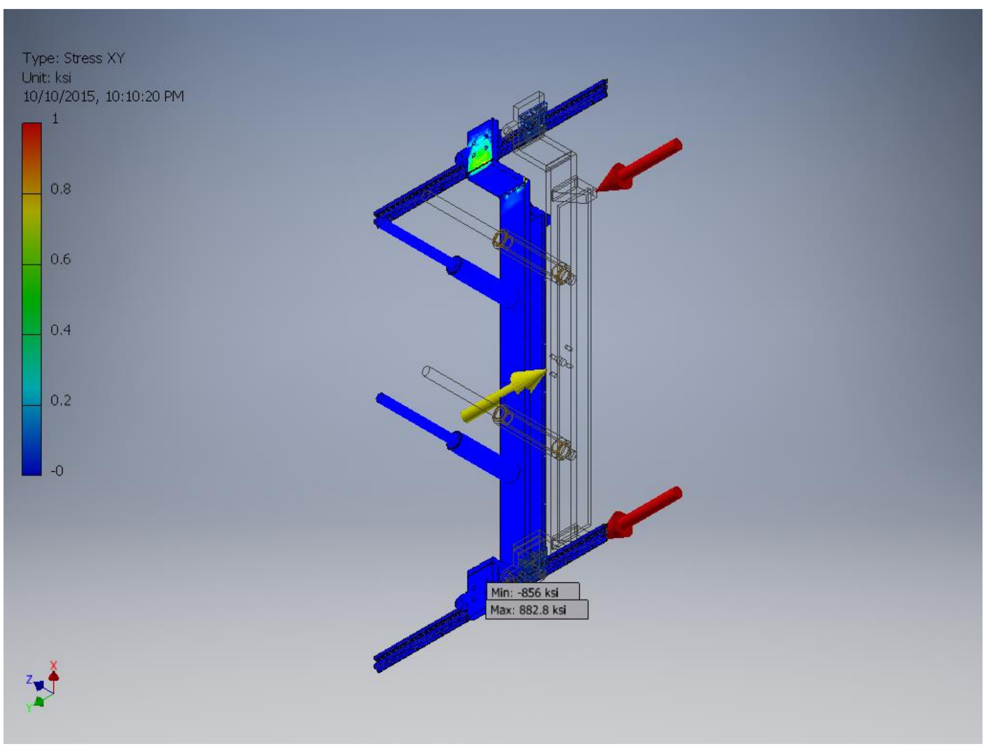

Figure 44: Stress XY 2nd view

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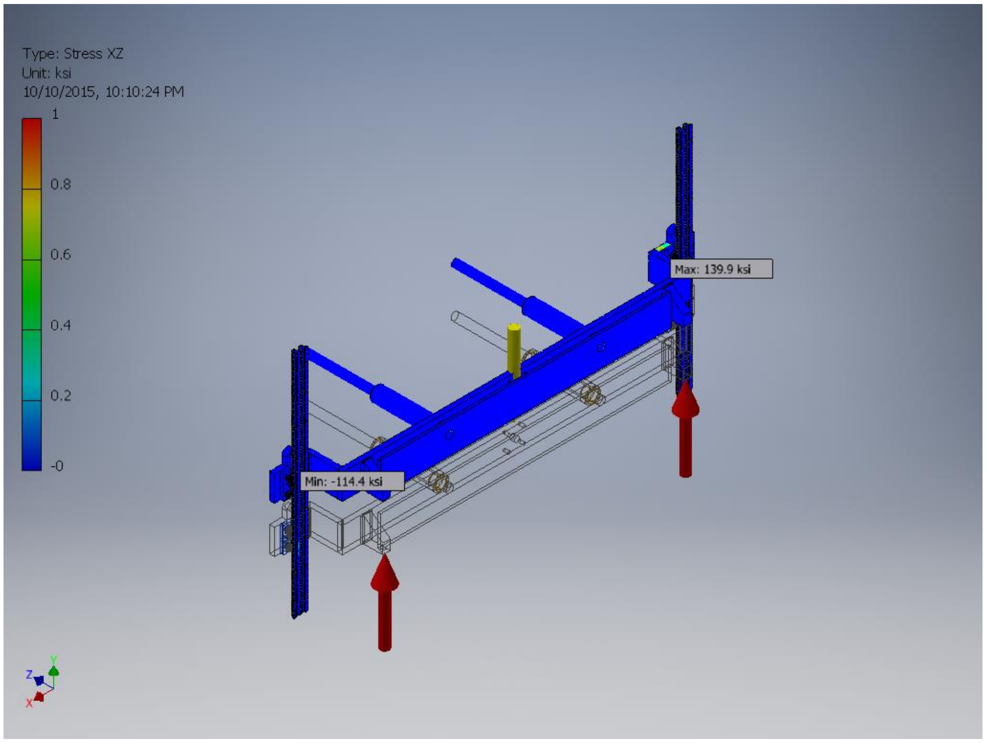

Figure 45: Stress XZ

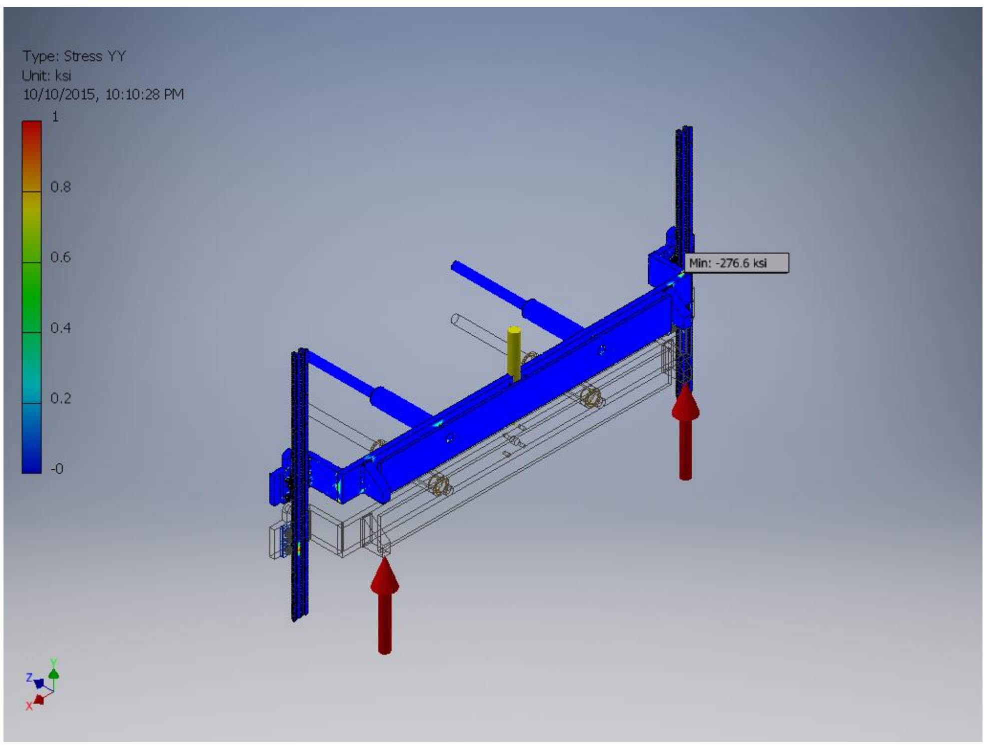

Figure 46: Stress YY

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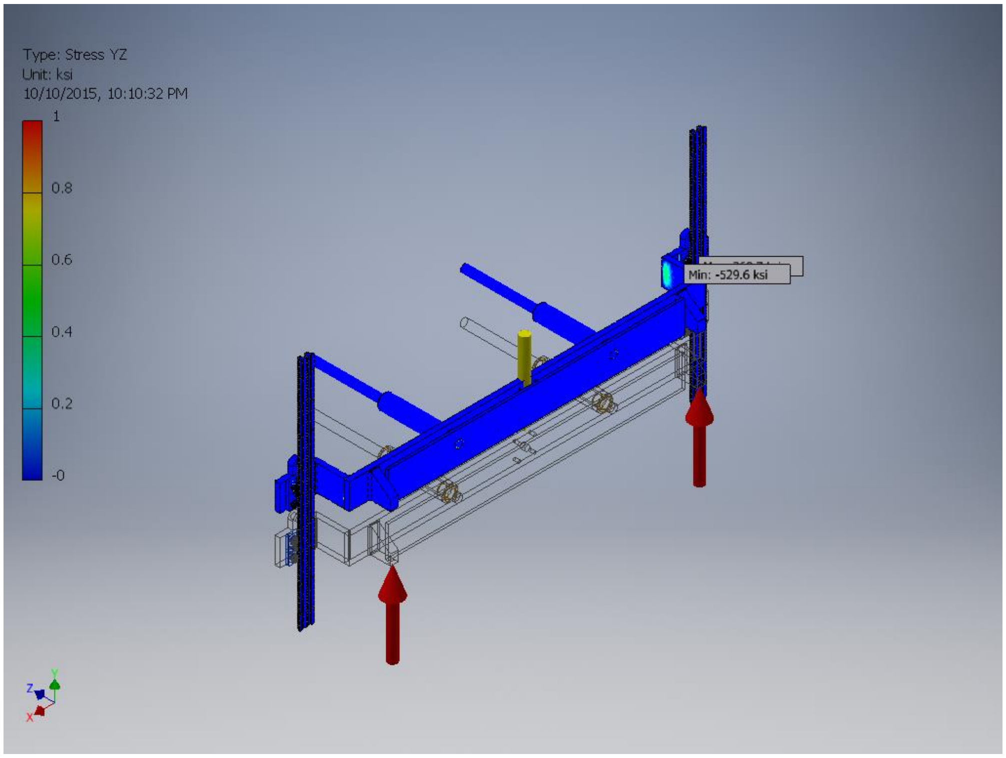

Figure 47: Stress YZ

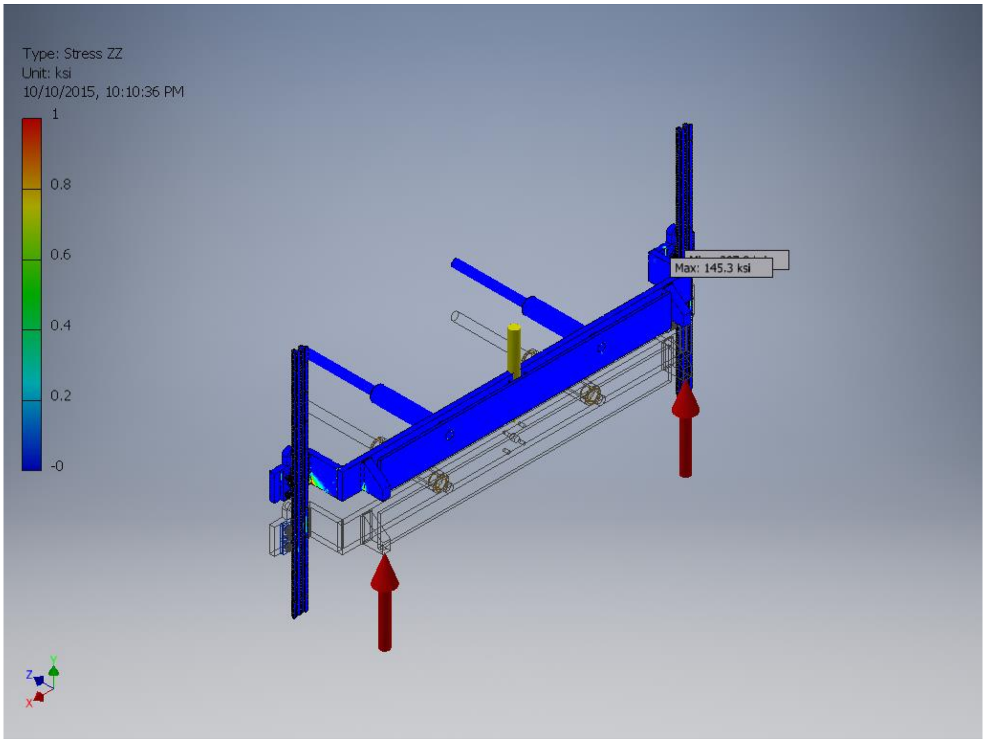

Figure 48: Stress ZZ

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3.3.7 Displacement along X, Y and Z

Form the analysis it can be noticed that the mechanism tilts a little causing displacement along X and Z directions, these maximum displacements and there locations can be seen in below figures.

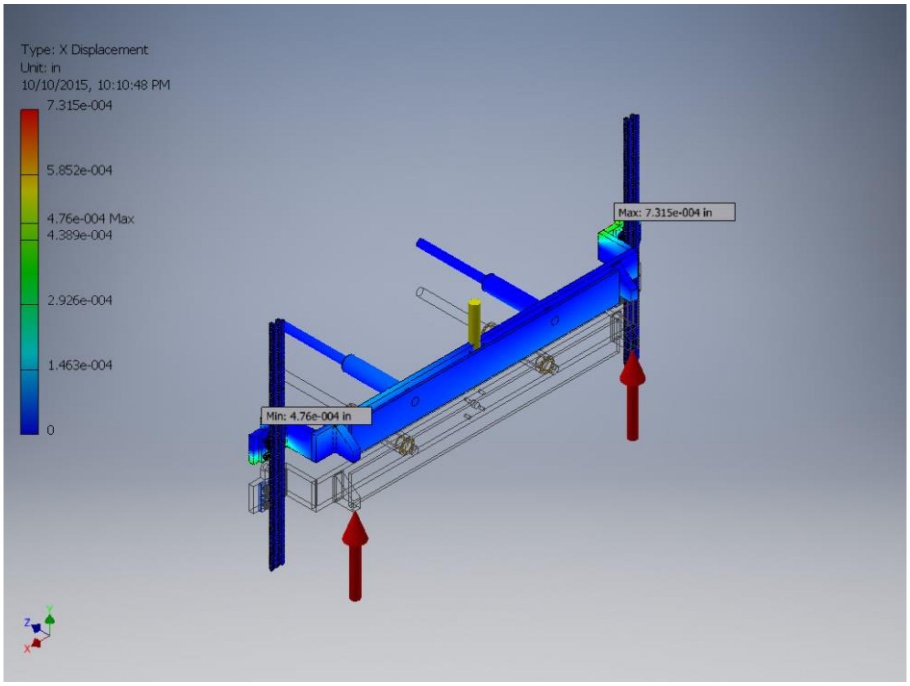

Figure 49: X Displacement

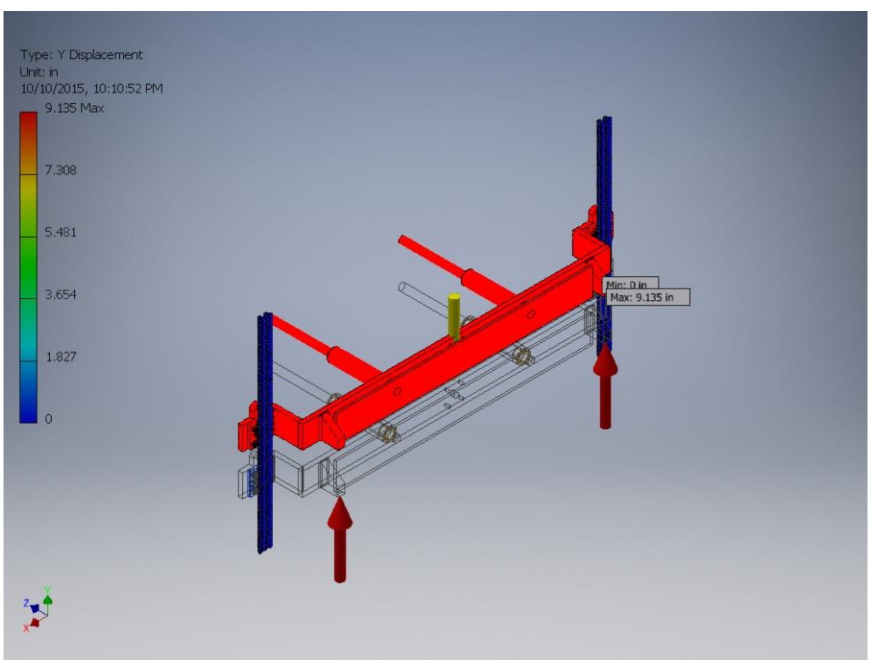

Figure 50: Y Displacement

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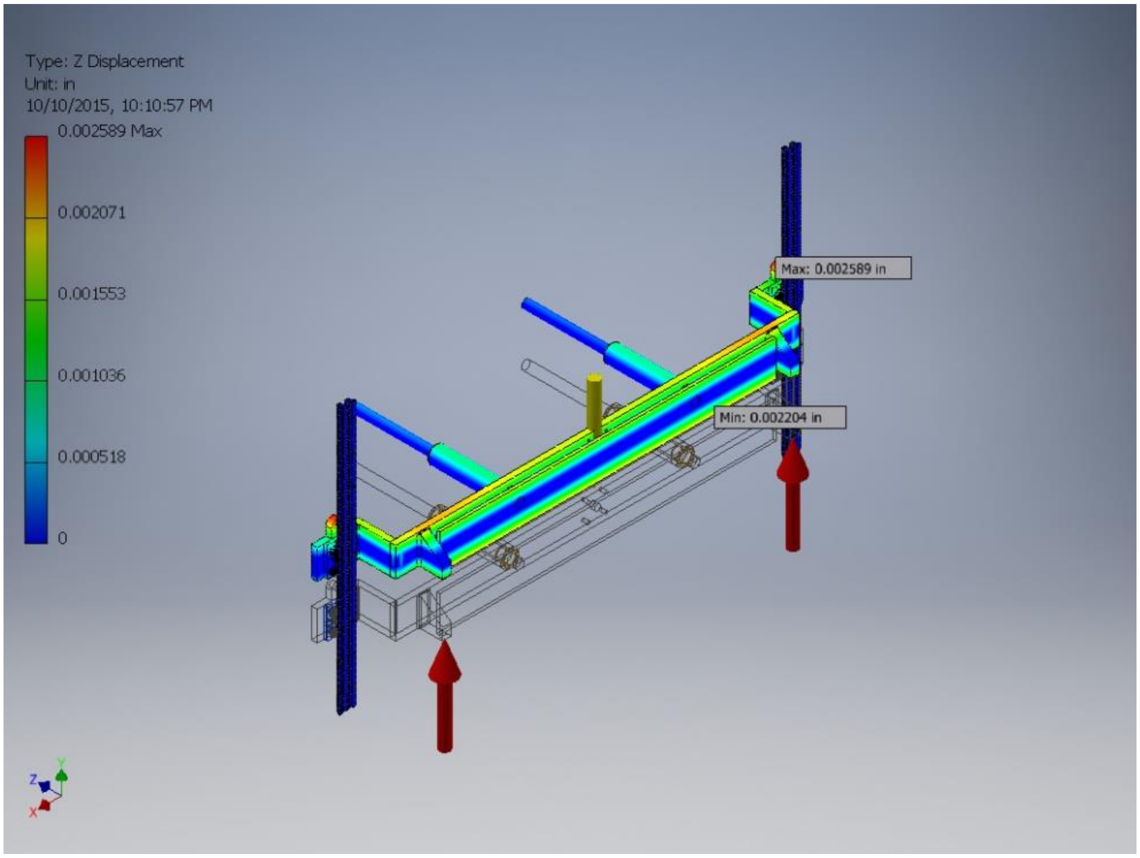

Figure 51: Z Displacement

3.4 Testing and Observations

Fabricated and assembled parts are shown in Figure 52. Guide tubes are welded on the support beam in position along with brass bushings installed in them, and guide rods are welded on the scraper support bar exactly aligned with the guide tubes. Results are obtained by manually operating this mechanism because of a few safety concerns. Automation can be achieved by programming the pneumatic cylinder controls in to the programmable logic controller (plc). Once it has been done the push bar mechanism will be able to run continuously without effecting the production time. Only limited results have been noted as manual operating takes a lot of time.

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Figure 52: Fabricated and assembled parts

Waste material being spilled out for every 50 cycles of the paver machine was collected in to a container and weighed (Table 8). This values are graphically represented in Figure 53, taking X axis as number of cycles and Y axis as weight in pounds. The below graph indicates a mean loss of 1.22 pounds for 50 cycles when compared to the graph in Figure 20, it can be noticed that material waste has been reduced by more than 80%.

Table 8: Material waste

Number of cycles	Weight in pounds
50	0.8
100	2
150	3.4

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Table 8 (continuation)

200	5
250	6
300	7.4

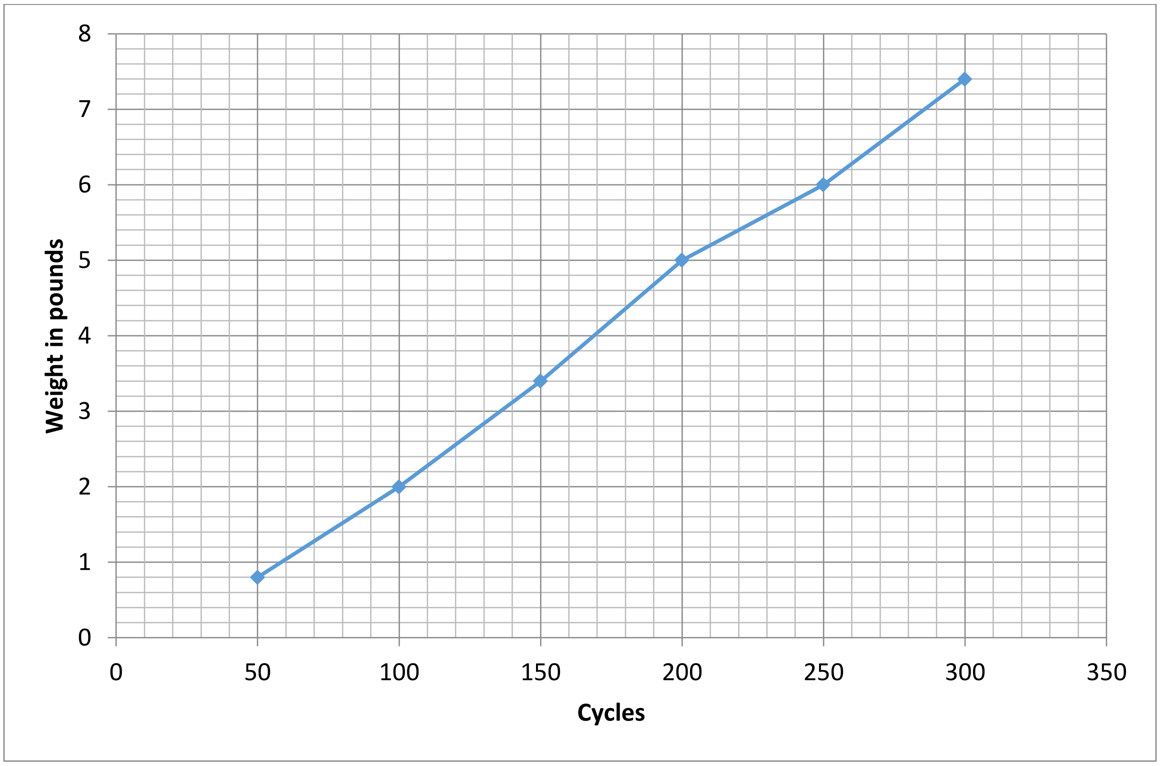

Figure 53: Material waste occurred when the push bar mechanism is implemented

3.5 Advantages and Disadvantages

3.5.1 Advantages

- Reduces down time for cleaning in the machine room.
- Increases the overall efficiency of production.
- The whole mechanism can be moved up during the mold change process.
- The height of the scraper can be adjusted for effective cleaning.
- Reduces the amount of material accumulating on the mold there by reducing the cleaning time.

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3.5.2 Disadvantages

- This mechanism only cleans the first 14" of the mold, allowing material deposits after its length.
- Scraper needs to be cleaned daily.

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CHAPTER 4

TWIN SCREW CONVEYER CLEANING SETUP

Another major source of material waste occurs when transporting large volumes of raw materials and wet concrete mixture using conveyor belts. Material spilling from conveyer belts is of two types. First one is material loss occurring at the loading point, and the second type occurs as a result of the fine material getting stuck to the belt and fall off during the conveyors return trip [19] (Figure 54). This causes accumulation of material under the conveyor frame and also leads to drive problems and shortens belt life. Cleaning this spilled material off the ground around moving conveyor belts is a hazardous task. Scrapers are generally used for the cleaning of these belts, but as the material being transported is wet it starts forming debris over the scraper and rotating parts of the conveyor, causing permanent damage due to frictional forces.

Figure 54: Fine material stuck to conveyor belt (from [19] in public domain)

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4.1 Working of Twin Screw Conveyor Cleaning Setup

Twin screw conveyor cleaning setup is another adaptive cleaning mechanism that can be implemented in concrete industries for cleaning and preventing material spills of conveyor belts.

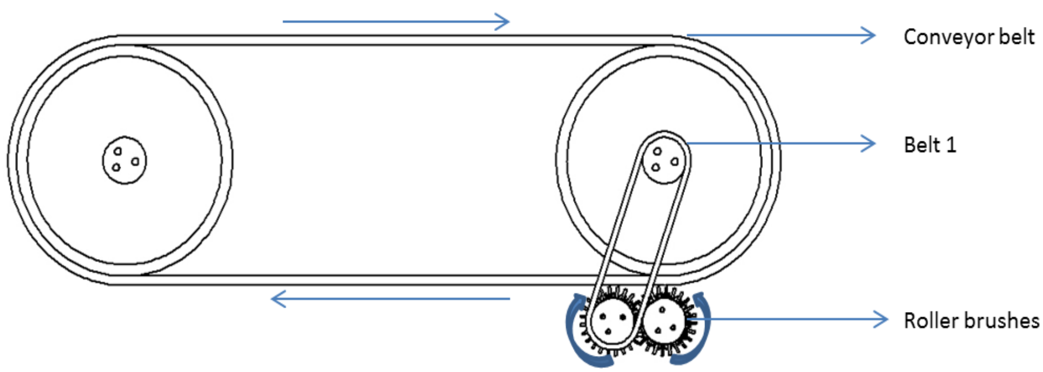

Figure 55: Twin screw conveyor cleaning system

This twin screw setup is as shown in the above Figure 55. Two roller brushes are clamped in place using bearings to provide free rotation. Belt 1 is used to drive one of these rollers as shown in the above figure, and both the brushes are coupled using gears. When the conveyor belt starts moving roller 1 starts to spin. This powers roller 2 and it starts spinning in the opposite direction. This rotating brushes clean non-working side of the conveyor belt and direct the waste to drop from the center. The collected material can be redirected to the dropping point which helps in increasing the efficiency. Also as they rotate in opposite direction they clean each other in the process thus increasing their service life and reducing their maintenance cost [13]. Due to the existence of a similar Patent design this mechanism was not been fabricated.

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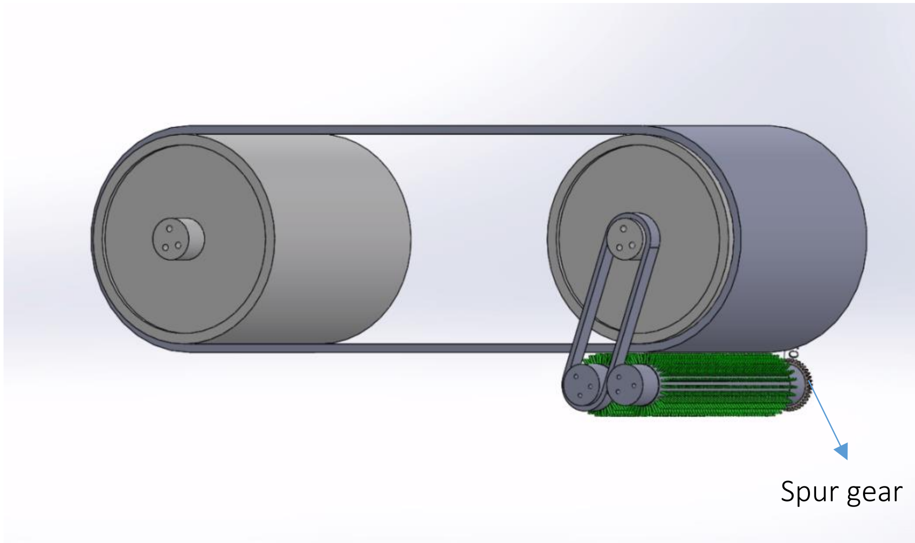

Figure 56: Isometric view

4.2 Conclusion

Concrete is the single most used material all over the world. Though there is a lot of research work being carried on for using construction wastes and other industrial wastes to replace aggregates in concrete production, for preserving and reducing the use of natural resources, reducing the occurrence of waste inside the plant should be given the first priority.

These adaptive cleaning mechanisms are cost efficient and easy to maintain. Not only do they reduce the waste but also highly contribute in increasing the service life of other in plant equipment. Maintaining a cleaner work environment can saves a lot of time and money. Though the problem cannot be completely prevented a significant amount of this material can be saved and reused.

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REFERENCES

1. Rollings, Raymond S., et al. Concrete Block Pavements. U.S. Army Engineer Waterways Experiment Station, 1983. Print.
2. Concrete, Manufacturers Association. Concrete Block Paving: Introduction. Concrete Manufacturers Association, 1998. Print.
3. Beall, Christine. Masonry Design and Detailing: For Architects and Contractors. New York: McGraw-Hill, 2004. Print.
4. Adam, G., E. Grant, and G. Lee. ""RoboPress" - an Automated Mobile Press for Manufacturing Concrete Products". Information Technology and Applications, 2005. ICITA 2005. Third International Conference on. 2005. 3-8. Print.
5. Pavingexpert. Block Paving Introduction. Retrieved from http://www.pavingexpert.com/blocks.htm
6. Paving Stone Expert [Video file]. Retrieved from https://www.youtube.com/watch?v=oQlwf9G2PNQ
7. MASA, Concrete Block Production Reliable, First Class and Solid. Retrieved from http://www.masa-group.com/images/stories/info-material/concrete-block-production-en.pdf
8. KVM Industrimaskiner A/S, Industrivej 22, 8620, Kjellerup. 1998. Block Machine operation manual.
9. Mehta, P. Kumar. "Reducing the Environmental Impact of Concrete." Concrete International 23.10 (2001): 61-6. Print.
10. Mehta, P. K., and P. J. M. Monteiro. Concrete: Structure, Properties, and Materials. Prentice Hall, 1993. Print.
11. Babor, Dan, Diana Plian, and Loredana Judele. "Environmental Impact of Concrete." Buletinul Institutului Politehnic din Iasi.Sectia Constructii, Arhitectura 55.4 (2009): 27. Print.

المنارة للاستشارات
www.manaraa.com

12. Wilson, Alex. "Cement and Concrete: Environmental Considerations." Environmental Building News 2.2 (1993): 1-11. Print.
13. Efremenkov, V. "Improvement of Systems for Cleaning Conveyor Belts." Glass & Ceramics 71.3 (2014): 96-8. Print.
14. Tingjun Wang, et al. "Simulation Design and Application of Music Playing Robot Based on SolidWorks". Measuring Technology and Mechatronics Automation, 2009. ICMTMA '09. International Conference on. 2009. 339-342. Print.
15. ASTM C936 / C936M-15, Standard Specification for Solid Concrete Interlocking Paving Units, ASTM International, West Conshohocken, PA, 2015, www.astm.org
16. Gregory, E. N., and A. A. Armstrong. Welding Symbols on Drawings. [Electronic Resource]. Burlington : Elsevier Science, 2005, 2005. Print.
17. Jaffe, R. Masonry Instant Answers. McGraw-Hill Education, 2003. Print.
18. Moriconi, Giacomo. "Recyclable Materials in Concrete Technology: Sustainability and Durability". Sustainable construction materials and technologies, Proc. Special Sessions of First inter. conf. on sustainable construction materials and technologies, Coventry, UK. 2007. 11-13. Print.
19. Rhoades, C. A., T. L. Hebble, and S. G. Grannes. Basic Parameters of Conveyor Belt Cleaning. Pittsburgh, PA: U.S. Dept. of the Interior, Bureau of Mines, 1989, 1989. Print.
20. Shackel R, (ca 2004).. Symposium on School of Civil Environmental Engineering. University of New South Wells, Sydney, Australia.
21. THE MANUFACTURE AND USE OF INTERLOCKING CONCRETE PAVING BLOCKS IN GHANA, Y.A. Tuffour, University of Science & TechnologyKumasL Ghana(1996).
22. Environmental Building News, “Cement and Concrete Environmental Considerations”. Environmental Building News, Vol.2, No. 2, March/April 1993.

المنارة للاستشارات
www.manaraa.com

23. Tremron Group. Olde Towne Sierra Patio [image file]. Retrieved from http://www.tremron.com/pavers/olde-towne
24. KVM. Blockmachine series 750 Type 62/62. Retrieved from http://www.kvm.com/Page-122.aspx
25. Difference between 1st principle stress and 3rd principle stress. Retrieved from http://forums.autodesk.com/t5/inventor-general-discussion/difference-between-1st-and-3rd-principal-stress/td-p/5112472
26. Visualize Results. Retrieved from http://knowledge.autodesk.com/support/inventor-products/learn-explore/caas/CloudHelp/cloudhelp/2014/ENU/Inventor/files/GUID-A88840EF-391B-4987-A77B-5D58F19600CA-htm.html
27. Horizontal-Mount Track Roller Carriage. Retrieved from http://www.mcmaster.com/mv1444077061/#9685k2/=zn205n
28. Stress analysis overview. Retrieved from http://knowledge.autodesk.com/support/inventor-products/learn-explore/caas/CloudHelp/cloudhelp/2014/ENU/Inventor/files/GUID-61F01A5D-7E54-45A1-9698-7BB11F0AEE94-htm.html
29. The Cement Era: Devoted to Cement, Concrete and Related Machinery. Cement era publishing Company, 1912. Print.
30. Pavement of Praça de D. Pedro IV in Lisbon (Calçada portuguesa) of black basalt and white limestone. Retrieved from https://commons.wikimedia.org/wiki/File:Cal%C3%A7ada_da_Pra%C3%A7a_do_Rossio.jpg
31. Paving stone driveway. Retrieved from https://commons.wikimedia.org/wiki/File:Paving_stone_driveway.jpg
32. Spring day in St. Joe. Retrieved from https://commons.wikimedia.org/wiki/File:Spring_day_in_St._Joe.jpg

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APPENDIX A

USF FAIR USE WORKSHEET

The fair use exception was added to the Copyright Act of 1976 as section 107 and was based on a history of judicial decisions that recognized that unauthorized use of copyrighted materials were "fair uses".The distinction between fair use and infringement may be unclear and not easily defined. There is no specific number of words, lines, or notes that may safely be taken without permission. This worksheet is offered as a tool to help you determine if your use of copyrighted content is likely to be considered to be a “fair use”. Before you begin your fair use determination, ask yourself the following questions:

1. Is the work no longer protected by copyright?
    a. Is it in the public domain?
    b. Did I retain my copyright ownership over a work I created when signing my publication contract?
2. Is there a specific exception in copyright law that covers my use?
    a. Does my use fit within Section 108 of copyright law: ‘Reproduction by libraries and archives?’
    b. Does my use fit within Section 110 (1) of copyright law: ‘performance or display of works in face to face classrooms?’
    c. Does my use fit within Section 110 (2) of copyright law: ‘performance or display of works in online classrooms (also known as the TEACH Act)?’ see TEACH Act checklist
3. Is there a license that covers my use?

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a. Is the work issued under a Creative Commons license and can I comply with the license terms?

b. Do I have access to the material through library licensed content? Ask your librarian

If your answer to the above questions was no, then you should proceed with your fair use evaluation. Section 107 also sets out four factors to be considered in determining whether or not a particular use is fair:

1. The purpose and character of the use, including whether such use is of commercial nature or is for nonprofit educational purposes
2. The nature of the copyrighted work
3. The amount and substantiality of the portion used in relation to the copyrighted work as a whole
4. The effect of the use upon the potential market for, or value of, the copyrighted work

None of these factors are independently determinative of whether or not a use is likely to be considered fair use. In evaluating your use, you should evaluate the totality of the circumstances and consider all of the factors together. The Fair Use Worksheet will help you balance these factors to determine if your use of copyrighted material weighs in favor of 'fair use.' While valuable for your own documentation the Worksheet is not intended as legal advice, which can be provided only by USF General Counsel.

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The fair use evaluation form for Figure 7 is below.

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INSTRUCTIONS

Check all boxes that apply, and keep a copy of this form for your records. If you have questions, please contact the USF General Counsel or your USF Tampa Library Copyright Librarian.

Name: Mahendra Palnati Date: 11/2/2015

Class or Project: Masters Thesis

Title of Copyrighted Work: MASA, Concrete Block Production Reliable, First Class and Solid.Retrieved (Figure 7)

PURPOSE AND CHARACTER OF THE USE

Likely Supports Fair Use	Likely Does Not Support Fair Use
☐ Educational ☐ Teaching (including multiple copies for classroom use) ■ Research or Scholarship ■ Criticism, Parody, News Reporting or Comment ■ Transformative Use (your new work relies on and adds new expression, meaning, or message to the original work) ☐ Restricted Access (to students or other appropriate group) ■ Nonprofit	☐ Commercial ☐ Entertainment ☐ Bad-faith behavior ☐ Denying credit to original author ☐ Non-transformative or exact copy ■ Made accessible on Web or to public ☐ Profit-generating use

Overall, the purpose and character of your use ■supports fair use or ☐does not support fair use.

NATURE OF THE COPYRIGHTED MATERIAL

Likely Supports Fair Use	Likely Does Not Support Fair Use
■ Factual or nonfiction ☐ Important to favored educational objectives ■ Published work	☐ Creative or fiction ☐ Consumable (workbooks, tests) ☐ Unpublished

Overall, the nature of the copyrighted material ■supports fair use or ☐does not support fair use.

AMOUNT AND SUBSTANTIALITY OF MATERIAL USED IN RELATION TO WHOLE

Likely Supports Fair Use	Likely Does Not Support Fair Use
■ Small amount (using only the amount necessary to accomplish the purpose) ☐ Amount is important to favored socially beneficial objective (i.e. educational objectives) ■Lower quality from original (ex. Lower resolution or bitrate photos, video, and audio)	☐ Large portion or whole work ☐ Portion used is qualitatively substantial (i.e. it is the 'heart of the work') ☐Similar or exact quality of original work

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Overall, the amount and substantiality of material used in relation to the whole ■supports fair use or ☐does not support fair use.

EFFECT ON THE MARKET FOR ORIGINAL

Likely Supports Fair Use	**Likely Does Not Support Fair Use**
■ No significant effect on the market or potential market for the original ☐ No similar product marketed by the copyright holder ■ You own a lawfully acquired copy of the material ☐ The copyright holder is unidentifiable ☐ Lack of licensing mechanism for the material	☐ Replaces sale of copyrighted work ☐ Significantly impairs market or potential market for the work ☐ Numerous copies or repeated, long-term use ■ Made accessible on Web or to public ☐ Affordable and reasonably available permissions or licensing

Overall, the effect on the market for the original ■supports fair use or ☐does not support fair use.

CONCLUSION

The combined purpose and character of the use, nature of the copyrighted material, amount and substantiality of material used in relation to the whole and the effect on the market for the original

■likely supports fair use or ☐likely does not support fair use.

Note: Should your use of copyrighted material not support fair use, you may still be able to locate and request permissions from the copyright holder. For help on this, please feel free to [contact your Copyright Librarian.]()

This worksheet has been adapted from:

Cornell University's Checklist for Conducting A Fair use Analysis Before Using Copyrighted Materials:
https://copyright.cornell.edu/policies/docs/Fair_Use_Checklist.pdf
Crews, Kenneth D. (2008) Fair use Checklist. Columbia University Libraries Copyright Advisory Office.
http://copyright.columbia.edu/copyright/files/2009/10/fairusechecklist.pdf
Smith, Kevin; Macklin, Lisa A.; Gilliland, Anne. A Framework for Analyzing any Copyright Problem. Retrieved from:
https://d396qusza40orc.cloudfront.net/cfel/Reading%20Docs/A%20Framework%20for%20Analyzing%20any%20Copyright%20Problem.pdf

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The fair use evaluation form for Figure 8 is below.

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INSTRUCTIONS

Check all boxes that apply, and keep a copy of this form for your records. If you have questions, please contact the USF General Counsel or your USF Tampa Library Copyright Librarian.

Name: Mahendra Palnati Date: 11/2/2015

Class or Project: Masters Thesis

Title of Copyrighted Work: Blockmachine series 750 Type 62/62 (Figure 8)

PURPOSE AND CHARACTER OF THE USE

Likely Supports Fair Use	Likely Does Not Support Fair Use
☐ Educational ☐ Teaching (including multiple copies for classroom use) ■ Research or Scholarship ■ Criticism, Parody, News Reporting or Comment ■ Transformative Use (your new work relies on and adds new expression, meaning, or message to the original work) ☐ Restricted Access (to students or other appropriate group) ☐ Nonprofit	☐ Commercial ☐ Entertainment ☐ Bad-faith behavior ☐ Denying credit to original author ☐ Non-transformative or exact copy ■ Made accessible on Web or to public ☐ Profit-generating use

Overall, the purpose and character of your use ■supports fair use or ☐does not support fair use.

NATURE OF THE COPYRIGHTED MATERIAL

Likely Supports Fair Use	Likely Does Not Support Fair Use
■ Factual or nonfiction ☐ Important to favored educational objectives ☐ Published work	☐ Creative or fiction ☐ Consumable (workbooks, tests) ■ Unpublished

Overall, the nature of the copyrighted material ☐supports fair use or ☐does not support fair use.

AMOUNT AND SUBSTANTIALITY OF MATERIAL USED IN RELATION TO WHOLE

Likely Supports Fair Use	Likely Does Not Support Fair Use
■ Small amount (using only the amount necessary to accomplish the purpose) ☐ Amount is important to favored socially beneficial objective (i.e. educational objectives) ■Lower quality from original (ex. Lower resolution or bitrate photos, video, and audio)	☐ Large portion or whole work ☐ Portion used is qualitatively substantial (i.e. it is the 'heart of the work') ☐Similar or exact quality of original work

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Overall, the amount and substantiality of material used in relation to the whole ■supports fair use or ☐does not support fair use.

EFFECT ON THE MARKET FOR ORIGINAL

Likely Supports Fair Use	Likely Does Not Support Fair Use
■ No significant effect on the market or potential market for the original ☐ No similar product marketed by the copyright holder ■ You own a lawfully acquired copy of the material ☐ The copyright holder is unidentifiable ☐ Lack of licensing mechanism for the material	☐ Replaces sale of copyrighted work ☐ Significantly impairs market or potential market for the work ☐ Numerous copies or repeated, long-term use ☐ Made accessible on Web or to public ☐ Affordable and reasonably available permissions or licensing

Overall, the effect on the market for the original ■supports fair use or ☐does not support fair use.

CONCLUSION

The combined purpose and character of the use, nature of the copyrighted material, amount and substantiality of material used in relation to the whole and the effect on the market for the original **■likely supports fair use or ☐likely does not support fair use.**

Note: Should your use of copyrighted material not support fair use, you may still be able to locate and request permissions from the copyright holder. For help on this, please feel free to contact your Copyright Librarian.

This worksheet has been adapted from:

Cornell University's Checklist for Conducting A Fair use Analysis Before Using Copyrighted Materials: *https://copyright.cornell.edu/policies/docs/Fair_Use_Checklist.pdf*

Crews, Kenneth D. (2008) Fair use Checklist. Columbia University Libraries Copyright Advisory Office. *http://copyright.columbia.edu/copyright/files/2009/10/fairusechecklist.pdf*

Smith, Kevin; Macklin, Lisa A.; Gilliland, Anne. A Framework for Analyzing any Copyright Problem. Retrieved from: *https://d396qusza40orc.cloudfront.net/cfel/Reading%20Docs/A%20Framework%20for%20Analyzing%20any%20Copyright%20Problem.pdf*

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The fair use evaluation form for Figure 9, 10 and 11 is below.

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INSTRUCTIONS

Check all boxes that apply, and keep a copy of this form for your records. If you have questions, please contact the USF General Counsel or your USF Tampa Library Copyright Librarian.

Name: Mahendra Palnati Date: 11/2/2015

Class or Project: Masters Thesis

Title of Copyrighted Work: Operation manual of Block Machine by KVM (Figure 9,10 and 11)

PURPOSE AND CHARACTER OF THE USE

Likely Supports Fair Use	**Likely Does Not Support Fair Use**
☐ Educational	☐ Commercial
☐ Teaching (including multiple copies for classroom use)	☐ Entertainment
■ Research or Scholarship	☐ Bad-faith behavior
■ Criticism, Parody, News Reporting or Comment	☐ Denying credit to original author
■ Transformative Use (your new work relies on and adds new expression, meaning, or message to the original work)	☐ Non-transformative or exact copy
☐ Restricted Access (to students or other appropriate group)	■ Made accessible on Web or to public
☐ Nonprofit	☐ Profit-generating use

Overall, the purpose and character of your use ■supports fair use or ☐does not support fair use.

NATURE OF THE COPYRIGHTED MATERIAL

Likely Supports Fair Use	**Likely Does Not Support Fair Use**
■ Factual or nonfiction	☐ Creative or fiction
☐ Important to favored educational objectives	☐ Consumable (workbooks, tests)
☐ Published work	■ Unpublished

Overall, the nature of the copyrighted material ☐supports fair use or ☐does not support fair use.

AMOUNT AND SUBSTANTIALITY OF MATERIAL USED IN RELATION TO WHOLE

Likely Supports Fair Use	**Likely Does Not Support Fair Use**
■ Small amount (using only the amount necessary to accomplish the purpose)	☐ Large portion or whole work
☐ Amount is important to favored socially beneficial objective (i.e. educational objectives)	☐ Portion used is qualitatively substantial (i.e. it is the 'heart of the work')
■Lower quality from original (ex. Lower resolution or bitrate photos, video, and audio)	☐Similar or exact quality of original work

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Overall, the amount and substantiality of material used in relation to the whole ■supports fair use or ☐does not support fair use.

EFFECT ON THE MARKET FOR ORIGINAL

Likely Supports Fair Use	Likely Does Not Support Fair Use
■ No significant effect on the market or potential market for the original ☐ No similar product marketed by the copyright holder ■ You own a lawfully acquired copy of the material ☐ The copyright holder is unidentifiable ☐ Lack of licensing mechanism for the material	☐ Replaces sale of copyrighted work ☐ Significantly impairs market or potential market for the work ☐ Numerous copies or repeated, long-term use ☐ Made accessible on Web or to public ☐ Affordable and reasonably available permissions or licensing

Overall, the effect on the market for the original ■supports fair use or ☐does not support fair use.

CONCLUSION

The combined purpose and character of the use, nature of the copyrighted material, amount and substantiality of material used in relation to the whole and the effect on the market for the original

■likely supports fair use or ☐likely does not support fair use.

Note: Should your use of copyrighted material not support fair use, you may still be able to locate and request permissions from the copyright holder. For help on this, please feel free to contact your Copyright Librarian.

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http://copyright.columbia.edu/copyright/files/2009/10/fairusechecklist.pdf

Smith, Kevin; Macklin, Lisa A.; Gilliland, Anne. A Framework for Analyzing any Copyright Problem. Retrieved from:
https://d396qusza40orc.cloudfront.net/cfel/Reading%20Docs/A%20Framework%20for%20Analyzing%20any%20Copyright%20Problem.pdf

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