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DESIGN AND FABRICATION OF MOTORIZED MULTI PURPOSE MECHANICAL MACHINE

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ABSTRACT

The Multi-Purpose Mechanical Machine is widely used in manufacturing. Industries are primarily designed to provide usable goods and services at a cheap cost of production, low cost of machinery, and low cost of inventory. We are providing drive to the main shaft, which is directly coupled to the bevel gear mechanism; on the main shaft, we have used a bevel gear system for power transfer to three places. Drilling centre, cutting centre, and grinding centre will all be driven by bevel gear. Because it is driven by a single power source, the concept allows us to undertake operations at multiple working centres at the same time. Electricity conservation (power supply), cost savings related with power usage, increased productivity, and reduced floor space are all features of this strategy. The scotch yoke mechanism is used in this machine, which is autonomous and operated by an electric motor. It can be used to work on thin metallic sheets and wood in a carpentry shop in small size industries/workshops.

1. INTRODUCTION

This idea is for the "Multi-purpose Mechanical Machine" to be designed, developed, and manufactured. Multi-purpose mechanical machines are primarily utilised in small-scale companies. The industries are primarily geared on producing valuable goods and services at low production, machine, and inventory costs [1-10]. Every activity in this world has become faster and faster as a result of technical growth, but this progress also necessitates significant investments and expenditures. In today's society, all actions have been accelerated due to technology advancement; however this advancement also necessitates significant investments and expenditures. Every industry aspires to achieve a high rate of productivity while maintaining product quality and standard at a low average cost. Machine installation accounts for a significant portion of a sector's investment [10-15]. So, in this project, a work is proposed in which a machine is created to be capable of simultaneously doing operations such as drilling, cutting, and grinding at multiple work centres, implying that the Industrial will not have to pay a high price for the machine.

2. LITERATURE SURVEY

The broad literature review will aid in comprehending the concepts, theorems, and various aspects that influence the machine's performance. Before beginning our work, we reviewed several research papers that indicated that machine installation in production-based industries is a crafty and skilled task because many factors are involved, such as power consumption, time required, maintenance costs, number of units produced per machine, and so on.

Amit Kumar et al.,[1] Amit Kumar et al.,[2] Amit Kumar et al.,[3] Proposed in conjunction with the creation of a multifunctional mechanical machine. Drilling, cutting, and grinding are the three activities included in a single machine. The machine is fully automated and is driven by an AC motor that is powered by electricity. The main working principles are the Scotch yoke mechanism, chain, and sprocket, and the shaft is made of mild steel.

Aquib Ahmad et al.,[2] Aquib Ahmad et al.,[2] Aquib

Ahmad et al.,Explains the conceptual model of a machine that can drill, saw, cut, and grind while doing many operations at the same time. For machine operations, two mechanisms are used: a single slider rapid return system for operating the hacksaw, and a bevel gear arrangement to transmit power between work centres.

Barbara Linke et al.,[3] Barbara Linke et al.,[4] Barbara Linke et al.,[5] Designed and built a multipurpose grinding machine. It is proved that a machine may be converted from an outer diameter grinding to a freeform grinding configuration using modular robot modules, and it is used to demonstrate topics such as machine tool downsizing, multi-functionality, and re-configurability.

Dixon Jim Joseph. J, et.al.,[4] Fabricated the motorized multipurpose tooling machine. The operations performed are Drilling, Grinding and Cutting through motor drive with Bevel Gear Mechanism.

Jyothi and colleagues[5] proposed the construction of a multi-purpose mechanical machine. Drilling, cutting, and grinding are the activities carried out. It is suitable for usage in thin metals, wood, and PVC. Different pulleys appear parallel to the main shaft, each with its own way of action.

R. Krishnappa et al. [6] The proposed paper is about the construction of a motorised multifunctional machine. Drilling, Shaping, Sawing, and Grinding are the four processes contained in a single machine.

Kuldeepak et al. [7] The versatile material removal machine was created. Grinding, super finishing, filing, and cutting are the four processes contained in a single machine. The motor has a horsepower of 746 watts and runs on a single motor with the assistance of a V-Belt that transmits power to the shaft through pulleys.

S. S. Kulkarni, S. S. Kulkarni, S. S. Kulkarni, S. S. Kulkarni, S. S. Kulk [8} The drilling, cutting, and grinding machine was built by myself. In this tooling machine, belt drives with pulleys, bevel gears, and scotch yoke mechanisms are employed, and the machine is powered by an electric motor.

Kumar Penumuru et al. [9] the worm gear mechanism is used for sawing and the Bevel gear mechanism is used for power transmission, according to the explanation. Drilling, Sawing, and Grinding are the three activities contained in a single machine.

Maguteeswaran.R, et al. [10] developed a machine that conducts three different operations in one machine, such as drilling, slotting, and shaping, which helps to save time and money. Bevel gears are utilised to transmit power perpendicularly, whereas Cam arrangement, Slotting and Shaping tool, Drill bit, Chuck, and Bearings are employed throughout the machine.

Manish Kale et al. [11] I designed and built the special purpose machine. The major goal of this equipment is to cut down on labour time and costs.

Perumal. S, et al., [12] The manufacture of a multifunctional hand driller machine was proposed. It combines drilling, grinding, and cutting processes into a single machine.

Prathyusha et al. [13] The versatile operating machine was created. Drilling, Sawing, and Shaping are the three processes contained in a single machine. Power is applied to the shaft, which has a bevel gear mounted on it, and a second bevel gear mounted at a right angle to it on a drill shaft, to which a drill bit is attached, and the machine is operated using two major principles: Scotch yoke Mechanism, which converts linear motion of the slider into rotational motion, and power transmission through Bevel Gears.

Praveen Karanam, et.al.,[14] Fabricated the multipurpose mechanical machine. It performs drilling, hacksaw cutting, and shaping operations. The mechanism used is scotch yoke mechanism.

Rajendra Kelwa et al.,[15] Rajendra Kelwa et al.,[15] Rajendra Kelwa et al., It combines two tasks, drilling and cutting, into a single machine. The motor, bevel gear, bearing, pulleys, and V belt are the key components.The most typical circumstance is for a gear to mesh with another gear, but a gear can also mesh with a rack, which is a non-rotating toothed element that produces translation rather than rotation.

Ravi Teggin and colleagues[16] proposed building a versatile woodworking machine. The major goal of this equipment is to cut down on labour time and costs. Planning, Drilling, Forming, and Cutting are the operations conducted, and each operation is fitted with its own shaft that is driven by the main shaft.

The multifunctional grinding machine was invented by Rohit U, et al.,[17]. It combines five different tasks into one machine: centerless grinding, rough grinding, fine grinding, medium grinding, and cutting. Electric motor, V-belt, pulley, shaft, bearing, grinding wheel, and centerless grinding are among the components utilised.

The versatile operating machine was created by Sharad Srivastava and colleagues[18]. For sawing, the scotch yoke mechanism is utilised, and it combines three processes into one machine: drilling, sawing, and grinding.

Yogesh S. Shete, et al.,[19] Fabricated the universal drilling machine, which is a mixture of a hand drill and a bench drill that is aimed to save time and effort. This machine is powered by a 12 volt DC motor. Reaming, Boring, Counter Boring, Counter Sinking, Spot facing, and Tapping are some of the tasks that this machine can execute.

Ankit Kumar Awadhesh, et al.,[20] Singh Ankit Kumar Awadhesh, et al., The multifunctional mechanical machine was created. Whitworth's rapid return mechanism, power transmission to belt drive, and Eccentric and rod mechanism are the three functioning principles.

Sreedhar J, et al. [21] Proposed the construction of a machine for multiple tool design and development. Drilling, grinding, cutting, shaping, and circular saw cutter are the activities conducted, and the mechanism is a scotch yoke mechanism that is utilised for cutting.

Syed Shahnawaz et al.,[22] Syed Shahnawaz et al.,[22] Syed Shahnawaz et al. Sawing is done with a worm gear mechanism, and power transmission is done with a bevel gear mechanism. Drilling, Sawing, and Grinding are the three activities contained in a single machine.

Tao Lu et al.[23] The surface integrity of a machined surface has long been seen as crucial to a machined product's long-term performance.

Vaibhav Dhokpande et al.,[24] Vaibhav Dhokpande et al.,[24] Vaibhav Dhokpande et all..The creation of a versatile wood cutting machine is the subject of this article.

Drilling, grinding, and cutting are the three processes included in a single machine.

Yashraj V. Patil et al. [25] This tooling machine makes use of belt drives with pulleys, bevel gears, and a scotch yoke mechanism. Drilling, Shaping, Cutting, Buffing, and Grinding are the five processes included in a single machine [26].

Based on the literature analysis, we presented a machine that can perform operations such as drilling, cutting, and grinding at many working centres at the same time, demonstrating that industrialists do not need to pay for machines that perform the above duties separately for operation.

3. FABRICATION PROCESS

3.1 Part design and its specifications

The fabrication work is done by the mechanical process known as welding for joining different lengths of mild steel rod for obtaining the structure of frame and connecting the bevel gear with the rotating shaft and also to the motor for performing the operations. Three shafts of different lengths according to the need is taken and at one end of the each shaft is connected to grinding wheel, cutting wheel, and drill bit for performing the multiple operations parts shows on fig. 1.

Fig.1 Fabrication process

There are several number of parts have to assemble for the prototype with various dimensions. The different parts and its specifications will be explained detail below.

3.2 Frame and its specifications

- Length of the frame = 760 mm
- Breadth of the frame = 700 mm
- Height of the frame = 680 mm
- Frame rod = 1 inch

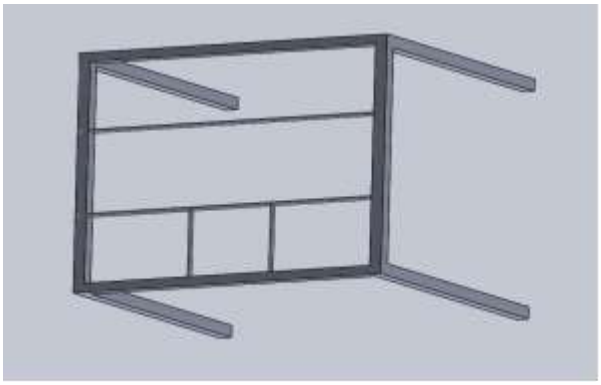


Fig.2 3D Part design of frame

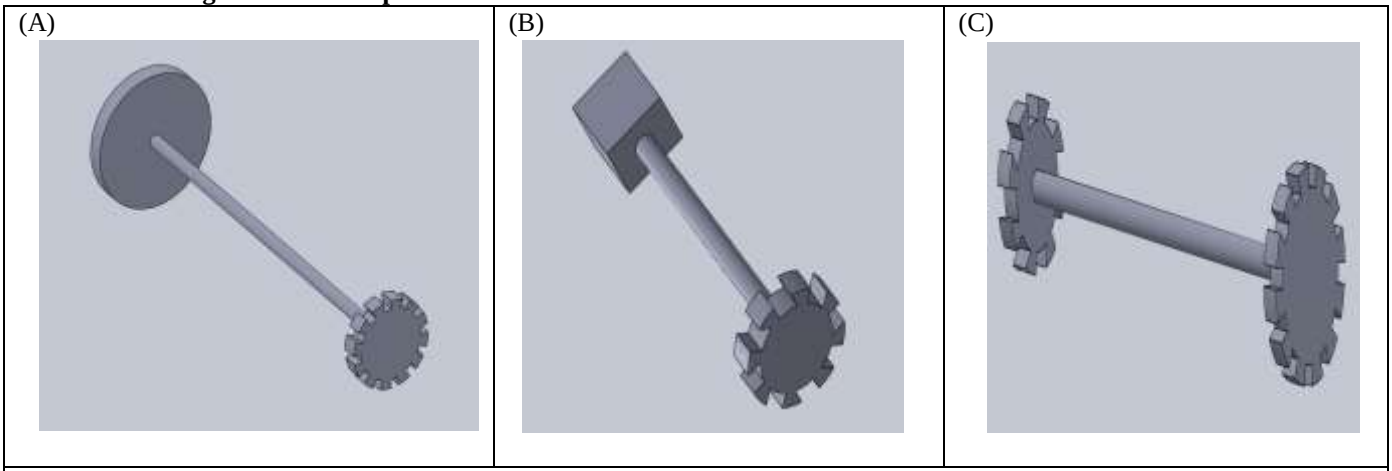
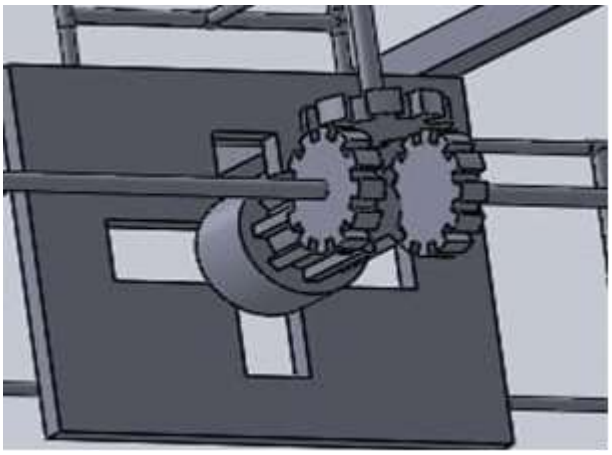


Fig.3. 3D Design of shaft with (a) grinding wheel (b) drill chuck (c) cutting wheel

- Length of shaft with cutting wheel = 480 mm
- Length of shaft with drill bit = 460 mm
- Length of shaft with grinding wheel = 420 mm
- Diameter of the shaft = 12 mm

3.3 Bevel gears and its specifications



- No. of teeth in driver gear connected to motor = 10 Nos.
- No. of teeth in driven gears connected to shaft = 16 Nos.
- No. of teeth in driver gear connected to shaft of drill chuck = 20 Nos.
- No. of teeth in driven gear connected to drill chuck = 20 Nos.

3 Assembly of Prototype model

Fig.4. Bevel gear mechanism

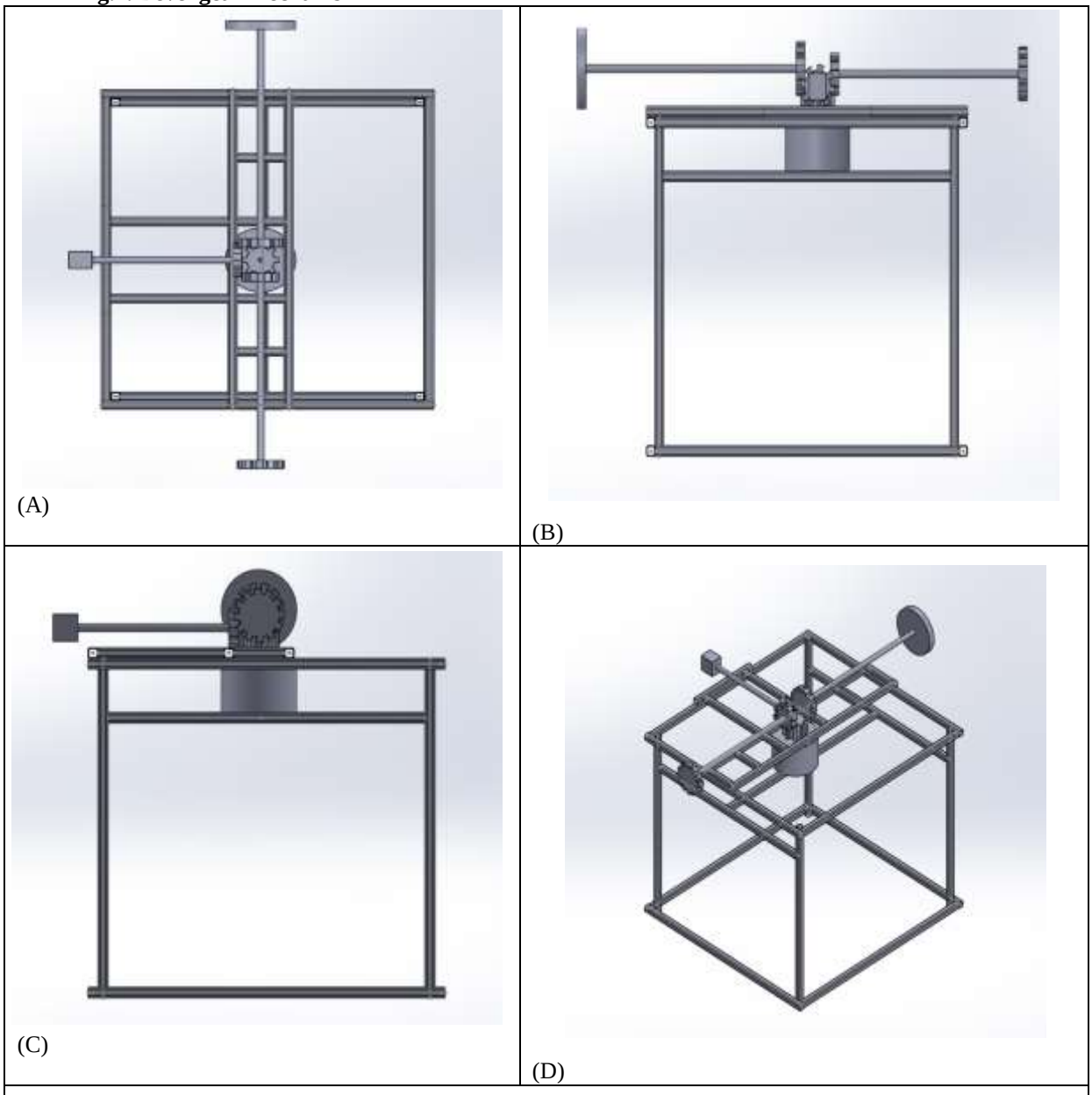
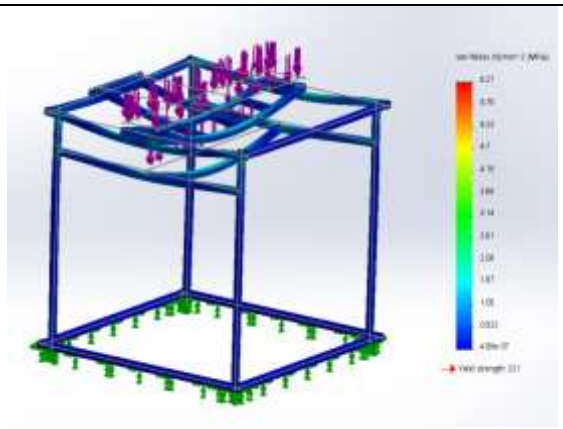


Fig.5. Assembly of Prototype model (a) Top View (b) Left Side View (C) Elevation (d) Isometric View

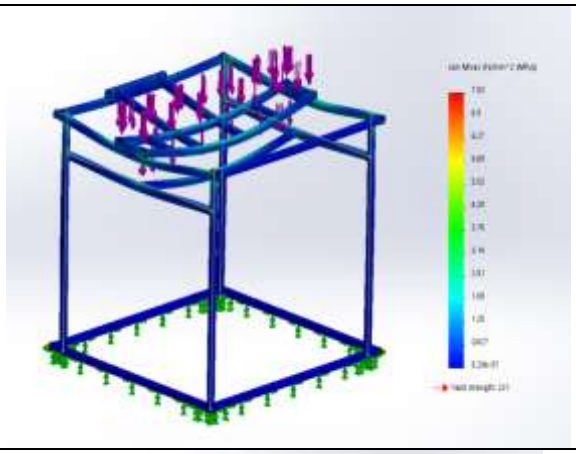
4. RESULTS AND DISCUSSION

4.1 STRESS ANALYSIS

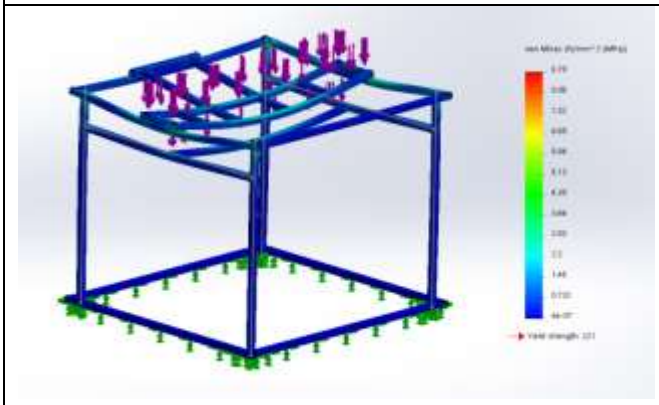
(A)



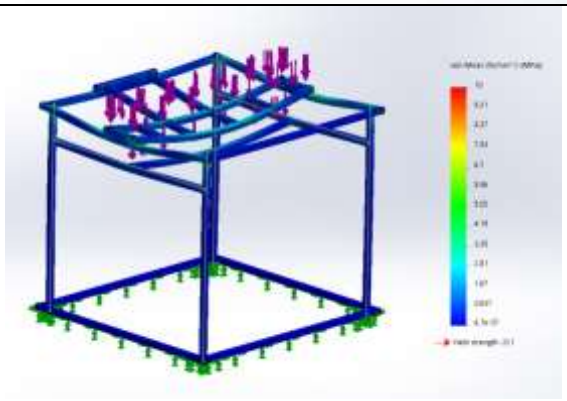
(B)



(C)



(D)



(E)

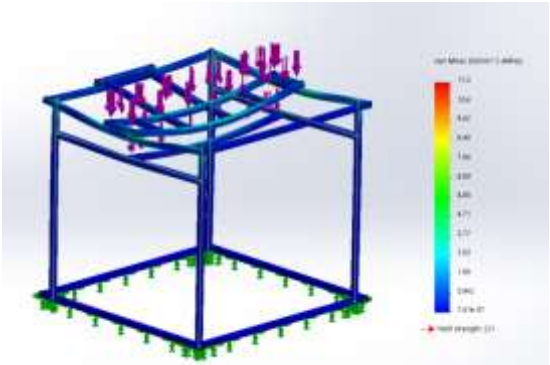
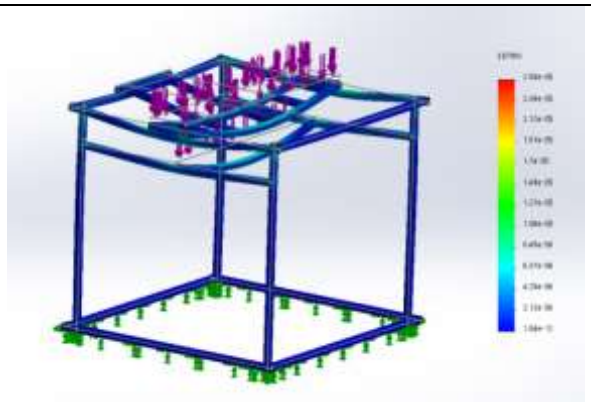


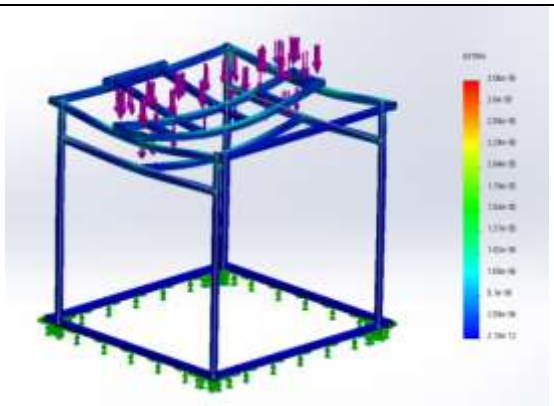
Fig.6 Stress diagram (A) 3 Kg (B) 4 Kg (C) 5 Kg (D) 6 Kg (E) 7 Kg

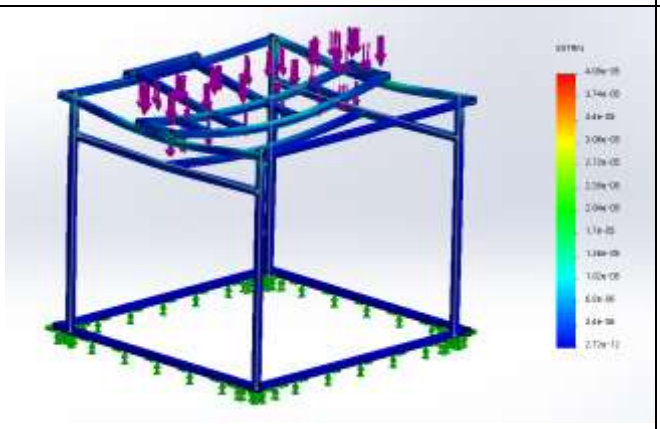
4.2 STRAIN ANALYSIS

(A)

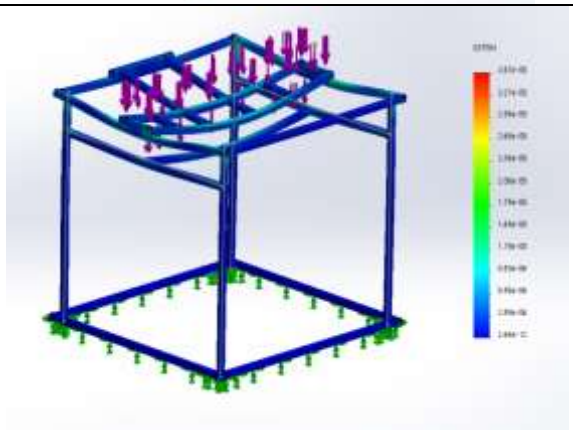


(B)





(C)



(D)

(E)

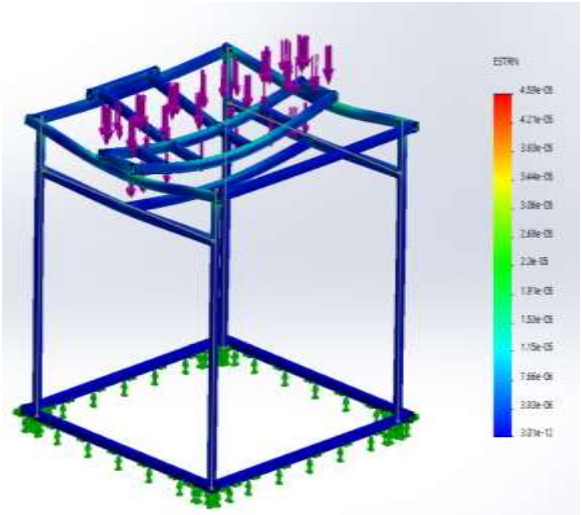


Fig.7 Strain diagram (A) 3 Kg (B) 4 Kg (C) 5 Kg (D) 6 Kg (E) 7 Kg

4.3 DISPLACEMENT ANALYSIS

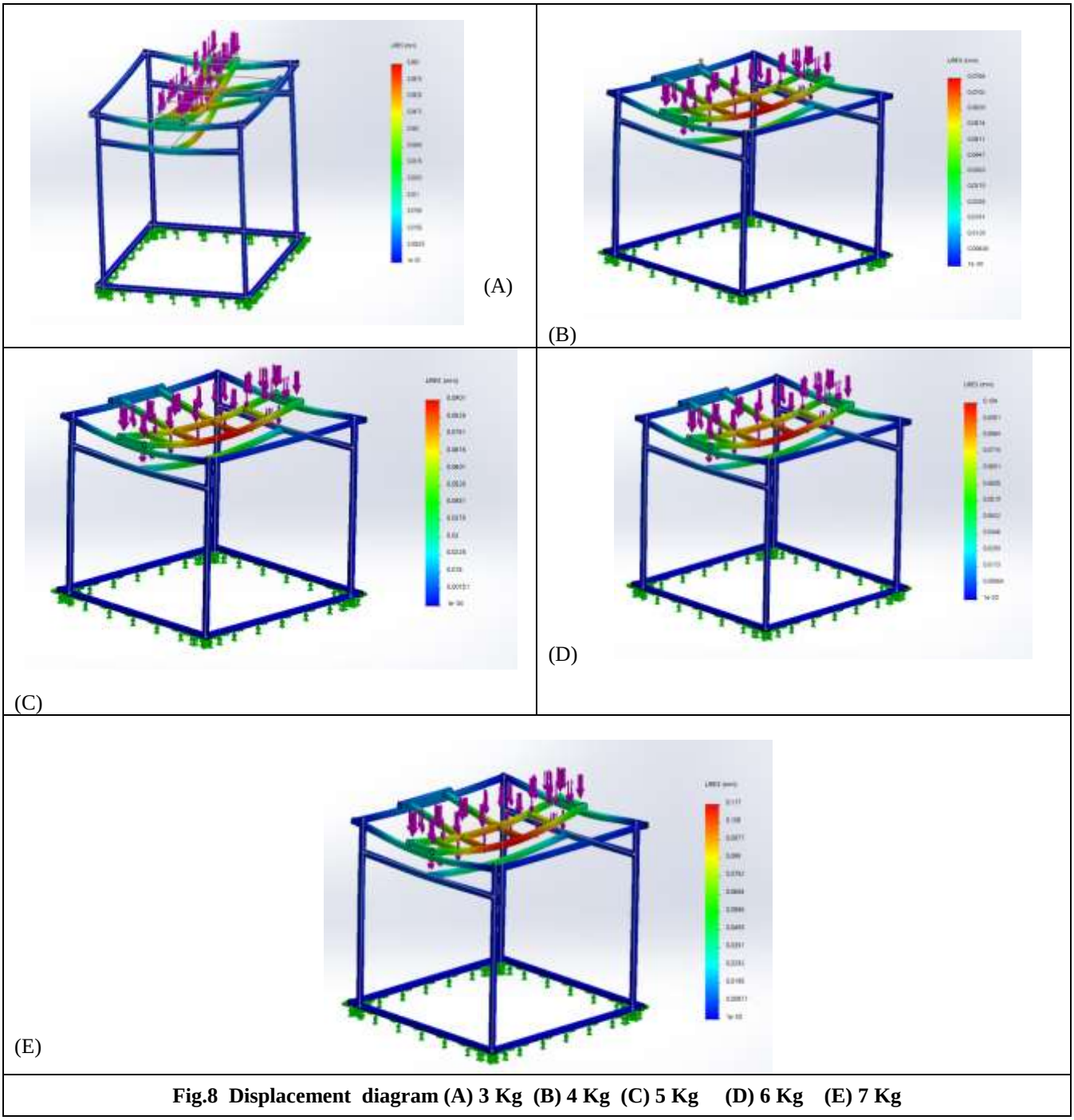


Fig.8 Displacement diagram (A) 3 Kg (B) 4 Kg (C) 5 Kg (D) 6 Kg (E) 7 Kg

Table 1 Load Applied VS Stress Indused (N/mm^2)

Load Applied(Kg)	Stress Indused(N/mm^2)
3kg	6.27
4kg	7.53
5Kg	8.79
6kg	10
7kg	11.3

Table 2 Load Applied VS Strain Indused

Load Applied(Kg)	Strain Indused
3kg	0.0000255
4kg	0.0000306
5Kg	0.0000357
6kg	0.0000408
7kg	0.0000459

Table 3 Load Applied VS Displacement (mm)

Load Applied(Kg)	Displacement(mm)
3kg	0.063
4kg	0.0766
5Kg	0.0911
6kg	0.104
7kg	0.117

4.4 SPEED CALCULATIONS

4.4.1 Shaft speed

Speed of driver gear (N_G) = 1440 RPM
No. of teeth in driver gear (T_D) = 10 Nos.
No. of teeth in driven gear (T_d) = 16 Nos.
Velocity ratio (VR) = T_D/T_d
= 10/16 = 0.625
Speed of driven gear (N_g) = $VR \times N_G$
= 0.625×1440
= 900 RPM

4.4.2 Drilling speed

Speed of driver gear (N_G) = 900 RPM
No. of teeth in driver gear (T_D) = 20 Nos.
No. of teeth in driven gear (T_d) = 20 Nos.
Velocity ratio (VR) = T_D/T_d
= 20/20 = 1
Speed of driven gear (N_g) = $VR \times N_G$
= 1×900
= 900 RPM

5. CONCLUSION

1) All production-based sectors desire low production costs and a high work rate, which can only be achieved by utilising multi-function operating machines that consume less power, time, and labour.
2) Because this equipment allows you to work at multiple centres, you can cut down on your time to a significant extent.
3) In a given industry, a significant amount of the investment is spent on machinery installation, which is quite expensive.
4) The machine is very handy for small businesses.
5) Workers' movements can be reduced to a minimum.
6) A single machine may do a large number of processes.
7) The amount of energy used is lowered.
8) The amount of floor space required is lowered.
9) Manufacturing costs are also lowered.

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