Pedal Powered Elliptical Trainer Cum Wet Grinder

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***Abstract*: Nowadays most of the machines are performing one operation at one time because of that it consumes much more time & also those machines are driven by electricity and highly expensive. The machine operating by means of electricity has limited application in the rural area. Therefore, it is possible to convert human applied energy through pedaling into mechanical work. It will save cost, electricity as well as find application in rural area. Two operations like grinding and drilling will be done by pedaling. A person can generate four times more power by pedaling than by hand cranking. The system is also useful for the work out purpose because pedaling will act as a health exercise and also doing a useful work. Now a days grinder is used for grinding and elliptical trainer is used for excercise. In olden days Ammi kal is used. It plays a major role in grinding and workout. The multipurpose machine that is excercise bicycle which was basically used for exercising purpose has been modified for grinding without the help of electricity. The consideration for designing was to grind and to workout by using a pedal and lever.**

***Keywords:* elliptical trainer, pedal power, grinder.**

I. INTRODUCTION

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces und adding a filler material to com a pool of molten material (the weld pool) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve molting a lower-melting point material between the work places to form a bond between them, without melting the work pieces. Many different energy sources can be used for welding, including a gas flame, an Electric are, a laser, an electron beam, friction, and ultrasound. While often an industrial Process, welding may be performed in many different environments, including open air, Under water and in outer space. Welding is a potentially hazardous undertaking and Precautions are required to avoid burns, electric shock, vision damage, inhalation of Poisonous gases and fumes, and exposure to intense ultraviolet radiation. Welding is a material joining process which produces coalescence of material by heating them to suitable temperatures with or without the application of pressure or by the application of pressure alone, and with or without the use of filler material. Welding is used for making permanent Joints. It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building.

Elliptical Trainer

An elliptical trainer or cross-trainer (also called an X-trainer) is a stationary exercise machine used to stair climb, walk, or run without causing excessive pressure to the joints, hence decreasing the risk of impact injuries. For this reason, people with some injuries can use an elliptical to stay fit, as the low impact affects them little. Elliptical trainers offer a non-impact cardiovascular workout that can vary from light to high intensity based on the speed of the exercise and the resistance preference set by the user. Elliptical trainers first entered the market in the 1990s, invented by Precor.

Most elliptical trainers work the user's upper and lower body (although some models do not have moving upper body components). Though elliptical trainers are considered to be minimal-impact, they are an example of a weight-bearing form of exercise. They can be self-powered by user-generated motion or need to be plugged in for adjustment of motion and/or for supplying their electronic consoles and resistance systems.

Elliptical riders use an arrangement of links known to the kinematics community as four-bar linkage. The pedals are attached to the floating link referred to as the coupler. The first published work on the subject of elliptical path generation is given in 1988 by researchers at Purdue University in which the path of a point on the floating link is shown to approximately follow an elliptical shape. In 1995, Precor introduced the Elliptical Fitness Cross-trainer (EFX), the first piece of exercise equipment to allow the foot to roll from heel to toe just like in running. Its patented mechanism weds a rear flywheel with a forward foot pedal, creating a smooth, elliptical movement. This is key to foot comfort and reduces numbing of the foot experienced on other stationary cardio equipment.

This approach is classified as "low impact" as it keeps a person's heels in contact with the pedals, reducing muscle and tendon stress. An elliptical cross trainer is comparable to a treadmill in its exertion of leg muscles and the heart. Elliptical produce an intermediate range of leg motion between that of stationary bikes and treadmills

In a 2010 study, 9 males and 9 females were chosen to exercise at the same RPE on the treadmill or elliptical and found that energy expenditure and oxygen consumption were the same in the two forms of exercise equipment. Thomas Altena, a professor of nutritional and exercise physiology at the University of Missouri, measured oxygen retention, lactic acid build-up, heart rate, and perceived rate of exertion to compare treadmills and elliptical trainers, finding that the "physiological responses associated with elliptical exercise were nearly identical to treadmill exercise". However, it is important that the resistance set on the elliptical machine is at a relatively high setting, depending on the user. Since users do not take their feet off the pedals, there is no footfall noise in contrast with other fitness trainers such as treadmills.

A 2002 study by the University of Idaho shows that varying the stride length on the elliptical trainer can recruit a larger variety of muscle groups. The study also showed that as the stride is lengthened, more calories are burned without any higher rate of perceived exertion by the user. This study is in agreement with the claims made about the adjustable stride length feature on some newer elliptical.

Table 1.1 Calories burned using elliptical trainer

Morning Workout (Min)	***Evening Workout (Min)***	***Calories Burned (Cal)***
30	30	820

Wet Grinder

A Wet grinder is a food preparation appliance used especially in Indian cuisine for grinding food grains to produce a paste or batter. Wet grinding is rare in western cuisine but common in Indian cuisine. These grinders generally consist of a few granite stone plates that are rolled against another stone plate with the items to be ground between them. Wet grinders have two advantages over electric mixers or blenders. First, the stone grinder generates less heat than a mixer; heat affects the flavor of the food. Second, the stones remain sharp for a greater time than do metal blades.

As the product was invented in the city, Coimbatore naturally emerged as a center for the manufacture of wet grinders. The availability of raw material in the form of granite stones, electric motor manufacturing units and the necessary heavy equipment such as lathes, drilling and milling machines used in manufacturing aided the development of the industry. The city contributes to about 75% of the 1 lakh total monthly output of wet grinders in India. The industry employs 20,000 people directly and provides indirect employment to 50,000. In 2011, the cluster had a yearly turnover of ₹225 crores (US$32 million) which grew to ₹2,800 crores (US$390 million) in 2015.

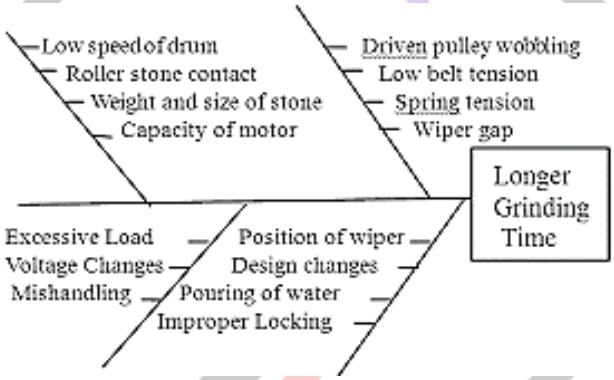

Fig 1 Report on analysis done in wet grinder

Need of Development of Machine

In the present scenario machines are electrically driven. Machine with electric motor are faster but that are costly as well as required electricity. The unit operating by means of electricity has limited applications in the rural area. In remote and interior places there is no facility of electricity as well as in urban areas, while in the duration of load shading or during electrical power off timings, this type of human power operated unit will have very extensive utility. Therefore, this human powered machine is having extensive utility in such areas. Also it reduces the machining equipment cost as two machines can be used simultaneously on same platform.

The operation can be powered manually for the following reasons.

- To reduce electricity
- To increase the work load to attain workout.
- To reduce the production time.
- Can be used both as grinder and elliptical trainer in homes.

II. LITERATURE REVIEW

R. Subash, K. Samuel Jayakaran, (2014), In this paper author has designed Pedal operated hacksaw machine which can be used for industrial applications and Domestic needs in which no specific input energy or power is needed. This project consists of a sprocket arrangement, the eccentric disc mechanism, the chain drive. In the mechanism, chain drive is directly connected between the primary shaft and secondary shaft, these both shafts are mounted on the primary stand and secondary stand. The flywheel and pedal arrangement is arranged on the primary shaft. On the secondary shaft the eccentric disc mechanism for cutting operation, the gear mechanism for the wet grinding and washing machine and cam is used for striking operation are arranged. Whereas the DC generator arranged on the primary stand and their wheel i.e., generator wheel is generating the power, that power is using in this project as a cell phone charging.

David Gordon Wilson, (1986), more power (1/4 horsepower continuous at half this person to drive effort and fatigue. Pedal power also lets one drive d winnower), or operate The main use of watts and above of pedal power seem to power is unavailable their wheel i.e., generator wheel is generating the power, that power is using in this project as a cell phone charging. avid Gordon Wilson, (1986), power (1/4 horsepower continuous pedaling is for can at half this power (1/8 hp) can be sustained for around 60 minutes. Pedal power enables a person to drive devices at the same rate as that achieved by hand effort and fatigue. Pedal power also lets one drive d winnower), or operate The main use of pedal watts and above of pedal power – for seem to be potentially power is unavailable their wheel i.e., generator wheel is generating the power, that power is using in this project as a cell phone charging. avid Gordon Wilson, (1986), power (1/4 horsepower pedaling is for can power (1/8 hp) can be sustained for around 60 minutes. Pedal power enables a device at the same rate as that achieved by hand effort and fatigue. Pedal power also lets one drive d winnower), or operate devices that require too much power for hand pedal power today is still for bicycling, least in the high watts and above of mechanical power). In the lower for agriculture, construction, water pumping, and electrical generation be potentially advantageous, at least when electrical or internal power is unavailable or very expensive avid

Gordon Wilson, (1986), According to the author, a power (1/4 horsepower (hp)) by pedaling than by hand pedaling is for can done only short periods, about power (1/8 hp) can be sustained for around 60 minutes. Pedal power enables a device at the same rate as that achieved by hand effort and fatigue. Pedal power also lets one drive d devices that require too much power for hand power today is still for bicycling, least in the high mechanical power). In the lower agriculture, construction, water pumping, and electrical generation advantageous, at least when electrical or internal very expensive.

In the state of the art literature, US Pat No. 5872413 teaches a pedal activated motor attachment for a hand operated food grinder for allowing a user to convert a hand operated machine into a pedal driven machine; US Pat No. 7253534 discloses a method and apparatus for converting human power into electricity, wherein the force exerted on the pedals is transferred to a generator via a gear-to-gear transmission assembly; US Pat No. 7504737 is continuation-in-part of the prior art identified by US Pat No. 7253534;

CCATs Pedal Power Grinder, a published project by Bart Orlando, teaches a grinder driven by pedaling means. Similarly, pedal-powered grain grinders are known to be made by Maya Pedal (http://mavapedal.org/). a Guatemalan NGO based in San Andres Itzapa. However, the said inventions use fan belt and chain to transfer the rotational kinetic energy from the pedals to the grinder shaft.

III. Problem Description

Now a days grinder is used for grinding and elliptical trainer is used for excercise. In olden days Ammi kal is used. It plays a major role in grinding and workout. The multipurpose machine that is excercise bicycle which was basically used for exercising purpose has been modified for grinding without the help of electricity. The consideration for designing was to grind and to work out by using a pedal and lever. The major factor for developing this powered operated or powered grinder are coming under follows:

- Can we control electricity bill
- Is cost is feasible
- Is the output is sufficient.

In order to ensure good output and workout, pedals and hand lever is used. The pedal is used by leg and the lever is used by hand. It is estimated to work out at same time with more efficiency. This product reduces electricity and cost along with a better health.

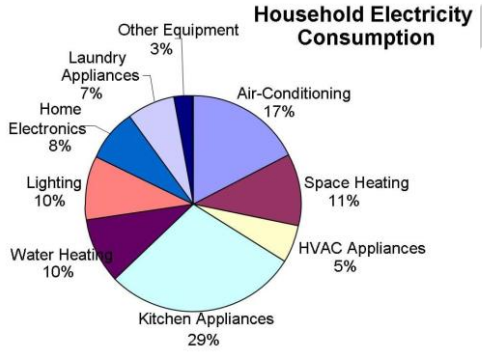

Fig 2 Household electricity consumption

Table 2 Percentage of efficiency

Factors/ Equipment's	***Ancient Equipment's***	***Electric Grinder/Mixer***	***Orbitrek***
Electricity	0%	50%	0%
Price	20%	50%	90%
Result	Output: 48% Workout:48%	Output: 48% Workout: 0%	Output: 0% Workout:48%

IV. Experimental Work

Today in the industries production have been made very quick and fast because of a new technology but this technology also demands a high investment. Our human powered machine is cheap that's why it reduces a cost of production. Electrically driven machines are mostly heavy weighted because of this it cannot be used for a mobile use. This automation is also become a cause of a

worker`s weaker health. Pedal operated machine also increase human health by a pedaling process its work as an exercise. Mostly electrically driven machines are single purpose machines. That`s why it increases a machine equipment cost. Our multipurpose machine can be used for a more than one operations simultaneously on a same platform.

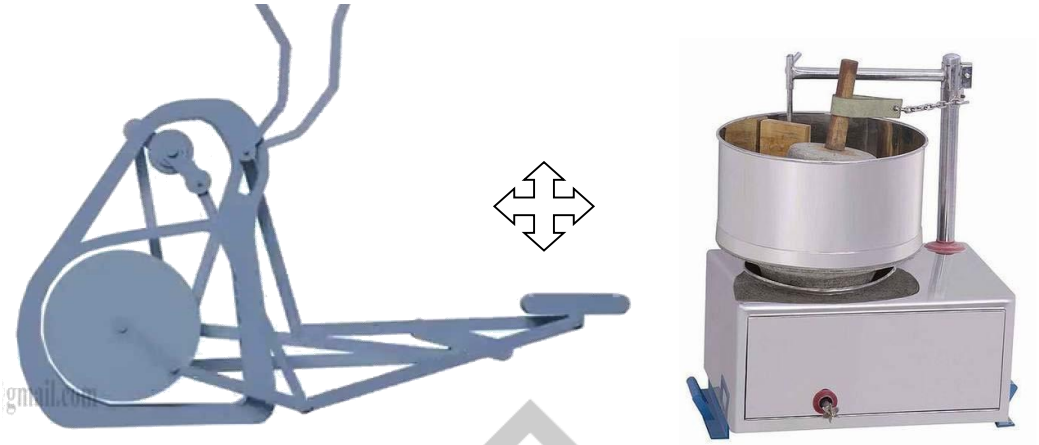

Fig 3 Combining elliptical trainer and a wet grinder

Requirements and Its Parts

- Tension belt
- Crank shaft
- Craing bearing
- Foot pedal right side
- Shaft and brush bush
- Crank wheel
- Display meter
- Allen key bolt
- Hand grip
- Cylindrical drum
- Gear
- Belt
- Pulley.

Technology Behind It

A pedal operated wet grinder devoid of any belt or chain transmission is disclosed. The grinder is operated by pedaling means, wherein the rotational kinetic energy generated from pedaling is transferred to the grinder drum through bevel gear-shaft assembly means. The said grinder is fixed on a suitable support mechanism, complete with seating and handle means for the user.

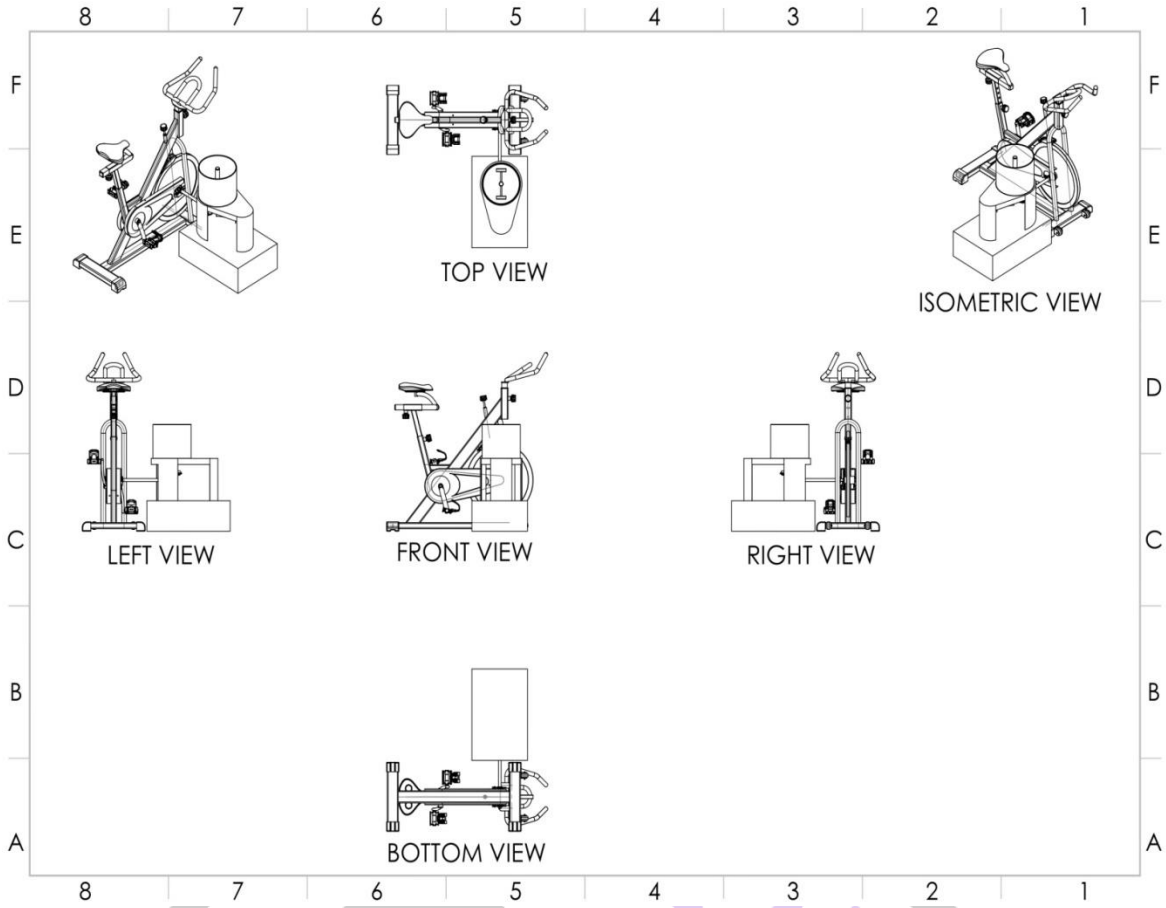

Fig 4 Drafted different views of pedal powered wet grinder

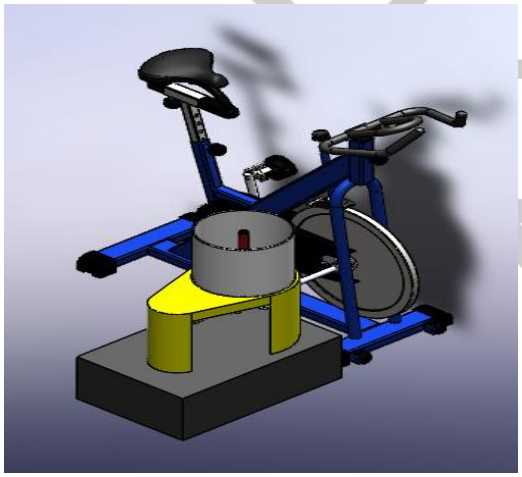

Fig 5 3D View

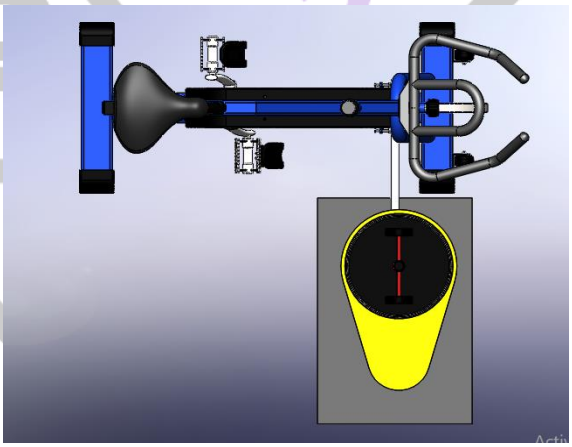

Fig 6 3D top view

Design Calculations for Pedal Operated Multi-Purpose Machine

Chain Drive Design:

Speed of rotation of pinion = 800 r.p.m

- Speed of rotation of wheel = 500 r.p.m

1) Transmission Ratio = N1/N2 = 800/500 = 1.6

2) Transmission Ratio 1.6 therefore Z1 is taken in between (30-27 using psg data book) Z1 = 28 3) Z2 = i×Z1 = i × 28 = 1.6×28 = 44.8 ≈ 45

4) Assume center distance is 635mm

Optimum center distance a = (30 to 50) P [Eq 1]

635 = 40P

Pitch (P) = 15.875 mm

5) Calculation of Power Transmitted on the basis of Allowable Bearing Stress N = (σ×A×V ÷ 102× ks) in kw

σ For (Z1=28 & N1=800) is 2.42 kgf/cm2 & projected bearing area =0.26 cm2 ks = k1. k2. k3. k4. k5. k6 Ks= 1.5×1.25×1×1×1.5×1 = 2.8125

V= Z1 × N1 × P ÷ 60×1000 = (28×800×15.875) ÷ (60×1000) =5.92 m/s

N= (2.42×0.26×5.92) ÷ (102×2.8125) = 0.01298 kW

4) Power Transmitted on the basis of Breaking Load

= Breaking Load= 820 for R1548

N= (Q×V) ÷(102×n×ks) = (820×5.92)÷(102×10.2×2.8125) = 1.65 kw

5) Check for Factor for Safety= [n]= Q÷ [∑p]

[n]=actual factor of safety should be greater than allowable

∑p= Pt + Pc + Ps

Pt = 102N÷V , if N in kw =(102×1.65)÷(5.92) =28.42 kw [7.78] Pc = wv ÷ g = (0.29×5.292)÷(9.81)=1.036 [7.78]

where w = weight per meter of chain, kgf = 0.29 [Eq 2]

Ps =k. w. a where k = coefficient of slag =6 a = center distance in m =0.635m [Eq 3] Ps =0.635×6×0.29=1.1049

∑p= 28.42+1.036+1.1049 = 30.5609 [n]= 820÷30.5609 = 26.83

Here, 26.83>10.2 therefore design is safe. Calculated actual factor of safety is greater than Minimum factor of safety than the design is safe

Calculation of actual length of chain (lp) = 2ap + ((Z1+Z2)/ (2)) + ({(Z2-Z1)/ (2∏)} 2/ {ap}) ap = (ao)/(p) = 40 mm lp = 80+36.5+0.18225 = 116.68 mm

6) Calculation of exact center distance (a)=(e+√(e2−8m)×p) ÷ (4) m= ((Z2−Z1)÷ (2∏))2

7) Calculation of pitch diameter of sprocket, d1= = 141.97 mm

DESIGN OF BELT DRIVE = Data available is

Power = 1.65 kW Driver speed = 500 rpm Transmission ratio (i) = 2 Center Distance(c) = 1.5m Driven pulley diameter = 0.630m

1) Selection of std. Pulleys = i = D/d = n/N 2= 630/d therefore d= 315mm

Tolerances on nominal diameter = + or - 3.2 mm (page no 7.54)

2) Design power calculation =

Design power = (Rated kW × Load correction factor)/ (Arc of contact factor × small pulley Factor) For shock load correction factor = 1.5 (page no 7.53)

Arc of contact = 180*- {(D-d)/(c)} × 60 (page no 7.54) = 167.4* For arc of contact 167.4* Arc of contact factor = 1.04 (page no 7.54) For transmission ratio (I) =2 small pulley diameter factor = 1.13 (7.62)

3) Selection of Belt= Dunlop "FORT" Belt is selected based on load type. (Page no 7.52)

4) Load Rating and No. of Belt Plies =V= (∏×D×N) ÷ (60) = (∏×0.315×500) ÷ (60) = 8.25 m/s Load rating at V m/s = load rating at 10 m/s × (V/10) (page no 7.54)

= 0.0289×(8.25/10) = 0.02384 kw/mm/ply

Based on the values of V= 15.05 m/s & d= 400mm from page no (7.52) No of plies = 6

5) Selection of std. Belt width =

From page no 7.52 for FORT type & 6 ply belt std. width of belt = 112mm

6) Calculation of belt length (page no 7.53) =

For open belt drive L = 2c + (∏/2) × (D+d) + (D−d) 2/ (4c)

= 3000+1484.40+16.53 = 4500.93mm

Pulley Dimensions (page no 7.54) =width of pulley from page no 7.54 pulley width = 125 mm from page no 7.55 std, pulley width = 125mm Tolerance is +or- 1.5mm No.of arms (from page no 7.56) for small pulley, 4 arms for larger pulley, 6 arms

Crowing of pulley (from page no 7.55)

For small pulley, (d=315mm & pulley width =125mm) h = 1mm

For larger pulley, (D=630mm & pulley width=125mm) h = 1mm

Design Analysis

Stress-Stress Analysis

Stress–strain analysis (or stress analysis) is an engineering discipline that uses many methods to determine the stresses and strains in materials and structures subjected to forces. In continuum mechanics, stress is a physical quantity that expresses the internal forces that neighboring particles of a continuous material exert on each other, while strain is the measure of the deformation of the material.

In simple terms we can define stress as the force of resistance per unit per unit area, offered by a body against deformation. Stress is the ratio of force over area (S =F/A, where S is stress, F is the external force or load and A is the cross-sectional area). Strain is the ratio of change in length to the original length, when a given body is subjected to some external force (Strain= change in length÷the original length).

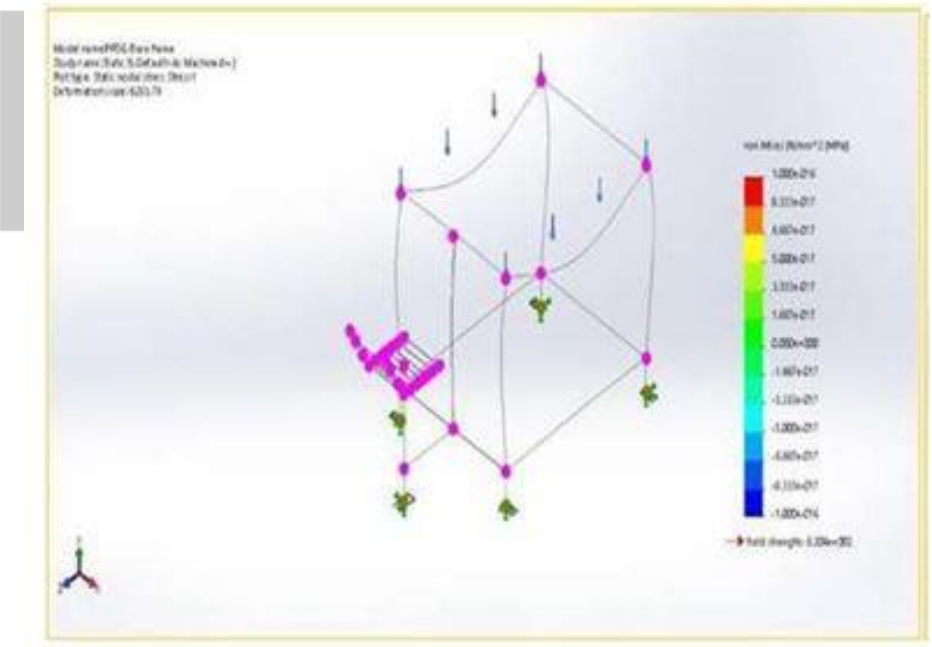

Fig 4.4 Stress-stress analysis

Displacement Analysis

The word displacement implies that an object has moved, or has been displaced. Displacement is defined to be the change in position of an object.

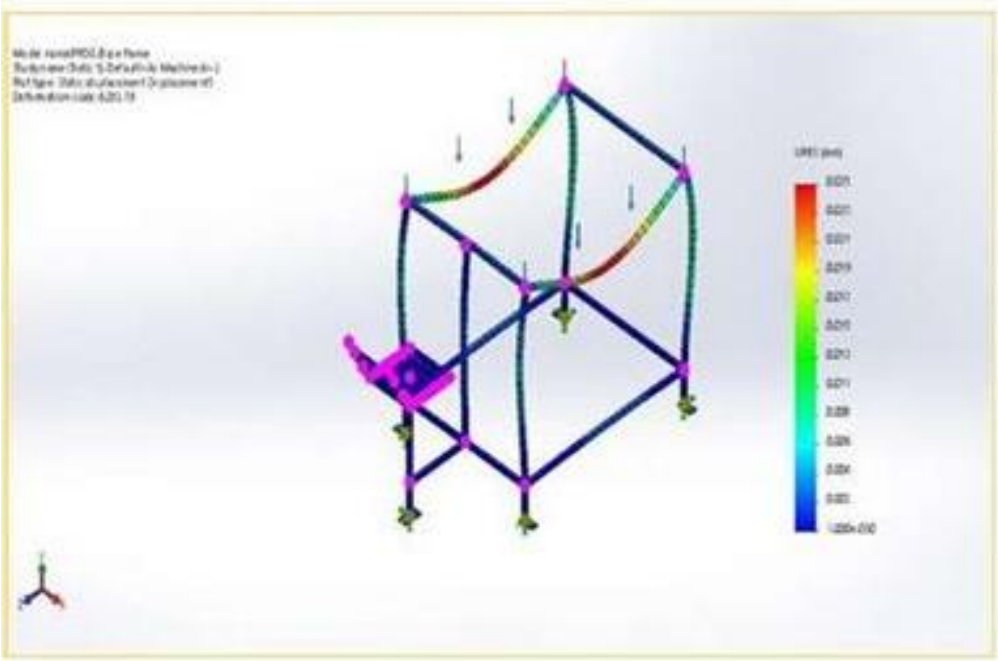

Fig 4.5 Displacement analysis

V. CONCLUSION

By using this machine, we can perform more than two operations simultaneously which save the production time as well as cost. For operating this machine there is no need of very high skilled worker. This machine is very useful in rural area because regular power cut-off is takes place in rural area.

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