DESIGN OF A PLASTIC / RUBBER SHREDDER MACHINE FOR RECYCLING AND MANAGEMENT OF WASTE

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ABSTRACT

The world is facing a huge crisis of waste management. The amount of plastic waste is increasing with a very high rate. In order to tackle the problem of plastic waste management, the plastic should be recycled. In this project stage we are going design a machine which is able to shred the plastic and rubber material. For designing the shredder machine Blade is an important part. If we design a blade which has High fundamental frequency and more stiffness the blade life lasts longer. In this stage of project, we are going to design a digital 3D model of shredder blade and we are going to modal analyze the for finding the fundamental frequency. Also, in this project it describes about the experimentation of plastic and rubber waste cutting machine and analysis of cutting blade tooth with respective thickness and teeth position. We are making this project model for recycling of plastic and rubber wastage in domestic area; industries as well as it can be useful for plastic-soil bricks or rubber - soil bricks. A comparative study of burnt brick and plastic/ rubber -concrete bricks is done to showcase the advantage of plastic/ rubber -concrete bricks in areas of strength, weight, economy, etc. Compression strength test was performed on the plastic/ rubber -concrete bricks in ANSYS.

Key Words: - *Design Optimization, Waste management, Shredding machine, recycle*

1. INTRODUCTION

Municipal solid waste (MSW) generation in developing countries could be a major concern to government, establishment and therefore the society at large; this solid waste is worrisome particularly with associate increasing population pressure and socio-economic factors. Solid wastes are the unusable and undesirable product in solid state, discarded by members of the society. Generally, solid wastes will be classified on the idea of their supply as: Municipal Solid Waste, Industrial Solid Waste and Agricultural Solid Waste. Most cities in Asian country pay 20-50% of their environmental budget on solid waste management and solely 20-80% of the waste is collected. what is more, the quality of solid waste management in Asian country is at its lowest with poor documentation of waste generation rates, inefficient storage and assortment system, and therefore the under-utilization of disposal sites. India's urban cities are nowadays troubled to clear plenty of solid waste from its setting. Strategic centers of desirability in Asian country are currently seized by the disorderliness nature of unattended heaps of solid waste emanating from the society. town officers seem unable to combat unlawful merchandising of solid house-hold and industrial waste, that could be a clear dirtiness of the clean Air and Health Edicts in our environmental sanitation laws and laws in Asian country. Plastic waste could be a constituent of the solid waste stream of that polythene terephthalate (PET) could be a half. PET is employed to supply plastic & Glass bottles different and several other} other plastic product. Most bottles made from PETs are clear in nature and used for packaging water, soda etc. they're non-biodegradable and might keep unchanged for as long as 4500 years on earth inflicting menace to our lands, streams and avoidance systems. Plastic waste accounts for quite 2 hundredth of the municipal solid waste stream in Asian country. the matter of plastic waste isn't solely restricted to Asian country rather it's a worldwide development. The world's annual consumption of plastic materials has enhanced from around five million tons within the 1950's to quite a hundred million tons; so, twenty (20) times additional plastic is made nowadays than within the past fifty (50) years ago. This merely means additional resources are getting used to satisfy the enhanced

demand for plastic, thus, additional plastic waste is being generated. the continual increase in atmospheric condition as a result of warming in addition to the dearth of accessible safe potable in each rural and concrete areas of India's growing population drives constant demand for drinking water. though some areas do have public water systems on the market however distribution channels aren't sure to supply safe potable. several Indians own non-public boreholes however the purification system is usually poor. A shredding machine is meant to cut back giant solid material objects into a smaller volume, or smaller items. Shredding machines are typically wont to scale back the dimensions and form of materials so that they will be with efficiency used for the aim meant to. Shredding a bit like crushing will be outlined because the method of transferring a force amplified by ratio through a cloth fabricated from molecules that bond along additional powerfully, and resist deformation additional, then those within the material being crushed do. The shredding materials should possess an improved strength and toughness than the plastic materials.

2. BACKGROUND

Municipal solid waste (MSW) generation in developing countries could be a major concern to government, establishment and therefore the society at large; this solid waste is worrisome particularly with associate increasing population pressure and socio-economic factors. Solid wastes are the unusable and undesirable product in solid state, discarded by members of the society. Generally, solid wastes will be classified on the idea of their supply as: Municipal Solid Waste, Industrial Solid Waste and Agricultural Solid Waste. Most cities in Asian country pay 20-50% of their environmental budget on solid waste management and solely 20-80% of the waste is collected. what is more, the quality of solid waste management in Asian country is at its lowest with poor documentation of waste generation rates, inefficient storage and assortment system, and therefore the under-utilization of disposal sites. India's urban cities are nowadays troubled to clear plenty of solid waste from its setting. Strategic centers of desirability in Asian country are currently seized by the disorderliness nature of unattended heaps of solid waste emanating from the society. town officers seem unable to combat unlawful merchandising of solid house-hold and industrial waste, that could be a clear dirtiness of the clean Air and Health Edicts in our environmental sanitation laws and laws in Asian country. Plastic waste could be a constituent of the solid waste stream of that polythene terephthalate (PET) could be a half. PET is employed to supply plastic & Glass bottles different and several other} other plastic product. Most bottles made from PETs are clear in nature and used for packaging water, soda etc. they're non-biodegradable and might keep unchanged for as long as 4500 years on earth inflicting menace to our lands, streams and avoidance systems. Plastic waste accounts for quite 2 hundredth of the municipal solid waste stream in Asian country. the matter of plastic waste isn't solely restricted to Asian country rather it's a worldwide development. The world's annual consumption of plastic materials has enhanced from around five million tons within the 1950's to quite a hundred million tons; so, twenty (20) times additional plastic is made nowadays than within the past fifty (50) years ago. This merely means additional resources are getting used to satisfy the enhanced demand for plastic, thus, additional plastic waste is being generated. the continual increase in atmospheric condition as a result of warming in addition to the dearth of accessible safe potable in each rural and concrete areas of India's growing population drives constant demand for drinking water. though some areas do have public water systems on the market however distribution channels aren't sure to supply safe potable. several Indians own non-public boreholes however the purification system is usually poor. A shredding machine is meant to cut back giant solid material objects into a smaller volume, or smaller items. Shredding machines are typically wont to scale back the dimensions and form of materials so that they will be with efficiency used for the aim meant to. Shredding a bit like crushing will be outlined because the method of transferring a force amplified by ratio through a cloth fabricated from molecules that bond along additional powerfully, and resist deformation additional, then those within the material being crushed do. The shredding materials should possess an improved strength and toughness than the plastic materials.

3. LITERATURE REVIEW

Hongshen Oluwatobi I. Okunola, Damilola A. Oyebade, Olawale O. Olanrewaju et.al [1], Plastics, attributable to its far and wide use in practically all areas, has become a first significant ecological danger confronting humanity and reusing is viewed as the best and reasonable choice to handle this risk. The motivation behind this exploration was to create and assess PET containers destroying and clothes washer for squander the executives and reusing. The exploration was pointed toward destroying PET containers into required sizes with a space of 0.001m2 (10mm x 10mm) for a plastic pelletizer. The machine created performs washing, cleaning and destroying of PET jugs utilizing

turning cutting edges are masterminded in drill like way, different highlights of the machine incorporate container, washing chamber, movable screen and divergent siphon. The machine was planned with high thought for security, simple activity, productivity and cost. The machine has the ability to shred 50-75kg of PET jugs each hour. The reusing productivity, destroying effectiveness and rate maintenance are the boundaries used to assess the presentation of the machine at variable activity speeds (187.5rpm, 273.8rpm and 350.2rpm) and taking care of rates (1.0kg/hr, 1.8kg/hr and 2.4 kg/hr). Tests results showed higher proportion of the destroyed plastic of the ideal size at 1.8kg/hr and 350.2rpm, representing 60.01% destroying productivity. The reusing productivity of the destroying and clothes washer is 93.73% at 273.8rpm and 1.8kg/hr taking care of rate, with the most elevated maintenance of 17.9% at 2.4kg/hr taking care of rate and 185.7rpm. The destroying and clothes washer will be utilized in blend with plastic pelletizing machine in a waste reusing plant.

Xianyan Zhou, Zhili Hu, Xiang Xiao and Mingbo Li et.al [2], To adapt to the issues of energy deficiency and natural contamination brought about by the huge number of resigned vehicles, the energy productivity of destroying reused vehicle bodies desperately should be improved. Prior to destroying, reused vehicle bodies are constantly cut into formed metal plates and heaped in a few sheets like sandwich plates. As of now, the lightweight plan reasoning has driven the inescapable utilization of multi-materials in vehicle bodies. In this examination, the limited component and exploratory techniques are utilized to break down the destroying interaction of multi-material plates from reused vehicle bodies to decide the attributes of plates with various thicknesses and materials. The outcomes showed that the destroying productivity of steel covers with under three sheets is very low albeit the proficiency can be raised by expanding the thickness. The destroying energy productivity is higher for Al amalgam covers than for prepares. The destroying energy productivity can be improved by raising the strength of the destroying material. The consequences of this examination demonstrated that the destroying energy utilization can be decreased by destroying the various materials of the multi-material sheets independently.

Tolulope A. Olukunle et.al [3], Plastic waste administration has arisen as perhaps the best test confronting non-industrial nations. This paper portrays the plan of different parts of a plastic shredder. This machine is generally utilized in ventures and reusing plants. The presentation of plastic shredder machine will advance decrease of post-purchaser plastic waste gathering and fills in as a framework for abundance creation and strengthening through transformation of waste into monetarily practical items. In this plan research, a 10 kW electric engine with a rotational speed of 500 rpm was picked to drive the shredder. A pulley size of 400 mm is mounted on the electric engine a good way off of 1000 mm away from the shredder pulley. The shredder rotational speed is 300 rpm. Because of the non-biodegradable nature of plastic waste, the way forward for plastic garbage removal is through reusing. Reusing of waste plastic will carry various advantages to Nigeria and the world. Reusing of plastic waste is natural amicable when contrasted with the alternate methods of arranging it. Plastics are materials comprising of a wide scope of manufactured or semi-engineered natural solids that are pliant. Plastics are regularly natural polymers of high sub-atomic mass and by far most of these polymers depend on chains of carbon particles alone or different substances like oxygen, sulfur, or nitrogen too. Plastics are delivered by an interaction called polymerization. This is the way toward going along with at least one monomers like ethylene, styrene vinyl chloride together.

Abebe Mengistu Alemayehu, et.al [4], Dumping of waste plastic, which are non-biodegradable causes genuine natural issues. In addition to the fact that they take up enormous measure of room in unloading landfills yet additionally being a non-inexhaustible asset, it faces exhaustion. Thus, it is exceptionally fundamental any place conceivable to decrease this waste plastics method for reusing. Likewise, the expanding patterns of plastics in differed applications drives for additional answers for reuse of waste plastics. The current reusing machines, which are presently in activity, are costly and are functional just for huge scope ventures. Moreover, shredder and expulsion work independently yet on this investigation shredder and expulsion are incorporated to play out the given errand all the while including mould. All part of the machine works dependent on planning. This current work henceforth centers around planning a plastic reuse machine for limited scope applications by consolidating an expulsion container system. Different machines parts and get together of container, shredder, extruder, warming curl, disintegrate, and outline are planned and broke down utilizing CATIA, ANSIS and FESTO. Detail examination of the machine turns into a proficiency of 80%, having a limit of conveying up to 20.4 kg of completed plastic squares each hour. The functioning limit of the machine product right around three full cycle each minute which gave the creation pace of 180 items each hour.

Sanket Yadav, Shubham Thite, Nandan Mandhare Ashutosh Pachupate, et.al [5], The open machines used to reuse this waste are in all regards excessive. They pack this waste and offer them to the area planning plants. So, the way toward packaging and shipping is much extravagant. So, our intension behind this endeavor is to handle the plastic waste as unobtrusive as possible by annihilating it into pieces and after that usage it for additional applications. An obliterating machine is planned to diminish immense solid material things into a humbler volume or little pieces. In this assignment there depicts about the experimentation of plastic compartment annihilating machine and examination of framework used in machine. Plastic container obliterating is a machine used for cutting the plastic in little pieces to make waste the board less requesting. We are making this endeavor model for reusing of plastic wastage in neighborhood zone; undertakings similarly as it will in general be important to the piece finders. This machine is course of action on the issue of room. The annihilated plastic will be used in making every one of the more solidified roads as plastic have amazing confining quality, the covering will be given to the absolute using plastic.

Nitin Kumar Singh, Prakash Tiwari, Rishabh Upadhyay, Sadan Ahmed and Wasim Ansari et.al [6], Today the removal of waste is the greatest reason for our contamination that makes unsafe gasses which straightforwardly influences the climate and human body. These waste for the most part incorporates plastic, elastic, papers, coke can and so on Most waste materials, presently a-days are non-biodegradable or it requires a very long time to corrupt; this prompts an expansion in the measure of squanders in dump locales. The nonstop cycle of creation and utilization of items from elastic, plastic, papers and the escalated development led to a genuine aggregation of waste, lopsidedness, and risk for the climate. In every modern culture, the need shows up for lessening the family and techno genic waste and their reintegration in the creation cycle. This shredder machine pounds utilized jugs and jars and helps in west administration and removal. This machine is planned utilizing locally accessible crude materials which make it modest and simple to keep up with and fix.

Dr. M. MUTHUKUMARAN, P. MURASOLI MARAN, et.al [7], The extent of this undertaking was to plan and advancement of Shredder machine center around plastic squanders to set up the new item. The venture started with assortment of data and information on client way of life and current cycle by which they play out their work. Idea was created considering the security factor clients working climate and support. Thinking about the clients' necessities and purchasing limit, a model was manufactured. The machine comprises of single-stage engine, spike gear gathering, primary edge, pipe and shaper. The machine outline is assembled utilizing gentle steel and tungsten carbide is utilized for shaper tip planning. The force from the electrical engine is sent to shaper shaft through a belt drive. The shred molecule can be changed over into the new item. Consuming of plastic waste are additionally decreased and contamination controlled.

Prof. M. A. Deore, Tejas P. Zope, et.al [8], Now daily's plastic is quite possibly the most utilized material in around the world. There are benefits and drawbacks of plastic, however impediments are more than benefits. The most genuine detriments of plastic are, it requires an excessive number of years to decay over 400 years and this to an extreme. So, there is a need of reusing the plastic to reuse and to diminish the utilization of plastic. This item is utilized for cutting and pulverizing plastic in little pieces to make squander the board simpler. We are making this venture model for reusing of plastic wastage in homegrown region, industry and so on in this space the plastic waste is available in huge amount. Yet, the accessible machine used to reuse this waste are expensive. So, our intension behind this task is to handle the plastic waste as modest as conceivable by destroying. Advantages of accordingly machine are the decrease of work which bring about cost decrease So we will plan this for shred the plastic waste, with the assistance of sharp edges.

Mulla Irfan Faiyyaj, Mete Rushabh Pradip, et.al [9], Plastics are economical, lightweight and sturdy materials, which can promptly be formed into an assortment of items that discover use in a wide scope of utilizations. As a result, the creation of plastics has expanded notably throughout the most recent 60 years. Nonetheless, current levels of their use and removal create a few ecological issues. Around 4% of world oil and gas creation, a non-sustainable asset, is utilized as feedstock for plastics and a further 3–4% is consumed to give energy to their assembling. A significant segment of plastic created every year is utilized to make dispensable things of bundling or other fleeting items that are disposed of inside a time of assembling. These two perceptions alone demonstrate that our present utilization of plastics isn't supportable. Also, in view of the strength of the polymers in question, considerable amounts of disposed of end-of-life plastics are gathering as trash in landfills and in regular territories around the world. Reusing is quite possibly the main activities at present accessible to diminish these effects and addresses perhaps the most powerful regions in the plastics business today. Reusing gives freedoms to lessen oil utilization,

carbon dioxide outflows and the amounts of waste requiring removal. Here, we momentarily set reusing into setting against other waste-decrease techniques, in particular decrease in material use through down measuring or item reuse, the utilization of option biodegradable materials and energy recuperation as fuel.

Akash. B. P, Christina, Darshan K. S, Manoj et.al [10], The plastic has become indispensable resource for mankind. Plastic have been utilized broadly in both water and food bundling ventures. Plastic waste isn't homogeneous so uncommon consideration must be taken for overseeing plastic waste. Plastic keeps on compromising the nature of our territory, water and air. Over 40% of this amount is arranged dangerously. Hazardous removal of plastic in provincial regions is becoming predominant and will come at gigantic expense for the rustic biology and economy. Plastic don't disintegrate by any stretch of the imagination; others could require as long as 450 years to breakdown. Subsequently in our task we decide to plan and improvement of the plastic shredder Machine. This machine is utilized for slicing the plastic into little pieces, which are in unpredictable molded drops which can be taken care of in to expulsion machine where it can frame fiber and further utilized in 3D printing machine. Thus, it decreases the unloading of waste plastic on earth's current circumstance. Our shredder project includes honed cutting edges comprised of callous steel which shreds plastics. It is hard to envision our advanced world without plastics. Today they are a fundamental piece of everybody's way of life with applications changing from normal spot homegrown articles to complex logical and clinical instruments. Plastic can require over 500 years to deteriorate. plastics are made out of major poisonous toxins, it can possibly make extraordinary damage climate as air, water and land contamination. Consequently, it establishes adverse consequence on the common habitat and makes issues for plants, natural life and surprisingly on individuals. Thus; there is the need to advance the reusing of plastic materials. Plastic reusing will undoubtedly understand a ton of reserve funds underway expenses, save restricted assets, and ease ecological contamination.

Vaibhav Edke, Swapnil Yemle, Prof. S. V. Raut, Prof. G. E. Kondhalkar et.al [11], In most recent couple of a long time there is an exceptionally enormous expansion in the utilization of plastic. The Plastic is a substance which is hurtful to the climate. So, this plastic can be reused by the plastic shredder machine. Plastic shredder machine and investigation of system utilized in machine. Plastic shredder might be a machine utilized for cutting the plastic in little pieces to shape squander the executives simpler. We are making this undertaking model for plastic shredder machine. There the plastic waste is available in incredible amount; however, the accessible machines to reuse this waste are expensive. They pack this waste and gives them to the nearby preparing plants. So, the way toward bundling and moving is much expensive. So, our intension behind this venture is to deal with the plastic waste as modest as conceivable by destroying where it's made for diminishing expense of preparing and transportation. Advantage of this machine is the decrease of work which brings about cost decrease.

4. PROBLEM STATEMENT

The plastic waste and rubber waste which is produced on earth is far more hazardous for the surrounding environment. for such non-degradable materials shredder machine plays an important role for shredding them and recycle them. As the natural frequency of the blade is low the blade won’t survive the vibrations take place in machine.

4.1. Objectives

The objectives of this project are as follows:

- To develop shredder machine blade which has high vibrational stability.
- Analytical validation of shredder blade for plotting the values of fundamental frequency.
- Build a functioning shredding machine for plastics and rubber waste.
- Redevelop the shredder to improve performance, output quality, assembly after testing of the machine.
- Design and analysis of shredder blades with uniform thickness and changing the material of the shredder blade to make the machine more efficient.

5. DESIGN OF SHREDDING MACHINE

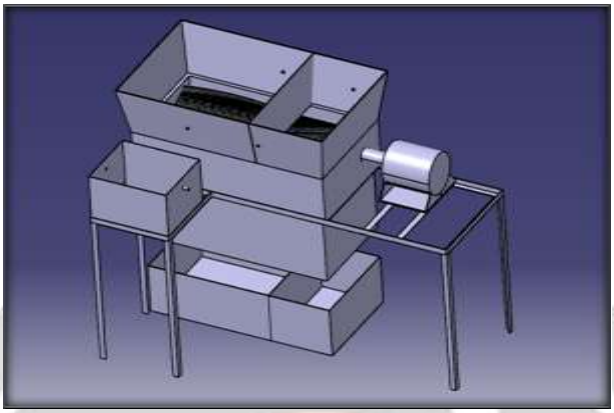


Fig. 1: CATIA model of Shredding Machine

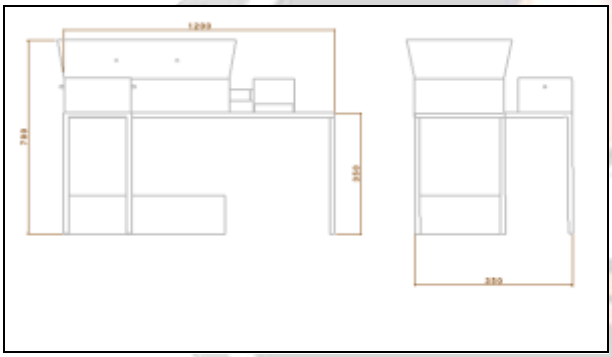


Fig. 2: Overall dimensions of machine

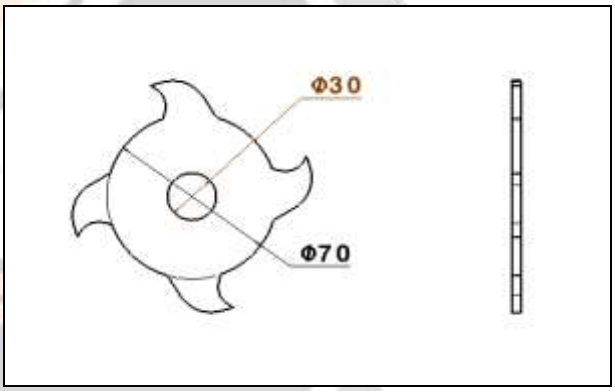


Fig. 3: Geometry of cutter blade

5.1 Calculations

Properties of Mild Steel to be used**:**

- Density = 7850 kg/m3
- Young's Modulus = 2.08×105 N/mm2
- Poisson's Ratio = 0.3

A. Motor HP Calculation:

Cutting area made by edge of the blade:

A= W × T
A= 7mm× 7mm
A= 49 mm2. 7 mm
Where, A = cutting area made by edge of the blade.
W = width of cutting edge.
T = thickness of cutting edge.
ii. Force acting on edge of the blade:
Shear strength of PET bottles = 51.71 MPa.
Shear strength = Force ÷Area

51.71= force ÷ 49
Force = 2533.79 N.

Torque exerting on the blade as well as shaft:
Torque (T) = Force × perpendicular distance
Torque = 2533.79 × 50×e-3
Torque (T) = 126.689 Nm.

Power required:
Required speed, N = 60 rpm
P = (2×Π×N×T) ÷ 60000
P = (2×3.143×60×126.689) ÷ 60000
P = 0.79 kW.
=>P = 1 HP.

B. Selection of gearbox

We need to shred approximately 300 kg of wastes per hour
Which means 8.3 Kg per minute
If the motor speed is 1440 and the required speed is 48
So, the gear ratio will be 1:30
48 revolutions per minute means 0.8 revolutions per sec
0.8/ 8.3 =0.096kg/s
0.096* 60= 5.76 Kg/min
5.76 * 60= 345.6 Kg/hr

C. Bearing calculations

Diameter of the shaft = 30 mm
Deep groove ball bearing is selected.
Specification of selected Bearing:
d= 30mm
D= 37mm
Approx. life hours = 1440 hrs.
(Co) Standard capacity = 14600N
(C) Dynamic capacity = 22000N
$P = (X * F\,r) + (Y * F\,a)$
F r = radial force F a = axial force
$Fa/Co = 0.102$
$Fa / Fr = 1.93$
Service factor(s) = 1.5 for rotatory
Fa/Fr >e
e = 0.31
x = 0.56 y= 1.4
$P = ((X * F\,r) + (Y * F\,a)) * S$
= ((0.56 * 2900) + (1.4 * 1500)) * 1.5
P = 5586 N

6. MODAL ANALYSIS OF SHEDDER BLADE

6.1 Case 1

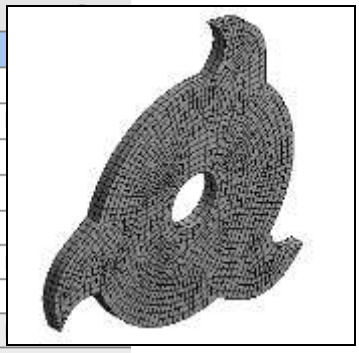
Fig. 4: Three blade cutter

A. Material used:

Properties of Outline Row 3: Structural Steel

	A	B	
1	Property	Value	
2	Material Field Variables	Table	
3	Density	7850	
4	Isotropic Secant Coefficient of Thermal Expansion		
6	Isotropic Elasticity		
7	Derive from	Young's Modu...	
8	Young's Modulus	2E+11	
9	Poisson's Ratio	0.3	
10	Bulk Modulus	1.6667E+11	
11	Shear Modulus	7.6923E+10	Pa

Fig. 5: Material properties of Blade



Statistics	
Nodes	17474
Elements	3052

Fig. 6: Meshing of three blade cutter

B. Boundary Condition

A boundary condition for the model is the setting of a known value for a displacement or an associated load. For a particular node you can set either the load or the displacement but not both.

The main types of loading available in FEA include force, pressure and temperature. These can be applied to points, surfaces, edges, nodes and elements or remotely offset from a feature. The way that the model is constrained can significantly affect the results and requires special consideration. Over or under constrained models can give stress that is so inaccurate that it is worthless to the engineer. In an ideal world we could have massive assemblies of components all connected to each other with contact elements but this is beyond the budget and resource of most people. We can however, use the computing hardware we have available to its full potential and this means understanding how to apply realistic boundary conditions.

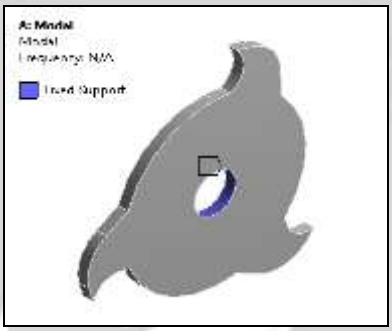


Fig. 7: Boundary Conditions

C. Mode Shape Results and Plots:

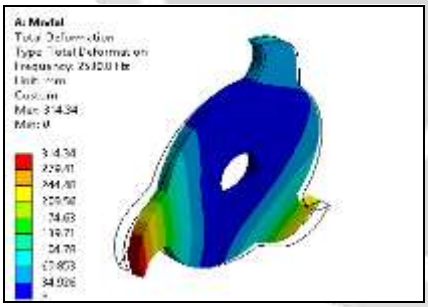


Fig. 8: Mode 1

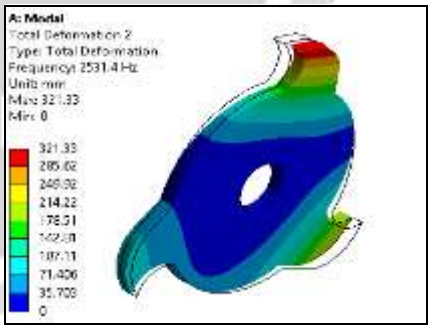


Fig. 9: Mode 2

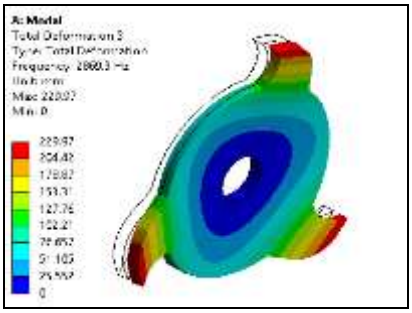


Fig. 10: Mode 3

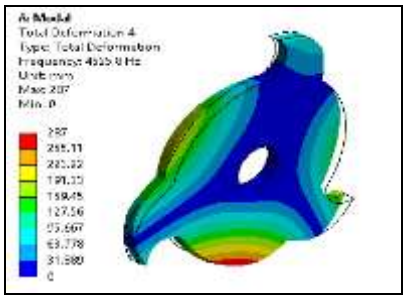


Fig. 11: Mode 4

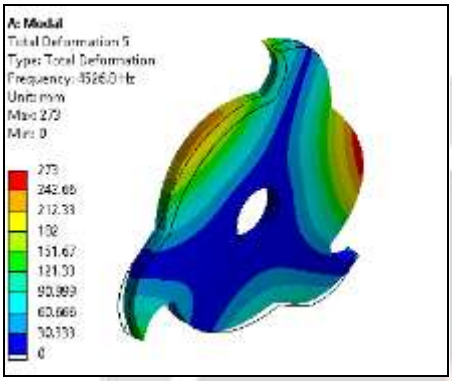


Fig. 12: Mode 5

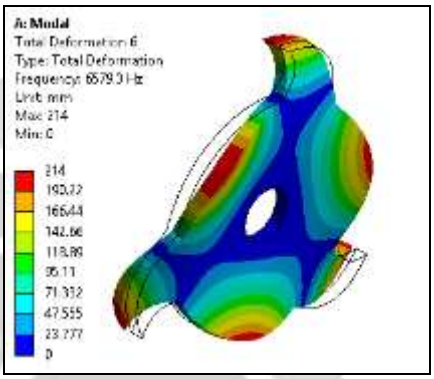


Fig. 13: Mode 6

D. Case 02

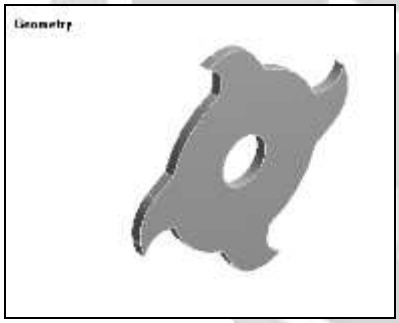


Fig. 14: Four blade cutter

E. Case 03

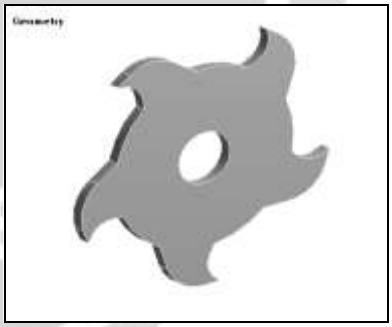


Fig. 15: Five blade cutter

As per case 1 remaining modal analysis of shedder 4 blade and 5 blades performed

From the analysis we have observed that the fundamental frequency of the shredder with four blade is high. That means the shredder with four blades have more stiffness than the other cases, so we have selected the four-blade shedder

7. COMPOSITE BRICKS

Different types of bricks are used in masonry construction based on material such as clay, concrete, lime, fly ash etc. Filed field identification of bricks for their properties, uses and suitability for different construction works are important. A brick is an important construction material which is generally available in rectangular shape manufactured from clay and concrete. They are very popular from olden days to modern days because of low cost and durability. The size of brick that we have considered is 240mm x 112mm x 70mm

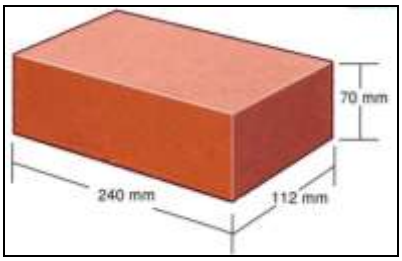


Fig. 16: Standard size of brick

For the experimentation, we have used three specimens with 10%, 15% and 20% of plastic / rubber with concrete.

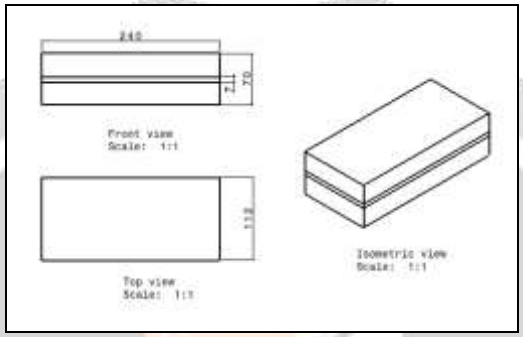


Fig. 17: Brick dimension for 10% composition

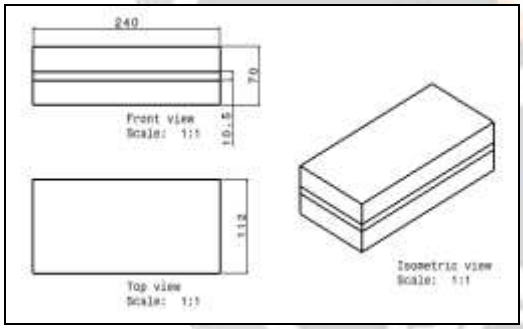


Fig. 18: Brick dimension for 15% composition

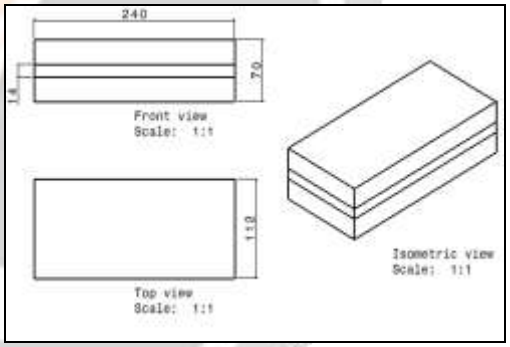


Fig. 19: Brick dimension for 20% composition

7.1. Analysis of bricks

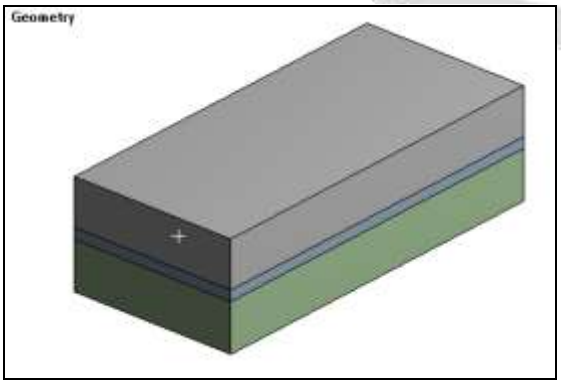


Fig. 20: Composite Brick

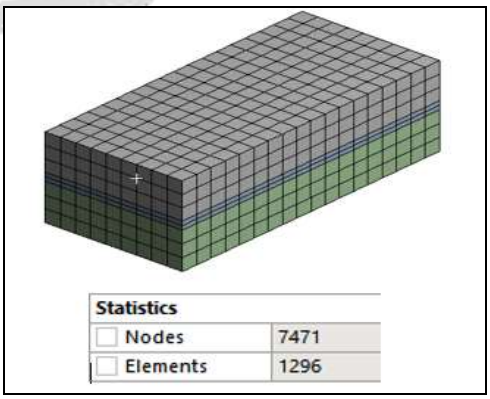


Fig. 21: Meshing details

Area of the brick upper surface where force is applied

= 26880 mm^2

Boundary conditions

Apply displacement at upper face of 1mm as an external boundary condition apply fixed support at bottom face.

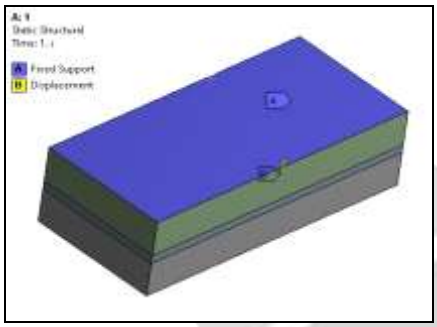


Fig. 22: Boundary conditions

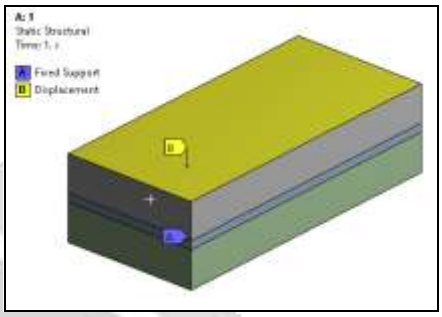


Fig. 23: Boundary conditions

7.2. Condition 1: Plastic + Concrete brick

Pet plastic with 10%, 15% and 20 % composition

	A	B	C
1	Property	Value	Unit
2	Material Field Variables	Table	
3	Isotropic Elasticity		
4	Derive from	Young's Modulus and...	
5	Young's Modulus	1700	MPa
6	Poisson's Ratio	0.37	
7	Bulk Modulus	2179.5	MPa
8	Shear Modulus	620.44	MPa
9	Bilinear Isotropic Hardening		
10	Yield Strength	100	MPa
11	Tangent Modulus	570	MPa

Fig. 24: PET properties

Properties of Outline Row 4: Concrete NL

	A	B	C
1	Property	Value	Unit
2	Material Field Variables	Table	
3	Density	2300	kg m^-3
4	Isotropic Elasticity		
5	Derive from	Young's Modulus and...	
6	Young's Modulus	3E+10	Pa
7	Poisson's Ratio	0.18	
8	Bulk Modulus	1.5625E+10	Pa
9	Shear Modulus	1.2712E+10	Pa

Fig. 25: Concrete properties

Result for 10% plastic

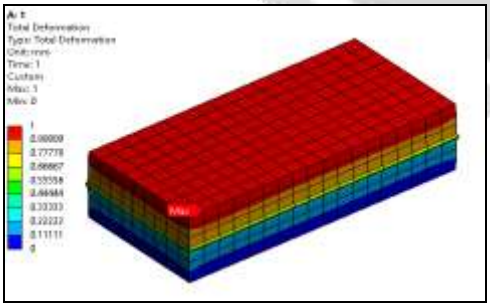


Fig. 26: Total displacement observed on brick

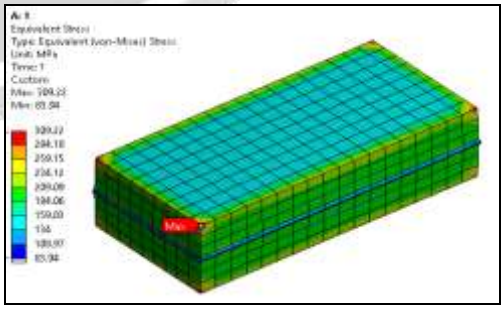


Fig. 27: Equivalent stress observed on brick

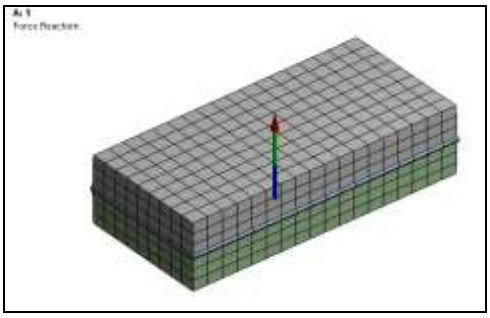


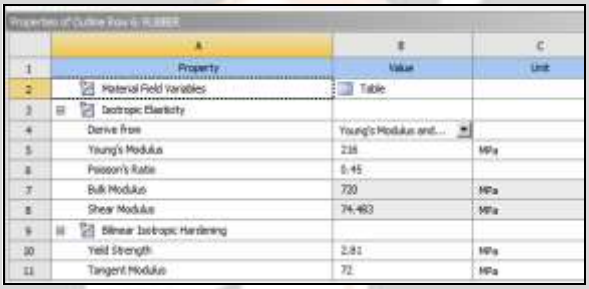
Fig. 28: Reaction observed on brick

Reaction force observed in this condition is 5144 kN.

As per case 1 remaining analysis of 15% & 20% of composition plastic brick was performed

7.3. Condition 2: Rubber + Concrete

Rubber with 10 %, 15% and 20% of composition



	A	B	C
1	Property	Value	Unit
2	Material Field Variables	Table	
3	Isotropic Elasticity		
4	Derive from	Young's Modulus and...	
5	Young's Modulus	216	MPa
6	Poisson's Ratio	0.45	
7	Bulk Modulus	720	MPa
8	Shear Modulus	74.483	MPa
9	Bilinear Isotropic Hardening		
10	Yield Strength	2.81	MPa
11	Tangent Modulus	72	MPa

Fig. 29: Rubber properties

Result for 10% rubber

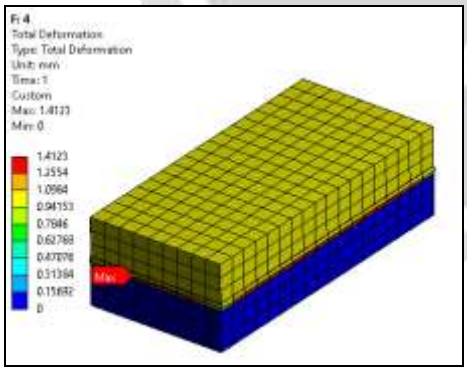


Fig. 30: Total displacement observed on brick

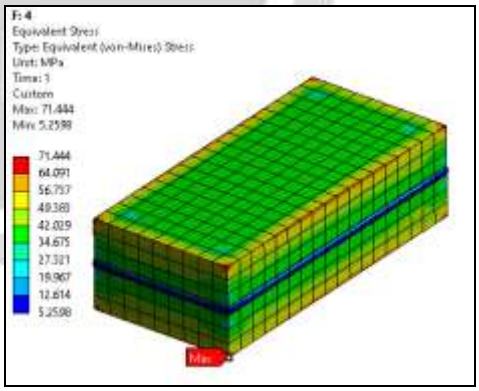


Fig. 31 Equivalent stress observed on brick

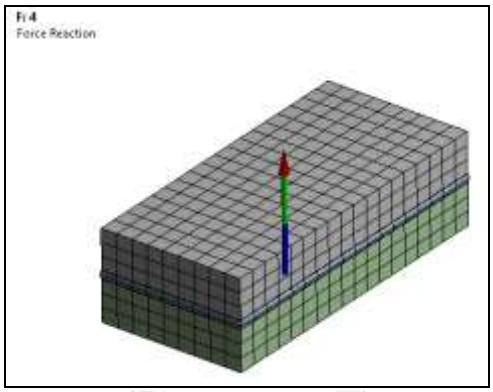


Fig. 32: Reaction observed on brick

Reaction force observed in this condition is 1333 kN.

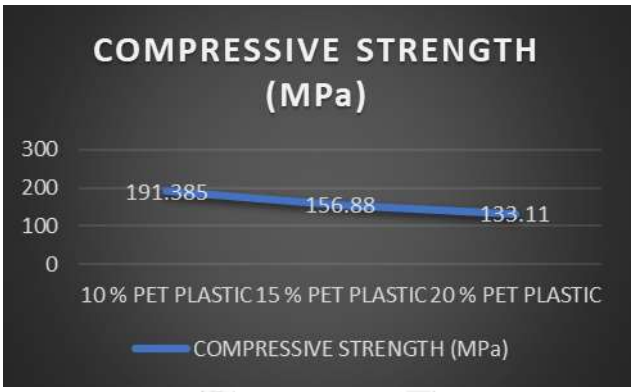
As per case 1 remaining analysis of 15% & 20% of composition plastic brick was performed.

8. RESULTS

Table 1: Results table

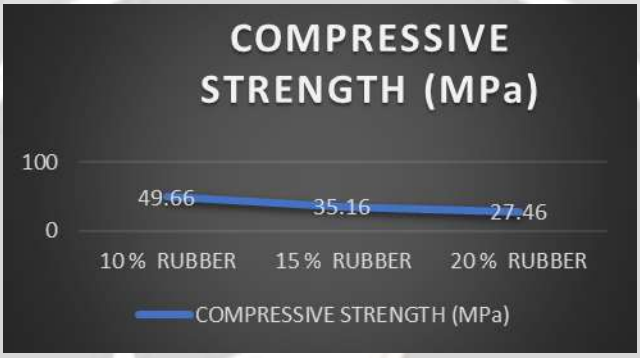
SR NO	COMPOSITION	WEIGHT (Kg)	COMPRESSIVE STRENGTH (MPa)
1	10 % PET PLASTIC, 90 % CONCRETE	4.1546	191.385
	15 % PET PLASTIC , 85 % CONCRETE	4.068	156.88
	20 % PET PLASTIC , 80 % CONCRETE	3.98	133.11
2	10 % RUBBER , 90 % CONCRETE	4.18	49.66
	15 % RUBBER , 85 % CONCRETE	4.1	35.16
	20 % RUBBER , 80 % CONCRETE	4.03	27.46
3	100 % CONCRETE	4.3277	150

8.1. PET plastic composite results



Graph 1: Compressive strength comparison for composition of PET plastic material

8.2. Rubber composite results



Graph 1: Compressive strength comparison for composition of rubber material

9. CONCLUSION

From the analysis we have observed that the compressive strength of brick has increased due to addition of plastic. Whereas there is decrease in strength due to addition of rubber. As the percentage of plastic or rubber increases beyond 10%, the strength decreases. The compressive strength is decreasing with the increasing the material percentage. And the maximum compressive strength observed in the PET plastic and rubber brick is 191.385 and 49.66 MPa. There is reduction is weight due to addition of plastic and rubber. The weight reduction per bricks for PET plastic material is 8.03 % compare to concrete brick and for rubber material 6.87% weight reduces. So main outcome is that weight is inversely proportional to composition of material. So, we can use this composite bricks as per required application.

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