Designing, Remodeling and Analyzing the Blades of Portable Concrete Mixture

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Abstract— **This paper deals with the design and analysis of a blade for cement mixer in a purpose to find a safe designed removable blade for multi use cement mixer. It's a main part of a mixer which helps mixing the ingredients of the cement for better quality concrete. For side blades type the blades rotates with drum but in Centrifugal Blades Type the blades rotates directly. We use the blades several times in order to find the optimum blade shape for better mixing, minimum failure, easier to replace and cheaper in price thus avoiding change in the whole drum when the blade fails.**

Index Terms—**design, Solidworks, blade analysis, side blades, centrifugal blades, concrete mixture**

I. Introduction

A concrete mixer is a device that mixing homogeneously the cement, gravel, sand and water with appropriate ratio to form concrete and generally called as cement mixer and achieves this by rotating the drum of the mixer. Nowadays market requirements forces to produce mixer machines which is able to mix cement ingredients homogeneously in short time for industrial production. To produce ready mix continuously it is necessary to the mixer machine to work in good condition, but it has been seen that there are some failure in the shaft and the blades of the mixer machine after a time of working.

The concrete is widely used in the construction industry. The cement is the main material to bind the concrete components which are mixed with water and these components such as gravel and sand give strength to the concrete after mixing. The concrete is considered as the unique material used in construction sites. The bottom word is that we cannot dispense from mixer machine in construction site work.

In this study, the mixer is fully designed by using Solidwork V. 2017. But the main focus in this design is based on the designing the blades. The idea came from machines that use multi-parts which are removable in cases that cause the parts to fail. In the existing cement mixers most of blades parts are welded to the drum which leads to change the entire drum in order to get a new part.

For the first procedure the drum, blade and blades holders are designed, the second part involves designing the optimum blades and blade holders which helps to mix the cement ingredients. The third part is the analysis of the blades to find the failure points in order to get a safe design.

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II. Methodology

A. CAD-Models

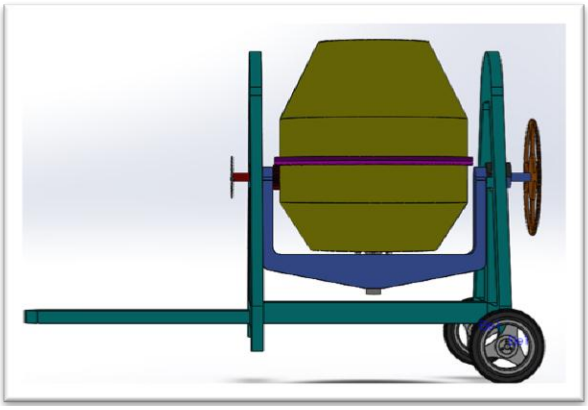

Figure 1. Front view of CAD model of a cement mixer.

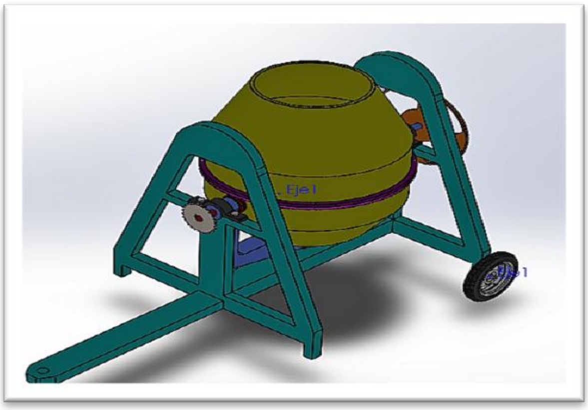

Figure 2. Isometric view of CAD model of a cement mixer.

The solid model of Cement mixer machine is created in Solidworks V. 2017 software.

B. Analytical Design

Analytical Design of Cement mixer machine contains Drum of total size of 1.9 m^3 made of Alloy steel Yield strength of (620.422 N/m^2) rotates at speed of (21-22) RPM to mix cement ingredients. The blades are connected to the drums is made of AISI 1010 Steel, hot rolled bar at yield strength of (180 N/m^2). The given

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data are calculated from Construction of building field. And we get the side pressure cement while pouring into the drum and the supplied force to the blades.

Given Data

Side Blade area = 12860.6 mm^2

Centrifugal blade area = 10000 mm^2

Pressure acting on blade = (2500 to 4500) $\frac{kg}{m^2}$ Range

$F = P \times A$

F_1 = 315.4 to 567.7 N

F_2 = 245.25 to 441.45 N

Motor specification:

Electric motor = 3HP, R.P.M. of motor = 980

Specification of Drum:

Lower Drum

Drum Main Dia. = 900 mm, Drum Center height = 450 mm, Drum Lower cone = 230 mm height at 66.22 °, Drum Thickness = 3 mm, Ring Gap thickness = 2 mm.

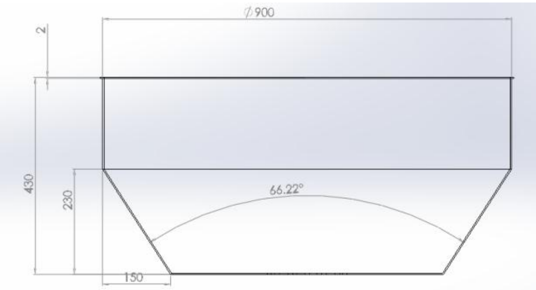


Figure 3. Lower drum dimensions.

Upper Drum

Drum Main Dia. = 900 mm, Upper Drum Height from Center = 570 mm, Drum Lower cone = 230 mm height at 53.25 °, Drum Pouring Dia. = 500 mm.

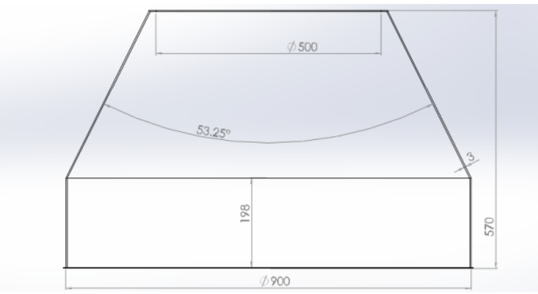


Figure 4. Upper drum dimensions.

Specification of Blade Holder:

Shaft Dia. = 37 mm, Outer Dia. = 100 mm, Height = 76 mm, Blade hole dia. = 25 mm, Blade hole depth = 45 mm, Bolt used = 12M.

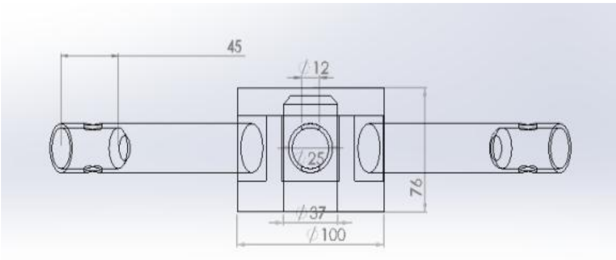


Figure 5. Blade Holder dimensions.

Specification of Blades:

The part is responsible for the homogeneous mixing of concrete.

The dimension of the blade is as shown below:

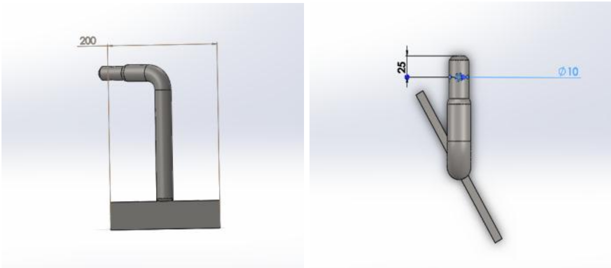


Figure 6. Straight Centrifugal Blade.

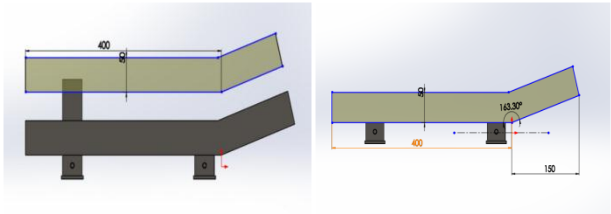


Figure 7. Uniform Side blade.

Meshing of Cement Mixer

In this work, SOLIDWORK SIMULATION is used for meshing the Cement Mixer. It creates sufficient smooth meshing as shown in figure below.

Figure 8. Meshing of Drum.

The Drum is made of Alloy Steel with Maximum Shear and Tensile Strength of (7.9e+10 N/ mm^2), (7.24e+08 N/ mm^2) respectively. It holds the blades which help to mix the cement ingredients and it rotates by the rings which takes power from the motor.

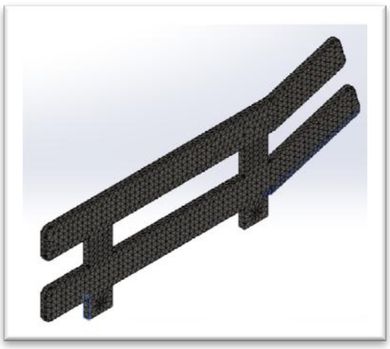
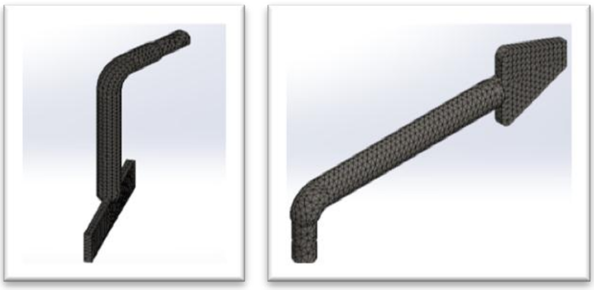


Figure 9. Meshing of Side Blade.

Side blade is basically connected to the drum from the sides and it is used to mix the cement ingredients radially. It's made of AISI 1010 steel, hot rolled bar with maximum shear and tensile strength of (8e+10 N/mm^2), (3.25e+08 N/mm^2) respectively.



(a) (b)

Figure 10. Meshing Centrifugal blades type (a) & (b).

Centrifugal blade is basically connected to the drum with central shaft which holds the dram and it is used to mix the cement ingredients by a centrifugal rotation with the drum. It's made of AISI 1010 steel, hot rolled bar with maximum shear and tensile strength of (8e+10 N/mm^2), (3.25e+08 N/mm^2) respectively.

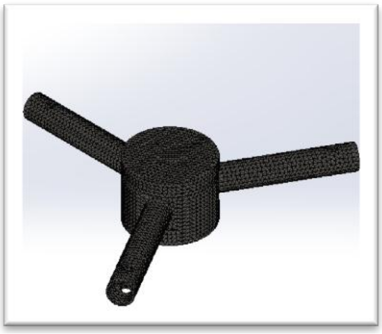


Figure 11. Meshing Centrifugal Blades holder.

Centrifugal Blades holder, hold the central blades and connects it to the drum shaft and it has a replaceable body which can be replaced when the blades are damaged and holds onto it by fixed bolts. Made of AISI 1010 steel, hot rolled bar with maximum shear and tensile strength of (8e+10 N/mm^2), (3.25e+08 N/mm^2) respectively.

(a) (b)

Figure 12. Meshing Centrifugal blades type (a) & (b).

C. Boundary Condition

The side blade is connected to the drum wall thus we can simulate it as a fixed point.

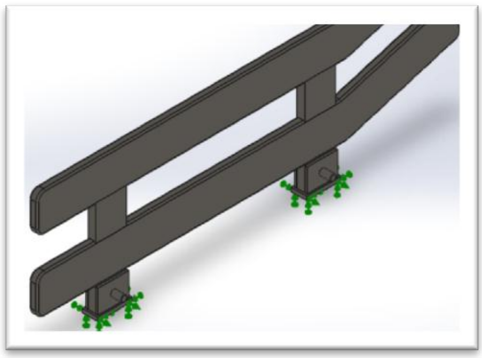
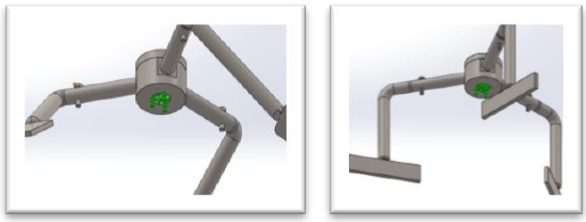


Figure 13. Fixed point for side blade.



(a) (b)

Figure 14. Fixed piont for certrifugal blades (a) & (b).

D. Analysis

Applying tests to the simulation in order to check whether the design is safe or not.

- For side blades.

Stress simulation with calculated force at 315.4 N.

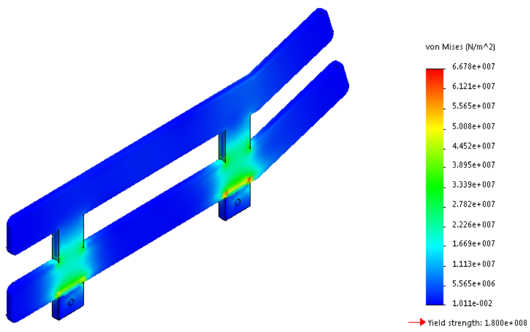


Figure 15. Equivalent stress of the side blade at (315.4 N).

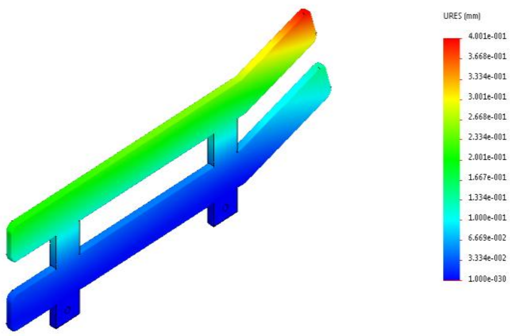


Figure 16. Total deformation of the side blade at (315.4 N).

Stress Simulation with calculated force at 567.7 N.

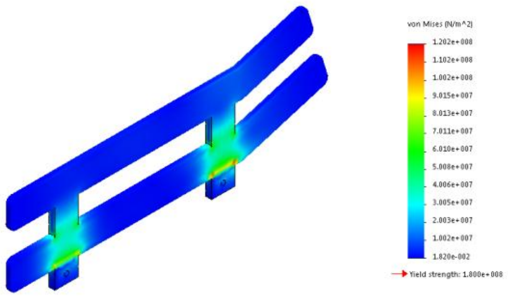


Figure 17. Equivalent stress of the side blade at (567.7 N).

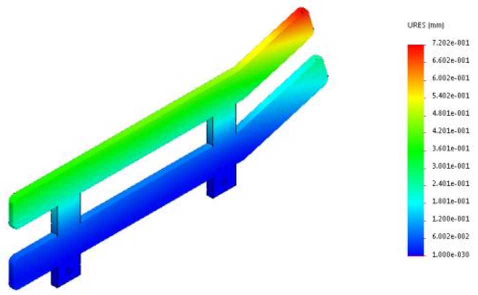


Figure 18. Total deformation of the side blade at (567.7 N).

- For Centrifugal Blades Type (a)

Stress simulation with calculated force at 245.25 N.

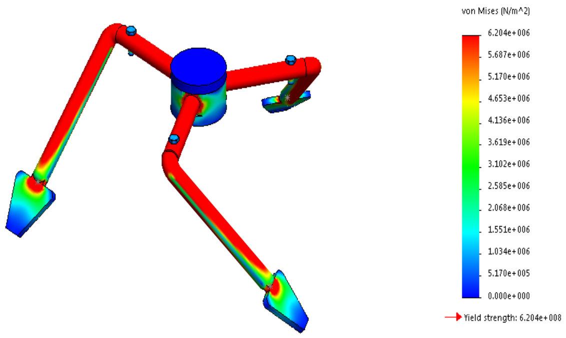


Figure 19. Equivalent stress of the centrifugal blade at (245.25 N).

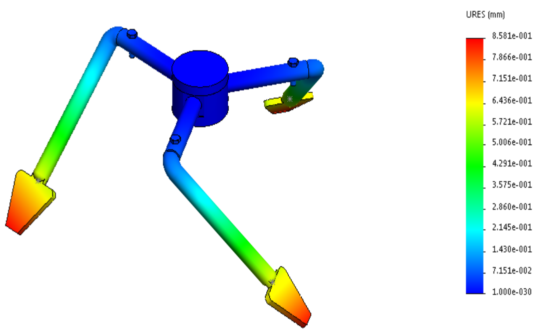


Figure 20. Total deformation of the centrifugal blade at (245.25 N).

Stress simulation with calculated force at 441.45 N.

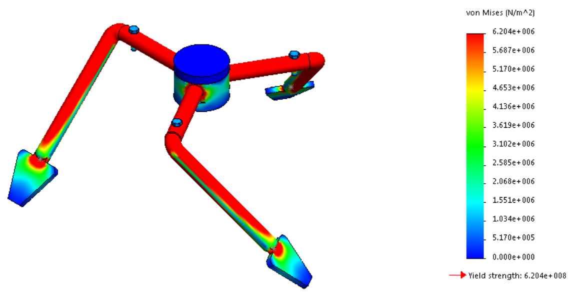


Figure 21. Equivalent stress of the centrifugal blade at (441.45 N).

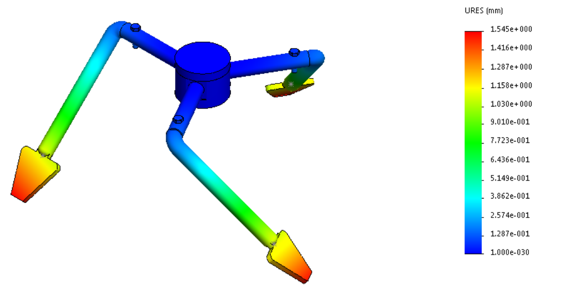


Figure 22. Total deformation of the centrifugal blade at (441.45 N).

- For Centrifugal Blades Type (b)

Stress simulation with calculated force at 245.25 N.

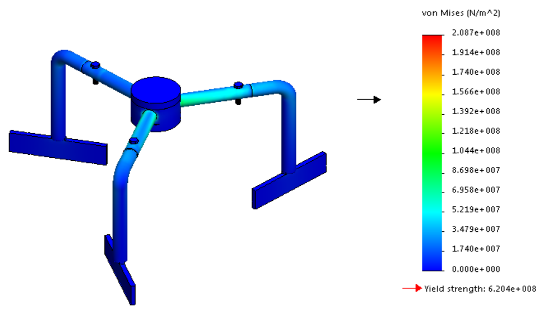


Figure 23. Equivalent stress of the centrifugal blade at (245.25 N).

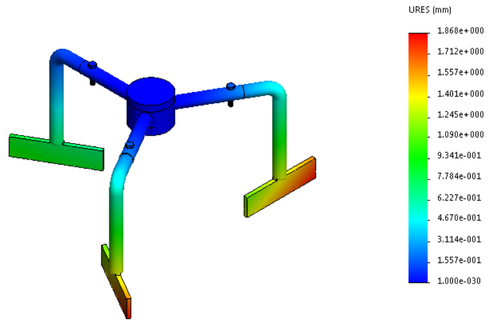


Figure 24. Total deformation of the centrifugal blade at (245.25 N).

Stress simulation with calculated force at 441.45 N.

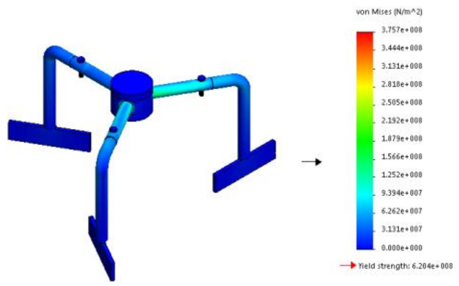


Figure 25. Equivalent stress of the centrifugal blade at (441.45 N).

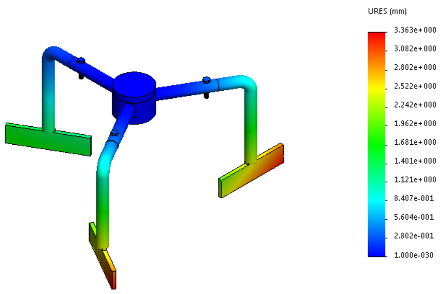


Figure 26. Total deformation of the centrifugal blade at (441.45 N).

III. Results and Discussion

For side blades as in Figure 15, the supplied force is 315.4 N and the result is safety because we do not exceed Yield Strength and the distortion ratio is almost zero, while in Figure 17, the force is raised to 567.7 N, the result is not very safe due to the presence of areas where the amount of stress are close to the amount of Yield Strength. This means that this type of blade does not withstand the force of more than 567.7 N during the time.

For Centrifugal Blades Type (a) as shown in Figures 19 & 21, the force is increased from 245.25 N to 441.45 N, which are also had poor results.

In the case of Figure 23 For Centrifugal Blades Type (b), the supplied force is 245.25 N, the results are good because the amount of stress is very far from Yield Strength and the deformation ratio is approximately 1.86 mm and this means that this type of blade works more safely. In Figure 25 the supplied force is increased to 441.45 N to exam the analysis, the reached result was safety too, while the deformation rate was approximately 3.4 mm, this means that we must change the thickness of the blades of this type to reduce the deformation ratio close to zero.

As a result, from the software analysis and simulation we can assure that Centrifugal Blades Type (b) is better from the other ones. Another merit that these types of blades are connected to the holder with bolts which make it easier to replace one that fail.

IV. Future Scope

1. The design of blade can be analyzed by changing the material.
2. Design of different components of the mixer can also be optimized.

References

[1] Wainganga spun pipe industry pvt ltd sewagram.

[2] Pharmaceutical engineering and mixing By: - Dr. Bhawan Bhatt.

[3] Concrete Mixing Methods and Concrete Mixers: State of the Art Journal of Research of the National Institute of Standards and Technology. By Chiara F. Ferraris.

[4] Artin Levon edition 1983 at chapter 8 of Molds and Scaffolding.

[5] Ristow G H 2000 Mixing and segregation in rotating drums, Proc. Symposium on Segregation in Granular Flows, The Netherlands: Kluwer Academic publishers, 311–320.

[6] Turbula T2C Heavy-Duty Shaker-Mixer 2004 www.artisan-scientific.com/ 49853.asp accessed 12.06. 2007.

[7] Ferraris, C.F., "Concrete Mixing Methods and Concrete Mixers: State of the Art", Journal of Research of the National Institute of Standards and Technology, Vol. 106, No. 2, 391-399 (2001).

[8] Effect of nonlinearities on components: International Journal of Advanced Technology in Engineering and Science www.ijates.com Volume No.03, Special Issue No. 02, February 2015. By Mr. Jamir A. Mulani1, Prof. Dr. S.H. Sawant.

[9] 3D Motion mixer for material: International journal of pure and applied research in Engineering &Technology. By P. S. KULAT1, PROF. R. B. CHADGE.

[10] Design and Fabrication of an Industrial Mixer: International Journal of Practices and Technologies ISSN 1583-1078 Issue 20, January-June 2012. By Thompson Aguheva.

[11] Solidworks Engineering Design and Technology Series, 2017.

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