International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 6 Issue 9, September-2017, Impact Factor: 4.059

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. The main power source for the drum is a motor which powers up the drums and thus rotates the blades in it. We use 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.

Keywords: Design, Solid works, Blade Analysis, 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[1-2].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 [3].

In this study, the mixer is fully designed by using Solidwork v.2016. 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 cementingredients. The third part is the analysis of the blades to find the failure points in order to get a safe design.

II. METHODOLOGY:

A. CAD-Models

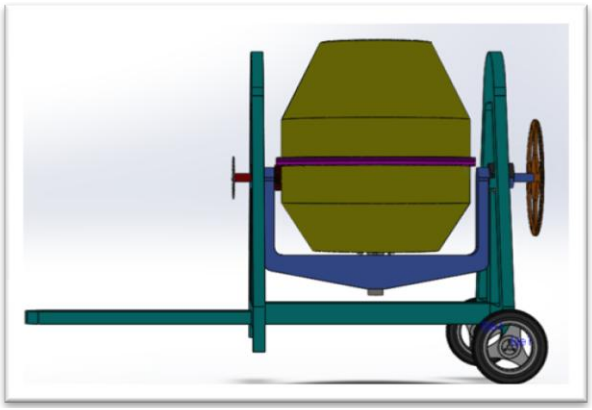


Fig. 1: Front view of CAD model of a cement mixer

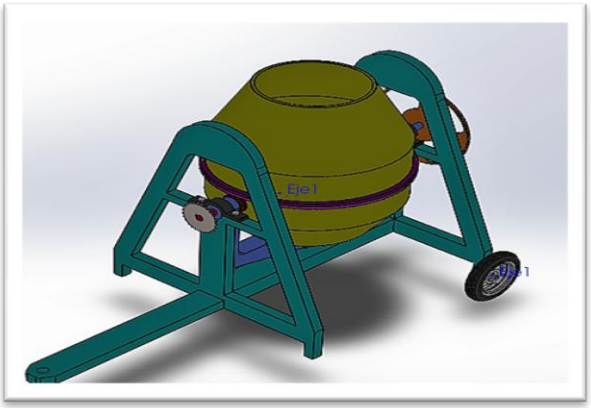


Fig. 2: Isometric view of CAD model of a cement mixer

The solid model of Cement mixer machine is created in SOLIDWORKS V. 2016 software.

B. Analytical Design of Cement mixer machine contains Drum of total size of 1.9m^3made of Alloy steel Yield strength of (620.422N/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 (180N/m^2). The givendata are calculatedfrom Construction of building [4].Andwe 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×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.

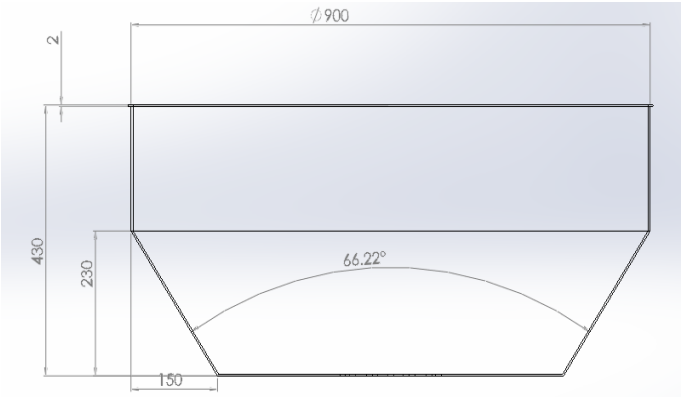


Fig. 3: Lower drum dimensions

Upper Drum
Drum Main Dia. = 900 mm, Upper Drum Height from Center = 570 mm, Drum Lower cone = 230 mm height at53.25°, Drum Pouring Dia. = 500 mm.

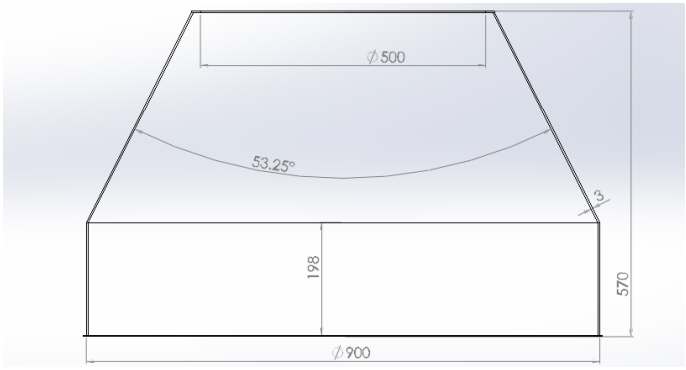


Fig. 4: Upper drum dimensions

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.

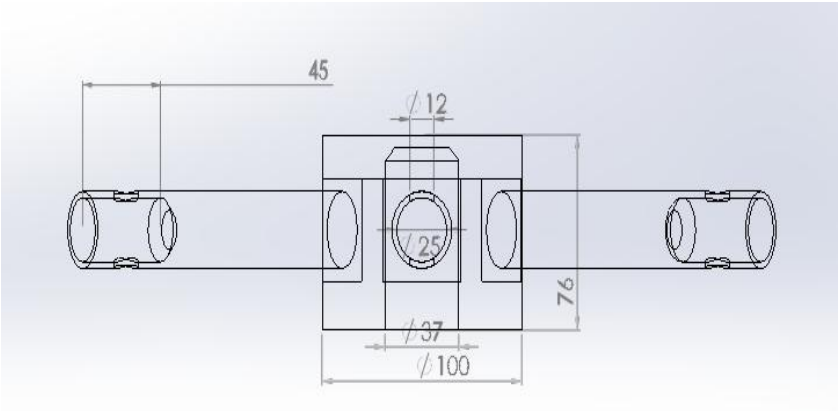


Fig. 5: Blade Holder dimensions

Specification of Blades:

The part isresponsible for the homogeneous mixing of concrete.
The dimension of the blade is as shown below:

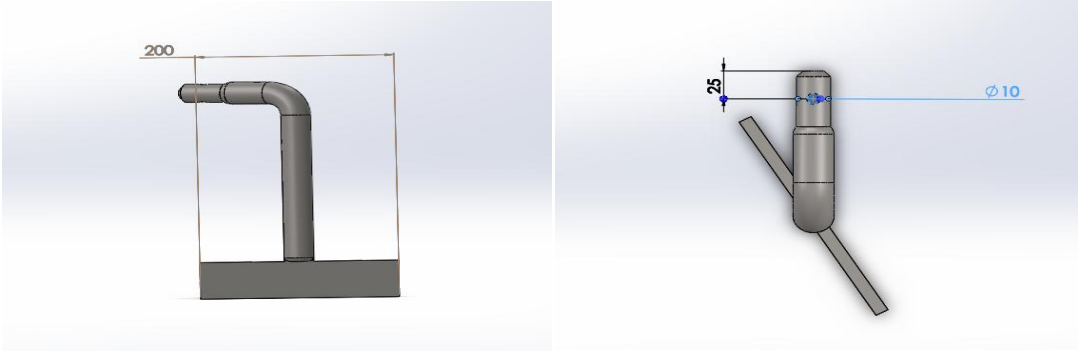


Fig.6: Straight Centrifugal Blade

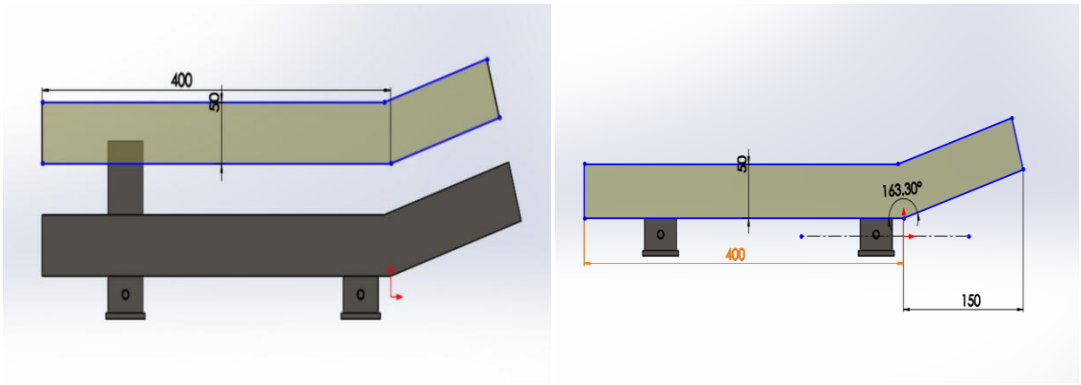


Fig.7: Uniform Side blade

Meshing of Cement Mixer

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

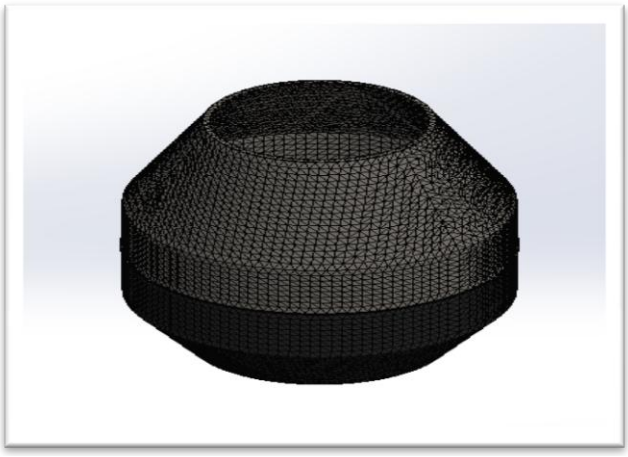


Fig. 8: Meshing of Drum

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

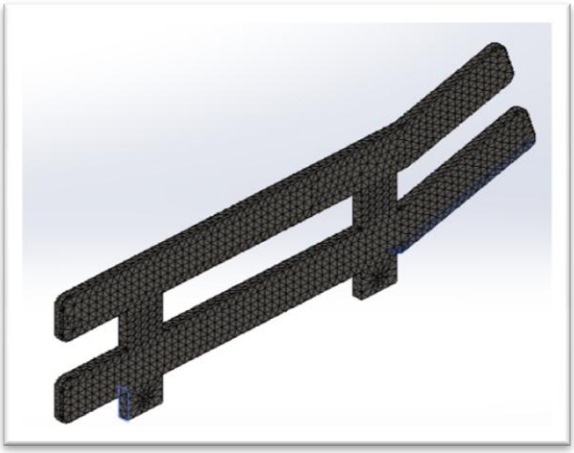
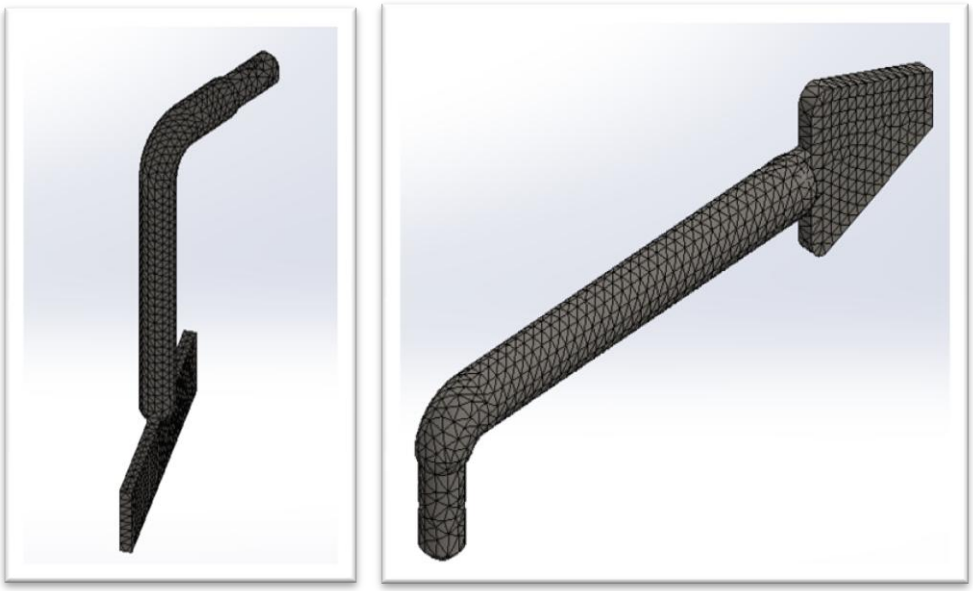


Fig 9: Meshing of Side Blade

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+10N/mm^2), (3.25e+08 N/mm^2) respectively.



(a) **(b)**

Fig 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+10N/mm^2), (3.25e+08 N/mm^2) respectively.

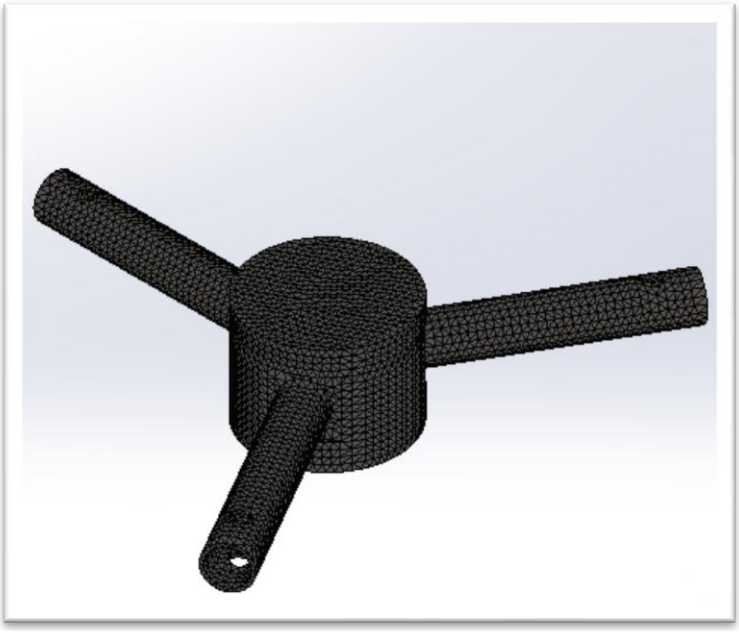
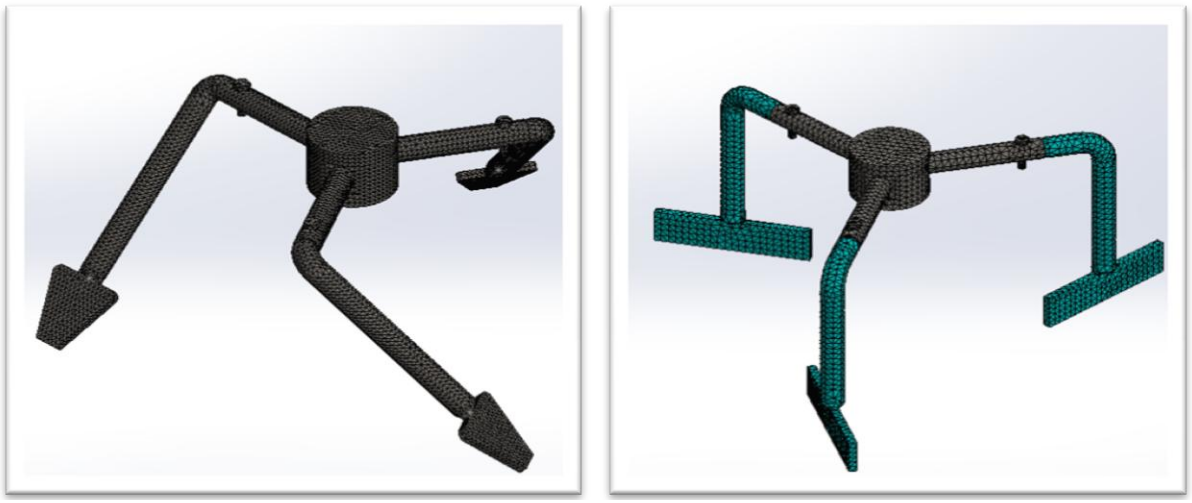


Fig 11: Meshing Centrifugal Blades holder

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 ofAISI 1010 steel, hot rolled bar with maximum shear and tensile strength of (8e+10N/mm^2), (3.25e+08 N/mm^2) respectively.



(a) **(b)**

Fig 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.

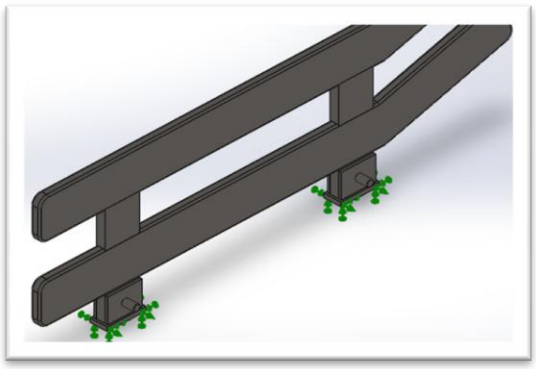
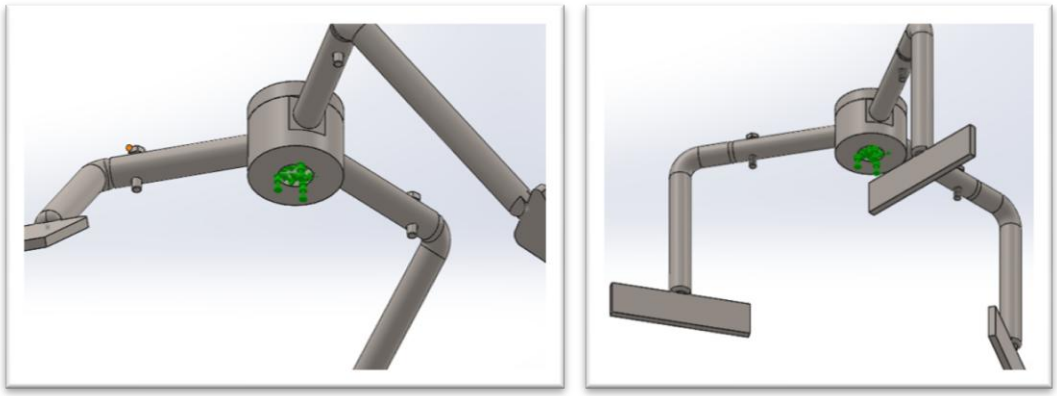


Fig 13: fixed point for side blade



(a) **(b)**

Fig 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.

1. Stress simulation with calculated force at (315.4N).

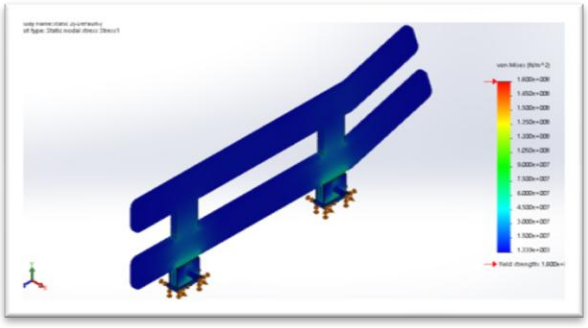


Fig. 15:Equivalent stress of the side Blade at (315.4N)

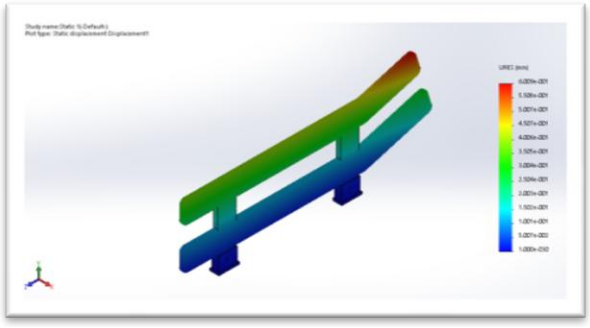


Fig. 16:Total deformation of the side Blade at (315.4N)

2. Stress Simulation with calculated force at (567.7 N).

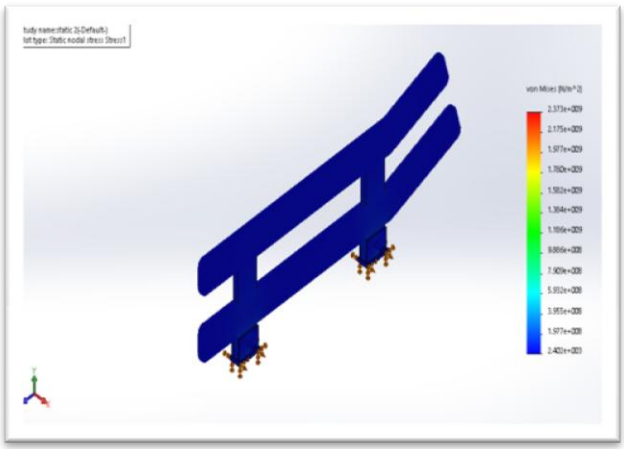


Fig. 17: Equivalent stress of the side Blade at (567.7 N)

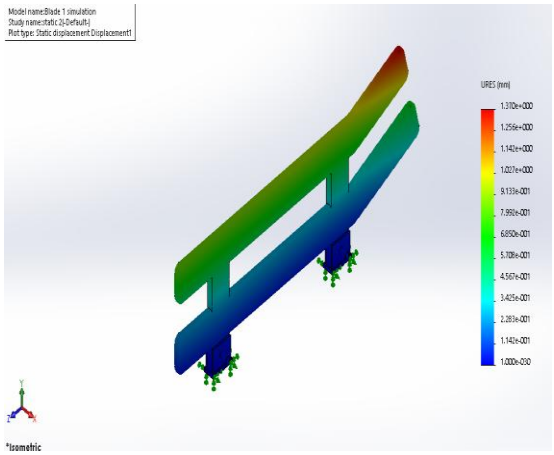


Fig. 18: Total deformation of the side Blade at (567.7 N)

- For Centrifugal Blades Type (a)

1. Stress simulation with calculated force at (245.25N).

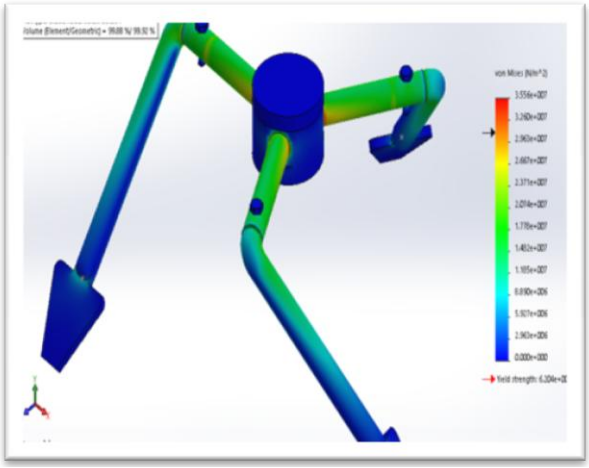


Fig. 19: Equivalent stress of the centrifugalblade at (245.25N)

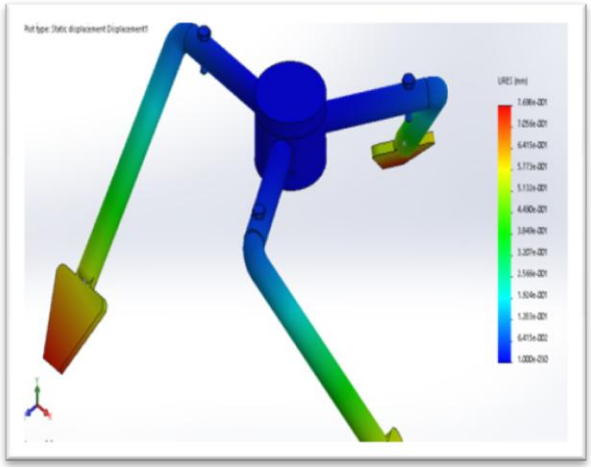


Fig. 20: Total deformation of the centrifugal Blade at (245.25 N)

2. Stress simulation with calculated force at (441.45N).

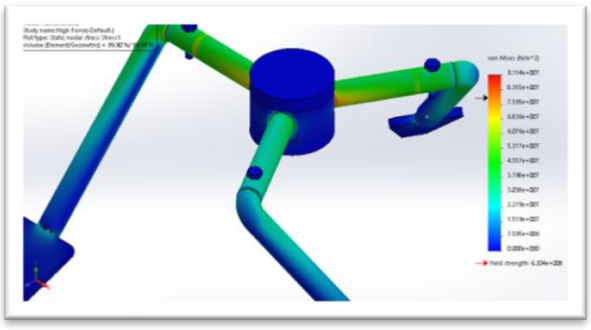


Fig. 21: Equivalent stress of the centrifugal blade at (441.45N)

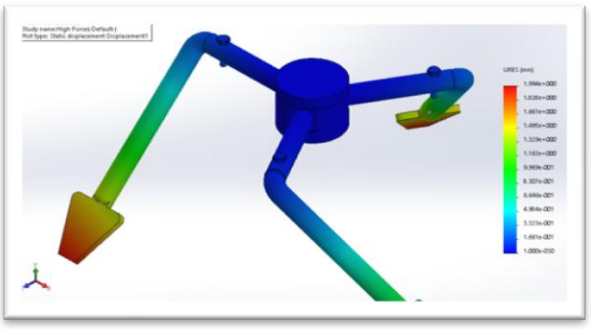


Fig. 22: Total deformation of the centrifugal Blade at (441.45 N)

- For Centrifugal Blades Type (b)

1. Stress simulation with calculated force at (245.25 N).

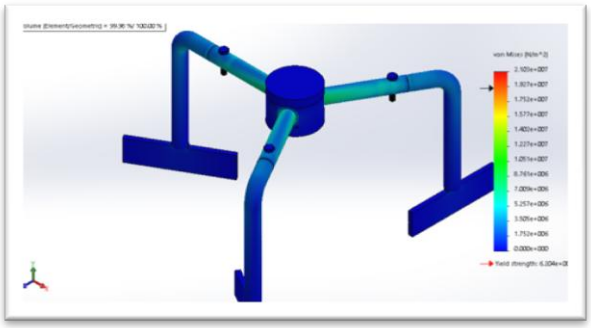


Fig. 23: Equivalent stress of the centrifugal blade at (245.25N)

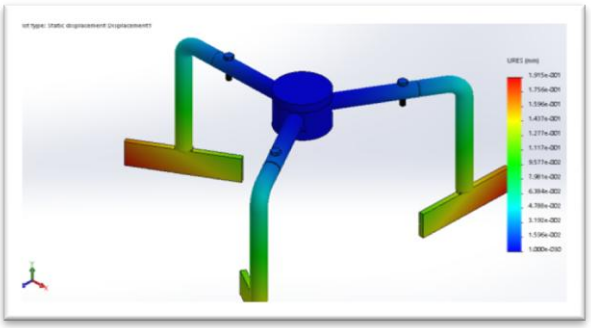


Fig. 24: Total deformation of the centrifugal Blade at (245.25N)

2. Stress simulation with calculated force at (441.45N).

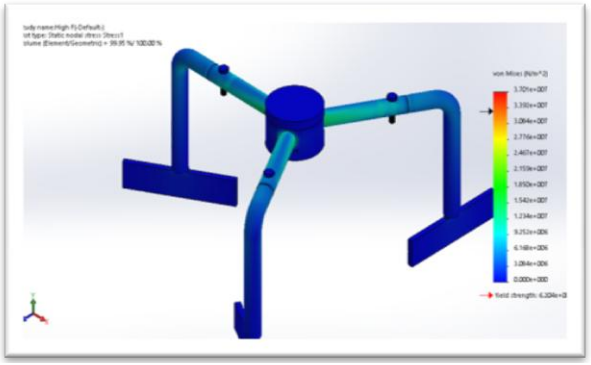


Fig. 25: Equivalent stress of the centrifugal blade at (441.45N)

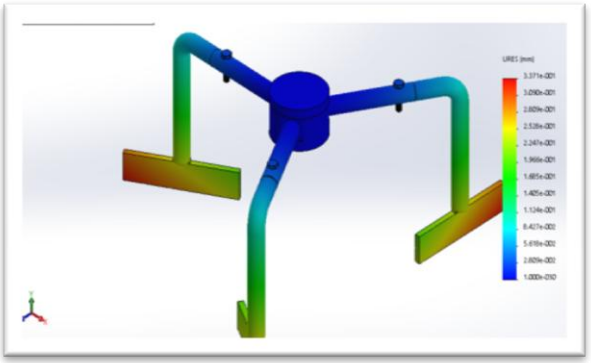


Fig. 26: Total deformation of the centrifugal Blade at (441.45 N)

III. RESULTS AND DISCUSSION

As a result, from the software analysis and simulation we can assure that all the designs are in safe zone,from the simulation we can decide that the side blade has better mixing power than the centrifugal one because the load focuses on the side wall of drum during rotation. While the centrifugal is more useful for more rough cement types since it has to bear fewer loads than the side one. Accordingly, all the blades are connected to the drum with bolts which make it easier to replace one that fail and also the design has a benefit of switching from the side blade to centrifugal blade whenever client chooses to have different type of mixing for different type of cement.

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