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Methodology of Designing and Failure Analysis of Concrete mixer Machine Blades

Shubham B. Babhale^{*1}, Dr. R. R. Gawande^{*2}

PG-Student, Department of Mechanical Engineering, Bapurao Deshmukh College of Engineering,
Sewagram, Wardha, Maharashtra, India. ^{*1}

Professor, Department of Mechanical Engineering, Bapurao Deshmukh College of Engineering,
Sewagram, Wardha, Maharashtra, India. ^{*2}

ABSTRACT: Wainganga spun pipe industries pvt. Ltd, Sewagram used special types of Concrete mixer machine for making concrete mixture required for making RCC spun pipe. In this machine, there is horizontal shaft on which 4 blade assembly bolted which mixes the concrete mixer. All concrete mixtures homogeneously mix by rotating blade on shaft of mixer machine. In this project Design and Analysis of blades of concrete mixer machine has been done. The main objective of this analysis is to optimize the design of blades of concrete mixer machine. Mixer blades directly affect the mixing performance. Good mixing performance is obtained by designing the mixing arm and mixing blade. Mixing blades force the concrete material along the circumference for mixing, and also along the shaft for transport during the mixing process. While mixing concrete material, machine blades do not mix mixture uniformly and pull all material on one side, causing high stresses induced in blade & blade gets broken. Also low quality concrete mixture reduces the efficiency of concrete mixer machine. Present design of blades is not strong enough to bear stresses & not satisfactory for making mixture. So this study is made for Design And Failure Analysis Of Blades of concrete mixer to make it effective. Study done on existing concrete machine blades & with the help of existing blades, modified blades design by making this study blades work more effectively, uniformly mix all material & increase efficiency of machine. The analytical results which are done on FEM ansys also show that existing model of blade has high value for deformation, max shear stress and von mises stress. So the deformation, maximum shear stress and von mises shear stress reduced in modified blade assembly design shown by FEM ansys.

KEYWORDS: Horizontal shaft concrete mixer machine, Modification of blade, failure analysis on blade of concrete mixer, T shape blade of concrete mixer.

I. INTRODUCTION

Concrete mixer machine is utilized for mixing cement, sand, gravel and water uniformly. In Wainganga spun pipe industries pvt. Ltd, Sewagram road, MIDC Wardha. In concrete mixer machine rotating blades mix concrete material uniformly. In Wainganga Spun Pipe Industry, it has been observed that the blades of mixer not mix concrete mixture uniformly also blade gets broken. While working of machine, concrete mixture between blades remains unmixed. Existing blade design push all concrete material unevenly causes high stresses on one blade & blade gets broken. So in this project research is done to identify the causes of blade failure & modified design of existing blade which is capable to withstand heavy stresses.

In this project I studied the existing concrete machine at Wainganga industry and take measurement of blade assembly & parameters required for design. Then I studied various literature papers on designs of concrete machine, shapes of blades, material of blades & working of machine and reasons behind the failure of blade. Then created the CAD model of blade assembly with existing material and properties. Analyse it using ANSYS software for deformation value, maximum shear stress value and von mises shear stress & then this value reduced in modified blade assembly.

II. RELATED WORK

a) Number of Blades on shaft

Konstantin (2020) It states that impact of the number and tallness of sharp edges of a substantial blender on the combination quality. point of this investigation was to develop the effect of the number and stature of forefronts of a drum blender on the idea of the set up mix of concentrated feed. The execution of the used investigation reasoning for the action of the drum blender made it possible to develop an adequate helpful dependence of the effect of the amount of edges and their height on the idea of the mix. The amount of sharp edges used essentially doesn't impact the coefficient of assortment of the substance of the control part. Methods and Materials obliged the foundation of replaceable working bodies (L-shaped edges) on the inside surface of the turning drum of the blender, changing in number and height; confirmation of the idea of the coordinated mix and quantifiable examination of the results (2).

Wankhede (2016) It expresses that The property of edge and shaft improved either by changing material or by changing its measurement. Shaft is a huge stuff of considerable blender machine use for significant mix arranging and for help a turning drum. The essential objective of this assessment is to upgrade the arrangement of generous blender machine. To research this shaft using FEM, as a matter of first importance a suitable CAD model is made using Pro/E lowlife programming. By then by using ANSYS programming FEM assessment is done to choose the different sorts of stresses and redirection made. After did the examination it has been found that the current arrangement of shaft of significant blender machine isn't suitable and therefor I had proposed to change the material of the shaft for capable working and to withstand the unmistakable static and dynamic weight (10).

b) Fixing Angle Of Blade

Zechen YAO (2019) investigates that the blender sharp edges load increments with the cutting edge setting point. Additionally blending arm is exposed to the consolidated impact of ductile and twisting anxieties. at the point when point between the blending arm and the blending shaft is $\theta=90^\circ$, the pressure arrives at its most extreme. The inspiration driving this paper is to improve the numerical limits of the mixing paddle of CSAM blender from the mechanical assessment viewpoint. In this paper, the improvement of a mixing arm and sharp edge's numerical limits was finished ward on mechanical assessment using the Matlab programming group and FEA. It offers speculative assistance for the arrangement and smoothing out of mixing paddles for CSAM blenders. It justifies raising that the examination procedure depicted here can be applied to the arrangement of mixing paddle of blender for various organizations. The assessment results are summarized: A mixing edge's stack FN'is influenced by such factors as the material thickness ρ , mixing edge area A, mixing rotational speed ω , distance between mixing bleeding edge and center r, and the mixing edge point setting α . The FN'on a mixing sharp edge increases with the state of the art setting point (3).

Zhang (2020) explore that The more modest the cutting edge establishment point, the more uniformly the pressing factor dissemination on edge. This examination can give a reference to the arrangement choice of the foundation point of the mixing bleeding edge of significant blenders. The surface squeezing factor spreads of the mixing part under the five edge foundation focuses were gotten. The best squeezing factor is scattered at the most elevated mark of the squeezing factor surface of the mixing edge. The theoretical most outrageous line wear speed of the edges for the five state of the art foundation focuses was inspected, and the speculative life at five focuses was controlled by the contrasting change on the establishments of the scratched spot arrangement of the blender and unpleasant wear formula. Also, the best foundation point and its span were settled (4).

c) Cross-sectional Shape of Blade

Khidir(2018) studied that Centrifugal Blades is best from the Other ones for adequacy. This paper deals with the arrangement and examination of an edge for substantial blender in motivation to find a safe arranged removable bleeding edge for multi utilize substantial blender. It's a guideline part of a blender which helps mixing the components of the substantial for better quality concrete. For side bleeding edges type the sharp edges turns with drum notwithstanding in Centrifugal Blades Type the edges turns clearly. We use the edges a couple of times to find the best edge shape for better mixing, least disillusionment, easier to supersede and more affordable in esteem consequently avoiding change in the whole drum when the edge crashes and burns (5).

Valigi(2019) Studied that the blender with complete system power with the T sharp edges is 3.8% above than the case with the L shape which grant energy saving and upgraded creation rates. In this paper, the mechanical direct of



generous twin-shaft blenders is destitute down similarly as power usage and exchanged forces between the mix and the mixing organs during the mixing cycle. The mixing cycle is isolated into two huge scope stages, named transient and framework stage, where the direct of the blend is exhibited in two unmistakable habits. A force appraisal and power use assumption model are presented for both the considered stages and they are supported by test campaigns. From the utilization of this model to different machines and by changing assorted arrangement limits, the smoothing out of the power use of the significant twin-shaft blenders is analyzed. Eventual outcomes of this work can be used to extend effectiveness and advantage of generous blenders and lessen energy waste in the endeavors which incorporate mixing measures (6).

Maria(2016) investigates that further developed calculation of blending edges for planetary substantial blenders permitted lower wear rates and longer sturdiness. Wear of machine fragments is one of the principal wonders to control and limit to work on the show and lessen the creation costs. In this paper, the upgrade of a planetary considerable blender to the extent wear impediment of sharp edges is proposed and another arrangement of the mixing forefronts' shape is showed up and analyzed. Test tests performed with two stars planetary significant blenders are portrayed and achieved preliminary outcomes are showed up. Those results show the progression of sharp edges' wear as time goes on and exhibit that the proposed changed edge's computation further develops the wear resistance and widens the important life (7).

d) Material used for making Blade

Samual(2018) considered that the by choosing hardened steel material as the sharp edge material, there is increment of solidarity, erosion. Concrete is used comprehensively for advancement reason. Considering the utilization of concrete, robotization of the cooperation is expected to grow creation yield. This investigation work is based on the arrangement of an insignificant cost significant blender machine. The machine was viably planned. The efficiency of a blender is directed by the consistency of the generous made. It could similarly be considered as being directed by the power used in conveying a given measure of concrete of the important consistency. Others limits like force, and power was reasonable enough that the outcome conveyed a negligible cost machine(8).

Torotwa(2018) investigates that the impeller edge design influence the presentation of a blender. Plan and movement of mixing structures using instigated vessels is a problematic endeavor due to the trial of securing exact information on impeller-provoked roughness. The usage of CFD can give point by point cognizance of such structures. In this assessment, test tests and computational fluid components multiplications were performed to take a gander at the stream characteristics of four impeller plans (anchor, saw-tooth, counter-stream and Rushton turbine), in achieving course of action homogeneity. It was gathered that, through CFD examination, separated information can be gotten for ideal arrangement of mixing contraption. These disclosures are significant in picking the best mixing equipment and gives a reason to expanding mixing errands in greater structures (9).

III. METHODOLOGY

3.1. Identification Of Problem

Problem identified in concrete mixer machine related to Failure of blade at Wainganga Spun Pipe Industry, Sewagram. For pipe making its important that the concrete mixer should be effectively working In Wainganga Spun Pipe Industry. but it has been observed that the blades of mixer not mix concrete mixture uniformly. Also present design of blade is not effective & stronger. It is observed that the blade of mixer machine break due to overloading of input mixture only at one side and various forces acts on it. This results into low quality of concrete mixture. So in this project I am researches to identify the different causes of blade failure & design such blade which is effective & strong.

3.2. Data Accumulation

Design data related to dimensions and process of concrete mixer machine gathered from Wainganga Spun Pipe Industry, Sewagram. Study The Present Design Of Blades & Machine .Takes information about concrete mixture machine machine working, background information about machine, electric motor specification, amount of concrete material fed into concrete mixer machine from production in charge. Take dimensions of various part of concrete mixer machine like blade assembly, gear & pinion teeth measurement , mixing tank measurement, shaft measurement, with the help of measuring tape . Then Draft 2D diagram of concrete mixture machine. Blade

assembly is total combination of blade, arm, blade mounting plate (upper plate, bottom plate with stiffener) & fixing bolts.

- There are 4 blade assemblies (T section) mounted on square shaft as shown in pictures. Blade is made up of Mild Steel material (A36 Grade)
- Blade assembly fixed at 85 degree with respect to axis of shaft.
- The peripheral speed of the paddles is approximately 167 RPM.
- Cross-sectional area of blade assembly = 75530 mm^2 or 0.075530 m^2



Figure 1 :- Blade Assembly in concrete mixer machine

3.3. Literature Survey

A detailed literature study about design of concrete mixer blade, concrete mixer machine is carried out from research paper shown in literature review section.

3.4. Design Calculations Of Concrete Mixer Blade Assembly

Design of blade of mixer to modify the existing blade assembly by performing design calculations. Then after finding reasons behind the breaking of blade from various research papers and books I collected data about shear stress analysis and shear capacity strength of blade for calculations. I followed many research papers, books and design data book for material properties of blade to solve calculations.

i) calculation of forces on blade assembly

The loads exerted on the blade include:

- 1) centrifugal force F_c
 - 2) pressure F_N
 - 3) frictional F_F
 - 4) gravity G
 - 5) mass of concrete on 1 blade F_{CM}
- Combining all force we get total force.

ii) Calculation Of Stress On Blade Assembly

Axial tensile load on blade (σ_t) = total load / cross sectional area

Also shear force calculated.

iii) calculation of maximum shear stress & equivalent shear stress by von mises stress (according to distortion energy theory) on existing blade

by calculating maximum shear stress & Von mises stress, we know that all forces acts on blade is above the allowable stresses of blade. So blade break.

3.5. CAD Modeling Of Design

Develop CAD model of modified machine by using CAD software. The designing of existing blade on the AutoCAD cad model and designing of Modified blade done.

i) Existing Design Of Blade

There are 4 blade assemblies (T section) mounted on square shaft as shown in pictures. Blade is made up of Mild Steel material(A36 Grade).
Weight of blade assembly= 10 kg

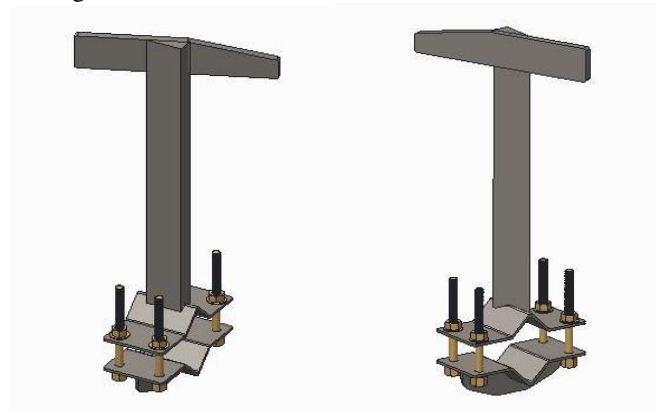


Figure 2:- Existing Design Of Blade

ii) Modified Design Of Blade

Shape of blade arm changes from T section to Y section to make it more strong & as blade length increases it is capable to withstand total deformation, maximum shear stress & equivalent stress as shown in FEM result.
Cross-sectional area of y shape arm= 56850 mm²

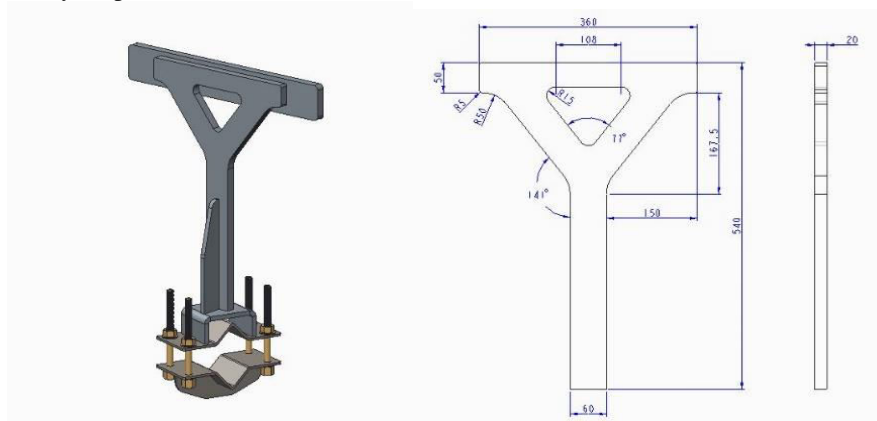


Figure 3:-Modified Design Of Blade With Dimension Of Arm (Y Shape Arm)

3.6. Finite Element Model Generation(Modified Design Of Blade)

To discretize a continuous body into Finite Elements, A finite element model of the machine generated by using CAD model in hyper mesh.

i) Geometry Of Blade

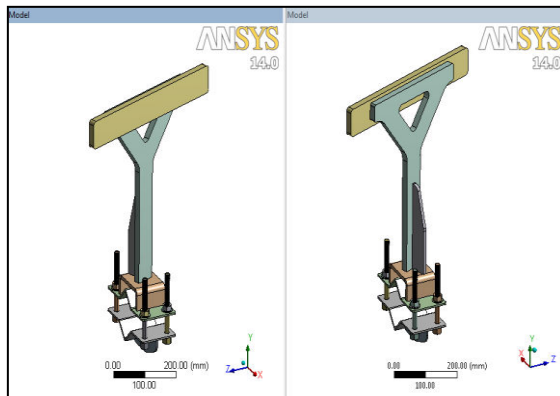


Figure 4:-Modified Design Of Blade
CAD Model (Geometry)

ii) Meshing

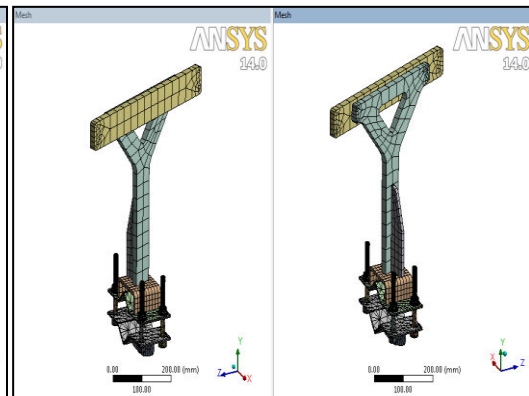


Figure 5:-Modified Design Of Blade
CAD Model (meshing)

Meshing of blade assembly done. Mesh Type = Tetrahedral Mesh

Nodes=156118

Elements = 79115

iii) Boundary Condition

a) Fixed Support

b) Force Applied(78780 N)

a) Fixed Support



Figure 6:-Modified Design Of Blade
CAD Model (fixed support)

b) Force

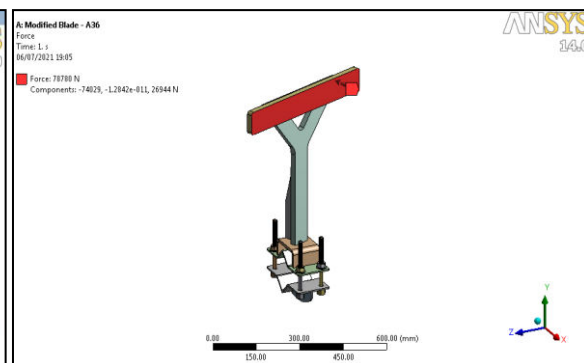


Figure 7:-Modified Design Of Blade
CAD Model (force applied)

3.7. Finite Element Analysis

A Linear Static analysis is performed, for finding displacement and stresses for different boundary conditions. In FEM analysis there are three inputs geometry, meshing and boundary conditions. In boundary condition we give the data of loading, moment, after that it provides the results in the deformation, max shear stress, von-mises shear stress. By comparing all values we can find out about the result.

- Material of blade is A36 Grade Steel

i)Material Properties

1	Property	Value	Unit
2	Density	7850	kg m ⁻³
3	Isotropic Elasticity		
4	Derive from	Young's Modu...	
5	Young's Modulus	2E+05	MPa
6	Poisson's Ratio	0.26	
7	Bulk Modulus	1.3889E+11	Pa
8	Shear Modulus	7.9365E+10	Pa
9	Tensile Yield Strength	250	MPa
10	Tensile Ultimate Strength	400	MPa

Figure 8 : A36 Material properties table

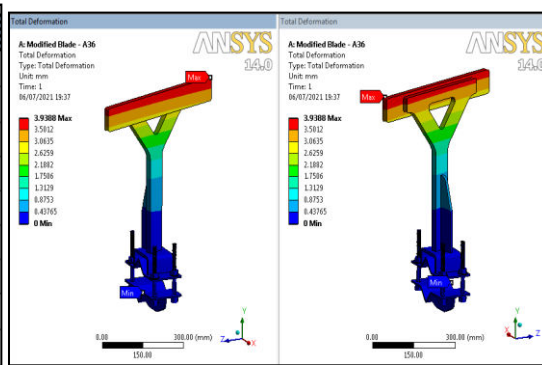
ii)Total Deformation

Figure 9: Total Deformation Developed On Modified Blade

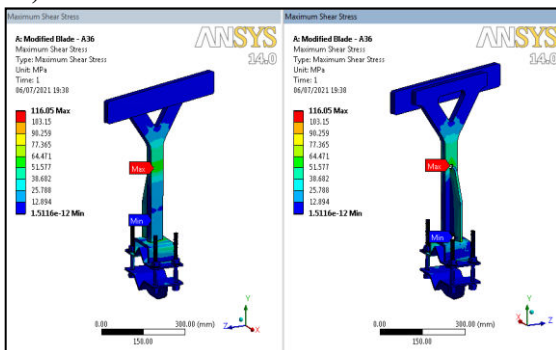
iii)Max Shear Stress

Figure10 : Maximum Shear stress developed blade.

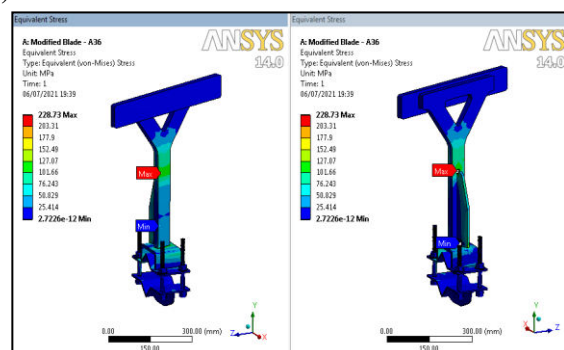
iv)Von-Mises Stress

Figure 11: Equivalent stress developed on Modified on Modified blade.

After applying different boundary conditions analysis is carried out. Maximum shear stress observed is 116.05 Mpa which is lower than allowable stress . Thus blade design is safe.

Equivalent stress of blade is 228.7 MPa which is lower than allowable stress . Thus blade design is safe.

IV. RESULT DISCUSSION

As per the detailed study and observation from the existing concrete mixer blade assembly from Wainganga spun pipe industry, modified blade is designed. it consist of selection material for blade, changes size & shape of blade & designed modified blade.

In a modified blade assembly thickness of blade increases from 15 mm to 20 mm to sustain deformation of blade. Which will results in increase strength of blade .Also width of modified blade is increased to its now mixes more concrete uniformly .so there is no concrete remains between gap of two blades. Additional stiffener support gives to the modified blade arm. So now it not break as it capable to withstand heavy shear stresses. Based on design calculations graphical representation 3D CAD model of blade assembly and Modified model is generated in Creo 2.0 and to validate the design a finite element analysis is carried out in ANSYS . From the results it is observed that max shear stress in blade assembly is found to be under allowable stresses and observed that the design is safe for the given loading conditions.

Existing Design = A36 Steel Material (F=78780 N)	Total deformation(mm)	23.49
	Max shear stress(Mpa)	365.14
	von-mises stress(Mpa)	687.62
Modified Design = A36 Steel Material (F=78780 N)	Total deformation(mm)	3.93
	Max shear stress(Mpa)	116.05
	von-mises stress(Mpa)	228.73

Table. 1: Result comparison Between Existing Design & Modified Design Of Blade with same material & same force.

V.CONCLUSION

To increase the quality of concrete mixtures & machine efficiency we have design modified blade. The project includes accumulation of data of concrete mixture machine, blade assembly , performing design calculations, modification in existing model, cad modelling of proposed model is done. The performance of concrete mixer machine can be improved by application of modified blade assembly. Finite element analysis of blade assembly is done. From the results of finite element analysis, we can see the stresses developed in the design are within the allowable stress which results in safe design. Modified blade of machine is safer & stronger to existing blade assembly and will become useful in effective concrete mixture making. The existing blade design which has high max shear stress value , high deformation value and high von misses stress value and low shear strength value the blade is found to fail. With the study of the blade and using ansys software we found out the values and keeping with 6 cases we found out the best blade assembly design the shear failure will be overcome. The cases which are consider in this project with the calculations and stress analysis will help the other people to understand the design and analysis of blade assembly .

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