Simulation of Bucket body of Bucket Wheel Stacker Reclaimer

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***Abstract* - In bucket wheel stacker reclaimer, the reclaiming process is used to reclaim the material with the help of bucket. So the amount reclaiming material is mainly dependent on capacity of the bucket. Moreover, the capacity (volume) of the bucket is concern to reclaim the material. In this paper, parametric model of bucket is made so we can change the bucket dimension to different capacity of bucket and use bucket to simulate the same. In the simulation, analyze the bucket body against the normal and tangential digging resistance acts on the blade during reclaiming process. The model made in Pro-E and simulated in Ansys 14 Workbench. The result is verified with yield strength of the material. Digging analysis is performed in static condition.**

***Keywords* - Bucket wheel stacker reclaimer, Bucket body, Normal & Tangential digging resistance of bucket, Pro-E and Ansys**

I. INTRODUCTION

Bucket wheel stacker reclaimer is a kind of machine to transport the bulk solids materials in the stockpile yard .The stockpile yard is a place to store some bulk solids materials like coal ,iron ore ,limestone etc. Most of the machine are used in port , power plant , steel plant , and cement mill and so on .There are many of the machines are used in the world. For reclaiming purpose, buckets are used. A bucket is a specialized container attached to a machine. It is a bulk material handling component. The bucket has an inner volume as compared to other types of machine attachments like blades or shovels.

II. MODELING OF BUCKET BODY

Bucket body is made of plates, blades and teeth. Bucket body attached to the bucket wheel. For extra stiffness the stiffeners are attached at the base where the bucket is mounted with bucket wheel. For restriction degree of freedom from the front side lugs are used. Bucket is a part which is undergone through stresses so structural steel has been selected due to its ductility as a manufacturing material (2). The capacity of the bucket is 1.350 cu m. This bill of material and dimensions are found by using standard data book. Parametric model of the bucket is made by considering the main variable. The main variable is height of the bucket and the length of the bucket, dimensions are as given below.

Height of the bucket – 1457 mm
Length of the bucket – 1501 mm

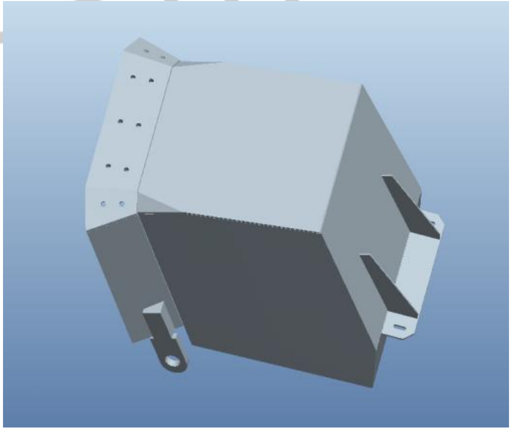

Fig 1 Isometric view of the bucket body

III. STATIC ANALYSIS OF THE BUCKET BODY

Assumptions for Analysis of the bucket body

- The material of the bucket body is perfectly homogeneous (i.e. of the same material throughout) and isotropic (i.e. of equal elastic properties in all directions).
- Load conditions are assumed to be constant throughout the operational life.
- Assumed welding efficiency equal to parent material.

Table No.1 Material of construction

Sr No.	Component	Material	Yield Strength In Mpa
1	Plate & Blade	ST-42	250

IV. NORMAL DIGGING RESSISTANCE

Speaking of bucket wheel excavators, the force characteristics mean the forces which act on the bucket and the wheel. The forces which act on the bucket are: the cutting force (digging) Fx which acts according to the tangency of the trajectory of the bucket; the penetration force F which acts according to the normal of the trajectory of the bucket; the lateral force Fz which acts according to the binormal of the trajectory of the bucket [29, 30].

The cutting force F will be determined with the following equation: - in the main vertical plane (θ = 0)

Fx = kuz Ke Stm N 4.1

Where: Ke represents the specific resistance of the reclaiming material to the cutting force, i.e. N/cm2;

Stm – is the average surface of the transversal section of the chip, i.e. cm2;

θ–is the positioning angle of the bucket in relation to the axis of the main cutting vertical plane, i.e. rad;

kuz - represents the coefficient regarding the wear of teeth and cutting wedge of the bucket (kuz = 1 for new tooth, kuz= 1.2…1.5 for average worn teeth, kuz ≥ 2 for much worn teeth, kuz being determined experimentally for each case) [18].

The value of the force Fx is constant for θ ≤ θL and decreases if θ ≥ θL, becoming Fx=0 for

θ =90o, where θL is the limited pivoting angle.

For starting reclaiming of the material,

Specific resistance of the excavated material Ke= 60 N/cm2, [18, 30] Coefficient regarding the wear of teeth and cutting wedge of the bucket Kuz = 1 for new tooth Assuming Average surface of the transversal section of the chip Stm= 0.1 m2

Fx = kuz Ke Stm

Therefore, Fx = 60 * 1 * 1000

= 60000 N

The total load of the 60000 N during reclaiming is applied on surfaces as remote force. The load and constrains are given as shown in figure 22. Also, the Von-Mises stress and deformation due to this loading condition is given in figure 23 and figure 24 respectively.

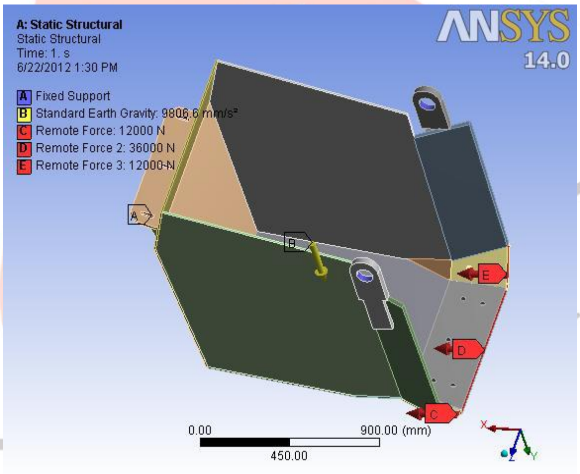

Fig 2 Constrains and load for normal digging resistance of modified bucket

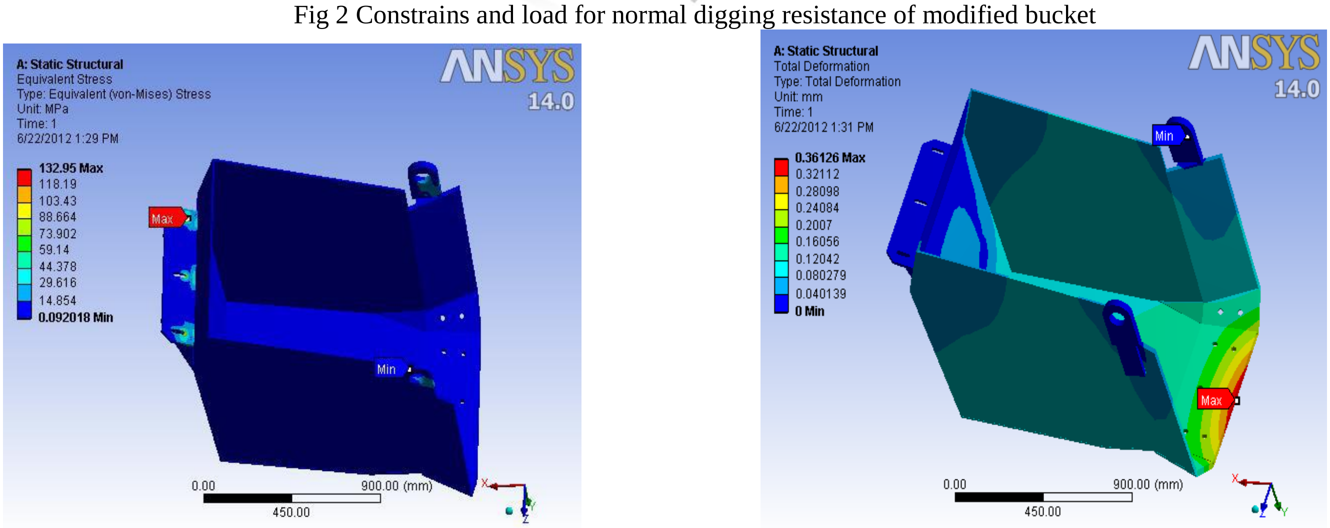

Fig 3 (a)Von-Misses stress of normal digging resistance of modified bucket (B)Deformation of normal digging resistance of modified bucket

V. NORMAL LATERAL RESSISTANCE

The normal lateral resistance can be assumed to be 0.3 times of the normal digging resistance [28, 31].

Normal lateral resistance = 0.3 x 60000 = 18000 N

The total load of the 18000 N during reclaiming is divided into two different surfaces as remote force which is 9000 N at side plate. The load and constrains are given as shown in figure 28. Also, the Von-Mises stress and deformation due to this loading condition is given in figure 29 and figure 30 respectively.

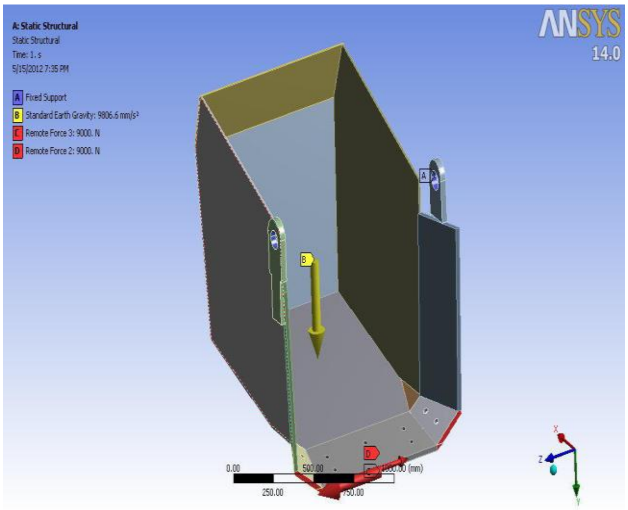

Fig 4 Constrains and load for lateral resistance analysis

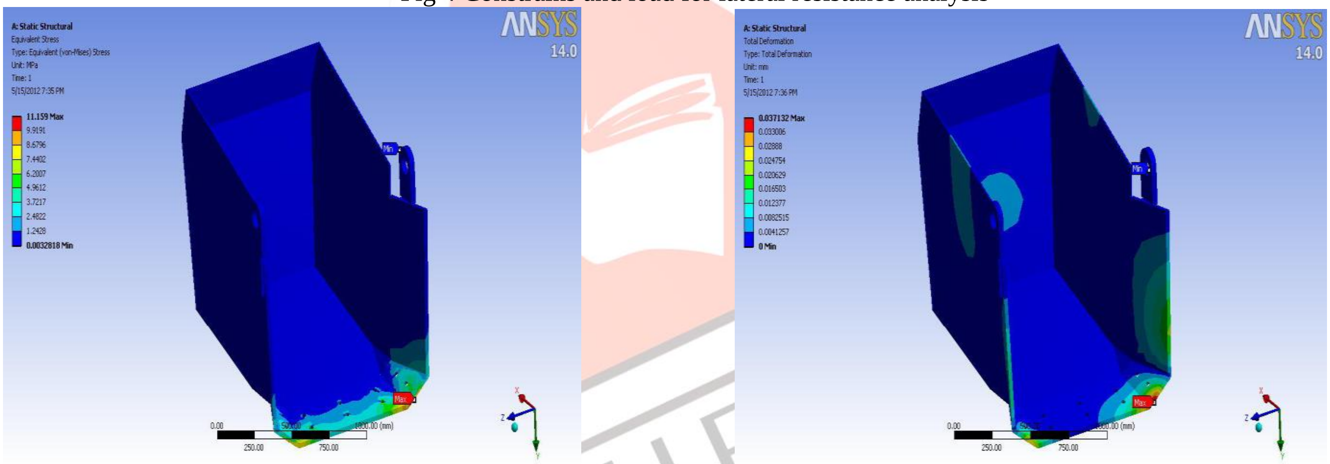

Fig 5 (a) Von-misses stress of lateral resistance analysis (b) Deformation of lateral resistance analysis

VI. RESULT

Sr no.	Load Case	Allowable Direct Stress in Mpa	Max Von-Mises Stress in Mpa	Deformation In mm
1	Normal digging resistance	166.7	132.95	0.361
2	Normal lateral resistance	166.7	11.159	0.037

VII. CONCLUSION

The Capacity of the Bucket is the maximumVon-Mises stress is equal to 132.95 MPa and maximum deformation is equal to 0.361 mm achieved later are within the permissible limits. Above analysis shows that the maximum stress developed in the bucket body are less than the ultimate stress of the material. So, the above design is said to be safe. The deflection is also under the range. This is also advantageous because modifications are possible and can be designed with better strength, with minimum stresses and deformation. Due to these the manufacturing cost can be optimize and best efficient model can be generated.

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