

# OPTIMISATION OF RECTANGULAR BUCKET ELEVATOR SYSTEM BY ANALYSING BUCKET AND SHAFTS

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**Abstract** - In this innovative serious modern times one will stretch out on the far side his rival by selection of applicable material handling equipment. Material handling method is overhead for the production however it is heart of any process plant. Bucket elevator has evolved as advanced material handling instrumentation in mechanized bulk material handling industry. The effective use of various kind of bucket elevators are completely depends on its style and sort of bulk materials. during this report differing types of bucket elevator are mentioned on their different components and therefore the design of rectangular bucket elevator with coincident buckets for lifting limestone at an explicit height is accounted for a selected yield rate. the main aim of the project is to extend the load carrying capability of the elevator bucket. this will be accomplished from finite element approach. This report deals with the design and analysis of various components of elevator for conveying different types of materials.

**Key Words:** Bucket Elevator, Bucket Handling Equipment, FEA analysis, Optimisation, Shaft, Material properties.

## 1. INTRODUCTION

Material handling is an engineering field in design of equipment used for the handling of bulk materials like coal, grains, sand, gravel and stone etc. in loose bulk kind. The bucket elevator is probably the oldest known form of conveyor, its history can be traced back to the days of Babylon where wicker baskets lined with a natural pitch and fastened to ropes operating over wooden sheaves turned by slaves, were used for the elevating of water into irrigation ditches.

The Concept of the elevator has been around for many years. Variations that have changed to the elevator are its method of manufacture and types of materials used. Bucket Elevators are powered instrumentation consisting of an endless belt, or chain to that metallic or non-metallic buckets square measure fastened for conveyancing bulk materials in a steep or vertical path. Buckets hooked up to versatile belt/chain move unidirectional within a casing.

Bulk material is collected at bottom end of the elevator and delivered at the highest end.

It consists of:

- 1) Buckets to contain the material;
- 2) A belt to hold the buckets and transmit the pull;

3) means to drive the belt;

4) Accessories for loading the buckets or lifting up the material, for receiving the discharged material, for keeping the belt tension constant and for enclosing and protecting the elevator. A bucket elevator works by connecting several buckets via chains or a conveyer around a powered pulley system. The buckets are filled with bulk material at the bottom of the elevator. Then the buckets ascend the elevator ramp, till they reach the terribly high wherever the material is discharged. The buckets are designed to remain upright to prevent spillage. the pinnacle is one of the main structural elements of the elevator.

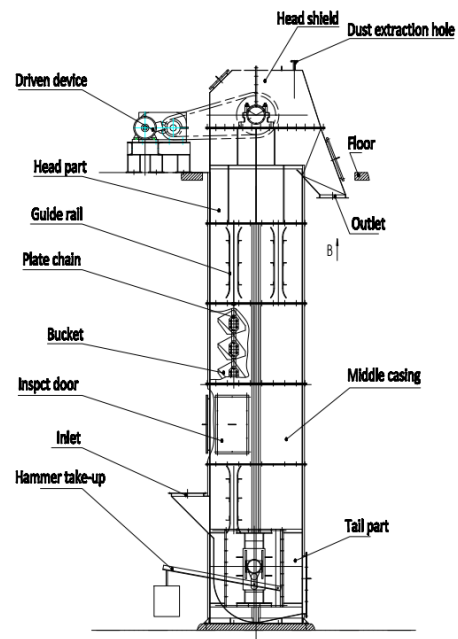


Fig 1: Parts of bucket elevator

## 1. LITERATURE REVIEW

1. Jigar Patel carried out an altered plan of bucket elevator to increase capacity to 2 tonnes/hr for a height of 12 m.
2. N. Yashaswini, Raju. B and A. Purushottham, design and optimization of bucket elevator through finite element analysis, International Journal of Mechanical Engineering Volume 2, Issue 9, Sep 2014.
3. Snehal Patel, Sumant Patel gave a brief review on design of bucket elevator in their research paper. The study shows negative influence parameter on the performance of bucket elevator.

4. Swapnil Deokar, Prof, Ashish Lagad modified design of bucket with weight reduction of approximately 36% is achieved in bucket material.

## 2. PROBLEM STATEMENT

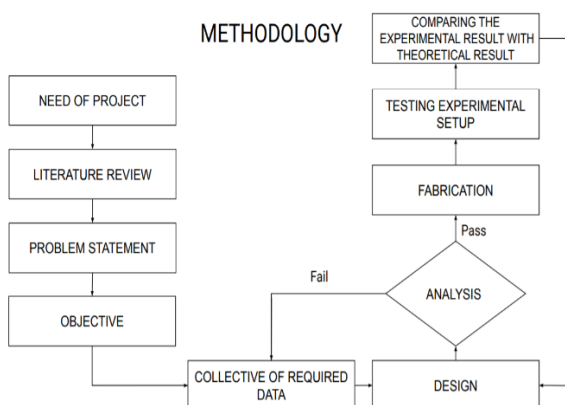
Bucket elevators widely used equipment in mechanical industry. Satisfactory level of materials we tend to be using till now for buckets aren't sufficient thus it's always it is to find the new material. Vibration will cause failure of structure. Bucket elevators always faces drawback throughout build-up loads. because of shape of bucket 200<sup>th</sup> material stay after the discharge that should be reduced by optimizing the bucket form. As said, bucket elevators go along with a set of issues. Simply put, there be a maintenance (and production) nightmare. they're complicated. They increase the number of gears and components to keep track of and replace. they're hard to clean, tough they are aligned and flowing at the right speeds, need tensioning, and on and on. There are a lot of little things which will fail and, once not caught early, will quickly cause huge problems. manufacturers who use bucket elevators rely on the shaft for the strain to be provided on the most effective as the machines collect material and elevate it, a lot of force is placed on those shafts. If these shafts begin to fail and maintenance doesn't catch it, the buckets can victimise the belt and do a lot of damage and a lot of downtime.

## 3. OBJECTIVES

- Material selection using Ashby Chart.
- Bucket elevator calculations as per CEMA (conveyor equipment manufacturing association) standard.
- Repeatedly drawing and performing FEA analysis:
  - (a) Fatigue Analysis on Shaft.
  - (b) Weight Reduction of product.
- Material Costing.
- Welding Costing.

## 4. METHODOLOGY

Following is the flow chart of the methodology that was



followed for the project.

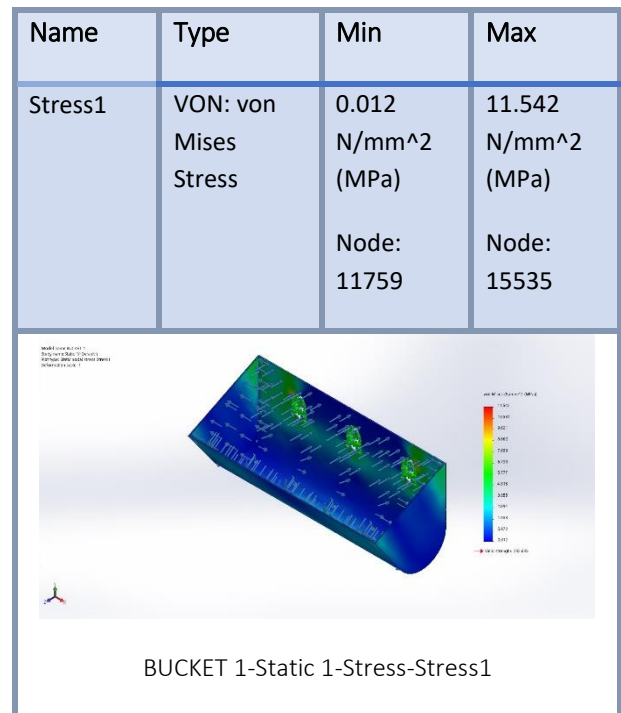
## 5. RESULTS

### 5.1 Analysis on Initial bucket design:

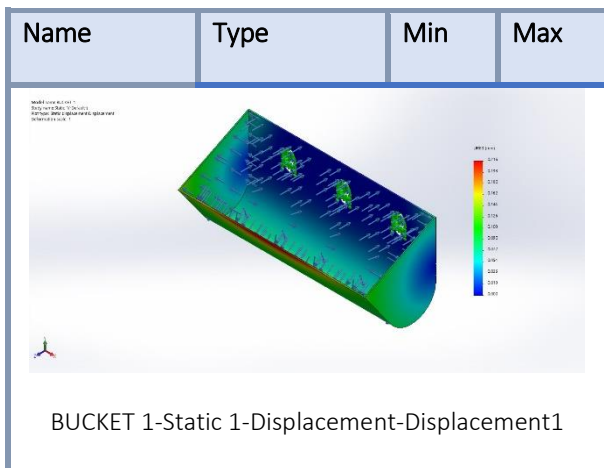
The initial bucket material was High Carbon Steel with density 8300kg/m<sup>3</sup>. The bucket weight was 3.7Kg initially which is quite high for the existing machine working. Bucket dimensions initially were 9" x 6". The deformation of the bucket was initially 0.367mm.

### 5.2 Analysis on optimized bucket design:

The optimised bucket material is Carbon Steel with density 7450Kg/m<sup>3</sup>. The bucket weight after optimisation is reduced to 1.62 Kg1. Optimised bucket dimensions are 8" x 5". The deformation of the bucket was initially 0.216mm which is acceptable by the customer.



Name	Type	Min	Max
Displacement1	URES:	0.000	0.216
	Resultant	mm	mm
	Displacement	Node: 3595	Node: 4907

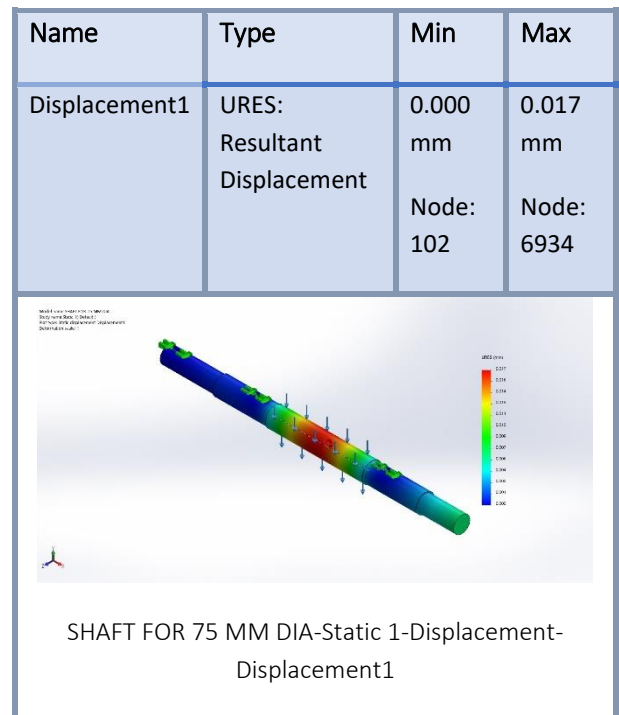
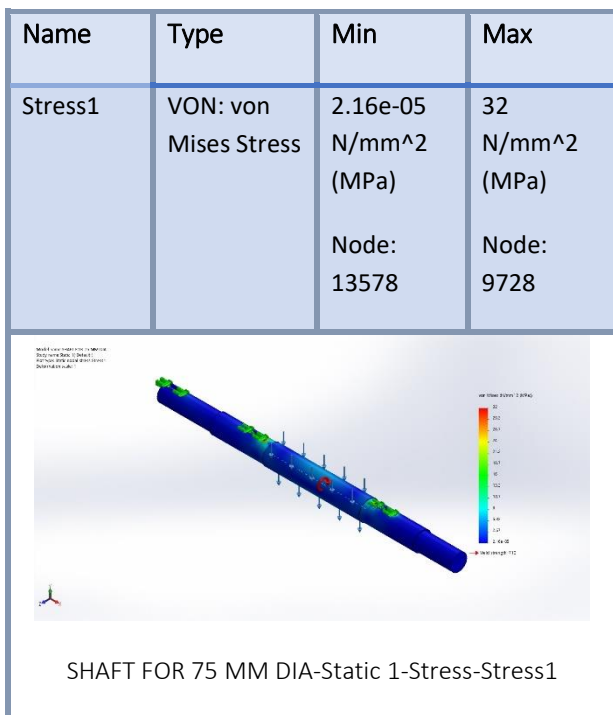


### 5.3 Analysis on Initial shaft:

According to the analysis report obtained, the deflection of the shaft was 0.9mm. Hence, the design is safe. But the weight of the shaft is the major concern that is 56 Kg which can be reduced by changing the material of the shaft. The material of the shaft was IS 2062.

### 5.4 Analysis on optimized shaft:

After changing the material to 4340 Steel, the deflection of the shaft was 0.017 mm. Hence, the design is safe. Also, the weight of the shaft is reduced to 43Kg because of the change in material.



## 6. DISCUSSION

The existing model is analysed for limestone material and the analysis is carried out by changing the material of the bucket and the shaft. By first analysing the existing material of the bucket and then changing the material of bucket to reduce its weight as required by the customer.

Sr. No	Case	Weight
1	Existing Bucket	3.7 Kg
2	Optimized Bucket	1.62 Kg

$$\begin{aligned} \text{Weight Reduction} &= (\text{Existing} - \text{Optimized}) / \text{Existing} \\ &= (3.7 - 1.62) / 3.7 \\ &= 56.21\% \end{aligned}$$

Along with the weight reduction in bucket, the weight is also reduced by optimizing the shaft. In this, the material of the shaft is changed to 4340 steel. The material of the shaft is selected by ASHBY chart and then best material obtained by calculations and then analysed.

## 7. CONCLUSION

In this paper the belt driven bucket elevator, for material transport is modelled in SOLIDWORKS and FEA analysis studies are made considering the optimization of the weight of bucket elevator. The proposed bucket elevator model is almost equal to the model used initially by industry for a 10TPH. The stresses and deformations are critically

examined on two critical components of the setup (i.e., Buckets and Shaft).

## 8. REFERENCES

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