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Design and Manufacturing of Ladder Roof Lift for Material Lifting

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Abstract - At construction site for material handling labours are used but this process is time consuming and due to which there will be possibility of accidents and thus for a multi stored building it is not economical. In this project we design and manufacture a ladder roof lift for material handling. For the operation of lift, we can use roller mechanism, chain drive or rack and pinion. For carrying different materials multiple containers will be placed on the lift. This process is economical and there is no chance of accidents and material wastage is also avoided. This design is compact and cost efficient.

***Key Words*: Aluminium Alloys, Chain Sprocket, Shaft, Conveyor Bucket.**

1. INTRODUCTION

Material Handling equipment's are used in movement of bulk, packaged, & individual products within the limits of place of business. The different types of handling equipment can be classified into four major categories transport equipment, positioning equipment, unit load formation equipment, and storage equipment. Material handling equipment's used for following purpose:

To increase efficiency of material flow
To reduce material handling cost
To improve facilities utilization
To improve safety & working conditions
To facilitate construction processes
To increase productivity

All Material handling equipment are classified in main types, i.e

1) CONVEYORS

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another in fixed path. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries.

2) CRANE & HOISTS:

Cranes & Hoists is a tower or derrick that is equipped with cables and pulleys that are used to lift and lower material. They are commonly used in the construction industry. Cranes for construction are normally temporary structures, either fixed to the ground or mounted on a custom built vehicle or ship. They can either be controlled from an operator in a cab that travels along with the crane, by a push button pendant control station, or by radio type controls.

2. PROBLEM STATEMENT

At a construction site for lifting a material labor is required. If the building is multistoried it becomes difficult to transfer the material. Thus by this traditional system accident occurs and the process is very time consuming. Due to which costing for labours also increases. Also due to improper handling of material there is wastage of material.

So to overcome the problems arise in the existing method of material handling. We design a lift which carries the material at particular height of building from ground level. This lift can be made using roller mechanism, chain mechanism or rack and pinion. And for carrying the material multiple containers will be placed on the lift. For the operation of lift, we use motor.

3. OBJECTIVE

a) The main objective of the devices used for lifting purposes is to make material handling easy.

b) Ladder roof lift is used to raise or lower, convey and or transfer material between two or more elevations.

c) This ladder roof lift used for material handling process can transfer large quantity of material to the desirable height without its wastage.

4. Methodology

PHASE 1

a. Market survey
During this period detail market survey has been done to learn available parking systems and their utility also their literatures of different types of parking systems and its difference between have been observed.

b. Problems in existing systems
The problems regarding the existing system have been found such as, Complicated programming, High budgets, Unfeasible design, high end robots, etc.

c. Conceptual Design.
Taking problem statement from above and studying the fundamental engineering concepts various concepts regarding modern parking system are prepared and amongst those best concepts design has been selected for further phases.

PHASE 2

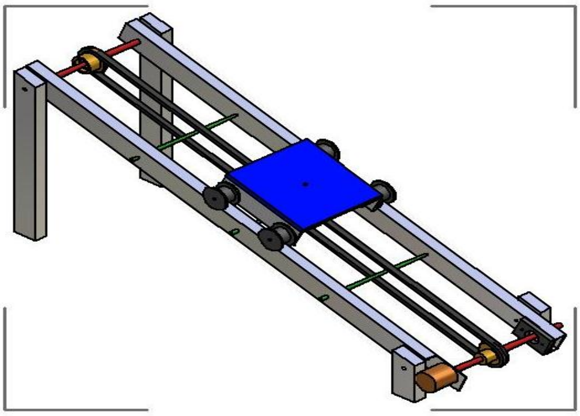
a. Modeling in CATIA.
Putting the ideas on the modeling software for visualization of the prototype and making it more and more compatible so that there will be less complexity in designing

b. Material Selection and Procurement
In this phase material selection is done and also its procurement as per need the dimensions are taken from CATIA model.
c. Fabrication
This phase includes fabrication of prototype in the workshop from the procured material and preparing the Prototype model from the software model.

d. Assembly & Testing
This phase includes Assembly of all the sub parts, also the arrangement of the motor and its wiring is done, all finishing operations like grinding, trimming, painting is done here.

4. WORKING MODEL

For making lift which is used for the application at construction site we need to consider all the parameters. We need to design a lift which will be able to reach a height of around 25 ft. Main advantage of the ladder roof lift is that it is portable thus it can be used at maximum places. For the movement of the ladder roof lift we can use chain drive or rope drive. Instead of using a single container for transferring material it is convenient to use multiple containers as large amount of material will be transferred in lesser time. For transferring the lift to different places it should be of lesser weight. Thus we use aluminum composite material for manufacturing of ladder roof lift.



Calculations

Design of Chain Drive

Torque acting on the motor is T = 0.8 kg
= 7.848 N.m.

RPM = 100rpm

Let, Number of teeth = Z1= 21 (sprocket)

The number of teeth for the both sprockets are same because we will have to transmit same power to another axis.

Tooth correction factor (K) for the both sprocket

K2 = 1.26
k1=1

For smooth chain & DC motor
Ks=1.0
We required power transmitted for the further calculations
Power

$$P = \frac{2\pi nT}{60}$$

$P = \frac{2\pi * 100 * 7.484}{60}$

P = 82.18W

KW Rating of Chain

$= \frac{(\text{power to be transmitted}) * Ks}{K1 * K2}$

$= \frac{(82.18) * 1.0}{1 * 1.26}$

Power rating=0.065KW

Smaller value for 100 rpm in table 14.2 is 0.25

For 100 rpm & Power 0.065KW
Power rating of simple roller chain
The Power rating at 06 B is 100rpm & 0.25 KW power
Therefore, chain number 06B is selected.
For chain number 06B

Dimensions

Pitch (P)	P=9.525 mm
Roller diameter (d1)	d1=6.35 mm (max.)
Width (b1)	b1=5.72mm
Transverse Pitch (Pt)	Pt=11.24mm

Breaking load

Simple = 8900 N
Duplex = 16900 N
Triplex = 24900N

Pitch Circle diameter of driving & driven shaft (PCD)

$$D1 = \frac{P}{\sin(\frac{180}{z})} = \frac{9.525}{\sin(\frac{180}{20})} = 64 \text{ mm}$$

For driving sprocket D1= 64mm
For driven sprocket D2= 64mm

Number of chain link (Ln)
The central distance between sprocket wheels should between 30P to 50 P
By taking the minimum value
Approximate central distance (a)

a= 790mm

$$Ln = 2 * \left(\frac{a}{P}\right) + \left[\frac{z1+z2}{2}\right] + \left[\frac{z2-z1}{2\pi}\right]^2 * \left(\frac{P}{a}\right)$$

$$= 2 * \left(\frac{790}{9.525}\right) + \left[\frac{21+21}{2}\right] + \left[\frac{21-21}{2\pi}\right]^2 * \frac{9.525}{790}$$

$$= 2 * \left(\frac{790}{9.525}\right) + \left[\frac{42}{2}\right] + 0 * \frac{9.525}{495}$$

= 187

No of links are 187

Correct central distance

$$[\,Ln - (\frac{Z1+Z2}{2})] = [187 - (\frac{21+21}{2})] = 166$$

$$a = \frac{P}{4}\{[\,Ln - (\frac{Z1+Z2}{2})] + \sqrt{\left[Ln - \left(\frac{Z1+Z2}{2}\right)\right]^2 - 8\left[\frac{Z2-Z1}{2}\right]^2}\,\}$$

$$a = \frac{9.525}{4}\{166 + \sqrt{166^2}\}$$

a= 790.575mm

To provide small sag, for allowing the chain links to take the best position on the sprocket teeth, the centre distance is reduced by (0.002a). Therefore, the correct centre distance is given by

a= 0.998*790.575
a=788.99mm

To calculate tension in chain
The chain velocity is given by

$$v = \frac{Z_1 P n_1}{60 * 10^3}$$

$$V = \frac{21 * 9.525 * 100}{60 * 1000}$$

V= 0.3334 m/s

The chain tension is given by

$$T_1 = \frac{1000 * KW}{v}$$

$$T_1 = \frac{1000 * 0.25}{0.3334}$$

$$T_1 = 749.85\ N$$

Factor of safety
FS = 11.86

Design Of Shaft

Material of shaft is **C45Cr75.**

Table. Shaft Material Properties

Yield strength	Syt	247MPa , N/mm2
Ultimate tensile strength	Sut	841 MPa, N/mm2
Factor of safety	FS	2
Poisons ratio	μ	0.303
θ		180°

For chain drive max tension

$T_1 = 749.85N$ =0.749KN

Permissible shear stress

$\tau = 0.18 * Sut$

$\tau = .018 * 841$

$\tau = 151.38\ N/mm2$

Torsion moment

$T_1 = 0.746\ KN$

$$\frac{T1}{T2} = e^{\mu\theta}$$

$$\frac{T1}{T2} = e^{0.303 * \Pi}$$

$T2 = 289.11N$

Torque supplied to the shaft is given by

Mt1=(T1-T2) * 64/2

= (749 -289.11) *64/2

=14716.48 N.mm

Bending moment

Also, Mt2 = 1038.11 * 102

= 105887.22 N-mm

Shaft diameter,

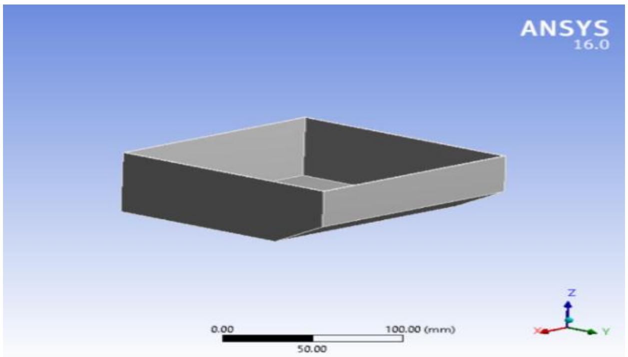
$$\tau_{max} = \frac{16}{\pi d^3}\sqrt{(M_b)^2 + (M_t)^2}$$

$$151.38 = \frac{16}{\pi d^3} * \sqrt{(105887.22\ )^2 + (14716.48)^2}$$

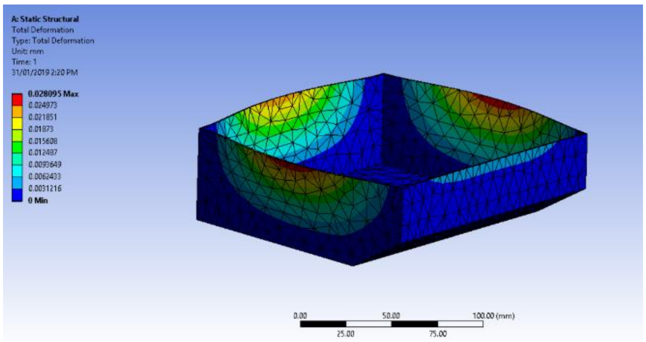
D=15.32 mm

Taking safe value diameter of shaft is 16 mm.

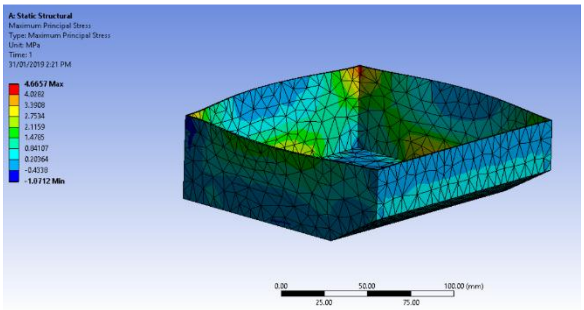
Bucket Analysis



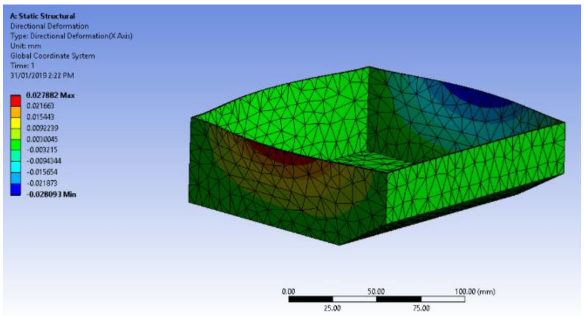
Total deformation



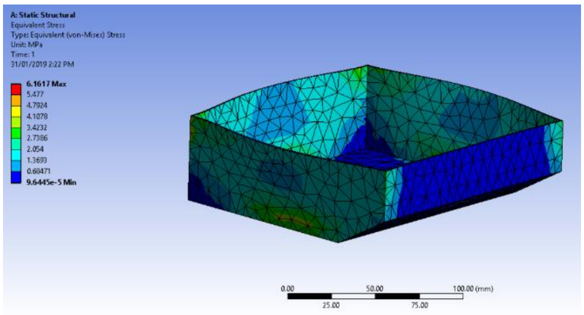
Maximum principal stress



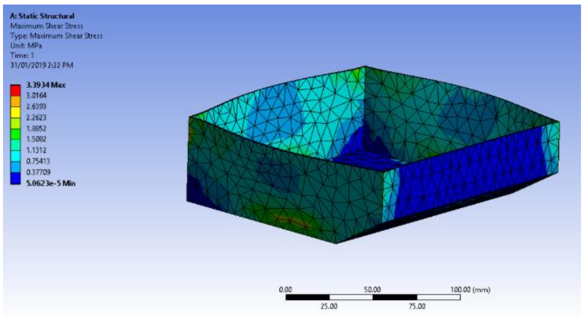
Directional deformation



Equivalent stress



Maximum shear stress



Advantages

1. Easy and convenient material handling.
2. Accidents will be avoided as no labour is required.
3. Due to lesser weight ladder roof lift is portable.
4. Due to multiple numbers of containers larger amount of material is transferred in lesser time.

Disadvantages

1. Initial cost is high.
2. Maintenance is required.

CONCLUSION

In our project we are getting more effective results and effective work than previous system so this project is cost effective and work efficient

REFERENCES

[1] Pradnyaratna A Meshram, Dr. A R Sahu, Design, "Modeling and Analysis of conveyor system used for transportation of Cartons". International Journal of Research in Advent Technology, Vol.4, No.1, January 2016, PP.79-88.

[2] Ghazi Abu Taher, Yousuf Howlader, Md. Asheke Rabbi, Fahim Ahmed Touqir, "Automation of Material Handling with Bucket Elevator and Belt Conveyor". International Journal of Scientific and Research Publications, Volume 4, Issue 3, March 2014, PP.1-13.

[3] Alireza Jalali Yazdi, Mojtaba Maghrebi, Jafar Bolouri Bazaz, "Mathematical model to optimally solve the lift planning problem in high-rise construction projects". Journal of Automation in Construction. Published in 2018, PP.120-132.

[4] Taehoon Kim, Hyunsu Lim, SeungWoo Kim, Hunhee Cho, Kyung-In Kang,"Inclined construction hoist for efficient resource transportation in irregularly shaped tall buildings". Journal of Automation in Construction. Published in 2016, PP.124-132.

[5] Michael G. Kay, "Material Handling Equipment". Journal of North Carolina State University. Published in January, 2012, PP. 1-67.

[6] Manan Mehta, Roshan Patel, Vishal Patel, Smit Patel, "Fabrication of Vertical Material Handling Equipment". International Research Journal of Engineering and Technology (IRJET), Volume 3, Published in 2016, PP. 1191-1193.

[7] "Design of Machine", V.B.Bhandhari, 3rd Edition. Published by Tata McGraw Hill Education Private Limited, in 2010, PP. 564-576.