International Journal of Research Publication and Reviews, Vol 5, no 6, pp 1814-1818 June 2024

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Design and Manufacturing of Emergency Exit Device

Shubham Jadhav, Gurudev Chavan, Prathmesh Gadhave, Gaurav Gaikwad *

JSPM Rajarshi Shahu College of Engineering, Tathawade, Pune .

ABSTRACT

Emergency exit devices are crucial components of building safety systems, providing a means for rapid egress during emergencies such as fires or other disasters. This paper presents the design and manufacturing process of an innovative emergency exit device aimed at enhancing user safety and ease of use.The design phase begins with a comprehensive analysis of user needs, building codes, and safety regulations. Utilizing advanced CAD software, various design iterations are explored to optimize functionality, durability, and aesthetics. The device incorporates features such as intuitive operation, clear signage, and robust construction to ensure reliability in emergency situations.The manufacturing process employs state-of-the-art techniques such as 3D printing, CNC machining, and injection molding to produce high-quality components with precision and efficiency. Materials selection focuses on durability, fire resistance, and environmental sustainability, aligning with modern safety standards and regulations.Quality control measures are implemented throughout the manufacturing process to guarantee adherence to specifications and standards. Prototypes undergo rigorous testing procedures, including functionality tests, load tests, and fire resistance tests, to validate performance and reliability.

Keywords: : Design and manufacturing of emergency exit from refuge area of building (Sky Saver)

I. INTRODUCTION

Ensuring the safety of occupants within buildings during emergencies is paramount in modern architecture and construction. Emergency exit devices serve as vital components of building safety systems, facilitating rapid egress during critical situations such as fires, natural disasters, or other emergencies. This paper delves into the meticulous process of designing and manufacturing an innovative emergency exit device, with a primary focus on enhancing user safety and ease of use.

The design phase of the emergency exit device entails a comprehensive analysis that considers various factors, including user requirements, building codes, and safety regulations. Leveraging advanced Computer-Aided Design (CAD) software, designers explore multiple iterations to optimize functionality, durability, and aesthetic appeal. Central to the design is the integration of intuitive operation, clear signage, and robust construction to ensure the device's reliability and effectiveness during emergencies.

Subsequently, the manufacturing process employs cutting-edge techniques such as 3D printing, Computer Numerical Control (CNC) machining, and injection molding to fabricate high-quality components with precision and efficiency. Material selection plays a pivotal role, emphasizing attributes such as durability, fire resistance, and environmental sustainability, aligning with contemporary safety standards and regulations.

Quality control measures are rigorously implemented throughout the manufacturing process to ensure adherence to specifications and standards. Prototypes undergo exhaustive testing procedures, including functionality tests, load tests, and fire resistance tests, to validate performance and reliability under simulated emergency conditions.

In summary, the design and manufacturing of this emergency exit device epitomize a holistic approach to safety engineering. By amalgamating innovative design concepts with advanced manufacturing techniques, the resulting product prioritizes user safety while adhering to stringent regulatory requirements. This endeavor underscores the commitment to safeguarding lives and property in the face of unforeseen emergencies within built environments.

Methodology

- Introduction of concept
- Designing of simple mechanism for reuse it by any person
- Select material rope, brake and all components
- Mathematical calculation of size for every component
- CAD design of each and every component

- Manufacture sky saver for the obtained parameters
- Testing of the sky saver by dead weight and generate result table and

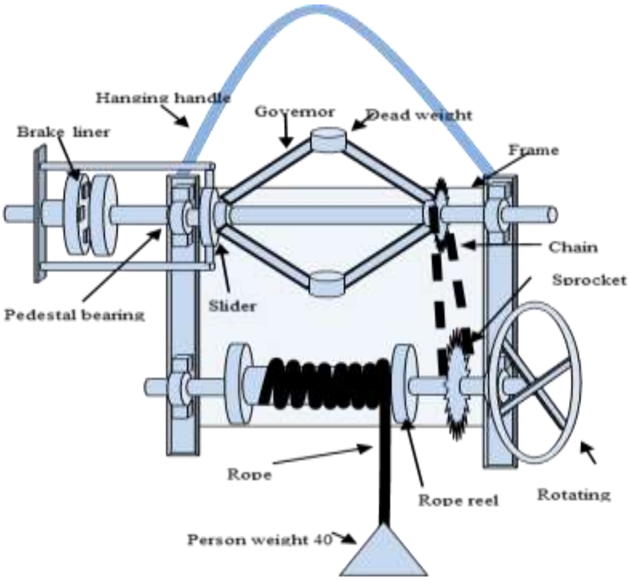


Fig. 1 - (a) 2d Working methodology

Calculation

Let us design the machine for caring 100 kg weight and downfall speed of 2 m/s

Rope selection

The relationship between mass and force (weight) can be expressed as: - m = f/g

Where,

F = force, weight (N)

m = mass (kg)

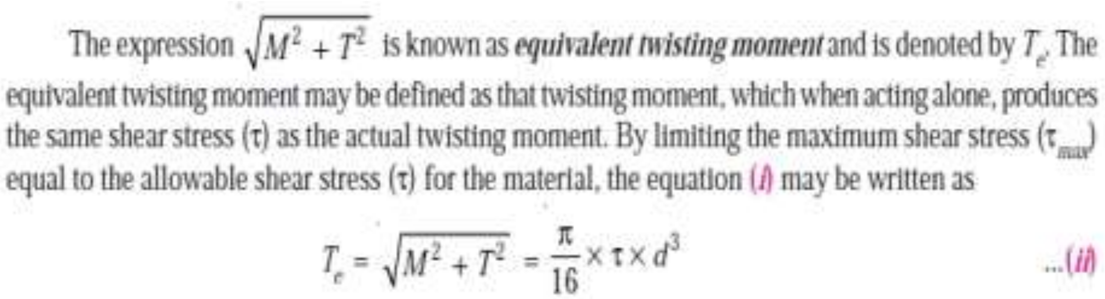
g = acceleration of gravity (9.81 m/s2)

Maximum safe mass for a 3/8" nylon rope where safe load is 1.2 KN can be calculated as

m = (1.2 x 1000 N) / (9.81 m/s2)

= 122 kg

So, the rope we chose is a nylon rope and it can carry maximum 122 kg > 100kg



The expression $\sqrt{M^2 + T^2}$ is known as ***equivalent twisting moment*** and is denoted by T_e. The equivalent twisting moment may be defined as that twisting moment, which when acting alone, produces the same shear stress (τ) as the actual twisting moment. By limiting the maximum shear stress (τ_{max}) equal to the allowable shear stress (τ) for the material, the equation (*i*) may be written as

$$T_e = \sqrt{M^2 + T^2} = \frac{\pi}{16} \times \tau \times d^3 \qquad \ldots(ii)$$

1.Reel shaft des

The total weight on shaft coming is: -

W=100 kg= 981 N

M= w x L/4 = 981 x 300/4 = 73575 N-mm

T = f x r (reel radius) = 981 x 30= 29430 N-mm

$T_e = \sqrt{M^2+T^2} = \sqrt{73575^2+29430^2}$

Also, $T_e = \pi/16 \times 135 \times d^3$

So, $79242.70 = \pi/16 \times 135 \times d^3$

d=14.40 mm

So, d=15 mm

But we are using 20mm shaft so design is safe. 20mm > 15mm.

2.Bearing selection

For 20mm Shaft diameter we take standard bearing no. P204

P204: -

P = Pedestal bearing.

2 = Spherical ball or deep groove ball bearing

= 04 = 5 * 4 = 20 mm.

20mm = Bore diameter of bearing.

3.RPM of reel shaft

d= diameter of reel

V = 2 m/s

Linear velocity V= π x d x N / 60

2=3.142 x 0.06 x N/60

So, N= 636 rpm

4.RPM of governor shaft

Pulley Ratio=250/100 =2.5

636 x2.5 = 1590 RPM

5. Number of V-Belts

We know that the power transmitted per belt,

P = (T1-T2) x V

As we know maximum torque on shaft = Tmax = T = 29430 N-mm

Where,

T1 = Tension in tight side

T2 = Tension in slack side

O1O2 = centre distance between two shafts

$$\sin \alpha = \frac{R1 - R2}{O1O2}$$

$$\sin \alpha = \frac{125 - 50}{310}$$

Sin ∝ = 0.2419

∝ = 14

TO FIND θ

θ = (180 –2∝) X 3.14/180

θ = (180 –2*14) X 3.14/180

θ =2.652 rad

we know that,

$T1/T2 = e^{\mu\theta \text{ Cosec } \beta}$

$T1/T2 = e^{0.25 \text{ x } 2.652 \text{ cosec } 20}$

T1 = 6.95T2

We have,

T = (T1 – T2) x R

29430 = (6.95T2 – T2) x 125

T2 = 39.57 N

T1 = 6.95 X 39.57

T1 =275 N

So, tension in tight side = T1= 275 N

V = πDN/60

= 3.142 x 0.125 x 636/60

V = 4.16 m/sec.

P = (275 –39.57) x 4.16

P = 979.39 W (N-m/s)

Also, P=2πNT/60

P=1960.08

Number of V-Belts: -

N = Total Power transmitted / Power transmitted per belt

= 979.39/1960.08 = 0.499

= Say 1 belt

So, 1 belt is sufficient for transmission of power

Calculation on length of belt

We know that radius of pulley on shaft,

r1 = d1/2 = 250/2 = 125mm

Radius of pulley on motor shaft,

r2 = d2/2 = 50/2 = 50 mm

Centre distance between two pulley = 305mm

We know length of belt,

$L = \Pi (r2+r1) + 2 \text{ x } X + (r2-r1)^2 / x$

$= \Pi (125 + 50) + (2 \text{ x } 310) + (125 – 50)^2 / 310$

L = 1143 mm = 45 inches

(1)

4. Acknowledgements

We would like to express our gratitude to Prof. D. M Kupade for his guidance and support throughout this project. We also thank Dr. S.N. Khan and Dr. R.K. Jain for their invaluable advice and encouragement.

References

1. To complete the project, report the use of various book is important.

2. R. S. Khurmi, and J. K. Gupta. Theory of machines. S. Chand, 2001.
3. B. D. Shiwalkar “Design Data for Machine Element”.
4. V.B BHANDARI “Design of machine element” McGraw-Hill publication co. ltd 16th edition.
5. PANDYA AND SHAH “Machine design” Charotar publishing house 13th edition.
6. Design and Stress Analysis of Watt and Porter Governor*Ravindra Singh Rana, Rajesh Purohit, Alok Singh.
7. Sumit Kumar1, Rajeev Kumar2, Harish Kumar3 "Analysis & Investigation on Watt Governor to Improve the Speed Range of the Governor" International Journal of Research and Scientific Innovation (JRSI) | Volume III, Issue VI, June 2016 | ISSN 2321-2705.