International Journal of Interdisciplinary Innovative Research &Development (IJIIRD)
ISSN: 2456-236X
Vol. **05** Special Issue **01 | 2020**

Design and Development of Rescue Backpack for Descent Escape

Mr. Pratik Gite[1], Mr.Ishvar Daund[2] , Mr.Prasad Patil[3] , Mr.Harshal Gaikwad[4] ,Prof. A.D. More[5]

[1,2,3,4]Student, [5]Professor
[1,2,3,4,5]Department of Mechanical Engineering
[1,2,3,4,5] SIEM, Nashik, SavitribaiPhule Pune University, India.

***Abstract*- Rescue Backpack is your way out of life threatening situations caused by fire, earthquakes, hurricanes and terror attacks, when main escape routes are inaccessible. The Rescue Backpack enables you to easily, quickly and safely evacuate from emergency situations through a window or balcony. Rescue Backpack is a Controlled Descent Device (CDD), which will slowly and automatically lower you to safety. Rescue Backpack is designed for everyone - no special training or skill required.Safely self-evacuate from your apartment building: Survival backpack allows you to quickly escape your apartment building instead of helplessly waiting for salvation. Backpack is a Controlled Descent Device (CDD) that enables you to self-evacuate from life threatening situations caused by fire, terror attacks, hurricanes and earthquakes. Securely Evacuate In 3 Simple Steps: You need no skill or training to use the Survival Backpack: (1) buckle up (2) clip onto the pre-installed anchor point (3) exit through window. Once out of the window, the escape kit automatically and slowly descends you towards the ground, making your escape easy, quick and more reliable than any other alternative.**

I. PURPOSE OF THIS PROJECT

• Provide guidance to users on the need for proper fall protection planning to either remove the fall hazard
• Prevent access to the fall hazard, restrict downward movement at the fall hazard, or provide the proper survival system
• Illustrate fall protection systems
• Familiarize fall protection equipment users with the appropriate OSHA and ANSI standards pertaining to their use
• Assist in the proper selection, care, use and inspection of equipment
• Demonstrate procedures and the proper wearing of equipment
• Determine which products to use in specific work environments Demonstrate proper anchoring procedures

II. PROBLEM STATEMENT

The number of people residing or working in multi-story buildings has been steadily rising for many years. However, the emergency exits

and escape routes of these buildings are out-dated and do not provide a reasonable solution for emergencies such as fires, terror attacks andearthquakes.

III. PROBLEM SOLUTION

The development of Backpack Evacuation System changes this reality. Backpack enables evacuation from any situation in all types of emergencies without additional assistance. Backpack is a sophisticated and technologically advanced, but very easy to use product.

IV. Eddy Current Brakes

If the conductor we are moving through the magnetic field isn't a wire that allows the electricity to flow neatly away. We still get electric currents, but instead of flowing off somewhere, they swirl about inside the material. These are what we call eddy currents.They're electric currents generated inside a conductor by a magnetic field that can't flow away so they swirl around instead, dissipating their energy as heat. One of the interesting things about eddy currents is that they're not completely random: they flow in a particular way to try to stop whatever it is that causes them. This is an example of another bit of electromagnetism called Lenz's law (it follows on from another law called the conservation of energy, and it's built into the four equations summarizing electromagnetism that were set out by James Clerk Maxwell).Here's an example. Suppose you drop a coin-shaped magnet down the inside of a plastic pipe. It might take a half second to get to the bottom. Now repeat the same experiment with a copper pipe and you'll find your magnet takes much longer (maybe three orfour seconds) to make exactly the same journey. Eddy currents are the reason. When the magnet falls through the pipe, you have amagnetic field moving through a stationary conductor (which is exactly the same as a conductor moving through a stationarymagnetic field). That creates electric currents in the conductor—eddy currents, in fact. Now we know from the laws of electromagnetism that when a current flows in a conductor, it produces amagnetic field. So the eddy currents generate their own magnetic field. Lenz's law tells us that this magnetic field will try to oppose its cause, which is the falling magnet. So the eddy currents and the second magnetic field produce an upward forceit from falling. That's why it fallsmore slowly. In other words, the eddy currents produce a braking effect on the falling magnet.

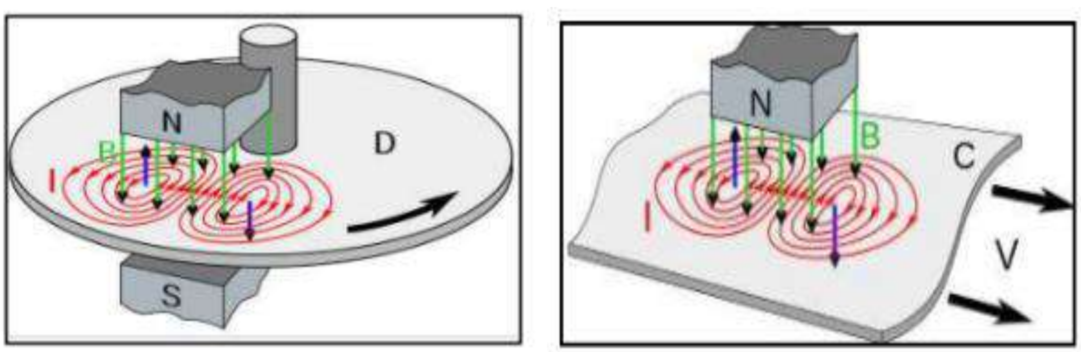

Fig.1 Eddy Current Principle

Essentially the eddy current brake consists of two parts, a stationary magnetic field system and a solid rotating part, which include a metal disc. During braking, the metal disc is exposed to a magnetic field from an electromagnet, generating eddy currents in the disc. The magnetic interaction between the applied field and the eddy currents slow down the rotating disc. Thus the wheels of the vehicle also slow down since the wheels are directly coupled to the disc of the eddy current brake, thus producing smooth stopping motion.

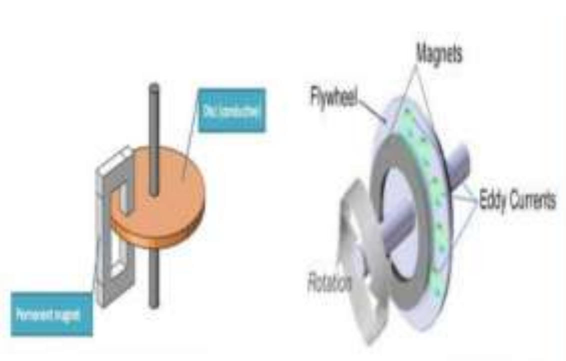

Fig.2 Eddy Current Brake System

V. COMPONENTS:

A. Wire Rope

Wire rope is a complex mechanical device that has many moving parts all working in tandem to help support and move an object or load. In the lifting and rigging industries, wire rope is attached to a crane or hoist and fitted with swivels, shackles or hooks to attach to a load and move it in a controlled matter. It can also be used to lift and lower elevators, or as a means of support for suspension bridges or towers.Wire rope is a preferred lifting device for many reasons. Its unique design consists of multiple steel wires that form individual strands laid in a helical pattern around a core. This structure provides strength, flexibility, and the ability to handle bending stresses. Different configurations of the material, wire, and strand structure will provide different benefits for the specific lifting application, including: Strength, Flexibility, Abrasion resistance, Corrosion resistance

B. Roof Anchor / Ceiling Hooks

Roof anchors are designed to function in many uses. A roof anchor may be used a standalone product or in conjunction with various other forms of permanent equipment such as davits, horizontal lifelines, rigging sleeves and outrigger beams. At first glance a roof anchor is a very simple piece of equipment.A joist is one of the beams that support a ceiling. It's the securest place to fasten a hook for heavy items so that you don't risk damaging the ceiling or the item. For items lighter than 5 lb (2.3 kg), you canuse an adhesive hook as an easy alternative.

Fig.3 Roof Hooks

C. Magnet

A neodymium magnet (also known as NdFeB, NIB or Neo magnet), the most widely used type of rare-earth magnet, is a permanent magnet made from an alloy of neodymium, iron and boron to form the $Nd_2Fe_{14}B$ tetragonal crystalline structure. Neodymium magnets are metal, and they are colored silver, like most other metals.
Developed in 1982 by General Motors and Sumitomo Special Metals, neodymium magnets are the strongest type of permanent magnet commercially available. They have replaced other types of magnet in the many applications in modern products that require strong permanent magnets, such as motors in cordless tools, hard disk drives and magnetic fasteners. Rare Earth magnets (also known as Neodymium magnets) are 5 to 7 times stronger than Ferrite Magnets and offer the greatest value for money Neodymium magnets are graded according to their maximum energy product, which relates to the magnetic flux output per unit volume. Higher values indicate stronger magnets and range from N35 up to N52. Letters following the grade indicate maximum operating temperatures (often the Curie temperature), which range from M (up to 100 degrees Celsius) to EH (200 degrees Celsius). Neodymium magnets are metal, and they are colored silver, like most other metals. Hematite is not a metal, although it has some metal atoms in it. It is instead a mineral, formed primarily of iron oxide, specifically, the Fe_2O_3 oxide, which is common iron rust. Usually there are other elements mixed with it. Hematite magnets vary in colour from red,grey and black.

Some important properties used to compare permanent magnets are: remanence (Br), which measures the strength of the magnetic field; coercivity (Hci), the material's resistance to becoming demagnetized; energy product (BHmax), the density of magnetic energy; and Curie temperature (TC), the temperature at which the material loses its magnetism. Neodymium magnets have higher remanence, much higher coercivity and energy product, but often lower Curie temperature than other types. Neodymium is alloyed with terbium and dysprosium in order to preserve its magnetic properties at high temperatures.

D. Body Harness

A safety harness is a form of protective equipment designed to protect a person, animal, or object from injury or damage. The harness is an attachment between a stationary and non-stationary object and is usually fabricated from rope, cable or webbing and locking hardware.
Full Body Harness-
A full body harness is a body support device that distributes fall arrest forces across the shoulders, thighs and pelvis. Full body harnesses have a centre back fall arrest attachment for connection to the fall arrest connecting device and may have other D-rings for use in worker positioning, fall prevention, suspension or ladder climbing. The only form of body wear acceptable for fall arrest is the full -body harness. Full body harnesses should beselected based on work to be performed and the work environment. Front D-rings on full body harnesses are used only for laddertype fall arrestors, work positioning, travel restraint or rescue. Side D-rings are for positioning only. The connecting subsystem is the critical link which joins the body wear to the anchorage/ anchorage connector. It can be an energy-absorbing lanyard, fall limiter, self-retracting lanyard, rope grab, or retrieval system. Connecting means will vary depending on whether the worker is equipped for personal fall arrest or work positioning and travel restriction. Connecting Means for Personal Fall Arrest The connecting means for personal fall arrest is often a lanyard equipped with an energy-absorbing element to reduce the energy transmitted to the user's body in the event of a fall. Self-retracting lifelines or fall limiters reduce free-fall distance as well as reducing energy loads from a fall. Go for guidance on calculating fall clearance for Connecting Means for Positioning and Travel Restriction.The connecting means for positioning and travel restriction is often a simple lanyard, constructed of rope, web or wire rope. These may also include specialized positioning assemblies for rebar work, constructed of chain or web. All positioning devices are intended to reduce the potential for free fall to a distance of less than two feet. Restraint lanyards are specified in length to prevent the user from reaching a fall hazard zone.

Anchorage - Support structure.
Anchorage Connector – Tie-off sling is an option.
Body Support - Full body harness with either front or shoulder mounted D-ring.

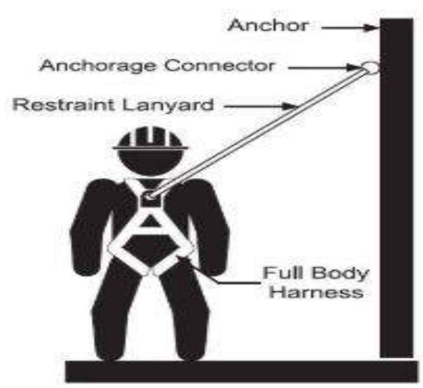

Fig.4 Full Body Harness of Fall Protection System

VI. DESIGN PARAMETER OPTIMAZATION

The design of an eddy current brake reduced to five optimization problems which are discussed in the proceeding sections.

A. Rotor Disc Clearance

The rotor disc clearance must be optimized to maximize torque when the brake is on and maximize back drivability when the brake is off. The trade-offs of this optimization are: maximum torque requires minimum clearances while maximum back drivability may have a clearance threshold where within the eddy currents cannot be eliminated due to the parabolic shape of the magnetic field lines in the off case. This optimization will be largely conducted experimentally.

B. Rotor Material

The material of the rotor disc must also be optimized in order to minimize the time constant, τ and minimize the disc's moment of inertia, *I*. There are two strong candidates in our selection of material which are copper and aluminium. This evaluation is based on the qualitative result of Equation 7. In order to minimize the time constant, we must choose the smallest ratio of density, ρ to conductivity, σ from all the materials available. We have evaluated the ratios for a number of possible commercial materials. We find that copper and aluminium rank top. The ratio for copper is calculated to be 1.5*10^-4 kgm^2/S and for aluminium is 0.76*10^-4 kgm^2/S. Therefore, we plan to use aluminium as the material for our rotating disk in the prototype in order to achieve better brake performance.

$$\tau = I/b = 2\rho R^2/n\sigma D^2 B^2$$

Table No.1 Comparison between Cu & Al

	Density $[kg/m^3]$	Specific Conductivity [S/m]	Ratio $[kgm^2/S]$
Copper	$8.9*10^3$	$58.0*10^6$	$1.5*10^{-4}$
Aluminum	$2.7*10^3$	$35.5*10^6$	$0.76*10^{-4}$

C. Rotor Disc Thickness

The thickness of the rotor disc, *d*, must also be optimized in order to minimize the time constant, τ and minimize the disc's moment of inertia, *I*. The inertia of the disc is linearly proportional to the thickness, so minimizing the disk radius minimizes the disk inertia. The time constant does not depend on the disc thickness. Thus, the optimization problem reduces to minimizing disc thickness while maintaining enough structural rigidity.

$$I = \frac{1}{2}\rho d\pi R^4$$
$$\tau = I/b = 2\rho R^2/\sigma D^2 B^2$$

D. Rotor Disc Radius

The radius of the rotor disc, *R*, must also be optimized in order to minimize the time constant, τ and minimize the disc's moment of inertia, *I*. The inertia of the disc is proportional to the radius 9
to the fourth power , so minimizing the disk radius minimizes the disk inertia. The functionality of the time constant on the disc radius isn't as clear. Equation 11 shows that the time constant is proportional to the radius squared, however the magnetic flux, $\phi(R)$, is also a function of the disc radius because the larger the radius the more magnets can be mounted and thus the stronger the magnetic field. This functionality of the magnetic field on the disc radius is unknown and may only be evaluated experimentally. Thus, optimization of the rotor disc radius possesses a design challenge due to incomplete governing mathematical relations.

$$I = \frac{1}{2}\rho d\pi R^4$$
$$\tau = I/b = 2\rho R^2/\sigma D^2 B^2 n$$
$$\phi(R) = BD(R)n(R)$$

VII. ADVANTAGES

A. Easy to use
B. Fire resistant
C. High Curie temperature
D. Constant descent velocity irrespective of weight Portable
E. Low Cost
F. Also suitable for lower heights
G. Self-contained unit
H. No power source required

VIII. APPLICATIONS

A. Fire
B. Terror
C. Natural disaster
D. Oil rig
E. Cranes
F. Emergency responders
G. Army/special forces

IX. CONCLUSION:

From the above system and components we build up a new safety device or we can say emergency escape device to protect human being from hazardous situations like fire, robbery, earthquake, building collapse. This device used to protect ourself from this kind of situations occurs in day to day life. This device is economical, light in weight, portable and easy to use. . The backpack is designed for everyone so that it does not require any kind of special skills and training. Recognize fall hazard. The project includes following aspects: Know 3 parts of a fall arrest system: anchorage, body support & connection. Properly fit harness, Select anchor point, Inspect & maintain equipment, Understand limitations &requirements of system.

REFERENCE:

[1] Krawczyk, A. and Wiak, S,2002. Electromagnetic Fields in Electrical Engineering. Netherlands: IOS Press. s

[2] Puttewar, A ,S., Kakde , N, U., Fidvi ,H , A. and Nandeshwar, B .(2014). Enhancement of Braking System in Automobile Using Electromagnetic Braking, Journal of Mechanical and Civil Engineering, e-ISSN: 2278-1684, PP 54-59

[3] Sevvel, P., NirmalKannan ,V .and Mars Mukesh ,S.(2014).Innovative Electro Magnetic Braking System. International Journal of Innovative Research in Science, Engineering and Technology. Volume 3, Special Issue 2,PP 46-53

[4] Patel,S, Patel.,A, Patel.,M, Sanghani.,C and Patel., D .(2015) .Development of the Electro-Magnetic Brake. International Journal for Innovative Research in Science & Technology. Volume 1, Issue 12, May ISSN (online): 2349-6010

[5] Baharom, M, Z., Nuawi, M, Z., Priyandoko, G., Harris, S, M .and Siow, L,M..(2011). Eddy current braking study for brake disc of aluminum, copper and zinc. Regional Engineering Postgraduate Conference.

[6] Baharom, M., Nuawi, M., Priyandoko, G. and Harris, S. (2012). Eddy current braking experiment using brake disc from aluminium series of A16061 and A17075. IOP Conf. Ser.: Mater. Sci. Eng., 36, p.012005.

[7] Gillmore, M., Golding, L., Angel, B., Adams, M. and Jolley, D. (2016). Toxicity of dissolved and precipitated aluminium to marine diatoms. Aquatic Toxicology, 174, pp.82-91.

[8] Sommers, F., Mudrock, E., Labenia, J. and Baldwin, D. (2016). Effects of salinity on olfactory toxicity and behavioral responses of juvenile salmonids from copper. Aquatic Toxicology, 175, pp.260-268.

[9] Karwa, R., 2006. machinedesing. second ed. New Delhi: Laxmi Publications.
Hollowell, Thomas Culver; Kahl, Justin Tyme; Stanczak, Matthew Don; Wang, Yizhou
2010, Eddy Current Brake Design for Operation with Extreme Back-drivable Eddy Current Motor

[10]International Safety Equipmemt Association (2011). Personal Fall Protection System.
http://safetyequipment.org