Suspensable Floating Bag

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Abstract- *The suspensable-load Bag is designed to capture mechanical energy generated as the load oscillates vertically on the wearer's back during movement. This project aims to develop a Bag allowing relative movement between the load and wearer during walking and running, reducing vertical motion fluctuations. This movement can be harnessed to generate electrical or mechanical energy, potentially powering devices. Moreover, the design reduces forces on the wearer, minimizing the risk of orthopedic injury. The Bag includes a suspension system enabling movement of the pack body relative to the wearer's shoulders, enhancing comfort and stability during walk*

Keywords- Suspensable-load Bag, Mechanical energy, Vertical oscillations, Relative movement, Walking and running, Suspension system, Comfort, Stabilityetc.

I. INTRODUCTION

In Indian army, load carriage is an unavoidable part of field operations which is the reason why soldiers often make use of a military Bag. Infantry soldiers usually carry loads weighting more than 30% of their body weight. When the soldier carries a certain weight, his energy expenditure increases, which causes a reduction in performance. The transported load has a movement similar to the vertical displacement of the center of mass of the soldier while walking. This leads to a significant increase in the acceleration forces generated by the action of said load on the body which explains the increase in energy expenditure**.**

The objective of this project is to develop a load carriage system that suspends the load and reduces its vertical displacement. There will be the reduction in both the vertical excursion of the load and in the total vertical ground reaction force when carrying a load with the developed prototype, with respect to the conventional military Bag and will help military forces to transport supplies, equipment, personal items, ammunition and clothing in training or field operations. This Bag is based on Suspensable load technology which reduces the vertical movement and forces generated by the load on the carrier leading to energetic benefits. It dramatically reduces the impact forces during locomotion, even permitting running comfortably with heavy loads.

1) Muscle fatigue due to prolonged use of conventional Bags
2) Reduces the endurance capabilities
3) More chances of injuries such as stress fractures, knee pains and back pain
4) Rucksack palsy (Rucksack palsy is a traction or compression injury to the brachial plexus, caused by the shoulder straps of the rucksack. The patient presents with parenthesis, paralysis,

Camouflage bag-pack : Militia Camouflage Army Travel Bag / Tracking Bag designed for Military/Army/Special Forces use, Militia 65L Rucksack is a tough light weight rucksack with plenty of compartments to carry essentials. It has a Stock cord attachment on the top hence more compartment to add extra bit.

Compartments:

- Top Cap section with zipper (Ideal for handy items like mobile charger, sunglasses, medicines, etc)
- Main Upper Compartment
- Main Lower Compartment - Separate bottom opening to be used for storing dirty clothes, emergency items or shoes
- Spacious deep pockets on each side
- Mesh pockets on each side
- Laptop/File Compartment
- Front main Pocket Capacity: 25/30 Liters

Additional features:

- Easy Detachable Bag
- Fiber padding in the back along with lightweight aluminum strips provides a strong internal frame
- Extra soft breathable cushioning on the back provides easy air flow while walking for long hours
- 8 Utility straps to wrap additional items (sleeping bag, mat, camping equipment) on the sides, bottom and top
- Elastic cords and hooks on the day pack to hold mountaineering gear and additional emergency items
- Double layered strong fabric at the bottom provides durability for rough usage and carrying excess load
- Plastic padding on the bottom protects from rough terrain

Rain cover: Included in the bottom pocket

Load management:

- Torso adjustment straps to fit multiple physiques
- Four load setting pulls on the shoulder straps
- Flexible and movable waist strap to fit below the pelvis area

Table 1 : Bag Specification

Product Details	
Size	26 inches
Water Proof	Yes
Capacity	25/30 L
Compartments	1
Material	Polyester
With Rain Cover	Yes
No. of Pockets	4
Dimensions	W X H: 14 X 26 Inch
Weight	1500 gm

Photo 1: Travel Bag

Spring arrangement:

Springs are flexible machine elements used for controlled application of force (or torque) or for storing and release of mechanical energy. Flexibility (elastic deformation) is enabled due to cleverly designed geometry or by using of flexible material. In our project it is used for pulling or pushing the mechanism required.

The various machining operations conducted after material selections are as follows:

II. IDENTIFY, RESEARCH AND COLLECT IDEA

The comprehensive methodology for the design is based on system engineering design and analysis approach. While giving due importance to the design procedure, the analysis of different methods and procedures were undertaken to design a reliable model for reducing the force exerted by the bag on human body.

Laurence C Rome, Andy L Ruina et al. [1] shows a suspensable-load ergonomic-Bag has been developed that dramatically reduces the dynamic forces on the body (e.g., 82-86%) and consequently reduces the metabolic rate for carrying the load (e.g., by 40 W for a 60 lb load), providing the ability to carry significantly greater loads for the same metabolic cost (5.3 Kg more). The suspensable-load ergonomic Bag of the invention can be used to transport loads more quickly and more comfortably at running speeds—in contrast with a conventional Bag were running with a heavy load is essentially impossible.

Joseph J Knapik, Katy L Reynolds, Everett Harman et al [2] reviewed historical and biomedical aspects of soldier load carriage. Before the 18th century, foot soldiers seldom carried more than 15 kg while on the march, but loads have progressively risen since then. This load increase is presumably due to the weight of weapons and equipment that incorporate new technologies to increase protection, firepower, communications, and mobility. Research shows that locating the load center of mass as close as possible to the body center of mass results in the lowest energy cost and tends to keep the body in an upright position similar to unloaded walking. Loads carried on other parts of the body result in higher energy expenditures: each kilogram added to the foot increases energy expenditure 7% to 10%; each kilogram added to the thigh increases energy expenditure 4%. Hip belts on rucksacks should be used whenever possible as they reduce pressure on the shoulders and increase comfort. Low or mid-back load placement might be preferable on uneven terrain but high load placement may be best for even terrain.

Deepti Majumdar, Madhu Sudan Pal, Dhurjati Majumdar[3] shows the importance to evaluate the kinematic responses to existing load carriage operations and to provide guidelinestowards the future design of heavy military Bags (BPs) for optimizing soldiers' performance. Kinematic changes of gait parameters in healthy male infantry soldiers whilst carrying no load (NL) and military loads of 4.2-17.5 kg (6.5-27.2% body weight) were investigated. There were increases in step length, stride length, cadence and instance with the addition of a load compared to NL. These findings were resultant of an adaptive phenomenon within the individual to counterbalance load effect along with changes in speed. Ankle and hip ranges of motion (ROM) were significant. The ankle was more dorsiflexed; the knee and hip were more flexed during foot strike and helped in absorption of the load. The trunk showed more forward leaning with the addition of a load to adjust the center of mass of the body and BP system back to the NL condition. Significant increases in ankle and hip ROM and trunk forward inclination (> or =10

degrees) with lighter loads, such as a BP (10.7 kg), BP with rifle (14.9 kg) and BP with a light machine gun (17.5 kg), may cause joint injuries. It is concluded that the existing BP needs design improvisation specifically for use in low intensity conflict environments.

Camilla Perez, Evan Campo et al. [4] shows that in military life, load carriage is an unavoidable part of field operations which is the reason why soldiers often make use of a military Bag. Infantry soldiers usually carry loads weighting more than 30% of their body weight. When the soldier carries a certain weight, his energy expenditure increases, which causes a reduction in performance. The transported load has a movement similar to the vertical displacement of the center of mass of the soldier while walking. This leads to a significant increase in the acceleration forces generated by the action of said load on the body which explains the increase in energy expenditure. The objective of this project was to develop a load carriage system that suspends the load and reduces its vertical displacement. Results show a reduction in both the vertical excursion of the load and in the total vertical ground reaction force when carrying a load with the developed prototype, with respect to the conventional military Bag.

III. SCOPE OF THE PROJECT or OVERVIEW

The scope of the project encompasses the entire lifecycle of designing, developing, manufacturing, and deployingSuspensable load bags, with the ultimate goal of creating a reliable, efficient, and marketable product thataddresses the needs of users in various industries.

SIGNIFICANCE

Increase endurance capability
Carry surplus amount of ammunition, ration etc.
Less fatigue to soldier
Reduces injuries in shoulders and backbones

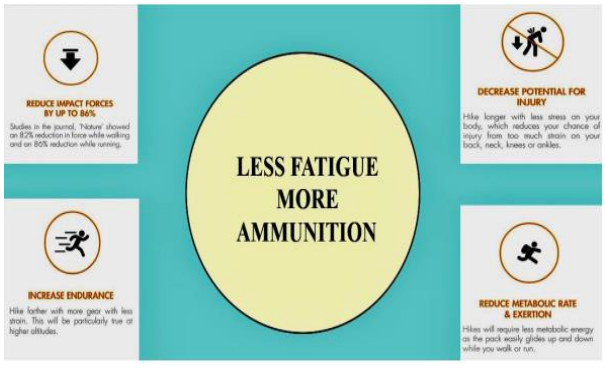

Fig.1: Advantages of Floating Bag

FIELD APPLICATIONS

A suspensable-load Bag designed to permit the load to move relative to the wearer during walking and running so that the large movements between the load and the wearer of the Bag reduce the fluctuations of vertical motion of the load with respect to ground. Because the hip (and thus the pack body) goes up a down a good deal during walking, a large relative movement between the wearer and the load reduces the absolute excursion of the load. Such movement of the suspensable-load relative to the wearer also reduces the forces on the wearer's body while walking or running, thus reducing the likelihood oforthopedic injury. Thus, thismodified Bag can be extensively used in long marches, prolonged standing duties, Trans border patrols etc.

IV. DETAILS OF DESIGN, WORKING AND PROCESSES

Morphology of design refers to the study of the chronological structure of design projects. The following phases are usually involved in any design project. To give the project a particular form and structure, and before we started with the actual design, we carried out preliminary studies regarding material property, material selection and design aspects of the raw material which we will use to construct the project, the construction of the project includes the structure of frame, pulleys, shaft, springs, bolts and elastic rope.

FRAME:

Frame is helping the supporting of the various light load support. Frame shows the good aesthetic loop. Frame material should have high strength because frame balancing of another machine load, so we have used aluminum material. In ours project the frame showing important role. The vertical pulley andsprocket are mounted on vertical support of the frame. Main whole project assembly our project mounted on frame.

Aluminum is feasible because

1. Aluminum has a lower density than any other commercial metal
2. It has excellent resistance to corrosion
3. It can be cast, machined and molded quickly

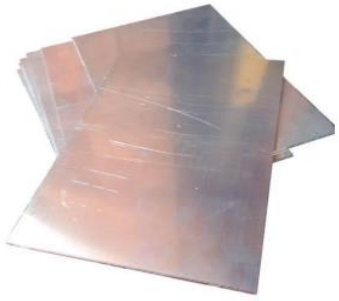

Photo 2 : Aluminum Plates For Frame

Aluminum Rod:

Photo 3: Aluminum Rod

Photo 4: Elastic Rope

Photo 5: Nylon Pulley

CAD MODEL

The entire model has been designed with the help of designing software solid works. With the help of colour feature the colures are given to the entire model.Figure- Cad model of the assembled project is designed on Solid works 2022 software

Solid Modeling

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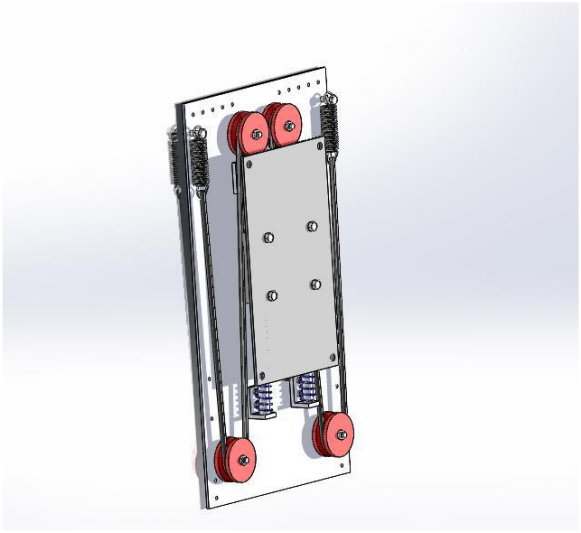

Figure 2: Assembly of floating bag

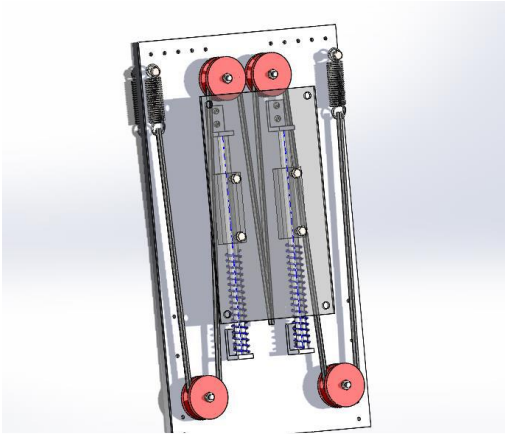

Figure 3: Mechanism view

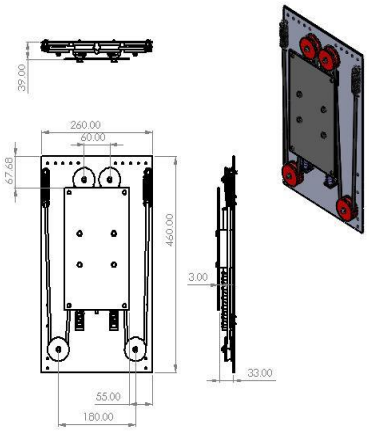

Figure 4: Drafting of bag-pack

V. CONCLUSION

Our product is going to cater the physiological and muscoskeletal problems faced by a soldier on duty. Using a double-frame and pulley system design, this bag pack reduces the dynamic forces impacting on body. It helps in long marches with less stress on body, also reducing chances of injury from too much strain on back, neck or knees. In future this can further be enhanced to small scale electricity generation and casualty evacuation.

VI. RESULT AND APPLICATIONS

Field Trials is an integral part of a project. It not only gives the idea of the working condition of the project, but we also come to know about the problems in the model and the errors that have been made so that they can be rectified.

TRIAL I We conducted the first trial of the project at the college ground.

1. Walking without load
2. Walking with the traditional load system used by soldiers (the carried mass weighted 20 kg).
3. Walking with the load carriage system prototype (the carried mass weighted 20 kg)

TRIAL II The second trial was conducted.

1. Fast running by 3 individuals and their experience with varying weight
2. Jumping with the bag
3. Field craft movement

APPLICATIONS: Ideal for mountain climbers, long duration hikes lasting more than 15 days and for carrying luggage on motorcycles and cars.

Photo 6: All Parts of Suspensable Floating Bag

Photo 7: Suspensable Floating Bag

VII. FUTURE SCOPE

Due to time constraints and dearth of manpower and technology, we have made a very basic model. Given more time and resources, we may be able to improve upon the project even further. Some of the future scopes that we thought of, which could be added to the basic model, to improve the its efficiency and further decrease human efforts. Weight reduction can be done moreby using different lightweight materialsi.e., Kevlar and composite materials. Small scale electricity can be generated by converting mechanical energy to the electrical energy. This energy is can be utilized for charging Motorola batteries. Extra arm can be provided to hold weapon in firing position during long marches.

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