DESIGN AND DEVELOPMENT OF SAFETY FRAME STRUCTURE FOR HUMAN

A PROJECT REPORT

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CERTIFICATE

This is to certify that the project report submitted along with the project entitled **DESIGN AND DEVELOPMENT OF SAFETY FRAME STRUCTURE FOR HUMAN** has been carried out by **NEEL AHIR (190420119001), PRAYASH JARIWALA (190420119022), AYUSH PATEL (190420119044), MIHIR PATEL (190420119049), ROMIN PATEL (190420119051), JENIL SHAH (190420119060), RUSHI TAILOR (190420119065)** under my guidance in partial fulfilment for the degree of Bachelor of Engineering in **Mechanical Engineering**, 8th Semester of Gujarat Technological University, Ahmadabad during the academic year 2021-22.

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DECLARATION

We hereby declare that the Project report submitted along with the Project entitled **DESIGN AND DEVELOPMENT OF SAFETY FRAME STRUCTURE FOR HUMAN** submitted in partial fulfilment for the degree of Bachelor of Engineering in **Mechanical Engineering** Branch to Gujarat Technological University, Ahmedabad, is a bonafide record of original project work carried out by us at **Sarvajanik college of engineering and technology** under the supervision of **Mr. Piyush T. Patel** and that no part of this report has been directly copied from any students' reports or taken from any other source, without providing due reference.

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ABSTRACT

The problem face by labours or any humans who often lifts the load for a long time has been observed and several attempts also have been made to find the solution of it in the society. However the aim of this project is to provide a frame with light weight and economical materials for any human who is engaged with such type lifting work.

At the same time the, the load of materials which need to be carried out during work is also needed to be considered while selecting frame and its material. With the help of this product, the human who want to lift the material can not comfortably lift but also can lift more than one load at a time and s/he can also use wheels to transport the loads.

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CHAPTER 1 INTRODUCTION

Transportation of loads of different capacities has been a part and parcel of our daily routine, may it be in industry, household, construction sites, etc. Most importantly, the ways and means of transportation has a profound impact on the development of any society. Bullock carts were, and still being used for transportation of various goods, and long distances are covered by trains, trucks etc.

Figure 1.0 worker lifting head load.

Despite various modern ways of transportation, lifting loads on head (head loading) still is a common practice in many parts of the world e.g. transportation of drinking water, luggage, construction material such as baskets of bricks, concrete mixture, etc.

CHAPTER 2 BACKGROUND

In India, the financial activities involved in the construction industry are the second largest after that of agriculture. In addition, safe environment is still lacking at the construction sites/warehouses etc. where majority of the labours work under risky and hazardous conditions. Load lifting carried out at docks in India is around 100 kg per lift, which is quite harmful for a labour performing manual lifting tasks. Furthermore, in the non-organized sector, loads as heavy as 115 Kg to135 Kg are manually lifted by an individual worker. In India, and in other developing nations, head loading such as carrying bricks and concrete mixture at the construction sites is the most widely recognized practice carried out by the labourers. Carrying load on head may lead to torment muscles, injuries in skull/brain/neck, and other spinal issues. Construction sites are an abundant source of musculoskeletal disorders, and complaints related to long-term work duration have also been associated with construction industry.

Work-related musculoskeletal disorders (WMSDs) and wounds are amongst the most frequently reported causes which accounts to nearly 33 per cent of all harmful and ailment cases (Bernard and PutzAnderson, 1997; Abas et al., 2018). The maximum occurrence of musculoskeletal disorders (MSDs) has been observed in construction workers, truck drivers, and cashiers.

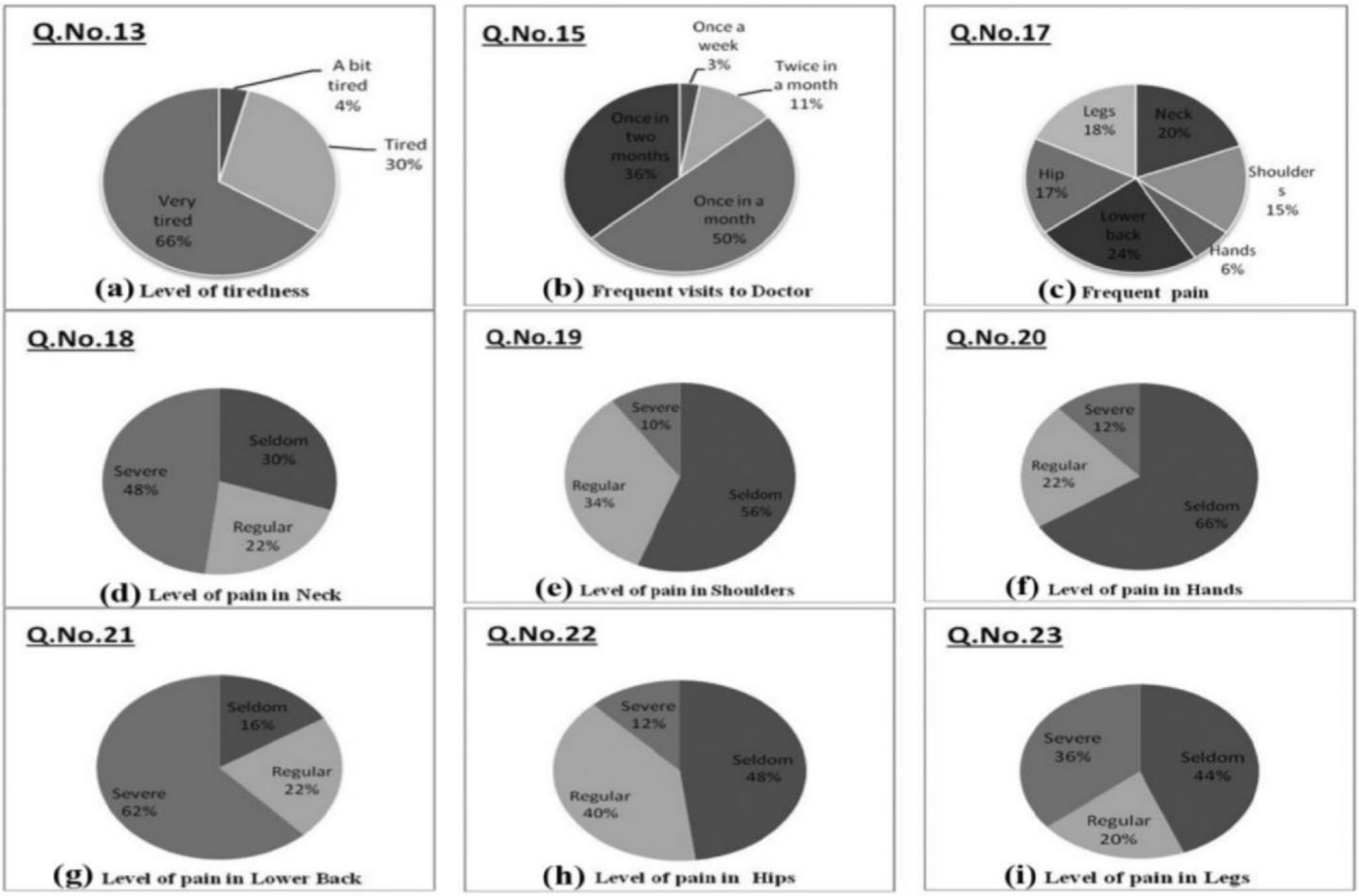

Figure 2.1 Level of Pain

It is pertinent to mention here that the percentage pertaining to above mentioned problems will increase as the number of observations increase. The most common causes of the health issues faced by the workers has been summarised, and are; sudden movements during working hours, lifting of heavy loads for a long period of time, bad postures, poor load lifting/unloading technique; and the working environment.

Risks	Current data analysis	Past data analysis (Rahaman *et al.*, 2017)	Past data analysis (Reddy *et al.*, 2016)	Past data analysis (AlghadirandAnwer, 2015)
Neck	56%	92%	Not mentioned	48
Shoulders	44	58	12	47
Hands/ Wrists	18	36	11	48
Lower Back	70	62	20	50
Hips	48	Not mentioned	Not mentioned	Not mentioned
Legs/Knee	52	Not mentioned	Not mentioned	20
Level of Risk				
Seldom/ Moderate	43%	28%	Not mentioned	42
Regular	27	Not mentioned		Not mentioned
Severe	30	40		32
No pain	0	10		Not mentioned

Table 2.1 Comparison of risks amongst workers in construction industry

The identification of the health issues amongst the workers carrying out head loading has formed a strong basis for the fabrication of a mechanical system (Frame), which will not only safeguard them from several musculoskeletal disorders but also induce motivation amongst them. The detailed design and testing of the Frame has been discussed in the succeeding sections.

CHAPTER 3 OBJECTIVE

The objective of this project is to identify the musculoskeletal problems faced by the workers carrying out head lifting at the construction sites and to present a solution for the identified problems with designing different types of frame which are also convenient for them.

Various safety features considered while designing frame
free neck rotation; limited twist of waist; limited or no forward bending of neck; use of vertical postures during lifting rather than waist; minimum distance between centre of gravity of the worker and load; transfer of load from head to shoulders;
Minimal engagement of hand during lifting; and multiple load lifting.

CHAPTER 4 DESIGN APPROACH

Initial considering all the safety considerations, we have come up with initial Designs shown in the figure below.

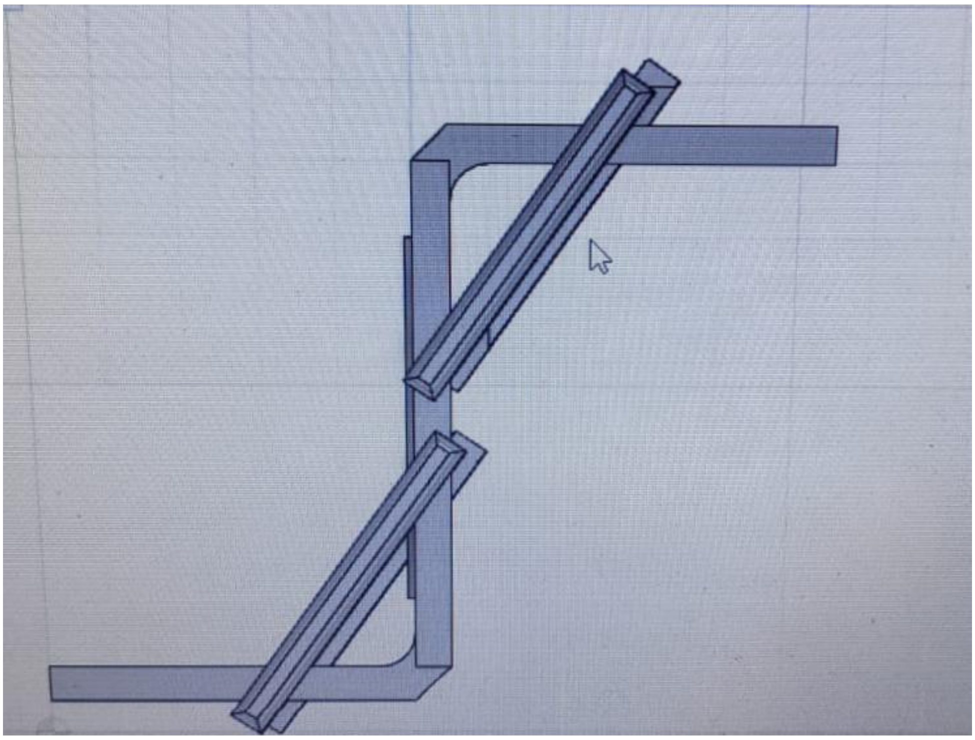

Figure 4.0 Cad drawing of Initial model 1

With a little more modification in the structure, we designed a new modified structure which is more convenient for users.

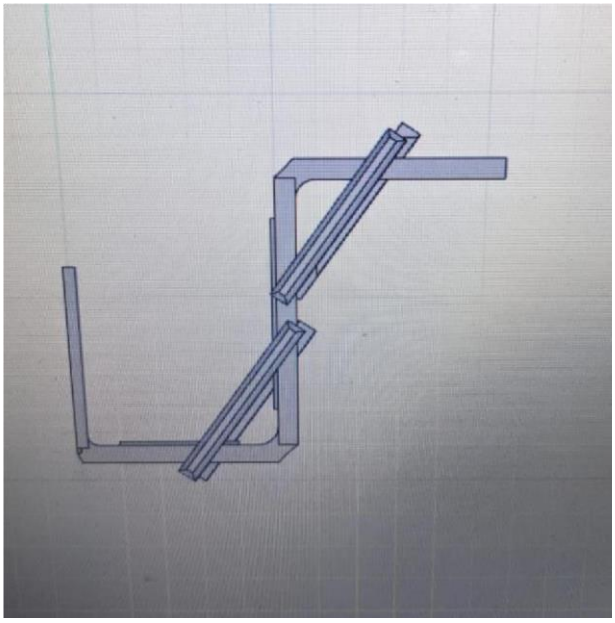

Figure 4.1 Cad drawing of initial model 1

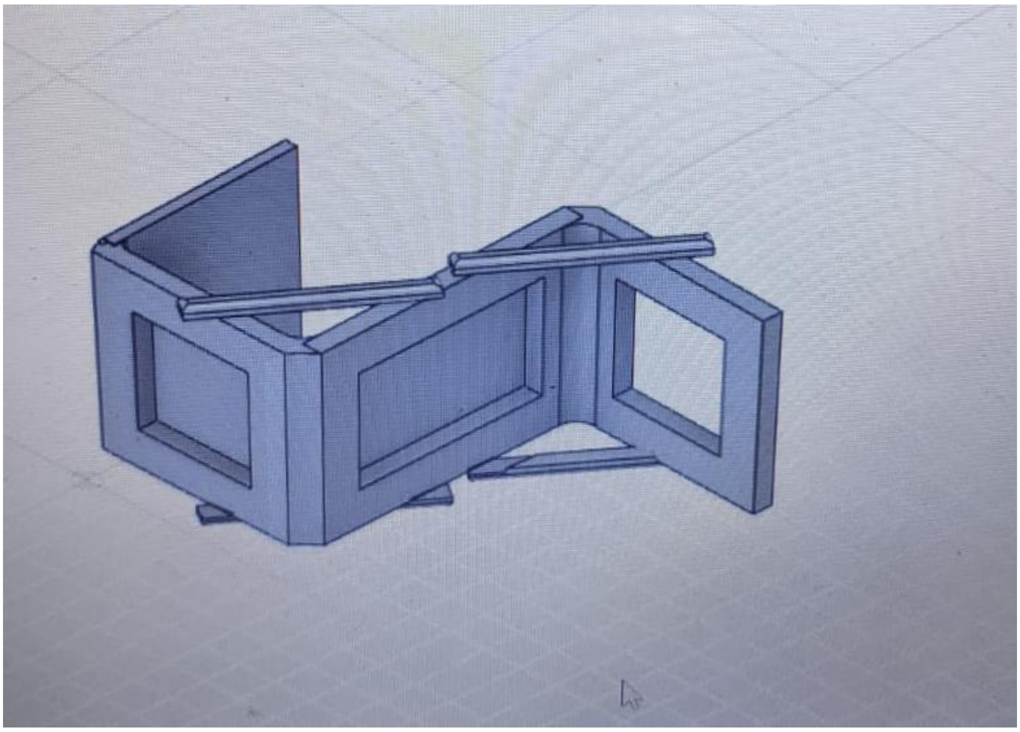

Figure 4.2 Cad drawing of initial mode 2

After careful analysis of all the parameters such as safety, cost of product, convenience of product, weight of product etc., the final design of the structure is shown in below figure.

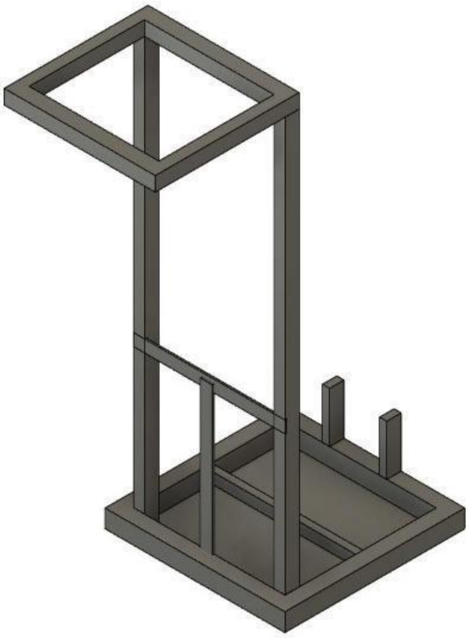

Figure 4.3 Drawing of final product

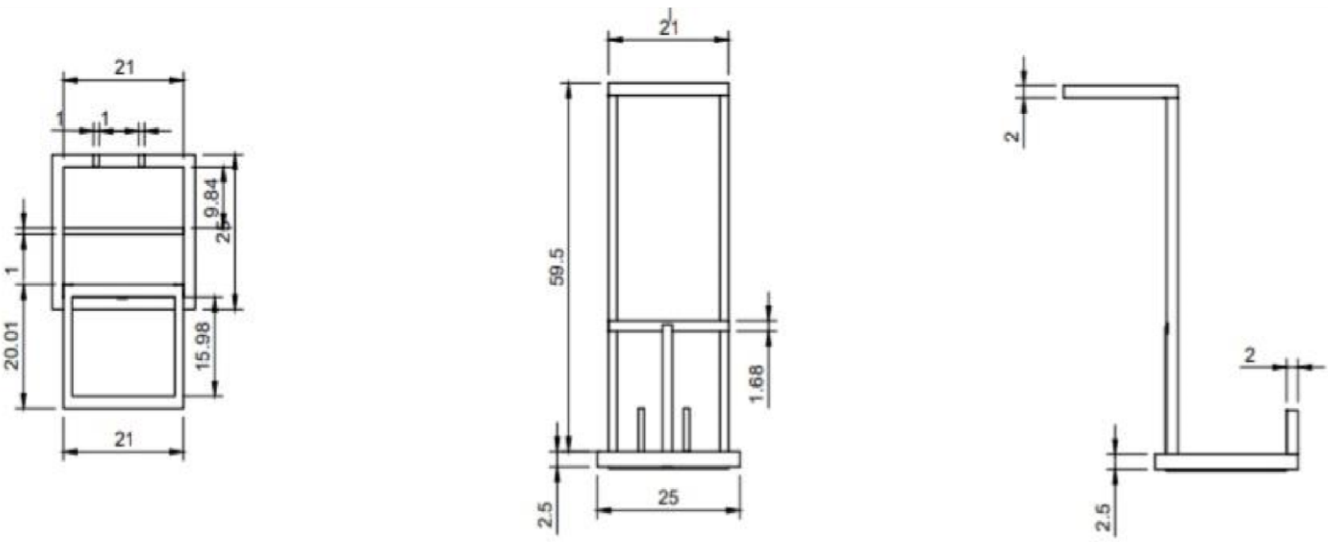

Figure 4.4 Drawing of final product with dimensions

CHAPTER 5 MANUFACTURING PROCESS

- Cutting of stainless steel materials (square pipe) as per the drawing dimensions.
- Facing of all the structure components made of stainless.
- Welding of all the components as shown in CAD drawing.
- Cleaning of weld surfaces and again doing facing operation on weld surfaces.

Figure 5.1 Final Prototype 1

Figure 5.2 Final Prototype 2

Figure 5.3 Final Prototype 3

Figure 5.4 Final Prototype 4

Figure 5.5 Final Prototype 5

Figure 5.6 Final Prototype 6

Figure 5.7 Final Prototype 7

CHAPTER 6 DESIGN SPECIFICATIONS

6.1 Economic analysis of product

Cost of materials used = 170 Rs per kg of material

As the total weight of the product is 5.9 kg

Total cost of material used in product = 170 × 5.9

= 1003 Rs

Labour cost = 300 Rs

Cost of 2 wheels = 140 Rs

Other material cost (belt & Spunch) = 60 Rs

TOTAL COST OF PRODUCT = 1503 Rs

6.2 MATERIAL

As far as material of the final model is concerned we have to look through stress coming on particular parts of the model as well as its cost and also it's reaction towards various environmental conditions.

Now as per our survey we can go for number of materials available in the market, but the most reliable ones are:-

1) stainless steel
2) Aluminium
3) wood
4) Plastic

As far as wood is concerned it gets affected by moisture and may swell so the shape of model can be comprised and may also result in failure of the model. And as far as plastic is concerned as a raw material for model we can't fully rely on it and it is also harmful to the environment. So we came to a conclusion that the handle of prototype will be made of stainless steel.

6.3 Operating Requirements

Indoor/outdoor

- ➢ Device must be useable indoors and outdoors.
- ➢ The device is designed for those who want independence both inside their own homes and outside.

Weather Conditions

- ➢ This device will work fine in fair weather or even rainy conditions.

6.4 WEIGHT OF PRODUCT

The weight of the product should be as low as possible as users of this product will already be carrying too much load in it. If the weight of the product will be high then it will be convenient and comfortable for users. However at the same time, it also need to take in to account that product should be able to with stand around 100 to 120 kg weight. Hence the balance of both will be required.

Considering all the above things, the weight of our final product is about 5.9 Kg.

6.5 LIMITATIONS

The developed frame has been appreciated by the Physiotherapists also; however, it still has certain limitations which can be taken as a future scope for the further modification of the frame. The limitations are as mentioned below:

i. The weight of the frame is a limitation, as the worker has to bear this load in addition to the load which is to be lifted. However, this can be dealt with by replacing the material of the frame with lightweight materials such as aluminium, alloys, carbon fibres, etc.

ii. ii. The continuous wearing of the frame may result in discomfort, as the worker cannot freely roam around.

CHAPTER 7 CANVAS

7.1 AEIOU CANVAS

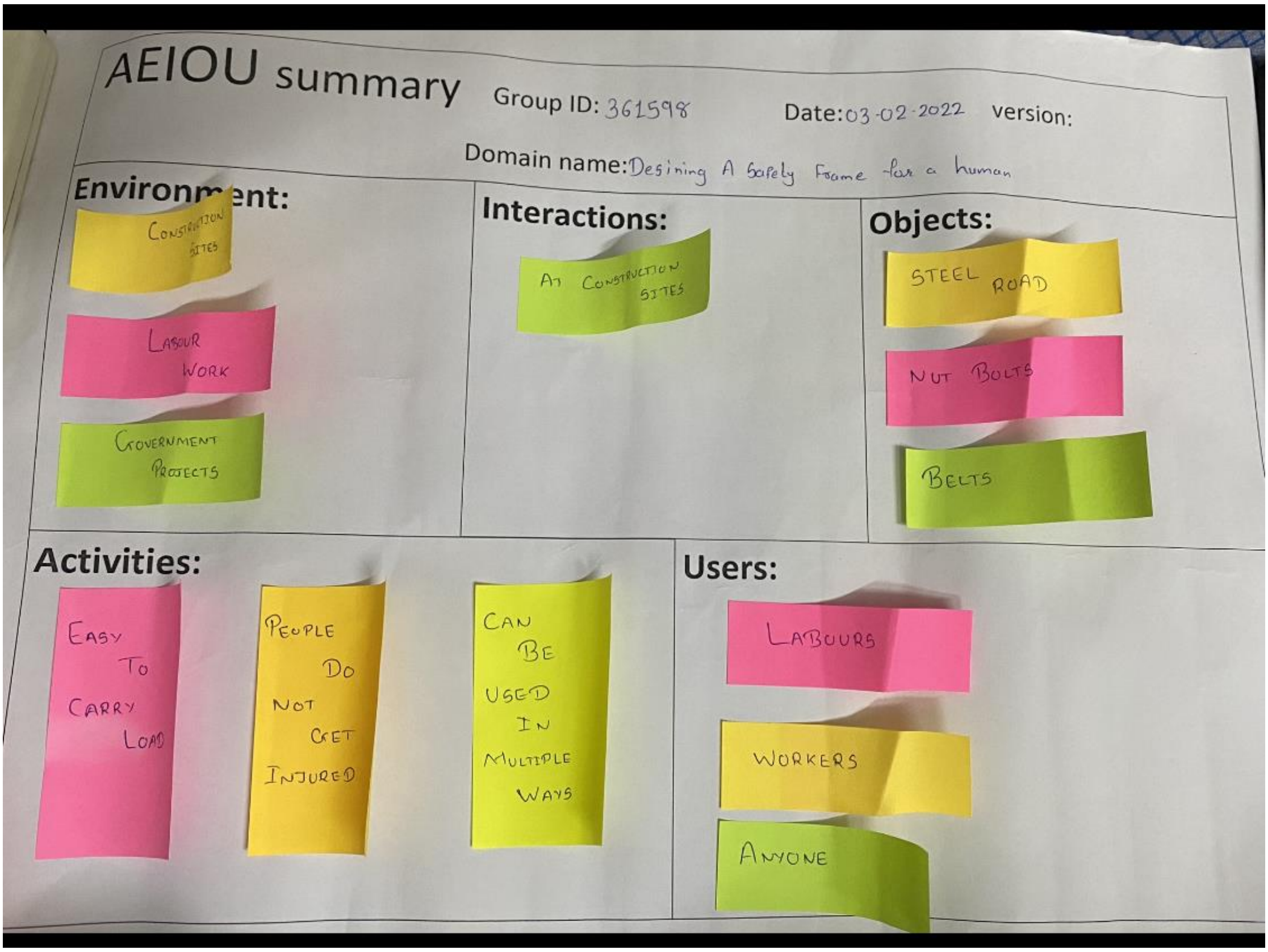

Figure 7.1 AEIOU Canvas

7.2 MIND MAPPING

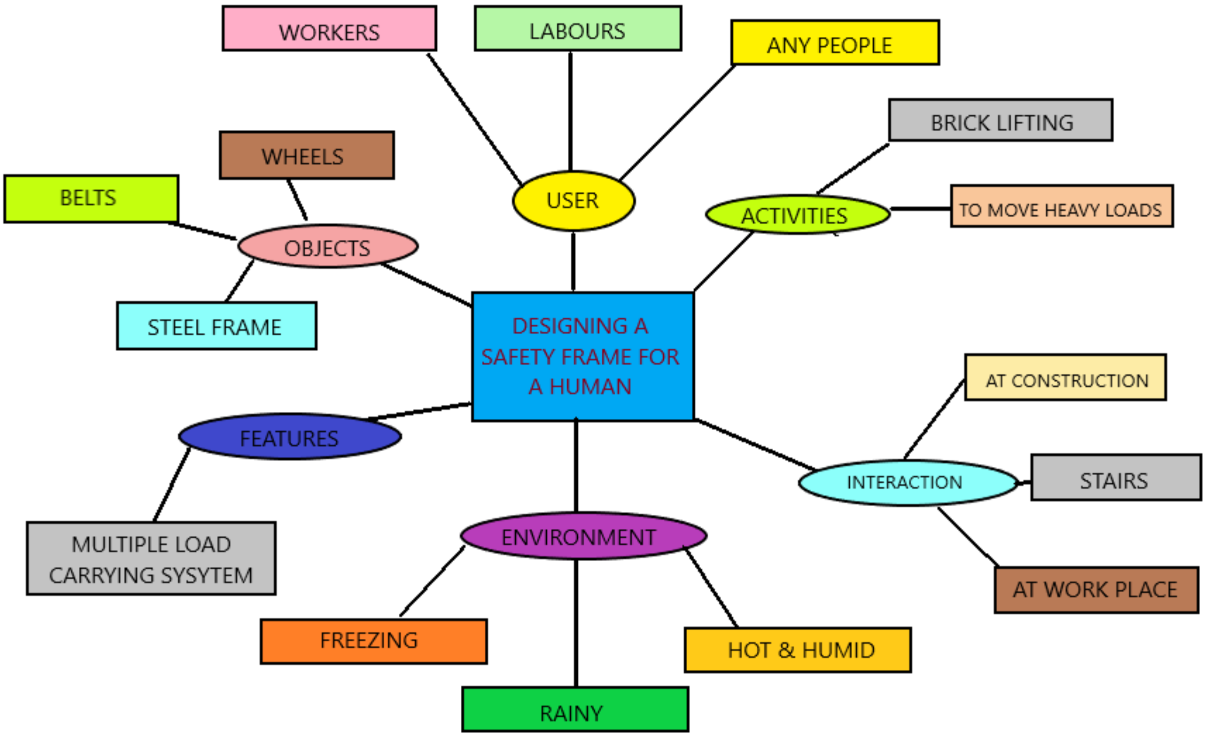

Figure 7.2 Mind Mapping

7.3 EMPATHY CANVAS

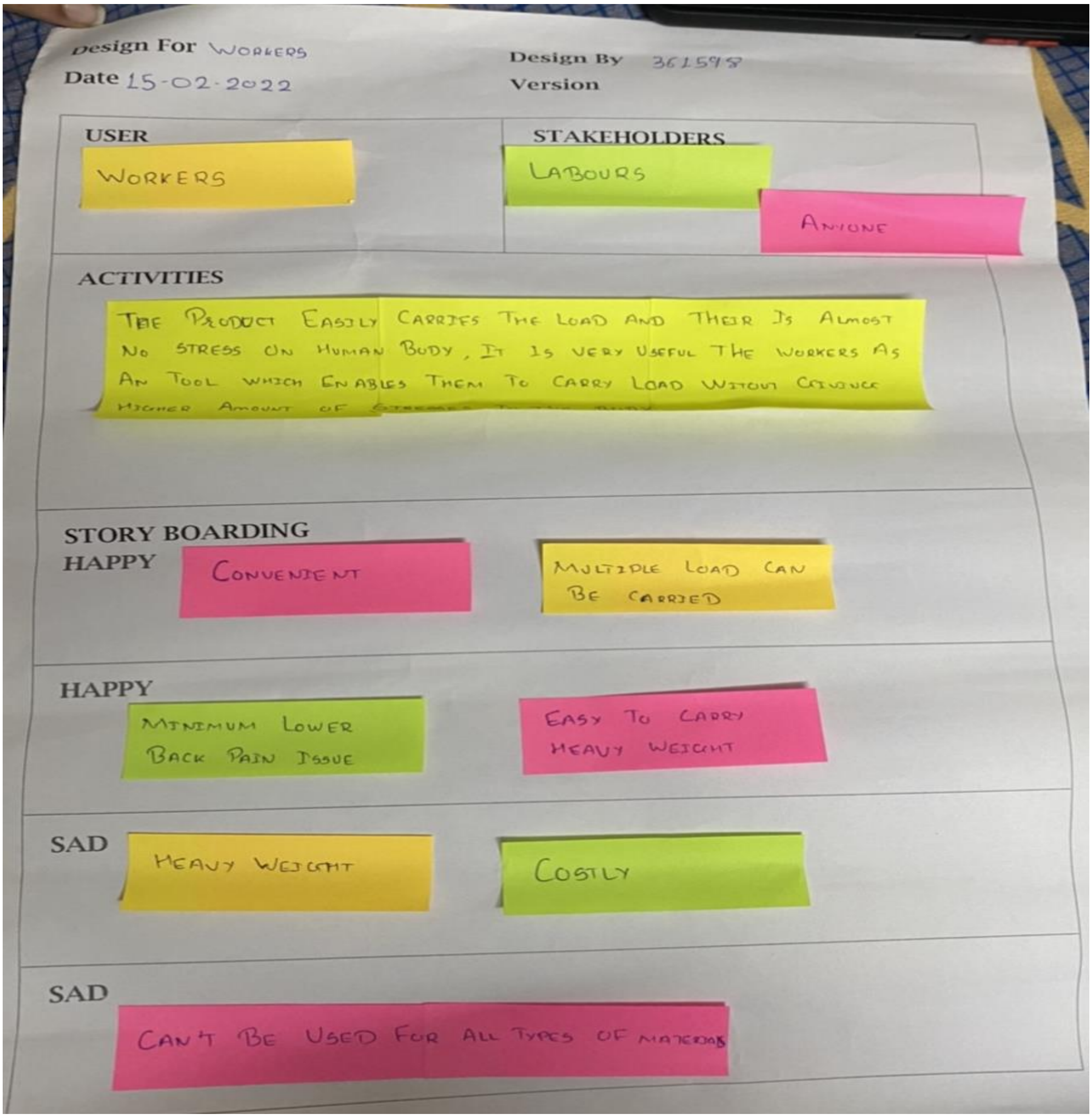

Figure 7.3 Emphathy Canvas

7.4 IDEATION CANVAS

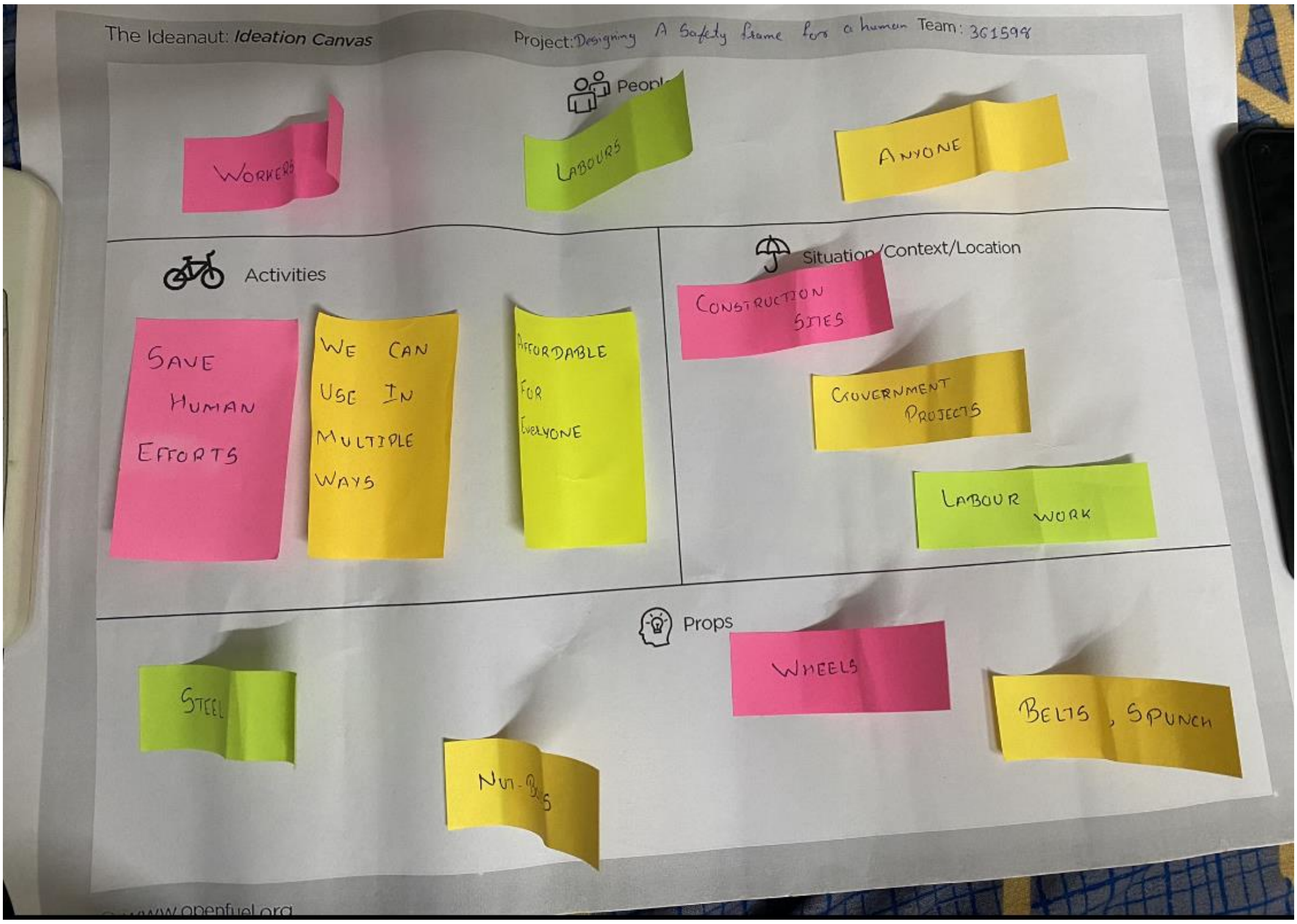

Figure 7.4 Ideation Canvas

7.5 PRODUCT DEVELOPMENT CANVAS

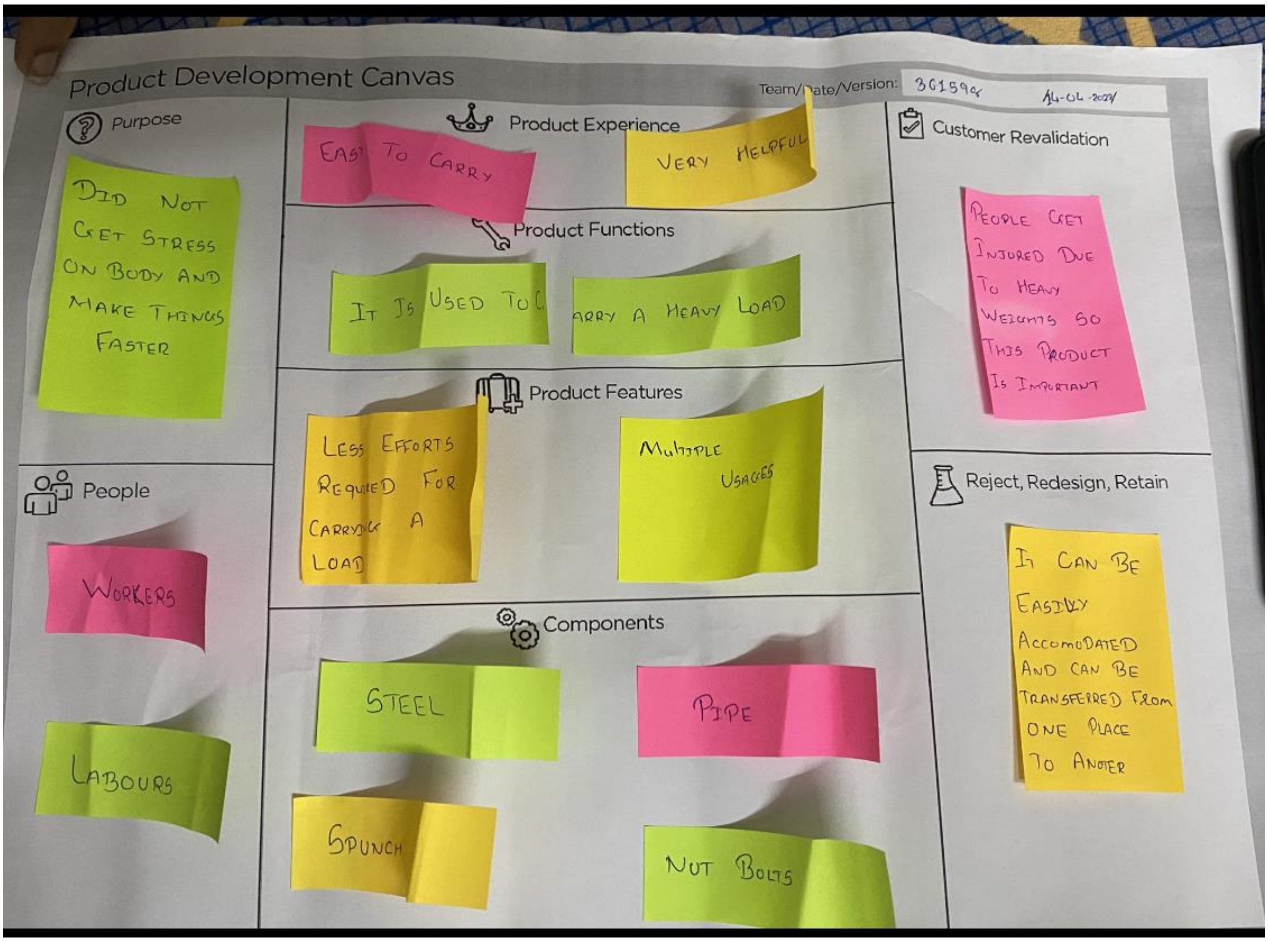

Figure 7.5 Product Development Canvas

7.6 LNM CANVAS

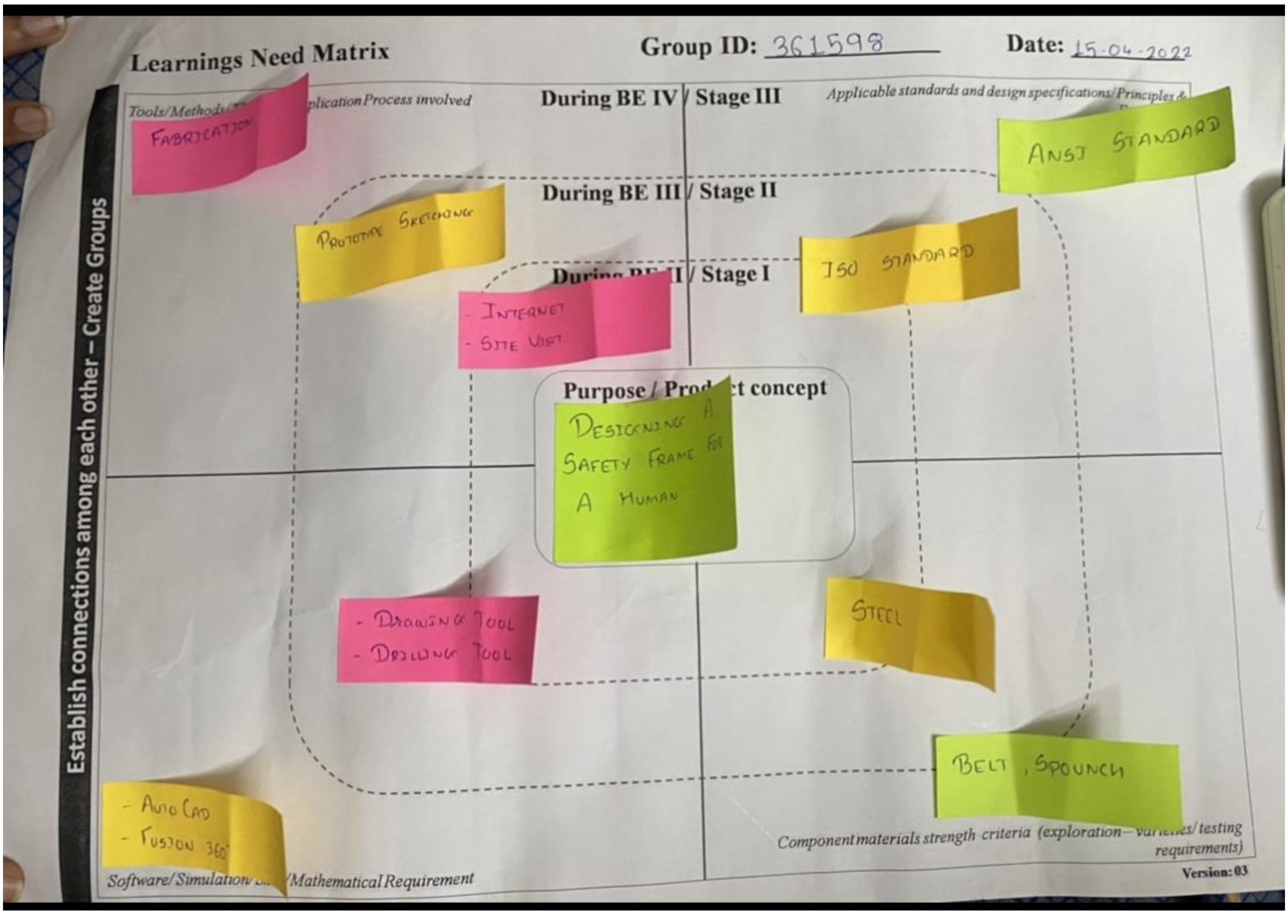

Figure 7.6 LNM Canvas

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