# Development of Ergonomically Evaluated Grape's Crate Carrier

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## ABSTRACT

***In Western Maharashtra most of the agricultural operations like carrying of grape's crates are performed manually by workers. The agricultural growth and technological improvements have lead to greater demand and development of machines and devices used in agricultural settings. With these dramatic changes there has also been greater interaction between man and machines. It is important to design these tools using ergonomic principles for increasing efficiency of the operation, safety and comfort of user. This paper presents ergonomic evaluation of grapes crate carrier. Present study analyzes best posture of farm worker during the crate carrying operation. Analysis uses modules of CATIA like Human Builder, Human Activity Analysis and Rapid Upper Limb Assessment (RULA) analysis.***

**Keywords***: Ergonomics, Anthropometry, Agricultural Equipments. Digital Manikin*

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## 1. INTRODUCTION

In number of agriculture applications, crate carrying equipment are important equipment [1]. In many occupations, some of the major reasons of work-related injuries and disease are linked to the use of ergonomically bad equipment [2]. Mostly there are lots of varieties in fruit crates as per kilogram rating. In this study, 16 kg grape crate design is considered for evaluated carrier. It has shown that equipment design may play an important role in development of work related problems in the upper limbs. Poor design of hand equipment may result in cumulative trauma disorders [3]. Occupational accidents can be linked directly to the use of specific hand equipment.

Ergonomically well designed manually operated carrier may reduce the discomforts. It also provides comforts for the workers. As the use of hand equipments may play an important role in the development of disorders and accidents, it is obvious that ergonomic design changes of carrier are essential for promoting professional users health, particularly where there is intensive exposure. Newly adopted ergonomic design software techniques can use for ergonomic evaluation.

## 2. METHODS

### 2.1 Anthropometric data for digital manikin

This study uses 33 anthropometric parameters of male agricultural workers from four districts of Western Maharashtra [4]. Table 1 presents standard deviation and mean.

**Table-1: Anthropometric Data Analysis Sheet**

| Sr. | Dimension | Mean | SD |
|---|---|---|---|
| 1 o | Right Hand Grip Strength (Kg) | 28.01 | 6.75 |
| 2 | Left Hand Grip Strength (Kg) | 27.90 | 7.75 |
| 3 | Stature | 164.43 | 5.61 |

| | | | |
|---|---|---|---|
| 4 | Wrist-wall Length | 64.13 | 3.00 |
| 5 | Wrist-wall Length, Extended | 66.91 | 2.89 |
| 6 | Acromion – Radiale Length | 32.57 | 2.40 |
| 7 | Radiale Stylion Length | 26.81 | 2.50 |
| 8 | Shoulder-Elbow Length | 37.32 | 2.96 |
| 9 | Forearm Hand Length | 45.70 | 2.02 |
| 10 | Forearm Centre of Grip Length | 34.31 | 3.23 |
| 11 | Waist back Length, Omphalion | 41.15 | 3.33 |
| 12 | Interscyle I | 31.64 | 3.18 |
| 13 | Chest Breadth | 26.89 | 1.98 |
| 14 | Waist Breadth, Omphalion | 26.06 | 2.59 |
| 15 | Hip Breadth, Standing | 30.18 | 2.31 |
| 16 | Elbow–Elbow Breadth-Sitting | 40.23 | 3.82 |
| 17 | Waist Depth, Omphalion | 20.07 | 4.15 |
| 18 | Sleeve Length, Outseam | 60.15 | 2.99 |
| 19 | Wrist circumference | 15.76 | 0.81 |
| 20 | Elbow Circumference, Straight | 23.54 | 1.69 |
| 21 | Knee Circumference, Standing | 33.53 | 2.90 |
| 22 | Waist Circumference | 82.38 | 8.82 |
| 23 | Acromion-wall Length | 10.40 | 1.13 |
| 24 | Hand Length | 18.19 | 1.22 |
| 25 | Wrist-Index Finger Length | 16.76 | 0.84 |
| 26 | Palm Length | 10.35 | 0.60 |
| 27 | Hand Breadth(At Metacarpal- III) | 8.06 | 0.48 |
| 28 | Hand Breadth Across Thumb | 9.83 | 0.55 |
| 29 | Grip Diameter(Inside) | 4.81 | 0.41 |
| 30 | Grip Diameter (Outside) | 8.23 | 0.53 |
| 31 | Palm Grip Diameter | 3.08 | 0.29 |
| 32 | Grip Span (Standing/sitting) | 8.76 | 0.82 |
| 33 | Age (years) | 45.23 | 11.1 |

Fig 1. Digital Manikin

### 2.2 Generation of Digital manikin in Human builder

In CATIA V5R18, Anthropometric data is fed to CATIA in .sws format using Human Builder tool, which creates digital manikin of particular anthropometry (Fig.1). Human Builder gives many options like gender selection, percentile selection, editing human anthropometry. In this study 95th percentile are considered.

### 2.2 Crate and Carrier designs with Attachments

Fig.2 Isometric view of equipment

Fig 3. Attachment with Digital manikin

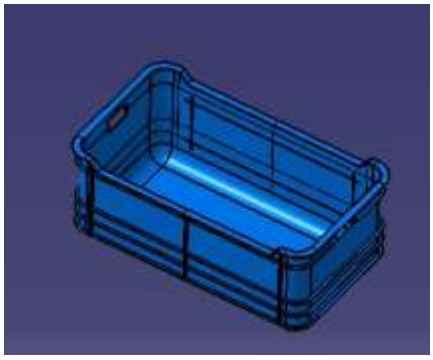

Fig.4 Crate Design

### 2.3 RULA Analysis:-

Due to the modifications score obtained is below or equals to 2 for both sides which is ergonomically accepted and no further modifications are necessary.

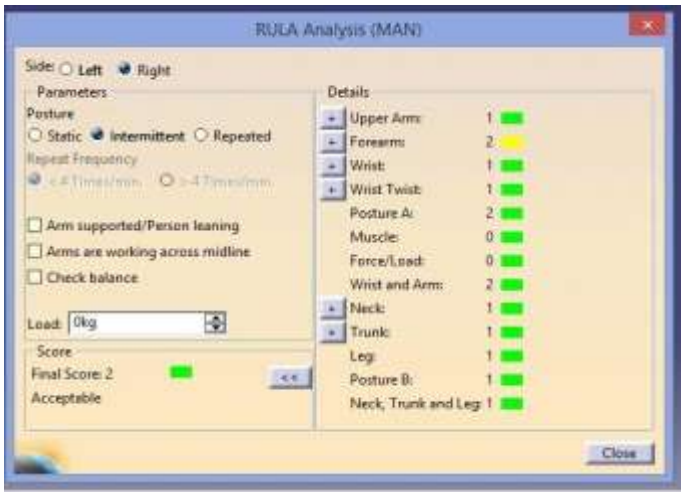


Fig.3. RULA analysis

## CONCLUSION

1. Study shows that an ergonomic design of agricultural equipment's and tools is important. This is because the design of a product does reflect the human posture that is handling the product. The analysis using RULA techniques in CATIA indicates the scoring for human posture.
2. More over through this analysis it can be concluded that human cannot stay in one posture for long period because this might present some risk of injury from his work posture.
3. The ergonomics study is very important to improve the performance, reduce potential accidents and ill health. Based on the analysis that has been done, it can be concluded that it is impossible to prevent any injury while using the hand tool but it can only be minimized

4. An ergonomic well design of hand tools can minimize the risk or the potential of the injury caused by the posture while using the hand tool. The design of a hand tool reflects the posture of the users. Hence an ergonomic well design of hand tool will improve the user postures.

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