An Ergonomic Study on the Ideal Interior of Jeepneys Based on Anthropometric Measurements of Filipinos

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ABSTRACT

Jeepneys are the most popular means of public transportation in the Philippines. However, since it is considered one of the country’s cultural icons, aesthetics have been the main focus of the design while functionality of its interior is nearly neglected upon creation. Known standards are not strictly enforced, hence, there is a variation in the jeepney interior design which may not benefit the comfort, safety and well-being of its passengers. This research aims to develop an ideal design of jeepney interior based on the anthropometric measurements of Filipinos aged 18 to 64. A survey was conducted to determine the problems they experienced and what would be considered as possible solutions for the given situation. To address the common problems mentioned by the respondents and to ensure comfort and safety of passengers, necessary adjustments have been made to design the ideal interior of the jeepney based on anthropometric measurements.

Keywords. Philippine Jeepney, Design, Ergonomics, ESK-JES Joint Session

I. INTRODUCTION

Jeepneys originated from U.S. military jeeps which were left in the Philippines after World War II. Through the years, not only did the vehicle become a mode of public transport in the country, but it is also considered a cultural icon being known for its loud and creatively unique design. It is for this reason that the functionality of the interiors is not necessarily put into consideration.

Jeepneys are the archipelago’s most popular means of transportation, comprising 70% of public transport trips, 39% of daily commute trips and 55% of daily person trips. With this statistics, 55% are business-related trips as reported by the Metro Manila Urban Transportation Integration Study. This means that those who are part of the workforce (18 to 64 years old) are the jeepney’s most frequent passengers which makes the vehicle more vital to the country.

With its big role in the transportation system of the Philippines, the Land Transportation Office (LTO) and the Land Transportation Franchising and Regulatory Board (LTFRB) have set national standards for assembly of jeepneys and other similar vehicles. However, these national standards were only prescribed and not strictly enforced.

Because of the lenient enforcement of standards, jeepneys have been designed poorly and inconsistently. The maltreatment of jeepneys and its standards have inspired the government to consider the complete phasing out of jeepneys by 2018. The Federation of Jeepney Operators and Drivers Association of the Philippines want to preserve the idea of jeepneys and propose to redesign or modernize the design instead of terminating them indefinitely.

II. METHOD

a. Sampling

Filipinos from different places in the country such as Metro Manila, Batangas, Baguio, Davao, Bicol and Catanduanes and also fall between ages 18 and 64 were chosen as primary subjects of the study.

b. Data Gathering

155 respondents from 26 places in the Philippines were covered in the survey. The age composition of the people surveyed is shown in Figure 1.
An online survey was created to identify the problems experienced by the passengers during their jeepney trips. It is composed of the basic information on the respondent, trip characteristics and the important concerns with regard to various parts of the jeepney enumerated by the researchers in the survey. Results from the survey were used as the qualitative basis of the design.

For the quantitative aspect, anthropometric data from Del Prado-Lu’s Anthropometric Measurement of Filipino Manufacturing Workers has been used as basis.

c. Designing

The anthropometric measurements and other data gathered were analyzed and made as basis of the design of the jeepney’s interior.

III. RESULTS

Data collected from the survey suggest that the main problems encountered by jeepney passengers concern the way the dimension of components fit their physique. Table 1 shows the primary concerns experienced by the respondents.

<table>
<thead>
<tr>
<th>Part</th>
<th>Primary Concern</th>
<th>Concerns (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrance Step</td>
<td>High</td>
<td>57</td>
</tr>
<tr>
<td>Entrance Height</td>
<td>Low</td>
<td>60</td>
</tr>
<tr>
<td>Pathway</td>
<td>Narrow</td>
<td>75</td>
</tr>
<tr>
<td>Standing Height</td>
<td>Low</td>
<td>59</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>Low</td>
<td>34</td>
</tr>
<tr>
<td>Seat Height</td>
<td>Low</td>
<td>23</td>
</tr>
<tr>
<td>Seat Width</td>
<td>Cramped</td>
<td>86</td>
</tr>
<tr>
<td>Seat Depth</td>
<td>Short</td>
<td>17</td>
</tr>
<tr>
<td>Backrest Design</td>
<td>No Cushion</td>
<td>14</td>
</tr>
<tr>
<td>Arm Handles</td>
<td>Broken/Not Present</td>
<td>10</td>
</tr>
</tbody>
</table>

The front, cross-sectional and top views of the design created based on anthropometric measurements are shown and discussed below.

a. Entrance Height

60% of those surveyed experienced problems with how low the entrance height is, causing them to bump their heads upon entering the vehicle. Based on the anthropometric measurements, males are taller than females. To get the ideal entrance height of the jeepney, the 95th percentile of the male sitting height, 92 cm, was chosen and a clearance of 20.75 cm was added. Illustration can be seen in Figure 2. Since 4 m is the height limit for motor vehicles such as the jeepney, there is still enough room for the top baggage and the height of the tires.

b. Arm Handles

Respondents complained that the arm handles are usually too high or too far from them or are too close to the ceiling or a combination of the aforementioned complaints. To address this, the average of the median of arm span of both male and female were used in the design. Figure 2 also shows the dimensions for the arm handles - a length of 32 cm, a height of 42.5 cm and a clearance of 20.75 cm.

c. Seat Depth

Most respondents have no issues with the depth of the seat but the most reported concern is that it is not enough to support their whole thighs. Based on the anthropometric data, 45.5 cm will be used in the design. Figure 2 shows that this is the buttock to popliteal length of the average of the median of both male and female.

d. Entrance Step Height

More than half of the respondents complained that the entrance step is too high, making it hard for them to alight the jeepney. The 5th percentile of half of the female knee length was chosen in designing the height of the step which is 20.5 cm as shown in Figure 2.
e. Entrance Step Width

In addition to the height of the entrance step, the width is also a concern. Some complained that their feet were usually too big for the step. Since it was observed in the anthropometrics data obtained that males have larger feet compared to females, the 95th percentile of male foot length was chosen. Figure 3 shows the 28 cm entrance step width which is already adjusted.

f. Pathway

The narrowness of the pathway is the most reported problem of the passengers. In designing this part, legroom is also taken into consideration. So the pathway design should have enough space for legroom and the actual pathway where passengers pass. Since the foot and shoulder measurements of males are larger than that of females, their anthropometrics were basis for the design of this part. As shown in Figure 3, this makes the pathway 100.4 cm wide where the 95th percentile of male shoulder width and their foot length's median are the considerations in the dimension.

g. Seat Width

Majority of the respondents found the seat width to be insufficient. This is because drivers want to maximize the space depending on the predetermined seating capacity despite the inconvenience, discomfort, and actual shape of the passengers. In this case, the 95th percentile of the female hip breadth, 36 cm, was used since anthropometric data obtained suggests that females have larger hip breadth. This is a centimeter more than the minimum standard set by the LTO. Figure 3 shows this measurement. Using the usual jeepney capacity of 24 passengers with 12 passengers on each side, a total of 432 cm out of the 11 m seat length limit will result. This gives plenty of space left for the driver's work station, length of the engine and other necessary equipment and machinery.

h. Backrest

The primary concern reported for the backrest design is the absence of cushion. However, since the study only deals with those that can be solved using anthropometrics as basis, the design focuses on the height of the backrest. The low-level design is used as basis in which the support for the lumbar region is given importance since it is the part of the spine most prone to back pains. Figure 4 shows this concept with a measurement of 22.86 cm.

i. Seat Height

Only about a quarter of the respondents have an issue with the seat height being too low for them. This causes strain in their popliteal muscles especially during long trips. Because majority has no problem with the current seat height of the jeepney, the 50th percentile of both the male and female popliteal height was used as basis for seat height. This gives a height of 41.75 cm as what is shown in Figure 4.

j. Sitting Height

Around one-third of the subjects complained that the jeepney’s seat to ceiling height is too low which forces them to bend their neck or slouch throughout their trip. In the design shown in Figure 4, the 95th percentile of males, 50.25 cm, is considered in the length of the sitting height since data acquired shows that they are taller than females.

IV. CONCLUSION

The result of the study shows that the current design of jeepneys in the country is not actually standardized and fit for the physique of its most frequent passengers in the Philippines. This proves the need for improving the current design of one of the country's
main mode of transportation. Evaluating the design created in the study, it shows that it still conforms to the standards set by the Philippine government.

REFERENCES