A study on application of user centered design For Interior Design of Travel Bus

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Abstract

This study tries to redesign the interior design of inter-city bus in order to fulfill needs of Iranian User. The goal of this study is practically investigate how user centered design can be applied considering cultural needs of Iranian user. By defining common needs between cultural and physical aspects of Iranian user, the main focus was on improving the sitting condition of the traveler with intercity bus. Ergonomic redesign of the Bus Seat was the result of such a study

Keywords*: selection of position, bus, sitting position, independence of selecting mode, walking state, ergonomic.*

Introduction

In this paper, we try to improve the design of passenger seat for Inter-city bus through ergonomic redesign of the seat. The hypothesis of this research was that sitting situation of the passenger of such bus could be more satisfying if it could be nearer to the condition of the seat of railroad train. The reason for such a hypothesis was that regarding our surveys, passengers were more tended toward railroad trains because of the possibilities for rest in distances with more than ١٠ hours. Another privilege of this change was that it could also improve the safety coefficient of the passenger. While such a change would not improve the ergonomic condition of the passenger, but it could also support the behavior of the passenger during the trip, such as sleeping, having more comfort and independence, without disturbing other passengers.

In this research the Bus has been divided into three parts, containing these: ١. Driver Cabin, ٢.passenger Cabin, ٣. Load Cabin. In the continuum they are defined this way.

Passenger Cabin: This part in the first generation of such buses has divided the main room into ٥ parts, each part is called a sleeper (or compartment) , being inspired from railway train carriages. Such compartments are exactly the same as train sleepers, however their length is ٥٨,٨ centimeter bigger and their width is ٨ centimeter more than train sleepers. Such a change would improve the capacity and improve the comfort of the passengers. The capacity of each sleeper is ٨ persons. In contrast with other buses, the corridor in the middle of the bus has been omitted and each sleeper has an exit door, which is usable through a compact mechanism named as foldable steps which is included in the lower part of each sleeper, so passenger would be able to access the outer space. The step mechanism is included of ٤ steps, which their thickness is ١٥ millimeter and their distance is ٢٥ centimeter, while their volume is (٧٠ *٦* ١٥٥) cm, which such a mechanism has consumed a lot of time in order to be designed. As mentioned before, the main corridor of the bus been omitted and passenger would access the driver through an internal message and paging system. It should be also mentioned that such a design would need other security systems such as alarm system to ensure the closed situation of the door or a separating system of Clutch from the wheels,

when the doors are open in the beginning of the bus movement.

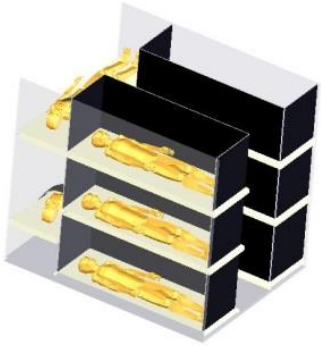


Figure ١. The assumption model

This project has been done based on the chassis and structure of one of Iran's production buses that we call it C٤٧٥ with restricted Tolerance, all these has also been represented on Solid works. One of the most important reasons for injuries on road accidents is illegal speed or in other words with two cars at high speed on opposite side we observe severe Press force which affects the whole body and even until seat of ٣th row at this kind of accidents. One of the main reasons is lack of protector wall in order to prevent brought in pressure force from opposite car, however in this project we will have to decrease the Pressure force by means of separating driver's cabin space from passengers cabin, changing the situation of beds situation and putting ٢ beds in the direction of vehicle movement. Through these arrangements, we can decrease soul injuries into ٤/٧٦٪ (from ٣٣/٣٣٪). In other accidents such as rollovers of cars and other similar accidents, since ٨ people are limited in a space called bus coupe and spaces are limited as well, number of casualties could be reduced to zero as well.

In the new idea we planned to add a corridor to the interior space, while the coupe walls are diagonal, but the width of the sleepers was not changed. This change could facilitate passengers walking inside the bus and using toilet service. This design could also reduce the expenses, because there is no need for step mechanisms in such a design. On the other hand, the diagonal direction of the sleeper would also decrease the pressure force generated from accidents and such walls would act as truss and as a result , we can see that the safety coefficient of passengers would increase in this design.

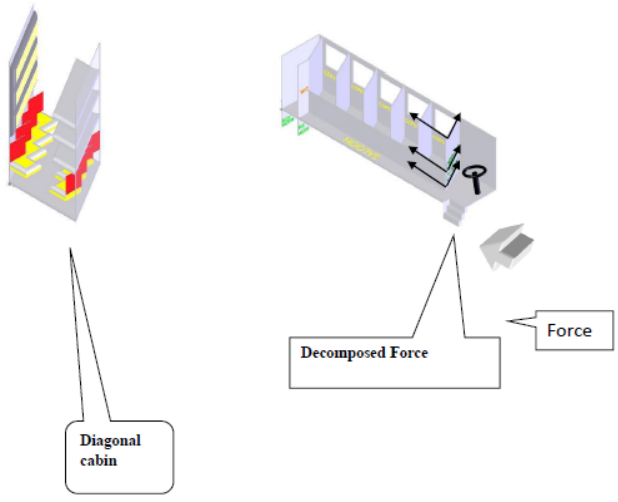
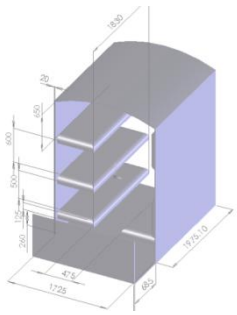
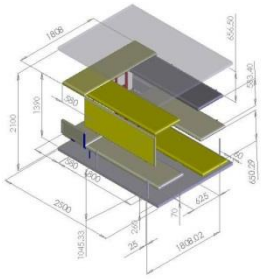
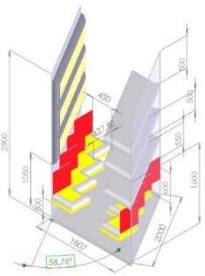


Table١. Comparison between normal bus, cabin bus and bus with diagonal cabin

			
	Normal Bus	**Cabin Bus**	**Bus with Diagonal Cabin**
Length, width and Height from the lowest surface (٢٩٣٠ +- ٧٠٠)	١١٦٩٠*٢٥٠٠*٢ ٩٣٠ mm	١١٦٩٠*٢٥٠٠*٢ ٩٣٠ mm	١١٦٩٠+٧٠٠*٢٥٠٠*٢٩٣٠+٧ ٠٠mm
Ergonomics	Sleeping mode Sitting mode√ Walking√	Sleeping mode√ Sitting mode√ Walking	Sleeping mode√ Sitting mode√ Walking√
Safety from accidents and environments	Very low and dangerous because of not being wall facing accidents	It seems safe because of protector wall between accidents	Facing accident and force contribution to ٢ force branches between crossover walls such as rafter force
Number of casualties in accidents from front if it would harm until third row	٢+١٢= ١٤ Driver + Driver assistance	٢ individuals (driver assistance +driver)	٢ individuals (driver+ driver assistance)
Capacity	٤٠ pax	٥Cabin *٨pax = ٤٠ax	٥Cabin *٨pax = ٤٠ pax
Load Capacity	Box volume (٨٤٠*٢٥٠٠*٤١٦٧)	Box volume (٧٧٠*٢٥٠٠*١٦٧) Buffet bus volume (١٦٦٠* ١٠٠٠*٢٥٠٠)	Box volume (٧٧٠*٢٥٠٠*١٦٧)+ Buffet bus (٢٣٦٠* ١٠٠٠*٢٥٠٠)+ corridor roof (٥*(١٨١٠*٧٦٠*٥٠٠)
Driver concentration	Would be reduced because of contact with passengers	Would be increased since Driver Cabin is independent and passengers have less contact	Would be increased since Driver Cabin is independent and passengers have less contact
Passengers monitoring the driver	Would be increased since contact is direct	Would be primarily reduced because of cabins, but a LCD monitor could solve the problem	Would be primarily reduced because of cabins, but a LCD monitor could solve the problem
Heat	Is not satisfactory since there are only	٥ heaters would exist , every cabin has	٥ heaters would exist , every cabin has one so more satisfaction

	two heaters in the whole bus	one so more satisfaction	
Cooling	Distribution channel would give every ٢ passengers one branch so more satisfaction	Distribution channel would give every ٨ passengers one branch so less satisfaction	Distribution channel would give every ٨ passengers one branch so less satisfaction

Train cabin	Bus Cabin	Diagonal cabin of bus
		
Independence on choosing sitting mode or lay mode ٢ individuals	Independence on choosing sitting mode or lay mode ٨ individuals	Independence on choosing sitting mode or lay mode ٧ individuals
Passenger Numbers : ٦ individuals	Passenger Numbers : ٨ individuals	Passenger Numbers: ٨ individuals
Quality of passenger light absorbent: intermediate	Quality of passenger light absorbent: excellent	Quality of passenger light absorbent: : intermediate
Degree of passenger view to outside environment : intermediate	Degree of passenger view to outside environment : excellent	Degree of passenger view to outside environment : intermediate

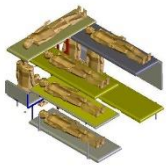
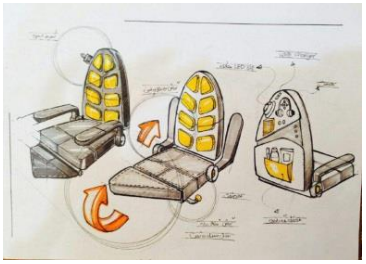
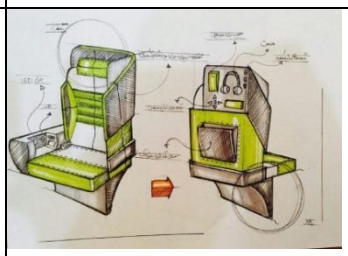
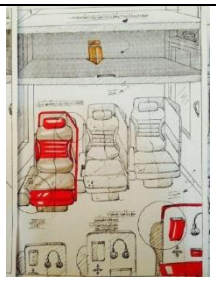
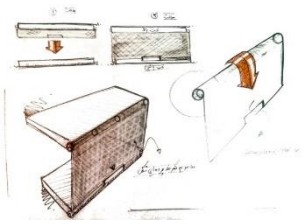
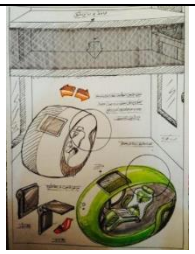
Result: based on gathering questionnaires which resulted into operationalizing Kansei, asking users about their opinions and changing the opinions into variables and interpreting them,

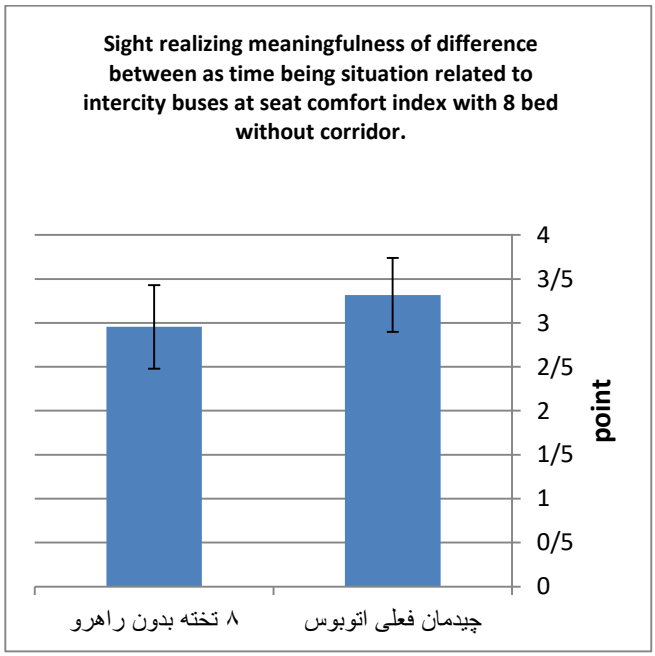
new ideas were generated: ١.Coupe (sleeper) arrangement without corridor ٢.arrangment of ٨ beds with corridor٣. Arrangement of ٦ beds with corridor,٤. Arrangement of ٤ beds with corridor. The ideas were built in ٣D and ٣٠ questionnaires were given to the participants.

First of all, a data chart was separately prepared for all the questions and median was generated for every question. Based on that and according to data, the data frequency diagram has been studied and deviation factor has been also generated, the goal was to see how much deviation toward left or right of the chart could be detected. After that the Deviation was divided into half and was applied in Excel Software through error bars tool in order to see the meaningfulness of the data. Normally dividing the deviation into half would make it possible that half of the index line would be lower than average and half other would be higher than average and all would

generate a better visual understanding and insight. After that through T-test and finding the number P and considering the difference with Number ۰,۰۵ , we could also find out whether the difference is meaningful or not.

Data was generated for question ۱ from questionnaire and the view of Statistical population on their tendency for using intercity bus was asked and collected. It was obvious that ۱۰۰ percent of those questioned had tendency to use Bus in inter-urban trips. On the other hand, if anyone would not be interested in using the bus, the whole questionnaire would not and could not be valid. That was the reason that we generated those data for the second question and a diagram was generated out of the average of the data.

Kind of Cabin	**Design in laying position**	**Deisgn in compact position**
۸ bed cabin without corridor		
۸ bed cabin with corridor		
۶ bed cabin with corridor and personal space		
۴ bed cabin with personal space		



Average	۳,۳۱۸۱۸۱۸۱۸	۲,۹۵۴۵۴۵۴۵۵
Std	۰,۸۳۸۷۲۷۱۳۳	۰,۹۵۰۰۵۱۲۶۳
std/۲	۰,۴۱۹۳۶۳۵۶۶	۰,۴۷۵۰۲۵۶۳۲
t-test	۰,۱۰۳۵۲۸۹۳	۰,۱۰۳۵۲۸۹۳

bed with corridor --- current arrangement of the bus

Through gaining the deviation factor, dividing it into half and projecting it on the chart, we do see that difference is not meaningful .After that by generating the p= = ۰.۱۰۳۵۲۸۹۳, which is less than p> ۰,۰۵ , we would reach the result that there is no meaningful difference between the designed proposal and current usage of buses. Other factors were drafted, t-test was conducted on them and the related results were included in such table

As can be seen in the table, the amount of meaningful factors (t-test<۰,۰۵) in the design of bus cabin with ٦ beds with corridor and another bus cabin with ٤ beds and corridor is more than other designs. Now based on the information of the related chart, it can be concluded that the

design of bus cabin with ٦ bed, which is based on data frequency, whether factors' density would be included or not, would be the best design. As a result we expect that such a design would have a revolutionary effect on Iranian transportation industry, at least; while it could also have a positive effect on global transportation system.

index ← / model name ↓	Being meaningful or being meaningless question ١: (seat comfort index(	Being meaningful or being meaningless Question٢ : (independent index at choosing sitting mood standing)	Being meaningful or being meaningless Question٣ : (independent index at choosing sitting mood walking)	Being meaningful or being meaningless question ٤ : (prone index or degree zero angle	Being meaningful or being meaningless question ٥:(security sense index from environment)	Being meaningful or being meaningless question ٦ : (increasing price index due to capacity decrease)	Being meaningful or being meaningless question ٧: (to be available shipment space index)	Being meaningful or being meaningless question ٨: (sight index to outside view)
Index coefficiency	۴	۶	۷	۸	۲	۵	۳	۱
Current city buses	۰,۱۰۳۵۲۸۹۳	۰,۵۹۰۹۷۰۵۰۵	۰,۰۰۰۰۰۱۸۲۶۱	۰,۰۰۴۸۷۱۱۵۳	۰,۰۰۴۱۸۸۵۹۹۹	۰,۰۰۰۰۰۰۰۳۳۹	۰,۰۷۶۲۷۲۳۸۸۰	۰,۰۰۰۰۰۰۰۰۰۰۰۰۹۸
۸ flats without corridor	۰,۱۰۳۵۲۸۹۳	۰,۵۹۰۹۷۰۵۰۵	۰,۰۰۰۰۰۱۸۲۶۱	۰,۰۰۴۸۷۱۱۵۳	۰,۰۰۴۱۸۸۵۹۹۹	۰,۰۰۰۰۰۰۰۳۳۹	۰,۰۷۶۲۷۲۳۸۸۰	۰,۰۰۰۰۰۰۰۰۰۰۰۰۹۸
۸ flats with corridor	۰,۸۷۳۸۵۱۵۹۲	۰,۰۰۰۰۰۰۰۲۹ ۳۷۸۲۰۱	۰,۰۰۵۶۲۹۹۲۷۸	۰,۰۰۰۰۰۱۱۲۰۰۷ ۸۵۷۵	۰,۰۰۰۰۱۱۶۰۸۹	۰,۰۰۰۰۰۰۰۷۷۸۵	۰,۰۰۹۴۹۹۱۸۵۴	۰,۰۰۰۰۱۵۶۴۷۷
۶ flats of personal space with corridor	۰,۰۰۶۱۰۰۷۵۲	۰,۰۰۰۰۰۰۰۰۲ ۵۹۳۴۷۱	۰,۰۰۳۲۳۸۰۷۲۹۰ ۴۳۱۵	۰,۰۰۰۰۰۰۰۱۹۴۹ ۱۱۳۶		۰,۰۰۰۰۰۰۰۴۶ ۵۶۹۱۱	۰,۰۰۰۰۰۰۰۰۰۲ ۸۲۵۹	۰,۰۰۰۱۴۴۵۱۲۷۸ ۱۴۰۳
۴ flats of personal space with corridor	۰,۰۰۹۴۹۹۱۸۵	۰,۰۰۰۰۰۰۰۰۳ ۹۰۹۲۳۶	۰,۰۰۵۶۲۹۹۲۷۷۹ ۱۶۵۳	۰,۰۰۰۰۰۰۰۳۱۷ ۱۹۱۲	۰,۰۰۰۰۰۰۰۱ ۱۸۱۷۵۴	۰,۲۵۹۱۵۳۸۶۸۳ ۸۱۲۰۱	۰,۰۰۰۰۰۰۰۰۰۰ ۱۱۸۷	۰,۰۰۰۲۱۵۹۳۴۳۵ ۳۹۰۱

This paper is extracted out of thesis of master of science level examination board of first author by supervision of second author

References:

[1]. Ciampone, Sandra(2012): Methods for seated posture recognition; University of London PhD thesis.

[2]. Crashworthiness Evaluation of Mass Transit Buses Federal Transit Association Report (2012)

[3]. Designing the future of Bus system; European Union Press kit Report Andrew Canning, Press & Media Manager

[4]. KOTTENHOFF, KARL (?): Passenger Train Design for Increased Competitiveness; TRANSPORTATION RESEARCH RECORD 1623

[5]. Kwasniewski , Leslaw (2009): Crash and safety assessment program for paratransit buses ; International Journal of Impact Engineering

[6]. MEAN WONG JIAR (2010): DEVELOPMENT OF CONCEPT DESIGN FOR AN IDEAL CITY BUS ; University of Technology Malaysia

[7]. Pan,Qui (2008) : CRITICAL FACTORS FOR SERVICE QUALITY IN THE INTERCITY BUS TRANSPORT INDUSTRY; Master thesis Submitted at Durban University

[8]. Sachin Thorat, G.Amba Prasad Rao (2011) COMPUTATIONAL ANALYSIS OF INTERCITY BUS WITH IMPROVED AESTHETICS AND AERODYNAMIC PERFORMANCE ON INDIAN ROADS ; International Journal of Advanced Engineering Technology