STUDY PROJECT ON CHAIRS

A THESIS SUBMITTED IN PARTIAL FULLFILMENT OF THE

REQUIRMENT FOR THE DEGREE OF

bachelor of technology in

Industrial design

by

Yajnyadatta Dora (111ID0271)

Under the supervision of

Proff B.B.Biswal

Department of Industrial design

National Institute of Technology, Rourkela
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Declaration

We Hereby Declare That This Thesis Is Our Own Work And Effort. Throughout This Documentation Wherever Contributions Of Others Are Involved, Every Endeavour Was Made To Acknowledge This Clearly With Due Reference To Literature. This Work Is Being Submitted For Meeting The Partial Fulfilment For The Degree Of Bachelor Of Technology In Industrial Design At National Institute Of Technology, Rourkela For The Academic Session 2011 – 2015.

Yajnyadatta Dora (111ID0271)

NATIONAL INSTITUTE OF TECHNOLOGY ROURKELA

CERTIFICATE

*This is to certified that the thesis entitled "**Study projects on chairs**" submitted by **YAJNYADATTA DORA (111id0271)** in partial fullfilment of the requirement for the award for the of the degree **BACHELOR OF TECHNOLOGY** in **INDUSTRIAL DESIGN** at **National institute of technology, Rourkela** is an original work carried out by him under my supervision and guidance.*

The matter embodied in the thesis has not been submitted to any other university/institute for award of any other degree

Dr. B.B Biswal

ACKNOWLEDGEMENT

ABSTRACT

A chair is a piece of furniture used as a place to lie, sit, or stand in a relaxed or lazy way. People use beds, tables, and other accessories for other purposes. So, here we discuss about lots of chairs and its use towards the society. A brief discussion of ergonomics and anthropometric data analysis of two individual kinds. Chair analysis and it's different type of style. Discussion of different types of chairs and it's major uses. We choose three different chairs and done analysis by taking two individual kinds. Different customer needs have been identified, existing models have been studied and chair has been ergonomically designed. The additional features of the chair has been ergonomically design for office purpose, easy to carry from one place to another, and you can adjust that chair by its tilting mechanism. Chair and all other components are designed and mechanisms have been developed using CAD software (CATIA V5R17) and simulated. To evaluate the CAD model in virtual environment by "digital human modeling" software like CATIA.

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1 INTRODUCTION

The present project "A Study project on chairs" is being pursued, by applying the techniques of ergonomics and analysis of anthropometric data under the guidance of Professor B.B Biswal at NIT Rourkela, Dept. of Industrial Design.

The chair is of compelling artifact and simplicity, in spite of the fact that for a long time and undoubtedly for a great many years it was an article of state and pride as opposed to an article of customary utilization. The chest, the bench and the stool were until then the ordinary seats used in regular living, what's more, the quantity of chairs which have made due from a before date is exceedingly restricted; a large portion of ecclesiastical or seigneurial beginning. Our knowledge into the chair of remote relic is gotten altogether from landmarks, model and artworks. Many types of chairs seen around such as :

- A seat without a back or arm rests is a stool.
- When bump up, a bar stool.
- Arm chair is having arms.
- A recliner is a chair with folding action and reclining footrest.
- A forever settled seat in a train or theater is a seat.
- A chair with wheels is called a wheelchair.
- When riding, it is a saddle.
- A seat for more than one individual is a sofa, couch, seat, settee or loveseat.

1.2 PROBLEM STATEMENT

Sitting is a position that adds anxiety to the structures in the spine. To abstain from creating or intensifying back issues, it is vital to have an ergonomic seat that backings the lower back and inspires great stance. In today's general public, numerous will be sitting throughout the day either in office situations or working machines. Although sitting requires less physical exertion than standing or strolling, regardless it puts a considerable measure of weight on the lumbar zone. Joined impacts of an inactive way of life and work that obliges sitting can prompt numerous wellbeing issues. The choice of a suitable seat is a basic venture in anticipating wellbeing issues for individuals working in a sitting position.

Sitting is a position that adds stress to the structures in the spine. To abstain from creating or An all around outlined seat permits the client to sit in an adjusted position. Purchasing an ergonomic seat is a decent starting however it must be consolidated with a legitimate stance to augment the advantages.

1.2 Objective of Work

- To study ergonomics and anthropometric measurement of human body of different kinds.
- To develop some concepts based on their needs.
- Different chair analysis and it's type and it's major uses.
- Analysis of three different chairs for different types of people.
- To find office chair concepts that satisfying most of the needs and which gives more comfort and also economical.
- To develop CAD model of those concept.
- To evaluate the CAD model in virtual environment by "digital human modeling" software like CATIA, Delmia, Jack etc.

2 REVIEW LITERATURE

2.1 ERGONOMICS

Ergonomics is the examination of the collaboration in the middle of individuals and machines and the components that influence the communication. Its object is to enhance the execution of frameworks by enhancing human machine connection. This could be conceivable by 'delineating in' an unrivaled interface or by 'arranging out' components in the work environment, in the errand or in the association of work that corrupt human–machine execution. Frameworks can be improved by

• Outlining the client interface to make it more good with the undertaking and the client. This makes it less requesting to use and more impervious to lapses that individuals are known to make.

• Changing the workplace to make it secure and more suitable for the task.

• Changing the undertaking to make it more immaculate with customer characteristics.

• Changing the way work is created to suit people's mental and social needs.

2.2 ANTHROPOMETRY

Changing the way work is formed to suit people's mental and social needs the word "anthropometry" implies estimation of the human body. It is gotten from the Greek words "anthropos" (man) and "metron" (measure). data are used as a piece of ergonomics to demonstrate the physical estimations of workspaces, equipment, furniture and clothing to ensure that physical mismatches between the measurements of gear and items and the relating client measurements are evaded.

Designing for a solitary individual demands his dimensional variations to be well accommodated. When designing for mass utilization and for unknown individuals, one of the most relevant statistical interpretations & considerations is the percentile estimation of the gathered information taken from a specific population group.

Many types of chairs are discovered now-a-days and their design are different from one another.

To build a chair many objects are required for example:

- Material
- Chair be located (kitchen/ office)
- How often will chair be used (3*day/ all day)
- Will be people be doing anything else as they sit in the chair (eating/ reading)
- Will this chair get dirty often (yes/ hopefully not)
- Who will use the chair

To design a chair anthropometric data are most important feature.

Anthropometry is the measurement and the art of application that establishes the physical geometry, mass properties and quality abilities of human body. Anthropometry data helps designer to determine the size and shape of perfect chair. Anthropometry data for most male and female body measurements overlap so the designer work to sizes.

2.3 PERCENTILE

Percentile are the statistical value of distribution of variable transferred into hundred scale. Percentile estimation of anthropometry information either be figured from total recurrence charts or by numerically.

2.4 ANTHROPOMETRIC FIT

A chair should fit the body like a piece of clothing. In a perfect world a work seat ought to give the individual attack of a shirt or a couple of paints. Individuals shift broadly in every one of their measurements. Dishonourably fitted seats can bring about uneasiness and add to wellbeing issue. Individuals extensively fit as a fiddle and general size. There are gender related differentiations in bone structure and weight spread and unending mixture in extremity lengths and body shape. Indeed, even among a gathering of individuals of the same gender orientation, age and structure one finds critical variety in substantial advancement.

Two men of the same standing height for occurrence, can give off an impression of being altogether different tallness, when situated and their situated elbow statures may differ by as much as 3/4 inches.

Exacerbating the issue is that the anthropometric information utilized via seat fashioner don't essentially mirror the aggregate grown-up populace that will be utilizing their item. This makes it basically difficult to focus the real rate of client that will be fit for any given measurements.

3 METHODOLOGY

3.1 MISSION STATEMENT

Product Description: Chairs

Benefit Proposition: More comfort to users

Primary market: For Haryana and Assam people

Secondary market: Home, office, conference room, saloon and many other places.

3.2 IDENTIFICATION OF CUSTOMER NEEDS

Here the lead users are students. We have interacted with hostel students of NIT Rourkela and many students in nearby schools and colleges of NIT Rourkela and got some useful statements from them which led us to some need statements. Unnecessary and repeated statements have been neglected.

3.3 CONCEPT DEVELOPMENT

Based on the customer needs, some daily life observations and some analysis of existing products, some concepts have been developed. However, it is not possible to satisfy all the needs in a single design.

Fig-1(Kitchen chair and arm chair)

- T he above figure is suitable for kitchen table sets idea for home.
- You are feeling happy with your parking space.
- Light weight.
- The second figure is a Deco chair use in plane.
- Deco design that will enhance and enrich your own special interiors.
- Luxurious.
- Perfect for den, office, or living room.

Fig-2(sofa and lounger)

- Sofa have much space for sleeping, it's more like sofa-bed combination.
- Much comfortable.
- Use for drawing room.
- Lounge uses in sea coast area mainly for relaxing purpose.
- It used as a place to lie, sit, or stand in a relaxed or lazy way.
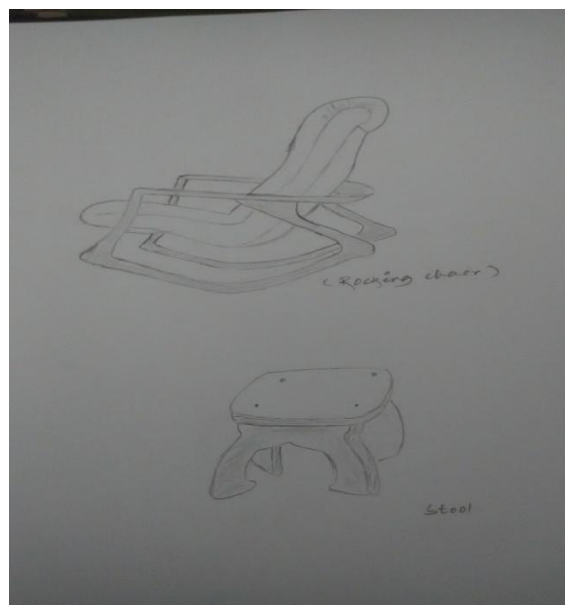- Reduce back pain.

Fig-3 (Rocking chair and stool)

- Rocking chair with two curved band attached to the bottom of the legs.
- Interface the legs on every side to one another.
- The rockers contact the floor at just two focuses, giving the tenant the capacity to shake forward and backward by shifting human body weight or pushing lightly with his/her feet.
- Rocking chairs are made of wood.
- A stool is one of the earliest forms of furniture.
- It has many similarities to a chair.
- It consists of a single seat, without back or armrests, on a base of either three or four legs.
- A stool is different kind from chairs by their lack of arms and a back.
- Variants exist with one, two or five legs and these various stools are referred to by some people as "backless chairs".
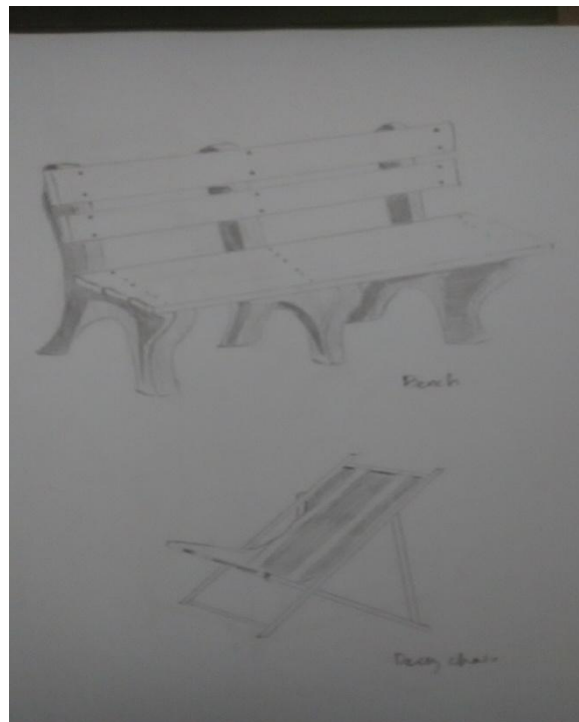

Fig-4(Bench and Deck chair)

- Piece of furniture which several people may sit at the same time.
- Benches are typically made of wood, but may also be made of metal, stone, or synthetic materials.
- Many benches have arm and back rests; some have no back rest and can be sat on from either side.
- Benches are used both outdoors and indoors.
- Deck is a folding chair, usually with a frame of treated wood or other material.
- Portable folding chair, with a single strip of fabric or vinyl forming the backrest and seat.
- It is easily transportable and stackable.

Fig-5 (Spa chair and Diva chair)

- The above one is spa chair used for manicure and pedicure.
- It provides much comfortable.
- The below one is Diva chair used for various purpose in home or office.
- Elegant in looks.
- Very light weight.

Fig-6 (Yoga chair and club chair)

- Extremely comfortable.
- It also use for yoga purpose.
- The second one is most popular chair for home office is ergonomic chair known as desk chair.
- These kinds of chairs are particularly intended to fit to the shape of the users' body.
- It allow the arms relax contentedly alongside the chair and a towering back that hold the back and neck of the sitter tightly.
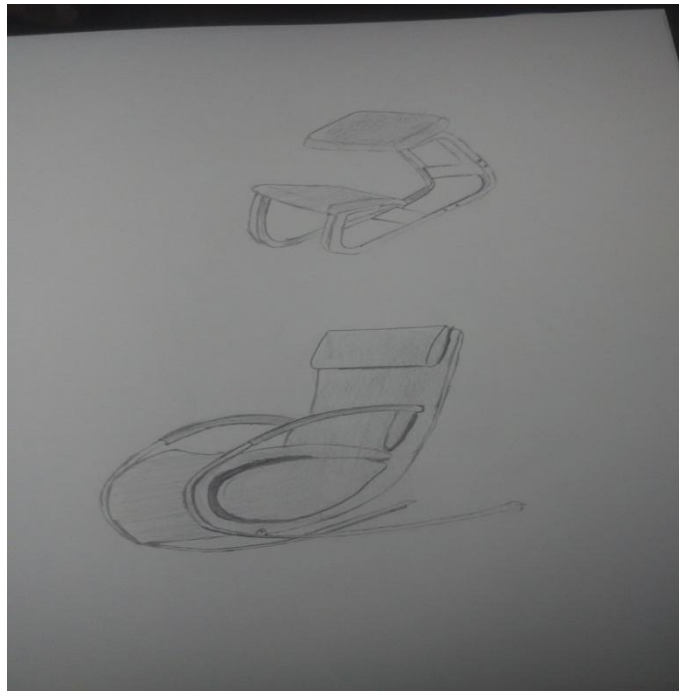

Fig-7 (Kneeling chair and papasan chair)

- The above one is kneeling chair sitting in a position with the thigh dropped to an angle of about 60 to 70 degrees from vertical.
- The below one is soft comfortable with beautiful Morden design.
- Stress resistance.

Fig-8 (wheel chair)

- A wheelchair is a chair with fitted with wheels.
- The device comes in variations where it is may be either manually propelled by the seated occupant turning the rear wheels by hander or electrically propelled by motors.
- Often there are handles behind the seat for someone else to do the pushing.
- Wheelchairs are used by people for whom waling is difficult or impossible due to illness, injury, or disability.

3.4 CHAIR ANALYSIS

It might be helpful to have a way of determining the identity and style of using visual means rather than by memorizing the names of all arts of style.

It has forty distinct styles such as :

- Straight back with straight legs
- Inclined back with straight legs
- Inclined back with back legs inclined
- Back and legs inclined
- Back inclined and legs crossed
- Upright form
- Inclined form
- X or scissors form

We can identify chairs by a watching view of such as :

- Front and side elevation
- Arm
- Seat plans
- Outline of chair back
- Composition of back

Choosing an ergonomics chair making an informed choice so here is some application to be considered.

- Chair strength
- Seat dimension
- Seat height
- Seat tilt
- Seat depth
- Seat width
- Seat material
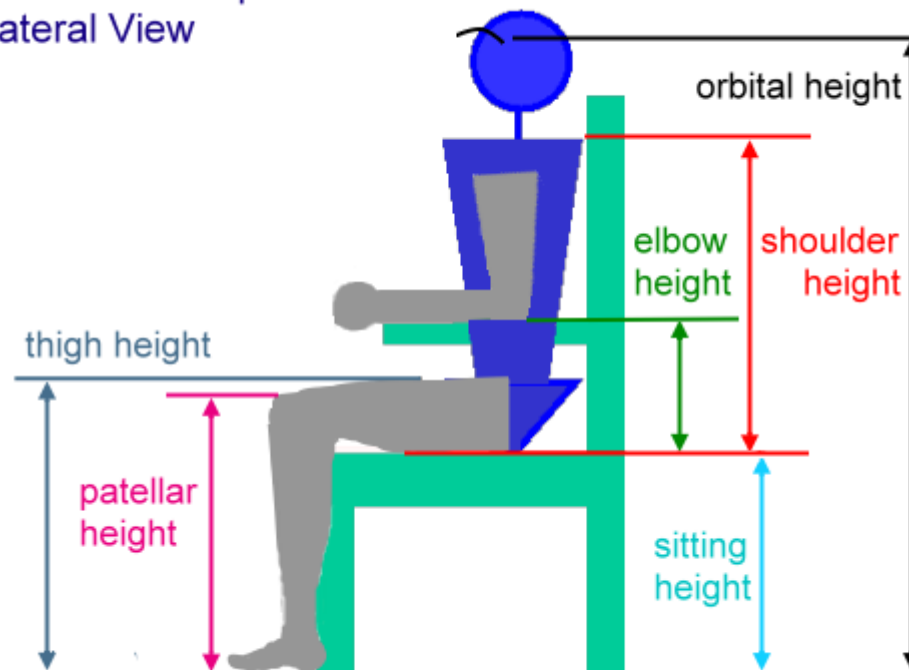- Seat-to-back angle
- Backrest dimension
- Controls
- Armrest

Fig-9 (Vertical anthropometric measurements)

3.5 Haryana VS Assam

Haryana people are generally healthier than Assamese people. Height of the Haryana people are minimum for men is 168cm and for female minimum 154cm. Haryana placed third position in tallest state for men and placed second position for women after Jammu and Kasmir. Haryana people are also heavy in weight, generally found that men of Haryana weight is 65.5kg and for women 62.5kg. Their shoulder length and legs are bigger than Assamese people.
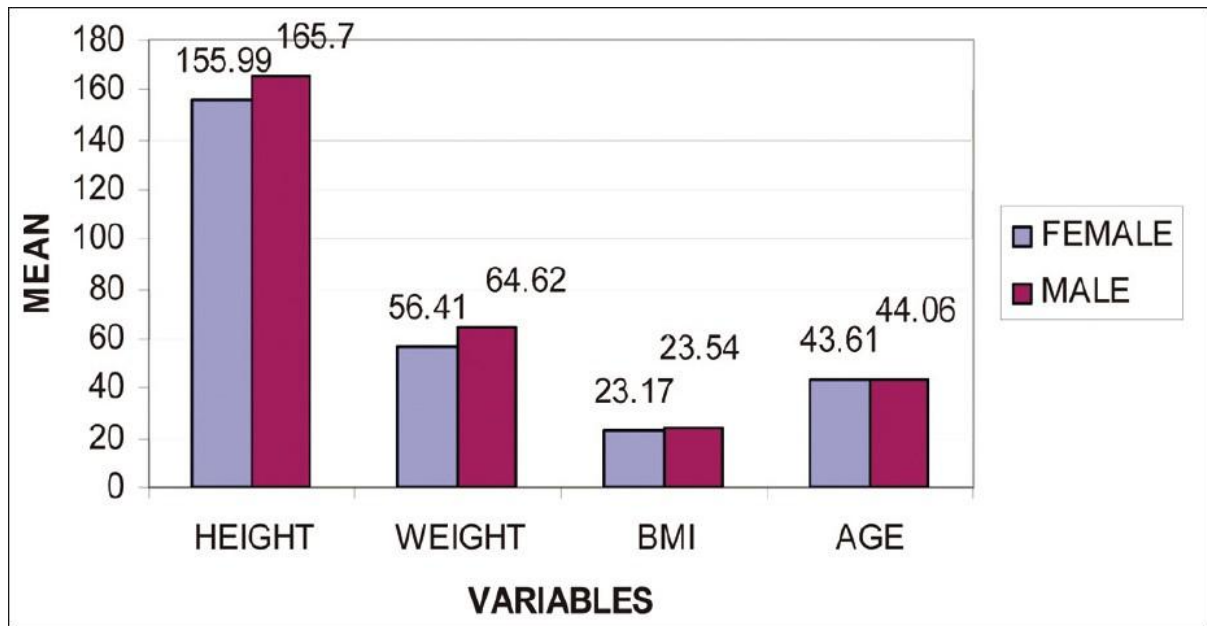

Fig-10 (Haryana people's Height, weight, BMI and age graph)

Assamese people are generally less in height and weight. It's seen that general height of Assam is 156.1cm. General weight is 59.8 and body mass index is 24.5. Assamese people are generally not seen to carry too much weight. They are looking fit and active. When they get older their weight is also simultaneously increasing.
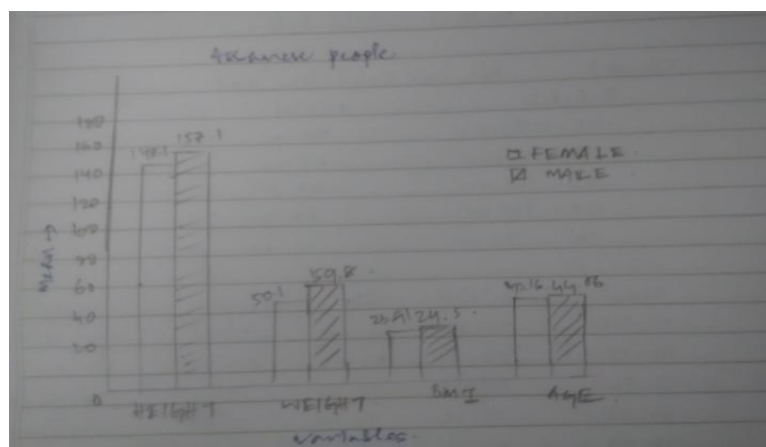

Fig-11 (Assam people's Height, weight, BMI and age graph)

18

MEN'S DATA:

Height in cm	Waist in cm
145-150	54
150-155	58
155-160	62
160-165	66
165-170	70

Table-1(Data for men)

Waist	Hip	Height	Weight
26 - 28	32 - 34	< 5' 8.5"	105 - 115
27 - 29	33 - 35	< 5' 8.5"	115 - 125
27 - 30	33 - 36	< 5' 8.5"	125 - 135
28 - 31	34 - 37	< 5' 8.5"	135 - 145
30 - 33	36 - 39	< 5' 8.5"	155 - 165
30 - 34	36 - 40	< 5' 8.5"	160 - 170
31 - 35	37 - 41	< 5' 8.5"	170 - 180
32 - 36	38 - 42	< 5' 8.5"	180 - 190
33 - 37	39 - 43	< 5' 8.5"	190 - 200
34 - 39	40 - 45	< 5' 8.5"	200 - 220
36 - 41	42 - 47	< 5' 8.5"	210 - 220
38 - 44	44 - 50	< 5' 8.5"	220 - 240
40 - 46	46 - 52	< 5' 8.5"	240 - 260

Table-2 (Men's data 2)

WOMEN'S DATA:

Height from (4'11"- 5'4")

Bust	Waist	Hip
32 1/2	26 1/2	35 1/2
33 1/2- 34 1/2	27 1/2- 28 1/2	36 1/2- 37 1/2
35 1/2- 36 1/2	29 1/2- 30 1/2	38 1/2- 39 1/2

Table-3 (women's data)

Height from (5'4"- 5'9")

Bust	Waist	Hip
32-33	26-27	35-36
34-35	28-29	37-38
36-37	30-31	39-40
38 1/2-40	32 1/2-34	41 1/2-43
41 1/2-43	35-37 1/2	44 1/2-46 1/2

Table-4 (women's data 2)

3.6 DESIGN PROBLEM AND IT'S SOLUTION

Most work chair or daily used chair try to accommodate sizes and shapes with series of mechanical adjustment. For example while the variation in lower leg length of adult Haryana and Assamese population span more than six inches, chair height adjustment mechanism generally are not engineered to provide more than four-one-half inches of adjustment. Individuals are more likely to get proper support from a chair that requires only minor adjustment to fine- tune the fit.

By designing first for the extremes, we developed a chair that gives virtually every person a reasonable good fit, even if it's never adjusted. We built in most adjustability for the dimensions where we found the greatest variation. For example we found a considerable amount of diversity in LUMBER HEIGHT so we design a LUMBER PAD for the chair that allows appropriate range of height adjustment.

3.7 CHAIR DESIGN FOR BOTH HARYANA AND ASSAM PEOPLE

OFFICE CHAIR FOR HARYANA POPULATION:

Above we calculated Haryana's people anthropometric data that are :

Height	155-165cm
Weight	56-66 kg
Waist	37-38 cm
Hip	34-37 1/2 cm
Chest	34-37

Table-5 (general anthropometry data of Haryana people)

So the office chair would be :

- Chair width should be broad.
- Seat material should be lathery or spongy to maintain height.
- Seat width should be min 38cm.
- Office chair should be strong to carry large weight.
- Design to fit lower body like a glove

- The absolute favourite among anyone which reduce back pain or spinal injuries(though Haryana people have height they can easily get back pain)
- It should offer outstanding back, neck and spinal support and it should promotes healthy posture
- Harman Miller Aeron is the best chair for above 5'9" people for office purpose.
- Lumber support should be there because lumber depth of Haryana people are higher than Assmese people.
- Adjustable seat height mechanism should be there to avoid thigh and knee pain.
- Seat back angle and knee angle should be 90 degree.
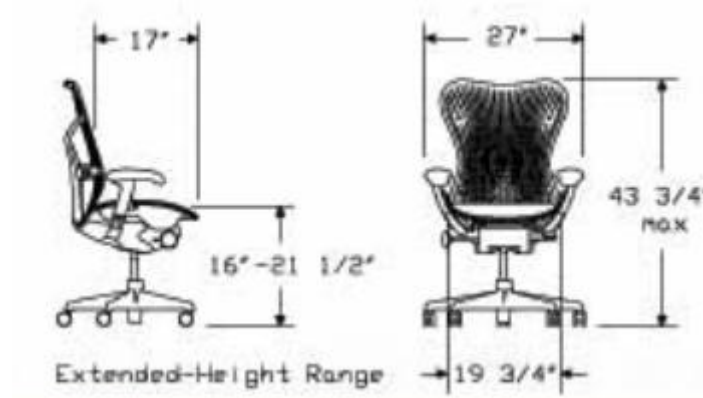
Fig-12 (Seat dimension for Large size people like Haryana)

OFFICE CHAIR FOR ASSAM PEOPLE

Earlier we calculated the anthropometric data of Assamese people that are

Height	156cm
Weight	59kg
Waist	29-35 cm
Hip	33-36cm
Chest	33-35cm

Table-6 (General anthropometric data of Assam people)

So the office chair for Assam population would be

- They don't need high back chair.
- Seat material may be normal not lathery or spongy.
- Office chair should not be heavy or strong like Haryana populations.
- They basically adjust in any Office chair because of their shape and size.
- They don't have much lumber depth.
- Feet flat on ground or resting on foot for Assamese people to avoid knee pain.
- Seat back angle and knee angle should be 90- 120 degree.
- Front of the office seat should not pressing on back of knee.
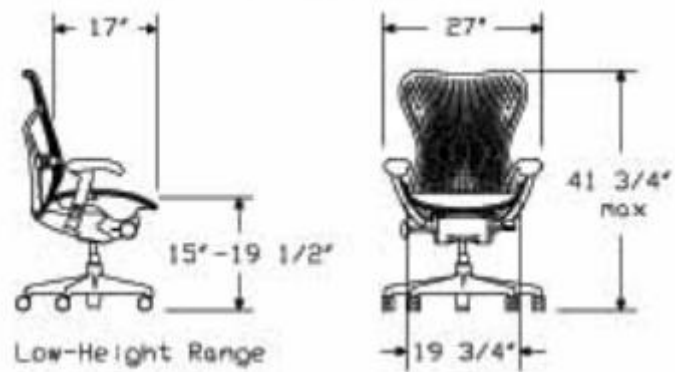- Adjustable seat height mechanism should be their to avoid pain.

Fig-13(Seat dimension for small size people like Assam)

DINNING CHAIR FOR HARYANA PEOPLE

- Chair should be heavy in weight.
- Seat material should be there.
- Dinning chair depends on the height and clearance of dining table.
- For Haryana people due to their height it easily or comfortably fits them anywhere.

DINNING CHAIR FOR ASSAM PEOPLE

- Chair should be light in weight.
- Seat material doesn't matter much.
- Such a small height would not comfortably accommodate able-bodied dinner.
- Seat height problem may arise here.
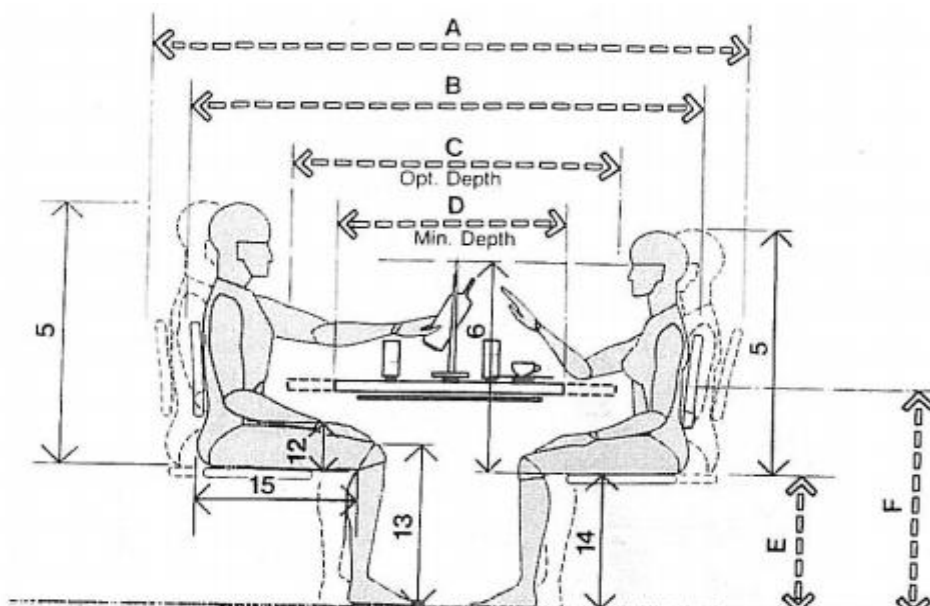
Fig-14 (Tables/ Minimum and optimum Depths/ Vertical clearence)

|	in	cm
A	76–88	193.0–223.5
B	66–78	167.6–198.1
C	40	101.6
D	30	76.2
E	16–17	40.6–43.2
F	29–30	73.7–76.2
G	18–24	45.7–61.0
H	31	78.7
I	30 min.	76.2 min.
J	29 min.	73.7 min.

Table-7 (Dining chair and table collected anthropometric data)

This data may be applied for both Haryana and Assam people. It perfectly calculated the approximate height and weight of both kinds of people.

WHEEL CHAIR FOR HARYANA PEOPLE

- Chair should be strong.
- Seat material should be comfortable.
- Instrumented wheel would be perfect.
- Height of wheel should be high.
- Haryana people are heavy in weight so they find very difficult to get up from the chair so an electronic power stand-up wheel chair would be great.
- A stable and seating base.
- A vehicle that easily manoeuvre.
- Freedom of travel.

WHEEL CHAIR FOR ASSAM PEOPLE

- Wheel width should be less so that they can easily applied force.
- Height of the seat would be less than Haryana people.
- Chair might be light in weight.
- They don't need an electronic power stand-up wheel chair as much as Haryana people do.
- A vehicle that meets the assistance need.
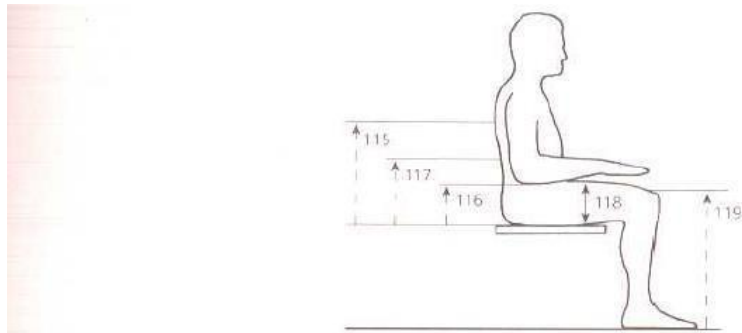
R.No.	Parameters	Definition (brief)
115	Tip of shoulder blade	Lower tip of the shoulder blade (scapula).
116	Elbow rest	Lower most part of the elbow.
117	Waist	Upper margin of the lateral iliac crests (where the belt is worn).
118	Mid thigh	Top of the middle thigh.
		Heights from floor
119	Knee	Uppermost point on the knee (at lower thigh).
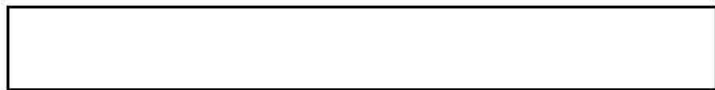
Fig- 15 (Anthropometric measurements)
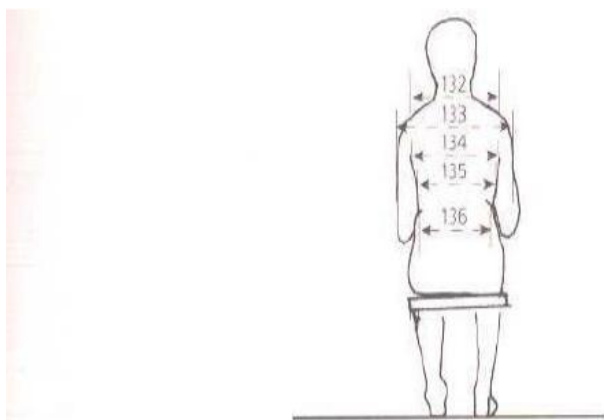
| R.No.	Parameters	Definition (brief)
		Breadths
132	Bi-acromion	Maximum horizontal distance across the shoulders, breadth measured between the most lateral points on the superior surfaces of the acromion processes of the scapula.
133	Bi-deltoid	Maximum horizontal distance across the shoulders, breadth measured to the protrusions of the deltoid muscles.

Fig-16 (Anthropometric measurements)

137 **Hip breadth**   Maximum horizontal distance across the hips.
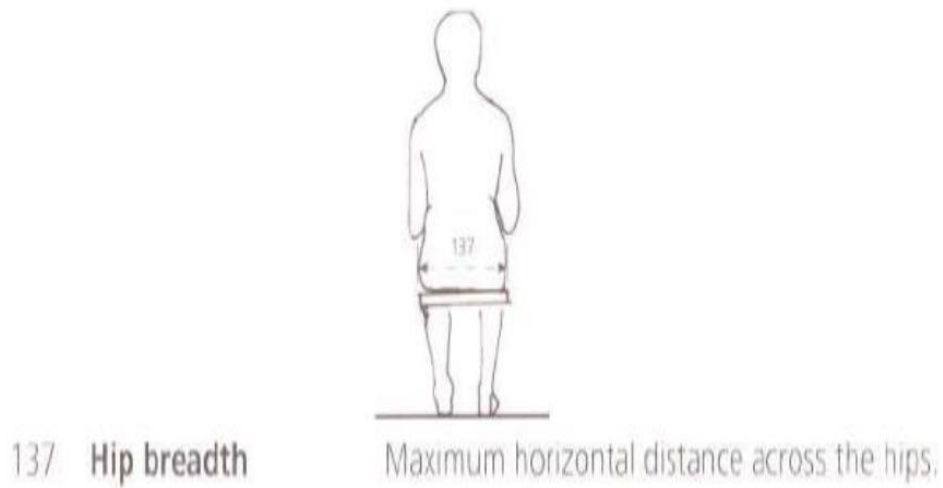
Fig-17 (Anthropometric measurments)

4 DETAILED DESIGN
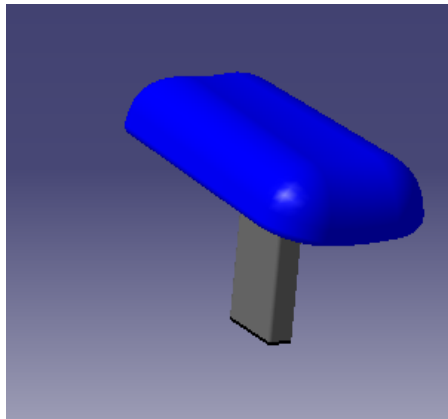
BACK OF A OFFICE CHAIR:

Different types of office chair has different design different material different looks but basically it's comfort features matters a lot.
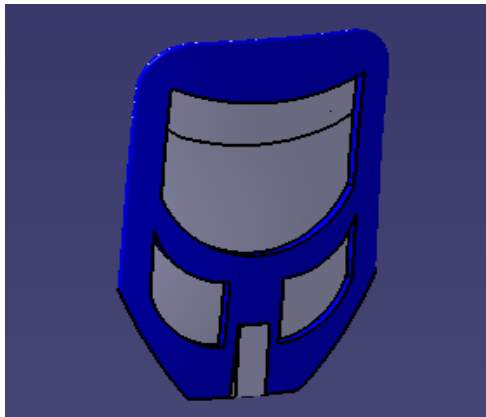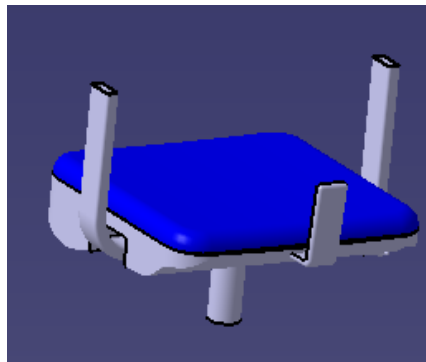

CATIA MODEL-1 (BACK OF A CHAIR)
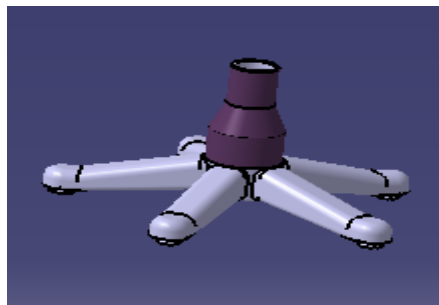
OFFICE CHAIR HANDLE:

CATIA MODEL -2 (Office chair handle)

OFFICE CHAIR SEAT:

CATIA MODEL-3(Seat of a office chair)

WHEEL OF OFFICE CHAIR:

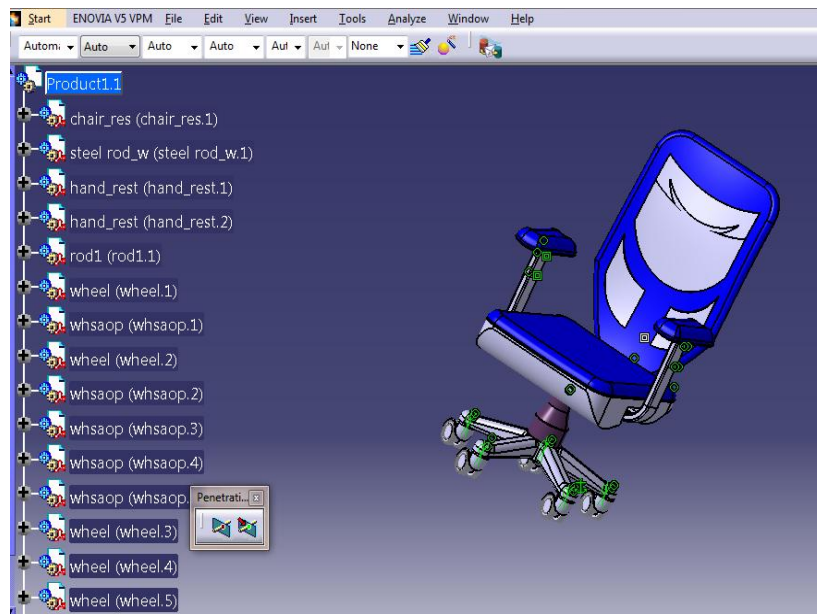CATIA MODEL-4(Office chair wheel)

FINAL ASSEMBLY OF CAD MODEL

Fig-18 (CAD model of a Office chair)

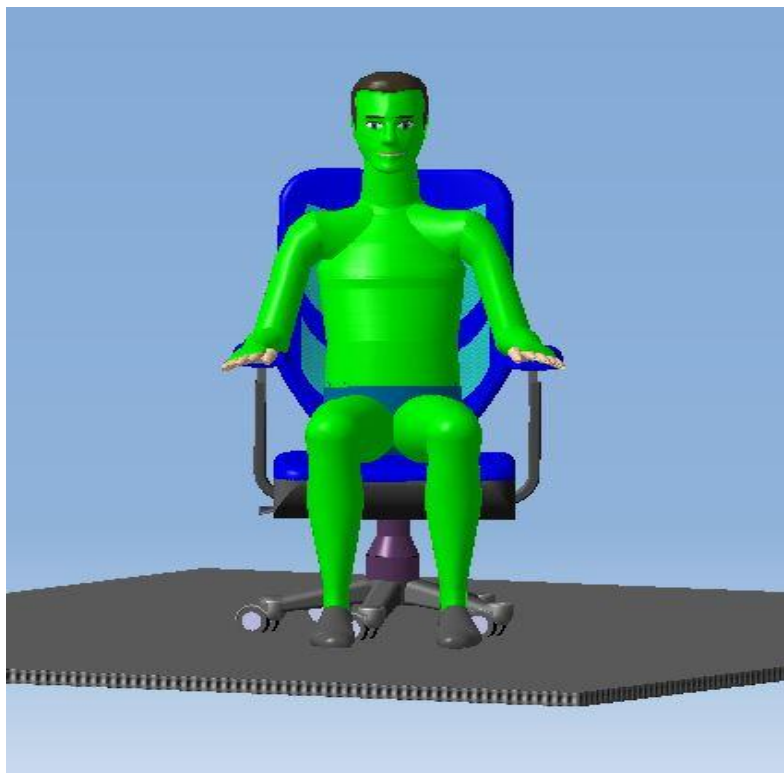## ANALYSIS DONE BY USING DIGITAL HUMAN MODELLING

FOR ASSAM PEOPLE

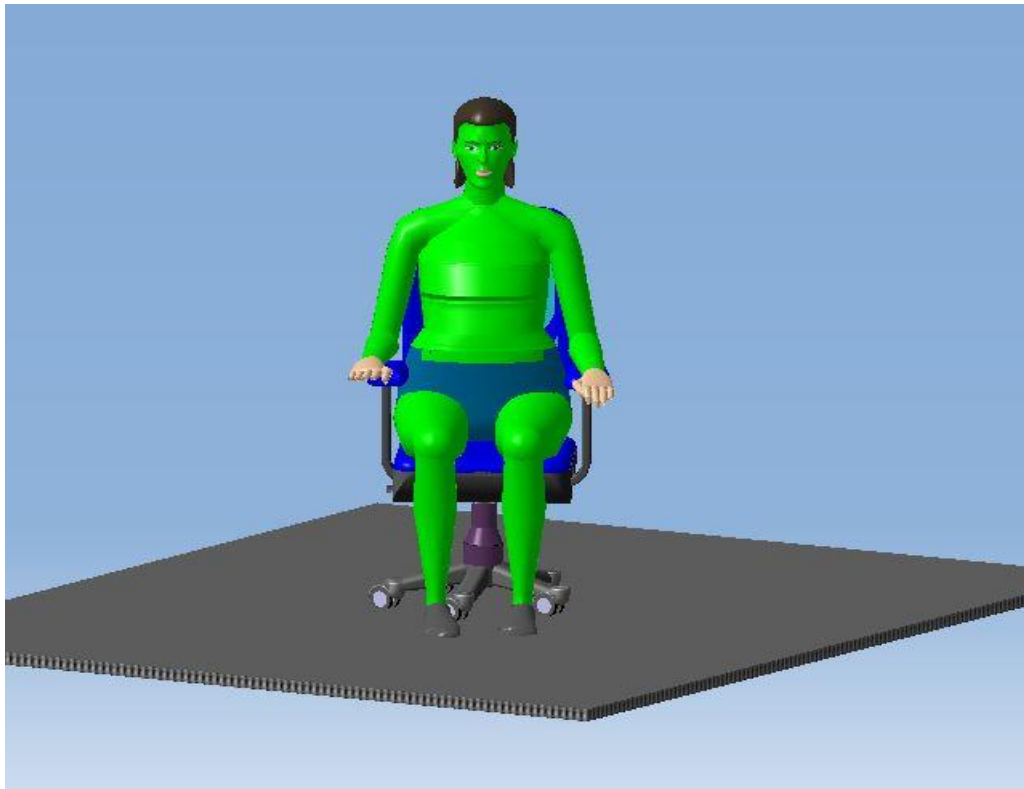
Fig-19

FOR HARYANA EPOPLE

Fig-20

5 RESULTS AND DISCUSSIONS

- Project on chair evaluation has been done partly.
- Customer survey and the study of each and every chair are the most challenging parts of the project.
- CAD model is ergonomically design for office purpose.
- Done analysis of different types of chairs by considering two different kind of people in India such as Haryana and Assam.

6 CONCLUSIONS

- During my project, I got to know that there are several types of chairs are available in market for many different purposes.
- Got to know different anthropometric data of two different individual.
- I know different types of chairs and it's major uses.
- One chair has been designed and modelled in CAD software namely "CATIA". An attempt had been made to incorporate all ergonomic features in chair design based on detailed ergonomic principles.
- The exposure and knowledge i received has made me aware about the working of a research scholar.

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