❖ Design of A Portable Stool For Train Travelers at The Railway Station.

- Guide : Prof. G.G.Ray.

IINDUSTRIAL DESIGN
POJECT II

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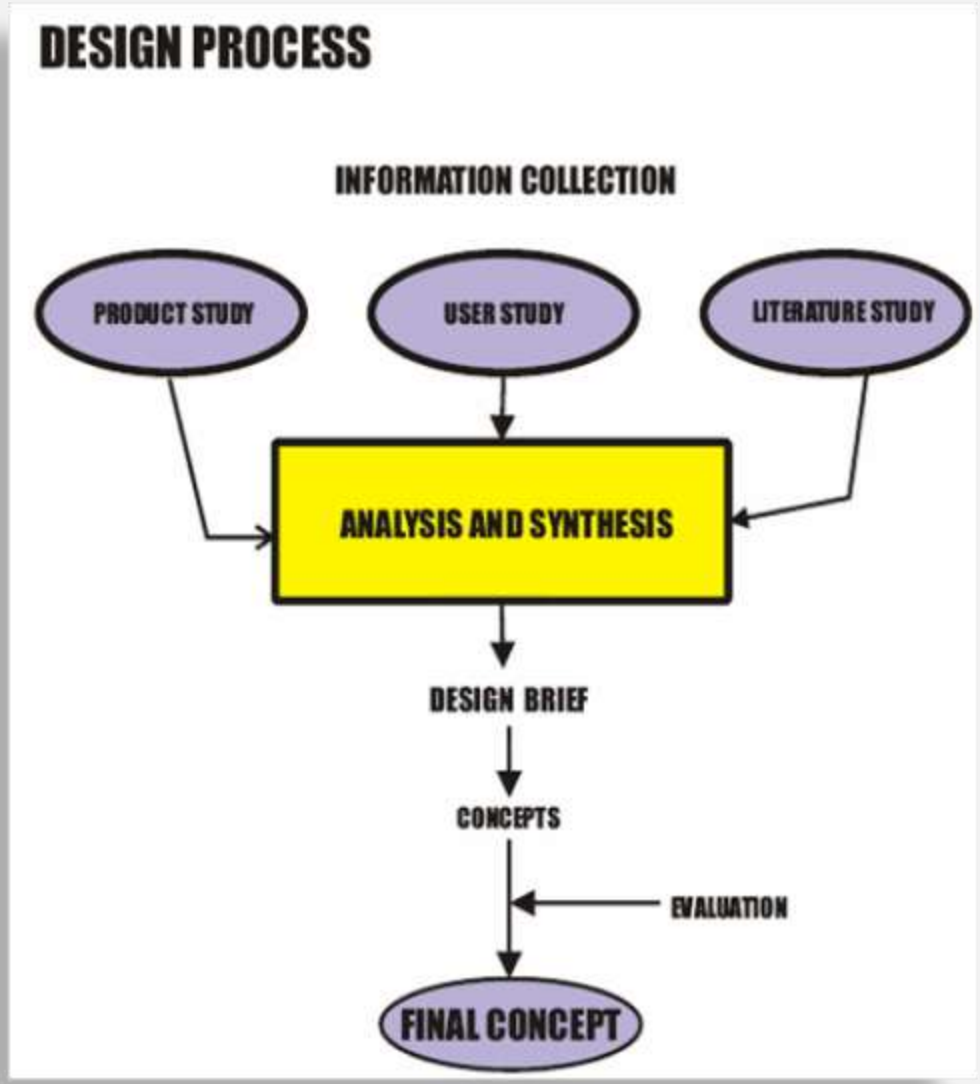
INTRODUCTION & DESIGN OBJECTIVE:

- India is a highly populated country and an ever growing one-
- brings in complex issues : space constraints, infrastructure quality and saturation.

- The traveler daily goes through a torturous means of travel.
- Hence the need for physical rest arises:
  - a **very compact and lightweight portable** seating device for the traveler.
  - would provide the user a seat at his own will.

MY APPROACH :


DESIGN PROCESS
INFORMATION COLLECTION
PRODUCT STUDY
USER STUDY
LITERATURE STUDY
ANALYSIS AND SYNTHESIS
DESIGN BRIEF
CONCEPTS
EVALUATION
FINAL CONCEPT

WHAT IS COLLAPSIBILITY:

References - Collapsibles: By Per Mullerup

The Nons and the Quasis:

- **The Nons:**

  - objects designed to fold and unfold merely once in a lifetime.

  - this includes knock-down furniture, and self assembly.

WHAT IS COLLAPSIBILITY:

References - Collapsibles: By Per Mullerup

The Nons and the Quasis:

➢ The Quasis:

- Simply **repeated fold and unfold** operations will **not classify** the product as collapsible.

- The **primary function** of such a product must be for **space saving**.- this qualifies a product as collapsible.

❖ **A genuine collapsible - one folded passive state, and one or more unfolded active states.**

DEGREES OF COLLAPSIBILITY:

Self-assembly furniture.
NON:
-Only unfolds once.

Office Chair:
QUASI:
Many active states, no passive state.

Scissors:
QUASI:
Only active state.

Umbrella:
GENUINE
One active state, one passive state.

Foldable adjustable chair:
Quasi
Many active states, and one passive state.

PRODUCT STUDY : Nature of collapsibility:

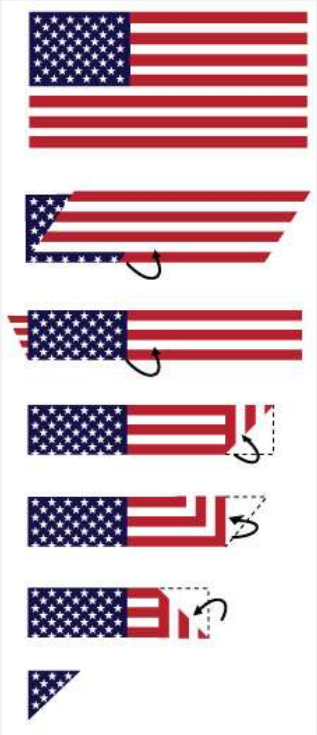
References - Collapsibles: By Per Mullerup

A structured approach was required:

CLASSIFICATION OF COLLAPSIBILITY:

PRODUCT STUDY : Nature of collapsibility:

Stress

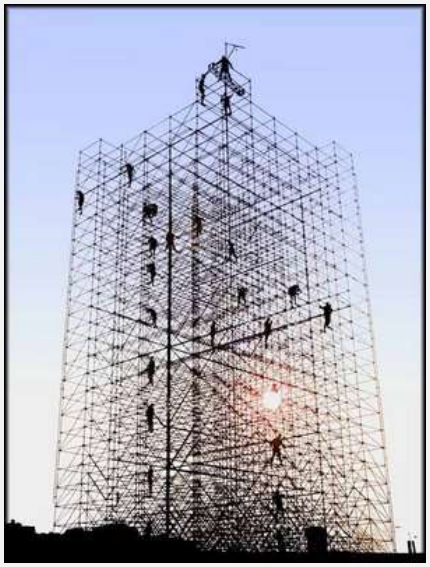


Folding

PRODUCT STUDY : Nature of collapsibility:

Bellows

Assembling



PRODUCT STUDY : Nature of collapsibility:

Hinging

Rolling

Sliding

PRODUCT STUDY : Nature of collapsibility:

Concertina

Fanning

SIMILAR EXISTING PRODUCTS :

1 . Stanton Folding Stool
(less than 2 kg.
Height 40cm(16").

2. Golf Folding Stool
0.95 kg. maximum load of 99 Kg.
13" x 13" x 15 1/2"; 3.5" x 3.5" x 24" folded

3. Folding Stool 45 cm high

4. TexSport Folding Saw.
13" x 13" x 17" open size.
2-1/3" x 2-1/3" x 23" closed
Weight : 1kg

5. Par stool :

- golf training aid - retain perfect posture before every swing.
- **facilitate** proper bend at the knees and hips.
- **establishes** muscle memory, which is fashioned over time through repetition.

Pochade Folding Stool
Epoxy coated tubular steel
Height 35cm
Wt. 1.2kg ,
£3.99

Wychwood Stool & Bag
combination with 3 piece plated steel stool frame

SIMILAR EXISTING PRODUCTS :

Jacob's stool
collapsible stool
pine, canvas fabric, silk, polyurethane

Camo Collapsible Chair
17" high stool, 16" wide, HW black steel frame, folds to 3" diameter
Stool weights 3.35 Lbs
Weight capacity: 200 Lbs.

Wag-Bag Kit : Dual Purpose Folding Frame. AKA Stool, Commode . **40$**

Collapsible Stool -
Dimension: 50-50-42 (cm). Packing Dimension: 62-30-35/12 (cm/pcs).
Tube: 13 (mm).

E-Z Foldz Folding Stool
Folds to 2" wide for easy under the cabinet storage. $14.99

THE CONTEXT :

- It was understood that there could not be a **universal design** for all the contexts.
- **Design issues** related to one context, **differed** from the design issues within another context. For e.g. a stool at a beach/garden.
- Also the **intensity of requirement** of the product differed in different contexts.
- Different **age groups** had a different behavioral pattern, and different likings.
- Each context demanded a different **system** of function. E.g. buss stop queue.

THE CONTEXT :

Daily commuters under different contexts were identified and studied:

Commuters in Different areas:

- Buss stops,
- Railway station platforms,
- Mumbai to Pune General Compartment.
- Trekkers
- Beaches / Gardens

- a **questionnaire** was prepared,
- simultaneously a **detailed personal observation** was also done accordingly on each context.

THE CONTEXT :

The questionnaire and observations dealt with :

- the **time limit** to which one can **stand or sit continuously in the particular context.**

- If such a product is available, would you use it within your context?

- Its **worthwhile weight and size** within a particular context?

- the **level of comfort** expected within each context

- **Design issues** related to the specific context.

- The probable age groups at different contexts.

- type of a bag one carries, and the probable manner of carrying the product within the particular context?

- The **Intensity of requirement** of the product within the particular context.

THE CONTEXT :

- **Core user** : Daily office going train commuters.
- **Micro environment** : Railway Platform

Followed by the user study, the context was further refined to the age segment of:

- **Age segment** : 40 to 60 years.

- **Probable Secondary Mass Users :**

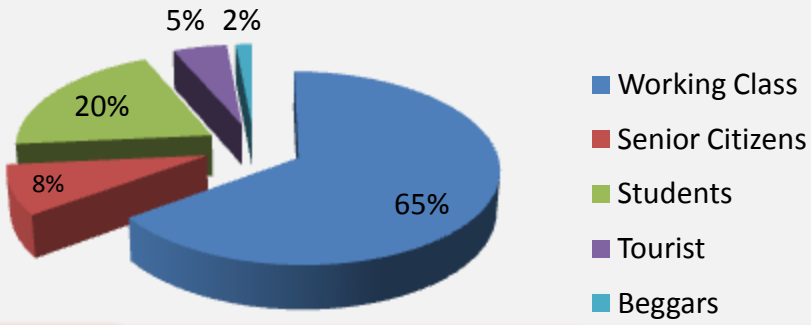
-Long distance travelers *(e.g. Mumbai to Pune – General Class)*

-Daily commuters (non-office timings) in trains.

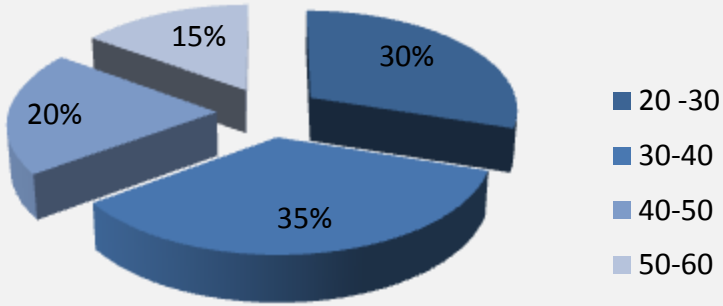
-Trekkers

DATA COLLECTION :

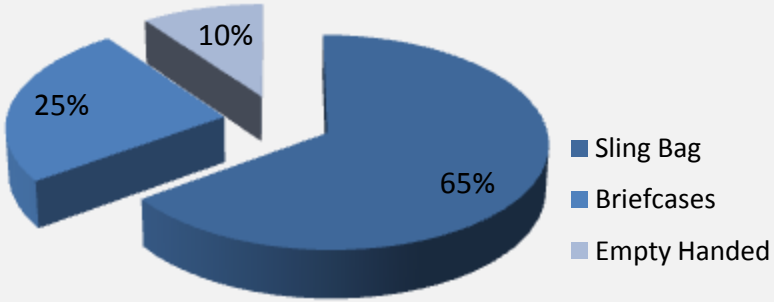
Population Bifurcation – Indian Local trains



Age Segment Bifurcation:



Age segment 40- 60. What they carry:



USER STUDY :

Stage A: User Feedback

User study - directed towards :

- Requirement of the product.
- Problem identification.
- Types of people commuting.
- Behavioral pattern of the commuter.
- User insight.
- Crowd density.

USER STUDY : Stage A**:**

Questionnaire:

Name- **Age-** **Occupation-**
Gender- **Date-**

- What is the **maximum time limit** to which you can **stand continuously within a stationary system?**
- What **distance** do you commute daily?
- What can be the **convenient weight and size** for a portable seating device within your context?
- What can be the **worthwhile price** for a portable seating device within your context?
- What is the **preferable minimum time** that is required to open and retract the product?
- To what **level of comfort** is expected by you during travelling in realistic terms?
- What would be your likable **anticipated image** about the product?
- How would you **prefer to carry** the product? - *(in a hand bag, sling bag, carry as a sling, etc).*
- Would you face any **social influences** while using this product?
- Are you **aware of any similar products**, and if yes, why don't you use it?

USER STUDY : Stage A**:**

User Feedback Statistics:

2	Name	Sex	age	standing(hr)	sitting (hr)	weight (gms)	size (ft)	price	level of comfort *(1/10)*
4	Pravin . T	m	24	1	6	1000	1	1300	4
5	Soli	m	54	1.5	2	500	1.5	1000	4
6	Dilshad	f	52	1	2.5	500	1	250	5
7	Homi	m	85	0.2	0.2	250	1.5	250	6
8	Laxman	m	25	1	3	700	2	400	5
9	Sangeetha	f	39	1	2	500	1.2	450	6
10	subhash	m	42	2	4	700	1.5	175	4
11	kunal .m	m	56	0.5	1.5	450	2	250	6
12	Vinayak	m	38	1.5	2.5	500	2	550	5
13	kirti	m	31	2	4	600	1	900	6
14	Shrushti	f	32	0.5	2	450	1.5	600	6
15	Jeetendra.G	m	28	2	5	650	1	300	4
16	Jatin .s	m	31	2	5	600	2	400	5
17	Kumar.G	m	53	0.3	2	600	1.5	300	7
18	br	m	50	4	8	500	1	200	4
19	Sadashiv	m	52	2	3	1000	1.5	100	5
20	Ajay	m	32	1	1.5	500	1	300	5
21	Neeta	f	27	2	0.5	500	1	200	7
22	Nargis	f	75	0.2	1	300	1.5	300	7
23	Perin	f	78	0.2	1	300	1.5	250	5
24	Hoshi	m	53	0.5	2.5	550	2	475	5
25	Zaver	f	25	0.4	1.5	400	1	400	5
26	Anshul	m	38	1.5	2.5	500	1.5	350	5
27	Sanjay	m	45	1.5	2.5	600	2	400	6
28	**Avg.**	**.....**	**44.4**	**1.2**	**2.7**	**547.9**	**1.4**	**420.8**	**5.29**
29	**Avg. Deviation**	**.....**	**12.98**	**0.69**	**1.16**	**104.76**	**0.29**	**147.47**	**0.74**

USER STUDY : Stage A**:**

Additional Feedbacks :

• **Time factor**: operation time limit of approx. **10 seconds** with least no. of operations. *(Preferably 2 nos.)*

• **Likable anticipated image** – a bunch of sticks that can be collapsed together like an umbrella, and a few mentioned the analogy of a laptop, which is flat.

• The preference of the **manner of carrying** – almost all preferred to carry it within their bag.(either sling bags or briefcases).

• **Social influences** –did not have any external social influences to initiate the use of such a product, *older age segment showed some hesitation for the initiation of the usage of such a product.*

• **Awareness of similar products** – '**yes**' almost all were aware,
but were reluctant to use – not as small as required.
- heavy for the context.

USER STUDY :

Stage B:

Personal Observations and role playing:

The Observations were directed towards:

- The types of people within the context,
- Their corresponding crowd density variation at different hours of the day,
- What they carried along,
- Their behavioral pattern.

USER STUDY :

OBSERVATION:

Type of User Observed:

Office going - average income groups,
age -40 to 60 years, - loners and in groups.

Probable timing of their high density at the railway platforms – 7.30am to 10am, and 4.30 pm to 10 pm.

What they Carry:

- Almost all with bags,
- 23 percent of the people carrying briefcases.
-tiffins, and other daily usable utilities, few office documents, napkin, books to read, newspaper,
-some carry playing games like cards etc.
-Many of them had a sling mobiles in the front pocket rather than the pant pockets.

Behavioral Pattern:

-almost all avoided sitting on the existing metal seats.
- were in groups, and knew each other well.
- had fixed compartments
- people in groups would sit on the briefcase and chat, while the loners somehow avoided sitting on their briefcases.
- this age segment preferred to reach the platform approx. 10 to 15 minutes before the train arrival.
- used handkerchief very often.

PRODUCT BRIEF :

- **Statement:**

  To design a portable stool for the daily train commuter of office going class for the age segment of 40 to 60 years at railway stations.

- **Brief:**

  Collapsible and **highly compact** on retraction.

I.e. **Optimum ratio** of physical spaces occupied.

Shall provide instant **seating facility** at the **users will.**
Time taken to open and retract must be minimal *(approx. 5 to 8 sec.)*

Must be **non-robust** and **form sensitive** too.

It must have an influence on the buyer by any **interesting feature** in design or operation.

The product must fit in a normal carrying bag

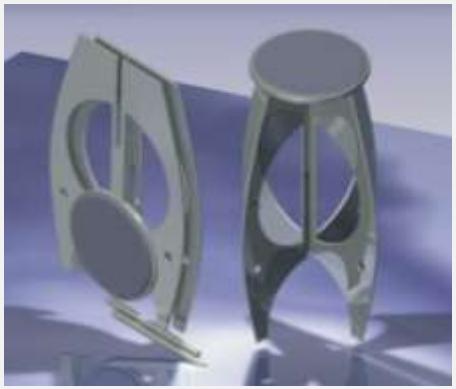
must be **free from any sharp edges**, projections or protutations to avoid hurting others in the train while carrying and travelling.

PRODUCT BRIEF :

- **Product Facets / Mandates :** *In priority ranking :*

1. Stability:
2. Lightweight
3. Load bearing capacity : 90 – 100 kg.
4. Size
5. Easy to maneuver – i.e. least no. of operations.
6. Optimum ratio of physical spaces in both states..
7. Safety Criteria
8. Interesting feature of influence.
9. Appropriateness

IMAGEBOARD :



IMAGEBOARD :














IDEATION & EXPLORATIONS:

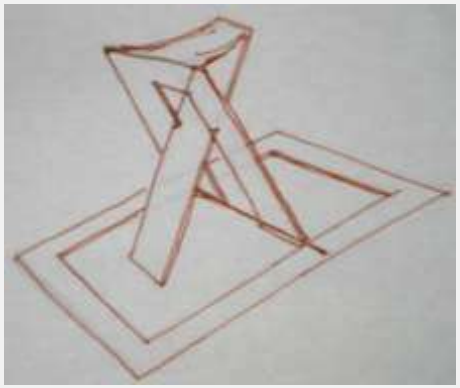
Explorations were earlier carried out towards two approaches:

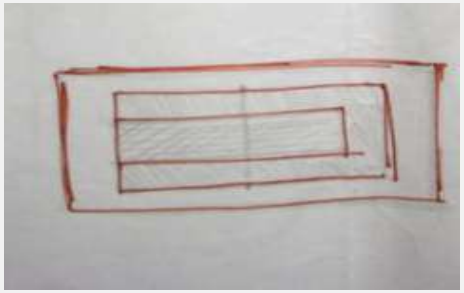
1. Flatness
2. Stick like

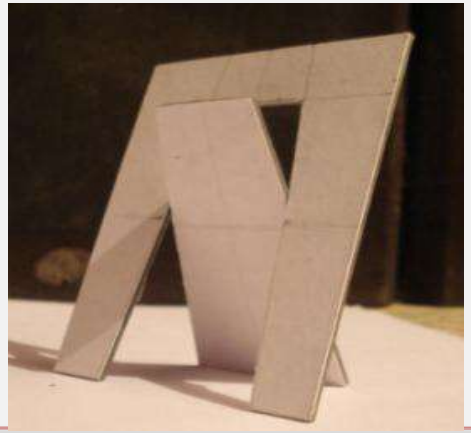
Later the approaches were further analyzed and the stick or pipe like form was developed.

IDEATION & EXPLORATIONS:

1







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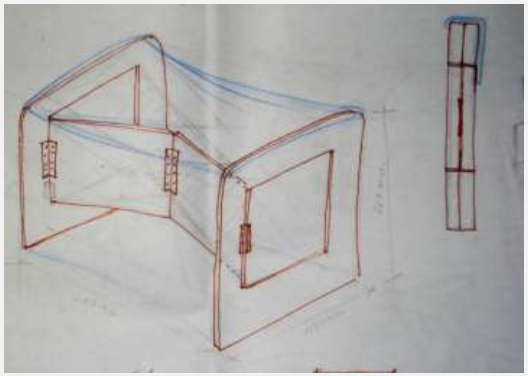

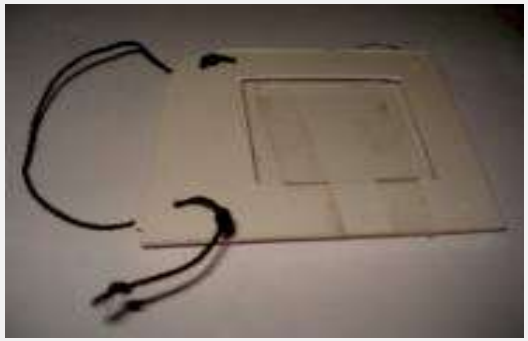

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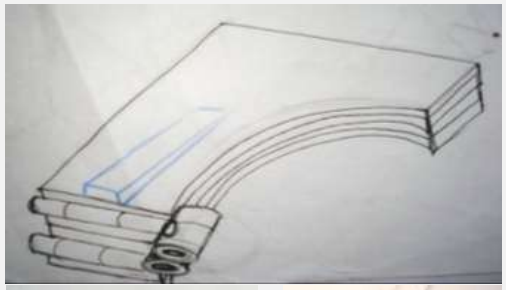
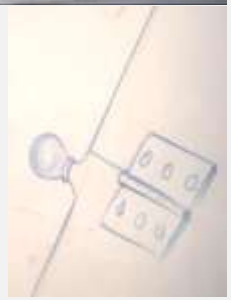
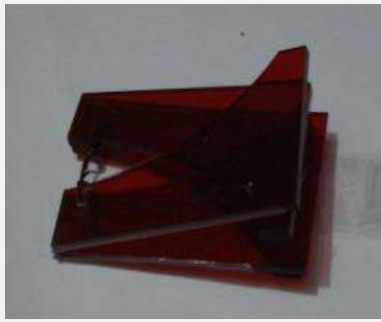
IDEATION & EXPLORATIONS:







Exploration Feedback :

Disadvantages like:

- demanded more material
- decrease in strength
- inverse increase in weight.
- called for many advanced materials like C.F.R.P., G.R.P. in high amount.

Hence it was concluded :

second approach – *(stick like)* would be preferable.

CONCEPT GENERATION :

APPROACH:

- Formal aspects of the product,

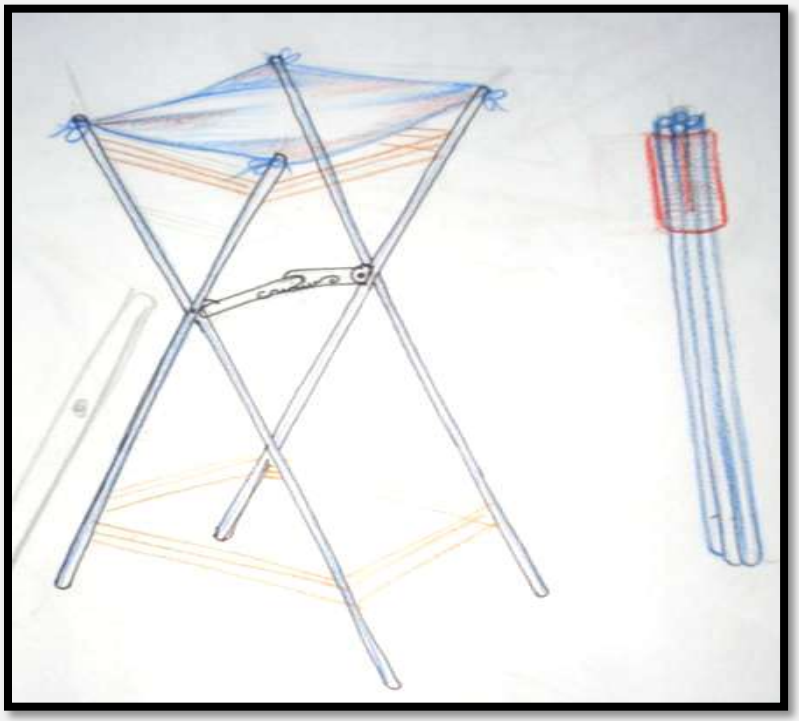
- Structural system, joinery possibilities, material possibilities, & geometry.

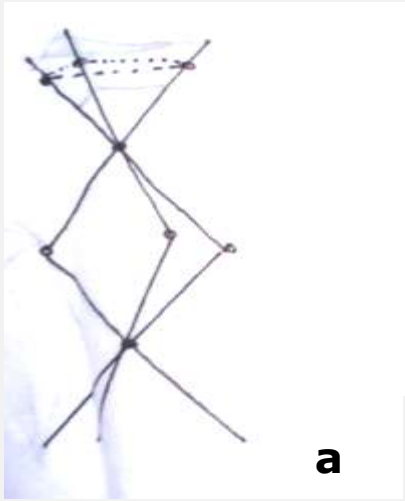
CONCEPT 1:

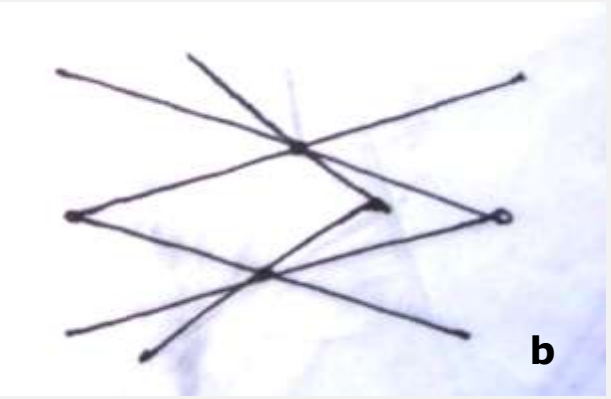
Cluster 1

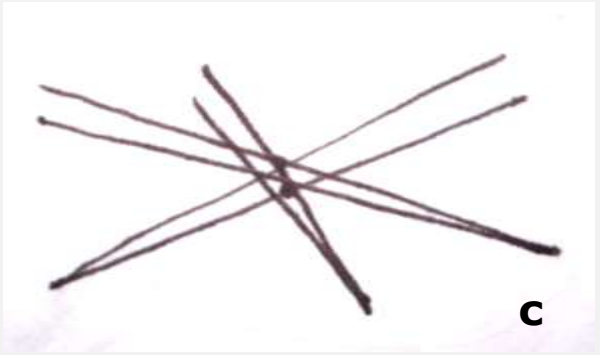
Bend Pipe / Stick : Here all the designs may have inherited a complexity in structure but **were all bend pipe formations** which would decrease the eventual selling price.

CONCEPT GENERATION :









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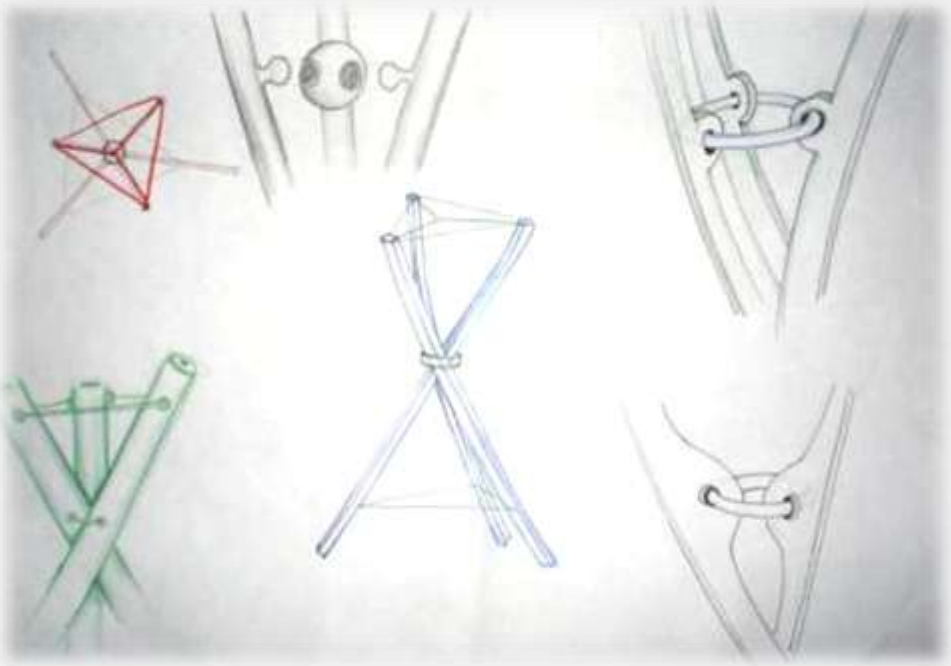

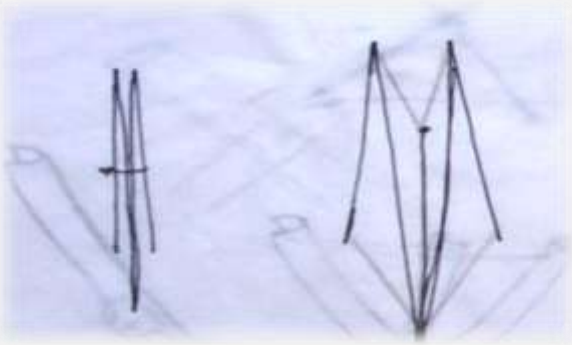

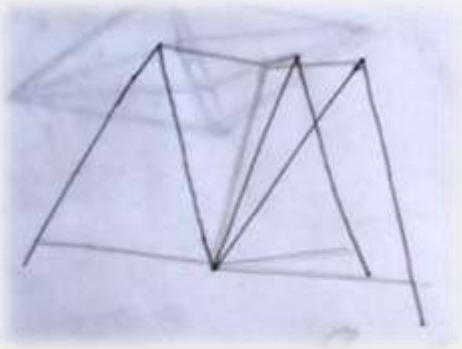

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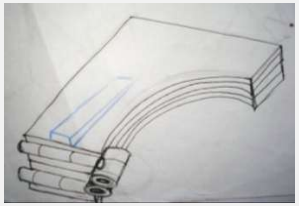

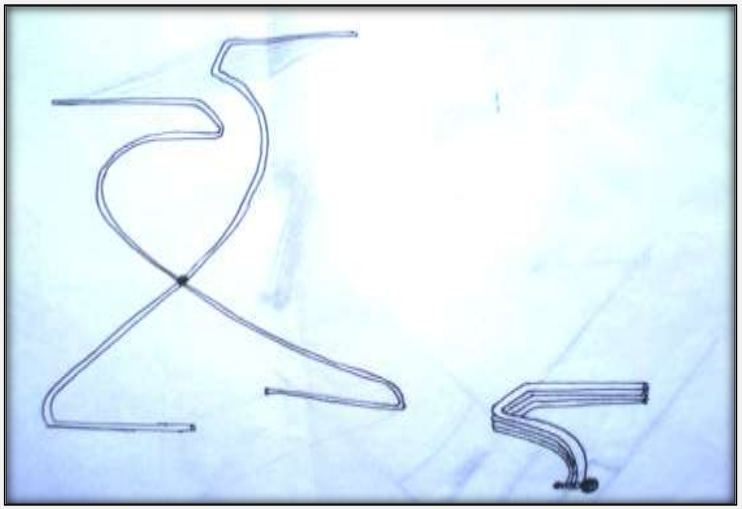

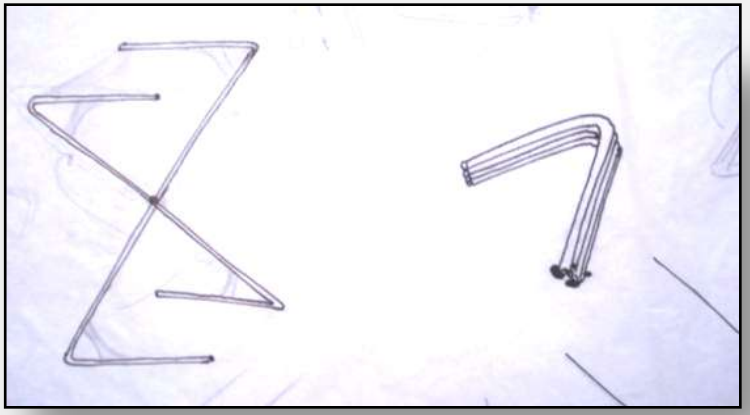

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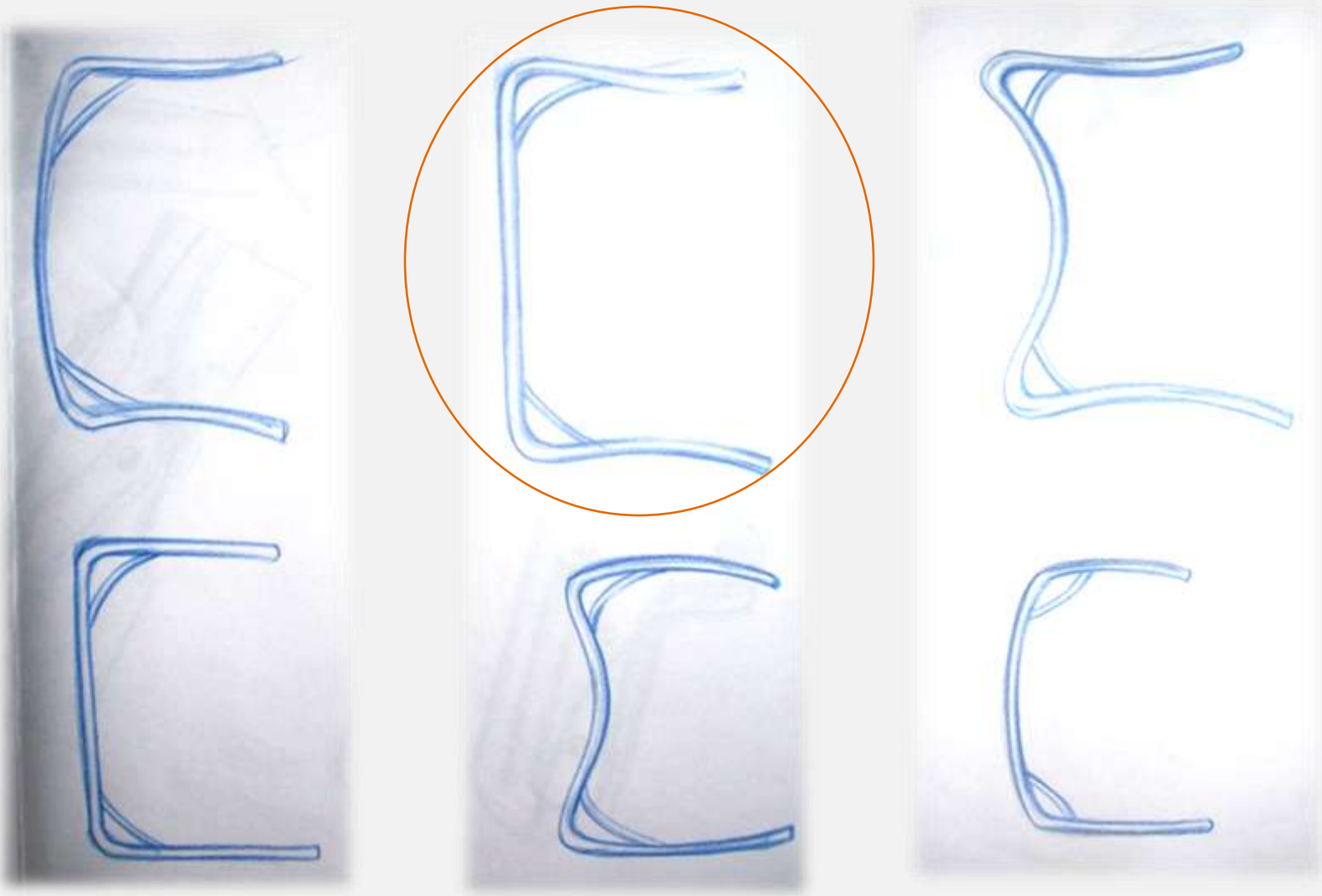

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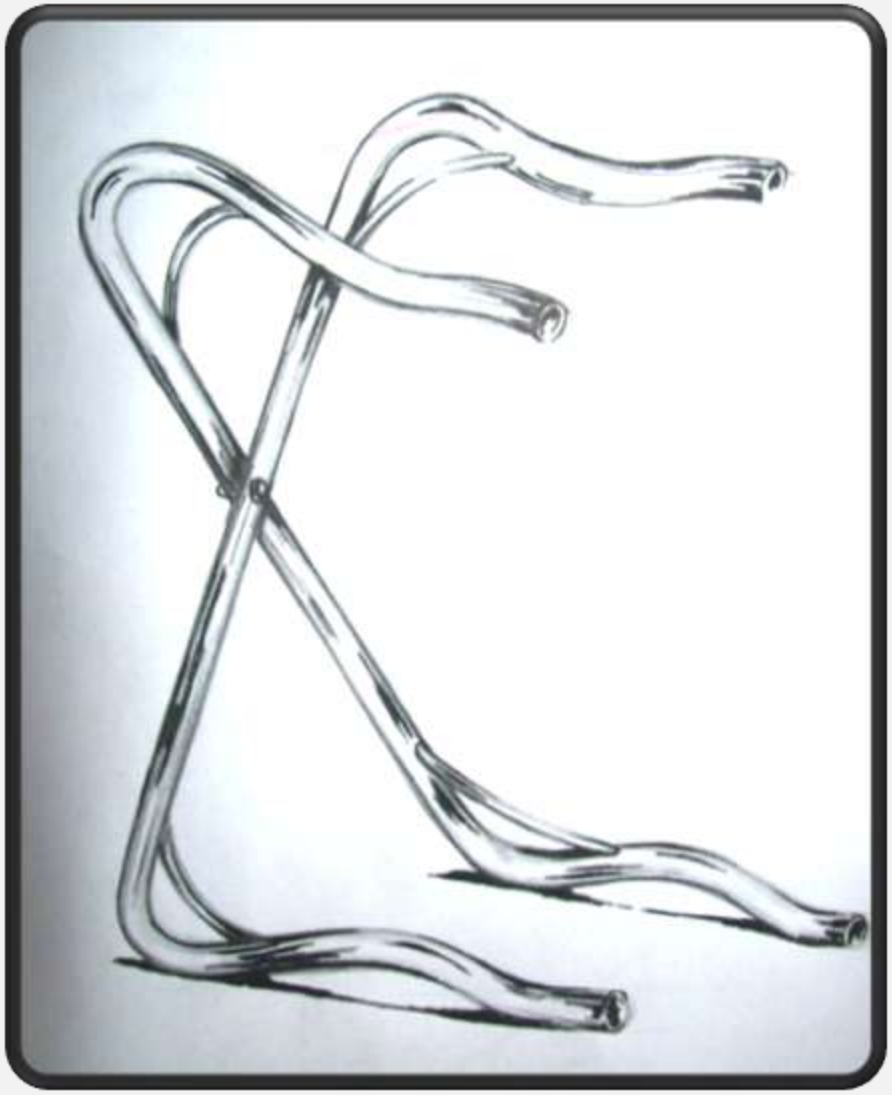
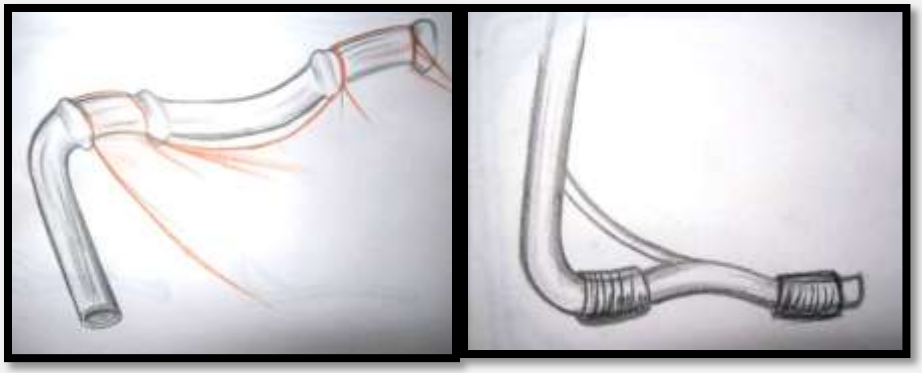




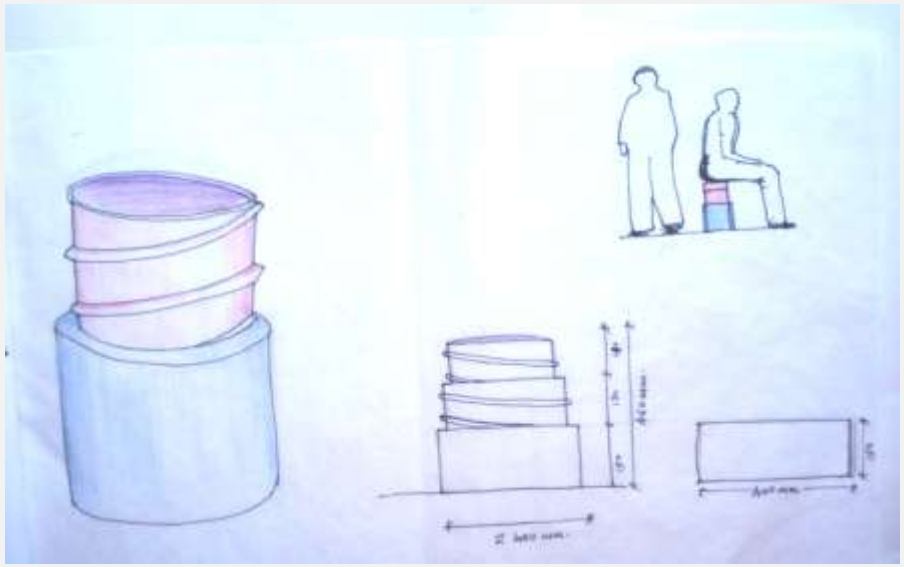
CONCEPT 2:

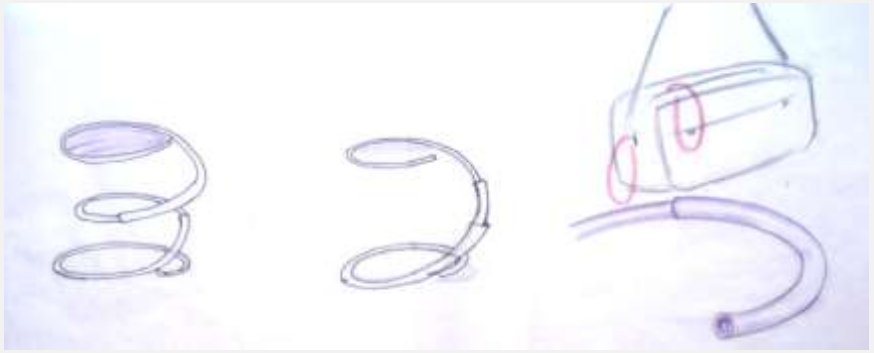
Cluster 2.

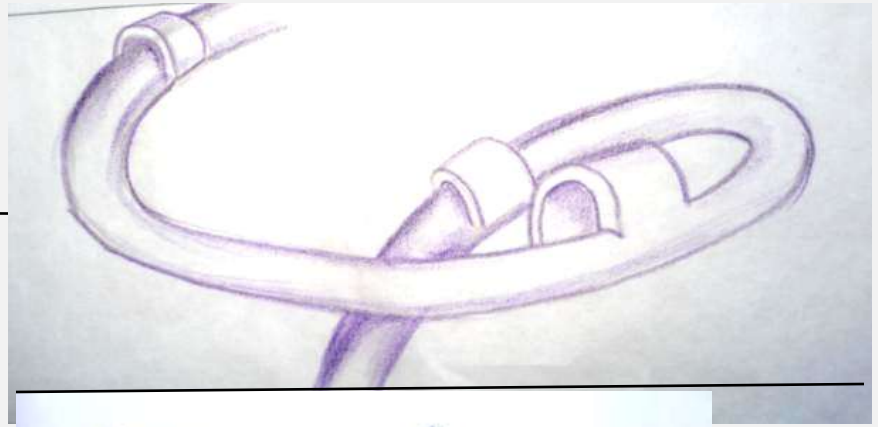
Significant Operating Systems:

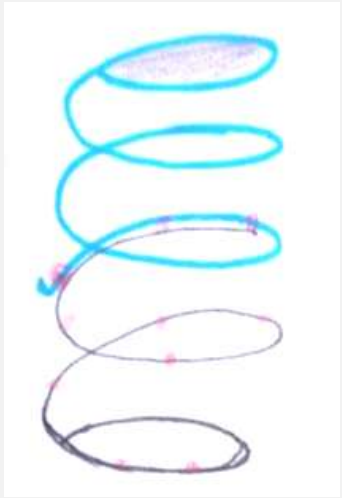
This was a cluster which had all designs oriented towards significant operating systems.

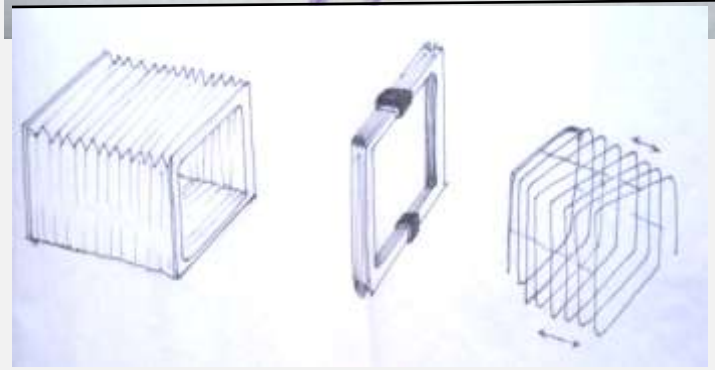
CONCEPT 2:



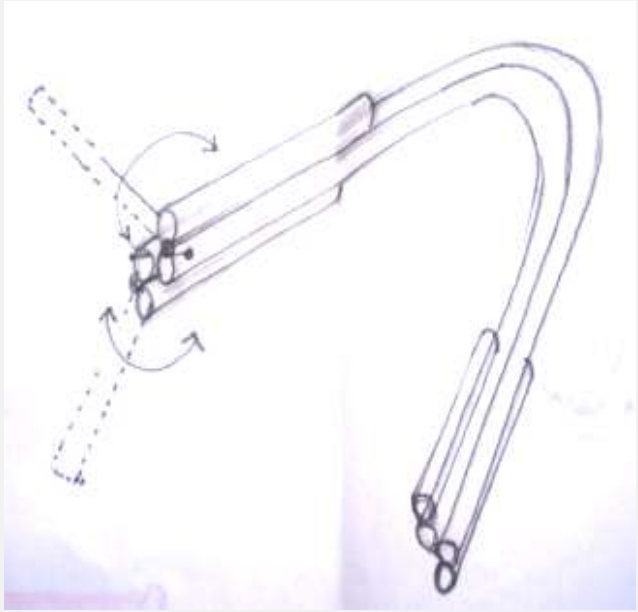


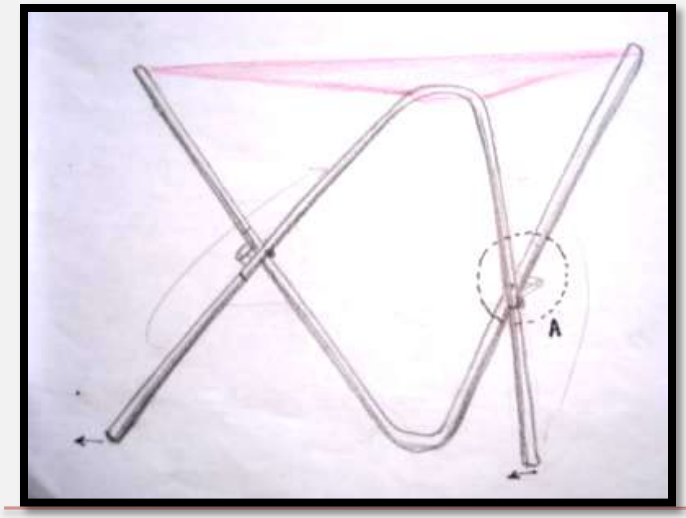


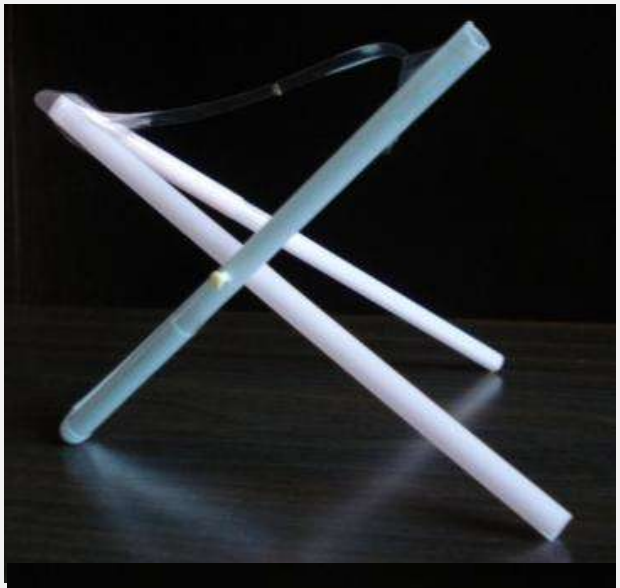


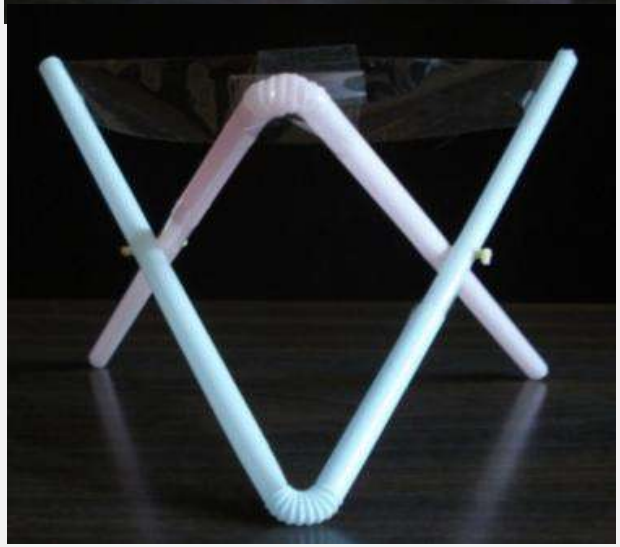


CONCEPT 2:

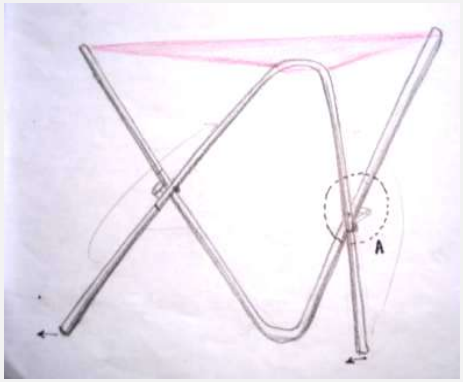








CONCEPT 2:



CONCEPT 3:

Cluster 3.

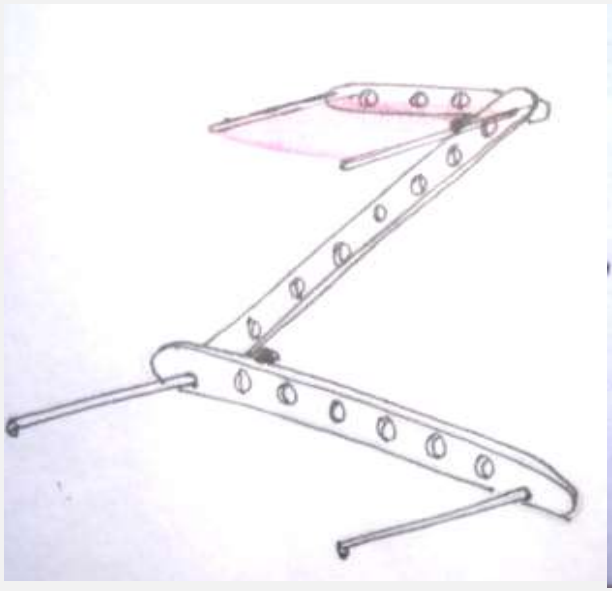
Flange plate – self Locking System:

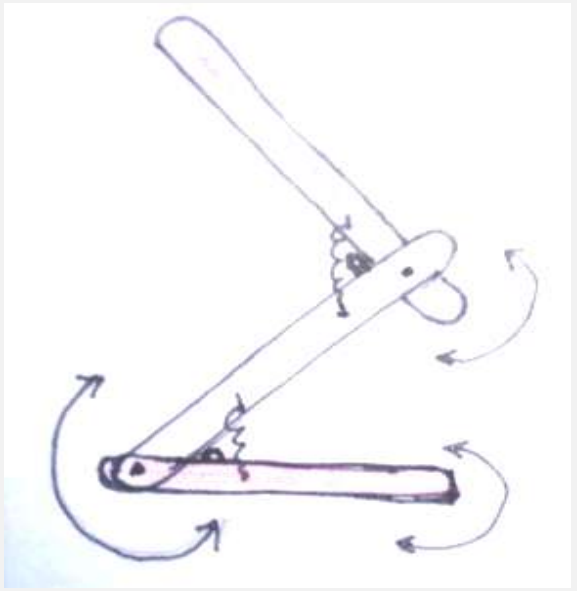
This cluster comprised of a self locking system with use of flanges.

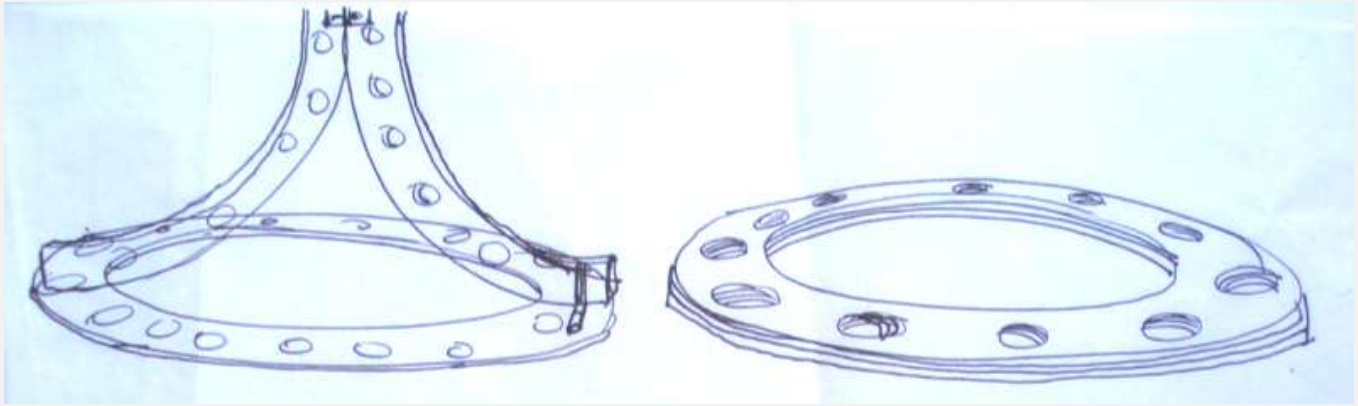
Later the concepts were refined to merge with the bend pipe elements.

The attempt was to generate a self locking system where the same elements of support fold and unfold to lock itself just by changing their orientations.

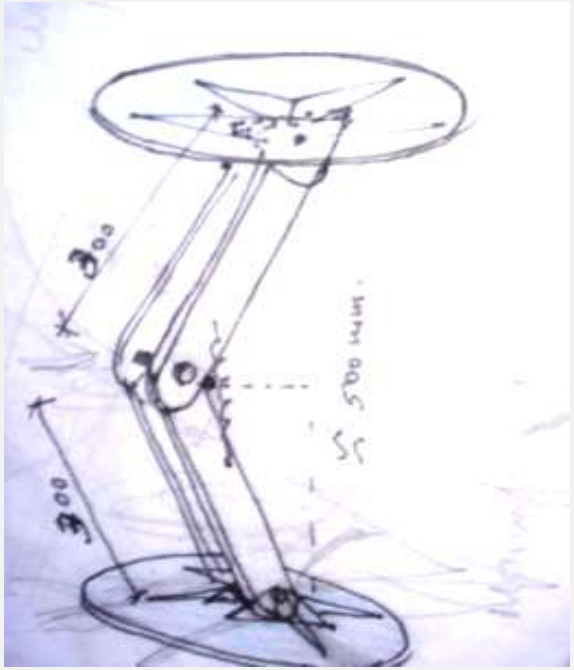
CONCEPT 3:

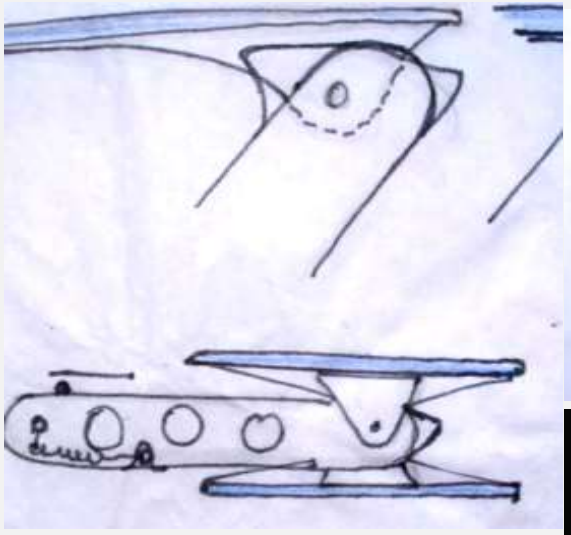


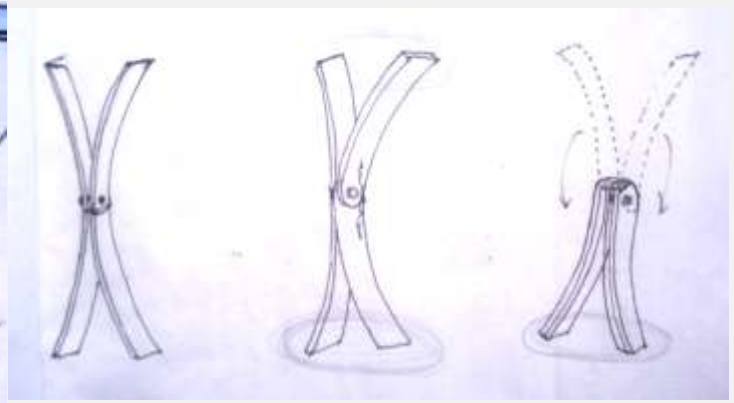


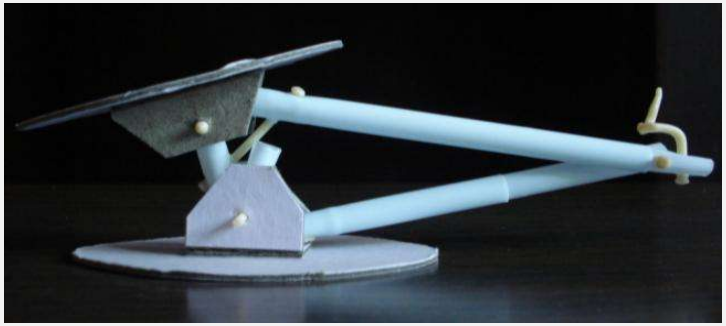


CONCEPT 3:

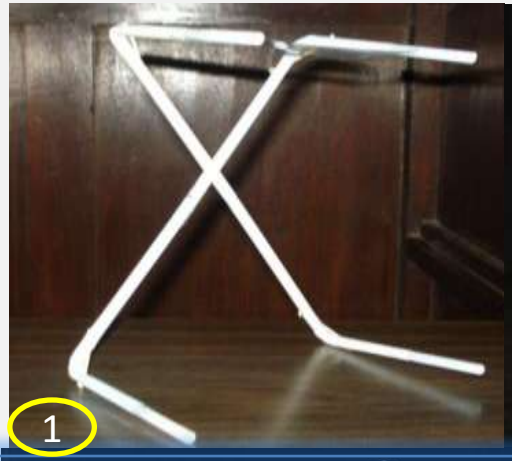


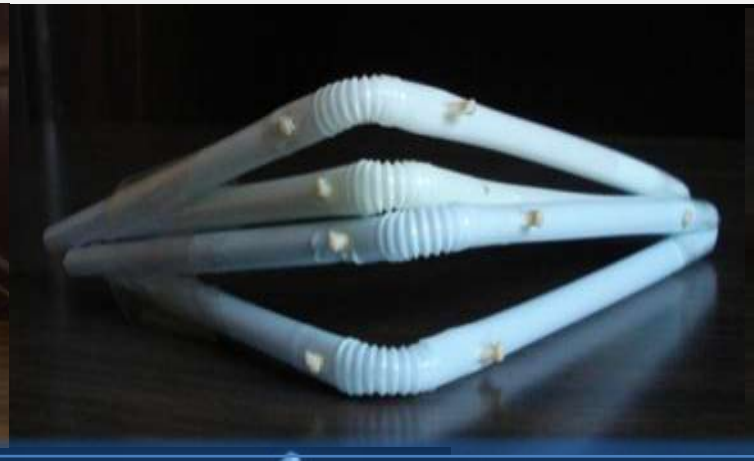






FINAL CONCEPTS:





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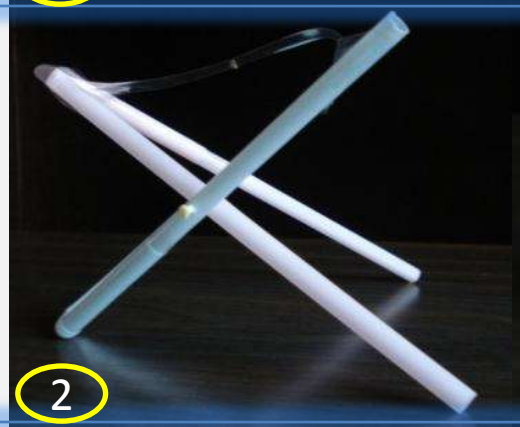

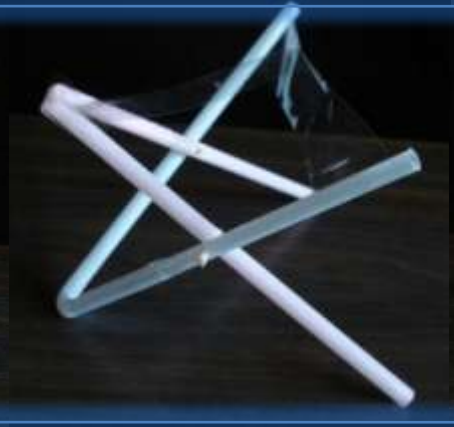

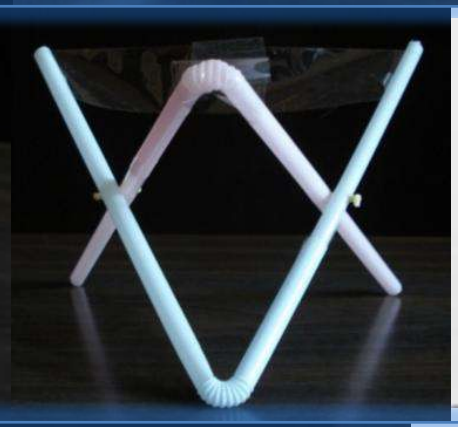

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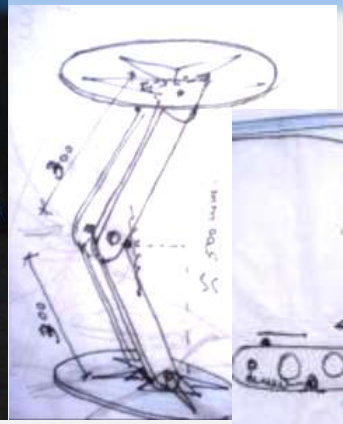
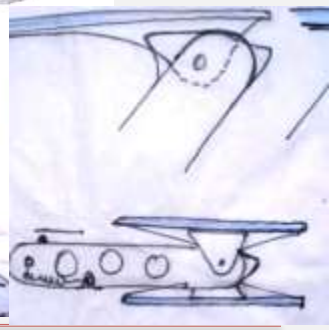


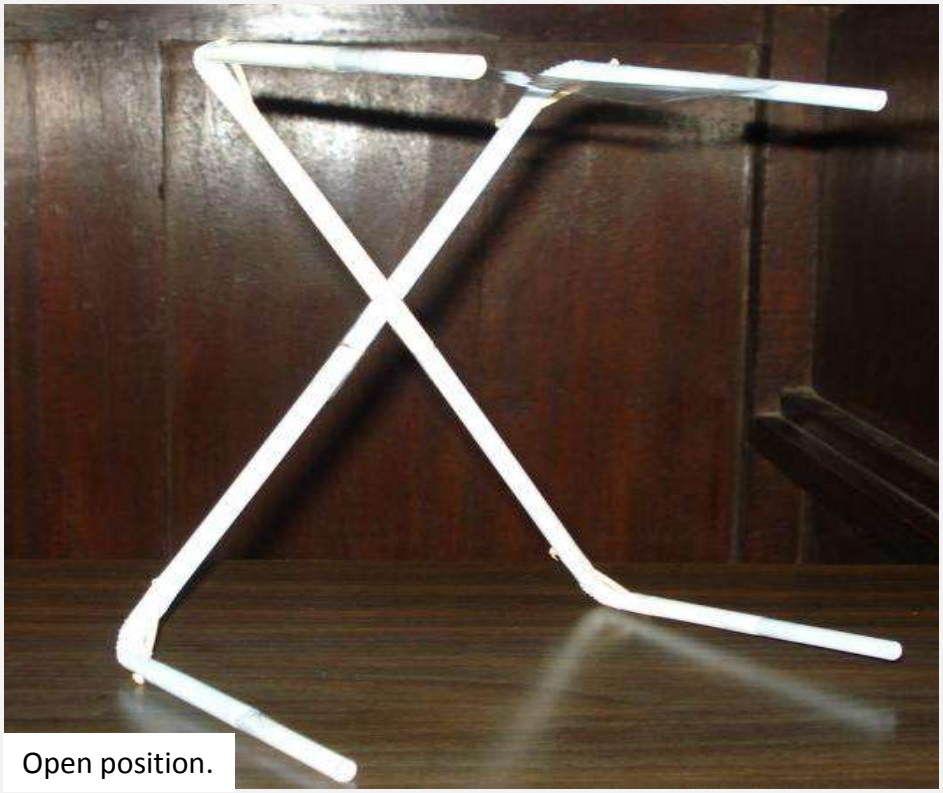


3

CONCEPT EVALUATION:

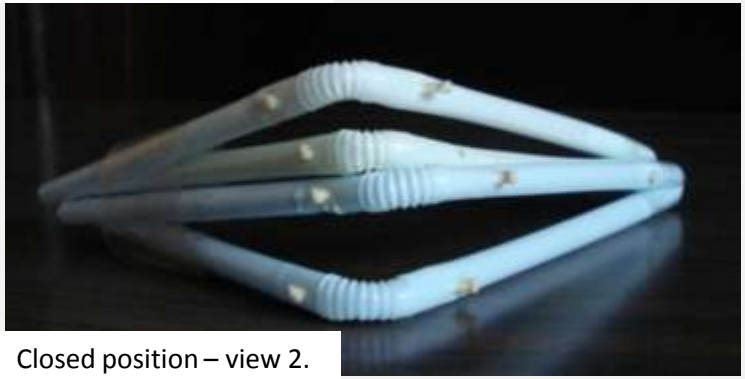
Concept.No	Stability	Self Weight	Weight Bearing Capacity	Size	Ease of Operation	Ratio of physical spaces	Safety Criteria	Interesting factor of Influence	Appropriateness	Total Value
Value Weightage	100%	90%	80%	70%	60%	55%	20%	40%	20	---
Concept1	70	50	60	90	60	90	60	70	80	**367**
Concept2	80	70	70	70	40	70	70	20	60	**344**
Concept 3	60	60	50	60	80	80	40	60	40	**326**

FINAL CONCEPT:



Open position.

Closed position - View 1

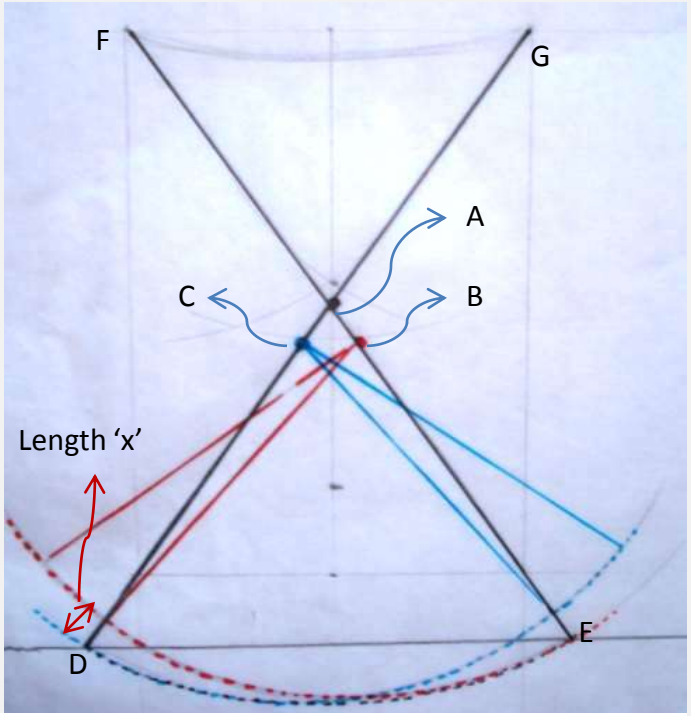


Closed position – view 2.

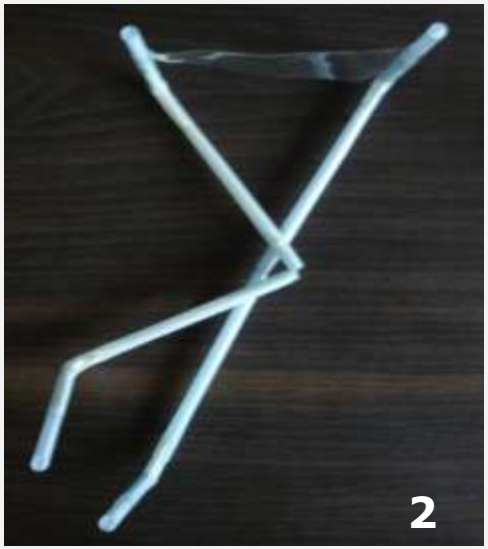
- **Core Benefits :**

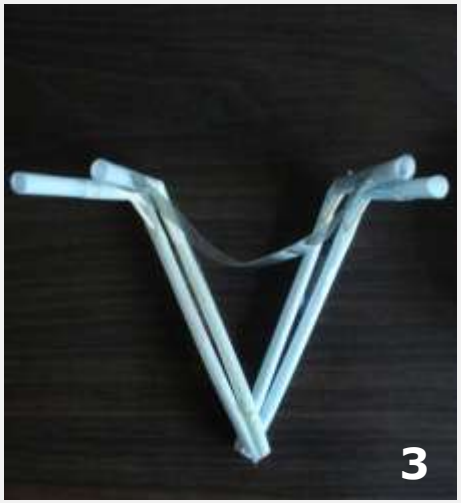
- **High ratio** between the physical spaces. *(in both positions)*.
- There is a **defined formal expression** in both positions.
- The **retracted 'L' form** suits the context best.
- Simple **bend pipes** used.
- The interesting **geometry** for operation.

GEOMETRY AND SEQUENCE OF OPERATION:

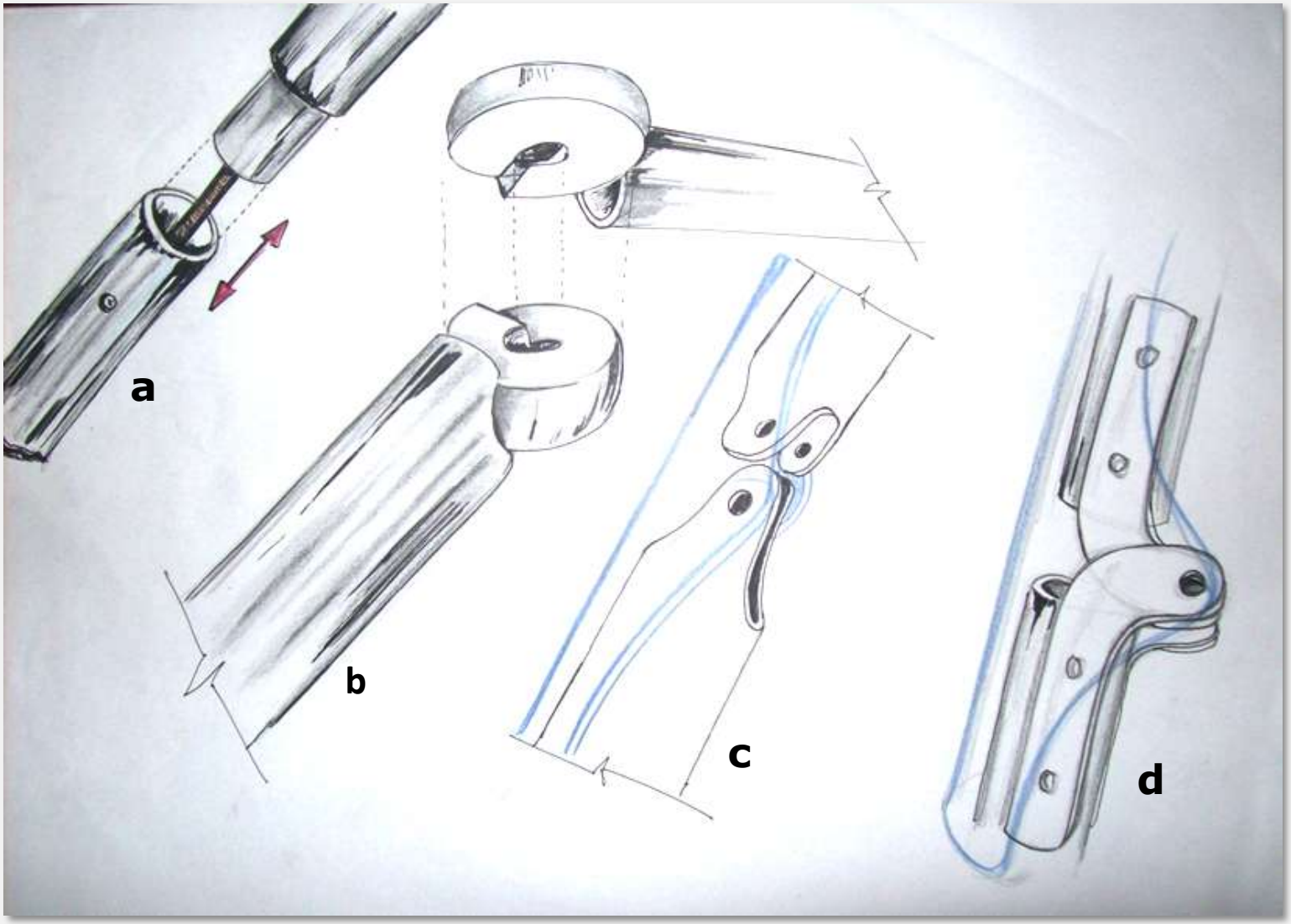


The geometry of front elevation.





JOINERY POSIBILITIES:

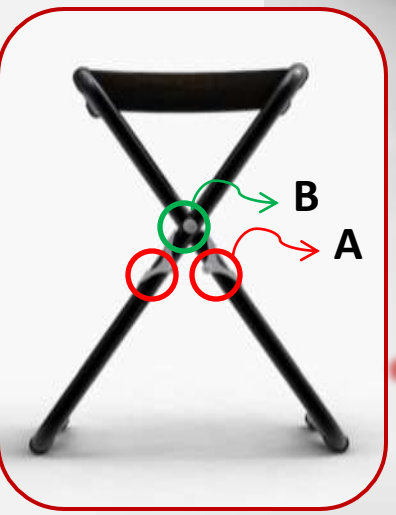


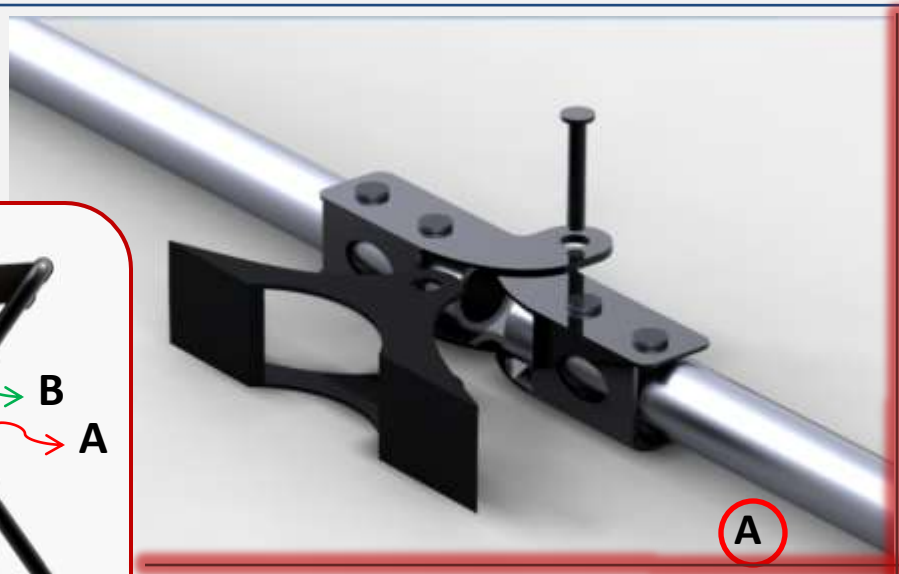
FINAL RENDERED IMAGE:

FINAL RENDERED IMAGE:

❑ Details:

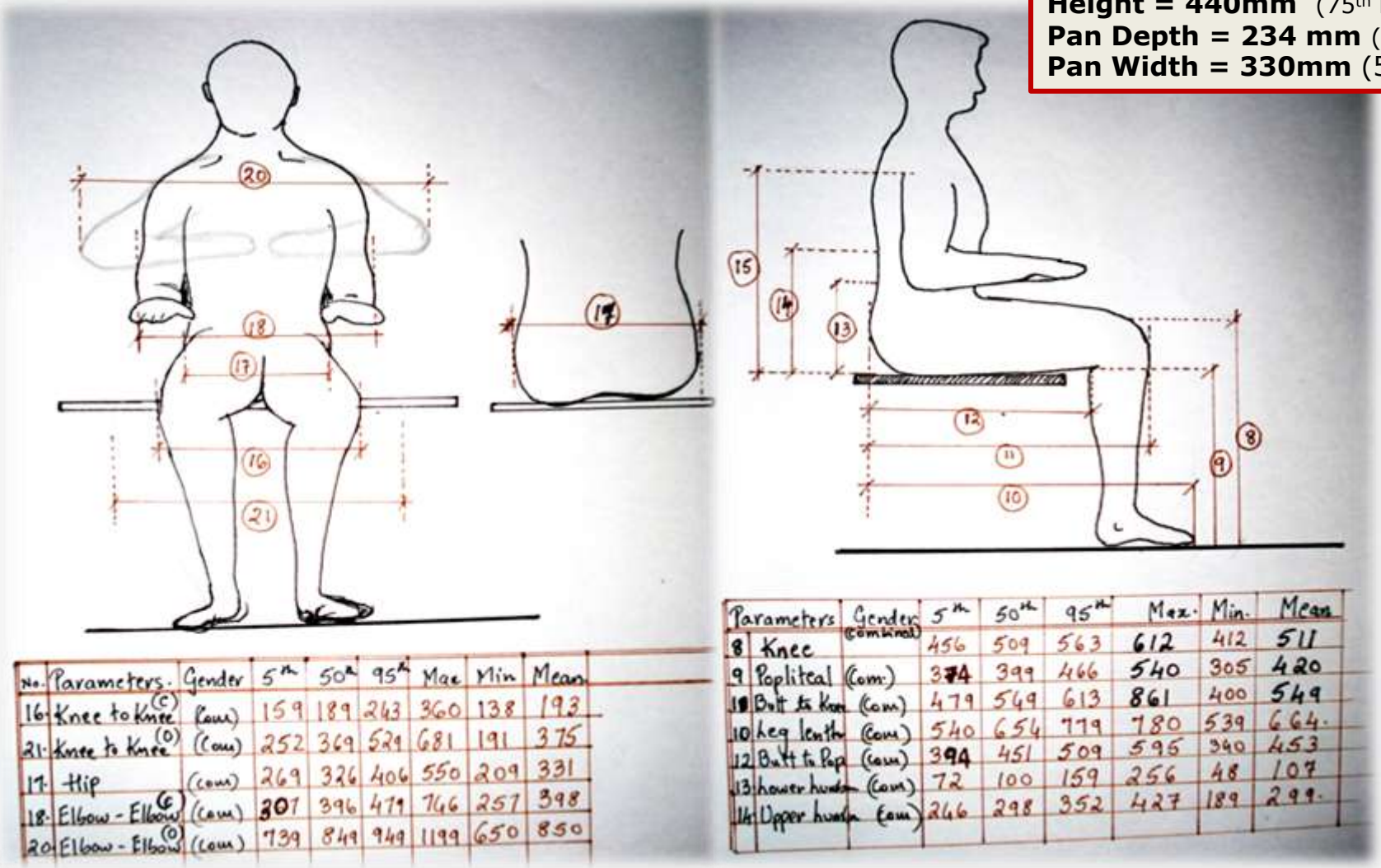
FINAL JOINERY DETAIL:





DIMENSION APPROACH :

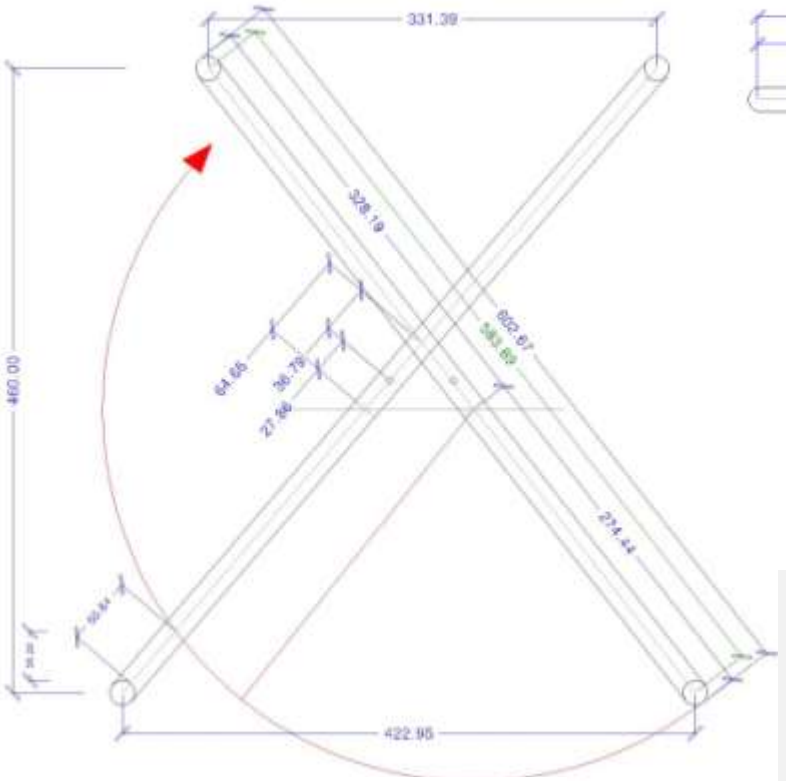
Height = 440mm (75th Prct.)
Pan Depth = 234 mm (1/2 of 50th)
Pan Width = 330mm (50th Prct.)



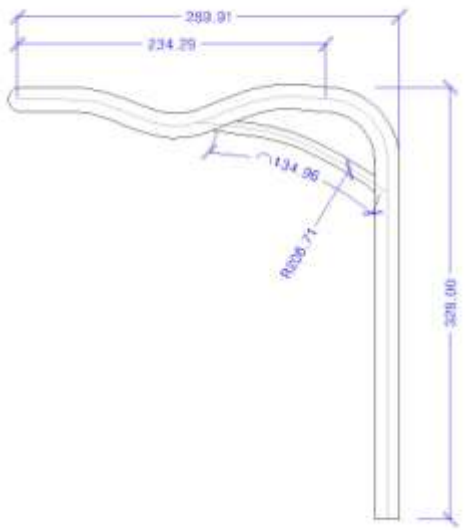
No.	Parameters	Gender	5th	50th	95th	Max	Min	Mean
16	Knee to Knee (C)	(com)	159	189	243	360	138	193
21	Knee to Knee (O)	(com)	252	369	529	681	191	375
17	Hip	(com)	269	326	406	550	209	331
18	Elbow - Elbow (C)	(com)	307	396	479	746	257	398
20	Elbow - Elbow (O)	(com)	739	849	949	1199	650	850

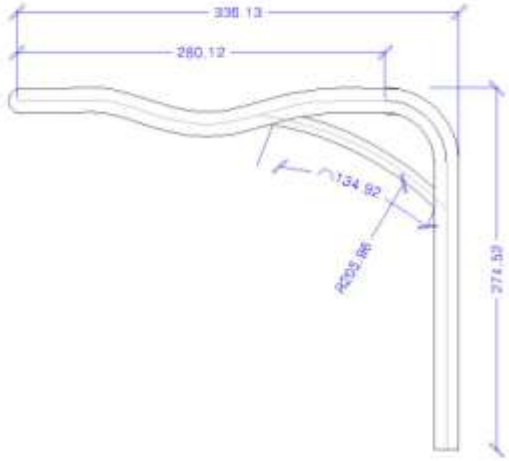
Parameters	Gender (combined)	5th	50th	95th	Max.	Min.	Mean
8 Knee		456	509	563	612	412	511
9 Popliteal	(com.)	374	399	466	540	305	420
12 Butt to Knee	(com)	479	549	613	861	400	549
10 leg length	(com)	540	654	779	780	539	664
12 Butt to Pop	(com)	394	451	509	595	340	453
13 shoulder height	(com)	72	100	159	256	48	107
14 Upper height	(com)	246	298	352	427	189	299

WORKING DRAWINGS:



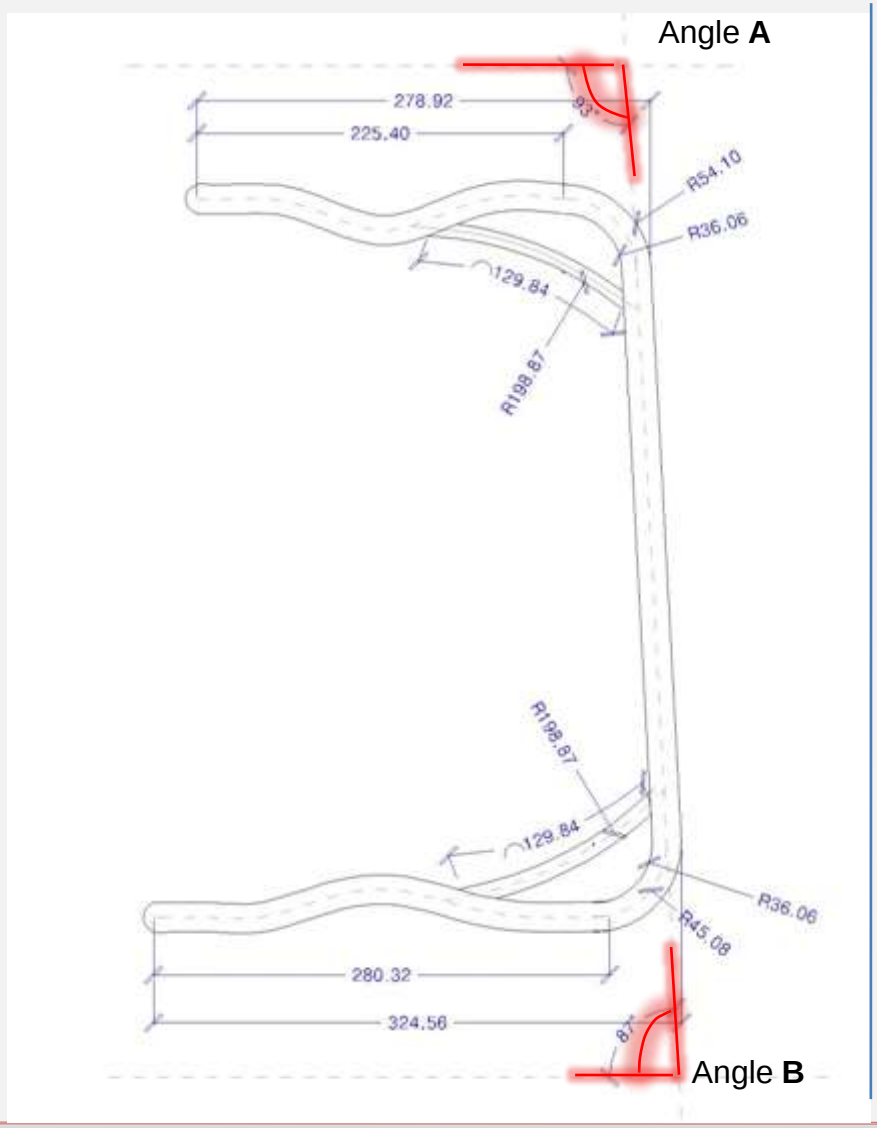
Front Elevation

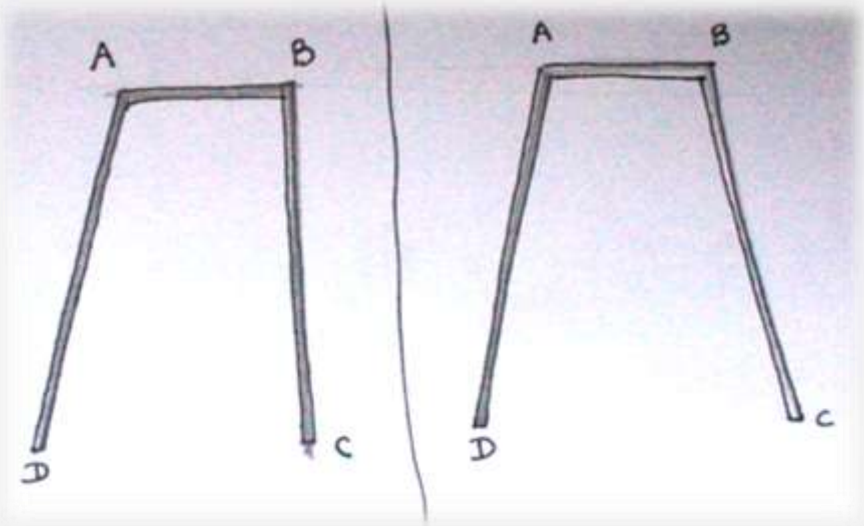




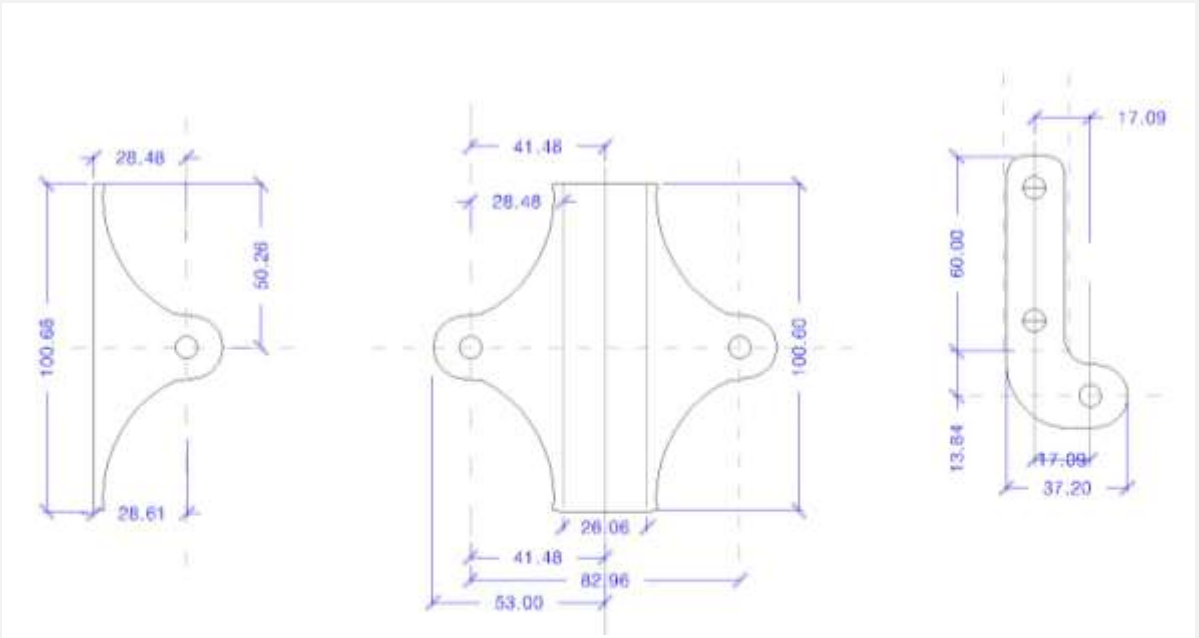
The two parts of a single arm support

WORKING DRAWINGS:

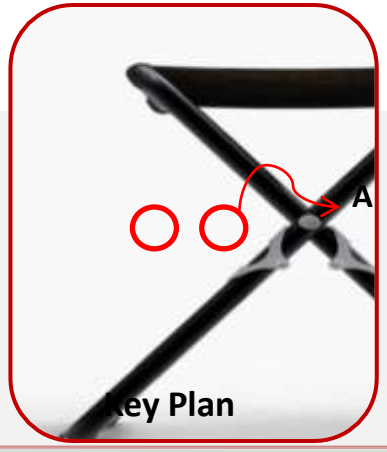


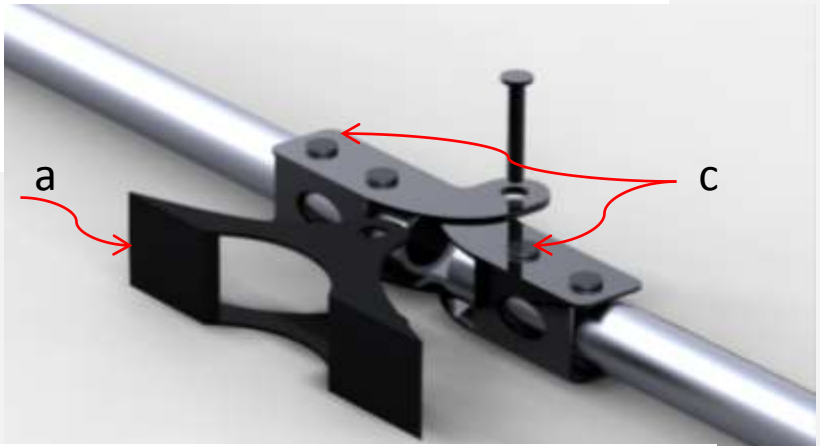


WORKING DRAWINGS:



Details of the clamp at point A :



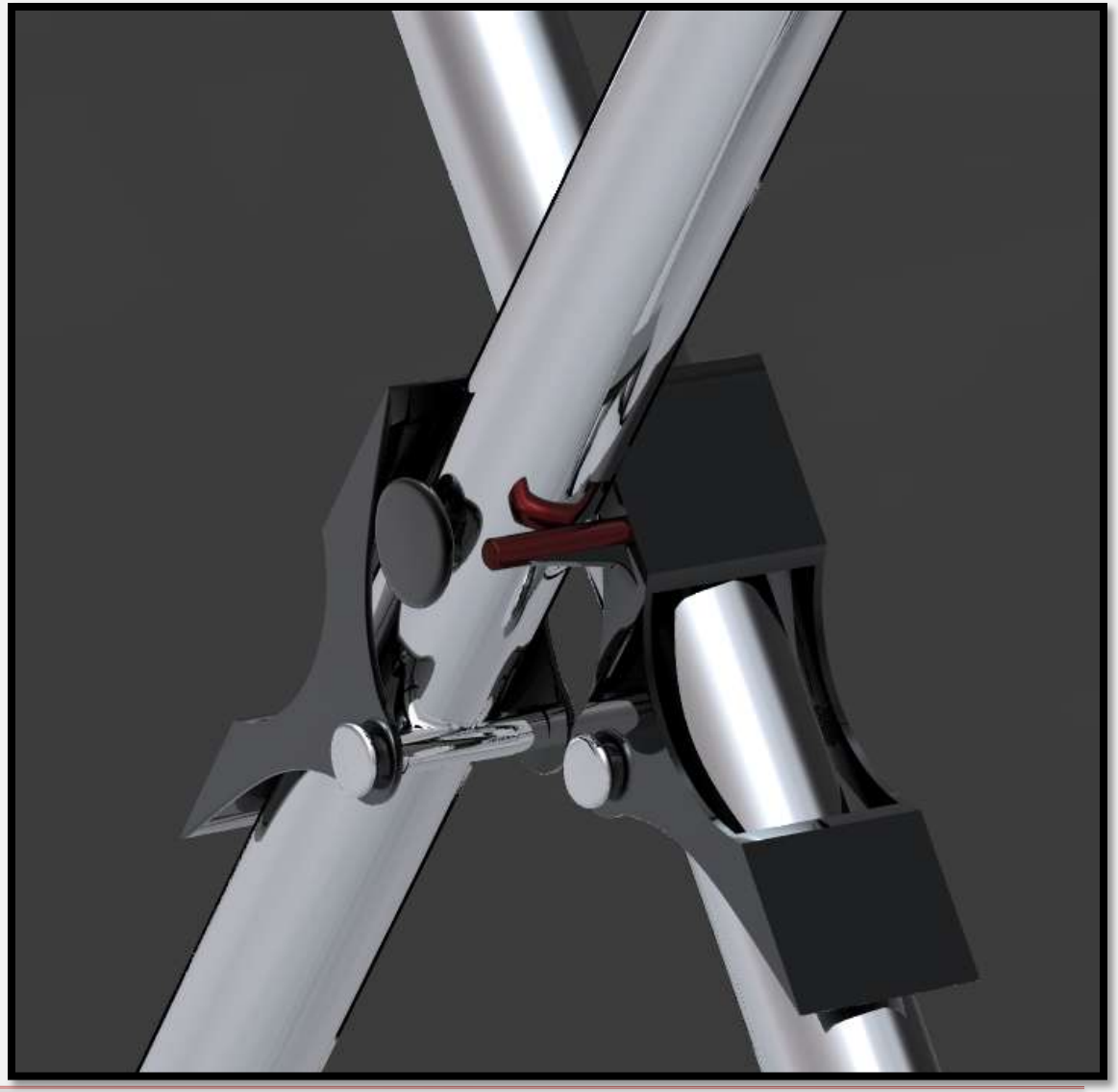


Detail assembly of the hinge joint at point A.

PROTOTYPE:

PROTOTYPE :

FEEDBACK :



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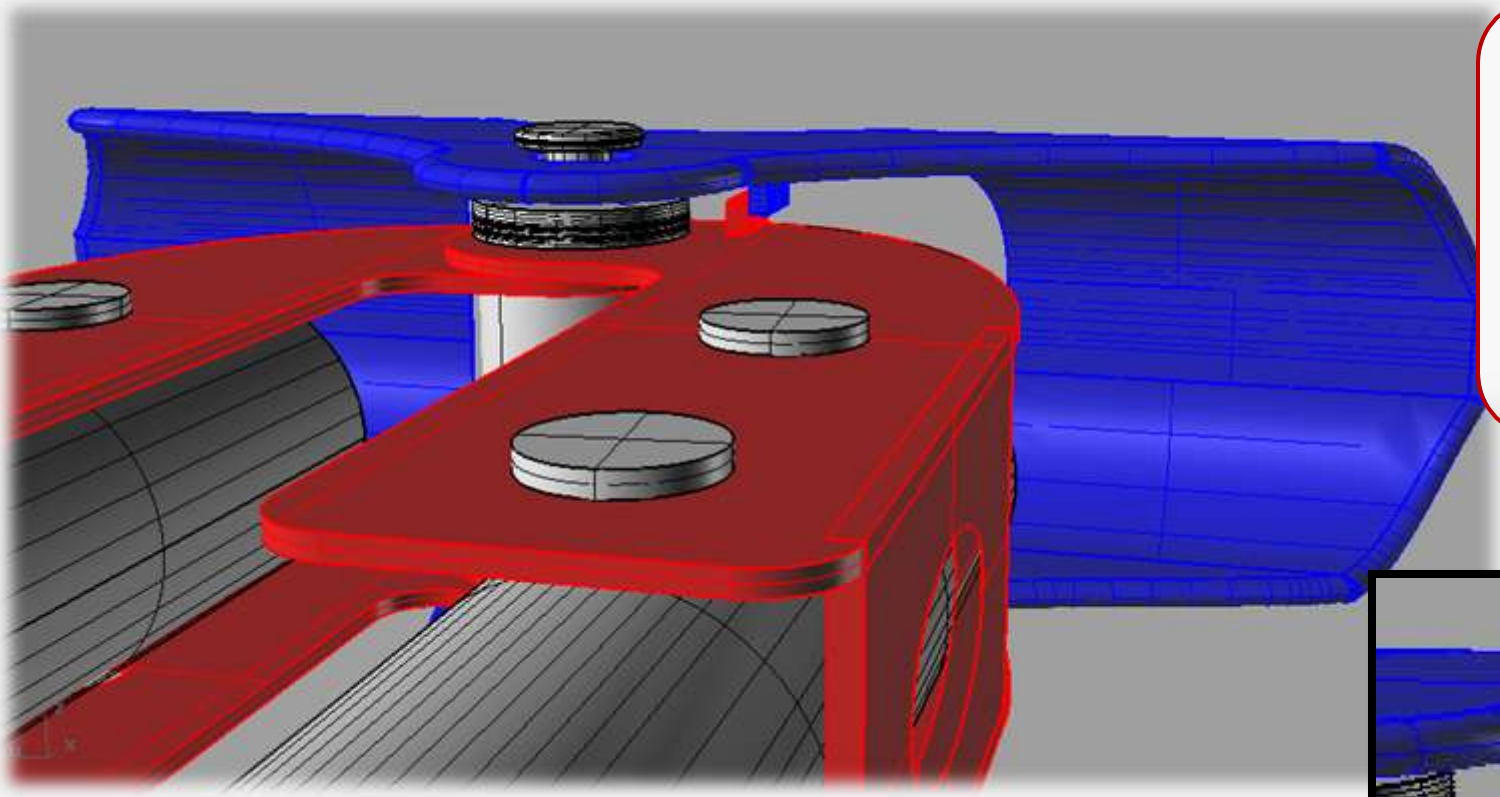
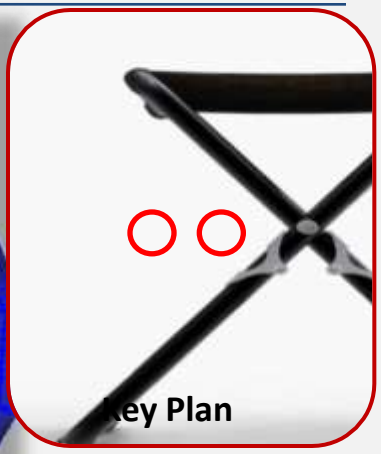
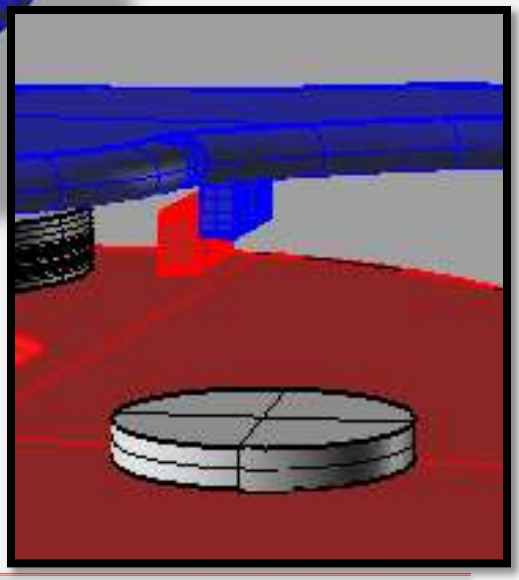




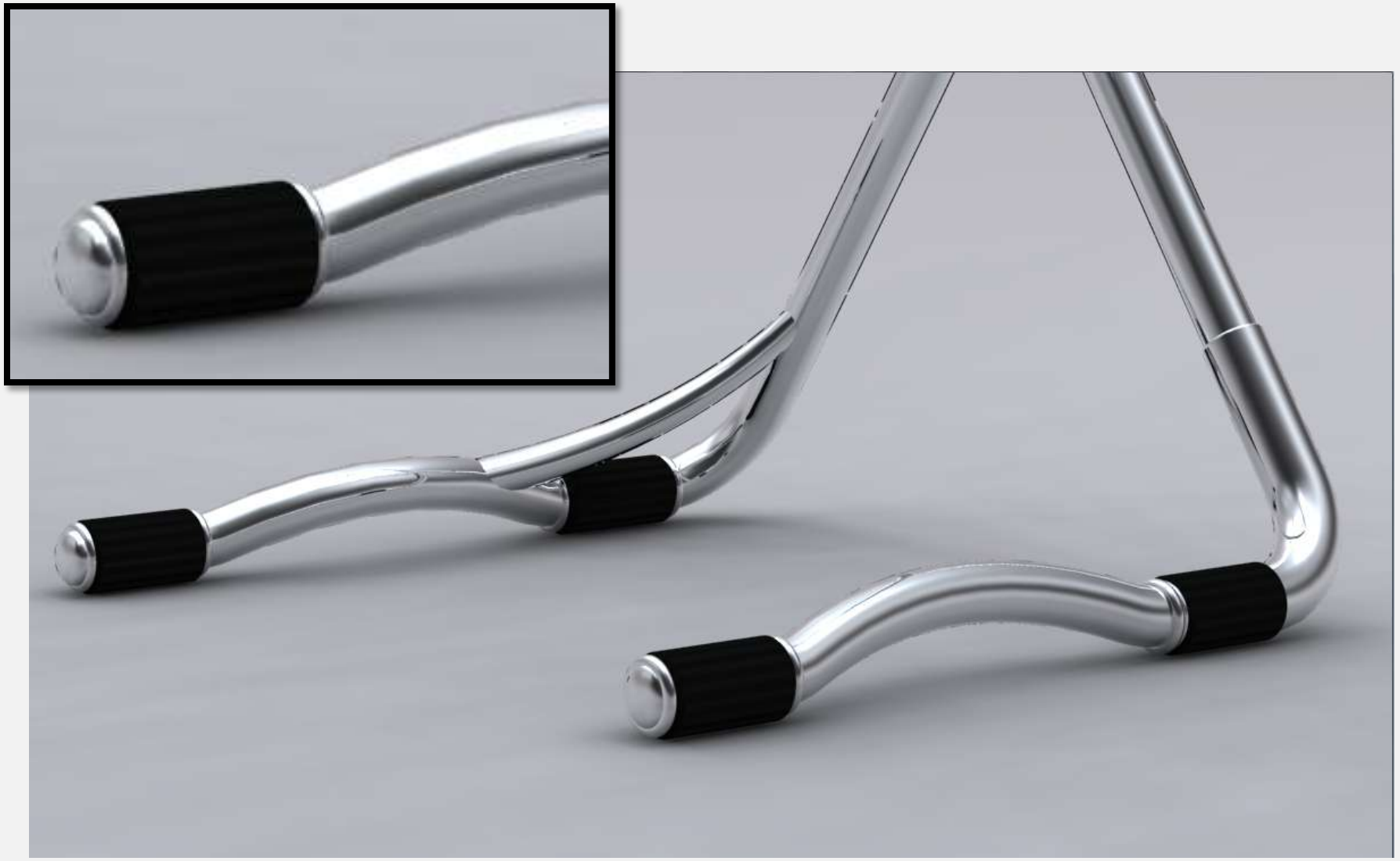


Detail at Hinge Joint

FEEDBACK :

FEEDBACK :

FEEDBACK :



PROBABLE MATERIALS:

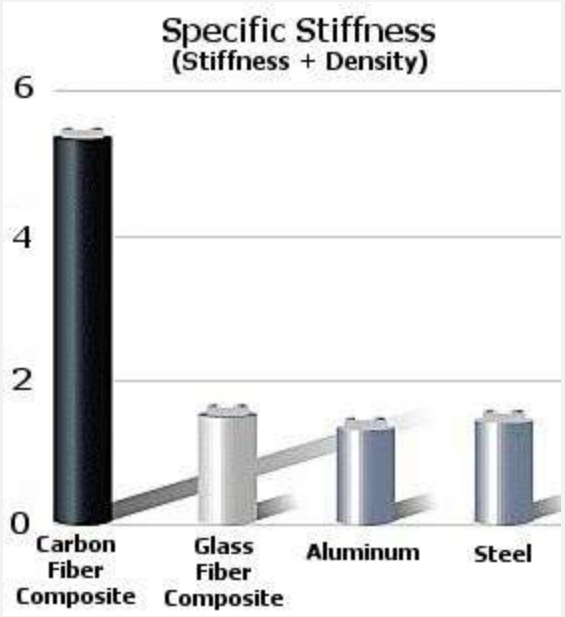
- **Lower cost C.F.R.P.** 320K, 120K 40K and 24K.

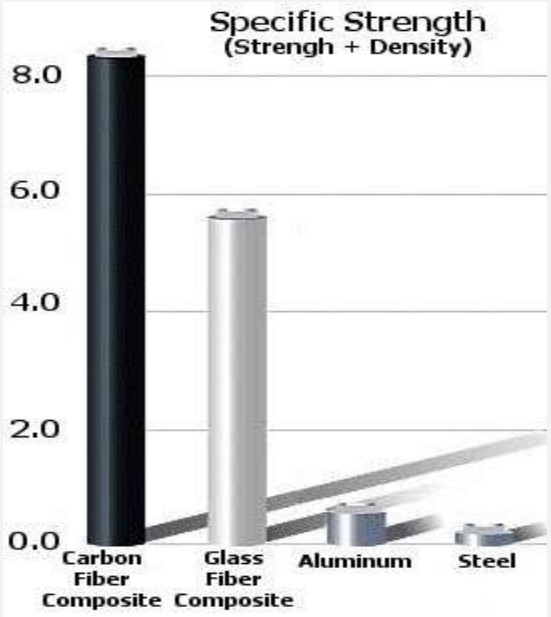
- **Glass Reinforced Plastic**

- **Steel alloys** *(HSLA -High-Strength Low-Alloy) steel)* - Manganese steel

Element	Weight %
C	0.28-0.33
Mn	1.60-1.90
P	0.035 (max)
S	0.04 (max)
Si	0.15-0.30

- **Aluminum Alloys**





FINAL DESIGN:

➢ References:

Books:

- **Collapsibles**: By Per Mullerup – A Design Album Of Space Saving Objects.

- **Indian anthropometric dimensions for ergonomic design practice** :By Debkumar Chakrabarti

Websites:

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- *http://shopping.msn.com/specs/texsport-folding-tripod-stool/itemid1059001760/?itemtext=itemname:texsport-folding-tripod-stool*

- *http://www.inhabitat.com/2006/12/05/one-shot-stool-by-materialise/*

Thank You.