THINK!
DESIGN

D'source Project

Open Design School

MoE's Innovation Cell

Case Study
Project

Design Thinking & Innovation

Case Study: Prototyping

Project: Design of Bamboo Sliver Furniture

Section: C13, Week 13

Design Thinking & Innovation (DT&I)

Section: C13

Week 13

Design Thinking & Innovation (DT&I)

Presented by:
Prof. Ravi Poovaiah
IDC School of Design, IIT Bombay

DT&I Case Study

C13 Case Study Project:

Design of Bamboo Sliver Furniture

by Sumit Ranjan Kumar
and Prof. Avinash Shende

Module C13:

THINK!
DESIGN

C13.1

Design of Bamboo Sliver Furniture

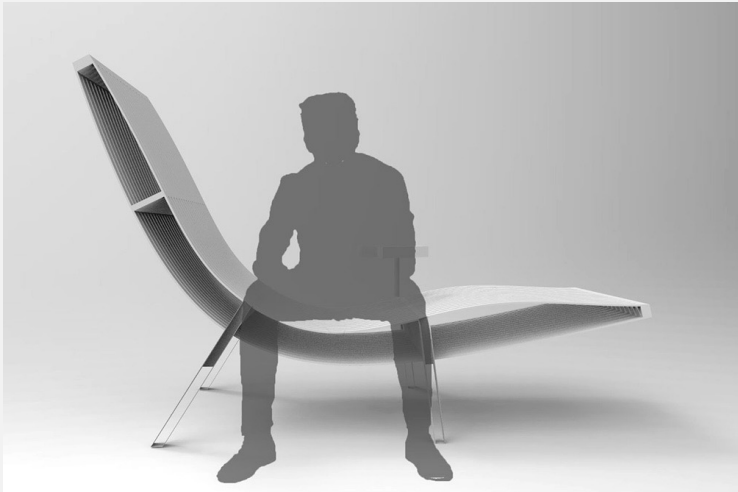
Case Study:

Design of **Bamboo Sliver Furniture**

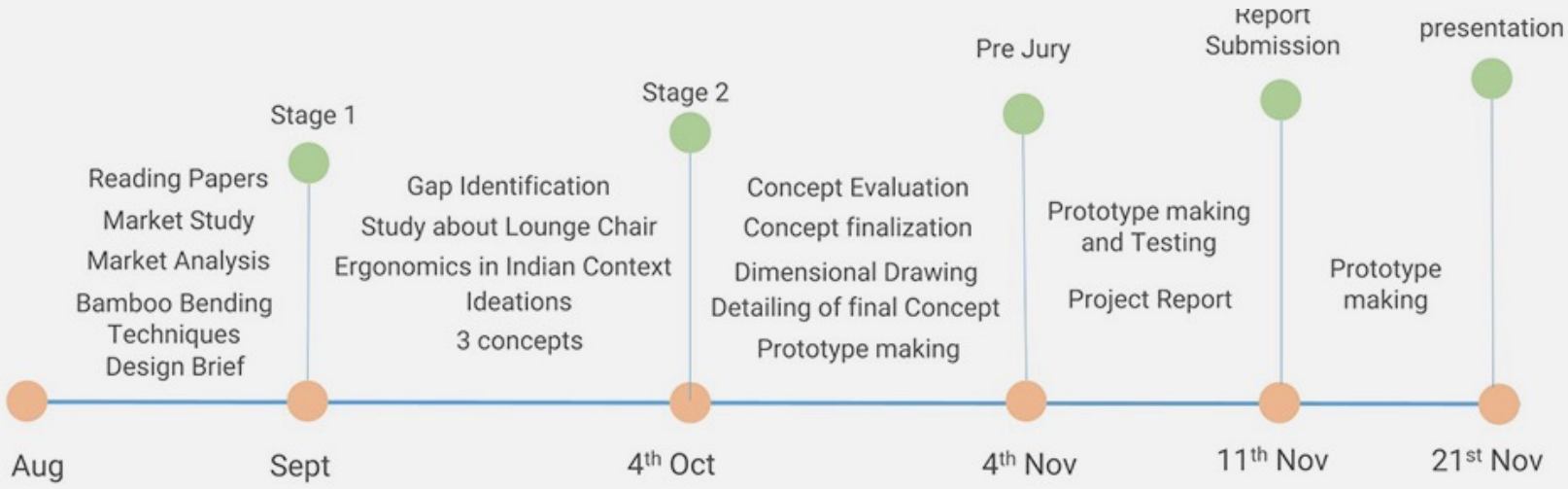
- Using natural material for a lounge chair

by
Sumit Ranjan Kumar (MDes students)
and Prof. Avinash Shende (Mentor)

Content



DT&I Process Timeline:



Design Brief:

To design a lounge chair using bamboo slivers for the airports, where people can just sit and relax!

In Guwahati, Assam airport, They are promoting bamboo just by creating interior wall paneling to the pillars, which seems to be very less effective! whereas Madrid Airport in Spain shows a complete contrast of it.

Gap Identification and Opportunity

An opportunity to include bamboo material for sitting, so that people get to interact with it directly!

Key words: Bending, Flow, relax, inviting

Guwahati and Madrid Airport

Background Research: keywords

Bamboo as a new material for Design.

Background Research: Bamboo material properties

Bamboo is an excellent material for indoor and outdoor furniture's with the following properties:
- its light-weight structure,
- superior mechanical properties and
- natural resistance against biological attacks.

(Solomon-Ayeh 2002, Chele et al. 2012)

The **mechanical properties of bamboo veneers, stripes, strands, particles and fibers** are comparable and sometimes better to those generated from wood.

(Hidalgo 2003, Zehui 2007, Malanit et al. 2010)

Reference:
https://graminno.org/bamboo-plantation-and-furniture-for-rural-sustainability/

Background Research: economic and environmental factors

Some of the economic and environmental advantages of bamboo:
- it **grows quick as a straight stem**.
- after drying, it is **resistant to swelling or shrinkage due to climate changes.**
- it is extremely **durable and resistant after some treatments for reservation.**

Bamboo seems like a **sustainable and environment-friendly material** for making **furniture**.

Reference:
https://graminno.org/bamboo-plantation-and-furniture-for-rural-sustainability/

Background Research: on existing products

Trusse Me –
by Sandeep Sangaru

Foldable Chair
by Getkraft

By Prajakta Bamanikar
at IDC, IIT Bombay

Cube Stool
by Prof. M. P. Ranjan

Cantilever chair '43: **Yil**
by konstantin grcic

Spring Chair:
by Anthony Marschak

A New Layer II: 2012-2018: a
by Jin Kuramoto Led by NTCRI

Bamboo Bending Techniques:

Steam Bending

Blow Bending

Hot Air Gun

Types of Lounge Chair:

Classic Lounge Chairs

Long chair, can stretch out completely on without to use an ottoman

Chaise Lounge

Long chair, can stretch out completely on without to use an ottoman

Club Chairs

Low back with deep seats. It also inspired the Eames lounge Chair

Recliners

Arm Chair with Recliner for better comfort

Poolside Loungers

Designed for outdoor uses

Grand Master's design:

Eames Lounge

Price: 4 Lacs

Le Corbusier's Lounge

Price: 2.9- 3 Lacs

Inferences:

Great curves and lines to admire the beauty!

Cushioned Seats given for better comfy

Fixed and adjustable inclination

Metal base structure

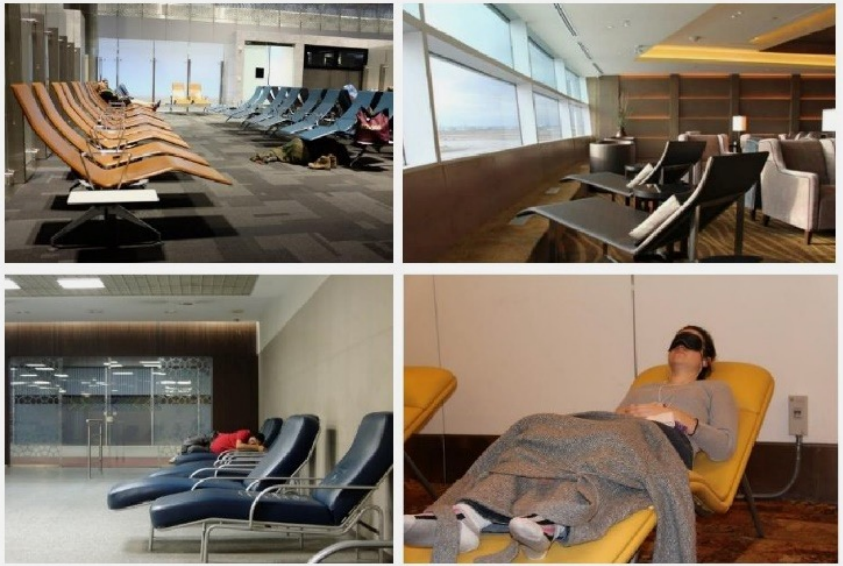
Ref:
https://chairinstitute.com/types-of-lounge-chairs/

Lounge chair in different scenarios:

Lounge Chair in hotels

Lounge chair at swimming pool

Lounge chair in different scenarios:

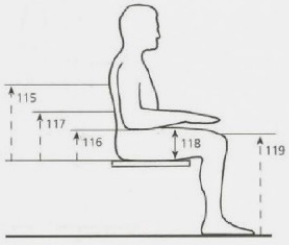


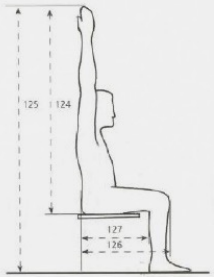
Lounge Chair at Airports

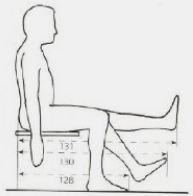
Lounge Chair at Airports

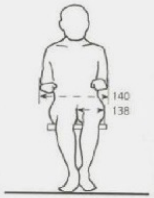
Anthropometric consideration as per Indian Dimensions:

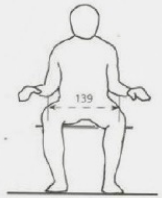
R.No.	Parameters		Min	Percentiles 5th	25th	50th	75th	95th	Max	Mean	±SD	Ratio
115	Tip of shoulder blade	Male	341	373	399	417	442	476	600	422	32	0.26
		Female	231	303	351	364	385	419	448	367	36	0.24
		Combined	231	350	389	411	437	470	600	412	39	0.25
116	Elbow rest	Male	112	158	192	213	236	270	335	215	34	0.13
		Female	102	124	170	194	218	265	290	195	39	0.13
		Combined	102	150	188	210	234	268	335	211	36	0.13
117	Waist	Male	103	154	173	188	199	221	327	189	24	0.11
		Female	136	165	188	204	221	260	287	207	29	0.14
		Combined	103	157	176	189	203	231	327	192	26	0.12
119	Knee	Male	438	472	497	519	539	567	612	520	30	0.32
		Female	412	440	462	484	499	520	578	483	28	0.32
		Combined	412	456	489	509	534	563	612	511	33	0.32
126	Buttock to knee length, normal sitting	Male	400	489	529	558	581	615	861	556	43	0.34
		Female	409	459	503	526	553	585	670	527	40	0.35
		Combined	400	479	520	549	575	613	861	549	44	0.34
127	Buttock to popliteal length, normal sitting	Male	350	399	431	455	477	512	595	456	35	0.28
		Female	340	384	417	439	468	494	560	442	36	0.29
		Combined	340	394	429	451	474	509	595	453	35	0.28

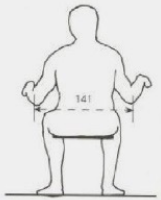






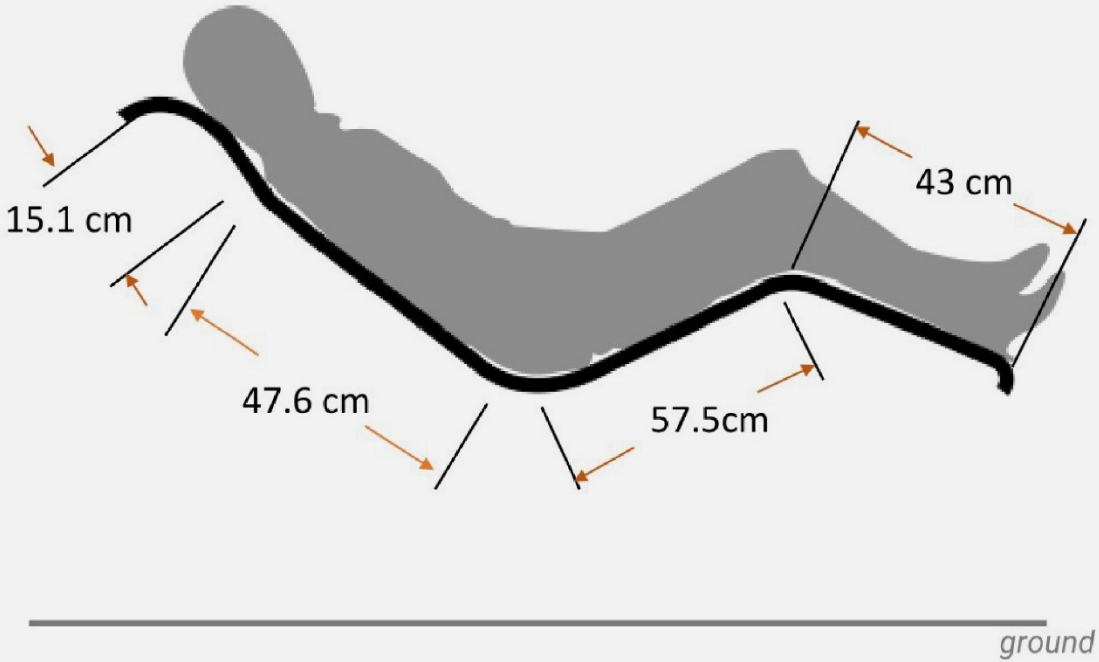




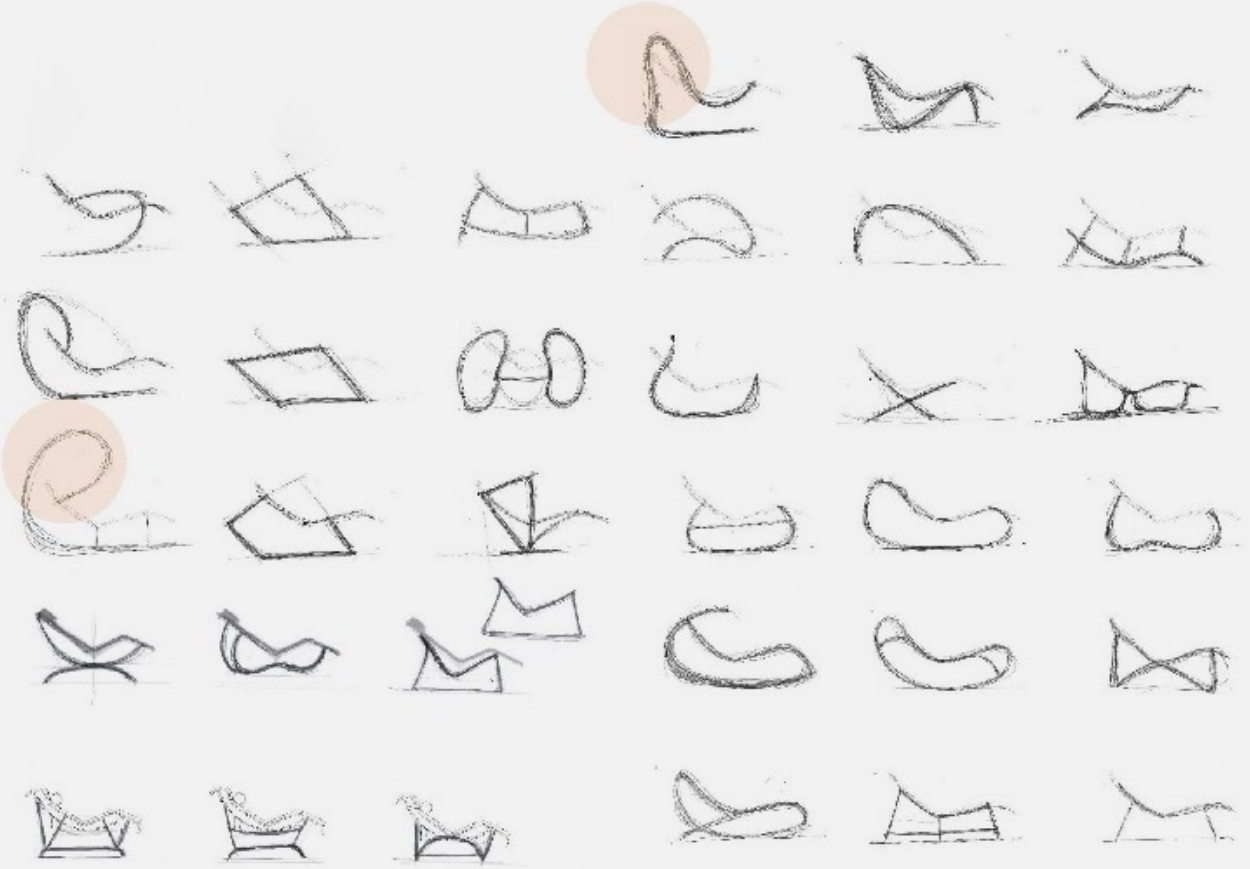


Ref:
Anthropy data
by Dev Kumar

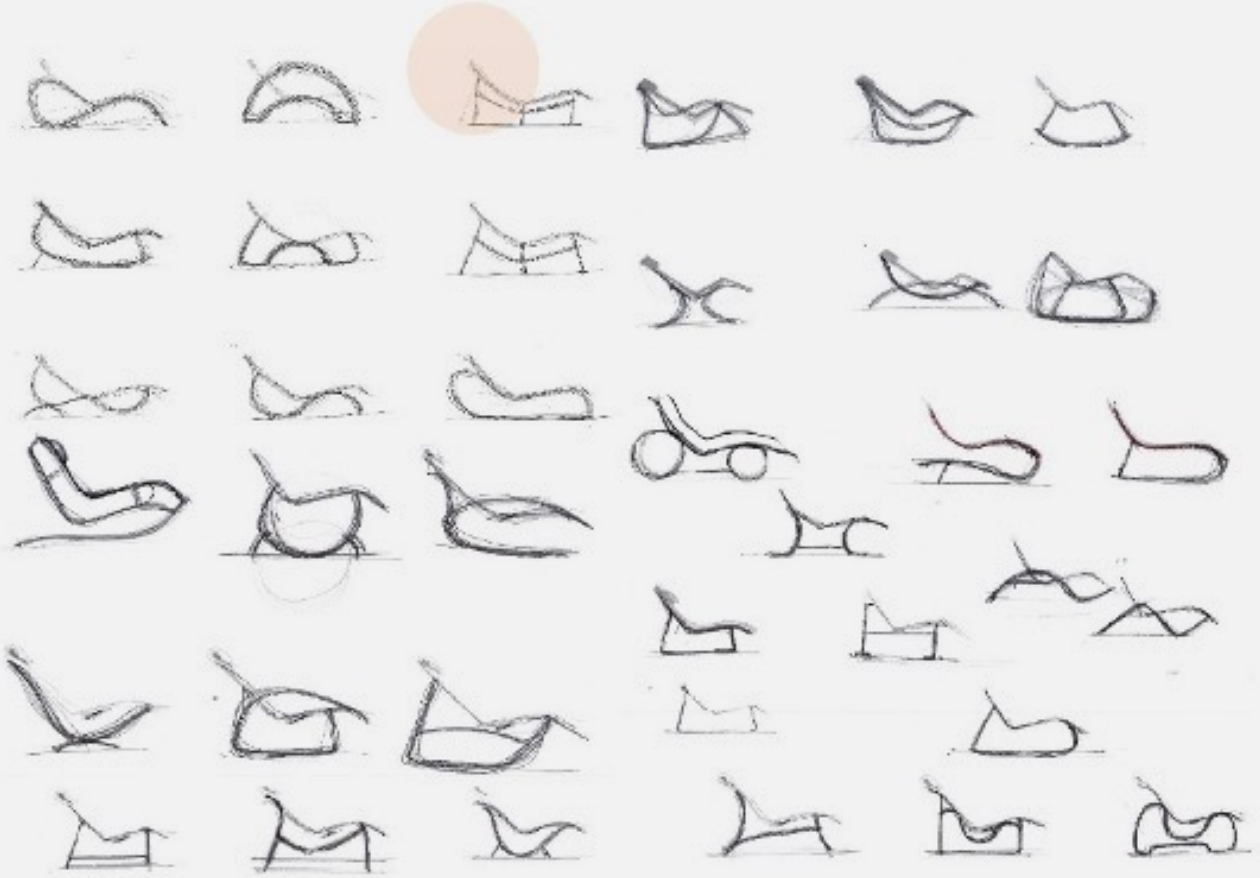
Ergonomics considerations as per Indian Standard:



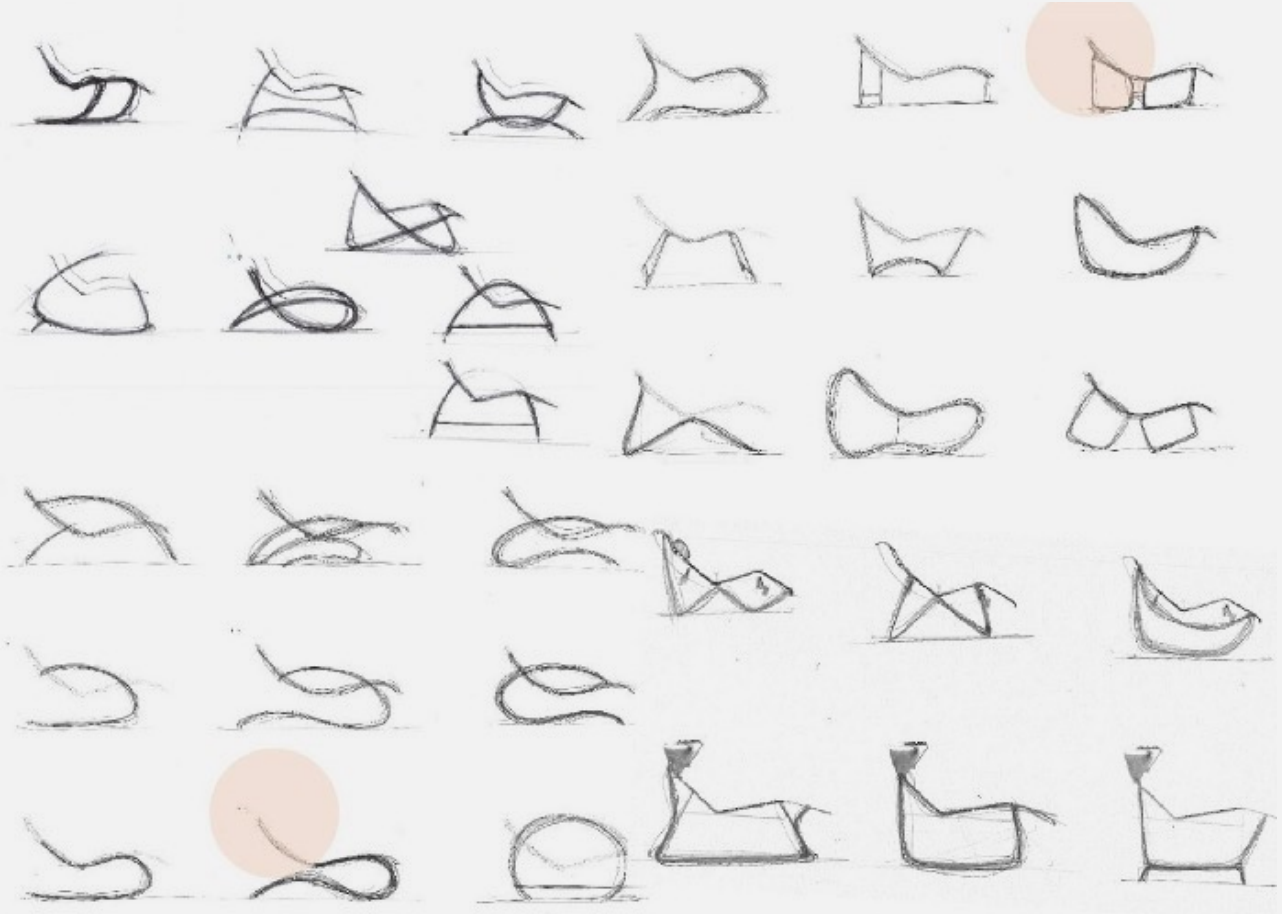
Ideations:



Further Ideations . . .



Further Ideations . . .



Concept 1: Alpha:

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This concept has continuity in its form that shouts out, so we worked upon it further. there are three repetitive strips on the both side that creates a spring mechanism while sitting, which can enhance the experience while lounging. we Also considered the activities which are done while lounging at the airport.

Concept 1: Alpha - prototyping:

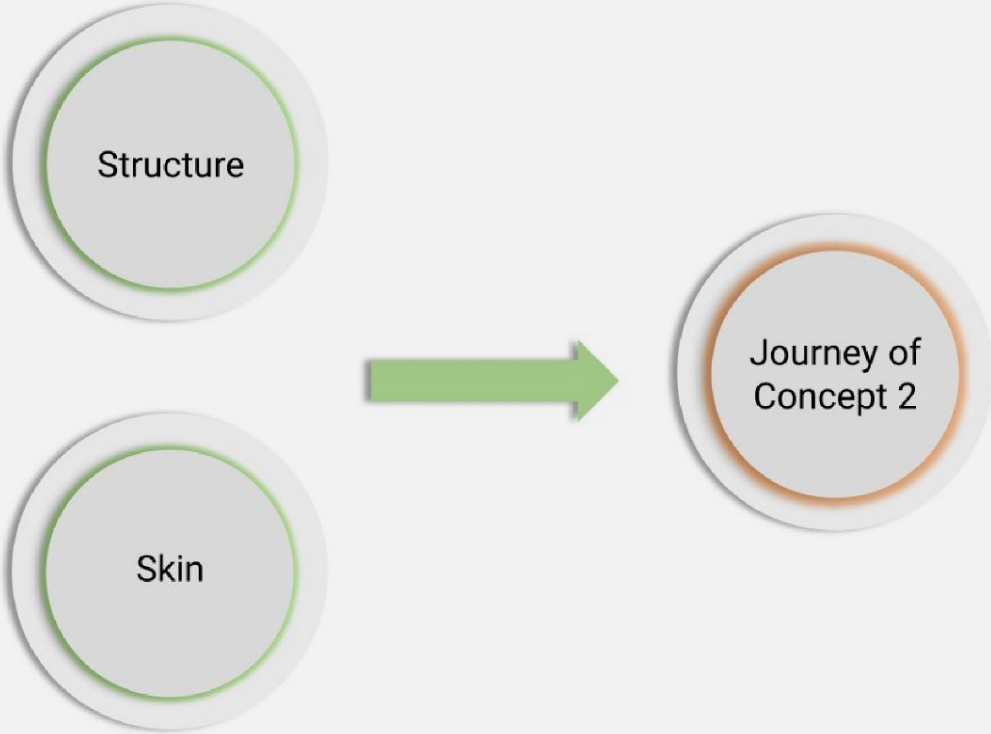
Prototype concept one was made at 1:1 scale and found that it is not sturdy enough and would not be able to support the human weight.

More insights from the failed prototype are: - A metallic frame would be needed to support the structure and person's weight.

Concept 2: Voronoi:

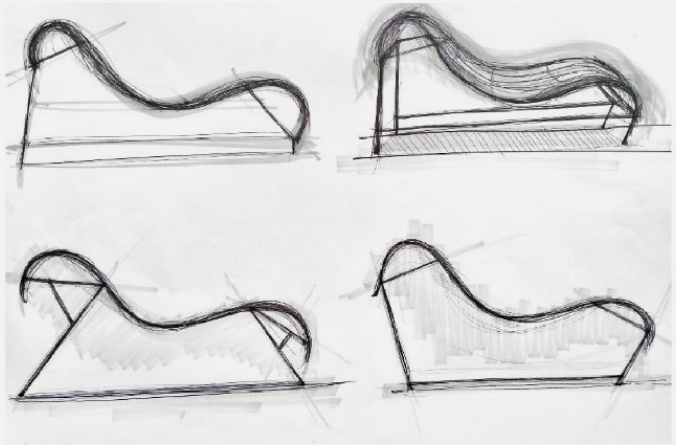
Voronoi Pattern

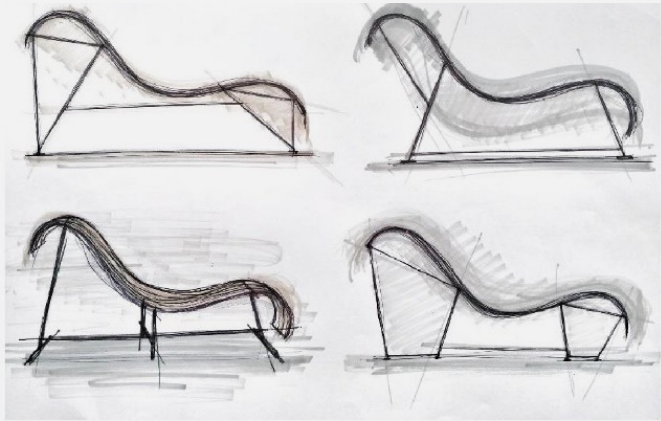
Journey to concept 3. . . . .

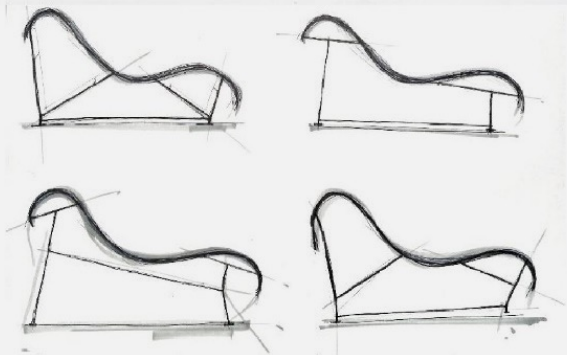


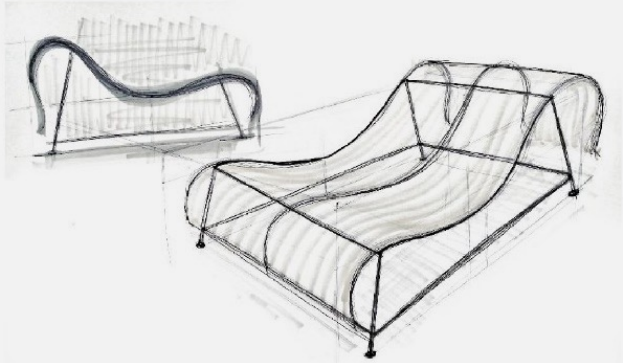
Further Ideations:

Ideations with the base structure as metal for stable using least structural elements.



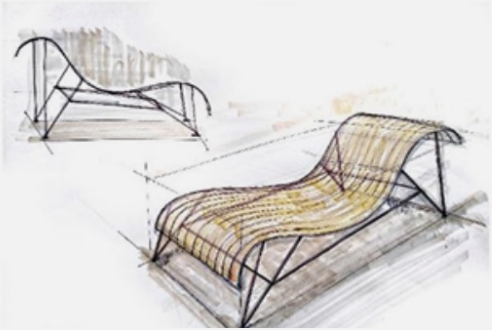




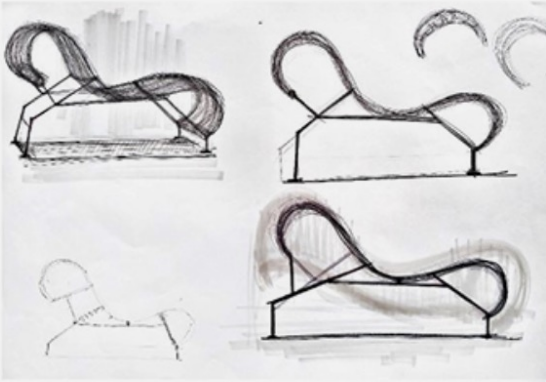


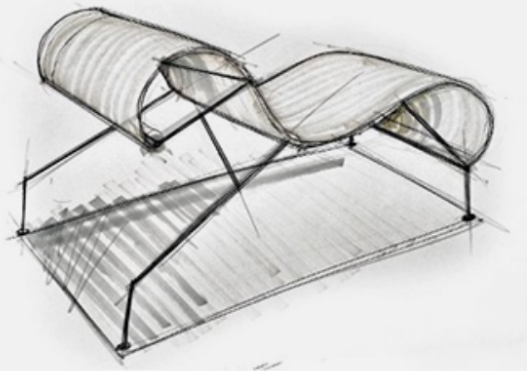
Further Ideations . . . .

Here, the base point of the structure is towards inside, which might create instability in the overall form.



Here, the base point of the structure is taken slightly outwards and the metallic element increased to create the balance

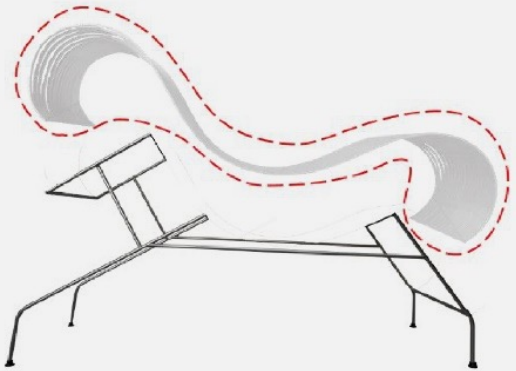




After playing with this idea, it started showing a horse form,

Further Ideations . . . .

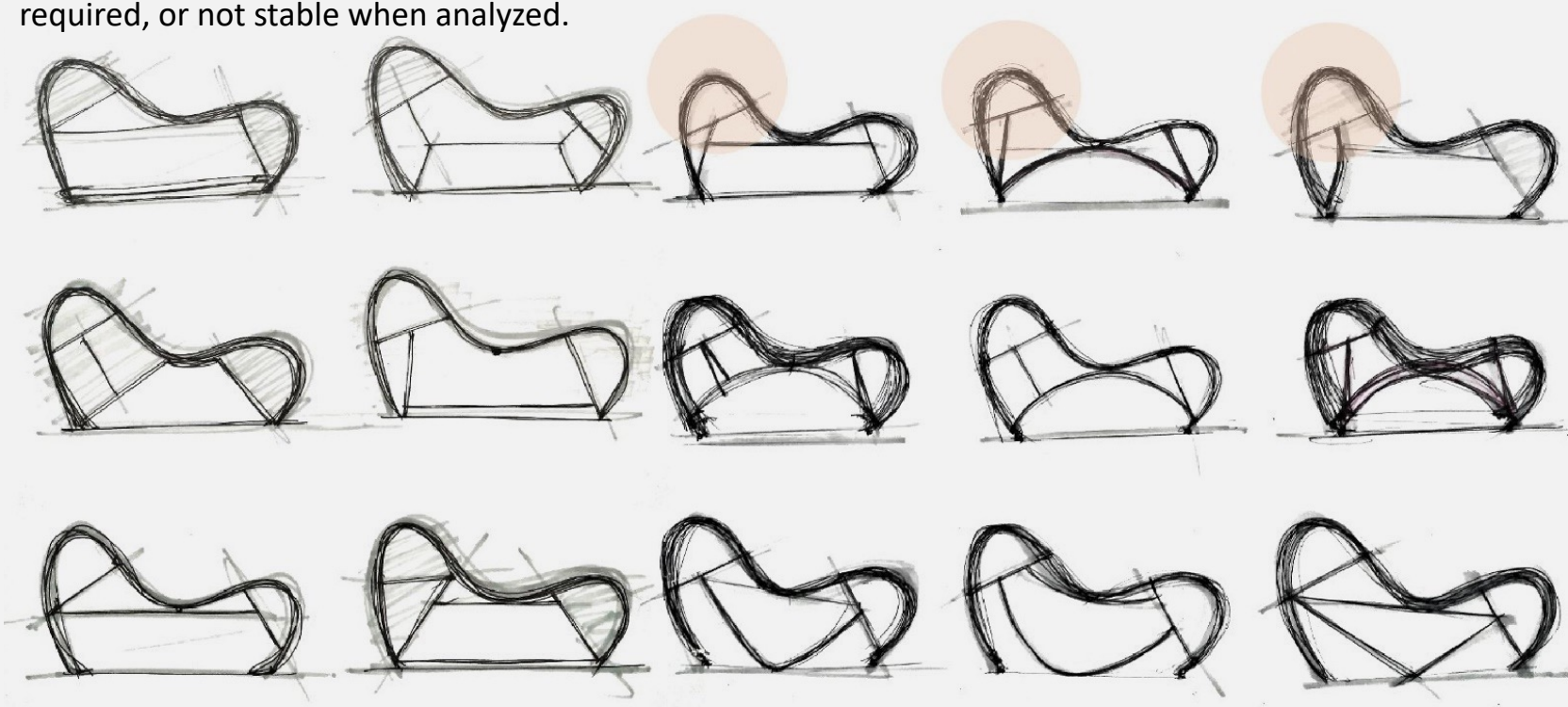
Paper Prototype
Scale 1:7



This idea was analyzed with the conclusion that the structural part dominates compared to the elements of Bamboo element. Further ideation evolved into spline concept.

Spline Concept:

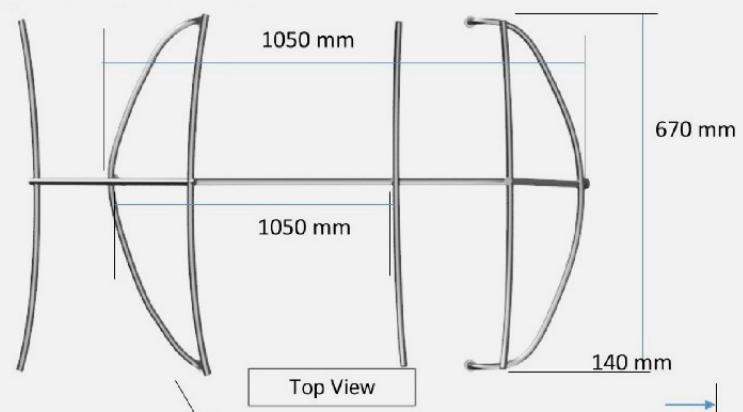
The highlighted ideas were taken further and worked upon, other ideas either dominate in structure, or have more elements than required, or not stable when analyzed.

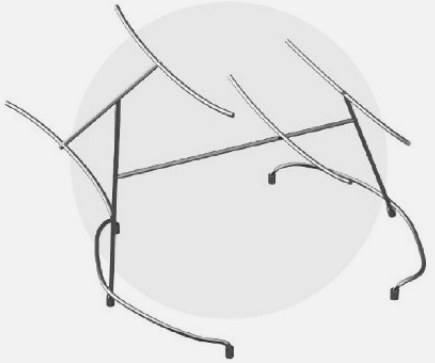


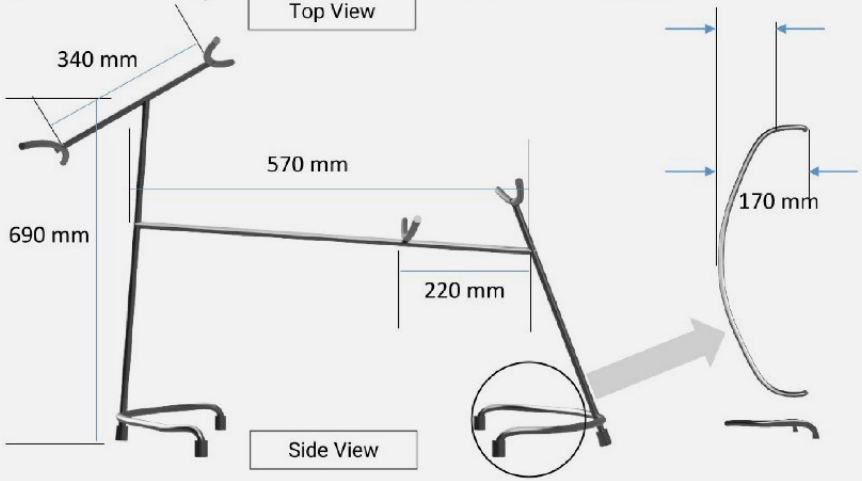
3D Explorations:

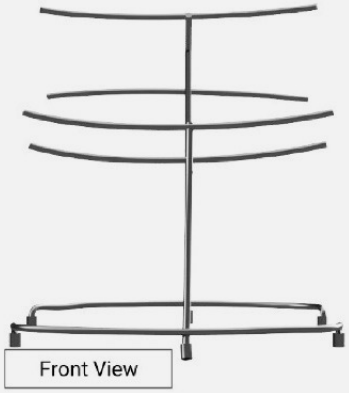
Paper model of Spline concept:

Detailed Dimensions:

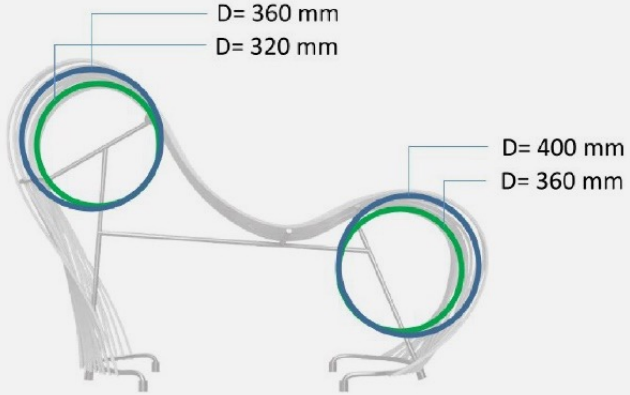


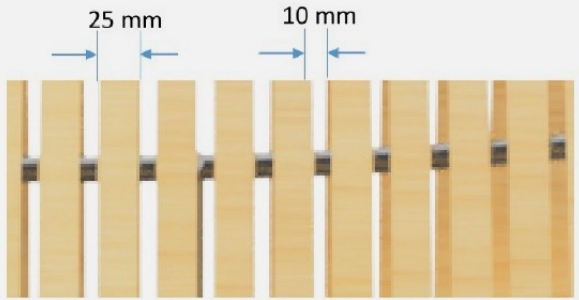






Cad Drawing with dimensions:





Spline Lounge – Design 1:

Manufacturing and Feedback:

Making the steel structure and trying it out.

Manufacturing and Feedback:

Bamboo Sliver making.

Bamboo slivers kept in water to make it softer for further treatment

Heating and bending

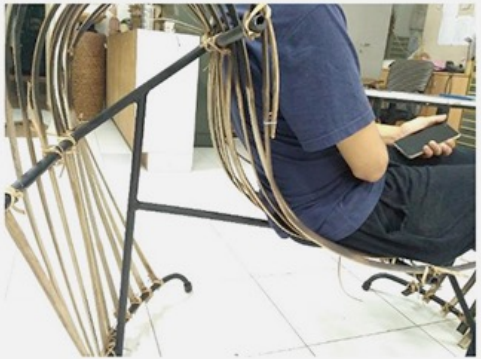
Bent slivers putting on frame

User Testing and Feedback:

Sitting Position1- the head part should be little up for better comfort, cushioning is a good option!

Sitting posture 3

Sitting posture 2



Gap to be filled by changing the sliver curve or some cushioning need to be provided

User Testing and Feedback:

Sitting Position

Resting Position

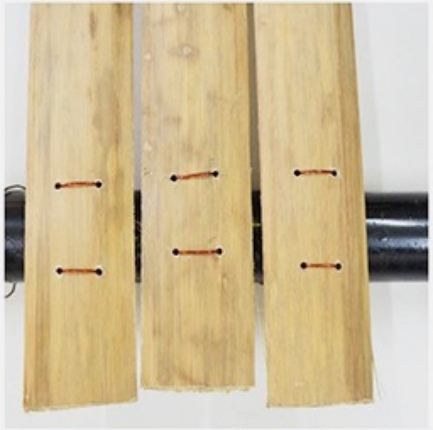
Required Ottoman position

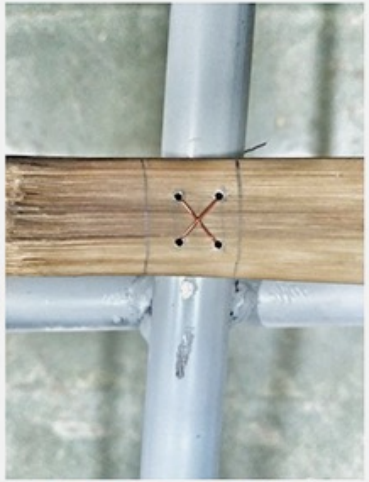
Feedback from user testing:

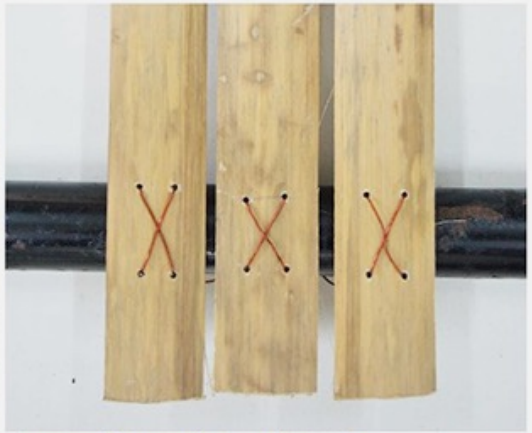
Head and back need cushioning
A Leg Rest/ Ottoman would be great!
Person can sit in various position as per the need

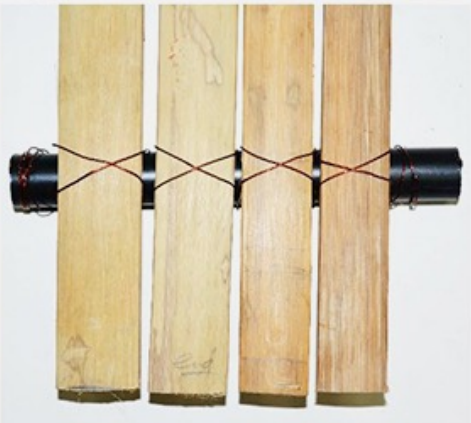
Study of Joinery details:

Joinery details – trying out options:









Joinery with holes in bamboo tied up is more strong and stays tightly at the position

Material and Manufacturing cost of a unit (BOM):

Material cost		Labor cost	Time Taken
Bamboo - 24 ft. Bamboo. - 20 slivers from 2 bamboo	400/-	MS Bending and welding- 400/-	Bending and welding- 4 Hrs.
MS Pipe - 50 Rs. Per meter	600/-	Bamboo Bending work (2 craftsmen) - 3000/-	Bamboo bending- 4 days (8 hrs.)

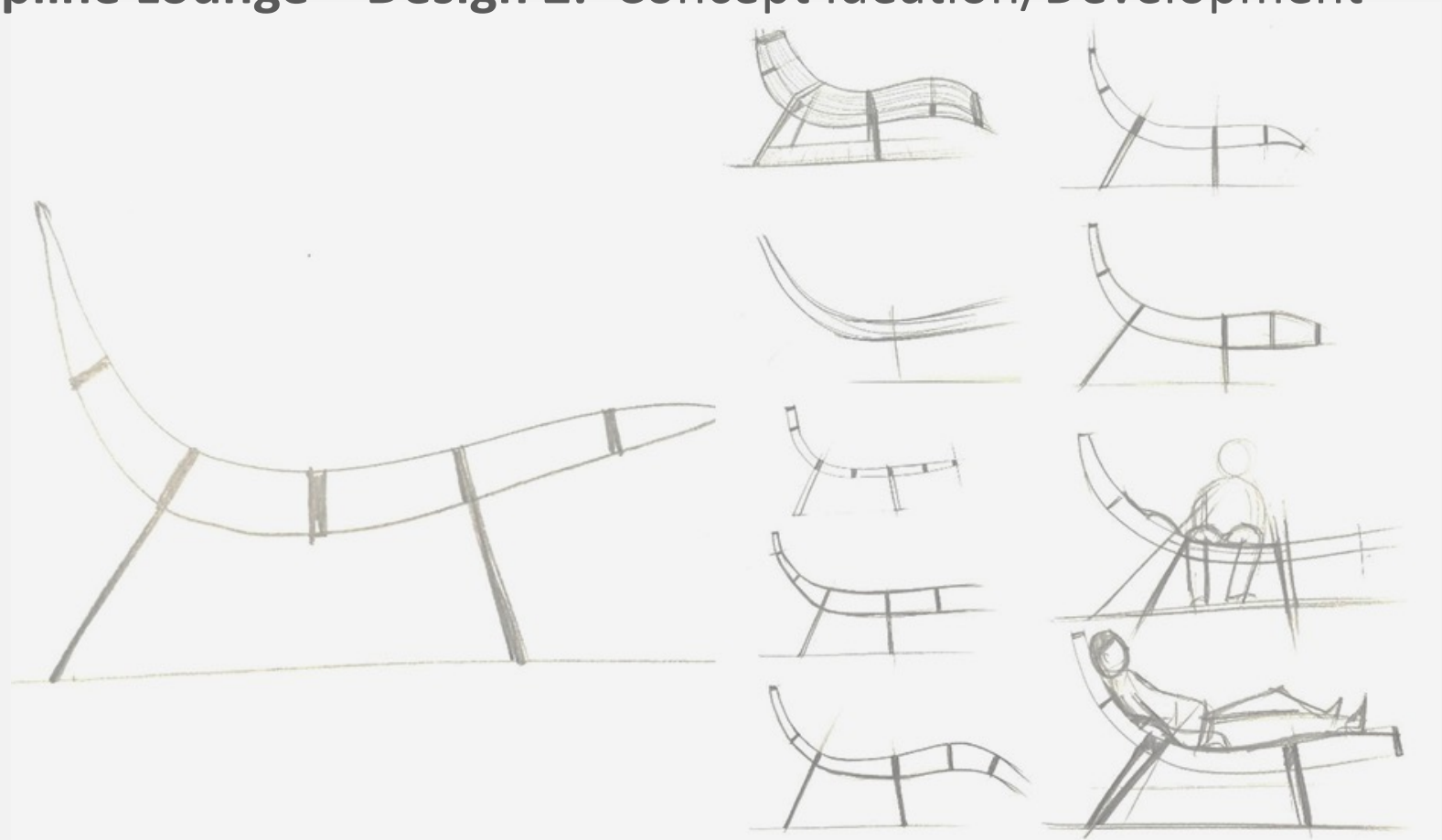
Total Cost = Rs 5000/-

Spline Lounge – Design 1: Manufacturing options

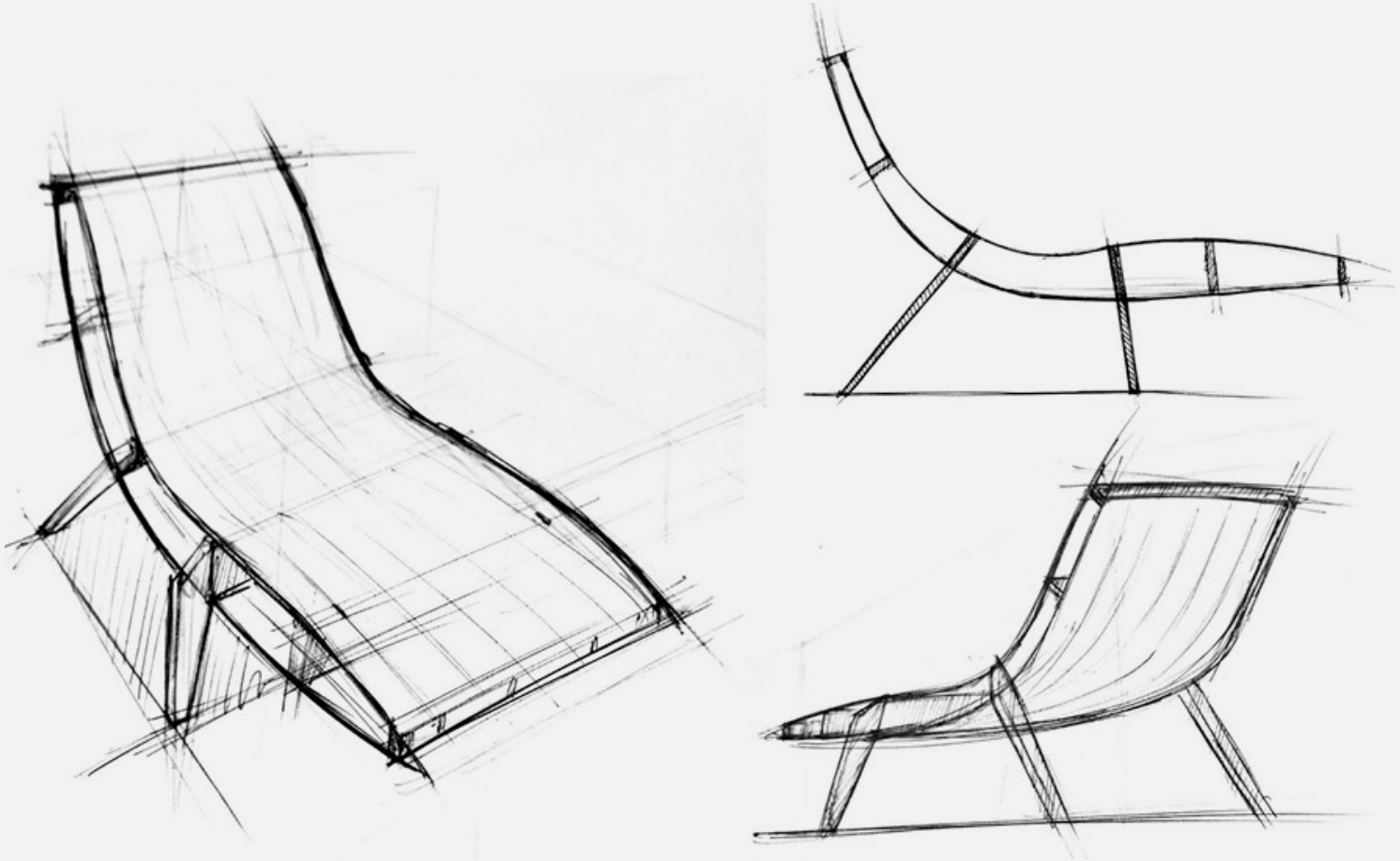
The spline design 1 lets entrepreneurs manufacture separately in parts as Bamboo and metal framework and merket this together as a combined final product.

Spline Lounge – Design 2: Inspirations

Spline Lounge – Design 2: Concept Ideation/Development

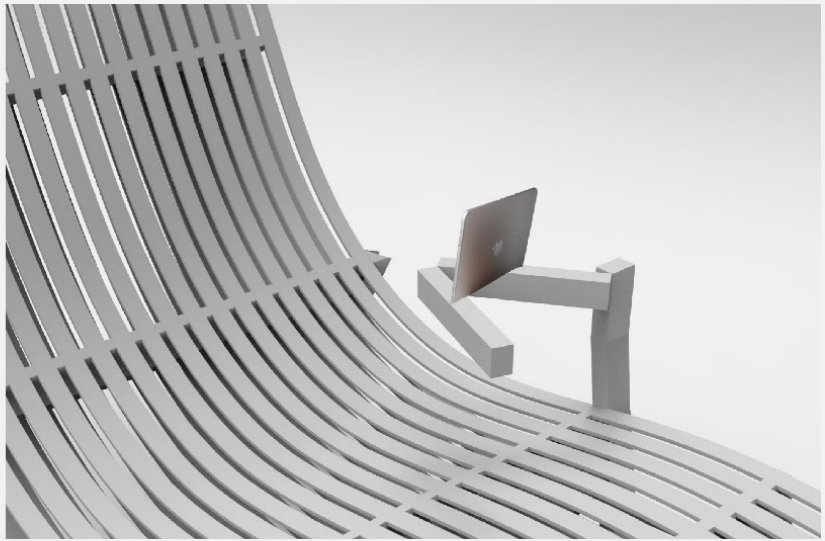


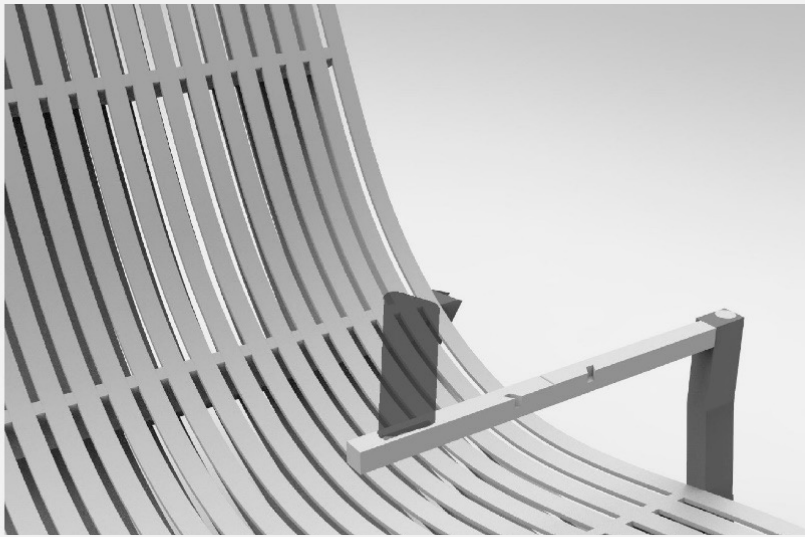
Spline Lounge – Design 2: Concept Ideation/Development



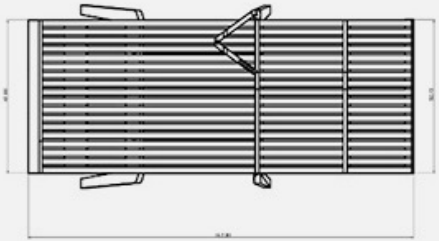
Spline Lounge – Design 2: 3D modelling/visualisation

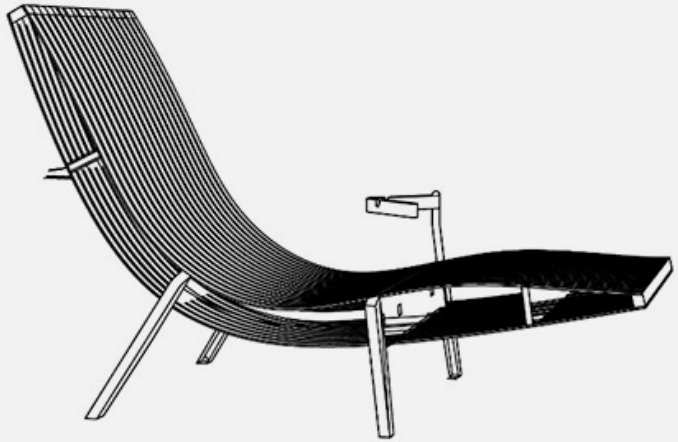
Spline Lounge – Design 2: Accessory

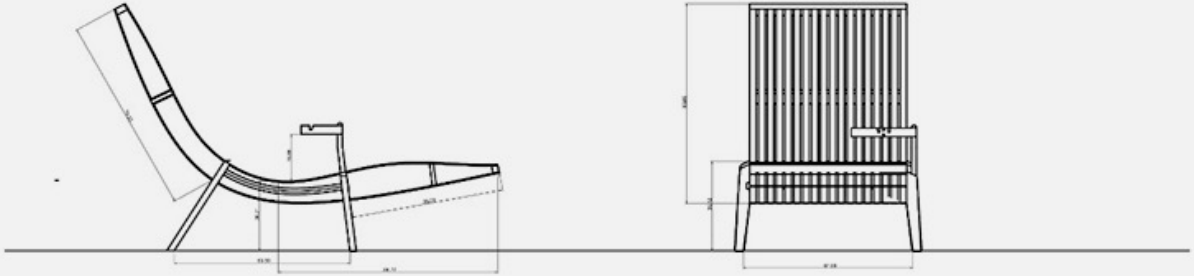




Spline Lounge – Design 2: Dimensional drawing







Spline Lounge – Design 2: Making Process

Spline Lounge – Design 2: Making Process - details

Smoke Curing

Spline Lounge – Design 2: Making Process - Prototyping

Spline Lounge – Design 2: Making Process - Prototyping

Material and Manufacturing cost of a unit (BOM):

THINK! DESIGN

Spline Lounge: Design 2 costing:

Bamboo - 24 ft. Bamboo. - 20 slivers from 2 bamboo	400/-	MS Bending and welding- 400/-	Wooden base- 5 hrs.
Pinewood	1500/-	Bamboo Bending work (2 craftsmen) - 3000/-	Bamboo bending and fixing - 2 days (8 hrs.)

Total making cost of one unit – 7000/- (approx.)

Selling Cost = Rs 16,000/-

References:

Referred links from the Net:

http://www.assambamboofurniture.com
https://betweenenglandandiowa.com/2017/12/24/why-airports-are-the-most-emotional-places-in-the-world
https://edition.cnn.com/travel/article/airport-arrival-time-opinions/index.html
https://www.zoomlite.com.au/blogs/news/while-waiting-at-an-airport
https://www.dimensions.guide/collection/lounge-chairs
http://design-for-india.blogspot.com/2007/07/
www.sangaru.com

Referred Books:

Indian Anthropometric Dimensions for Ergonomic Design Practice By Debkumar Chakrabarti
https://www.scribd.com/document/511496232/INDIAN-Anthropometric-Dimensions

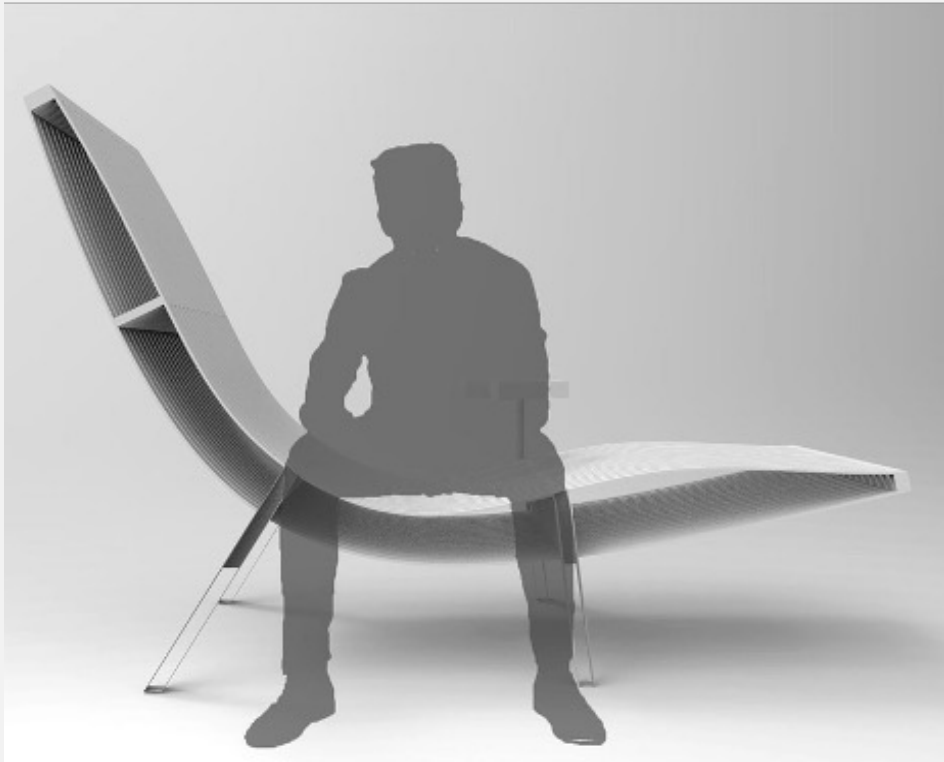
Credits:

Design of Bamboo Sliver Furniture

- Using natural material for a lounge chair

by
Sumit Ranjan Kumar
(Master of Design Student)

Mentored by
Prof. Avinash Shende
(IDC School of Design, IIT Bombay)



Thanks for Listening

DT&I Case Study

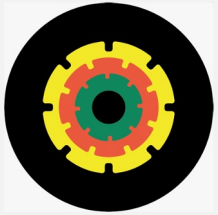
Section: C13

Week 13

DT&I Course – Week 13:

DT&I Process
(20%)

> Human Factors / Ergonomics
> Systems Mapping
> Hi-fidelity prototyping
> 3D Modeling & Printing



DT&I Tools
(20%)

> Human Factors / Ergonomics
> Systems Mapping
> Hi-fidelity prototyping
> 3D Modeling & Printing

DT&I Project
(50%)

> Apply > Human Factors / Ergonomics
> Systems Mapping
> Hi-fidelity prototyping
> 3D Modeling & Printing

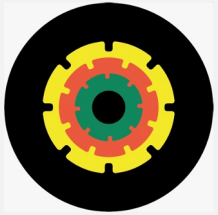
DT&I Cast Study
(10%)

> Case Study Project:
Design Of Bamboo Sliver Furniture

DT&I Course – Week 14:

DT&I Process
(20%)

> Usability Studies, Feedback and Iterations
> User feedback & iterate
> User Feedback Methods
> Finalize Design



DT&I Tools
(20%)

> User feedback and iterate
> Methods of getting User Feedback
> Finalize Design

DT&I Project
(50%)

Apply
> User feedback and iterate
> Methods of getting User Feedback
> Finalize Design

DT&I Cast Study
(10%)

> Case Study Project: **Redesigning a Solar Powered Cookstove**

THINK!
DESIGN

Supporting Organizations:

D’source

D’source Project

Open Design School

MoE’s Innovation Cell

D'source Project

Open Design School

MoE's Innovation Cell

Credits:

Storage Unit for Post Harvest Veggies :

Student Designer for Case Study:
Arunprakash Ezhilarasan

Mentor for Case Study:
Prof. Avinash Shede
IDC School of Design, IIT Bombay

Credits:

Presented by:

Prof. Ravi Poovaiah

D'source Project

Open Design School

MoE's Innovation Cell

Credits:

Camera & Editing:
Santosh Sonawane

D'source Project

Open Design School

MoE's Innovation Cell

Credits:

Think Design Animation:
Rajiv Sarkar

D'source Project

Open Design School

MoE's Innovation Cell

Credits:

End Title Music:
C P Narayan

D'source Project

Open Design School

MoE's Innovation Cell

Credits:

Produced by:

IDC School of Design

IIT Bombay

D'source Project

Open Design School

MoE's Innovation Cell