GNG 1103: Deliverable D

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1.0 Introduction

The conceptual design process is meant to distill all the ideas brought forth by the team after speaking with the client and subsequently exploring possibilities for a solution. Each solution will be compared with the project metrics, analyzed for design criteria and innovation to aid in the decision process. We started this process with 13 possible designs and had whittled our choices down to the 3 designs that have the most “ideal” characteristics. From our most ideal designs, we chose the most promising design to continue with. This is the design that will be prototyped and presented to our client for feedback.

2.0 Problem Statement:

To provide the domestic violence victims in the city of Ottawa a safe place to sleep, a lightweight and compactable bed frame that is made entirely from cardboard, can support a single 250 pound person and can be transported needs to be made.

3.0 Design Criteria:

Taking into account the problem statement, client needs, benchmarking, metrics and target specifications, the following criteria are deemed most important for a successful design.

a. The solution can support a maximum weight of 250 pounds.
b. The solution can fit a single size mattress which ideally will be 60cm off the ground.
c. The solution is stable.
d. The design is easy and quick to operate and not a burden the client to assemble or disassemble the bed.
e. The design can be compacted to 50% smaller in volume.
f. The design is relatively light weight.
g. The solution should cost $100 at max.

4.0 Analysis and Evaluation of Each Design

For each design the idea is evaluated against the metrics, and feasibility, as well as the innovation factor. Feasibility is given the lowest rank since this is not an in depth analysis or a detailed design. However, the metrics will ideally be satisfied for each design.

4.1 List of Metrics

Table 1. Description of Metrics

Metrics Units	Units	Client's Perception/ Technical Performance
1. Weight of Bedframe	Kilograms	Any sized person should be able to sleep on the bed.
2. Longevity of product	Years	The product needs to be durable
3. Compaction Ratio	%(cm^3)	The bed is to be folded and or taken apart and packed up into one unit to be relatively lightweight, easily carried and transported.
4. Dimensions of the Bed	Centimeters	Design needs to fit the given space for the bedroom.
5. Easy and Quick to Operate	Seconds/ Minutes	The design should be time efficient. The design should not burden the client to assemble or disassemble the bed.
6. Stability to transmit various loadings safely to the ground.	Yes/No	The bedframe is able to be used without rocking or instability
7. Cost	$CAD	The product needs to be cost effective

Table 2. Ideal and Marginally Acceptable Metrics

Metrics	Marginally Acceptable	Ideal
1	75 Kg	120 Kg
2	5 years	7 years
3	25%	50%
4	92cm x 187cm	92cm x 187cm
5	10 min	5 min
6	Stable	Stable/Yes
7	$130 if extra budget is approved	$100

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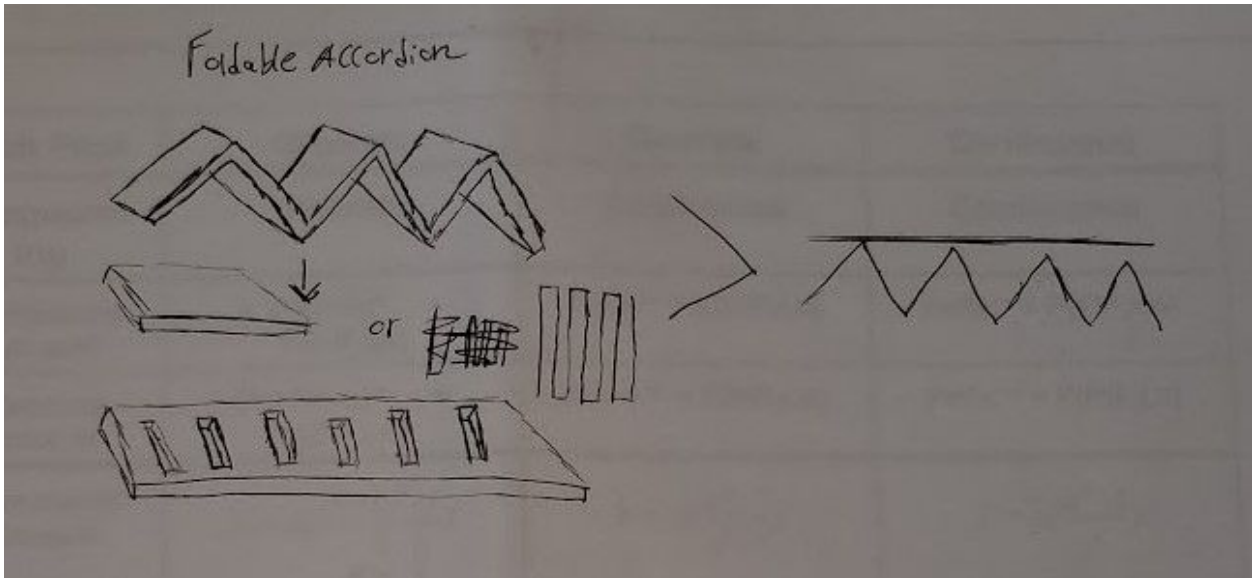
5.0 Solutions

5.1 Design Idea 1(Justin)



Does it satisfy the metrics? (YES / NO / UNSURE)

1:unsure
2:unsure
3:yes
4:yes
5:yes
6:yes
7:yes

Feasible? (YES / NO / UNSURE)

Yes

Innovative? (YES / NO)

No

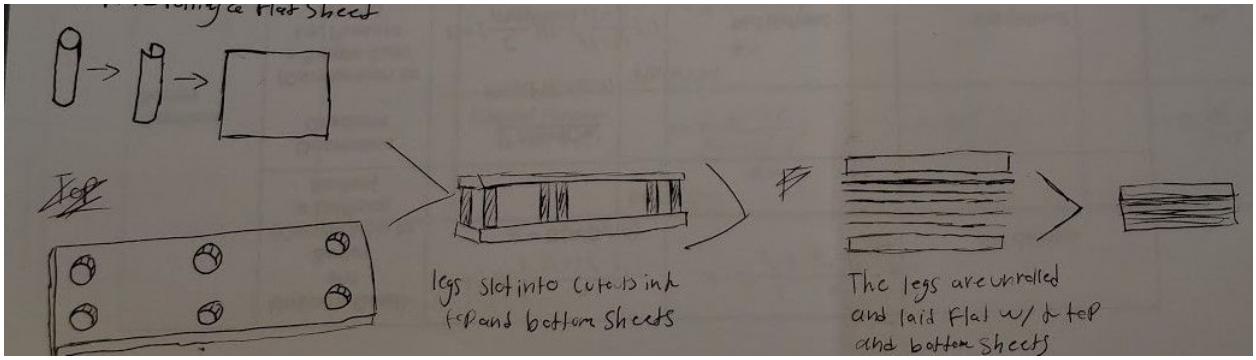
Benefits?

Simple, few pieces, quick assembly

Drawbacks?

The legs will tend to spread out, exerting a lot of force on the sides of the slits, eventually the slits in the platform will widen and the frame will weaken. The platform itself also cannot be compacted and takes up a lot of space.

5.2 Design Idea 2(Justin)



Does it satisfy the metrics? (YES / NO / UNSURE)

1:unsure
2:unsure
3:yes
4:yes
5:yes
6:yes
7:yes

Feasible? (YES / NO / UNSURE)

Yes

Innovative? (YES / NO)

No

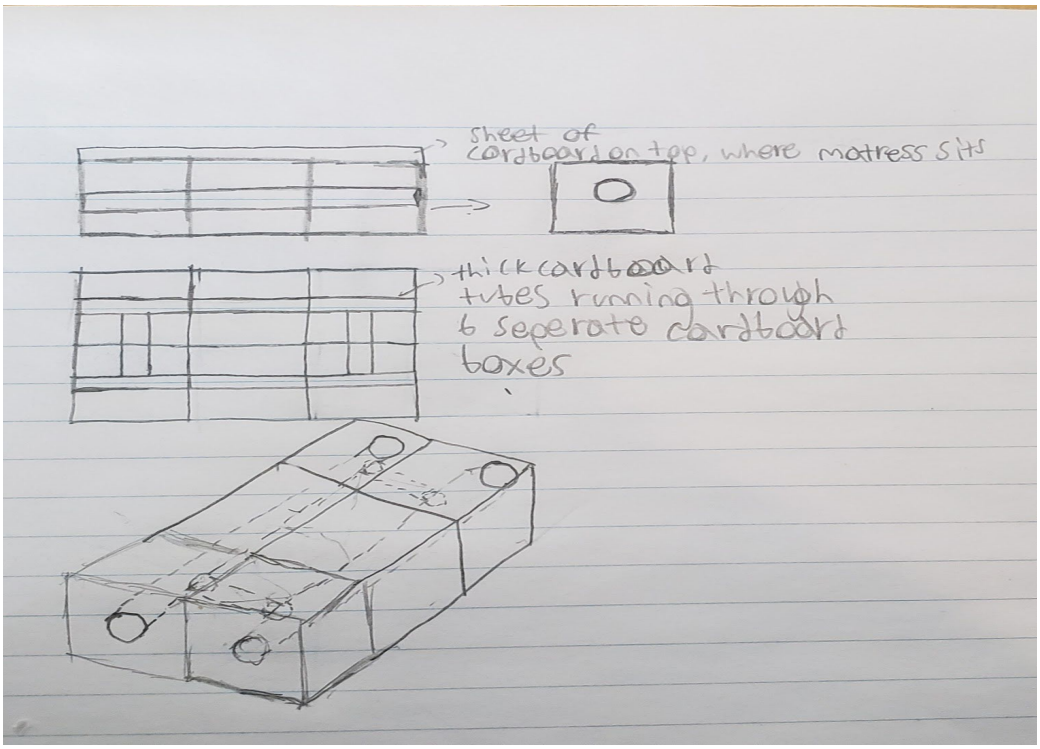
Benefits ?

Flat-pack design, high stability

Drawbacks ?

Slower assembly, many pieces

5.3 Design Idea 3 (Owen)



Does it satisfy the metrics? (YES / NO / UNSURE)

1. Unsure
2. Unsure
3. No
4. Yes
5. Yes
6. Unsure
7. Yes

Feasible? (YES / NO / UNSURE)

yes

Innovative? (YES / NO)

yes

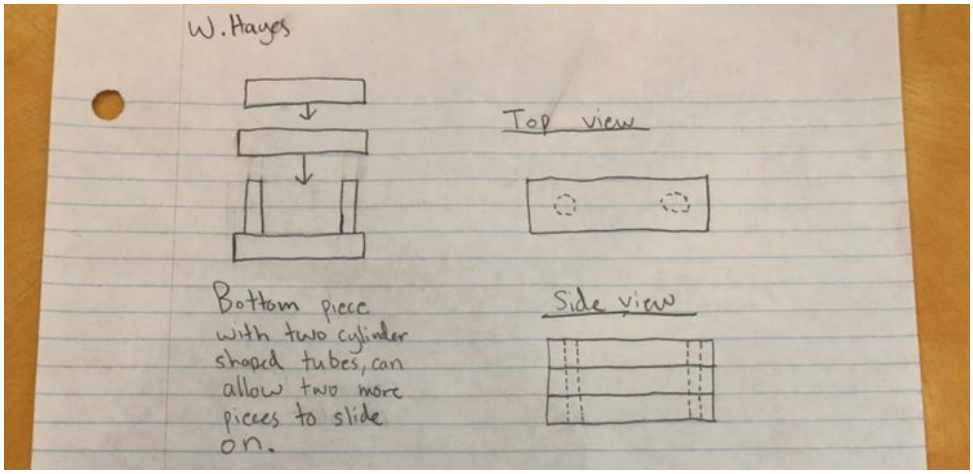
Benefits ?

Easy to put together, lightweight, cost-effective

Drawbacks ?

Difficult to transport, as it does not compact at all

5.4 Design Idea 4 (Will)



Does it satisfy the metrics? (YES / NO / UNSURE)

1. Unsure
2. Unsure
3. Yes
4. Yes
5. Yes
6. Yes
7. Yes

Feasible? (YES / NO / UNSURE)

yes

Innovative? (YES / NO)

no

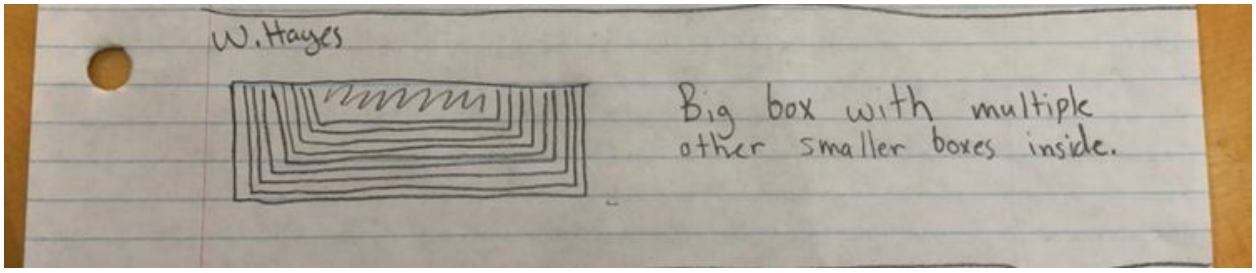
Benefits ?

Very simple, not many pieces required.

Drawbacks ?

Underdeveloped idea

5.5 Design Idea 5 (Will)



Does it satisfy the metrics? (YES / NO / UNSURE)

1. Unsure
2. Unsure
3. No
4. Yes
5. Yes
6. Unsure
7. Yes

Feasible? (YES / NO / UNSURE)

yes

Innovative? (YES / NO)

yes

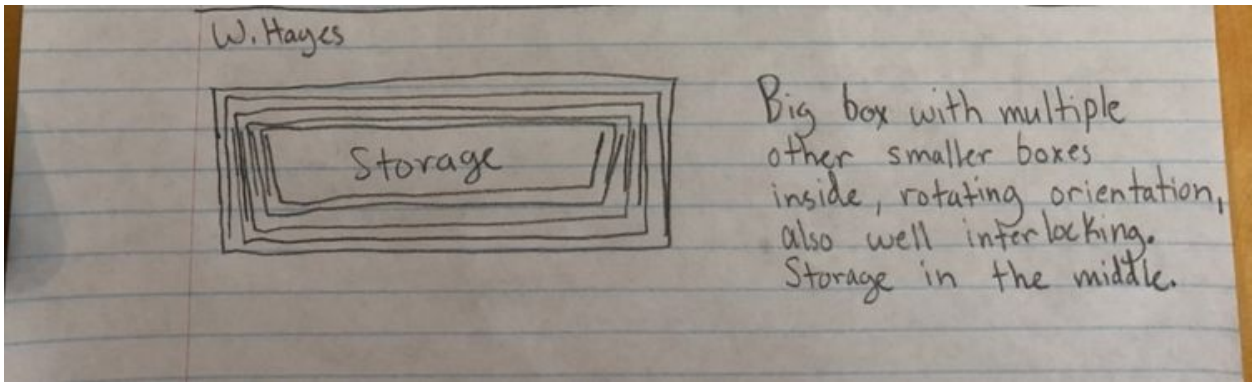
Benefits ?

Very simple

Drawbacks ?

Too many large pieces, not able to be compacted. Possibly not very stable.

5.6 Design Idea 6 (Will)



Does it satisfy the metrics? (YES / NO / UNSURE)

1. Unsure
2. Unsure
3. Yes
4. Yes
5. Yes
6. Unsure
7. Yes

Feasible? (YES / NO / UNSURE)

yes

Innovative? (YES / NO)

yes

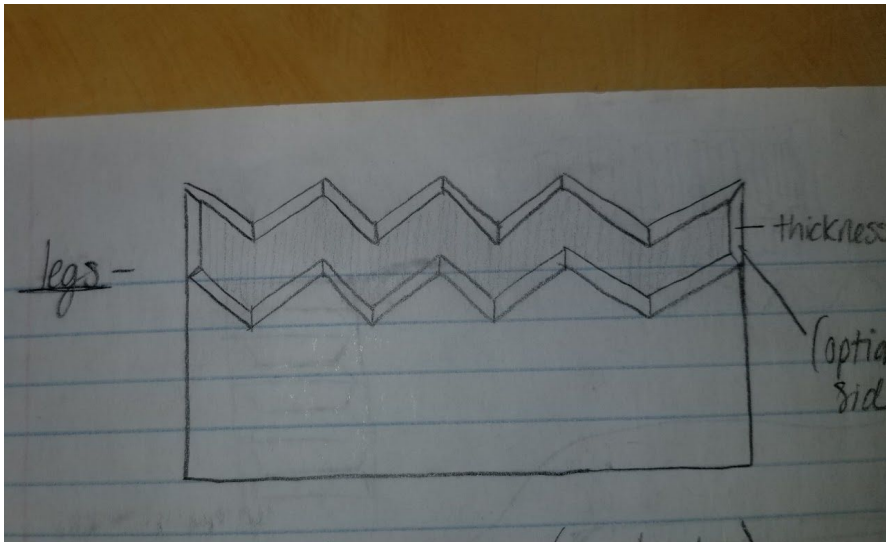
Benefits ?

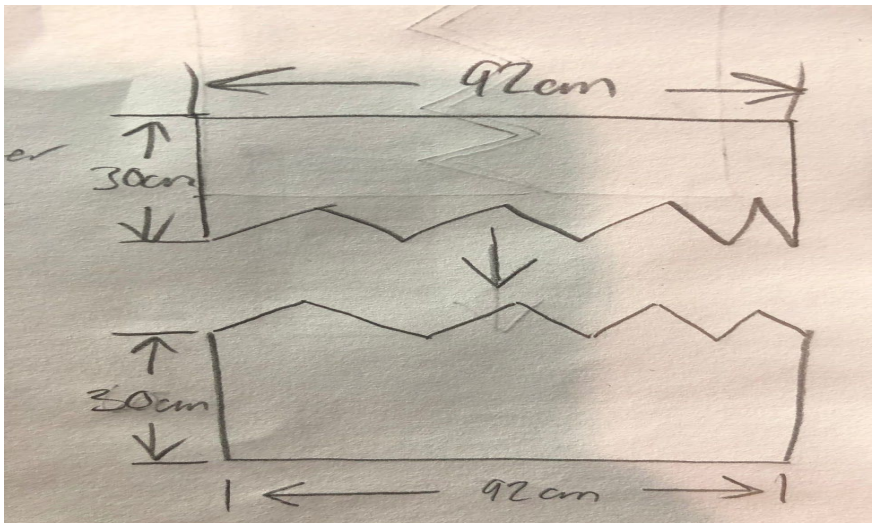
Very simple, possible extra storage.

Drawbacks ?

Too many large pieces, possibly not very stable.

5.7 Design Idea 7(Leena)





Does it satisfy the metrics? (YES / NO / UNSURE)

1:unsure
2:unsure
3:yes
4:yes
5:yes
6:yes
7:yes

Feasible? (YES / NO / UNSURE)

yes

Innovative? (YES / NO)

yes

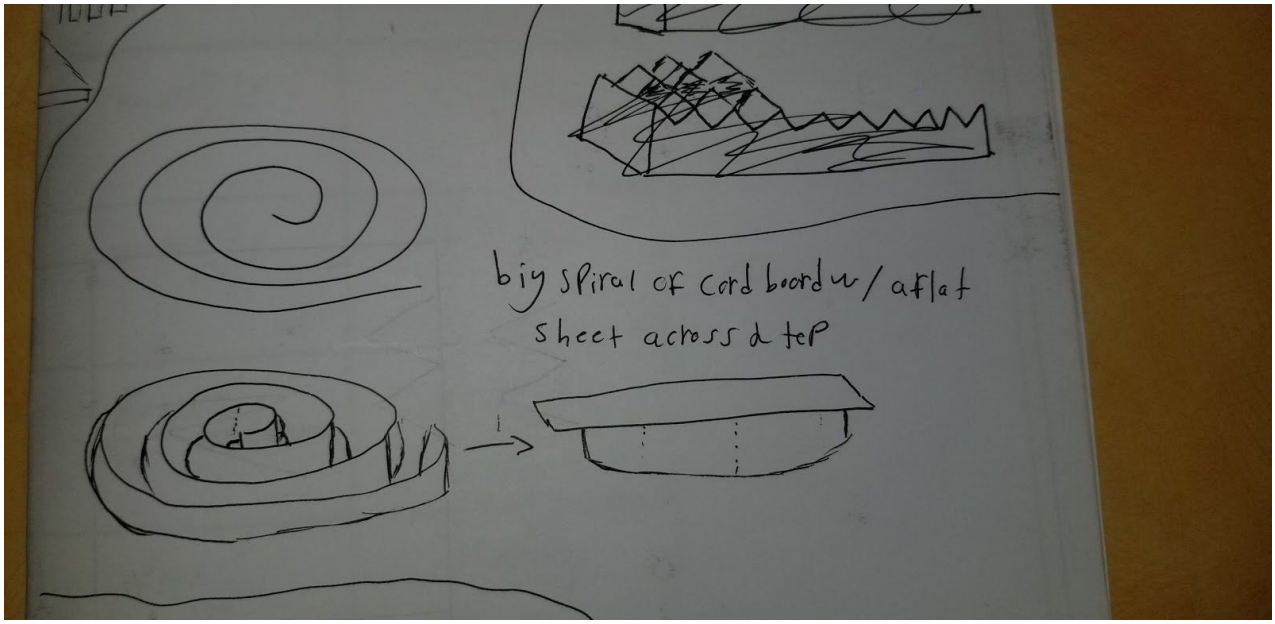
Benefits ?

Strength, stability, quick assembly time

Drawbacks ?

Lower compactness ratio than other designs

5.8 Design Idea 8(Justin)



Does it satisfy the metrics? (YES / NO / UNSURE)

1:unsure
2:unsure
3:yes
4:yes
5:yes
6:no
7:yes

Feasible? (YES / NO / UNSURE)

yes

Innovative? (YES / NO)

yes

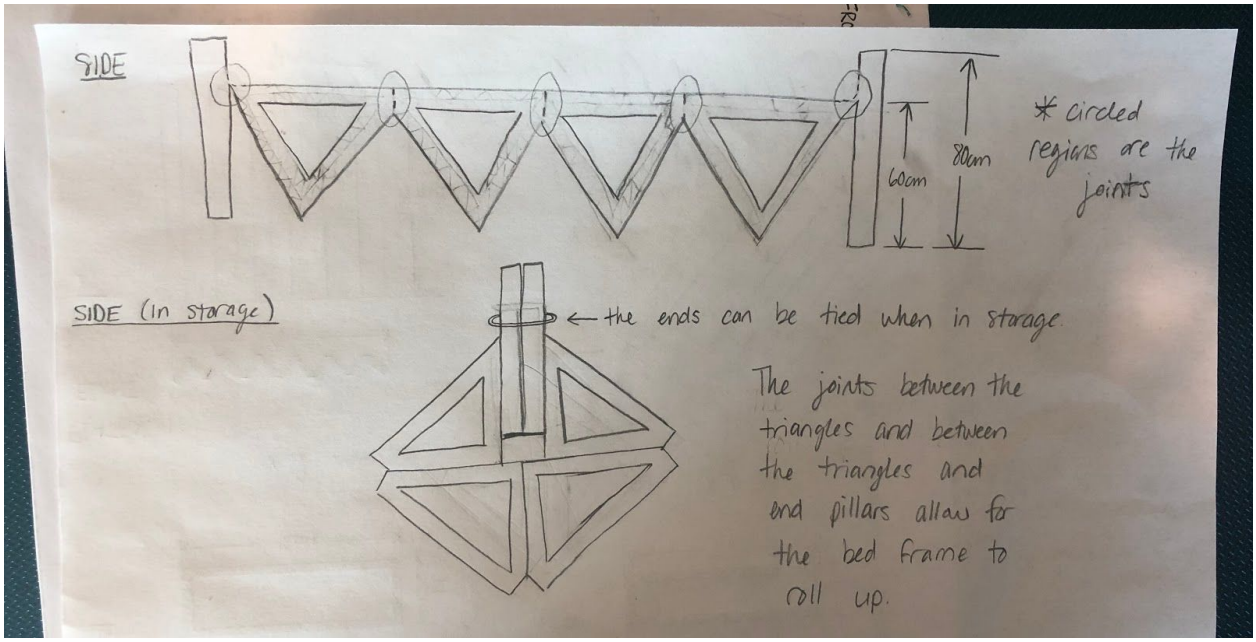
Benefits ?

Extremely simple, very compact when rolled

Drawbacks ?

Low stability

5.9 Design Idea 9 (Leena)



Does it satisfy the metrics? (YES / NO / UNSURE)

1:unsure
2:unsure
3:yes
4:yes
5:yes
6:no
7:yes

Feasible? (YES / NO / UNSURE)

unsure

Innovative? (YES / NO)

yes

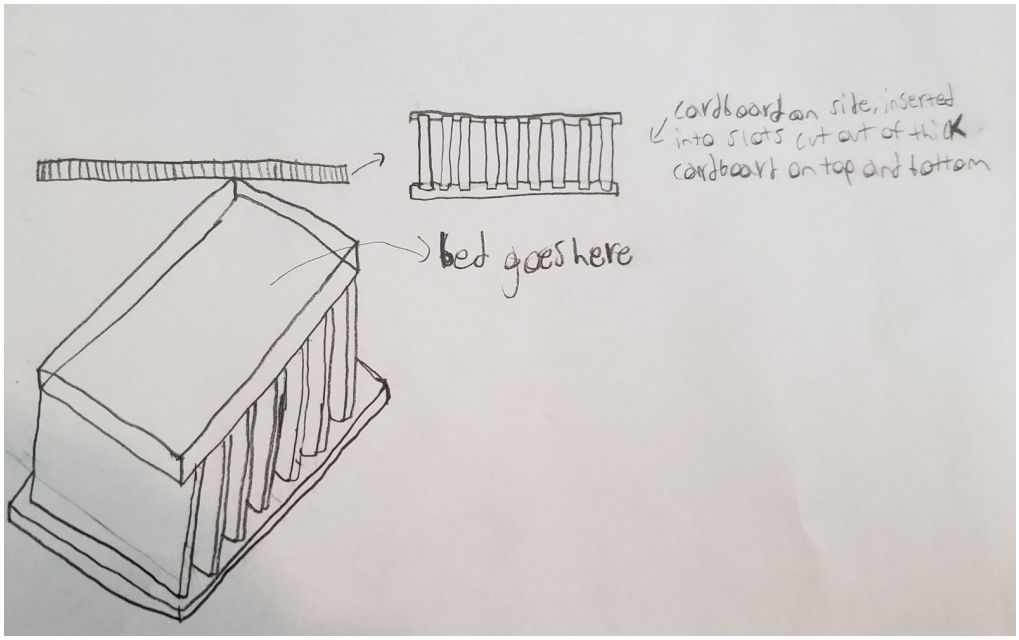
Benefits ?

Easy to assemble, compact

Drawbacks ?

Low stability, may be unfeasible

5.10 Design Idea 10 (Owen)



Does it satisfy the metrics? (YES / NO / UNSURE)

1. Unsure
2. Unsure
3. No
4. Yes
5. Yes
6. Yes
7. Unsure

Feasible? (YES / NO / UNSURE)

yes

Innovative? (YES / NO)

yes

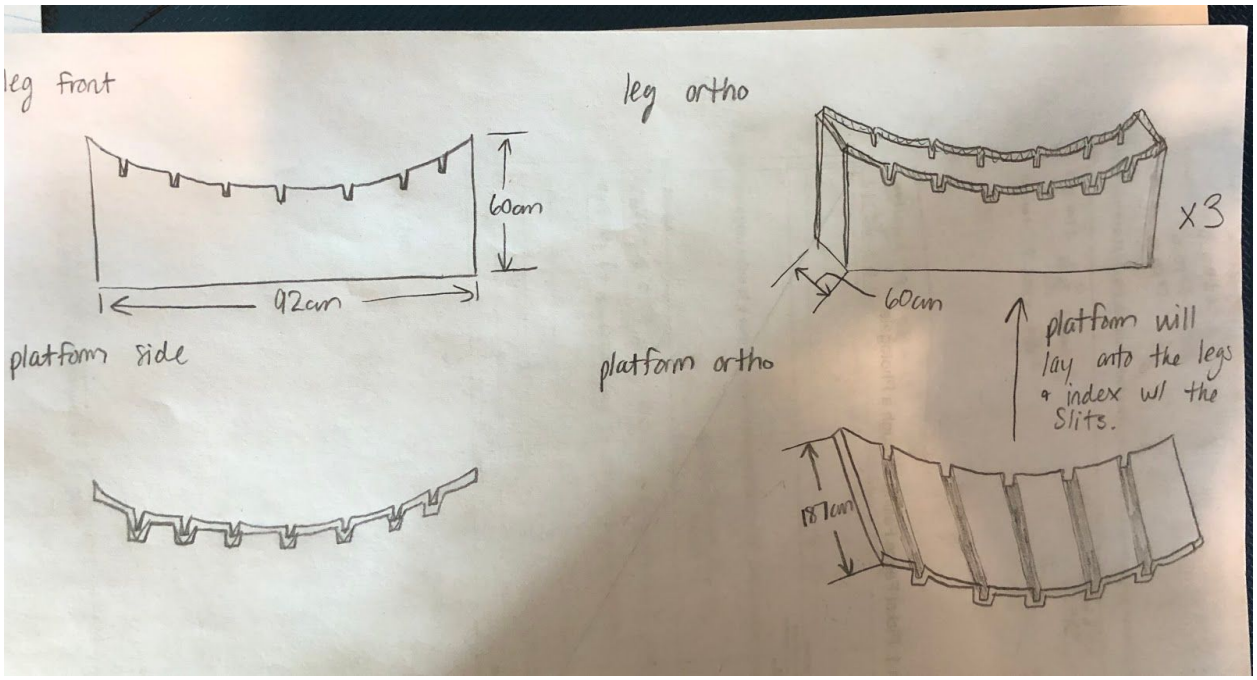
Benefits ?

Very structurally sound, simple

Drawbacks ?

Not able to be compacted, not lightweight, not very cost effective, not easily transportable

5.11 Design Idea 11 (Leena)



Does it satisfy the metrics? (YES / NO / UNSURE)

1:unsure
2:unsure
3:no
4:yes
5:yes
6:yes
7:yes

Feasible? (YES / NO / UNSURE)

yes

Innovative? (YES / NO)

yes

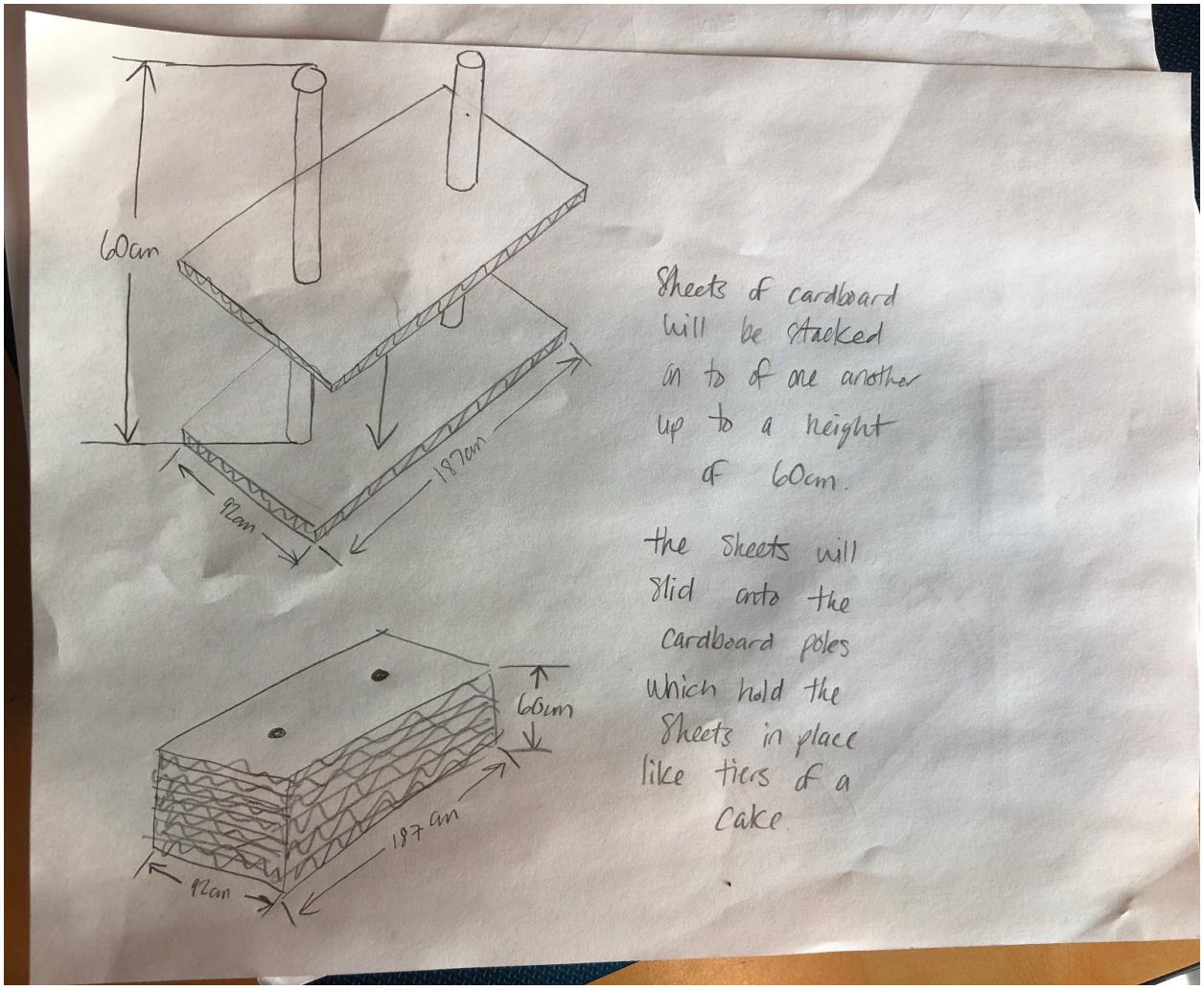
Benefits ?

stability

Drawbacks ?

Low compactness ratio, complex shapes

5.12 Design Idea 12 (Leena)



Does it satisfy the metrics? (YES / NO / UNSURE)

1: unsure, likely not
2: yes
3. no
4: yes
5: yes
6: yes
7: unsure, likely not

Feasible? (YES / NO / UNSURE)

Yes

Innovative? (YES / NO)

No

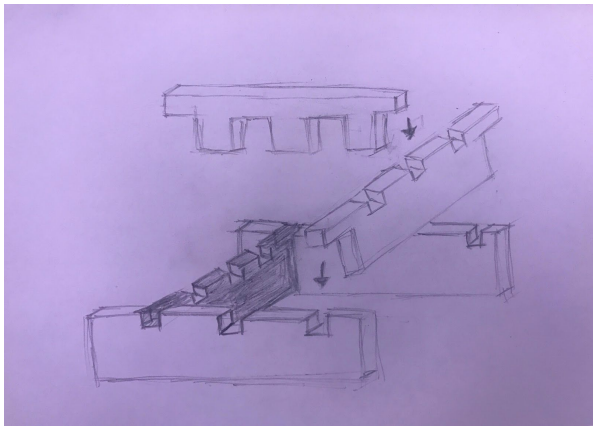
Benefits ?

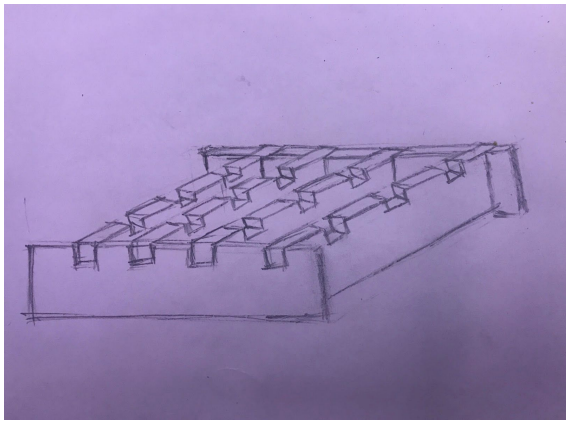
Simple, easy to put together, and take apart

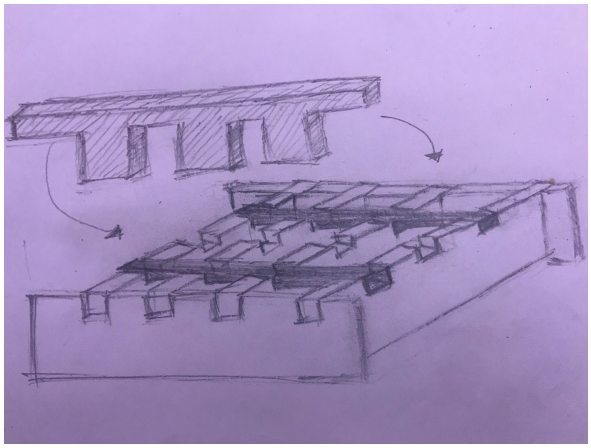
Drawbacks ?

Compactness ratio of 0%

5.13 Design Idea 13 (TEYE ADEKEYE)







Does it satisfy the metrics? (YES / NO / UNSURE)

1: unsure
2: yes
3. Yes
4: yes
5: yes, 5mins
6: yes
7: Yes

Feasible?

Yes, the combination of several interlocking cardboards for strength and stability and also compact-able and easy to transport.

Innovative?

Yes, It does not require existing mechanisms to be used and not many designs on the market use a simplified method like this.
Single sheets of corrugated cardboard piled up into a board.

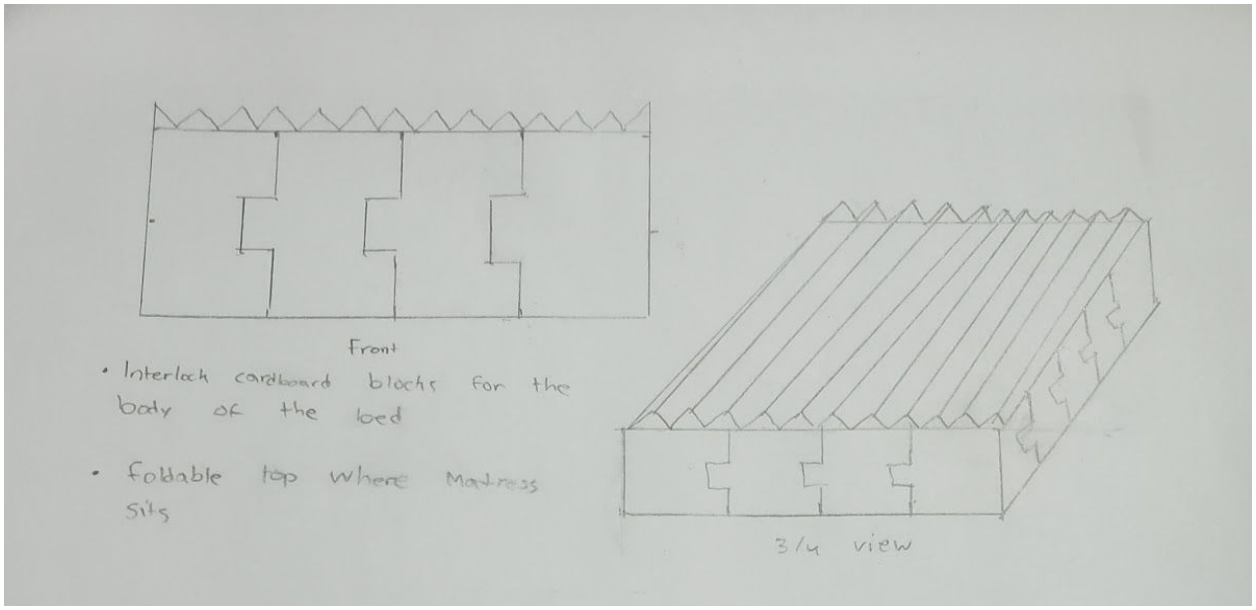
Benefits ?

Simple, easy to assemble and take apart to re-use in less than 5 minutes, very practical and efficient. Can also be used as a shelf. Use of recycled cardboards, making the design renewable.

Drawbacks ?

Potentially cost a little over budget

5.14 Design Idea 14 (Shivam Syal)



Does it satisfy the metrics? (YES / NO / UNSURE)

1: unsure
2: unsure
3. yes
4: yes
5: yes
6: yes
7: unsure

Feasible? (YES / NO / UNSURE)

Yes

Innovative? (YES / NO)

No

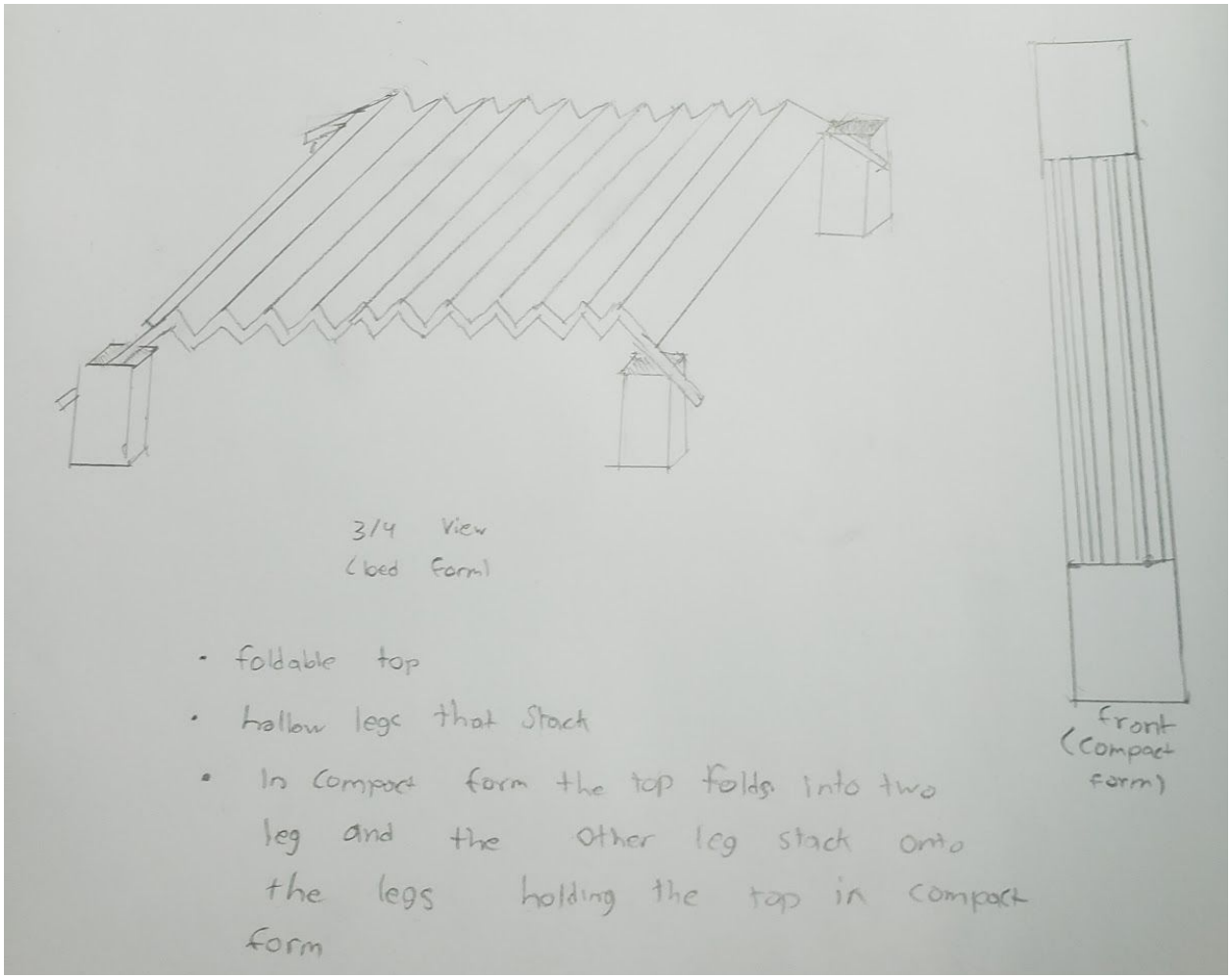
Benefits ?

Simple to put together, fairly compatible, strong.

Drawbacks ?

Requires a fair amount of cardboards, so it may cost over a 100 dollars.

5.15 Design Idea 15 (Shivam Syal)



Does it satisfy the metrics? (YES / NO / UNSURE)

1: unsure
2: unsure
3. yes
4: yes
5: yes
6: unsure
7: unsure

Feasible? (YES / NO / UNSURE)

Yes

Innovative? (YES / NO)

Yes

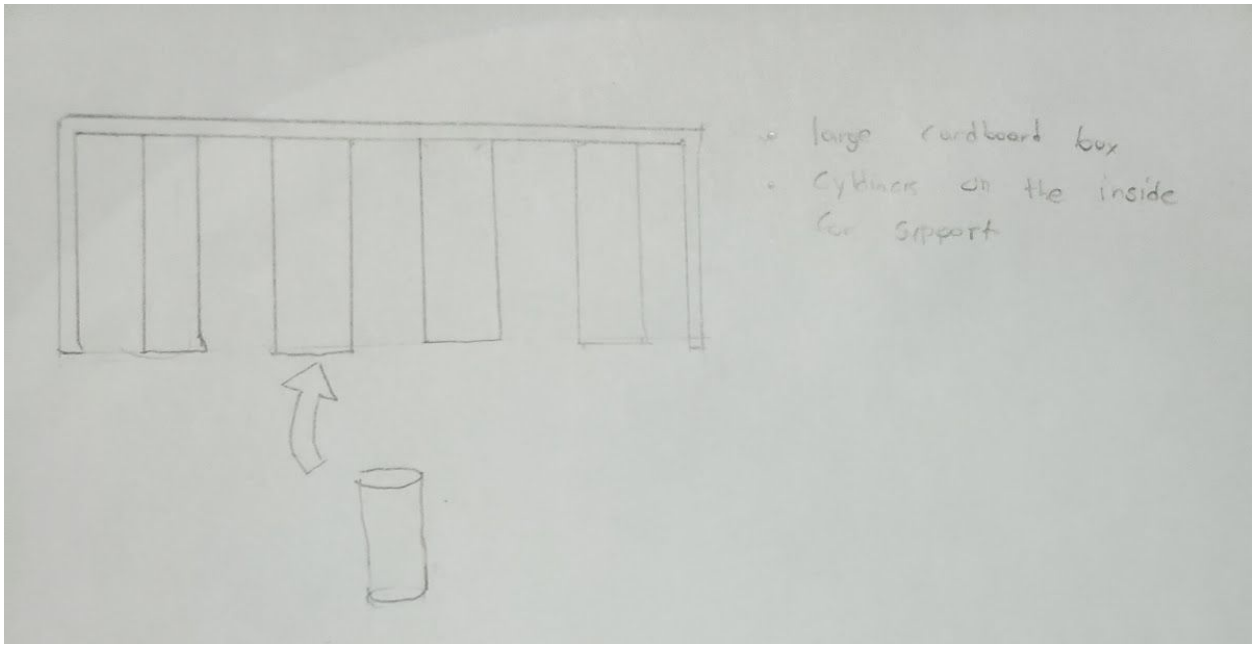
Benefits ?

Simple to put together, very compatible, extremely portable.

Drawbacks ?

Bed has a weak point in the center, therefore the center may become weak after multiple uses.

5.16 Design Idea 16 (Shivam Syal)



Does it satisfy the metrics? (YES / NO / UNSURE)

1: unsure
2: unsure
3. no
4: yes
5: yes
6: yes
7: unsure

Feasible? (YES / NO / UNSURE)

Yes

Innovative? (YES / NO)

No

Benefits ?

Simple to put together, strong.

Drawbacks ?

The bed is not compatible and therefore not very portable.

6.0 Analysis of Solutions

Table 3: Decision Matrix for all Design Ideas

Table 4 : Decision Making Criteria

Criteria	Weighting
Strength	40 %
Lifespan	20 %

Compactness Ratio	5 %
Dimensions	15 %
Ease of Assembly	5 %
Stability	10 %
Cost	5%

Table 5 : Evaluation of Performance

Common Scale	
Performance Level	Value
Perfect	5
Very Good	4
Good	3
Satisfactory	2
Poor	1

6.1 Design Selection:

Considering the weighting analysis performed based on the design criteria, the best design with the highest weight is idea 7 which includes inspiration from idea 1 and idea 11. The team decided to use the decision matrix because it shows a clearer comparison of all design prototypes based on the given design criteria. This is much easier to understand. The rows tie into our specifications, so that when we are ranking our solutions we rank what is important for the client.

Table 4. Decision Matrix with Top 3 Design Ideas

Design Criteria (weighting)	**Idea 7**	**Idea 1**	**Idea 11**
Strength (5)	2	1	3
Longevity (3)	2	1	2
Compactness Ratio (3)	2	3	1
Dimensions (3)	2	2	2
Ease of Assembly (3)	3	2	1

Stability(5)	3	1	3
Cost(2)	1	3	1
Score	**54**	**40**	**50**

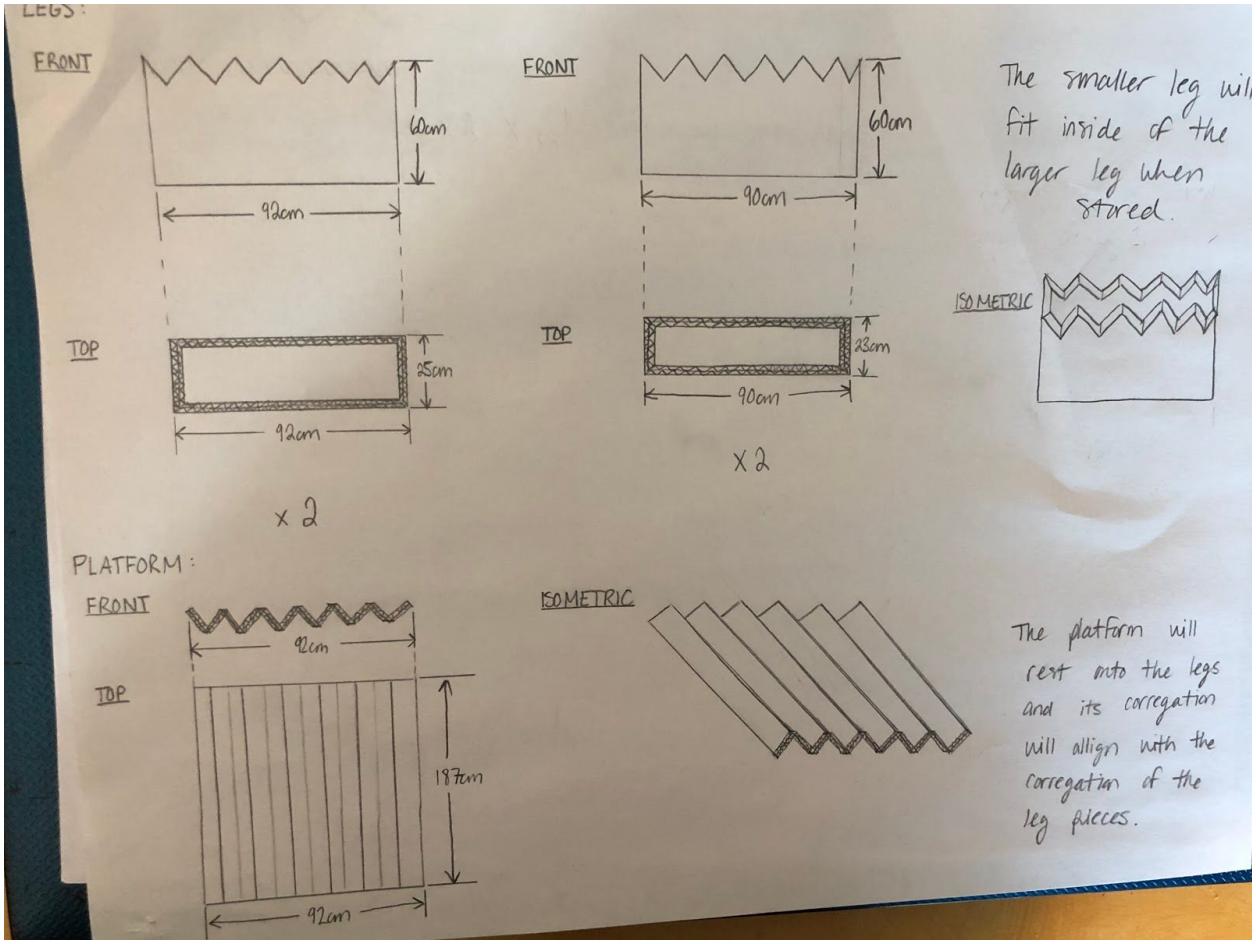
Top 3 Designs

- Design Idea 7 (5.7) , Design Idea 1 (5.1), Design Idea 11 (5.11)

7.0 Final Design Concept/ Diagram

The final design concept chosen for this project is the prototype which provides the best strength and stability, and good compactness

This design was chosen because it is an integration of our top three weighted designs on the decision matrix. These ideas complement each other well, and if done properly, can achieve our ideal specifications.



BENEFITS: High stability and strength, easy to assemble and disassemble

DRAWBACKS: Compromised slightly on compactness to achieve a more functional product

8.0 Conclusion

Each design provided different and unique concepts. The top three designs were designs 1, 7 and 11. From these three design ideas, we integrated different concepts into our final design. However, it was mostly influenced by design 7, which was the best overall as decided by the second decision matrix. The final design incorporates the hollow block leg idea taken from design 7 and 11. The legs will have a corrugated top to provide strength as this design evenly distributes forces exerted at the points. The final design involves four legs: two with the dimension 92 cm x 25cm, the other two with the dimension 90cm x 23cm. The legs are made with different dimensions so that the smaller legs can be put inside of the larger legs when in storage. The corrugated platform top can be folded up like an accordion. In terms of the metrics, the design uses minimal amounts of cardboard, making it lightweight. The structure should be very strong and as a result, there will be no/minimal failure points and thus will make the bed frame last for a long time. The platform can be folded, making it more compact. Unfortunately the platform cannot be compacted length-wise. The design is very easy to understand and to set up. We predict it can be set up in under 5 minutes. The legs cover a considerable surface area of the ground and will be spaced out to evenly disperse the forces exerted on the bed by the user, so we expect it to be very stable. Again, the design uses minimal amounts of cardboard, which lowers the cost of the bed. Overall, we are pleased with our final design and are confident in moving forward to the prototyping and client feedback stages with our selected design.