



Adaptable Recliner Bed

Submitted in partial fulfillment of the requirements of the degree of

Masters of Design

by

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22M2234

Project guide

Prof. B. K. Chakravarthy



IDC School of Design

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
(2024)

Approval form

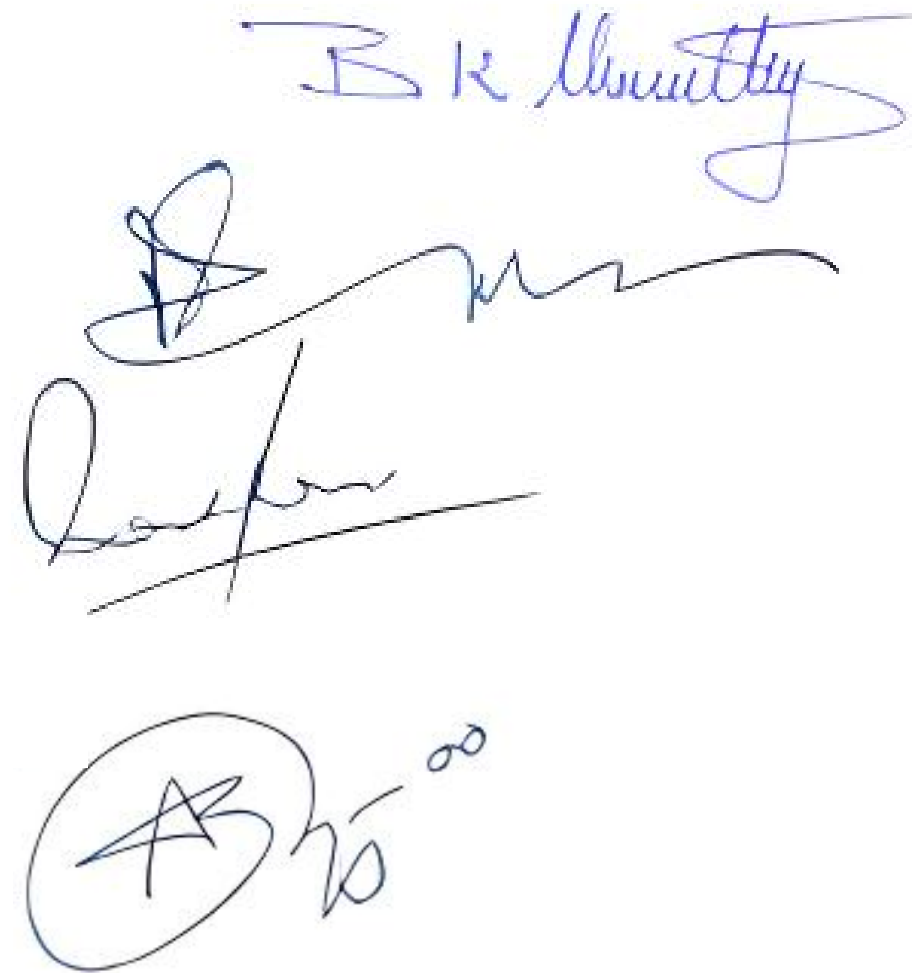
This document serves as official confirmation that the Industrial Design Project titled "**Adaptable Recliner Bed**" authored by Infant *Tarun Pahadiya* has been sanctioned for partial fulfillment in pursuit of the Master of Design degree in Industrial Design.

Prof. B. K. Chakravarthy
[project guide]

Signature of the
Internal Examiner

Signature of the
chair person.

Signature of the
External Examiner



Declaration form

I declare that this written submission represents my ideas in my own words and, where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented, fabricated, or falsified any idea, data, fact, or source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Tarun

Signature:

Name of the student: Tarun Pahadiya

Roll number: 22m2234

Abstract

The "Adaptable Recliner Bed" project focuses on creating an ergonomic and versatile bed that enhances both sleep quality and productivity. Collaborating with Recliners India and guided by Prof. B. K. Chakravarthy, the project aims to address the ergonomic needs of users by offering a bed that adapts to various postures and activities, promoting health and comfort.

Incorporating smart technology, the bed allows adjustments in firmness, temperature, and position through manual or automated controls, catering to individual preferences. The project also embraces a DIY approach, encouraging users to personalize their furniture, enhancing their sense of ownership.

The research phase involved secondary market research and primary research, including visits and interviews with stakeholders. The findings highlighted the demand for smart, adaptable furniture and the need for ergonomic solutions to prevent health issues related to poor posture. The design phase included brainstorming and the development of multiple concepts, with a final design integrating advanced ergonomic features and smart technology.

Prototype development included detailed CAD modeling and physical prototypes, tested and refined based on user feedback. The project also focused on aesthetics and material selection, achieving a modern, sleek design that fits various interiors.

The final product, showcased in a photoshoot, is an adaptable recliner bed that meets ergonomic needs and aligns with contemporary design trends. The project exemplifies the benefits of smart furniture in everyday life, offering a functional and aesthetically pleasing solution. It highlights the importance of interdisciplinary collaboration, rigorous research, and a user-centric design process, contributing significantly to the field of ergonomic furniture design and setting a standard for future innovations in smart furniture.

Acknowledgement

I wish to convey my sincere appreciation to my mentor, '*Professor B. K. Chakravarthy*', for his indispensable guidance throughout the project. I extend my special thanks to the professors of the Industrial Design Department and '*Recliners India's team*' for their constructive critiques and valuable guidance. My gratitude also extends to all the instructors, staff, and students at the Industrial Design Centre (IDC) for their unwavering assistance, insightful advice, and helpful suggestions. I am particularly thankful to our lab assistants for their technical guidance. Lastly, I would like to express my deep appreciation to my family and friends for their steadfast support.

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Introduction

Overview of the project

The project involves the redesign of an adjustable ergonomic bed to meet the evolving needs of users, particularly focusing on improving sleep quality and addressing health concerns related to improper posture. By incorporating smart features and DIY elements, the goal is to create a product that promotes user engagement and customization. Additionally, this project aims to study the Indian market and needs, developing a furniture solution that will be accepted by Indian customers, aligning with their lifestyle and budget. Furthermore, the objective is to make it profitable for manufacturers, enabling them to overcome existing competition in the market.

What is a Smart bed?

A smart bed incorporates advanced technology features to enhance sleep quality and overall health. These beds are equipped with tech which can control bed's firmness, temperature, and position like features automatically, optimizing comfort and support tailored to individual needs. Additionally, smart beds often integrate with mobile apps or home automation systems, allowing users to track their sleep patterns, make manual adjustments, and receive personalized insights to improve sleep health. This integration of technology into traditional bedding represents a significant step forward in personalized health and wellness management.

Why Smart bed?

The primary appeal of a smart bed lies in its ability to enhance sleep quality through personalized settings. Smart beds can adjust various aspects such as firmness and temperature to ensure optimal sleep conditions tailored to individual needs. This not only helps achieve deeper, more restful sleep but also improves overall comfort throughout the night.

- **Enhanced Comfort**
- **Improved sleep quality**
- **Health and Wellness Monitoring**
- **Personalized Sleep Experience**

WHAT IS DIY?

DIY (Do-It-Yourself)

DIY, or "Do It Yourself," refers to the practice of creating, modifying, or repairing things without the direct aid of experts or professionals. This approach allows individuals to personally undertake projects and tasks in various domains such as home improvement, crafting, and technology. DIY promotes self-reliance, creativity, and innovation, often leading to a more personalized and cost-effective result than purchasing ready-made products or hiring professionals.

The popularity of DIY has grown with the availability of online tutorials, resources, and communities that offer step-by-step guides and support for a myriad of projects. This movement empowers people to take control of their environment and learn new skills, making it a fulfilling and practical pursuit.



Internet

How we can use DIY?

DIY as a Design Feature

Products, systems, or kits designed for DIY activities are specifically tailored to empower end-users to engage in self-directed projects. These items are typically modular and customizable, allowing individuals to adapt them according to their specific needs and preferences. They often come with detailed instructions or the necessary tools to facilitate assembly or modification.

This design approach not only enhances the user's ability to perform DIY tasks with greater ease and efficiency but also promotes a deeper understanding of how the product works. By involving the user in the assembly or customization process, these products foster a sense of accomplishment and ownership, making the DIY experience both educational and enjoyable.



Internet

IDC Projects

I have conducted a thorough review of previous projects related to furniture design, examining the methodologies employed by other students and the challenges they encountered. This research has provided valuable insights into the process of product development and problem-solving within this domain. Moving forward, I will take these considerations into account to refine my approach and enhance the effectiveness of my project.

Industrial Design Project-3

TRANSFORMABLE FURNITURE

Ibynta B Tiewsoh

10613005

Guide:

Professor Purba Joshi

Co. Guide:

Professor N. Sadhu

DESIGN OF FURNITURE SYSTEMS FOR AFFORDABLE HOUSING - FITTING MORE IN VOLUME

INDUSTRIAL DESIGN PROJECT II

IDP602

BY

VISHAL BHUSHAN JHA

146130008

GUIDE: PROF. VIJAY P. BAPAT

CO-GUIDE: PROF. U A ATHAVANKAR



INDUSTRIAL DESIGN CENTRE

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

2015

Designing of furniture system of affordable housing.

-By VISHAL BHUSHAN JHA

Under Prof. Purba Joshi

Transformable furniture

-By Ibyanta B

Under Prof. Bapat

First frame for bed above and ladder

phase 1 finished

Phase 2 finished with platform

Phase 3 finished

Final phase finished

Final design details:

- The Bracket is removed and the flang length is reduced.
- The beams are rotated so that the open side of closed C cross section faces towards wall and not down. This is done for aestical purpose but also provides many structural and assembly benefits.
- beams above the column where mezzanine floor panel is resting is made with a step in it for the plank to just sit on it. This will make the assembly and disassembly easy and faster.
- there are M10 bolts used at all the column frame fixing area for extra stability.
- At frame to frame joining, M5 bolts are used.
- The house develops in 4 phases and people buy what they can phase wise and draw the house.

Fig. 44 Fitting details explorations

exploded view

Assembly

Corner detail

Using Tapped Flanges and brackets:

- The detail was further modified into Flanges with Tapped holes which supported the frame on Columns.
- Here the need for replacing a L-joint with T-joint structur is eliminated and we can just add a flange to extend the structure
- Extra brackets are there for additional stability and aesthetical features
- actual scale prototype of a corner detail was made to check the ease of assembly and aesthetics.

It was realised that the structure looks too bulky and unappealing, hence the decision to eliminate the brackets and make the frames slimmer was taken.

Fig. 45 Exploration of approach with tapped flanges

Detail 1

Detail 2

Detail 3

Detail 4

Fig. 39 3d view of working layout. Details to be referred in Fig. 40

Scenario

5000

4000

BATH

KITCHEN

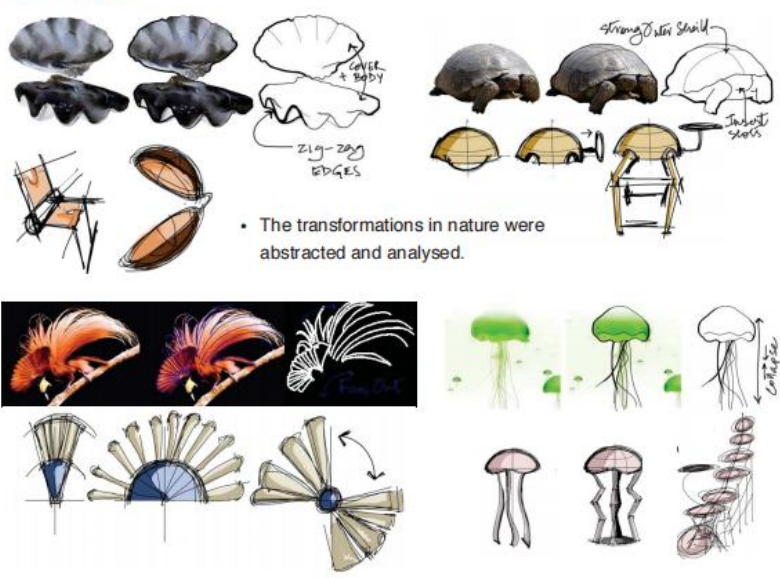
•The above plan is of an one room apartment i had studied. Its 5m x 4m in area with an attached kitchen and bath.

•The main room is used for sleeping, working,dining, entertaining friends and storage purposes.



Exploration

• The transformations in nature were abstracted and analysed.



Rig testing of concept # 3

Single sitting

Work unit

Extended recliner

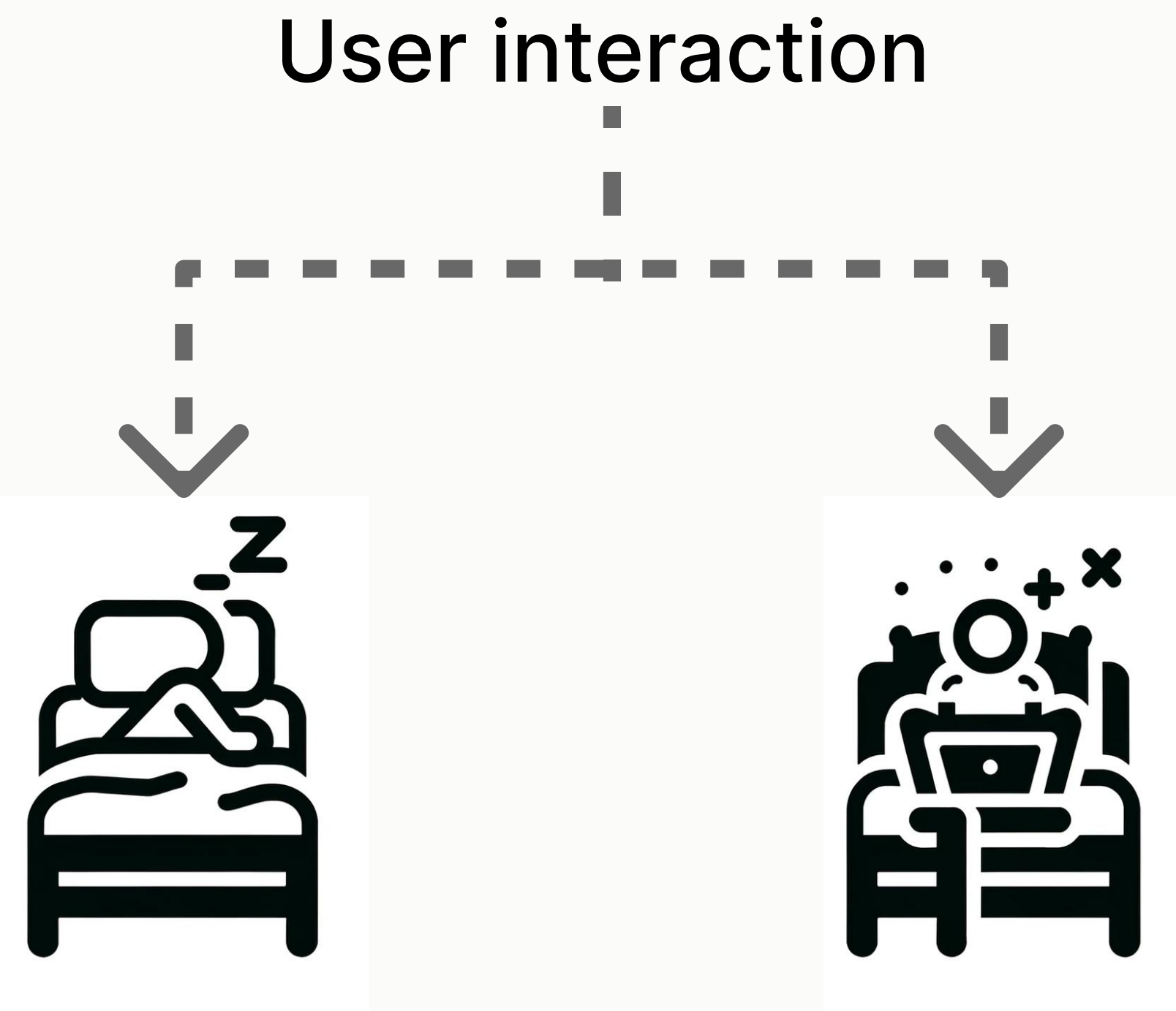
Double sitting plus coffee table

Storage for books, magazines...

5

User Interaction study

On the left, the bed is depicted in a position suitable for rest, either lying flat or slightly inclined, conducive to states ranging from semi-conscious to unconscious. This setup is ideal for sleep or relaxation, emphasizing comfort. On the right, the bed can be adjusted to an inclined or sitting position, supporting activities that require alertness and engagement, such as working on a laptop or eating. This adaptability highlights the bed's versatility in accommodating various user needs throughout the day, seamlessly transitioning between relaxation and productivity.



Position: lying (flat/inclined).

Motive: Rest.

State: Semi/Unconscious.

Position: Inclined or Sitting.

Motive: Working, eating, etc.

State: Conscious.

Possible related issues



Issues due to improper posture

- Increased Insomnia
- Less Stress on the Heart
- Decrease in Relaxation
- Decreased Lung Capacity
- Digestive Issues
- Muscle Degradation and Weakness
- Back Pain
- Improper blood Circulation
- Breathing issues
- Relief from Acid Reflux and Heartburn
- Snoring

These are the various health issues resulting from improper posture during sleep and prolonged work hours. For sleeping, incorrect posture can lead to increased insomnia, decreased relaxation, and physical issues such as decreased lung capacity, digestive problems, and muscle degradation.



Issues due to improper posture

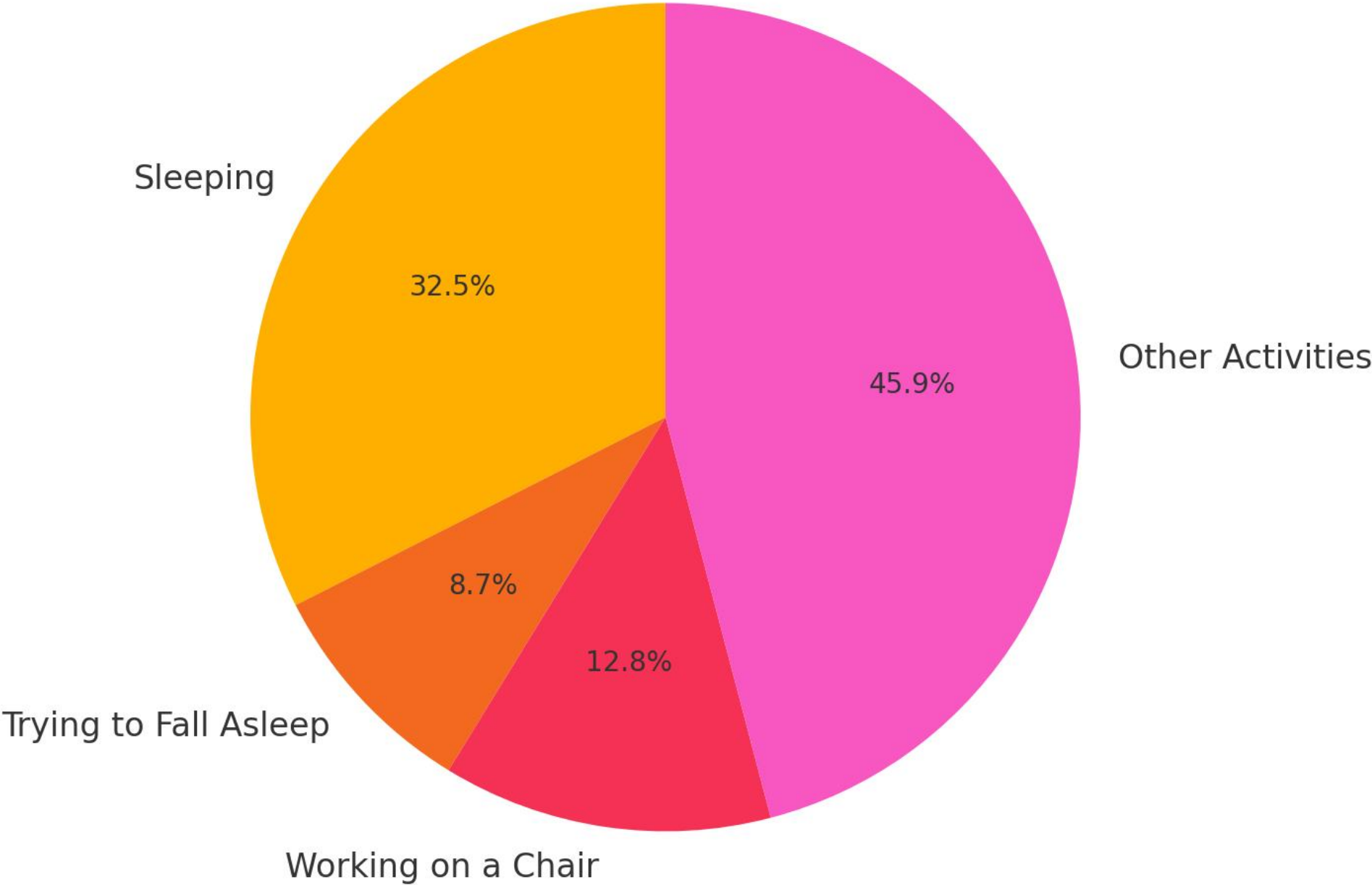
- Headaches
- Poor Concentration
- Decrease in Productivity
- Negative Impact on Mood
- Joint Wear and Tear
- Decrease in Relaxation
- Back Pain
- Neck and Shoulder Pain
- Increased Risk of Spinal Injuries
- Poor Circulation

These conditions emphasize the importance of proper spinal alignment and support during sleep to promote overall health and well-being environments.

Average time allocation of human life

The average human dedicates a substantial portion of their life to sleep, with about one-third of their existence spent in bed, amounting to approximately 26 years. In addition to sleep, people spend around 7 years just trying to fall asleep. Furthermore, the typical individual accumulates about 90,000 hours seated at work, contributing to a significant amount of time in a sedentary position. When combined, the total time spent in bed—sleeping and attempting to sleep—can reach up to 45 years over the course of a lifetime.

This highlights the immense impact that sleeping habits and work environments have on one's life, underscoring the importance of comfortable and ergonomic design in both living and working spaces.

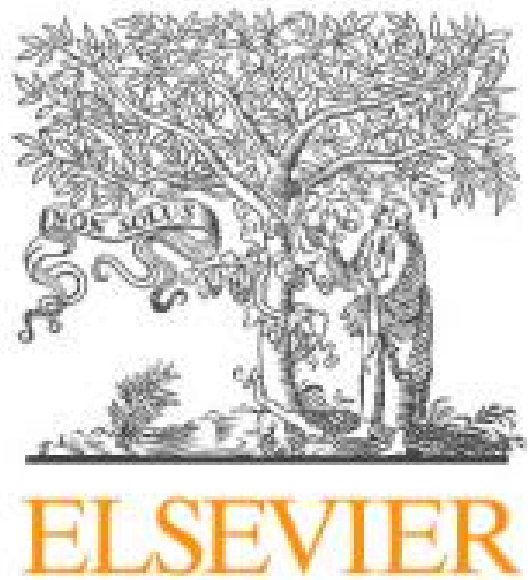


the pie chart representing the average time allocation in a human life, based on your data:

- Sleeping: 32.5%
- Trying to Fall Asleep: 8.7%
- Working on a Chair: 12.8%
- Other Activities: 45.9%

Research paper

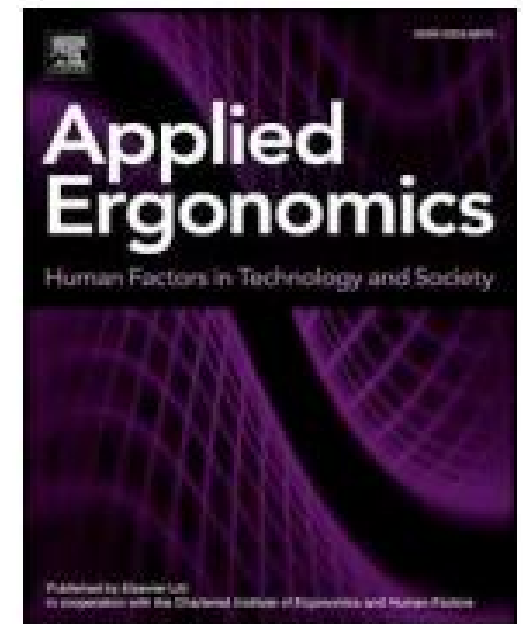
Applied Ergonomics 79 (2019) 25–37



Contents lists available at [ScienceDirect](#)

Applied Ergonomics

journal homepage: www.elsevier.com/locate/apergo



This study examines the impact of a headrest on comfort and neck muscle activity in a reclined posture while watching in-flight entertainment in business class seats. Findings indicate no significant change in muscle activity but improved expected comfort with a headrest.

The study suggests that a headrest promotes a more neutral, comfortable head position and calls for further research on headrest design and its long-term effects on comfort and muscle fatigue.

[Reference link](#)

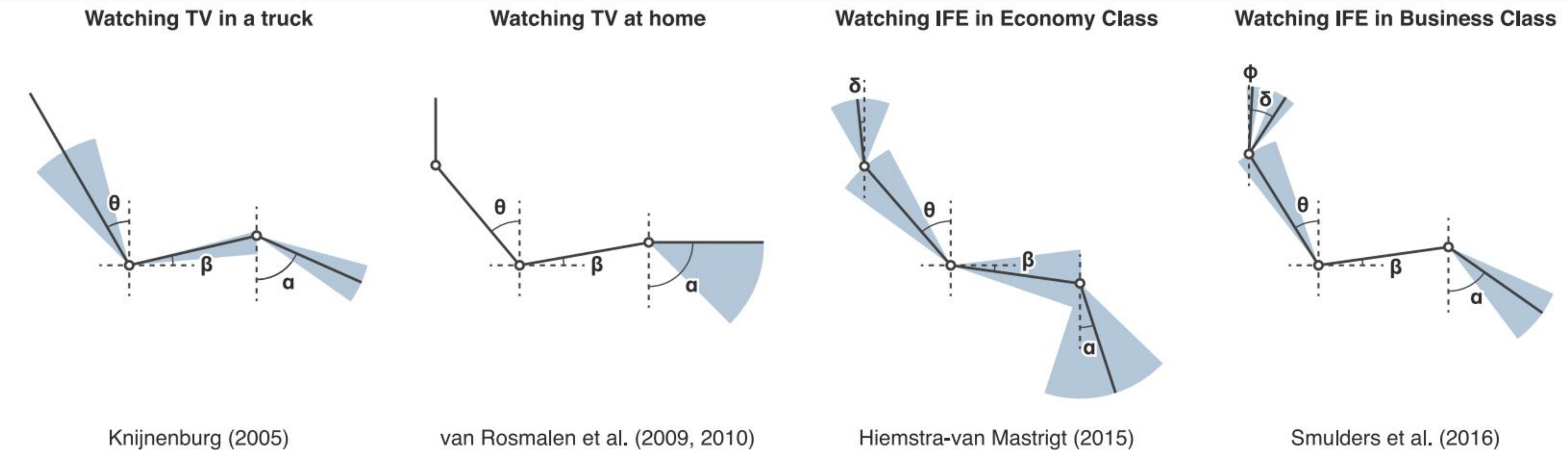


Fig. 1. 2D visual representation of seat angles as given in Table 2. Black lines represent mean values, where the blue areas represent the observed range (minimal and maximal angles, without outliers). Figure representation based on Hiemstra-van Mastrigt (2015). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article).

Most people prefer to sit in a reclined posture when watching television (TV) at home and in flight entertainment (IFE) during flight. A preferred backrest recline of 30° for watching TV in a lorry. Van Rosmalen et al. (2009, 2010) propose a backrest angle of 40° for their prototype television seat for the home, based on an experiment with an office chair.

Hiemstra-van Mastrigt (2015) found a preferred mean inclination for watching IFE in an economy class aircraft seat of 41° , where Smulders et al. (2016) found 32° for watching IFE in a business class aircraft seat.



Fig. 7. Condition B: subject sitting in the seat with headrest.

Subjects were asked to sit in the lounge seat in a slouched posture (back against reclined backrest) while resting the head against the headrest, looking forward in a preferred head angle and rest the arms in their lap.



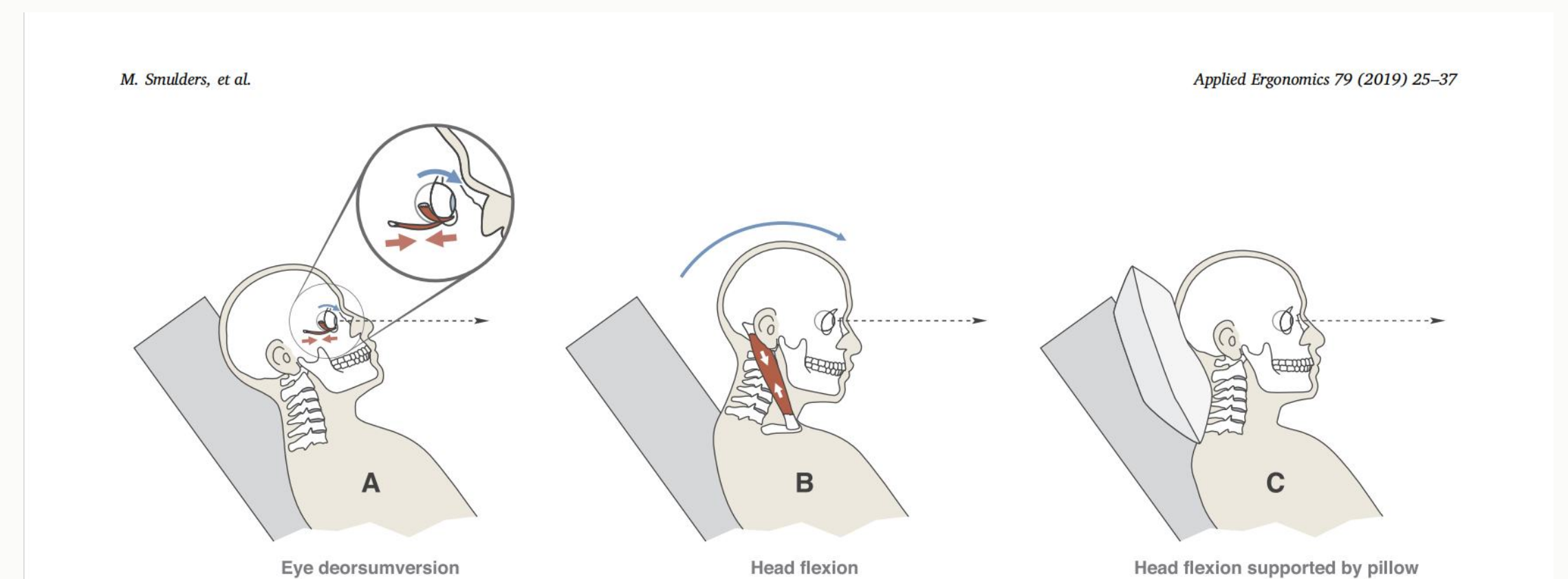
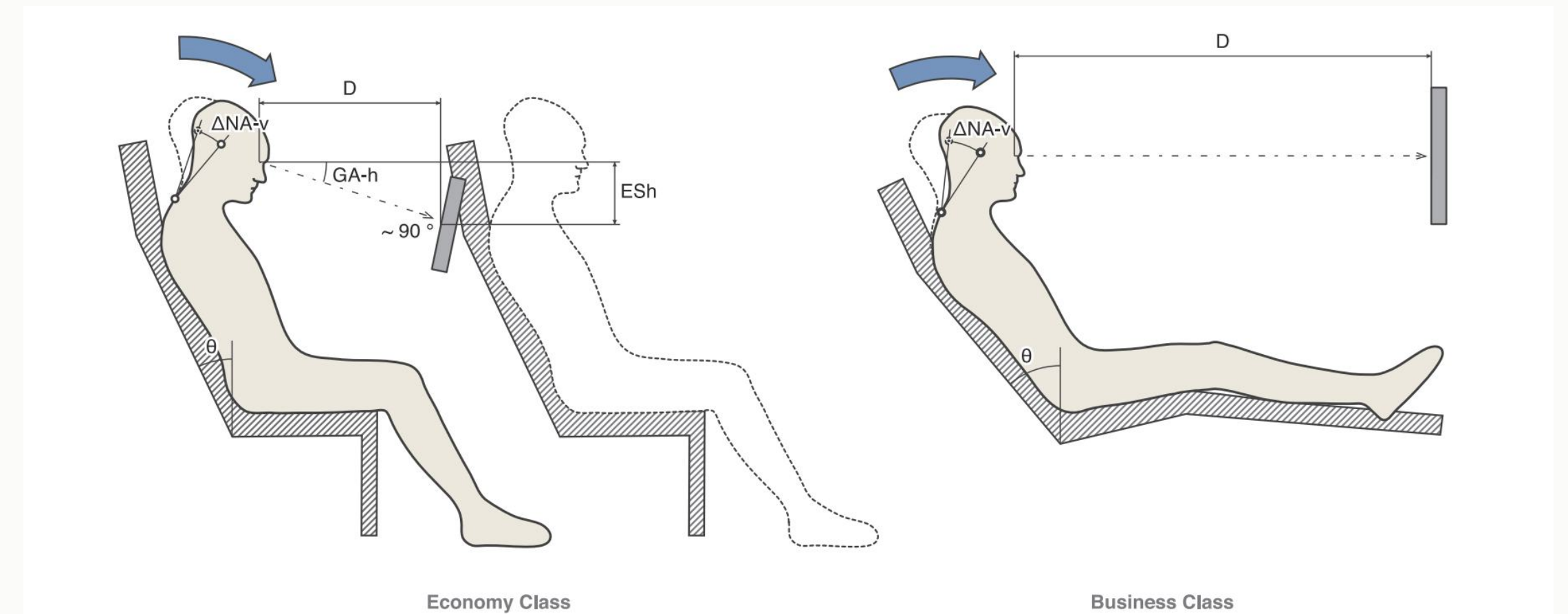
Fig. 8. Condition C: subject sitting in the seat without headrest.

The height of the IFE screen was adjusted to meet the subject's eye height with the IFE screen's centre and the height of the headrest was adjusted to make the headrest support the neck and head. Thereafter the subjects were asked to stand up and select a TED talk movie of their interests.

Holding the head upright for watching TV

According to Delleman et al. (2004) the head angle is – besides the orientation of the trunk – influenced by the viewing angle on the (IFE) screen and thus its position and orientation. Kroemer and Hill (1986) show the preferred gaze angle becomes lower as the viewing distance decreases, indicating that in economy class – where space is more scarce – an IFE screen should be below eye level and oriented perpendicular to the line of sight.

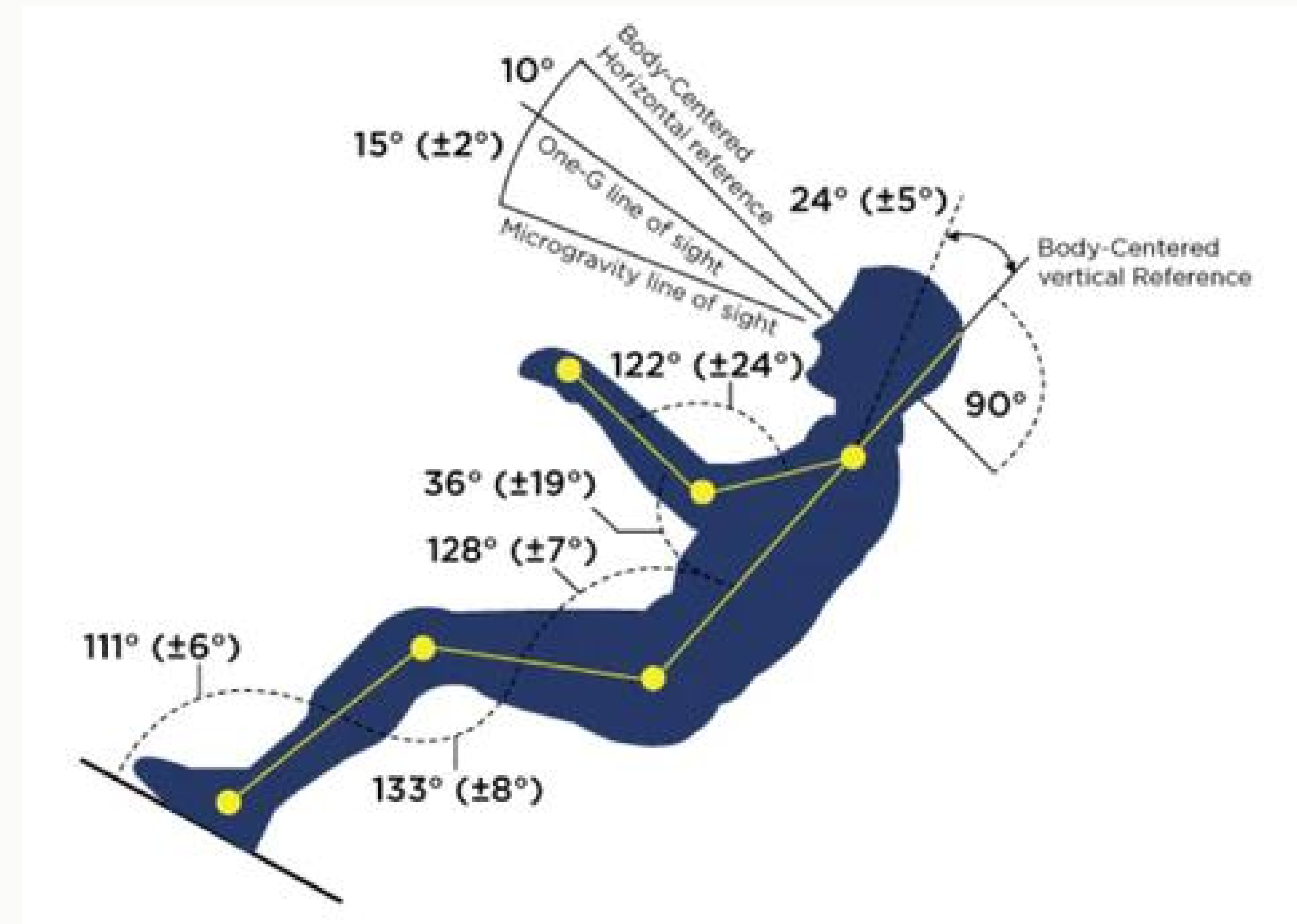
Subject watching IFE in slouched posture while A) deorsumversion of the eyes by contracting a.o. the m. inferior rectus and m. inferior oblique B) flexing the head forward with respect to the trunk by contracting a.o. the m. sternocleidomastoid and C) flexing the head forward while gaining support of a pillow (anatomical representations indicative only)."



Zero Gravity Position

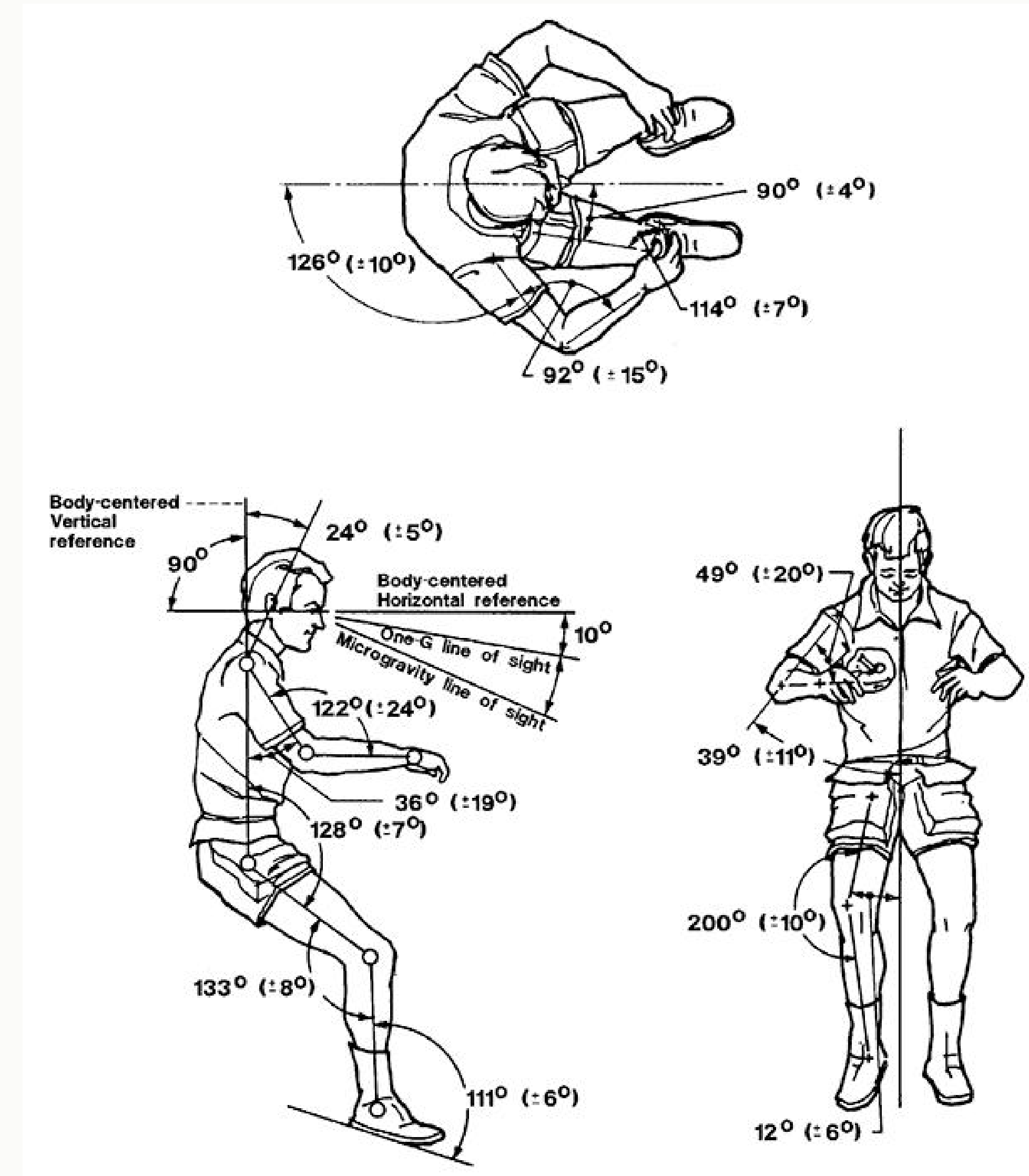
It inspired by the posture astronauts assume during liftoff to evenly distribute stress across their bodies. It has been adopted for use in various seating and sleeping solutions to promote health and comfort.

This position elevates the legs above the heart and often includes a slight bend at the knees to reduce pressure on the spine, simulating a weightlessness effect that provides numerous benefits

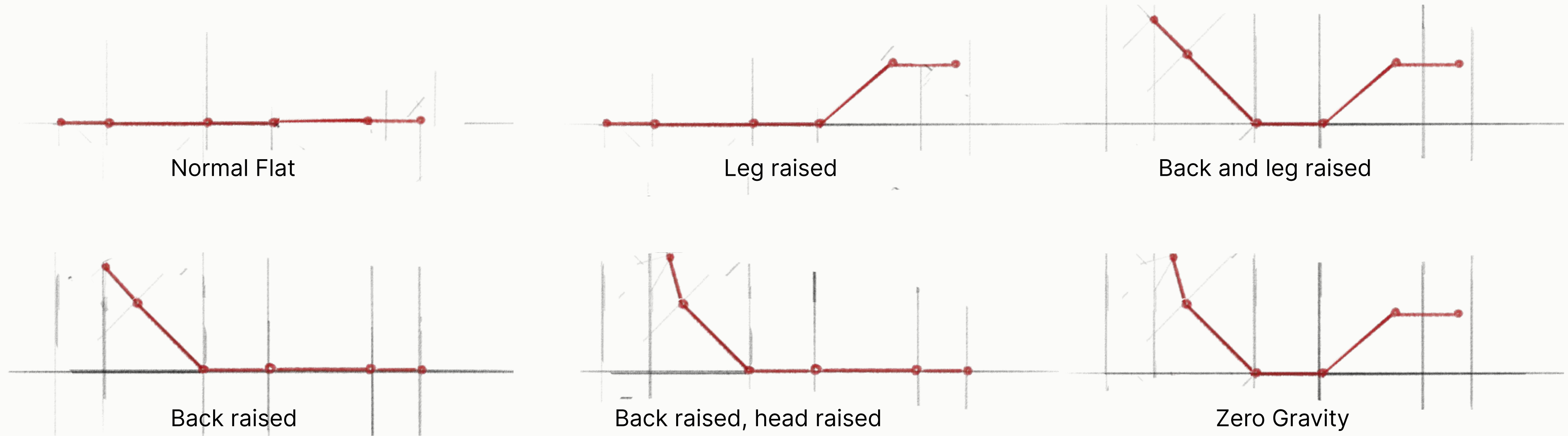




This sleeping style is particularly great for back and side sleepers, who may need even more **relief for sensitive pressure points and aches than a traditional flat bed could offer**. So, while a trip to outer space may not be on your itinerary at the moment, for now, you and your joints can at least experience a weightless, zero-gravity sensation as you sleep.



SIX-Key positions to be covered



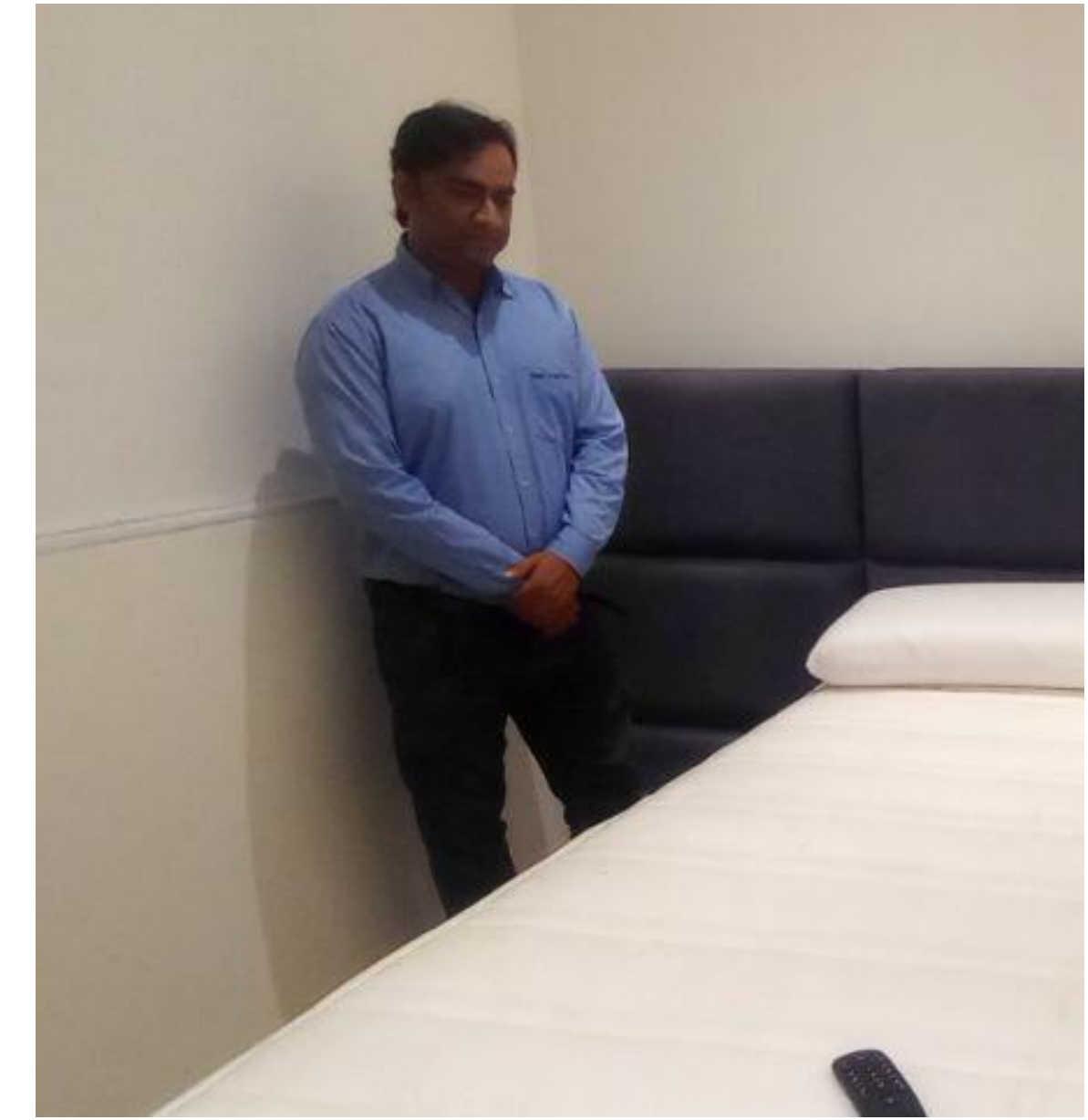
By offering a range of adjustable positions, this recliner-bed can significantly improve comfort and address health issues such as snoring, poor blood circulation, and digestive problems. Elevating the head can reduce snoring by aligning the airways, while raising the legs promotes better circulation.

Additionally, adjusting the torso section can enhance digestion by positioning the body optimally during and after eating. This multifunctional design ensures both enhanced comfort and overall health benefits.

Showroom visit (Thane, Mumbai)



Recliners India showroom
Thane, Mumbai

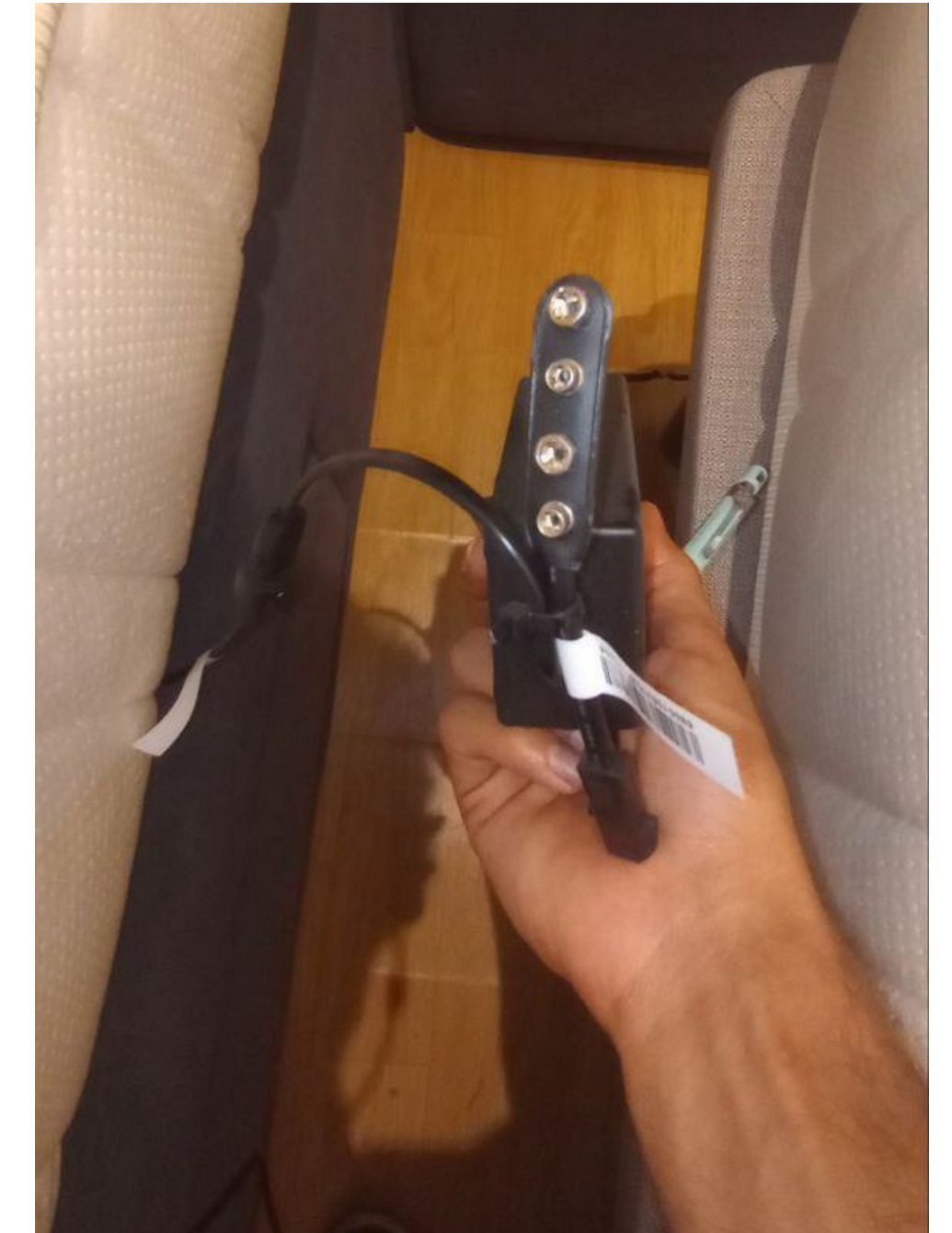
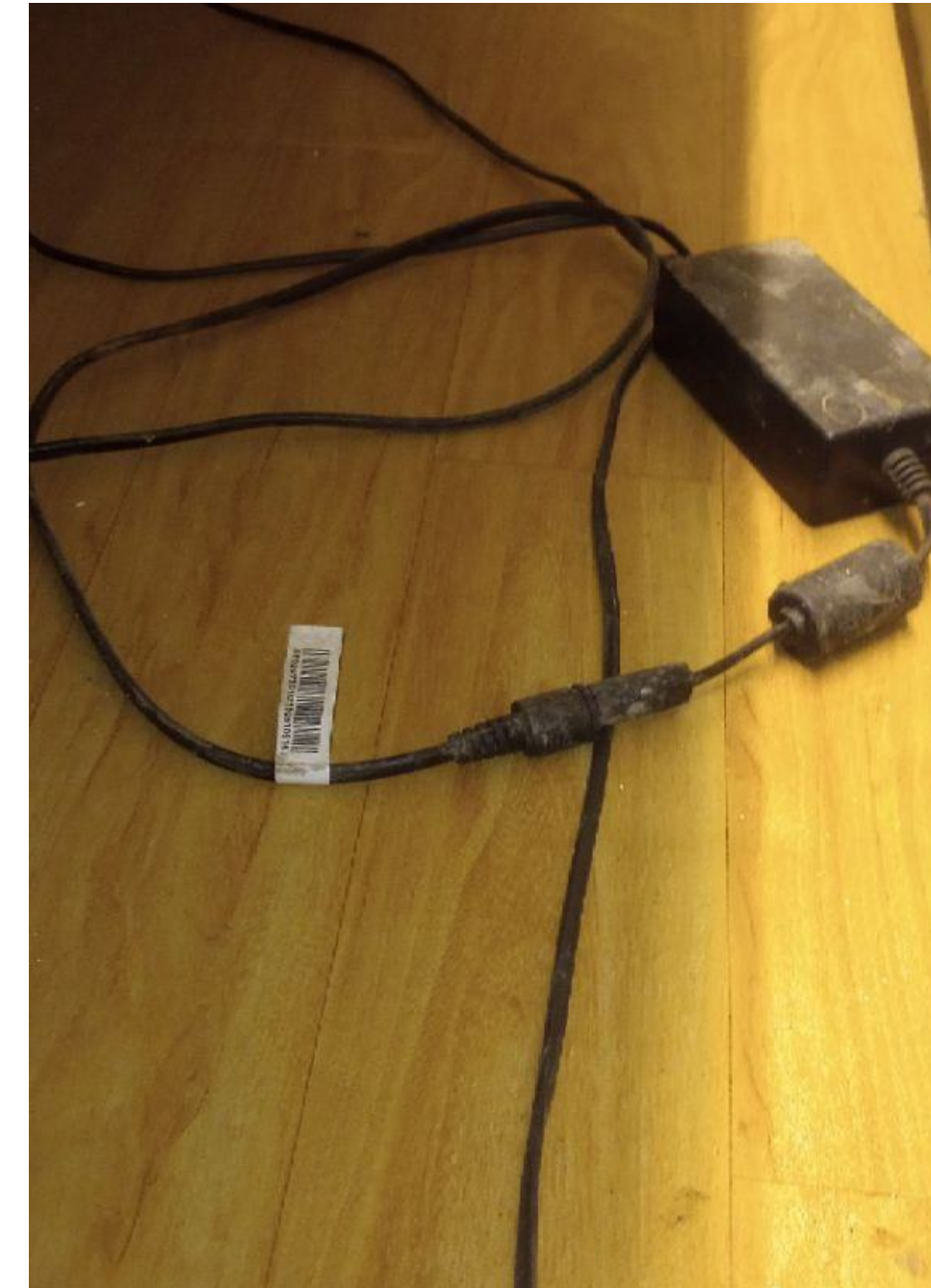
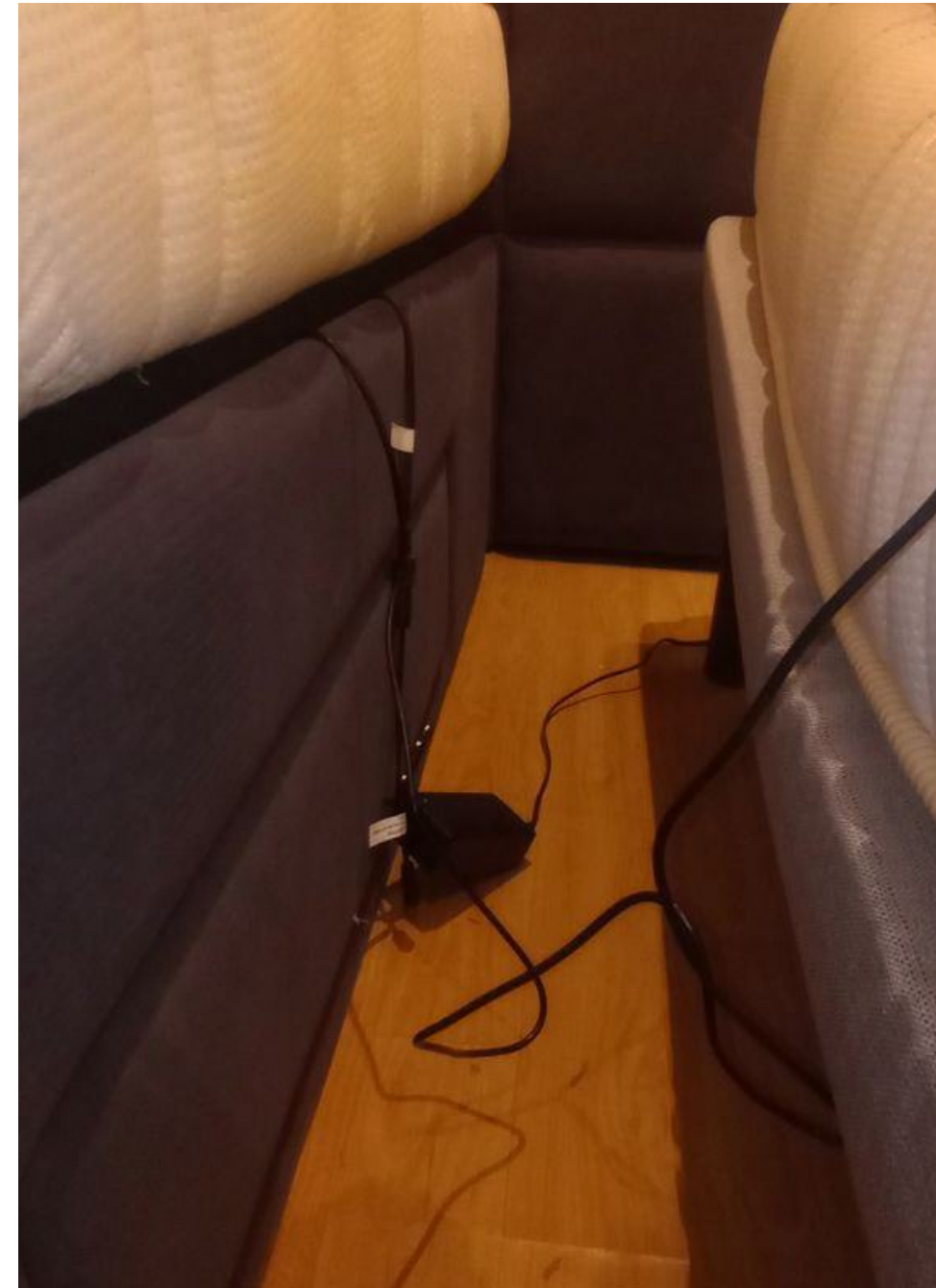
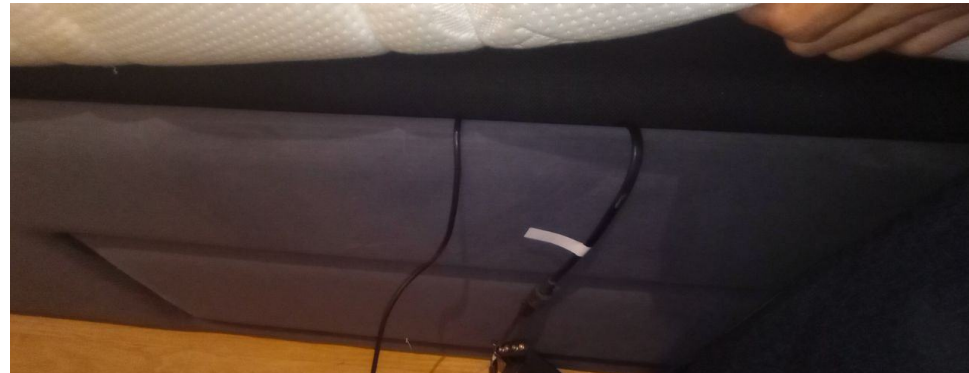


Mr. Anwar Iqbal
Manager

I visited the Recliners India showroom in Thane, Mumbai, to examine their existing products for insights that could aid in redesigning an ergonomic and innovative recliner-bed. During my visit, I carefully observed the features and functionalities of their current models, noting aspects that could be enhanced or redesigned.

I also interacted with customers to gather their reviews, focusing on their experiences and any discomforts, which provided valuable feedback for potential improvements in the new design.

Observations- Cable Management



I observed a significant issue with cable management, where all the cables were left unsecured on the floor. This not only led to the cables collecting dirt and grime, making the setup look untidy, but also posed a safety hazard.

There was a real risk of customers tripping over the loose wires, which could result in injuries or damage to the product itself. This observation highlights the need for an integrated cable management system in the design to ensure safety and maintain the aesthetics of the environment.

Observations- Interaction Point



I also noticed issues with the voice module and remote control used for voice commands. Similar to the cable management problem, the setup for the voice module was cluttered and inconveniently placed, with no dedicated space near the bed for easy access. This arrangement could lead to potential mishandling or damage.

Addressing this in the redesign would involve creating a specific, integrated storage solution for the remote control and voice module to ensure they are both accessible and neatly organized, enhancing the overall functionality and user experience.

Observations- Safety Hazard



Observations- User Experience



Observations

User Experience, Safety Hazard

During my visit, I identified additional safety concerns, particularly when changing the frame positions of the recliner-bed. The process appeared risky, possibly due to the lack of intuitive controls or safeguards, which could lead to accidents during adjustment. Furthermore, the assembly of the bed frame posed a significant challenge.

The complexity of assembly varied widely among different users, with some steps potentially requiring professional intervention to ensure safety and correctness. This complexity suggests a need to simplify the assembly process and clearly identify which steps, if any, should be handled exclusively by professionals to prevent incorrect setup and enhance user safety.

Visits- IKEA showroom, Mumbai

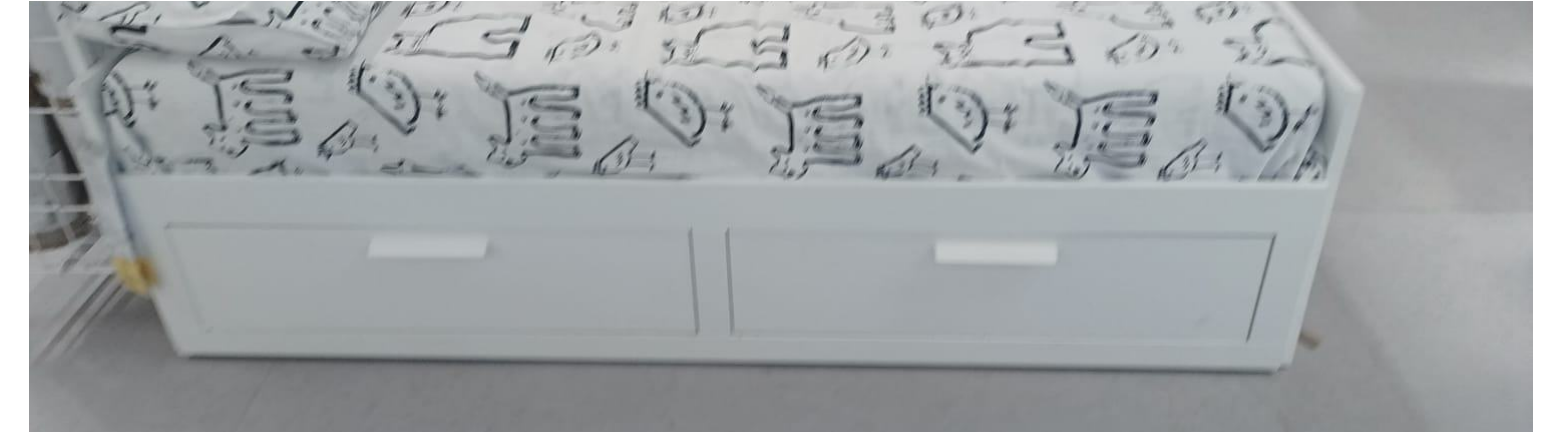


When exploring furniture types that could contribute to your research on an adjustable ergonomic bed with smart features, it's important to consider a variety of options that impact user comfort, posture, and overall health.



There were various type of storage area underneath the bed. Almost all of them offering storage on the side instead in the front of the bed. I also observed that not all of them using total space available underneath the bed and left some space(MY assumption is this space is left user will have side table).

Visits- Drawer types



There were also different type of drawers with respect to the bed. Almost each bed have its own type of opening. Some having groves, some having indents, some have dedicated handles attached to it and some have nothing the bedding itself provide a grove due to its shape.



Potential user/Advisors



Prof. Manjunath Electrical Department IIT Bombay

Home Improvement Enthusiasts: Enjoys furniture projects and are keen on adding a personal touch to their furniture. He has experience with designing and assembling furniture or are looking for a new project to tackle.

Insights:

- The product could be very useful for those who have issues with good sleep.
- Wake up multiple times in the middle of the night.
- Used to have breathing issues.
- Uses 2-3 pillows behind the back to read a book.
- IKEA are DIY but hardly customizable.
- IKEA and other DIY products are not providing top notch quality.
- The building experience of the product is not so good.
- Product should be age sensitive or marked with difficulty levels.
- Separate lighting which does not disturb the other person sleeping by side will be great plus.
- Eating and working on the bed is not the part of culture.
- The feeling of building your own product creates a bond.
- Taking care gets a push if the product is made by you.
- Like to have a challenge.
- Would like to order product if above things are considered.

Potential user/Advisors



INTERNET

Prof. Kishor Munshi
Managing Director at CTech Labs
IIT Bombay

Vison for tech-Savvy user: Interested in the latest technology and smart features in Products. Have strong views for niche markets of this project. Curious of the smart functionalities of the bed, such as adjustable positions, built-in chargers, or other smart home integrations and its practicality and demand.

Insights:

- Prefer to have this product in the home.
- DIY should be a option rather than the only way to be able to have the product.
- Interesting to have a product with multiple feature but not sure if those features will be used as much.
- Full freedom should not be given to the user. User in not aware of the outcome of wrong usage.
- Pre-set positions and features should be provided for best outcome.
- It will be an issue to use the product if another person is also using it and prefer different comfort settings.
- Need to track the usage time of the user group for better design.
- Should not take much time or effort than using a simple pillow to change position.
- Facilities should be provided as per the user demand.
- Owning can be too much a rental option should be available.
- Fancy piece of tech should not over come the main functionality.
- User can upgrade the features as pet the time demands.

Top insights

Health benefits: Product should provide health benefits as one of its main features. which includes body posture, reduced snoring, reduces back pain, blood circulation, etc.

Seamless experience: while Interacting with the product user should not feel any discomfort neither while using nor while assembling it by their own.

Fast and safe: The posture changing process should be simple, quick and effective as it meant to replace using pillows to get into a comfortable position.

DIY difficulty grading: User should be aware about the skill set needed to assemble it by their own before making any commitment to buy it.

Quality and durability: Product should show some decent durability and easy repair so user can take care of it without outside help.

Lighting: Lightning that limited to the requested user and wont effect other will be a great plus for couples with different sleep cycles.

DIY as an option: Assistance and possible service should be available so if user want the product and not able to DIY, they can still have this product without any issue.

Pre-set modes: Giving Modes as per the mood and conditions will be safe and quick to use. Full freedom of motion can harm harms user as they might end up using unhealthy posture.

Separate user request: If the product accommodate more than one user then it should be able tu satisfy every user's request without effecting other users.

Upgradable: As the product could offer various features it might not a good idea putting every feature in one product instead make it compatible to pick and drop few feature in case user requirements changes with time.

Cost efficient: As a DIY product it shown a great potential to be cost efficient and an eco friendly product in this market.

Revised Design Brief

Aim:

To Redesign an **adjustable ergonomic bed** to enhance sleep and work experiences, ensuring user comfort and **preventing health issues** associated with prolonged poor posture. The product must be **flat-packable** to reduce transportation costs.

Constrains:

User needs

- Storage
- Comfort
- Experience

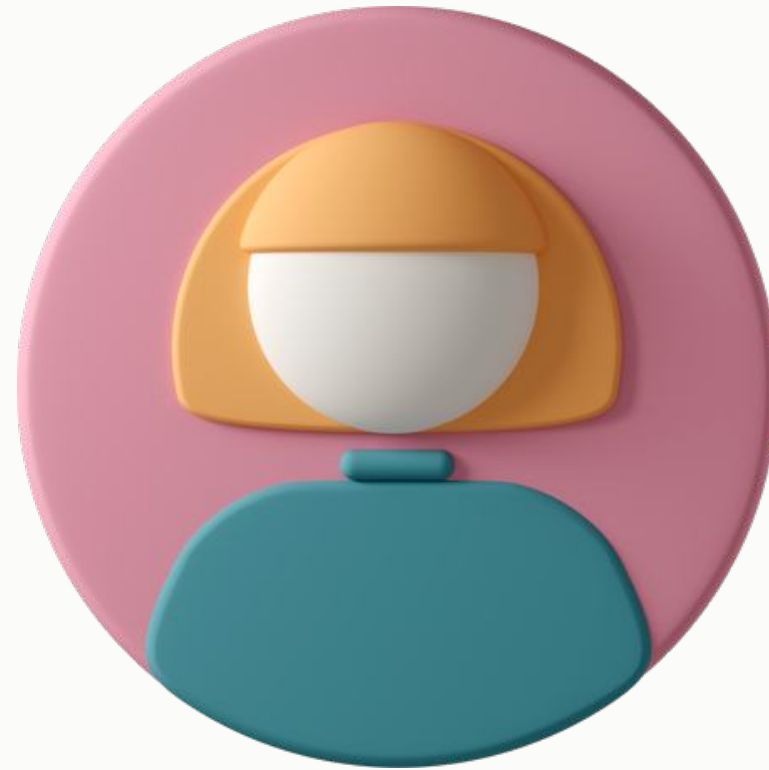
Manufacturing needs

- Low cost
- Flat pack
- DIY featured

Context

- Company product (Recliners India)
- Stablised tech.
- Premium customer

User persona



Rani Rathor

Background:

Rani is a dedicated professional with family responsibilities. She lives with her husband and have two children. Rani is health-conscious, values quality products that enhance her lifestyle, and is willing to invest in items that offer comfort and health benefits.

Interests:

- Home improvement and interior design to create a comforting home environment.
- Health and wellness, including yoga and meditation for stress relief.
- Reading and using technology for both work and relaxation.

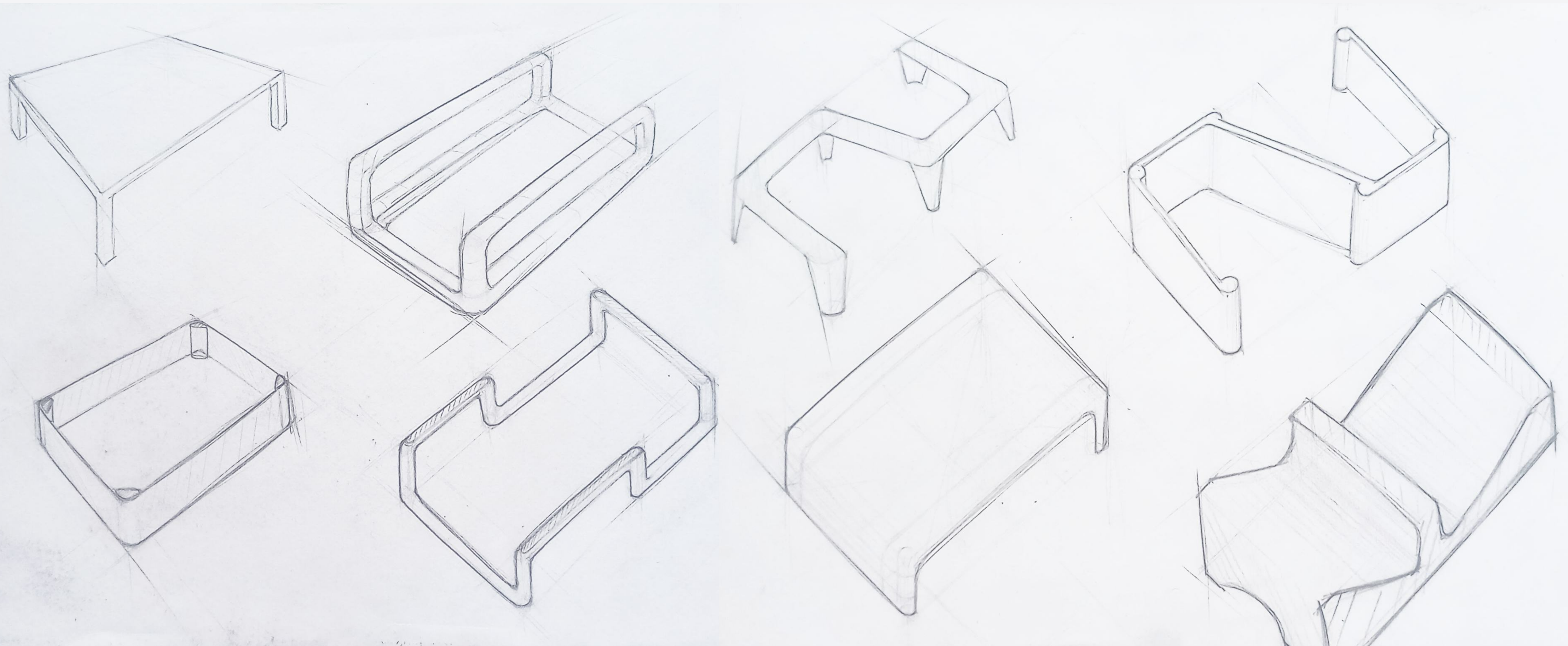
Demographics:

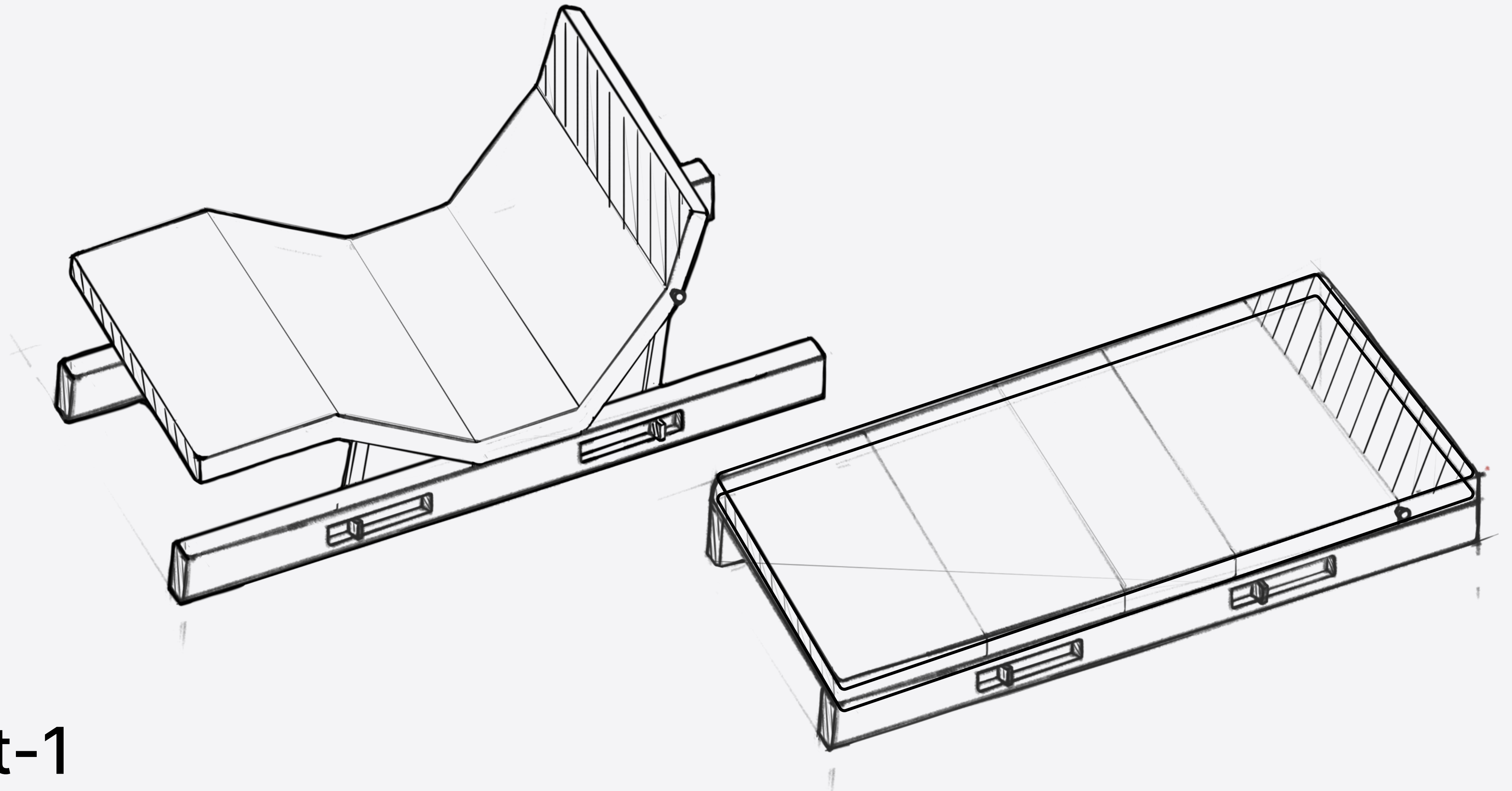
- Age: 45 years old
- Gender: Female
- Location: Living in a Navi Mumbai.
- Occupation: Senior Project Manager at a tech company
- Marital Status: Married with two teenage children
- Income: Upper Middle class

Goals:

- Improve sleep quality to enhance overall health and daily performance.
- Find a bed that offers comfort for reading and watching TV in bed, as well as supports her occasional back pain issues.
- Reduce stress and improve relaxation at home.

Ideation

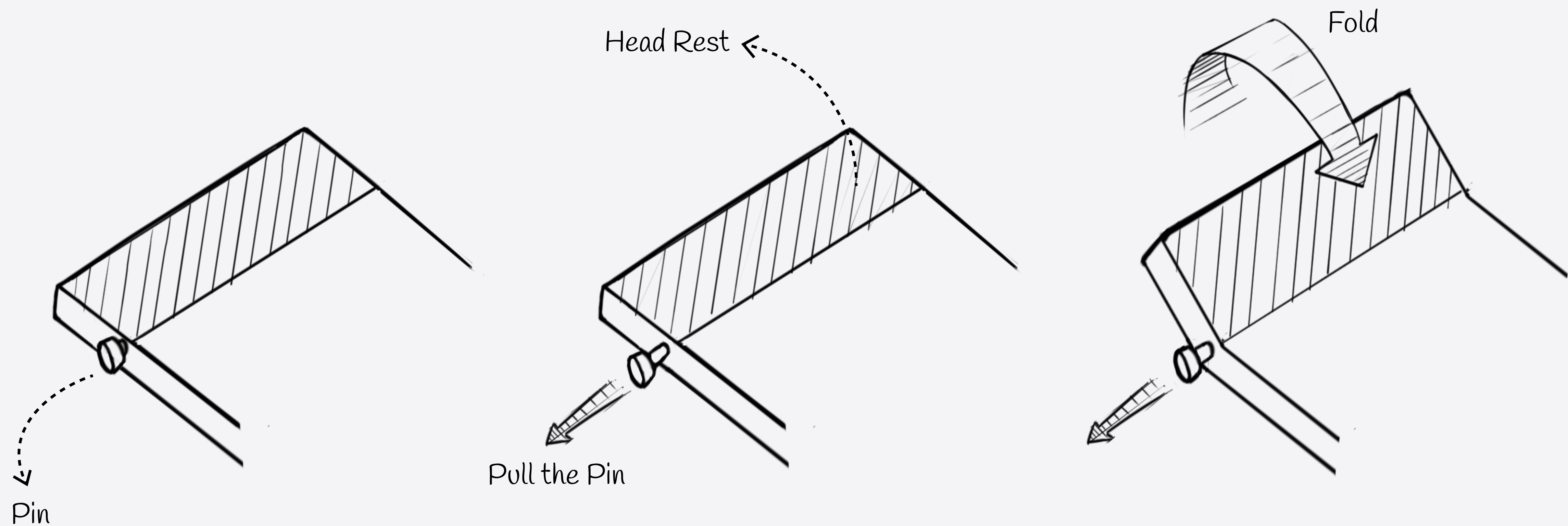




Concept-1

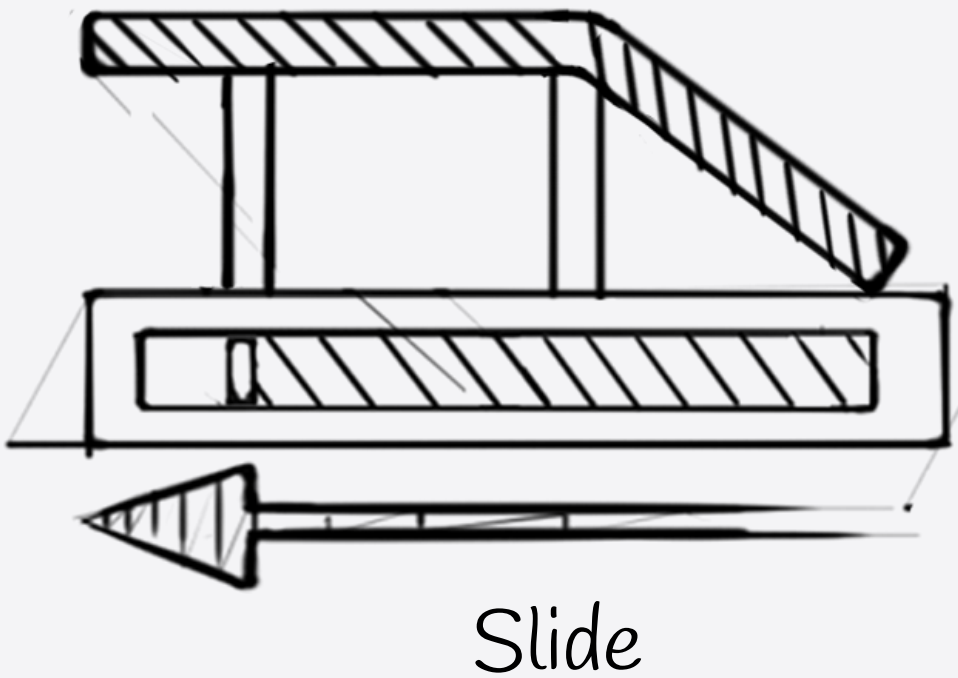
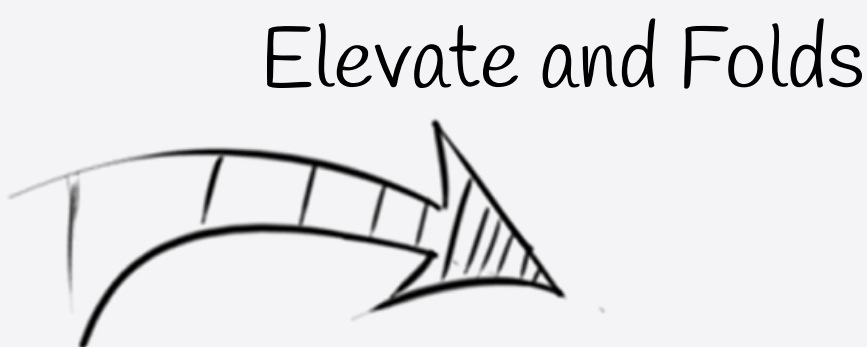
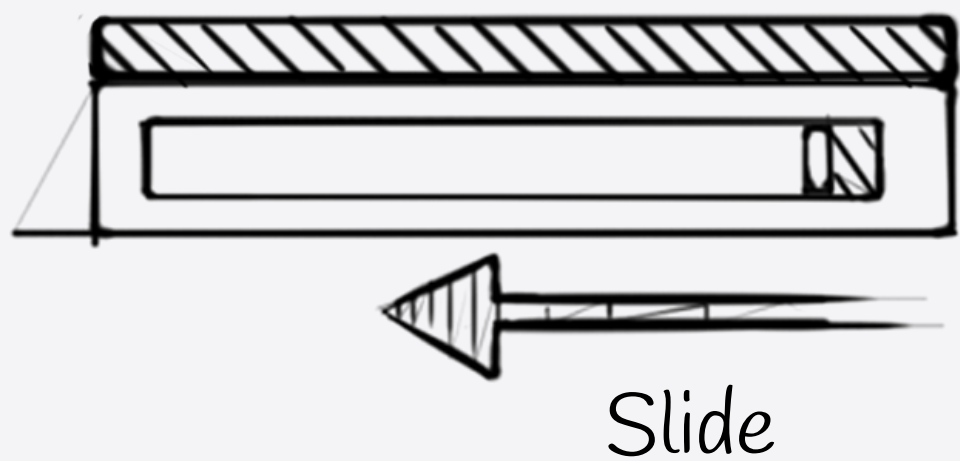
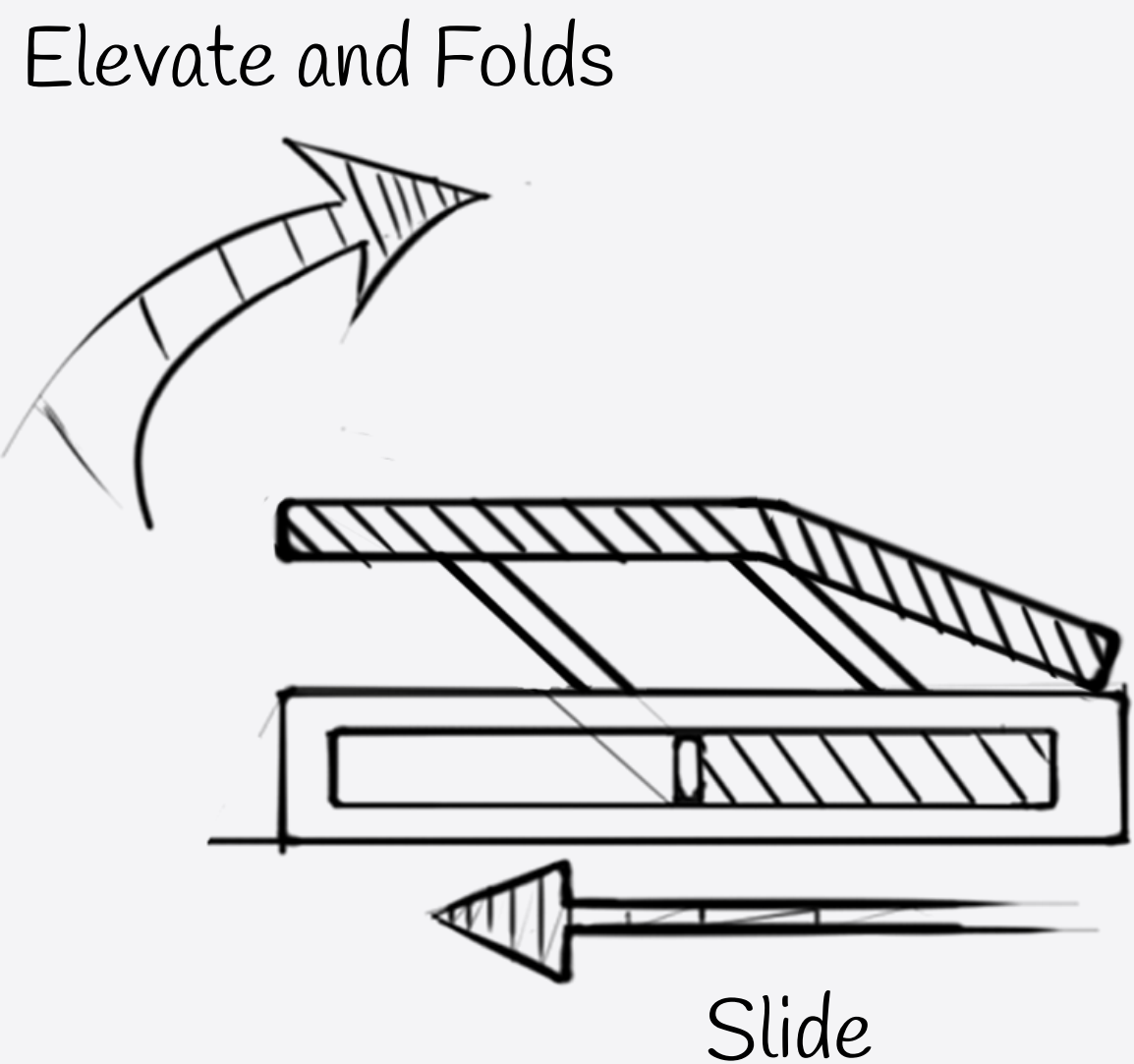
This concept is based on the manual operation to change the positions of the bed into the selected six positions. It has two slots that can be controlled separately to achieve the desired combinations.

Concept-1



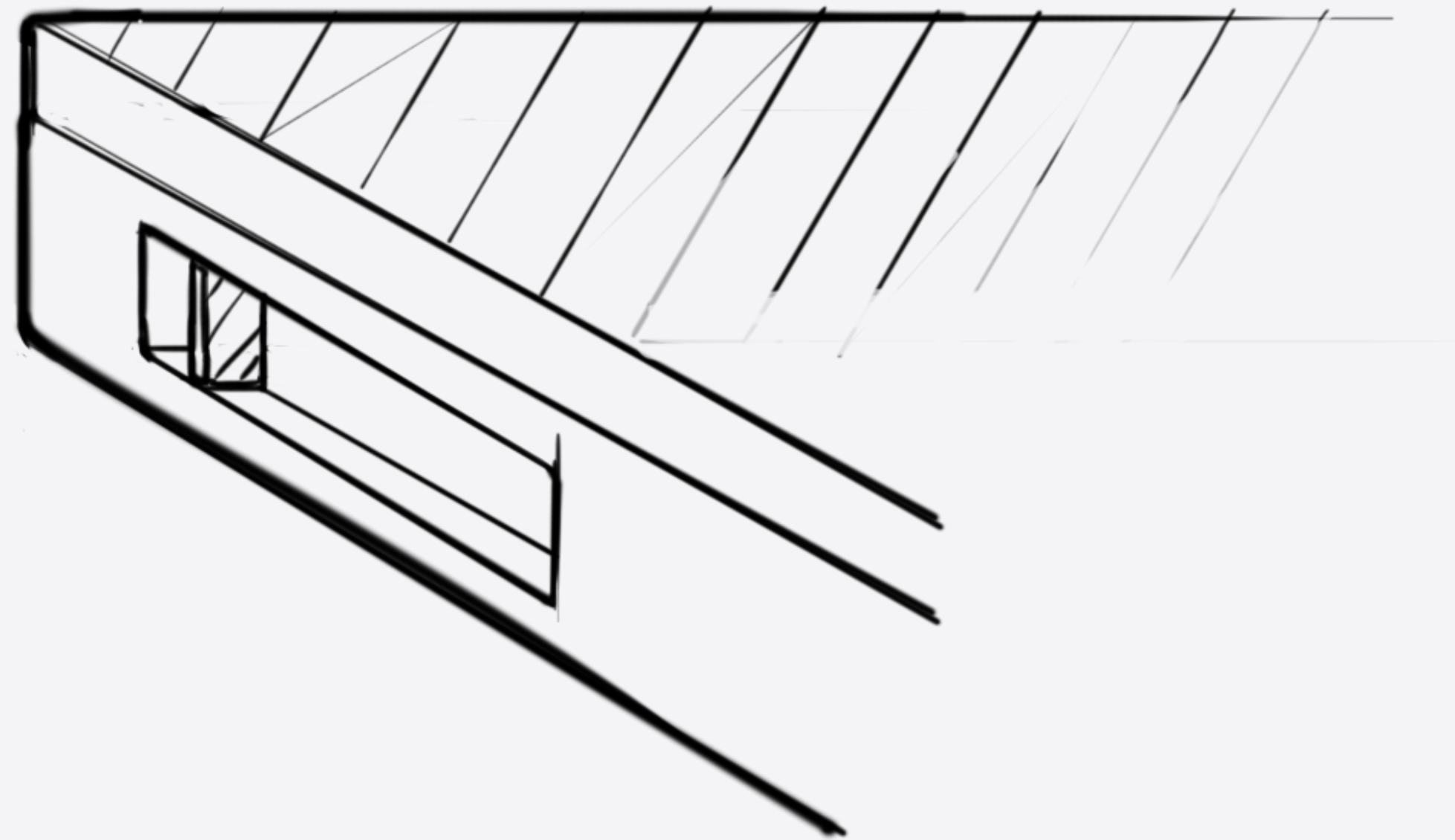
Adjusting head rest using simple pin-pull mechanism

Concept-1

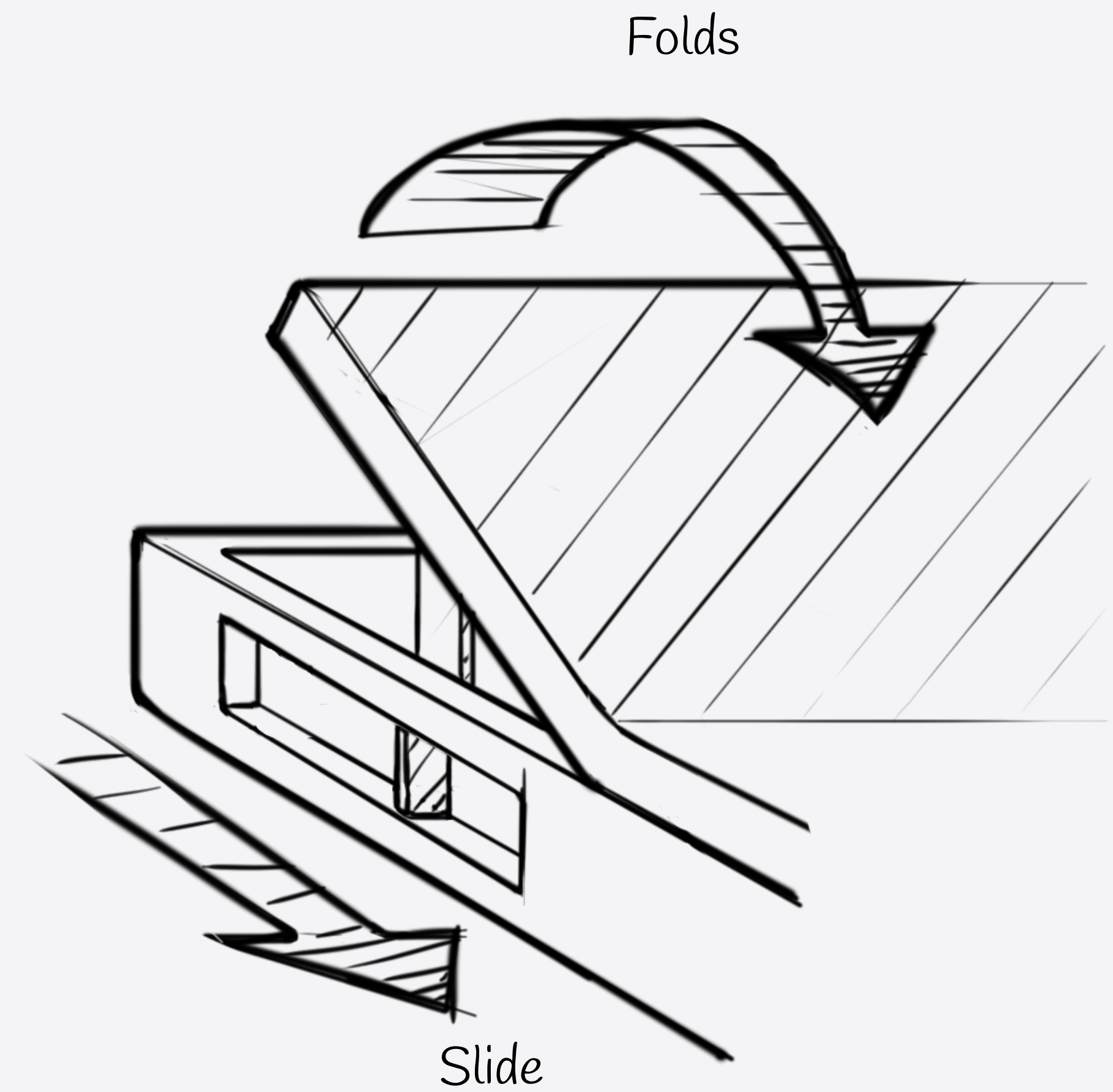


Elevating bed level through sliding mechanism

Concept-1



Elevating head rest through sliding mechanism







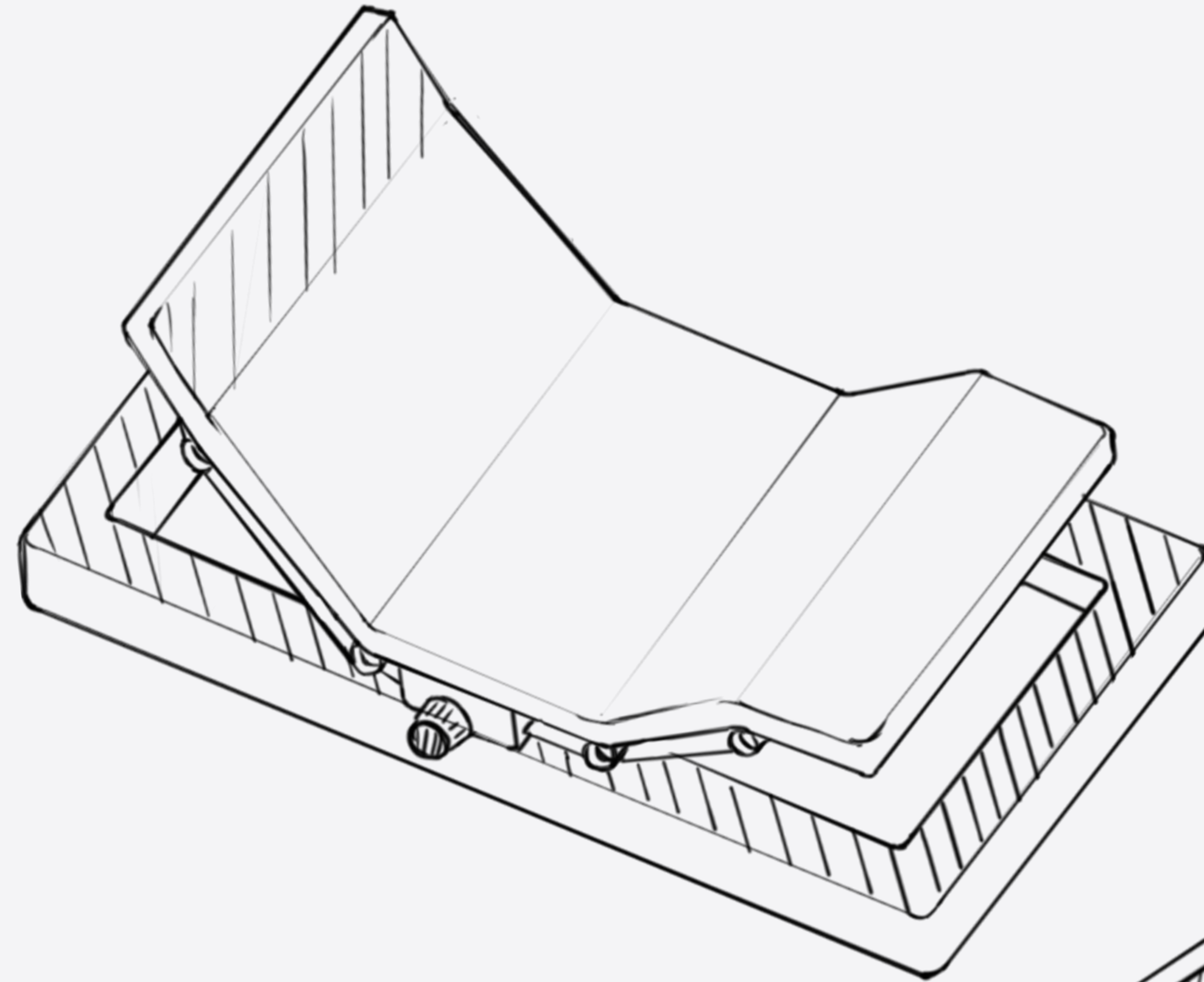
Concept-1

Pros

- Low manufacturing cost.
- Light weight.
- Low complexity.
- Easy maintenance.
- Can add preset modes.

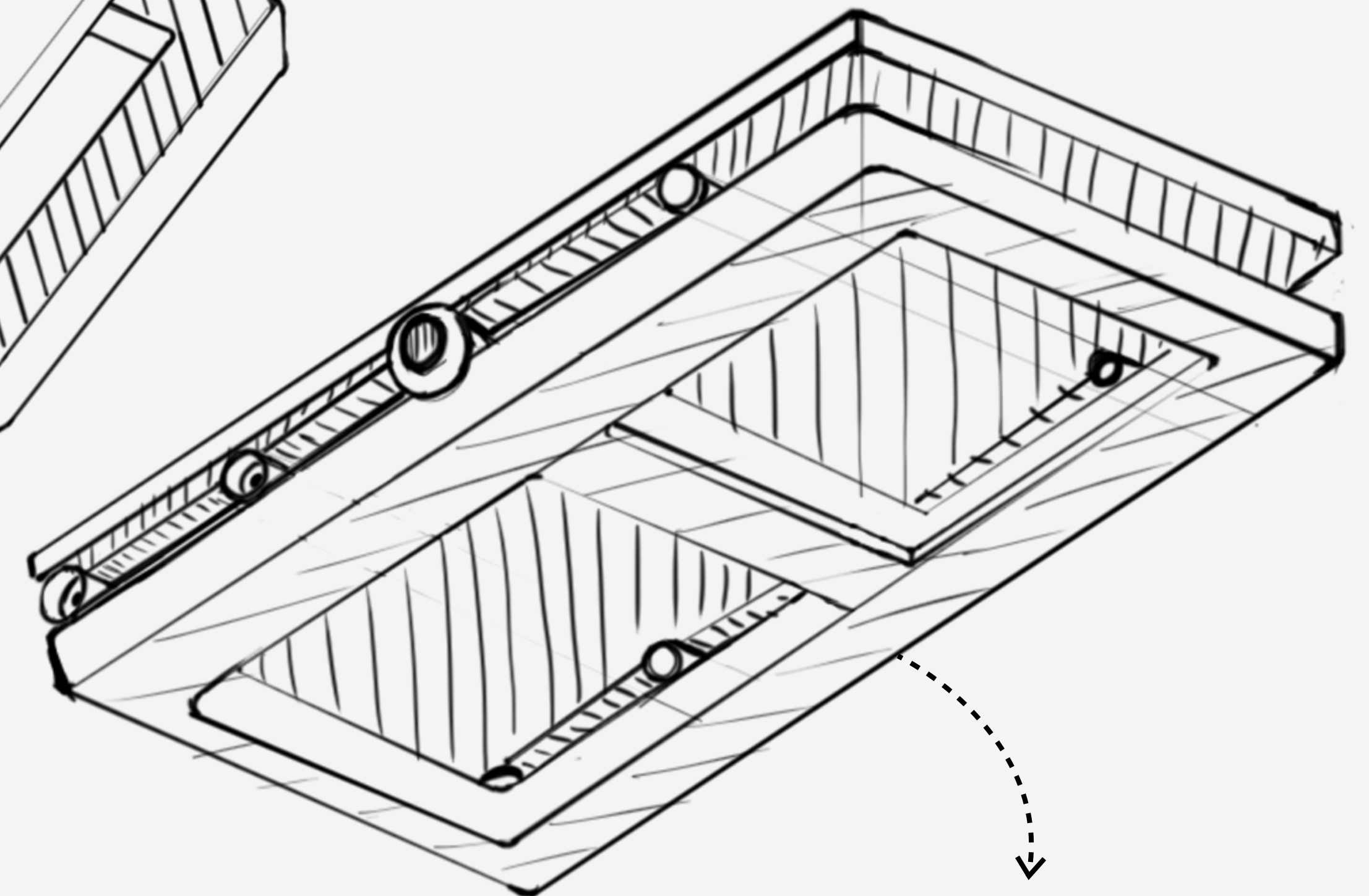
Cons

- Manual work.
- Have to get up to adjust.
- Static positions.
- Difficult for elderly to adjust it.



Concept-2

This concept is based on the strap and pulley mechanism. Using this mechanism we are aiming to control both leg raise and back raise using single nob control. This nob will be connected with other pulleys via strap/string and rotate them as we rotate it.



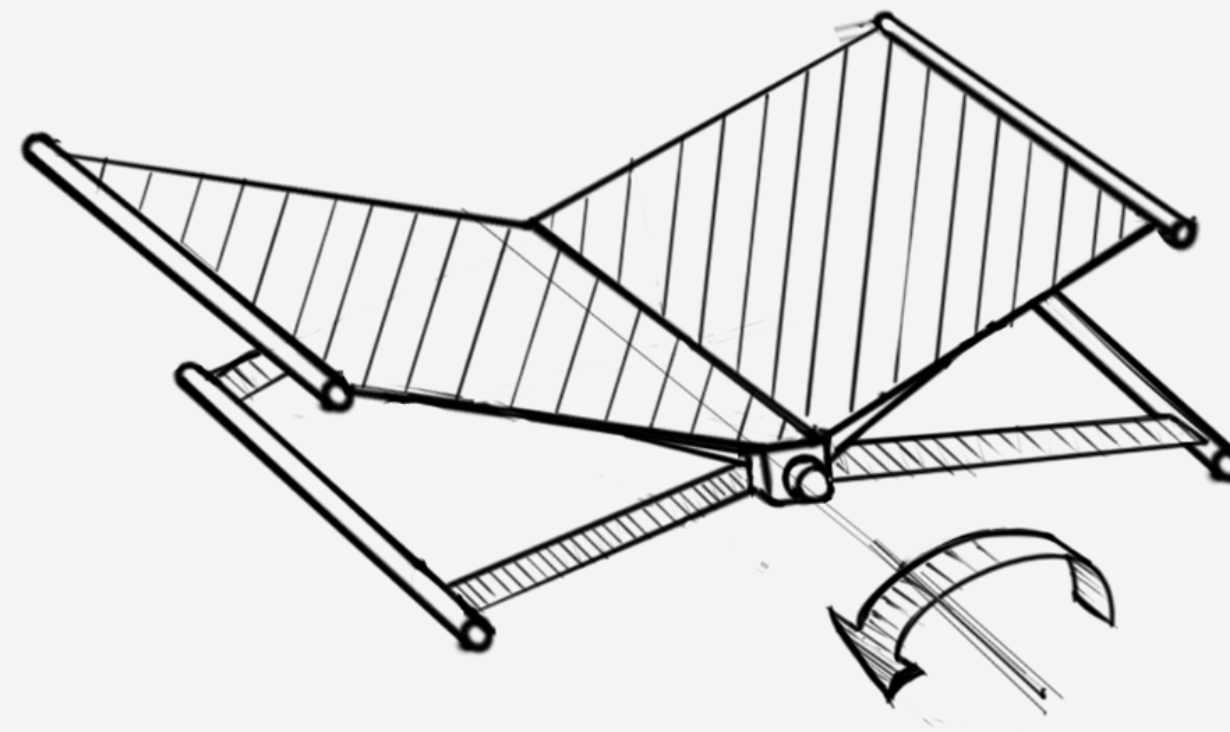
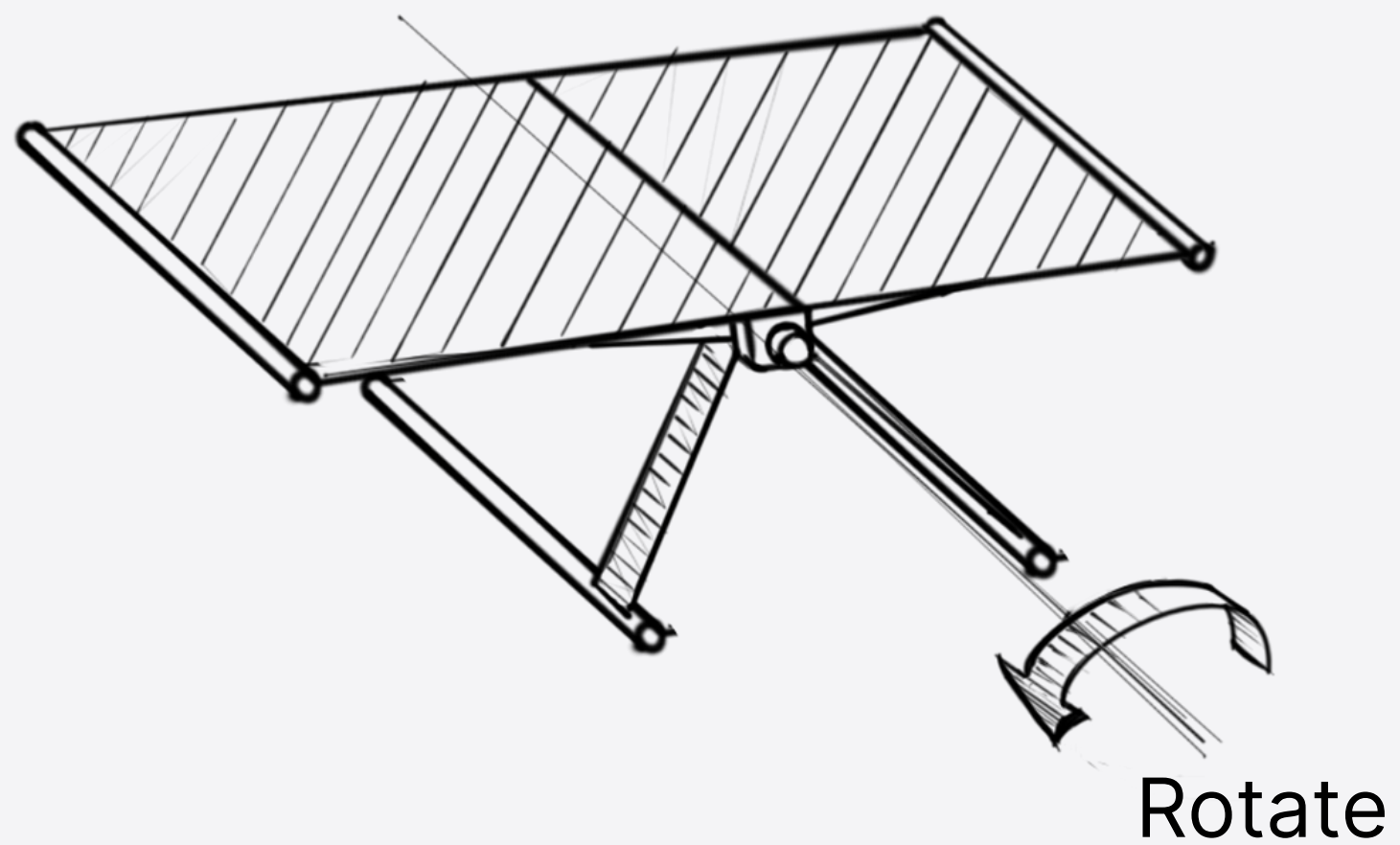
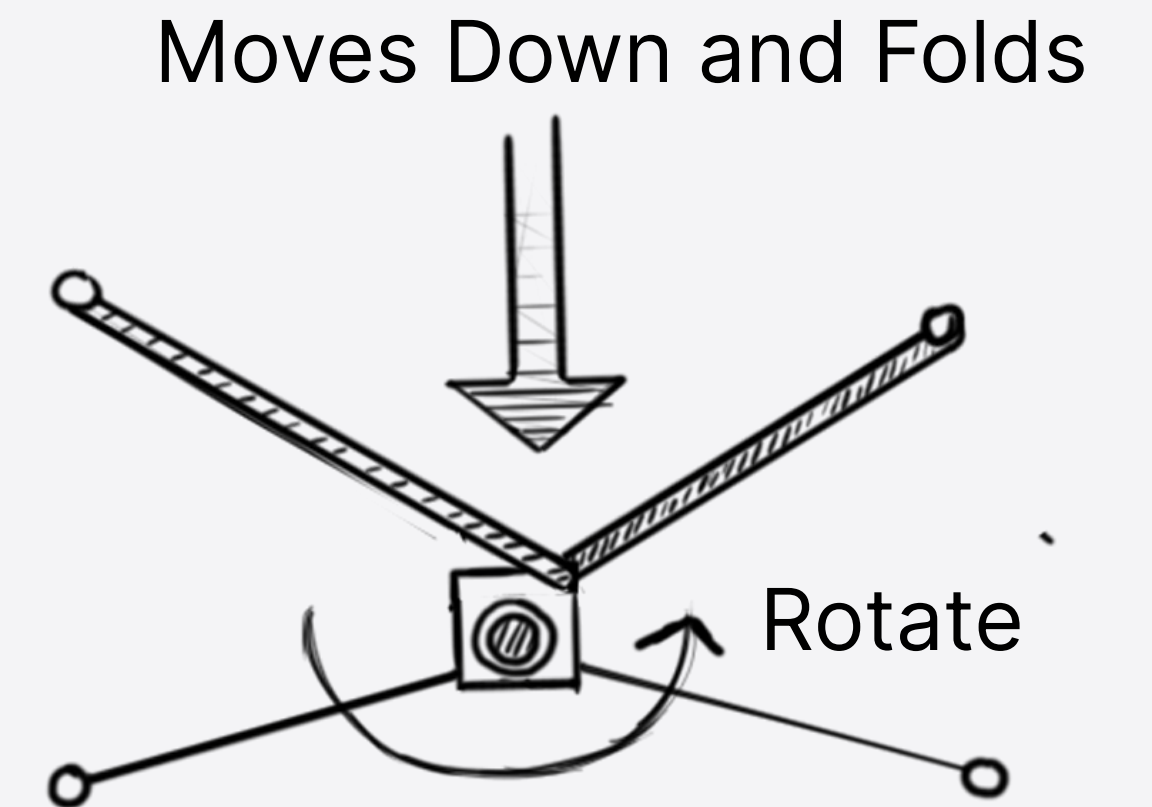
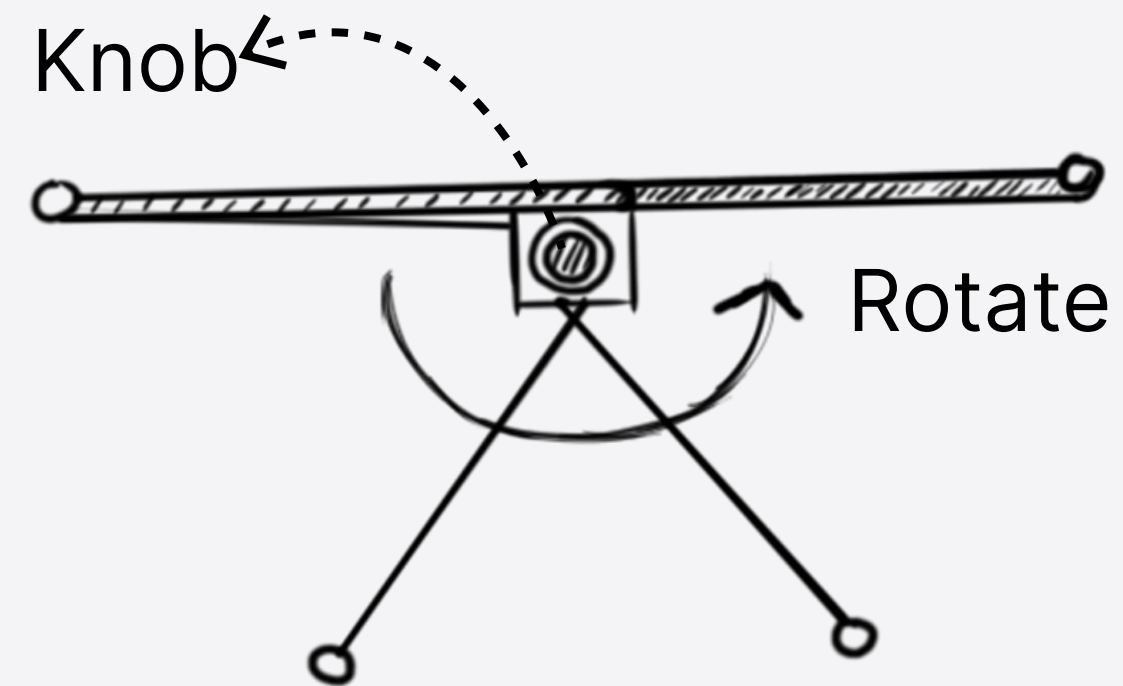
Bottom View

Solid Base

Concept-2

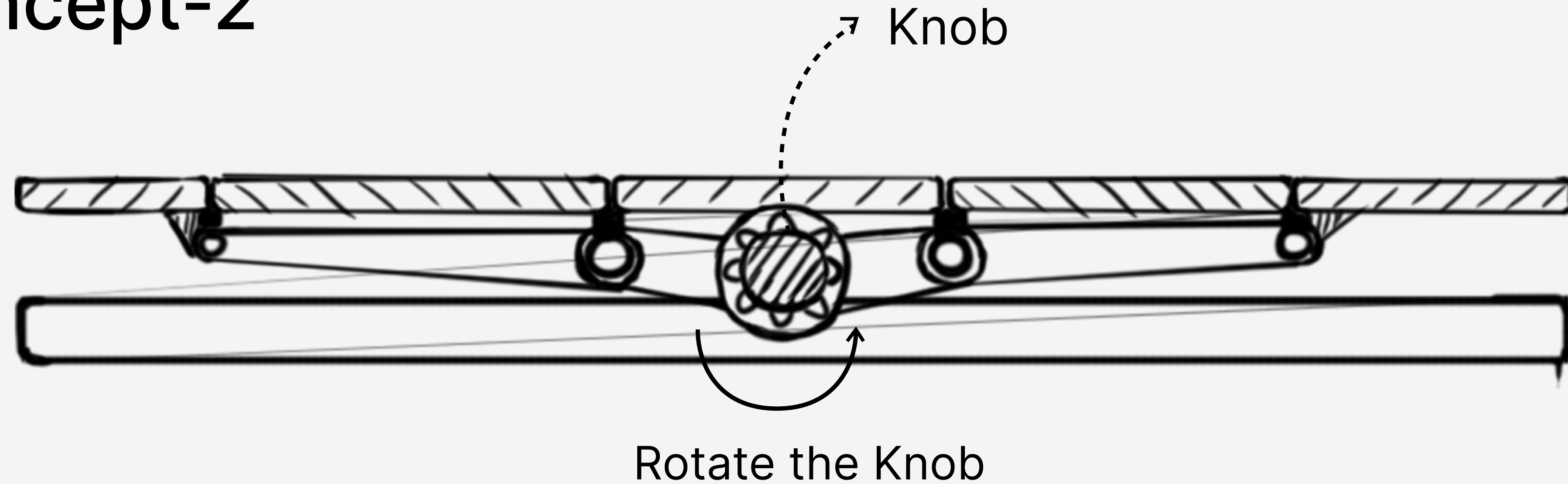
Tension based mechanism for **folding of bed.**

This is the basic of the mechanism which will control the whole beds to achieve the desired positions.



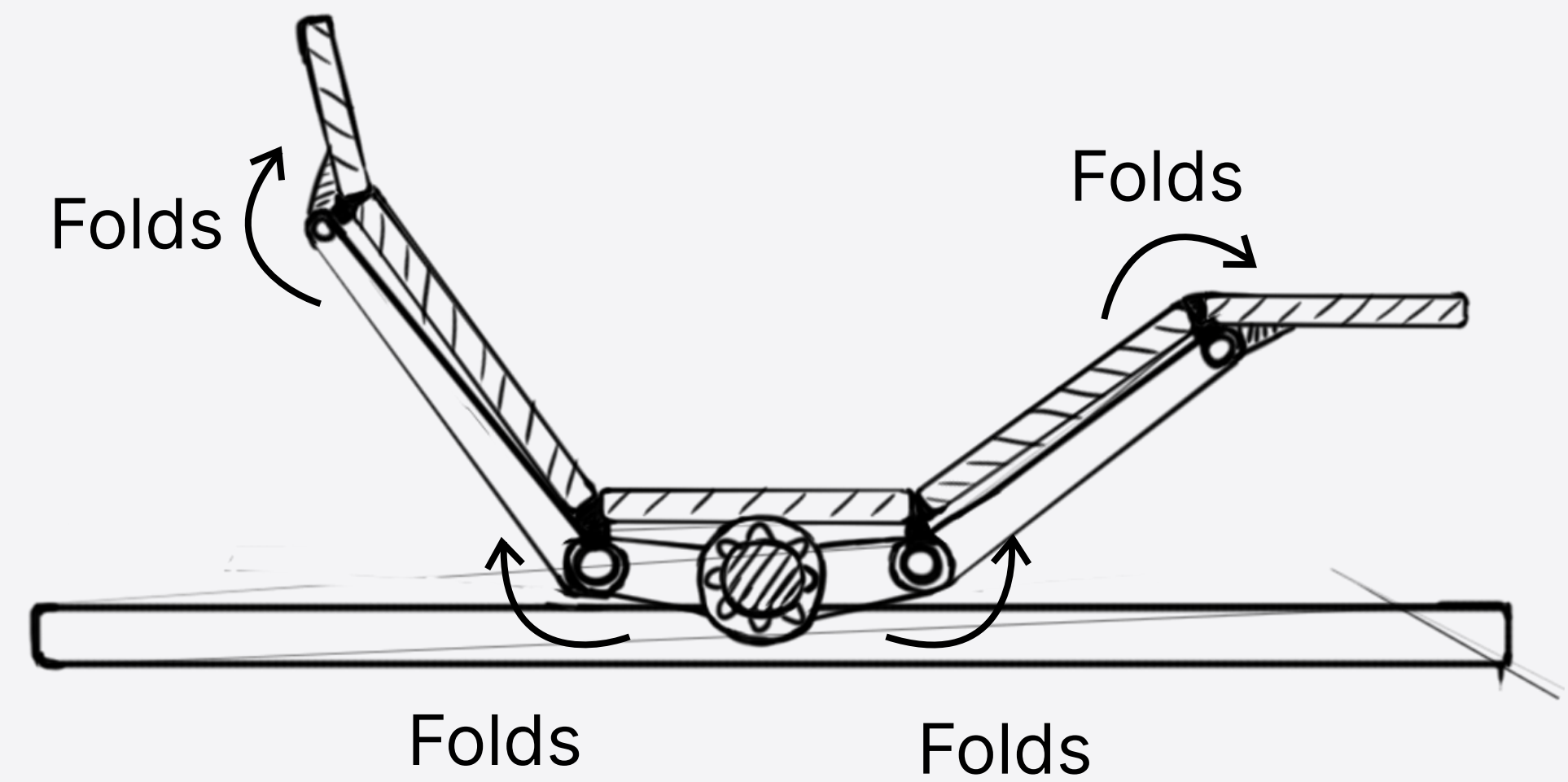
Rotate

Concept-2



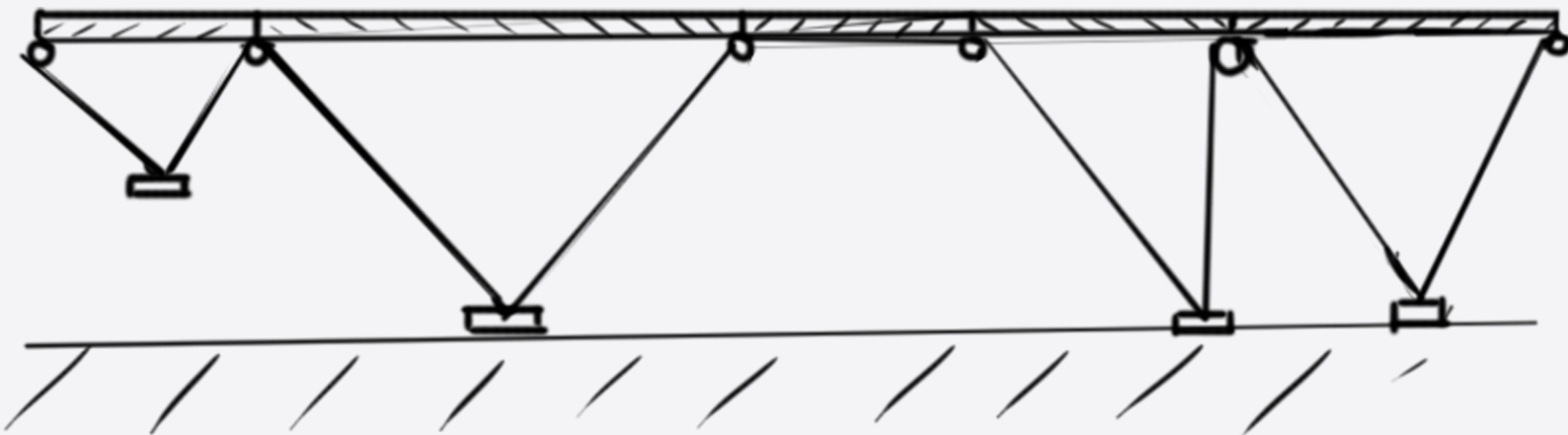
Multiple section folding

As can be seen there are various pully pieces with varying diameter so it will give desired elevations of the surfaces on the same amount of rotation because we are rotating only one nob.

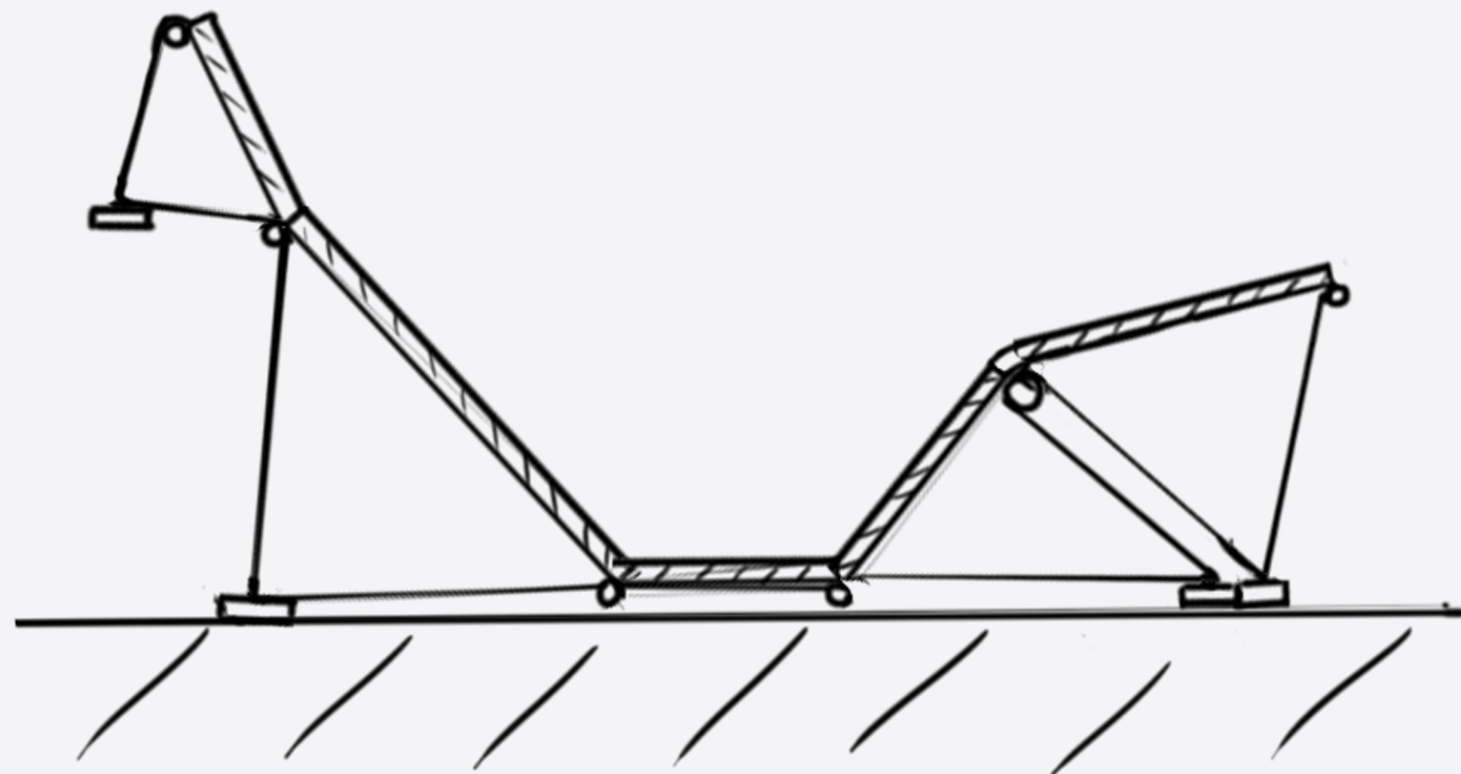


Concept-2

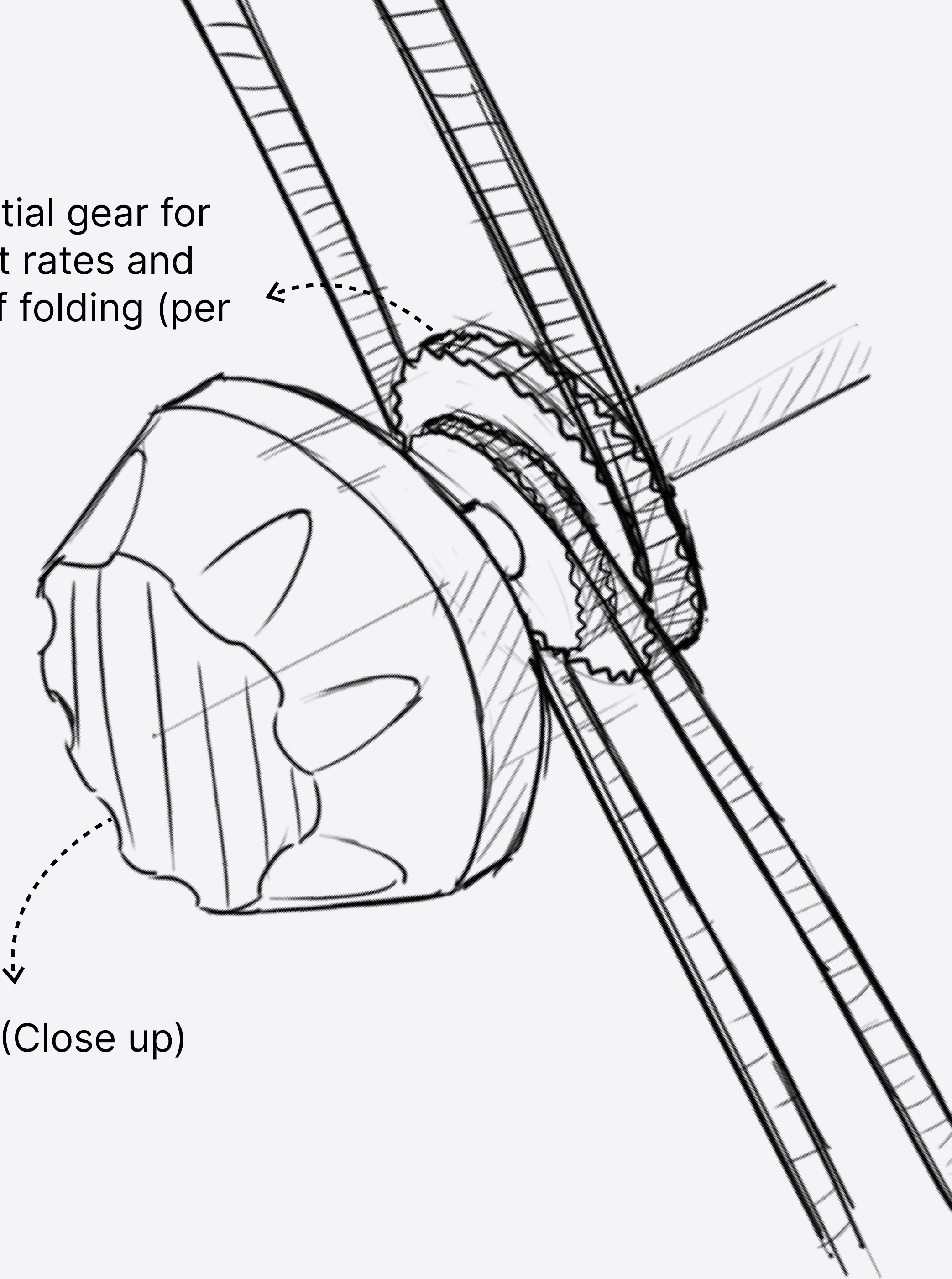
Initial State



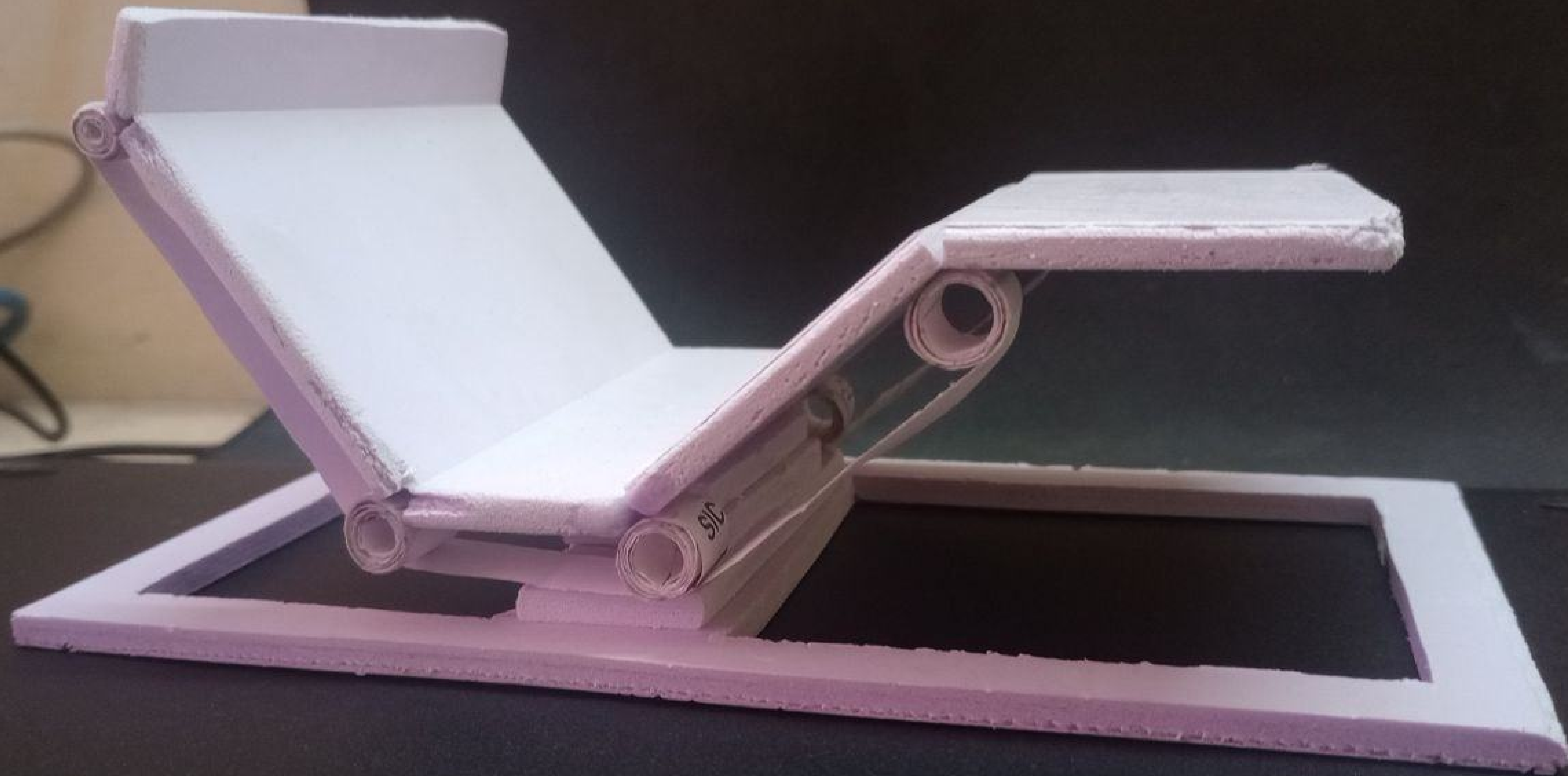
Final State

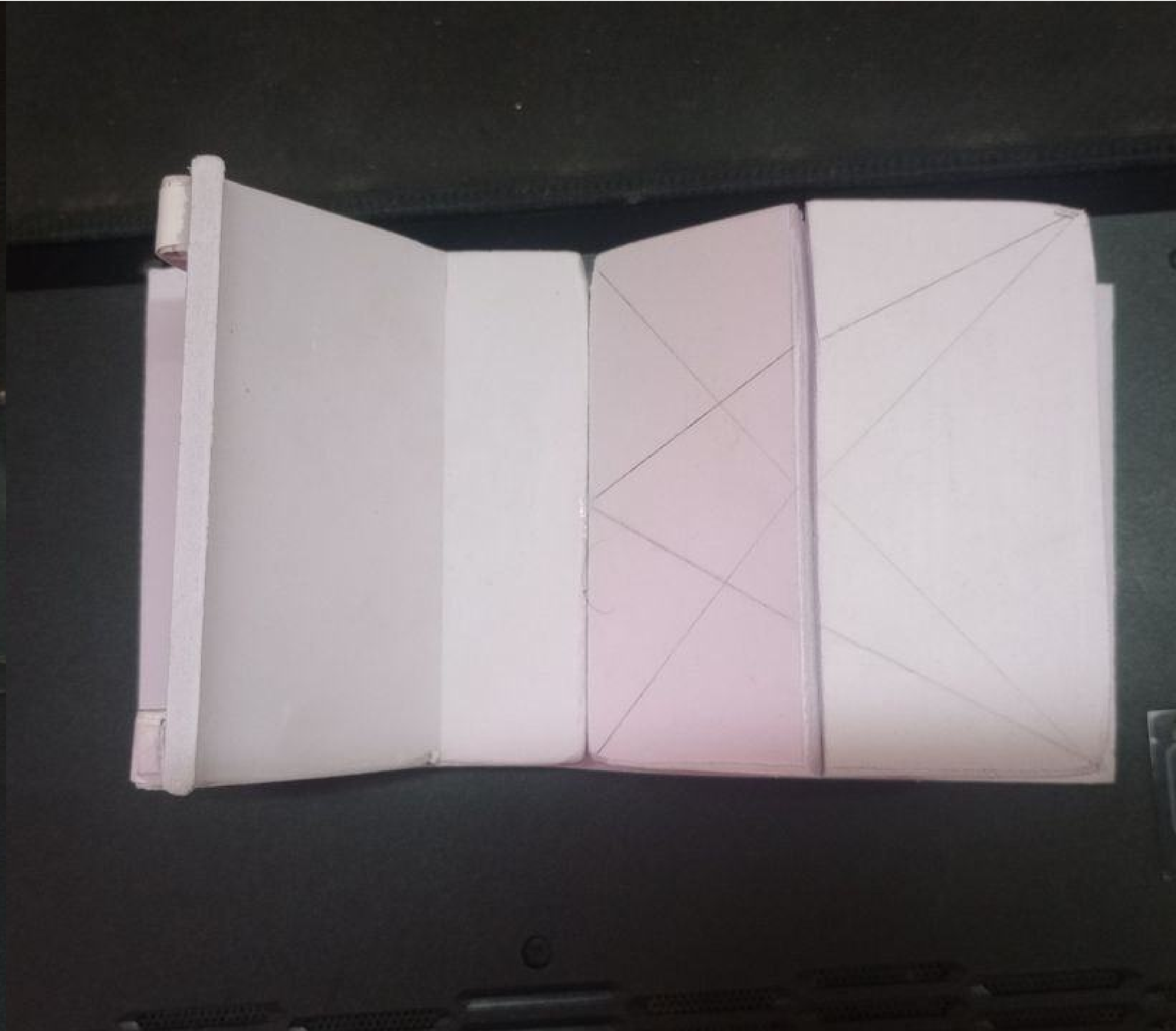
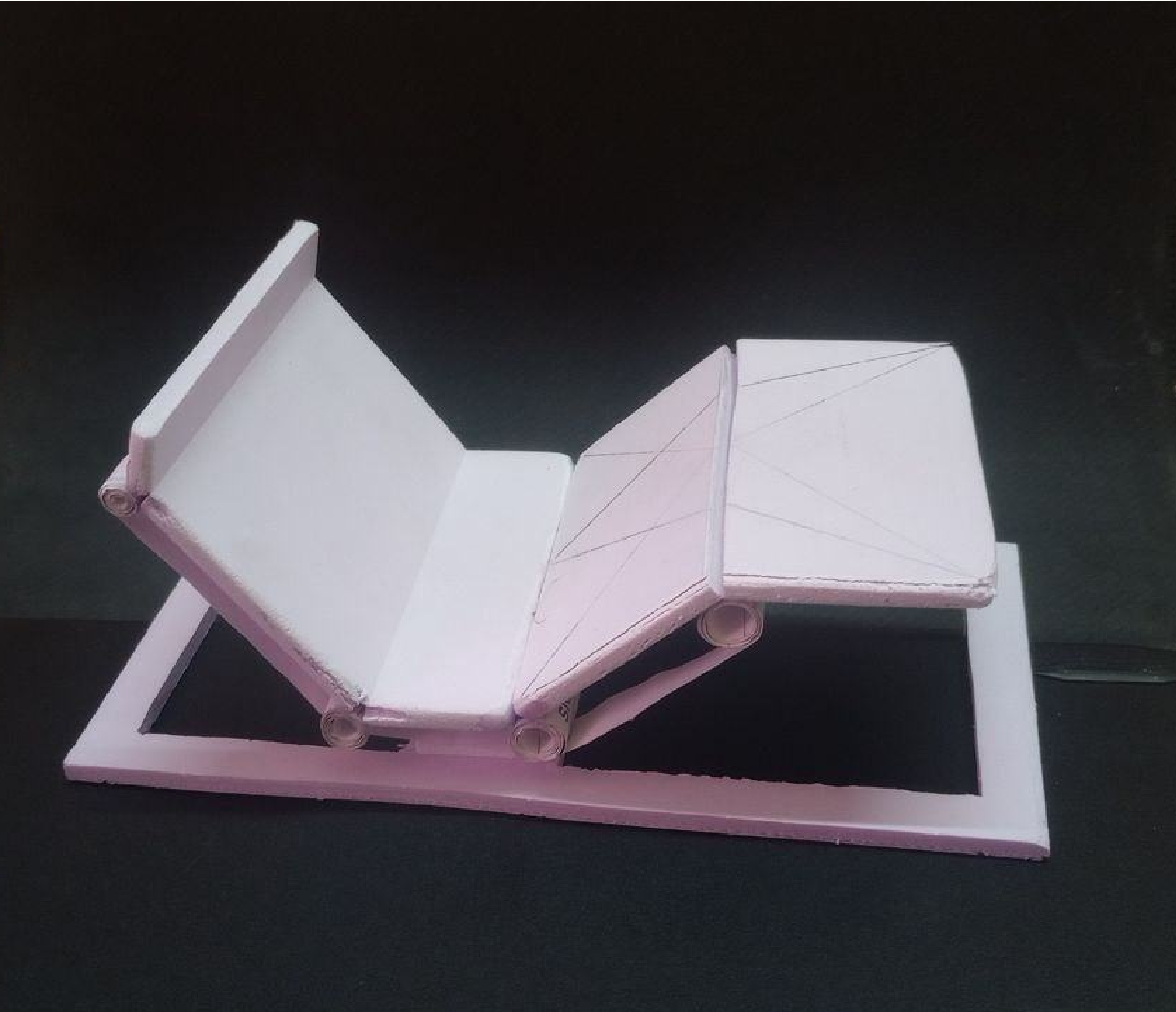


Differential gear for different rates and range of folding (per section)



Knob (Close up)





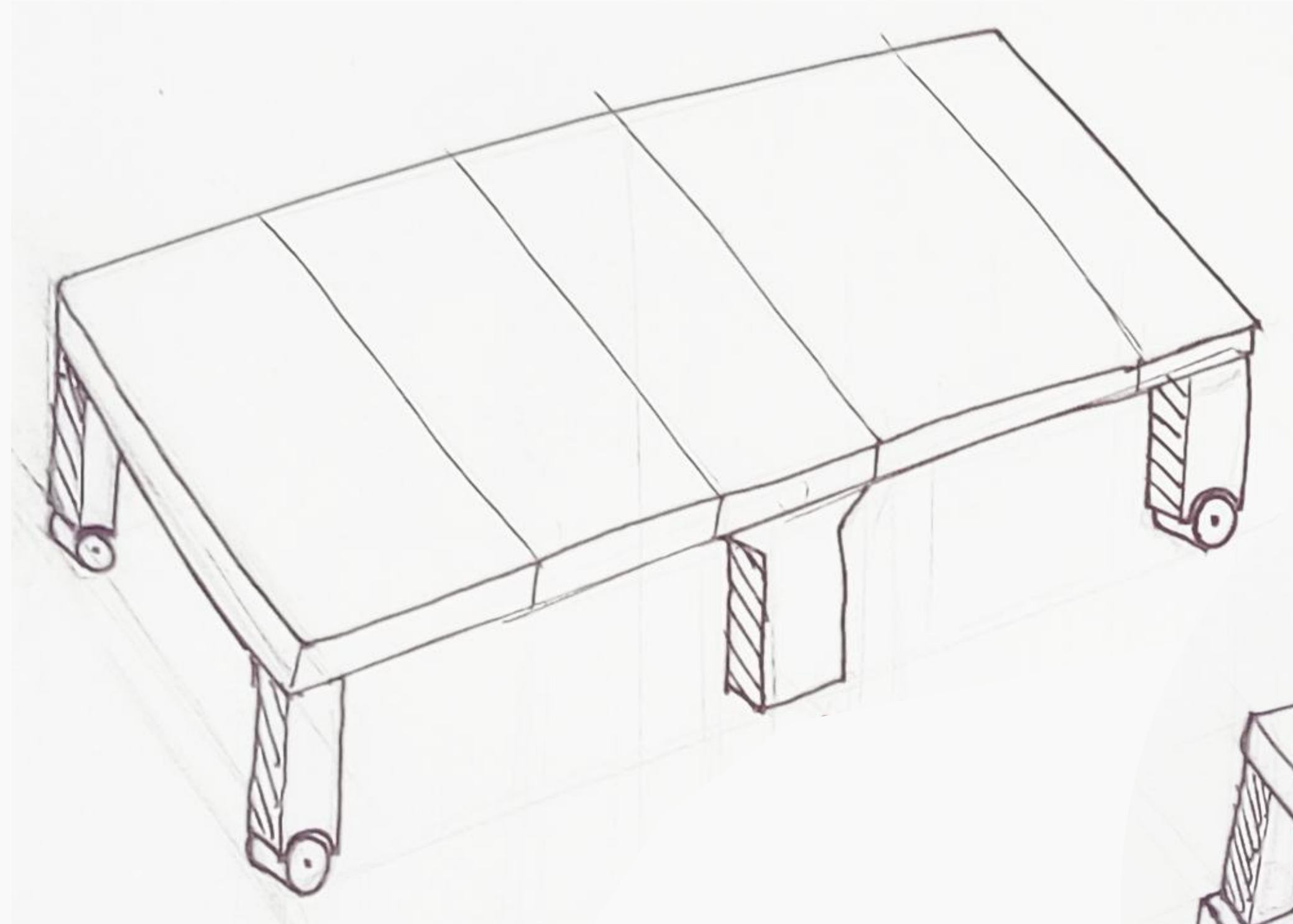
Concept-2

Pros

- Can adjust while lying.
- Aesthetic approach.
- Not limited to specific positions.

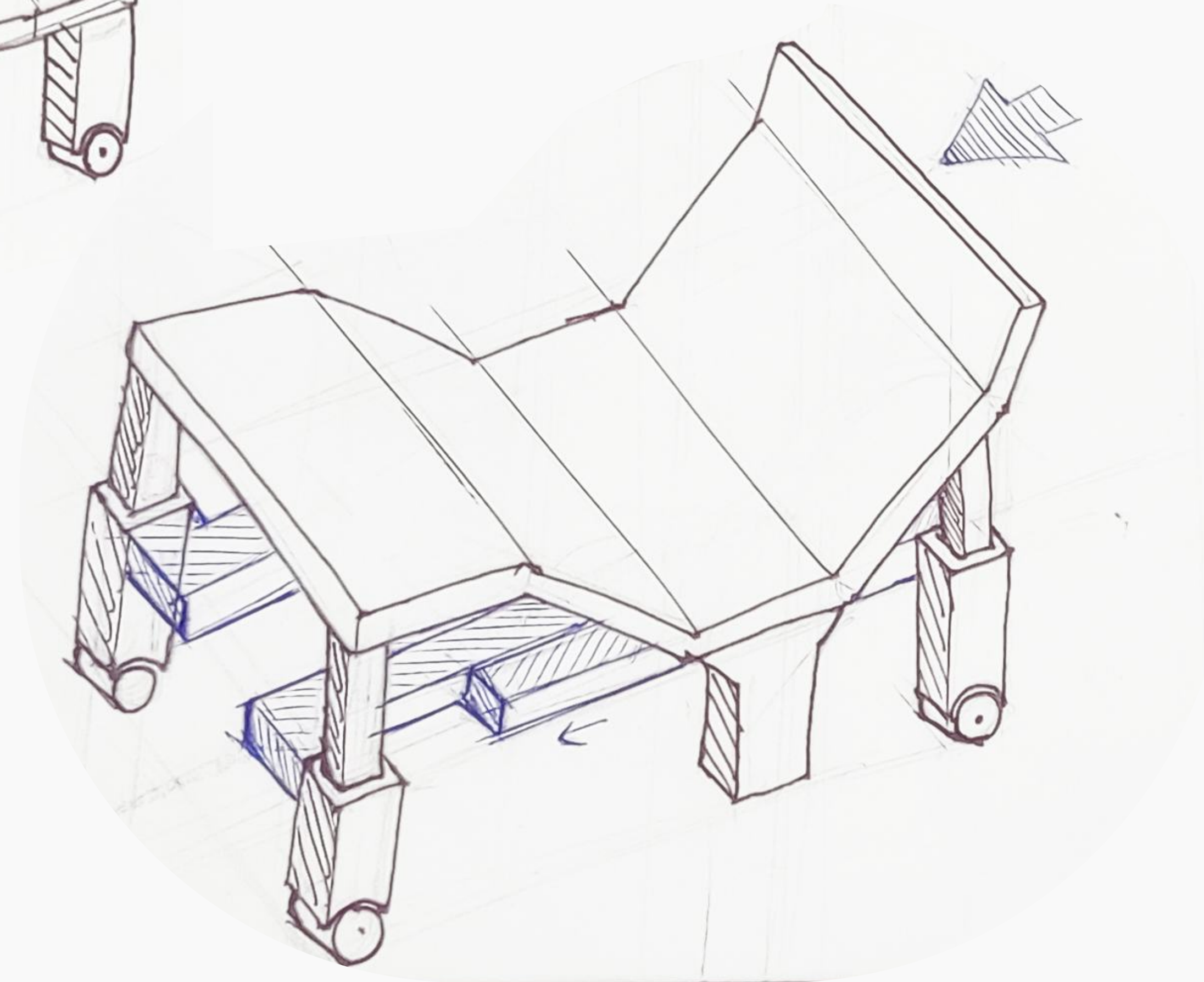
Cons

- Manual work.
- Complex.
- Slow adjustments.
- Cant make separated head/
leg adjustments.

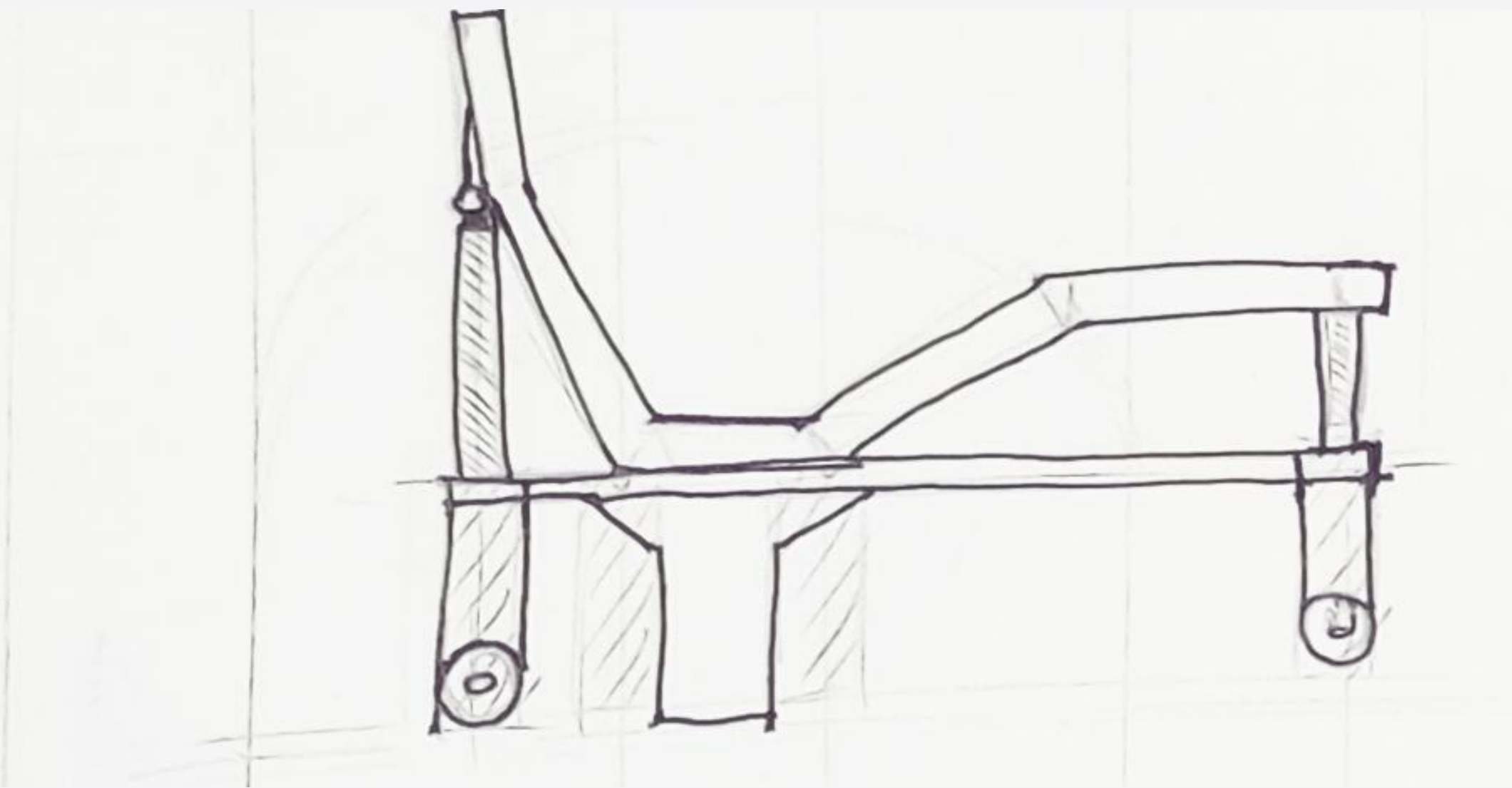
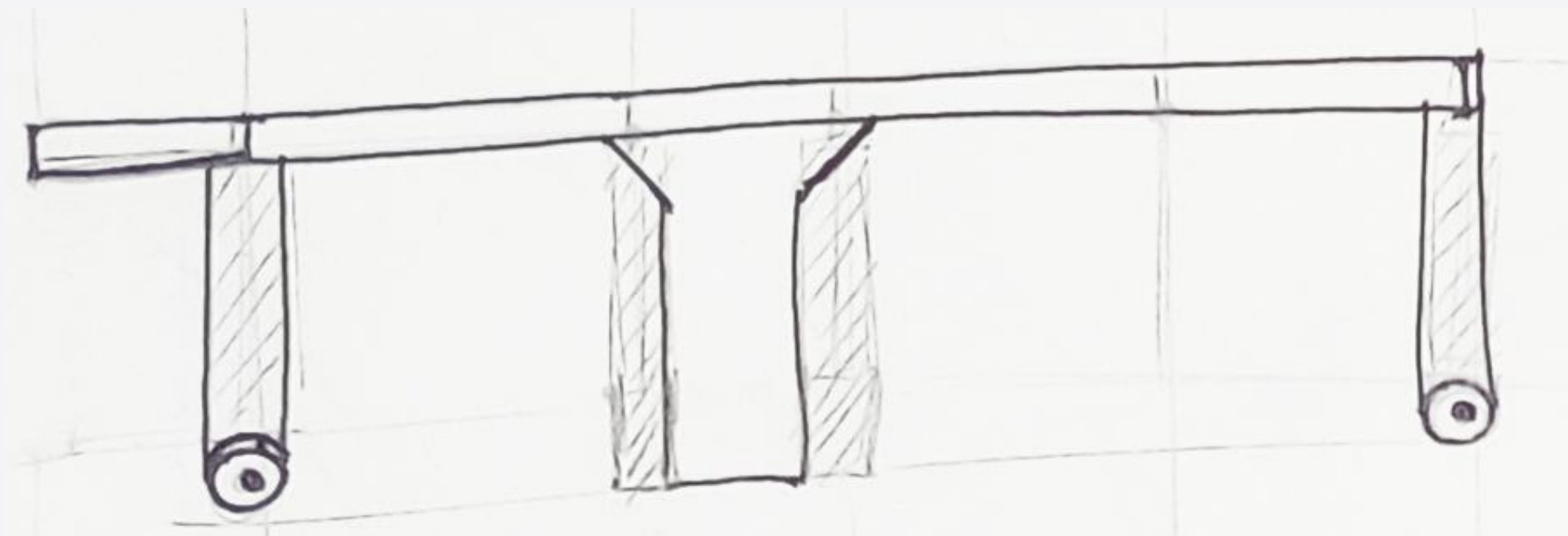
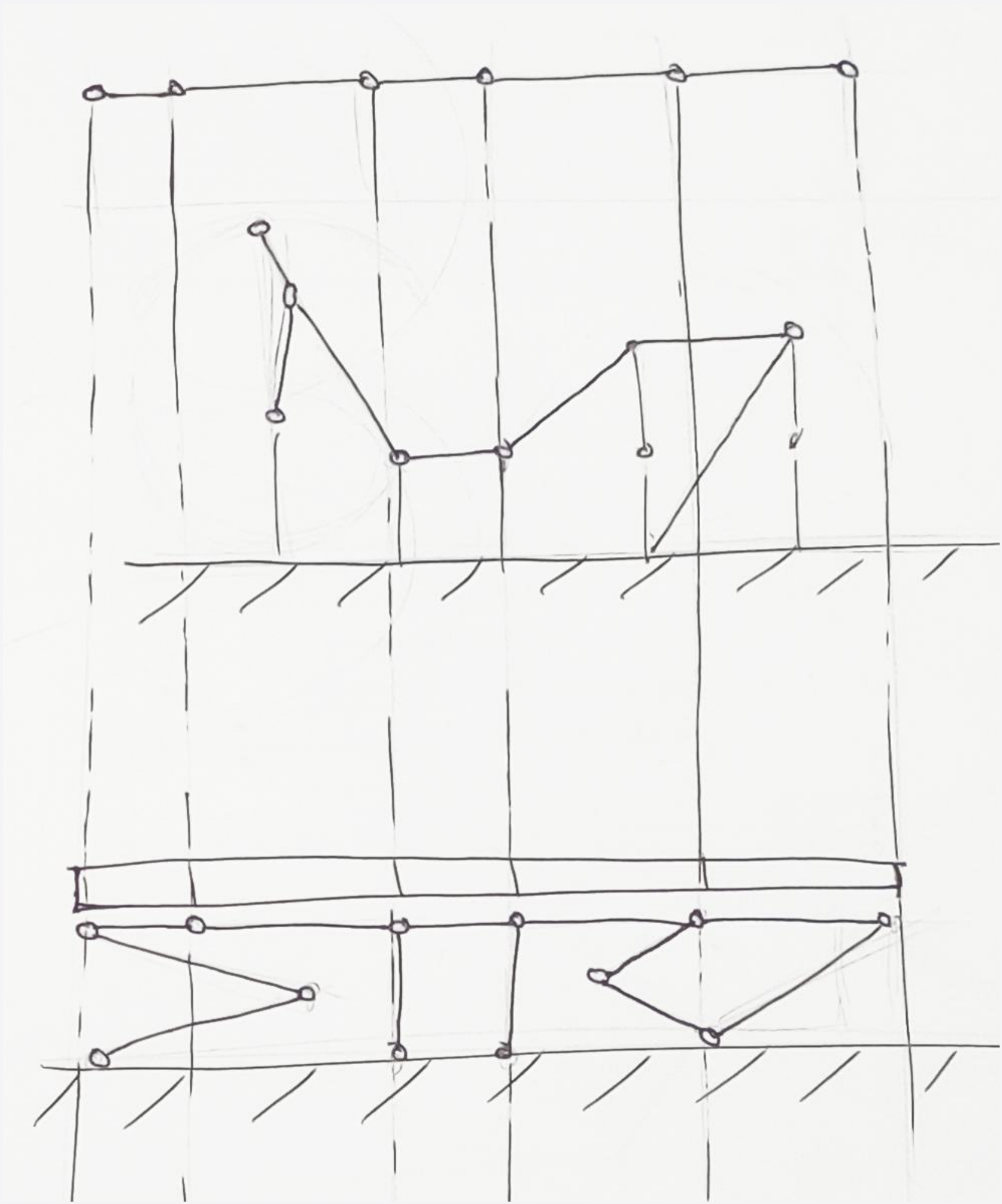


Concept-3

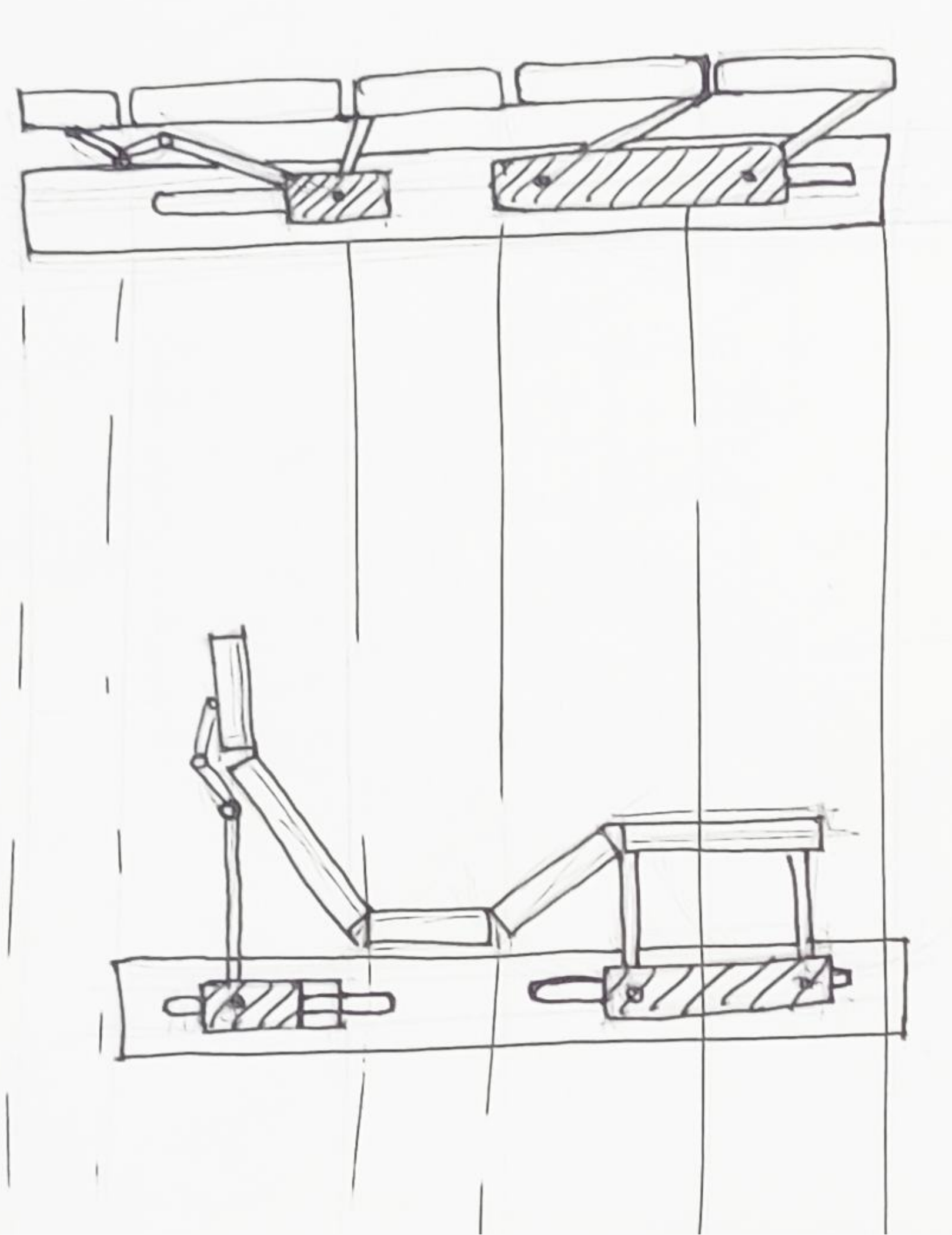
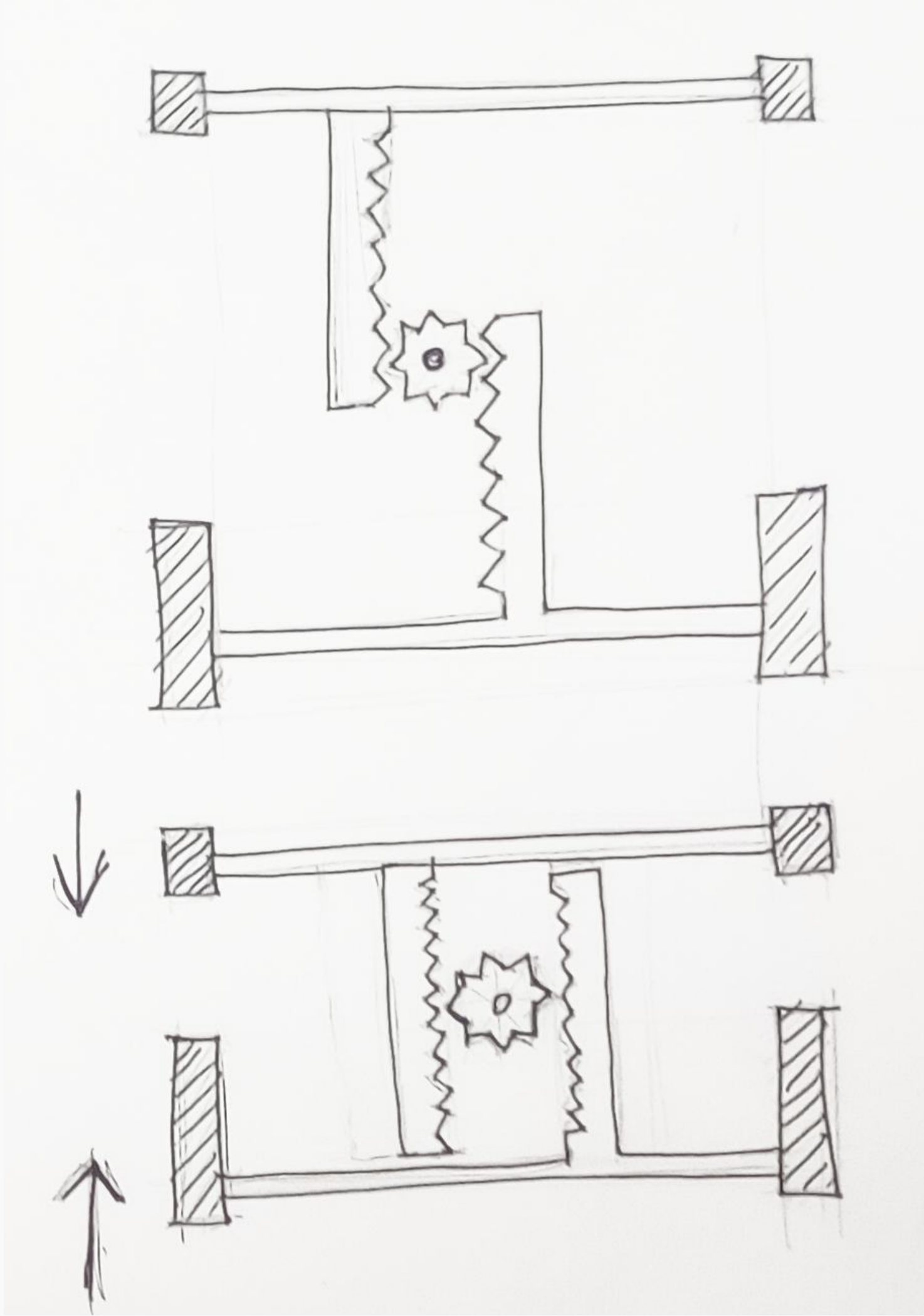
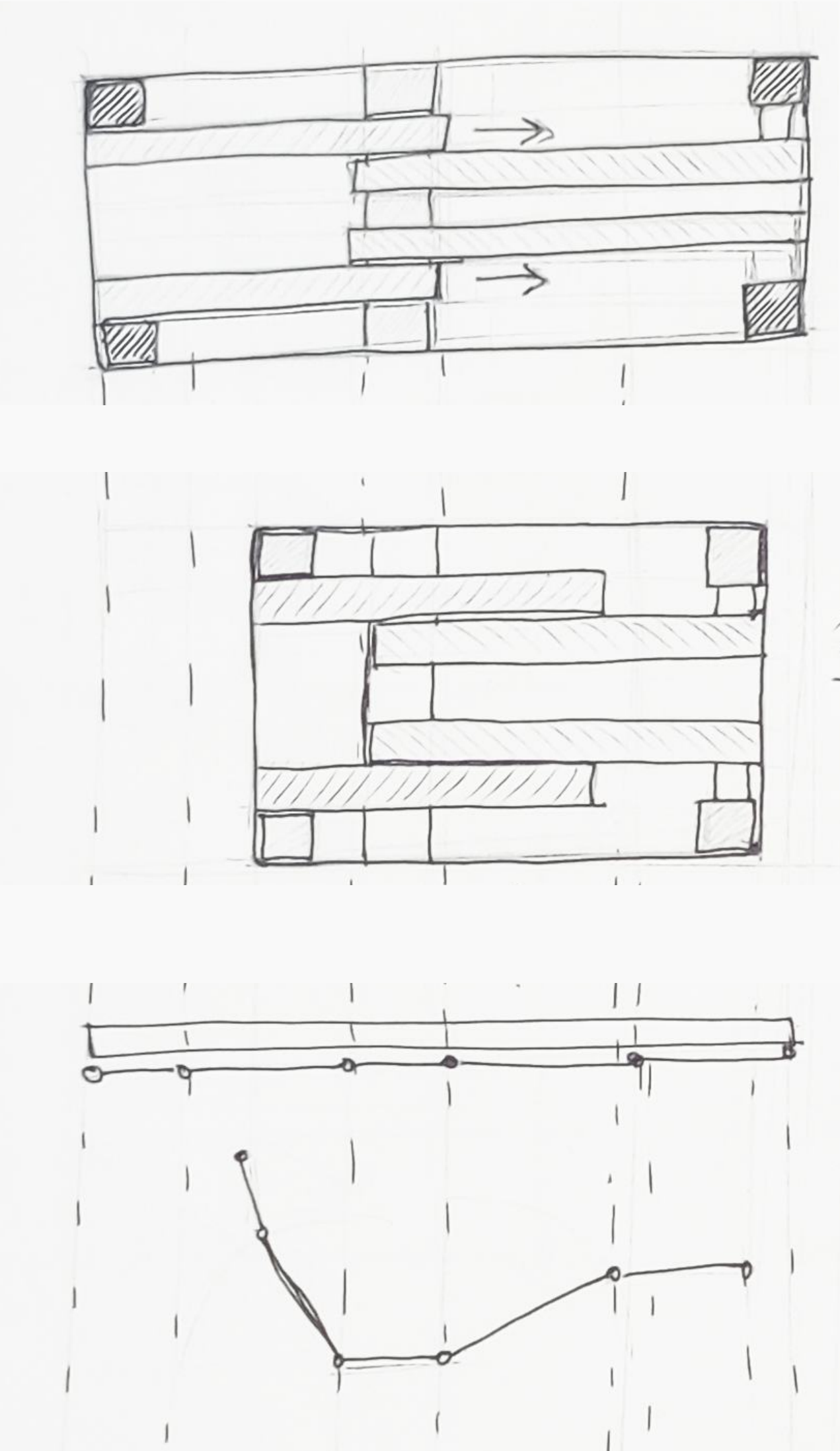
In this design whole frame moves in to a single position as it contracts longitudely. The frame can be categorized into two section, Head side and leg side. These parts can be controlled individually to achieve the desired combinations.



Concept- 3



Concept- 3



Concept- 3

Pros

- Can adjust while lying.
- Smooth operation
- Not limited to specific positions.
- Reduction on overall space usage.

Cons

- Active space needed
- Floor can damage after long time of use.
- Cant make separate adjustment.
- Help needed to adjust.

Concept 4- Exinsting tech

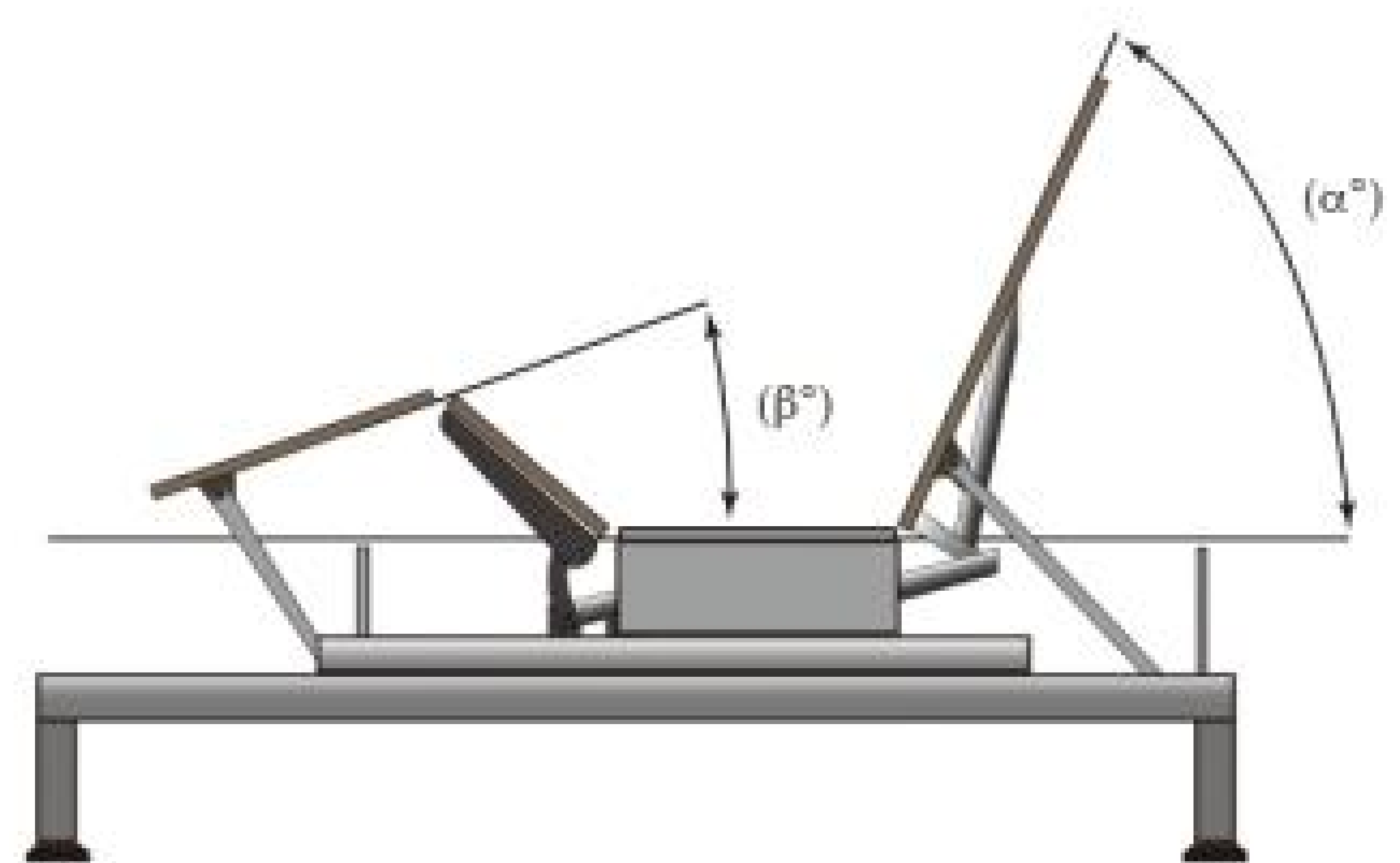
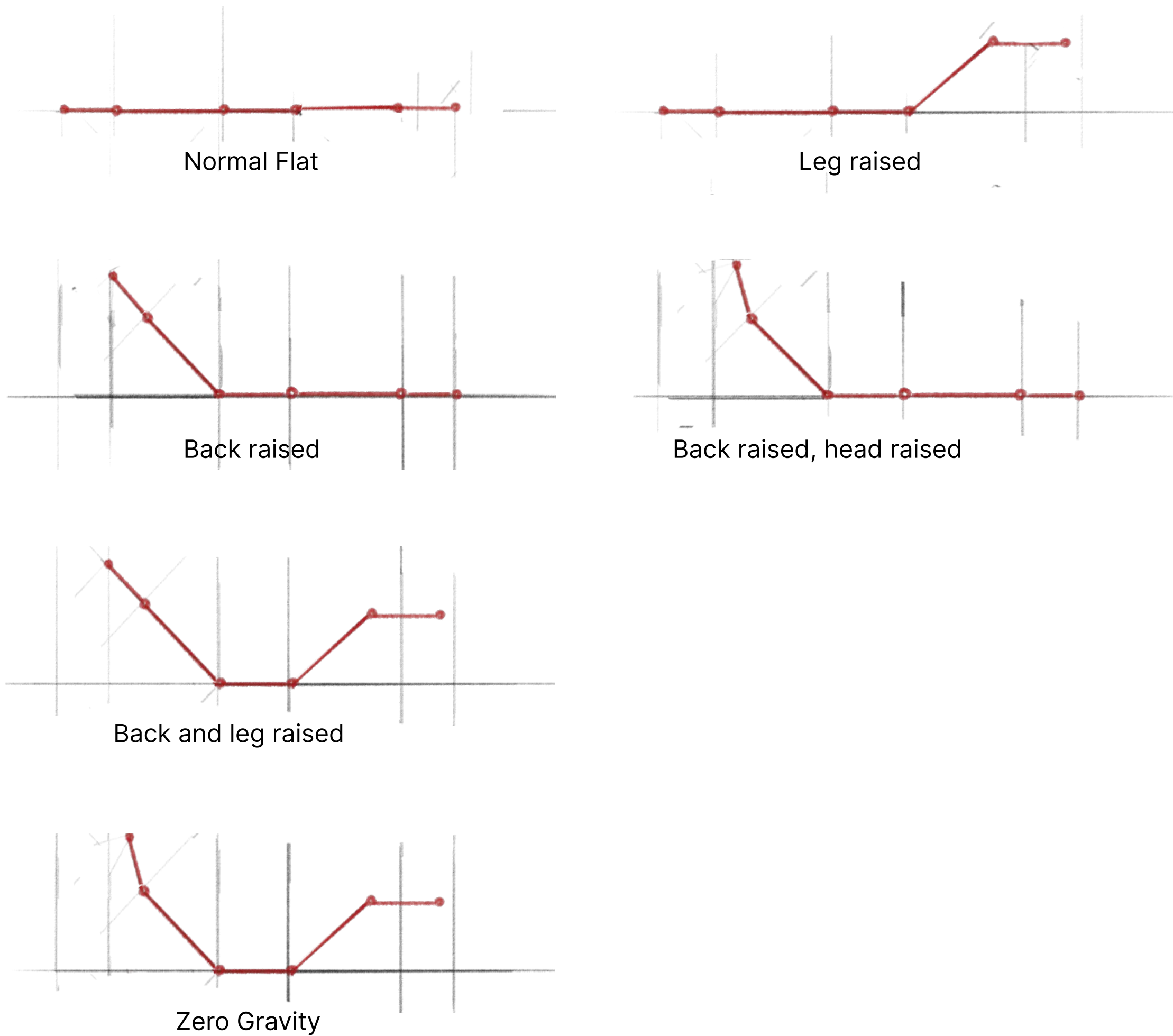
This concept utilizes existing technology, specifically motor-driven mechanisms and telescopic extensions, to enable smooth shape transformations in response to user inputs. The design incorporates motors that are strategically positioned to adjust various segments of the product.

These motors are linked to telescopic extensions that expand or contract, allowing the product to change its form or configuration seamlessly.



Concept 4- Exinsting tech

To satisfy all the required positions this mechanism in used and it works with the help of two motors.



Concept 4- Exinsting tech

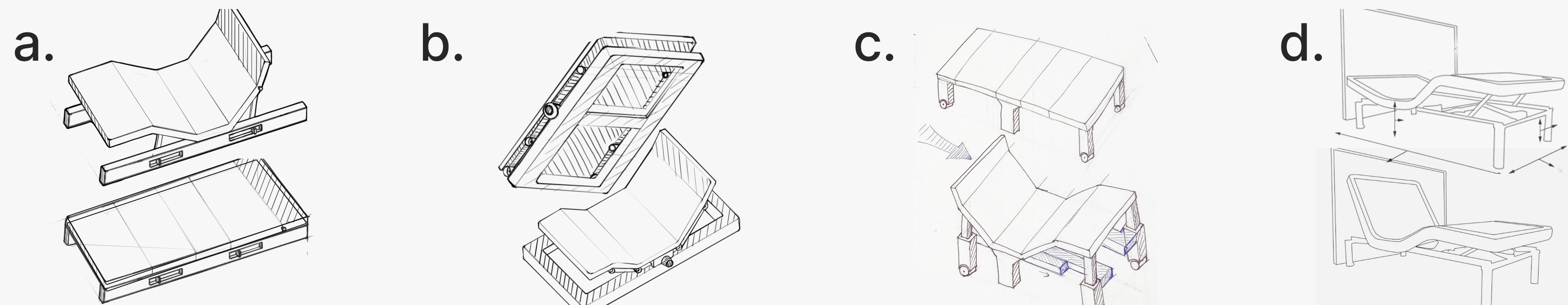
Pros

- Can adjust while lying.
- Smooth and silent motors.
- Preset modes.
- Flat pack
- Voice & remote control.
- Easy assembly.

Cons

- Have no base of its own.
- Needed 6-legd frame to stand.
- No storage space.
- No head support.
- Lacking the feel of a bed.
- Other frames do not solve its flat-packing need.

Concept Comparison and selection

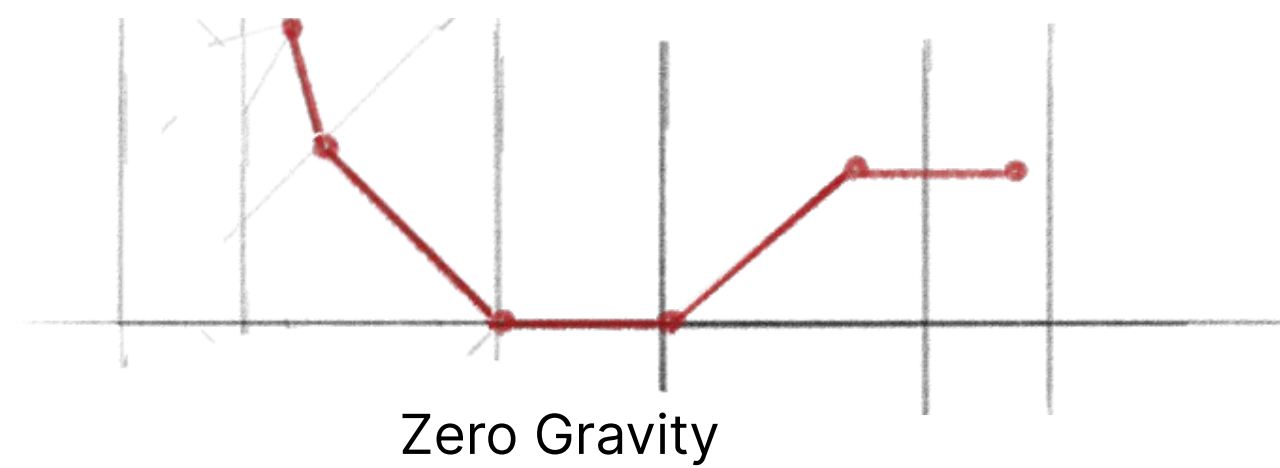
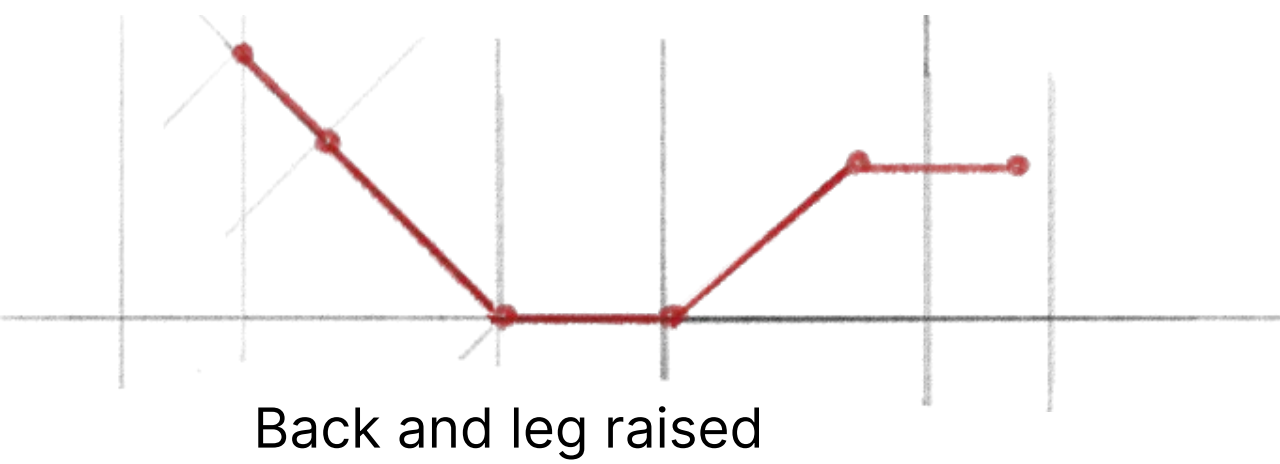
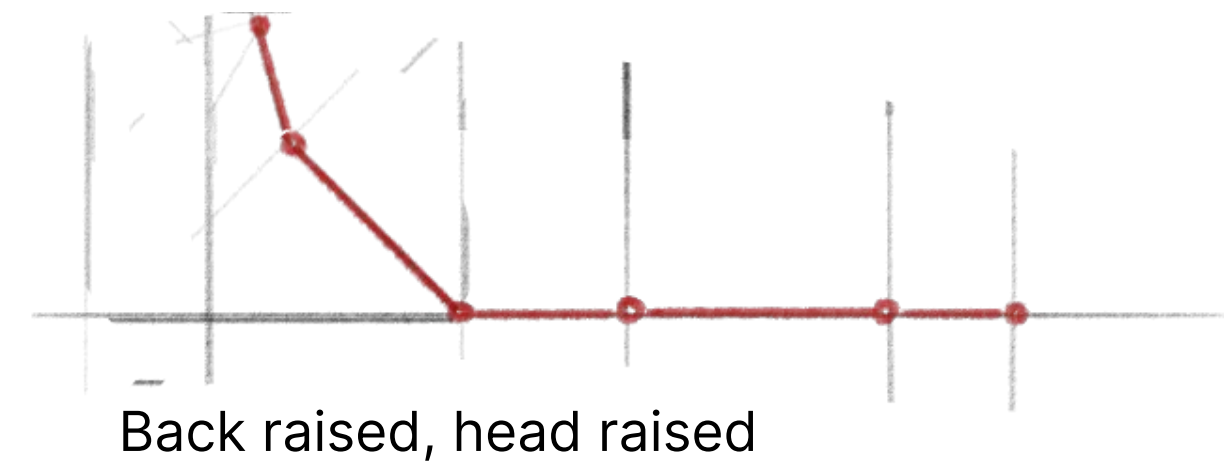
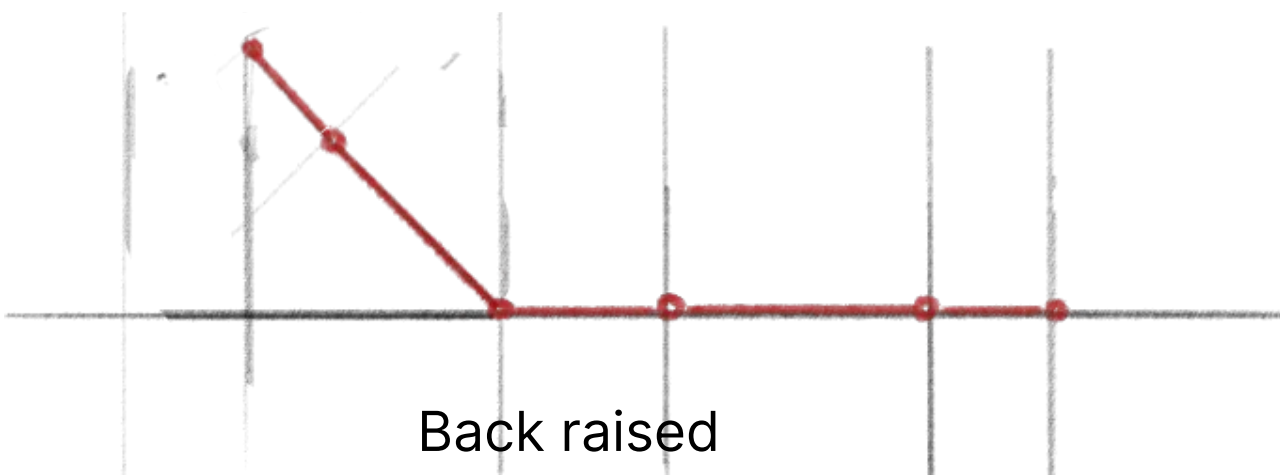


Design	Preset modes	Auto adjustment	Flat pack	manufacturing cost	Maintenance	remote control
a.	yes	no	good	very low	very easy	no
b.	no	yes	good	very high	very complex	no
c.	no	yes	no	high	complex	yes
d.	yes	yes	best	low	easy	yes

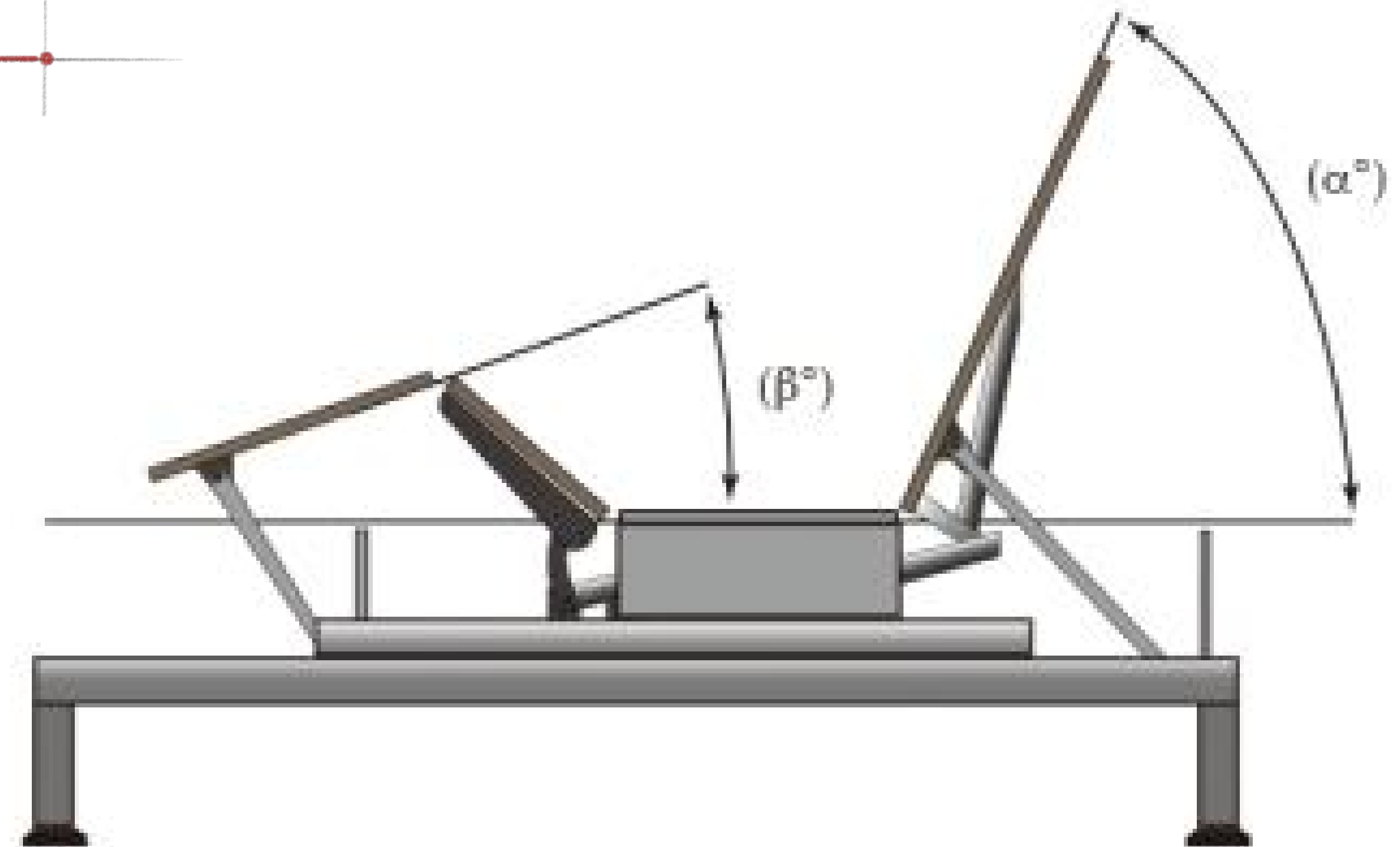
This design technology which works on the motor and telescopic extension to change its shape smoothly with remote controls and voice commands.

(Existing tech.)





To satisfy all the required positions this mechanism is used and it works with the help of two motors.



Pros

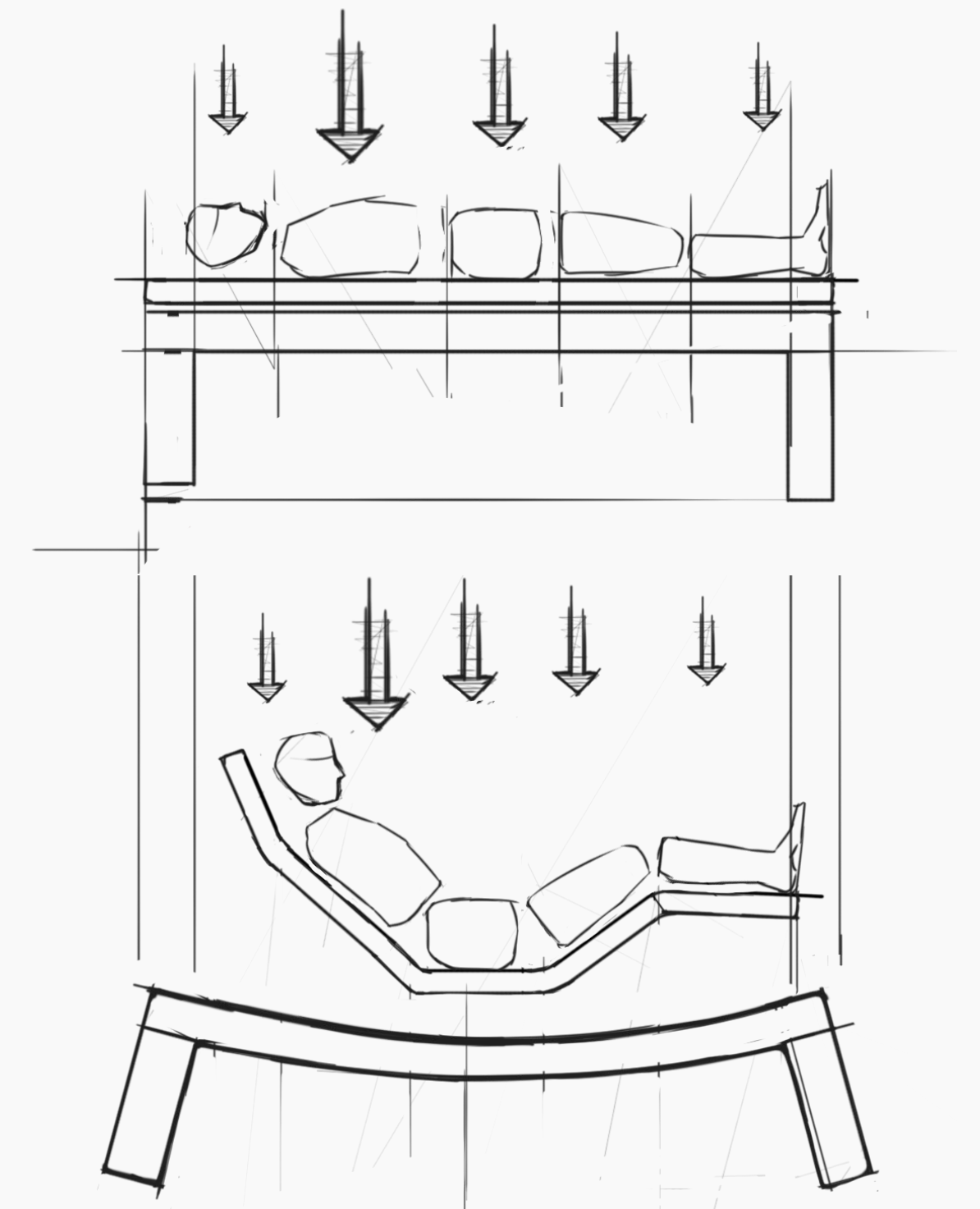
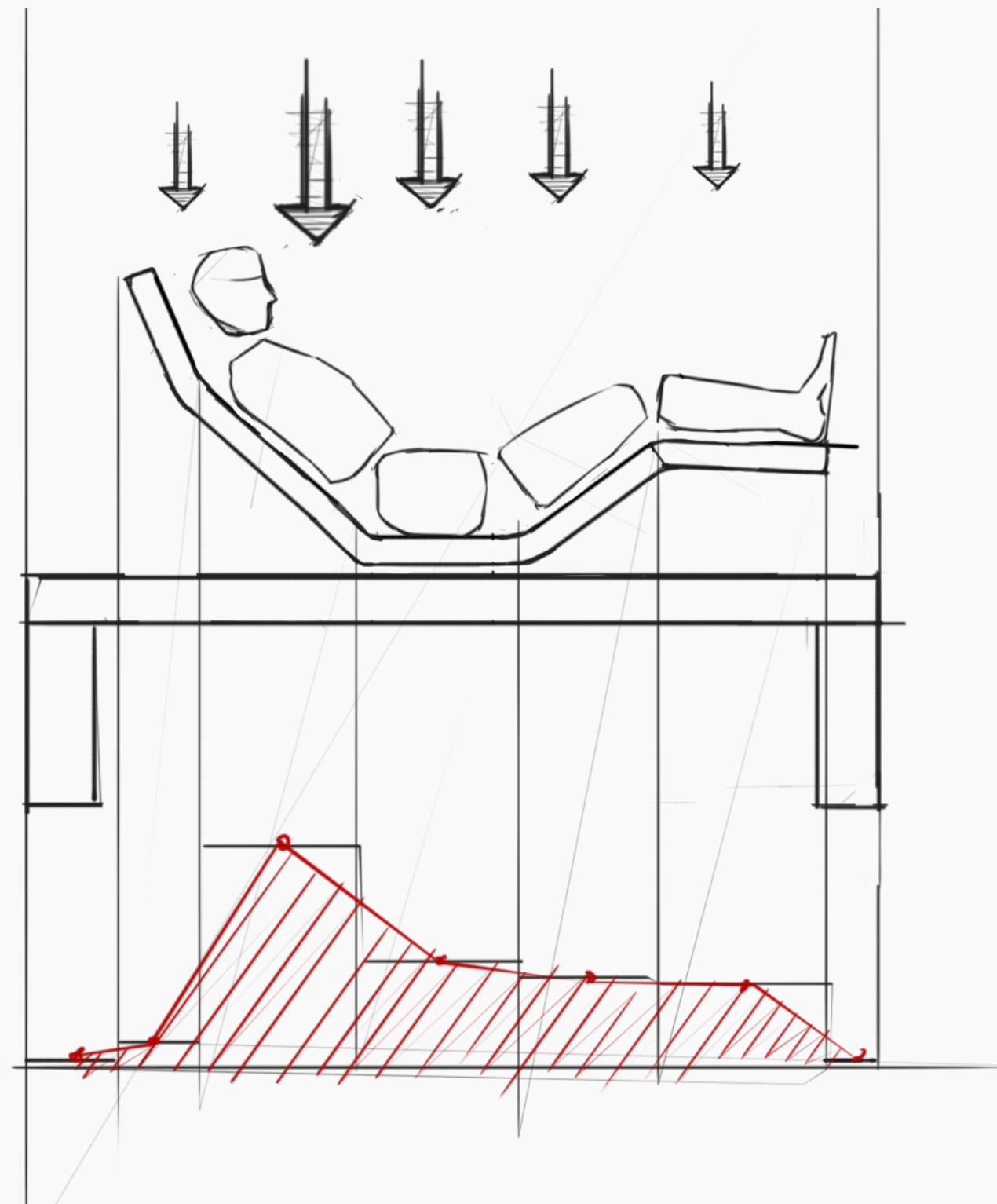
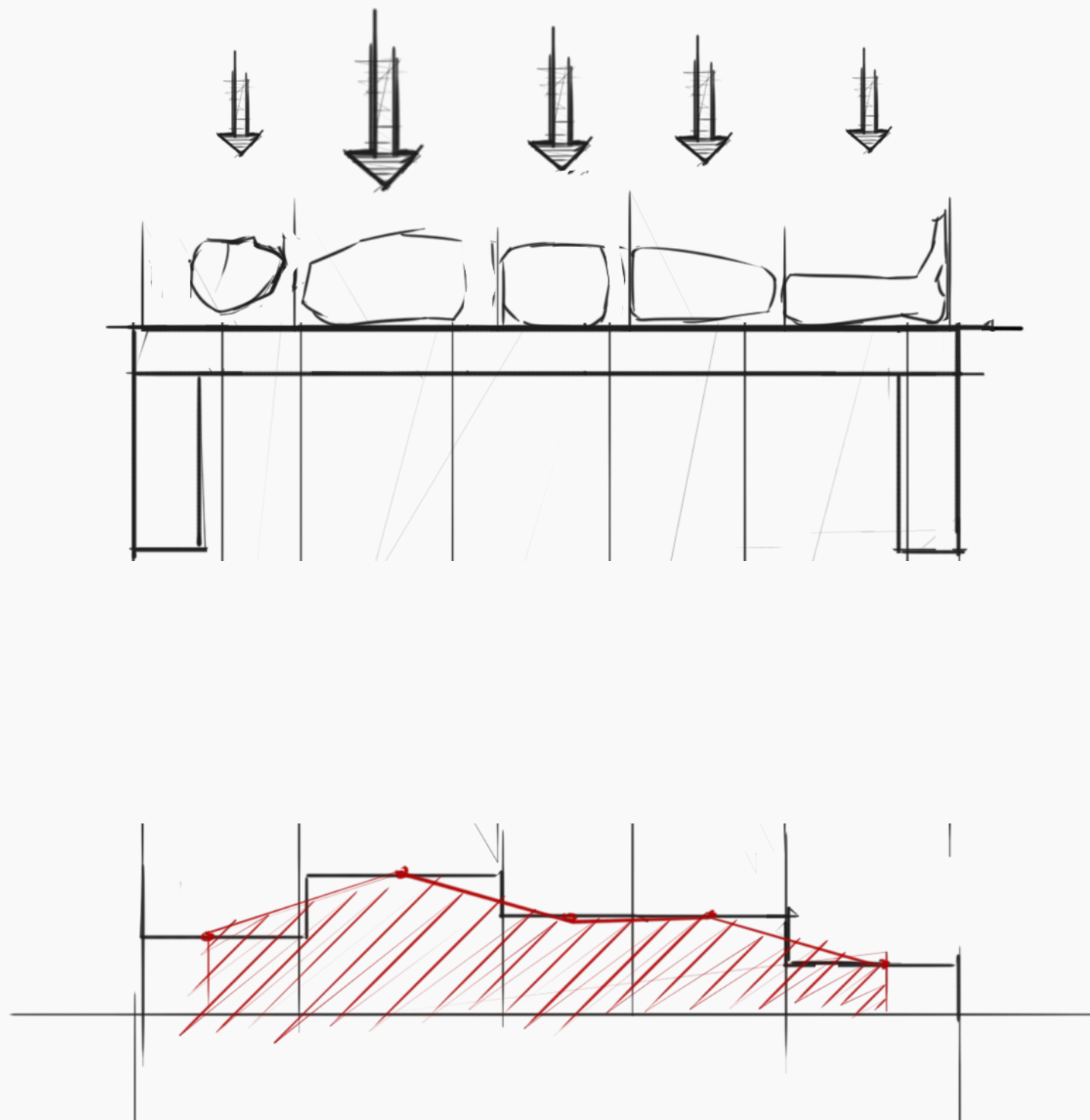
- Can adjust while lying.
- Smooth and silent motors.
- Preset modes.
- Flat pack
- Voice & remote control.
- Easy assembly.

Cons

- Have no base of its own.
- Needed 6-legd frame to stand.
- No storage space.
- No head support.
- Lacking the feel of a bed.
- Other frames do not solve its flat-packing need.

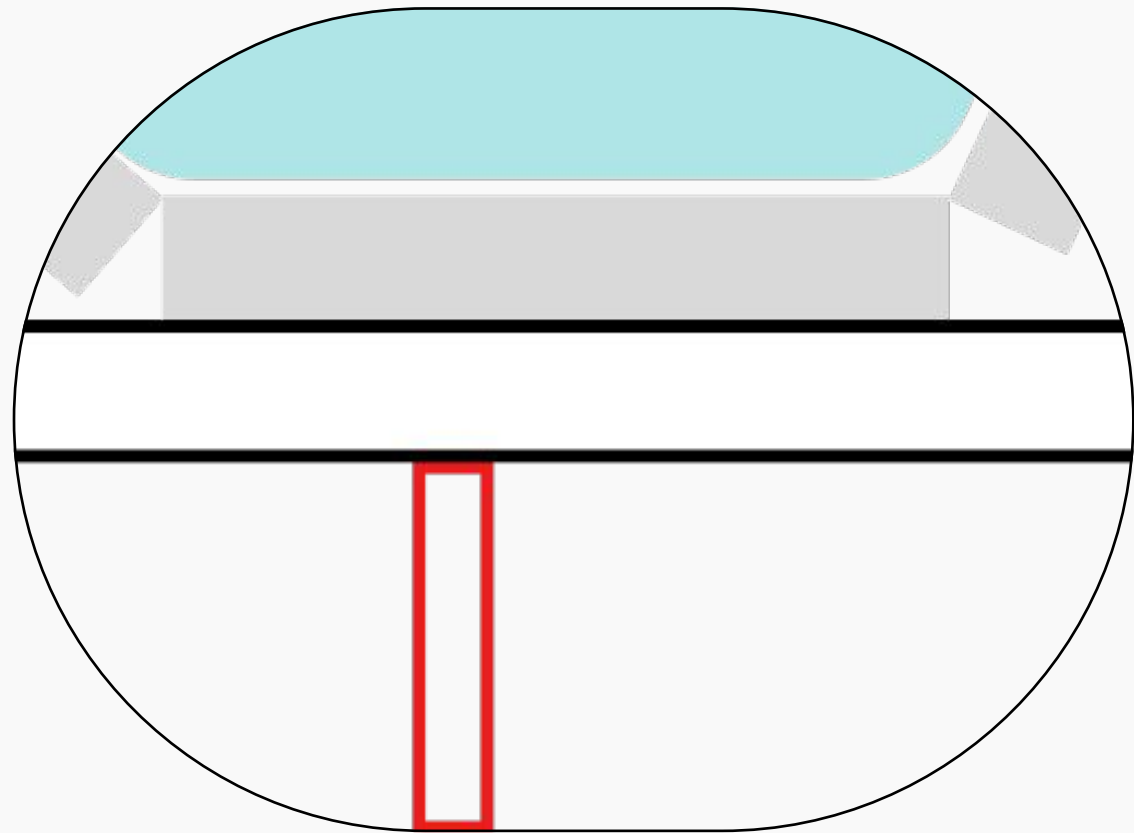
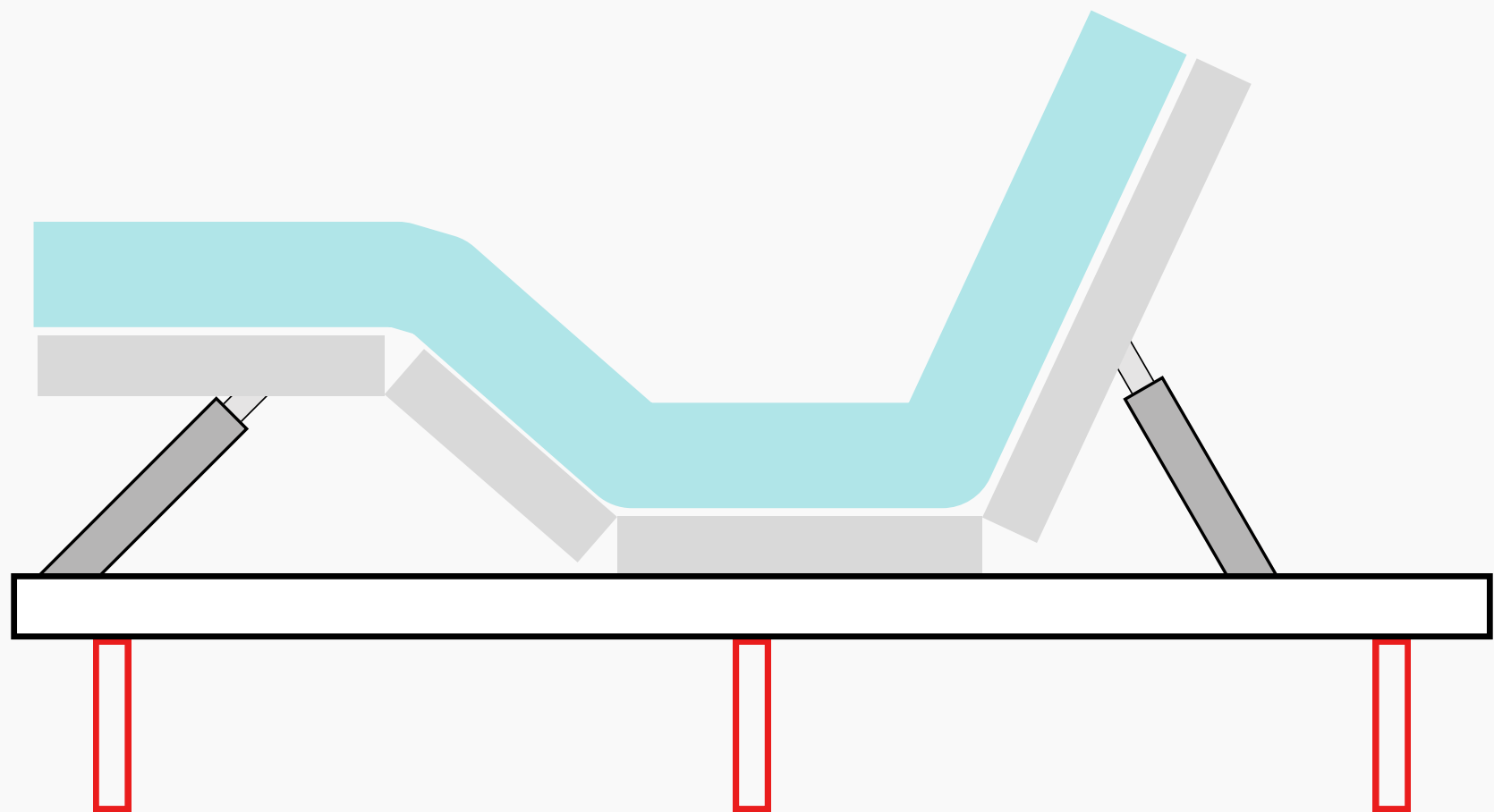
This design is an **existing technology** which serves the all the desired features. There are its own flaws which are addressed.

Frame- Weight distribution

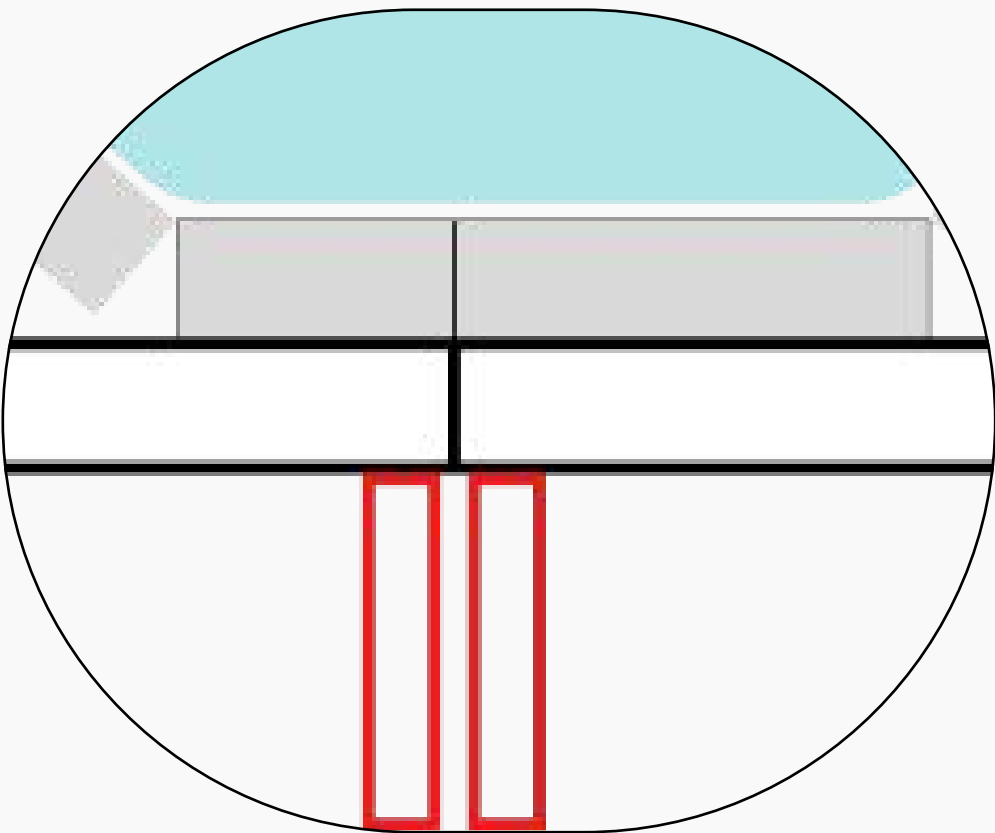
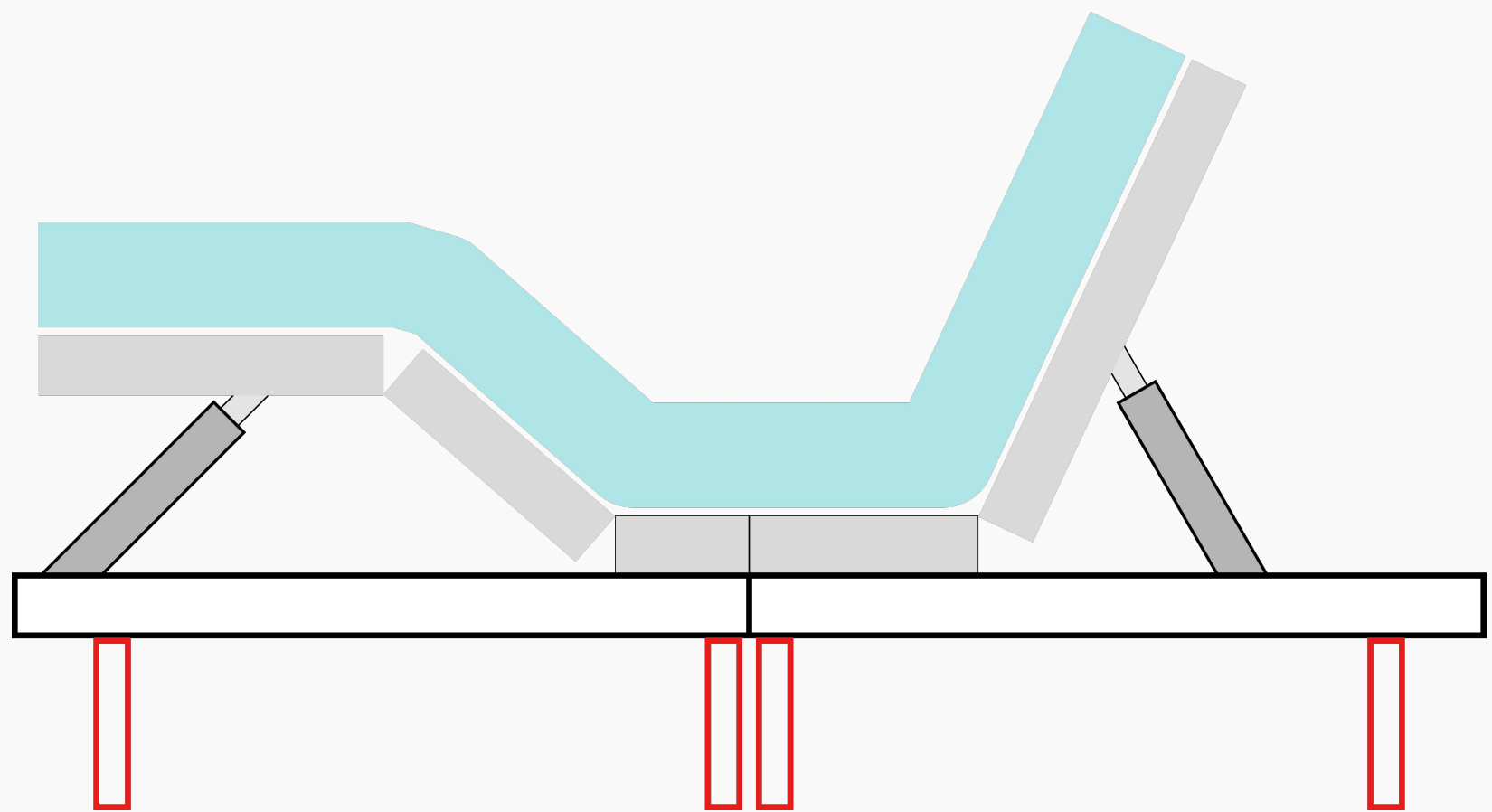


Standard four legged frame won't be enough for this type of weight distribution. Either have to make the frame with stronger material (costly) or add two more legs.

Frame- Mld leg support

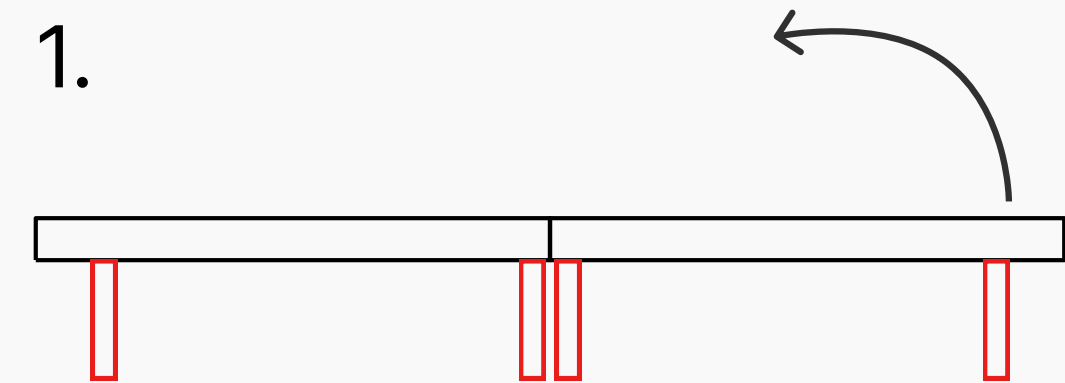
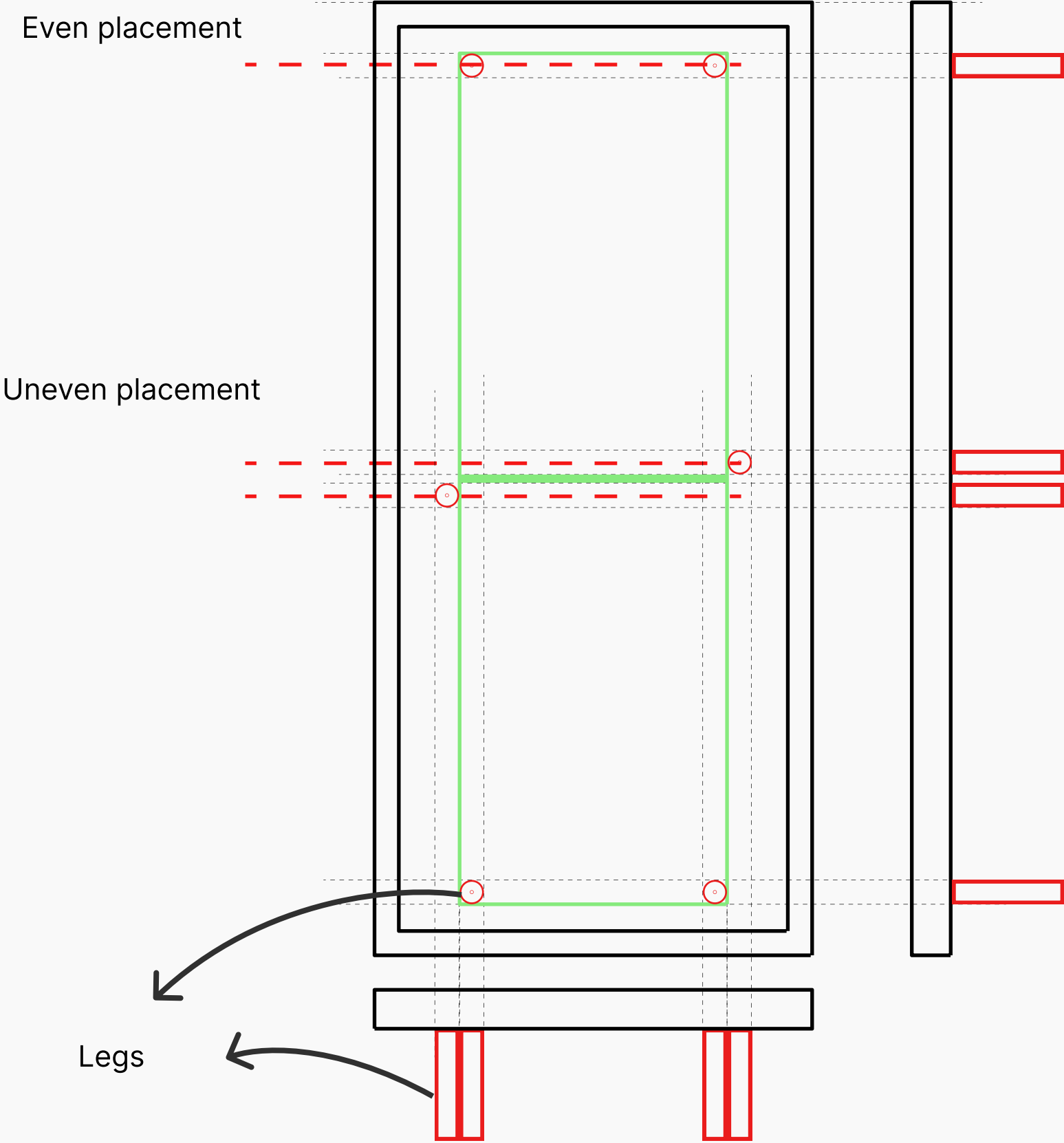


Six legged frame
(equally placement)

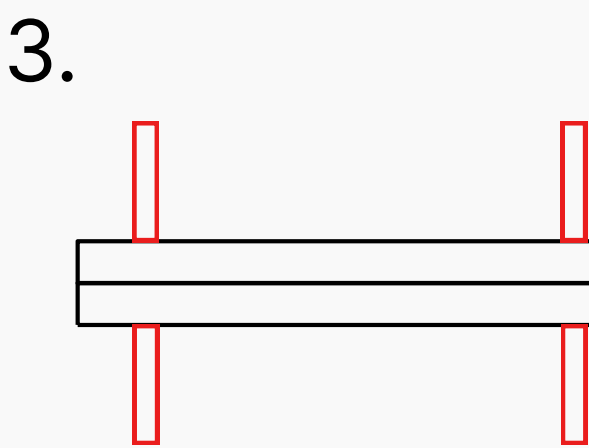
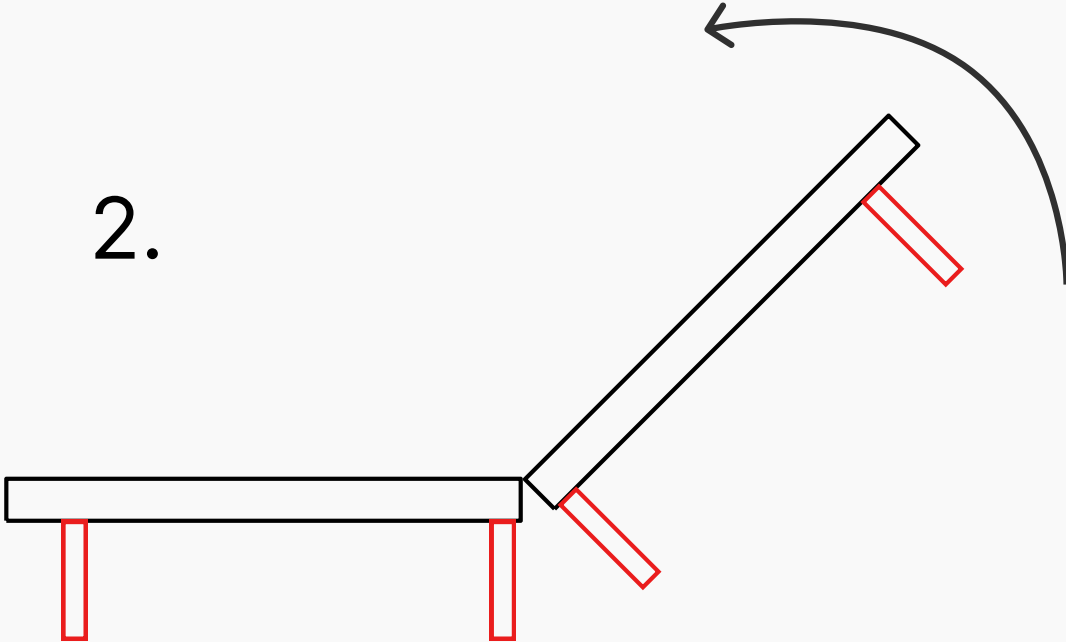


Six legged frame
(shifted leg placement)

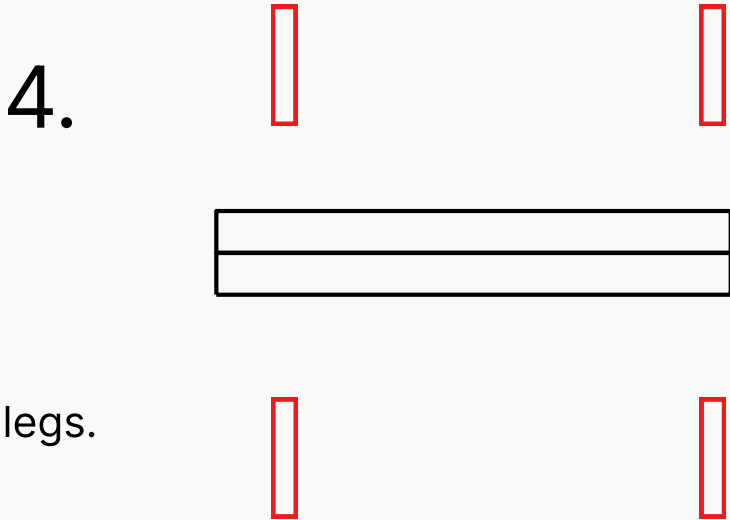
Frame- Layout



- Lift one half to fold the bed in half.

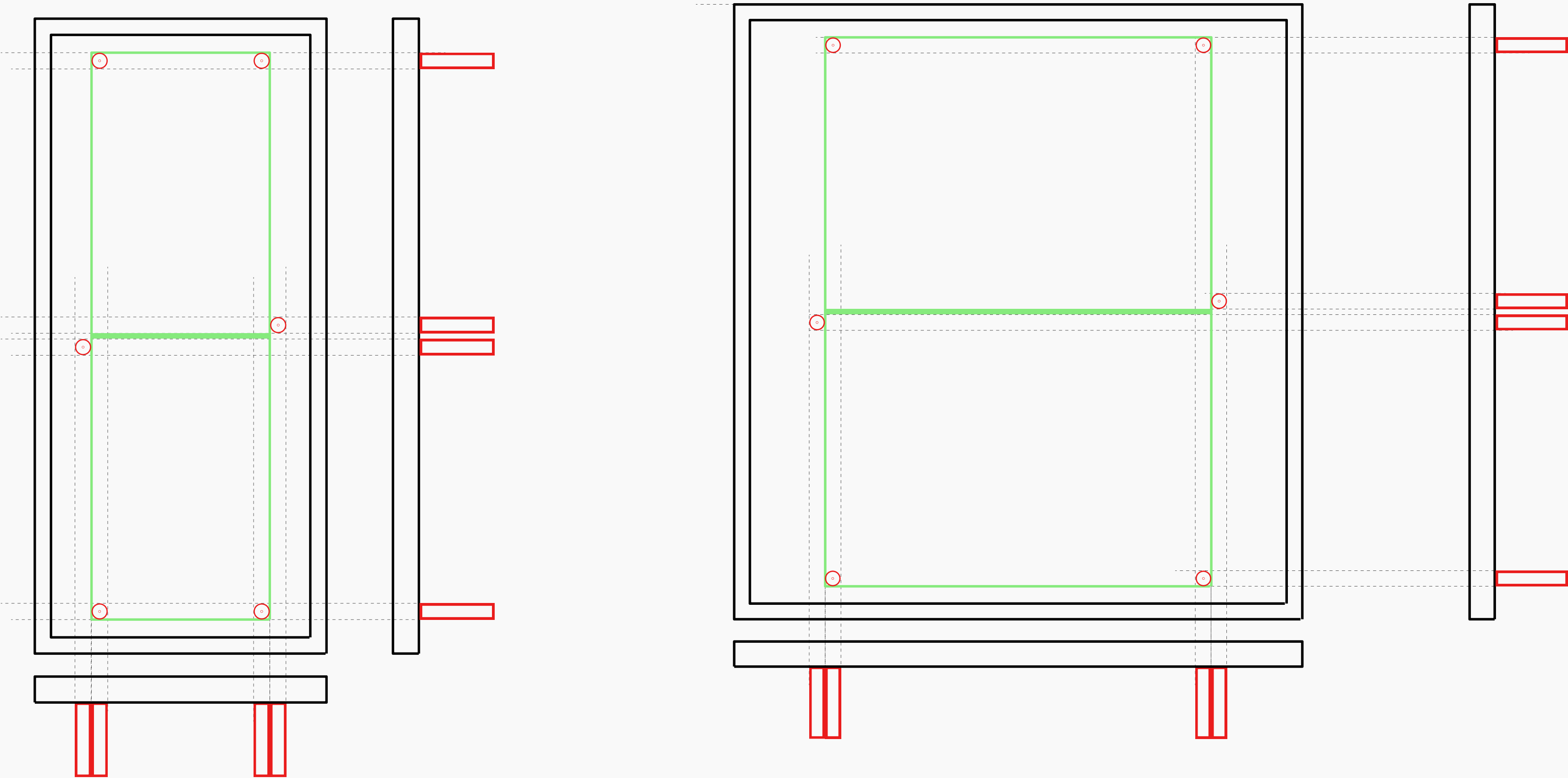


- Flat packed easy to transport



- Removable legs.

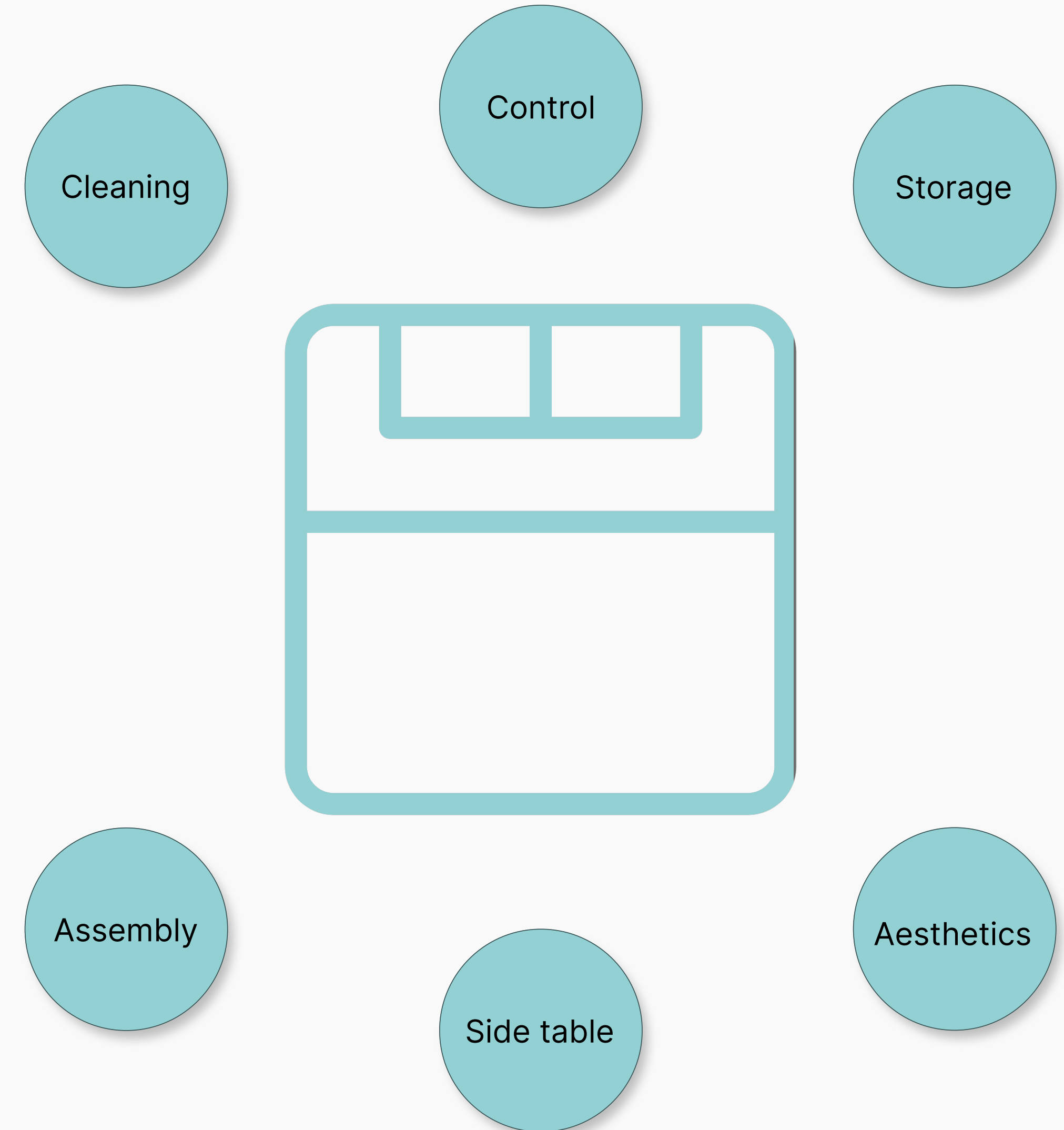
Frame- Single and double bed



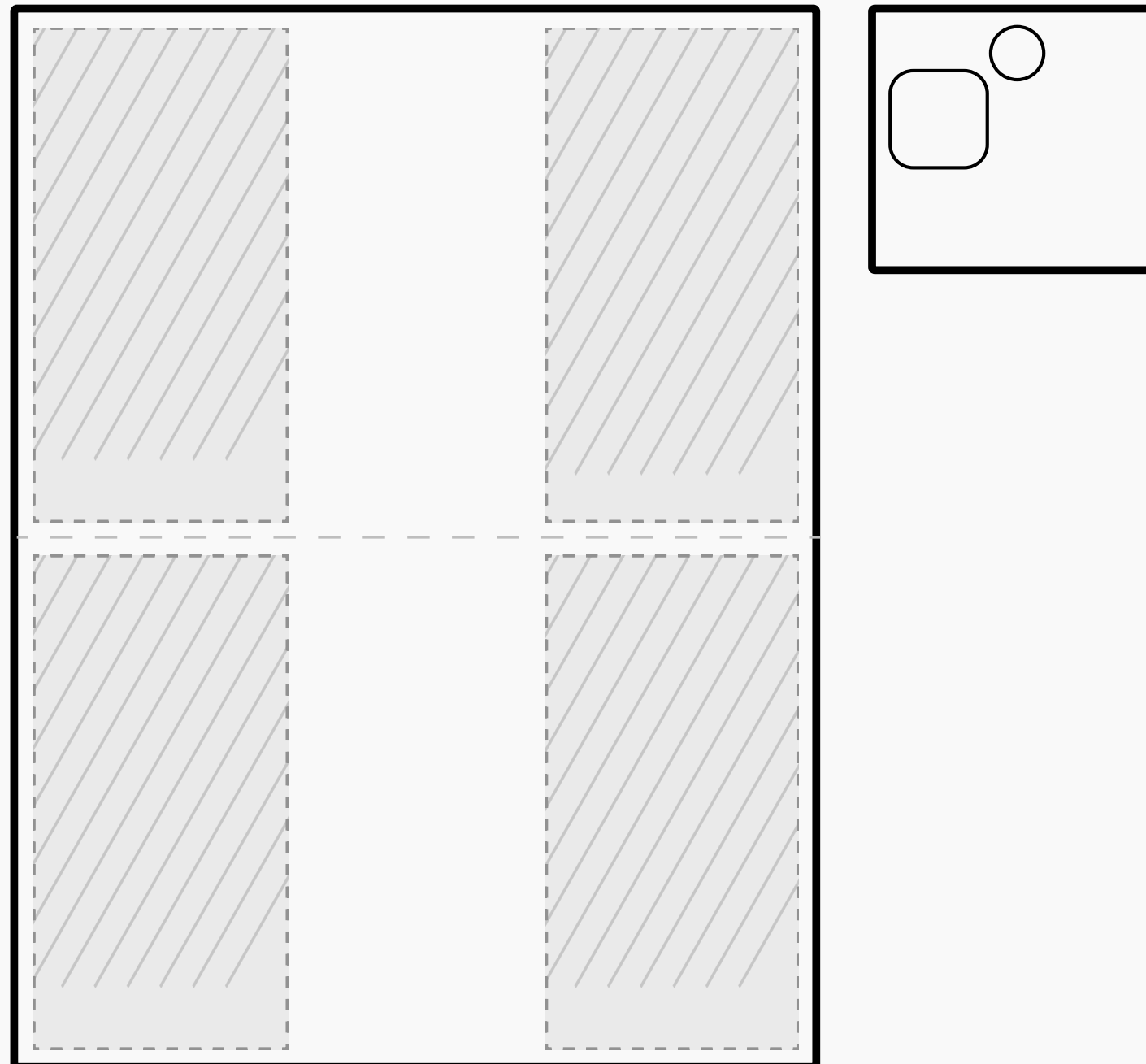
System design

This approach involves closely observing the users interacting with the product to identify their needs and desires. Through methods such as surveys, focus groups, and interviews, detailed insights are gathered to understand what users value or feel could be improved.

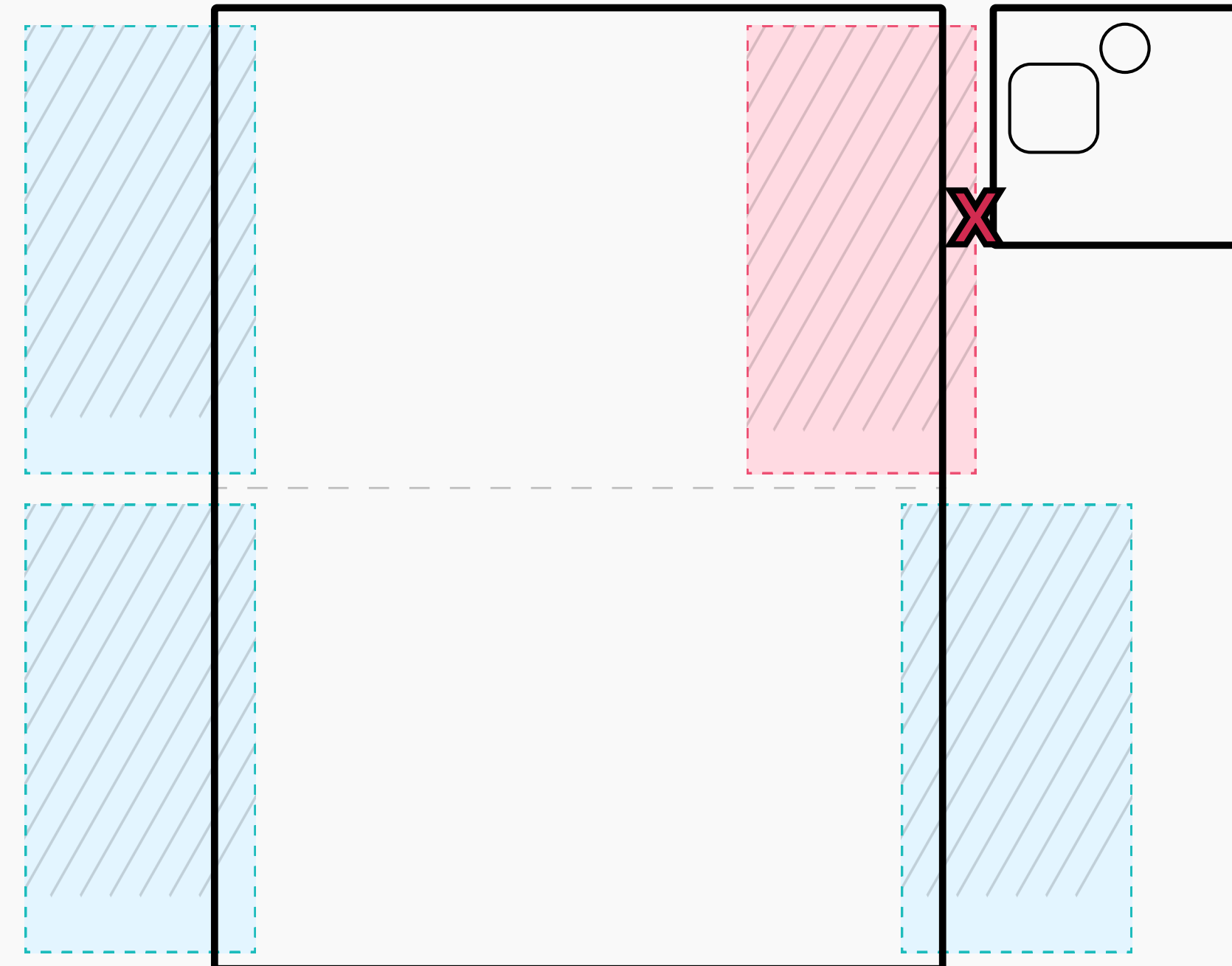
The product is subsequently designed or adjusted to address these prioritized needs. This user-centric method enhances product usability and satisfaction by aligning the product features closely with user expectations and requirements.



Bed table issue



Side table is one of the most important part of the bed room. Side table is used to hold various essential thing which are needed by the user while interacting with the product (bed). These things basically includes: Mobile, clock, vase, remote, water bottle, books, keys, etc.

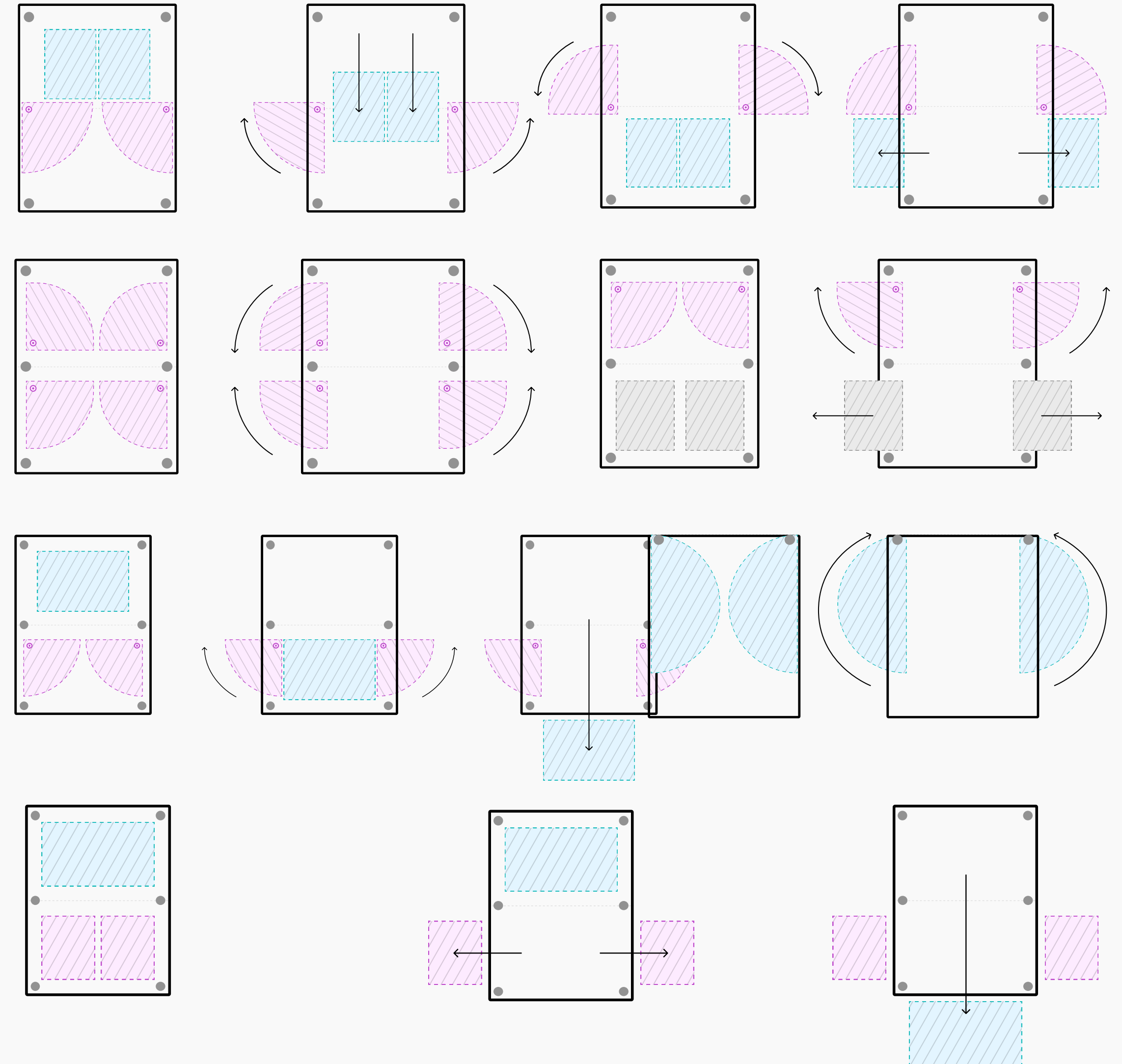


There is an issue with the side table and the drawer, when user try to open the storage drawer (drawer taking full area under the bed) near the side desk, It get stuck due to the side desk and won't allow user to use that specific drawer.

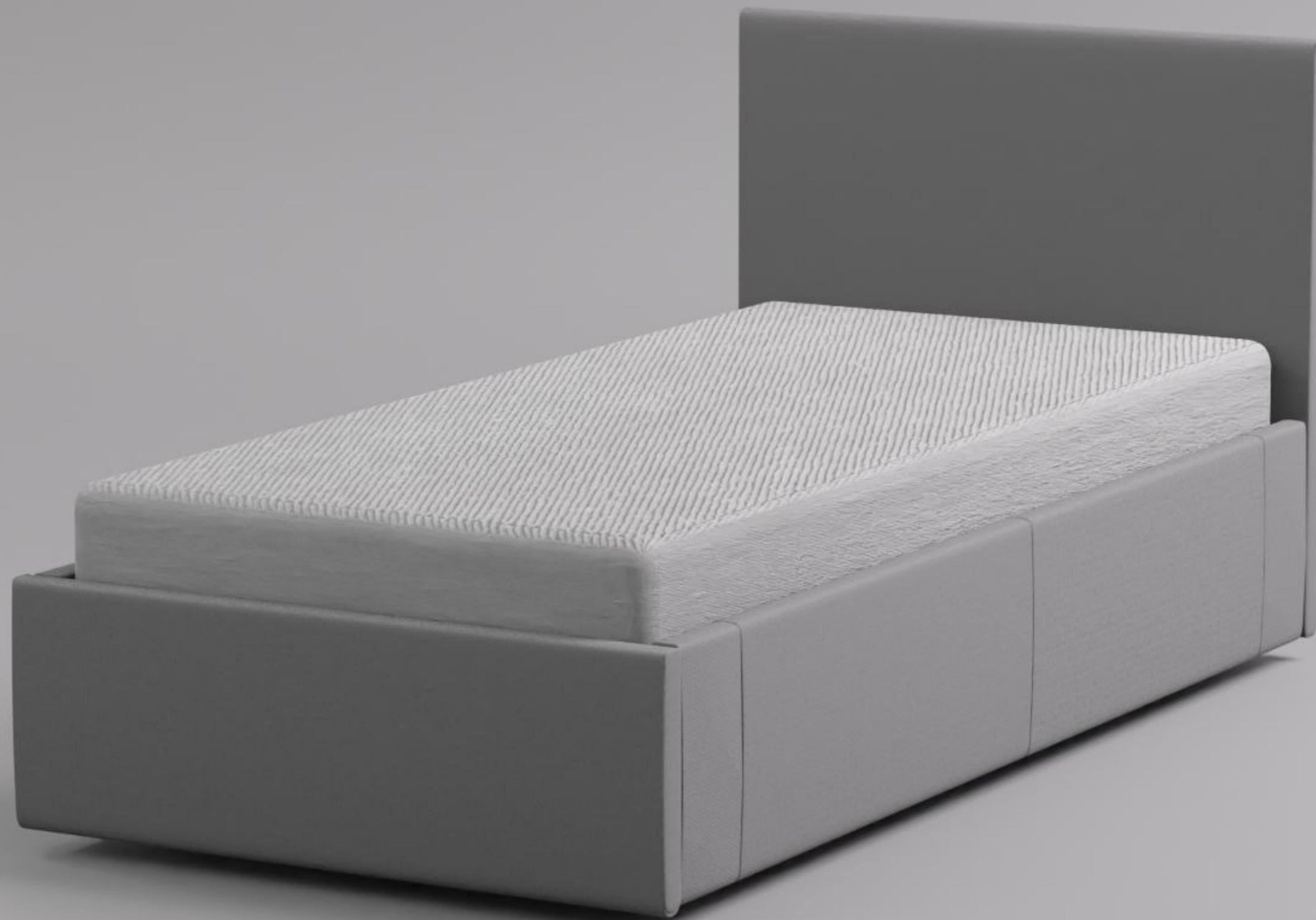
Storage drawers

To tackle these issue I considered the all kind of possible configuration of the drawers under the bed. these configuration is done keeping the constrain in mind. the constrain is the arrangement of the legs under the metal base of the existing mechanism. These legs are not evenly arranged but little shifted to give strength to the metal base.

There are total 6 legs as well which makes it almost impossible to have single long drawer.

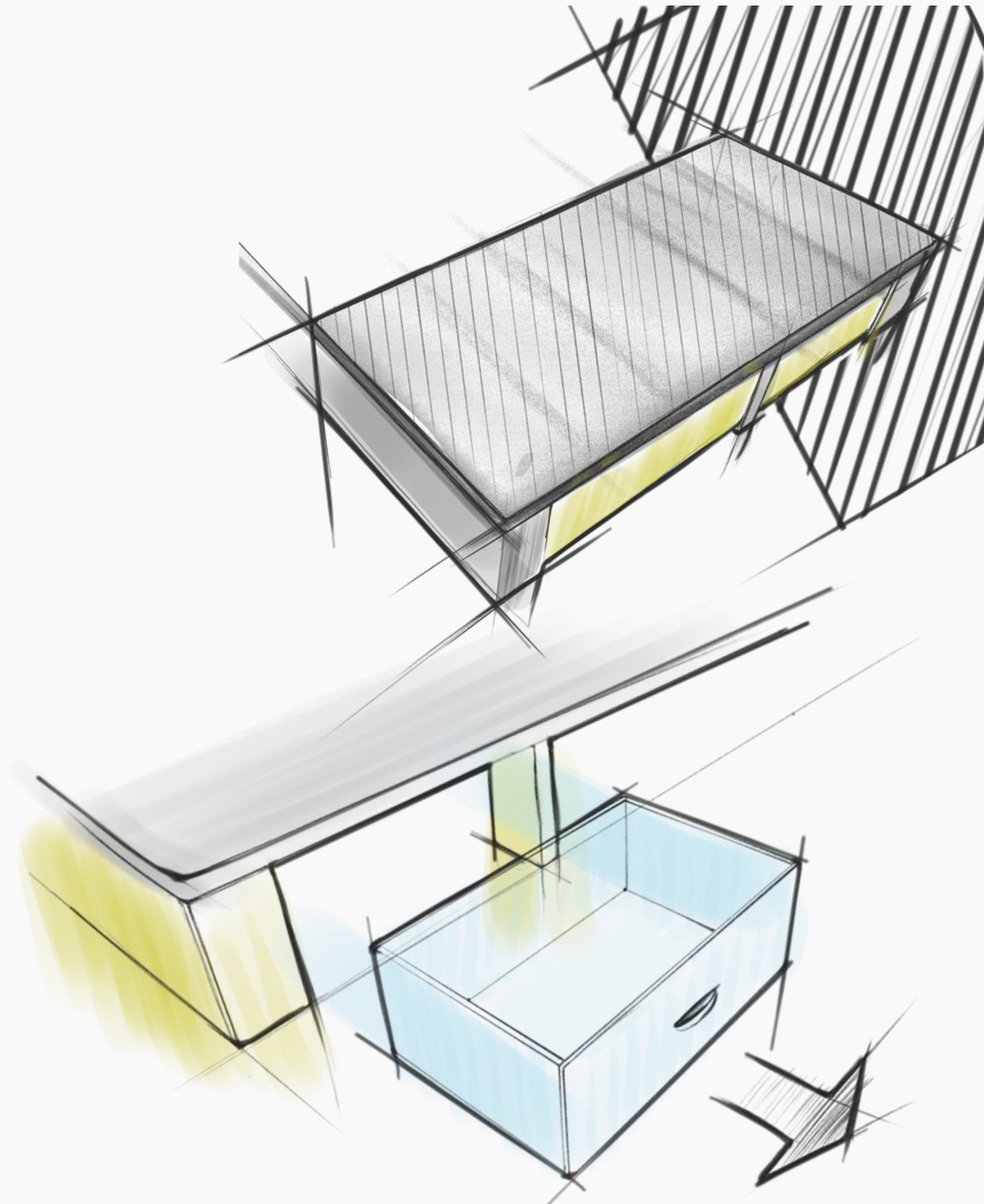
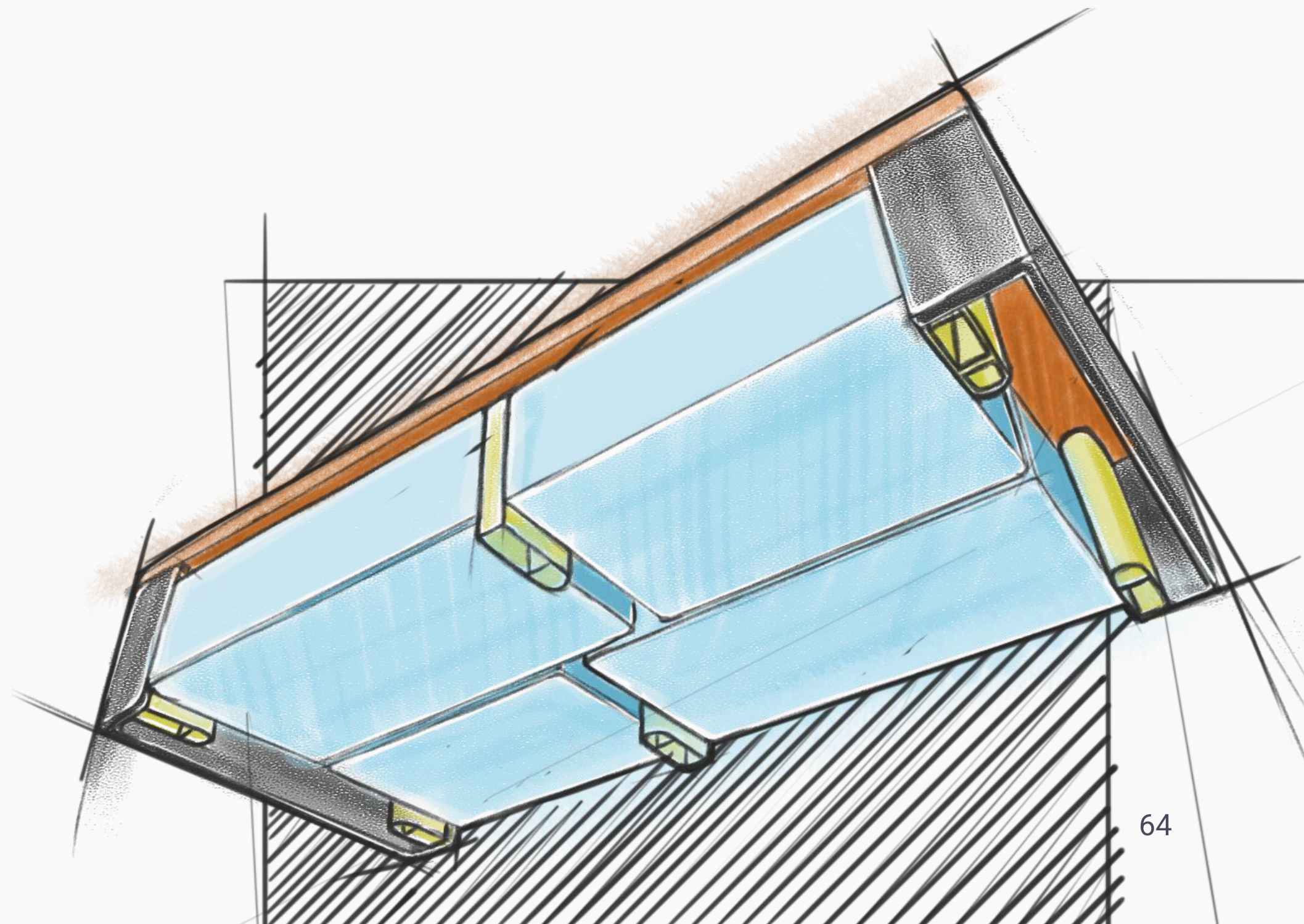


First design

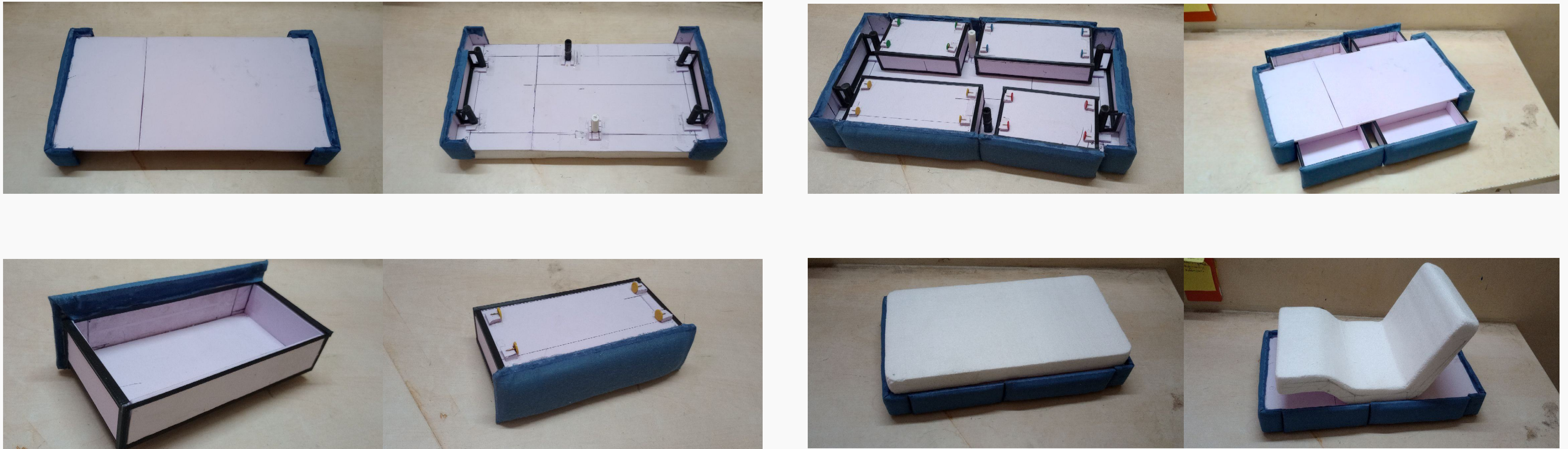


First design- Drawer Arrangement

At this point the conventional arrangement of drawers looks most promising as per the constraints given. But still there are some changes which can be seen in the sketches. The change is that all the drawers are not of equal measurements, as the alignment of the legs were shifted so does the dimension of the drawers. as a result we have two shorter drawers of equal length and two longer drawers of equal length.



Scaled prototype- Bed and the drawers



System working-

Simple cuboidal box shaped storage will be used. All drawers will have caster wheels which can be moved in all directions in case user want to take them out and move it for some use- ***done by users before***. The storage have the capacity to hold the essential thing which will be needed to store as a bed storage which are pillows, bedsheets, blankets, etc.





Drawer size: Two sizes fo drawer is used so, it can be fit inside the unique frame of the bed. this is to provide most of the storage space to the user in the given frame.



Drawer for double bed will also have the same design with the little wider storage drawers.

Drawer 1



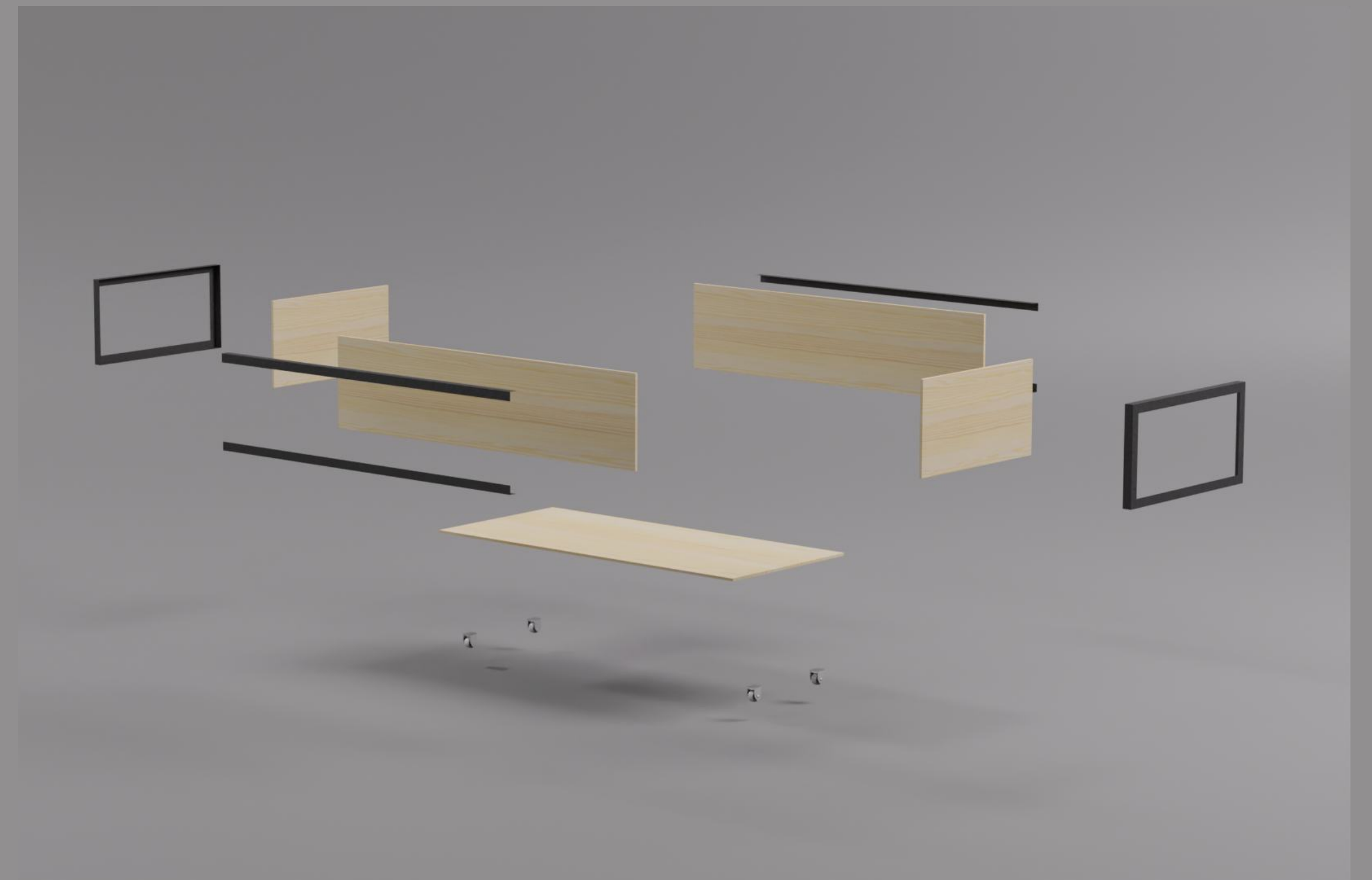
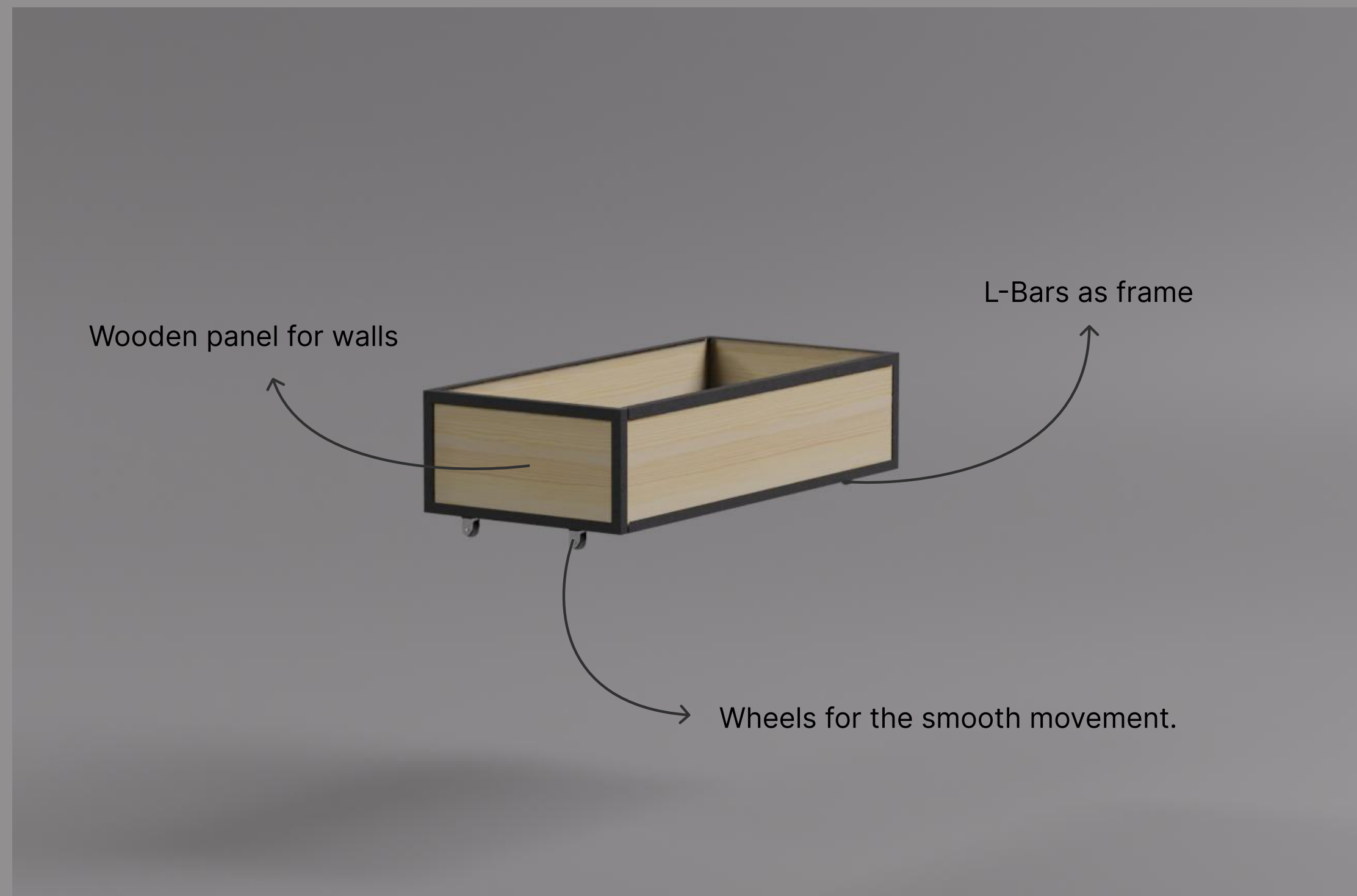
Drawer 2



There are two suggested designs,

First design is more focused to easy manufacturing and selection of the commonly used material that can easily be replaced.

Second design is focused on the easy assembly by the user without using any tools. This design will cost more in manufacturing in the exchange of user experience.



Exploded view

As we can see the whole drawers is made up of only L-bars and wooden panels which will be assembled using hex screws only.



Collapsible

This drawer can be made up of plastic or wood as per the manufacturer's need but cost more. In return it will be assembled in seconds without any need of screws.

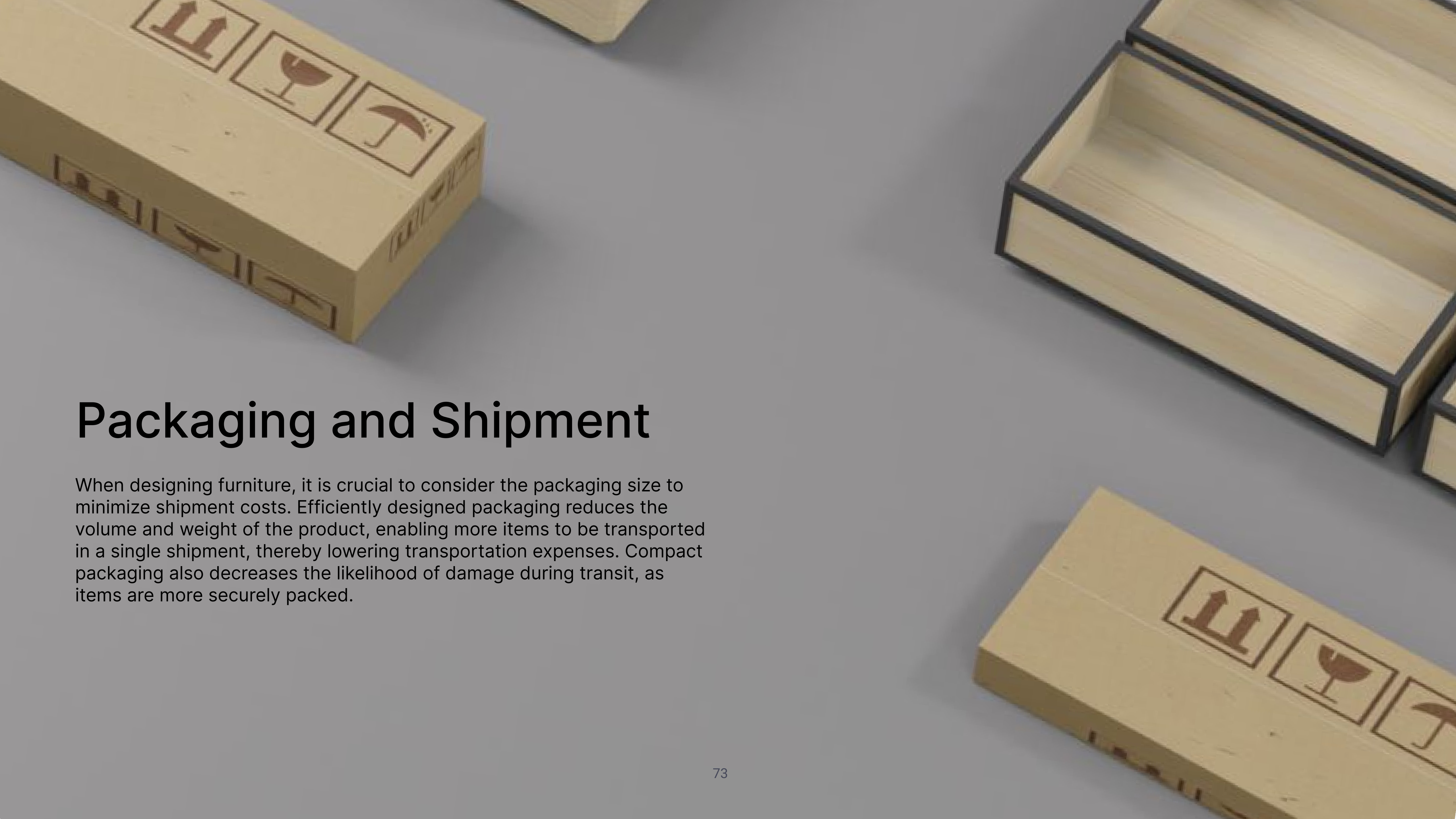


Packaging volume

Both drawers can be flat packed into a small cuboidal box which is almost one forth the storage all four drawers will cover.



The packaging volume of design 2 will be almost twice than the designn one hence cost more than the design one to ship.



Packaging and Shipment

When designing furniture, it is crucial to consider the packaging size to minimize shipment costs. Efficiently designed packaging reduces the volume and weight of the product, enabling more items to be transported in a single shipment, thereby lowering transportation expenses. Compact packaging also decreases the likelihood of damage during transit, as items are more securely packed.



Side table+ work desk

A side table is a crucial component in creating a well-rounded design system around a bed. It serves the dual purpose of enhancing the aesthetic appeal and providing practical storage solutions. A well-designed side table addresses the common need for convenient access to frequently used lifestyle products. Some of the typical items that people keep on their side tables include:

- **Phone:** For easy access to communication and alarm functions.
- **Lamp:** Providing adequate lighting for reading or other activities without disturbing others.
- **Alarm Clock:** Ensuring timely wake-ups and maintaining daily schedules.
- **Medicines:** Keeping essential medications within arm's reach for convenience and safety.
- **Glass of Water:** Offering hydration during the night without the need to leave the bed.
- **Vase:** Adding a touch of nature and beauty to the bedroom environment.
- **TV Remote:** Allowing control of the entertainment system from the comfort of the bed.

By incorporating a side table into the bedroom design, you can effectively address the storage and accessibility needs of these frequently used items, contributing to a more organized and functional living space.



As our product (adjustable bed) is not limited to these needs, we have other needs of the user to be taken care of. That need is to have a work desk as well. Our product is aimed to serve as a work station for the user to work on for longer periods of time. To work on the bed, it has to serve the user some specific services which resemble a table and chair for some level. Among those services, one of the major features which we are aiming to deliver is to give them an option to use this side table as a platform on which the user can use their product, put their books while reading or writing, etc.





Drawer opening issue

Another aim to merge both side table and desk table in on product. which can serve both roles. While allowing drawers to be used with out any obstructions.



Design evaluation

Cons

- Less storage height.
- More storage area can be used.
- Table design feels like it is for hospitals.
- Need to empty the table before using it as a desk tabel.

Pros

- No Changes done to existing mech.
- Using existing legs.
- Easy assembly.
- Fast assembly.
- Flat pack.
- cheap shipping cost.
- One product is serving both side table and study table.

Feed backs

New requirements

Need more storage, as much as the other competitors are giving in their beds (*NON-ADJUSTABLE*).

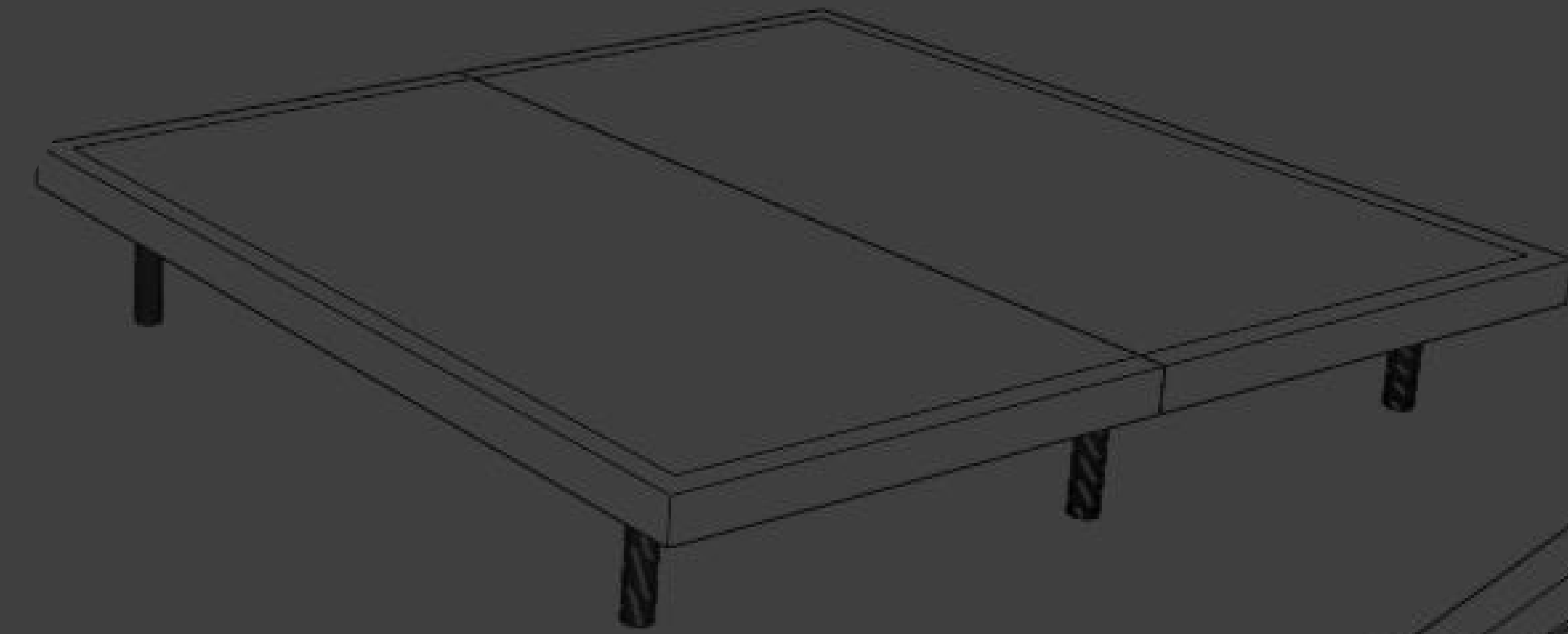
Suggested design

To increase the volume of the storage:

1. Raise the height of each legs by adding a single piece of 3 inches.
2. Reduce the gap left between the two storage units.

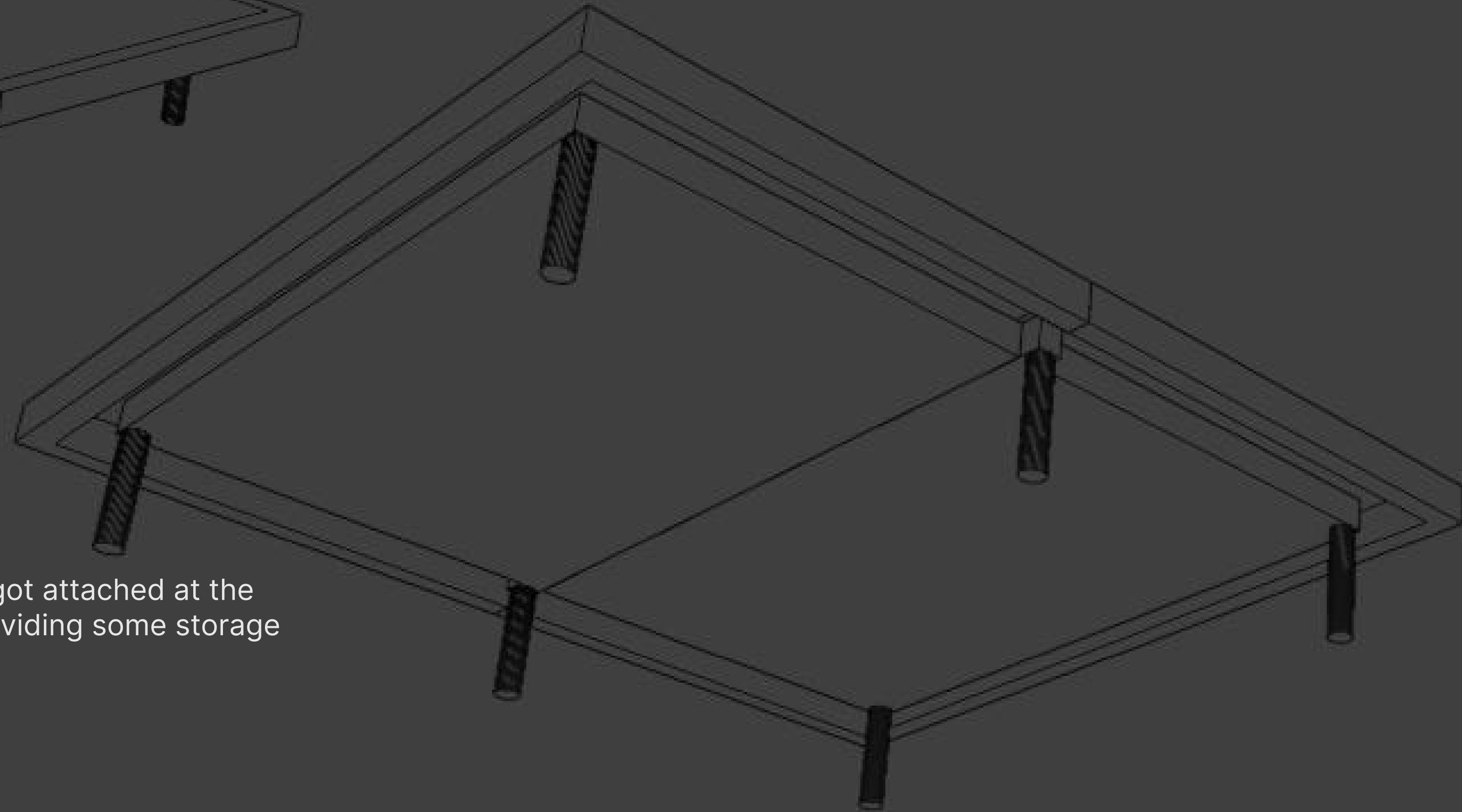
Outcome

- More space.
- Have to manufacture only one part.
- Increase the total height of the bed by 3 inches.
- Will fit in existing packaging(no extra space required).

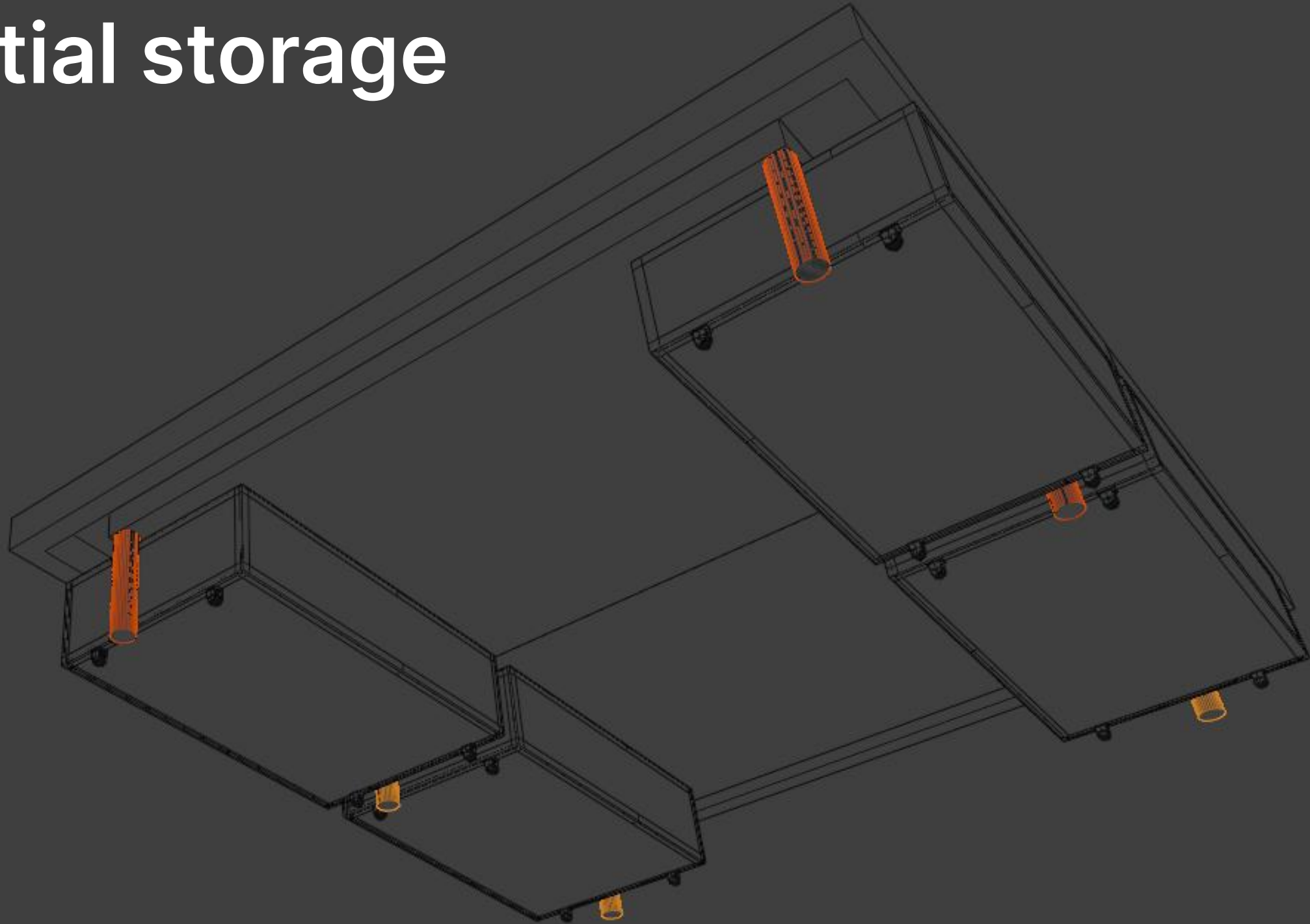


Original frame

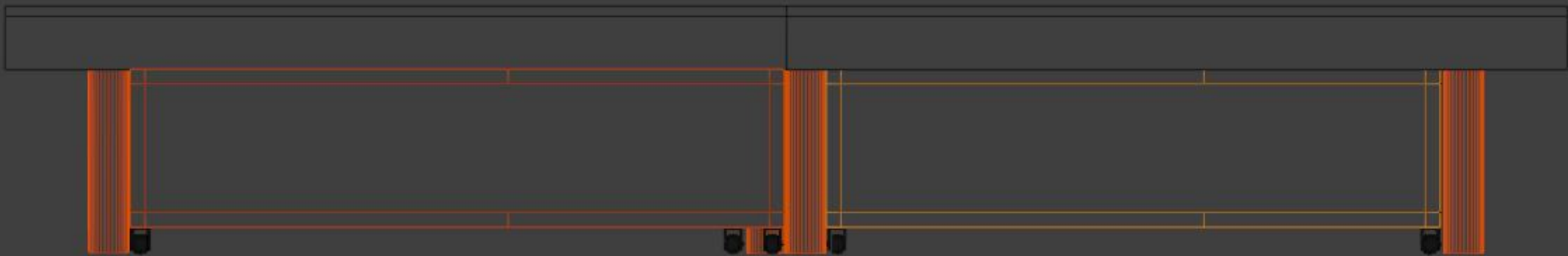
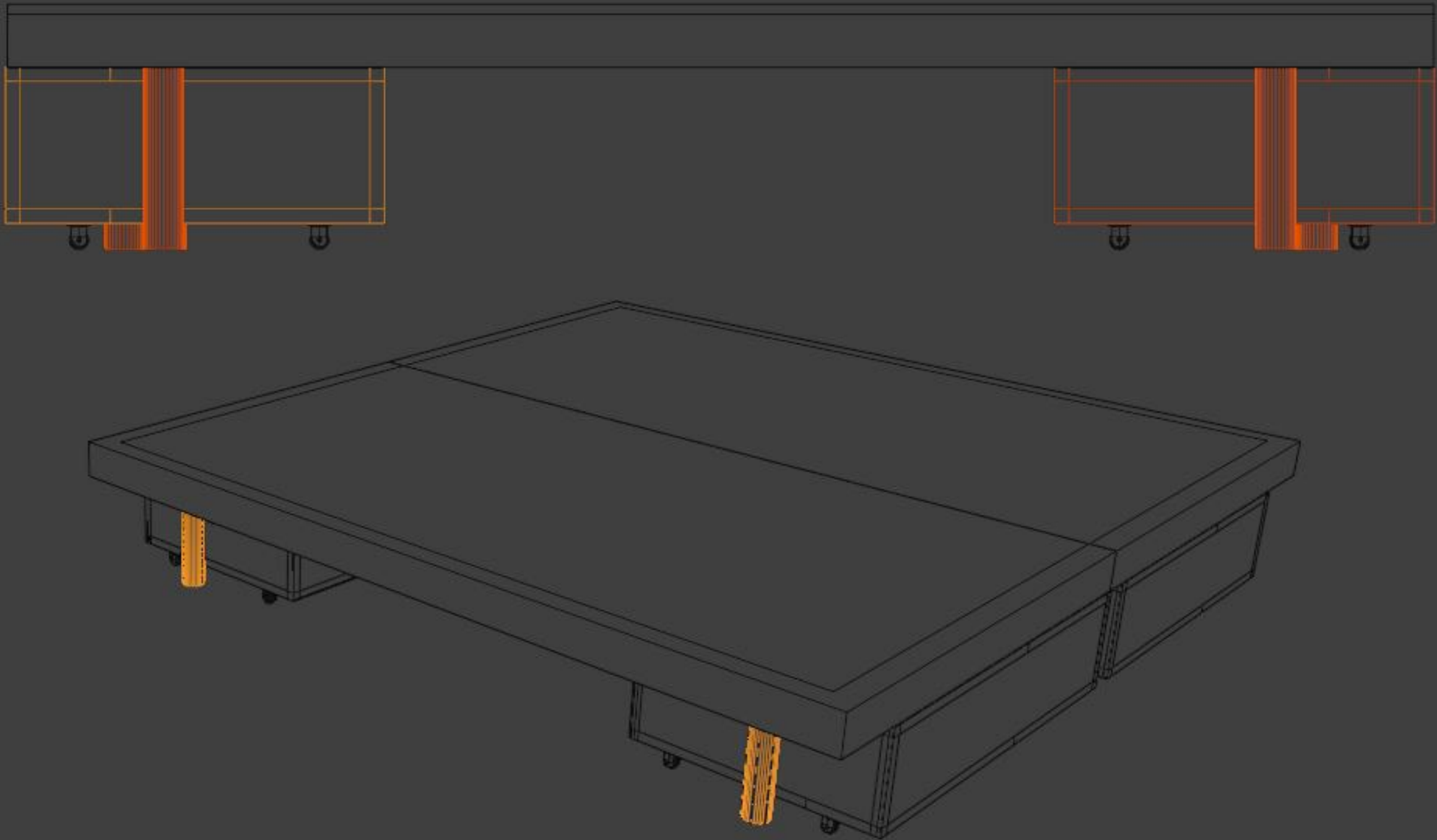
This frame consist 6 separate cylindrical legs which got attached at the bottom of the frame to elevate it from the ground providing some storage space for the storage.



Initial storage



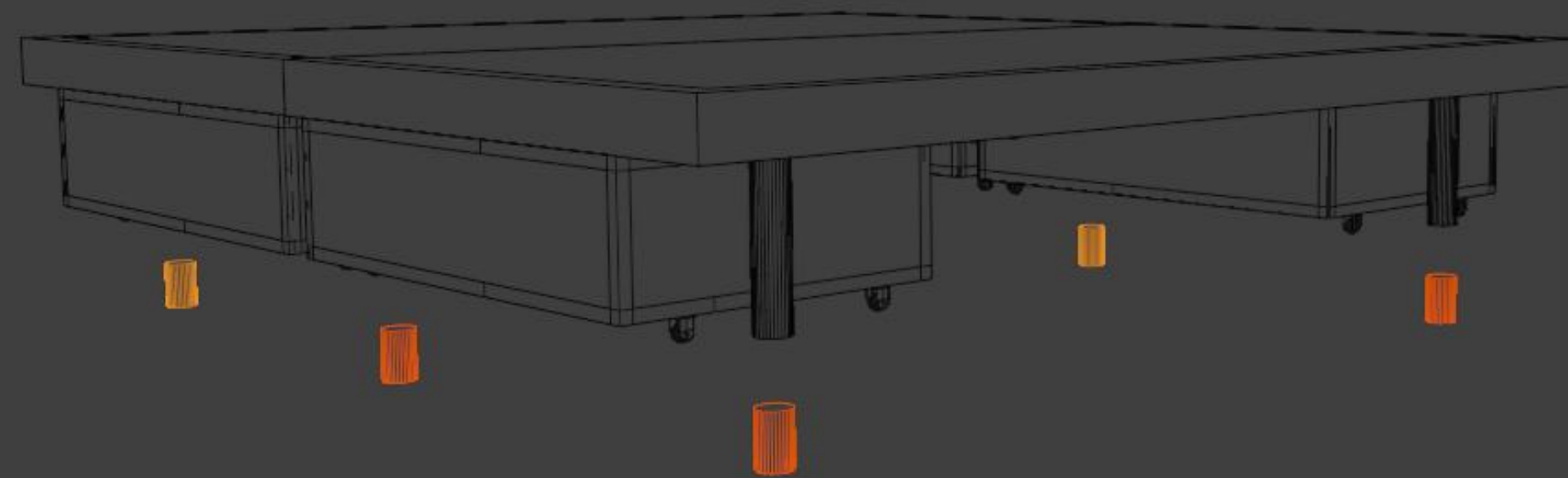
Front view



Side view

Original Storage

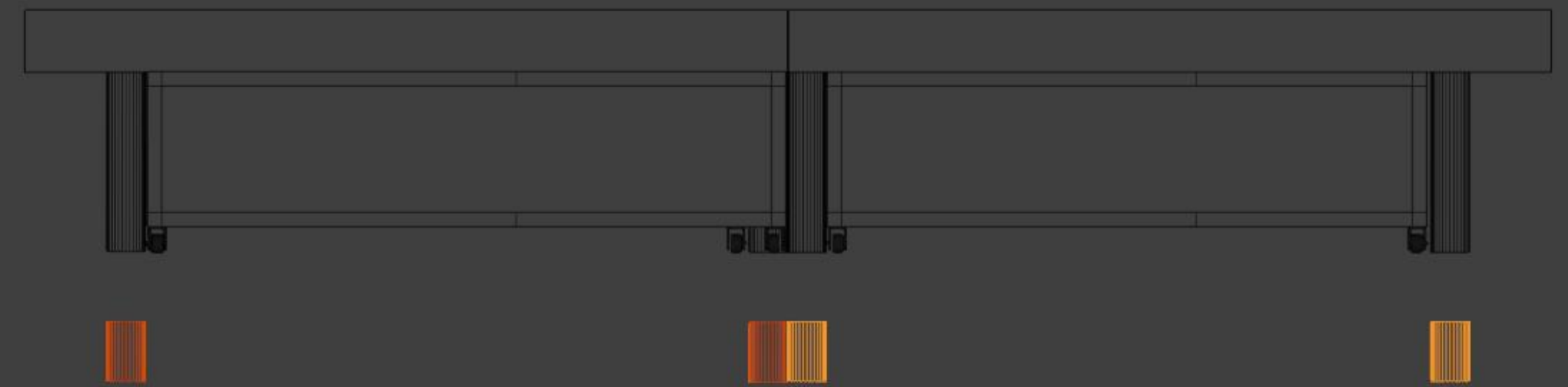
To increase the storage capacity there is a need to increase to total space under the frame so we can fit bigger storage drawers.



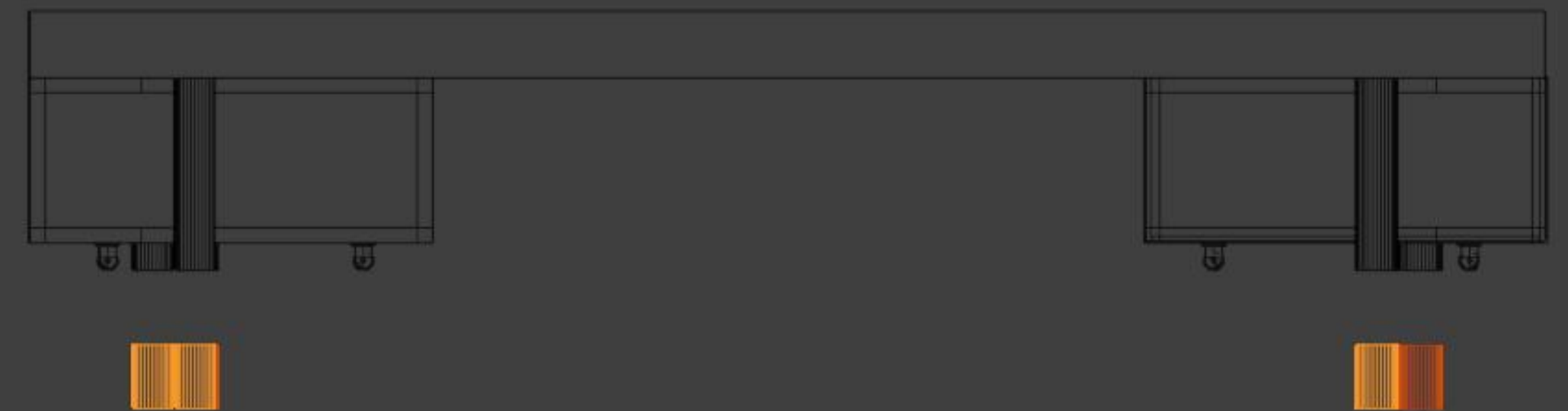
Suggested design

To increase the storage capacity we can either increase one or more than one dimensions. And to do this we have to keep in mind that it should be a minimal costing change.

So, the suggestion is to add 3 inch in the legs either by changing the smaller ones with bigger once or adding separate piece of 3 inches.

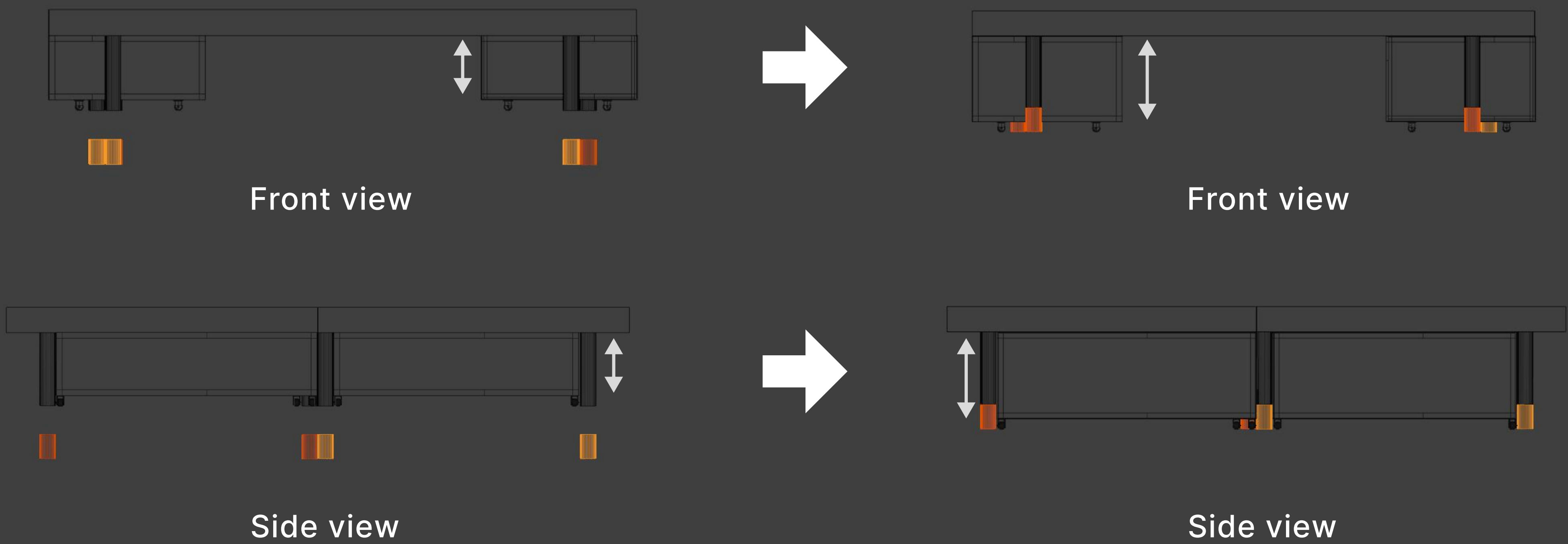


side view



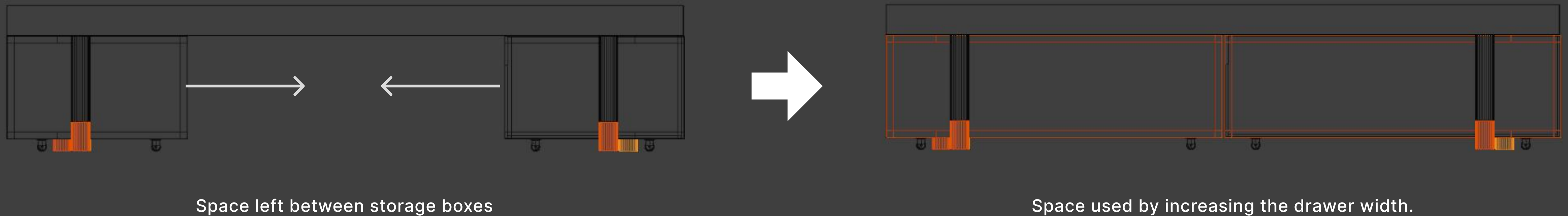
Front view

New design(Leg attachment)



With the increase in the length of each leg, we can also increase the length of the storage. Will increase the total storage capacity.

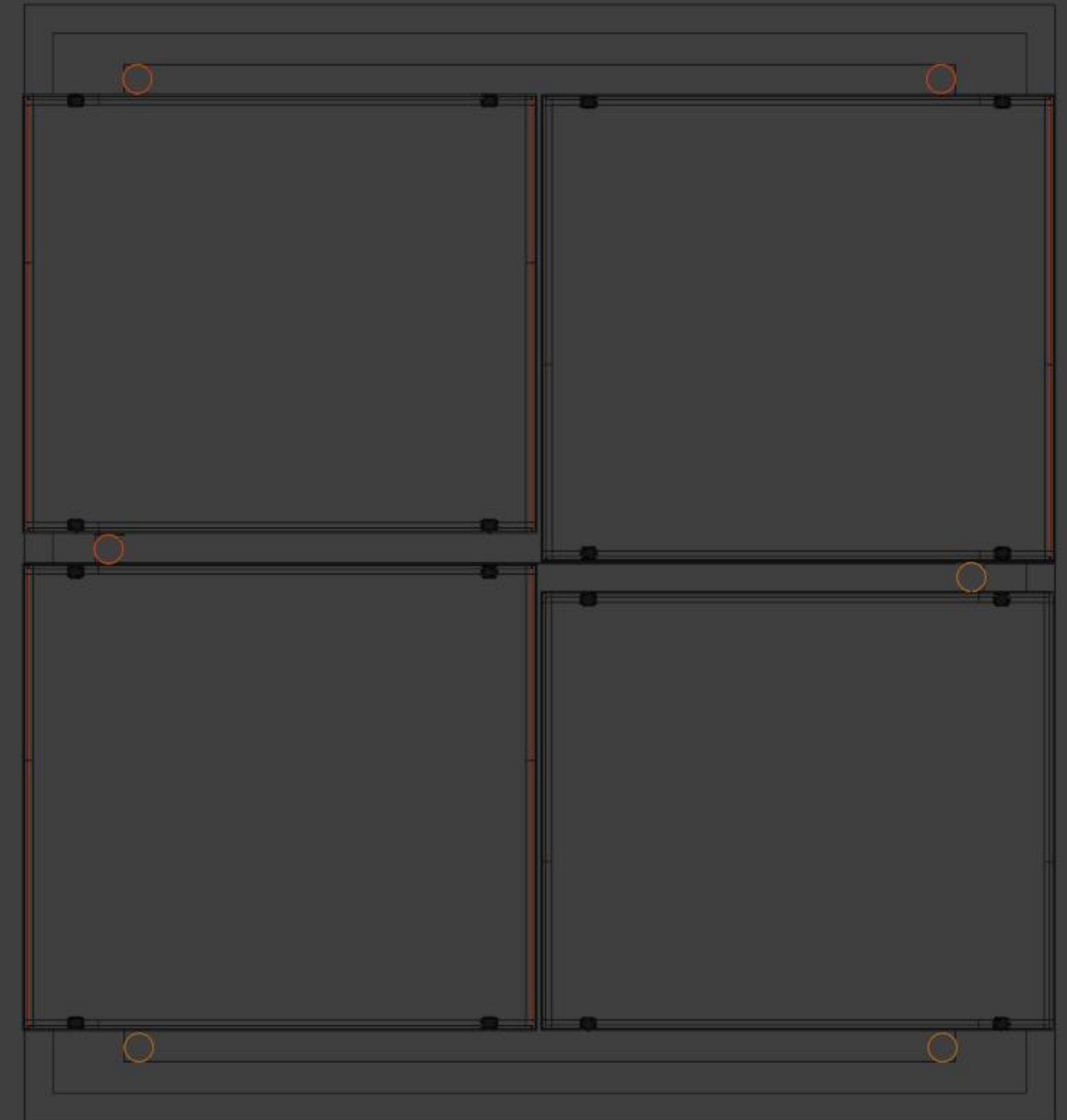
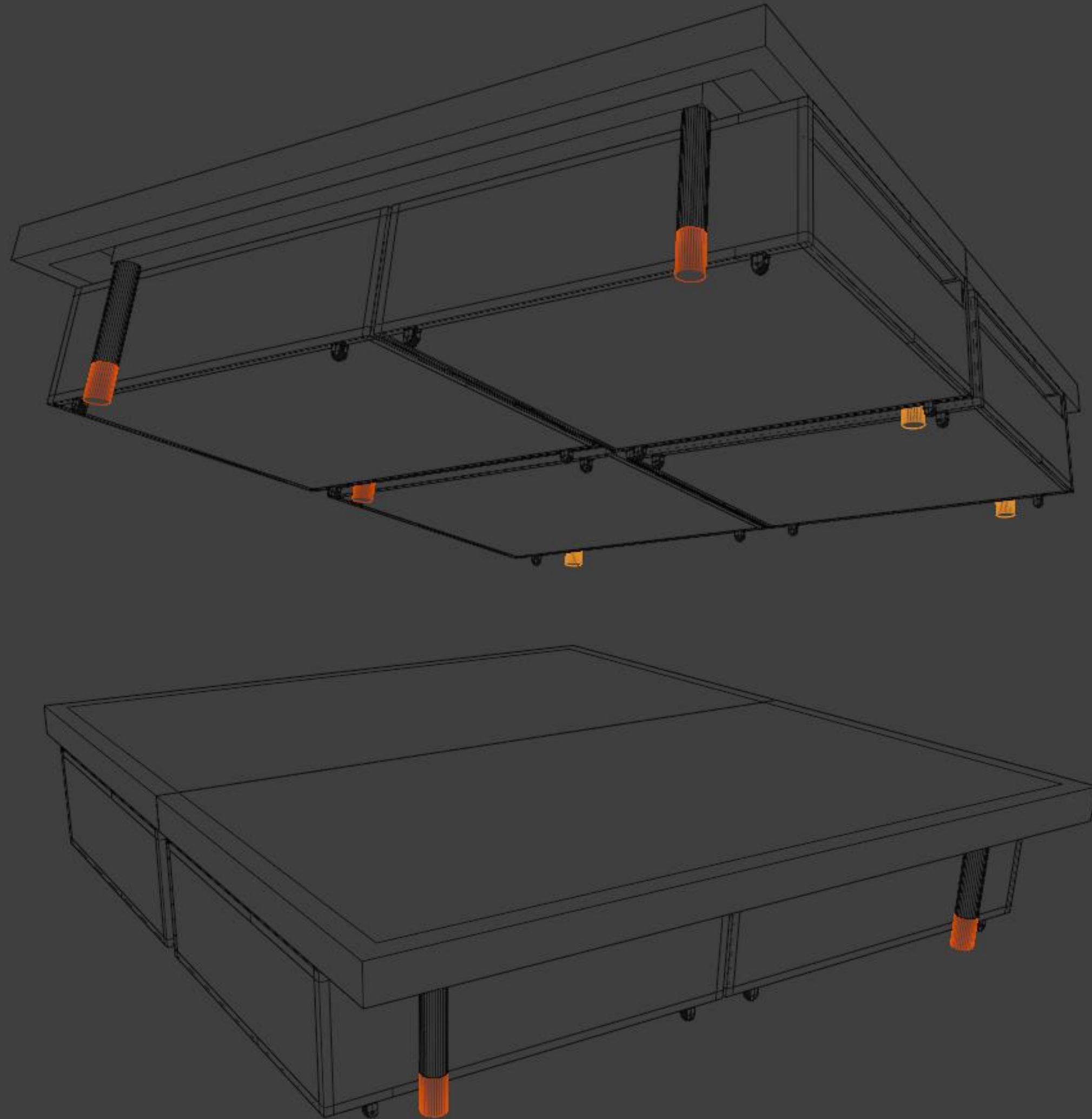
New design (Using space between the storage boxes)



Suggested design

To increase the storage we decided to use the remaining space between the drawers. This will result in the increase of the storage by 2.6 times than the previous storage.

Suggested design



Old storage

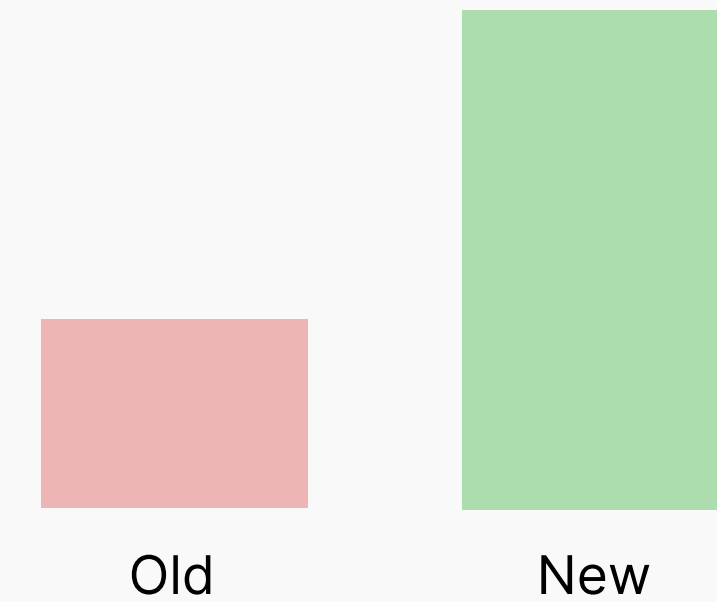
Total storage capacity:
= **141.55 dm cube**

New storage

Total storage capacity:
= **374.33 dm cube**

New storage is about **2.65 Times bigger**
than the old storage.

With the total bed height (ground to mattress) of
22 inches.



(storage in volume)

Feed backs

New requirements

Build a separate frame instead of legs. Use the remaining space which was restricted by the leg placement.

Suggested design

To make a bed frame in the replacement of existing legs structure which:

Will be in separate pieces.

Can be assembled using Allen key only.

Easy to assemble.

Can be flat packed.

Outcome

- Total height will increase.
- Manufacturing cost will increase considerably.
- User will need more time and skill to assemble the whole frame.
- Need well structured assembly manual to guide the user.

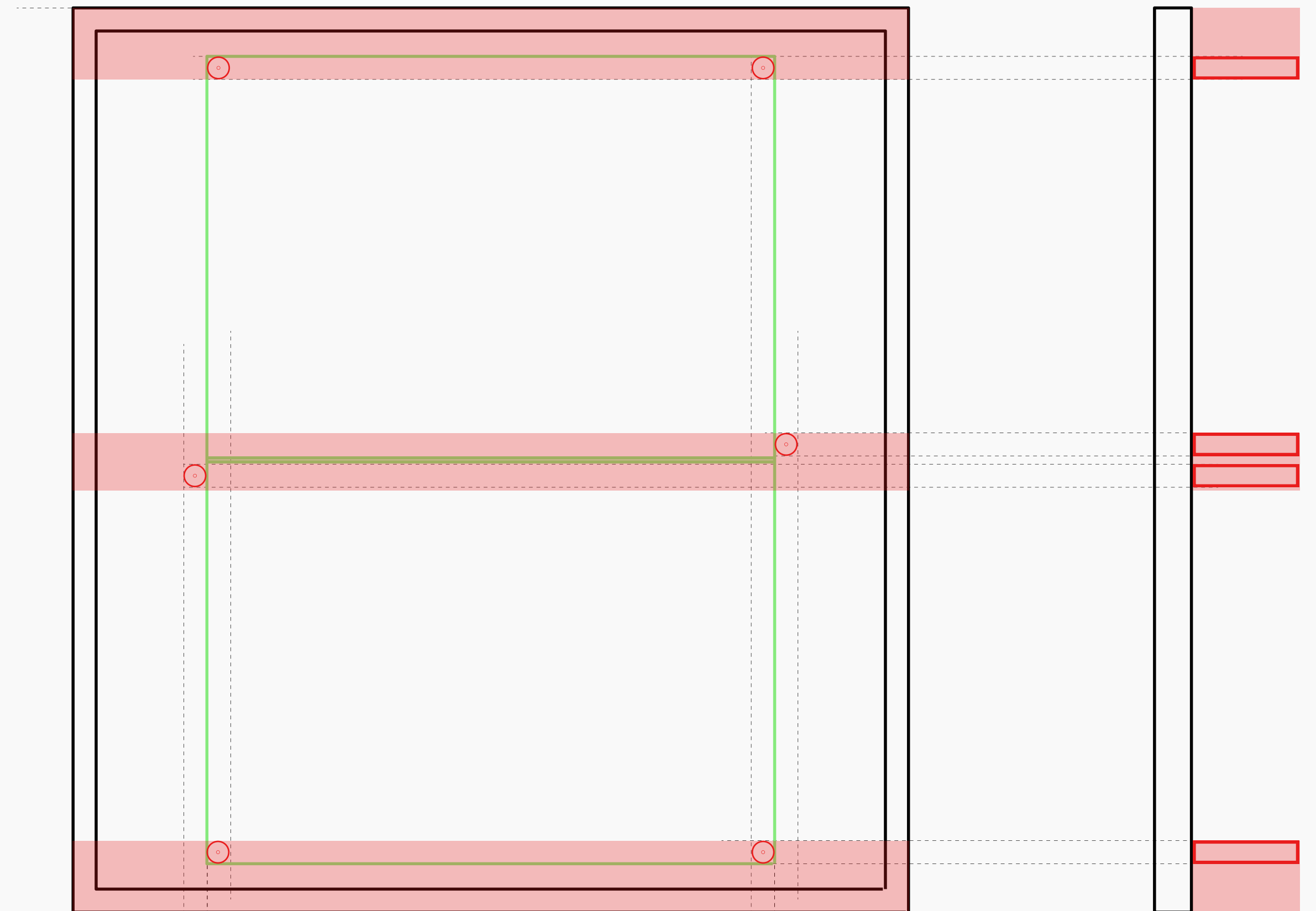
Frame- Single and double bed

Wasted storage

Red color shows the area which can't be used for storage as per the placement of the legs under the frame in original design.

So the suggestion is to make a bed frame which not just allow us to use that space but can also be assembled by the user using only Allen key.

This bed frame should also be able to compile with all the other factors which was delivered by the previous frame which are: easy manufacturing, esy assembly, Flat packing, etc.

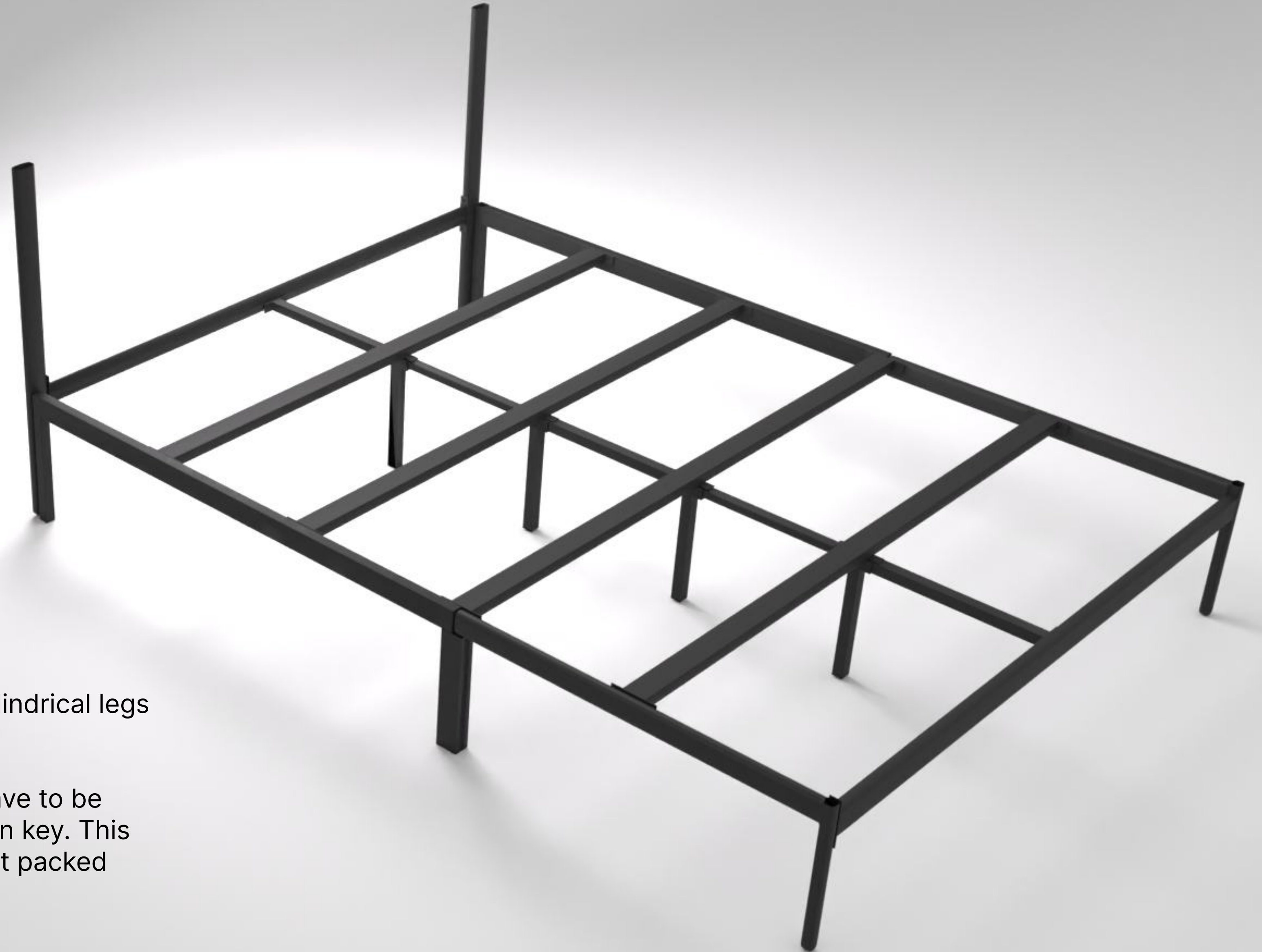


Frame- 1

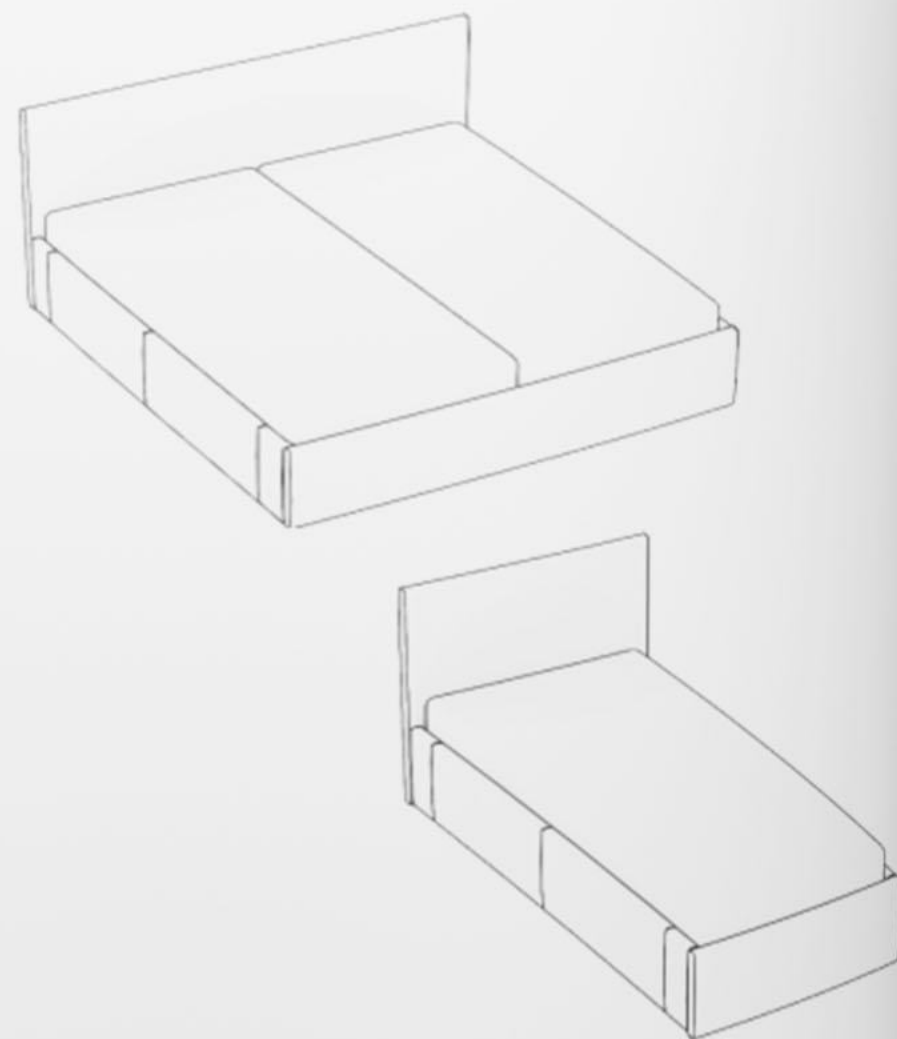
Frame Design

This frame is designed in the replacement of those cylindrical legs to give better results in the form storage.

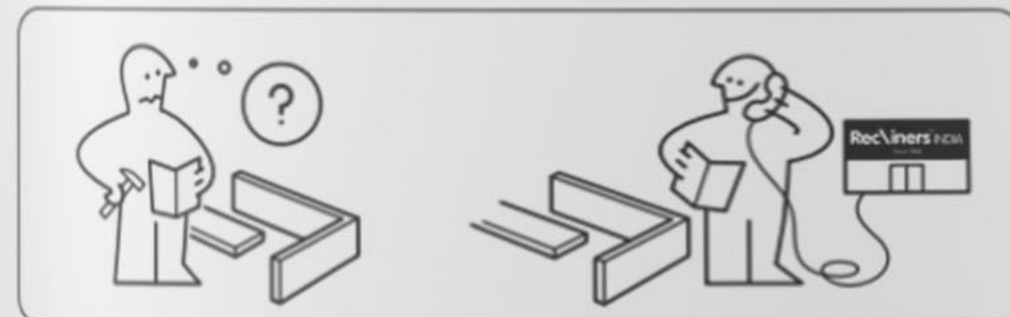
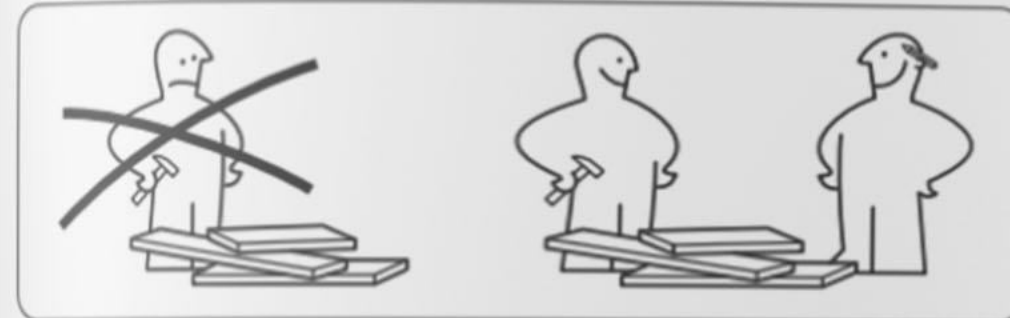
This frame is designed while keeping in mind that it have to be assembled by the user with help of the one single Allen key. This frame is made up of simple parts that can be easily flat packed and shipped affordably.



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Assembly manual

There is an assembly manual for the user so they can assembly the whole frame by just following simple instruction step by step.

(PDF File was uploaded on the drive)

[Link to drive](#)

Feed backs

New requirements

Need lesser number of parts. they should be assembled with the lesser number of bolts.

Additional information.

Shipment will be charged on the bases of volume and weight only. hence having a long single piece parts wont effect the shipping price.

Suggested design

To make a bed frame in the replacement of existing legs structure which:

Will have less number of pieces.

Few parts will assemble with out any bolt or screws.

Can be assembled using Allen key only.

Easy to assemble.

Flat packed.

Outcome

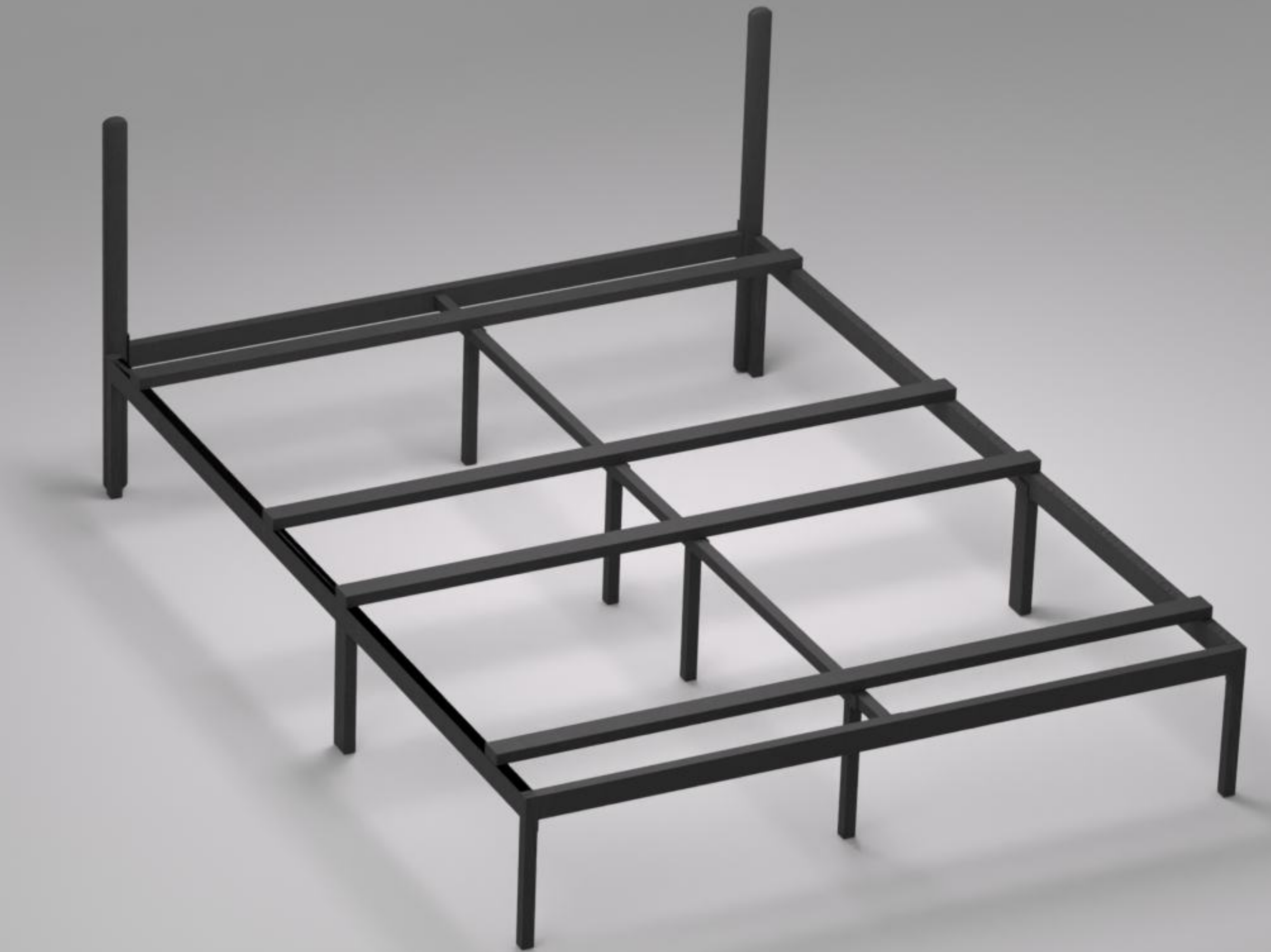
- Total height will increase.
- Manufacturing cost will increase.
- User will take less time to assemble it.
- Assembly manual will be less complex.
- User experience will increase.

Frame- 2

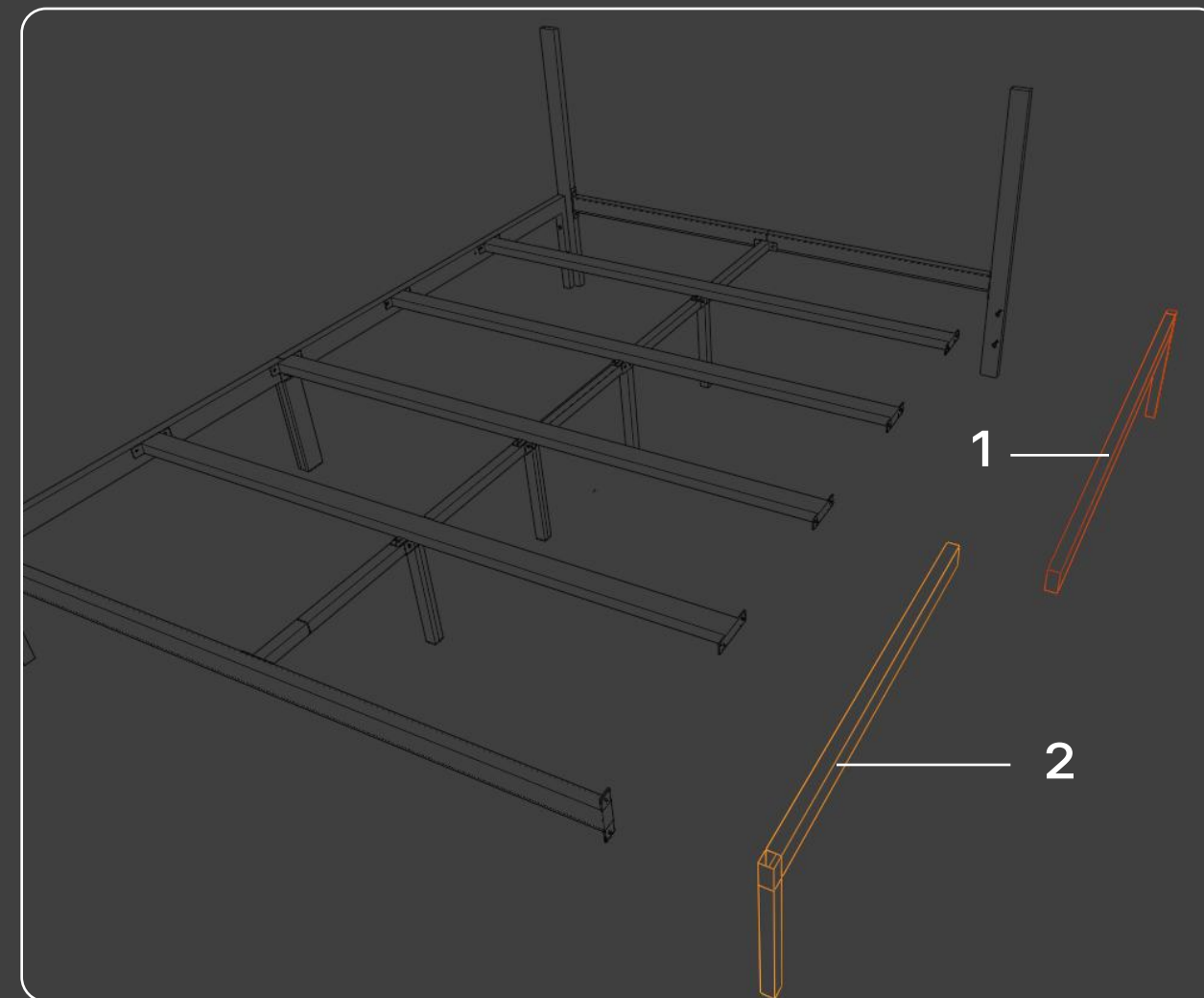
Updated Frame Design

This frame is designed in the replacement of those cylindrical legs to give better results in the form storage with lesser number of parts.

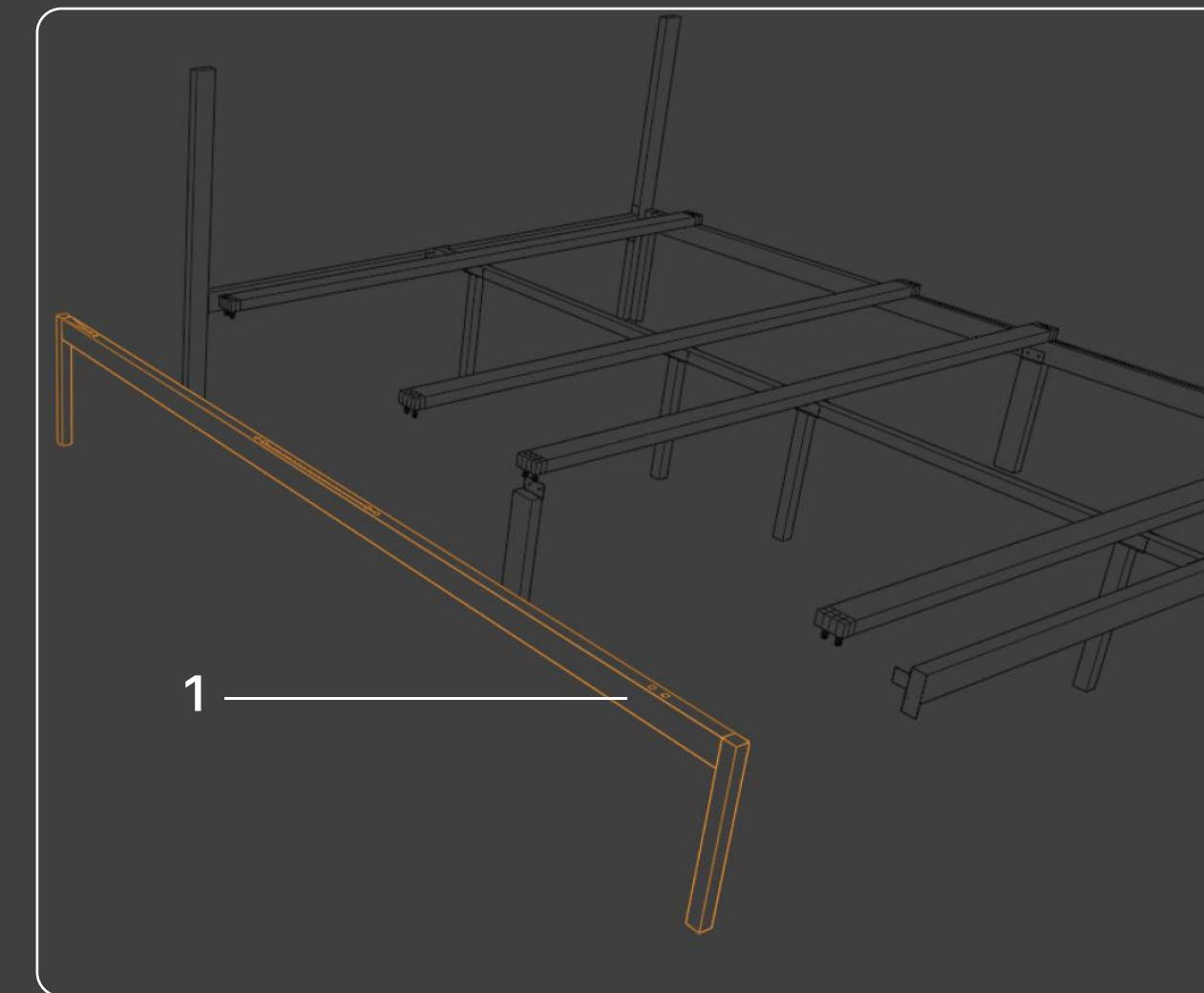
This frame is designed while keeping in mind that it have to be assembled by the user with help of the one single Allen key and with lesser effort. This frame can also be flat packed with low production cost and better user experience.



Changes done with respect to previous design.



Previous design

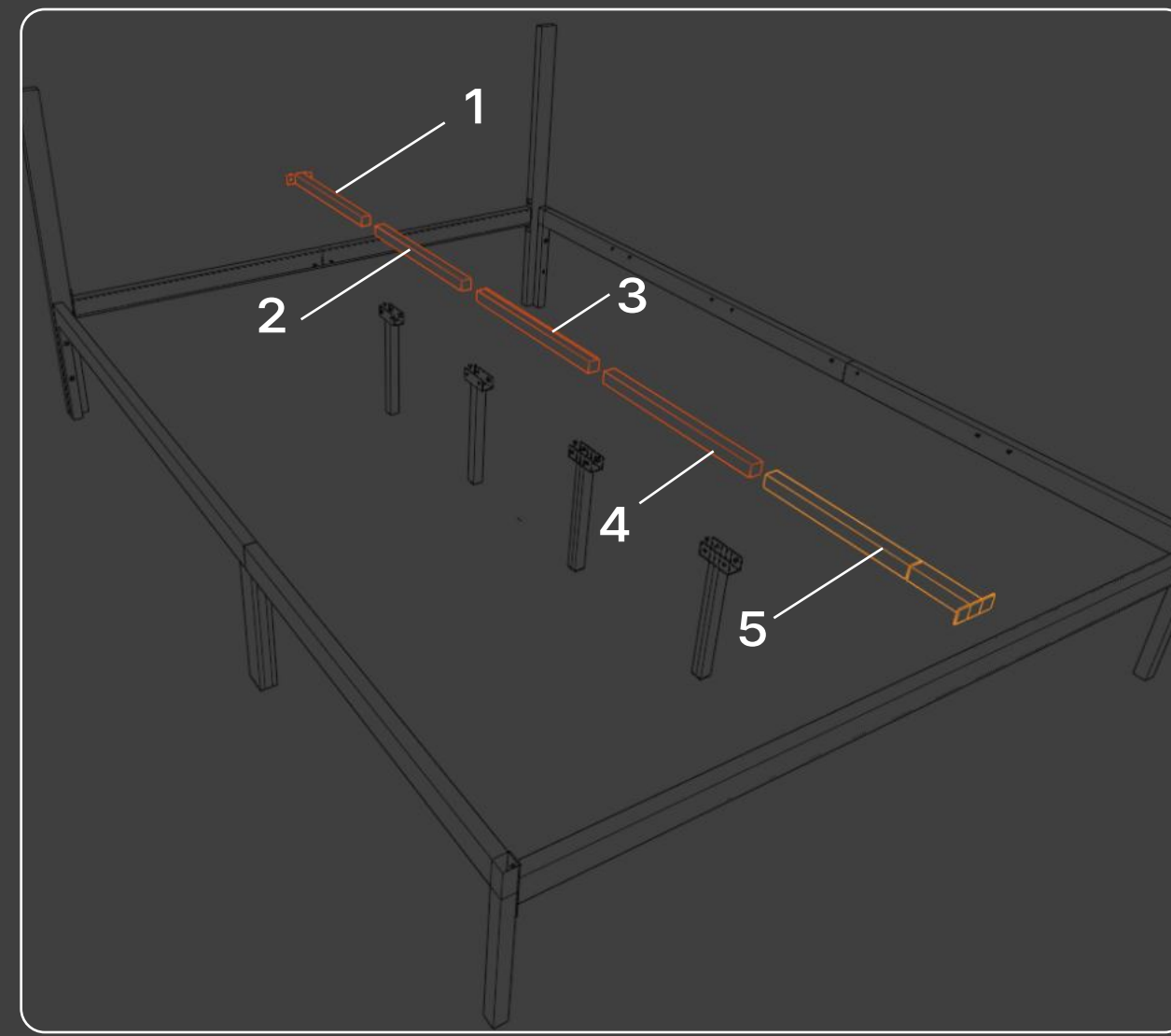


New design

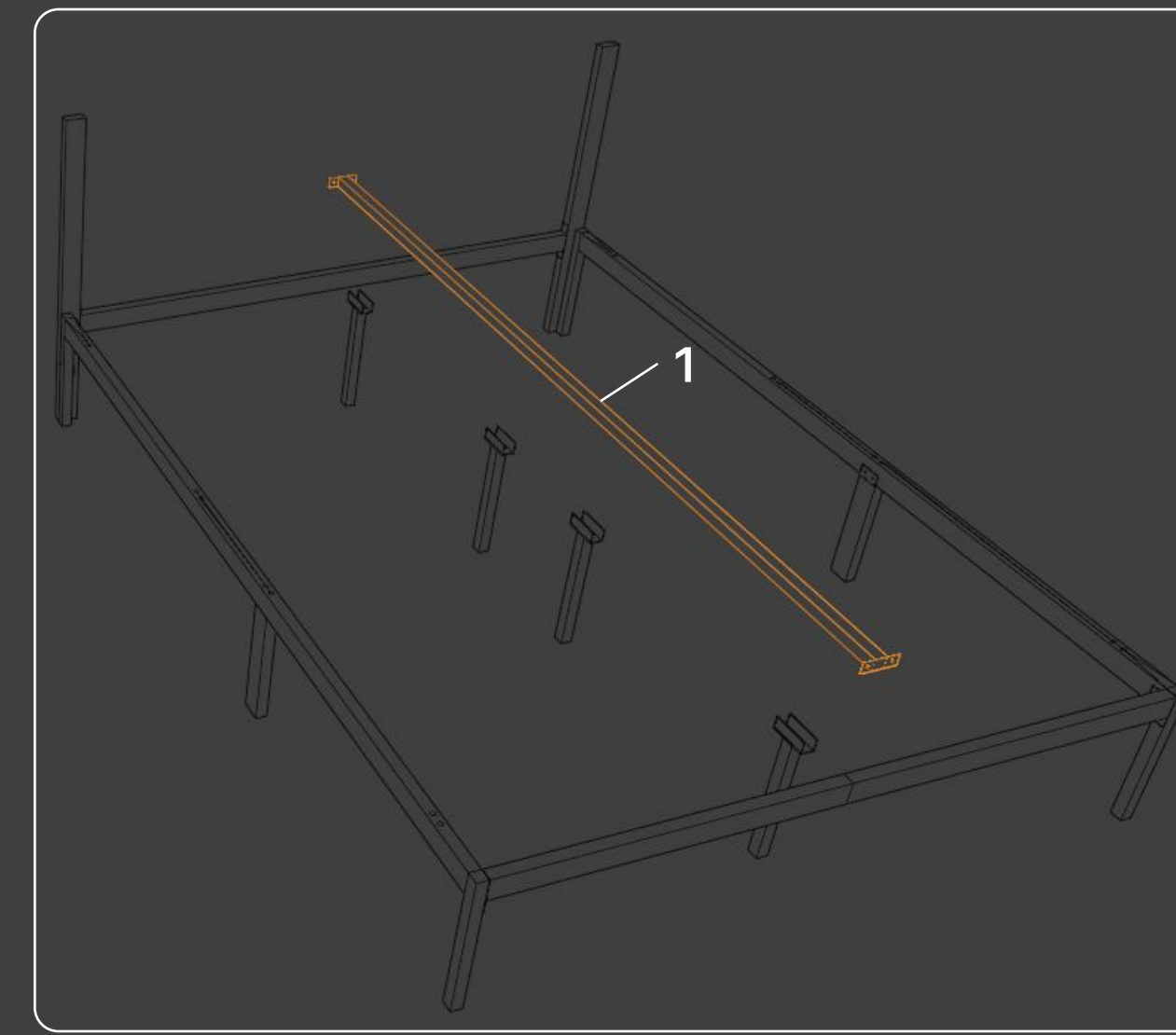
Frame pieces is joined into a single piece results in:

- Single piece to manufacture instead of two separate pieces.
- Lesser number screws needed.
- Lesser time needed to assemble.
- Better user experience.
- No increase in shipping cost.

Changes done with respect to previous design.



Previous design

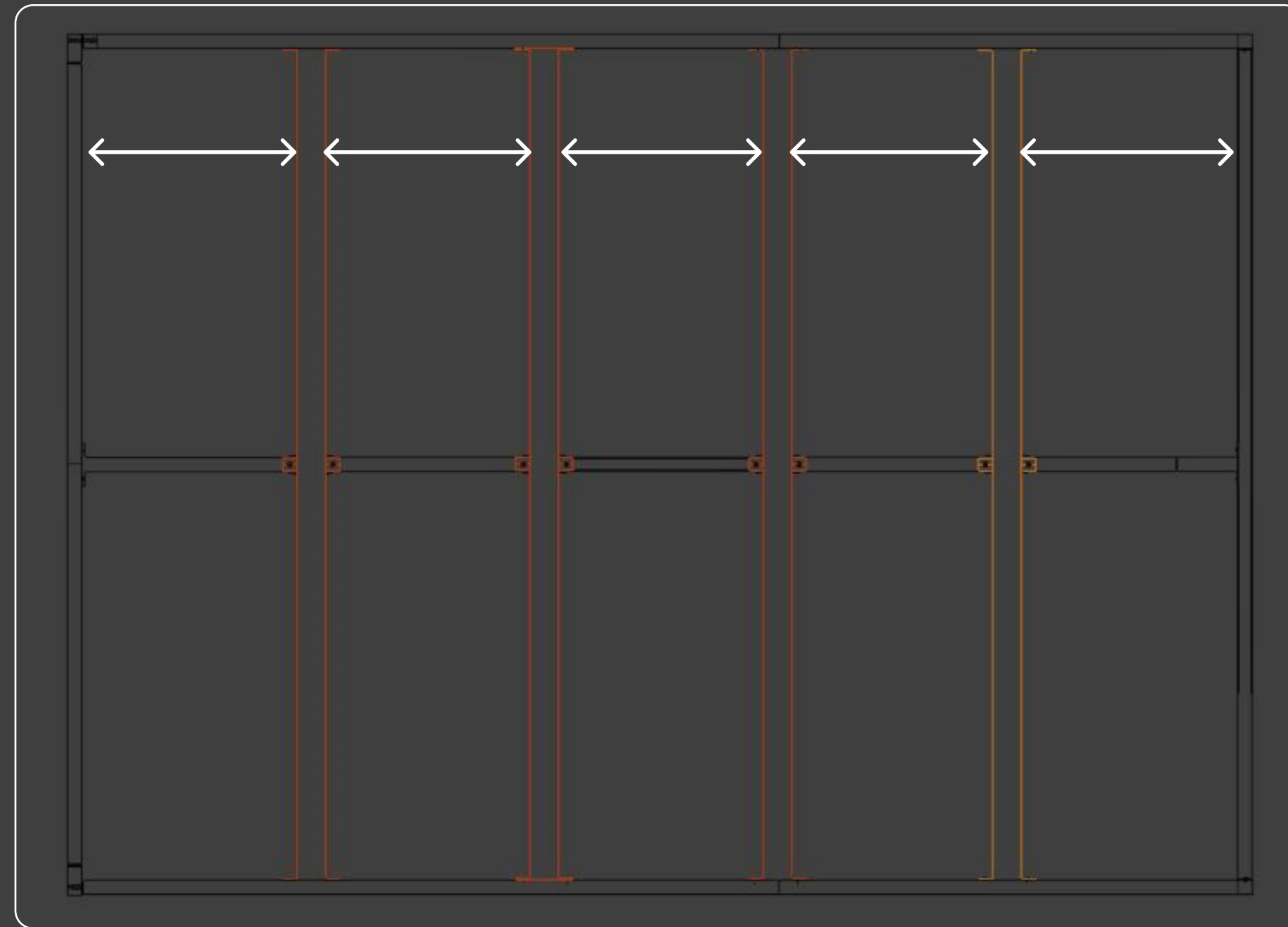


New design

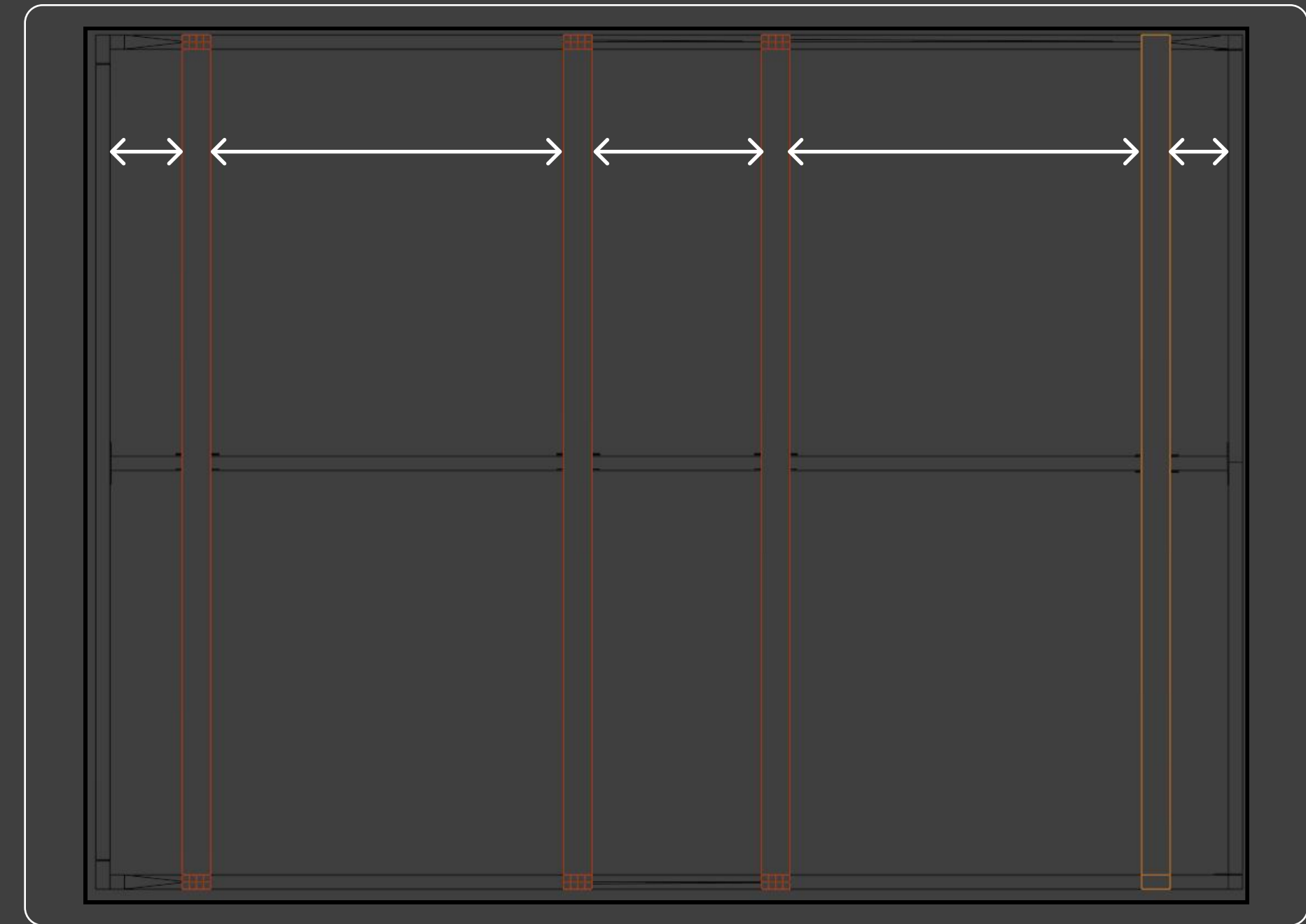
Frame pieces is joined into a single piece results in:

- Single piece to manufacture instead of '5' separate pieces.
- Lesser number screws needed.
- Lesser time needed to assemble.
- Better user experience.
- No increase in shipping cost.

Changes done with respect to previous design.



Previous design



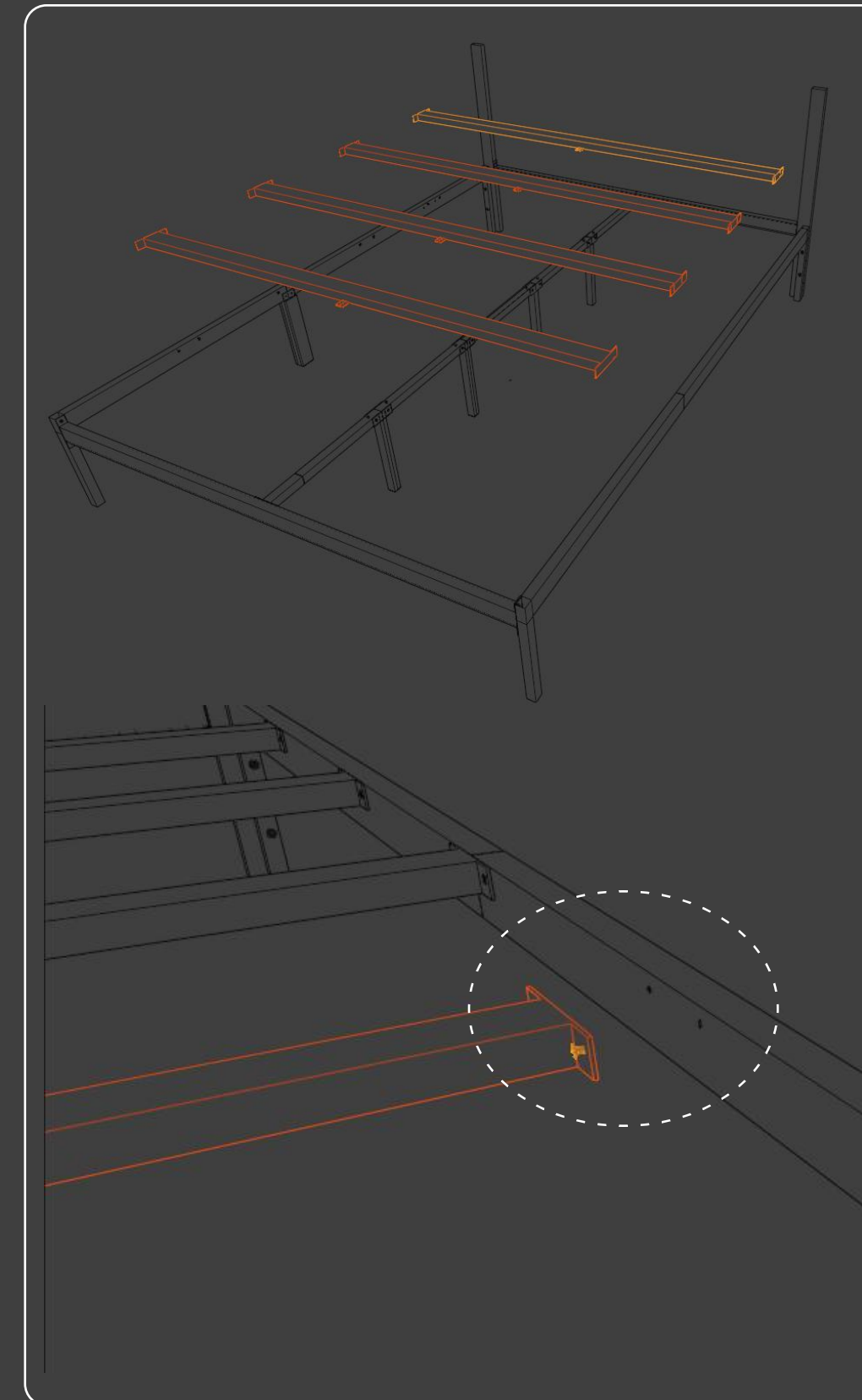
New design

Rearranging the spacing between the parts to give support the mechanism where the legs were. Gives better strength and durability.

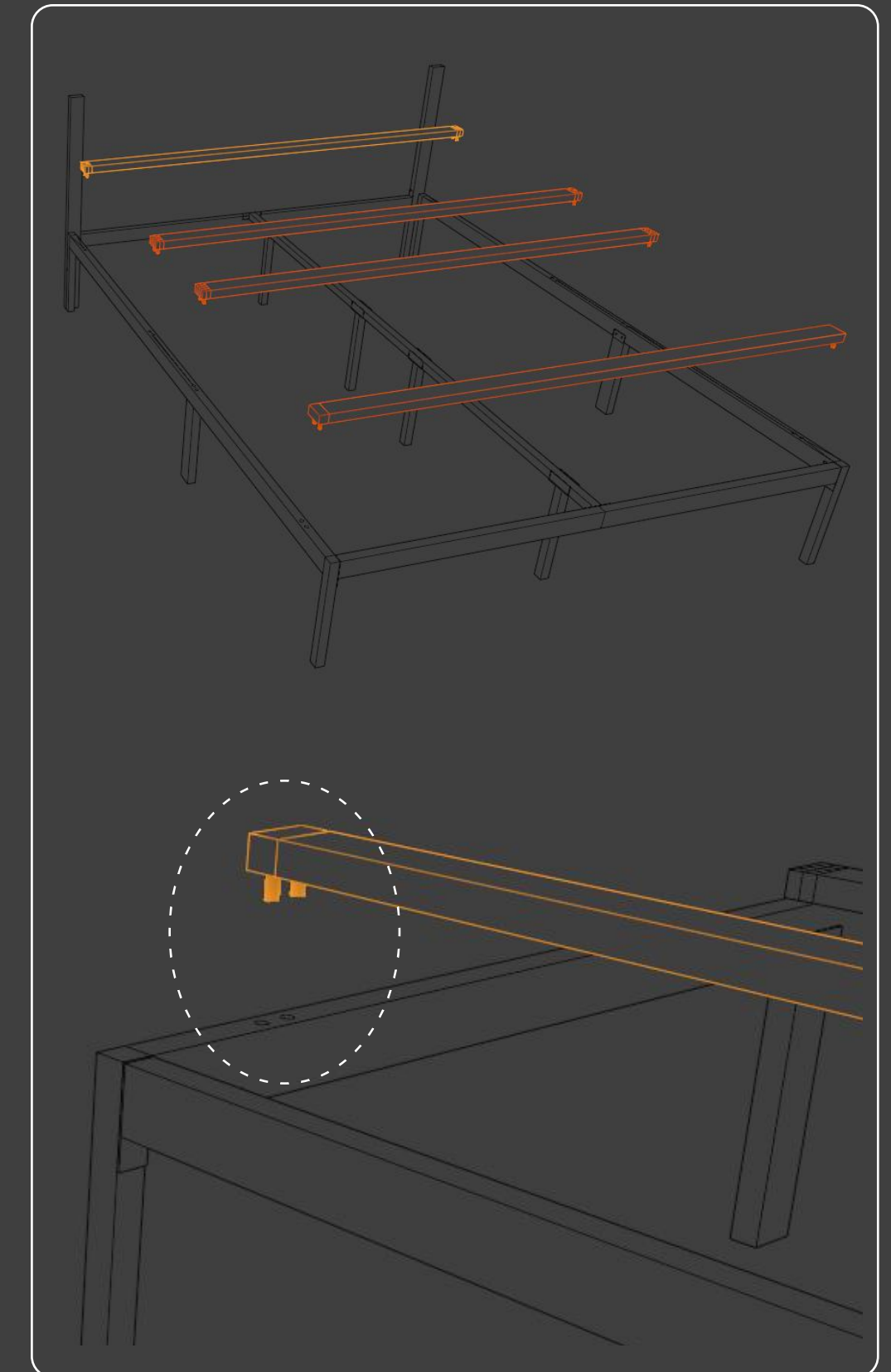
Changes done with respect to previous design.

Changing joineries from screw to pin-socket joint.

This joineries will be effective in this specific place because of the weight the mechanism keep the joint strong and won't let it loose.

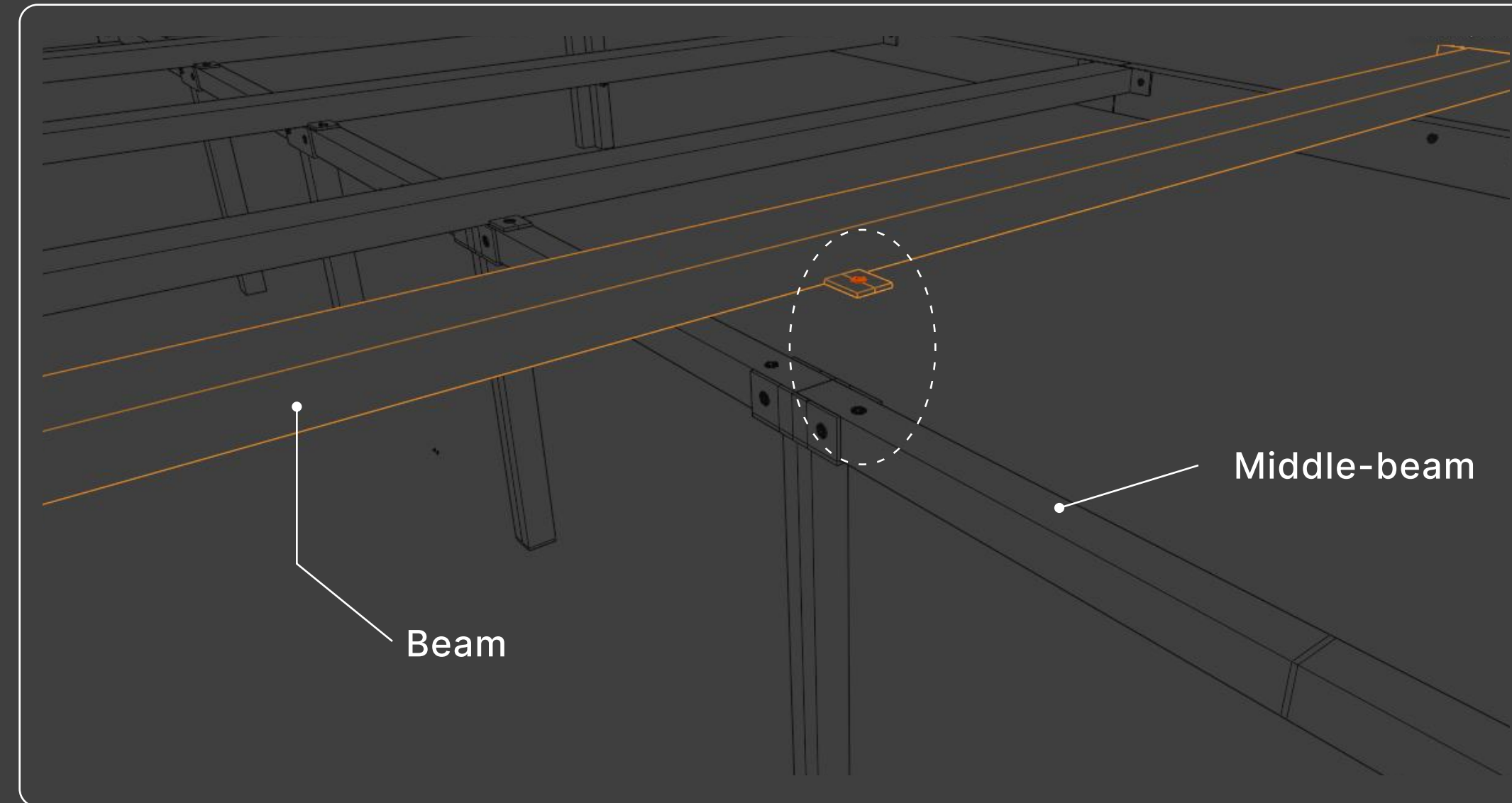


Previous design

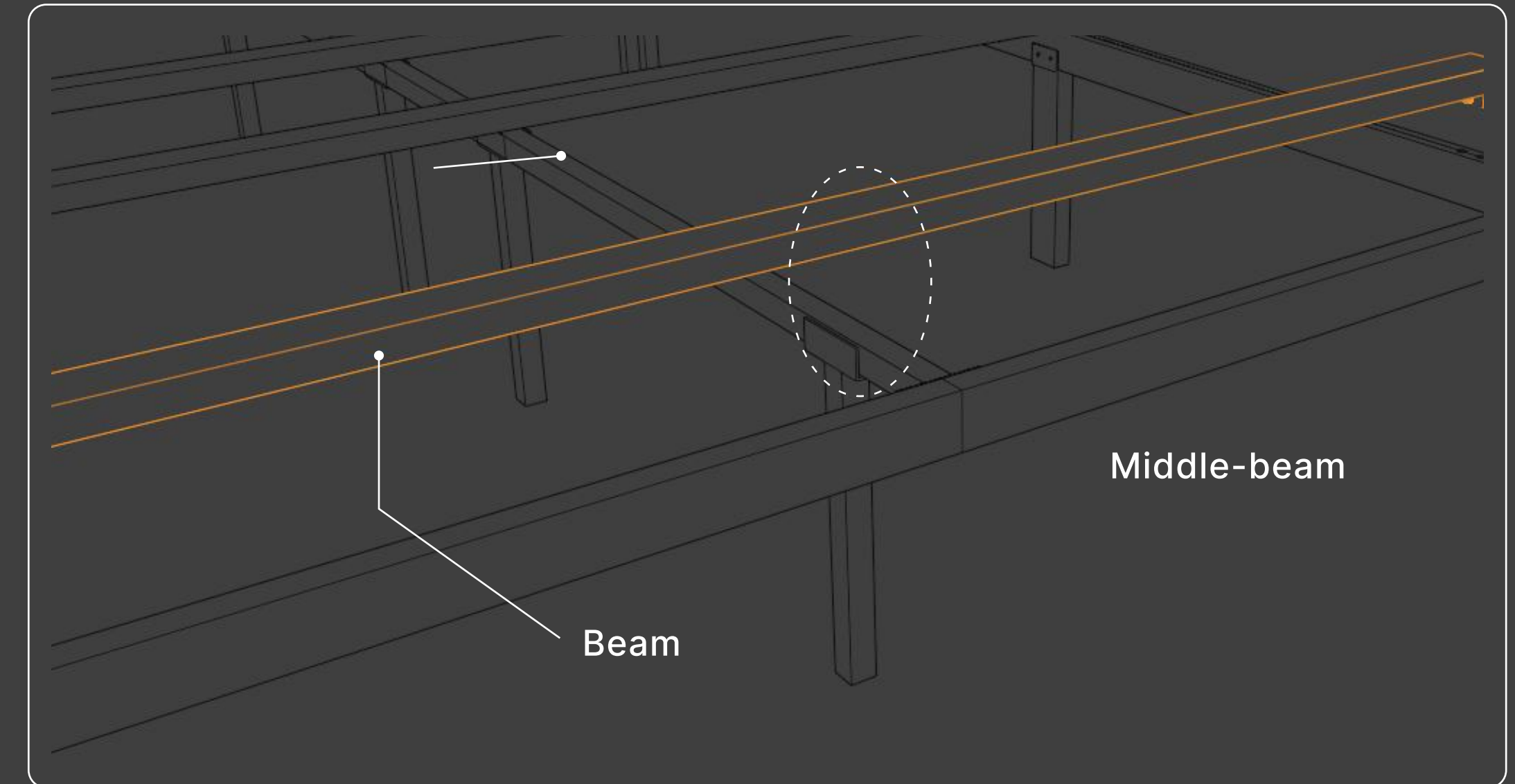


New design

Changes done with respect to previous design.



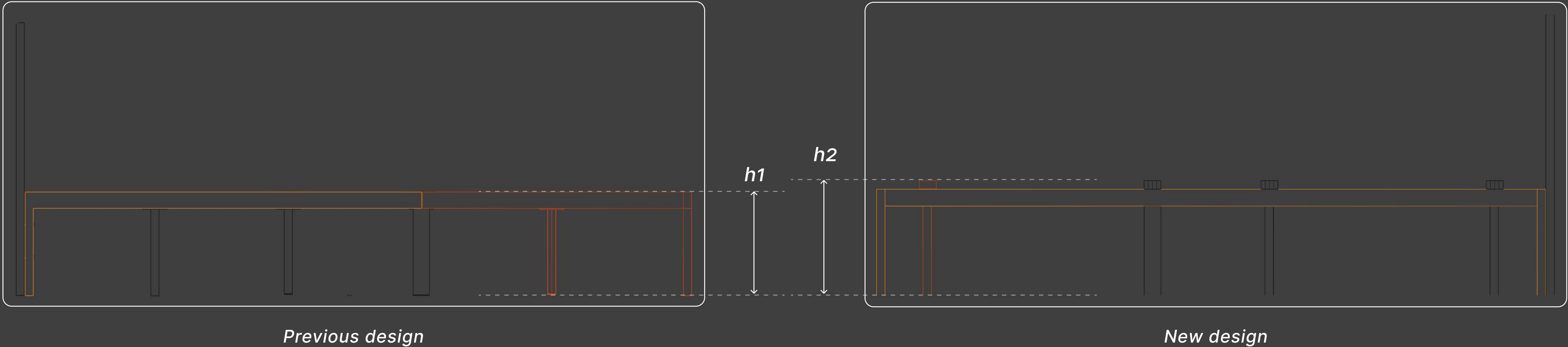
Previous design



New design

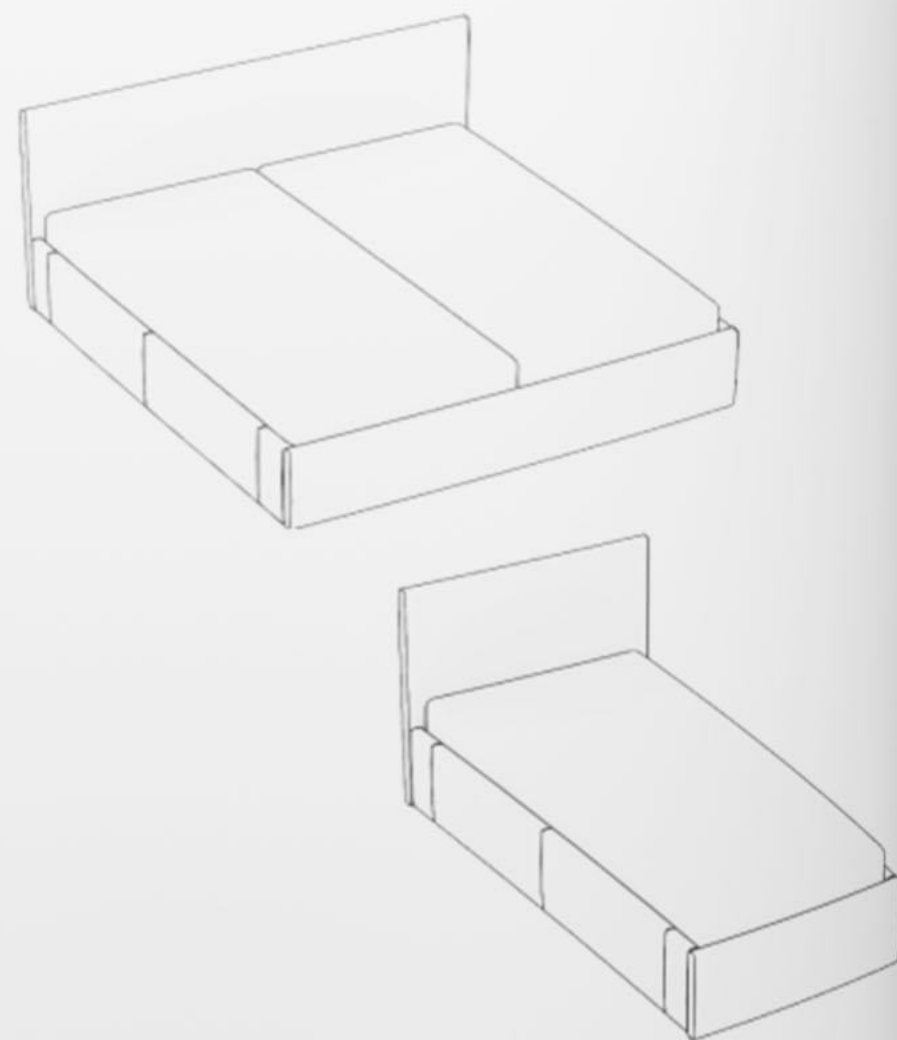
Joineries(Screws) removed from the middle part of 'Beam'.
Pin-socket joint should be enough to give required strength.

Changes done with respect to previous design.

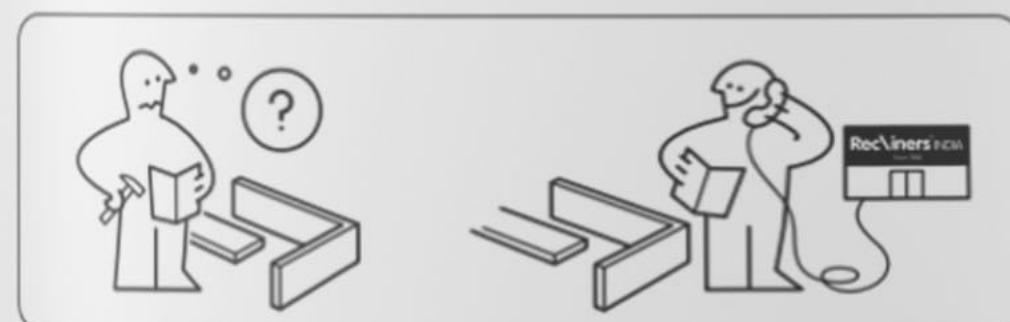
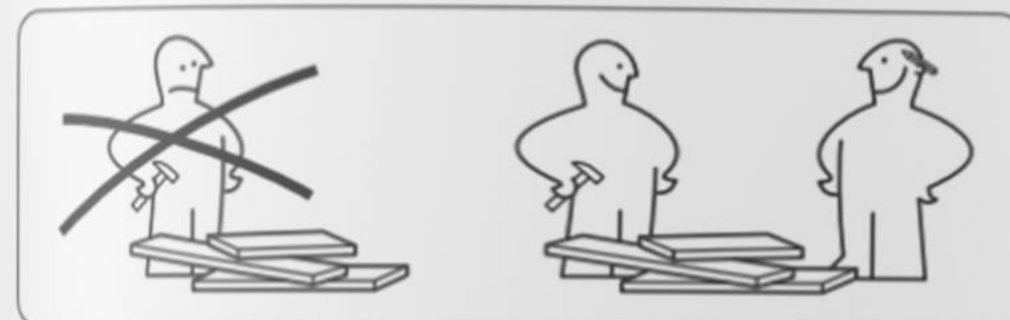


Total height (ground to mattress) of the whole frame will increase by 1 inch.

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Assembly manual

There is an assembly manual for the user so they can assembly the whole frame by just following simple instruction step by step.

(PDF File was uploaded on the drive)

[Link to drive](#)

SN.	Model	No. of parts	No. of screws	Costing	Packaging	Storage volume	User experience
1.	Leg frame	6	6	Very low	Flat Packed	Very low	Good
2.	Extended Leg frame	6-12	6-12	Low	Flat Packed	Very low	Good
3.	Frame 1	13	44	Very High	Flat Packed	High	Bad
3.	Frame 2	8	24	High	Flat Packed	High	Medium

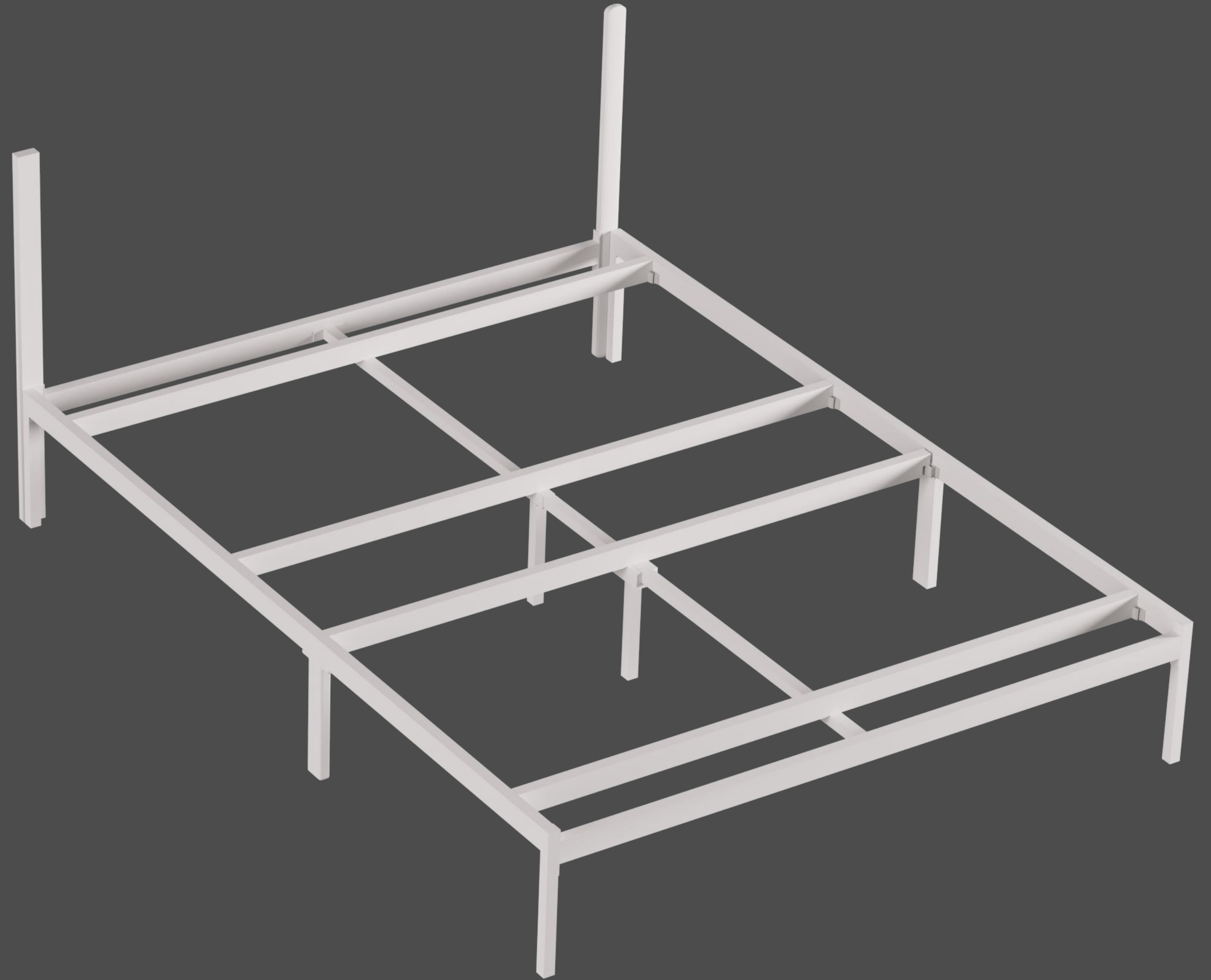
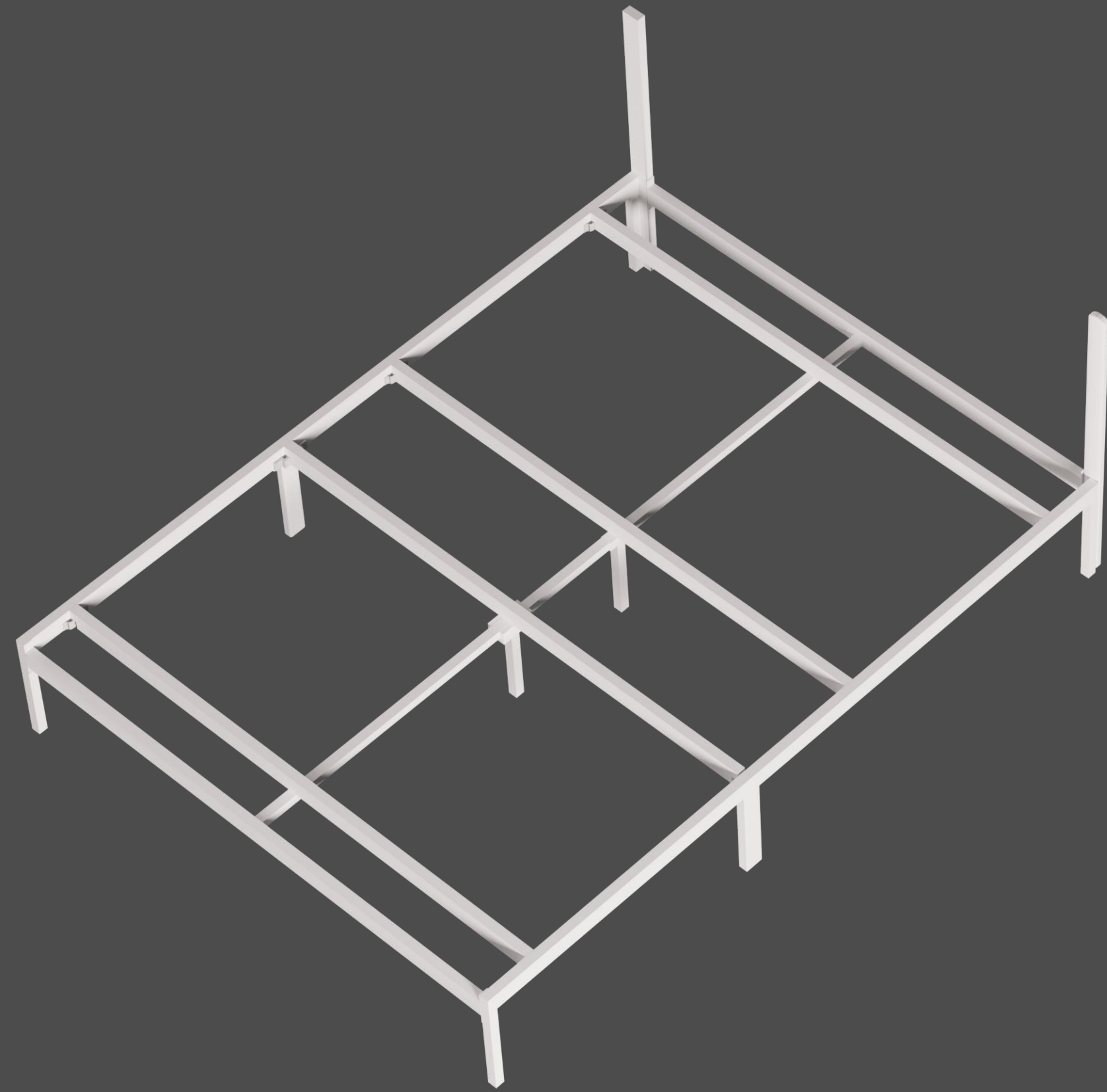
Comparison of all frames

This comparison between the frame design shows which design concept performs in various spectrums. those spectrums are selected on the constrains which will directly or indirectly effect the user and the manufacturer if selected.

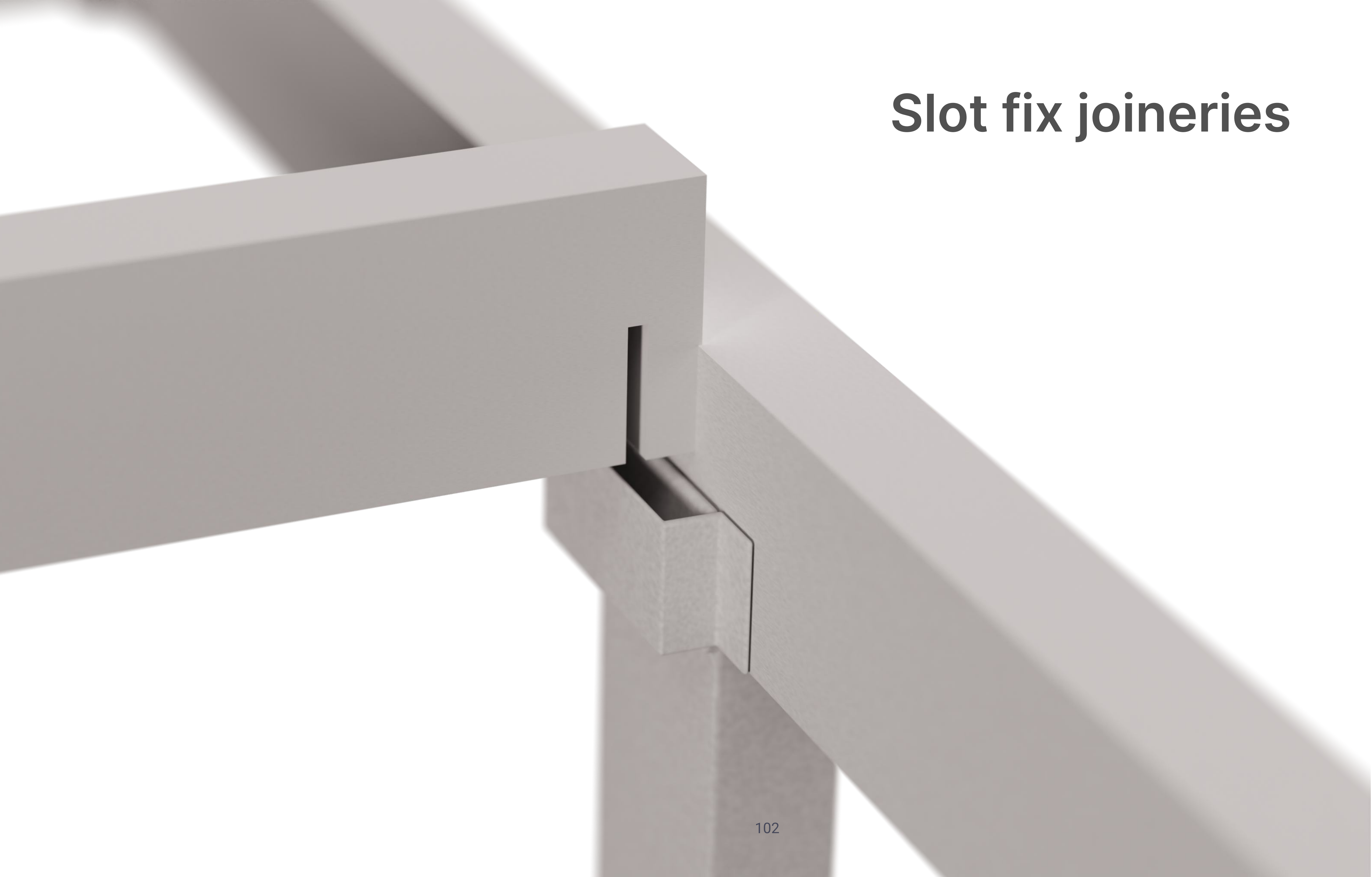
Design specifications

Material	SS pipes	Mfg. processes	Easy
No. of parts	16	Assembly	Easy
No. of screws	28	Cost	Low
Height	Increased by 1 inches		

Final design



Slot fix joineries



Similar hex screws



Flat packing

84*509*25.4



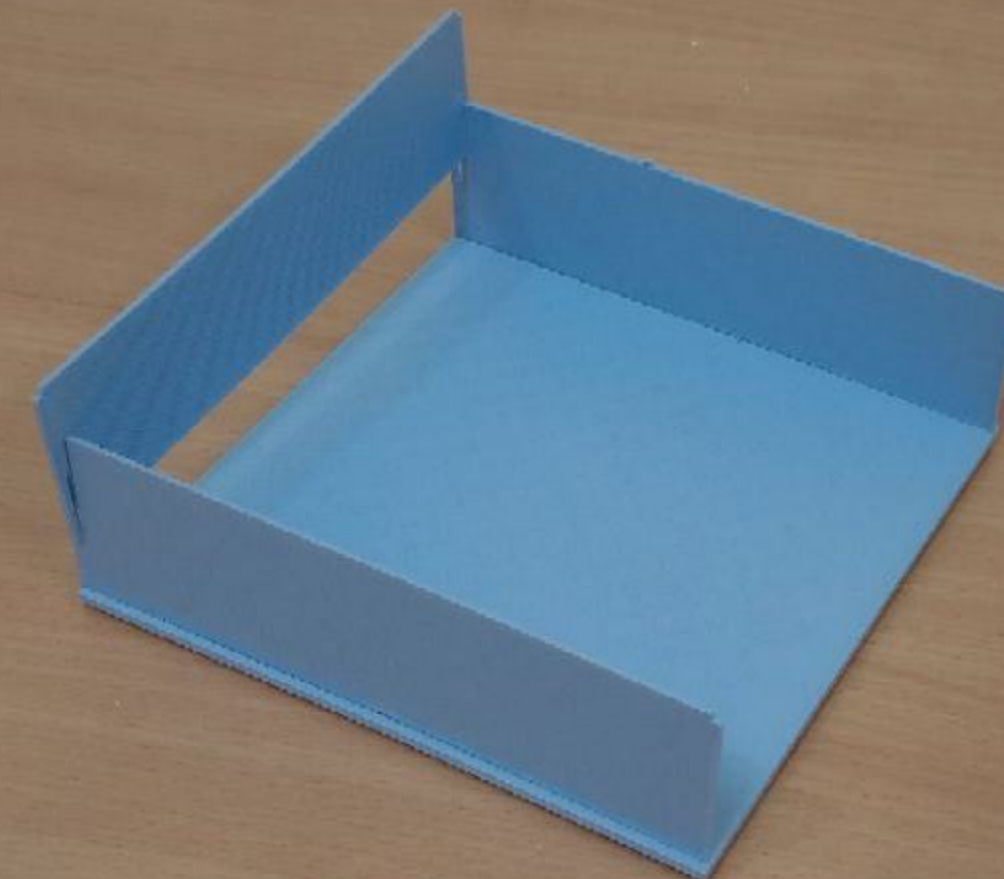
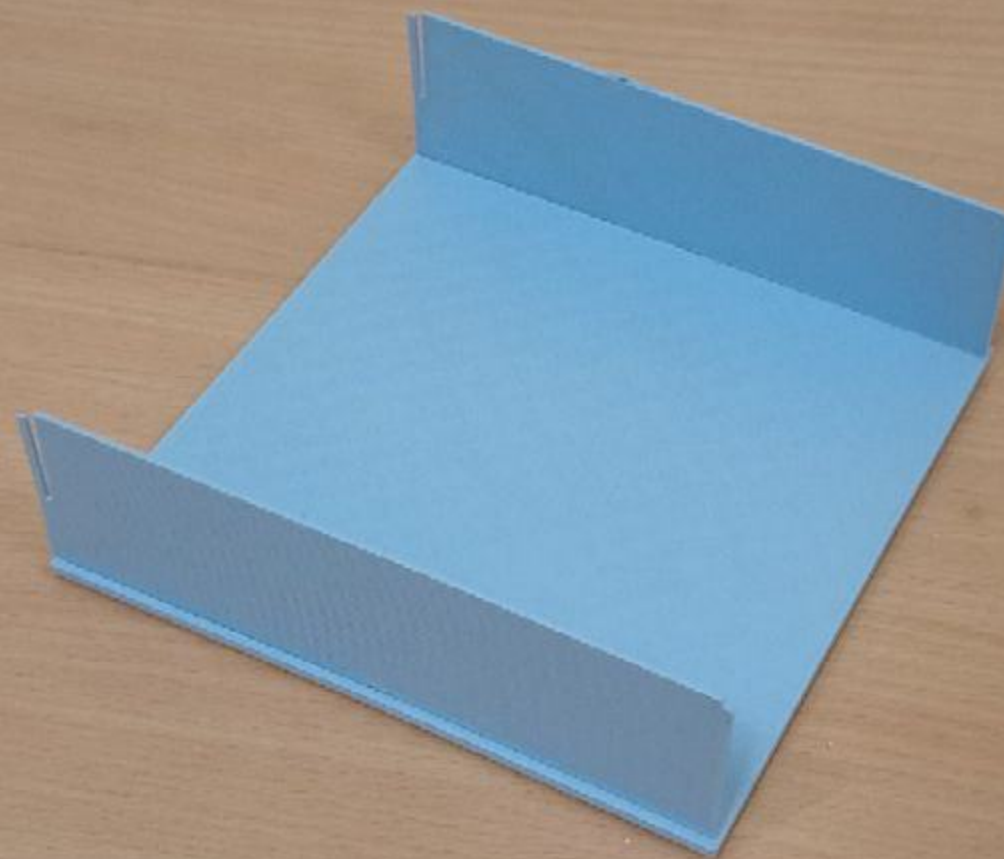
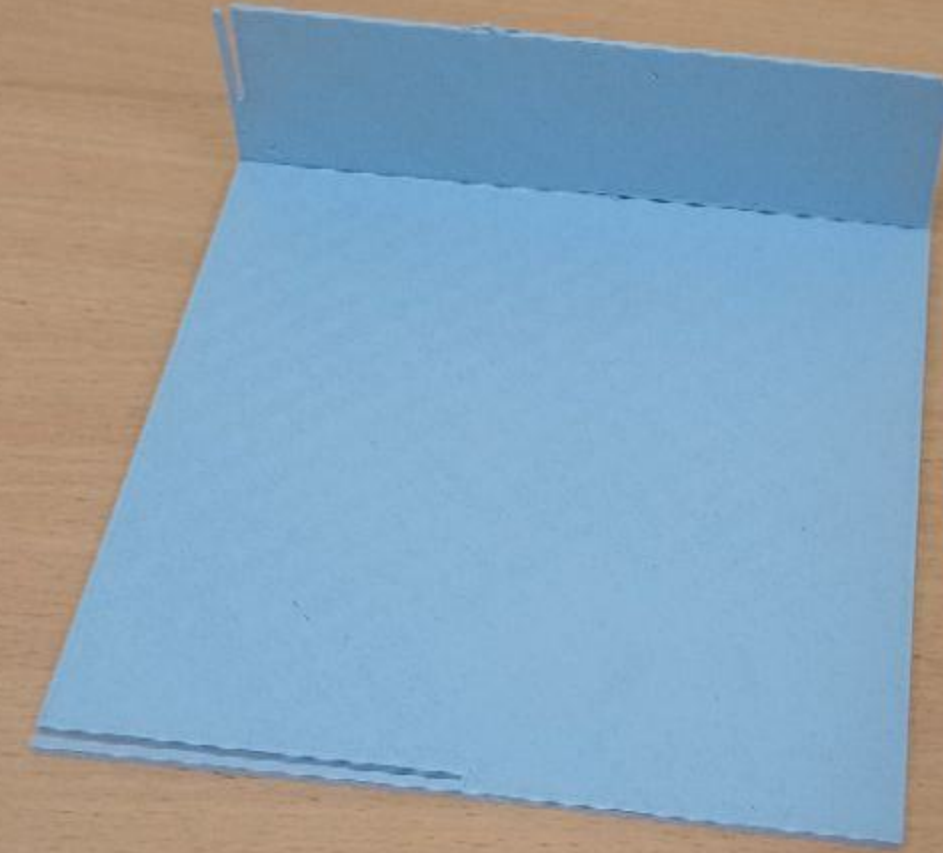
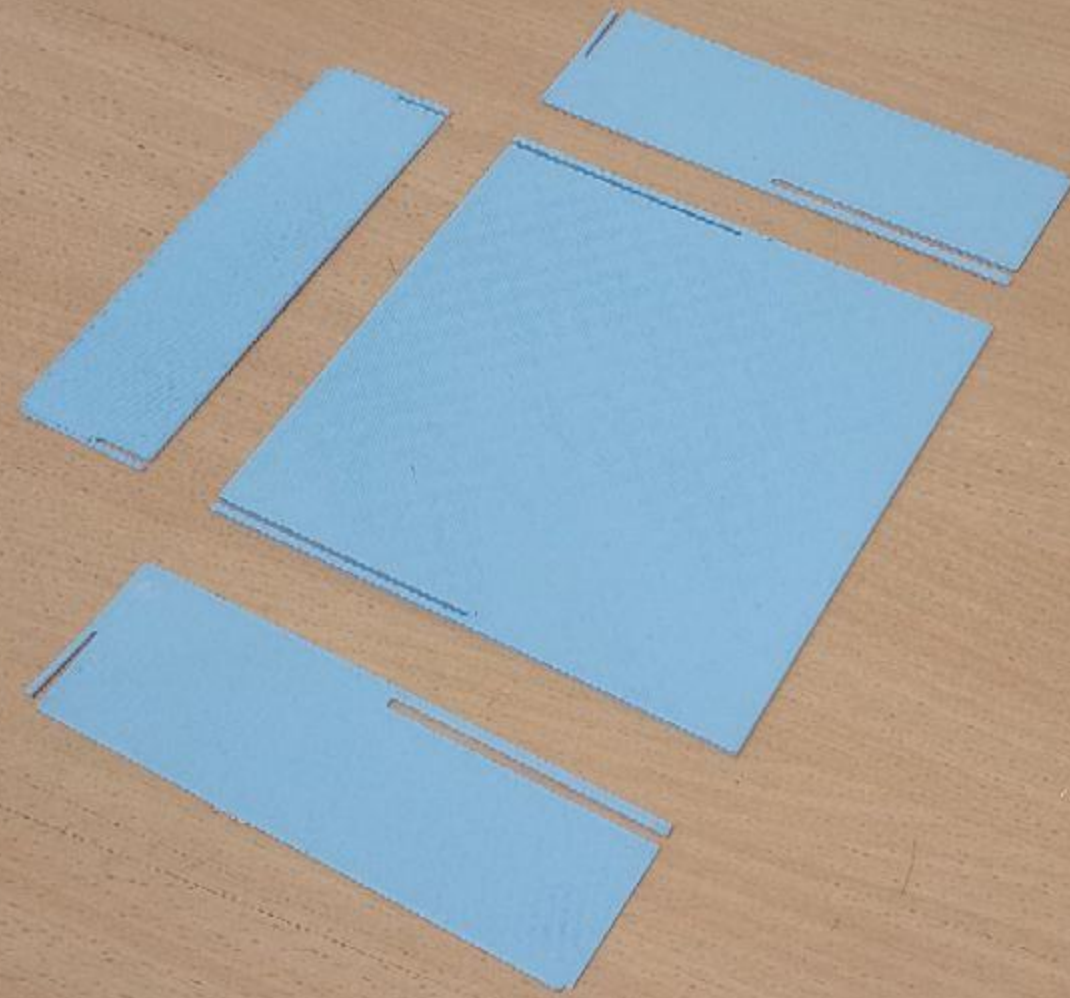
Design specifications

Material	SS pipes	Mfg. processes	Easy
No. of parts	16	Assembly	Easy
No. of screws	24	Cost	Low
Height	Decreased by 1 inches		

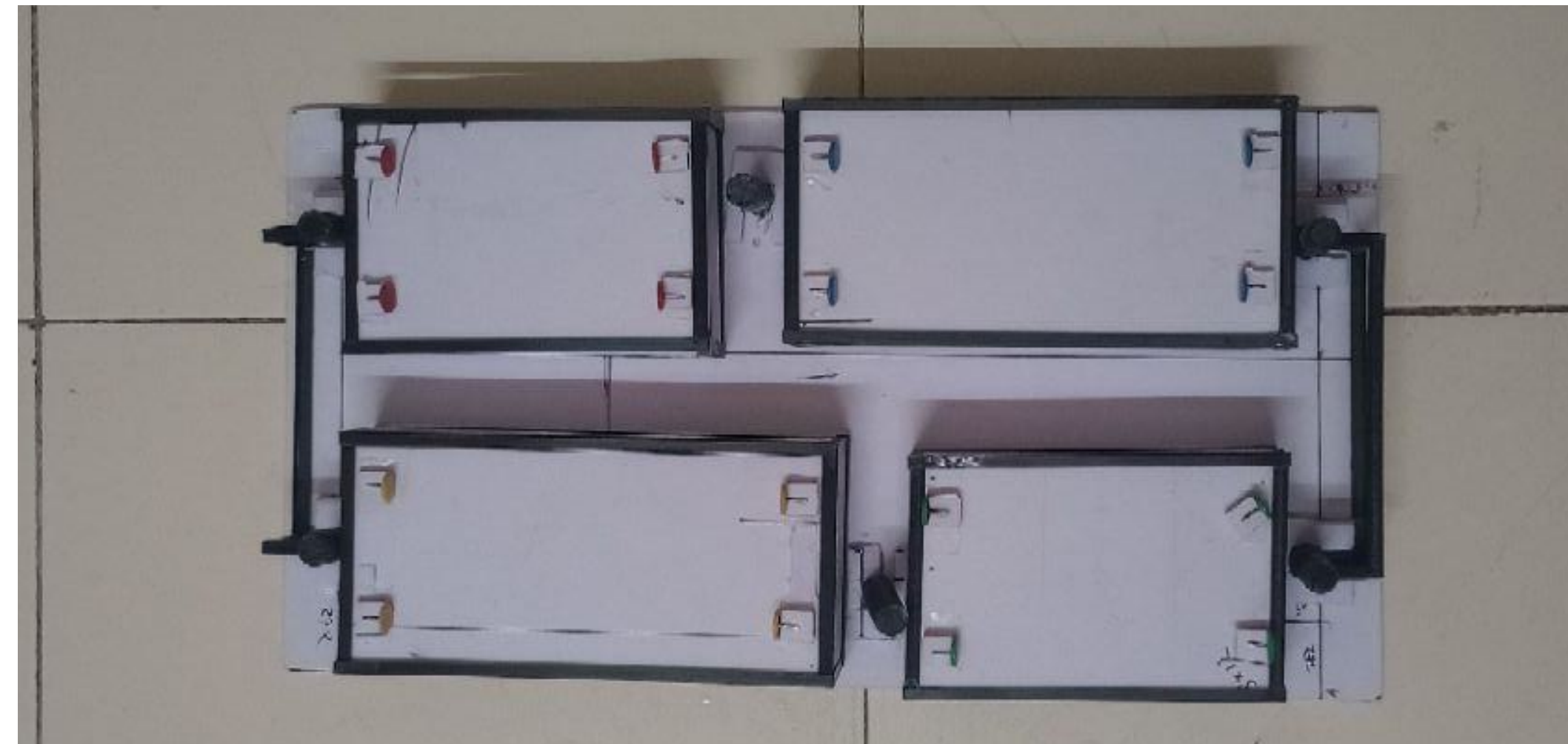
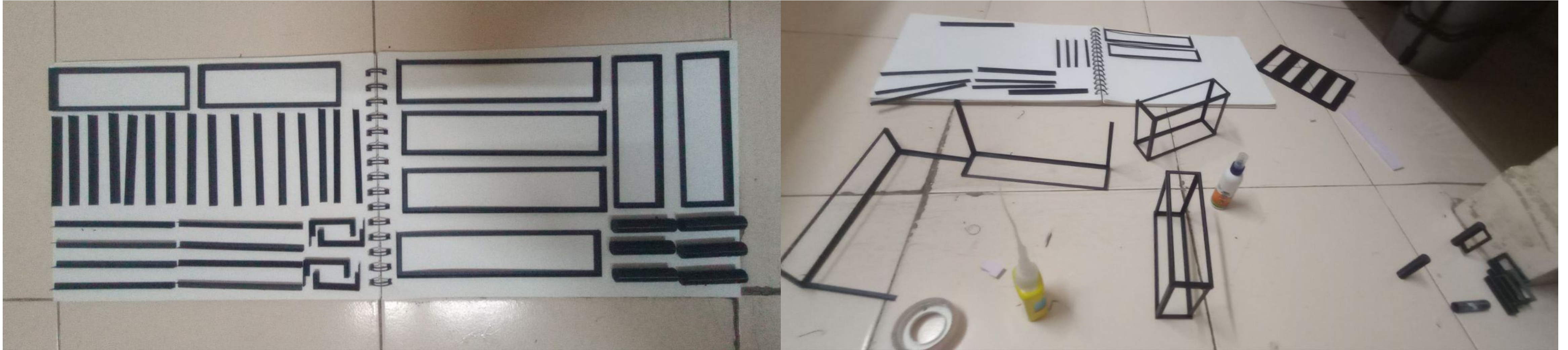
Storage drawer



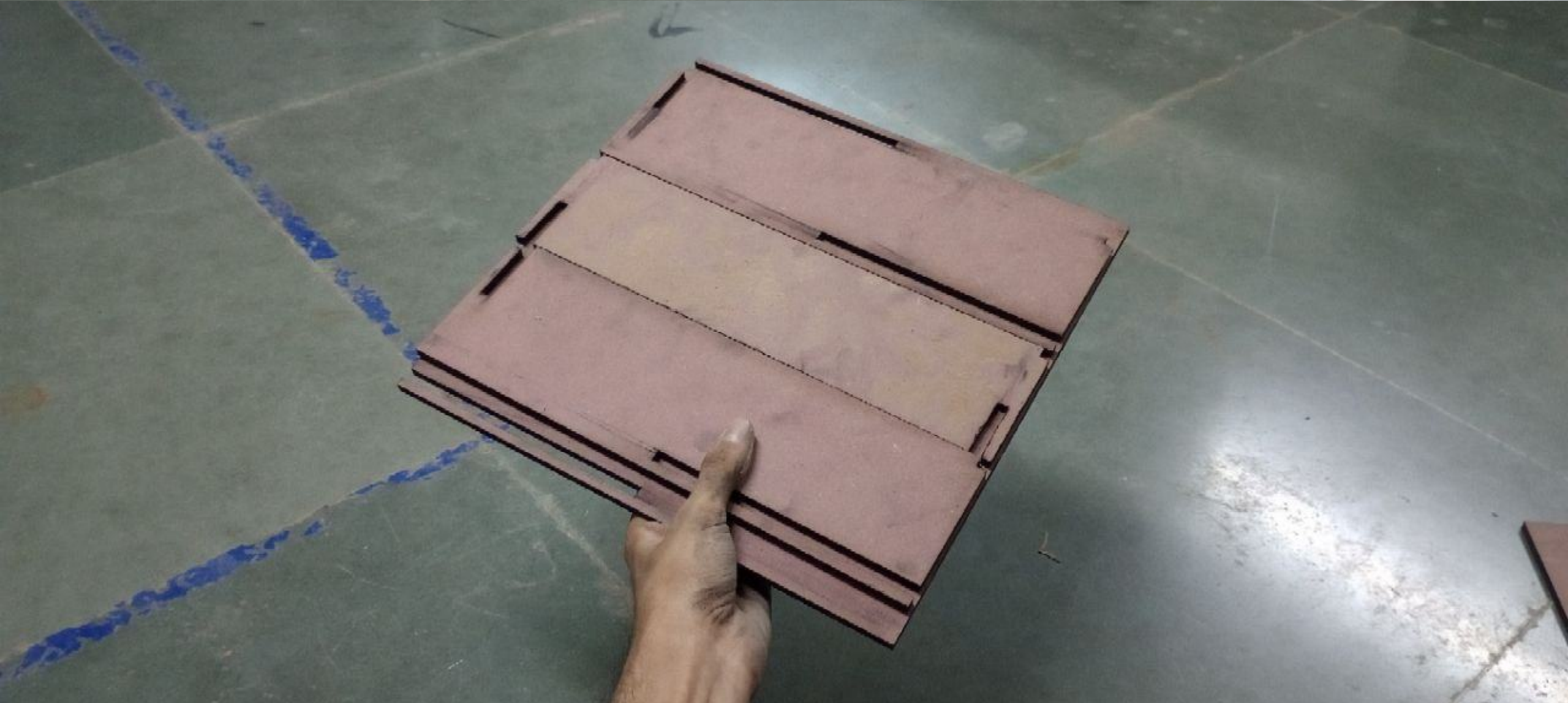
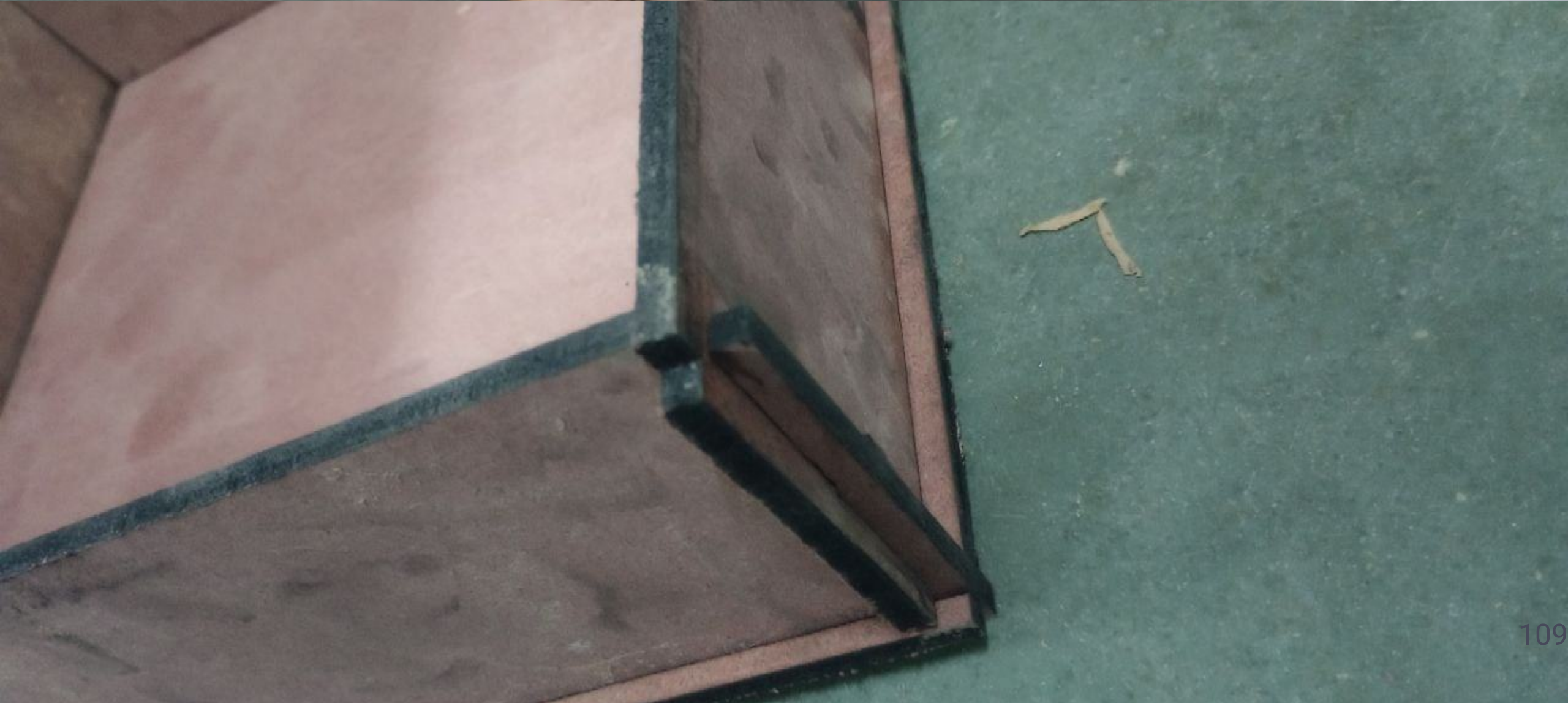
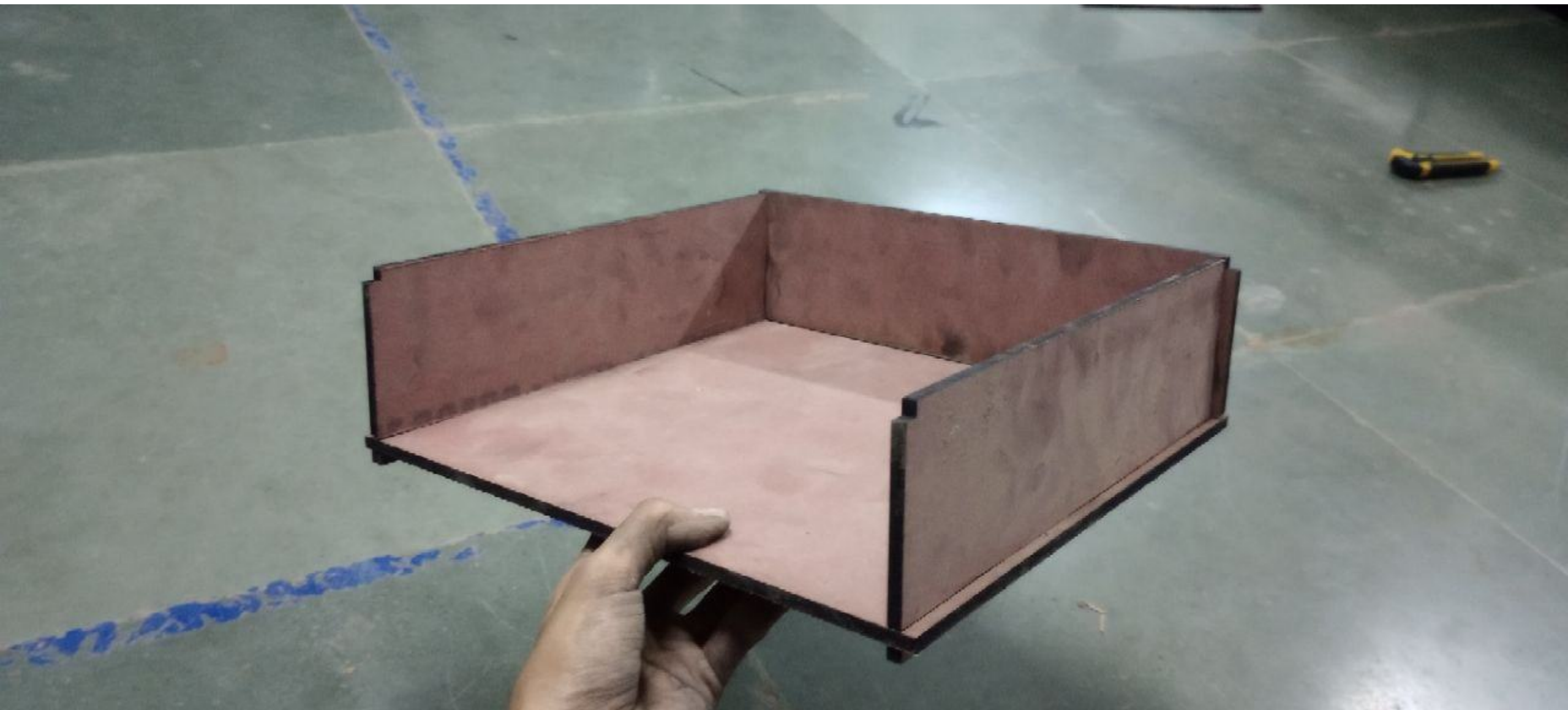
Storage drawer- Slide in slot concept



L-bar case concept



Slide in slot concept in MDF





Storage drawers

Each drawer is very easy to manufacture and assemble. It need only **8** hex screws to assemble the whole drawer with bedding.





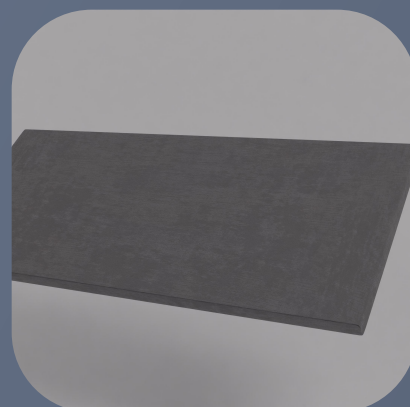
Parts used in a Drawer.



Hex screws of thread length 5mm, 30mm.



Ply wood (10mm), San mica sheets.



Bedding Panels.



Threaded Rivets according to the hex screws.



Number of screws used in a Drawers.



Old Drawer joineries
needs **28** Hex screws



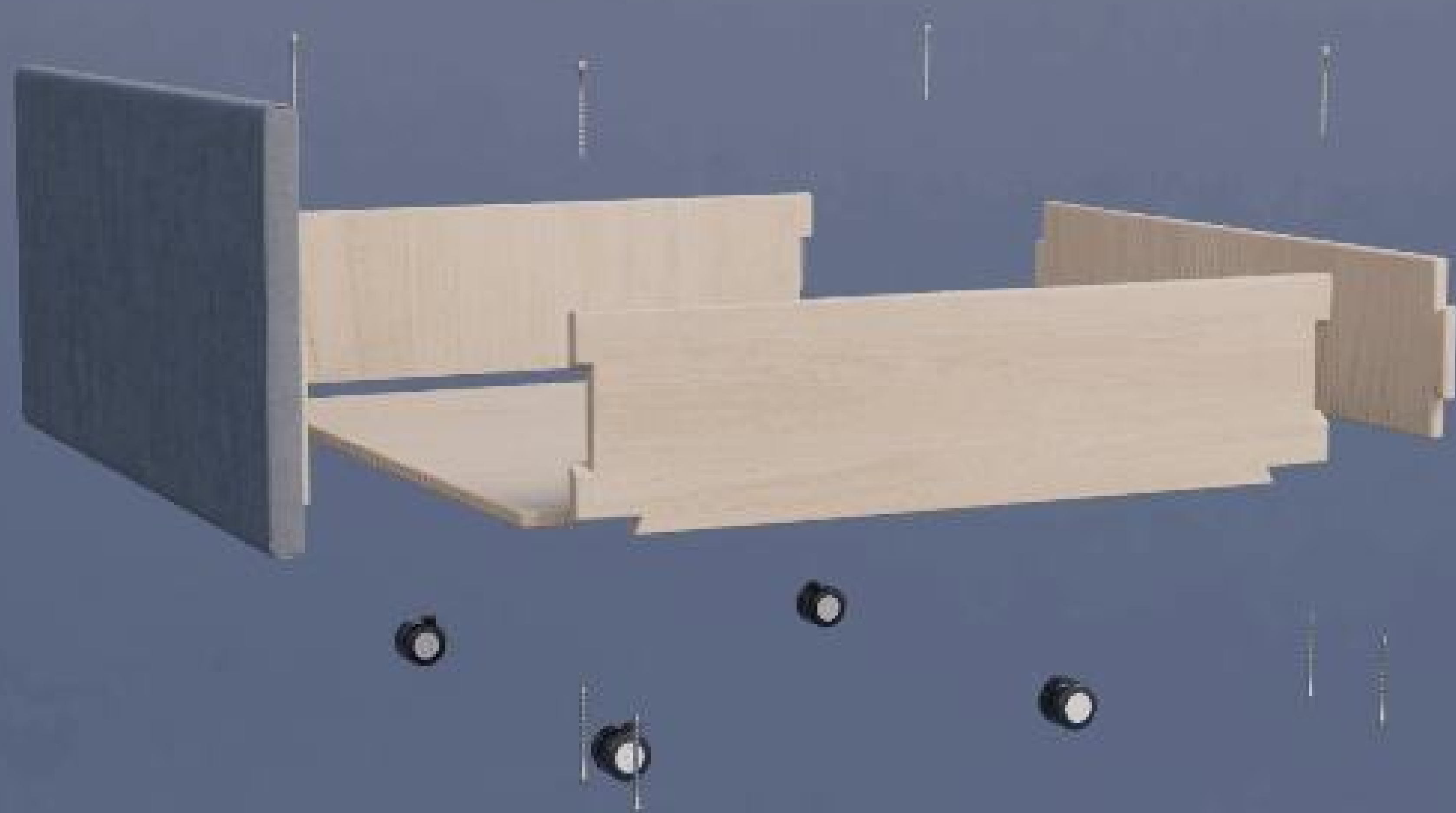
Final Drawer joineries
needs **8** Hex screws.



Flat Packing

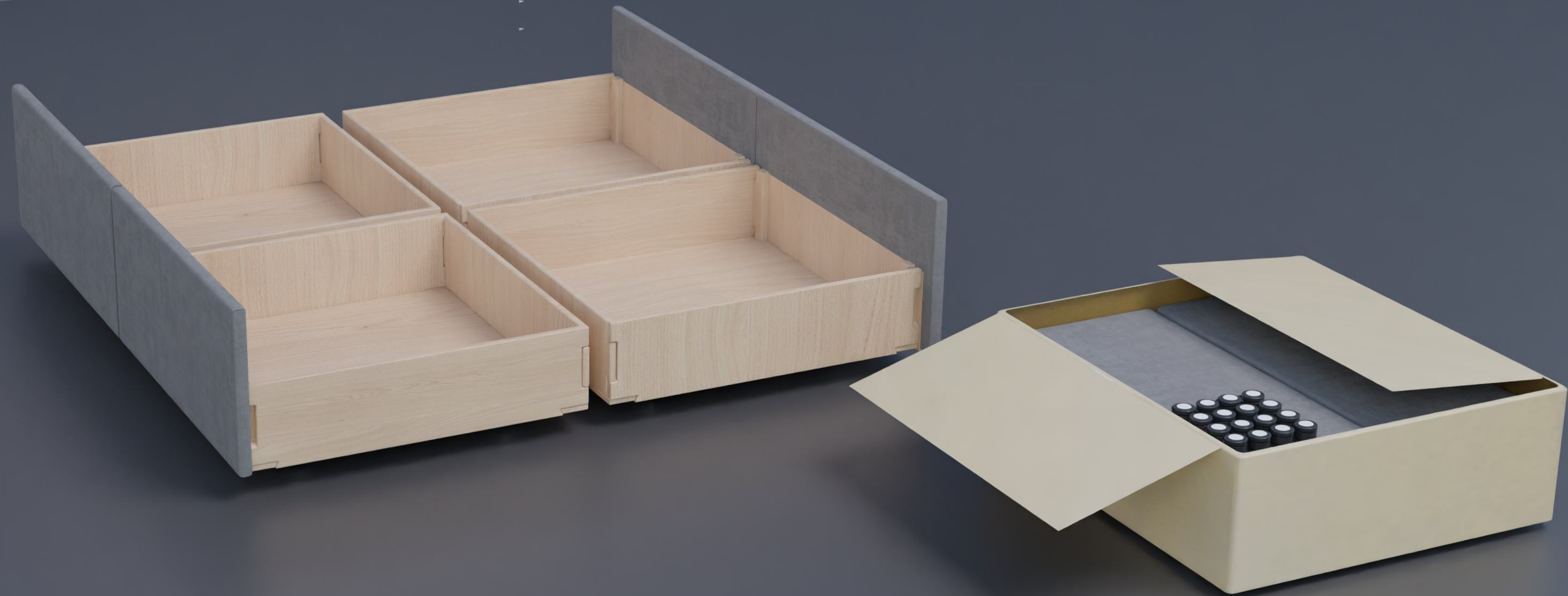
All of the parts can be flat packed to take minimum space while shipping. Every part designed to cater both flat packing, easy assembly and minimum manufacturing cost.





Flat Packing

All four drawers with there parts can be flat packed in a compact box of dimensions **76cm * 83cm * 28cm.**





Packaging

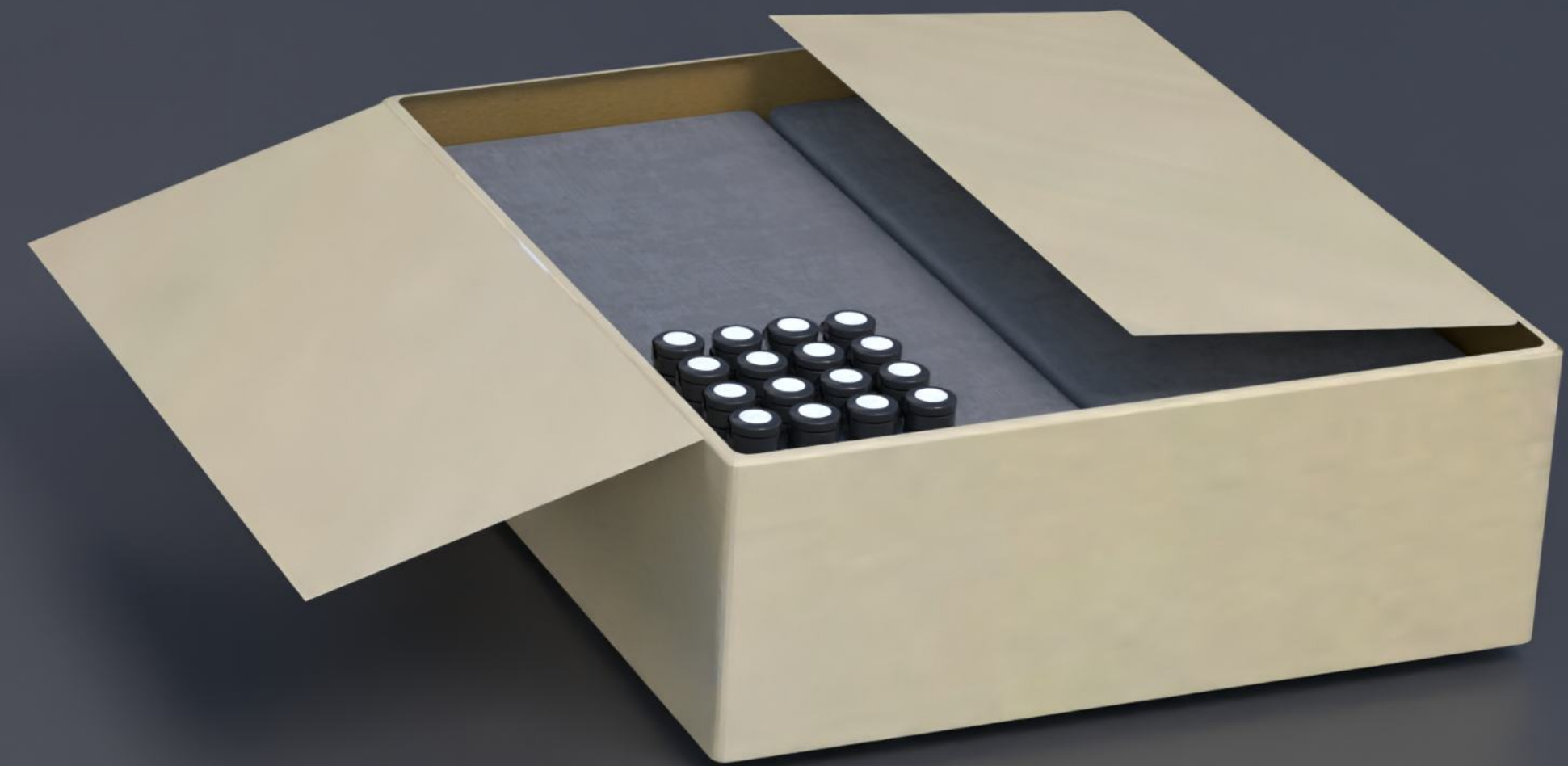
4 Side bedding

16 Wooden panels

16 Caster wheels

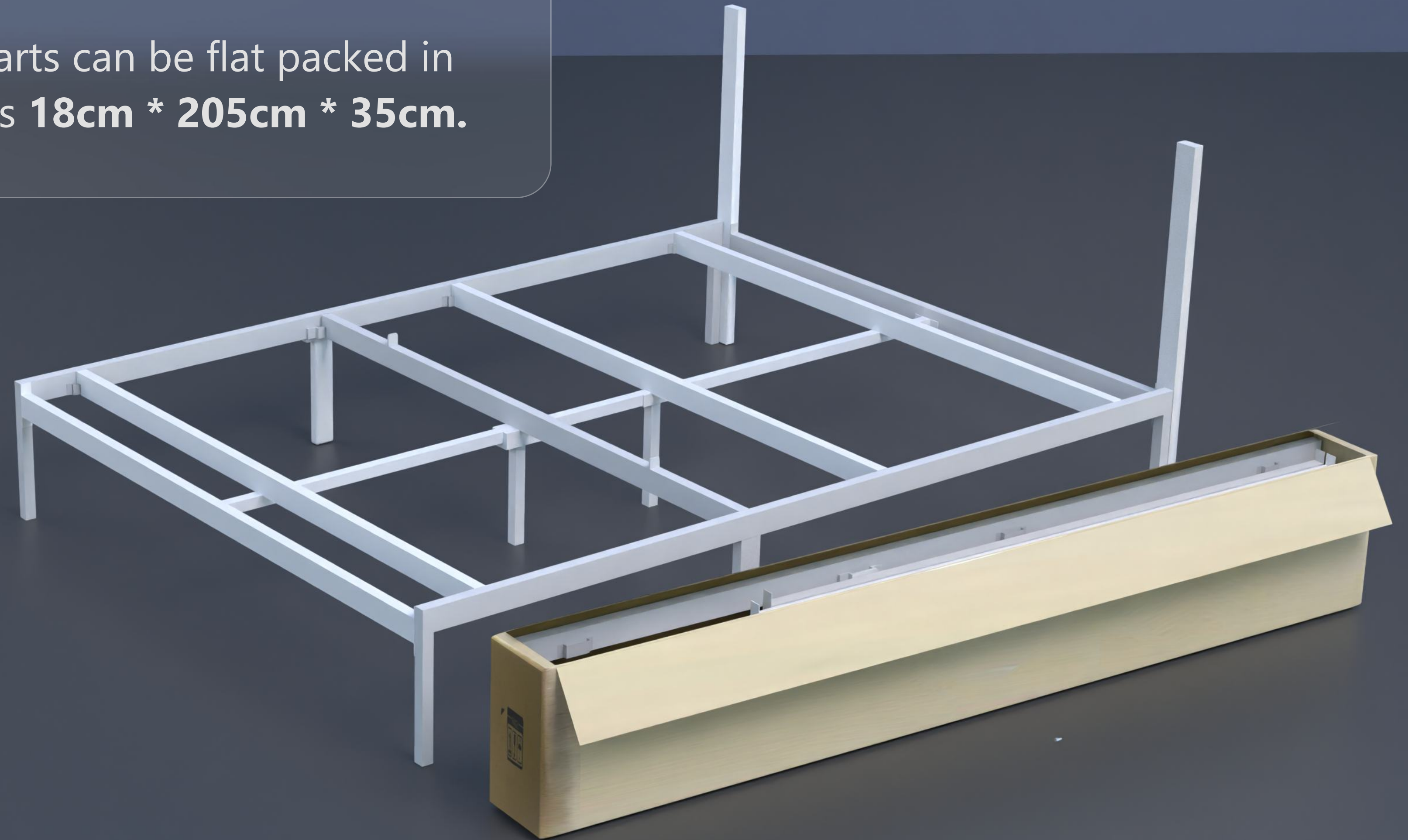
32 Screws

All these things will be packed in a box
of **76cm * 83cm * 28cm**.



Flat Packing

Whole frame with all of its parts can be flat packed in a compact box of dimensions **18cm * 205cm * 35cm**.





Packaging

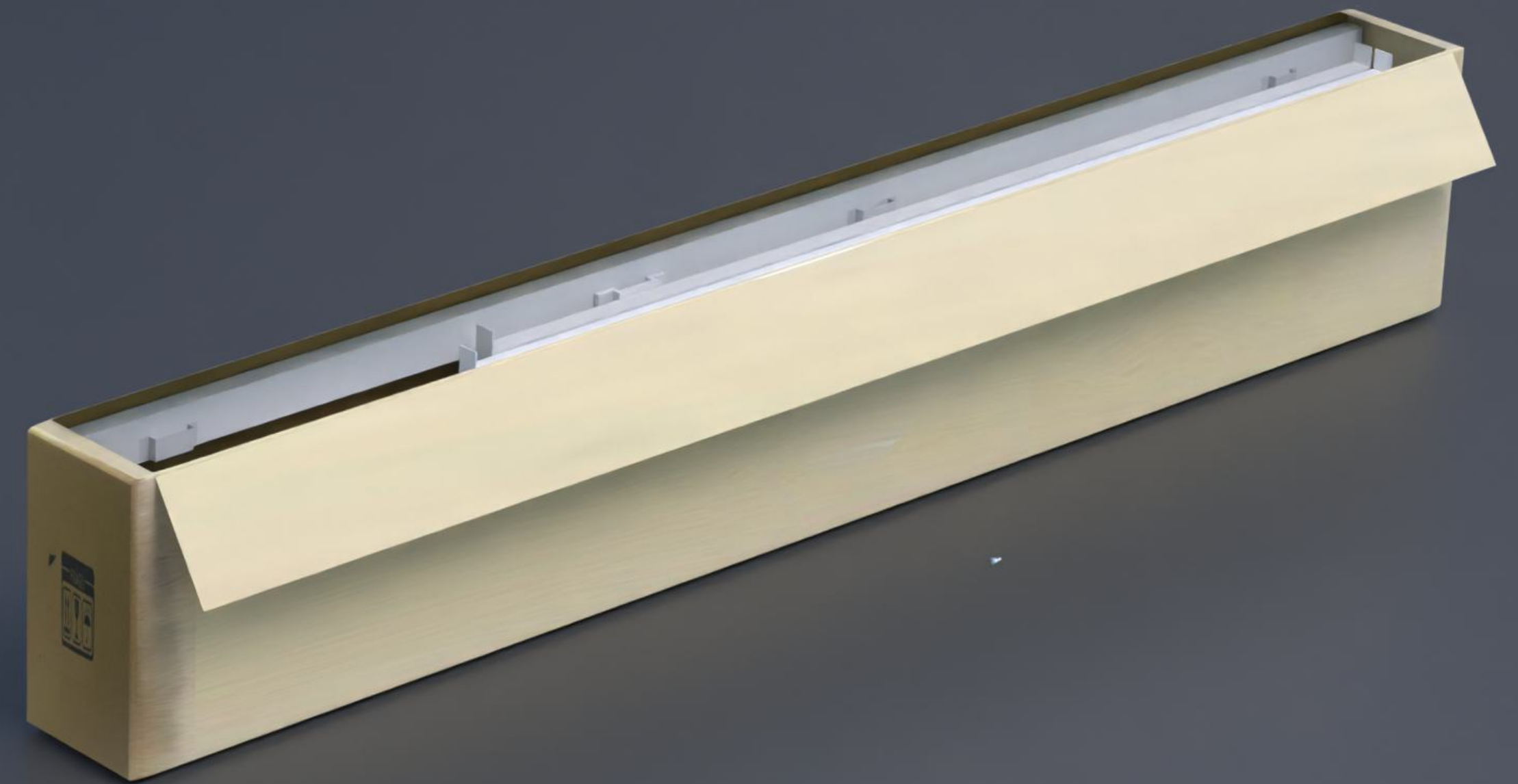
5 Different rectangular pipe pieces.

2 Different square pipe pieces.

3 Front and back bedding pieces.

16 Screws. **16** Threaded rivets.

All these things will be packed in a box
of **18cm * 205cm * 35cm**.





Packaging

Size comparison



We have our frame and drawers issues solved. But still this is not what a bed should look like.

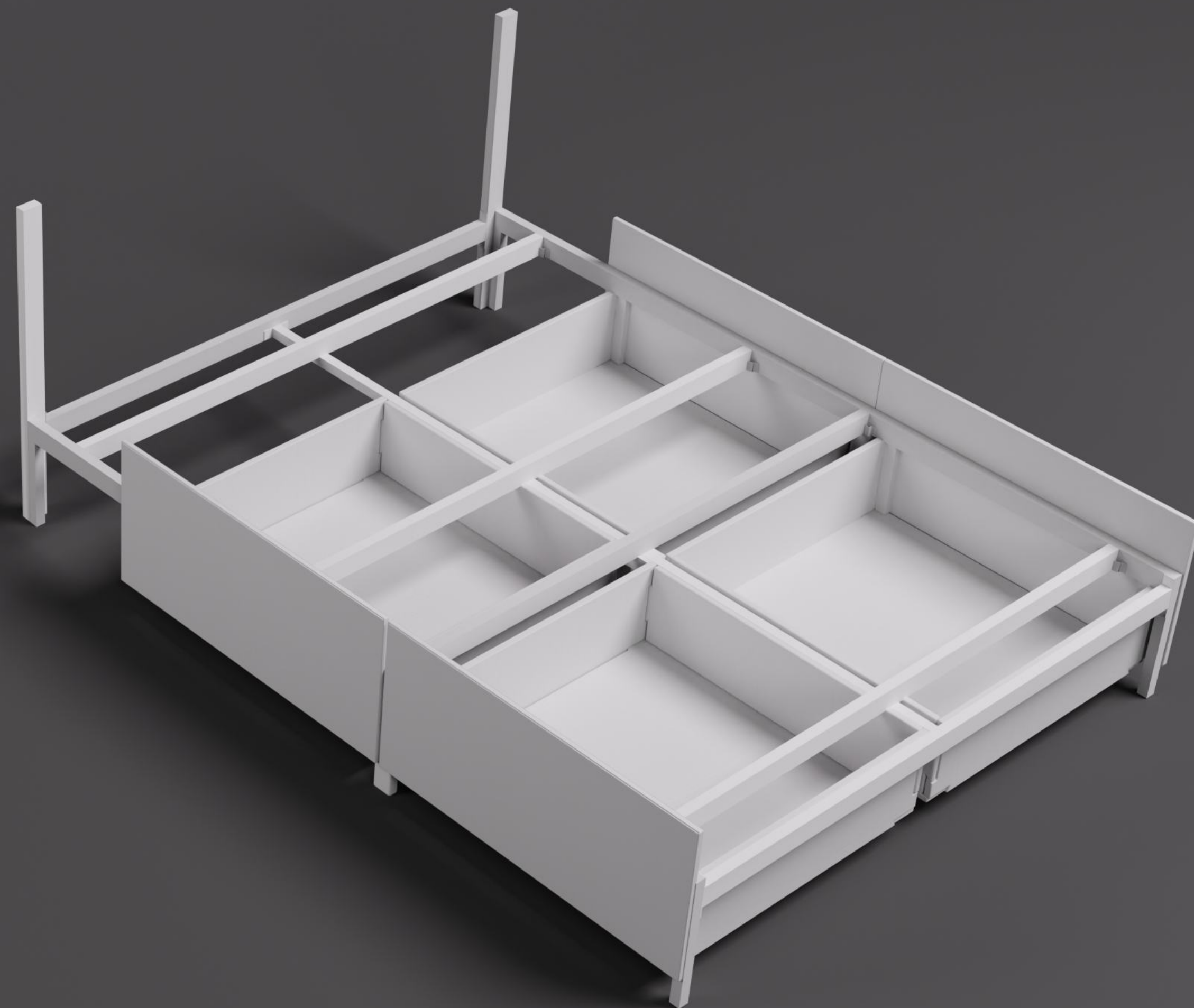
It lacks some necessary features like bedding, back rest and side table etc.



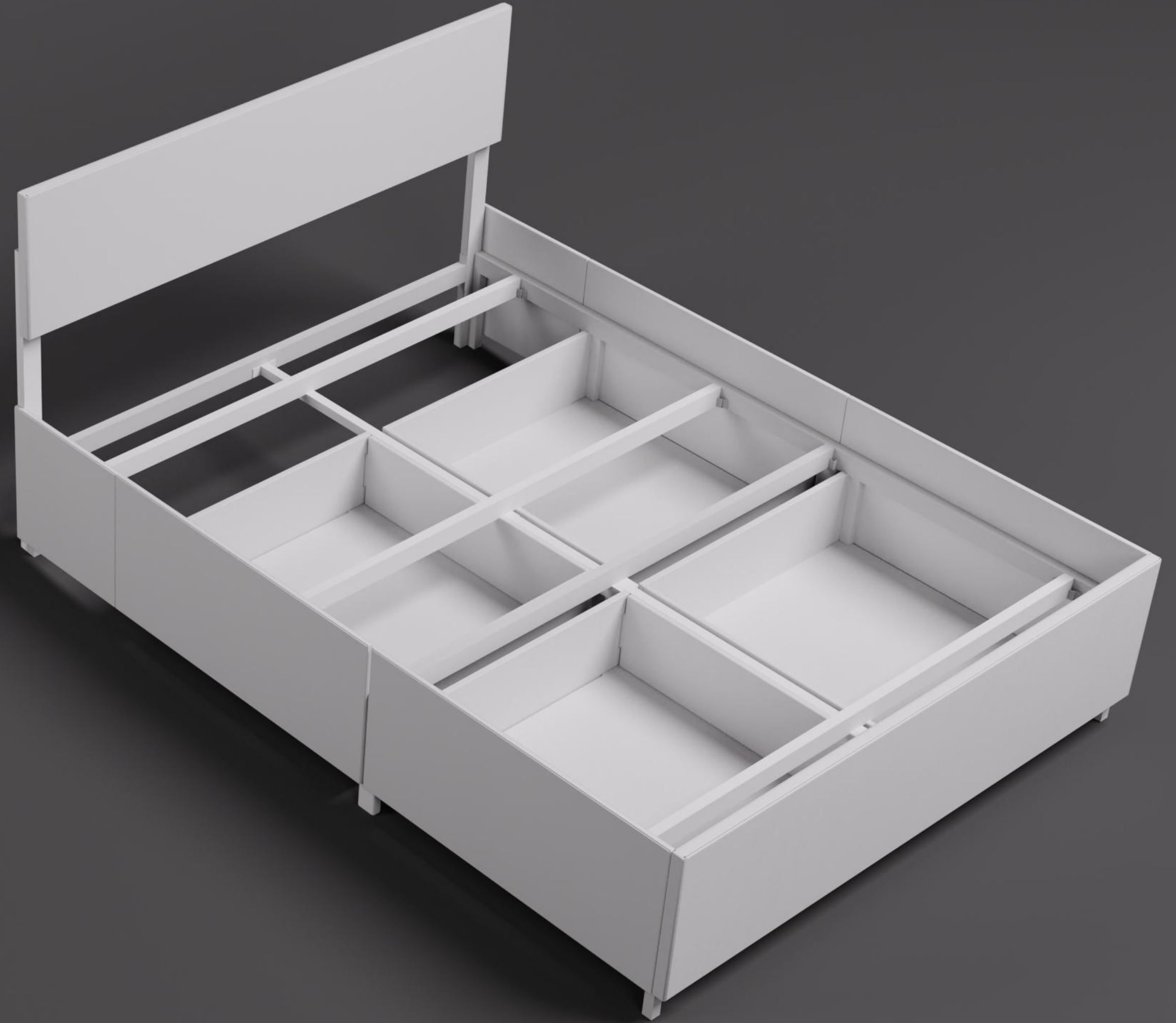
Adding remaining part of the **bedding** to give our bed a comfy and familiar Visual language which demanded by the user in the current market.



We have drawers and the cover as well but leaving some more open area to be covered.



We added extra covering to the open are to make it look like a bed.

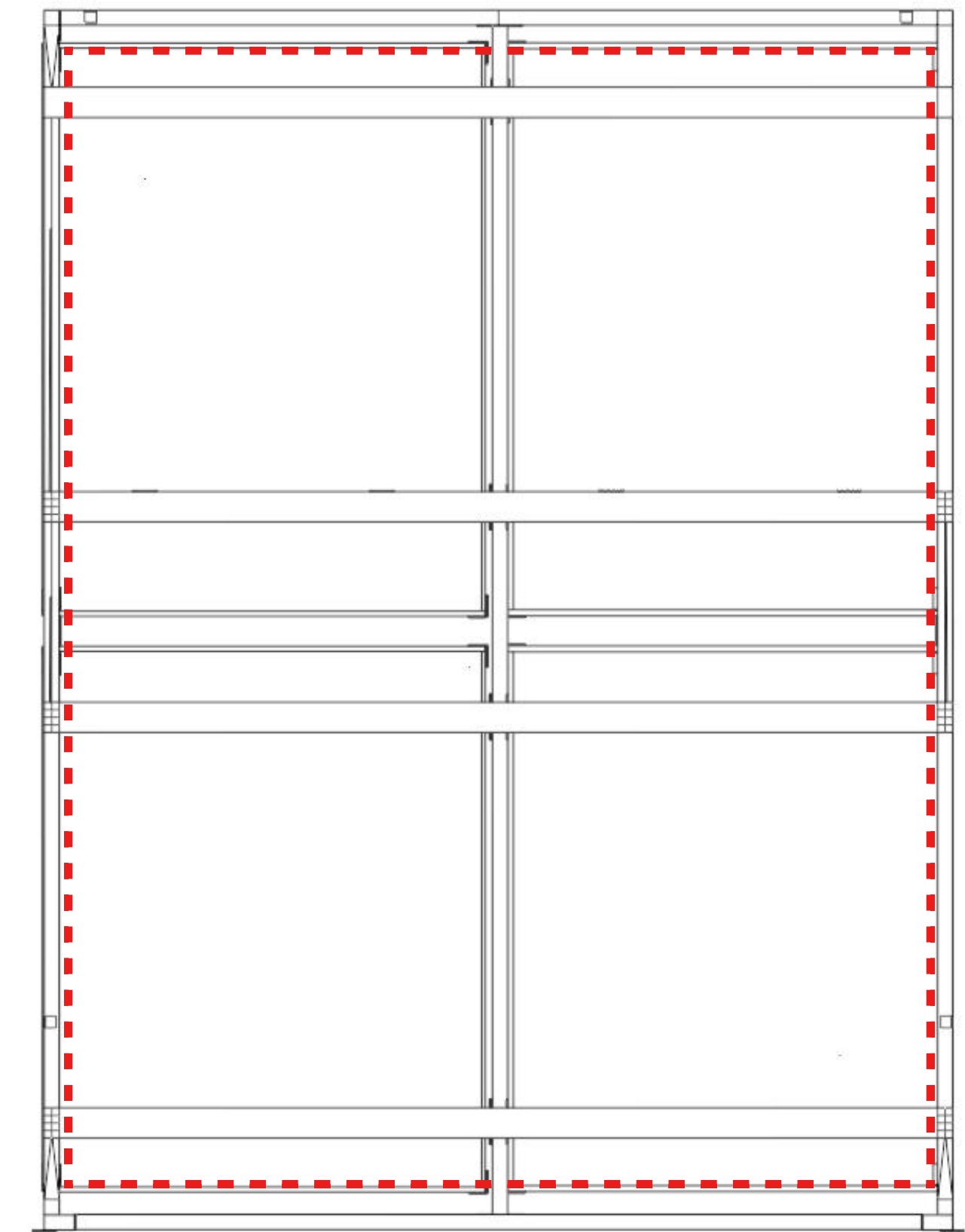
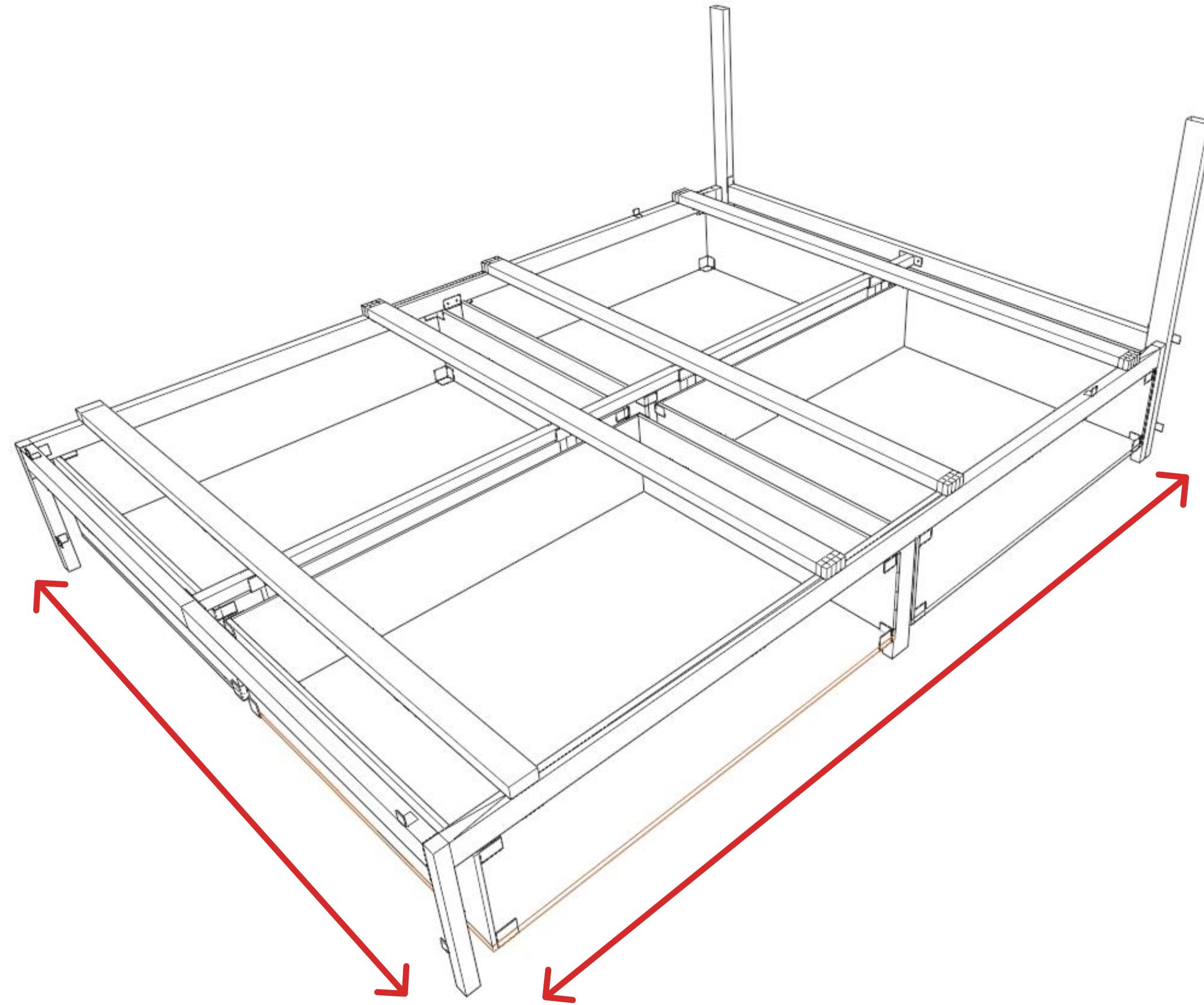


There is a piece added at selected beams to give support to the mechanism so it won't slide anywhere with out using any screw or extra manufacturing process.



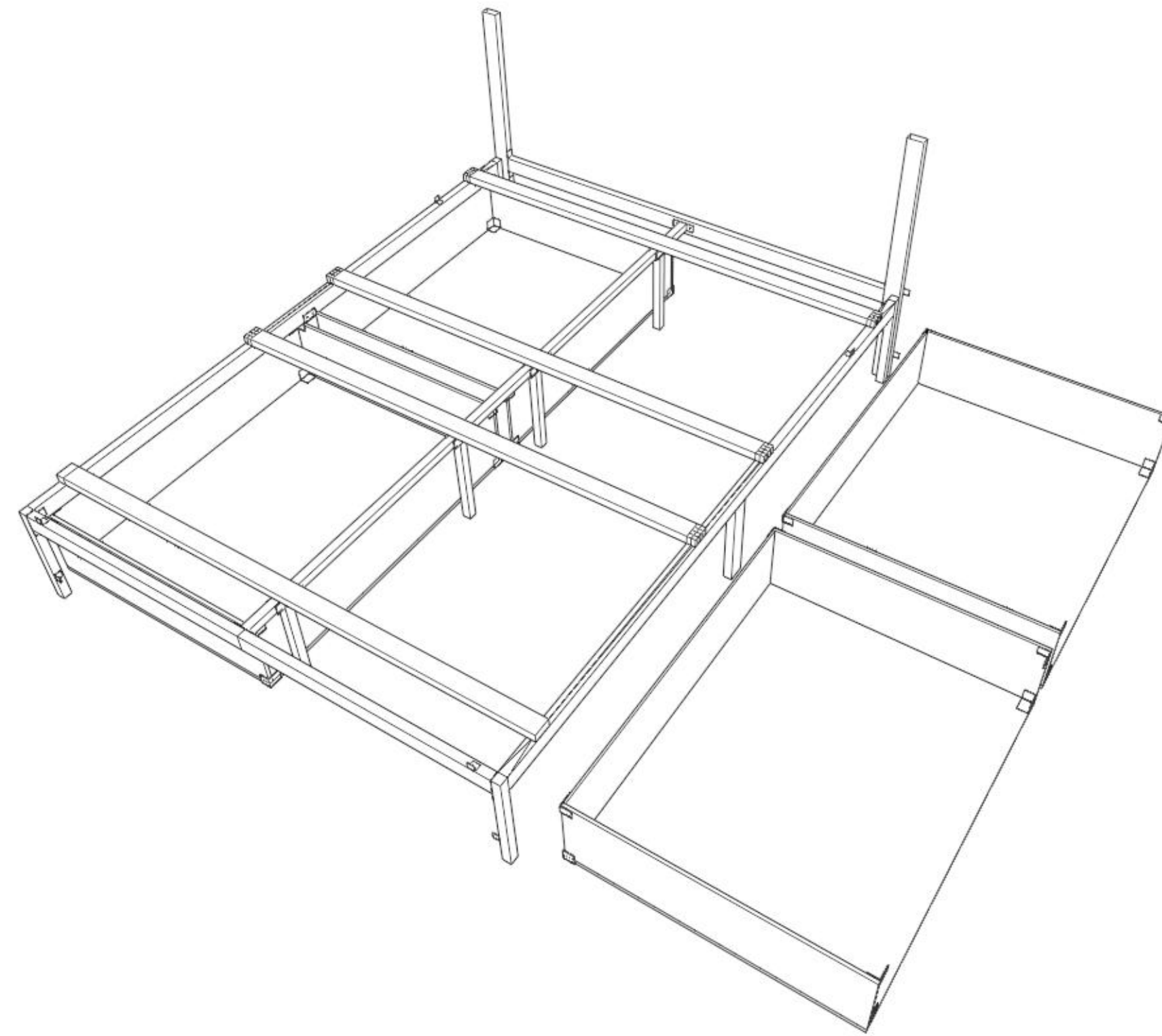
Black piece represents the selected mechanism which is in the support of extruded piece we introduced in the frame.

Side table design

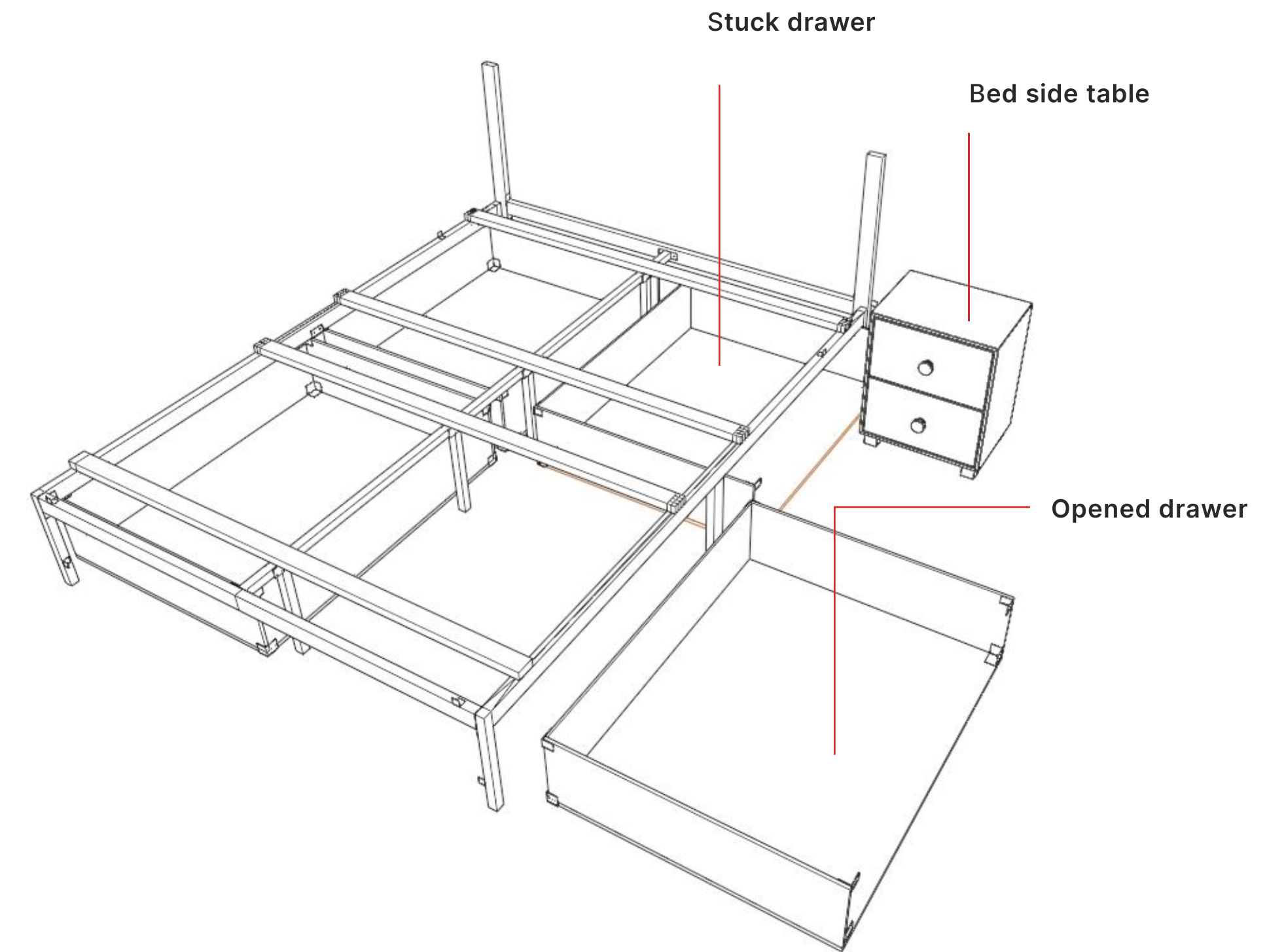


Space covered by the storage drawers

Initially the the volume covered by the storage drawers is max(
Almost equal to the volume available underneath the bed).

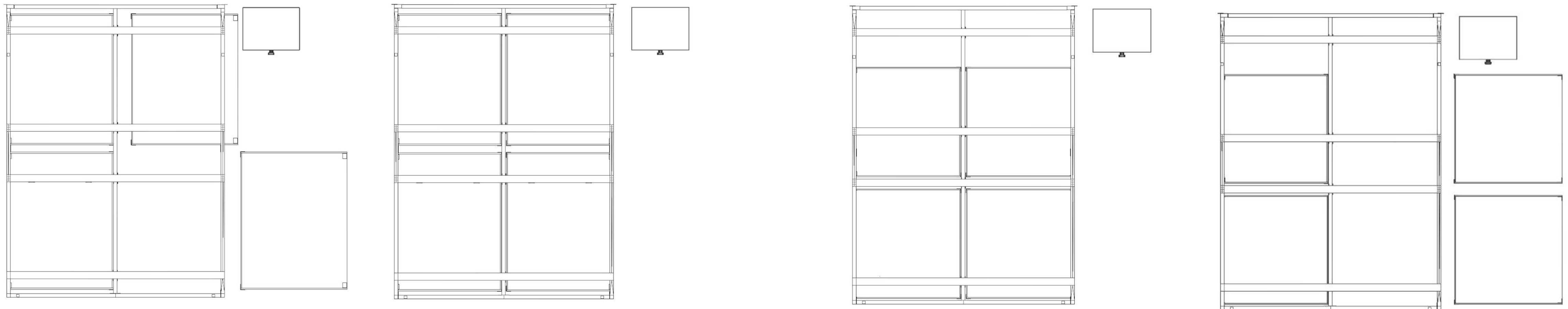


Bed without side table



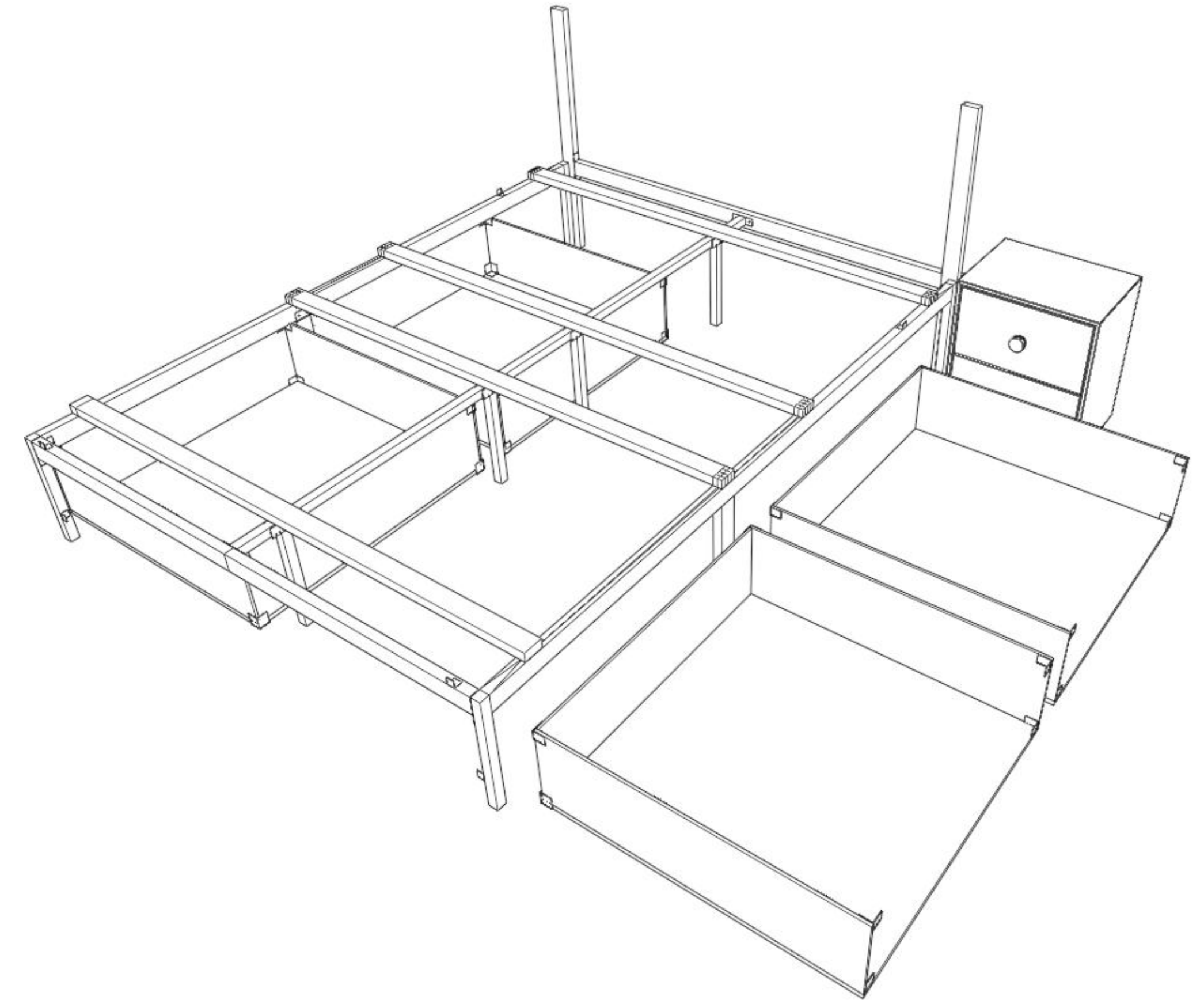
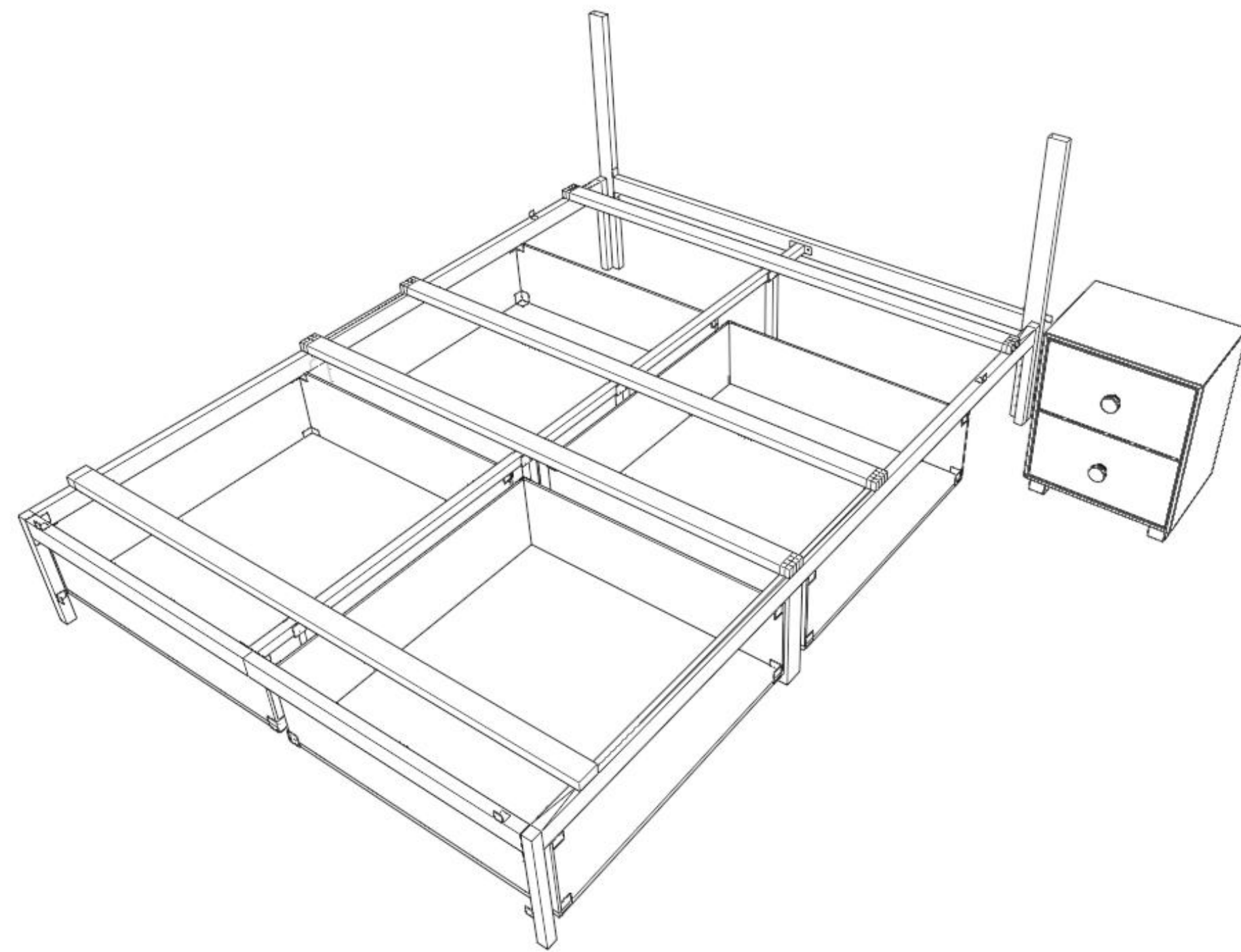
Bed with common side table

To open the drawer out user will need to clear the space outside the bed all around it. if no then they might face some issues to open the drawer out and use it.



As suggested the in previous design to have a table which could work as both study + side table and also allowed the user to open the drawer turns out having problems like:

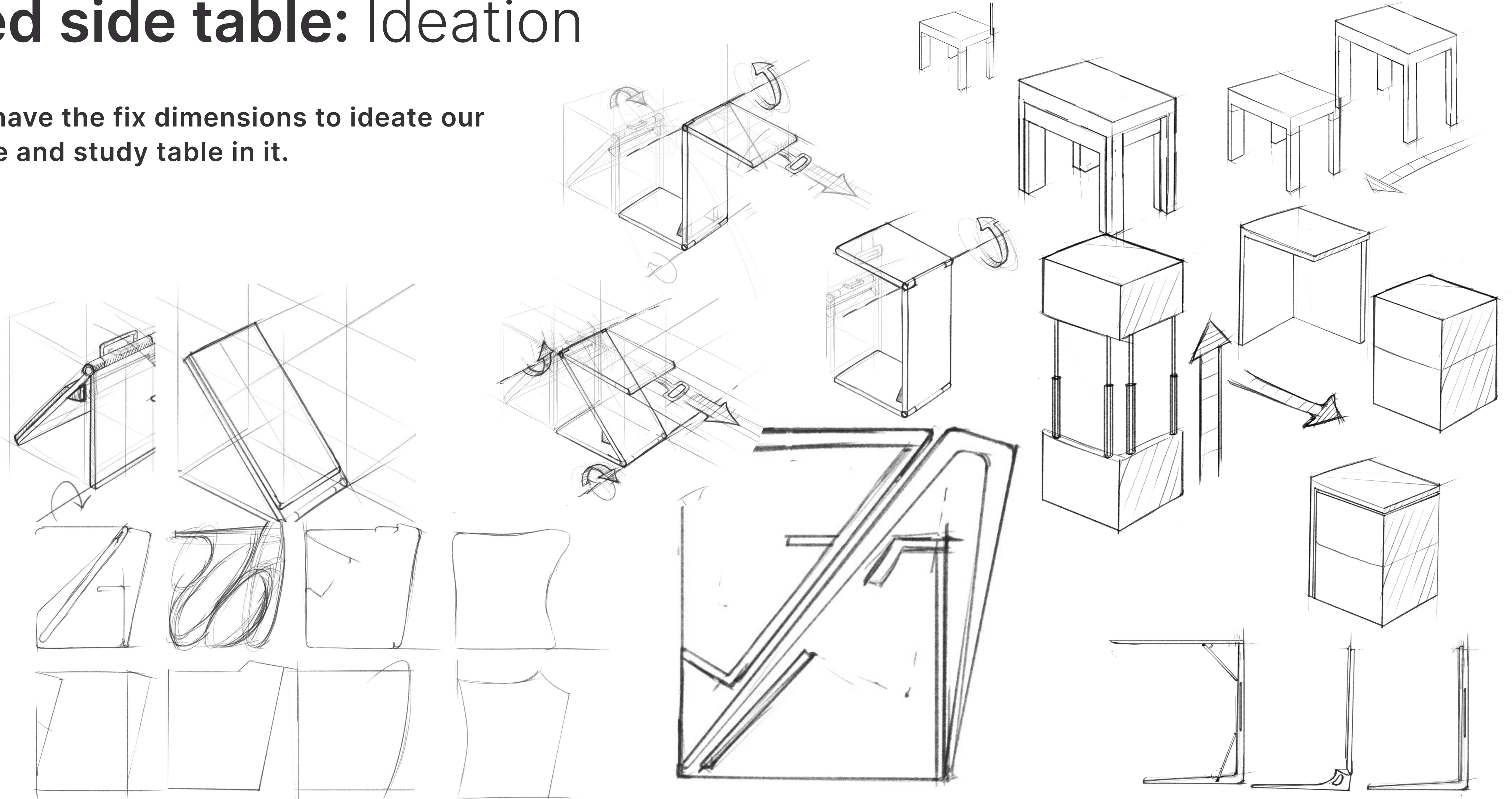
- Not easy for the respective company to manufacture.
- Considering User might have their own drawer already.
- Difficulty to move the table with things on it like lamp, glass of water, phone and charger.
- Hospital like stigma.



Cutting the length of the drawer will allow user to be able to use all drawers with out removing their discarding their existing table(If any). The area reduced is based on the Above average area used by side tables. Hence It allow user to have any kind of side table with te bed.

Bed side table: Ideation

We have the fix dimensions to ideate our table and study table in it.

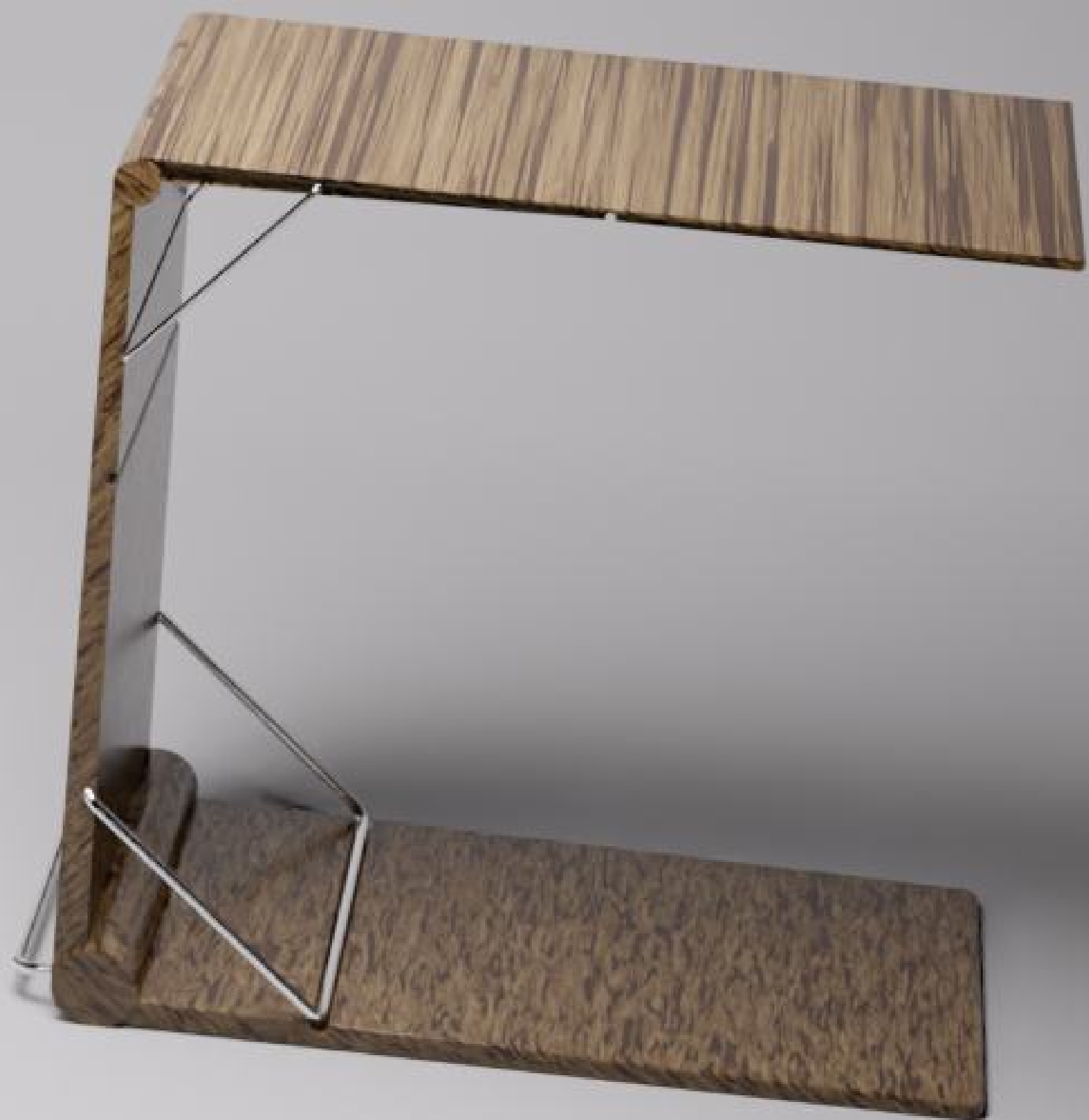


This design have a **nested table inside** which will be taken out to be used as a work table on bed.

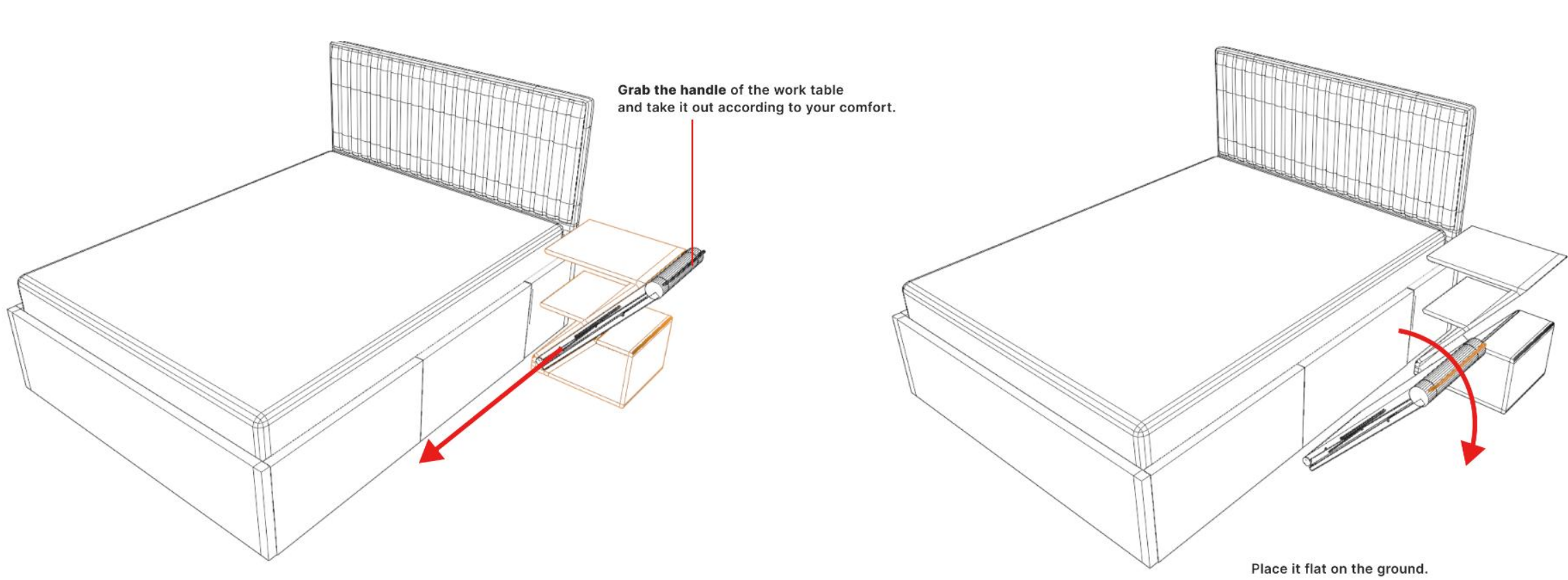


Nested table can be slide out easily.
Which is **folded in a flat rectangular**
shape. User then can unfold it and start
using it as a desk table.

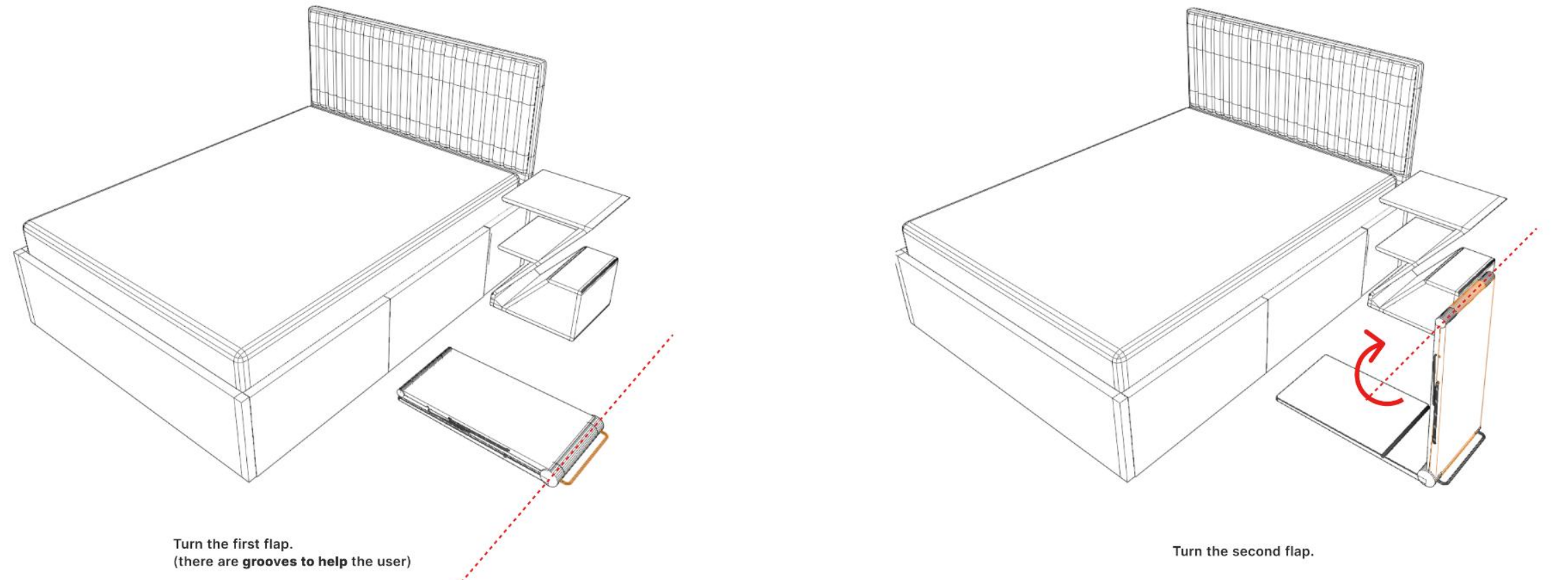




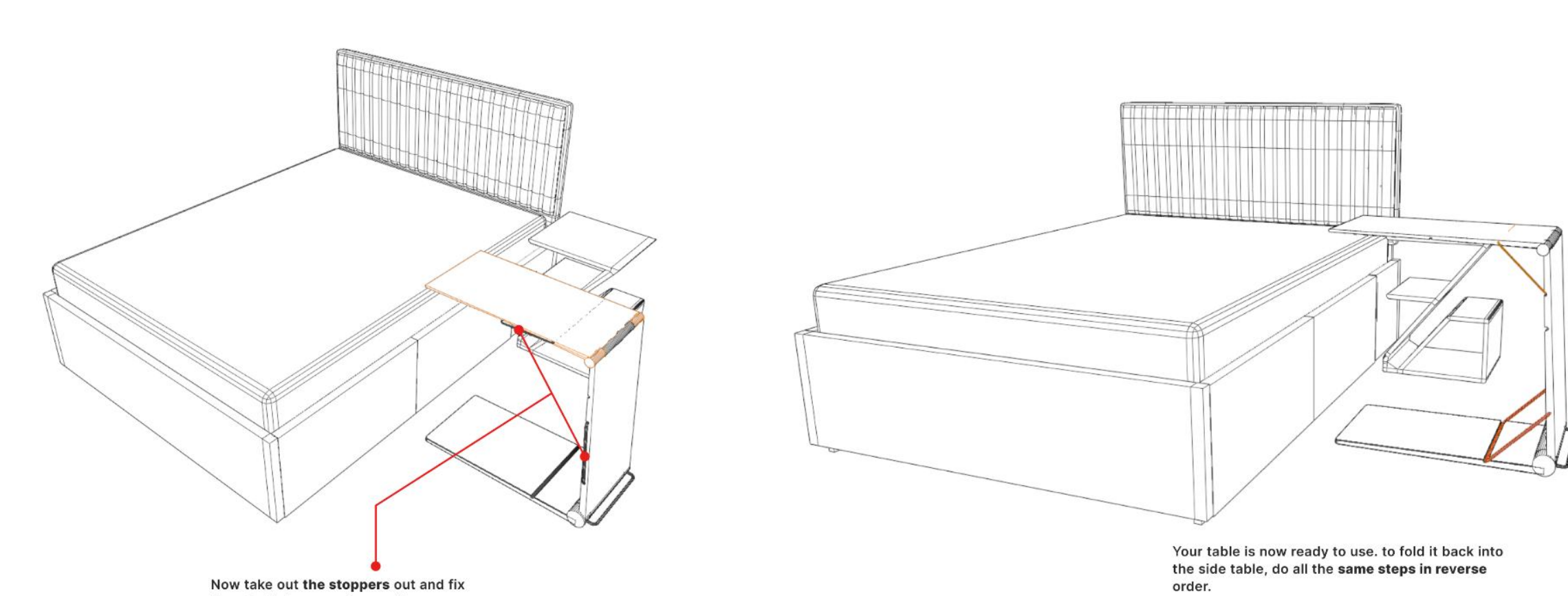
User guide



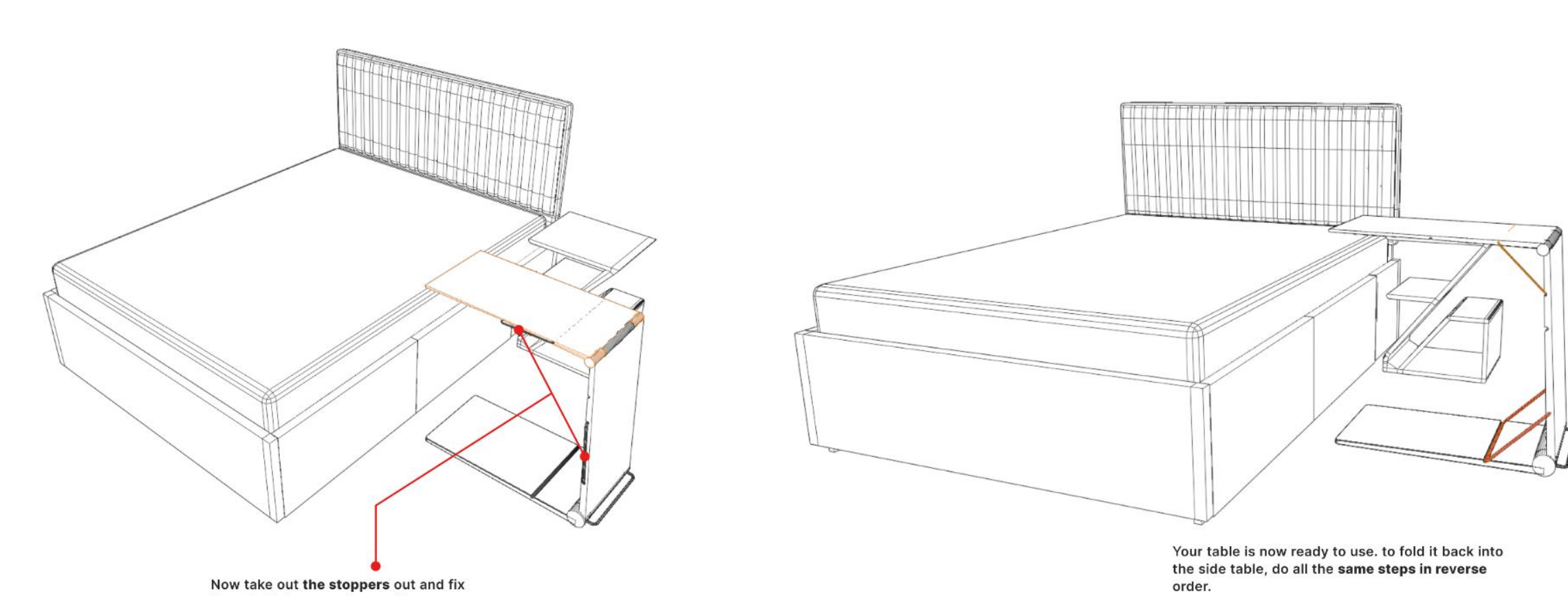
User guide



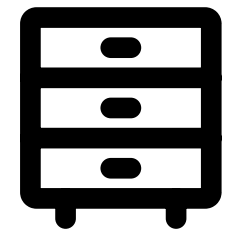
User guide



User guide



To solve it considering second option of leaving some space at the top is taken as the most promising solution as per the market requirements. which will have:



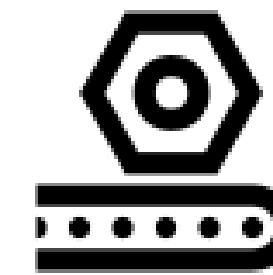
Work as common side table.



Easy to take out and use.



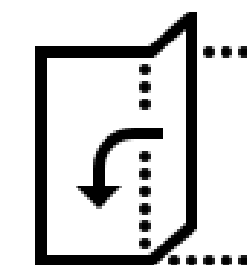
Nested with a work table.



Easy to manufacture.



Cost efficient.



Foldable

Feedbacks

New requirements

User should be able to use the study table with out getting out of the bed or with lest amount of effort.
looking bulky and not going with the language of the bed.

Additional information.

Shipping and manufacturing cost will be high for this product and will be in less demand as it might not be needed by the user.

Suggested design

To design a cheap alternative which will feels light and modern like the bed as per the targeted user.

The table will be designed separately and might be stored inside on of the drawers.

Outcome

- Manufacturing cost will increase.
- User have to do less efforts
- Improve the experience.

Dimensional detailing

(All files were uploaded on the drive)

[Link to drive](#)

As per the requirements and constrains all parts will be assembled using ‘Allen’ key only. wall and base will be made up of wood and joineries are of mild steel sockets.

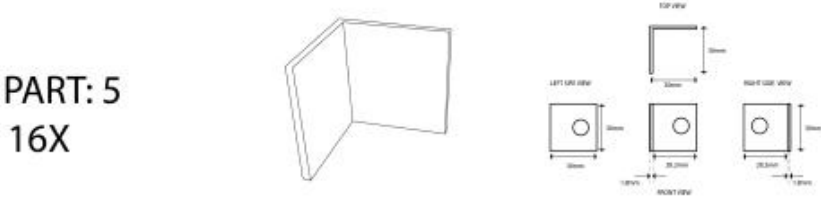
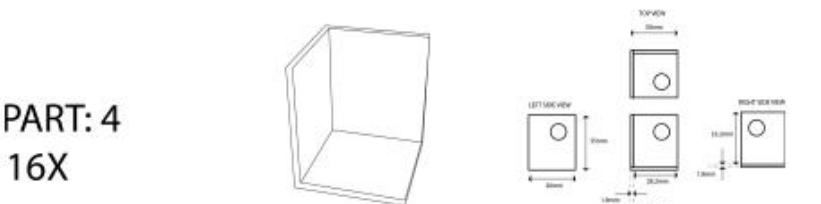
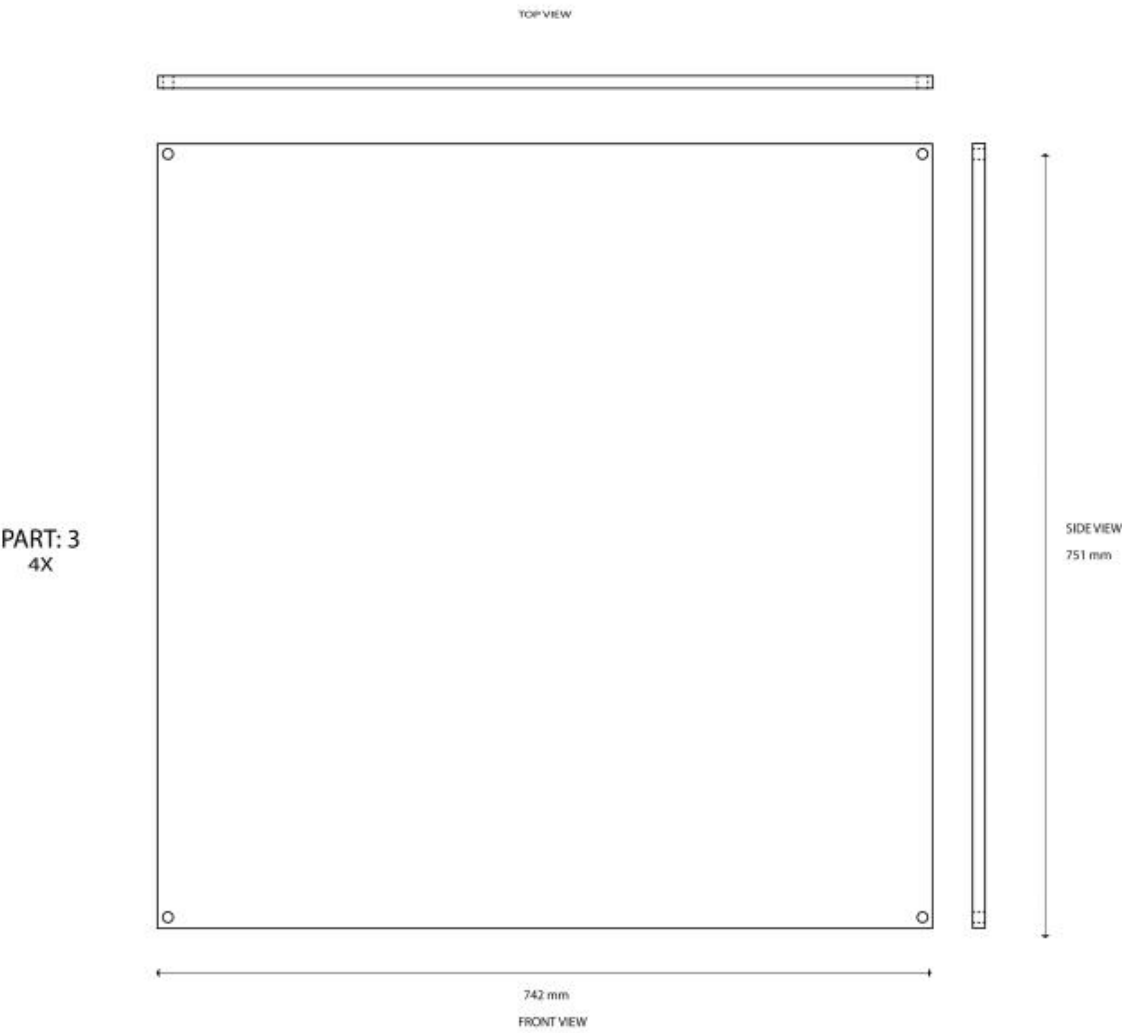
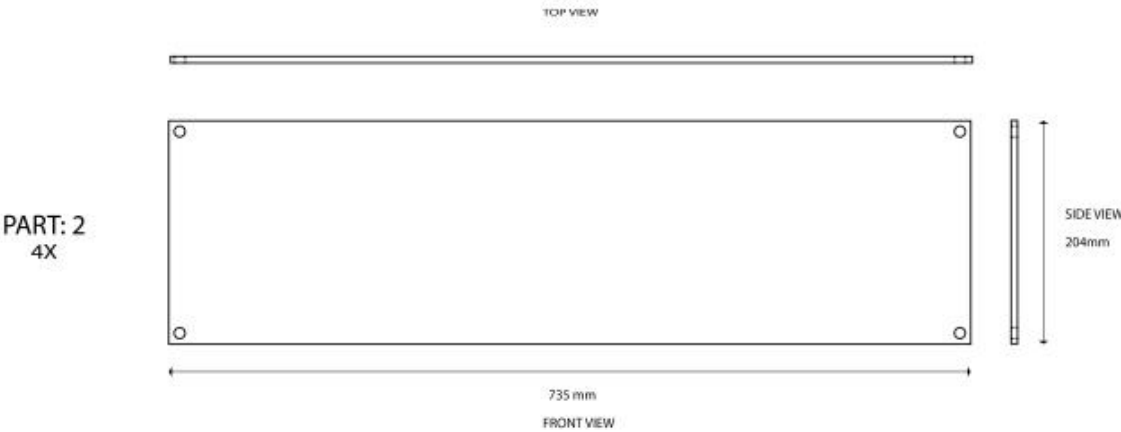
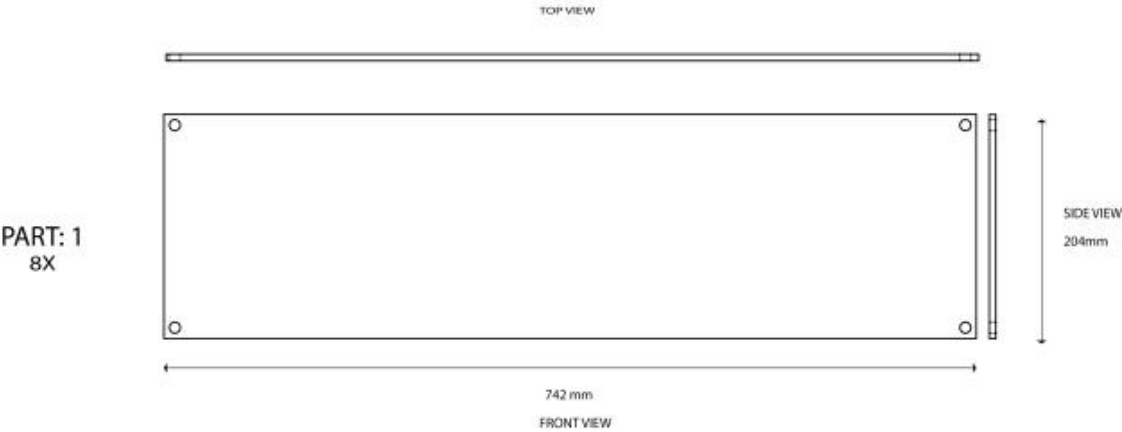
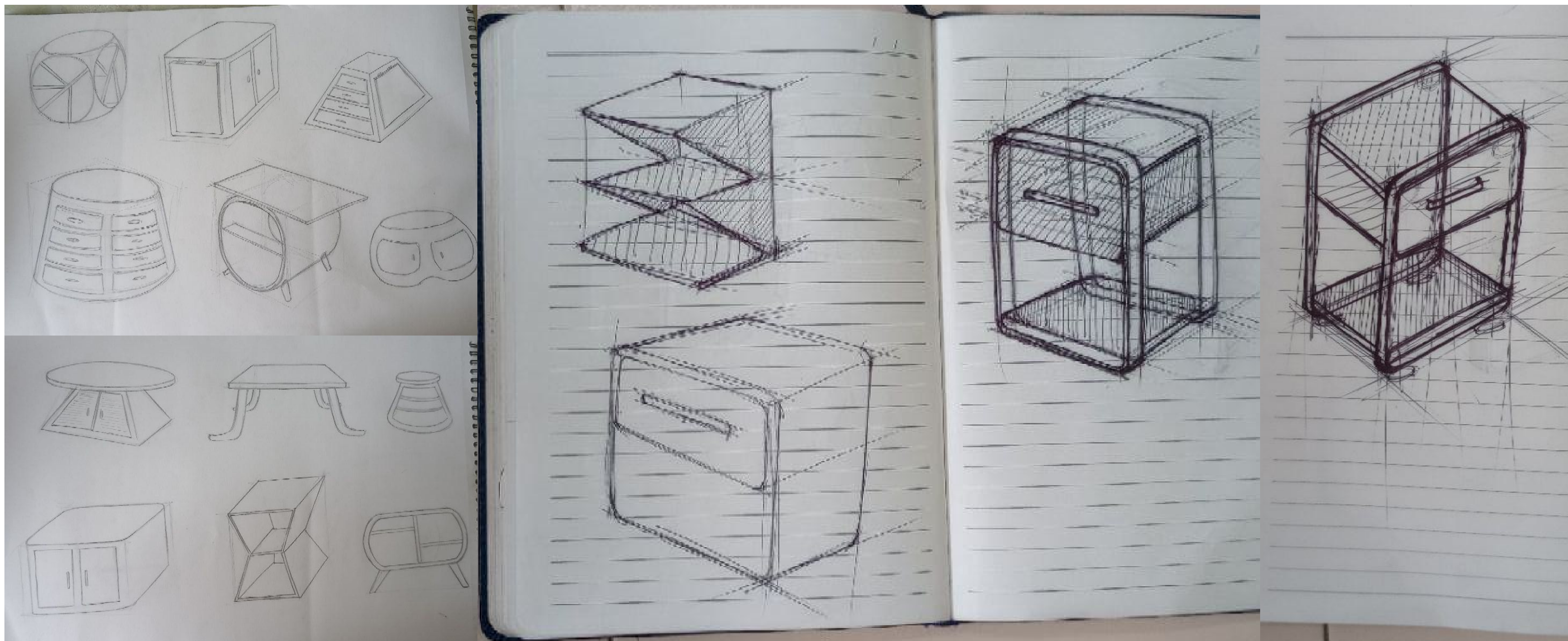


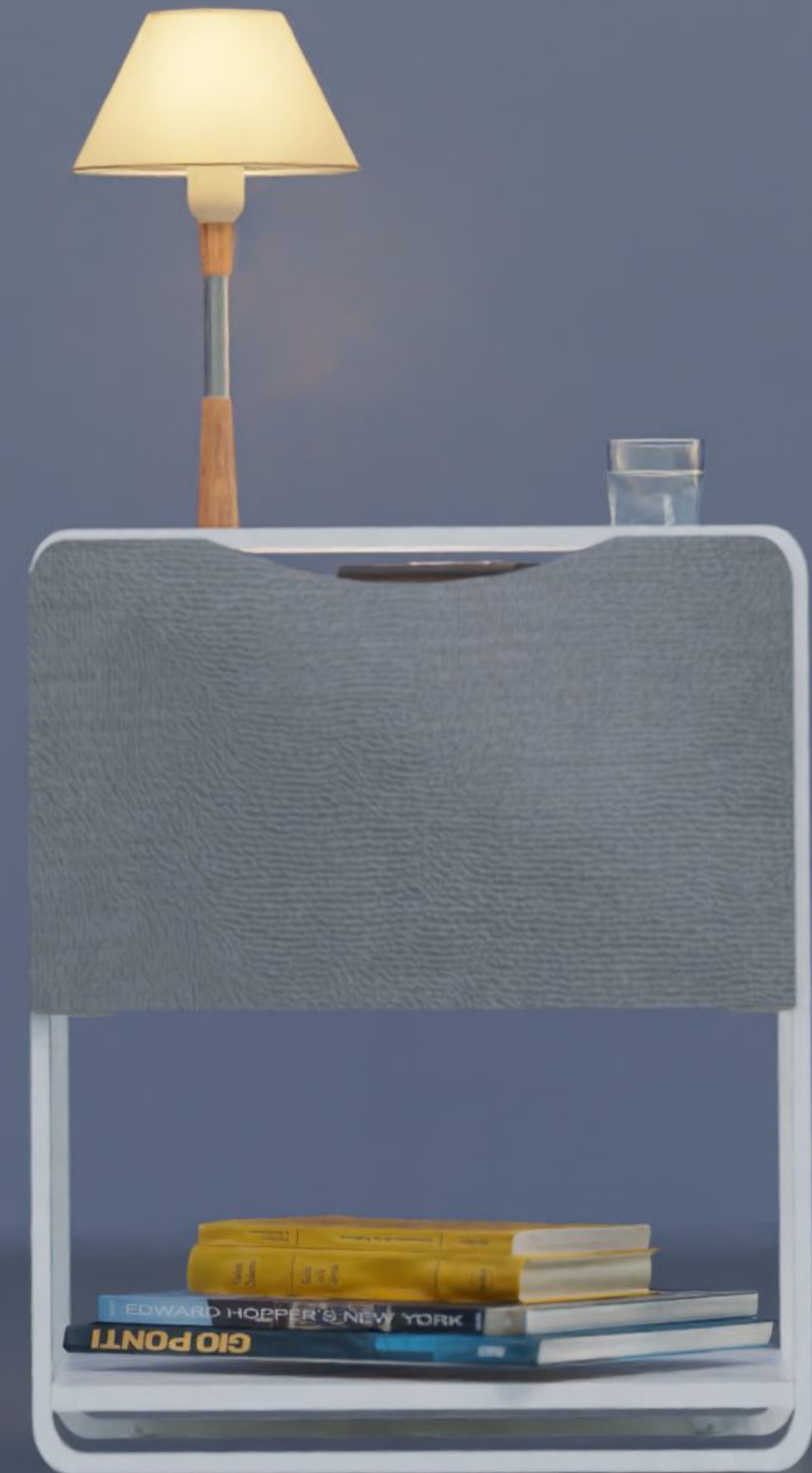
Table redesign



Bed side table

This table design is focused on giving a separate product as an assistive product which belongs to the same visual family of main product (bed).

It also adds the minimal and clean look to the bedroom.



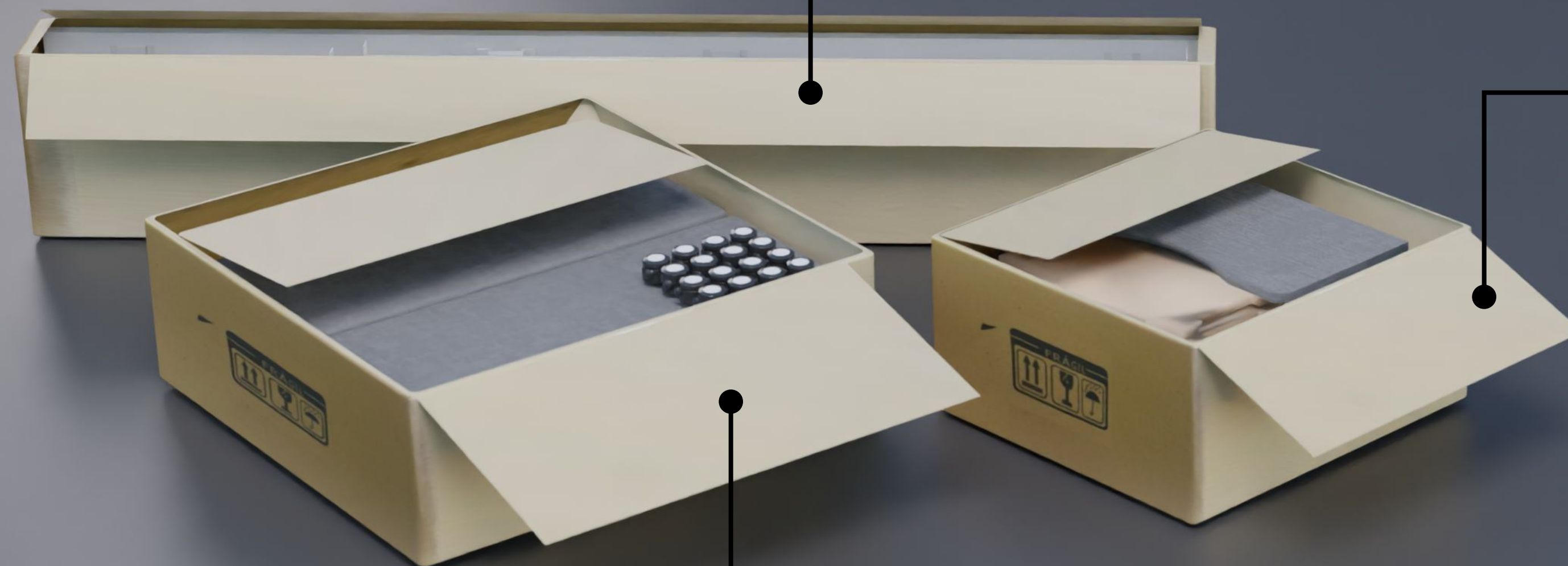


This table is also designed on the same ground as Flat packing, Easy manufacturing, Easy assembly, etc.

Flat Packing

Whole side table with all of its parts can be flat packed in a compact box of dimensions **58cm * 62cm * 30cm.**

For Frame & bdding



For side table

For Frame & bdding



Packaging

8 Rectangular wooden panel.

2 Channels.

2 Metal rings.

20 Screws.

All these things will be packed in a box of **58cm * 62cm * 30cm**.





Study table

Our product's one of the biggest feature is that user can go to positions like work and eating from flat by one click.

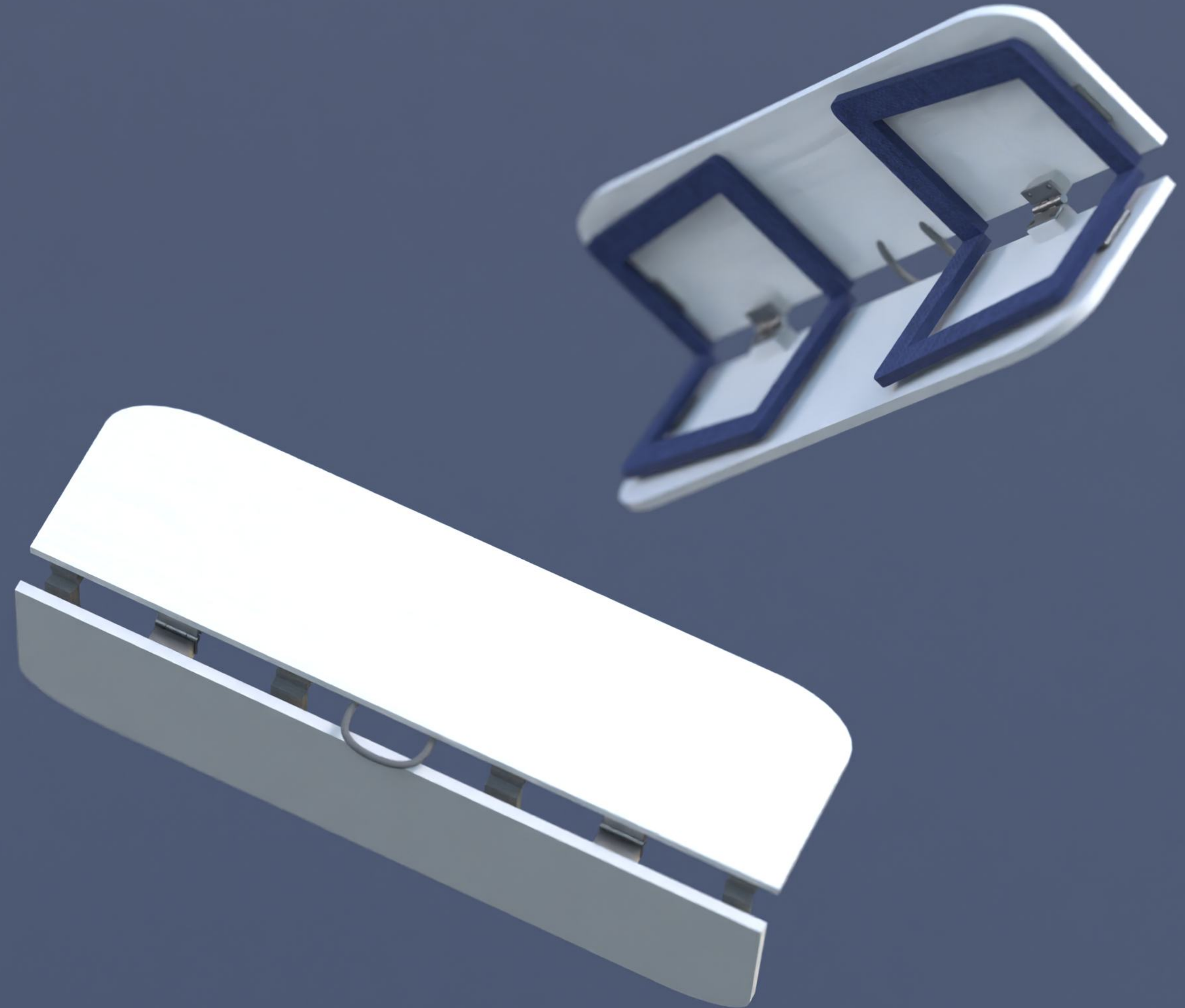
To use laptop, eat and read book user need bed table as well





Features

- Foldable design.
- Easy manufacturing.
- No need to assemble.
- Slip packaging
- Low transportation cost.



References

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Thank You!