



A project Report on P2

Designing a work from bed furniture.

By: Prathamesh S. Sawant | 22M2223

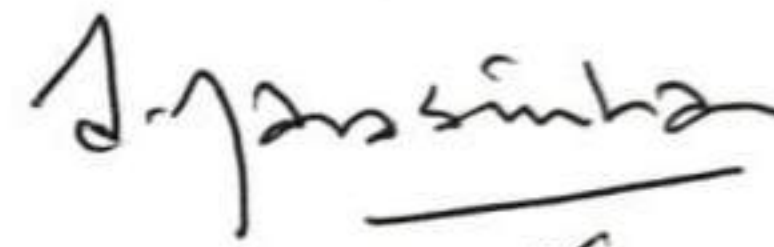
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This is to certify that the Industrial Design Project entitled "Furniture Design for Work from Bed" by Prathamesh S. Sawant is approved for partial fulfilment for the Master of Design degree.

Prof. B. K. Chakravarthy (Project guide)

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Signature of internal examiner 

Signature of external examiner 

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Declaration form

I, declare that this written report represents my ideas in my own words, and where other's 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 falsified, misinterpreted or fabricated any idea, data, facts or source in my submission. I understand that any violation of the above will be caused for disciplinary action by the Institute and can also evoke penal action from the source, from which proper permission has not been taken or improperly been cited.

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A handwritten signature in black ink, appearing to read 'Prathamesh Sawant', written diagonally across the page.

Acknowledgement

I would like to sincerely thank my guide, Prof. B. K. Chakravarthy for his invaluable guidance at every stage of the project. Special thanks to my friend Aparajita Prasad for helping me to make the prototype and documenting my process through photography. I am also grateful to all the faculty, staff and students of IDC School of design for their kind help and useful opinions and suggestions. I would like to thank my family for their unconditional support.

Abstract

Responding to the growing use of remote work, especially in the wake of the COVID-19 pandemic, this technology design service addresses the unique challenges faced by individuals residing in short-term accommodation such as hotels and PGs in India. These spaces often lack dedicated workspaces, forcing many people to work from their couches, leading to inconvenience and potential back pain issues. A large portion of employees in India demonstrate a desire for employment patterns isolated or hybrid species have eaten, so the need for more efficient and space-saving solutions to work from the bed is greater than ever.

This project aims to develop innovative and practical furniture solutions that meet the specific needs of individuals living in limited space. Understanding the constraints of hotel and PG living, the project seeks to develop high-performance and adaptable products that can transform the bedroom into a comfortable and productive work environment. It recognizes the importance of affordability and efficient use of space while providing a sense of community in this shared living space.

The post-pandemic work culture in India is expected to continue embracing remote work, making this project's focus on enhancing the work-from-bed experience both relevant and timely. Through thoughtful industrial design, it endeavours to improve the quality of work and study experiences, addressing the physical and psychological well-being of those who have embraced this new cultural trend while living in temporary accommodations.

This project is to make life better for hostel students who have to work and study on their Beds. We are focused on dealing with back pain and discomfort from being in bed for long hours. Our goal is to design furniture that helps these students function more effectively from their beds, enhancing their overall health, wellbeing and quality of life.

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Introduction

A growing number of students and working professionals are migrating to urban areas in India in search of educational and employment opportunities, contributing to the country's dynamic socio-economic landscape. As a result, due to their affordable prices, convenient locations near educational institutions, and ability to foster a supportive community, hostels and private guest rooms have become increasingly popular. However, because hostel rooms are small and frequently lack designated workspaces for studying or working, people tend to make do with their beds.

The emergence of the COVID-19 pandemic in India prompted an unprecedented shift towards remote work, as strict lockdown measures were implemented to prevent the virus's spread. This transition had a significant impact on the work and study habits of people living in hostels and other small spaces. According to research, approximately 45% of the Indian workforce now prefers to work entirely remotely, while 42% prefer a hybrid work model that combines remote and on-site work.

As India's student population continues to grow, the limited living space in hostels and PG accommodations has compelled many to work and study from their beds. However, this shift to unconventional workspaces has given rise to problems such as lower back pain and discomfort, primarily due to the lack of appropriate furniture, poor posture, and inadequate back support. This project is dedicated to designing solutions that address these issues, offering ergonomic and space-efficient solutions that promote the health and well-being of students who have embraced this new norm.

Design methodology

- Context study and Secondary Research
This involves a comprehensive study of the bed-based work trend, encompassing the cultural and behavioural facets, as well as the synthesis of valuable findings from existing research papers.
- Problem definition and design brief
This stage involves pinpointing the project's purpose, identifying issues, and establishing a design brief and criteria to guide subsequent brainstorming.
- User study
This comprises gaining a comprehensive grasp of the issue by taking into account user requirements through activities such as user interviews, online surveys, prototype testing, and observational research.
- Ideation and conceptualization
Exploration through sketching was undertaken to address these issues and align with user desires and requirements. Subsequently, these ideas were grouped together to formulate key concepts aimed at resolving the identified problems.
- Final design and Prototyping
Among the selected concepts, a single idea was chosen for further development, leading to the creation of a final design. This design was then prototyped to conduct user testing.

The Cause of the product

In India, many students and working professionals choose to live in hostels or paying guest accommodations (PGs) when they move for their education or work. They do this because it's close to their institutions or workplaces, it's affordable, and it offers a sense of community.

However, there are some problems with hostel life. One big issue is that there's not much space in hostel rooms. In famous institutes like IIT, more students are coming in, and the hostel authorities are putting more students in one room. This means there's not enough room and furniture like tables and chairs for students to study or work properly.

Because of this, many students have to work from their beds. But working from a bed is not good for your health. It doesn't support your back well, and it makes you sit in a bad way. You might end up slouching, and that's not good for your body. It can lead to back pain and other health problems.

So, we need a project in industrial design to fix this problem. The project's goal is to make things better for the health and well-being of hostel students who have to work and study from their beds. This can be done by creating special furniture or workspace solutions that work well in small hostel rooms. This will help students work and study in a healthier and more comfortable way, making their lives better.

Therefore, the principal objective of my project is to address these issues to the best extent possible through an industrial design initiative.

"To work for the health, well-being, and relief from back pain among hostel students who work and study from their beds."

User context

Background

The demographic under consideration comprises students aged between 18 and 40 years, residing in urban locales. The primary form of accommodation for this group is hostels and paying guest (PG) facilities. This choice of residence is largely driven by the high cost of living in cities, which often makes independent housing unaffordable for students.

However, residing in hostels and PGs presents a unique set of challenges. One of the most significant issues is the constraint of space, especially for those sharing rooms with others. The limited space can lead to discomfort and a lack of privacy, which can negatively impact the students' quality of life.

Considering our batches recent condition of living with a roommate for a first-year masters students in small single capacity room was a challenge. Following are the images of student's rooms at hostel 18 at IIT Bombay showing the amount of space available and the lack of furniture available for studying and working of students.

Considered context:

- Age group: 18 to 30 years of age
- Profession: Students
- Demographics: Urban population
- Accommodation conditions- Students living in hostels and Pgs.
- Additional constraints- Living in shared room with problem of space constraint and lack of furniture to work.

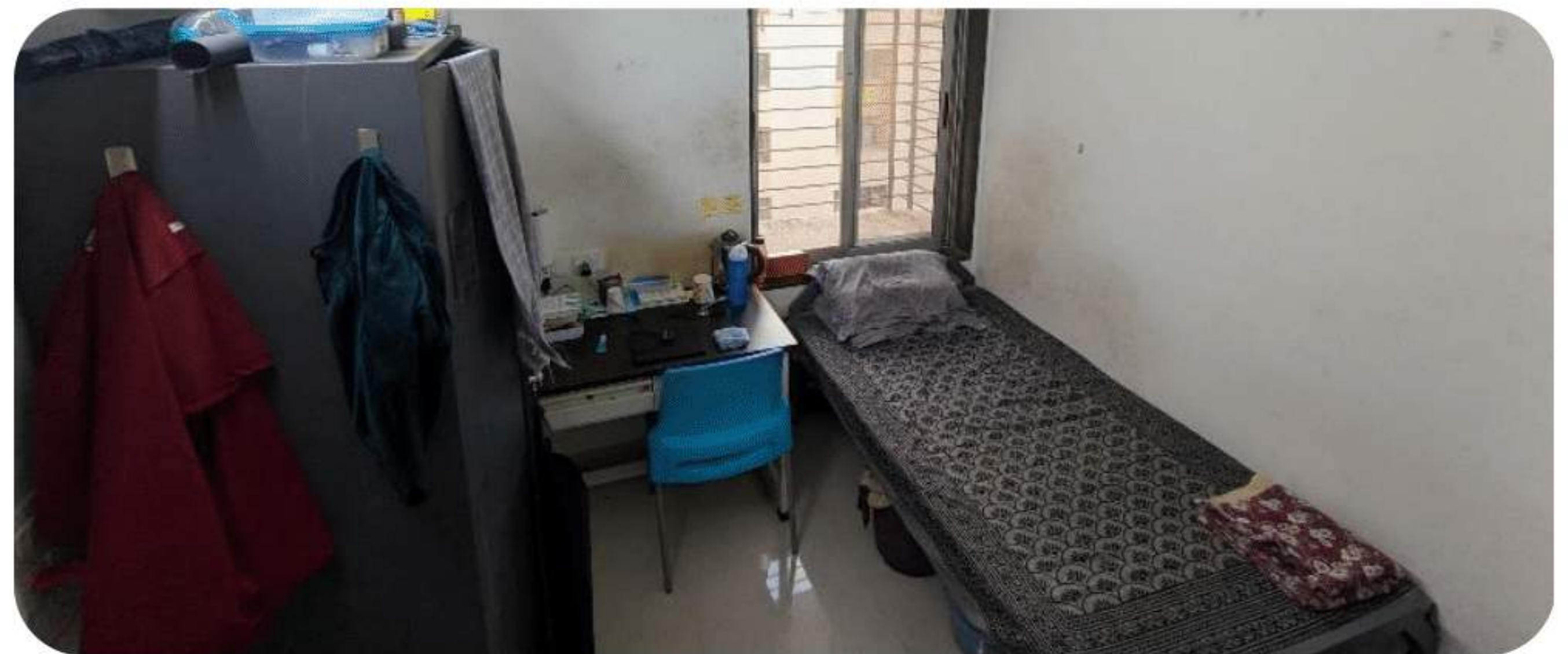
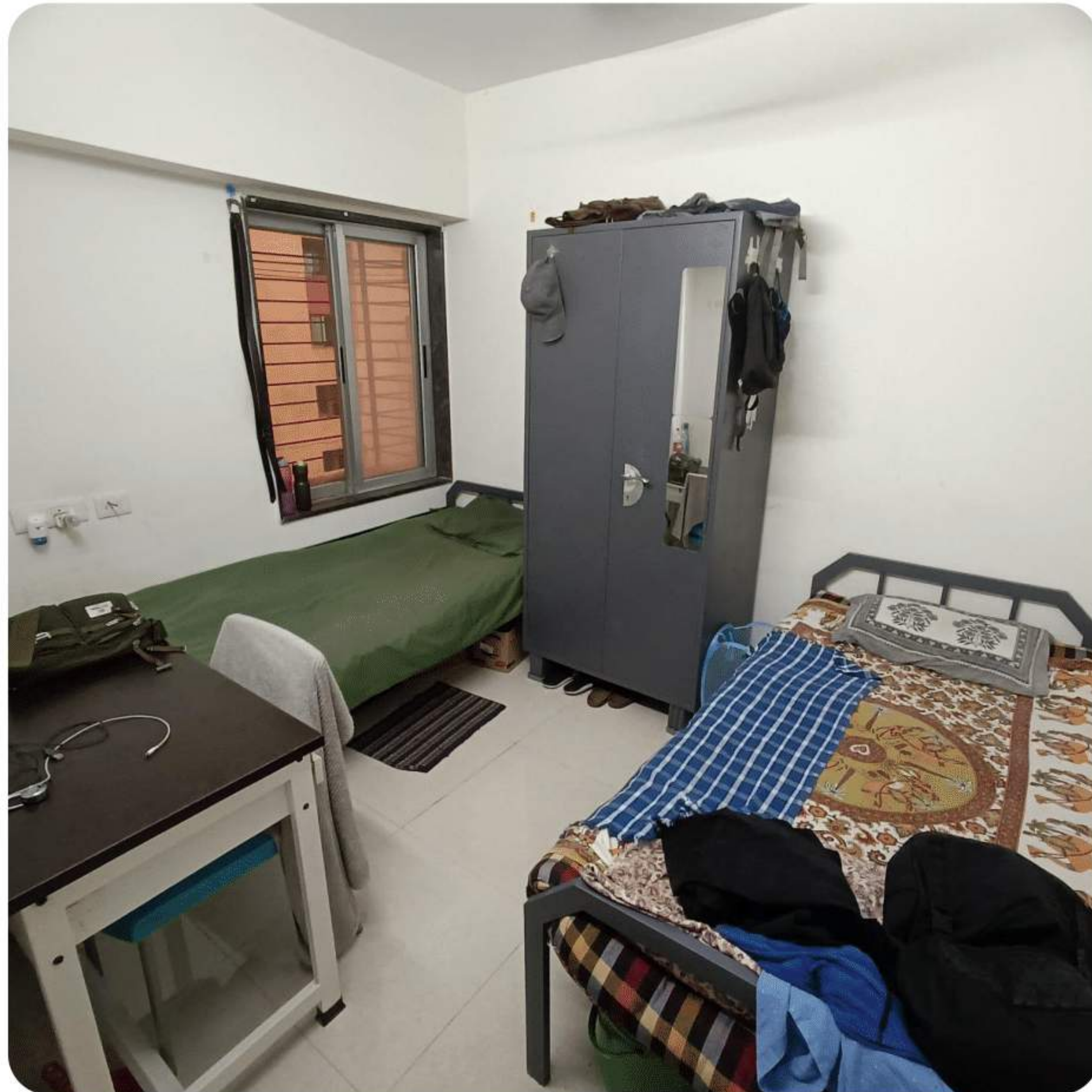


Figure 1 hostel 18 room from IIT B

Literature review:

The advent of the COVID-19 pandemic has precipitated a significant shift in work patterns, with remote work becoming increasingly prevalent. This has led to a rise in unconventional workspaces, including working from bed. However, this practice has been associated with a myriad of health issues and productivity challenges.

Health Implications

Working from bed can lead to physical health problems such as back and neck pain due to poor posture[1]. The lack of proper ergonomic support when working from a soft surface like a bed can strain the neck, back, and hips[2].

In addition to physical health problems, working from bed can also have psychological implications. One significant concern is the disruption of sleep patterns.[1] The bed is traditionally associated with sleep and intimacy. When it is used for work, this association weakens, potentially leading to sleep disturbances[1]. Furthermore, working from bed can blur the boundaries between work and personal life, leading to increased stress levels[2].

Productivity Concerns

The relaxed environment of a bed may seem appealing for work. However, it can also pose challenges to maintaining focus and productivity. Working from bed can decrease work productivity and energy levels[4]. This is because the bed becomes associated with work, making it difficult to “turn off” work thoughts when it’s time to sleep[5]. Moreover, the comfort and ease of working from bed can lead to a lack of self-control, making it difficult to maintain a regular work schedule[6].

Furniture Trends

In response to these challenges, there has been a growing trend towards multi-purpose furniture designed to accommodate bed-based work. This includes bed-desks, laptop stands, adjustable tables, and supportive cushions[7]. These pieces of furniture aim to provide ergonomic support and create a more conducive work environment within the confines of a bedroom [8]. They represent an attempt to mitigate the health and productivity issues associated with working from bed.

In conclusion, while working from bed has become increasingly common due to the rise of remote work, it presents significant health and productivity challenges. The development of multi-purpose furniture represents a potential solution, but further research is needed to fully understand and address the implications of this shift in work patterns.

Ergonomic posture of working from bed

The shift towards remote work, particularly work-from-bed (WFB), necessitates a comprehensive understanding of the ergonomic needs associated with this practice. The following points highlight the key ergonomic considerations for individuals working from bed:

- **Flexibility in Posture:** Maintaining a single posture for extended periods can lead to muscle strain and discomfort[9]. Therefore, it is advisable to vary positions periodically to alleviate strain and support different areas of the body[10].
- **Weight Distribution and Neutral Position:** An optimal work posture involves evenly distributing weight and maintaining a neutral position. This approach facilitates efficient work without strain, reducing the risk of musculoskeletal issues[11].
- **Back Support:** Proper back support is crucial when working from bed to prevent strain. Tools such as lumbar support pillows can be beneficial in maintaining a healthy posture. Additionally, elevating the laptop to eye level can promote better posture and reduce the risk of neck and shoulder pain[12].
- **Regular Stretch Breaks:** Prolonged static postures can lead to stiffness and reduced flexibility. Therefore, it is recommended to take stretch breaks every 45-60 minutes to maintain flexibility and promote circulation[13].
- **Harder Surface to Sit:** Softer surfaces, such as beds, provide less support compared to harder surfaces, leading to potential posture issues. Opting for a firmer seat can help maintain awareness of posture and prevent sinking[14].

It is essential to consider these ergonomic needs to maintain health and productivity. Further research is needed to develop comprehensive guidelines for work-from-bed practices.



Figure 2 ergonomic recommendations suggested by experts

User study:

To understand the problems of working from bed, there is no better way than understanding it through users' perspective and to see what they want and what they need. Hence user study was conducted among the hostel students of IITB, Specifically from Hostel 12, Hostel 18 and Hostel 15. Following are the methods used for user testing to understand the depth of problems.

1. Online survey and In-depth interviews
2. Observation study
3. User review for props.

The results of each method are discussed as follows.

1. Online survey and In-depth interviews:

To understand the issues related working from bed that user face, how much do they do work from bed and what are their inclinations towards the current products available in market, we used to methods of user interview, one through online medium of google form to understand the masses while 10 in depth interviews to understand the human behaviour and psychology behind why people do work from bed and how they resolve the challenges of working from such odd position.

Following is the detail of questionnaire made for interviews and online surveys.

1. Name
2. Age group
3. Gender
4. Were you a resident of any PG or hostel during any period of time?
5. How many hours per day do you work from your room or home?
6. How often do you experience discomfort or pain while sitting and working for longer periods of time?
7. How often do you work from your bed?
8. what type of furniture do you have in your room for working purposes? (check all that apply)

9. What are the main reasons you choose to work from your bed instead of a desk or table?
10. What specific issues or problems do you face with your current chair while working for longer periods? (Check all that apply)
11. How would you describe the level of comfort while working from your bed?
12. How do these furniture challenges affect your productivity or well-being while working in your room?
13. What specific discomfort or physical issues do you experience while working from your bed? (Check all that apply)
14. Have you tried any methods or accessories to improve the comfort and ergonomics while working from bed? If yes, please describe.
15. Have you encountered any existing products designed for working from bed? If yes, please share your experience with them.
16. How important is it for you to have a solution that allows you to work comfortably from your bed while maintaining a correct ergonomic posture?
17. Any additional comments, suggestions, or feedback regarding furniture challenges and solutions for people in temporary accommodation or working from home?

From the above questionnaire we got the opinion of 60 participants which is described below.

1. 58 percent participants do their work from their room for 3 to 8 hours daily. Which is considered as prolonged period of working.
2. 46 percent participants consider their prolonged period of working are causing back pain and health issues.
3. People have table, bed and a cupboard as a main furniture in their room lacking chair.
4. Lack of proper back support, no handrails, limited mobility are the prominent issues that users mentioned about their chair.
5. Around 50 percent users find themselves working from bed more often due to reasons such as comfort and coziness, lack of furniture, or space constraints in the room.
6. 40 percent users tend to believe that their work setup highly affects their productivity

7. Back pain, lower back pain, neck stiffness pain in the wrist and lack of proper posture are the main concerns regarding health of working from bed.
8. Other irritations such as things toppling from bed, lack of organization, cable tangling, crumpling of mattress and lack of ability to get up from bed easily were mentioned.
9. 30 percent users rated their comfort of working from bed as below average which was the concerning fact.
10. Adjustable supports, ability to work in multiple postures, easy setup and storage having good lumbar support and comfortable padding were the main features users think they want from a work from bed furniture.
11. 78 percent of the users are willing to pay 1000 to 5000 rs in a furniture that can solve their work from bed issues.
12. Most of the users tend to not buy a seat for bed, as a bed table are available at cheap rates.

Following are the problems clustered according to user needs and wants.



Problems identified in working from bed

User preferences and inclinations

Observation study

To understand their subconscious behaviour of working from bed and what type of postures they used to work in I conducted an observation study of certain students of IIT Bombay at hostel 12 and hostel 15. Following are the insights from the observation study.

1. Limited Mobility and Posture:

- *Observation:* The user tends to sit in only one position for an extended period, indicating a lack of flexibility or discomfort in changing positions.
- *Insight:* The absence of swivel or alternate position options provided by bed pillows contributes to restricted mobility. This limitation can lead to discomfort and strain, affecting overall work productivity and well-being.

2. Difficulty in Object Handling:

- *Observation:* The user struggles while grabbing objects and picking up things around the work area.
- *Insight:* The confined space and limited reach on the bed table hinder the user's ability to easily access and handle work tools. This can impact efficiency and cause frustration during tasks that require frequent tool usage.

3. Wire Management Challenges:

- *Observation:* There are difficulties in wire management around the bed.
- *Insight:* The absence of features or products for cable management exacerbates the issue, leading to a cluttered and potentially hazardous work environment. A lack of organized cable management can also affect the longevity and functionality of electronic devices.

4. Struggles with Table Adjustment:

- *Observation:* The user faced challenges when attempting to change positions and fold legs, particularly in pulling the table towards them.

- *Insight:* The design or functionality of the bed table may not support easy adjustments, hindering the user's attempts to create a comfortable and ergonomic working setup. This limitation can contribute to physical discomfort and dissatisfaction with the workspace.

5. Inadequate Leg Space and Workspace:

- *Observation:* The leg space in the bed table is too small to accommodate folded legs, and the overall area is insufficient for all work tools.
- *Insight:* The constraints in leg space and work surface area limit the user's ability to adopt varied postures or comfortably organize work tools. This can lead to a cramped and inefficient workspace, potentially affecting work quality and focus.

6. Lack of Support for Ankles and Knees:

- *Observation:* The user experiences strain due to more ankle movement during normal working.
- *Insight:* The absence of support for ankles and knees, beyond the mattress, contributes to discomfort and strain. Incorporating ergonomic features or accessories that provide support to these areas can significantly improve the user's overall comfort and well-being.



Figure 3 pictures from observation study

User feedback with prop study

To understand user preferences for curvature of the seat and the correctness of posture we made three props and give the users to sit on the bed with the props as seat and back rest and interviews them about the feedback and review of each prop given. Following were the props given to users as leg less chairs.

1. Multipurpose chair



Reviews:

- No lumbar support hence discomfort in lower back area.
- Bottom seat curves do no match different users.
- Not satisfied with the seat.

Star rating: 3 out of 5 stars.

2. Stadium chair



Reviews:

- Better lumbar support than other chairs.
- User was slipping out of the chair due to smooth texture.
- Abrupt end to seat causes knee pain.

Star rating: 4 out of 5 stars.

3. Waiting chair



Reviews:

- The upper half of the chair does not support upper back creating discomfort.
- The seat bump creates pressure and pain in buttocks and tail bone.
- No lumbar support.

Star rating: 2 out of 5 stars

Figure 4 props used for prop study

From the above study it was found that the stadium chair curvatures and angles were preferred for working from yet it did not solve all of the problems as the side curvatures was too strong and knee pain due to height was main concerns apart from that the stadium chair performed as desired.

Market research

Considering the problems identified in user study, in depth research was done on what type of products are available in the market to resolve the issue of back pain and facilitate working from bed for longer period of time.

Analysis of market research:

The advent of remote work has led to a surge in the demand for products that facilitate work-from-bed (WFB) practices. These products range from over-bed tables and desks to back supports and pillows, and accessories holders or organizers. Each of these products is designed with specific features to enhance the WFB experience [15].

Over-Bed Tables and Desks

Over-bed tables and desks are designed to provide a stable surface for work while in bed¹. They are typically adjustable, allowing users to modify the height and angle to suit their needs. This flexibility in adjustability is crucial in maintaining a comfortable posture during work, thereby reducing the risk of musculoskeletal issues. Some over-bed tables and desks also come with wheels for easy mobility, allowing users to move them around as needed[16].

Back Supports and Pillows

Back supports and pillows are essential for maintaining proper posture while working from bed¹. They provide the necessary support to the back, reducing strain and preventing back pain. Some back supports and pillows are ergonomically designed to fit the natural curve of the spine, providing optimal support. Others are adjustable, allowing users to modify the level of support based on their comfort.[17]

Accessories Holders and Organizers

Accessories holders and organizers are designed to keep work essentials within reach. They come in various forms, including bedside caddies, storage pockets, and desk organizers. These products help keep the workspace tidy and organized, enhancing productivity and efficiency.

Aesthetics

The aesthetics of WFB products play a crucial role in their appeal. Many products are made from high-quality materials and come in sleek designs and various finishes. The choice of material not only influences the product's durability but also its look and feel. A well-designed product can enhance the overall ambiance of the workspace, making it more conducive to work.

Comfort Factors

Comfort is a key consideration in the design of WFB products. This includes factors such as cushioning, ergonomics, and breathability. Cushioning provides comfort during prolonged periods of work, while ergonomic design ensures that the product aligns with the body's natural posture. Breathability is particularly important for products like back supports and pillows, as it prevents overheating and promotes comfort.

Space Considerations

Space considerations are crucial in the design of WFB products. Many products come with features like foldable legs or compact designs for space-saving. These features allow the products to be stored away when not in use, maximizing the available space.

Despite the variety of products available, there appears to be a gap in the market for a product that combines all the desired features for a one-stop user experience. A product that successfully combines flexibility, comfort, aesthetics, and space-saving features could potentially meet the unfulfilled needs of this growing market segment. Further research and innovation in this field can lead to the development of such a product, enhancing the WFB experience for many.

In conclusion, the market for WFB products is diverse and dynamic, with a wide range of products designed to cater to the unique needs of individuals working from bed[6]. However, there is still room for innovation and improvement, particularly in the development of products that combine all the desired features for a comprehensive WFB solution[8]. As remote work continues to grow, the demand for such products is likely to increase, presenting opportunities for businesses and manufacturers in this field.

Product Gap:

The market for work-from-bed (WFB) products has seen significant growth, particularly in the wake of the COVID-19 pandemic. These products range from over-bed tables and desks to back supports and pillows, and accessories holders or organizers. Each of these products is designed with specific features to enhance the WFB experience.

However, despite the variety of products available, there appears to be a gap in the market for a product that combines all the desired features for a one-stop user experience. A product that successfully combines flexibility, comfort, aesthetics, and space-saving features could potentially meet the unfulfilled needs of this growing market segment.

For instance, a product that combines the adjustability of an over-bed table, the comfort of a back support pillow, the convenience of an accessory's holder, and the compactness of a foldable design could potentially fill this gap. However, no such product currently exists in the market.

This product gap is not just a missing feature or functionality from a product, but it arises from failing to build the product around a flagship piece of functionality the market wants. For example, while there are products that offer either adjustability, comfort, aesthetics, or space-saving features, there is a lack of products that offer all of these features in one package.

Moreover, another type of product gap arises when a product is positioned for the wrong persona. For instance, a product might be designed with the assumption that the user will be working from bed for long hours, while in reality, the user might only be working from bed occasionally.

Comprehension

Following an examination of user issues and available solutions in the market, we compiled a list of problems that were both notable and recurrent in user studies. These issues were categorized into two segments. The first segment pertains to problems associated with back pain and posture-related concerns, while the second segment encompasses issues related to work surfaces and bedside tables. These problems mainly revolve around discomfort, inadequate support, and their adverse effects on productivity. The specific problems within each segment are detailed below.

Segment 1: Back pain and posture related issues.

1. **Lower Back Problem Due to Lack of Lumbar Support:** Working from bed often means there's insufficient support for the lower back or lumbar region. This lack of support can lead to discomfort and long-term back problems. Proper lumbar support is crucial to maintain the natural curve of the spine and prevent strain.
2. **Lack of Flexibility to Sit in Different Postures:** Working from bed limits the ability to change postures frequently. This lack of flexibility can lead to stiffness and discomfort over time. Regular movement and changes in posture are recommended to prevent musculoskeletal problems.
3. **Absence of Leg Support:** Current setups do not provide adequate leg support. This can lead to circulation problems and contribute to discomfort during prolonged periods of work.
4. **Irritation and Decreased Productivity Due to Bad Posture:** Maintaining a poor posture while working can lead to physical discomfort, causing irritation and a decrease in productivity. Over time, bad posture can also lead to chronic health issues like back pain and neck strain.
5. **Tendency to Slouch:** The soft nature of beds often leads to individuals slouching or leaning against the wall. This posture can strain the neck, shoulders, and back, leading to discomfort and potential musculoskeletal problems.

6. **Crumpling of Mattress and Bedsheet:** The weight distribution while working from bed can lead to the crumpling of the mattress and bedsheet. This not only leads to an uneven surface, which can cause discomfort, but also can lead to wear and tear of the bedding materials over time.
7. **Stiffness in Neck Due to Lack of Neutral Posture:** Working from bed often means the neck is not in a neutral position, especially if a laptop is used. This can lead to stiffness in the neck and potentially cause long-term issues like chronic neck pain.

Segment 2: Work surface and Bed table related problems.

1. **Problem of Getting in and Out of the Bed:** Working from bed often involves having work materials spread out on the bed. This can make it difficult for individuals to get in and out of the bed without disturbing their workspace.
2. **Fear of Toppling Things Down the Bed:** The lack of a secure place to keep work materials can lead to the fear of items toppling down the bed. This can cause stress and disrupt concentration.
3. **Lack of Flexibility in Leg Position Due to Table Legs:** Over-bed tables often have rigid structures that limit the flexibility in leg position. This can lead to discomfort over time, especially during long work hours.
4. **Insufficient Space to Use Multiple Work Tools:** The limited space on over-bed tables can make it challenging to use multiple work tools simultaneously. This can hinder productivity and lead to frustration.
5. **Arm and Wrist Discomfort Due to Negative Wrist Angle:** Working from bed can often lead to maintaining a negative wrist angle, especially while using a laptop. This can cause discomfort in the arms and wrists over time.
6. **Irritation Due to Unmanageable Cables and Wires:** Managing cables and wires while working from bed can be a hassle. The lack of proper cable management solutions can lead to tangled wires, causing irritation and potential damage to the devices.

7. **Crumpling of Mattress and Bedsheet:** The weight distribution while working from bed can lead to the crumpling of the mattress and bedsheet. This not only leads to an uneven surface, which can cause discomfort, but also can lead to wear and tear of the bedding materials over time.

Product Gap

In delving into the landscape of available products in the market, a meticulous analysis brought to light a notable absence of solutions tailored explicitly to the unique space constraints encountered in hostel living—an aspect we emphasized earlier in our examination. It became evident that the prevailing products were predominantly crafted within the context of apartment bedrooms, where ample storage and movement space are often the norm. This discrepancy prompted a critical revaluation of our project's direction, leading us to recognize the imperative of developing specialized solutions that cater specifically to the distinct challenges posed by hostel environments.

The prevailing market offerings, particularly bed tables, exhibited an array of features tailored to the needs of apartment dwellers, yet a discernible dearth of back rests designed to alleviate prevalent issues in hostel settings became apparent. While bed tables are abundant, their features are often geared towards spacious bedroom layouts, neglecting the nuanced demands of compact hostel living. Consequently, a key insight emerged: there exists a significant gap in the market for back rests that not only prioritize ergonomic design but also effectively address concerns such as back pain, the maintenance of a neutral posture, and the swift and efficient setup—crucial considerations in the context of hostel accommodations.

Given this evident gap in available products, a strategic decision was made to channel our project's focus exclusively toward the development of innovative back rests. By honing in on this specific category, we aim to rectify the market's oversight and provide hostel residents with a practical solution that harmonizes seamlessly with their spatial limitations. Our commitment lies in not merely addressing the physical constraints of hostel living but also enhancing the overall well-being and comfort of individuals inhabiting these confined spaces. In concentrating on back rests, we strive to introduce a product that transcends conventional limitations, offering a thoughtful response to the unique challenges posed by hostel environments and ensuring a more ergonomic and satisfying living experience for its residents.

Problem statement

Considering all of the above problems individually identified, we come to following problem statement that encompasses the problems and issues that we are focusing considering the market gap that the proposed product will solve.

“Individuals, especially those living in temporary accommodations like hostels, PGs, or dormitories, face significant challenges in maintaining right posture and comfort when required to work from their beds.”

Existing solutions do not adequately address the unique ergonomic needs of this scenario, potentially leading to physical discomfort or health issues over time.

Design brief

Based on the problem statement provided above and the identified gap in the market through research, we aim to formulate the project's objectives and goals. This will serve as the foundation for the project, and the following product brief will be taken into account.

How might we design furniture for students working in hostels or PGs that addresses the following issue:

- Prevents back pain due to prolonged period of working from bed in unsupported position.
- Allows users to sit in multiple postures while working.
- Provides a quick and easy setup over the bed.
- Provides a compact and space efficient storage.

The check

In crafting an optimal seating solution, key design considerations were meticulously addressed. The proposed seat prioritizes spinal comfort with a firm lower surface and provides a leg rest for a relaxed knee angle of around 130 degrees. Emphasizing convenience, it is collapsible and space-efficient during storage, designed to rest on a bed without causing damage. Focusing on ergonomics, the seat promotes a neutral body posture for comfortable working. Its adjustability caters to individual preferences, and it efficiently fits within the limited space of a single bed, offering a versatile and adaptable seating solution. Design considerations taken into account while ideating.

- The proposed seat should have a hard surface at the bottom to reduce discomfort in spine.
- The seat should provide leg rest that can provide knee angle of around 130 degrees.
- Should be collapsible and space efficient while not in use or in storage.
- The seat should be able to rest on the bed without damaging the mattress or bedsheet.
- Should provide a working position close to the neutral posture of the body.
- Should be adjustable according to user comfort and desire.
- Should fit within the space of single bed.

Ideations

To generate a range of solutions for addressing the pain points outlined in the problem statement, the following factors were taken into account. The ideas were diverse, offered in various sizes, incorporated a range of features, and provided different levels of comfort for the user. Ensuring that these ideas offered solutions for maintaining proper posture and back support was crucial, as well as including optional features such as collapsibility, knee support, and easy setup.

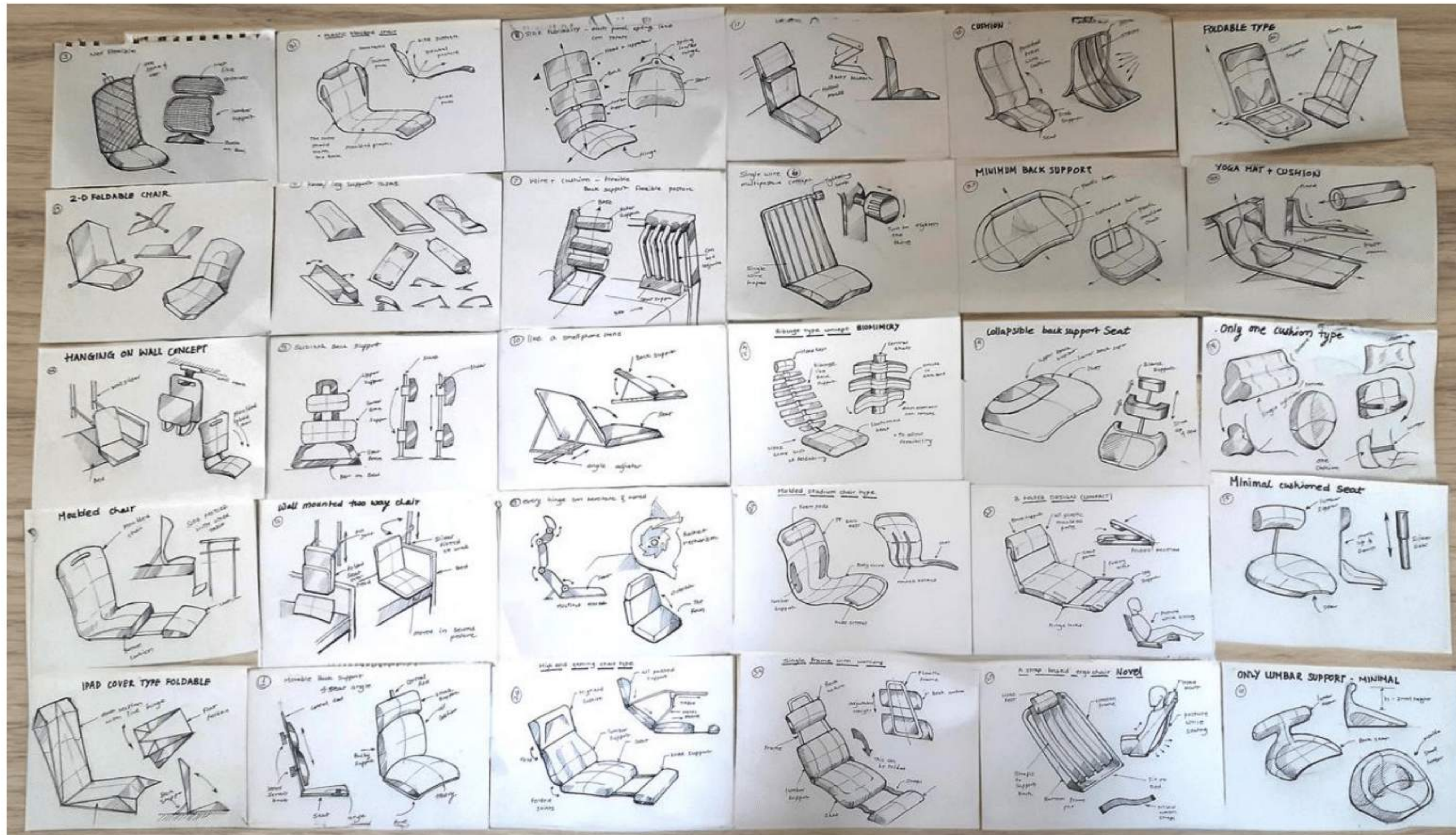


Figure 5 pages of ideations

Affinity clustering

During the creative process of idea clustering, the various concepts were grouped based on their size and the level of comfort they offered. This clustering phase allowed us to categorize the ideas effectively and identify common themes or characteristics. After thorough evaluation and consideration, three standout ideas, which displayed the most promise in addressing the user's needs and the identified pain points, were selected as the final champion concepts.

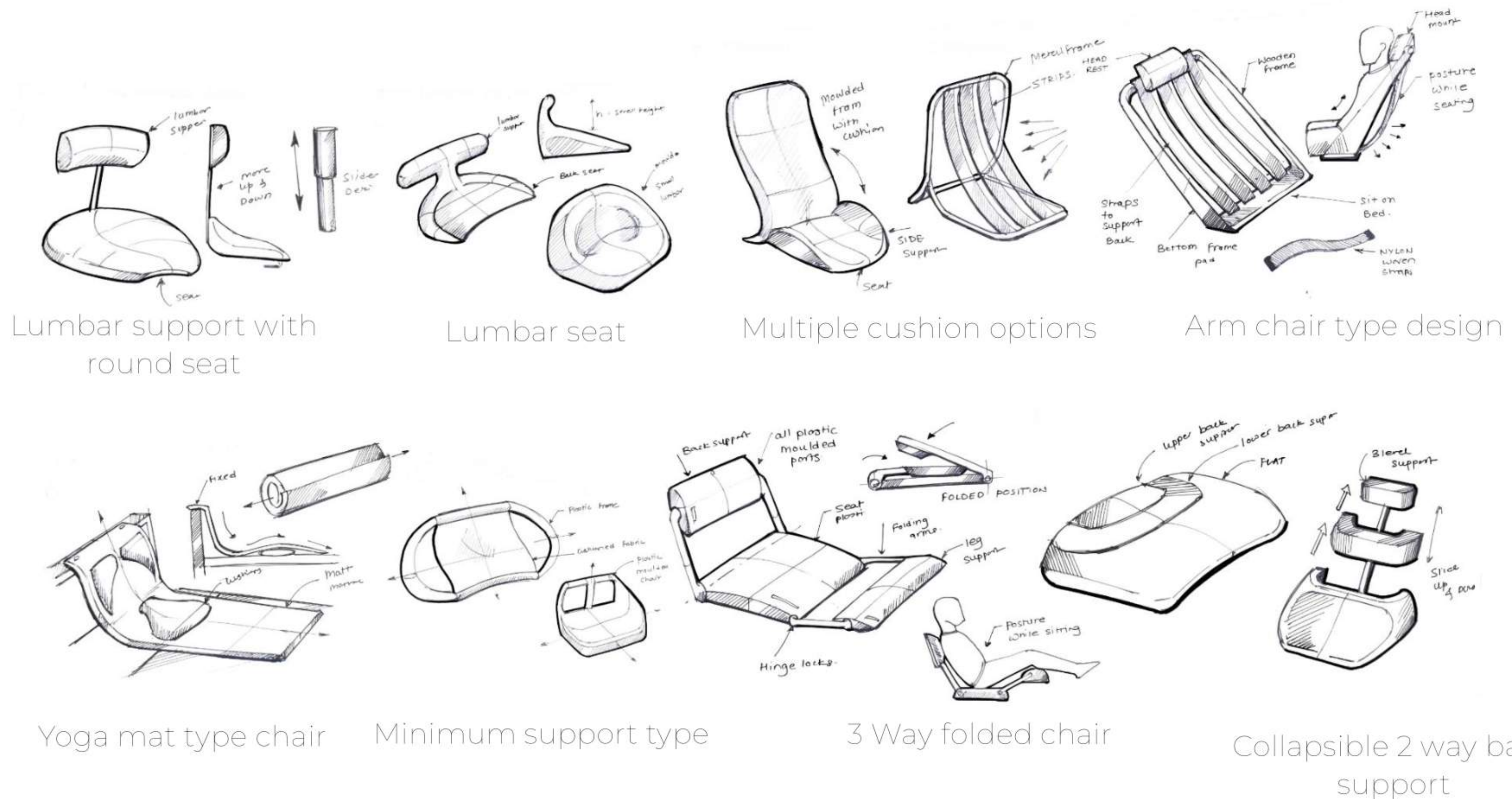
To create a comprehensive concept from these champion ideas, we conducted a synthesis process where we analysed the strengths and unique attributes of each concept. This involved identifying the common threads and the most innovative features that could be integrated into a single, cohesive solution. By merging the best aspects of these champion ideas, we aimed to create a concept that not only addressed the identified problems but also provided a well-rounded and user-centric design. This approach allowed us to capitalize on the strengths of each idea, ultimately leading to a more robust and effective design solution.

- Cluster 1- Minimal features, small seats
- Cluster 2- Medium sized seats with quick setup
- Cluster 3- Maximum comfort, big size

These above clusters and the ideas in those clusters are discussed as below.

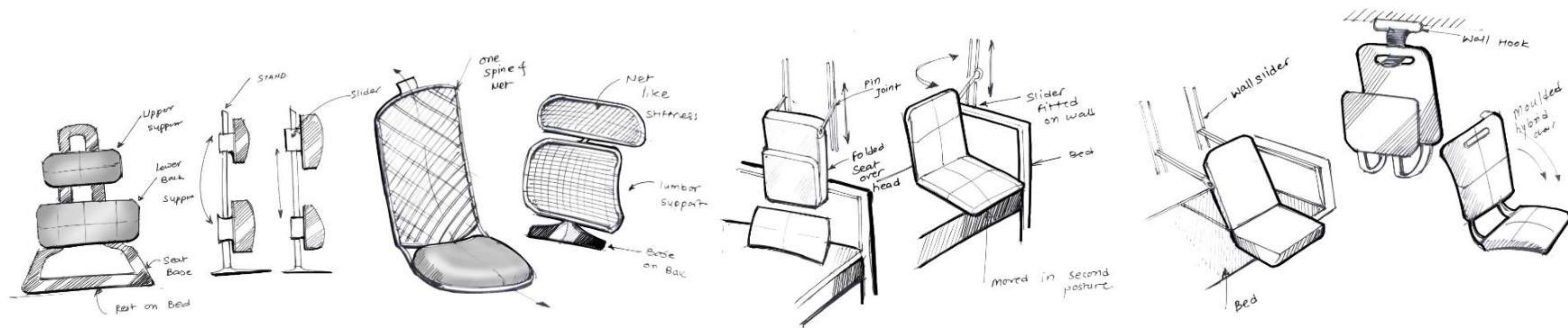
Cluster 1- Minimal features, small seats

This phase involved considering ideas that primarily focused on providing lower back support and a comfortable seat. These ideas excelled in terms of meeting the criteria for easy setup and efficient storage. While they may not have offered the most extensive range of features or posture support, they demonstrated a clear advantage in terms of their simplicity and convenience. These ideas were tailored to address the specific user needs related to back support and the ease of setting up and stowing away the product.



Cluster 2- Medium sized seats with quick setup

These ideas prioritize not only the physical comfort and health of the user, but also the practical aspects of everyday use. One of the key features of these ideas is the convenience of quick setup. This means that the products or solutions based on these ideas are designed to be user-friendly, requiring minimal time and effort to assemble or prepare for use. Another significant feature is the efficient use of storage space. Products or solutions based on these ideas are designed to occupy minimal space when not in use.

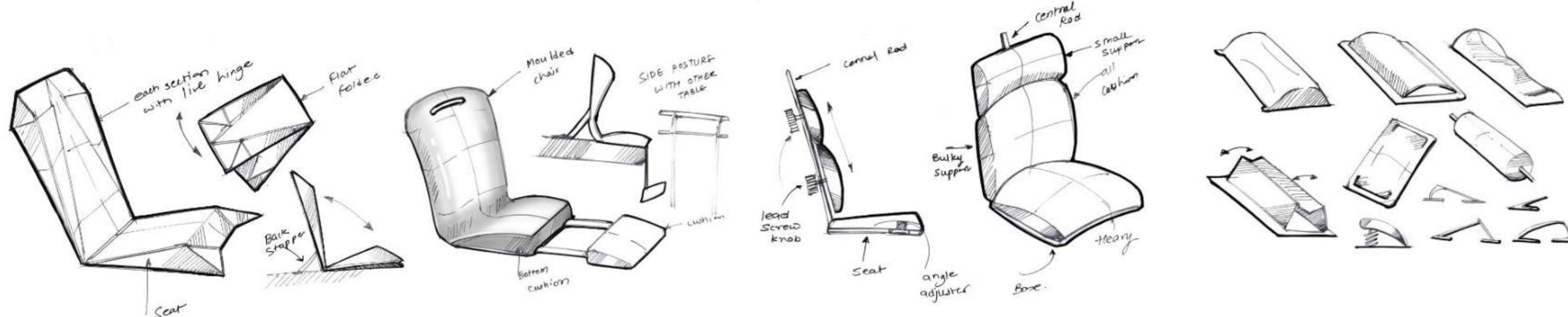


Height adjustable supports

Tensioned mesh support

Wall mounted

Storage on wall hook



iPad cover type chair

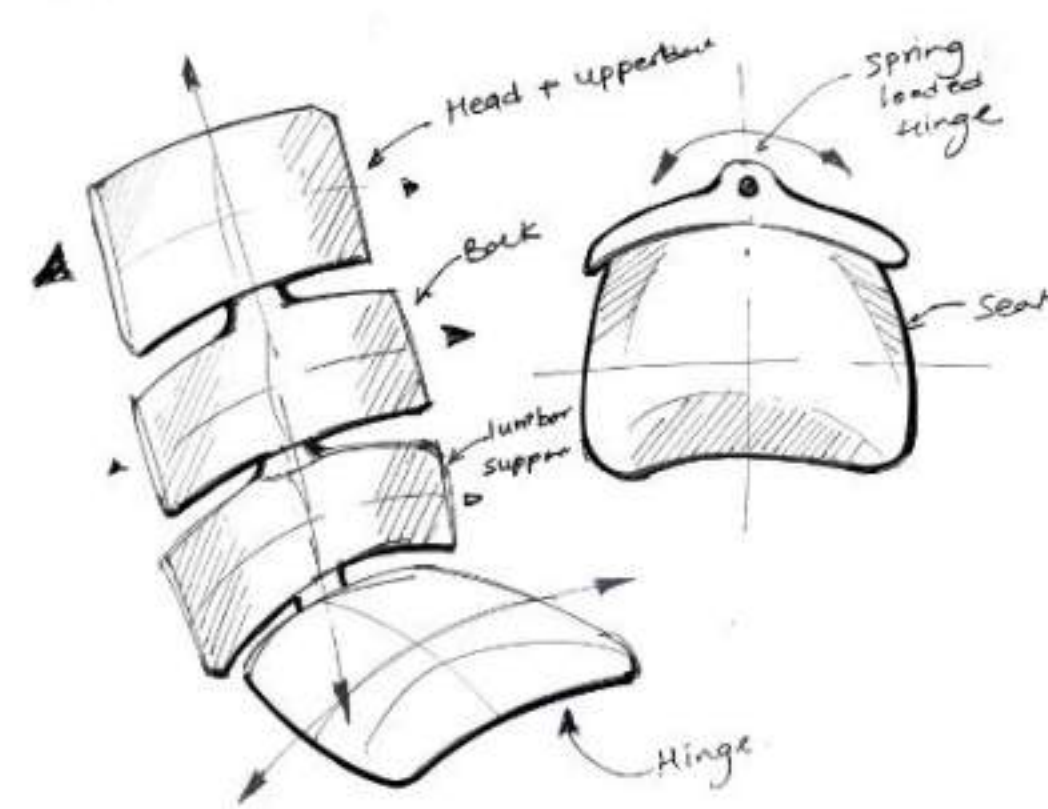
Plastic structure with soft cushions

Cushion adjustable

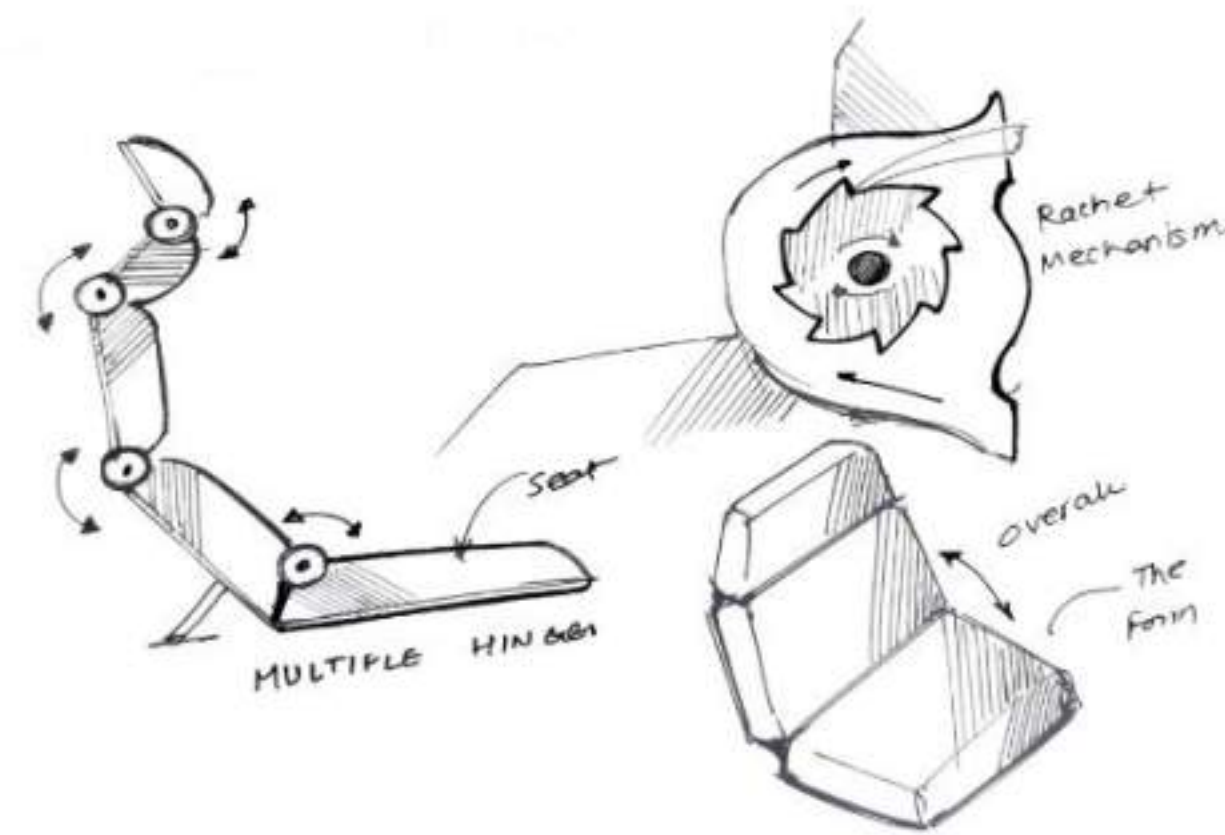
Knee support types

Cluster 3- Maximum comfort, big size

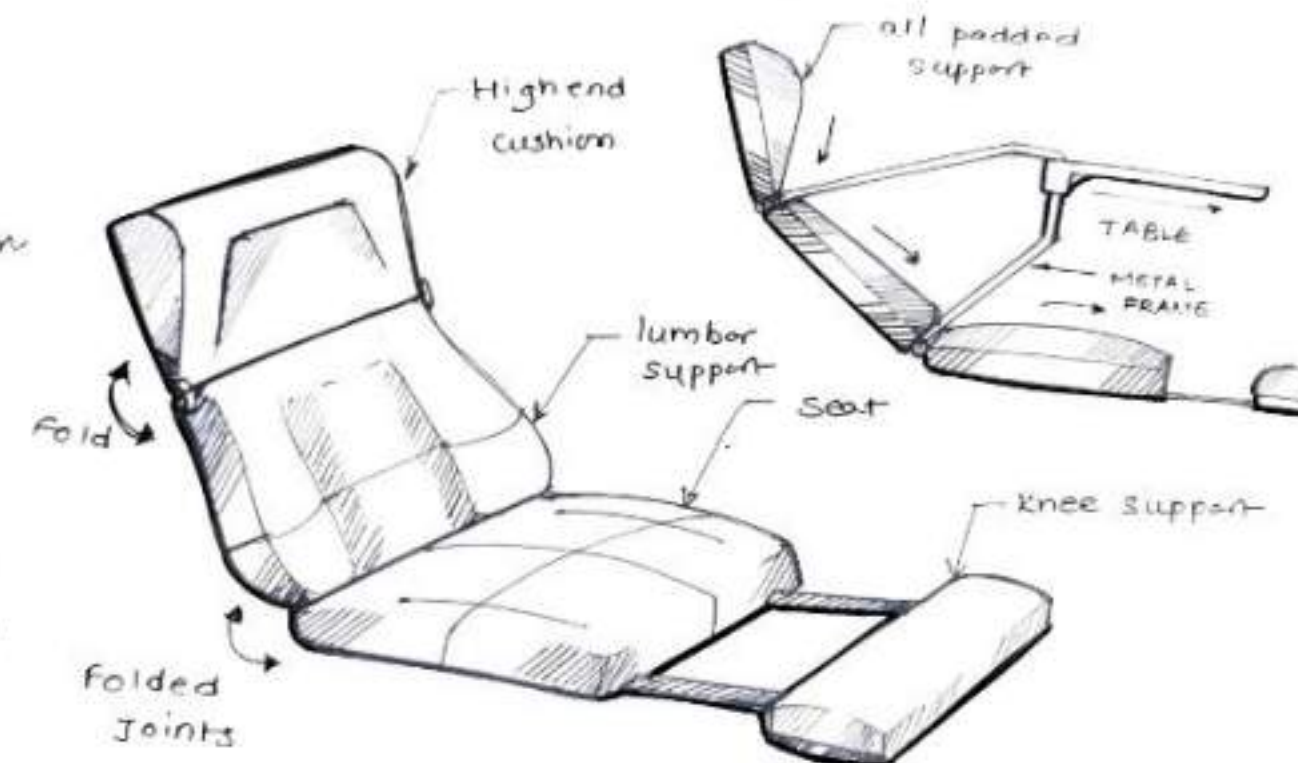
This statement encompasses concepts that prioritize maximum comfort. These ideas focus on creating an environment or product that provides the highest level of comfort to the user. One of the key aspects of these ideas is softer cushioning. This implies that the products or solutions based on these ideas use materials that are soft and plush, providing a comfortable and luxurious feel. Bulky designs can provide a sense of security and coziness, and they are often associated with a more relaxed and casual style.



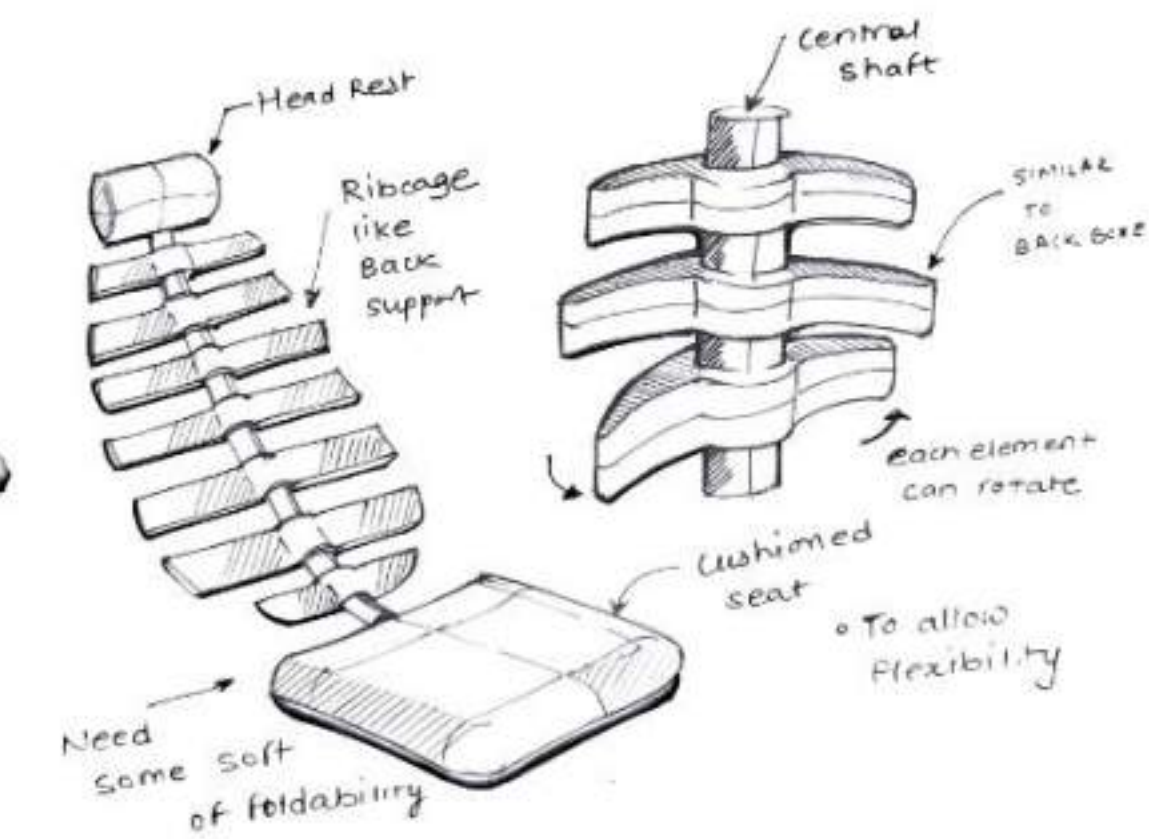
3 divided back support



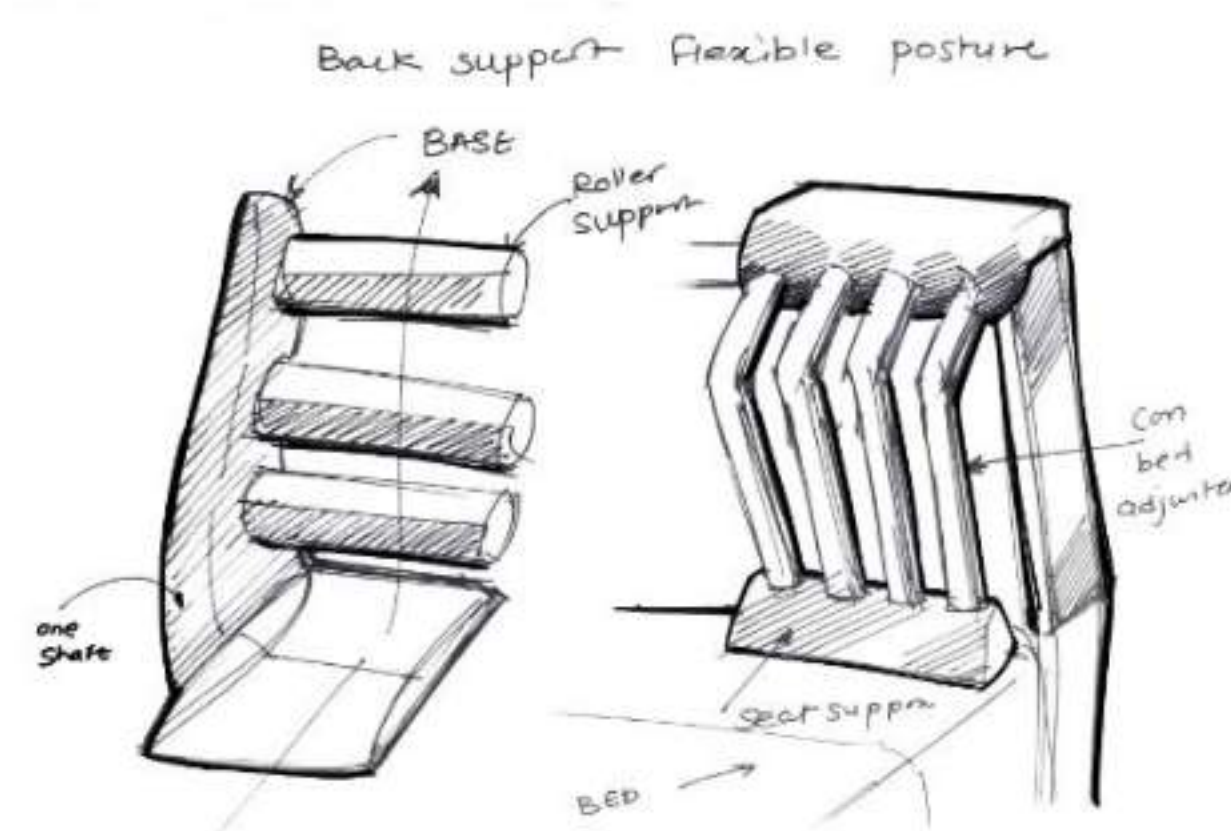
Adjustable hinges



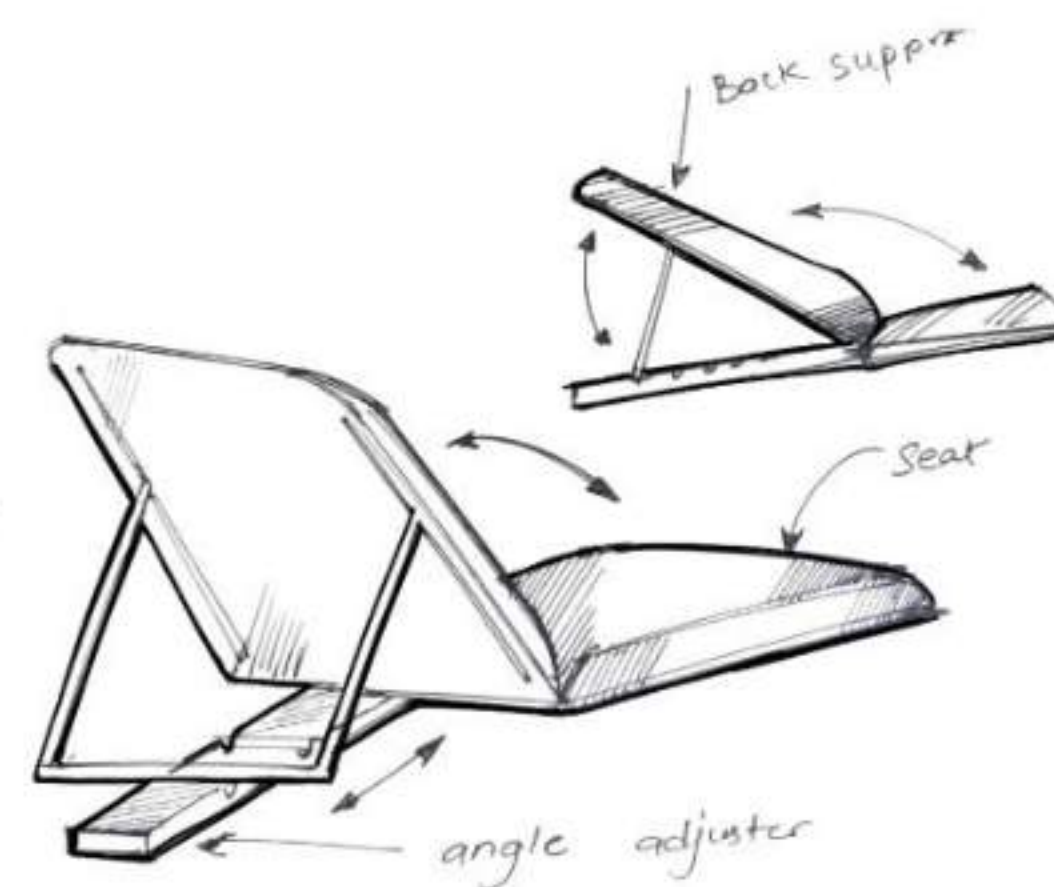
Recliner cushioned chair



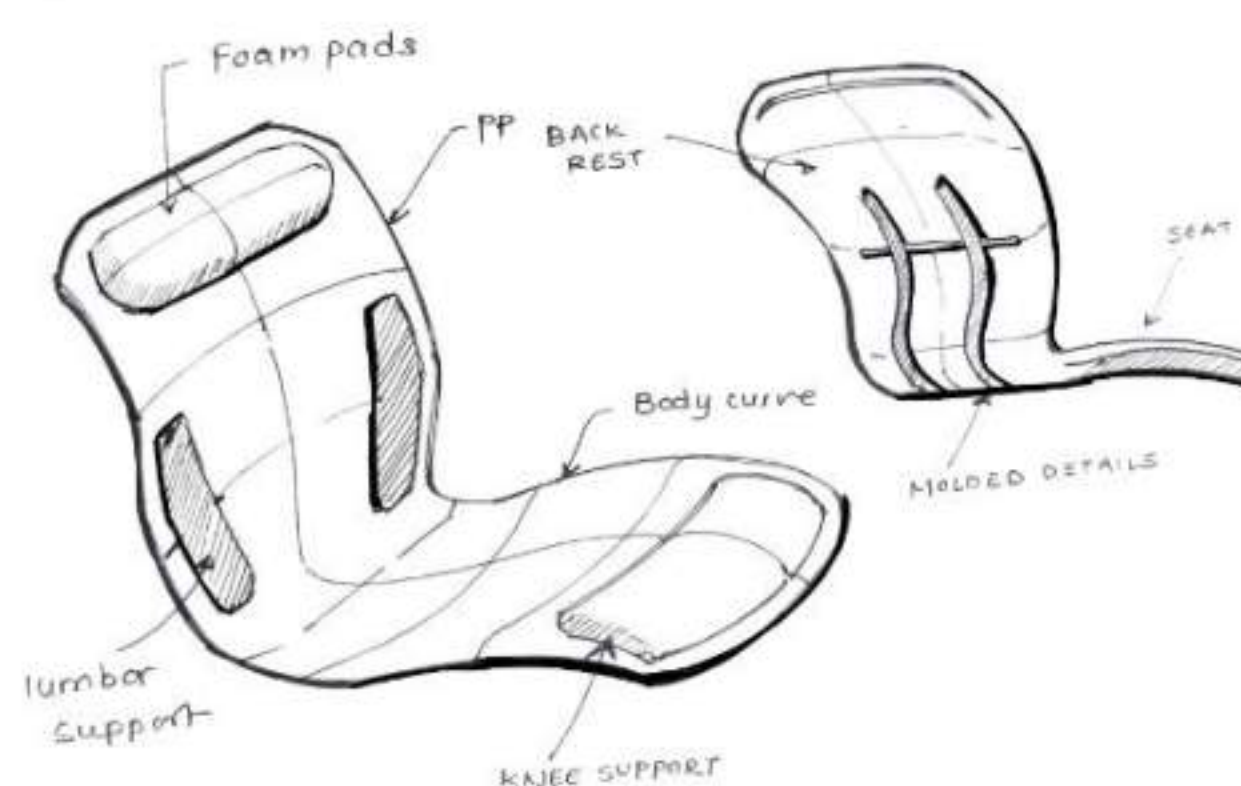
Spine support chair



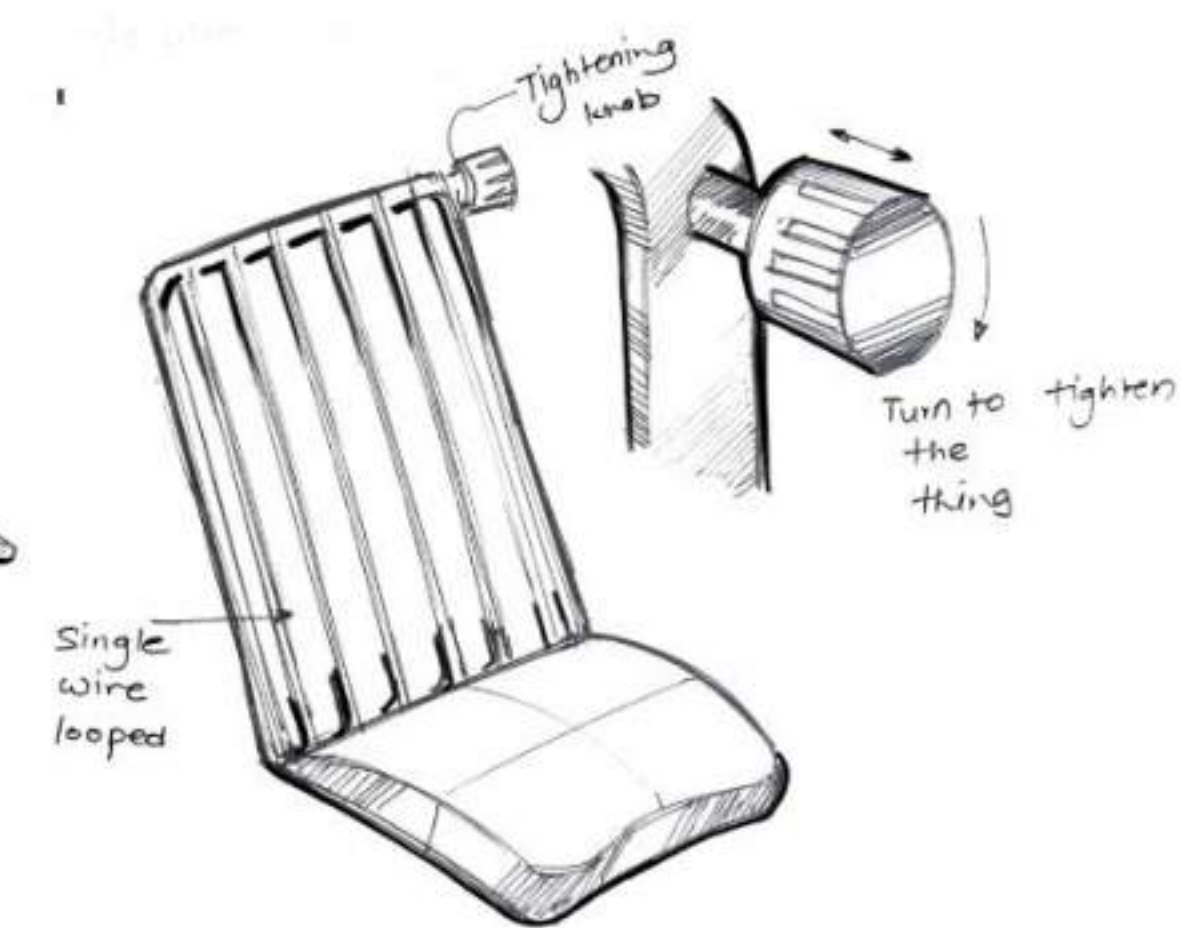
Flexible roller cushions



Adjustable tilt



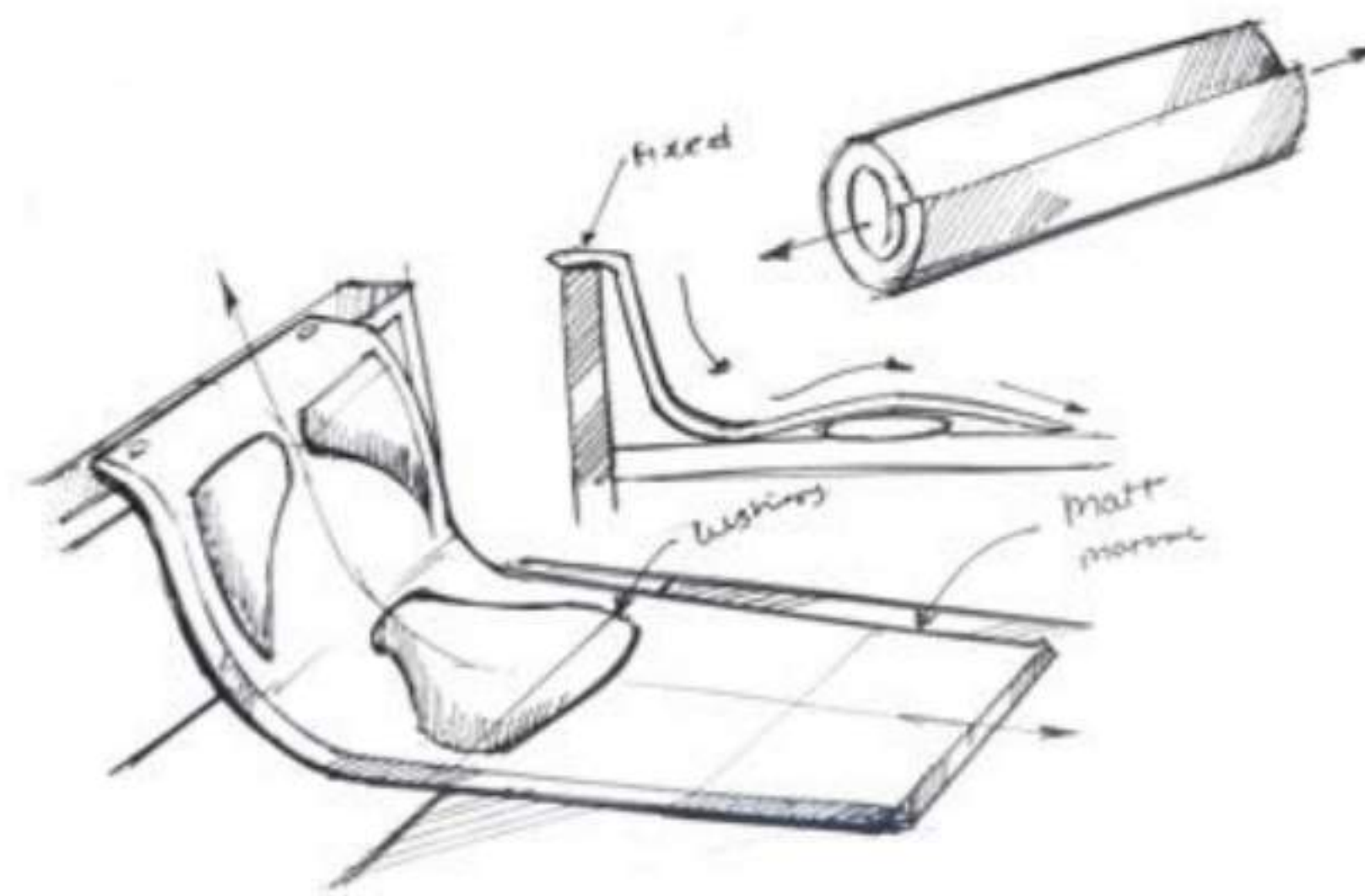
Moulded plastic chair



Adjustable wire tension chair

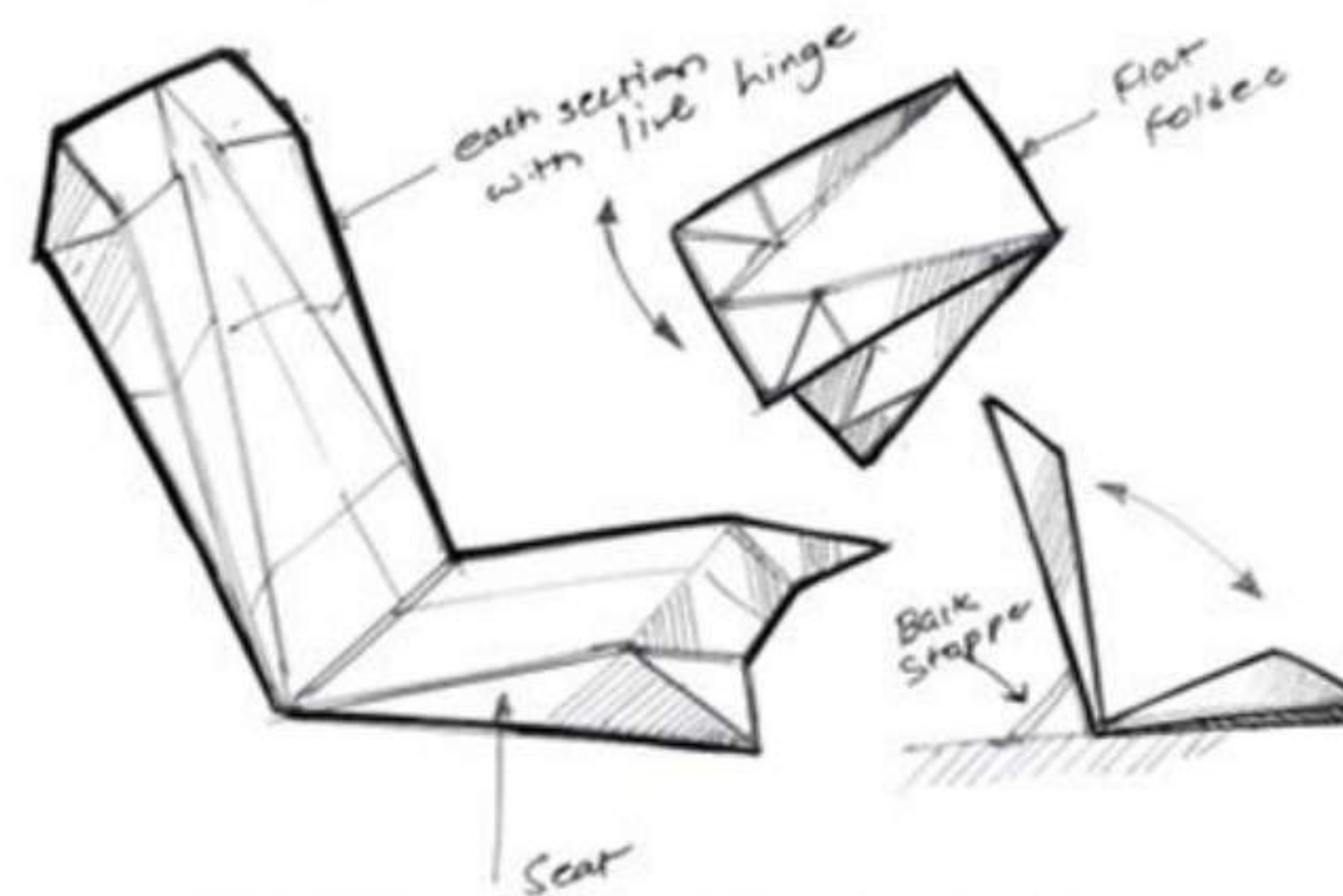
Champion Ideas

The selection process involves evaluating a variety of ideas, which are grouped into clusters based on their similarities or shared characteristics. From each of these clusters, three champion concepts are chosen. The selection of these champion concepts is not arbitrary; instead, it is based on a specific checklist.



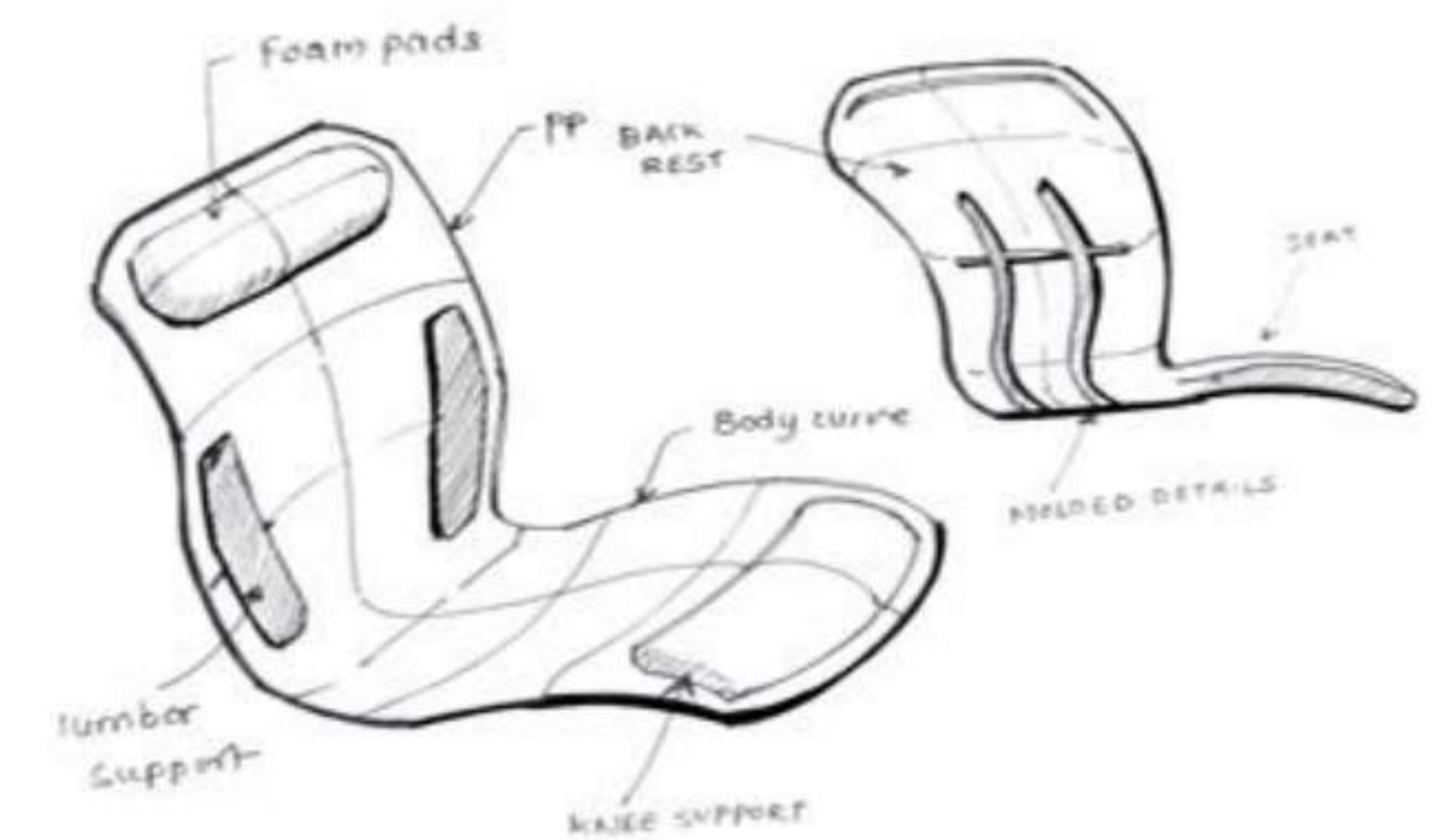
Foam mat with flexible postures

Cluster 1- Minimal features,
Small seats



Plastic flat segments in bonded fibre

Cluster 2- Medium sized seats
with quick setup



Plastic moulded chair with soft cushions

Cluster 3- Maximum comfort,
Big size

Figure 6 champion ideas

Developing concepts

Concept 1: Yoga mat inspired concept

This concept is derived from a cluster of minimalistic ideas and involves the use of a foam mat, similar to a yoga mat. The unique aspect of this mat is its ability to be folded and curved to support various postures of the body, thereby providing flexibility and adaptability to the user's needs.

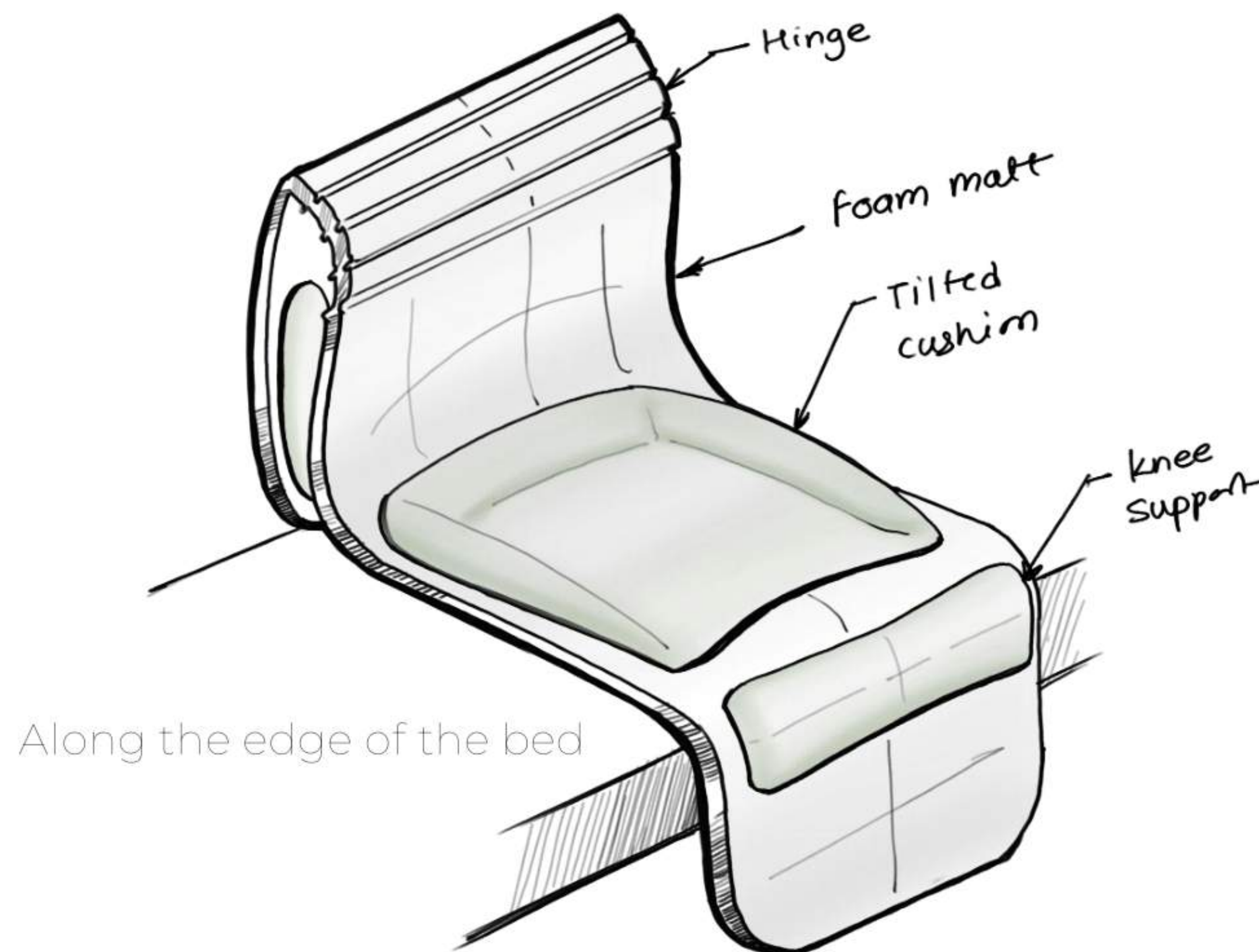


Figure 8 concept 1 along the edge

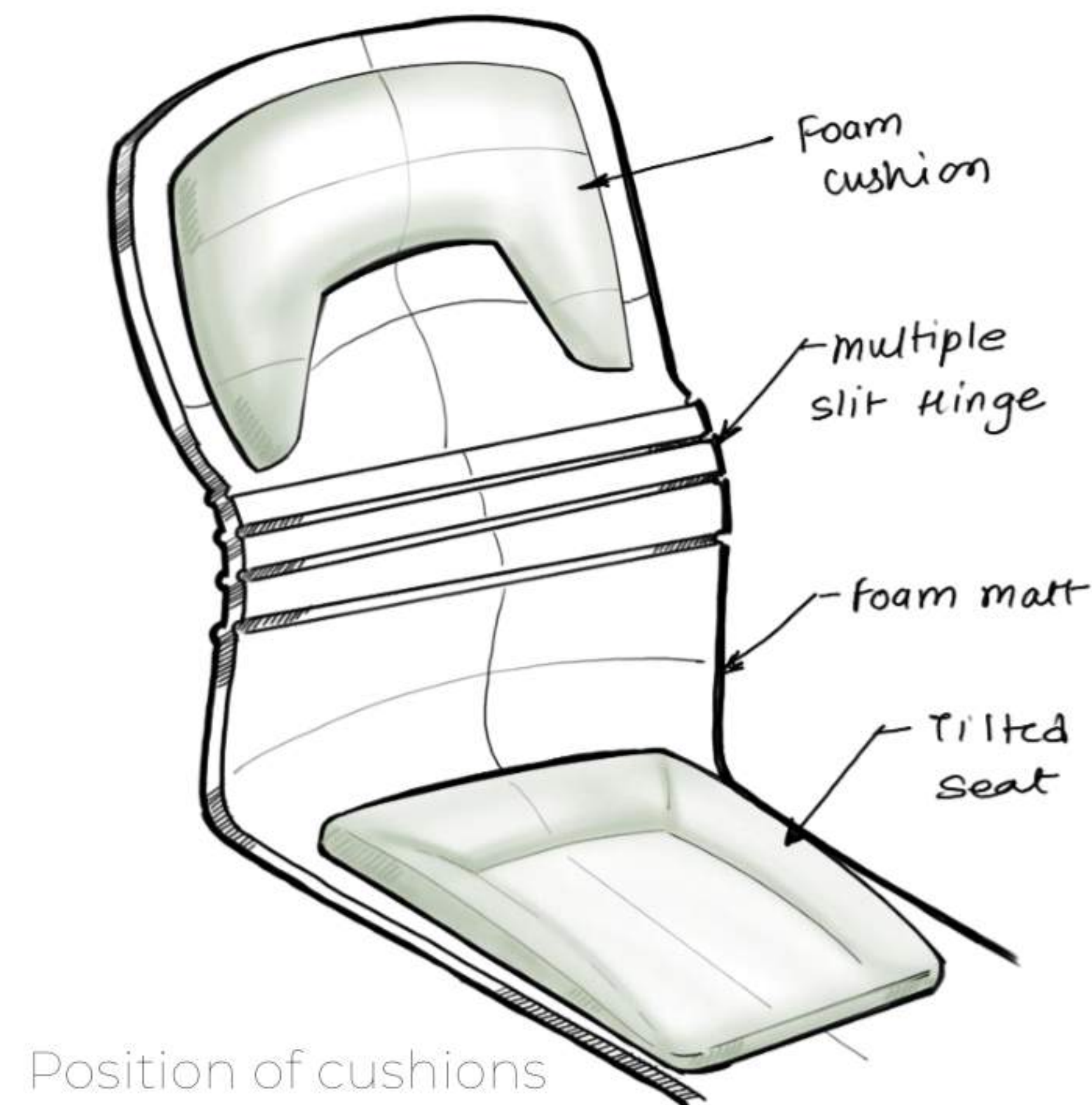


Figure 7 concept 1 back rest details

Here are the expanded details of the features:

1. **Tilted Semi-Soft Seat:** The seat is designed with a slight tilt and is made of semi-soft material. This design can help in maintaining a good posture and can prevent the discomfort that often comes from sitting for extended periods. The semi-soft material ensures a balance between firmness for support and softness for comfort.
2. **Soft Foam Mat:** The mat is made of soft foam, providing a comfortable surface for the user. This can help in reducing pressure points and can make sitting or lying down on the mat more comfortable, especially for extended periods.
3. **Two Postures of WFB:** The mat is versatile and can be used in two postures of Work From Bed (WFB). This could mean that the mat can be adjusted or positioned in different ways to support various activities such as sitting, reclining, etc., making it a flexible solution for different needs.
4. **Full Back and Lumbar Support:** One of the key features of this concept is its ability to provide support to different parts of the back. It can be adjusted to provide full back support, which is beneficial for maintaining a healthy posture and preventing back pain. Additionally, it can also be configured to provide targeted support to the lumbar region, which can be particularly helpful for those with lower back issues.

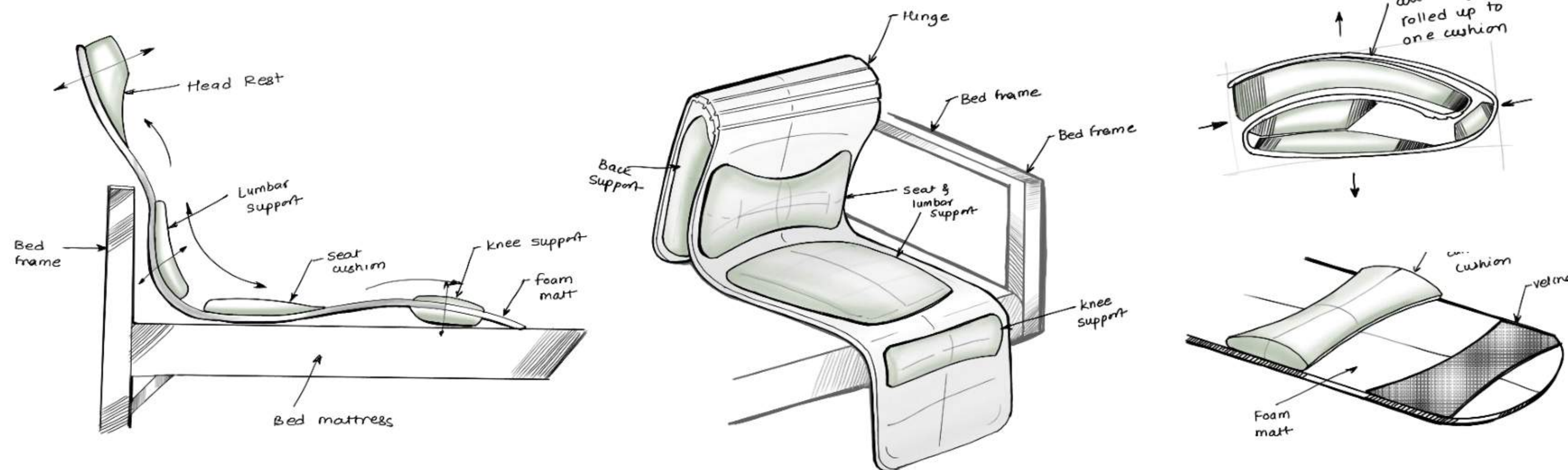


Figure 9 concept 1 development

Concept 2: iPad cover inspired Design

This design is inspired by the segmented covers used for iPads. The primary goal of this design is to offer a compact and flat storage solution while also providing the flexibility to accommodate multiple postures. This makes it a versatile and practical choice for users who value both functionality and convenience.

One of the key features of this design is its quick setup and foldability. This is made possible by the use of plastic flat segments that are bonded in cloth fibre.

The design is also versatile in terms of its usability. It can be used in two different postures of Work from Bed (WFB), providing users with the flexibility to choose a posture that is most comfortable for them. This adaptability makes it suitable for a variety of different tasks and activities, enhancing its overall utility

Another notable feature of this design is the use of Velcro on the cloth fibre. This allows users to attach cushions in multiple positions according to their comfort and needs. This feature adds an extra layer of customization to the design, enabling users to personalize their seating arrangement for optimal comfort.

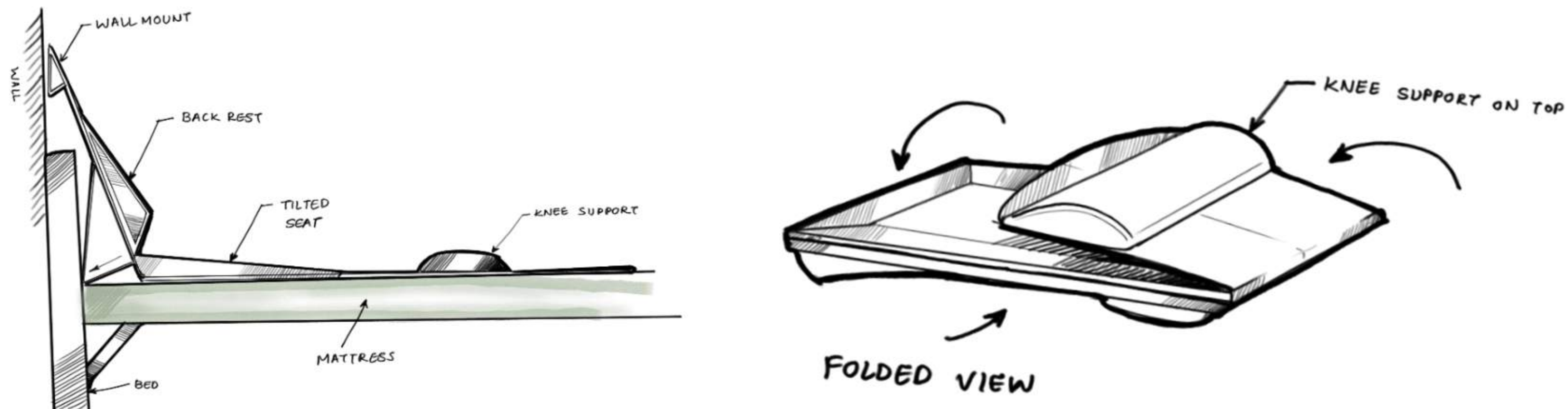


Figure 10 concept 2 side view

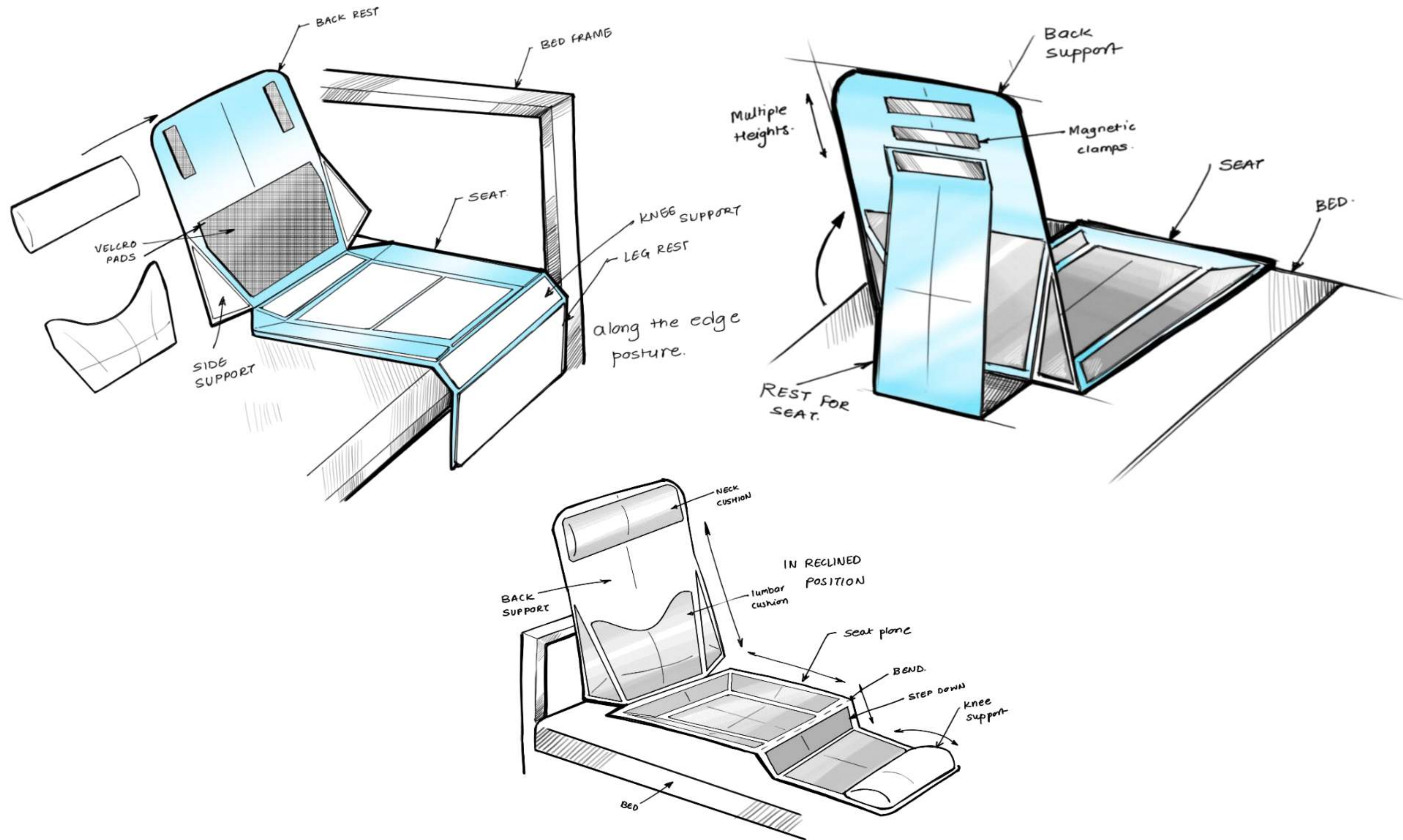


Figure 11 development of concept 2

Concept 3: Plastic moulded chair

This concept takes inspiration from the design of multipurpose plastic moulded chairs. It aims to provide flexibility in back posture, which is a crucial aspect of seating comfort. This is achieved through the use of multiple spring-loaded hinges that support the backrest. These hinges allow for a range of motion, enabling the user to adjust their back posture according to their comfort.

One of the standout features of this concept is the adjustable tilt of the seat. This feature allows the user to modify the angle of the seat to suit their preference, further enhancing the comfort and adaptability of the chair.

The chair features a hard plastic support surface, which ensures durability and stability. However, to enhance comfort, soft cushion pads are added to the hard surface. This combination of hard and soft materials provides a balance between support and comfort.

The design is versatile and can be used in two different postures of Work from Bed (WFB). This makes it a suitable choice for various activities, whether it's working on a laptop or reading a book.

Additionally, the chair provides a headrest and knee support. The headrest offers support to the neck and head, reducing strain during prolonged use. The knee support helps maintain a comfortable leg position, contributing to overall body comfort.

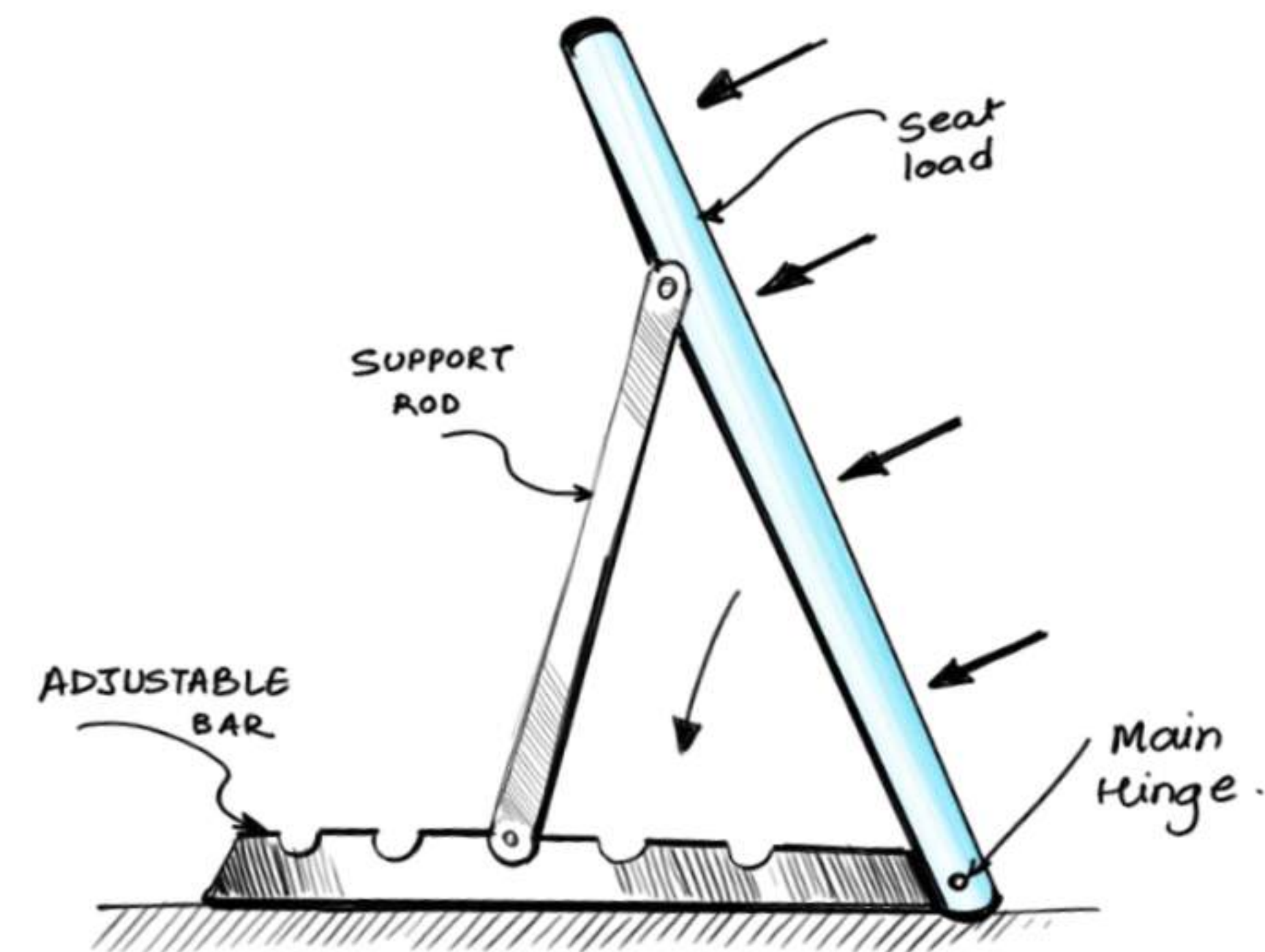
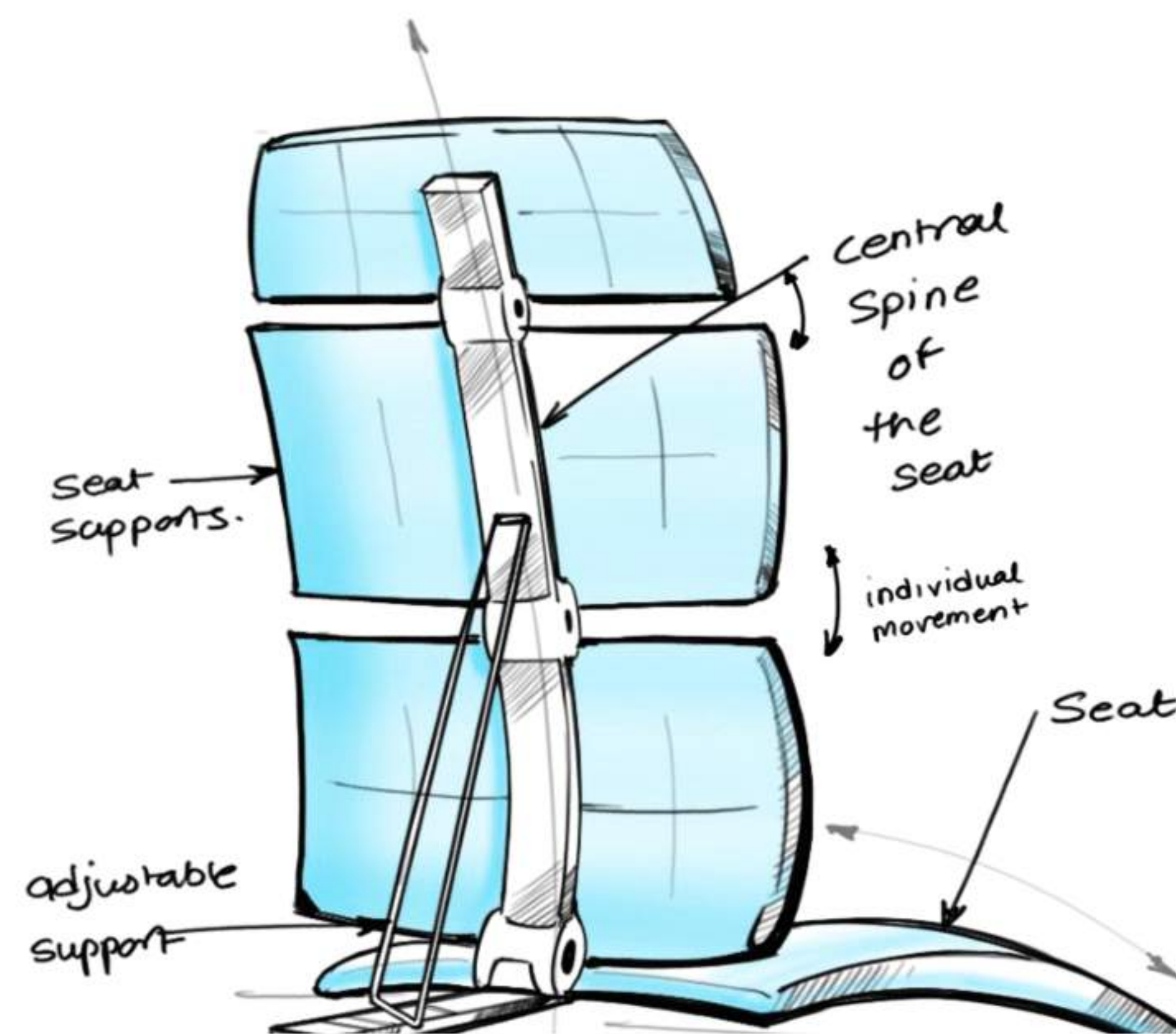
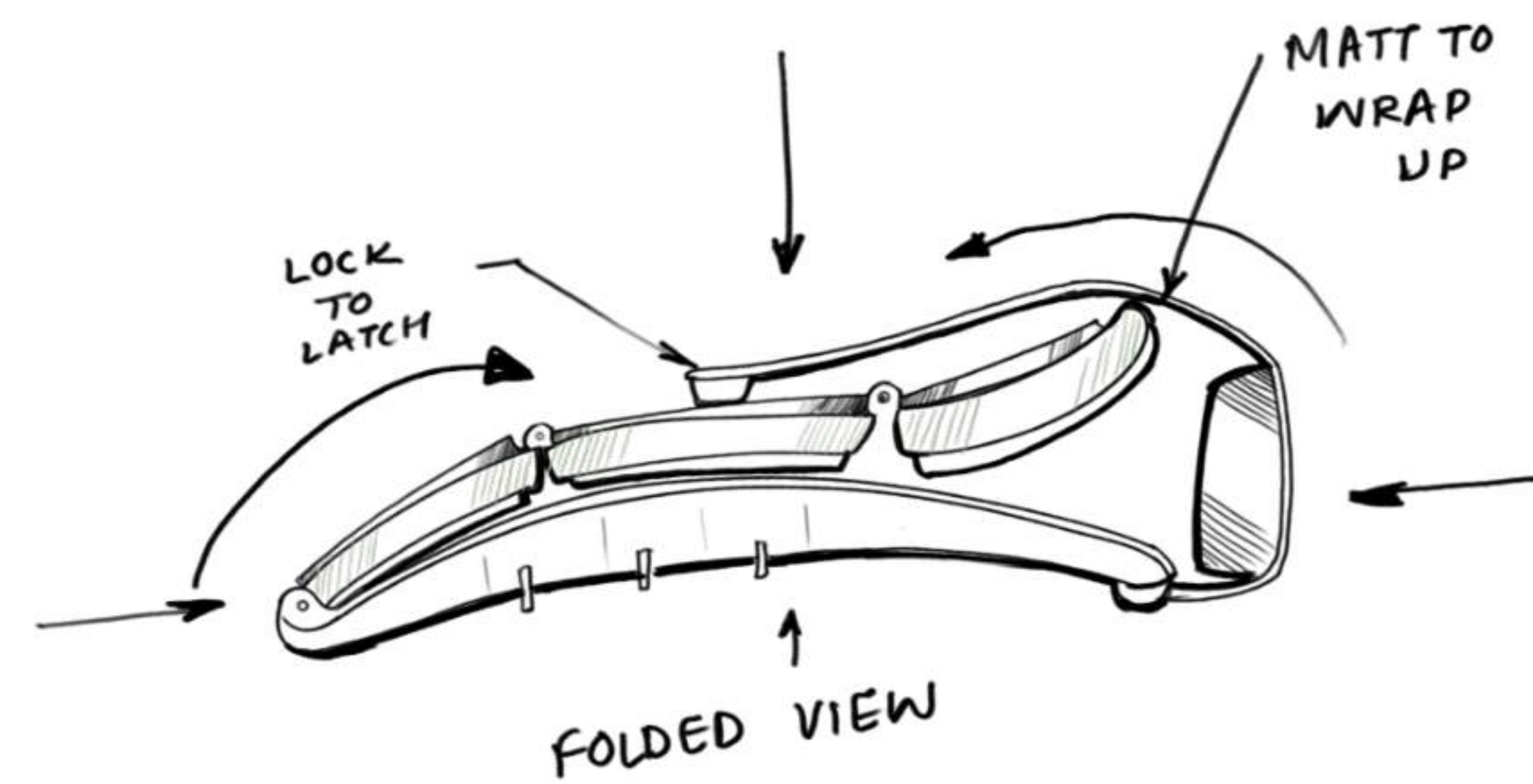
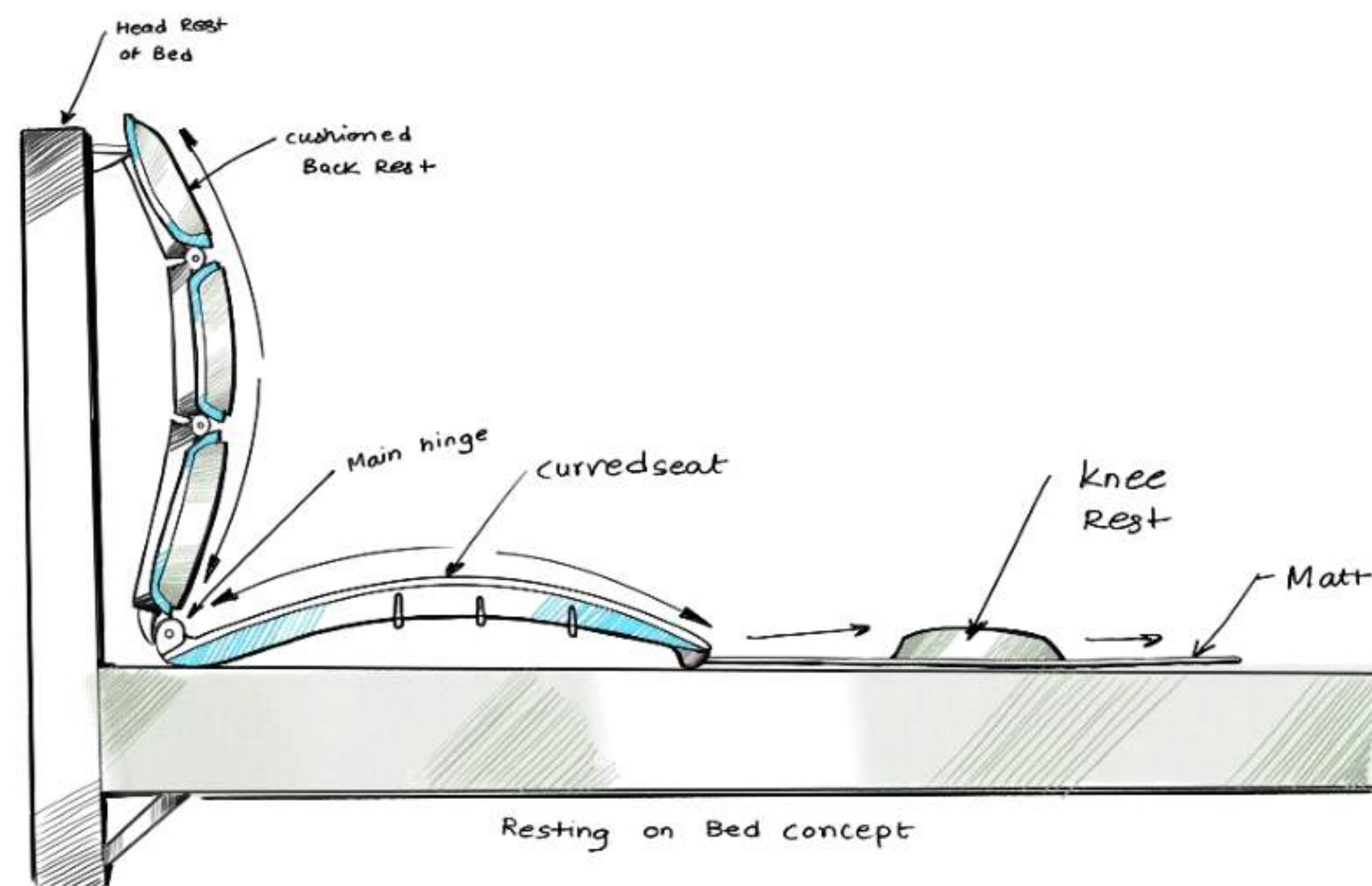


Figure 12 development and details of concept 3

Mock-ups

Scaled 3D-printed models at a 10:1 ratio were used to test hinge stiffness, product form, and collapsibility. This hands-on approach provided crucial insights into structural integrity and real-world functionality. Leveraging 3D printing technology streamlined the design process, allowing for quick iterations and optimal performance improvements.

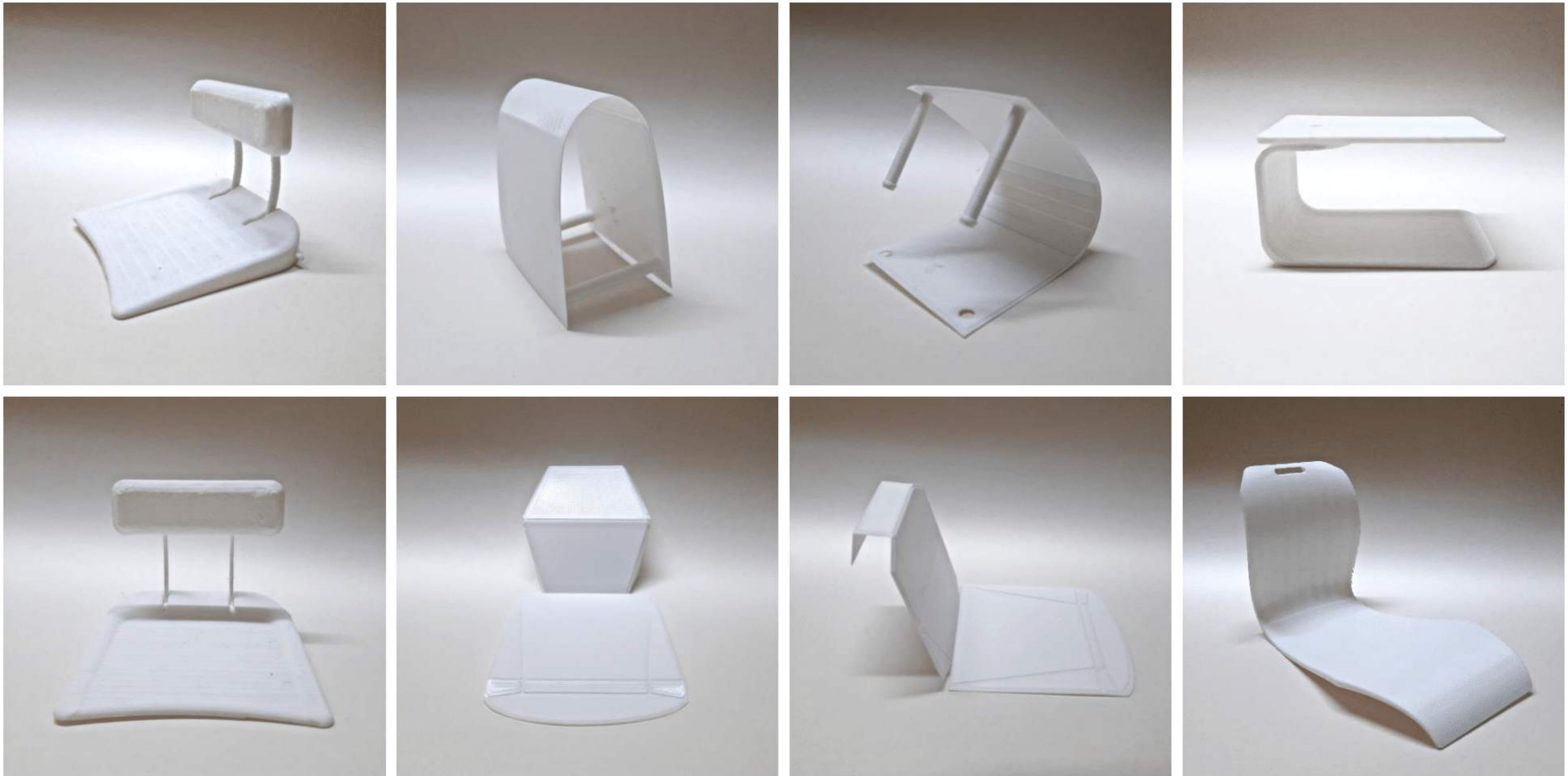


Figure 13 mock-ups images

Redefining the stakeholder's perspective:

As the context of the project is designing for the hostels and hostel resident, the buyer and the consumer are different individuals hence considering both of their needs was important for the project to be suitable for market needs.

Following are the consumer (user needs) needs for the product.

- Effective back support for prolonged sitting on a bed
- Promotion of correct posture during extended work sessions
- Convenient storage in small spaces, addressing modern living constraints
- Creation of a comfortable and conducive workspace directly on the bed
- Dedicated leg support feature for enhanced overall comfort
- Consideration of neck posture to reduce strain during prolonged use
- Holistic design approach reflecting evolving consumer needs for balance between ergonomic support, practical storage, and a comfortable work setting.

And following are the consumer wants as their inclination towards the product.

- Quick and easy setup for seamless transition to a work environment over the bed.
- Priority on mattress and sheet protection, ensuring no damage during use.
- Flexibility in movement, allowing for easy and quick transitions in and out of the workspace.
- Aesthetically pleasing design that seamlessly matches and merges with the overall bed aesthetics.

And the major buyer of this product will be hostelling authorities who are looking to provide comfortable working facility to their residents. Their needs from the following product are as follows.

- Cost-effective solution for bulk purchase.
- Easy maintenance and repair for minimized downtime.
- Durable design for extended years of use by diverse individuals.

- Multi-user adaptability for versatility over time.
- Washable components for hygiene after prolonged use.
- Affordable and readily accessible for widespread availability.

Selection of Final Concept

Following are the selection parameter which were modified a bit to select the final concept that can be developed further.

1. Back support for comfortable sitting on a bed.
2. Quick and easy setup for user convenience.
3. Integrated leg rest for enhanced comfort.
4. Compact storage design for efficient space utilization.
5. Adjustable features for personalized user comfort.
6. Promotion of a neutral sitting posture for ergonomic support.
7. Mattress-friendly design to prevent damage.
8. Sized to fit a single bed for optimal space utilization.

Selection of final concept using Pugh matrix

The Pugh matrix is utilized in industrial contexts to systematically select the final concept from a set of alternatives, employing predefined criteria. Prior to generating concept sketches, criteria are established and assigned priority marks or weightage. Subsequently, each concept is scored based on the extent to which it fulfils each criterion, with a score of 1 denoting compliance and 0 denoting non-compliance. These scores are then multiplied by their respective weightage, and the summation of these products yields a final concept score. The concept with the highest score is then chosen. In the specific application discussed, this method was applied to three concepts, each assessed against predetermined criteria and weightages as outlined in the table below. The scoring matrix revealed that concept 2 garnered the highest marks, closely followed by concept 1. Consequently, concept 2 was selected as the final concept, with an intention to incorporate favourable aspects from concept 1.

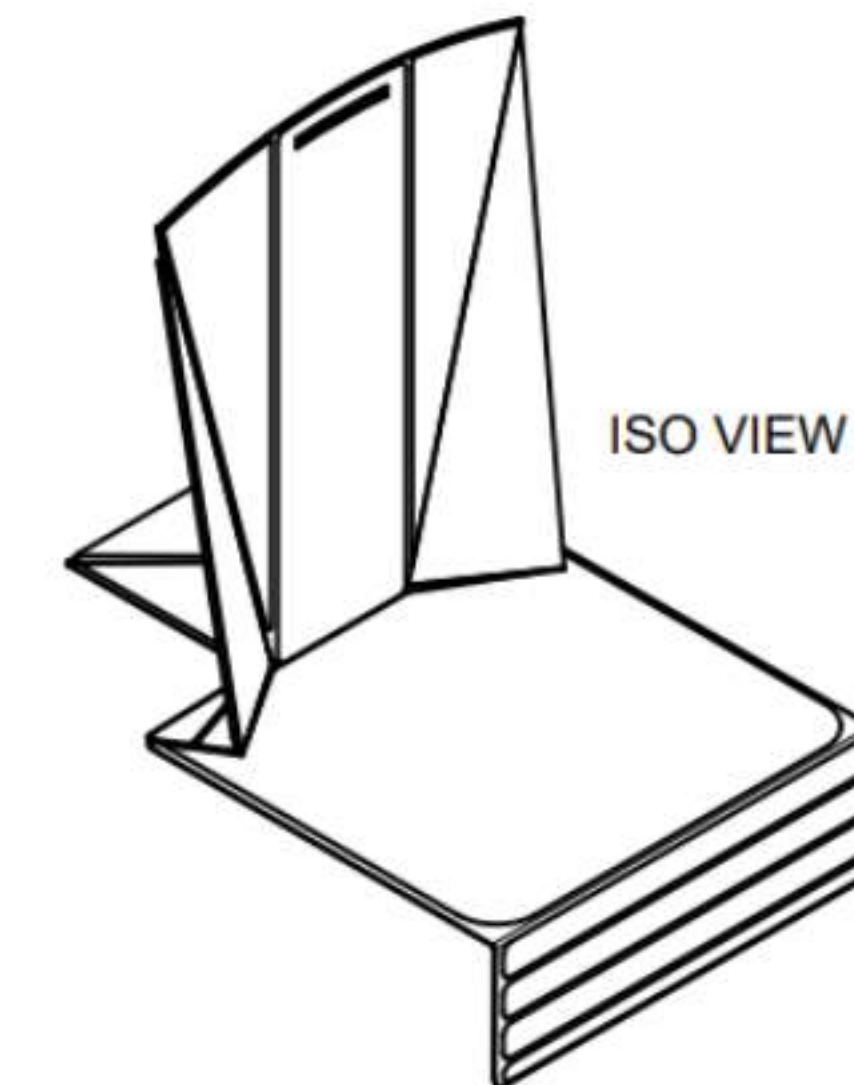
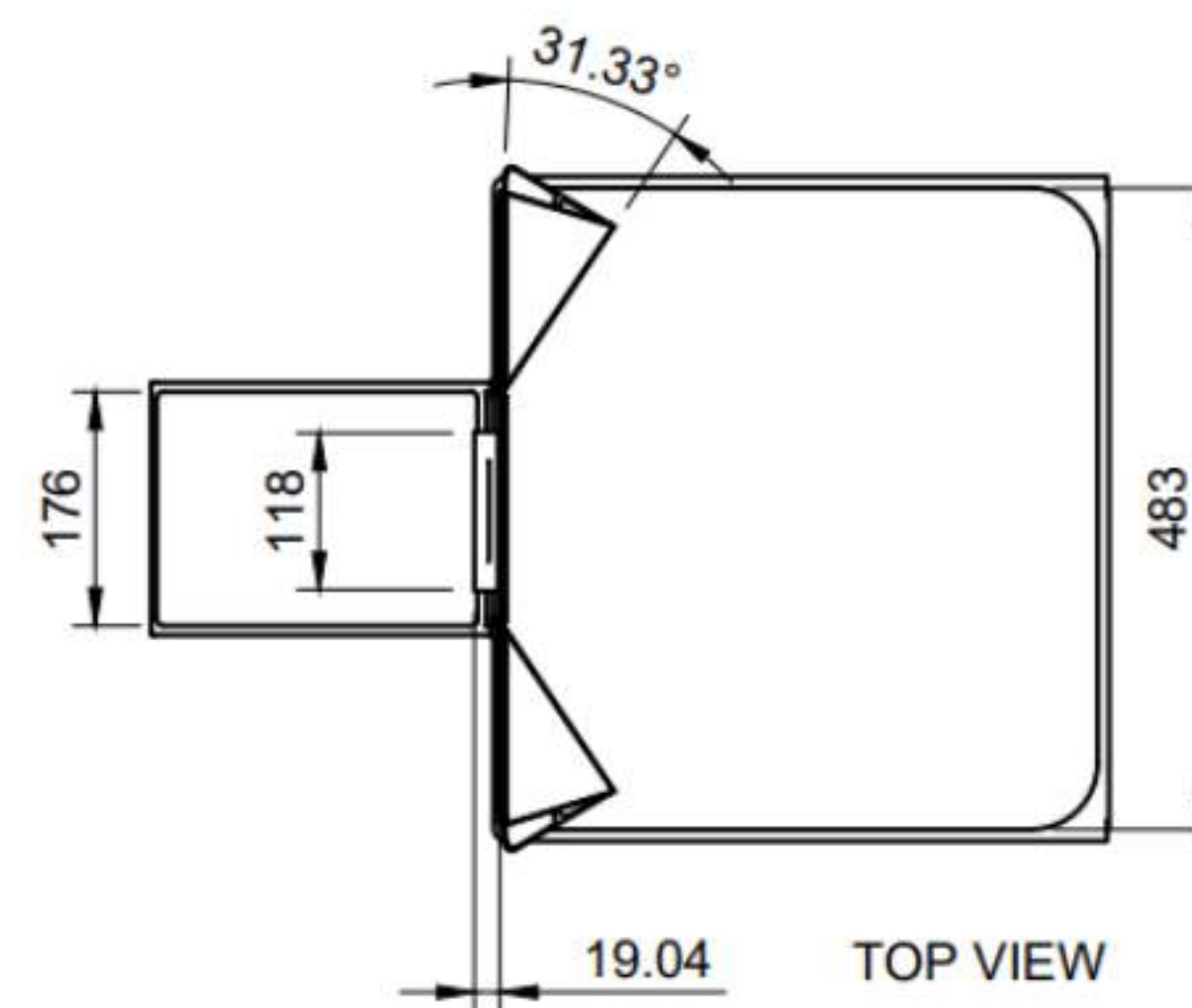
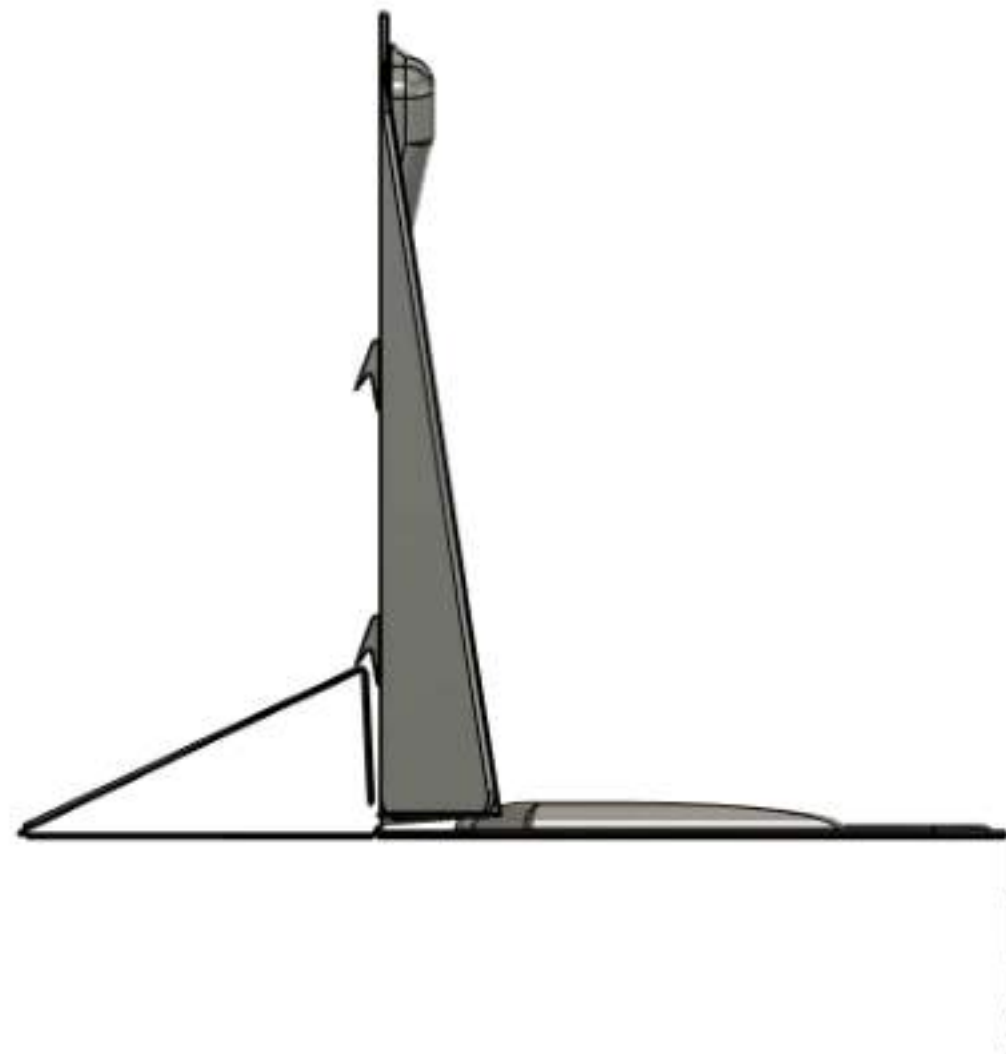
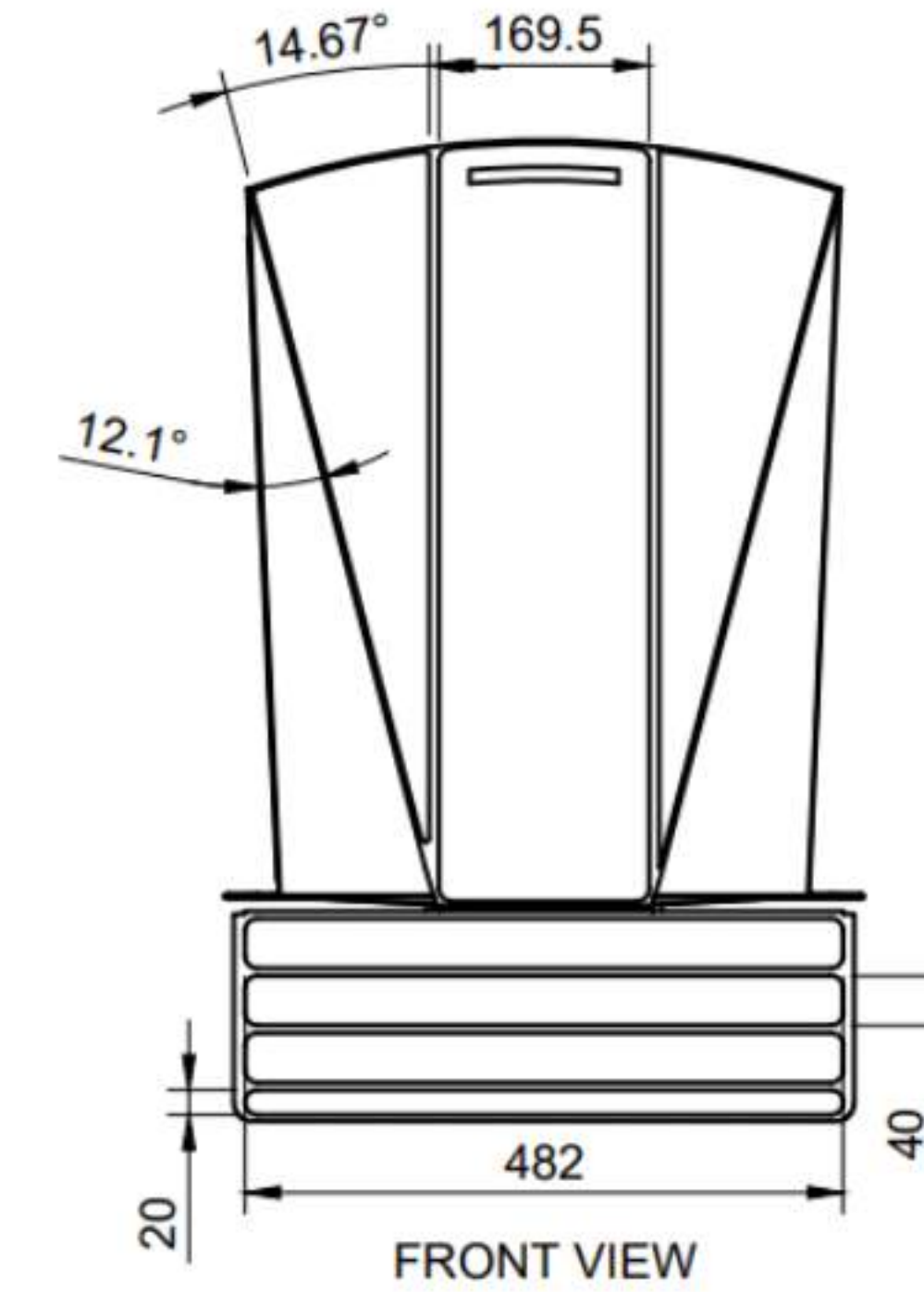
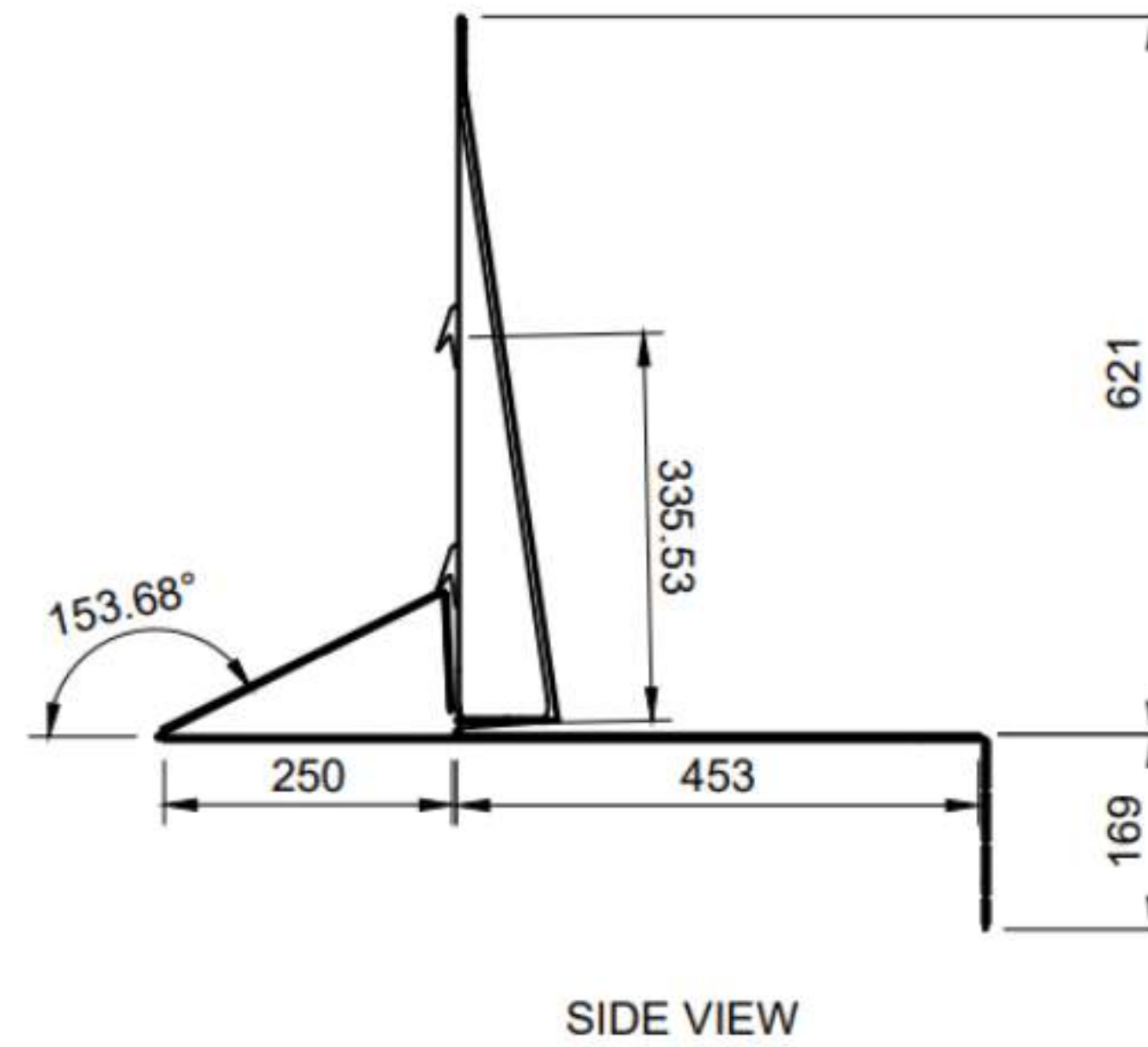
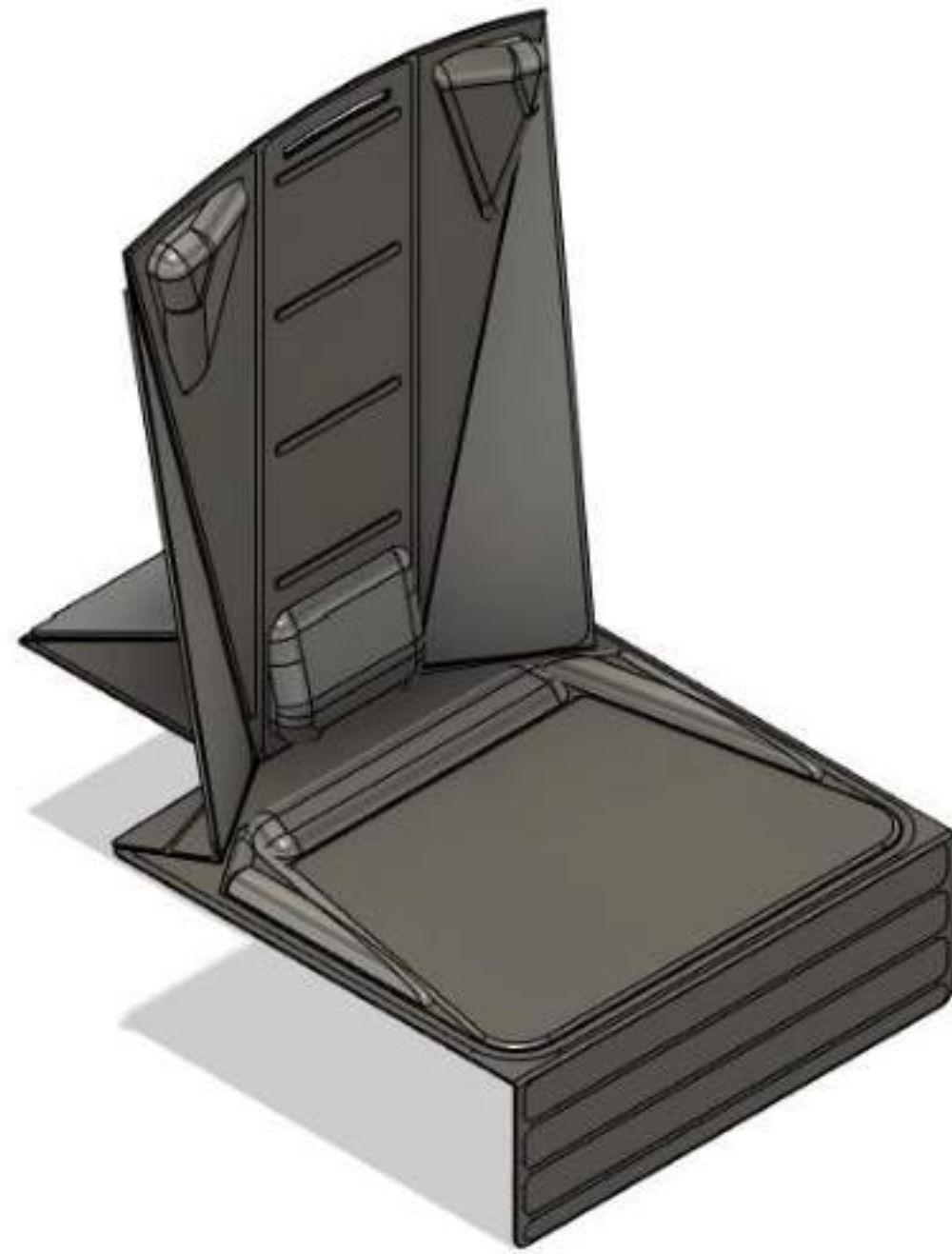
Criteria	weightage	Yoga mat type #1	Yoga mat type #1	lpad cover type #2	lpad cover type #2	Molded chair type	Molded chair type
Should provide back support while sitting on bed.	5	1	5	1	5	1	5
Should have easy and quick setup.	3	1	3	1	3	0	0
Should have some sort of leg rest while sitting.	1	1	1	0	0	1	1
Should be able to store in compact form.	2	0	0	1	2	0	0
Should be adjustable according to user comfort and desire.	2	1	2	1	2	0	0
Should provide neutral posture	1	1	1	1	1	1	1
Should have no damage to mattress	1	1	1	1	1	0	0
Should come in single bed size.	1	1	1	1	1	0	0
should merg with bed	1	1	1	1	1	0	0
Total			15		16		7

Figure 14 Pugh matrix calculations

In summary, the Pugh matrix analysis identified concept 2 as the most favourable choice among three alternatives, backed by its superior performance against established criteria. Acknowledging the merits of concept 1, an adaptive approach will be taken to incorporate its positive attributes into the selected concept. This ensures a nuanced final solution that maximizes strengths and addresses potential weaknesses, exemplifying a thoughtful and refined industrial design process.

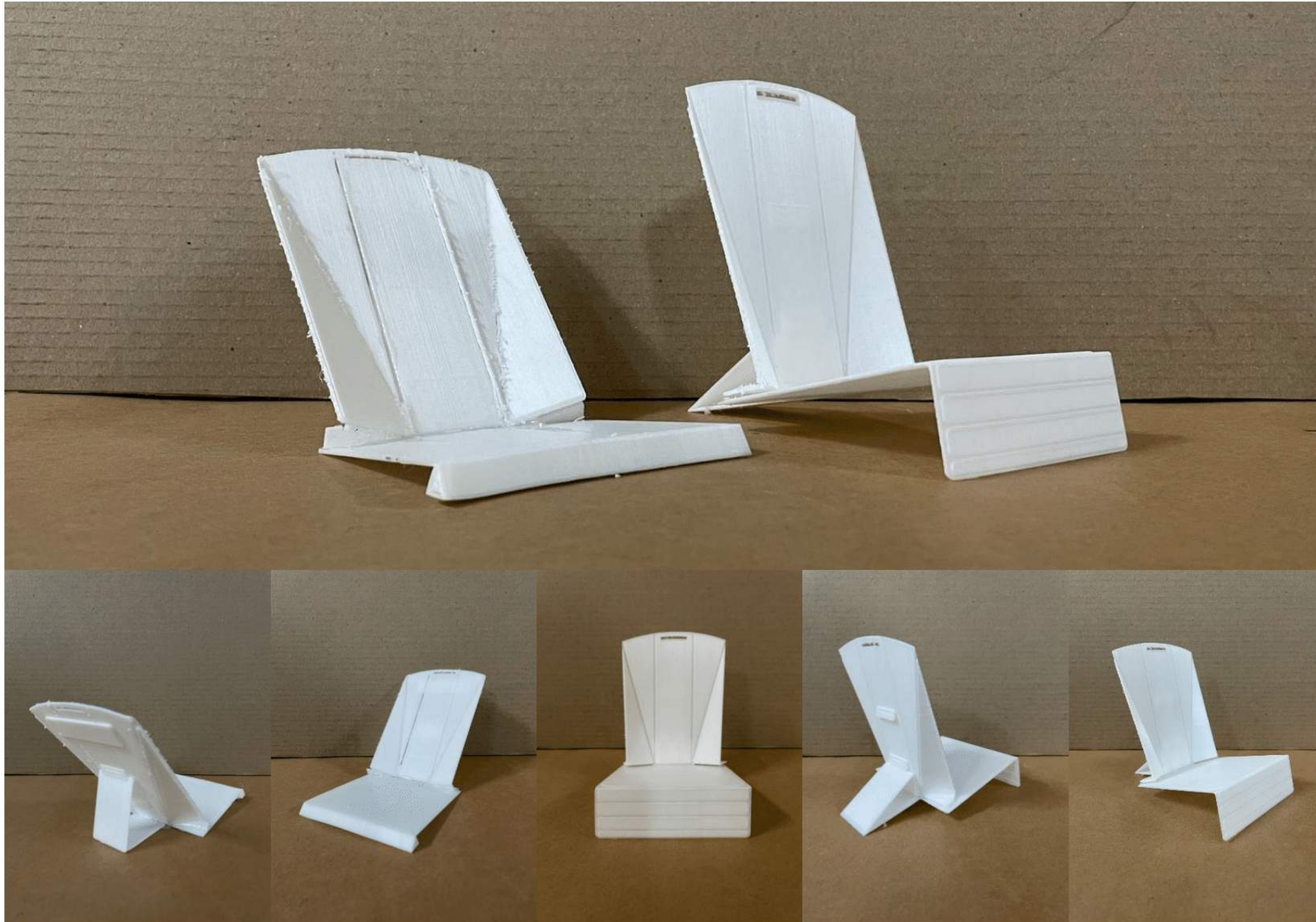
Final selected concept:

hard sheet concept with live hinges (similar to iPad covers)



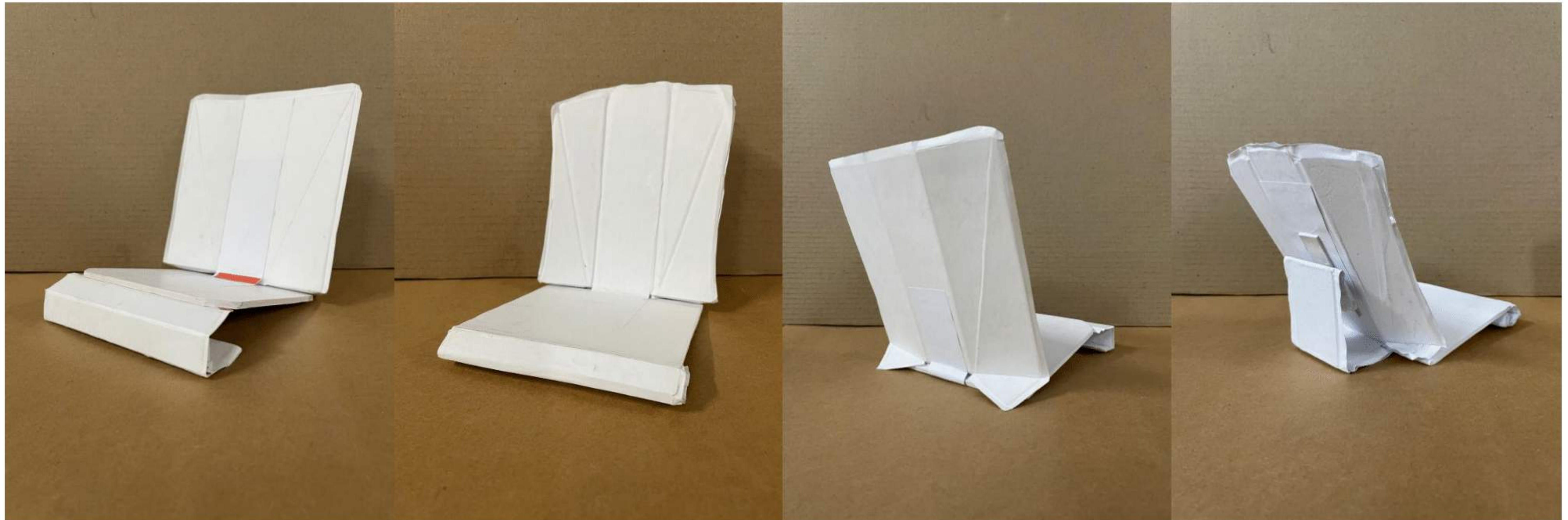
Small scaled mock-ups

3d printed 1:8 scaled models of final cad design to understand the angles and dimensions of the product.

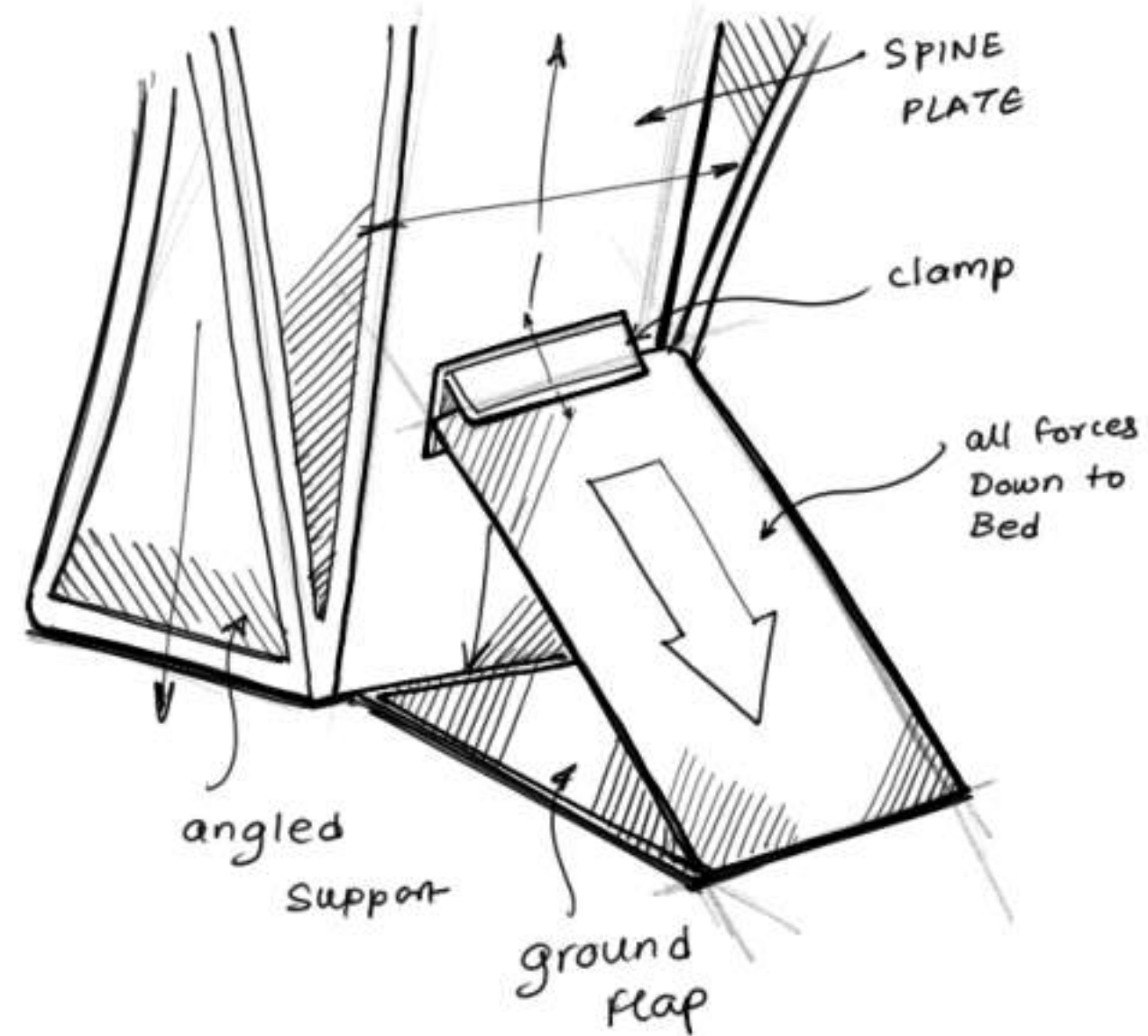


Paper prototypes

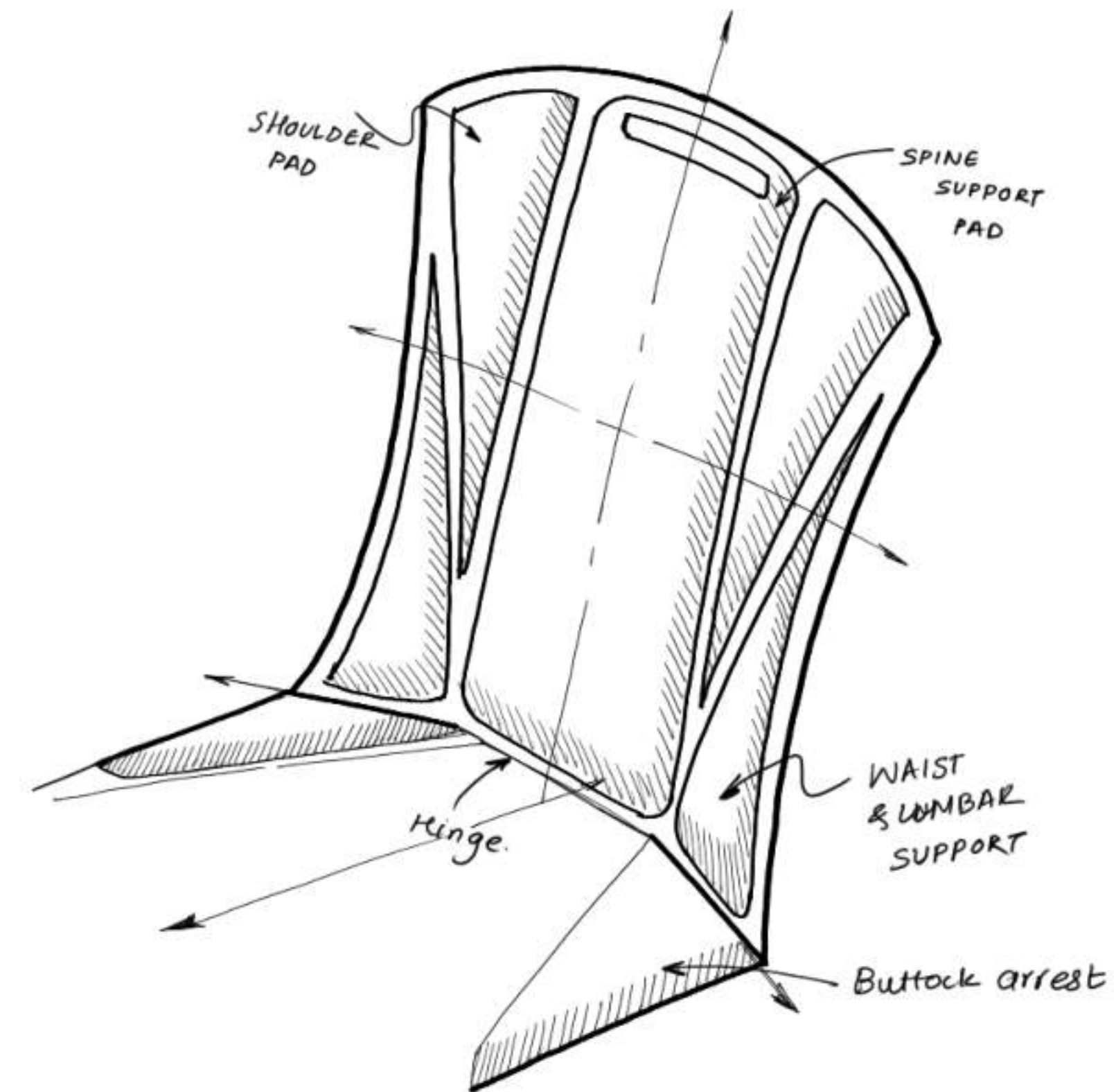
Paper models of 1:8 scales with cardboard as core material and 70 GSM paper as binding medium to understand the folding and the angle made due to various folding.



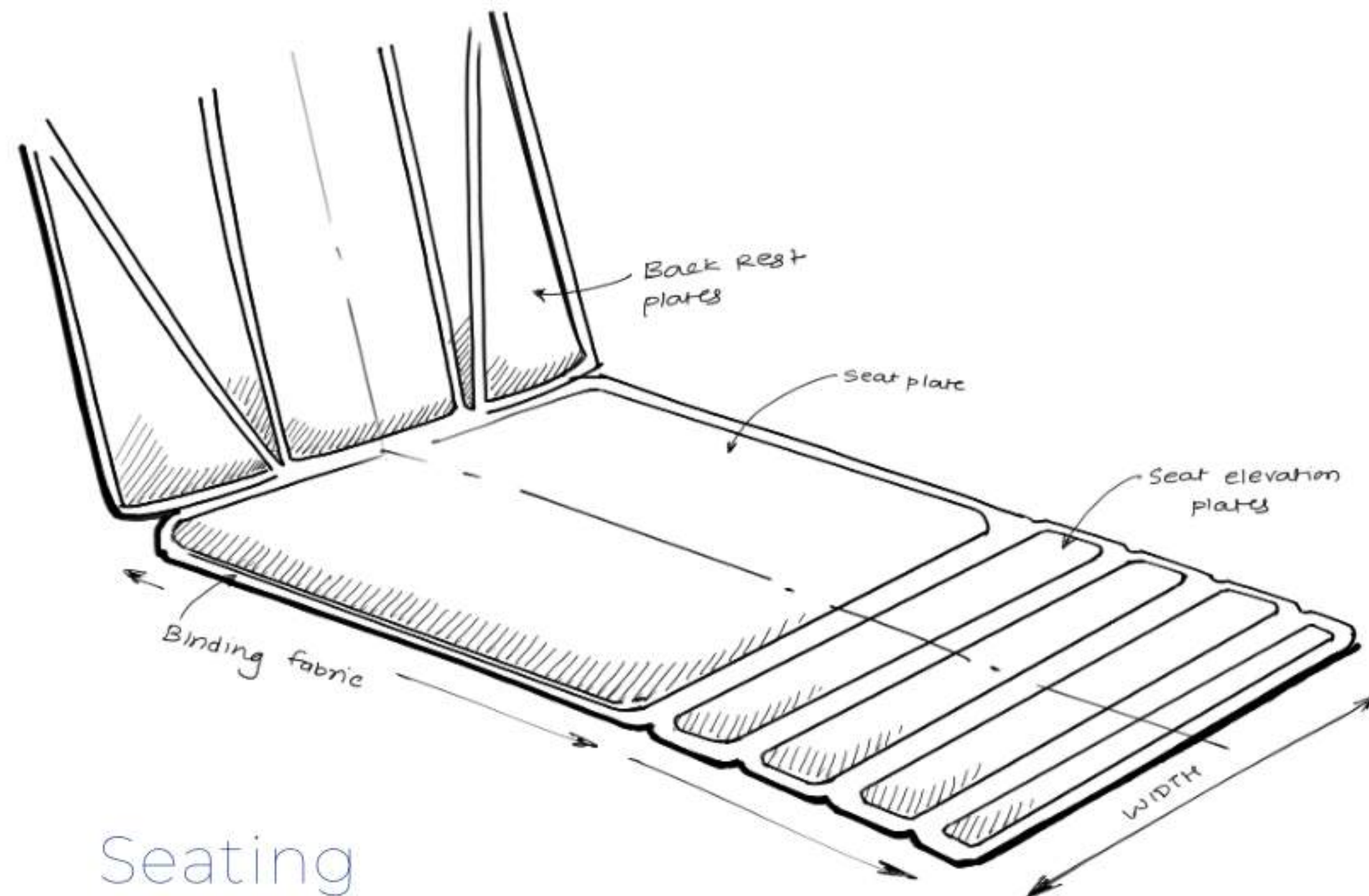
Working of the concept



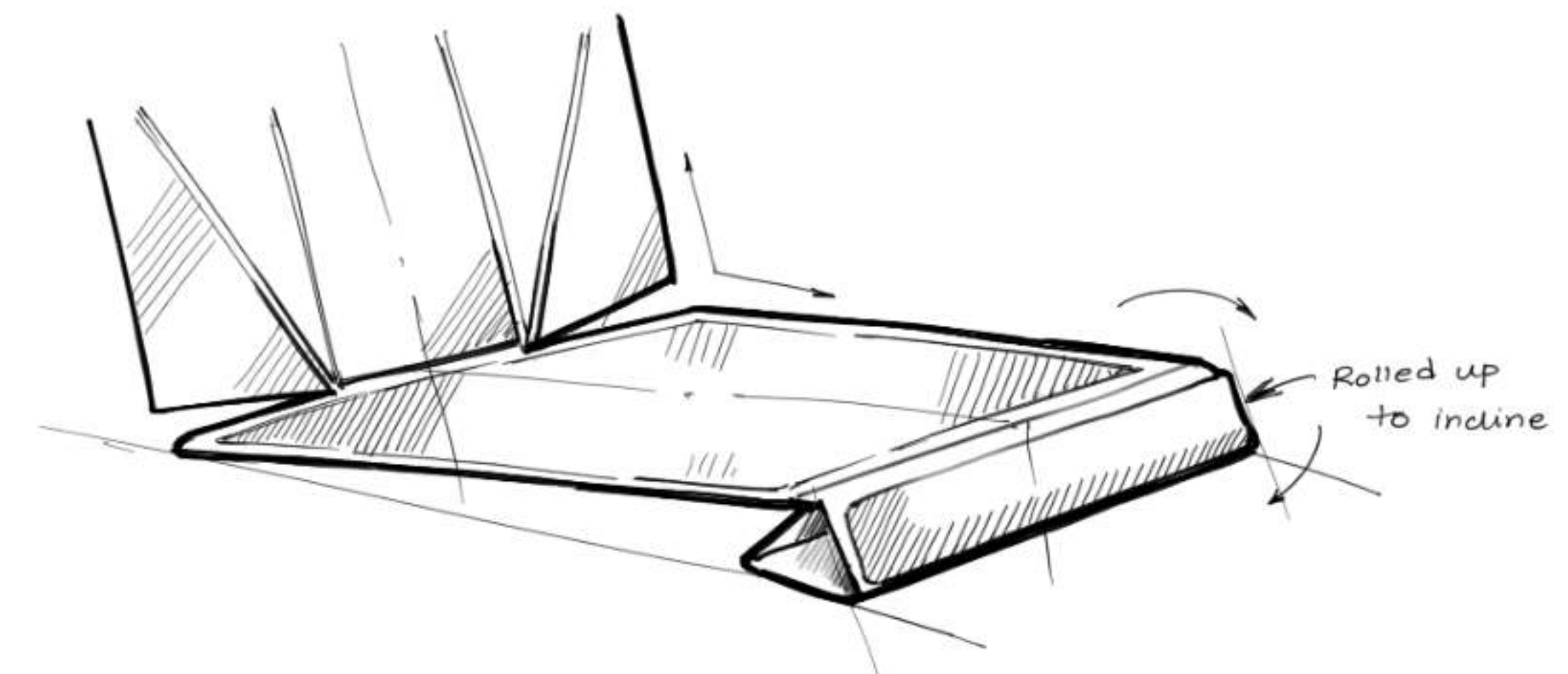
Back support mechanism



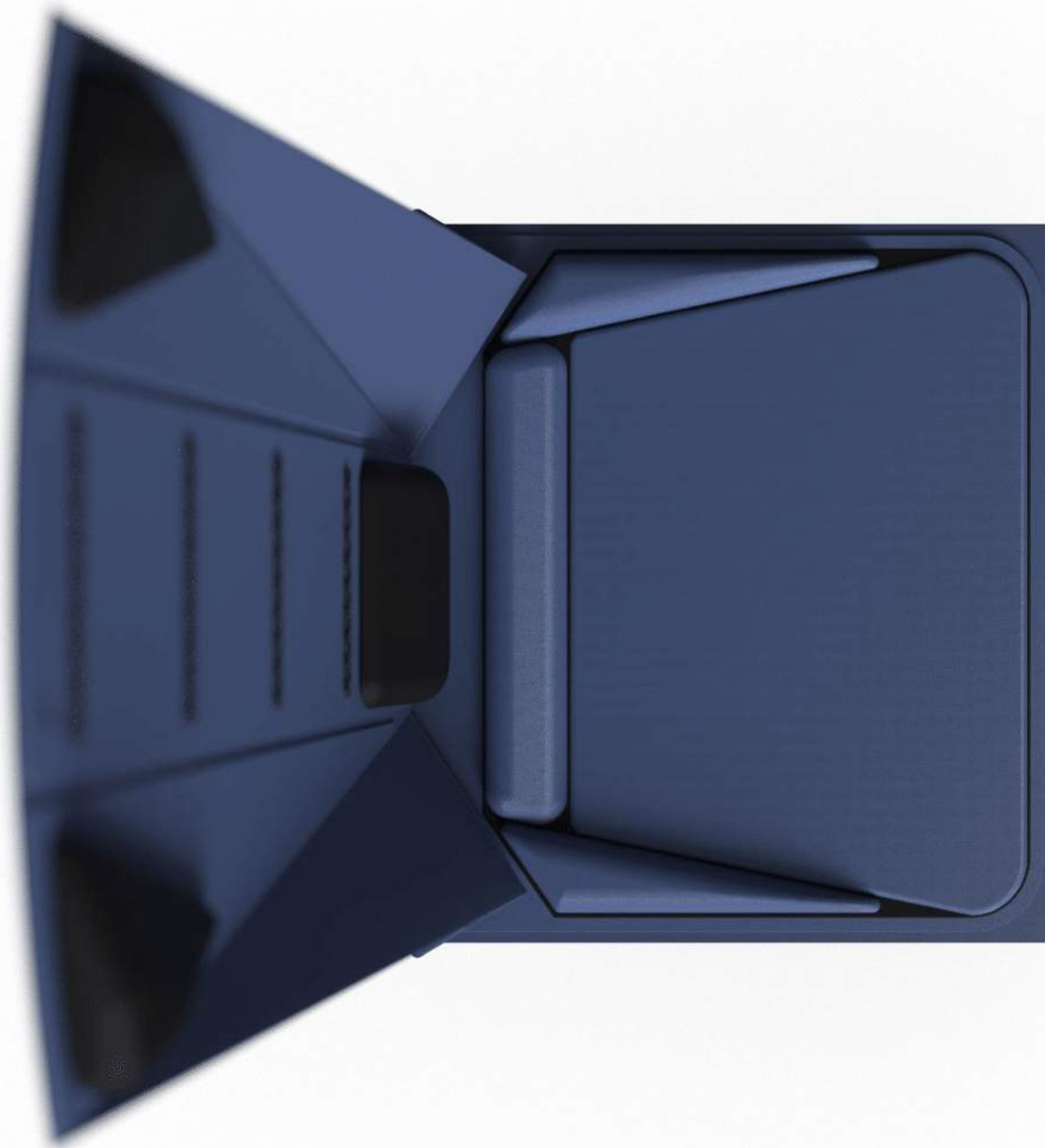
Back rest padding



Seating
arrangement on
bed



Seat elevation



Seat comfort

The seat provided is wide enough so that it is easier to get up and get into the seat yet addition comfort can be provided through cushioning shown in render which provides side arrest and lower back inclination for the user.



Backrest cushioning

The plates of backrest are attached with 5 mm thick foam yet for additional support and comfort lumbar support and shoulder side support can be attached using Velcro arrangement hence user can adjust the position of cushions according to comfort.



Space efficient storage

The seat, similar to folio cases of phones and tabs can be folded into a flat sheet of thickness less than 50 mm which can be stored anywhere, in a space efficient manner.



Recline angle adjustment mechanism

A simple threefold plate folio arrangement at back provides the support that back rests needs and a simple magnet adjustment can change its angle from 95 degrees to 128 degrees according to user needs.



Upright posture

In this arrangement chair provides 95 degree of angle to support the back while doing work from the edge of the bed on another table.



Reclined neutral posture

In this arrangement chair provides 128 degree of reclined angle that to be used when user is working with laptop or worktable on his lap on the bed.

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15. The advent of remote work has led to a surge in the demand for products that facilitate work-from-bed (WFB) practices.
16. Over-bed tables and desks are popular products for WFB.
17. Back supports and pillows are essential for comfort and maintaining good posture during WFB