



System Design: Playarea furniture for Preschools using bamboo

Submitted in partial fulfillment of the requirement of the degree of

Master of Design
by

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Project Guide
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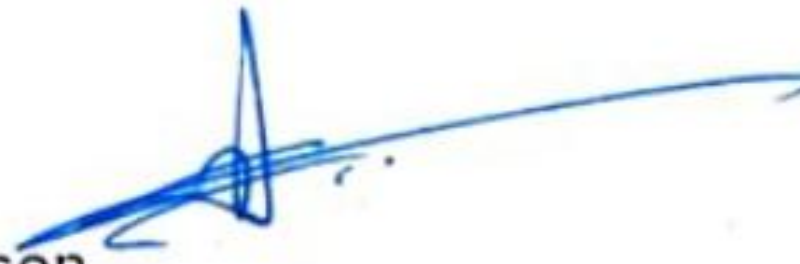
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Approval Sheet

The Design Project III titled "Play area furnitures for kids using Bamboo" by Rani Panit roll number 22m2231 is approved in partial fulfillment of the Masters Degree (Industrial Design) at the IDC School of Design, Indian Institute of Technology Bombay.



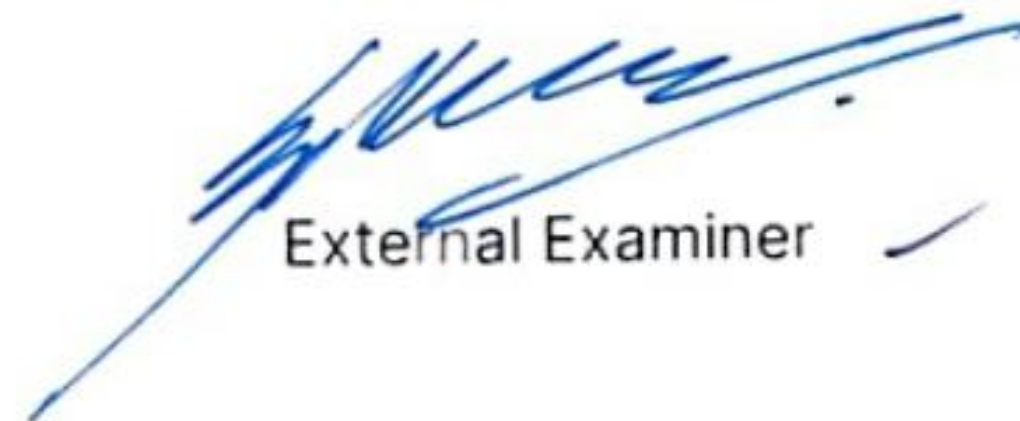
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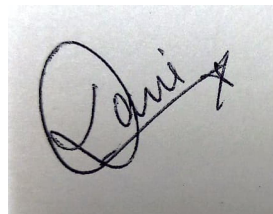
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Declaration

I declare that this project report submission contains my own ideas and work, and if any pre-existing idea or work has been included, I have adequately cited and referenced the original author(s). I also declare that I have adhered to all the principles of academic honesty and integrity and have not misinterpreted, fabricated or falsified any idea/ data/ fact 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.

A small, square image showing a handwritten signature in black ink on a light background. The signature appears to be 'Rani' followed by a stylized mark.

Signature:

Name: Rani Panit

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Date: 23/04/24

Abstract

Play stands as the cornerstone of a child's development, a truth underscored by the global shift toward play-centric educational paradigms. This report explores the pivotal role of play furniture in preschool settings as a catalyst for nurturing holistic development in young children. Drawing upon contemporary educational psychology and developmental theories, the study investigates the manifold benefits of play furniture in fostering cognitive, social, emotional, and physical growth during the crucial formative years.

Synthesizing empirical research, observational studies, and expert insights, this report elucidates how play furniture stimulates imaginative play, enhances problem-solving skills, and encourages sensory exploration among preschoolers. It examines how thoughtfully designed play environments, equipped with diverse and adaptable furniture pieces, facilitate collaborative play, peer interaction, and conflict resolution, thereby fostering essential social competencies.

Moreover, the report discusses the rationale behind utilizing bamboo as a sustainable material for play furniture. Not only is bamboo organic and safe for children, but its natural aesthetics imbue warmth and homeliness to the environment. Its cylindrical shape offers ample space for creating gross motor skill-based play furniture, aligning seamlessly with the developmental needs of preschoolers.

The report underscores the importance of ergonomic considerations and adherence to safety standards in the design and selection of play furniture for preschool environments.

This report advocates for sustainable, purposeful play furniture as a cornerstone of modern preschool education.

Acknowledgment

I am immensely grateful to Prof. Sandesh R., my project guide, for his invaluable mentorship, unwavering support, and insightful guidance throughout this endeavor.

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CHAPTER 1

INTRODUCTION TO CHILD THEORIES

1.1. THEORIES

1. Piaget's Cognitive Developmental Theory (1936)

He outlined distinct stages through which children progress as they grow. The stages are:

- **Sensorimotor Stage (0-2 years):** Infants learn about the world through their senses and motor activities. It is defined as the period when infants “think” by means of their senses and motor actions. **Infants continually touch, manipulate, look, listen to, and even bite and chew objects.**
- **Preoperational Stage (2-7 years):** Children begin to use language and symbols to represent objects and ideas. they have difficulty understanding others' perspectives (usually egocentric).
- **Concrete Operational Stage (7-11 years):** Logical reasoning becomes more developed, and children start to understand conservation. **Piaget called this period the concrete operational stage because children mentally “operate” on concrete objects and events.**
- **Formal Operational Stage (11+ years):** Abstract thinking and hypothetical reasoning become possible.

2. Erikson's Psychosocial Theory (1940)

Erikson's theory proposes that individuals go through eight stages of development, each with its own unique challenge and resolution. At the core of Erikson's theory is the concept of a sense of independence. He believed that individuals develop a sense of independence during their early years, and that this sense continues to grow and develop throughout their lives.

Erik Erikson's theory of 8 Stages of Development suggests that **people's ego identity grows** all through their life during the following specific stages:

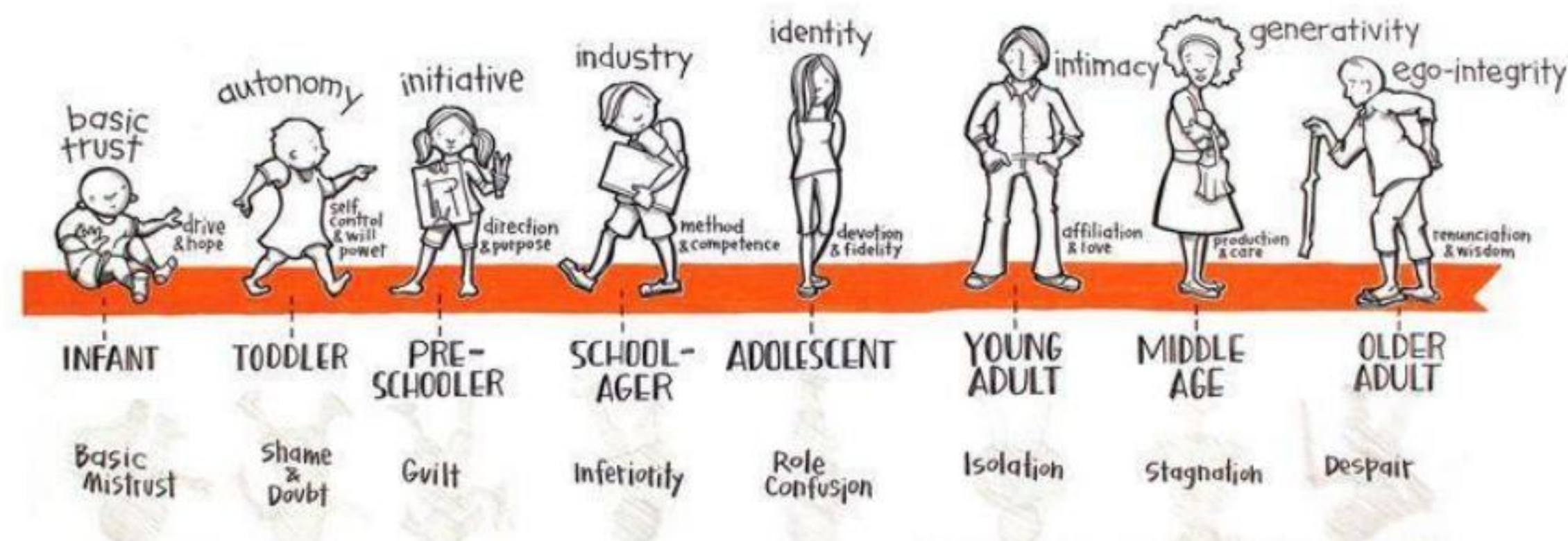


Fig. 1

He believes that none of these stages end with one and start with the other, though. But, each one of these may overlap. If one does not master a specific stage in life, he may extend into any other stage later on.

The Preschool stage, which is 3rd stage, encompassing ages 3 to 5, is a **vital phase** in Erikson's psychosocial development theory. During this stage, children grapple with **feelings of initiative versus guilt**, focusing on **autonomous actions** and the **formation of goals and aims**.

3. Lev Vygotsky sociocultural Development Theory (1962)

His ideas are particularly influential in understanding how social and cultural factors shape cognitive development in children. Vygotsky's theory places importance on guiding children's learning through their interaction with a more knowledgeable other (MKO). He believes we are born with 4 elementary functions:

- **Attention**
- **Sensation**
- **Perception**
- **Memory**

He says that provided an environment there is something that we can do and then there more that we can do with help of more knowledgeable other.

The zone of proximal development can be described as:

- Tasks a learner can accomplish without assistance
- Tasks a learner can accomplish with assistance
- Tasks a learner cannot accomplish with assistance

Scaffolding: Scaffolding is the support provided by a more knowledgeable person to help a child successfully complete a task within their ZPD.

Social Interaction and Language Development: Vygotsky highlighted the importance of social interaction, especially through language, in cognitive development.

Vygotsky's sociocultural theory about child development says that cognitive development occurs as a result of social interactions.

1.2. DEVELOPMENTAL MILESTONE

Development milestone vary in kids depending on their age and their surrounding or social interaction. Certain milestones are common to certain ages and they can be taught beyond that by outer stimulation but that too has limit. After understanding the development I have grouped ages:

0 TO 2 YEARS

- Curious and Active
- Desire for Independence
- Pretend play
- Imitates daily activity
- Rituals and Repetition
- Starts to Run, jump and climb

3 TO 5 YEARS

- Elaborate pretend play
- Interested in community play
- Understands social rules
- Develops problem solving
- Shows interest in puzzles
- Curious
- Likes challenges
- Enjoys storytelling

6 TO 11 YEARS

- Manage personal belongings
- Have sense of responsibility
- Can do tasks independently
- Can understand complex concepts
- Longer attention span
- Participates in organized sports
- Focused learning

CHAPTER 2

FURNITURES

2.1. SPACE

Home

- Furnitures at home are usually sharp edged and hence kids furniture with **round edge** provides safety.
- Kids love to climb and explore every corner and therefore furnitures need to be **stable and durable**.
- It needs to be **free from chemicals**.
- Furnitures needs to be **kids size** for them to **comfortably use**.



Fig. 2



Fig. 3



Fig. 4



Fig. 5

Image Source: Google

School

Classroom

Preprimary

- A preschool needs to make the setup **more creative** to ensure that the classroom promotes a **positive learning environment**.
- These furnitures focus on **interactive play**.
- Kids get easily bored and hence classroom should give them a lot of excitement and **encourage them to stay focused**.
- It should **not occupy entire space**.



Fig. 6



Fig. 7

Image Source: Google

Classroom

Primary

- A classroom layout **greatly impacts** how children use the supplies and how teachers facilitate learning methodologies.
- Classroom furnitures small and spaced as kids move around a lot and hence need **space for safety**.
- In Indian schools, more focus is on making young learners **feel at home**.



Fig. 8



Fig. 9

Image Source: Google

Playground

Preprimary

- Playground are usually enclosed and if not then kids are allowed to go out only when sun is low.
- The height of equipments are as per required.
- There are abstraction of different animals, flowers, sun, moon, stars to help them imagine and it help them build stories around them.
- Standing on the raised platform makes them feel as if the are standing above the world which helps their imagination to build stories.
- There are many holding places making sure they can climb and move down smoothly even in the absence of an elder.



Fig. 10



Fig. 11

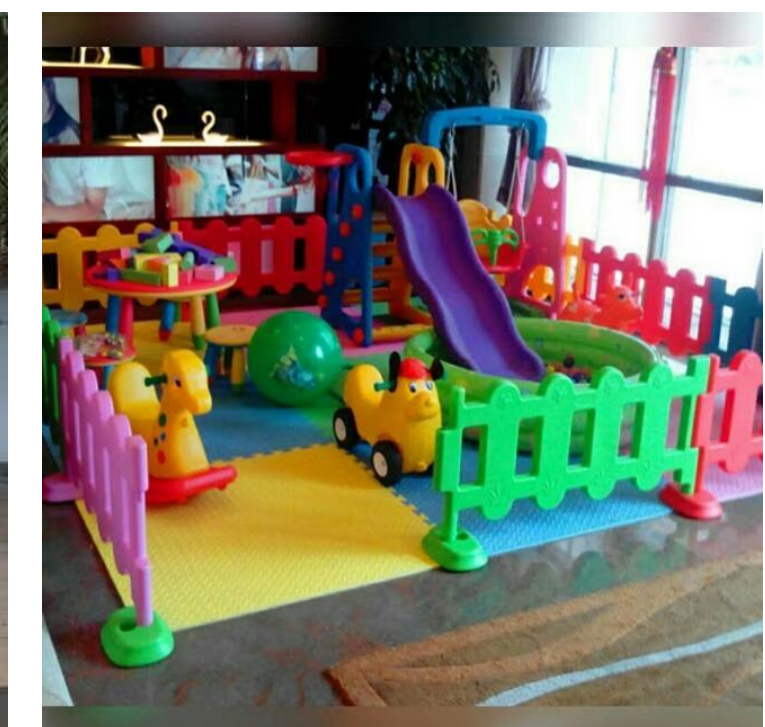


Fig. 12

Image Source: Google

Playground

Primary

- The age group is usually 6 to 12.
- These kids are full of energy and their play is usually rough.
- They need space to release their energy and equipments that can challenge them.
- Their equipments are usually full of holding and climbing and jumping.
- Usually made up of metal to cater their rough energy.
- Height of equipments are 2 to 3 times higher than that of preschool equipments.
- Colours are usually subtle and not bright.
- Most equipments are combination of different bars.



Fig. 13



Fig. 14



Fig. 15

Parks

- The range of play equipment varies to cover larger age group.
- Jungle jim is both suitable for preschoolers and primary schoolers.
- Jungle jim offers variety of activities such as climb, hang, slide, rope climb, on roof walk, spiral slide.
- It offers simple to complex activities such as climb using stairs and also with zigzag climber.
- Parents are usually present with kids.
- Sand area provides maximum exploration and hence most kids are involved with sand and of vast age group.
- They use sand for making domes, writing names, jump on them (as it provides natural cushioning), throw at each other, do long jumps.
- **They gather sand in a bottle and then let it fall slowly out of bottle. They do it continuously.**
- There are solid domes to climb and walk down. Kids rarely use it.
- Equipments are colourful and bright.
- There are circular holdings to hold while they walk on the platform.



Fig. 16



Fig. 17



Fig. 18



Fig. 19



Fig. 20

2.2. MATERIAL

Plastic

- **Stackable**, providing convenient storage options when not in use. This is particularly beneficial in smaller spaces.
- Can be **easily molded** into **different shapes and sizes**, allowing for **customization**.
- Comes in a **wide range of colors**, allowing for vibrant and playful designs.
- Equipments are usually one piece with rounded corners.
- Joints are big making sure kids do not take is in mouth.
- Thick and bobbly.
- Soft in appearance and low to ground.



Fig. 21



Fig. 22



Fig. 23



Fig. 24



Fig. 25

Image Source: Google

Metal

- Metal furniture often has a **sleek and modern appearance**.
- Appealing for **contemporary or modern design preferences**.
- It can contribute to a stylish and updated look in a child's room.
- Slick in design and minimalist.
- Usually bared and bright colours.



Fig. 26



Fig. 27



Fig. 28



Fig. 29



Fig. 30

Image Source: Google

Wood

- Both plywood and MDF are widely used to manufacture furniture for a child's room.
- Offers great **design flexibility**
- Creation of a wide range of styles and shapes.
- **Playful and child-friendly aesthetics.**
- **Warm and inviting** aesthetic to children's spaces.
- The natural beauty of wood can contribute to creating a **cozy and comfortable** atmosphere in a child's room.
- Equipments have very organic look and feel.
- Wood's natural colour has been used for aesthetics.
- Used in ply wood form.
- Thin and rounded edges.
- Soft look and feel.



Fig. 31



Fig. 32



Fig. 33



Fig. 34



Fig. 35

Image Source: Google

CHAPTER 3

USER STUDY

3.1. SCHOOL VISITS

I conducted visits to four schools with the aim of gaining insights into classroom setups, playground equipment and setup, evaluating the overall learning environment, and comprehending the curriculum structure. Additionally, my goal was to explore teachers' perspectives and understanding, particularly in relation to diverse age groups.

Points of Observation:

- Available Play aids
- Available Learning aids
- Classroom furnitures
- Pros and cons of available furnitures
- Materials used
- Prices
- The age groups
- Students in a batch
- Curriculum
- Attention span
- Kids behaviour with things around
- Type of activities conducted
- Teachers issues
- Teachers insights

1. Shishu Vihar, IIT Bombay

Disclaimer: I was not allowed to take any picture and even enter classroom due to ethics. I was allowed to observe the play area and had an initial level talk with the school in charge.

Insights

- Its a day care that take kids aged from 2 to 12 years old.
- They have 2 categories of kids depending on their age:
 - 2 to 5 years old
 - 6 to 12 years old
- The classroom set ups, playground equipments and it's setups are different for both.
- As it being a day care they focus more on social skills, language skills, pre read and pre writing skills.
- The classroom setup, playground equipments are as per their requirement which is based on their developmental milestones.
- The classroom set up and curriculum is based on **Child Developmental Theories**.
- They need ample amount of space and dynamic setup as different types of activities happen.
- Since furnitures are age specific, it cannot be used universally and hence they go for mat.
- Furnitures are used when needed such as writing, craft, drawing.
- furnitures are moved inside class only when needed.
- For 2 to 5 years old the equipments are based on different kinds of play that they go through, that is:
 - Isolatory play
 - Parallel Play
 - Community Play
 - Game

Differentiation based on Observation

2 to 5 years old

- Usual material is plastic and wood
- Helps enhance their cognitive
- Involved in imaginative play
- One piece, bright coloured, rounded corners
- Minimum to no joints
- There is ample space to hold and pull themselves
- Need toys that involves repetition.
- Open ended toys (helps develop their cognitive skills)
- 3*3 sq. feet accommodates 15 kids in class

6 to 11 years old

- Usual material is metal and wood
- Enhances their balance, eye hand coordination and muscle toning
- Involved in rough play
- Avoidable joints and use of cushions at joints. such as rubber covers.
- Mostly climbing and jumping involved
- Need challenging toys like puzzles
- Rule bounded and challenging toys
- 3*3 sq. feet accommodates 25 kids classroom
- Systematic arrangement of seats.
- Desk and bench are usually joined.

2. Kendriya Vidhalaya, IIT Bombay

Disclaimer: I was not allowed to take any picture where kids were there but was allowed to have class and play area observation. Also had an initial level talk with the class in charge (teacher).

Insights

- Its an institute that works on formal education that is there is specific curriculum which is highly academic based that has to be done in given time, its result bound, specific subjects and time table to be followed, uniform.
- They have proper chair and benches.
- Subtle colour to no colour (as going higher to class 6th, 7th and beyond).
- Classroom is full of furniture and little space for movement.
- Everyone has their designated place to sit and have to sit their for that specific day.
- Specific amount of time is given to specific subject and once time is over, subject changes.
- There is presence of blackboard.
- Desk has space for writing , reading, drawing, to keep books and pencil box.
- Most of the tasks happen on desk and bench.
- Highly energetic kids and are involved in rough play.
- The playground equipment mostly involves climbing, jumping, sliding.

Classroom Setup (Class 1 and 2)



Fig. 36

Source: Google Chrome

A standard classroom both helping kids to merge with further education system while maintaining the comfort of preprimary with use of colour.
Age specific furnitures.
Little space to move and have standard setting.
Reduced bulletin boards and artworks.

Playground (Class 1 and 6)



Fig. 37



Fig. 38



Fig. 39

Clicked during observation

Made up of metal that gives great stability as kids of age 6 to 12 years old are full of energy.
Designed to help run, climb, jump and slide.
The equipments help a lot with muscle toning and balance.

3. Balwadi

I got chance to visit, observation and talk with the teachers of the Balwadi.

Insights

- Kids here are from age 4 to 5.
- One class has 40 kids with 2 teachers and a care taker.
- Classroom consists of a blackboard, mat to sit, some games, books, notebooks and toy shelf.
- 4 years old in junior kindergarten and 5 years in senior kindergarten.
- Teachers primary aim is to encourage kids to come to school.
- To encourage they have TV time or cartoon time at school, storytelling and games.
- Their secondary aim is to teach manners and provide a safe learning environment which is usually absent at their homes.
- Environment at home is usually abusive, violence and no one to teach them how to properly sit and eat.
- Also initiatives are taken to teach parents how to behave in front of kids.



Fig. 40



Fig. 41



Fig. 42



Fig. 43



Fig. 44



Fig. 45

Pictures from the classroom taken during observation

- They have their own way of teaching and curriculum.
- Their curriculum is academic based teaching them 3 subjects: English, Mathematics and Environmental Science.
- Their curriculum is mostly based on preparing them for formal education.
- There is need of classroom furniture so that they can teach kids to sit on chair and use desks.
- Kids usually keep their bags and water bottles with them, creating hindrance in their focus.
- Teachers get 3 to 4 hours with kids and they wish to use time properly to teach.
- They have to do all the writing, drawing on mat which does not help them with posture correction.
- It also becomes inconvenient for teacher to walk while they are writing or drawing.
- Mats are not of good quality and it gets crumbled.
- Teacher wishes to have a classroom with defined spaces to keep bag, water bottles and study area.
- There are also times when they do not need furnitures such as during oral times.

4. Just Kiddin (Preschool)

- This class of kids is 3 years old.
- They are very expressive and everyone wants to express one or other things.
- They easily get distracted from one thing and switch to other.
- Also class did not have anything other than table and chair, maybe to avoid distraction while they are studying.
- They only hear when they are called out by their name otherwise they do not give attention.
- They want to do things themselves without the interference of others.
- They need constant appreciation for whatever they do.
- There are huge foamed cubes and rectangle in outside play area to play.
- They have a jungle gym.
- 2 year kids were being taught how to kick a ball and aim at goal.
- There was a child of 3 years who was making something out of cubes and was trying to balance horse and a bull on top of that and then used the whole structure like a bridge (I could not think that).
- They are involved in each others play and want to explore what other is doing.



Fig. 46



Fig. 47



Fig. 48



Fig. 49

Image Source: Google Map (Just Kiddin Gallery)

- A lot of discussion happens on a thing. E.g. One of the girl child said she had a golden teeth and everybody jumped to see and started discussing.
- They think a lot.E.g. There were two girls who were playing a guess game where one has to guess the colour which other was thinking.
- They copying each other and specially the elders (here, their teachers)
- They switch from one thing to other thing very easily (that is their attention span is too low) hence, keeping them engaged is very difficult.
- They love moving and running around even for no reasons.
- They touch everything to feel and understand.
- They want to do more and more complex things. If they have done something, they want to do something more difficult.
- They can focus on one thing at a time and hence if they are distracted, they are completely distracted.

3.2. OBSERVATION DURING THEIR PLAY

- For every action there is reaction.
- They need instant result or reward for their action to keep themselves engaged that is play for them.
- Anything that helps them use their recently learnt skills, is play for them.
- Anything that bring certain change due to their action is play. Which they can do repeatedly.
- Anything that helps them explore by themselves.
- Anything that they think and are able to do.
- Anything that surprises them due to their action.

3.3. ASER (Annual Status of Education Report) 2022

ASER phone surveys of 2020 and 2023 found that parents' belief in the importance of education was strong even while schools were closed.

In 2022 in rural India, 75.8% of 3-year-olds and 82% of 4-year-olds are enrolled in some form of pre-school, an increase of 7.7 and 6 percentage points respectively over 2018 levels (Chart 1).

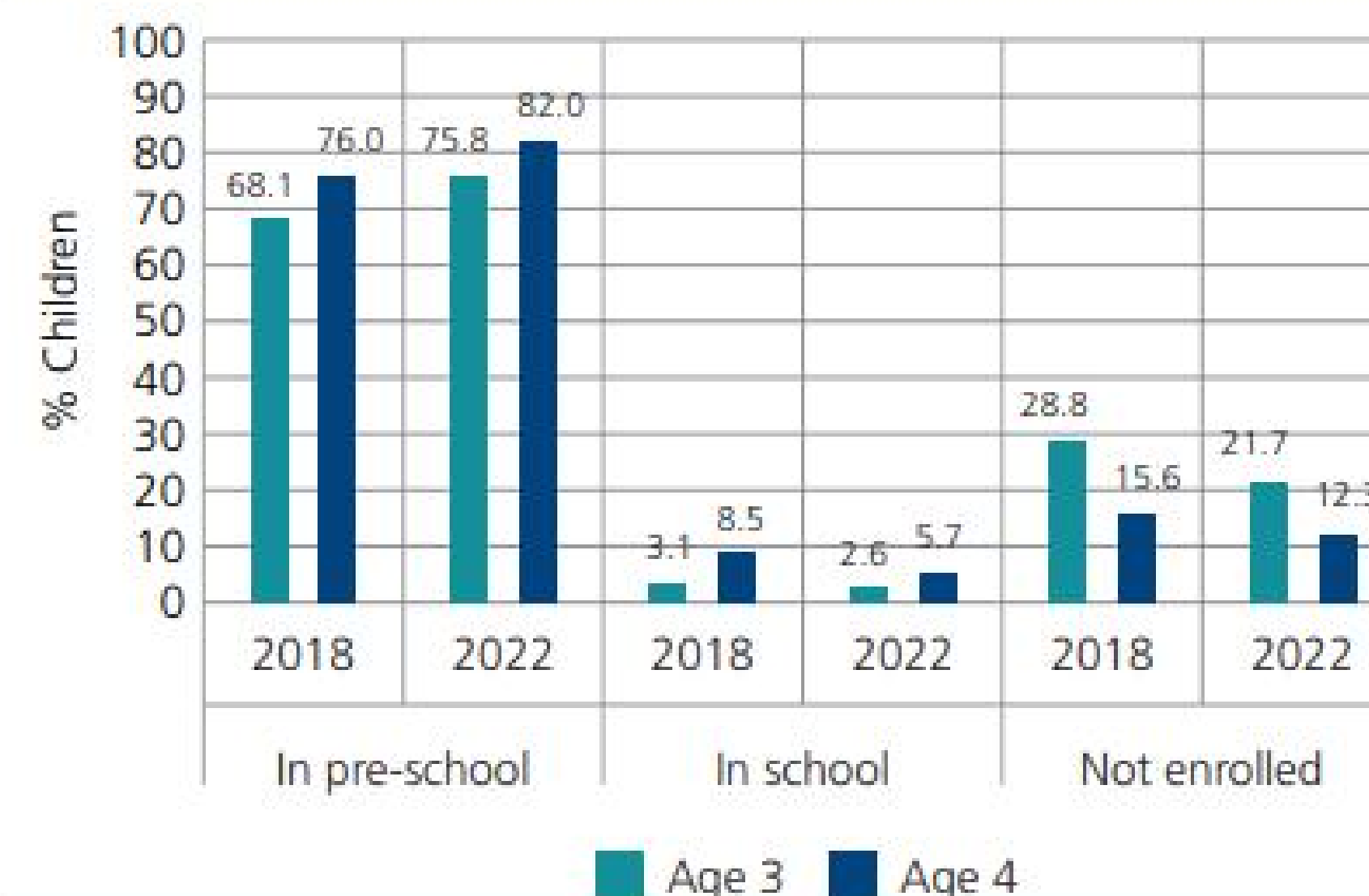
The fraction of children in this age group not enrolled anywhere has fallen sharply.

Enrollment data shows a **shift from private to government** institutions at all levels of schooling, unsurprising given the loss of livelihoods and financial distress experienced by households during the pandemic as well as the reported closure of many low-cost private schools.

At the national level, the shift from private to government institutions is especially visible in the case of 4-year-olds.

Nationally, enrollment of 4-year-olds in government pre-schools or schools increased by 10 percentage points, such that in 2022 more than two thirds of all 4-year-olds (67.8%) are enrolled in government institutions, the vast majority in ICDS (Integrated Child Development Services) Anganwadis.

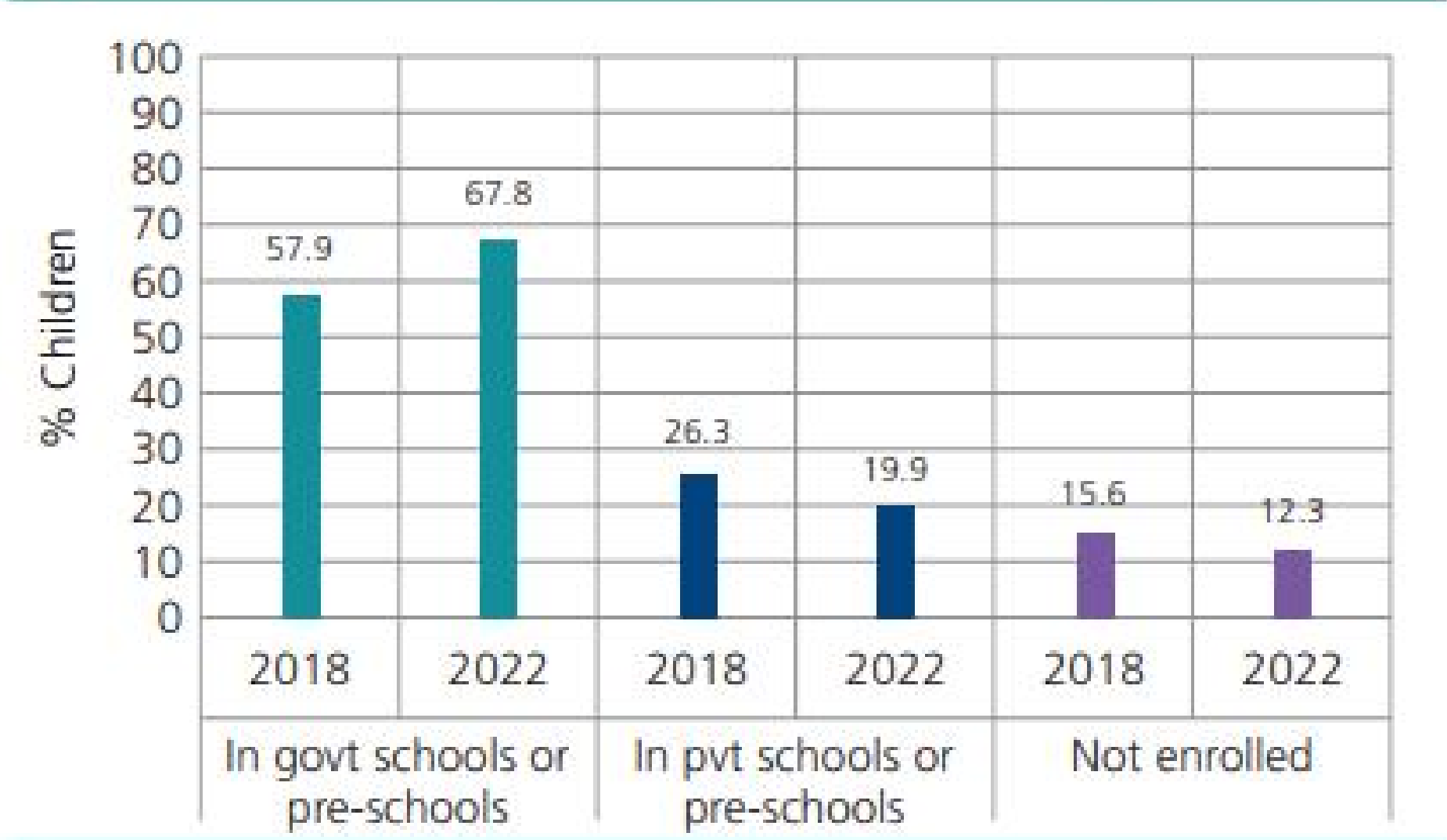
Chart 1: Enrollment status of 3- and 4-year-olds. All India. 2018 and 2022



Graph. 1

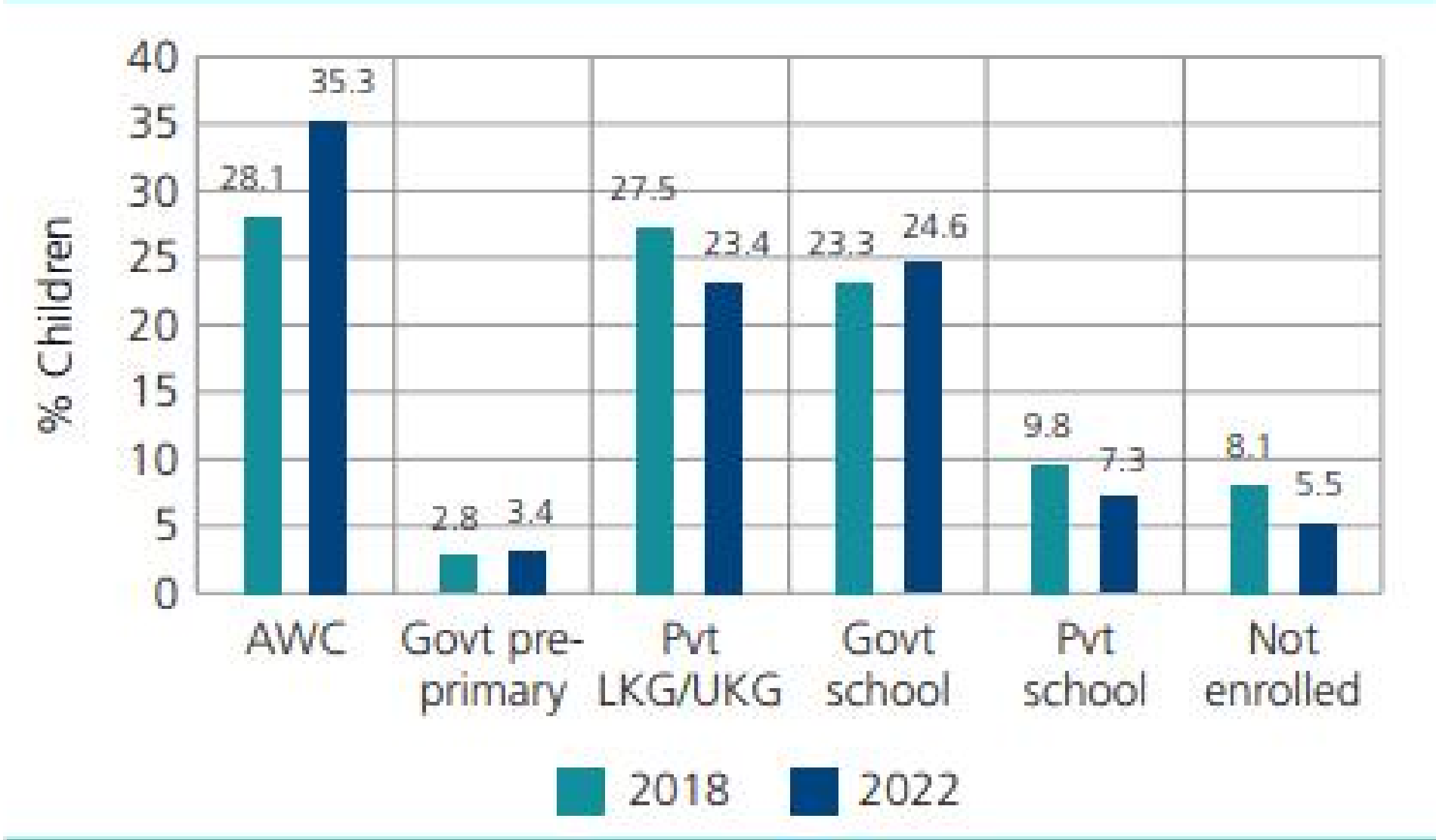
Source: ASER (Annual Status of Education Report) 2022

Chart 3: Enrollment of 4-year olds in different types of pre-schools and schools. All India. 2018 and 2022



Graph. 2

Chart 4: Enrollment of 5-year-olds in different types of pre-schools and schools. All India. 2018 and 2022



Graph. 3

Source: ASER (Annual Status of Education Report) 2022

3.4. DEFINING AGE GROUP

For kids I could figure out 3 age groups depending on their developmental milestones and child developmental theories. The most focused group from the schooling point of view is preschoolers that is age group of **3 to 5 years old kids**.

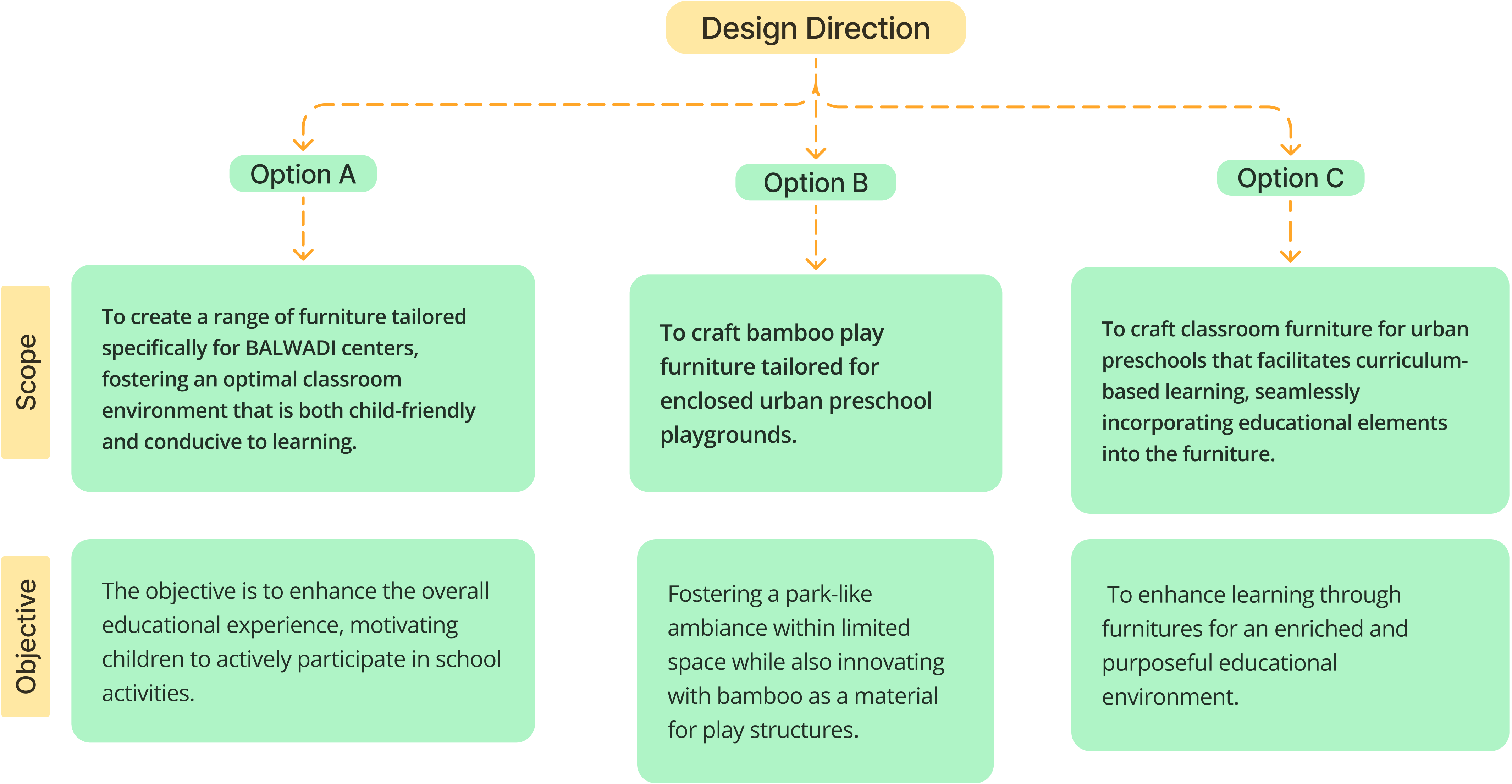
Following are the reasons to choose this group:

- 0 to 2 years kids are under early development phase and their primary needs are focused on **basic care, bonding, and exploration** in a safe and nurturing environment.
- They need a lot of **individualized attention**.
- primary caregivers are often parents or family members.
- primary needs of infants and toddlers are focused on **nutrition, sleep, and physical comfort**.
- Children are generally not developmentally ready for structured formal education until they reach the age of 3 or 4.
- Young children are more **susceptible to illnesses**, and their immune systems are still developing.
- Hence actual learning for future starts from the age of 3 or 4.
- As said by **Pieget** in his theory that after the age of 7 there is settlement in thought.
- According to **Lev Vygotsky**, provided an environment there is something that we can do and then there more that we can do with help of more knowledgeable other.
- **The Preschool stage**, which is 3rd stage, encompassing ages 3 to 5, is a **vital phase** in **Erikson's psychosocial** development theory. During this stage, children grapple with **feelings of initiative versus guilt**, focusing on **autonomous actions and the formation of goals and aims**.

CHAPTER 4

SCOPE OF DESIGN

4.1. DESIGN DIRECTIONS



4.2. DESIGN DIRECTIONS SELECTION

Timeframe

I have a three-month window starting from February 1st to complete the project.

- Ideation
- Concept Generation
- Mock ups
- Prototyping
- Field trial
- Final design
- Final Design making

Accessibility Challenge

Private institutions are challenging to access due to ethical considerations, while government schools offer easier entry but continuous visit hinders education. **Design Direction B** gives maximum opportunity as access to parks are free. Also any open space can be used to test prototypes

Usability opportunity

Recognizing a significant gap in play and learning aid furniture, there is a potential for a substantial market development. Classroom furniture is a fundamental necessity for focused learning, and the absence of adequate furniture hampers the training for the future. As we see learning is being made through play. Play is being included in different ways in preschools. A lot of efforts are being made for their motor skills as it completes their learning which is mostly done through play.

Scope

Introducing furniture that goes beyond its conventional role holds the potential to revolutionize class learning. It can positively impact the overall learning experience.

Use of bamboo for play furnitures brings a whole new category of play furnitures which can used both by rural and urban schools. Also bamboo being orgaanic material can attract people from different groups to make it part of their play area.

Considering the above factors and reasons Design Direction B which is, **to craft bamboo play furniture tailored for enclosed urban preschool playgrounds fostering a park-like ambiance within limited space while also innovating with bamboo as a material for play structures**, gives most of the opportunity and scope. it also helps use create a whole new category of play furnitures.

CHAPTER 5

USER UNDERSTANDING

5.1. ECONOMIC POSITIONING

Kidzee Preschool & Daycare in Powai - Hiranandani Garden:
₹8334/month



Fig. 50



Fig. 51

Happy Minds International, Powai: ₹4164/month



Fig. 52



Fig. 53

VIVERO International Preschool & Child Care: ₹4134 - 8459/month



Fig. 54



Fig. 55

Just Kiddin' International, Powai: ₹4000/month



Fig. 56



Fig. 57



Fig. 58

Upper-class schools (5k - 10k/month school fee)

- Mother's pride
- Euro Kids
- Kidzee
- Kangaroo Kids
- Hello Kids
- Little Elly



Fig. 59

Middle-class schools (2k - 5k/month school fees)

- Mother's lap preschool
- Footprint preschool
- Shemrock
- Gurukul
- Bachpan playschool
- Sanfort preschool



Fig. 60

Low-class schools (400 - 2k/month school fee)

- NDPS Kids empire
- Kids island
- Saraswati aanchal school
- Apple plays school
- Little kids preparatory school
- Native pride public school
- Blue moon public school
- Jingle bells

Source: Vishal Saroj P2 Report

5.2. ETHNOGRAPHIC STUDY



Fig. 61

- They climb
- Jump from top to ground
- Run to the top
- They lie down on the top



Fig. 62



Fig. 63

- She was holding leaving one in middle that is how she tried increasing her difficulty level.
- She used the plastic base come down to ground.
- She is swinging her body back and forth to gain momentum.



Fig. 64



Fig. 65

- They play long and high jump
- They dig
- Write using it by filling in bottle
- They lie down and make butterfly
- Throw it at each other



Fig. 66



Fig. 67

- There is this jungle gym which provides many different things in one and for varied age group.
- It has 2 slides of different heights and one spiral slide catering different age groups.
- Many kids were just walking on the elevated surface and were looking down or were talking.
- Many used slid for going up than sliding as it gave them smooth surface to climb up.
- They also ran faster to climb the slide quickly.

5.2. ACTIVITY ANALYSIS

- Running
- Jumping
- Climbing
- Spine balancing
- Sliding
- Imaginative play with open ended blocks
- Exploring
- Use of full body muscles



Allowing their basic activities

Gross motor skills

Static, simple structure, Appropriate height, Colourfull, Rigid, minimum to no joints, Round edges, bars, holding spaces, allows space for exploration, imagination, self doing, Engaging

CHAPTER 6

PLAY UNDERSTANDING

6.1. THEORIES

1. Caillois's Attitude in Play

Describing play by six characteristics:

- free-not obligatory
- limited in time and space
- uncertain
- unproductive
- governed by intrinsic rules
- allows makes-believe

Caillois also identified four broad attitudes in play experiences, which lead to four play forms, on a continuum from completely unstructured, free play to structured, rule-based play:

- Agon or Competition: Based on the idea of winning by mastering a single quality/skill against opponents, within defined limits and without outside assistance such that there is an equal chance of winning e.g. chess.
- Alea or Chance: Based on the idea of winning by favor/luck, rather than skill and experiencing pleasure in the lack of control and anticipation. Agon and Alea both involve creating conditions of equality. E.g. slot machine.
- Mimicry or Role Playing: Based on pretending to be another to convince others (audience) such that imaginative reality is maintained. Unlike Agon and Alea, mimicry does not have explicit rules or conditions but relies on improvisations. E.g. playing doctor-patient.
- Ilinx or Vertigo: Based on the pleasure from altering perception and shocking self through bodily movement. It may also involve pleasure in destruction/disruption of moral order. E.g. roller-coaster ride.

Source: <https://www.dsource.in/course/designing-children-play-and-learn/learning-theories-and-design>

2. Play Pyramid by Kudrowitz and Wallace

The play pyramid is a three-dimensional map that allows designers to classify a toy concept by placing it in a space between four independent axes representing four types of play

sensory

fantasy

construction

challenge-based play, applicable to all ages.

3. Csikszentmihalyi's Flow Theory

- Clear goals and immediate feedback
- Equilibrium between the level of challenge and personal skill
- Merging of action and awareness
- Focussed concentration
- Sense of potential control
- Loss of self-consciousness
- Time distortion

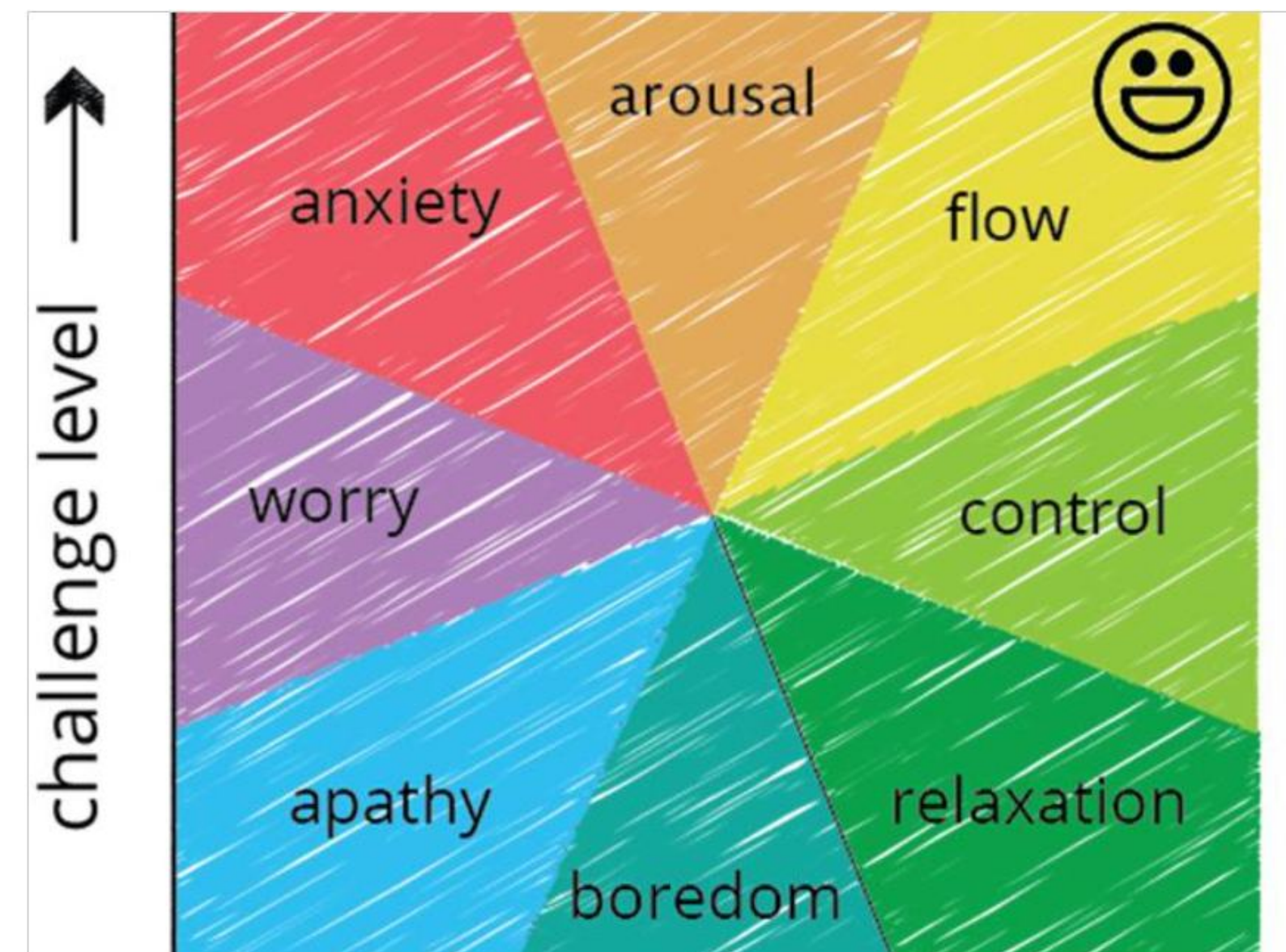


Fig. 68

Source: <https://www.dsource.in/course/designing-children-play-and-learn/learning-theories-and-design>

4. Apter's Reversal Theory

Apter's reversal theory proposes using design to induce changes (reversal) in motivational states and/or emotional arousal, to guide the user in a desired experience.

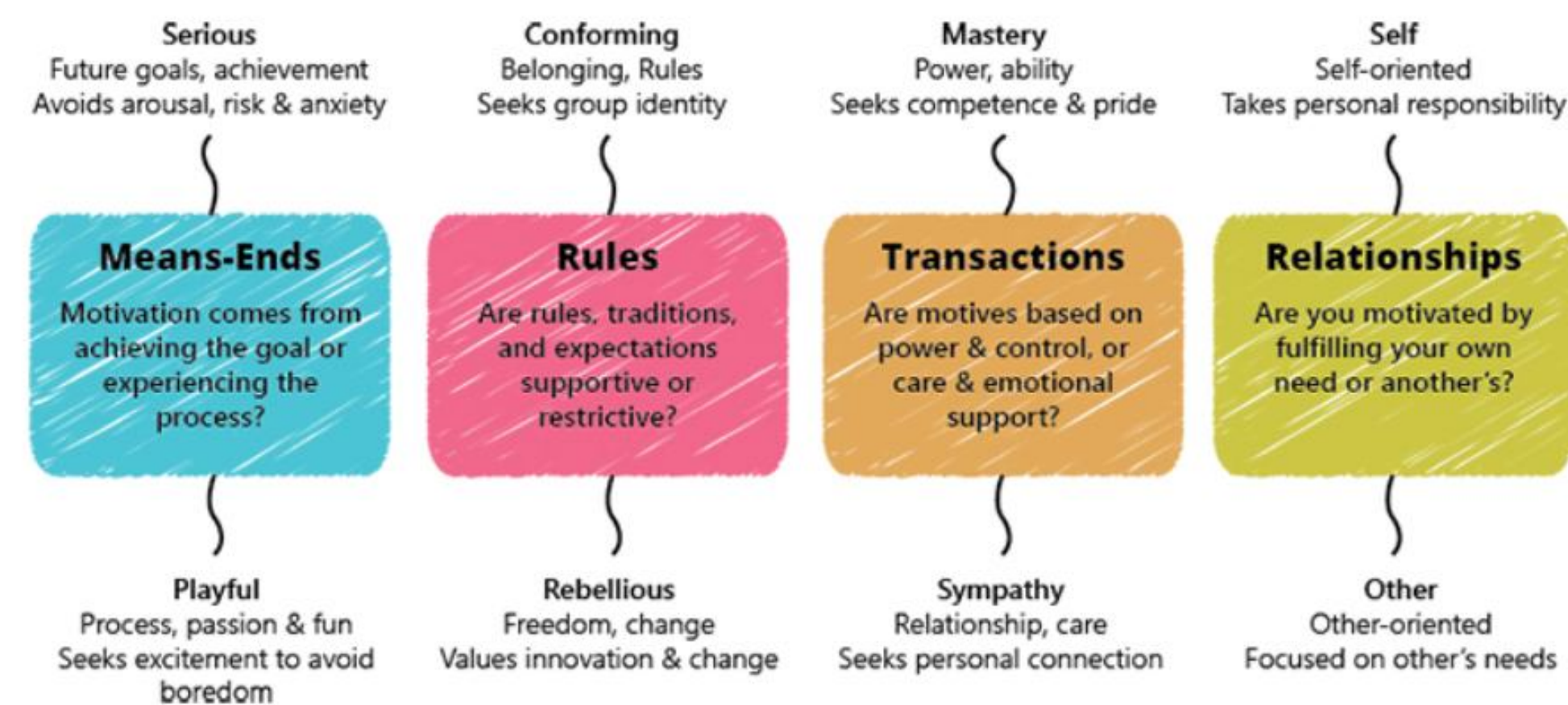


Fig. 69

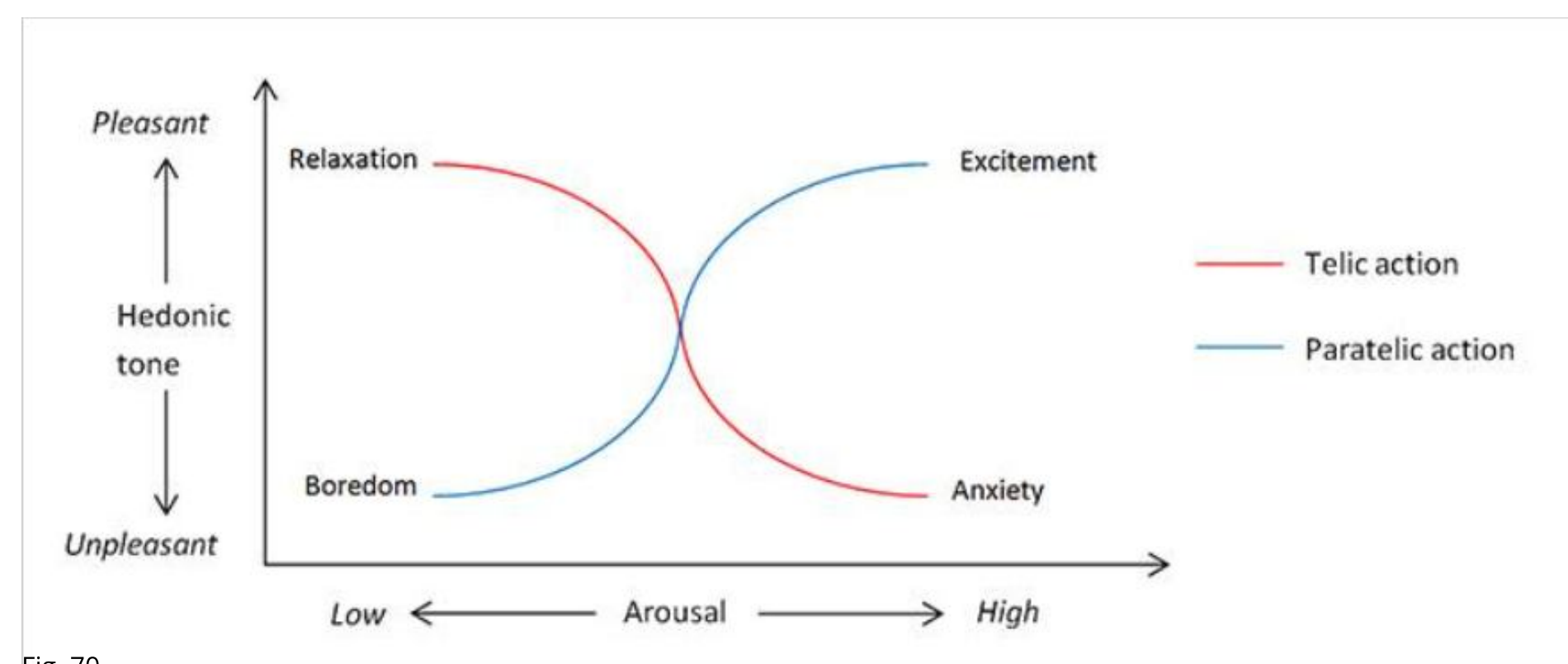


Fig. 70

Insights

- Intrinsic Motivation
- Non literary
- Active engagement
- Free not obligatory
- Allows create their own stories
- Context based
- Multi dimentional

Source: <https://www.dsource.in/course/designing-children-play-and-learn/learning-theories-and-design>

CHAPTER 7

MATERIAL UNDERSTANDING (BAMBOO)

7.1. WHY BAMBOO

- Bamboo is an **incredibly strong and sustainably** sourced material around the world, in fact, it's one of the **most eco-friendly** materials on Earth.
- Bamboo is a **safe** and **healthy material**. Unlike plastic or other alternatives, you don't have to worry about harmful toxins.
- Bamboo grows very quickly (4 to 5 years) and hence is abundance in nature.
- Bamboo is cylindrical and gives lot of space to make gross motor skill based furniture that requires lot of holding. Most motor skills starts with holding.
- Bamboo furniture is generally **lightweight** compared to some other materials. This makes it easy to move around.
- Bamboo furniture often has a **natural and appealing aesthetic**. It can add a touch of **warmth and organic beauty** to a child's room, creating a **pleasant and comfortable** atmosphere.

7.2. FURNITURE STRUCTURE

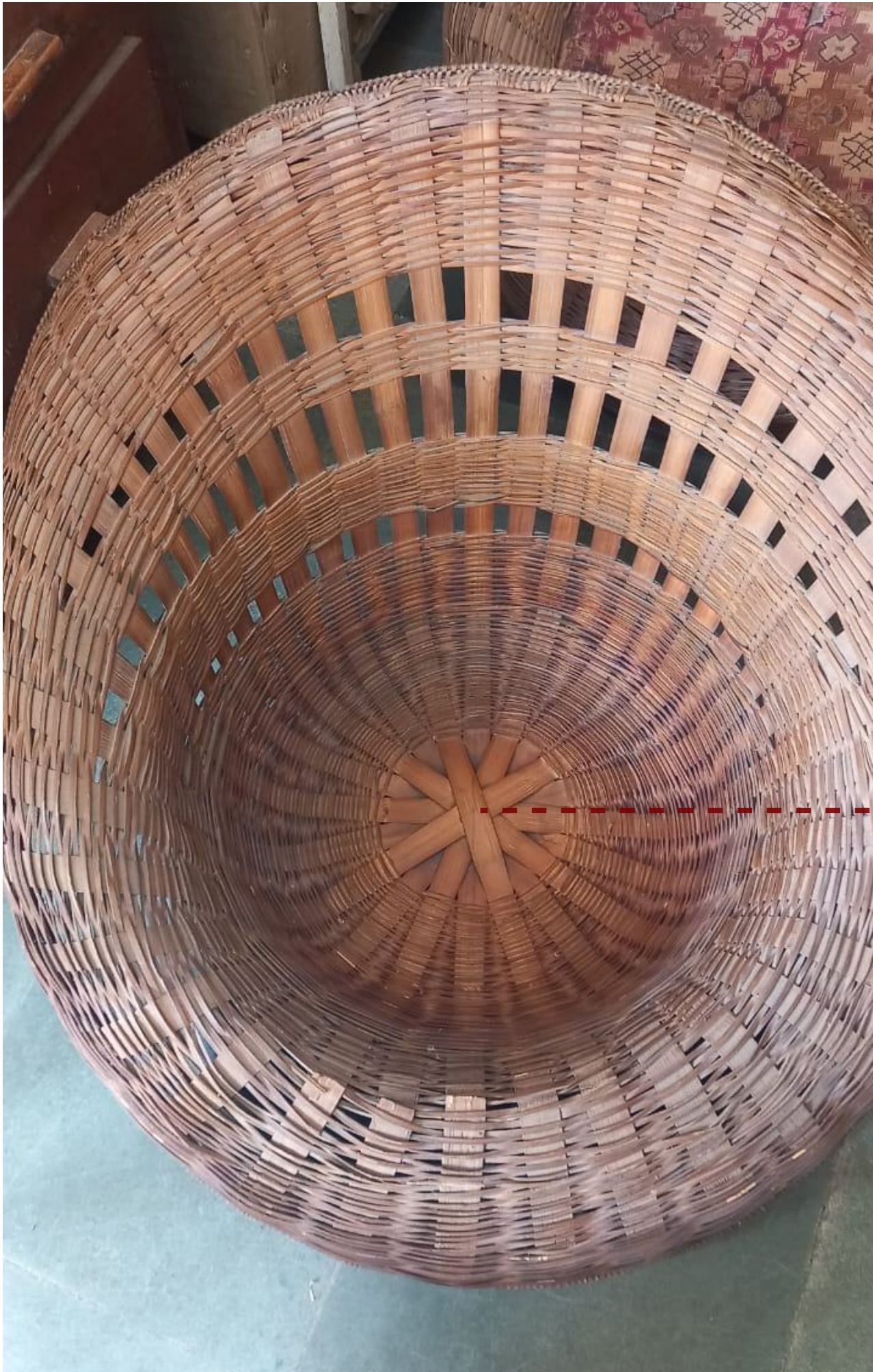


Fig. 71

Gapping provided to increase the distance to get required form.

Pine needle method

Chrysanthemum base

Fully Woven

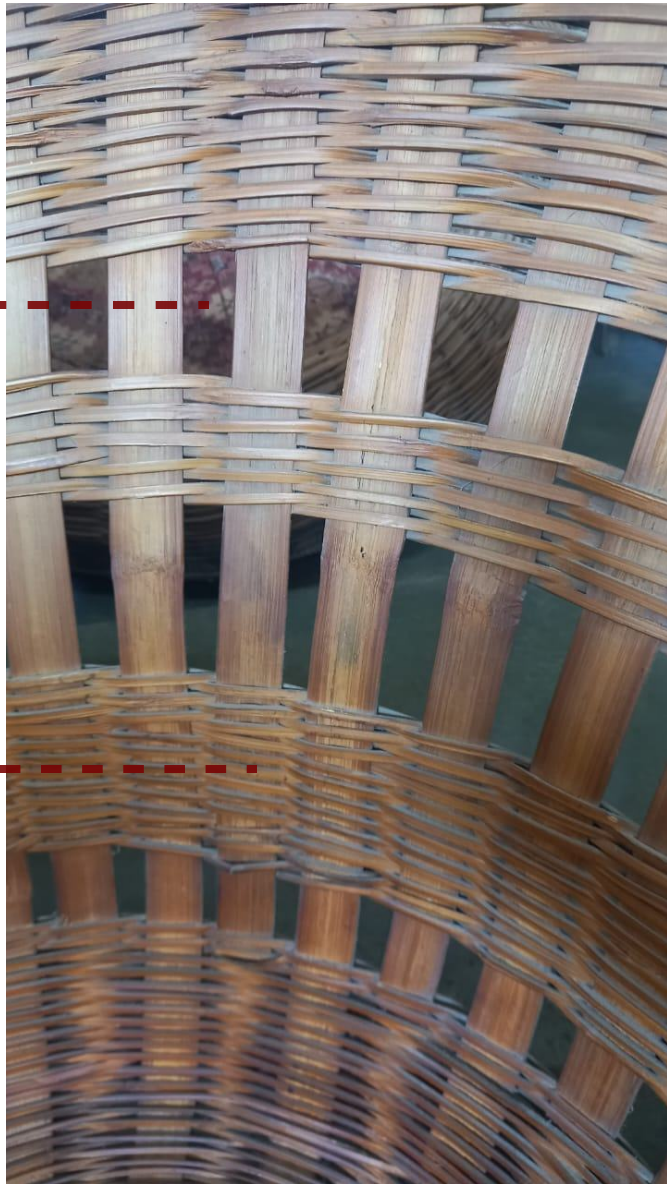


Fig. 72



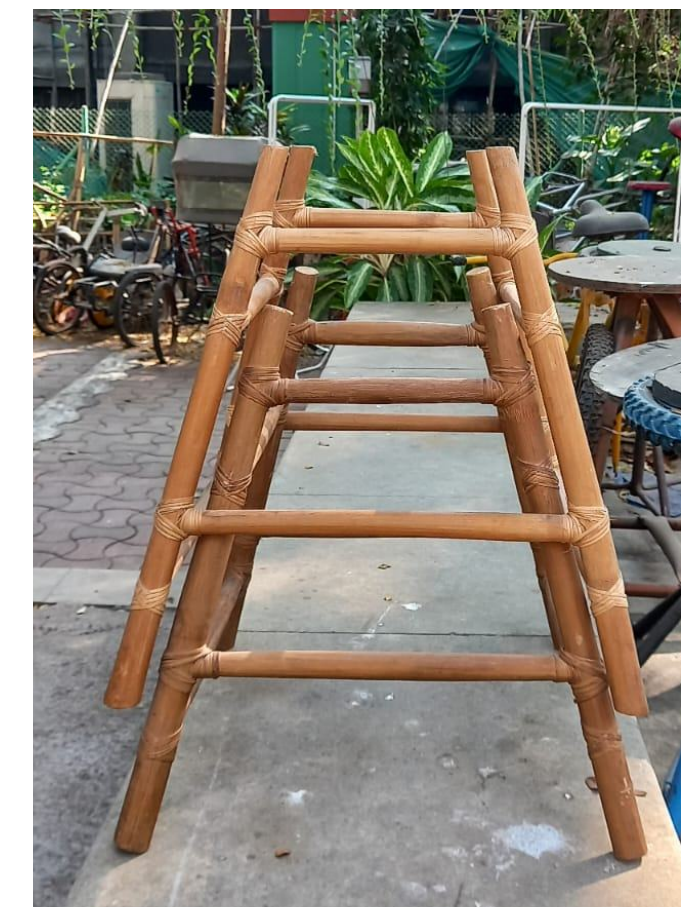
Fig. 73

Bent using hot gun to provide comfortable sitting

Modular and Stackable
(Tapered legs provide space for stackability.)

Friction tight (Cane used)

Use of Solid
Bamboo and Slat



Fish mouth joint



Fig. 74



Use of solid bamboo

Fig. 75

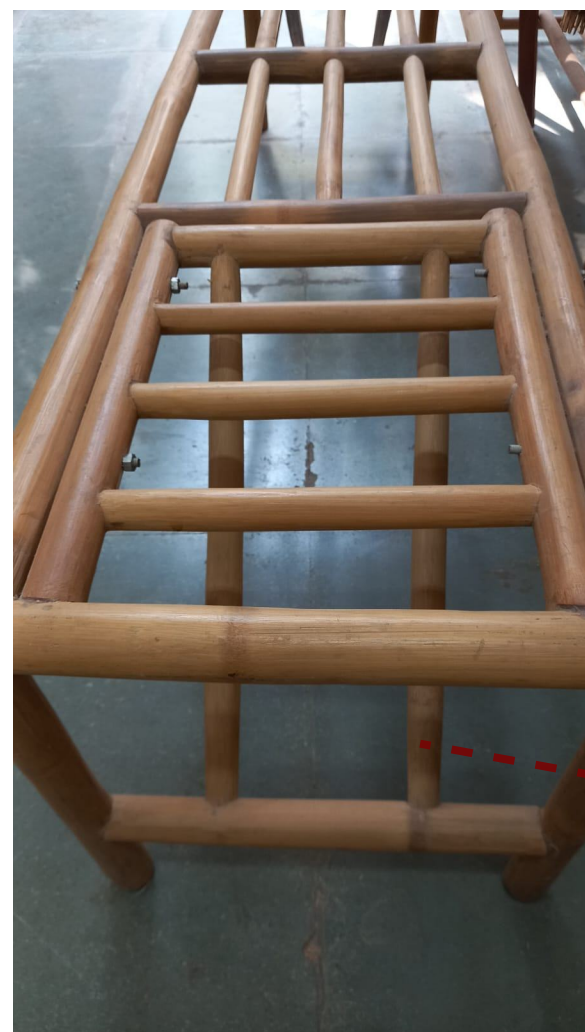


Fig. 76

Cross legs to support straight legs

Plug in nut bolt connection



Fig. 77



7.3. BAMBOO FORM



Fig. 78

Solid Bamboo



Fig. 79

Bamboo Slat



Fig. 80

Bamboo Strips



Fig. 81

Bamboo Sticks

Image Source: Pinterest

7.4. BAMBOO MAKING PROCESS

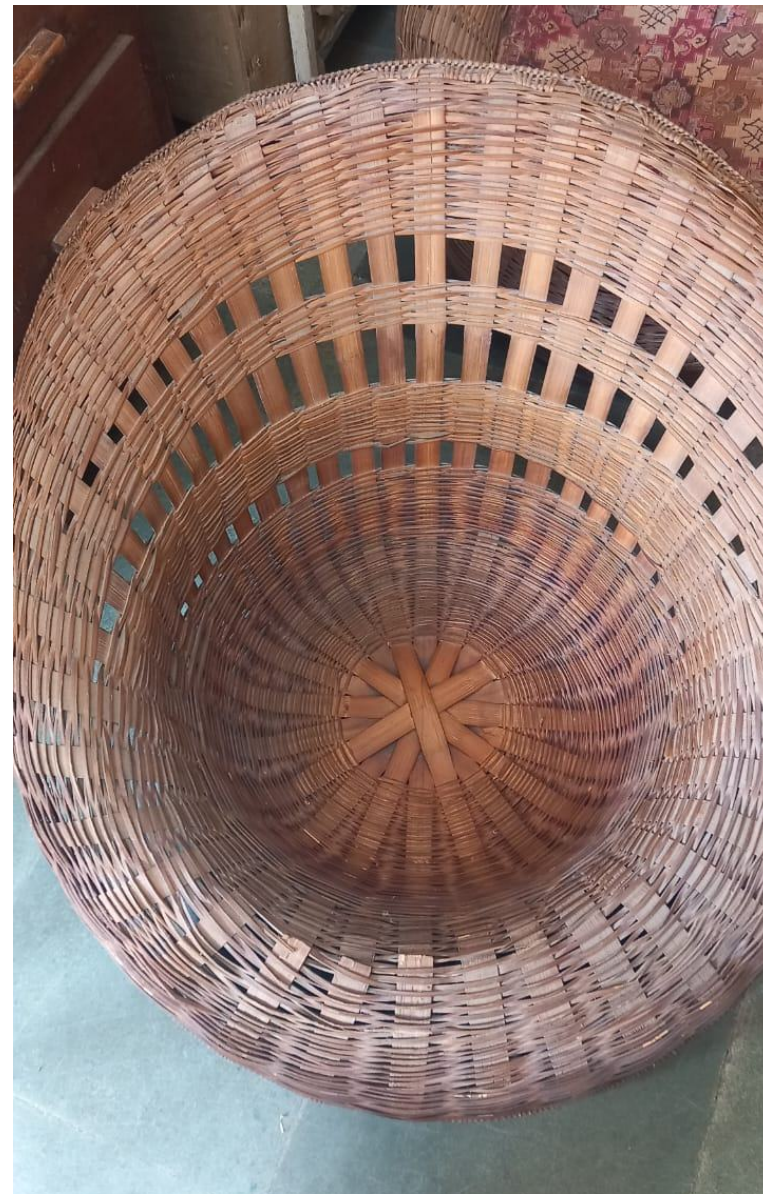


Fig. 82

Bamboo Weaving



Fig. 83

Bamboo Bending



Fig. 84

Bamboo Quilling



Fig. 85

Solid Bamboo

7.5. DESIGN BRIEF

To design indoor play furnitures for urban middle class preschools having fee range of 2k to 5k per month using bamboo as a material.

- Should have play element in it such as: Intuitive, active engagement, repetitive in nature (the action performed)
- Should allow activities such as climbing, jumping, sliding, balancing, running, swinging.
- Should be static, structured and rigid providing safety.
- Should be of appropriate height allowing kids for self exploration and imagination.
- Should help them enhance their motor skills which part of their developmental milestone.
- Attributes of furniture: Inviting, engaging, lot of holding spaces, bars, rounded edges.
- Use of primary colors.
- Using solid, hollow and slat bamboo to maintain structure and needed attributes of play furnitures.

CHAPTER 8

ANTHROPOMETRY

8.1. BODY DIMENSION



Fig. 86



Fig. 87

Source: Vishal Saroj P2 Report

8.2. STANDARD MEASUREMENT OF EQUIPMENTS

Infant/Toddler: 6 – 23 months	Preschool: Ages 2 – 5	School-age: Ages 5 – 12
Climbing equipment up to 32" high	Climbing equipment up to 60" high	Climbing equipment up to 84" high
Ramps	Horizontal ladders and overhead rings 60" high or less for 4-5 year-olds	Arch climbers
		Free standing flexible climbers
Single file step ladders	Merry-go-rounds	Stairways
Slides	Ramps	Chain or cable walks
Spiral slides less than 360°	Rung ladders	Fulcrum seesaws
Spring rockers	Single file step ladders	Ladders- horizontal (84" high), rung, and step
Stairways	Slides	Overhead rings up to 84" high
Swings with full bucket seats	Spiral slides up to 360°	Merry-go-rounds
Ramps	Spring rockers	Ring treks
Single file step ladders	Stairways	Slides
	Swings- belt, full bucket (2-4 yrs.), and rotating tire	Spiral slides more than one 360° turn
		Vertical sliding poles
	Balance beams up to 12" high	Swings- belt and rotating tire
		Track rides
		Balance beams up to 16" high

Fig. 88

From Paper: Playground Information to Use with the Environment Rating Scales

Requirements for slides:

For preschool and school-age: The exit region of slides should be at least 11" long. The exit height of slides up to 4 ft. high should be 11" or less, and the exit height of slides over 4 ft. high should be at least 7" but not more than 15". The fall zone around slides should be at least 6 ft on all sides, except at the slide's exit. For slides up to 6 ft. high, the fall zone at the exit should be at least 6 ft. For slides greater than 6 ft., the fall zone at the exit should be at least as long as the slide is high up to 8 ft. max. The fall zone at a slide's exit should not overlap the fall zone of any other equipment.

For infants and toddlers: The exit region of slides should be 7" – 10" long, and the exit height should be 6" or less. The fall zone around slides should be at least 3 ft., except at the slide's exit, which should be at least 6 ft. The fall zone at a slide's exit should not overlap the fall zone of any other equipment.

Requirements for swings:

For preschool and school-age: **Single-axis swings** should have a pivot point of 8 ft. or less. There should be no more than 2 swings located within a single swing bay. The distance between swings at rest within a single bay should be at least 24", and the distance between a swing at rest and its support structure should be at least 30" (measured 5 ft. from the ground). The seat of swings for preschool-age children should rest at least 12" inches from the ground, and the seat of swings for school-age children should rest at least 16" from the ground. The fall zone for single-axis swings is 2 times the distance from the pivot point to the ground, both in front and back of swings, and cannot overlap the fall zone of any other equipment. A 6 ft. fall zone is required from the perimeter of the supporting structure. **Tire swings** should not be attached to composite structures and should not be suspended from a structure with other swings in the same bay. The bottom of the seat of the tire swing should rest at least 12" from the ground. The clearance between the seat and the sides of the support structure should be 30" when the tire is held in its closest position to the support structure. The fall zone for tire swings is the distance from the pivot point to the top of the tire plus 6 ft. in all directions, and should not overlap the fall zone of any other equipment. A 6 ft. fall zone is required from the perimeter of the tire swing's supporting structure.

For infants and toddlers: **Single-axis swings** should have a pivot point of 47" or less, and the seat should rest at least 6" from the ground. The fall zone for single-axis swings is 2 times the distance from the pivot point to the ground, both in front and back of swings and cannot overlap with the fall zone of any other equipment. A 3 ft. fall zone is required from the perimeter of the supporting structure. **Bucket swings** should have a pivot point between 47" and 95", and the seat should rest at least 24" from the ground. The fall zone for bucket swings is 2 times the distance from the pivot point to the bottom of the swing seat, both in front and back of swings and cannot overlap the fall zone of any other equipment. For both types of swings, there should be no more than 2 swings located within a single swing bay, and the distance between swings at rest within a single bay or between a swing at rest and its support structure should be at least 20" (measured 5 ft. from the ground).

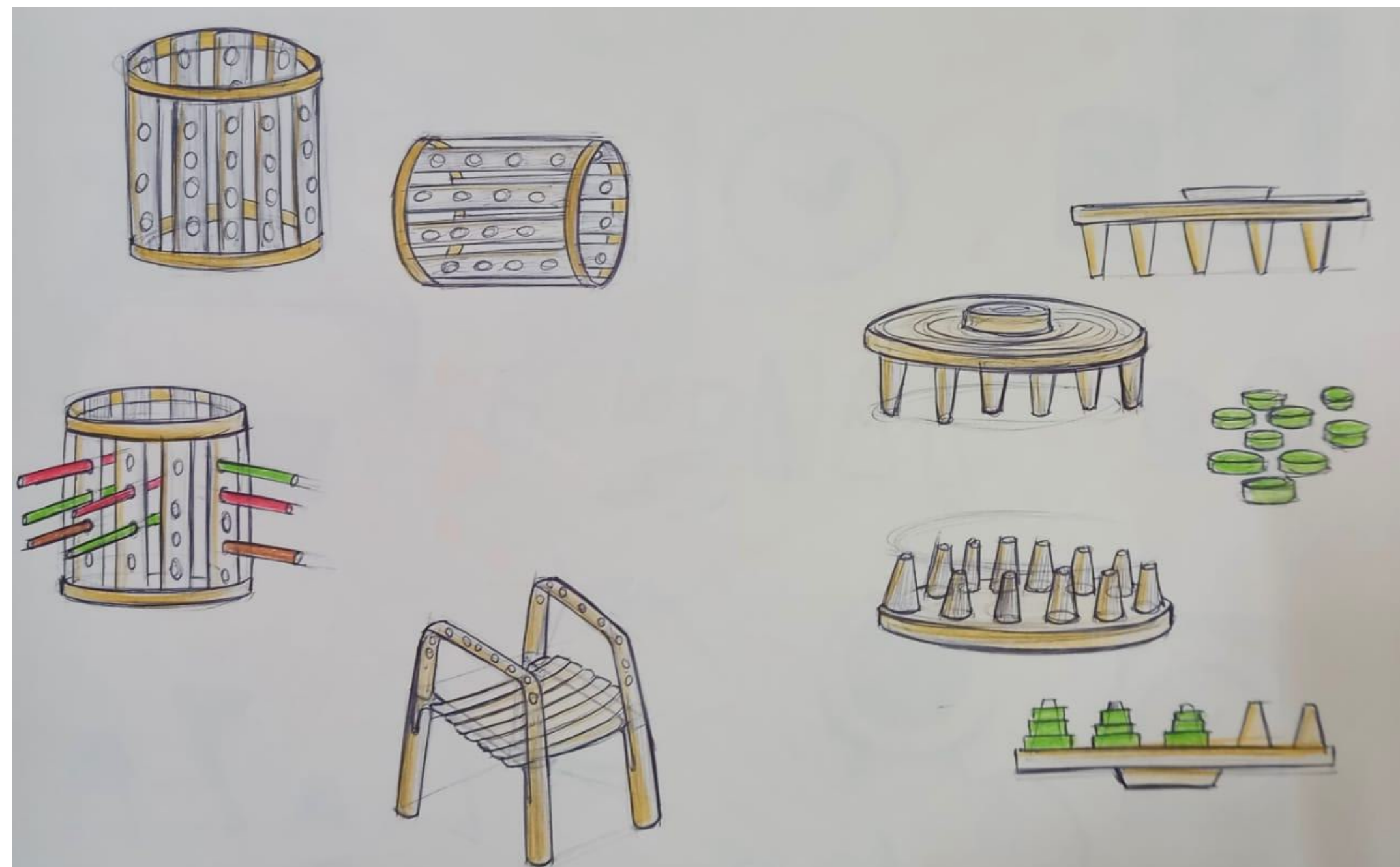
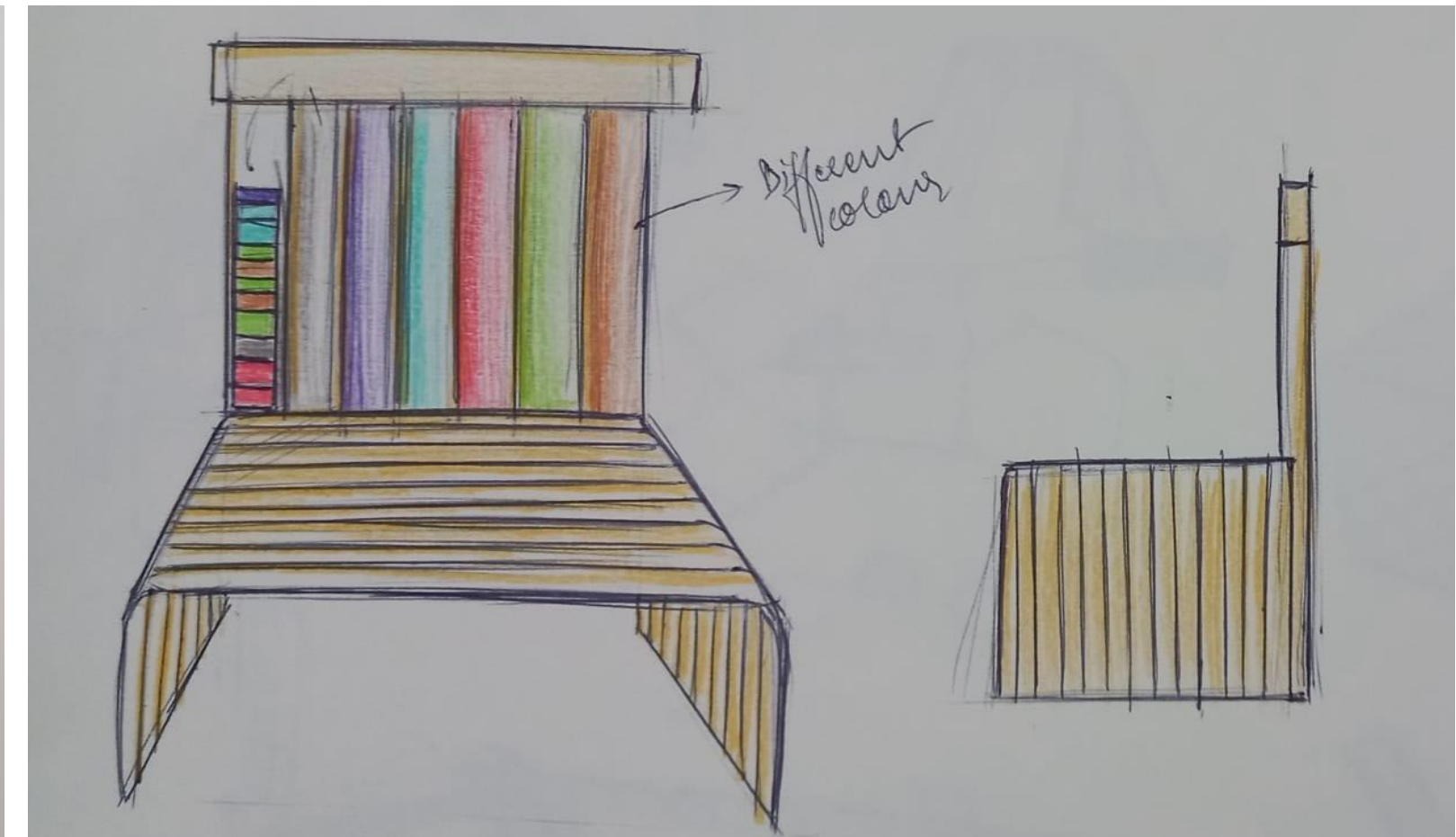
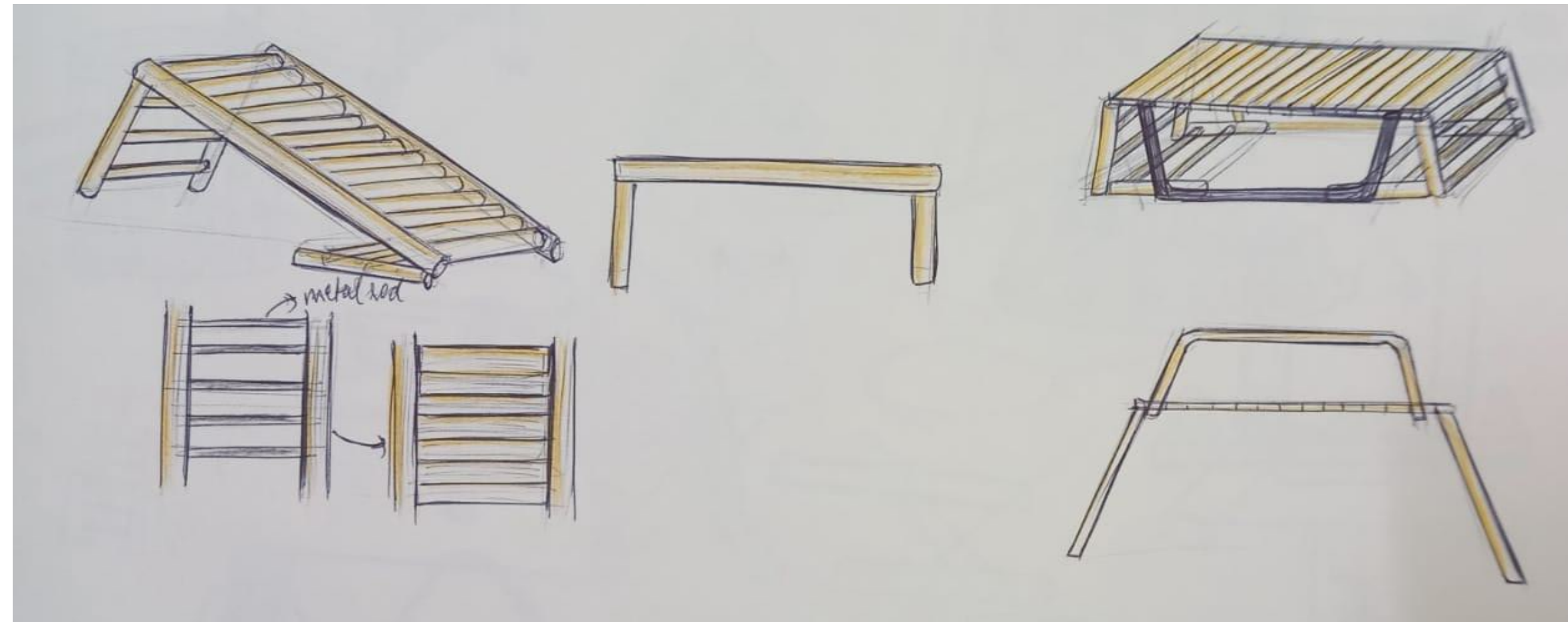
Fig. 89

CHAPTER 9

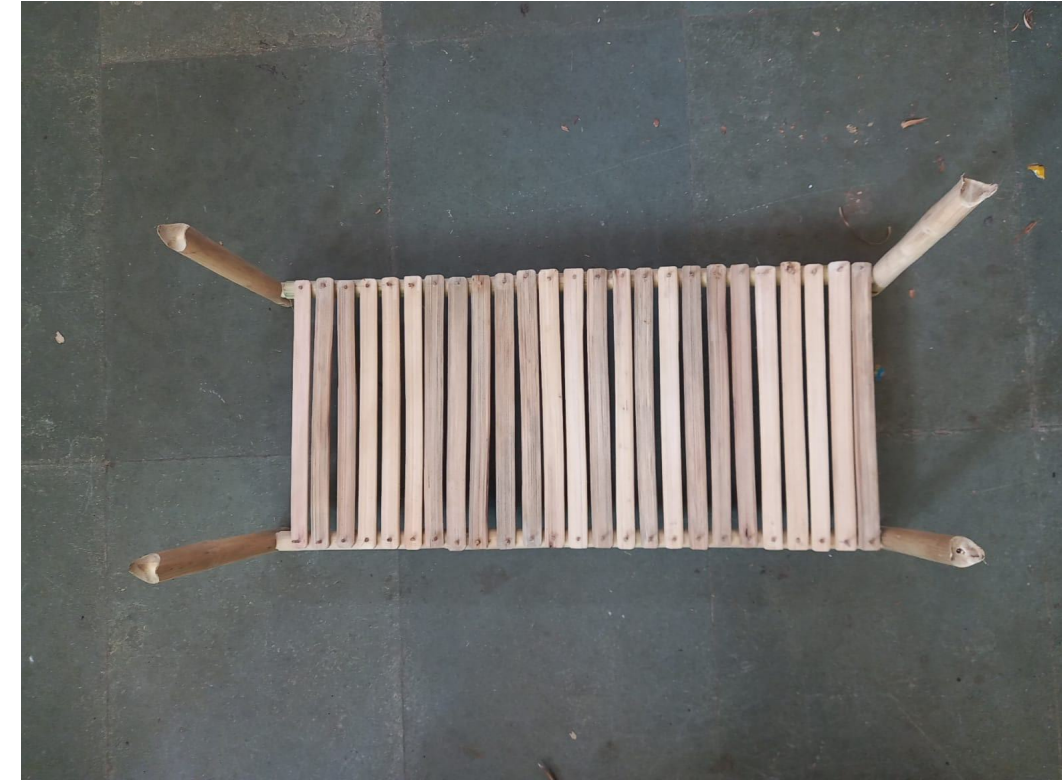
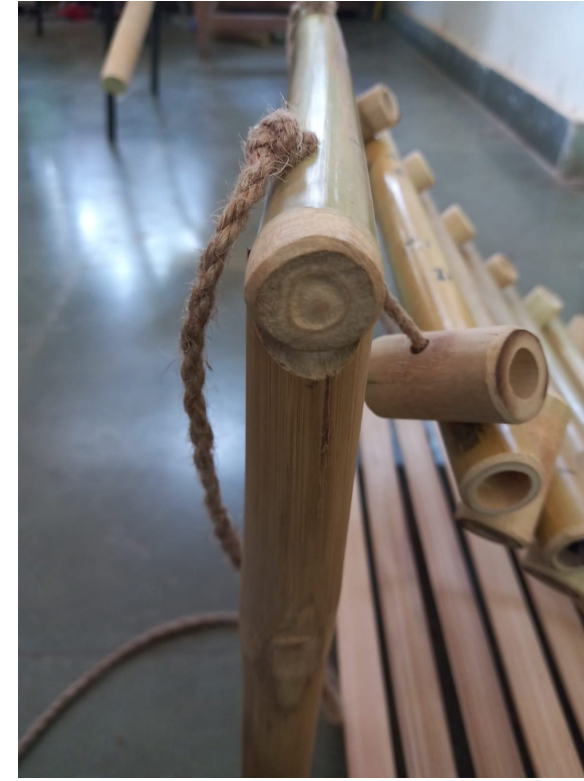
IDEATION

9.1. PHASE 1



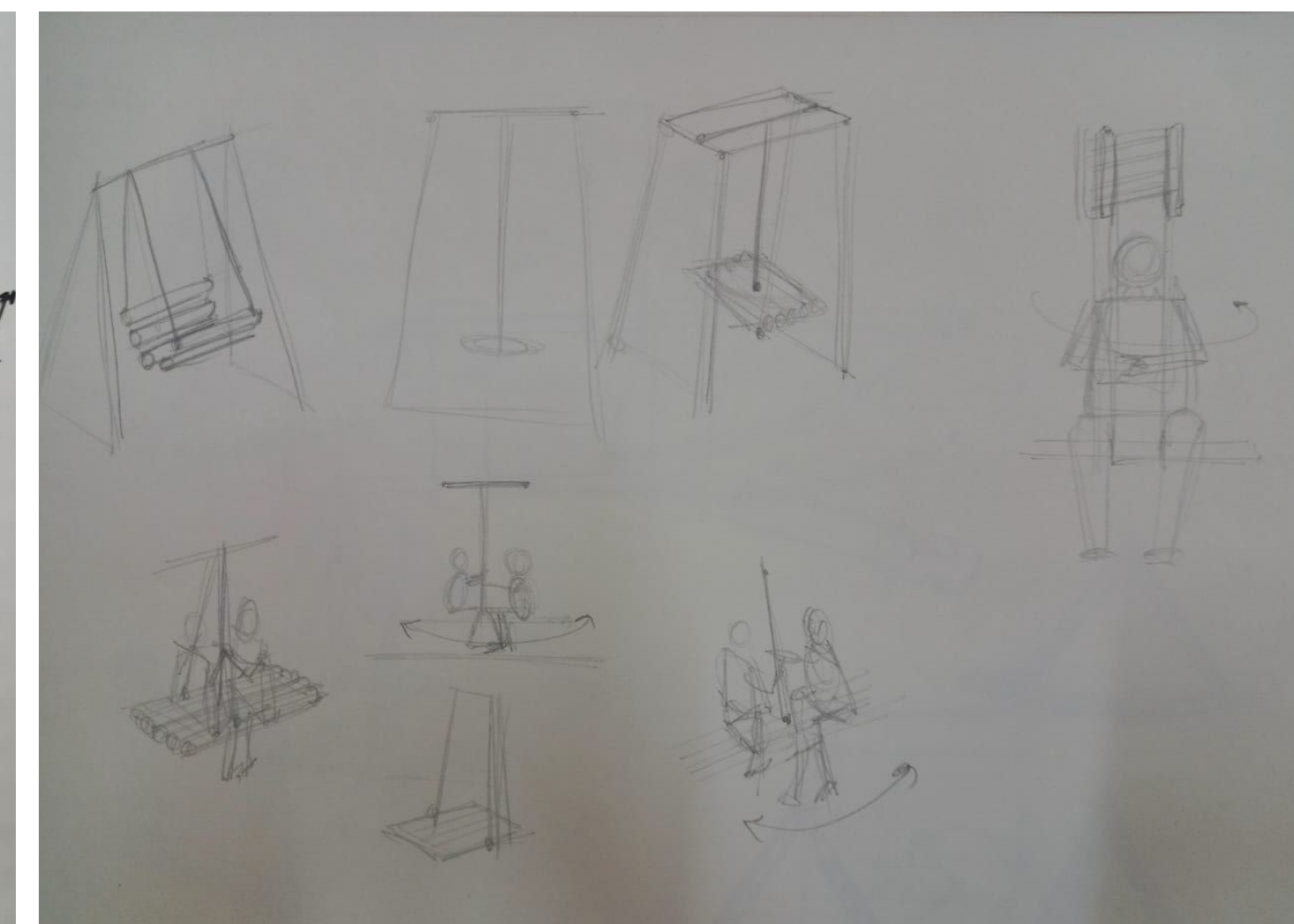
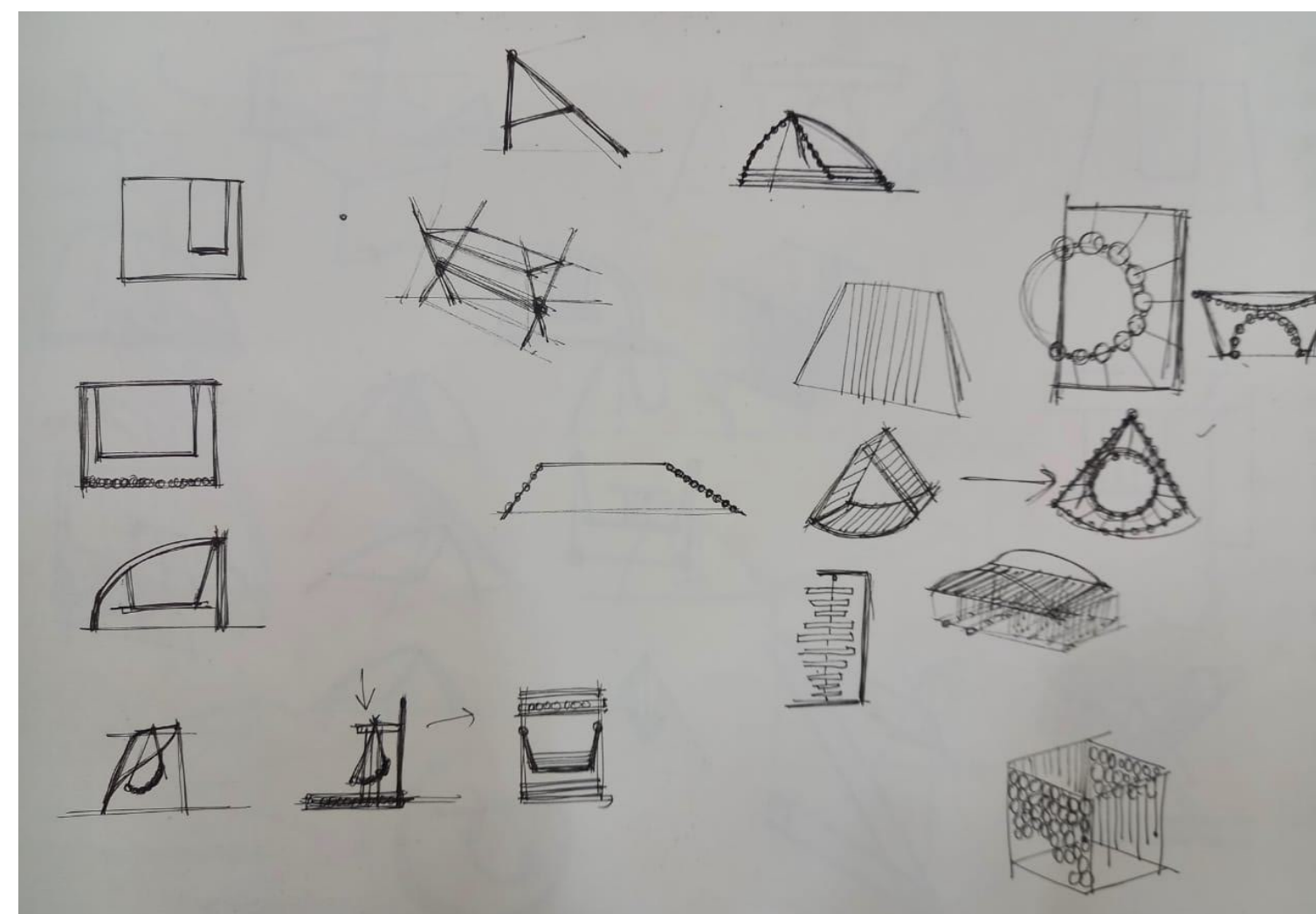
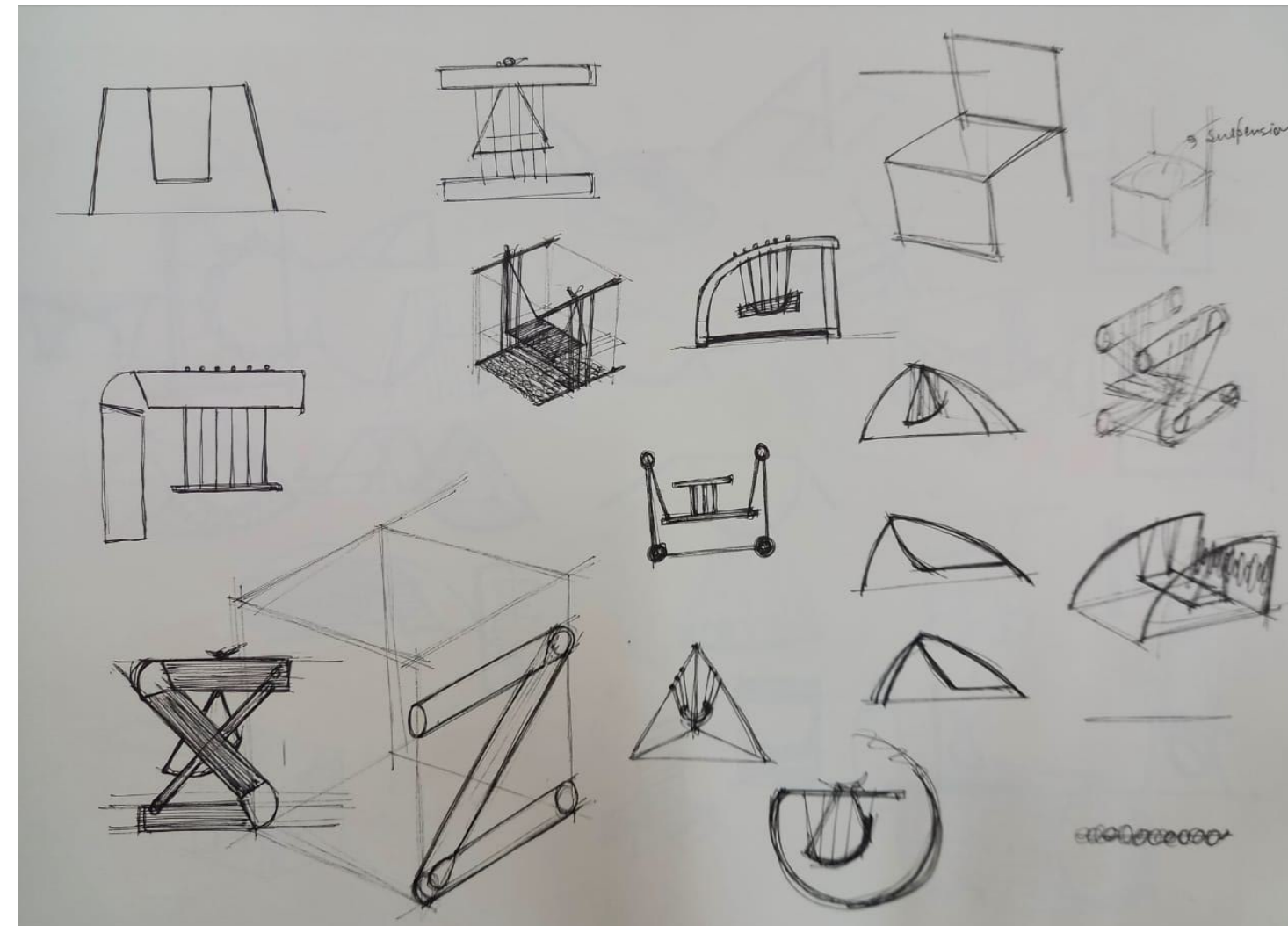
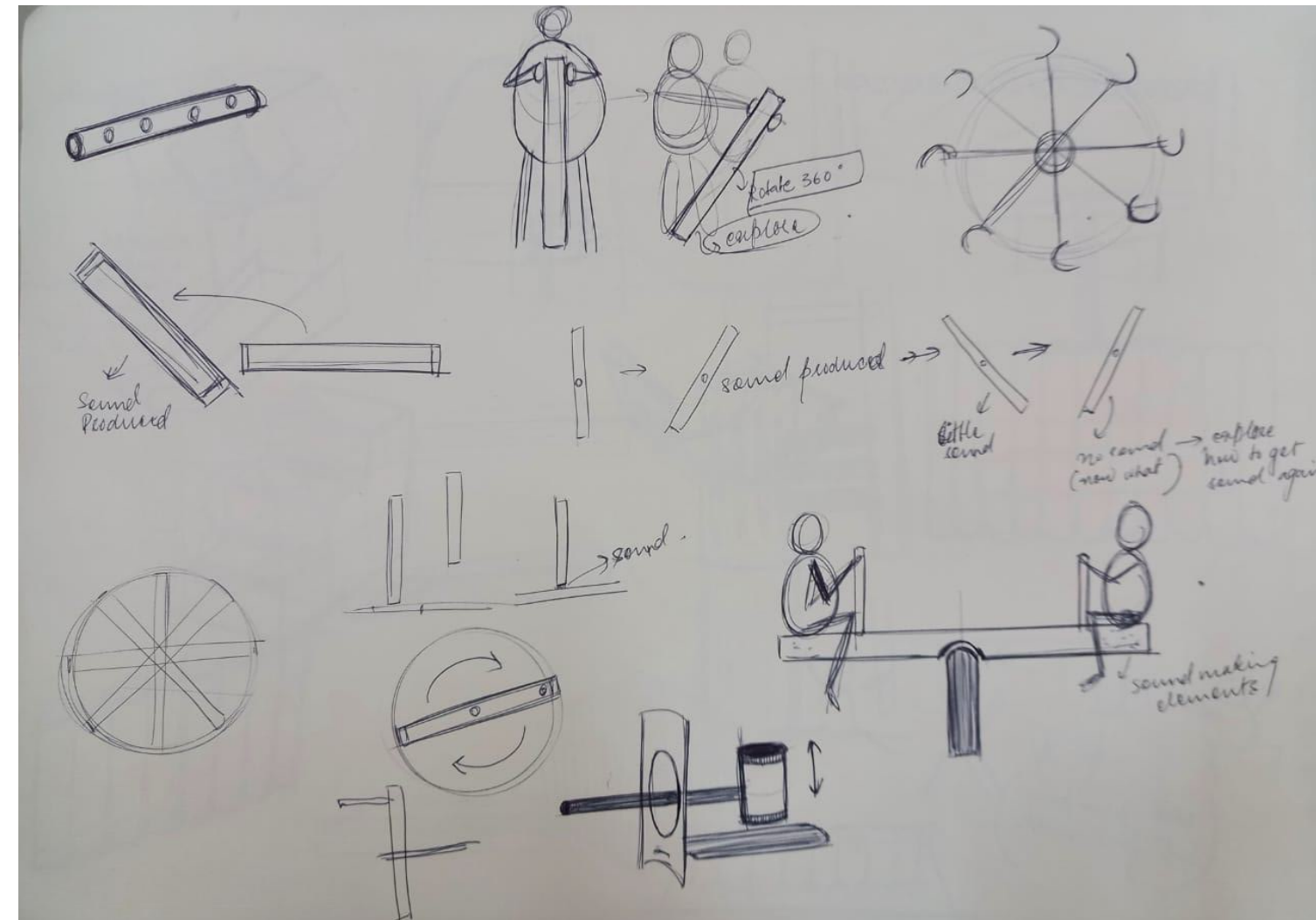


9.2. EXPLORING BAMBOO



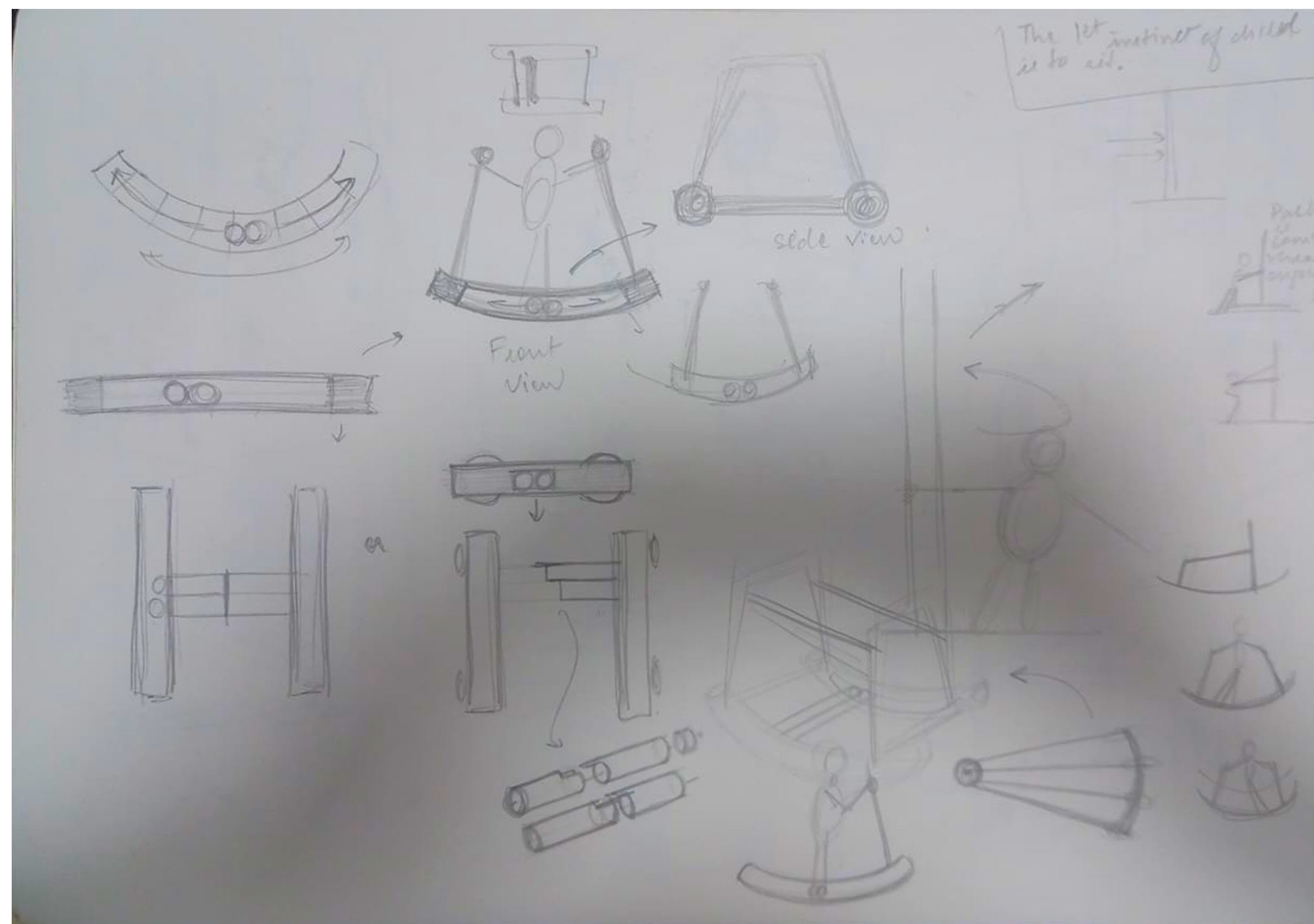
The aim was to explore bamboo to get familiar with its advantages, its limits, to understand how and what kind of joineries can be used.

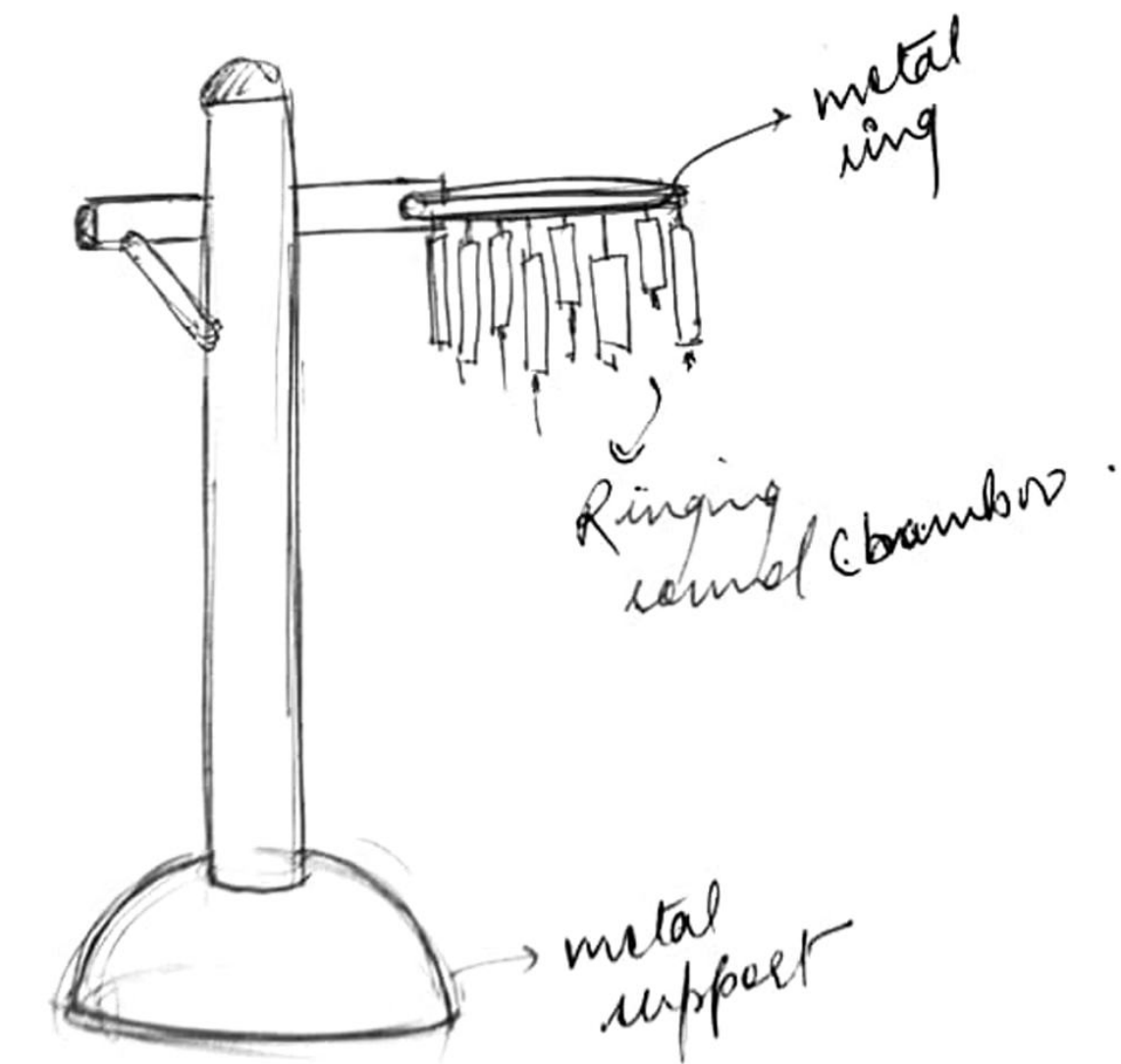
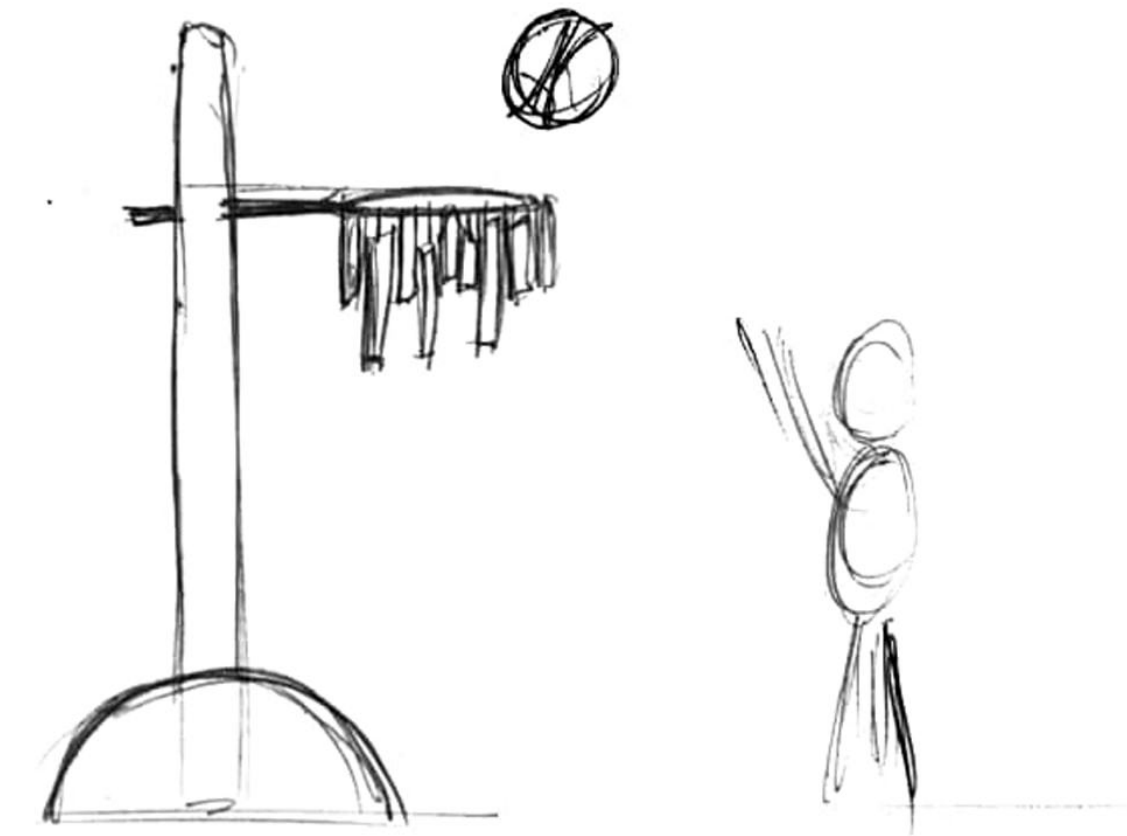
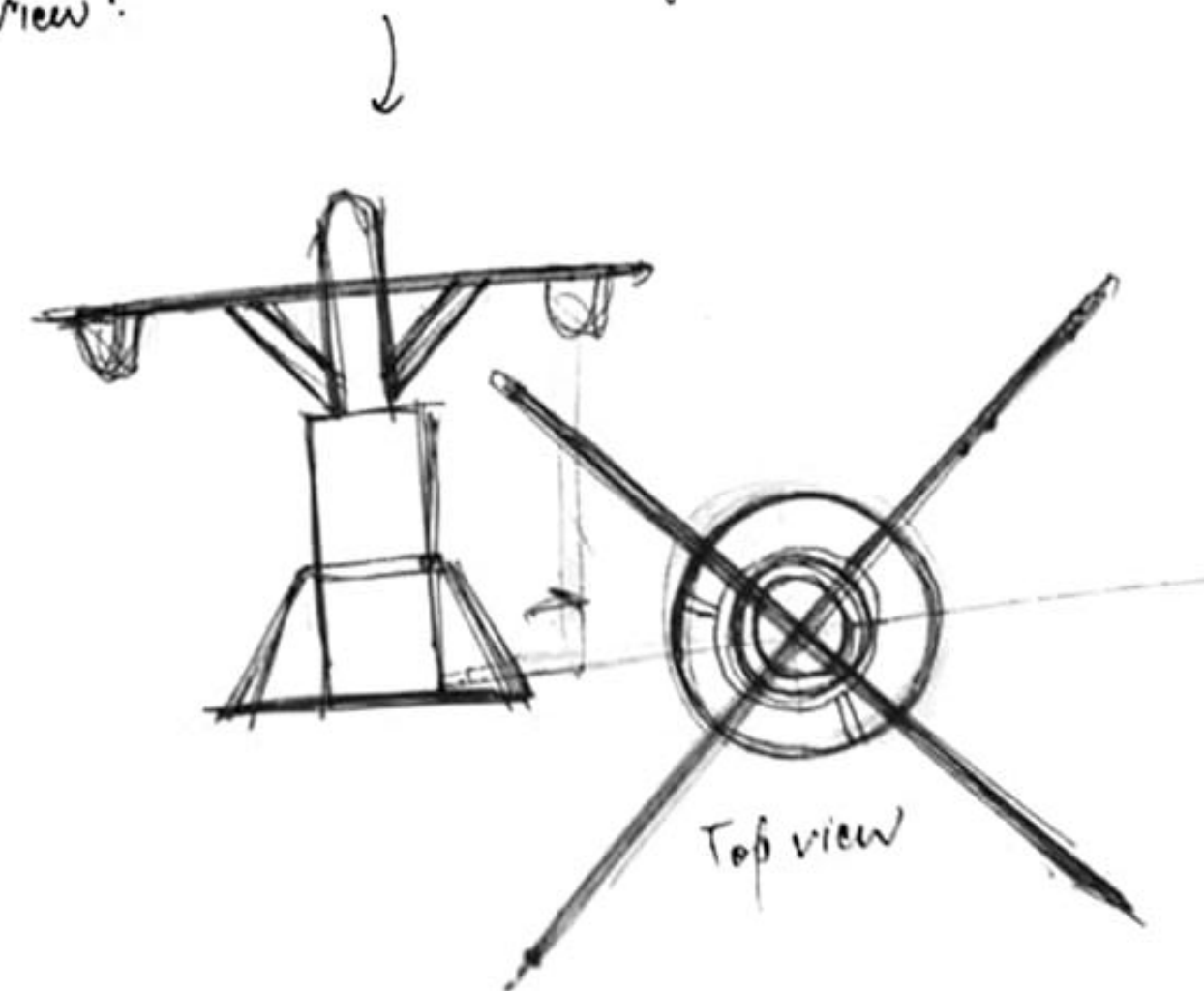
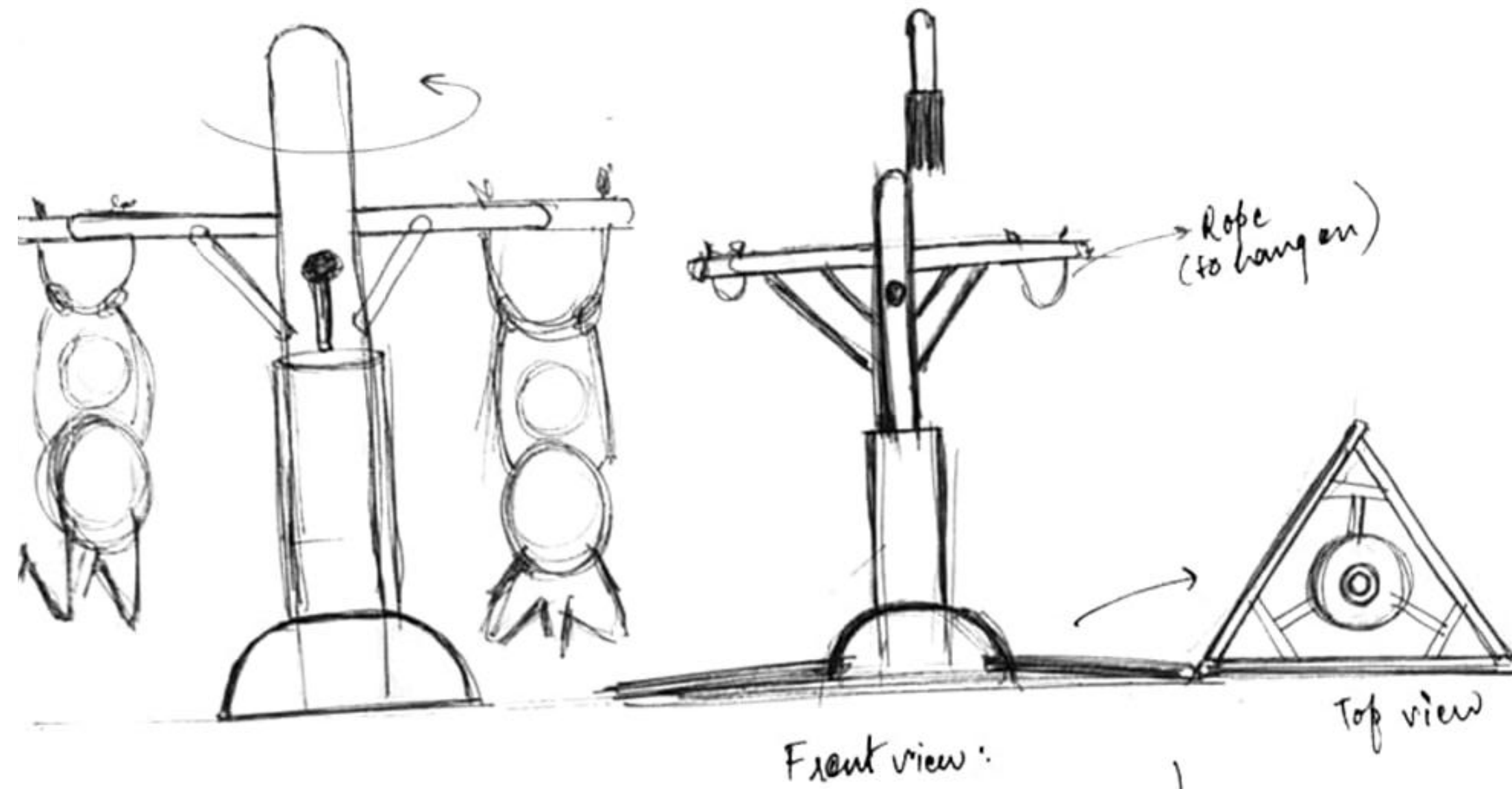
9.3. PHASE 2

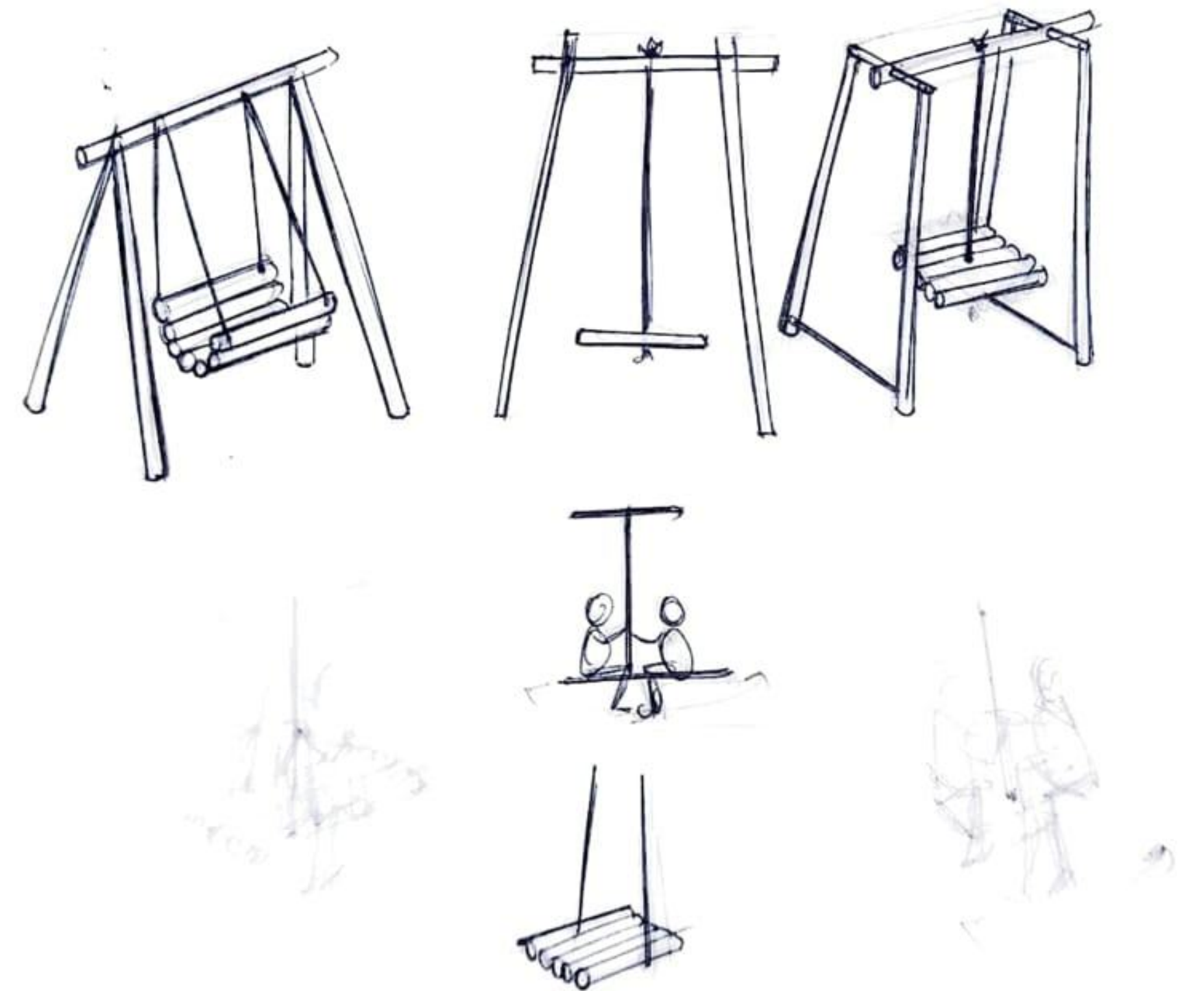
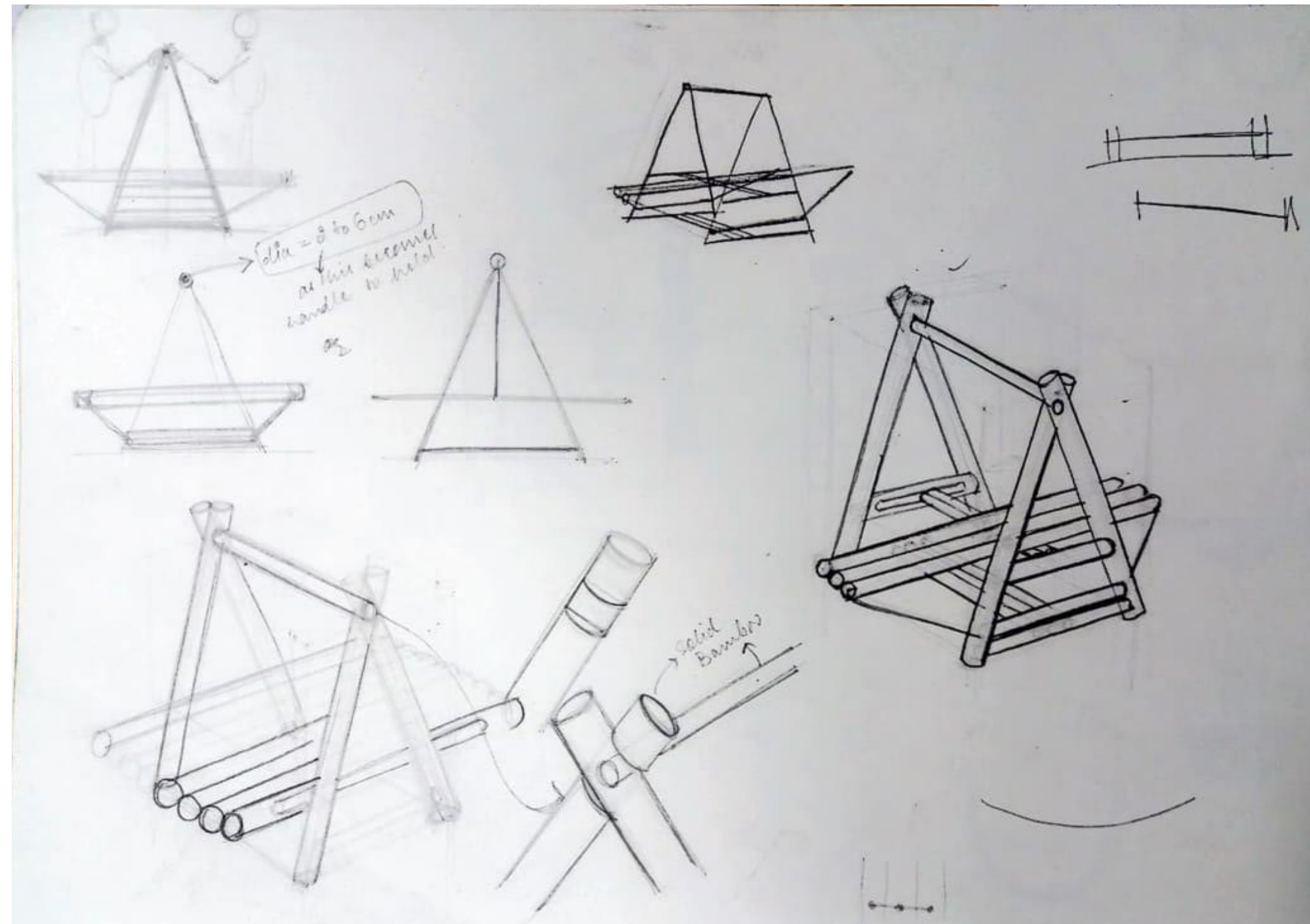


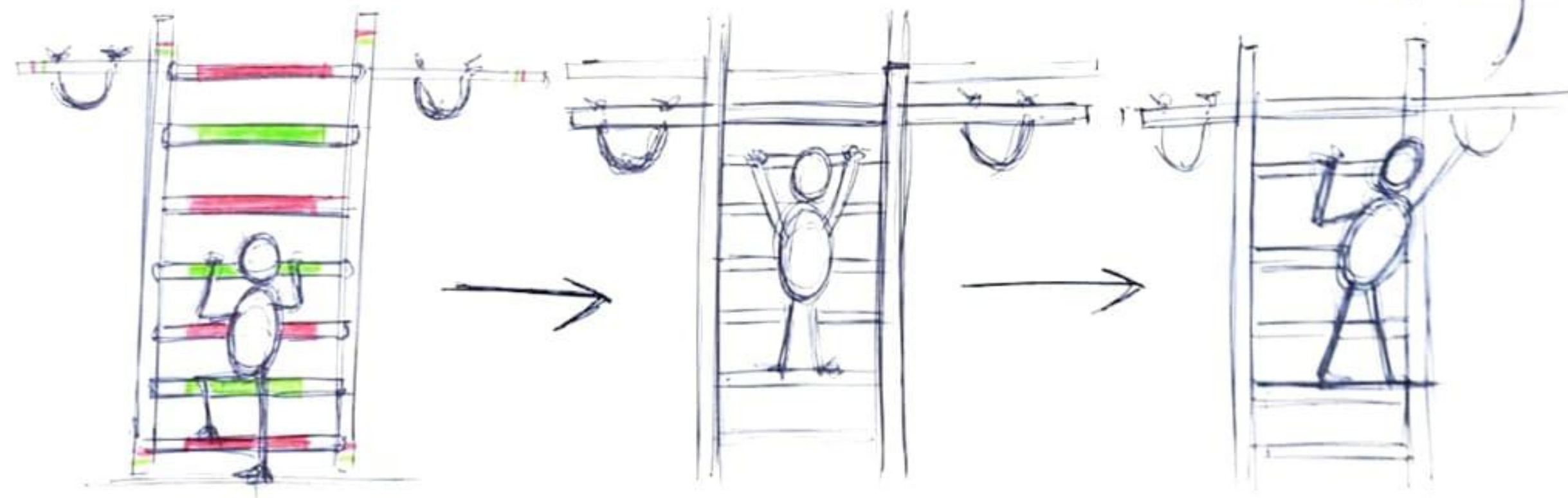
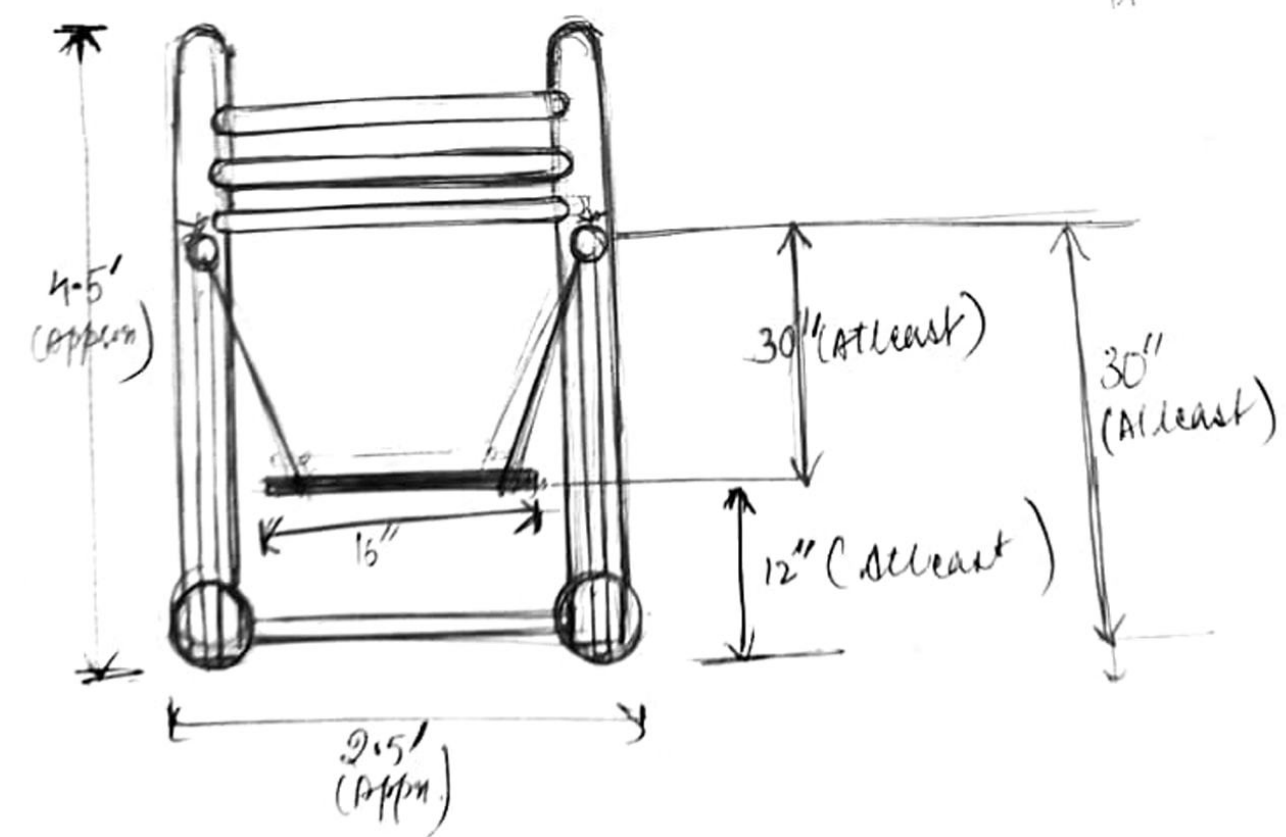
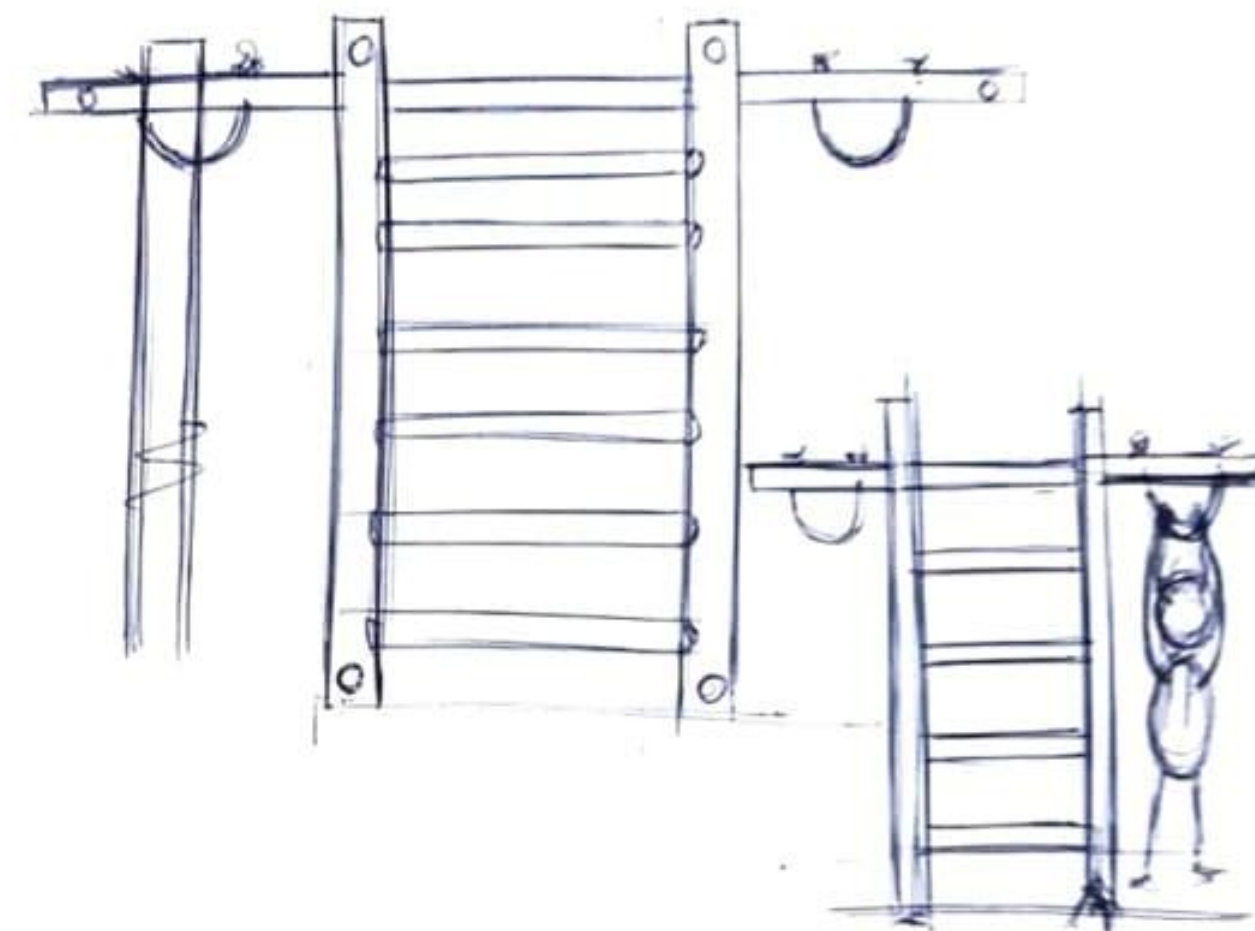
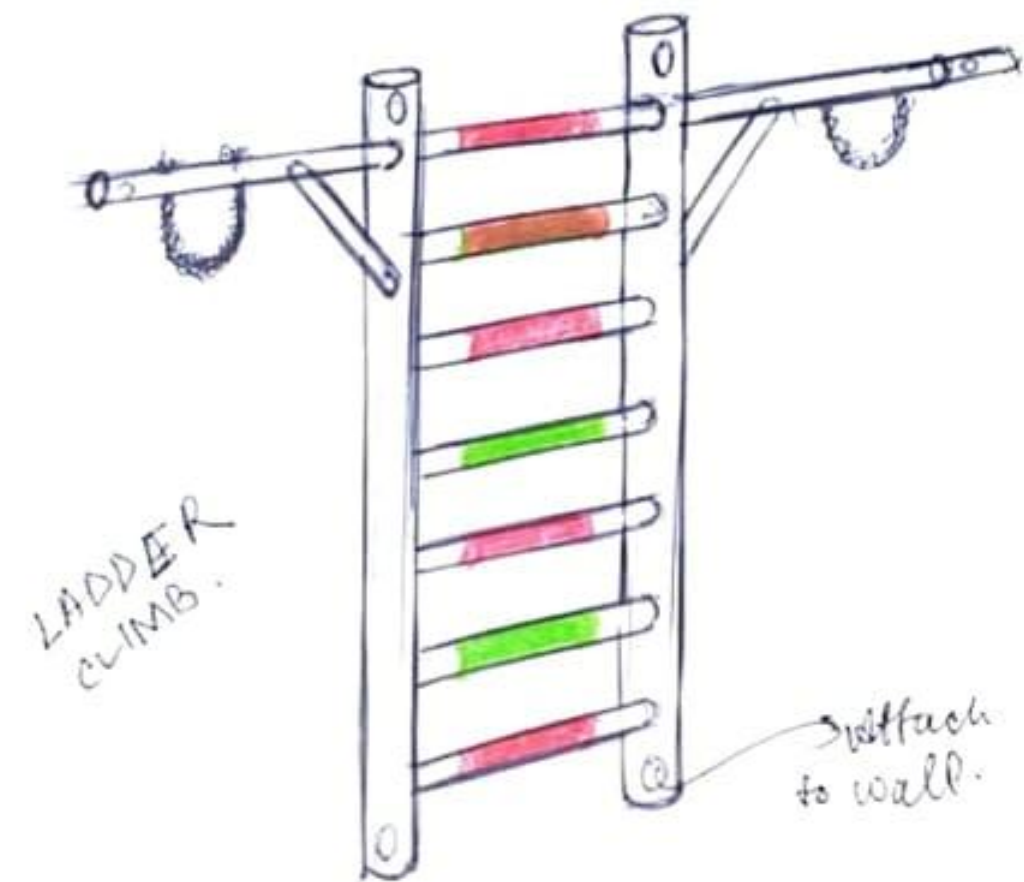
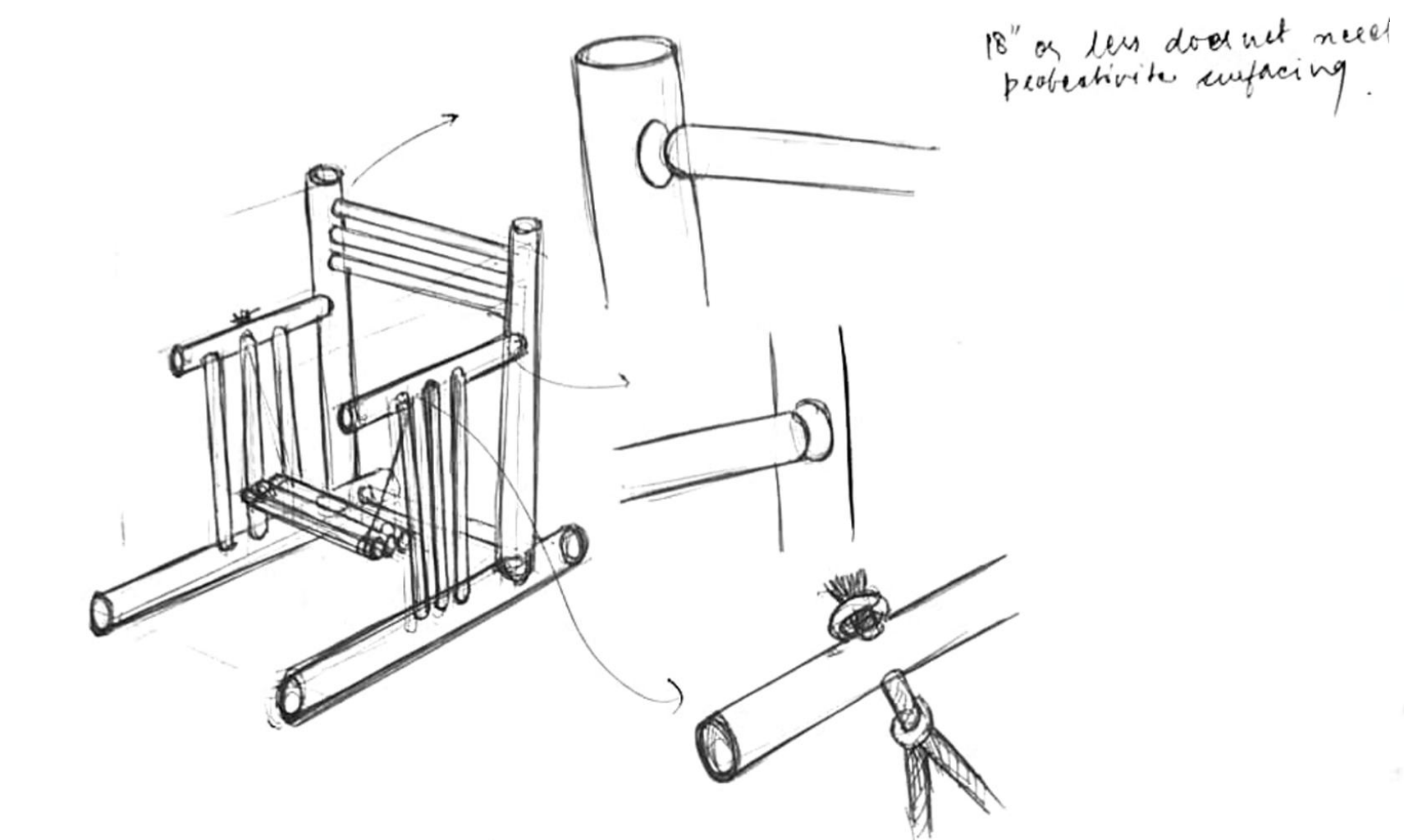
Ideation started with how I can use **bamboo in its most original form** without making much modifications to it while also ensuring it aligns with my design brief that is **focus to motor skills**.

Also the solid form of bamboo gives **stability and rigidity** which helps in safe play.

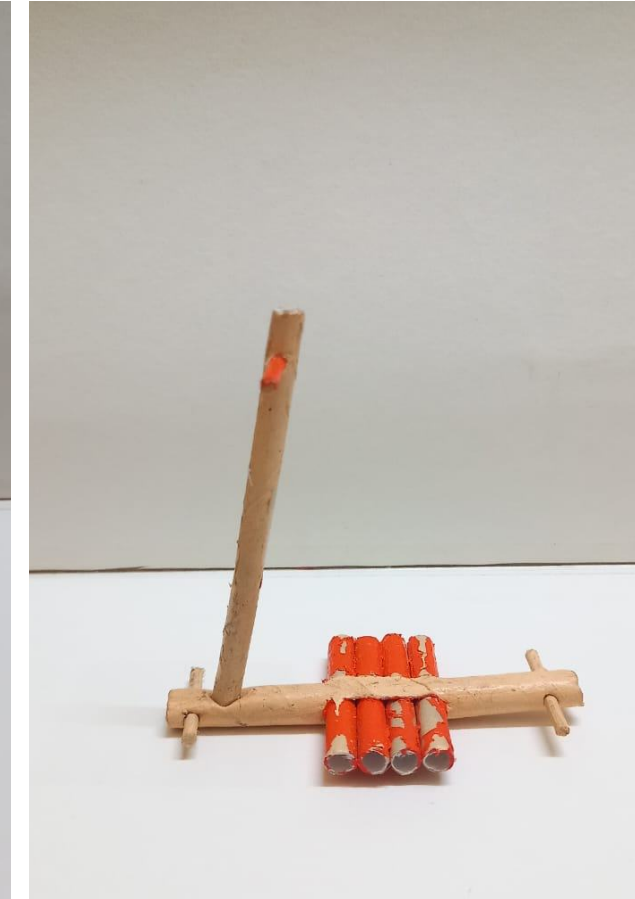








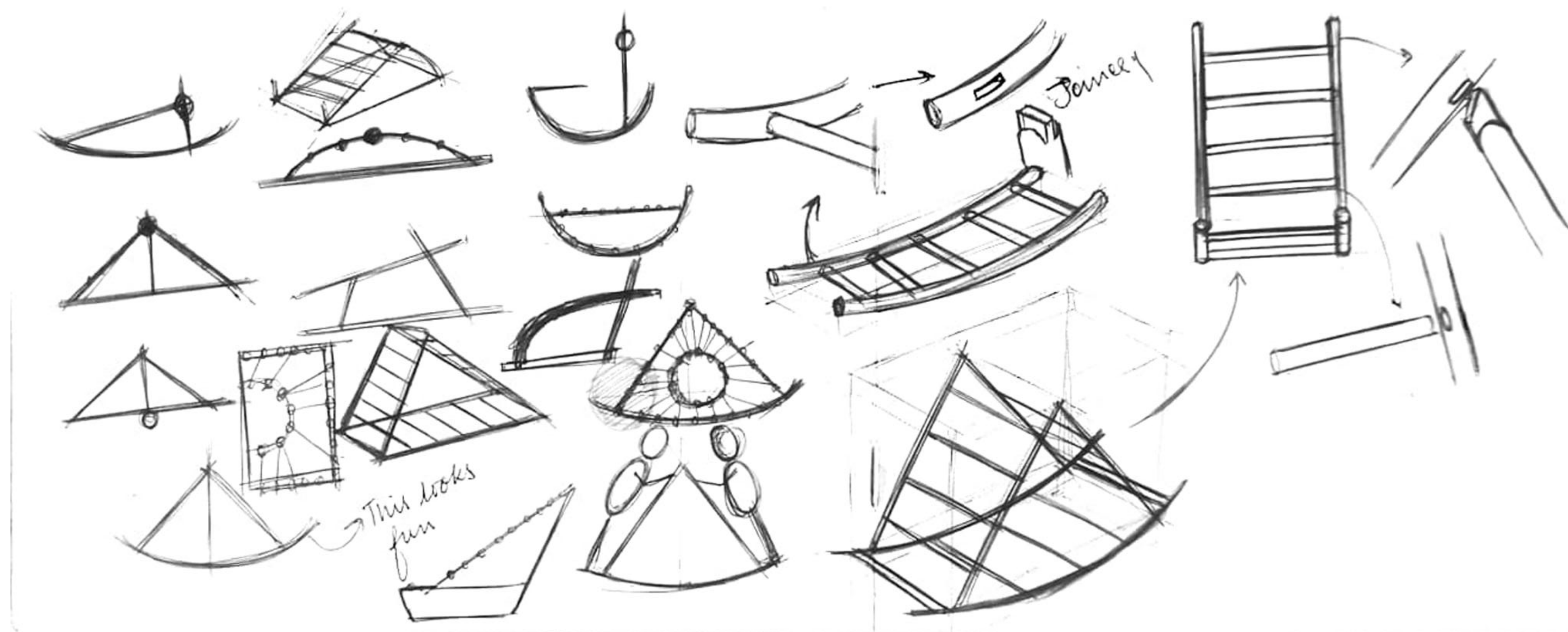
9.4. MOCK UPS



These are few mock ups that I made using straws. I used straws as a false material to understand detailing for bamboo, specially joinery details. Also, it helped me explore other different ways to use bamboo and what cannot be done.

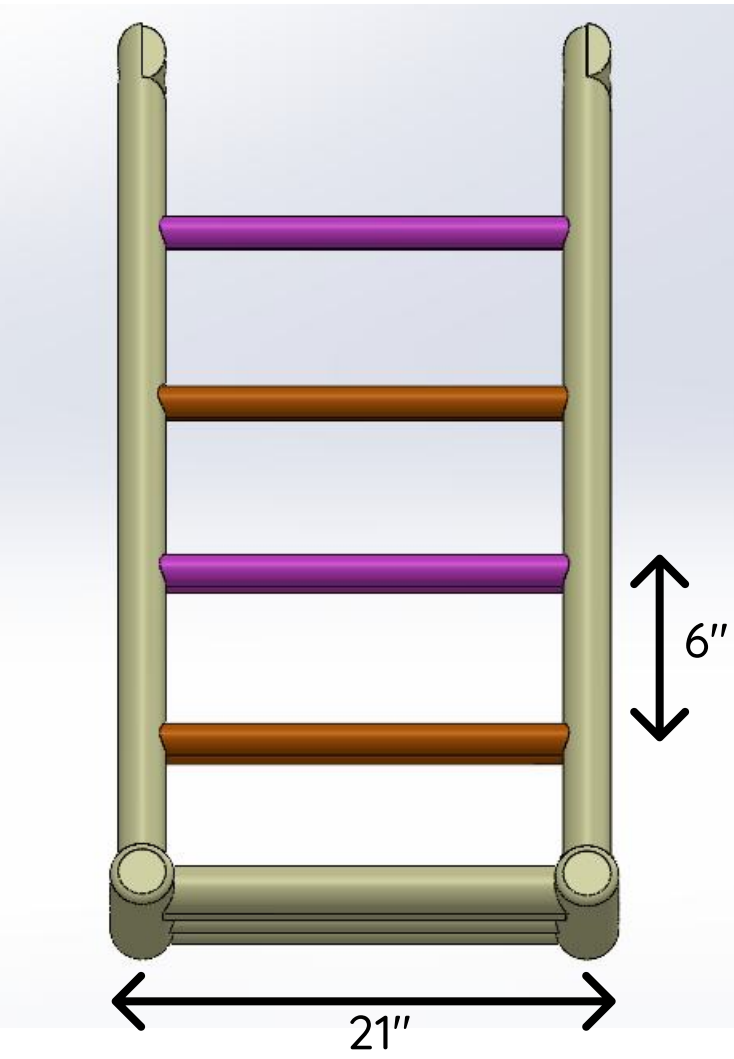
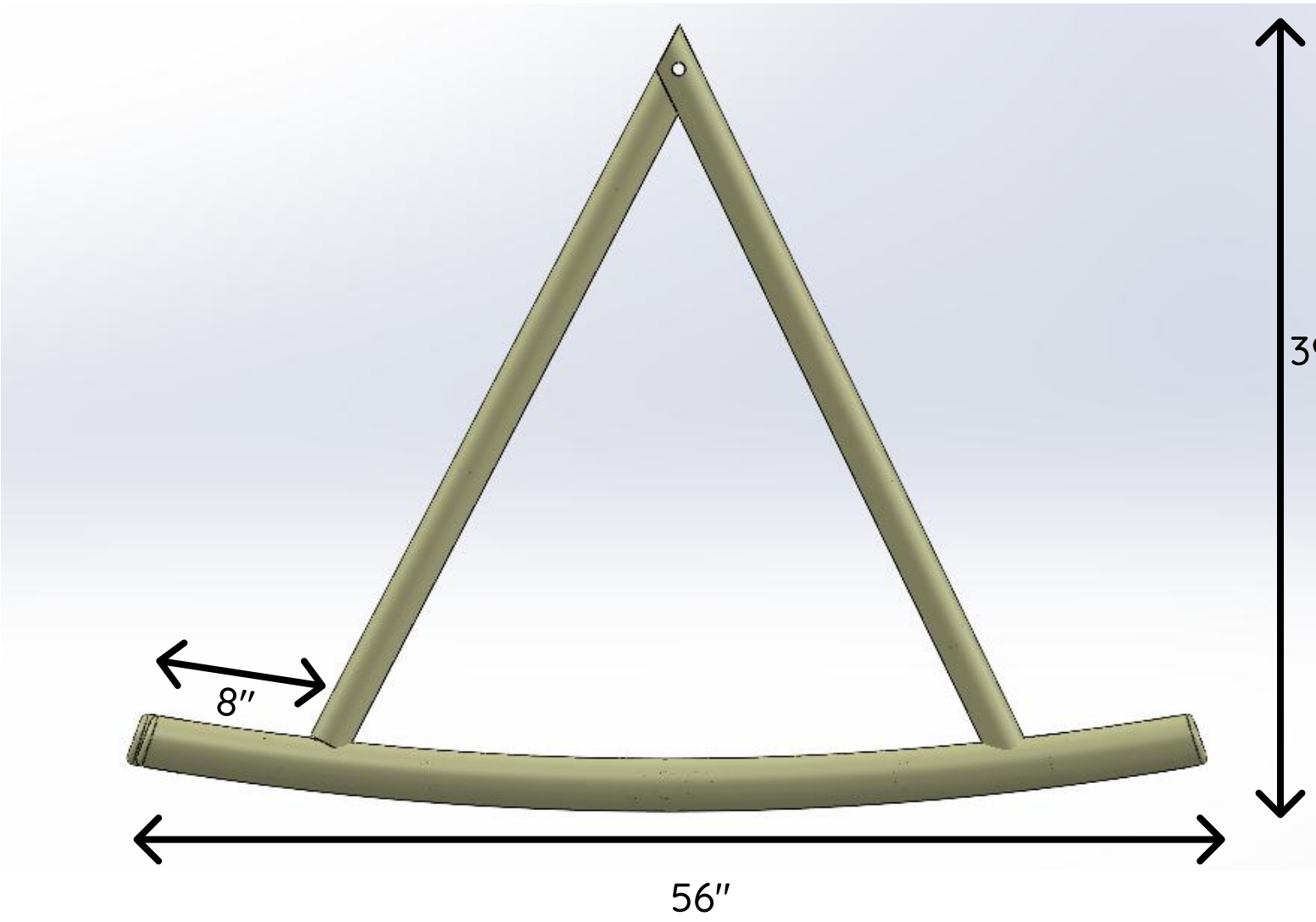
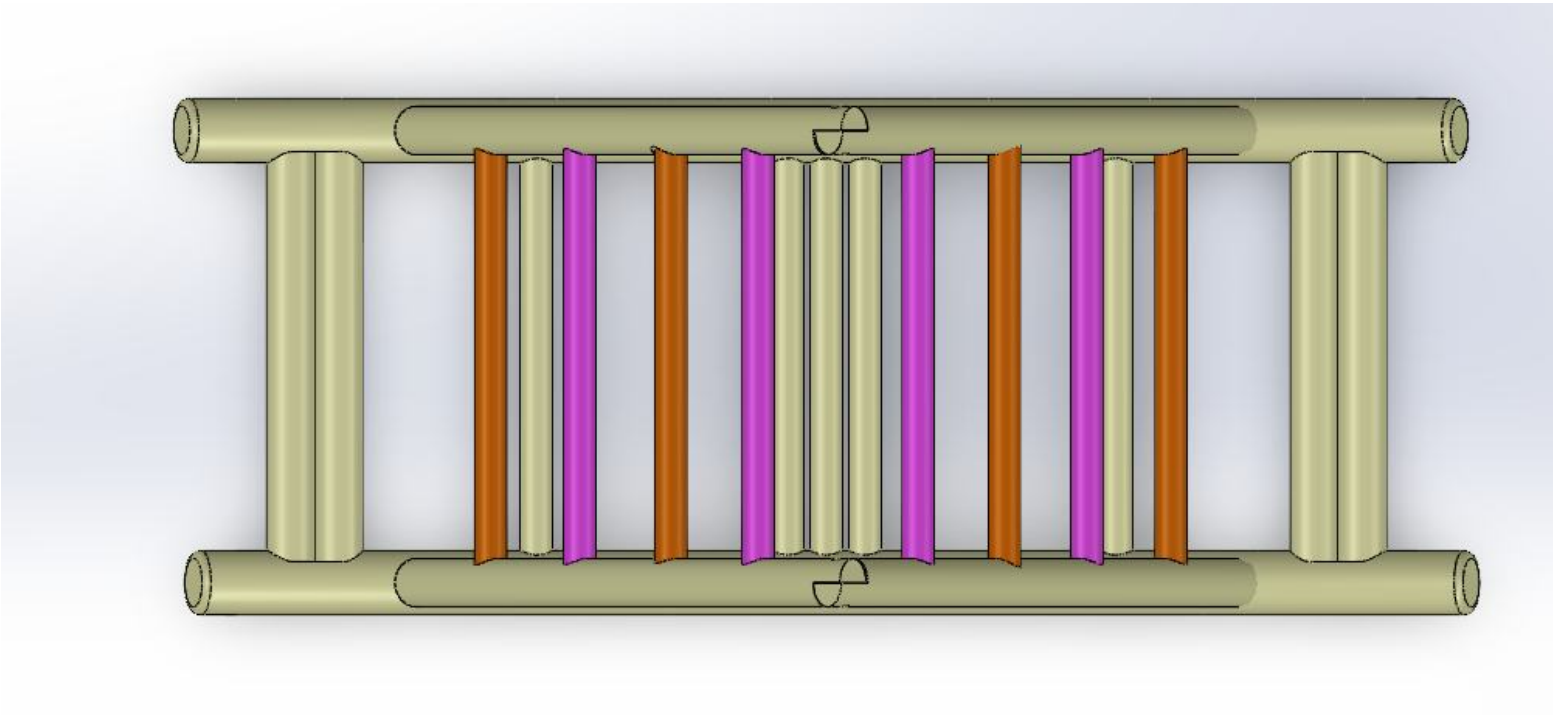
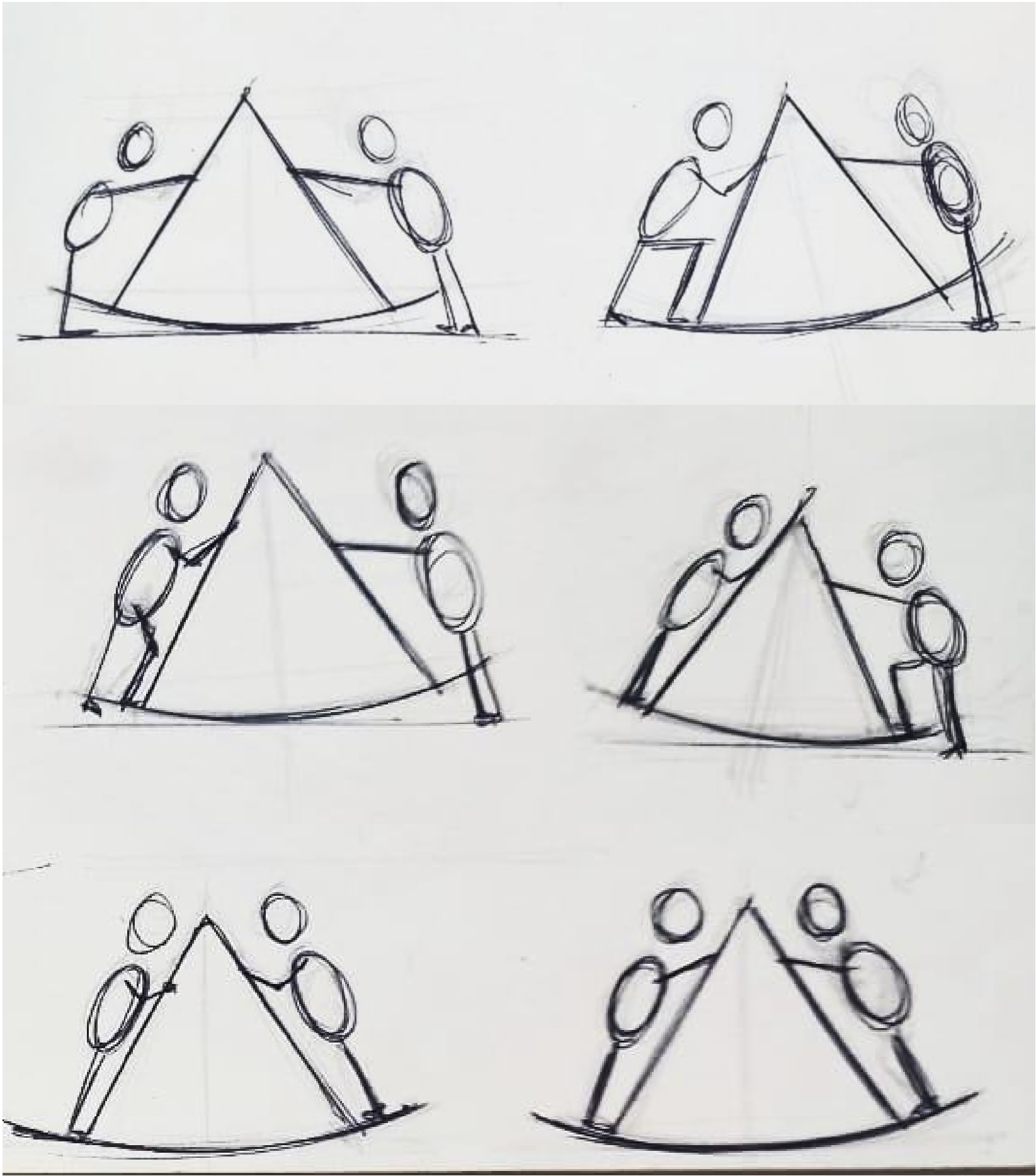
9.5. CONCEPTS

1. Concept 1



The thought was to get the maximum use of their gross motors. This helps them use their whole body at a time to balance themselves and rock to play.

CAD Model



Making



About the Product

Number of user: One kid at a time.

Motor Skills: The repetitive action of legs to move forward strengthens the leg muscles. Enhances gripping as kids have to keep their grip stronger while moving.

Play: It gives them freedom to navigate while they are moving without efforts.



User Testing



They tried sitting in between the gap but were not able because of single rod.



They used the upper most bar which was meant to be holding for sitting and other two for rocking.





They turned it and used mat for making a home for themselves. They wanted to construct a house.



Climbing on the vertical ladder to speed more and rock higher.



Tried standing on the sideways.



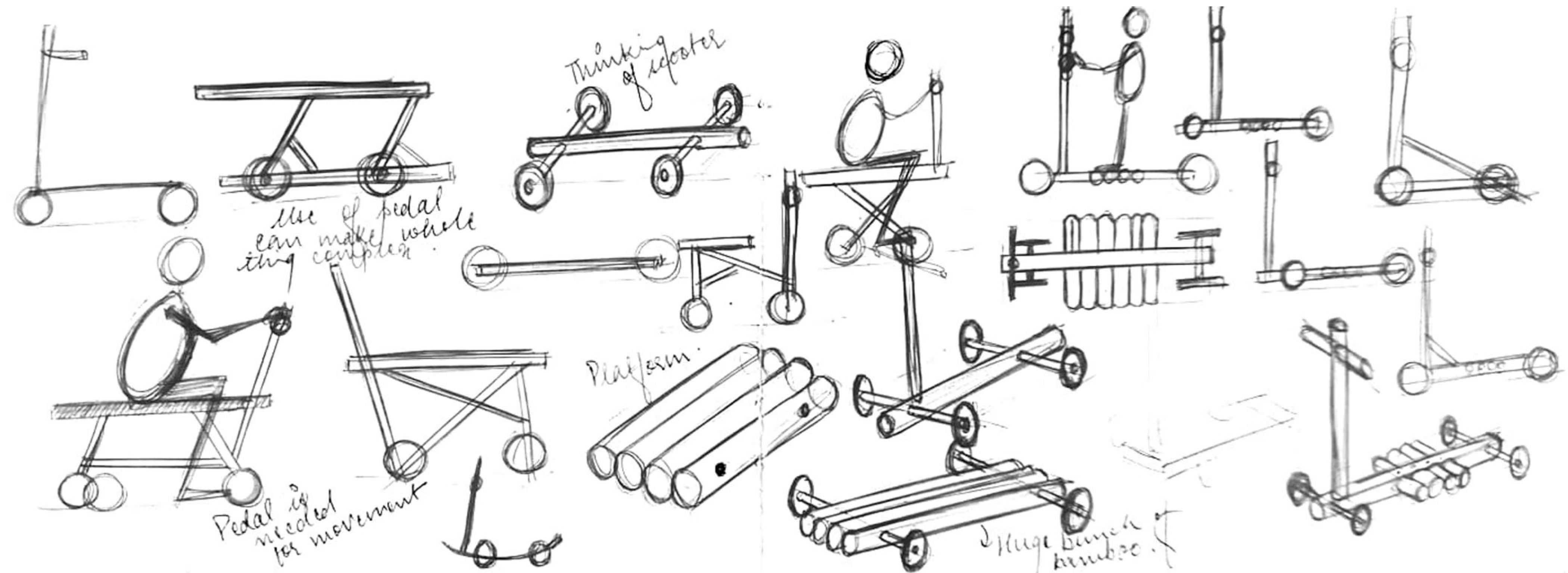
Sitting on the part which was meant for standing while facing each other.



The most unexpected was to use it for climbing up and down by tilting the whole furniture.



2. Concept 2



Scooter is one main part of their play area as they have learnt to walk and use their leg muscles. Hence, they love to move around and use their leg muscles as much as possible. The thought was to use bamboo for scooter.

Making

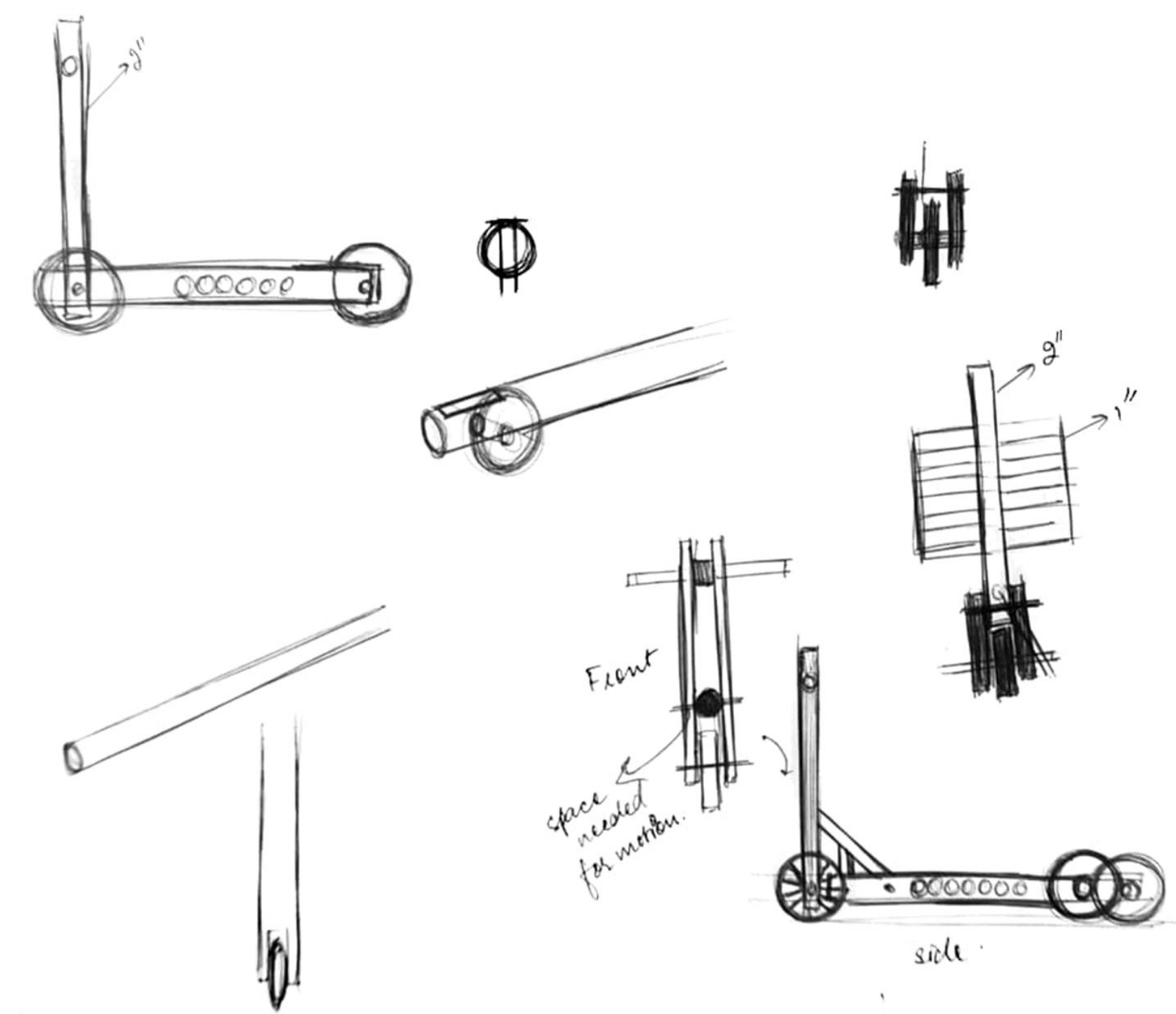


User Testing

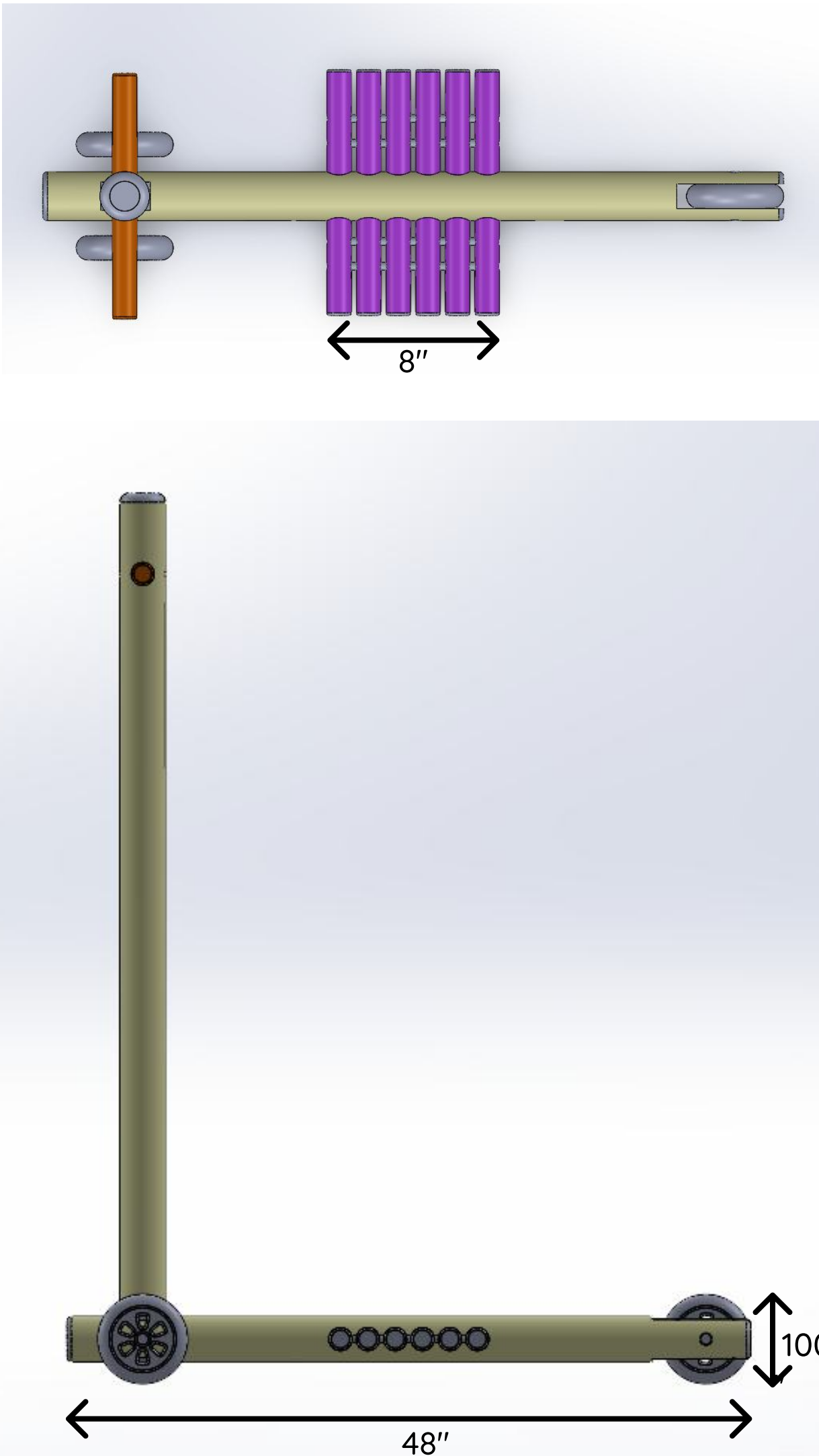


- They enjoyed the ride but they want it to be able to change direction. Wheels were little in motion that annoyed them during ride.
- One of the wheels also came out.

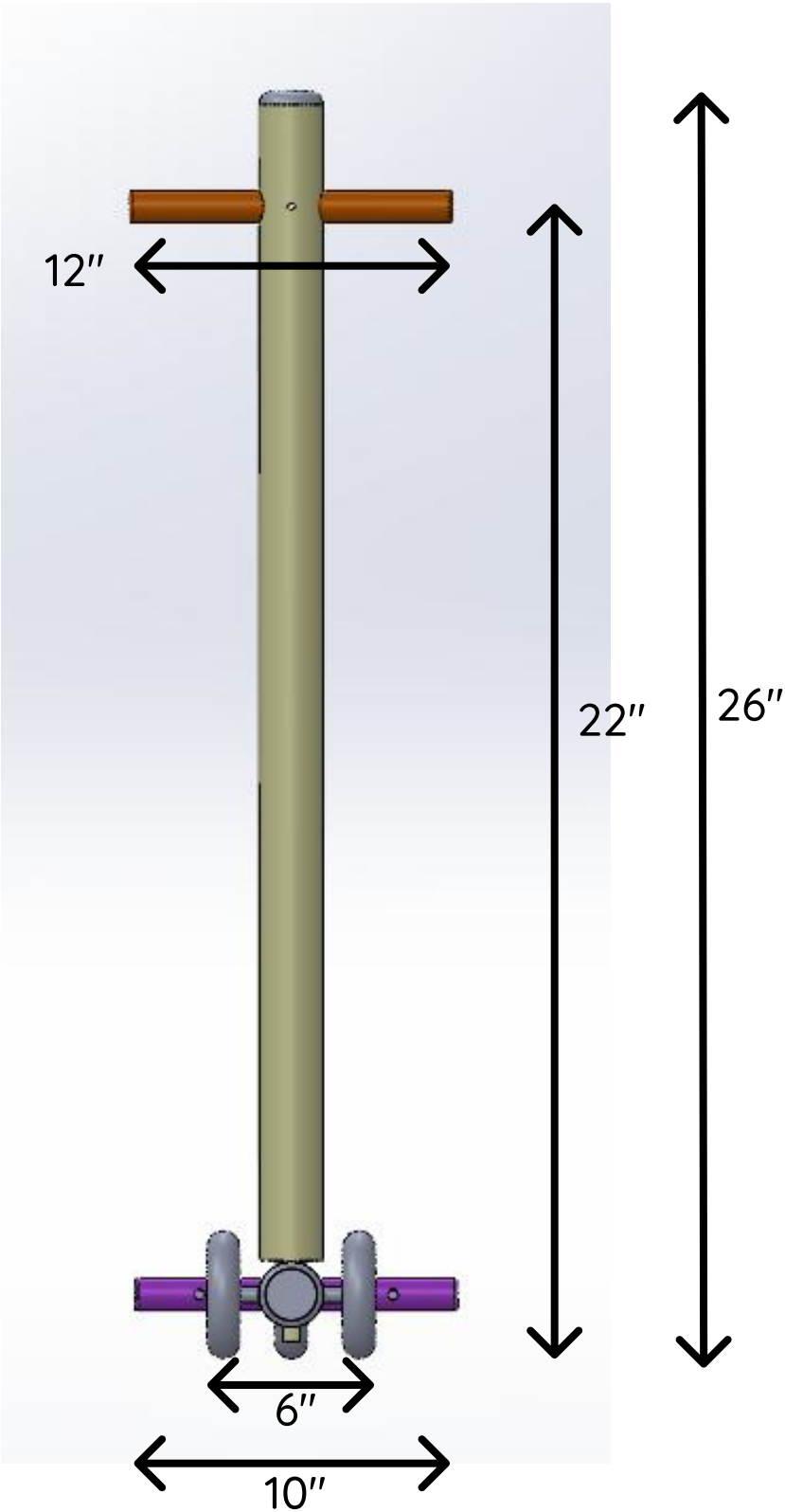
CAD Model



,Trying to make steering to have a little angle turn which was absent in my previous prototype.



78



Refinement



About the Product

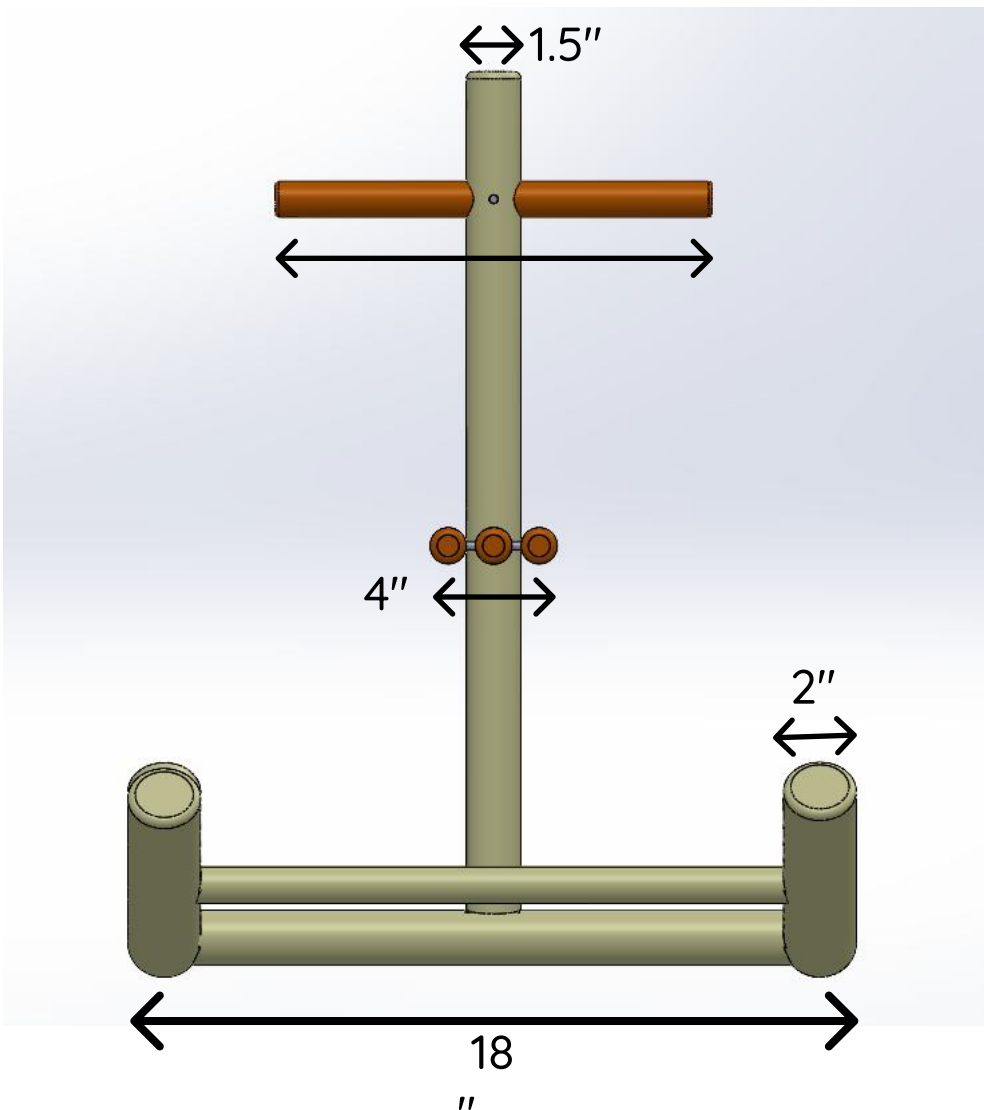
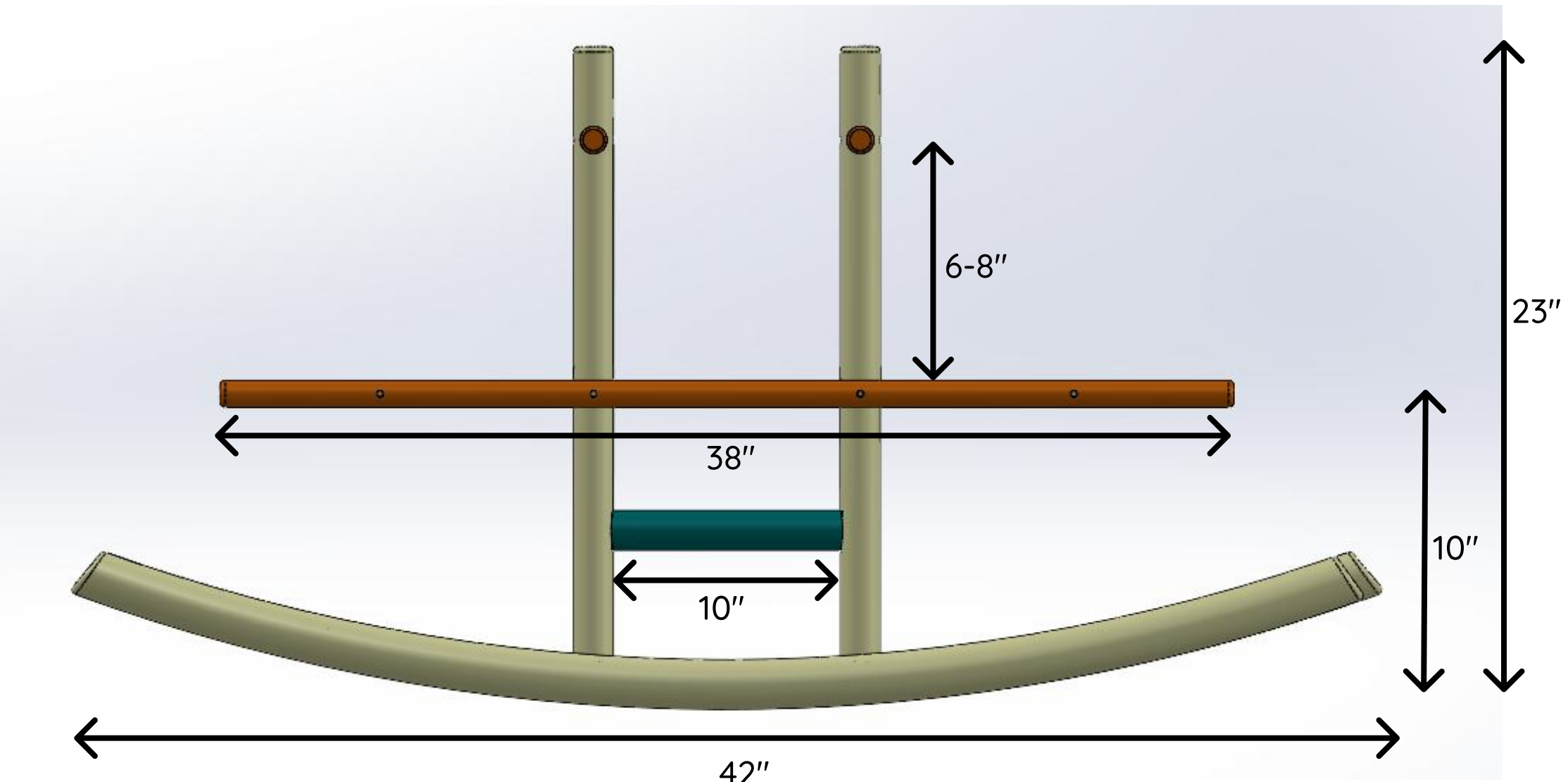
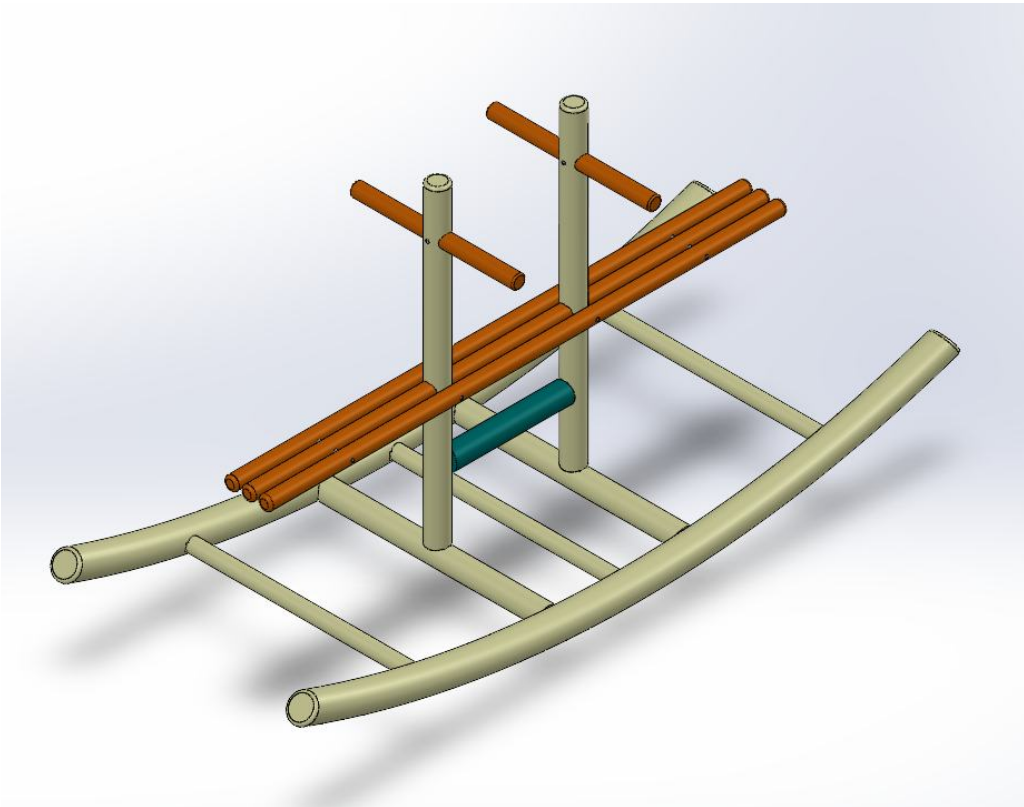
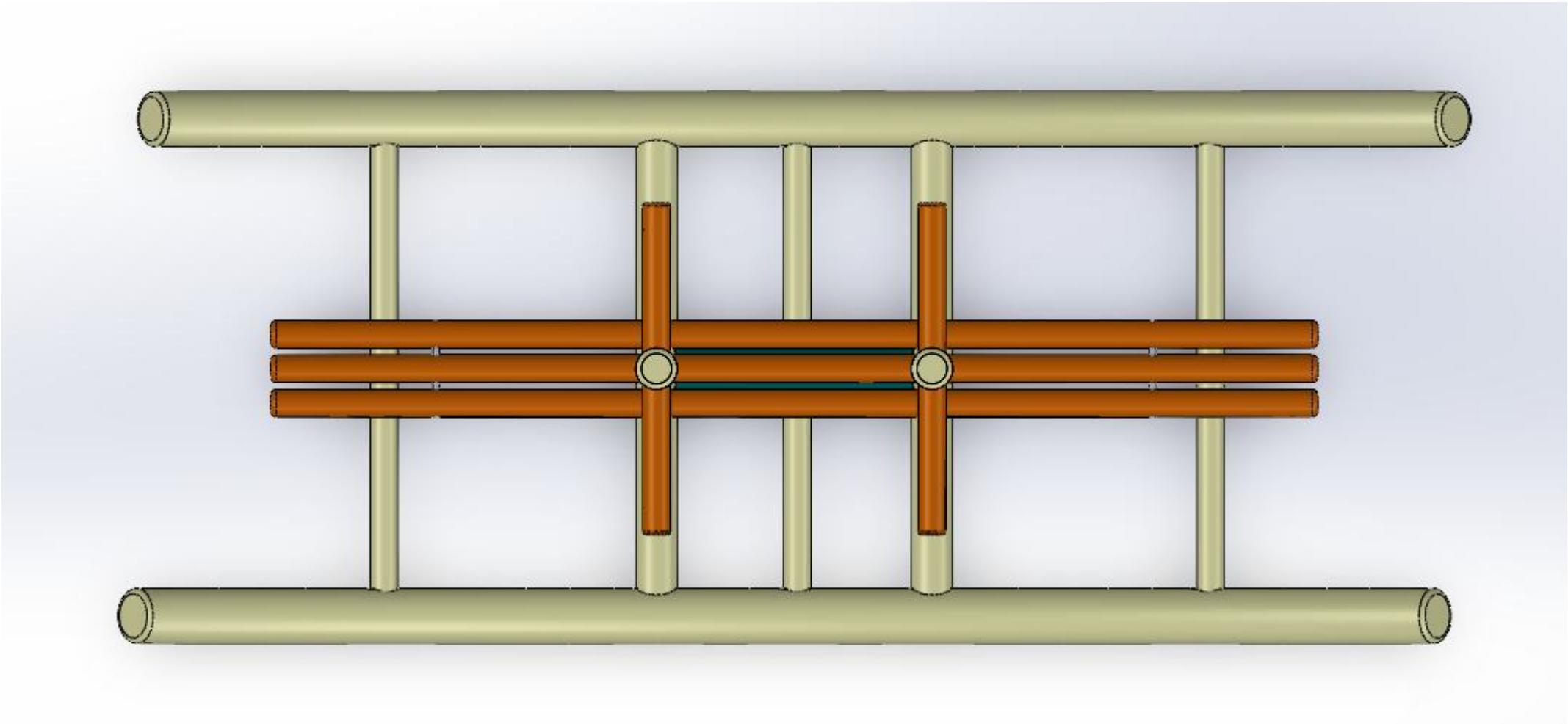
Number of user: One kid at a time.

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Play: It gives them freedom to navigate while they are moving without efforts.



CAD Model



Making



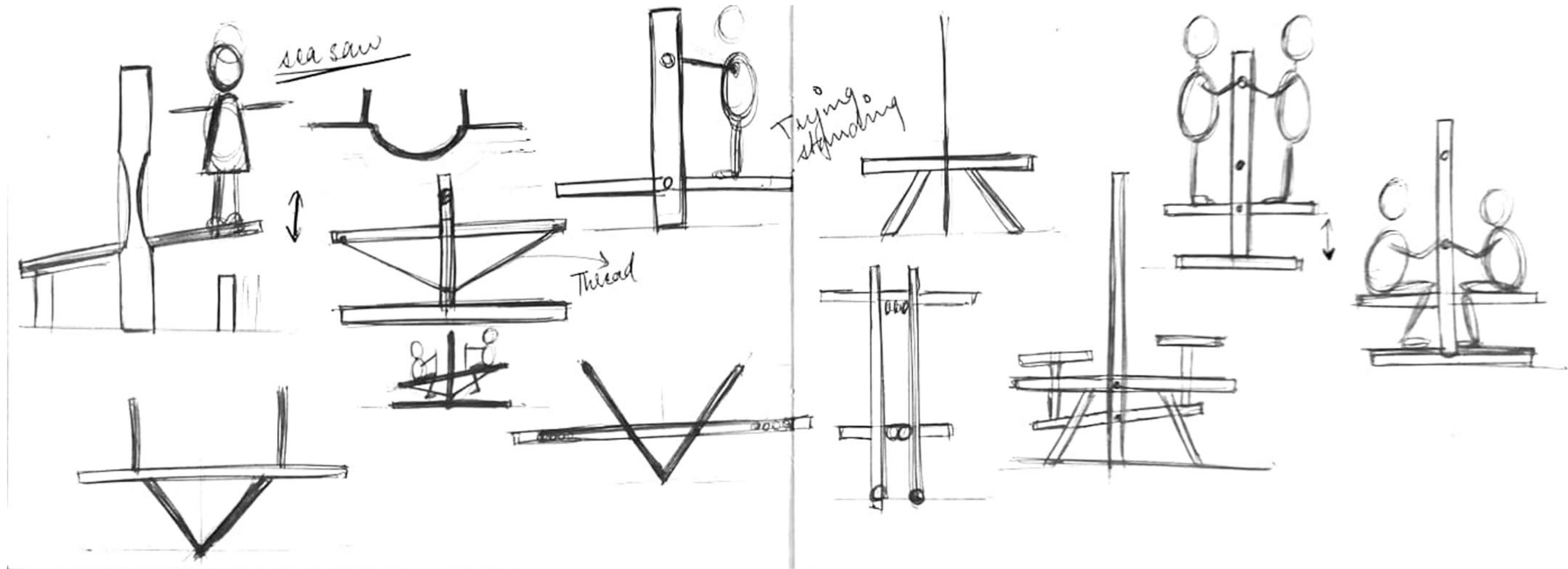
Number of user: 2 kids at a time.

Motor Skills: Use of upper body for rocking it helps body muscles to strengthen. Hand muscle strengthen.

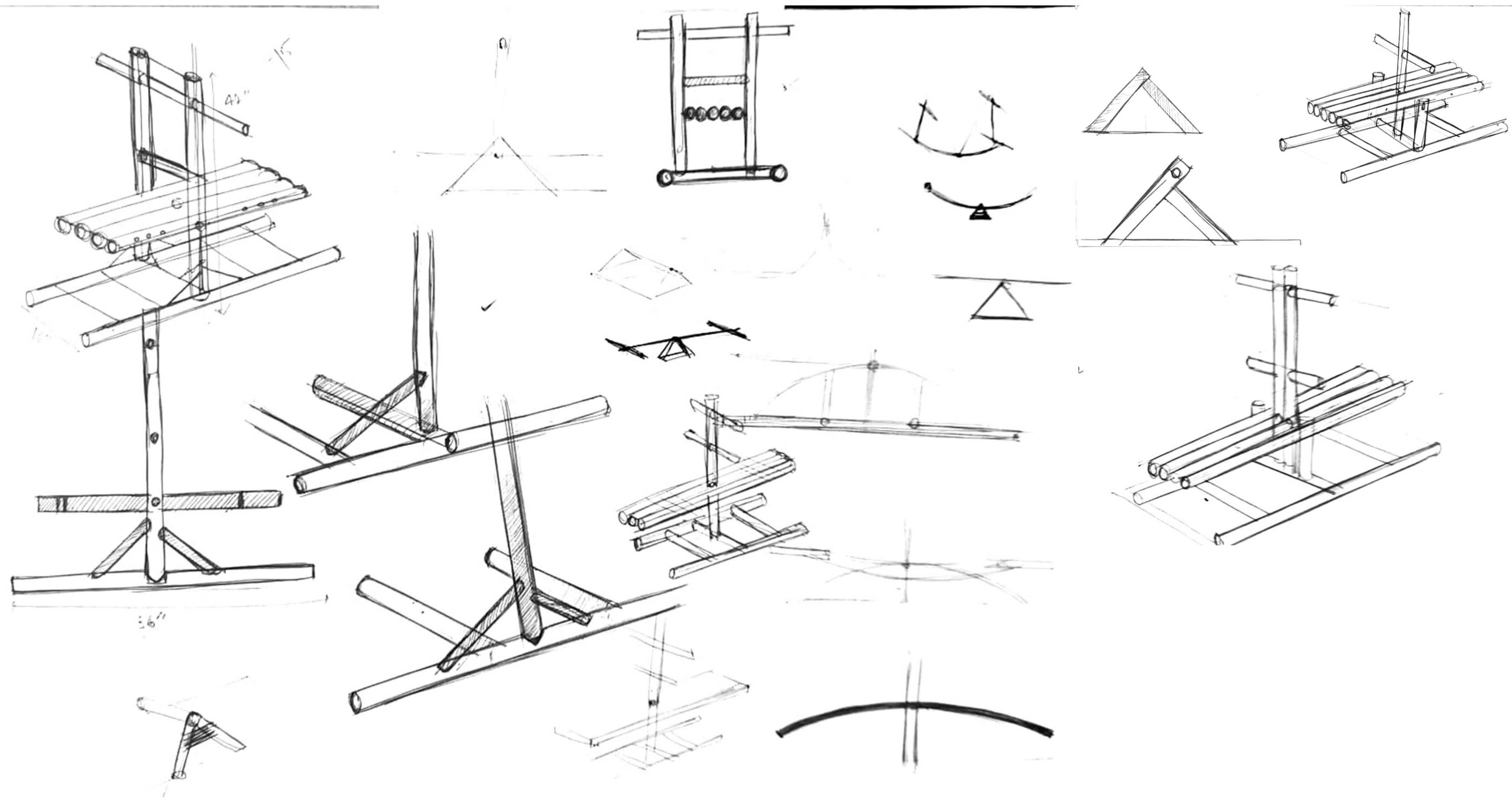
Play: Swaying in the air
Flying from one end to another end.



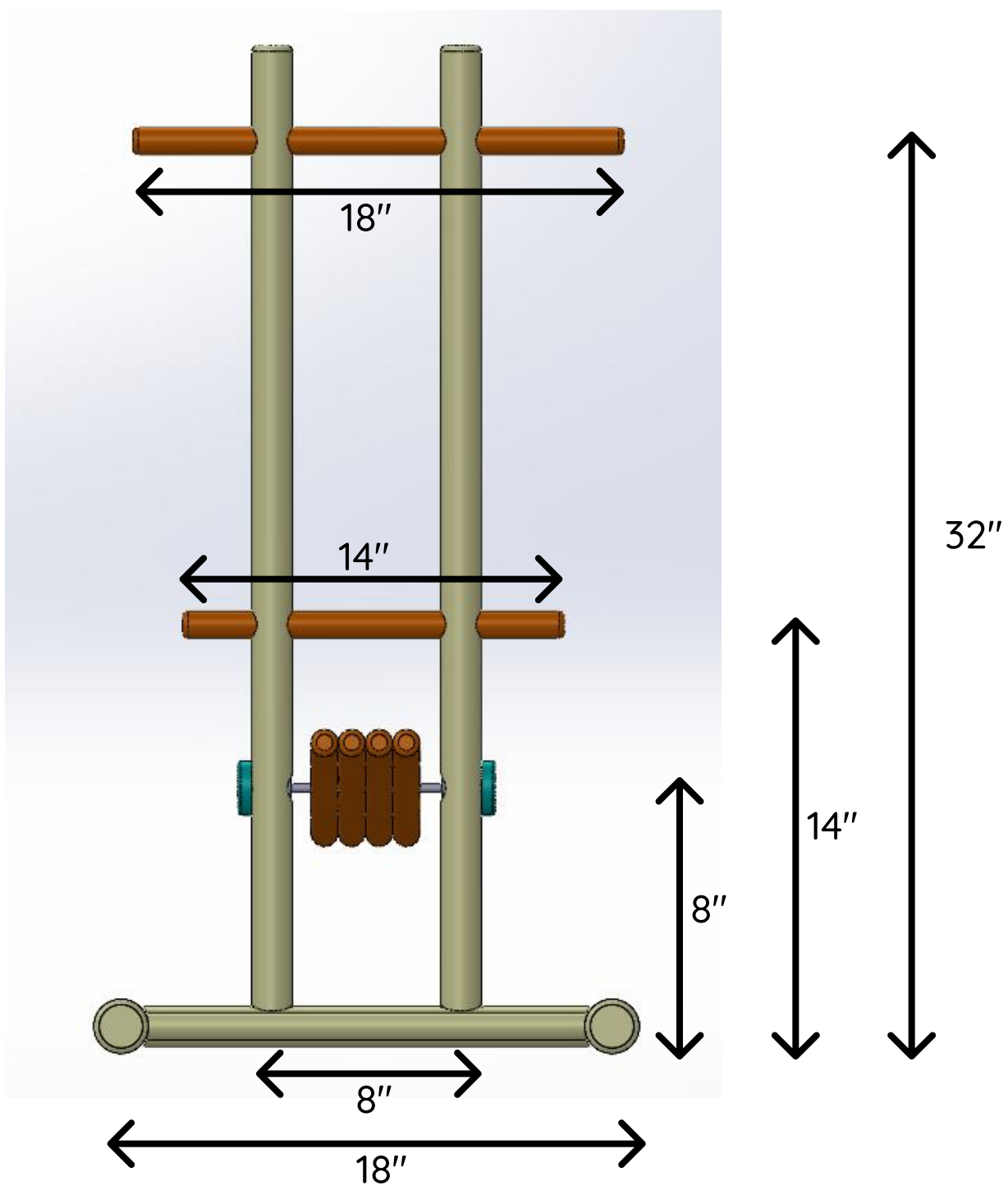
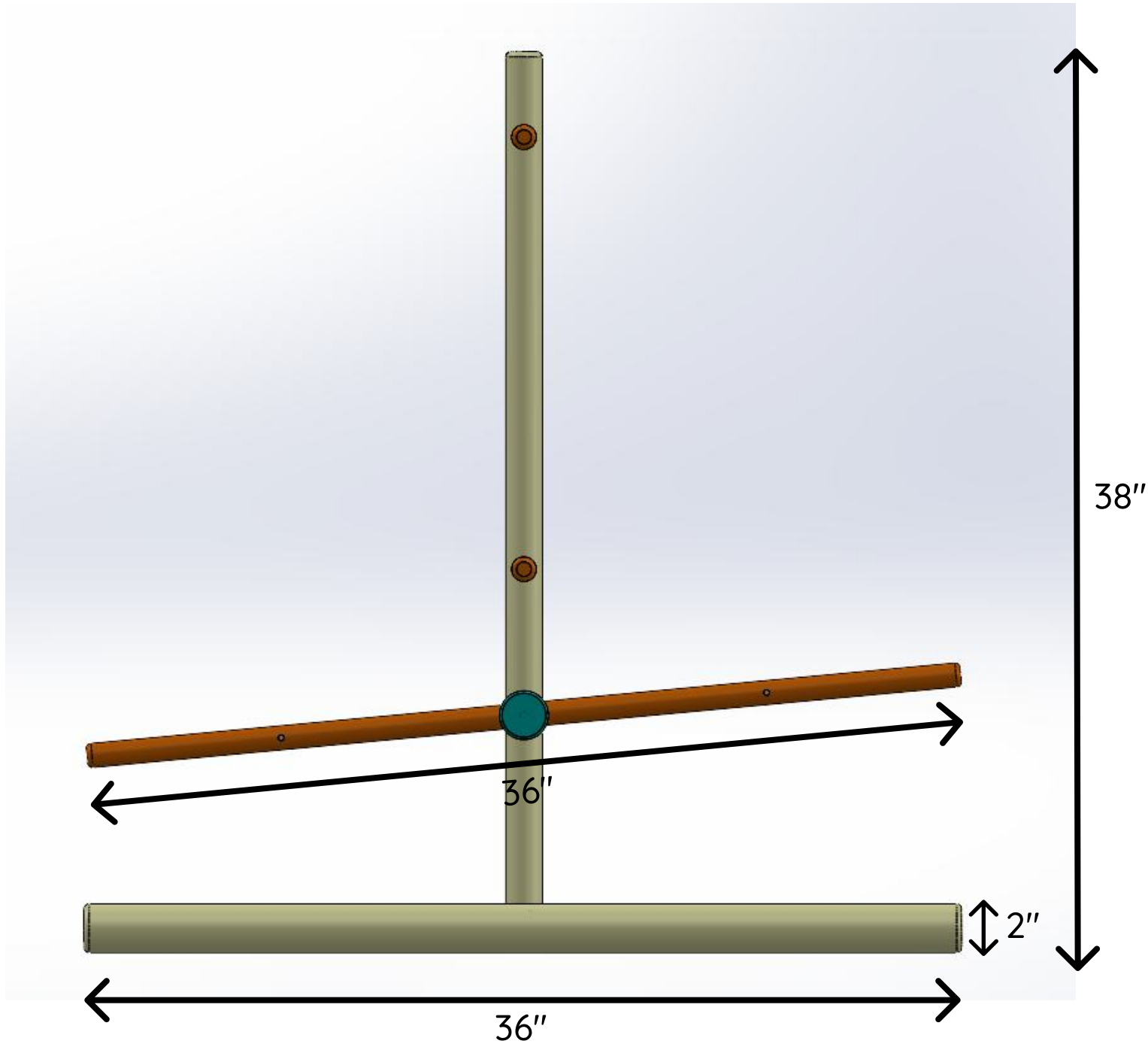
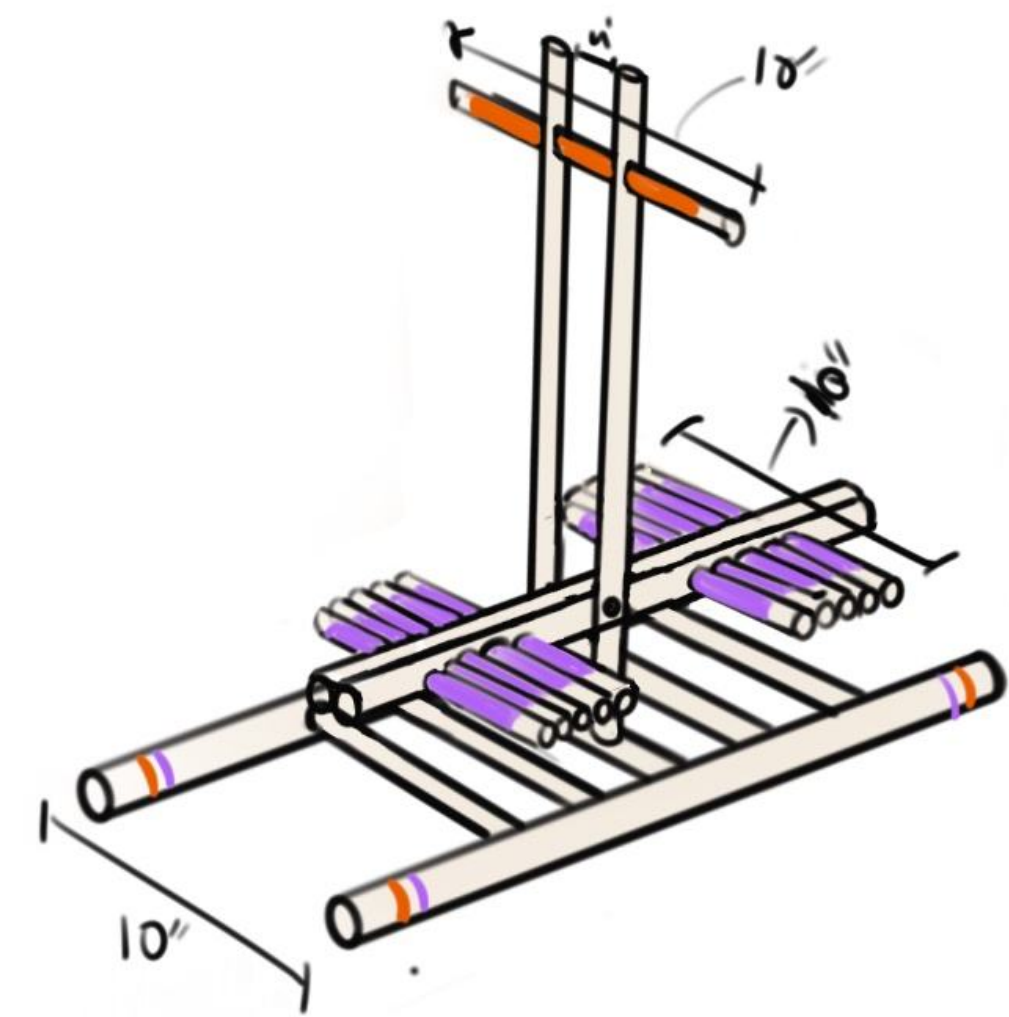
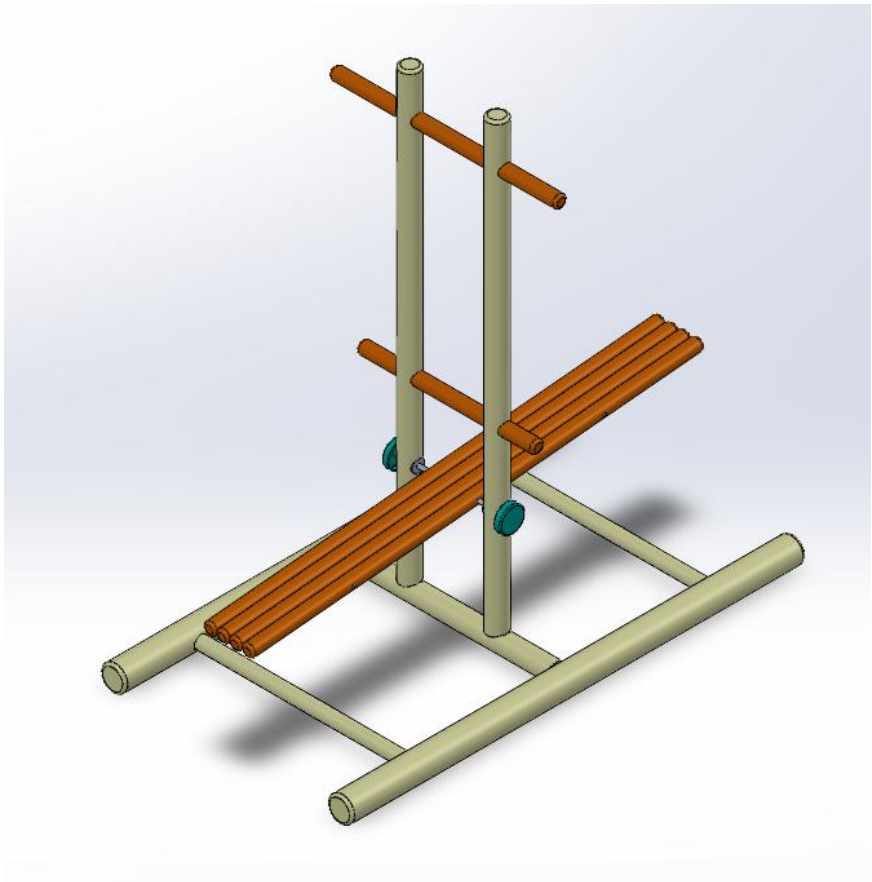
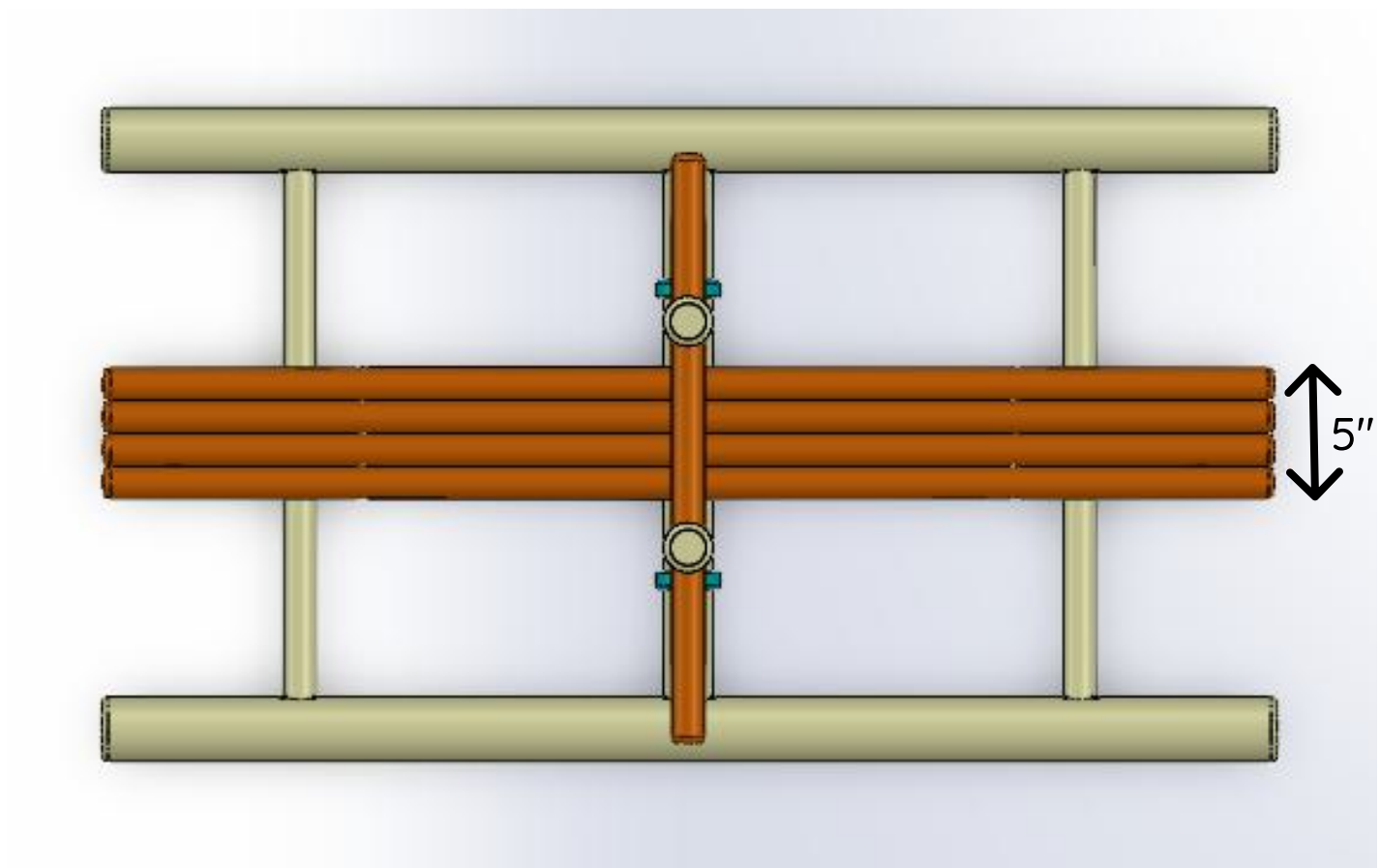
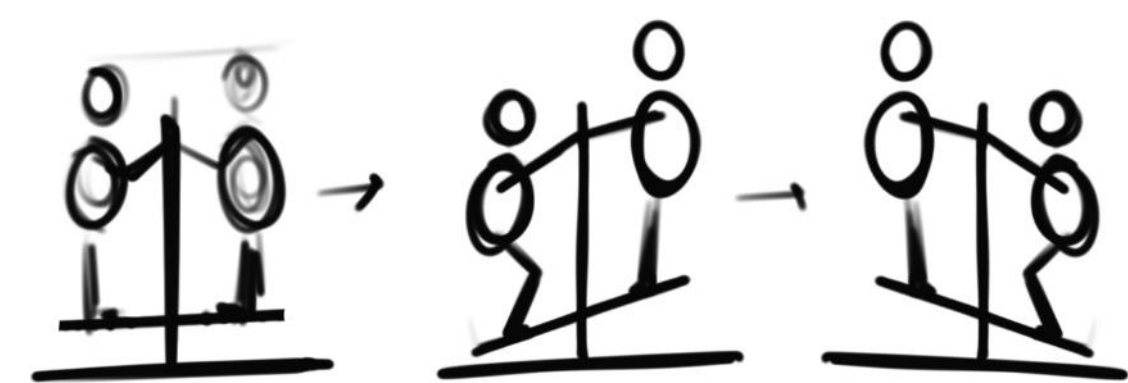
4. Concept 4



- Fine motor skill (Grip), Body balance
- Socializing, Coordination with others
- Swaying in air, Continuous displacement of body.



CAD Model



Making



About the Product

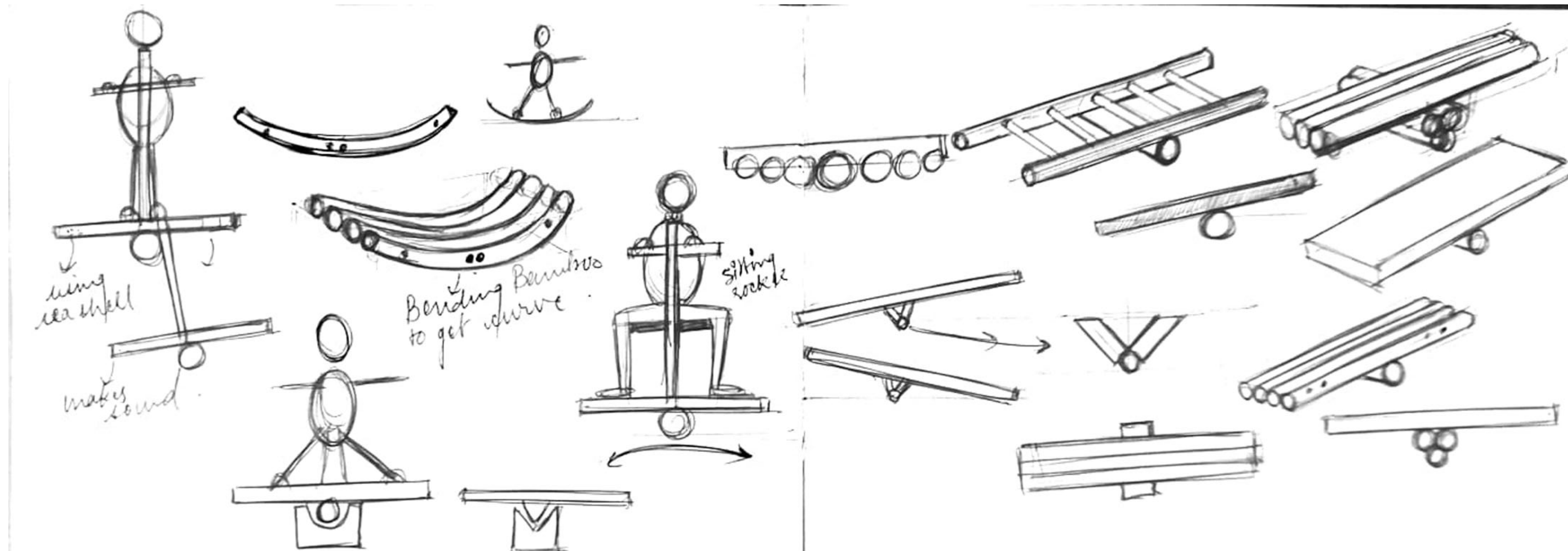
Number of user: 2 kids at a time. Can be used both while sitting and standing.

Motor Skills: Fine motor skill (Grip),
Body balance.
Socializing, Coordination with others

Play: Swaying in air, Continuous displacement of body.

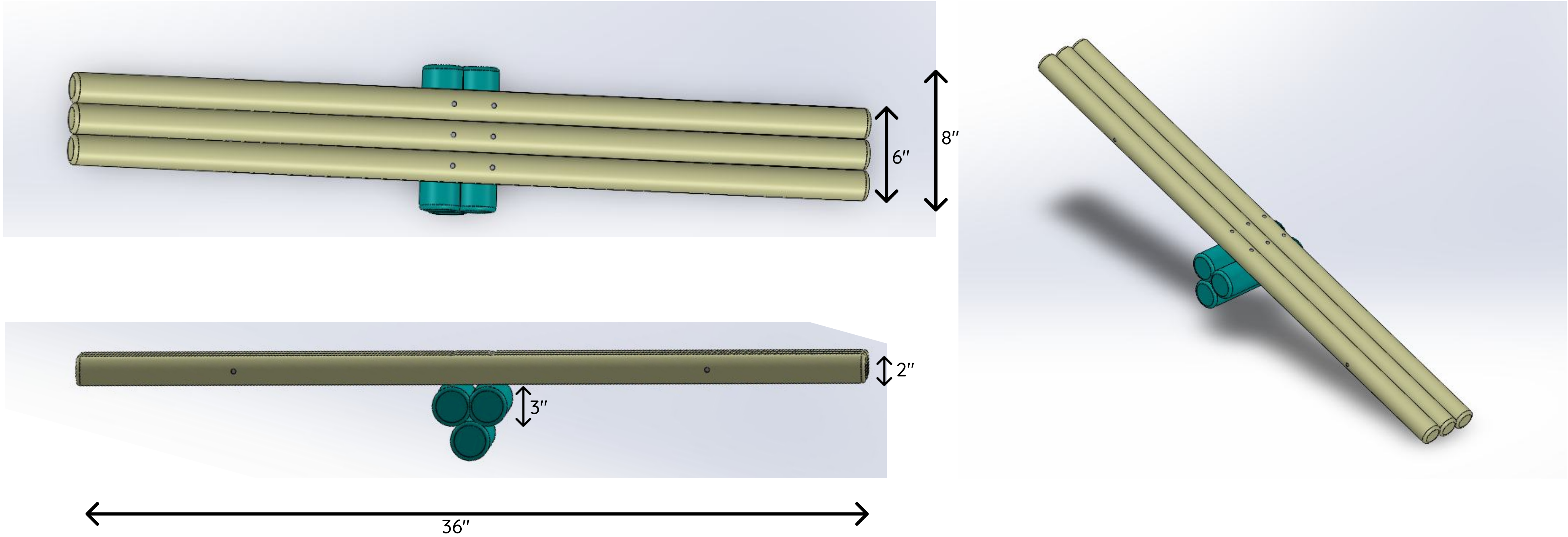


5. Concept 5



- Learning to maintain body balance,
- Leg muscle strengthening
- Coordination of movements on an unstable surface.

CAD Model



Making



About the Product

Number of user: One or many kids at a time.

Motor Skills: Learning to maintain body balance, leg muscle strengthening, coordination of movements on an unstable surface.

Play: Its like a game, as they walk near to the center they inclined surface gets straight. Similar to sea-saw but it involves walking rather siting. (I discussed my idea and showed them.They are excited to try standing sea saw because they found it new.



User Testing



During user testing with kids there were certain observations as how kids used balancer in different ways. Such as using it like seasaw. Also as a game where one sits and other stands pushes up and down.



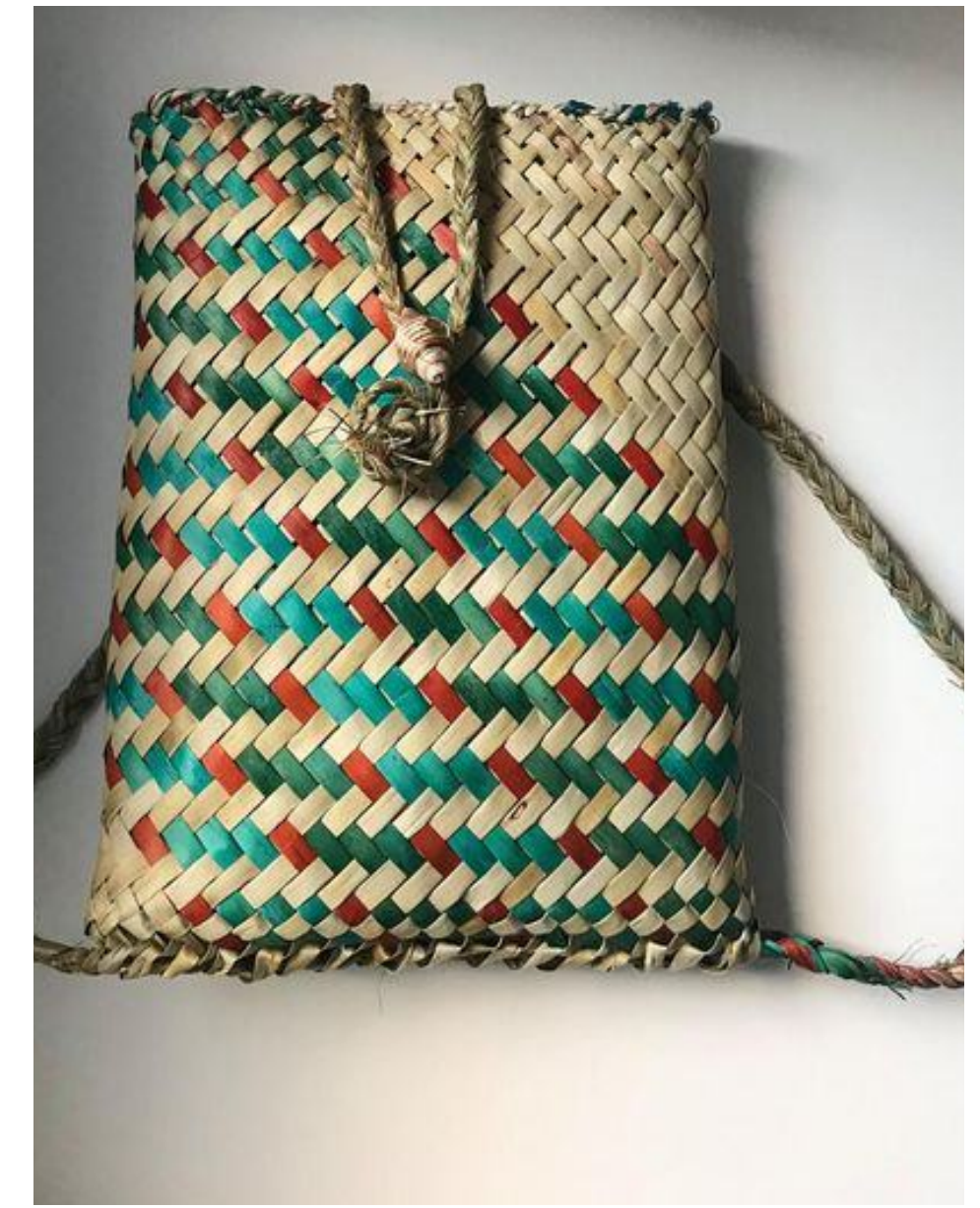


9.6. COLOURING



I wanted to understand what kinds of colours are being used or are in trend for kids so that I can use similar colours for my products.

Image Source: Pinterest



I went through certain colours that are done on bamboo to understand which colours will pop out and how they look with bamboo.

Image Source: Pinterest



Project 3, IDC, IIT Bombay





Standard Dimension of bamboo used

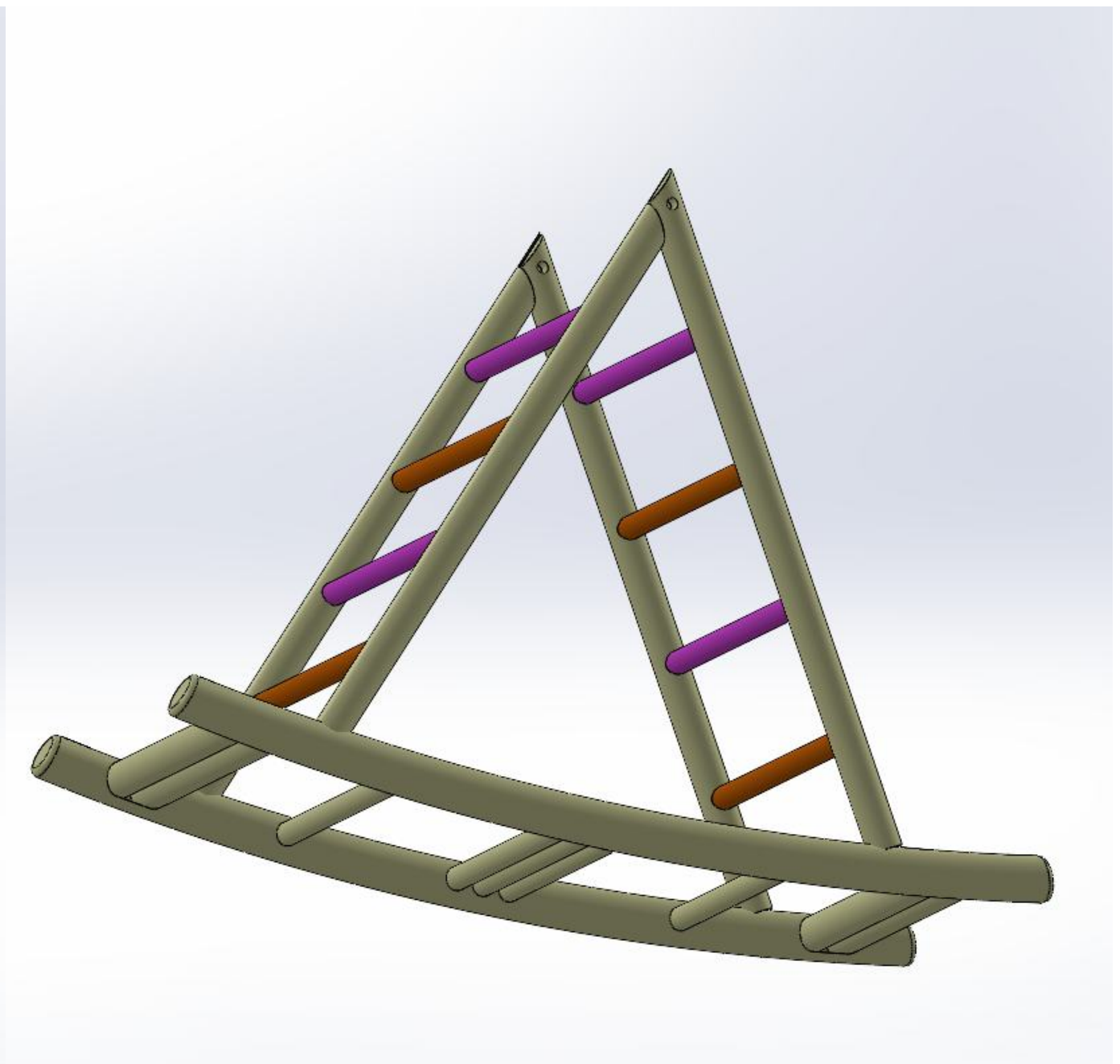
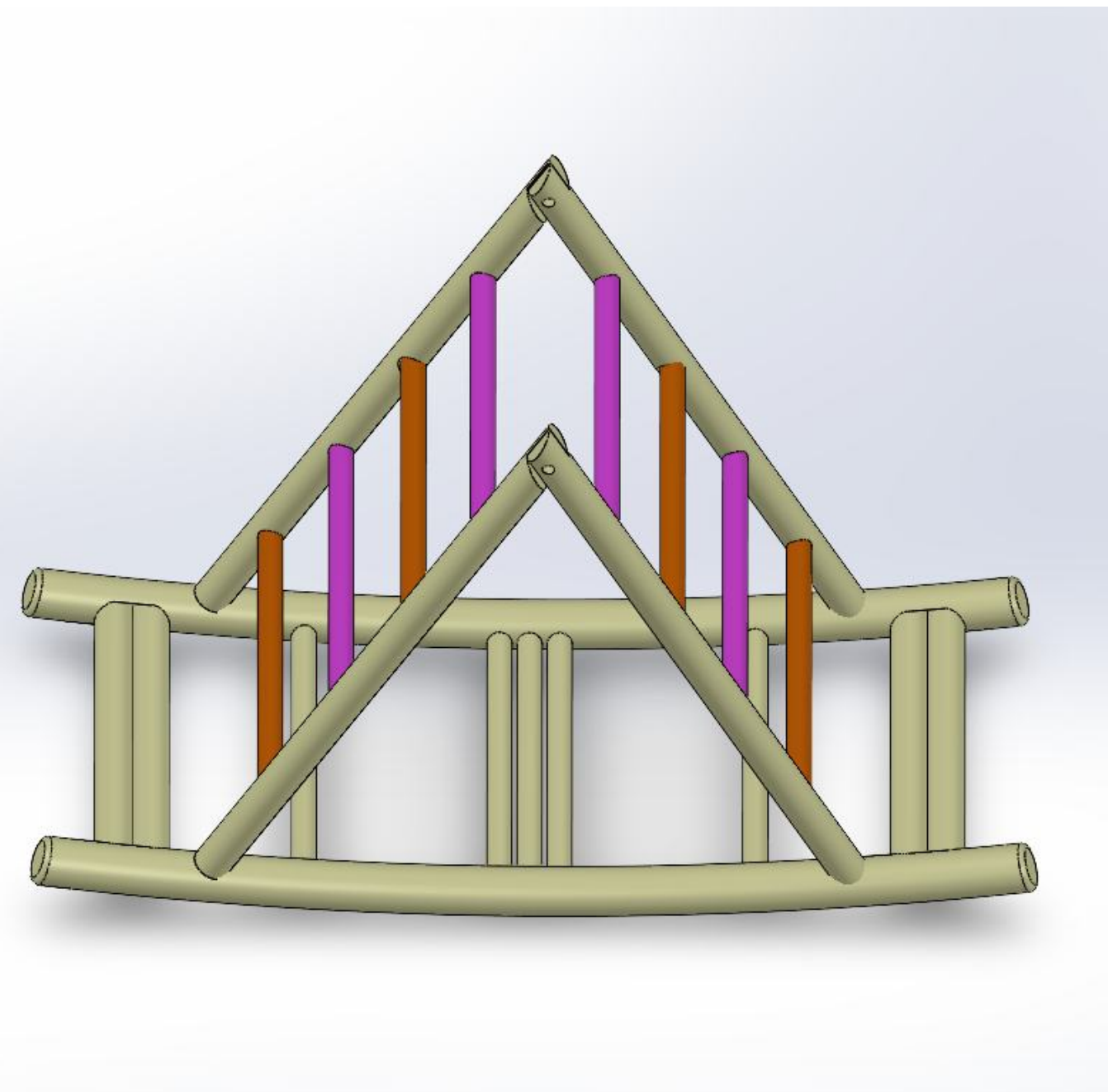
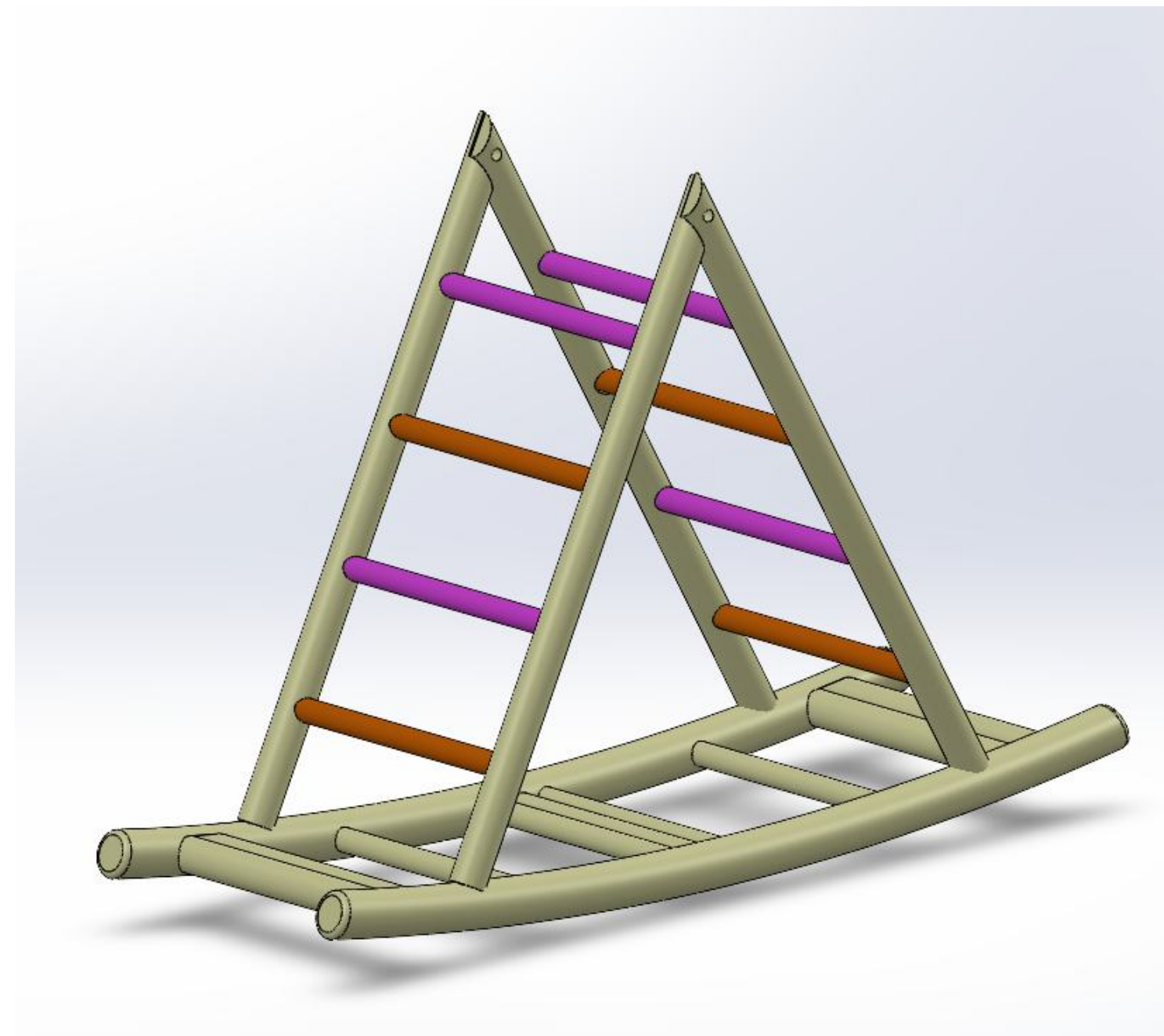
SPECIFICATIONS	DIMENTION (Inches)
Distance between 2 bars	6
Length of ladder bars	14
Length of sitting and standing platform	8-12
Breadth of sitting and standing platform	8-12
Diameter of bamboo used for sitting and standing	1
Diameter of bamboo used for walking and climbing	1.5
Curve angle	10-15
Ground clearance	8-12
Depth of dowe	1
Width of dowel (for rectangular joinery	0.5
Diameter of dowel	1
Diameter of pin	6mm
Depth of pin	1
Diameter of base bamboo	2

CHAPTER 10

RENDERS

10.1. PRODUCT 1

CAD Model



3D Render



Product

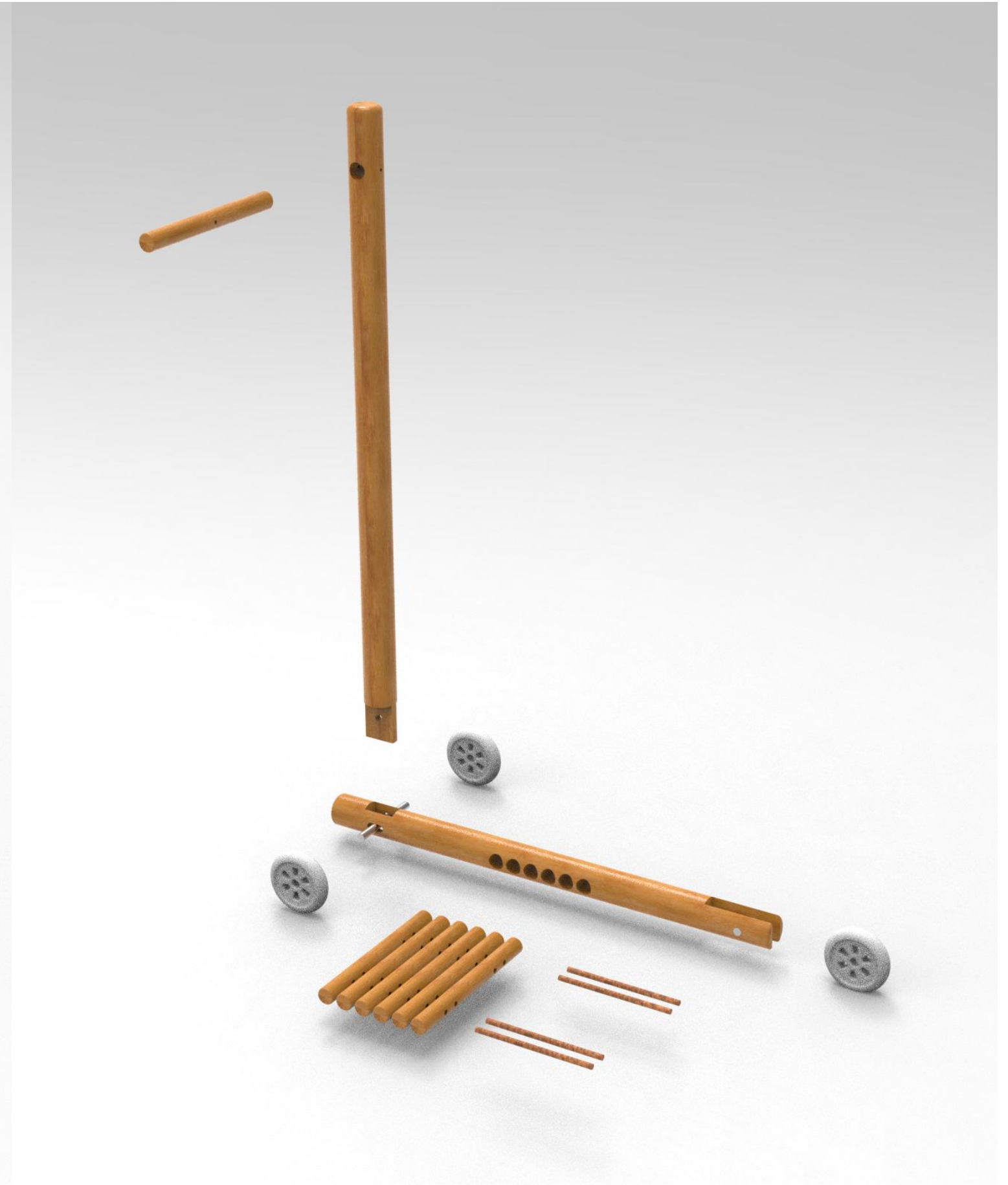


10.2. PRODUCT 2

CAD Model



3D Render

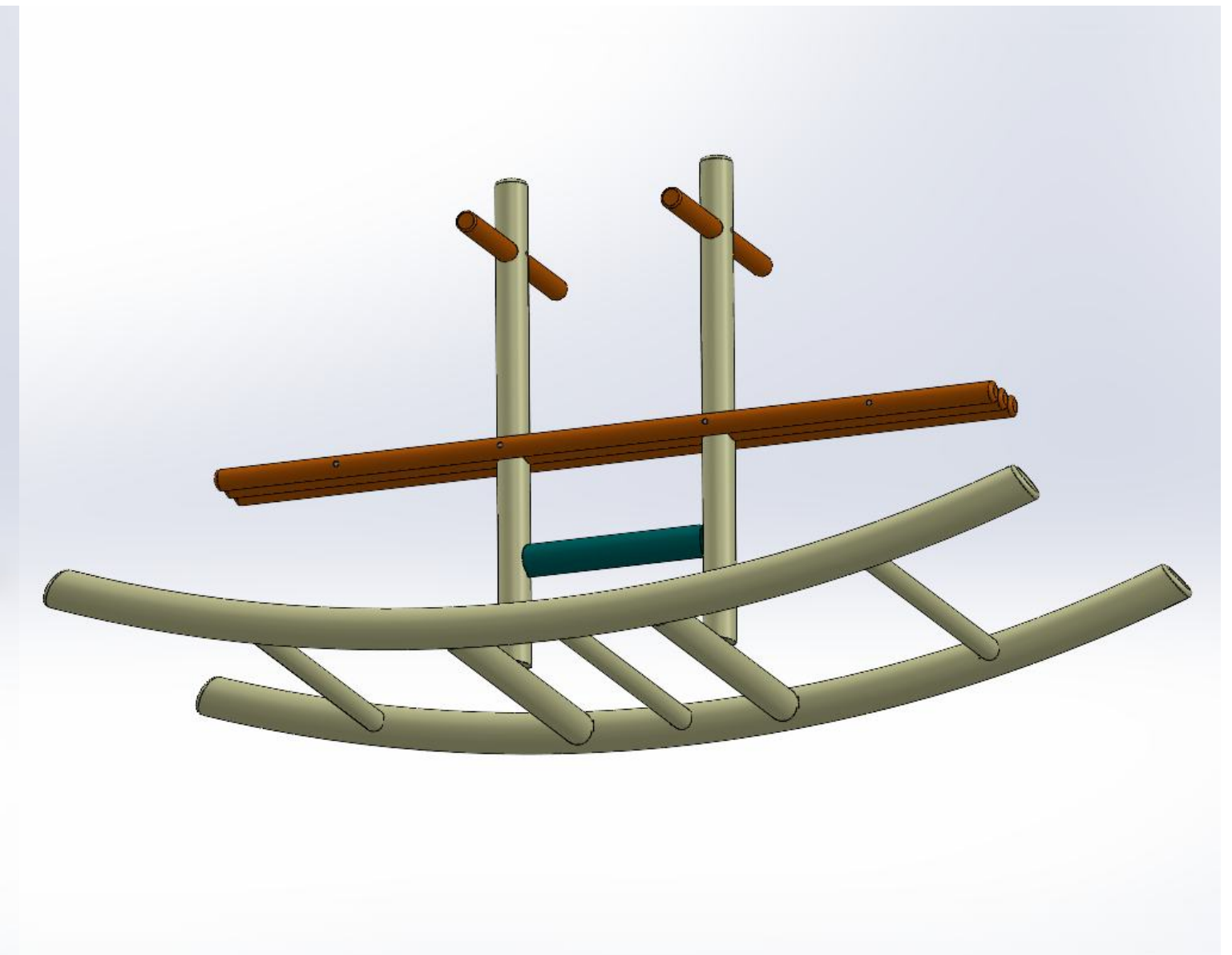
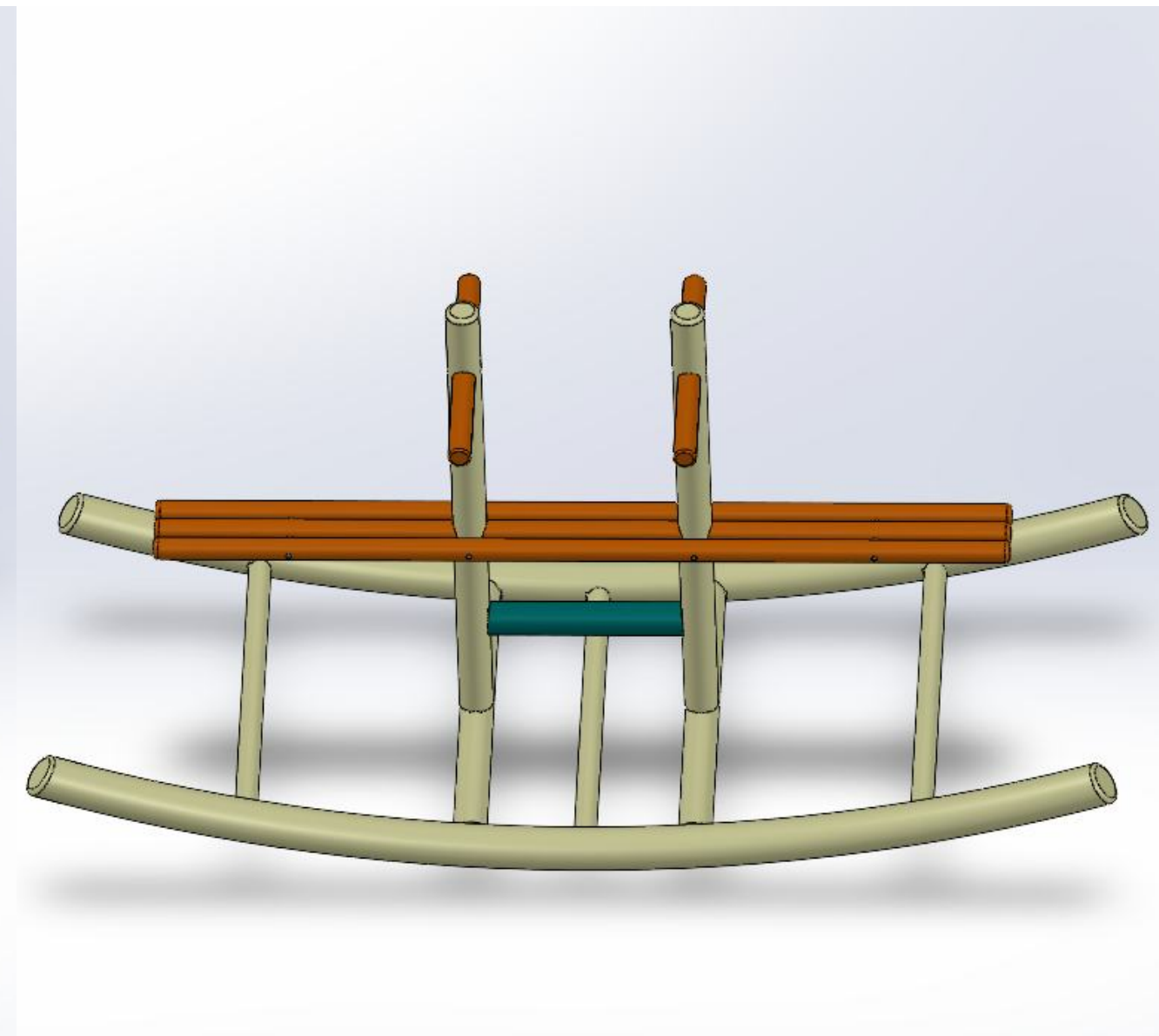
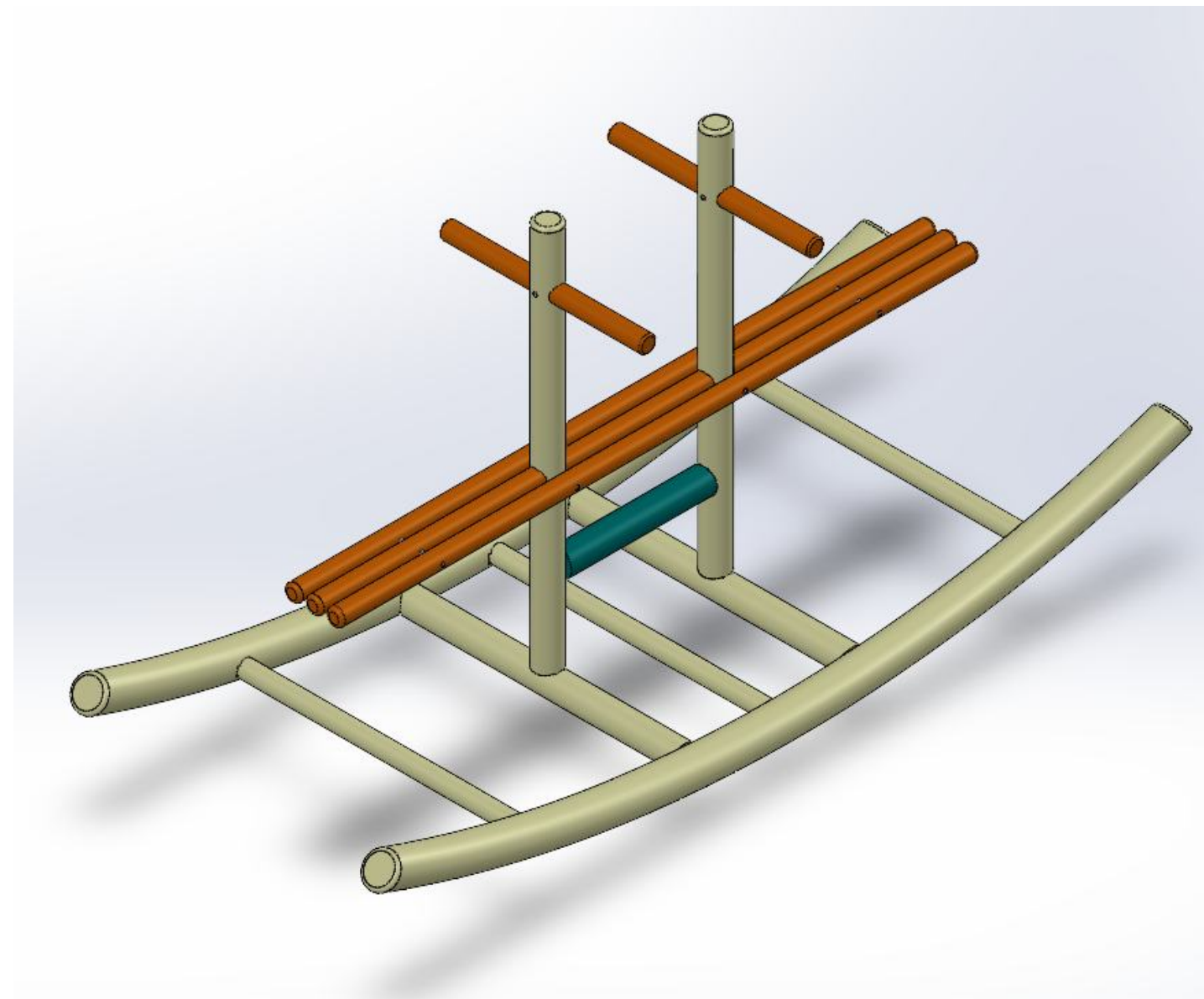


Product

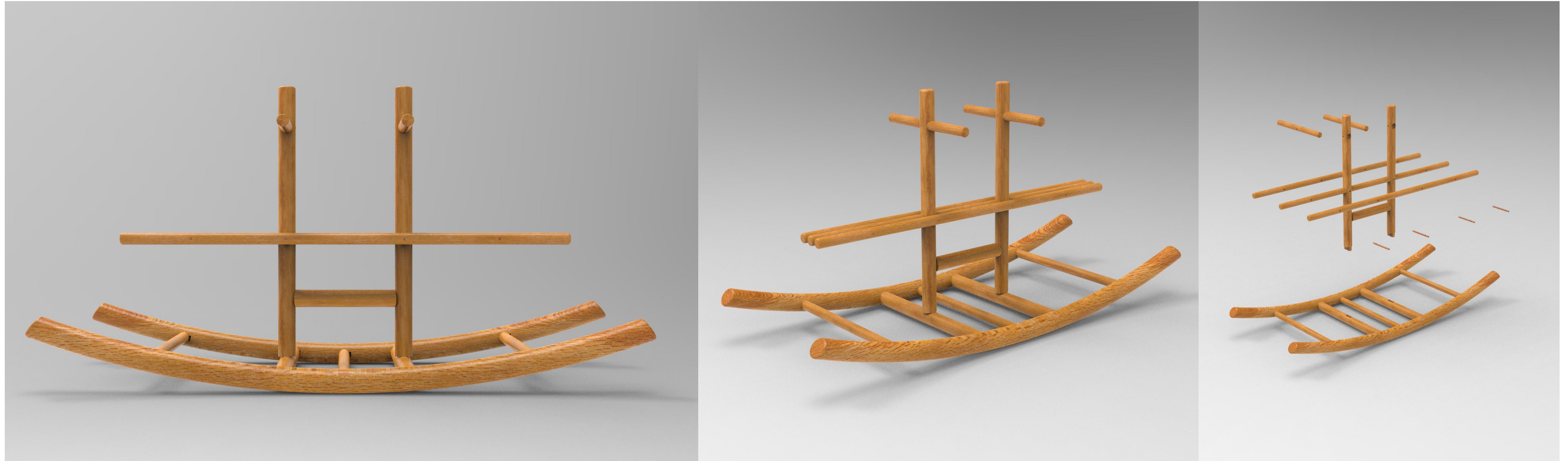


10.3. PRODUCT 3

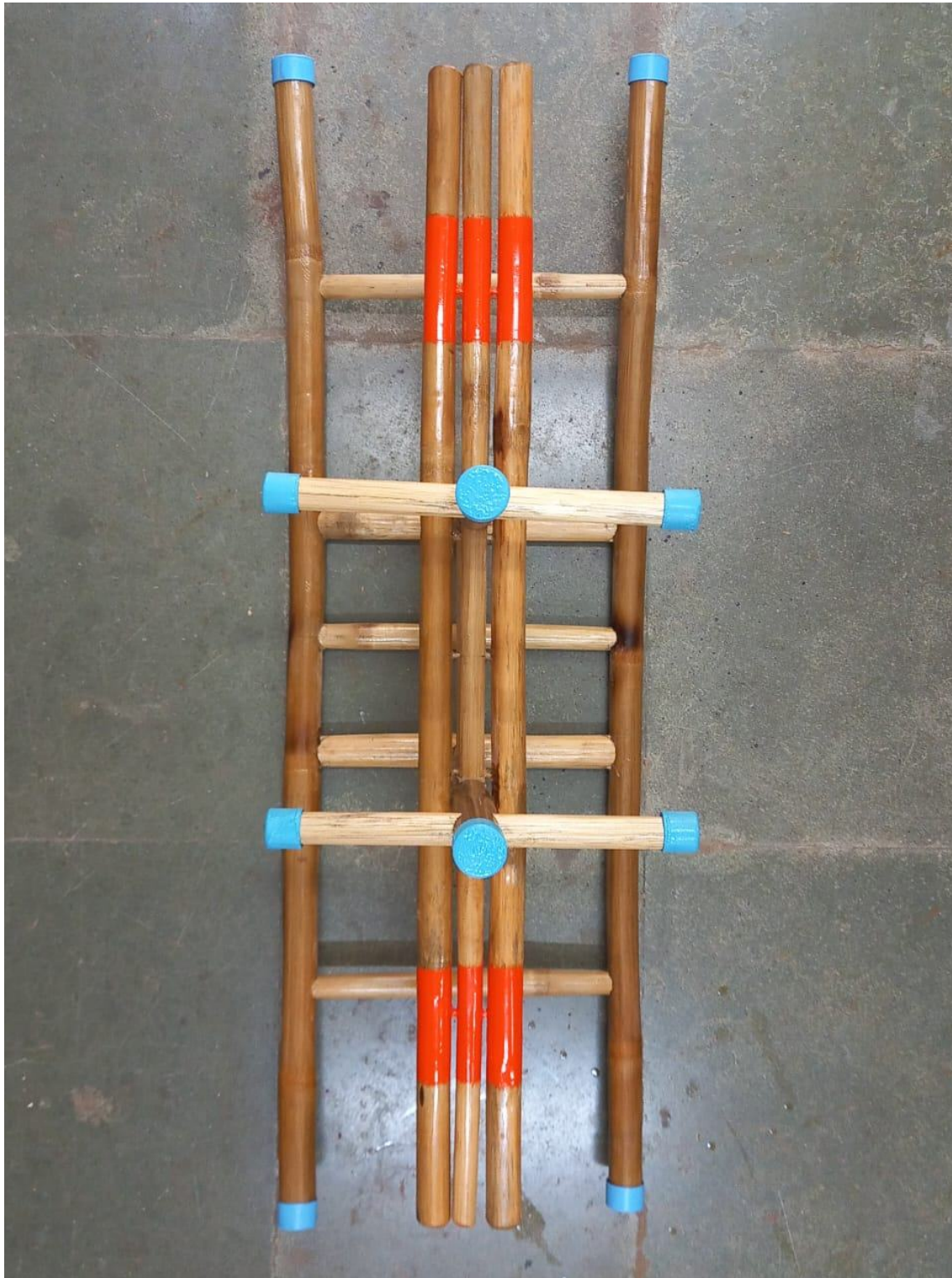
CAD Model



3D Render

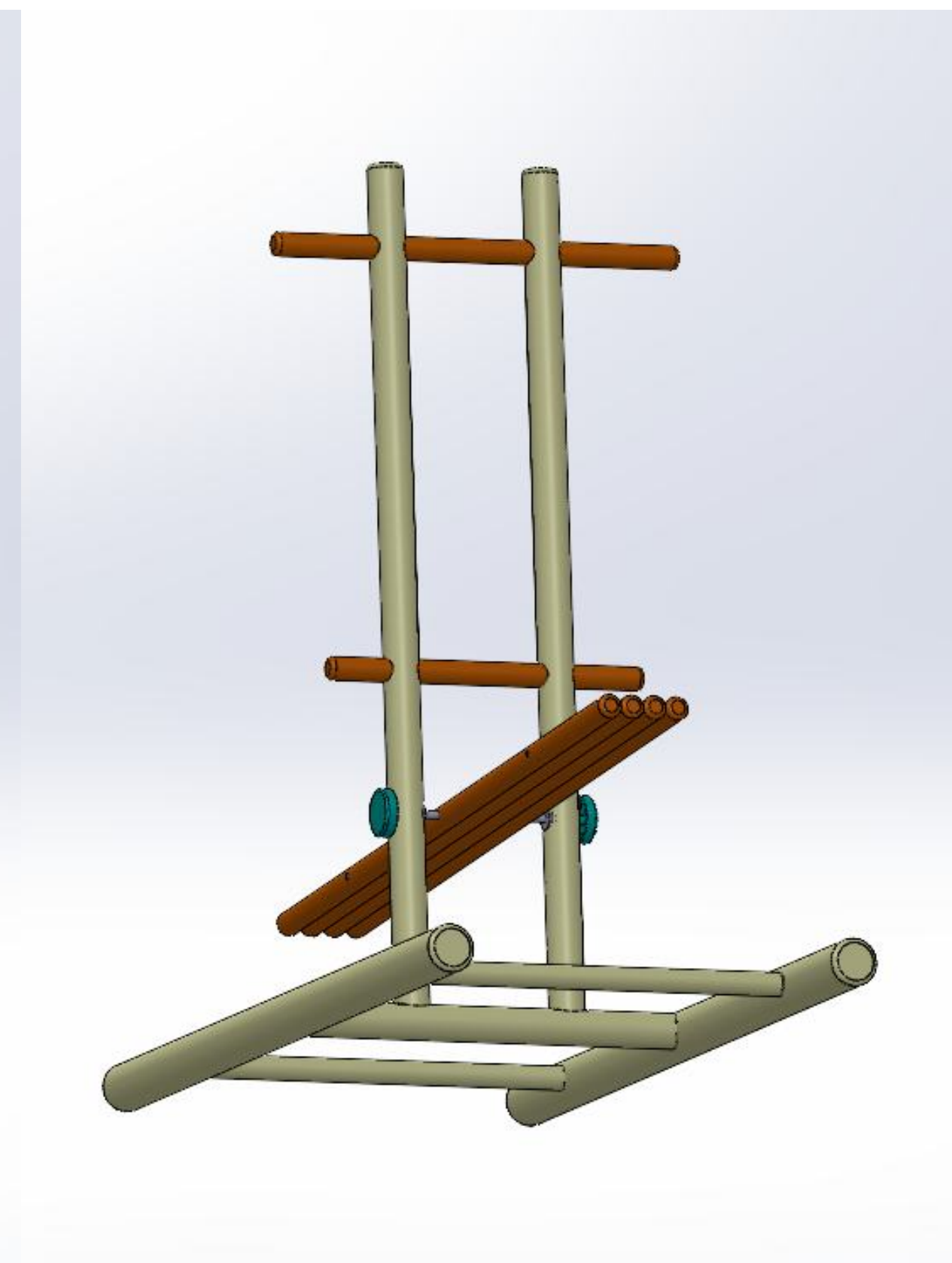
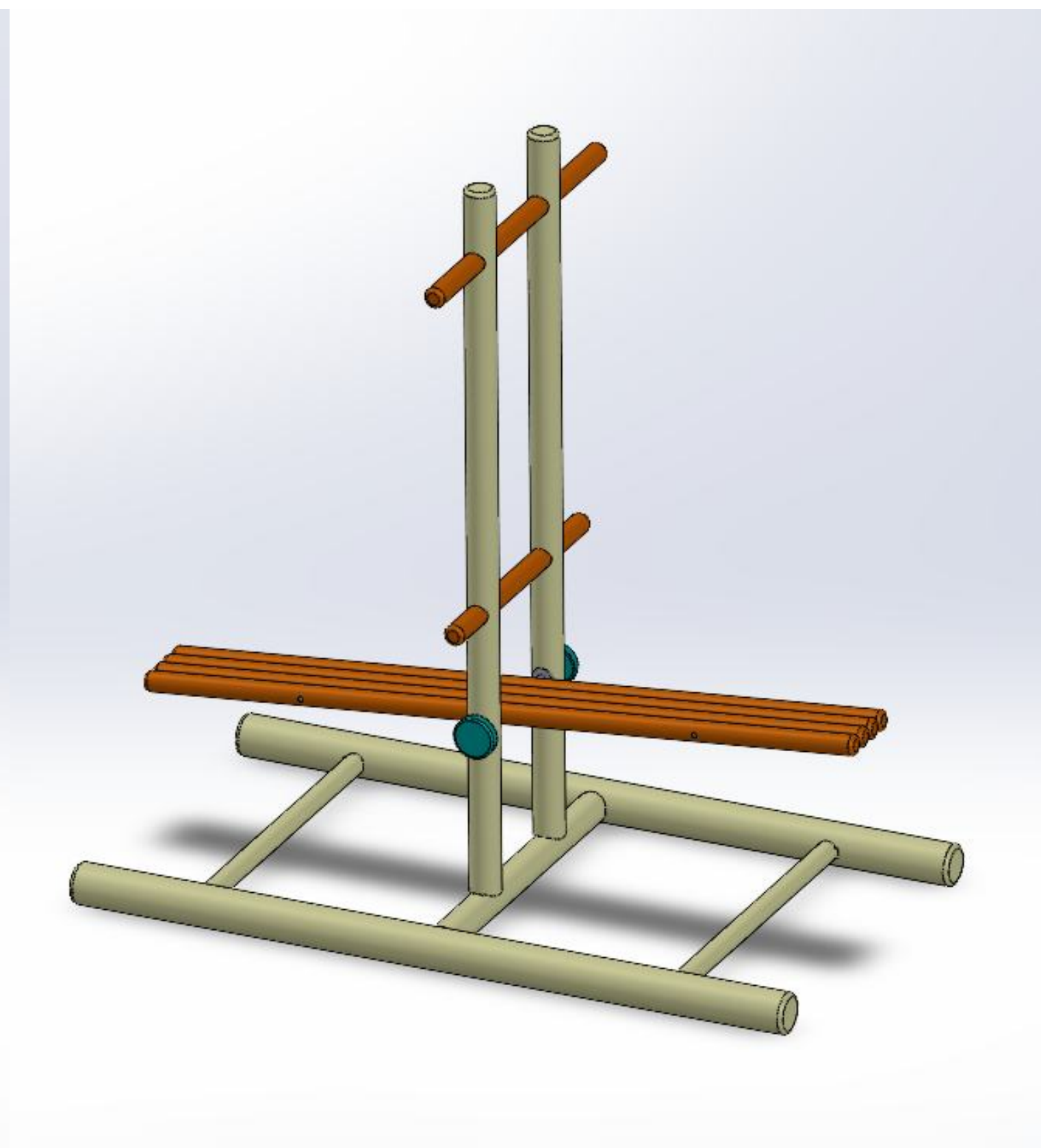
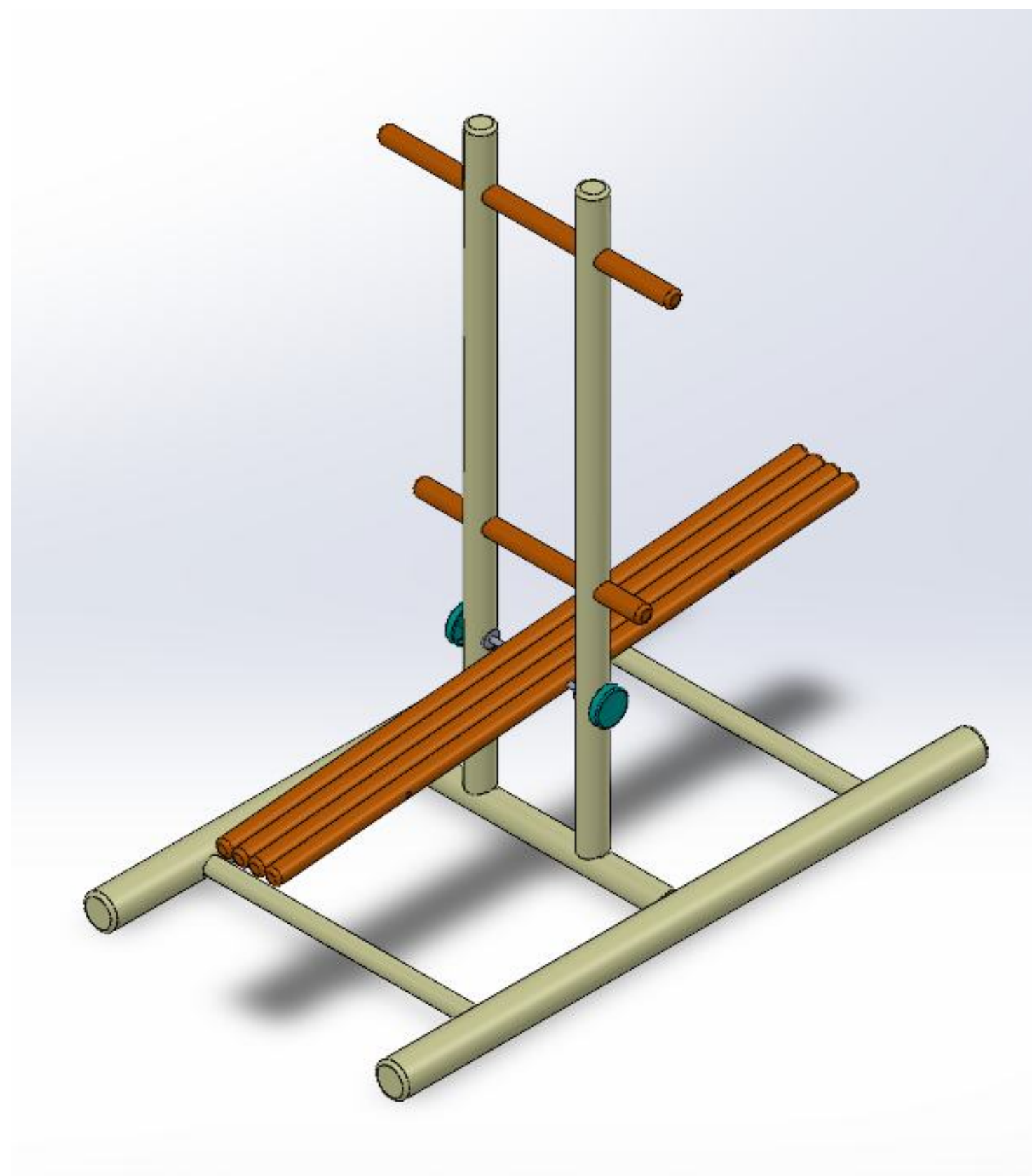


Product



10.4. PRODUCT 4

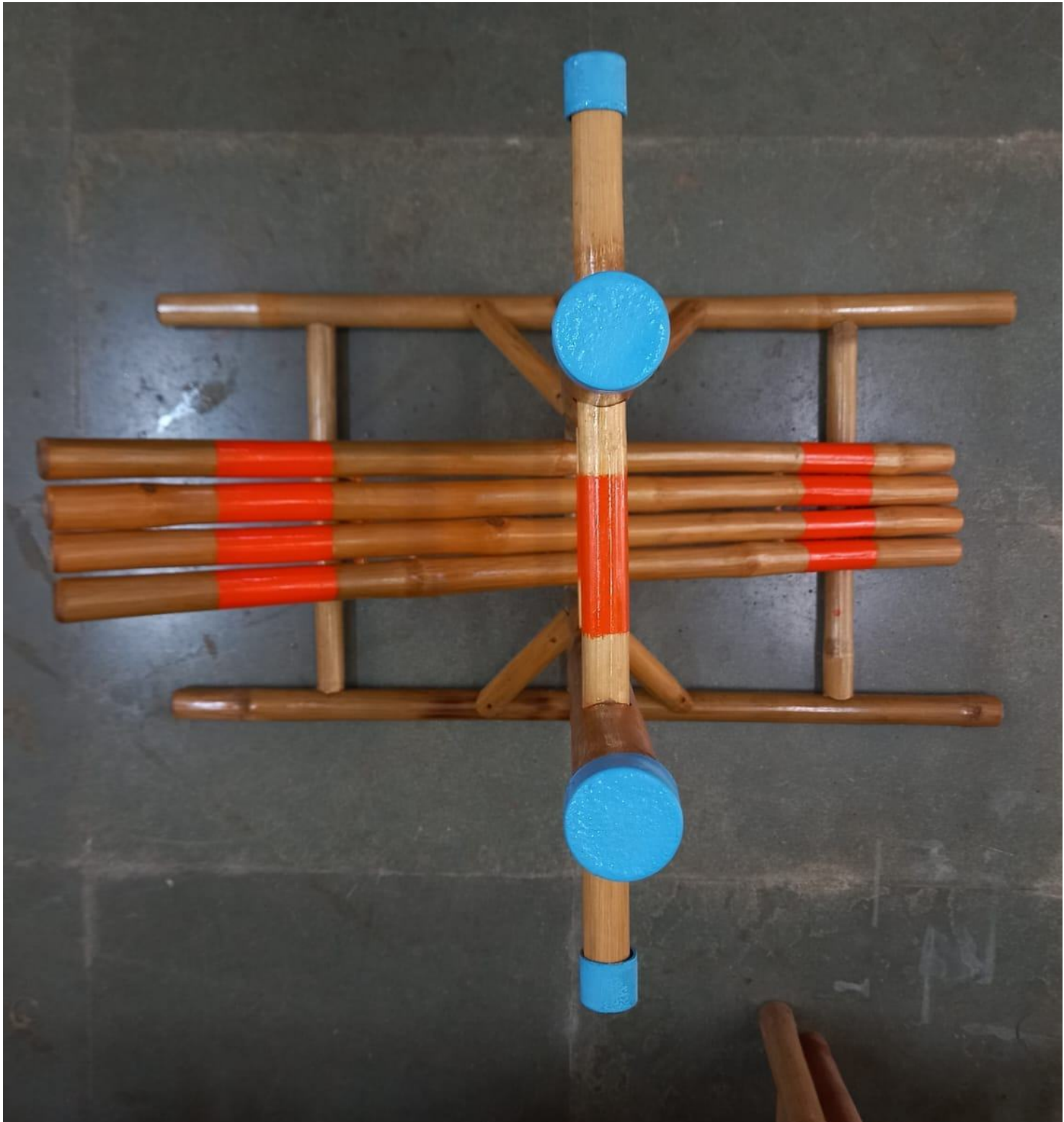
CAD Model



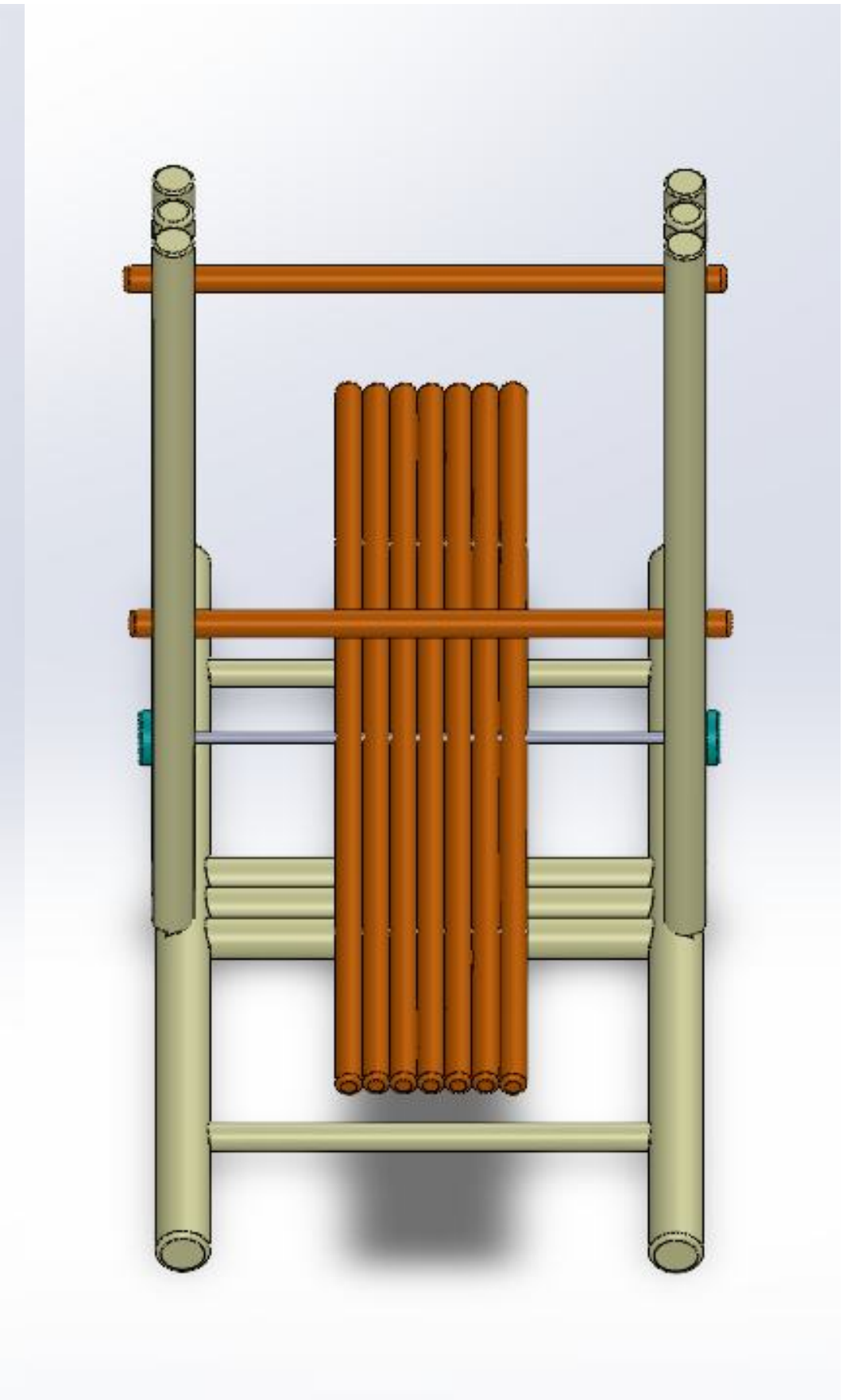
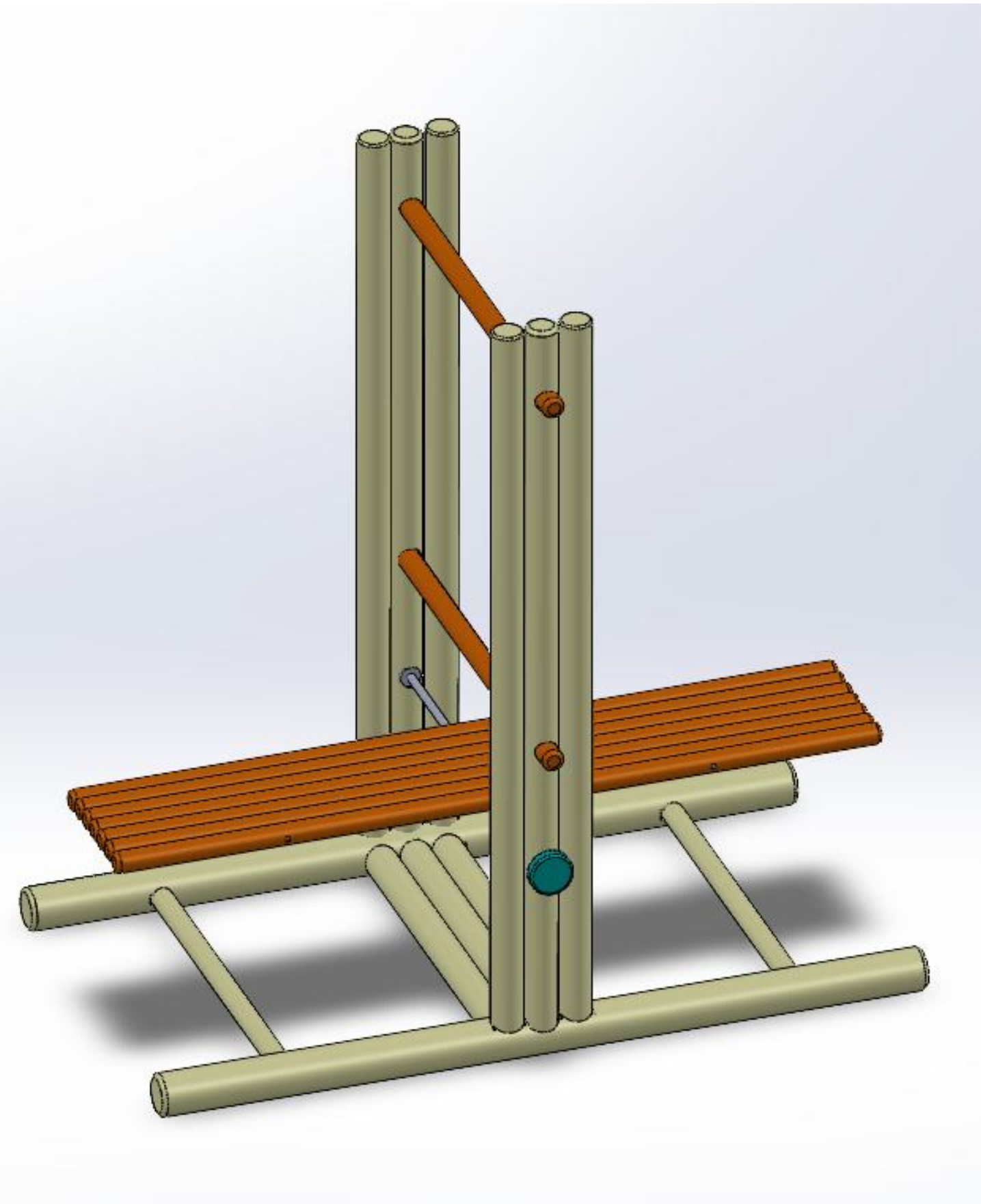
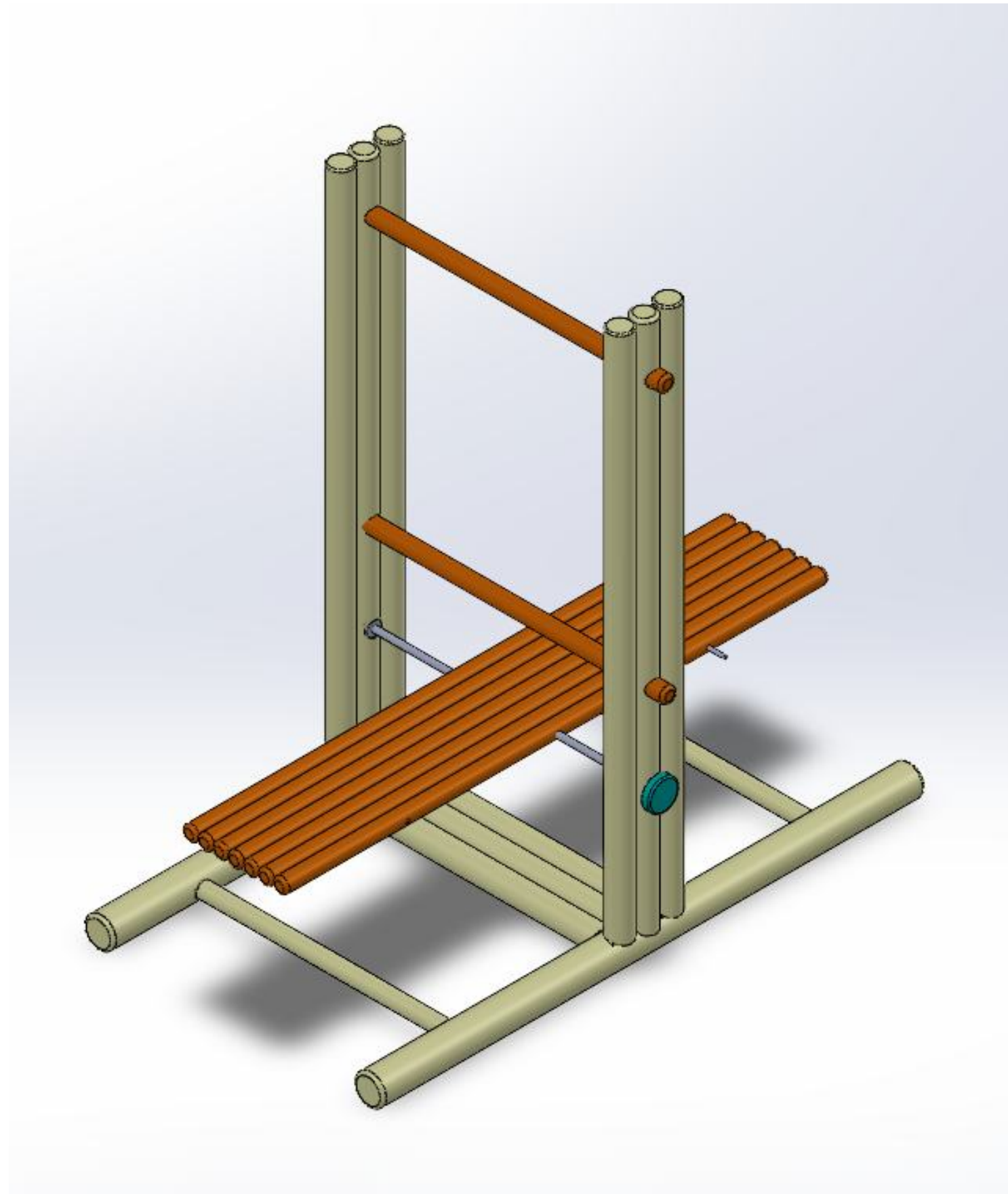
3D Render



Product

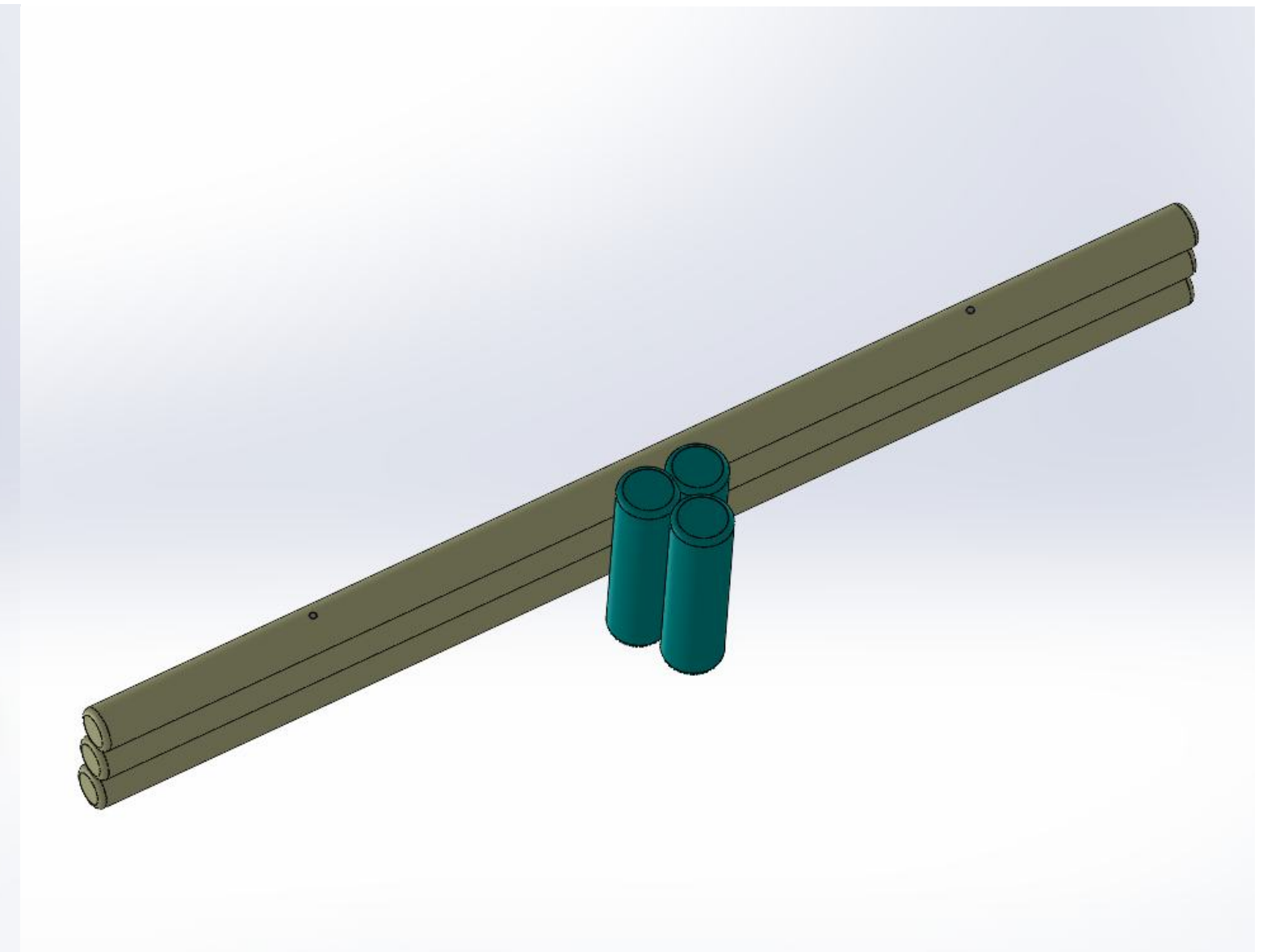
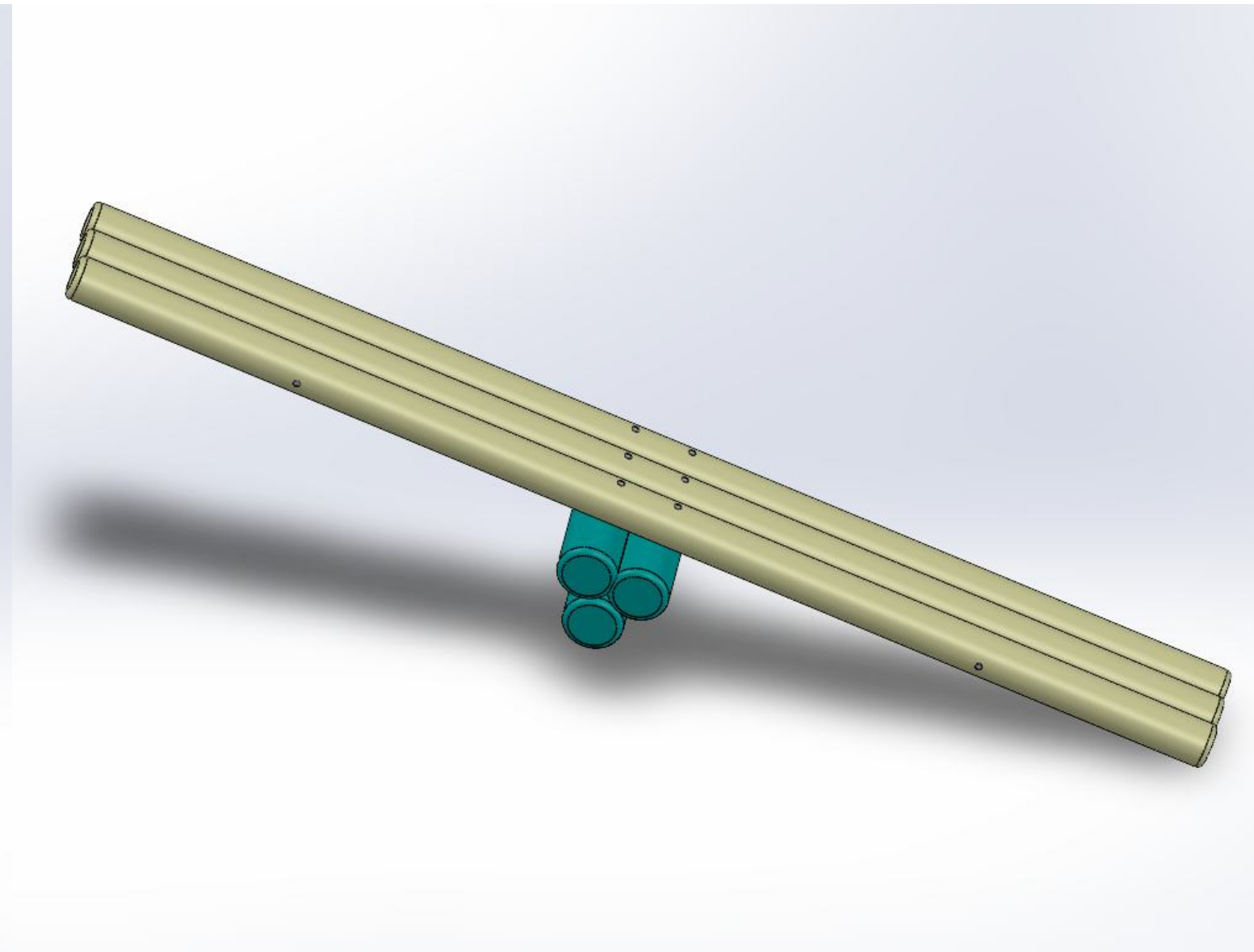
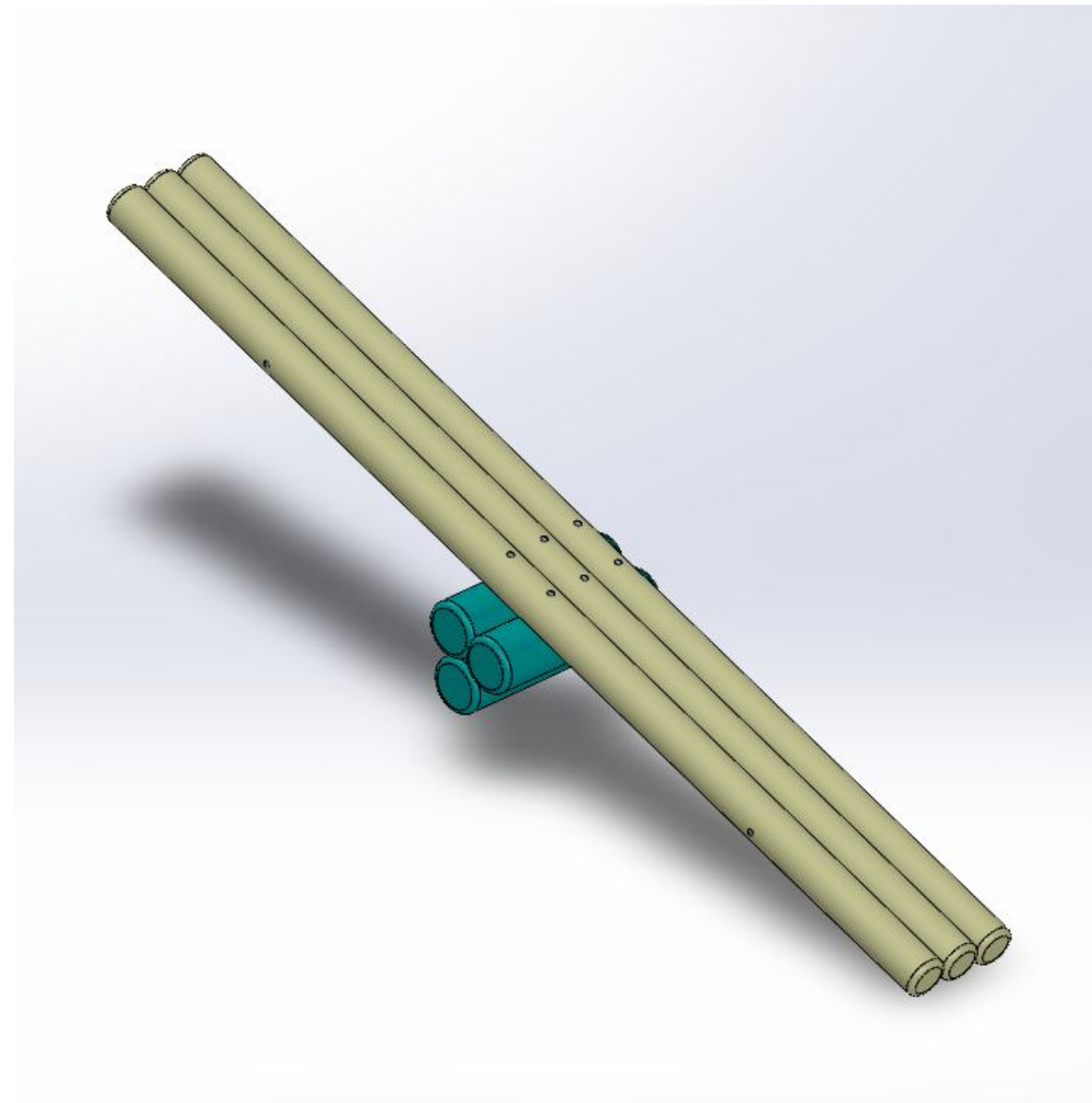


Refinement of C4



10.5. PRODUCT 5

CAD Model



3D Render



Product



10.6. CRAFTING



The process of making involved:

- Cutting bamboo to desired length
- Bending (If needed)
- Removing the upper skin (To get fresh and clean skin)
- Finishing the edges to make it 90 degrees
- Marking for joinery
- Making grooves for joinery
- Assembly
- Finishing with sand paper
- Color
- Varnish

10.7. FUTURE SCOPE

- Unconventional joineries offer a viable alternative to conventional methods, which are often difficult to fabricate and reduce material strength due to the insertion of one part into another.



- By using different materials, joinery can be simplified, enhancing both ease of construction and aesthetic appeal. Additionally, exploring color variations can further improve the visual aspects of the design.
- A deeper engineering understanding is necessary to ensure better structural stability.

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