



GEOMETRY KIT

FOR
VISUALLY IMPAIRED KIDS

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Project Guide : Purba Joshi

The number of blind people in India is 12 million out of which 26% are children. These children will be making major contributions to the society in coming years.

A photograph of three children in a computer lab, wearing headsets and looking at computer monitors. The image is faded to serve as a background for the text.

The number of blind people in India is **12 million** out of which **26%** are children. These children will be making major contributions to the society in coming years.

Introduction

What is Visual Impairment?

Introduction

Decreased ability to see to a degree that causes problems not fixable by usual means, such as glasses.

Causes

Refractive errors (43%),
Cataracts (33%), and
Glaucoma (2%).

Visits

Model School for the Visually Handicapped

National Institute for the Empowerment of Persons with Visual Disabilities
(Divyangjan), Dehradun



A black and white photograph of a large group of students in school uniforms sitting on the floor in a classroom. They are arranged in rows, facing towards the left side of the frame. The students are of various ages, likely elementary school. The room has large windows with curtains in the background. The text is overlaid on the left side of the image.

Interacting with students
Meeting Teachers
Observing the surroundings

Education

“It has been realised that blind students leave subjects like science and mathematics after school because the Braille books come without diagrams, and everything is dependent on the effort of the teacher.” quoted a teacher.

Interview- Mathematics Teacher

Difficulty in construction of diagrams, the students are totally dependent on the efforts of the teacher.

No considerable changes have been made in the mathematics kits over years.

Visits

National Association for Blind, Worli, Mumbai

Visits

Kumudhben Dwarkadas Vora Industrial Home
for Blind Women, Mumbai.

Visits

Happy Home School for Blind, Worli

Interview- Mathematics Teacher

The school has not included geometry in the mathematics syllabus for students as they think that they cannot learn it properly. She also mentioned that the visually disabled students must restrict themselves to the topics where they can perform better and must accept their shortcomings.

Visits

Workshop by Xavier's Resource Center for the Visually Challenged (XRCVC).

Possible design directions

**Educational
Products**

Skill
Development

Vocational
Training

Possible design directions

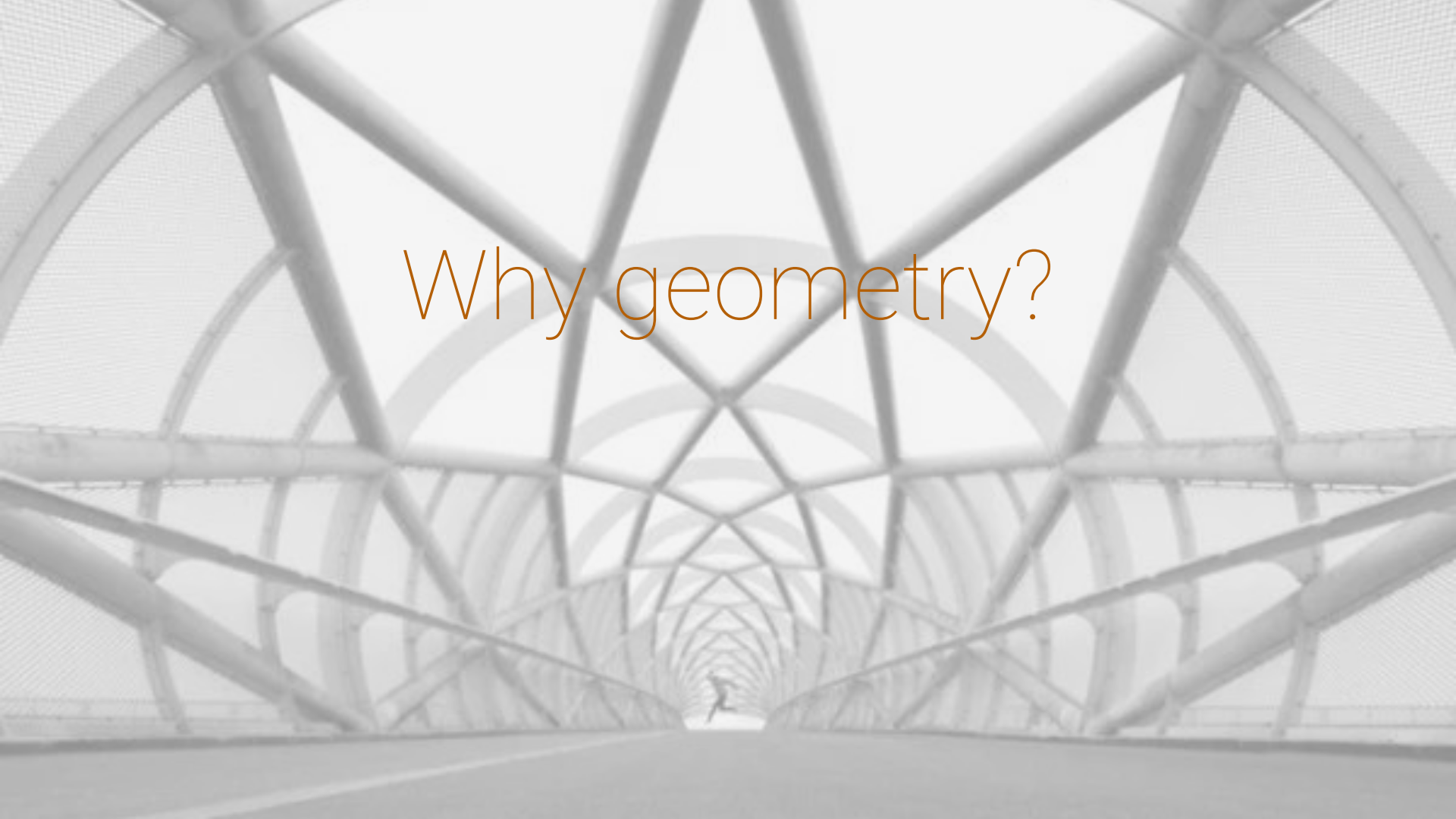
**Educational
Products**

Skill
Development

Vocational
Training

Design of Geometry kits for
Visually Impaired Kids

Why geometry?



Why geometry?



Fundamental basis of the understanding of
Forms and shapes

Helps improve visualisation skills

The gateway to professions such as
Architecture, design

Products for Visually Impaired



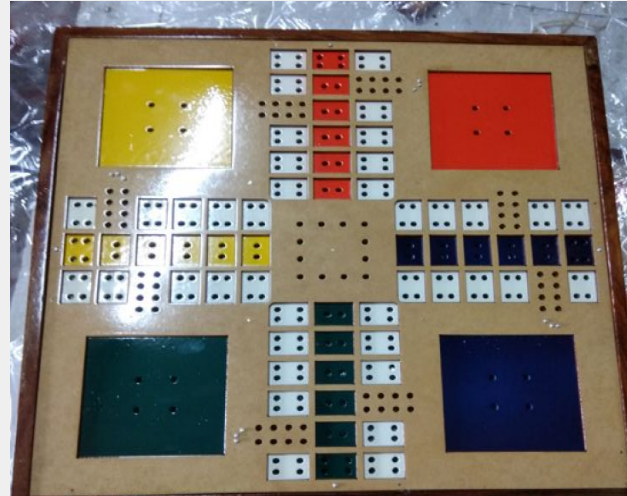
TEACHING AND LEARNING AIDS

Products for Visually Impaired



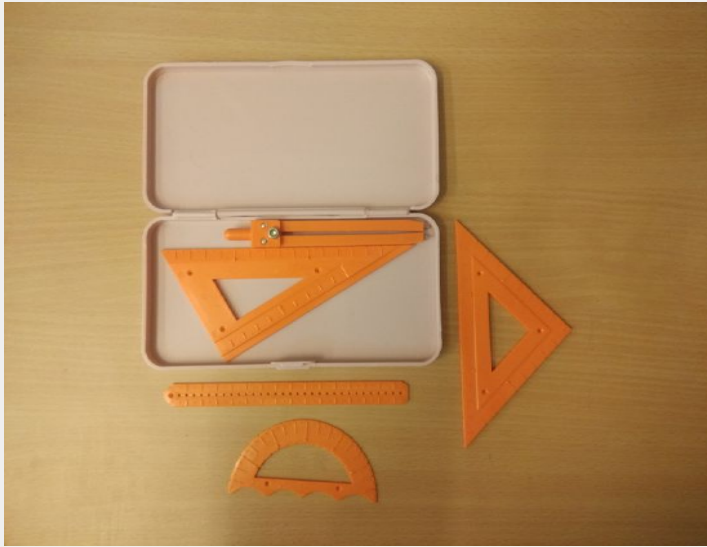
TEACHING AND LEARNING AIDS

Products for Visually Impaired

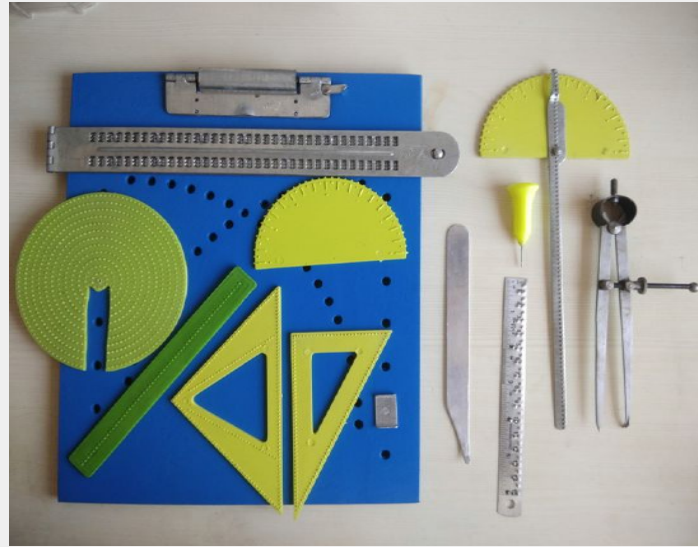


ADAPTED GAMES FOR BLIND

Geometry Kits for Blind

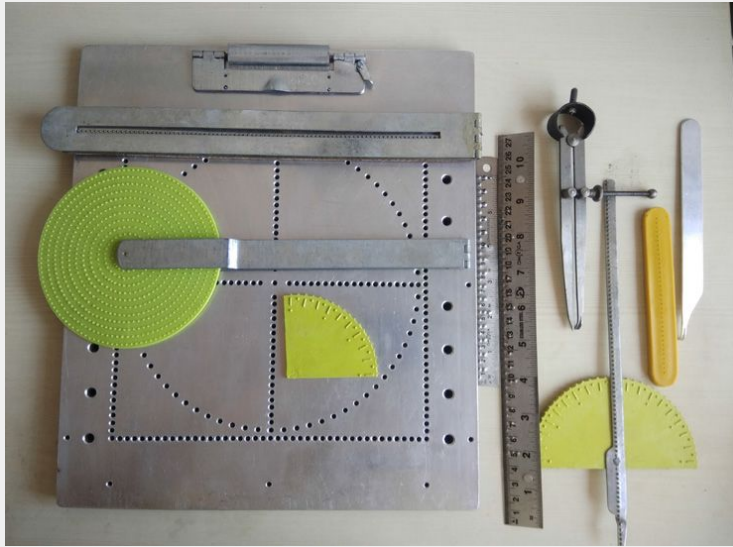


Mini Plastic Geometry Set



Rubber Based Geometry Kit

Geometry Kits for Blind

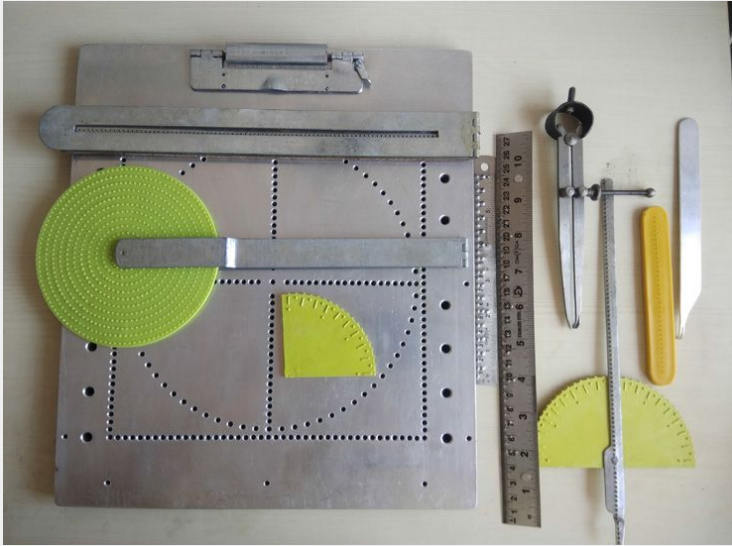


Versatile geometry kit (aluminium base with embossed accessories)



Plastic and rubber geometry kit

Activity analysis



Versatile geometry kit (aluminium base with embossed accessories)

Slate

- Too heavy
- Difficulty in locking and unlocking for fixing paper
- Inconvenience in locking the clip.
- Edge of the sheet of paper and end of the slate alignment.
- Locking mechanism tends to tear the paper if the paper and the slate is not aligned.



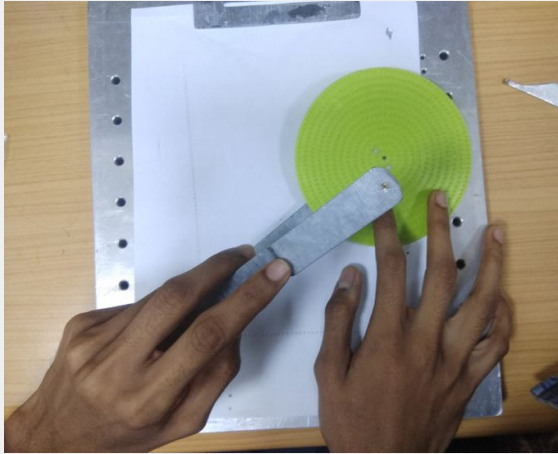
30CM RULER

- The markings are not precise and are confusing.
- Sharp edges
- Easily manufacturable.
- Low cost



15CM RULER

- Not precise markings, difficult to count and measure.
- No Braille feedback available.



CIRCLE MASTER

- Difficult to locate the center from the top of the paper.
- Sharp pin at the bottom.
- The top flap might fold the paper(might not coincide with the width of the paper).



PROTRACTOR

- Finding the centre for making the angle is difficult.
- Bad quality of lines.
- It is difficult to measure angles from the device due to the difference in depth.

Design Brief

Users & Target Market Segment

- Visually Impaired kids between classes 5th to 8th.
- Schools following NCERT syllabus.

Design Brief

USER REQUIREMENT

- Should be easy to learn (Reducing the learning curve)
- Should be easy to use
- Easy to carry around
- Should have the option to write on the same medium
- May also help in learning the concepts
- Should be safe to use

Design Brief

Design Considerations

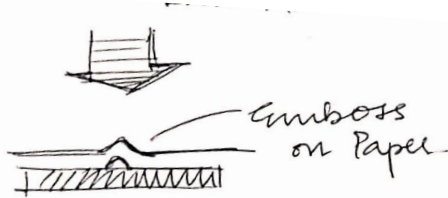
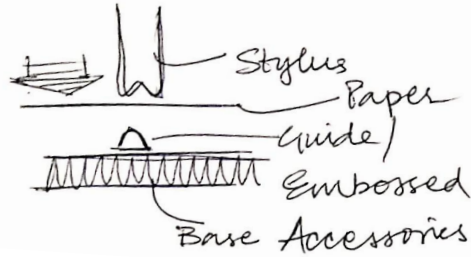
- The Students must be trained with the essential motor skills.
- Also, they must have the basic knowledge of geometric concepts as taught in junior classes

The Approach

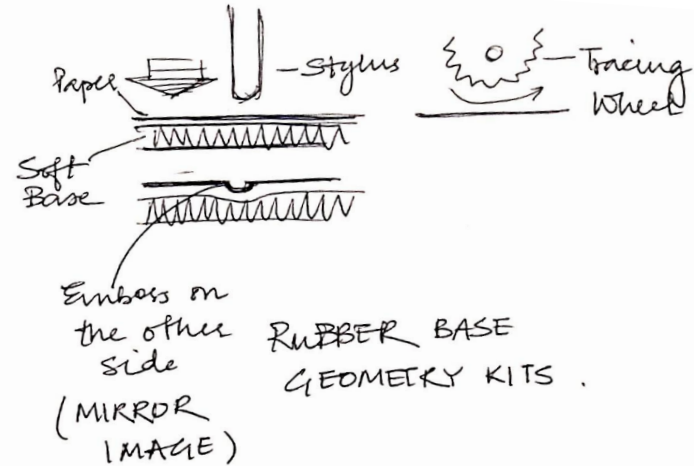
To define the tasks to be carried out by the geometry kit, a thorough study of the syllabus of NCERT mathematics was carried out. In Principle, to draw geometrical shapes and geometrical constructions, we need tools to draw the following:

- Point
- Line and Line Segment
- Circle and Arc
- Angle between two lines

The Approach

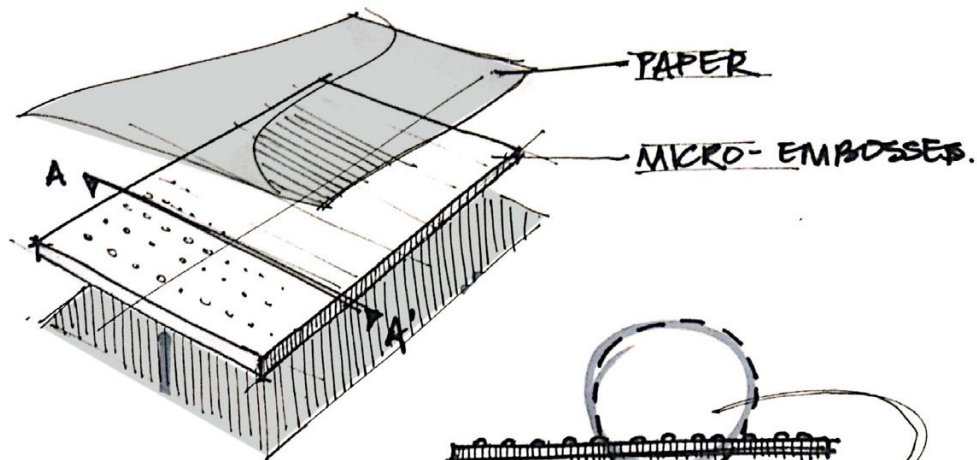


DIRECT DRAWING WITH
EMBOSSED ACCESSORIES



Idea Generation

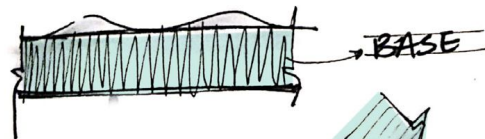
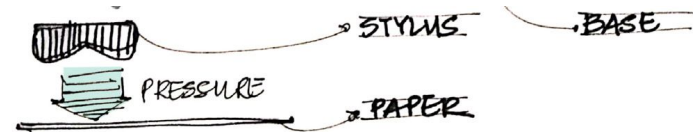
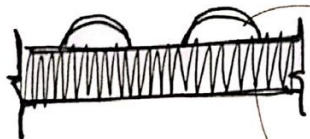
Ideas for base



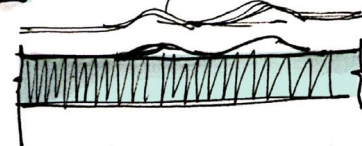
SECTION AA'

→ ZOOMED IN

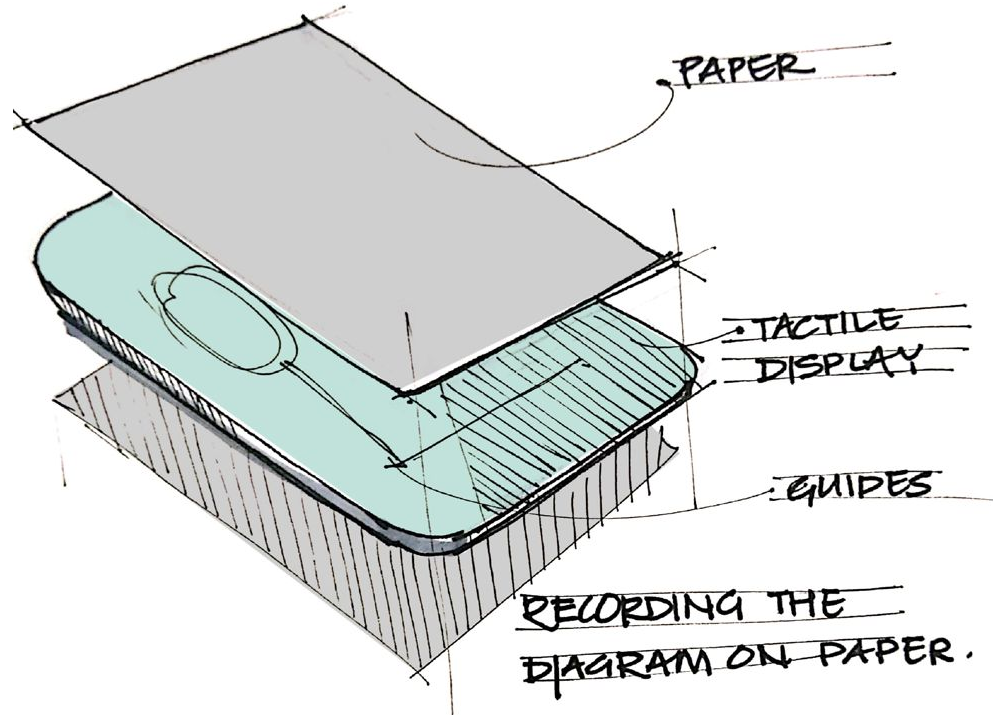
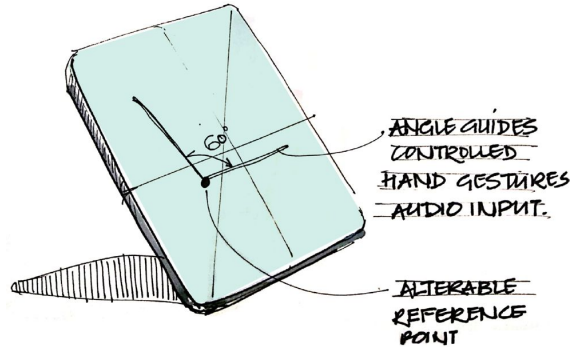
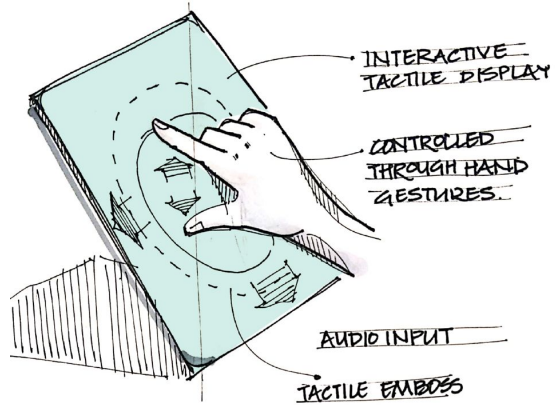
GUIDES



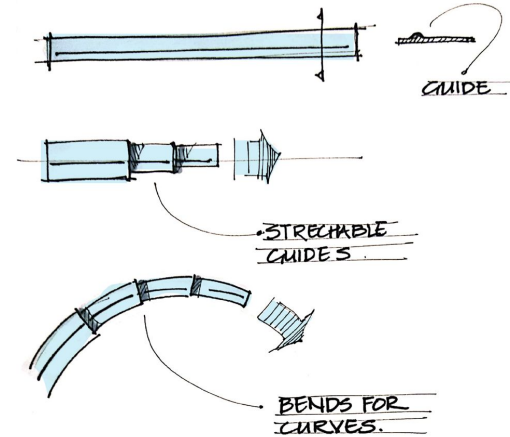
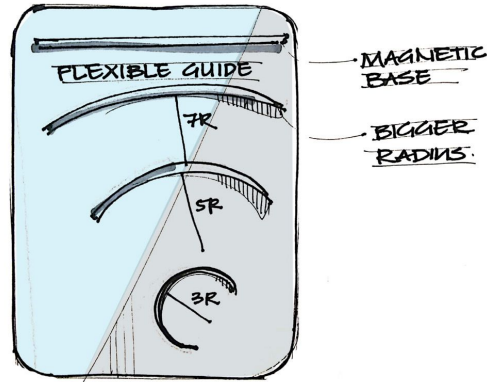
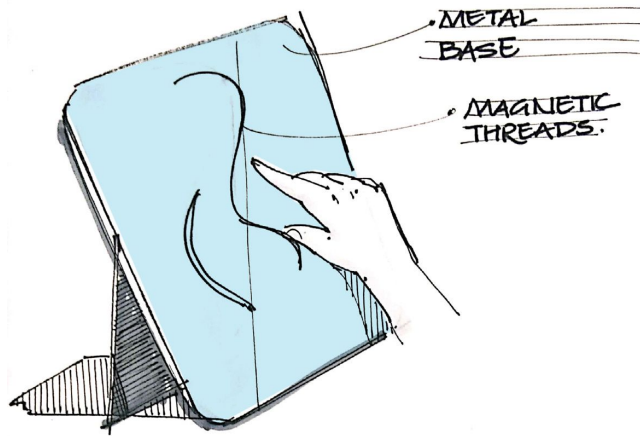
IMPRESSION ON PAPER



Ideas for base

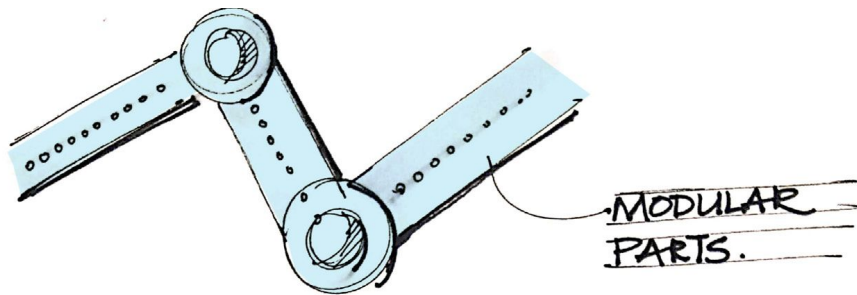
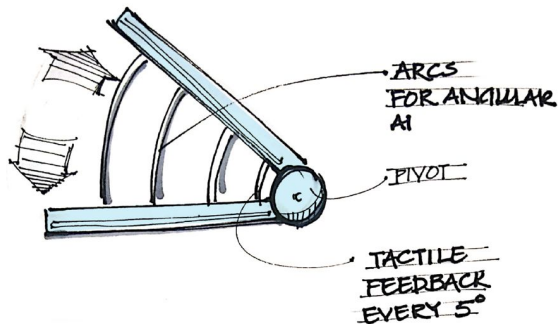
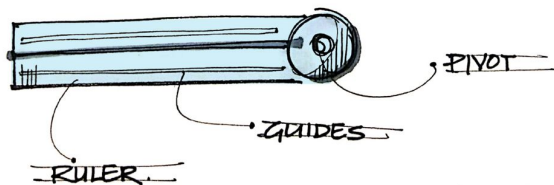


Ideas for Guides

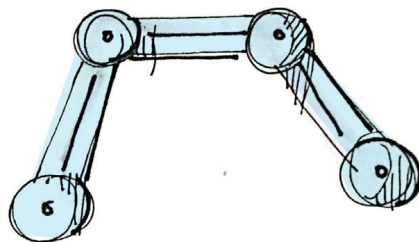


Magnetic and flexible guides for direct drawing on paper. They can stick onto a metallic base and help in forming a diagram before hand.

Ideas for Guides



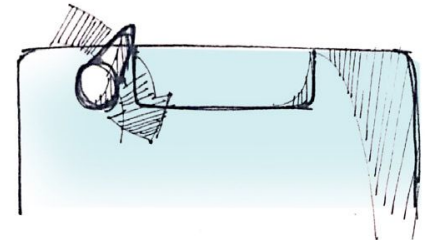
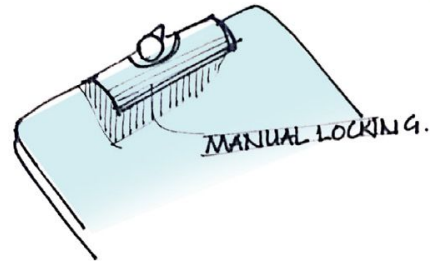
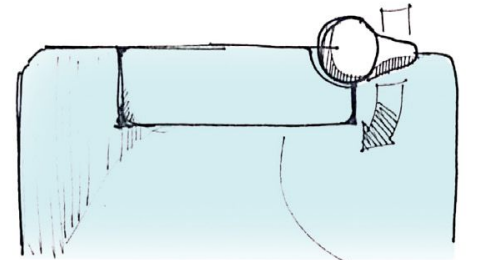
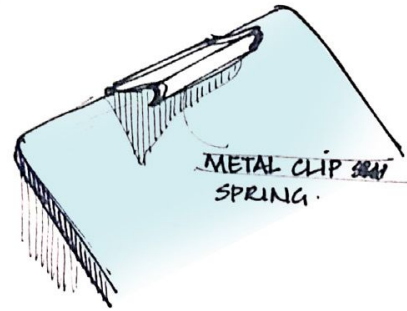
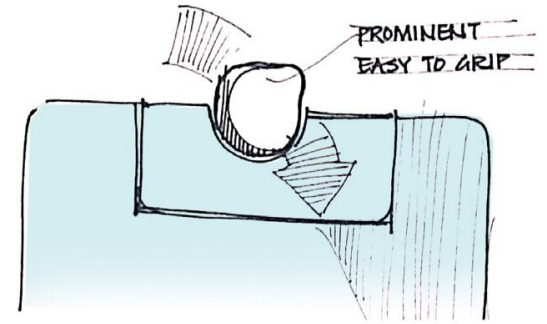
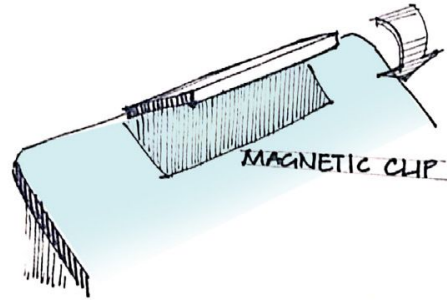
JOIN TO FORM PAR SHAPES.



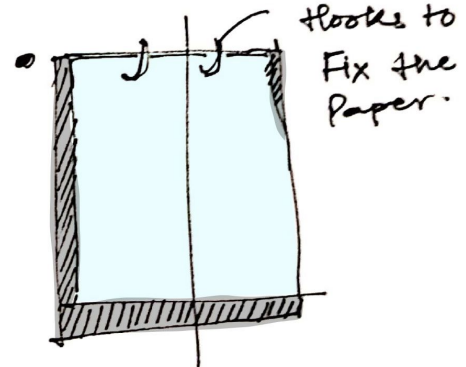
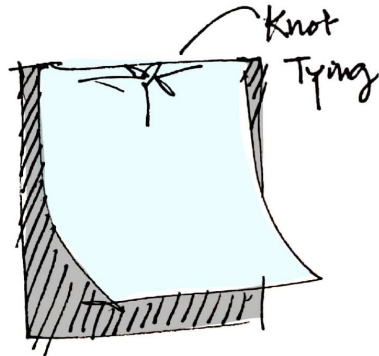
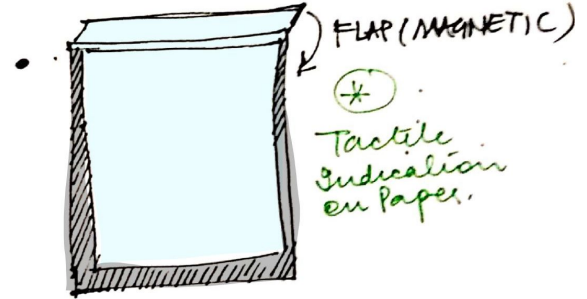
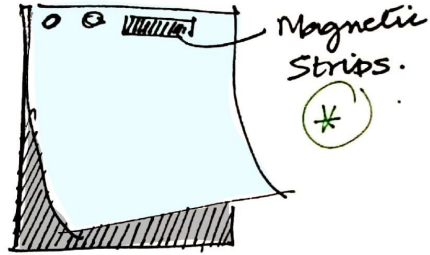
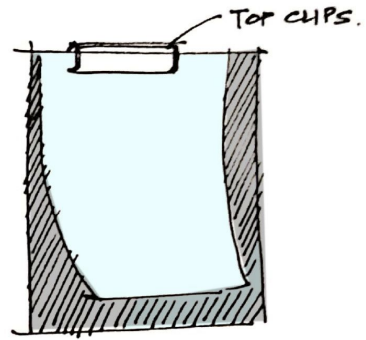
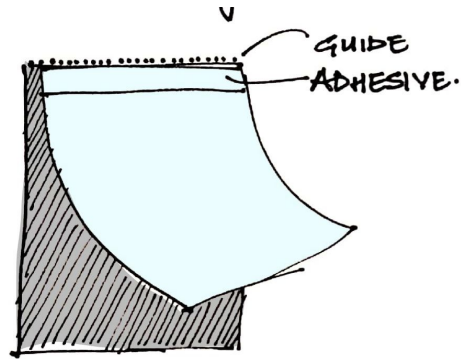
TRACE ON PAPER FOR A TACTILE EMBOSS.

INTERACTIVE KIT.

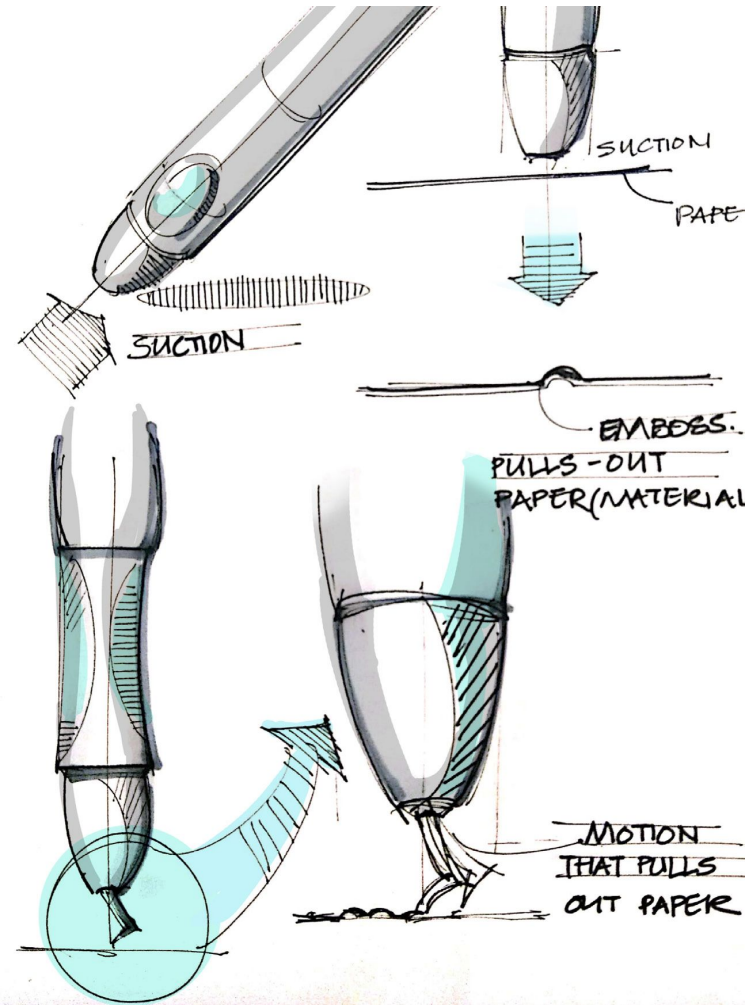
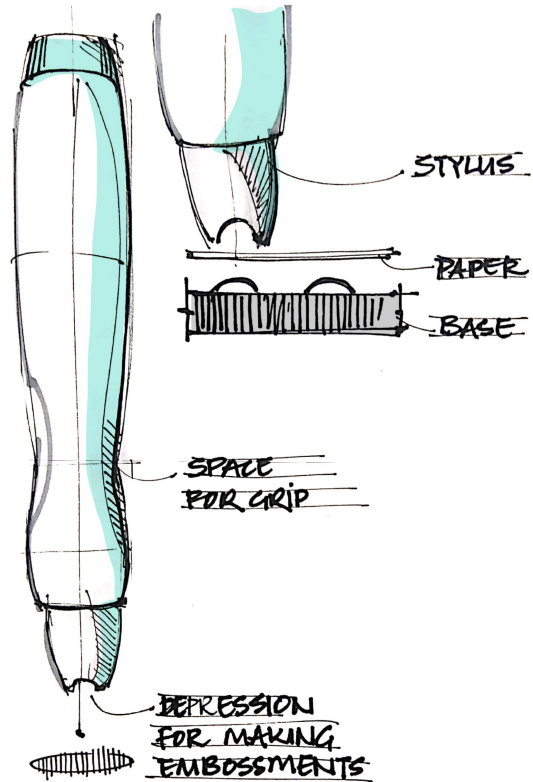
Ideas for Clamping



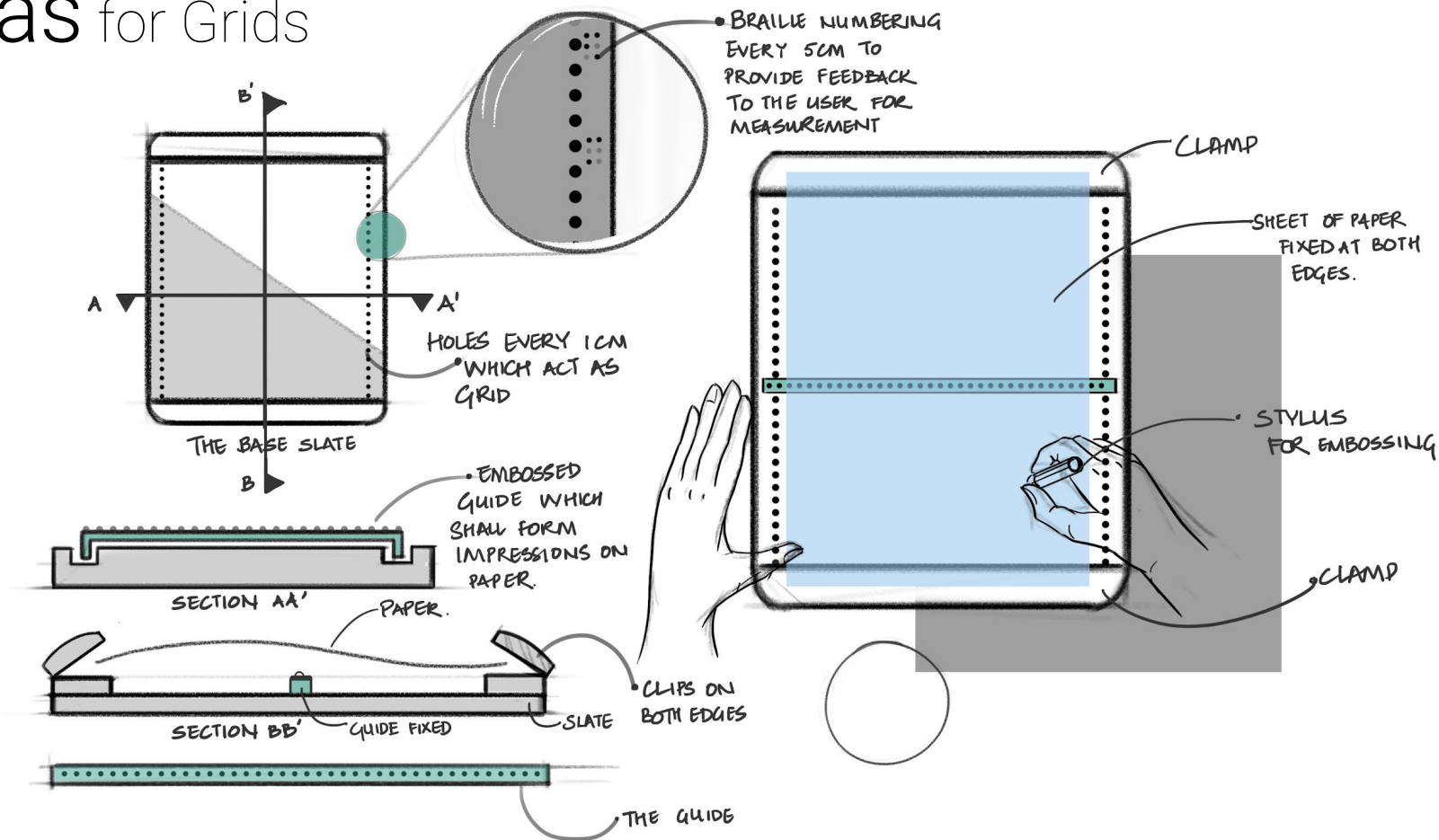
Ideas for Clamping



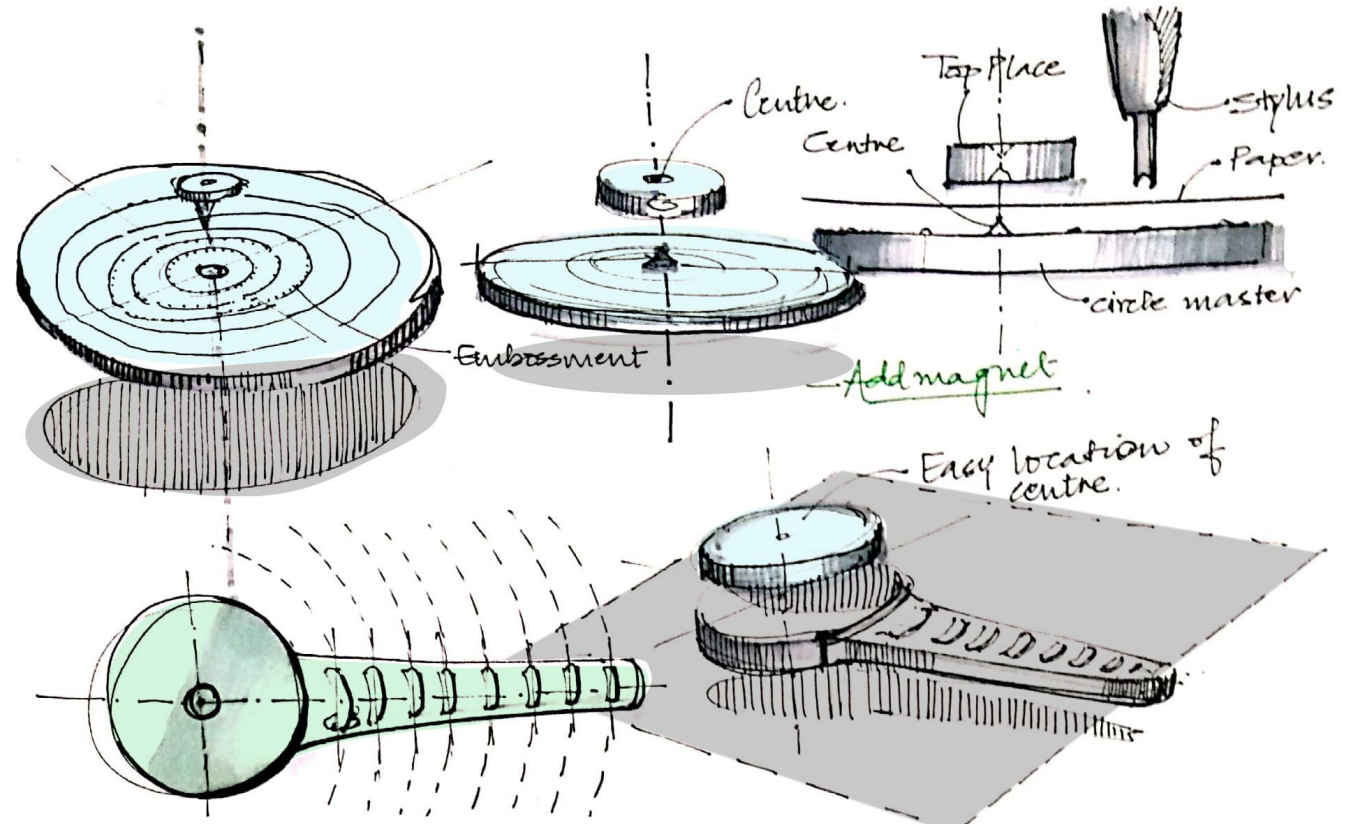
Ideas for Stylus



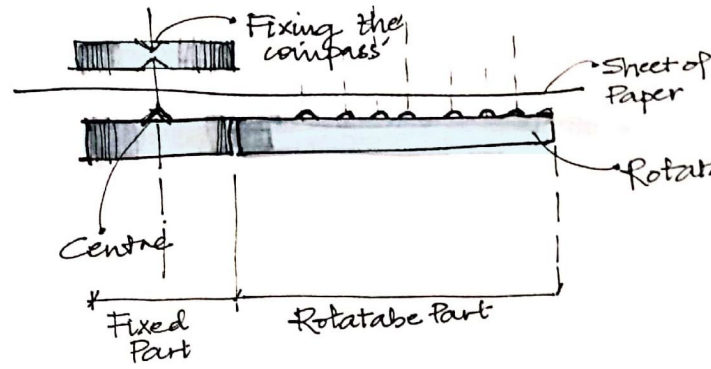
Ideas for Grids



Ideas for Circles and Arcs

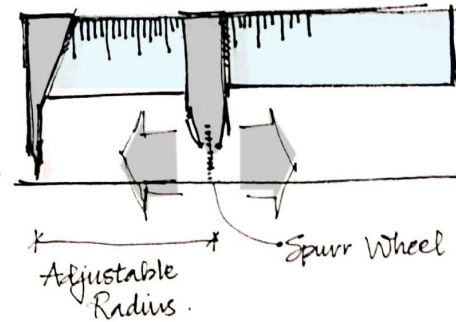
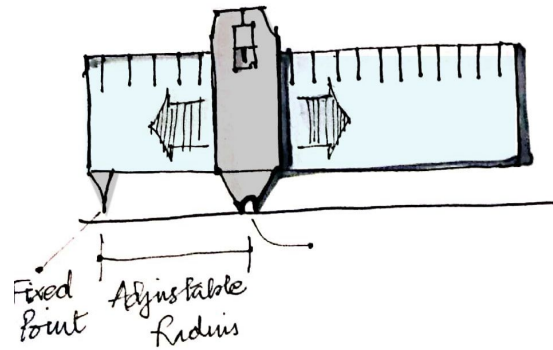


Ideas for Circles and Arcs



- Use Plastic Sheets for impressions.

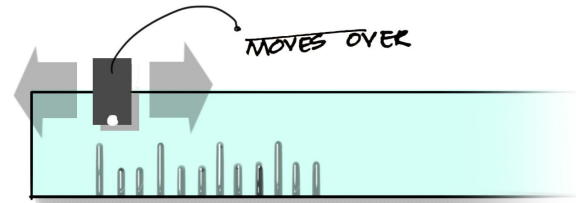
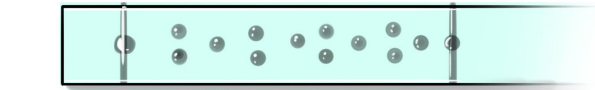
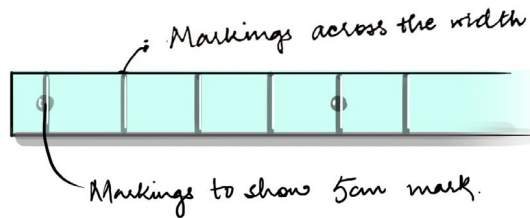
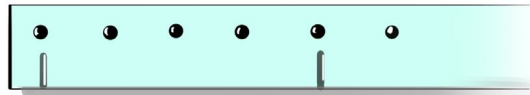
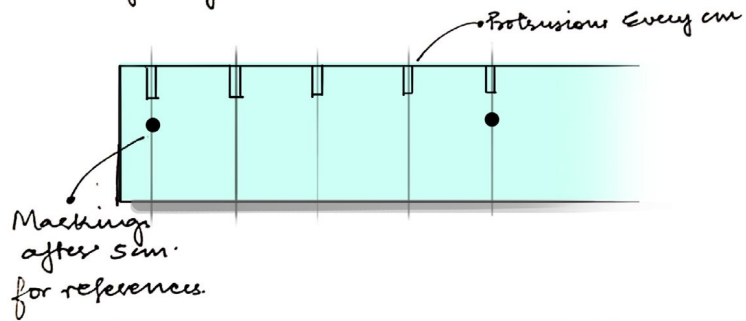
- Using a stylus for making circles.



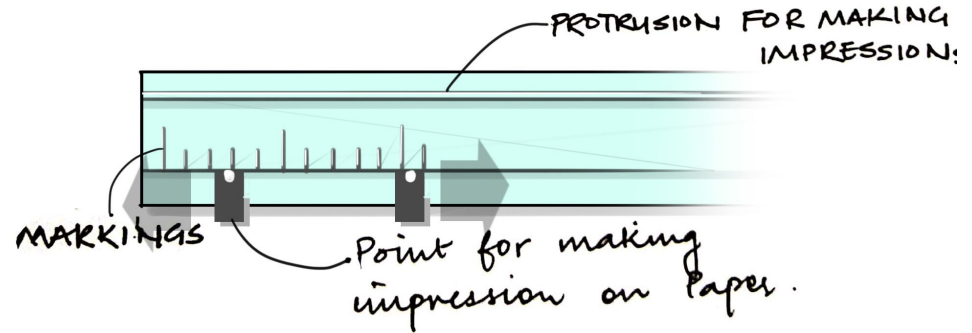
Ideas for Circles and Arcs

30cm Ruler.

- The markings are not precise and are confusing.

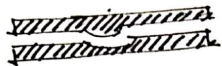


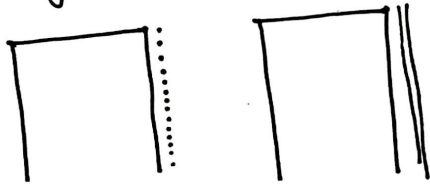
GIVES AUDIO FEEDBACK



Feedback and alignment of paper

- FEEDBACK ONCE THE SHEET IS FIXED. (CORRECTLY)

- Sound Feedback
- Pinching of Paper (Sound). 
- Snap + fitting into a groove
- Touch Feedback.
- - Alignment of the paper with the edge of the slate.
 - Alignment with a guide.

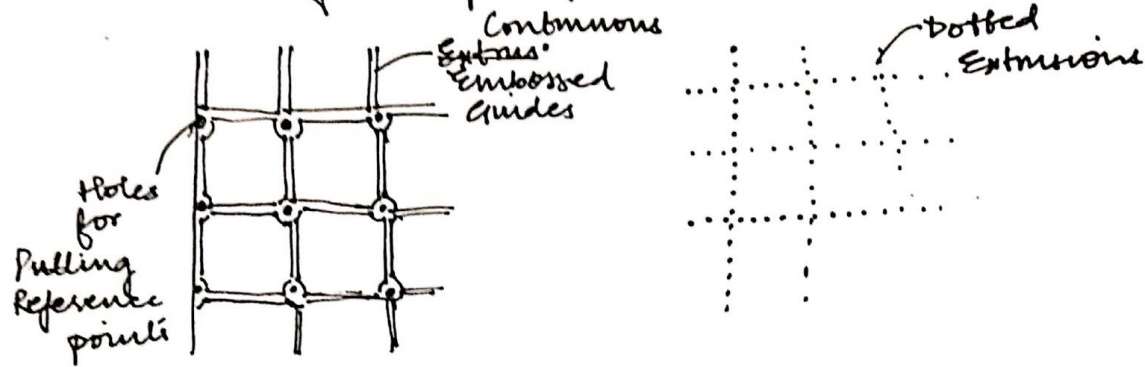


- Lock To Fix the sheet in place (touch feedback).

Ideas for Grids

- GRID.

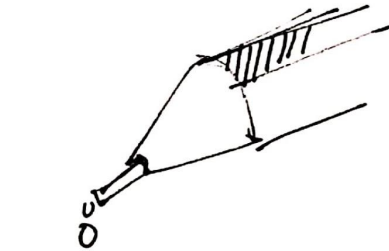
- Giving a more precise 1x1 cm grid
- Ideas for improvements.



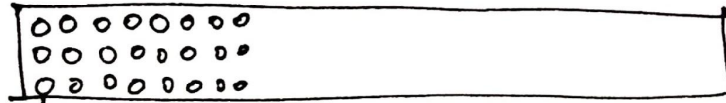
- External grid which can be placed over the slate to act as a grid.

Ideas for reducing the need to flip paper

- 3-D Pen like thing (a grid to provide an assistance to write in braille).

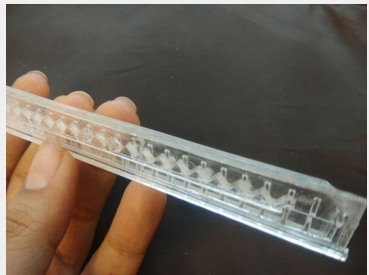
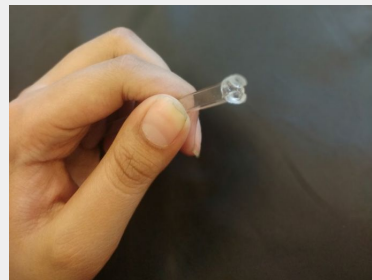
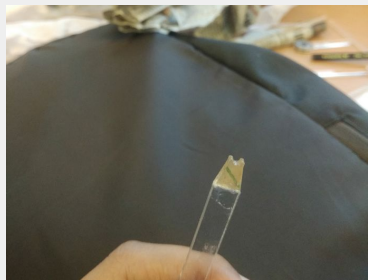


Fills in
cavity.

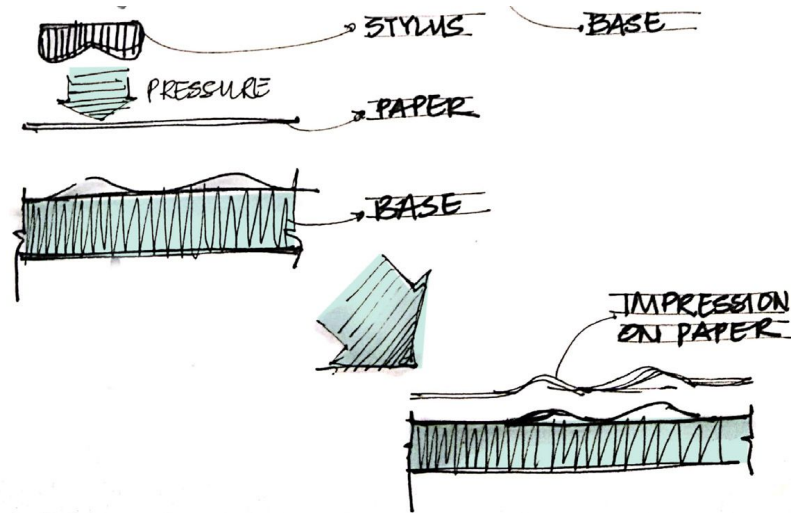


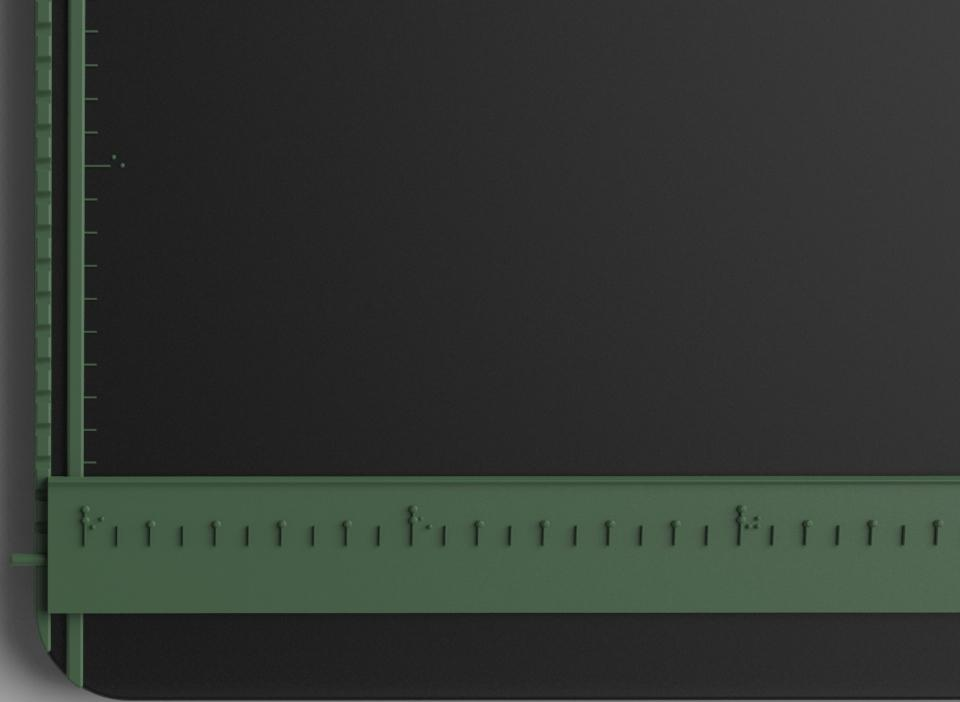
GRID FOR HELPING IN WRITING.

Mock-ups



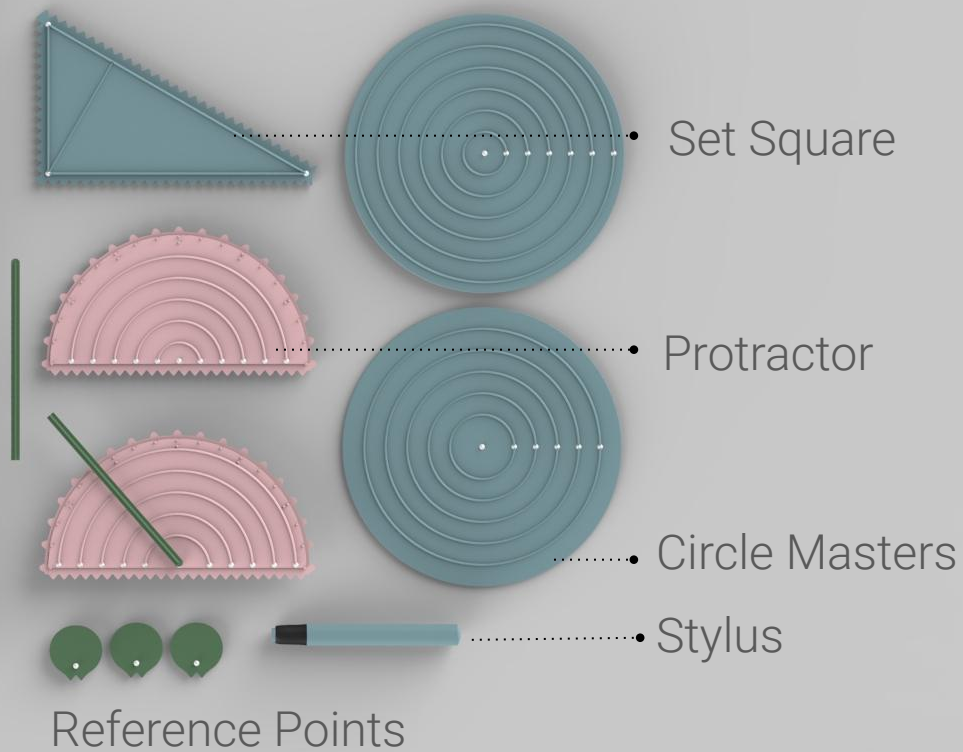
Concept 1



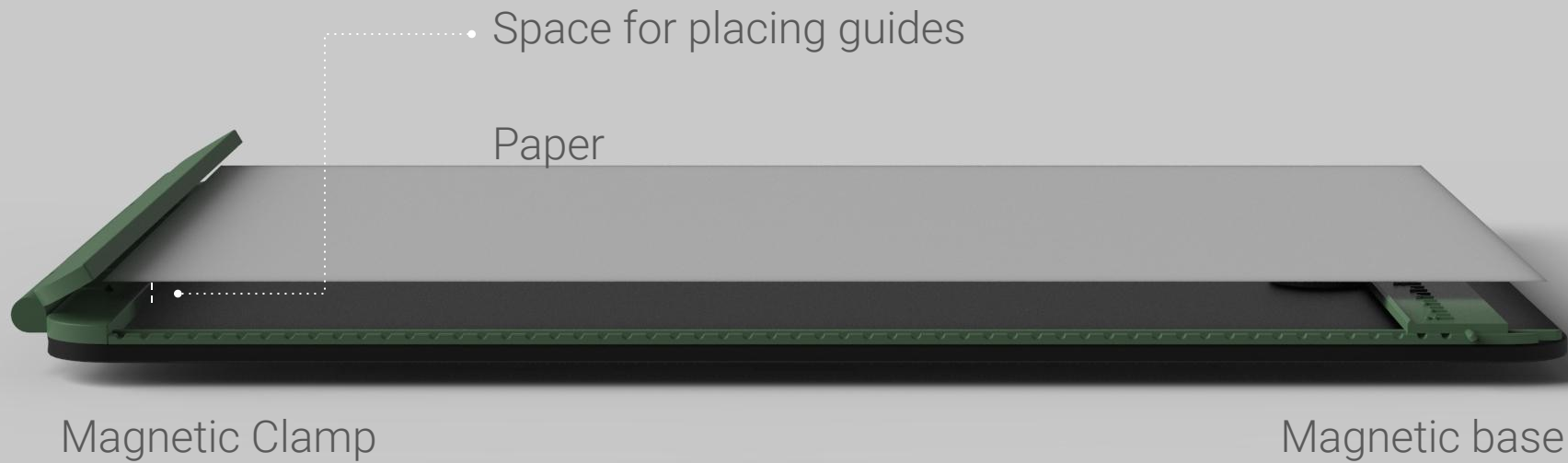


A tactile geometry kit which allows the user to draw geometric diagrams without visualising the mirror image of each diagram.

The Base



Components

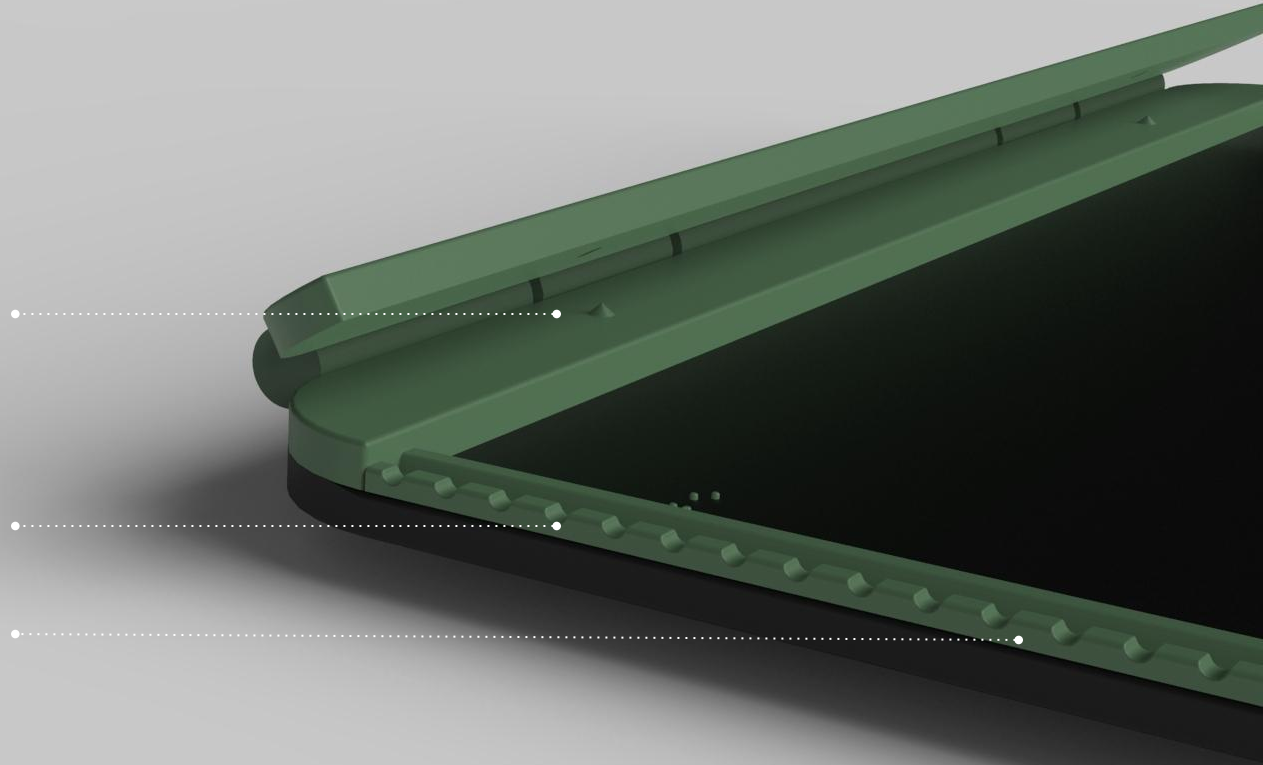


1. The Base

Feature for Punching
the paper

Rail for sliding the ruler

5mm depressions for
tactile feedback



Tactile markings every
5mm on the base

Guide for lines

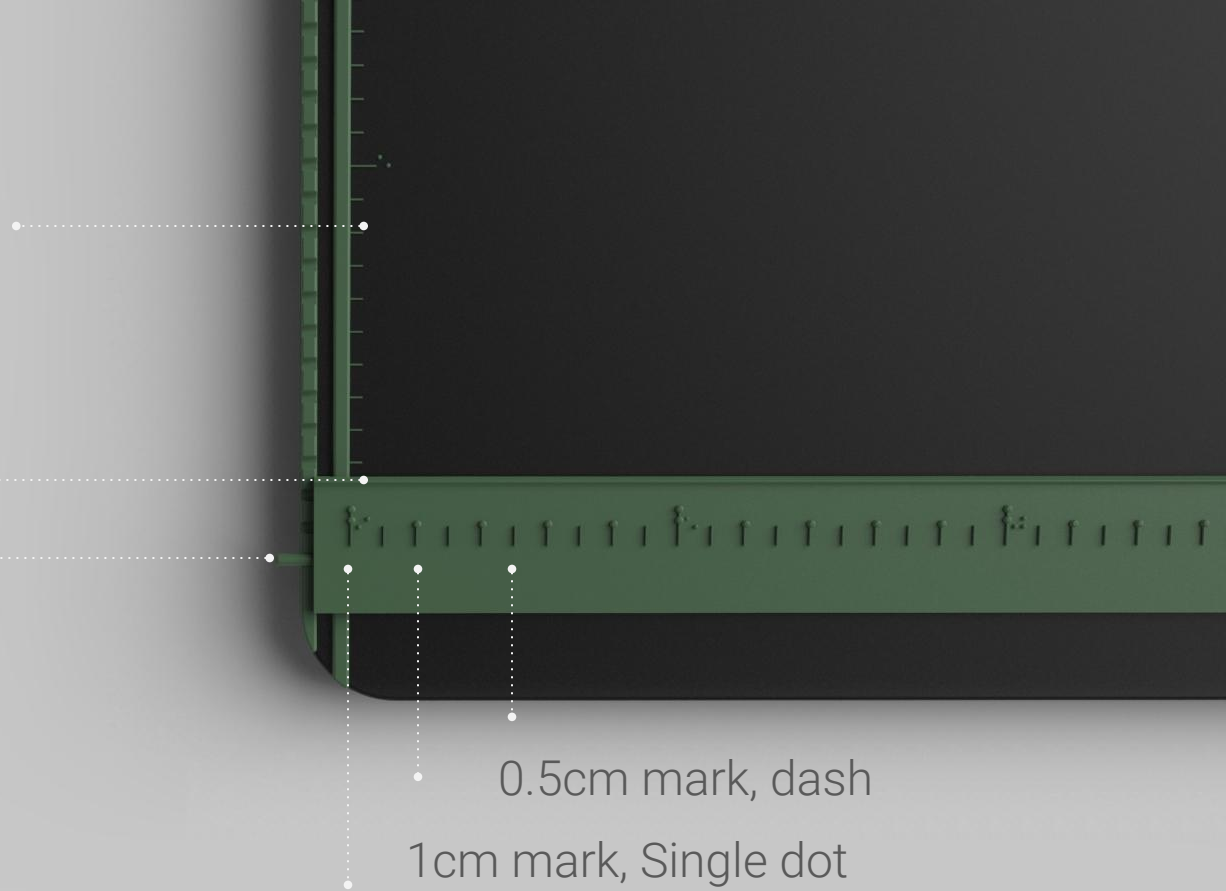
Feature to adjust in
depressions on the rail
to give tactile feedback

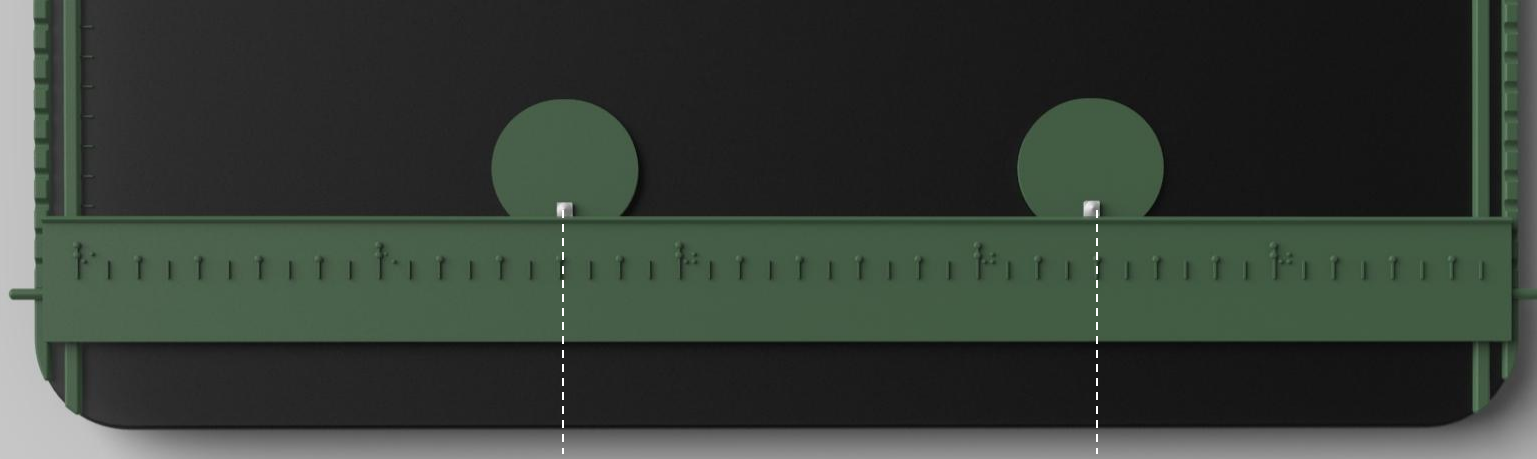
0.5cm mark, dash

1cm mark, Single dot

5cm mark, Double dot

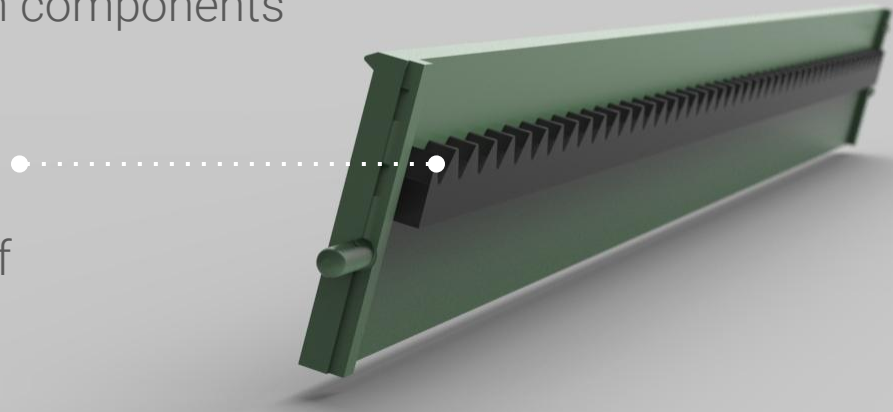
2. Ruler





Grooves are designed in a manner so that the markings align with components

Grooves at the back for other components to align, they also resist the horizontal movement of guides while drawing.



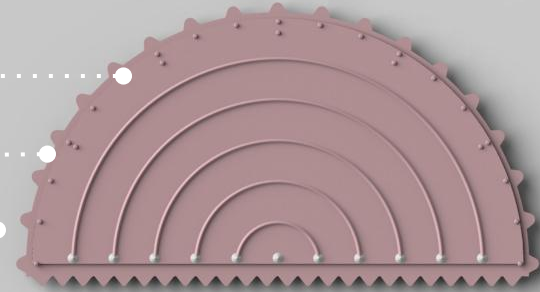
Tactile markings every
10 degrees

Double dots for 0, 30,
60 and 90 degrees

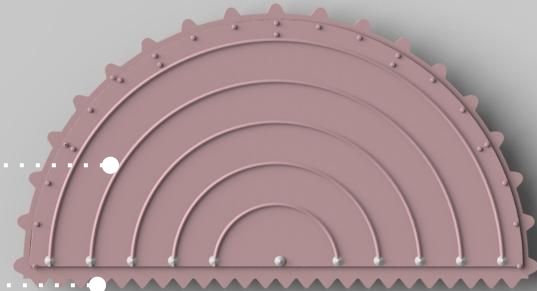
Grooves for aligning
reference points

Guide for making arcs

Grooves for ruler



1, 2, 3, 4, 5cm radius arcs

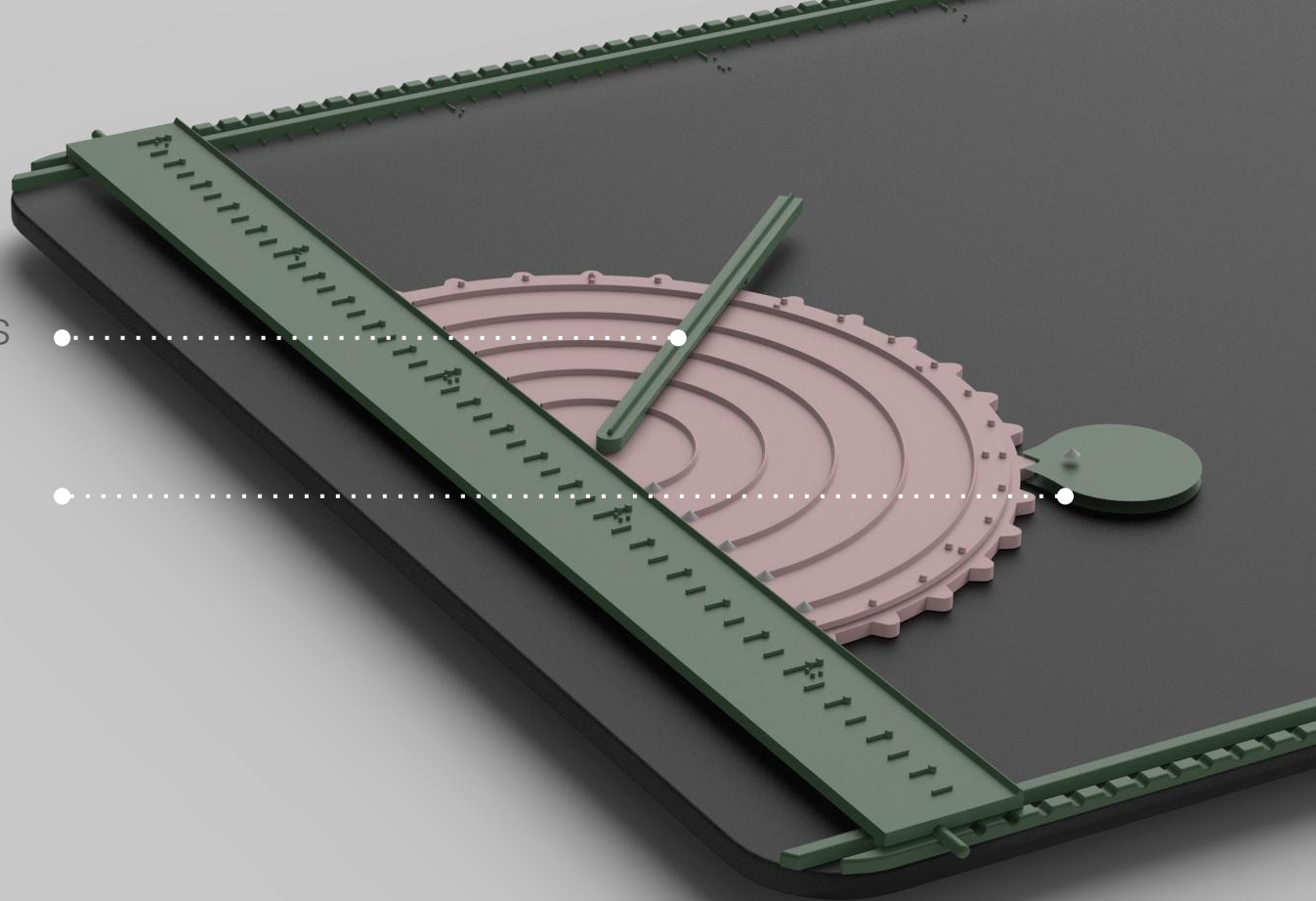


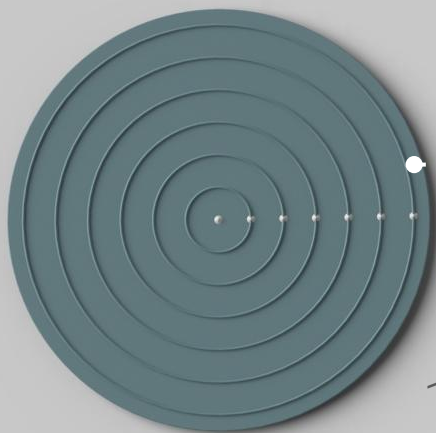
1.5, 2.5, 3.5, 4.5, 5.5 cm radius arcs

3. Protractor

Guide for making angles

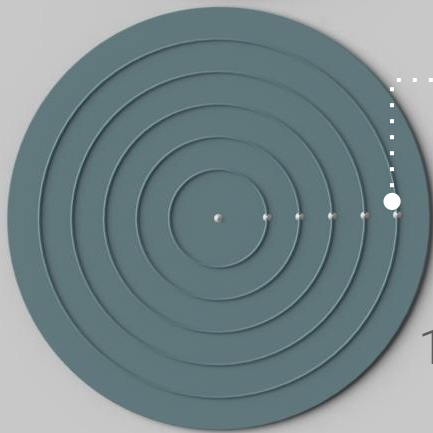
Reference Point





1, 2, 3, 4, 5 cm radius circles

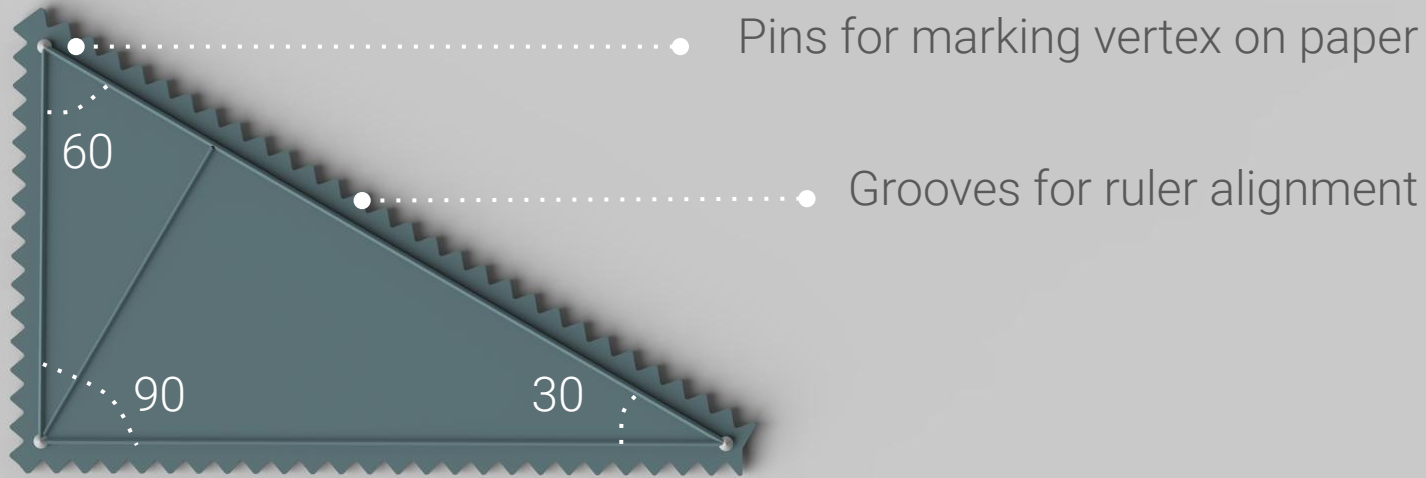
Embossed guides for making
circles on paper



1.5, 2.5, 3.5, 4.5, 5.5 cm radius circles

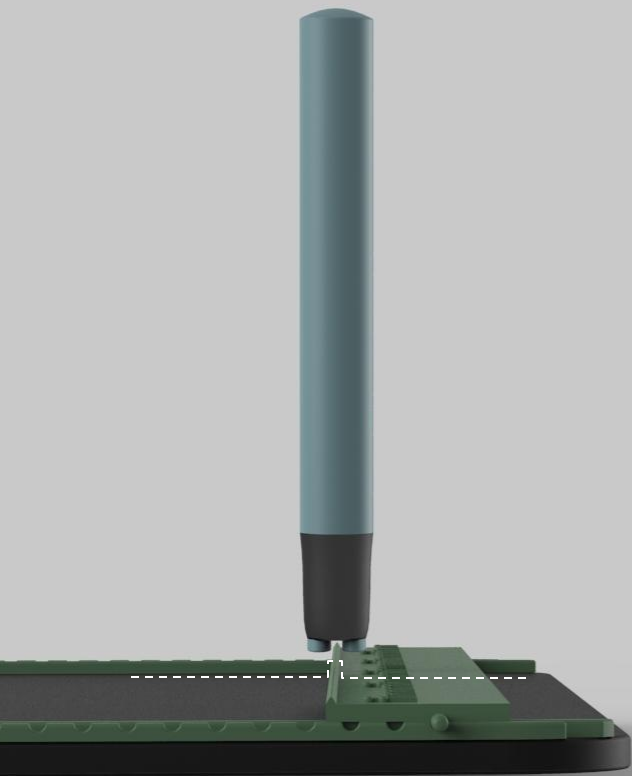
Pins for marking points on paper
and also depicting the centre

4. Circle Master



5. Set Square

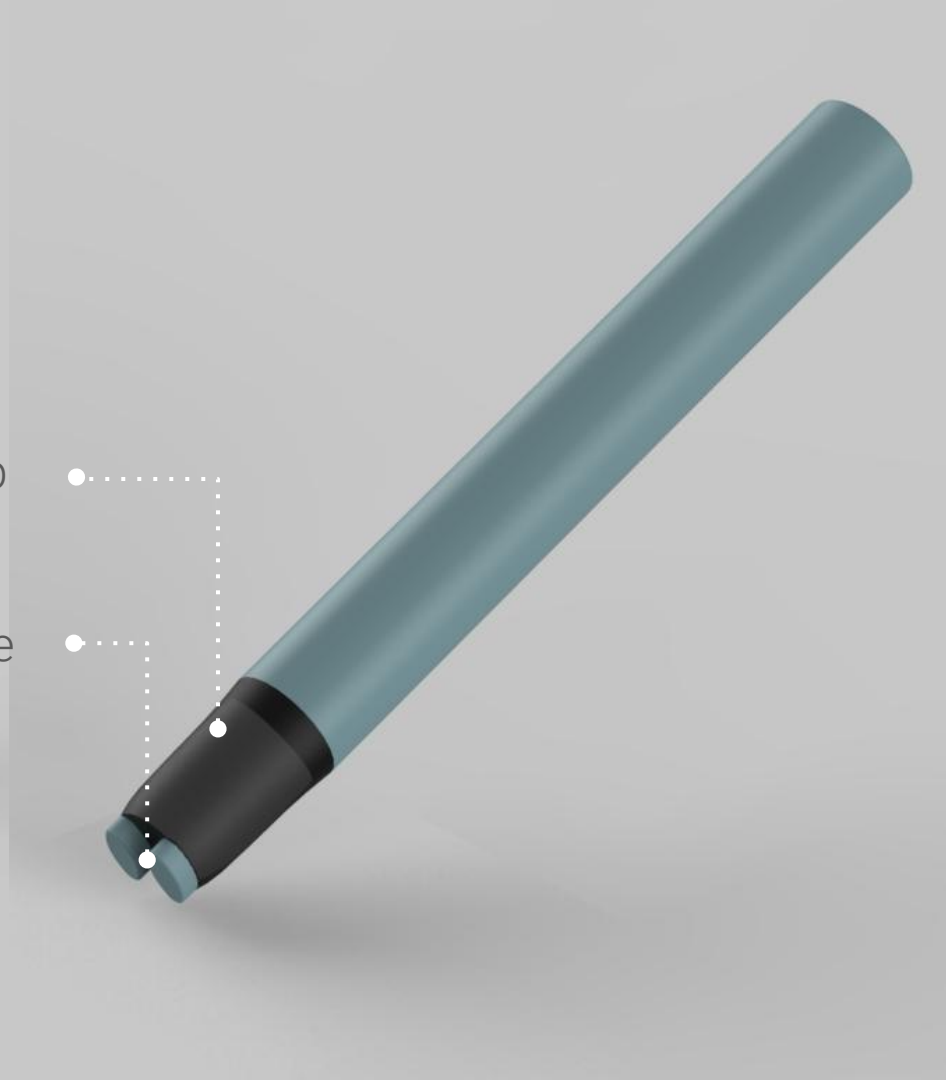
For making quick angles of
90, 60, 45 and 30 degrees

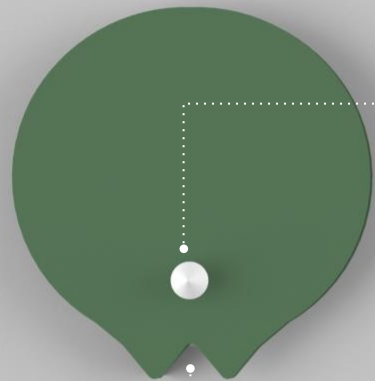


Rubber grip

Space for guide

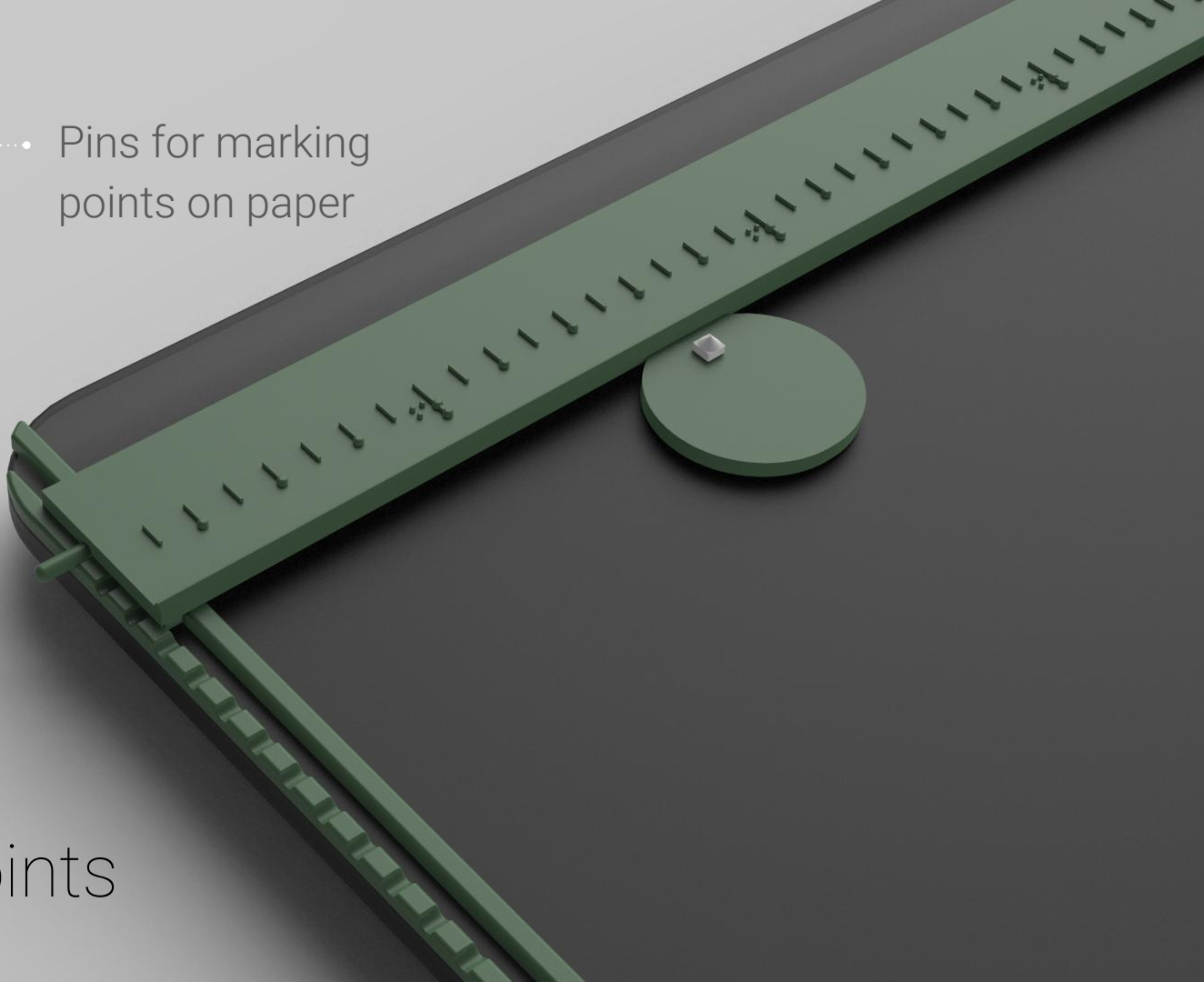
6. Stylus





Pins for marking
points on paper

Groove for ruler and
protractor



7. Reference Points

First Prototype



Feedback

- Need for an intervention to hold the paper back while placing the guides.
- detailed marking on protractor is required.
- A reduction in the depth of the point markers is required since it is leading in the tearing of paper.
- A more fluent movement and a better feedback required for the movement of parallel ruler.
- A better intervention required for the joining the point markers to draw straight lines.

Feedback

- Need to organise the tools for easy finding and placing of the tools.
- Reduction in the magnetic power of the tools is required.
- Requirement for a better grip of the stylus.
- Need for a good packaging of the kit to increase the portability.
- An addition of writing in Braille.

Feedback from XRCVC

The use of tactile geometry kit with embossed accessories was not preferred as it was extremely difficult for students to learn.

The use of direct drawing was preferred.

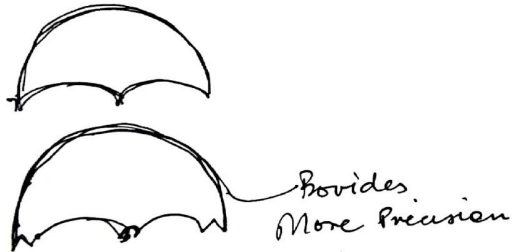
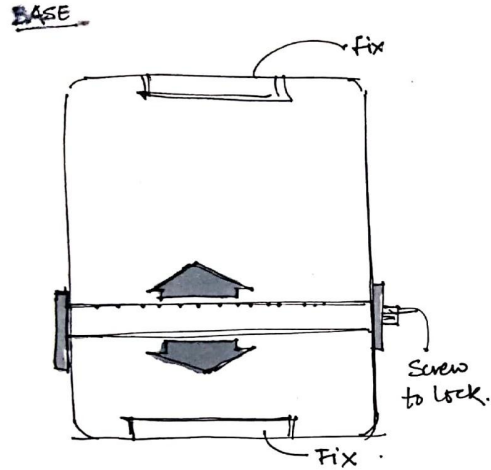
The idea of locking and aligning the instruments parallel to the base was appreciated.

More precision required for Protractor



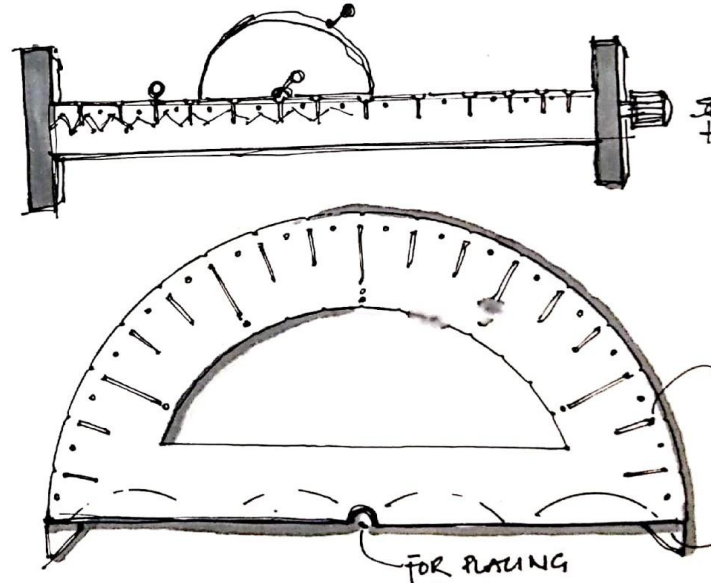
**Xavier's Resource Centre
for the
Visually Challenged**

Refinements

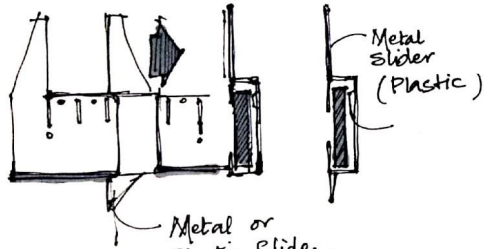


Scale
Compass.
Stylus.

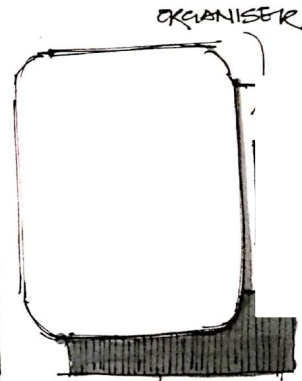
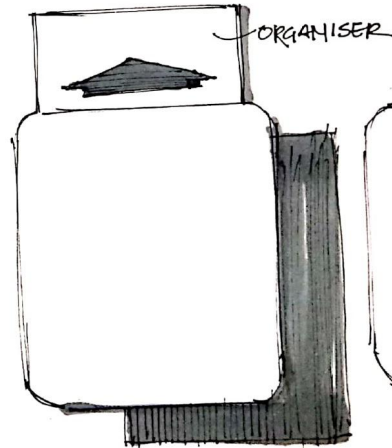
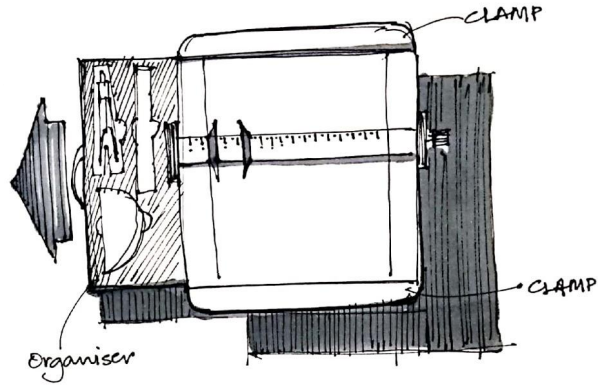
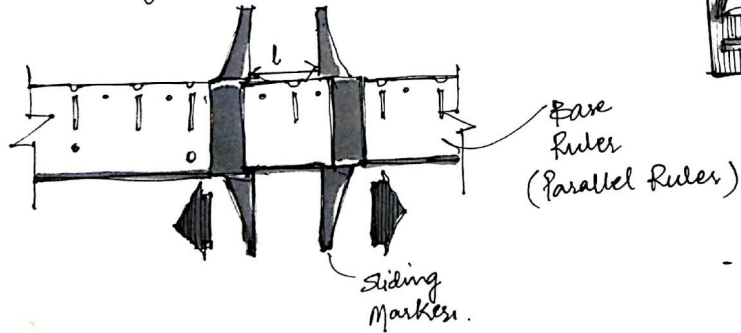
Organises. — Keeping Pins.
Scale.

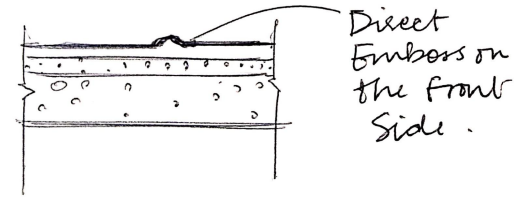
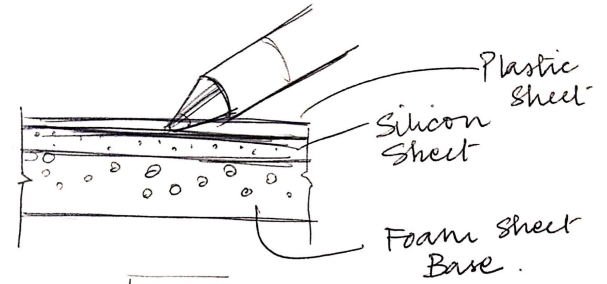
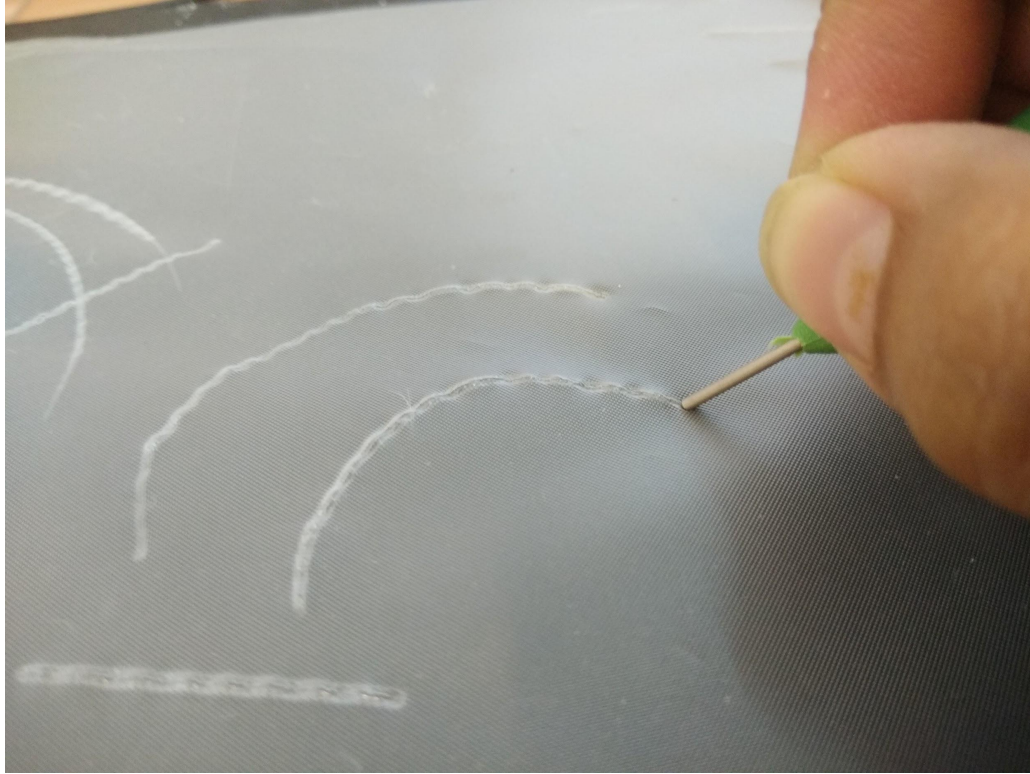


Refinements

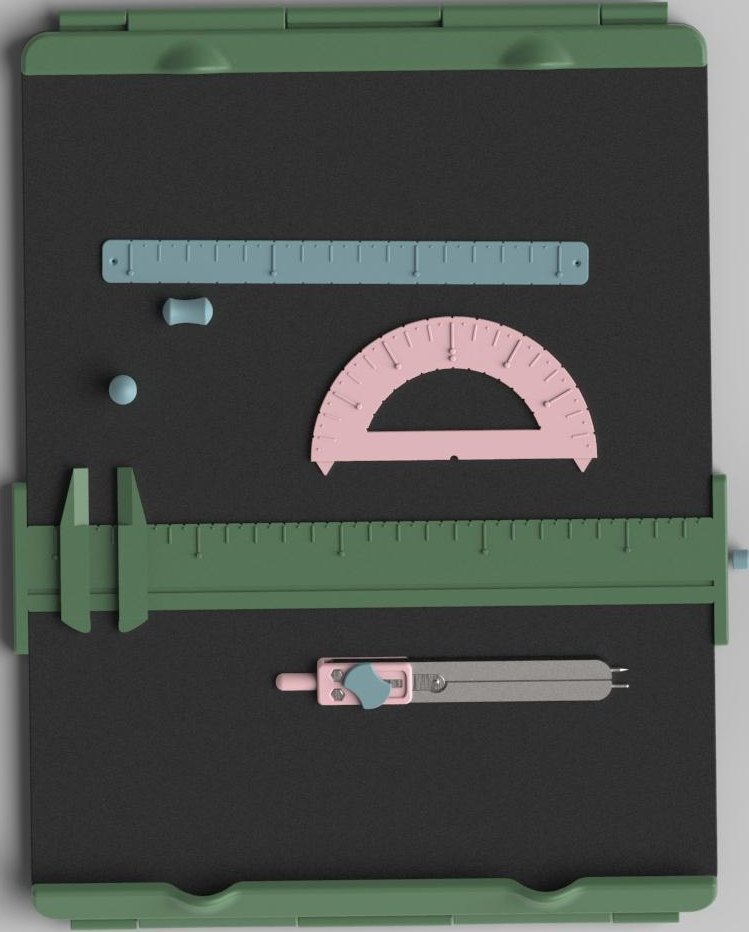


- Used for measurement and for drawing line segments.



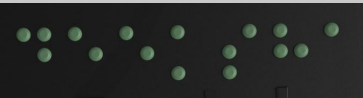
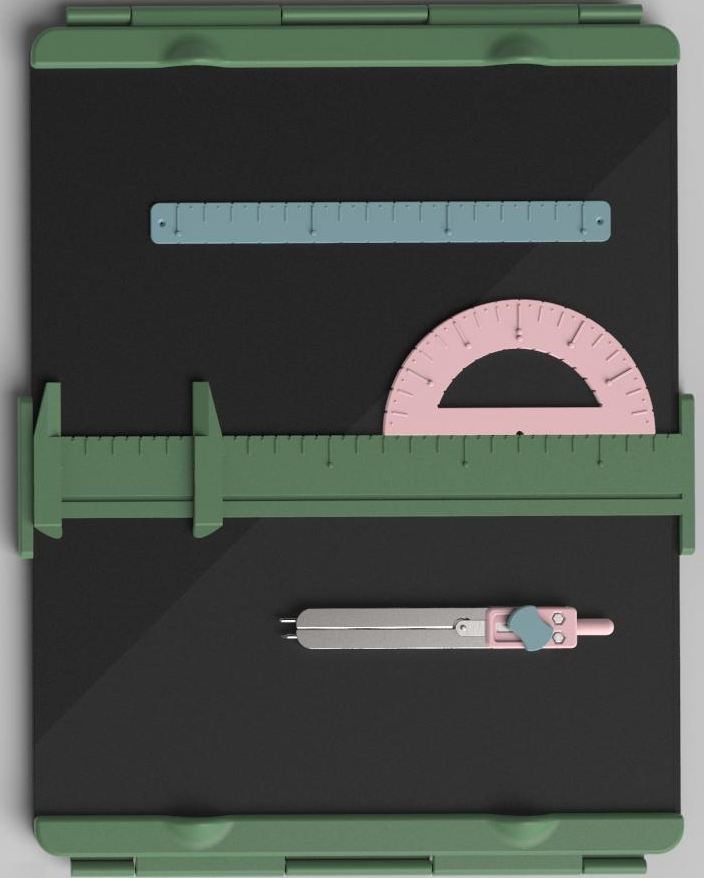


Final Refined Concept



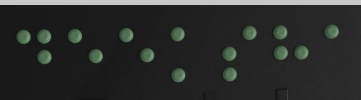
Components

1. Silicon Base
2. Parallel Ruler with sliders
3. 15cm Ruler
4. Protractor
5. Compass
6. Organiser
7. Pins



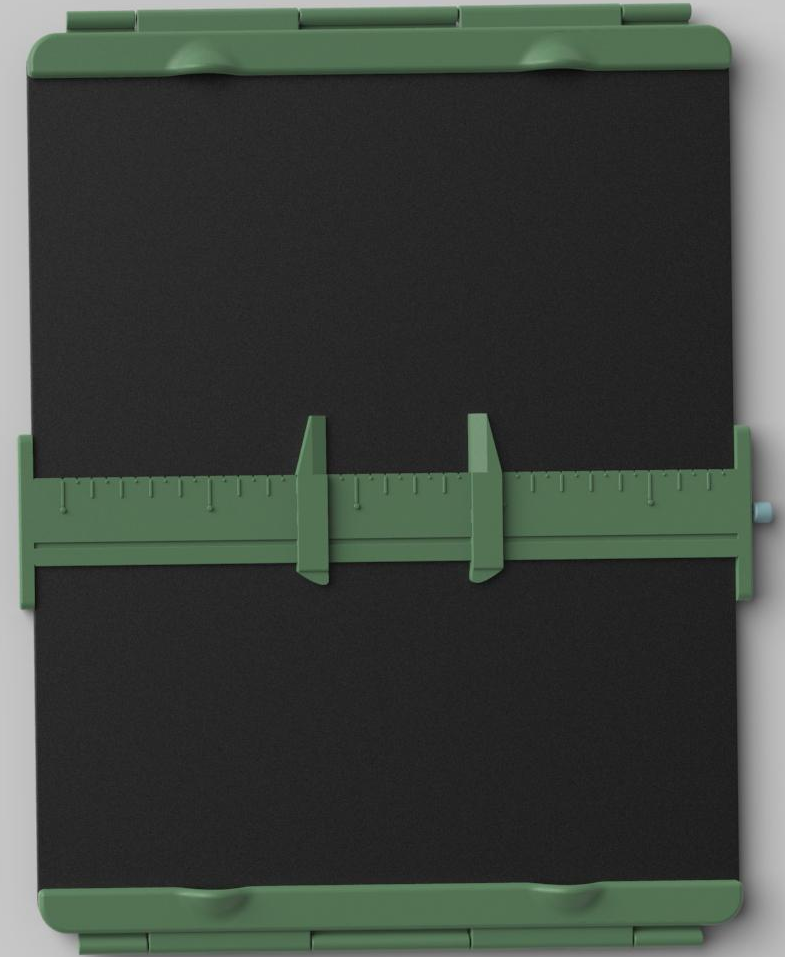
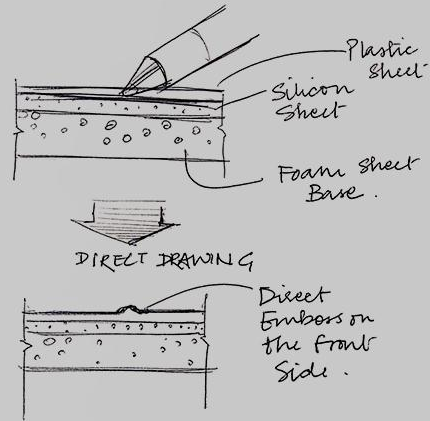


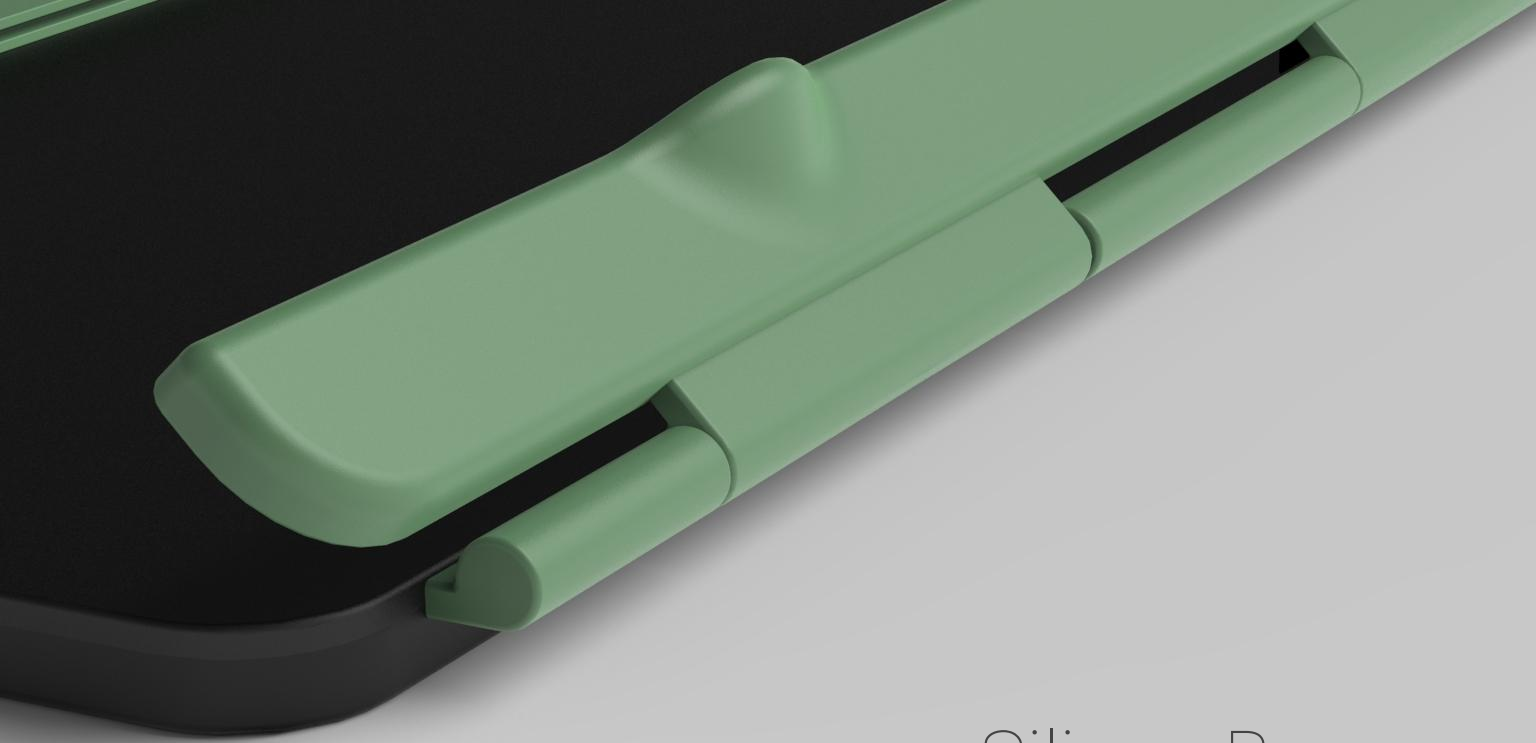
A direct drawing geometry kit with least number of elements, closest to the experience of a sighted student. It uses the braille stylus or any other daily use pen to create emboss



Silicon Base

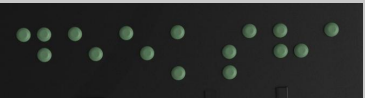
The base layer is of silicon which provides an elastic base, further down it is foam, which provides the stability to the pins.





Silicon Base

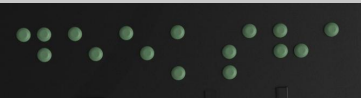
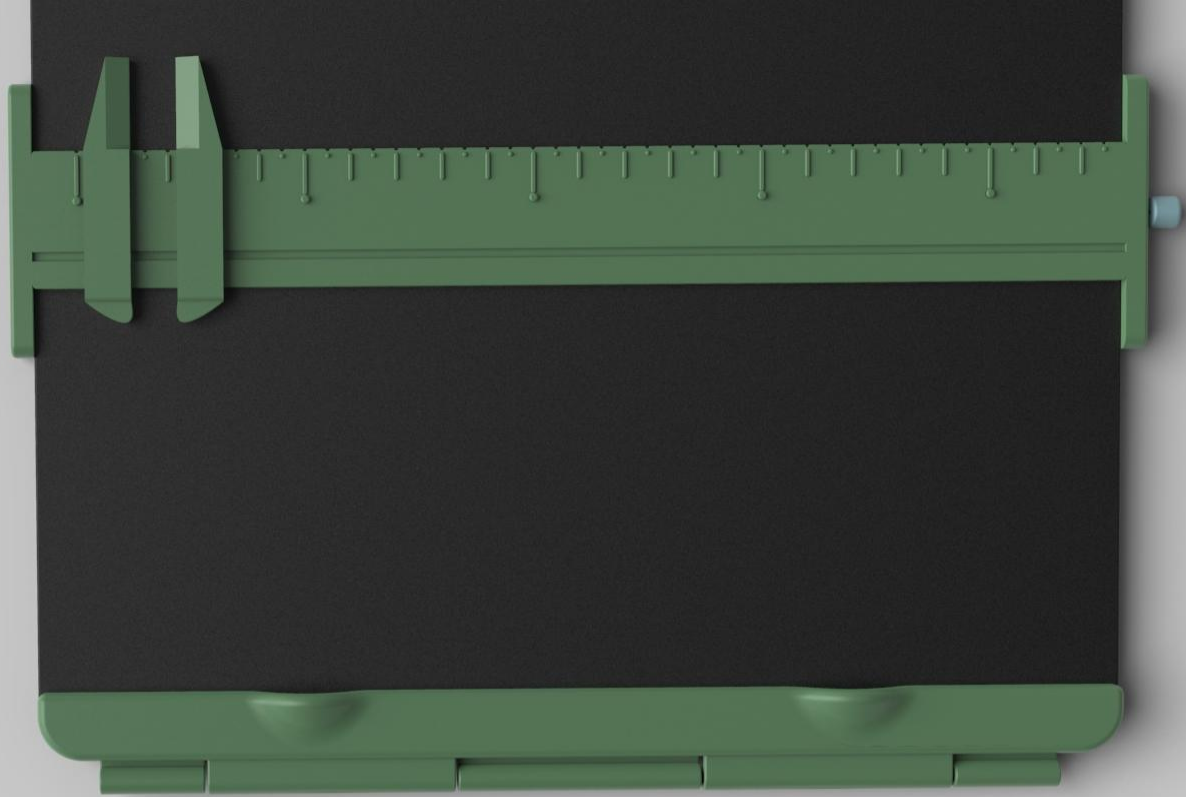
Magnetic clamps on both edge to stop sliding of paper.
Bumps on top to provide ease of grip



Parallel Ruler with sliders

The parallel Ruler with grooves underneath provides alignment and stability to other tools

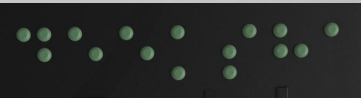
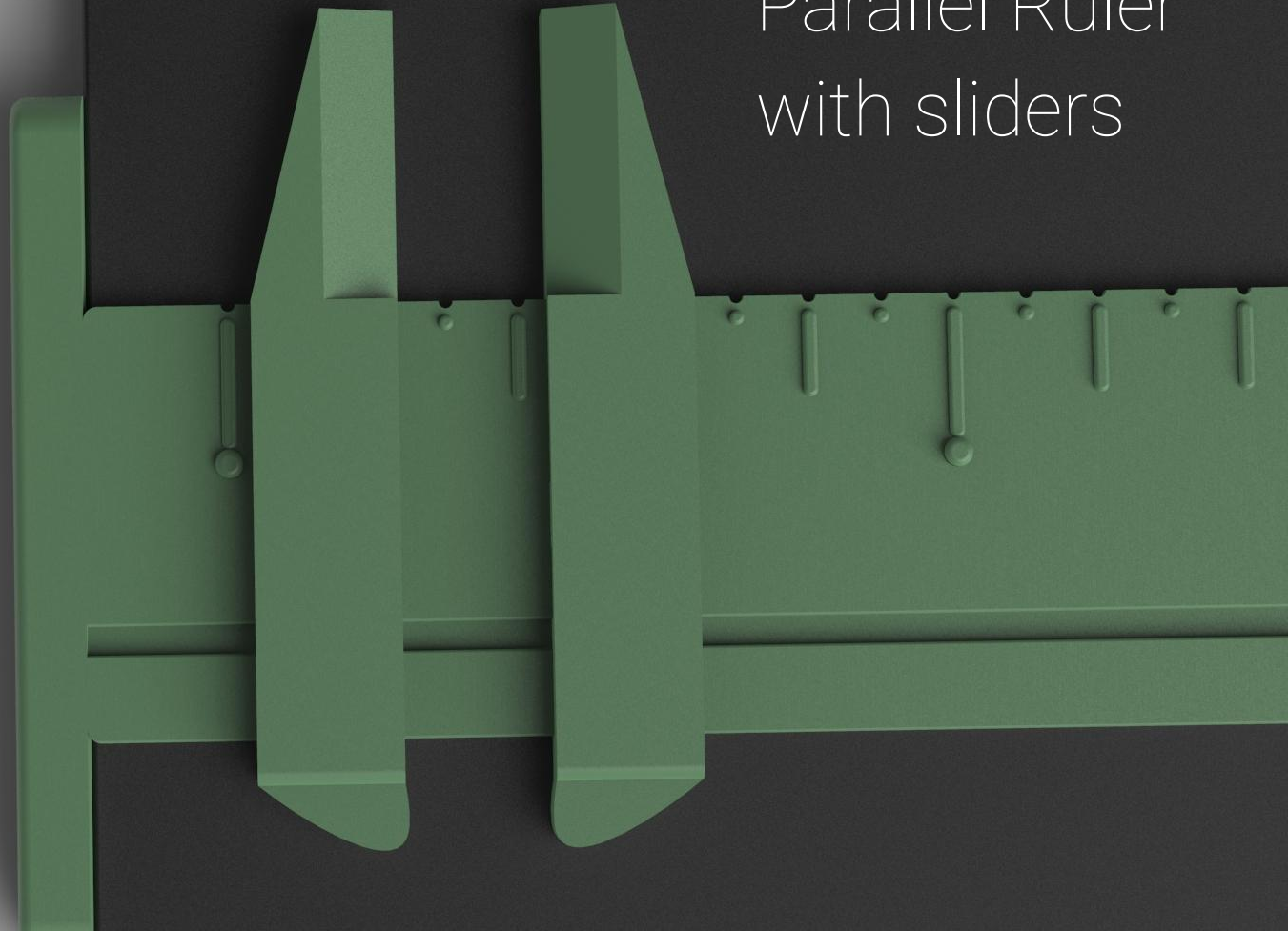
Screw to lock position

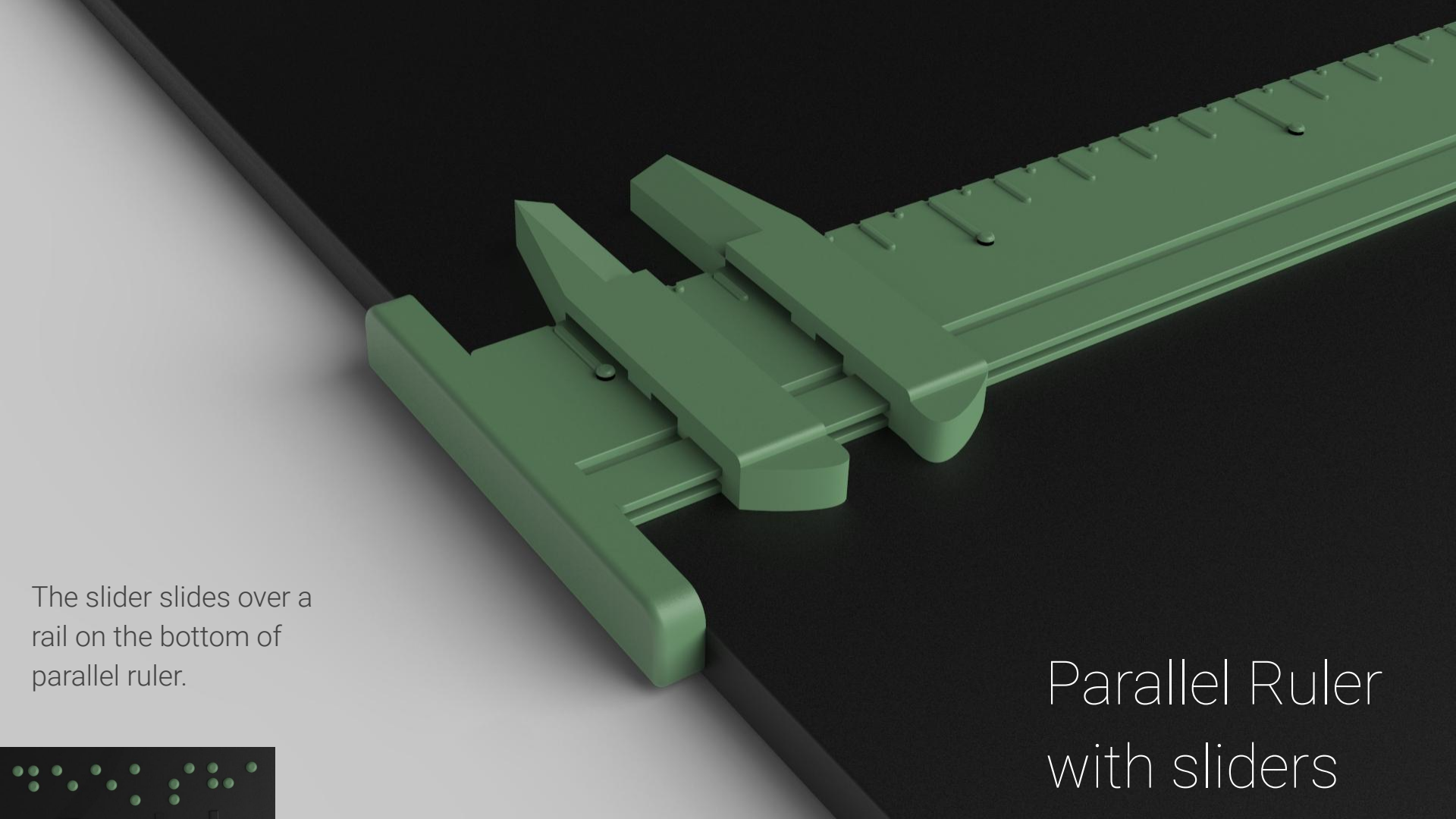


There are grooves on the edge to provide tactile feedback while making lines

Can also be used to measure lengths of objects.

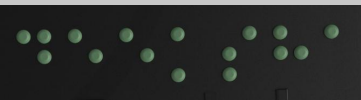
Parallel Ruler with sliders





The slider slides over a rail on the bottom of parallel ruler.

Parallel Ruler
with sliders



15cm Ruler

Grooves on the edge
every 5mm

Holes to insert pins on
the ends to fix it on
base.

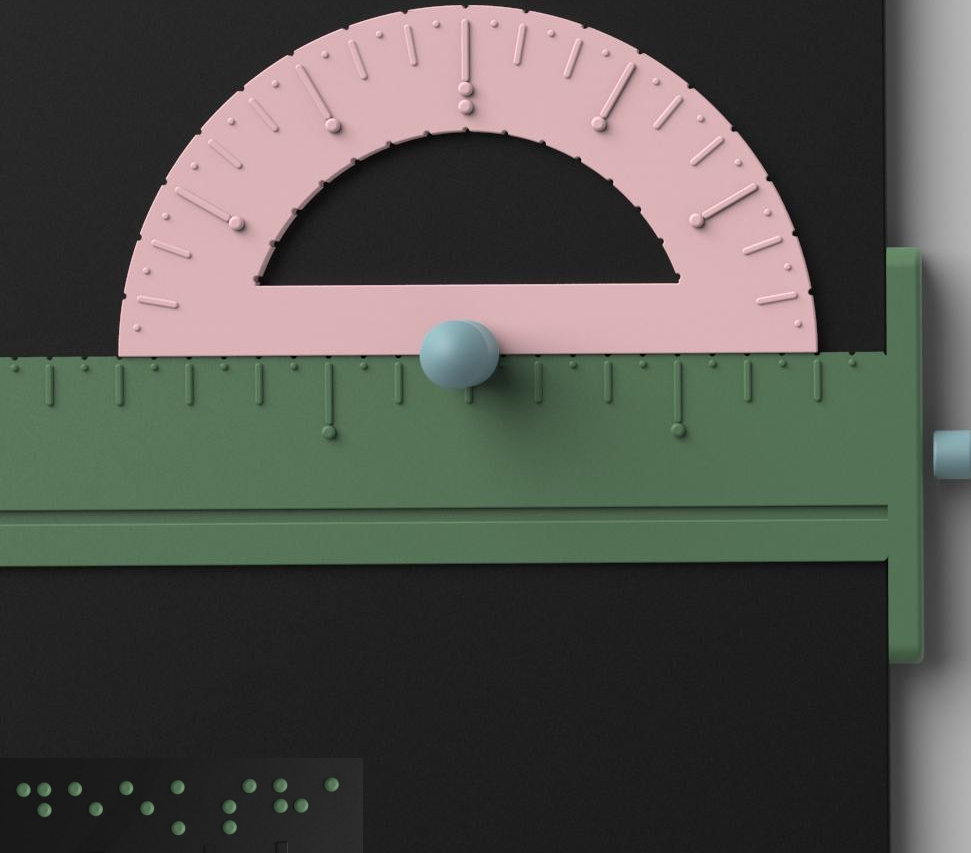


15cm Ruler

Standard
measurements



Protractor



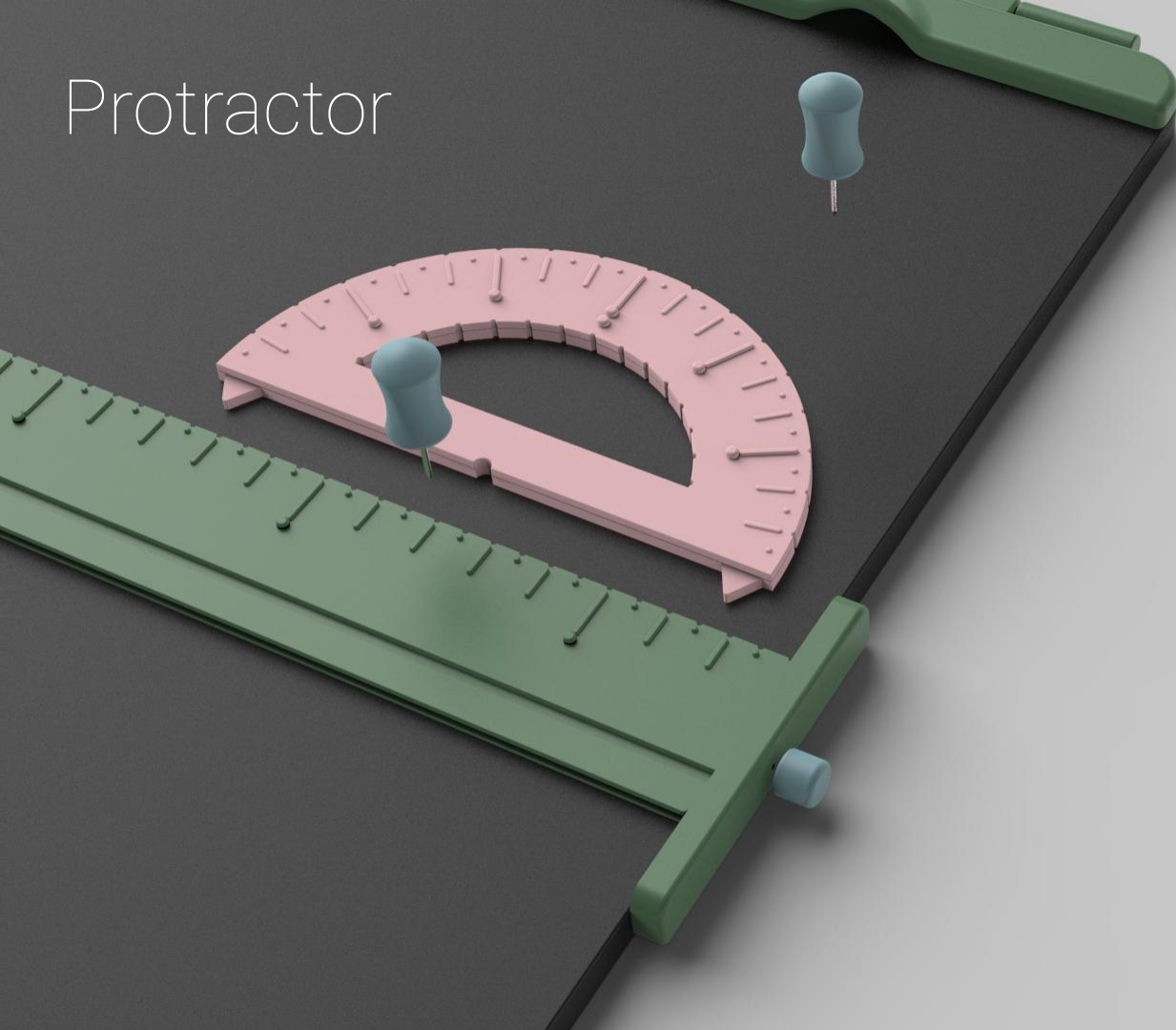
Standard measurements

Hole in the centre to put the pin to
locate vertex

Very Precise

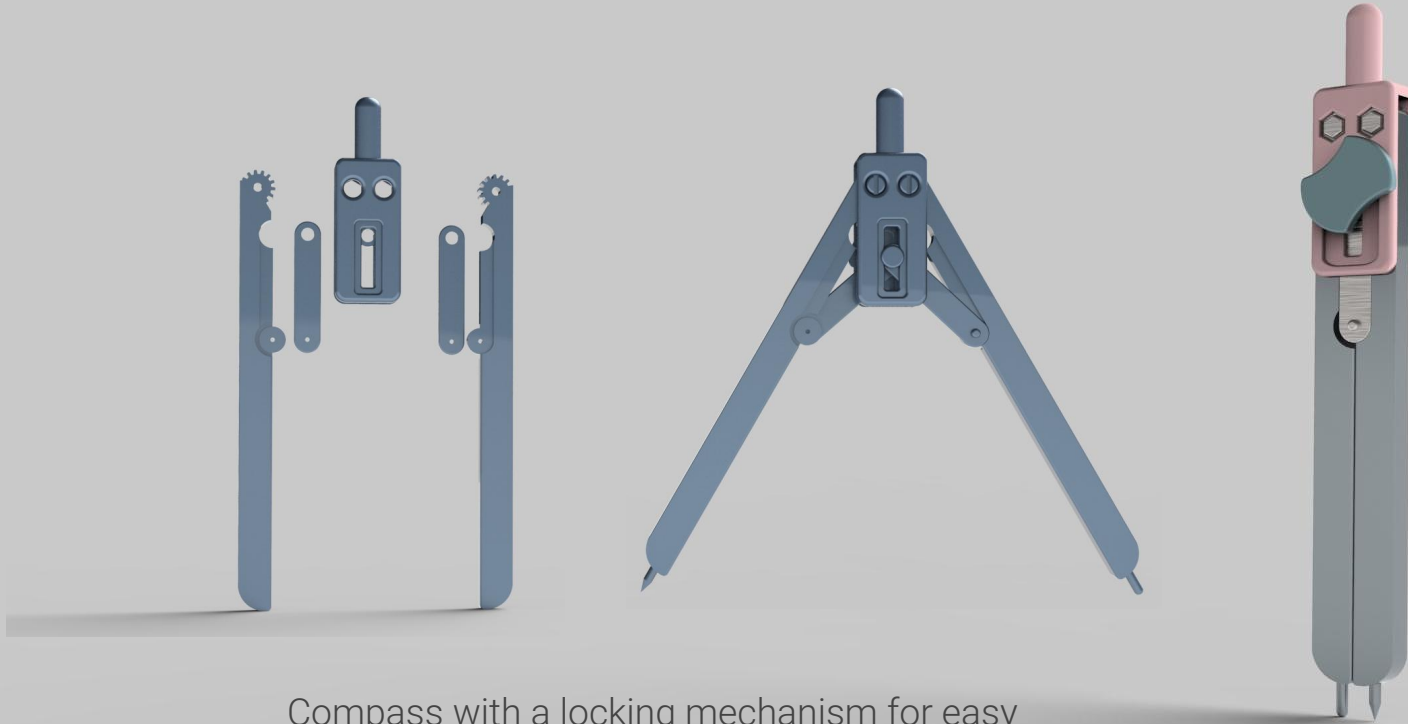
Helps making Angles

Protractor



Triangular extrusion the end
which fits in the grooves in
the parallel ruler.

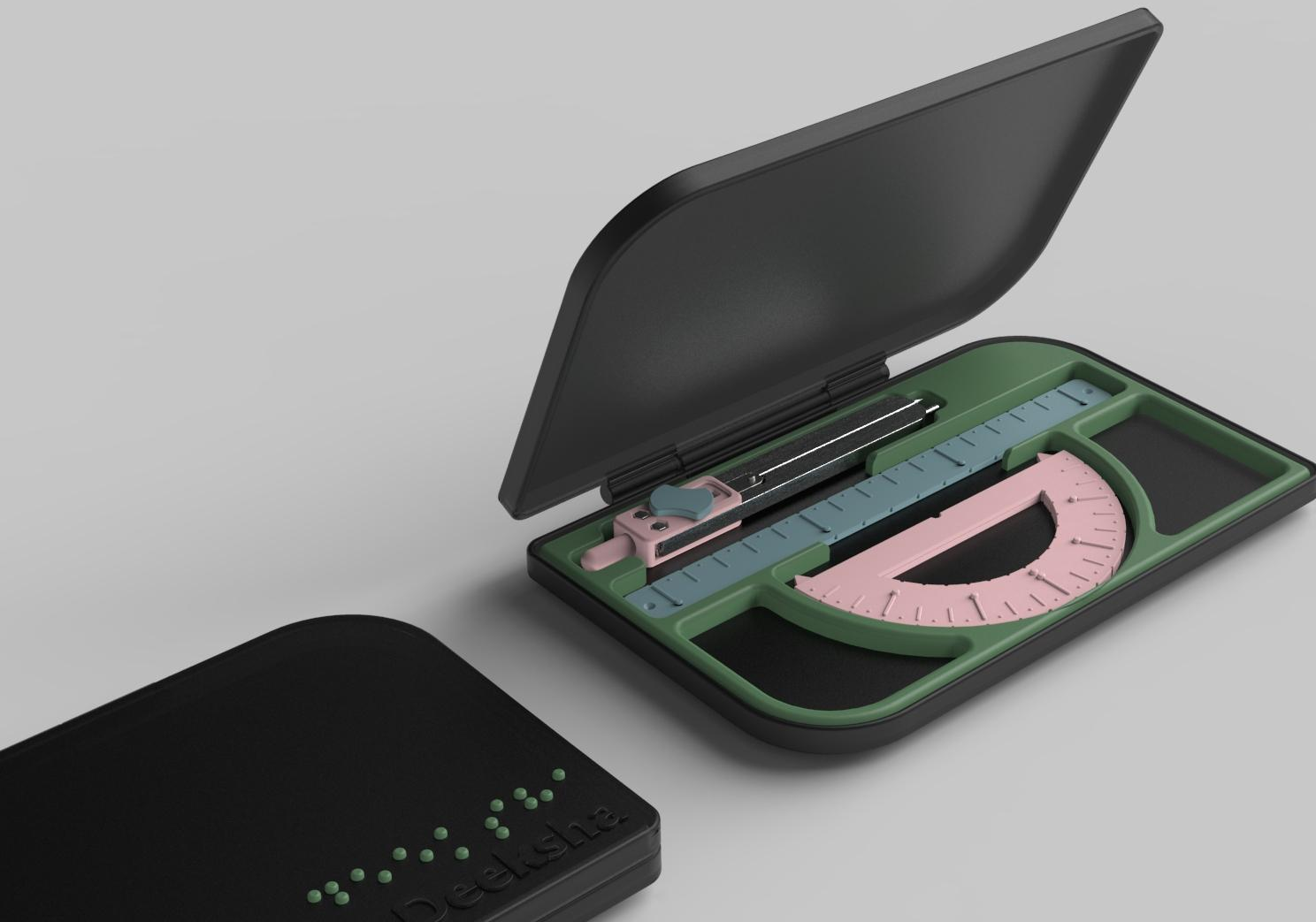
Compass

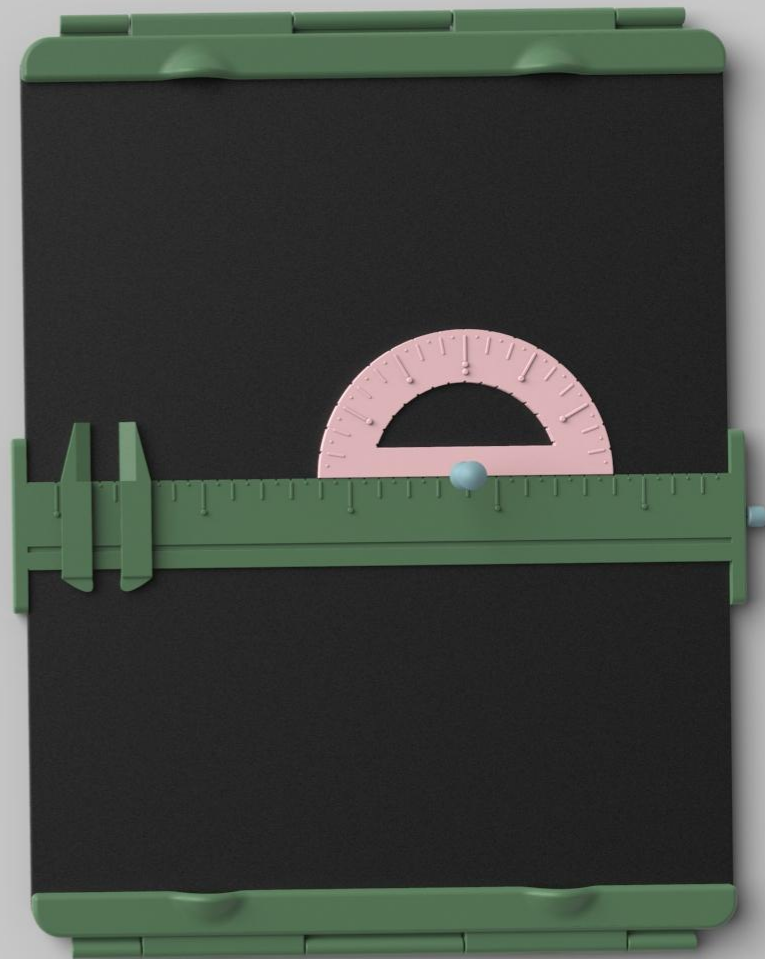
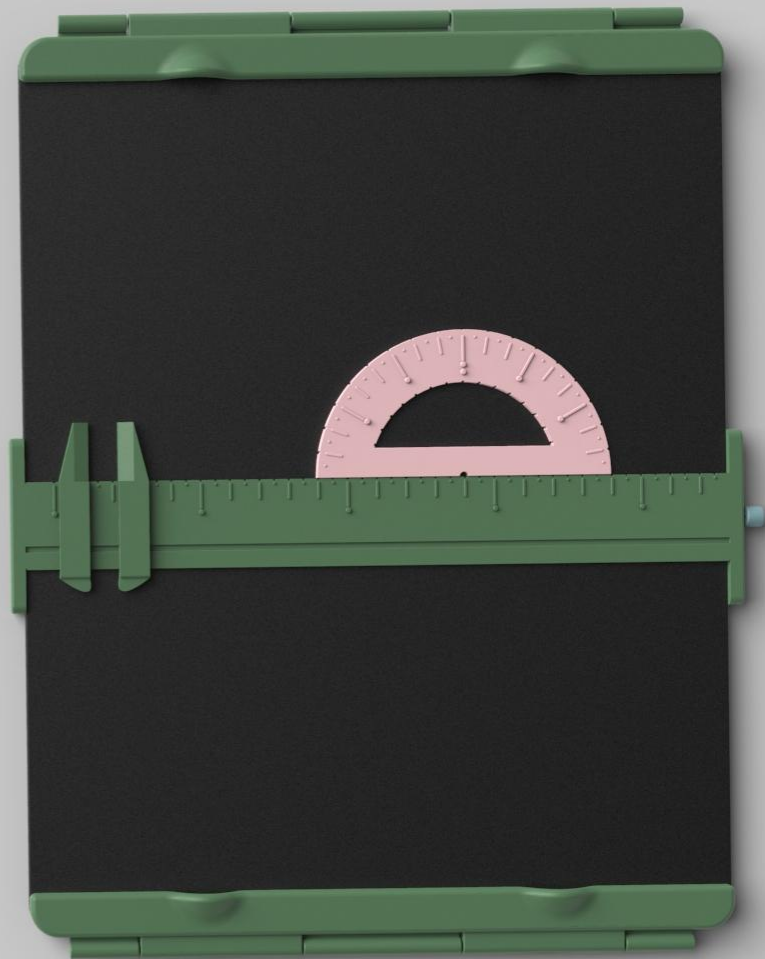


Compass with a locking mechanism for easy adjustment of arc length.

Metal Legs and Plastic cap

Organiser





THANKYOU

