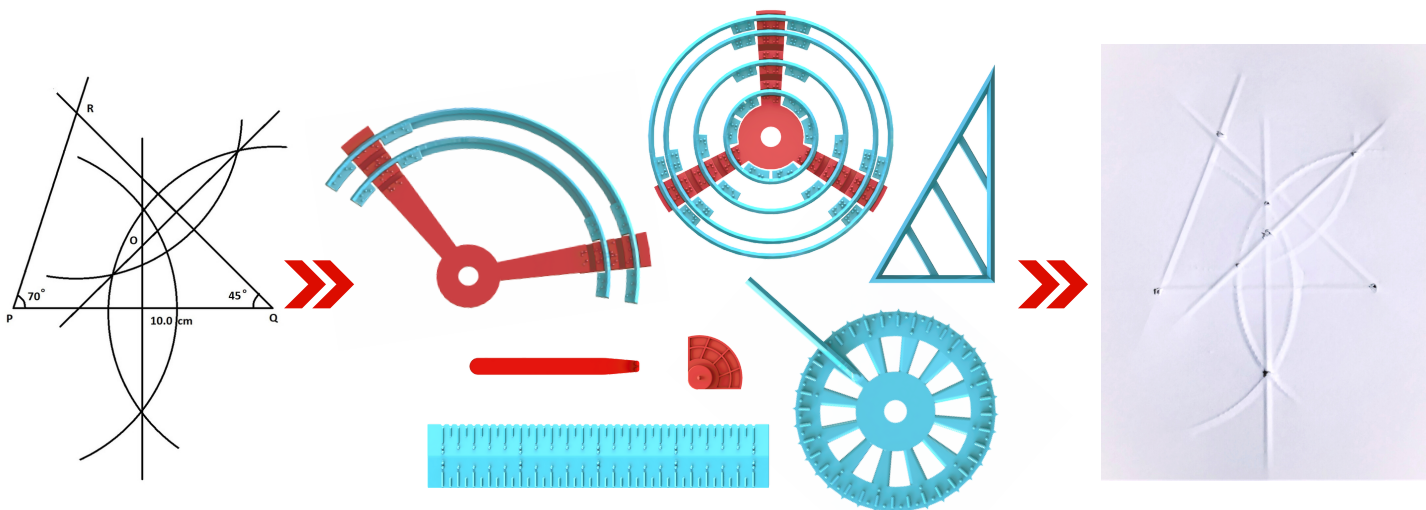# Tactile Geometry Kit

User Guide

Version 1.1

Enables Students with Visual Impairment to do Geometry Constructions

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Tactile Geometry Kit

Enables Students with Visual Disabilities to do Geometry Constructions

User Guide

Manual Ver 1.1

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GEOMKIT® is an outcome of the joint effort by Mr. Anupam Kumar Garg, Raised Lines Foundation, and Saksham Trust.

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Table of Content

1. Purpose of this User Guide

The purpose of this self-learning user guide is to familiarize the user with the working principle, the various tools and components, and the use of GEOMKIT$^®$. It is advisable for the GEOMKIT users to read and understand the contents of this user guide before using the Kit.

The contents of the user guide are available in Clear Print for the Special Educators and the low vision students, and in accessible digital formats for persons with visual impairment.

2. Why GEOMKIT is needed?

Geometry is one of the most eyes-intensive branches of Mathematics. Incidentally, it is also at the core of many advanced Maths concepts like Trigonometry, Coordinate Geometry, Calculus, Mensuration, Statics and Dynamics. But, due to the visual nature of the curriculum, coupled with unavailability of technology solutions, large number of students with Visual Disabilities are forced to drop Maths in their higher secondary.

Persons with Visual Disabilities use touch sensation to visualize a drawing – therefore, what the students with visual disabilities need is a Geometry Kit, using which they can construct embossed geometrical patterns. GEOMKIT$^®$ Tactile Geometry Kit, is designed to fulfil that need. Incidentally, all the geometrical constructions as per India NCERT Class VI – X syllabus have been successfully made using GEOMKIT.

3. Design Principle of GEOMKIT

In order to draw geometrical shapes and geometrical constructions, we need, in principle, tools and components to draw the following:

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

GEOMKIT provides all that and many more.

GEOMKIT is based on the principle of magnetism and leverages the soft-yet-firm grip between a magnet and a ferrous metal. The base constituent of the GEOMKIT is a specially designed **Slate** with ferrous metal top, while a few other instruments are having magnets embedded at key positions providing the grip.

GEOMKIT works with 3 distinct planes. The Slate provides the "***Design Layout Plane***" for the geometrical construction on which the whole design is laid out using magnet-embedded instruments – the primary among them is the magnet-embedded **Point Marker**. While **Ruler** and **Protractor** provide the appropriate measurements for the right placement of the Point Markers, the other marker-instruments like **Line Markers**, **Circle Markers** and **Arc Markers**, and **Set Square** with raised pattern on top – all constitute the "***Instrument Layout Plane***". This raised pattern is specially designed to make embossed impression on paper when the **Stylus** traces over it. The braille paper, placed over the "Instrument Layout Plane", provides the "***Embossed Drawing Plane***" where the embossed impressions of the actual geometrical construction are made.
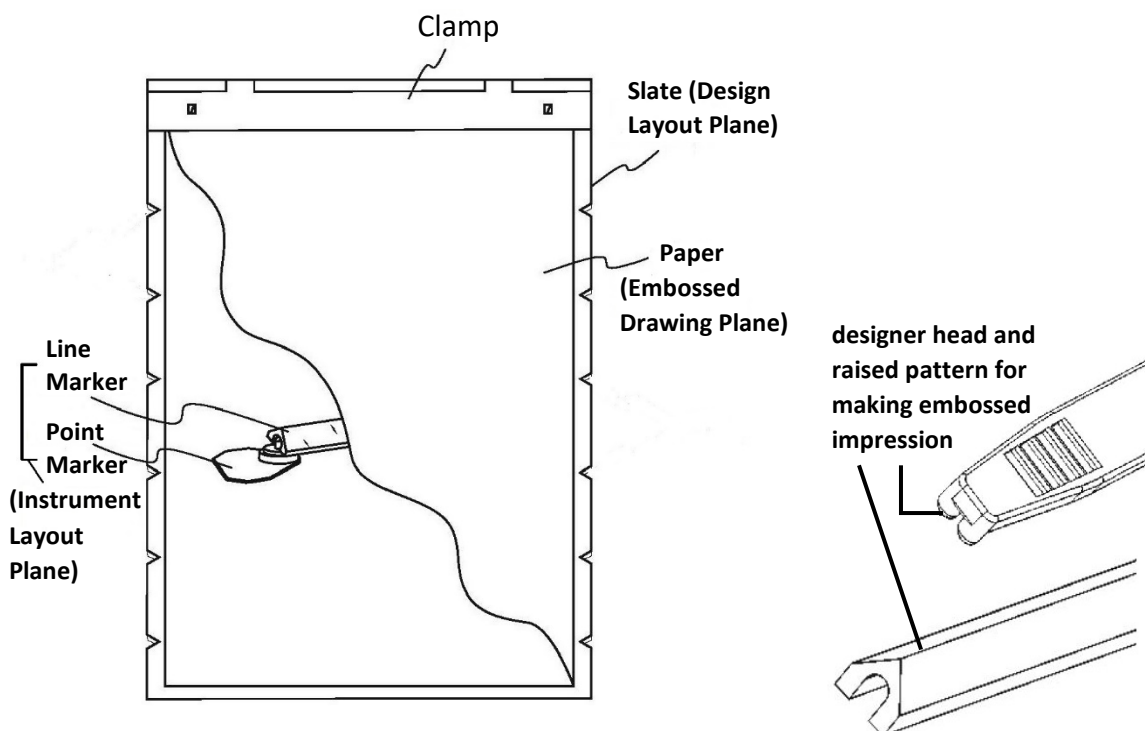
4. The Components of GEOMKIT

(a) Slate

This is the base component of GEOMKIT that provides all 3 distinct planes with its tier'ed design. The slate has a ferrous-metallic top, providing "Design Layout Plane" to instruments of the "Instrument Layout Plane" for the geometrical construction. It has a tier'ed clamp to secure the paper at a height, thus providing an "Embossed Drawing Plane" for the geometrical construction. The clamp has 2 punch pins and 2 magnetic engagements for soft yet firm grip.
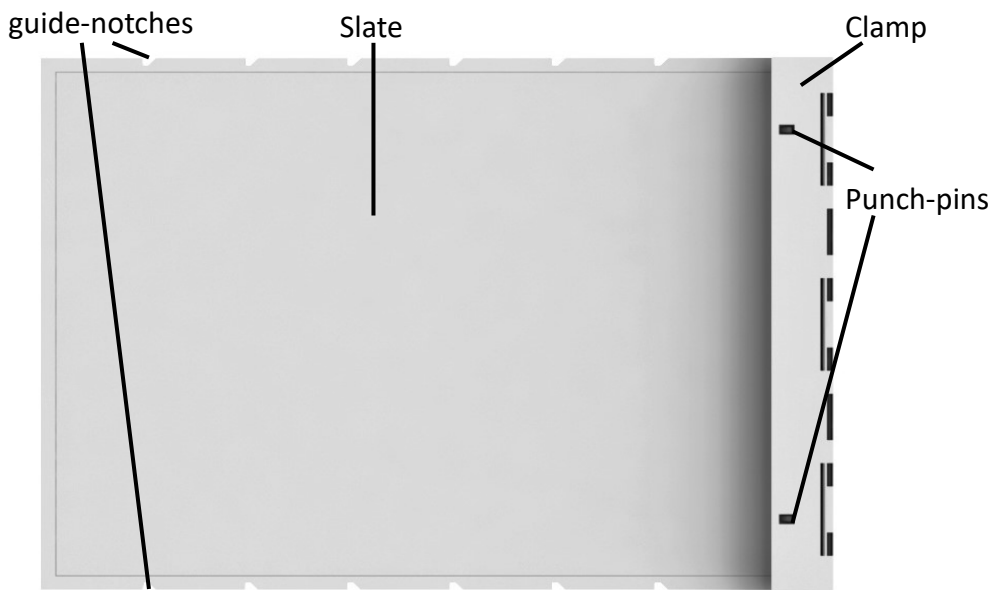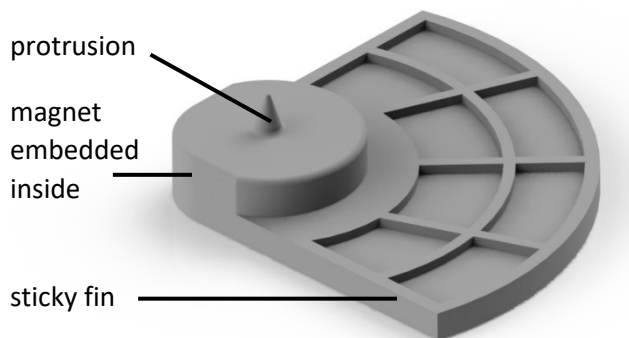

Slate also has Guide-notches on both side edges to align Ruler horizontally if so desired.

(b) Point Markers

Point Marker is used for marking a Point. It has an embedded magnet for grip and a protrusion for making a point mark on paper.

Point Marker also has a sticky fin for added grip and for controlling Point Marker's movement on the Slate by hand.

(c) Line Markers

Line Markers are used for drawing line segments. They have designer groove at the bottom to grip and slide over the Point Marker; and have a raised pattern on the top to make embossed impression on paper when the Stylus traces over it.

magnetic support-grip

Raised pattern

Designer Groove

Two Line Markers are included in the Kit – of lengths 15 cm and 21 cm respectively. Each Line Marker has one "magnetic support-grip" at the bottom to provide better grip on the slate. While 15 cm Line Marker has it placed on a side making it suitable for drawing Angle using Protractor, the 21 cm Line Marker has it placed in the center to prevent sagging – thus making it suitable for drawing Line segments.

(d) Stylus

The Stylus is specially designed to make an embossed impression on paper when traces over a Line Marker, Circle Marker, Arc Marker, or Set Square. User just needs to hold and use it similar to the way we hold and use a normal cutter. It has grooves on top surface for better grip.

grooves for better grip

side-edge for erasing embossed impression

designer head for making embossed impression
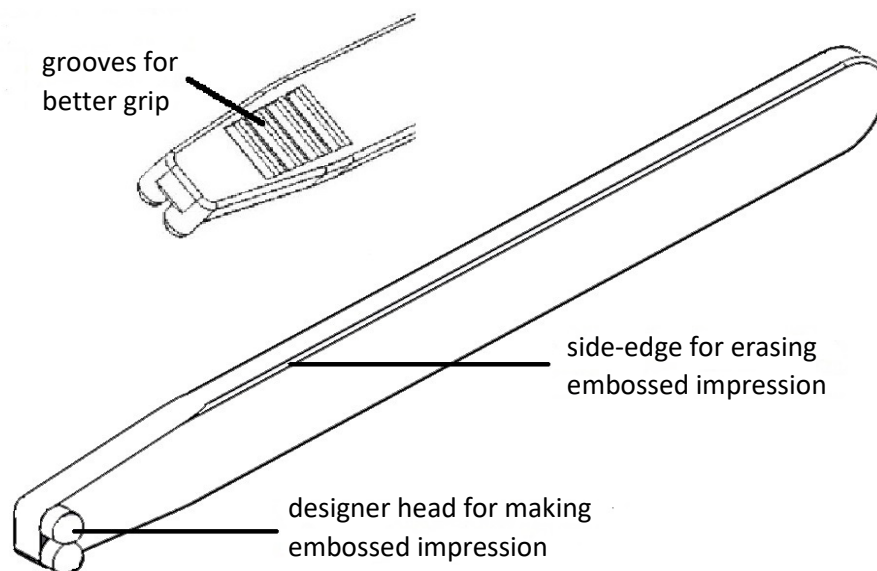
Moreover, its side-edge can be used to erase an embossed impression, if needed.

(e) Ruler

It is a 20 cm Ruler with Tactile markings at the standard 0.5cm resolutions for persons with visual disabilities. It has embedded magnets at the bottom for firm grip on the 'Design Layout Plane'. On one side, it has specially designed Step and Guide-notches to ensure that the Point Marker can be perfectly aligned to the Tactile marking of the Ruler. The other side has "wedge-edge" to facilitate the measurement of length.


Designer Step and Guide-notches for perfect alignment of Point Marker

tactile markings

wedge-edge for measurement
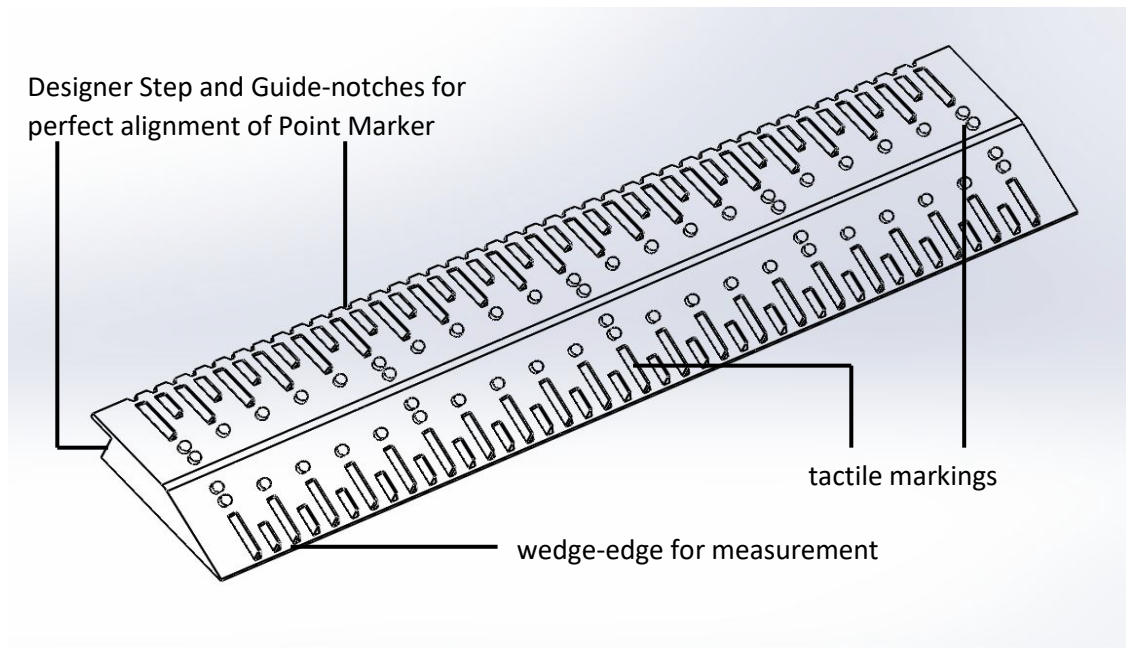
(f) Circle Markers and Arc Markers (of multiple radii) and the corresponding Circle Frames/Arc Frames to draw Circles and Arc
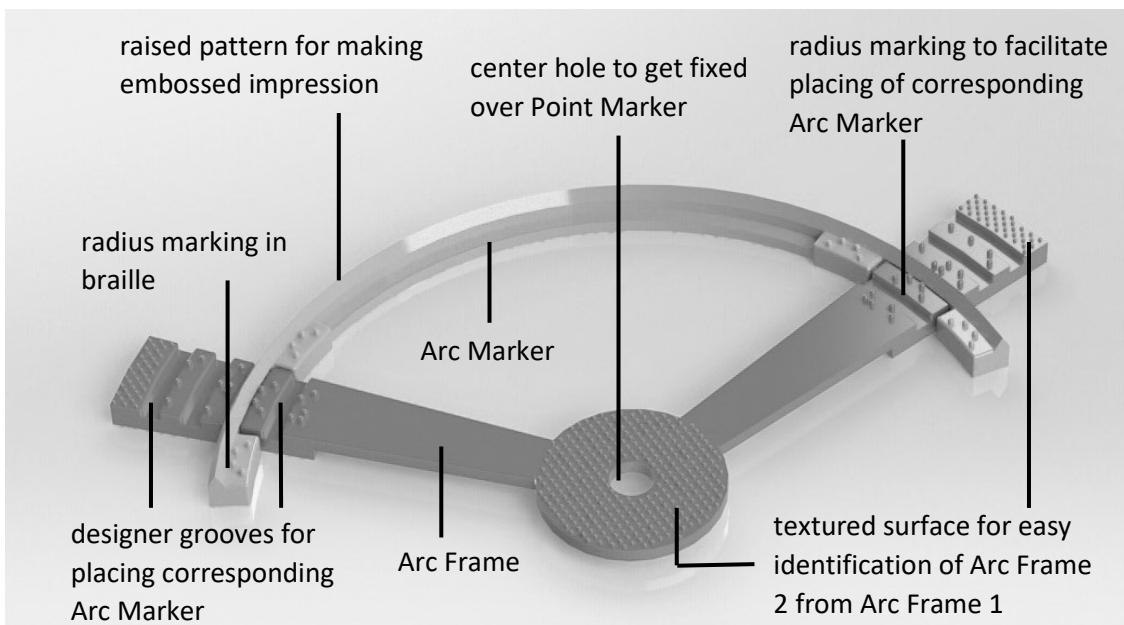
Circle Markers and Arc Markers are like stencils for creating Circles and Arc of various radii. They are the substitutes for Compass. One can draw circles or arcs of radius 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, and 80 mm using the Circle Markers, and of radius 85, 90, 95, 100, 105, 110, 115, and 120 mm using the Arc Markers. Each Circle Marker and Arc Marker have radius marking embossed in braille to facilitate identifying and picking the appropriate one by students with visual disabilities.

To facilitate the drawing, GEOMKIT provides the Circle Frames and Arc Frames. there are 2 types of Circle Frames. Circle Frame 1 can house Circle Markers of radius 30, 40, 50, 60, 70, and 80 mm, while Circle Frame 2 can house Circle Markers of radius 35, 45, 55, 65, and 75 mm. Each Circle Frame has designer grooves with radius marking embossed in braille to facilitate placing the corresponding Circle Marker on it correctly.
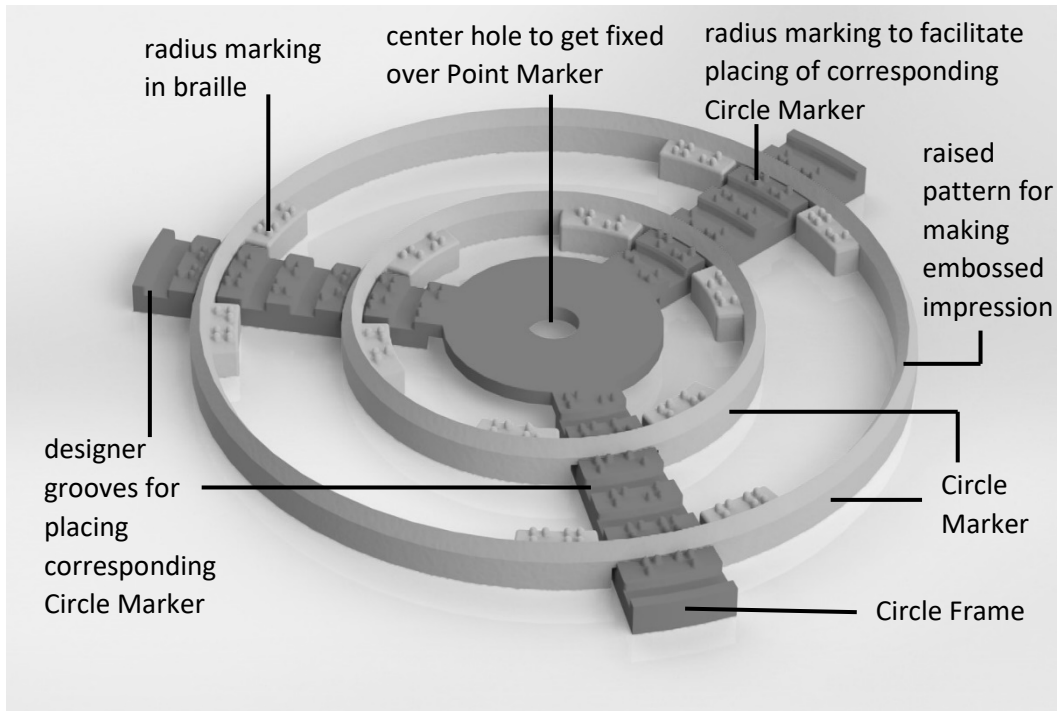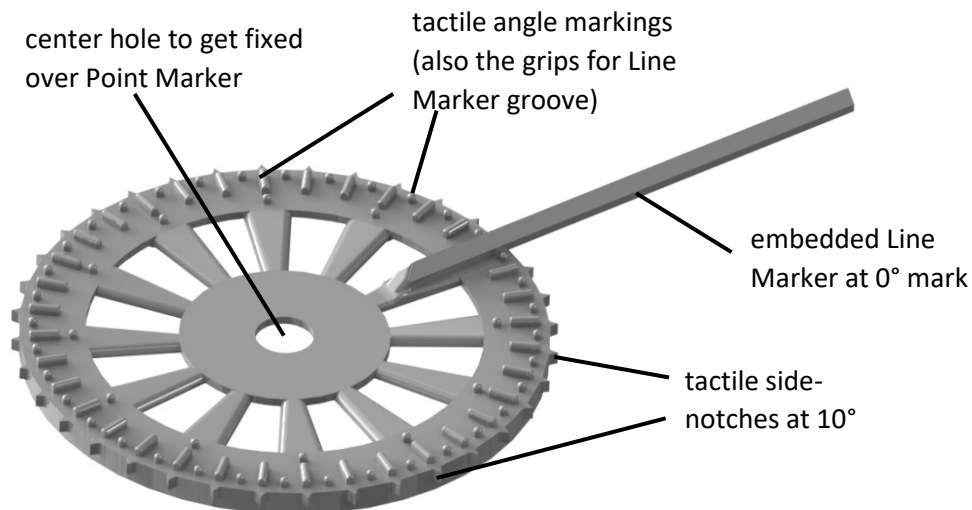
Similarly, there are 2 types of Arc Frames. Arc Frame 1 can house Arc Markers of radius 90, 100, 110, and 120 mm, while Arc Frame 2 can house Arc Markers of radius 85, 95, 105, and 115 mm. Each Arc Frame also has designer grooves with radius marking embossed in braille to facilitate placing the corresponding Arc Marker on it correctly.

The Circle Frames and Arc Frames have a center hole to get fixed over the Point Marker. All Circle Markers and Arc Markers have a raised pattern on the top to make embossed impression on paper when the Stylus traces over it. The Circle Frame 2 and Arc Frame 2 have textured surface around center and over edges on the front side, as well as over arms on the back side in order to differentiate from Circle Frame 1 and Arc Frame 1 respectively.
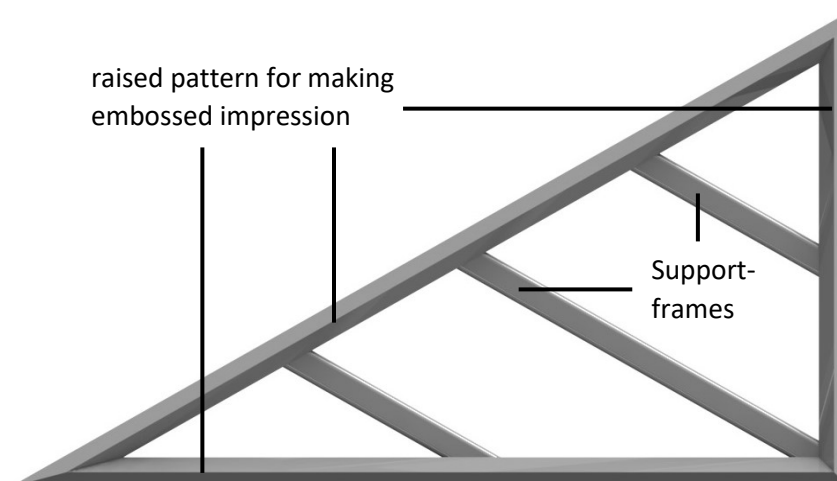
(g) Protractor

It is a 360° Round Protractor with Tactile markings at standard 5° resolutions for students with visual disabilities. Protractor has a center hole to get fixed over the Point Marker. It has an embedded Line Marker fixed at 0° mark and the tactile markings are designed to provide a grip for the "15 cm Line Marker" that may be placed at any desired Angle. In addition, tactile side-notches at 10° facilitate quick measuring of an angle. The embedded magnets at the bottom provide a firm grip on the 'Design Layout Plane'.

center hole to get fixed over Point Marker

tactile angle markings (also the grips for Line Marker groove)

embedded Line Marker at 0° mark

tactile side-notches at 10°

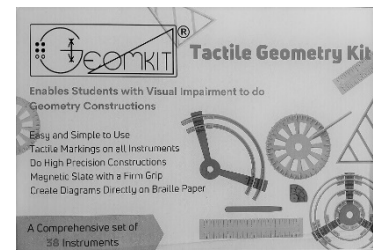## (h) Set Square

Set Square is useful in drawing 30°, 60°, and 90° angles quickly. It has groove at the bottom to grip and slide over the Point Marker. It has a raised pattern on the top to make embossed impression on paper when the Stylus traces over it. The support-frames in the middle prevent bending of the Set Square while tracing.
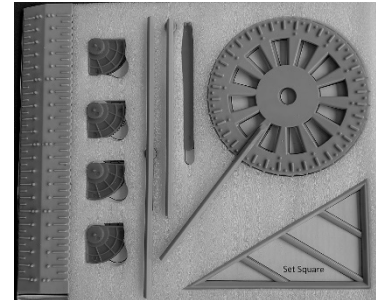

raised pattern for making embossed impression

Support-frames

5. The GEOMKIT Box

The various instruments of GEOMKIT are placed in the GEOMKIT Box in multi-layered fashion.

Layer 1
- Ruler
- Point Markers – 4 nos.
- Line Markers – 15 cm and 21 cm
- Stylus
- Protractor
- Set Square

Layer 2
- Slate

Layer 3
- Circle Markers of radius 30, 40, 50, 60, 70, and 80 mm housed on a fixed Circle Holder 1 and a loose Circle Frame 1 placed (flipped) over them
- Circle Markers of radius 35, 45, 55, 65, and 75 mm housed on a fixed Circle Holder 2 (textured) and a loose Circle Frame 2 (textured) placed (flipped) over them
- Pickup Tool
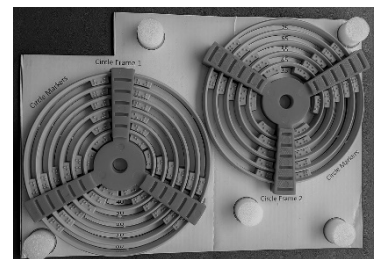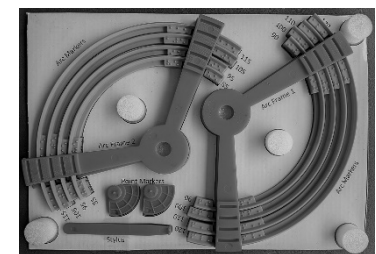

Layer 4
- Arc Markers of radius 90, 100, 110, and 120 mm housed on a fixed Arc Holder 1 and a loose Arc Frame 1 placed (flipped) over them
- Arc Markers of radius 85, 95, 105, and 115 mm housed on a fixed Arc Holder 2 (textured) and a loose Arc Frame 2 (textured) placed (flipped) over them
- Point Markers – 2 nos. (SPARE)
- Stylus (SPARE)

Box Flap
- Braille sheets
- GEOMKIT User Guide

6. Learning to use GEOMKIT

(a) Holding the Stylus correctly and tracing it over raised pattern.

Stylus is the key instrument that makes the embossed impression on paper. However, if it is not held and used properly, tracing may not get right embossment – worse, the paper may get torn.

(a.1) Stylus has, on the front end (head), a double protrusion that should always point downwards while using. Slide your index finger over the Stylus till it gets to the tactile groove. Hold the Stylus such that your index finger presses the Stylus at the groove, while the back end (tail) of Stylus touches your palm. Now, you are holding the Stylus correctly.
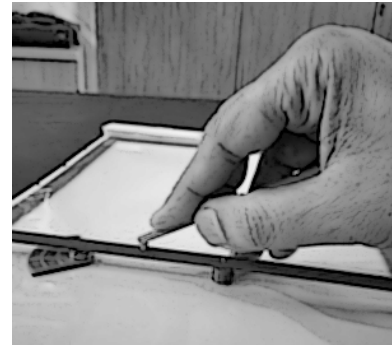
(a.2) Next, take out the Set Square and place it on the flat surface of the Slate. Hold it on the slate by hand. Feel the raised pattern on top of the 3 edges of the Set Square.

(a.3) Place the Stylus over one of the edges such that the raised tip of the edge fits comfortably between the double protrusion of the Stylus head. Slide the Stylus over the edge smoothly, keeping a mild downward pressure with the index finger. Ensure that the Stylus does not lose the grip over the raised pattern of the edge.

(a.4) Do the same for all 3 edges of Set Square. Try multiple times till you get it correct.

(a.5) Next, take out one of the Circle Markers and place it on the flat surface of the Slate. Hold it on the slate by hand.

(a.6) Feel the raised pattern on top of the edge of the Circle Marker. Place the Stylus over the edge such that the raised tip of the edge fits comfortably between the double protrusion of the Stylus head. Slide the Stylus over the edge smoothly, keeping a mild downward pressure with the index finger. Ensure that the stylus does not lose the grip over the raised pattern of the edge. You may need to bend your hand to do that. It is suggested that you do tracing of the full circle in 3 distinct strokes (arcs). Try multiple times till you get it correct.

(b) Putting the paper on the Slate, Clamping it, and Flipping - Un-flipping it.

(b.1) Place the Slate in front of you such that its clamp is away from you. Open the clamp using your both thumbs close to the two bottom corners of the clamp. Now, take a standard braille paper sheet, hold its top corners with both hands and place them close to the clamp's hinge. Close the clamp and press it hard using your both thumbs over clamp's punch pins till you hear the punching sound. The paper is now secured on the Slate.

(b.2) Next, lift the paper from the bottom edge, flip it softly over the clamp, and press its bottom edge underneath the slate.

(b.3) Now, un-flip the paper. Ensure that the paper does not come out of the clamp during this flipping and un-flipping action. This sequence would be needed when you would be making instrument layout for the construction.
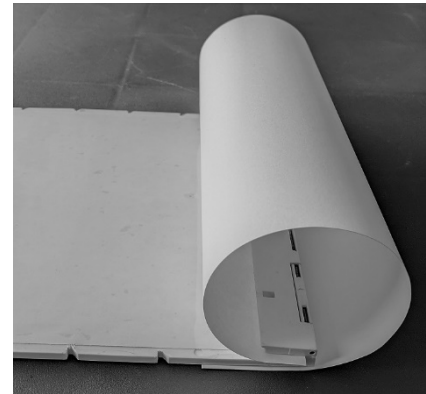
(b.4) Next, open the clamp and take the paper out.

(b.5) Now, put the paper back by placing the already created punch marks over the punch pins. Close the clamp. You may need these steps if the paper comes out accidentally in between the construction and you have to place the paper back at the precise location.

(c) Marking a Point with Point Marker and Aligning it to a Point.

(c.1) Take a Point Marker and place it on the Slate with its sticky fin towards you. Point Marker has an embedded magnet for grip and a protrusion for making a point mark on paper. While marking a Point, do not push on the protrusion with a finger – it may prick you. Instead place the protrusion in between your index and middle fingers and push the paper to make a marking.

(c.2) Next, put the paper on the Slate *(refer b.1 above)*. The Point Marker is now underneath the paper.

(c.3) Press the paper slightly and feel the protrusion of the Point Marker with your index and middle fingers. Once found, place the protrusion in the gap of your index and middle fingers and press the paper into the protrusion to mark the Point.

(c.4) Next, we will guide you how to align the Point Marker using its sticky fin.

(c.5) Flip the paper and mis-align the Point Marker by shifting it slightly. Now, grip the Point Marker by pressing your index and middle fingers lightly on its fin. Un-flip the paper. Use index and middle fingers of your other hand to press the paper slightly and feel the protrusion of the Point Marker as well as the mark earlier made over the paper. Try to align the two by sliding Point Marker using its fin. Once you feel that both are aligned, press the paper to mark the Point again.

(c.6) Check if the alignment was correct. Try multiple times till you get it right. This alignment would be needed while marking Point of Intersection during the construction.

(d) Drawing a Line Segment using Ruler and 21 cm Line Marker.

The 20 cm Ruler has, on one side, the "Step and Guide notch edge" to ensure that the Point Marker can be perfectly aligned to the Tactile marking of the Ruler. The other side has "Wedge edge" to facilitate the measurement of length.

The Slate and Ruler are designed to assist drawing a horizontal line, which is a usual demand for a geometrical construction. The Slate has Guide-notches on both side edges aligned horizontally, and the length of Ruler matches with the width of the Slate.

Below is the guide to draw an embossed line segment of 12 cm "horizontally".

(d.1) Put the paper of the Slate *(refer b.1 above)*. Flip the paper around the Clamp underneath the Slate *(refer b.2 above)*.

(d.2) Place the Ruler on the Slate with the "Step and Guide notch edge" towards you. Its embedded magnets at the bottom would provide the firm grip on the Slate. Align the Ruler with the edges of the Slate.

(d.3) Now, take a Point Marker and place it close to the left of the "Step and Guide notch edge" such that its fin is towards you and its protrusion is fitted into a guide-notch aligned with a tactile marking. Next, take another Point Marker and place it also on the "Step and Guide notch edge" such that its fin is towards you and its protrusion is fitted into a guide-notch aligned with a tactile marking that is 12 cm on the right of the first Point Marker.
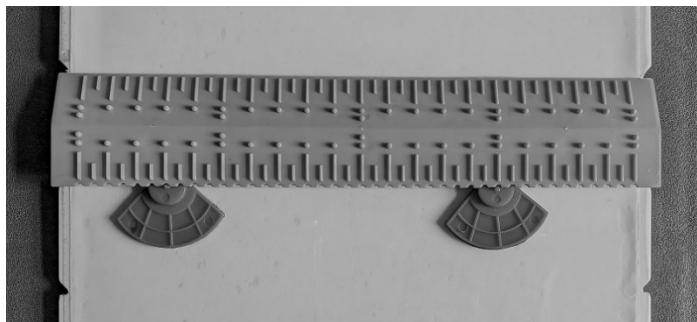
(d.4) Use the fingers on the corners of the "Wedge edge" of the Ruler and push the Ruler (along with the 2 Point Markers) slowly towards you, aligning with the pair of Guide-notches on the side edges of the Slate. The Ruler is now aligned horizontally.

(d.5) Push the Ruler away from you such that Point Markers are not disturbed. Remove the Ruler.

(d.6) Now, un-flip the paper. Mark the 2 points of both Point Markers on the paper *(refer c.3 above)*. These 2 points are 12 cm apart.

(d.7) Flip the paper again. Take out the 21 cm Line Marker (with "magnetic support-grip" in the center). Line Markers have a designer groove at bottom to grip and to slide over the Point Marker and have a raised pattern on top to make embossed impression on paper. Place the Line Marker over the 2 Point Markers such that their protrusions fit inside the groove of the Line Marker. Keep the "magnetic support-grip" in the middle to prevent sagging.

(d.8) Un-flip the paper. Feel the raised pattern of Line Marker. Now, take the Stylus and join the 2 point-marks by tracing over the raised pattern on the top of Line Marker *(refer a.3 above)*. Trace firmly so that the embossing is prominent enough.

You now have the embossed horizontal Line Segment of 12 cm between the 2 points.

(e) Measuring a given embossed Line Segment using Ruler.

(e.1) Place the paper, that has the embossed Line Segment, on the slate.

(e.2) Take out the Ruler and place its "Wedge edge" alongside the embossed Line Segment.

(e.3) Keep one end of the line at 0 cm tactile mark. The Ruler is now aligned to measure the length.

(e.4) Measure the length by counting the tactile markings.
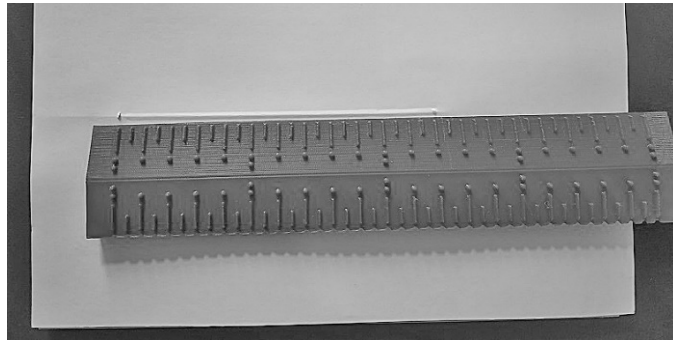
(f) Drawing a Circle and an Arc using Circle Marker and Arc Marker.

Circle Markers and Arc Markers are like stencils for creating Circles and Arc of various radii – the substitutes for Compass. One can draw circles or arcs of radius 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, and 80 mm using the Circle Markers, and of radius 85, 90, 95, 100, 105, 110, 115, and 120 mm using the Arc Markers. Each Circle Marker and Arc Marker have radius marking embossed in braille to facilitate identifying and picking the Circle Marker or Arc Marker of a given radius.

Apart of these, the Circle Frames and Arc Frames are provided to facilitate the drawing. There are 2 types of Circle Frames. Circle Frame 1 houses Circle Markers of radius 30, 40, 50, 60, 70, and 80 mm, while Circle Frame 2 houses Circle Markers of radius 35, 45, 55, 65, and 75 mm. Each Circle Frame has designer grooves with radius marking embossed in braille to facilitate placing the corresponding Circle Marker correctly.

Similarly, there are 2 types of Arc Frames. Arc Frame 1 houses Arc Markers of radius 90, 100, 110, and 120 mm, while Arc Frame 2 houses Arc Markers of radius 85, 95, 105, and 115 mm. Each Arc Frame also has designer grooves with radius marking embossed in braille to facilitate placing the corresponding Arc Marker correctly.

The Circle Frame 2 and Arc Frame 2 have textured surface around center and over edges on the front side, as well as over arms on the back side in order to differentiate from Circle Frame 1 and Arc Frame 1 respectively.

The Circle Frames and Arc Frames have a center hole to get fixed over the Point Marker. All Circle Markers and Arc Markers have a raised pattern on the top to make embossed impression on paper when the Stylus traces over it.

Incidentally, you may find a set of Circle Holders and Arc Holders fixed into the GEOMKIT box (similar to the Circle Frames and Arc Frames) that houses all the Circle Markers and Arc Markers.

Below is the guide to draw a Circle of radius 70 mm and an Arc of radius 105 mm.

(f.1)   Put the paper of the Slate *(refer b.1 above)*. Flip the paper around the Clamp underneath the Slate *(refer b.2 above)*.

(f.2)   Take a Point Marker and place it near the center of the Slate. Un-flip the paper. Mark the point on the paper *(refer c.3 above)*. This would be our Center of the Circle and Arc.

(f.3)   Next, we need to select the right Circle Marker or Arc Marker. Since radius 70 mm is less than 85 mm, it would be a Circle Marker. Moreover, radius has unit value of 0, hence it would be housed in Circle Holder 1.

(f.4)   Go to the Circle Holder 1 (similar to Circle Frame 1) fixed in the Box and take out the Circle Frame 1 kept loosely and flipped over it.

(f.5)   Now, identify the 70 mm Circle Marker based on the radius marking in braille.

(f.6)   Pick the Circle Marker using the "Pickup tool". You need to just push its pointed part below the Circle Marker and flip up. Remove the Circle Marker softly from the Circle Holder grip (keep in mind, Circle Marker is gripped at 3 places). However, get a feel how that Circle Marker was placed on the Circle Holder while removing. That would be helpful while placing it on Circle Frame while construction as well as while placing it back into Circle Holder.
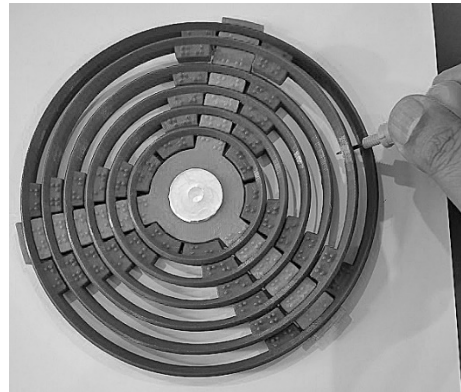
(f.7)   Flip the paper again. Fit the center-hole of the Circle Frame over the Point Marker (the center of Circle). Ensure that the side of Circle Frame, that has braille markings, is on top.

(f.8)   Next, place the 70 mm Circle Marker on the Circle Frame the same way as it was placed in Circle Holder in the Box. Circle Frame has 3 arms with grooves for each Circle Marker with the radius marking in braille next to the groove. Identify the grooves with 70 marked in braille. The Circle Marker also has corresponding 3 grooves. Fix the Circle Marker on the Circle Frame accordingly.
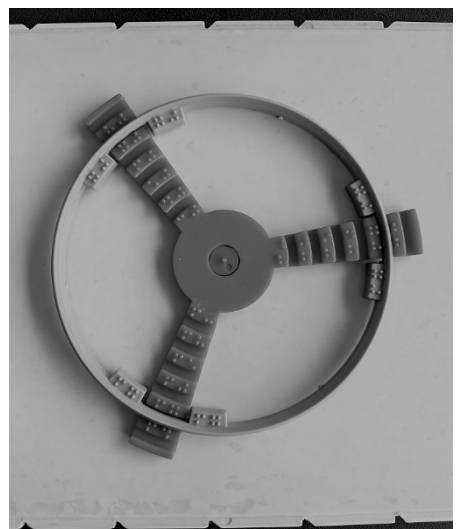
(f.9)   Un-flip the paper. Feel the raised pattern of the Circle Marker. Now, take the Stylus and trace the circle. Use multiple strokes as desired *(refer a.6 above)*. Trace firmly so that the embossing is prominent enough. You may also rotate the slate while tracing the circle.

You now have the embossed Circle of radius 70 mm. Please note that if you wish to draw an arc of radius 70 mm, you may just trace only the portion of the circle that is needed.

(f.10) Flip the paper again. Remove the Circle Marker and the Circle Frame softly so that Point Marker is not disturbed.

(f.11) Next, we need to select the arc of radius 105 mm. Since radius has unit value of 5, hence it would be housed in Arc Holder 2.

(f.12) Go to the Arc Holder 2 (similar to Arc Frame 2) fixed in the Box and take out the Arc Frame 2 kept loosely and flipped over it.

(f.13) Now, identify the 105 mm Arc Marker based on the radius marking in braille.

(f.14) Pick the Arc Marker using the "Pickup tool". Remove the Arc Marker softly from the Arc Holder grip (keep in mind, Circle Marker is gripped at 2 places). However, get a feel how that Arc Marker was placed on the Arc Holder while removing. That would be helpful while placing it on Arc Frame while construction as well as while placing it back into Arc Holder.

(f.15) Fit the center-hole of the Arc Frame over the Point Marker (the center of Circle). Ensure that the side of Arc Frame, that has braille markings, is on top.

(f.16) Next, place the 105 mm Arc Marker on the Arc Frame the same way as it was placed in Arc Holder in the Box. Arc Frame has 2 arms with grooves for each Arc Marker with the radius marking in braille next to the groove. Identify the grooves with 105 marked in braille. The Arc Marker also has corresponding 2 grooves. Fix the Arc Marker on the Arc Frame accordingly.

(f.17) Un-flip the paper. Feel the raised pattern of the Arc Marker. Now, take the Stylus and trace the arc. Use multiple strokes as desired *(refer a.6 above)*. Trace firmly so that the embossing is prominent enough.
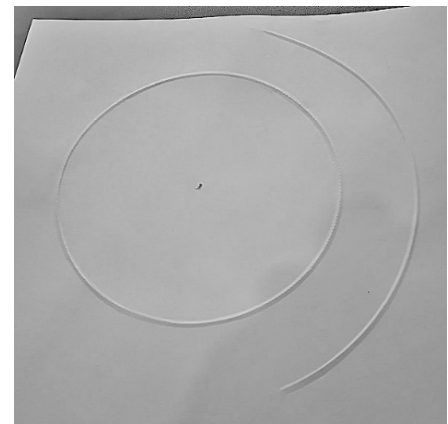
You now have the embossed Arc of radius 105 mm.

(g) Drawing an Angle using Protractor and Line Marker.

Protractor is a 360° Round Protractor with Tactile markings at standard 5° resolutions. It has a center hole to get fixed over the Point Marker. It has an embedded Line Marker fixed at 0° mark and the tactile markings are designed to provide a grip for the "15 cm Line Marker" that may be placed at any desired Angle.

Below is the guide to draw two embossed lines making 50° angle between them.

(g.1) Draw a Line Segment of 12 cm (say) using Ruler and the 21 cm Line Marker *(refer d above)*. This would be the Base Line of the angle.

(g.2) Flip the paper. Softly remove the 21 cm Line Marker but keep the 2 Point Markers (denoting the two ends of the line segment) stay on the slate.

(g.3) Take out the Protractor. Fit the center-hole of the Protractor over the left-side Point Marker. That Point Marker will be the Vertex of the angle.

(g.4) Softly swivel the Protractor around the vertex (ensuring that the Point Marker at vertex is not disturbed) such that the 0° Line Marker (fixed with the Protractor) reaches over the right-side Point Marker. Make sure the protrusion of this Point Marker fits inside the groove of the 0° Line Marker. This would align the Protractor with the Base Line of the angle.

(g.5) Next, take out the 15 cm Line Marker (with "magnetic support-grip" on one side). Place its open end over the protrusion of the Point Marker at the center of Protractor (Vertex). Find the tactile marking 50° from the 0° Line. Softly swivel the 15 cm Line Marker such that the 50° tactile marking fits into its groove perfectly (press softly over the groove if needed). The other end of the Line Marker with the magnetic support-grip would grip the slate automatically.

(g.6) Now, un-flip the paper. Feel the raised pattern of 15 cm Line Marker. Take the Stylus and trace over the raised pattern on the top of Line Marker – starting from the point-mark of the center till end of Line Marker. Trace firmly so that the embossing is prominent enough.
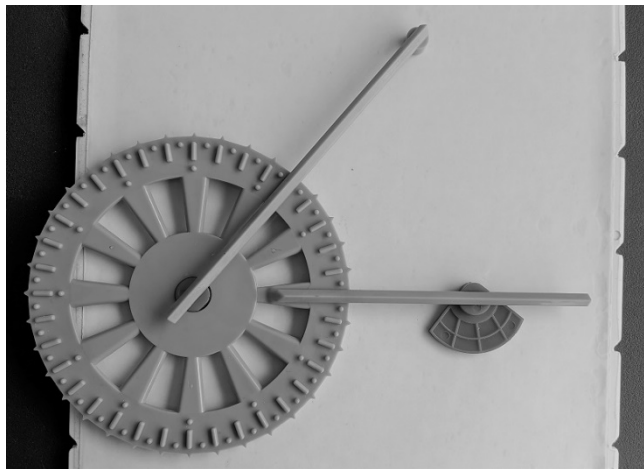
You now have drawn the two embossed lines making 50° angle between them.

(h) Measuring a given Angle using Protractor.

(h.1) Place the paper, that has the embossed drawing of angle, on the slate.

(h.2) Take out a Point Marker and align it just below the Vertex of the angle (similar to c.5 above). Press the paper to mark the vertex. Keep the Point Marker stay on the slate.

(h.3) Take out the Protractor and place it over the paper such that its 0° Line Marker (fixed with the Protractor) is over the Base Line of the angle.

(h.4) Softly slide the Protector over this embossed Base Line; using your little finger inside the center of the Protractor, feel for the Vertex mark. Fix the Protractor such that the Vertex mark is at the middle of center of the Protractor while its 0° Line Marker is over the embossed Base Line of the angle. The Protractor is now aligned to measure the angle.
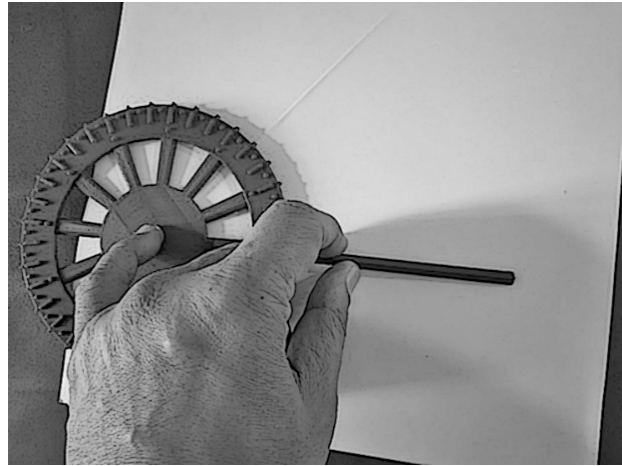
(h.5) Feel the other embossed Line on the paper and the point where it meets the Protractor. Measure the angle by counting the tactile markings. You may also use the tactile side-notches at 10° gaps for quick measuring of an angle.

(i) Drawing a quick 90° Angle using Set Square and 21 cm Line Marker.

Set Square is useful in drawing 30°, 60°, and 90° angles quickly. It has groove at bottom to grip and to slide over the Point Marker.

(i.1) Draw a Line Segment of 12 cm (say) using Ruler and the 21 cm Line Marker *(refer d above)*. This would be the Base Line of the angle.

(i.2) Flip the paper. Softly remove the 21 cm Line Marker but keep the 2 Point Markers (denoting the two ends of the line segment) stay on the slate. Let's call them PM-1 and PM-2 (say).
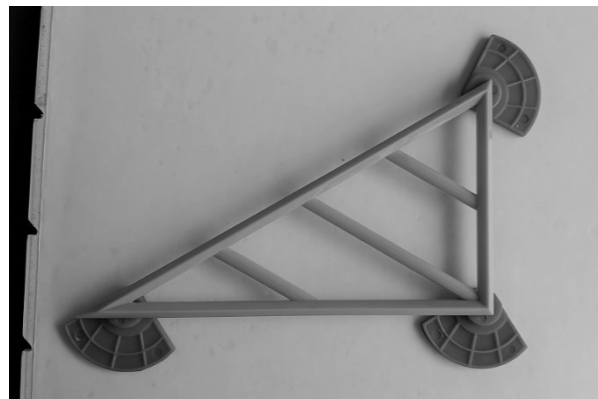
(i.3) Place the Set Square such that its longer arm next to 90° angle is over both the Point Markers with their protrusions fitting inside the groove of the Frame.

(i.4) Slide the Frame softly towards the left till its 90° angle corner hits the PM-2.

(i.5) Take out 3rd Point Marker (PM-3) and slide it below the groove of the shorter arm next to 90° angle. Now, slide PM-3 softly till it hits the end of this shorter arm.

(i.6) Remove the Set Square softly such that Point Markers are not disturbed.

(i.7) Take out the 21 cm Line Marker (with magnetic "support-grip" in the center). Place it over the PM-2 and PM-3 such that their protrusions fit inside the groove of the Line Marker. Keep the "magnetic support-grip" in the middle to prevent sagging.

(i.8) Un-flip the paper. Feel the raised pattern of Line Marker. Now, take the Stylus and trace over the raised pattern on the top of Line Marker. Trace firmly so that the embossing is prominent enough.

You now have drawn 90° angle using Set Square.

7. Making Geometrical Constructions with GEOMKIT

Tutorial A: Drawing Perpendicular Bisector of a Line Segment

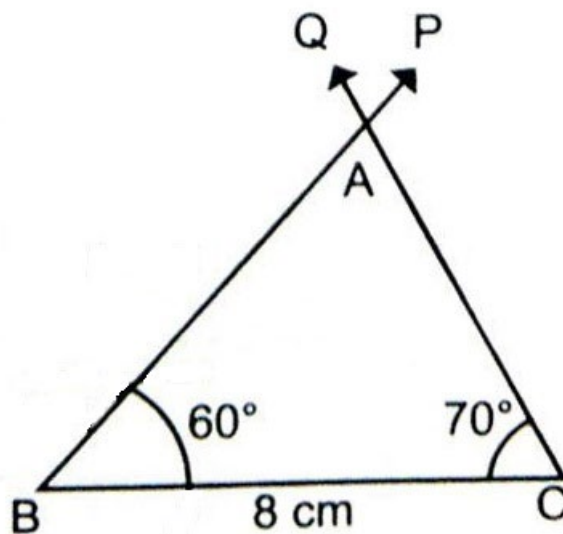| Steps using conventional Geometry Set (for sighted students)	Steps using GEOMKIT® (for students with visual disabilities)
Draw a Line Segment AB of 10 cm length (say) using Ruler.	Draw a Line Segment AB of 10 cm length (say) using Ruler and 21 cm Line Marker.
With A as center, using compass, draw a Semi-circular Arc of radius 8 cm (say) across the line, such that Arc is equally above and below the line.	With A as center, using Circle Marker of radius 8 cm (say), draw a Semi-circular Arc across the line, such that Arc is equally above and below the line.
Now with B as center, using compass, draw a similar Semi-circular Arc of same radius across the line. Ensure that this arc cuts the previous arc both above and below the line.	Now with B as center, using same Circle Marker, draw a similar Semi-circular Arc across the line. Ensure that this arc cuts the previous arc both above and below the line.
Mark the two intersection points (say 1 and 2).	Align two Point Markers below the two intersection points (say 1 and 2) respectively and mark them on paper.
Draw a line joining points 1 and 2 using Ruler. This line is perpendicular bisector of line segment AB.	Draw a line joining points 1 and 2 using 21 cm Line Marker. This line is perpendicular bisector of line segment AB.

Tutorial B: Drawing an ASA Triangle

Steps using conventional Geometry Set (for sighted students)	Steps using GEOMKIT® (for students with visual disabilities)
Draw a Line Segment AB of 8 cm length using Ruler.	Draw a Line Segment AB of 8 cm length using Ruler and 21 cm Line Marker.
With BC as the base line and B as vertex, using Protractor, draw a ray BP at angle 60°.	With BC as the base line and B as vertex, using Protractor, draw a ray BP at angle 60°.
Now with CB as the base line and C as vertex, using Protractor, draw a ray CQ at angle 70°.	Now with CB as the base line and C as vertex, using Protractor, draw a ray CQ at angle 70°.
Mark the intersection point (i.e. A) of the two rays BP and CQ. The triangle ABC is constructed.	Align a Point Marker below the intersection point (i.e. A) of the two rays BP and CQ. Mark it on paper. The triangle ABC is constructed.

Annexure A: Frequently Asked Questions (FAQ)

How am I sure that the paper will not slide while I am drawing?

The clamp secures the paper with 2 punch pins as well. Once you punch the paper with the clamp, you can be sure the paper will not slide.

Why am I limited to resolution of 5mm, when the geometry set for sighted has 1mm resolution?

This is a standard set for tactile drawings for visually handicapped users. Actually, a tactile mark on Ruler has its own width and tactile marks made too close may not be differentiable by persons with visual disabilities. Moreover, tactile marks at 1mm would mean 5 marks within 5mm width – that may clutter the whole Ruler.

Moreover, the focus is on learning concepts – therefore most of the educational material, even for sighted, asks for line drawings in multiple of 0.5cm.

Why am I limited to resolution of 5° on Protractor, when the geometry set for sighted has 1° resolution?

This is a standard set for tactile drawings for visually handicapped users. Actually, a tactile mark on Protractor has its own width and tactile marks made too close may not be differentiable by persons with visual disabilities. Moreover, tactile marks at 1° would mean 5 marks within 5° width – that may clutter the whole Protractor.

Moreover, the focus is on learning concepts – therefore most of the educational materials, even for sighted, asks for angle drawings in multiple of 5°.

Why are there a limited set of Circle Markers and Arc Markers?

When the standard set for resolution in tactile drawings for visually handicapped users is 5mm, the focus of this Kit had been to allow the users to draw circles and arcs of radii multiple of 5mm. Moreover, it is found that drawing a circle of radius less than 30mm or greater than 120mm is too unmanageable for a small child – hence, the educational materials usually do not ask even sighted students to draw circles less than 30mm or greater than 120mm radius. Furthermore, a circle of diameter 170mm (radius 85mm) or more is difficult to fit on a regular page.

Therefore, we provide Circle Markers of radii *30mm, 35mm, 40mm, 45mm, 50mm, 55mm, 60mm, 65mm, 70mm, 75mm, and 80mm*, and Arc Markers of radii *85mm, 90mm, 95mm, 100mm, 105mm, 110mm, 115mm, and 120mm*.

Annexure B: Technical Specifications

Physical Specifications

Box Dimensions (W x D x H)	:	350 x 230 x 60 mm
Box Weight with all components	:	1300 gms
Box Material	:	Corrugated cardboard
Component Material	:	Plastic (ABS)

Annexure C: Instruments, Quantity and Purpose

Name	Quantity	Purpose
Slate	1	Base for doing geometry constructions on Braille sheet
Ruler	1	Drawing lines and measuring distance upto 20 cm
Protractor	1	Drawing and measuring angles in interval of 5 degrees
Set Square	1	Drawing angles of 30°, 60°, 90° without protractor
Stylus	2	Drawing embossed impressions on Braille paper
Pickup Tool	1	Picking circle and arc markers from the holders
Point Markers	6	Marking points and vertices in geometry constructions
Line Markers	2	Drawing embossed lines of upto 15 cm and 21 cm
Circle Markers	11	Drawing embossed circles of 30 to 80 mm in intervals of 5mm
Circle Frame 1	1	Holding circle markers of 30, 40, 50, 60, 70 and 80mm
Circle Frame 2	1	Holding circle markers of 35, 45, 55, 65 and 75 mm
Arc Markers	8	Drawing embossed arcs of 85 to 120 mm in intervals of 5mm
Arc Frame 1	1	Holding arc markers of 90, 100, 110 and 120 mm
Arc Frame 2	1	Holding arc markers of 85, 95, 105 and 115 mm
Braille Sheets	10	Doing geometry constructions