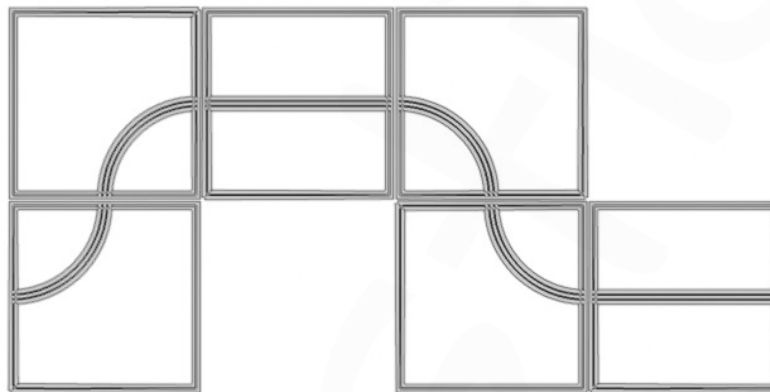


MAKE • DISCOVER • COLLECT

Paths That Connect

Beginners of various ages; assistance according to skill level and device instructions. • 30–48 min of 3D pen work; 45–70 min total. Estimate without a physical trial.



Build six separate 40 × 40 mm tiles: two straights and four curves. Rotate them on the table and find three different paths from start to finish. For home or workshop use.



Your outcome

Have fun rotating tiles and composing a continuous path.

Construction illustration. The instructions show the successive stages. Full-size (1:1) templates are supplied on a separate sheet.

What you need

A 3D pen, the selected filament and equipment available in your workspace. See the complete list below.

Equipment

- | | |
|--|---|
| ☐ PLA-compatible 3D pen | 1 |
|--|---|

Materials

- | | |
|--|---|
| ☐ PLA, input diameter 1.75 mm | 1.8 m in total, selected colors, including ≥50% spare |
|--|---|

Equipment

- | | |
|--|-------------------------|
| ☐ Flexible transparent mat for a 3D pen | 1, at least 120 × 80 mm |
|--|-------------------------|

Materials

- | | |
|---|---------------------------|
| ☐ W01 (straight) and W02 (curve) printed on A4 paper | Both patterns, 100% scale |
|---|---------------------------|

Equipment

- | | |
|--|---|
| ☐ Ruler with mm graduations | 1 |
|--|---|

Filament — amounts include extra

- | | |
|---|-----------------|
| ☐ PLA 1.75 mm — colour shown in the illustration | 1.8 m · ≈ 5.4 g |
|---|-----------------|

Total filament: 1.8 m · approximately 5.4 g

The quantities include extra filament. Grams indicate estimated net filament mass, excluding packaging.

Before you start

- 1 Print W01 (straight ×2) and W02 (curve ×4) at 100% scale, without fitting to the page. Check the 20 mm segment. Place the pattern under the transparent pen mat.
- 2 PLA: input diameter 1.75 mm. Each strand is approximately 1.2 mm wide and approximately 1.2 mm high. Frame: two overlapping strands, width 2.2 mm. Path: three strands, width 3.2 mm. Everything is in one layer, with an outer dimension of 40 × 40 mm.
- 3 Select settings and assistance according to the device instructions and skill level. Do not touch the nozzle or hot PLA. Set the 3D pen down according to its instructions. The age indication in the metadata does not replace the device requirements.
- 4 Viewed from above: N = top, E = right, S = bottom, W = left. At 0°, the straight connects W–E and the curve connects W–N. Rotate clockwise, always keeping the top side up. The IDs and arrows describe the illustration; you do not make any additional parts.
- 5 W01: P1/P2 ×2; W02: L1/L2/L3/L4 ×4. Make the tile frames and roads from PLA. The light background grid, labels, IDs and sheet borders are guides only. During play, follow the wide road inside the tile.
- 6 Choose PLA colors: the frames and roads may be different colors. First make the six frames (K01), then the straights (K02) and curves (K03). Before adding the road, align the cold frame with its pattern.

Estimate based on sequence and geometry; not a physical trial result.



How to read the instructions

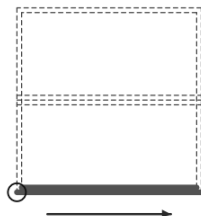
The large image shows the completed stage. Small views show the action and current parts. ×N means repeat the whole action N times, cooling and checking each time. Illustrations are not at 1:1 scale.

STAGE 01 / 08 • Session 1

Six frames: side by side

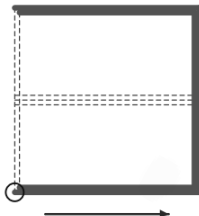
K01 · Frames: W01 ×2, W02 ×4

S01 · First side of P1



Two overlapping strands.
Start at the lower corner.

S02 · Three sides of P1



Join the successive corners.
Join both strands at the corners.

S03 · P1 frame closed



Close the frame at the starting point.
The road pattern remains for K02.

Dashed: pattern lines before applying PLA.

Blue: completed PLA strands — frame and road.

W01: straight ×2. W02: curve ×4.

Make the tile frames; labels, IDs and sheet borders are guides.

Circle: start / join. Arrow: direction.

Diagram not to scale. Print patterns W01 and W02 at 1:1.

Narastanie pasm PLA; linie ramki kafła należą do wzoru. W01: prosta ×2; W02: łuk ×4.

PARTS FOR THIS STAGE

1 × Tile P1 — straight · PLA | template W01

1 × Tile P2 — straight · PLA | template follow the written method

1 × Tile L1 — curve · PLA | template W02

1 × Tile L2 — curve; 1 × Tile L3 — curve; 1 × Tile L4 — curve · PLA | template follow the written method

→ T001, T002 • Techniques — reference appendix

Make frames P1 and P2 on W01, and frames L1–L4 on W02. Each side: two overlapping strands, one layer. Add three sides, then close the fourth. Repeat the three phases shown for each ID. Wait until the PLA has cooled completely.



Check

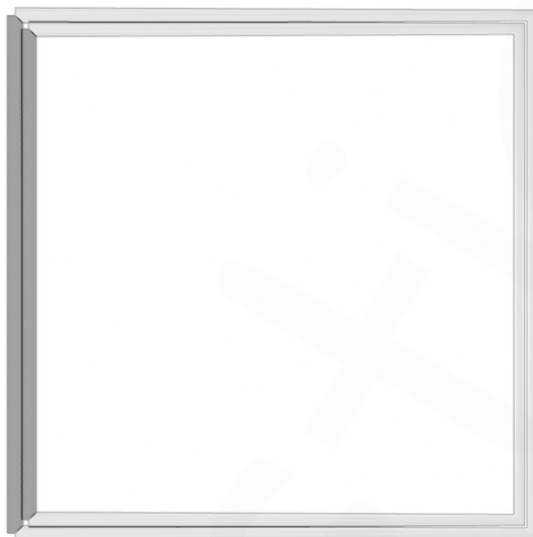
Six closed 40 × 40 mm frames; frame width 2.2 mm.

If it does not work

Fill the small gap without widening the outline.

Six frames: side by side — construction details

Stage outcome



First side • What to repeat: P2: first side; L1: first side; L2: first side; L3: first side; L4: first side

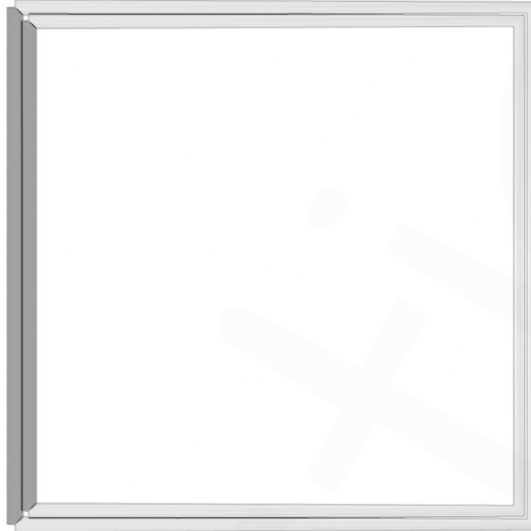


Six frames: side by side — construction details

Three sides • What to repeat: P2: three sides; L1: three sides; L2: three sides; L3: three sides; L4: three sides



Frame closed • What to repeat: P2: closed frame; L1: closed frame; L2: closed frame; L3: closed frame; L4: closed frame



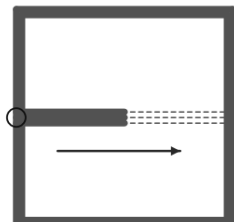
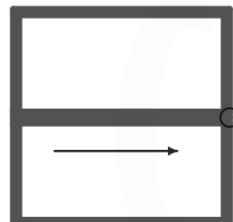
STAGE 02 / 08 • Session 1

Two straights: join the entries

K02 · Straight W01: P1 and P2

S04 · Entry and part of the straight

S05 · Straight connected



Three strands from the left side.
The entry overlaps the frame.

Connect to the right side.
The entry is 3.2 mm wide.

Dashed: pattern lines before applying PLA.

Blue: completed PLA strands — frame and road.

W01: straight ×2. W02: curve ×4.

Make the tile frames; labels, IDs and sheet borders are guides.

Circle: start / join. Arrow: direction.

Diagram not to scale. Print patterns W01 and W02 at 1:1.

Narastanie pasm PLA; linie ramki kafla należą do wzoru. W01: prosta ×2; W02: łuk ×4.

Align frame P1 with W01. Using the selected PLA color, lay three adjacent strands from the center of the left side: first to the midpoint, then to the right side. Join the road to the frame. Repeat both phases for P2.



Check

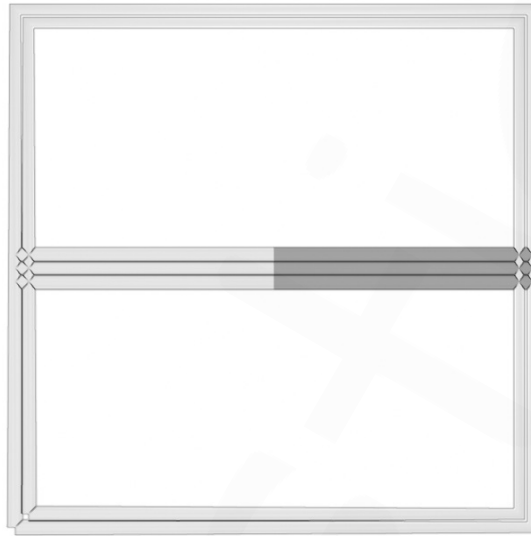
Two W–E straights; road width 3.2 mm, both entries connected.

If it does not work

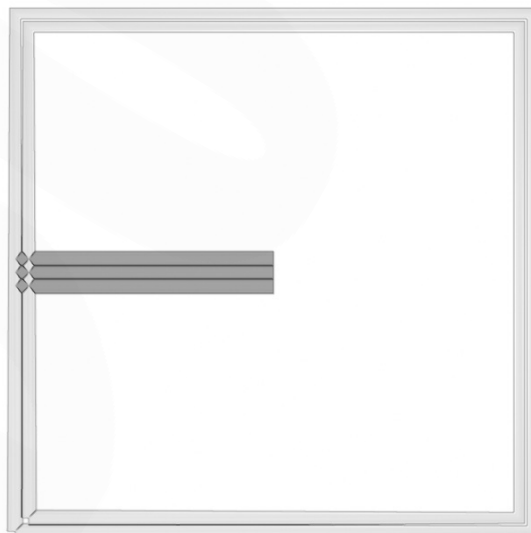
Complete the missing connection within the pattern.

Two straights: join the entries — construction details

Stage outcome

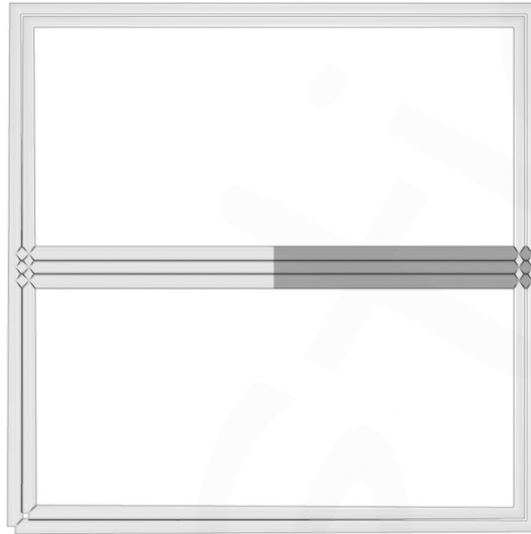


Entry and half the straight • What to repeat: P2: part of the road



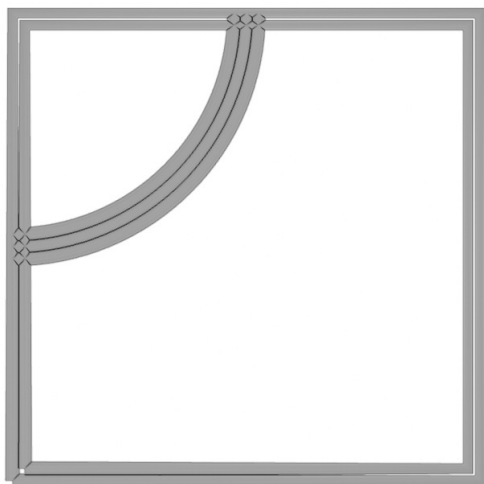
Two straights: join the entries — construction details

**Straight connected • What to repeat: P2: road
connected**



STAGE 03 / 08 • Session 1

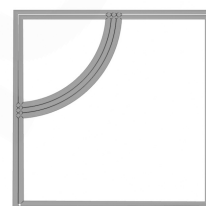
Four curves: turn upward



Stage outcome



Entry and half of curve W02 • What to repeat: L2: part of the road; L3: part of the road; L4: part of the road



Curve connected • What to repeat: L2: road connected; L3: road connected; L4: road connected

NOW Tile L1 — curve · Tile L2 — curve · Tile L3 — curve · Tile L4 — curve

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

Align frame L1 with W02. Lay three adjacent strands from the center of the left side: first half the curve, then to the center of the top side. Join both entries to the frame. Repeat for L2, L3 and L4.



Check

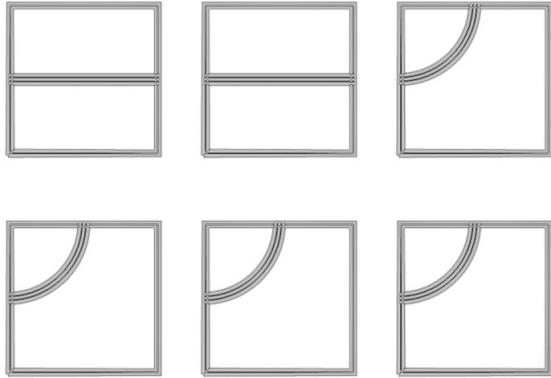
Four W–N curves; the three strands meet along the entire road.

If it does not work

Fill the gap to match curve W02.

STAGE 04 / 08 • Session 1

Check the six tiles



2 straights + 4 curves

NOW Complete model — all previously made parts

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

Wait until the PLA has cooled completely. Arrange the set as shown: two straights and four curves. Check the closed frames and both entries of each road.



Check

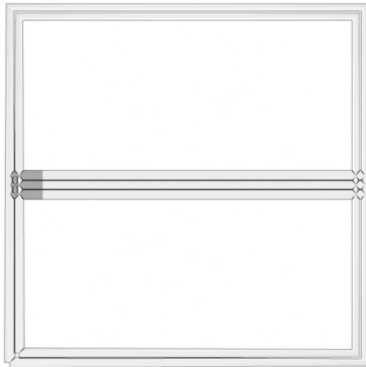
You have exactly P1, P2, L1, L2, L3, L4: two straights and four curves. The tiles are separate, cold, and flat.

If it does not work

Repair a small gap at an entry according to K05; greater damage requires remaking the tile.

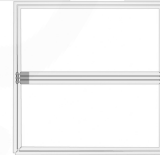
STAGE 05 / 08 • Session 1

Only when an entry needs repair


Cold ends lie on the mat
Example: gap at the inlet


Small gap at the entry

Nozzle from above: short bridge Hold the cold right frame



Three short strands connect the entry

Stage outcome

NOW Tile P1 — straight

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

Only if an entry has a small gap: place the cold tile on the pattern. Do not damage a correct tile. Keep the cold right frame away from the nozzle. Fill the gap with three short, overlapping strands. Wait until the PLA has cooled completely; check the entry and the 40 mm dimension.

✓ Check

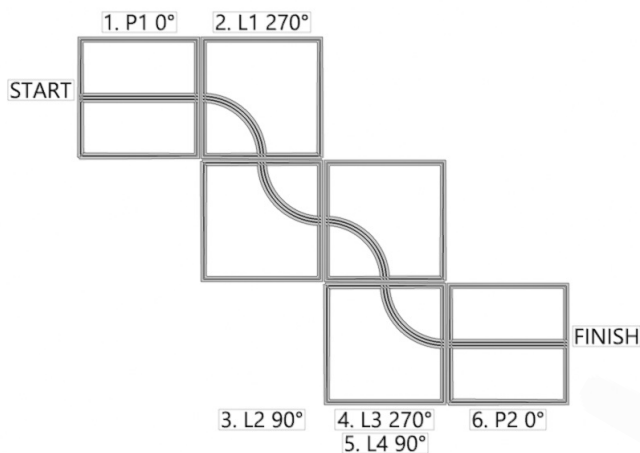
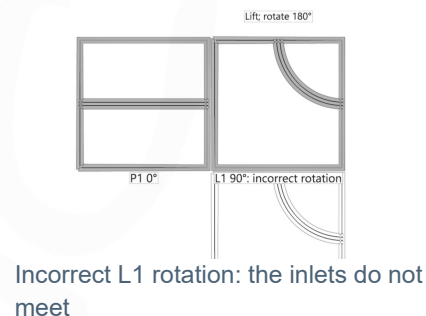
After repair and cooling, three strands once again connect the path to the frame. The inlet is not loose; the outline is still 40 mm.

If it does not work

If the damage is substantial, remake the tile using the correct pattern.

STAGE 06 / 08 • Session 1

Correct the rotation and check route A



A — Steps: check 1–6

NOW Complete model — all previously made parts

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

Puzzle A: find the incorrectly rotated tile. The wrong rotation of L1 (90°) disconnects the road from P1. Lift the cold L1, rotate it another 180° clockwise and place it back at 270° . Arrange Steps as shown. Trace the wide road with your finger from START to END in order 1–6; check each of the five joints.

✓ Check

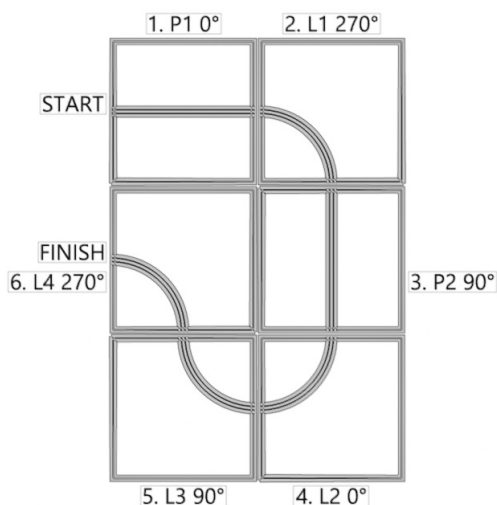
After rotation, the wide inlets meet. Go from START to FINISH through numbers 1–6; all five joints are continuous.

If it does not work

Lift the cold tile, rotate it with the top side up, and set it down again. Do not weld the tiles together or route the path along the frame.

STAGE 07 / 08 • Session 1

Arrange and check route B



B — Winding Road: check 1–6

NOW Complete model — all previously made parts

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

Challenge B: rearrange the same tiles and check the new road. Separate the tiles. Move and rotate them one at a time over the table, face up. Arrange Winding Road as shown. Trace the wide road with your finger from START to END in order 1–6, checking the five joints.

Check

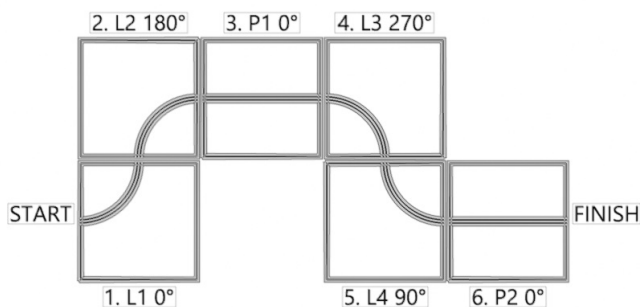
All six IDs appear once. The path 1–6 is continuous at all five joints and ends only at START and FINISH.

If it does not work

Lift the cold tile, rotate it with the top side up, and set it down again. Do not weld the tiles together or route the path along the frame.

STAGE 08 / 08 • Session 1

Arrange and check route C



C — Up and Down: check 1–6

NOW Complete model — all previously made parts

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

Challenge C: trace from START to END with your finger. Separate the tiles. Move and rotate them one at a time over the table, face up. Arrange Up and Down as shown. Trace the wide road with your finger from START to END in order 1–6, checking the five joints. Now create your own route using all six tiles.

Check the five joints; you may invite another person to trace it.



Check

All six IDs appear once. The path 1–6 is continuous at all five joints and ends only at START and FINISH.

If it does not work

Lift the cold tile, rotate it with the top side up, and set it down again. Do not weld the tiles together or route the path along the frame.

Finished — check the outcome

✓ Check

Set: P1, P2, L1, L2, L3, L4 — six separate, cold 40 × 40 mm tiles. All frames are closed, and the paths make wide connections at the centers of their sides. No section is loose.

✓ Check

Arrange A, B, and C from cards K06–K08 in sequence. In each route, use all six IDs once. Trace the wide path with your finger from START to FINISH, following numbers 1–6. There is no gap or offset at any of the five joins, and there is no dead end within the route.

✓ Check

If a road joint does not align, rotate or move the cold tile. Do not weld the tiles together. Repair a small damaged entry according to K05. Wait until it has cooled completely and check again. For greater damage, remake the tile.

✓ Check

Using the same set, create your own route: all six tiles once, five aligned joints, START and END. Check it with your finger. After play, store the tiles flat; turn off the device according to its instructions.

Storage

Store the model in a cool place away from sunlight and heat. Repair it on a suitable 3D-pen work surface using the same material as the part.

Techniques — reference appendix

T001 • Stage 1

1 × Tile P1 — straight · PLA | template W01

1 × Tile P2 — straight · PLA | template follow the written method

K01: frame. K02: straight W01. K04: check the cold tile. Finished cross-section [mm]: pasmo: szerokość 1,2; wysokość 1,2; ramka: szerokość 2,2; droga: szerokość 3,2. Support: Flat, on the pen mat. Strand direction: Frame: 2 strands; path: 3 strands W–E or W–N. Cooling: Wait until the PLA has cooled completely.

Tip access: From above; grip away from the nozzle.

T002 • Stage 1

1 × Tile L1 — curve · PLA | template W02

1 × Tile L2 — curve; 1 × Tile L3 — curve; 1 × Tile L4 — curve · PLA | template follow the written method

K01: frame. K03: curve W02. K04: check the cold tile. Finished cross-section [mm]: pasmo: szerokość 1,2; wysokość 1,2; ramka: szerokość 2,2; droga: szerokość 3,2. Support: Flat, on the pen mat. Strand direction: Frame: 2 strands; path: 3 strands W–E or W–N. Cooling: Wait until the PLA has cooled completely.

Tip access: From above; grip away from the nozzle.