

Maze Making

One of the reasons that more people don't do Micromouse is the challenge of making enough of a maze to test on.

One of the challenges for UKMARS is transporting a maze around the country.

One of the challenges for WARRIORS is having enough of a maze to test a solver to the centre.

I collected lots of ideas from lots of people and this is my take on the easiest way to make a maze. Apologies to people who don't get credited, I don't remember where all the ideas came from.

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CONSTRAINTS

Accuracy and precision

The most important thing for me is that the bumps between sections must be as small as possible. The formal constraints in the rules are quite lax but most mice can't cope with a maximum bump of a couple of millimetres so it has to be pretty good. Walls and posts need to be interchangeable.

Weight

Each piece should weigh no more than 12.5Kg to meet mechanical handling rules

Size of pieces

The pieces should be transportable in a large car

Interchangeability

This is interesting. I wanted all the pieces to be interchangeable so that several individuals might have a couple of pieces to use at home and then they can get together in any combination to make a competition maze. If the centre is special, you can't run a competition if the person who has it doesn't come along!

Cost

Obvious but things can soon get out of hand.

Available technology

I can't injection-mould pieces. I don't have a big CNC router, I do have a laser cutter, 3D printer and a mill. Lots of DIY stores have reasonably accurate board cutters.

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NINE pieces

To get identical pieces that tessellate, the options are limited. Four pieces work but each piece is too big to get in most cars. 16 pieces are nice and small but there are a lot of joins and a single piece is quite a small test maze.

9 pieces is a good size but it takes some thinking to make them identical. 16 cells divided into 3 makes each piece 5 and a third cells square. It is tricky to make these identical.

My solution is to have a notional 18 cell maze with the outer cells ignored. This allows the joins to have any relationship with the cell walls. I chose to make the joins 10mm from the centre of the post holes so that the joins will be mostly too close to the walls to affect the mouse.

The sections are bigger than they might be but the gain in interchangeability compensates .

One section makes a 5 by 5 maze. Two sections make an 11 by 5 maze. Three sections can include the centre. Four sections will make a useful small competition maze at 11 by 11.

The full nine pieces can make a 17 by 17 maze but this is of no consequence.

Subcontract the precision bit.

My younger son makes harps. He has a CNC router that can operate on half sheets (1220mm square) of sheet materials. He can convert a sheet of 12mm MDF into 2 of these. He charges £40 for a pair but you have to go to Stroud to collect them.

If you want any, please sort it out with me later.

MDF seems like a suitable material as the thickness and surface finish are fairly well controlled. It is not particularly prone to changing shape with humidity but care is needed in storage to avoid it taking a set.

The holes are 6.1mm diameter to allow 6mm diameter posts prongs to work without the risk of jamming.

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The joins

The top of the tongue is aligned with the bottom of the maze. The spacer for the groove is the same material as the tongue so that the groove thickness is closely controlled.

There is a spacer under the tongue to support this edge of the maze.

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The paper is theoretically the clearance in the tongue and groove. It is easily available and about the right thickness for a close joint.

I glued up loads of these strips and clamped them in the Workmate with extra clamps at the ends. You need to take a lot of care to ensure that the pieces don't slide across one another when they are clamped. Guess how I found that out!

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If the tongue bottoms in the groove before the edges of the maze pieces come together there will be a gap on the maze floor.

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The maze relies on support from something underneath. The floor is always an option but it may be possible to find enough tables. The edges are supported by the tongue and groove system but I decided that the middle needed support to reduce the "switchback" effect. The feet are 100mm square made up of two pieces of 5.5mm plywood and a paper spacer.

They are fitted to keep the post holes clear. I wanted to be able to push out broken-off post pins easily. Time will tell if the base needs more support.

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With the tongue and groove engaged and both pieces properly aligned a hole is drilled through the tongue. The end of a specially strengthened post prong engages the hole to keep the maze pieces aligned. There are two of these for each join.

The pieces are painted with two coats of blackboard paint.

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The posts are 3D printed in white ABS. Bernard can tell you more.

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Mass wall top painting

The walls started as a sheet of 12mm MDF. Bunnings cut it into 40-odd strips 50mm wide and 1220mm long. They cut the 5.5mm plywood into 50, 75 and 100 mm wide strips at the

same time. They cut 3 sheets of ply at the same time for economy. The materials plus cutting came to just under £100

I clamped as many as possible of these strips in the Workmate and clamped the ends as well. I applied two coats of primer and rubbed-down after each coat. This was finished-off with a coat of red gloss.

The walls were then cut to length in a sliding mitre saw using a hard stop to set the length. I checked the length against a pair of posts installed in a maze base.

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The slots for the wall end tabs were cut with a 2mm slitting saw. The jig makes the cut at the correct height and the stop ensures the correct slot depth. It could also be done using a pillar drill instead. It should also be possible with a 2mm router bit with suitable jigs.

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Pass wall samples round.

The bottom one has had the tab slots added. The tabs in the middle were lasered from a sheet of 2mm acrylic. They are glued in the slots to locate the walls in the posts.

The top one has white matt self-adhesive vinyl stuck on the sides. This should be done before the tabs are glued in place to make it easy to trim the sheet back after it has been stuck on.

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The little black plugs with the screws in are 3D printed. They are inserted in the maze base holes during painting to stop excess paint blocking the holes.

The steel cylinder is a square to hold the electric drill bit vertical when drilling out the positioning holes. The point is used as a centre before drilling.

The slitting saw was mounted in this home-made arbor.

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I have with me four sections. If there is space and time, I would like to make a maze tomorrow to test how your mice get on. I haven't got enough walls and posts to do anything very complex.

If you want any maze base sections, let me know. I suggest that you get together in groups and arrange collection from Stroud for numbers of maze bases. Two each is a good number, then any two of you can get together to run an 11X11 competition.

If you ask me nicely, I can probably supply wall tabs. I think Bernard has the stl files for printing the posts available.

I am interested in making at least one half-size maze. I think 9X9 on a single sheet so that four make a 19X19 would be quite usable and would fit in more cars. 9X9 on its own is a good test maze. What do you think? Would you like Creag to make you some half-size bases?