

Decagonal Penrose cushion: a modular knit-in-one P3 (rhombic) Penrose tiling by Astrid S. de Wijn



This pattern is for two different regular decagons (10-sided polygons). These can be used to make a nearly-round cushion cover, or potholders. The pattern works with provisional cast-on, no normal cast-on ever, and finishes with binding off at the edge. There is no sewing to make the decagons, but for the second decagon, it will be necessary to kitchener two tiles together. There are a lot of ends to darn in. And of course if you want to use these for cushion covers, then making the actual cushion cover will require some sewing.

This modular knitting system results in P3 Penrose tilings. It has a reasonably ok-looking wrong side (see picture below). For more information on Penrose tilings and why they are interesting (at least for mathematicians), see the Wikipedia article on Penrose tilings.

This pattern is handy to get started if you want to do a more complex tiling with this system, such as a scarf. I am planning to post a pattern for a scarf using this technique in the future. If you find any mistakes, or if you find something hard to understand, please let me know.

This pattern can be downloaded for free because I am a strong believer in open source and free software. If you sell items based on this pattern, please include both the pattern and credit to me. If you create and distribute another pattern based on this, please also include a credit to me. If you'd like, you are welcome to send me cash anyway through paypal, or donate to the Electronic Frontier Foundation, the Free Software Foundation, or effective charities.

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The completed cushion fronts, Decagon One (left), and Decagon Two (middle), and the wrong side of Decagon One (right).

1 Materials and basic information

- Yarn. Three colours with the same gauge. It is important that the Contrasting Colour (CC) and Main Colour (MC) for the fat rhombs tend to keep their shape. I used Hooooked Ribbon XL for all of them in colourways
 - MC1: Emeralds Splash for the inside of the fat rhombs (50 m per decagon)
 - MC2: Stone Grey for the inside of the skinny rhombs (29 m per decagon)
 - CC: Black Night for CC for the edges (60 m per decagon). This estimate is based on the fact that I had a little bit left over from the skein, which is nominally 120 m. Your milage/meterage may vary.
- Gauge 10 stitches \times 20 rows = 10 \times 10 cm² in garter stitch. This will get you a diameter of about 43 cm. Adjust if you want something smaller.
- Needles that will give you the gauge you want. Double-pointed or magic loop.
- Material for provisional cast-on: some smooth scrap yarn or ribbon, and depending on your method maybe a suitably-sized crochet hook.
- It may be convenient to have a thinner double-pointed needle for transferring live stitches from the second side of a provisional cast-on.
- A tapestry needle for darning in the ends.
- It can save you a lot of darning in if you know how much yarn 24 stitches takes. We'll call this length l . For my gauge this was about 2.1 m. Test this beforehand.
- Scrap yarn or ribbon to use for holding stitches on.
- (Optional, but handy) Two stitch holders such as safety pins. They'll need to hold at most 4 stitches.

2 Abbreviations and glossary

RS	right side	byf	bring yarn forward
WS	wrong side	m1	make one: with the left needle lift the yarn between the needles from front to back, and knit into the back of this loop*
MC1	main colour for fat rhombs		
MC1	main colour for skinny rhombs		
CC	contrasting colour for edges	kfb	knit once normally into the front of the loop, and once into the back of the loop
k	knit	wt	wrap and turn [†] : s1 byf, slip the stitch back onto the right needle, turn the work and continue with the next row.
k2tog	knit the next two stitches together		
p2tog	purl the next two stitches together		
s	slip stitch as if to purl		

Notes on provisional cast-on

All provisional casting on is done with the RS of the work facing you.

By provisional cast-on I mean that you should end up with a single strand of working yarn equivalent to one row of stitches. You can do this, for example, by picking up stitches through a crocheted chain. This will be the first row of the rhomb, which is why afterwards you continue with row 2.

When you are ready to knit another rhomb in the other direction, you have to unravel the provisional cast-on and transfer the live stitches to a needle. You may then end up with one extra stitch. This is corrected by k2tog on the next row (details below).

3 Construction of the tiling

The rhombs are knitted one by one following the charts below. The chart shows how the rhombs are connected, and if they are fat or skinny. Each rhomb in the chart is marked with a number indicating the order that the rhombs should be knitted in. The arrow in the rhomb indicates the direction of the knitting. The tip points towards the blunt corner in the middle of the final row. The non-pointed end of the arrow is at the blunt corner in the middle of the first row. The small lines across the sides at the corner indicate that you should not cut the CC yarn immediately, but at the very least leave a tail long enough to complete the future rhombs connected in this way. Detailed instructions for the two different types of rhombs are in the next section.

In the two subsections below, one for each decagon, there are pictures of the setup for each rhomb (except for 1), and each rhomb directly after it is finished. Hopefully this will provide some visual assistance.

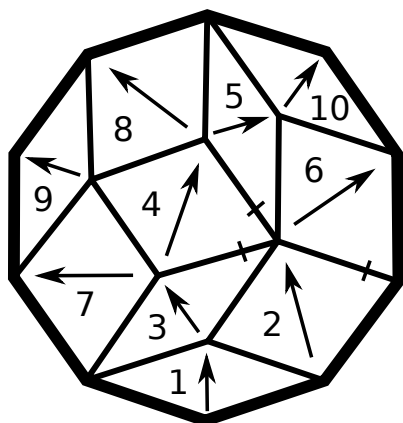
The edge and darning-in instructions are the same for both decagons. The darning in should be done in a specific way if you care about the reverse side.

The detailed instruction for the rhombs are at the end, in section 5

*You can also use a crochet hook to lift the yarn.

[†]The use of wrap-and-turn for short rows here is done so that the WS will look nice and symmetric. I have not tested if this will work for other methods of doing short rows.

3.1 Decagon One



Rhomb 1

For rhomb 1, start by provisionally casting on 24 stitches in CC. Then follow the instructions for the skinny rhomb starting from row 2. When you are finished, cut the CC yarn, leaving a short end to darn in later. Your work will now look like this:



Rhomb 2

Place the left 12 stitches from rhomb 1 on a scrap piece of ribbon or yarn. Provisionally cast on 12 new stitches with CC. Then knit the right 12 stitches from the first rhomb.



Turn the work and continue by following the instructions for the fat rhomb, starting with row 2 (WS).



When finished, cut the CC yarn, but leave a tail of length 4l for rhomb 6.

Rhomb 3

Place the right 12 stitches from rhomb 2 on some scrap yarn, and put the other 12 stitches from rhomb 1 back on your needle.



With the RS facing you, start following the instructions for the skinny rhomb, including the first row. Do not cut the CC yarn.



Rhomb 4

Place the left 12 stitches from rhomb 3 on some scrap yarn. Continue with your CC skein and the

RS facing you, and knit the 12 stitches that are on the needle. Then provisionally cast on 12 new stitches.

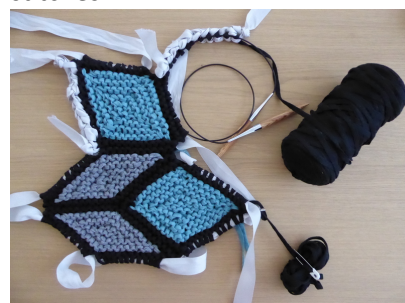


Turn the work and follow the instructions for the fat rhomb, starting with row 2 (WS). Do not cut the CC yarn.



Rhomb 5

Place the left 12 stitches from rhomb 4 on some scrap yarn. Continue with your CC skein and the RS facing you, and knit the 12 stitches that are on the needle. Then provisionally cast on 12 new stitches.



Turn the work and follow the instructions for the skinny rhomb, starting with row 2 (WS). Cut the CC yarn, leaving a tail that is a

bit longer. You will need this for pulling together the hole here later, so it should not be too short.



Rhomb 6

Place the left 12 stitches of rhomb 5 on some scrap yarn, and put the right 12 stitches from rhomb 2 back on your needle.

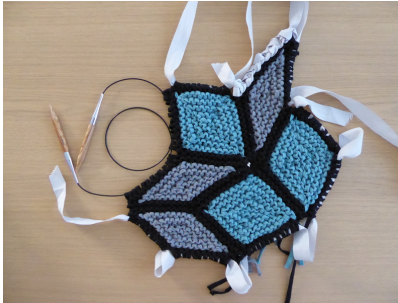


Starting with the RS facing you, and starting with the yarn tail that you left dangling from rhomb 2, follow the instructions for the fat rhomb, starting from row 1.



Rhomb 7

Put all the stitches on some scrap yarn. Now go back to the provisional cast-on from rhomb 4, unravel it, and put the stitches on your needle. Put the remaining 12 stitches from the last row of rhomb 3 on your needle as well.



Starting with the RS facing you, take the CC skein. You may have ended up with 13 stitches from the provisional cast on, in this case, k12 k2tog k11. Otherwise, k24. Then turn the work and continue with the fat rhomb starting from row 2 (WS). Cut the CC yarn, leaving a short tail.



Rhomb 8

Put all the stitches on some scrap yarn. Now go back to the provisional cast-on from rhomb 5, unravel it, and put the stitches on your needle. Put the remaining 12 stitches from the last row of rhomb 4 on your needle as well.



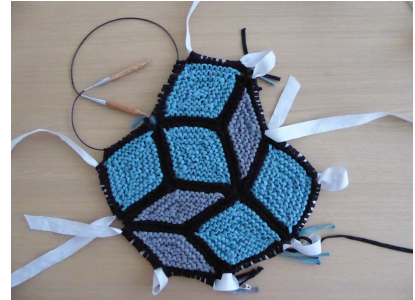
Starting with the RS facing you, take the CC skein. You may have ended up with 13 stitches from the provisional cast on, in this

case, k12 k2tog k11. Otherwise, k24. Then turn the work and continue with the fat rhomb starting from row 2 (WS). Cut the CC yarn, leaving a short tail.



Rhomb 9

Place the right 12 stitches from rhomb 8 on some scrap yarn, and place the right 12 stitches from the last row of rhomb 7 on your needle.



Starting with the RS facing you, take the CC skein and follow the instructions for the skinny rhomb starting from row 1. Cut the CC yarn.



Rhomb 10

Place all the stitches on scrap yarn. Put the remaining stitches from rhombs 5 and the left 12 from rhomb 6 on your needle.

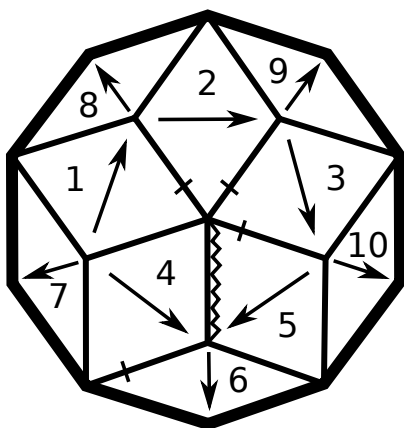


Starting with the RS facing you, take the CC skein and follow the instructions for the skinny rhomb starting from row 1. Do not cut the CC yarn.



Continue with the instructions in section 4 for the edge and finishing.

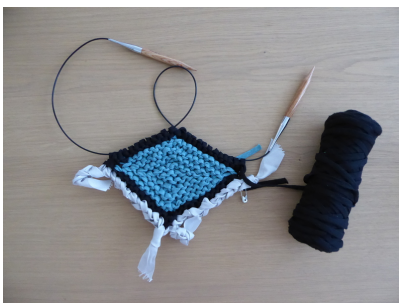
3.2 Decagon two



Rhomb 1

For rhomb 1, start by provisionally casting on 24 stitches in CC. Then turn the work and follow the instructions for the fat rhomb starting from row 2. When you are fin-

ished, do not cut the CC yarn. Your work will now look like this:

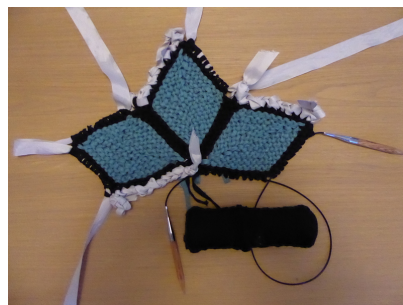
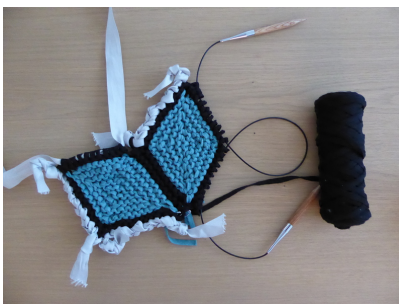


Rhomb 2 and 3

Rhomb 2 and 3 are very similar. Place the left 12 stitches from rhomb 1 (2) on a scrap piece of ribbon or yarn. Then, with the RS facing you, knit the right 12 stitches from rhomb 1 (2) and then provisionally cast on 12 new stitches with CC.



Turn the work and follow the instructions for the fat rhomb, starting with row 2 (WS). Do not cut the CC yarn.



When finished with rhomb 3, cut the CC yarn, but leave a tail of length 4l for rhomb 5.

Rhomb 4

Place all the stitches on scrap yarn. Go back to rhomb 1. Unravel the provisional cast on and place the base of the first 12 stitches you knitted for rhomb 1 on your needle. The second 12 go on some scrap yarn. If you have one stitch extra from the provisional cast on, put 13 stitches on the needle.

Provisionally cast on 12 stitches. With the RS of the work facing you, knit the 12 stitches from the provisional cast on of rhomb 1 that are on the needle. If you had 13 stitches from the provisional cast on, then k2tog k11 instead.



Turn the work and follow the instructions for the fat rhomb, starting with row 2 (WS). Do not cut the CC yarn.



Rhomb 5

Place all the stitches on scrap yarn. Go back to rhomb 3 and put the last 12 stitches you knitted there back on the needles. With the dangling tail from the end of rhomb 3, knit these 12 stitches, and then provisionally cast on 12 more.

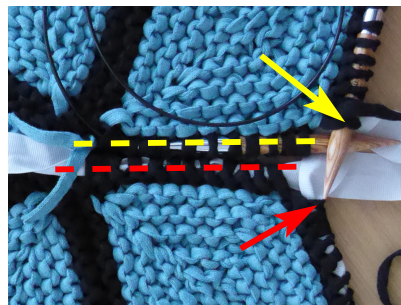


Turn the work and follow the instructions for the fat rhomb, starting with row 2 (WS), but do not knit the last 12 stitches of the final row.



These last 12 stitches will instead be kitchenered to the matching 12 stitches of rhomb 4. In order to make the vertex of the rhomb edges look nice, you will need to use a modified setup for the kitchener grafting.

Normal garter stitch kitchener starts with sticking the yarn purlwise through the first stitch on the front needle, and then purlwise through the first stitch on the back needle. The the normal repeat starts. Instead of this, you should also involve the "zeroth stitches" for both needles: the stitches not on the needles, but right next to them on the same rhombs. The zeroth stitch on the back needle is the one that you just been knitted with the yarn tail you are using for the kitchenering. In the picture below, the front needle (on rhomb 4) is indicated by the dashed red line, and the back needle (rhomb 5) by the dashed yellow line. The corresponding arrows point to the corresponding zeroth stitches.

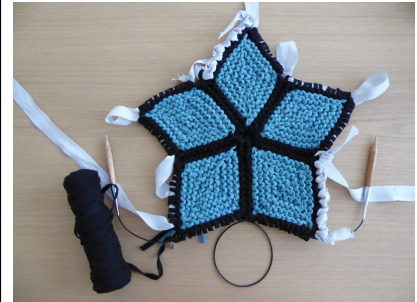


First stick the yarn knitwise through the zeroth stitch on the front needle, then purlwise through the first stitch on the front needle. Then knitwise through the zeroth stitch on the back needle, and then purlwise through the first stitch on the back needle. Then continue with the kitchener method for garter stitch fabric as normal. (* ** Knitwise through the first stitch on front needle, drop the first stitch from front needle, purlwise through the new first stitch on the front needle, repeat from ** for the back needle. Repeat from * until one stitch is left on each needle, then go

knitwise through both remaining stitches and drop them.)

Rhomb 6

After kitchenering, put the 12 remaining stitches from the final rows of rhombs 4 and 5 on the needle together.



Using the long tail still dangling from rhomb 4, start knitting and follow the instructions for the skinny rhomb.



Rhomb 7, 8, 9, and 10

Rhombs 7, 8, 9, and 10 are all very similar.

Put all the stitches on some scrap yarn. Unravel the provisional cast on from rhomb 4 (2, 3, 5) and put the stitches on your needle, together with the 12 remaining stitches from the provisional cast on of rhomb 1 (the final row of rhomb 1, the final row of rhomb 2, the final row of rhomb 3).



If the provisional cast on gave you 13 stitches, then k12 k2tog k11, otherwise k24. Next follow the instruction for the skinny rhomb,

starting from row 2 (WS).



Cut the CC yarn after rhombs 7, 8, and 9, but not 10.



After rhomb 10, continue with the edge and finishing, using the instructions in section 4.

4 Edge and finishing

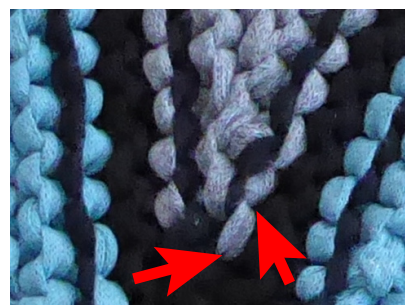
Edge

If you plan to use this for a very bulgy cushion, you can make the edge a bit rounder by skipping any m1 in the instructions for this edging.

Continue knitting in the same direction as you were during the last row of the final rhomb. m1 wt. Now knit all the way around, putting stitches from scrap yarn or provisional cast-ons back on your needles as you go, and putting them back on scrap yarn if you need to afterwards. At every corner, m1. When you reach your wt, continue the second edge round by binding off purlwise. When you are finished, you can loop the loose end of the final stitch of the bind-off round around the first stitch of the bind-off round, to make a complete purl bind-off.

Darning in the ends

Darn in the loose ends of the MC, making sure to connect them in such a way as to complete the wrong-side pattern with the wrap for a non-existent wt. The ends are already prepped for this and just need to be connected. If you do not care what the WS looks like, you can even just tie them together in a not. If you do care, then each end goes into the hole that the other end sticks out of. The result is shown in picture on the right, with the red arrows indicating the holes that the two ends came out of, and the yarn running between the newly finished wrap.



Darn in the CC ends in whatever way you prefer. There are places where many rhombs meet where there might be bigger holes. Here you should try to pull the sides of the hole together a bit with the end before darning it in.

Finally, sew onto an existing round pillow case of the right size, or make a decagonal one yourself.

5 Instructions and diagrams for the rhombs

On the next two pages, there are the instructions and diagrams for the rombs. In the instructions, the number between [] indicates how many stitches before the end the row ends, and therefore also where the next one begins. The odd rows are always RS, and the even rows are always WS.

The diagrams are just a visual representation of the instructions, for those who prefer to knit that way. They are not in a standard diagram style that I'm aware of, because I could not find a way to indicate wt and keep track of the number of stitches you turn before the end in a convenient way.

Fat rhomb

Start with CC.

1. k24 [0] (RS)
2. k11 k2tog k10 [1] (WS, 23 stitches)

Switch to MC, start where you left off, 1 stitch from the end.

3. s1 k9 k2tog k8 wt [2] (22 stitches)[‡]
4. k17 wt[§] [3]
5. k7 k2tog k7 wt [3] (21 stitches)
6. k6 k2tog k6 wt [4] (20 stitches)
7. k11 wt [5]
8. k4 k2tog k4 wt [5] (19 stitches)
9. k4 k2tog k2 wt [6] (18 stitches)
10. k5 wt [7]
11. k3 wt [8]
12. k2 wt [8]
13. k3 wt [7]
14. k1 kfb k3 wt [6] (19 stitches)
15. k3 kfb k4 wt [5] (20 stitches)[¶]
16. k10 wt [5]
17. k5 kfb k5 wt [4] (21 stitches)
18. k6 kfb k7 wt [3] (22 stitches)
19. k16 wt[§] [3]
20. k7 kfb k9 s1 byf[¶] s1 [0] (23 stitches)

Cut the MC yarn, leaving about 8 cm for darning in. Switch to CC and start from the beginning. Make sure that the CC is wrapped around the

last stitch like a wt.

21. s1 k10 kfb k10 wt (24 stitches) [1]
22. k23 [0]

Skinny rhomb

Start with CC.

1. k24 [0] (RS)
2. k23 [1] (WS)

Switch to MC.

3. s2 k8 k2tog k8 wt [3] (23 stitches) **
4. k16 wt [4]
5. k13 wt [6]
6. k4 k2tog k4 wt [7] (22 stitches)
7. k6 wt [9]
8. k3 wt [10]
9. k2 wt [10]
10. k3 wt [9]
11. k2 kfb k3 wt [7] (23 stitches)
12. k10 wt [6]
13. k13 wt [4]
14. k7 kfb k8 s1 byf[¶] s2 [0] (24 stitches)

Cut the MC yarn, leaving about 8 cm for darning in. Switch to CC and start from the beginning. Make sure that the CC is wrapped around the last stitch like a wt.

15. s1 k22 wt [1]
16. k23 [0]

[‡]While knitting the 3rd row, you can place the first two stitches (CC stitches) on a stitch marker and leave it dangling. This will prevent them from loosening, which will mess up their tension even more. You will have to put them back on row 19.

[§]This wt is a stitch too early. It should really be k1 wt k1 instead of just wt. However, that does not look good on the WS of the work, and this seems to be the only way to make it look ok.

[¶]If you are using double-pointed needles, you might want to split the stitches onto two needles around here, to prevent too much pulling on the stitches at the ends.

[¶]This will set up a simulated wt at this point when you darn in the ends, so that everything is nice and symmetric on the WS.

^{**}While knitting the 3rd row, you can place the first three stitches (CC stitches) on a stitch marker and leave it dangling. This will prevent them from loosening, which will mess up their tension even more. You will later have to put them back on row 14.

The horizontal lines indicate the working yarn. Start at the bottom right and follow the mostly horizontal lines. A line from right to left is a right-side row, from left to right is a wrong-side row. The vertical lines indicate stitch chains. All stitches are knit, never purl.

