How to Build the Perfect Igloo

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Building an igloo, or dome in general, is a task humanity has faced since antiquity. The chord lengths of geodesic domes were considered classified military information in the United States until the sixties, and some believe that the secrets of medieval cathedral dome builders formed the origins of Freemasonry. Even now, the construction is not an easy procedure.

The Inuit are known for their ability to build snow domes. They build layers of bricks in a spiral pattern, causing the dome to close in loxodromically (see Figure 1). Due to the multitude of different brick shapes, this method is rather difficult for the amateur to carry out.

Mathematical Formulation

In developing an easier process for igloo-building, we are interested the following question: is it possible to split a spherical dome of given thickness. We draw aligned spherical triangles (polygons in general) on the inner and outer sphere, and connect them by straight line segments (see Figure 2).

The Construction Procedure

Combining the above gives us a method for constructing an igloo. To start the dome, we begin with two concentric circles (see Figure 3a). To initialise construction, we first place 12 segments in a non-trivial order (Figure 3b). Note that three elements of the same orientation are placed next to each other, on three different triangle sides. The first row has point reflection symmetry with respect to the centre of the circles. Further blocks are simple reflections of those already placed (Figures 2c and 2d). The most difficult operation is the placement of the final four elements (Figures 2e and 2f), which should ideally all be placed at once.

Paper, gypsum, wet snow and ice bricks have been used to test this procedure on small scales. The igloo has some tendency to come apart under its own weight, so a band around the base must be used.

Conclusion

The ‘2, 3, 5’ spherical triangle above provides a working solution to the igloo building problem, requiring only two different brick forms (the two orientations). Another interesting solution is based on geodesic domes (two different equilateral triangles, 90 bricks). It is still not known whether any single small block type is sufficient to tile the hemispherical dome. Possible search areas are exceptional spherical tilings, and nearly spherical polyhedrons similar to the deltoidal icositetrahedron.

References