



geodesic domes



what are they?

The word geodesic relates to lines drawn between points on a sphere or a curved surface. So to picture a geodesic dome, think of a sphere (or half a sphere) with some dots on it, with the dots connected with straight lines making triangles (usually), and the sphere removed.

It's often thought that Buckminster Fuller invented the geodesic dome, but he didn't, although he coined the term. They were actually invented by Walter Bauersfeld, around 1920 in Germany. 'Bucky' Fuller was at the forefront of a little post-WW2 explosion of interest in mathematically-designed structures, and he designed many famous domes such as the Union Tank Car Dome – over 100 metres in diameter – used for repairing railway cars in the 1950s, that has since been demolished. The maths of large domes was the biggest challenge, and it was where Fuller excelled, using trigonometry, in an age without computer modelling.

More modern examples include Spaceship Earth at the Epcot Centre, and the Eden Project. Domes are perfect for large structures required to encompass a lot of volume. They can be found all over the world, with perhaps the greatest concentration being found in North America.

Geodesic domes can have many small-scale uses, from temporary accommodation or an extra room outside the house, summerhouse, workshop, storage space, children's playhouse, meeting room, spare bedroom, study area, sauna, meditation retreat, travelling tent, etc.



One method of connecting poles for a home-made geodesic tent frame.



Geodesic dome greenhouse.

what are the benefits?

Strength: triangulation gives huge strength.

Energy & resource efficiency: domes represent the lowest material use for the largest volume (as long as there's no wastage when you're cutting triangles), which means the smallest surface area per unit of volume, and therefore minimum heat loss.

Wind resistance: wind flows over and around a dome, without causing damage; and they offer the same profile for any wind direction – so they're excellent for windy locations.

Simplicity: they may look complicated, but once you've got the hang of it, there are fewer components with a geodesic dome structure. A typical rectangular home will have vertical, straight walls, windowsills, lintels, sloping roofs, fascias, gable ends etc., but a geodesic dome could be made of the same components, repeated across the entire structure. Plus, a dome kit could be put together by someone with very little experience of conventional building.

Space: the open span surprises people when they first walk inside one; they definitely have the 'wow' factor.

Downsides: they're maybe not so fantastic as a typical, three-bedroom family home that needs to be divided into smaller rooms, because really, they're the wrong shape. They're much better for spanning a clear space. So great for a single person or a couple who want to live in one large space.

They also have a reputation for being leaky, but that's almost definitely because conventional builders / roofers weren't prepared to work on early models, and so enthusiastic but inexperienced amateurs had a go, with predictable results in many cases. Geodesic domes don't leak if they're built well.



what can I do?

Types of dome: have a go at making a model first. And if you're fascinated by the maths behind it, you're going to have a lot of fun. You could then graduate to a tent, which work well, because you can assemble and disassemble reasonably easily, for sturdy mobile accommodation. You could make all the struts and connectors yourself, from natural materials and from bits of kit you might have lying around. We have a guide on the website to making your on dome tent. You have various options for the canvas, and there are canvas manufacturers to help you; but even without a canvas, you'll have gained experience and ended up with a kiddie's climbing frame!

Greenhouses are good as domes too, as they're less likely to be damaged by wind, and they lose less heat at night.

Geodesic dome houses, as mentioned, might not work that well for families, but are fine for singles or couples – as part of the 'tiny house' trend; but if you decide to go for it, you'll then have the problem of building regs (which you don't need for a workshop, garage, or something you're not going to live in). The building regulations system is quite inflexible, so anything unusual is quite difficult to get through. As their structures are so strong, they work quite well underground, and don't require heavy trusses to take the weight of the overfill.

Building a dome: an intro like this is too short for detailed instructions for building a geodesic dome house, but there's lots of information out there, including detailed tutorials and plans, many of them free. See our links page, search online and look for instructional videos on YouTube. There are many different styles and shapes, and innovations are emerging all the time – e.g. the beveled frame method removes the need for a joint, with a hole, where the tips of triangles meet. It's perhaps the simplest way to build, although you'll need a table saw with a tilt function, to cut the bevel angles.

Frequency is an important concept in dome-building. Most domes are based on an icosahedron shape, with 20 faces. This is a '1-frequency' dome, and is a bit 'boxy'. A 2-

frequency dome makes it more spherical, by adding more triangles. Imagine a single triangle, with a dot in the middle of each side. Join these dots to create another triangle (upside down) inside the first one. Frequency (and therefore complexity) tends to increase with the size of the dome, to keep panel sizes manageable. A 3-frequency dome is the most common.

Domes can be coated with a waterproof sealer, with a drip-sheet behind the outer skin, so any moisture that managed to get through would run to the bottom and out. There's then an air gap, then insulation and interior walls, which can be timber studwork and plasterboard. A tiny wood stove should keep even a large dome toasty on the coldest winter day.

If you enjoy building domes, there's a demand for garden offices and glamping pods. Start small, get the hang of it, build things you can take down and sell, and you could launch an interesting career in dome-building & designing. And if you don't enjoy it, you can find geodesic dome designers / builders / suppliers online.

resources

- lowimpact.org/geodesic-domes for more info, suppliers, links & books, including:
- Simon Mitchell, *the DIY Geodesic Growdome*
- Borin Van Loon, *Geodesic Domes*
- Magnus Wenninger, *Spherical Models*
- bit.ly/3f0AG9q – geodesic dome calculator
- geo-dome.co.uk – articles, plans, ideas
- desertdomes.com – FAQ, lots of info



Giant geodesic biomes housing tropical rainforest at the Eden Project in Cornwall. Notice the tiny people in the foreground.

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