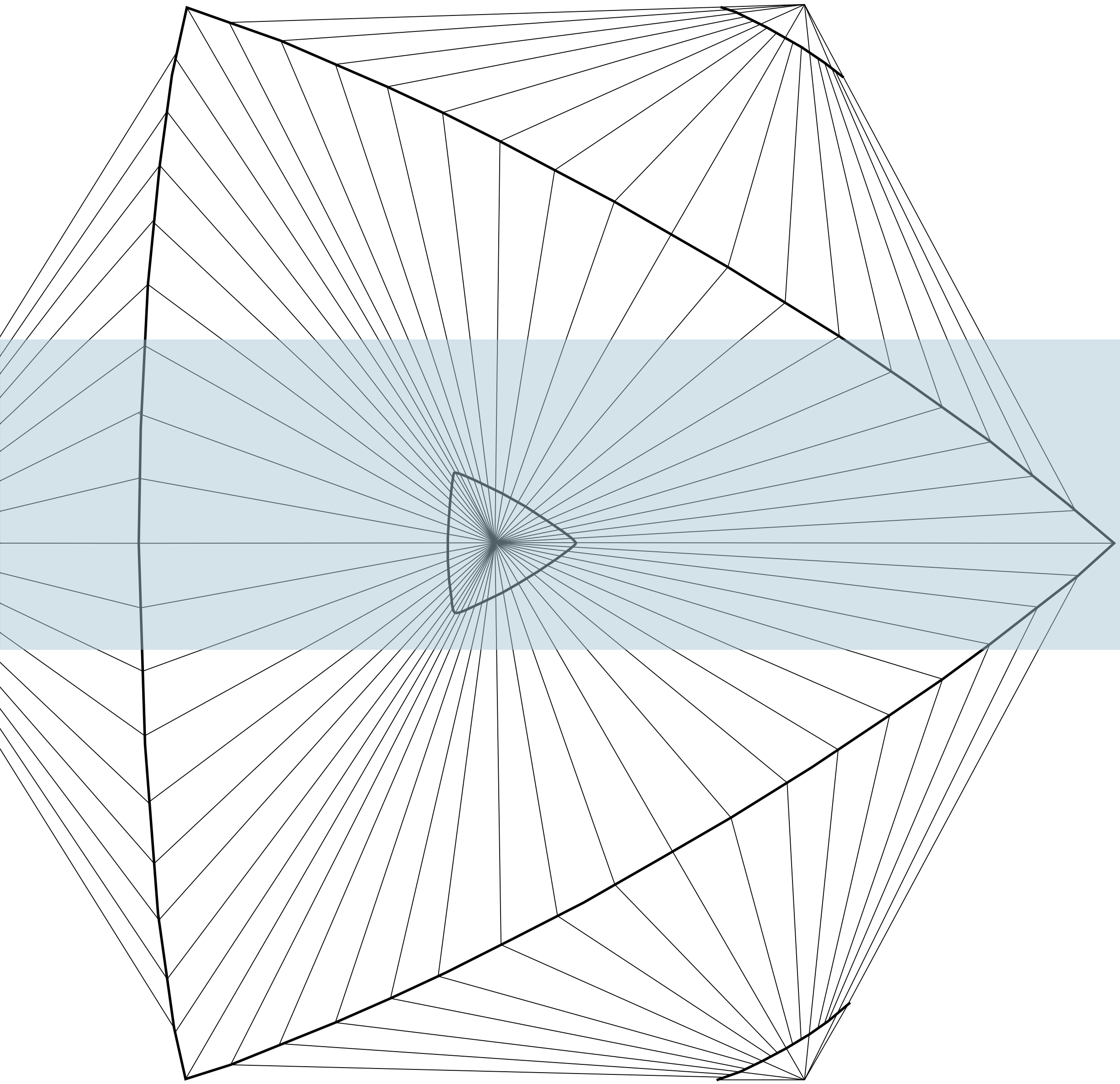
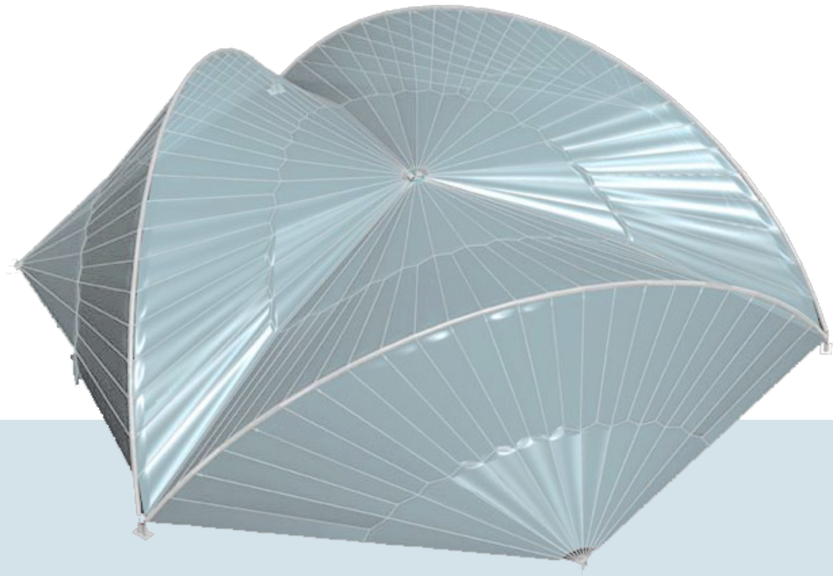


XANADOME

inherently efficient structures

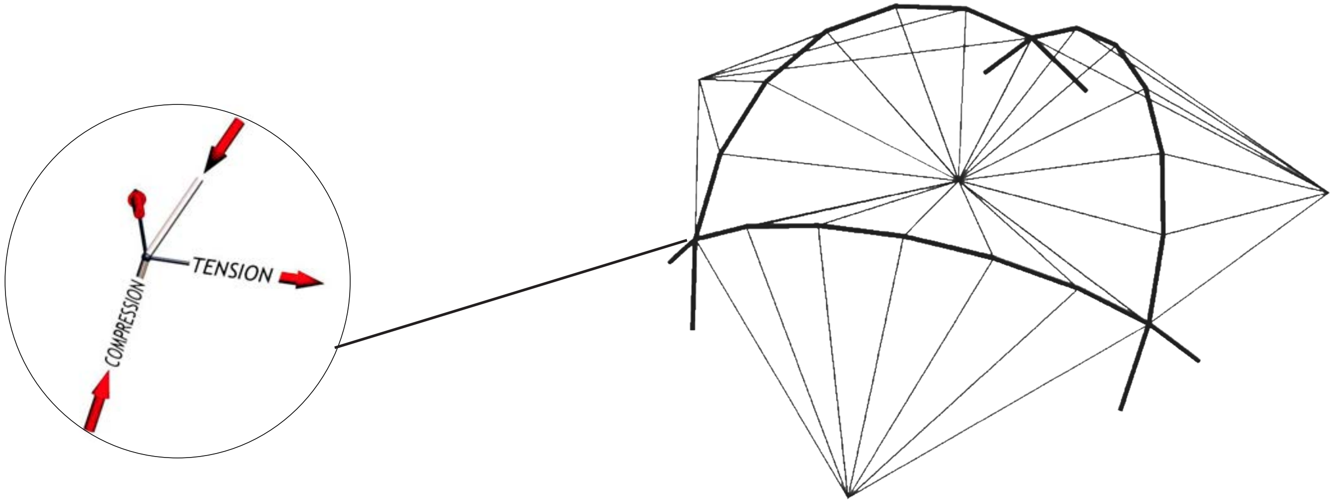


XANADOMES

are unique forms of structure for enclosing large spaces

In our pursuit of innovative forms of structure, Peter Dann Ltd. invented 'Xanadome'. Aesthetically, Xanadome structures are fashioned by the forces within them and assume their own organic shapes. This natural 'vocabulary' of the system offers limitless opportunity to create attractive new forms and no other structure performing the same function may be lighter. The structure all lies in the planes of the covering and is consequently almost invisible.

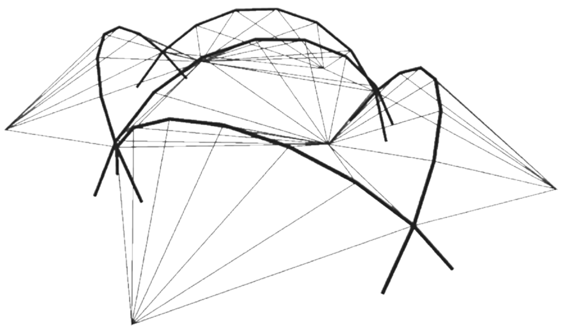
Potential uses are for covering any large span of clear space including sports and leisure facilities, stadiums, shopping malls, refugee shelters, large' hangers or warehousing. Materials available to most locations could be used and the structure is easily demountable, transportable and re-usable, so could be transported to any location around the globe.

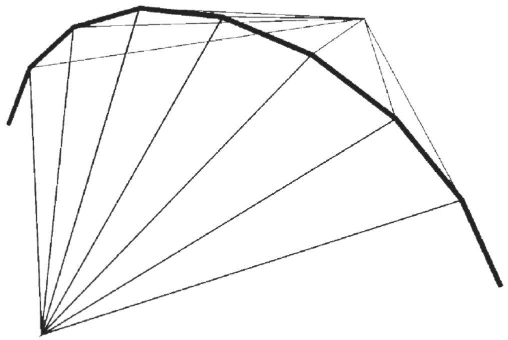


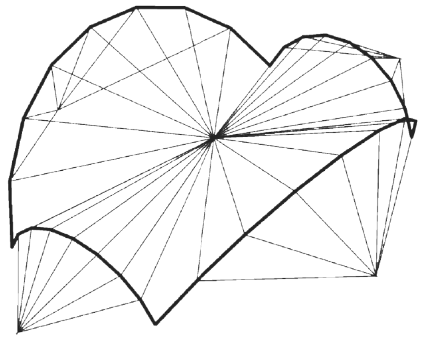
UNIQUE
maximum structural efficiency

A characteristic of theoretically efficient structures is their remarkable rigidity. Think of the bicycle wheel with its thin spokes and light rim. It doesn't deform noticeably when it is bumped up a kerb. Xanadomes are very stiff and rigid. Deflections are a small fraction of movements in similar looking conventional structures.

The structural form is simple: 'articulated arches' restrained in a particular way by cables. The arches are not rigid but are made from a chain of linking struts freely jointed together like a necklace, and consequently having no strength or fixed form until restrained by the cables.



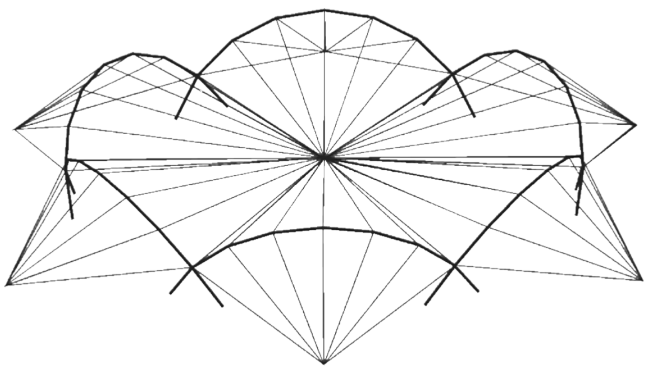




COMBINATIONS

a number of single Xanadomes can be joined together to form different shapes and volumes for different units

Versatility is achieved by combining basic units in any way to suit the shape and size of the application. The arches themselves may be many shapes. They need not be symmetrical, flat or vertical. By covering different shapes in different configurations, an infinite variety of structural forms is achievable.



sculpture

sports

hangers

civic space

military

concerts

USE

a variety of shapes and sizes of Xanadomes are available to use for many different functions

botanical

temporary

disaster relief

airport hangers

museum

entertainment

atria

inherently efficient structure

every joint is held rigidly in position by the balance of forces in the structure

maximum efficiency

realising the theoretical limit of structural efficiency

infinite variety

a single unit may be many shapes: tall, short, sloping, twisted, asymmetrical e.t.c

harnessing nature to full effect

natural shapes formed by forces within structure

PRINCIPLES

based on the theorems of structural efficiency “no other structure performing the same task may be lighter.”

a simple idea

an articulated arch restrained by two fans of cables

combinations

different shaped units may be combined by sharing aerial nodes

maximum size

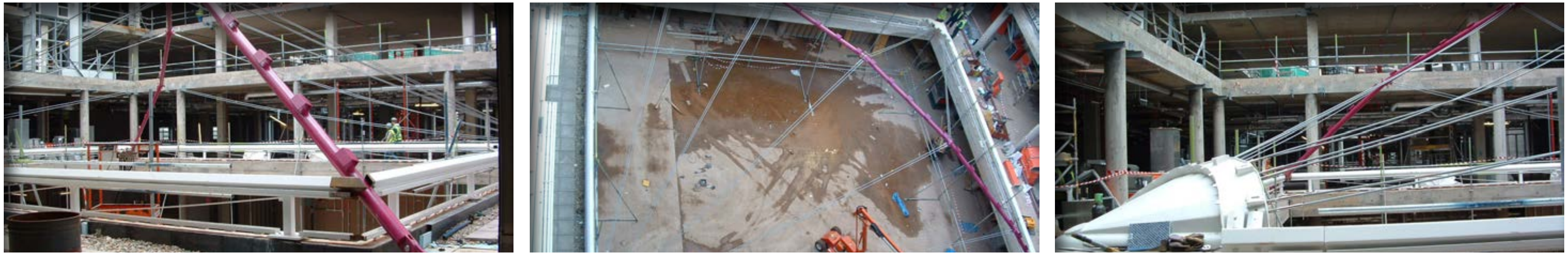
can be larger than any other structure

possibilities

lifetime as conventional building, fixed, mobile, insulated, variable light transmission, photovoltaic covering, clear, translucent, opaque, coloured, printed; can support large internal loads

minimum mass

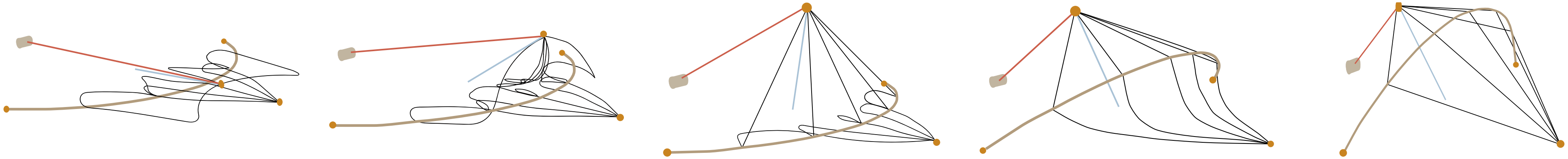
no other structure can be lighter

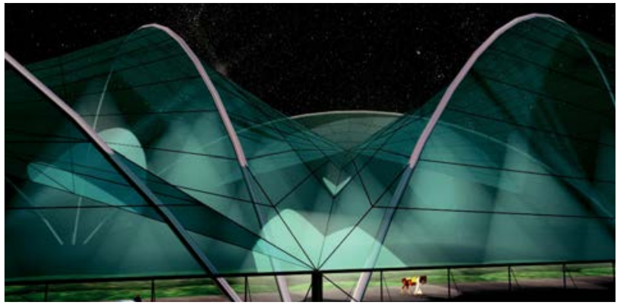


BUILDABILITY

safe working at ground level re-usable short program easily transportable easy adjustment scaffold-free erection zip-in cladding demountable

Parts arrive on site in short lengths with simple joints, assembled on the ground, erected by winch, hawser and temporary mast.





CLADDING

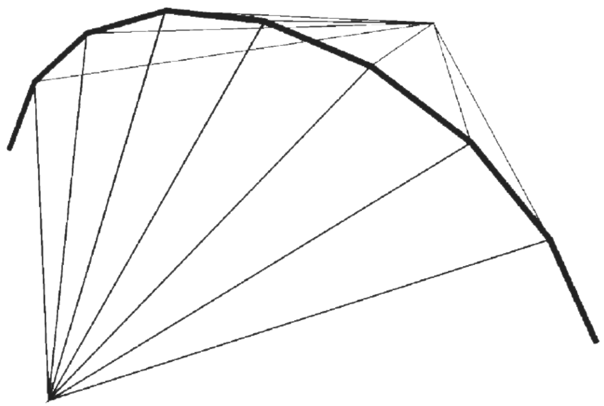
stressed membranes: reinforced PVC for economy, PTFE and glass fibre (Teflon) for durability

any flexible membrane cladding

fabric/stressed membrane for rain and shade protection, insulated pneumatic EFTE cushions for permanent clear-span enclosures

insulated pneumatic cushions

controllable light transmission during use, wide spectrum transparency, printable including dot matrix shading, covered with photovoltaic cells

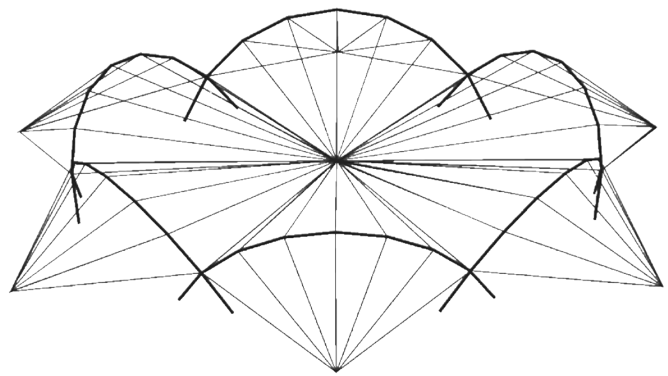


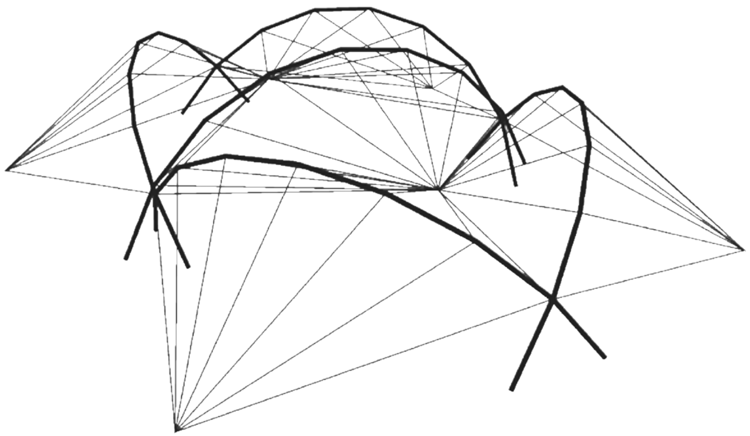
Efficient structures utilise every part of their material at its full strength capacity, but this is only possible when their components are axially loaded as pure struts or pure ties. Beams have high stresses at their outer faces, but internally the stresses are lower and consequently the material is not fully utilised, making them inefficient. Xanadome structures are not amenable to analysis by the standard techniques used in nearly all commercially available software. Special analysis methods and software are needed.

TECHNICAL

“Xanadomes are not just another shape of structure, they are special in their inherent efficiency”

Only two or three “theoretically efficient” structures are known, including the Xanadome. Unlike most structures, Xanadomes satisfy the conditions of theorems of structural efficiency stated by James Clark-Maxwell and by Michell, meaning that no other structure performing the same task may be lighter. The other well known examples are the bicycle wheel and the guyed mast. Nearly all other structures, including all those utilising beams, are heavier than theoretically necessary.





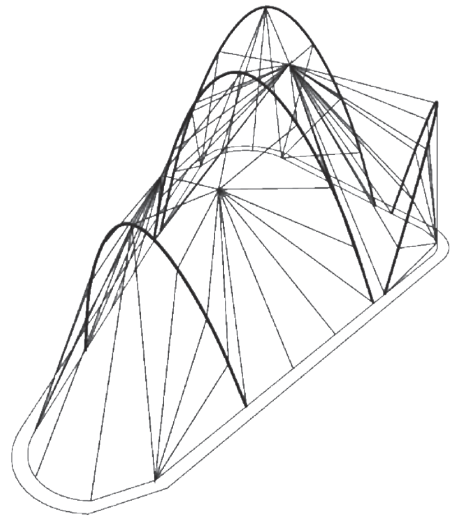
Usually the critical loading cases for conventional arches are when the loading becomes asymmetrical, for example, when one side becomes unloaded. This does not happen with a Xanadome. Removing load simply reduces forces throughout.

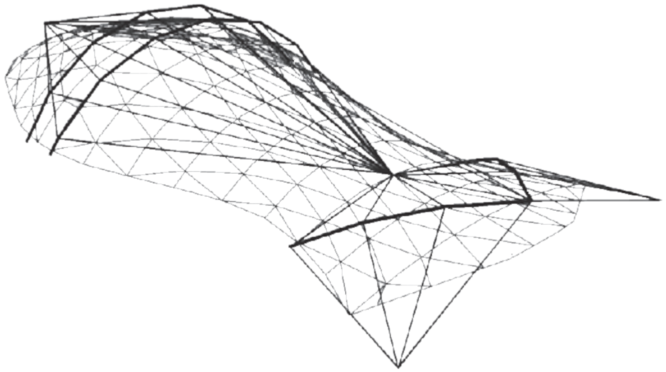
Xanadome arches are made from a series of segments (usually six or more) with simple joints between. Because of this, and their light weight, transport and assembly are simpler than with conventional alternatives.

The arches of a Xanadome are quite different from conventional arches. They are articulated with ball joints at every node where cables are connected. If a conventional arch had just two ball joints it would collapse. Deflections are a small fraction of movements in similar looking conventional structures.

Xanadomes may use their cable network as part of their erection system. Provided that some temporary light cable bracing is provided, they can be assembled on the ground and pulled up using a hawser and a temporary lightweight erection mast.

Conventional arches work both by carrying axial forces and bending moments. To carry similar loads to a Xanadome they need to be an order of magnitude heavier. In a Xanadome, the cables support the arches and the arches support the cables. Many conventional arches support cables but they are not arranged so that this mutual support is achieved. Only the particular arrangement in which the cables radiate from common nodes creates a Xanadome.





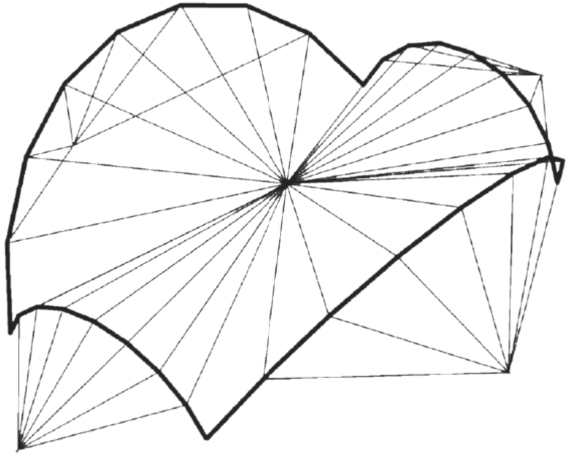
Responsible use of the earth's resources is a major concern of our times. Xanadomes use less material than any alternative and they are also re-usable. Their inherent simplicity produces intriguing and complex patterns which change according to the vantage point.

The most frequently used material in Xanadomes is steel, both for the arches and the cables, but most structural materials could be used. For example the arches could be Glulam timber and the cables could be Kevlar.

Consequently, the restrictions on size dictated by existing cranes or by scaffold costs are by-passed making very large spans economically viable. Erection is cheaper and safer than for conventional arches.

Perhaps, surprisingly, Xanadomes are easily made to cover the usual geometrical shapes of buildings, such as squares, rectangles, hexagons and most polygons.

All structures have a maximum size, above which they are not strong enough to support their own weight. This limit is reached much earlier with inefficient structures. Efficient structure can therefore be much larger than other structures. Long before the limit is reached, inefficient structures cease to be economically viable. Xanadomes remain viable to very large spans.



XANADOME

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