

**THE BARBED QUATREFOIL IS A 1500-YEAR-OLD SYMBOL
OF ARCHITECTURAL ADVANCE**

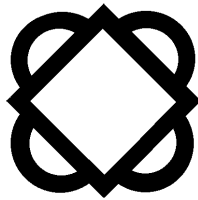
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Several years ago Stevens Institute of Technology selected as its new logo a unique figure which was found decorating the front of the Edwin A. Stevens Hall.



The logo is shown below. The EAS Hall was built in 1870, but the reason the symbol was placed there was a mystery and the subject of much speculation. But a chance discovery showed the figure to have an ancient source, and one that formed a link between art and engineering.



In May, 1992, I traveled to Istanbul, Turkey for a conference. While there I visited the famous Sancta Sophia. Also known as Hagia Sophia, it is a massive Byzantine-era church, now a museum.



Sancta Sophia, whose name means "divine wisdom", was built in the mid-sixth century by the Byzantine architects Anthemios and Isodoros, for the Roman emperor Justinian. For 1000 years it was the largest dome in Christendom, until the construction of St. Peter's Basilica in Rome. In 1453, when the Ottomans conquered Constantinople and renamed it Istanbul, Sedefker Mehmet Agha (a student of the renowned Ottoman architect Sinan) recognized the beauty and strength of the design of Sancta Sophia's dome complex, and copied it for the nearby "Blue Mosque", and for many grand mosques throughout the Ottoman empire. The image below shows the Blue Mosque in the foreground, with Sancta Sophia in the background.

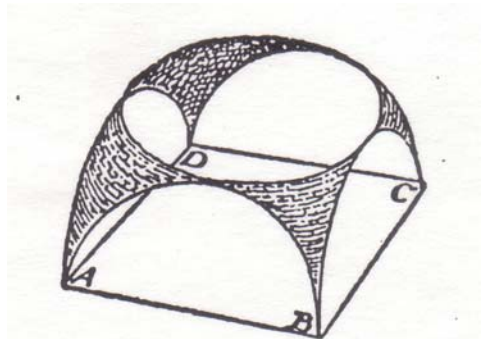


Structural basis of the dome

I first learned about Sancta Sophia in L. Sprague DeCamp's book "The Ancient Engineers". This book described how the dome structure was an architectural and engineering advance, making it possible to span a very large space with a stable structure. With any structural material, there is a limit to the size of a hemispherical dome which can be built. In any dome, the weight of the top of the dome pushes down on the sides, tending to rotate them outward. A point is reached where the bending moment at the equator of the dome exceeds the ability of the material to resist it, and the dome collapses.

A dome can be made more stable by the addition of buttresses along the side, but these would have to be very large to transfer the horizontal forces to the ground. The designers of Sancta Sophia developed an innovative way to buttress the dome while increasing the open space below it. Essentially, they pushed smaller half-domes up against the sides of the main dome.

The figure below from DeCamp's book shows the basic structure of the pendentive dome. The central part of the structure is the pendentive dome, which is a dome with four sides cut off. Smaller domes are placed against the arches which are left, and a central dome placed on top of the pendentive. (See the section on Constructing the Pendentive Dome Structure with grapefruit and oranges at the end of this document.)



from L. Sprague DeCamp, "The Ancient Engineers"

Discovery of the symbol in Sancta Sophia

Having learned about Sancta Sophia's design, I was looking forward to touring the monument on my trip. Nevertheless, I felt like a typical tourist during my visit, somewhat dispassionately wandering around the building, ready to pass on to other sights to see.

After viewing the domes from the main floor, I climbed the cobblestone switchback ramp to the upper gallery which overlooks the main floor. Immediately upon entering the North Gallery I was taken aback by the sight which would change my visit from a sightseeing trip to an exploration. The ceiling fresco of the gallery was decorated with a repeating pattern of large symbols identical in form to the Stevens logo, with florid embellishments. I was very excited by the discovery, because new the symbol had been a

source of mystery to the Stevens community, and because this indicated the symbol was based on ancient roots of our civilization.

Furthermore, I discovered that there is a relationship between the design of the symbol and the architecture of the building which represents an engineering advance of the time. Thus, the logo can be seen as a connection between Stevens and the technological roots of our civilization.



Meaning of the symbol

Now, as I continued my visit, I searched for other examples. I found many, as well as several variations of the symbol, in both fresco and mosaic.

Now, I puzzled over the origin of the symbol. At this point I considered it to be a purely abstract design. The variations led me to think the symbol was developed primarily as modifications of some design theme. However, later on, as I continued to think about it in my hotel room, I suddenly realized that there might be a relationship between the design of the symbol and that of the dome structure.

As can be seen from L. Sprague DeCamp's diagram, the pendentive dome represents a transition from a circle to a square, which is inscribed in the circle formed from the equator of the dome. The half-domes placed around the sides create half-circles attached to the sides of the square. This is the form of the Stevens logo, and therefore, the logo has the appearance of a plan view of Sancta Sophia's dome structure.

Actually, Sancta Sophia only has two half-domes placed opposite each other. Massive conventional buttresses were placed on the other two sides. Agha completed the design in the more recent (only 500 years old!) Blue Mosque and others.

Since the symbol with four half domes was used to decorate Sancta Sophia, I suggest that the architects' original intent was to complete the other two sides, but were forestalled by economic or other considerations. Thus, Sancta Sophia may actually be an incomplete version of the architect's original vision.

The relationship between the symbol and the structure gives added meaning to its use as a logo for Stevens. Stevens is a small technical university in which most students major in engineering. The symbol thus serves as a link to our technological heritage for a school whose mission includes the advancement of that heritage.

Other evidence of connections between architecture and abstract symbols

During the same trip, I also visited ancient sites along the Aegean coast of Turkey, which was part of the Roman Empire. At one site, the ruins of Aphrodesia, I found a copy of one of the modifications of the symbol in Sancta Sophia, carved in a stone fragment in the ruins of a church.

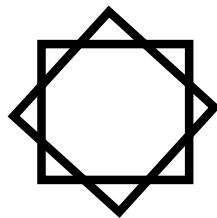
At the ruins of Heiropolis (the modern Pamukkele), I visited the ruins of a church called the Martyrium of St. Philip. The remains of one of the apostles was purportedly buried there.



This church was octagonal in plan. Only the eight arches and some walls remain. Carved on the keystone of one of the arches I noticed the following figure:



In this simple figure two squares combine to form an eight-pointed star. Notice also that the figures form an octagon in the interior. This seemed to me to be another example of the architecture of a building being echoed in an abstract symbol.



Christian churches since at least the middle ages have been designed with a floor plan corresponding to the shape of a cross. Again, there is a correspondence between the architecture and a symbol, this time with theological implications. It is known that the earliest Christians used a fish as the symbol of their religion. I suggest that the selection of the cross as today's symbol of Christianity may have developed out of the practice of abstracting a church's architecture.

Gothic use of the barbed quatrefoil

On a subsequent trip to Florence, I also found that the symbol, which is called a “barbed quatrefoil,” is a common early Gothic motif. This may be the route it took to its use on the Stevens Building. The best known example may be seen in the famous Baptistry Doors by Pisano, and in the entries by Brunelleschi and Ghiberti in the competition for new Baptistry doors. The sponsors of the bronze panels initially required that his sculptures be framed by the barbed quatrefoil. Many other examples of the use of the symbol by other artists can be seen in the museums of Florence, and in modern usage, such as in the logo of the Bank of Florence.

Use of the barbed quatrefoil in Florence, Italy.

- (a) and (b) Panels from Pisano’s doors to the Baptistry;
- (c) Brunelleschi’s entry in the competition for the Baptistry door panels;
- (d) Ghiberti’s winning entry in the same competition
(from <http://www.mega.it/eng/egui/monu/bo.htm>).



San Antonio Missions

There is one place in the U.S. where the barbed quatrefoil has been widely adopted is in and around San Antonio, Texas (<http://www.espadadoor.com/>). There, it was used as a decorative and architectural element in the Spanish Colonial Missions, and has been adopted for modern use by the City of San Antonio. There are many examples in the four mission structures outside San Antonio, and possibly one in the most famous mission within the city – the Alamo.

The most obvious example of a barbed quatrefoil here is the “Rose Window” at Mission San José.



The Alamo, site of the famous battle in 1836, does not have an obvious quatrefoil. However, its most recognizable feature – the portico (which was actually added some years after the battle) – may be inspired by the quatrefoil. It is crowned by a segment of the quatrefoil, and flanked by a pair of reflected segments:



The barbed quatrefoil can also be found in a number of places in Mexico, often forming a doorway arch (<http://www.espadadoor.com/examples.html>).

Modern San Antonio has adopted the barbed quatrefoil as a civic symbol. It can be seen in many places, from signage on the Riverwalk to decorative elements on highway overpasses:



Other modern examples

The symbol is fairly common, even in the U.S. It seems to be used as an architectural detail, apparently copied from older works without knowledge of its origin.

Examples of the Sancta Sophia symbol, along with variations, can be seen in the clerestory windows of churches such as the Kirkpatrick Chapel on the Old Queens campus of Rutgers University. It is common to see the barbed quatrefoil shape forming the walls of the pools surrounding classically-influenced fountains, notably in the fountains of Trafalgar Square in London.



One of the variations found in Sancta Sophia mosaics involves replacing the semicircles with circular loops as extensions of the sides of the square. This form can be found in the U.S. Capitol building in Washington, D.C., where a mosaic copy is prominent in the floor of the small domed room just to the north of the rotunda. Another location has this version in tile:

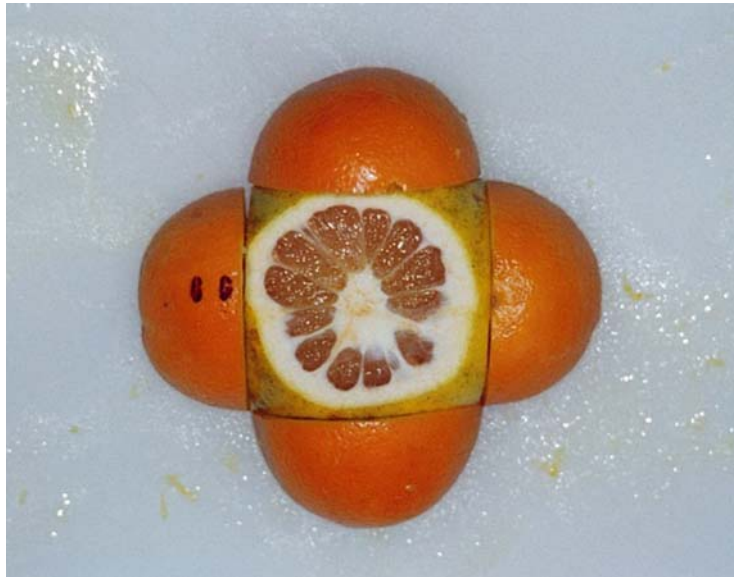


A recent story (<http://99percentinvisible.org/episode/the-fancy-shape/>) identified the “barbed quatrefoil” as “the fancy shape.” An interesting example of its decorative use is these tissue boxes marketed under the Kleenex® brand. It is used in many commercial products, such as the linoleum tiles shown here.

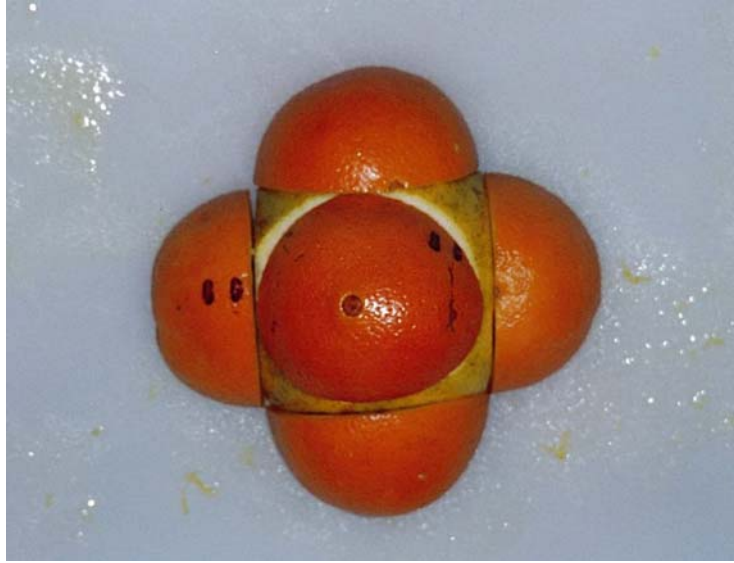


The web site says of the barbed quatrefoil “it’s probable that it has roots in Islamic architecture” and dates back “before the Renaissance.” My discovery of the figure at Sancta Sophia and its connection to the structure shows that its true root is in Byzantine architecture.

Constructing the Pendentive Dome Structure with grapefruit and oranges:



The final structure:



The partial buttressing structure as used in Hagia Sophia:

