

Music and Architecture: Spiral Lecture Notes (2021.12.08)

From the very **first human constructions of shelter**, there has been **two types of structures: roofs and walls**. (roof/canopy/cover vs. wall/nest/corral).

For today's lecture, we are looking at spirals. In particular, **upward spirals**.

Architecturally, will give you examples of **roof spirals**, which are a **dome**. (mound, canopy)

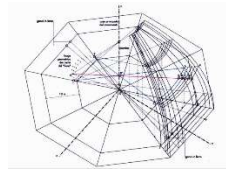
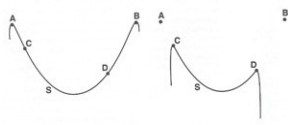
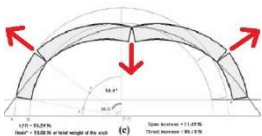


Florence Cathedral Duomo

Duomo is **eight-sided octagon** in plan, with **vertical rib arches at corners**, meeting at **open oculus** at top.

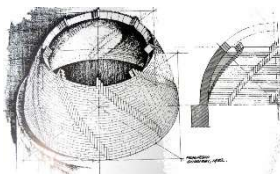


City Council approved **Arnolfo di Cambio** design for naves and octagon base for dome (1294: 1296-1302 died, 1330-1348 black plague, 1349-1380 nave complete). **Higher** (171ft. at base, 376ft. top) & **wider** (144ft. wide) than any previous, no buttressing (**Neri di Fioravanti's** dome design in 1367, **rejecting Gothic buttressing**, marked **start of Italian Renaissance**). Massive inner dome, open at top based on **Rome's Pantheon** (Trajan/Hadrian, 113-125 AD, 142ft. interior dia., 21ft. thick base, 4ft. thick top), enclosed by thin outer shell (2ft. thick at base, 1ft. thick at top) for weather.



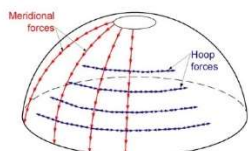
19 Aug. 1418, Arte della Lana announced competition for dome (**Lorenzo Ghiberti**, Baptistry doors, 1401).

Filippo Brunelleschi (supported by banker **Cosimo de Medici**) won (1420-1436 construction, 1423 solo. 1446-1461 lantern, 1469 copper cross by Andrea del Verrocchio and Leonardo da Vinci). **Catenary curve**, natural profile of **structural forces imposed by gravitational loading** of material weight, **inverted hanging chain**.



Puzzling, fitting together, **herringbone pattern** of **flat bricks** (37K tons, 4 million bricks).

Laid **without centering** (scaffolding supports), by laying in **self-supporting circular plan**, with herringbone pattern used to **infill gaps of inside corners** of the octagon ribs. Layered, offset/staggered seams. **Spiral**.



A dome from a **structural perspective**, in physics, **gravitational loads** on a dome **disperse**, (spread, reduce, diffuse, thin, separate) become **entropic**.

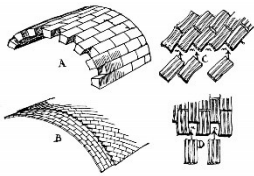
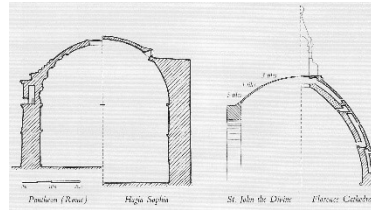
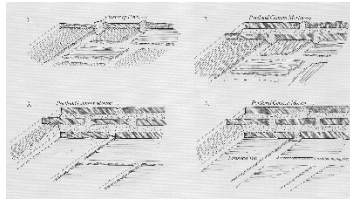


Fig. 1. Stone vs. tile vaults (Moya, *Bóveda tabicada*).



Catalan structural tile vaulting, first documented in Valencia, Spain on a 1382 monastery.

Juan Franch economizing material, cost and time, **substituted flat terracotta bricks** for cut stone **infilling** the webbing of an arched vault (which is a linear, directional dome). **Reduces weight**, enables flatted vault.

Staggered layers of interlocking herringbone pattern. Called **bóveda tabicadas** (vault partition) in Spanish, **maó de pla** (brick of flat) in Catalan.

Begin in corners, fitting flat tiles on the perpendicular sides, **projecting outward corner**. First layer with fast setting **Plaster-of-Paris (gypsum)**, second layer lapped at joints, large flat sides bonded with slower, stronger **Portland Cement (calcium carbonate, from baked ground limestone)**.



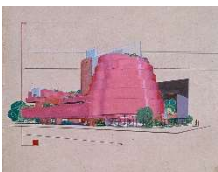
Variations on the dome: **Rafael Guastavino Jr.'s**

U.S. Bureau of Mines / Hamburg Hall (Pgh. 1916) infill vault

Allegheny County Courthouse (Pgh. 1924-28) **Akoustolith** basement structural vaults.

Mellon Residence Pool (Pgh. 1917) barrel vault with **groin vaulted** arched windows.

St. Boniface Roman Catholic Church (Pgh. 1926) **pendentive** dome with arched windows.



Inverted dome is a bowl, open courtyard (valley, palazzo) **roof becomes a wall, upward spiral becomes downward spiral**: **FLW's Guggenheim Museum** (1959).

Structurally, **gathers dispersed entropic space** into a **concentrated (gravitational) point** at **center base**.

Combine dome and bowl you get a sphere, when staggered a sinuous wave cycle, balanced plasticity. Origins trace back to the tree, branches forming a canopy structure above, woven nest rooted below. Forks in streams.