STEAMcat

IES La Sénia

Institut la Sénia
Programa d'Innovació Pedagògica STEAMcat

Antoni Gaudí:

geometry, form and function.

Gaudi Biography (I)

Antoni Gaudí i Cornet (1852-1926) was a Spanish Catalan architect and the best known practitioner of Catalan Modernism.

Gaudí's works reflect an individualized and distinctive style.

Most are located in Barcelona, including his magnum opus, the Sagrada Família.

Gaudi Biography (II)

Gaudí's work was influenced by his passions in life: architecture, nature, and religion.

Gaudí considered every detail of his creations and integrated into his architecture such crafts as ceramics, stained glass, wrought ironwork forging and carpentry.

Gaudi Biography (III)

Gaudí rarely drew detailed plans of his works, instead preferring to create them as three-dimensional scale models and molding the details as he conceived them.

The picture shows the conceptual brilliance by Gaudi. It's an upside-down model of a cathedral made of string and bags of shot.

Gaudi Biography (IV)

His masterpiece, the still-incomplete Sagrada Família, was declared World Heritage Sites by UNESCO.

Gaudí's Roman Catholic faith intensified during his life and religious images appear in many of his works.

Gaudi's inspiration: Art and Science

Gaudí's inspiration came from many sources, including nature, philosophy, art and literature, and mathematics.

His nature-inspired designs, found everywhere throughout his work, are as much functional as they are decorative.

Take a look at these columns at La Sagrada Familia. Gaudí didn't just try to make them look like tree trunks with branches – he studied how exactly the branches of a tree support the weight of its crown, then applied the same principles to his columns:

"Do you want to know where I found my model? An upright tree; it bears its branches and these, in turn, their twigs, and these, in turn, the leaves. And every individual part has been growing harmoniously, magnificently, ever since God the artist created it."

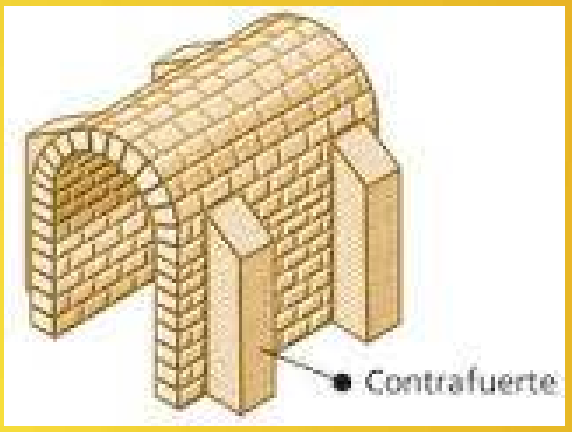
Gaudi's Geometry

"Nothing is art if it does not come from nature"

For Gaudi, form and function were inseparable; one found aesthetic beauty only after seeking structural efficiency, which rules the natural world.

Gaudi's Geometry

One example are Parabolic arches. Were introduced in construction by Gaudi, who admired the structural system of Gothic style, except for the buttresses, which he termed "architectural crutches".



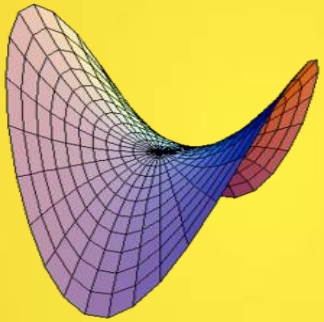
The catenary arches also carry all horizontal thrust to the foundation and so do not need additional elements.

Gaudi also applied Ruled surfaces in construction (hyperbolic paraboloid and revolution hyperboloid). Can be generated by sliding each end of a stright line on their own generating curve.

Gaudi's Geometry: **Hyperbolic Paraboloid**

The hyperbolic paraboloid (not to be confused with a hyperboloid) is a doubly ruled surface shaped like a saddle. It can be represented by the equation:

$$\frac{z}{c} = \frac{y^2}{b^2} - \frac{x^2}{a^2}.$$

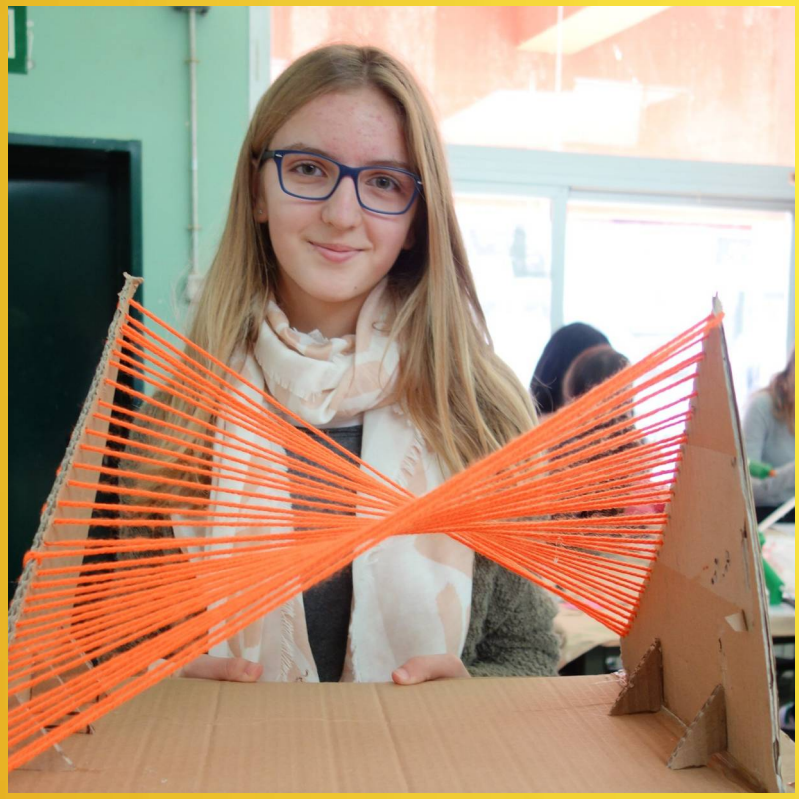


Horse Saddle

Skewer Model

Gaudi's Geometry: **Hyperbolic Paraboloid**

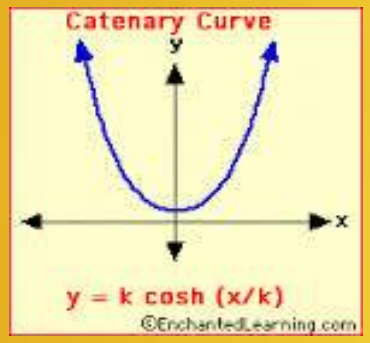
"Anything created by human beings is already in the great book of nature."



Pringles Chips

Gaudi's Geometry: **The Catenary**

The "Chain" Curve: the catenary is the shape of a hanging flexible chain or cable when supported at its ends and acted upon by a uniform gravitational force (its own weight).



When $x = 0$, for $y = a$ and $\frac{dy}{dx} = 0$,

$$\frac{d^2y}{dy^2} = \frac{1}{a}\sqrt{1+\left(\frac{dy}{dx}\right)^2} \text{ becomes}$$

$$y = a\cosh\left(\frac{x}{a}\right), \text{ the catenary.}$$

In its exponential form we have

$$y = \frac{a}{2}\left(e^{x/a} + e^{-x/a}\right).$$

Gaudi's Geometry: **The Catenary**

The "Chain" Curve: the catenary is the shape of a hanging flexible chain or cable when supported at its ends and acted upon by a uniform gravitational force (its own weight).

Upside down model

"There are no straight lines or sharp corners in nature.
Therefore, buildings must have no straight lines or sharp corners."

Gaudi's Geometry: **Revolution hyperboloid**

"Anything created by human beings is already in the great book of nature."

The one-sheeted circular hyperboloid is a doubly ruled surface. When oriented along the z-axis, the one-sheeted circular hyperboloid with skirt radius a has Cartesian equation

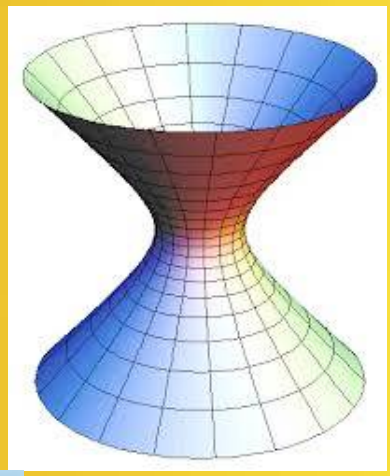
$$\frac{x^2}{a^2} + \dots$$

Our model

hyperboloid in Gaudi's Sagrada Familia

Gaudi's Geometry: **Revolution hyperboloid**

The one-sheeted circular hyperboloid is a doubly ruled surface. When oriented along the z-axis, the one-sheeted circular hyperboloid with skirt radius a has Cartesian equation



Refrigeration Tower

Brasilia Cathedral

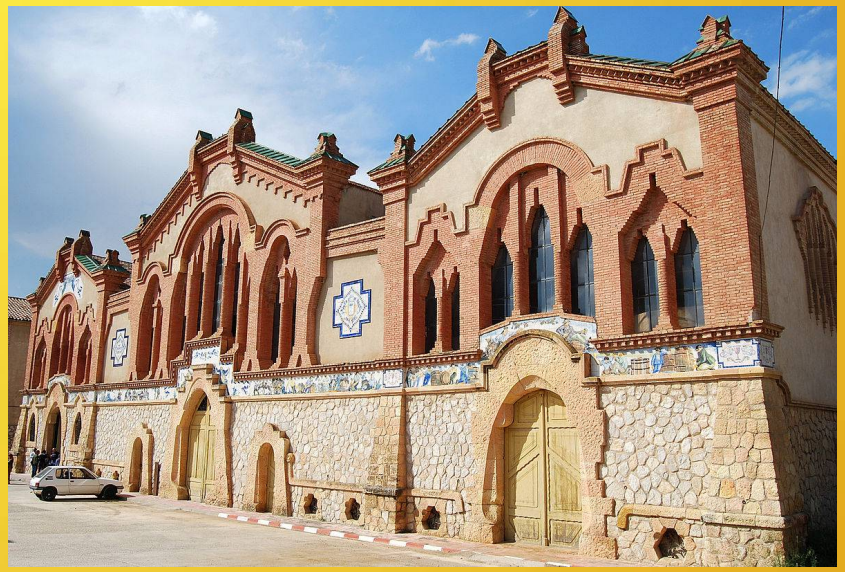
Gaudi's Geometry near la Sénia

César Martinell was a catalan architect part of the selected group of architects connected to Gaudí. He applied Gaudí's geometry in his works, most of them near la Sénia.

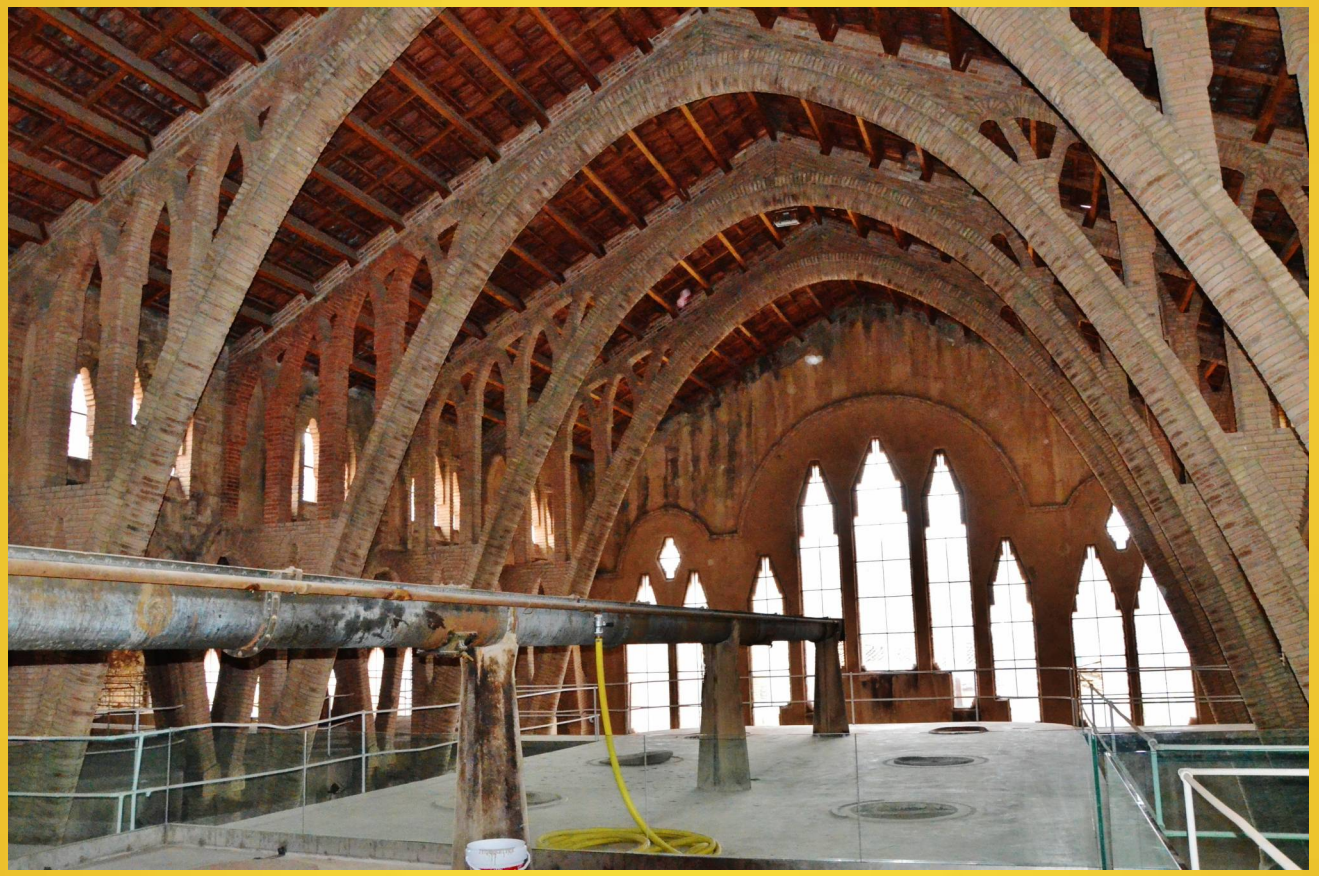
Gaudi's Geometry examples (I): Wine Cathedrals Terra Alta region

The cathedrals of wine are designed by Caesar Martinell.
to optimize the productivity and quality of wine.
Beyond architecture, therefore, constitute the most important examples of industrial engineering in rural areas.

You can visit two examples in Pinell de Brai and Gandesa.



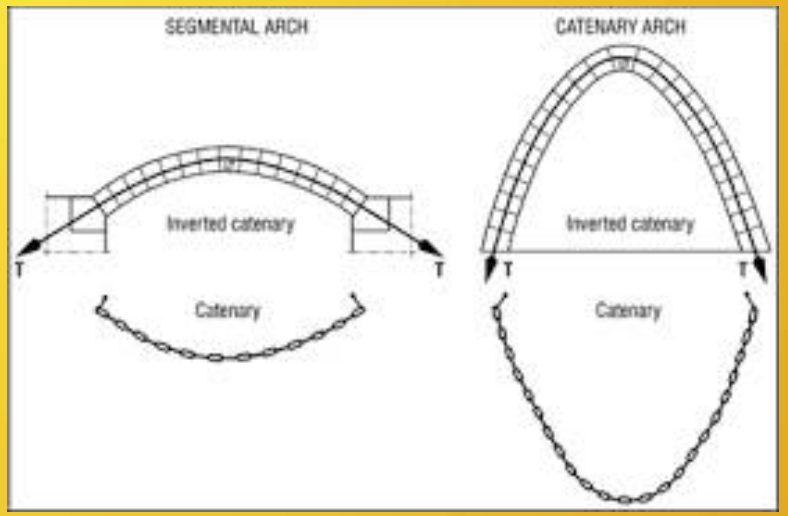
Gaudi's Geometry applied in Wine Cathedrals



Architecturally, a catenary arch has the ability to withstand the weight of the material from which it is constructed, without collapsing.

Gaudi's Geometry applied in Wine Cathedrals

It takes over the system of vaults and buttresses in stone vaulted Gothic cathedrals and in Renaissance domes



Gaudi's Geometry examples (II): Ulldecona Modernist buildings

In Ulldecona we find two Cesar Martinell works: Casa de la Feligresa and Molí d'Oli.

Thank You for your interest