Precast Concrete Structural Shapes

Double Tees & Single Tees

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System Spans & Effective Spans

- Single tee

A 36in. deep single tee can span 85 feet, and at 48 in. deep a single tee can span up to 105 feet.

System Spans & Effective Spans

- Double tees Has a typically range from 12 to 32 inches in depth with a typically span from 28 to 75 feet.

Effective uses

- A thin-flange Tee without topping is commonly used for lightly loaded applications such as roof structures.

- The thin-flange Tee with topping, and the thick-flange Tee are used for moderately loaded applications, such as floors for warehouses, office buildings, schools, shopping malls and parking garages.

- The thick-flange Tee that is four inches or More are used for heavily loaded surfaces, such as piers and bridges.

Construction Time & Costs

- Single tee and Double Tee systems are made in factories before being bought to the construction site. This saves time and money as the precast system is ready for assembly as soon as it gets to the work site. Once assembled, a concrete topping is poured on top to lock each slab together and give it a single smooth finished surface.

Case Study

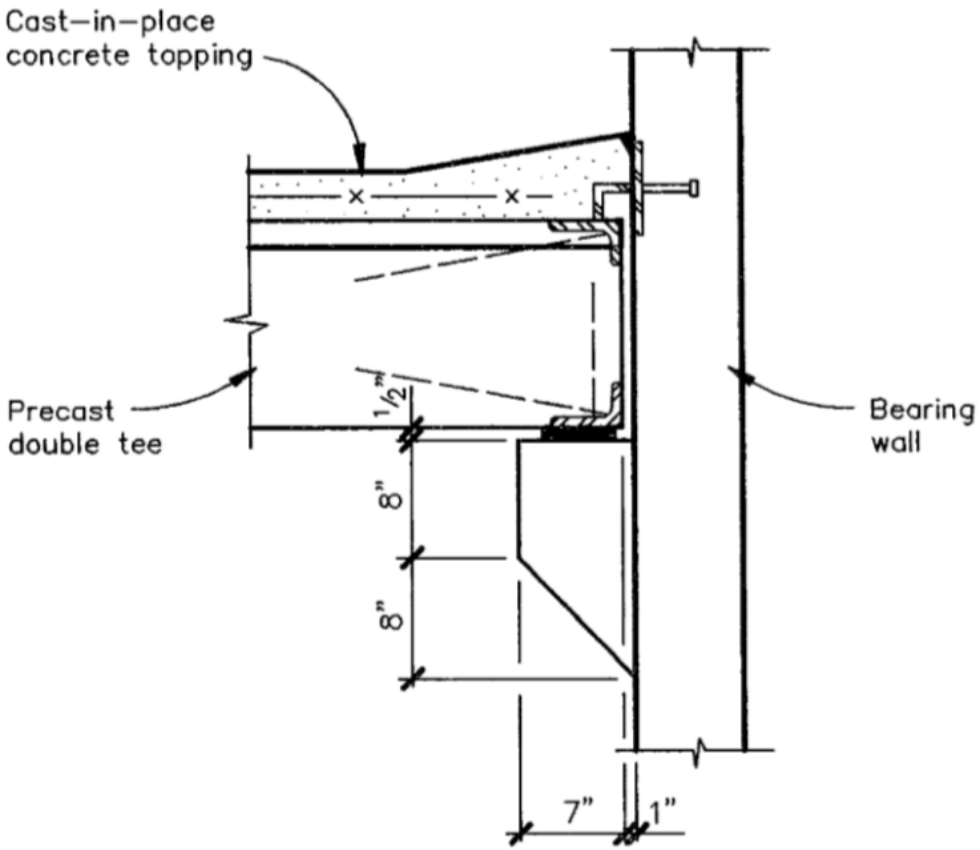
- Mountain Dwellings:

Mountain Dwellings is 2/3 parking garage and 1/3 residential that is located in Copenhagen, Denmark. Designed by BIG Architects (Bjarke Ingles Group) in 2008. It has a constructed area of 33,000 square meters, holding 80 apartments and 480 parking spots. The parking garage is located off the street and below the apartments. It utilizes double tee precast systems throughout the floors for a stable structure that doesn't use unnecessary space. The apartments are brightly lit by facing the sun and each includes an outdoor garden.

Connection Details

- Corbel Detail

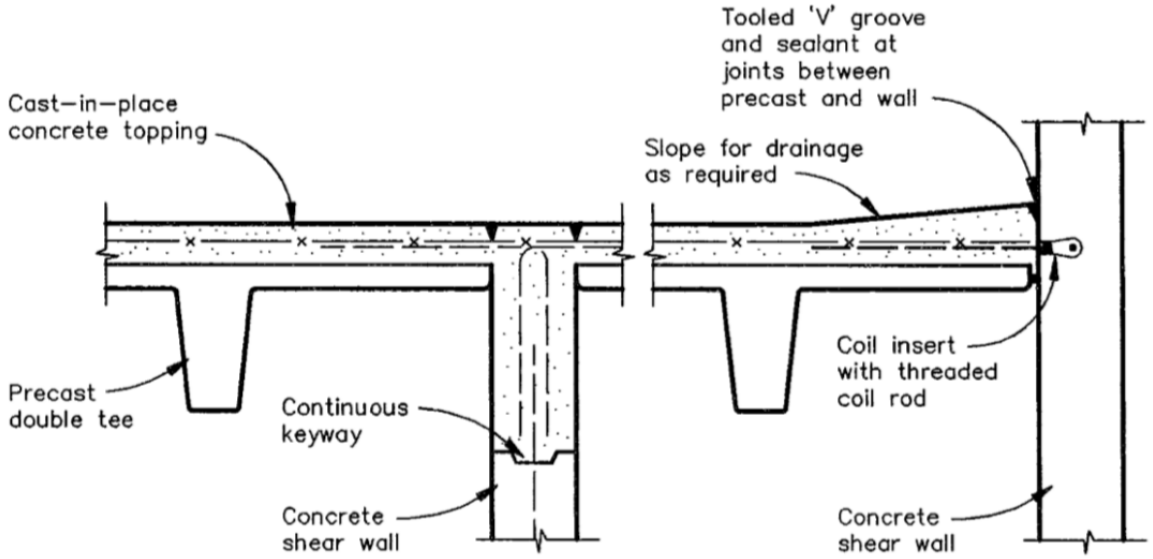
A double tee floor system
can be connected to a bearing
Wall with the help of a corbel,
On which it rests up, along with
being welded or other ways.



Connection Details

- Thin Flange Topped Double Tee

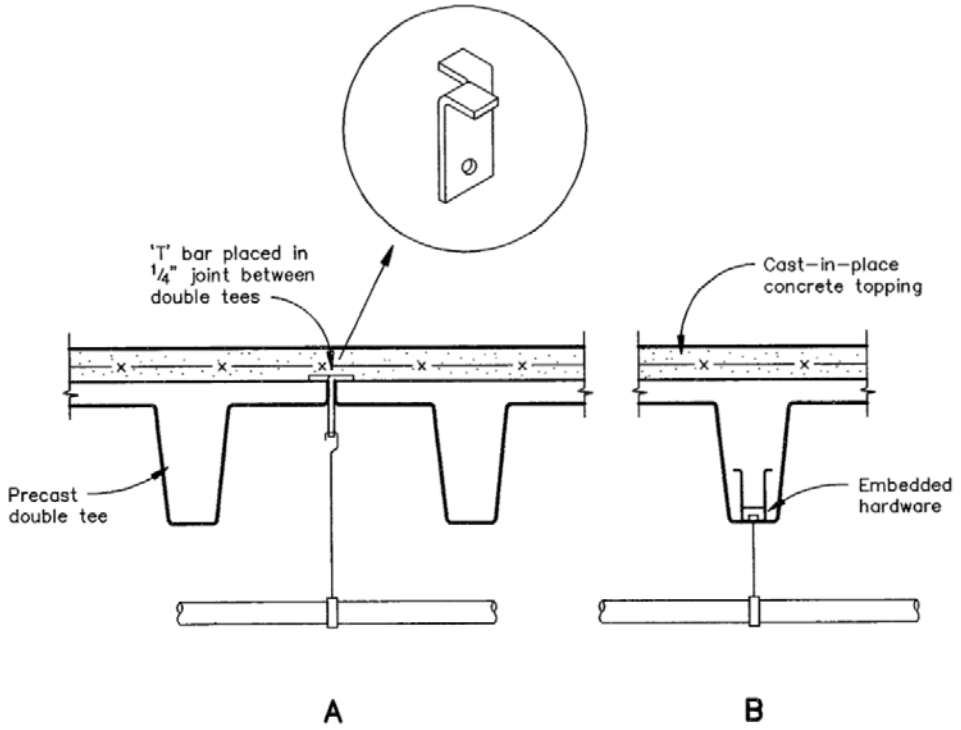
The floor system can be
Put on a concrete
Shear wall by inserting
A threaded coil rod
And by the use of a
Continuous keyway.



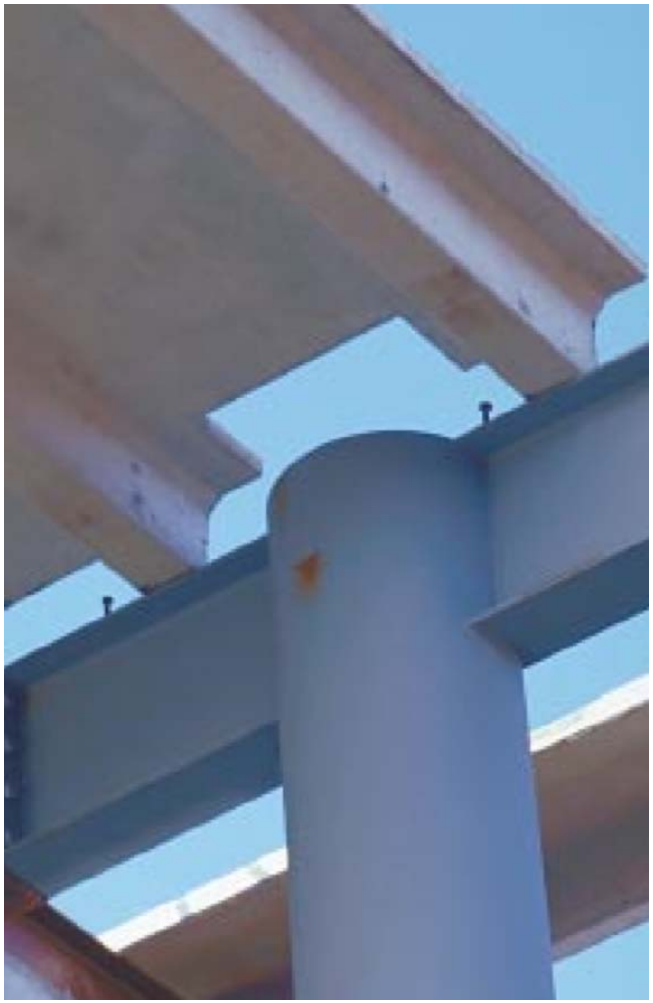
Connection Details

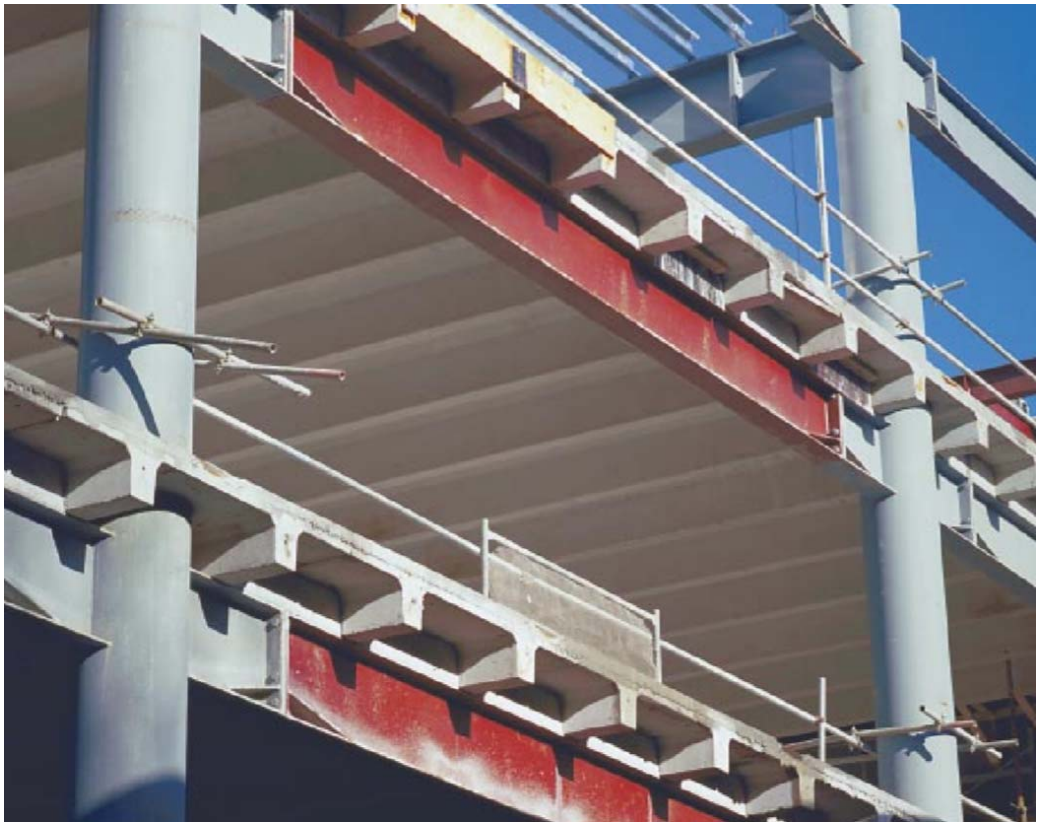
- Hanger Details

A Hanger detail can be put Into the floor system with an i-bar, through which a pipe or ceiling can be hung.



Connection Details





Strengths & Weaknesses

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- They are really affective for long spans of construction such as parking structures, warehouses, industrial plants, etc.
- It is quick to produce, cost efficient, and helps to resist lateral forces during seismic occurrences.

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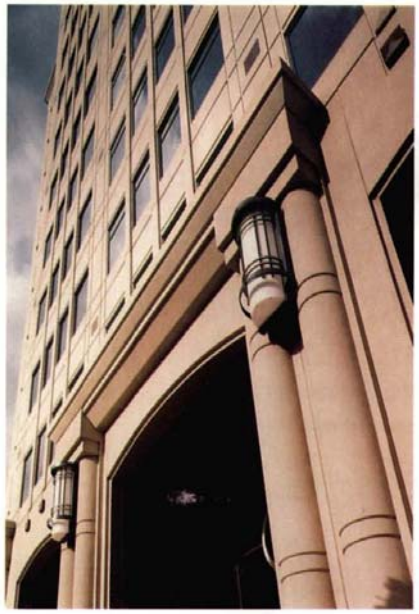
- Not affective for short spans.
- For short spans solid slabs and hollow core slabs save on the overall building height on multistory structures. And their smooth undersides can be just painted and used as finished ceilings in many cases.
- Double tees and single tee floor systems cannot offer a good finished ceiling in itself.

The United Bank Tower

- The United Bank Tower in Colorado was able to implement the double tee floor system, which eventually became a key element of its design.



Case Study

- The United Bank Tower located on Colorado Springs was a $13-million, 16 story building with 249,000 square feet of space. It was complete in 1990 by Klipp Partnership along with the Structural Consultants Inc. of Colorado. A key element of its design was its structural floor system. By using 24 inch double tees on load bearing architectural wall panels, a column free interior was made. This allowed for flexible use of office space.

Precast concrete flexibility

Concrete casting techniques

Today, a number of technologies have emerged, that offers casting methods for a range of purposes. On a large scale, the market is domina ted by well known techniques such as precast elements made from standard moulds and in-situ casting in standardized modular systems. On a small scale, new methods for casting and new types of moulds have emerged to meet the rising demand for customiz ation and creation of curved concrete architecture.

Milled foam moulds

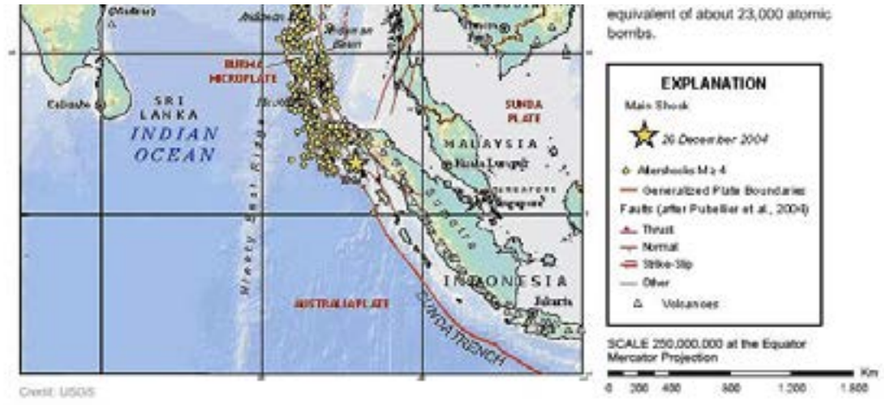
The milled foam method represents the newest and the most economic version of custom manufactured moulds, historically made by hand and recently milled in different materials using CNC.

The weakness of the method is, that it requires manual fairing and coating to a large extend, if the surface has to be of a perfectly smooth, polished quality. For a large pro ject, the formwork is extensive, and

Precast concrete flexibility

Textile formwork

Casting in membrane formwork or textile moulds have been around for a long time. A common feature for all objects that can be cast in this way is, that they must consist of convex surfaces exclusively, since the method relies on the principle that all textiles must be in tension caused by the viscous pressure. The final shape of the cast piece is a result of the membrane's adaption to the pressure, like the shape of an inflated balloon. The formwork is inexpensive in comparison to the surface area and totally smooth surfaces can be achieved. Because of the limited use of material, little waste is produced.

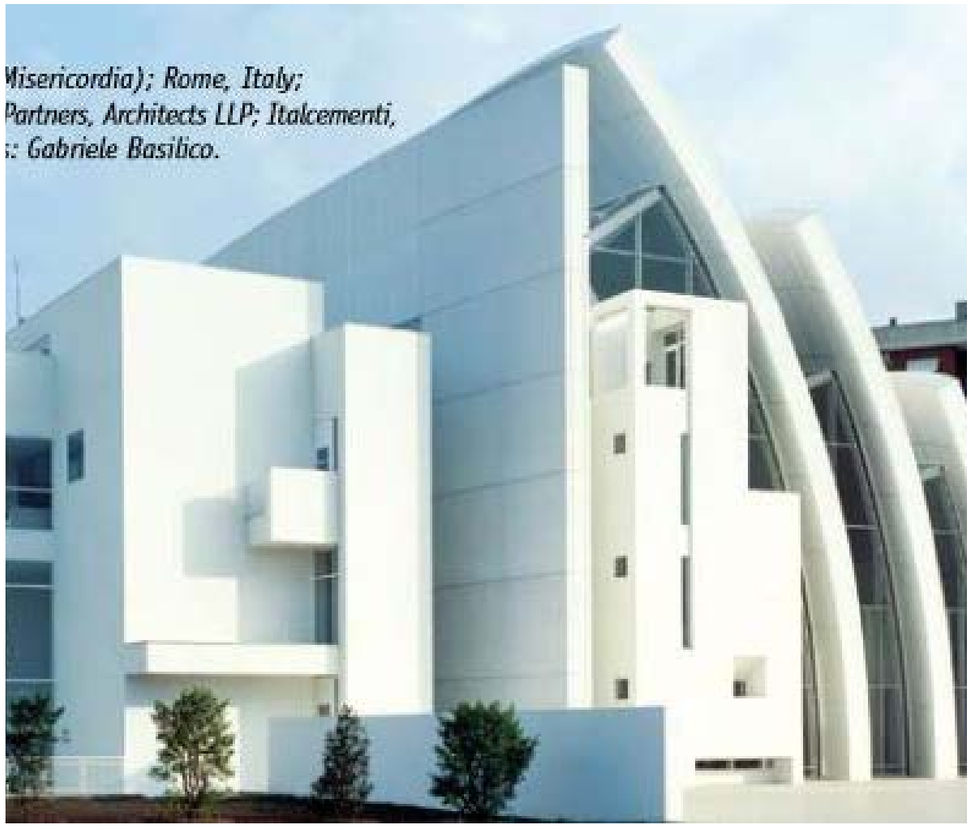


equivalent of about 23,000 atomic bombs.

Fixed or anchored concrete traffic barriers

Spray applied concrete

This method has been around for decades, but is sti
ll used for curved surfaces today. In
short, the concrete paste is mixed with chopped fiberglass
in a spraying nozzle, and
applied to an underlying form with the reinforcement
iron bars bend in place. After
application, the concrete surface is manually faired
or kept rough. The fibers' added to
the concrete serve to add extra strength, but more
importantly to keep the newly applied
concrete in place. The method is mainly used for
 in-situ castings, and can form large
spans and surfaces in one continuous, structural piece
, as the reinforcement is a
continuous structure as well.



Jubilee Church ,Rome Italy
Architect Richard Meier and partners

The structure is also something of a temple to nanoscience—for it retains its bright white hue thanks to the presence of nanostructured titanium dioxide particles embedded within the cement binder that was used to make its concrete walls.

The concrete is made with a white cement containing photocatalytic particles of titanium dioxide that oxidize organic and inorganic pollutants, so that the brightness and color will not degrade over time—resulting in self-cleaning concrete. In addition, the thermal mass of the exposed interior concrete walls keep heat inside in the winter and outside in the summer, reducing the energy

Nanostructured TiO2 particles theoretically will keep the concrete white forever, even in smoggy Rome, says Luigi Cassar, one of the material's inventors. Titanium dioxide, known for its snowy white hue, is used as a pigment in paint and food coloring. But it has self-cleaning properties as well. When ultraviolet light strikes the anatase form of TiO2, it excites the material so that it becomes a catalyst for oxidizing organic grime.

And the concrete doesn't just resist smog, it eats smog. The same photocatalytic chemistry that keeps the church clean also cleans the air around it, gobbling up NOx, SOx, carbon monoxide, aromatics, ammonia, and aldehydes. Italcementi estimates that if it covered 15% of the visible surfaces of a large urban area, such as Milan, with its current product containing the smog-eating nanostructured substance, TX Active, it could cut the city's air pollution in half.

FLEXIBILITY OF SPACE PLANNING

From a design perspective, the greatest advantage of a total precast system is the versatilityand flexibility of space planning options. Total precast delivers interior space unencumbered by a multitude of columns, allowing for greater freedom of design options. Using this system the trend for larger open floor plates is accommodated quite easily. Typical total precast column grid spacing is 50% greater or more than other framing systems.

Color of the final design

Samples can include one or more colors, finishes, or different materals (such as brick or stone) cast into the precast. The varieties available are almost endless. These samples establish the basis for beginning the mock-up process and are the catalyst for other exterior selections such as glazing, window and door framing, and other exterior design features

Jubilee church

Photocatalytic concrete

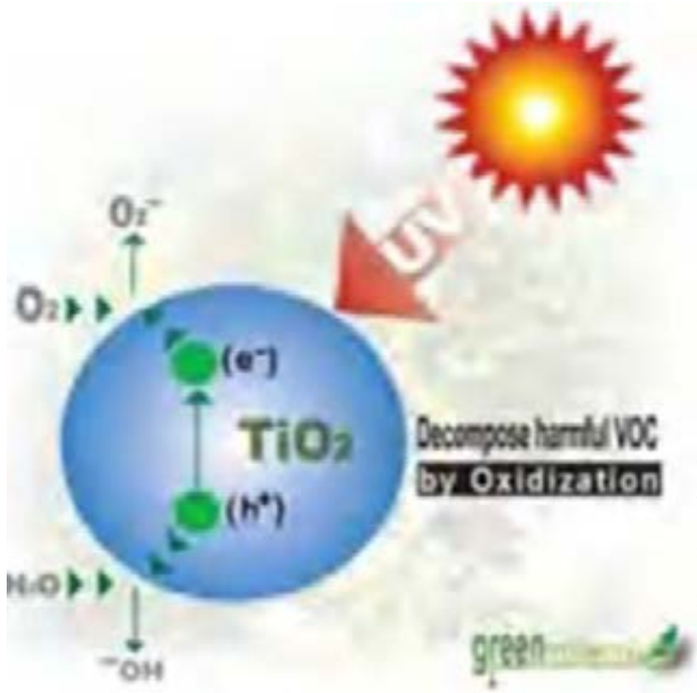
Self-cleaning buildings and pollution-reducing
Recently introduced formulations of cement are able to neutralize pollution. Harmful smog can be turned into harmless compounds and washed away.

The used of
particles of titanium dioxide is what makes this cement special.
The technology can be applied to white or gray cement and it works like any other portland cement: it can be used in all varieties of concrete, including plaster.
Presumably, applications for mortar might be beneficial, too., although the mortar has a smaller surface area. The only difference is that it is capable of breaking down smog or other pollution that has attached itself to the concrete substrate, in a process known as photocatalysis.
As sunlight hits the surface, most organic and some inorganic pollutants are neutralized. They would otherwise lead to discolored concrete surfaces.

The titanium-based catalyst is not spent as it breaks down pollution, but continues to work.
Typical products are oxygen, water, carbon dioxide, nitrate, and sulfate.

Because rain washes away the pollution from the concrete surface, buildings stay cleaner and do not require chemical applications that are potentially harmful to the environment.

Maintenance costs are reduced.



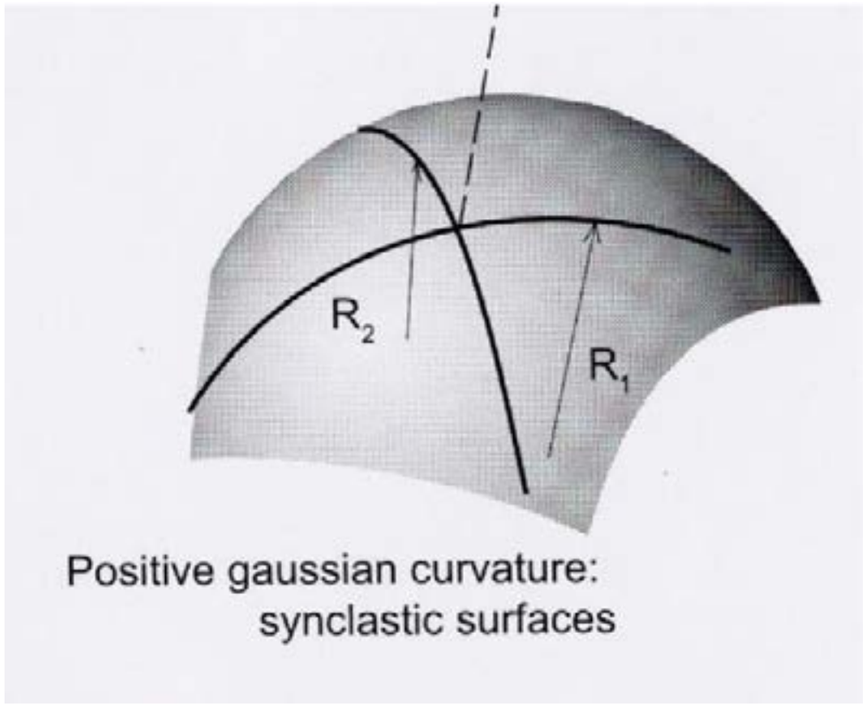
Using the energy from the light titanium dioxide creates two oxydation reactants:
-Hydroxyl radicals
-superoxide anion
which decomposes toxic organic substance by oxydation.

Flexibility of the structure

The system used for the arch of this church is a
double curvature system," which Bechthold describes as a hybrid, but is also known as a 3D system, has the benefit of taking on greater loads and stresses

Double curvature
systems spread their loads evenly in all direction

These systems themselves can be divided into two forms. The first being the "Positive Gaussian Curvature," also formally and more rarely known as a synclastic system (see fig. 16). The second is the "Negative Gaussian Curvature" or anticlastic system (see fig. 17). Positive Gaussian Curvatures are similar to the shapes of domes in found nature, such as the fore-mentioned egg.



Positive gaussian curvature:
synclastic surfaces

A major reason for their structural strength is that double-curvature systems spread their loads evenly in all directions