

COMPETITION ELECTIVE: ESSAY PORTION

ECO TUNNELS: WEAVING THE GARDEN INTO THE VERTICAL CITY

J CAMERON PARKIN

As architects and planners have approached dense urbanism there has been conflict between green space and dense housing. Many iconic city plans such as *Plan Voisin* and *Regent Park* have focused on mediating these two elements. In addition to this, the typology of tower (for example, point, linear, cruciform) has also been a key feature of these modernist urban idealist plans. My proposal, *Eco Tunnels* utilizes the raised linear typology of housing tower developed by architects such as Le Corbusier and Mario Fiorentino. While *Eco Tunnels* references an existing formal typology and addresses modernist themes of dense housing being combined with green space, this project uses contemporary appropriation of complex mathematical geometries and phenomena seen in Toyo Ito and Mark Fornes' work to interweave these elements, offering a contemporary solution to previous issues caused by the separation of residential and park space.

In looking at dense residential towers, it can be seen that their typologies are often a result of the shape of the tower in plan, combined with the treatment of the ground plane and street frontage, for example, the typology of a point tower on a podium, which is currently very common in Toronto. With regard to the tower itself, *Eco Tunnels* uses a linear typology, which was used by modernist architects to create a sense of community in the long continuous, double-loaded floor slabs. An example of this is *Unité d'habitation* (Fig. 1),

where Le Corbusier created one of the first housing developments after World War Two in the form of a linear raised tower.¹ Le Corbusier's goal was to create "communal living for all the inhabitants to shop, play, live, and come together in a 'vertical garden city.'"² Le Corbusier achieved this by creating long, bright, and spacious communal hallways and by including public amenities on the roof and dispersed throughout the building.³ Le Corbusier enforced this idea of community by raising the buildings, creating a public arcade along the length of the linear building at ground level. *Eco Tunnels* uses this linear typology to achieve the same goals of creating community by having double-loaded floor plates with large open communal areas for circulation and meetings, which receive light through the algae façade (Fig. 2). This algae façade encloses the park space, which weaves throughout the linear mass of the building, exaggerating the typology of the "vertical garden city". *Eco Tunnels* is also raised above ground level, like *Unité d'habitation*, which not only allows the public to circulate at ground level, but also leaves the existing urban fabric and street frontages intact as development encroaches on established low rise areas.

Another project that uses the modern linear typology to create a sense of community is *Corviale*, by Mario Fiorentino (Fig. 3). *Corviale* is a kilometer long housing development on the outskirts of Rome, which was conceived as its own independent community.⁴ In addition to utilizing a linear plan to connect residents, *Corviale* incorporates interstitial public space in the form of interior courtyards,

¹ "Unité d'habitation, Marseille, France, 1945," Foundation Le Corbusier, accessed Aug 19, 2015, <http://www.fondationlecorbusier.fr/corbuweb/morpheus.aspx?sysId=13&IrisObjectId=5234&sysLanguage=en-en&itemPos=58&itemCount=78&sysParentId=64&sysParentName=home>.

² "AD Classics: Unite d' Habitation / Le Corbusier," Arch Daily, accessed Aug 19, 2015, <http://www.archdaily.com/85971/ad-classics-unite-d-habitation-le-corbusier>.

³ "AD Classics: Unite d' Habitation / Le Corbusier,"

⁴ "Corviale," Housing Prototypes, accessed Aug 19, 2015, http://www.housingprototypes.org/project?File_No=ITA004.

circulation, and a fourth floor which was to be dedicated to public program.⁵ Despite the high aspirations of creating community in this building, a lack of funding in implementing the public amenities and in maintenance led to squatting and eventually disrepair and a dangerous environment.⁶ This is one of many examples where aspirations around public space, through poor maintenance, segregation, and separation have resulted in an urbanism that is dangerous and unwelcoming, rather than communal and lush. This was also the case with Toronto's first public housing project, *Regent Park*, which resembles Le Corbusier's *Plan Voisin*. *Plan Voisin* was a proposed plan created for the center of Paris. Le Corbusier's plan consisted of tall, dense, glass cruciform towers that left the ground level open for leisurely parks.⁷ Le Corbusier pushed this plan as an alternative to dense, crowded, and dangerous streets, promoting his utopian vision of a lush and breezy ground plane with "crystal" towers rising above, neither interrupted by each other.⁸ However, when this idea of open green spaces at ground level was applied to Regent Park in the form of public courts between widely spaced buildings, the results were anything but utopian. The courts, because they had no sense of ownership, and because buildings enclosed them, became difficult to patrol, isolated, and dangerous.⁹ This shows the shortcomings of urban plans that isolate large public green spaces from dense residential blocks. By weaving park space throughout the project, *Eco Tunnels* creates a new solution to Le Corbusier's idea of the tower in a park (Fig. 4). In addition to this, by raising the building above the existing urban fabric, the project abandons both the podium and the park at ground

⁵ Beatrice Bruscoli, *Modernism in Rome*, University of Waterloo School of Architecture, Rome, November, 2015.

⁶ Bruscoli

⁷ "Plan Voisin, Paris, France, 1925," Foundation Le Corbusier, accessed Aug 19, 2015, <http://www.fondationlecorbusier.fr/corbuweb/morpheus.aspx?sysId=13&IrisObjectId=6159&sysLanguage=en-en&itemPos=2&itemCount=2&sysParentName=Home&sysParentId=65>.

⁸ "Plan Voisin, Paris, France, 1925,"

⁹ Tabatha Southey "Reconsidering Toronto's Regent Park," *The Globe and Mail*, accessed Aug 20, 2015, <http://www.theglobeandmail.com/globe-debate/columnists/reconsidering-torontos-regent-park-look-again-its-where-canada-works/article17496247/>

level, typologies that ignore context and divorce the ground form the residential tower. By weaving green space throughout the entire volume of the building, this project offers a contemporary solution to the issues of existing urban typologies by utilizing mathematical geometry and theory.

This project uses mathematical geometries that have recently been appropriated in architecture to solve spatial issues with continuous and efficient surfaces. *Eco Tunnels* is heavily influenced by the gyroid, which is a specific type of minimal surface. The gyroid consists of a complex single surface that creates two spaces (one on each side of the surface), which are interwoven but remain continuous and never fully interrupt each other (Fig. 5).¹⁰ This allows the park and residential space to be integral and beneficial to each other while remaining two separated and continuous systems (Fig. 6). Minimal surfaces have been common phenomena in math since the 1700s¹¹ and are also seen in other fields such as chemistry where polymers, which repel each other, create a minimal surface that separates them. This is known as phase separation polymers.¹² While these geometric typologies have existed in scientific and mathematic fields for centuries, they have only recently become popular in architecture as complex modeling and construction methods have become available. An example of this is Toyo Ito's *Taichung Metropolitan Opera* (Fig. 7). Ito uses a gyroid inspired minimal surface to curate dynamic and continuous spaces with a single surface.¹³ This type of surface, in addition to its ability to curate strong and engaging spatial matrixes, has inherent structural benefits, due to its double curvature with tight radii. These beneficial properties found in minimal surfaces are exploited

¹⁰ "Triply-periodic minimal surfaces," Schoen Geometry, accessed Aug 19, 2015, <http://schoengeometry.com/e-tpms.html>.

¹¹ "Minimal Surface," Wolfram MathWorld, accessed Aug 19, 2015, <http://mathworld.wolfram.com/MinimalSurface.html>.

¹² Michael. R. Bockstaller and Edwin L. Thomas, *Nanostructures From Phase Separated Polymers* (Cambridge, MA: M.I.T.)

¹³ Jane Burry and Mark Burry, *The New Mathematics of Architecture*, (London: Thames and Hudson, 2012) pg. 205.

to a great degree in Marc Fornes' work. Fornes relies on these tight radii double curves surfaces to create installations that consist of self-supported surfaces that envelope its inhabitants (Fig.8). This creates surfaces that are complex and exploratory as well as efficient and calculated. This exploration of efficient self-supporting surfaces relates to work by Felix Candela and Eero Saarinen using thin shell concrete (Fig. 9). While exploration of structural efficiency and curvature in thin surfaces stems from Candela's work, new computational methods have allowed huge advancements in the complexity and accessibility of this strategy, creating an emerging contemporary typology. This typology has taken on more significance as it has evolved, as described by Greg Lynn. Greg Lynn explains in *Architectural Curvilinearity*, how these "smooth" solutions are a response to postmodern and deconstructivist fragmentation.¹⁴ He talks about how this new typology can solve complex issues and contradictions with one continuous solution.¹⁵ This speaks to the power of using continuous geometries to create synthesis in opposing typologies, in this case, park and tower.

It can be seen that by using complex geometries from the field of mathematics, which are being harnessed with increasing complexity and affect in architecture, to efficiently intertwine a raised linear residential building with a network of performative public park spaces, *Eco Tunnels* is able to offer a new urban typology which solves issues caused by the separation of park space and dense housing. *Eco Tunnels'* strategy of respecting existing context as development encroaches on established low-rise neighborhoods, in this case, where Liberty Village expands to meet Queen West in Toronto, while incorporating public green space throughout the mass of the building, is increasingly important as Toronto and other cities continue to grow. This allows sensitivity and preservation of existing fabric as well as

¹⁴ Lynn, Greg, "Architectural Curvilinearity" in *Constructing a New Agenda for Architecture: Architectural Theory 1993 - 2009*, Chapter 1 (New York: Princeton Architectural Press, 2010), pg 8

¹⁵ Lynn, Pg 8

widely accessible green space in increasing urban density. This is a powerful demonstration of how existing typologies should be constantly updated with cotemporary technology and strategies in order to create new typologies that react to evolving needs and motives as our urban environment becomes more dense and thus, increasingly delicate.

FIGURES



Fig. 1 – Exterior of *Unité d'habitation* by Le Corbusier

<<http://www.fondationlecorbusier.fr/corbuweb/morpheus.aspx?sysId=13&IrisObjectId=5234&sysLanguage=en-en&itemPos=58&itemCount=78&sysParentId=64&sysParentName=home>>

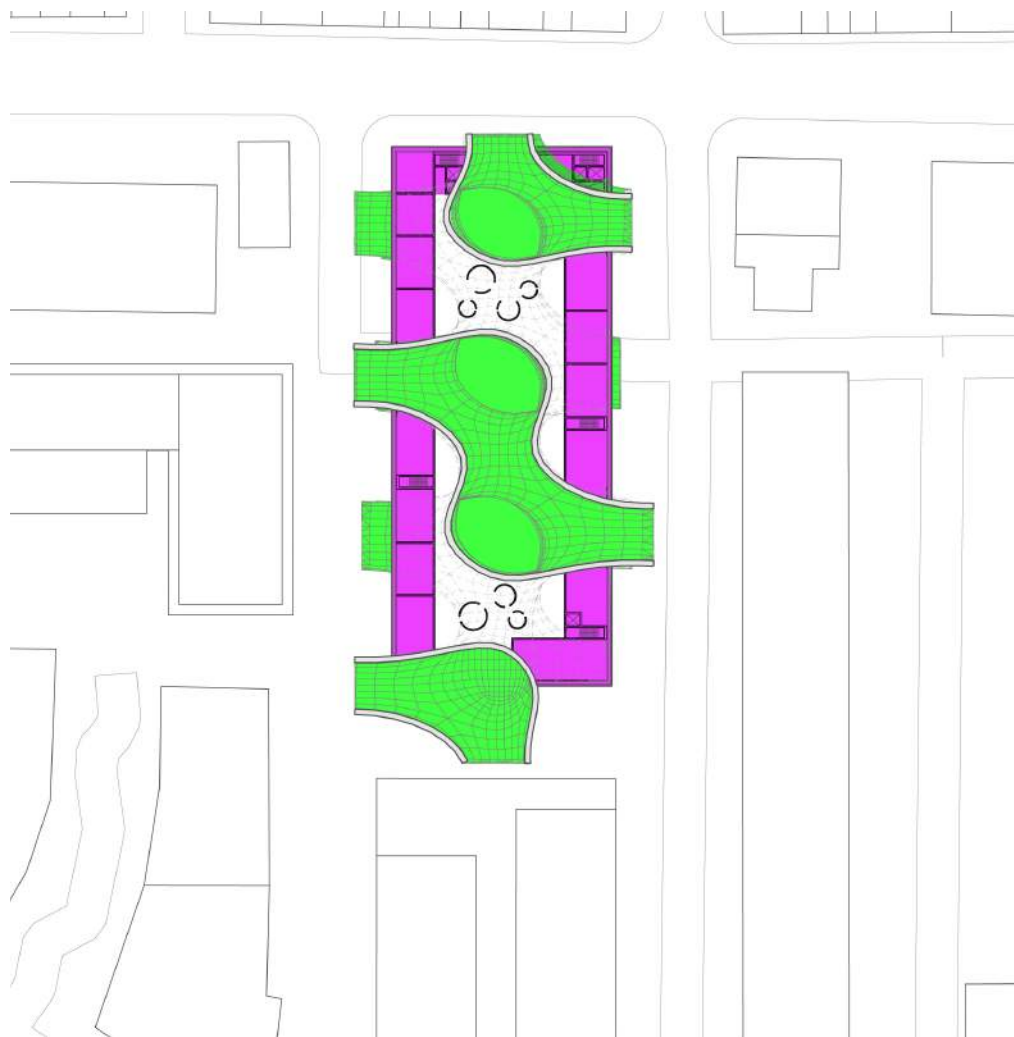


Fig. 2 - Typical plan of *Eco Tunnels* showing residential units in pink, and the green space in green. The remaining white is communal circulation and meeting space.



Fig. 3 – Exterior and interior courtyard of *Corvia* by Mario Fiorentino
< <http://www.housingprototypes.org/images/Corvia01m.jpg> >

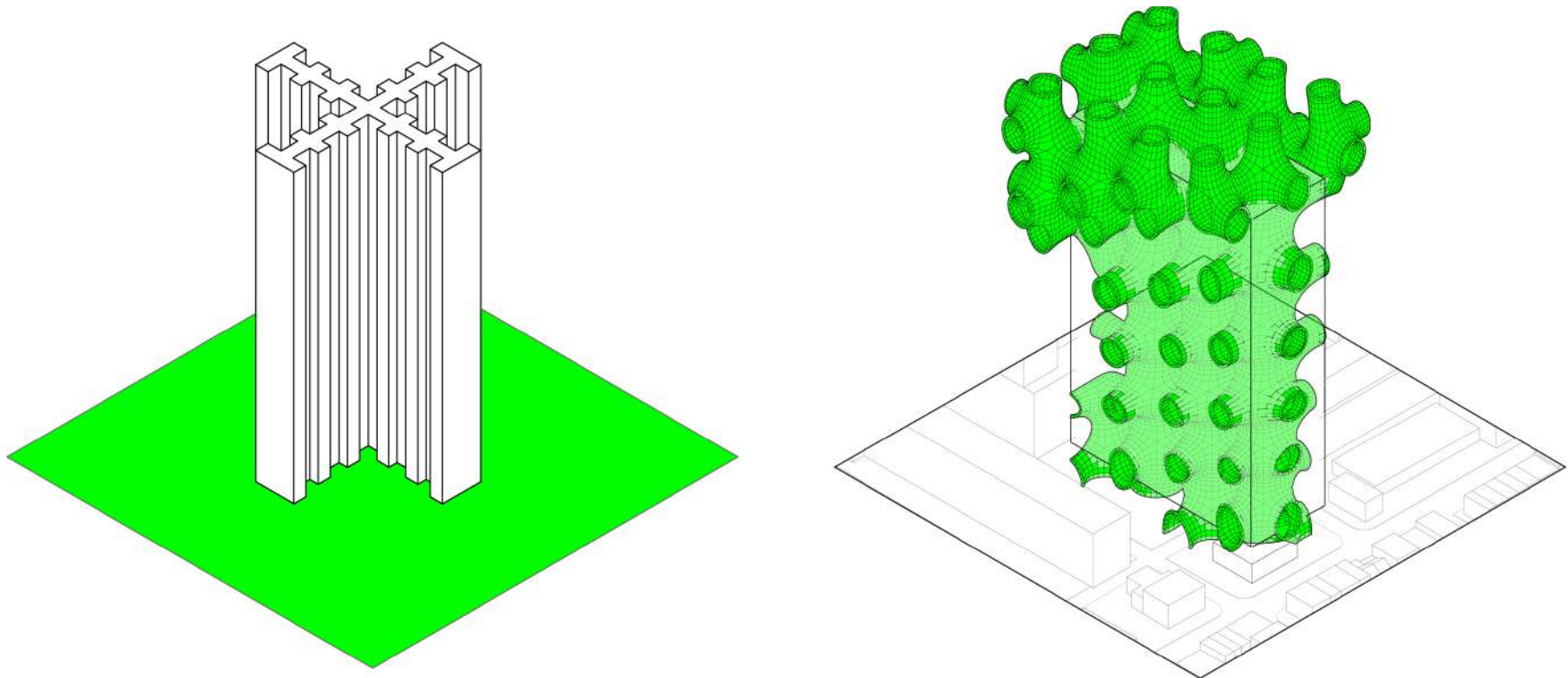


Fig. 4 - Diagram comparing *Plan Voisin's* separation of park and tower and *Eco Tunnels'* combination of these typologies

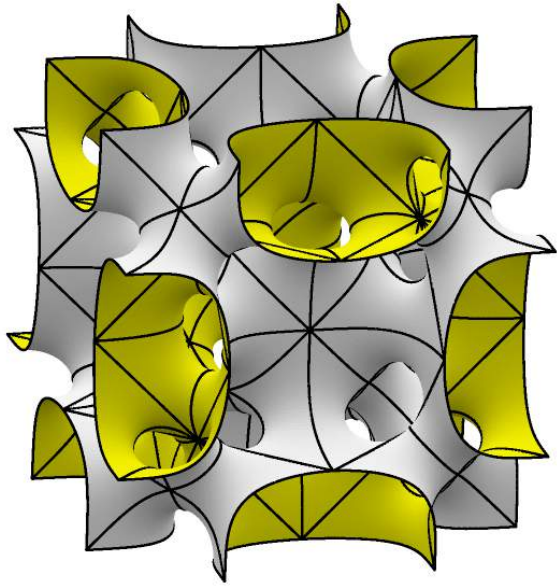


Fig. 5 - Triply Periodic Minimal Surface
<http://facstaff.susqu.edu/b/brakke/evolver/evolver.html>

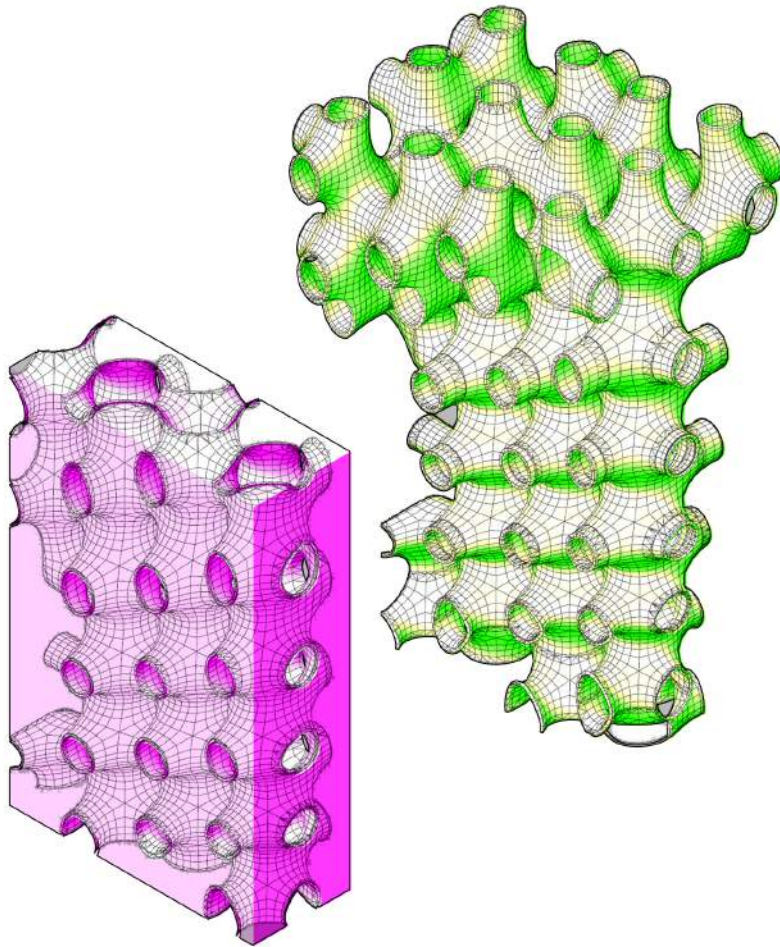


Fig. 6 – Separated continuous residential (green) and public (pink) volumes of *Eco Tunnels*



Fig. 7 – Model of Toyo Ito's *Taichung Metropolitan Opera*
<<http://www.designboom.com/architecture/toyo-ito-taichung-metropolitan-opera/>>



Fig. 8 – Model of Toyo Ito's *Taichung Metropolitan Opera*
< http://theverymany.com/constructs/10-frac-centre/tvm_f-lauginie_015_s/>

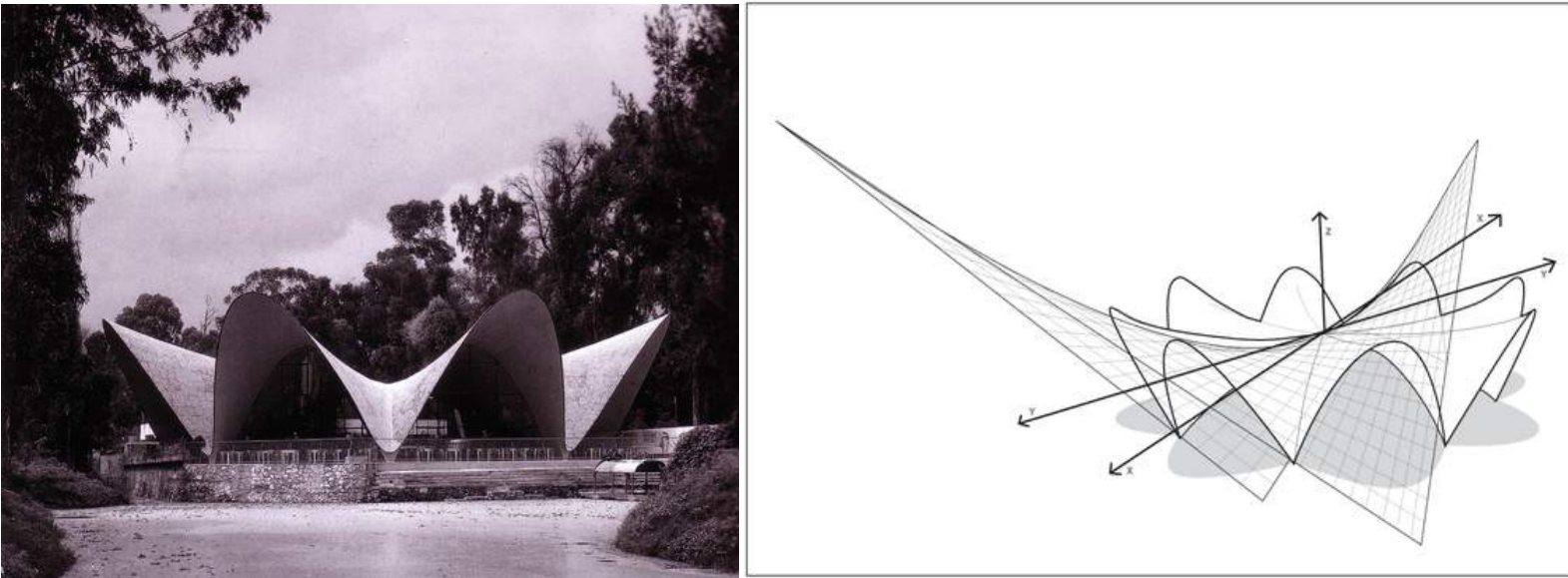


Fig. 9 – Exterior and geometric diagram of *Los Manantiales* by Felix Candela
< http://theverymany.com/constructs/10-frac-centre/tvm_f-lauginie_015_s/>

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