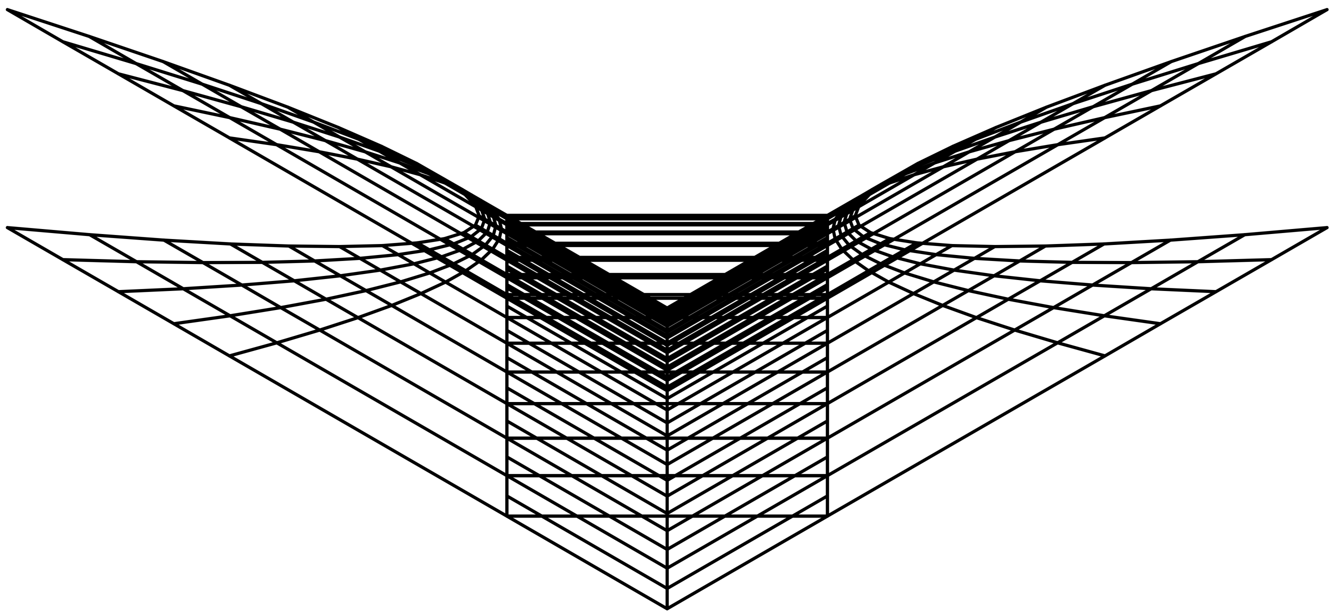
Luis Bozzo Estructuras y Proyectos

Innovative Structural Engineering

Luis Bozzo

Estructuras y Proyectos



Contents

OUR HISTORY SINCE 1939

Luis Bozzo Structures and Projects S.L. is a company of engineers, architects and technical specialists that offers the highest specialisation in the area of structures and in particular its seismic protection and / or **large open spaces**. It has specific patents in Peru, Spain and Mexico for seismic energy dissipators or for large-span decks.

Based in Spain, the company has offices in Lima, Peru and Guadalajara, Mexico. Its beginnings in Spain were in 2003, although it was previously part of the family business DIRACSA SA, with Miguel Bozzo Ch. engineers founded in 1939 to design large span innovative structures of the time.

Club Regatas in Lima, Peru designed in 1940's by Miguel Bozzo.

Luis Bozzo Estructuras y Proyectos SL is currently the Spanish engineering firm that has designed some of the most innovative buildings designed in South America (Paradox tower in Santa Fe, Mexico with 60 stories and Puebla Tower with 51 stories) together with the Christian cathedral of free form with the greatest dimension without intermediate supports (Sanctuary of the Martyrs of the Church in Guadalajara, Mexico). The combination of the highest professional specialisation, integrated in a dynamic and close team produces quality results.

Through our network of offices in Barcelona, Lima and Guadalajara we contribute to with our experience and professionalism in countries and diverse cultural environments. At present we have carried out projects in Spain, Mexico, Peru, Chile, Bolivia, Ecuador, France, Bahrain, Bulgaria, Ghana, among others.

We have developed projects with many structural types for buildings and in all its areas such as housing, offices, schools, sports centres, stadiums, cathedrals, social housing and private homes. We annually project more than 1,200,000 m2 per year of structure in particular for high-rise buildings and for open-plan floors without intermediate columns. We are currently developing in Puebla one of the most slender buildings with 210m of height and only 20m wide equipped with our patent for seismic dissipators SLB ("Shear Link Bozzo").

Miguel Bozzo

YEARS OF CONTINUOS INNOVATIONS

Our company combines the advanced calculation of structures together with the specific development of automated drawing programs that facilitate efficiency and savings for the client. The associated company SESPID (www.sespid.com) has developed specific computer tools for the optimal generation of plans of structures that allows not only to have the security of its correct delineation but also to optimise resources with common quality standards.

Industrial building in 1987 with a 100x70m structured supported only on 4 interior columns and the perimeter.

OUR GLOBAL STRUCTURAL ENGINEERING INNOVATIONS

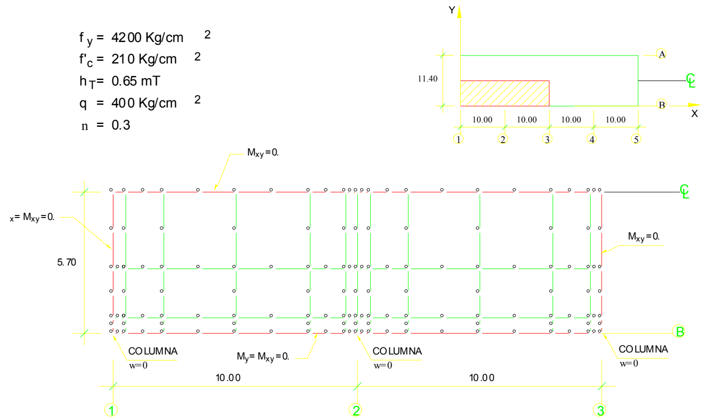
Finite Element Analysis

Our company has been one of the global leaders in developing and using finite element analysis techniques for long span slabs since 1985

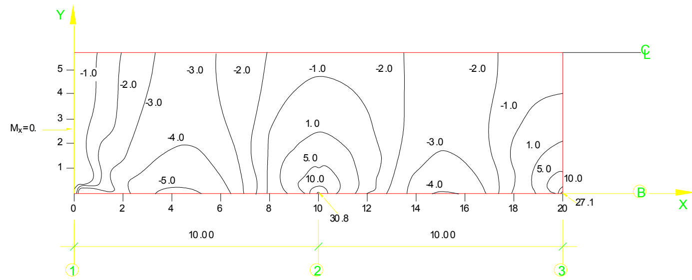
We have developed and programmed a computer software for the analysis and design of shells creating a new Finite Element that we have called CI8m

In fact our CI8m element has been the world precisest element, much better performance than standard Melosh FE.

MALLA DE ELEMENTOS FINITOS CONSIDERADA



DISTRIBUCION DEL MOMENTO FLECTOR Mx (T m)



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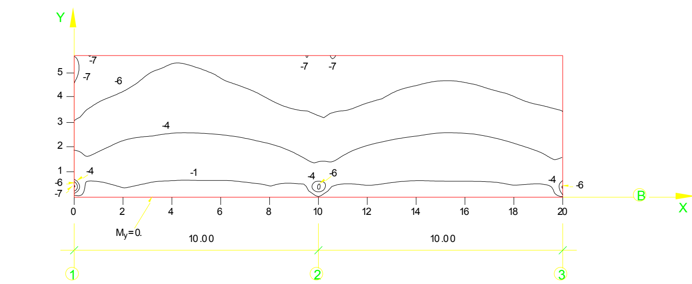
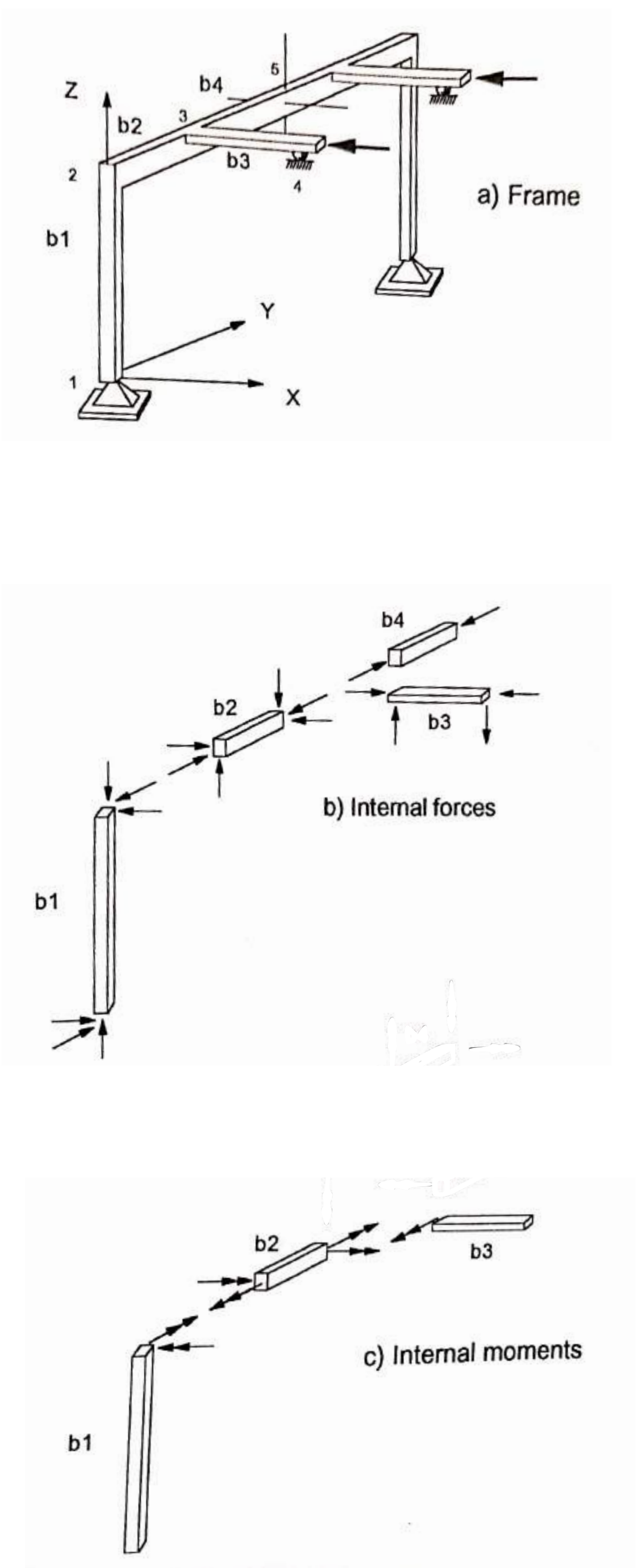
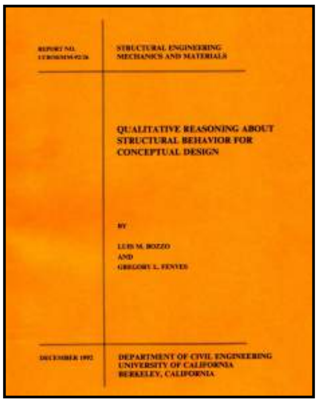


Captures of 1985 structural analysis of a 10x40m free of interior columns slabs constructed by our company DIRACSA.

First world computer program simulating artificial intelligence in structural analysis



Between 1988 - 1992 we developed and programmed the first “deep thought” or “hard artificial intelligence” methodology tool for conceptual structural design in a platform called Agrippa. Based on bar’s qualitative states and deep equilibrium and compatibility laws Agrippa predicts, without any numerical value, qualitative structural response such as, for example, the complex load transfer characteristics for the Cypress Viaduct shown below. This qualitative analysis indicates the structure for this Viaduct was not adequate because there is no redundancy and component b2, in the load transfer path, is subjected to a complex state of stresses including torsion. The deficiency is detected by our AI software because a subsequent evaluation indicates that if the member b2 fails in torsion the whole structure would collapse (as it did and tragically shows the photo) because there is no load path that would transfer the longitudinal load.


STRUCTURAL ENGINEERING
MECHANICS AND MATERIALS

QUALITATIVE REASONING ABOUT
STRUCTURAL BEHAVIOR FOR
CONCEPTUAL DESIGN

BY

LUIS M. BOZZO
AND
GREGORY L. FENVES

DECEMBER 1992

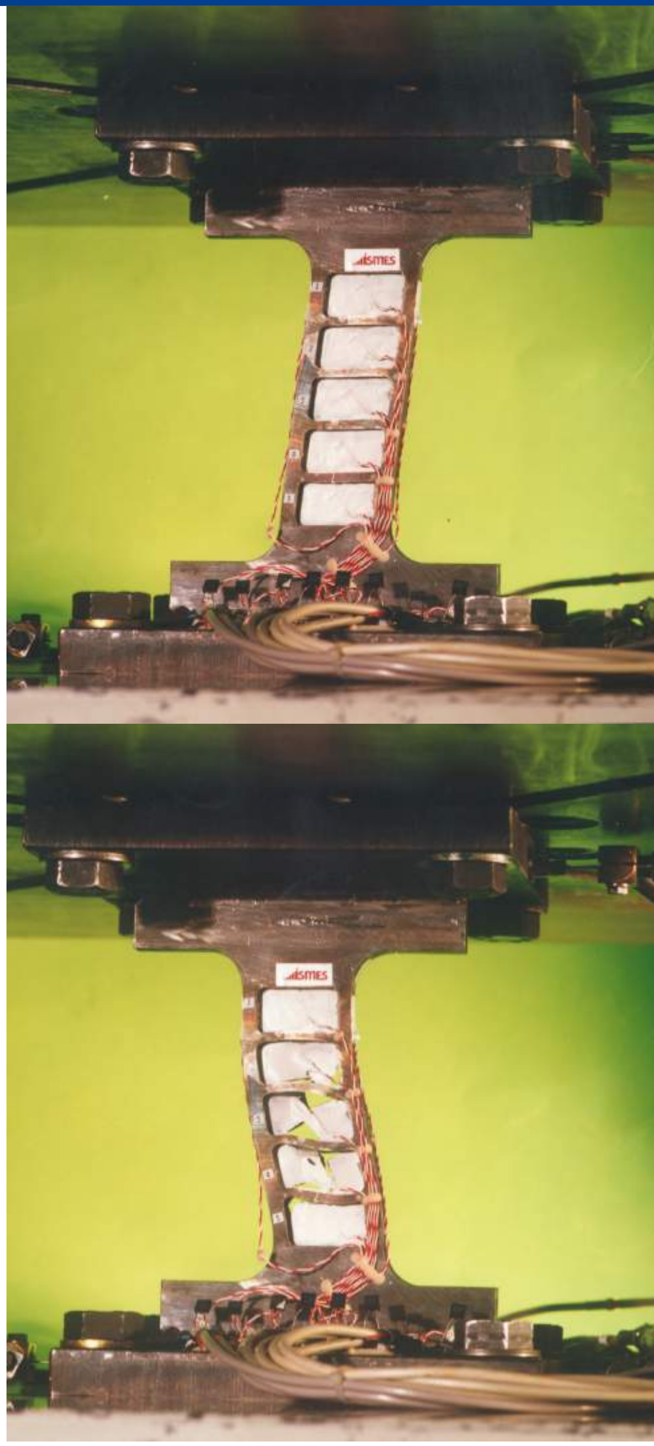
DEPARTMENT OF CIVIL ENGINEERING
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA


```
% Module : coupled_eqs
% Purpose: Add Relations by Coupled Equations
```

Shear Link Bozzo Dissipator

Our Shear Link Bozzo dissipator (SLB) has been selected for protecting buildings in Mexico, Peru, Ecuador, Costa Rica and Guatemala. Presently there are more than 2000 units installed in many countries protecting buildings economically.

The system has been tested in the largest European laboratories such as Ismes and Federico II University testing lab (Italy), as well as in UNAM (Mexico) and PUCP (Perú).



Shear and Flexural failure test

Shaking table results with and without SLB devices.
("*Simulación de un ensayo en mesa vibrante de una estructura con dispositivos de disipación sísmica para viviendas de bajo coste*" by Eng. Guillermo Bozzo Fernández, TFG 2018)

Semi-Precast prestressed structural system for long span flat slabs of heavy loads

We have developed in Spain and Mexico a semi-precast system based on prestressed pre-slabs.

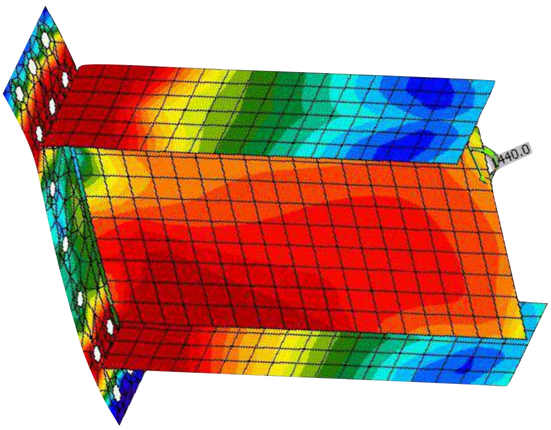
Using our structural system we have constructed more than 1.500.000 m2 only in Spain and France.

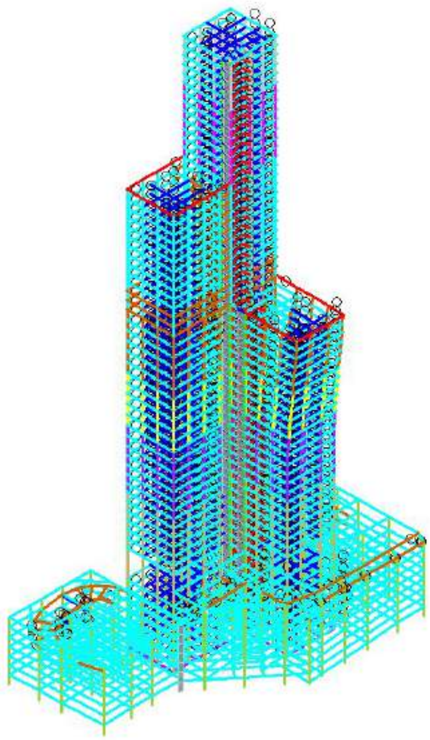
Advantages

- Constructive simplicity.
- Use of highly resistant materials.
- Ductile details connections designed for seismic loadings.
- High quality guaranteed.
- Reduction of loads in columns and footings.
- 20-40% reduction of depth compared to conventional forging.
- Labor reduction.
- Bidirectional work using a semi-precast solution.
- Use of prestressed slabs with welded truss that ensures a joint work between the slabs and the concrete.

Our Services

- Long span free form architectonical structures for more than 80 years.
- High rise complex on slender tall structures.
- Minimum depth / maximum span free of columns structures.
- Global innovations and specific structural systems such as our SLB devices or semi-precast prestressed slabs.
- BIM model generation.
- Structural reinforcement / retrofitting using our patented SLB systemic energy dissipators.





OUR PROJECTS
SINCE 1985

10 Countries
+2000 Projects
+400 SCIENTIFIC PAPERS

Torre OAK 58

Location
Puebla, Mexico

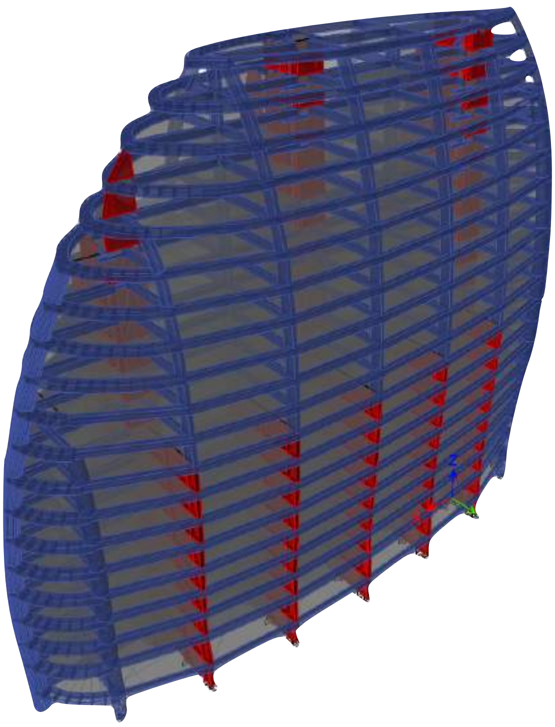
Height
218m / 51 floors

Year
2019

The Puebla OAK58 tower is a singular multi uses building made up of two high-rise buildings interconnected by 3 bridges located in different elevations. The structure is a rigid central core of reinforced concrete, columns, and lightweight unidirectional Post-tensioned slabs that reduces significantly the self weight (of great impact in tall buildings reducing ecological footprint).

In order to minimise human sensitivity under strong wind gust the towers incorporate 400 SLB units located between departments with un-coupled concrete walls.

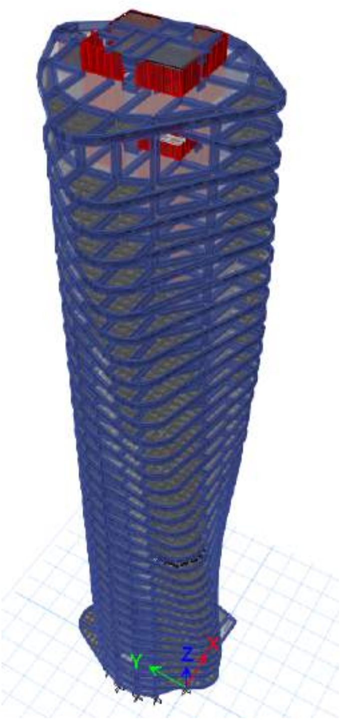
Mare by Cavalli



Location	**Height**	**Year**
Acapulco, Mexico	64m / 21 floors	2019

The complex architectonical shape is perfectly integrated with a dual structural system with central core concrete walls and 3D frames. The columns are variable section and length on the perimeter of the structure suiting the architectonical shape. The floor system is lightened postensioned bi-directional and uni-directional slabs.

Cúspide Bosque Real



Location	**Height**	**Year**
Huixquilucan, Mexico	130m / 35 floors	2019

The very complex architectonical shape with different plan levels for each floor creates a dramatic visual effect which is perfectly matched with a concrete central core and only perimetral columns. The seismic loads are primarily transferred by the central core and the complex floor geometry is solved with special frames for each level.

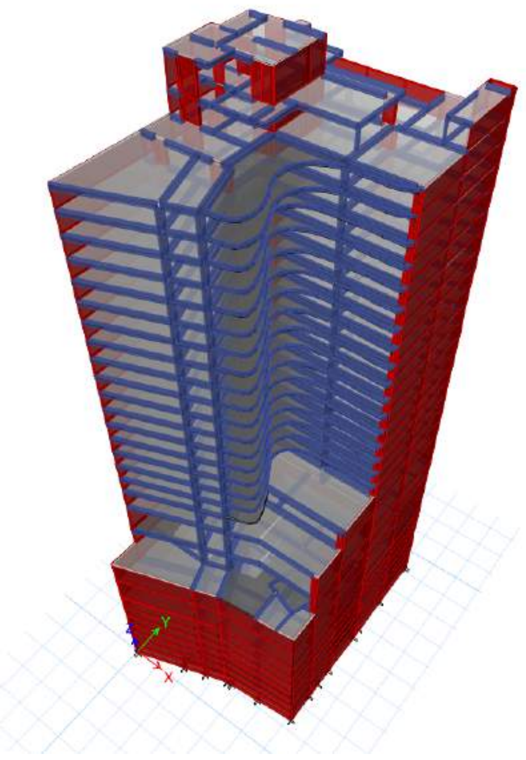
Hotel Ritz

Location
Lima, Peru

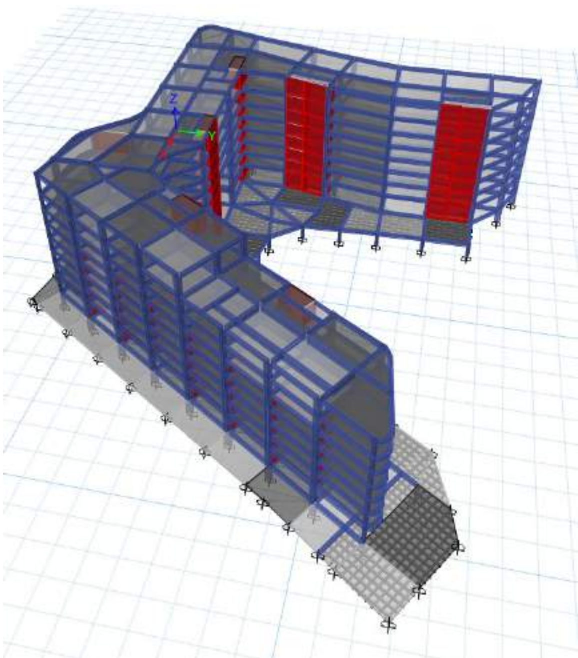
Height
108m / 22 floors

Year
2019

This hotel in first line above Lima's cliffs opens its interior dramatically in order to maximise rooms with a sea side view. Besides it requires open spaces at 4th floor solved with a special transfer beam that supports more than 17 levels above. This unique structure in Lima uses massively postensioning and integrates perfectly strong architectonical requirements with an efficient structure.



Marina Vallarta



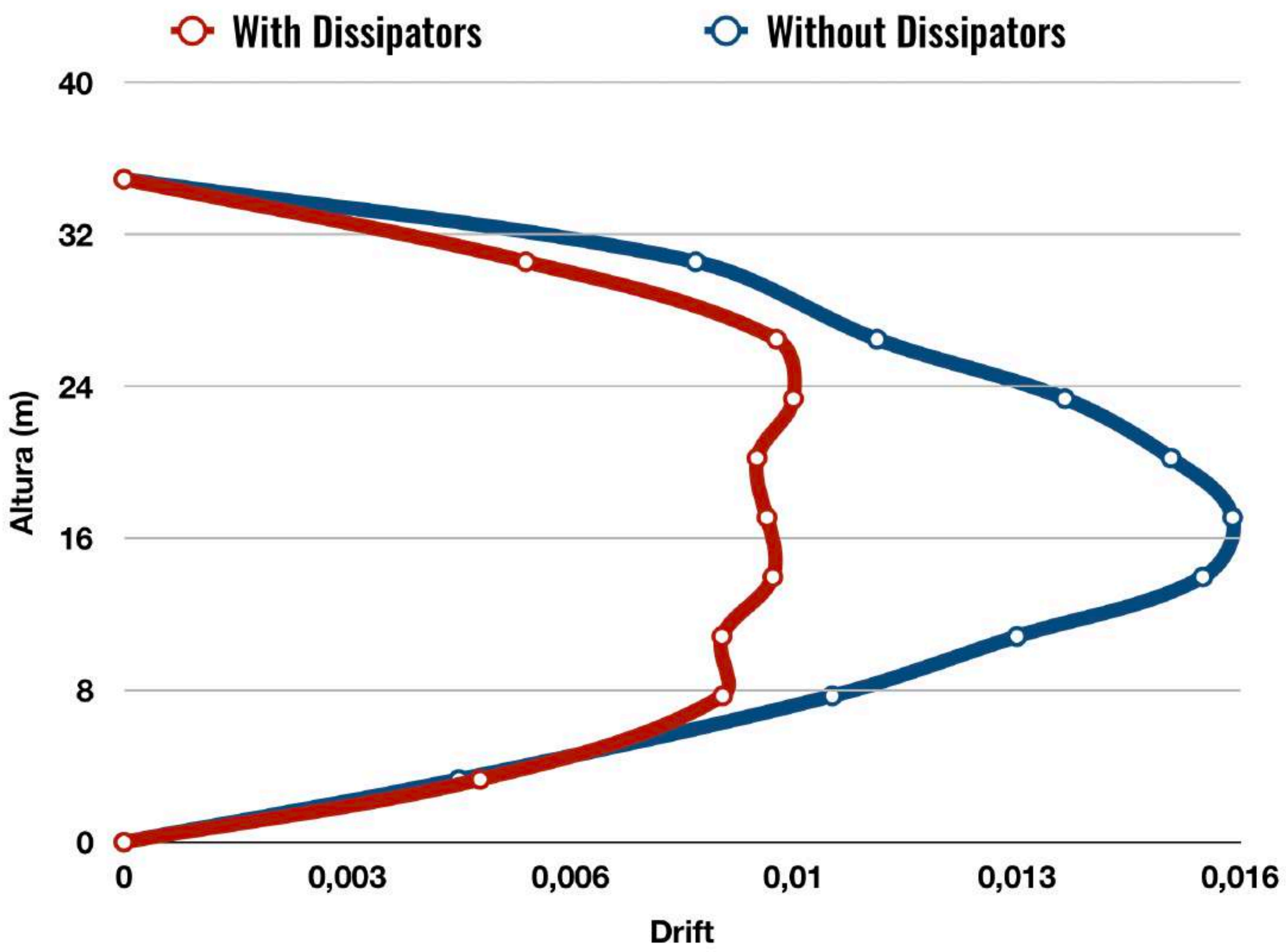
Location
Puerto Vallarta, Mexico

Height
27m / 8 floors

Year
2019

The project is in Vallarta, Mexico, in a strong seismicity area. The architectonical layout made very difficult to incorporate long concrete walls so the building should be based on ductile concrete frames. At this point any structural designer has two options: (1) increase significantly columns and beams dimensions or (2) add uncoupled walls with SLB dissipators at the upper levels only at the department's partitions.

Marina Vallarta

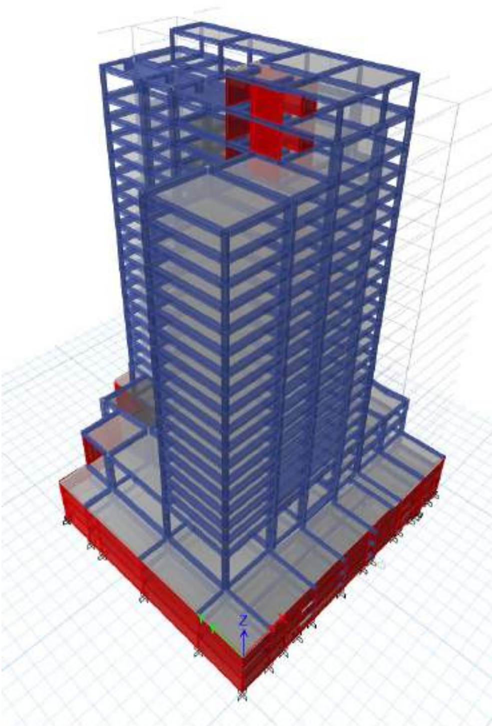


Marina Vallarta's Drift With and Without Dissipators

SLB Dissipators

Our patented "almenada" connection avoids transfer axial loads allowing to incorporate "wall panel dissipators" or "uncoupled concrete walls with SLB dissipators" at any level, any position or even any length adding ductility and stiffness specifically where the project requires it. In this specific project the drift reduction was 40% as the images show and more important, the column's sections where according to the architectonical layout.

Hidalgo



Location
Guadalajara, Mexico

Height
68m / 23 floors

Year
2017-2019

A dual structural system is perfectly integrated with its complex architectonical shape. It is designed with a central core concrete walls and a lightened, postensioned and uni-directional floor system slabs.

It has cantilevers of approximately 4m in length and special precast low weight (860Kg/m) facade elements.

Torre Paradox

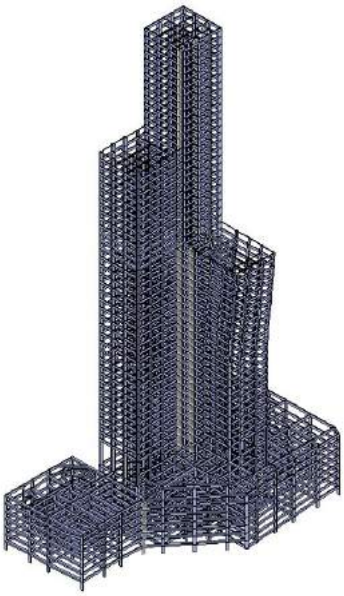
Location
Santa Fe, Mexico

Height
196m / 60 floors

Year
2018

The Paradox Tower is one of the tallest and certainly more geometrically complex Tower in Latin America with its 60 levels made up of 3 connected towers and two of them inclined. Our company provided not only assistance for the design but also predicted displacements under construction which were precisely determined by a complex staged by staged construction.

This extremely complex structure is formed by 3 buildings (A, B and C) "twinned" or linked together at different heights and including our innovative "SLBs" seismic protection devices that allowed reductions of more than 2000ton of weight for the foundation. Material use is directly related to sustainability and ecological footprints so even though it's complexity the tower is sustainable.



Puerta Las Lomas

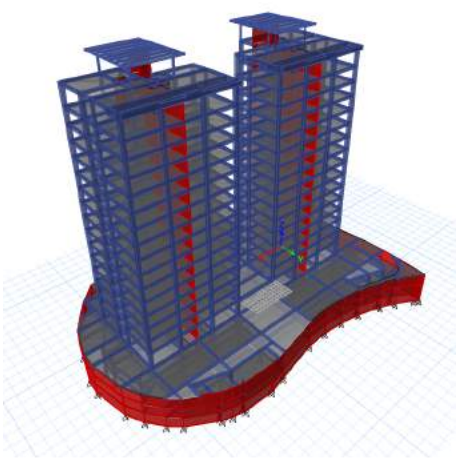
Location
Zapopan, Mexico

Height
71m / 19 floors

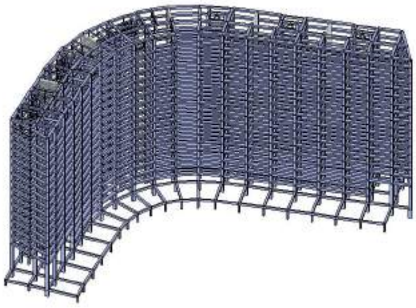
Year
2018

The "Condominium Puerta Las Lomas" is located in Zapopan, Jalisco and it has a 61.10m of total height. The lateral load system is based on the combined action of three-dimensional concrete frames and walls in both directions. The lightweight slabs allow to reduce own weight with diaphanous interior spaces, always very elegant for homes.

The type floor of each building is approximately 25.04mx20.91m and for basements, approximately, it is 80mx55m. At the entrance there is large flat variable section cantilever 6m long. In relation to the selected materials it varies from C25 concrete up to C50.



Península Ixtapa



Location	**Height**	**Year**
Ixtapa, Mexico	59m / 18 floors	2017

The Ixtapa building is 59 m total height and it is located in the Mexican Pacific coast subjected to potentially very strong earthquakes. The structure replaced concrete frames and concrete walls with by steel diagonals incorporating on top SLB dissipators. The floor system is made up of lightened postensioned slabs.

The SLB dissipators provide ductility and stiffness saving significantly self weight.

Urbania

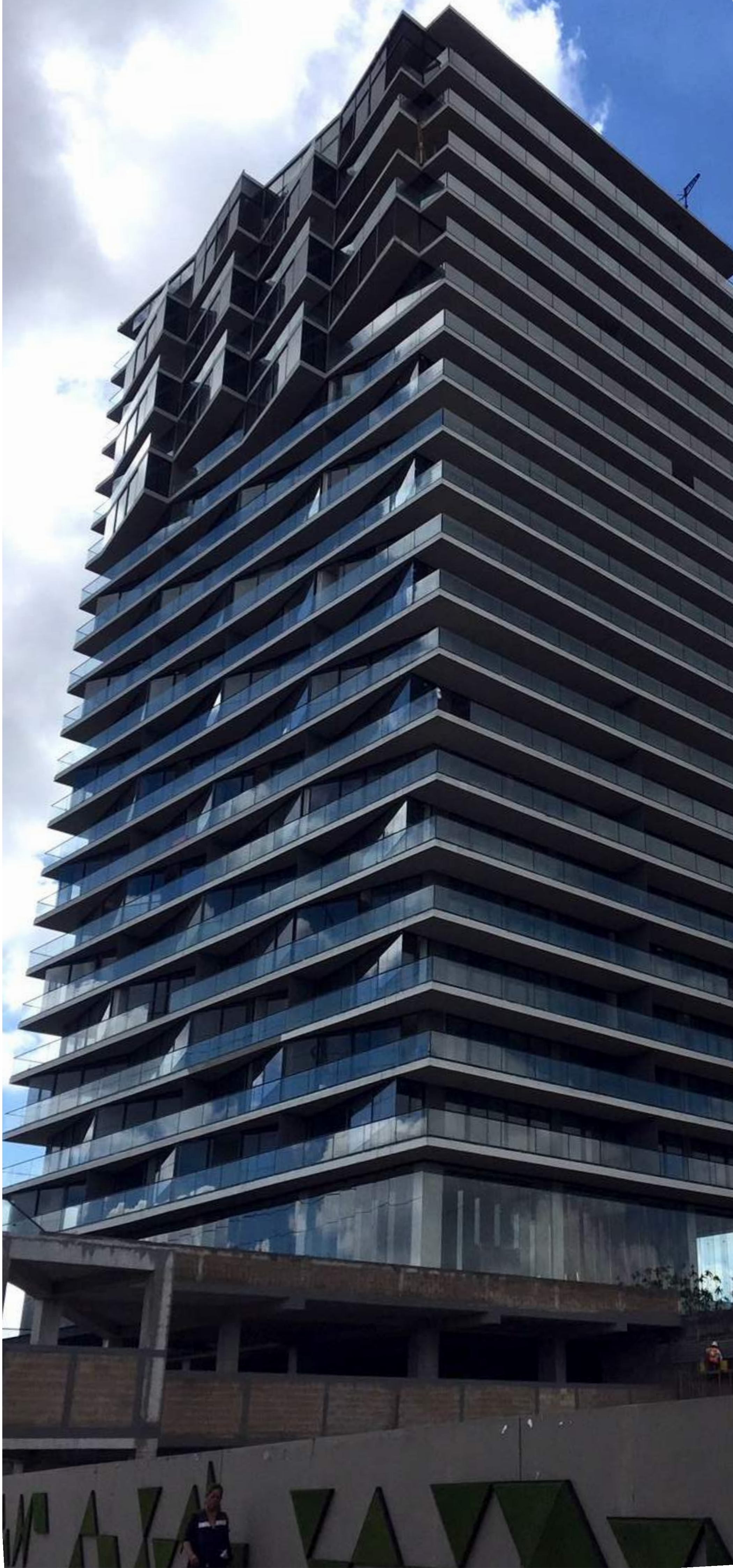
Location
Zapopan, Mexico

Height
80m / 26 floors

Year
2017

The project is in the municipality of Zapopan, Jalisco. It's based on three residential towers (T100, T200 and T300) and a common parking lot. The T100 Tower has the parking at the basement plus two commercial areas, a lobby and 21 levels. The structural scheme for the T100 and T200 towers is similar using walls and 3D frames. A significant aspect for this project is that the concrete walls are only on one side of the towers generating very strong plan torsion. On the other hand opposite to these walls there are department's divisions that may allow additional walls although they cannot be continued until the basement because vehicles circulation at the parking areas.

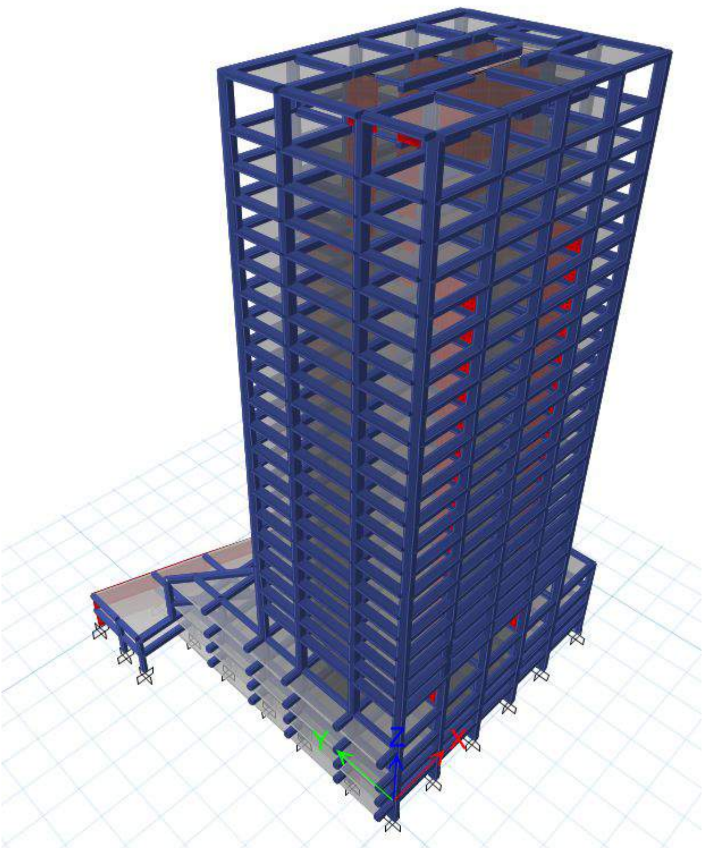
At this point any structural designer has two options: (1) increase significantly columns and beams dimensions to take into account torsional effects or (2) add the discontinuous walls providing a transfer girder which in seismic areas may provide a potentially brittle failure mode.

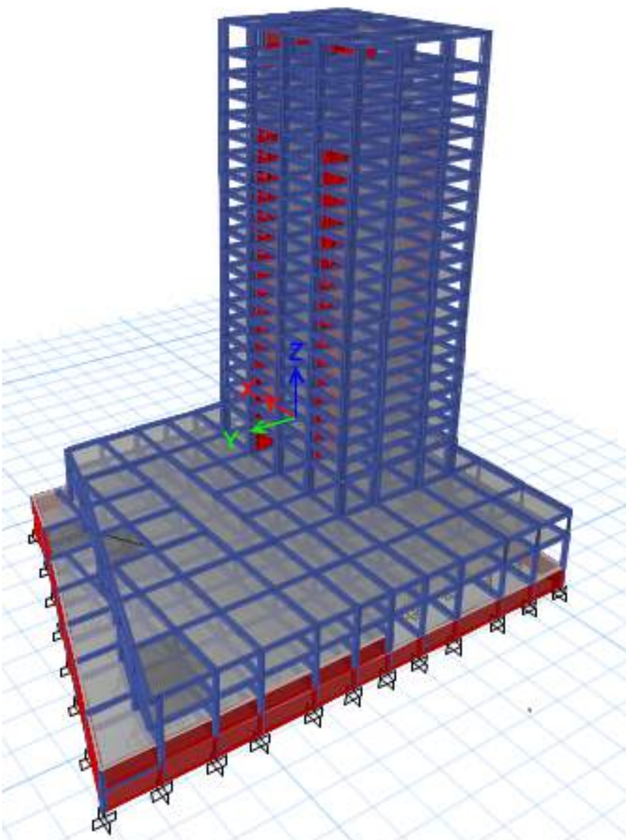


Urbania

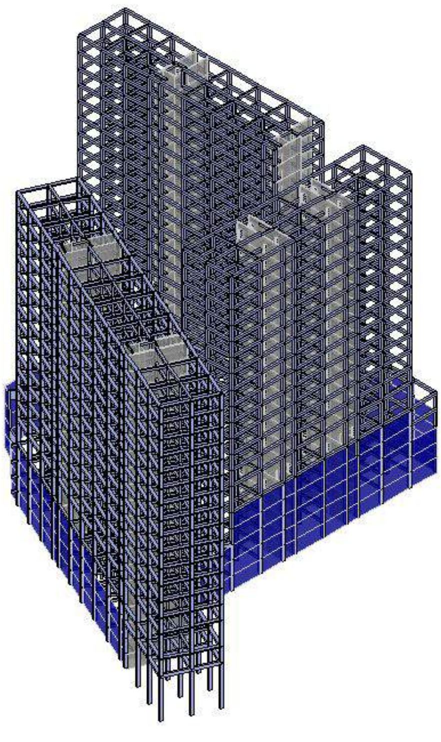
Our company provided a (3) pioneered world solution incorporating SLB uncoupled walls at exactly the positions where architectonically are suitable controlling torsional effects and furthermore providing a ductile state of the art but economical solution. Due to its excellent results the tower T200 and various other projects now incorporated on this innovative solution in all projects where for architectonical reasons there is a strong plan eccentricity and opposite walls are at least partially allowed.

In fact this requirement guides us to develop our patented "almenada" connection that avoids transfer axial loads allowing to incorporate "wall panel dissipators" or "uncoupled concrete walls with SLB dissipators" at any level, position or even length adding ductility and stiffness specifically where the project requires it.





Rinconada Margaritas



Location
Guadalajara, Mexico

Height
72m / 16 floors

Year
2017

The project is in the municipality of Zapopan, Jalisco. It consists of three housing towers and a common parking base that connects two of them, all located on a land of great unevenness. The structure is a dual system with frames and walls of reinforced concrete with attached columns in the ends, in addition to a rigid core. The floor system is a prestressed precast lightened unidirectional slab. On the nucleus and cantilevers we adopted thinner solid slabs.

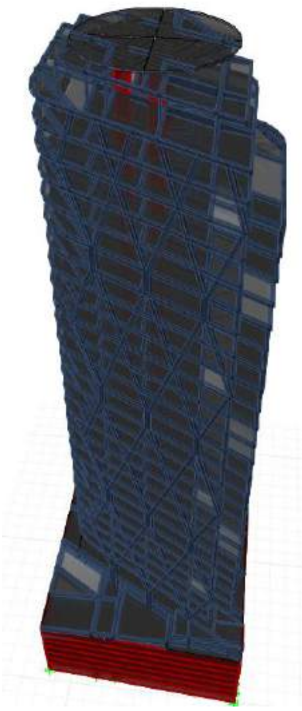
Corporativo Central Park

Location
Guadalajara, Mexico

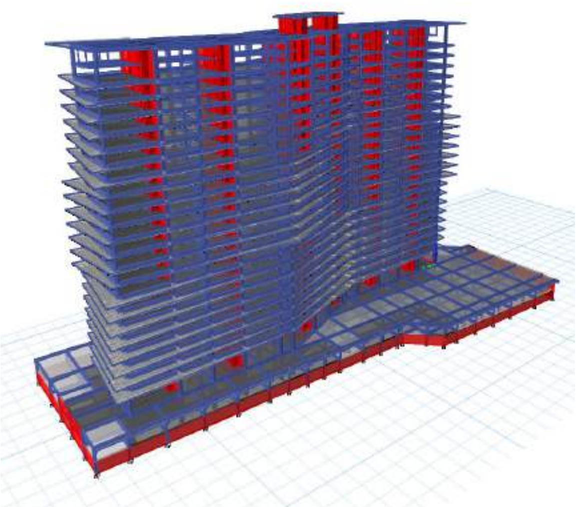
Height
124m / 36 floors

Year
2017

The Corporative Central Park Tower is a 124m total height special building which incorporates a central core and diamond's inclined columns in facade. The diagonal column set up provides a dramatic load transfers mechanisms compensated by horizontal postensioned rods at certain levels where the axial traction forces are maximum. The slabs on upper floors are lightened post-tensioned and in basements our pre-stressed pre-slabs semi prefabricated systems was adopted for almost flat open spaces. Globally the building has a constant trapezoidal shape of 42m x 22m with mezzanine's height of 4.5m on the upper floors and 3.9m in the basements.



Velera



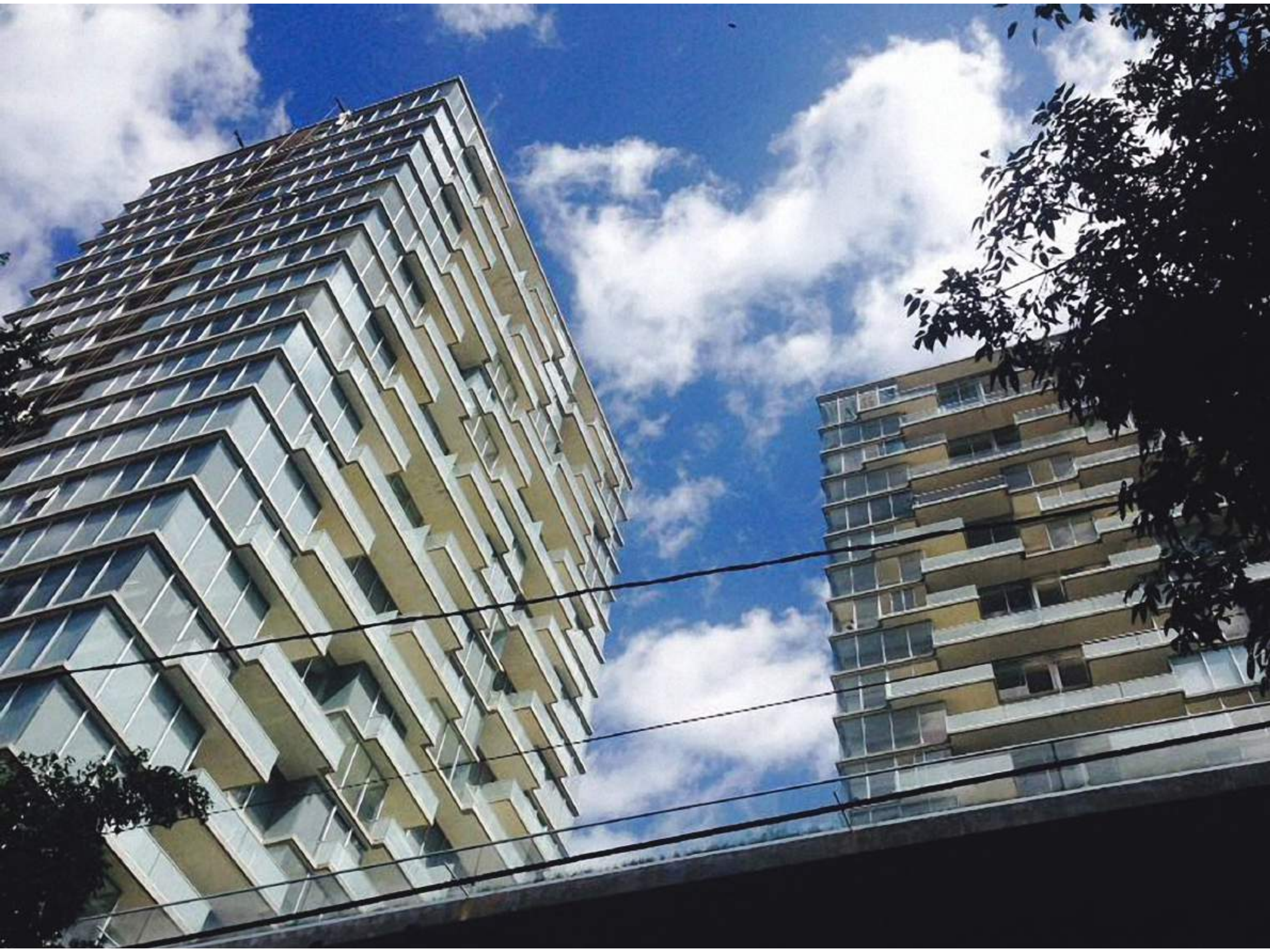
Location
Acapulco, Mexico

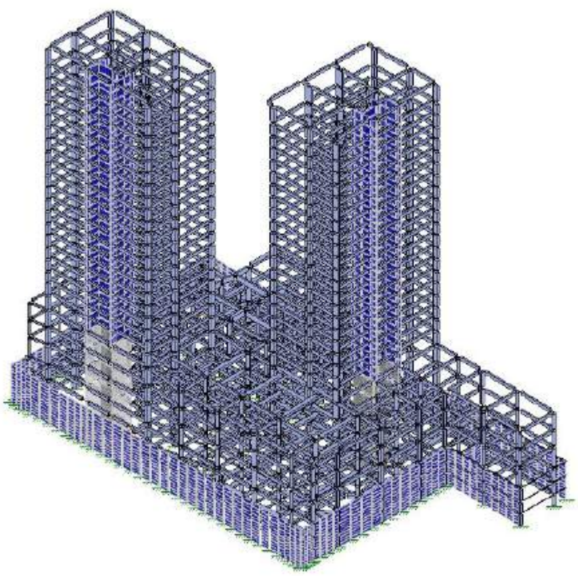
Height
83m / 25 floors

Year
2016-2018

A unique aspect of this project are the cantilevers which vary from 4m up to 5,5m in the corners all solved with 270mm constant thickness postensioned slabs. This project is also located in Acapulco where the seismic coefficient is of maximum intensity with a peak value of 0.86g (where g is gravity). Consequently the structure is very stiff but ductile and the lateral loads system is based on the combined action of three-dimensional frames and concrete walls. Due to its residential use the departments are separated by concrete walls in armoury with the geometrical plan. The lightweight slabs allow reduce the weight with diaphanous interior spaces, always very elegant for open sea side apartments.

Cititower





Location	**Height**	**Year**
Guadalajara, Mexico	80m / 25 floors	2016

Globally this project is formed by two independent towers connected at the base. The structure is a rigid concrete core with tridimensional frames. The towers have a 21m x 31m plan, except for the mezzanine and basements. There are commercial areas on the base and housing on top.

An innovative aspect for this project is its 7m span mixed cantilevers solved initially by a lightened post-tensioned concrete slab continued on top by steel shapes. This solution minimises self weight at the end of the cantilever (where its effects are more negative) and allows adjust small mismatches at its free end allowing a perfect horizontal alignment.

Estudios de América Televisión

Location
Lima, Peru

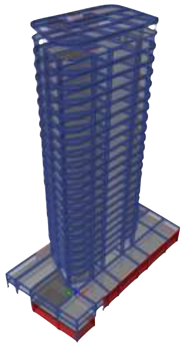
Year
2015

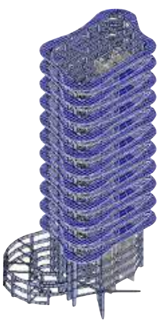
Award Winning

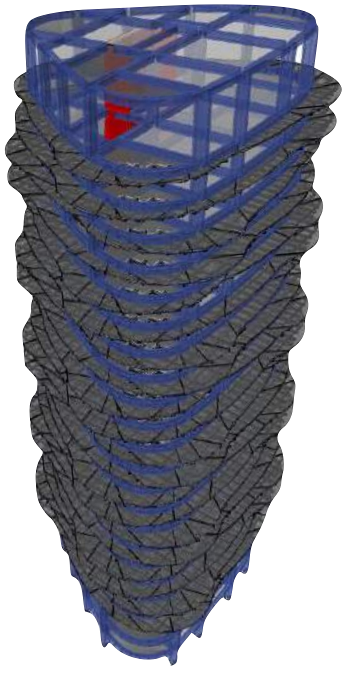
New America TV headquarters is an eco environmental friendly project located in a natural landscape close to Lima. The drastic architectonical solution goes half underground in order to minimise the impact in the environment and providing for most building green top covers in an interconnected layout of sets and production departments.

Various recording sets are long span with 20m x 40m open spaces without interior columns. The roof is flat postensioned lightened and the structural system for seismic loads is the surrounding wall required for acoustic isolation so there is a perfect match in form and function.

Parque San Javier







Location	**Height**	**Year**
Guadalajara, Mexico	70m / 22 floors	2015

The project is a set of towers called T100, T200 and T300 all with a dual structural system incorporating a central core and 3-D frames. The height of the tower is 70m with curved wavy facades formed by variable span cantilevers. The floor system is a post-tensioned lightened slab in both directions with variable section/span cantilevers which require special attention: they are up to 4m long with a depth at the embedment of only 300mm with a constant front height of only 250mm.

Península Desierto de los Leones

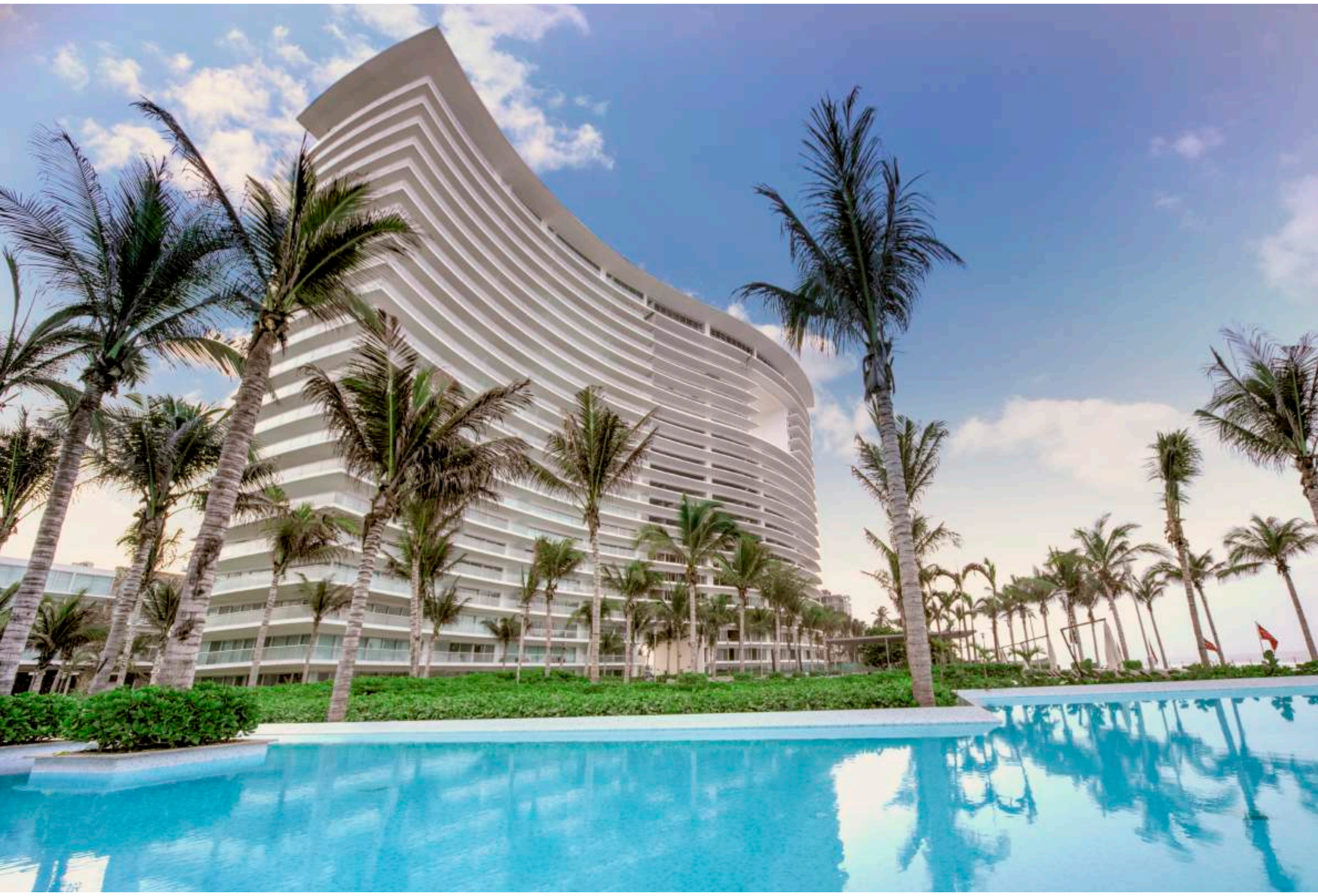
Location
Mexico City, Mexico

Height
70m / 22 floors

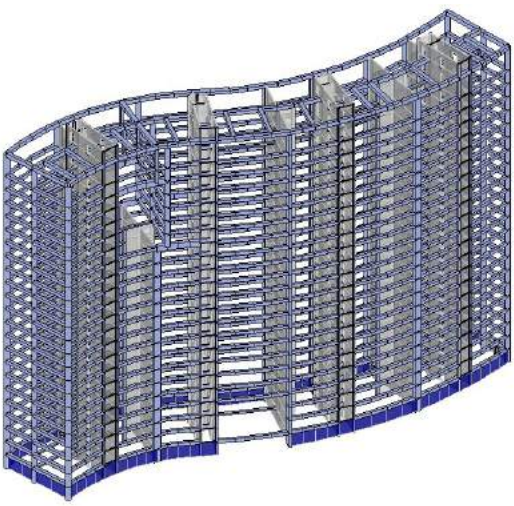
Year
2015

The project is located on the Desierto de los Leones Avenue in Mexico City. It has a residential use and consists of different independent towers sharing similar architectonical languages and a common basement. Globally, the towers have a constant interior elliptical shape with variable section wavy cantilevers. At the base, the parking occupies the entire plant, joining all the towers.

Península Playa Diamante

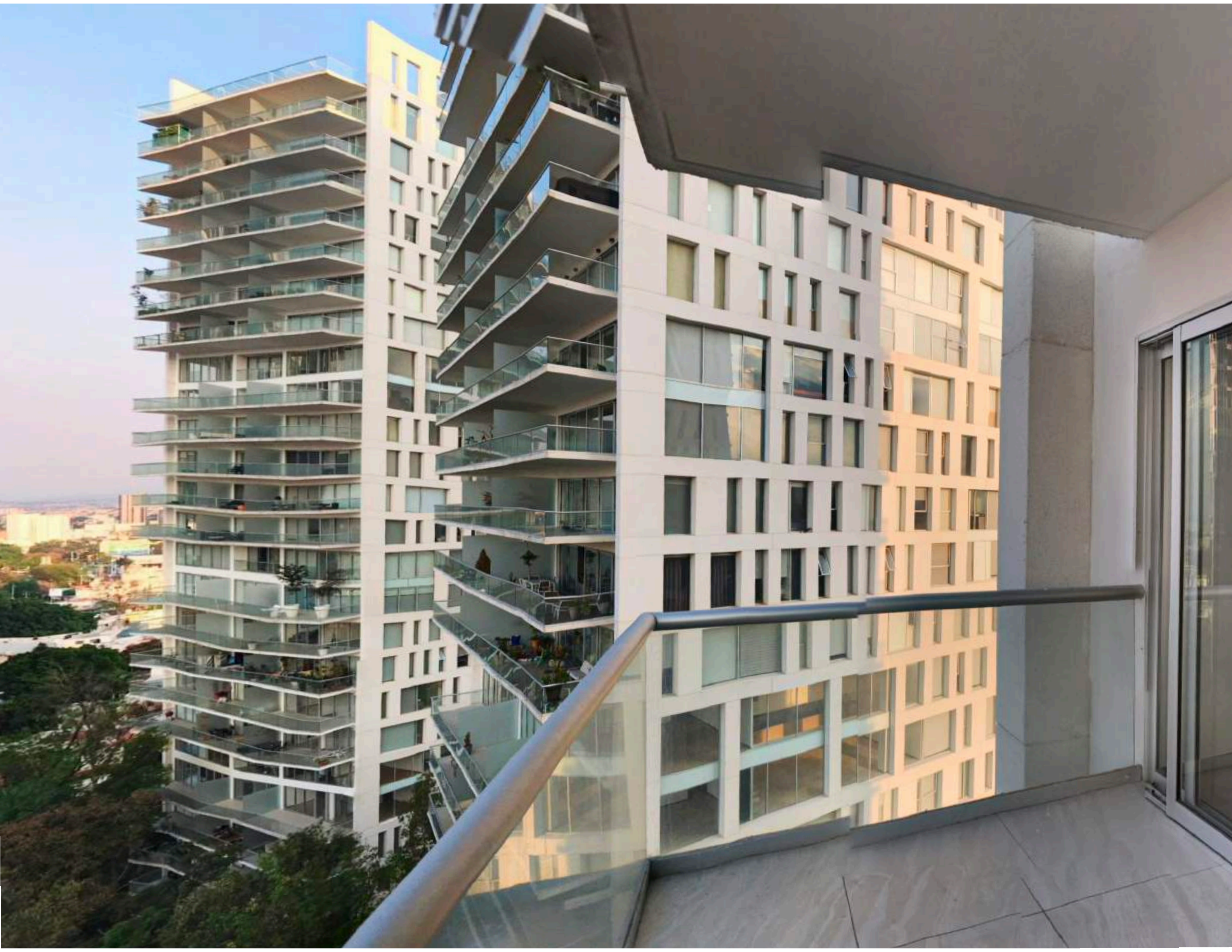


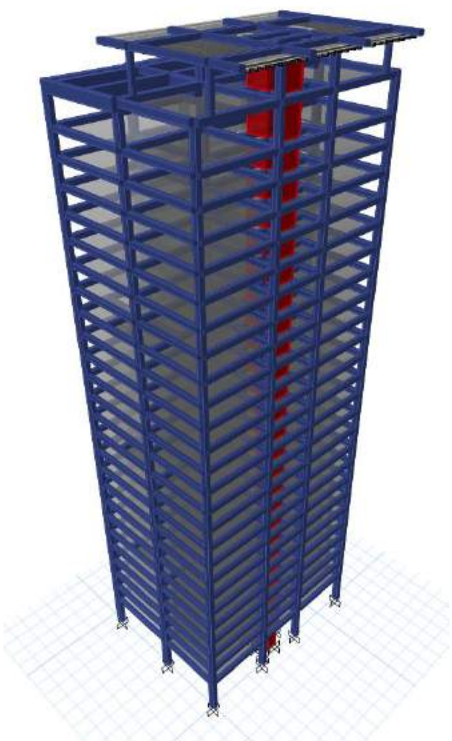
Location	Height	Year
Acapulco, Mexico	72m / 23 floors	2015



This project is located in Acapulco where the seismic coefficient is maximum intensity with a peak value of 0.86g (where g is gravity). Consequently the structure is very stiff but ductile and the lateral loads system is based on the combined action of three-dimensional frames and concrete walls. Due to its residential use the departments are separated by concrete walls which have a radial layout in perfect harmony with the geometrical plan. The SLB seismic devices are incorporated locally in some areas of the tower. The lightweight slabs allow reduce the weight with diaphanous interior spaces, always very elegant for open sea side apartments. A unique aspect of the building is the strong discontinuity of a vain in the high and lateral part of the tower eliminating the structure as a great picture window.

Torres Central Park





Location
Guadalajara, Mexico

Height
89m / 25 floors

Year
2015

The project is made up of 3 towers T100, T200, T300 and a SPA building close to the Corporative central park tower. The structure is a dual system with tridimensional frames and lightened 10m x 10m postensioned 300mm thickness slabs. The towers are, approximately, 89m height from the base with a heliport on top. Globally the buildings have a rectangular 23m x 29m plan with a mezzanine and lobby.

Torre Américas 1500

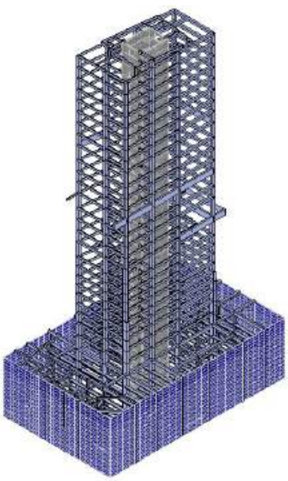
Location
Guadalajara, Mexico

Height
118m / 34 floors

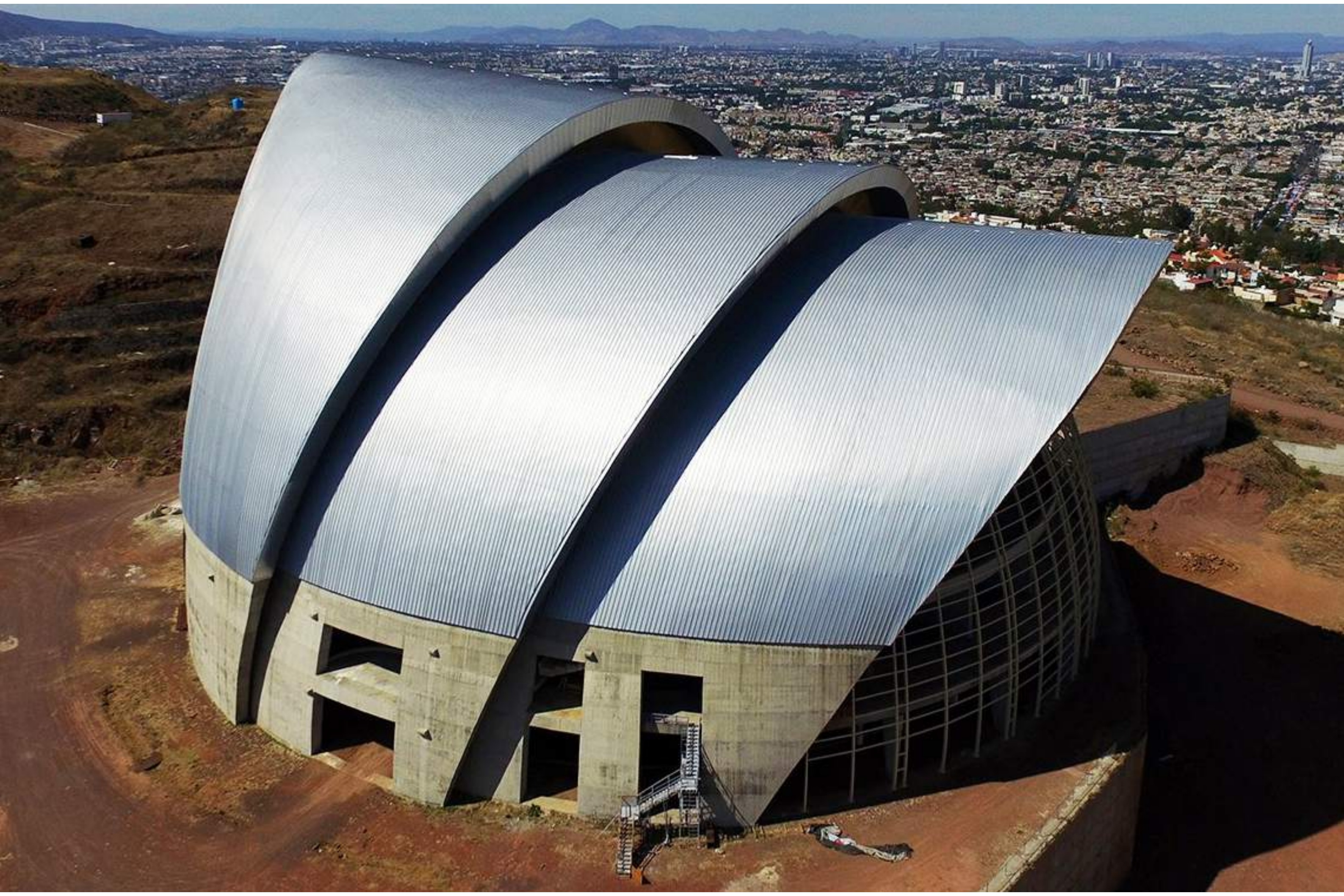
Year
2014

The Americas 1500 Tower is a tall scultoric building with dramatic plan movements in height. It has approximately 118m total height from the base to the top floor for heliports. The structure is designed with a rigid core of reinforced concrete and three-dimensional frames. The central core is constant with height and the plan is approximately 47m x 20m.

The top level slabs are lightened postensioned and in the lower underground levels our semi-precast pre-stressed solution was adopted resulting in minimum slab depth. The semi-precast system has a depth of 50cm for a 10m x 14m area without interior columns, an almost flat solution which saves in excavations and simplifies equipment installation.



Santuario de los Mártires



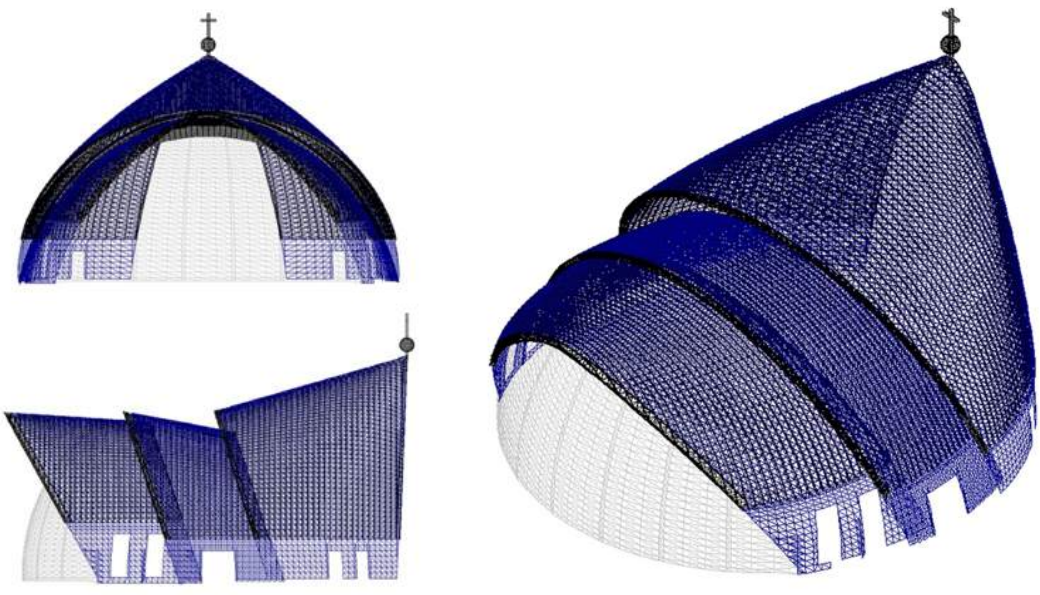
Location	Height	Main Roof Steel Ratio	Year
Guadalajara, Mexico	105m	60 Kg/m^2	2002 - 2015

This unique world project is a spiritual and meditation center for shelter the urns of the Mexicans revolution religious Martyrs, as well as medical and humanitarian centres and other religious works. The architectural project was made by GVA (Architect José Manuel Gómez Vázquez Aldana) and it is located in the top of a hill called "Cerro del Tesoro" in Tlaquepaque, Guadalajara, Jalisco Mexico.

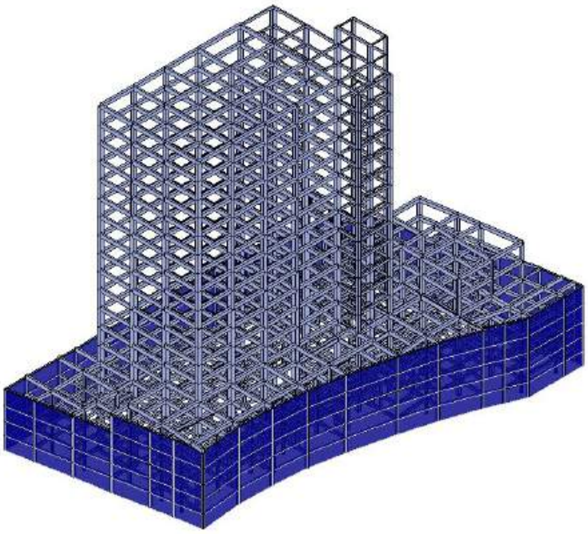
Geometrically the structure is made up of 4 interconnected shells, 3 of free form and a semi-sphere at the main entrance overlooking the city. The three consecutive steel shells start from 15m tall concrete walls 120cm thickness. The steel lattice arches have double curvature and they are formed by one lower cord and 2 upper cords all tubular steel shapes. The total interior height of the church is 60m with more than 105m free interior spans. Each arch is separated horizontally 1.5m and adapt the strong geometry double curvature through more than 50,000 different length bars. All the arches and shells are connected to each other to eliminate relative movements that could break glass or facades in front of extreme winds. As impressive as the outside are the inner concrete ribs that provide 15m cantilevers for the mezzanine with has a curved design in plant with variable section in height.

Santuario de los Mártires

This is a project of maximum structural complexity due to its geometry, dimensions and low budget by private donations. The challenge was to integrate free architecture form with a limited budget and maximum security. This is achieved with the tridimensional arcs and, more important, clear load transmission mechanisms based on interior arcs and inclined space arcs in the cantilevers, which in facade arrive up to 30m.



Torre Acueducto



Location	**Height**	**Year**
Guadalajara, Mexico	76m	2013

The Torre Acueducto was the first building in Guadalajara that adopted the semi-precast pre-stressed lightened solutions for the slabs. Globally the structure is rectangular and the spans are even so the precast solution was suitable for the project. The spans are 11,6m x 9m with unidirectional 300mm depth slabs transferring the load in the 9m direction. The foundation has a rectangular slab grid using inverted T shapes that maximises earth contact reducing contact pressure as well as incorporated postensioning to redistributes concentrated loads from the columns.

Torre Península Santa Fe

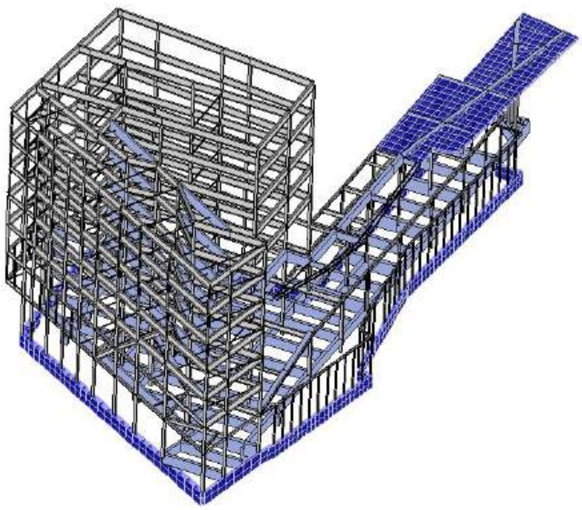
Location
Mexico City, Mexico

Height
167m / 52 floors

Year
2012

The Santa Fe II tower is one of the newest dramatic features in the skyline of Mexico City, Mexico. At a height of 167 m (548 ft), the building was the tallest residential building in Mexico. Only the Torre Mayor and Torre Ejecutiva Pemex, both office buildings in Mexico City, are taller. In addition to its height, the Santa Fe II tower is unique in regards to its façade, with its many discontinuous non structural white columns. So, in spite of the irregular appearance of the façade, the building structure is quite regular. Lateral loads are transferred mainly by the central core, allowing elimination of all interior columns. As a result, there are only nine columns—four located at the corners of the floor plate, three centered on three of the building sides, and two more located near the third points of one side.

Casal en San Feliu



Location
Llobregat, Spain

Year
2011

The architect Luis Angel Dominguez team proposed this singular structure for the rest of elderly people in San Feliu de Llobregat, Spain. It has an irregular geometry having to consider, in addition, the existence of a construction underneath (prepared for the supposed load) and another future indeterminate expansion from above. Therefore the current project is able to withstand the actual loads plus the future extension and must, on the other hand, verify the existing structure of the basements.

To achieve this complex structure a tridimensional postensioned frame is adopted but on top of the flat slab supported on the steel “tripod”. From walk level the structure perfectly integrates the no structure seeminless architectonical proposal.

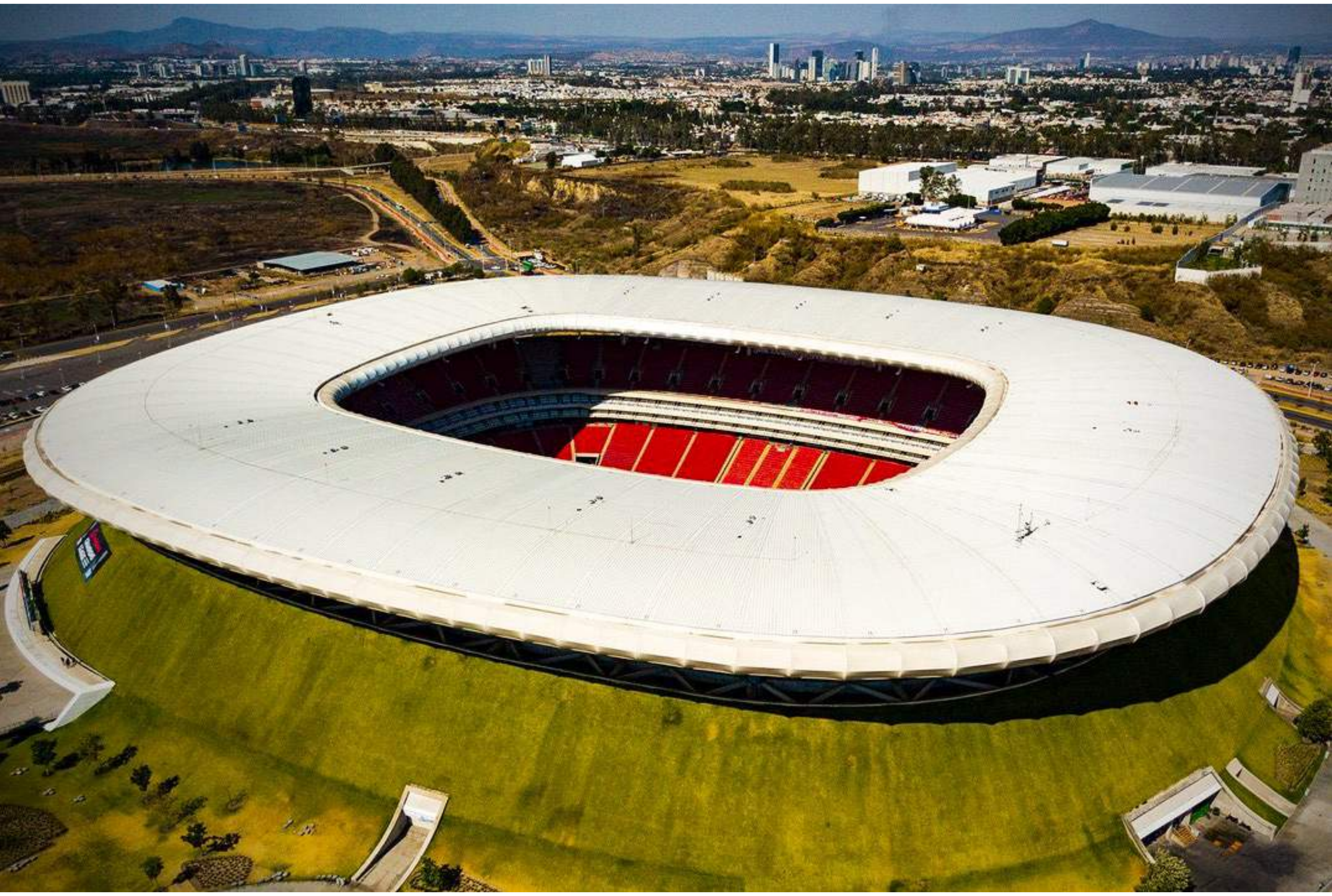
The JVC Exchange Urban Node

Location
Guadalajara, Mexico

Year
2010

In this project we designed all aspects such as vehicles flow, illuminations, architectonical aspects and structure. Three-level urban node including a central single curved bridge with cable stays only on one side and 80m of free span. The main central inclined column supports the curved slabs which are “tridilosas”. In the access of the viaduct inverted V concrete columns give rigidity for lateral loads using in between the columns a flat pre-stressed and post-tensioned solution according to the span / loads.

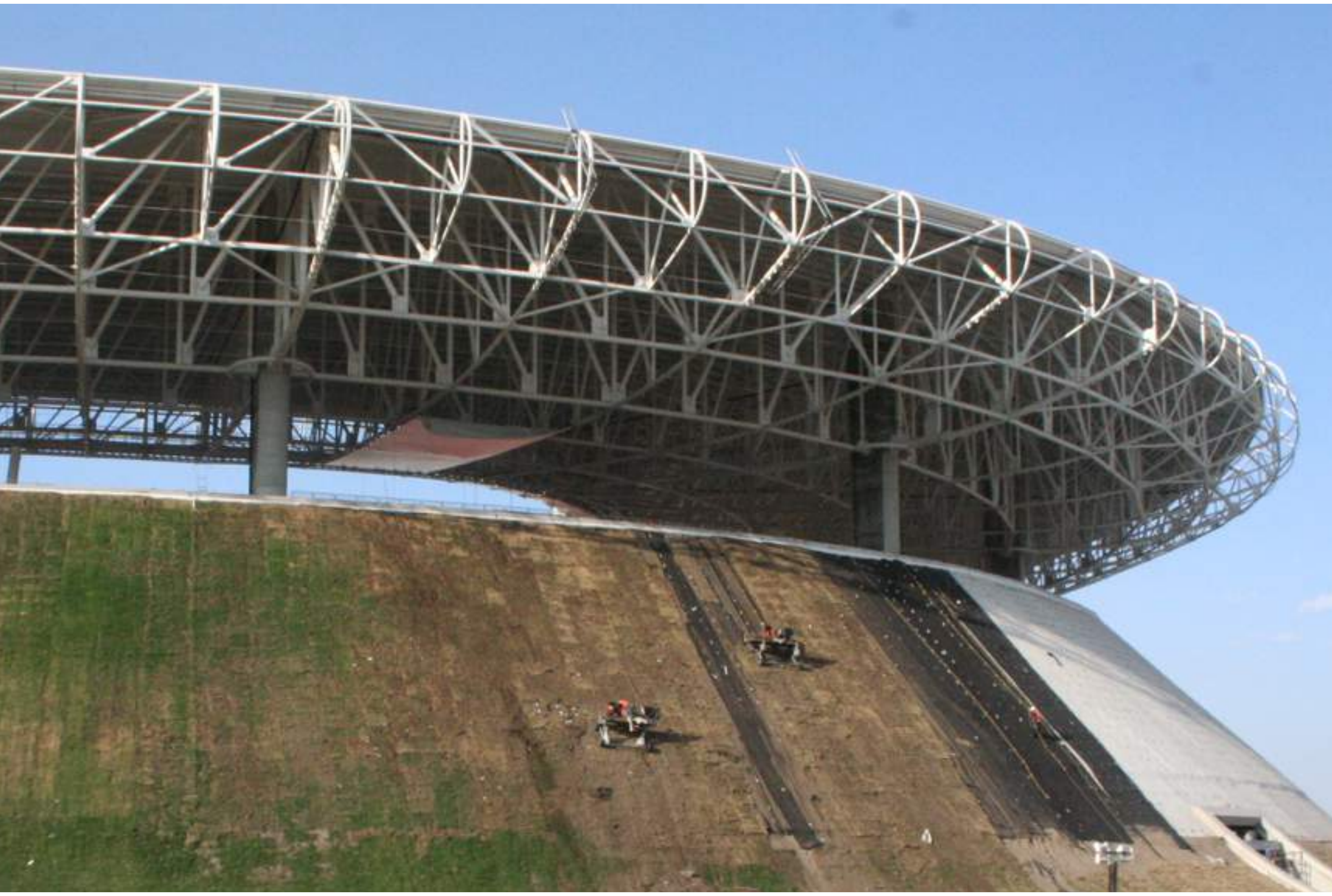
Estadio Akron (Chivas)



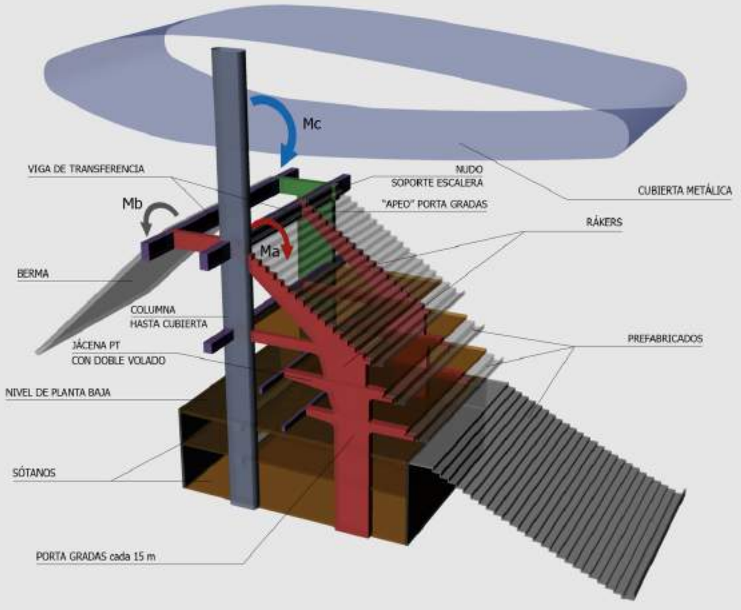
Location	**Capacity**	**Year**
Guadalajara, Mexico	50,000	2010

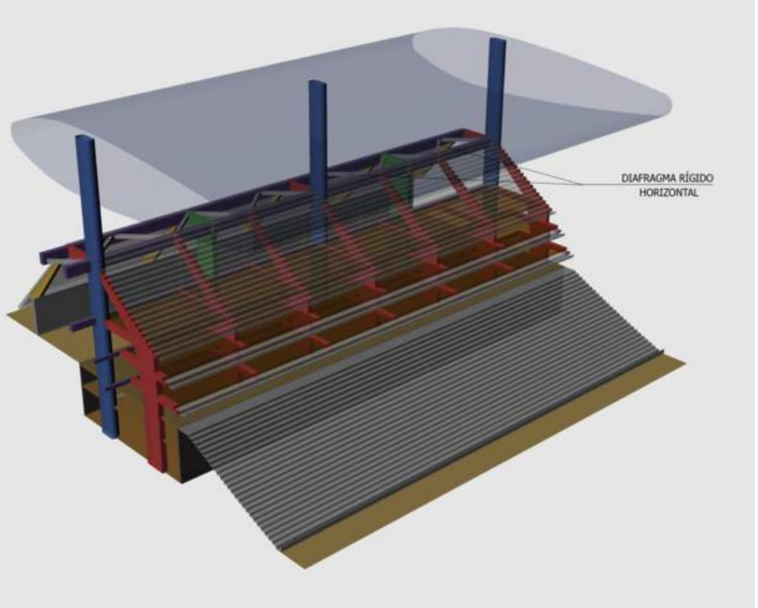
The soccer stadium for “Las Chivas” club in Guadalajara, Mexico, is one of the most outstanding stadium structures recently constructed. The powerful architectural concept was proposed by the French studio Massaud-Pouzet. Our company developed the structural concept perfectly fitting the architecture of the stadium as a “volcano” with a “cloud” represented by the main roof. This roof has a constant width of 60m and surrounds the whole plant in an approximately elliptical shape, supported on just 16 macro-columns. The exterior incline “semi-cone faces” defines the slopes of the volcano which are covered by natural grass. This magnificent proposal solves in an ecological simple way the formal complex architectonical problem that always arises from such a large facade. Besides, this environmental friendly solution fits very well with the background of the “spring hill”, a natural park behind the stadium.

Estadio Akron (Chivas)



Load transfer mechanisms are quite clear from the interior with a very rigid inclined concrete diaphragm that represents the slopes of the volcano which control drastically seismic lateral movements. The interior open spaces have received numerous awards inviting to just walk inside the "volcano" in its commercial areas open to public.





Torre Cube I

Location
Guadalajara, Mexico

Height
70m / 20 floors

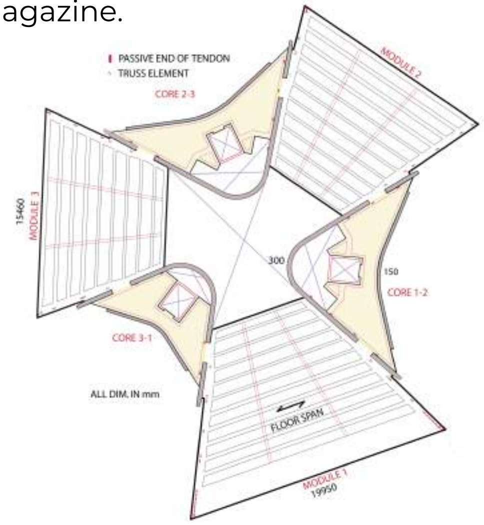
Year
2007

Award Winning

The award winning Architect Carme Pinos's Cube I tower not only provides a singular space, but it provides open office views with natural light and good ventilation. The structure, like a tree, is formed by three hanged towers supported on three macro columns with 20 levels.

Despite its great architectonical complexity its structure is quite simple and the load transfer mechanism quite clear. The lateral steel trussed provide redundancy allowing natural light to pass but reducing self weight. The macro columns are hollow providing vertical circulation. The slab system is lightened and unidirectional with only 400mm depth.

This tower has been granted with numerous architectonic awards and its structure has been selected by the American Concrete Institute CI Magazine.



Torre Cube II

Location
Guadalajara, Mexico

Height
124m / 33 floors

Year
2013

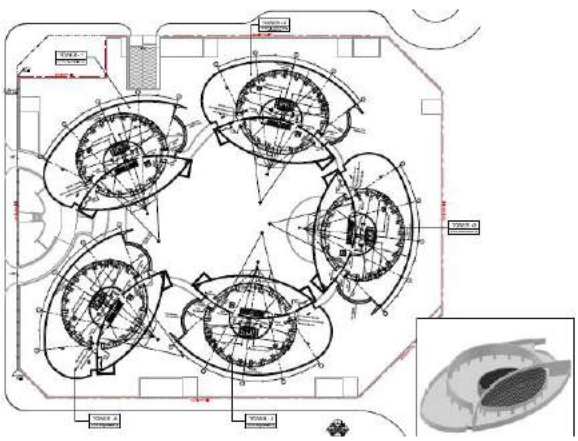
Award Winning

Architect Carme Pinos's Cube Tower II proposed a significantly different approach than her previous award winning Cube Tower I. In this case the tower is made up of two triangular areas developed in height at 4 degrees inclination. The two triangles are connected by a communications central core and each plant has different dimensions.

We eliminated all initially previously proposed interior columns using a special "A shape" beam post-tensionning layout providing up to 20m x 15m open spaces and only one intermediate column per side. This special structural configuration was particularly developed for this specific tower obtaining a perfect function/form/architectonical shape symbiosis. The result is diaphanous interior offices similar but architectonically totally different than Cube I.

Busaiteen

Location	Area	Year
Busaiteen, Bahrain	9000 m^2	2009



The project corresponds to a residential complex of 5 buildings of up to 8 levels supported on a large transfer slab, built in Busaiteen. The transfer slab, clearly the distinctive element of the project from the structural point of view, is post-tensioned and has a plant without expansion joints of approximately 100m x 90m with more than 100 pillars without continuity. The upper plants, also post-stressed, are thin with an approximately elliptical geometry per plant. Both the transfer slab and each level of the residential buildings were made with the MK4 post-tensioning system.

Hospital Sant Pau’s Base Isolation

Location
Barcelona, Spain

Year
2004

The base isolation and post-tensioning for the Sant Pau Hospital in Barcelona with its 600,000kN isolated weight was selected for its special interest by the “American Concrete Institute” CI Magazine.

This hospital is constantly affected by the vibration cause by the city’s metro (subway) that runs parallel to the longest side of the wing about 5 m underground.

For the optimum solution, post-tensioned floors were combined with base isolation.

Post-tensioned Cover of the Sabadell Swim club

Location	Dimensions	Year
Sabadell, Spain	70mx70m	2004

This post-tensioned building accommodates two Olympic-sized pools and one recreational pool.

It was necessary to span an area of 50x45m without interior columns, while supporting the loading of a 1.3m deep swimming pool on top and below.

First Building in Peru with Energy Dissipators

Location
Lima, Peru

Year
2000

This project called “Casino Mubarack” started in year 2000 and it was the first building in Peru equipped with energy dissipation devices. In this case the devices were manufactured by the multinational German company GERB. Open spaces and minimum weight were achieved by using “Tridilosas” and uncoupled concrete walls in the building corners.

Mixed Reticular Slabs

Location	**Dimensions**	**Year**
Lima, Peru	70mx70m	1983-1987

The "Tridilosa" is Eng. Heberto Castillo invent that combines a spatial steel truss and one or two concrete membranes on top and bottom layers ideally providing concrete on compression areas and steel in tension areas. Certainly it should be recognise as one of the most important Mexican contributions to global engineering. The basic idea is minimise concrete volume avoiding all near the “neutral axis”. This great system allows long span roofs with minimum self weight (only about 200kg/m2 for 10m x 10m spans). It was adopted and expanded in Peru from the ’60 by Eng. Miguel Bozzo and our company DIRACSA designed and built many structural typologies such as arches, domes, and Vierendell beams, among others.

Our global contribution was to provide numerical finite element techniques to analyse and design such complex structures as far as in 1985 being in those day global leaders in applying finite element techniques to long and complex slabs.

Academic activity

Civil Engineer. "Universidad Nacional de Ingeniería (UNI)", Lima, Peru. 1987

MSc. Civil Engineering. Universidad of California in Berkeley, USA. 1988

PhD. Civil Engineering. Universidad of California in Berkeley, USA. 1988-1992

Teaching and research assistant. Civil Engineering Department, University of California at Berkeley, EU, 1989-1992

Full Professor (TU), Industrial Engineering school," Universidad de Girona", Spain, 2001-2004

Professional activity

Company "Diseños Racionales SA (DIRACSA)" in Lima, Peru. Main structural designer between years 1983-1998 and assessor during 1999-2002.

Company "Luis Bozzo Estructuras y Proyectos S.L." in Barcelona, Spain. Main designer and technical director since its beginning in year 2003 up to date.

Distinction of the National Order of Peruvian Engineering to Luis Bozzo. Lima, 2018

Luis M Bozzo, Msc., Ph.D

Chief executive officer

Career Summary

The last 30 years were of continuous innovation and deeply interplay between theoretical and practical applications to civil engineering. So the theoretical plate analysis finite element CI8m (using mixed Reissner Functional) that Dr Bozzo developed and programmed in FORTRAN back in the year 1983-85 raised from the need to accurately analyse long-span slabs (more than 20m free spans in both directions). In those years Dr Bozzo designed and built in Lima using an innovative typology of "mixed reticular mixed slabs" or "tridilosas" that allowed records for this structural type made up of a bi-directional space truss and one or two thin 5cm concrete layers top and bottom. Thus developed theoretical activity has often been caused by the need to solve practical problems.

In U.C. Berkeley his initial activity was focused on base isolation working for Prof. Steve Mahin in the Frictional Pendulum System (FPS). Later on he focused his attention on what he consider the most important aspect in Structural Engineering which is the Conceptual Design. Is in Conceptual Design where main improvements or lacks may have a design compared to others. So my doctoral dissertation at U.C. Berkeley achieved to simulate "intelligence" using his computer program Agrippa under the direction of Prof. Greg Fenves.

Patents

- "Losa espacial compuesta prefabricada industrialmente en taller", Spain, 1993.
- "Losa espacial mixta y procedimiento de fabricación y utilización correspondientes", Spain, 2001.
- "Disipador de energía sísmica", Peru, 2013.

High level computer programs and educational tools

More than 10 significant computer programs such as CI8M, "Andrea", "Agrippa", "Mixed3D", "Dominios" and "Anser" using Fortran, C++ and Prolog.

Theoretical contributions

- Finite Element CI8m for planar plate analysis developed and code programmed between 1983-1986 (at that time was one of the more precise elements in particular for variables of more practical interest as are bending moments compared to rotations).
- Modelling and design of structures equipped with sliding type connections "Frictional Pendulum System (FPS)" to protect buildings against sever earthquakes, 1987.
- Doctoral dissertation at U.C. Berkeley using artificial intelligence in order to simulate qualitative structural reasoning, Years 1988-1992.
- Development of general seismic energy dissipator Shear Link since year 2000 and up to date with various practical improvements.
- Semi-precast slabs as published in CI magazine (February 2008).
- Semi-precast wall and self supported semi-precast-pre-stressed slabs, 2009.

Scientific articles and worldwide distribution books

- More than **100 scientific articles published** in American or European Journals as well as congress such as:
  - Research in engineering design.
  - Applied artificial intelligence.
  - Earthquake engineering and structural dynamics.
  - Archives of computational methods in engineering.
  - Journal of structural Control.
  - Journal of Structural engineering, ASCE .
  - Concrete International, CI Journal. ACI magazine.
  - Engineering structures
- "Diseño sismorresistente de edificios. Técnicas convencionales y Avanzadas" by Luis Bozzo and Alex Barbat, 2000.
- "Losas reticulares mixtas. Proyecto, análisis y dimensionamiento" by Miguel Bozzo and Luis Bozzo, 2003.

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