BULK HANDLING

The Freedome - Francisco Castaño father and son


Francisco Castaño Sr

For 23 years, Geometrica has built strong, energy-efficient structures around the globe. Its expertise is due, in large part, to the pioneers of gridshell technology. Among them is Francisco Castaño Hernandez, a Mexican engineer who initially specialised in building concrete shells in the 1960s, and then broadened the horizon to metal gridshell technology. He is referred to here as Francisco Castaño Sr., his son, Francisco Castaño,being the current CEO of Geometrica.

Castaño Sr. was the first to realise the potential for free form and long span in gridshell design. Many of the projects he built are architectural icons even today, including the Palacio de los Deportes, the atrium dome at Archivo de la Nación, various hyperboloid water towers, and the Rio 70 theatre, among others. Geometrica domes, barrel vaults and long span structures have taken gridshell technology to new heights all over the globe, thanks to his pioneering efforts.

Francisco Castaño Sr. was the eldest of six children. His interest in engineering was kindled by his father, an engineer who manufactured cabinetry and light equipment support structures out of sheet metal for use in industrial laboratories and kitchens. In his father's factory he became familiar with the extremely slender forms common in sheet metal. This exposure gave him an invaluable intuitive feel for thin surface buckling phenomena. During his civil engineering studies in the fifties he was inspired by the works of Candela, Torroja and Nervi. He wrote his professional thesis on the design of hyperbolic paraboloid shells in reinforced concrete.

For a few years after graduating from Monterrey Tech, Castaño Sr. worked for large construction firms designing and building hyperbolic paraboloids "umbrellas" in concrete for factories and exhibit spaces, and occasionally invited his young wife, Reyna García, to enjoy the breeze atop these light constructions.

In the early 1960s, Castaño Sr. met the Fentiman brothers, who had developed a compact joint to build aircraft hangar doors as "space frames." He saw the potential to use such joint to build gridshells, and launched his own company in one small room inside an apartment in Mexico City. His idea was to apply the "space frame" technology to enable the forms envisioned by the concrete shell pioneers. In fact, Castaño Sr. was able to merge these two budding technological advances and lay the early foundation for today's Freedome®. He quickly realised the huge advantages of expressing structural form with a lattice of circular tubular sections.


Francisco Castaño Jnr

A premier test in Castaño Sr.'s career came in 1966 when he was charged with the design and construction of a beautiful multi-leaf hyperbolic paraboloid for the Mexico pavilion at Expo '67 in Montreal. The architects were A. García Corona and L. Fabela. The engineering was by Castaño Sr. and Dr. Douglas Wright, then heading the Civil Engineering department at the University of Waterloo.

Design and fabrication of gridshells requires exacting calculations, measurements, jigs and tools. It is difficult enough

these days with high-speed electronic computers. But back in the 1960s, computers were people, and the design of arbitrary forms was beyond imaginable. Castaño Sr. developed a system of design that involved laying out parallel pairs of coordinate maps representing a gridshell's geometry.

Each map was drawn on a 'blanket' of paper that was often 10 m2. Using mechanical calculators, slide rules and tables of trigonometric, algebraic and logarithmic functions, human computers would tape coordinates on the geometry blanket, then calculate lengths, cut angles, twists and other fabrication parameters for each of a gridshell's components.

To achieve the volume of calculations Castaño Sr. required, the recruited "computers" often went beyond himself and employees, to friends, wife and children. Everything was done twice, once on each of the blankets. The results were then tabulated and cross-checked thoroughly. Despite the limited technology, the whole process would have aced a modern ISO 9001 audit. The resulting forms were revolutionary, including hypars, geodesic domes, freeform shells, hyperboloids of revolution. Projects streamed in: Multiple cinemas, arenas, exhibit halls, shopping centers, zoo enclosures were built in metal gridshells.

Castano Sr.'s concrete background came in handy as he designed efficient elevated water towers. The gridshell became scaffold, steel plates provided tension strength and concrete formwork, and concrete provided compressive strength in an innovative hyperboloid of revolution geometry.

Another first came in using domes to store bulk materials. He first applied this technology to store grains and aggregates in volumes previously undreamed, starting a business line in which Geometrica has thrived to this day.

Later in his career, in the Third International Conference on Space Structures, Castaño Sr. was recognised by the Space Structures Research Center at the University of Surrey in England as a Special Pioneer. This award recognised his "outstanding contribution to the development of space frame structures."

He was inspired and supported by his wife, Reyna García, who outlived him. She often played a part in the realisation of the structures, and enabled her husband to pursue a global career.Their sons, Francisco and Roel, followed in their father's footsteps and continue to expand upon his innovations. They founded Geometrica in 1992, and today, the company continues to provide technology that inspires architects and designers to realise bold visions. Geometrica structures have been built in over 30 countries for a variety of applications. Innovations continue in several fronts, including structural geometry, an improved joint, new software and wiki-based quality management.

Through the years dome technology continued to evolve and led to the Freedome® — Geometrica's trademarked free-style dome. As circular domes, Freedomes may have lamella, Lace™ or Sol™ in-surface patterns and single or double grid layers. But these structures can also be designed with a non-circular plan, bringing complete design freedom to architects and engineers the world over. Using the inherent strength of doubly curved surfaces, Freedomes can clear spans up to 300 m on any terrain, including brutal mountainside slopes or areas with an irregular shape requiring a nonconventional enclosure.