SIEMENS

Architectural engineering

Octatube

Engineering is the key to realizing striking architectural designs

Products

Femap, NX

Business challenges

High-quality engineering

Risk management

"First time right" on-site construction

Keys to success

Collaborating with architect partners

Simulating stresses and loads

Meeting build specifications and compliance codes

Results

Won new, profitable contracts

Built striking features cost-effectively

Employed unconventional building materials to cost and aesthetic advantage

Architecture is an art form made possible by engineering

Startling, interesting, compelling and even controversial freeform building structures can be pleasing to the eye, but must also be supported by sound structural work. Engineers are charged with making sure eye-catching buildings and building features can withstand expected loads and stresses as well as the local climate.

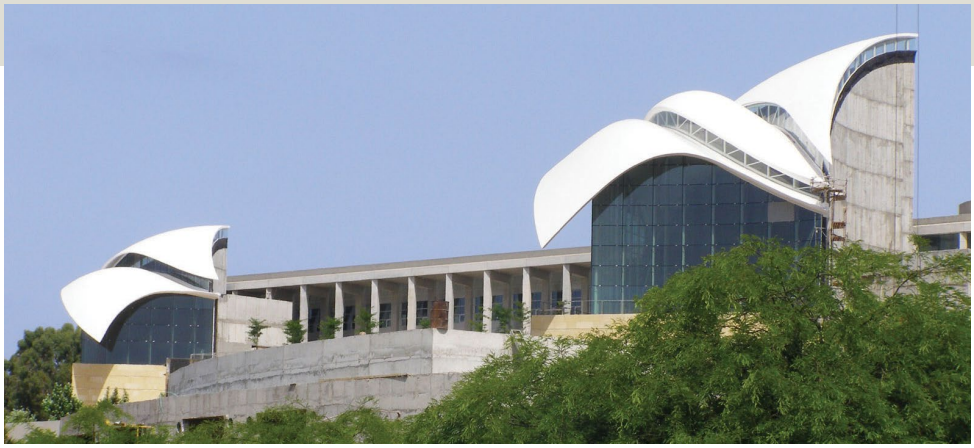
Octatube, a Dutch design, engineering and manufacturing company, works closely with leading architects to bring their ideas to life. Developing new structures and retrofitting older buildings with visually stunning new features is made more challenging by compliance with building codes and restrictions on what can be done to historic structures.

Twenty-five years ago, Octatube founder Mick Eekhout searched for ways to realize his ideas for new building materials, elements and components. Prefabrication and industrialization played an important part in this vision. Because he couldn't find a company that could realize his unique designs, he started his own. Eekhout's design philosophy stipulates that his company's constructions should be shipped as prefabricated elements to be assembled on-site and avoid the need for welding.

"This is a great idea, but very challenging to actually carry out," says Luis Weber,

"The power of Femap lies in its generic nature. Using Femap with NX Nastran, virtually any kind of calculation can be made."

Luis Weber
Head of Construction
Octatube



head of the Octatube construction department. "Creating prefab elements for on-site construction means we need to create robust, top-class designs and components. Tight tolerances need to be taken into account for the materials to be assembled, as well as the building itself. Overall quality must be very high to ensure there are no unpleasant surprises during construction."

Special materials underpin striking designs

Octatube is responsible for the entire process, from designing and building architectural elements through construction and follow-up. The company takes over part of the building processes from the construction firm. Materials used include steel, glass, fiberglass-reinforced polyester, cardboard and composites.

"These materials allow us to create striking constructions into which various architectural functions may be integrated," Weber says. "One good example is a recent project. We needed to cover a building facade with fiberglass-reinforced polyester. This had to be weatherproof and meet fire safety requirements. We constructed a solution with self-supporting elements and a glass outer skin. Using cardboard in a building may sound odd, but in tubular form, it is an excellent and cost-effective construction element. Plasticization makes the cardboard tubes weatherproof."

During the bidding phase of a project, detailed design calculations must be carried out. Femap™ with NX™ Nastran® software is used for this purpose. Femap is an advanced engineering simulation software program that creates finite element

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analysis (FEA) models of complex engineering products and systems; NX Nastran is a solver. Both are from product lifecycle management (PLM) specialist Siemens PLM Software. Weber explains, "In this initial phase, designs are sketched and different material thickness and profile types are considered. Calculations are geared towards finding optimal combinations of materials and constructions. Costs are minimized, without making any compromises in creativity or customer requirements."

Engineering challenges aided by Femap and NX Nastran

Once the project has been approved, engineering begins in earnest. At first, statistical and natural frequency calculations are made. Some of the connections are elasto-plastic, and calculations are made on the basis of line elements. "We import these in DXF format or enter them ourselves," Weber says. "The main advantage of Femap is the ease of use and easy data entry. We've been using Femap since 2000 and recently expanded it with the use of NX Nastran, which is better integrated with Femap than the software we used previously."

Other firms use software packages specifically designed for steel construction, but Octatube engineers find these are too limited. "The power of Femap lies in its generic nature," notes Weber. "Using Femap with NX Nastran, virtually any kind of calculation can be made."

Minimizing risks

Femap is used to help Octatube engineers get a realistic impression of how glass will behave in an architectural construct. Calculations are carried out in accordance with the relevant Dutch standards. Resulting tension and shift values serve as input for algorithms, which predict the behavior of glass under given conditions. These algorithms are entered into Excel® spreadsheet software and transferred to Femap for subsequent mathematical processing.

Removing project risk is an important condition for success. "Risk analysis is primarily carried out by the construction company," says Weber. "Identified risks are worked out mathematically to determine whether they may become critical in a real-life situation. Femap and NX Nastran are important tools for helping us quantify risk beforehand, and allow the construction firm to focus on actual on-site risks. The worst thing that can happen would be

Solutions/Services

Femap with NX Nastran
www.siemens.com/plm/femap

Customer's primary business

Octatube designs complex and innovative architectural constructions with glass and steel accents, fiberglass reinforced polyester, cardboard, composites and other materials. Octatube provides design, engineering, production and assembly. Projects are often engaged with leading architects and can be found all over the world.
www.octatube.nl

Customer location

Delft
Netherlands

"Our process aims to remove as much risk as possible. Femap with NX Nastran is vital in this respect. The applications we use play a vital role in optimizing design. This allows us to make cost-effective project proposals. In short, for us, Femap with NX Nastran is an important member of our team."

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for errors to become apparent on-site. Tight schedules don't allow for such errors. Design quality must be absolutely flawless."

Although architectural drawings provide the basis for construction design, real-world tolerances need to be carefully taken into account. In construction, deviations of several centimeters from the original plan are often required. Anchor points are measured on-site to check if they fall within the tolerance values specified. At this point, the entire assembly has already been developed and is almost ready for production. If the measurements exceed the given limits, solutions are sought to enable construction. Once the assembly has been delivered to the building site, it is simply screwed together; no welding or grinding is required.

"On-site assembly is much faster and easier than welding," says Weber. "However, it is only possible to work this way if we know nothing can go wrong. Our process aims to remove as much risk as possible. Femap with NX Nastran is vital in this respect. The applications we use play a vital role in optimizing design. This allows us to make cost-effective project proposals. In short, for us, Femap with NX Nastran is an important member of our team."

Siemens Industry Software

Americas	+1 314 264 8499
Europe	+44 (0) 1276 413200
Asia-Pacific	+852 2230 3308

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