



## Success story

# Takenaka Corporation: from integration to collaboration in the simulation process

## **VOLTA enterprise platform expands the usage of simulation and optimization in the architectural structural design process.**

*Discover how designers, engineers and managers benefit from ESTECO Technology to simplify their DESIGN&BUILD process. Using VOLTA simulation process & data management, and design optimization capabilities, they collaboratively assessed the performance of structural elements of a new company building to maximize office space capacity.*

### **Why DESIGN&BUILD and Simulation Process and Data Management (SPDM)**

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Collaboration between design and construction has traditionally been playing an important role in the Architecture, Engineering, and Construction (AEC) industry. Takenaka Corporation, one of the top construction companies in Japan, ensures certified process and construction quality at the highest levels with its integral DESIGN&BUILD system. This methodology integrates architecture, building technology, and construction in a unified flow of work from concept through completion, replacing the traditional approach where the design and construction phases of a building project are carried out in a sequential manner.

The DESIGN&BUILD system leads to many advantages: effective communication, unified quality, effective timing and cost overruns, and reduced completion time. In fact, architects and engineers collaborate with

each other, share data, and are updated on various requirements to deliver innovative building solutions and meet clients' expectations. When Takenaka Corporation embraced the DESIGN&BUILD system, it looked for a reliable Simulation Process and Data Management (SPDM) platform.

That is why they partnered with ESTECO to simplify the whole simulation design process, manage a huge amount of data across teams, and shorten product development time. Designers, engineers and managers involved in the architectural projects access ESTECO VOLTA from a web browser and intuitively interact with the simulation process. From running 3D building simulations to applying design optimization techniques, analyze results and share data on the internal cloud for collaborative decision making.

## Expanding 3D building modeling and design optimization techniques across the enterprise

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Conducting manually parametric studies on 3D building models can become a time-consuming process leading to delays in project schedules. Overcoming these challenges for designers and engineers at Takenaka Corporation translate into an extensive use of ESTECO process automation, integration, and design optimization technology to significantly accelerate the architectural simulation design process.

By combining modeling solvers as Rhino3D/Grasshopper, Abaqus, Midas iGen, or other in-house design software in modeFRONTIER powerful workflow, they can execute complex simulation chains and evaluate thousands of complex geometries in a short time. On top of that, applying ESTECO state-of-the-art design exploration and optimization algorithms to assess the correlation between several requirements (room size, thermal comfort, structural design to name a few) and maximize the building performance.

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With VOLTA, our designers and engineers can now access to the simulation results in one click and collaboratively take decisions without only relying on siloed reports of data.

### **Toru Inaba**

*Computational Design Group  
at Takenaka Corporation*

At Takenaka, they had to make a step forward to expand the usage of 3D building modeling and design optimization techniques across teams with different expertise. Indeed, designers and engineers usually perform simple data analysis and are not necessarily confident in simulation and workflow set-up execution.

Moreover, the DESIGN&BUILD methodology requires effective collaboration between the different actors involved in the simulation process to make changes and update their models for further analysis.

This gap has been filled by scaling up modeFRONTIER desktop solution capabilities across the enterprise with the ESTECO VOLTA collaborative web platform. It enables simulation experts to create and make the simulation workflow ready to be executed via web. Then, designers and engineers can

**VOLTA**

Do you want to see VOLTA in action and discuss how you can apply it to your engineering processes?



VOLTA user scenario at Takenaka: enabling teams with different expertise to effectively collaborate in a 3D building project and perform a series of tasks (automate and run simulations, apply design space exploration techniques and analyze results) directly from a web interface.

use these simulation models, apply design optimization techniques, and analyze results in the VOLTA platform.

Since the simulation data are accessible in their internal cloud, it is easier for them to quickly interact with the simulation experts asking for updated CAD/CAE models when design changes are required.

In the end, managers can log in to the VOLTA web platform, access product performance metrics, and monitor the whole simulation product development advancements. This scenario has been successfully applied in the early design phase of a new office building project. VOLTA made simulation usable by different teams to optimize structural elements in order to guarantee maximum office space capacity.

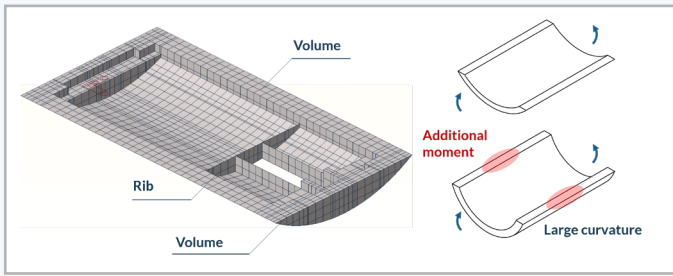
### Use case: rationalize the slab shape of a office building with VOLTA

Expanding the usage of simulation and optimization became a true fact when Takenaka’s designers and engineers had to collaborate in order to assess the performance of structural elements for a new office building.

The subcontracted project required to drastically reduce the number of columns to make the most of the office space. However, the expected distance between the columns is about 17 meters, which is quite a lot according to the Japanese regulations. This has an unavoidable impact on the flat surface of a slab, a common structural element used to construct floors and ceilings. The slab needs a proper curve in order to guarantee the stiffness.

Although, a side effect of the increased curvature may unbalance the floor forces and cause local additional bending moments. The solution is not just filling the curved slab shape, rather including massive amounts of ribs

in some areas. To achieve this, the company’s designers and engineers combined the use of 3D building modeling techniques with ESTECO VOLTA collaborative web platform to explore reasonable volume amounts and coverage of the slab.



Curved slab: including massive amounts of ribs to avoid local bending moments.

First, they used Rhino3D/Grasshopper to create and model the shape of the office building and then converted it (in Grasshopper) to be meshed in Midas iGen to perform structural analysis.. In the end, the several outputs from finite element analysis such as maximum displacement and the stress were extracted by using a python script. The interaction between the different simulation solvers was automated in the modeFRONTIER workflow coupled within the ESTECO VOLTA platform environment.

This enabled simulation experts to upload the modeFRONTIER workflow and execute it through a web interface. Then, the structural engineers benefited from the VOLTA Advisor, a web environment for advanced post-processing and data visualization, to assess the simulation results from the finite element analysis model and validate the deformed shape of the all structure.



The VOLTA web platform and its apps enabled us to truly democratize our DESIGN&BUILD simulation process.

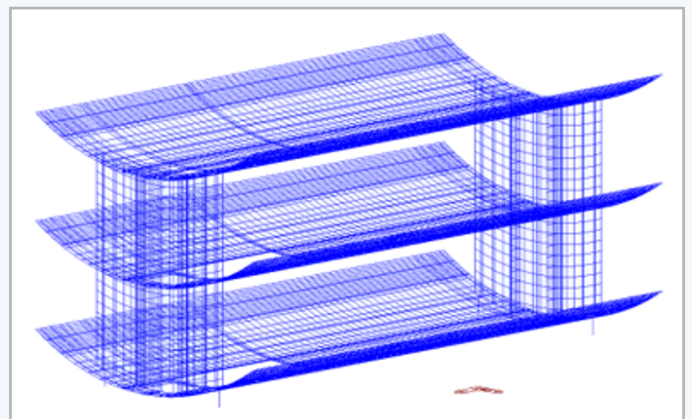
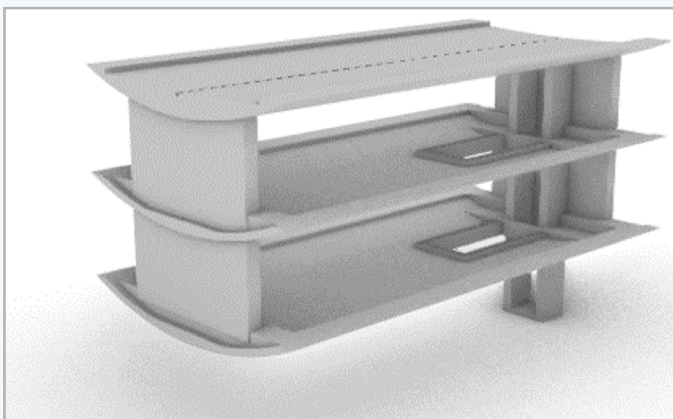
**Toru Inaba**

*Computational Design Group  
at Takenaka Corporation*

For the same project, they also performed additional analysis through the VOLTA Planner dashboard, a modular interface to apply several optimization strategies in an intuitive way. This allowed them to easily create new simulation plans, change parameters bound, objectives and constraints with the aim of finding the best designs with minimized both the building weight and the maximum displacement of slab.

“Thanks to the VOLTA HPC & Cloud capabilities, we were able to evaluate more than 700 designs in just four days.

The VOLTA Player interface allowed to execute these computational heavy multi-objective optimization analysis on the cloud without having to think how resources are used remotely”.



Rhino3D/Grasshopper and Midas iGen: modeling the shape of the office building and meshing it to perform structural analysis.

Toru Inaba, Computational Design Group at Takenaka Corporation, also said that one of the key benefits of using VOLTA is to make simulation data accessible to a broader team of designers and engineers.

“In particular,” concluded Toru Inaba, “our simulation experts could share the best practices on how to use the VOLTA Advisor, the web environment for advanced data analysis and visualization, with the structural engineers. The VOLTA web platform and its apps enabled us to truly democratize our DESIGN&BUILD simulation process. Designers and engineers can now access to the simulation results in one click and collaboratively take decisions without only relying on siloed reports of data”.



The session with the summary of VOLTA Planner configuration, a modular environment to apply several optimization strategies, shows the set-up and execution results of the design space exploration plan chosen to optimize the shape of the all structure.



VOLTA Advisor, the advanced data analysis web environment, allowed to assess simulation results and choose the optimum design with minimized both the building weight and the maximum displacement of slab.

## About Takenaka Corporation

With yearly sales of \$9 billion, 20 overseas offices, the largest construction R&D laboratory in the world and over 1,000 architects in our design department, Takenaka offers comprehensive services worldwide across the entire spectrum of space creation from site location and planning to design and construction as well as postcompletion services such as building maintenance. At Takenaka, we strive to consistently improve the quality of our works to ensure building owners that orders placed with us will be fulfilled with the utmost confidence, security, satisfaction and pride throughout the contract period and beyond. [takenaka.co.jp](http://takenaka.co.jp).



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