

## - White Paper -

### **Structural design with ArchiCAD, and its integration with structural software**

*- Great buildings need great structure -*

#### **The Role of Structure in Architectural Design**

A building's architectural design and its physical structure are closely interrelated: on the one hand, the architectural design of the building defines the structure; on the other hand, the structural design of a building reflects the overall architectural design.

As structure became a visual and aesthetic part of the design in modern architecture, structures must be as light as possible while maintaining complete integrity. Also, the structure must be optimized for performance and price.

ArchiCAD<sup>®</sup> is Graphisoft's purpose-built virtual modeling solution that allows architects to create a 3D model of their design, effectively creating a Virtual Building<sup>™</sup>. This White Paper details how ArchiCAD (AC) supports key aspects of structural design and the optimized workflow between the two disciplines. Architectural and structural design use the same Virtual Building model from the earliest sketches through to CNC machine production of building elements, using the appropriate software solution for every phase.

#### **Standards for structural design**

The standards set by authorities and developed over the course of decades are traditionally different for every material (RC, Steel, Wood etc.) in every country or region (e.g. DIN in Germany and Central Europe; BS in the UK; AISC in US). Lately, there has been a trend to unify these into a common standard - at least across regional economies, like the EU's Eurocode.

#### **Structural analysis and production**

ArchiCAD provides sophisticated design information along with the necessary level of model detail. This information can be directly imported and exported in the native format of the structural software or through IFC and used for structural analysis by specialized software.

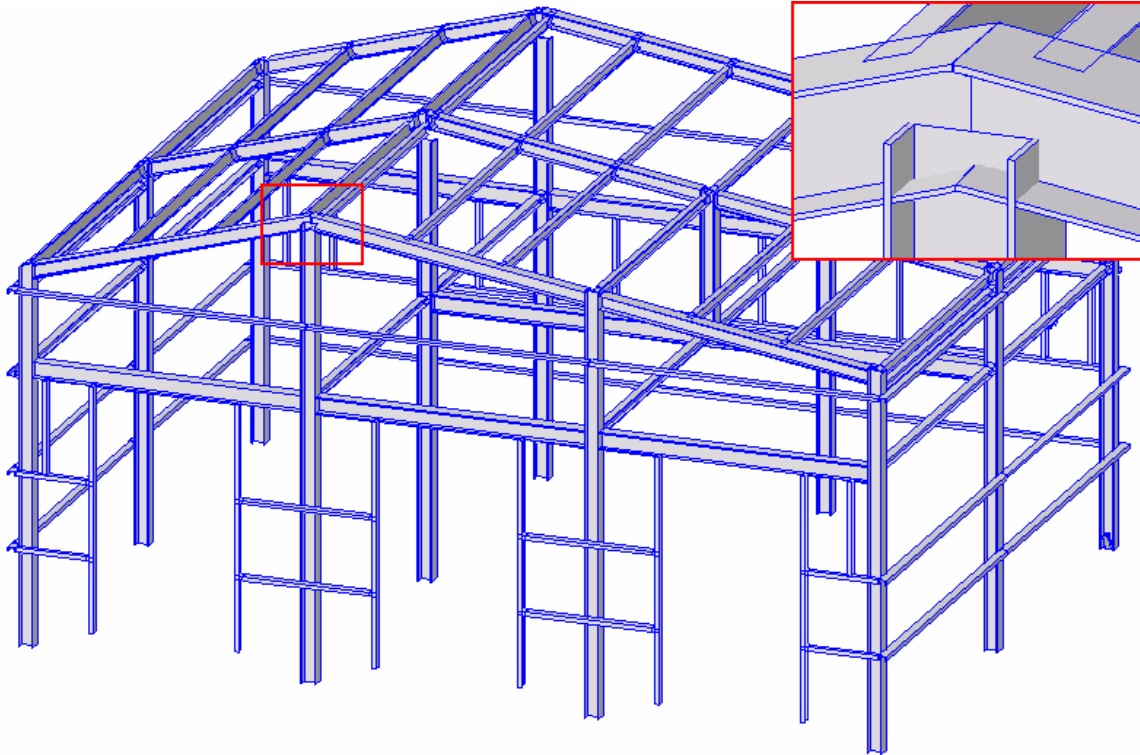
These import/export Add-Ons fully integrate structural design and analysis simulation programs that dramatically improve the simulation of whole-building approaches in design, planning, production and construction. This opens new doors for cost savings and structural optimization and performance.

Using ArchiCAD with these tools provides great benefits to both architects and structural engineers. Because the structural analysis tool can directly access ArchiCAD Virtual Building models, feedback on the structural design of the building can be obtained at any time during the design process. And ongoing changes to the design do not result in laborious (and duplicated) reworking in both separate applications - manually adjusting the geometry of the building to keep up with the alterations - because the essence of a 3D model means that all data is up-to-date and immediately usable.

An example of the seamless workflow:

1. The architect creates a simple, model of the envisioned structure. In creating this model, the architect chooses the spans and the profile (H, L etc.) from ArchiCAD's Library of profiles, and uses the slab, beam, column or wall tool to place the other load-bearing structures.

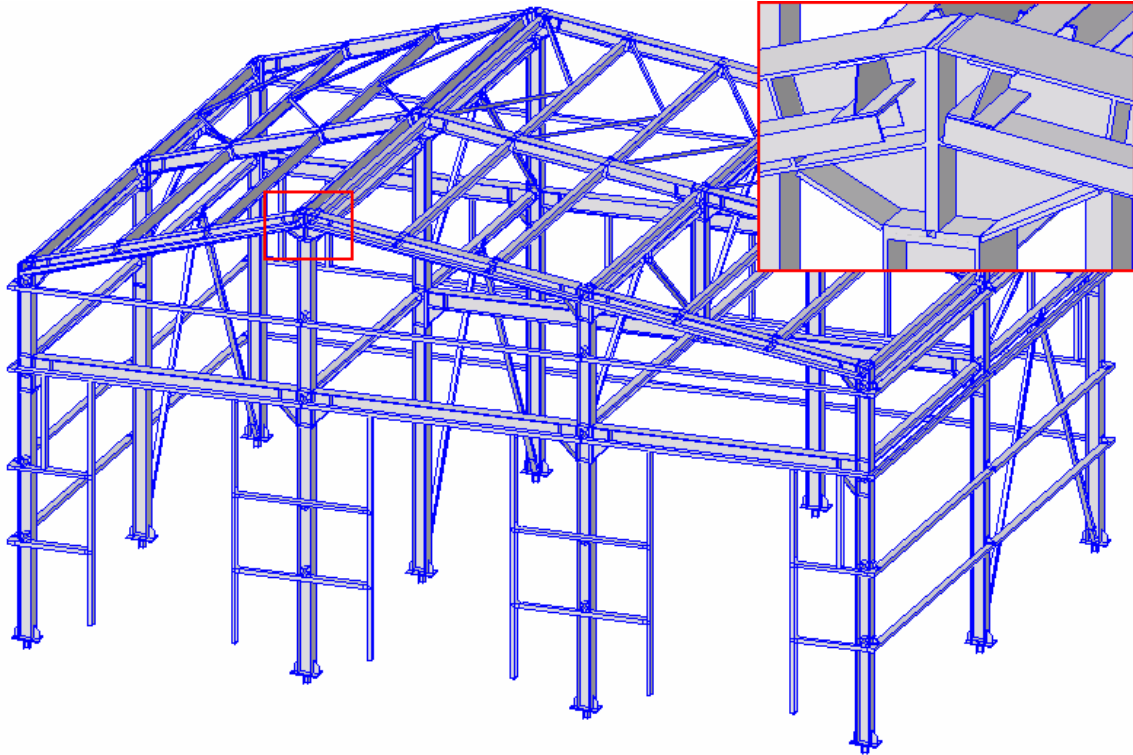
This is how it will look like in ArchiCAD:



2. He exports this simple model directly into the chosen structural design application.

3. In the structural design application, the structural engineer designs the connections, analyzes the model and chooses the right profile sizes.
4. The structural engineer exports this detailed model back into AC without bolts or screws, but with the connecting plates.

This is how it will look when imported back into ArchiCAD:



5. The architect can continue adding walls, windows and doors to this structure, because this representation is detailed enough for the architectural documentation drawings of the building.
6. The structural elements can be sent to production machines if there is a CNC output from the structural application.

In the following pages, we outline the main features and benefits of the structural software tools mentioned above, and we'll give you a brief introduction to how they can be used together with ArchiCAD at a professional level.

## Partner products

### AxisVM 8

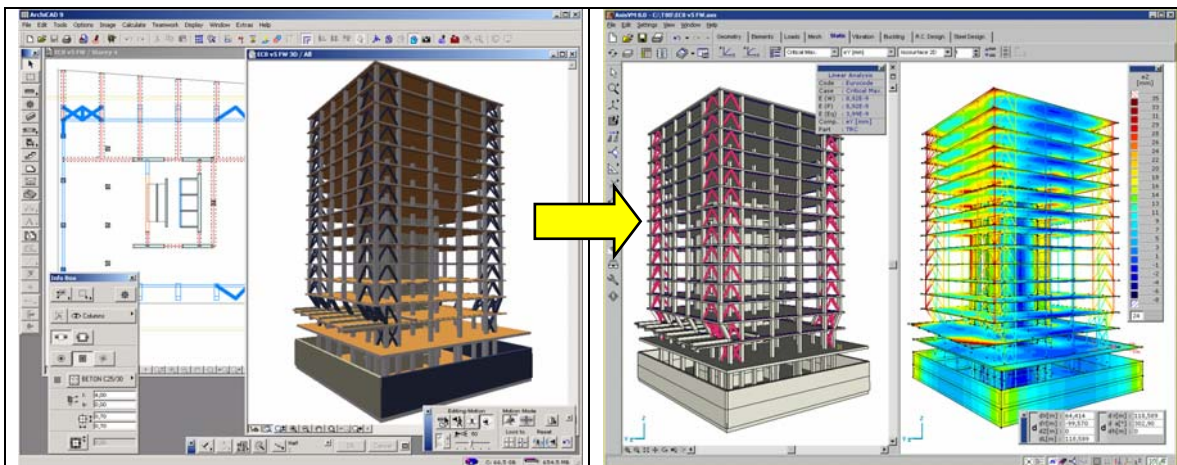


AxisVM has been successfully used as the structural analysis and design software for many of ArchiCAD designed projects. AxisVM is a high productivity finite element analysis software used by civil engineers in 22 countries. Due to its extensive analysis capabilities and robust graphic CAD user interface, the 3D structural building model combines the most complete visual and report details available. AxisVM has proven success in design of projects ranging from world-class international airports to design of steel microwave towers, from mega shopping malls to school gymnasiums, from showrooms and theaters to municipal water tanks, even underground structures.

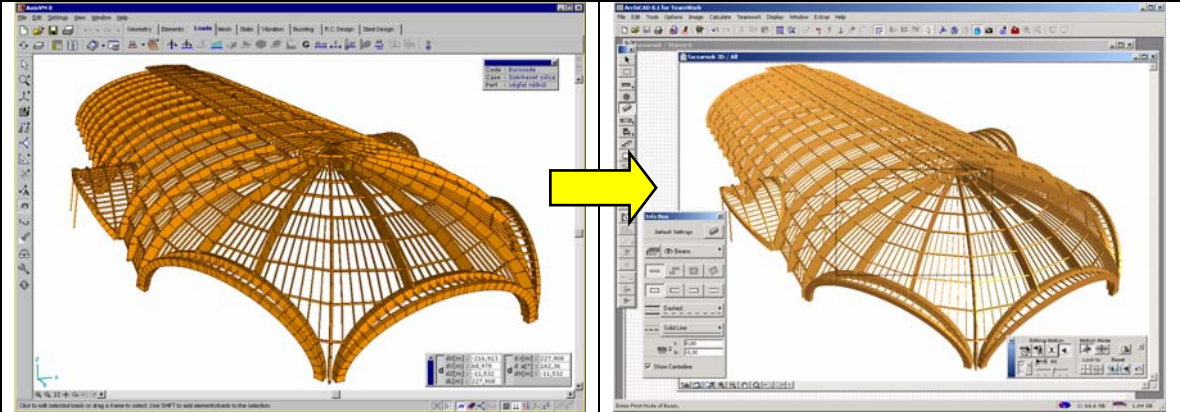
It performs linear and non-linear static, vibration, buckling and seismic analysis of 2D and 3D complex structures. Enables use of unlimited number of finite elements that can freely be combined in a model. Users can import-export ArchiCAD models via the IFC 2x2. Engineers can edit the model using the simple toolbar, dialog boxes and menu functions and commands available in the Visual Modeling environment. The AxisVM's user interface provides graphic, numerical and tabular results which can be saved, printed or combined into user defined reports, which are dynamically saved as the engineer makes changes.

AxisVM allows the engineer to model an entire structure or to separately model layers or floors, or components such as walls, plates, slabs, columns or beams with any combination of concrete, steel, wood, aluminum or user defined special materials. Users can work in a 2D or 3D environment, working on separate parts or the total building as they may need.

The engineer can quickly make verification of designs, review optimization possibilities or pose complex 'what-if questions.

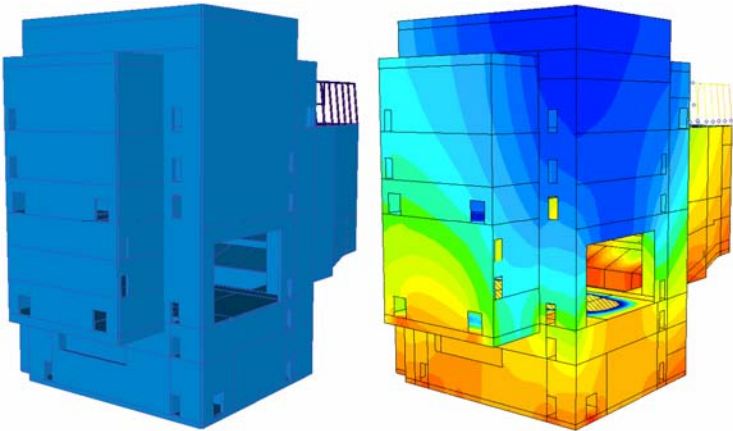


*Model import from ArchiCAD to AxisVM via the IFC 2x2*

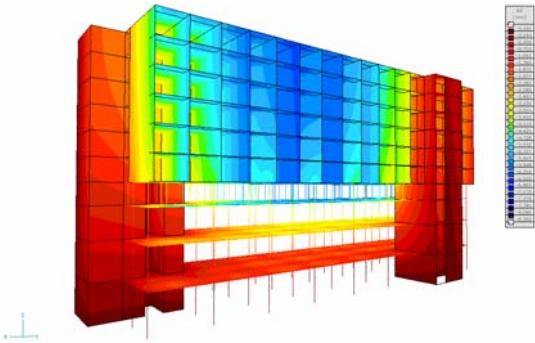


*Model export from AxisVM to ArchiCAD via the IFC 2x2*

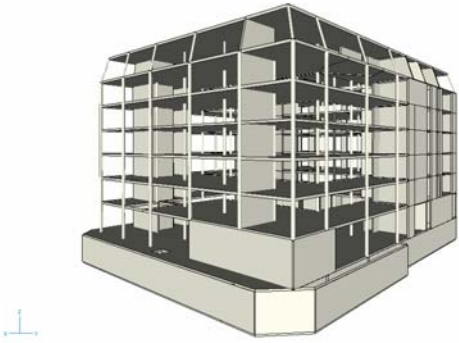
Show cases



*Concert hall*



*Hotel*



*Office building*

## Appendix

### AxisVM 8

#### Value proposition

The major strength of AxisVM is its intuitive user interface that lets structural and civil engineers model simple structural elements or total buildings with any combination of materials, loads, and conditions. The value propositions are

- Easy to learn and use graphical user interface
- Fast and accurate finite element method
- Long history of analysis of ArchiCAD designed projects

#### Main features

- Visual Modeling with unlimited number of finite elements
- Extensive section and material libraries, and the ability for users to input new type of materials or cross-sections
- Performs linear and non-linear static, vibration, buckling, and seismic analysis
- Automatic meshing, meshing refinements and user defined meshing
- Unlimited load definitions, load cases and combinations
- Reinforced concrete and steel design
- Built in standards: Eurocode, DIN, SIA and other country codes
- Integrated Report Generator with dynamically updated results
- File export to IFC, DXF, DSTV, RTF, ASCII, WMF, JPG

#### ArchiCAD compatibility:

- ArchiCAD 9
- IFC 2x2 import-export
- Download from: [www.graphisoft.com/support/ArchiCAD/downloads/AC-AxisVM](http://www.graphisoft.com/support/ArchiCAD/downloads/AC-AxisVM)
- MacOS and PC platform

#### Target market

Six configurations of the software are available, covering even the most specific needs of small to large firms.

#### Relevant countries

AxisVM is used by engineers in Austria, Germany, Switzerland, Italy, Netherlands, Hungary, Romania, Yugoslavia, Greece, Sudan, Egypt, Spain, Finland, England, Brazil, Uruguay, Belgium, Latvia, Croatia, Slovenia, Czech Republic, Kenya

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