

ObjectiveFrame - An educational tool for understanding the behaviour of structures

J. Lindemann, O. Dahlblom and G. Sandberg

Division of Structural Mechanics, Lund University

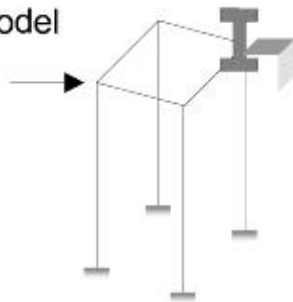
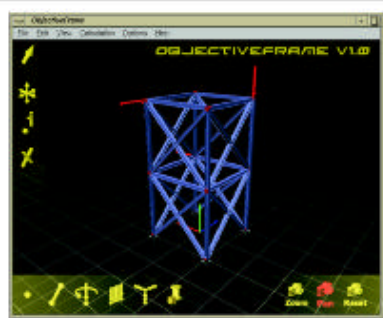
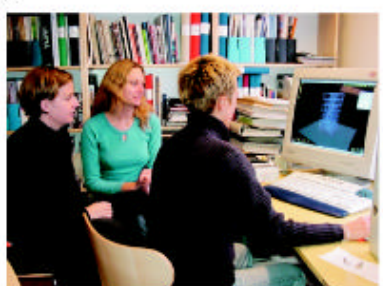


Goals

- Reducing user interface complexity
- Using direct manipulation and feedback
- "Feeling" the structure
- Create tool for understanding forces and structures



Conceptual model

Domain	Product	Process
Application	Beam model 	Edit, change and move nodes, beams, loads, boundary conditions and materials.
System		User interface, editing functions, 3D graphics, view transformations, FE solver.
User	Students, Architects, Engineers 	Visualise behaviour of structures

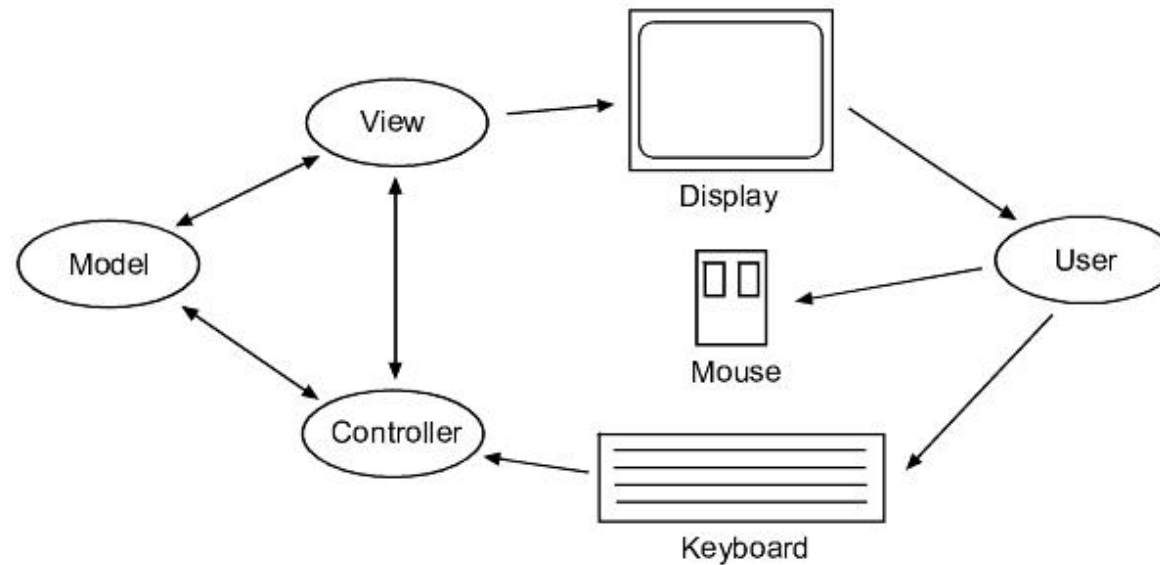


Direct manipulation system

- Visibility of the objects of interest.
- Rapid and reversible, incremental actions.
- Replace complex command language by direct manipulation.



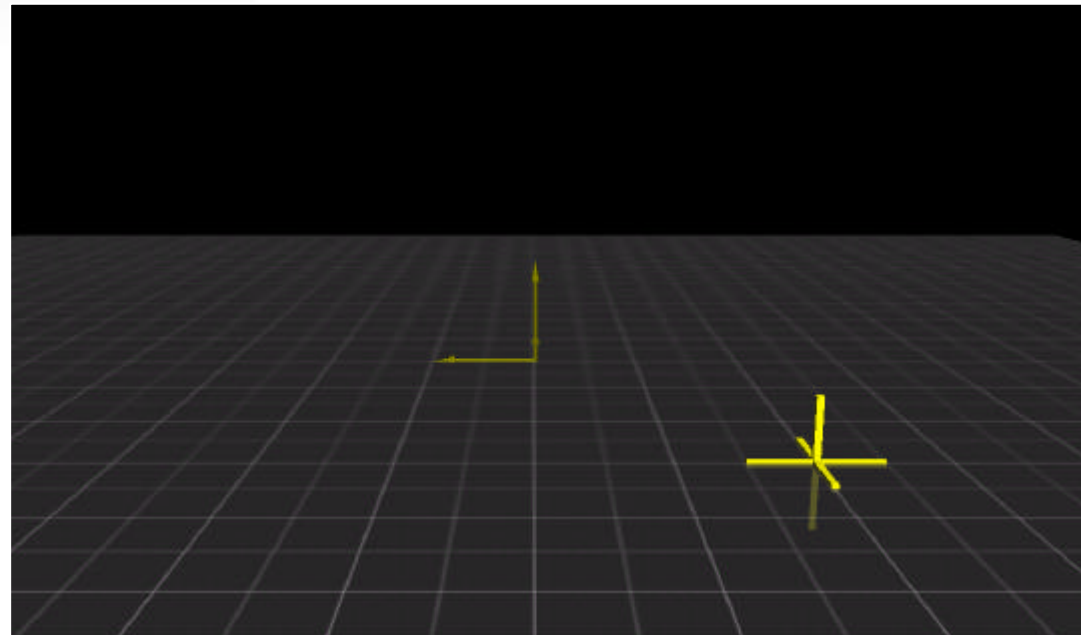
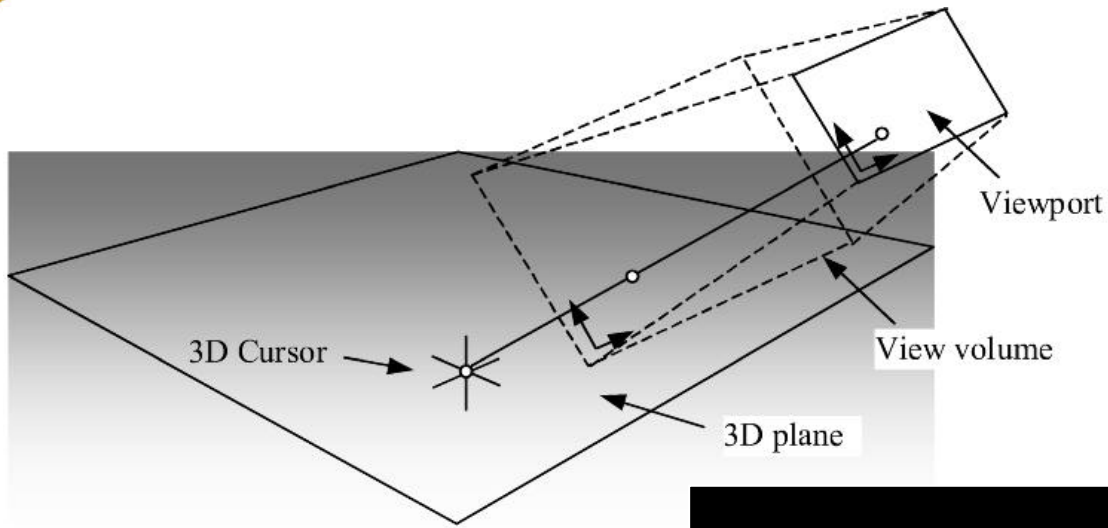
Model-View-Controller paradigm MVC



- Model component representing the application
- One or more view components responsible for displaying views of the model
- The controller component receiving input from devices controlling the view and model components

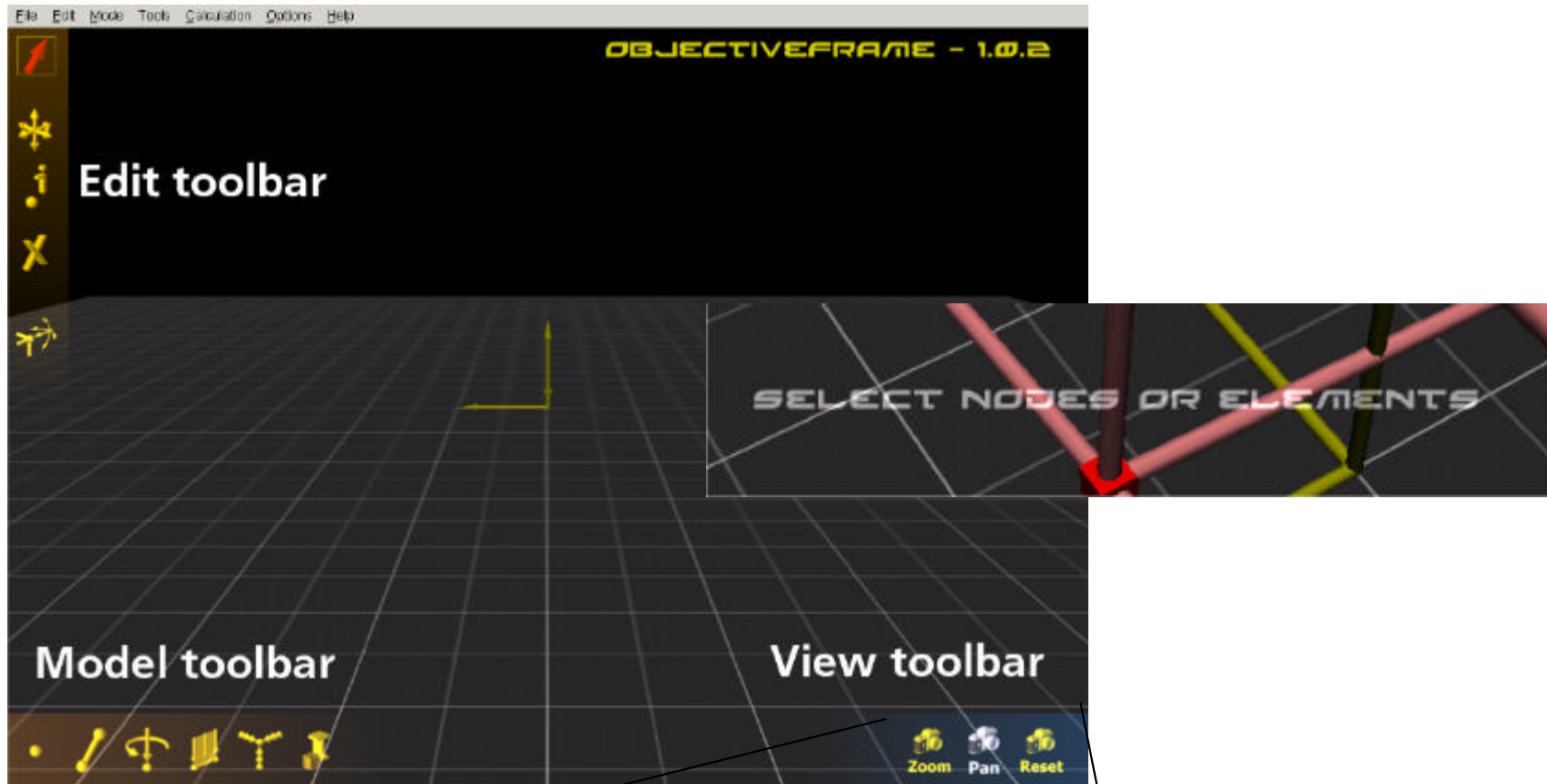


3D Workspace





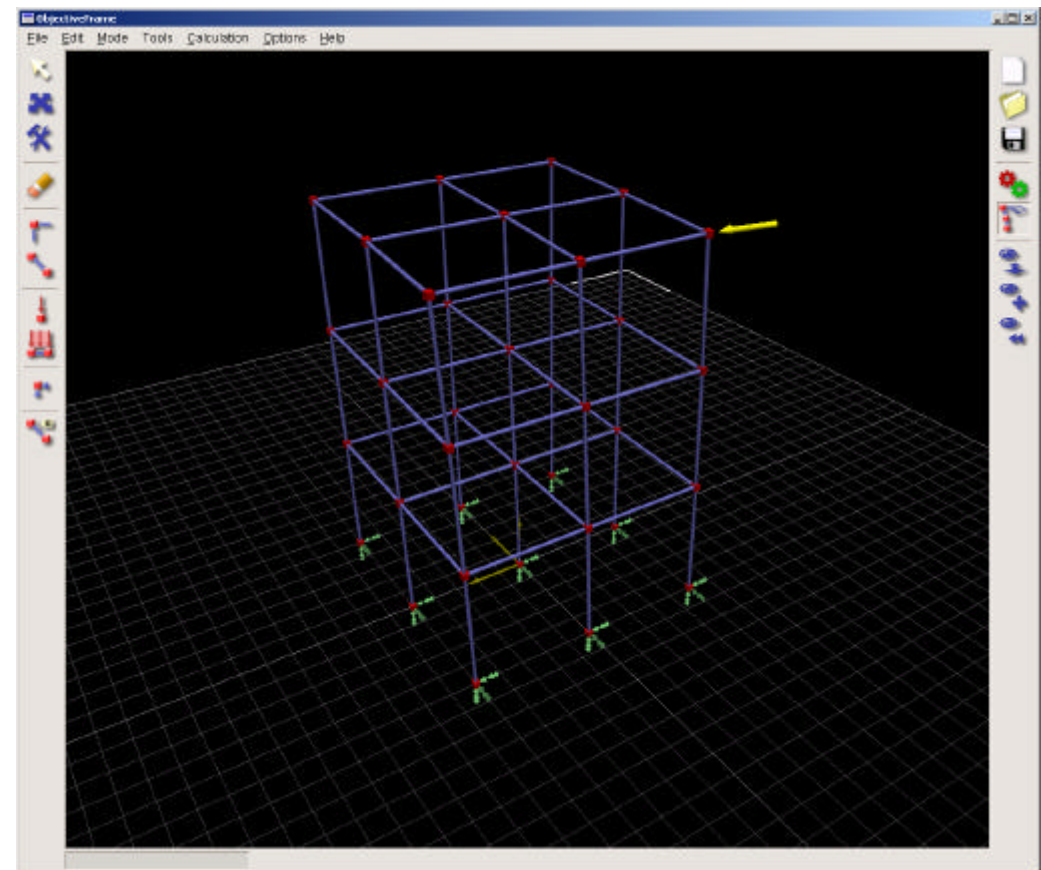
Toolbars and HUD





Lite edition

- Blending and texturing not supported well on all hardware platforms
- Based on the same source
- Using standard FLTK 2d toolbars instead





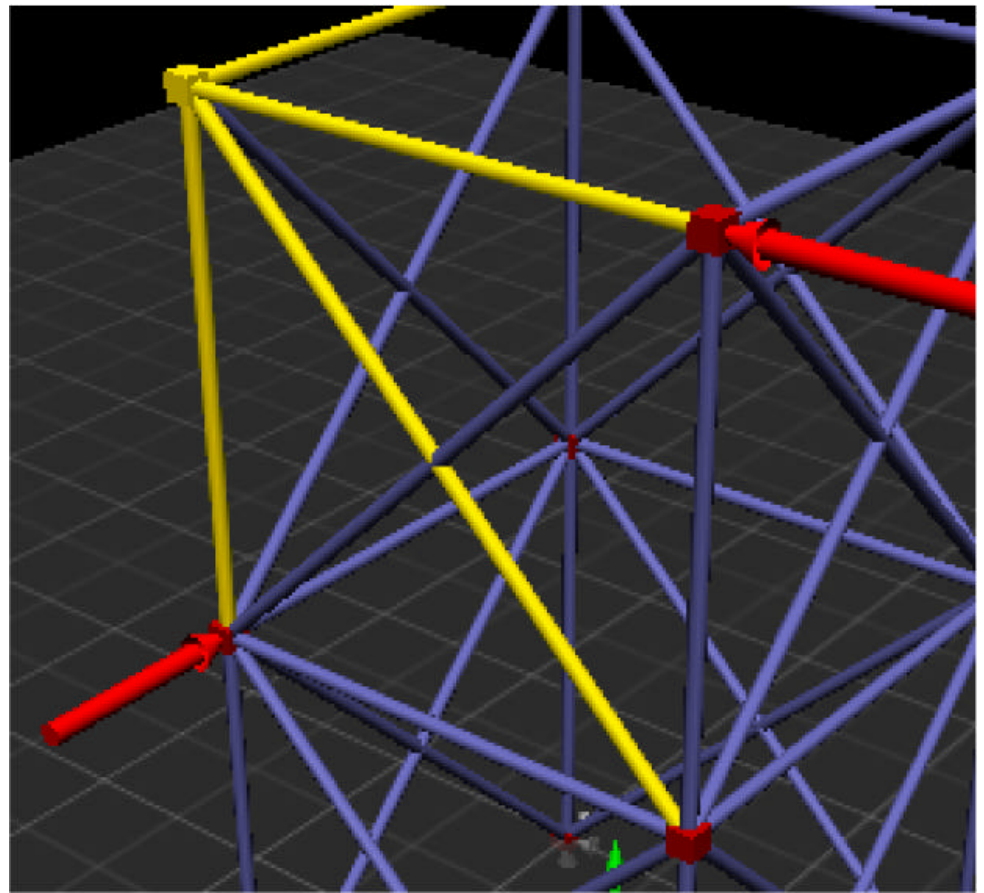
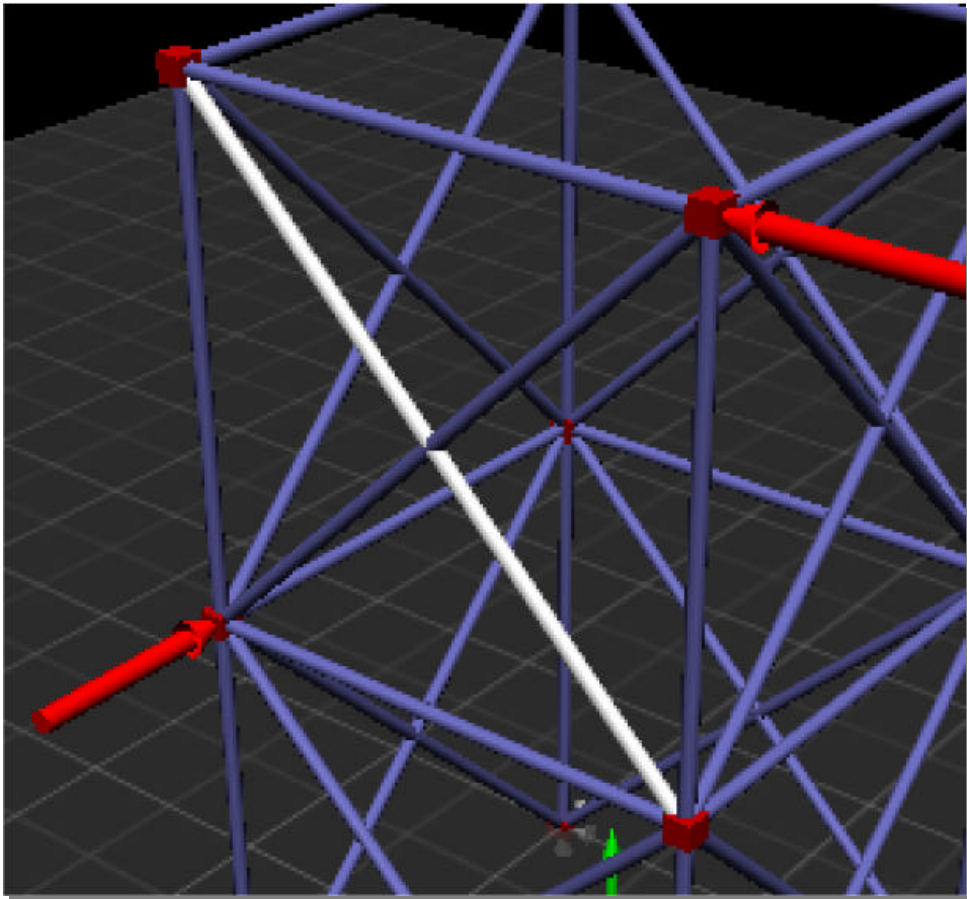
Modes

- Select
- Move
- Feedback mode
- Create nodes
- Create beams
- View/Zoom
- View/Pan



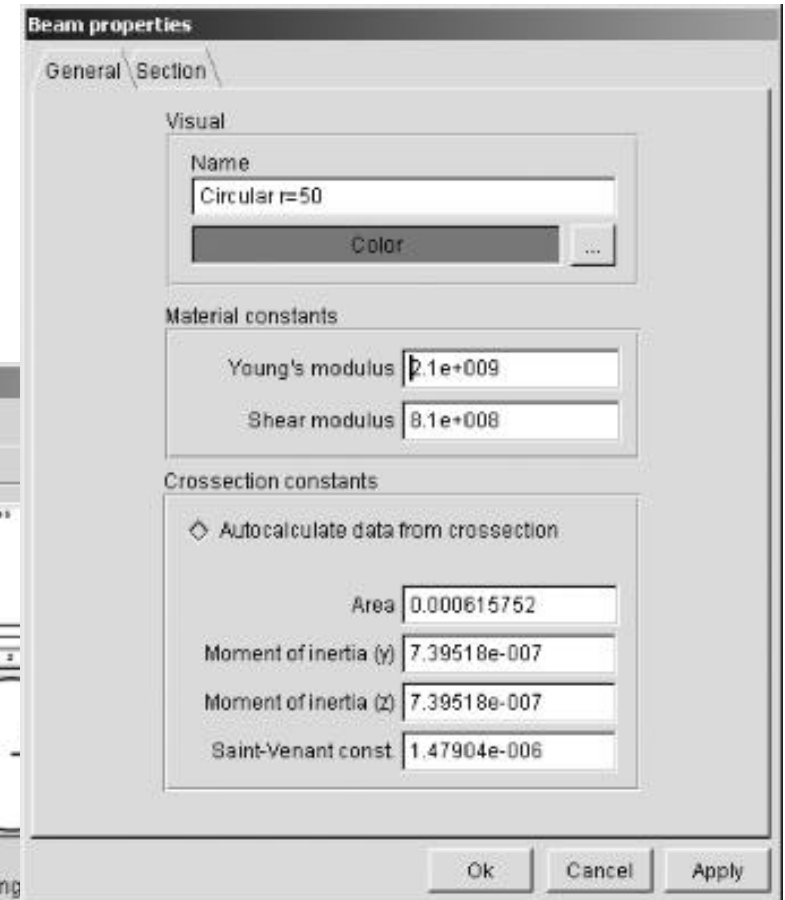
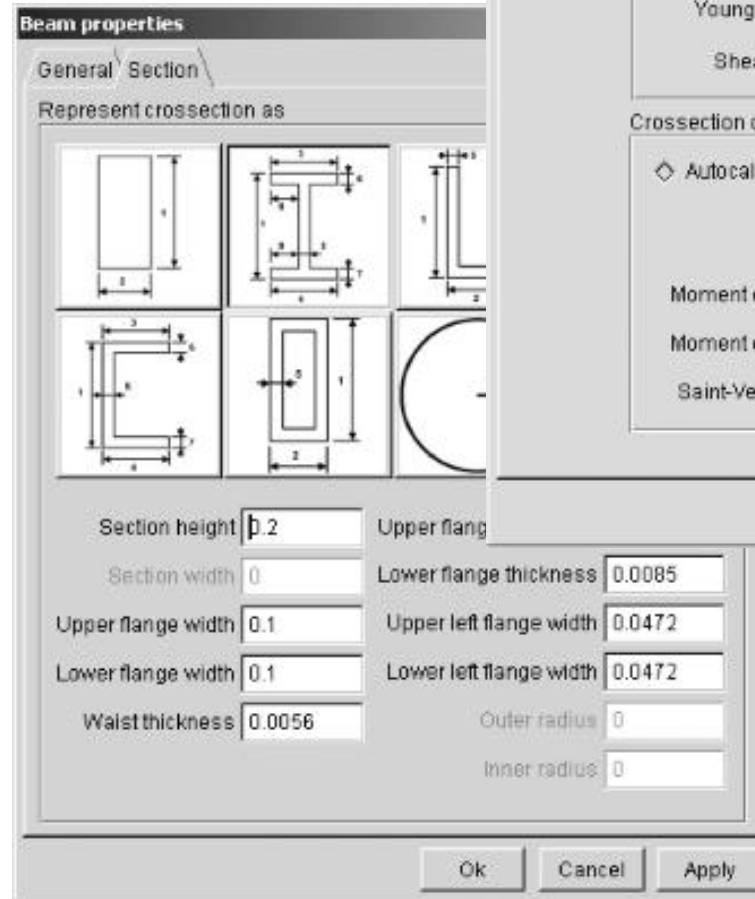


Selection and deletion



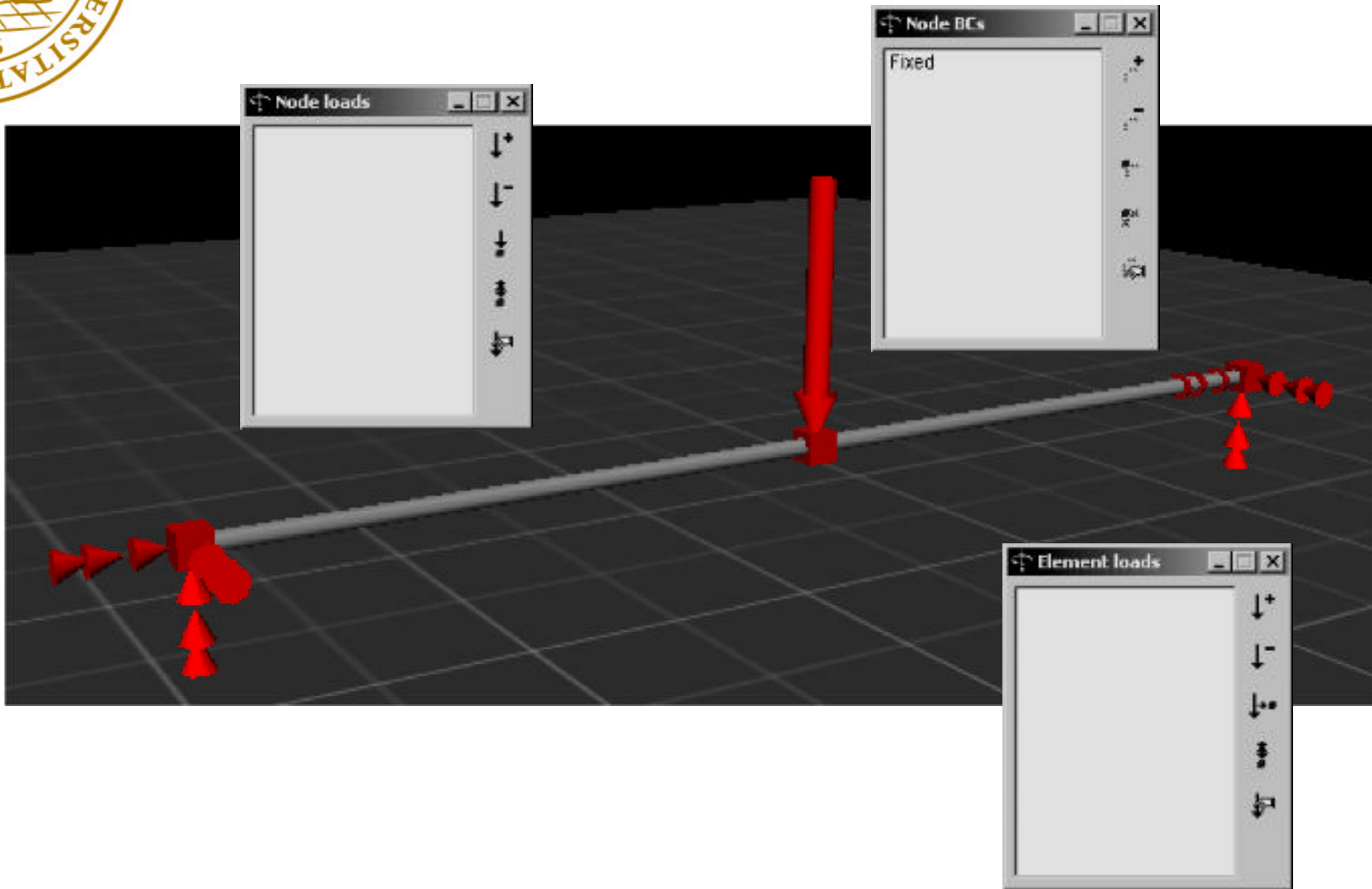


Element properties



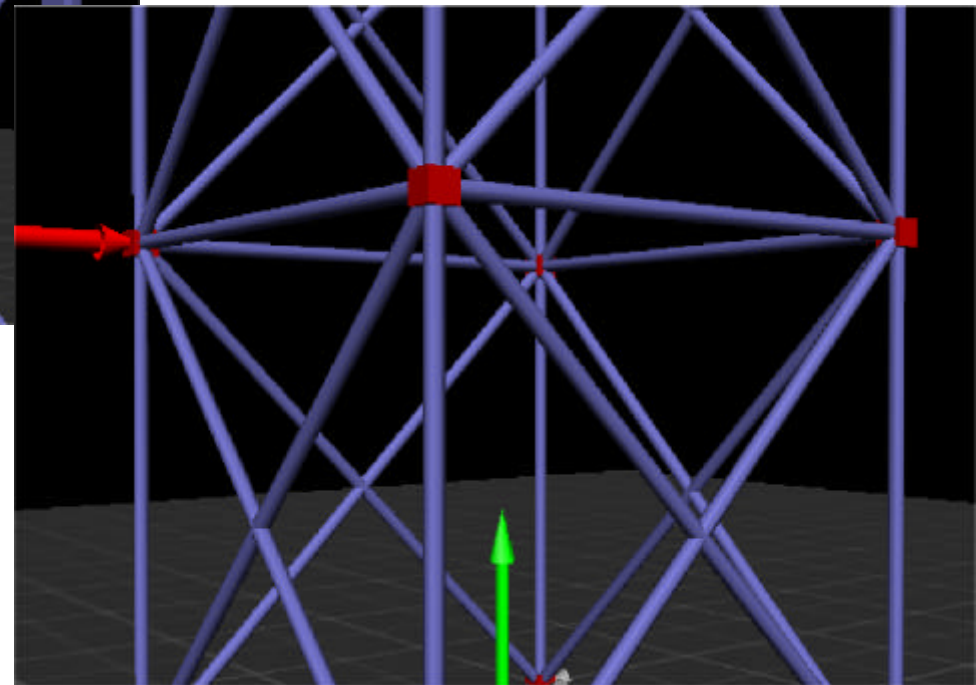
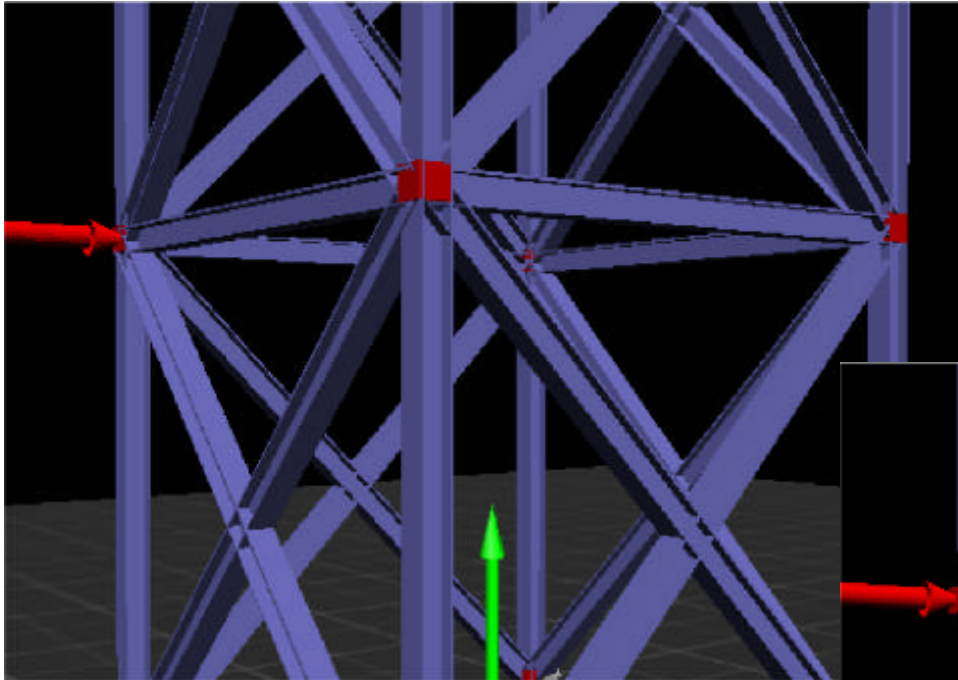


Loads and boundary conditions



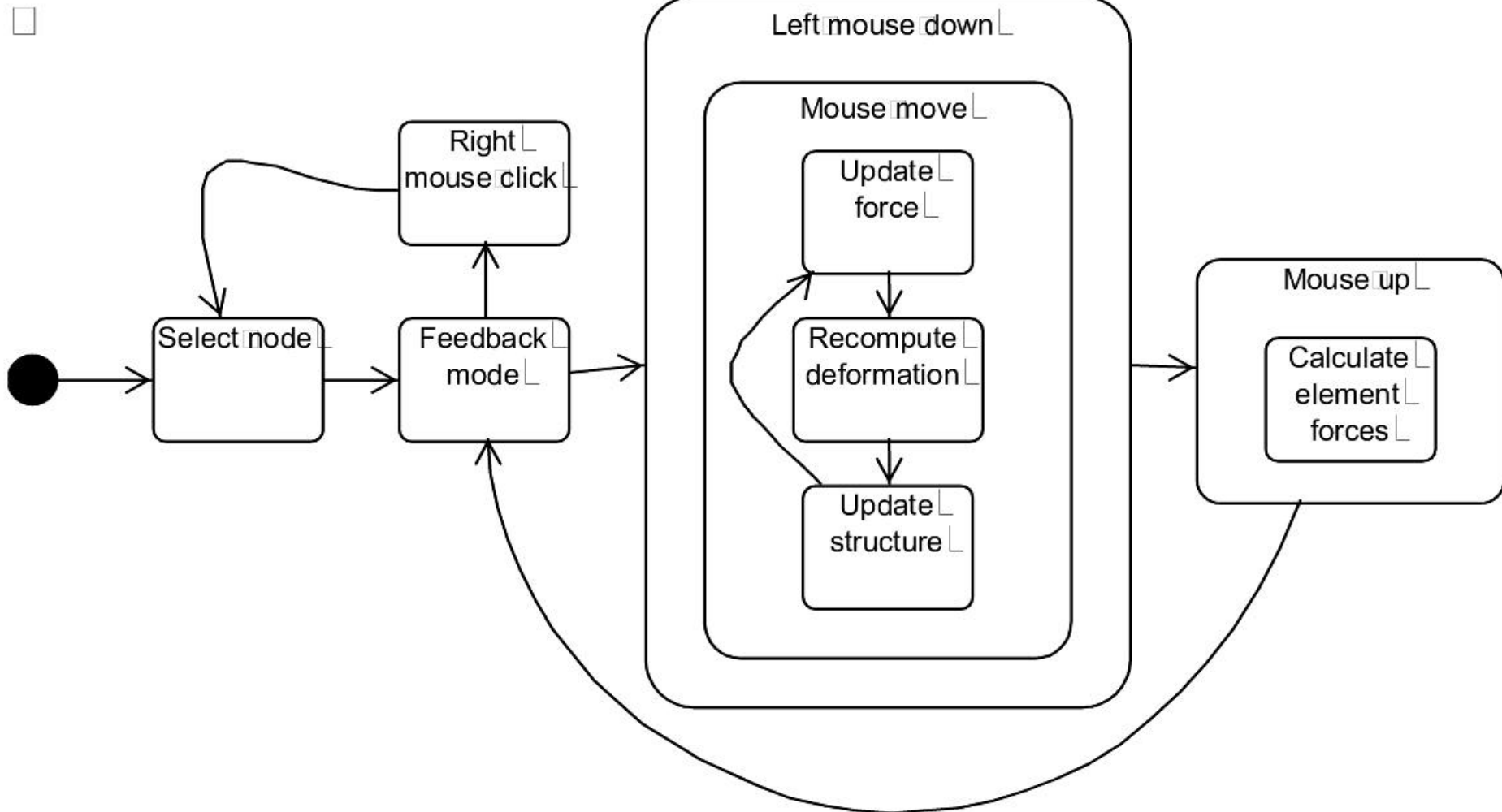


Geometry and finite element mode



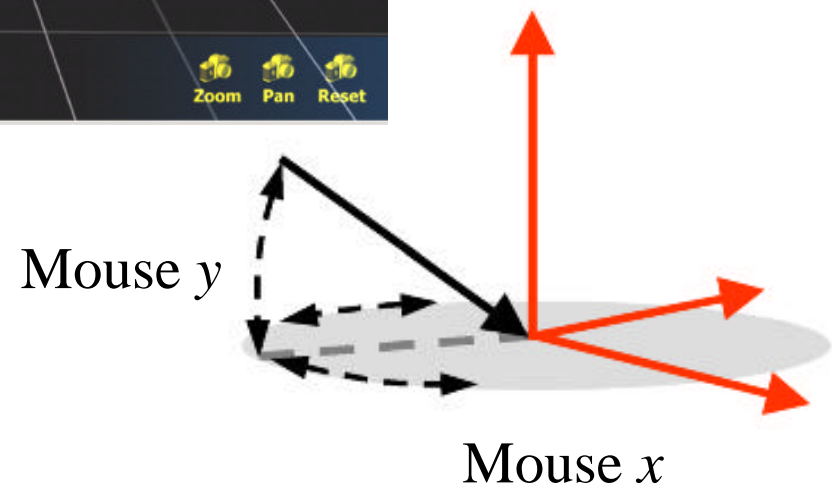
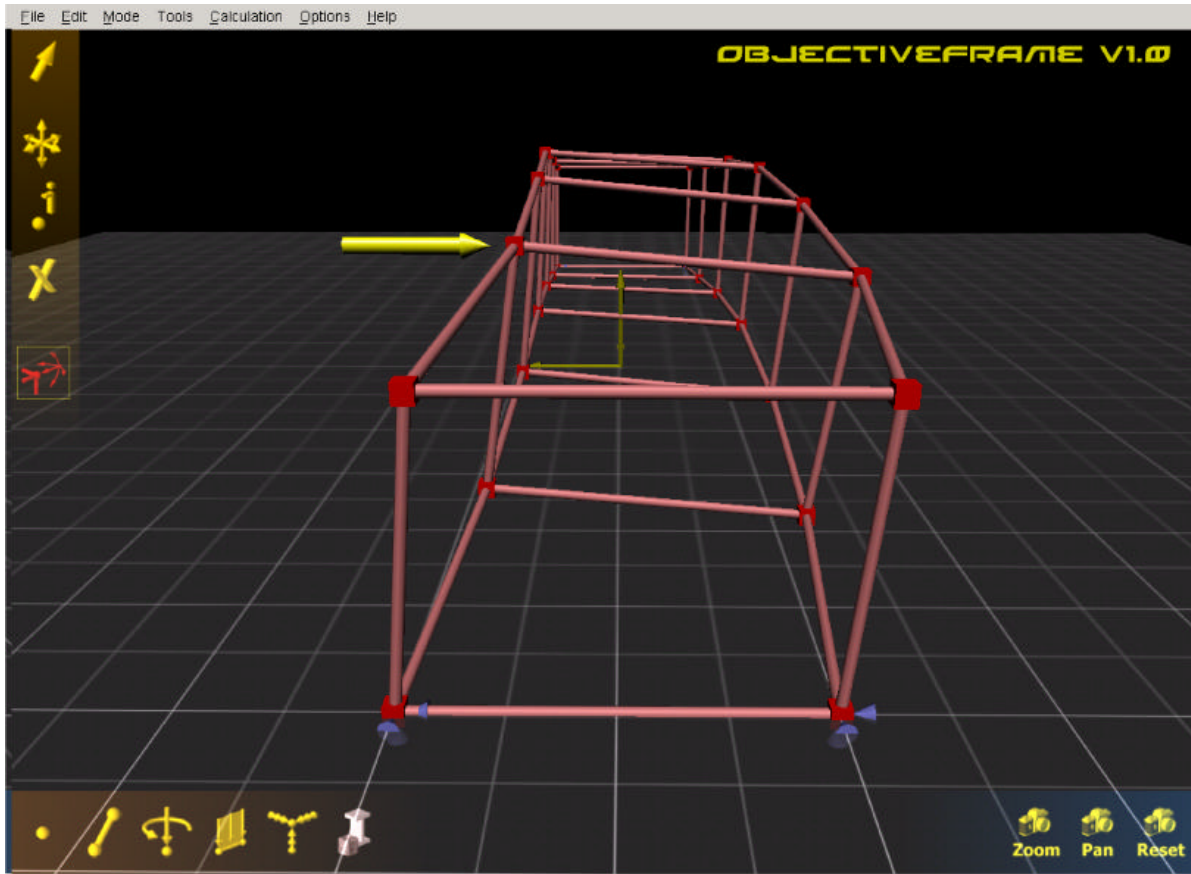


Feedback mode





Feedback continued

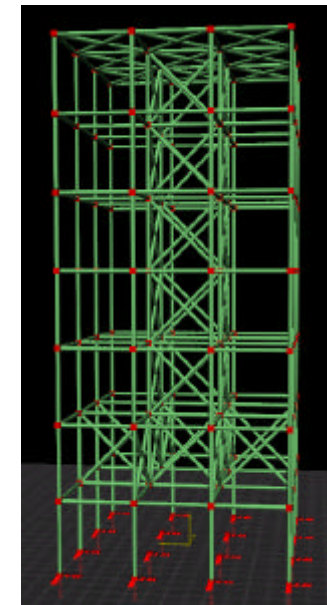
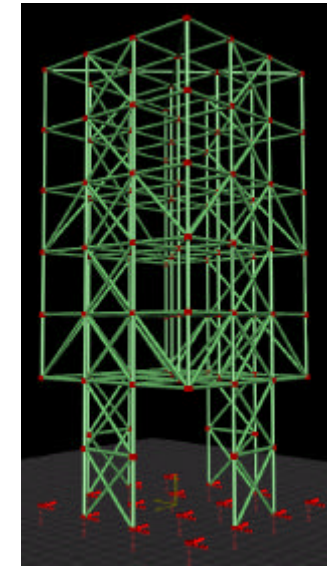
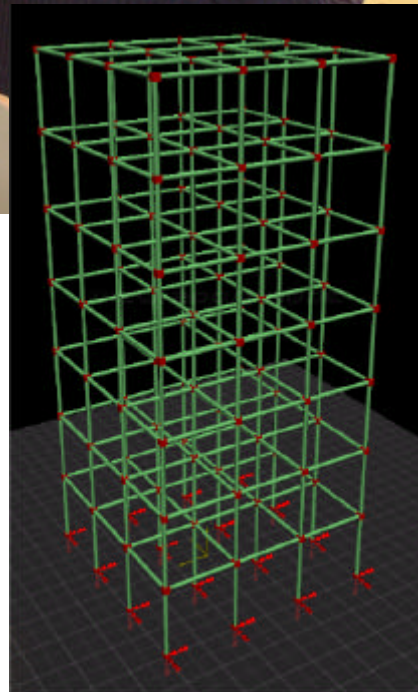
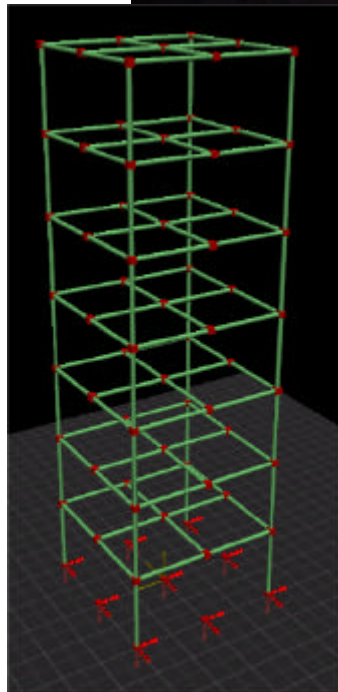




ObjectiveFrame Demo



Example of use





Implementation

- 2D-GUI using the Fast Light Toolkit – FLTK
 - Platform independent Linux/Irix/Win32
 - Fast and lightweight
- 3D-GUI using Ivf++ and OpenGL
 - Ivf++, OO C++ 3D graphics library
 - OpenGL for platform independent 3d acceleration
- Solver using newmat09 C++ matrix library
 - Easy to use
 - Similar to matlab in syntax



Conclusions

- A direct manipulation interface can be effectively used in 3D beam analysis.
- Transparent toolbars and HUD can be used to free valuable screen space.
- Feedback mode enables users to "feel" the structures subjected to loading.
- ObjectiveFrame can be used as a "Virtual Workshop" for students in architectural education as well in furniture design.