



Comparison with ETABS

The theoretical basis of the FEAKalc 3D shell formulation is broadly comparable to the thick-shell formulation available in ETABS.

Both programs employ shell elements that combine membrane action, plate bending and transverse shear deformation within a six-degree-of-freedom nodal formulation.

Both programs also utilise local shell coordinate systems for recovery of internal membrane forces, bending moments and transverse shear forces.

Although the underlying theory is similar, the implementations are independent.

ETABS employs proprietary shell technology developed by Computers and Structures, Inc. (CSI), whereas FEAKalc 3D uses an independently developed shell formulation incorporating ANS/MITC4-inspired transverse shear treatment, custom drilling-rotation stabilisation and its own meshing and result recovery procedures.

Consequently, exact element-by-element agreement should not be expected.

Meaningful verification is achieved by comparing:

- support reactions
- nodal displacements
- membrane force distributions
- bending moment distributions
- transverse shear distributions

using equivalent geometry, material properties, boundary conditions, shell thicknesses, mesh densities and loading.

As mesh refinement increases, both programs should demonstrate convergence towards comparable engineering results.



Verification

The shell formulation implemented in FEAKalc 3D has been verified through comparison with analytical benchmark problems and independent finite element solutions produced using ETABS.

Verification studies compare:

- support reactions
- maximum displacements
- membrane forces
- bending moments
- transverse shear forces

under identical modelling assumptions.

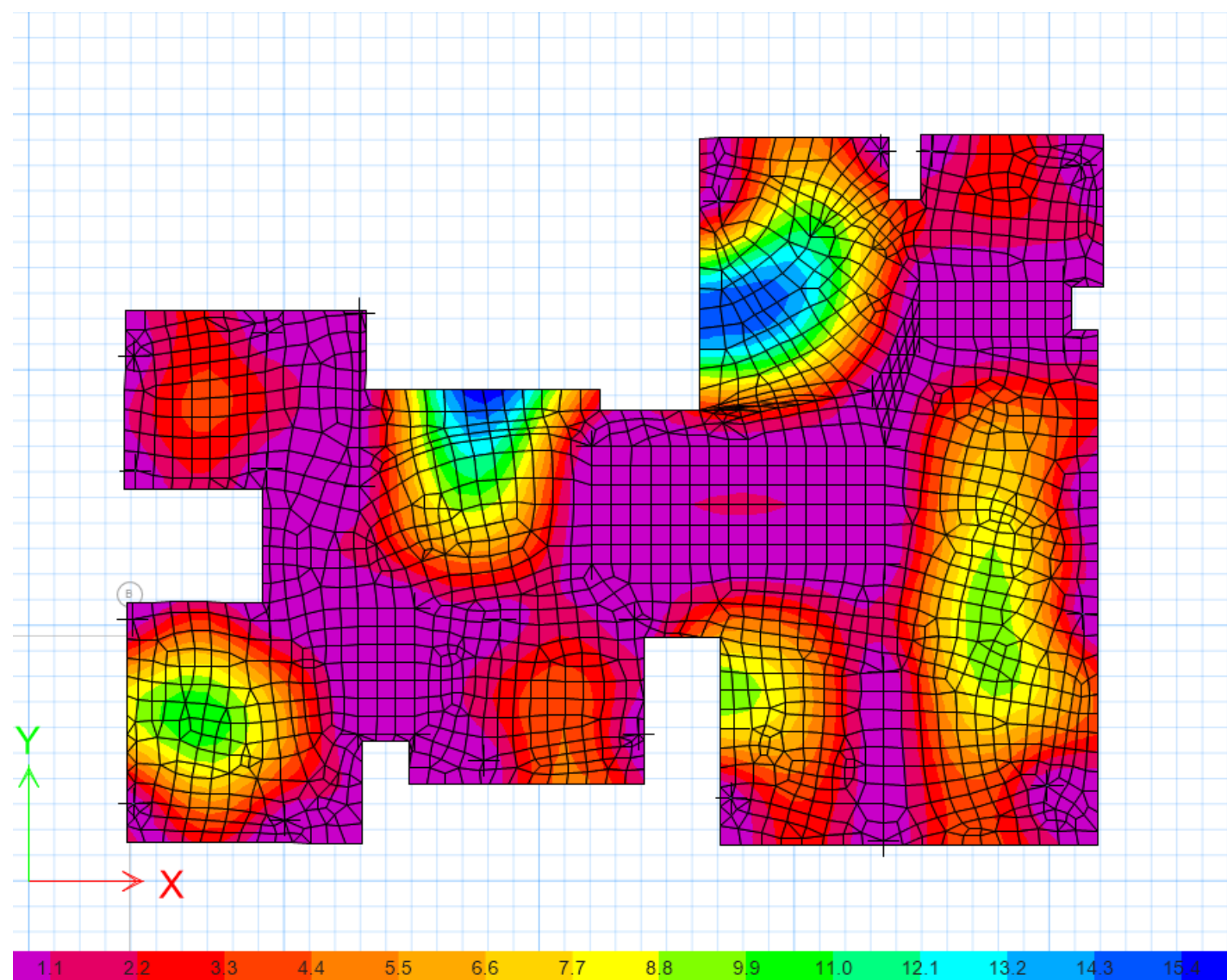
Minor local differences may occur near concentrated loads, supports, re-entrant corners and regions of stress concentration owing to differences in meshing strategy, numerical integration, result recovery and proprietary implementation details.

Verification therefore focuses on overall structural behaviour, equilibrium, displacement response and converged internal force distributions rather than exact agreement of individual element contour values.

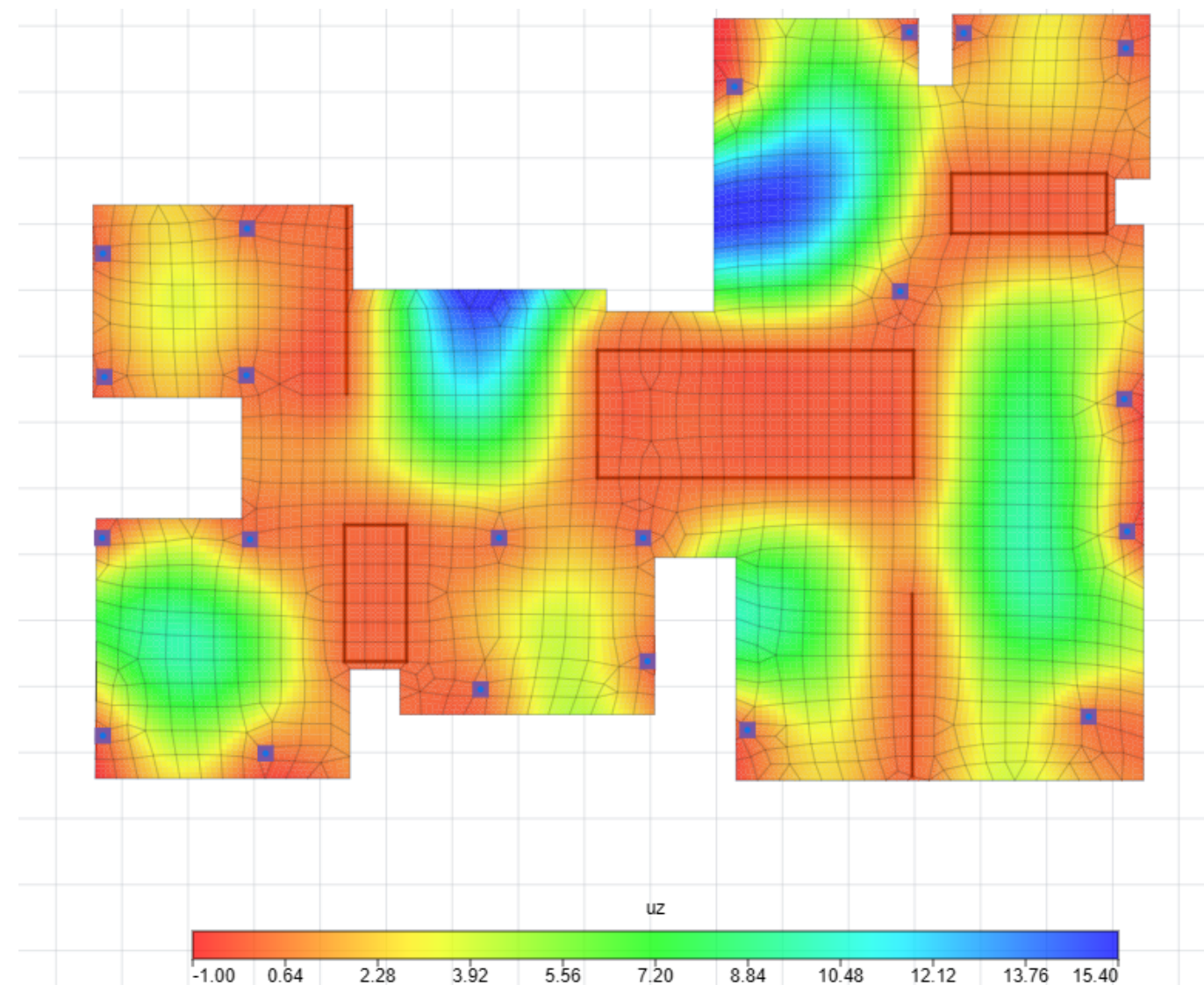
The comparisons demonstrate that FEAKalc 3D produces results consistent with established finite element practice while maintaining an independently developed shell formulation specifically tailored to the FEAKalc 3D analysis engine.



ETABS

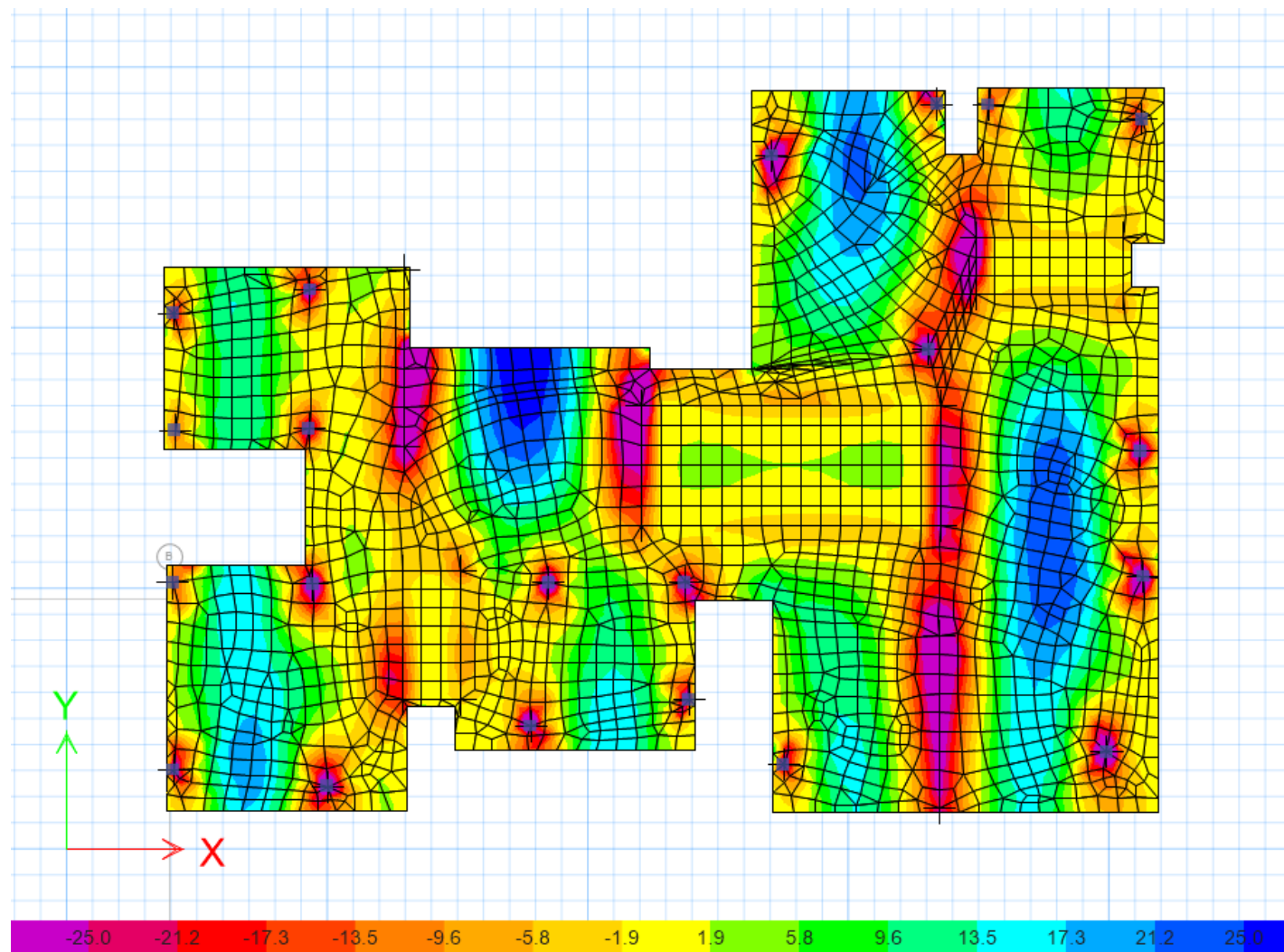


FEAKalc 3D





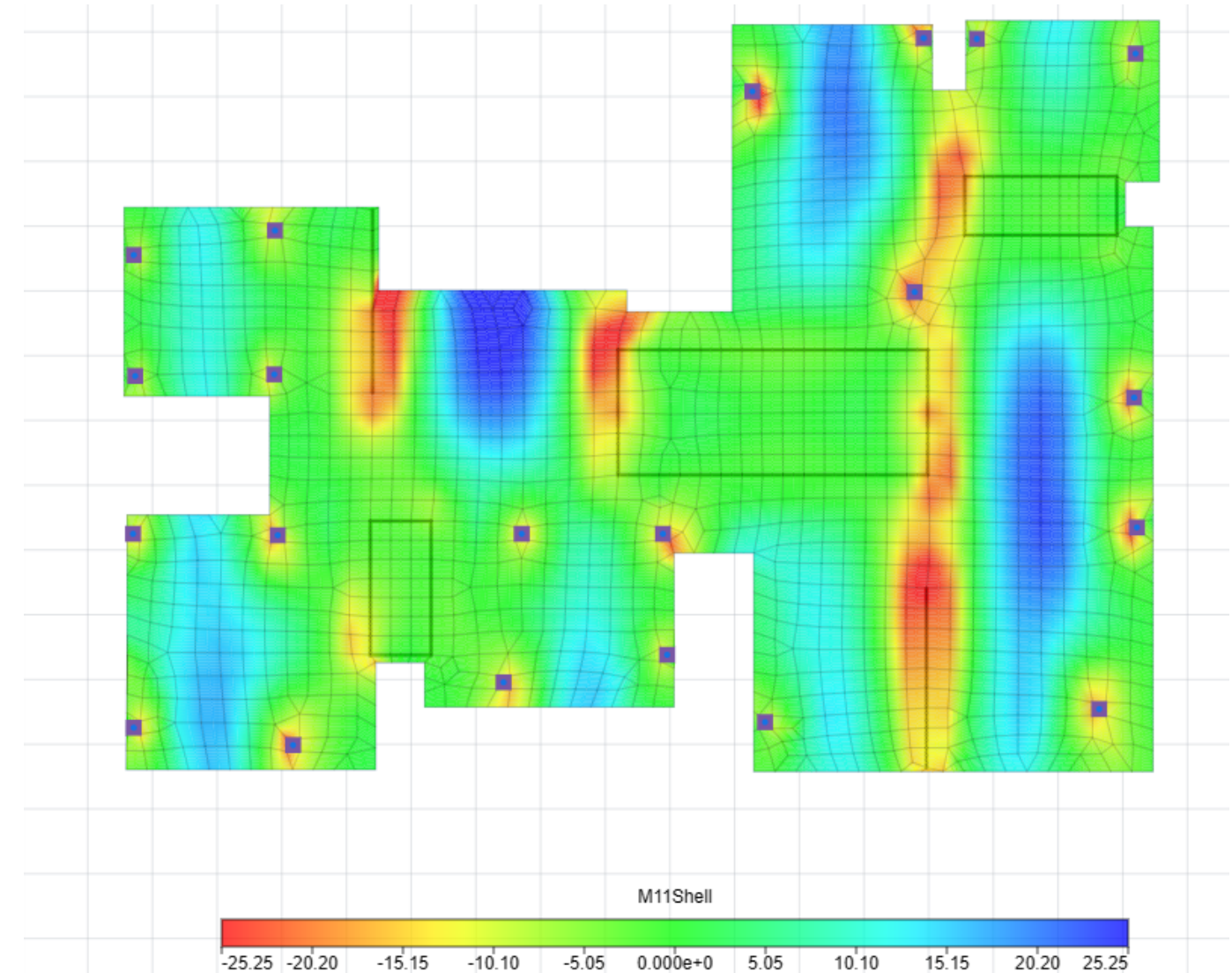
ETABS



M11 Shell Diagram

Under Self Weight

FEAKalc 3D

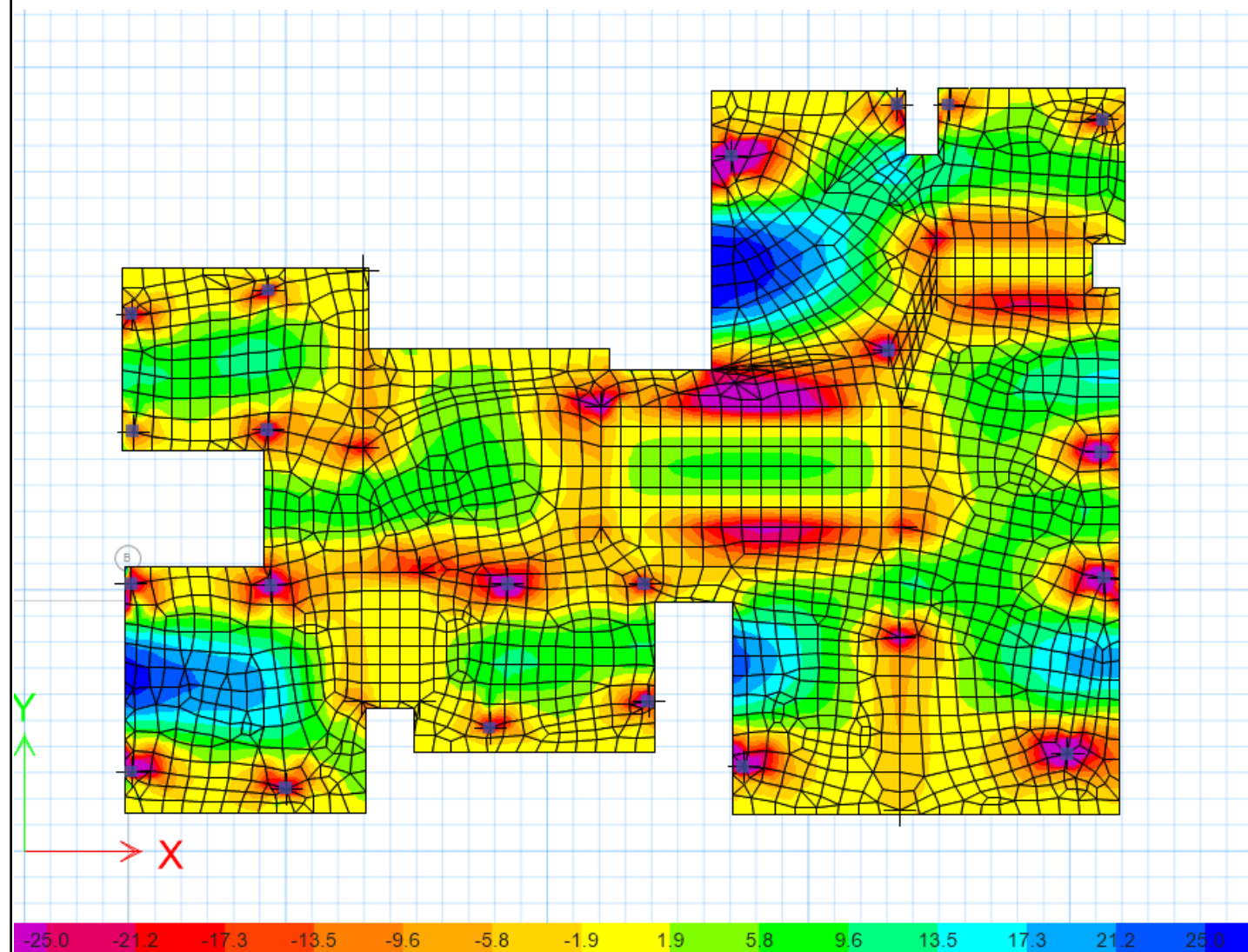


M11 Shell Diagram

Under Self Weight



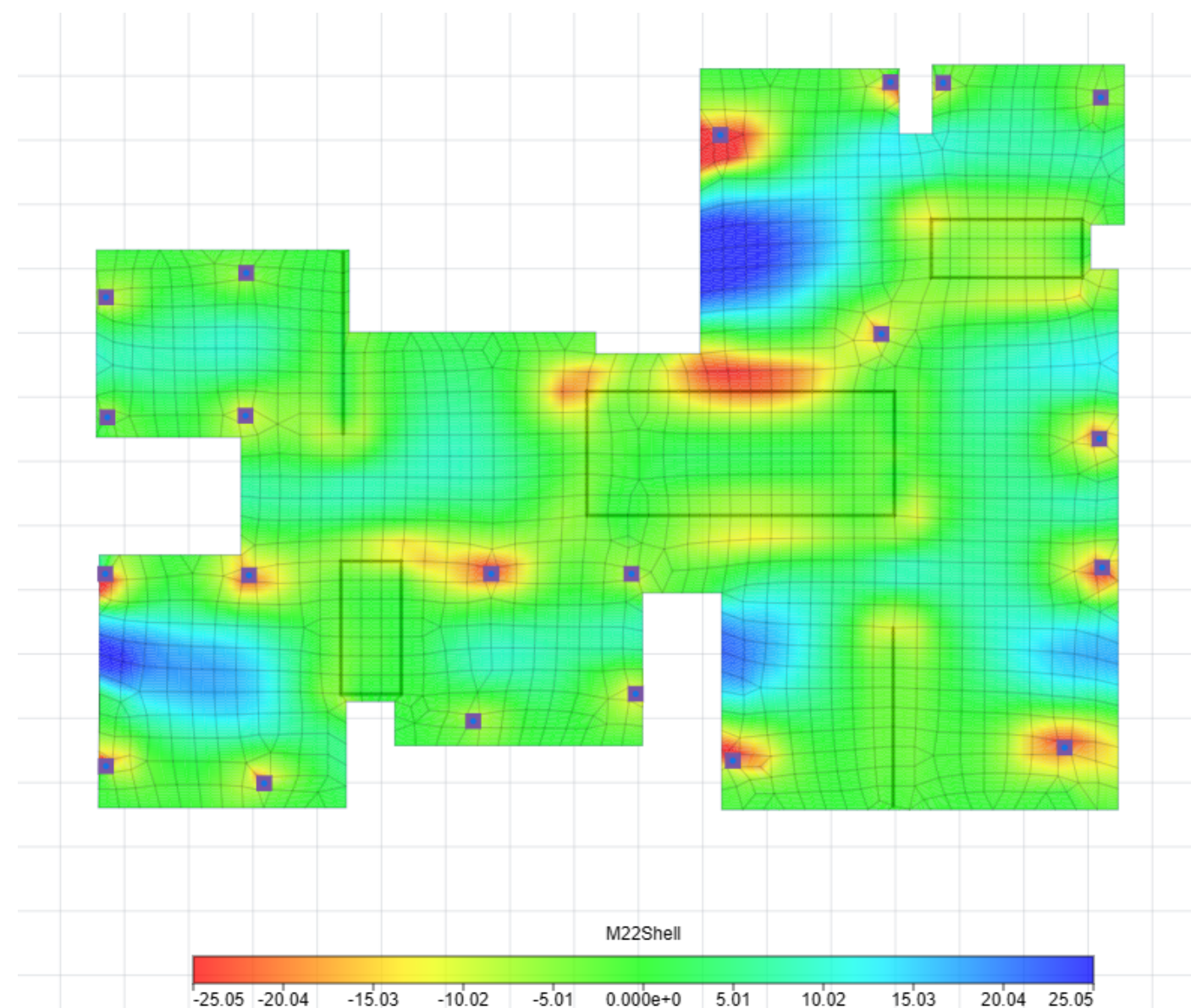
ETABS



M22 Shell Diagram

Under Self Weight

FEAKalc 3D

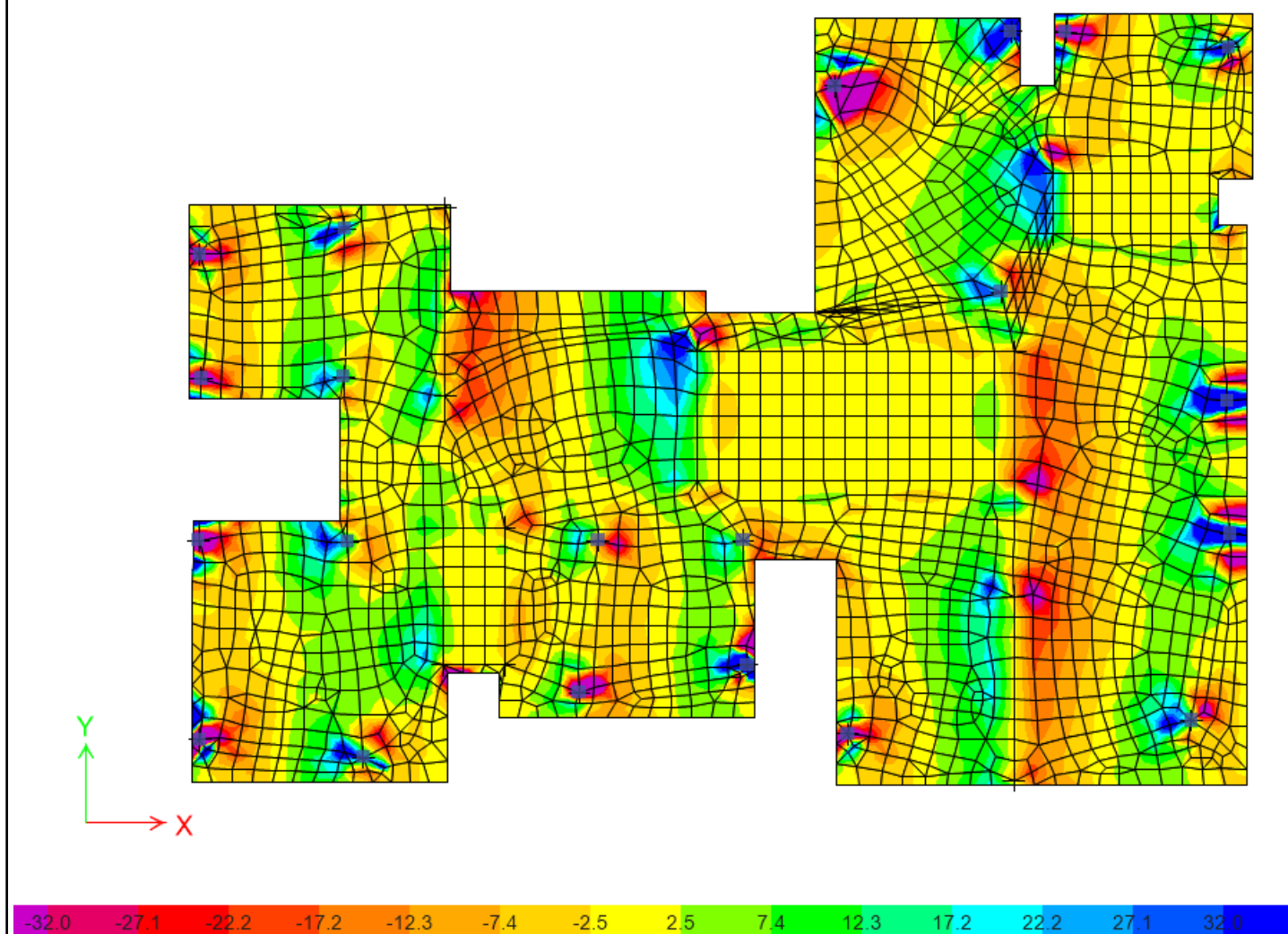


M22 Shell Diagram

Under Self Weight



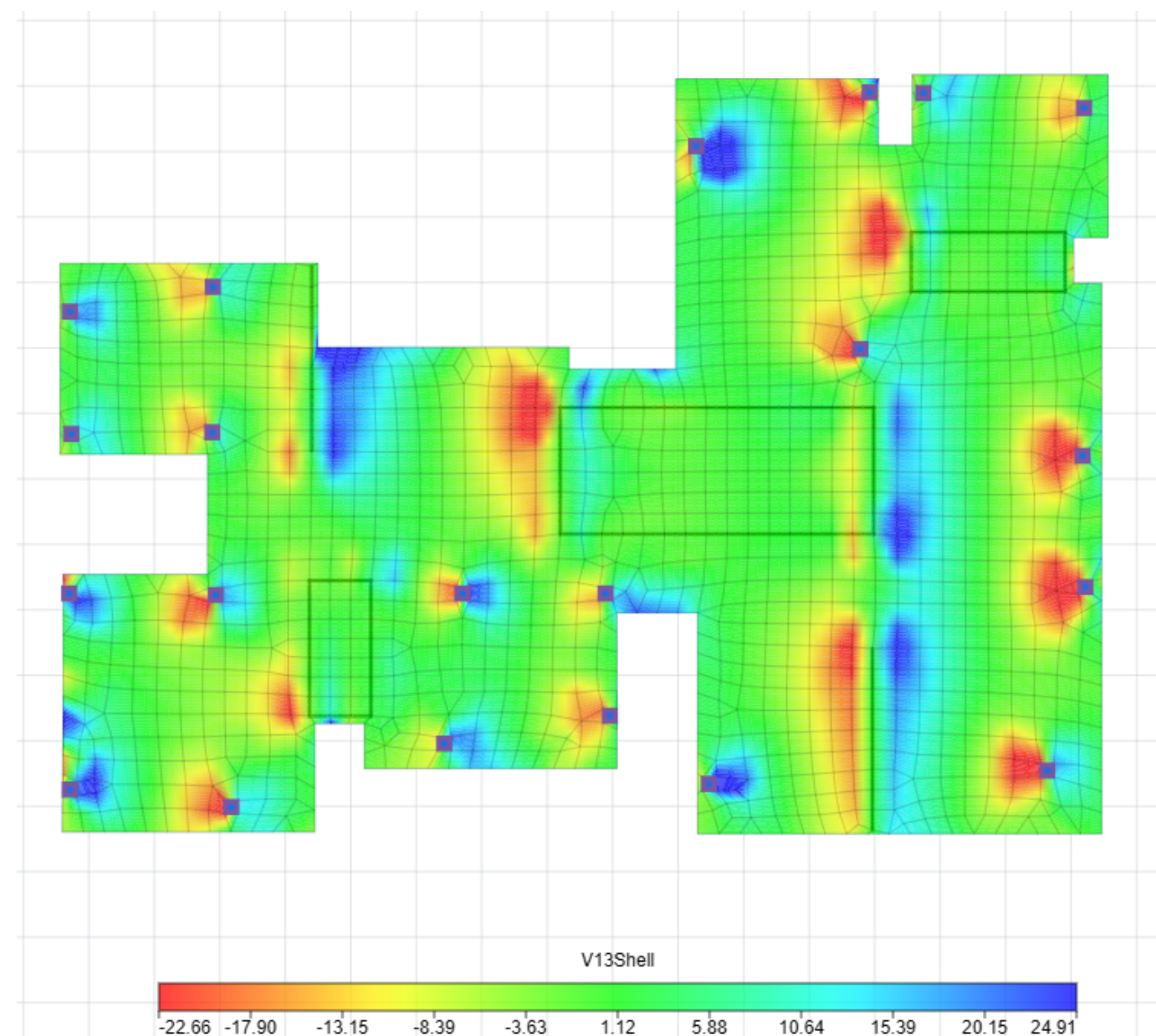
ETABS



V13 Shell Diagram

Under Self Weight

FEAKalc 3D

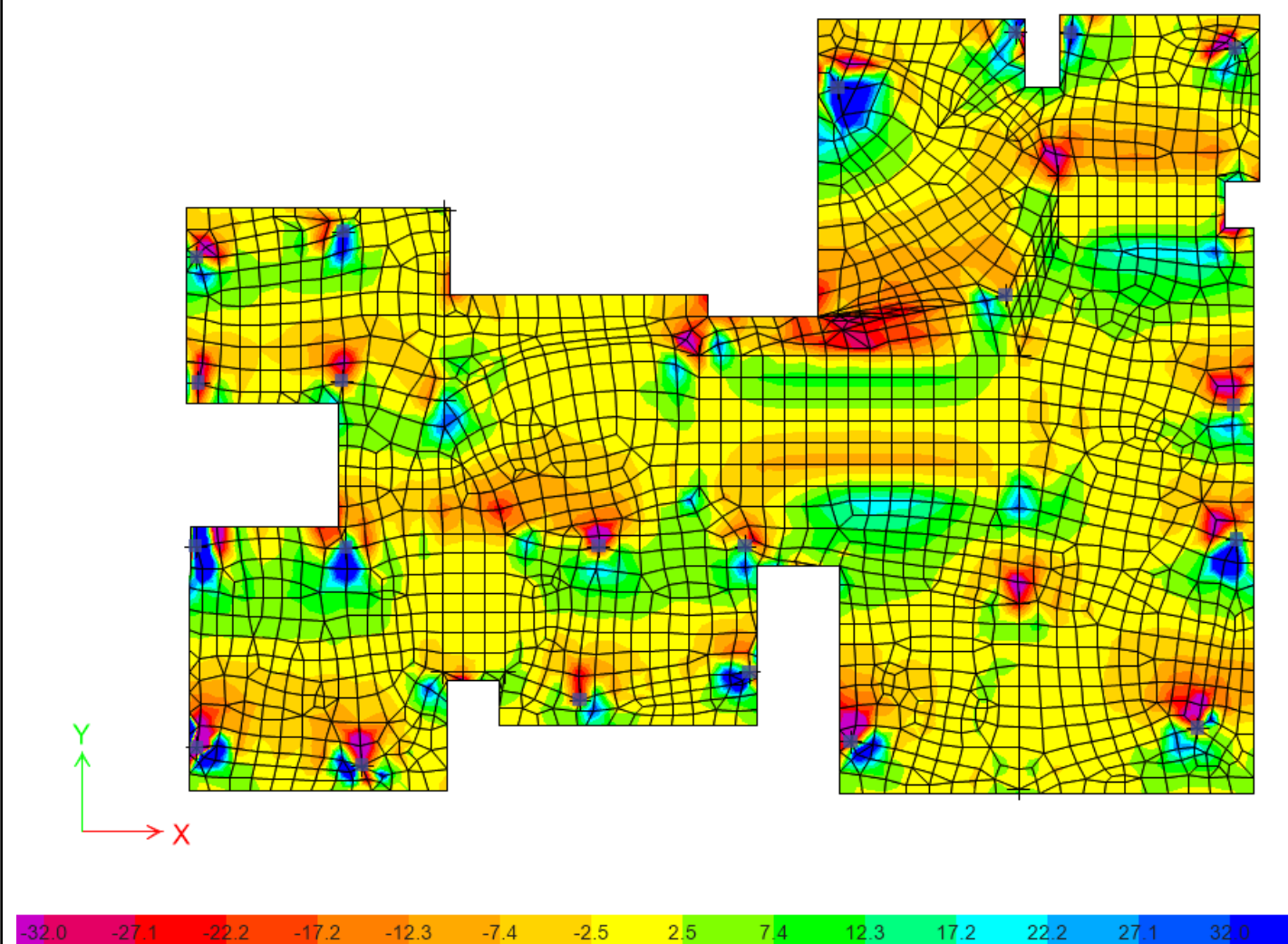


V13 Shell Diagram

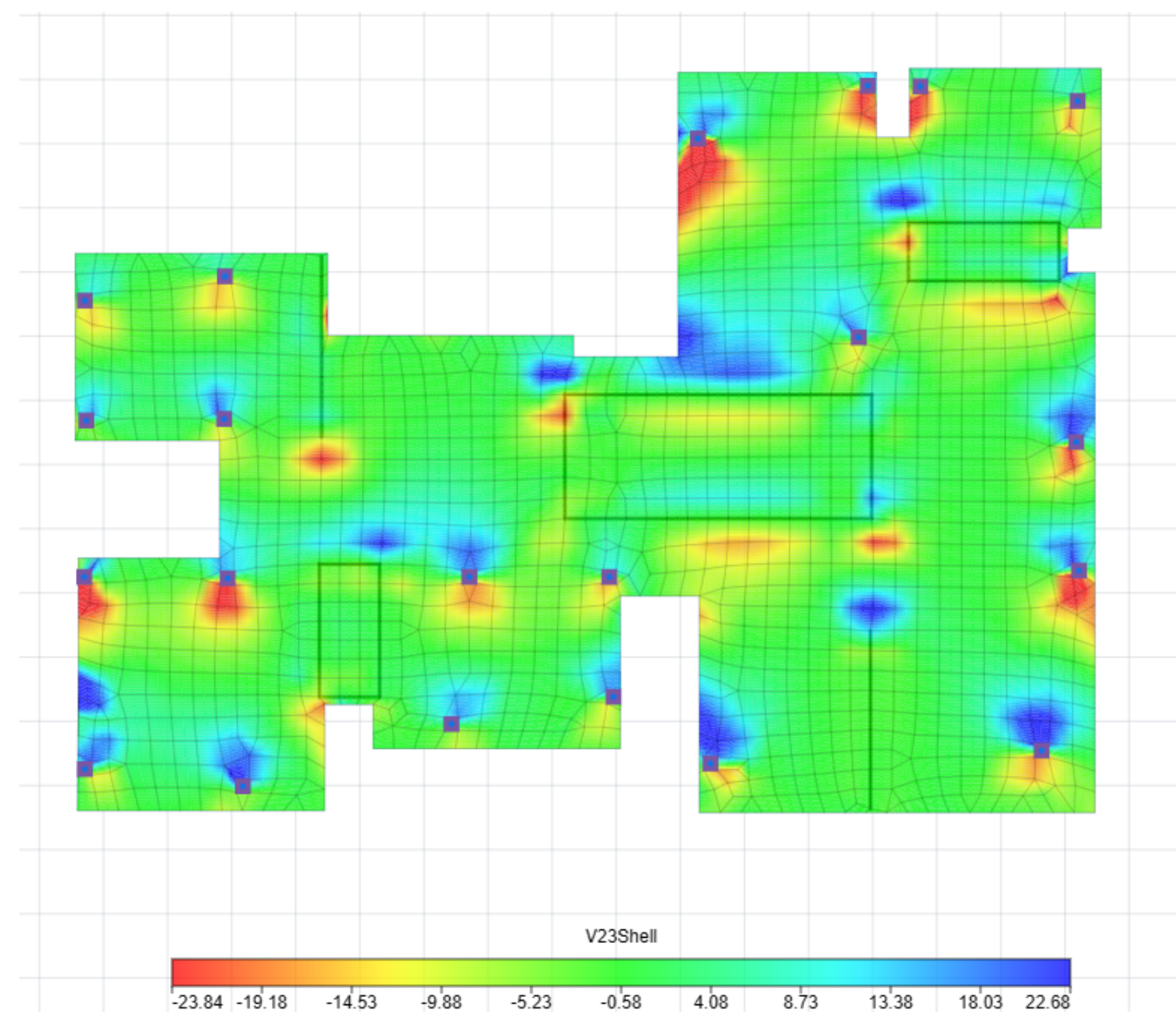
Under Self Weight



ETABS

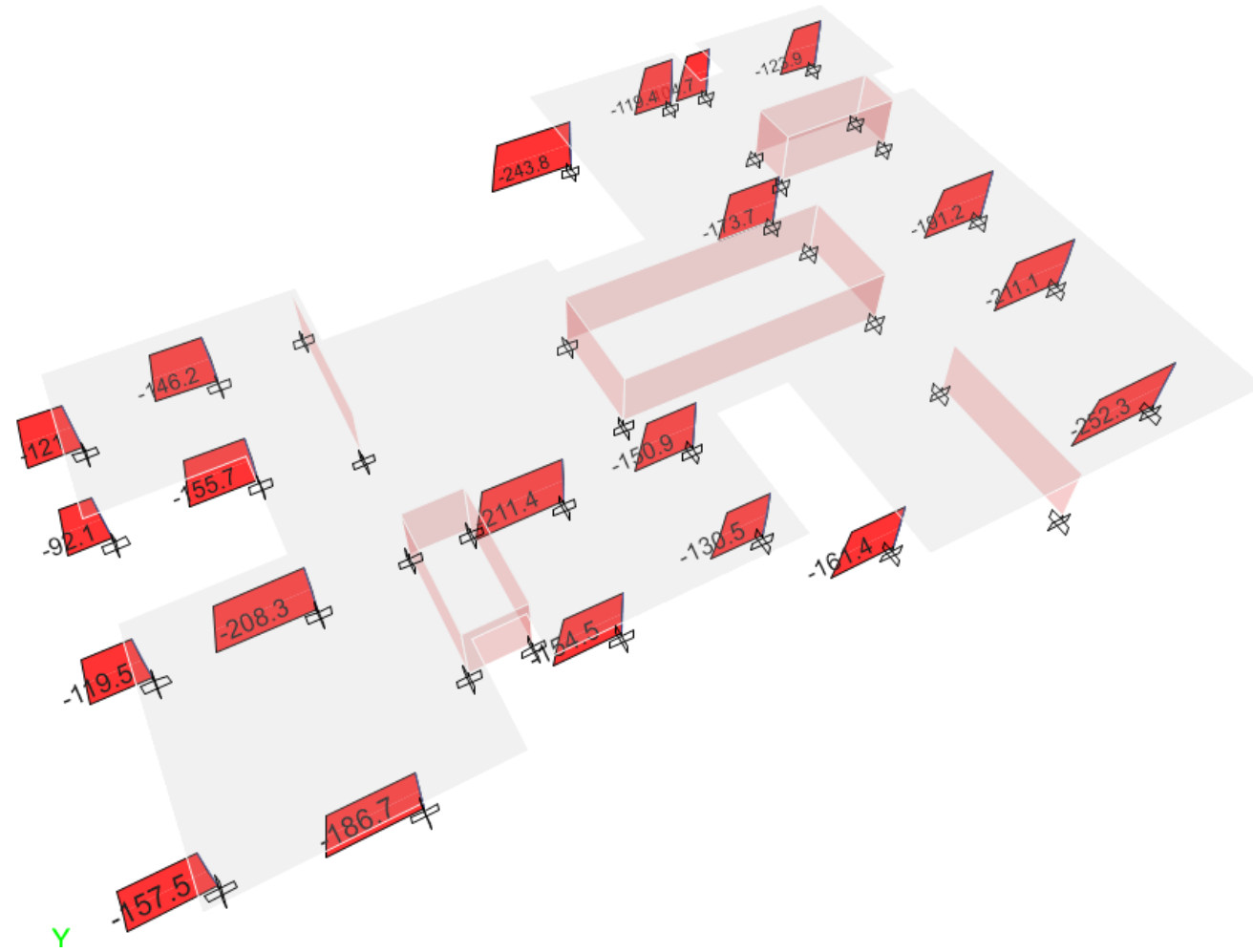


FEAKalc 3D





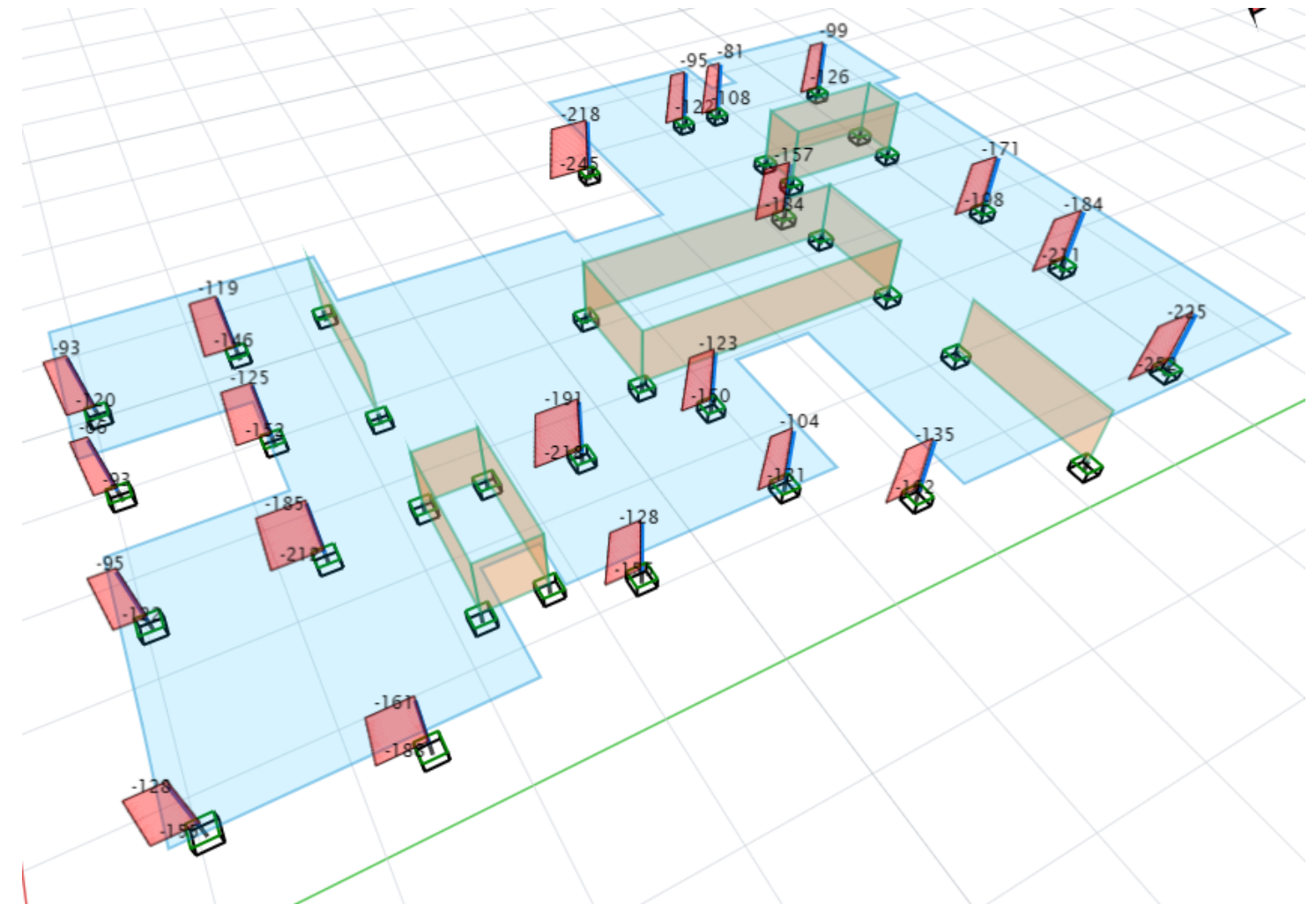
ETABS



Axial Force Diagram

Under Self Weight

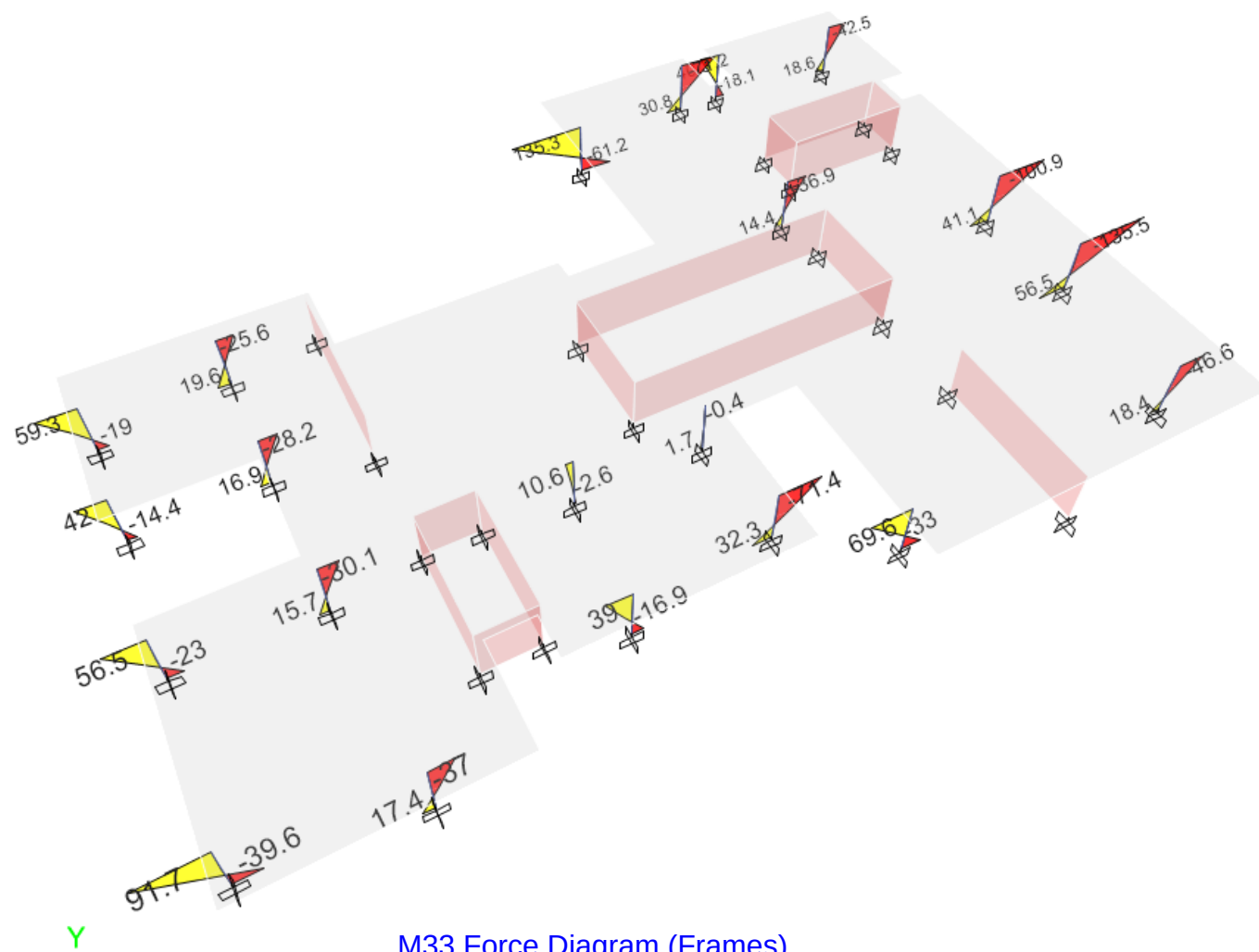
FEAKalc 3D



Axial Force Diagram

Under Self Weight

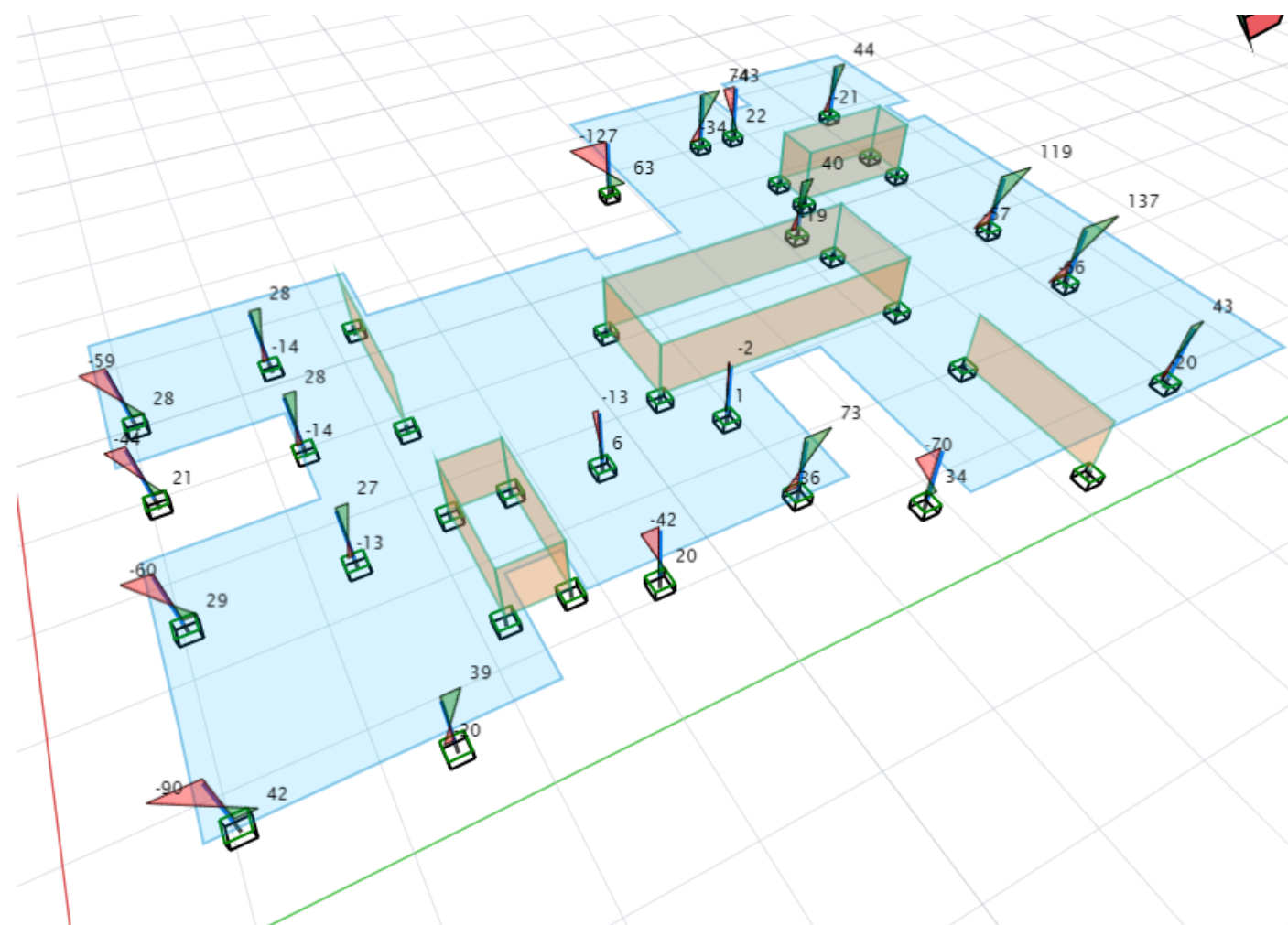
ETABS



M33 Force Diagram (Frames)

Under Self Weight

FEAKalc 3D



M33 Force Diagram (Frames)

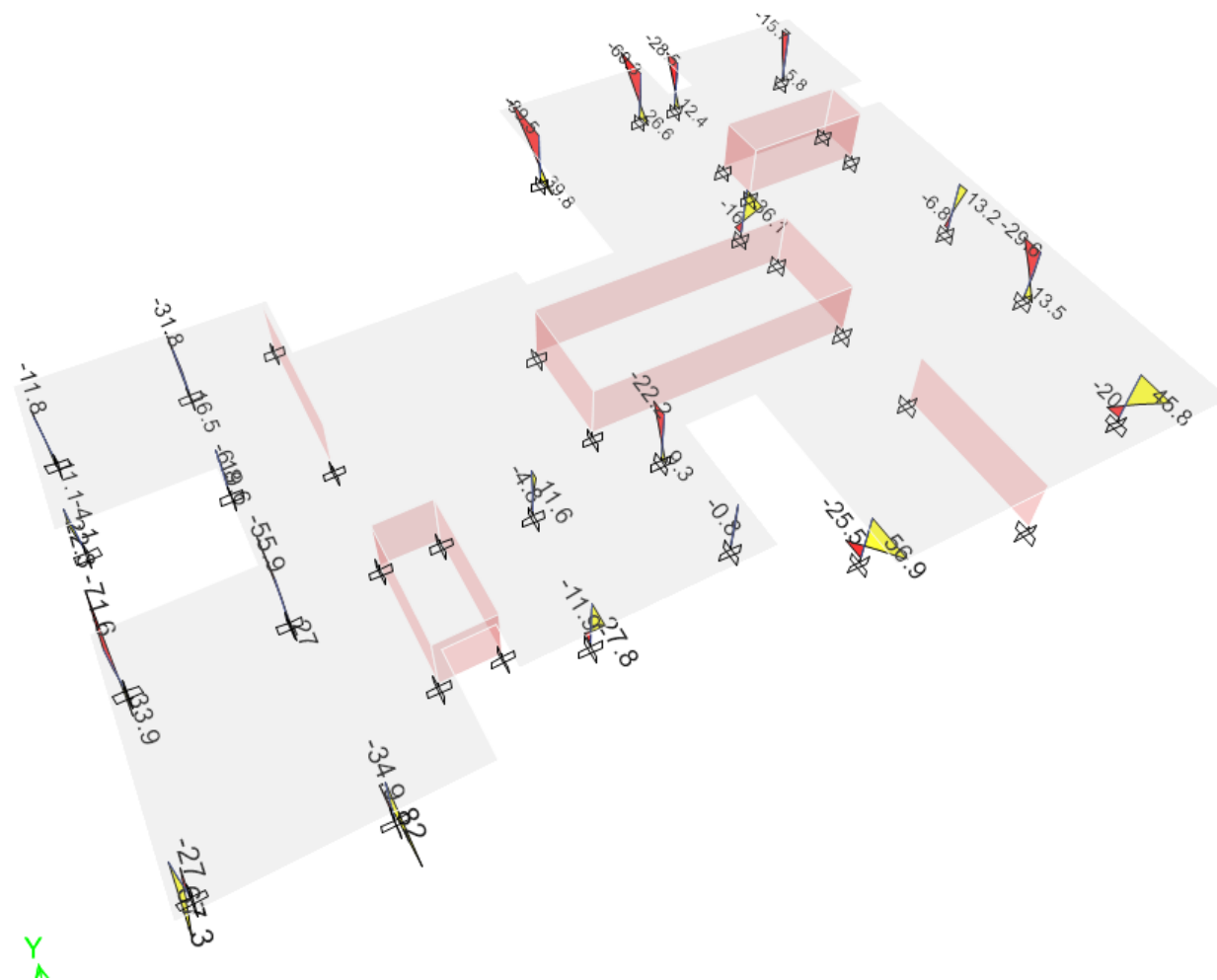
Under Self Weight

The comparison demonstrates good overall agreement between FEAkalc 3D and ETABS in the distribution and magnitude of frame end moments. Local differences remain at some slab–column connections, where FEAkalc generally predicts slightly different connection moments than ETABS. These differences are expected, as frame-to-shell interaction is influenced by the implementation of shell formulations, rotational compatibility, rigid connection modelling, mesh topology, and numerical result recovery. Despite these local variations, the overall structural behaviour, load paths, support reactions, and moment distributions show close agreement, confirming that FEAkalc provides engineering results consistent with those obtained from established commercial finite element software.



ETABS

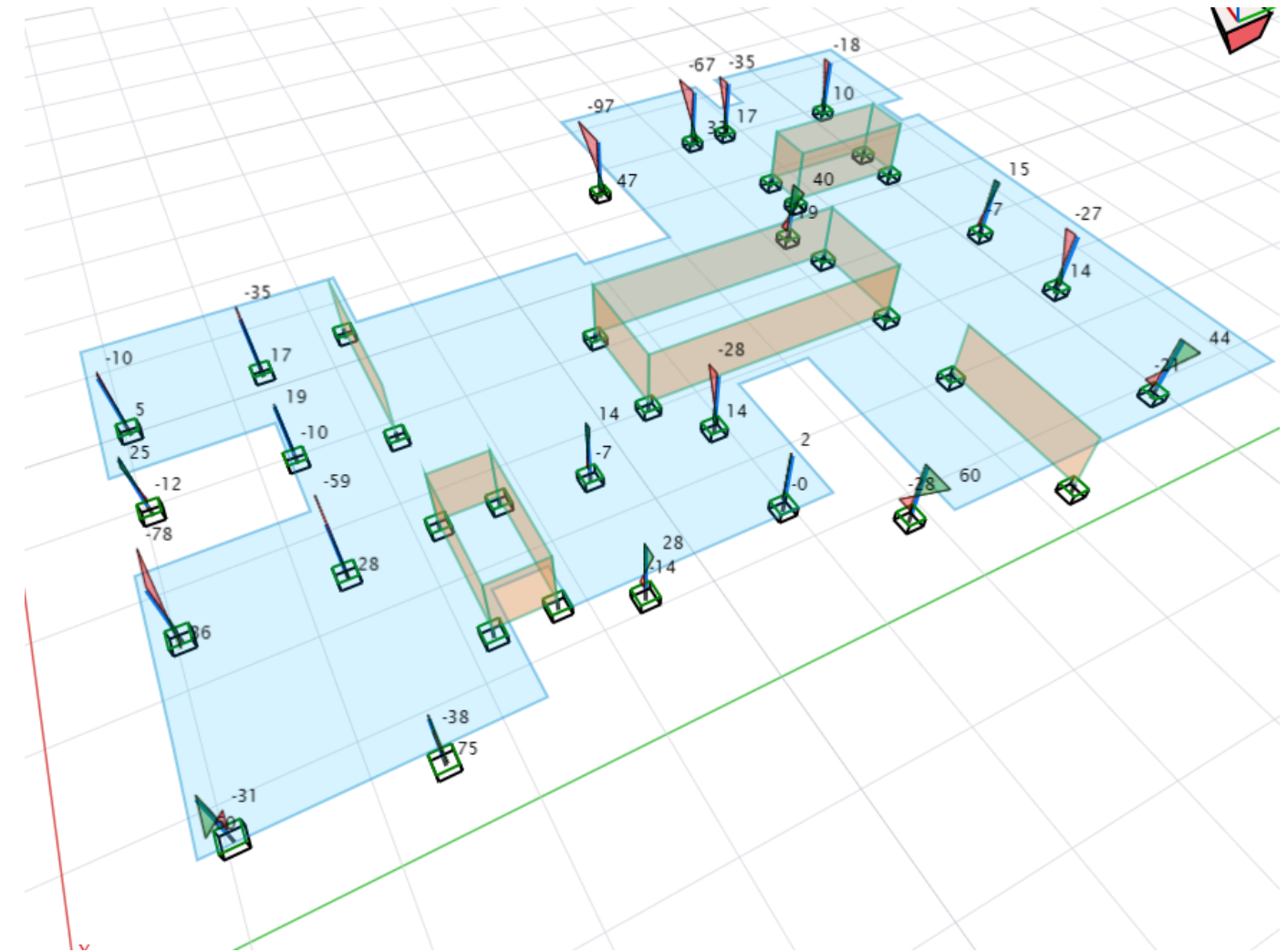
See note in page 11



M22 Force Diagram (Frames)

Under Self Weight

FEAKalc 3D



M22 Force Diagram (Frames)

Under Self Weight