

FEAKalc3D

Coupled Shear Wall Verification Report

Comparison with ETABS

25 October 2026 | Linear static benchmark | Revision 0

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1. Introduction

The repaired automatic wall mesher generates the coupled shear wall directly from 39 source panels into 858 rectangular shells. All shell polygons and 1,040 nodes match the ETABS mesh after coordinate alignment. The current horizontal-load roof displacement is 40.3465 mm against 41.6910 mm in ETABS, a 3.22% difference. Overall equilibrium agrees closely; local member differences remain and are evaluated using absolute force differences.

2. Scope and verification basis

This report compares a thirteen-storey concrete frame and coupled wall using self-weight and a separate horizontal load case. The evidence combines independent static analyses, member-end force recovery, matched frame stations, joint translations and the supplied graphical comparisons. It concerns the stated linear elastic model and does not establish general mesh independence or concrete member resistance.

Evidence	Coverage	Finding
Piers and spandrels	26 piers and 13 spandrels; six components at both ends	Automatic mesh: all four end-edge segments at every spandrel connect to piers
Frame actions	13 beams and 13 columns; all ETABS output stations	Residual axial, shear and moment differences remain
Displacements	1,040 corresponding ETABS joints	Live roof Ux 3.22% lower in FEAKalc in the current automatic-mesh run
Equilibrium	Six global base resultants in each case	Gravity total 1,527.5 kN and horizontal total 1,300 kN closely reproduced
Graphical evidence	16 response screenshots and two loading screenshots	Original response screenshots retained as historical visual evidence

Numerical tables and the mesh figure use the 25 October rerun of file 1 with automatic meshing and a fresh ETABS export. The supplied response screenshots and file 3 workbook remain historical records; their labels are not the current rerun values.

3. Problem definition and loading

The model is a planar frame coupled to two wall piers by thirteen spandrels. Storeys are 3 m apart. FEAKalc has five authored fixed supports; eight additional wall-base nodes inherit Ux, Uy and Uz. Rotations remain fixed only where explicitly assigned. ETABS fixes all six freedoms at its thirteen base nodes. Dimensions below use ETABS coordinates.

Input	Adopted value
Height and framing	13 storeys at 3.0 m; total height 39.0 m; frame bay 4.0 m

Input	Adopted value
Wall geometry	Left pier width 3.0 m; right pier width 2.0 m; opening width 1.5 m
Wall and spandrel sections	Wall thickness 0.20 m; spandrel depth 1.0 m; span 1.5 m
Frame section	200 × 1,000 mm concrete rectangle; $A = 0.20 \text{ m}^2$
Elastic properties	$E = 32,800 \text{ MPa}$; Poisson ratio 0.20; concrete unit weight 25 kN/m^3
Dead case	Own weight only, acting vertically
Live case	100 kN global +X at the frame column on each floor; total 1,300 kN

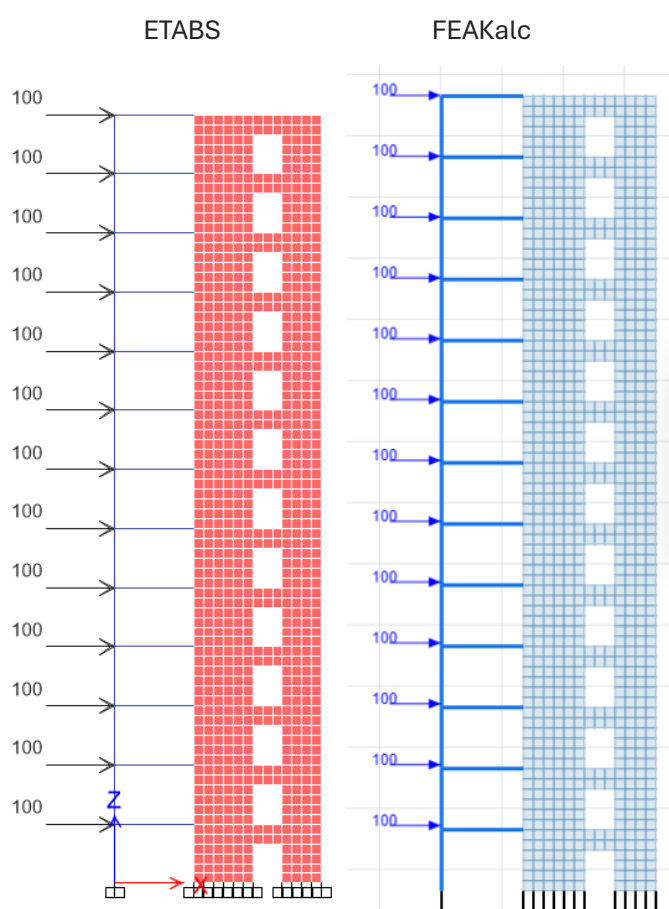


Figure 1. Supplied loading views. Each arrow represents 100 kN horizontal loading in the Live case. Dead is a separate self-weight case; Live is not a scaled Dead response.

4. Analysis meshes and connectivity

FEAkalc now meshes the original 39 wall and spandrel polygons automatically at 0.5 m. The rectangular-wall engine generates 858 quadrilaterals with no triangles. ETABS retains 858 manually divided quadrilaterals. All 858 element polygons and 1,040 nodes match after removing the FEAkalc coordinate offset; this is now a matched shell-layout comparison.

Measure	ETABS	FEAKalc automatic mesh
Source wall and spandrel panels	858	39 undivided polygons
Analysis shell elements	858 quads	858 quads; no triangles
Total model nodes	1,040	1,040
Total wall area	214.500000 m ²	214.500000 m ²
Coordinate relation	Reference coordinates	ETABS + (0.05, 0, 1.95) m

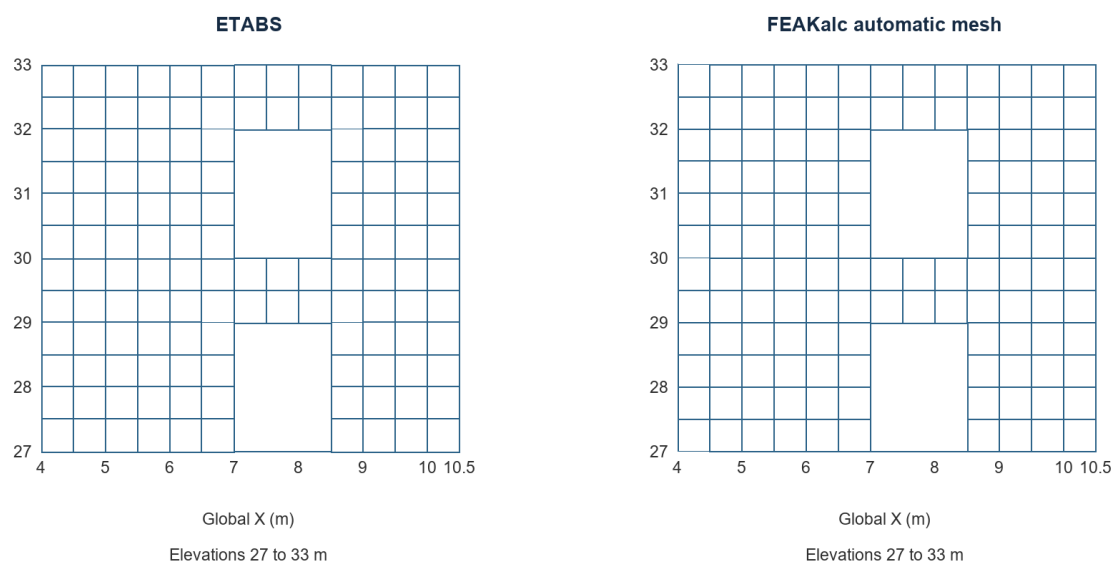


Figure 2. Current exported analysis meshes around B10 and B11 at elevations 27 to 33 m. Element edges are drawn directly from both result meshes. FEA Kalc coordinates are translated into the ETABS system; the rectangular layouts coincide.

Automatic meshing now resolves the earlier B10/B11 connection anomaly without manual panel division. Every spandrel B1 to B13 has four end-edge segments shared with adjacent piers, including all B10 and B11 segments. The five authored supports plus eight inherited base nodes are retained in assembly.

Both models have 6,240 total DOF before restraints. FEA Kalc has 6,186 free DOF after its 54 restraints. Matching all thirteen ETABS base restraints in a controlled copy changes Live roof Ux by only 0.0051 mm, so that rotational-restraint difference does not explain the remaining displacement discrepancy.

5. Numerical results and interpretation

Translations below refer to the corresponding roof point at ETABS (0, 0, 39) m. FEAKalc deformation output is converted to physical sign and millimetres. A signed difference is FEAKalc minus ETABS; the percentage denominator is the absolute ETABS value.

Case	Component	FEAKalc mm	ETABS mm	Difference mm	Difference
Dead	Ux	-1.0298	-1.0320	0.0022	+0.21%
Dead	Uz	-1.0286	-1.0280	-0.0006	-0.06%
Live	Ux	40.3465	41.6910	-1.3445	-3.22%
Live	Uz	4.3899	4.3110	0.0789	+1.83%

Base resultants are evaluated about the ETABS origin, including the coordinate transformation of reaction moments. Values are shown at export precision; very small differences should be interpreted with that rounding in mind.

Case	Resultant	FEAKalc	ETABS	Difference
Dead	FZ kN	1,527.5001	1,527.5000	0.0001
Dead	MY kN.m	-8,198.1255	-8,198.1250	-0.0005
Live	FX kN	-1,299.9999	-1,300.0000	0.0001
Live	MY kN.m	-27,300.0012	-27,300.0000	-0.0012

Maximum absolute member discrepancies are taken over all corresponding ends or frame stations. P, V2 and M3 maxima may occur at different locations and do not form one concurrent design-action tuple.

Case	Member group	Max $ \Delta P $ kN	Max $ \Delta V2 $ kN	Max $ \Delta M3 $ kN.m
Dead	Piers	4.435	0.737	4.402
Dead	Spandrels	0.623	0.224	0.366
Dead	Frame beams	0.451	0.168	0.644
Dead	Frame columns	0.304	0.524	0.970
Live	Piers	69.551	19.359	89.334
Live	Spandrels	1.912	5.915	4.498
Live	Frame beams	8.796	5.091	17.460

Case	Member group	Max $ \Delta P $ kN	Max $ \Delta V_2 $ kN	Max $ \Delta M_3 $ kN.m
Live	Frame columns	37.912	11.860	21.002

For forces, absolute differences of 2 kN or less are treated as small differences; percentages around negligible reference values are not meaningful. The archived workbook retains its editable magnitude and difference floors. These are reporting rules, not solver-accuracy tolerances. Current full-precision results are in VerificationData-20261025.

6. Live Load Case Comparison

6.1. Live axial force comparison

The overturning response changes axial force from tension in the lower left pier to compression in the right pier. Both views show the same broad redistribution and the accumulation toward the base.

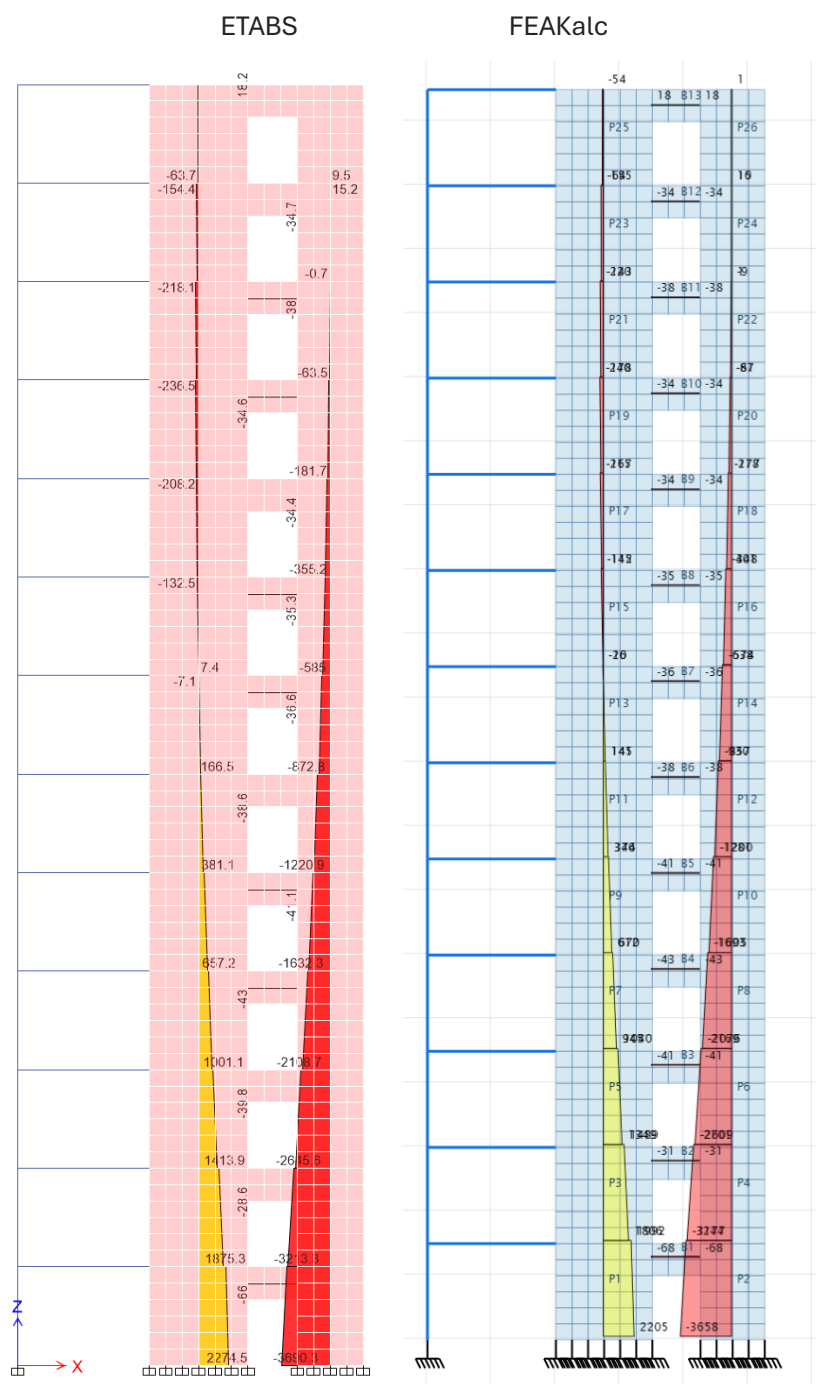


Figure 3. Axial force in kN. The supplied FEAKalc labels include both member ends; neighbouring labels overlap in places.

6.2. Live shear force comparison

Pier shear generally builds toward the base, while spandrel shear varies through the height.

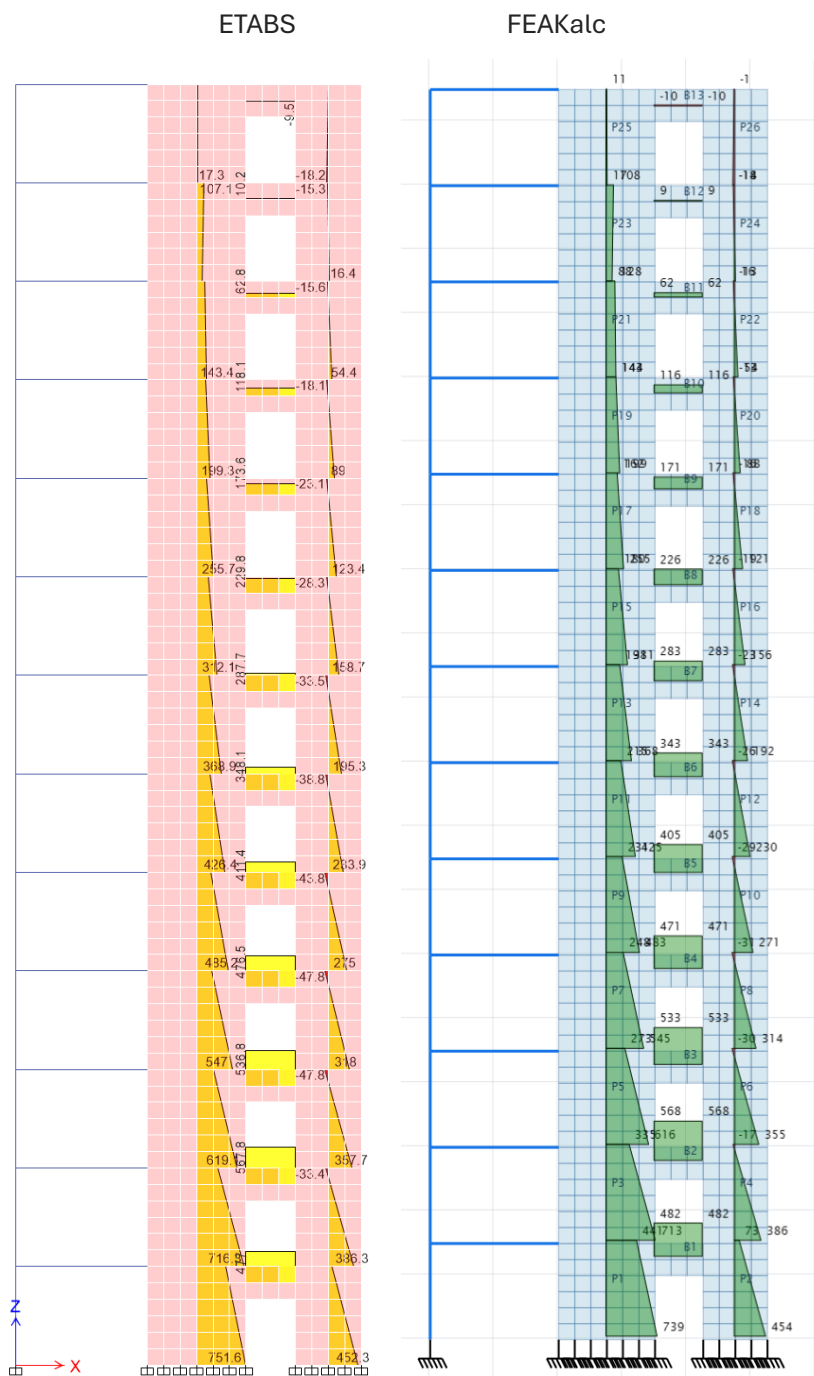


Figure 4. Local shear V2 in kN. ETABS and FEAkalc diagram fills use different colours; compare the labels and distribution.

6.3. Live bending moment comparison

Both programs show double-curvature spandrel moments and increasing pier demand toward the base. Sign changes in the upper pier regions occur in both graphical records.

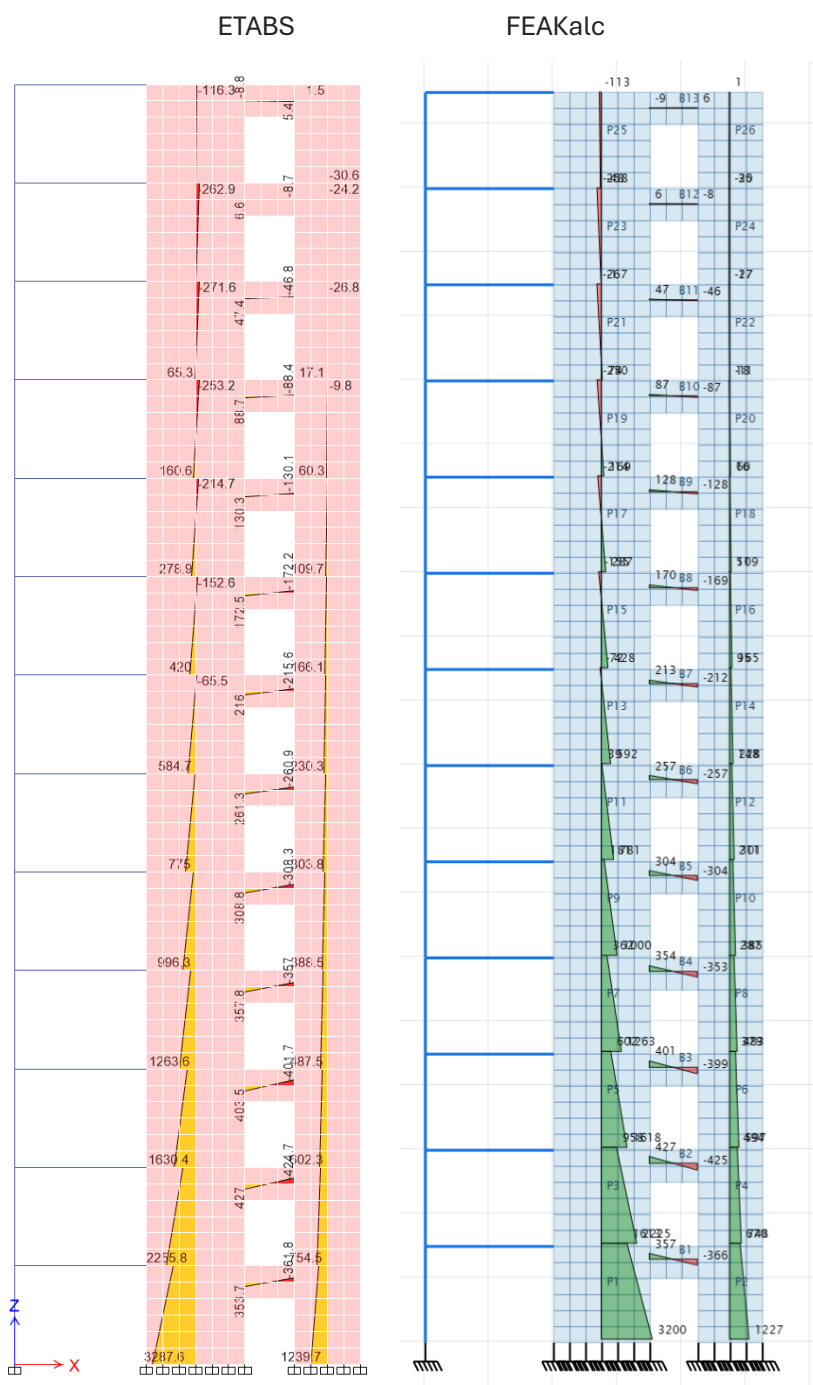


Figure 5. Local moment M3 in kN.m. Relative plot widths are independently scaled in each application.

6.4. Live deformation comparison

Both deformed shapes sway in the direction of the applied horizontal forces and show a similar overall curvature. The FEAKalc screenshot uses a larger deformation magnification.

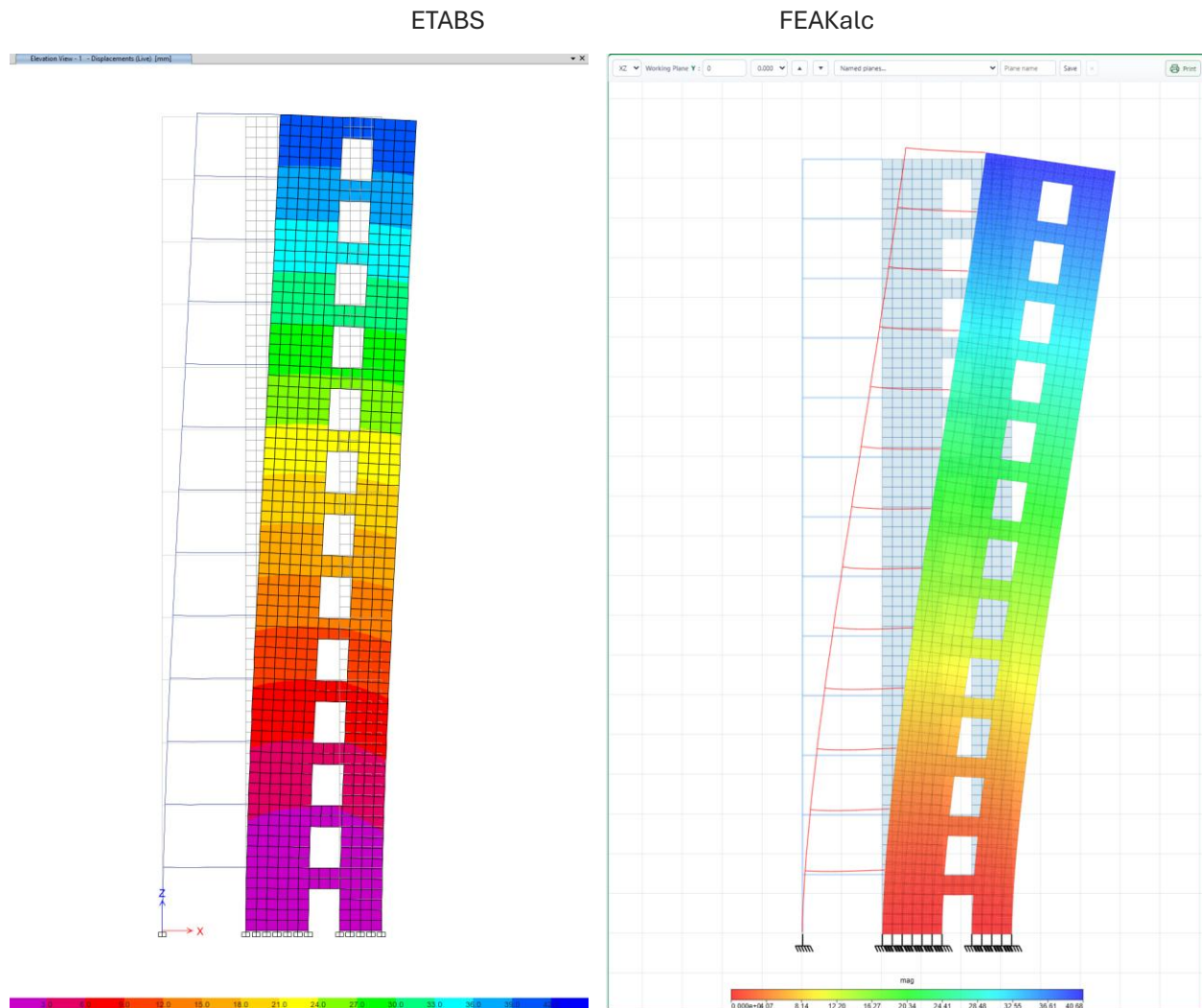


Figure 6. Supplied displacement displays from the earlier comparison. FEAKalc shows magnitude; colour ranges and deformation magnifications differ. Current roof translations are given in the numerical results table.

The screenshots are retained with their original legends and display conventions. Numerical comparison should use the same displacement component at the same coordinates, rather than the visual displacement amplitude or a colour match.

7. Dead Load Comparison (self-weight)

7.1. Dead axial force comparison

Self-weight produces compression increasing toward the base in both piers. The wider left pier attracts greater compression. Most upper spandrel axial values are close to zero.

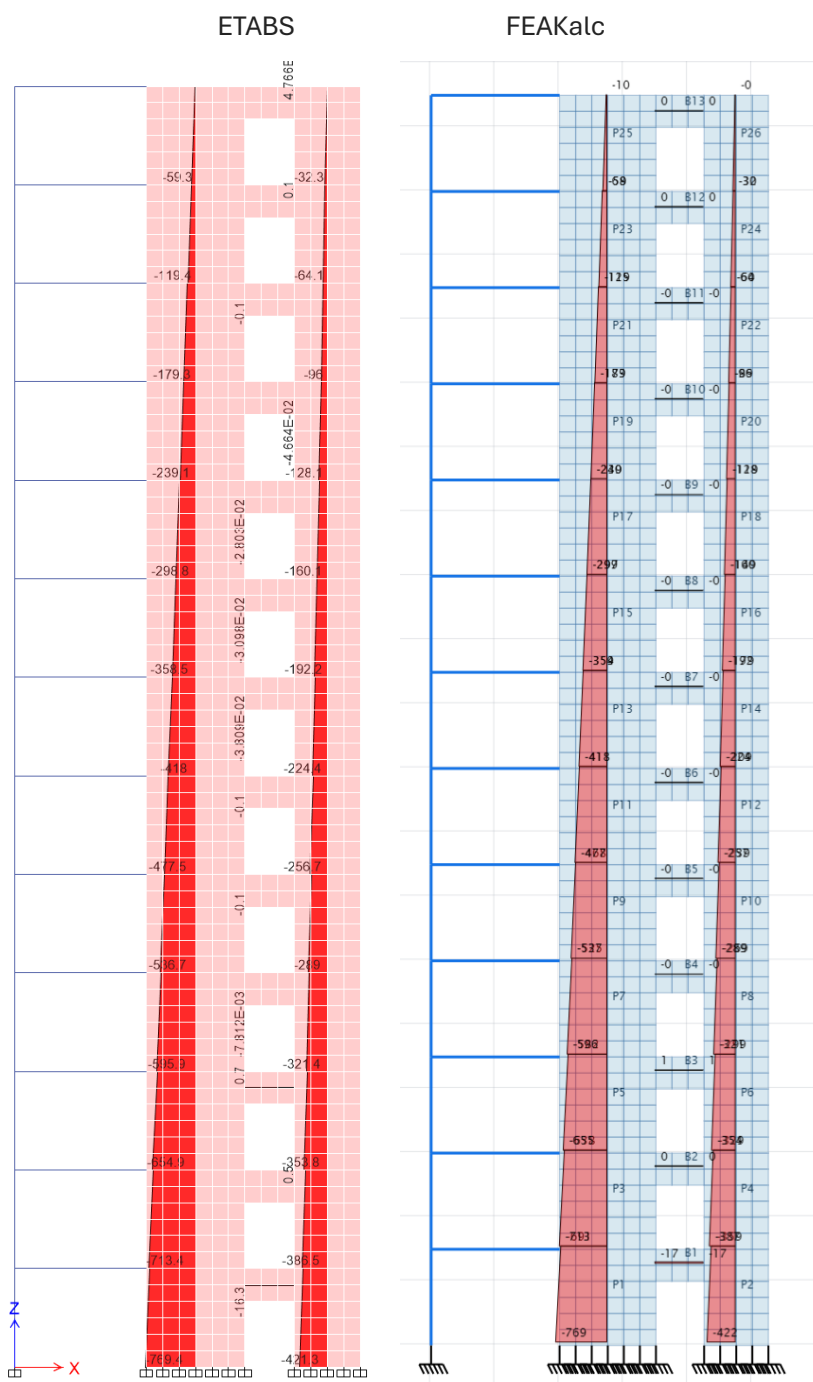


Figure 7. Axial force in kN under own weight. Rounded zero labels are retained and do not imply an exactly zero computed action.

7.2. Dead shear force comparison

Spandrel shear changes across the span under self-weight. Most pier shears are small, with larger local effects near the base. Absolute force differences are more informative than percentages around these small values.

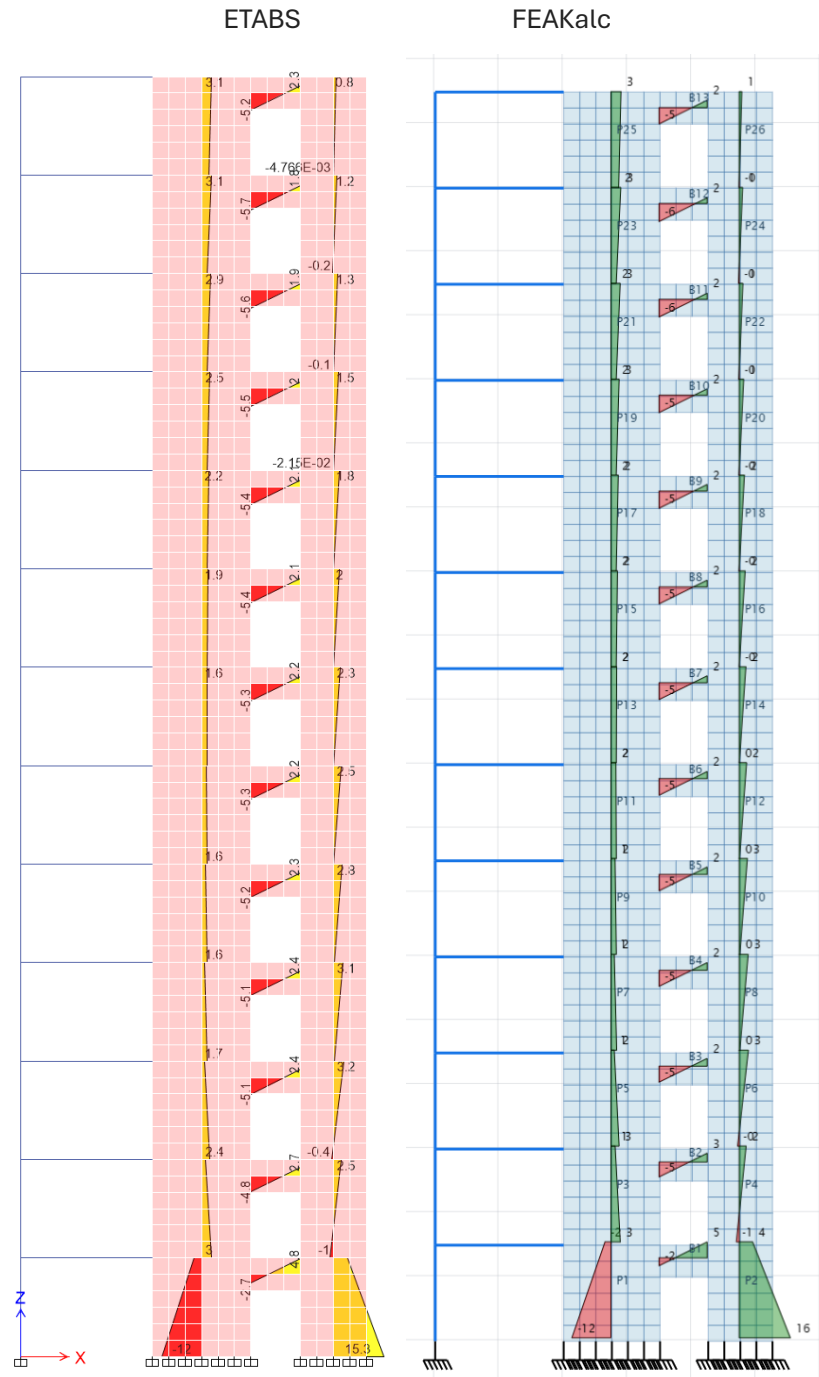


Figure 8. Local shear V2 in kN under own weight. Different end values are expected under distributed gravity loading.

7.3. Dead bending moment comparison

Both views show the same general pier-moment pattern under gravity, including the change toward the base and the smaller spandrel end actions. Differences remain visible in the lower pier values.

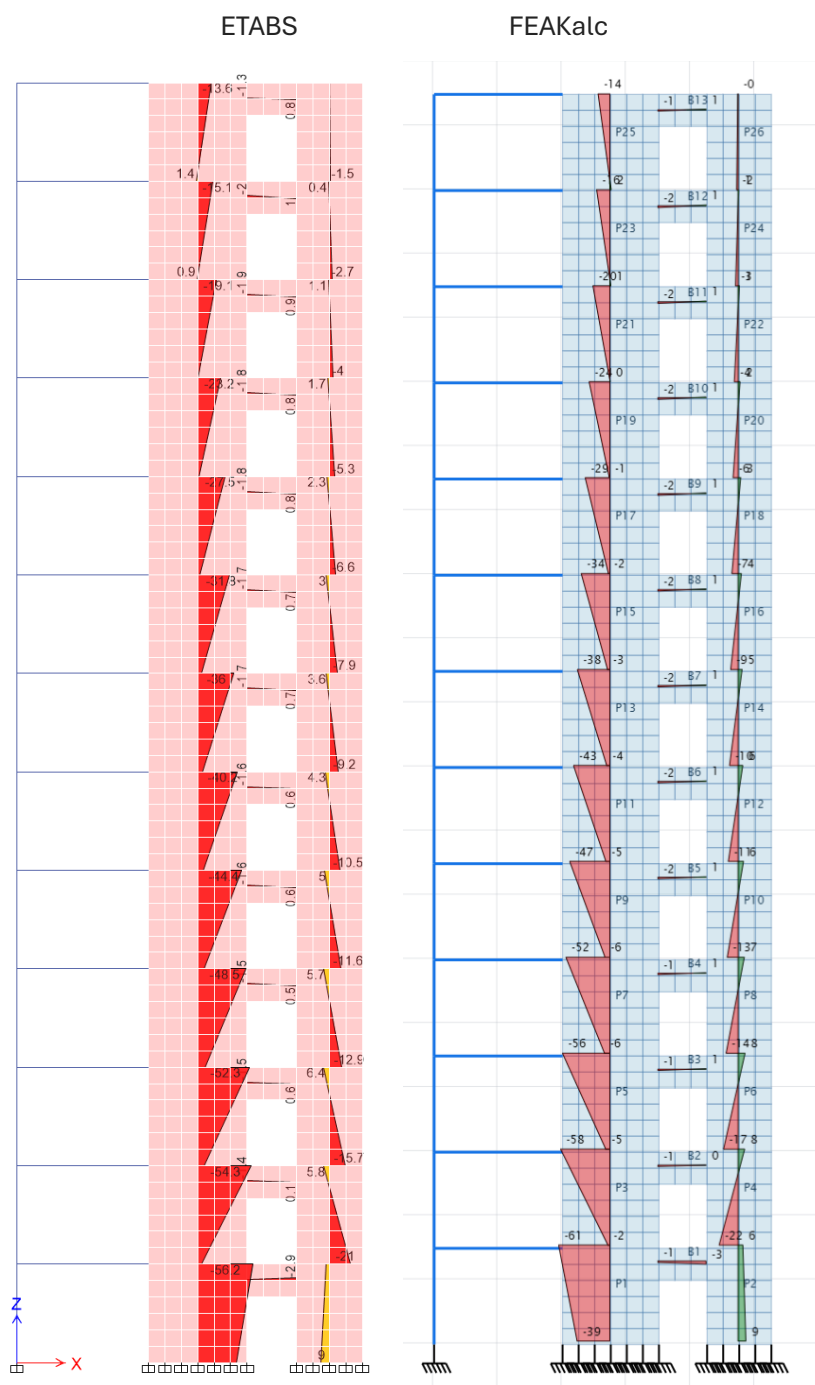


Figure 9. Local moment M3 in kN.m under own weight. Labels are the supplied graphical output, not substituted numerical table values.

7.4. Dead deformation comparison

The deformed shapes show gravity shortening accompanied by leftward movement of the coupled assembly. Their on-screen exaggeration differs and must not be interpreted as a direct stiffness ratio.

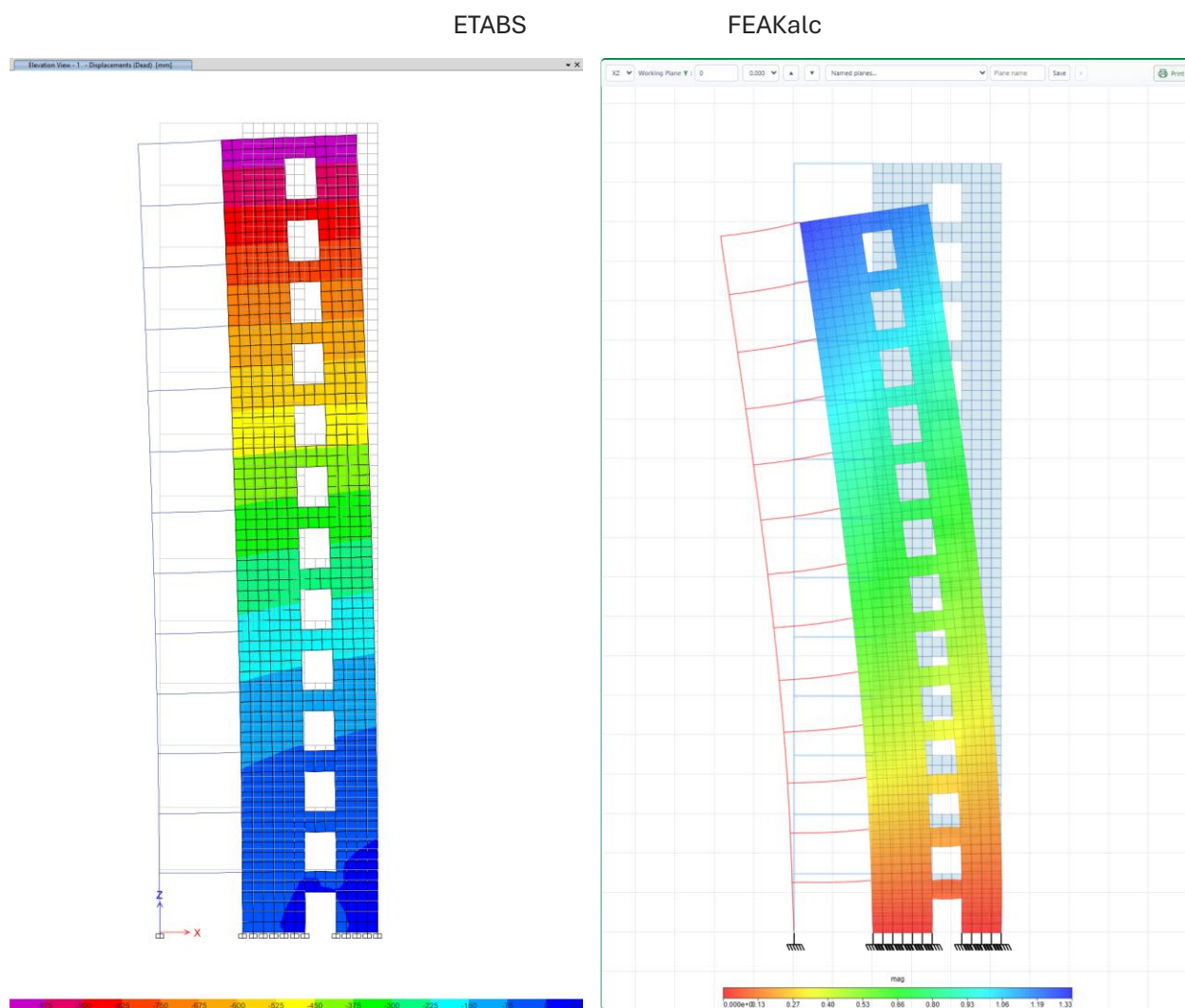


Figure 10. FEAkalc displays non-negative displacement magnitude. ETABS displays a signed component, as indicated by its negative colour legend. These contour colours do not represent the same quantity.

The screenshots are retained with their original legends and display conventions. Numerical comparison should use the same displacement component at the same coordinates, rather than the visual displacement amplitude or a colour match.

8. Applicability and remaining verification

The repaired automatic mesher reproduces the ETABS shell layout directly from the undivided wall model and eliminates the observed B10/B11 connectivity problem. Current Dead and horizontal Live analyses reproduce global equilibrium and the broad force and deformation patterns. This finding applies to the stated linear elastic benchmark.

Remaining differences include 3.22% in Live roof horizontal displacement and local frame actions. The matching shell topology now removes the earlier mesh-layout difference from this comparison. Shell interpolation, stiffness formulation, frame connections, local-axis conventions and force recovery still require separate investigation before assigning the residual differences to one cause.