Finite Element Method
STAAD PRO Assignment.

Q. What is FEM?

⇒. FEM is numerical technique for solving problems which are described by partial differential equations or can be formulated as functional minimization. A domain of interest is represented as an assembly of finite elements. Approximating functions in finite elements are determined in terms of nodal values of physical field which is sought.

A continuous physical problem is transferred into a discretized finite element problem with unknown nodal values. For a linear problem a system of linear algebraic equations should be solved. Values inside finite elements can be recovered using nodal values.

Two features of FEM

1) Piecewise Approximation 2) Locality of approximation.

Q. How FEM works in STAAD pro?

⇒ 1) Discretise the continuum :- The first step is to divide solution region into finite elements. Preprocessor programme generates the finite element mesh. The description of mesh consists of several arrays main of which are nodal co-ordinates and element connectivities.

2) Select interpolation function :- Polynomials of different order are chosen and interpolated field variables are adopted. Degree of polynomial depends on no. of nodes assigned to element.

3) To find element properties:- Matrix equation for finite element should be established which relates the nodal values of the unknown function to other parameters. For this task different approaches can be used

4) Assembly :- Global equation or matrices are formed by assembly process. Element connectivities are used for assembly process.

5) Solve global eq's :- Reduced matrices are solved.

6) Compute addnal results :- stress, strains in mechanical systems or velocities and accelerations in fluid system are found out.

Q. Material Data & Loading Data :-

$(Sut)_{steel} = 545.\ MPa.$

$(High\ yield\ strength)_{steel} = 500\ MPa.$

$\mu = 0.3$

$E = 2.05 \times 10^8\ kN/m^2.$

$\rho = 7850\ kg/m^3$

1) Dead load → self weight
2) Live load → $10\ kN/m^2$ (on plates (deck)).
3) Nodal force → Berthing load → 250kN (at corner pt).
4) serviceability → for above loads with 1.0 factor.
5) collapsibility → for above loads. with 1.5 factors.

Beam Displacement Detail Summary

Displacements shown in italic indicate the presence of an offset

	Beam	L/C	d (m)	X (mm)	Y (mm)	Z (mm)	Resultant (mm)
Max X	47	5:collapse	9.292	**9.594**	-2.473	-1.870	10.082
Min X	45	5:collapse	9.246	**-21.113**	-6.750	-11.017	24.752
Max Y	105	5:collapse	0.000	0.000	**0.000**	0.000	0.000
Min Y	45	5:collapse	0.000	-8.202	**-7.526**	-7.494	13.419
Max Z	78	5:collapse	20.753	-5.841	-1.909	**2.977**	6.828
Min Z	48	5:collapse	6.969	7.026	-4.104	**-16.539**	18.432
Max Rst	45	5:collapse	6.934	-21.101	-6.815	-11.425	**24.944**

Beam Force Detail Summary

Sign convention as diagrams:- positive above line, negative below line except Fx where positive is compression. Distance d is given from beam end A.

				Axial	Shear		Torsion	Bending	
	Beam	L/C	d (m)	Fx (kN)	Fy (kN)	Fz (kN)	Mx (kNm)	My (kNm)	Mz (kNm)
Max Fx	105	5:collapse	0.000	**4.1E+3**	-343.881	-472.328	79.735	452.759	34.001
Min Fx	47	5:collapse	0.000	**462.569**	124.542	-34.183	3.803	590.895	1.89E+3
Max Fy	48	5:collapse	0.000	754.144	**125.798**	32.425	-20.186	-570.896	1.9E+3
Min Fy	108	5:collapse	2.525	2.99E+3	**-352.514**	-109.753	-3.479	-32.337	1.09E+3
Max Fz	106	5:collapse	0.000	2.94E+3	-318.928	**363.592**	-90.486	-222.981	100.042
Min Fz	105	5:collapse	0.000	4.1E+3	-343.881	**-472.328**	79.735	452.759	34.001
Max Mx	105	5:collapse	0.000	4.1E+3	-343.881	-472.328	**79.735**	452.759	34.001
Min Mx	106	5:collapse	0.000	2.94E+3	-318.928	363.592	**-90.486**	-222.981	100.042
Max My	45	5:collapse	0.000	688.580	54.396	-96.875	9.899	**1.62E+3**	716.567
Min My	46	5:collapse	0.000	475.013	53.758	96.444	-26.124	**-1.61E+3**	713.448
Max Mz	48	5:collapse	0.000	754.144	125.798	32.425	-20.186	-570.896	**1.9E+3**
Min Mz	48	5:collapse	23.229	987.056	92.859	32.425	-20.186	182.308	**-641.906**

Node Displacement Summary

	Node	L/C	X (mm)	Y (mm)	Z (mm)	Resultant (mm)	rX (rad)	rY (rad)	rZ (rad)
Max X	3	4:Serviceability	**-3.909**	-4.120	-4.972	7.549	-0.001	0.000	-0.003
Min X	241	4:Serviceability	**-5.501**	-57.933	-5.855	58.487	0.008	0.000	-0.009
Max Y	4	4:Serviceability	-3.970	**-3.503**	-7.373	9.077	-0.002	0.000	0.003
Min Y	500	4:Serviceability	-4.728	**-124.802**	-6.607	125.066	-0.000	0.000	0.003
Max Z	3	4:Serviceability	-3.909	-4.120	**-4.972**	7.549	-0.001	0.000	-0.003
Min Z	4	4:Serviceability	-3.970	-3.503	**-7.373**	9.077	-0.002	0.000	0.003
Max rX	307	4:Serviceability	-5.255	-78.812	-6.688	79.270	**0.020**	0.000	0.012
Min rX	404	4:Serviceability	-4.195	-78.218	-6.691	78.616	**-0.021**	0.000	0.012
Max rY	3	4:Serviceability	-3.909	-4.120	-4.972	7.549	-0.001	**0.000**	-0.003
Min rY	1	4:Serviceability	-5.468	-5.017	-4.996	8.946	0.001	**0.000**	-0.003
Max rZ	542	4:Serviceability	-4.730	-58.372	-7.092	58.991	-0.000	0.000	**0.031**
Min rZ	193	4:Serviceability	-5.077	-37.688	-5.329	38.400	0.003	0.000	**-0.013**
Max Rst	500	4:Serviceability	-4.728	-124.802	-6.607	**125.066**	-0.000	0.000	0.003

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Job Title	Ref		
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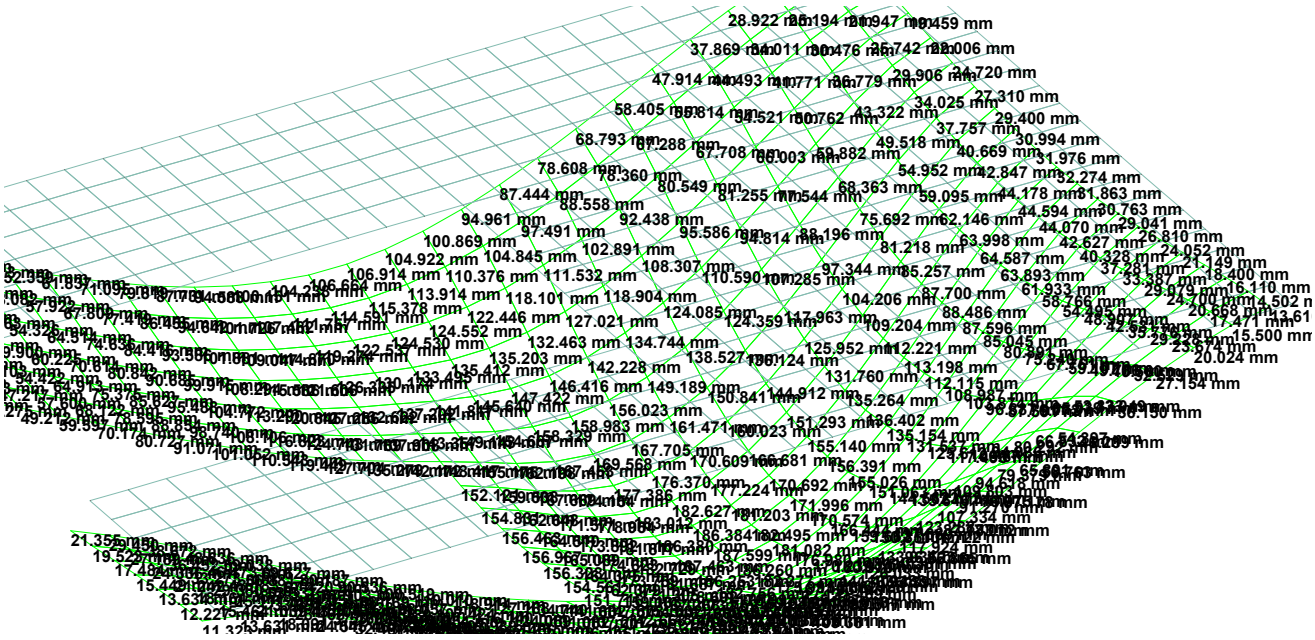

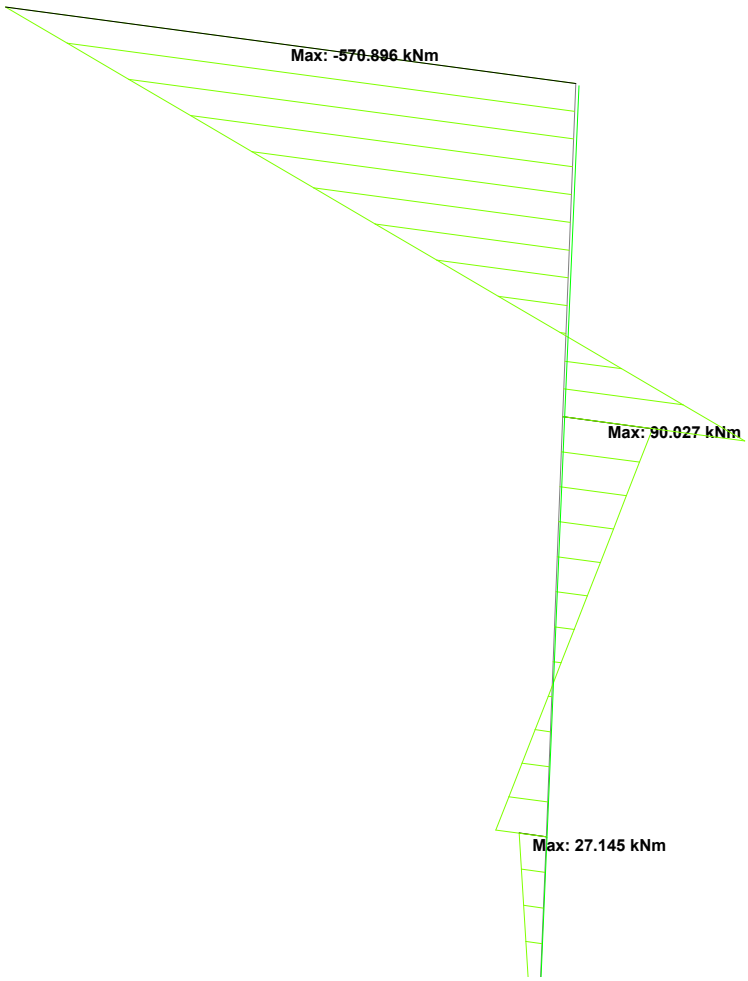
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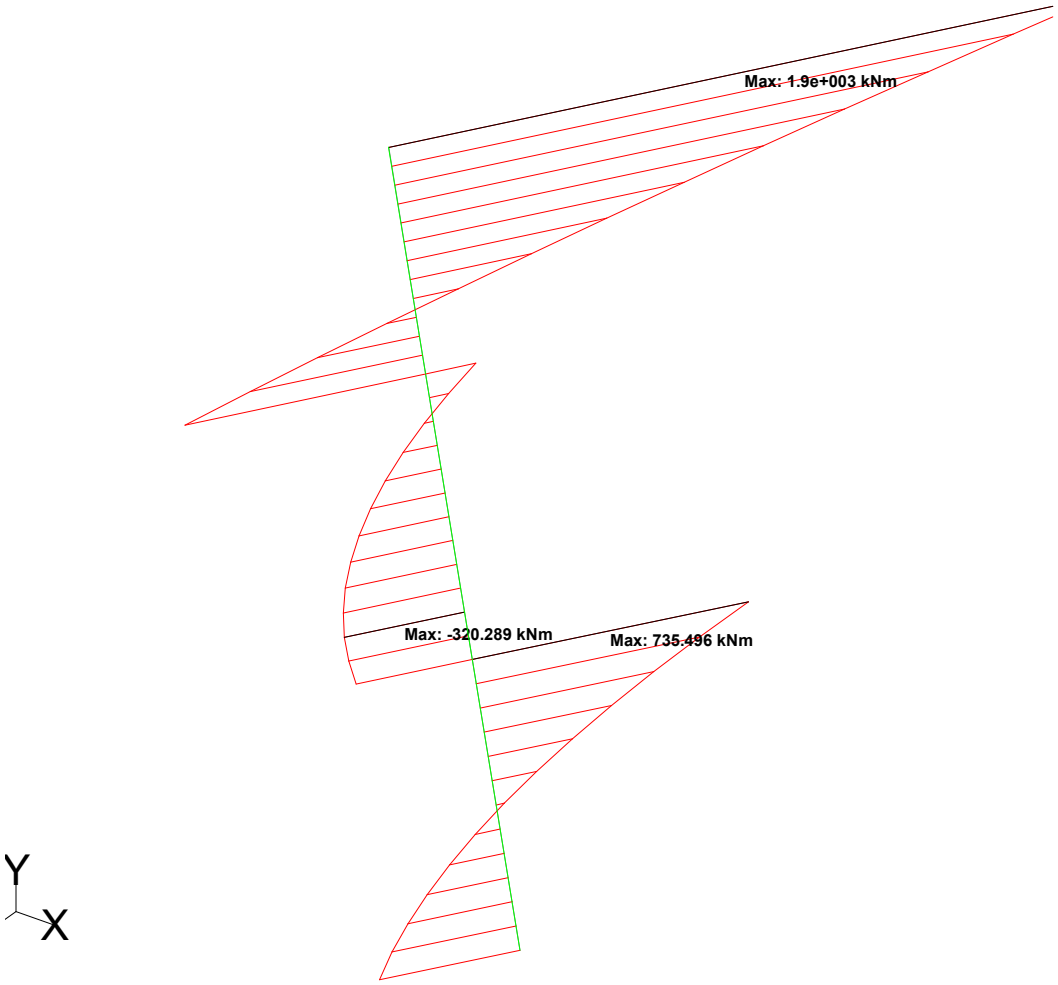
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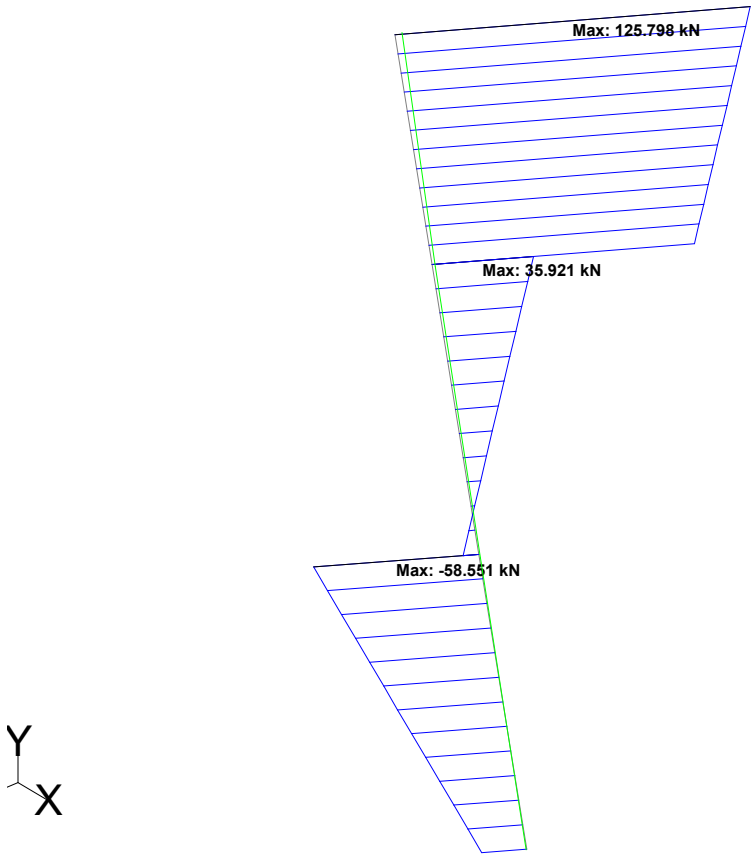
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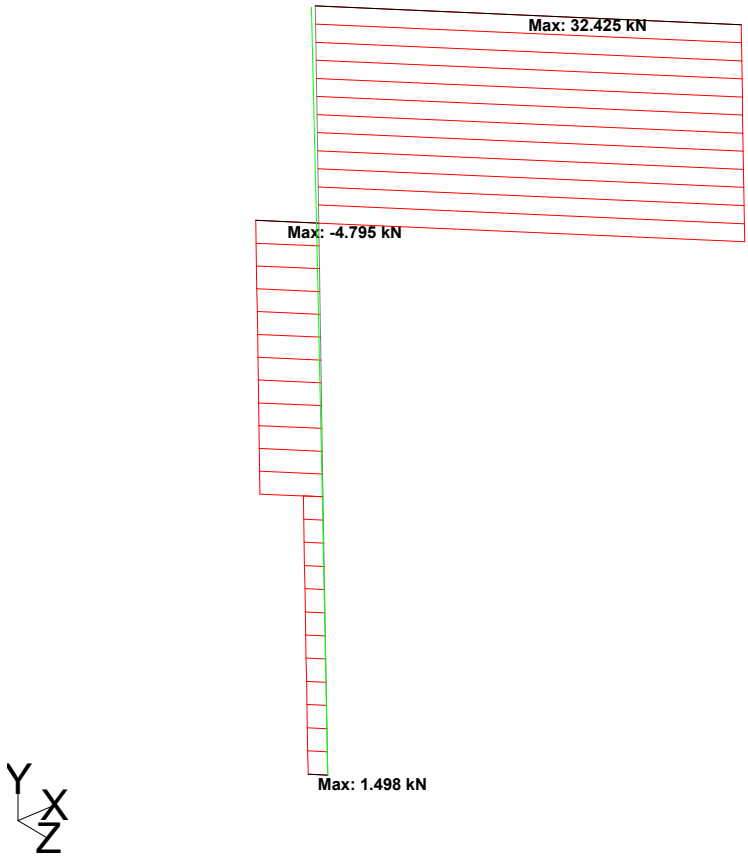
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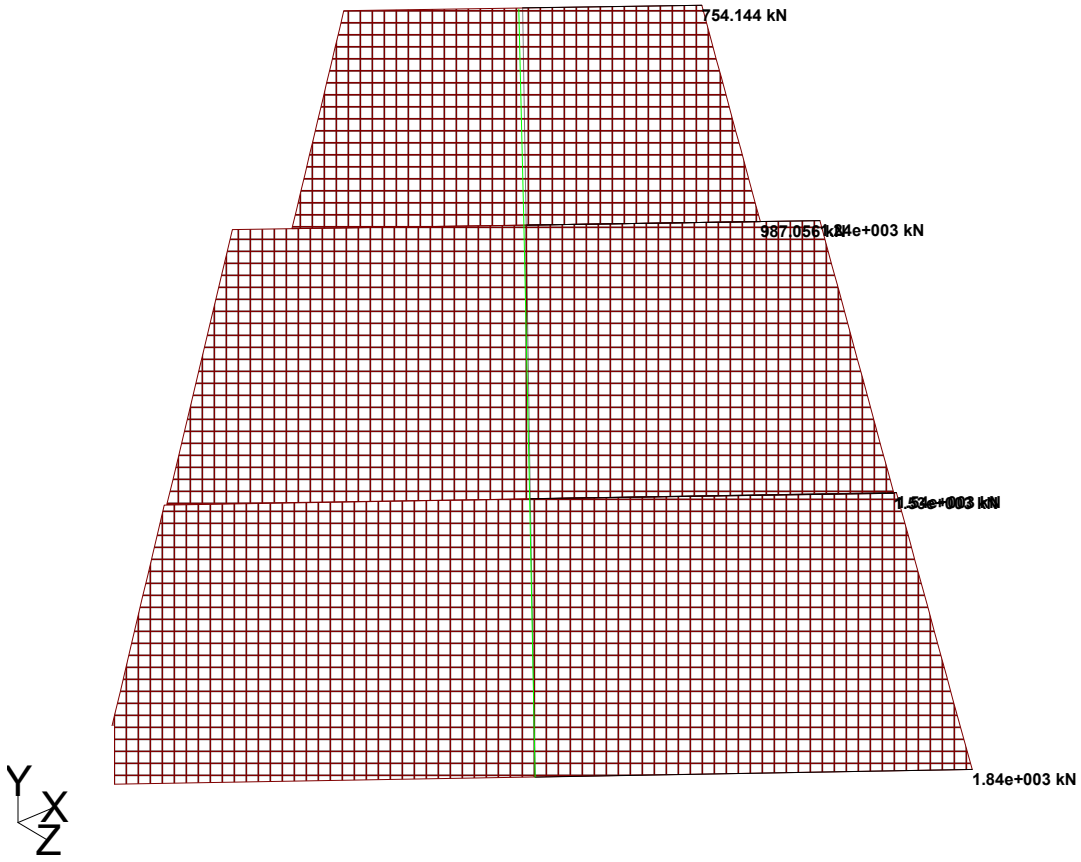
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