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Design & Analysis of Beam-Column Structures with Nonlinear Supports &Computer Program

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Abstract – This paper will be helpful for researchers for method selection design validation of beam column structures with nonlinear support and computer program, technique for computer-aided design and analysis of beam-columns under various load with nonlinear support .To ease numerical solutions of complicated structural elements, the approach employs discrete-element mechanical models of continuous parts. The axial and lateral solutions are linked to account for the impact of axial forces on the bending behavior of the member.

The members are designed for maximum Tension and Compression load for the most critical load combination as per code IS 2062, IS802 & IS 1852. The Seismic behavior of the Beam and column structure for factory shed has been tabulated and the deflections, axial forces, modal time period and base shear of both types of methodare noted and comparison between computer analysis, numerical analysis & experimental analysis.

Keywords- Computer Programing, Numerical Method, Experimental Method, Design validation, Mechanical Structure, Displacement load.

I - SINTRODUCTION

A number of difficulties involving beam-column type members exist, for which there are no suitable mathematical solutions. These include axially and laterally loaded piles with nonlinear supports, beams with variable cross-sections or resting on closely spaced dispersed supports, and elastic buckling of columns with varied cross-sections or with distributed nonlinear supports. The programmable computer

programmer for analyzing beam column members under combined axial and lateral stresses with nonlinear support has been created, the effected of internal axial forces on

bending behaviors are investigated. A computer program for analysis of general beam-column structures supported and/or loaded by components which interact with displacements of the beam and/or column the computer program described in this report has been checked to ensure that the results are accurate within the limitations of the procedures employed. However, there may be unusual situations which were not anticipated, and these situations may cause the program to produce questionable results. It is the responsibility of the user to judge the validity of the results. No responsibility is assumed by the author for the design or behavior of any structure based on results obtained with the program. Describes the general beam- column system considered and the mathematical model used for analysis. Presents the force-displacement relationships for the mathematical model and describes the computational procedure used for the solution.

II -HOW ARE BEAMS AND COLUMNS USED IN A STRUCTURE?

Columns and beams are two fundamental structural elements that are essential to stability. They support the weight of the building and create a safe load path, transferring the weight and forces applied to the structure of the building to the foundation and the ground.
Uses: Light Gauge Steel Framing Prefabricated Hall Building / Factory / Shed Steel Structure Drawing, Find Complete Details about Light Gauge Steel Framing Prefabricated Hall Building / Factory / Shed etc.

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Fig: Beam and Column Steel Structure

Fig: Difference types of Load

III - OBJECTIVES

➢ To study the nonlinear response of corner beam-column junctions with inclusion of the effect of construction joint between the column and the beam fabricated at different times and subjected to cyclic and repeated loads, a computer program of three dimensional nonlinear finite element analysis.

➢ A parametric study dealing with fabricated joint is presented by taking various conditions of the junction. These include the axial load on the column, strength of joint in the second cast.

➢ An important result from the research done so far is that the notion of a rigid joint can be discarded forever. Thus, just as beams, columns and other structural elements exhibit flexibility in response to applied loading.

➢ Comparison Study with help of Computer programing, Numerical method & Experimental Method and Design Validation.

IV -METHODOLOGY

➢   Mechanical Model Development
➢   Computer Base Analysis
➢   Numerical Method
➢   Experimental Method

V- GENERAL ANALYSIS REQUIREMENTS OF COLUMN AND BEAM STEEL STRUCTURES

➢ Transverse Load
➢ Longitudinal Load
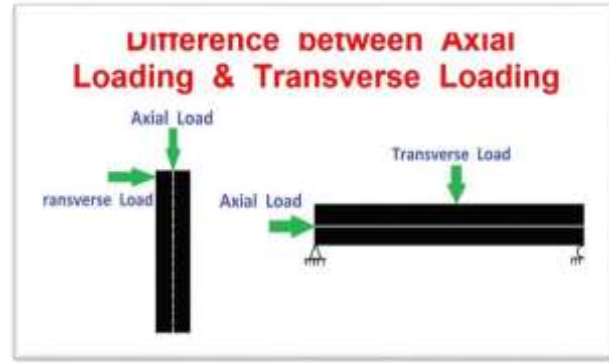➢ Torsional shear Load
➢ Self-weight
➢ Wind Load

VI -MECHANICAL MODEL DEVELOPMENT

When the need for a new structure arises, an individual or agency has to arrange the funds required for its construction. The individual or agency henceforth referred to as the owner then approaches an architect. The architect plans the layout so as to satisfy the functional requirements and also ensures that the structure is aesthetically pleasing and economically feasible. In this process, the architect often decides the material and type of construction as well. The plan is then given to a structural engineer who is expected to do locate the structural elements so as to cause least interference to the function and aesthetics of the structure. He then makes the strength calculations to ensure safety and serviceability of the structure. This process is known as structural design. Finally, the structural elements are designed in 3D model with help of computer programming.

Fig: 3D Model

COMPUTER BASE ANALYSIS MAIN STEPS

➢ Entering job information.
➢ Building model geometry
➢ Defining member properties, sections.
➢ Assigning loads (load cases, combinations...)
➢ Defining pre-analysis print out, analysis type, and post-analysis printout.

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➢ Defining design requirements
➢ Apply the load
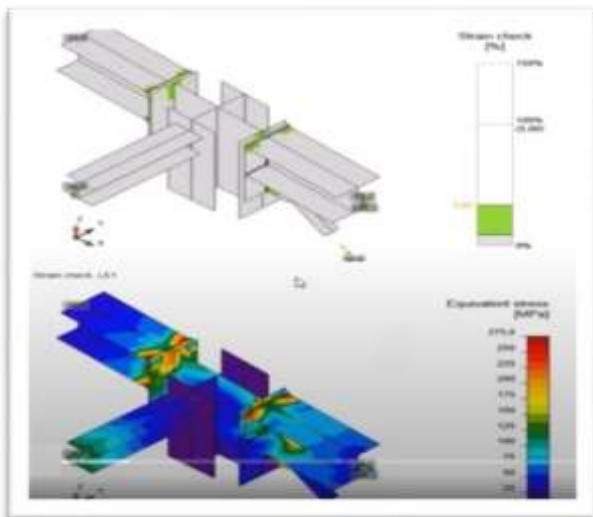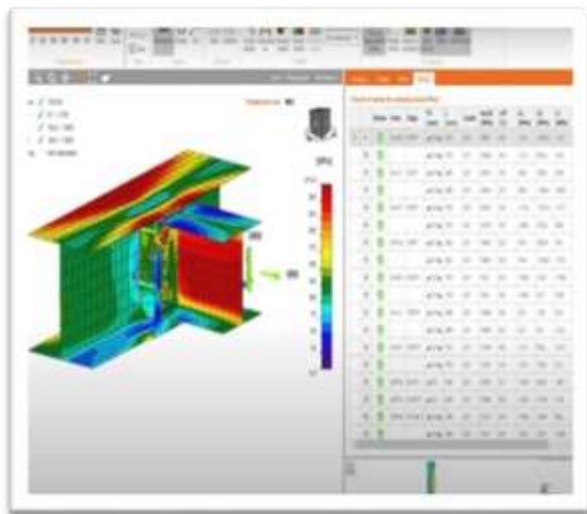
Fig: Load Analysis

No	Material	Yield Result (N/mm2)	Deflection Value (mm)
1	BEAM 152 X 203	511	Welded
2	SC 250	549	Joint
3	SC 225	449	Deflection 3.25 MM
4	Plate 20 MM	546	
5	Plate 10 MM	526	

NUMERICAL METHOD

Slope: $\theta = \dfrac{dy}{dx}$ $\theta_i = \dfrac{-y_{i-1} + y_{i+1}}{2h}$

Curvature: $\emptyset = \dfrac{d^2y}{dx^2}$ $\emptyset_i = \dfrac{y_{i-1} - 2y_i + y_{i+1}}{h^2}$

Moment: $M = F\dfrac{d^2y}{dx^2}$ $M_i = F_i\left[\dfrac{y_{i-1} - 2y_i + y_{i+1}}{h^2}\right]$

Shear: $V' = \dfrac{dM}{dx}$ $V'_i = \dfrac{-M_{i-1} + M_{i+1}}{2h}$

Load: $w' = \dfrac{d^2M}{dx^2}$ $w'_i = \dfrac{M_{i-1} - 2M_i + M_{i+1}}{h^2}$
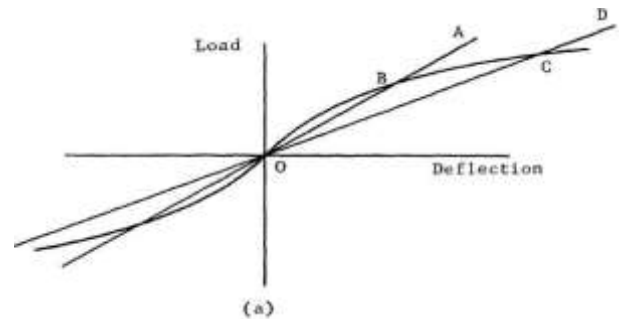

Fig: Numerical Method

No	Material	Yield Result (N/mm2)	Deflection Value (mm)
1	BEAM 152 X 203	510	Welded
2	SC 250	551	Joint
3	SC 225	500	Deflection 3.24 MM
4	Plate 20 MM	546	
5	Plate 10 MM	525	

EXPERIMENTAL METHOD

The detailed process for Experimental Testing

1. First assemble the steel structure as shown in figure.1 with with help of Manpower and crane
2. After that Hanging the Wire rope with load cell, load cell connected with control room.
3. Applied the load according load chart with help of control room controller
4. Note down the load and deflection of Steel Structure in your note pad as per table 1

5. Deflection measured by Total station machine on each node of element and load measure by load meter

6. Once the all load applied on the Steel structure according to load chart & the tower will standing itself within the limit , then testing was passes

7. Where the deflection is more we can check that element yield load by practically by using Universal testing machine as per table no. 1.

Fig: Hanging of load cell with wire

Fig: Experimental Testing setup

Table 1: *Experimental Testing Tower Structure yieldload and deflection as per below*

No	Material	Yield Result (N/mm2)	Experimental Deflection Value (mm)
1	BEAM 152 X 203	511	Welded
2	SC 250	550	Joint Deflection 3 MM
3	SC 225	499	
4	Plate 20 MM	547	
5	Plate 10 MM	526	

RESULTS AND DISCUSSION

Statistical Comparison between Experimental, Computer-based Analysis, Analytical Calculation

Table: *Experimental Testing Tower Structure yield load and deflection as per below*

S N	Material /Joint	Experimental Result		Numerical Result		Computer Based Analysis	
		Yield Result (N/mm2)	Deflection Value (mm)	Yield Result (N/mm2)	Deflection Value (mm)	Yield Result (N/mm2)	Deflection Value (mm)
1	BEAM 152 X 203	511	Welded Joint Deflection 3 MM	510	Welded Joint Deflection 3.24 MM	511	Welded Joint Deflection 3.25 MM
2	SC 250	550		551		549	
3	SC 225	499		500		449	
4	Plate 20 MM	547		546		546	
5	Plate 10 MM	526		525		526	

The computer program described in this report has been checked to ensure that the results are accurate within the limitations of the procedures employed. However, there may be unusual situations which were not anticipated, and these situations may cause the program to produce questionable results. It is the responsibility of the user to judge the validity of the results. No responsibility is assumed by the author for the design or behavior of any structure based on results obtained with the program

The results are performed in three ways i.e. in experimental basis and validate by using software testing including Analytical. The above table shows that the test which is conducted by applying various at different element as mentioned in the previous chapter. The results are obtained under specially test vision persons. The horizontally and vertically assembly of test prototype was inspected and steel structure was erected on the factory premises successfully.

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CONCLUSION

The paper was successfully achieved its objectives that is the problems which are occurred in the steel structure are now overdesigned and checked by using all possible parameter which are occurred while installation as well as giving its service life without any catastrophic failure. And it is possible because of team work and support of senior person in this project. It is tested by using experimental technique and validate by using software based modeling technique, for this 3D modeling is design in such a way that the proposed model will not be failed in the future and its fatigue life will be more.

ACKNOWLEDGMENT

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