

## **Conclusions and Recommendations**

### **6.1 Conclusions**

A general computer system coded in MATLAB, has been modified and implemented, which can be used for the analysis of linear and nonlinear static beam structures, under point loads.

Based on the results of the numerical examples, it can be concluded that:

1. The displacements for linear analysis for any number of increments and/or any number of elements gave accurate results.
2. For nonlinear analysis in case of cantilever under point load at free end, it is found that for (5) increments and sixteen elements the displacements, values are close to known published solutions.
3. For more than (5) increments the displacements values are not close to known solutions. The inaccurate integration between axial force and moments due to the very large values of slope.
4. The tangent stiffness matrix equal infinitesimal displacement ( $K_0$ ) plus initial stress stiffness matrix (geometric stiffness) was used. The linear displacement stiffness matrix ( $K_L$ ) was neglected.
5. Iterations within increments gave in-accurate results and were, thus, not applied.

### **6.2 Recommendations:**

- a. The program can be used for all cases of linear analysis and pure incremental nonlinear analysis. Incremental iterative solutions are obtained for some specific cases only.
- b. The following is recommended as future work:
  - 1) Calculation of element properties at Gauss points instead of nodes.

- 2) Using a parabolic variation for axial displacement.
- 3) Checking and modifying the incremental program procedure and the Newton-Raphson iterations.
- 4) Including  $K_L$  the linear displacement stiffness matrix.
- 5) The program can be developed to use for geometric nonlinear finite elements analysis Total Lagrangian-Engineering strains
- 6) Introduction geometrically nonlinear 3-D element.
- 7) Modification of program to cover other types of beam elements and other types of load distributions including element loads and different types of strain measures.