# CEE282 Programming Assignment Report

## Description of Code

The provided code analyzes 2-dimensional structures under incremental loading and accounts for deformations in geometry or geometric nonlinearity. It is applicable for prismatic rigid frame elements and contains all features necessary to evaluate a linear-elastic 1st order analysis. The key differences between this 2nd order analysis program and a 1st order analysis program are that this code: (1) computes a geometric stiffness matrix, (2) applies incremental loading and accounts for changes in geometry, and (3) uses the natural deformation approach to force recovery to calculate and record errors for each step. The code can check the tangent matrix for both an unstable structure and for limit points. The code can also calculate and plot the load norm error and energy norm error as a function of the applied load ratio upon completion of the analysis.

The code is limited in that it cannot analyze 3-dimensional structures and that analysis is only performed until the limit load is reached.

### Geometric Stiffness Matrix

The geometric stiffness matrix calculated in this program is given by the equation below.

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### Approach to Internal Force Recovery

The program uses the natural approach to internal force recovery in that the method is based in “natural” or undeformed configuration of the structure. Loads are applied to the structure in its initial configuration and at each step of deformation, the structure is ensured to be in equilibrium.

## Code Design Document

See attached.

## Verification Problems

### Problem 1

#### Part A: Compute Euler Buckling load & AISC Column Strength

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Description automatically generated with medium confidenceA line of lines with numbers

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As the applied load ratio is 87.21 in the first buckling mode with an applied load of 1 kip, the Euler Buckling Load can be found as 87.21 kip.

The AISC column strength is calculated as follows: 91.9 kip through AISC Steel Construction Manual Table 6-2.

#### Part B: Plot P vs. Mid-Height Lateral Displacement

#### Part C: Plot Norm & Energy Error vs. Applied Load Ratio

#### Part D: Report Lateral Disp., Axial Force, Shear Force, & Bending Moment for P=80kip at Mid-Height

#### Part E: Verify Internal Forces by Checking Equilibrium on Deformed Geometry

#### Part F: Verify Answers using Diagnostic Tools

#### Part G: Comment on Accuracy of Solution

### Problem 2

## Critique to Assignment

## Responsibility Distribution