# CEE 235A: Final Project
# Interim Submission 3

We validated the structure explained in class:

Our code ouputs compared with the mastan in-built 1st order analysis were:

```
Delta_f
-7.355e-15
-2.831e-15
  -0.00546
    -4.025
-1.578e-15
 1.414e-15
  -0.04425
    -4.061
  3.12e-15
 6.999e-15
   0.08184
    0.3061
    -1.537
-1.266e-12
-1.191e-14
 1.281e-14
   -0.1282
```

| Node: | 1 | Disp X | ~~0~~ | Disp Y | ~~0~~ | Disp Z | ~~0~~ |
|---|---|---|---|---|---|---|---|
| Displacement | | Rot X | -8.102e-15 | Rot Y | -1.536e-15 | Rot Z | -0.00546 |

| Node: | 2 | Disp X | ~~0~~ | Disp Y | -4.025 | Disp Z | ~~0~~ |
|---|---|---|---|---|---|---|---|
| Displacement | | Rot X | 7.486e-16 | Rot Y | 7.413e-16 | Rot Z | -0.04425 |

| Node: | 3 | Disp X | ~~0~~ | Disp Y | -4.061 | Disp Z | ~~0~~ |
|---|---|---|---|---|---|---|---|
| Displacement | | Rot X | -1.549e-15 | Rot Y | -8.462e-15 | Rot Z | 0.08184 |

| Node: | 4 | Disp X | 0.3061 | Disp Y | -1.537 | Disp Z | -1.15e-12 |
|---|---|---|---|---|---|---|---|
| Displacement | | Rot X | -1.004e-14 | Rot Y | -9.84e-15 | Rot Z | -0.1282 |

Striked out => DoFs that aren't free, hence not included in Delta_F. Only the 17 values for free DOF are checked.

Values that are very small (~0) are very small and close to each other in both cases even though they don't seem to match.

```
Rs
   4163.0
   7920.0
1.146e-11
   -203.5
8.736e-13
  -4048.0
1.205e-11
```

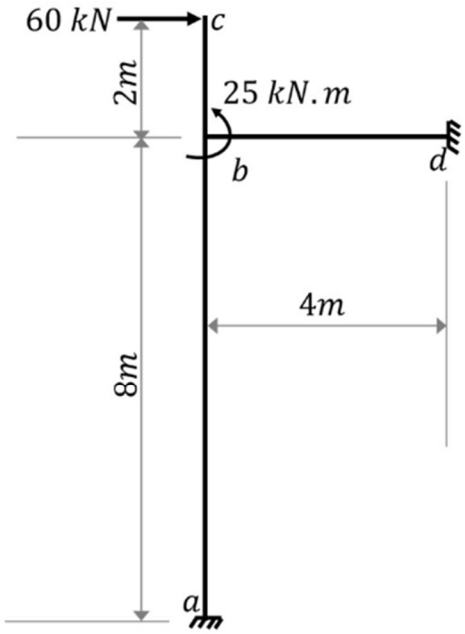
| Node: | 1 | Fx | 4163 | Fy | 7920 | Fz | 4.85e-13 |
|---|---|---|---|---|---|---|---|

| Node: | 2 | Fx | -203.5 | Fy | | Fz | -4.85e-13 |
|---|---|---|---|---|---|---|---|

| Node: | 3 | Fx | -4048 | Fy | | Fz | 9.699e-13 |
|---|---|---|---|---|---|---|---|

We see that all reaction forces match those from Mastan in-built analysis

We also tested our code on the structure in HW 4, Problem 2:




$E = 200\ kN/mm^2$

$I = 500 \times 10^6 mm^4$

A= $10 \times 10^3 mm^4$

For the sake of a space frame analysis, we ensure that Iyy and J are non-zero. We set Izz= Iyy = I and J ~ I/5 for this problem.

We compare our code results with MASTAN built in analysis.

```
Delta_f
    0.1318
   0.09276
-2.631e-17
-8.106e-20
 4.099e-20
-0.0006648
     3.061
   0.09276
-1.705e-16
 -8.45e-20
 1.145e-19
 -0.001865
```

Only free DOFS correspond to nodes 2 and 3.

| Node: | 2 | Disp X | 0.1318 | Disp Y | 0.09276 | Disp Z | 0 |
|---|---|---|---|---|---|---|---|
| Displacement | | Rot X | 0 | Rot Y | 0 | Rot Z | -0.0006648 |

| Node: | 3 | Disp X | 3.061 | Disp Y | 0.09276 | Disp Z | 0 |
|---|---|---|---|---|---|---|---|
| Displacement | | Rot X | 0 | Rot Y | 0 | Rot Z | -0.001865 |

We see that the values match. The values that are really small are almost 0, so they match as well.

For Reaction forces:

```
Rs
     5.923
    -23.19
-2.105e-15
-2.175e-12
 9.419e-13
  -15380.0
    -65.92
     23.19
-1.876e-15
 1.822e-12
 3.339e-12
  -29760.0
```

| Node: | 1 | Fx | 5.923 | Fy | -23.19 | Fz | 0 |
|---|---|---|---|---|---|---|---|
| Reactions | | Mx | 0 | My | 0 | Mz | -1.538e+04 |

| Node: | 4 | Fx | -65.92 | Fy | 23.19 | Fz | 0 |
|---|---|---|---|---|---|---|---|
| Reactions | | Mx | 0 | My | 0 | Mz | -2.976e+04 |

These match as well.