

Appendix: The relative member tangent stiffness matrix [t] is given by Oran(11) as:

$$\begin{aligned}
 & \left[ \begin{array}{cccccc}
 \frac{G_2}{L} & \frac{G_1 G_2}{L} & \frac{G_1 G_2}{L} & \frac{G_1 G_1}{L} & \frac{G_1 G_2}{L} & \frac{G_1}{L} \\
 \frac{G_1 G_2}{L} & \frac{G_2}{L} & \frac{G_2}{L} & \frac{G_1 G_2}{L} & \frac{G_2}{L} & \frac{G_2}{L} \\
 \frac{G_2}{L} & \frac{G_1 G_2}{L} & \frac{G_1 G_2}{L} & \frac{G_1 G_2}{L} & \frac{G_2}{L} & \frac{G_2}{L} \\
 \frac{G_1 G_2}{L} & \frac{G_2}{L} & \frac{G_2}{L} & \frac{G_1 G_1}{L} & \frac{G_1 G_2}{L} & \frac{G_1}{L} \\
 \frac{G_1 G_2}{L} & \frac{G_2}{L} & \frac{G_2}{L} & \frac{G_1 G_2}{L} & \frac{G_2}{L} & \frac{G_2}{L} \\
 \frac{G_1}{L} & \frac{G_1}{L} & \frac{G_1}{L} & \frac{G_1}{L} & \frac{G_1}{L} & \frac{G_1}{L}
 \end{array} \right]
 \end{aligned}$$

(1.1.)

For a truss element, since the stability and bowing functions as well as relative rotations are equal to zero, therefore, all the elements of [t] are equal to zero except:

$$t_{ss} = \frac{EA}{L} \tag{1.2}$$

$$G_{1n} = C'_{1n}\theta_{1n} + C_{2n}\theta_{2n} \tag{1.3}$$

$$G_{2n} = C'_{2n}\theta_{1n} + C'_{1n}\theta_{2n} \tag{1.4}$$

[g<sup>k</sup>] : is the (12x12) geometry matrix, thus:

$$[-g(k)] = \left[ \begin{array}{c} f_{-f(k)}^{(K)} \\ -f_{[f(k)]}^{(K)} \end{array} \right] \tag{1.5}$$

in which [f<sup>(k)</sup>] are (6X6) matrices defined by:

for K=1,2  $f_{ij}^{(k)} = 0$  except  $f_{12}^{(k)} = f_{21}^{(k)} = \frac{1}{Lc} \cdot 2$

for K= 2,3  $f_{ij}^{(k)} = 0$  except  $f_{13}^{(k)} = f_{31}^{(k)} = -\frac{1}{Lc} \cdot 2$

for K= 5  $f_{ij}^{(k)} = 0$

for K=6  $f_{ij}^{(k)} = 0$  except  $f_{22}^{(k)} = f_{33}^{(k)} = -\frac{1}{L.Lc}$