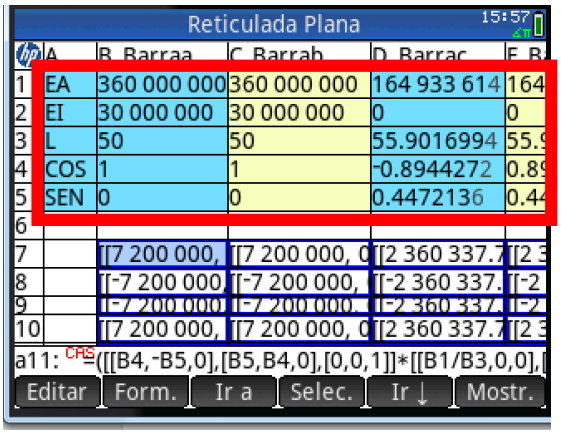
Reticulated Structures (Nodes with 3 degrees of freedom)

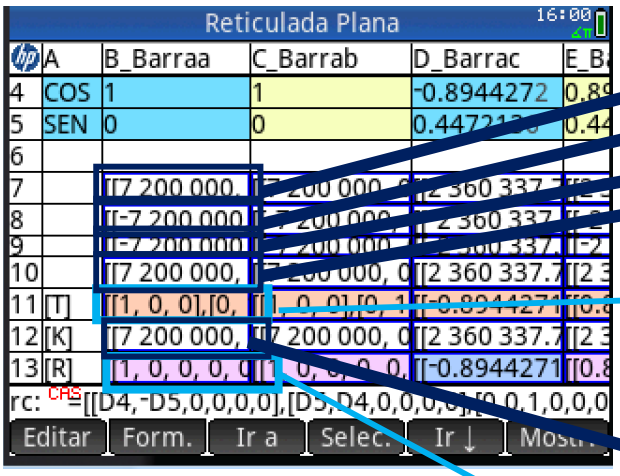
When the nodes are rigid. It`s very similar to the articulated structures spreadsheet.

1.-Introduce the characteristics of all the beams (barra)



- **E:** is the elastic modulus (or Young's modulus)
- **A**: is the cross-sectional area.
- **I:** Inertia
- **L:** is the length of the beam.
- **COS :** cosine of the angle between the main axes and the beam.
- **SIN:** sine of the angle between the main axes and the beam.

2.-You get the stiffness matrix of the beams



Stiffness submatrix of the beam "a":

$[K_{11a}]$ it's named by "a11"
$[K_{12a}]$ it's named by "a12"
$[K_{21a}]$ it's named by "a21"
$[K_{22a}]$ it's named by "a22"

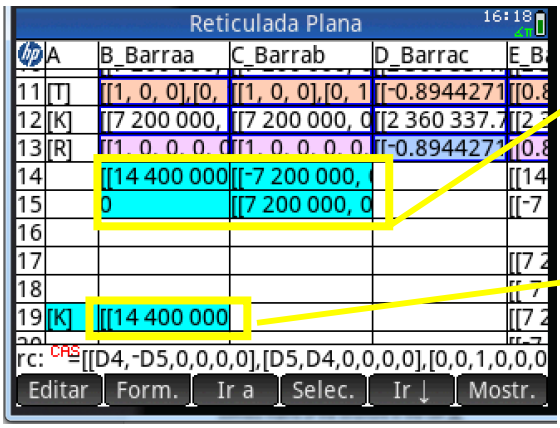
Translation matrix named by "ta"

Stiffness matrix of the beam "a" named by "ka"

Rotation matrix named by "ra"

3.-Assembly the stiffness matrix of the structure

You need to write in a paper the stiffness matrix of your structure.
-If you have 2 nodes: you have to go to the cells B14:C15 (the blue ones) and there you write each element of the stiffness matrix. You get the assembly matrix of the structure in global in the cell B19.

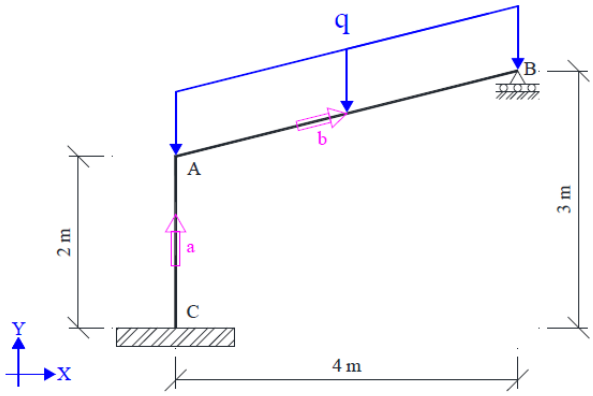


In each cell you put each element of the stiffness matrix.

Stiffness matrix of the structure

-If you have 3 nodes: you have to go to the cells m12:O14 (the greens) You get the stiffness matrix of the structure in the cell R19
-If you have 4 nodes: you have to go to the cells m1:P4 (the oranges). You get the stiffness matrix of the structure in the cell S8.
-If you have 5 nodes: you have to go to the cells m22:Q16 (the blues). You get the stiffness matrix of the structure in the cell T29

For example if we have this structure



1. We Introduce the characteristics of all the beams in our spreadsheet.

2. We write in a paper the stiffness matrix of the structure, in this case (node C is non active that why we don't consider it)

$$[K_{Estructura}\ ] = \begin{bmatrix} [K_{22a}] + [K_{11b}] & [K_{12b}] \\ Simétrica & [K_{22b}] \end{bmatrix}_{6x6}$$

3. We have 2 nodes actives so we go to the cells B14:C15 (the blue) and we introduce each stiffness submatrix of each beam.
If some cell would be zero you have to write **the matrix zero 3x3.**

In our case we have to introduce in our spreadsheet:

=a22+b11	=b12
	=b22

It`s better to use CAS mode to introduce it, if not, sometimes crash.
It is non necessary to introduce the symmetric part.

Writing that in the cells B14:C15 you get the stiffness matrix of the structure in the cell B19. Then you go to the home view, write B19 and you get it there, where you can to inverse it, or delete rows and columns, in order to solve and obtain the displacements.

Fernando. A