

$vif()$ 
 $\text{odos}(x,y)$ 

$$\begin{bmatrix} 'x'' \\ 'y'' \end{bmatrix} \begin{bmatrix} 0 & 3048 & 3048 \\ 0 & 0 & -3658 \end{bmatrix}$$
 $\text{onectividad}(xi,xf)$ 

$$\begin{bmatrix} 'ni'' \\ 'nf'' \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix}$$
 $\text{atos}(\text{Area}, E, \text{Iner})$ 

$$\begin{bmatrix} 'Area'' \\ 'E'' \end{bmatrix} \begin{bmatrix} 2312 & 2312 \\ 200000 & 200000 \end{bmatrix}$$

$$'Inercia'' \begin{bmatrix} 2464818 & 2464818 \end{bmatrix}$$

[R Elemento 1

|                  |                    |                    |                  |                    |                    |
|------------------|--------------------|--------------------|------------------|--------------------|--------------------|
| <u>57800000</u>  | 0                  | 0                  | <u>-57800000</u> | 0                  | 0                  |
| 381              |                    |                    | 381              |                    |                    |
| 0                | <u>1283759375</u>  | <u>5135037500</u>  | 0                | <u>-1283759375</u> | <u>5135037500</u>  |
|                  | 6145149            | 16129              |                  | 6145149            | 16129              |
| 0                | <u>5135037500</u>  | <u>82160600000</u> | 0                | <u>-5135037500</u> | <u>41080300000</u> |
|                  | 16129              | 127                |                  | 16129              | 127                |
| <u>-57800000</u> | 0                  | 0                  | <u>57800000</u>  | 0                  | 0                  |
| 381              |                    |                    | 381              |                    |                    |
| 0                | <u>-1283759375</u> | <u>-5135037500</u> | 0                | <u>1283759375</u>  | <u>-5135037500</u> |
|                  | 6145149            | 16129              |                  | 6145149            | 16129              |
| 0                | <u>5135037500</u>  | <u>41080300000</u> | 0                | <u>-5135037500</u> | <u>82160600000</u> |
|                  | 16129              | 127                |                  | 16129              | 127                |

[R Elemento 2

|                      |                   |                      |                      |                   |                      |
|----------------------|-------------------|----------------------|----------------------|-------------------|----------------------|
| <u>739445400000</u>  | 0                 | <u>739445400000</u>  | <u>-739445400000</u> | 0                 | <u>739445400000</u>  |
| 6118445789           |                   | 3345241              | 6118445789           |                   | 3345241              |
| 0                    | <u>231200000</u>  | 0                    | 0                    | <u>-231200000</u> | 0                    |
|                      | 1829              |                      |                      | 1829              |                      |
| <u>739445400000</u>  | 0                 | <u>985927200000</u>  | <u>-739445400000</u> | 0                 | <u>492963600000</u>  |
| 3345241              |                   | 1829                 | 3345241              |                   | 1829                 |
| <u>-739445400000</u> | 0                 | <u>-739445400000</u> | <u>739445400000</u>  | 0                 | <u>-739445400000</u> |
| 6118445789           |                   | 3345241              | 6118445789           |                   | 3345241              |
| 0                    | <u>-231200000</u> | 0                    | 0                    | <u>231200000</u>  | 0                    |
|                      | 1829              |                      |                      | 1829              |                      |
| <u>739445400000</u>  | 0                 | <u>492963600000</u>  | <u>-739445400000</u> | 0                 | <u>985927200000</u>  |
| 3345241              |                   | 1829                 | 3345241              |                   | 1829                 |

[R Ensamble

|                  |                    |                    |                           |                         |                        |
|------------------|--------------------|--------------------|---------------------------|-------------------------|------------------------|
| <u>57800000</u>  | 0                  | 0                  | <u>-57800000</u>          | 0                       | 0                      |
| 381              |                    |                    | 381                       |                         |                        |
| 0                | <u>1283759375</u>  | <u>5135037500</u>  | 0                         | <u>-1283759375</u>      | <u>5135037500</u>      |
|                  | 6145149            | 16129              |                           | 6145149                 | 16129                  |
| 0                | <u>5135037500</u>  | <u>82160600000</u> | 0                         | <u>-5135037500</u>      | <u>41080300000</u>     |
|                  | 16129              | 127                |                           | 16129                   | 127                    |
| <u>-57800000</u> | 0                  | 0                  | <u>353927895301600000</u> | 0                       | <u>739445400000</u>    |
| 381              |                    |                    | 2331127845609             |                         | 3345241                |
| 0                | <u>-1283759375</u> | <u>-5135037500</u> | 0                         | <u>1423106444696875</u> | <u>-5135037500</u>     |
|                  | 6145149            | 16129              |                           | 11239477521             | 16129                  |
| 0                | <u>5135037500</u>  | <u>41080300000</u> | <u>739445400000</u>       | <u>-5135037500</u>      | <u>275484491800000</u> |
|                  | 16129              | 127                | 3345241                   | 16129                   | 232283                 |
| 0                | 0                  | 0                  | <u>-739445400000</u>      | 0                       | <u>-739445400000</u>   |
|                  |                    |                    | 6118445789                |                         | 3345241                |
| 0                | 0                  | 0                  | 0                         | <u>-231200000</u>       | 0                      |
|                  |                    |                    |                           | 1829                    |                        |
| 0                | 0                  | 0                  | <u>739445400000</u>       | 0                       | <u>492963600000</u>    |
|                  |                    |                    | 3345241                   |                         | 1829                   |

conocidos

GDL[7 8 9]

valor GDL[0 0 0]

conocidos

GDL[1 2 3 4 5 6]

valor F[-6000 -6000 0 0 0 0]

AA (Q con)

|                  |                    |                    |                           |                         |                        |
|------------------|--------------------|--------------------|---------------------------|-------------------------|------------------------|
| <u>57800000</u>  | 0                  | 0                  | <u>-57800000</u>          | 0                       | 0                      |
| 381              |                    |                    | 381                       |                         |                        |
| 0                | <u>1283759375</u>  | <u>5135037500</u>  | 0                         | <u>-1283759375</u>      | <u>5135037500</u>      |
|                  | 6145149            | 16129              |                           | 6145149                 | 16129                  |
| 0                | <u>5135037500</u>  | <u>82160600000</u> | 0                         | <u>-5135037500</u>      | <u>41080300000</u>     |
|                  | 16129              | 127                |                           | 16129                   | 127                    |
| <u>-57800000</u> | 0                  | 0                  | <u>353927895301600000</u> | 0                       | <u>739445400000</u>    |
| 381              |                    |                    | 2331127845609             |                         | 3345241                |
| 0                | <u>-1283759375</u> | <u>-5135037500</u> | 0                         | <u>1423106444696875</u> | <u>-5135037500</u>     |
|                  | 6145149            | 16129              |                           | 11239477521             | 16129                  |
| 0                | <u>5135037500</u>  | <u>41080300000</u> | <u>739445400000</u>       | <u>-5135037500</u>      | <u>275484491800000</u> |
|                  | 16129              | 127                | 3345241                   | 16129                   | 232283                 |

AB (Q desco)

$$\begin{array}{r}
 0 \\
 0 \\
 0 \\
 \hline
 -739445400000 \\
 6118445789 \\
 0 \\
 \hline
 -739445400000 \\
 3345241
 \end{array}
 \begin{array}{r}
 0 \\
 0 \\
 0 \\
 0 \\
 \hline
 -231200000 \\
 1829 \\
 0
 \end{array}
 \begin{array}{r}
 0 \\
 0 \\
 0 \\
 \hline
 739445400000 \\
 3345241 \\
 0 \\
 \hline
 492963600000 \\
 1829
 \end{array}
 \Bigg]$$

desconocidos

$$\begin{array}{r}
 -15914519366027 \\
 \hline
 35616620100 \\
 -36887595754557 \\
 \hline
 47488826800 \\
 11242609 \\
 \hline
 41080300 \\
 -2753133343 \\
 \hline
 6162045 \\
 -5487 \\
 \hline
 115600 \\
 8920033 \\
 \hline
 41080300
 \end{array}
 \Bigg]$$

solution

$$\begin{array}{r}
 -15914519366027 \\
 \hline
 35616620100
 \end{array}
 \begin{array}{r}
 -36887595754557 \\
 \hline
 47488826800
 \end{array}
 \begin{array}{r}
 11242609 \\
 \hline
 41080300
 \end{array}
 \begin{array}{r}
 -2753133343 \\
 \hline
 6162045
 \end{array}
 \begin{array}{r}
 -5487 \\
 \hline
 115600
 \end{array}
 \begin{array}{r}
 8920033 \\
 \hline
 41080300
 \end{array}
 \begin{array}{r}
 0 \\
 0 \\
 0
 \end{array}
 \Bigg]$$

ext nodos

$$\begin{array}{r}
 -6000 \quad -6000 \quad 0 \quad 0 \quad 0 \quad 0 \quad 6000 \quad 6000 \quad -40236000
 \end{array}
 \Bigg]$$

Done



```

Define LibPub vif()=
Prgm
©
©Elemento Viga
©Creador Ivan Fernandez Gracia
©Universidad de Santiago de Chile
©Ingenieria Civil Mecanica
©-----
©Sistema de Unidades SI
©-----
©L[mm]
©Modulo E[MPa]
©Inercia[mm4]
©Area[mm2]
©Torque[N·mm]
©Fuerza[N]
©-----
©Sistema de Unidades EG
©-----
©L[in]
©Modulo E[psi]
©Inercia[in4]
©Area[in2]
©Torque[lb·in]
©Fuerza[lb]
©-----
ClearAZ
©-----
©Definir variables
©-----
Local n,b,i,ni,nf,nn,nii,nff,j,h,hh,gdl1,gdl2
Local le,c,s
Local xn,yn
Local area,eyoung,largox,sigmaf
Local iner
Local ii,jj,cont,cont2
©-----
©Entrada de datos
©-----
Request "Numero Nodos",n,0
Request "Numero Vigas/Barras",b,0
Request "Q Conocidos",desp,0
Request "F o M Conocidas",load,0
nn:=n·3
©-----
©Crear memoria matrices
©-----
newMat(n,2)→nodos
newMat(b,2)→datosn
newMat(b,5)→datos
newMat(nn,nn)→mrk
newMat(6,6)→kb
newList(6)→gdl

```

```

newMat(desp,1)→mdesp1
newMat(desp,1)→mdesp2
newMat(load,1)→mload1
newMat(load,1)→mload2
newMat(nn-desp,nn-desp)→kprim
newMat(nn-desp,desp)→kab
newMat(nn,1)→ff
newMat(nn-desp,1)→fa
newMat(nn-desp,1)→qqprima
newMat(nn-desp,1)→ffprimagauss1
newMat(nn,1)→qq
©-----
©Coordenadas Nodos
©-----
For i,1,n
Request "(x)Pos Nodo",xn,0
Request "(y)Pos Nodo",yn,0
nodos[i,1]:=xn
nodos[i,2]:=yn
EndFor
Disp "Nodos(x,y)"
Disp ["x",nodos'
      "y"]
©-----
©Matriz conectividad y Datos
©-----
©Datos carac :Area,E,L,sigmaf
©-----
For i,1,b
Request "Nodo ni/1",nii,0
Request "Nodo nf/2",nff,0
Request "Area",area,0
Request "E",eyoung,0
Request "Inercia",iner,0
datosn[i,1]:=nii
datosn[i,2]:=nff
datos[i,1]:=area
datos[i,2]:=eyoung
©datos[i,3]:=largox
©datos[i,4]:=sigmaf
datos[i,5]:=iner
EndFor
Disp "Conectividad(xi,xf)"
Disp ["ni",
      "nf"],(subMat(datosn,1,1,b,2))'
Disp "Datos (Area,E,Iner)"
Disp ["Area",
      "E"],(subMat(datos,1,1,b,2))'
Disp ["Inercia"],(subMat(datos,1,5,b,5))'
©-----
©Creacion Matriz Kb y Mrk
©-----
For i,1,b
nii:=datosn[i,1]
nff:=datosn[i,2]

```



$$le := \sqrt{(nodos[nff,1] - nodos[nii,1])^2 + (nodos[nff,2] - nodos[nii,2])^2}$$

$$c := \frac{nodos[nff,1] - nodos[nii,1]}{le}$$

$$s := \frac{nodos[nff,2] - nodos[nii,2]}{le}$$

$$\begin{bmatrix} c & -s & 0 & 0 & 0 & 0 \\ s & c & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & c & -s & 0 \\ 0 & 0 & 0 & s & c & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} \frac{datos[i,2] \cdot datos[i,1]}{le} & 0 & 0 & \frac{-datos[i,2] \cdot datos[i,1]}{le} \\ 0 & \frac{12 \cdot datos[i,2] \cdot datos[i,5]}{le^3} & \frac{6 \cdot datos[i,2] \cdot datos[i,5]}{le^2} & 0 \\ 0 & \frac{6 \cdot datos[i,2] \cdot datos[i,5]}{le^2} & \frac{4 \cdot datos[i,2] \cdot datos[i,5]}{le^1} & 0 \\ \frac{-datos[i,2] \cdot datos[i,1]}{le} & 0 & 0 & \frac{datos[i,2] \cdot datos[i,1]}{le} \\ 0 & \frac{-12 \cdot datos[i,2] \cdot datos[i,5]}{le^3} & \frac{-6 \cdot datos[i,2] \cdot datos[i,5]}{le^2} & 0 \\ 0 & \frac{6 \cdot datos[i,2] \cdot datos[i,5]}{le^2} & \frac{2 \cdot datos[i,2] \cdot datos[i,5]}{le^1} & 0 \end{bmatrix}$$

Disp "MR Elemento",i

Disp kb

gdl[1]:=3·nii-2

gdl[2]:=3·nii-1

gdl[3]:=3·nii

gdl[4]:=3·nff-2

gdl[5]:=3·nff-1

gdl[6]:=3·nff

For hh,1,6

For j,1,6

gdl1:=gdl[hh]

gdl2:=gdl[j]

mrk[gdl1,gdl2]:=kb[hh,j]+mrk[gdl1,gdl2]

EndFor

EndFor

EndFor

Disp "MR Ensamble"

Disp mrk

©-----

©Cond.Despla.Q

©-----

For i,1,desp

Request "Q GDL",mdesp1[i,1],0

Request "Valor Q",mdesp2[i,1],0

EndFor

Disp "Q conocidos"

Disp "Q GDL",mdesp1'

Disp "Valor GDL",mdesp2'

©-----

©Cond.Despla.F

©-----

For i,1,load

Request "F GDL",mload1[i,1],0

Request "Valor F",mload2[i,1],0

```

EndFor
Disp "F conocidos"
Disp "F GDL",mload1'
Disp "Valor F",mload2'
©-----
©Kaa (Q conocidos)
©-----
i:=1
j:=1
ii:=1
jj:=1
While j≤nn
  cont:=0
  For h,1,desp
    If mdesp1[h,1]=i or mdesp1[h,1]=j Then
      cont:=cont+1
      If i=j Then
        cont:=cont+1
      EndIf
    EndIf
  EndFor
  If cont=0 Then
    kprim[ii,jj]:=mrk[i,j]
    jj:=jj+1
    If jj>nn-desp Then
      ii:=ii+1
      jj:=1
    EndIf
  EndIf
  j:=j+1
  If j=nn+1 Then
    j:=1
    i:=i+1
  EndIf
  If i=nn+1 Then
    j:=nn+1
  EndIf
EndWhile
Disp "KAA (Q con)"
Disp kprim
©-----
©Kab (Q desconocidos)
©-----
i:=1
j:=1
ii:=1
jj:=1
While j≤nn
  cont:=0
  For h,1,desp
    If mdesp1[h,1]=i or mdesp1[h,1]=j Then
      cont:=cont+1
      If i=j Then
        cont:=cont+1
      EndIf
    EndIf
  EndFor

```

```

EndFor
cont2:=0
For h,1,desp
  If mdesp1[h,1]=i Then
    cont2:=cont2+1
  EndIf
EndFor
If cont=1 and cont2=0 Then
  kab[ii,jj]:=mrk[i,j]
  jj:=jj+1
  If jj>desp Then
    ii:=ii+1
    jj:=1
  EndIf
EndIf
j:=j+1
If j=nn+1 Then
  j:=1
  i:=i+1
EndIf
If i=nn+1 Then
  j:=nn+1
EndIf
EndWhile
Disp "KAB (Q desco)"
Disp kab
©-----
©Matrix Fext
©-----
For i,1,nn
  ff[i,1]:=0
EndFor
For i,1,load
  ff[mload1[i,1],1]:=mload2[i,1]
EndFor
©-----
©M Fext conocidas
©-----
For i,1,nn-desp
  fa[i,1]:=0
EndFor
ii:=1
For i,1,nn
  cont2:=0
  For h,1,desp
    If mdesp1[h,1]=i Then
      cont2:=cont2+1
    EndIf
  EndFor
  If cont2=0 Then
    fa[ii,1]:=ff[i,1]
    ii:=ii+1
  EndIf
EndFor
©-----
©Solucionar Q desconocidos

```



```

©-----
ffprimagauss1:=kab·mdesp2
For i,1,nn-desp
ffprimagauss1[i,1]:=fa[i,1]-ffprimagauss1[i,1]
EndFor
For i,1,nn-desp
If kprim[i,i]=0 Then
kprim[i,i]:=1.E-7
EndIf
EndFor

qqprima:=kprim-1·ffprimagauss1
Disp "Q desconocidos"
Disp qqprima
©-----
©Crear M.Q.desp
©-----
For i,1,nn
qq[i,1]:=0
EndFor
For i,1,desp
qq[mdesp1[i,1],1]:=mdesp2[i,1]
EndFor
ii:=1
For i,1,nn
cont:=0
For h,1,desp
If mdesp1[h,1]=i Then
cont:=cont+1
EndIf
EndFor
If cont=0 Then
qq[i,1]:=qqprima[ii,1]
ii:=ii+1
EndIf
EndFor
Disp "Q solution"
Disp qqT
©-----
©Solucion Fext FF
©-----
mrk·qq→ff
Disp "Fext nodos"
Disp ffT
EndPrgm

```