Appendix A

Immediate losses

```
'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

'           - PRESTRESSING LOSSES COMPUTATION -

'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

'DESCRIPTION. This script is used to compute the
prestressing losses for each tendon of the GiD geometry.
The calculation is done in the sheet "Tratamiento de
datos" where columns A to C have the information
obtained with GiD macro "?????" that computes the
coordinates X (=A), Y (=B) and Z (=C) of each node of
the prestressing system. In addition an input base data
is prepared in a sheet called "Datos de Partida" that
must be modified by the user. For the purpose of the
Benchmark, the initial parameters are:

'DATOS PARA EL CÁLCULO DE LAS CURVAS

'   Tensión antes de PC 1488    Mpa
'   PC  8   mm
'   Área de cable   139 mm2
'   Nº de cables    4
'   E acero 190000  MPa
'   Threshold PC    845.12  kNm
'   Tendones Verticales
'   Coeficiente de rozamiento en curva  0.16
'   Coeficiente de rozamiento parástio  0.0008
'   Tendones Horizontales
'   Coeficiente de rozamiento en curva  0.17
'   Coeficiente de rozamiento parástio  0.0015
'   Tendones Gamma - Tramo vertical
'   Coeficiente de rozamiento en curva  0.16
'   Coeficiente de rozamiento parástio  0.0008
'   Tendones Gamma - Tramo cúpula
'   Coeficiente de rozamiento en curva  0.16
'   Coeficiente de rozamiento parástio  0.0015
'   Tendones Cúpula
'   Coeficiente de rozamiento en curva  0.16
'   Coeficiente de rozamiento parástio  0.0015

'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Sub main()
'The 'main' procedure calls the other procedures of this
VBA module

id_node
Length
angle
Acumulated_Longitude
Initial_stress
Initial_force
Id_prestressing
Force_after_friction_losses
Intersection_1
Wedge_losses
Intersection_2
Forces_After_WedgeLosses
```

```
TendonForceAfterInsLosses
Stress_distribution
uniform_stress_distribution
family_main_stress
End Sub

'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Sub id_node()
'This procedure writes the ID of each node of the lines
that compose the tendons

Dim i As Long

'Column E of the spreadsheet is used
Worksheets("Tratamiento de datos").Activate
Worksheets("Tratamiento de datos").Columns("E:E").Select
Selection.ClearContents
i = 1
Worksheets("Tratamiento de datos").Cells(i, "E") =
"ID_node"

i = i + 1
Do While Worksheets("Tratamiento de datos").Cells(i, "A")
 <> ""
    If WorksheetFunction.And(Worksheets("Tratamiento de
    datos").Cells(i, "A") <> "X", Worksheets(
    "Tratamiento de datos").Cells(i, "A") <> "GROUP:",
    Worksheets("Tratamiento de datos").Cells(i, "A") <>
    "LINE:", Worksheets("Tratamiento de datos").Cells(i,
    "A") <> "END") Then
        If Worksheets("Tratamiento de datos").Cells(i - 1
        , "E") = "" Then
            Worksheets("Tratamiento de datos").Cells(i,
            "E") = 1
        Else
            Worksheets("Tratamiento de datos").Cells(i,
            "E") = Worksheets("Tratamiento de datos").
            Cells(i - 1, "E") + 1
        End If
    End If
    i = i + 1
Loop
End Sub

'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Sub Length()
'This procedure computes the distance between the nodes
of a tendon

Dim i As Long

'Column F of the spreadsheet is used
Worksheets("Tratamiento de datos").Activate
Worksheets("Tratamiento de datos").Columns("F:F").Select
Selection.ClearContents
i = 1
Worksheets("Tratamiento de datos").Cells(i, "F") =
"Length [m]"

```

```
i = i + 1
Do While Worksheets("Tratamiento de datos").Cells(i, "A") <> ""
    If Worksheets("Tratamiento de datos").Cells(i, "E") = "" Then
    ElseIf Worksheets("Tratamiento de datos").Cells(i, "E") = 1 Then
        Worksheets("Tratamiento de datos").Cells(i, "F") = 0
    Else
        Worksheets("Tratamiento de datos").Cells(i, "F") = Sqr((Worksheets("Tratamiento de datos").Cells(i - 1, "A") - Worksheets("Tratamiento de datos").Cells(i, "A")) ^ 2 + (Worksheets("Tratamiento de datos").Cells(i - 1, "B") - Worksheets("Tratamiento de datos").Cells(i, "B")) ^ 2 + (Worksheets("Tratamiento de datos").Cells(i - 1, "C") - Worksheets("Tratamiento de datos").Cells(i, "C")) ^ 2)
    End If
    i = i + 1
Loop
End Sub

'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Sub angle()
'This procedure computes the angle between the two lines that converge in a tendon node

Dim i As Long

'Column F of the spreadsheet is used
Worksheets("Tratamiento de datos").Activate
Worksheets("Tratamiento de datos").Columns("G:G").Select
Selection.ClearContents
i = 1
Worksheets("Tratamiento de datos").Cells(i, "G") = "Angle [º]"

i = i + 1
Do While Worksheets("Tratamiento de datos").Cells(i, "A") <> ""
    If Worksheets("Tratamiento de datos").Cells(i, "E") = "" Then
    ElseIf Worksheets("Tratamiento de datos").Cells(i, "E") = 1 Then
        Worksheets("Tratamiento de datos").Cells(i, "G") = 0
    ElseIf Worksheets("Tratamiento de datos").Cells(i, "E") = 2 Then
        Worksheets("Tratamiento de datos").Cells(i, "G") = 0
    Else
        If ((Worksheets("Tratamiento de datos").Cells(i - 1, "A") - Worksheets("Tratamiento de datos").Cells(i - 2, "A")) * (Worksheets("Tratamiento de datos").Cells(i, "A") - Worksheets("Tratamiento de datos").Cells(i - 1, "A")) + (Worksheets("Tratamiento de datos").Cells(i - 1, "B") - Worksheets("Tratamiento de datos").Cells(i - 2,
```

```
                "B")) * (Worksheets("Tratamiento de datos").Cells
                (i, "B") - Worksheets("Tratamiento de datos").
                Cells(i - 1, "B")) + (Worksheets("Tratamiento de
                datos").Cells(i - 1, "C") - Worksheets(
                "Tratamiento de datos").Cells(i - 2, "C")) * (
                Worksheets("Tratamiento de datos").Cells(i, "C")
                - Worksheets("Tratamiento de datos").Cells(i - 1,
                 "C"))) / (Worksheets("Tratamiento de datos").
                Cells(i, "F") * Worksheets("Tratamiento de datos"
                ).Cells(i - 1, "F")) >= 1 Then 'este >= está
                puesto porque el cálculo lleva consigo un error
                numérico que hace que se parase el cálculo al no
                estar definida la función ACOS para valores
                mayores de 1. En cualquier caso, se ha
                comprobado manualmente aquellos valores
                problemáticos y, efectivamente, es un error
                numérico que queda solventado con esto.
                    Worksheets("Tratamiento de datos").Cells(i,
                    "G") = 0
                Else
                    Worksheets("Tratamiento de datos").Cells(i,
                    "G") = 180 / WorksheetFunction.Pi() *
                    WorksheetFunction.Acos(((Worksheets(
                    "Tratamiento de datos").Cells(i - 1, "A") -
                    Worksheets("Tratamiento de datos").Cells(i -
                    2, "A")) * (Worksheets("Tratamiento de datos"
                    ).Cells(i, "A") - Worksheets("Tratamiento de
                    datos").Cells(i - 1, "A")) + (Worksheets(
                    "Tratamiento de datos").Cells(i - 1, "B") -
                    Worksheets("Tratamiento de datos").Cells(i -
                    2, "B")) * (Worksheets("Tratamiento de datos"
                    ).Cells(i, "B") - Worksheets("Tratamiento de
                    datos").Cells(i - 1, "B")) + (Worksheets(
                    "Tratamiento de datos").Cells(i - 1, "C") -
                    Worksheets("Tratamiento de datos").Cells(i -
                    2, "C")) * (Worksheets("Tratamiento de datos"
                    ).Cells(i, "C") - Worksheets("Tratamiento de
                    datos").Cells(i - 1, "C"))) / (Worksheets(
                    "Tratamiento de datos").Cells(i, "F") *
                    Worksheets("Tratamiento de datos").Cells(i -
                    1, "F")))
                End If
            End If
            i = i + 1
        Loop
        End Sub

        '%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

        Sub Acumulated_Longitude()
        'This procedure calculates the accumulated tendon length
        from each extreme (A and B), which is needed for
        computing the prestressing losses

        Dim i As Long

        'Columns H and I the spreadsheet are used
        Worksheets("Tratamiento de datos").Activate
        Worksheets("Tratamiento de datos").Columns("H:I").Select
        Selection.ClearContents
        i = 1
```

```
Worksheets("Tratamiento de datos").Cells(i, "H") = "Acumulated_Longitude_A"
Worksheets("Tratamiento de datos").Cells(i, "I") = "Acumulated_Longitude_B"

i = i + 1
Do While Worksheets("Tratamiento de datos").Cells(i, "A") <> ""
    If Worksheets("Tratamiento de datos").Cells(i, "F") = "" Then
    Else
        Worksheets("Tratamiento de datos").Cells(i, "H") = Worksheets("Tratamiento de datos").Cells(i, "F") + Worksheets("Tratamiento de datos").Cells(i - 1, "H")
    End If
    i = i + 1
Loop

Do While i > 1
    If Worksheets("Tratamiento de datos").Cells(i, "F") = "" Then
    Else
        If Worksheets("Tratamiento de datos").Cells(i + 1, "F") = "" Then
            Worksheets("Tratamiento de datos").Cells(i, "I") = 0
        Else
        Worksheets("Tratamiento de datos").Cells(i, "I") = Worksheets("Tratamiento de datos").Cells(i + 1, "F") + Worksheets("Tratamiento de datos").Cells(i + 1, "I")
        End If
    End If
    i = i - 1
Loop
End Sub

'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Sub Initial_stress()
'This procedure shows an initial uniform distributed stress state at each tendon considering NO losses

Dim i As Long

'Column J of the spreadsheet is used
Worksheets("Tratamiento de datos").Activate
Worksheets("Tratamiento de datos").Columns("J:J").Select
Selection.ClearContents
i = 1
Worksheets("Tratamiento de datos").Cells(i, "J") = "Initial_stress [MPa]"

i = i + 1
Do While Worksheets("Tratamiento de datos").Cells(i, "A") <> ""
    If Worksheets("Tratamiento de datos").Cells(i, "H") = "" Then
    Else
        Worksheets("Tratamiento de datos").Cells(i, "J")
```

```
            = Worksheets("Datos de Partida").Cells(5, "B")
199         End If
200         i = i + 1
201     Loop
202     End Sub
203
204     '%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
205
206     Sub Initial_force()
207     'This procedure computes the initial force considering
        that any prestressing loss takes place
208
209     Dim i As Long
210
211     'Column K of the spreadsheet is used
212     Worksheets("Tratamiento de datos").Activate
213     Worksheets("Tratamiento de datos").Columns("K:K").Select
214     Selection.ClearContents
215     i = 1
216     Worksheets("Tratamiento de datos").Cells(i, "K") =
        "Initial_force [kN]"
217
218     i = i + 1
219     Do While Worksheets("Tratamiento de datos").Cells(i, "A")
         <> ""
220         If Worksheets("Tratamiento de datos").Cells(i, "J") =
             "" Then
221         Else
222             Worksheets("Tratamiento de datos").Cells(i, "K")
                = Worksheets("Tratamiento de datos").Cells(i, "J"
                ) * Worksheets("Datos de Partida").Cells(7, "B")
                * Worksheets("Datos de Partida").Cells(8, "B") /
                1000
223         End If
224         i = i + 1
225     Loop
226     End Sub
227
228     '%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
229
230     Sub Id_prestressing()
231     'This script identify which tendon has one active end
        (=1) and which has both ends actives (=2). For the
        original purpose of ths script, only VERTICAL TENDONS
        have the ID = 1 and only the lower end was prestressed.
        For them a second ID is used: A or B, where A indicates
        that the tendon has been drawn in GiD from the bottom to
        the top and B indicates that the tendon has been drawn
        from the top to the bottom. This second is essential in
        order to define the direction in which prestressing
        losses take place.
232
233     Dim i As Long
234
235     'Column L of the spreadsheet is used
236     Worksheets("Tratamiento de datos").Activate
237     Worksheets("Tratamiento de datos").Columns("L:L").Select
238     Selection.ClearContents
239     i = 1
240     Worksheets("Tratamiento de datos").Cells(i, "L") =
        "ID_prestressing (1//2 & A//B)"
```

```

i = i + 1
Do While Worksheets("Tratamiento de datos").Cells(i, "A") <> ""
    If InStr(Worksheets("Tratamiento de datos").Cells(i, "C"), "C") <> 0 Then
        Worksheets("Tratamiento de datos").Cells(i, "L") = 2
    ElseIf InStr(Worksheets("Tratamiento de datos").Cells(i, "C"), "G") <> 0 Then
        Worksheets("Tratamiento de datos").Cells(i, "L") = 2
    ElseIf InStr(Worksheets("Tratamiento de datos").Cells(i, "C"), "H") <> 0 Then
        Worksheets("Tratamiento de datos").Cells(i, "L") = 2
    ElseIf InStr(Worksheets("Tratamiento de datos").Cells(i, "C"), "V") <> 0 Then
        Worksheets("Tratamiento de datos").Cells(i, "L") = 1
        If Worksheets("Tratamiento de datos").Cells(i + 2, "C") < Worksheets("Tratamiento de datos").Cells(i + 3, "C") Then
            Worksheets("Tratamiento de datos").Cells(i + 1, "L") = "A"
        Else
            Worksheets("Tratamiento de datos").Cells(i + 1, "L") = "B"
        End If
    End If
    i = i + 1
Loop
End Sub

'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Sub Force_after_friction_losses()
'This procedure computes the distribution of forces in the tendon discounting the friction losses from both ends, if necessary.

Dim i, j, ID_tendon As Long
Dim f, fi As Double
Dim ID_bucle As Integer

'Column M and N of the spreadsheet are used
Worksheets("Tratamiento de datos").Activate
Worksheets("Tratamiento de datos").Columns("M:N").Select
Selection.ClearContents
i = 1
Worksheets("Tratamiento de datos").Cells(i, "M") = "Force_after_friction_losses A [kN]"
Worksheets("Tratamiento de datos").Cells(i, "N") = "Force_after_friction_losses B [kN]"

i = i + 1
Do While Worksheets("Tratamiento de datos").Cells(i, "A") <> ""
    If Worksheets("Tratamiento de datos").Cells(i, "K") = "" Then
        i = i + 1
```

```
283         Else
284             If Worksheets("Tratamiento de datos").Cells(i - 2
                , "L") = 2 Then
285                 ID_tendon = i - 2
286                 ID_bucle = 0
287                 If InStr(Worksheets("Tratamiento de datos").
                    Cells(ID_tendon, "C"), "C") <> 0 Then
288                     f = Worksheets("Datos de Partida").Cells(
                        24, "B")
289                     fi = Worksheets("Datos de Partida").Cells
                        (25, "B")
290                 ElseIf InStr(Worksheets("Tratamiento de
                    datos").Cells(ID_tendon, "C"), "G") <> 0 Then
291                     ID_bucle = 1
292                 ElseIf InStr(Worksheets("Tratamiento de
                    datos").Cells(ID_tendon, "C"), "H") <> 0 Then
293                     f = Worksheets("Datos de Partida").Cells(
                        15, "B")
294                     fi = Worksheets("Datos de Partida").Cells
                        (16, "B")
295                 ElseIf InStr(Worksheets("Tratamiento de
                    datos").Cells(ID_tendon, "C"), "V") <> 0 Then
296                     f = Worksheets("Datos de Partida").Cells(
                        12, "B")
297                     fi = Worksheets("Datos de Partida").Cells
                        (13, "B")
298                 End If
299                 Do While Worksheets("Tratamiento de datos").
                    Cells(i, "K") <> ""
300                     If ID_bucle = 1 Then
301                         If Worksheets("Tratamiento de datos"
                            ).Cells(i, "C") >= 15.667 Then
302                             f = Worksheets("Datos de Partida"
                                ).Cells(21, "B")
303                             fi = Worksheets("Datos de
                                Partida").Cells(22, "B")
304                         Else
305                             f = Worksheets("Datos de Partida"
                                ).Cells(18, "B")
306                             fi = Worksheets("Datos de
                                Partida").Cells(19, "B")
307                         End If
308                     Else
309                     End If
310                     If Worksheets("Tratamiento de datos").
                        Cells(i - 1, "M") = "" Then
311                         Worksheets("Tratamiento de datos").
                            Cells(i, "M") = Worksheets(
                            "Tratamiento de datos").Cells(i, "K")
312                     Else
313                         Worksheets("Tratamiento de datos").
                            Cells(i, "M") = Worksheets(
                            "Tratamiento de datos").Cells(i - 1,
                            "M") - Worksheets("Tratamiento de
                            datos").Cells(i - 1, "M") * (1 - Exp
                            (-(f * Worksheets("Tratamiento de
                            datos").Cells(i, "G") *
                            WorksheetFunction.Pi() / 180 + fi *
                            Worksheets("Tratamiento de datos").
                            Cells(i, "F"))))
314                     End If
```

```
315                 i = i + 1
316             Loop
317             j = i - 1
318             Do While Worksheets("Tratamiento de datos").
                Cells(j, "K") <> ""
319                 If ID_bucle = 1 Then
320                     If Worksheets("Tratamiento de datos"
                        ).Cells(j, "C") >= 15.667 Then
321                         f = Worksheets("Datos de Partida"
                            ).Cells(21, "B")
322                         fi = Worksheets("Datos de
                            Partida").Cells(22, "B")
323                     Else
324                         f = Worksheets("Datos de Partida"
                            ).Cells(18, "B")
325                         fi = Worksheets("Datos de
                            Partida").Cells(19, "B")
326                     End If
327                 Else
328                 End If
329                 If Worksheets("Tratamiento de datos").
                    Cells(j + 1, "N") = "" Then
330                     Worksheets("Tratamiento de datos").
                        Cells(j, "N") = Worksheets(
                        "Tratamiento de datos").Cells(j, "K")
331                 Else
332                     Worksheets("Tratamiento de datos").
                        Cells(j, "N") = Worksheets(
                        "Tratamiento de datos").Cells(j + 1,
                        "N") - Worksheets("Tratamiento de
                        datos").Cells(j + 1, "N") * (1 - Exp
                        (-(f * Worksheets("Tratamiento de
                        datos").Cells(j + 2, "G") *
                        WorksheetFunction.Pi() / 180 + fi *
                        Worksheets("Tratamiento de datos").
                        Cells(j + 1, "F"))))
333                 End If
334                 j = j - 1
335             Loop
336         ElseIf Worksheets("Tratamiento de datos").Cells(i
             - 2, "L") = 1 Then
337             f = Worksheets("Datos de Partida").Cells(12,
                "B") 'La única familia que se tesa desde un
                extremo es la de tendones verticales
338             fi = Worksheets("Datos de Partida").Cells(13,
                 "B") 'La única familia que se tesa desde un
                extremo es la de tendones verticales
339             If Worksheets("Tratamiento de datos").Cells(i
                 - 1, "L") = "A" Then
340                 Do While Worksheets("Tratamiento de
                    datos").Cells(i, "K") <> ""
341                     If Worksheets("Tratamiento de datos"
                        ).Cells(i - 1, "M") = "" Then
342                         Worksheets("Tratamiento de datos"
                            ).Cells(i, "M") = Worksheets(
                            "Tratamiento de datos").Cells(i,
                            "K")
343                     Else
344                         Worksheets("Tratamiento de datos"
                            ).Cells(i, "M") = Worksheets(
                            "Tratamiento de datos").Cells(i -
```

```
                                1, "M") - Worksheets(
                                "Tratamiento de datos").Cells(i -
                                1, "M") * (1 - Exp(-(f *
                                Worksheets("Tratamiento de datos"
                                ).Cells(i, "G") *
                                WorksheetFunction.Pi() / 180 + fi
                                * Worksheets("Tratamiento de
                                datos").Cells(i, "F"))))
                            End If
                            i = i + 1
                        Loop
                    ElseIf Worksheets("Tratamiento de datos").
                    Cells(i - 1, "L") = "B" Then
                        Do While Worksheets("Tratamiento de
                        datos").Cells(i, "K") <> ""
                            i = i + 1
                        Loop
                        j = i - 1
                        Do While Worksheets("Tratamiento de
                        datos").Cells(j, "K") <> ""
                            If Worksheets("Tratamiento de datos"
                            ).Cells(j + 1, "N") = "" Then
                                Worksheets("Tratamiento de datos"
                                ).Cells(j, "N") = Worksheets(
                                "Tratamiento de datos").Cells(j,
                                "K")
                            Else
                                Worksheets("Tratamiento de datos"
                                ).Cells(j, "N") = Worksheets(
                                "Tratamiento de datos").Cells(j +
                                1, "N") - Worksheets(
                                "Tratamiento de datos").Cells(j +
                                1, "N") * (1 - Exp(-(f *
                                Worksheets("Tratamiento de datos"
                                ).Cells(j + 2, "G") *
                                WorksheetFunction.Pi() / 180 + fi
                                * Worksheets("Tratamiento de
                                datos").Cells(j + 1, "F"))))
                            End If
                            j = j - 1
                        Loop
                    End If
                End If
            End If
Loop
End Sub

'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Sub Intersection_1()
'This procedure finds the intesection point between the
curves obtained after discounting the friction losses in
those tendons that have been prestressed in both ends. 4
columns are used which give information about the
location of this point and its magnitude.
'IMPORTANT ISSUE: a lineal force distribution is being
considered between the two closest points of the
intersection.

Dim i As Long

```

```
375   'Column O, P, W and R of the spreadsheet are used
376   Worksheets("Tratamiento de datos").Activate
377   Worksheets("Tratamiento de datos").Columns("O:R").Select
378   Selection.ClearContents
379   i = 1
380   Worksheets("Tratamiento de datos").Cells(i, "O") =
      "Intersection_1"
381   Worksheets("Tratamiento de datos").Cells(i, "P") =
      "Acumulated_Longitude_A [m]"
382   Worksheets("Tratamiento de datos").Cells(i, "Q") =
      "Acumulated_Longitude_B [m]"
383   Worksheets("Tratamiento de datos").Cells(i, "R") =
      "Force [kN]"
384
385   i = i + 1
386   Do While Worksheets("Tratamiento de datos").Cells(i, "A")
       <> ""
387       If Worksheets("Tratamiento de datos").Cells(i, "L") =
           "" Then
388           i = i + 1
389       ElseIf Worksheets("Tratamiento de datos").Cells(i,
          "L") = 1 Then
390           i = i + 2
391       Else
392           i = i + 1
393           Do While Worksheets("Tratamiento de datos").Cells
              (i, "L") = ""
394               If Worksheets("Tratamiento de datos").Cells(i
                   + 1, "M") >= Worksheets("Tratamiento de
                  datos").Cells(i + 1, "N") Then
395                   i = i + 1
396               Else
397                   Worksheets("Tratamiento de datos").Cells(
                      i, "O") = "INT1"
398                   Worksheets("Tratamiento de datos").Cells(
                      i + 1, "O") = "INT2"
399                   Worksheets("Tratamiento de datos").Cells(
                      i, "P") = ((Worksheets("Tratamiento de
                      datos").Cells(i, "M") - Worksheets(
                      "Tratamiento de datos").Cells(i, "N")) *
                      (Worksheets("Tratamiento de datos").Cells
                      (i + 1, "H") - Worksheets("Tratamiento
                      de datos").Cells(i, "H")) / ((Worksheets(
                      "Tratamiento de datos").Cells(i, "M") -
                      Worksheets("Tratamiento de datos").Cells(
                      i, "N")) - (Worksheets("Tratamiento de
                      datos").Cells(i + 1, "M") - Worksheets(
                      "Tratamiento de datos").Cells(i + 1, "N"
                      )))) + Worksheets("Tratamiento de datos"
                      ).Cells(i, "H")
400                   Worksheets("Tratamiento de datos").Cells(
                      i + 1, "Q") = ((Worksheets("Tratamiento
                      de datos").Cells(i + 1, "N") - Worksheets
                      ("Tratamiento de datos").Cells(i + 1, "M"
                      )) * (Worksheets("Tratamiento de datos").
                      Cells(i, "I") - Worksheets("Tratamiento
                      de datos").Cells(i + 1, "I")) / ((
                      Worksheets("Tratamiento de datos").Cells(
                      i + 1, "N") - Worksheets("Tratamiento de
                      datos").Cells(i + 1, "M")) - (Worksheets(
                      "Tratamiento de datos").Cells(i, "N") -
```

```
                    Worksheets("Tratamiento de datos").Cells(
                    i, "M")))) + Worksheets("Tratamiento de
                    datos").Cells(i + 1, "I")
                    Worksheets("Tratamiento de datos").Cells(
                    i, "R") = (((Worksheets("Tratamiento de
                    datos").Cells(i + 1, "M") - Worksheets(
                    "Tratamiento de datos").Cells(i, "M")) *
                    (Worksheets("Tratamiento de datos").Cells
                    (i, "P") - Worksheets("Tratamiento de
                    datos").Cells(i, "H"))) / (Worksheets(
                    "Tratamiento de datos").Cells(i + 1, "H")
                     - Worksheets("Tratamiento de datos").
                    Cells(i, "H"))) + Worksheets(
                    "Tratamiento de datos").Cells(i, "M")
                    i = i + 1
                    Exit Do
                End If
            Loop
        End If
    Loop
    End Sub

    '%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

    Sub Wedge_losses()
    'This procedure computes the wedge losses  at the active
    tendon ends. This is done through an equilbrium of
    energies following the indications of EHE-08.

    Dim i As Long
    Dim A_tot As Double          'Constant value of the total
    area A_tot=a·Ep·Ap
    Dim A_i, A_j As Double       'Value to be compared at
    each point of the tendon

    'Columns S to T and Y to Z of the spreadsheet are used
    Worksheets("Tratamiento de datos").Activate
    Worksheets("Tratamiento de datos").Columns("S:T").Select
    Selection.ClearContents
    Worksheets("Tratamiento de datos").Activate
    Worksheets("Tratamiento de datos").Columns("Y:Z").Select
    Selection.ClearContents
    i = 1
    Worksheets("Tratamiento de datos").Cells(i, "S") =
    "A_i_A [kNm]"
    Worksheets("Tratamiento de datos").Cells(i, "T") =
    "A_tot [kNm]"
    Worksheets("Tratamiento de datos").Cells(i, "Y") =
    "A_i_B [kNm]"
    Worksheets("Tratamiento de datos").Cells(i, "Z") =
    "A_tot [kNm]"

    A_tot = Worksheets("Datos de Partida").Cells(6, "B") *
    Worksheets("Datos de Partida").Cells(7, "B") * Worksheets
    ("Datos de Partida").Cells(8, "B") * Worksheets("Datos
    de Partida").Cells(9, "B") * 10 ^ (-6)

    i = i + 1
    Do While Worksheets("Tratamiento de datos").Cells(i, "A")
     <> ""
        If Worksheets("Tratamiento de datos").Cells(i, "L") =
```

```
          "" Then
437           i = i + 1
438       ElseIf Worksheets("Tratamiento de datos").Cells(i,
          "L") = 2 Then
439           i = i + 1
440           Do While Worksheets("Tratamiento de datos").Cells
              (i, "L") = ""
441               If Worksheets("Tratamiento de datos").Cells(i
                  , "K") = "" Then
442                   If Worksheets("Tratamiento de datos").
                      Cells(i, "A") = "" Then
443                       Exit Do
444                   Else
445                   End If
446               Else
447                   A_i = 2 * (0.5 * Worksheets("Tratamiento
                      de datos").Cells(i - 1, "S") + (
                      Worksheets("Tratamiento de datos").Cells(
                      i - 1, "M") - Worksheets("Tratamiento de
                      datos").Cells(i, "M")) * Worksheets(
                      "Tratamiento de datos").Cells(i - 1, "H")
                       + 0.5 * (Worksheets("Tratamiento de
                      datos").Cells(i, "H") - Worksheets(
                      "Tratamiento de datos").Cells(i - 1, "H"
                      )) * (Worksheets("Tratamiento de datos").
                      Cells(i - 1, "M") - Worksheets(
                      "Tratamiento de datos").Cells(i, "M")))
448                   If Worksheets("Tratamiento de datos").
                      Cells(i - 1, "S") <= A_tot Then
449                       Worksheets("Tratamiento de datos").
                          Cells(i, "S") = A_i
450                       Worksheets("Tratamiento de datos").
                          Cells(i, "T") = A_tot
451                   Else
452                       Exit Do
453                   End If
454               End If
455               i = i + 1
456           Loop
457           j = i
458           Do While Worksheets("Tratamiento de datos").Cells
              (j + 3, "L") = ""
459               j = j + 1
460               If Worksheets("Tratamiento de datos").Cells(i
                  , "A") = "" Then
461                   Exit Do
462               Else
463               End If
464           Loop
465           Do While Worksheets("Tratamiento de datos").Cells
              (j, "L") = ""
466               If Worksheets("Tratamiento de datos").Cells(j
                  , "K") = "" Then
467                   If Worksheets("Tratamiento de datos").
                      Cells(i, "A") = "" Then
468                       Exit Do
469                   Else
470                   End If
471               Else
472                   A_j = 2 * (0.5 * Worksheets("Tratamiento
                      de datos").Cells(j + 1, "Y") + (
```

```
                    Worksheets("Tratamiento de datos").Cells(
                    j + 1, "N") - Worksheets("Tratamiento de
                    datos").Cells(j, "N")) * Worksheets(
                    "Tratamiento de datos").Cells(j + 1, "I")
                     + 0.5 * (Worksheets("Tratamiento de
                    datos").Cells(j, "I") - Worksheets(
                    "Tratamiento de datos").Cells(j + 1, "I"
                    )) * (Worksheets("Tratamiento de datos").
                    Cells(j + 1, "N") - Worksheets(
                    "Tratamiento de datos").Cells(j, "N")))
473                 If Worksheets("Tratamiento de datos").
                    Cells(j + 1, "Y") <= A_tot Then
474                     Worksheets("Tratamiento de datos").
                        Cells(j, "Y") = A_j
475                     Worksheets("Tratamiento de datos").
                        Cells(j, "Z") = A_tot
476                 Else
477                     Exit Do
478                 End If
479             End If
480             j = j - 1
481         Loop
482     ElseIf Worksheets("Tratamiento de datos").Cells(i,
        "L") = 1 Then
483         i = i + 1
484         If Worksheets("Tratamiento de datos").Cells(i,
            "L") = "A" Then
485             i = i + 1
486             Do While Worksheets("Tratamiento de datos").
                Cells(i + 1, "L") = ""
487                 If Worksheets("Tratamiento de datos").
                    Cells(i, "K") = "" Then
488                     If Worksheets("Tratamiento de datos"
                        ).Cells(i, "A") = "" Then
489                         Exit Do
490                     Else
491                     End If
492                 Else
493                     A_i = 2 * (0.5 * Worksheets(
                        "Tratamiento de datos").Cells(i - 1,
                        "S") + (Worksheets("Tratamiento de
                        datos").Cells(i - 1, "M") -
                        Worksheets("Tratamiento de datos").
                        Cells(i, "M")) * Worksheets(
                        "Tratamiento de datos").Cells(i - 1,
                        "H") + 0.5 * (Worksheets(
                        "Tratamiento de datos").Cells(i, "H")
                         - Worksheets("Tratamiento de datos"
                        ).Cells(i - 1, "H")) * (Worksheets(
                        "Tratamiento de datos").Cells(i - 1,
                        "M") - Worksheets("Tratamiento de
                        datos").Cells(i, "M")))
494                     If Worksheets("Tratamiento de datos"
                        ).Cells(i - 1, "S") <= A_tot Then
495                         Worksheets("Tratamiento de datos"
                            ).Cells(i, "S") = A_i
496                         Worksheets("Tratamiento de datos"
                            ).Cells(i, "T") = A_tot
497                     Else
498                         Exit Do
499                     End If
```

```
                End If
                i = i + 1
            Loop
        ElseIf Worksheets("Tratamiento de datos").Cells(i, "L") = "B" Then
            i = i + 1
            j = i
            Do While Worksheets("Tratamiento de datos").Cells(j + 3, "L") = ""
                j = j + 1
                If Worksheets("Tratamiento de datos").Cells(i, "A") = "" Then
                    Exit Do
                Else
                End If
            Loop
            Do While Worksheets("Tratamiento de datos").Cells(j, "L") = ""
                If Worksheets("Tratamiento de datos").Cells(j, "K") = "" Then
                    If Worksheets("Tratamiento de datos").Cells(i, "A") = "" Then
                        Exit Do
                    Else
                    End If
                Else
                    A_j = 2 * (0.5 * Worksheets("Tratamiento de datos").Cells(j + 1, "Y") + (Worksheets("Tratamiento de datos").Cells(j + 1, "N") - Worksheets("Tratamiento de datos").Cells(j, "N")) * Worksheets("Tratamiento de datos").Cells(j + 1, "I") + 0.5 * (Worksheets("Tratamiento de datos").Cells(j, "I") - Worksheets("Tratamiento de datos").Cells(j + 1, "I")) * (Worksheets("Tratamiento de datos").Cells(j + 1, "N") - Worksheets("Tratamiento de datos").Cells(j, "N")))
                    If Worksheets("Tratamiento de datos").Cells(j + 1, "Y") <= A_tot Then
                        Worksheets("Tratamiento de datos").Cells(j, "Y") = A_j
                        Worksheets("Tratamiento de datos").Cells(j, "Z") = A_tot
                    Else
                        Exit Do
                    End If
                End If
                j = j - 1
            Loop
        End If
    Else
    i = i + 1
    End If
Loop
End Sub

'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

```

```
539  Sub Intersection_2()
540  'This procedure finds the intersection points due to
     wedge losses with the line obtained after friction losses
541
542  Dim i, j As Long
543
544  'Columns U to X and AA to AD of the spreadsheet are used
545  Worksheets("Tratamiento de datos").Activate
546  Worksheets("Tratamiento de datos").Columns("U:X").Select
547  Selection.ClearContents
548  Worksheets("Tratamiento de datos").Activate
549  Worksheets("Tratamiento de datos").Columns("AA:AD").Select
550  Selection.ClearContents
551  i = 1
552  Worksheets("Tratamiento de datos").Cells(i, "U") =
     "Intersection_2"
553  Worksheets("Tratamiento de datos").Cells(i, "V") =
     "Acumulated_Longitude_A [m]"
554  Worksheets("Tratamiento de datos").Cells(i, "W") =
     "Force [kN]"
555  Worksheets("Tratamiento de datos").Cells(i, "AA") =
     "Intersection_2"
556  Worksheets("Tratamiento de datos").Cells(i, "AB") =
     "Acumulated_Longitude_B [m]"
557  Worksheets("Tratamiento de datos").Cells(i, "AC") =
     "Force [kN]"
558
559  i = i + 1
560  Do While Worksheets("Tratamiento de datos").Cells(i, "A")
      <> ""
561      If Worksheets("Tratamiento de datos").Cells(i, "L") =
          "" Then
562          i = i + 1
563      ElseIf Worksheets("Tratamiento de datos").Cells(i,
         "L") = 2 Then
564          If Worksheets("Tratamiento de datos").Cells(i,
             "S") = "" Then
565              Do While Worksheets("Tratamiento de datos").
                 Cells(i, "S") = ""
566                  i = i + 1
567                  If Worksheets("Tratamiento de datos").
                     Cells(i, "A") = "" Then
568                      Exit Do
569                  End If
570              Loop
571          End If
572          Do While Worksheets("Tratamiento de datos").Cells
             (i, "S") <> ""
573              If Worksheets("Tratamiento de datos").Cells(i
                  + 1, "S") = "" Then
574                  If Worksheets("Tratamiento de datos").
                     Cells(i, "S") > Worksheets("Tratamiento
                     de datos").Cells(i, "T") Then
575                      Worksheets("Tratamiento de datos").
                         Cells(i - 1, "U") = "INT1"
576                      Worksheets("Tratamiento de datos").
                         Cells(i, "U") = "INT2"
577                      Worksheets("Tratamiento de datos").
                         Cells(i - 1, "V") = -(((Worksheets(
                         "Tratamiento de datos").Cells(i - 1,
                         "S") - Worksheets("Tratamiento de
```

```
                    datos").Cells(i - 1, "T")) * (
                    Worksheets("Tratamiento de datos").
                    Cells(i, "H") - Worksheets(
                    "Tratamiento de datos").Cells(i - 1,
                    "H"))) / ((Worksheets("Tratamiento
                    de datos").Cells(i, "S") - Worksheets
                    ("Tratamiento de datos").Cells(i, "T"
                    )) - (Worksheets("Tratamiento de
                    datos").Cells(i - 1, "S") -
                    Worksheets("Tratamiento de datos").
                    Cells(i - 1, "T")))) + Worksheets(
                    "Tratamiento de datos").Cells(i - 1,
                    "H")
578                 Worksheets("Tratamiento de datos").
                    Cells(i - 1, "W") = Worksheets(
                    "Tratamiento de datos").Cells(i - 1,
                    "M") - (((Worksheets("Tratamiento de
                    datos").Cells(i - 1, "M") -
                    Worksheets("Tratamiento de datos").
                    Cells(i, "M")) * (Worksheets(
                    "Tratamiento de datos").Cells(i - 1,
                    "V") - Worksheets("Tratamiento de
                    datos").Cells(i - 1, "H"))) / (
                    Worksheets("Tratamiento de datos").
                    Cells(i, "H") - Worksheets(
                    "Tratamiento de datos").Cells(i - 1,
                    "H")))
579             Else
580                 Worksheets("Tratamiento de datos").
                    Cells(i, "U").Select
581                 With Selection.Interior
582                     .Pattern = xlSolid
583                     .PatternColorIndex = xlAutomatic
584                     .Color = 65535
585                     .TintAndShade = 0
586                     .PatternTintAndShade = 0
587                 End With
588                 Worksheets("Tratamiento de datos").
                    Cells(i, "U") = "LONGITUD
                    INSUFICIENTE"
589             End If
590         End If
591         i = i + 1
592         If Worksheets("Tratamiento de datos").Cells(i
            , "A") = "" Then
593             Exit Do
594         End If
595     Loop
596     Do While Worksheets("Tratamiento de datos").Cells
        (i + 1, "N") <> ""
597         i = i + 1
598         If Worksheets("Tratamiento de datos").Cells(i
            , "A") = "" Then
599             Exit Do
600         End If
601     Loop
602     j = i
603     Do While Worksheets("Tratamiento de datos").Cells
        (j, "Y") <> ""
604         If Worksheets("Tratamiento de datos").Cells(j
             - 1, "Y") = "" Then
```

```
605                     If Worksheets("Tratamiento de datos").
                        Cells(j, "Y") > Worksheets("Tratamiento
                        de datos").Cells(j, "Z") Then
606                         Worksheets("Tratamiento de datos").
                            Cells(j + 1, "AA") = "INT1"
607                         Worksheets("Tratamiento de datos").
                            Cells(j, "AA") = "INT2"
608                         Worksheets("Tratamiento de datos").
                            Cells(j + 1, "AB") = -(((Worksheets(
                            "Tratamiento de datos").Cells(j + 1,
                            "Y") - Worksheets("Tratamiento de
                            datos").Cells(j + 1, "Z")) * (
                            Worksheets("Tratamiento de datos").
                            Cells(j, "I") - Worksheets(
                            "Tratamiento de datos").Cells(j + 1,
                            "I"))) / ((Worksheets("Tratamiento
                            de datos").Cells(j, "Y") - Worksheets
                            ("Tratamiento de datos").Cells(j, "Z"
                            )) - (Worksheets("Tratamiento de
                            datos").Cells(j + 1, "Y") -
                            Worksheets("Tratamiento de datos").
                            Cells(j + 1, "Z")))) + Worksheets(
                            "Tratamiento de datos").Cells(j + 1,
                            "I")
609                         Worksheets("Tratamiento de datos").
                            Cells(j + 1, "AC") = Worksheets(
                            "Tratamiento de datos").Cells(j + 1,
                            "N") + (((Worksheets("Tratamiento de
                            datos").Cells(j, "N") - Worksheets(
                            "Tratamiento de datos").Cells(j + 1,
                            "N")) * (Worksheets("Tratamiento de
                            datos").Cells(j + 1, "AB") -
                            Worksheets("Tratamiento de datos").
                            Cells(j + 1, "I"))) / (Worksheets(
                            "Tratamiento de datos").Cells(j, "I")
                             - Worksheets("Tratamiento de datos"
                            ).Cells(j + 1, "I")))
610                     Else
611                         Worksheets("Tratamiento de datos").
                            Cells(j, "AA").Select
612                         With Selection.Interior
613                             .Pattern = xlSolid
614                             .PatternColorIndex = xlAutomatic
615                             .Color = 65535
616                             .TintAndShade = 0
617                             .PatternTintAndShade = 0
618                         End With
619                         Worksheets("Tratamiento de datos").
                            Cells(j, "AA") = "LONGITUD
                            INSUFICIENTE"
620                     End If
621                 End If
622                 j = j - 1
623                 If Worksheets("Tratamiento de datos").Cells(i
                    , "A") = "" Then
624                     Exit Do
625                 End If
626             Loop
627         ElseIf Worksheets("Tratamiento de datos").Cells(i,
            "L") = 1 Then
628             i = i + 1
```

```
629             If Worksheets("Tratamiento de datos").Cells(i,
                "L") = "A" Then
630                 If Worksheets("Tratamiento de datos").Cells(i
                    , "S") = "" Then
631                     Do While Worksheets("Tratamiento de
                        datos").Cells(i, "S") = ""
632                         i = i + 1
633                     If Worksheets("Tratamiento de datos").
                        Cells(i, "A") = "" Then
634                         Exit Do
635                     End If
636                     Loop
637                 End If
638                 Do While Worksheets("Tratamiento de datos").
                    Cells(i, "S") <> ""
639                     If Worksheets("Tratamiento de datos").
                        Cells(i + 1, "S") = "" Then
640                         If Worksheets("Tratamiento de datos"
                            ).Cells(i, "S") > Worksheets(
                            "Tratamiento de datos").Cells(i, "T")
                             Then
641                             Worksheets("Tratamiento de datos"
                                ).Cells(i - 1, "U") = "INT1"
642                             Worksheets("Tratamiento de datos"
                                ).Cells(i, "U") = "INT2"
643                             Worksheets("Tratamiento de datos"
                                ).Cells(i - 1, "V") = -(((
                                Worksheets("Tratamiento de datos"
                                ).Cells(i - 1, "S") - Worksheets(
                                "Tratamiento de datos").Cells(i -
                                 1, "T")) * (Worksheets(
                                "Tratamiento de datos").Cells(i,
                                "H") - Worksheets("Tratamiento
                                de datos").Cells(i - 1, "H"))) /
                                ((Worksheets("Tratamiento de
                                datos").Cells(i, "S") -
                                Worksheets("Tratamiento de datos"
                                ).Cells(i, "T")) - (Worksheets(
                                "Tratamiento de datos").Cells(i -
                                 1, "S") - Worksheets(
                                "Tratamiento de datos").Cells(i -
                                 1, "T")))) + Worksheets(
                                "Tratamiento de datos").Cells(i -
                                 1, "H")
644                             Worksheets("Tratamiento de datos"
                                ).Cells(i - 1, "W") = Worksheets(
                                "Tratamiento de datos").Cells(i -
                                 1, "M") - (((Worksheets(
                                "Tratamiento de datos").Cells(i -
                                 1, "M") - Worksheets(
                                "Tratamiento de datos").Cells(i,
                                "M")) * (Worksheets("Tratamiento
                                de datos").Cells(i - 1, "V") -
                                Worksheets("Tratamiento de datos"
                                ).Cells(i - 1, "H"))) / (
                                Worksheets("Tratamiento de datos"
                                ).Cells(i, "H") - Worksheets(
                                "Tratamiento de datos").Cells(i -
                                 1, "H")))
645                         Else
646                             Worksheets("Tratamiento de datos"
```

```
                        ).Cells(i, "U").Select
647                     With Selection.Interior
648                         .Pattern = xlSolid
649                         .PatternColorIndex =
                            xlAutomatic
650                         .Color = 65535
651                         .TintAndShade = 0
652                         .PatternTintAndShade = 0
653                     End With
654                     Worksheets("Tratamiento de datos"
                        ).Cells(i, "U") = "LONGITUD
                        INSUFICIENTE"
655                 End If
656             End If
657             i = i + 1
658             If Worksheets("Tratamiento de datos").
                Cells(i, "A") = "" Then
659                 Exit Do
660             End If
661         Loop
662     ElseIf Worksheets("Tratamiento de datos").Cells(i
        , "L") = "B" Then
663         If Worksheets("Tratamiento de datos").Cells(i
            , "N") = "" Then
664             Do While Worksheets("Tratamiento de
                datos").Cells(i, "N") = ""
665                 i = i + 1
666                 If Worksheets("Tratamiento de datos"
                    ).Cells(i, "A") = "" Then
667                     Exit Do
668                 End If
669             Loop
670         End If
671         Do While Worksheets("Tratamiento de datos").
            Cells(i + 1, "N") <> ""
672             i = i + 1
673             If Worksheets("Tratamiento de datos").
                Cells(i, "A") = "" Then
674                 Exit Do
675             End If
676         Loop
677         j = i
678         Do While Worksheets("Tratamiento de datos").
            Cells(j, "Y") <> ""
679             If Worksheets("Tratamiento de datos").
                Cells(j - 1, "Y") = "" Then
680                 If Worksheets("Tratamiento de datos"
                    ).Cells(j, "Y") > Worksheets(
                    "Tratamiento de datos").Cells(j, "Z")
                     Then
681                     Worksheets("Tratamiento de datos"
                        ).Cells(j + 1, "AA") = "INT1"
682                     Worksheets("Tratamiento de datos"
                        ).Cells(j, "AA") = "INT2"
683                     Worksheets("Tratamiento de datos"
                        ).Cells(j + 1, "AB") = -(((
                        Worksheets("Tratamiento de datos"
                        ).Cells(j + 1, "Y") - Worksheets(
                        "Tratamiento de datos").Cells(j +
                         1, "Z")) * (Worksheets(
                        "Tratamiento de datos").Cells(j,
```

```
                        "I") - Worksheets("Tratamiento de datos").Cells(j + 1, "I"))) / ((Worksheets("Tratamiento de datos").Cells(j, "Y") - Worksheets("Tratamiento de datos").Cells(j, "Z")) - (Worksheets("Tratamiento de datos").Cells(j + 1, "Y") - Worksheets("Tratamiento de datos").Cells(j + 1, "Z")))) + Worksheets("Tratamiento de datos").Cells(j + 1, "I")
                        Worksheets("Tratamiento de datos").Cells(j + 1, "AC") = Worksheets("Tratamiento de datos").Cells(j + 1, "N") + (((Worksheets("Tratamiento de datos").Cells(j, "N") - Worksheets("Tratamiento de datos").Cells(j + 1, "N")) * (Worksheets("Tratamiento de datos").Cells(j + 1, "AB") - Worksheets("Tratamiento de datos").Cells(j + 1, "I"))) / (Worksheets("Tratamiento de datos").Cells(j, "I") - Worksheets("Tratamiento de datos").Cells(j + 1, "I")))
                    Else
                        Worksheets("Tratamiento de datos").Cells(j, "AA").Select
                        With Selection.Interior
                            .Pattern = xlSolid
                            .PatternColorIndex = xlAutomatic
                            .Color = 65535
                            .TintAndShade = 0
                            .PatternTintAndShade = 0
                        End With
                        Worksheets("Tratamiento de datos").Cells(j, "AA") = "LONGITUD INSUFICIENTE"
                    End If
                End If
                j = j - 1
                If Worksheets("Tratamiento de datos").Cells(i, "A") = "" Then
                    Exit Do
                End If
            Loop
        End If
    End If
Loop
End Sub

'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Sub Forces_After_WedgeLosses()
'This procedures computes the force distribution between the tendon end and the intersection point obtained after the wedge losses. In those cases where the tendon lenght is not sufficient to absorb the wedge losses, the formula used is rebuilt* according to a trapezioum
```

```
    geometry
711 '* The new formula is:
712 '
    F_sim_x=(sum(i=1,n,0.5*(x_i-x_(i-1))*(F_i+F_(i-1)))-0.5*A_
    tot)/(sum(i=1,n,(x_i-x_(i-1)))
713 '                    -->nomenclatura:
    F_sim=(0.5*sum_XiFi-0.5*A_tot)/sum_Xi
714
715 Dim i As Long
716 Dim F_simA, F_simB As Double    'These variables are the
    forces magnitude at the points where the friction losses
    curve intersects the force distribution due to wedge
    losses
717 Dim i_F_sim As Long             'This variable looks for
    the rows where the F_simA and F_simB data are stored
718 Dim i_TenA, i_TenB As Long      'These variables are
    used to identify the first point of a tendon in the ens
    A or B
719 Dim sum_XiFi, sum_Xi As Double
720
721 'Columns AD to AG of the spreadsheet are used
722 Worksheets("Tratamiento de datos").Activate
723 Worksheets("Tratamiento de datos").Columns("AD:AG").Select
724 Selection.ClearContents
725 i = 1
726 Worksheets("Tratamiento de datos").Cells(i, "AD") =
    "Acumulated_Longitude_A [m]"
727 Worksheets("Tratamiento de datos").Cells(i, "AE") =
    "Forces_After_WedgeLosses_A [kN]"
728 Worksheets("Tratamiento de datos").Cells(i, "AF") =
    "Acumulated_Longitude_B [m]"
729 Worksheets("Tratamiento de datos").Cells(i, "AG") =
    "Forces_After_WedgeLosses_B [kN]"
730
731 i = i + 1
732 Do While Worksheets("Tratamiento de datos").Cells(i, "A")
     <> ""
733     If Worksheets("Tratamiento de datos").Cells(i, "L") =
        "" Then
734         i = i + 1
735     ElseIf Worksheets("Tratamiento de datos").Cells(i,
        "L") = 2 Then
736         Do While Worksheets("Tratamiento de datos").Cells
            (i, "M") = ""
737             i = i + 1
738         Loop
739         i_TenA = i
740         i_F_sim = i
741         Do While Worksheets("Tratamiento de datos").Cells
            (i_F_sim, "U") = ""
742             i_F_sim = i_F_sim + 1
743         Loop
744         If Worksheets("Tratamiento de datos").Cells(
            i_F_sim, "U") = "INT1" Then
745             F_simA = Worksheets("Tratamiento de datos").
                Cells(i_F_sim, "W")
746             Do While i_TenA <= i_F_sim
747                 Worksheets("Tratamiento de datos").Cells(
                    i_TenA, "AD") = Worksheets("Tratamiento
                    de datos").Cells(i_TenA, "H")
748                 Worksheets("Tratamiento de datos").Cells(
```

```
                    i_TenA, "AE") = Worksheets("Tratamiento
                    de datos").Cells(i_TenA, "M") - 2 * (
                    Worksheets("Tratamiento de datos").Cells(
                    i_TenA, "M") - F_simA)
749                 If i_TenA = i_F_sim Then
750                     Worksheets("Tratamiento de datos").
                        Cells(i_TenA + 1, "AD") = Worksheets(
                        "Tratamiento de datos").Cells(i_TenA,
                         "V")
751                     Worksheets("Tratamiento de datos").
                        Cells(i_TenA + 1, "AE") = F_simA
752                 End If
753                 i_TenA = i_TenA + 1
754             Loop
755         ElseIf Worksheets("Tratamiento de datos").Cells(
            i_F_sim, "U") = "LONGITUD INSUFICIENTE" Then
756             sum_Xi = 0
757             sum_XiFi = 0
758             i = i + 1
759             Do While i <= i_F_sim
760                 sum_Xi = sum_Xi + (Worksheets(
                    "Tratamiento de datos").Cells(i, "H") -
                    Worksheets("Tratamiento de datos").Cells(
                    i - 1, "H"))
761                 sum_XiFi = sum_XiFi + (Worksheets(
                    "Tratamiento de datos").Cells(i, "H") -
                    Worksheets("Tratamiento de datos").Cells(
                    i - 1, "H")) * (Worksheets("Tratamiento
                    de datos").Cells(i, "M") + Worksheets(
                    "Tratamiento de datos").Cells(i - 1, "M"))
762                 i = i + 1
763             Loop
764             F_simA = (0.5 * sum_XiFi - 0.5 * Worksheets(
                "Datos de Partida").Cells(10, "B")) / sum_Xi
765             i = i_TenA                  'Esta orden se
                pone para evitar conflictos en la parte del
                cálculo de tensión desde B
766             Do While i_TenA <= i_F_sim
767                 Worksheets("Tratamiento de datos").Cells(
                    i_TenA, "AD") = Worksheets("Tratamiento
                    de datos").Cells(i_TenA, "H")
768                 Worksheets("Tratamiento de datos").Cells(
                    i_TenA, "AE") = Worksheets("Tratamiento
                    de datos").Cells(i_TenA, "M") - 2 * (
                    Worksheets("Tratamiento de datos").Cells(
                    i_TenA, "M") - F_simA)
769                 i_TenA = i_TenA + 1
770             Loop
771         End If
772         Do While Worksheets("Tratamiento de datos").Cells
            (i + 1, "N") <> ""
773             i = i + 1
774         Loop
775         i_TenB = i
776         i_F_sim = i
777         Do While Worksheets("Tratamiento de datos").Cells
            (i_F_sim, "AA") = ""
778             i_F_sim = i_F_sim - 1
779         Loop
780         If Worksheets("Tratamiento de datos").Cells(
            i_F_sim, "AA") = "INT1" Then
```

```
781             F_simB = Worksheets("Tratamiento de datos").
                Cells(i_F_sim, "AC")
782             Do While i_TenB >= i_F_sim
783                 Worksheets("Tratamiento de datos").Cells(
                    i_TenB, "AF") = Worksheets("Tratamiento
                    de datos").Cells(i_TenB, "I")
784                 Worksheets("Tratamiento de datos").Cells(
                    i_TenB, "AG") = Worksheets("Tratamiento
                    de datos").Cells(i_TenB, "N") - 2 * (
                    Worksheets("Tratamiento de datos").Cells(
                    i_TenB, "N") - F_simB)
785                 If i_TenB = i_F_sim Then
786                     Worksheets("Tratamiento de datos").
                        Cells(i_TenB - 1, "AF") = Worksheets(
                        "Tratamiento de datos").Cells(i_TenB,
                         "AB")
787                     Worksheets("Tratamiento de datos").
                        Cells(i_TenB - 1, "AG") = F_simB
788                 End If
789                 i_TenB = i_TenB - 1
790             Loop
791         ElseIf Worksheets("Tratamiento de datos").Cells(
            i_F_sim, "AA") = "LONGITUD INSUFICIENTE" Then
792             sum_Xi = 0
793             sum_XiFi = 0
794             i = i - 1
795             Do While i >= i_F_sim
796                 sum_Xi = sum_Xi + (Worksheets(
                    "Tratamiento de datos").Cells(i, "I") -
                    Worksheets("Tratamiento de datos").Cells(
                    i + 1, "I"))
797                 sum_XiFi = sum_XiFi + (Worksheets(
                    "Tratamiento de datos").Cells(i, "I") -
                    Worksheets("Tratamiento de datos").Cells(
                    i + 1, "I")) * (Worksheets("Tratamiento
                    de datos").Cells(i, "N") + Worksheets(
                    "Tratamiento de datos").Cells(i + 1, "N"))
798                 i = i - 1
799             Loop
800             F_simB = (0.5 * sum_XiFi - 0.5 * Worksheets(
                "Datos de Partida").Cells(10, "B")) / sum_Xi
801             i = i_TenB                  'se añade esta
                línea para trasladar el indicador i al final
                del tendón
802             Do While i_TenB >= i_F_sim
803                 Worksheets("Tratamiento de datos").Cells(
                    i_TenB, "AF") = Worksheets("Tratamiento
                    de datos").Cells(i_TenB, "I")
804                 Worksheets("Tratamiento de datos").Cells(
                    i_TenB, "AG") = Worksheets("Tratamiento
                    de datos").Cells(i_TenB, "N") - 2 * (
                    Worksheets("Tratamiento de datos").Cells(
                    i_TenB, "N") - F_simB)
805                 i_TenB = i_TenB - 1
806             Loop
807         End If
808     ElseIf Worksheets("Tratamiento de datos").Cells(i,
        "L") = 1 Then
809         i = i + 1
810         If Worksheets("Tratamiento de datos").Cells(i,
            "L") = "A" Then
```

```
811             Do While Worksheets("Tratamiento de datos").
                Cells(i, "M") = ""
812                 i = i + 1
813             Loop
814             i_TenA = i
815             i_F_sim = i
816             Do While Worksheets("Tratamiento de datos").
                Cells(i_F_sim, "U") = ""
817                 i_F_sim = i_F_sim + 1
818             Loop
819             If Worksheets("Tratamiento de datos").Cells(
                i_F_sim, "U") = "INT1" Then
820                 F_simA = Worksheets("Tratamiento de
                    datos").Cells(i_F_sim, "W")
821                 Do While i_TenA <= i_F_sim
822                     Worksheets("Tratamiento de datos").
                        Cells(i_TenA, "AD") = Worksheets(
                        "Tratamiento de datos").Cells(i_TenA,
                         "H")
823                     Worksheets("Tratamiento de datos").
                        Cells(i_TenA, "AE") = Worksheets(
                        "Tratamiento de datos").Cells(i_TenA,
                         "M") - 2 * (Worksheets("Tratamiento
                        de datos").Cells(i_TenA, "M") -
                        F_simA)
824                     If i_TenA = i_F_sim Then
825                         Worksheets("Tratamiento de datos"
                            ).Cells(i_TenA + 1, "AD") =
                            Worksheets("Tratamiento de datos"
                            ).Cells(i_TenA, "V")
826                         Worksheets("Tratamiento de datos"
                            ).Cells(i_TenA + 1, "AE") = F_simA
827                     End If
828                     i_TenA = i_TenA + 1
829                 Loop
830             ElseIf Worksheets("Tratamiento de datos").
                Cells(i_F_sim, "U") = "LONGITUD INSUFICIENTE"
                 Then
831                 sum_Xi = 0
832                 sum_XiFi = 0
833                 i = i + 1
834                 Do While i <= i_F_sim
835                     sum_Xi = sum_Xi + (Worksheets(
                        "Tratamiento de datos").Cells(i, "H")
                         - Worksheets("Tratamiento de datos"
                        ).Cells(i - 1, "H"))
836                     sum_XiFi = sum_XiFi + (Worksheets(
                        "Tratamiento de datos").Cells(i, "H")
                         - Worksheets("Tratamiento de datos"
                        ).Cells(i - 1, "H")) * (Worksheets(
                        "Tratamiento de datos").Cells(i, "M")
                         + Worksheets("Tratamiento de datos"
                        ).Cells(i - 1, "M"))
837                     i = i + 1
838                 Loop
839                 F_simA = (0.5 * sum_XiFi - 0.5 *
                    Worksheets("Datos de Partida").Cells(10,
                    "B")) / sum_Xi
840                 Do While i_TenA <= i_F_sim
841                     Worksheets("Tratamiento de datos").
                        Cells(i_TenA, "AD") = Worksheets(
```

```
                    "Tratamiento de datos").Cells(i_TenA,
                     "H")
842                 Worksheets("Tratamiento de datos").
                    Cells(i_TenA, "AE") = Worksheets(
                    "Tratamiento de datos").Cells(i_TenA,
                     "M") - 2 * (Worksheets("Tratamiento
                    de datos").Cells(i_TenA, "M") -
                    F_simA)
843                 i_TenA = i_TenA + 1
844             Loop
845         End If
846     ElseIf Worksheets("Tratamiento de datos").Cells(i
        , "L") = "B" Then
847         Do While Worksheets("Tratamiento de datos").
            Cells(i, "N") = ""
848             i = i + 1
849         Loop
850         Do While Worksheets("Tratamiento de datos").
            Cells(i + 1, "N") <> ""
851             i = i + 1
852         Loop
853         i_TenB = i
854         i_F_sim = i
855         Do While Worksheets("Tratamiento de datos").
            Cells(i_F_sim, "AA") = ""
856             i_F_sim = i_F_sim - 1
857         Loop
858         If Worksheets("Tratamiento de datos").Cells(
            i_F_sim, "AA") = "INT1" Then
859             F_simB = Worksheets("Tratamiento de
                datos").Cells(i_F_sim, "AC")
860             Do While i_TenB >= i_F_sim
861                 Worksheets("Tratamiento de datos").
                    Cells(i_TenB, "AF") = Worksheets(
                    "Tratamiento de datos").Cells(i_TenB,
                     "I")
862                 Worksheets("Tratamiento de datos").
                    Cells(i_TenB, "AG") = Worksheets(
                    "Tratamiento de datos").Cells(i_TenB,
                     "N") - 2 * (Worksheets("Tratamiento
                    de datos").Cells(i_TenB, "N") -
                    F_simB)
863                 If i_TenB = i_F_sim Then
864                     Worksheets("Tratamiento de datos"
                        ).Cells(i_TenB - 1, "AF") =
                        Worksheets("Tratamiento de datos"
                        ).Cells(i_TenB, "AB")
865                     Worksheets("Tratamiento de datos"
                        ).Cells(i_TenB - 1, "AG") = F_simB
866                 End If
867                 i_TenB = i_TenB - 1
868             Loop
869         ElseIf Worksheets("Tratamiento de datos").
            Cells(i_F_sim, "AA") = "LONGITUD
            INSUFICIENTE" Then
870             sum_Xi = 0
871             sum_XiFi = 0
872             i = i - 1
873             Do While i >= i_F_sim
874                 sum_Xi = sum_Xi + (Worksheets(
                    "Tratamiento de datos").Cells(i, "I")
```

```
                     - Worksheets("Tratamiento de datos").Cells(i + 1, "I"))
                    sum_XiFi = sum_XiFi + (Worksheets("Tratamiento de datos").Cells(i, "I") - Worksheets("Tratamiento de datos").Cells(i + 1, "I")) * (Worksheets("Tratamiento de datos").Cells(i, "N") + Worksheets("Tratamiento de datos").Cells(i + 1, "N"))
                    i = i - 1
                Loop
                F_simB = (0.5 * sum_XiFi - 0.5 * Worksheets("Datos de Partida").Cells(10, "B")) / sum_Xi
                i = i_TenB                  'se añade esta línea para trasladar el indicador i al final del tendón
                Do While i_TenB >= i_F_sim
                    Worksheets("Tratamiento de datos").Cells(i_TenB, "AF") = Worksheets("Tratamiento de datos").Cells(i_TenB, "I")
                    Worksheets("Tratamiento de datos").Cells(i_TenB, "AG") = Worksheets("Tratamiento de datos").Cells(i_TenB, "N") - 2 * (Worksheets("Tratamiento de datos").Cells(i_TenB, "N") - F_simB)
                    i_TenB = i_TenB - 1
                Loop
            End If
        End If
    End If
Loop
End Sub

'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Sub TendonForceAfterInsLosses()
'This procedure defines the final forces layout of the tendons after discounting friction and wedge losses

Dim i, j As Long            'i is an internal variable used to detect when to stop the procedure and j is the internal variable that writes the final procedure output
Dim a, b As Double

'Columns AH to AI of the spreadsheet are used
Worksheets("Tratamiento de datos").Activate
Worksheets("Tratamiento de datos").Columns("AH:AJ").Select
Selection.ClearContents
i = 1
Worksheets("Tratamiento de datos").Cells(i, "AH") = "Tendon_ID"
Worksheets("Tratamiento de datos").Cells(i, "AI") = "Acumulated_Longitude [m]"
Worksheets("Tratamiento de datos").Cells(i, "AJ") = "Forces_After_InsLosses [kN]"

i = i + 1
j = i
```

```
910     Do While Worksheets("Tratamiento de datos").Cells(i, "A")
         <> ""
911         Do While Worksheets("Tratamiento de datos").Cells(i,
            "B") <> "Tendon"
912             i = i + 1
913             If Worksheets("Tratamiento de datos").Cells(i,
                "A") = "" Then
914                 Exit Do
915             End If
916         Loop
917         Worksheets("Tratamiento de datos").Cells(j, "AH") =
            Worksheets("Tratamiento de datos").Cells(i, "C")
918         j = j + 1
919         Do While Worksheets("Tratamiento de datos").Cells(i,
            "H") = ""
920             i = i + 1
921             If Worksheets("Tratamiento de datos").Cells(i,
                "A") = "" Then
922                 Exit Do
923             End If
924         Loop
925         Do While Worksheets("Tratamiento de datos").Cells(i,
            "H") <> ""
926             Worksheets("Tratamiento de datos").Cells(j, "AI")
                = Worksheets("Tratamiento de datos").Cells(i,
                "H")
927             'Define A
928             If Worksheets("Tratamiento de datos").Cells(i + 1
                , "AE") <> "" Then
929                 a = Worksheets("Tratamiento de datos").Cells(
                    i, "AE")
930             ElseIf Worksheets("Tratamiento de datos").Cells(i
                , "U") = "LONGITUD INSUFICIENTE" Then
931                 a = Worksheets("Tratamiento de datos").Cells(
                    i, "AE")
932             Else
933                 a = Worksheets("Tratamiento de datos").Cells(
                    i, "M")
934             End If
935             'Define B
936             If Worksheets("Tratamiento de datos").Cells(i - 1
                , "AG") <> "" Then
937                 b = Worksheets("Tratamiento de datos").Cells(
                    i, "AG")
938             ElseIf Worksheets("Tratamiento de datos").Cells(i
                , "AA") = "LONGITUD INSUFICIENTE" Then
939                 b = Worksheets("Tratamiento de datos").Cells(
                    i, "AG")
940             Else
941                 b = Worksheets("Tratamiento de datos").Cells(
                    i, "N")
942             End If
943             Worksheets("Tratamiento de datos").Cells(j, "AJ")
                = WorksheetFunction.Max(a, b)
944             j = j + 1
945             'Intersections
946                 'For the forces after friction losses branches
947             If Worksheets("Tratamiento de datos").Cells(i,
                "O") = "INT1" Then
948                 If WorksheetFunction.And(a = Worksheets(
                    "Tratamiento de datos").Cells(i, "M"), b =
```

```
                Worksheets("Tratamiento de datos").Cells(i, "N")) Then
                    Worksheets("Tratamiento de datos").Cells(j, "AI") = Worksheets("Tratamiento de datos").Cells(i, "P")
                    Worksheets("Tratamiento de datos").Cells(j, "AJ") = Worksheets("Tratamiento de datos").Cells(i, "R")
                    j = j + 1
                End If

                'For the forces after wedge-blocking losses
            ElseIf Worksheets("Tratamiento de datos").Cells(i, "U") = "INT1" Then
                If a > b Then
                    Worksheets("Tratamiento de datos").Cells(j, "AI") = Worksheets("Tratamiento de datos").Cells(i, "V")
                    Worksheets("Tratamiento de datos").Cells(j, "AJ") = Worksheets("Tratamiento de datos").Cells(i, "W")
                    j = j + 1
                End If
            ElseIf Worksheets("Tratamiento de datos").Cells(i, "AA") = "INT2" Then
                If b > a Then
                    Worksheets("Tratamiento de datos").Cells(j, "AI") = Worksheets("Tratamiento de datos").Cells(i, "H") + (Worksheets("Tratamiento de datos").Cells(i, "I") - Worksheets("Tratamiento de datos").Cells(i + 1, "AB"))
                    Worksheets("Tratamiento de datos").Cells(j, "AJ") = Worksheets("Tratamiento de datos").Cells(i + 1, "AC")
                    j = j + 1
                End If
            End If
            i = i + 1
        Loop
    Loop
End Sub

'%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Sub Stress_distribution()
'This procedures transforms the forces distribution into stresses distribution

Dim i As Long

'Column AK of the spreadsheet is used
Worksheets("Tratamiento de datos").Activate
Worksheets("Tratamiento de datos").Columns("AK:AK").Select
Selection.ClearContents
i = 1
Worksheets("Tratamiento de datos").Cells(i, "AK") = "Stress_distribution [MPa]"

i = i + 1
Do While Worksheets("Tratamiento de datos").Cells(i, "A")
```

```
    <> ""
989     If Worksheets("Tratamiento de datos").Cells(i, "AJ")
        = "" Then
990     Else
991         Worksheets("Tratamiento de datos").Cells(i, "AK")
             = Worksheets("Tratamiento de datos").Cells(i,
            "AJ") * 1000 / (Worksheets("Datos de Partida").
            Cells(7, "B") * Worksheets("Datos de Partida").
            Cells(8, "B"))
992     End If
993     i = i + 1
994 Loop
995 End Sub
996
997 '%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
998
999 Sub uniform_stress_distribution()
1000 'This procedure computes the mean stress state for each
    tendon
1001
1002 Dim i1, i2 As Long
1003 Dim a, m_stress As Double
1004
1005 'Column AL of the spreadsheet is used
1006 Worksheets("Tratamiento de datos").Activate
1007 Worksheets("Tratamiento de datos").Columns("AL:AL").Select
1008 Selection.ClearContents
1009 i1 = 1
1010 Worksheets("Tratamiento de datos").Cells(i1, "AL") =
    "Mean_Stress_distribution [MPa]"
1011
1012 i1 = i1 + 1
1013 Do While Worksheets("Tratamiento de datos").Cells(i1, "A"
    ) <> ""
1014     Do While Worksheets("Tratamiento de datos").Cells(i1,
         "AK") = ""
1015         i1 = i1 + 1
1016         If WorksheetFunction.And(Worksheets("Tratamiento
            de datos").Cells(i1 - 1, "AH") = "", Worksheets(
            "Tratamiento de datos").Cells(i1 - 1, "AI") = "",
             Worksheets("Tratamiento de datos").Cells(i1 - 1,
             "AJ") = "") Then
1017             Exit Do
1018         End If
1019     Loop
1020     i2 = i1
1021     i1 = i1 + 1
1022     a = 0
1023     Do While Worksheets("Tratamiento de datos").Cells(i1,
         "AK") <> ""
1024         a = a + 0.5 * (Worksheets("Tratamiento de datos"
            ).Cells(i1, "AI") - Worksheets("Tratamiento de
            datos").Cells(i1 - 1, "AI")) * (Worksheets(
            "Tratamiento de datos").Cells(i1, "AK") +
            Worksheets("Tratamiento de datos").Cells(i1 - 1,
            "AK"))
1025         i1 = i1 + 1
1026         If WorksheetFunction.And(Worksheets("Tratamiento
            de datos").Cells(i1 - 1, "AH") = "", Worksheets(
            "Tratamiento de datos").Cells(i1 - 1, "AI") = "",
              Worksheets("Tratamiento de datos").Cells(i1 - 1
```

```
            , "AJ") = "") Then
                Exit Do
            End If
        Loop
        If WorksheetFunction.And(Worksheets("Tratamiento de datos").Cells(i1 - 1, "AH") = "", Worksheets("Tratamiento de datos").Cells(i1 - 1, "AI") = "", Worksheets("Tratamiento de datos").Cells(i1 - 1, "AJ") = "") Then
            Exit Do
        End If
        i1 = i1 - 1
        m_stress = a / Worksheets("Tratamiento de datos").Cells(i1, "AI")
        Do While i2 <= i1
            Worksheets("Tratamiento de datos").Cells(i2, "AL") = m_stress
            i2 = i2 + 1
            If WorksheetFunction.And(Worksheets("Tratamiento de datos").Cells(i1 - 1, "AH") = "", Worksheets("Tratamiento de datos").Cells(i1 - 1, "AI") = "", Worksheets("Tratamiento de datos").Cells(i1 - 1, "AJ") = "") Then
                Exit Do
            End If
        Loop
        i1 = i1 + 1
    Loop
    End Sub

    '%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

    Sub family_main_stress()
    'This procedure computes the main stress state at each family of tendons (H//V//D//G)

    Dim i As Long
    Dim cont_C, cont_G, cont_H, cont_V As Integer
    Dim stress_C, stress_G, stress_H, stress_V As Double

    'Columns AN to AP of the spreadsheet are used
    Worksheets("Tratamiento de datos").Activate
    Worksheets("Tratamiento de datos").Columns("AN:AP").Select
    Selection.ClearContents
    i = 1
    Worksheets("Tratamiento de datos").Cells(i, "AN") = "Tendon Family"
    Worksheets("Tratamiento de datos").Cells(i + 1, "AN") = "C_tendons"
    Worksheets("Tratamiento de datos").Cells(i + 2, "AN") = "G_tendons"
    Worksheets("Tratamiento de datos").Cells(i + 3, "AN") = "H_tendons"
    Worksheets("Tratamiento de datos").Cells(i + 4, "AN") = "V_tendons"

    Worksheets("Tratamiento de datos").Cells(i, "AO") = "Mean stress [MPa]"

    cont_C = 0
    cont_G = 0
```

```
1070    cont_H = 0
1071    cont_V = 0
1072    stress_C = 0
1073    stress_G = 0
1074    stress_H = 0
1075    stress_V = 0
1076
1077    Do While WorksheetFunction.Or(Worksheets("Tratamiento de
        datos").Cells(i, "AH") <> "", Worksheets("Tratamiento de
        datos").Cells(i, "AK") <> "")
1078        If InStr(Worksheets("Tratamiento de datos").Cells(i,
            "AH"), "C") <> 0 Then
1079            cont_C = cont_C + 1
1080            stress_C = stress_C + Worksheets("Tratamiento de
                datos").Cells(i + 1, "AL")
1081        ElseIf InStr(Worksheets("Tratamiento de datos").Cells
            (i, "AH"), "G") <> 0 Then
1082            cont_G = cont_G + 1
1083            stress_G = stress_G + Worksheets("Tratamiento de
                datos").Cells(i + 1, "AL")
1084        ElseIf InStr(Worksheets("Tratamiento de datos").Cells
            (i, "AH"), "H") <> 0 Then
1085            cont_H = cont_H + 1
1086            stress_H = stress_H + Worksheets("Tratamiento de
                datos").Cells(i + 1, "AL")
1087        ElseIf InStr(Worksheets("Tratamiento de datos").Cells
            (i, "AH"), "V") <> 0 Then
1088            cont_V = cont_V + 1
1089            stress_V = stress_V + Worksheets("Tratamiento de
                datos").Cells(i + 1, "AL")
1090        End If
1091        i = i + 1
1092    Loop
1093
1094    'Mean stresses by family
1095        'Dome
1096    Worksheets("Tratamiento de datos").Cells(2, "AO") =
        stress_C / cont_C
1097        'Gamma
1098    Worksheets("Tratamiento de datos").Cells(3, "AO") =
        stress_G / cont_G
1099        'Horizontal
1100    Worksheets("Tratamiento de datos").Cells(4, "AO") =
        stress_H / cont_H
1101        'Vertical
1102    Worksheets("Tratamiento de datos").Cells(5, "AO") =
        stress_V / cont_V
1103    End Sub
```