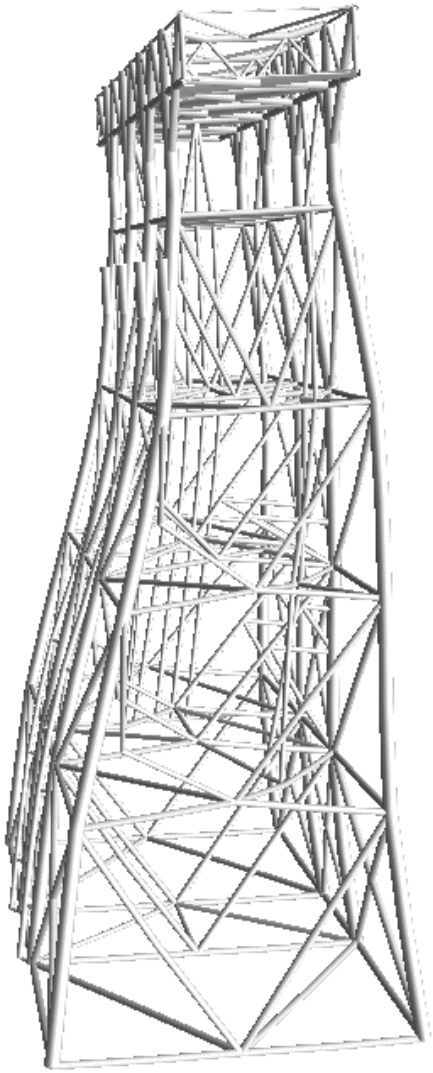
P I L E R E S

User's Manual



CONTENTS:

1 Introduction

PILERES is a simple tool, which is available for free for the users of Usfos. The tool is used to extract and print reaction force results from an Usfos analysis, and the results are taken from the "RAF" file.

The tool is found on the web (www.usfos.com under download modules). PILERES is available on the following computer platforms:

- Windows
- Linux 64 bit
- Mac OSX

PILERES is under development and at present, only beta versions (0.9-X) are available. This document is based on PILERES version 0.9-1, April 2013.

2 Running PILERES

2.1 From a command shell

The most efficient way to run PILERES is from a command shell (DOS or Unix). By just typing ***pileres***, the tool starts and asks for the following information:

- Raf file name prefix (without file extension)
- Output file name (to print the actual data, complete name)
- Step number (stored step no)

```
          ------------------------------------------------
          ------------------------------------------------
          -----                                      -----
          -----   R E A C T I O N    R E S U L T S   -----
          -----                                      -----
          -----      Version 0.9-1/ Apr, 04, 2013    -----
          -----                Usfos AS              -----
          -----                                      -----
          ------------------------------------------------
          ------------------------------------------------
Give RAF File Name Prefix         :  res
Give Output File Name             :  pileres01.txt
Give Stored Step Number   /all/   :

...Using last stored step:    105

Processing step no:     1
Processing step no:    10
Processing step no:    20
Processing step no:    30
```

Table 2-1 Running PILERES from a simple command shell

PILERES could also be run from the Usfos GUI (Run Utilities), and the user gives the same input information.

2.2 From USFOS gui.

PILERES is found under File/Run Utility/pileres as shown in Figure 2-1. The raf file prefix, file to print the results and the step no are typed into the "standard input" field. Give blank field (hit enter) to go through all steps.

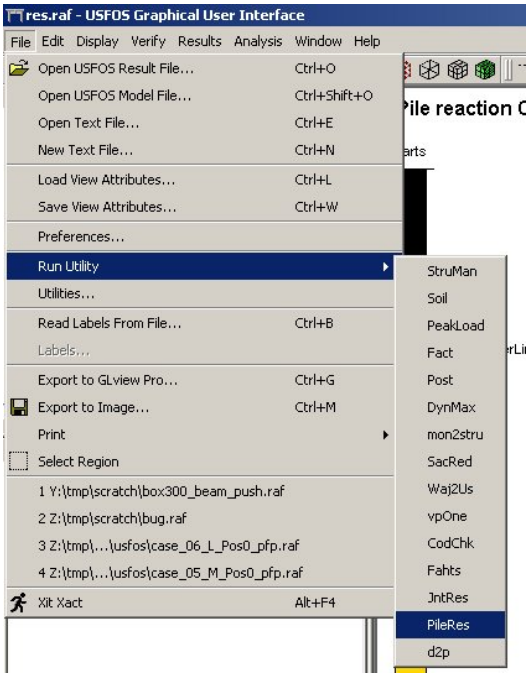


Figure 2-1 – Selecting Run Utility – pileres from USFOS gui.

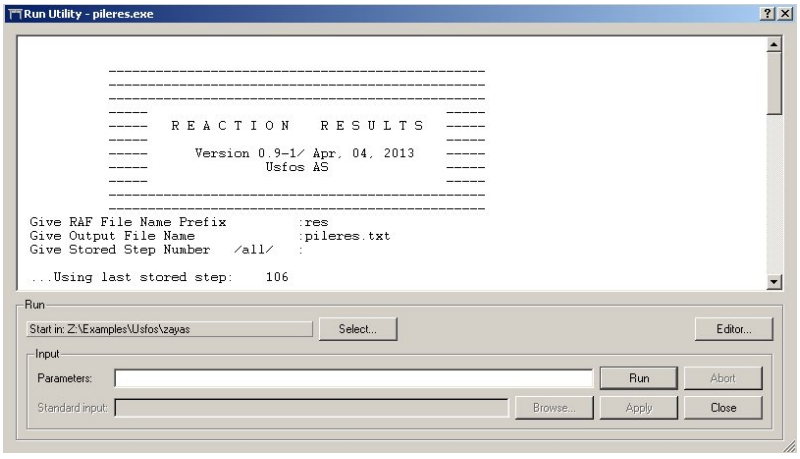


Figure 2-2 – pileres dialogue from USFOS gui.

2.3 Input parameters

The three input parameters are explained in Table 2-2. If the default parameters are used, only the two first parameters (raf- and output) need to be specified. For the 3rd , the default is selected by just hitting the "enter" button, (i.e. blank).

Input/option	Comments
Raf file name prefix	USFOS result database. Either : 1. file name (if PILERES is activated from the same file folder as the raf file is stored), or 2. full path. For example: 1. res 2. /tmp/scratch/res
Output file name	Complete file name for result printing. For example: pileres01.txt
Stored step	PILERES goes trough all steps up to the specified step. NOTE. Specify *stored* step number (not analysis step). F example, if the default storing is used, USFOS will store every 10th analysis step: 1, 10, 20, 30, 40, etc. For example will *stored* step no 2 mean analysis step 10, stored step no 3 means analysis step 20, etc. By default, all steps are used, (i.e. up to last stored step).

Table 2-2 - PILERES input parameters and options.

2.4 Output

The output consists of 6 main blocks of data as shown in the table:

Output Blocks	Comments
Block-1: Heading and key results	Contains: ❑ PILERES version ❑ USFOS analysis status ❑ Processed date ❑ Input raf file ❑ Number of connections ❑ Last used step (stored step is converted to USFOS analysis step in the print) See Table 3-1
Block-2: Global Reaction summary	This output is generated also for analyses with no piles and prints the global reaction forces in X-, Y- and Z-directions. One line per stored step. See Table 3-2
Block-3: Total Pile reaction	Total pile reactions in X-, Y- and Z- directions are printed. One line per stored step. See Table 3-3
Block-4: Total Pile Tip reaction	Total pile tip reactions in X-, Y- and Z-directions are printed. One line per stored step. See Table 3-4
Block-5: Total Pile Head reaction	Total pile head reactions in X-, Y- and Z-directions are printed. One line per stored step. See Table 3-5
Block-6: Step-by-step	Pile Head reactions, (axial and horizontal), are printed pile-for-pile. Compression / tension information. See Table 3-6

Table 2-3 - PILERES output blocks.

3 Output Print Example

3.1 Block-1

This block contains the usual key information.

```
          ------------------------------------------------
          ------------------------------------------------
          ------------------------------------------------
          -----                                      -----
          -----   R E A C T I O N   R E S U L T S    -----
          -----                                      -----
          -----      Version 0.9-1/ Apr, 04, 2013    -----
          -----               Usfos AS               -----
          -----                                      -----
          ------------------------------------------------
          ------------------------------------------------

        --- U S F O S   A N A L Y S I S  S T A T U S ---

                    Version 8-7 / Release 14-01-01
                           U s f o s  A/S

                    Pileres Demo Example
               Non-linear Plastic Collapse Analysis
                         2013

                         Input files:
                                     head.fem
                                     model.fem
                                     soil.fem


Number of nodal points                 :                      6884
Number of elements                     :                     11345

                                                          Comb  Step    Load
                                                           No    No     level
First yield, (elasto-plastic hinge) at:                     2   115     2.09
First fully developed plastic hinge at:                     1     1     0.97
First buckling at                      :                    2   223     2.84
No fracture detected
Utilization threshold of :  1.10 not ecceded
Max number of negative pivot element  :        2 at :      2   338     3.34
Max number of new hinges in one step  :        2 at :      2   185     2.58
Number of steps without convergence   :      325 first     2    13     0.98
Convergence tolerance                 : 1.00E-04
Max iterations specified              :        5
Analysis terminated at                :                    2   350     3.35


Processed    : Date : 2014-01-01 22:51:00
RAF File     : res.raf

Number of Piles          :     12
Number of Processed Steps :     38
Last used (usfos) step    :    351
```

Table 3-1 - PILERES result overview (“block-1”). Key data

3.2 Block-2

This block is also generated for analyses with no pile/soil foundation. Load Case, analysis step no and load levels are printed together with the actual reactions. Number of iterations per step is printed. If the iteration aborts, the solution may deviate. The “Chg” indicates deviation from the correct solution, (is based on the development of load level and total reactions).

```
    ------------------------------------------------
    ------------------------------------------------
    ----                                        ------
    ----            G L O B A L                 ------
    ----     R e a c t i o n  F o r c e s       ------
    ----                                        ------
    ------------------------------------------------
    ------------------------------------------------

LoadCase StepNo LoadLevel   Fx          Fy          Fz        Chg     nIter
     1      1    0.971   5.301E+05   8.350E+04   2.026E+08     0 %      5

LoadCase StepNo LoadLevel   Fx          Fy          Fz        Chg     nIter
     2     10    0.780   1.029E+07  -1.006E+07   2.031E+08     0 %      4
     2     14    0.999   1.303E+07  -1.290E+07   2.033E+08     0 %      5
     2     20    1.108   1.439E+07  -1.432E+07   2.034E+08     0 %      5
     2     30    1.235   1.598E+07  -1.597E+07   2.035E+08     0 %      5

       ----------

     2    310    3.318   4.200E+07  -4.302E+07   2.050E+08     0 %      5
     2    320    3.357   4.249E+07  -4.352E+07   2.050E+08     0 %      5
     2    330    3.395   4.296E+07  -4.401E+07   2.051E+08     0 %      5
     2    340    3.339   4.227E+07  -4.329E+07   2.050E+08     0 %      3
     2    350    3.346   4.254E+07  -4.357E+07   2.050E+08     0 %   Aborted
```

Table 3-2 - PILERES result overview (“block-2”). Global Reaction.

3.3 Block-3

This block gives the total pile reactions in X-, Y- and Z-directions. In addition following is given:

- RelGlb_Z : Pile Z-reaction relative to Total Z-Reaction.
- RelPeak : Pile Z-reaction relative to the total Z-capacity

RelGlb_Z = 100% means that the structure is supported by the piles only, (no fixed nodes).

```
     ------------------------------------------------
     ------------------------------------------------
     ----                                      ------
     ----            T  O  T  A  L             ------
     ----      P i l e   R e a c t i o n s     ------
     ----        ( sum over all piles )        ------
     ----                                      ------
     ------------------------------------------------
     ------------------------------------------------

LoadCase StepNo LoadLevel   Fx          Fy          Fz     RelGlb_Z  RelPeak   nIter
     1      1    0.971   5.301E+05   8.350E+04   2.026E+08   100 %     38 %      5

LoadCase StepNo LoadLevel   Fx          Fy          Fz     RelGlb_Z  RelPeak   nIter
     2     10    0.780   1.029E+07  -1.006E+07   2.031E+08   100 %     38 %      4
     2     14    0.999   1.303E+07  -1.290E+07   2.033E+08   100 %     38 %      5
     2     20    1.108   1.439E+07  -1.432E+07   2.034E+08   100 %     38 %      5
     2     30    1.235   1.598E+07  -1.597E+07   2.035E+08   100 %     38 %      5

        ------

     2    310    3.318   4.200E+07  -4.302E+07   2.050E+08   100 %     40 %      5
     2    320    3.357   4.249E+07  -4.352E+07   2.050E+08   100 %     40 %      5
     2    330    3.395   4.296E+07  -4.401E+07   2.051E+08   100 %     40 %      5
     2    340    3.339   4.227E+07  -4.329E+07   2.050E+08   100 %     40 %      3
     2    350    3.346   4.254E+07  -4.357E+07   2.050E+08   100 %     40 %   Aborted
```

Table 3-3 - PILERES result overview (“block-3”). Total Pile Reaction.

3.4 Block-4

This block gives the total pile tip reactions in X-, Y- and Z-directions. In addition following is given:

- RelPile: Pile tip Z-reaction relative to Total pile Z-Reactions.

RelPile = 0% means that the pile tip is not (yet) mobilized.

```
    ------------------------------------------------
     ----------------------------------------------
     ----                                    ------
     ----  P i l e   T i p   R e a c t i o n s ------
     ----        ( sum over all piles )      ------
     ----                                    ------
     ----------------------------------------------
     ----------------------------------------------

LoadCase StepNo LoadLevel   Fx          Fy          Fz      RelPile
     1      1    0.971   5.499E+01  -5.461E+02   2.519E+06     1 %

LoadCase StepNo LoadLevel   Fx          Fy          Fz      RelPile
     2     10    0.780  -1.318E+02   1.309E+03   3.114E+06     2 %
     2     14    0.999  -1.855E+02   1.842E+03   3.290E+06     2 %
     2     20    1.108  -2.062E+02   2.048E+03   3.401E+06     2 %
     2     30    1.235  -2.268E+02   2.253E+03   3.466E+06     2 %

        --------

     2    310    3.318  -5.183E+02   5.148E+03   6.788E+06     3 %
     2    320    3.357  -5.459E+02   5.422E+03   6.862E+06     3 %
     2    330    3.395  -5.936E+02   5.896E+03   6.951E+06     3 %
     2    340    3.339  -6.421E+02   6.377E+03   7.001E+06     3 %
     2    350    3.346  -6.793E+02   6.747E+03   7.049E+06     3 %
```

Table 3-4 - PILERES result overview ("block-4"). Pile Tip Reaction.

3.5 Block-5

This block gives the total pile head reactions in X-, Y- and Z-directions. In addition following is given:

- RelGlb_Z : Pile Head reaction relative to Total Z-reaction
- RelPile : Pile head Z-reaction relative to Total pile Z-Reactions.

The total pile reactions includes the self-weight of the pile. Therefore, the pile head reactions should be less than 100%. In the example, the relative reaction is 85%, and this means that 15% of the pile reaction is caused by the self weight of the piles.

```
    ------------------------------------------------
    ------------------------------------------------
    ----                                       -----
    ----  P i l e   H e a d  R e a c t i o n s -----
    ----        ( sum over all piles )         -----
    ----                                       -----
    ------------------------------------------------
    ------------------------------------------------

LoadCase StepNo LoadLevel   Fx          Fy          Fz     RelGlb_Z  RelPile   nIter
     1      1    0.971   5.304E+05   8.349E+04   1.722E+08    85 %     85 %      5

LoadCase StepNo LoadLevel   Fx          Fy          Fz     RelGlb_Z  RelPile   nIter
     2     10    0.780   1.030E+07  -1.006E+07   1.728E+08    85 %     85 %      4
     2     14    0.999   1.303E+07  -1.291E+07   1.729E+08    85 %     85 %      5
     2     20    1.108   1.440E+07  -1.433E+07   1.730E+08    85 %     85 %      5
     2     30    1.235   1.599E+07  -1.598E+07   1.731E+08    85 %     85 %      5

        --------

     2    310    3.318   4.205E+07  -4.307E+07   1.746E+08    85 %     85 %      5
     2    320    3.357   4.254E+07  -4.358E+07   1.746E+08    85 %     85 %      5
     2    330    3.395   4.302E+07  -4.407E+07   1.747E+08    85 %     85 %      5
     2    340    3.339   4.232E+07  -4.335E+07   1.746E+08    85 %     85 %      3
     2    350    3.346   4.259E+07  -4.362E+07   1.746E+08    85 %     85 %   Aborted
```

Table 3-5 - PILERES result overview ("block-5"). Pile Head Reaction.

3.6 Block-6

This block gives an overview, pile-by-pile for each stored step:

- Pile ID : User's Pile ID
- Type : Pile Geometry Type (single or group)
- Status : Compression or Tension at pile and tip
- RelPeak : Pile Z_force relative to each piles' peaks.
- Z-ReacHd : Z-reaction at Pile Head for each pile
- XY-ReacHd : Horizontal reaction at pile head
- HeadZ/PileZ : Ratio between pile head and total pile Z-force

NOTE! For piles tension, the ratio between head and total could exceed 100%. F ex will pile head tension equal to the self weight of the pile give zero forces in the soil and the ratio goes towards infinite.

```
    ------------------------------------------------
    ------------------------------------------------
    ----                                        -----
    ----        P i l e   S u m m a r y         -----
    ----          Step - by - Step              -----
    ----                                        -----
    ------------------------------------------------
    ------------------------------------------------

-------------------------------------------------------------------------------
LoadCase StepNo LoadLevel    nIter
     1      1    0.971        5

Pile_ID   Type       Status      RelPeak   Z-ReacHd    XY-ReacHd   HeadZ/PileZ
                  Head / Pile
  21351   Single   Comp / Comp     46 %    1.859E+07   1.074E+06       88 %
  21352   Single   Comp / Comp     43 %    1.695E+07   1.176E+06       86 %
  21353   Single   Comp / Comp     44 %    1.747E+07   9.474E+05       87 %
  21354   Single   Comp / Comp     39 %    1.509E+07   9.443E+05       85 %
  21355   Single   Comp / Comp     36 %    1.398E+07   1.052E+06       84 %
  21356   Single   Comp / Comp     37 %    1.428E+07   8.497E+05       84 %
  21357   Single   Comp / Comp     37 %    1.342E+07   8.240E+05       85 %
  21358   Single   Comp / Comp     36 %    1.307E+07   9.957E+05       84 %
  21359   Single   Comp / Comp     38 %    1.405E+07   9.281E+05       85 %
  21360   Single   Comp / Comp     34 %    1.227E+07   7.659E+05       84 %
  21361   Single   Comp / Comp     31 %    1.079E+07   8.064E+05       82 %
  21362   Single   Comp / Comp     34 %    1.224E+07   1.139E+06       84 %

                           Sum PileHead:    1.722E+08   5.369E+05
                                           ======================

         ------  Final Step -----
-------------------------------------------------------------------------------
LoadCase StepNo LoadLevel    nIter
     2    340    3.339        3

Pile_ID   Type       Status      RelPeak   Z-ReacHd    XY-ReacHd   HeadZ/PileZ
                  Head / Pile
  21351   Single   Comp / Comp     69 %    2.903E+07   5.359E+06       92 %
  21352   Single   Comp / Comp     30 %    1.115E+07   4.181E+06       81 %
  21353   Single   Tens / Tens      1 %   -3.135E+06   5.522E+06      647 %
  21354   Single   Comp / Comp     91 %    3.920E+07   5.095E+06       94 %
  21355   Single   Comp / Comp    109 %    4.745E+07   5.803E+06       95 %
  21356   Single   Comp / Comp     79 %    3.343E+07   4.929E+06       93 %
  21357   Single   Tens / Tens     27 %   -1.259E+07   4.973E+06      124 %
  21358   Single   Tens / Tens     66 %   -2.777E+07   6.169E+06      110 %
  21359   Single   Tens / Tens     25 %   -1.182E+07   5.177E+06      126 %
  21360   Single   Comp / Comp     93 %    3.732E+07   5.170E+06       94 %
  21361   Single   Comp / Comp     48 %    1.835E+07   3.407E+06       88 %
  21362   Single   Comp / Comp     38 %    1.401E+07   5.490E+06       85 %

                           Sum PileHead:    1.746E+08   6.058E+07
                                           ======================
```

Table 3-6 - PILERES result, Step-by-step.

4 Limitations

PILERES needs results, which are created by USFOS version 8-7 (or later versions).

PILERES does not print reactions for the following cases:

- If the “soildisp” or “soilacc” (earthquake) options are used.
- If prescribed motions are used.

If dynamic analysis is performed, the “chg” parameter cannot be computed (due to inertia forces), and therefore N/A is printed.