User Manual for VC4OWT

Version 20171226

[1] Download

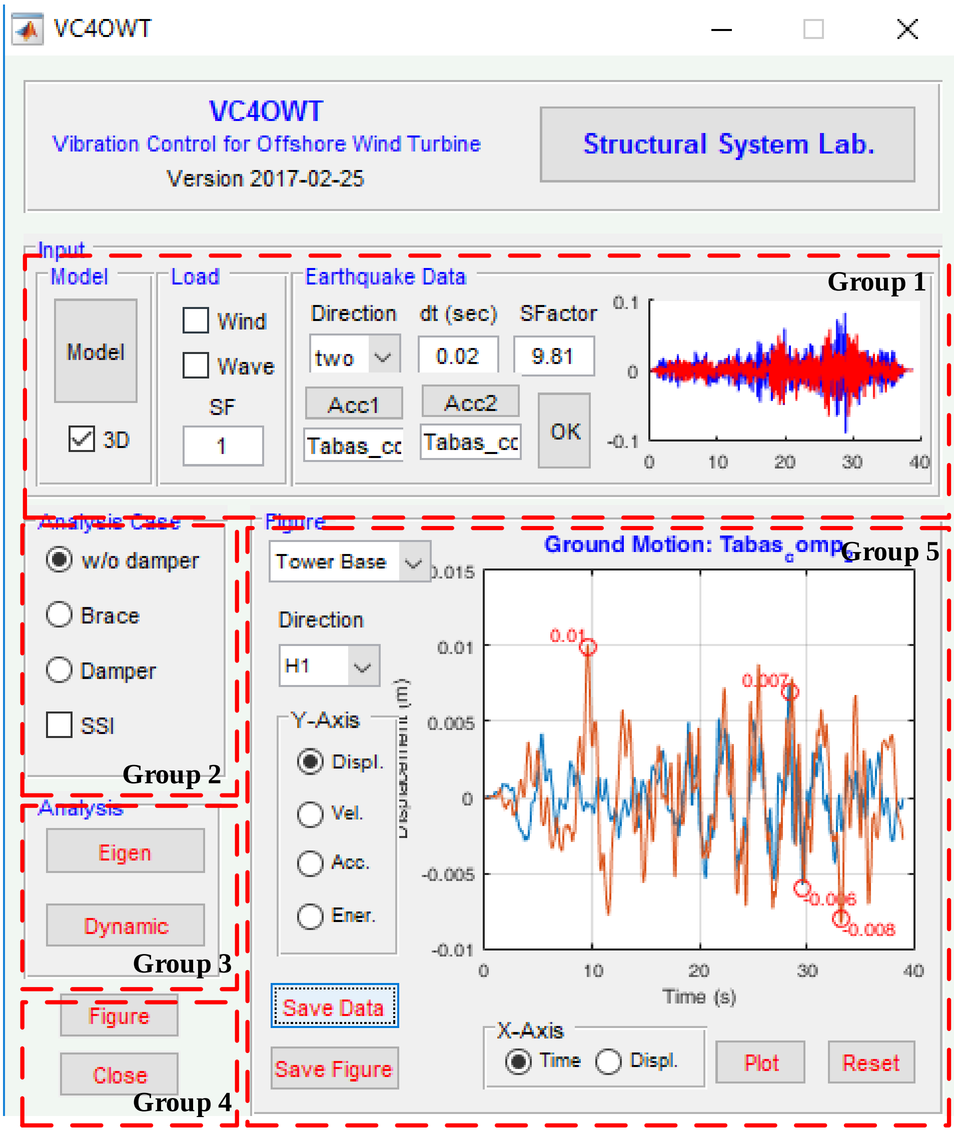
VC4OWT.zip:

Execution: Type "VC4OWT" on the command window of the MATLAB, and then enter

Input File (Sample): (e.g. model.inp)

Output File (Sample): (e.g. figure.png, output.txt)

[2] EXAMPLE:



[3] Updates

- 15-06-2018 wind and wave load are updated
- 26-12-2017 input file is changed as text file; considering the static load
- 20-09-2017 option directions for earthquake data, eigen analysis
- 27-05-2017 analysis case
- 25-02-2017 guide for VC4OWT

VC4OWT

Vibration Control for Offshore Wind Turbine

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Contents

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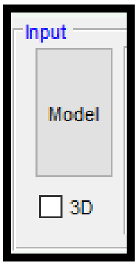
1. Introduction

The computer program VC4OWT (Vibration Control for Offshore Wind Turbine) is mainly used to evaluate the steel jacket platform seismic behavior by friction dampers and comparing them with steel brace. The used model in this program is evaluated in three cases, one case it is without brace and another case with steel braces and the last one with friction dampers. In addition, Soil-Structure Interaction can be considered in this program.

2. How to run VC4OWT?

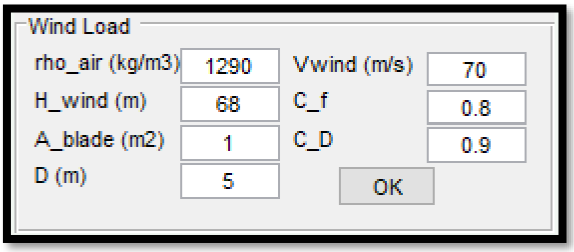
STEP 1 Input (Group 1)

1.1. Import model (e.g.model.inp)

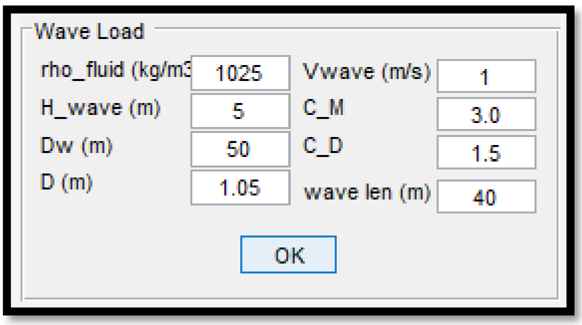


1.2. Wind and Wave loads

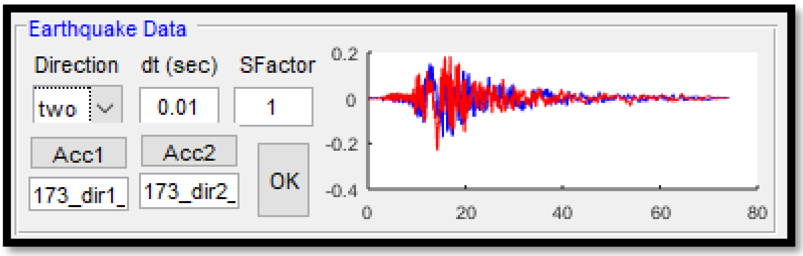
1.2.1. Wind Load



1.2.1 Wave Load

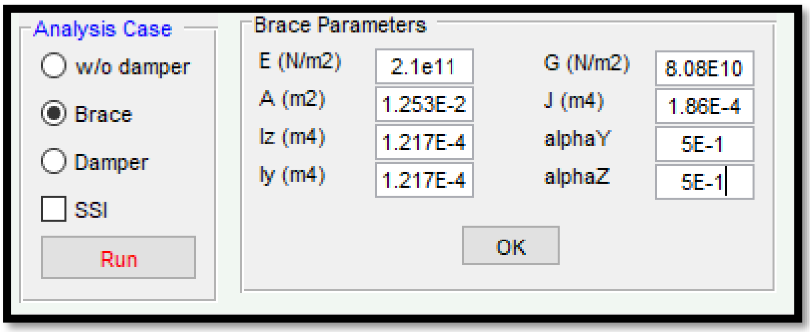


1.3. Earthquake data (3 options: x direction, y direction and two directions)

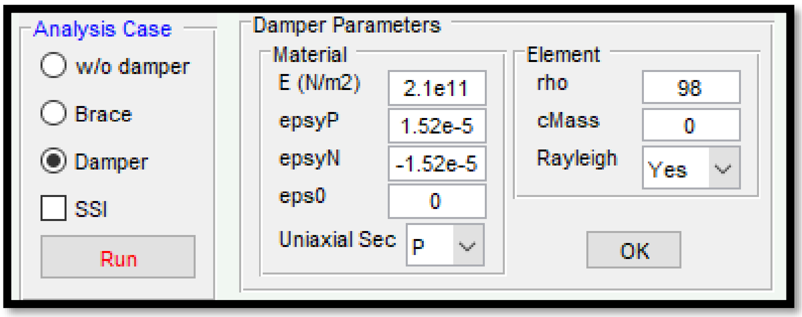


STEP 2 Analysis Cases (Group 2)

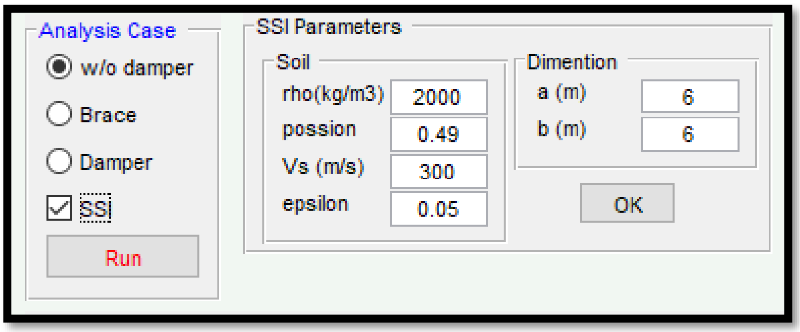
2.1. Brace properties



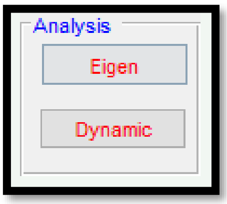
2.2. Damper properties



2.3. Soil properties



STEP 3 Analysis (Group 3)



3.1. Eigen Analysis

3.2. Dynamic Analysis

STEP 4 Output (Group 5)

4.1. Eigen value

4.2. Responses at tower base and top

4.3. Save data

4.4. Save figure

2. Input Data Format

Template Input Data file for VC4OWT

```
# --------------------------------- MEMBER NODES ---------------------------------------------
   nN          # Number of Nodes
# NodeID   xCrdyCrd    zCrd    mx      my      mz      mIx     mIy     mIz
#   (-)  (m)    (m)      (m)
    N[1]        x[1]    y[1]    z[1]    mx[1]   my[1]   mz[1]   mIx[1]  mIy[1]  mIz[1]
      :    :       :       :       :       :       :       :       :       :
   N[nN]        x[nN]   y[nN]   z[nN]   mx[nN]  my[nN]  mz[nN]  mIx[nN] mIy[nN] mIz[nN]


# --------------------------------- BOUNDARY CONDITIONS ---------------------------------------
   nS          # Number of Boundary Condition Nodes
# Node  x       y       z        xx      yy      zz      1=fixed, 0=free
    N[1]        Rx[1]   Ry[1]   Rz[1]   Rxx[1]  Ryy[1]  Rzz[1]
         :         :       :       :       :       :       :
 N[nS]  Rx[nB nS        Ry[nS]  Rz[nS]  Rxx[nS] Ryy[nS] Rzz[nS]


# --------------------------------- MULTI-POINT CONSTRAINTS ------------------------------------
 nMP            # Number of MP Constraints
#mNode          sNode          dof            #mNode: master node; sNode: slave node; dof (1 2 3 4 5 6)
   mN[1]               sN[1]          dof[1]         dof [1]        dof [1]
         :                 :              :              :              :
   mN[nMP]      sN[nMP 1]             dof[nMP]              dof [nMP]              dof [nMP]


# --------------------------------- MEMBER SECTIONS ---------------------------------------------
# E      : Modulus of Elasticity
# A      : Cross section Area
# Iy, Iz        : Moment of Inertia
# J             : Torsional Moment of Inertia
# G             : Shear Modulus
nSec           # Number of Sections
#           E(N/m^2)    Poisson's Ratioanpha
       2.10E+11         0.3           0.5
# SecID D       tw
#  (-)  (m)     (m)
    S[1]        D[1]    tw[1]
         :         :       :
    S[nSec]     D[nSec] tw[nSec]


# --------------------------------- GEOTRAN ELEMENTS ---------------------------------------------
   nGeo        # Number of Tower Geotrans
#  ID   vecxz
   G[1] vec[1]  vec [1] vec [1]
         :         :       :       :
   G[nGeo]      vec[nGeo]      vec [nGeo]      vec [nGeo]
```

```
# ---------------------------------- MEMBER ELEMENTS --------------------------------------------
  nE           # Number of Tower Elements
# + NIP:
# + massDens:  element mass density (per unit length), from which a lumped-mass matrix is formed
# + maxIters:  maximum number of iterations to undertake to satisfy element compatibility
# + tol:              tolerance for satisfaction of element compatibility
# NIP   massDens       maxIters       tol
    5   98      10     10E-12
# EleID NodeI          NodeJ          secTag         geoTran
   E[1] NodeI[1]              NodeJ[1]             secTag[1]              geoTran[1]
         :       :               :              :              :
   E[nE]       NodeI[nE]             NodeJ[nE]             secTag[nE]             geoTran[nE]


# ---------------------------------- PLATFORM SECTIONS --------------------------------------------
#SecID  h       E       Density        Poisson's Ratio
# (-)   (m)     (N/m^2) (N/m^3/g)              (-)
   ID[1]       h[1]     E[1]     Density[1]             ratio[1]


# ---------------------------------- PLATFORM ELEMENTS --------------------------------------------
   nEP         # Number of Platform Elements
# EleID NodeI          NodeJ          NodeK          NodeL          secTag
   EP[1]       NodeI[1]             NodeJ[1]             NodeK[1]             NodeL[1]
       secTag[1]
          :      :               :              :              :              :
  EP[1] NodeI[1]              NodeJ[1]             NodeK[1]             NodeL[1]
       secTag[1]


# ---------------------------------- SSI NODES --------------------------------------------
    2          # Number of SSI Nodes
# NodeID       xCrd     yCrd    zCrd
#  (-)  m)     (m)      (m)
N[1]    x[1]    y[1]    z[1]           # first node: assign mass
N[2]    x[2]    y[2]    z[2]           # second node: assign bound condition


# ---------------------------------- CONTROL ELEMENTS --------------------------------------------
    nC         # Number of Control Elements
# EleID NodeI          NodeJ          secTag         geoTran (for brace-e)
   EC[1]       NodeI[1]             NodeJ[1]             secTag[1]             geoTran[1]
           :     :               :              :              :
  EC[nC]       NodeI[nC]             NodeJ[nC]             secTag[nC]             geoTran[nC]
```

Note: Option [geoTran] is only used for brace control elements.

```
# ---------------------------------- STATIC LOADS --------------------------------------------
   64          # Number of Points for Wave Load
```

```
# ---------------------------------- OUTPUT NODE-----------------------------------------------
#BNode  TNode
   Base[1]     Top[1]

Note: Base and Top Node of tower


# End of input data file
```

3. Example

Example 1: To get the top and base point responses of the Wind Turbine with friction damper under Elcentro earthquake ignoring SSI effect.

3.1 Input Examples:

```
# -------------------------------- VC40WT Input File --------------------------------------
# -------------------------------- MEMBER NODES --------------------------------------------
   94          # Number of Nodes
# NodeID  xCrd    yCrd       zCrd       mx        my        mz        mIx       mIy       mIz
#  (-)        (m)            (m)       (m)
    1      4.00    4.00     20.15   54280.75  54280.75  54280.75     0.00      0.00      0.00
    2     -4.00    4.00     20.15   54280.75  54280.75  54280.75     0.00      0.00      0.00
    3     -4.00   -4.00     20.15   54280.75  54280.75  54280.75     0.00      0.00      0.00
    4      4.00   -4.00     20.15   54280.75  54280.75  54280.75     0.00      0.00      0.00
    5     -4.00    4.00     16.15    1395.76   1395.76   1395.76     0.00      0.00      0.00
    6      4.00    4.00     16.15    1395.76   1395.76   1395.76     0.00      0.00      0.00
    7      4.00   -4.00     16.15    1395.76   1395.76   1395.76     0.00      0.00      0.00
    8     -4.00   -4.00     16.15    1395.76   1395.76   1395.76     0.00      0.00      0.00
    9     -6.00    6.00    -49.50   17144.93  17144.93  17144.93     0.00      0.00      0.00
   10      6.00    6.00    -49.50   17144.93  17144.93  17144.93     0.00      0.00      0.00
   11      4.02    4.02     15.65    8513.60   8513.60   8513.60     0.00      0.00      0.00
   12     -4.02    4.02     15.65    8513.60   8513.60   8513.60     0.00      0.00      0.00
   13     -4.02   -4.02     15.65    8513.60   8513.60   8513.60     0.00      0.00      0.00
   14      4.02   -4.02     15.65    8513.60   8513.60   8513.60     0.00      0.00      0.00
   15     -4.39    4.39      4.38   18161.95  18161.95  18161.95     0.00      0.00      0.00
   16      4.39    4.39      4.38   18161.95  18161.95  18161.95     0.00      0.00      0.00
   17      4.39   -4.39      4.38   18161.95  18161.95  18161.95     0.00      0.00      0.00
   18     -4.39   -4.39      4.38   18161.95  18161.95  18161.95     0.00      0.00      0.00
   19      4.19    0.00     10.26    5411.91   5411.91   5411.91     0.00      0.00      0.00
   20     -4.19    0.00     10.26    5411.91   5411.91   5411.91     0.00      0.00      0.00
   21      0.00   -4.19     10.26    5411.91   5411.91   5411.91     0.00      0.00      0.00
   22      0.00    4.19     10.26    5411.91   5411.91   5411.91     0.00      0.00      0.00
   23     -4.82    4.82     -8.92   21271.72  21271.72  21271.72     0.00      0.00      0.00
   24      4.82    4.82     -8.92   21271.72  21271.72  21271.72     0.00      0.00      0.00
   25      4.82   -4.82     -8.92   21271.72  21271.72  21271.72     0.00      0.00      0.00
   26     -4.82   -4.82     -8.92   21271.72  21271.72  21271.72     0.00      0.00      0.00
   27      4.59    0.00     -1.96    6226.42   6226.42   6226.42     0.00      0.00      0.00
   28      0.00    4.59     -1.96    6226.42   6226.42   6226.42     0.00      0.00      0.00
   29     -4.59    0.00     -1.96    6226.42   6226.42   6226.42     0.00      0.00      0.00
   30      0.00   -4.59     -1.96    6226.42   6226.42   6226.42     0.00      0.00      0.00
   31     -5.33    5.33    -24.61   28769.94  28769.94  28769.94     0.00      0.00      0.00
   32      5.33    5.33    -24.61   28769.94  28769.94  28769.94     0.00      0.00      0.00
   33      5.33   -5.33    -24.61   28769.94  28769.94  28769.94     0.00      0.00      0.00
   34     -5.33   -5.33    -24.61   28769.94  28769.94  28769.94     0.00      0.00      0.00
   35      0.00   -5.06    -16.37    7194.84   7194.84   7194.84     0.00      0.00      0.00
   36      5.06    0.00    -16.37    7194.84   7194.84   7194.84     0.00      0.00      0.00
   37      0.00    5.06    -16.37    7194.84   7194.84   7194.84     0.00      0.00      0.00
   38     -5.06    0.00    -16.37    7194.84   7194.84   7194.84     0.00      0.00      0.00
   39     -5.94    5.94    -43.13   18159.82  18159.82  18159.82     0.00      0.00      0.00
   40      5.94    5.94    -43.13   18159.82  18159.82  18159.82     0.00      0.00      0.00
   41      5.94   -5.94    -43.13   18159.82  18159.82  18159.82     0.00      0.00      0.00
   42     -5.94   -5.94    -43.13   18159.82  18159.82  18159.82     0.00      0.00      0.00
```

```
 43     5.62     0.00   -33.37   8343.83   8343.83   8343.83     0.00     0.00     0.00
 44     0.00    -5.62   -33.37   8343.83   8343.83   8343.83     0.00     0.00     0.00
 45    -5.62     0.00   -33.37   8343.83   8343.83   8343.83     0.00     0.00     0.00
 46     0.00     5.62   -33.37   8343.83   8343.83   8343.83     0.00     0.00     0.00
 47    -5.97     5.97   -44.00   5922.01   5922.01   5922.01     0.00     0.00     0.00
 48     5.97     5.97   -44.00   5922.01   5922.01   5922.01     0.00     0.00     0.00
 49     5.97    -5.97   -44.00   5922.01   5922.01   5922.01     0.00     0.00     0.00
 50    -5.97    -5.97   -44.00   5922.01   5922.01   5922.01     0.00     0.00     0.00
 51    -6.00     6.00   -45.00   1063.84   1063.84   1063.84     0.00     0.00     0.00
 52     6.00     6.00   -45.00   1063.84   1063.84   1063.84     0.00     0.00     0.00
 53     6.00    -6.00   -45.00   1063.84   1063.84   1063.84     0.00     0.00     0.00
 54    -6.00    -6.00   -45.00   1063.84   1063.84   1063.84     0.00     0.00     0.00
 55    -6.00     6.00   -45.50  16750.61  16750.61  16750.61     0.00     0.00     0.00
 56     6.00     6.00   -45.50  16750.61  16750.61  16750.61     0.00     0.00     0.00
 57     6.00    -6.00   -45.50  16750.61  16750.61  16750.61     0.00     0.00     0.00
 58    -6.00    -6.00   -45.50  16750.61  16750.61  16750.61     0.00     0.00     0.00
 59     6.00    -6.00   -49.50  17144.93  17144.93  17144.93     0.00     0.00     0.00
 60    -6.00    -6.00   -49.50  17144.93  17144.93  17144.93     0.00     0.00     0.00
 61    -6.00     6.00   -50.00    748.91    748.91    748.91     0.00     0.00     0.00
 62     6.00     6.00   -50.00    748.91    748.91    748.91     0.00     0.00     0.00
 63     6.00    -6.00   -50.00    748.91    748.91    748.91     0.00     0.00     0.00
 64    -6.00    -6.00   -50.00    748.91    748.91    748.91     0.00     0.00     0.00
 65    -4.00     0.00    20.15  57756.73  57756.73  57756.73     0.00     0.00     0.00
 66     0.00    -4.00    20.15  57756.73  57756.73  57756.73     0.00     0.00     0.00
 67     4.00     0.00    20.15  57756.73  57756.73  57756.73     0.00     0.00     0.00
 68     0.00     4.00    20.15  57756.73  57756.73  57756.73     0.00     0.00     0.00
 69     0.00     0.00    20.15 116612.20 116612.20 116612.20     0.00     0.00     0.00
 70     0.00     0.00    20.65  14229.62  14229.62  14229.62     0.00     0.00     0.00
 71    -4.00    -4.00    18.15   2289.12   2289.12   2289.12     0.00     0.00     0.00
 72     4.00    -4.00    18.15   2289.12   2289.12   2289.12     0.00     0.00     0.00
 73     4.00     4.00    18.15   2289.12   2289.12   2289.12     0.00     0.00     0.00
 74    -4.00     4.00    18.15   2289.12   2289.12   2289.12     0.00     0.00     0.00
 76    -4.80    -4.00    20.15  12706.48  12706.48  12706.48     0.00     0.00     0.00
 77    -4.80     4.00    20.15  12706.48  12706.48  12706.48     0.00     0.00     0.00
 78    -4.00    -4.80    20.15  12706.48  12706.48  12706.48     0.00     0.00     0.00
 79     4.00    -4.80    20.15  12706.48  12706.48  12706.48     0.00     0.00     0.00
 80     0.00     0.00    26.65  33675.17  33675.17  33675.17     0.00     0.00     0.00
 81     0.00     0.00    37.15  39743.21  39743.21  39743.21     0.00     0.00     0.00
 82     0.00     0.00    48.15  34749.87  34749.87  34749.87     0.00     0.00     0.00
 83     0.00     0.00    59.15  27877.94  27877.94  27877.94     0.00     0.00     0.00
 84     0.00     0.00    69.15  22424.58  22424.58  22424.58     0.00     0.00     0.00
 85     0.00     0.00    78.65  20685.79  20685.79  20685.79     0.00     0.00     0.00
 86     0.00     0.00    85.65  14260.48  14260.48  14260.48     0.00     0.00     0.00
 87     0.00     0.00    88.15 353672.30 353672.30 353672.30     0.00     0.00     0.00
 88     4.80    -4.00    20.15  12706.48  12706.48  12706.48     0.00     0.00     0.00
 89     4.80     4.00    20.15  12706.48  12706.48  12706.48     0.00     0.00     0.00
 90     4.00     4.80    20.15  12706.48  12706.48  12706.48     0.00     0.00     0.00
 91    -4.00     4.80    20.15  12706.48  12706.48  12706.48     0.00     0.00     0.00
 92    -4.80     4.80    20.15   1155.13   1155.13   1155.13     0.00     0.00     0.00
 93     4.80     4.80    20.15   1155.13   1155.13   1155.13     0.00     0.00     0.00
 94     4.80    -4.80    20.15   1155.13   1155.13   1155.13     0.00     0.00     0.00
 95    -4.80    -4.80    20.15   1155.13   1155.13   1155.13     0.00     0.00     0.00

# -------------------------------- BOUNDARY CONDITIONS -------------------------------------
    4              # Number of Boundary Condition Nodes
# Node  x    y    z   xx   yy   zz          1=fixed, 0=free
```

```
   61    1    1    1    1    1    1
   62    1    1    1    1    1    1
   63    1    1    1    1    1    1
   64    1    1    1    1    1    1

# -------------------------------- MULTI-POINT CONSTRAINTS ----------------------------------
       4              # Number of MP Constraints
#mNode  sNode     dof         #mNode: master node; sNode: slave node; dof (1 2 3 4 5 6)
   69    1    1    2    3
   69    2    1    2    3
   69    3    1    2    3
   69    4    1    2    3

# -------------------------------- MEMBER SECTIONS -----------------------------------------
# E         : Modulus of Elasticity
# A      : Cross section Area
# Iy, Iz: Moment of Inertia
# J      : Torsional Moment of Inertia
# G      : Shear Modulus
   15          # Number of Sections
#          E(N/m^2)   Poisson's Ratioanpha
        2.10E+11        0.3          0.5
# SecID           D        tw
#  (-)       (m)         (m)
    1      0.800     0.020
    2      1.200     0.050
    3      1.200     0.035
    4      1.200     0.040
    5      2.080     0.491
    6      2.080     0.060
    7      5.600     0.032
    8      5.557     0.032
    9      5.318     0.030
   10      5.082     0.028
   11      4.800     0.024
   12      4.565     0.022
   13      4.329     0.020
   14      4.118     0.030
   15      4.000     0.030

# -------------------------------- GEOTRAN ELEMENTS -----------------------------------------
   40          # Number of Tower Geotrans
#  ID   vecxz
    1    1.00E+00  0.00E+00  0.00E+00
    2    0.00E+00  1.00E+00  0.00E+00
    3    0.00E+00 -1.00E+00  0.00E+00
    4   -1.00E+00  0.00E+00  0.00E+00
    5   -7.07E-01 -7.07E-01  0.00E+00
    6    7.07E-01 -7.07E-01  0.00E+00
    7    7.07E-01  7.07E-01  0.00E+00
    8   -7.07E-01  7.07E-01  0.00E+00
    9    9.99E-01  4.39E-02  0.00E+00
   10    9.99E-01 -4.39E-02  0.00E+00
   11   -9.99E-01  4.39E-02  0.00E+00
   12   -9.99E-01 -4.39E-02  0.00E+00
   13   -4.39E-02 -9.99E-01  0.00E+00
```

```
   14  -4.39E-02  9.99E-01  0.00E+00
   15   4.39E-02  9.99E-01  0.00E+00
   16   7.07E-01  7.07E-01  0.00E+00
   17   9.99E-01 -4.72E-02  0.00E+00
   18  -9.99E-01 -4.72E-02  0.00E+00
   19   4.72E-02  9.99E-01  0.00E+00
   20  -4.72E-02  9.99E-01  0.00E+00
   21  -9.99E-01  4.72E-02  0.00E+00
   22   9.99E-01  4.72E-02  0.00E+00
   23  -4.72E-02 -9.99E-01  0.00E+00
   24  -4.72E-02  9.99E-01  0.00E+00
   25  -5.05E-02 -9.99E-01  0.00E+00
   26  -5.05E-02  9.99E-01  0.00E+00
   27   9.99E-01  5.05E-02  0.00E+00
   28   9.99E-01 -5.05E-02  0.00E+00
   29  -5.05E-02 -9.99E-01  0.00E+00
   30  -5.05E-02  9.99E-01  0.00E+00
   31  -9.99E-01  5.05E-02  0.00E+00
   32  -9.99E-01 -5.05E-02  0.00E+00
   33   9.99E-01 -5.37E-02  0.00E+00
   34  -9.99E-01 -5.37E-02  0.00E+00
   35  -5.37E-02 -9.99E-01  0.00E+00
   36  -5.37E-02  9.99E-01  0.00E+00
   37  -9.99E-01  5.37E-02  0.00E+00
   38   9.99E-01  5.37E-02  0.00E+00
   39   5.37E-02  9.99E-01  0.00E+00
   40  -5.37E-02  9.99E-01  0.00E+00

# ----------------------------------- MEMBER ELEMENTS -------------------------------------------
  125          # Number of Tower Elements
# + NIP:
# + massDens:  element mass density (per unit length), from which a lumped-mass matrix is formed
# + maxIters:  maximum number of iterations to undertake to satisfy element compatibility
# + tol:               tolerance for satisfaction of element compatibility
# NIP   massDens       maxIters       tol
    5         98         10    10E-12
# EleID   NodeI     NodeJ      secTag   geoTran
    2          8        71         4         2
    3         71         3         4         2
    4          7        72         4         2
    5         72         4         4         2
    6          6        73         4         2
    7         73         1         4         2
    8          2        74         4         3
    9         74         5         4         3
   19         12         5         3         5
   20         13         8         3         6
   21         14         7         3         7
   22         11         6         3         8
   25         69        70         7         2
   26         70        80         8         2
   27         18        13         3         6
   28         17        14         3         7
   29         12        15         3         7
   30         11        16         3         6
   31         80        81         9         2
```

32	81	82	10	2
33	82	83	11	2
34	83	84	12	2
35	84	85	13	2
36	85	86	14	2
37	41	49	2	5
38	49	53	2	5
39	17	19	1	9
40	19	11	1	9
41	14	19	1	10
42	19	16	1	10
43	12	20	1	11
44	20	18	1	11
45	15	20	1	12
46	20	13	1	12
47	13	21	1	13
48	21	17	1	13
49	14	21	1	14
50	21	18	1	14
51	16	22	1	14
52	22	12	1	14
53	11	22	1	15
54	22	15	1	15
55	86	87	15	2
59	15	23	3	16
60	17	25	3	5
61	26	18	3	6
62	24	16	3	8
64	53	57	2	3
65	57	59	5	3
66	59	63	6	3
67	64	60	6	2
68	60	58	5	2
69	58	54	2	2
70	54	50	2	6
71	17	27	1	17
72	27	24	1	17
73	16	27	1	18
74	27	25	1	18
75	16	28	1	19
76	28	23	1	19
77	24	28	1	20
78	28	15	1	20
79	15	29	1	21
80	29	26	1	21
81	18	29	1	22
82	29	23	1	22
83	18	30	1	23
84	30	25	1	23
85	17	30	1	24
86	30	26	1	24
91	31	23	3	5
92	33	25	3	7
93	34	26	3	6
94	32	24	3	8
95	50	42	2	6

96	39	47	2	7
97	26	35	1	25
98	35	33	1	25
99	25	35	1	26
100	35	34	1	26
101	47	51	2	16
102	51	55	2	3
103	33	36	1	27
104	36	24	1	27
105	25	36	1	28
106	36	32	1	28
107	55	9	5	3
108	9	61	6	3
109	31	37	1	29
110	37	24	1	29
111	32	37	1	30
112	37	23	1	30
113	62	10	6	2
114	10	56	5	2
115	23	38	1	31
116	38	34	1	31
117	31	38	1	32
118	38	26	1	32
123	31	39	2	7
124	33	41	2	5
125	42	34	2	6
126	40	32	2	8
127	40	48	2	6
128	48	52	2	6
129	52	56	2	3
135	33	43	1	33
136	43	40	1	33
137	32	43	1	34
138	43	41	1	34
139	34	44	1	35
140	44	41	1	35
141	33	44	1	36
142	44	42	1	36
143	31	45	1	37
144	45	42	1	37
145	34	45	1	38
146	45	39	1	38
147	32	46	1	39
148	46	39	1	39
149	40	46	1	40
150	46	31	1	40
151	47	48	1	3
152	48	49	1	4
153	49	50	1	2
154	50	47	1	1

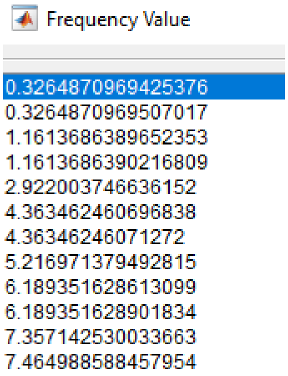
---------------------------------- PLATFORM SECTIONS ---

#SecID	h	E	Density	Poisson's Ratio
# (-)	(m)	(N/m^2)	(N/m^3/g)	(-)
16	4	2.10E+11	0.00	0.3

```
# ---------------------------------- PLATFORM ELEMENTS --------------------------------------------
   12          # Number of Platform Elements
# EleID   NodeI     NodeJ     NodeK     NodeL   secTag
 1001        65        69        68           2        16
 1002        69        67         1          68        16
 1003         3        66        69          65        16
 1004        66         4        67          69        16
 1005        76         3         2          77        16
 1006        78        79         4           3        16
 1007         4        88        89           1        16
 1008         2         1        90          91        16
 1009        77         2        91          92        16
 1010         1        89        93          90        16
 1011        79        94        88           4        16
 1012        95        78         3          76        16

# ---------------------------------- SSI NODES --------------------------------------------
    2          # Number of SSI Nodes
# NodeID   xCrd    yCrd       zCrd
#  (-)        (m)              (m)       (m)
   75      0.00     0.00   -50.001
   96      0.00     0.00   -50.001

# ---------------------------------- CONTROL ELEMENTS --------------------------------------------
    4          # Number of Control Elements
# EleID   NodeI     NodeJ       secTag  geoTran (for brace-e)
    1         1        81         17         8
   10         2        81         17         5
   11         3        81         17         6
   12         4        81         17         7

# ---------------------------------- STATIC LOADS --------------------------------------------
   64          # Number of Points for Wave Load

# ---------------------------------- OUTPUT NODE--------------------------------------------
#BNode   TNode
   69    87

# End of input data file
```

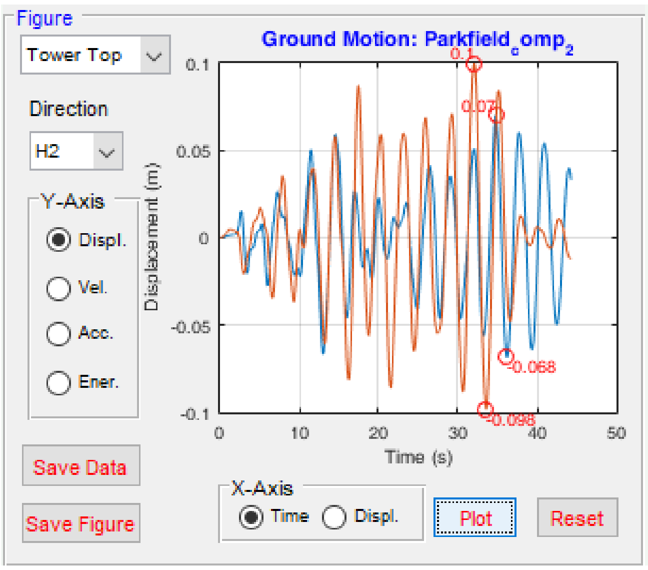
3.2 Output

3.2.1 Eigen

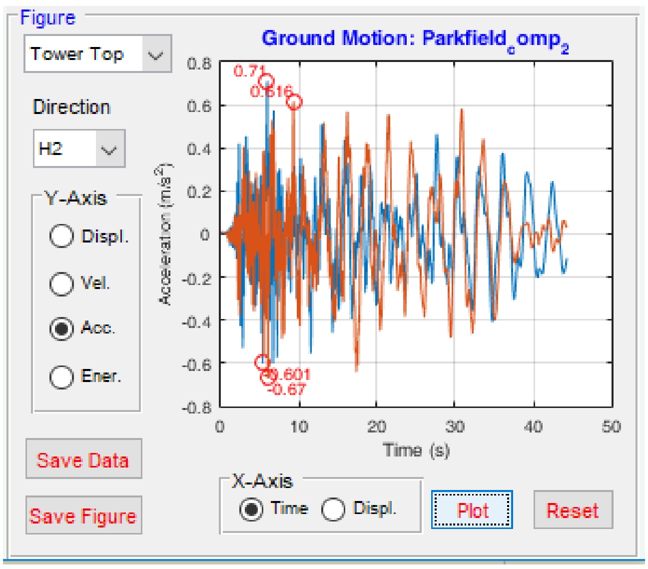


3.2.2 Response

Top Displacement:



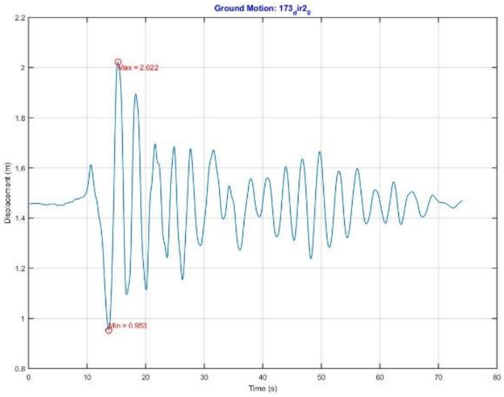
Total acceleration at tower top

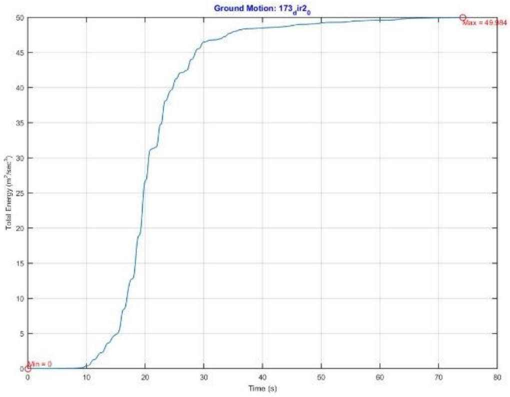


3.3 Save

3.3.1 Save Data

3.3.2 Save Figure



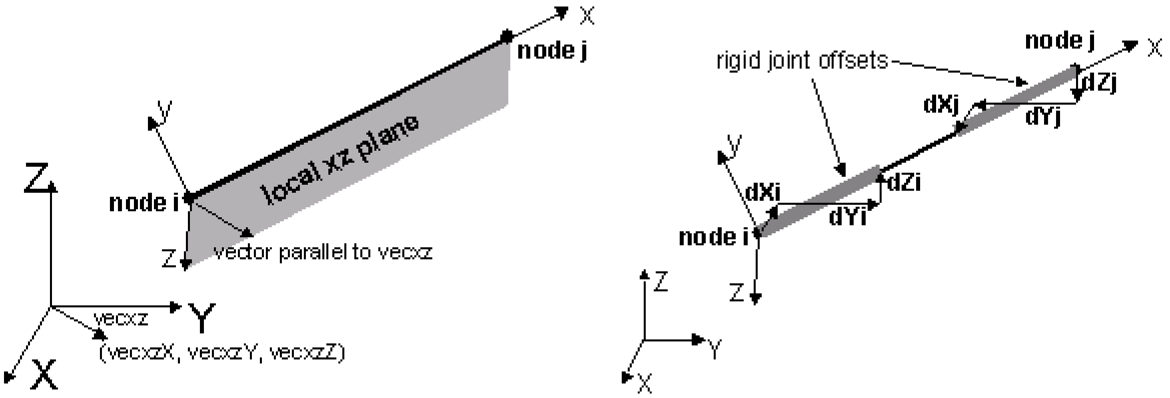


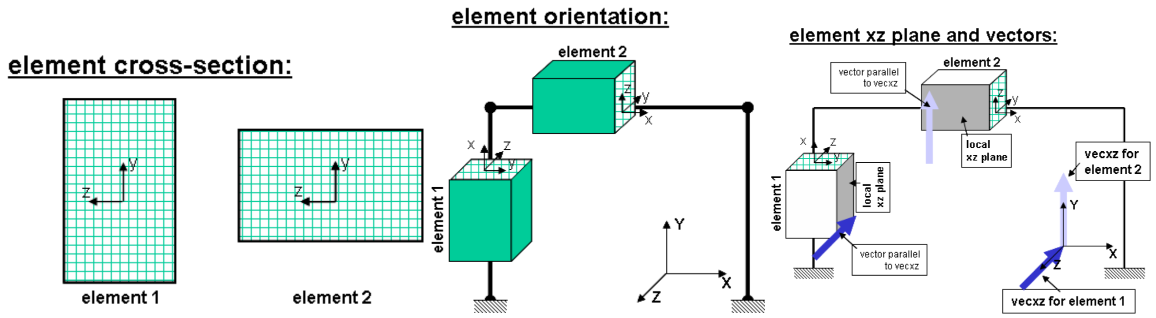
4. Appendix

4.1 Element Coordinate Transformation

The element coordinate system is specified as follows:

The x-axis is a vector given by the two element nodes; The vector vecxz is a vector the user specifies that must not be parallel to the x-axis. The x-axis along with the vecxz Vector define the xz plane. The local y-axis is defined by taking the cross product of the x-axis vector and the vecxz vector (Vy = Vxz X Vx). The local z-axis is then found simply by taking the cross product of the y-axis and x-axis vectors (Vz = Vx X Vy). The section is attached to the element such that the y-z coordinate system used to specify the section corresponds to the y-z axes of the element.





References

- Dookie Kim (2017). Dynamics of Structures: 4th Edition, Goomibook
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