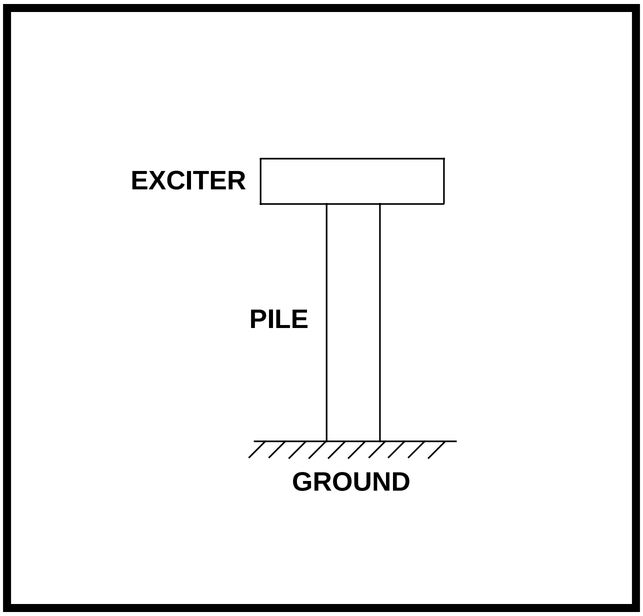
WORKSHOP PROBLEM 12

Complex Modes of a Pile Driver



Objectives

- Define complex eigenvalue extraction parameters.
- Submit the file for analysis in MSC/NASTRAN.
- Compute complex modes.

Model Description:

The model is idealized as shown below in Figure 12.1. (Note that both a spring element and a damper element will be created connected Grid 2 and Grid 3.)

Figure 12.1-Model Description

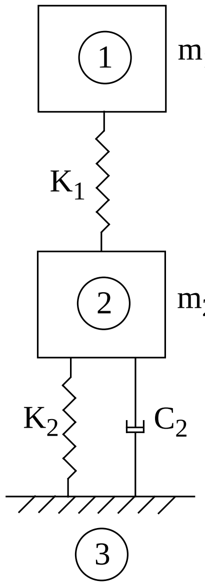


Table 12.1

m_1	**3.0 lb-sec^2/in**
m_2	**1.5 lb-sec^2/in**
K_1	**50,000 lb/in**
K_2	**12,500 lb/in**
C_2	**30 lb-sec/in**

Suggested Exercise Steps

- Generate an input file and submit it to the MSC/NASTRAN solver for complex eigenvalue analysis.
- Generate a finite element representation of the pile driver using GRID, CONM2, CELAS, and CVISC elements.
- Define material (MAT1), and element (PELAS) and (PVISC) properties.
- Apply x-direction boundary constraint (SPC1).
- Specify complex eigenvalue extraction parameters (CMETHOD) and (EIGC).
- Prepare the model for complex eigenvalue analysis (SOL107).
- Review the results, specifically the complex eigenvalues.

```
ID SEMINAR,PROB12
```

```
CEND
```

```
BEGIN BULK
```

1	2	3	4	5	6	7	8	9	10

1	2	3	4	5	6	7	8	9	10

ENDDATA

Exercise Procedure:

1. Users who are not utilizing MSC/PATRAN for generating an input file should go to Step 16, otherwise, proceed to step 2.

2. Create a new database and named **prob12.db**

   File/New Database

New Database Name	**prob12**

   OK

   In the *New Model Preference* form set the following:

Tolerance	◆ **Default**
Analysis code:	**MSC/NASTRAN**

   OK

3. Create the model by the edit method in **Finite Elements**.

   ◆ **Finite Elements**

Action:	**Create**
Object:	**Node**
Method:	**Edit**

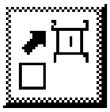
   ❑ **Associate with Geometry**

Node Location List	**[0 0 0]**

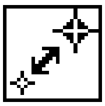
   Apply

   Turn on the label and increase the node size by using the Quick Pick buttons.

   Show Label

   Node Size

4. Similarly, create Nodes 2 and 3.

Node	**Location**
Node 2	[1 0 0]
Node 3	[2 0 0]

5. Create the Bar Element for Node 1 and Node 2.

◆ **Finite Element**

Action:	**Create**
Object:	**Element**
Method:	**Edit**
Shape	**Bar**
Node 1 =	**Node 1**
Node 2 =	**Node 2**

Apply

6. Similarly, create the 2nd bar element by:

Node 1 =	**Node 2**
Node 2 =	**Node 3**

Apply

7. Create the 2 mass elements at Node 1 and Node 2.

◆ **Finite Element**

Action:	**Create**
Object:	**Element**
Method:	**Edit**
Shape:	**Point**
Element ID List	**3**
Node 1 =	**Node 1**

Apply

Element ID List	**4**
Node 1 =	**Node 2**

Apply

8. Create the damper elements connecting Node 2 and Node 3.

◆ **Finite Element**

Action:	**Create**
Object:	**Element**
Method:	**Edit**
Shape	**Bar**
Node 1 =	**Node 2**
Node 2 =	**Node 3**

Apply

9. Create Element Properties, (spring constant).

◆ **Properties**

Action:	**Create**
Dimension:	**1D**
Type:	**Spring**
Property Set Name:	**spring1**

Input Properties ...

Spring Constant:	**50000**
DOF at Node 1:	**UX**
DOF at Node 2:	**UX**

OK

Application Region (*In the select menu, select the **Beam Element** filter.*)	**Element 1**

Beam Element

Add

Apply

10. Similarly, create the spring constant of 12,500 for the 2nd spring element.

Property Set Name: **spring2**

Input Properties ...

Spring Constant: **12500**

DOF at Node 1: **UX**

DOF at Node 2: **UX**

OK

Application Region **Element 2**

Add

Apply

11. Create Element Properties, (damper coefficient), for the damper element:

◆ **Properties**

Action: **Create**

Dimension: **1D**

Type: **Damper**

Property Set Name: **damper**

Option(s)... **Viscous**

Input Properties ...

[Ext. Viscous Coeff.] **30**

OK

Application Region **Element 5**

Add
Apply

12. Create the mass properties of the mass elements.

◆ **Properties**

Action:	**Create**
Dimension:	**0D**
Type:	**Mass**
Property Set Name:	**mass1**
Option(s):	**Lumped**
Input Properties ...	
Mass:	**3**
OK	
Application Region *(In the select menu, select the* ***Point Element*** *filter.)*	**Element 3**

○ **Point Element**

Add
Apply

13. Similarly, create the mass property of the 2nd mass element:

◆ **Properties**

Action:	**Create**
Dimension:	**0D**
Type:	**Mass**
Property Set Name:	**mass2**
Option:	**Lumped**

Input Properties ...

Mass: **1.5**

OK

Application Region **Element 4**

Add

Apply

14. Create the constraint at the ground, Node 3.

◆ **Load/BCs**

Action: **Create**

Object: **Displacement**

Type: **Nodal**

New Set Name: **constraint**

Input Data...

Translations < T1 T2 T3 > **< 0, , >**

OK

Select Application Region...

◆ **FEM**

Select Nodes: **Node 3**

Add

OK

Apply

15. Create the analysis deck.

◆ **Analysis**

Action: **Analyze**

Object: **Entire Model**

Method: **Analysis Deck**

Job Name: **prob12**

Solution Type...	
Solution Type:	**◆ COMPLEX EIGENVALUES**
Solution Parameters ...	
Formulation	**Direct**
Complex Eigenvalue...	
Number of Desired Roots=	**4**
OK	
OK	
OK	
Apply	

Generating an input file for MSC/NASTRAN Users:

MSC/NASTRAN users can generate an input file using the data previously stated. The result should be similar to the output below.

16. MSC/NASTRAN input file: **prob12.dat**

```
ID SEMINAR, PROB12
SOL 107
TIME 5
CEND
TITLE= TWO-DOF MODEL (IMAC 8, PG 891)
SUBTITLE= COMPLEX MODES
DISPLACEMENT= ALL $ DEFAULT= REAL, IMAGINARY
SPC= 100
CMETHOD= 99
$
BEGIN BULK
$
$ COMPLEX EIGENVALUE EXTRACTION PARAMETERS
$
EIGC, 99, HESS, , , , , 4
$
$ DEFINE GRIDS, MASSES, AND STIFFNESSES
$  GRID 1 = EXCITER (X=2, MASS=3)  50K STIFFNESS BETWEEN GRIDS 1 AND 2
$  GRID 2 = PILE (X=1, MASS=3)   12.5K STIFFNESS BETWEEN GRIDS 2 AND 3
$  GRID 3 = BASE (X=0, FIX BASE)
$
GRID, 1, , 2., 0., 0.
GRID, 2, , 1., 0., 0.
GRID, 3, , 0., 0., 0.
GRDSET, , , , , , , 23456
CELAS2, 1, 50000., 1, 1, 2, 1
CELAS2, 2, 12500., 2, 1, 3, 1
CONM2, 201, 1, , 3.0
CONM2, 202, 2, , 1.5
SPC, 100, 3, 1
$
$ DEFINE DAMPER OF 30 BETWEEN GRIDS 2 AND 3
$
CVISC, 101, 1, 2, 3
PVISC, 1, 30.
$
ENDDATA
```

Submitting the input file for analysis:

17. Submit the input file to MSC/NASTRAN for analysis.

    17a. To submit the MSC/PATRAN **.bdf** file, find an available UNIX shell window. At the command prompt enter **nastran prob12.bdf scr=yes**. Monitor the run using the UNIX **ps** command.

    17b. To submit the MSC/NASTRAN **.dat** file, find an available UNIX shell window and at the command prompt enter **nastran prob12 scr=yes**. Monitor the run using the UNIX **ps** command.

18. When the run is completed, edit the **prob12.f06** file and search for the word **FATAL**. If no matches exist, search for the word **WARNING**. Determine whether existing WARNING messages indicate modeling errors.

19. While still editing **prob12.f06**, search for the word:

    E I G E N V A L U E (spaces are necessary).

Comparison of Results

20. Compare the results obtained in the **.f06** file with the results on the following page:

```
                                  C O M P L E X   E I G E N V A L U E   S U M M A R Y
          ROOT     EXTRACTION                EIGENVALUE                       FREQUENCY              DAMPING
           NO.        ORDER             (REAL)           (IMAG)                (CYCLES)             COEFFICIENT
               1          2         -2.660969E+00    -4.983521E+01          7.931520E+00           1.067907E-01
               2          3         -7.339031E+00    -2.360312E+02          3.756553E+01           6.218695E-02
               3          1         -2.660969E+00     4.983521E+01          7.931520E+00           1.067907E-01
               4          4         -7.339031E+00     2.360312E+02          3.756553E+01           6.218695E-02
                                                                                                  SUBCASE 1
COMPLEX EIGENVALUE = -2.660969E+00, -4.983521E+01
                                C O M P L E X   E I G E N V E C T O R   NO.         1
                                                   (REAL/IMAGINARY)

POINT ID.   TYPE          T1             T2             T3             R1             R2             R3
      1      G      1.000000E+00    .0             .0             .0             .0             .0
                     .0             .0             .0             .0             .0             .0
      2      G      8.514119E-01    .0             .0             .0             .0             .0
                    1.591320E-02    .0             .0             .0             .0             .0
      3      G       .0             .0             .0             .0             .0             .0
                     .0             .0             .0             .0             .0             .0
                                                                                                  SUBCASE 1
COMPLEX EIGENVALUE = -7.339031E+00, -2.360312E+02
                                C O M P L E X   E I G E N V E C T O R   NO.         2
                                                   (REAL/IMAGINARY)

POINT ID.   TYPE          T1             T2             T3             R1             R2             R3
      1      G     -4.241094E-01    .0             .0             .0             .0             .0
                   -3.768431E-02    .0             .0             .0             .0             .0
      2      G      1.000000E+00    .0             .0             .0             .0             .0
                     .0             .0             .0             .0             .0             .0
      3      G       .0             .0             .0             .0             .0             .0
                     .0             .0             .0             .0             .0             .0
                                                                                                  SUBCASE 1
COMPLEX EIGENVALUE = -2.660969E+00,  4.983521E+01
                                C O M P L E X   E I G E N V E C T O R   NO.         3
                                                   (REAL/IMAGINARY)

POINT ID.   TYPE          T1             T2             T3             R1             R2             R3
      1      G      1.000000E+00    .0             .0             .0             .0             .0
                     .0             .0             .0             .0             .0             .0
      2      G      8.514119E-01    .0             .0             .0             .0             .0
                   -1.591320E-02    .0             .0             .0             .0             .0
      3      G       .0             .0             .0             .0             .0             .0
                     .0             .0             .0             .0             .0             .0
                                                                                                  SUBCASE 1
COMPLEX EIGENVALUE = -7.339031E+00,  2.360312E+02
                                C O M P L E X   E I G E N V E C T O R   NO.         4
                                                   (REAL/IMAGINARY)

POINT ID.   TYPE          T1             T2             T3             R1             R2             R3
      1      G     -4.241094E-01    .0             .0             .0             .0             .0
                    3.768431E-02    .0             .0             .0             .0             .0
      2      G      1.000000E+00    .0             .0             .0             .0             .0
                     .0             .0             .0             .0             .0             .0
      3      G       .0             .0             .0             .0             .0             .0
                     .0             .0             .0             .0             .0             .0
```

21. MSC/NASTRAN Users have finished this exercise. MSC/ PATRAN Users should proceed to the next step.

22. Proceed with the Reverse Translation process, that is importing the **prob12.op2** results file into MSC/PATRAN. To do this, return to the ***Analysis*** form and proceed as follows.

◆ **Analysis**

Action:	**Read Output2**
Object:	**Result Entities**
Method:	**Translate**
Select Results File...	
Select Available Files	**prob12.op2**
OK	
Apply	

23. View the results.

◆ **Results**

Form Type:	**Basic**
Select Result Cases	**<select one of the modes>**
Select Deformation Result	**2.1-Eigenvectors, Translation**