

Demonstration Problem Manual

For the

MYSTRAN General Purpose Finite Element

Structural Analysis Computer Program

(May 2010)

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Preface

This manual is not a complete reference for all types of MYSTRAN analyses but does contain example problems to demonstrate the use of MYSTRAN for solving unique kinds of problems. At the present time, only examples that use the unique Craig-Bampton model generation and synthesis capability are covered. Additional examples will be added as needed to explain how to use the program for solving problems not generally covered by the popular NASTRAN computer program known to most users of finite element analysis computer programs

1 Demo Problem 1 – Craig-Bampton model generation and synthesis into an overall structure model

1.1 Example Problem Definition

1.1.1 Introduction

This example demonstrates two different features in MYSTRAN:

- Generation of Craig-Bampton (CB) models from physical finite element model (FEM). See Appendix C in the MYSTRAN User's Reference manual for a discussion of the theory behind Craig-Bampton substructure modeling.
- Synthesis of CB models, with optional physical FEM's, into overall system models.

Figure 1.1 shows a model made up of a basic structure and 2 substructures. The model can certainly be analyzed as a physical FEM using SOL 3 to obtain the modes of the combined structure. It actually will be so analyzed as a comparison with the CB synthesis model results, but the main purpose of this example is to demonstrate how a structure like the one in Figure 1.1 can be modeled with substructures using the CB substructure technique. The CB reduction technique will be referred to as a modal synthesis or substructure technique to distinguish from the ordinary FEM technique wherein all degrees of freedom (DOF) are physical displacements and rotations at grid points

The simple structure in Figure 1.1 is small enough that using substructure techniques are not economical but is used to demonstrate the techniques that would be used on much larger structural models. The CB technique is a mathematical reduction of the ordinary FEM model having all physical DOF to an approximate model consisting of the physical DOF at the boundary of the substructure (where it connects to other substructures) plus some fixed boundary modal DOF. The technique is exactly equivalent to obtaining the modes (eigenvalues) from the ordinary FEM with all physical DOF if all of the fixed boundary modes are included. However, the economy in using the CB approach is that the user can truncate the boundary modal DOF to some acceptably small fraction of all of the complete set without appreciable loss of accuracy. From a physical point of view, this statement is equivalent to saying that the substructure probably has many higher modes of vibration that are not of interest to the user and do not contribute significantly to the responses of interest to the user.

The first step in a modal synthesis is to break the complete structure into separate substructures. In many cases this is a process of convenience in that separate entities may be responsible for different parts of a structure and would have their own FEM's of their structure's designs. However, there are also modeling concerns, as listed below, in breaking the complete structure into separate substructures:

- It is more economical to separate the substructures at locations where there are a relatively few physical boundary DOF.
- In order to take advantage of modal truncation the separate substructures should be able to be adequately represented using only a small number of modes.

In Figure 1.1 we have already taken into account the considerations above and have made the decision to separate the model into 3 parts:

- A basic structure consisting of the frame of CBAR's connected to the grids numbered in the range 111 to 222. This will be kept as a physical FEM in the analysis rather than reducing it to a CB model.

- Substructure 1, modeled as 1 CBAR from grids 3101 to 3102. This physical FEM will be reduced to a CB model containing only the boundary DOF's (6 components of motion at grid 3101) plus some modal DOF's.
- Substructure 2, modeled as a frame of CBAR's connecting grids 3201 through 3204. This physical FEM will be reduced to a CB model containing only the boundary DOF's (in this case the 3 translation components of motion at grids 3201, 3202, 3203) plus some modal DOF's

Sections 1.1.2 and 1.1.3 will explain the input/output data for the 2 CB models. Section 1.1.4 will explain the model to obtain the system modes using these 2 CB models and the physical FEM of the basic structure. Finally, section 1.1.5 will show that the CB synthesis results are the same as those from a completely physical FEM model.

1.1.2 Generation of Craig-Bampton model of substructure 1

Section 1.4 has the input data for the generation of a CB model of substructure 1. Note the following regarding the input data deck (see Figure 1.1 for a picture of this substructure):

- SOL 31 is for CB model generation
- OUTPUT4 calls for CB matrices KRRGN and MRRGN (NASTRAN nomenclature for MYSTRAN matrices KXX and MXX) to be output to binary OUTPUT4 formatted files.
- METHOD = 2 selects an EIGR with set ID = 2 to find the eigenvalues (so modes found will be fixed base relative to the boundary DOF's identified by the SUPORT Bulk Data entry)
- Model has 2 GRID's and 1 CBAR
- Coordinate system 19 is used for the global system for the 2 grids. This is only done to demonstrate the flexibility of MYSTRAN to deal with coordinate systems other than basic in CB analyses
- The only mass is a concentrated mass at grid 3102
- SUPORT identifies the boundary DOF for this substructure to be the 3 translation components of displacement at grid 3101
- PARAM CUSERIN requests MYSTRAN to print out equivalent CUSERIN Bulk Data entries for this substructure

The output is shown on the following pages in section 1.4. Note the following:

- Grid Point Weight Generator output shows the rigid body mass properties of substructure 1 relative to its basic coordinate system.
- *INFORMATION: message listed shows that matrices KXX, MXX, RBM0 have been written to binary file CB1d-SUBSTR-1-CB-MODEL.OP1 which will be used in the synthesis run (section 1.6)
- Based on Bulk data PARAM CUSERIN, the Bulk Data entries needed in the synthesis run for this CB substructure is listed. Some of the entries will have to be modified (e.g. CID0 must be defined) for the synthesis run in section 1.6

- Only 3 eigenvalues were found although 4 were requested. Since the model has only 3 mass DOF, there are only 3 finite eigenvalues. Normally we would not be asking for all modes in a CB analysis but are doing so here so that the system modes can be compared to a run in which a complete FEM model is used (section 1.7)
- Output of displacements was requested in Case Control and the output is shown next. Note that for CB analyses, “displacement” output is of the rows of the Displacement Output Transformation Matrix (Displ OTM) described in Appendix D to Reference 1

1.1.3 Generation of Craig-Bampton model of substructure 2

Section 1.5 has the input data for the generation of a CB model of substructure 2. Note the following regarding the input data deck (see Figure 1.1 for a picture of this substructure):

- SOL 31 is for CB model generation
- OUTPUT4 calls for CB matrices KXX and MXX (NASTRAN matrices KRRGN and MRRGN) to be output to binary OUTPUT4 formatted files
- METHOD = 2 selects an EIGR with set ID = 2 to find the eigenvalues (so modes found will be fixed base relative to the boundary DOF's identified by the SUPORT Bulk Data entry)
- Model has 4 GRID's and 6 CBAR's
- Coordinate systems 291 through 294 are used for the global system for the 4 grids. This is only done to demonstrate the flexibility of MYSTRAN to deal with coordinate systems other than basic in CB analyses
- The only mass is a concentrated mass at grid 3204
- SUPORT identifies the boundary DOF for this substructure which is to be the 3 translation components of displacement at grids 3201, 3202, 3203
- PARAM CUSERIN requests MYSTRAN to print out equivalent CUSERIN Bulk Data entries for this substructure

The output is shown on the following pages in section 1.5. Note the following:

- Grid Point Weight Generator output shows the rigid body mass properties of substructure 2 relative to its basic coordinate system.
- *INFORMATION: message listed shows that matrices KXX, MXX, RBM0 have been written to binary file CB1d-SUBSTR-2-CB-MODEL.OP1 which will be used in the synthesis run (section 1.6)
- Based on Bulk data PARAM CUSERIN, the Bulk Data entries needed in the synthesis run for this CB substructure is listed. Some of the entries will have to be modified (e.g. CID0 must be defined) for the synthesis run in section 1.6
- Only 3 eigenvalues were found although 4 were requested. Since the model has only 3 mass DOF, there are only 3 finite eigenvalues. Normally we would not be asking for all modes in a CB analysis but are doing so here so that the system modes can be compared to a run in which a complete FEM model is used (section 1.7)

- Output of displacements was requested in Case Control and the output is shown next. Note that for CB analyses, “displacement” output is of the rows of the Displacement Output Transformation Matrix (Displ OTM) described in Appendix D to Reference 1

1.1.4 System modes using the 2 CB models and the basic structure FEM

Section 1.6 has the input data for the system modes model. In this run we will use the CB model data generated in the runs described in the 2 previous sections along with a physical model FEM of the basic structure. Note the following about the input data:

- IN4 statements in Exec Control define the files that contain the stiffness and mass data generated in the 2 CB runs described in the last 2 sections. There must be one of these IN4 statements for every CB model included in the synthesis run
- SOL 3 requests an eigenvalue run with METHOD = 2 selecting Bulk data EIGRL entry with set ID 2
- The 1st portion of the Bulk Data is a standard FEM model of the basic structure containing 8 grids and 12 CBAR's and concentrated masses at all 8 grids
- The 2nd portion of the input data is the CB model definition for substructure 1. It uses the CUSERIN, PUSERIN, etc data written to the F06 file in section 1.4 to describe the substructure 1 CB model connection and “property” data (more on this below)
- The 3rd portion of the input data is the CB model definition for substructure 2. It uses the CUSERIN, PUSERIN, etc data written to the F06 file in section 1.5 to describe the substructure 2 CB model connection and “property” data (more on this below)
- Each CB model must have its basic coordinate system defined relative to the basic coordinate system of the overall system model. All other CB unique coordinate systems must be defined relative to this CB basic coordinate system.
- In this example, RBE2 rigid elements are used to connect CB boundary grids to the basic structure grids. This is not at all necessary, only a preference of the author. The CUSERIN connection data for each substructure could have alternately referred to grids from the basic structure where the CB model attached. For example, CUSERIN 100 would have referred to grid 112 instead of 3101 and then the RBE2 1001 and GRID 3101 would have been omitted from the substructure 1 CB model definition. *Note that this would also have required that GRID 112 have the coordinate system 19 that was used in CB model 1 as the global coordinate system.*

Since some of the input data for the CB models is not standard NASTRAN type of input, the description below is given to help explain that input data.

The CUSERIN Bulk Data connection parent entry specifies:

- Field 1: CUSERIN
- Field 2: element ID
- Field 3: property ID
- Field 4: number of boundary grids (the number that are in the R-set when the CB model was generated)

- Field 6: number of SPOINT's (1 for each modal DOF in the CB model)
- Field 6: ID of the coordinate system which defines the basic system used when the CB model was generated. It must define this coordinate system relative to the basic coordinate system of the overall system model

Subsequent CUSERIN continuation entries define

- grids/components that define the support (boundary) DOF for this substructure
- ID's of SPOINT's for MYSTRAN to use as the DOF identifiers for the modal DOF (these must begin on a new continuation entry; i.e. they can not be on the same continuation entry as the grid/component definition)

The PUSERIN "property" entry does not define physical properties (as is the case with other finite elements); rather it specifies information about the files that contain the KRRGN and MRRGN matrices for the CB element. It also specifies the names of these matrices as they were written to the OUTPUT4 file when the CB model was generated. There is one more matrix defined; RBM0, which is a 6x6 rigid body mass matrix relative to the basic coordinate system origin for the CB model (RBM0 generated in the run that creates the CB model). If the RBM0 matrix is not present one will be generated internally.

Specifically, the PUSERIN Bulk Data entry specifies:

- Field 1: PUSERIN
- Field 2: property ID referenced in field 3 of the CUSERIN entry
- Field 3: ID of a IN4 Executive Control Deck entry which has the name of the file containing the KXX, MXX, RBM0 (NASTRAN KRRGN, MRRGN and RBMCG) matrices
- Field 4: Name of the KRRGN matrix (can be up to 8 characters long)
- Field 5: Name of the MRRGN matrix (can be up to 8 characters long)
- Field 6: Name of the RBM0 matrix (can be up to 8 characters long) if there is one

The KXX, MXX, RBM0 (NASTRAN KRRGN, MRRGN, RBMCG) matrices are read into MYSTRAN in NASTRAN INPUTT4 format. The command statements to do this are part of the Executive Control Deck, the format of which is shown in the listing in section 1.6. The commands to read in the matrices are: IN4 i = *filename*, where i is the file ID in field 3 of the PUSERIN property entry for the CUSERIN element and *filename* is the name of the file in which the matrices were written when the CB model was generated

The output for this modal synthesis run is the standard type of output one would expect from a SOL 3 modal analysis. Note the following:

- The Grid Point Weight Generator gives the rigid body mass properties of the complete model. Unless the CB matrices RBM0 had been input (IN4 Exec Control command), the overall model mass properties would not have been correct and would not match those shown in the next section in which a completely physical FEM model is run
- The eigenvalues are system values and will be directly comparable to those in section 1.7. They will, in fact, be exactly the same since we have used all of the finite modes for each substructure (not a normal circumstance, only done here for demonstration purposes)

- The eigenvectors show the “mode shapes” for the CB synthesis DOF's, which, in this model, uses physical grids for the basic structure and CB boundary DOF's plus modal DOF's for the fixed base modes of each substructure. The meaning of an eigenvector like this for the CB fixed base modes is the following. The magnitudes shown in system eigenvector i for the CB DOF's (scalar points 10001,2,3 and 20001,2,3) are the relative magnitudes of the substructure CB eigenvectors in their contribution to system eigenvector i .

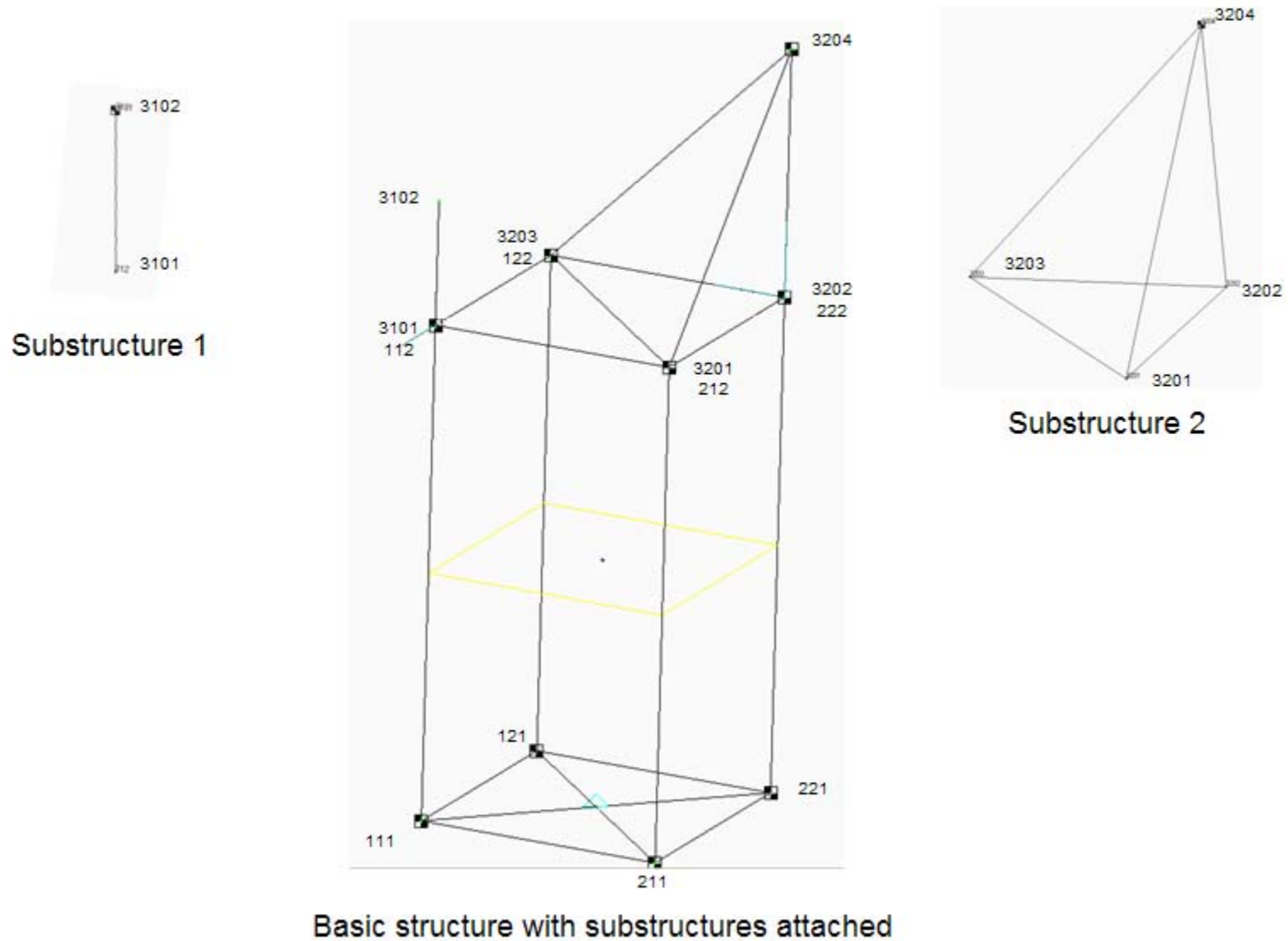
1.1.5 System modes using complete structure FEM

In order to demonstrate that the CB substructure techniques used in the last section can yield the same eigenvalues as would be used if it were analyzed as a full FEM model, section 1.7 is included. It shows the results of a run using a complete physical FEM of the basic structure with the 2 substructures run as one complete model. The input shown is that used in a standard analysis of a FEM with SOL 3 and requesting 10 eigenvalues. The output shows the rigid body mass properties of the complete model, the 10 eigenvalues and 1 of the eigenvectors. The eigenvalue data in section 1.7 is to be compared with those in section 1.6 (using CB models for the 2 substructures). The eigenvector data will, however, be different as the system DOF's for the two runs are not the same. In the case of the complete FEM, the DOF's are all 6 component displacement components at physical grids. For the CB synthesis run the DOF's are physical grids for the basic structure but the DOF's for the substructures have physical grids for the boundary DOF's and modal DOF's for the remainder of the CB model. Analysts familiar with modal synthesis will be aware of this distinction.

1.2 Summary

The eigenvalues in section 1.7, which is a complete FEM model, form the baseline for comparison with the eigenvalues in section 1.6, which uses CB models for substructures 1 and 2. Since all of the finite mass modes were included in generating the substructure CB models, it should be expected that the eigenvalues in section 1.6 should be exactly the same as those in section 1.7. As shown in these two sections the 10 eigenvalues found for the combined structure are identical. In a practical CB synthesis, only some of the modes of each CB model would be used and then the CB synthesis eigenvalues would not be identical to those from the completely physical FEM model. However, if the analyst is careful in modeling the problem at hand the important eigenvalues in the CB synthesis should be a very good approximation to the ones that would have been obtained from a run using a completely physical FEM.

1.3 Fig 1.1 – Simple example problem: Basic structure and 2 substructures



1.4 Substructure 1 – Generate CB model
(input deck CB1d-SUBSTR-1-CB-MODEL.DAT)

511121050

MYSTRAN Version 6.13 May 10 2010 by Dr Bill Case

>> MYSTRAN BEGIN : 5/11/2010 at 12:10:50.531 The input file is CB1d-SUBSTR-1-CB-MODEL.DAT

>> LINK 0 BEGIN

ID CB1, RUN (d)

SOL 31

\$

OUTPUT4 KRRGN,MRRGN,,,/-1/21

\$

CEND

TITLE = CB PROBLEM - SUBSTR 1, GENERATE CB MODEL

SUBTI = SUBSTR GLOBAL IS COORD SYSTEM 19

LABEL = V VEC FOR BAR IS X19 DIR WHICH IS OA MODEL BASIC X0

ECHO = UNSORT

METHOD = 2

DISP = ALL

MEFFMASS = ALL

BEGIN BULK

\$

EIGR 2 MGIV 1 4 +E1

+E1 MASS

\$

CORD2R 19 0. 0. 0. 1. 0. 0. +C19

+C19 0. 0. 1.

\$

GRID 3101 0. 0. 0. 19

GRID 3102 25. 0. 0. 19

\$

CBAR 3101 3101 3101 3102 1. 0. 0.

\$

PBAR 3101 301 1. 20. 20. 40.

\$

MAT1 301 30.+6 .3

*INFORMATION: MAT1 ENTRY 301 HAD FIELD FOR G BLANK. MYSTRAN CALCULATED G = 1.153846E+07

\$

CONM2 3102 3102 400.

\$

SUPPORT 3101 123456

\$

PARAM CUSERIN 100 190 10001 100

PARAM GRDPNT 0

PARAM WTMASS .002591

\$

ENDDATA

OUTPUT FROM GRID POINT WEIGHT GENERATOR
(reference point is basic coord system origin)

Total mass = 4.000000E+02

X Y Z
C.G. location : 2.500000E+01 0.000000E+00 0.000000E+00
(relative to reference point in basic coordinate system)

6x6 Rigid body mass matrix - about reference point in basic coordinate system

```
***
* 4.000000E+02 0.000000E+00 0.000000E+00 * 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 4.000000E+02 0.000000E+00 * 0.000000E+00 0.000000E+00 1.000000E+04 *
* 0.000000E+00 0.000000E+00 4.000000E+02 * 0.000000E+00 -1.000000E+04 0.000000E+00 *
* ***** ***** ***** * ***** ***** ***** *
* 0.000000E+00 0.000000E+00 0.000000E+00 * 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 * 0.000000E+00 2.500000E+05 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 * 0.000000E+00 0.000000E+00 2.500000E+05 *
***
```

M.O.I. matrix - about reference point in basic coordinate system

```
***
* 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 2.500000E+05 0.000000E+00 *
* 0.000000E+00 0.000000E+00 2.500000E+05 *
***
```

M.O.I. matrix - about above c.g. location in basic coordinate system

```
***
* 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 *
***
```

M.O.I. matrix - about above c.g. location in principal directions

```
***
* 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 *
***
```

Transformation from basic coordinates to principal directions

```
***
* 1.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 1.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 1.000000E+00 *
***
```

*INFORMATION: THE FOLLOWING 2 MATRICES HAVE BEEN REQUESTED TO BE WRITTEN TO 1 OUTPUT4 FILES IN THE ORDER LISTED BELOW:

OUTPUT4 file on unit 21 has been created as: CBld-SUBSTR-1-CB-MODEL.OP1 and will contain the matrices:

(1) KRRGN : this is MYSTRAN matrix KXX
 (2) MRRGN : this is MYSTRAN matrix MXX

E I G E N V A L U E A N A L Y S I S S U M M A R Y (MGIV)

NUMBER OF EIGENVALUES EXTRACTED 3
 LARGEST OFF-DIAGONAL GENERALIZED MASS TERM 0.0E+00 (Vecs renormed to 1.0 for gen masses)
 . . . 1
 MODE PAIR 1
 . . . 1
 NUMBER OF OFF DIAGONAL GENERALIZED MASS
 TERMS FAILING CRITERION OF 0.0E+00. 0

MODE NUMBER	EXTRACTION ORDER	EIGENVALUE	R E A L E I G E N V A L U E S		GENERALIZED MASS	GENERALIZED STIFFNESS
			RADIANS	CYCLES		
1	1	1.111540E+05	3.333977E+02	5.306188E+01	1.000000E+00	1.111540E+05
2	2	1.111540E+05	3.333977E+02	5.306188E+01	1.000000E+00	1.111540E+05
3	3	1.157854E+06	1.076036E+03	1.712565E+02	1.000000E+00	1.157854E+06


```

$*****
$ B U L K   D A T A   E N T R I E S   F O R   C U S E R I N   E L E M       100
$      (to be used to define a substructure in an overall systems model)

$ The GRID and CUSERIN entries below are for the R -set from file:
$ CBld-SUBSTR-1-CB-MODEL.F06
$ run on  5/11/2010 at 12:10:50.531
$--1---|---2---|---3---|---4---|---5---|---6---|---7---|---8---|---9---|--10---|

GRID      3101      "CID0"  0.00    0.00    0.00    19

CORD2R  19      "CID0"  0.00    0.00    0.00    1.00    0.00    0.00
        0.00    0.00    1.00

SPOINT  10001    THRU    10003

CUSERIN 100      190      1          3          "CID0"
        3101      123456

PUSERIN 190      100      <-"mat 1 name"-><-"mat 2 name"-><-"mat 3 name"->

$ NOTES:
$ -----
$ "CID0"   is to be replaced with the coord sys ID that is used to define the
$ basic coord sys of this USERIN elem rel to the system model basic coord
$ system in the system model run

$ If the above grid entries are used, and are different than the corresponding
$ grids in the system model, RBE2's should be included to connect them to the
$ corresponding grids in the system model.
$ **NOTE: If RBE2's are NOT used, it is imperative that the grids in the
$ system model that this USERIN element is connected to have the same global
$ coordinate system as was used in generating this substructure.

$ name 1 is to be replaced with the stiffness matrix name:
$      For CB model generation, KXX or its alias, KRRGN
$      For statics, KGG, KAA, etc

$ name 2 is to be replaced with the mass matrix name (if one is input):
$      For CB model generation, MXX or its alias, MRRGN
$      For statics, MGG, MAA, etc

$ name 3 is to be replaced with:
$      For CB model generation, RBM0 (not required)
$      For statics, load matrix PG, PA, etc

$ The matrices whose names are "name i" must have been requested to be
$ written to binary files via Exec Control OUTPUT4 statement(s) in this run

$ Finally, make sure that the real numbers above have enough decimal places to
$ accurately represent the quantities. Otherwise replace them before using them
$*****

```

OUTPUT FOR CRAIG-BAMPTON DOF 1 OF 15 (boundary acceleration for grid 3101 component 1)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3101	19 0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3102	19 -8.996528E-06	0.0	0.0	0.0	-5.397917E-07	0.0	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 2 OF 15 (boundary acceleration for grid 3101 component 2)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3101	19 0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3102	19 0.0	-8.996528E-06	0.0	5.397917E-07	0.0	0.0	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 3 OF 15 (boundary acceleration for grid 3101 component 3)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3101	19 0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3102	19 0.0	0.0	-8.636667E-07	0.0	0.0	0.0	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 4 OF 15 (boundary acceleration for grid 3101 component 4)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3101	19 0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3102	19 0.0	2.249132E-04	0.0	-1.349479E-05	0.0	0.0	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 5 OF 15 (boundary acceleration for grid 3101 component 5)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3101	19 0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3102	19 -2.249132E-04	0.0	0.0	0.0	-1.349479E-05	0.0	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 6 OF 15 (boundary acceleration for grid 3101 component 6)

		C B D I S P L A C E M E N T O T M		(in global coordinate system at each grid)				
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3101	19 0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3102	19 0.0	0.0	0.0	0.0	0.0	0.0	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 7 OF 15 (modal acceleration for mode 1)

		C B D I S P L A C E M E N T O T M		(in global coordinate system at each grid)				
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3101	19 0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3102	19 -8.837130E-06	0.0	0.0	0.0	0.0	-5.302278E-07	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 8 OF 15 (modal acceleration for mode 2)

		C B D I S P L A C E M E N T O T M		(in global coordinate system at each grid)				
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3101	19 0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3102	19 0.0	-8.837130E-06	0.0	5.302278E-07	0.0	0.0	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 9 OF 15 (modal acceleration for mode 3)

		C B D I S P L A C E M E N T O T M		(in global coordinate system at each grid)				
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3101	19 0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3102	19 0.0	0.0	-8.483644E-07	0.0	0.0	0.0	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 10 OF 15 (boundary displacement for grid 3101 component 1)

		C B D I S P L A C E M E N T O T M		(in global coordinate system at each grid)				
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3101	19 1.000000E+00	0.0	0.0	0.0	0.0	0.0	0.0	
3102	19 1.000000E+00	0.0	0.0	0.0	0.0	0.0	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 11 OF 15 (boundary displacement for grid 3101 component 2)

			C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)					
GRID	COORD SYS	T1	T2	T3	R1	R2	R3	
3101	19 0.0		1.000000E+00	0.0	0.0	0.0	0.0	
3102	19 0.0		1.000000E+00	0.0	0.0	0.0	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 12 OF 15 (boundary displacement for grid 3101 component 3)

			C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)					
GRID	COORD SYS	T1	T2	T3	R1	R2	R3	
3101	19 0.0		0.0	1.000000E+00	0.0	0.0	0.0	
3102	19 0.0		0.0	1.000000E+00	0.0	0.0	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 13 OF 15 (boundary displacement for grid 3101 component 4)

			C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)					
GRID	COORD SYS	T1	T2	T3	R1	R2	R3	
3101	19 0.0		0.0	0.0	1.000000E+00	0.0	0.0	
3102	19 0.0		-2.500000E+01	0.0	1.000000E+00	0.0	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 14 OF 15 (boundary displacement for grid 3101 component 5)

			C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)					
GRID	COORD SYS	T1	T2	T3	R1	R2	R3	
3101	19 0.0		0.0	0.0	0.0	1.000000E+00	0.0	
3102	19 2.500000E+01		0.0	0.0	0.0	1.000000E+00	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 15 OF 15 (boundary displacement for grid 3101 component 6)

			C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)					
GRID	COORD SYS	T1	T2	T3	R1	R2	R3	
3101	19 0.0		0.0	0.0	0.0	0.0	1.000000E+00	
3102	19 0.0		0.0	0.0	0.0	0.0	1.000000E+00	

CB PROBLEM - SUBSTR 1, GENERATE CB MODEL
 SUBSTR GLOBAL IS COORD SYSTEM 19
 V VEC FOR BAR IS X19 DIR WHICH IS OA MODEL BASIC X0

E F F E C T I V E M O D A L M A S S E S O R W E I G H T S
 (in coordinate system 0)
 Units are same as units for mass input in the Bulk Data Deck
 Reference point is the basic coordinate system origin

MODE NUM	CYCLES	T1	T2	T3	R1	R2	R3
1	5.306188E+01	0.000000E+00	0.000000E+00	4.000000E+02	0.000000E+00	2.500000E+05	0.000000E+00
2	5.306188E+01	0.000000E+00	4.000000E+02	0.000000E+00	0.000000E+00	0.000000E+00	2.500000E+05
3	1.712565E+02	4.000000E+02	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
Sum all modes:		4.000000E+02	4.000000E+02	4.000000E+02	0.000000E+00	2.500000E+05	2.500000E+05
Total model mass:		4.000000E+02	4.000000E+02	4.000000E+02	0.000000E+00	2.500000E+05	2.500000E+05
Modes % of total mass*:		100.00%	100.00%	100.00%		100.00%	100.00%

*If all modes are calculated the % of total mass should be 100% of the free mass (i.e. not counting mass at constrained DOF's).
 Percentages are only printed for components that have finite model mass.

1.5 *Substructure 2 – Generate CB model*
(input deck CB1d-SUBSTR-2-CB-MODEL.DAT)

511121051

MYSTRAN Version 6.13 May 10 2010 by Dr Bill Case

>> MYSTRAN BEGIN : 5/11/2010 at 12:10:51.890 The input file is CB1d-SUBSTR-2-CB-MODEL.DAT

>> LINK 0 BEGIN

```
ID CB1, RUN (d)
SOL 31
$
OUTPUT4    KRRGN,MRRGN,,,/-1/21
$
TIME 7
CEND
TITLE      = CB PROBLEM - SUBSTR 2, GENERATE CB MODEL
SUBTI      = SUBSTR GLOBAL IS COORD SYSTEM 29
LABEL      = BARS 3201-3 V IS OA MODEL BASIC Z0, BARS 3204-6 V IS OA MODEL BASIC Y0
ECHO       = UNSORT
METHOD     = 2
DISP       = ALL
MEFFMASS = ALL
BEGIN BULK
$
EIGR      2            MGIV                            1            4                            +E1
+E1       MASS
$
CORD2R    291            0.            0.            0.            1.            0.            0.            +C29
+C29      0.            1.            0.
$
CORD2R    292            0.            0.            0.            0.            1.            0.            +C29
+C29      0.            0.            1.
$
CORD2R    293            0.            0.            0.            0.            0.            1.            +C29
+C29      1.            0.            0.
$
CORD2R    294            0.            0.            0.            0.            0.            1.            +C29
+C29      1.            0.            0.
$
GRID      3201            50.            0.            0.            291
GRID      3202            0.            0.            0.            292
GRID      3203            0.            0.            50.            293
GRID      3204            0.            50.            0.            294
$
CBAR      3201            3201            3201            3202            1.            0.            0.
CBAR      3202            3201            3202            3203            0.            0.            1.
CBAR      3203            3201            3203            3201            0.            1.            0.
$
```

CBAR	3204	3201	3201	3204	0.	0.	1.
CBAR	3205	3201	3202	3204	0.	1.	0.
CBAR	3206	3201	3203	3204	1.	0.	0.
\$							
PBAR	3201	302	1.	20.	20.	40.	
\$							
MAT1	302	30.+6		.3			
*INFORMATION: MAT1 ENTRY 302 HAD FIELD FOR G BLANK. MYSTRAN CALCULATED G = 1.153846E+07							
\$							
CONM2	3201	3204		600.			
\$							
SUPORT	3201	123	3202	123	3203	123	
\$							
PARAM	CUSERIN	200	290	20001	200		
PARAM	GRDPNT	0					
PARAM	WTMASS	.002591					
\$							
ENDDATA							

OUTPUT FROM GRID POINT WEIGHT GENERATOR
REFERENCE POINT IS BASIC COORD SYSTEM ORIGIN

Total mass = 6.000000E+02

X Y Z
C.G. location : 0.000000E+00 5.000000E+01 0.000000E+00
(relative to reference point in basic coordinate system)

6x6 Rigid body mass matrix - about reference point in basic coordinate system

```
***
* 6.000000E+02 0.000000E+00 0.000000E+00 * 0.000000E+00 0.000000E+00 -3.000000E+04 *
* 0.000000E+00 6.000000E+02 0.000000E+00 * 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 6.000000E+02 * 3.000000E+04 0.000000E+00 0.000000E+00 *
* ***** ***** ***** * ***** ***** ***** *
* 0.000000E+00 0.000000E+00 0.000000E+00 * 1.500000E+06 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 * 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 * 0.000000E+00 0.000000E+00 1.500000E+06 *
***
```

M.O.I. matrix - about reference point in basic coordinate system

```
***
* 1.500000E+06 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 1.500000E+06 *
***
```

M.O.I. matrix - about above c.g. location in basic coordinate system

```
***
* 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 *
***
```

M.O.I. matrix - about above c.g. location in principal directions

```
***
* 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 *
***
```

Transformation from basic coordinates to principal directions

```
***
* 1.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 1.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 1.000000E+00 *
***
```

*INFORMATION: THE FOLLOWING 2 MATRICES HAVE BEEN REQUESTED TO BE WRITTEN TO 1 OUTPUT4 FILES IN THE ORDER LISTED BELOW:

OUTPUT4 file on unit 21 has been created as: CBld-SUBSTR-2-CB-MODEL.OP1 and will contain the matrices:

(1) KRRGN : this is MYSTRAN matrix KXX
 (2) MRRGN : this is MYSTRAN matrix MXX

E I G E N V A L U E A N A L Y S I S S U M M A R Y (MGIV)

NUMBER OF EIGENVALUES EXTRACTED 3
 LARGEST OFF-DIAGONAL GENERALIZED MASS TERM 2.5E-11 (Vecs renormed to 1.0 for gen masses)
 3
 MODE PAIR 1
 1
 NUMBER OF OFF DIAGONAL GENERALIZED MASS
 TERMS FAILING CRITERION OF 0.0E+00. 3

MODE NUMBER	EXTRACTION ORDER	EIGENVALUE	R E A L E I G E N V A L U E S		GENERALIZED MASS	GENERALIZED STIFFNESS
			RADIANS	CYCLES		
1	1	8.209320E+04	2.865191E+02	4.560093E+01	1.000000E+00	8.209320E+04
2	2	1.470796E+05	3.835096E+02	6.103745E+01	1.000000E+00	1.470796E+05
3	3	7.295666E+05	8.541467E+02	1.359417E+02	1.000000E+00	7.295666E+05

```

$*****
$ B U L K   D A T A   E N T R I E S   F O R   C U S E R I N   E L E M       200
$      (to be used to define a substructure in an overall systems model)
$ The GRID and CUSERIN entries below are for the R -set from file:
$ CB1d-SUBSTR-2-CB-MODEL.F06
$ run on  5/11/2010 at 12:10:51.890
$--1---|---2---|---3---|---4---|---5---|---6---|---7---|---8---|---9---|---10---|
GRID   3201   "CID0"  50.0   0.00   0.00   291
GRID   3202   "CID0"   0.00   0.00   0.00   292
GRID   3203   "CID0"   0.00   0.00   50.0   293

CORD2R  291   "CID0"   0.00   0.00   0.00   1.00   0.00   0.00
        0.00   1.00   0.00
CORD2R  292   "CID0"   0.     0.     0.     1.00   0.00   0.00
        0.00   1.00   0.00
CORD2R  293   "CID0"   0.     0.     0.     0.00   0.00   1.00
        1.00   0.00   0.00

SPOINT  20001  THRU    20003

CUSERIN 200    290     3      3      "CID0"
        3201    123     3202    123     3203    123

PUSERIN 290    200     <-"mat 1 name"-><-"mat 2 name"-><-"mat 3 name"->

$ NOTES:
$ -----
$ "CID0"   is to be replaced with the coord sys ID that is used to define the
$ basic coord sys of this USERIN elem rel to the system model basic coord
$ system in the system model run

$ If the above grid entries are used, and are different than the corresponding
$ grids in the system model, RBE2's should be included to connect them to the
$ corresponding grids in the system model.
$ **NOTE: If RBE2's are NOT used, it is imperative that the grids in the
$ system model that this USERIN element is connected to have the same global
$ coordinate system as was used in generating this substructure.

$ name 1 is to be replaced with the stiffness matrix name:
$       For CB model generation, KXX or its alias, KRRGN
$       For statics, KGG, KAA, etc
$ name 2 is to be replaced with the mass matrix name (if one is input):
$       For CB model generation, MXX or its alias, MRRGN
$       For statics, MGG, MAA, etc
$ name 3 is to be replaced with:
$       For CB model generation, RBM0 (not required)
$       For statics, load matrix PG, PA, etc
$ The matrices whose names are "name i" must have been requested to be
$ written to binary files via Exec Control OUTPUT4 statement(s) in this run
$ Finally, make sure that the real numbers above have enough decimal places to
$ accurately represent the quantities. Otherwise replace them before using them
$*****

```

OUTPUT FOR CRAIG-BAMPTON DOF 1 OF 21 (boundary acceleration for grid 3201 component 1)
 CB PROBLEM - SUBSTR 2, GENERATE CB MODEL
 SUBSTR GLOBAL IS COORD SYSTEM 29
 BARS 3201-3 V IS OA MODEL BASIC Z0, BARS 3204-6 V IS OA MODEL BASIC Y0

C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)								
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291	0.0	0.0	0.0	3.863993E-10	-6.960263E-09	4.572454E-08	
3202	292	0.0	0.0	0.0	-8.427715E-08	1.606673E-08	2.200350E-10	
3203	293	0.0	0.0	0.0	2.034509E-08	-8.242526E-09	-9.579740E-08	
3204	294	8.954192E-06	2.284642E-06	2.155154E-06	5.610407E-08	-1.791753E-08	-1.976135E-07	

OUTPUT FOR CRAIG-BAMPTON DOF 2 OF 21 (boundary acceleration for grid 3201 component 2)

C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)								
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291	0.0	0.0	0.0	-2.270768E-11	7.125241E-11	-3.715046E-10	
3202	292	0.0	0.0	0.0	2.636055E-10	-2.636055E-10	0.0	
3203	293	0.0	0.0	0.0	-7.125241E-11	2.270768E-11	3.715046E-10	
3204	294	-2.916436E-08	-1.191538E-08	-2.916436E-08	-6.656870E-10	0.0	6.656870E-10	

OUTPUT FOR CRAIG-BAMPTON DOF 3 OF 21 (boundary acceleration for grid 3201 component 3)

C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)								
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291	0.0	0.0	0.0	-2.109567E-10	5.870611E-09	-4.005508E-08	
3202	292	0.0	0.0	0.0	7.696471E-08	-1.315541E-08	-2.058377E-10	
3203	293	0.0	0.0	0.0	-1.839181E-08	7.560184E-09	8.689709E-08	
3204	294	-8.163419E-06	-2.027860E-06	-1.803074E-06	-4.751698E-08	1.676144E-08	1.798959E-07	

OUTPUT FOR CRAIG-BAMPTON DOF 4 OF 21 (boundary acceleration for grid 3202 component 1)

C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)								
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291	0.0	0.0	0.0	-6.596340E-10	1.882026E-09	-8.528800E-09	
3202	292	0.0	0.0	0.0	2.647710E-09	-7.048835E-09	1.419727E-11	
3203	293	0.0	0.0	0.0	-1.018400E-09	1.527349E-10	5.297961E-09	
3204	294	-3.229157E-07	-2.448662E-07	-7.616085E-07	-1.705199E-08	-1.156089E-09	7.921403E-09	

OUTPUT FOR CRAIG-BAMPTON DOF 5 OF 21 (boundary acceleration for grid 3202 component 2)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291 0.0	0.0	0.0	0.0	-1.527349E-10	1.018400E-09	-5.297961E-09	
3202	292 0.0	0.0	0.0	0.0	7.048835E-09	-2.647710E-09	-1.419727E-11	
3203	293 0.0	0.0	0.0	0.0	-1.882026E-09	6.596340E-10	8.528800E-09	
3204	294 -7.616085E-07	-2.448662E-07	-3.229157E-07	-7.921403E-09	1.156089E-09	1.705199E-08		

OUTPUT FOR CRAIG-BAMPTON DOF 6 OF 21 (boundary acceleration for grid 3202 component 3)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291 0.0	0.0	0.0	0.0	-9.370576E-09	4.100224E-08	-1.710049E-07	
3202	292 0.0	0.0	0.0	0.0	1.175621E-07	-1.175621E-07	0.0	
3203	293 0.0	0.0	0.0	0.0	-4.100224E-08	9.370576E-09	1.710049E-07	
3204	294 -1.339399E-05	-7.011891E-06	-1.339399E-05	-3.129434E-07	0.0	3.129434E-07		

OUTPUT FOR CRAIG-BAMPTON DOF 7 OF 21 (boundary acceleration for grid 3203 component 1)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291 0.0	0.0	0.0	0.0	-2.270768E-11	7.125241E-11	-3.715046E-10	
3202	292 0.0	0.0	0.0	0.0	2.636055E-10	-2.636055E-10	0.0	
3203	293 0.0	0.0	0.0	0.0	-7.125241E-11	2.270768E-11	3.715046E-10	
3204	294 -2.916436E-08	-1.191538E-08	-2.916436E-08	-6.656870E-10	0.0	6.656870E-10		

OUTPUT FOR CRAIG-BAMPTON DOF 8 OF 21 (boundary acceleration for grid 3203 component 2)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291 0.0	0.0	0.0	0.0	8.242526E-09	-2.034509E-08	9.579740E-08	
3202	292 0.0	0.0	0.0	0.0	-1.606673E-08	8.427715E-08	-2.200350E-10	
3203	293 0.0	0.0	0.0	0.0	6.960263E-09	-3.863993E-10	-4.572454E-08	
3204	294 2.155154E-06	2.284642E-06	8.954192E-06	1.976135E-07	1.791753E-08	-5.610407E-08		

OUTPUT FOR CRAIG-BAMPTON DOF 9 OF 21 (boundary acceleration for grid 3203 component 3)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291 0.0	0.0	0.0	0.0	-7.560184E-09	1.839181E-08	-8.689709E-08	
3202	292 0.0	0.0	0.0	0.0	1.315541E-08	-7.696471E-08	2.058377E-10	
3203	293 0.0	0.0	0.0	0.0	-5.870611E-09	2.109567E-10	4.005508E-08	
3204	294 -1.803074E-06	-2.027860E-06	-8.163419E-06	-1.798959E-07	-1.676144E-08	4.751698E-08		

OUTPUT FOR CRAIG-BAMPTON DOF 10 OF 21 (modal acceleration for mode 1)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291 0.0	0.0	0.0	0.0	-4.832001E-09	1.815683E-08	-8.362304E-08	
3202	292 0.0	0.0	0.0	0.0	5.836064E-08	-5.836064E-08	0.0	
3203	293 0.0	0.0	0.0	0.0	-1.815683E-08	4.832001E-09	8.362304E-08	
3204	294 -6.556822E-06	-3.076394E-06	-6.556822E-06	-1.515262E-07	0.0	1.515262E-07		

OUTPUT FOR CRAIG-BAMPTON DOF 11 OF 21 (modal acceleration for mode 2)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291 0.0	0.0	0.0	0.0	4.455374E-09	-7.590815E-09	2.839736E-08	
3202	292 0.0	0.0	0.0	0.0	3.868356E-08	3.868356E-08	-2.495729E-10	
3203	293 0.0	0.0	0.0	0.0	-7.590815E-09	4.455374E-09	2.839736E-08	
3204	294 -3.855877E-06	0.0	3.855877E-06	8.025298E-08	2.032281E-08	8.025298E-08		

OUTPUT FOR CRAIG-BAMPTON DOF 12 OF 21 (modal acceleration for mode 3)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291 0.0	0.0	0.0	0.0	9.763913E-10	5.550272E-09	2.829765E-09	
3202	292 0.0	0.0	0.0	0.0	-4.812417E-09	4.812417E-09	0.0	
3203	293 0.0	0.0	0.0	0.0	-5.550272E-09	-9.763913E-10	-2.829765E-09	
3204	294 2.447762E-07	-1.043400E-06	2.447762E-07	2.246170E-10	0.0	-2.246170E-10		

OUTPUT FOR CRAIG-BAMPTON DOF 13 OF 21 (boundary displacement for grid 3201 component 1)

C B D I S P L A C E M E N T O T M							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
3201	291	1.000000E+00	0.0	0.0	0.0	2.000000E-02	0.0
3202	292	0.0	0.0	0.0	2.000000E-02	0.0	0.0
3203	293	0.0	0.0	0.0	0.0	0.0	2.000000E-02
3204	294	-1.000000E+00	-2.680920E-16	-2.606869E-16	0.0	0.0	2.000000E-02

OUTPUT FOR CRAIG-BAMPTON DOF 14 OF 21 (boundary displacement for grid 3201 component 2)

C B D I S P L A C E M E N T O T M							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
3201	291	0.0	1.000000E+00	0.0	-2.085837E-02	4.767823E-05	-2.602008E-03
3202	292	0.0	0.0	0.0	-5.875979E-05	5.875979E-05	-1.000000E-02
3203	293	0.0	0.0	0.0	-4.767823E-05	8.583711E-04	2.602008E-03
3204	294	2.636149E-03	-5.319149E-05	2.636149E-03	-1.052564E-03	-1.000000E-02	1.052564E-03

OUTPUT FOR CRAIG-BAMPTON DOF 15 OF 21 (boundary displacement for grid 3201 component 3)

C B D I S P L A C E M E N T O T M							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
3201	291	0.0	0.0	1.000000E+00	-4.742082E-03	5.577378E-03	2.256943E-03
3202	292	0.0	0.0	0.0	-1.150011E-02	-1.588240E-04	2.304165E-03
3203	293	0.0	0.0	0.0	2.669116E-04	-6.405944E-03	-8.894334E-03
3204	294	9.192786E-01	-1.447398E-02	-1.619859E-02	3.256101E-04	-2.717381E-03	-1.373142E-02

OUTPUT FOR CRAIG-BAMPTON DOF 16 OF 21 (boundary displacement for grid 3202 component 1)

C B D I S P L A C E M E N T O T M							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
3201	291	0.0	0.0	0.0	1.445243E-02	2.192333E-04	-6.292326E-03
3202	292	1.000000E+00	0.0	0.0	-1.000642E-04	-1.155887E-02	1.230417E-02
3203	293	0.0	0.0	0.0	5.625056E-03	-5.600453E-03	-3.450652E-04
3204	294	1.356244E-02	1.452717E-02	7.808521E-02	-1.267885E-02	7.282619E-03	-7.269543E-04

OUTPUT FOR CRAIG-BAMPTON DOF 17 OF 21 (boundary displacement for grid 3202 component 2)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291	0.0	0.0	0.0	5.600453E-03	-5.625056E-03	3.450652E-04	
3202	292	0.0	1.000000E+00	0.0	1.155887E-02	1.000642E-04	-1.230417E-02	
3203	293	0.0	0.0	0.0	-2.192333E-04	-1.445243E-02	6.292326E-03	
3204	294	7.808521E-02	1.452717E-02	1.356244E-02	7.269543E-04	-7.282619E-03	1.267885E-02	

OUTPUT FOR CRAIG-BAMPTON DOF 18 OF 21 (boundary displacement for grid 3202 component 3)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291	0.0	0.0	0.0	0.0	-2.000000E-02	2.000000E-02	
3202	292	0.0	0.0	1.000000E+00	-2.000000E-02	2.000000E-02	0.0	
3203	293	0.0	0.0	0.0	2.000000E-02	0.0	-2.000000E-02	
3204	294	1.000000E+00	1.000000E+00	1.000000E+00	2.000000E-02	0.0	-2.000000E-02	

OUTPUT FOR CRAIG-BAMPTON DOF 19 OF 21 (boundary displacement for grid 3203 component 1)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291	0.0	0.0	0.0	-8.583711E-04	4.767823E-05	-2.602008E-03	
3202	292	0.0	0.0	0.0	-5.875979E-05	5.875979E-05	1.000000E-02	
3203	293	1.000000E+00	0.0	0.0	-4.767823E-05	2.085837E-02	2.602008E-03	
3204	294	2.636149E-03	-5.319149E-05	2.636149E-03	-1.052564E-03	1.000000E-02	1.052564E-03	

OUTPUT FOR CRAIG-BAMPTON DOF 20 OF 21 (boundary displacement for grid 3203 component 2)

		C B D I S P L A C E M E N T O T M (in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291	0.0	0.0	0.0	0.0	0.0	-2.000000E-02	
3202	292	0.0	0.0	0.0	0.0	-2.000000E-02	0.0	
3203	293	0.0	1.000000E+00	0.0	-2.000000E-02	0.0	0.0	
3204	294	0.0	0.0	-1.000000E+00	-2.000000E-02	0.0	0.0	

OUTPUT FOR CRAIG-BAMPTON DOF 21 OF 21 (boundary displacement for grid 3203 component 3)

		C B D I S P L A C E M E N T O T M						
		(in global coordinate system at each grid)						
GRID	COORD	T1	T2	T3	R1	R2	R3	
	SYS							
3201	291	0.0	0.0	0.0	6.405944E-03	-2.669116E-04	8.894334E-03	
3202	292	0.0	0.0	0.0	1.588240E-04	1.150011E-02	-2.304165E-03	
3203	293	0.0	0.0	1.000000E+00	-5.577378E-03	4.742082E-03	-2.256943E-03	
3204	294	-1.619859E-02	-1.447398E-02	9.192786E-01	1.373142E-02	2.717381E-03	-3.256101E-04	.

CB PROBLEM - SUBSTR 2, GENERATE CB MODEL
 SUBSTR GLOBAL IS COORD SYSTEM 29
 BARS 3201-3 V IS OA MODEL BASIC Z0, BARS 3204-6 V IS OA MODEL BASIC Y0

E F F E C T I V E M O D A L M A S S E S O R W E I G H T S
 (in coordinate system 0)

Units are same as units for mass input in the Bulk Data Deck
 Reference point is the basic coordinate system origin

MODE NUM	CYCLES	T1	T2	T3	R1	R2	R3
1	4.560093E+01	2.702533E+02	5.949331E+01	2.702533E+02	6.756334E+05	-2.092247E-15	6.756334E+05
2	6.103745E+01	3.000000E+02	4.284921E-14	3.000000E+02	7.500000E+05	5.291766E-28	7.500000E+05
3	1.359417E+02	2.974665E+01	5.405067E+02	2.974665E+01	7.436663E+04	5.230616E-16	7.436663E+04
		-----	-----	-----	-----	-----	-----
Sum all modes:		6.000000E+02	6.000000E+02	6.000000E+02	1.500000E+06	-1.569185E-15	1.500000E+06
Total model mass:		6.000000E+02	6.000000E+02	6.000000E+02	1.500000E+06	4.184493E-15	1.500000E+06
Modes % of total mass*:		100.00%	100.00%	100.00%	100.00%	-37.50%	100.00%

*If all modes are calculated the % of total mass should be 100% of the free mass (i.e. not counting mass at constrained DOF's).
 Percentages are only printed for components that have finite model mass.

1.6 *FEM basic structure and CUSERIN substructures*
(input deck CB1d-BASIC-STR-W-CUSERIN-SUBSTRS.DAT)


```

CBAR    1009    1103    111    112    1.    0.    0.
CBAR    1010    1103    211    212    1.    0.    0.
CBAR    1011    1103    221    222    1.    0.    0.
CBAR    1012    1103    121    122    1.    0.    0.
$
PBAR    1101    100    1.    80.    80.    80.
PBAR    1102    100    1.    80.    80.    80.
PBAR    1103    100    1.    80.    80.    80.
$
MAT1     100    10.+06    .3
*INFORMATION: MAT1 ENTRY    100 HAD FIELD FOR G BLANK. MYSTRAN CALCULATED G = 3.846154E+06
$
RBE2     1000    100    123456  111    211    221    121
$
CONM2    1001    111    500.
CONM2    1002    211    500.
CONM2    1003    221    500.
CONM2    1004    121    500.
CONM2    1005    112    500.
CONM2    1006    212    500.
CONM2    1007    222    500.
CONM2    1008    122    500.
$
SPC1     1      123456  100
$
$*****
$ Substr #1
$ -----
$ CORD2R 10 defines the basic system for substr 1 relative to OA model basic
$
CORD2R   10      -25.  -25.  50.  -20.  -25.  50.  +C10
+C10     -25.  -25.  60.
$
CORD2R   19      10      0.    0.    0.    1.    0.    0.  +C19
+C19      0.    0.    1.
$
GRID     3101    10      0.    0.    0.    19
$
SPOINT   10001   THRU   10003
$
CUSERIN  100     190     1      3      10
        3101     123456
        10001   THRU   10003
$
PUSERIN  190     100     KXX     MXX
$
RBE2     1001    112    123456  3101
$
$*****
$ Substr #2
$ -----
$ CORD2R 20 defines the basic system for substr 2 relative to OA model basic

```

```

$ CORD2R 291, 292, 293, 294 are global systems for substr 2
$
CORD2R 20      25.    25.    50.    20.    25.    50.    +C20
+C20    25.    20.    50.
$
CORD2R 291     20     0.     0.     0.     1.     0.     0.     +C29
+C29    0.     1.     0.
$
CORD2R 292     20     0.     0.     0.     0.     1.     0.     +C29
+C29    0.     0.     1.
$
CORD2R 293     20     0.     0.     0.     0.     0.     1.     +C29
+C29    1.     0.     0.
$
GRID    3201    20     50.     0.     0.     291
GRID    3202    20     0.     0.     0.     292
GRID    3203    20     0.     0.     50.     293
$
SPOINT 20001    THRU    20003
$
CUSERIN 200     290     3       3       20
        3201    123    3202    123    3203    123
        20001    THRU    20003
$
PUSERIN 290     200     KXX     MXX
$
RBE2    2001    212     123     3201
RBE2    2002    222     123     3202
RBE2    2003    122     123     3203
$
$*****
PARAM   GRDPNT   211
PARAM   WTMASS   .002591
PARAM   PRTDOF   2
PARAM   PRTSET   1
PARAM   PRTSTIFF 1       3       3       3       3
PARAM   PRTSTIFD 1       3       3       3       3
PARAM   PRTMASS  1       3       3       3       3
$
ENDDATA

```

Total mass = 4.000000E+02

X Y Z
C.G. location : -5.000000E+01 0.000000E+00 1.250000E+02
(relative to reference point in basic coordinate system)

6x6 Rigid body mass matrix - about reference point in basic coordinate system

```
***
* 4.000000E+02 0.000000E+00 0.000000E+00 * 0.000000E+00 5.000000E+04 0.000000E+00 *
* 0.000000E+00 4.000000E+02 0.000000E+00 * -5.000000E+04 0.000000E+00 -2.000000E+04 *
* 0.000000E+00 0.000000E+00 4.000000E+02 * 0.000000E+00 2.000000E+04 0.000000E+00 *
* ***** ***** ***** * ***** ***** ***** *
* 0.000000E+00 -5.000000E+04 0.000000E+00 * 6.250000E+06 0.000000E+00 2.500000E+06 *
* 5.000000E+04 0.000000E+00 2.000000E+04 * 0.000000E+00 7.250000E+06 0.000000E+00 *
* 0.000000E+00 -2.000000E+04 0.000000E+00 * 2.500000E+06 0.000000E+00 1.000000E+06 *
***
```

M.O.I. matrix - about reference point in basic coordinate system

```
***
* 6.250000E+06 0.000000E+00 2.500000E+06 *
* 0.000000E+00 7.250000E+06 0.000000E+00 *
* 2.500000E+06 0.000000E+00 1.000000E+06 *
***
```

M.O.I. matrix - about above c.g. location in basic coordinate system

```
***
* 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 -9.313226E-10 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 *
***
```

M.O.I. matrix - about above c.g. location in principal directions

```
***
* -9.313226E-10 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 0.000000E+00 *
***
```

Transformation from basic coordinates to principal directions

```
***
* 0.000000E+00 1.000000E+00 0.000000E+00 *
* 1.000000E+00 0.000000E+00 0.000000E+00 *
* 0.000000E+00 0.000000E+00 1.000000E+00 *
***
```

Total mass = 6.000000E+02

X Y Z
C.G. location : -1.065874E-14 5.000000E+01 1.500000E+02
(relative to reference point in basic coordinate system)

6x6 Rigid body mass matrix - about reference point in basic coordinate system

```
***
* 6.000000E+02 1.164963E-13 1.339038E-14 * -2.091041E-11 9.000000E+04 -3.000000E+04 *
* 1.205134E-13 6.000000E+02 -7.029948E-14 * -9.000000E+04 1.782527E-11 -6.395245E-12 *
* 8.569842E-14 1.178353E-13 6.000000E+02 * 3.000000E+04 1.096940E-11 -5.484699E-12 *
* ***** ***** ***** * ***** ***** ***** *
* -2.193880E-11 -9.000000E+04 3.000000E+04 * 1.500000E+07 -2.106124E-09 1.053062E-09 *
* 9.000000E+04 1.765387E-11 1.371175E-12 * -2.895921E-09 1.350000E+07 -4.500000E+06 *
* -3.000000E+04 -6.427381E-12 -5.998889E-13 * 1.118879E-09 -4.500000E+06 1.500000E+06 *
***
```

M.O.I. matrix - about reference point in basic coordinate system

```
***
* 1.500000E+07 -2.106124E-09 1.053062E-09 *
* -2.895921E-09 1.350000E+07 -4.500000E+06 *
* 1.118879E-09 -4.500000E+06 1.500000E+06 *
***
```

M.O.I. matrix - about above c.g. location in basic coordinate system

```
***
* 2.980232E-08 -2.425887E-09 9.377550E-11 *
* -3.215683E-09 1.862645E-09 3.725290E-09 *
* 1.595919E-10 3.725290E-09 -2.793968E-09 *
***
```

M.O.I. matrix - about above c.g. location in principal directions

```
***
* -4.921328E-09 3.518674E-11 -4.441183E-10 *
* 2.394211E-11 3.711538E-09 6.492380E-10 *
* 2.500863E-12 -5.372939E-12 3.008079E-08 *
***
```

Transformation from basic coordinates to principal directions

```
***
* -3.673723E-02 -4.919769E-01 8.698328E-01 *
* 7.892750E-02 8.662729E-01 4.932968E-01 *
* -9.962032E-01 8.677609E-02 7.006038E-03 *
***
```


OUTPUT FROM THE GRID POINT WEIGHT GENERATOR FOR RESIDUAL STRUCTURE
(reference point is grid point 211)

Total mass = 4.000000E+03

X Y Z
C.G. location : -2.500000E+01 2.500000E+01 5.000000E+01
(relative to reference point in basic coordinate system)

6x6 Rigid body mass matrix - about reference point in basic coordinate system

```
***
* 4.000000E+03 0.000000E+00 0.000000E+00 * 0.000000E+00 2.000000E+05 -1.000000E+05 *
* 0.000000E+00 4.000000E+03 0.000000E+00 * -2.000000E+05 0.000000E+00 -1.000000E+05 *
* 0.000000E+00 0.000000E+00 4.000000E+03 * 1.000000E+05 1.000000E+05 0.000000E+00 *
* ***** ***** ***** * ***** ***** ***** *
* 0.000000E+00 0.000000E+00 0.000000E+00 * 2.500000E+07 2.500000E+06 5.000000E+06 *
* 0.000000E+00 0.000000E+00 0.000000E+00 * 2.500000E+06 2.500000E+07 -5.000000E+06 *
* 0.000000E+00 0.000000E+00 0.000000E+00 * 5.000000E+06 -5.000000E+06 1.000000E+07 *
***
```

M.O.I. matrix - about reference point in basic coordinate system

```
***
* 2.500000E+07 2.500000E+06 5.000000E+06 *
* 2.500000E+06 2.500000E+07 -5.000000E+06 *
* 5.000000E+06 -5.000000E+06 1.000000E+07 *
***
```

M.O.I. matrix - about above c.g. location in basic coordinate system

```
***
* 1.250000E+07 0.000000E+00 0.000000E+00 *
* 0.000000E+00 1.250000E+07 0.000000E+00 *
* 0.000000E+00 0.000000E+00 5.000000E+06 *
***
```

M.O.I. matrix - about above c.g. location in principal directions

```
***
* 5.000000E+06 0.000000E+00 0.000000E+00 *
* 0.000000E+00 1.250000E+07 0.000000E+00 *
* 0.000000E+00 0.000000E+00 1.250000E+07 *
***
```

Transformation from basic coordinates to principal directions

```
***
* 0.000000E+00 0.000000E+00 1.000000E+00 *
* 0.000000E+00 1.000000E+00 0.000000E+00 *
* 1.000000E+00 0.000000E+00 0.000000E+00 *
***
```

OUTPUT FROM THE GRID POINT WEIGHT GENERATOR FOR OVERALL MODEL
(reference point is grid point 211)

Total mass = 5.000000E+03

X Y Z
C.G. location : -2.400000E+01 2.600000E+01 6.800000E+01
(relative to reference point in basic coordinate system)

6x6 Rigid body mass matrix - about reference point in basic coordinate system

```
***
* 5.000000E+03 0.000000E+00 0.000000E+00 * 0.000000E+00 3.400000E+05 -1.300000E+05 *
* 0.000000E+00 5.000000E+03 0.000000E+00 * -3.400000E+05 0.000000E+00 -1.200000E+05 *
* 0.000000E+00 0.000000E+00 5.000000E+03 * 1.300000E+05 1.200000E+05 0.000000E+00 *
* ***** ***** ***** * ***** ***** ***** *
* 0.000000E+00 0.000000E+00 0.000000E+00 * 4.625000E+07 2.500000E+06 7.500000E+06 *
* 0.000000E+00 0.000000E+00 0.000000E+00 * 2.500000E+06 4.575000E+07 -9.500000E+06 *
* 0.000000E+00 0.000000E+00 0.000000E+00 * 7.500000E+06 -9.500000E+06 1.250000E+07 *
***
```

M.O.I. matrix - about reference point in basic coordinate system

```
***
* 4.625000E+07 2.500000E+06 7.500000E+06 *
* 2.500000E+06 4.575000E+07 -9.500000E+06 *
* 7.500000E+06 -9.500000E+06 1.250000E+07 *
***
```

M.O.I. matrix - about above c.g. location in basic coordinate system

```
***
* 1.975000E+07 -6.200000E+05 -6.600000E+05 *
* -6.200000E+05 1.975000E+07 -6.600000E+05 *
* -6.600000E+05 -6.600000E+05 6.240000E+06 *
***
```

M.O.I. matrix - about above c.g. location in principal directions

```
***
* 6.172763E+06 4.656613E-10 1.877026E-10 *
* 3.492460E-10 1.919724E+07 5.969503E-09 *
* 1.271812E-10 2.321052E-09 2.037000E+07 *
***
```

Transformation from basic coordinates to principal directions

```
***
* 5.080514E-02 5.080514E-02 9.974155E-01 *
* 7.052793E-01 7.052793E-01 -7.184932E-02 *
* -7.071068E-01 7.071068E-01 1.018074E-15 *
***
```

E I G E N V A L U E A N A L Y S I S S U M M A R Y (LANCZOS Mode 2 DPB Shift eigen = 0.00E+00)

NUMBER OF EIGENVALUES EXTRACTED 10

LARGEST OFF-DIAGONAL GENERALIZED MASS TERM -7.0E-11 (Vecs renormed to 1.0 for gen masses)

```

MODE PAIR . . . . . 4

```

```

NUMBER OF OFF DIAGONAL GENERALIZED MASS
TERMS FAILING CRITERION OF 1.0E-04. . . . . 0

```

		R E A L E I G E N V A L U E S					
MODE	EXTRACTION	EIGENVALUE	RADIANS	CYCLES	GENERALIZED	GENERALIZED	
NUMBER	ORDER				MASS	STIFFNESS	
1	1	2.682498E+03	5.179284E+01	8.243086E+00	1.000000E+00	2.682498E+03	
2	2	2.726318E+03	5.221415E+01	8.310141E+00	1.000000E+00	2.726318E+03	
3	3	5.121950E+03	7.156780E+01	1.139037E+01	1.000000E+00	5.121950E+03	
4	4	2.254593E+04	1.501530E+02	2.389760E+01	1.000000E+00	2.254593E+04	
5	5	4.873465E+04	2.207593E+02	3.513493E+01	1.000000E+00	4.873465E+04	
6	6	5.145711E+04	2.268416E+02	3.610296E+01	1.000000E+00	5.145711E+04	
7	7	5.822092E+04	2.412901E+02	3.840251E+01	1.000000E+00	5.822092E+04	
8	8	8.792938E+04	2.965289E+02	4.719404E+01	1.000000E+00	8.792938E+04	
9	9	1.045087E+05	3.232780E+02	5.145130E+01	1.000000E+00	1.045087E+05	
10	10	2.864546E+05	5.352146E+02	8.518204E+01	1.000000E+00	2.864546E+05	

OUTPUT FOR EIGENVECTOR

1

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	2.257796E-01	2.257796E-01	5.556862E-02	-1.831903E-03	1.831903E-03	1.369739E-16
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	2.253124E-01	2.244884E-01	5.061107E-03	-1.544883E-03	1.930698E-03	1.247654E-05
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	2.244884E-01	2.253124E-01	5.061107E-03	-1.930698E-03	1.544883E-03	-1.247654E-05
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	2.248731E-01	2.248731E-01	-6.717091E-02	-1.902515E-03	1.902515E-03	1.456876E-16
3101	19	2.257796E-01	2.257796E-01	5.556862E-02	-1.831903E-03	1.831903E-03	1.369739E-16
3201	291	5.061107E-03	-2.244884E-01	-2.253124E-01	0.0	0.0	0.0
3202	292	-2.248731E-01	-2.248731E-01	-6.717091E-02	0.0	0.0	0.0
3203	293	-2.244884E-01	5.061107E-03	-2.253124E-01	0.0	0.0	0.0
10001	0	6.837237E-03	0.0	0.0	0.0	0.0	0.0
10002	0	6.837237E-03	0.0	0.0	0.0	0.0	0.0
10003	0	1.313670E-04	0.0	0.0	0.0	0.0	0.0
20001	0	-1.770954E-02	0.0	0.0	0.0	0.0	0.0
20002	0	-2.673628E-15	0.0	0.0	0.0	0.0	0.0
20003	0	3.163012E-04	0.0	0.0	0.0	0.0	0.0

OUTPUT FOR EIGENVECTOR

2

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	2.098268E-01	-2.098268E-01	1.478671E-14	1.908249E-03	1.908249E-03	-7.239933E-04
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	2.469433E-01	-2.077252E-01	6.053706E-02	1.625426E-03	1.844591E-03	-7.442003E-04
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	2.077252E-01	-2.469433E-01	-6.053706E-02	1.844591E-03	1.625426E-03	-7.442003E-04
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	2.462213E-01	-2.462213E-01	-1.795691E-14	1.814842E-03	1.814842E-03	-7.644073E-04
3101	19	2.098268E-01	-2.098268E-01	1.478671E-14	1.908249E-03	1.908249E-03	-7.239933E-04
3201	291	-6.053706E-02	-2.077252E-01	2.469433E-01	0.0	0.0	0.0
3202	292	-2.462213E-01	2.462213E-01	-1.795691E-14	0.0	0.0	0.0
3203	293	2.077252E-01	6.053706E-02	-2.469433E-01	0.0	0.0	0.0
10001	0	6.592239E-03	0.0	0.0	0.0	0.0	0.0
10002	0	-6.592239E-03	0.0	0.0	0.0	0.0	0.0
10003	0	2.936680E-17	0.0	0.0	0.0	0.0	0.0
20001	0	-4.995894E-15	0.0	0.0	0.0	0.0	0.0
20002	0	1.023825E-02	0.0	0.0	0.0	0.0	0.0
20003	0	9.411529E-17	0.0	0.0	0.0	0.0	0.0

OUTPUT FOR EIGENVECTOR

3

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	2.793835E-01	-2.793835E-01	5.004811E-16	1.441582E-03	1.441582E-03	9.660273E-03
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	-2.099831E-01	-2.745273E-01	-8.363813E-04	7.782410E-04	-6.846300E-04	9.577011E-03
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	2.745273E-01	2.099831E-01	8.363813E-04	-6.846300E-04	7.782410E-04	9.577011E-03
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	-2.091551E-01	2.091551E-01	-6.517893E-16	-7.371523E-04	-7.371523E-04	9.493750E-03
3101	19	2.793835E-01	-2.793835E-01	5.004811E-16	1.441582E-03	1.441582E-03	9.660273E-03
3201	291	8.363813E-04	-2.745273E-01	-2.099831E-01	0.0	0.0	0.0
3202	292	2.091551E-01	-2.091551E-01	-6.517893E-16	0.0	0.0	0.0
3203	293	2.745273E-01	-8.363813E-04	2.099831E-01	0.0	0.0	0.0
10001	0	1.551155E-02	0.0	0.0	0.0	0.0	0.0
10002	0	-1.551155E-02	0.0	0.0	0.0	0.0	0.0
10003	0	5.819547E-18	0.0	0.0	0.0	0.0	0.0
20001	0	-1.474285E-16	0.0	0.0	0.0	0.0	0.0
20002	0	-1.340916E-02	0.0	0.0	0.0	0.0	0.0
20003	0	0.0	0.0	0.0	0.0	0.0	0.0

OUTPUT FOR EIGENVECTOR

4

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	1.409456E-01	1.409456E-01	4.074739E-02	-3.821831E-03	3.821831E-03	2.238448E-17
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	8.206453E-02	9.996514E-02	-6.860444E-02	-1.050561E-03	-4.367738E-03	6.187025E-04
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	9.996514E-02	8.206453E-02	-6.860444E-02	4.367738E-03	1.050561E-03	-6.187025E-04
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	8.332244E-02	8.332244E-02	2.732509E-01	4.602225E-03	-4.602225E-03	2.034953E-17
3101	19	1.409456E-01	1.409456E-01	4.074739E-02	-3.821831E-03	3.821831E-03	2.238448E-17
3201	291	-6.860444E-02	-9.996514E-02	-8.206453E-02	0.0	0.0	0.0
3202	292	-8.332244E-02	-8.332244E-02	2.732509E-01	0.0	0.0	0.0
3203	293	-9.996514E-02	-6.860444E-02	-8.206453E-02	0.0	0.0	0.0
10001	0	6.125957E-02	0.0	0.0	0.0	0.0	0.0
10002	0	6.125957E-02	0.0	0.0	0.0	0.0	0.0
10003	0	8.237927E-04	0.0	0.0	0.0	0.0	0.0
20001	0	2.051004E-01	0.0	0.0	0.0	0.0	0.0
20002	0	-5.005985E-16	0.0	0.0	0.0	0.0	0.0
20003	0	5.714306E-03	0.0	0.0	0.0	0.0	0.0

SPC Force Summary on AUTOSPC'd DOF's

OUTPUT FOR EIGENVECTOR

5

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	6.341469E-02	6.341469E-02	-3.911836E-01	1.145572E-02	-1.145572E-02	-1.047146E-17
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	1.623121E-01	1.473997E-01	2.739692E-02	3.671459E-03	-2.130204E-03	-1.163037E-03
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	1.473997E-01	1.623121E-01	2.739692E-02	2.130204E-03	-3.671459E-03	1.163037E-03
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	1.668975E-01	1.668975E-01	1.681957E-01	1.416000E-03	-1.416000E-03	-5.235730E-17
3101	19	6.341469E-02	6.341469E-02	-3.911836E-01	1.145572E-02	-1.145572E-02	-1.047146E-17
3201	291	2.739692E-02	-1.473997E-01	-1.623121E-01	0.0	0.0	0.0
3202	292	-1.668975E-01	-1.668975E-01	1.681957E-01	0.0	0.0	0.0
3203	293	-1.473997E-01	2.739692E-02	-1.623121E-01	0.0	0.0	0.0
10001	0	-1.772331E-01	0.0	0.0	0.0	0.0	0.0
10002	0	-1.772331E-01	0.0	0.0	0.0	0.0	0.0
10003	0	-1.749863E-02	0.0	0.0	0.0	0.0	0.0
20001	0	4.296179E-02	0.0	0.0	0.0	0.0	0.0
20002	0	1.534069E-15	0.0	0.0	0.0	0.0	0.0
20003	0	1.510498E-02	0.0	0.0	0.0	0.0	0.0

OUTPUT FOR EIGENVECTOR

6

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	3.724522E-02	3.724522E-02	-3.693792E-01	-2.515040E-03	2.515040E-03	9.222831E-18
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	-2.542942E-02	-1.207365E-02	-3.433346E-01	1.395074E-03	-6.731852E-04	7.305658E-04
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	-1.207365E-02	-2.542942E-02	-3.433346E-01	6.731852E-04	-1.395074E-03	-7.305658E-04
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	-2.487312E-02	-2.487312E-02	-2.889412E-01	1.012371E-03	-1.012371E-03	4.611415E-17
3101	19	3.724522E-02	3.724522E-02	-3.693792E-01	-2.515040E-03	2.515040E-03	9.222831E-18
3201	291	-3.433346E-01	1.207365E-02	2.542942E-02	0.0	0.0	0.0
3202	292	2.487312E-02	2.487312E-02	-2.889412E-01	0.0	0.0	0.0
3203	293	1.207365E-02	-3.433346E-01	2.542942E-02	0.0	0.0	0.0
10001	0	8.785845E-02	0.0	0.0	0.0	0.0	0.0
10002	0	8.785845E-02	0.0	0.0	0.0	0.0	0.0
10003	0	-1.748922E-02	0.0	0.0	0.0	0.0	0.0
20001	0	3.348994E-02	0.0	0.0	0.0	0.0	0.0
20002	0	-2.274965E-15	0.0	0.0	0.0	0.0	0.0
20003	0	-2.930656E-02	0.0	0.0	0.0	0.0	0.0

OUTPUT FOR EIGENVECTOR

7

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	-1.161277E-01	1.161277E-01	2.066697E-15	8.532284E-03	8.532284E-03	1.991342E-03
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	-2.103757E-01	1.580113E-01	3.700141E-01	3.813257E-03	5.055154E-03	1.576458E-03
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	-1.580113E-01	2.103757E-01	-3.700141E-01	5.055154E-03	3.813257E-03	1.576458E-03
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	-2.239355E-01	2.239355E-01	-8.999290E-15	4.548427E-03	4.548427E-03	1.161574E-03
3101	19	-1.161277E-01	1.161277E-01	2.066697E-15	8.532284E-03	8.532284E-03	1.991342E-03
3201	291	-3.700141E-01	1.580113E-01	-2.103757E-01	0.0	0.0	0.0
3202	292	2.239355E-01	-2.239355E-01	-8.999290E-15	0.0	0.0	0.0
3203	293	-1.580113E-01	3.700141E-01	2.103757E-01	0.0	0.0	0.0
10001	0	1.088153E-01	0.0	0.0	0.0	0.0	0.0
10002	0	-1.088153E-01	0.0	0.0	0.0	0.0	0.0
10003	0	1.610520E-16	0.0	0.0	0.0	0.0	0.0
20001	0	2.616073E-16	0.0	0.0	0.0	0.0	0.0
20002	0	1.834231E-01	0.0	0.0	0.0	0.0	0.0
20003	0	-9.287058E-16	0.0	0.0	0.0	0.0	0.0

OUTPUT FOR EIGENVECTOR

8

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	-1.419129E-01	1.419129E-01	2.317995E-14	9.845793E-03	9.845793E-03	-3.905077E-03
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	9.985553E-02	3.117029E-01	-1.565936E-01	-7.646235E-03	-1.079164E-03	-6.508205E-03
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	-3.117029E-01	-9.985553E-02	1.565936E-01	-1.079164E-03	-7.646235E-03	-6.508205E-03
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	1.077791E-01	-1.077791E-01	-1.665356E-14	-2.559339E-03	-2.559339E-03	-9.111334E-03
3101	19	-1.419129E-01	1.419129E-01	2.317995E-14	9.845793E-03	9.845793E-03	-3.905077E-03
3201	291	1.565936E-01	3.117029E-01	9.985553E-02	0.0	0.0	0.0
3202	292	-1.077791E-01	1.077791E-01	-1.665356E-14	0.0	0.0	0.0
3203	293	-3.117029E-01	-1.565936E-01	-9.985553E-02	0.0	0.0	0.0
10001	0	4.017448E-01	0.0	0.0	0.0	0.0	0.0
10002	0	-4.017448E-01	0.0	0.0	0.0	0.0	0.0
10003	0	2.252365E-15	0.0	0.0	0.0	0.0	0.0
20001	0	1.141315E-14	0.0	0.0	0.0	0.0	0.0
20002	0	-1.473824E-01	0.0	0.0	0.0	0.0	0.0
20003	0	-2.797529E-15	0.0	0.0	0.0	0.0	0.0

E I G E N V E C T O R
(in global coordinate system at each grid)

GRID	COORD SYS	T1	T2	T3	R1	R2	R3
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	9.874954E-03	9.874954E-03	-3.318802E-01	-3.540108E-04	3.540108E-04	-2.349437E-16
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	-1.314425E-01	-1.303271E-01	3.130906E-01	1.280416E-02	1.936418E-03	1.852483E-03
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	-1.303271E-01	-1.314425E-01	3.130906E-01	-1.936418E-03	-1.280416E-02	-1.852483E-03
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	-1.451769E-01	-1.451769E-01	1.668669E-01	-6.882197E-04	6.882197E-04	-6.703288E-16
3101	19	9.874954E-03	9.874954E-03	-3.318802E-01	-3.540108E-04	3.540108E-04	-2.349437E-16
3201	291	3.130906E-01	1.303271E-01	1.314425E-01	0.0	0.0	0.0
3202	292	1.451769E-01	1.451769E-01	1.668669E-01	0.0	0.0	0.0
3203	293	1.303271E-01	3.130906E-01	1.314425E-01	0.0	0.0	0.0
10001	0	2.997971E-01	0.0	0.0	0.0	0.0	0.0
10002	0	2.997971E-01	0.0	0.0	0.0	0.0	0.0
10003	0	-3.352174E-02	0.0	0.0	0.0	0.0	0.0
20001	0	-2.006229E-01	0.0	0.0	0.0	0.0	0.0
20002	0	-9.353935E-15	0.0	0.0	0.0	0.0	0.0
20003	0	3.435181E-02	0.0	0.0	0.0	0.0	0.0

E I G E N V E C T O R
(in global coordinate system at each grid)

GRID	COORD SYS	T1	T2	T3	R1	R2	R3
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	5.244173E-01	5.244173E-01	3.226796E-02	1.104391E-02	-1.104391E-02	-4.352106E-17
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	-1.457712E-01	3.010482E-02	1.107608E-01	-2.311276E-03	2.176723E-03	6.667304E-03
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	3.010482E-02	-1.457712E-01	1.107608E-01	-2.176723E-03	2.311276E-03	-6.667304E-03
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	-1.849120E-01	-1.849120E-01	-1.282324E-01	-3.080425E-03	3.080425E-03	0.0
3101	19	5.244173E-01	5.244173E-01	3.226796E-02	1.104391E-02	-1.104391E-02	-4.352106E-17
3201	291	1.107608E-01	-3.010482E-02	1.457712E-01	0.0	0.0	0.0
3202	292	1.849120E-01	1.849120E-01	-1.282324E-01	0.0	0.0	0.0
3203	293	-3.010482E-02	1.107608E-01	1.457712E-01	0.0	0.0	0.0
10001	0	-4.130922E-01	0.0	0.0	0.0	0.0	0.0
10002	0	-4.130922E-01	0.0	0.0	0.0	0.0	0.0
10003	0	1.079876E-02	0.0	0.0	0.0	0.0	0.0
20001	0	2.823822E-01	0.0	0.0	0.0	0.0	0.0
20002	0	-2.915911E-15	0.0	0.0	0.0	0.0	0.0
20003	0	-6.471028E-02	0.0	0.0	0.0	0.0	0.0

CB PROBLEM - BASIC STR AND 2 SUBSTR'S

SUBSTR'S LOCATED IN SEPARATE COORD SYSTEMS. SUBSTR GLOBAL ARE SEVERAL SYS DEFINED IN EACH SUBSTR DECK

E F F E C T I V E M O D A L M A S S E S O R W E I G H T S
(in coordinate system 0)

Units are same as units for mass input in the Bulk Data Deck

Reference point is the PARAM GRDPNT grid: 211

MODE NUM	CYCLES	T1	T2	T3	R1	R2	R3
1	8.243086E+00	1.441150E+03	1.441150E+03	1.174957E+00	2.086481E+07	2.086481E+07	3.759155E-21
2	8.310141E+00	1.453188E+03	1.453188E+03	1.618394E-25	2.026645E+07	2.026645E+07	9.350473E+04
3	1.139037E+01	1.220303E+01	1.220303E+01	4.104911E-27	3.352989E+04	3.352989E+04	3.641755E+06
4	2.389760E+01	2.613795E+01	2.613795E+01	2.373060E+02	7.807750E+04	7.807750E+04	6.648079E-25
5	3.513493E+01	3.252471E+01	3.252471E+01	4.597040E+01	1.147872E+05	1.147872E+05	1.750904E-24
6	3.610296E+01	1.331710E-04	1.331710E-04	2.636815E+03	6.072446E+03	6.072446E+03	1.160188E-24
7	3.840251E+01	3.422216E+01	3.422216E+01	5.893452E-25	1.529019E+05	1.529019E+05	1.057675E+02
8	4.719404E+01	1.393397E-01	1.393397E-01	7.232226E-25	3.848304E+04	3.848304E+04	1.442802E+04
9	5.145130E+01	2.890068E-02	2.890068E-02	7.515295E+01	5.791888E+04	5.791888E+04	6.246470E-23
10	8.518204E+01	6.853074E-02	6.853074E-02	7.414881E-01	1.497763E+03	1.497763E+03	1.715368E-25
Sum all modes:		2.999662E+03	2.999662E+03	2.997161E+03	4.161452E+07	4.161452E+07	3.749794E+06
Total model mass:		5.000000E+03	5.000000E+03	5.000000E+03	4.625000E+07	4.575000E+07	1.250000E+07
Modes % of total mass*:		59.99%	59.99%	59.94%	89.98%	90.96%	30.00%

*If all modes are calculated the % of total mass should be 100% of the free mass (i.e. not counting mass at constrained DOF's). Percentages are only printed for components that have finite model mass.

1.7 FEM basic structure and FEM substructures

(input deck CB1d-BASIC-STR-W-FEM-SUBSTRS.DAT)

NOTE: This run is only made to show that the answers from the synthesis run using C-B models gives the correct results

511121054

MYSTRAN Version 6.13 May 10 2010 by Dr Bill Case

```
>> MYSTRAN BEGIN : 5/11/2010 at 12:10:54. 15 The input file is CB1d-BASIC-STR-W-FEM-SUBSTRS.DAT
```

```
>> LINK 0 BEGIN
```

ID CB1,RUN (d)

SOL 3

CEND

TITLE = CB PROBLEM - PHYSICAL FEM MODELS FOR BASIC STR AND SUBSTR'S

SUBTI = SUBSTR'S LOCATED IN SEPARATE COORD SYSTEMS. SUBSTR GLOBAL ARE SEVERAL SYS DEFINED IN EACH SUBSTR DECK

ECHO = UNSORT

$$\text{SPC} = 1$$

METHOD = 2

MEFFMASS = ALL

DISP = ALL

BEGIN BULK

\$

EIGRL	2	10	MASS
-------	---	----	------

\$ Basic str

\$ _____

```
GRID      100              0.      0.    -50.
```

\$

```
GRID      111          -25.    -25.   -50.
```

```

GRID      211              25.      -25.      -50.

```

```

GRID      221              25.      25.     -50.

```

```
GRID      121          -25.      25.   -50.
```

\$

```
GRID      112          -25.    -25.    50.
```

```
GRID      212              25.    -25.    50.
```

GRID	222	25.	25.	50.
------	-----	-----	-----	-----

```
GRID      122          -25.      25.      50.
```

\$

CBAR	1001	1101	111	211	0.	0.	1.
------	------	------	-----	-----	----	----	----

CBAR	1002	1101	211	221	0.	0.	1.
------	------	------	-----	-----	----	----	----

CBAR	1003	1101	221	121	0.	0.	1.
------	------	------	-----	-----	----	----	----

CBAR	1004	1101	121	111	0.	0.	1.
------	------	------	-----	-----	----	----	----

\$

CBAR	1005	1102	112	212	0.	0.	1.
------	------	------	-----	-----	----	----	----

CBAR	1006	1102	212	222	0.	0.	1.
------	------	------	-----	-----	----	----	----

CBAR	1007	1102	222	122	0.	0.	1.
------	------	------	-----	-----	----	----	----

CBAR	1008	1102	122	112	0.	0.	1.
------	------	------	-----	-----	----	----	----

\$

CBAR	1009	1103	111	112	1.	0.	0.
------	------	------	-----	-----	----	----	----

CBAR	1010	1103	211	212	1.	0.	0.
------	------	------	-----	-----	----	----	----

CBAR	1011	1103	221	222	1.	0.	0.
------	------	------	-----	-----	----	----	----

CBAR	1012	1103	121	122	1.	0.	0.
------	------	------	-----	-----	----	----	----

```

$
PBAR 1101 100 1. 80. 80. 80.
PBAR 1102 100 1. 80. 80. 80.
PBAR 1103 100 1. 80. 80. 80.
$
MAT1 100 10.+06 .3
*INFORMATION: MAT1 ENTRY 100 HAD FIELD FOR G BLANK. MYSTRAN CALCULATED G = 3.846154E+06
$
RBE2 1000 100 123456 111 211 221 121
$
CONM2 1001 111 500.
CONM2 1002 211 500.
CONM2 1003 221 500.
CONM2 1004 121 500.
CONM2 1005 112 500.
CONM2 1006 212 500.
CONM2 1007 222 500.
CONM2 1008 122 500.
$
SPC1 1 123456 100
$
$*****
$ Substr #1
$ -----
$ CORD2R 10 defines the basic system for substr 1 relative to OA model basic
$
CORD2R 10 -25. -25. 60. -25. 50. -20. -25. 50. +C10
+C10 -25. -25. 60.
$
CORD2R 19 10 0. 0. 0. 1. 0. 0. +C19
+C19 0. 0. 1.
$
GRID 3101 10 0. 0. 0. 19
GRID 3102 10 25. 0. 0. 19
CBAR 3101 3101 3101 3102 1. 0. 0.
PBAR 3101 301 1. 20. 20. 40.
MAT1 301 30.+6 .3
*INFORMATION: MAT1 ENTRY 301 HAD FIELD FOR G BLANK. MYSTRAN CALCULATED G = 1.153846E+07
$
RBE2 1001 112 123456 3101
$
CONM2 3102 3102 400.
$
$*****
$ Substr #2
$ -----
$ CORD2R 20 defines the basic system for substr 2 relative to OA model basic
$ CORD2R 291, 292, 293, 294 are global systems for substr 2
$
CORD2R 20 25. 25. 50. 20. 25. 50. +C20
+C20 25. 20. 50.
$

```

CORD2R	291	20	0.	0.	0.	1.	0.	0.	+C29
+C29	0.	1.	0.						
\$									
CORD2R	292	20	0.	0.	0.	0.	1.	0.	+C29
+C29	0.	0.	1.						
\$									
CORD2R	293	20	0.	0.	0.	0.	0.	1.	+C29
+C29	1.	0.	0.						
\$									
CORD2R	294	20	0.	0.	0.	0.	0.	1.	+C29
+C29	1.	0.	0.						
\$									
GRID	3201	20	50.	0.	0.	291			
GRID	3202	20	0.	0.	0.	292			
GRID	3203	20	0.	0.	50.	293			
GRID	3204	20	0.	50.	0.	294			
\$									
CBAR	3201	3201	3201	3202	1.	0.	0.		
CBAR	3202	3201	3202	3203	0.	0.	1.		
CBAR	3203	3201	3203	3201	0.	1.	0.		
\$									
CBAR	3204	3201	3201	3204	0.	0.	1.		
CBAR	3205	3201	3202	3204	0.	1.	0.		
CBAR	3206	3201	3203	3204	1.	0.	0.		
\$									
PBAR	3201	302	1.	20.	20.	40.			
MAT1	302	30.+6		.3					
*INFORMATION: MAT1 ENTRY 302 HAD FIELD FOR G BLANK. MYSTRAN CALCULATED G = 1.153846E+07									
\$									
RBE2	2001	212	123	3201					
RBE2	2002	222	123	3202					
RBE2	2003	122	123	3203					
\$									
CONM2	3201	3204		600.					
\$									
\$*****									
PARAM	GRDPNT	100							
PARAM	GRIDSEQ	GRID							
PARAM	WTMASS	.002591							
\$									
ENDDATA									

OUTPUT FROM THE GRID POINT WEIGHT GENERATOR FOR OVERALL MODEL
(reference point is grid point 100)

Total mass = 5.000000E+03

X Y Z
C.G. location : 1.000000E+00 1.000000E+00 6.800000E+01
(relative to reference point in basic coordinate system)

6x6 Rigid body mass matrix - about reference point in basic coordinate system

```
***
* 5.000000E+03 0.000000E+00 0.000000E+00 * 0.000000E+00 3.400000E+05 -5.000000E+03 *
* 0.000000E+00 5.000000E+03 0.000000E+00 * -3.400000E+05 0.000000E+00 5.000000E+03 *
* 0.000000E+00 0.000000E+00 5.000000E+03 * 5.000000E+03 -5.000000E+03 0.000000E+00 *
* ***** ***** ***** * ***** ***** ***** *
* 0.000000E+00 0.000000E+00 0.000000E+00 * 4.287500E+07 -6.250000E+05 -1.000000E+06 *
* 0.000000E+00 0.000000E+00 0.000000E+00 * -6.250000E+05 4.287500E+07 -1.000000E+06 *
* 0.000000E+00 0.000000E+00 0.000000E+00 * -1.000000E+06 -1.000000E+06 6.250000E+06 *
***
```

M.O.I. matrix - about reference point in basic coordinate system

```
***
* 4.287500E+07 -6.250000E+05 -1.000000E+06 *
* -6.250000E+05 4.287500E+07 -1.000000E+06 *
* -1.000000E+06 -1.000000E+06 6.250000E+06 *
***
```

M.O.I. matrix - about above c.g. location in basic coordinate system

```
***
* 1.975000E+07 -6.200000E+05 -6.600000E+05 *
* -6.200000E+05 1.975000E+07 -6.600000E+05 *
* -6.600000E+05 -6.600000E+05 6.240000E+06 *
***
```

M.O.I. matrix - about above c.g. location in principal directions

```
***
* 6.172763E+06 0.000000E+00 -6.017513E-13 *
* 1.164153E-10 1.919724E+07 3.742019E-09 *
* -2.910383E-11 3.725290E-09 2.037000E+07 *
***
```

Transformation from basic coordinates to principal directions

```
***
* -5.080514E-02 -5.080514E-02 -9.974155E-01 *
* 7.052793E-01 7.052793E-01 -7.184932E-02 *
* 7.071068E-01 -7.071068E-01 0.000000E+00 *
***
```

E I G E N V A L U E A N A L Y S I S S U M M A R Y (LANCZOS Mode 2 DPB Shift eigen = 0.00E+00)

NUMBER OF EIGENVALUES EXTRACTED	10
LARGEST OFF-DIAGONAL GENERALIZED MASS TERM	-3.8E-11 (Vecs renormed to 1.0 for gen masses)
MODE PAIR	3
MODE PAIR	1
NUMBER OF OFF DIAGONAL GENERALIZED MASS TERMS FAILING CRITERION OF 1.0E-04.	0

			R E A L E I G E N V A L U E S			
MODE	EXTRACTION	EIGENVALUE	RADIANS	CYCLES	GENERALIZED	GENERALIZED
NUMBER	ORDER				MASS	STIFFNESS
1	1	2.682498E+03	5.179284E+01	8.243086E+00	1.000000E+00	2.682498E+03
2	2	2.726318E+03	5.221415E+01	8.310141E+00	1.000000E+00	2.726318E+03
3	3	5.121950E+03	7.156780E+01	1.139037E+01	1.000000E+00	5.121950E+03
4	4	2.254593E+04	1.501530E+02	2.389760E+01	1.000000E+00	2.254593E+04
5	5	4.873465E+04	2.207593E+02	3.513493E+01	1.000000E+00	4.873465E+04
6	6	5.145711E+04	2.268416E+02	3.610296E+01	1.000000E+00	5.145711E+04
7	7	5.822092E+04	2.412901E+02	3.840251E+01	1.000000E+00	5.822092E+04
8	8	8.792938E+04	2.965289E+02	4.719404E+01	1.000000E+00	8.792938E+04
9	9	1.045087E+05	3.232780E+02	5.145130E+01	1.000000E+00	1.045087E+05
10	10	2.864546E+05	5.352146E+02	8.518204E+01	1.000000E+00	2.864546E+05

OUTPUT FOR EIGENVECTOR

1

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	2.257796E-01	2.257796E-01	5.556862E-02	-1.831903E-03	1.831903E-03	4.204085E-16
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	2.253124E-01	2.244884E-01	5.061107E-03	-1.544883E-03	1.930698E-03	1.247654E-05
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	2.244884E-01	2.253124E-01	5.061107E-03	-1.930698E-03	1.544883E-03	-1.247654E-05
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	2.248731E-01	2.248731E-01	-6.717091E-02	-1.902515E-03	1.902515E-03	4.353024E-16
3101	19	2.257796E-01	2.257796E-01	5.556862E-02	-1.831903E-03	1.831903E-03	4.204085E-16
3102	19	2.782932E-01	2.782932E-01	5.569766E-02	-2.234869E-03	2.234869E-03	4.206278E-16
3201	291	5.061107E-03	-2.244884E-01	-2.253124E-01	-1.633467E-05	1.467460E-03	-1.573769E-03
3202	292	-2.248731E-01	-2.248731E-01	-6.717091E-02	1.535535E-03	-1.535535E-03	4.390095E-16
3203	293	-2.244884E-01	5.061107E-03	-2.253124E-01	-1.467460E-03	1.633467E-05	1.573769E-03
3204	294	-3.070889E-01	-7.139002E-02	-3.070889E-01	-1.671972E-03	4.584769E-16	1.671972E-03

OUTPUT FOR EIGENVECTOR

2

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	2.098268E-01	-2.098268E-01	2.749016E-14	1.908249E-03	1.908249E-03	-7.239933E-04
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	2.469433E-01	-2.077252E-01	6.053706E-02	1.625426E-03	1.844591E-03	-7.442003E-04
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	2.077252E-01	-2.469433E-01	-6.053706E-02	1.844591E-03	1.625426E-03	-7.442003E-04
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	2.462213E-01	-2.462213E-01	-3.353193E-14	1.814842E-03	1.814842E-03	-7.644073E-04
3101	19	2.098268E-01	-2.098268E-01	2.749016E-14	1.908249E-03	1.908249E-03	-7.239933E-04
3102	19	2.640084E-01	-2.640084E-01	2.755243E-14	2.296775E-03	2.296775E-03	-7.239933E-04
3201	291	-6.053706E-02	-2.077252E-01	2.469433E-01	-7.846801E-04	-1.195091E-03	-1.258295E-03
3202	292	-2.462213E-01	2.462213E-01	-3.353193E-14	-1.277410E-03	-1.277410E-03	-7.662186E-04
3203	293	2.077252E-01	6.053706E-02	-2.469433E-01	-1.195091E-03	-7.846801E-04	-1.258295E-03
3204	294	3.132401E-01	-3.567182E-14	-3.132401E-01	-1.341269E-03	-8.044487E-04	-1.341269E-03

OUTPUT FOR EIGENVECTOR

3

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
111	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
112	0 -2.793835E-01	2.793835E-01	-1.257871E-17	-1.441582E-03	-1.441582E-03	-9.660273E-03	
121	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
122	0 2.099831E-01	2.745273E-01	8.363813E-04	-7.782410E-04	6.846300E-04	-9.577011E-03	
211	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
212	0 -2.745273E-01	-2.099831E-01	-8.363813E-04	6.846300E-04	-7.782410E-04	-9.577011E-03	
221	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
222	0 2.091551E-01	-2.091551E-01	-1.551879E-16	7.371523E-04	7.371523E-04	-9.493750E-03	
3101	19 -2.793835E-01	2.793835E-01	-1.257871E-17	-1.441582E-03	-1.441582E-03	-9.660273E-03	
3102	19 -3.306597E-01	3.306597E-01	-1.357894E-17	-2.355785E-03	-2.355785E-03	-9.660273E-03	
3201	291 -8.363813E-04	2.745273E-01	2.099831E-01	-9.691665E-03	3.082395E-06	-7.822932E-05	
3202	292 -2.091551E-01	2.091551E-01	-1.551879E-16	-1.026739E-04	-1.026739E-04	-9.669339E-03	
3203	293 -2.745273E-01	8.363813E-04	-2.099831E-01	3.082395E-06	-9.691665E-03	-7.822932E-05	
3204	294 2.183707E-01	-1.464586E-16	-2.183707E-01	-1.861042E-04	-9.718228E-03	-1.861042E-04	

OUTPUT FOR EIGENVECTOR

4

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
111	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
112	0 -1.409456E-01	-1.409456E-01	-4.074739E-02	3.821831E-03	-3.821831E-03	4.833014E-17	
121	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
122	0 -8.206453E-02	-9.996514E-02	6.860444E-02	1.050561E-03	4.367738E-03	-6.187025E-04	
211	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
212	0 -9.996514E-02	-8.206453E-02	6.860444E-02	-4.367738E-03	-1.050561E-03	6.187025E-04	
221	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
222	0 -8.332244E-02	-8.332244E-02	-2.732509E-01	-4.602225E-03	4.602225E-03	4.019032E-17	
3101	19 -1.409456E-01	-1.409456E-01	-4.074739E-02	3.821831E-03	-3.821831E-03	4.833014E-17	
3102	19 -2.966655E-01	-2.966655E-01	-4.155659E-02	7.432282E-03	-7.432282E-03	4.883887E-17	
3201	291 6.860444E-02	9.996514E-02	8.206453E-02	-4.408058E-04	7.160866E-03	-8.333937E-03	
3202	292 8.332244E-02	8.332244E-02	-2.732509E-01	7.811994E-03	-7.811994E-03	4.375149E-17	
3203	293 9.996514E-02	6.860444E-02	8.206453E-02	-7.160866E-03	4.408058E-04	8.333937E-03	
3204	294 -3.689602E-01	-3.293645E-01	-3.689602E-01	-9.440189E-03	4.426023E-17	9.440189E-03	

OUTPUT FOR EIGENVECTOR

5

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
111	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
112	0 -6.341469E-02	-6.341469E-02	3.911836E-01	-1.145572E-02	1.145572E-02	-1.207958E-16	
121	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
122	0 -1.623121E-01	-1.473997E-01	-2.739692E-02	-3.671459E-03	2.130204E-03	1.163037E-03	
211	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
212	0 -1.473997E-01	-1.623121E-01	-2.739692E-02	-2.130204E-03	3.671459E-03	-1.163037E-03	
221	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
222	0 -1.668975E-01	-1.668975E-01	-1.681957E-01	-1.416000E-03	1.416000E-03	-7.629207E-17	
3101	19 -6.341469E-02	-6.341469E-02	3.911836E-01	-1.145572E-02	1.145572E-02	-1.207958E-16	
3102	19 3.970712E-01	3.970712E-01	4.083722E-01	-2.190130E-02	2.190130E-02	-1.245356E-16	
3201	291 -2.739692E-02	1.473997E-01	1.623121E-01	4.095169E-04	2.914967E-03	-3.029385E-03	
3202	292 1.668975E-01	1.668975E-01	-1.681957E-01	3.023068E-03	-3.023068E-03	-7.404819E-17	
3203	293 1.473997E-01	-2.739692E-02	1.623121E-01	-2.914967E-03	-4.095169E-04	3.029385E-03	
3204	294 1.427369E-03	-1.904093E-01	1.427369E-03	-3.371325E-03	-5.534915E-17	3.371325E-03	

OUTPUT FOR EIGENVECTOR

6

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
111	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
112	0 -3.724522E-02	-3.724522E-02	3.693792E-01	2.515040E-03	-2.515040E-03	-1.867623E-16	
121	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
122	0 2.542942E-02	1.207365E-02	3.433346E-01	-1.395074E-03	6.731852E-04	-7.305658E-04	
211	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
212	0 1.207365E-02	2.542942E-02	3.433346E-01	-6.731852E-04	1.395074E-03	7.305658E-04	
221	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0
222	0 2.487312E-02	2.487312E-02	2.889412E-01	-1.012371E-03	1.012371E-03	-1.298882E-16	
3101	19 -3.724522E-02	-3.724522E-02	3.693792E-01	2.515040E-03	-2.515040E-03	-1.867623E-16	
3102	19 -1.864230E-01	-1.864230E-01	3.865585E-01	7.693148E-03	-7.693148E-03	-1.859938E-16	
3201	291 3.433346E-01	-1.207365E-02	-2.542942E-02	-3.130493E-04	1.017383E-03	-1.451089E-03	
3202	292 -2.487312E-02	-2.487312E-02	2.889412E-01	1.356019E-03	-1.356019E-03	-1.329625E-16	
3203	293 -1.207365E-02	3.433346E-01	-2.542942E-02	-1.017383E-03	3.130493E-04	1.451089E-03	
3204	294 -1.029617E-01	3.028070E-01	-1.029617E-01	-1.544026E-03	-1.068311E-16	1.544026E-03	

OUTPUT FOR EIGENVECTOR

7

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	-1.161277E-01	1.161277E-01	3.712861E-14	8.532284E-03	8.532284E-03	1.991342E-03
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	-2.103757E-01	1.580113E-01	3.700141E-01	3.813257E-03	5.055154E-03	1.576458E-03
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	-1.580113E-01	2.103757E-01	-3.700141E-01	5.055154E-03	3.813257E-03	1.576458E-03
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	-2.239355E-01	2.239355E-01	9.574826E-15	4.548427E-03	4.548427E-03	1.161574E-03
3101	19	-1.161277E-01	1.161277E-01	3.712861E-14	8.532284E-03	8.532284E-03	1.991342E-03
3102	19	2.040667E-01	-2.040667E-01	3.904488E-14	1.494552E-02	1.494552E-02	1.991342E-03
3201	291	-3.700141E-01	1.580113E-01	-2.103757E-01	1.047123E-03	-7.116251E-03	-8.256382E-03
3202	292	2.239355E-01	-2.239355E-01	9.574826E-15	-8.601971E-03	-8.601971E-03	1.387704E-03
3203	293	-1.580113E-01	3.700141E-01	2.103757E-01	-7.116251E-03	1.047123E-03	-8.256382E-03
3204	294	2.627866E-01	8.790004E-15	-2.627866E-01	-9.747110E-03	6.965249E-04	-9.747110E-03

OUTPUT FOR EIGENVECTOR

8

E I G E N V E C T O R							
(in global coordinate system at each grid)							
GRID	COORD	T1	T2	T3	R1	R2	R3
	SYS						
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	1.419129E-01	-1.419129E-01	-1.945058E-15	-9.845793E-03	-9.845793E-03	3.905077E-03
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	-9.985553E-02	-3.117029E-01	1.565936E-01	7.646235E-03	1.079164E-03	6.508205E-03
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	3.117029E-01	9.985553E-02	-1.565936E-01	1.079164E-03	7.646235E-03	6.508205E-03
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	-1.077791E-01	1.077791E-01	-2.571978E-16	2.559339E-03	2.559339E-03	9.111334E-03
3101	19	1.419129E-01	-1.419129E-01	-1.945058E-15	-9.845793E-03	-9.845793E-03	3.905077E-03
3102	19	-4.988587E-01	4.988587E-01	-2.395155E-15	-3.352340E-02	-3.352340E-02	3.905077E-03
3201	291	-1.565936E-01	-3.117029E-01	-9.985553E-02	8.204729E-03	-2.921019E-03	-3.800032E-03
3202	292	1.077791E-01	-1.077791E-01	-2.571978E-16	-4.062794E-03	-4.062794E-03	8.431563E-03
3203	293	3.117029E-01	1.565936E-01	9.985553E-02	-2.921019E-03	8.204729E-03	-3.800032E-03
3204	294	1.398105E-01	-3.214973E-16	-1.398105E-01	-4.977733E-03	7.906040E-03	-4.977733E-03

E I G E N V E C T O R
(in global coordinate system at each grid)

GRID	COORD SYS	T1	T2	T3	R1	R2	R3
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	9.874954E-03	9.874954E-03	-3.318802E-01	-3.540108E-04	3.540108E-04	1.057657E-17
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	-1.314425E-01	-1.303271E-01	3.130906E-01	1.280416E-02	1.936418E-03	1.852483E-03
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	-1.303271E-01	-1.314425E-01	3.130906E-01	-1.936418E-03	-1.280416E-02	-1.852483E-03
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	-1.451769E-01	-1.451769E-01	1.668669E-01	-6.882197E-04	6.882197E-04	-1.232222E-17
3101	19	9.874954E-03	9.874954E-03	-3.318802E-01	-3.540108E-04	3.540108E-04	1.057657E-17
3102	19	3.132106E-01	3.132106E-01	-3.648080E-01	-1.802313E-02	1.802313E-02	1.177457E-17
3201	291	3.130906E-01	1.303271E-01	1.314425E-01	1.955859E-04	3.010059E-03	-4.448523E-03
3202	292	1.451769E-01	1.451769E-01	1.668669E-01	4.163780E-03	-4.163780E-03	-7.256419E-18
3203	293	1.303271E-01	3.130906E-01	1.314425E-01	-3.010059E-03	-1.955859E-04	4.448523E-03
3204	294	-1.276522E-01	1.427482E-01	-1.276522E-01	-5.587510E-03	-1.293833E-17	5.587510E-03

E I G E N V E C T O R
(in global coordinate system at each grid)

GRID	COORD SYS	T1	T2	T3	R1	R2	R3
100	0	0.0	0.0	0.0	0.0	0.0	0.0
111	0	0.0	0.0	0.0	0.0	0.0	0.0
112	0	-5.244173E-01	-5.244173E-01	-3.226796E-02	-1.104391E-02	1.104391E-02	2.466193E-16
121	0	0.0	0.0	0.0	0.0	0.0	0.0
122	0	1.457712E-01	-3.010482E-02	-1.107608E-01	2.311276E-03	-2.176723E-03	-6.667304E-03
211	0	0.0	0.0	0.0	0.0	0.0	0.0
212	0	-3.010482E-02	1.457712E-01	-1.107608E-01	2.176723E-03	-2.311276E-03	6.667304E-03
221	0	0.0	0.0	0.0	0.0	0.0	0.0
222	0	1.849120E-01	1.849120E-01	1.282324E-01	3.080425E-03	-3.080425E-03	-7.253510E-17
3101	19	-5.244173E-01	-5.244173E-01	-3.226796E-02	-1.104391E-02	1.104391E-02	2.466193E-16
3102	19	1.574536E-01	1.574536E-01	-4.287539E-02	-3.539030E-02	3.539030E-02	2.611264E-16
3201	291	-1.107608E-01	3.010482E-02	-1.457712E-01	-4.762449E-03	-4.392630E-03	2.025267E-03
3202	292	-1.849120E-01	-1.849120E-01	1.282324E-01	-3.668946E-03	3.668946E-03	0.0
3203	293	3.010482E-02	-1.107608E-01	-1.457712E-01	4.392630E-03	4.762449E-03	-2.025267E-03
3204	294	-7.299191E-02	1.050199E-01	-7.299191E-02	1.354195E-03	1.015491E-16	-1.354195E-03

CB PROBLEM - PHYSICAL FEM MODELS FOR BASIC STR AND SUBSTR'S
 SUBSTR'S LOCATED IN SEPARATE COORD SYSTEMS. SUBSTR GLOBAL ARE SEVERAL SYS DEFINED IN EACH SUBSTR DECK

E F F E C T I V E M O D A L M A S S E S O R W E I G H T S
 (in coordinate system 0)

Units are same as units for mass input in the Bulk Data Deck
 Reference point is the PARAM GRDPNT grid: 100

MODE NUM	CYCLES	T1	T2	T3	R1	R2	R3
1	8.243086E+00	1.441150E+03	1.441150E+03	1.174957E+00	2.086481E+07	2.086481E+07	3.128029E-20
2	8.310141E+00	1.453188E+03	1.453188E+03	7.813450E-25	2.026645E+07	2.026645E+07	9.350473E+04
3	1.139037E+01	1.220303E+01	1.220303E+01	1.498775E-26	3.352989E+04	3.352989E+04	3.641755E+06
4	2.389760E+01	2.613795E+01	2.613795E+01	2.373060E+02	7.807750E+04	7.807750E+04	3.128762E-24
5	3.513493E+01	3.252471E+01	3.252471E+01	4.597040E+01	1.147872E+05	1.147872E+05	5.111790E-25
6	3.610296E+01	1.331710E-04	1.331710E-04	2.636815E+03	6.072446E+03	6.072446E+03	2.361307E-24
7	3.840251E+01	3.422216E+01	3.422216E+01	6.691178E-24	1.529019E+05	1.529019E+05	1.057675E+02
8	4.719404E+01	1.393397E-01	1.393397E-01	3.924220E-27	3.848304E+04	3.848304E+04	1.442802E+04
9	5.145130E+01	2.890068E-02	2.890068E-02	7.515295E+01	5.791888E+04	5.791888E+04	2.324093E-26
10	8.518204E+01	6.853074E-02	6.853074E-02	7.414881E-01	1.497763E+03	1.497763E+03	2.607528E-25
Sum all modes:		2.999662E+03	2.999662E+03	2.997161E+03	4.161452E+07	4.161452E+07	3.749794E+06
Total model mass:		5.000000E+03	5.000000E+03	5.000000E+03	4.287500E+07	4.287500E+07	6.250000E+06
Modes % of total mass*:		59.99%	59.99%	59.94%	97.06%	97.06%	60.00%

*If all modes are calculated the % of total mass should be 100% of the free mass (i.e. not counting mass at constrained DOF's).
 Percentages are only printed for components that have finite model mass.