CUSTOMER SUPPORT NOTE

Extraction of Stiffness, Mass, and Damping Matrices

Note Number:	**CSN/LUSAS/1020**

This support note is issued as a guideline only.

LUSAS

Forge House, 66 High Street, Kingston upon Thames, Surrey, KT1 1HN, UK
Tel: +44 (0)20 8541 1999 Fax: +44 (0)20 8549 9399
Email: info@lusas.com www.lusas.com

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1. Introduction

This technical note presents a method for extracting stiffness, mass, and damping matrices. The procedure is described in detail in the following section.

2. Step-by-step Procedure and Example

2.1 Procedure

The procedure is as follows:

1. Set up an eigenvalue analysis.
    a. Define a single loadcase and request only one eigenfrequency. This ensures the software assembles the mass matrix required.
2. Tabulate the data file.
    a. Right-click the eigenvalue analysis in the Analysis treeview and select Export Solver Datafile.
    b. Save the data file in the desired folder. The files containing the matrices will be automatically generated in the same folder.
3. Open the data file generated in Step 2 using a text editor such as Notepad++ or a similar text editor.
4. Add the SYSTEM and DEBUG commands at the start of the data file, as shown below.

```
C LUSAS solver datafile
C Created by LUSAS 24.0-0c6 - Modeller Version 24.0.1606.57562
C Created at 12:58 on Monday, May 18 2026
C (C) Finite Element Analysis Ltd 2026

SYSTEM
SOLVER=2
EXIT

DEBUG
ASMMAT 4
EXIT

PROBLEM TITLE no Title set
UNITS  N  m  kg  s  C
```

5. Save and close the data file.
6. Create a desktop shortcut to the Solver batch file located at:
   C:\ProgramData\LusasXYZ\x64\Lusas_S.bat
   Note that XYZ depends on the software version: for example, 230 for Version 23, 240 for Version 24, and so on for other releases.
7. Drag and drop the edited data file onto the Solver batch file shortcut.

The data file will be processed by the LUSAS Solver, which will generate three new files:

Stiffness matrix: *_stmat.dat

Mass matrix: *_mamat.dat

Damping matrix: *_damat.dat

Note that mass and damping matrices will only be generated if they exist.

2.2 Example

2.2.1 Stiffness matrix

Figure 1 shows how stiffness matrices are presented in data files generated using the procedure described above.

```
GLOBAL STIFFNESS MATRIX
ENTRIES ARE SHOWN AS COLUMN : ROW : VALUE.

*SYMMETRIC* MATRIX - ONLY THE LOWER HALF IS STORED (AND SHOWN).

RESTRAINED EQUATIONS REMOVED FROM MATRIX (ROW AND COLUMN NUMBERS ALTERED ACCORDINGLY).

          12         51
         1          1       538255470.1992
         1          2     0.0000000000000E+00
         1          3     0.0000000000000E+00
         1         10     -538255470.1992
         1         11     0.0000000000000E+00
         1         12     0.0000000000000E+00
         2          2      30186485.93427
         2          3     -18866553.70892
         2         10     0.0000000000000E+00
         2         11     -30186485.93427
         2         12     -18866553.70892
         3          3      17528061.62017
         3         10     0.0000000000000E+00
         3         11      18866553.70892
```

Figure 1 – Example – Stiffness matrix.

2.2.2 Mass matrix

Figure 2 shows how mass matrices are presented in data files generated using the procedure described above.

```
GLOBAL MASS MATRIX
ENTRIES ARE SHOWN AS COLUMN : ROW : VALUE.

*SYMMETRIC* MATRIX - ONLY THE LOWER HALF IS STORED (AND SHOWN).

RESTRAINED EQUATIONS REMOVED FROM MATRIX (ROW AND COLUMN NUMBERS ALTERED ACCORDINGLY).

          12         51
         1          1       110.4782667629
         1          2     0.0000000000000E+00
         1          3     0.0000000000000E+00
         1         10      5.239133381454
         1         11     0.0000000000000E+00
         1         12     0.0000000000000E+00
         2          2      111.3872891187
         2          3     -1.889188425890
         2         10     0.0000000000000E+00
         2         11      4.330111025628
         2         12      1.385269937519
         3          3     0.4808417743099
         3         10     0.0000000000000E+00
         3         11     -1.385269937519
```

Figure 2 – Example – Mass matrix.

3. Summary

This technical note presents a method for extracting stiffness, mass, and damping matrices. The method can be applied to both small and large models; however, it should be noted that the size of the resulting matrices depends on the number of degrees of freedom. Consequently, for large models, extracting these matrices may be impractical and of limited value.

If you have any doubts or require specific advice for your type of analysis, please contact the LUSAS Technical Support team at support@lusas.com.