

MAXMIN User Manual

Version 12

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MAXMIN User Manual

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MAXMIN

Find Maximum and Minimum Element Stress Levels

1. Introduction

The MAXMIN program permits users to access the stress output files from ASAS (or the identically formatted files from LOCO) and determine the maximum and minimum stress levels in the structure for those loadcases requested by the user, which may be a subset of the total loadcases in the ASAS or LOCO analysis.

The facility exists to save the backing file used by MAXMIN for further use. The user can output a selected subset of the elements within the structure, or select given groups to be output.

Additionally, the user can compare successive runs on a structure by reading the stress file for the later analysis and comparing the values with the MAXMIN filed values from a preceding analysis.

Included within this is the feature to do 'fail-safe' comparison analyses. If an initial run is conducted with a complete structure and a MAXMIN file produced then the subsequent comparison runs may have elements omitted. If this option is exercised then the structure (and defective derivatives thereof) must have **unique user element numbers** defined in the element topology data of the ASAS analyses.

There is no theoretical restriction on the number of times MAXMIN may be run on a structure or its derivatives. An example of the possibilities is shown in Figure 1.

Another user option included is the ability to produce output for the axial elements with either the overall element maxima and minima or the values related to each end of the element. It must be noted that if comparison runs are conducted using axial elements, the both ends option must be set consistently between runs.

MAXMIN prints the maximum and minimum stress levels for the elements requested plus the loadcase which generates these stresses and the structure and component (if multi-level analysis) on which the load is applied.

MAXMIN automatically prints the maximum and minimum stresses and their associated loadcases. The user can, however, request up to the next 9 critical loadcases, i.e. those loadcases which generate the next largest or smallest stress levels. The percentage of the maximum and minimum stress values is printed out with each loadcase.

1.1. Program Description

The MAXMIN program operates on the files saved from one or more ASAS and/or LOCO analyses and/or previous MAXMIN runs. These files are saved by adding a SAVE LOCO FILES command to the preliminary data block(s) of the original ASAS, LOCO or MAXMIN runs. The files contain the stresses together with various information about the original runs necessary for post-processing.

Results from one or more ASAS analyses may be selected, providing that the structures (or components) under consideration have unique user element numbers. They may differ with regard to the suppressions and loadcases. It is important to note that each structure from which stresses are extracted must have been run under the same Project name.

MAXMIN requires an ASAS style preliminary data block which is fully described in Appendix A. The remaining data refer to the structure(s), component(s), original loadcases and previous MAXMIN analyses. These data are all entered in an entirely free format style and are described fully in Section 2

Files Produced at Various Stages (Fail Safe Runs)

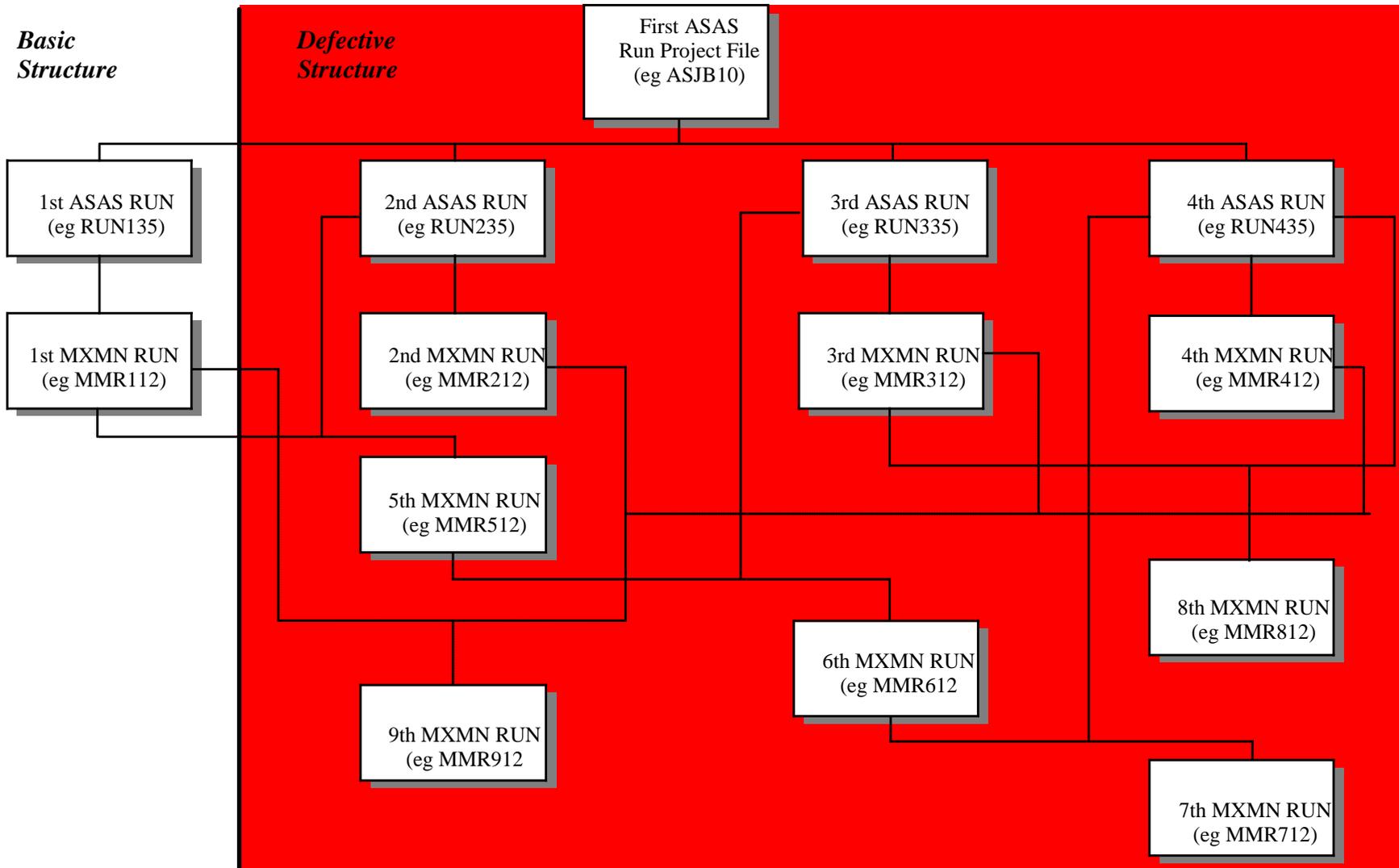
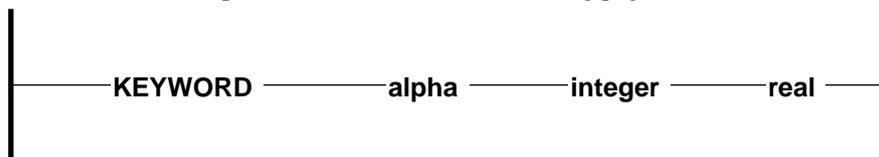


Figure 1: Flow Chart for MAXMIN Runs

2. Data Formats

2.1. General Principles

The input data for MAXMIN are specified according to syntax diagrams similar to that shown below. The conventions adopted are described in the following pages.



The sequence of the input data follows the vertical line down the left hand side of the page. Each horizontal branch represents a possible input instruction. Input instructions are composed of keywords (shown in upper-case), numerical values or alphanumerics (shown in lower-case characters), and special symbols. Each item in the list is separated from each other by a comma or one or more blank spaces.

An input line must not be longer than 80 characters

Numerical values have to be given in one of two forms:

- (i) If an integer is required a decimal point must not be supplied.
- (ii) If a real number is required the decimal point may be omitted if the value is a whole number.

Exponent formats may be used where real numbers are required.

For example 0.004 4.0E-3 4.0D-3 are equivalent
 similarly 410.0 410 4.10E2 are the same.

Alphanumerics must begin with an alpha character (A-Z). The letters A-Z may be supplied in either upper or lower case but no distinction is made between the upper and lower case form. Hence "A" is assumed identical with "a", "B" with "b" and so on.

For example CASE are all permissible alphanumeric strings
 STR1
 END
 also COMB are all identical strings
 Comb
 comb

However 3BMD 5BL are examples of inadmissible alphanumeric strings

Alphanumeric strings must not include any special symbols (see below)

2.1.1. Special Symbols

The following is a list of characters which have a special significance to the MAXMIN input.

- * An asterisk is used to define the beginning of a comment, whatever follows on the line will not be interpreted. It may appear anywhere on the line, any preceding data will be processed as normal. For example

```
* THIS IS A COMMENT FOR THE WHOLE LINE
ELEMENT 5 10 * THIS IS A COMMENT FOR PART OF A LINE
```

- ' single quotes are used to enclose some text strings which could contain otherwise inadmissible characters. The quotes are placed at each end of the string. They may also be used to provide in-line comments between data items on a given line.

For example

```
STRUCTURE 'As used for design study' STRU
```

- , A comma or a blank will act as a delimiter between items in the line. For example

```
5, 10, 15 is the same as 5 10 15
```

Note that two commas together signify that an item has been omitted. This may be permissible for certain data blocks. For example

```
5,, 15
```

Unless otherwise stated in the section describing the data block omitted numerical values are zero.

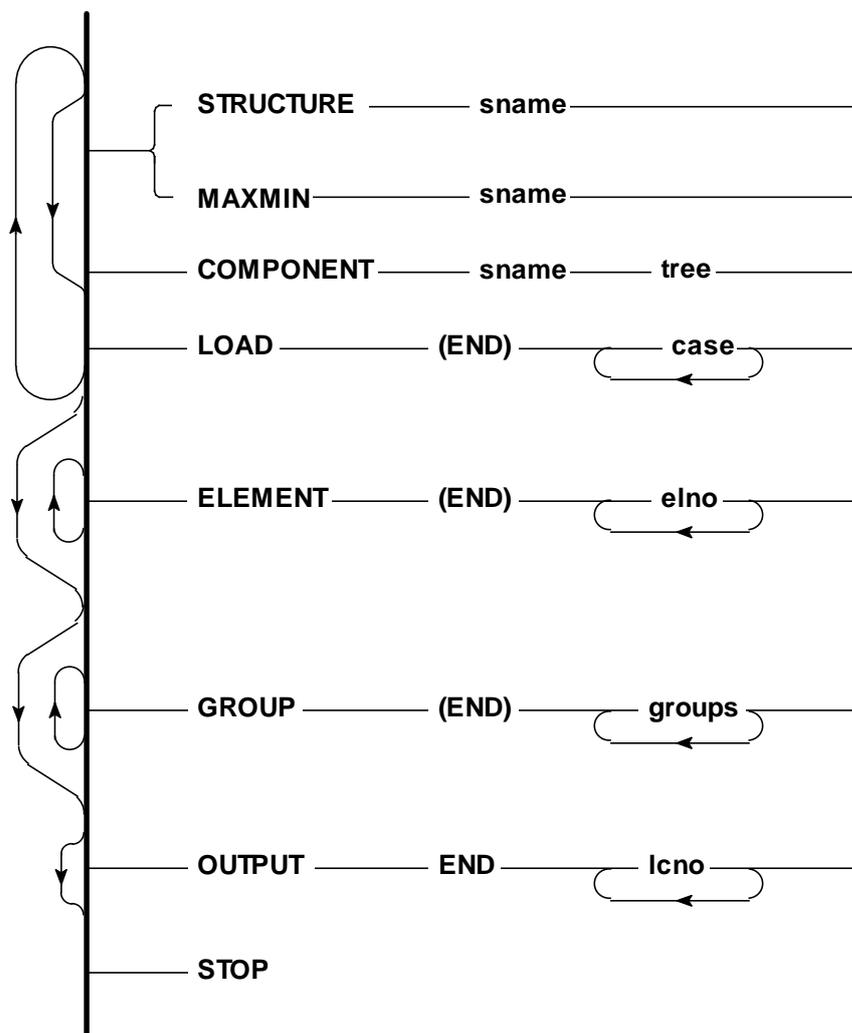
2.2. Preliminary Data

This data block at the head of the MAXMIN data contains the **JOB**, **TITLE**, **TEXT**, **SAVE**, **OPTIONS**, etc. commands and is fully described in Appendix A.

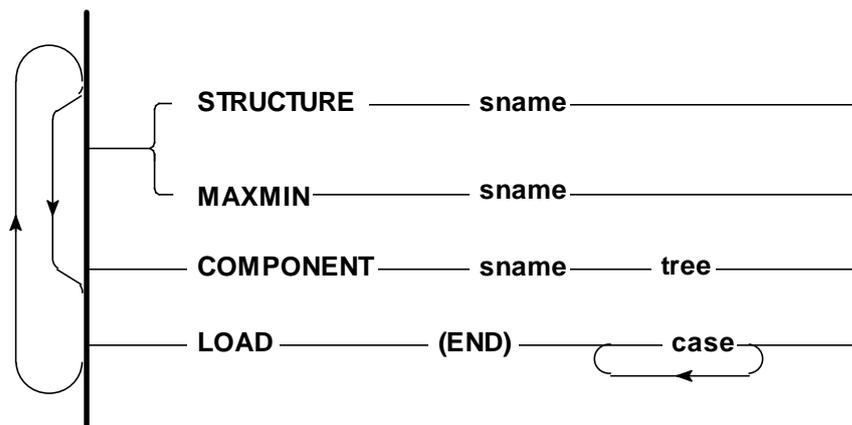
2.3. MAXMIN Data

The data for MAXMIN is entered in up to 4 distinct blocks as shown below. Of these only the **LOAD** and **STOP** commands are compulsory.

2.4. LOADCASE Selection Commands



Each **LOAD** command contains a list of loadcase numbers. The final **LOAD** command must carry the word **END** between the word **LOAD** and the first loadcase number.



Parameters

- STRUCTURE** : keyword to denote that loadcases from a different structure are to be utilised.
For a substructured analysis, this command may be followed by a **COMPONENT** command.
- MAXMIN** : keyword to denote that loadcases from a previous MAXMIN run are to be utilised. For a substructured analysis, this command may be followed by a **COMPONENT** command.
- COMPONENT** : keyword to denote that loads from a different component are to be utilised.
This command is only used for substructure analyses (but see below).
- sname** : structure name identifying which existing structure is to be accessed from the project defined in the preliminary data for subsequent loadcases.
- tree** : this is the path down the component tree from the given structure in **sname** to the recovered component being used for the MAXMIN processing. If processing a global structure run from a multilevel analysis and the component tree is not required, use the **STRUCTURE** or **MAXMIN** command instead. See example, Section 3.4.
- LOAD** : compulsory keyword
- END** : keyword - last command of loadcase set only
- case** : List of loadcase numbers. (Integer)

Notes

1. If no loadcase numbers are specified on a load command then the program defaults to include all loadcases.
2. If results are drawn from more than one structure or MAXMIN run and use is made of the **STRUCTURE**, **MAXMIN** or **COMPONENT** commands, loadcase information is drawn from the currently defined structure or component until another **STRUCTURE**, **MAXMIN** or **COMPONENT** command is defined. However for clarity in such cases it is recommended that these commands should precede each **LOAD** command as appropriate. See Example 2, Section 3.2.

Example

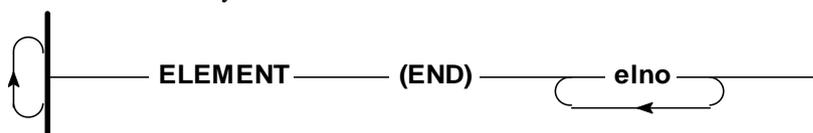
Suppose MAXMIN has so far been dealing with structure STR1 and component CMP7 (as defined in the preliminary deck) and that loadcases 1, 2, 3 and 6 are taken from this component. From structure STR2 and component CMP9 it is required to include all loadcases.

```
LOAD    1      2      3
LOAD    6
STRUCTURE STR2
```

COMPONENT STR2 CMP9
 LOAD END

2.5. ELEMENT Selection Command

A subset of the total number of elements within the run can be selected to be output using this command. Each **ELEMENT** command contains a list of user element numbers. The final **ELEMENT** command must carry the word **END** between the word **ELEMENT** and the user element number.



Parameters

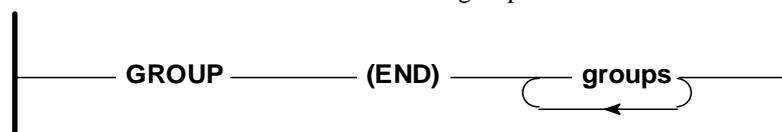
- ELEMENT** : keyword to denote the start of element selection
- (END)** : keyword - last command of element set only
- elno** : list of element numbers. (Integer)

Notes

The program default is that all elements are output if no **ELEMENT** command is present in the data.

2.6. GROUP Selection Command

A subset of the total number of groups within the run can be selected using this command. Each **GROUP** command contains a list of group numbers. The final group command must carry the word **END** between the word **GROUP** and the group number.



Parameters

- GROUP** : keyword to denote the start of group selection.
- (END)** : keyword - last command of group set only
- groups** : list of element numbers. (Integer)

Notes

The program default is that all groups are output if no **GROUP** command is present in the data.

2.7. OUTPUT Selection Command

The program calculates the maximum and minimum stresses plus the 9 next most critical loadcases for each stress. This command allows a given subset of the stresses for 10 cases to be output. As only one **OUTPUT** command is required this command must carry the word **END** between the word **OUTPUT** and the number of output cases requested.

```
|
|-----OUTPUT-----END-----ncrit-----
|
```

Parameters

- OUTPUT** : keyword to denote that the user wishes to define the number of critical cases for output
- END** : compulsory keyword
- ncrit** : number of cases to be output. Number of cases requested must be less than or equal to 10. (Integer)

Note

If no **OUTPUT** command is present, the program outputs only the single maximum and minimum cases. If more cases are requested than exist in the preceding analyses, values of minus or plus 10^{30} will appear in the maxima and minima respectively for the non-existent cases.

2.8. STOP Command

The final command of the MAXMIN data must always be the **STOP** command.

```
|
|-----STOP-----
|
```

Parameters

- STOP** : compulsory keyword

3. Examples

3.1. Example 1: Simple ASAS Analysis

This example illustrates the usage of MAXMIN to select three loadcases from an ASAS run and to compute the maximum and minimum stresses for all elements and all groups in the structure. Only one set of ASAS files is accessed. The Project Name for both the ASAS and MAXMIN runs is JACK. The four character backing file name of the ASAS run was JAC1. The MAXMIN run produces new files with the identifier JAC2. Note that in this instance (a single ASAS analysis) the STRUCTURE name is also taken as the four character backing file identifier JAC1. The NEWSTRUCTURE name becomes JAC2.

The files used in this run are required for further post-processing and hence a SAVE card is included.

```
SYSTEM DATA AREA 30000
PROJECT JACK
JOB POST
FILES JAC2
TITLE AIRPLANE LANDING CASES
STRUCTURE JAC1
NEWSTRUCTURE JAC2
SAVE LOCO FILES
OPTIONS END
END
LOAD END 1 2 3
STOP
```

3.2. Example 2: Comparison of Loadcases from Three Individual Analyses

This example takes three loadcases; one each from three different analyses, and computes the maximum and minimum stresses for the 2 most critical loadcases for user element number 10. Note that the first loadcase is taken from structure GD02 as defined in the preliminary deck. The Project Name is GHPJ and the files used in this MAXMIN analysis are identified by LOC1. As there is no SAVE card no further post-processing will be possible. Note that all three structures must have been run under the same Project Name (GHPJ), the three identifiers used on the runs being GD02, GD22 and GD12.

```
SYSTEM DATA AREA 30000
PROJECT GHPJ
FILES LOC1
JOB POST
TITLE MAXMIN EXAMPLE, 3 STRUCTURES CONTRIBUTING
STRUCTURE GD02
```

```
NEWSTRUCTURE LOC1
OPTIONS END
END
ELEMENT END 10
OUTPUT END 2
STRUCTURE GD02
LOAD 1
STRUCTURE GD22
LOAD 1
STRUCTURE GD12
LOAD END 11
STOP
```

3.3. Example 3: Multiple Use of MAXMIN for Simple ASAS Analyses

This example illustrates the use of MAXMIN to process files of stress information from previous uses of MAXMIN itself.

3.3.1. Original MAXMIN Run

This run takes the files from an ASAS analysis, Project Name GD12 and backing file name GD12 (the user either gave the file name as GD12 or left it blank and hence it defaulted to the Project Name). A NEWSTRUCTURE called YZLO is being created and the files will be saved.

```
SYSTEM DATA AREA 320000
PROJECT GD12
FILES YZLO
JOB POST
TITLE FIRST USAGE OF MAXMIN ON GD12 STRUCTURE
STRUCTURE GD12
NEWSTRUCTURE YZLO
OPTIONS END
SAVE LOCO FILES
END
LOAD 5
LOAD END 4
STOP
```

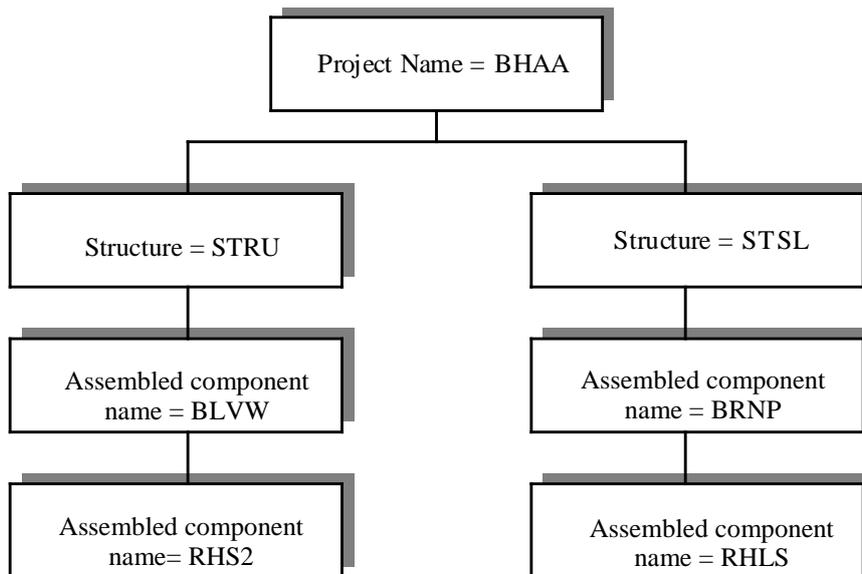
3.3.2. Second MAXMIN Run

This run combines the information from the original analysis (Project and File Names GD12) with the previous MAXMIN run (File Name YZLO).

```
SYSTEM DATA AREA 320000
PROJECT GD12
JOB POST
FILES ZZL1
TITLE          SUBSEQUENT USAGE OF MAXMIN ON GD12 + YZLO
STRUCTURE      GD12
NEWSTRUCTURE   ZZL1
OPTIONS END
END
LOAD
MAXMIN        YZLO
LOAD END 1
STOP
```

3.4. Example 4: Substructured Usage of MAXMIN

This example demonstrates the use of MAXMIN with the substructure facility. The tree structure is as follows:



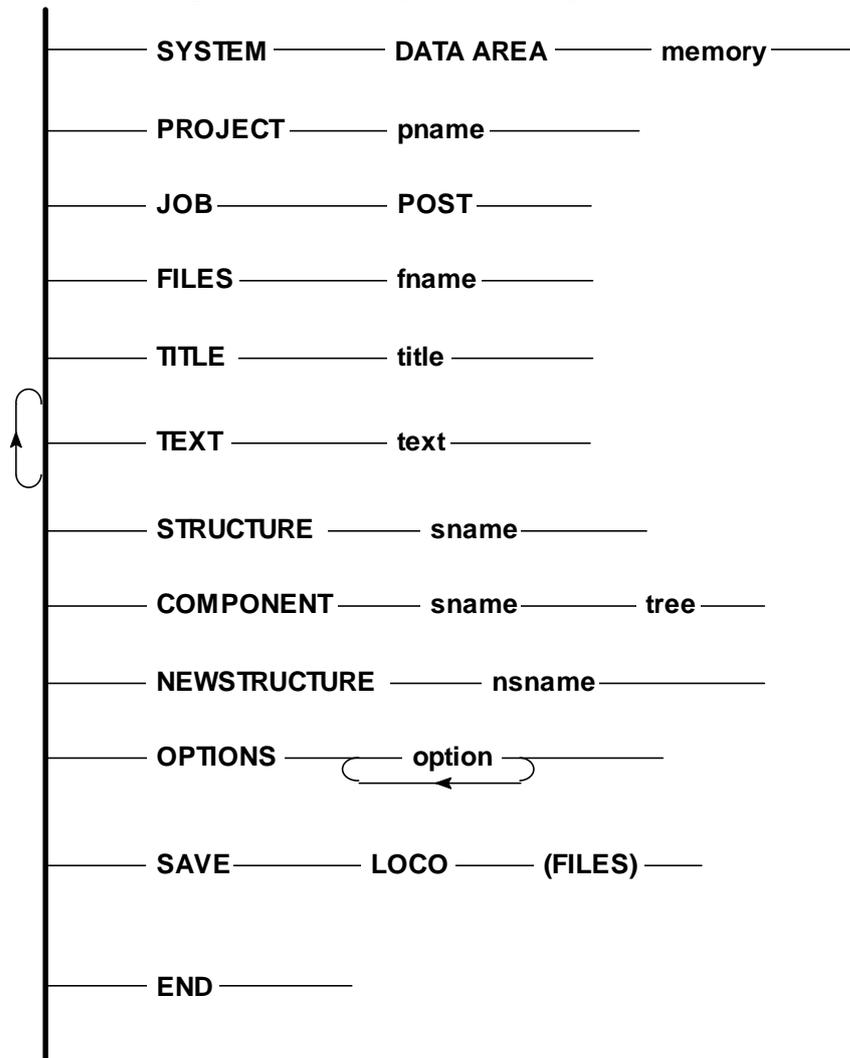
The stress values are drawn from component RHS2 of structure STRU and component RHLS of structure STSL. Components RHS2 and RHLS are both usages of the same master component and, of course, all the structures and components have been run under the same project name: BHAA. Components BLVW and BRNP are intermediate components between the ones used and their structures. New files created will be identified by BHST.

```
SYSTEM DATA AREA 350000
PROJECT BHAA
JOB POST
FILES BHST
TITLE          EXAMPLE OF COMPONENTS IN MAXMIN
STRUCTURE      STRU
NEWSTRUCTURE   STNW
COMPONENT STRU BLVW RHS2
OPTIONS END
SAVE LOCO FILES
END
LOAD 2
STRUCTURE STSL
COMPONENT STSL BRNP RHLS
LOAD 5
STRUCTURE STRU
COMPONENT STRU BLVW RHS2
LOAD 2
STRUCTURE STSL
COMPONENT STSL BRNP RHLS
LOAD END 7
STOP
```

Appendix - A Preliminary Data Deck for MAXMIN

A.1 Introduction

The preliminary data is the first block of the MAXMIN information. It defines the size of the job and the structure/component that will be processed during the course of the analysis.



The preliminary data must commence with the **SYSTEM** command and terminate with **END**. Within these bounds the other commands may be given in any order. It is suggested, however, that the order given above is adopted.

A.2 SYSTEM Command

To define the amount of memory used for data by this run. (Optional)

```

|-----SYSTEM-----DATA AREA-----memory-----

```

*Parameters***SYSTEM** : keyword**DATA AREA** : keyword**memory** : amount of memory (in 4 byte words) to be used by this run. Typical values are between 30000 and 1000000. If the SYSTEM command is omitted, a default value of 1000000 is used.*Examples*

```

SYSTEM DATA AREA 80000

```

A.3 PROJECT Command

To define the project name for the current run. Optional.

```

|-----PROJECT-----pname-----

```

*Parameters***PROJECT** : keyword**pname** : project name for current run. (Alphanumeric, 4 characters, first character must be alphabetic)*Note*

All runs with the same project name access the same data base. A project data base consists of one project file (with a file name consisting of the 4 characters of **pname** with the number 10 appended) which acts as an index to other files created under this project, together with those other files.

Example

```

PROJECT HIJK

```

A.4 JOB Command

To define the type of analysis being performed. Compulsory.

```
|
|-----JOB-----POST-----
```

Parameters

JOB : keyword.

POST : keyword.

Example

```
JOB POST
```

A.5 FILES Command

To define the prefix name for the backing files created in this run. Optional.

```
|
|-----FILES-----fname-----
```

Parameters

FILES : keyword.

fname : prefix name for any backing files created by this run. (Alphanumeric, 4 characters, first character must be alphabetic)

Note

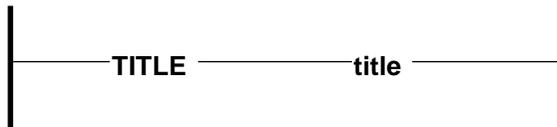
fname is used as a prefix for all files created during the current run. The four characters are appended with two digits in the range 12 to 35 to create each individual file.

Example

```
FILES BILL
```

A.6 TITLE Command

To define a title for this run. Recommended.

*Parameters*

TITLE : keyword

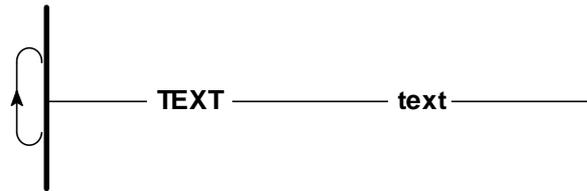
title : this line of text will be printed out at the top of each page of ASAS output.
(Alphanumeric, up to 74 characters)

Example

```
TITLE THIS IS AN EXAMPLE OF A TITLE LINE
```

A.7 TEXT Command

To define a line of text to be printed once only at the beginning of the output. Several **TEXT** lines may be defined to give a fuller description of the current analysis on the printed output.

*Parameters*

TEXT : keyword

text : this line of text will be printed once, at the beginning of the output. (Alphanumeric, up to 75 characters)

Example

```
TEXT THIS EXAMPLE OF THE TEXT
TEXT COMMAND IS SPREAD
TEXT OVER THREE LINES
```

A.8 STRUCTURE Command

To define the name of an existing structure within the current project that is to be processed in this run.

```

|-----STRUCTURE-----sname-----

```

Parameters

STRUCTURE : keyword

sname : structure name identifying which existing structure is to be accessed from the project defined on the **PROJECT** command. (Alphanumeric, 4 characters, the first character must be alphabetic)

Note

The loadcase information to be processed may be drawn from more than one structure and this is achieved by respecifying a **STRUCTURE** command within the MAXMIN data (see Section 2.3.). The structure defined in the preliminary data is adopted until a new **STRUCTURE** command is encountered.

See also A.9 **COMPONENT** command.

Example

```

STRUCTURE SHIP

```

A.9 COMPONENT Command

To define the component tree for a substructure MAXMIN run. Not valid for a non-substructured analysis.

```

|-----COMPONENT-----sname-----tree-----

```

Parameters

COMPONENT : keyword

sname : structure name as defined on the previous **STRUCTURE** command. (Alphanumeric, 4 characters, the first character must be alphabetic).

tree : this is the path down the component tree from the given structure in **sname** to the component which is being used for the MAXMIN stress processing.

Notes

1. If the user is processing the global structure run in a substructure analysis, use only the **STRUCTURE** command (A.8).
2. The loadcase information to be processed may be drawn from more than one component and this is achieved by respecifying a **COMPONENT** command within the MAXMIN data (see Section 2.3.) The component defined in the preliminary data is adopted until a new **COMPONENT** command is encountered.

Example

```
COMPONENT SHIP PORT BULK
```

A.10 NEWSTRUCTURE Command

To define a new structure name associated with the results created by the current run.

```
NEWSTRUCTURE nsname
```

Parameters

NEWSTRUCTURE : keyword

nsname : structure name associated with the results being created by the current run in order to identify these results from others in the project. **nsname** must be unique for this project (Alphanumeric, 4 characters).

Note

If a component is being processed, the resultant structure will be identified as

```
nsname tree
```

where tree is the existing path down the component tree from the original structure name to the component which is being processed.

e.g. If the original component is given by

```
STRU CMP1 CMP2
```

and the new structure is STR2, then the new component results will be identified by

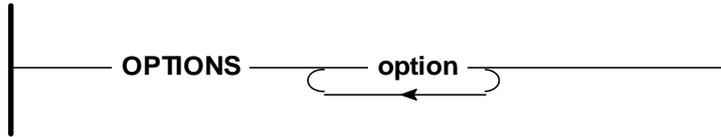
```
STR2 CMP1 CMP2
```

Example

NEWSTRUCTURE STR2

A.11 OPTIONS Command

To define the control options for this run. Optional.



Parameters

OPTIONS : keyword

option : 4 character option name, or list of option names.

Valid options are:

DATA Performs data checking only

NOBL Do not print the MAXMIN title pages

PRNO Suppress printing of the input data

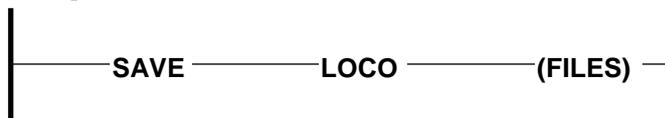
BOTH Requests that for all axial elements, i.e FLA2, FLA3, GRIL, BM2D, BM3D, BEAM, CURB, GCB3, FAX3, TCBM, TUBE and BAX3, the maximum and minimum values are to be computed for each end of the element. Note that if this option is set then any subsequent MAXMIN run to access this run must also include the BOTH option. Similarly, if the initial MAXMIN run did not include a BOTH option no subsequent MAXMIN run may include it.

Example

```
OPTIONS DATA END
```

A.12 SAVE Command

To specify that results of this MAXMIN run are to be saved in a file for further enveloping in subsequent MAXMIN runs.



Parameters

Contains proprietary and confidential information of ANSYS, Inc. and its subsidiaries and affiliates.

Appendix - B Running MAXMIN

B.1 ASAS Files Required by MAXMIN

MAXMIN operates on the files produced by the preceding ASAS, LOCO and/or MAXMIN runs and hence these must physically be present in the user's disc space for the program to be run successfully. In all cases there will be the project file which contains information about all other files in the current set of analyses. The name of this file is derived from the four character Project Name defined on all the PROJECT commands in the set. (For example, if the Project Name is PRKZ, the Project File will be PRKZ10).

For each ASAS, LOCO or MAXMIN analysis preceding this run with a 'SAVE LOCO FILES' command in its preliminary data, there will be a physical file containing the stress information from that analysis. Again the physical file names are derived from the four character name defined on the FILES command. Typically if the names used were STVK, SQSY, and TBSS then the physical files would be STVK35, SQSY35 and TBSS35. The information stored in each file will depend on the form of the run producing the output. The stresses may relate to a single step analysis of a structure or to the results associated with elements at any level in a substructured analysis. Provided that the user has the requisite files on disc the program will handle them in a transparent manner.

B.2 Saving Files Produced by MAXMIN

MAXMIN uses files in the same way as ASAS, and a new physical file of the maximum and minimum stresses will be produced. For example, this file will be named YYYY35, where YYYY is the four character identifier on the FILES command in the MAXMIN preliminary data. This physical file may be saved (and hence used for further post-processing) by including a SAVE command in the preliminary data of the MAXMIN run. If this command is absent then the file will not be saved.

B.3 Running Instructions for MAXMIN

See the appendices in the ASAS User Manual for details on how to run any of the programs in the ASAS suite