RESTARTS ON NASTRAN

1. INTRODUCTION

The restarts on NASTRAN are a way to start again a model run, once it has been previously finished or not, without starting from the beginning and taking advantage of the calculations already performed so then.

There are some large finite element models on NASTRAN that require the usage of restarts in order to avoid useless computational time. For example, when several output requests are necessary for the same load cases, it is not needed to re-calculate the whole model because the solution of the system has been already got on the first run and only some additional magnitudes have to be calculated.

Another good example is when the light goes out. In these situations the computers usually shut down and the FEM could have been running during days so then. It is possible to restart the run from the point when the light went out and not from the beginning.

Sometimes it can also be useful to recover the complete model cards, for this purpose a RESTART with ECHO=PUNCH will provide the whole model on a pch file.

2. RESTART VERSIONS

The following files are normally created by NASTRAN when the model 'model' runs (if scr=no parameter is used):

model.MASTER
model.DBALL

These two files contain the data stored by NASTRAN according to the solution sequence used on the model. These data are useful for NASTRAN to restart the solution and therefore these two files are necessary to perform the restart of the model.

For each RESTART of the model, an index called VERSION is attached by NASTRAN to the FEM. So as, the first run of the clean model is version 1, the first restart is the version 2, and so on. The MASTER and DBALL files of the model change as the new versions are restarted storing the new data of the restarts and increasing the version. Even the failed restarts (because a failure on the bulk data definition or due to a shut down) are stored with a new version.

The engineer can decide if he wants to keep the information of all the restarts performed on the model on the MASTER and DBALL files or if he prefers just to store the last version (to keep the files MASTER and DBALL with reduced size). Keeping different versions of the model can be useful if the model is changed during the restarts (the bulk data entries can be changed in a restart as will be explained later).

When a restart is performed, the engineer can decide from which version he wants to start. If the information is available on the DBALL and MASTER files (because he decided on the past to keep this information on the files) and the version is restartable (and this requires that this version of the model could run correctly with no bulk data errors for example), he will be able to restart the model from this version. When a version of the model is not valid for restart purposes, a user warning numbered 784 is issued on the f06 file indicating: that the version run is not restartable, and the last version that can be used for restarts.

There is a way to find out the list of restartable versions contained on a MASTER and DBALL files. The way is just to create a bdf with the following three lines.

assign MASTER='model.MASTER'
DBDIR VERSION=*
ENDJOB

On the f06 file a table like this is written:

P R O J E C T V E R S I O N D I R E C T O R Y P R I N T

PROJECT_ID	ASSIGNED INT. VALUE	VERSION_ID	CREATION TIME
" B L A N K "	1	** 1	4/ 2/14 12:38.19
		** 2	4/ 2/14 12:46.25
		** 3	4/ 2/14 12:47.33
		** 4	4/ 2/14 12:48.30
		** 5	4/ 2/14 12:49.41
		6	4/ 2/14 13: 4.41

This table contains the VERSION_ID stored on the DBALL and MASTER file and a '**' for each version not restartable (due to lack of data because the engineer decided not to store the information or to errors). From the previous table, it can be figured out that only the version 6 is available.

3. RESTARTS WITHOUT CHANGING THE FEM

A restart without changing the model means a restart where the bulk data is unchanged. The case control can be modified without limitations; in fact, it has to be completely included on the restart.

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In order to perform a Restart the File management section of the model (just below the NASTRAN statement if it exists or the very first line of the bdf if the NASTRAN statement does not exist) has to be modified including the following statement:

RESTART
assign MASTER='model.MASTER'

Or

RESTART VERSION=[1,2,3,4…],[KEEP|NOKEEP]
assign MASTER='model.MASTER'

The first number indicates from which version the restart will be performed. The word KEEP or NOKEEP indicates if the engineer wants to KEEP the data of the last version (not the current one) or if he prefers to overwrite this data with the current restart. The default values are the last version and NOKEEP.

From this point up to the bulk data, the bdf can be modified as the engineer wants, including all the data normally used on the executive control deck and case control deck. Any number of load cases can be included and the output request is absolutely customizable at engineer's free will.

The bulk data has to be completely removed from the bdf, the bulk data of the bdf will look like this:

BEGIN BULK

ENDDATA

A complete bdf of a RESTART will look like this:

```
RESTART
assign MASTER='restart_b0.MASTER'
SOL 101
CEND
ECHO = NONE
  SPC = 2
  MPC=101106
  DISPLACEMENT(SORT2,REAL)=ALL
```

```
SUBCASE 1
  LABEL=APERTURA
  LOAD=1


SUBCASE 5000
  LABEL= 1G LC 50
  LOAD = 5000

BEGIN BULK

ENDDATA
```

4. RESTARTS CHANGING THE MODEL

A restart changing the model means a restart where the bulk data is changed. The case control can be modified without limitations; in fact, it has to be completely included on the restart.

The procedure is exactly the same that the one explained previously but additionally there is an option to:

- Remove cards from bulk data
- Add cards on bulk data
- Modify cards on the bulk data

In order to remove or modify a card it is necessary to find out what is the ENTRY COUNT of the line to be removed or modified. The way to see these ENTRY COUNTS is to perform a restart including an ECHO=SORTED in the case control:

```
RESTART
assign MASTER='restart_b0.MASTER'
SOL 101
CEND
ECHO = SORTED

BEGIN BULK

ENDDATA
```

The f06 file of this restart includes the entire model with and ENTRY COUNT associated with each line.

```
                                    S O R T E D   B U L K   D A T A   E C H O

ENTRY
COUNT      .   1   ..   2   ..   3   ..   4   ..   5   ..   6   ..   7   ..   8   ..   9   ..  10   .
    1-     CORD2R  7000001         0.      0.      0.      0.      0.      1.        +00002R
    2-     ++00002R1.      0.      0.                                                +00002S
    3-     CORD2R  7000002         22652.  398.741 2976.55 20417.8 -882.64 -19728.   +00002T
    4-     ++00002T45392.4 399.199 738.822                                           +00002U
    5-     CORD2R  7000003         22652.  -398.7412976.55 20419.2 1106.41 -19714.4 +00002V
    6-     ++00002V45392.4 -399.199738.822                                           +00002W
    7-     CORD2R  7000004         23057.6 0.      2946.94 20561.4 74.1048 -20163.7 +00002X
    8-     ++00002X46168.3 0.      450.685                                           +00002Y
    9-     CORD2R  7000005         22215.3 -249.3013010.92 22215.3 22170.5 3010.92  +00002Z
   10-     ++00002Z44615.  -249.3013959.72                                           +000030
   11-     CQUAD4  171428441712710017102977171029681710296917102978700000 1 0.
   12-     CQUAD4  171428451712710017102978171029691710297017102979700000 1 0.
   13-     CQUAD4  171428461712710017102979171029701710297117102980700000 1 0.
   14-     CQUAD4  171428471712710017102980171029711710297217102981700000 1 0.
   15-     CQUAD4  171428481712710017102981171029721710297317102982700000 1 0.
   16-     CQUAD4  171428491712710017102982171029731710297417102983700000 1 0.
   17-     CQUAD4  171428501712710017102983171029741710297517102984700000 1 0.
   18-     CQUAD4  171428511712710017102984171029751710297617102985700000 1 0.
   19-     CQUAD4  171428521712710017102985171029761710493517102986700000 1 0.
   20-     CQUAD4  171428531712711017102987171029771710297817102988700000 1 0.
```

- **Removing lines**

In order to remove lines from the BULK DATA the following statements can be used on the BULK DATA of the restart bdf:

/ENTRY1

This statement will remove the line numbered as ENTRY1 on the bulk data

/ENTRY1,ENTRY2

This statement will remove all the line between ENTRY1 and ENTRY2 lines on the bulk data

- **Adding lines**

If the engineer adds new lines on the BULK DATA of the model, these lines will be included on the bulk data of the model.

- **Modifying lines**

In order to modify an entry, the engineer has to find out its ENTRY COUNT, remove the line and add a new one with the modified values:

For example, the following restart and its associated f06:

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```
RESTART
assign MASTER='restart_b0.MASTER'
SOL 101
CEND
ECHO = SORTED

BEGIN BULK

/,11
CQUAD4  17142844171271001710297717102968171029691710297870000001 10.

ENDDATA
```

```
                                    S O R T E D   B U L K   D A T A   E C H O
ENTRY
COUNT        .    1    ..    2    ..    3    ..    4    ..    5    ..    6    ..    7    ..    8    ..    9    ..   10    .
    1-       CORD2R  7000001         0.       0.       0.       0.       0.       1.       +00002R
    2-       ++00002R1.       0.       0.                                                    +00002S
    3-       CORD2R  7000002         22652.   398.741 2976.55 20417.8 -882.64 -19728.  +00002T
    4-       ++00002T45392.4 399.199 738.822                                               +00002U
    5-       CORD2R  7000003         22652.   -398.7412976.55 20419.2 1106.41 -19714.4 +00002V
    6-       ++00002V45392.4 -399.199738.822                                               +00002W
    7-       CORD2R  7000004         23057.6 0.       2946.94 20561.4 74.1048 -20163.7 +00002X
    8-       ++00002X46168.3 0.       450.685                                              +00002Y
    9-       CORD2R  7000005         22215.3 -249.3013010.92 22215.3 22170.5 3010.92  +00002Z
   10-       ++00002Z44615.  -249.3013959.72                                               +000030
   11-       CQUAD4  17142844171271001710297717102968171029691710297870000001 10
   12-       CQUAD4  17142845171271001710297817102969171029701710297970000001 0.
   13-       CQUAD4  17142846171271001710297917102970171029711710298070000001 0.
   14-       CQUAD4  17142847171271001710298017102971171029721710298170000001 0.
   15-       CQUAD4  17142848171271001710298117102972171029731710298270000001 0.
   16-       CQUAD4  17142849171271001710298217102973171029741710298370000001 0.
   17-       CQUAD4  17142850171271001710298317102974171029751710298470000001 0.
   18-       CQUAD4  17142851171271001710298417102975171029761710298570000001 0.
   19-       CQUAD4  17142852171271001710298517102976171049351710298670000001 0.
```

The restarts modifying the model are usually not very efficient in terms of computational time if the change implemented on the model can have an impact on the stiffness matrix of the model. The reason is that in this case the matrix has to be inverted again which is the most time consuming task.