

ASG-DesignManager™ Load Factor Calculation

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Hong Kong	001.800.9932.5536	Sweden/Telia	009.800.9932.5536
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Preface

The *ASG-DesignManager Load Factor Calculation* describes an optional additional facility. This facility enables ASG-DesignManager (herein called DesignManager) users to model the physical access times of selected data elements during the database design process. DesignManager is a information modeling and logical database design system.

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About this Publication

This publication consists of these chapters:

- [Chapter 1, "Introduction,"](#) summarizes the load factor calculation process.
- [Chapter 2, "Load Factor Calculation Data Specifications,"](#) specifies the load factors that are calculated for each selected data element when the Load Factor Calculation facility is used.
- [Chapter 3, "How to Use the Facility,"](#) summarizes the commands that DesignManager provides in the facility for carrying out load factor calculations. It also describes how these commands should be used relative to other DesignManager commands, so that load factor calculations are carried out at the appropriate places in the database design process.
- [Chapter 4, "Command Specifications,"](#) specifies the syntax and action of the commands provided in the facility.

Publication Conventions

Allen Systems Group, Inc. uses these conventions in technical publications:

Convention	Represents
ALL CAPITALS	Directory, path, file, dataset, member, database, program, command, and parameter names.
Initial Capitals on Each Word	Window, field, field group, check box, button, panel (or screen), option names, and names of keys. A plus sign (+) is inserted for key combinations (e.g., Alt+Tab).
<i>lowercase italic monospace</i>	Information that you provide according to your particular situation. For example, you would replace <i>filename</i> with the actual name of the file.
Monospace	Characters you must type exactly as they are shown. Code, JCL, file listings, or command/statement syntax. Also used for denoting brief examples in a paragraph.
Vertical Separator Bar () with underline	Options available with the default value underlined (e.g., Y <u>N</u>).

Notation for Statement Formats

In all publications relating to DesignManager, the following notation is used in the specification of statement formats (for commands and data definition statements):

- All words printed in capitals are statement identifiers or keywords that must be present in full or truncated form in the circumstances stated in the statement specification. The extent beyond which a word must not be truncated is indicated by under-lining of the characters that must be retained.
- All words printed in lower case are variables for which the user must substitute a value consistent with the specification.
- Material enclosed in square brackets [] is an option which may be included or omitted as required.
- Braces { } indicate that a choice must be made of one of the options enclosed within them.
- Three full stops . . . indicate that the material they immediately follow may be repeated. Where . . . immediately follows a closing square bracket or brace, the material that can be repeated is bounded by that square bracket or brace and the corresponding opening square bracket or brace. If material can be repeated only a limited number of times, the repetition permitted is stated in the specification.
- Other punctuation marks and symbols must be coded as shown, subject to the implications of any square brackets or braces enclosing them; except that where a single quote ' , is shown, a double quote " , can alternatively be used, provided that the opening and closing quotes of any pairs of quotes are the same character (single quote or double quote).

1

Introduction

The DesignManager Load Factor Calculation optional additional facility provides the database designer with the ability to model the physical access times for data elements of the logical database model with respect to each of the userviews in which those data elements appear.

The Load Factor Calculation facility is provided for DesignManager users as a separate selectable unit (DSR-PHI0).

The facility uses as input the information given in userview declarations as to the response time required for each userview, the estimated frequency of access of that userview, and the multiplicity of data elements that appear within that userview.

Load factor calculations may be carried out whenever any userviews are present in the workbench design area; that is, whenever at least one MERGE, DESIGN, or FETCH command has been executed.

The user determines the point or points in the design process at which load factor calculations are to be carried out, by issuing the appropriate DesignManager command (CALCULATE) at the appropriate points. Load factors are always calculated for those and only those userviews that are currently present in the workbench design area.

Thus the user can have DesignManager carry out load factor calculations for all the userviews of the database model by issuing a CALCULATE command after the merging of userviews is completed. Alternatively, the user can have DesignManager carry out load factor calculations for the data elements that appear in a selected set of userviews, by issuing a CALCULATE command immediately after merging those userviews.

After they have been calculated, all load factors are held in the workbench design area (together with the details of merged userviews, relations, and so on). The load factors will remain extant and accessible as long as the corresponding version of the workbench design area exists. Thus particular sets of load factors may be saved and re-used by use of the DesignManager STORE and FETCH commands.

ASG-DesignManager Load Factor Calculation

The user can output a report of all, or a selection of, the load factors that are currently in the workbench design area, by using the appropriate DesignManager command (REPORT). This selection can be made in two ways: a user can specify that only those load factors that relate to particular data elements are to be output, and a user can also specify that, for each selected data element, either the full set or summary set of load factor values are to be output. In addition, users whose DesignManager installation incorporates the User Formatted Output optional additional facility (selectable unit DSR-UD30) can specify their own formats for output of load factor values.

After inspection of the calculated load factor values, the database designer may recommend controlled departures from third normal form in the final logical schema, in order to cater for extremes in accessing requirements.

2

Load Factor Calculation Data Specifications

Introduction

This chapter specifies the values that are calculated by the facility. Load factor calculations are carried out on the userviews currently present in the workbench design area. The results of the calculations are a set of load factors for each data element that is contained in the userviews that were used in the calculations.

In this chapter, the term *relevant* is used as follows. A userview is said to be relevant to a particular data element if it contains a reference to that data element in any of its dependencies and it is present in the workbench design area when load factor calculations are carried out.

These load factors make up the set that is calculated (given the appropriate input values) for each such data element:

- Minimum response time (one value for each data element)
- Maximum response time (one value for each data element)
- Total access frequency (one value for each data element)
- Average response time (one value for each data element)
- Percentage total access frequency (one of these values is calculated for each relevant userview of the data element)

Those load factors that are time values are not expressed in specific units (for example, seconds or minutes); they are relative values only.

Minimum Response Time

This is the minimum value defined in the RESPONSE-TIME clause of any relevant userview declaration. It represents the shortest time within which the value of the current data element must be accessed in any of its relevant userviews.

If none of the relevant userview data declarations contain a RESPONSE-TIME clause, then DesignManager outputs the message NOT CALCULATED when a user requests output of load factors for that data element. A default value is not calculated.

Maximum Response Time

This is the maximum value defined in the RESPONSE-TIME clause of any relevant userview declaration. It represents the longest time within which the current data element must be accessed in any of its relevant userviews.

If none of the relevant userview data declarations contain a RESPONSE-TIME clause, then DesignManager outputs the message NOT CALCULATED when a user requests output of load factors for that data element. A default value is not calculated.

Total Access Frequency

This load factor represents the cumulative frequency with which a data element is accessed from all of its relevant userviews. Its value is the sum of the individual access frequencies of each relevant userview. The individual access frequency of each relevant userview is calculated as:

$$M * Rf$$

where

M is the total multiplicity of the data element within that userview.

Rf is the relative frequency value given in the RELATIVE-FREQUENCY clause of that userview.

If a value of Rf is not specified for a userview, then the individual access frequency for that userview is defined as zero.

The total multiplicity of a data element with respect to any one of its relevant userviews is defined as follows in this section:

The root dependencies of the userview are first determined. (A root dependency is a dependency whose left-hand side cannot be reached from any other dependency in that userview.) For example, for the userview (U) with the following dependencies:

$$A \overset{5}{---} >> B$$

$$B --- > C$$

$$C \overset{3}{---} >> D,$$

the only root dependency is $A --->> B$, because A, unlike B, C, and D, cannot be reached from any other dependency in U. A is termed the *root side* of the dependency. Note that A, B, C, or D may be sets of, rather than individual, data elements.

All possible paths from each of the userview's root sides to the given data element are then determined. For each possible path, the product of the multiplicities of each of the dependencies in that path is calculated. (If any of the dependencies has not been assigned an explicit multiplicity, then a default multiplicity value of one is assumed.) The total multiplicity of the data element with respect to that userview is then defined as the sum of the product multiplicities of each possible path from the root sides to the data element.

In the example given above, the total multiplicity of data element D with respect to userview U would be calculated as follows. The only path from the single root side of the dependency (that is, A) to D is the sequence of dependencies A --->> B, B ---> C, C --->> D. The multiplicity of this path is the product of the multiplicity of each individual dependency; that is $5 * 1 * 3 = 15$. Since there is only one access path from the root side to D, the value of the total multiplicity of D in U is also 15. The individual access frequency of D with respect to U is then 15 multiplied by the relative frequency of U.

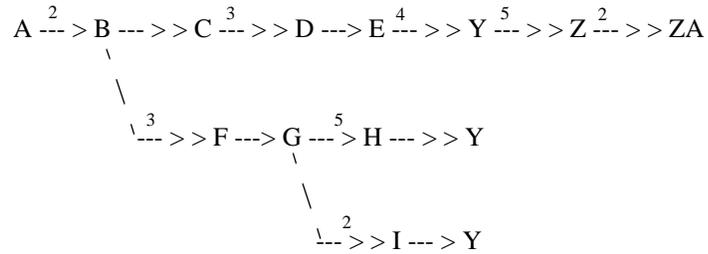
These calculations are then repeated for every userview in the workbench design area; the total access frequency of the data element is then the sum of these individual access frequencies.

The following example shows the calculation of the total multiplicity of a data element (Z) with respect to a userview that contains several access paths. If the userview's declaration contains these dependencies:

```

DEPENDENCIES
  LHS      A      FD      RHS B
DEPENDENCIES
  LHS      B      MVD 2    RHS C
                MVD 3    RHS F
DEPENDENCIES
  LHS      C      MVD 3    RHS 0
DEPENDENCIES
  LHS      D      FD      RHS E
DEPENDENCIES
  LHS      E      MVD 4    RHS Y
DEPENDENCIES
  LHS      Y      MVD 5    RHS z
DEPENDENCIES
  LHS      F      FD      RHS G
DEPENDENCIES
  LHS      G      FD      RHS H
                MVD 2    RHS I
DEPENDENCIES
  LHS      H      MVD 5    RHS Y
DEPENDENCIES
  LHS      I      FD      RHS Y
DEPENDENCIES
  LHS      Z      MVD 2    RHS ZA
  
```

Then these dependencies can be shown diagrammatically as:



Thus the total multiplicity of Z within this userview is the value of:

$$\begin{aligned}
 & (1 * 2 * 3 * 1 * 4 * 5) + (1 * 3 * 1 * 1 * 5 * 5) \\
 & + (1 * 3 * 1 * 2 * 1 * 5) \\
 & = 225.
 \end{aligned}$$

Average Response Time

This load factor represents an *average* access time for a data element calculated over all relevant userviews. The value is weighted towards those of its relevant userviews with the greatest total access frequencies. It is defined to be the value of the expression:

$$(TAF_1 * RT_1) + (TAF_2 * RT_2) + \dots + (TAF_n * RT_n)$$

TAF

where:

TAF_i is the individual access frequency for the ith. userview.

RT_i is the response time of the ith. userview.

TAF is the total access frequency.

Percentage Total Access Frequency

This load factor represents (as a percentage) the proportion of accesses of a data element that occur from a each of its relevant userviews. One such value is calculated for each userview in the workbench design area. For the nth. relevant userview, it is defined as the value of this expression:

$$\frac{\text{TAF}_n}{\text{TAF}} * 100\%$$

The value of this load factor for any relevant userview that does not appear in the workbench design area, and for each non-relevant userview, is defined as zero.

3

How to Use the Facility

The action of the facility consists of the calculation of the load factors defined in the previous section, and the output of some or all of them in a report format. The facility provides the CALCULATE command for carrying out load factor calculations, and a new keyword (LOAD-FACTORS) for use with the REPORT command for outputting load factor reports. The format of these commands is specified in [Chapter 4, "Command Specifications," on page 11](#).

Execution of a CALCULATE command causes load factors to be calculated for all the data elements that appear in those userviews that are currently present in the workbench design area. Thus the number of data elements for which load factor data is calculated, and the calculated values, will depend on the stage of the design process that has currently been reached, that is, on which userviews have been merged into the workbench design area.

A CALCULATE command will overwrite any previously calculated load factors in the workbench design area.

Execution of a REPORT LOAD-FACTORS command causes the output of some or all of the load factor data that is currently present in the workbench design area (that is, the load factors that were calculated by the previous CALCULATE command).

A user may intersperse CALCULATE and REPORT LOAD-FACTORS commands among other design mode commands (with the restrictions mentioned below) in order to calculate and display the change in load factor values as successive userviews are merged into the workbench design area.

When using this facility, the user first decides which userviews require load factor data to be calculated. The user then assigns frequency and response time values to each of these userviews, using the RELATIVE- FREQUENCY and RESPONSE- TIME clauses of the relevant userview data declarations.

The user then executes one or more MERGE and/or DESIGN commands, possibly as part of the overall database design process, or specifically to define the subset of userviews for which load factor data values are to be generated. The user then executes a CALCULATE command to generate load factors for all data elements that are mentioned in userviews that have already been merged. The user should bear in mind that the merging and/or design processes may have eliminated some data elements or dependencies from merged userviews. These eliminations will, in general, affect the calculated values of load factors. Thus the user should use the REPORT command to ascertain exactly which data elements and dependencies are contained in merged userviews when the CALCULATE command is executed.

The currently calculated load factors are then available for output until the next CALCULATE, MERGE, or DESIGN command is executed. Alternatively, the user can save values by executing a STORE command to transfer the whole of the workbench design area to an external file.

The user can output all or some of the load factors by using the REPORT LOAD-FACTORS command. By including the appropriate keywords (see [Chapter 4, "Command Specifications," on page 11](#)), the user can selectively output the load factors for particular data elements and specify summary or detailed output for each selected data element. If the user's DesignManager installation includes the User Formatted Output optional additional facility, then the user can also specify individual output formats; the use of this facility is described in *ASG-DesignManager User Formatted Output*.

4

Command Specifications

Calculate

The CALCULATE command causes DesignManager to calculate the load factor values specified in [Chapter 2, "Load Factor Calculation Data Specifications," on page 3](#) for each data element that is referenced by any of the userviews that are currently present in the workbench design area.

This is the CALCULATE command format:

```
CALCULATE [LOAD-FACTORS] [UNCONDITIONALLY] { ;  
      . }
```

Remarks

1. The CALCULATE command may only be used when DesignManager is in design mode.
2. The presence or absence of the LOAD-FACTORS keyword has no effect on the action of the CALCULATE command.
3. If the UNCONDITIONALLY keyword is used in a CALCULATE command, then load factor calculations are carried out even if the workbench design area contains inconsistent userviews.

If UNCONDITIONALLY is not used in a CALCULATE command, then load factor calculations are only carried out if the workbench design area does not contain any inconsistent userviews. If inconsistent userviews have been merged, then no calculations are carried out, and an error message is output:

```
WORKBENCH DESIGN AREA PRODUCED FROM INCONSISTENT USERVIEWES .
```

4. The load factors generated by each CALCULATE command overwrite any previously calculated load factors that are already present in the workbench design area.
5. Userviews are processed in the order in which they were added to the workbench design area.

6. During normal load factor calculations (that is, where none of the fault conditions listed in [Remark 8](#) and [Remark 9](#) below occur), these informatory messages are output:

- For the first (or only) root dependency in each relevant userview:

```
FIRST ROOT DEPENDENCY absolute-dependency-number IN  
USERVIEW userview-name,
```

- After completion of processing for each separate CALCULATE command:

```
CALCULATIONS COMPLETED.
```

In addition, this warning message is output for each dependency other than the first in each relevant userview:

```
NEXT ROOT DEPENDENCY absolute-dependency-number IN USERVIEW  
userview-name.
```

7. DesignManager outputs this warning message for each data-view in the workbench design area that is not a userview (that is, is an entity):

```
DATA-VIEW entity-name IS NOT A USERVIEW.
```

Entities are only present in the workbench design area if the Enterprise Modeling optional additional facility is being used.

8. If any of these conditions holds, then no load factors will be calculated:

- The workbench design area is empty.
- The workbench design area is not empty, but does not contain any merged userviews.
- The workbench design area contains inconsistent userviews (and the UNCONDITIONALLY keyword has not been specified).

If any of these conditions holds, then DesignManager outputs the corresponding one of the following error messages:

```
WORKBENCH DESIGN AREA EMPTY-NOTHING TO CALCULATE
```

```
NO MEMBERS OF USERVIEW TYPE IN WORKBENCH DESIGN AREA
```

```
WORKBENCH DESIGN AREA PRODUCED FROM INCONSISTENT USERVIEWS.
```

DesignManager then outputs this message:

```
CALCULATE COMMAND TERMINATED
```

and starts the processing of the next command.

9. If either of these conditions holds for a userview in the workbench design area:
- The userview does not contain a root dependency.
 - The userview contains a set of dependencies that form a closed loop.

then no contribution from that userview will be taken into account when load factors are calculated. In addition, DesignManager outputs the relevant one of the following error messages:

```
NO ROOT DEPENDENCIES FOUND IN USERVIEW userview-name
```

```
LOOP FOUND IN USERVIEW userview-name AT DEPENDENCY absolute-  
dependency-number.
```

Examples

```
CALCULATE ;
```

This command will calculate load factors (when there are no inconsistent userviews in the workbench design area).

```
CALCULATE UNCONDITIONALLY ;
```

This command will calculate load factors (even if any of the userviews in the workbench design area are inconsistent).

Report Load Factors

This form of the REPORT command causes DesignManager to output all or some of the load factors that are present in the workbench design area.

Format

```
REPORT [LOAD-FACTORS] { ALL  
                          RECENT  
                          NAMES names-list  
                          NUMBERS range-list }
```

```
[ALPHA] [ { SUMMARY  
          DETAILS  
          USING FORMAT format-name } ] { ;  
                                          . }
```

This statement format specification only shows the form of the REPORT command that is used to output load factor data. The general form of the REPORT command is described in the appropriate section of the *ASG-DesignManager User's Guide*.

Remarks

1. Information on the general use of the REPORT command is given in the description of the REPORT command in the appropriate section of the *ASG-DesignManager User's Guide*.

The following remarks give additional information on the use of the REPORT command to output load factors specifically.

2. The effect of specifying the various keywords shown above is detailed in this table:

Keyword	Action
LOAD-FACTORS	Specifies the <i>report category</i> of the current REPORT command so that DesignManager will output load factors (rather than any other category of data).
ALL	Causes DesignManager to output load factor data for all data elements available.
RECENT	Causes DesignManager to output load factors only for those data elements that are referenced in userviews that were added to the workbench design area by the preceding MERGE command.
NAMES	Causes DesignManager to output load factors only for those data elements whose names are included in names-list.
NUMBERS	Causes DesignManager to output load factors only for those data elements whose numbers are included in range-list.
ALPHA	Causes load factors to be output in alphanumeric order of data element name. If absent, the data is output in order of data element number.
SUMMARY	Causes the following load factors to be output for each selected data element: minimum response time, maximum response time, total access frequency, and average response time. The factors for each separate data element are output starting on a new page.
DETAILS	Causes DesignManager to output all defined load factors for the selected data elements. The percentage total access frequencies for each data element are output in order of relevant userview number. In addition, one or more of these codes may be printed against each userview name: <ul style="list-style-type: none">• RF (= valid relative frequency given for this userview)• RT (= valid response time given for this userview)• LOOP IN USERVIEW The output for each separate data element begins on a new page.
USING FORMAT	Causes DesignManager to output load factors in the format specified by the contents of the <i>format-name</i> member of the modeling dictionary. This facility is available as part of the User Formatted Output optional facility (selectable unit DSR-UD30). The use of this facility is described in <i>ASG-DesignManager User Formatted Output</i> .

3. DesignManager outputs this error message if no load factor calculations have yet been performed (that is, if the current REPORT command is not preceded by appropriate MERGE and CALCULATE commands):

LOAD-FACTORS HAVE NOT BEEN CALCULATED YET.

4. DesignManager outputs this error message if no further load factor calculations have been carried out since the previous set of load factors was overwritten by the most recently executed MERGE command:

ERROR-MERGE PERFORMED SINCE LAST CALCULATION.

5. DesignManager outputs this error message:

NO VALID USERVERIEWS TO REPORT ON.

if load factors cannot be calculated from any of the userviews in the workbench design area; that is, if every merged userview meets these conditions:

- Has no relative frequency or response time value
- Contains a loop in its dependencies
- Has no root dependency.

Examples:

REPORT LOAD-FACTORS NAMES DEF,ABC ALPHA DETAILS;

This command outputs all the load factors calculated for data element ABC, followed by all those calculated for data element DEF.

REPORT LOAD-FACTORS NUMBERS 10 TO 100 SUMMARY;

This command outputs the values of minimum and maximum response times, total access frequency, and average response time for each data element whose data element number lies in the range 10 to 100, in order of data element number.

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