

Technical note

Project:	Structures Toolkit	To:	HAMFIG Steering Group
Subject:	Calculating Structures' GRC and DRC for Whole of Government Accounts 2014/2015	From:	Atkins Project Team
Date:	Apr 2015	cc:	

1. Introduction

This Technical Note provides guidance in the use of the Structures Toolkit, for the function of calculating GRC and DRC for the 2014/2015 Whole of Government Accounts (WGA) returns ONLY.

It does not cover the use of the Toolkit's asset management functionality, and is not intended to replace the User Guide and other supporting documentation as available on the CIPFA website:

<http://www.cipfa.org/Policy-and-Guidance/Local-Authority-Transport-Infrastructure-Assets/Local-Authority-Transport-Infrastructure-Assets-supporting-documents>

Please note that Version 2.01 of the Toolkit is now available from the CIPFA website, and replaces the previous versions released in 2012, 2013 and 2014. It is recommended that the CIPFA website should be periodically consulted for updated versions uploaded after the issue of this note.

Please note that the Toolkit is designed for Excel 2013 and Excel 2007, and will not run on earlier versions such as Excel 2003.

The 'Full version' has capacity for 2,500 individual or groups of structures, and 30,000 elements.

The 'Small version' can accommodate up to 250 individual or groups of structures, and 3,750 elements.

Splitting the stock of structures over two or more copies of the Toolkit is not recommended, as this approach is not suitable for use with the asset management functionality. Please note that if you do use several copies of the Toolkit this year, all elements belonging to a single structure must be in the same copy. This is to allow the appropriate calculation of traffic management costs etc. (i.e. the Toolkit can combine works on a structure if they are due to take place in the same year).

Grouping of structures should only be used as an interim measure, and plans should be put in place to enable progress to a full inventory as soon as possible. This is particularly important given that CIPFA/LASAAC has agreed that from 2016/17, valuation will be required on a depreciated replacement cost basis and will be subject to audit.

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2. Four Key Steps

The four key steps of operating the toolkit (i.e. preparing the data, preparing the model, running the model and obtaining the results) are discussed below.

2.1. Preparing the data

Depending on the quality / completeness of inspection data available, and the format it is stored in, a number of options are available for compiling the data.

2.1.1. No grouping (full inventory)

This approach is deemed as recommended and is predominantly aimed at users with complete sets of inspection data, held in electronic format.

The accompanying note from Hertfordshire County Council *A Practical Guide to the Structures Asset Management Planning Toolkit* is available to download from the CIPFA website, and outlines the process for extracting and assembling data from a bridge management system, to make populating the toolkit as easy (or non-labour-intensive) as possible. Whilst this is strictly related to Hertfordshire's system only, it should provide guidance for users of similar systems to develop their own process.

The benefits of this approach include:

- Robust, accurate valuation figures.
- Authorities will be well-positioned to take on board asset management (if not already).

The possible risks associated with this approach involve:

- Potentially lengthy process to construct a full inventory.
- Authorities may not have sufficient data or resource to complete.

2.1.2. Refined grouping

The approach is aimed at users with incomplete sets of inspection data and / or data held in non-electronic format.

The stock of structures on the network should be split into a number of groups, based on their structure type, construction type and construction material, and then refined into further categories. For example, bridges of the same location, route supported, obstacle crossed, number of spans, average structure condition and critical structure condition.

For each group, the full data for a representative structure and the number of structures within the group are entered in the 'Structures Database' worksheet of the toolkit.

The benefits of this approach include:

- Fairly accurate valuation figures.
- Authorities well on course for developing solid database of structures and their condition.

The possible risks associated with this approach involve:

- Potentially lengthy process to refine the grouping.
- Authorities may not have sufficient data or resource to complete.

2.1.3. Crude grouping

This approach is aimed at users with some sets of inspection data and / or data held in non-electronic format and may require assumptions to be made, using local / engineering knowledge. By utilising this approach users can benefit from obtaining appreciation of the valuation process required by the CIPFA code.

The stock of structures on the network should be split into a number of crude groups, based on their structure type, construction type and construction material. For example, bridges composed of a reinforced concrete deck slab construction technique.

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For each group, the full data for a representative structure and the number of structures within the group is entered in the 'Structures Database' worksheet.

The possible risks associated with this approach include less accurate valuation figures and an abortive effort if user decides to move to refined grouping at a future date.

2.1.4. General note on grouping

Regardless of the approach taken to prepare the data, it should be recorded within the Data Collection Tool for WGA. In particular, if grouping has been used, the assumptions made should be clearly outlined. These will be key to demonstrating progress in future years' valuations of structures.

The criteria used to determine homogeneous groups should be those that have a significant influence on the lifecycle behaviour or Level of Service requirements of the assets. Criteria that should be considered when defining homogeneous groups for highway structures include:

- Structure type, e.g. bridge, culvert, retaining wall, etc.;
- Location, e.g. urban, rural, environmentally sensitive area, same route corridor, etc.;
- Structure usage, e.g. route supported, obstacle crossed, traffic, etc.;
- Structure size, e.g. number of spans and dimensions;
- Level of Service requirements, e.g. high visual standard required, loading requirements;
- Construction type, material and condition of components.

It is considered that the primary drivers for deterioration and interventions are the structure type, construction type and construction material, as these would determine whether a group of structures behave in a similar or different manner with regard to deterioration. It is not recommended to group structures with different deterioration behaviour, i.e. 'location' should not be used as the sole or most significant criterion for grouping structures, as structures on the same route corridor but of different construction and material type (e.g. a simply supported concrete bridge and a masonry arch) will not deteriorate in the same manner.

More information on grouping can be found in *Part A: Methodology*, Section 2.

2.2. Preparing the model

1. Download and open the most recent version of the template (currently Version 2.01) directly from the CIPFA website.
2. Enable macros.
3. Click 'View / Enter Essential Data'. A pop-up window will appear, indicating that data needs to be entered into 4 worksheets. Once familiarised with the content of the message, click 'Close'.
4. Go to 'Formulas' in the taskbar at the top of the screen, and under 'Calculation', click on 'Calculation Options'. Ensure that this option is set to 'Automatic'.
5. If not already there, select the 'Structures Database' worksheet.
6. Enter the relevant data. The fields 'Identifier of Structure or Group of Structures' to 'Is Obstacle Crossed salted?' can be pasted as one block, but the fields 'Heritage' to 'Substandard Structure' must be pasted in as a separate block.
7. Select the 'Element Database' worksheet and enter the relevant data.
8. Do not enter any data into the 'Upgrades, Improvements & LCPs' worksheet.
9. Do not enter any data into the 'Rtn Mntnce, Inspctns & Assmts' worksheet.
10. Select the 'Main Page' worksheet, and click 'Show Main Menu' in the centre of the screen.
11. Click 'Analyse New Scenario'.
12. Click 'Calculate HAMFIG DRC for 2014/2015'.
13. Click 'Analyse Scenario'. The model will begin calculating the GRC and DRC values.

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In agreement with HAMFIG, the following assumptions are made during the calculation of DRC:

- Unconstrained budget
- Unplanned reactive intervention only
- Default deterioration curve
- Default reference data
- No upgrades, improvements or lifecycle plans

To incorporate these assumptions, no further action is required if the user opens the spreadsheet in the form that it is downloaded, follows the instructions above, and makes no further changes to the model.

2.3. Running the model

While the Toolkit's operation is very calculation-intensive, it has incorporated a number of changes from Version 1.03 to substantially reduce (up to 20 times faster) the time required to derive GRC and DRC figures.

The table below compares the time required to analyse two datasets in different versions of the toolkit using the same computer (i.e. Intel® Core™ i5 CPU M480 @ 2.67GHz, 4.00 GB RAM, Windows 7 Ultimate x64, MS Office 2013). The datasets used in comparison are:

- Small dataset - 184 structures and 1528 element
- Large dataset - 2392 structures and 30000 elements

Table A – Toolkit analysis time comparison

Dataset	Version 1.03 (2013/14)	Version 2.01 (2014/15)
Small Toolkit version		
Small dataset	549 secs 9 mins	63 secs 1 min
Full Toolkit version		
Small dataset	21639 secs 361 mins 6.0 hours	1185 secs 20 mins 0.4 hours
Large dataset	26165 secs 436 mins 7.3 hours	1281 secs 21 mins 0.4 hours

Nonetheless, to minimise the time taken and impact on computer performance, please follow the steps listed below:

1. Utilise the highest specification computer available. To check for the specification, right-click on My Computer > Properties to obtain details of processor and memory available. In particular, a multi-core processor (for example dual-core, quad-core or higher) will reduce the time required to complete the process.
2. To enable macros, the latest Microsoft updates should be applied to Excel 2007, namely Microsoft Office Service Pack 3. This particular update is free to download from the Microsoft website linked below (advice will be required from local IT departments to install): <http://www.microsoft.com/en-us/download/details.aspx?id=27838>
3. As previously mentioned, it is strongly recommended that the 'Small version' of the Toolkit is used if the magnitude of the inventory permits, as this will run much faster than the 'Full version'.
4. Close all unnecessary applications running on the computer (e.g. Email, Word documents etc.) prior to opening the Toolkit.
5. Store the Toolkit spreadsheet on the computer's hard disk (not a network drive if possible) and open it from there.

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6. No other work should be carried out on the computer whilst the model is running.
7. If the Toolkit is to be run overnight, please remember to temporarily disable any automatic shutdown or hibernation function (advice will be required from local IT departments). The Toolkit will still operate in the background even if the screensaver or security login screen appears automatically.

2.4. Obtaining the results

1. Once the model has completed its run, a pop-up window will appear. Click 'Ok'
2. If not already there, select the 'Valuation Results' worksheet. The current GRC value can be found in cell G26.
3. The current DRC value can be found in cell H26.
4. The Accumulated Depreciation value can be found in cell G29.
5. Save the Toolkit with 'Save As', including the date in the file name for historic / QA purposes.

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3. Frequently Asked Questions

A. Excel 2003 / 2007 compatibility issue

The current version of the toolkit is compatible with Excel 2007 and Excel 2013 and does not support Excel 2003.

B. The 'Full version' of the Toolkit runs too slowly

Please see Section 3 – Running the model, from page 5 of this note. If issues persist, please use the 'Small version' instead, as outlined on Page 1.

C. Resource / data limitations in populating the Toolkit in time for L-Pack return this year

Use grouping of structures, as outlined on Pages 2 and 3 of this note. However, this should only be used as an interim measure, and plans should be put in place to enable progress to a full inventory as soon as possible.

D. Definition of length and width

The length of a bridge is defined as:

Length = centreline to centreline of end supports

Or (if centreline details unknown)

Length = distances between faces of end supports + 0.6m

This means that the length is for all spans combined, rather than counting each individually.

More detail on definitions of length and width for structures can be found in Section 4.8 of *Guidance Document for Performance Measurement of Highway Structures – Part B1: Condition Performance Indicator*, included as Appendix B of *Structures Asset Management Planning Toolkit – Part A: Methodology v2.01*.

E. Data listed as 'not essential' (e.g. average height for a cantilever road sign)

Leave the cell blank in the 'Structure Database'. Or, if the information is available, you can enter it but the data won't affect any calculations (i.e. the average height for a cantilever road sign is not used anywhere in the model).

All elements and their associated conditions should be listed in the 'Element Database', however, for some structures it is possible to treat the whole structure as an element. For example, a culvert can be treated as an element rather than breaking it down into individual elements.

This should be done by selecting the correct item from the drop-down menu in the "Element Database" (e.g. 'St03. Culvert').

F. Bridges with multiple spans / construction types

There should only be one entry in the 'Structure Database' worksheet for a multi-span structure (i.e. with total length of structure, most common obstacle crossed, etc.). The element list for that one entry of the multi-span structure should be entered in the 'Element Database' worksheet (i.e. element list and associated component/material types for the most common span and element condition).

Different span types should NOT be entered as separate structures. Otherwise, the assumptions regarding element size will not be applied as intended.

G. Timber

Timber is provided as a material type option for some component types. If timber is not an option provided in the Toolkit for a particular component, use the 'Other/Unknown' option.

H. Structures with unknown ownership

If the authority assumes responsibility for the maintenance of any element of one of these structures, then they should be included in the valuation process.

The authority should make every effort to ensure that there is no double-counting (i.e. that no other authority is including these assets in its valuation).

I. GRC value different to last year's

A difference will arise when structures have been removed or added. Furthermore, the unit rates for basic GRC and the adjustment factors are slightly different in the Toolkit than they were in last year's GRC spreadsheet, following indexation.

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J. Blank rows

Blank rows are not permissible in between rows of data in the Toolkit. Entire rows cannot be deleted either, due to the locked format settings. If you wish to delete a row of data, please clear the contents of the relevant cells, then 'Copy > Paste Special > Values' all the rows below into the blank space. This will leave one row of duplicate data at the bottom, which must be cleared of content, by highlighting the cells and pressing the delete button.

K. Distance from spray zone unknown

If the distance is not known, then bridge managers should use engineering judgement and consider the type of obstacles crossed and routes supported, to identify if the element is at risk of spray or not. The 3m distance included in the Toolkit is provided as a good example of how to assess this risk.

It is recommended that going forward, inspectors should identify areas at risk of chloride contamination for asset management and maintenance planning purposes.

If there is insufficient information to undertake the above steps, then the valuation process should be run for the affected structures twice, once using 'Within 3 metres' proximity to spray zone' and once with 'Not within 3 metres' proximity to spray zone / Not applicable'. A mean average of the two results can then be calculated.

L. Heritage and Special Structures

Heritage and Special Structures are those that due to a combination of their size, construction and/or character are not suitable to be valued using the standardised unit rates that are included in the Toolkit. They should be valued individually using the principles given in the Transport Infrastructure Assets Code, including the concept of Modern Equivalent Asset (MEA). In many cases, this information is unlikely to be available; therefore Heritage/Special Structure Unit Rates can be either:

- MEA unit rates adjusted by an appropriate factor, either the default factor provided or a locally derived/agreed factor; or
- Unit rates derived using engineering judgement and experience (and advice sought from a Quantity Surveyor if appropriate).

For Heritage Structures, an indicative uplift may be applied by flagging the appropriate adjustment factor in Column Y of the 'Structures Database' worksheet.

For the purpose of calculating DRC for 2014/2015, the Structures Toolkit is designed to be run with default reference data only, which includes using the default unit rates, service lives and deterioration rates.

While it is possible that the reference data within the Toolkit can be modified to reflect the circumstances of a Heritage or Special Structure, this will need to be carefully considered on a case-by-case basis using an auditable approach, and thus no generic guidance can be provided.

If reference data within the Toolkit is to be modified, then that version of the model MUST be clearly labelled as such, so as to avoid any confusion and erroneous use of the modified Toolkit in calculating DRC for non-Special Structures.

M. Traffic levels for pedestrian bridges

'Low' traffic level should be used for pedestrian bridges, referring to level of pedestrian traffic on the footway route supported rather than of vehicular route crossed / adjacent.

N. 'Cantilever Road Sign' and 'Sign/Signal Gantry [cantilever]'

Where dimensions are unknown, the 'Cantilever Road Sign' option should be used, which uses assumptions to cover missing data.

Where dimensions are available, the 'Sign/Signal Gantry [cantilever]' option should be used, which permits more specific data to be entered.

O. Elements of multiple material types

Where a structure has elements made of multiple materials, the most widespread material should be the only one entered in the Element Database.

If there is an equal split of material types, then the material with the shortest service life should be used as the single input (refer to *Part C: Supporting Information*, Section 4a – Default Deterioration Profiles for Materials).

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P. Elements containing sub-elements with multiple condition scores

Only one condition score should be entered for each element within a structure. Where condition scores of sub-elements vary, an average score should be calculated as below.

Advice on this is provided within *Guidance Document for Performance Measurement of Highway Structures – Part B1: Condition Performance Indicator*, included as Appendix B of *Structures Asset Management Planning Toolkit – Part A: Methodology v2.01*.

The key steps are as follows:

- Consider the element type that has been reported at the detailed level, e.g. transverse beams, bearings etc.
- To ensure consistency, this approach requires all the sub-elements, for this particular element, to be identified and their conditions known, even those in 1A condition. If this data is not available then the suitability of the data must be challenged.
- Assign a weighting to each sub-element based on the typical dimensions, e.g. length, deck area served etc. The sub-elements need to be weighted so that the extent, of the sub-elements in the most severe condition, can be correctly calculated. If all the sub-elements are of the same, or similar, size then the weighting for each can be the same, i.e. $W_{SE} = 1.0$.
- However, if the sub-elements are not of equal size then the weightings should reflect this and be based on an appropriate dimension, e.g. length, width, height, deck area served etc. For example, consider expansion joints that have different lengths when sub-divided for inspection, the weightings would be as shown in Table B.

Table B - Sub-Element Weighting Examples

Expansion Joint Sub- Element	Length	Sub-Element Weighting, W_{SE}
Sub-Element 1	10m	10/10 = 1.0
Sub-Element 2	8m	8/10 = 0.8
Sub-Element 3	8m	8/10 = 0.8
Sub-Element 4	6m	6/10 = 0.6

- Therefore the weighting for each sub-element is simply:

$$W_{SE} = \frac{\text{Dimension of sub - element}}{\text{Maximum Dimension of sub - elements}}$$

Equation A

- Select the sub-element/s in the most severe condition. This sub-element severity is assumed to dictate the element severity (frequently it may only be one sub-element with the determining severity score).
- Convert the extent ratings for the sub-elements in the most severe condition to numerical extent scores as shown in Table C.

Table C - Extent Numeric Values

Extent Rating	Numeric Value Range
A	0.0
B	0.0
C	0.1
D	0.3
E	0.7

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- Aggregate the extent scores of these sub-elements using the weighted average formula which is shown below:

$$Extent = \frac{\sum (Ex_{WS-i} \times W_{SE-i})}{\sum W_{SE}}$$

Equation B

Where:

- Ex_{WS-i} = Extent for sub-elements in the most severe condition in this element group
- W_{SE-i} = Weighting for sub-elements in the most severe condition in this element group
- $\sum W_{SE}$ = Sum of all sub-element weightings in this element group

Note: the *Numerator* calculations in Equation B are only for the sub-elements in the most severe condition, while the *Denominator* summation is for all the sub-elements.

- If the calculated extent value does not match exactly one of the numeric values from Table B, it should be rounded up to the next highest extent rating.
- Finally, combine the severity and extent scores to give the average Element Condition Score (ECS) for the element group as below:

$$ECS = Severity + Extent$$

Equation C

Where:

- ECS = Element Condition Score to be included in the Toolkit
- $Extent$ = Mean average extent score from Equation B
- $Severity$ = Worst severity rating for sub-elements

Example 1: consider two elements, each of 5m length, one of condition 2B and the other 3D.

- As the lengths are the same, the weighting for both elements is 1.0.
- The critical severity rating is 3.
- The extent rating of the element with severity 3 is D, which equates to a numeric extent value of 0.3.
- Aggregating these together gives:

$$\begin{aligned} Extent &= (0.3 \times 1) / (1 + 1) \\ &= 0.3 / 2 \\ &= 0.15 \end{aligned}$$

- Rounding up to the next extent rating (0.3) gives a rating of D.
- Combining worst severity rating and extent gives:

$$ECS = 3 + D = 3D$$

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Example 2: consider three elements, with the following properties:

- 5m length and 4E condition
- 20m length and 2B condition
- 5m length and 4C condition
- The respective weightings are:
 - $5 / 20 = 0.25$
 - $20 / 20 = 1$
 - $5 / 20 = 0.25$
- The worst severity rating is 4.
- The extent ratings of those elements with severity 4 are E and C, which equate to numeric extent values of 0.7 and 0.3 respectively.
- Aggregating these together gives:
 - $$Extent = (0.7 \times 0.25) + (0.3 * 0.25) / (0.25 + 1 + 0.25)$$
 - $$= (0.175 + 0.075) / 1.5$$
 - $$= 0.25 / 1.5 = 0.167$$
- Rounding up to the next extent rating (0.3) gives a rating of D.
- Combining worst severity rating and extent gives:

$$ECS = 4 + D = 4D$$

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4. Contact

If you have any further queries, questions or comments, please contact the HAMFIG Helpdesk:

Telephone: 0121 483 5168

Email: hamfig@atkinsglobal.com

Or refer to the **CIPFA website:**

<http://www.cipfa.org/Policy-and-Guidance/Local-Authority-Transport-Infrastructure-Assets/Local-Authority-Transport-Infrastructure-Assets-supporting-documents>