ADEPT
ASSOCIATION OF DIRECTORS OF ENVIRONMENT, ECONOMY PLANNING AND TRANSPORT

# ADEPT NATIONAL BRIDGES GROUP

# COMMUTED SUMS FOR THE RELIEF OF MAINTENANCE AND RECONSTRUCTION OF BRIDGES

## GUIDANCE NOTES

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INDEX

## 1. INTRODUCTION TO COMMUTED SUMS

1.1 A commuted sum is the calculated sum of money necessary to compensate for the transfer of a liability from one to another. The sum should be sufficient to provide for all future costs associated with taking on the liability. When bridges are transferred between owners, or adopted as public highway it may be appropriate for a commuted sum to be paid to the party which is taking on the liability. These notes which were originally prepared for Derby City Council to complement the CSS 2008 'best practice' publication "Commuted sums for future maintenance in relation to Adoption and Transfer of Infrastructure Assets", and are intended to provide further guidance on the application of commuted sums in respect of ownership and management of highway bridges. They are not intended to be prescriptive and are open to interpretation as required. A methodology for determining sums is provided, which is based on a rational appraisal of the financial liability which accompanies maintenance and management of highway structures. However it is recognised that other authorities may consider they have more appropriate methods to be applied in particular cases. The suggested values for typical maintenance costs have been derived from the structures Toolkit as developed for CIPFA to predict maintenance costs for highway structures.

## 2. WHEN ARE COMMUTED SUMS APPROPRIATE ?

2.1 There are generally 2 situations in which a local authority may wish to charge a commuted sum for taking on liability for a bridge or other highway structure:

a) adoption of a bridge as public highway under Section 38 or Section 278 of the Highways Act 1980.
b) transfer of a bridge from another public body or from private ownership to the highway authority.

2.2 It is apparent from discussions at ADEPT (formerly CSS ) that there is variation between the policies of local authorities in the approach to commuted sums. In some cases developers are charged routinely for the adoption of new highway infrastructure. The 2008 CSS Guidance document suggests asset categories for which it is appropriate for developers to pay a commuted sum: in situations where a highway authority is being asked to adopt an asset as maintainable highway. Highway structures is one such category.

## 3. DESCRIPTION OF METHODOLOGY

3.1 In the case of a highway structure a commuted sum may calculated by estimating all future costs of management, inspection, maintenance and replacement of a structure and the dates at which these costs are predicted to occur. If a structure is in poor condition, and is in need of refurbishment in the near future, these costs are also included.

3.2 Using standard discounting (accountancy) techniques and an appropriate discount rate, the overall net present value of these future costs is determined. The discount rate used takes into account interest rates and inflation over an extended time period. Small variations in discount rate can significantly change the total commuted sum. The 2008 CSS Guidance recommended a discount rate of 2.2% and the worked examples in these notes are based on a 2.2% rate, however recent guidance from HM Treasury has recommended a discount rate of 2% for long term projects, and so the Calculator which accompanies this guidance has been amended to use a 2% rate. However a local authority may have its own reasons to use a different rate and the calculations can be modified accordingly.

3.3 When calculated by this method of discounting, the commuted sum will represent the theoretical sum of money which must be invested now to yield the funds necessary to meet future costs over an extended time period. If the time period is long enough the sum is very close to the whole life cost of maintaining the asset, because even relatively large future costs become insignificant when discounted at 2% per annum over a sufficient number of years.

3.3 There are other methods of calculation in use for commuted sums. They are usually based on some form of interest (or discounting) calculation. Some utilise a simple interest calculation rather than a compound method, so when these methods are deployed the principal sum remains intact in perpetuity, with the annual interest providing funds for maintenance.

3.4 There are a number of methods of calculating future maintenance costs. Those included in this document were derived from the values used in the CIPFA Structures Toolkit provided for local authorities to enable financial planning for management of its structures assets. Other methods in use by bridge owners consider fixed proportions of new construction costs (typically between 1 and 2%) as annual maintenance costs, or the cyclical maintenance figures provided by the Highways Agency in Departmental Standard BD36.

## 4. METHOD OF CALCULATION

### 4.1 Components of Commuted Sums

For bridges the commuted sum comprises three elements which are determined separately.

(a) Sum to provide costs of reconstruction(s) SUM A

(b) Sum to meet costs of predictable maintenance SUM B

(c) Sum to provide costs of refurbishment SUM C

Total Commuted sum = SUM A + SUM B + SUM C

Appendix A includes forms to assist with the calculation of these sums.

### 4.2 Discounting and Discount Rate

Commuted sum calculations will generally be based on timescales of either 60 years or 150 years depending on whether the bridge simply provides access to a commercial development or is part of a strategic highway route. Determination of the commuted sum therefore requires all future costs over either 60 or 150 years to be discounted to the net present value (ie the theoretical sum which should be invested today to provide those funds in the future) using the 2% rate.

The CSS Commuted Sums Guidance publication recommends use of a discount rate of 2%
The tables and forms provided in the appendices to this guide to assist with calculations are derived using the 2 % discount rate, and provide figures for the 60 year and 150 year scenarios.

Using standard accounting practice the net present value of a future cost y years from now for a discount rate d

$$= \text{estimated future cost at present prices.} \times \frac{1}{(1+d)^y}$$

Some values of $\frac{1}{(1+d)^y}$ for the 2% discount rate are given in Table B2.

## 4.3 First Component - Sum To Provide Costs Of Reconstructions (SUM A)

All reconstructions up to and including 60 years or 150 years from ownership transfer are taken into account (or any other chosen evaluation period).

For each planned reconstruction y years from now, the net present value of the reconstruction cost is calculated using

$$\text{Sum A} = \text{cost of reconstruction at current prices} \times \frac{1}{(1+d)^y}$$

Example

A bridge has an expected service life of 20 years and will then be replaced by a new bridge at an estimated present day cost of £400,000 with a life of 120 years.

Reconstructions will take place after 20 and 140 years at a present day cost of £400,000. It is therefore necessary to add the net present values of £400000 calculated for these time periods using the factors from Table B2.

Net Present Value of cost of reconstructions 20 and 140 years from now is:

$$\text{SUM A} = 400000 \times \frac{1}{(1+0.02)^{20}} + 400000 \times \frac{1}{(1+0.02)^{140}}$$

$$= 400000\ (0.6730 + 0.0625)$$

$$= £294200$$

The sum to provide costs of reconstructions of the culvert 20 and 140 years from now is £2942000.

## 4.4 Second Component - Sum To Provide Costs Of Predictable Maintenance (SUM B)

Average maintenance costs and anticipated intervals at which they are anticipated to occur for a range of structural types and elements are listed in Table B1.

These figures were derived from the CIPFA Structures Toolkit in 2012. They are subject to ongoing revisions and may not be appropriate in some situations. Other figures may be substituted if available and more reliable. Further historic guidance on periodic bridge maintenance costs for highway bridges is available in Departmental Standard BD 36.

The tables in Appendix A can be used to calculate SUM B, the present sum of money required to meet the cost of all predictable maintenance throughout the next 150 years. The net present value figures produced in Table A3 for maintenance costs should, if appropriate, be adjusted from 2012 to current prices for incorporation in the commuted sum.

## 4.5 Third Component - Sum To Provide Costs Of Early Refurbishment Work

The figures provided in this document for typical maintenance costs assume a structure is in good condition and that all necessary previous maintenance works have been undertaken. An additional allowance is required if any elements of a structure are in poor condition. If refurbishment is not required immediately, but will be necessary within a few years then the cost must be determined and discounted in a similar manner to the reconstruction costs.

Example

A bridge is to be transferred to the highway authority but is in poor condition and requires substantial refurbishment works to bring it up to normal serviceable highway condition. It will then require normal maintenance operations until likely reconstruction in 50 years time. The major refurbishment is expected to take place in 2 years time and will cost an estimated £150,000.

Net Present Value of refurbishment

$$\text{SUM C} = 150000 \times \frac{1}{(1+0.02)^2}$$

$$= 150000 \times 0.96117 \quad \text{(from Table B2 )}$$

$$= £144175$$

The sum to provide the cost of the planned refurbishment of the bridge in 2 years time is £144175

## 4.6 Total Commuted Sum

The commuted sum is calculated by adding together SUM A, SUM B, SUM C. This figure reflects the total liability of maintaining the asset over the evaluation period (usually either 60 or 150 years).

COMMUTED SUM = SUM A + SUM B + SUM C

The forms provided in Appendix A provide the means to determine the 3 components of the commuted sum for a UK highway bridge using the recommended discount rate and evaluation periods.

Appendix B provides background information concerning discounting and costs of bridge maintenance throughout the service life of the structure.

The ADEPT Bridges Group has provided an Excel spreadsheet toolkit to assist in calculating commuted sums following the above methodology.

# APPENDIX A – FORMS FOR CALCULATION OF COMMUTED SUMS

STRUCTURE NAME _____

STRUCTURE NUMBER _____

## SUM A
### CALCULATION OF SUM TO PROVIDE FOR RECONSTRUCTIONS - SUM B

| **Table A1 - CALCULATION OF SUM TO PROVIDE FOR RECONSTRUCTION COSTS SUM A** | |
|---|---|
| | |
| EVALUATION PERIOD USED (60, 120, 150, other - years) | |
| DISCOUNT RATE % (normally 2%) | |
| | |
| Time to first planned reconstruction (years) | |
| Cost of first planned reconstruction at current prices - R1 | |
| Discount factor for first reconstruction - D1<br>( from Table B2 for 2% rate ) | |
| Sum to provide for first reconstruction A1 = R1 x D1 | |
| | |
| Time to second planned reconstruction (if applicable - years) | |
| Cost of second planned reconstruction at current prices - R2 | |
| Discount factor for second reconstruction - D2<br>( from Table B2 for 2% rate ) | |
| Sum to provide for second reconstruction A2 = R2 x D2 | |
| | |
| TOTAL SUM FOR RECONSTRUCTIONS SUM A = A1 + A2 | |

# SUM B
## CALCULATION OF SUM TO PROVIDE MAINTENANCE COSTS - SUM B

**SUM B Stage 1**. Determine relevant maintenance operations, costs and cycle times using the following table.

See notes below table for derivation and applicability of these maintenance costs and guidance on Environment / Traffic classifications.

### Table A2

| Maintenance Activity in connection with various structure elements | Unit | Unit Rate (£) | Quantity | Cost Each Occasion (£) M | Cycle Time To Maintenance Activity (Years) | Discount Factor D from Appendix B Table B3 | Maintenance Sum (£) M x D |
|---|---|---|---|---|---|---|---|
| **Buried Foundations** | | | | | | | |
| None | n/a | Replacement Cost to be Included in Element A | | | n/a | | |
| **Buried Piles** | | | | | | | |
| None | n/a | Replacement Cost to be Included in Element A | | | n/a | | |
| **Steel Sheet Piles** | | | | | | | |
| None | n/a | Replacement Cost to be Included in Element A | | | n/a | | |
| **Scour Monitoring** | | | | | | | |
| Environment: any | item/year | 894 | | | Flood event | | |
| **Revetments (Under water): Maintenance** | | | | | | | |
| Environment: Moderate | m² | 2,122 | | | 55 | | |
| Environment: Severe | m² | 2,122 | | | 32 | | |
| **Bearings: Replacement** | | | | | | | |
| Environment: Moderate | m | 894 | | | 44 | | |
| Environment: Severe | m | 894 | | | 30 | | |
| **Insitu Prestressed Concrete (Post-Tensioned): Repairs** | | | | | | | |
| Environment: Moderate | m² | 1,788 | | | 55 | | |
| Environment: Severe | m² | 1,788 | | | 28 | | |
| **Insitu Reinforced Concrete: Repairs** | | | | | | | |
| Environment: Moderate | m² | 1,788 | | | 75 | | |
| Environment: Severe | m² | 1,788 | | | 35 | | |
| **Precast Prestressed Concrete (Pre-Tensioned): Repairs** | | | | | | | |
| Environment: Moderate | m² | 1,788 | | | 110 | | |
| Environment: Severe | m² | 1,788 | | | 45 | | |
| **Precast Reinforced Concrete: Repairs** | | | | | | | |
| Environment: Moderate | m² | 1,788 | | | 130 | | |
| Environment: Severe | m² | 1,788 | | | 45 | | |
| **Encased Steel: Repairs to concrete** | | | | | | | |
| Environment: Moderate | m² | 1,788 | | | 75 | | |
| Environment: Severe | m² | 1,788 | | | 35 | | |
| **Cathodic Protection: Installation, Maintenance and Monitoring** | | | | | | | |
| Environment: any | item/year | 2,400 | | | 1 | | |
| **Masonry: Repairs (stone/brick)** | | | | | | | |
| Environment: Moderate | m² | 2,146 | | | 90 | | |
| Environment: Severe | m² | 2,146 | | | 45 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Re-painting Steel Beams and Gantries. (Including Surface Preparation)** | | | | | | | |
| Environment: Moderate | m² | 72 | | | 30 | | |
| Environment: Severe | m² | 72 | | | 15 | | |
| **Finishes to Concrete: Repairs (For Example Subway Linings)** | | | | | | | |
| Environment: Moderate | m² | 143 | | | 30 | | |
| Environment: Severe | m² | 143 | | | 15 | | |
| **Waterproofing: Replacement** | | | | | | | |
| Environment: Any | m² | 387 | | | 37 | | |
| **Expansion Joint Replacement: 0 to 15m span** | | | | | | | |
| Traffic: Moderate | m | 181 | | | 12 | | |
| Traffic: High | m | 181 | | | 8 | | |
| **Expansion Joint Replacement: 15 to 40m span** | | | | | | | |
| Traffic: Moderate | m | 776 | | | 20 | | |
| Traffic: High | m | 776 | | | 13 | | |
| **Expansion Joint Replacement: > 40m span** | | | | | | | |
| Traffic: Moderate | m | 1,614 | | | 28 | | |
| Traffic: High | m | 1,614 | | | 23 | | |
| **Parapet Maintenance: Concrete** | | | | | | | |
| Environment: Moderate | m² | 1,788 | | | 35 | | |
| Environment: Severe | m² | 1,788 | | | 23 | | |
| **Parapet Maintenance: Steel** | | | | | | | |
| Environment: Moderate | m² | 680 | | | 35 | | |
| Environment: Severe | m² | 680 | | | 23 | | |
| **Parapet Maintenance: Aluminium** | | | | | | | |
| Environment: Moderate | m² | 680 | | | 57 | | |
| Environment: Severe | m² | 680 | | | 45 | | |
| **Parapet Maintenance: Masonry** | | | | | | | |
| Environment: Moderate | m² | 2,146 | | | 85 | | |
| Environment: Severe | m² | 2,146 | | | 38 | | |
| **Timber Handrail: Maintenance** | | | | | | | |
| Environment: Moderate | m² | 1,538 | | | 23 | | |
| Environment: Severe | m² | 1,538 | | | 17 | | |
| **Safety Fence: Maintenance** | | | | | | | |
| Environment: Moderate | m² | 1,538 | | | 47 | | |
| Environment: Severe | m² | 1,538 | | | 30 | | |
| **Drainage: Maintenance (Routine Clearance and Occasional Component Replacement)** | | | | | | | |
| Environment: Any | item | 1,500 | | | 35 | | |
| **Mechanical/Electrical Element: Annual Maintenance** | | | | | | | |
| Environment: Any | item/year | specific to structure | | | 1 | | |
| **Mechanical/Electrical Element: Renewal of Component** | | | | | | | |
| Environment: Moderate | item | specific to structure | | | specific to structure | | |
| **Other: Specific to Structure** | | | | | | | |
| Environment: Moderate | item | specific to structure | | | specific to structure | | |
| **Corrugated Culvert: Maintenance** | | | | | | | |
| Environment: Moderate | m² | 1,788 | | | 55 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Environment: Severe | m² | 1,788 | | | 28 | | |
| **Concrete Pipe**<br>None | | Replacement Cost to be Included in Element A | | | n/a | | |
| **Routine Inspections**<br>Environment: Any | item | 40 | | | 2 | | |
| **Total net present value of cost of maintenance activities = ∑ M x D** | | | | | | | |

## Notes on Table A2

Maintenance Rates have been derived, averaged or interpolated from those in the CIPFA Structures Toolkit in December 2012 .(ref. Structures Asset Management Toolkit Version 1.01 Part C Supporting Information Table C.7)

These rates are applied to total surface areas but are based on assumptions that entire area will not require repairs on every occasion.

Cycle times are based on the assumption that the Maintenance Activity happens when the Condition Scoring for the Component or Material has reached 4B.

The applicability of these rates and prices may be considered in each case if desired.

**Environment Classifications**. For simplification the environment is classified as either moderate or severe as defined in the CIPFA Toolkit (ref. Structures Asset Management Toolkit Version 1.01 Part C Supporting Information Table C.1.B )

Severe: structure and or elements exposed to regular severe weather, freeze / thaw; within 3 metres of traffic spray on salted routes; in marine environment or subject to fumes / contaminated ground; subject to rapid river flow etc etc.

Moderate: Any environment not classified as severe.

**Traffic Categories**. For simplification the traffic category is classified as either moderate or high as defined in the CIPFA Toolkit (ref. Structures Asset Management Toolkit Version 1.01 Part C Supporting Information Table C.1.A )

High: frequent queuing / slow moving traffic; speed limit greater than 40mph coupled with high gradient or curvature; over 2500 commercial vehicles per day; AADT greater than 25000; high volume of HGVs.

Moderate: Where none of the parameters which define a 'high' traffic category is applicable.

**SUM B Stage 2**. Apply price adjustment factors to allow for factors such as location, nature of obstacle crossed, road hierarchy, conservation factors etc,

**Table A3 - PRICE ADJUSTMENTS**

| The following Price Adjustment Factors can be applied as appropriate to ∑ M x D | | |
|---|---|---|
| | **Factor** | **Is factor applicable ?** |
| **Heritage structure** | 2.00 | |
| **Conservation Area** | 1.25 | |
| **Environmentally Sensitive** | 1.40 | |
| **Route Supported - Unclassified** | 0.80 | |
| **Obstacle crossed - Railway** | 2.00 | |
| **Obstacle crossed - Navigable Watercourse** | 1.00 | |
| **Obstacle crossed - Non-Navigable Watercourse** | 0.90 | |
| **Obstacle crossed - Footway/Cycleway** | 0.75 | |
| **Obstacle crossed - Tenanted/Business** | 1.10 | |
| **Obstacle crossed - Land/Disused** | 0.90 | |
| **Location - Urban** | 1.00 | |
| **Location - Rural** | 0.70 | |
| **River, Coastal etc. Walls** | 1.60 | |
| **Tunnel (> 400m length)** | 1.25 | |
| **Structure Part Infilled** | 0.9 to 1.1 | |
| **Factors to be applied : x x x x x x x x x = ( F )** | | |

| **Overall adjustment factor F** | |
|---|---|

| **Total net present value of maintenance activities after application of Price Adjustment Factors = F x ∑ M x D (from Table A2)** | **= X** | **=** |
|---|---|---|

**SUM B Stage 3** Determine net present value of any additional costs associated with maintenance operations such as traffic management, contract preliminaries, railway possessions, design fees.

3a Traffic Management

| Table A4 - Traffic Management Costs Associated with Maintenance Operations | | | | | |
|---|---|---|---|---|---|
| | Maintenance operation which will require traffic management | Cost Each Occasion (£) c1 | Cycle Time of cost occurring (Years) | Discount Factor D | Additional Cost Sum (£) c1xD |
| Traffic mgt. activity 1 | | | | | |
| Traffic mgt. activity 2 | | | | | |
| Traffic mgt. activity 3 | | | | | |
| Traffic mgt. activity 4 | | | | | |
| Traffic mgt. activity 5 | | | | | |
| **Total net present value of traffic management costs for maintenance∑ c1xD** | | | | | |

| | | | |
|---|---|---|---|
| **SUMMATION TO PRODUCE RUNNING TOTAL** | **+** | **Total net present value of maintenance activities after application of Price Adjustment Factors = F x ∑ M x D (from Table A3 above)** | |
| | | **Total net present value of traffic management costs for maintenance∑ c1xD from above** | |
| | **=** | **RUNNING TOTAL of Net Present Value of Maintenance Costs** | |

3b Contract preliminaries and design / works supervision fees.

| Table A5 - Works Contract Preliminaries and Fees | | | | |
|---|---|---|---|---|
| **SUMMATION of Preliminaries and Fees** | **+** | **Works Contract Preliminaries** | **12.5% of Running Total in Table A4** | |
| | | **Design and Works Supervision Costs** | **10% of Running Total in Table A4** | |
| | **=** | **Net Present Value of Contract Preliminaries and design/supervision fees associated with Maintenance Costs** | | |

SUM B Stage 3 continued

3c Railway Possession costs for maintenance and inspections.

| Table A6 - Railway Track Possession Costs Associated with Maintenance Operations | | | | | |
|---|---|---|---|---|---|
| | Maintenance operation which will require rail possession | Cost Each Occasion (£) c2 | Cycle Time of cost occurring (Years) | Discount Factor D | Additional Cost Sum (£) c2xD |
| Rail possession activity 1 | | | | | |
| Rail possession activity 2 | | | | | |
| Rail possession activity 3 | | | | | |
| Rail possession activity 4 | | | | | |
| Rail possession activity 5 | | | | | |
| **Total net present value of rail possession costs for maintenance ∑ c2xD** | | | | | |

SUM B Stage 4

Add rail possession costs to running total to produce final sum to provide future maintenance costs of the structure - SUM B

| Table A7 - FINAL TOTAL VALUE - SUM B | | | |
|---|---|---|---|
| **SUMMATION TO PRODUCE RUNNING TOTAL** | **+** | **Total net present value of maintenance costs from Table A4** | |
| | | **Net present value of contract Preliminaries and Fees from Table A5** | |
| | | **Total net present value of rail possession costs for maintenance ∑ c2xD from Table A6** | |
| | **=** | **SUM B Maintenance element of Commuted Sum** | |

## SUM C
### CALCULATION OF SUM TO PROVIDE COST OF EARLY REFURBISHMENT WORKS - SUM C

This is only to be included if the structure is not in good condition and will require expenditure in excess of that allowed for in the calculation of predictable maintenance costs (SUM B).

Cost of refurbishment at current prices = ($C_{Ref}$)

Time to refurbishment (years) = (t)

Sum to provide refurbishment cost = $C_{Ref}$ x $\frac{1}{(1+d)^t}$ (See Table B2)

SUM C = x = £_____

## TOTAL COMMUTED SUM FOR STRUCTURE

= SUM A + SUM B + SUM C

(SUM A from table A1, SUM B from Table A7, SUM C from page 12)

= £ + £ + £

= £_____

CALCULATION BY…….....

FOR..... DATE.....

## APPENDIX B – MAINTENANCE COSTS AND DISCOUNT FACTORS

## MAINTENANCE COSTS

This appendix shows the cost information and derivation of discount factors which are used in the calculation proformas contained in appendix A.

The following table shows maintenance operations which may be carried out on highway structures over their service lives. The table also provides standard cost rates for many items items which have been taken from the CIPFA Structures Toolkit, together with anticipated average intervals between the different maintenance operations. The intervals are based on the assumption that defects will be rectified and components renewed when they reach condition 4B as defined in Bridge Condition Indicator (BCI) guidance. For simplification certain operations have been omitted or combined. These standardised values are provided for use in determination of future maintenance expenditure on bridges in the absence of more detailed structure specific data.

As costs of maintenance works will normally vary depending on factors such as location, nature of obstacle crossed, road hierarchy, conservation factors etc, standard adjustment factors are provided to allow for such parameters.

TABLE B1 BRIDGE MAINTENANCE COSTS AND CYCLE TIMES

| Maintenance Activity | Cycle Time To Maintenance Activity (Years) | Unit | Unit Rate (£) | Notes |
|---|---|---|---|---|
| **Buried Foundations** | | | | |
| None | n/a | n/a | Replacement Cost to be Included in Element A | |
| **Buried Piles** | | | | |
| None | n/a | n/a | Replacement Cost to be Included in Element A | |
| **Steel Sheet Piles** | | | | |
| None | n/a | n/a | Replacement Cost to be Included in Element A | |
| **Scour Monitoring** | | | | |
| Environment: any | Flood event | item/year | 894 | |
| **Revetments (Under water): Maintenance** | | | | |
| Environment: Moderate | 55 | m² | 2,122 | |
| Environment: Severe | 32 | m² | 2,122 | |
| **Bearings: Replacement** | | | | |
| Environment: Moderate | 44 | m | 894 | |
| Environment: Severe | 30 | m | 894 | |
| **Insitu Prestressed Concrete (Post-Tensioned): Repairs** | | | | |
| Environment: Moderate | 55 | m² | 1,788 | |
| Environment: Severe | 28 | m² | 1,788 | |
| **Insitu Reinforced Concrete: Repairs** | | | | Unit rate also applicable to unreinforced concrete. |
| Environment: Moderate | 75 | m² | 1,788 | |
| Environment: Severe | 35 | m² | 1,788 | |
| **Precast Prestressed Concrete (Pre-Tensioned): Repairs** | | | | |
| Environment: Moderate | 110 | m² | 1,788 | |
| Environment: Severe | 45 | m² | 1,788 | |

| | | | | |
|---|---|---|---|---|
| **Precast Reinforced Concrete: Repairs** | | | | |
| Environment: Moderate | 130 | m² | 1,788 | |
| Environment: Severe | 45 | m² | 1,788 | |
| **Encased Steel: Repairs to concrete** | | | | |
| Environment: Moderate | 75 | m² | 1,788 | |
| Environment: Severe | 35 | m² | 1,788 | |
| **Cathodic Protection: Installation, Maintenance and Monitoring** | | | | |
| Environment: any | 1 | item/year | 2,400 | |
| **Masonry: Repairs (stone/brick)** | | | | |
| Environment: Moderate | 90 | m² | 2,146 | |
| Environment: Severe | 45 | m² | 2,146 | |
| **Re-painting Steel Beams and Gantries. (Including Surface Preparation)** | | | | |
| Environment: Moderate | 30 | m² | 72 | |
| Environment: Severe | 15 | m² | 72 | |
| **Finishes to Concrete: Repairs (For Example Subway Linings)** | | | | |
| Environment: Moderate | 30 | m² | 143 | |
| Environment: Severe | 15 | m² | 143 | |
| **Waterproofing: Replacement** | | | | |
| Environment: Any | 37 | m² | 387 | |
| **Expansion Joint Replacement: 0 to 15m span** | | | | |
| Traffic: Moderate | 12 | m | 181 | |
| Traffic: High | 8 | m | 181 | |
| **Expansion Joint Replacement: 15 to 40m span** | | | | |
| Traffic: Moderate | 20 | m | 776 | |
| Traffic: High | 13 | m | 776 | |
| **Expansion Joint Replacement: > 40m span** | | | | |
| Traffic: Moderate | 28 | m | 1,614 | |
| Traffic: High | 23 | m | 1,614 | |
| **Parapet Maintenance: Concrete** | | | | |
| Environment: Moderate | 35 | m² | 1,788 | apply to estimated surface area |
| Environment: Severe | 23 | m² | 1,788 | apply to estimated surface area |
| **Parapet Maintenance: Steel** | | | | |
| Environment: Moderate | 35 | m² | 680 | apply to estimated surface area |
| Environment: Severe | 23 | m² | 680 | apply to estimated surface area |
| **Parapet Maintenance: Aluminium** | | | | |
| Environment: Moderate | 57 | m² | 680 | apply to estimated surface area |
| Environment: Severe | 45 | m² | 680 | apply to estimated surface area |
| **Parapet Maintenance: Masonry** | | | | |
| Environment: Moderate | 85 | m² | 2,146 | apply to estimated surface area |
| Environment: Severe | 38 | m² | 2,146 | apply to estimated surface area |
| **Timber Handrail: Maintenance** | | | | |

| | | | | |
|---|---|---|---|---|
| Environment: Moderate | 23 | m² | 1,538 | apply to estimated surface area |
| Environment: Severe | 17 | m² | 1,538 | apply to estimated surface area |
| **Safety Fence: Maintenance** | | | | |
| Environment: Moderate | 47 | m² | 1,538 | apply to estimated surface area |
| Environment: Severe | 30 | m² | 1,538 | apply to estimated surface area |
| **Drainage: Maintenance (Routine Clearance and Occasional Component Replacement)** | | | | |
| Environment: Any | 35 | item | 1,500 | |
| **Mechanical/Electrical Element: Annual Maintenance** | | | | |
| Environment: Any | 1 | item/year | specific to structure | |
| **Mechanical/Electrical Element: Renewal of Component** | | | | |
| Environment: Moderate | specific to structure | item | specific to structure | |
| **Other: Specific to Structure** | | | | |
| Environment: Moderate | specific to structure | item | specific to structure | |
| **Corrugated Culvert: Maintenance** | | | | |
| Environment: Moderate | 55 | m² | 1,788 | |
| Environment: Severe | 28 | m² | 1,788 | |
| **Concrete Pipe** | | | | |
| None | n/a | | Replacement Cost to be Included in Element A | |
| **Routine Inspections** | | | | |
| Environment: Any | 2 | item | 40 | |

| **ADDITIONAL COSTS ASSOCIATED WITH MAINTENANCE OPERATIONS** | | |
|---|---|---|
| **DESCRIPTION** | **ADJUSTMENT OR ADDITIONAL COST TO INCLUDE** | **Notes** |
| **Traffic Management** | Determine estimated cycle time and costs appropriate for anticipated inspection and maintenance activities | |
| **Works Contract Preliminaries** | 12.5% to be added to all maintenance costs and traffic management to allow for contract preliminaries | |
| **Design and Supervision Costs** | 10% to be added to all maintenance costs and preliminaries to cover costs of design, works procurement and works supervision. | These costs are not included in total for calculating Contract Preliminaries and Design/Supervision costs. |
| **Rail Possessions** | For railway bridges where track possessions will be necessary for maintenance operations. Use best estimate of cost and frequency of possessions. | |

| PRICE ADJUSTMENT FACTORS TO BE APPLIED TO MAINTENANCE COSTS | | |
|---|---|---|
| | **Factor to apply to Total Costs** | **Notes** |
| **Heritage structure** | 2.00 | Use for ancient monument and grade 1 listed. May be reduced for other listing grades. |
| **Conservation Area** | 1.25 | Use in an area of architectural interest |
| **Environmentally Sensitive** | 1.40 | Use in an area where the preservation of wildlife is of particular concern |
| **Route Supported - Unclassified** | 0.80 | |
| **Obstacle crossed - Railway** | 2.00 | |
| **Obstacle crossed - Navigable Watercourse** | 1.00 | |
| **Obstacle crossed - Non-Navigable Watercourse** | 0.90 | |
| **Obstacle crossed - Footway/Cycleway** | 0.75 | |
| **Obstacle crossed - Tenanted/Business** | 1.10 | Apply where land beneath structure is in use for private business, storage etc |
| **Obstacle crossed - Land/Disused** | 0.90 | Use when access for works is eased by absence of restrictions arising from land use. |
| **Location - Urban** | 1.00 | |
| **Location - Rural** | 0.70 | |
| **River, Coastal etc. Walls** | 1.60 | |
| **Tunnel (> 400m length)** | 1.25 | |
| **Structure Part Infilled** | 0.9 to 1.1 | Suggested range of possible effects on overall maintenance costs. Individual consideration required to take account of nature of infill and its impact on cyclical maintenance operations. |

## NOTES ON MAINTENANCE COSTS IN TABLE B1

Maintenance Rates have been derived, averaged or interpolated from those in the CIPFA Structures Toolkit in December 2012.(ref. Structures Asset Management Toolkit Version 1.01 Part C Supporting Information Table C.7)

These rates are applied to total surface areas but are based on assumptions that entire area will not require repairs on every occasion.

Cycle times have been derived, averaged or interpolated from those in the CIPFA Structures Toolkit in December 2012.(ref. Structures Asset Management Toolkit Version 1.01 Part C Supporting Information ) and are based on the assumption that the maintenance operation takes place when the Condition Scoring for the Component or Material has reached 4B.

These rates are used in the Appendix A proformas to determine the overall maintenance element of the commuted sum.

The applicability of these rates and prices may be considered for each individual example.

## DISCOUNT FACTORS

This section contains 4 tables. Table B2 lists the values of discount factor for a 2% discount rate which can be applied to one off future costs, y years from now, to determine the net present value. Tables B3 to B5 show compound discount factors for repeated operations at different intervals and for different evaluation periods. These are derived by summing the factors (from Table B2) for the individual years when the operations will take place.

TABLE B2. COMMUTED SUM PER £1 PRESENT COST (expenditure y years from now using 2% discount rate)

| Commuted Sum Discount Factors | | |
|---|---|---|
| **Year y** | **Discount rate d** | **1/(1+d)**y** |
| 1 | 0.02 | 0.98039 |
| 2 | 0.02 | 0.96117 |
| 3 | 0.02 | 0.94232 |
| 4 | 0.02 | 0.92385 |
| 5 | 0.02 | 0.90573 |
| 6 | 0.02 | 0.88797 |
| 7 | 0.02 | 0.87056 |
| 8 | 0.02 | 0.85349 |
| 9 | 0.02 | 0.83676 |
| 10 | 0.02 | 0.82035 |
| 12 | 0.02 | 0.78849 |
| 14 | 0.02 | 0.75788 |
| 15 | 0.02 | 0.74301 |
| 16 | 0.02 | 0.72845 |
| 18 | 0.02 | 0.70016 |
| 20 | 0.02 | 0.67297 |
| 22 | 0.02 | 0.64684 |
| 24 | 0.02 | 0.62172 |
| 25 | 0.02 | 0.60953 |
| 26 | 0.02 | 0.59758 |
| 28 | 0.02 | 0.57437 |
| 30 | 0.02 | 0.55207 |
| 32 | 0.02 | 0.53063 |
| 34 | 0.02 | 0.51003 |
| 35 | 0.02 | 0.50003 |
| 36 | 0.02 | 0.49022 |
| 38 | 0.02 | 0.47119 |
| 40 | 0.02 | 0.45289 |
| 42 | 0.02 | 0.43530 |
| 44 | 0.02 | 0.41840 |
| 45 | 0.02 | 0.41020 |
| 46 | 0.02 | 0.40215 |
| 48 | 0.02 | 0.38654 |
| 50 | 0.02 | 0.37153 |
| 52 | 0.02 | 0.35710 |
| 54 | 0.02 | 0.34323 |
| 55 | 0.02 | 0.33650 |
| 56 | 0.02 | 0.32991 |
| 58 | 0.02 | 0.31710 |
| 60 | 0.02 | 0.30478 |
| 62 | 0.02 | 0.29295 |
| 64 | 0.02 | 0.28157 |
| 65 | 0.02 | 0.27605 |
| 66 | 0.02 | 0.27064 |
| 68 | 0.02 | 0.26013 |
| 70 | 0.02 | 0.25003 |
| 72 | 0.02 | 0.24032 |
| 74 | 0.02 | 0.23099 |
| 75 | 0.02 | 0.22646 |
| 76 | 0.02 | 0.22202 |
| 78 | 0.02 | 0.21340 |
| 80 | 0.02 | 0.20511 |
| 82 | 0.02 | 0.19715 |
| 84 | 0.02 | 0.18949 |
| 85 | 0.02 | 0.18577 |
| 86 | 0.02 | 0.18213 |
| 88 | 0.02 | 0.17506 |
| 90 | 0.02 | 0.16826 |
| 92 | 0.02 | 0.16173 |
| 94 | 0.02 | 0.15545 |
| 95 | 0.02 | 0.15240 |
| 96 | 0.02 | 0.14941 |
| 98 | 0.02 | 0.14361 |
| 100 | 0.02 | 0.13803 |
| 102 | 0.02 | 0.13267 |
| 104 | 0.02 | 0.12752 |
| 105 | 0.02 | 0.12502 |
| 106 | 0.02 | 0.12257 |
| 108 | 0.02 | 0.11781 |
| 110 | 0.02 | 0.11324 |
| 112 | 0.02 | 0.10884 |
| 114 | 0.02 | 0.10461 |
| 115 | 0.02 | 0.10256 |
| 116 | 0.02 | 0.10055 |
| 118 | 0.02 | 0.09665 |
| 120 | 0.02 | 0.09289 |
| 122 | 0.02 | 0.08929 |
| 124 | 0.02 | 0.08582 |
| 125 | 0.02 | 0.08414 |
| 126 | 0.02 | 0.08249 |
| 128 | 0.02 | 0.07928 |
| 130 | 0.02 | 0.07620 |
| 132 | 0.02 | 0.07324 |
| 134 | 0.02 | 0.07040 |
| 135 | 0.02 | 0.06902 |
| 136 | 0.02 | 0.06767 |
| 138 | 0.02 | 0.06504 |
| 140 | 0.02 | 0.06251 |
| 142 | 0.02 | 0.06009 |
| 144 | 0.02 | 0.05775 |
| 145 | 0.02 | 0.05662 |
| 146 | 0.02 | 0.05551 |
| 148 | 0.02 | 0.05335 |
| 150 | 0.02 | 0.05128 |

## MAINTENANCE COMPOUND DISCOUNT FACTORS

### TABLE B3 - 60 YEAR EVALUATION PERIOD, 2% DISCOUNT RATE

| MAINTENANCE INTERVAL | DISCOUNT FACTOR WITHOUT RECONSTRUCTION |
|---|---|
| 1 | 34.7609 |
| 2 | 17.2084 |
| 5 | 6.6796 |
| 8 | 3.9036 |
| 10 | 3.1746 |
| 12 | 2.5918 |
| 13 | 2.1897 |
| 15 | 2.0101 |
| 17 | 1.5884 |
| 20 | 1.4306 |
| 23 | 1.0363 |
| 28 | 0.9043 |
| 30 | 0.8569 |
| 32 | 0.5306 |
| 35 | 0.5000 |
| 37 | 0.4806 |
| 38 | 0.4712 |
| 44 | 0.4184 |
| 45 | 0.4102 |
| 47 | 0.3943 |
| 50 | 0.3715 |
| 55 | 0.3365 |
| 57 | 0.3234 |

### TABLE B4 - 120 YEAR EVALUATION PERIOD, 2% DISCOUNT RATE.

| MAINTENANCE INTERVAL | DISCOUNT FACTOR WITHOUT RECONSTRUCTION | DISCOUNT FACTOR D WITH RECONSTRUCTION AT 120 YEARS |
|---|---|---|
| 1 | 45.3554 | 45.2820 |
| 2 | 22.4532 | 22.3797 |
| 5 | 8.7154 | 8.6420 |
| 8 | 5.2843 | 5.2109 |
| 10 | 4.1422 | 4.0687 |
| 12 | 3.3817 | 3.3082 |
| 13 | 3.0702 | 3.0702 |
| 15 | 2.6227 | 2.5493 |
| 17 | 2.2618 | 2.2618 |
| 20 | 1.8667 | 1.7932 |
| 23 | 1.5556 | 1.5556 |
| 28 | 1.2026 | 1.2026 |
| 30 | 1.1180 | 1.0446 |
| 32 | 0.9616 | 0.9616 |
| 35 | 0.8751 | 0.8751 |
| 37 | 0.8226 | 0.8226 |
| 38 | 0.7978 | 0.7978 |
| 44 | 0.5935 | 0.5935 |
| 45 | 0.5785 | 0.5785 |
| 47 | 0.5497 | 0.5497 |
| 50 | 0.5096 | 0.5096 |
| 55 | 0.4497 | 0.4497 |
| 57 | 0.4280 | 0.4280 |

## TABLE B5 - 150 YEAR EVALUATION PERIOD, 2% DISCOUNT RATE.

| MAINTENANCE INTERVAL | DISCOUNT FACTOR WITHOUT RECONSTRUCTION | DISCOUNT FACTOR D WITH RECONSTRUCTION AT 120 YEARS |
|---|---|---|
| 1 | 47.4358 | 47.3430 |
| 2 | 23.4831 | 23.3902 |
| 5 | 9.1152 | 9.0223 |
| 8 | 5.4890 | 5.3962 |
| 10 | 4.3322 | 4.2393 |
| 12 | 3.5127 | 3.4198 |
| 13 | 3.2053 | 3.1975 |
| 15 | 2.7430 | 2.6501 |
| 17 | 2.3294 | 2.3281 |
| 20 | 1.9292 | 1.8363 |
| 23 | 1.6207 | 1.6145 |
| 28 | 1.2651 | 1.2560 |
| 30 | 1.1693 | 1.0764 |
| 32 | 1.0409 | 0.9616 |
| 35 | 0.9376 | 0.8751 |
| 37 | 0.8760 | 0.8226 |
| 38 | 0.7978 | 0.7978 |
| 44 | 0.6667 | 0.5935 |
| 45 | 0.6475 | 0.5785 |
| 47 | 0.6110 | 0.5497 |
| 50 | 0.5608 | 0.5096 |
| 55 | 0.4497 | 0.4497 |
| 57 | 0.4280 | 0.4280 |