

# Life Cycle Costing for Construction

## University of Wales Trinity Saint David

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- Introduction
  
- **Part 1 – Basic Awareness**
  - What is WLC/LCC?
  - Why LCC is important?
  - Definitions, process, scoping and Standards
  - LCC Process
  - What does an LCC involve?
  
- **Part 2 – Practical Application**
  - RICS Black Book guidance
  - Sustainability and BREEAM
  - Links to BIM

# Introduction



- Regional Director & National Life Cycle Champion for Faithful+Gould in the Strategic Asset Management team
- Chartered Building Surveyor (MRICS)
- Based in London but support Regions from SAM Centre of Excellence
- Named contributor to PD 156865 Standardized Method of Life Cycle Costing in Construction (SMLCC)
- Steering group member for RICS NRM3 for Costing Maintenance
- Member of BSi CB/101 Service Planning
- Over 30 years life cycle cost consultancy experience in various sectors

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# PART 1 –Life Cycle Costing Basic Awareness



- What is Whole Life Costing / Lifecycle Costing?
- Why Bother? Why it matters
- BS/ISO 15686-5 and UK Standardised Method – including definitions, distinction between LCC and WLC, process and scoping
- The LCC Process – what information is required, the timescale etc.
- What does LCC involve?
- Worked Examples

# What is Life Cycle Costing (LCC)?

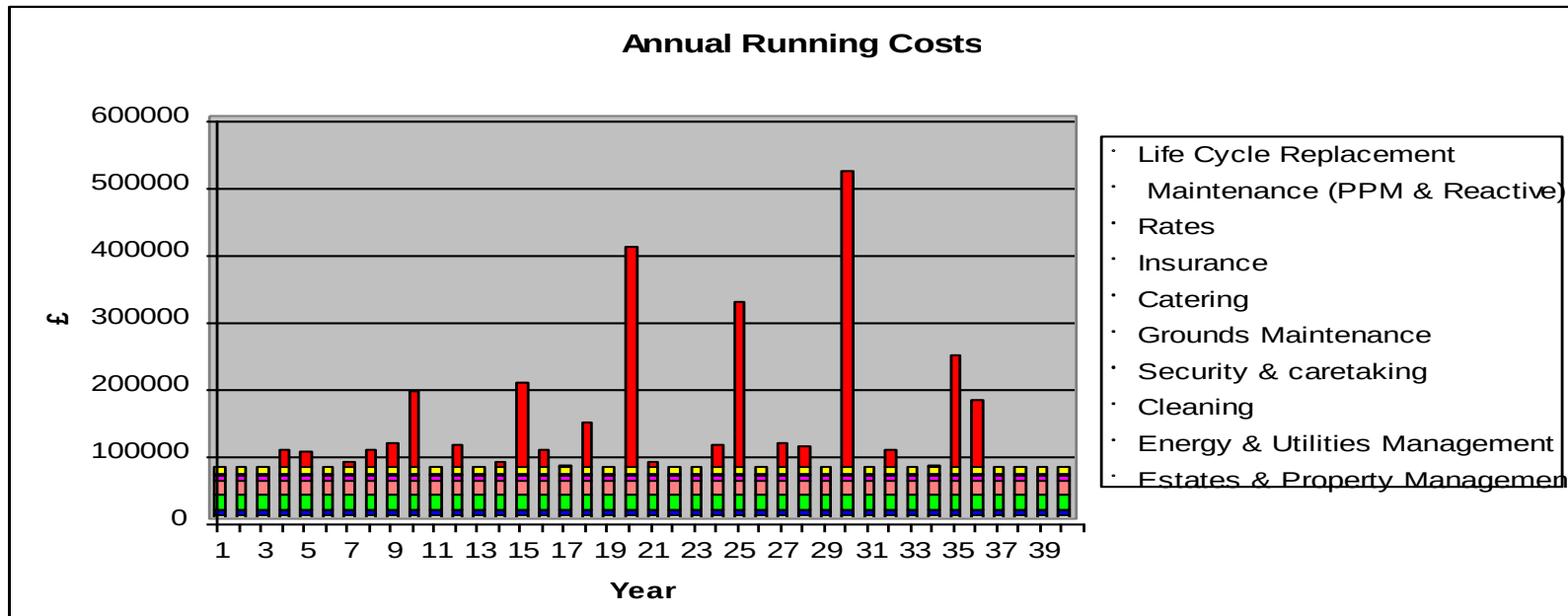
## In summary LCC details....

- What work that needs to be done to the building or constructed asset in the future?
- When the work is to be done & at what frequency?
- How much will it cost?
- How the LCC be expressed?
- Generally in today's values...

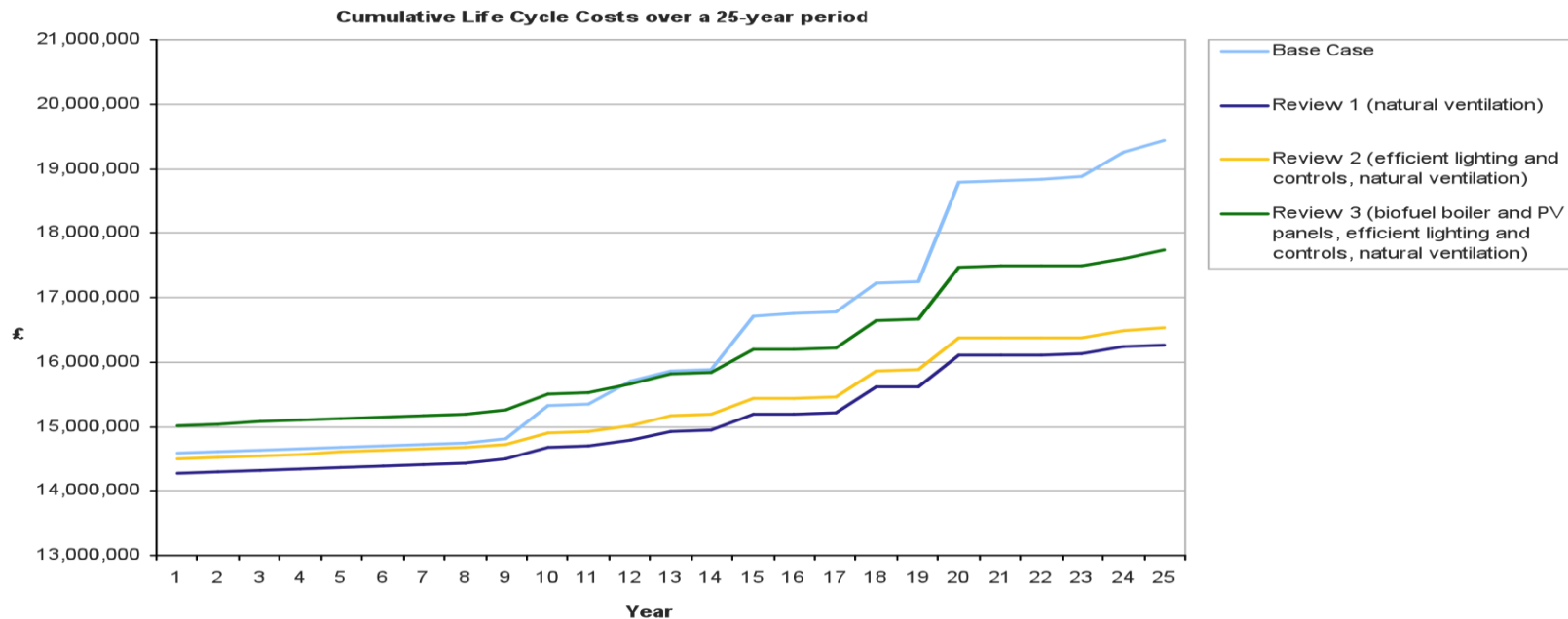
# What is LCC for?

- ▶ To set budgets for business cases
- ▶ To compare options
- ▶ To judge whether an investment is affordable over the long term
- ▶ To identify high cost items to focus on
- ▶ To comply with client requirements...

# What does LCC involve?

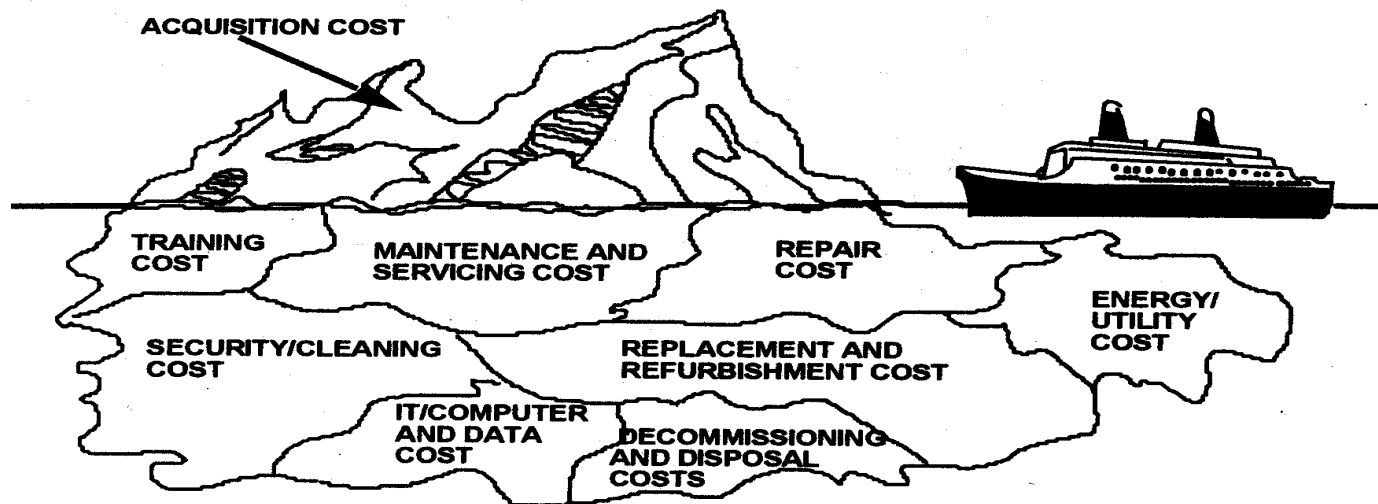


# LCC Option Comparisons



# Why LCC is important?

## The Iceberg!



# Why LCC is important? (2)

1:5:200

1 = Construction Cost

5 = Maintenance and Building Operating Costs

200 = Business Operating Costs (including staff costs)

*\*source: The Royal Academy of Engineering (based on office building – but BEWARE....)*

# Why LCC is important (3) – the clients view



## ► **Clients want:**

- To deliver energy cost reductions for customers
- To assess and (im)prove durability/specification choices
- To help produce (and reduce) FM and operational budgets for their buildings
- To measure whole life carbon and environmental cost impacts
- To meet funding criteria and gain access to funding

# Why LCC is Important (4)

## - Cost v Environment?



### ► **World Green Building Council Report 2013** says:

- Building green doesn't necessarily cost more.
- Green buildings are easier to let, purchasers will pay more (and expect a discount for non-sustainable buildings).
- Green buildings save money through reduced energy and water use, lower long term operations and maintenance costs.
- Energy savings normally exceed any premium on design and construction, with reasonably short payback periods.
- Good indoor environment can improve worker productivity and occupant health and well-being, giving bottom line business benefits.
- Sustainability risk factors can affect rental income, asset value and return on investment, increasing risk of obsolescence.
- Reduced maintenance requirements provide less disruption to normal operation.

# LCC Standards & Definitions

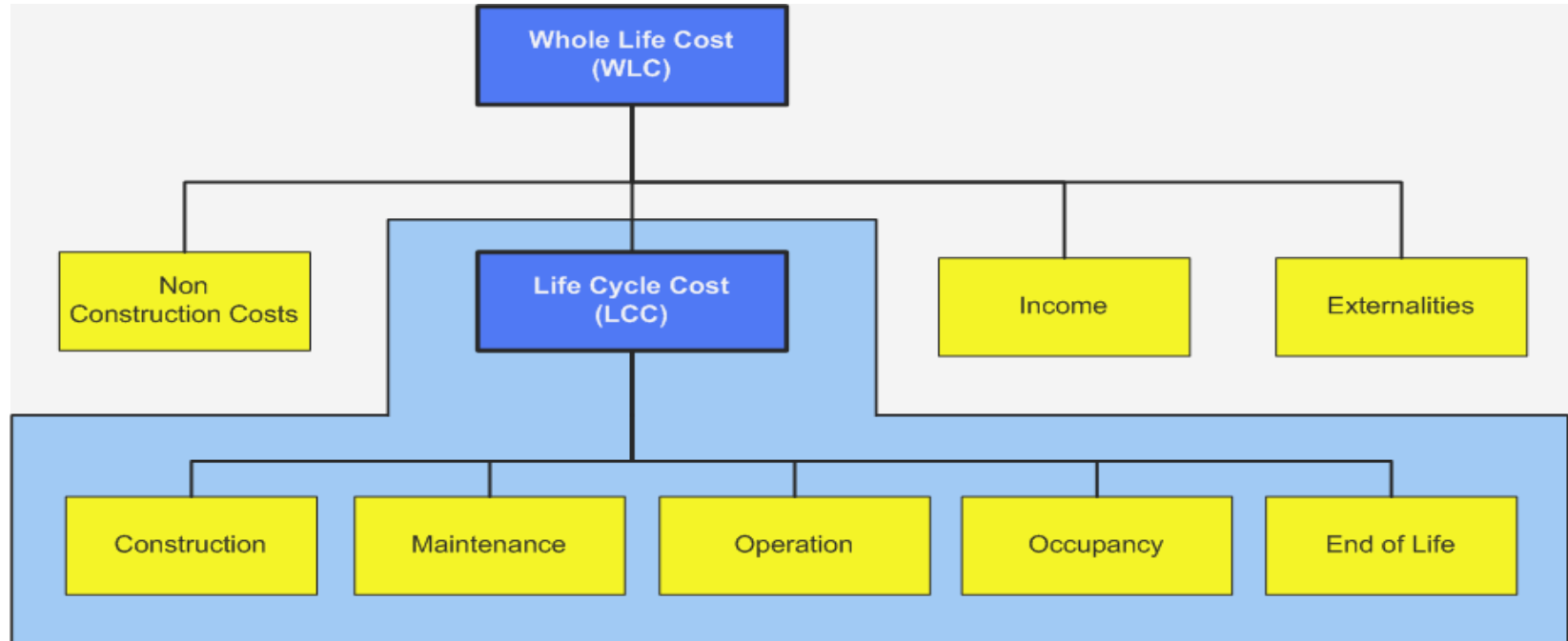
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- ▶ **Whole Life Costing (WLC)** is defined in BS/ ISO 15686 Part 5 as:
- ▶ *"economic assessment considering all agreed projected significant and relevant cost flows over a period of analysis expressed in monetary value.*
- ▶ *The projected costs are those needed to achieve defined levels of performance, including reliability, safety and availability".*
- ▶ **WLC includes all costs and incomes (including land costs for example)**

- ▶ **Life Cycle Costing** is.... *'Methodology for systematic economic evaluation of the life cycle costs over a period of analysis, as defined in the agreed scoping'.*
- ▶ **Life Cycle Costs** are..... *"cost of an asset or its parts throughout its life cycle, while fulfilling the performance requirements".*
- ▶ **LCC is about the costs (only) associated with a building or constructed assets.**

- ▶ **Life Cycle Assessment (LCA)** is a systematic set of procedures for compiling and examining the inputs and outputs of materials and energy and the associated environmental impacts directly attributable to the functioning of a product or service system throughout its life-cycle.
- ▶ **LCA is about environmental assessment, not about cost assessment – so not dealt with further today....**

# What is the difference between WLC and LCC?



**ISO 15686 Part 5** covers life cycle costing;

- ▶ Principles of life cycle costing
- ▶ Definitions, terminology and guidance on the use of information and data sources
- ▶ Forms of LCC calculations and the methods of economic evaluation (with informative examples)
- ▶ Setting the scope for LCC studies and how to deal with risks and uncertainty
- ▶ How LCC forms part of the whole life costing investment option appraisal process.

It links to other aspects of guidance in the rest of the ISO 15686 Series, such as data requirements (Pt 4) and reference service lives (Pts 1 and 8), - in order to help improve 'value for money through sustainable procurement'.



# UK Standardised Method for LCC in Construction 2008

- 1 Introduction
- 2 Guiding principles
- 3 Life cycle cost data structure
- 4 Applications
- 5 Metrics
- 6 Risks and uncertainty
- 7 Information and data assumptions
- 8 Terms, definitions and abbreviations

## ANNEXES

- A Menu of LCC and WLC (In/out of scope)
- B BCIS SFCA elemental cost breakdown
- C Cost mapping to BCIS and ITOC structures
- D Informative worked examples
- E Example LCC risk log
- F Forms for LCC analysis and benchmarking
- G Sources of information

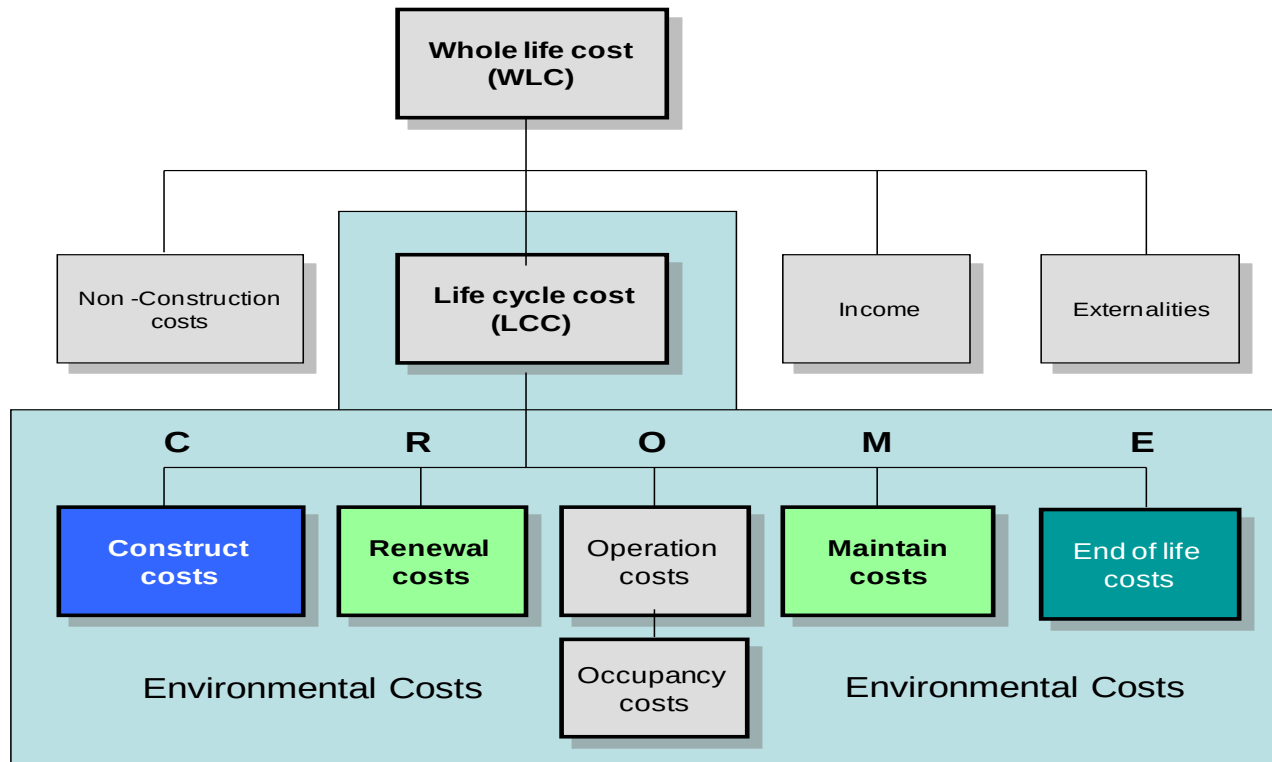


- LCC for the In-use phases – Asset Register or Condition Surveys
- It provides a consistent basis for maintenance cost planning and comparison.
- Allows clients to target precisely what is being spent and where and when
- Informs option appraisals (e.g. during budgeting and funding scenarios of projects and cost in use)
- Gives a basis for transparent / fair procurement and avoiding adversarial contracting
- Provides rules for interoperable data for effective CAFM solutions and the BIM data drops



- Order of cost estimating and planning for building maintenance costs
- Provides consistent rules for quantification & measurement of maintenance works to produce LCC estimates throughout the building's life cycle
- Structured format facilitates meaningful comparison and more robust LCC data analysis
- Advises clients on the likely LCC cash flow requirements for:
  - annual budgeting & initial sinking funds
  - forward maintenance work programmes
  - Linking with BIM





# RICS Black Book on LCC 2016



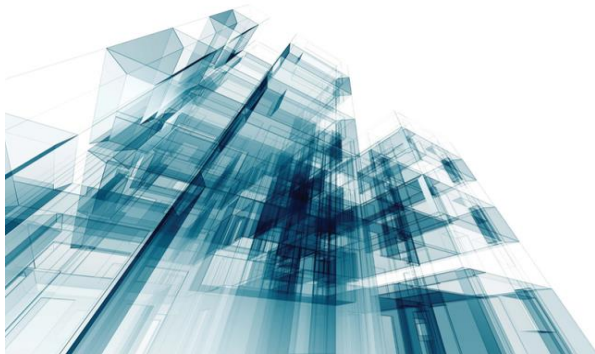
RICS guidance note



RICS professional guidance, UK

## Life cycle costing

1st edition, April 2016

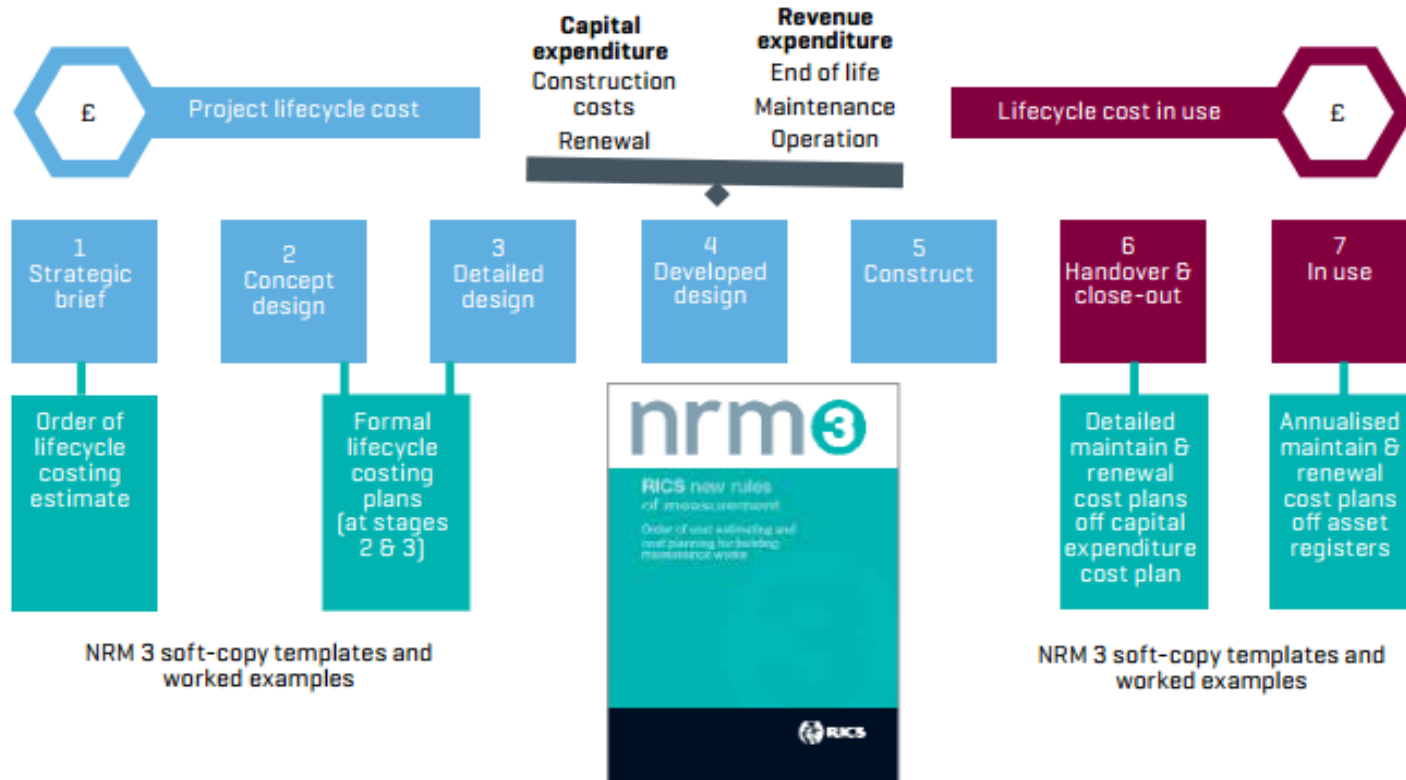


[rics.org/guidance](https://rics.org/guidance)

# THE LCC PROCESS

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# RICS NRM 3 – Digital Plan of Work



- **The RICS NRM 3** - provides a structured basis for measuring and quantifying the annualised maintenance and life cycle renewal works for buildings – which are carried out during the construction procurement and throughout the in use phases of the constructed assets, or built environment or facility.
- 1. **Order of cost estimates** – high-level budget cost estimates based on GIFA £/ m<sup>2</sup>
- 2. **Elemental cost plans** - budget cost estimates based on elemental £/m<sup>2</sup>
- 3. **Formal cost plans 1 to 3** during construction phase – generated from a capital cost plan
- 4. **Formal cost plans 4** - post construction phase – generated from a capital cost plan and/or an asset maintenance register and condition / lifing surveys
- 5. **Cost reporting and analysis**
- 6. **Cost benchmarks** (by floor area, functional & elemental methods)

# The Process - Scoping LCC

## ANNEX A

### Menu of life cycle costs and whole life cycle costs

|       | LIFE CYCLE COSTS                                       | INCLUDE/EXCLUDE | COMMENT |
|-------|--------------------------------------------------------|-----------------|---------|
| 1     | Construction costs                                     |                 |         |
| 1.1   | Construction works costs (see Annex A2 SFCA)           |                 |         |
| 1.2   | Other construction related costs                       |                 |         |
| 1.3   | Client definable costs                                 |                 |         |
| 2     | Maintenance costs                                      |                 |         |
| 2.1   | Major replacement costs                                |                 |         |
| 2.2   | Subsequent refurbishment and adaptation costs          |                 |         |
| 2.3   | Redecorations                                          |                 |         |
| 2.4   | Minor replacement, repairs and maintenance costs       |                 |         |
| 2.5   | Unscheduled replacement, repairs and maintenance costs |                 |         |
| 2.6   | Grounds maintenance                                    |                 |         |
| 2.7   | Client definable costs                                 |                 |         |
| 3     | Operation costs                                        |                 |         |
| 3.1   | Cleaning costs                                         |                 |         |
| 3.1.1 | Windows and external surfaces                          |                 |         |
| 3.1.2 | Internal cleaning                                      |                 |         |
| 3.1.3 | Specialist cleaning                                    |                 |         |
| 3.1.4 | External works cleaning                                |                 |         |
| 3.2   | Utilities costs                                        |                 |         |
| 3.2.1 | Fuel                                                   |                 |         |
| 3.2.2 | Water and drainage                                     |                 |         |
| 3.3   | Administrative costs                                   |                 |         |
| 3.3.1 | Property management                                    |                 |         |
| 3.3.2 | Staff engaged in servicing the building                |                 |         |
| 3.3.3 | Waste management/disposal                              |                 |         |
| 3.4   | Overheads costs                                        |                 |         |
| 3.5   | Taxes (if applicable)                                  |                 |         |
| 3.6   | Client definable costs                                 |                 |         |
| 4     | Occupancy costs                                        |                 |         |
| 4.1   | Internal moves (churn)                                 |                 |         |
| 4.2   | Reception and customer hosting                         |                 |         |

# The Process - Scoping LCC (2)

|       |                   |                                                  |
|-------|-------------------|--------------------------------------------------|
| 2     | Maintenance costs |                                                  |
| 2.1   |                   | Major replacement costs                          |
| 2.2   |                   | Subsequent refurbishment and adaptation costs    |
| 2.3   |                   | Redecorations                                    |
| 2.4   |                   | Minor replacement, repairs and maintenance costs |
| 2.5   |                   | Unscheduled replacement, repairs and maintenance |
| 2.6   |                   | Grounds maintenance                              |
| 2.7   |                   | Client definable costs                           |
| 3     | Operation Costs   |                                                  |
| 3.1   |                   | Cleaning costs                                   |
| 3.1.1 |                   | Windows and external surfaces                    |
| 3.1.2 |                   | Internal cleaning                                |
| 3.1.3 |                   | Specialist cleaning                              |
| 3.1.4 |                   | External works cleaning                          |
| 3.2   |                   | Utilities costs                                  |
| 3.2.1 |                   | Fuel                                             |
| 3.2.2 |                   | Water and drainage                               |
| 3.3   |                   | Administrative costs                             |
| 3.3.1 |                   | Property management                              |
| 3.3.2 |                   | Staff engaged in servicing the building          |
| 3.3.3 |                   | Waste management/disposal                        |
| 3.4   |                   | Overheads costs                                  |
| 3.5   |                   | Taxes (if applicable)                            |
| 3.6   |                   | Client definable costs                           |

# LCC Worked Examples

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# Whole Building Budget level LCC

Table D.1 Budget life cycle cost plan at stage 1

|               | GIFA                                                 | 1665 m <sup>2</sup>       | (a)             |                      |
|---------------|------------------------------------------------------|---------------------------|-----------------|----------------------|
|               | Period of analysis                                   | 30 yrs                    | (b)             |                      |
| <b>1.0</b>    | <b>Construction costs</b>                            | <b>£/m<sup>2</sup></b>    |                 | <b>£</b>             |
| 1.1           | Building                                             | 1250                      | x (a)           | 2,081,250 (c)        |
|               | Fees 12.5%                                           |                           | x (c)           | 260,156              |
|               | <i>Total</i>                                         |                           |                 | <b>2,341,406 (d)</b> |
| <b>2.0</b>    | <b>Maintenance costs</b>                             | <b>£/m<sup>2</sup>/yr</b> |                 |                      |
| 2.1 and 2.4   | Major and minor replacement, repairs and maintenance |                           |                 |                      |
| 2.1a and 2.4a | Fabric maintenance                                   | 9.40                      | x (a) x (b)     | 469,530              |
| 2.1b and 2.4b | Services maintenance                                 | 13.10                     | x (a) x (b)     | 654,345              |
| 2.3           | Redecorations                                        | 3.65                      | x (a) x (b)     | 182,318              |
|               | <i>Total</i>                                         | <b>26.15</b>              |                 | <b>1,306,193 (e)</b> |
| <b>3.0</b>    | <b>Operation costs</b>                               |                           |                 |                      |
| 3.1           | Cleaning                                             | 15.40                     | x (a) x (b)     | 769,230              |
| 3.2           | Utilities                                            | 8.42                      | x (a) x (b)     | 420,579              |
| 3.3           | Admin                                                | 18.36                     | x (a) x (b)     | 917,082              |
|               | <i>Total</i>                                         | <b>42.18</b>              |                 | <b>2,106,891 (f)</b> |
|               | <b>Total Life Cycle Cost</b>                         |                           | (d) + (e) + (f) | <b>5,754,490 (g)</b> |
|               | <b>Total LCC £/m<sup>2</sup>/yr</b>                  |                           | (g) ÷ (a) ÷ (b) | <b>115.21</b>        |



| Option Reference                                | Option 1                          |                              |                        |                           |                           |               |                                | Option 2                                |                              |                        |                           |                           |               |                                |
|-------------------------------------------------|-----------------------------------|------------------------------|------------------------|---------------------------|---------------------------|---------------|--------------------------------|-----------------------------------------|------------------------------|------------------------|---------------------------|---------------------------|---------------|--------------------------------|
| Period of Analysis                              | 60 years                          |                              |                        |                           |                           |               |                                | 60 years                                |                              |                        |                           |                           |               |                                |
| Discount Rate                                   | 3.0%                              |                              |                        |                           |                           |               |                                | 3.0%                                    |                              |                        |                           |                           |               |                                |
| Description                                     | External Aluminium Door and Frame |                              |                        |                           |                           |               |                                | External Hardwood Timber Door and Frame |                              |                        |                           |                           |               |                                |
| Construction Costs                              |                                   |                              |                        |                           |                           |               |                                |                                         |                              |                        |                           |                           |               |                                |
| Capital Cost                                    | £1,420                            |                              |                        |                           |                           |               |                                | £1,015                                  |                              |                        |                           |                           |               |                                |
| Maintenance Costs                               | Capital Cost                      | Adjustment to Capital Cost % | Quantity Replacement % | Adjusted Maintenance Cost | Replacement Cycle (Years) | Present Value | Maintenance Cost Present Value | Capital Cost                            | Adjustment to Capital Cost % | Quantity Replacement % | Adjusted Maintenance Cost | Replacement cycle (Years) | Present Value | Maintenance Cost Present Value |
| Option 1                                        |                                   |                              |                        |                           |                           |               |                                |                                         |                              |                        |                           |                           |               |                                |
| Replace Frame and Door                          | £1,420                            | 110%                         | 100%                   | £1,562                    | 40                        | 0.3065568     | £479                           |                                         |                              |                        |                           |                           |               |                                |
| Replace Ironmongery                             | £150                              | 105%                         | 100%                   | £158                      | 20                        | 0.5536758     | £87                            |                                         |                              |                        |                           |                           |               |                                |
|                                                 |                                   |                              |                        |                           | 40                        | 0.3065568     | £48                            |                                         |                              |                        |                           |                           |               |                                |
|                                                 |                                   |                              |                        |                           | 60                        | 0.1697331     | £27                            |                                         |                              |                        |                           |                           |               |                                |
| Replace Seal                                    | £20                               | 105%                         | 100%                   | £21                       | 20                        | 0.5536758     | £12                            |                                         |                              |                        |                           |                           |               |                                |
|                                                 |                                   |                              |                        |                           | 40                        | 0.3065568     | £6                             |                                         |                              |                        |                           |                           |               |                                |
|                                                 |                                   |                              |                        |                           | 60                        | 0.1697331     | £4                             |                                         |                              |                        |                           |                           |               |                                |
| Option 2                                        |                                   |                              |                        |                           |                           |               |                                |                                         |                              |                        |                           |                           |               |                                |
| Replace Frame and Door                          |                                   |                              |                        |                           |                           |               |                                | £1,015                                  | 110%                         | 100%                   | £1,117                    | 40                        | 0.3065568     | £342                           |
| Painting to Doors                               |                                   |                              |                        |                           |                           |               |                                | £30                                     | 100%                         | 100%                   | £30                       | 5                         |               | £156                           |
| Painting to Door-frames                         |                                   |                              |                        |                           |                           |               |                                | £20                                     | 100%                         | 100%                   | £20                       | 5                         |               | £104                           |
| Replace Ironmongery                             |                                   |                              |                        |                           |                           |               |                                | £150                                    | 105%                         | 100%                   | £158                      | 20                        | 0.5536758     | £87                            |
|                                                 |                                   |                              |                        |                           |                           |               |                                |                                         |                              |                        |                           | 40                        | 0.3065568     | £48                            |
|                                                 |                                   |                              |                        |                           |                           |               |                                |                                         |                              |                        |                           | 60                        | 0.1697331     | £27                            |
| Replace Seal                                    |                                   |                              |                        |                           |                           |               |                                | £20                                     | 105%                         | 100%                   | £21                       | 20                        | 0.5536758     | £12                            |
|                                                 |                                   |                              |                        |                           |                           |               |                                |                                         |                              |                        |                           | 40                        | 0.3065568     | £6                             |
|                                                 |                                   |                              |                        |                           |                           |               |                                |                                         |                              |                        |                           | 60                        | 0.1697331     | £4                             |
| Total Maintenance Cost                          |                                   |                              |                        |                           |                           |               | £663                           | £777                                    |                              |                        |                           |                           |               |                                |
| Operation Costs                                 |                                   |                              |                        |                           |                           |               |                                |                                         |                              |                        |                           |                           |               |                                |
| Operation Cost (total £ for period of analysis) |                                   |                              |                        |                           |                           |               |                                |                                         |                              |                        |                           |                           |               |                                |
|                                                 |                                   |                              |                        |                           |                           |               | £1,245                         | £1,993                                  |                              |                        |                           |                           |               |                                |
| Total Life Cycle Cost NPV                       | £3,328                            |                              |                        |                           |                           |               |                                | £3,784                                  |                              |                        |                           |                           |               |                                |

# Life Cycle Costs are Future costs

- ▶ The time value of money £1 now or next year?
- ▶ How do we represent this?
- ▶ The discount rate represents the “opportunity cost”
- ▶ For the public sector, there are rules about the discount rate to apply (HM Treasury Green Book) – currently 3.5% up to 30 years.
- ▶ For the private sector, the opportunity cost is the cost of borrowing the money, or internally funding the investment.
- ▶ The higher the discount rate, the lower future costs are in present day terms

# LCC is typically measured in NPV (Net Present Value)

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- ▶ The NPV is the sum of all the future cash flows, discounted to the present day
- OR
- ▶ The amount to be invested to pay for all future costs at a given interest rate and time horizon.
  - ▶ It allows you to compare options with different cash flows over different time periods
  - ▶ For education projects, it is a requirement to report the NPV of the life cycle replacement costs only (not the whole LCC or WLC).

# How to calculate NPV

- ▶ Note that if inputs to the equation change, the answer may (hence sensitivity analysis)
- ▶ NPV is the sum of all the PV's

PV = Future Cost in year N

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$(1 + \text{discount \%})^N$

*(where N is number of years between base date and year of occurrence)*

# How to calculate NPV (2)

- ▶ Identify a future costs in today' s money
- ▶ Identify when it will be spent
- ▶ Discount the future cost by the agreed discount rate

For example:

£100 in year 5 @ 3% = £86.26

OR

£100

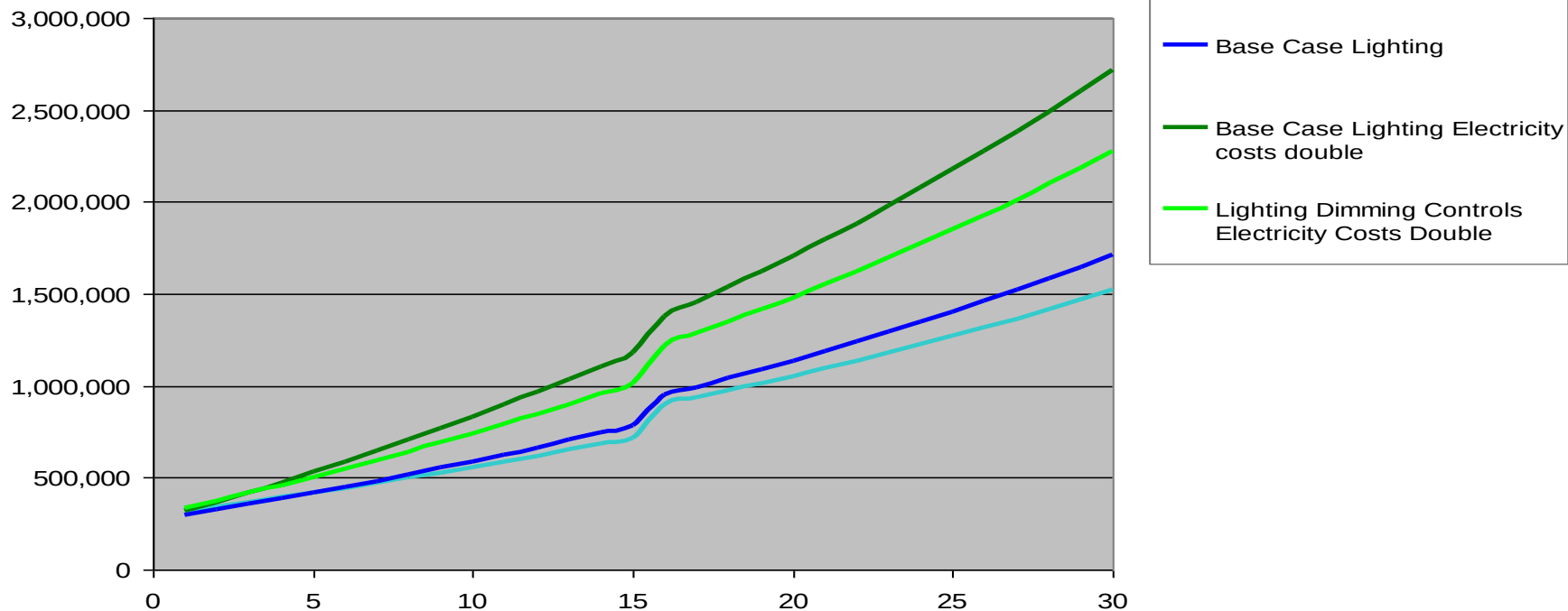
$$\frac{£100}{(1+0.03)^5} = £100 \times 0.862608784$$



| Option Reference                                  | Option 1          |                              |                            |                           |                     |                     |                                |
|---------------------------------------------------|-------------------|------------------------------|----------------------------|---------------------------|---------------------|---------------------|--------------------------------|
| Period of Analysis (years)                        | 25                |                              |                            |                           |                     |                     |                                |
| Discount Rate for NPV                             | 5%                |                              |                            |                           |                     |                     |                                |
| Description                                       | Biomass Boilers   |                              |                            |                           |                     |                     |                                |
| Construction Costs                                |                   |                              |                            |                           |                     |                     |                                |
| Capital Cost                                      |                   |                              |                            |                           |                     |                     | £40,000                        |
| Maintenance Costs                                 | Capital Cost      | Adjustment to capital cost % | Capital Cost Replacement % | Adjusted Maintenance Cost | Year of Replacement | Present Value of £1 | Maintenance Cost Present Value |
| <b>Option 1</b>                                   |                   |                              |                            |                           |                     |                     |                                |
| Replace boiler                                    | £40,000           | 115%                         | 35%                        | £16,100                   | 20                  | 0.3584859           | £5,772                         |
| Replace burners                                   | £40,000           | 135%                         | 12%                        | £6,480                    | 12                  | 0.5403601           | £3,502                         |
|                                                   | £40,000           | 135%                         | 12%                        | £6,480                    | 24                  | 0.2919890           | £1,892                         |
| Replace wood chip conveyor                        | £40,000           | 135%                         | 5%                         | £2,700                    | 12                  | 0.5403601           | £1,459                         |
|                                                   | £40,000           | 135%                         | 5%                         | £2,700                    | 24                  | 0.2919890           | £788                           |
| <b>Option 2</b>                                   |                   |                              |                            |                           |                     |                     |                                |
| Replace boiler shell                              |                   |                              |                            |                           |                     |                     |                                |
| Replace burners                                   |                   |                              |                            |                           |                     |                     |                                |
| <b>Total Maintenance Cost NPV</b>                 |                   |                              |                            |                           |                     |                     | £13,413                        |
| Operation Costs                                   | Initial Unit Rate | Uplift for Management etc    | Area/ Units                | Total Cost per Event      | Frequency per annum | Present Value of £1 | Annual Opex Cost Present Value |
| <b>Option 1</b>                                   |                   |                              |                            |                           |                     |                     |                                |
| Annual Maintenance Contract                       | £2,500            | 105%                         | 1                          | £2,625                    | 1                   | 1.0000000           | £2,625                         |
| Fuel cost / woodchips                             | £1.32             | 105%                         | 750                        | £1,040                    | 1                   | 1.0000000           | £1,040                         |
| Cleaning fouled burners etc                       | £250              | 105%                         | 1                          | £263                      | 3                   | 1.0000000           | £788                           |
| Other                                             | £0                | 105%                         | 100                        | £0                        | 1                   | 1.0000000           | £0                             |
| <b>Total Opex Cost p.a</b>                        |                   |                              |                            |                           |                     |                     | £4,452                         |
| <b>Option 2</b>                                   |                   |                              |                            |                           |                     |                     |                                |
| Annual Maintenance Contract                       |                   |                              |                            |                           |                     |                     |                                |
| Fuel cost / gas                                   |                   |                              |                            |                           |                     |                     |                                |
| Cleaning fouled burners etc                       |                   |                              |                            |                           |                     |                     |                                |
| Other                                             |                   |                              |                            |                           |                     |                     |                                |
| <b>Total Opex Cost p.a</b>                        |                   |                              |                            |                           |                     |                     |                                |
| <b>Total Opex Cost NPV</b>                        |                   |                              |                            |                           |                     |                     | £61,124                        |
| <b>Total WLC (Capex + Maintenance + Opex) NPV</b> |                   |                              |                            |                           |                     |                     | £114,537                       |

# Sensitivity Analysis – e.g electricity costs

Lighting Options



# Recap of Part 1

- ▶ WLC / LCC is not very complicated in terms of concept – what needs doing, when, how much will it cost?
- ▶ Its important because clients are committing to much more than the capital costs
- ▶ There are standards which lay out the rules in detail – including scoping
- ▶ There are two main types of costs – recurring (hard and soft FM) and occasional (major replacements)
- ▶ Allow time and provide the necessary information – LCC follows capital cost estimating in level of detail

# PART 2 – LCC Practical Application

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## Part 2 – Overview of Practical Application



- ▶ RICS Black Book on LCC
  - ▶ (Knowing / Doing / Advising levels)
- ▶ Practical application – briefing, analysis, calculations, models
- ▶ Practical application – reporting on energy, sustainability, risk
- ▶ Practical application – brief overview of BREEAM requirements for LCC
- ▶ LCC and BIM – different stages of DPOW and brief link to COBIE

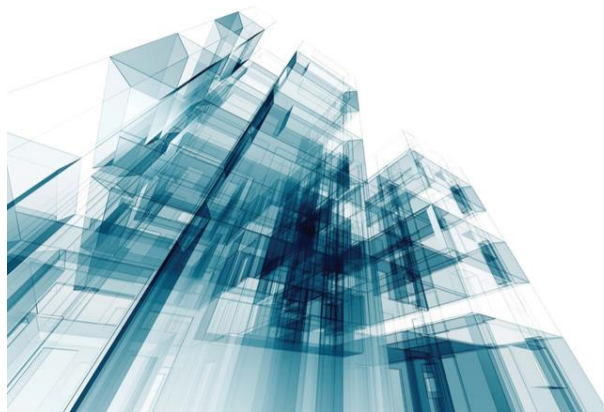
RICS guidance note



RICS professional guidance, UK

## Life cycle costing

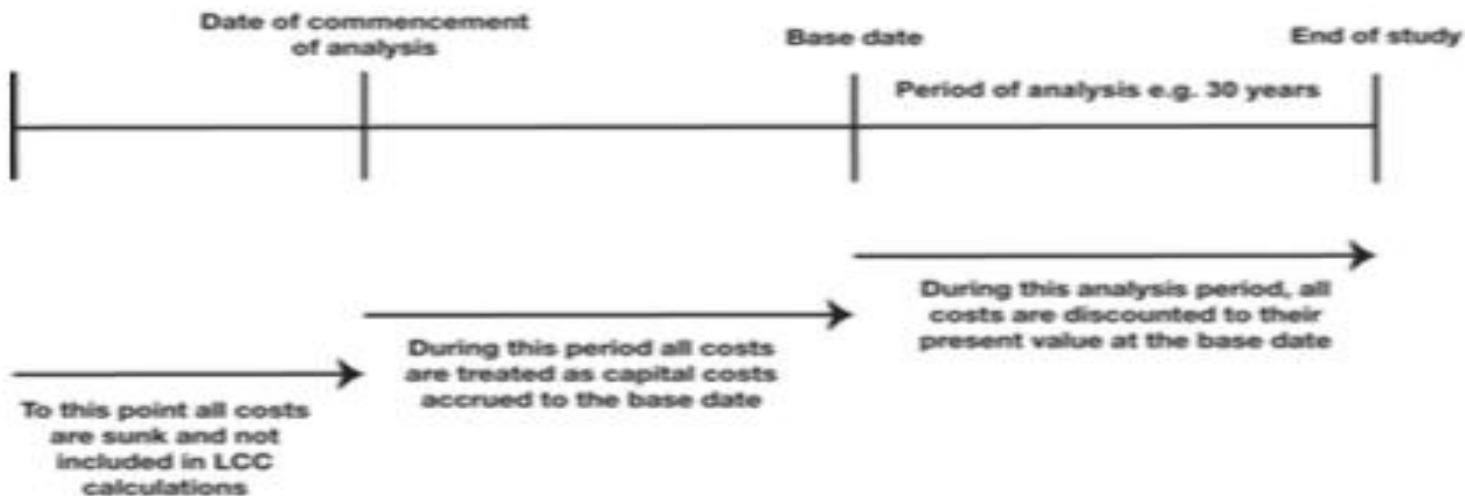
1st edition, April 2016



|                                                                                                                                      |   |
|--------------------------------------------------------------------------------------------------------------------------------------|---|
| <b>1 General principles (Level 1 – Knowing)</b>                                                                                      |   |
| 1.1 Introduction                                                                                                                     |   |
| 1.2 General principles                                                                                                               |   |
| 1.3 LCC standards and definitions                                                                                                    |   |
| 1.4 LCC in development and design of construction projects                                                                           |   |
| 1.5 The essentials of life cycle costing                                                                                             |   |
| 1.5.1 Level of LCC estimates                                                                                                         |   |
| 1.5.2 Relevant costs and cost data structures                                                                                        |   |
| 1.5.3 LCC period of analysis                                                                                                         |   |
| 1.5.4 Base date                                                                                                                      |   |
| 1.5.5 Real and nominal costs                                                                                                         |   |
| 1.5.6 Discounting, inflation and the time value of money – introduction of net present value (NPV) and annual equivalent value (AEV) |   |
| 1.5.7 Doing the calculations                                                                                                         |   |
| 1.6 LCC links with other aspects of sustainability                                                                                   |   |
| 1.7 Sources of data for LCC                                                                                                          | 1 |
| 1.8 Deliverables – the LCC report – essential aspects                                                                                | 1 |

# Base Date and other key dates

Figure 2: Representation of key LCC dates



**Real Costs** – at today's cost, excluding inflation

OR

**Nominal Costs** – at future costs, including inflation

RECOMMENDATION IS....

- ▶ Use real costs
- ▶ Do not mix real and nominal
- ▶ Discount rate will depend on real or nominal
- ▶ Use sensitivity analysis to examine differential inflation
- ▶ See section 1.5.5. of Black Book

- ▶ **Sustainability** – will cover BREEAM assessment later. Also note the CEN TC350 series of standards on integrated sustainability assessment (BS/EN 15643-4 is the methodology and BS/EN 16627 is the calculation rules). They are based on the ISO rules but there are some specific pitfalls to be aware of if you are asked to report to these standards....
  
- ▶ **Data sources**
  - ▶ In house data (essential but rarely in easily used forms)
  - ▶ Published historical data (e.g. RICS Running Costs Online, CIBSE Guide M)
  - ▶ Modelling data (normally for experts)
  - ▶ Manufacturers etc. data (take with a pinch of salt & adjust for project conditions!)

# RICS LCC Black Book - Level 2 - Doing

|                                                                                                   |       |
|---------------------------------------------------------------------------------------------------|-------|
| <b>2 Practical application (Level 2 – Doing)</b>                                                  | ..... |
| 2.1 Introduction                                                                                  | ..... |
| 2.2 Taking the brief for the study                                                                | ..... |
| 2.3 Analysis and calculations – key variables                                                     | ..... |
| 2.4 Analysis and calculations – dealing with<br>terminal and residual values and other<br>incomes | ..... |
| 2.5 Calculations – designing an appropriate LCC<br>model                                          | ..... |
| 2.6 Analysis and calculations – post-occupancy –<br>including BS 8544 and NRM3                    | ..... |
| 2.7 Analysis and calculations – sustainability and<br>energy efficiency assessment                | ..... |
| 2.8 Calculations – sensitivity analysis and risk                                                  | ..... |
| 2.9 Validating and interpreting the results from an<br>LCC model                                  | ..... |

- ▶ **What's the problem to be solved, what's it for?**
  - ▶ To predict cash flows (e.g. for budget)
  - ▶ To appraise options (i.e. a comparison)
  - ▶ To review tenders (rules should be provided transparently)
  
- ▶ **What information does the client need to make the decision?**
  - ▶ For example, is sensitivity analysis necessary
  - ▶ How far has design developed (LCC follows level of capital cost availability)
  - ▶ For existing buildings is there enough data to assess the condition etc. or are surveys required first?

- ▶ **What is the LCC scope?**
  - ▶ Construction, Renewal, Operation, Maintenance, End of Life (CROME)
  - ▶ Period of Analysis – 25, 60, 120 years
  - ▶ Define scope & state assumptions
  
- ▶ **What can vary?**
  - ▶ Capital, maintenance & operational cost rates
  - ▶ Reference service lives
  - ▶ Percentages of replacement
  - ▶ Define level of sensitivity

- ▶ **Terminal or Scrap value** – of something which fails within the period of analysis – this represents a minor (positive) cash flow and is included in the calculation of NPV
- ▶ **Residual values** – of something that has not yet failed at the end of the period of analysis – are only relevant to option appraisals (i.e. one option has a residual value, the other might not). If the value is the same for all options it can be ignored. Otherwise typically assume straight line depreciation.
- ▶ Note – if the building is at the end of its life no residual value (may be costs associated with end of life).
- ▶ Sale value (major revenue) falls outside LCC and in WLC or investment appraisal – outside today's topic...

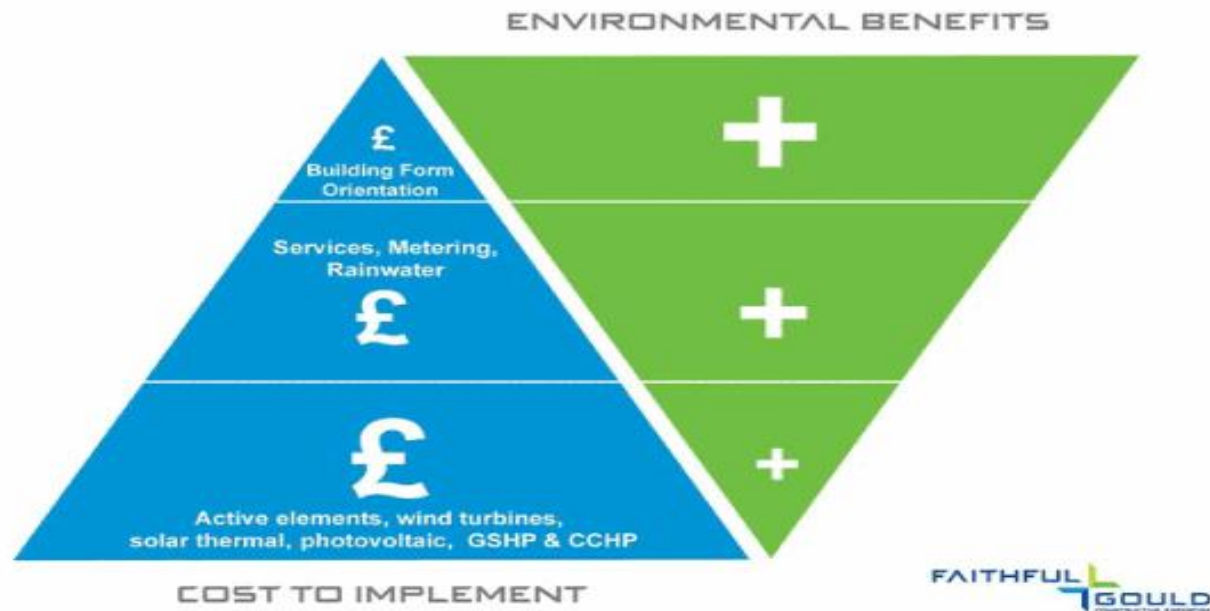
|                                                                                  |  |
|----------------------------------------------------------------------------------|--|
| <b>3 Practical considerations (Level 3 – Doing/Advising)</b> .....               |  |
| 3.1 Introduction .....                                                           |  |
| 3.2 LCC models for different project development stages .....                    |  |
| 3.2.1 Strategic outline case (Stage 1 of Digital Plan of Work) .....             |  |
| 3.2.2 Outline business case (Stage 2 of Digital Plan of Work) .....              |  |
| 3.2.3 Design development (Stages 3 to 5 of Digital Plan of Work) .....           |  |
| 3.2.4 Final business case (Stage 6 of Digital Plan of Work) .....                |  |
| 3.2.5 Post-occupancy (Stage 7 of Digital Plan of Work) .....                     |  |
| 3.3 Meeting client requirements in tendering .....                               |  |
| 3.4 Whole life value .....                                                       |  |
| 3.5 Alternative projects/programme assessment .....                              |  |
| 3.6 Model inputs and data assessment including use of 'proprietary' models ..... |  |
| 3.7 Benchmarking .....                                                           |  |
| 3.8 Reporting and record keeping – including brief link to BIM .....             |  |

# Level of analysis and project stage

Figure 3: Level of study and stages of the project



# Sustainability and LCC



## Two credits - Elemental life cycle cost (LCC)

1. An outline, entire asset elemental life cycle cost (LCC) plan has been carried out at Process Stage 2 (equivalent to Concept Design - RIBA Stage 2) in line with 'Standardised method of life cycle costing for construction procurement' PD 156865:2008<sup>1</sup>.
2. The elemental LCC plan:
  - a. Provides an indication of future replacement costs over a period of analysis as required by the client (e.g. 20, 30, 50 or 60 years);
  - b. Includes service life, maintenance and operation cost estimates.
3. Demonstrate, using appropriate examples provided by the design team, how the elemental LCC plan has been used to influence building and systems design/specification to minimise life cycle costs and maximise critical value.

## One credit - Component level LCC option appraisal

4. A component level LCC option appraisal has been developed by the end of Process Stage 4 (equivalent to Technical Design – RIBA Stage 4) in line with PD 156865:2008 and includes the following component types (where present):
  - a. Envelope, e.g. cladding, windows, and/or roofing
  - b. Services, e.g. heat source cooling source, and/or controls
  - c. Finishes, e.g. walls, floors and/or ceilings
  - d. External spaces, e.g. alternative hard landscaping, boundary protection.
5. Demonstrate, using appropriate examples provided by the design team, how the component level LCC cycle appraisal has been used to influence building and systems design/specification to minimise life cycle costs and maximise critical value.

## One credit - Capital cost reporting

6. Report the capital cost for the building in pounds per square metre (£k/m<sup>2</sup>), via the BREEAM Assessment Scoring and Reporting tool, Assessment Issue Scoring tab, Management section.

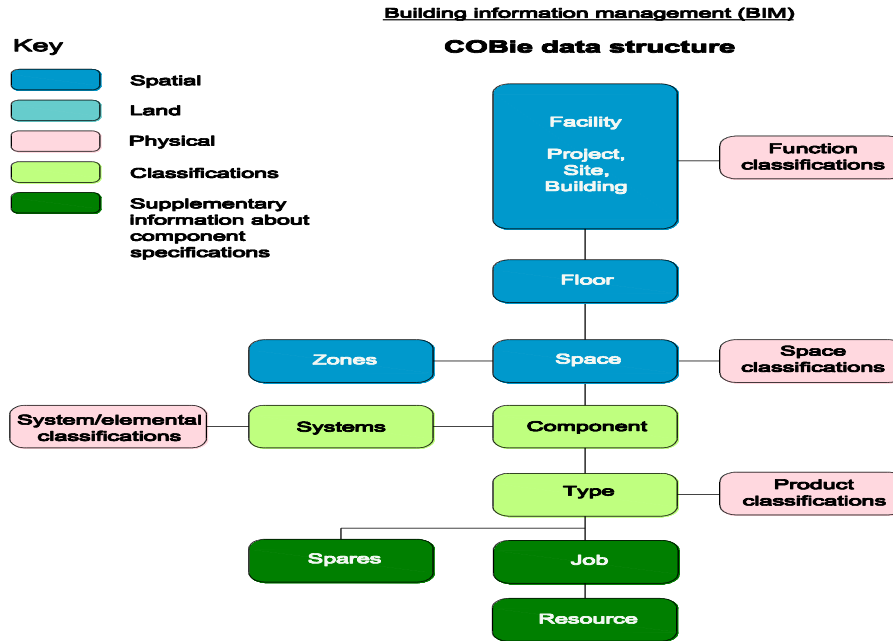
# BREEAM Reporting for MAN 02 – LCC Analysis



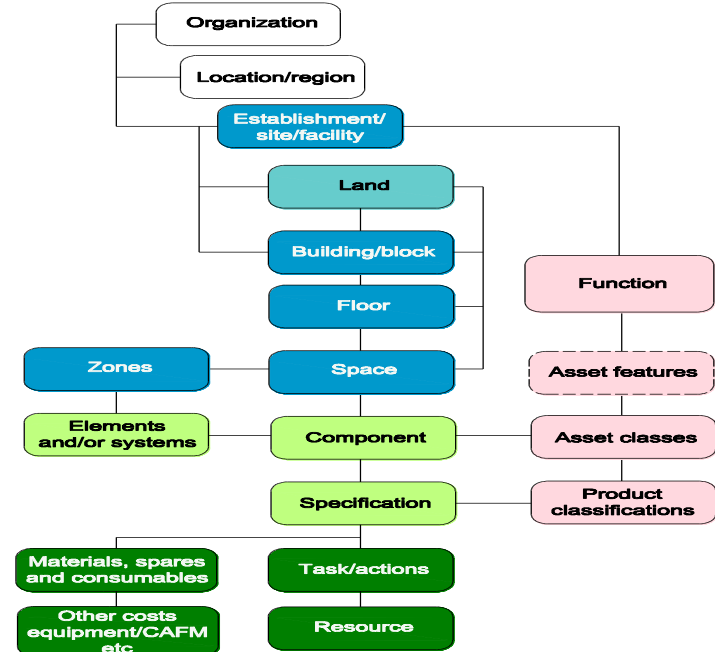
- ▶ LCC model and reports can provide the elemental LCC plan at the level of detail required for first two credits. In order to illustrate the impact of changing design options GIFA level analysis and rates can be used for these credits.
- ▶ Calculation alone can't provide the text required for item 3 – needs collaboration.
- ▶ Case study will show how model can be used at elemental level of specification to illustrate the requirements for item 4. Again the text for 5 needs collaboration.
- ▶ Capital Costs – item 6 - are reported via the BREEAM assessor's portal.

- ▶ BS 8544 (on LCC of maintenance) includes mapping of LCC guidance and cost data structure to COBIE requirements.
- ▶ Case studies are ongoing with MOJ, various universities and local government on how to undertake LCC on existing buildings and exchange data via COBIE.
- ▶ There are BIG gains to be made in application of BIM to existing buildings.....

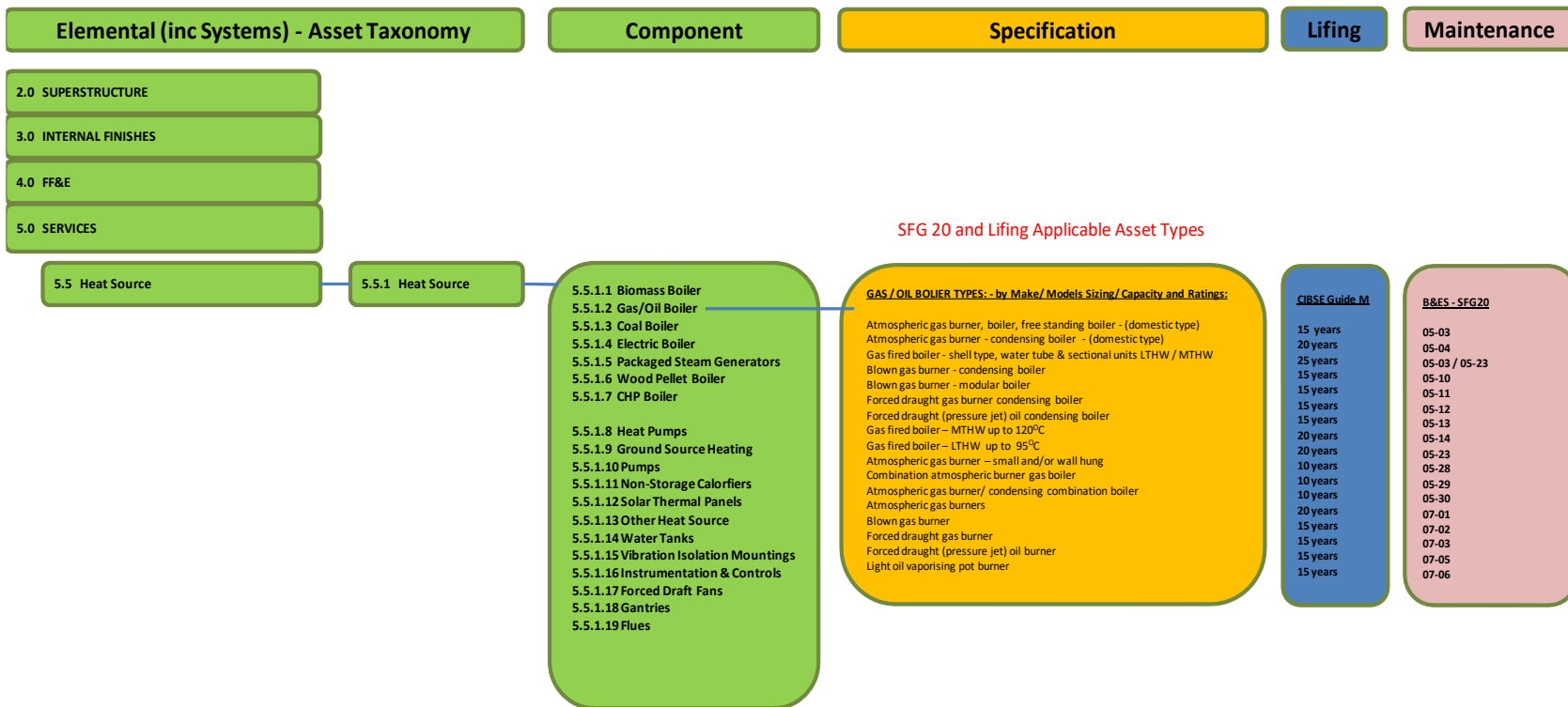
# Section 8 aligns COBIE with NRM 3



## NRM aligned to SFG20 / Lifting data structure

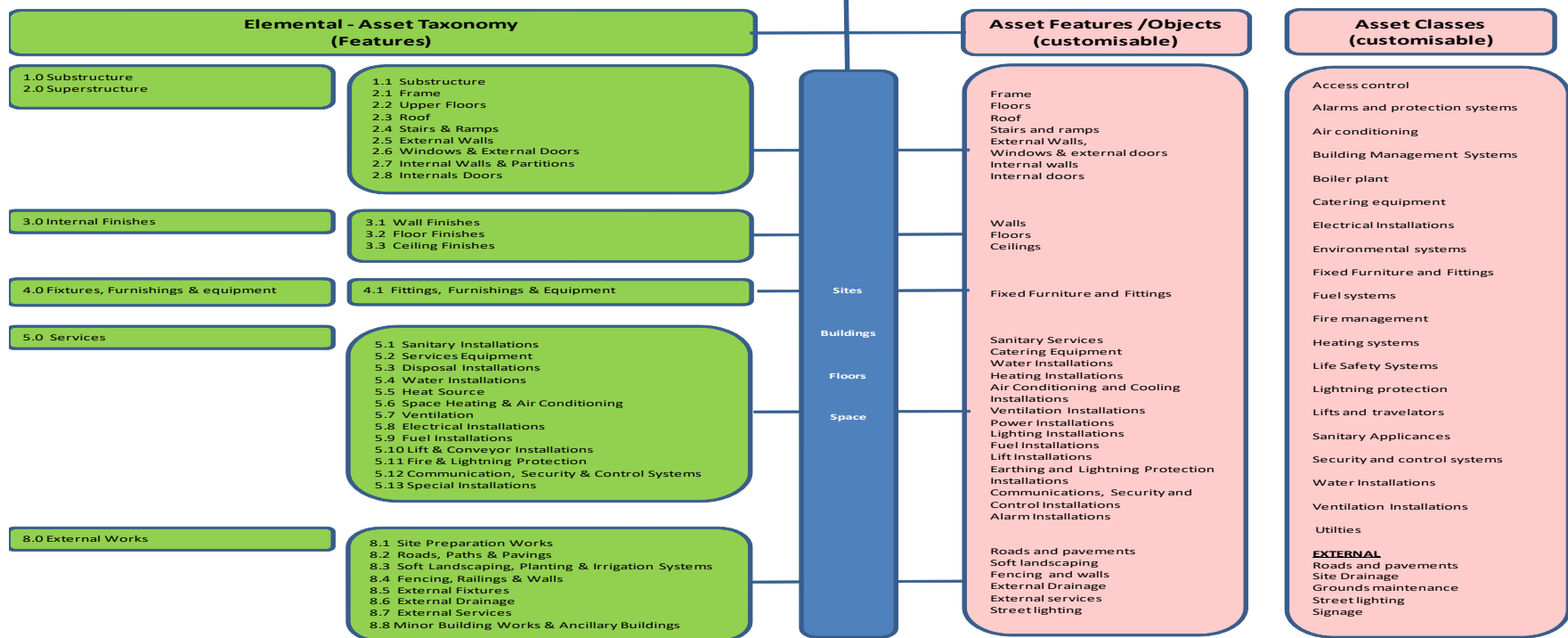


# Asset Element Systems, Components - linked to SFG20 and CIBSE Guide M



# Asset Element Systems, Components

# Features /Objects/Classes



- **Part 1 – Basic Awareness**

- What is WLC/LCC?
- Why LCC is important
- Definitions, process, scoping and Standards
- LCC Process
- What does an LCC involve?

- **Part 2 – Practical Application**

- RICS Black Book guidance
- Sustainability and BREEAM
- Links to BIM

# Summary of LCC in Practice

- LCC Guidance has moved on over the last few years
- LCC is becoming more mainstream – not just confined to very specific procurement routes such as PFI & PPP
- LCC is already achievable in the context of BIM Level 2 and possibly also level 3 as it extends to handover and existing buildings e.g. RICS Black Book and BS8544
- There is increasing interest in LCC as one indicator of sustainability e.g. BREEAM Man02 LCC & HQM LCC credits
- Practitioners will increasingly be expected to understand the basics & not just pass onto a LCC specialist for all LCC Analyses.

*Our values are the essence of our company's identity.  
They represent how we act, speak and behave together,  
and how we engage with our clients and stakeholders.*

~~SAFETY~~

*We put safety at the heart of everything we do, to safeguard people, assets and the environment.*

~~INTEGRITY~~

*We do the right thing, no matter what, and are accountable for our actions.*

~~COLLABORATION~~

*We work together and embrace each other's unique contribution to deliver amazing results for all.*

~~INNOVATION~~

*We redefine engineering by thinking boldly, proudly and differently.*

**Thank you!**

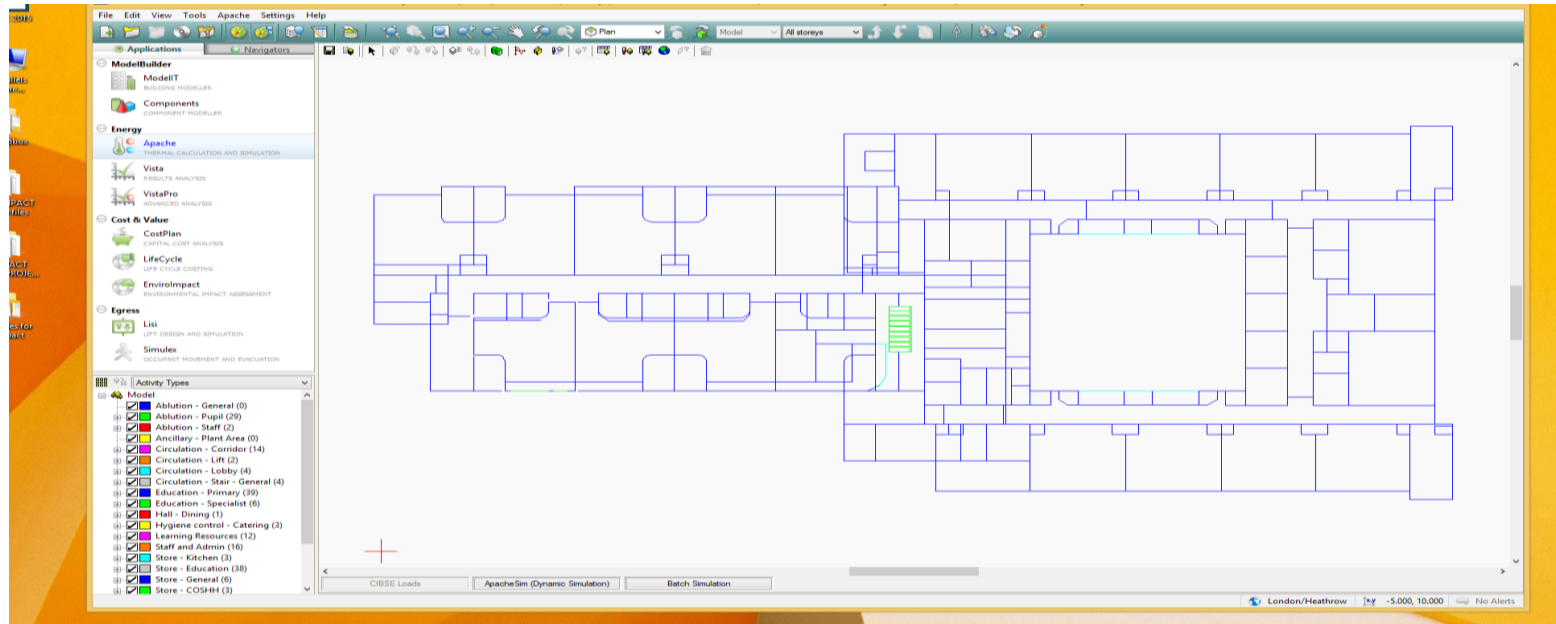
**Any  
Questions?**



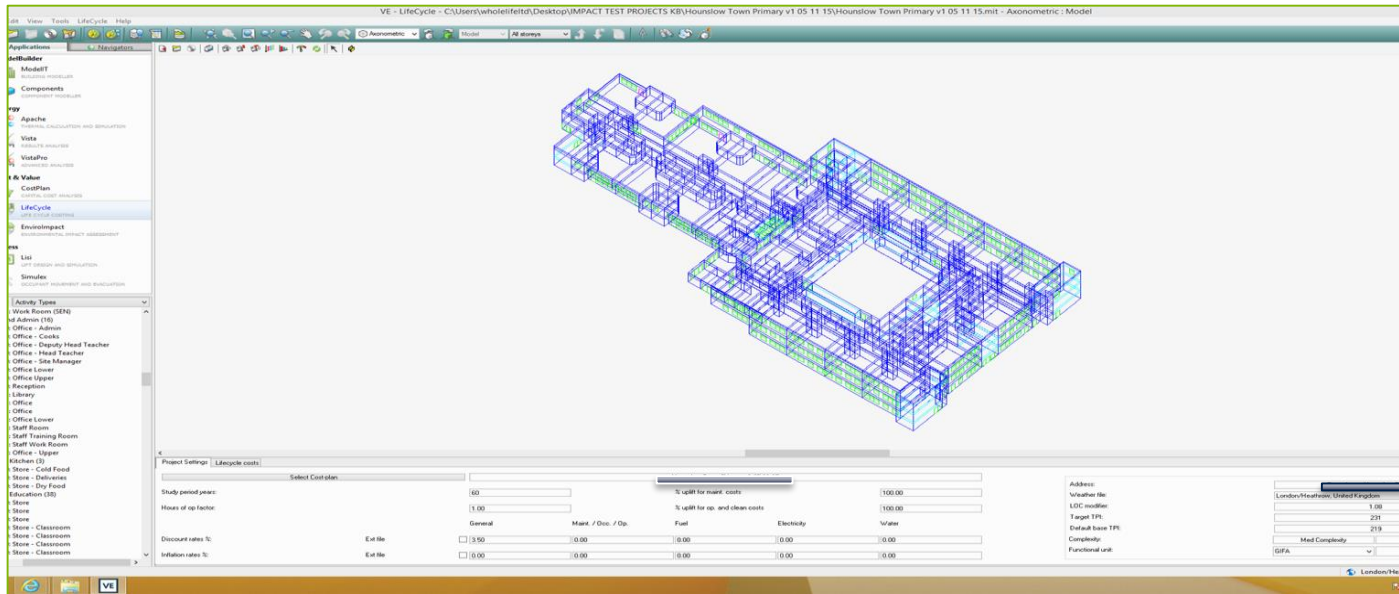
# Worked Example – Using IES IMPACT modelling for LCC

- The following slides show a school project and show how use of a proprietary tool (in this case IES IMPACT) can allow library data to be used and re-used.
- They also illustrate the use of the tool to meet level 2 BIM requirements.

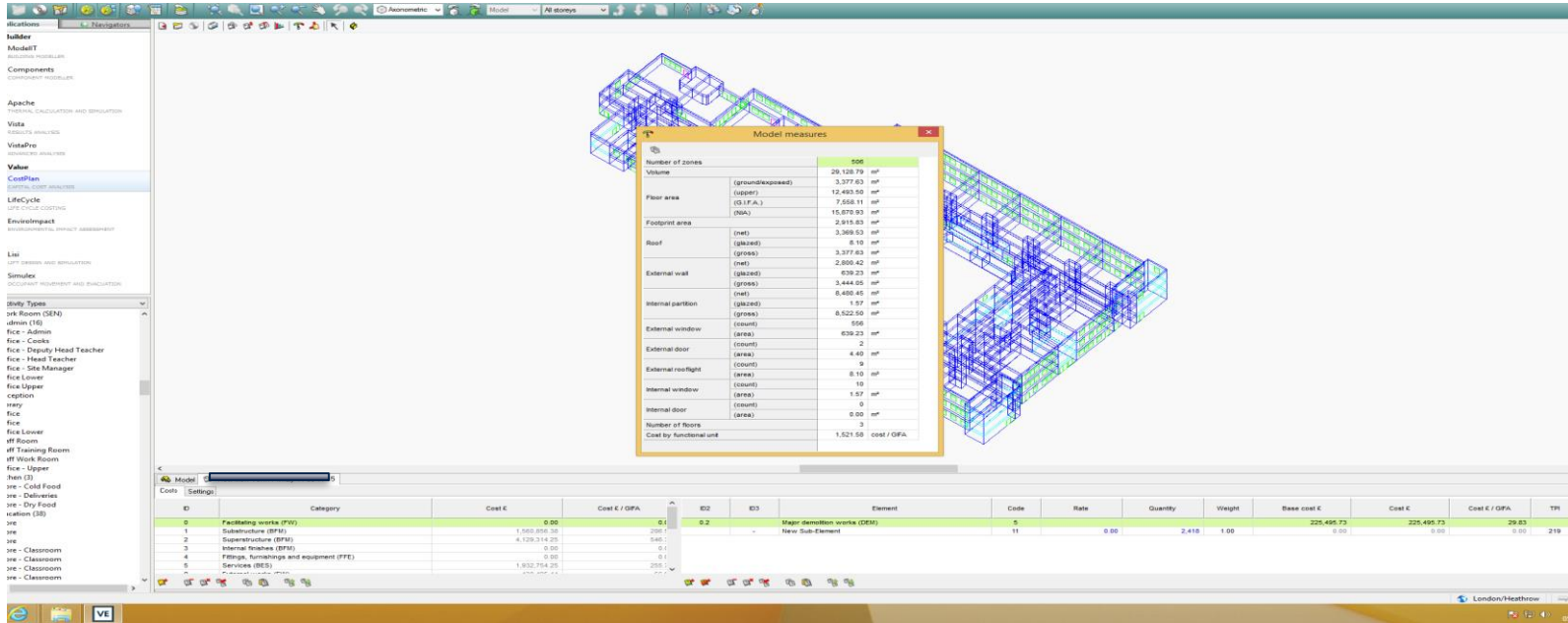
# Geometry imported from DWG or IFC



# Project LCC settings – TPI, location, discount rate, period of analysis



# Model high level measures



# Use of element codes to get specific model measures

The screenshot displays a software interface with a list of element codes on the left and a table of measures on the right. The element codes are organized into a tree structure under the 'Elements' tab. The table shows various measures for each element code, including 'Cost', 'Rate', 'Quantity', 'Weight', 'Base cost', 'Cost E', 'Cost E / GFA', and 'Tm'. The table is filtered to show only 'Cost E' measures.

**Element Codes List:**

- 0 Zero Cost
- 1 By Item Quantity (based on 1)
- 2 Unit element
- 3 Number of items
- 4 Vehicle building (cost)
- 5 N/A
- 6 Auto sub-element
- 7 Fish
- 8 Forged Area
- 9 Forged Area
- 10 Forged Area
- 11 Upper Floor Area
- 12 Upper Floor Area
- 13 Upper Floor Area
- 14 Pool Area
- 15 Suspended ceiling Area
- 16 Floor coverage Area
- 17 Internal wall Area
- 18 External wall Area
- 19 External wall Area
- 20 Total Number of Windows
- 21 Total Area of Windows
- 22 Number of External Windows
- 23 Area of External Windows
- 24 Total Number of Windows
- 25 Total Area of Windows
- 26 Number of Internal Windows
- 27 Area of Internal Windows
- 28 Total Number of Doors
- 29 Total Area of Doors
- 30 Number of External Doors
- 31 Area of External Doors

**Table of Measures:**

| Code                                        | Rate     | Quantity | Weight | Base cost  | Cost E       | Cost E / GFA | Tm  |
|---------------------------------------------|----------|----------|--------|------------|--------------|--------------|-----|
| 6                                           | 157.60   | 3,370    | 1.00   | 530,775.00 | 604,947.25   | 60.00        | 219 |
| 2                                           | 200.00   | 0        | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 11                                          | 15.00    | 7,550    | 1.00   | 113,375.01 | 129,148.63   | 17.09        | 219 |
| 42                                          | 1,200.00 | 4        | 1.00   | 4,800.00   | 5,480.00     | 0.72         | 219 |
| 126                                         |          |          |        |            |              |              |     |
| 6                                           | 255.00   | 14       | 1.00   | 3,570.00   | 4,086.87     | 0.54         | 219 |
| 6                                           | 121.00   | 2,660    | 1.00   | 314,600.00 | 360,381.47   | 47.43        | 219 |
| 6                                           | 0.00     | 180      | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 126                                         |          |          |        |            |              |              |     |
| 32                                          | 625.00   | 638      | 1.00   | 399,375.00 | 454,919.28   | 60.19        | 219 |
| 43                                          | 1,100.00 | 2        | 1.00   | 2,200.00   | 2,506.19     | 0.33         | 219 |
| 43                                          | 180.00   | 2        | 1.00   | 360.00     | 410.19       | 0.05         | 219 |
| 127                                         |          |          |        |            |              |              |     |
| 6                                           | 0.00     | 2        | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 125                                         | 57.50    | 8,400    | 1.00   | 487,000.00 | 555,463.25   | 72.45        | 219 |
| 45                                          | 750.00   | 0        | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 45                                          | 120.00   | 0        | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 2.5.1                                       |          |          |        |            |              |              |     |
| Internal doors - nonemergency               |          |          |        |            | 4,129,314.25 | 545.34       |     |
| 3                                           |          |          |        |            |              |              |     |
| Internal finishes (IFM)                     |          |          |        |            |              |              |     |
| 3.1                                         | 0.00     | 0        | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 3.2                                         | 0.00     | 0        | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 3.3                                         | 0.00     | 0        | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 4                                           |          |          |        |            |              |              |     |
| Fittings, furnishings and equipment (FFE)   |          |          |        |            |              |              |     |
| 4.1                                         | 0.00     | 0        | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| General fittings, furnishings and equipment |          |          |        |            | 0.00         | 0.00         |     |
| 6                                           |          |          |        |            |              |              |     |
| Services (BS)                               |          |          |        |            |              |              |     |
| 6.1                                         | 0.00     | 7,550    | 1.00   | 49,127.00  | 55,964.41    | 7.40         | 219 |
| 6.2                                         | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.3                                         | 0.00     | 7,550    | 1.00   | 113,375.01 | 129,148.63   | 17.09        | 219 |
| 6.4                                         | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.5                                         | 0.00     | 7,550    | 1.00   | 64,343.00  | 73,164.22    | 9.50         | 219 |
| 6.6                                         | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.7                                         | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.8                                         | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.9                                         | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.10                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.11                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.12                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.13                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.14                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.15                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.16                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.17                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.18                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.19                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.20                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.21                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.22                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.23                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.24                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.25                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.26                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.27                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.28                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.29                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.30                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.31                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.32                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.33                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.34                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.35                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.36                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.37                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.38                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.39                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.40                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.41                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.42                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.43                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.44                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.45                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.46                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.47                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.48                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.49                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.50                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.51                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.52                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.53                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.54                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.55                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.56                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.57                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.58                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.59                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.60                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.61                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.62                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.63                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.64                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.65                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.66                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.67                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.68                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.69                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.70                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.71                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.72                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.73                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.74                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.75                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.76                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.77                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.78                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.79                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.80                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.81                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.82                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.83                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.84                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.85                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.86                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.87                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.88                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.89                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.90                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.91                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.92                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.93                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.94                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.95                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.96                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.97                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.98                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.99                                        | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |
| 6.100                                       | 0.00     | 7,550    | 1.00   | 0.00       | 0.00         | 0.00         | 219 |

# Capital cost plan

| ID     | Description                                                                            | Code | Rate     | Quantity | Weight | Base cost    | Cost E       | Cost E / GFA | TPI |
|--------|----------------------------------------------------------------------------------------|------|----------|----------|--------|--------------|--------------|--------------|-----|
| 0      | Facilitating works (FWS)                                                               |      |          |          |        |              |              |              |     |
| 0.2    | Major demolition works (DEM)                                                           | 5    | 0.00     | 0        | 1.00   | 0.00         | 0.00         | 0.00         | 219 |
|        |                                                                                        |      |          |          |        |              | 0.00         | 0.00         |     |
| 1      | Substructure (SFM)                                                                     |      |          |          |        |              |              |              |     |
| 1.1.2  | Special foundations system                                                             | 11   | 150.00   | 7.556    | 1.00   | 1,133,700.00 | 1,291,466.38 | 179.87       | 219 |
| 1.1.3  | Lowest floor construction                                                              | 12   | 70.00    | 3,379    | 1.00   | 236,460.00   | 269,370.93   | 36.64        | 219 |
|        |                                                                                        |      |          |          |        |              | 1,560,836.38 | 206.51       |     |
| 2      | Superstructure (SFM)                                                                   |      |          |          |        |              |              |              |     |
| 2.1.1  | Steel frames                                                                           | 11   | 161.70   | 7.556    | 1.00   | 796,846.36   | 875,827.69   | 119.85       | 219 |
| 2.2.1  | Upper floors (UF)                                                                      | 121  |          |          |        |              |              |              |     |
|        | Scored beam and medium dense solid block flooring(Commercial) (DOOP448)                | 6    | 80.00    | 12,494   | 1.00   | 899,520.00   | 1,138,631.55 | 155.85       | 219 |
| 2.3.1  | Roof structure                                                                         | 122  |          |          |        |              |              |              |     |
|        | Beam and dense block deck, EPDM single ply roofing membrane; insulation; pavin...      | 6    | 157.50   | 3,379    | 1.00   | 530,775.00   | 604,647.25   | 80.00        | 219 |
| 2.3.5  | Roof lights                                                                            | 61   | 250.00   | 0        | 1.00   | 2,650.00     | 2,279.36     | 0.30         | 219 |
| 2.3.6  | Internal systems                                                                       | 2    | 0.00     | 0        | 1.00   | 0.00         | 0.00         | 0.00         | 219 |
| 2.4    | Stairs and ramps (STR)                                                                 | 2    | 0.00     | 0        | 1.00   | 0.00         | 0.00         | 0.00         | 219 |
| 2.5    | External walls (EWAL)                                                                  | 124  |          |          |        |              |              |              |     |
|        | Canadian rubber underlayment; breather membrane; plywood (temperate EU 6...            | 6    | 255.00   | 14       | 1.00   | 3,570.00     | 4,366.87     | 0.54         | 219 |
|        | Brickwork outer leaf; insulation; aercrete blockwork inner leaf; cement mortar; pla... | 6    | 121.00   | 2,660    | 1.00   | 314,860.00   | 358,355.47   | 47.42        | 219 |
| 2.6.1  | Type 1 - Brick/block cavity wall (V24)                                                 | 6    | 0.00     | 186      | 1.00   | 0.00         | 0.00         | 0.00         | 219 |
|        | External windows                                                                       | 126  |          |          |        |              |              |              |     |
|        | Aluminium curtain walling system (DOOL32)                                              | 6    | 625.00   | 639      | 1.00   | 399,375.00   | 454,959.28   | 60.19        | 219 |
| 2.6.2  | External doors                                                                         | 43   | 1,100.00 | 2        | 1.00   | 2,200.00     | 2,506.19     | 0.33         | 219 |
| 2.6.2  | External doors - non-masonry                                                           | 43   | 180.00   | 2        | 1.00   | 360.00       | 415.10       | 0.05         | 219 |
| 2.6.1  | Internal windows                                                                       | 127  |          |          |        |              |              |              |     |
|        | IGM system internal window (IGCM, (T07)                                                | 6    | 0.00     | 2        | 1.00   | 0.00         | 0.00         | 0.00         | 219 |
| 2.7    | Internal walls and partitions (IWAL)                                                   | 128  |          |          |        |              |              |              |     |
|        | Galvanised steel stud; plasterboard; paint (DOOP625)                                   | 6    | 57.50    | 8,450    | 1.00   | 487,600.00   | 555,483.25   | 73.49        | 219 |
| 2.8.1  | Internal doors - buffed-panel                                                          | 45   | 750.00   | 0        | 1.00   | 0.00         | 0.00         | 0.00         | 219 |
| 2.8.1  | Internal doors - non-masonry                                                           | 45   | 120.00   | 0        | 1.00   | 0.00         | 0.00         | 0.00         | 219 |
|        |                                                                                        |      |          |          |        |              | 3,996,975.75 | 528.83       |     |
| 3      | Internal finishes (SFM)                                                                |      |          |          |        |              |              |              |     |
| 3.1    | Wall finishes (WF) plasterboard and paint included with superstructure walls           | 2    | 0.00     | 0        | 1.00   | 0.00         | 0.00         | 0.00         | 219 |
| 3.2    | Floor finishes                                                                         | 5    | 0.00     | 0        | 1.00   | 0.00         | 0.00         | 0.00         | 219 |
| 3.3    | Suspended ceilings                                                                     | 15   | 0.00     | 0        | 1.00   | 0.00         | 0.00         | 0.00         | 219 |
|        |                                                                                        |      |          |          |        |              | 0.00         | 0.00         |     |
| 4      | Fittings, furnishings and equipment (FFE)                                              |      |          |          |        |              |              |              |     |
| 4.1.1  | General fittings, furnishings and equipment                                            | 2    | 0.00     | 0        | 1.00   | 0.00         | 0.00         | 0.00         | 219 |
|        |                                                                                        |      |          |          |        |              | 0.00         | 0.00         |     |
| 5      | Services (SFC)                                                                         |      |          |          |        |              |              |              |     |
| 5.1.1  | Sanitary appliances                                                                    | 11   | 6.50     | 7,556    | 1.00   | 49,127.00    | 55,364.41    | 7.40         | 219 |
| 5.2.1  | Services equipment                                                                     | 11   | 0.00     | 7,556    | 1.00   | 0.00         | 0.00         | 0.00         | 219 |
|        |                                                                                        |      |          |          |        |              |              |              |     |
| Cost E |                                                                                        |      |          |          |        |              | 221,795.27   | 29.34        | 219 |

# LCC cost plan

LCC full data view:

| Category      | Total €       | Total € / OFA | Total excl. consp. cost € | ID2    | ID3 | Element       | CM | Code | Rate      | Quantity  | Vol  | Service cost | Maint. Activities | Major repair rate % | Major repair cycle 1/y | Major repair cost € | Major repair rate % | Major repair cycle 1/y | Major repair cost € | Major repair rate % | Major repair cycle 1/y | Major repair cost € | Major repair rate % | Major repair cycle 1/y | Reserve repair cost € | Reserve repair cycle 1/y |
|---------------|---------------|---------------|---------------------------|--------|-----|---------------|----|------|-----------|-----------|------|--------------|-------------------|---------------------|------------------------|---------------------|---------------------|------------------------|---------------------|---------------------|------------------------|---------------------|---------------------|------------------------|-----------------------|--------------------------|
| Facilitating  | 0.00          | 0.00          | 0.00                      | 5.1.1  |     | Sanitary ap.  | A  | 11   | 6.50      | 7.558     | 1.00 | 55,564.41    | Partial repl.     | 15.00               | 10                     | 0                   | 0                   | 15,729.32              | 0.00                | 0                   | 0.00                   | 5.20                | 0                   | 0.00                   | 5.20                  | 0                        |
| Substructure  | 1,660,856.38  | 236.51        | 0.00                      | 5.2.1  |     | Services s.   | A  | 11   | 0.00      | 7.558     | 1.00 | 0.00         | 0.00              | 0.00                | 0                      | 0                   | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                  | 0                        |
| Superstruc.   | 8,253,369.00  | 1,091.99      | 4,256,393.25              | 5.3.1  |     | Foul drain.   | A  | 11   | 15.00     | 7.558     | 1.00 | 129,148.00   | Partial Repl.     | 15.00               | 15                     | 0                   | 0                   | 38,744.58              | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
| Internal fit. | 0.00          | 0.00          | 0.00                      | 5.3.3  |     | Refuse dis.   | A  | 11   | 0.00      | 7.558     | 1.00 | 0.00         | 0.00              | 0.00                | 0                      | 0                   | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                  | 0                        |
| Fittings fur. | 0.00          | 0.00          | 0.00                      | 5.4.2  |     | Cold water.   | A  | 11   | 8.50      | 7.558     | 1.00 | 73,184.22    | Partial Repl.     | 15.00               | 10                     | 0                   | 0                   | 32,802.90              | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
| Services L    | 6,690,021.50  | 885.16        | 4,757,287.25              | 5.4.3  |     | Hot water.    | A  | 152  |           |           |      |              |                   |                     |                        |                     |                     |                        |                     |                     |                        |                     |                     |                        |                       |                          |
| External w.   | 432,495.44    | 56.96         | 0.00                      | 5.5    |     | Main syste.   | A  | 6    | 0.00      | 15,871    | 1.00 | 0.00         | 0.00              | 0.00                | 0                      | 0                   | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                  | 0                        |
| Contractor    | 1,654,216.13  | 229.60        | 0.00                      | 5.6    |     | Heat sourc.   | A  | 1    | 85,000.00 | 1         | 1.00 | 96,036.16    | replace bur.      | 15.00               | 10                     | 0                   | 0                   | 36,732.06              | 0.00                | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                  | 0                        |
| Contractor    | 396,054.03    | 52.48         | 0.00                      | 5.6.1  |     | Space heat.   | A  | 151  |           |           |      |              |                   |                     |                        |                     |                     |                        |                     |                     |                        |                     |                     |                        |                       |                          |
| Project con.  | 665,520.69    | 87.76         | 0.00                      | 5.6.3  |     | Main syste.   | A  | 6    | 0.00      | 15,871    | 1.00 | 0.00         | 0.00              | 0.00                | 0                      | 0                   | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                  | 0                        |
| Other client  | 226,740.00    | 30.00         | 226,740.00                | 5.6.3  |     | Central coo.  | A  | 153  |           |           |      |              |                   |                     |                        |                     |                     |                        |                     |                     |                        |                     |                     |                        |                       |                          |
| Risk          | 237,632.42    | 31.44         | 0.00                      | 5.7    |     | Main syste.   | A  | 6    | 0.00      | 15,871    | 1.00 | 0.00         | 0.00              | 0.00                | 0                      | 0                   | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                  | 0                        |
| Inflation     | 221,792.27    | 29.34         | 0.00                      | 5.8.1  |     | Ventilation   | A  | 154  |           |           |      |              |                   |                     |                        |                     |                     |                        |                     |                     |                        |                     |                     |                        |                       |                          |
| Routine mt.   | 6,651,767.62  | 882.39        | 4,651,767.62              | 5.8.1  |     | Main syste.   | A  | 6    | 0.00      | 15,871    | 1.00 | 0.00         | 0.00              | 0.00                | 0                      | 0                   | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                  | 0                        |
| Operation     | 6,713,065.50  | 888.19        | 6,713,065.50              | 5.8.2  |     | Electrical m. | A  | 11   | 32.50     | 7.558     | 1.00 | 279,022.00   | Partial repl.     | 5.00                | 15                     | 0                   | 0                   | 77,862.20              | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
| Occupancy     | 2,768,922.75  | 368.09        | 2,768,922.75              | 5.8.3  |     | Power inst.   | A  | 11   | 26.00     | 7.558     | 1.00 | 205,287.25   | Partial repl.     | 15.00               | 10                     | 0                   | 0                   | 114,875.34             | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
| End of life   | 0.00          | 0.00          | 0.00                      | 5.8.3  |     | Lighting ins. | A  | 11   | 25.00     | 7.558     | 1.00 | 215,247.75   | Partial Repl.     | 15.00               | 10                     | 0                   | 0                   | 126,148.63             | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
| Present w.    | 35,165,440... | 4,644.74      | 23,794,138...             | 5.8.6  |     | Earthng an.   | A  | 11   | 0.75      | 7.558     | 1.00 | 6,437.43     | repair alt.       | 5.00                | 15                     | 0                   | 0                   | 645.74                 | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
|               |               |               |                           | 5.9    |     | Fuel instat.  | A  | 11   | 8.00      | 7.558     | 1.00 | 65,079.27    | repair alt.       | 5.00                | 0                      | 0                   | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                  | 0                        |
|               |               |               |                           | 5.10   |     | Lift and co.  | A  | 2    | 20,000.00 | 0         | 1.00 | 0.00         | Partial Repl.     | 5.00                | 7                      | 0                   | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
|               |               |               |                           | 5.11   |     | Firefighting  | A  | 11   | 14.00     | 7.558     | 1.00 | 120,530.73   | repair alt.       | 5.00                | 7                      | 0                   | 0                   | 17,144.78              | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
|               |               |               |                           | 5.11.3 |     | Lightning p.  | A  | 11   | 1.35      | 7.558     | 1.00 | 11,023.36    | repair alt.       | 5.00                | 15                     | 0                   | 0                   | 1,462.34               | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
|               |               |               |                           | 5.12.1 |     | Telephone     | A  | 11   | 1.50      | 7.558     | 1.00 | 12,814.50    | repair alt.       | 5.00                | 10                     | 0                   | 0                   | 1,837.23               | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
|               |               |               |                           | 5.12.2 |     | Security sy.  | A  | 11   | 3.00      | 7.558     | 1.00 | 25,029.73    | repair alt.       | 5.00                | 10                     | 0                   | 0                   | 3,185.95               | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
|               |               |               |                           | 5.12.4 |     | CCTV          | A  | 11   | 5.00      | 7.558     | 1.00 | 43,049.50    | repair alt.       | 5.00                | 0                      | 0                   | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
|               |               |               |                           | 5.13.6 |     | Smoke Det.    | A  | 11   | 10.00     | 7.558     | 1.00 | 80,099.10    | repair alt.       | 0.00                | 0                      | 0                   | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
|               |               |               |                           | 5.13.7 |     | Rh system     | A  | 11   | 13.00     | 7.558     | 1.00 | 116,233.70   | repair alt.       | 5.00                | 10                     | 0                   | 0                   | 23,246.76              | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
|               |               |               |                           | 5.13.8 |     | Sprinklers    | A  | 11   | 30.00     | 7.558     | 1.00 | 226,287.25   | repair alt.       | 15.00               | 20                     | 0                   | 0                   | 77,489.17              | 0.00                | 0                   | 0.00                   | 5.00                | 0                   | 0.00                   | 5.00                  | 0                        |
|               |               |               |                           | 5.14   |     | Builder's w.  | A  | 115  | 4.00 %    | 1,855,418 | 1.00 | 74,336.73    | General AB        | 15.00               | 10                     | 0                   | 0                   | 44,892.04              | 0.00                | 0                   | 0.00                   | 0.00                | 0                   | 0.00                   | 0.00                  | 0                        |

| Present values by year |              |              |              |              |           |              |           |                |                |                |                |                |                |                |                |                |
|------------------------|--------------|--------------|--------------|--------------|-----------|--------------|-----------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
|                        | Residue Name | Residue mass | Residue mass | Residue mass | Decompose | Residue mass | Decompose | Operation rate | Operation rate | Operation rate | Operation rate | Operation rate | Operation rate | Operation rate | Operation rate | Operation rate |
| 1                      | 11.311.302.. | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 0.00           | 0.00           | 0.00           | 0.00           | 0.00           | 0.00           | 0.00           | 0.00           | 0.00           |
| 1                      | 64.196.12    | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 2                      | 64.196.12    | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 3                      | 64.196.12    | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 4                      | 64.196.12    | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 5                      | 64.196.12    | 41.01        | 6.644.69     | 106.795.16   | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 6                      | 64.196.12    | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 7                      | 64.196.12    | 5.643.10     | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 8                      | 64.196.12    | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 9                      | 64.196.12    | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 10                     | 64.196.12    | 116.479.88   | 6.644.69     | 103.137.75   | 0.00      | 126.148.66   | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 11                     | 64.196.12    | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 12                     | 64.196.12    | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 13                     | 64.196.12    | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 14                     | 64.196.12    | 5.643.10     | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 15                     | 64.196.12    | 34.837.62    | 127.753.64   | 102.692.01   | 0.00      | 142.514.63   | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 16                     | 64.196.12    | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 17                     | 64.196.12    | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 18                     | 64.196.12    | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 19                     | 64.196.12    | 0.00         | 0.00         | 0.00         | 0.00      | 0.00         | 0.00      | 32.095.62      | 2.671.36       | 0.00           | 0.00           | 64.649.60      | 50.260.70      | 0.00           | 0.00           | 0.00           |
| 20                     | 64.196.12    | 206.249.55   | 6.644.69     | 90.207.64    | 0.00      | 417.550.63   | 0.00      | 32.095.62      | 2.671.36       |                |                |                |                |                |                |                |

# Example of LCC plan graphics

