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# Level(s) indicator 2.4: Design for deconstruction

*User manual: introductory briefing, instructions and guidance*

*(Publication version 2.0)*

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**Title**

Level(s) indicator 2.4: Design for deconstruction user manual: introductory briefing, instructions and guidance (Publication version 2.0)

**Abstract**

Developed as a common EU framework of core indicators for assessing the sustainability of office and residential buildings, Level(s) can be applied from the very earliest stages of conceptual design through to the projected end of life of the building.  As well as environmental performance, which is the main focus, it also enables other important related performance aspects to be assessed using indicators and tools for health and comfort, life cycle cost and potential future risks to performance.

Level(s) aims to provide a common language of sustainability for buildings. This common language should enable actions to be taken at building level that can make a clear contribution to broader European environmental policy objectives. It is structured as follows:

1. Macro-objectives: An overarching set of 6 macro-objectives for the Level(s) framework that contribute to EU and Member State policy objectives in areas such as energy, material use, waste management, water and indoor air quality.
2. Core Indicators: A set of 16 common indicators, together with a simplified Life Cycle Assessment (LCA) methodology, that can be used to measure the performance of buildings and their contribution to each macro-objective.

In addition, the Level(s) framework aims to promote life cycle thinking. It guides users from an initial focus on individual aspects of building performance towards a more holistic perspective, with the aim of wider European use of Life Cycle Assessment (LCA) and Life Cycle Cost Assessment (LCCA) methods.

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*Figure 1. The Level(s) document structure*

## How this indicator user manual works

Level(s) is a framework of core indicators of sustainability that can be applied to building projects in order to report on and improve their performance. The supporting documentation has been designed to be accessible to all the actors that may be involved in this process.

If you are new to the assessment of building sustainability, we recommend reading the **first part of the Level(s) user manual**. This will provide you with an introduction to the basic concepts behind Level(s) and how you can apply it to a building project.

If you haven't yet set up your building project to use Level(s), including completing the project plan and the building description, then we recommend reading the **second part of the Level(s) user manual**.

**This indicator user manual forms part of the third part of the Level(s) user manual** where you will find instructions on how to use the indicators themselves. It is designed to help you apply your chosen indicator to a building project. It will help you to do this in the following way:

- **Introductory briefing:** This section provides an overview of the indicator, including:
  - ✓ why you may wish to measure performance with it,
  - ✓ what it measures,
  - ✓ at which stages in a project it can be used,
  - ✓ the unit of measurement, and
  - ✓ the relevant calculation method and reference standards.
- **Instructions on how to use the indicators at each level**: This section provides:
  - ✓ step by step instructions for each level,
  - ✓ what is needed to make an assessment,
  - ✓ a design concept checklist (at Level 1), and
  - ✓ the reporting formats.

  The instructions often refer to the guidance and further information section, which can be found after the instructions.
- **Guidance and further information for using the indicator**: This section provides more background information and guidance to support you in following specific steps in the instructions, including the design concepts introduced at Level 1 and the practical steps to calculate or measure performance at Levels 2 and 3. They are all cross-referenced to specific instruction steps at either level 1, 2 or 3.

This indicator user manual is structured so that once you are familiar with using the indicator and you know how to work with it, you may no longer need to refer to the guidance and background information, but only work directly with the instructions at the level of your choice.

## Technical terms and definitions used

| Term | Definition |
|---|---|
| Accessibility | The ability to allow for easy access to building components for disassembly, refurbishment, replacement, or upgrade. |
| Assembly | An arrangement of more than one material or component to serve specific overall purposes |
| Building fabric | All construction works that are fixed to the building in a permanent manner, so that the dismantling or replacement of the product constitute construction operations |
| Building component | Construction product manufactured as a distinct unit to serve a specific function or functions. |
| Deconstruction | A process of selectively and systematically dismantling buildings to reduce the amount of waste created and generate a supply of high value secondary materials that are suitable for reuse and recycling. |
| Disassembly | The taking apart of a constituent element of a building or assembly at the end of its useful life in such a way that allows components and parts to be re-used, recycled or recovered. |
| In-use condition | Any circumstance that can impact the performance of a building or assembled system under normal use. |
| Life cycle inventory analysis | Phase of a life cycle assessment involving the compilation and quantification of inputs and outputs for product throughout its life cycle. |
| Material separation | Operation to separate materials, including mechanical, chemical or thermal processes (e.g. shredding, smelting, sorting etc.) other than dismantling or disassembly. |
| Recovery | Any operation by which waste serving a useful purpose by replacing other materials, which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in a plant or in the wider economy. |
| Recycling | Any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. |
| Reuse | Operation by which a product, or a part thereof, having reached the end of one use stage is used again for the same purpose for which it was conceived. |
| Recyclability | Ability of waste product to be recycled, based on actual practices. |
| Scenario | Collection of assumptions and information concerning an expected sequence of possible future events |
| Selective demolition | Removal of materials from a demolition site in a pre-defined sequence in order to maximize recovery and recycling performance. |

## Introductory briefing

**Why measure performance with this indicator?**

Building elements such as structures, envelopes and facades account for the majority of the embodied environmental impacts of constructing a building. Multiple renovation cycles for the internal fit out of a building are moreover likely to take place along the intended service life.

As a result, any progress to achieve 'circularity' by designing for the recovery of these building parts and materials for reuse (either in situ within a new building or on another site), or by recycling them to make new building products, will contribute to a progressive reduction in the embodied life cycle impacts and natural resource consumption of the building sector as a whole.

A major barrier to design for deconstruction is the disconnect between decisions made at the design stage of a building and those that may be made several decades later when the building reaches the end of its life. Studies of demolition and deconstruction practices have identified four main barriers to material reuse and recycling:

- **Building designs**: Current construction methods and materials do not support the recovery of materials. Examples include contamination with hazardous materials, entanglement of services in structural elements and the use of composite steel and concrete systems.

- **Demolition processes**: Current schedules and practices do not support the recovery of materials in a useable state. Examples include the use of shears to cut steel sections because of welded joints or the limit of time.

- **Logistics systems**: There is a lack of space to store reclaimed materials. One example is the storage of reclaimed steel sections before they may be required in new construction. Even if sections are recovered, the types of modifications required may be prohibitive.

- **Markets**: There is a lack of demand for reclaimed materials. This may be constrained by the limited supply and variability in sizes of elements or sections versus those which may be required. Changes in standard specifications over time have resulted in a greater variety of building elements. Uncertainty about material properties and use history may also play a role.

Whilst building assessments cannot address all of these aspects, they can have an important role to play in identifying aspects of building design that can influence future end of life recovery processes and decisions.

**What does it measure?**

The indicator provides a quantitative assessment of the extent to which the design of a building could facilitate the future reuse, recycling or recovery of building elements, components and constituent parts and materials. It therefore provides a proxy for:

- the contribution of the building to the circular economy, and

- the practical potential to access the material value reported under Module D of indicator 1.2 of the Level(s) framework.

The indicator considers the ease of disassembly for a minimum scope of building elements, as well as the ease of reuse and recycling for these elements and their associated parts and materials.

**At what stage of a project?**

| Level | Activities related to the use of indicator 2.4 |
|---|---|
| 1. Conceptual design (following design principles) | ✓ Key design aspects for the architect, structural engineer and contractor to take into consideration and to include in later specifications.<br>✓ Value appraisal of the design aspects by the building promoter and cost surveyors. |
| 2. Detailed design and construction (based on calculations, simulations and drawings) | ✓ Assessment of the structure, façade and building design and specification for deconstruction.<br>✓ Assessment of renovation building parts and fit out materials for their |

| Level | Activities related to the use of indicator 2.4 |
|---|---|
| | deconstruction potential on a shorter timescale. |
| 3. As-built and in-use (based on commissioning and inspection) | ✓ Awareness and information relating to circular design features and their potential future value. |

**The unit of measurement**

The common unit of measurement is a **dimensionless scoring of the circularity potential** of a building.

**System boundary**

The assessment boundary is the building and its complete bill of quantities and materials, if they are addressed in the design assessment by a Level(s) user.

**Scope**

The building's bill of quantities and materials, in so far as they are encompassed by the design assessment and the minimum scope of building elements that is identified in the instructions for level 2 and 3. The scope for building elements and materials is effectively the same as Level(s) indicator 2.1.

**Calculation method and reference standards**

A bespoke calculation method has been developed for Level(s) that is broadly related to the principles of the German Green Building Council's (DGNB) ease of recovery and recycling criterion TEC1.6. The method results in a score between 0 and 100 for the applicable building elements and components, with 100 being the best design that allows for full reuse of the elements and components. The score can be weighted by mass or by value of the applicable components and elements.

The instructions for each level and guidance additionally make reference to the principles and design aspects that are included in ISO 20887.

## Instructions on how to use the indicator at each level

### *Instructions for Level 1*

**L1.1. The purpose of this level**

This level is for those users who would like to:

- Understand how the design of a building could facilitate ease of future deconstruction in order to access and disassemble building elements and components and, if applicable, dismantle them into their constituent parts and materials.
- Consider the extent to which these building elements, components, parts and materials may be recovered for either reuse and/or for recycling.

**L1.2. Step-by-step instructions**

*These instructions should be read in conjunction with the accompanying Level 1 technical guidance and supporting information (see page 17).*

1. Make sure to have completed the Level(s) building description in User Manual 2, as some of the information may be needed to check the relevance of design concepts
2. Consult the checklist of deconstruction design concepts in section L1.4 of these instructions and read the associated technical guidance and supporting information that appears later in this document.
3. <u>*Optional step*</u>*:* Seek advice from a demolition contractor or waste management expert with relevant knowledge of the building type and the state of the art in deconstruction techniques and local, regional and/or national end-markets (as relevant to the bill of quantities and materials).
4. <u>*Optional step:*</u> Consider the availability of building components and parts with building material passports and seek advice from experts familiar with the Buildings As Material Banks (BAMB) concept.
5. Within the design team, review and identify how the deconstruction design concepts could be introduced into the design process.
6. Once the design concept is finalised with the client, record the deconstruction design concepts that were taken into account using the L1 reporting format at the end of these instructions (L1.5).

**L1.3. Who should be involved and when?**

Actors involved at the conceptual design stage, led by the concept architect. The deconstruction design concepts can be further explored once professionals such as the structural engineers as well as contractors, including fit-out specialists, have become more involved in the project.

**L1.4. Checklist of relevant design concepts**

The following deconstruction design concepts have been identified from surveys of professionals, research reported in the literature and building certification tools. They provide proxies for a building design that is easier to deconstruct and may provide improved long-term environmental performance.

| General deconstruction aspect | Specific design aspect to address | Description |
|---|---|---|
| 1. Ease of disassembly | 1.1 Elements and their parts are independent and easily separable | The potential to separate building elements that are connected to each other[1] and to disassemble elements into their constituent components and parts.<br>*The nature of the connections are addressed by design aspects 1.2 and 1.3.* |
| | 1.2 Connections are mechanical and reversible | The use of mechanical, non-destructive connections as opposed to chemical bonding. |

[1] For example, the façade and building services can be easily removed without damaging the structure of the building or generating significant material waste from inside the building.

| General deconstruction aspect | Specific design aspect to address | Description |
|---|---|---|
| | 1.3 Connections are easily accessible and sequentially reversible | Easy and sequential access in order to reverse mechanical connections and remove elements, components or parts. |
| | 1.4 The number and complexity of the disassembly steps are low. | The disassembly should not suppose the need for complex preparatory steps, the intensive use of manpower and machinery and/or off-site processes. |
| 2. Ease of reuse | 2.1 Specification of elements and parts using standardised dimensions. | Specification of elements and parts that are of a standardised specification in order to provide consistent future stock. |
| | 2.2 Specification of modular building services. | Specification of modular systems that may retain value upon de-installation or which may be more easily swapped out and upgraded. |
| | 2.3 Design supports future adaptation to changes in functional needs. | Design of the building parts to support ongoing use in the same or a different design configuration in the same building. |
| 3. Ease of recycling | 3.1 Parts made of homogenous materials with minimal unnecessary treatments or finishes | Specification of components and constituent parts made of homogenous materials, the same materials or materials mutually compatible with recycling processes. Finishes, coatings, adhesives or additives should not inhibit recycling. |
| | 3.2 Constituent materials can be easily separated | It should be possible to separate components and parts into their constituent materials. |
| | 3.3 There are established recycling options for constituent parts or materials | The part or material is readily recyclable into products with a similar field of application and function, thereby maximising their circular value. |

### L1.5. Reporting format

| Deconstruction design concept | Specific design aspect | Addressed? (yes/no) | How has it been incorporated into the building design concept? *(provide a brief description)* |
|---|---|---|---|
| 1. Ease of disassembly | 1.1 Elements and their parts are independent and easily separable | | |
| | 1.2 Connections are mechanical and reversible | | |
| | 1.3 Connections are easily accessible and sequentially reversible | | |
| | 1.4 The number and complexity of the disassembly steps are low. | | |
| 2. Ease of reuse | 2.1 Specification of elements and parts using standardised dimensions. | | |
| | 2.2 Specification of modular building services. | | |
| | 2.3 Design supports future adaptation to changes in functional needs. | | |

| **Deconstruction design concept** | **Specific design aspect** | **Addressed?** (yes/no) | **How has it been incorporated into the building design concept?** *(provide a brief description)* |
|---|---|---|---|
| 3. Ease of recycling | 3.1 Parts made of homogenous materials with minimal unnecessary treatments or finishes | | |
| | 3.2 Constituent materials can be easily separated | | |
| | 3.3 There are established recycling options for constituent parts or materials | | |

### *Instructions for Level 2*

**L2.1. The purpose of this level**

This level is for those users who wish to set quantitative design targets or who are at the stage of making design decisions and wish to compare design options for their deconstruction potential based on quantitative scoring of design for deconstruction.

**L2.2. Step-by-step instructions**

*These instructions should be read in conjunction with the accompanying Level 2 technical guidance and supporting information (see page 21).*

1. Bring together the architect as well as the structural engineers, service engineers and fit-out contractors in order to review the design concepts and aspects that will be assessed, starting with the minimum scope.
2. *Optional step:* Seek advice from a demolition contractor or waste management expert with relevant knowledge of the building type and the state of the art in deconstruction techniques and local, regional and/or national end-markets (as relevant to the bill of quantities and materials).
3. *Optional step:* Consider the availability of building components and parts for building material passports and seek advice from experts familiar with the Buildings As Material Banks (BAMB) concept.
4. *For renovation projects:* a reduced scope may be considered that only targets those building elements that are affected by the proposed works.
5. Develop the design options for appraisal, taking into account the different deconstruction design concepts and aspects and if these lead to outcomes involving the potential for reuse, pure stream recycling, mixed stream recycling, material recovery or energy recovery.
6. For residential developments with several housing typologies, a representative selection of the building designs and fit-outs may be made. For apartment blocks, the whole building shall also be assessed.
7. Identify and gather the relevant architectural and structural design drawings, service plans, fit-out plans and bill of quantities. If indicator 2.1 is also being reported on, this should be the source of information for the bill of quantities.
8. Fill out the Level(s) excel reporting template for indicator 2.4 with the relevant building elements, components, parts and materials, together with their respective weights (and optionally their values) and select the best practical outcome at the end of life of each element.
9. Calculate a circularity score that takes into account the best practical outcome (based on consideration of ease of disassembly and the potential for reuse, recycling and recovery) and the weighted masses (and optionally values) for each end-of-life outcome.
10. *Going a step further:* In order to explore the potential for trade-offs in the life cycle environmental performance of different deconstruction design concepts, a life cycle GWP assessment or full LCA assessment may be carried out.

**L2.3. What do you need to make an assessment?**

The main items needed are as follows:

- ✓ A building design with a bill of quantities, as well as structure and servicing plans. These should be sufficiently advanced to provide the detailed information on which to make a scoring for the deconstruction design aspects.
- ✓ *For renovation projects:* an agreed scope of building parts and fit-out that will allow for those deconstruction design aspects that can be influenced to be identified.
- ✓ The Level(s) excel calculator for indicator 2.4.

**L2.4. Who should be involved and when?**

Most actors at the detailed design stage would be involved, led by the architect and with the involvement of the structural engineers, service engineers, contractors and product manufacturers for relevant elements and components.

If a supporting life cycle Global Warming Potential (GWP) or Life Cycle Assessment (LCA) is to be carried out as part of "going a step further", this would involve the energy/sustainability consultants or those within the design team possessing these competencies.

**L2.5. Ensuring the comparability of results**

For results to be comparable, it is important that the scope is the same. Because users can reduce the scope according to the specificities of their project, the scope needs to be clearly visible in the reporting format. The calculation method uses a tailor-made excel spreadsheet that is described in more detail in the further guidance.

**L2.6. Going a step further**

Two options can be pursued in order to optimise designs for the deconstruction of a building:

1. **Life cycle performance**: Indicator 1.2 Life cycle GWP or a cradle to grave LCA may be used to assess the performance of different building design options or to optimise the life cycle performance of a design. To do this, designs shall be developed and tested and the rules laid down for end of life scenario modelling under L2.4: Step 4 of the indicator 1.2 instructions (which can be found in the user manual for that indicator) shall be followed.
2. **End of life scenarios**: Project-specific scenarios should be built up from primary data for deconstruction techniques and technology that is applied by the construction and demolition sector to the building type/design and, as specifically as possible, in the geographical location.

Note that for option 1, if the life cycle GWP or LCA results are to be publicly reported, it is recommended that input is sought from a demolition contractor and/or a waste management expert and that their opinion is appended to the reporting.

**L2.7. Format for reporting the results of an assessment**

The format below is the same as that generated in the excel template for indicator 2.4. It should be noted that reporting on value is optional.

| Overall circularity score (by mass) | Overall circularity score (by value) |
|---|---|
| | |

A more detailed breakdown of the scores for different building elements also forms part of the reporting format, in this case, any elements with no data or excluded from the scope by users, should clearly state this in the entry field.

| Building element-specific information and circularity scores | | | |
|---|---|---|---|
| **Element** | **Further details** | **By mass** | **By value** |
| Piles or shallow foundations | | | |
| Basements | | | |
| Retaining walls | | | |
| Frame (beams, columns and slabs) | | | |
| Upper floors | | | |
| External walls | | | |
| Balconies | | | |
| Ground floor slab | | | |
| Internal walls, partitions and doors | | | |
| Stairs and ramps | | | |
| External wall systems, cladding and shading devices | | | |
| Façade openings (including windows and external doors) | | | |

| Building element-specific information and circularity scores | | | |
|---|---|---|---|
| **Element** | **Further details** | **By mass** | **By value** |
| (Roof) Structure | | | |
| (Roof) Weatherproofing | | | |
| Parking facilities (above ground or below ground, so long as it is within the curtilage of the building) | | | |
| Sanitary fittings | | | |
| Built-in cupboards, wardrobes and worktops | | | |
| Ceilings | | | |
| Wall and ceiling finishes | | | |
| Floor coverings and finishes | | | |
| Light fittings | | | |
| Control systems and sensors | | | |
| Electricity generation and distribution | | | |
| Air handling units | | | |
| Ductwork and distribution | | | |
| Cold water distribution | | | |
| Hot water distribution | | | |
| Water treatment systems | | | |
| Building drainage system | | | |
| Lift and escalators | | | |
| Firefighting installations | | | |
| Communication and security installations | | | |
| Telecoms and data installations | | | |
| Connections and diversions | | | |
| Substations and equipment | | | |
| Paving and other hard surfacing | | | |
| Fencing, railings and walls | | | |
| Exterior drainage systems | | | |

### *Instructions for Level 3*

**L3.1. The purpose of this level**

This level is for those users who wish to compare the final as-built design with the earlier detailed designs. It can also form the starting point for preparing the technical content of a building passport or building material bank record. Level 3 can be used for an existing building where indicator 2.1 is not reported on and where the only information about bill of materials would come from a survey of the existing building.

**L3.2. Step-by-step instructions**

*Since the approach for Level 2 and Level 3 is very similar, these instructions should be read in conjunction with the accompanying Level 2 technical guidance and supporting information (see page 21).*

1. Bring together the architect and contractor as well as the structural and service engineers in order to identify the design concepts and aspects that have been addressed.
2. Identify and gather the relevant architectural and structural design drawings, service plans and fit-out plans as well as supporting calculations required to check on and confirm the as-built scoring for elements within the scope. If any supplied elements or components have material passports, compile this information.
3. If a representative selection of houses or apartment types was used for scoring at Level 2, ensure that the same selection is considered at Level 3.
4. Fill out the Level(s) excel reporting template for indicator 2.4 with the relevant building elements, components, parts and materials, together with their respective weights (and optionally their economic values) and select the best practical outcome at the end of life of each element.
5. Calculate a circularity score that takes into account the best practical outcome (based on consideration of ease of disassembly and the potential for reuse, recycling and recovery) and the weighted masses (and, optionally, economic values) for each end-of-life outcome.
6. <u>*Going a step further*</u>*:* In order to finalise an assessment of the potential for trade-offs in the life cycle environmental performance of different adaptability design concepts, a further life cycle GWP assessment or full LCA assessment may be carried out.

**L3.3. What do you need to make an assessment?**

The main items needed are as follows:

- ✓ A building design with a bill of quantities, as well as structure and servicing plans, which are sufficiently advanced to provide the detailed information on which to make a circularity score.
- ✓ For renovation projects: an agreed scope of building parts and fit-out that will allow for those deconstruction design aspects that can be influenced to be identified.

**L3.4. Who should be involved and when?**

Those actors involved in the completion of the building, led by the architect and with the involvement of the contractor(s) and structural and services engineers. Supporting life cycle GWP or LCA assessments may be carried out by the energy/sustainability consultants or those within the design team with in-house competencies.

**L3.5. Ensuring the comparability of results**

For results to be comparable, it is important that the scope is the same. Because users can reduce the scope according to the specificities of their project, the scope needs to be clearly visible in the reporting format. The calculation method uses a tailor-made excel spreadsheet is described in more detail in the further guidance.

**L3.6. Format for reporting the results of an assessment**

The format below is the same as that generated in the excel template for indicator 2.4. It should be noted that reporting on value is optional.

| Overall circularity score (by mass) | Overall circularity score (by value) |
|---|---|
| | |

A more detailed breakdown of the scores for different building elements also forms part of the reporting format, in this case, any elements with no data or excluded from the scope by users, should clearly state this in the “further details” entry field.

Designers or suppliers have the possibility to use the Level(s) excel template to calculate results for their own building elements and this information could then be copy-pasted into a master excel for the entire building project.

| Building element-specific information and circularity scores | | | |
|---|---|---|---|
| **Element** | **Further details** | **By mass** | **By value** |
| Piles or shallow foundations | | | |
| Basements | | | |
| Retaining walls | | | |
| Frame (beams, columns and slabs) | | | |
| Upper floors | | | |
| External walls | | | |
| Balconies | | | |
| Ground floor slab | | | |
| Internal walls, partitions and doors | | | |
| Stairs and ramps | | | |
| External wall systems, cladding and shading devices | | | |
| Façade openings (including windows and external doors) | | | |
| (Roof) Structure | | | |
| (Roof) Weatherproofing | | | |
| Parking facilities (above ground or below ground, so long as it is within the curtilage of the building) | | | |
| Sanitary fittings | | | |
| Built-in cupboards, wardrobes and worktops | | | |
| Ceilings | | | |
| Wall and ceiling finishes | | | |
| Floor coverings and finishes | | | |
| Light fittings | | | |
| Control systems and sensors | | | |
| Electricity generation and distribution | | | |
| Air handling units | | | |
| Ductwork and distribution | | | |
| Cold water distribution | | | |
| Hot water distribution | | | |
| Water treatment systems | | | |
| Building drainage system | | | |
| Lift and escalators | | | |
| Firefighting installations | | | |
| Communication and security installations | | | |
| Telecoms and data installations | | | |
| Connections and diversions | | | |
| Substations and equipment | | | |
| Paving and other hard surfacing | | | |
| Fencing, railings and walls | | | |
| Exterior drainage systems | | | |

## Guidance and further information for using the indicator

### *For using level 1*

Additional background guidance and explanations are provided for the three deconstruction design concepts, ease of disassembly, ease of reuse and ease of recycling.

In this way, users can obtain a better understanding of why design for deconstruction is important to address and how it can influence the circularity of a building in the medium to long term.

**L1.1a. A brief explanation of the scope of indicator 2.4**

At the concept design stage, there is no limitation on the scope to be considered. However, for practical purposes, users are *recommended* to focus in particular on the following scope in black in the table below. The rest of the scope is listed below in grey and italics, which would later be applicable at Level 2:

*Table 1. The maximum recommended scope for design for deconstruction assessment with Level(s)*

| Tier 1 | Tier 2 | Tier 3 (building elements) |
|---|---|---|
| Shell | Foundations (substructure) | Piles and shallow foundations |
| | | Basements |
| | | Retaining walls |
| | Loadbearing structural frame | Frame (beams, columns and slabs) |
| | | Upper floors |
| | | External walls |
| | | Balconies |
| | Non-load bearing elements | Ground floor slab |
| | | Internal walls, partitions and doors |
| | | Stairs and ramps |
| | Facades | External wall systems, cladding and shading devices |
| | | Façade openings (including windows and external doors) |
| | | *External paints, coatings and renders* |
| | Roof | Structure |
| | | Weatherproofing |
| | *Parking facilities* | *Above ground and underground (within the curtilage of the building and servicing the building occupiers)* |
| Core | Fittings and furnishings | Sanitary fittings |
| | | *Cupboards, wardrobes and worktops (where provided in residential property)* |
| | | Ceilings |
| | | *Wall and ceiling finishes* |
| | | Floor coverings and finishes |
| | In-built lighting system | Light fittings |
| | | *Control systems and sensors* |
| | Energy system | Heating plant and distribution |
| | | Cooling plant and distribution |
| | | Electricity generation and distribution |
| | Ventilation system | Air handling units |
| | | Ductwork and distribution |
| | Sanitary systems | Cold water distribution |
| | | Hot water distribution |
| | | Water treatment systems |
| | | Building drainage system |
| | *Other systems* | *Lifts and escalators* |
| | | *Firefighting installations* |
| | | *Communication and security installations* |
| | | *Telecoms and data installations* |
| *External works* | *Utilities* | *Connections and diversions* |
| | | *Substations and equipment* |
| | *Landscaping* | *Paving and other hard surfacing* |
| | | *Fencing, railings and walls* |
| | | *Drainage system* |

**L1.1b. Clarification on terms used in indicator 2.4.**

To minimise potential confusion between the terms used, the following distinction is considered in Level(s) indicator 2.4:

- Building **elements** are considered as features of the building aligned with the Tier 3 scope in Table 1 above (e.g. external wall systems). Building **elements** may consist of multiple **components** (e.g. bricks, mortar, insulation and cladding), **parts** (e.g. connectors to façade openings) and **materials** (e.g. brick, mortar, metal, mineral wool etc.).
- Building **components** are considered to be features of the building which can combine with other components to form building elements. Although inherently simpler than building **elements**, building **components** may consist of multiple **parts** and **materials** (e.g. glass window and metal lock mechanism in a door "element").
- Building **parts** are features of the building that can combine to form building **components**. Although inherently simpler than building **components**, they may also consist of multiple **materials** (e.g. glass window in the door may be reinforced with metal wire).
- Building **materials** are the lowest level to be considered in terms of design for deconstruction as it is the purest form that can practically be recovered from the building. For clarity, cases of certain composite materials such as unreinforced concrete (which is cement, sand and coarse aggregate), alloyed metals (more than one metal) and plasticised plastics (polymer plus plasticiser additive) should be considered as "pure materials" so long as no barrier to their recyclability is presented by their composite nature.

So to summarise, in terms of complexity, the following logic generally applies:

elements > components > parts > materials.

**L1.4. Checklist of deconstruction design concepts**

As a general rule, the shorter the design life of a building, the greater consideration is made for design for deconstruction. This is evident if considering for example portacabins or buildings in refugee camps, where the structure must be easily connected and disconnected to services, access ramps or stairs, depending on the specifics of the site. The ultimate example of a building structure for scoring well under Level(s) indicator 2.4 would be a tent –where everything is designed for direct reuse!

However, buildings with design lives spanning several decades, there is a disconnection between decisions made at the design stage of a building and those that may be made later when the building reaches the end of its life. In this respect, assessment schemes and reporting tools may therefore have an important short to medium term role to play in incentivising such practices and providing reference to tools and guidance.

*Identifying the main barriers to reuse and recycling*

A study carried out by Charlson (2013) for Arup and the Chartered Institute of Building (CIOB) provides useful insight on that factors that would support deconstruction practices. The study comprised an international literature review and survey of 26 demolition industry professionals [2]. The most commonly cited actions in currently available guidance were also compiled. Table 2 lists the actions with the greatest number of citations. These potential actions were verified with demolition industry professionals in a survey. This resulted in two main actions being identified that should be encouraged, and which indicator 2.4 can be used to make progress on:

1. **Building information**: Information about the building should be passed on, to include full as-built drawings and a deconstruction plan.
2. **Design stage actions**: A number of specific design actions should be taken to enable the separation of materials and elements.

In relation to the second point above, the design actions identified as being of greatest potential significant were:

[2] Charlson.A, *Designing for the deconstruction process*, Final report produced for the Sir Ian Dixon Scholarship, 25th February 2013, UK

- Independent and easily separable elements of the building *e.g. structure, envelope, services & interior finishes*;
- Ease of access to connections;
- Mechanical and reversible (not chemical) connections;
- Avoidance of resins, adhesives or coatings on the elements to be disassembled;
- Avoidance of poured in-situ concrete structures;
- Avoidance of composite floor constructions;
- Prefabricated elements should be permanently marked with details of their properties.

VTT and TUT (2013) came to broadly similar findings, with the additional focus on long life and easy-to-maintain structural elements and on the ease of removal and recyclability of external and internal cladding materials and coatings applications that have to be renewed. Avoidance of the use of hazardous materials that may hinder recycling was also highlighted.

*Table 2. Design for deconstruction actions cited in current guidance*

| Actions cited as contributing to design for deconstruction | Number of sources that cited action |
|---|---|
| Use reversible mechanical/non-chemical connections | 15 |
| Ensure elements of the building are independent and separable (structure, envelope, services, fit out) | 12 |
| Use standardised elements | 10 |
| Use non-composite floor systems | 10 |
| Permanently mark materials with properties | 10 |
| Ensure as-built drawings are available | 9 |
| Develop a deconstruction plan during design phase | 8 |
| Avoid use of resins, adhesives and coatings | 8 |
| Ensure post-construction ease of access to fixings | 8 |
| Do not use in-situ concrete | 7 |
| Avoid use of hazardous materials | 7 |
| Use modular elements | 6 |
| Use prefabricated elements | 6 |
| Use lime-based mortar with masonry | 6 |
| Minimal number of materials and components | 6 |
| Think about early in design process (scheme & design development) | 6 |
| Use components of singular materials | 5 |
| Train all team members on Design for Deconstruction | 5 |
| Establish feasibility of element reuse | 5 |
| Design in tie offs for deconstruction | 4 |
| Provide construction plan | 4 |
| Use durable materials | 4 |
| Size components for manual handling | 4 |
| Include information on deconstruction techniques | 3 |
| Do not use structural grout with precast elements | 3 |

*Source:* Charlson (2013)

*Understanding the potential for greater reuse*

The Finnish ReUSE project is a useful source of information to understand the practical potential for re-use. The project sought to address the potential and challenges currently facing the reuse of elements from existing buildings and design for reuse in new buildings [3]. Although the findings are relatively generic, and related to the nature of local and regional construction practices as well as end markets for products and materials, it means that it is always important to look at design for deconstruction solutions in the local context.

The ReUSE project had a specific focus on larger structural elements in commercial, industrial and residential buildings (columns, beams, wall panels, and floor and roof elements) including those made from timber, steel and concrete. The project's findings broadly agreed with those of Charlson (2013). Figure 2 serves to illustrate the complex interactions between the different actors involved in the re-use process.

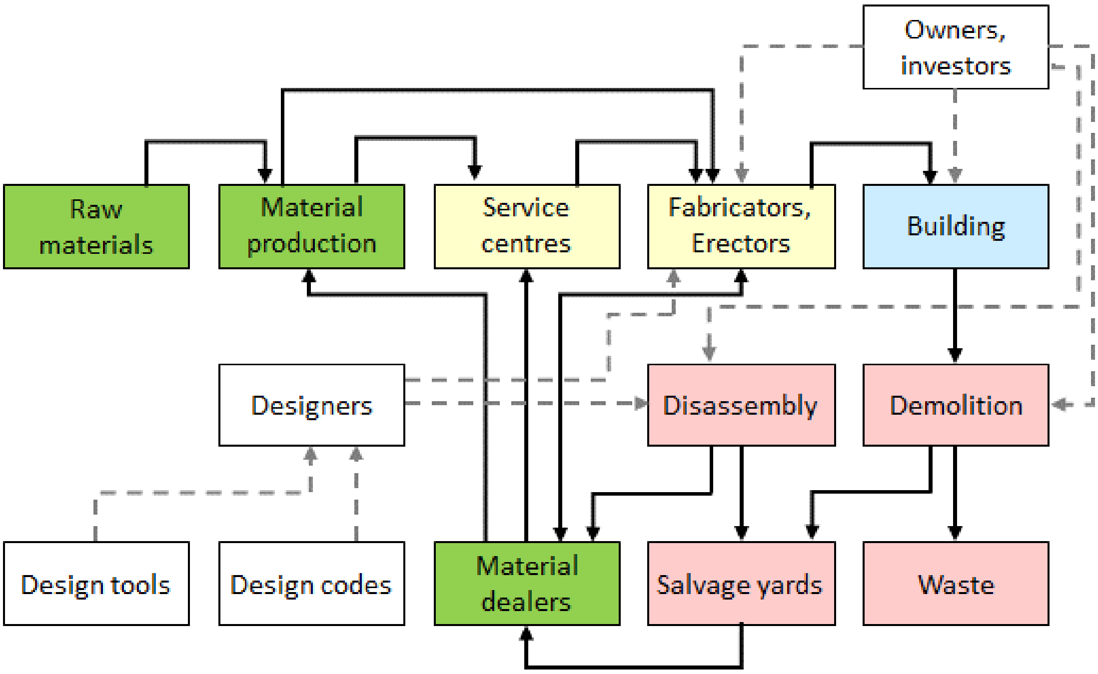



*Figure 2.* Major roles in the re-use process and their interaction

*Source:* VTT (2014)

The accompanying survey of construction and demolition professionals in Finland highlighted that beams and columns made of steel or concrete offered the best near term reuse potential. Timber beams, columns and cross laminates could have improved potential in the future. The following additional observations were made:

- Timber: Beams, columns and CLT were highlighted as having potential.
- Concrete: Beams and columns were seen to have good prerequisites for reuse, but the lack of an established market was seen as a major obstacle. For panels and slabs, the difficulty of deconstruction was seen as the first obstacle followed by market-related issues.
- Steel: Construction technology was not seen to hinder the reuse of steel components, but rather the lack of established practices.

The study also identified the practical potential to re-use concrete panels from the 1960's and 1970s panel built (prefabricated) lower rise detached housing, reflecting similar practices in the former East Germany [4].

[3] VTT Technical Research Centre of Finland and Tampere University of Technology (2014) *Re-use of structural elements of building components.*

[4] IEMB (2007) *Recycling Prefabricated Concrete Components – a Contribution to Sustainable Construction*, Neue Ergebnisse, Germany

## *For using level 2*

In this section of the guidance, additional background explanations and information are provided in order to support use of the instructions for Level 2. The following steps in the instructions are specifically addressed:

- L2.2. Step 1: Identifying the scope of assessment
- L2.2. Step 3: (optional) Buildings As Material Banks (BAMB) concept
- L2.2. Step 5: Further considerations on logic to apply with identifying final outcomes for building elements
- L2.2. Step 8: Filling out the Level(s) calculator
- L2.2. Step 9: Assessment of the life cycle environmental performance of building designs

### L2.2. Step 1: Identifying the scope of assessment

Users should first consult the minimum building elements identified in Table 1, and identify which building elements will be assessed. The scope should be clearly stated using Tier 3 and ideally Tier 4 descriptions. Tier 4 entries are optional in the indicator 2.4 reporting excel template but are important for providing further information. Due to the very large number of components, parts and materials that could appear in Tier 4, only an indicative list is provided here for guidance.

*Table 3*. The minimum scope of building parts to be assessed

| Tier 3 (building elements) | Tier 4 (components, parts, materials) |
|---|---|
| Piles or shallow foundations | For piles: e.g. load-bearing piles, end-bearing piles, friction piles, pile caps and ground anchors.<br>For shallow foundations: e,g, strip, trench-fill, rubble trench or raft foundations. soil |
| Basements | e.g. waterproofing, masonry blocks, precast concrete modules, reinforced concrete, insulation |
| Retaining walls | e.g. sheet piles or diaphragm walls |
| Frame (beams, columns and slabs) | e.g. all loadbearing elements appearing in the superstructure (above ground structure) |
| Upper floors | e.g. coverings on floors, including screeds, damp-proof courses, insulating and protective layers, wearing surfaces, false floors for services and floating floors. |
| External walls | e.g. components used for building the wall, whether it is loadbearing or non-loadbearing. Also covers parapets, infillings, protective treatments, insulation and connections to other building elements. |
| Balconies | e.g. balcony wall, glazing, privacy screens etc. |
| Ground floor slab | e.g. reinforcement, concrete, connections to structural columns, surface treatments for waterproofing. |
| Internal walls, partitions and doors | e.g. infills, precast wall units, window frames, windows, door frames, doors, locking mechanisms, toilet cubicles or partitions and any plaster rendering, cladding, sealing, insulation or protective layers. |
| Stairs and ramps | e.g. structural material plus any physical support rails for users and connections. |
| External wall systems, cladding and shading devices | e.g. external cladding, including renders, damp-proofing, insulation and protective layers. |
| Façade openings (including windows and external doors) | e.g. lintels, window frames, door frames, windows, doors, locking mechanisms, shutters, window sills, fittings and ventilation components. |
| (Roof) Structure | e.g. standard structural elements such as wall plates, rafters, joists, gable walls, purlins, trusses, connectors, any connected overhanging canopies, roof slab, blue roofs (designed to hold rainwater on roof); green roofs (designed for vegetation) |
| (Roof) Weatherproofing | e.g. roof coverings such as plain tiles, interlocking tiles, slates, insulation, sealing and waterproofing treatments. |
| Parking facilities (above ground or below ground, so long as it is within the curtilage of the building) | e.g. flooring, surface treatments, floor/wall markings, access barriers etc. |

| Tier 3 (building elements) | Tier 4 (components, parts, materials) |
|---|---|
| Sanitary fittings | e.g. sanitaryware such as WC bowls, cisterns, urinals, bidets, washbasins, sinks, showers, bathtubs. |
| Built-in cupboards, wardrobes and worktops | (Mostly relevant to residential buildings) e.g. cupboard units, wardrobes, worktops, handles, panels, shelves and sealants. |
| Ceilings | e.g. ceiling lining, including plaster rendering, insulation, protective layers or acoustic materials associated with tightly-attached or suspended ceilings. . |
| Wall and ceiling finishes | e.g. paints, varnishes or plaster rendering. |
| Floor coverings and finishes | e.g. covering materials and associated underlays, damp-proof courses, insulation, grout, binders and coatings applied to floating floor or raised floor surfaces. Skirting boards at wall edges is also included here. |
| Light fittings | e.g. fixed lights or lighting units comprising one or more lamps and associated control gear (not including the light switch and wiring to the lighting unit). |
| Control systems and sensors | e.g. building automation and control for aspects such as CO2 concentration controlling ventilation equipment for maintaining indoor air quality or temperature controlling heating/cooling system for maintaining thermal comfort. |
| Heating plant and distribution | e.g. boilers, heat pumps, (combined heat and power plants are counted under "electricity generation") heat exchangers, connectors, radiators and distribution piping and ductwork. |
| Cooling plant and distribution | e.g. air conditioning units, fans, reversible heat pumps, dehumidification equipment, connectors and ductwork. |
| Electricity generation and distribution | e.g. photovoltaic, wind turbines or combined heat and power plant for onsite generation. Also including cabling from the local substation to the building junction box and cabling and switchgear, safety devices and circuits throughout the building to each plug socket. |
| Air handling units | e.g. equipment dedicated to mechanical ventilation, including ductwork. Any units responsible for heat recovery in ventilated air should be counted under heating plant and distribution. |
| Ductwork and distribution | e.g. ductwork and distribution for heating plant, cooling plant and mechanical or passive ventilation. |
| Cold water distribution | Piping, connections and fittings from the mains water inlet to sanitary devices throughout the building. Includes any equipment and parts for the collection, storage and distribution of collected rainwater or greywater. |
| Hot water distribution | e.g. piping, connections and fittings that transfer hot water from heating plant to sanitary devices (hot water taps and shower). |
| Water treatment systems | e.g. first flush diverters for collected rainwater or filters for collected greywater and rainwater. |
| Building drainage system | e.g. pipes, fittings and storage tanks for the drainage of greywater or blackwater from sanitary devices, roof guttering and drainage and drainage from impermeable ground on the plot. |
| Lift and escalators | e.g. motors, escalator handrails, lift compartment, interior lift cladding, escalator side panelling etc. |
| Firefighting installations | e.g. sprinkler piping network, water tank, spray units, booster pumps etc. |
| Communication and security installations | e.g. closed circuit TV network, cameras, data recording and storage devices, alarm systems, cabling and sensors. |
| Telecoms and data installations | e.g. cabling, wi-fi routers, servers and ancillary equipment for and onsite data centres. |
| Connections and diversions | e.g. to mains water line, to local sub-station for electricity supply etc. |
| Substations and equipment | e.g. control panels, fuses, transformers, trip switches and possible |
| Paving and other hard surfacing | e.g. tiles, flagstones, blocks and kerbstones made of natural stone, fired clay or precast concrete. |
| Fencing, railings and walls | e.g. iron grated railings, fencing posts, brick walls, plastic coated metal wire fencing etc. |
| Exterior drainage systems | e.g. to mains sewerage network or alternative drainage routes via |

| Tier 3 (building elements) | Tier 4 (components, parts, materials) |
|---|---|
| | sustainable drainage infrastructure installed onsite and possibly near site as well. |

**L2.2. Step 3: (optional) Building As Material Bank concept**

Buildings have traditionally been valued based on their floor area, the location and land area they sit on, architectural features and the use that can be made of the building. However, there is also a residual value that is locked into a building via the components and materials it is made of. This is the particular focus of indicator 2.4. This locked-in value (often viewed solely as a future demolition and disposal cost) is maximised when these components and materials can be adequately retrieved at the End of Life of the building for reuse.

This BAMB concept is relevant to all buildings but can be especially incorporated into the design of new buildings or in the definition of major renovation activities. By choosing elements and components that can be disassembled, and by providing clear instructions about their correct disassembly via building material passports, the possibility to reuse that material or element is maximised. The level of information for each product could include the product features, reuse/recycling potential and visual details of the building element or material. This principle can underpin the "*circularity*" of the whole building as well.

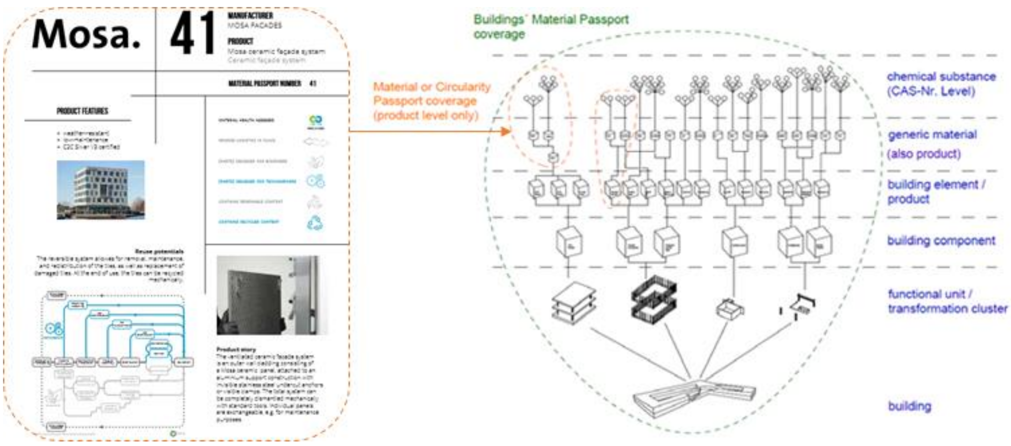



*Figure 3*. Example of a building material passport (left) and how this information can be structured for a whole building.

Source: BAMP project (2019)[5]

Input from architects and/or consultants with expert knowledge of the BAMB principles and of the availability of materials and elements with BAMB-type passports is crucial at the concept design stage if these principles are to be embraced. The BAMB approach is complimentary with Building Information Modelling (BIM) and can slot into the building model and related documentation.

**L2.2. Step 5: Further considerations on logic to apply with identifying final outcomes for building elements**

The outcomes that are considered in the indicator 2.4 calculator are generally aligned with the waste hierarchy set out in the Waste Framework Directive and are as follows, in order of best outcome first:

- Direct reuse (circularity coefficient = 1.00).
- Preparing for reuse (circularity coefficient = 0.90)
- Pure stream recycling (circularity coefficient = 0.75).
- Mixed stream recycling (circularity coefficient = 0.50).
- Material recovery (circularity coefficient = 0.25).
- Energy recovery (circularity coefficient = 0.15).
- Inert or non-hazardous landfill (circularity coefficient = 0.01).
- Hazardous waste disposal (circularity coefficient = 0.00).

[5] For further information visit the BAMB website: https://www.bamb2020.eu/library/overview-reports-and-publications

An illustration of the type of logic that should be applied when considered which end of life outcome is most appropriate for each building element, component, part or material is provided below.

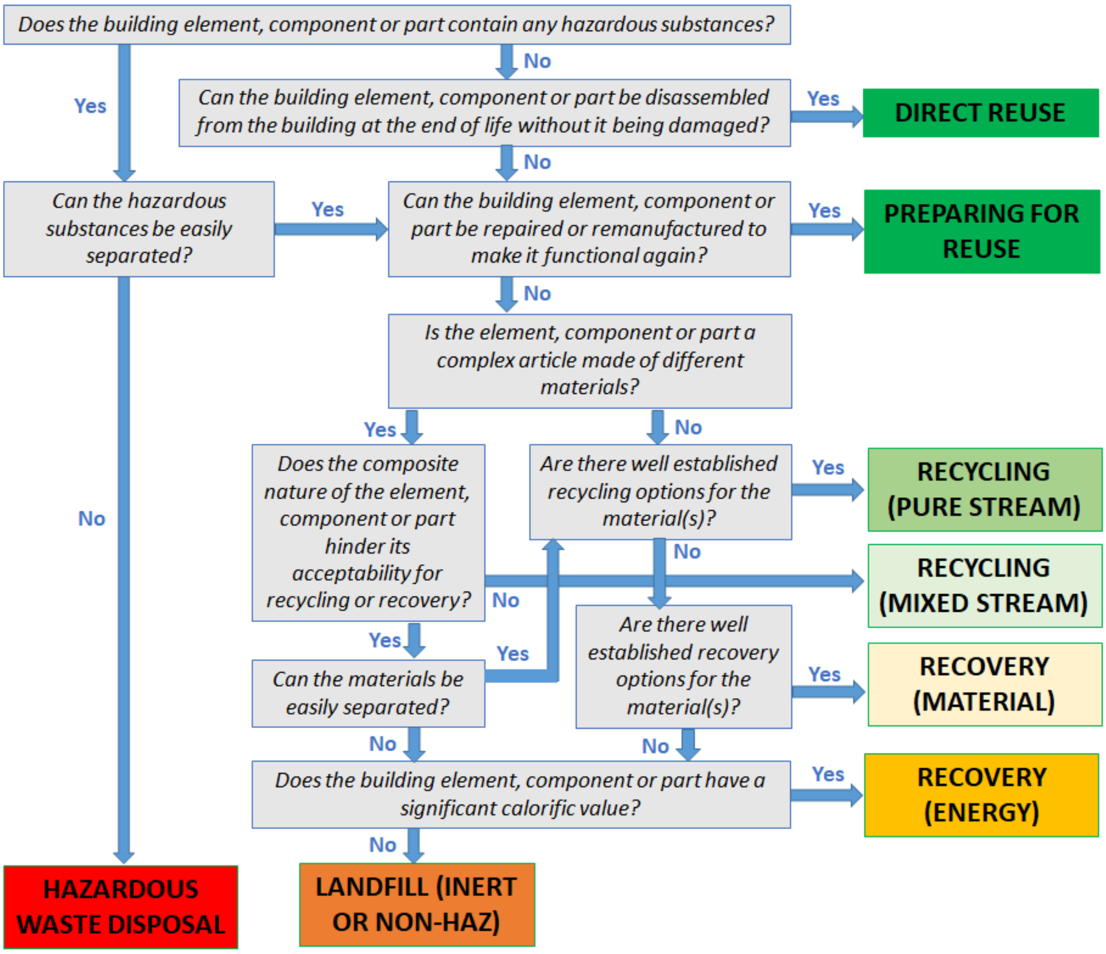
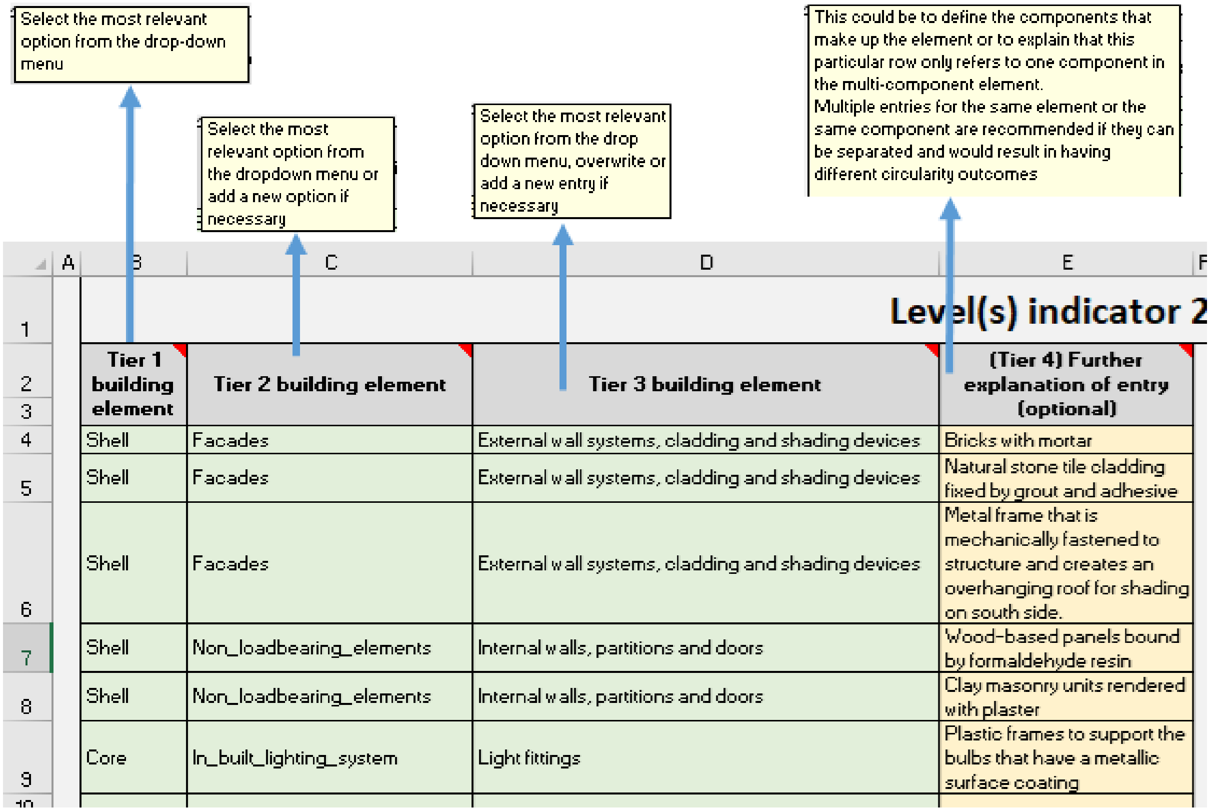



*Figure 4*. General logic applicable for deciding on best outcomes for building elements, components, parts or materials

These best practical outcomes should generally be identified using the flow diagram logic in the previous section of this guidance. Where available, declarations from waste management professionals and construction product suppliers could be useful. Especially for justifying decisions on reuse, building material passports provided by suppliers would be helpful.

### L2.2. Step 8: Filling out the Level(s) excel calculator

The Level(s) calculation method requires users to judge on what is the best outcome for all of the building elements, components, parts and materials in their defined scope. The guidance here simply walks users through how the excel sheet should be filled out and how the scores are calculated.




| Tier 1 building element | Tier 2 building element | Tier 3 building element | (Tier 4) Further explanation of entry (optional) |
|---|---|---|---|
| Shell | Facades | External wall systems, cladding and shading devices | Bricks with mortar |
| Shell | Facades | External wall systems, cladding and shading devices | Natural stone tile cladding fixed by grout and adhesive |
| Shell | Facades | External wall systems, cladding and shading devices | Metal frame that is mechanically fastened to structure and creates an overhanging roof for shading on south side. |
| Shell | Non_loadbearing_elements | Internal walls, partitions and doors | Wood-based panels bound by formaldehyde resin |
| Shell | Non_loadbearing_elements | Internal walls, partitions and doors | Clay masonry units rendered with plaster |
| Core | In_built_lighting_system | Light fittings | Plastic frames to support the bulbs that have a metallic surface coating |

*Figure 5*. First four (of seven) input fields for the Level(s) calculator for design for deconstruction

Any cells in green indicate the need for mandatory entries, cells in yellow are optional and cells in red are the automatic results of calculations from inputs in other cells. Columns B, C and D reflect the maximum scope that can be applied for indicator 2.4. The scope is based on the same scope originally defined in the guidance section (Table 11) of User Manual 2.

Any users that have used the excel template for indicator 2.1 (bill of quantities, materials and lifespans) will be familiar with the drop-down options for Columns B, C and D. It is necessary to first define an option in Column B and, depending on the option chosen, different options appear in Column C. Then an option needs to be chosen for Column C and this in turn will determine what options appear in Column D.

The input in Column E is optional, but in reality this is where key information that can help understand what is the best end-of-life outcome for the entry. It could include details of the type of component, part or material being considered in the entry and put this in the broader context of the building element, if the building element is indeed more complex than the single entry in question.

For the formal reporting format, users are required to briefly describe the overall building element(s) that they have included in the scope, together with the circularity score for each building element. The description needed in the reporting format (L2.7) could be based on any relevant optional information included in Column E.

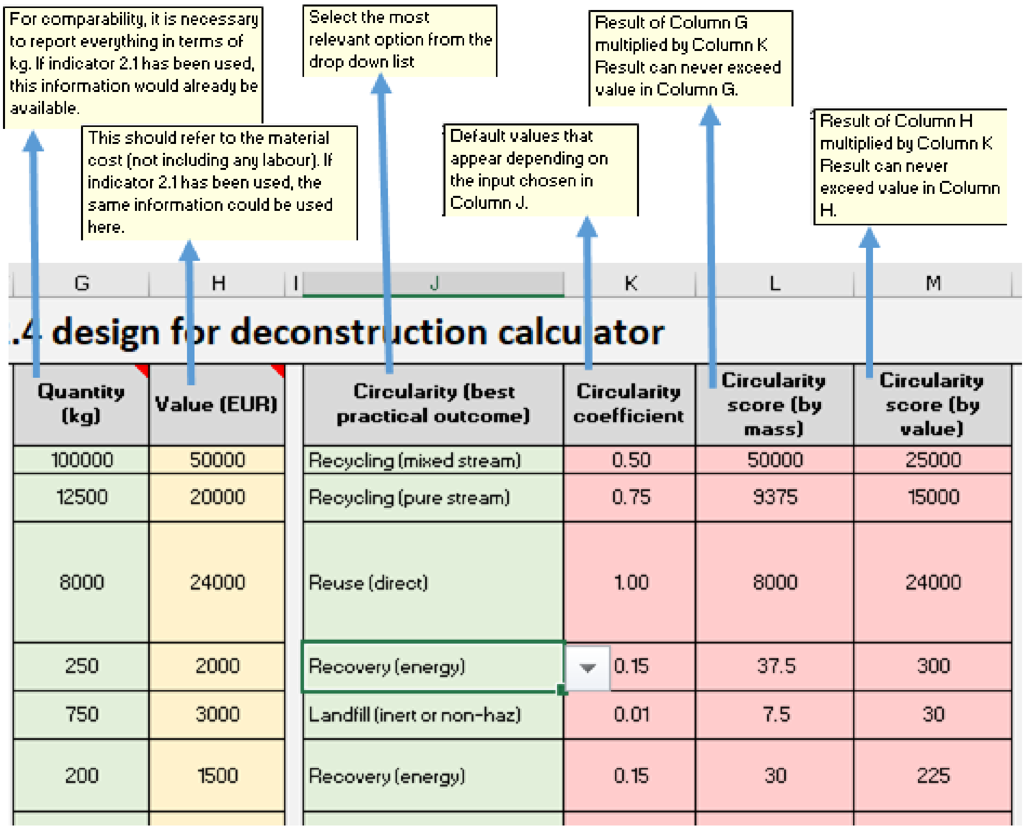



*Figure 6*. Last three (of seven) input fields for the Level(s) calculator for design for deconstruction

The input to Column G will normally require some conversion calculation, because many construction products and materials are supplied in units other than mass (e.g. number of units, volume, area or length). In order to convert these quantities to kg, it will be necessary to obtain an approximate conversion factor that generates a result in units of kg. If indicator 2.1 has been reported on, this conversion will already have been done.

A true comparison of different building elements requires a common unit and mass is the most convenient in terms of obtaining conversion factors. However, it is understandable that by focussing on mass, the circularity score becomes dominated by the heavier elements. In order to allow for another perspective, it is also possible to define entries by value (Column H). This is an optional entry in case specific cost data does not want to be shared by users. The cost data should be specific to costs of the product or material supplied and should not include any labour or installation costs. If this is not the case, then this could be explained briefly in Column E.

The final input to the excel template is the best practical outcome for the element, component, part or material at the end-of-life (of the entire building or the element/component/part/material itself). This is a judgment call based on information available to the user about the following aspects:

- The ease with which the element, component, part or material can be disassembled.
- The presence/non-presence of hazardous substances in the element, component, part or material.
- The existence of a reuse market for the element, component, part or material.
- The complexity of elements or components in terms of the number of different parts and materials they may contain.
- The existence of technologies and markets for the recycling or material recovery from the elements, components, parts or materials.
- The calorific value of the element, component, part or material.
- Would the element, component, part or material be considered as inert or non-hazardous according to landfill waste acceptance criteria?

These considerations are in line with the flow diagram logic shown in Figure 4, for the guidance above regarding step 5 of L2.2.

The final outputs of the excel template are shown below.

| Overall circularity score (by mass) | Overall circularity score (by value) |
|---|---|
| 55.4% | 64.2% |

| Building element specific circularity scores | By mass | By value |
|---|---|---|
| Piles or shallow foundations | | |
| Basements | | |
| Retaining walls | | |
| Frame (beams, columns and slabs) | | |
| Upper floors | | |
| External walls | | |
| Balconies | | |
| Ground floor slab | | |
| Internal walls, partitions and doors | 4.5% | 6.6% |
| Stairs and ramps | | |
| External wall systems, cladding and shading devices | 55.9% | 68.1% |
| Façade openings (including windows and external doors) | | |
| Structure | | |
| Weatherproofing | | |
| Sanitary fittings | | |
| Ceilings | | |
| Floor coverings and finishes | | |
| Light fittings | 15.0% | 15.0% |
| Heating plant and distribution | | |
| Cooling plant and distribution | | |

*Figure 7*. Last three (of seven) input fields for the Level(s) calculator for design for deconstruction

A single, overall circularity score is provided in Column O for mass and Column Q for value. The values can range from 0 to 100%. Empty cells do not affect the calculation. In Columns S, T and U, there is a full list of the individual Tier 3 building elements included in the scope. The scores in Columns T and U only consider earlier inputs that are associated with that particular building element. So circularity scores can be seen for each individual building element as well (remember that multiple entries for the same building element are possible using Columns B to J).

### L2.2. Step 8b: Further considerations about the best practical outcome

The key word here is "practical". It is difficult to envisage what will be practical or impractical several decades into the future, but there is a risk that users become over optimistic with what the best practical outcome will be. When deciding on the outcome to enter into the excel calculator, they should consider the following:

- How standard is the unit size of elements, components or parts that can be disassembled? More standard units will be more likely to find a demand for reuse, but customised units may have some added artistic or architectural value. So **cost-benefit thinking** is needed.
- For Level 3 and when looking at real buildings that are already old in particular, the state of repair must be considered when determining if remanufacturing or reconditioning would be **cost-effective**.
- The potential to reuse structural materials as new structural materials will require some integrity testing which would have an associated cost. Safety margins and the conservative nature of structural engineers should also be factored in when choosing the best outcome for structural elements.
- The potential to reuse building technical systems will depend on the continued availability of spare parts, connections and company´s willing to recertify the system when reinstalled elsewhere.
- Especially in countries with high labour costs, the time and labour requirement should be balanced against the added value of reuse compared to e.g. mixed use recycling or material recovery.

A mechanism for the cost-benefit considerations to be reflected in the final circularity score could be considered in the next revision of indicator 2.4. However, it is important for this first version to be simple and easy to understand for users.

#### L2.2. Step 9: Assessment of the life cycle environmental performance of building designs

Some of the deconstruction design concepts may involve trade-offs between improved ease of recovery and environmental performance. These trade-offs cannot be capture by the deconstruction score and can only be quantified by making a life cycle GWP assessment or a cradle to grave LCA for the building. This will allow for the performance of designs to be calculated and compared. To do this, possible future scenarios for the end of life of the building should be developed and tested drawing upon expert input. In doing this, the specific rules provided in L2.4: Step 4 of the indicator 1.2 instructions shall be followed. The can be found in the indicator 1.2 user manual.

### *For using level 3*

The exact same steps and instructions apply for Level 3 as for Level 2, the only difference is that with Level 3, the users will have a full knowledge of the building elements, components, parts and materials actually used and installed in the building, whereas at Level 2, these were estimates based on detailed designs.

Consequently, there is no need for any Level 3-specific guidance for newly built buildings.