WORLD CONFERENCE ON TIMBER ENGINEERING 2025
BRISBANE, AUSTRALIA
Advancing Timber for the Future Built Environment

CLARIFYING TERMINOLOGY FOR ASSESSING CIRCULARITY IN TIMBER CONSTRUCTION

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ABSTRACT: The ecological benefits and functional properties of wood are crucial for the transformation of the building sector. Reuse maximises the ecological impact by maintaining the material cycle for as long as possible. To effectively assess the reversibility of structural building parts for reuse purposes, specific criteria and indicators are required. Although numerous publications in this field exist, the terminological inconsistency between (Design for) Disassembly and (Design for) Deconstruction complicates the precise thematic classification of current assessment and certification systems in mapping criteria for reusability. By analysing the conception of these terms, this paper creates a profound basis for developing explicit definitions, differences and correlations. For this purpose, the central terms of the subject area are documented and evaluated in an integrative literature review. The gained insights facilitate the evaluation of current assessment and certification systems for the reusability of structural building parts and elements of timber constructions.

KEYWORDS: circularity assessment, timber construction, demountability, disassembly, deconstruction

1 – INTRODUCTION

Terminological clarity is a prerequisite for the accurate assessment of circularity in timber construction. Specifically, the reversibility of structural building parts is central to evaluating their potential for reuse. However, current literature and assessment systems show significant inconsistencies in the use of key terms such as Design for Disassembly and Design for Deconstruction. These ambiguities complicate the comparability and applicability of existing criteria.

This paper conducts an integrative literature review to examine how these terms are used, defined, and differentiated within the context of timber construction. By mapping their conceptual relationships and identifying overlaps and contradictions, the paper proposes clear, context-sensitive definitions for core "R-processes" relevant to the End-of-Life phase. Throughout this paper, the term "R-process" is used as a conceptual umbrella to describe all operational activities related to the removal of building parts, elements and components at the End-of-Life phase—such as disassembly, deconstruction, demounting, and separation. This working definition enables a structured differentiation of circular strategies based on material, connection type, and targeted product life cycle. The refined definitions aim to support the development and application of more consistent and meaningful criteria for assessing reusability in timber construction.

2 – BACKGROUND

Most publications addressing circularity in construction are associated with one or more planning principles, such as Design for Disassembly, Design for Deconstruction, Design for Reuse, and Design for Adaptability. While Design for Disassembly is defined by the International Standard Organization ISO 20887 [1], the other principles lack normative or consistent definitions [2]. As a result, their utilisation varies considerably across the literature, both in scope and meaning. In addition to their function as overarching planning principles, these terms are used to describe concrete operational activities, particularly those involving the removal of building parts, elements and components. In some cases, the term Design for Disassembly refers to the general planning strategy, while in others, it is used to describe the actual disassembly process itself. For example, disassembly is defined as follows: "Design for Disassembly is a method to design a building/product to enable the disassembly of building/components and reuse/recycling of its parts." [3].

This overlap between the strategic and procedural use of the same term illustrates the conceptual ambiguity found in the literature. Inconsistent terminology hinders the

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https://doi.org/10.52202/080513-0074

clear delineation of whether a given publications refers to a general design intent or to specific or material-related processes. While such ambiguity may be tolerable in abstract discussions of circularity, it becomes problematic when concrete processes are assessed and compared, especially in timber construction, where material-specific characteristics and connection techniques play a decisive role. This lack of terminological differentiation compromises the applicability and comparability of current assessment and certification systems. It limits the development of suitable indicators and hinders the implementation of circular strategies in practice.

The aim of this paper is to clarify the terminology of R-process-related terms, specifically as they are used, defined, and distinguished within the literature pertaining to timber construction. This investigation seeks to establish a more consistent and meaningful framework for assessing reversibility, supporting the reuse of timber constructions by reflecting the unique conditions inherent in their structure.

3 – PROJECT DESCRIPTION

A number of literature reviews have been published which analyse and conceptualise the expanding body of research on circularity in the building sector. For example, an integrative literature review of 288 articles was conducted by Munaro et al. [3] to investigate the definitions and conceptualisation of planning principles. Key findings include the clustering of planning principles into two main groups: Design for Disassembly and Design for Adaptability. According to the study, Design for Disassembly includes terms such as Design for Deconstruction, Dismantling, Demountability and Reuse, while Design for Adaptability comprises strategies such as Design for Flexibility, Durability and Change. Fig. 1 illustrates a comprehensive overview of these terms, and their conceptual distinctions.

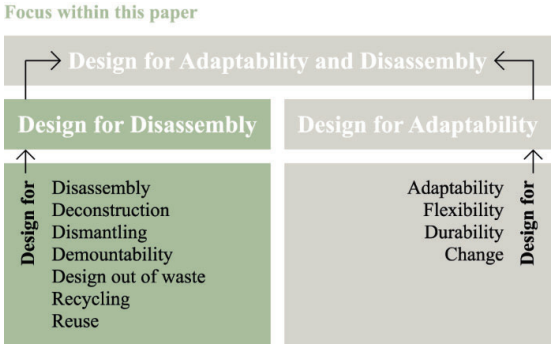

Figure 1. Conceptual framework of planning principles. Based on [3].

Munaro et al. [3] further emphasise the various interpretations and interchangeable use of the terms disassembly, deconstruction, demountabilty and dismantling to describe R-processes. Despite deriving definitions for the planning principles based on the reviewed literature, this source does not elaborate on a clear process-related distinction between the terms. In a subsequent review [2], the authors further analyse six strategies connected to Design for Disassembly and Adaptability: (i) design and construction strategies, (ii) tools, (iii) components and connections, (iv) barriers, drivers and guidelines. (v) existing building stock potential and (vi) selective deconstruction process. According to the review, standardisation, modularisation and prefabrication of components and materials are widely recognised in current research as key enablers for advancing the circular transition of the built environment. Timber construction already incorporates many of these features through established systems and methods.

The highlighted literature reviews provide an overview of the conceptualisation and terminology of circular planning principles. This supports a more precise delineation of the building sector's broad framework of circular practices. Despite the comprehensive nature of these reviews, the terminological differentiation between distinct R-processes remains unclear. This underscores the need for a more focused analysis that addresses the specific terminological challenges within the context of timber construction. This paper investigates the differentiation of terminology within the planning principle of Design for Disassembly with a focus on timber construction. Based on this objective, the central research question of this paper is:

How can R-processes in timber construction be clearly differentiated within the framework of Design for Disassembly and Design for Deconstruction, and how can these distinctions support the development of consistent criteria for assessing demountability?

In this context, "demountability" is used to describe a specific aspect of End-of-Life strategies: the potential of structural elements to be removed non-destructively for reuse. While the broader analysis includes various R-processes, "demountability" serves as a key indicator for evaluating reversibility and circularity.

4 – DESIGN PROCESS

This section is divided into two parts. Initially, the methodology is applied. Then, the terminology employed in the reviewed literature is analysed.

https://doi.org/10.52202/080513-0074

4.1 METHODOLOGY

This paper applies an integrative literature review, following a structured five-step process adapted from Torraco [4] and Lubbe et al. [5]. The aim is to identify, compare, and differentiate the application of terminology related to R-processes in timber construction. This provides the basis for developing a more consistent understanding of circular building strategies. Tab. 1 illustrates the research strategy and provides an explanation of the five review steps. The keywords applied in the systematic literature search are listed in Tab. 2.

Table 1. Strategy and stages of the integrative literature review.

	Strategy	
	Stage of review	***Explanation***
1	Problem identification	This review addresses the following research question: How can R-processes in timber construction be clearly differentiated within the framework of Design for Disassembly and Design for Decosntruction, and how can these distinctions support the development of consistent criteria for assessing demountability?
2	Literature search and preselection	The literature selection process was based on a systematic search strategy, including specific keywords, database queries, and a structured screening process. Publications were initially reviewed by title and abstract, followed by an in-depth analysis when necessary.
3	Evalutation and categorisation	The selected publications were classified based on quantifiable criteria, considering their relevance to circularity and timber construction.
4	Analysis	A qualitative analysis of the conceptual and terminological aspects of the selected publications was conducted.
5	Discussion	The results were interpreted through qualitative reasoning, identifying trends and gaps in the current terminology.

Table 2. Keywords applied in the systematic literature search.

KEWORD 1		***KEYWORD 2***
Design for Disassembly Disassembly Design for Disassembly and Reuse Design for Deconstruction Deconstruction Design for Reuse Reuse Design for Circularity Circularity Demountability	AND	Circular Economy Built Environment Sustainable building Construction Timber Wood Assessment Indicator

The search scope was intentionally kept broad to include perspectives from research and practice, encompassing existing certification systems such as EPEA [6] or DGNB [7]. The review includes peer-reviewed and non-peer-reviewed documents (e.g., reports, standards, and certification frameworks). Titles and abstracts were manually screened. In cases of uncertainty, the publications underwent a full-text review. Two primary selection criteria were applied:

- Relevance of planning principles and
- A specific focus on timber construction, or at least not excluding it.

The preselected publications were categorised into four groups:

- Fundamentals - publications addressing conceptual frameworks for circularity,
- Certification systems - established assessment frameworks,
- Qualitative assessment systems and
- Quantitative assessment systems.

Publications with specific focus on timber construction were marked separately. The selected literature was analysed with three guiding questions:

- Are the employed terms defined, and if so, how?
- Are the employed terms differentiated, and if so, how?
- Are there indications for specific features and requirements for R-processes in timber constructions, and if so, what are they?

This approach forms the basis for identifying conceptual overlaps, inconsistencies, and correlations in the terminology used across the reviewed literature.

4.2 ANALYSIS

Disassembly and *deconstruction* are the most frequently used terms [3], while *demountability, dismantling* and *separability* appear less throughout the reviewed literature. The interchangeable use of the terms, as noted by Munaro et al. [3], is confirmed in the reviewed sources. Despite acknowledging the coexistence of *Design for Disassembly* and *Design for Deconstruction*, a differentiation between the two terms is usually absent. Consequently, both are frequently summarised with the acronym “DfD” or “DfD&R”, e.g. [8–11]. Other publications use one term exclusively, though without clarifying distinction. A few sources offer differentiated approaches or enable contextual interpretation. These approaches can be grouped into three analytical perspectives: (1) general conceptualisation, (2) R-scenarios, and (3) connection properties.

General conceptualisation

Publications on circularity in timber construction address both upstream and downstream approaches [12]. According to Piccardo and Hughes [13], upstream approaches refer to strategies at the early stages of design or supply chain, while downstream approaches describe operative activities at the End-of-Life stage. Passarelli et al. [14] transfer this understanding to the concept of reuse by distinguishing *Design for Reuse* (upstream, future-oriented) and *Design from Reuse* (downstream, material-based) based on material availability and properties.

In some publications, *disassembly* is described as a form of *deconstruction*, e.g. [15], while in others, the reverse is implied, and *deconstruction* is described as a form of *disassembly*, e.g. [16]. Munaro et al. [3] confirm the latter in an analysis of 288 publications. Struck [17] suggests that *Design for Deconstruction* is a subcategory of *Design for Disassembly* in the context of the building sector. However, many construction-focused publications still use both terms interchangeably, which challenges this claim.

In several publications, *deconstruction* is used when describing the R-process. For example, Dechantsreiter et al. [18] and Munaro and Tavares [2] use *deconstruction* as a circular equivalent to *demolition*. According to the European Commission [19], the *deconstruction process* includes all superior actions of the R-process, including the analysis of contents, securing the current construction, and decontaminating hazardous waste. *Disassembly*, on the contrary, is exclusively applied to address the R-process itself.

R-scenarios

Based on the 10R strategy by Vermeulen et al. [20], the term "R-scenario" is used in the following to describe strategies connected to the targeted product life cycle. The differentiation of *disassembly* and *deconstruction* is repeatedly linked to the targeted R-scenario. ISO 20887 [1] employs *Design for Disassembly* and *disassembly* in a broad context, encompassing all loops within the R-scenarios: reuse, recycling or recovery for energy use. In most reviewed literature this understanding is transferred to *Design for Deconstruction* and the *deconstruction process*. However, exceptions exist. Cristescu et al. [16] state that *disassembly* encompasses all R-scenarios, while *deconstruction* primarily focuses on reuse. In contrast to the association of *disassembly* and *deconstruction* with all R-scenarios, *demountability* is predominantly associated with reuse [10, 21]. Most other publications refer to the planning principle *Design for Reuse* to describe processes aimed at reuse.

Connection properties

The reviewed literature repeatedly emphasises the significance of reversible connections for the implementation of circular processes, e.g. [8]. Nevertheless, the specific features of connections for reversibility are often overlooked when assessing the reusability in timber construction. The characteristics of structural connections of building parts and elements, as exemplified by those analysed by Ottenhaus et al. [8], differ fundamentally from connections of components. *Demountability* is employed in direct reference to the process of taking apart a connection, e.g. "demountable connection" [22, 23]. Munaro et al. [3] note the connection of *demountability* to prefabrication to enable the replacement of components.

Several publications further differentiate between distinct terms based on the structural properties of the connection. The removal of structural connections of self-contained building parts and elements is defined as:

- *dismantling* by Dechantsreiter et al. [18]
- *demountability* by Graf et al. [24] and Schuster and Geier [25] and
- *deconstruction* by O'Grady et al. [26].

The terms *demountability* and *deconstruction* are applied with a direct link to the R-scenario of reuse. The removal of non-structural connections of components such as windows, doors and radiators is defined as:

- *disassembly* by Dechantsreiter et al. [18] and O'Grady et al. [26] and
- *separability* by Graf et al. [24] and Schuster and Geier [25].

Consequently, these sets of terms are used to describe distinct R-processes based on connection type and intended R-scenario.

These findings confirm the terminological inconsistencies identified at the outset. Across the reviewed literature, central terms such as disassembly, deconstruction, demountability, and separability are used with varying meanings—sometimes interchangeably, sometimes contextually differentiated. By clustering the approaches according to conceptual framing, targeted R-scenarios, and connection properties, patterns of differentiation begin to emerge. In particular, the material-specific conditions of timber construction, such as the reversibility of structural connections, highlight the need for precise and consistent use of terminology. The observed overlaps and ambiguities underscore the importance of clearly distinguishing R-processes when aiming to assess demountability.

https://doi.org/10.52202/080513-0074

5 – RESULTS

The results of the analysis confirm the terminological inconsistencies outlined in the introduction. Throughout the reviewed literature, R-processes such as disassembly, deconstruction, demountability and separability are used inconsistently and often interchangeably. The material- and connection-specific requirements of timber construction underscore the importance of clearly distinguishing between R-processes.

By analysing the literature from three distinct perspectives – general conceptualisation, R-scenarios, and connection properties – recurring patterns of differentiation become visible. These patterns indicate that the presence of inconsistencies can be attributed to the absence of clear definitions and an underlying conflation of strategic design concepts with operative processes. This observation is explored further in the following discussion. Timber construction, while often cited as circular due to its modularity and prefabrication, still lacks consistent terminology when it comes to assessing reusability.

5.1 DISCUSSION

The analysis reveals a clear connection between the level of conceptual observation and the degree of terminological differentiation. Bottom-up approaches consider material- and process-specific requirements, particularly regarding the reversibility of connections. These perspectives enable a more precise definition and distinction of multiple R-processes. In contrast, top-down approaches tend to prioritise the broader framework of planning principles. As a result, they often apply terms interchangeably without accounting for the specific characteristics that influence demountability—especially in timber construction.

While top-down conceptualisations have laid the groundwork for many studies, they must now be critically reviewed and expanded through bottom-up insights. Only this combined perspective allows for a terminology that is both scientifically sound and practically applicable. This is particularly relevant for timber construction, where connection-specific properties play a decisive role in determining reusability and circular potential. The lack of precise definitions directly affects the reliability of assessment systems and may lead to misleading conclusions.

5.2 DEFINITION FRAMEWORK

To create a basis for further discussion, this section formulates definition proposals derived from a bottom-up perspective. The features and requirements of R-processes are discussed as conceptual elements that emerged from the literature analysis. The targeted R-scenario has a direct influence on the requirements of the R-process. It determines whether a building part, element or component must be removed non-destructively or can be subject to further processing. The structural characteristics and timber-specific features of the connection influence the reversibility of building parts.

Although the reviewed literature provides various useful concepts, overlapping and inconsistent terminology limits their practical applicability. The following definitions are derived from the bottom-up analysis:

- *Disassembly:* A general concept referring to the removal of components across all R-scenarios. It is not linked to a specific process or intervention level and often used as an umbrella term.
- *Deconstruction:* Removal of statically relevant (load bearing) connections, applicable to various R-scenarios (reuse, recycling, recovery). Often used as a process term, though sometimes also broadly.
- *Demountability:* Removal of statically effective connections with the explicit aim of reuse. Preferred over deconstruction when reuse is the goal. “Dismantling” appears as an alternative but is rarely used in the reviewed literature.
- *Separability:* Removal of non-structural connections, applicable to all R-scenarios. Used in place of “disassembly” where the latter is used ambiguously.

As illustrated in Fig. 2, separability, deconstruction, and demountability are identified as fundamental R-processes within Design for Disassembly. The figure illustrates the correlation of these processes with the structural property of the connections and the intended R-scenario. The R-process of non-structural connections specifically aimed at reuse is not defined conclusively in this paper. Although the demand for such a term exists, no clear expression could be derived from the literature. As a result of the preceding discourse, the terms “R-process” and “disassembly process” are synonymous. Nevertheless, the present paper retains the term “R-process” to facilitate a comprehensible analysis.

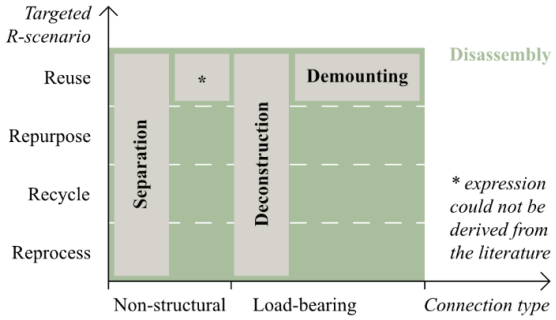

Figure 2. Overview of R-processes categorised by the nature of structural connections and the intended R-scenario.

When transferred back into the broad framework, the differentiation of R-processes enables the distinction of planning principles in the context of Design for Disassembly. Fig. 3 shows a further development of the classification proposed by Munaro et al. [3], expanded by the findings of this paper. All terms are clustered in upstream and downstream approaches.

The structured definitions support the identification of correlations between planning strategies. Design for/from Separability, Reuse, Demountability and Deconstruction are considered subordinate to the overreaching concept of Design for Disassembly. Design for/from Demountability is directly linked to Design for/from Reuse and Design for/from Deconstruction.

6 – CONCLUSION

This paper critically examined the inconsistent use of terminology related to the removal of building parts, elements, and components—referred to as R-processes—in the context of timber construction. The integrative literature review revealed widespread ambiguities in how terms, such as disassembly, deconstruction, demountability, and separability are used, often interchangeably and without clear differentiation.

Through a bottom-up analysis focused on material- and connection-specific requirements, particularly in timber construction, this study identified patterns that enabled the formulation of structured and context-sensitive definitions. The main contribution of this paper lies in the development of a systematic terminological framework, in which clear definitions are established to bridge the gap between abstract planning principles and their practical application in assessment and certification systems. This framework supports the development of substantial indicators for demountability and circularity in timber construction.

6.1 LIMITATIONS

Despite the structural approach, several limitations must be acknowledged:

- Some of the reviewed publications lack clear definitions, leading to interpretive uncertainty during evaluation.
- The field is rapidly evolving, and new strategies or terms may emerge that require future integration
- The scope is limited to four central R-process terms, excluding other potentially relevant concepts such as Design for Adaptability or Design for Circularity.

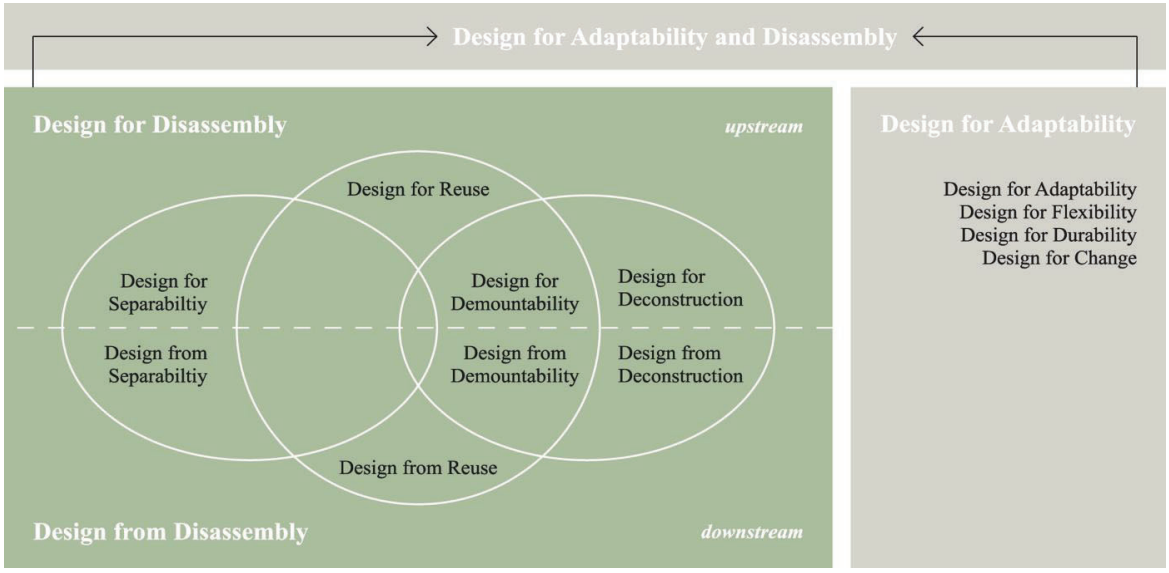

Figure 3. Classification and correlations of planning principles.

https://doi.org/10.52202/080513-0074

6.2 OUTLOOK

The proposed definitions establish a conceptual foundation that can be further developed in two directions:

- First, they may serve as a structured input for existing or future assessment systems, making demountability more measurable and comparable across projects.
- Second, they can support the refinement of planning principles by linking terminological clarity directly to practical requirements in timber construction.

A meaningful next step is to evaluate their applicability and robustness by testing the definitions either in actual construction projects or through case-based validation. Moreover, further studies may build on the derived terminology to support the development of material passports, BIM-based documentation, and decision tools that consider the logic of R-processes throughout the building's lifecycle. Ultimately, a more precise and consistent use of terminology improves assessment quality and contributes to a shared language between planning, construction, and certification. In the expanding field of circular timber construction, this consistency is of particular significance.

Acknowledgement

The research conducted within the RE:wood project is funded by the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) on behalf of the Federal Ministry of the Interior and Community through the Zukunft Bau research program. We gratefully acknowledge the Madaster Deutschland GmbH as a practice partner, whose collaboration contributes significantly to the practical application and validation of our research outcomes.

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