THE CURRENT STATE OF CIRCULAR ECONOMY IN CONSTRUCTION IN FINLAND

A Review of Finnish Research and Literature

Arctic Construction Cluster Finland

Pohjois-Suomen rakennusklusteri ry
Kasper Karjalainen

Table of Contents

Introduction

Circular economy is the antithesis of a linear economy. In a linear economy, products are manufactured, consumed, and discarded, leading to emissions, waste, and energy inefficiency. In contrast, a circular economy does not continuously generate new products from virgin raw materials; instead, it maximizes the utilization of previously created materials. The goal of circular economy is to reduce consumption, minimize the amount of waste and losses, increase reuse and recycling, and enhance overall efficiency. Sharing, renting, repairing, and refurbishing also contribute to the realization of circular economy. (1). In the construction industry, the benefits of circular economy are recognized, yet the transition to circular practices is perceived as slow (2).

The measurement of circular economy in construction is challenging due to the lack of a unified methodology. Nevertheless, companies have developed various metrics for assessing circular economy practices. These metrics are being investigated in a collaborative Nordic project with the aim of establishing a cohesive method for measuring the implementation of circular economy principles (3). In Finland, the state of circular economy in construction is described, for instance, through indicators such as recycling and utilization rates of waste, as well as findings from various surveys. The recycling rate illustrates the extent to which waste is reintroduced into circulation, excluding energy recovery, in contrast to the utilization rate (4).

The Green Building Council Finland has organized nationwide webinars on circular economy and low carbon emissions throughout Finland in the years 2021 and 2022. During these webinars, participants were asked about their experiences with the state of circular economy in the real estate and construction industry. The same survey was repeated among respondents in the year 2023. According to the feedback from respondents, the perception was that circular economy in the Real Estate and Construction industry had not progressed significantly between 2021 and 2023. Some progress was noted in material and construction product development, planning, and education. It is important to note that respondents to the survey were already interested in circular economy, which may lead to an emphasis on perceived challenges. (2).

Legislation and Standardization

Finland is committed to the collective European Union goal of utilizing 70% by weight of construction and demolition waste by the year 2020. However, we have not achieved this target, as our recycling rate remains below 60%. Consequently, a new deadline of the end of 2027 has been chosen. Construction waste is divided concerning renovation and new construction, with renovation generating 85% of all construction and demolition waste and new construction 15%. (5). Renovation encompasses extensive demolition, including the dismantling of entire buildings, making its share significantly larger than that of new construction. Nevertheless, there are projects or entire cities where the recycling rate of construction and demolition waste exceeds 70%.

The forthcoming building legislation reform in Finland, scheduled for 2025, aims to further promote circular economy principles within the construction sector. This reform introduces new technical requirements for buildings, specifically focusing on their life cycle characteristics. Life cycle characteristics encompass reusability, durability, and flexibility, from which project initiators are required to select at least one for consideration in the building design process. (6). With the advent of the new government, additional changes to the building law are anticipated, introducing uncertainties about the retention of these life cycle characteristics in the legislation (7).

Reusability is the most straightforward concept aligning with circular economy principles. It entails designing a building in a manner that allows it to be deconstructed intact and relocated or used as components in another structure. Durability and flexibility, from the perspective of circular economy, go hand in hand. Both aim to ensure a prolonged lifespan for the building. When focusing on durability in design, attention is given to the materials and their longevity. On the other hand, designing for flexibility involves considerations of structural systems and the adaptability of spaces. (6). In accordance with the waste hierarchy, the most valuable approach is to keep things in use for as long as possible, and durability and flexibility specifically support this. The second most valuable aspect is reuse. Reusability aligns with the principles of a circular economy, but from a circular economy perspective, durability and flexibility are even more valuable.

In 2023, a glossary for circular economy in construction was developed in Finland. Unlike in the English language, Finnish lacks distinct terms for various types of deconstruction. For instance, both "demolish" and "disassembly" are translated as "purkaminen" in Finnish. Additionally, terms such as "upcycle" and "downcycle" are not recognized in Finnish; only the term "kierrätys" (recycle) is used. The glossary for circular economy in construction provides definitions for "upcycle" and "downcycle" as processes that respectively add value or reduce value in recycling. (4).

In Finnish, terms such as "uusiokäyttö" (reuse) and "uudelleenkäyttö" (recycling) are often used interchangeably, despite having distinct meanings. "Uusiokäyttö" or recycling refers to reutilizing the materials in a product for another purpose, such as in a different product. "Uudelleenkäyttö," or reuse on the other hand, means using the same product again, either in a similar or different context (4). Therefore, the development of this glossary and its active utilization are crucial for fostering clarity and precision in communication within the context of circular economy in construction in Finland.

Circular Economy of Concrete

In Finland, as well as in other regions, concrete is a widely used building material. Concrete, being notably heavy, offers a swift means to achieve waste utilization goals in demolition projects. The production of cement, a key component in concrete manufacturing, results in substantial carbon dioxide emissions. In Finland, in the year 2018, cement production contributed to 1.6% of the country's total greenhouse gas emissions (8). However, a significant amount of cement is imported to Finland, so the 1.6% does not cover all emissions from concrete construction. To mitigate carbon dioxide emissions, the recycling and the reuse of concrete become paramount in sustainable practices.

Typically, concrete is recycled as crushed concrete, from which reinforcing steel and other materials have been separated. The most efficient way to crush large quantities of concrete is often directly at the demolition site. In such cases, the necessary permits and equipment are acquired to produce recyclable crushed concrete. Before use, the crushed concrete undergoes testing to ensure its suitability for the intended purpose. Following successful testing, it can be employed in applications such as earthworks or as aggregate material in the production of new concrete (9).

ReCreate Project

The University of Tampere is leading the ReCreate project, which focuses on the reuse of concrete elements. The project aims to salvage well-preserved elements from buildings designated for demolition, even if they were not originally designed for reuse. Financed by the European Union, the project contributes to several United Nations Sustainable Development Goals. By 2023, the project has advanced to a stage where the demolition site has been cleared, and the salvaged elements are safely stored (10).

Initiated in April 2021, the ReCreate project is set to conclude on March 31, 2025. The early stages of the project involved extensive planning to ensure the careful and secure dismantling of elements. Substantial research has been conducted within the project, focusing on measuring the durability of structures and verifying the reusability of elements. Initially, the process of detaching elements progressed slowly, with only a few elements dismantled per day, given the unprecedented scale of intact dismantling in Finland. However, those involved in the demolition were surprised at how rapidly the process unfolded once the last elements were being dismantled at a rate of dozens per day. The efficiency of the demolition project was undoubtedly influenced by the shared understanding among all involved that they were undertaking something unprecedented, coupled with a collective commitment to the project's success. (10).

Low carbon Classification of Concrete in Finland

The Finnish Concrete Association has developed the BY Low Carbon Classification, a voluntary national method aimed at mitigating the CO2 emissions associated with concrete production. When utilizing the low carbon classification, concrete suppliers calculate their emissions based on the SFS-EN15804 + A2:2019 standard modules A1-A3. This comprehensive approach incorporates emissions from raw material acquisition and processing, raw material transportation to the production site, and the concrete manufacturing process. The low carbon classification serves as an incentive for concrete manufacturers to innovate and develop recipes with lower carbon footprints, often incorporating industrial by-products as binders. (11).

The low carbon classification exclusively pertains to concrete and does not encompass concrete reinforcement or other steels embedded in the casting. The manufacturer-calculated value undergoes third-party verification before being compared to a reference level. Subsequently, the concrete's low carbon classification is expressed as a Global Warming Potential (GWP) value. The reference level, denoted as GWP.ref, serves as a benchmark against which the GWP values are compared. The low carbon classes are categorized as GWP.85, GWP.70, GWP.55, and GWP.40, with lower values indicating reduced carbon dioxide emissions from the concrete (11).

WOOL2LOOP Project

Circular economy-friendly materials similar to concrete are under investigation at the University of Oulu. In the WOOL2LOOP EU innovation project, researchers explored the production of geopolymers from mineral wool. Geopolymers are manufactured using alkali activators and mineral by-products. In this project, geopolymers were produced by separating and grinding mineral wool, which was then mixed with blast furnace slag. To this mixture, alkali activator and aggregates were added, resulting in a product resembling concrete. (12).

Within the WOOL2LOOP project, beyond formulation research, efforts were directed towards collecting mineral wool waste from various demolition sites and utilizing it in different concrete products. The tested applications included concrete elements (hollow-core slab, facade element), various tiles and panels, as well as 3D printing applications. (12).

Building Products and Circular Economy

The handling and productization of demolition waste from buildings have already given rise to business ventures. Puhi Ltd manufactures biochar from recycled demolition wood, which can be used for soil improvement, filtration, or as an additive in animal feed (13). Another company producing biochar is Carbon Balance Ltd (14).

Inspired by the WOOL2LOOP project, EcoUp manufactures a product called Cubeco. In the production of Cubeco, the company employs mineral wool waste collected internally. The mineral wool is ground and utilized as a substitute for cement, from which modular building products are cast. Cubeco stands out as a versatile building element suitable for urban construction applications, including use in planting beds or benches. (15). An illustrative instance of Cubeco's application can be observed in Malminkartano, Helsinki, where it was utilized in landscaping and furnishing a park area (16).

Hiil Ltd harnesses by-products from the sawmill, planning, and construction industries. They use crushed, knotty, discoloured, or unclassified timber, which they carbonize, making imperfections and colour variations inconsequential. Carbonized wood can be used as upholstery material (17).

In August 2023, Kuljetusrinki Ltd opened a recycling facility named Hyötyrinki, which utilizes artificial intelligence in sorting. They claim a 100% utilization rate for the waste materials they process. (18). The recycling facility can be utilized, for example, in demolition planning, where on-site waste is collected in a mixed waste container, which is then delivered to the recycling facility for sorting.

Summary

In Finland, significant research, and development efforts, as well as events and workshops, are dedicated to the field of circular economy. Despite this, the economic model in construction remains predominantly linear. Nevertheless, the research and events have given rise to companies actively promoting circular practices in construction. Furthermore, major consulting firms have recognized the benefits of circular economy services and offer solutions to advance projects and, consequently, the entire industry towards circularity.

Transitioning to a circular economy cannot be achieved solely through the efforts of businesses; governmental support is essential. This necessitates a systemic change in the entire economic structure, a transformation beyond the capacity of individual companies or financial institutions.

In the upcoming years, ongoing research projects and impending legislative changes are expected to contribute to the advancement of circular practices. It is hoped that the outcomes of these studies will spawn new enterprises that translate research findings into practical applications, while legislative changes facilitate a departure from linear economic models.

List of sources

1. Kiertotalousosaamiskeskus. Kiertotaloudesta: Kiertotalousosaamiskeskus.fi. [Online] Kiertotalousosaamiskeskus. [Viitattu: 15. Joulukuu 2023.] https://www.kiertotalousosaamiskeskus.fi/mita-kiertotalous-on/.

2. **Lahtinen, Ella.** *Kiertotalouden nykytila - mikä muuttuu seuraavaksi.* s.l. : Green Building Council Finland, 2023.

3. Kassi, Tuuli. Kiertotalouden mittarit. *Rakentamisen kiertotalouden ajankohtaispäivät 2023.* Helsinki, 16. Marraskuu 2023.

4. Green Building Council. *Rakentamisen kiertotalouden sanakirja.* s.l. : Green Building Council Finland, 2023. ISBN: 978-952-69926-8-6.

5. Ympäristöministeriö. Rakentamisen kiertotalous. ym.fi. [Online] Ympäristöministeriö. https://ym.fi/rakentamisen-kiertotalous.

6. **Valtioneuvosto.** Hallituksen esitys YM/2022/47. *Hallituksen esitys eduskunnalle rakentamislaiksi ja siihen liittyviksi laeiksi.* 2022.

7. Ympäristöministeriö. Maankäyttö- ja rakennuslaki: ym.fi. [Online] https://ym.fi/maankaytto-ja-rakennuslaki.

8. Betoni. Tietoa betonista: Betoni. [Online] [Viitattu: 15. Joulukuu 2023.] https://betoni.com/tietoa-betonista/betoni-rakennusmateriaalina/sementti-seosaineiden-kaytto/.

9. Kinnunen, Elli. Betonirakenteiden kiertotalouden nykytila. *Saint-Gobain Finland ja Pohjois-Suomen Rakennusklusteri, Joululounas: Kiertotalous rakentamisessa.* 29. Marraskuu 2023.

10. Weijo, Inari. EU-horizon -hanke: ReCreate. *Saint-Gobain Finland ja Pohjois-Suomen rakennusklusteri, Joululounas: Kiertotalous rakentamisessa.* Oulu, 29. Marraskuu 2023.

11. Suomen Betoniyhdistys ry. Vähähiilinenbetoni.fi. [Online] [Viitattu: 15. Joulukuu 2023.] https://vahahiilinenbetoni.fi/.

12. WOOL2LOOP. *WOOL2LOOP Final report.* 2022.

13. Ikonen, Päivi. Kemiamedia.fi. [Online] 21. Marraskuu 2023. [Viitattu: 15. Joulukuu 2023.] https://www.kemiamedia.fi/biohiilta-purkupuusta-liperilainen-puhi-valmistautuu-ensimmaisen-tuotantolaitoksensa-kaynnistamiseen/.

14. Carbon Balance Oy. Carbonbalance.fi. [Online] [Viitattu: 15. Joulukuu 2023.] https://www.carbonbalance.fi/.

15. EcoUp. Tuote: Cubeco.fi. [Online] [Viitattu: 15. Joulukuu 2023.] https://cubeco.fi/tuote/.

16. EcoUp Oyj. Kestavyysloikka.ymparisto.fi. [Online] 8. Elokuu 2023. [Viitattu: 15. Joulukuu 2023.] https://kestavyysloikka.ymparisto.fi/suomen-ensimmainen-uusioraaka-aineista-rakennettu-puisto-valmistui-malminkartanoon/.

17. Hiil Oy. Kiertopuu: Hiil Oy. [Online] [Viitattu: 15. Joulukuu 2023.] https://hiil.fi/kiertopuu/.

18. Kuljetusrinki Oy. Hyötyrinki kierrätyslaitos: Kuljetusrinki Oy. [Online] [Viitattu: 15. Joulukuu 2023.] https://kuljetusrinki.com/hyotyrinki-kierratyslaitos/.