

PEIKKO WHITE PAPER



**Circular
economy** |



THE JOURNEY INTO CIRCULAR ECONOMY

– MILESTONES AND SETBACKS ON THE ROAD TO THE CIRCULAR ECONOMY.
THE CASE OF PEIKKO.

Published: 12/2023

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WHITE PAPER

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1. Abstract

Peikko, a building materials company, has made a circular journey that has been winding and rich in different events. The journey has included both great successes and complete blunders. Change should always begin from the top and back in 2016, Peikko's management realized that the global building industry was in immediate need of change. In Peikko, this was recognized as a need for developing the solutions to enable the reuse of the building components, produced with the minimized environmental footprint.

It was clear from the beginning that the change could not be carried out alone, but finding the right stakeholders for cooperation is crucial. By participating in various events and through open discussions, it started to be clearer what else it takes to be in the frontline of circular change: One must try things out in practice, find and empower dedicated people, the solutions should be developed to be internationally scalable and based on scientific proof, and one must remain flexible for meeting the requirements of the changing environment. By following these fundamentals and taking steps both forward and backwards, Peikko has proceeded towards circular solutions and claimed its position as one of the forerunners of its niche field.

2. Rethinking of the business strategy required – a necessary shift towards circularity

Peikko Group Corporation, a company specialized in concrete connections, composite beams and wind turbine foundations, was established in 1965. During the 1990s, it began its export activities to other European countries and took the early steps toward internationalization by establishing its own sales teams outside of Finland, starting with its first one in Germany in 1997. A faster pace of internationalization began for the company in 2005, when its first production units outside of Finland were established.

From the time of its launch, the various solutions of Peikko have offered benefits for the construction sector, particularly to the concrete precast industry, with the aim of making the industry faster, safer and more efficient. But approaching the years 2016–2017, it was time to rethink whether these targets were enough for the years ahead. How would the pressures on the environment need to be considered at Peikko? Can Peikko make a change in its industry - is it big enough to make any real change by itself in its industry? What are the expectations of the future employees of Peikko with regards to sustainability?

One could ask why the time to rethink was during 2016–2017, and not before. Certainly, some sustainability work had been done by Peikko before, but the push from the market had not existed. This could be explained in part by the business cycle: the European construction market had experienced deep recession after the financial crisis, and the years 2009–2014 were still years of survival, hardly a time to think about development. Also, the external pressure from EU regulations was solely focused on measures to save energy, not on anything else.

Was the development need or the future business potential of Circular Economy pointed out by an industry-specific consultant? In one way or another, yes, as is examined in the following chapter. On the other hand, the process of “changing the mind” did not take place in planned strategy sessions, but unconsciously in talks with multiple industry partners, all of whom were trying to understand what may be worthwhile to do and what may not.



Figure 1: Topi Paananen and Kasper Guldager Jensen, during the practical tests of spraying out the lime mortars from Peikko's wall shoes in 2017.

3. Change began from the top – by chance

Peikko had launched a product called TENLOC® in 2015, a connection that worked like an IKEA connection between two precast wall elements – with a primary aim to simplify the precast wall assembly work. It was a “dry connection”, where very limited grouting concrete was required for the connections, and thus in theory the precast wall elements could be taken easily apart as well. This feature was by chance noticed in 2016 by a Danish architect from architect office GXN, **Kasper Guldager Jensen**, when he was trying to find solutions for circular economy in the construction industry. Kasper used the product TENLOC® in his research presentations as an example and also made one presentation featuring Peikko’s images in a seminar in Helsinki. An architect who had seen the presentation contacted Peikko’s CEO Topi Paananen and told him: “You need to see this man, he is making the world circular, and he has your products in his presentation.”

GXN and Kasper had also initiated a Danish pilot project *Circle House*, with an aim to build residential multi-story housing units with circular economy principles. A mock-up unit was built in Copenhagen, and Peikko’s team in Denmark was involved in this project and provided connections for it.

Contacts between Kasper and Topi were soon established, and in the beginning of 2017, Kasper found himself as a non-executive Board Member of Peikko, also giving speeches in internal Peikko management events on Circular Economy. A research project was also organized between GXN and Peikko, with the end result being the white paper *The Roadmap for Circular Economy*.

The roadmap made in 2017 described what Peikko had so far done with regards to work to better the environment, how Peikko’s existing products are potential solutions for the Circular Economy, and what could be the next steps to boost circularity at Peikko. During the process of making the project with GXN, it was also understood that many things had already been done, e.g., Peikko already had the first versions of Environmental Product Declarations (EPDs), Peikko had already supported various certificates such as LEED and BREEAM, and Peikko had worked for carbon calculations in various school projects in the UK.

When making the roadmap, it was also understood that the regulative framework for construction in Europe may see a big change in the years to come, including with regards to circularity. The first steps were already seen in the Netherlands, and some end-customer demand was also building up. Peikko felt that it was doing the change at the right time.

During Peikko’s management meeting in November 2017, the disassembly of the structures was piloted by arranging practical disassembly tests with special grout systems. The work was executed with the full commitment from management, since both Kasper and Topi were put into action and had fun with it.

4. Find out the right cooperation partners for your business – the failure of the Nordic Circular Building Alliance

During 2018, it became clear that Peikko could not make a difference alone. There were some visits done, e.g., in the Ellen McArthur Foundation meetings, but it was soon understood that although these generic Circular Economy organizations were doing brilliant work, they did not provide a platform for Peikko to join forces within its own industry.

In 2018, Kasper Guldager Jensen and Topi Paananen decided to establish a new organization, an organization whose aim would be to boost Circular Economy within the building branch, namely around building frames. The aim was to create an international organization, firstly in the Nordics (Denmark, Sweden, Norway, and Finland), with the aim in 1–2 years to have the first pilot projects done with the circular mindset. GXN & Peikko joined forces to form *The Nordic Circular Building Alliance*.

With GXN as an architect partner and Peikko as a steel structure partner, the aim was to attract a structural design company, a precast concrete company, a structural timber company and a construction company for the alliance. With this critical mass, the alliance would be large enough to execute pilot construction projects for advanced investors who wanted to construct buildings with a circular design. The alliance had a website, a memorandum, and had ongoing discussions with investors. A leading Nordic design company and a leading Nordic precast company committed to the alliance, and there were high hopes that the work of the alliance would get underway in 2019. Unfortunately, it did not.

What went wrong? The critical mass would have required at least a construction company to be a member, and the partners were not able to convince any Nordic player to join the alliance. Companies were simply having too many initiatives ongoing with regards to sustainability or had financial difficulties where no new ventures were approved by their management. Also, the timber companies did not see the value of circular economy, and some of them had simply a very narrow view of business – they considered the cooperation with steel and concrete players unethical or simply not competitively wise, as they were lobbying fiercely for full timber-frame buildings.

The initial aim of the alliance was to be regional, as it was understood that to be in one country would not create adequate critical mass for action. However, when looking for a construction company partner, it was clear that the regional Nordic view was difficult for many targeted companies – companies were organized by country and were not able to think regionally, regardless of what was suggested by their websites.

Furthermore, one could also question whether the years 2018–2019 would have been the right ones to initiate this kind of alliance. The idea may have been simply ahead of its time – and could have worked well some years after. On the other hand, during these 3–4 years, the international organizations such as the World Green Building Council have evolved, and thus the need for the Nordic Circular Building Alliance, if launched today, would be questionable.

5. Circular Economy vs. Sustainability – Stepping from pure circularity to adding sustainability

From 2017 to 2019, Peikko was focused on pure Circular Economy-based thinking, where Peikko's principal aim was to facilitate the re-use of the building components, such as beams, columns, or slabs. From 2019 to 2020, there was a growing need to crystallize the thinking with regards to general sustainability, as the regulative pressures to lower the CO₂ emissions from the building components became evident. Thus, even though the Circular Economy thinking was solid in the long term, something also had to be made in the short term.

It needs to be addressed that there seemed to be a clear trade-off or conflict between Circularity and reducing CO₂ emissions. It was understood that both actions were necessary, but required framework and solutions more expensive for customers. And if CO₂ emissions were a more acute problem, focus of regulative framework and customer investments went also in that direction. This was seen as a logical step by the authorities and customers, but at the same time, undermined the importance of the Circular Economy initiatives of Peikko.

Based on the demand received from the Norwegian customer, Peikko developed a low-carbon alternative of its beam product, DELTABEAM® Green, and launched this into the market in summer 2020. The company was one of the first ones to be able to manufacture structural steel components made from scrap-based steel, by giving the required EPD certifications – implying 50% less CO₂

content than a normal product. Again, management had very high expectations, however, apart from a couple of projects in Norway, the product was a huge commercial failure. Regulative framework was only under initial discussion, and customers were not willing to pay any percentage of premium when the legal framework was not yet clear. Only three years later, in 2023, the product became a success. This case once again shows that green concepts are not necessarily immediate successes but may need a longer time frame to reach maturity in the marketplace.

In addition to the DELTABEAM® Green product, Peikko also started to investigate whether it could develop some new technical solutions to improve the penetration of timber structures in multi-story buildings. During the period from 2020–2022, it created a series of timber connections called PUUCO® and made various experiments with its DELTABEAM® products combined with timber slabs, such as large-scale loading and fire tests. The goal of Peikko was to facilitate (with its steel components) the use of timber in construction, again to be able to reduce the CO₂ emissions of the frame structure.

From 2020 to 2021, for general sustainability-related topics, Peikko also defined the so-called Sustainable Development Goals, based on the UN classification. One of the goals was to prioritize and classify all the Research & Development activities based on sustainability criteria – thus, the projects entailing the features of Circular Economy & Sustainability had more focus from the management.

One could argue that without the focus of Circular Economy from 2017 to 2019, the above products and approaches would not have been made, at least not as early as they were.

6. Dedicated persons for Circular Economy – which failed, which worked?

In May 2019, Peikko recruited a full-time person, an experienced architect working in a home office in another Nordic country, to lead the development of its initiatives on Circular Economy. Unfortunately, the person ended up working with Peikko for less than a year.

Why was the recruitment a failure? A new project of this significance would have required a person to work closely with a team, preferably from the headquarters, to be able to have the similar vision and targets as other persons in the company. Also, it was understood that general knowledge was not enough to develop circular solutions for Peikko, as the person would have needed better technical knowledge of Peikko's specific solutions.

In 2020, **Jaakko Yrjölä** was nominated to be the leader in the technical development of Circular Economy projects, and at the same time, he started his PhD work at Aalto University on the subject. Jaakko's office was at Peikko's headquarters in Lahti, Finland, he had already more than seven years of experience for working for the company and thus had solidified the necessary network at Peikko, and he had a technical skillset to run R&D projects.

Later, the team was strengthened, and the existing Product Development team members started to focus more on sustainability-related projects. In 2023, more than half of all of Peikko's new product development efforts focus on sustainable or circular solutions.

Figure 2: DELTABEAM® Green, a product with 50% of the CO₂ emissions of the original one.



7. Circular Economy – science-based, solid technical background needed

The amount of standardization supporting the dismantling and reuse of building components is still thin. The ISO 20887 standard provides guidance about the principles of design for disassembly and adaptability, but there is no unambiguous definition for demountable connections. It was soon understood that more practical evidence would be needed to support the claim of demountability and reusability of building components.

Peikko's pilots were done in three phases. First, some small column piloting was done to understand the principles of the demountability of structures. Second, a larger structure was assembled, disassembled and reassembled with clear cooperation partners. Thirdly, Peikko took part of a real building, to be used by real people, and this building was designed and built using Circular Economy principles.

7.1. Pilot 1: Precast Column Assembly

The first small-scale experiments in late autumn 2019 included dismantling and reassembly of short precast column samples. Three concrete blocks measuring 500×500×500 mm were cast inside the ground and equipped with anchor bolts. Precast columns measuring 350×350×1500 mm were equipped with column shoe inserts and installed on the bolts. Connections were finished by grouting the gaps between the structures with Fescon's JB 600 (class C50/60).

In two of the connections, the precast surfaces were treated with release agents to reduce the bond between grout and precast structures. Those release agents were demolding oil and thin steel plates. The third of the connections was executed by the usual means without any treatment of joint faces.

While using release agents improved the demountability of the connections, the third connection also showed promise. Hardened grout pad was removable by using a jackhammer and the connection was re-established by cleaning the threads of the anchor bolts.

The results of the test were promising – Peikko is capable of testing the concepts, and the initial ideas work in practice.

7.2. Pilot 2: Full Precast Frame Assembly

Initiated and motivated by the results from the first pilot, the second, larger scale mock-up, was arranged in 2021. Instead of dismantling and reassembling simple column pieces, the whole load-bearing frame was considered. Since Peikko does not produce concrete structures, it was also important to find the right partners for cooperation. The precaster Consolis

Figure 3: Peikko carried out pilot tests in three phases to be able to offer Circular Economy solutions for third-party customers.



Pilot 1: Precast Column Assembly

Aim: To verify the demountability of a bolted connection for precast structures

Pilot 2: Full Precast Frame Assembly

Aim: To verify whether the concept can be scaled up to the whole load-bearing frame

Pilot 3: Residential building

Aim: To prove that the concept can be used in a real building

provided needed precast elements, and the tests were done in cooperation with TSS, a company training precast element assembly professionals. The load-bearing frame, standing over three meters tall and with 48 m² of surface area, consisted of Peikko's DELTABEAM® Green composite beams, precast columns and hollow core slabs. As it was already concluded from the first pilot, bolted connections are the key to effective dismantling of structures since they can be loosened as easily as they can be tightened. The principles of bolted connections were thus applied throughout the whole load-bearing frame.

The dismantling took place over a month after the assembly. As dismantling processes, in-situ grouted joints were opened by saw-cutting and removed by using a jackhammer, bolted connections were loosened, and structures were removed by a crane operator. No visual damage was observed in the structures after dismantling.

Reassembly of the structures took place as smoothly as the first assembly by utilizing the same connections.

The conclusion was clear, the bolted connection technology provides the technical feasibility to enable the effective reuse of precast structures.

7.3. Pilot 3: Residential building

The best practices learned from the pilots were implemented in residential house, the first of its kind in Lahti, Finland designed for dismantling in 2022. By maximizing the use of bolted connections, the whole load-bearing frame could be designed based on principles of Design-for-Dismantling.

In the project, the owners receive a house with demountable and reusable load-bearing structures with only small additional costs. This is an essential factor. The economic and environmental impacts of dismantling and reuse processes should be less than that which is gained from producing brand new building components.

7.4. Considerations for the future

Questions are often raised about systemic and economic challenges related to the reuse of building components. How can one control the stock of old, dismantled building components for sale? How can their fit and condition be ensured for meaningful second use? There are questions, which have not yet been answered, but finding solutions for them starts with an assessment of technical feasibility. One of the biggest problems with existing building stock is that it is not designed

for dismantling, which means that their reuse is instantly much less practical and expensive or even impossible. If we start to apply principles of Design-for-Dismantling (DfD) to our new buildings from now on, the future engineers and contractors have that possibility. And it is more than certain that business models, normative regulations, digital platforms, etc. will all develop within the coming decades. So, when the owners of the residential building in Pilot 3 decide to get rid of the house in the distant future, they will surely have more sustainable and economic options than using a wrecking ball.

Naturally, the full reuse of building components requires active storage of the 3D model of the building, which, according to local regulations, will be stored by the city municipality. A marketplace or market participants also need to evolve, whereby the buying and selling of structural components can happen and where demolition companies can master the right techniques to implement the dismantling. Also, there needs to be a regulative framework in place to allow the reuse of the building components.

All of the above factors are already a reality in some parts of Europe, so there are no technical challenges as such. But all of these factors need to be available in the city and country in question where the Pilot 3 was done, and it may be several years before this will become reality.

8. Cooperation within the industry is imperative

8.1. Construction Goes Circular – the challenge of thought leadership

At the time the unsuccessful Nordic Circular Building Alliance was buried, in late 2019, Peikko was approached by its home city in Finland, Lahti. Lahti had received a nomination to be the European Green Capital 2021, a title given by the European Commission to cities that have been successful in environmental matters, and cities that aim to further speed up this work. The representatives from Lahti came to Peikko to ask how Peikko could benefit from the city's nomination.

In January 2020, just months before the COVID-19 pandemic broke out, Peikko agreed together with two organizations (Green Business Council Finland and ISCOWA) to jointly organize something that had never been done before – a large-scale international conference called Construction Goes Circular, to be held in October 2021. This conference was to be marketed under the umbrella of the European Green Capital 2021, and naturally to be held in the home city of Peikko, Lahti.

Due to the pandemic, the conference naturally did not take place in October 2021, nor were the other events during the European Green Capital 2021 venture very successful. After several delays, finally in October 2022 the conference took place, with a set of eight international speakers and some 180 participants. The focus of the conference was not only on speeches but on facilitating networking between the participants. The first step was taken, and the second conference will be held in October 2023.

Why was the launch of Construction Goes Circular a relative success, despite the delays caused by the pandemic? First, during the previous alliance discussions, a lot of contacts had already been created, both to get relevant speakers and audience. Secondly, Peikko was also able to find partner organizations that were willing to cooperate. Thirdly, Circular Economy as a concept is becoming more and more widely known – the construction industry participants began to understand that recycling building components is starting to make sense and will require new solutions.

During 2023, it is way too early to know whether the conference will really take off as the annual event where the thought leaders of circular economy and construction in Europe would meet. Nevertheless, due to the conference, Peikko's customers now view Peikko as an expert on Circular Construction – Peikko is seen as a company that contributes to building an eco-system in this field.

8.2. The need to be selective in collaboration

On the matter of dealing with the systemic and economic challenges of reuse, there is always more strength in a group than amongst individualists. Peikko has proven the technical feasibility of its connection technology, but collaboration is the key to overcoming all challenges stigmatizing the reuse of building components.

During the years 2017–2023, there were more than 10 requests for Peikko to join various research projects, with all of them having some component of public funding included. Either national or EU-level funds

Figure 4: The Construction Goes Circular conference, held with the aim of creating thought leadership within the selected industry segment.



had been made available for Circular Economy-type of projects, and various institutions and companies have been eager to get these funds, at times even without realistic targets. There has been a clear need for Peikko to be very selective about which projects to be a part of and which not. The projects may offer a good opportunity to collaborate with other industrial partners, but at worst, they are only formed to keep some researchers busy and get them paid, leading to no results but a lot of bureaucracy.

One of the projects Peikko decided to be part of in 2023 was initiated by Tampere University (TAU) of Finland, a project called DfD-Ecosystem with both academic and industrial partners. There, the first target is to produce descriptions of value chains and functioning ecosystems for DfD concrete structures. Secondly, there is a need to produce standardizable structural solutions to support the further development of design standards. Both actions are designed to remove the barriers distracting the reuse of precast structures.

The project is planned to be carried out within a couple of years and consists of nine research packages, which are all focused on solving different challenges. Involvement of industrial partners is crucial to developing systems and solutions suited to commercial use, one of the main drivers and motivations of the research project.

This special project concerns Peikko's original home market of Finland, and it is important to understand that in the field of construction, solutions and future value chains with regards to Circular Economy may differ significantly in the future, even within the EU. Therefore, a lot of insight per each and individual market is and will be needed.

9. Conclusions

Peikko's journey into circular economy is just in the starting phase. Nevertheless, during this journey Peikko has been able to create a significant turnover from products with lower CO₂ emissions, or from products that have otherwise enabled construction with lower CO₂ emissions. Without the focus on Circular Economy in 2017, these products would not have been created.

Peikko's sales of products that enable the easy disassembly and reuse of building components are still marginal, however, Peikko is in the leading position when the markets are ready for them, with several patented solutions. Peikko has also been able to generate a lot of positive publicity and good will from its customers on its circular and sustainable solutions.

In summary, the following factors could be seen as vital for any company for its journey into Circular Economy:

- ▶ **Leadership must understand the business value, and the possible changes in the company's business model.**
- ▶ **The company must have a long-term view, as changing a business model is not a fast-track exercise.**
- ▶ **For many businesses, a partner network or ecosystem needs to be built. The network is evolving over time, and it needs to be constantly fine-tuned.**
- ▶ **Practical tests and piloting are more important than fancy statements. The concepts are oftentimes theoretical, and they are understood by the market players only via very practical, down-to-earth tests.**
- ▶ **It is essential to have the right organizational force and responsibilities, not only from senior leadership, but also from the technical personnel who develop the products and concepts. When business models change, it is important that all employees are ready to modify their thinking.**
- ▶ **In Circular Economy, different markets or geographical areas act at different speeds or are at different levels of maturity at different times. When a company is planning its actions, a market-based approach is in many industries a must.**

All in all, even medium-sized companies may at best give a significant boost for Circular Economy in their relevant industry. When searching for ways to change the world for the better, companies need to have both aggressive and idealistic targets, while also being very realistic as they examine the timeline of the change and their own capabilities.

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This White Paper has also been published as a chapter in the book "Circular Excellence – Strategische Ansätze auf dem Weg zur Circular Economy", authored by Martin Granzow, in autumn 2023.



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