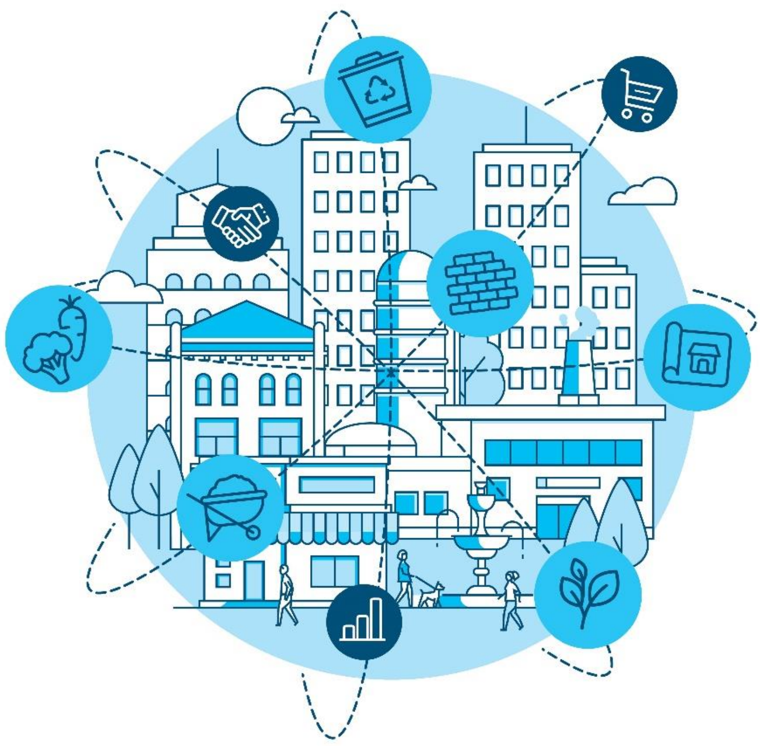
Circular demolition in Roskilde

Extract from the Demonstration Report

Roskilde, Denmark



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This text describes Roskilde's experience in applying circular demolition tools in the partial demolition and transformation of some secondary buildings. The sections come from Roskilde's CityLoops demonstration report available here.

Introduction to demo actions in Roskilde

The transition towards a circular build environment requires new approaches to construction, demolition and urban development. In the EU 2020 project CityLoops, the municipality of Roskilde, have developed procedures, methods, tools and generated knowledge to promote a circular transition, through a series of demonstration projects. These activities were based in the urban development area Musicon, a transformation of an old concrete factory and former waste deposit. The area contains a series of production halls, and the development of the area focuses on preserving the industrial aesthetic as well as the existing buildings, to be a hub for creativity, music and cultural activities.

The demonstration projects concern the 1) partial demolition and transformation of some secondary buildings, 2) construction of two Car Parks and 3) circular soil management in the area.

Transformation of Hall 11 & 12

Hall 11 and 12 are secondary buildings situated in the demonstration area. Hall 11 will be partly demolished and materials from the demolition incorporated into other construction projects. all 12 is preserved and renovated keeping its current function as a skatepark. Some of the high-quality aggregates such as steel structures are dismantled and preserved. Hall 12 will be connected to one of the car parks.

To secure the quality of the materials, the following actions was applied:

- pre-demolition audit and selective demolition was performed to preserve and document the materials.
- material passport afterwards documents the quality of materials and possible application.
- virtual material bank was developed using Building Information Modelling (BIM) for information on regulations, quantities, material types, etc.
- Life cycle assessment (LCA) on selected materials is performed to support decision making by revealing the carbon emissions impacts of different handling options.

Lifecycle CO2 calculator for construction materials

Lifecycle CO2 calculator - soil

The tool calculates the CO2 impact of excavating and moving soil from a site. In the demonstration phase, the methodology has been applied to planned soil movements in Musicon, including related to the demolition and reconstruction works of hall 11/12, and is also considered in the procurement/ bidding process for the demolition works, to encourage site soil balance.

<u>Lifecycle CO2 calculator - Concrete</u>

The tool calculates the lifecycle CO2 impact of using and demolishing concrete. This tool will be used in the Hall 11/12 pre-demolition screening to make decisions about the demolition and recycling of concrete. The tool will also be applied to other projects in the Musicon area.

<u>Lifecycle CO2 calculator - CDW</u>

The LCA tool for CDW (11 fractions) will serve as a planning and decision-making tool, specifically for the demolition process, helping you to make different decisions on whether to keep and refurbish, deeply renovate, or demolish a building by comparing a multi-material composite calculation. It will take into account the pre-demolition state, and post-demolition state of the CDW. The tool has been tested at Hall 11/12 and the methodology will be applied in other projects in Musicon.

CO2 calculator for soil

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Comments	LCI	
Cells marked in light blue, should be filled. All distances are calculated from site where soil is excavated.	Distance to end deposite, km	25
	Distance to local reuse, km	3
	Amount of soil, tons	9000
	Reuse percentage	100
	Use of wheel loader, hours	25
	Use of dumper, hours	25
CO2-emissions soil transport per tonne kilometre	Soil transport, kg CO2/tonkm	0,081
CO2-emissions crushing per tonne material, diesel crusher	Wheel loader, kg CO2/hour	25,68
CO2-emissions local transport	Dumper, kg CO2/hour	37,54
CO2-emissions full trailer combination, two way transport	Transport of loader and dumper kg CO2	135,13
	Kg CO2e per liter diesel	2,65

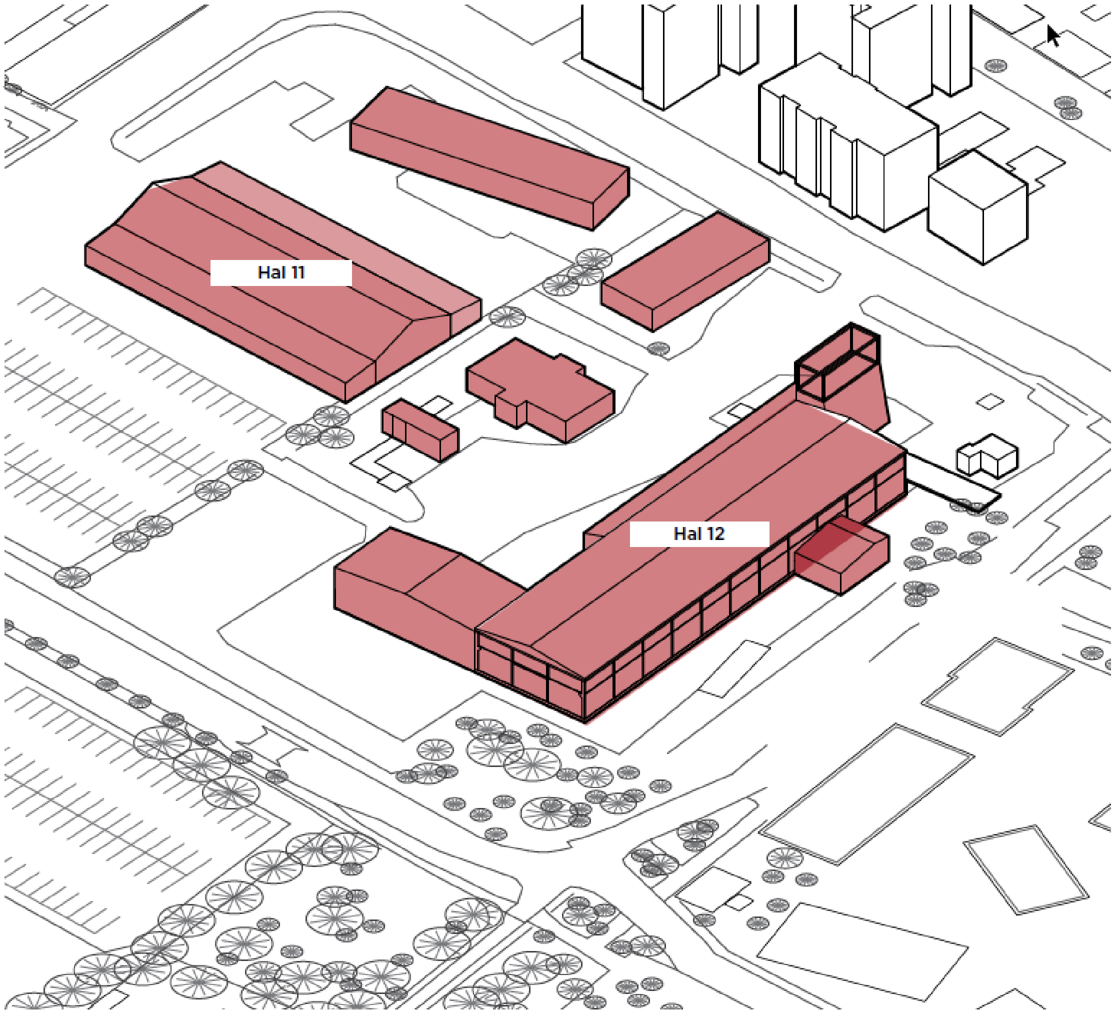
CO_2 saving potential

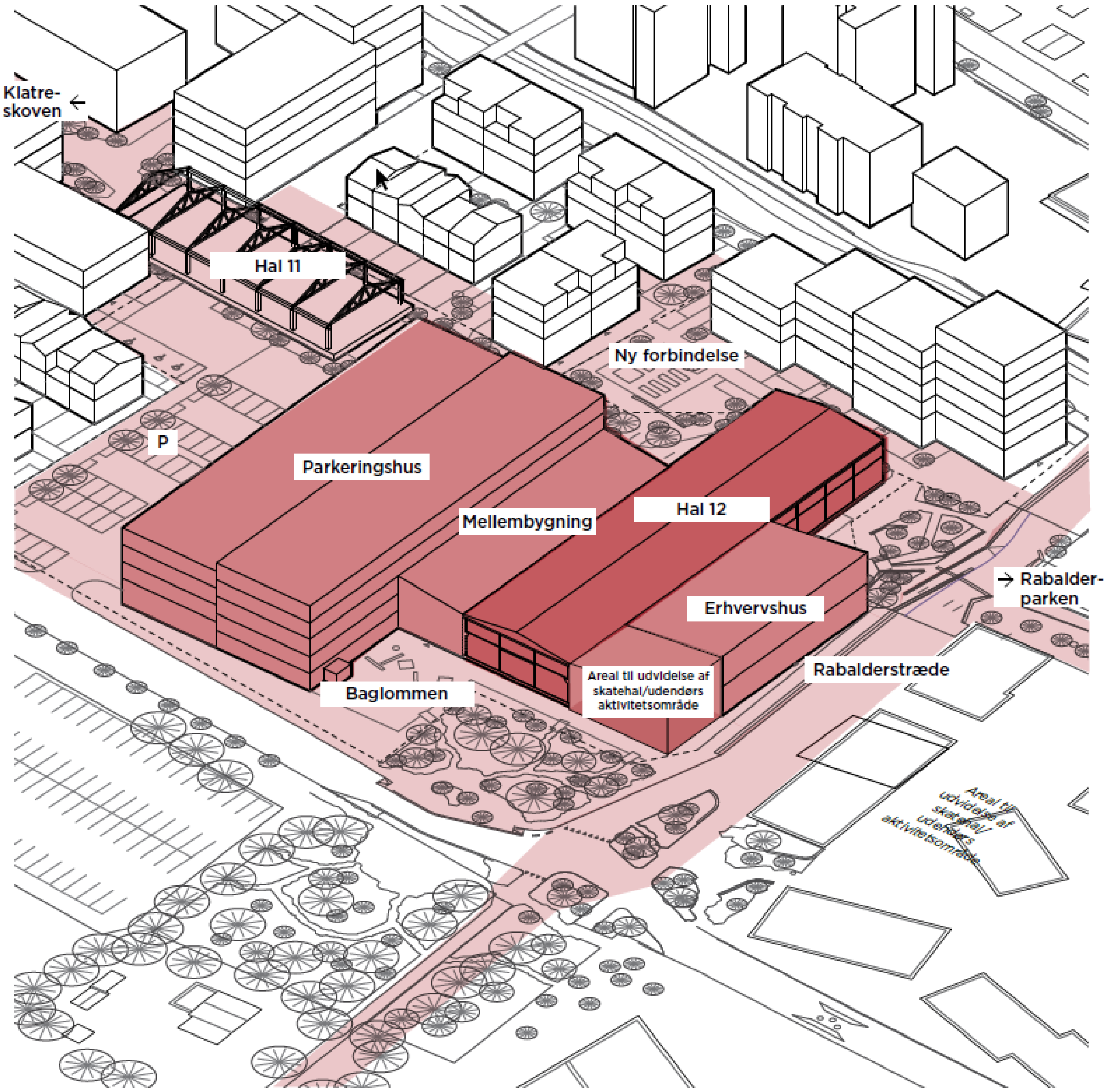
Soil transport	**Project CO2 saving**	**reference**
Transport to end deposite, kg CO2		18.293
Transport to site for reuse, kg CO2	2.195	
Use of wheel loader	642	
Use of dumper	939	
Transport wheel loader and dumper	135	
Kg CO_2	**14.382**	**Reference**

Partial demolition of Hall 11 and 12

Hall 11 is a secondary building situated in the demonstration area. It will be partly demolished and materials from the demolition will be incorporated into other construction projects. The function of hall 12 was and will remain a skate hall. Beams and pillars and the main steel structure of hall 12 will be preserved - therein lies the greatest savings in materials and CO_2. The building will get a new roof, new façade and new interior. Hall 12 will be connected with a new multi-storey car park by a roof spanning 12 x 45 metres.

The buildings had a pre-demolition screening and selective demolition will take place, keeping reusable elements in storage for reuse in new buildings and creating material passports documenting their quality and possible use. A virtual material bank will be created through design for disassembly using Building Information Modelling (BIM) for information on regulations, quantities, material types, etc. LCA on selected materials will aid in decision making by revealing the carbon emissions impacts of different handling options. Roskilde will also try to implement circular soil strategies in the project by minimising soil movement and facilitating reuse on site.





The transformation of Hall 12 should be carried out with respect and sensitivity towards the building's existing qualities and unique ambiance. These are characterised by:

- Graphic compositions
- Space for interpretation
- Uncompromising expressiveness

The goal is to preserve and enhance these characteristics during the transformation process, ensuring that the essence and atmosphere of Hall 12 are maintained. The graphic compositions within the space, along with the freedom for individual interpretation, contribute to its distinctiveness.

Graphic Compositions

The existing Hall 12 is a rational and simplistic structure with strong concrete pillars and beams, and long bands of windows above closed facades. The closed nature of the facades and the high-set windows give the hall a secretive and intriguingly dim appearance, which are qualities that are desired to be preserved in selected parts of the future skatepark, while the building as a whole opens up to the surroundings.

The large, uniform ceiling unifies the space and features visible concrete panels that, in contrast to the robust beams, appear elegant. The overall composition of large, simple surfaces and continuous lines holds exciting contrasts and graphic qualities that should be carried into the future skatepark - and should also be refined in the integration between new and old building elements.

Space for Interpretation

When the former concrete production facility shut down around the turn of the millennium, the factory buildings were not only emptied of content and activity but also of meaning. For skateboarders, the functionally empty hall became a space for interpretation, free from predetermined programs, with an inspiring invitation for new and creative interpretations. In Hall 12 today, one can observe rational, beautiful, and humorous encounters between the industrial remnants and the new functionality and expression.

Some of the industrial remnants should also be preserved to serve as reminders of the history and ignite curiosity.

Expressiveness through circularity

In addition to preserving the hall's industrial identity and raw environment, the transformation is also crucial for the project's sustainability, as the direct reuse of the building's structures will result in a significant reduction of greenhouse gas emissions compared to using new materials. Building preservation will therefore be complemented by the reuse of building components and materials. With this circular focus, the sustainability and aesthetics of the building begin to intertwine and become interdependent.

This circular approach aligns well with the municipality's overall work on sustainability in Musicon. Broadly speaking, the urban development of Musicon is a massive transformation project that upcycles a polluted former concrete factory, gravel pit, and landfill into a new dense and mixed-use neighbourhood. The development of the area incorporates a range of overarching and holistic sustainability principles that are put into practice and implemented throughout the area in specific construction and infrastructure projects.

Reusing the former industrial buildings and preserving traces of the industry as part of the area's identity and aesthetic expression has been a central aspect of Musicon's development. Roskilde Municipality has therefore gained previous experience in preserving structural building elements as character-defining elements in new construction and creating an entirely new aesthetic expression through a playful and unconventional use of recycled building materials.

Materials and Materiality

Prior to the renovation and expansion of Hall 12, a side building, a tower, and a canopy will be demolished, releasing construction materials that can be reused in the skatepark and thus recycled locally. The reusable materials have been carefully catalogued, allowing them to be gently extracted during the demolition and temporarily stored.

The renovation of Hall 12 provides an opportunity for a creative design process, where unconventional solutions can be explored, and surprising and playful aesthetic expressions can be created. The specific potentials for reuse will be investigated collaboratively with the involved design-build teams during an extended bidding phase.

In this work, emphasis will be placed on:

- Creative use of recycled materials that contribute to the development of a new, resource-appreciating aesthetic.
- Efforts to incorporate reuse in load-bearing structures.
- Minimization of construction waste through preservation or local reuse of materials that are extracted.

Drawings and photos on the opposite page illustrate the materials that will be released for reuse during the preceding demolition and where they may potentially be reused in the construction. Recycled materials from outside sources, such as windows discarded due to low insulation capacity, can also be added to the project.

In addition to recycled materials, a significant portion of the skatepark's materiality is expected to consist of plywood panels used for the floor, walls, and ramps. This will create a warm and soft backdrop in the hall, contrasting beautifully with the visible concrete structures. The plywood also provides acoustic dampening and serves as a good canvas for graffiti murals, which are expected to contribute to the atmosphere and architecture with vibrant colours and designs.

Furthermore, the skatepark will be enriched with architectural and artistic quality through the design of seating stairs/bleachers as prominent, sculptural, and inviting space-defining furniture, as well as the integration of a permanent artwork.

Screening procedure and selective demolition

Hall 11/12 has been screened for material inventory by Golder using the CityLoops guidelines. The selective demolition procedure will be applied to three buildings in the hall 11/12 area at Musicon, to identify and keep materials with potential for reuse.

The procedure was expanded to involve more key actors in the value chain. This meant in the case of pre demolition screening of Hal12 Special environmental consultants, architect, demolisher, contractor and representatives from the municipality were present at an initial planning meeting and later on at a physical inspection on site. At the physical inspection everybody was asked to keep an open mind and listen to others' experience and ideas. This kind of process demands very clear communication from the building client, in this case the municipality. If the purpose and frame for the work is not clear, many will not know how to act in the process. Basically, it is a creative process, and it was evident that the architect was familiar with the idea, but the environmental consultant on the other hand needed a bit more time and words before they were comfortable with the process.

We spend time talking about the process together in advance, so everybody grew to trust each other. This element of trust is key to understanding the procedure, since we will not be able to do anything, if elements like responsibility and risk are not kept open until later in the process. Everybody was encouraged to flag any elements of risk they were aware of at any time in the process. This meant that everybody felt secure to bring up risk elements, since it was our common responsibility to solve it. This again led to very fruitful discussions and creative problem solving in the process. As an example, a certain building element would be discussed, e.g., a fire door. The different members of the screening group would each have their own focus. The environmental consultant was worried about hazardous substances in the paint and sealant. The contractor focussed on dismantling the doorframe from the wall. The construction client focused on the value of the door opposed to a new door, and the architect loved the graffiti on the door. So, the procedure would start by determining the possible future use of the door. If the architect could see any use of it, the construction client would be asked whether he saw any use of the door. If it passed this initial test, the contractor was asked whether he could take down the door without ruining it for future use and without spending too many hours doing so. If the door still was interesting for reuse, the environmental consultant would be asked to test the door according to the agreed future use scenario.

The buildings have been screened by Golder (a contracted consultant) using the CityLoops pre-demolition guidelines along with the local procedure for pre-demolition in Roskilde.

The experience in Roskilde has shown the importance of involving all key actors in the early stages in order to minimise risk building.

Resource mapping

When a building is to be demolished or renovated, the developer is responsible for identifying and reporting any waste that may be classified as hazardous to the municipality. This is done through an environmental screening, which involves taking samples of the building components and materials involved in the construction project. It is through this screening that environmentally harmful substances are identified.

Before demolition or renovation, the building owner can conduct a more detailed examination of the building to map the available resources. This mapping provides a detailed overview of the materials suitable for reuse, recycling, and material recovery.

It was essential for the usability of resource mapping that it was carried out in the initial phase of the project in conjunction with or as an extension of an environmental survey of the building. The information about hazardous substances from the environmental survey was an important parameter for assessing whether the available materials could be considered resources or if they needed to be managed and disposed of as contaminated or hazardous waste. Together, these mappings formed the basis for subsequent planning and description of the demolition process.

Based on the resource mapping, the building owner could demand the extraction of demolition materials for reuse, recycling, or other forms of material recovery. For all materials that were removed from the building, sufficient information had to be provided to assess their circular potential.

'End of Waste' criteria for materials intended for recycling or other forms of recovery

Depending on whether the demolition material is intended for reuse, recycling, or recovery, there are different requirements for documenting its location, condition, environmental impact, etc. To achieve maximum transparency and flexibility, it is advisable to collect the same information for all materials intended for circular processes. This ensures that demolition materials can move from one category to another without requiring additional documentation in the regulatory process.

In Section 6 of the Waste Framework Directive (DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL), a series of conditions are listed that must be met for waste that has undergone a recycling operation or another recovery operation to be considered as ceasing to be waste. These are referred to as the 'End of Waste' criteria:

(a) the substance or object is commonly used for specific purposes.

(b) a market or demand exists for such a substance or object.

(c) the substance or object fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products; and

(d) the use of the substance or object will not lead to overall adverse environmental or human health impacts.

In other words, the above criteria needed to be addressed for demolition materials to cease being waste and be incorporated into new construction.

Requirements for reuse materials: "Reuse" referred to the reuse of products or components for the same purpose for which they were designed. An example of reusing construction materials from demolition projects was using bricks from masonry or entire floorboards that originated from the demolition of existing buildings and were reused in new construction as part of the masonry or flooring.

Construction materials from demolition projects that could be used for reuse were not considered waste and therefore did not need to be managed according to waste regulations. This meant that construction materials from demolition projects could be handled and freely sold by anyone, and it was not the responsibility of a municipal authority to grant permission for the handling of these materials.

Step-by-step procedure: In Roskilde Municipality, we aim to follow this procedure for all circular demolition of municipal buildings:

1. During the mandatory environmental screening, the circular potential of the demolition materials is assessed through a resource mapping, and the building owner decides to what extent materials should be extracted for reuse or other forms of recovery during demolition.

2. The 'End of Waste' criteria are assessed for all materials with circular potential.

3. A material passport is created and pre-filled for all materials with circular potential. The material passport accompanies the material throughout the entire process. The

material passport should contain at least the following information: a) Location of the building from which the material is extracted. b) Information about where the material will be stored until the time of reuse or recycling. c) Description of the material, including its dimensions and quantity. d) Test results from mandatory environmental screening and possibly resource mapping, including an assessment of the material's condition/durability. e) Assessment of the fulfilment of the 'End of Waste' criteria, including the expected future use and anticipated time of use. f) Photographic documentation of the demolition material.

4. Prior to demolition, a dialogue is conducted with the waste authority to provide an overview of which materials are expected to be reused, recycled, or disposed of.
5. Before demolition, the contractor applies for permission to dispose of materials deemed as construction waste.
6. Environmental inspections are conducted during the demolition process to ensure proper treatment of the demolition materials.
7. At the conclusion of the demolition, the information in all material passports is updated.
8. Prior to the reuse of materials, either the producing contractor/building owner or the receiving contractor/building owner applies for 'End of Waste' approval.
9. If materials intended for reuse are no longer desired, the material owner must apply to the waste authority, by the expected time of reuse stated in the material passport, for either permission to dispose of the material or permission for 'End of Waste' if the material is intended for recycling.
10. In case the reuse of materials is delayed, or changes compared to the expectations stated in the material passport, the material owner must inform the waste authority about the revised use or schedule for the material, prior to reuse or by the anticipated time of use stated in the material passport.
11. Upon completion of incorporating reused, recycled, or otherwise recovered materials, the information in the relevant material passports is updated.

LCA on selected materials have been performed as well. Selective demolition will take place between March – August 2023, keeping the main structure intact. Concrete recovered from the demolition will be crushed for recycling into new concrete in the construction of the new multi-storey car park.

This procedure was repeated for all relevant materials and ended up on a list with information on the materials location, future use scenario, need for further testing, number, etc. This list later on is transformed into the material passport.

Construction material passport, databank and digital market place

A material passport will be created for selected materials from the demolished buildings. A virtual material bank is sketched and will be used for hall 11/12 - both for materials going out (in the selective demolition) and in the new renovated hall. The first version consists of an Excel sheet for each material, describing its lifespan, what kind of testing it has to go through, and where it could end up in future uses. The virtual material passport and databank are merged in one database. The circular procurement strategy includes use of the virtual material bank to source and supply secondary construction materials. The data is extracted from BIM models and kept in a database.

Musicon, Hal 12 området: Materialepas

Materiale-kategori	Materiale	Lokalitet (Hal nr)	Reg nr.	Nærmere placering	Antal	Dimension	Foto	Miljøforhold: (A) Særlige arb.miljøkrav ved håndtering (skæring i materialet - afrensning af maling) (B) Særlige miljøkrav ved bortskaffelse som affald (C) Særlige krav ved genanvendelse og indbygning mht. indeklima (se *Miljøforhold* ark for nærmere beskrivelser)	Holdbarhed/ stand	Mulighed for/ metode til adskillelse	Potentiale (skriv bogstav) Genbrug lokalt (A) Genanvendelse lokalt (B) Genbrug / genanvendelse andetsteds (C) Bortskaffes (D)
Døre - træ/metal	Dobbelt trædør Venstre ud Venstre-gående	H12	**H12.H.5**	Hal 12 - nordlig ende - streetskate område. Udgang i vestlig facade	1	210 x 88 cm		Prøvetaget. Miljøforhold i maling: **A1** **B1** **C1**	God stand	Karmskruer skrues ud og døren inkl. karm tages forsigtigt ud. Dør opbevares fastmonteret i karm. Skruer og propper gemmes. Håndtag og greb afmonteres og opbevares sammen med døren. Døren stilles lodret på palle, med skråstivere monteret (som ved nye døre). Opbevares tørt og indendørs.	A Kan genbruges i ny hal 12
Døre - træ/metal	Dobbelt trædør Venstre ud Venstre-gående	H12	**H12.H.6**	Hal 12 - nordlig ende - streetskate område. Udgang mod silo i nordlig gavl	1	210 x 195 cm		Prøvetaget. Miljøforhold i maling: **A2** **B2** **C2 (PCB)**	God stand	Karmskruer skrues ud og døren inkl. karm tages forsigtigt ud. Dør opbevares fastmonteret i karm. Skruer og propper gemmes. Håndtag og greb afmonteres og opbevares sammen med døren. Døren stilles lodret på palle, med skråstivere monteret (som ved nye døre). Opbevares tørt og indendørs.	A - B Kan bruges til konstruktion i skure. Kan alternativt bruges indendørs hvis maling afrenses.
Døre - træ/metal	Dobbelt ståldør Venstre ud Venstre-gående	H12	**H12.H.7**	Hal 12 - nordlig ende - streetskate område. Udgang i vestlig facade	1	210 x 150 cm		Prøvetaget. Miljøforhold i maling: **A2** **B2** **C2 (metaller) (gennemsnitskoncentration)** **C2 (PCB)**	God stand	Karmskruer skrues ud og døren inkl. karm tages forsigtigt ud. Dør opbevares fastmonteret i karm. Skruer og propper gemmes. Håndtag og greb afmonteres og opbevares sammen med døren. Døren stilles lodret på palle, med skråstivere monteret (som ved nye døre). Opbevares tørt og indendørs.	A - B Kan bruges til konstruktion i skure. Kan alternativt bruges indendørs hvis maling afrenses.

Roskilde asks for the BIM in the tendering process for each building to be built at Musicon, to ensure such documentation is available for the future. Contractors need to provide a Revit/BIM model level of detail of each building with amounts/ types of materials.

PROCEDURE

Forudsætning for anvendelsen af materialepas er at det indgår i "Roskildemodellen", der er en procedure, hvor byggeaffald tages ud af affaldshierakiet og indgår som bygherreleverance under nogle bestemte omstændigheder.

"Roskildemodellen" består af fem faser:

1
Bygherre eller dennes repræsentant vurderer på baggrund af miljørapport/er, hvorvidt der er byggematerialer fra den kommende nedrivning, der har potentiale til genanvendelse/ genindbygning i fremtidigt byggeri. Hvis det er tilfældet, bliver det tilføjet som et udbudskrav til selektiv nedrivning, hvor nedriver får udfaldskrav til renhed af de pågældende materialer.

2
Når nedrivningen er overstået, bliver de nedtagne materialer kontrolleret i forhold til udbudskrav. Hvis de overholder de beskrevne krav, kan de testes yderligere for egnethed til genanvendelse. Det er typisk en specialrådgiver, der tester på foranledning af bygherre.

3
Når testresultaterne er kendte, kan bygherre vurdere, hvorvidt de nedtagne materialer er af en type, der:
A) kan genanvendes direkte uden yderligere undersøgelser
B) skal undersøges yderligere, før man kan vurdere egnetheden til genanvendelse
C) kategoriseres som byggeaffald og forlader materialestrømmen, fordi de fordi de er uegnede til genanvendelse.

4
Resultatet bliver derefter skrevet ned i et lokalt materialepas, der følger materialet videre i processen. I materialepasset kan man aflæse, om materialet er godkendt til genanvendelse eller yderligere undersøgelse, og man kan indskrive særlige begrænsninger for anvendelse af de materialer, der skal undersøges. Udover miljøforhold er der også anført byggeteknisk egnethed og begrænsning i materialepasset, der sammen med billede, mærkning og analyseresultater udgør en samlet dokumentation for materialet.

5
Den lokale byggemyndighed godkender genindbygning af materialer med medfølgende materialepas, hvis dokumentationen er fyldestgørende i forhold til det, materialet ønskes brugt til.

The tender of the demolition was prepared by the same consultant that participated in the screening and they were asked to procure a tender with the demand of taking all materials listed in the positive list out and preparing them for reuse. Therefore, the material passport list was part of the tendering material.

Gule felter: Kvalitetsikres af nedrivere forud for udbud
Grønne felter: Udfyldes af nedriver efter udtagning

Hal 12 - sidebygning (3)

	OPLYSNINGER TIL BRUG FOR UDTAGNING										OPLYSNINGER TIL BRUG FOR GENBRUG					
	Placering og omfang				Tilstand		Håndtering				Dokumentation efter udtagning *(udfyldes af nedriver)*					
Materiale	Bygning	Nærmere placering	Foto	Mængde/ antal/ dimensioner	Miljøforhold *(se ark om miljøforhold)*	Genbrugs-potentiale	Udfaldskrav/ ønsket kvalitet efter udtagning	Metode til adskillelse	Metode til pakning	Placering	Nummerering	Foto efter udtagning	Holdbarhed/ stand	Mængde/ antal	Dimensioner	Pakning
Træplader/krydsfiner.	H12, side	Nedre del af væg		Ca. 70 m²	Ingen, synes ubehandlet	Stabiliserende element i skurtag, interim eller skateramper	Hele plader	Skrues fra hinanden	Lægges på strøer	Indendørs lager, Hal 11, Pulsen 7						
Mursten, akustik-/hulsten, stående	H12, side	Indermure		Ca. 100 m²	Uden grafitti: Ingen, synes ubehandlet Miljøforhold i maling (grafitti): A2 B2 C2 (PCB)	Facadeparti i skatehal-passage	Flest mulige hele rene sten	Mursten nedrives nænsomt så stående mursten kan adskilles fra bagvedliggende mursten.	Mursten med grafitti udsorteres til deponi, og rene mursten samles i bunke og overdækkes med pressening.	Nærlager 1a ved Rabalderstræde 30						
Mursten, akustik-/hulsten, liggende	H12, side	Indermure		Ca. 200 m²	Ingen, synes ubehandlet	Skillevæg eller teknikkerne i skatehal	Kvadratiske skiver à ca. 142 x 142 cm. 	Udskæres i kvardratiske felter à ca. 142 x 142 cm. Min antal: 45 felter	Stilles lodret på paller. Tværstivere monteres på skrå (som ved nye vinduer) ved fastgørelse i palle og i felter/skiver. Overdækkes	Indendørs lager, Hal 11, Pulsen 7						
Armaturer, lystofrør + LED	H12, side	Ophængt under loft		14 stk lysstofrør + 6 stk LED	Ingen, kan umiddelbart anvendes uden behandling	Lysarmaturer i skatehal eller facadebeklædning i affaldsskure	Hele armaturer i bedst mulig stand	Demonteres forsigtigt. Ledning klippes i størst mulige længde.	Lægges forsigtigt på paller og strøer og overdækkes.	Indendørs lager, Hal 11, Pulsen 7						

This was a very ambitious goal and therefore it was important to communicate this to the bidding demolishers. Early market dialogue was carried out in collaboration with the environmental consultant and involved three well respected demolishers, who agreed on participating in the tender.

The three demolishers were given parts of the tendering material in advance for commenting and it was adjusted according to their remarks. This is a very efficient way of communicating complex assignments in advance and it is allowed under the public procurement act, as long as the fundamental information regarding time, prize and award criteria are not revealed.

Demands and award criteria

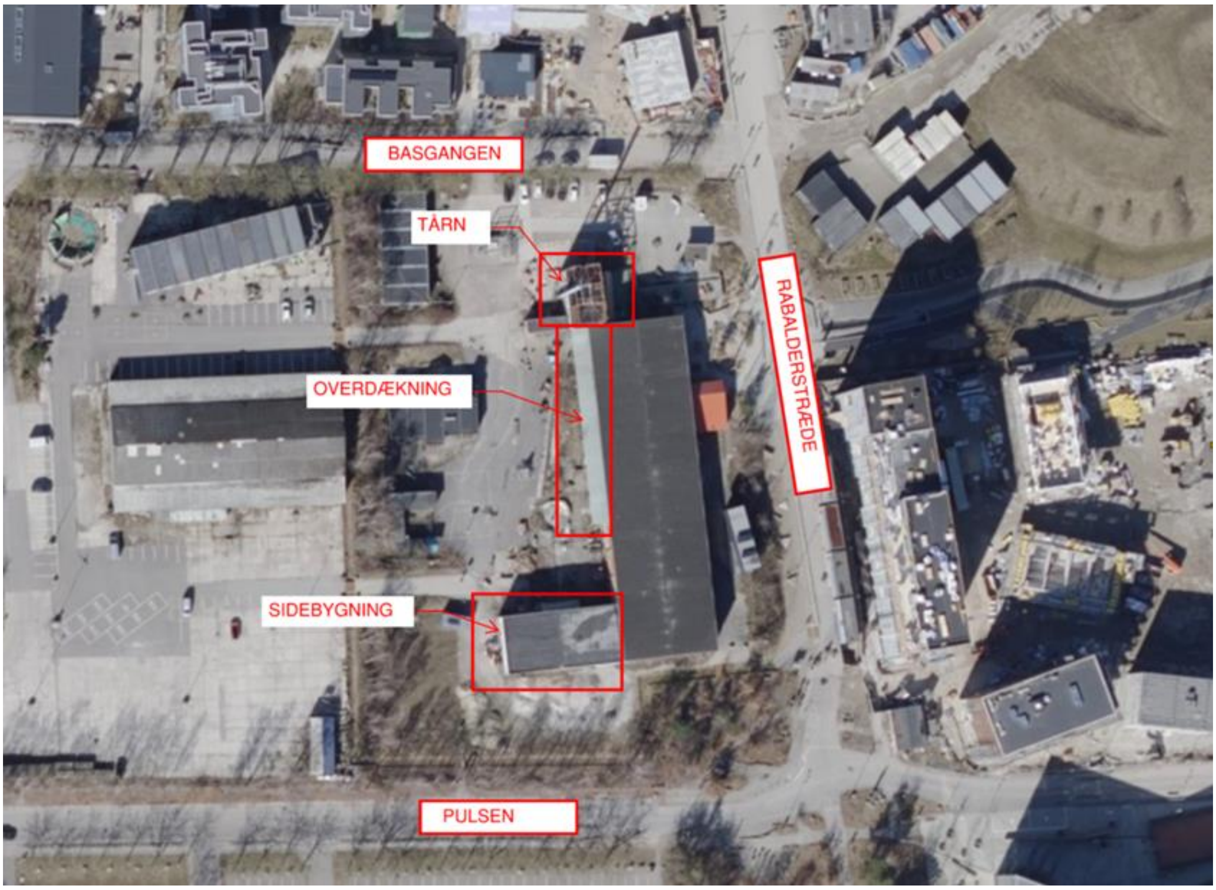
The balance between demands and award criteria is crucial when communicating your ambitions and prioritisation as a construction client. Demands are equal for all bidders and therefore perceived as a barrier more than an opportunity to excel.

Award criteria on the other hand are answered differently by each contractor/bidder and therefore allows for more specific solutions. The specific solution chosen by the contractor comes with an ownership and responsibility.

Overview of the tender

Roskilde Municipality aims to develop and explore possibilities for extracting construction materials from demolitions and remediation for future reuse and recycling. The current tender should be seen as part of that ambition.

The project includes environmental remediation and demolition of 2 buildings, the southern annex building and the northern tower, in the Musicon area, located in immediate proximity to Musicon Hall 12, 4000 Roskilde (Figure 1).



The buildings are to be demolished prior to the renovation of the skate hall in Hall 12, as well as the expansion of the new Hall 12 neighbourhood.

Furthermore, the demolition of the covering from the northern tower along Hall 12, as well as the demolition and filling of the existing pit, which is currently covered with metal trapezoid cladding panels.

Requirements for offers and award criteria

The following criteria, in the specified order and weighting, apply to the conclusion of the agreement:

Price: Weighting 40%

Quality: Weighting 60%

Quality criteria should include two elements:

Resource utilisation and methods:

A brief description (approximately 2 pages) is required of the Contractor's specific proposed solutions for how they will address the following critical tasks as part of the demolition:

Ensuring that documentation and labelling of materials extracted for reuse are done systematically, allowing for easy identification of the materials.

How the Contractor will address challenges related to dismantling the steel structure in the tower using a crane, specifically regarding detachment/cutting from underlying materials.

How the Contractor will safely remove metal trapezoid panels from roof surfaces and areas above the pit in the most secure manner.

Furthermore, a brief description is requested of the risks the contractor identifies regarding the tendered task, with a focus on ARB Appendix 5: Resource Mapping of Materials for the Client's Reuse. This should cover outcome requirements, extraction methods, and packaging methods, with particular emphasis on:

How brick sections from the annex building will be extracted in the described size without causing damage during dismantling, packaging, and transportation.

How concrete elements from the roof deck over the original part of the annex building can be removed/extracted in full length without damage.

Please note that the translation provided may need to be adapted to fit the specific requirements and terminology of the target document.

Communication and Key Personnel:

A brief description (approximately 1 page) is required of how the Contractor will ensure good communication and collaboration with the Client and other involved parties, including the users of Hall 12, throughout the different phases of the project.

Furthermore, a description is requested of the proposed organisation and key personnel who will be involved in the project, including their experience with similar tasks (approximately 1 page, including relevant CVs).

When evaluating this criterion, the Client will consider:

- The Contractor's proposal on how to ensure that the demolition is carried out as a collaboration between the Contractor, the Client, their consultants, and the users of Hall 12, including:
- Ongoing dialogue and collaboration to find gentle solutions to unforeseen problems.
- Prompt communication regarding unforeseen risks and issues with the proposed solutions.
- The relevant experience of the key personnel with similar demolition work.

Early Market Dialogue

Before the tender was sent out, an early market dialogue was conducted amongst three demolishers. They were asked to participate in onsite meetings and prior to the meeting they had access to a preliminary version of the tendering material. The material did not include timetable, award criteria, and price conditions which were translated to the fundamental elements of the tender.

The fundamental elements should be understood in relation to the fundamental principles of equal treatment and transparency. A change is considered a change in fundamental elements if it can impact the participation of potential applicants or tenderers in the specific procurement procedure or distort competition among applicants or tenderers.

In other words, any modification that affects the fundamental elements of a procurement procedure and has the potential to influence the participation of interested parties or create an unfair advantage for certain applicants or tenderers, would be classified as a change in fundamental elements. It is crucial to ensure that such changes are carefully managed to uphold the principles of equal treatment and transparency in the procurement process.

Early market dialogue is a very efficient way of getting feedback from the market before the tender is sent out. Often the balance between the contracting authorities' expectations and the economic operators' capacity does not meet each other. E.g., if the contracting authority doesn´t have sufficient knowledge about market conditions and/or the practical conditions of the job. Early market dialogue gives both parties a chance of eliminating the worst misunderstandings and reaching a balance between need and capacity.

However, it is crucial to have a good understanding of the rules described in Public Procurement Act No. 1564 of 15 December 2015. Most important is to focus on equal treatment and transparency at all times. The law says:

§ 2

A contracting authority shall comply with the principles of equal treatment, transparency, and proportionality in public procurement in accordance with Sections II-IV.

Paragraph 2. A public tender must not be designed with the purpose of excluding it from the scope of this law or artificially restricting competition. Competition is considered artificially restricted if the tender is designed with the intention of unjustifiably favouring a single or certain economic operator or placing them at a disadvantage.

§ 39

Prior to initiating a procurement procedure, a contracting authority may conduct market surveys in order to shape the tender and inform economic operators about the contracting authority's procurement plans and requirements. In this context, the contracting authority may engage in dialogue and receive advice from economic operators. The advice can be used in the planning and implementation of the procurement, provided that it does not violate the principles outlined in § 2.

Paragraph 2. If an economic operator or a company associated with an economic operator has provided advice to a contracting authority in connection with a market survey or has otherwise advised or been involved in the preparation of the procurement procedure, the contracting authority must take appropriate measures to prevent distortion of competition due to the involvement of that particular economic operator in the tender. At a minimum, the contracting authority must:

Ensure, to the extent possible, that relevant information exchanged during the economic operator's involvement in the procurement procedure is included in the tender documentation, and

Set the deadlines for the submission of applications and bids in a way that offsets any time advantage that an economic operator may have gained through involvement in the preparation of the tender, including through dialogue and advice received from economic operators.

Paragraph 3. If the contracting authority cannot ensure compliance with the principle of equal treatment through less intrusive measures, the contracting authority must exclude the respective applicant or tenderer in accordance with § 136, no. 2.

In the early market dialogue contractors were asked to participate in an onsite meeting, where they had the chance to express concerns regarding the bidding material, processes or time. Consultants in charge of the tendering process, were asked to compile the comments.

The following is a condensed version of this.

Focus points for preliminary dialogue regarding demolition, remediation, and resource utilization of the Side Building and Tower at Hall 12 - Musicon:

During the preliminary dialogue with three contractors, the following focus points were discussed. Below is an overview of the different focus points and the input from the contractors:

Contractor's design for the removal of decking elements above the Side Building:

• It is initially not problematic for the contractors to design the removal of concrete elements in the roof decking.

Access routes will be established via scaffolding towers for the removal of roofing membrane and for the positioning of elements for the crane. Additionally, the work area will be secured (with handrails or fall protection).

There is disagreement regarding whether the elements span the entire width of the building (12 m) or only half the width (6 m).

There are no guarantees, but it is assessed that the majority of elements can be removed without breaking.

The elements will be removed by an excavator "loosening" the elements, which will then be lifted down to the ground by a crane.

Cutting of brick squares in the Side Building:

• Horizontal bricks can be cut and placed on pallets, with two pieces per pallet.

• Vertical bricks (acoustic wall on the southern side of the central wall) cannot be cut into squares without significant waste. The stones can possibly be carefully removed and cleaned to separate individual bricks (they are fragile because they stand on their edges in a single layer, allowing the mortar to be removed).

Removal of steel structures and wooden framework in the walls of the Side Building:

• Cutting the steel and wood into the longest possible lengths is not a problem.

• If the steel is removed with an excavator, there is a risk that it may resemble a "crumpled summer hat" when it reaches the ground.

The contractor's design for the dismantling of the steel tower structure and the covering over the pit and chimney:

• It is initially not problematic for the contractors to design the dismantling of the tower structure in two parts, as well as the covering over the pit and chimney.

A 100-ton mobile crane is planned for the dismantling of all the parts.

• The description of backfilling the pit with stabilising gravel and concrete rubble should be improved.

Interim closures of the southeast and north facades (street skate) using recycled materials from the Side Building:

• It is possible to primarily use recycled materials for interim closures, but there may be certain parts that need to be purchased new.

Cutting of brick squares on the ground floor in the Tower:

• There is significant waste associated with cutting brick squares on the ground floor of the Tower due to:

Limited space for cutting.

Risk involved in hoisting the squares out of the building before moving the steel structure.

High risk of PCB contamination in the bricks in the transformer room, which would damage the stones during cleaning (it is also unclear how deeply the PCB has penetrated the stones).

Plaster and moisture on the stones in the boiler room adjacent to the transformer room.

Bill of quantities:

• It would be appropriate to include unit prices in the bill of quantities for:

Demolition work - hourly rate.

30-ton excavator including operator - daily rate including mobilisation and removal.

100-ton crane including operator - daily rate including mobilisation and removal.

• Additionally, there should be an item in the bill of quantities for the removal of vegetation, old ramps, fences, etc., in the corner between the Side Building and Hall 12, as well as along the covering.

Timeline:

• Two months for the task is somewhat tight to ensure a smooth process. This includes the removal of recycled materials, optimal cutting of bricks in the Side Building, and minimising disruption to the users of the hall. Three months would be more appropriate.

• However, it would be advantageous to commence the project before the summer vacation (July) to ensure it is underway before people go on holiday.

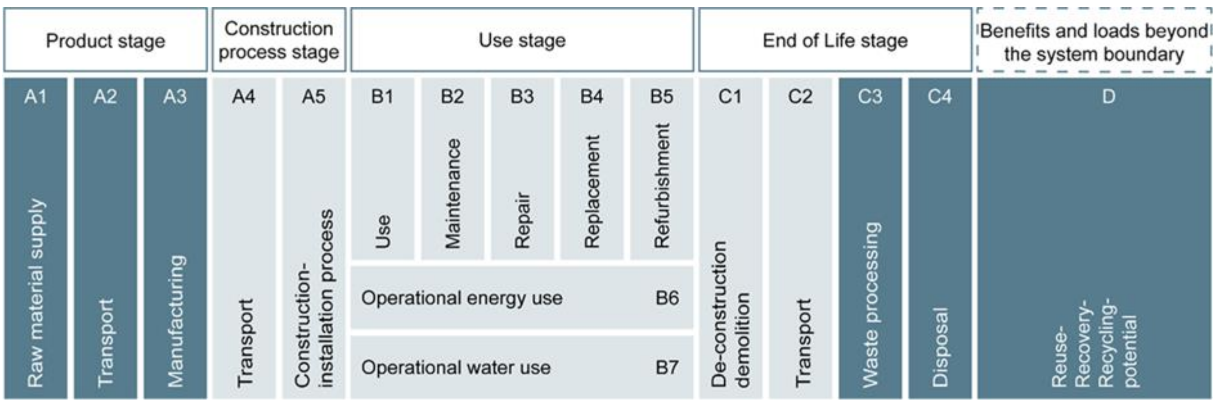
SAM

LCA calculations on recycled materials and design for disassembly

Embodied carbon can be contemplated the same way. When new products are introduced to a building, the materials come with a carbon “price”, which is the amount of carbon associated with the production, transport and handling of the building materials. This means, if we extend the idea, that a material bank not only will help minimise the need of new materials from primary sources (virgin materials), but it is also a way of maintaining embodied carbon in the materials and thereby avoiding emissions outside the system.

The effect of maintaining embodied carbon in a closed material loop is seen throughout the different life cycle stages. The life cycle stages are divided into several main groups according to EN 15804 and 15978, which are the European standards for Life Cycle Assessments (LCA) in the built environment.

The principles of LCA and circular economy are based on the same basic principles of circularity and therefore allow us to overlay the LCA methodology on circular economy in general.



This means that the carbon saving potential in circular economy is not isolated to the production process itself. There is also a carbon saving potential in the construction stages and in the end-of-life stages. Take, for example, wood as construction material. When timber grows in the forest it accumulates carbon and embeds it in the biomass. The accumulated carbon remains in the wood until it is released again at the end-of-life stage, therefore extending the lifespan of the product will prevent the carbon from being released to the atmosphere. Embodied carbon can be contemplated the same way. When new products are introduced to a building, the materials come with a carbon “price”, which is the amount of carbon associated with the production, transport and handling of the building materials. This means, if we extend the idea, that a material bank not only will help minimise the need of new materials from primary sources (virgin materials), but it is also a way of maintaining embodied carbon in the materials and thereby avoiding emissions outside the system.

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Basically, the use of the calculators is associated with early planning and procurement. The CO2 soil calculator has shown value in procurement, since the simple calculator allows contractors to compete on lowest possible CO2 emissions. Using a common calculator in the tender complies with the regulations according to Public Procurement Act 1565 in regard to transparency and equality.

CO2 calculator Concrete

The main purpose of the CO2 calculator is to provide primarily public developers with a tool for a qualified assessment of the CO2 savings potential associated with a specific quantity of recycled concrete. The CO2 calculator is based on three recycling classes: A, B, and C, which are described in the document "Recycling of Concrete - from manual effort to permanent change in practice." These three recycling classes are compared to the use of traditional mobile concrete for in situ casting as a reference value for CO2 emissions.

The CO2 calculator is built on a range of consumption data derived from various databases, reported consumption figures from contractors, and environmental product declarations. The purpose of these consumption data is to provide an overall overview of the CO2 emissions associated with different processes in the handling and processing of recycled concrete. A standard mobile concrete, strength class C30/37, has been chosen as the reference value. In addition to this, the efficiency of crushing and sorting at the processing site plays a significant role, as well as the transportation distances in the various scenarios.

When considering the different processes associated with concrete recycling, many of them are identical to those associated with traditional mobile concrete production in factories. These processes account for the majority of the total CO2 emissions associated with both methods of concrete processing. However, this does not exclude the possibility of considering the processes that differentiate the two methods and assessing which method results in the least climate impact in terms of CO2 equivalents.

The results from Musicon showed that the main CO2 saving potential is associated with the lower need of driving. A high percentage of the CO2 was used on the new cement needed for mixing the recycled concrete. Therefore, it was decided to focus on a simple calculation for driving materials from a to b. The reason why CO2 calculation of recycled concrete is still valuable is due to the high amount of concrete being produced. In addition to the saving potential of driving less with the aggregates, there is also a saving potential of optimising the mixing recipe. Many times, the recipe of the concrete mixture can be adjusted to fit local conditions and the quality of the aggregates. This saving potential can amount to 12% whereas the saving potential associated with minimising driving typically amounts to between 1 and 5 %.

The saved amount of CO2 in recycling concrete on Indfaldet was almost exclusively associated with saved transport of soil/concrete from the site and transport of new aggregates to the site. The calculated saving from in situ moulding 50m2 concrete was 0,4 tons CO2.

The calculator's prerequisites

It is a basic prerequisite for CO2 - the calculator that not only uses generic data from various sources, but to an equal extent is based on project-specific data such as the distance to the landfill and the amount of crushed concrete. This means that the comparison between

recycled concrete and mobile concrete - and their respective CO2 -discharge – is not static and therefore can never be seen as a general recommendation. So, it is only when you allow the project-specific data to be included in the calculation, that you can use the result to assess whether recycling is the right solution.

CO2 calculator Soil

As mentioned above it was decided to develop a dedicated CO2 calculator for soil, that only focused on driving and handling soil (and all other materials). The calculator simply calculates the CO2 associated with driving a given amount of soil or other materials, based upon standard EU values for CO2 emissions tonnes/kilometre.

CO_2 calculator for soil transport

ROSKILDE KOMMUNE

Comments	LCI	
Cells marked in blue, should be filled. All distances are calculated from site where soil is excavated. Cells marked in yellow cover on site handling of soil.	Distance to end deposite, km	0
	Distance to local reuse, km	0
	Amount of soil, tons	0
	Reuse percentage	0
	Use of wheel loader, hours	0
	Use of dumper, hours	0
CO2-emissions soil transport per tonne kilometre	Soil transport, kg CO2/tonkm	0,081
CO2-emissions crushing per tonne material, diesel crusher	Wheel loader, kg CO2/hour	25,68
CO2-emissions local transport	Dumper, kg CO2/hour	37,54
CO2-emissions full trailer combination, two way transport	Transport of loader and dumper kg CO2	135,13
	Kg CO2e per liter diesel	2,65

CO_2 saving potential		
Soil transport	**Project CO2 saving**	**reference**
Transport to end deposite, kg CO2		0
Transport to site for reuse, kg CO2	0	
Use of wheel loader	0	
Use of dumper	0	
Transport wheel loader and dumper	135	
Kg CO_2	**-135**	**Reference**

The calculator is Excel based and only demands filling out four values before getting a result:

1) Distance to end deposits, km. (Distance from excavation to standard end deposits. Standard end location for soil if nothing else is planned.)
2) Distance to local reuse, km. (Distance from excavation to site of local reuse. When on site or nearby reuse location, leave value as "0".)
3) Amount of soil, tons.
4) Reuse percentage. (Percentage of the soil that will be reused on site.)

In addition to the four main values, you can also add values for estimated amount of wheel loader and dumper hours necessary for local reuse. Only hours that are extra compared to standard handling, e.g., not for loading trucks.

Emission factors are taken from Lipasto, Energistyrelsen and consumption data from manufacturers of the crushing machinery.

Processes	Emissionsfactors	Source/comments
Transport, kg CO2/tonkm	0,081	LIPASTO, Earth moving lorry, Gross vehicle mass 32t, pay load capacity 19t, 75 % Highway driving and 25% urban driving, 2016 average LIPASTO 0% returnload
Transport crusher and screener kg CO2	135,13	LIPASTO, Full trailer combination Gross vehicle mass 76t, pay load capacity 51t, 9 axles. 75% Highway driving and 25% urban driving. Distance 4*25km.
Parameters for machinery		
CO2 per liter diesel	2,64	Energistyrelsen
kg CO2 per kWh	0,85	Kleemann
Efficiency [tonne per hour]	100	Informed by MIS
Weight [tons/m3 beton]	2,4	Epd
Engine capacity screener [kW]	95	McCloskey
CO2 emmision dumper [kg/hour]	37,54	LIPASTO
CO2 emmision wheel loader [kg/hour]	25,68	LIPASTO
Parameters for transport		
Earth moving lorry, highway driving [kg CO2/tkm]	0,04	LIPASTO
Earth moving lorry, urban driving [kg CO2/tkm]	0,073	LIPASTO
Earth moving lorry returload, highway driving [kg CO2/	0,558	LIPASTO
Earth moving lorry, returload urban driving [kg CO2/km	0,838	LIPASTO
Earth moving lorry, payload [ton]	19	LIPASTO
Full trailer combination (76t), highway [kg CO2/km]	1,43	LIPASTO
Full trailer combination (76t), urban driving [kg CO2/km	2,55	LIPASTO
Full trailer combination (76t), highway [kg CO2/km] Re	0,87	LIPASTO
Full trailer combination (76t), urban driving [kg CO2/km	1,36	LIPASTO
Percentage of highway driving (75%)	0,75	Average
Percentage of urban driving (25%)	0,25	Average
Total transport distance for machinery used on site [kr	100	Average

The calculator does not replace the need to make LCA calculations with dedicated tools, such as LCA build. LCAbyg is the market standard for LCA calculations in DK and can be downloaded for free at https://www.lcabyg.dk/

CO2 calculator CDW

In addition to the soil calculator a generic CDW calculator was developed. The CDW calculator is based upon more generic estimates of CO2 saving potential associated with recycling and reusing building materials and soil.

Construction and demolition waste

When a building owner has to decide whether to demolish a building and how to treat the waste, several deciding parameters are typically taken into account. One of these should be the overall effect the actions will have on the environment. The present calculator is meant as a step in that decision making process. The first steps would typically be to carry out a Pre-demolition audit. A Pre-demolition audit will deliver most of the necessary number for this calculator, e.g., amounts of different building waste fractions. The remaining numbers relate mainly to soil movements and can either be estimated or retrieved from soil screening procedures.

The core function of the calculator is to combine site specific information with generic information on Global Warming Potential (GWP) from the processes. This means that only very few numbers are needed in order to get a result that will help in the decision-making process. The result from the calculator therefore is focused on showing the CO_2e saving potential depending on the chosen actions, where the baseline is replacing a given building fraction with new building components and disposing the waste without any circular actions.

In order to keep the calculation simple and operational only three different actions are allowed. This makes the calculator very operational, however if more precise calculations are needed, further calculations should be carried out. Within CityLoops more detailed calculators have been made for specific use for soil and concrete.

A total of 11 different material fractions are included in the calculator. Each material fraction can be calculated by only adding two types of information, this means the calculator is very quick and simple to use. In the following each material fraction will be briefly described.

1. Sand/Gravel

Sand and Gravel from a demolition and renovation can in most cases be reused on site unless it is contaminated with environmental hazardous substances. The saving potential is measured against driving the sand/gravel to end deposits. Therefore, the information for this fraction is the amount of tons and the distance to deposit. The calculation is based on a reference emission of CO_2e from the transport itself, combined with a smaller amount of fuel for handling. In this calculation recycling is not an option. If more accurate calculations are needed, please use the dedicated CO_2e calculator for soil.

2. Soil

Like sand and gravel, soil can be reused on site unless it is contaminated with environmental hazardous substances. The saving potential is measured against driving the soil to end deposits. Therefore, the information for this fraction is the number of tons and the distance to deposit. The calculation is based on a reference emission of CO_2e from the transport itself, combined with a smaller amount of fuel for handling. In this calculation recycling is not an option. If more accurate calculations are needed, please use the dedicated CO_2e calculator for soil.

3. Concrete

Concrete is a very CO_2e heavy building material, mainly because of the cement added to the concrete. This also is the case when old concrete is crushed and used as aggregate in new concrete (Recycling). The big saving potential is associated with reuse of concrete elements, preferably on site. The information needed for this calculation is the amount in m3 and what kind of circular action is carried out. Reference value in "No circular action" is the embedded emissions associated with the production of one m3 new conventional concrete. If more accurate calculations are needed, please refer to the dedicated CO_2e calculator for concrete.

4. Bricks

Bricks from buildings before 1950 normally are able to be recycled and reused. The scenario where bricks are cleaned and reused either locally or in another building is referred to as recycling in this calculation. The "reuse" action is referring to the situation where parts of a brick wall are cut into smaller pieces and are reused on site. The reason for the low saving potential for reuse, is the high amount of transport needed for this action. Reference value is one m2 of conventional bricks.

5. Glass/windows

Reusing windows has great potential from both a climatic as well as an architectural point of view. When replacing or tearing down windows, there will most often be intact double-glazed windows with a certain remaining life, as well as window frames and frames with continued good durability. Windows however is a mixed building material and therefore the "Reuse" action is the only relevant for this fraction. Reference value is the production of one m2 new conventional window.

6. Gypsum

Gypsum is a more delicate building material and therefore the "reuse" action is not relevant for gypsum. Recycling however is commonly used in the production of new gypsum. Reference value is one m2 of conventional new gypsum. The reason for the small saving potential is that recycling already is used in the reference material from the Okobaudat database.

7. Steel

Recycling of load-bearing steel profiles has a great potential if it has been considered already in the design phase so that the profile can be dismantled. Steel structures found in halls and industrial buildings are constructed with bolted joints and are therefore ideal for reuse, as they are easy to disassemble and reassemble in a new building. Recycling is also a valid action since there is a long tradition for melting and recycling steel in new profiles. Reference value is the production of one kg conventional steel profile.

8. Aluminium

Recycling of aluminium sheets has great potential, as the sheets are made of aluminium which has great resistance to wind and weather. The plates are also easy to disassemble, as they are usually mounted with screws. When disassembled, the plates are sorted and cleaned after which they can be transported on pallets to a new destination, where they can again be mounted with screws. Likewise recycling aluminium is a valid action, since it often is seen in modern production in high numbers. Reference value is the production of one m2 conventional 1mm aluminium plate.

9. Bitumen/roofing

Roofing felt consists primarily of a mixture of bitumen, plastic materials, reinforcement and filler. Traditionally, bitumen from roofing felt was deposited, but in recent times bitumen has been recycled in asphalt production and to a lesser extent as a secondary product in new roofing felt. In the production of new roofing felt, secondary bitumen from roofing felt waste can replace parts of virgin bitumen. Direct reuse of roofing felt however is not an action in this scenario, since it is not commonly used. Reference value is the production of one m2 conventional roofing felt.

10. Insulation

Traditionally insulation materials are neither reused or recycled, but lately certain insulation manufacturers have been gathering used insulation material and adding it to the conventional production. This is the circular action referred to in this calculator. The reference value is the production of one m3 of conventional mineral wool.

11. Timber

Most often, wood is collected at large recycling plants, where it is sorted according to quality and impurities. The wood that is mapped as being clean is recycled as secondary raw materials for the production of new chipboard. This recycling process however is quite energy intensive, which can be read in the negative saving potential for recycling. Reuse on the other hand is very energy efficient and when possible, a very valid circular action. The reference value is the production of one m3 of conventional wood.

Before you can use the calculator to assess the environmental benefits of recycling concrete on a given construction project, you must obtain a number of information and data. You must be able to put numbers on e.g., the amount of crushed concrete that is available – or can be expected to be available – and you must also know the distances for gravel pit, site for landfill, recycling site and name of concrete supplier.

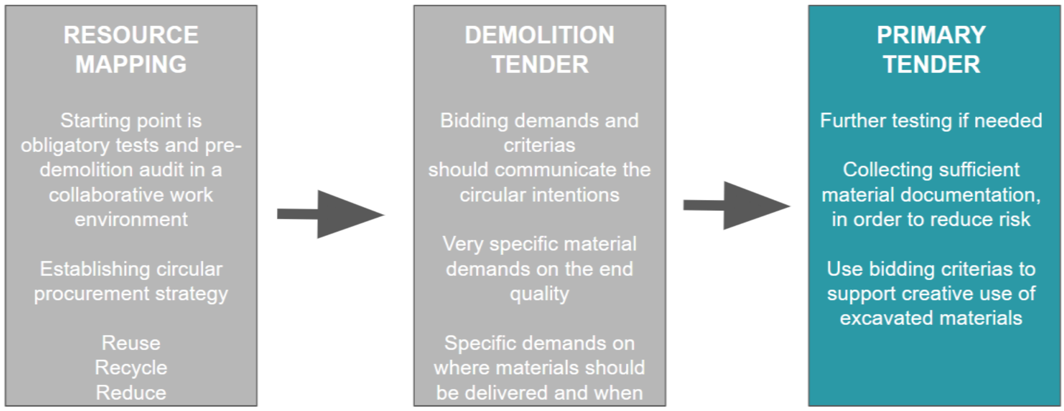
Once these data are in place, you can use the online CO2 - calculator to calculate the amount of CO2 - emissions that you can save the environment for, if you choose to reuse concrete on your construction project. The calculator is based on the three recycling levels and compares the three recycling levels with use of traditional mobile concrete for in situ casting as reference value for CO2 - the discharge.

Procurement

Working with Recycling and Reuse can be associated with several practical challenges. This is because the Recycled and/or Reused building materials will not always be thoroughly tested, and because several of the construction processes that are linked to building with these products and materials, are still relatively new.

The early collaboration is particularly important in construction projects that begin with an Environmental and Resource mapping of a building ready for demolition, because this gives the parties the opportunity to identify together the places where Recycling and/or Recycling of materials is possible. The contractor's knowledge is an important contribution to the advisor's work in the very early phases and in screening the Environmental and Resource Mapping. The detailing process around material use, construction technical conditions and technical assessments of a material's qualitative nature and thus future use can have an impact on how the material is used in relation to planning, detailing architectural and technical aspects. Based on interdisciplinary discussions in the project, a common knowledge base and a common process are created regarding the development of prototypes of the selected Recycled and/or Recycled materials. When knowledge about the use of materials is brought to the table, the demolisher can prioritise Selective removal of a building and its building parts, which must be brought to Recycling or Recycling. Parallel to the subsequent planning in accordance with YBL 18, it will be advantageous to initiate a further one product qualification and development in collaboration with relevant manufacturers and contractors.

3 STEPS OF CIRCULAR PROCUREMENT



It is recommended that, prior to the Circular tender, the client sets objectives for which Circular principles the client wants to work within the current construction. The objectives for Circular principles can be drawn up in collaboration with sustainability management.

As an example, the client can set concrete targets for CO_2 savings, targets for use of Circular principles such as Design for separation or the degree of use of Recycled or Recycled materials in the building when it is finished. The National Strategy for Sustainable Construction can advantageously be used as a baseline when targets for CO_2 impact are to be set. The objectives for Circular principles must be transparent for all parties in the construction, including builder, contractors, consultants and ultimately the end users. The objectives can be linked to incentive schemes to motivate the advisers and the contractor.

In connection with the client having to set targets for, for example, recycled material or recycling of materials, a calculation of any CO_2 savings (LCA calculations) could support the decision-making process. In order to identify all aspects of such a saving, and because in the industry does not yet have LCA calculations for many Recycled or Recycled materials, will it be necessary to bring more expertise across the value chain into play in order to enlighten everyone prerequisites for the recycling of the material. The Circular principles and requirements should be laid down already at the conclusion of the contract.

In the Circular turnkey contract, the objectives for Circular principles in construction are set by the client in collaboration with the Sustainability Management prior to holding the turnkey contract tender.

The key to innovation in a building with Circular principles assumes that the client can have an open and trusting dialogue with the contractor and advisers. The dialogue is the prerequisite for that the Circular principles in construction are as much as possible assessed from both an environmental point of view and architectural value, costs, quality, etc. The framework for innovation and the challenges involved should therefore already be discussed at the negotiation meetings, where the parties should articulate the special conditions that require dialogue and openness.

The negotiation topics below are an expression of the issues where law is particularly affected by the Circular principles. Dialogue about the themes creates transparency about what can be created in particular insecurity on the part of both the client, contractor and advisers.

Negotiation meetings can be structured in many different ways depending on the purpose of the negotiations and which resources are used. Since the negotiations are part of the evaluation of the offers, the client can advantageously divide the negotiation meetings so that they follow the award criteria in the tender conditions. This makes it easier for the client to give constructive feedback during the dialogue, just as it is easier for the tenderer to adjust his offer on the basis of the negotiations and the client's feedback.

Risk management

Risk management is a fundamental element within the planning process of circular projects. As a starting point, any potential risk factors should be identified as early as possible, followed by a risk assessment where responsibilities, risks, and consequences are described. Based on the risk assessment, an evaluation is made to determine if there are opportunities to mitigate the risks and ensure that responsibility for risk management is appropriately assigned. Frequently, rigidly assigned responsibilities can impede proactive problem-solving and risk mitigation. Therefore, it is crucial to maintain an open-minded approach towards each risk, accepting alternative responsibility placements if they prove advantageous in resolving the issue.

Incorporating proactive, transparent, and mutually agreed-upon rules for identifying, managing, and allocating responsibilities and risks among project stakeholders adds value to the project. Often, open dialogues about risks can help minimise the potential consequences resulting from triggered risks.

The nature of each risk determines the approach to its elimination or reduction. Certain types of risks can be neutralised through increased knowledge acquisition, such as conducting sampling. This is particularly relevant for risks related to insufficient information regarding scope and consequences. Identifying a risk associated with the presence of environmentally harmful substances early on provides an opportunity to investigate and address it directly, instead of delegating the risk to a consultant or contractor who may include it in their bid.

As part of the risk assessment process, early market dialogues are conducted with key stakeholders. Circular construction projects encompass a broader value chain compared to traditional construction, and individual stakeholders often have differing perspectives on risk. Therefore, assigning responsibility for a particular risk to the actor who has the best means to neutralise it presents a significant potential advantage. This approach can be effectively integrated into the tendering phase, encouraging bidders to identify risk elements impacting their responsibilities that may be beyond their immediate influence. This allows for the proactive management of risks to be addressed during contract negotiations.

During the construction process, new risk factors may emerge, or known risk factors may change, necessitating alternative management approaches. Hence, the tender should include a process description detailing how newly identified or altered risks will be managed throughout the construction process.

CityLoops is an EU-funded project focusing on construction and demolition waste (CDW), including soil, and bio-waste, where seven European cities are piloting solutions to be more circular.

Høje-Taastrup and Roskilde (Denmark), Mikkeli (Finland), Apeldoorn (the Netherlands), Bodø (Norway), Porto (Portugal) and Seville (Spain) are the seven cities implementing a series of demonstration actions on CDW and soil, and bio-waste, and developing and testing over 30 new tools and processes.

Alongside these, a sector-wide circularity assessment and an urban circularity assessment are to be carried out in each of the cities. The former, to optimise the demonstration activities, whereas the latter to enable cities to effectively integrate circularity into planning and decision making. Another two key aspects of CityLoops are stakeholder engagement and circular procurement.

CityLoops started in October 2019 and will run until September 2023.

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