Deconstruction Community Toolkit

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What is Deconstruction?

Deconstruction, or “unbuilding”, is the process of taking down a building by careful disassembly. This process goes hand-in-hand with material salvaging and reuse or recycling as the careful disassembly of the structure ensures materials of value and remaining in good shape are preserved for reuse or recycling. This works to create a circular economy within the construction space. While not all materials from deconstruction projects are salvageable due to toxic chemicals, material type and wear from use, the materials which usually are salvageable include lumber, metals such as steel, bricks, stone, ceramics, and fixtures such as sinks, doors, cabinets, and more.

The Maine solid waste management hierarchy emphasizes reuse as a top priority. While deconstruction increases the reuse of materials, an even better option to preserve existing material resources is adaptive reuse of a building. This practice ensures minimal materials go to waste by completely repurposing an existing structure rather than tearing it down to build a new building. This process still requires the same workforce skills and processes that support deconstruction as parts of the structure may need to be taken down or refurbished to repurpose the building while meeting project goals. Best practices would include removing and reusing the materials from sections that need to be removed.

As opposed to deconstruction and adaptive reuse, demolition tends to be the standard for building removal today. Demolition results in a loss of building materials, as limited recovery is possible once a building has been demolished and all materials crushed into pieces. Estimations show more than 75% of “construction and demolition debris” (“C&D” or “CDD”), could be reused or recycled, but this requires a change in process to support reuse and recovery. Currently, approximately half of the waste disposed via landfill in Maine comes from CDD.

Benefits of Deconstruction

Carl Elefante, past president of the American Institute of Architects, coined the now well-known phrase, “The greenest building is the one already built.”

While it may seem “greener” to tear down an old, inefficient building and replace it with a new, energy-efficient one, the reality is that replacing an existing building with a new one is rarely the more environmentally friendly course of action. Mining, harvesting, extracting, manufacturing, transporting, and assembling new buildings generates a lot of carbon emissions. Typically, the environmental impact of demolishing a building to replace it with new construction is much larger than a building renovation would be, even if the old building is being replaced with a highly energy efficient building.

Adaptive reuse of buildings is often the preferred course of action from an environmental standpoint, but when that is not feasible, deconstruction, which enables the building’s materials to be salvaged and reused, still provides many benefits.

1. Environmental
    - First and foremost, deconstruction is a more environmentally friendly practice in comparison to demolition. Deconstruction reduces overall CDD waste and prevents tons of waste from entering landfills each year conserving landfill space for other higher necessity usages. Additionally, it reduces air pollution, carbon dioxide emissions, and energy usage from demolition and new material production. On a similar note, the careful deconstruction of structures reduces the potential spread of particulate matter that may occur during demolition when materials are crushed with heavy equipment. Not only is deconstruction generally beneficial from an environmental perspective, but it can help businesses reach sustainability or climate goals.
2. Social
    - Social benefits include cultural and health benefits. Reuse of buildings and building materials preserves culturally significant historic buildings and materials important to communities’ heritage. Additionally, deconstruction and preservation support employment in traditional trades and culturally significant building practices. It also minimizes potential health impacts from dust and particulate matter entering the air as materials are carefully removed rather than crushed with heavy equipment.
3. Economic
    - In addition to environmental and social benefits, deconstruction can also have economic benefits. While deconstruction may appear more costly upfront than simply demolishing a building, reduced waste disposal costs, tax credits, and material resale value can bring down the overall cost of

the project over its lifespan. Deconstruction also supports local business development and presents an opportunity to grow local green jobs. Opting for deconstruction may also reduce material costs through reuse of existing materials.

Learn more about the economic potential of deconstruction and reuse:

- Treasure in the Walls: Recovering Value Through Material Reuse in San Antonio (2021)
- Constructing a Circular Economy in NYS: Deconstruction and Building Material Reuse

The Basic Process of Deconstruction

There are 8 basic steps to deconstruction, but specifics will vary from location to location based on local ordinances. Always refer to your local ordinances for the most accurate and complete information. The number one step in all deconstruction projects should be ***safety*** assurances, and this is important to have in place and reassessed throughout the entire process.

1. Assessment and planning – including deconstruction safety plan and general planning for deconstruction and material usage.
2. Bring in experts to complete the work.
3. Removal of internal materials.
4. Complete physical deconstruction.
5. Separation and organization of materials onsite.
6. Materials grading for quality check.
7. Transportation of materials to a storage facility or new projects.
8. Reuse of materials for new projects (or recycling of materials not up to new construction standards).

In addition to viewing buildings at end of life as a potential material bank rather than a waste disposal problem, how a building is constructed can also be viewed as an opportunity for reuse.

Design for Deconstruction

While understanding how to salvage a building at the end of its life is important, designing a building to be taken apart from the beginning of its life is just as, if not more, important for a circular construction economy. Designing for deconstruction requires a team effort between involved parties who are educated on deconstruction and invested in ensuring the building can easily be taken apart and repurposed. Aside from architects and builders needing to use the proper techniques and materials allowing for deconstruction, the project owners must be invested in funding a sustainably designed

project and understanding the benefits it will bring them in the long run. These benefits can include simpler maintenance, ease of renovations, flexible uses, and future cost savings along with all the benefits of deconstruction.

Things to consider when designing a building for deconstruction include reuse of old building materials, modularity that enables flexible uses, and avoidance of adhesives, spray foam, or other materials that cannot be removed. Opting for mechanical fasteners, interlocking systems, or gravity rather than fixtures that cannot be removed can support future reuse of a structure and its spaces. By taking future reuse potential into consideration, owners can ensure that they maximize the sustainability features of a project. For example, using salvaged lumber put together with visible fastening as opposed to gluing new lumber together not only reduces the embodied carbon for the project, but will enable a future project to have a reduced carbon footprint when the materials are repurposed. Additionally, use of structural elements such as moveable walls, tiled ceilings, and modular flooring works well for workplaces or other commercial spaces, as rooms and even entire structures can be taken apart and moved as needed.

To support design for deconstruction (DfD), all parties must be invested in deconstruction and design for reuse at the end of a building's life. Construction companies can train their staff in proper DfD building techniques and source salvaged materials, architectural schools can educate their students on how to design buildings for deconstruction, and builders can source salvaged materials and request DfD.

Maine Won't Wait 2024, Maine's Climate Action Plan, includes a "Lead by Examplev" goal to design certain buildings for deconstruction and reuse"

- "Require that by 2030, commercial and state-funded construction projects that meet certain thresholds (embodied carbon, structure size, etc.) be designed for deconstruction and reuse and sourced from reduced carbon materials."

Learn more about designing for deconstruction:

- NYCEDC-Circular-Construction-Guidelines-03-07-2024.pdf
- Design For Deconstruction
- Design-for-Deconstruction.pdf

Deconstruction for Homeowners

Deconstruction can be a useful tool for homeowners looking to do renovations on their house or looking to fully remove a building from their property. It can be a great option for people who want to preserve an important or sentimental part of their home or to salvage materials or features they love for reuse in a new or renovated room or structure. Deconstruction is not only a good choice for those who have materials they want to salvage; homeowners also may choose to donate or sell materials salvaged

from a room or building that they are taking down or renovating. By selling salvaged materials, homeowners can reduce their overall project costs. They may also choose to donate the materials and earn a tax credit for the value of the materials that were donated. Additionally, all the previously mentioned environmental, economic, and social benefits apply to small scale projects by homeowners as well. Any homeowner hoping to deconstruct a room or a building on their property should refer to their local code enforcement officer for more information on how to move forward on their project.

Alongside deconstruction of their old buildings, homeowners should consider designing any new buildings they plan to have constructed with future renovations, maintenance, and deconstruction in mind. This will help homeowners save on costs throughout their time living in a home as renovations and maintenance will be streamlined if the building is designed for flexible reuse. Additionally, homeowners can discuss their needs with their design team to create a space that will grow and change with them whether through modular furniture and materials, easily removable features, or other techniques. If building a new home on an lot with an existing structure, homeowners may want to assess the potential of salvaging materials from that structure or from other secondhand building supply businesses to find high quality, sustainable materials at affordable prices.

Resources for homeowners looking for materials or looking to deconstruct their home:

- Habitat for Humanity ReStores
- Second Story Builders – Midcoast Maine
- Deconstruction Toolkit - Sustainable Building & Salvage Guide

Deconstruction for Businesses

Businesses may choose to use deconstruction to renovate their existing buildings or to remove a building from their property. After deconstruction is complete the business will be able to profit from the salvaged materials by selling them or can choose to donate the materials and receive a tax break instead. These sales or tax breaks can help make up for the initial fiscal cost of the deconstruction project. Businesses with sustainability pledges can also use deconstruction to show their progress toward their goals including emissions reduction or waste reduction goals. Plus, depending on a company's aim in pursuing a deconstruction project, their team can personalize the approach, like using partial deconstruction, to maximize benefits to the company. So, even though the fiscal costs may initially appear high for deconstruction versus other options, the process can be personalized to maximize benefits and minimize costs. Businesses interested in deconstruction should refer to their local ordinances for specific information and seek out a company willing and able to personalize the deconstruction process to best fit the company's needs.

Alongside deconstructing old buildings, businesses may also find important benefits in constructing their new buildings with deconstruction already in mind. Like deconstruction itself, designing for deconstruction can help businesses reach their sustainability goals, can help reduce costs in the long run even if initials costs are higher, and can be customized for an individual business' needs. Designing for deconstruction not only reduces end-of-life cost for deconstruction and ensures maximum reuse, but it simplifies maintenance and enables easier renovations. This means that buildings may even last longer as they are easily repaired and can be changed for different needs as the company grows and changes.

Resources for businesses looking for materials or looking to deconstruct their buildings:

- ReStore
- Second Story Builders
- The Last Sheaf Building Materials Exchange

Deconstruction for Municipalities

Municipalities have a unique role in supporting deconstruction through their economic development or sustainability policies and programs. Communities may consider setting deconstruction or recycling standards with policy but can also serve as role models practicing deconstruction and designing for deconstruction on government buildings. Deconstruction is beneficial to municipalities as it supports job creation and economic growth in the construction and deconstruction sectors. In addition, supporting deconstruction businesses and organizations will help preserve a municipality's history and culture. Importantly, deconstruction significantly reduces waste, and is a quieter, less disruptive process than demolition that residents will appreciate. These are benefits for the municipality's community as well as for the municipality itself.

When a municipality decides to create an ordinance supporting deconstruction, they must assess their communities' needs and existing training programs, businesses, and organizations to ensure the best fit ordinance is put in place. For example, immediate compliance of 75% waste diversion in a community without deconstruction businesses would be impossible to implement successfully, but a gradual increase in requirements could allow time for deconstruction businesses to become established and begin offering services locally. An ordinance should lay out specific diversion requirements based on what is feasible and provide detailed guidance and resources to support compliance. See the "Encouraging Deconstruction: Model Ordinances" section for examples of existing ordinances from across the country.

Not only can municipalities lead by example when it comes to deconstruction, but they can work toward normalizing and setting standards for sustainable construction including designing for deconstruction.

There are many resources available to municipalities looking to start implementing deconstruction in their locale:

- How to start deconstructing and stop demolishing your city's built assets
- CR0WD - Local Government Deconstruction and Reuse Guide 5.3.2023.pdf
- Build Reuse Wiki
- Colorado Construction, Demolition & Deconstruction Policy Toolkit

Workforce Development

One of the most important aspects of the circular economy in general is the people who work to make it all happen; without them nothing would get done. Investing in workforce development for the construction circular economy is one of the most impactful steps to getting more deconstruction projects going. Companies interested in leading deconstruction or design for deconstruction projects should develop training programs for their employees. Schools or apprenticeship programs should include deconstruction education to prepare the next generation of workers to create a circular future. If a company itself can't develop a training program of their own, they may be able to send their employees to a separate existing program which matches the company standards. These trainings should cover each step of the process from safety and project planning to usage of proper tools, material assessment, deconstruction techniques, site preparation, materials organization, permitting and reporting, and materials management including transportation or reuse. Design for deconstruction education in programs should cover topics such as design methods, appropriate materials, and construction techniques.

Below are examples of training programs and guides already in use:

- Deconstruction Training | The ReUse People
- Build Reuse Training
- Example Programs:
    - Deconstruction Contractor Training — San Antonio Reuse
    - VIDEO: How King County is reducing waste generated by building demolition and creating more equitable access to green jobs - King County, Washington

Encouraging Deconstruction

There are many different approaches to encourage deconstruction. Municipalities may opt for ordinances that set requirements around materials management like recycling or reuse, or they may opt for establishing incentives, like a grant program that supports deconstruction.

Expedited permitting, free permitting, grant funding, technical assistance, or waste diversion ordinances, programs, or policies can all help to break down barriers to deconstruction and make it as easy or even easier than mechanical demolition. Building a local reuse economy takes time and buy-in from the community. Municipalities with a thriving deconstruction sector have avoided “all or nothing” thinking, taking time to invest in regionally appropriate programs and policies that support local workforce development and grow the deconstruction sector up over time. In some cases, a policy change may be as minor as offering expedited deconstruction permits while delaying demolition permits to provide time for salvage assessments, making deconstruction a more appealing option.

Below are several examples of different approaches municipalities have taken to encourage and support deconstruction and reuse. There are many municipal ordinances and program examples offering a variety of approaches not listed here. For a more comprehensive view of different policy and program options, explore the Build Reuse Wiki - Policies and Codes, Ordinances.

Municipal Programs, Policies, and Ordinances

Planning and Permitting

Safety plans are a part of the permitting process for most municipalities. Before any deconstruction project begins, safety must be a top priority; outlining safety plan requirements during permitting helps ensure processes align with local, state, and federal guidelines. The municipalities below have established processes to ensure compliance with safety requirements while maximizing recovery of valuable building materials.

- Portland, OR requires all buildings built before 1940 or designated a historic resource requiring a demolition review to be deconstructed unless more than 50% of the frame is damaged.
- Boulder, CO requires a waste diversion plan to be submitted through their “Green Halo” system; at least 75% of materials must be diverted from landfills, while 100% of new construction unused materials must reused or recycled.
- Seattle, WA incentivizes deconstruction with an expedited permit for deconstruction that is not available to applicants applying for a demolition permit.

Bringing in Experts

- San Antonio, TX requires older homes built before a certain year to be deconstructed. The City operates a Certified Deconstruction Contractor training program and a Material Innovation Center as well as community workshops to support deconstruction.

- Portland, OR requires homes built in 1940 or earlier to be deconstructed; applicants must hire a Certified Deconstruction Contractor approved by the municipality before receiving a permit. Property owners who contract with demolition companies not approved by the City may be subject to penalties.
- Palo Alto, CA ordinance requires all residential and commercial buildings to be deconstructed by a City approved reuse organization. deconstruction permit for approval that specifies which materials will be reused, and which will be recycled.

Materials Management Requirements

- The Certified Deconstruction Contractor is required to track the materials salvaged, recycled, or otherwise disposed of in Portland, OR.
- All building projects will utilize the city's GreenWaste of Palo Alto collection containers for deconstructed material storage on site. All materials must be sorted by type and by usage. Materials must be sent to a designated facility listed in Green Halo or the facility must be approved before materials are sent.
- Part of permitting for Boulder, CO includes a plan of what materials are going where to ensure the diversion rate meets ordinance standards.

Salvage and Reuse

- Palo Alto has a Construction and Demolition debris Diversion Program
- Berkley, CA operates its own transfer station working with a local organization who brings the materials to their reuse store to see what can be salvaged and then recycle or trash the rest

Adaptive reuse ordinances can allow for more flexible building zoning to create reuse opportunities for buildings instead of defaulting to tearing down and building an entirely new structure on a property. The adaptive reuse model focuses on providing housing opportunities by converting old business buildings into apartment buildings.

In Making the Case for Adaptive Reuse, the National Trust for Historic Preservation's references several municipalities with adaptive reuse ordinances or projects.

Penalties

- If a residential structure is removed without using a deconstruction contractor fine will be issued to the property owner. If a deconstruction contractor violates code they will be fined and may be removed for the list of Certified Deconstruction Contractors in Portland, OR.
- Boulder, CO has projects submit a $1/sf or minimum $1,500 deposit on deconstruction projects and will return 100% for 100% compliance, 75%

for >50% compliance, 50% for some compliance, and 0% for no effort to comply

Other Ordinance Pathways

- Expedited Permitting for Deconstruction projects versus demolition projects to make up for slightly longer project times. There are other ways to do this, but one example is Seattle, WA's ordinance.
- CDD Diversion Requirements: Example– Pitkin County, CO requires all projects requiring a building or demolition permit to participate in the C&D Debris Recovery Program. Prior to obtaining a permit, the property owner or designated project manager must sign a Recoverable Materials Diversion Acknowledgement Form and pay a refundable Diversion Compliance Deposit (DCD).
- Deposit Refund: submit a deposit and divert the minimum amount or don't get your deposit back as in Boulder, CO
- Material Recycling Requirements: Many of the deconstruction ordinances listed above have these such as in Boulder, CO where 75% of materials must be diverted from landfills for recycling or reuse.

Resources and Guides

Deconstruction Businesses and Organizations

- Second Story Builders
- Hancock Academy

Funding Opportunities

Grants and funding for deconstruction projects. The grants which can help support this work may not be specifically for deconstruction work, but advertising the grants as being available for this kind of work is important to getting the word out and promoting deconstruction.

- Maine's Community Action Grant program
- Solid Waste Diversion Grant program
- Workforce Opportunity for Rural Communities (Northern Border)
- WIOA Workforce Programs

Networking & Learning – Maine & New England

- Maine Deconstruction Network (MDN)
- CLF Boston | Northeast
- Massachusetts Reduce and Reuse Deconstruction Workgroup
- CR0WD (Circularity, Reuse, and Zero Waste Development) Network

Donating Building Materials

- Habitat for Humanity: Restores
- Last Sheaf Building Materials Exchange
- Maine Housing and Building Materials Exchange
- craigslist
- Facebook Marketplace
- eBay

Buying Salvaged Building Materials

- Second Story Builders
- Rousseau Reclaimed Lumber and Flooring
- The Old House Parts Company
- eBay
- craigslist
- Facebook Marketplace
- Facebooks Groups such as the Maine Building Materials Rescue

Deconstruction Resources

- Sustainable Management of Construction and Demolition Materials
- Build Reuse
- C40 Green job opportunities in clean construction
- Carbon Leadership Forum - Reclaimed and Reused: Recommended LCA Modeling Guidance to Support EPDs for Reused Construction Materials
- The U.S. Green Building Council - Zero Waste Blueprint: How LEED and TRUE Are Closing the Loop on Waste.
- CR0WD (Circularity, Reuse, and Zero Waste Development)
- Deconstruction Manuals for Construction and Demolition Projects
- CARE Tool | Carbon Avoided: Retrofit Estimator

Safety

- Lead-Safe Renovation

Design for Deconstruction and Reuse

1. ***Guides***
    - Design for Adaptability, Deconstruction, & Reuse Guide (American Institute of Architects)
    - Circular Design & Construction Guidelines (CDCG) NYC
2. ***Case Studies***
    - Circularity by Collaboration - Woodard & Curran, Lisa Whited
    - Arch Daily Design for Disassembly Case Studies

General Deconstruction Guidance

- "Residential Deconstruction Manual, Stardust Non-Profit Building Supplies, U.S. EPA Grant I.D. # X-97900301-1, June 2005"
- Building Deconstruction Guidelines: Tools for Recovering Building Materials
- Deconstruction Rapid Assessment Tool - Region 5
- Toolkit - Deconstructing Abandoned Mobile Homes | US EPA
- Can't Believe They Can Recycle Buildings! How De-Construction Diverts a MASSIVE Amount of Waste
- Design Follows Availability: Affordable Dwelling Units Based on Reclaimed Materials in San Antonio (2023)

Maine DEP is providing this information as a courtesy and does not recommend or endorse any particular organization or product.

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