Project Manager's Guide to Material Reuse in Commercial Buildings

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Hennepin

MSRDesign

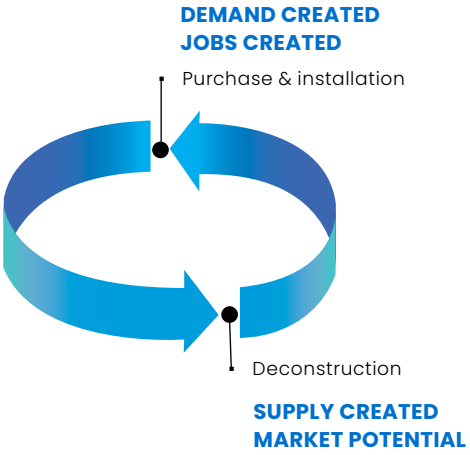
CSBR
Center for Sustainable Building Research

DOORS UNHINGED

Contents

Executive Summary

This guide is for owners, architects and contractors looking to integrate circularity into the design, construction and operation of buildings by utilizing reclaimed materials and by implementing deconstruction. A number of guides and reports address the topic of deconstruction, but as an industry we cannot focus exclusively on deconstruction. To close the loop and create a circular economy, owners and architects must include reclaimed materials in new designs.



Seven steps to designing with reused materials

A review of projects revealed a consistent set of actions supporting design with reused materials. This report also identifies new best practices to streamline the process. Distilled into seven steps, these are:

1. Owner, designer and contractor must have buy-in on the idea of material reuse
2. Structure the project contract for success
3. Identify procurement and destination of reclaimed materials in the construction documents
4. Create a Material Reuse & Deconstruction Plan
5. Source high-quality materials
6. Leverage green building certifications
7. Design for future disassembly

Templates are included in the appendices.

Deconstruction at commercial scale

The deconstruction guidance in this document emphasizes planning for materials' second life with focus on timing, selection of a deconstruction contractor, and salvage rights and appraisal of reclaimed materials. It also addresses owner responsibilities and specification language with examples in the appendix.

The toolkit

A selection of template documents are provided in the appendices to support reuse and deconstruction on commercial-scale projects by addressing barriers in current construction documents and workflows:

- **Appendix A - Sample language for use in writing specifications, including the following sections that should be included in the table of contents:**
  Division 1 Material Reuse
  Division 2 Building Deconstruction
  Division 8 Reused Interior Doors (example)
- **Appendix B - Template Material Reuse and Deconstruction Plan.** Structural materials considered for reuse at a commercial scale will require grading and assessment by a structural engineer.
- **Appendix C - Building Deconstruction Pre-audit Form Example.** For use in inventory of reusable materials on site, prior to deconstruction.
- **Appendix D - Template Schematic Design Reuse Narrative.** Outlines specific reuse goals for inclusion in early cost estimating.
- **Appendix E - Example Deconstruction Annotations on Demolition Plan.** Instructions to demolition contractor regarding items to be deconstructed.

These tools are intended to start a conversation and empower project teams to create a circular economy in commercial construction.

Background

This report was commissioned by Hennepin County with the goal of supporting the local construction industry in improving circularity of the built environment. Hennepin County estimates that 80% of construction materials in a demolition project could be reused or recycled, but currently only 30% of materials are being diverted from landfill. Significant opportunity for improvement remains untapped.

This report aims to engage and empower architects, designers, and other professionals to work with reclaimed building materials through specific recommendations for the salvaged material and deconstruction process, sample specification language, and other resources.

Hennepin County has been supporting deconstruction efforts in the Twin Cities for over a decade and offers the following resources:

- Building and material reuse grant funding for property owners: www.hennepin.us/building-reuse
- Study: Capacity for diverting construction and demolition waste through recycling and reuse (Foth, 2015) www.hennepin.us/-/media/hennepinus/your-government/projects-initiatives/solid-waste-planning/construction-demolition-diversion-capacity-study.pdf
- Study: Reuse and recycling practices at remodeling and renovation projects (Stantec, 2022) www.hennepin.us/-/media/hennepinus/your-government/projects-initiatives/solid-waste-planning/construction-demolition-waste-study-2023.pdf

Learn more about Hennepin County resources at hennepin.us/building-reuse

Reusable building materials at Minnesota landfills. Photos Becker County

Creating a Circular Building Materials Economy

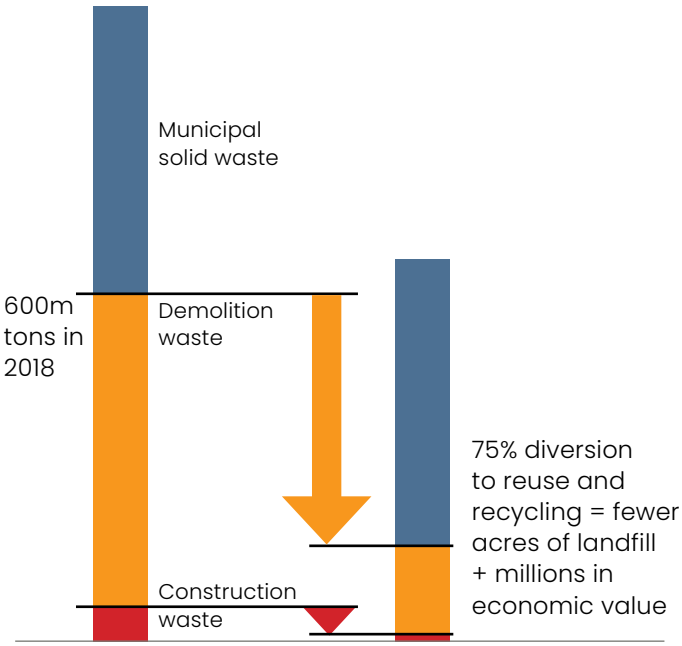
What is the potential impact of reuse at scale?

Avoiding waste is a value that translates across cultures and demographics, and conserving materials makes financial and environmental sense.

Six hundred million tons of construction and demolition (C&D) debris were generated in the United States in 2018, 90% of which was demolition waste and 10% construction waste, totaling more than the amount of municipal solid waste. (EPA, 2018) In Minnesota, 1.6 million tons of construction and demolition waste get landfilled annually across the 120 facilities that accept C&D debris in the state.

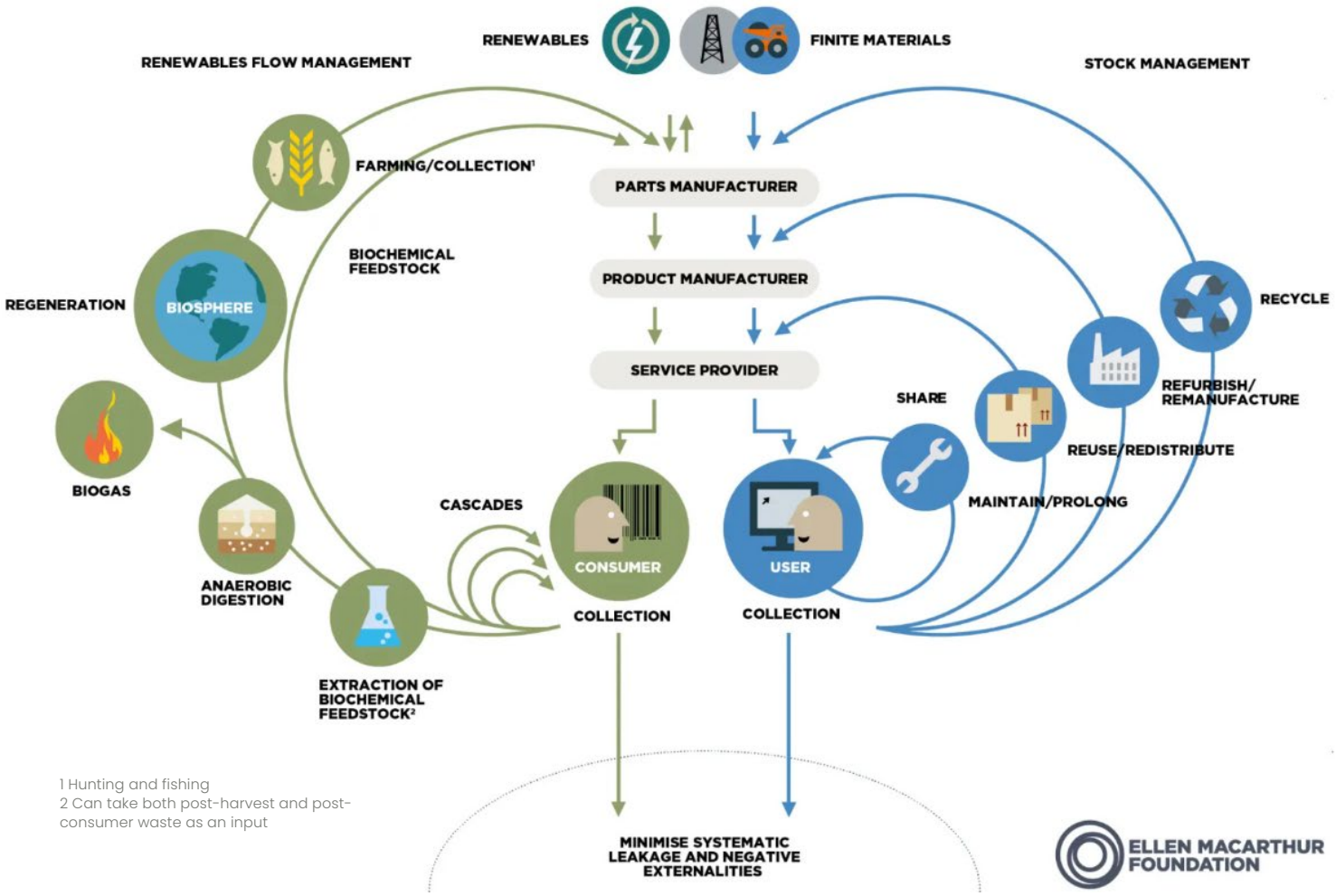
Unfortunately, a significant proportion of material sent to C&D landfill every year can truly be defined as needless waste. Items such as clean wood and gypsum board, metals, appliances, bricks, and furnishings are disposed of at waste transfer stations and landfills in counties across the state. Not only are some of these materials still viable and valuable, but in some cases, such as old growth lumber, they are also irreplaceable.

Meanwhile, 75% of landfilled C&D waste has the potential for reuse. (Purchase et al, 2021) Diverting this to recycling or reuse would remove 1.2 million tons of material from the waste stream, and generate millions of new dollars in economic opportunity from reuse businesses. Increasing reuse at scale would reduce not only waste, but also embodied carbon, land use, and impacts on groundwater and soil. (MPCA 2019)



US C&D debris totals, and the potential impact of reuse and recycling (EPA, 2018) (Purchase et al, 2021)

C&D landfill in Minnesota Photo MPCA



The Circular Economy Systems Diagram. Diagram by The Ellen MacArthur Foundation, 2019. Based on Braungart & McDonough, Cradle to Cradle.

Disrupting the cradle-to-grave mentality

The Ellen MacArthur Foundation identifies circulation of products and materials as the core principle of a circular economy. The goal is to preserve building materials in use via reuse, repair, re-manufacturing, and recycling, according to the combination of strategies that maintains their highest value and utility. (Ellen MacArthur Foundation, 2019)

On building projects, two critical decision points can dramatically shift the flow of materials during design: First, when the owner, designer and contractor make the decision to select reused materials instead of new materials (creating the demand), and second, at the time of remodel or decommissioning, when the owner and team make the decision to deconstruct and divert materials from landfill (creating the supply). In a review of existing guidance and reports from cities and counties around the United States, the words “deconstruction and reuse” were frequently found together in a single phrase or title.

It is worth considering that while both practices - deconstruction and reuse - are needed to create a functioning circular economy, deconstruction

and the implementation of reuse are in fact very different workflows. Without a clear path to a new destination, the logistics of managing and storing deconstructed materials can quickly become overwhelming. It cannot be assumed that materials automatically have a reuse pathway, simply because they were carefully removed from their prior location.

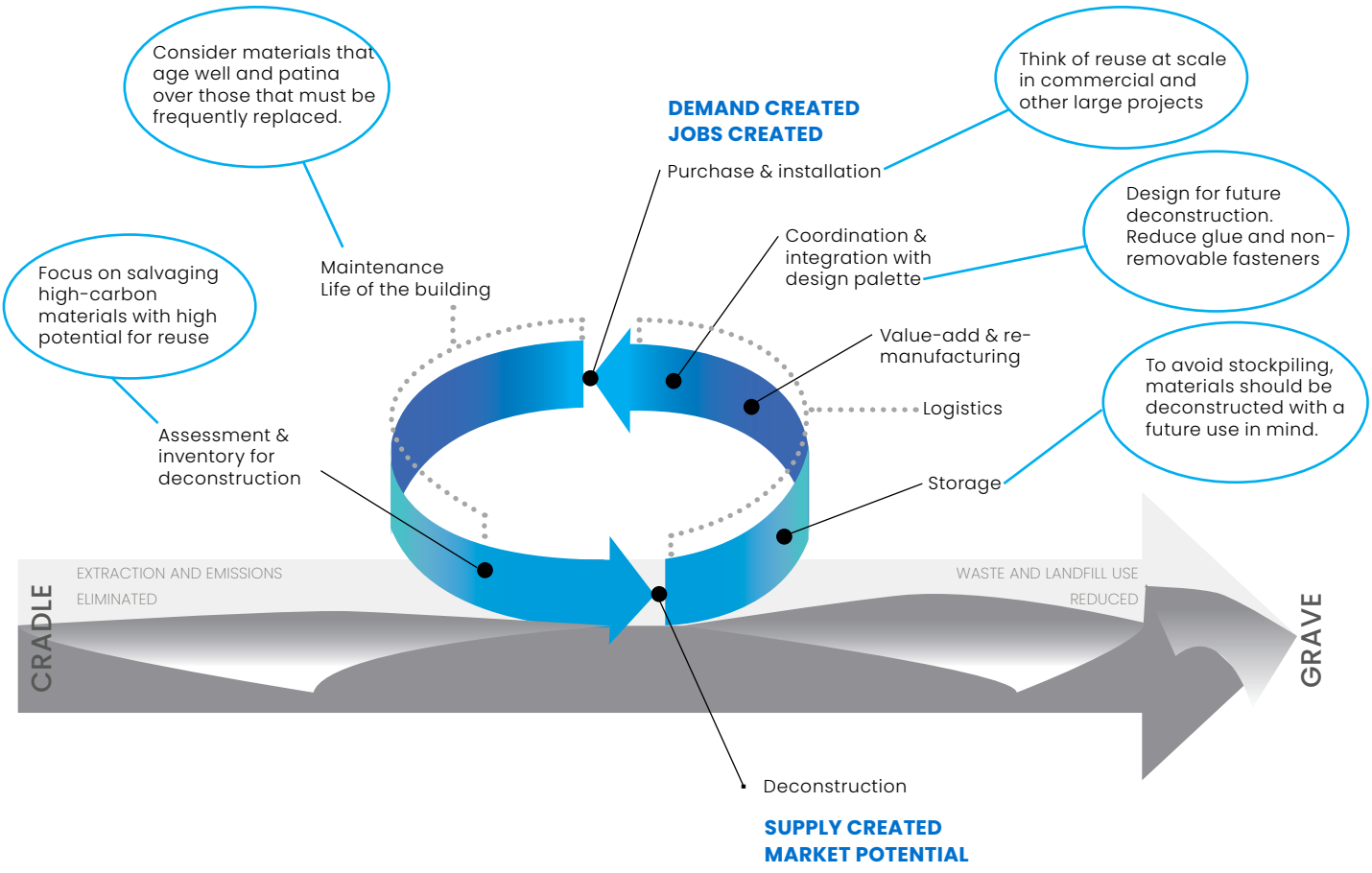
In reality, implementation of reclaimed materials in a new design versus deconstruction and diversion present unique considerations, with different design, cost, schedule, and other project workflow and delivery implications.

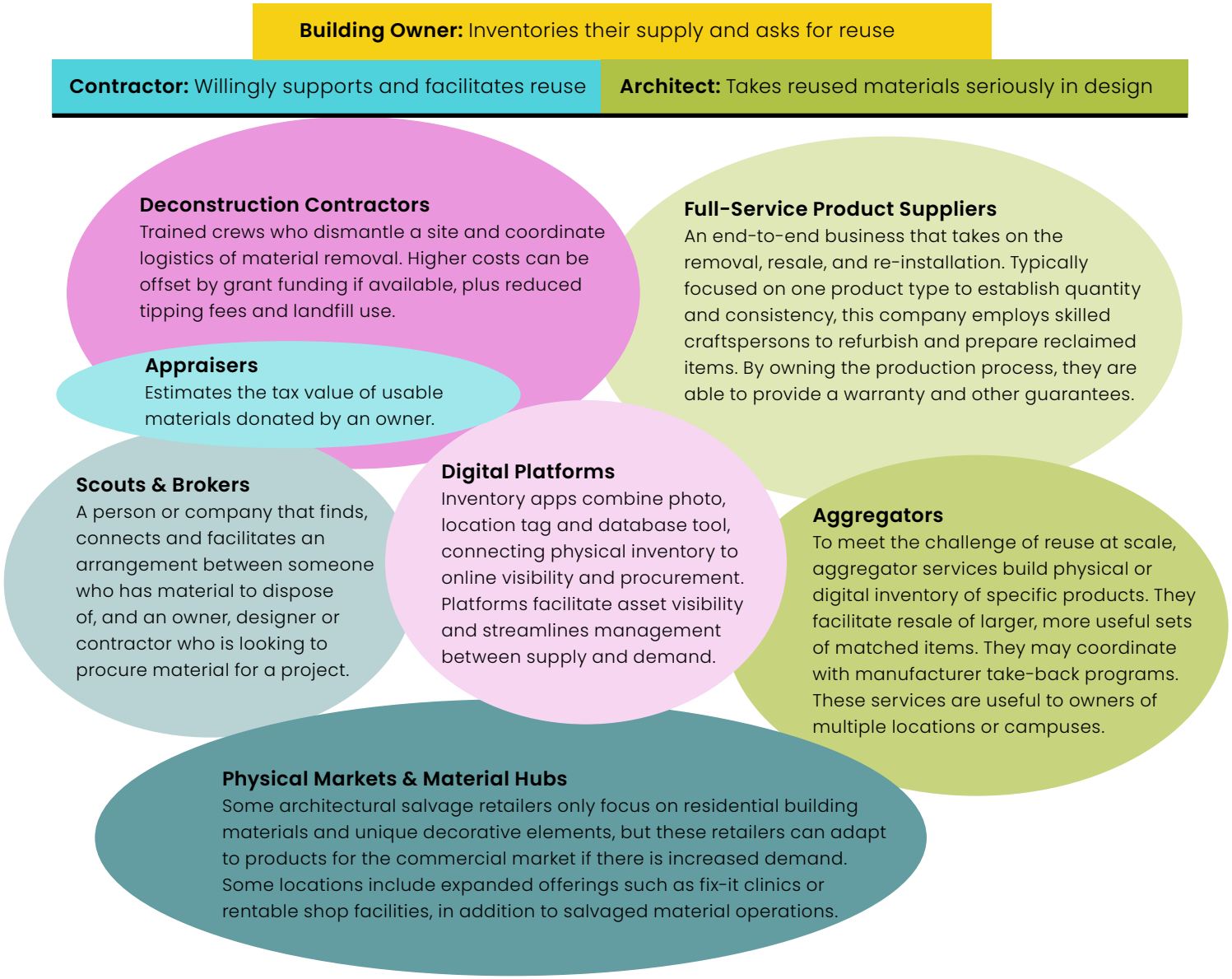
Emerging market, new business models

Distinguishing the practice of reuse from the practice of deconstruction highlights logistical and market challenges unique to each situation in switching to a new, circular model.

- For example, in typical demolition, a demolition contractor clears a site as efficiently as possible to prepare a blank slate. In a deconstruction model, buildings are taken apart by a trained crew, which may have schedule, storage and logistical implications.

Disrupting the cradle-to-grave mentality. Designers and owners who create demand for reclaimed materials in their projects grow the market for deconstruction.





Constellation of emerging business models to support the circular building material economy and the project team.
Based on original diagrams and research from Getting to Zero Waste (CRTKL, Harari, 2022)

- Depending on the intended reuse of a material, logistics may include product-specific transportation and storage. Material needs to be stored in an organized, accessible location to create the opportunity of a future life.
- Storage is among the logistical challenges. Some communities are exploring innovative warehousing ideas, such as re-purposing decommissioned schools into reuse centers. Durable construction and wide hallways work well for movement and sale of building materials.
- Material passport tagging and tracking methods are emerging as a way to help close the deconstruction-to-reuse loop.

A 2021 report on deconstruction and material reuse in retail architecture identified emerging and evolving business models needed to bring building material reuse at scale into the modern age. (CRTKL, Harari, 2021) A version of this diagram is represented in the illustration above.

Architects and owners drive the reuse marketplace

Logistical challenges are often the first subject of discussion when it comes to implementing reuse. But in practice, logistics tend to solve themselves as a function of the market, in the form of new businesses and tools – as long as there is a market and demand. This is where designers and builders play a critical role, and where a steep progress curve and rapid industry evolution are needed.

In a business-as-usual design and construction, architects and interior designers "shop" for materials based on information provided by sales representatives and manufacturers' websites. Designers rely on manufacturers to "own" the sustainability of materials by providing recycled content percentages or documentation of the embodied carbon footprint based on results of a life-cycle assessment (LCA).

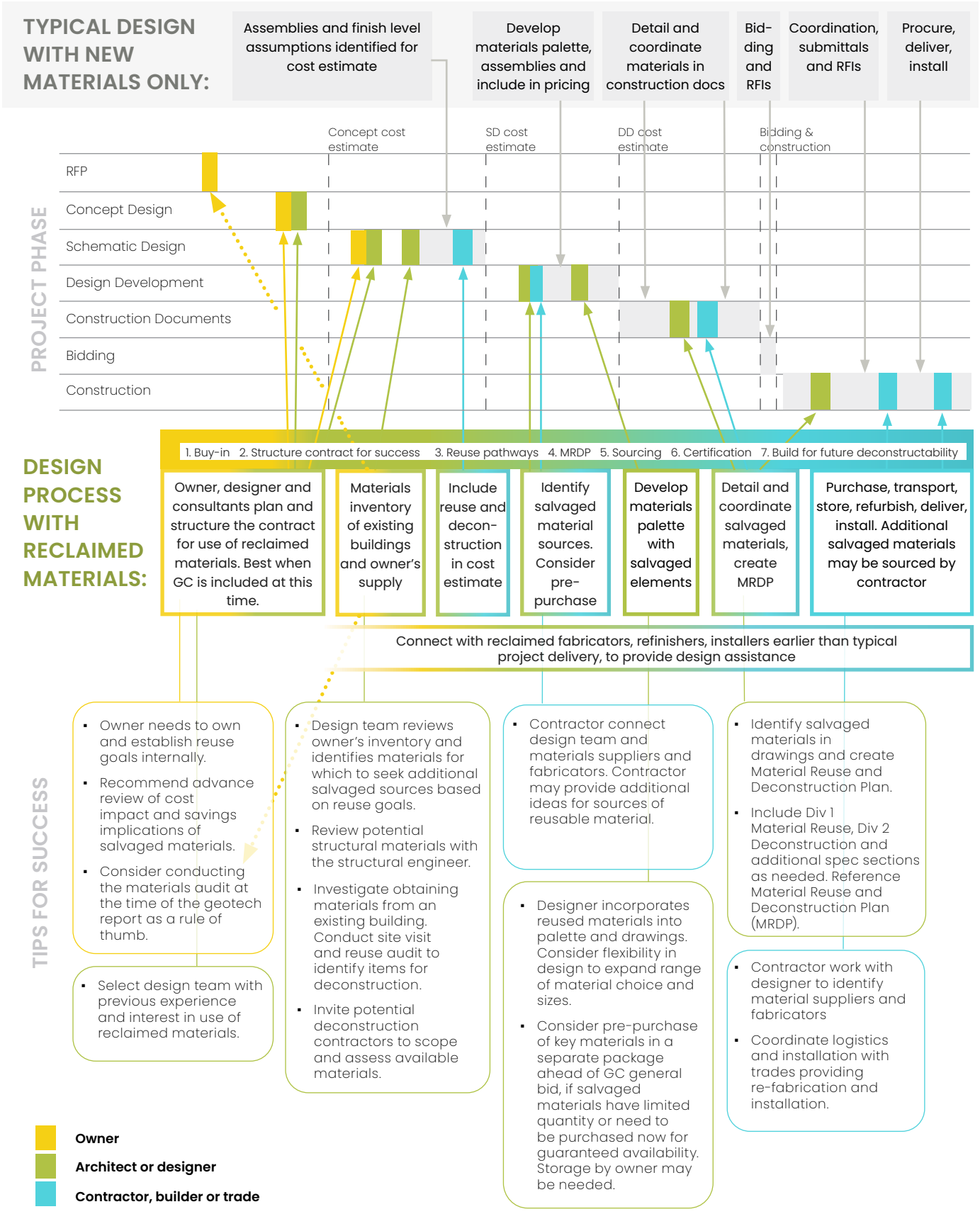
In a new, circular economy model of building materials, design professionals can reclaim ownership of the life cycle of materials by designing with reused materials and future reuse in mind. To do so will require rethinking typical processes related to sourcing materials and products, and significantly increasing the percentage of salvaged material on every project.

"The social and cultural significance of salvaged materials as physical links to the past should not be underestimated in an age where few artifacts, including buildings, are designed to last for long. In this context, imperfections in materials can be accepted and even welcomed. "

Old to New Design Guide
Paul Kernan, 2002

Repurposed vintage Carrara marble wall panels. MSR Design

Typical practice versus designing with reclaimed materials. Key steps, activities and considerations to successfully implement high quality reclaimed materials in commercial design and construction. Adapted from Kernan (2002)



Seven Steps to Designing with Reused Materials

A review of projects and reports from around the United States revealed a consistent set of elements supporting great outcomes in designing with reused materials. This guide also identifies some new elements to streamline the process. Distilled into seven steps, these are:

1. Owner, designer and contractor must have buy-in on the idea of material reuse
2. Structure contracts and project delivery for success
3. Identify reused material procurement pathways in the specifications
4. Provide a Material Reuse & Deconstruction Plan
5. Source high-quality materials
6. Leverage green building certifications
7. Design for future disassembly

The case studies below illustrate award-winning examples of reuse at a commercial scale.

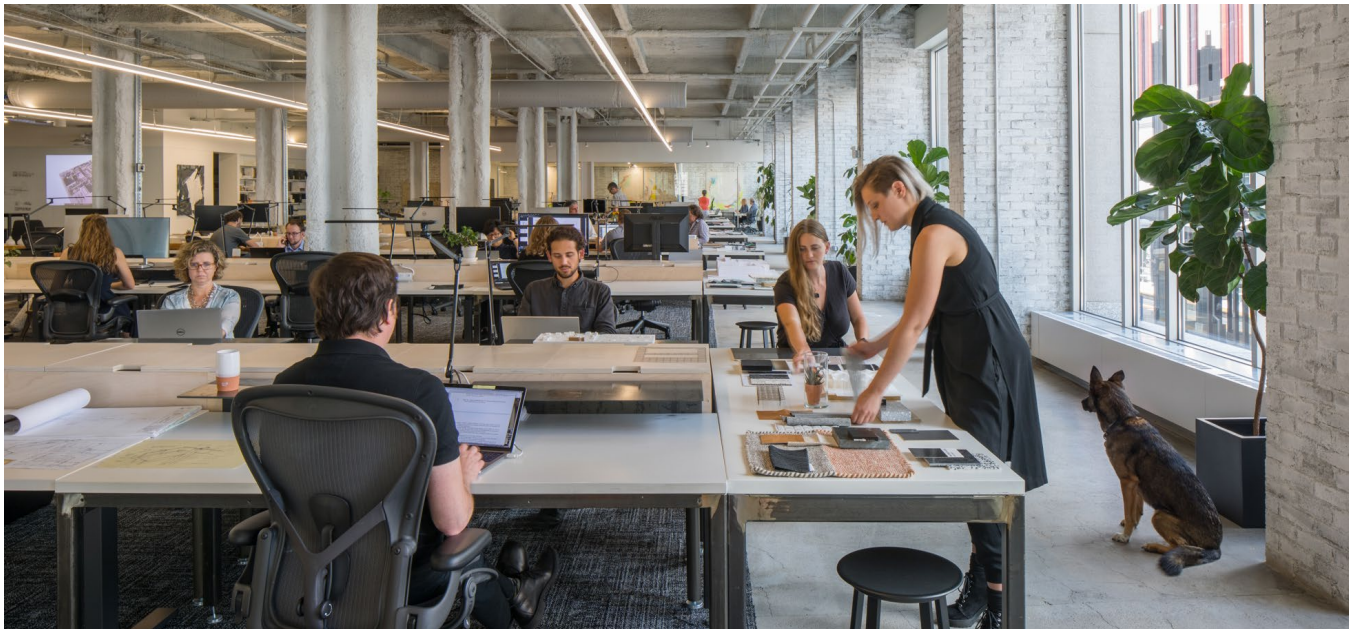
1. The whole team must have buy-in regarding reuse

Successfully incorporating reused materials on a project requires an aligned team:

Owner who values reducing waste and sees the other potential benefits including material cost savings, and who is willing to inventory their existing stock. Hennepin County offers building and material reuse grant funding for property owners. Ramsey, Washington and Carver Counties in Minnesota also offer reuse grant funding.

Architect who understands that all-new materials are not the only way to update and refresh a space. An important step is cultivating confidence in owners that reclaimed materials can lead to a high quality design outcome. Skilled designers can create beautiful, functional, contemporary spaces using reclaimed materials in new ways.

Contractor who is on board early, values the potential cost savings and waste reduction, and is equipped to work out logistical details.



Rebuilt workstations and office furniture as part of a commercial interior remodel. Photo MSR Design.

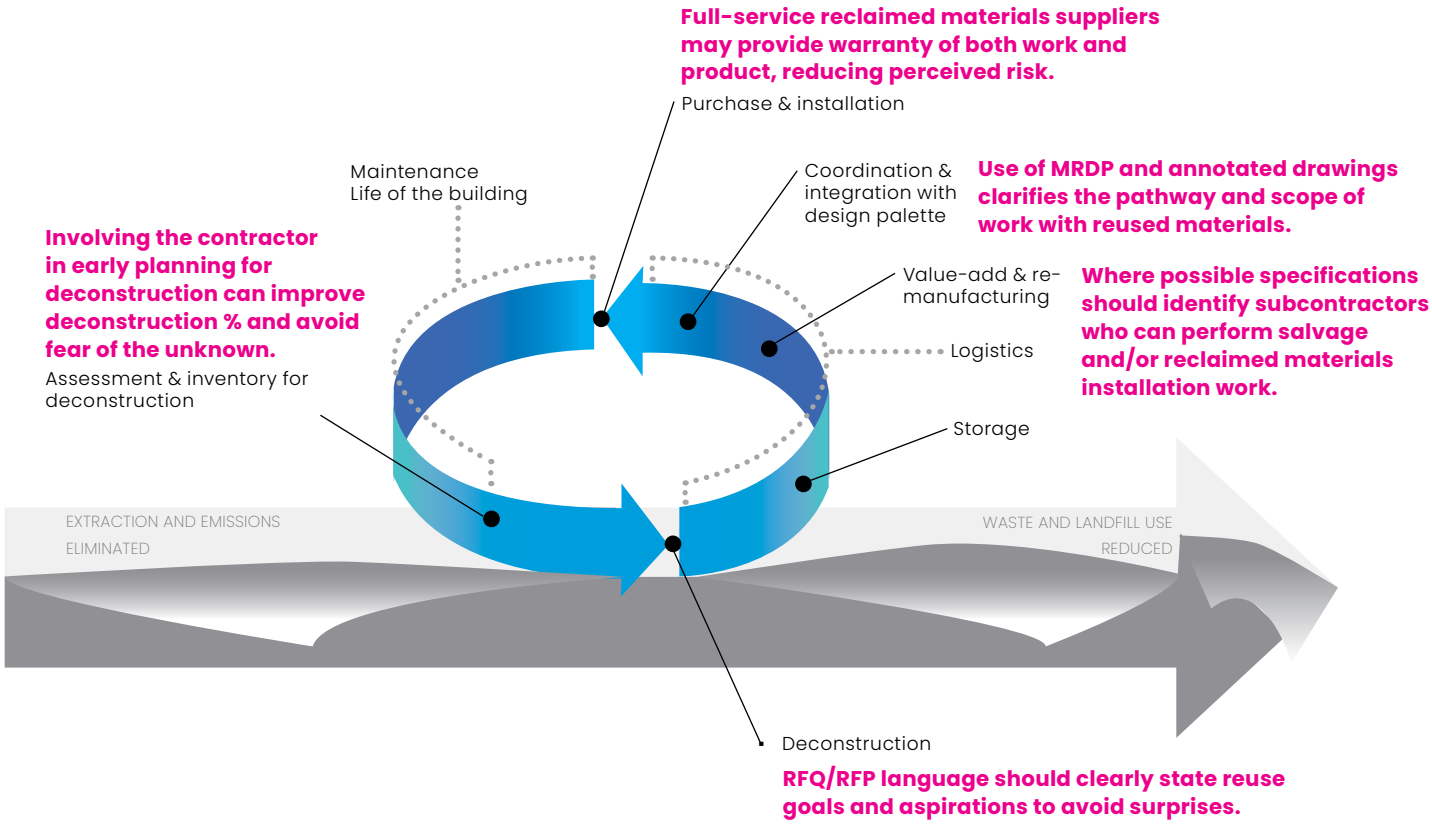
2. Structure contracts and project delivery for success

Integrated teams that include the general contractor early in the project are more likely to achieve successful integration of salvaged materials.

- Where applicable, a negotiated bid may enable owner, architect and contractor to discuss reclaimed material goals and establish unit and labor cost ranges, and alter course during construction. Design-build contracts may offer a similar flexibility.
- Construction manager as contractor (CMGC) and integrated project delivery methods enable the selection of a contractor and project team that is willing to work with salvaged materials from the start. RFQ and project RFP language should include this qualification and clearly state project goals and aspirations.
- It may require more planning to implement reclaimed materials at a meaningful scale on publicly bid projects. Contractors viewing specifications and narratives that include salvaged materials during bidding are likely to be wary of unknown procurement processes, so drawings and specifications must be clear regarding the sourcing of each material or a "material by owner" note. Ideally materials would be accessible with an opportunity for subcontractors to view and understand processes they may need to execute, with end-to-end reclaimed material suppliers identified and invited to bid.
- While the installation warranty should be similar or the same regardless of whether a product is new or reclaimed, the product warranty may vary based on the reuse pathway. See Step 3 for a discussion of reuse pathways.

The documents in the appendixes provide a template for representing reuse pathways in the specifications.

De-risking material reuse



3. Identify reuse sourcing pathways; include in specs and reference in drawings

This report identifies five primary sourcing pathways for reclaimed materials, illustrated in the diagram above with workflow implications.

Path 1. Sourced from deconstruction at the same location.

Path 2. Sourced by the same owner, but a different location, for example a campus.

Path 3. Furnished by contractor or sub.

Path 4. Purchased at reuse warehouse or outlet.

Path 5. Sourced by a full-service reclaimed material supplier.

Reclaimed materials must be clearly called out in the drawings and specifications. Template specifications are provided in the appendices.

- **Appendix A - Sample language for use in writing specifications, including the following sections that should be included in the table of contents:**
  Division 1 Material Reuse
  Division 2 Building Deconstruction
  Division 8 Reclaimed Door Systems (example)
- **Appendix D - Template Schematic Design Reuse Narrative.** Outlines specific reuse goals for inclusion in early cost estimating.
- **Appendix E - Example Deconstruction Annotations on Demolition Plan.** Instructions to demolition contractor regarding items to be deconstructed.

Identify the Reuse Pathway

Reuse Sourcing Pathway	Potential cost savings	Install warranty	Product warranty & documentation	Effort by Owner	Effort by Architect or Engineer	Effort by Contractor	Uncertainty / risk of sourcing issues	Need for temporary storage
Path 1. **Reuse at same location**	High	Yes	No	Low	High*	Medium to High	Medium	Yes
Path 2. **Reuse by same owner, new location**	High	Yes	No	Medium	High*	Medium	Medium	No
Path 3. **Furnished by the Contractor**	Medium	Yes	Possibly if item is near-new; likely No	Low	Medium*	High	High	Yes
Path 4. **Sourced from reuse warehouse or outlet**	Low to High	Yes	No	Low to Medium	High*	High	High; Lower if pre-purchased	Possibly if pre-purchased
Path 5. **Full-service reclaimed material supplier**	Low to Medium	Yes	Yes	Low	Low to Medium	Low	Low	No

**Structural materials require review by a structural engineer prior to reuse.*

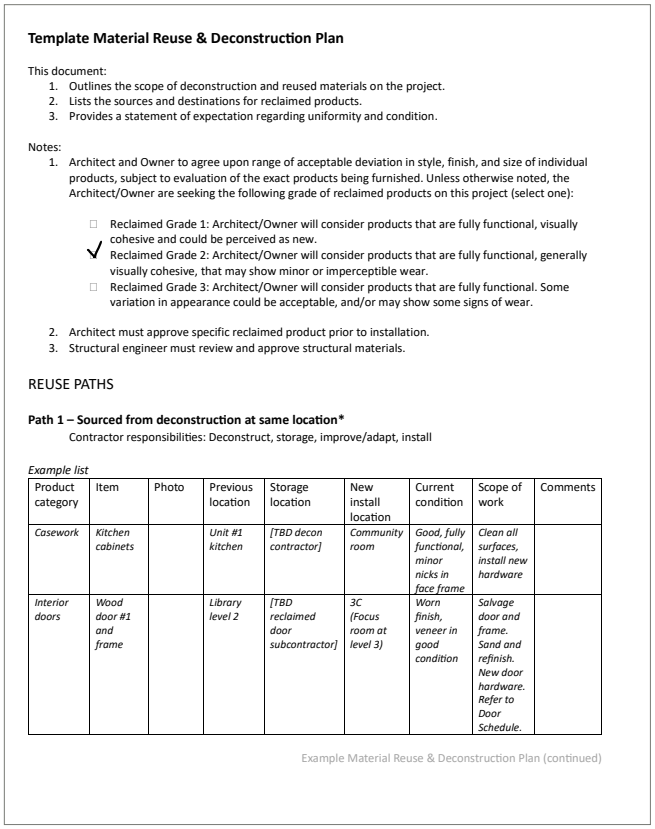
4. Provide a Material Reuse and Deconstruction Plan

The Material Reuse and Deconstruction Plan (MRDP) accompanies the specification and identifies specific materials, where they are coming from and where they will be installed, and information regarding partners and scope of work. The recipient of potential profit from materials available for reclamation may also be noted.

- **Appendix B - Template Material Reuse and Deconstruction Plan.** Refer to Appendix B for a sample MRDP.

The MRDP may provide "Reclaimed Grade" language, a method for establishing the acceptable range of aesthetic deviation in the appearance of reused finishes or furnishings:

- Reclaimed Grade 1: Architect/Owner will consider fully functional, visually cohesive products that could be perceived as new. For example, an owner interested in reused materials to meet carbon reduction goals may still wish that the resulting aesthetic is indistinguishable from new in appearance.
- Reclaimed Grade 2: Architect/Owner will consider fully functional, generally visually cohesive products that may show minor or imperceptible wear. Some owners may accept variation or patina that harmonizes with the composition.
- Reclaimed Grade 3: Architect/Owner will consider products that are fully functional. Some variation in appearance could be acceptable and/or may



Template Material Reuse & Deconstruction Plan

This document:
1. Outlines the scope of deconstruction and reused materials on the project.
2. Lists the sources and destinations for reclaimed products.
3. Provides a statement of expectation regarding uniformity and condition.

Notes:
1. Architect and Owner to agree upon range of acceptable deviation in style, finish, and size of individual products, subject to evaluation of the exact products being furnished. Unless otherwise noted, the Architect/Owner are seeking the following grade of reclaimed products on this project (select one):
   - ☐ Reclaimed Grade 1: Architect/Owner will consider products that are fully functional, visually cohesive and could be perceived as new.
   - ✓ Reclaimed Grade 2: Architect/Owner will consider products that are fully functional, generally visually cohesive, that may show minor or imperceptible wear.
   - ☐ Reclaimed Grade 3: Architect/Owner will consider products that are fully functional. Some variation in appearance could be acceptable, and/or may show some signs of wear.
2. Architect must approve specific reclaimed product prior to installation.
3. Structural engineer must review and approve structural materials.

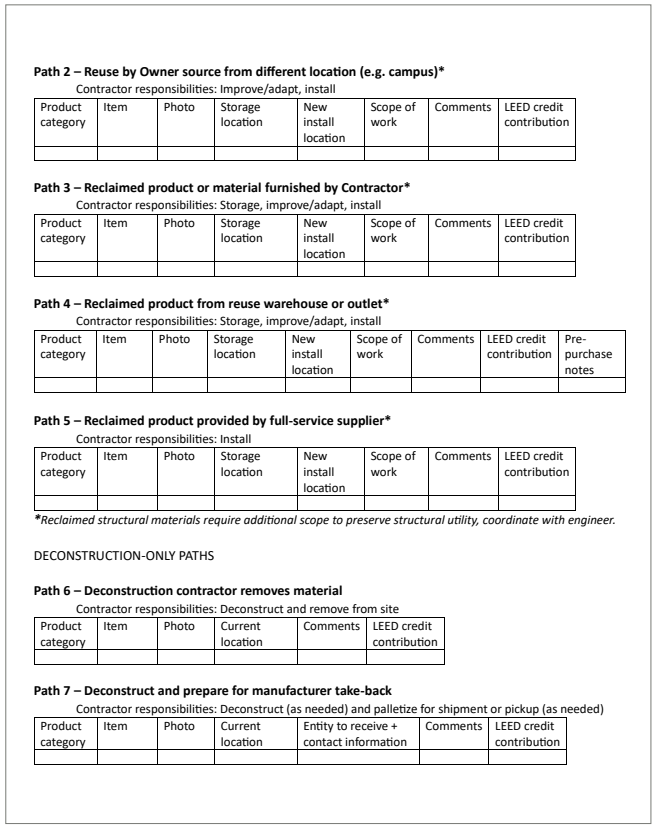
REUSE PATHS

Path 1 – Sourced from deconstruction at same location*
Contractor responsibilities: Deconstruct, storage, improve/adapt, install

Example list

Product category	Item	Photo	Previous location	Storage location	New install location	Current condition	Scope of work	Comments
Casework	*Kitchen cabinets*		*Unit #1 kitchen*	*[TBD decon contractor]*	*Community room*	*Good, fully functional, minor nicks in face frame*	*Clean all surfaces, install new hardware*	
Interior doors	*Wood door #1 and frame*		*Library level 2*	*[TBD reclaimed door subcontractor]*	*3C (Focus room at level 3)*	*Worn finish, veneer in good condition*	*Salvage door and frame. Sand and refinish. New door hardware. Refer to Door Schedule.*	

Example Material Reuse & Deconstruction Plan (continued)



Path 2 – Reuse by Owner source from different location (e.g. campus)*
Contractor responsibilities: Improve/adapt, install

Product category	Item	Photo	Storage location	New install location	Scope of work	Comments	LEED credit contribution

Path 3 – Reclaimed product or material furnished by Contractor*
Contractor responsibilities: Storage, improve/adapt, install

Product category	Item	Photo	Storage location	New install location	Scope of work	Comments	LEED credit contribution

Path 4 – Reclaimed product from reuse warehouse or outlet*
Contractor responsibilities: Storage, improve/adapt, install

Product category	Item	Photo	Storage location	New install location	Scope of work	Comments	LEED credit contribution	Pre-purchase notes

Path 5 – Reclaimed product provided by full-service supplier*
Contractor responsibilities: Install

Product category	Item	Photo	Storage location	New install location	Scope of work	Comments	LEED credit contribution

**Reclaimed structural materials require additional scope to preserve structural utility, coordinate with engineer.*

DECONSTRUCTION-ONLY PATHS

Path 6 – Deconstruction contractor removes material
Contractor responsibilities: Deconstruct and remove from site

Product category	Item	Photo	Current location	Comments	LEED credit contribution

Path 7 – Deconstruct and prepare for manufacturer take-back
Contractor responsibilities: Deconstruct (as needed) and palletize for shipment or pickup (as needed)

Product category	Item	Photo	Current location	Entity to receive + contact information	Comments	LEED credit contribution

Material Reuse and Deconstruction Plan. Appendix B.

show signs of wear. Functionality remains, but some owners may accept a range of appearance in alignment with cost savings goals.

5. Source high-quality reused materials

If the project scope includes demolition of an existing building or interior space, an opportunity to salvage and reuse exists. This is the time to engage a deconstruction contractor.

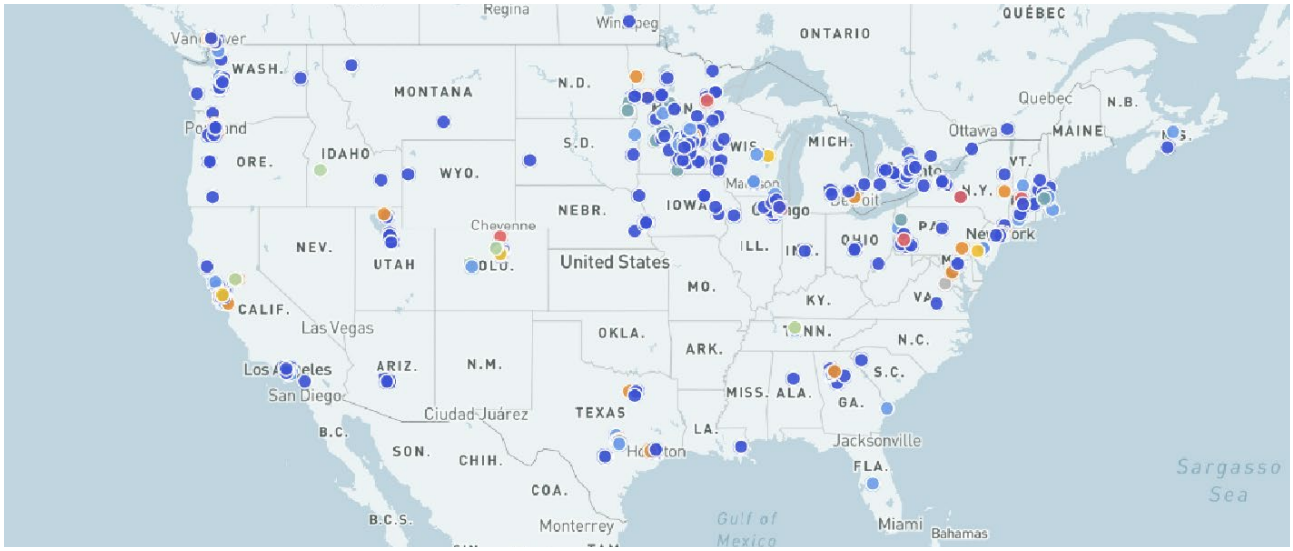
- **Appendix C - Template Building Deconstruction Pre-audit Form.** For use in inventory of reusable materials on site, prior to deconstruction.

The All for Reuse Ecosystem Map (below) is an open-source national database of reuse and deconstruction material and service providers: https://www.allforreuse.org/ecosystem-map Use the link to find or add a service provider to the map.

Sources of high quality materials may include:

- (Path 1, 2, or 3) Existing building that is being demolished. Materials obtained from a single source may be more consistent in material quality and appearance.
- (Path 2 or 3) Existing building at another location. The general contractor may know of other projects in process and be able to assist in identifying potential items.
- (Path 3 or 4) Demolition or deconstruction contractors.
- (Path 4) A salvaged building materials supply yard or reuse warehouse, auction, or via a materials broker or scout.
- (Path 5) Specialty salvaged materials suppliers that provide end-to-end service.

Prioritizing high-impact materials to reuse



	Entity Name	Website	Services Provided (Tags)	Product(s) Focus	Primary Role
STATE / PROVINCE: MN	Count 72				
182	A+ Plus Appliance	https://aplusappliance.org/	reuse retail	11 Residential Equipment (Appliances)	Reuse
183	Accent Store Fixtures	http://www.asfmn.com/	reuse retail	10 Visual Display Units, 10 Display Cases	Reuse
184	Anderson Building Movers	http://www.andersonbuildingmovers....	reuse retail		Hauling / Warehous
185	Architectural Antiques	http://www.archantiques.com/	reuse retail		Reuse
186	Art+architecture Inc.	http://www.artandarc.com/	antiques		Reuse
187	Atomic Recycling LLC	http://www.atomicrecycling.com/	reuse retail		Remanufacturing / F

All For Reuse Ecosystem Map. Searchable database with over 70 entries for deconstruction and reused material supply companies in Minnesota. https://www.allforreuse.org/ecosystem-map

Reuse at a large scale makes a case for itself where a significant volume of high-value material is available, relatively easy to salvage, and practical to implement in reuse.

A set of materials are listed on the following page according to ease and practicality of deconstruction and reuse, with higher-embodied-carbon materials highlighted. Annotations provide additional context.

Some materials are NOT recommended for reuse

Some materials must be vetted carefully prior to considering reuse, or even de-prioritized or avoided altogether.

- **Mechanical equipment.** Older HVAC equipment is less efficient and can contain high global-warming-potential refrigerants. The operating emissions from powering old equipment can quickly outstrip any embodied carbon savings, and an owner may inadvertently install equipment that increases utility bills. It is typically a best practice to recycle old heating and air conditioning equipment instead of reusing. Consult with a mechanical engineer for detailed recommendations.
- **Lighting.** Old fluorescent and compact fluorescent lighting is much less efficient and more expensive to operate than modern LED fixtures. Fluorescent fixtures should be recycled instead of reused. The payback on LED fixtures is worthwhile both in operating dollars and carbon emissions reduction.
- **Potentially toxic coatings on carpet and textiles.** Some finish materials, such as carpeting and textiles, can contain stain repellents, flame retardants, or other PFAS chemistry, also known as forever chemicals that are carcinogens and endocrine disruptors. If you are not sure about toxicity, and a material will be installed in a high-touch area, it may be best not to reuse, or to seek a similar item for which you can be sure that no toxic coatings or finishes were applied.
- **Microplastics and chemicals from recycled latex and acrylic paint.** Hennepin County promotes paint recycling. However, while the goal of recycling leftover paint to prevent dumping is a noble one, it is better to question whether plastic-based paints (acrylic, latex, or PVC) can be avoided in the first place. In addition to chemical additives, plastic-based paints from architectural projects are a leading source of global microplastic pollution in oceans and waterways. (EA, 2021) Consider prolonging the time between repainting, or use potassium silicate or lime-based paints without added polymers as an alternative.

Easy to deconstruct and practical to reuse

Furniture, finishes and fixtures

- **Office tables**
- **Office chairs**
- **Office cubicles**
- **Lounge furniture**
- Wood trim and moldings
- **Retail display shelving**
- **Carpet**
- **Solid core wood door**
- **Insulated steel door**
- Door hardware
- Pendant lights
- Linear light fixtures
- Plumbing fixtures
- Lockers
- Mirrors
- Fire extinguishers and cabinets
- **Sensors and electronic equipment, e.g. building automation system (BAS)**

Envelope and structure

- Plywood
- Steel cladding
- Wood siding
- Stone composite cladding
- Fiberglass batt insulation

Furnishings tend to be carbon-intensive due to complexity, quality of materials and manufacturing. They are also the simplest to reuse. Consider reupolstery or replacing components.

Cubicles can be labor-intensive to disassemble, but this needs to be done even if removing for landfil, so the labor involved in salvaging should not be considered a 100% increase.

Carpet is often one of the highest-carbon materials in a space due to volume and embodied carbon intensity.

Exterior steel doors should be checked for structural integrity.

Carbon note: There is still not enough widely available information on the embodied carbon impact of electronic equipment, but it is likely carbon-intensive. Newer models of sensors and equipment are good candidates for salvage and reuse.

Medium difficulty deconstruction or semi-practical reuse

Furniture, finishes and fixtures

- Acoustic ceiling tiles
- Solid oak flooring
- Engineered wood flooring
- **Casework and kitchen countertops**
- Library shelving
- Metal railings
- Wood interior veneer

Envelope and structure

- **GFRC, metal and composite rainscreen cladding**
- **Wood windows with intact IGUs**
- **Vinyl windows with intact IGUs**
- **Fiberglass windows with intact IGUs**
- **Aluminum windows with intact IGUs**
- Mineral board insulation
- **Glue-laminated timber beams and columns**
- **Cross-laminated timber (CLT) panels**
- **Cold rolled steel stud**
- **Steel beams, columns, joists**
- Light timber / dimensional lumber

The carbon impact of interior finishes add up significantly over multiple renovations. If these items can remain in place over multiple renovations, it reduces the overall impact of each refresh.

Rainscreen panels are typically mechanically fastened and may be good candidates for salvage and reuse.

Windows are relatively easy to salvage and tend to be high-carbon due to engineered glass. However, windows and glazing also contribute significantly to energy use which can far outstrip embodied carbon savings over time. It is important to select exterior windows with the appropriate U-value and provide installation details to minimize thermal bridging.

Carbon note: Reusing wood products ensures the carbon remains sequestered in a new project, instead of breaking down and being re-emitted.

Steel is a high-carbon, high-value material to reuse.

Difficult deconstruction or impractical reuse (not impossible!)

- **Cast-in-place concrete**
- **Brick**
- **Concrete masonry units (CMUs)**
- **XPS and other foam insulations**

Concrete and masonry materials are often high-carbon, high-volume materials. Unfortunately they are difficult to reclaim, but may be reused as site fill or aggregate.

Foam insulation is typically adhered, which makes it difficult to reclaim despite high embodied carbon.

High embodied carbon, compared to functionally similar materials

A list of reusable materials in order of ease of deconstruction and practicality of reuse.

Materials with higher embodied carbon are highlighted.

6. Get credit for reuse in green building certifications

Several green building certifications offer pathways to compliance or certification through the use of salvaged materials on a building project.

Minnesota B3

Under the Minnesota B3 Materials and Waste requirement, a minimum of 55% of building materials on any project must be either: Salvaged or reused; recycled content; bio-based; or responsibly sourced with a certification. The stretch goal is 75%. Reclaimed materials count towards achieving this goal.

LEED v4.1 (USGBC)

Within the LEED v4.1 Materials and Resources category, up to 5 points are available for reused material in the credit Building Life-Cycle Impact Reduction. From the credit library: The requirement is to "demonstrate reduced environmental effects during initial project decision-making by reusing existing building resources or demonstrating a reduction in materials use through life-cycle assessment."

Reused materials may be tabulated or modeled, with different numbers of points available depending on the scope of reuse and associated embodied carbon.

LEED v5 (forthcoming)

Proposed updates in LEED v5 in the Materials and Resources category offer points specifically for reusing salvaged interior finishes and furnishings, including up to 3 points for reusing targeted material types such as carpeting, ceilings and furniture.

Living Building Challenge 4.0 (ILFI)

Salvaged materials are beneficial to project teams seeking Materials Petal Certification under the Living Building Challenge. Salvaged materials can be moved from a previous location, or "in situ," e.g., when an existing floor finish is kept and reused in place.

Salvaged materials provide cost savings to the project in multiple ways. First, salvaged materials require less staff time to review per the Red List Imperative, compared to new materials. Second, since the embodied carbon of salvage is subtracted from the total embodied carbon of the project, use of salvage reduces the total carbon offset purchase required at the end of the project.

From the LBC v4.0 Materials Petal Handbook:

"Project teams using sites with existing buildings, landscape elements, and/or infrastructure must complete a pre-building audit that inventories available materials and assemblies for reuse or recycling. The requirement for one salvaged material per 500 square meters of gross building area is intended to showcase opportunities for beneficial reuse of salvaged materials. Projects over 15,000 square meters may cap the number of unique salvaged products at 30. Multiple salvaged products may be used in the same product category, but projects using this cap must use salvaged products in at least 10 separate product categories (i.e., CSI Sections). The salvaged materials do not need to be distributed evenly throughout the project, but should be sufficiently spread out and prominently located so as to be visible to each of the primary occupant types in the building."

7. Design for future disassembly and reuse

This guide would not be complete without a reminder that for the circular economy to remain circular, materials - including salvaged materials - should be designed for future deconstructability and another reuse.

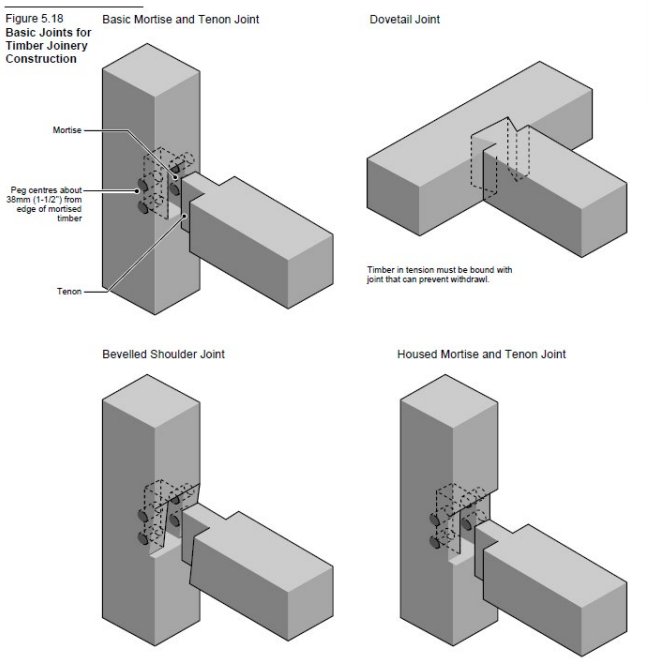
In general, best practices include:

- Eliminate glue and construction adhesives wherever possible
- Avoid “monstrous hybrids” where non-similar materials are laminated or glued together to a degree that it is unrealistic to recover either material for recycling
- Use mechanical fasteners such as nails, screws, or wooden dowels in lieu of gluing, welding or laminating
- Draw details showing mounting with brackets, clips and other mechanical fasteners instead of relying on glue

A balance must be found

For example, a structural layout with equally sized steel beams may create the easiest scenario for future reuse of the beams, but optimizing steel beam sizes based on structural loading will save both money and embodied carbon. A welded join may allow for less total steel than a bolted connection.

However, future deconstructability should always be considered in the drawings and during installation.



Timber connections without the use of glue or nails.
Canadian Wood Council

Deconstruction at Commercial Scale

Levels of deconstruction

The number of jurisdictions with deconstruction requirements to limit construction and demolition waste continues to grow. Total deconstruction of a building is possible, but in many cases a combination of deconstruction and demolition may be needed. It is helpful to plan a project using language that describes the level of deconstruction needed, from less complex tasks such as clean-out and soft-stripping to the more complex removal of structural elements or full deconstruction.

- **Appendix A - Division 2 spec section "Selective Building Deconstruction."** Example spec sections from counties and cities in California, Oregon, Pennsylvania, Texas and Washington were reviewed and adapted to provide a template.


HENNEPIN COUNTY

Building reuse grants

Commercial deconstruction

Hennepin County has funding available for building projects that use deconstruction techniques instead of standard demolition to remove materials from the destruction, alteration, or renovation of a building. Property owners and developers of commercial properties can receive up to $10,000 to help offset the additional time and labor costs associated with deconstruction.

Eligible recipients	Private property owners
Eligible property types	• Commercial properties, including multi-family buildings larger than 4 units • The structure being demolished or renovated must be at least 500 square feet
Application timeline	• Applications are accepted on an ongoing basis until available funds are depleted. • Deconstruction must take place after the agreement to issue grant funds is established. Grant funding cannot be used for deconstruction work that has already been completed.
Amount of funding available per project	$10,000 maximum per project (based on $2 per square foot)
Matching funds	No match required
Reporting requirements	Documentation verifying: • A minimum of five different building materials from category A are deconstructed for reuse. • At least 1,000 pounds of lumber from category B are deconstructed for reuse. • All non-reusable building material generated from the project must be sent to a construction and demolition waste recycling processing facility that achieves a minimum 60% recycling rate. Visit **hennepin.us/building-reuse** for a list of facilities that meet this criteria.

For more information

If you are considering applying for a grant, contact us to discuss your project, receive application assistance, or learn more about deconstruction.

- Visit **hennepin.us/building-reuse**
- Contact us at **olivia.cashman@hennepin.us** or 612-348-4843

Category A materials:
Cabinets, casing around doors and windows, carpet tiles*, ceiling tiles*, light fixtures, mantels, molding, plumbing fixtures, solid wood doors, stair treads and railings, stone details, radiators, wood-framed windows, shutters or siding

Category B materials:
Brick or stone blocks*, ceiling and/or floor joists, dimensional lumber, wood beams, wood flooring, other materials as approved by the county

*only eligible on commercial projects

Hennepin County
Environment and Energy

HENNEPIN COUNTY

Building reuse grants

Used building material installation

...porating used building materials into project designs ...es waste and embodied carbon associated with new ...ials, increases demand for used building materials, and ...orts local reuse retailers. Property owners and developers of ...rcial or commercial properties can receive up to $5,000 to ...offset the additional time and costs associated with installing ...building materials into projects.

...le ...ents	Private property owners
...e property	• Residential or commercial properties • Project size at least 300 square feet • Additions, renovations, remodels, and new construction projects are eligible
...cation ...ne	• Applications are accepted on an ongoing basis until available funds are depleted. • Project must take place after the agreement to issue grant funds is established. Grant funding cannot be used for work that has already been completed or for materials that have already been purchased.
...unt of ...ng ...ible per ...ct	• $5,000 maximum per project (based on $2 per square foot) • Used building materials could be used in conjunction with deconstruction or structural move-grant funds for projects that both deconstruct and incorporate used building materials into designs.
...ning funds	No match required
...rting ...rements	Documentation verifying new project designs incorporate: • A minimum of five different used building materials from category A • At least 500 pounds of used building materials from category B.

For more information

If you are considering applying for a grant, contact us to discuss your project, receive application assistance, or learn more about used building materials:

- Visit **hennepin.us/building-reuse**
- Contact us at **olivia.cashman@hennepin.us** or 612-348-4843

Category A materials:
Brick or stone blocks, cabinets, casing around doors and windows, carpet tiles*, ceiling tiles*, light fixtures, mantels, molding, plumbing fixtures, solid wood doors, stair treads and railings, stone details, radiators, wood-framed windows, shutters or siding

Category B materials:
Brick or stone blocks*, ceiling and/or floor joists, dimensional lumber, wood beams, wood flooring, other materials as approved by the county

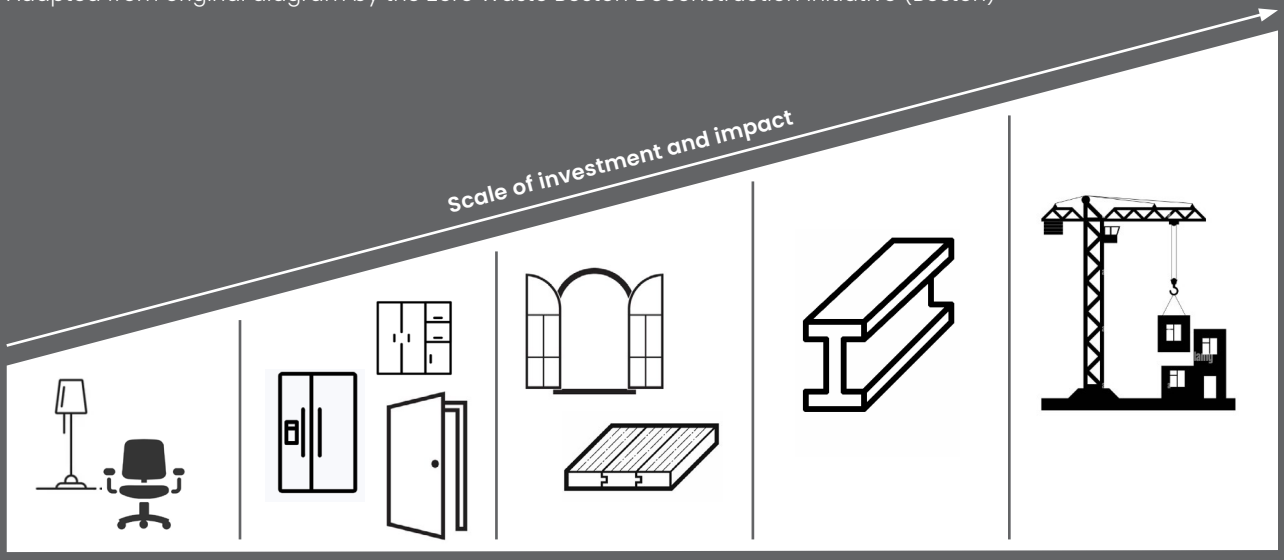
*only eligible on commercial projects

...en County
...ment and Energy

Hennepin County grants available for deconstruction
https://www.hennepin.us/building-reuse

Levels of Deconstruction

Adapted from original diagram by the Zero Waste Boston Deconstruction Initiative (Boston)



Clean-out
Removal of items such as furniture and other non-attached items before the project begins.

Soft-stripping
Easy-to-capture and high value materials like appliances, cabinetry, doors and frames.

Integral non-structural
Additional material including wood planks and other flooring, glazing, cladding.

Structural
May include steel, timber, wood studs, metal studs, stairs, post-tensioned concrete planks.

Full deconstruction
Recapture and diversion of the vast majority of materials.

Where will materials go?

The purpose of deconstruction is to enable future reuse. In a circular economy, there is no "away." There is only someone else's reuse sourcing pathway. If a material has no clear pathway to a future project, it is merely on a slower path to landfill, and the benefit of deconstruction is lost. Therefore, set your deconstruction strategy with the product's second life in mind.

Timing

It is best to identify deconstruction partners early in the design process to plan the process and inform the Material Reuse and Deconstruction Plan (MRDP), refer to example in Appendix B. Deconstruction can take longer than demolition and must be accounted for in the construction schedule.

Network of reclamation organizations

Materials removed from site must be diverted to the staging location for their future sourcing. The All for Reuse Ecosystem Map lists a number of reclamation organizations around the United States. It is helpful to make regional deconstruction reclamation connections during the design phase so that by the time a project is bid, materials have an identified destination. This should be included in the MRDP matrix (Appendix B).

Depending upon the local market for salvaged materials, potential reclamation organizations may wish to view materials ahead of a deconstruction bid. The owner should consider how and when to grant viewing access prior to deconstruction.

Who owns the salvaged items?

Unless otherwise arranged and noted in the contract and specification language, it is typically assumed that the deconstruction contractor or designated reclamation organization acquires the material at the time of deconstruction and takes responsibility for the items. The owner donates the material to the deconstruction contractor or reclaiming organization and agrees to grant any future profit to that organization. In exchange, the original owner may receive a receipt or appraisal of the tax value of their donation and would retain the tax benefit. The only entity that can claim a tax deduction is the entity that paid for the materials. Establishing clear ownership in certain situations, like tenant improvements, can be complicated. It is best to clarify before deconstruction commences.

If the owner wants to retain certain items or the salvage rights to those items, they should be physically marked in the building and addressed in the contract language.

Reclaimed yellow birch flooring. Photo LumberStash

Reuse warehouse at Better Futures Minnesota. Photo Hennepin County Energy & Environment

De-nailing a wood stud. Photo Hennepin County Energy & Environment

Performing the work

Different parties perform deconstruction work, including dedicated deconstruction contractors, general contractors, demolition contractors that offer deconstruction services, and third-party reclamation organizations that specialize in specific material categories. To ensure a qualified bidder, the owner may include language in the RFQ such as:

- Experience on commercial-scale deconstruction
- Proven record of 85% salvage and diversion rate
- If and when a certification is developed for deconstruction contractors, this could be listed in the RFQ

Owner responsibilities

Key steps include a pre-audit of available materials and selecting or coordinating with a deconstruction contractor early in the design process (well before the planned start of construction activities).

During design is also a good time to review materials for potential reuse. Inventory apps allow owners to create a dynamic dataset of available materials.

- **Appendix C - Template Building Deconstruction Pre-Audit form**

To encourage a circular economy, owners should consider available tax deductions and other life cycle cost savings as part of the pro forma or return on investment calculation.

Owner responsibilities typically include the following, unless otherwise arranged:

- Abatement work including lead and asbestos typically must be completed in preparation. The deconstruction contractor may require documentation proving completion of this work prior to commencing deconstruction. The team should sequence and coordinate deconstruction around abatement to maximize materials recovered and minimize potential release of hazardous materials.
- The owner (or the general contractor on commercial projects) is responsible for utility disconnections.
- The deconstruction contractor may or may not apply for a deconstruction permit. This should be clarified at the time of bidding the work.

Structural materials

The MRDP outlines suggested grades for classifying deconstructed finish materials. Structural materials must be assessed for potential reuse by an engineer, and may need to be labeled and handled in specific ways to ensure viability for future structural use. It is important to review the method and work plan with the structural engineer.

Utilizing manufacturer takeback programs

A growing number of manufacturers offer takeback programs with practice -- or eventual goal --of recycling salvaged materials into new product. Two product categories with multiple manufacturers offering takeback or extended producer responsibility (EPR) programs at this time include commercial carpet tiles and acoustic ceiling tiles (ACT). Since takeback programs mostly result in recycling, which is of lower environmental benefit than reuse, consider reuse first, and if materials are not fit for reuse then takeback programs are the next best option.

Coordinate the design, the drawings and the specs
Takeback programs have the potential for some cost savings on a project by reducing disposal fees, depending on the jurisdiction and the increase in cost for palletizing takeback materials for shipment. Successful takeback and potential cost savings have the best chance of being realized if the process is well coordinated:

- To ensure the best chance of materials being taken back, include notes on the drawings and language in the specification. In the demolition general notes and on the drawings, designer should identify items to be reclaimed for manufacturer takeback including manufacturer and name of existing product if possible. Include contact info for the manufacturer's program operator so the contractor knows who to call. See **Appendix E - Example Deconstruction Annotations on Demolition Plan**. Instructions to demolition contractor regarding items to be deconstructed.
- When takeback is attempted as a last-minute addition to a demolition scope, it is less likely to succeed. Demolition contractors need clarity when takeback is required scope and not an add-alternate, so they can plan and price additional site logistics. If the make/manufacturer is known, the manufacturer can provide a detailed spec on the procedure to package up. Manufacturers generally reserve the right to reject products at their discretion when arriving back at their factory.
- At this time many manufacturers only accept their own product returned and will not accept materials from another company. Or, there may be a requirement for a minimum quantity of removed material, or an incentive tied to specifying a minimum quantity of new product from the same manufacturer, for the company to pay for shipping and otherwise support the takeback effort. Designers can improve the odds of successful takeback by simplifying product selections to a single manufacturer and identifying that manufacturer's takeback program and contact info in the demo plans and spec.
- ...Or even better, designers can signal the market by prioritizing new products from manufacturers with strong takeback programs, and publicly sharing their decision in alignment with the Circularity bucket of the Common Materials Framework. Choosing manufacturers that are committed to circularity - and being transparent about the grounds for selection - sends a unified message about the importance of circularity to other designers and product manufacturers.
- By "strong takeback programs," we mean those that provide clear guidance regarding quantities and qualifications, assistance in coordinating logistics, and transparency regarding the destination and future use of the reclaimed material.
- Takeback becomes an especially viable option when the team develops a strategy that benefits the project in multiple ways, for example by reducing waste and reducing tipping fees by leveraging a takeback program where shipping is covered by the manufacturer.

In the spirit of maintaining the highest possible utility of materials in a circular economy, it is recommended to consider whether currently installed materials such as acoustic ceilings and carpet can be reused in situ, prior to arranging for deconstruction and replacement.

Case Studies of Commercial Reuse

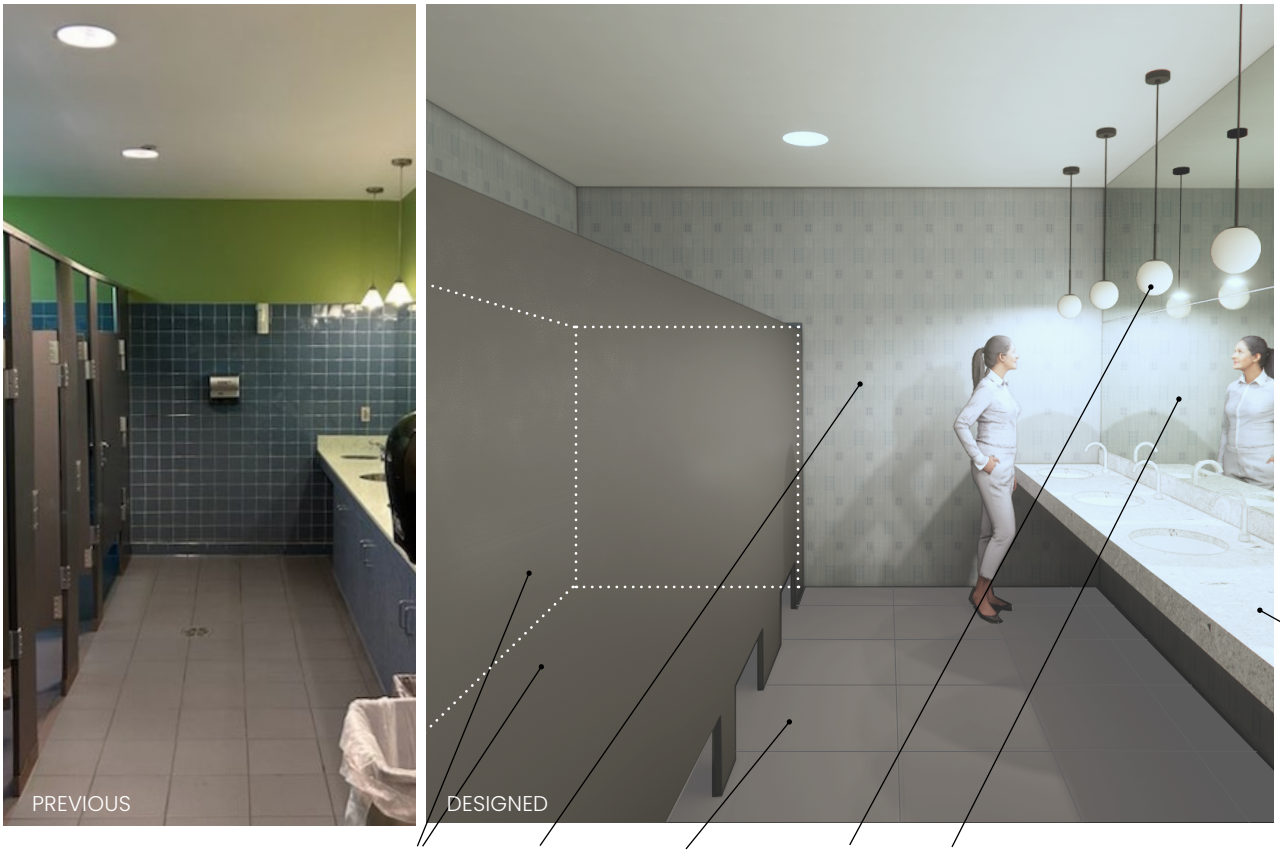
While the value of reusing materials may be intuitive from an ethical perspective, the content of this guide illustrates some of the complexities in addressing workflow challenge. However, workflow questions do not address the question of style:

What if the owner or designer feels averse to the idea of working with salvaged materials because of concerns that they will not be able to achieve their preferred aesthetic?

Logistics and new workflows are barriers that must be overcome, but the biggest challenge in growing demand for reclaimed materials may be in convincing owners and design professionals that old materials can make a space look and feel new.

The following commercial-scale case studies from Minnesota and around the United States feature salvaged materials incorporated into new designs within new or previously existing buildings.

A commercial restroom refresh with reused-in-place elements. Photo by Blue Rock, rendering by MSR Design.



Preserve fixtures, partitions, and blue wall tile within the stalls. Provide new metal edge strip at tile/wallcovering transition.

New paint and wall covering selected to work with existing finishes.

Existing floor tile was a neutral color and in good condition.

Client decided to reuse existing pendants instead of replacing with the globes shown in the rendering.

Mirror turned out to be damaged and needed to be replaced.

Countertop was meant to remain, but tile and cabinet removal made the counter too short and exposed structural concerns. Lesson learned: When designing for disassembly, detail the countertop structure and endwall connection to enable future wall finish refreshes while leaving durable materials in place.

Reuse case study

510 Marquette: Salvage in Support of LBC Petal Certification

Project type: Office tenant improvement
Client: MSR Design, Minneapolis, MN
Reuse paths: 1. Reuse onsite, 3. Furnished by Contractor
Year: 1925 original, renovation completed 2021
Design firm: MSR Design
Contractor: Stahl Construction

Salvaged metal studs and recovered batt insulation, ready for re-installation. Photos Stahl Construction

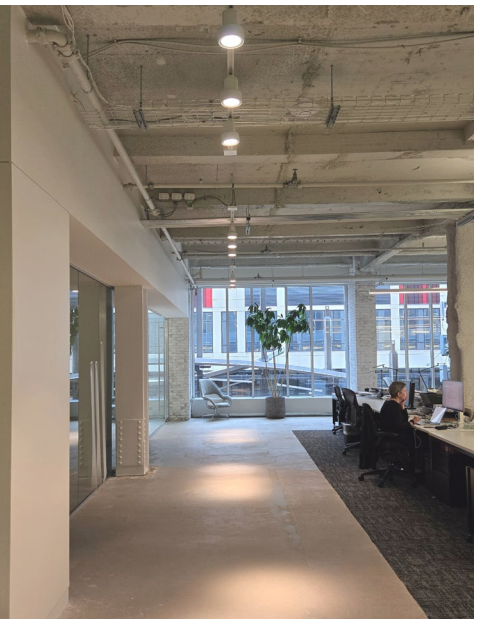
Salvaged materials were incorporated into this architecture studio renovation to create a making environment and to showcase the design process. Reclaimed materials include:

- LED lighting, downlights and linear fixtures, and electrical conduit.
- Furniture from the previous location was reused and some of it rebuilt with new legs to create adjustable-height workstations.
- Metal studs, batt insulation and gypsum wall board deconstructed and reused in acoustic isolation of conference rooms and focus rooms.
- The patchwork Travertine floor was left exposed and counted as in situ salvage.
- Carrara marble wall panels from nearby demo.
- Glass doors moved to create a new front entry.

The case for reuse: Learning from experience

The project achieved Living Building Challenge (LBC) Petal Certification for the materials, beauty, and equity petals. The materials petal entailed stringent carbon calculation and offset requirements.

The contractor was instrumental in sourcing salvaged materials from other demolition projects to reuse in this project. The electrical subcontractor sourced downlighting from the renovation of a Minneapolis-based corporate headquarters and provided leftover conduit from their surplus warehouse. In the contract, labor was priced based on the cost of equivalent new materials, and cost savings for using reclaimed lighting and conduit were passed along to the owner, resulting in an overall cost reduction for the owner without penalty to the installer. Use of salvaged materials resulted in 28% less embodied carbon than a typical T.I. project.



Reclaimed lighting and rebuilt workstations. Homasote pinboard panels from previous office. Photos MSR Design

Reuse case study

Hines Headquarters: Ultra-low Embodied Carbon Interior

Project type: Office tenant improvement
Client: Hines Interests Limited Partnership, Seattle, WA
Reuse paths: 1. Reuse onsite, 4. Reuse warehouse
Year: 1959 original, renovation completed 2022
Design firm: LMN Architects
Contractor: Stellen Construction
Overstock carpet provider: Legacy Group

When specifying materials for the project, reuse was always the first option, followed by the lowest-embodied-carbon new materials. The team conducted an initial walkthrough of space to catalogue materials that could be reused, including:

- Partition walls and glazing and doors.
- The original carpeting, which appeared dated, was actually in good condition and fit in when the color palette was designed to accommodate it.
- Entry glazing was salvaged from existing conference room wall.

Additional materials were sourced via different pathways:

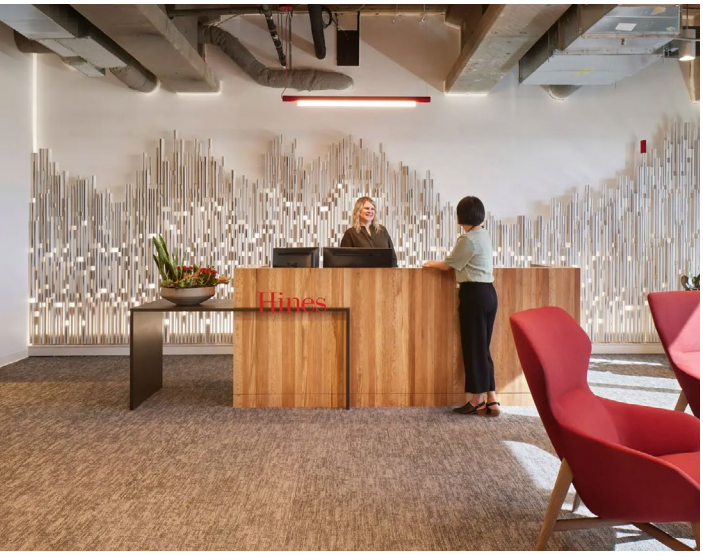
- The team discovered a local flooring distributor that is able to provide small quantities of new carpet from a warehouse of attic stock, which was great for accent locations and the elevator lobby.
- A feature wall designed from wood offcuts.
- Conference table made from a local fallen tree.

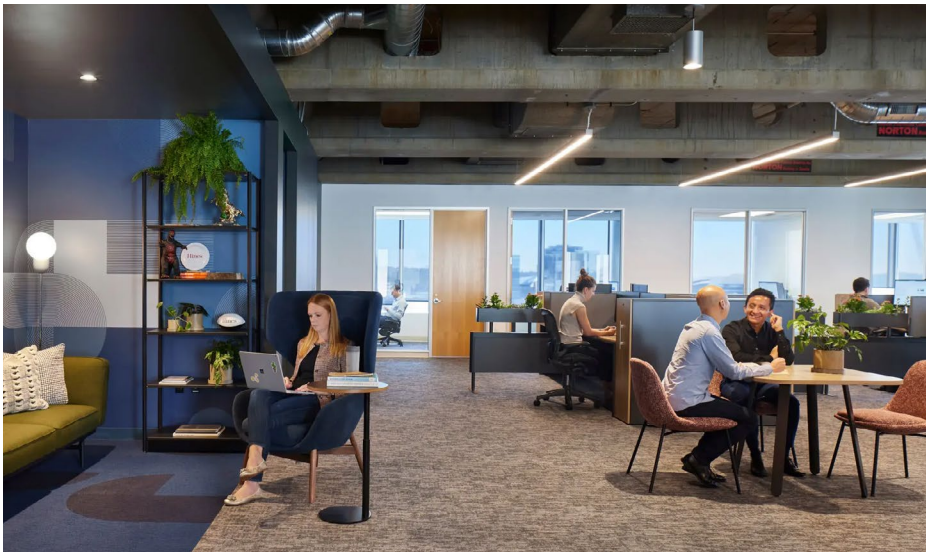
Before renovation. Old ceiling tiles stacked for donation.
Photos LMN Architects

The case for reuse: Big carbon reduction goals
The owner had intensive carbon reduction goals for operations, so the design team encouraged them to consider embodied carbon in the new office design.

Cultivating a mindset of reuse as a high priority was a mental shift for the design and construction team. The team was challenged to conceive of a contemporary, aesthetically pleasing new palette around the beige carpet, which was a large volume of existing material and would have been one of the largest sources of embodied carbon, if replaced.

Embodied carbon goals were a topic at every design meeting and all team members were engaged with the effort. The project achieved a 65% reduction in embodied carbon compared to a typical T.I. project.





Entry and workspaces with a contemporary materials palette built around the existing carpet. Photos LMN Architects

Reuse case study

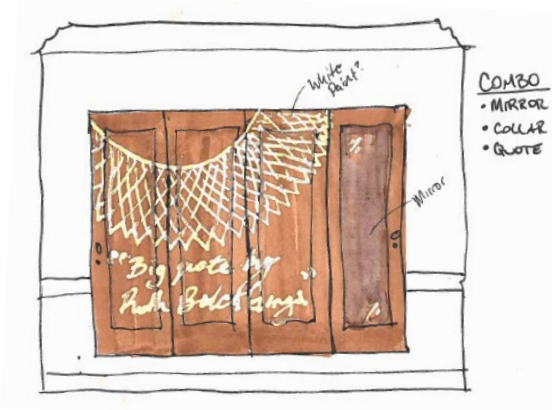
Balch Hall: Historic Doors to Wall Panels

Project type: Higher education, dormitory renovation
Client: Cornell University**,** Ithaca, New York
Reuse path: 1. Reuse onsite
Year: 1929 original, 2025 expected completion
Design firm: Goody Clancy
Contractor: Whiting-Turner
Door restoration contractor: E.M. Pfaff & Son

Material salvage and reuse was utilized as a strategy to preserve the historic character of Balch Hall, including careful disassembly and cataloging of reusable materials including:

- Original wood doors and trim
- Historic light fixtures (refurbished and converted to LED)
- Marble partitions
- Furniture, sinks

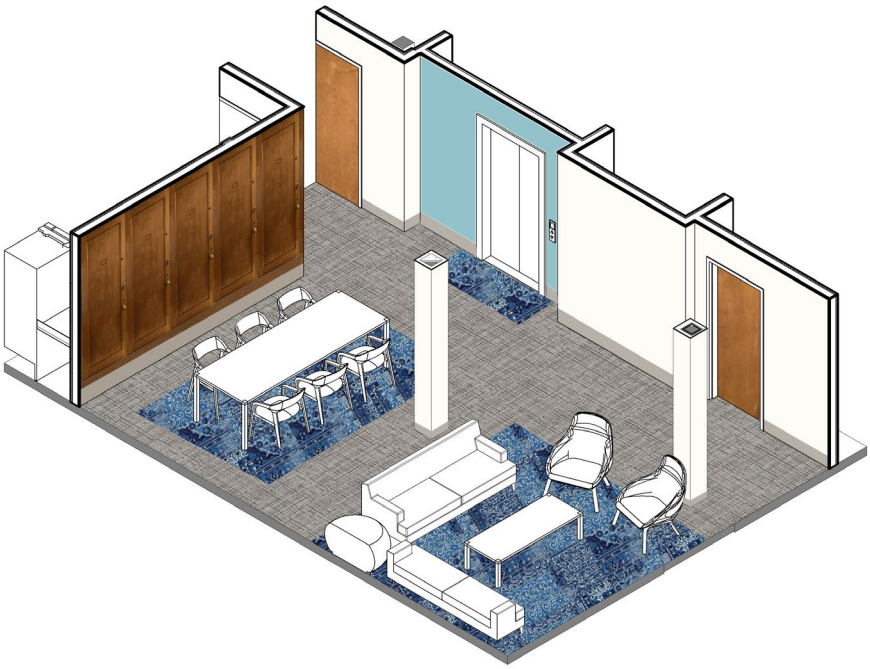
Over 1,100 solid wood doors were removed because they were too narrow to meet modern code requirements. The design team repurposed 100 doors as wall paneling wall paneling in lounges and public areas of the dormitory, with the existing door knobs functioning as hooks. Remaining doors were donated to a reuse retailer.



Design sketch of RBG art installation. Image Goody Clancy

The case for reuse: Character and cost savings
Repurposing non-code-compliant doors as wall paneling provided a historically authentic material with a significantly lower material cost than new wood paneling. The design team estimated that new wood paneling would have cost $1,500 for the same area as one of the doors, while restoring the existing doors as paneling cost only $400 per door.

Former Supreme Court Justice Ruth Bader Ginsburg resided in Balch Hall as a student at Cornell University. The doors from her dorm suite were used to create an art installation in her honor.



Reclaimed doors removed and stored prior to reuse. Rendering of the lounge with installed door panels.
Images Goody Clancy

Reuse case study

Hazelwood Green Roundhouse: Regionally Reclaimed Doors

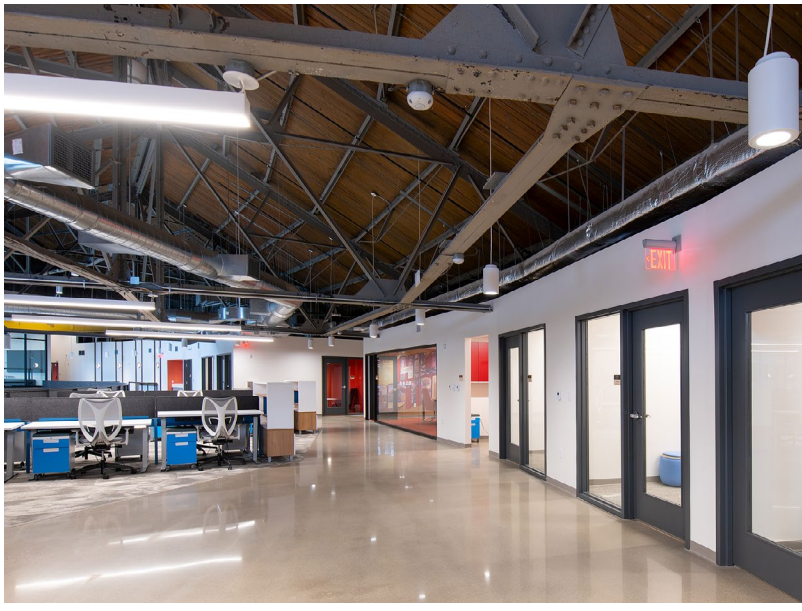
Project type: Co-working space, interior renovation
Client: Almono LP, Pittsburgh, PA;
Tenant: OneValley
Reuse path: 1. Reuse onsite, 5. Furnished by third-party supplier
Year: 1887 original, renovation completed 2021
Design firm: GBBN
Contractor: PJ Dick
Reclaimed door contractor: Doors Unhinged

This adaptive reuse project aimed to reuse as many original features of the historic building as possible, and also chose to incorporate regionally reclaimed materials, including:

- Nearly 50 locally and regionally reclaimed wood doors and hardware sets, wherever original-to-the-building materials could not be used.
- The original 10-ton gantry crane was taken down to be restored and later reinstalled as a prominent feature of the building's history.
- The operator cab from the turntable that was restored and relocated.

The case for reuse: Commitment to local economy
The 178-acre Hazelwood Green development aspires to be a model of sustainable urban redevelopment, including graywater reclamation, 2-MW solar photovoltaic installation, and the construction of buildings on the site that meet or exceed Pittsburgh's P4 sustainable development standard. The Roundhouse is one of three historic buildings on the site, and the partner organizations prioritized sustainable products designed and fabricated by local craftspeople. The design team saw an opportunity to accomplish both by working with Doors Unhinged.

The collaborative relationship and aligned goals of owner, architect, contractor and Supplier made the reclaimed product aspect a success. From a design perspective, the keys to success for making use of reclaimed doors were timing and flexibility. The design team explored reclaimed products early in the project, reaching out to Doors Unhinged during schematic design. The project designers were also willing to accept high quality doors with minor aesthetic differences in terms of height, species, and finish. This allowed for the possibility of piecing together a set of doors that while not perfectly matched, are similar enough and placed carefully in context with one another so as to achieve an overall uniform look. In addition to reducing the carbon footprint, the project benefitted from cost reductions as a result of choosing reclaimed doors.



The renovated Hazelwood Green Roundhouse, with reclaimed interior doors. Photos Craig Thompson Photography

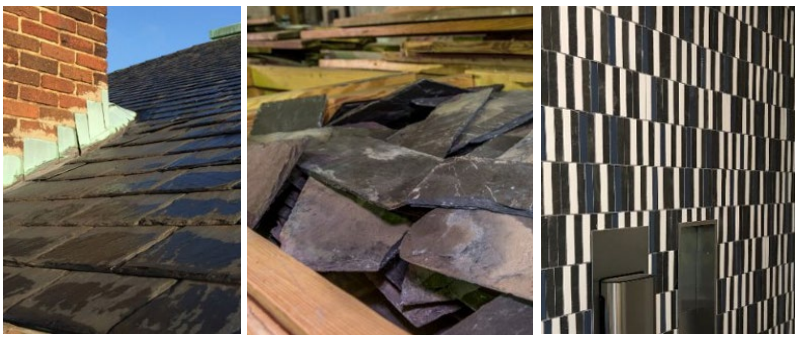
Reuse case study

Kendeda Building: Mass Timber Salvaged from Movie Sets

Project type: New construction
Client: Georgia Institute of Technology, Atlanta, GA
Reuse path: 2. Reuse on same campus 3. Reuse sourced by general contractor
Year: Completed 2019, Living Building Certified 2021
Design firm: Lord Aeck Sargent in collaboration with Miller Hull
Contractor: Skanska
Reclaimed materials supplier: Lifecycle Building Center

The Kendeda Building for Innovative Sustainable Design was designed to demonstrate regenerative systems in a mixed climate. Innovative use of reclaimed materials was a strategy to reduce the embodied carbon footprint and achieve Living Building Challenge (LBC) Certification, including:

- Dismantled movie sets provided 25,000 linear feet of 2x4s, made into exposed nail-laminated timber (NLT) floor and roof decks.
- 1880s heart pine joists removed in 2016 from the iconic Tech Tower were reused as stair treads.
- Lumber from storm-felled trees on campus was milled to make countertops and benches.
- Slate shingles from the Alumni House on campus were reused as restroom wall tile.
- Project reused more than 57,300 lbs of material and sent only 48,600 lbs to landfill.
- Locally-quarried granite curb was sourced from the demolished Georgia State Archives Building.



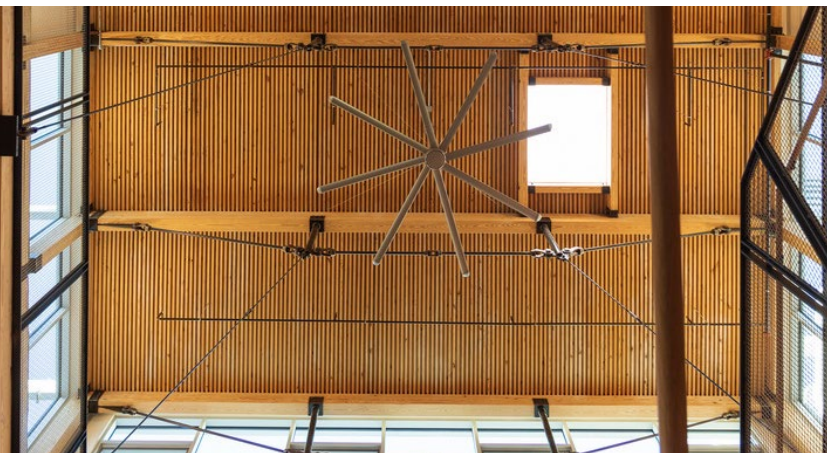
Slate tiles taken from a roof renovation and repurposed into restroom wall tile. Photos Lifecycle Building Center

- Wood panels and joists from a former church on the campus used to make the central ramp.

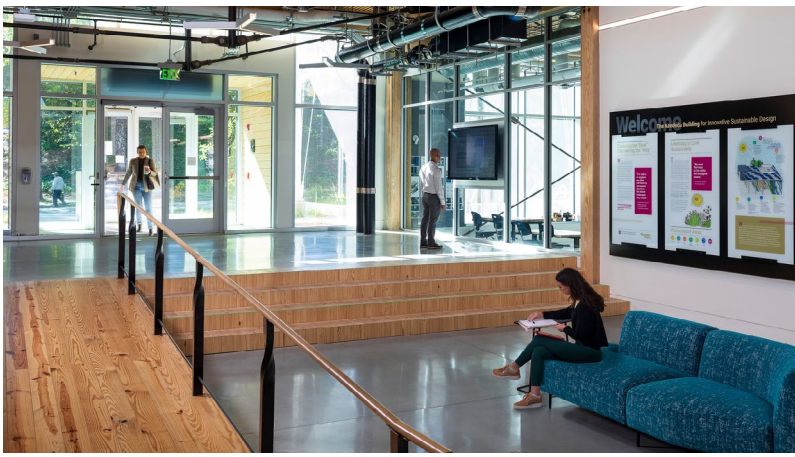
The case for reuse: Local economy and innovation

Through design, coordination, and resourcefulness, the project team reused a series of salvaged materials to incorporate 28 re-purposed components, more than tripling the minimum requirement. Mass timber was selected as the main structural material to minimize the use of high-GWP steel and concrete. The use of salvaged timber and other materials throughout the building reduced carbon emissions and landfill waste even further.

The Lifecycle Building Center captured thousands of two-by-fours from movie production sets to create the NLT panels, comprised of two-by-fours and two-by-sixes nailed together to create a distinctive fluted pattern. Skanska partnered with Georgia Works! to incorporate workforce development in the construction of the NLT roof and floor panels.



Nail-laminated timber roof deck constructed of lumber reclaimed from torn-down movie sets in Atlanta.



Salvaged heart of pine stairs and ramp. Images Gregg Willett Photo

Appendix A
Specifications for reuse and deconstruction

Division 1 Material Reuse
The purpose of this specification section is to formalize and legitimize the use of reclaimed materials on construction projects. Including the Division 1 Material Reuse specification section in the project manual provides structures necessary for fitting reused materials into the scope of work defined by the contract documents:

- Establishes accountability for following through on material reuse goals, and ensures material reuse shows up in the table of contents so it is not overlooked.
- Sets expectations by identifying which product categories have reclaimed product options for consideration and establishing one or more of the following reuse pathways:

  Path 1. Sourced from deconstruction at the same location.

  Path 2. Sourced by the same owner, but a different location, for example a campus.

  Path 3. Furnished by contractor or subcontractor.

  Path 4. Purchased at reuse warehouse or outlet.

  Path 5. Sourced by a full-service reclaimed material supplier.

- Establishes baseline acceptable conditions for reused materials, and points to the **Material Reuse and Deconstruction Plan** (Appendix B) for product-specific required criteria and range of acceptable deviation.
- Outlines the process for evaluating reclaimed materials for inclusion in the project.
- Identifies suppliers for specific products for contractor to invite bidding, and provides direction to bidders.

Division 2 Selective Deconstruction
The purpose of this section:

- Establish Owner/Architect's expectations of Contractor relative to deconstruction
- Give adequate direction to Contractor on how deconstruction should be accomplished
- Help Contractor select appropriate Deconstruction Contractor
- Allow the possibility for Contractor to self-perform deconstruction
- Communicate expectations to selected Deconstruction Contractor

This section is intended to accompany spec sections on selective demolition or whole building demolition, and refers to the **Material Reuse and Deconstruction Plan** (Appendix B) and **Building Deconstruction Pre-Audit** (Appendix C).

Division 8 Reclaimed Interior Door Systems (example)
A sample specification particularly intended for use in the case where a full-service reclaimed material supplier will cover all aspects of product delivery, similar to a new product, including refinishing, transport, installation, and warranty of their work. Some materials identified in the **Material Reuse and Deconstruction Plan** (Appendix B) will not require a full spec section, if there is not a dedicated reclaimed material supplier to do that scope of work.

Sole source or alternate?
When utilizing a reclaimed material supplier (Path 5), the specifier must decide whether to only specify reclaimed products, or to specify reclaimed products as an alternate. If utilizing alternates, these products should be referenced in Division 01 23 Alternates, or they may be missed at during bidding.

WARNING: This section is not a standalone division! It should be accompanied by the Material Reuse & Deconstruction Plan and material-specific spec sections.

Division 1 - 01 95 00 MATERIAL REUSE [SAMPLE LANGUAGE]

PART 1 – GENERAL

1.1 SUMMARY

Section includes: 019400 Facility Decommissioning, 024119 Selective Demolition, 024200 Removal and Diversion of Construction Materials, 024221 Salvage of Construction Materials

Related Sections: 02 42 93 BUILDING DECONSTRUCTION, 08 09 16 REUSED INTERIOR DOORS, [list all reclaimed product sections]

1.2 REFERENCES

Hennepin County Building Material Reuse and Deconstruction Guide

Material Reuse and Deconstruction Plan (MRDP)

1.3 DEFINITIONS

Material reuse, reclaimed materials, salvaged materials or second-hand materials refer to materials or products that were originally installed at and removed from, or sourced for, a project other than this one.

1.4 TESTING

Reclaimed products shall not be held to the testing standards of new products where testing requirements would preclude the use of the reclaimed product, unless the testing requirement is a matter of life safety, such as UL labeled doors and frames required by building code.

Reclaimed products typically cannot meet testing requirements, since the materials received can vary and the original manufacturer and vintage may be unknown. It is not feasible to test every item or batch, as this is logistically and cost prohibitive. However, reclaimed products can and should be closely inspected and compared to new products in terms of performance and functionality

1.5 GENERAL QUALITY

The Owner and Architect recognize a greater range of variability between reclaimed products identified in subsequent Reused Material sections, and will accept some variation in sourcing. Reclaimed materials shall meet the following criteria:

- Good condition
- Generally uniform
- Generally harmonious in appearance
- Equal in functionality to a new product
- Rated functionality including UL label, acoustic, fire or other rating preserved where applicable, unless otherwise noted in Material Reuse and Deconstruction Plan. May include transferable warranty.
- Range of acceptable deviation in style, finish, and size subject to evaluation of the furnished product. At the discretion of the Architect, deviations beyond what is noted in the Material Reuse and Deconstruction Plan will be considered, but may be rejected.
- Refer to Material Reuse and Deconstruction Action Plan for product-specific range of acceptable deviation

This section is essential to defining minimum standards for non-new products

Ensure labels certifying previous testing remain intact, and that the standards they represent are to remain fulfilled even when the product is moved to its new location

Division 1 - 01 95 00 MATERIAL REUSE [SAMPLE LANGUAGE] continued

1.6 PRODUCT PERFORMANCE

Reclaimed products are exempt from providing original manufacturer's documented compliance with performance standards.

Where required, a third-party supplier may provide written assurance that products are of the quality that meet applicable required performance standards, including but not limited to the following:

- Fire protection
- Fire resistance
- STC rating
- Reflectance
- Thermal performance
- Accessibility

Protects owners and architects from the risk of receiving substandard or nonfunctional products that do not meet regulatory performance requirements. It is important to note that too long of a list in this case may lead to disqualifying reused reclaimed products that perform, but cannot provide extensive documentation (or much at all). Expand this list with caution!

1.7 TYPES OF REUSE

1. **Sourced from deconstruction at the same location.**
2. **Sourced by the same owner, coming from a different location.**
3. **Furnished by contractor or subcontractor.**
4. **Purchased at reuse warehouse or outlet.**
5. **Sourced by a full-service reclaimed material supplier.**

Codifies the five pathways for reuse and connects these with parallel information in the Material Reuse & Deconstruction Plan

1.8 GENERAL ACTION SUBMITTALS

Submittals for reclaimed products are exempt from including original manufacturer's brochure or cutsheet. In general, contractor or third party supplier shall provide at minimum dimensions and high quality photos in good lighting of actual items being furnished for consideration, enabling Architect and Owner to evaluate condition and appearance.

If available, the original manufacturer's brochure or cutsheet should be provided.

If requested by the Owner or Architect, the Contractor or Third Party Supplier shall provide samples, or physical access to actual products, for purpose of evaluation.

Because reclaimed materials are not manufactured to spec, this section defines how to fulfill product documentation needs and answer the question, "what are we getting?"

1.9 ATTACHMENTS

Material Reuse and Deconstruction Plan

Division 1 - 01 95 00 MATERIAL REUSE [SAMPLE LANGUAGE] continued

PART 2 – PRODUCTS

The following are products to be considered for material reuse and whether new products are to be considered as well (listed as bid alternate). For products with no supplier, Contractor is encouraged to locate products directly.

NOTE:ALL PRODUCTS AND VENDORS LISTED HERE ARE FOR RECLAIMED PRODUCTS ONLY

Framing Lumber - <bid alternate> <sole source>

LumberStash, Minneapolis, MN. Contact: Jeremy Marshik, jeremy@lumberstash.com

Sheet Good Lumber

No supplier identified

Millwork - <bid alternate> <sole source>

Urban Wood Economy, Pittsburgh, PA. Contact Mike Gable, mgable@cjreuse.org

Suppliers of reclaimed dimensional lumber; fabrication by millwork subcontractor

Casework

No supplier identified

Doors, Frames & Hardware <bid alternate> <sole source>

Doors Unhinged, Pittsburgh, PA. Contact: Andrew Ellsworth, ae@doorsunhinged.com

Acoustic Ceiling Systems

Wood Flooring

Lighting Systems

Aluminum Storefront

Glazing

Access Flooring

Systems Furniture (usually purchased by Owner)

PART 3 – EXECUTION

Not used.

Add suppliers here specific to products that shall be reclaimed. Locate potential suppliers on the All for Reuse Ecosystem Map: https://www.allforreuse.org/ecosystem-map

If there is a product the owner would consider purchasing as reclaimed, but do not have a specific supplier identified, include the product in the list and list the supplier as "NO SUPPLIER IDENTIFIED." This can allow the contractor to source the material themselves or identify a supplier.

WARNING: This section is not a standalone division! It should be accompanied by the Material Reuse & Deconstruction Plan and material-specific spec sections.

MASTER
SECTION 024214
SELECTIVE DECONSTRUCTION

Purpose:

- Establish Owner/Architect's expectations of Contractor relative to deconstruction.
- Give adequate direction to Contractor on how deconstruction should be accomplished.
- Help Contractor select appropriate Deconstruction Contractor.
- Allow the possibility for Contractor to self-perform deconstruction.
- Communicate expectations to selected Deconstruction Contractor.

THIS SECTION SHOULD ACCOMPANY SPECIFICATION SECTIONS ON SELECTIVE DEMOLITION OR WHOLE BUILDING DEMOLITION. SEE OWNER'S SEPARATE HAZ MAT SECTIONS.

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
    1. Deconstruction and removal of selected portions of building or structure for salvage.
    2. Deconstruction and removal of selected site elements for salvage.
    3. Demolition and removal of selected portions of building or structure for disposal.
    4. Salvaging items for reuse by Owner.
B. Related Sections:
    1. Division 01 Section "Construction Waste Management and Disposal" for disposal of demolished materials.
    2. Division 01 Section "Material Reuse" and attached "Deconstruction and Reuse Action Plan"
    3. Division 02 Section "Selective Demolition"

1.2 REFERENCES

A. Hennepin County Reuse and Deconstruction Guide

1.3 DEFINITIONS

A. Full Deconstruction: Removal by disassembly of a building in the reverse order in which it was constructed.
B. Selective Deconstruction: Disassembly and removal of selected portions of building or structure.
C. Salvage: Removal of disassembled building materials for the purpose of reuse or recycling.
D. Demolish: Remove and legally dispose of off-site.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, deconstruction debris becomes property of Contractor.

Incentivize deconstruction by allowing the contractor to reap the benefits and proceeds from the value of material being deconstructed

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MASTER
SECTION 024214
SELECTIVE DECONSTRUCTION

1.5 ACTION SUBMITTALS

A. Qualification Data: For deconstruction firm.
B. Review and response to Building Deconstruction Pre-Audit
    1. Logistics plan materials identified for deconstruction and salvage.
    2. Proposed approach for storage of deconstructed items to be reused within project.
C. Deconstruction work plan and schedule
D. Health and Safety Plan
E. Deconstruction Debris Management Plan
    a. Identify each product/material type to be deconstructed and how it will be handled.
    b. Describe deconstruction methodology, sequencing, and materials handling and removal procedures for each product/material type.
    c. Note discrepancies or deviations from Building Deconstruction Pre-Audit, if provided.
F. Inventory: After deconstruction is complete, submit a list of items that have been salvaged, recycled and disposed of with documentation showing the quantities.

The Deconstruction Pre-Audit should ideally happen before or during design and may be included in the contract documents appended to this spec section

1.6 QUALITY ASSURANCE

A. Deconstruction Firm Qualifications: Company(ies) experienced and specializing in performing the Work of this Section with documented experience in similar types of deconstruction work.
    1. Better Futures Minnesota
    2. Birch Group
    3. Others will be considered on their merits
B. Regulatory Requirements: Comply with OSHA regulations, hauling and disposal regulations of authorities having jurisdiction, and refrigerant recovery regulations.
    1. Comply with noise and dust regulations of authorities having jurisdiction.
C. Pre-Deconstruction Conference: Conduct conference at Project site. Review methods and procedures related to deconstruction including, but not limited to, the following:
    1. Inspect and discuss condition of building to be deconstructed.
    2. Review structural load limitations of existing structure.
    3. Review and finalize deconstruction schedule and verify availability of materials, personnel, equipment, and facilities needed to make progress and avoid delays.
    4. Review requirements of work performed by other trades that rely on substrates exposed by deconstruction operations.
    5. Review areas where existing construction is to remain and requires protection.
    6. Review method for removing materials from the site.
    7. Review staging area for materials on the site.

1.7 PROJECT CONDITIONS

A. Hazardous Materials:
    1. Certain hazardous materials are known to be on this project and are being remediated or abated separately by owner. Deconstruction Contractor shall coordinate work with abatement work to ensure no release or exposure to hazardous materials. OR
    2. No known hazardous materials have been identified on this project. If in the course of work, hazardous materials are encountered or suspected, do not disturb; immediately notify Architect and Owner.
B. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during deconstruction operations.
    1. Maintain fire-protection facilities in service during deconstruction operations.

NOTE: The deconstruction contractor may or may not address or coordinate with abatement work. Refer to previous section, Deconstruction at Commercial Scale, for a discussion of work covered (or not typically covered) by deconstruction contractors

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MASTER
SECTION 024214
SELECTIVE DECONSTRUCTION

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.
B. Survey existing conditions and correlate with requirements indicated to determine extent of deconstruction required.
C. Inventory and record the condition of items to be removed and salvaged.
D. Perform surveys as the Work progresses to detect hazards resulting from deconstruction activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Ensure no damage or disruption to services/systems indicated to remain during deconstruction operations.

3.3 PREPARATION (Not Used)

3.4 DECONSTRUCTION

A. General: Deconstruct and remove existing construction in accordance with the materials identified for removal in the deconstruction plan. Use methods required to complete the Work within limitations of governing regulations and as follows:
    1. Proceed with deconstruction systematically, from higher to lower level. Complete deconstruction operations above each floor or tier before disturbing supporting members on the next lower level.
    2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing, prying or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain **<omit for complete building removal>.**
    3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
    4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
    5. Maintain adequate ventilation when using cutting torches.
    6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site in accordance with all federal, state, and local regulations.
    7. Remove structural framing members in such a way as to maintain their highest value.
    8. Locate deconstruction equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
    9. Dispose of demolished items and materials promptly.
B. Salvaged Items:
    1. Sort and organize salvaged materials as they are removed from the structure.
    2. Pack, crate or band materials to keep them contained and organized.
    3. Store items in a secure and weather protected area until removed from the site or

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transferred to Owner.
4. Refer to Material Reuse and Deconstruction Plan for storage.
5. Protect items from damage during transport and storage

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during deconstruction activities. When permitted by Architect, items may be removed to a suitable, protected storage location during deconstruction and cleaned and reinstalled in their original locations after deconstruction operations are complete. Refer to Material Reuse and Deconstruction Plan.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
   4. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
B. Burning: Do not burn demolished materials.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by deconstruction operations. Return adjacent areas to condition existing before deconstruction operations began.

3.7 SALVAGED MATERIALS FOR REUSE BY OWNER SCHEDULE

A. See Material Reuse & Deconstruction Plan.

END OF SECTION

SECTION 081090 – RECLAIMED DOOR SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 01 Bid Alternates Section

1.2 SUMMARY
- A. Section is intended to provide guidance and minimum standards for doors, frames and hardware that can be furnished reclaimed.
- B. Section Includes:
  1. Hollow metal doors.
  2. Hollow metal frames.
  3. Flush wood doors.
  4. Preparation of doors for hardware.
  5. Door hardware.
- C. Related Requirements:
  1. Division 01 Material Reuse, including Material Reuse and Deconstruction Plan.

1.3 DEFINITIONS
- A. Reclaimed: Referring to a product or system that has been recovered from installation in a building or space in a way that allows for it to be reused or repurposed in lieu of being sent to the landfill.

1.4 REFERENCES
- A. Standard Hollow Metal Work to comply with the following Steel Door Institute Performance Standards:
  1. ANSI/SDI A250.6 (R2009) - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
  2. ANSI/SDI A250.11 (2001) - Recommended Erection Instructions for Steel Frames.
  3. SDI 111 (2008 – Recommendations for Selection and Usage Guide for Standard Steel Doors and Frames.
  4. SDI 117 (2009) – Manufacturing Tolerances Standard Steel Doors and Frames.
  5. SDI 122 (2007) - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
  6. SDI 124 (1998) - Maintenance of Standard Steel Doors and Frames.

1.5 COORDINATION
- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.6 ACTION SUBMITTALS
- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
  1. Elevations of each door type.
  2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  4. Locations of reinforcement and preparations for hardware.
  5. Details of each different wall opening condition.
  6. Details of anchorages, joints, field splices, and connections.
  7. Details of accessories.
  8. Details of moldings, removable stops, and glazing.
  9. Details of conduit and preparations for power, signal, and control systems.

Sample spec section that can be adapted for other reclaimed products that are supplied by a dedicated reclaimed material supplier. Having this section highlights the presence of reclaimed materials in the design.

Standard submittal language to remain.

NOTE:
Reclaimed product suppliers cannot comply with some aspects of standard specification language. Using this section with typical compliance language reinserted may make the use of reclaimed material impossible. For reclaimed products, range of acceptable deviation should be outlined in the **Material Reuse and Deconstruction Plan** (Appendix B).

1.7 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site to review anchor methods, electrical conduit connections and custom installation of unusual openings such as pocket frames, single rabbet double egress frames and recessed doors flush with walls.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
   1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.
   1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.
   2. Any scratches or disfigurements caused in shipping or handling are promptly cleaned and touched up with a rust-inhibitive primer.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
   1. Warranty Periods: Minimum one-year warranty on all periods.
      a. Additional warranty shall be furnished at request of Owner.

Preserve standards with which a reclaimed supplier can feasibly comply. Exclude requirement for testing.

PART 2 - PRODUCTS

1.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 and UL10C, embossed labels are acceptable on standard 3 sided door frames.

B. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.
   1. Smoke-Control Door Assemblies: Comply with NFPA 105.

Maintain critical performance requirements.

1.2 MANUFACTURERS

A. Manufacturers: Provide products by the following:
   1. Doors Unhinged, LLC – Pittsburgh, PA (412)-414-9293, info@doorsunhinged.com

Contact info helps contractor send out bids to correct people, but should also be supplied in Division 01.

1.3 HOLLOW-METAL DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
   1. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches.
      c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (16 gage).
      d. Edge Construction: Model 2, Seamless.
      e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
   2. Frames:
      a. Materials: Steel sheet, minimum thickness of 18 gage.
      b. Construction: Face welded <knockdown>
      c. Knock down frames field welded are not acceptable.
   3. Exposed Finish: Factory primed; field painted. Refer to section 099100 – Painting.
      a. Thermal-Rated Doors: Provide doors fabricated with assembly thermal-transmittance value (U-Factor) of not greater than 0.61 Btu/h-sf-F when tested according to ASTM C 1363.

1.4 FLUSH WOOD DOORS, GENERAL

A. Particleboard-Core Doors:

1. Particleboard: Straw-based particleboard

B. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

Include sufficient detail about what will be provided.

1.5 WOOD DOORS FOR OPAQUE FINISH

A. Interior Solid-Core Doors:

1. Grade: Custom.
2. Faces: Hardboard or MDF.
3. Exposed Vertical Edges: Any closed-grain hardwood.
4. Core: Particleboard.
5. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.
6. Finish: Factory primed; field painted. Refer to section 099100 – Painting.

1.6 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Anchors: Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the (T-strap) (or) (stirrup) (or) (wire) type. Anchors shall be not less than 16 gage steel or 0.156” diameter steel wire. Stirrup straps shall be not less than 2” X 10” in size, corrugated and/or perforated. The number of anchors provided on each jamb shall be as follows:
   a. Frames up to 60” height 2 anchors.
   b. Frames greater than 60” up to 90” 3 anchors.
   c. Frames greater than 90” up to 96” 4 anchors.
   d. Frames greater than 96” 4 anchors plus one for each 24” or fraction thereof over 96”, spaced at 24”maximum between anchors.
2. Stud Anchors: Welded frames for installation in stud partitions shall be provided with steel anchors of suitable design, not less than 18 gage thickness, secured inside each jamb as follows:
   a. Frames up to 60” height 2 anchors.
   b. Frames greater than 60” up to 90” 4 anchors.
   c. Frames greater than 90” up to 96” 5 anchors.
   d. Frames greater than 96” 5 anchors plus one for each 24” or fraction thereof over 96” spaced at 24” maximum between anchors.
3. Frames to be anchored to previously placed concrete, masonry or structural steel shall be provided with anchors of suitable design and quantity as shown on approved shop drawings. Fasteners for such anchors shall be provided by others.
4. Slip on frames shall be provided with a single adjustable tension anchor in each jamb and provision for secure attachment of each jamb base to stud runners.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

1. Monolithic Concrete Slabs: Floor anchors shall be provided with two holes for fasteners and shall be fastened inside jambs with at least four spot welds per anchor.

1.7 FABRICATION

A. Reclaimed Metal Doors:
   1. Machined for Hardware: Hinges and lockset to match hardware sets.
   2. Door to be prepped for lites as specified in compliance with ADA, metal lite kits to be installed, utilizing reclaimed when available.
   3. Hardware preps from previous use to be obscured by new hardware.
   4. Visible dings or holes to be filled with Bondo, sanded smooth, and spray primed.
   5. Rust:
      a. No significant rust that has degraded the integrity of the metal is acceptable.
      b. Limited surface rust to be removed via sanding and spray primed.
   6. Fillers for previous preps on edges are acceptable only on door edges, not on door surfaces.

B. Reclaimed Metal Frames:
   1. Connections and anchors to be verified in good working order or to be replaced with new.
   2. Frames to have no visible damage, kinks, or warping.
   3. Welded frames to receive new shipping blocks.

C. Reclaimed Wood Doors:
   1. Machined for Hardware: Hinges and lockset to match hardware sets.
   2. Factory sanded to remove previous finish.
   3. Touched up as needed to eliminate dings and small holes.
   4. Door surface to be bowed no more than 1/16-inch over 42 inches.
   5. Filler shims are acceptable on door edges when necessary, provided they are puttied and sanded to ensure matching and smooth finish so as to not be visible on the door face.
   6. Door to be prepped for lites as specified in compliance with ADA, lipped glazing stops to be furnished unless noted otherwise, utilizing reclaimed when available.

1.8 DOOR HARDWARE PREPARATION

A. Comply with requirements in Section 08 71 00 “Door Hardware.”
B. Locations of hardware preps to be consistent across openings.
C. Hardware to be furnished with necessary screws and accessories to ensure complete functionality.
D. Hardware to be cleaned to remove residual paint and grime.
E. Hardware to match Specifications in terms of function and appearance. Slight and imperceptible variations may occur.

1.9 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

1.10 WOOD FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
B. Opaque Finish:
   1. Grade: Custom.
   2. Color: Refer to Architect’s Master Schedule.
   3. Sheen: Refer to Architect’s Master Schedule.

1.11 DOOR HARDWARE

A. Hardware to be furnished with all necessary screws and accessories to ensure complete functionality
B. All hardware to be cleaned to remove residual paint and grime
C. Hardware to match specifications in terms of function, durability, appearance and function. Slight and imperceptible variations may occur.
D. Some items may be purchased new to ensure a complete and matching set of hardware across the project.
E. Reference 087100 Door Hardware <or drawings> for hardware sets.
F. Supplier to provide hardware schedule noting any deviations.
G.

Include sufficient detail about what will be provided.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

2.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory after installation of frame in wall. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

2.3 INSTALLATION

A. General: Install work plumb, rigid, properly aligned, and securely fastened in place. Comply with manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
   a. At fire-rated openings, install frames according to NFPA 80.
   b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   c. Install frames with removable stops located on secure side of opening.
   d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   f. Field apply bituminous coating to backs of frames that will be filled with grout.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
   a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Field Supplied Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construation. Provide adjustable wedged or bolted anchorage to frame jamb members.
5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
6. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
7. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:
   a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
   b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
   c. At Bottom of Door: 3/8 inch plus or minus 1/32 inch.
   d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

Execution by a subcontractor specializing in a subset of reclaimed items, with end-to-end service, should be similar to (and warrantied in the same manner as) execution by a company that installs new product.

3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
   1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081090

Appendix B

Material Reuse and Deconstruction Plan

Template Material Reuse & Deconstruction Plan

This document:

1. Outlines the scope of deconstruction and reused materials on the project.
2. Lists the sources and destinations for reclaimed products.
3. Provides a statement of expectation regarding uniformity and condition.

Notes:

1. Architect and Owner to agree upon range of acceptable deviation in style, finish, and size of individual products, subject to evaluation of the exact products being furnished. Unless otherwise noted, the Architect/Owner are seeking the following grade of reclaimed products on this project (select one):

   - ☐ Reclaimed Grade 1: Architect/Owner will consider products that are fully functional, visually cohesive and could be perceived as new.
   - ☑ Reclaimed Grade 2: Architect/Owner will consider products that are fully functional, generally visually cohesive, that may show minor or imperceptible wear.
   - ☐ Reclaimed Grade 3: Architect/Owner will consider products that are fully functional. Some variation in appearance could be acceptable, and/or may show some signs of wear.

2. Architect must approve specific reclaimed product prior to installation.
3. Structural engineer must review and approve structural materials.

REUSE PATHS

Path 1 – Sourced from deconstruction at same location*

Contractor responsibilities: Deconstruct, storage, improve/adapt, install

Example list

Product category & Division #	Item	Photo	Previous location	Storage location	New install location	Current condition	Scope of work	Comments
Casework	*Kitchen cabinets*		*Unit #1 kitchen*	*[TBD decon contractor]*	*Community room*	*Good, fully functional, minor nicks in face frame*	*Clean all surfaces, install new hardware*	
Interior doors	*Wood door #1 and frame*		*Library level 2*	*[TBD reclaimed door subcontractor]*	*3C (Focus room at level 3)*	*Worn finish, veneer in good condition*	*Salvage door and frame. Sand and refinish. New door hardware. Refer to Door Schedule.*	

Example Material Reuse & Deconstruction Plan (continued)

Path 2 – Reuse by Owner source from different location (e.g. campus)*

Contractor responsibilities: Improve/adapt, install

Product category	Item	Photo	Storage location	New install location	Scope of work	Comments	LEED credit contribution

Path 3 – Reclaimed product or material furnished by Contractor*

Contractor responsibilities: Storage, improve/adapt, install

Product category	Item	Photo	Storage location	New install location	Scope of work	Comments	LEED credit contribution

Path 4 – Reclaimed product from reuse warehouse or outlet*

Contractor responsibilities: Storage, improve/adapt, install

Product category	Item	Photo	Storage location	New install location	Scope of work	Comments	LEED credit contribution	Pre-purchase notes

Path 5 – Reclaimed product provided by full-service supplier*

Contractor responsibilities: Install

Product category	Item	Photo	Storage location	New install location	Scope of work	Comments	LEED credit contribution

***Reclaimed structural materials require additional scope to preserve structural utility, coordinate with engineer.*

DECONSTRUCTION-ONLY PATHS

Path 6 – Deconstruction contractor removes material

Contractor responsibilities: Deconstruct and remove from site

Product category	Item	Photo	Current location	Comments	LEED credit contribution

Path 7 – Deconstruct and prepare for manufacturer take-back

Contractor responsibilities: Deconstruct (as needed) and palletize for shipment or pickup (as needed)

Product category	Item	Photo	Current location	Entity to receive + contact information	Comments	LEED credit contribution

Appendix C

Building Deconstruction Pre-Audit Example

Building / Site Materials Deconstruction Pre-Audit Date:

Project:

Consider: structure, concrete, interior finishes, shelving, lighting, interior doors, interior glass, site finishes, landscape materials, plantings, anything else

Item / type	**Quantity** # or estimated LF or volume	**Condition** exellent, good, damaged, other	**Current location**	**Photo?** y/n	**Description**	**Photo location** took photo

Appendix D

Material Reuse Schematic Design Narrative

Example Hennepin County project SD narrative:

Deconstruction and Material Reuse

Minnesota B3 Guidelines include M2A and M2B, requiring 55% environmentally preferable materials with a stretch goal of 75%. Environmentally preferable may include salvaged or reused materials. M3B and M3C require diversion of 75% of nonhazardous construction waste from landfill, with a stretch goal of 90%. A preliminary deconstruction audit by design team members of the existing [Hennepin County Project Name] identified the following materials with the potential for salvage and reuse in the new design:

Landscape

Some mature red pines at the northwest corner of the site are candidates for preservation.

- Trees removed from the site could be milled for use as seating and play elements.
- Asphalt from existing parking lot could be reused in site regrading.
- A series of 6" x 8" wood posts have been identified for reuse as bird houses.

Structural

The existing structure is steel framed with precast concrete plank floors and roof. Precast roof panels are 10" deep and have no concrete topping. The panels would be fairly easily deconstructed after welds are removed. The panels could either be stockpiled for reuse as aggregate in the new project's concrete foundations. Precast floor panels would be more difficult to separate from the topping for reuse, and would likely be crushed and recycled.

- STRUCTURAL STEEL
  Some steel floor beams are concrete-encased, making them difficult to reuse without damaging the steel beam inside. However, some steel beams and girders are not concrete-encased and have what appears to be cementitious fire protection. Given the building age it is not known if this may contain asbestos, testing will be needed. For the beams and girders to be reused, this cementitious fire protection would need to be removed as part of abatement. All columns are structural steel and columns to beam connections are predominantly bolted so these should be able to be deconstructed.
- STRUCTURAL STEEL COLUMNS
  The columns were not visible, but likely have cementitious fire protection. In DD the length of reusable steel members will be estimated (normally cutting approximately 1' off each end is sufficient to clean up coping and holes). Steel coupons will be taken to confirm the steel grade. Steel beams, girders and columns are likely grade A36 based on the building's age. Thereafter it is a matter of how carefully the building is deconstructed to comply within certain AISC straightness and other tolerances that the structural engineer will need for performance specification.
- COMPATIBILITY WITH NEW PROJECT GRID:
  The existing building is on a 33' x 33' structural bay layout. The new project is on a 36' x 30'-35' structural grid, so existing pieces could be reused along the smaller grid dimensions. All foundations are cast-in-place, reinforced concrete pad and strip footings. These may be crushed and used as aggregate in new concrete foundations.
- NOTE ON NEW STRUCTURAL DESIGN:
  Looking to future deconstruction of the new project, bolted steel connections will be used in most locations, minimizing the number of welded connections. Connections of mass

timber CLT floor to the glulam beams will be accomplished with screws that can be backed out once the fire resistant gypcrete topping is removed. The connections of the glulam beams and girders to each other, and the connections of the glulam girders to the steel columns will all be bolted. Cast in place concrete will be the most difficult to reuse, with crushing for aggregate as the most likely option.

Electrical

- The building automation system (BAS) and sensors throughout the building are relatively new, and could be salvaged for reuse in the new building or in another project or renovation that is underway at the time of demoltion of this building.

Finishes

Exterior and interior windows could be reused as glass partitions in the new project.

- Glass in windows with pink tint could be crushed for aggregate in countertop surfaces and in terrazzo flooring.
- Wood doors were inventoried with counts and dimensions. The vast majority of the doors and frames were in good shape and could be repainted and reused. New or existing hardware could be used - hardware will be evaluated in during CD.

Furnishings

Some chairs could be refinished or reupholstered for use in the new project.

- Flip-top meeting room tables are relatively new and will be reused.
- Most tables and desks to be removed due to the wide variety of styles and eras, but many are in good condition and could be successfuly reused at another location.
- Metal bookshelves could be re-powder-coated (due to scuffing and color) and installed in a new frame system, reducing the number of shelves that need to be purchased.
- A number of miscellaneous items were identified including but not limited to granite countertops at checkout, flat file cabinets and microfiche machines that will be reused as needed in the new project.
- Some parts, such as steel table legs on mismatched or damaged table tops, could be removed and reused with a new top.

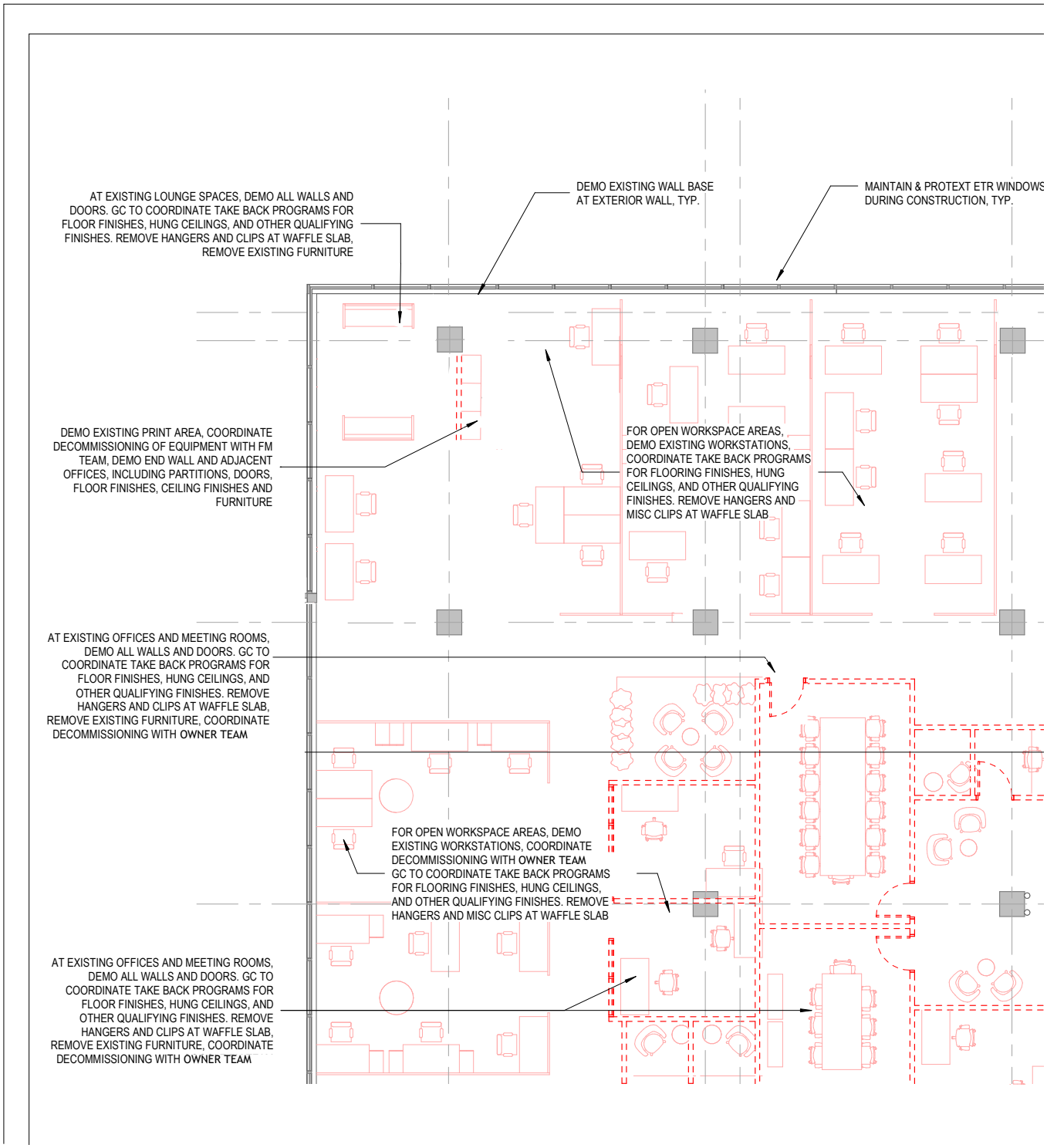
Deconstruction next steps

During DD phase, deconstruction contractors need to be evaluated and selected, and will do a pre-audit for deconstruction material value. At this time logistics should be discussed regarding the following questions:

1. Which items are being deconstructed and salvaged for reuse on the new project, versus materials that will be diverted to other reuse streams?
2. Where salvaged items will be stored by Hennepin County in preparation for refurbishment?
3. The degree of repair or refurbishment needed for each item? To be determined by MSR Design and consultants.

Appendix E

Example Deconstruction Annotations on Demolition Plan



References and Resources

Addis, Bill. *Building with Reclaimed Components and Materials*: *A Design Handbook for Reuse and Recycling.* Abingdon Earthscan from Routledge, 2020.

Betker, Sonya, Nick Vetsch, and Samantha Wheeler. "Hennepin County Construction and Demolition Waste Study." Stantec Consulting Services, Inc., June 2023. https://www.hennepin.us/-/media/hennepinus/your-government/projects-initiatives/solid-waste-planning/construction-demolition-waste-study-2023.pdf

Boston, City of. "Deconstruction: A Zero Waste Boston Initiative." Accessed July 2024. https://www.mass.gov/doc/city-of-boston-presentation/download

Boston, City of. "Workforce Development in Deconstruction." Massdep Deconstruction Workgroup Meeting #7, July 2024. https://www.mass.gov/doc/massdep-introduction-and-panelist-presentations/download. YouTube available at: https://www.youtube.com/watch?v=OrL9uS-AUy8

BuildReuse Wiki. https://www.allanswered.com/kb/build-reuse/doc/eaaxl/build-reuse-wiki-main-landing-page

"Building Deconstruction & Salvage Toolkit." Rethos, 2022. https://www.rethos.org/_files/ugd/504423_a2b7c1ca4675461b8ee680c8f65a1674.pdf

Carbon Leadership Forum (CLF) Boston Reuse Working Group, January 2024 meeting. "Palats Reuse Tool: Digital platform to make reuse as compelling as buying new." https://www.youtube.com/watch?v=_ZZSeMHPY_Y

Christensen (Chadzynski), Laurel, Michael Orbank, and James Kitchin. "Boston Deconstruction and Material Reuse Roadmap." CLF Boston/NE Deconstruction and Reuse Working Group. Accessed July 2024. https://www.paperturn-view.com/?pid=MjY266316&v=2.2

Chiles, Jim, Alex Hokenson, and Barbara Monaco. "Groundwater Impacts of Unlined Construction and Demolition Debris Landfilling Construction and Demolition." Saint Paul, MN: Minnesota Pollution Control Agency, October 2019. https://www.pca.state.mn.us/sites/default/files/w-sw5-54a.pdf

"Circular Economy Systems Diagram." Ellen MacArthur Foundation, 2019. https://www.ellenmacarthurfoundation.org/circulate-products-and-materials

"Construction and Demolition Debris Management in the United States." US Environmental Protection Agency, March 2020. https://www.epa.gov/sites/default/files/2020-03/documents/final_cd-eol-management_2015_508.pdf

Deconstruction Rapid Assessment Tool. US Environmental Protection Agency, 2015. https://www.epa.gov/sites/default/files/2015-07/documents/drat-instructions.pdf

Forghani, Reza, Willy Sher, and Sittimont Kanjanabootra. "Critical Technical Design Principles for Maximizing the Reuse of Building Components." International Journal of Construction Management 23, no. 7 (August 4, 2021): 1–9. https://doi.org/10.1080/15623599.2021.1959126.

Foth Consulting. Hennepin County website (2015): www.hennepin.us/-/media/hennepinus/your-government/projects-initiatives/solid-waste-planning/construction-demolition-diversion-capacity-study.pdf

Gorgolewski, Mark. "Designing with Reused Building Components: Some Challenges." Building Research & Information 36, no. 2 (March 2008): 175–88. https://doi.org/10.1080/09613210701559499

Harari, Yarden. "Getting to Zero Waste - Deconstruction + Material Reuse in Retail Architecture." CoLabs, CRTKL, March 2021. https://cdn.crtkl.com/wp-content/uploads/sites/1/2021/03/CRTKL-CoLab_Report-1.pdf

Hennepin County, 2022. “Zero Waste Plan.” https://www.hennepin.us/-/media/hennepinus/your-government/projects-initiatives/solid-waste-planning/zero-waste-plan.pdf

Kernan, Paul. “Old to New Design Guide: Salvaged Materials in New Construction.” Greater Vancouver Regional District Policy and Planning Department, January 2002. https://www.lifecyclebuilding.org/docs/Old%20to%20New%20Design%20Guide.pdf

MSW Consultants, Annika Bergen, Colleen Hetzel, Barbara Monaco, Tina Patton, Melissa Wenzel. “Construction and Demolition Materials Composition Study.” MPCA, November 2020. https://www.pca.state.mn.us/sites/default/files/w-sw5-55.pdf

“Plastic Paints in the Environment.” Earth Action, December 2021. https://www.e-a.earth/plastic-paints-the-environment

Purchase, Callun K. et al. “Circular Economy of Construction and Demolition Waste: A Literature Review on Lessons, Challenges, and Benefits.” Materials (Basel), 2021. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8745857

Tingley, Danielle Densley, and Buick Davison. “Design for Deconstruction and Material Reuse.” Proceedings of the Institution of Civil Engineers - Energy 164, no. 4 (November 2011): 195–204. https://doi.org/10.1680/ener.2011.164.4.195

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