**Exchange**

* Utilizing and contributing to open source design (wikihouse/shared solutions)
* Tracking material passports

Material passports are with a material throughout its entire life to ensure its continuous use. During Exchange, the product may be either in a building ready for demo, in a storage facility ready for delivery, or with a manufacturer ready for upcycling. It is the materials passport that allows designers and builders to find these materials to specify for their projects.

* Storing and distributing upcycled materials

Physical marketplace and services to enable harvest and distribution of materials from demolitions and other industries.

* + Upcycling- The logistics of storing and distribution is a big part in realizing upcycling of materials.
* Connecting salvaged material supply and demand via online platforms

By-passing physical warehouse, an online platform can connect supply and demand of salvaged materials directly from site to site.

* Remanufacturing salvaged materials into new products

When used material is modified into superior product. In this case these materials would otherwise go to a landfill or a recycling facility vs being upcycled. The remanufacturer then has the opportunity to give the new material a passport.

* Capturing waste material from other industries

Also called “Industrial Symbiosis,” captures waste from unrelated industries (e.g. agriculture) and turns them into useful products (e.g. hempcrete, straw bale)

* Applicable Buttons
  + Optimizing material transportation- This aims at leveraging local materials to reduce embodied carbon of products.

**Resource**

* Brownfield remediation

Repurposing these sites returns contaminated “waste” site into use, prevents development of a greenfield site, and, potentially, restores habitat.

* Leased building materials from manufacturer/supplier

If lifespan of a structure is known a contract can be made for the supplier or manufacturer to take back their product for reuse or replacement.

* Applicable Buttons
  + Take-back services- these services are important to maintain the exchange of materials from manufacturer/supplier in the interim when a material has no assigned building and is waiting to be resourced.
  + Existing structure- at the inception of a demo/rebuild project the existing structure can be utilized to reduce the introduction of new materials. Although this is an action of resource, this strategy is more relevant in the “Reuse” strategies since a building already exists to make this an applicable strategy.

**Resource/Source**

* Product as service systems

Manufacturer retains ownership of the products (e.g. light fixtures) and instead sells their performance (e.g. light).

* Applicable Buttons
  + Local materials – these are the materials the make optimizing material transportation possible

**Source**

* Biodegradable materials

Bio-degradable materials can be returned into bio-cycle by composting as long as they are not contaminated with chemicals and adhesives.

* Low impact materials – cradle to cradle

This is a general category for Cradle-to-Cradle of otherwise certified materials. These materials may not capture waste streams but have proven to be upcycled in their own processes.

**Design and Deliver**

* Designing for demountability

Demountability enables material re-use on a different project in case it is no longer needed prior to end of its lifespan. This becomes important during the design process as it has a large impact on how joints and details are designed.

* Designing for future recovery

Ensuring the design is demountable and has a plan is in place for who is accountable to recover materials.

* + Take-back services – when specifying materials during the design process these services become an option for recovery.
  + Product as service systems- when specifying materials during the design process these systems become an option for recovery.
  + Upcycling - when specifying materials during the design process there needs to be a recovery plan for upcycled materials.
* Designing for adaptation and mixed-use

Ability to accommodate various building programs can prolong building’s life and minimize waste of existing building stock.

* + Multispace and mixed-use- these spaces have to be considered early on in the design phase of a project to be successful in use.
  + Space sharing- this has to be planned for and considered early on in the design phase of a project to be successful in practice.
* Designing for modularity

Modular design enables pre-fabrication and standardization of elements which can drive further optimization.

* Designing for future adaptation

Ability to accommodate various building programs can prolong building’s life and minimize waste of existing building stock.

* + Adaptive reuse of existing building – if a future use of a building is known it is important to consider this during design.
* Maximizing space utilization

Making sure that building program is designed to maximize use of all spaces.

* Designing for longevity

The more adaptable the structure is, the more chances there are for it to survive changes in societal and user needs and therefore prevent premature end of life.

* Applicable Buttons
  + Harvesting runoff- needs consideration and planning during design and construction.
  + Harvesting grey water- needs consideration and planning during design and construction.
  + Designing for natural lighting and ventilation- needs consideration and planning during design and construction.
  + Using existing structure- needs consideration and planning during design and construction.
  + Designing with off shelf dimensions- decision made during the design process.
  + Modeling for future date exchange and use (IoT/BIM)- model is created in design and utilized through end of design life.

**Construct**

* Materials cut to modular or whole sizes

Cutting materials this way reduces on site waste of materials by minimizing unusable scrap pieces. This also gives the material a better chance of being used again in its current form.

* 3D printing cradle to cradle material

3D printing allows for minimal construction waste of the printed material

* Prefabrication

Pre-fabrication enables construction in controlled environment and greater material/energy efficiency.

* Mechanical fasteners (vs adhesives)

Mechanical fasteners enable various materials to be demounted, separated, and re-used at the end of life which is often impossible with adhesives.

**Intelligent Built Environment**

* Selling renewable energy back to grid

Enables use of surplus green energy generated on site,

* Internet of Things/BIM for Operations

Use of sensors, tracking systems and management software can assist with more effective operations and timely maintenance to prolong building’s life.

* + Product as service systems- supplier can use BIM to track their product output.
  + Tracking material passports- passports can be folded into BIM during the lifespan of a building.
* Utilizing online platform to facilitate space sharing

Web-based platforms can help to match underutilized spaces (e.g. office, homes) with potential users (e.g. Airbnb, WeWork)

**Reuse**

* Existing structure

The structure of a building can be reused for a future project, diverting it all from potential waste. It is during this Built Environment stage that the decision of reuse is made.

* Adaptive reuse of existing building

Prolongs life of the building and diverts existing structure from landfill.

* Building gray water

Reusing the buildings water reduces water waste and keeps the water in use for longer.

* Applicable Buttons
  + Modular Design

This idea is conceived in design but can make the building easily remodeled for reuse.

* + Brownfield remediation

Although this becomes predominantly relevant as resourcing something, as it is repurposing a site, brownfields are adding a use to a site otherwise wasted making it relevant in reuse.

* + Online platform to facilitate space sharing

These platforms can ensure a building is used and reused to its full capacity during its lifecycle.

* + Renewable energy

Makes selling energy back to the grid and involvement in a bigger economic system possible.

* + Modular design

Allows for a new use of the same building parts by rearranging modular parts. This can extend the life and use of those parts.

**Reuse/Use**

* Multispace and mixed-use

Buildings that can support mixed programs and change in these programs. This can insure maximum utilization of space.

* + Designing for adaptation and mixed-use – this design process makes mixed-use and adaptation possible during the lifespan of the building.
  + Designing for future adaptation - this design process makes mixed-use and adaptation possible during the lifespan of the building.
* Site runoff

Harvesting this water reduces water waste and utilizes the natural regenerative nature of the site.

**Use**

* Natural lighting and ventilation

Can help minimize operational waste related to lighting and mechanical system.

**End of Design Life**

* Upcycling
  + Designing for future recovery – necessary to upcycle
  + Low impact materials – cradle to cradle – these materials are design for upcycling.
* Utilizing take-back service material providers

Collection services offered by manufacturers/suppliers at the end of their product lifecycle for re-manufacturing and recycling (e.g. ceiling tile, carpet)

* + Product as service systems – these products utilize take-back services.
  + Leased building materials from manufacturer/supplier- these materials utilize take-back services.
* Applicable Buttons
  + Tracking material passports- at the end of life passports allow the materials to not get lost in transition.
  + Disassembling/refitting modular design – at the end of life for a modular design a rearrangement of pieces can be considered.
  + Connecting salvaged materials supply and demand via online platforms- the accountability of these connections becomes very relevant at the end of design life.
  + Using existing structure – this is relevant at the end of design life as it will change the way a building is demoed.
  + Composting biodegradable materials- this is relevant at the end of design life as these materials need to be properly disposed of.
  + Designing with off shelf dimensions- this is relevant at the end of design life because uncut materials or materials cut to modular sizes to their off the shelf size are far more likely to make it back into a supply chain vs irregular scraps.

**Deconstruct**

* Salvaged materials from demolitions

Diversion of materials from landfill for upcycling, re-use, or recycling. This can include harvesting from the project’s site or other demolitions.

* Applicable Buttons
  + Demountable design

Makes recovery of reusable materials possible during deconstruction.

* + Mech. Fasteners (vs adhesives)

Mechanical fasteners utilized during construction enable various materials to be disassembled, separated, and re-used at the end of life which is often impossible with adhesives.

* + Storage and distribution services for salvaged materials

During deconstruction these services are relevant as they are used to bring the disassemble pieces back into the exchange realm.

