



Facilities Reduction Program
Best Practices Toolbox



**UNITED STATES ARMY CORPS OF ENGINEERS
FACILITIES REDUCTION PROGRAM**

Best Practices Toolbox
(Library Document)

FRP Guide to Diversion Opportunities

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OVERVIEW

A recent U.S. Army policy memorandum, “[Sustainable Management of Waste in Military Construction, Renovation, and Demolition Activities](#)” (hereinafter “The Policy”) has established a waste management policy for diverting 50% (by total project weight) of C&D debris for construction, renovation, and demolition projects. The Policy states that compliance with this requirement will be evaluated annually as determined from the data reported in SWARWeb. The Policy should be reviewed for additional information regarding definitions, requirements, special considerations, and other important information.

The Policy will require careful planning and coordination to achieve the 50% goal or more. Conventional commercial practice, with respect to demolition, typically achieves a 50% diversion on an average basis. The majority of diversion, by weight, occurs as the result of concrete and steel. Light wood-frame buildings typically have the lowest diversion opportunities by weight since the cost of wood recovery often exceeds the cost of new lumber. However, large, solid timbers (non-laminated) are an exception to this rule and sometimes offer diversion opportunities. At the time this document was prepared, steel and other metals typically have a salvage/recycle value between \$100-200 per ton. Obviously, copper (wiring) would have significantly higher recycle value, but typically occurs in much lower quantities.

The remainder of this document will discuss common diversion practices as observed in the commercial demolition industry. This document is not intended to be all-inclusive, but rather a quick reference for those not familiar with demolition practices. The Policy requires that installation personnel develop a decision matrix for facility removal guided by [UFC 1-900-01](#).

Note: Contrary to common perception from outside the demolition industry, demolition practitioners do consider salvage, recycle, deconstruction, reuse, and other “diversion” measures to be part of common demolition practice. However, these practices are typically implemented only to the extent that they are the most economical practice available.

DIVERSION TECHNIQUES

Diversion can have different “official” meanings to different interest groups. However, the underlying principle is typically that, materials that would otherwise be classified as “waste” or end up in a landfill, are diverted from a landfill independent of the end-use.

The Policy defines diversion as: “The redirection of waste, ordinarily disposed of in a landfill or burned in an incinerator, to a recycling facility, to a composting yard, or to another destination for reclamation or reuse.” This section will focus on techniques that may be employed at US Army installations to divert C&D materials generated from facility removal efforts.

Relocation

This diversion method typically involves temporary or modular buildings, where the entire building is moved to an off-site location for reuse. Successful relocation efforts were demonstrated at [Fort Huachuca](#), in August 2006. A public auction of unneeded structures was held at the Installation. This auction resulted in the installation removing seven unneeded modular buildings from its real property inventory at no cost. The winner of each auction was responsible for moving the building, thus the installation incurred no removal costs.

Relocation is a viable option that can, in certain circumstances, contribute to meeting or exceeding diversion goals. However it's limited relativity to most buildings in the Army Real Property Inventory (permanent facilities) limits its overall effectiveness.

Deconstruction/Reuse

[Deconstruction](#) is often defined as the method of taking down a building in the reverse order of construction. It is an approach used to remove materials in order to reuse them, in such a way to preserve their integrity and value to the greatest extent possible, in as economical a manner as possible. Deconstruction is generally perceived as manual disassembly of a building, although various combinations of manual and mechanical methods can be applied to improve cost and time performance. Typical items that can be reused after a facility is deconstructed include large timbers, windows, doors, light assemblies, metal trusses, etc. While other materials could be reclaimed, such as lightweight wood framing (i.e. 2x4 studs), the labor required to reclaim these items can often exceed the cost of purchase for similar new items.

The Policy offers suggestions to reduce labor costs using not-for-profit organizations with a pool of volunteer labor. Another suggested approach is auction or sales to individuals, entrepreneurs, and specialty firms looking to harvest quantities of usable building materials for their own use.

Because careful, manual labor is typically needed for deconstruction, the cost-effectiveness of the project can often suffer. However it should also be considered an option to be used to completely or partially divert debris and/or materials from a landfill. Deconstruction was employed at [Fort Campbell](#) with a level of success.

Recycling

Recycling of demolition debris is a common practice where it is economically feasible, environmentally acceptable or mandated. [32 CFR 650.108](#) issues Department of Army policy regarding "recovery and recycle" and establishes a requirement that these practices be implemented to the "maximum extent practicable." Such a requirement is very subjective in nature and leaves much room for legal interpretation. The Policy ("Sustainable Management of Waste in Military Construction, Renovation, and Demolition Activities") has taken a more prescriptive approach and specifies that projects should include performance requirements for 50% diversion, by weight, of the project

C&D waste. The policy does seem to offer some room for interpretation in consideration of cost and schedule and should be reviewed for additional details.

In some cases, it may be necessary to “package” a set of buildings to achieve diversion success. For instance, an all-wood building, which typically has minimal divertible materials, can be packaged with a concrete or steel structure, which typically has maximum divertible materials. Because the percentage is based on a total diversion for all buildings in the contract/project, the diversion goal can be more easily achieved.

Recycling makes sense when it minimizes the use of non-renewable resources, diverts demolition waste projects from landfills or other waste streams, and provides a source of materials for agencies or non-profit groups who have few resources other than voluntary labor. Often, the economic feasibility of a reuse or recycling program depends on whether the associated added costs (such as increased time, effort, and equipment) are less than the avoided costs (such as tipping fees, surcharges, labor, hauling fees, maintenance, permit fees and taxes).

DIVERTIBLE MATERIALS

Compliance with diversion directives will be measured from SWARWeb data. Many of these listed materials have a recyclable or reusable benefit. However, the market varies from location to location. Items that are contaminated by certain environmental hazards may be recyclable, but many are not.

The major categories of items reported in SWARWeb include:

1. Wood
2. Metals
3. Masonry/Asphalt/Concrete/Stone
4. Land Clearing Debris
5. Other

Wood Diversion

According to The Policy, SWARWeb pick categories for wood include:

- Structural
- Finished
- Treated
- Other (C/D Wood)

Wood with residual salvage value (exceeding labor extraction costs) following “deconstruction” efforts is generally an exception to demolition practitioners. However, certain large-dimension, solid timbers can be cost effectively salvaged with a residual value.

In addition to salvage, grinding should be considered as an alternative when the wood can easily be segregated. Refer to The Policy for additional information regarding wood diversion.

Metal Diversion

According to The Policy, SWARWeb pick categories for metal include:

- Steel
- Copper
- Aluminum
- Mixed Metal
- Other (C/D Metal)

In almost all cases, various types of metal are recycled/salvaged by demolition practitioners. In some instances, large all-metal buildings and structures, including buildings with large quantities of metal industrial machinery, can be salvaged at costs much below equivalent demolition costs for similar wood-framed buildings. In rare instances, removal projects have been executed at no cost to the installation by demolition practitioners when an all-metal structure or building was removed. Sources of metal common to many projects include concrete reinforcement bar (rebar) and electrical wirings, both of which are near 100% recyclable.

Masonry/Asphalt/Concrete/Stone Diversion

According to The Policy, SWARWeb pick categories for masonry/asphalt/concrete/stone include:

- Asphalt
- Brick
- Concrete
- Concrete Block Unit
- Stone
- Other (C/D Masonry/Asphalt)

All masonry, asphalt, concrete, and stone materials are considered economically feasible to divert by demolition practitioners when they can be readily segregated from other building materials. When these materials are used to form structural components (i.e. foundations, walls, etc.) they can be most readily diverted. However, in some instances, such as where they have been used as veneers, the feasibility can drop dramatically. “Soft demolition” techniques can sometimes be employed on a cost-effective basis to remove adhered or fastened materials to structural components. An example would be removing gypsum board and furring strips from the interior of a structural masonry wall.

Concrete is diverted at near 100% quantities by demolition practitioners. In many cases, the weight of the building foundation alone will constitute 50%, by-weight, of the entire

building. For this reason, it is important that concrete be diverted in all cases, when practical, to maximize diversion potential and ensure cost-effective Policy compliance. Diversion techniques employed by demolition practitioners most often include either recycling at a commercial facility or keeping on-site to be crushed and reused as aggregate. In both cases, a cost in the range around \$10 per ton would not be uncommon. Commercial concrete recyclers are not available at all locations, as the aggregate market and local tipping fees typically dictate economic feasibility. In general, when commercial concrete recyclers are available locally, the concrete will be accepted for a nominal fee. Concrete recycling fees are often a fraction of the equivalent landfill tipping fees for installations located near large metropolitan areas. Utilizing a mobile concrete crusher can be a cost-effective solution, but requires a minimal quantity of material to become economically feasible. Portable crushing jobs are considered small and incur a mobilization fee when the quantity of materials ranges between 1,000 – 10,000 tons. Final feasibility would also need to consider local landfill tipping fees. When minimum threshold quantities are not available, installations should stockpile materials until significant quantities are accumulated.

Separating brick veneer from wood-framed buildings is not generally considered cost effective by demolition practitioners. However, solid (structural) brick walls can easily be separated for crushing/recycle. The same concept generally applies for stone, tile, and other masonry products.

Asphalt should be stockpiled for crushing along with concrete and other masonry products. However, it may be desirable to stockpile asphalt separate from such materials. Similar to, and generally in the same instances as concrete, some areas have recycling centers that will accept asphalt products.

More information regarding Concrete Reuse can be found in [PWTB 200-1-27, Reuse of Concrete Materials from Building Demolition](#).

Land Clearing Debris Diversion

According to The Policy, SWARWeb pick categories for land clearing debris include:

- Top Soil
- Sub Soil
- Petroleum-Contaminated Soil
- Non-Hazardous Lead-Contaminated Soil
- Vegetation/Timber (tree trunks and limbs)
- Crushed Stone/Base
- Other (C/D Land Clearing)

With the exception of crushed stone/base, the feasibility of recycling each of these materials is unique to a given project. Similar to all other items listed as masonry products, crushed stone should be maintained on-site for reuse or sent off-site to a commercial recycling facility. Obviously, soils could be readily diverted or used as

backfill for a removal project involving crawl spaces and basements. Some facilities are built at loading dock height, such as warehouses, and may require significant excavation to bring the site back to original grade. Depending on planned projects, it may be beneficial to stockpile (borrow pit) these materials to offset the high cost of import materials often encountered with basements, crawl spaces, and certain structures such as underground storage tanks, pools, and other below grade structures.

When significant quantities of vegetation and timber require removal, it may be feasible to bring a portable grinder on-site. For some very large demolition projects, especially when transport to a landfill is a considerable distance, it has been effective in certain instances to grind materials for compaction to maximize transport efficiency and reduce overall costs.

Other Diversion

According to The Policy, SWARWeb pick categories for “Other” debris include:

- Siding
- Composition Roof
- Insulation
- Doors/Windows/Stair/Cabinets
- Ceiling Tile
- Gypsum/Plaster
- Plastic
- Glass
- Paper
- Other (C/D Other)

The recycling and/or reuse of any of the above materials may help increase the overall landfill diversion percentage of a facility removal project. As with most diversion opportunities, the ability to readily segregate materials in a cost-effective manner is paramount to the success of diversion.

RECYCLING EQUIPMENT

Recycling is typically carried out using two methods, depending on the quantity of materials and proximity of recycling facilities. In locations where recycling facilities are near, recycled material will be transported off site (typically no more than 25 miles) to the recycling facility. For projects where no recycling facilities are near, yet significant quantities of recyclable material exist, on-site crushers and/or grinders can be utilized to achieve diversion. Once the material is crushed, it can typically be reused onsite for backfill or other needs.

Examples of crushing/grinding and other recycling components are depicted below.

Mobile Crushing Equipment

Concrete slabs from sidewalks and concrete blocks can be crushed and used as filler or bedding material for paved areas. Large amounts of concrete can be processed by mobile crushing equipment that is manufactured by many various companies. This type of system crushes large pieces of concrete, removing metals such as rebar using magnetic conveyors, which makes it ideal for crushing foundations, walls, slabs, and other steel reinforced concrete.



Mobile Crusher Being Fed By Excavator

The cost to mobilize a “portable” crusher can often be normalized by the value of the recycled material.



Grinding Equipment

In some instances, it may be practical to use grinding equipment to divert wood materials from the landfill. For example, clean scrap lumber can be processed and used for landscaping, compost, or boiler fuel. This method of diversion is most practical when large quantities of wood can easily be separated from other materials.

Instances where separation of wood for grinding becomes less practical includes wall studs with gypsum

attached, roof decking with asphalt shingles attached, and other instances where extensive labor would be required to isolate the wood components for feed into a grinder.

Commercial practice has recently demonstrated cost-effective application of grinders for handling land clearing debris. Using grinders to reduce volume has been demonstrated on large demolition projects, but diversion success has been somewhat limited unless the final product has an end use. Refer to final report in Toolbox library titled [Mobile Demolition Processing Team Feasibility Study](#) for additional considerations.



Assorted Project Metals

Metals such as aluminum, copper, steel, and brass can readily be sold to scrap metal yards. Materials could also be reused in other projects on base, or in the redevelopment taking place after deconstruction is complete. Virtually all metals have a positive scrap/salvage value and can most always be diverted with positive benefit.

ADDITIONAL RESOURCES

[FRP Best Practices Toolbox Library](#)

To view the official Army diversion policy requiring 50% project weight diversion:
[Sustainable Management of Waste in Military Construction, Renovation, and Demolition Activities](#)

[Analyzing What's Recyclable in C&D Debris](#)

[Fort Myer Waste Management Plan](#)

[FY06 Solid Waste Annual Reporting \(SWARWeb\) Schedule](#)

[PWTB 200-1-23 Guidance for the Reduction of Demolition Waste Through Reuse and Recycling](#)

[PWTB 200-1-27 Reuse of Concrete Materials from Building Demolition](#)

[Fort Carson Deconstruction Feasibility Assessment Report](#)