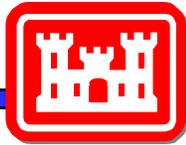


SUSTAINABLE ALTERNATIVES FOR FACILITY REMOVAL

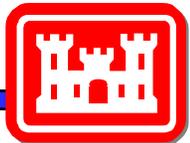
Tom Napier
US Army Corps of Engineers
Construction Engineering Research Laboratory

Installations Management Institute, January 2007

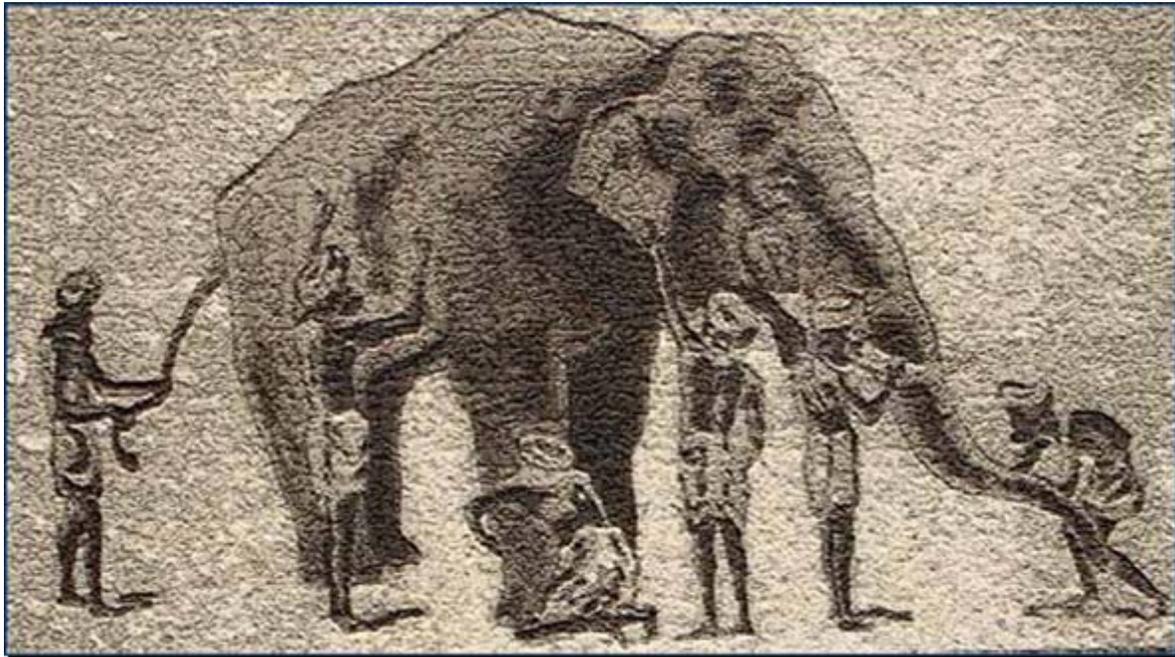


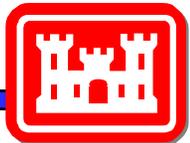
Purpose

- To describe practices for removing obsolete Army buildings and structures that are both environmentally and economically preferable to conventional demolition and landfill disposal
 - *Building removal methods*
 - *Project delivery approaches*



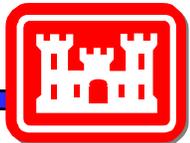
What are your interests in Building Removal?



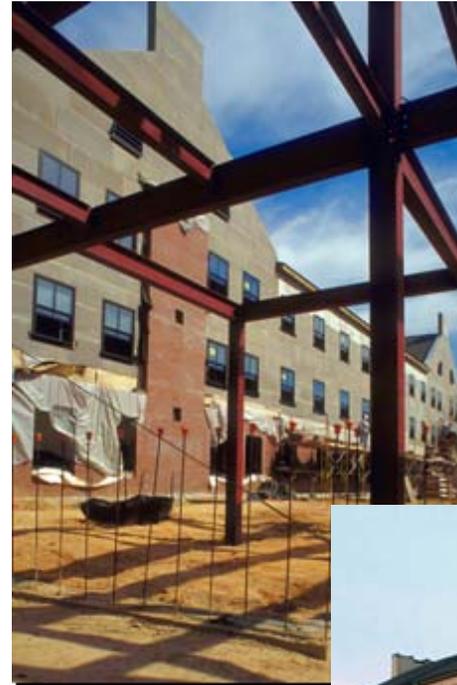


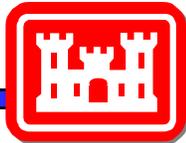
**US Army Corps
of Engineers**
Engineer Research and
Development Center

WHAT CAUSES C&D DEBRIS?

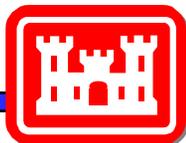


- **Response to a Mission**
 - *Upgrade capabilities & mission performance*
 - *Improve quality of life for soldiers & their families*
 - *Remove & replace obsolete buildings*
- **Debris is a byproduct of other mission-related activities**

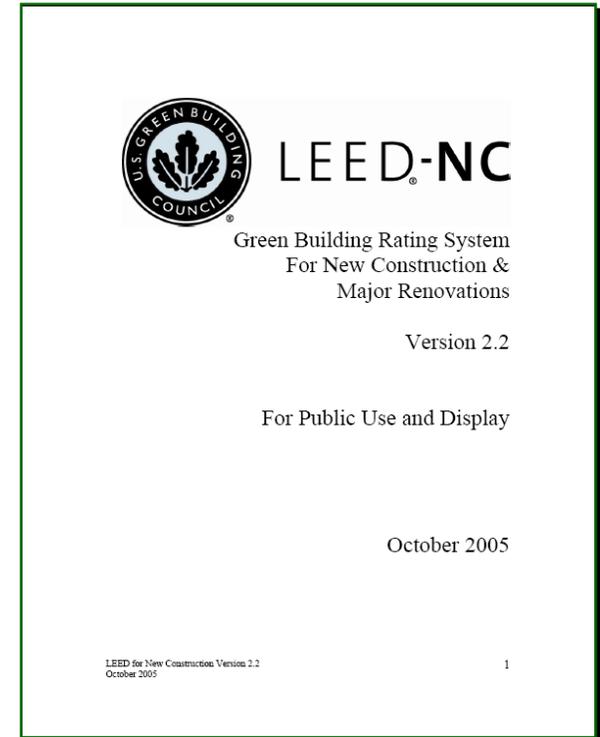




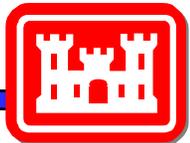
HOW RELEVANT IS C&D WASTE MANAGEMENT TO “SUSTAINABILITY?”



- **LEED construction waste management credits**
 - ***MR 2.1: Recycle and/or salvage at least 50% construction, demolition, & land clearing debris. 1 POINT***
 - ***MR 2.2: Recycle and/or salvage an additional 25% (75% total) construction, demolition, & land clearing debris. 1 POINT***



* ONLY... TWO ... #@!!*#% ...POINTS??



- **Construction materials = 60% of US materials' flow**
(US Geological Survey, 1998)

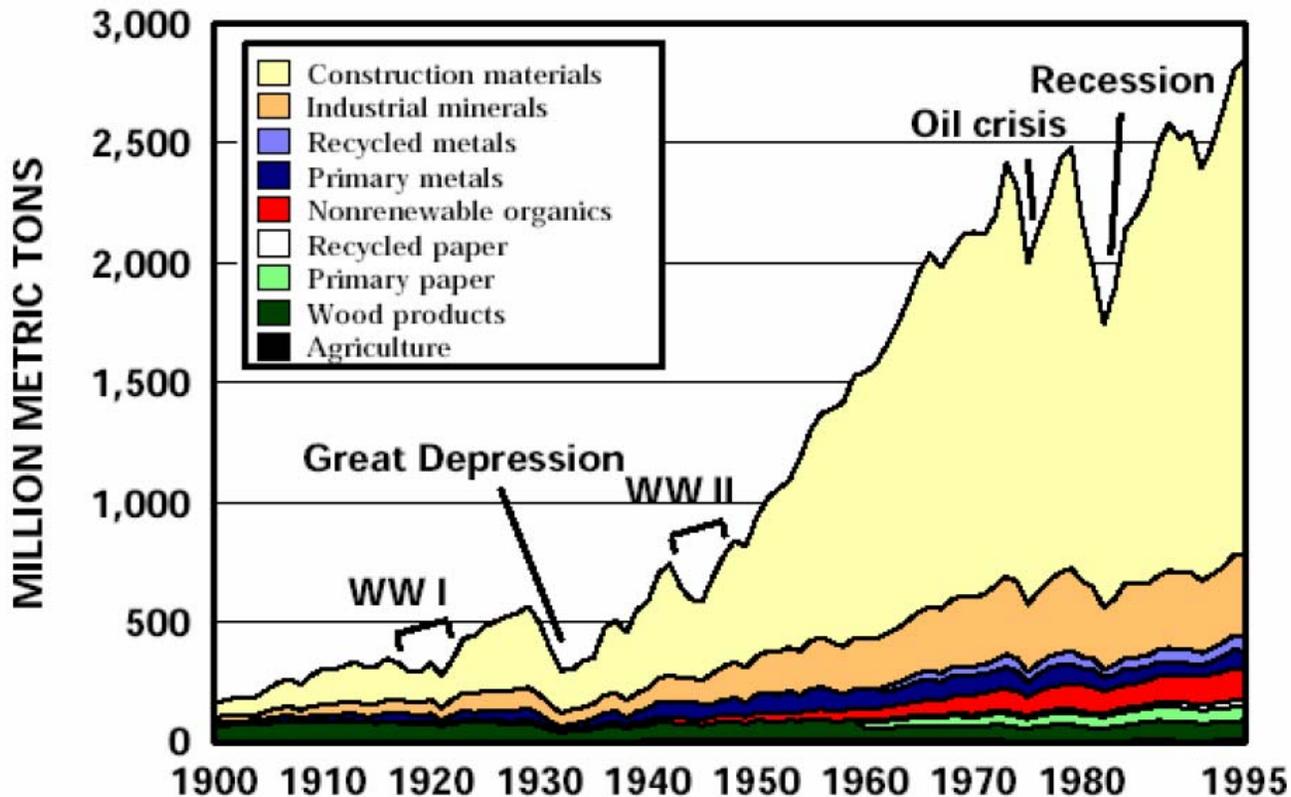


Figure 5: Measurement of the amount of raw materials consumed in the United States.

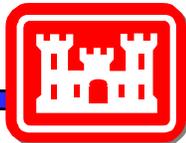


- **Life Cycle Assessment Data**

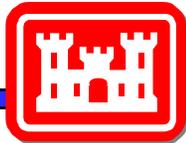
(Athena Sustainable Materials Institute, Environmental Impact Estimator)

- ***Materials extraction, manufacturing, & transportation consumption for lumber, asphalt, concrete, & steel***

- ***60% - 90% of total life cycle energy consumption***
- ***96% - 99% of total life cycle waste, air & water pollution, global warming potential, water use, & resource use.***



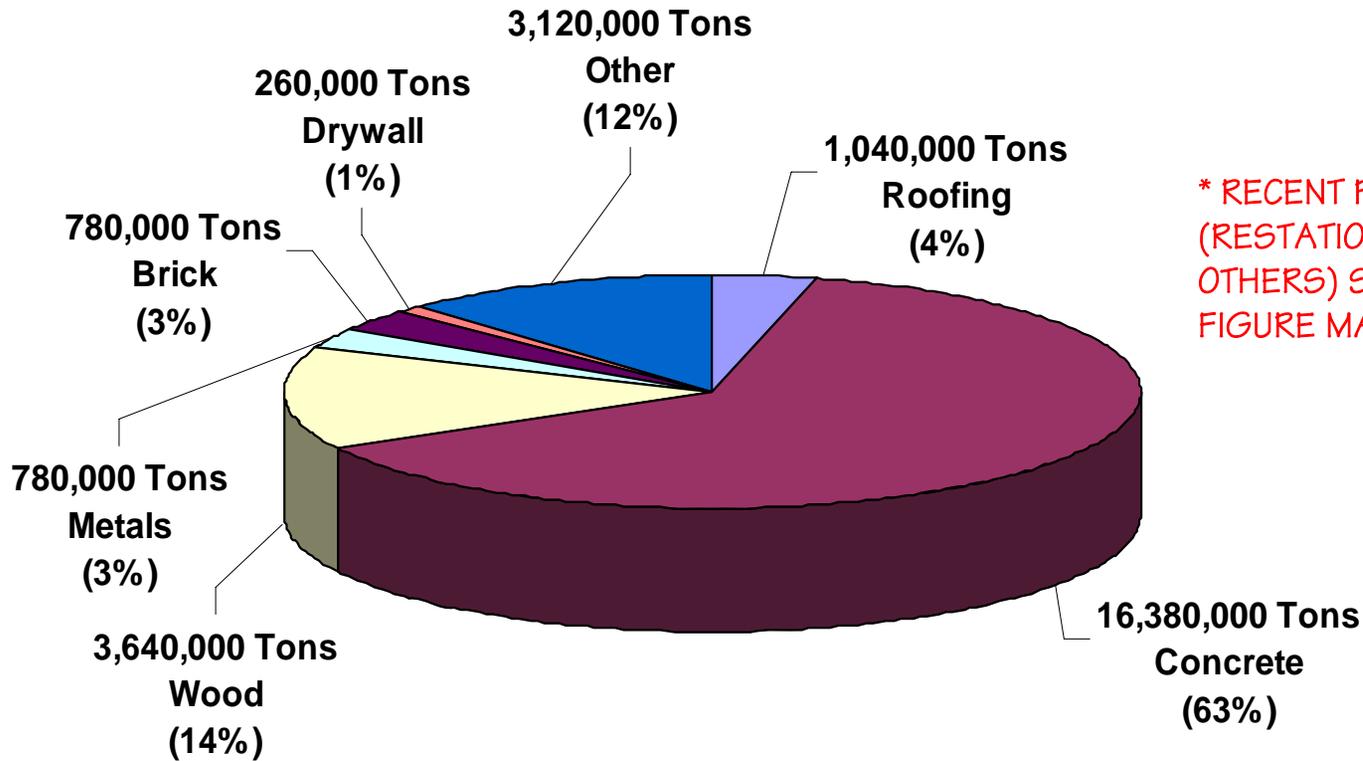
- **The majority of criteria defining “green building” have at least some relevance to materials’ reuse or recycling**
 - ***Society of Environmental Toxicologists and Chemists***
 - ***“A Technical Framework for Life Cycle Assessment”***
 - ***BuildingGreen.Com***
 - ***Environmental Building News, GreenSpec, GreenSpec Directory***
 - ***US Environmental Protection Agency***
 - ***Final Guidance on Environmentally Preferable Purchasing***
 - ***LEED***
 - ***Materials & Resources Credits***
 - ***Others***



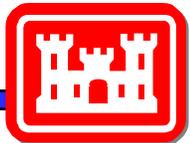
C&D WASTE; WHY IS THE ARMY CONCERNED?



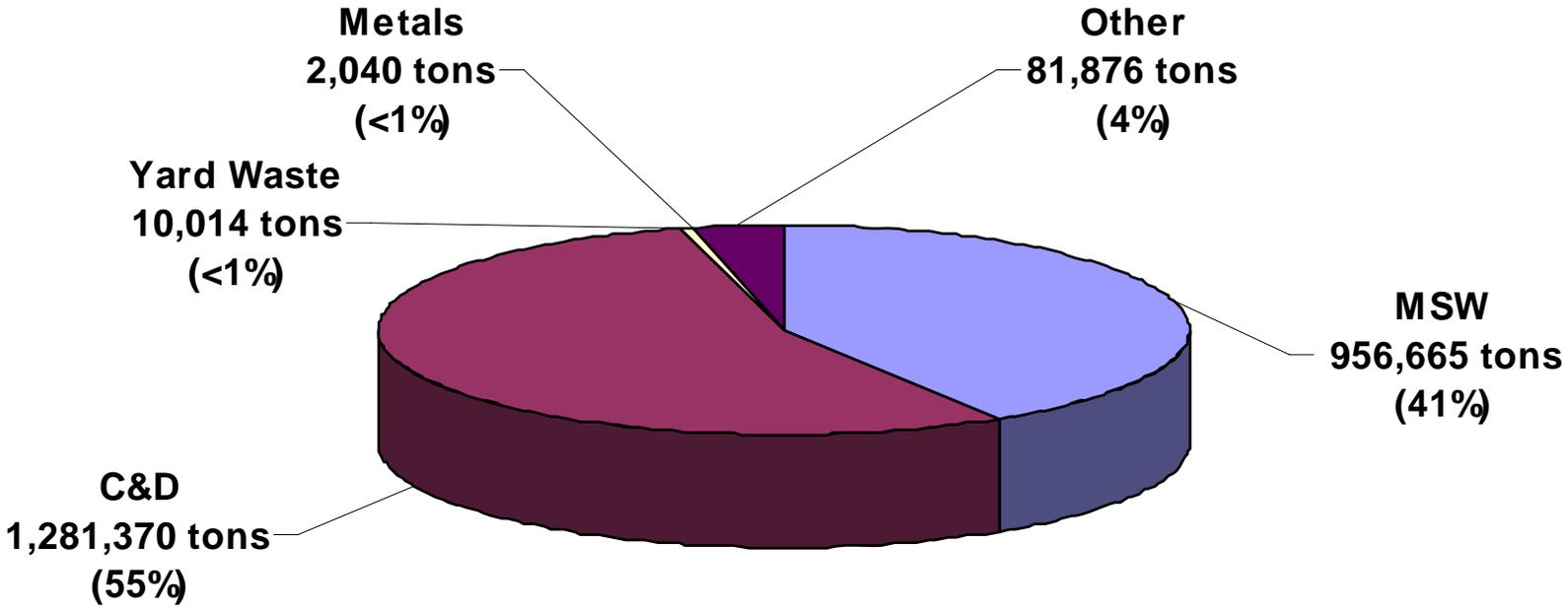
Estimated 26 Million Tons* Army C&D Debris (15 years)

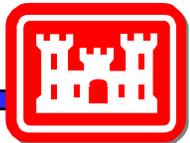


* RECENT PROGRAMS
(RESTATIONING, BRAC,
OTHERS) SUGGEST THIS
FIGURE MAY NOW BE LOW



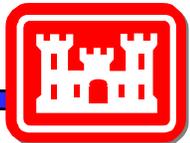
FY 2006 US Army Solid Waste by Category





- **Up to 80% of some installations' solid waste**
- **Diminishing Army landfill capacity**
- **Estimated \$1 Million/acre to operate over landfill's life**
- **26% fewer C&D landfills in the US from 1990 to 2002**
- **Higher disposal costs in the future**
- **Potential future liability**



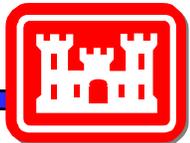


- Demolishing ONE WWII-era two-story barracks

- **Debris: 135 tons**
 - **Building mat'ls: 72 tons**
 - **Concrete : 63 tons**
- **Demolition cost: ~\$20,000**
- **On-post tipping: "free"**
- **On-post cost: \$28-50/ton**
- **Off-site tipping: \$18-90/ton**



*** AND ... IT'S AWFULLY DARNED WASTEFUL !!**



- One barracks, cont'd
 - **Creates > 40 Metric Tons Carbon Equivalent (MTCE)***
 - **Creates > 160 Metric Tons CO₂ Equivalent (MTCO₂E)***
 - **Equivalent to > 30 passenger cars / year**
 - **Embodied energy ~ 960 million BTU***
 - **Other life-cycle effects****
 - **Soil erosion**
 - **Depleted CO₂ sequestration**
 - **Altered habitat**

* USEPA WASTE Reduction Model WARM

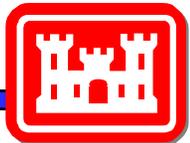
** AIA Environmental Resources Guide



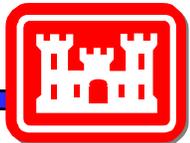


A LIABILITY ... OR A *RESOURCE* ?

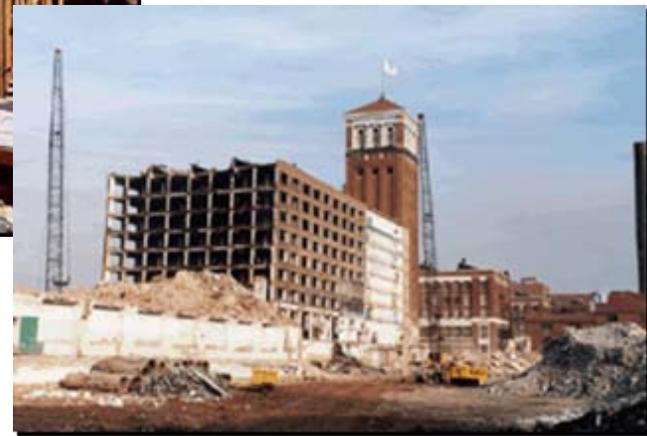




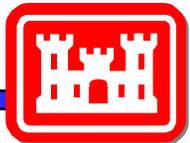
ALTERNATIVES TO DEMOLITION & LANDFILL DISPOSAL



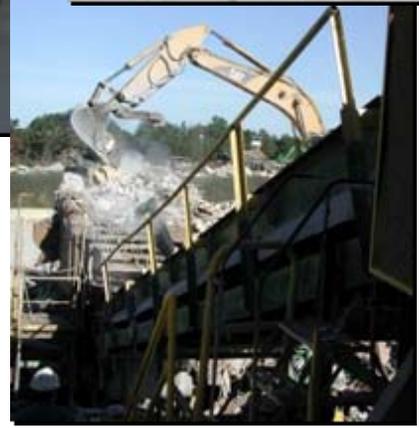
- **Commercial deconstruction & salvage**



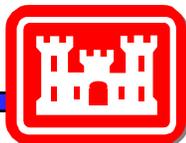
- **Used building materials outlets**



- Commercial C&D debris recyclers



- On-site waste recyclers



- **Public policy & regulation**
 - *Public Ordinances*
 - *State, county, & local Guides*
 - *EPA National Recycling Goals*
 - *Industry recycling goals*



City of Oakland
Building Permit Applicants
Construction & Demolition
Debris Recycling Requirements
OMC 15.34
Effective July 1, 2009

Affected Building Permit applicants are required to develop a recycling plan for all waste, scrap, and debris generated for the scope of work covered by a building permit. The Waste Reduction & Recycling Plan (WRSP) is due with the permit application and must be approved prior to issuance of a building permit. Failure to submit in a timely manner may delay the issuance of permit(s). The following types of permits are affected:

- * All New Construction
- * Demolition, including single family & duplex
- * Alterations/Additions, with construction volume of \$2,000 or greater, including single family & duplex

The WRSP documents how Applicants will meet the City's goal of reducing the quantity of construction and demolition (C&D) debris sent to landfill by 65% or greater.

Enduse completed WRSP forms to the Building Permit Center, 256 Frank St., Geneva Plaza, 2nd Floor, Oakland, CA, 94612. Allow 3-5 business days for processing.

DO NOT FAX FORMS.
Have a question? Contact the Construction &

11-4-1905 Construction or demolition site waste recycling

1. For purposes of this section, the terms:

- a. "Contractor" means general contractor as defined in Section 4.36-010 and also includes any person engaged in the demolition or servicing of a structure for a permit as required under Section 11-32-230.
- b. "Construction and demolition debris" has the meaning ascribed to the term in 11-4-120 of this Code, but does not include materials that are continuously hauled, off-site, or other hazardous materials in such a way as to reduce recycling to the maximum extent practicable.
- c. "Recycle" has the meaning ascribed to the term in Section 11-4-120 of this Code.
- d. "Recycling" means a recycling facility, transfer station, or other waste handling facility permitted pursuant to Section 11-4-250 of this Code which accepts construction and demolition debris for recycling or for further transfer to a recycling facility.
- e. "Reuse" means (i) the on-site use of reprocessed construction and demolition debris of such on-site use is authorized in writing by the commissioner pursuant to Section 11-4-1925 of this Code, and (ii) the off-site redistribution of a material which would otherwise be disposed of, for use in the same or similar form as it was produced.

2. Any project subject to this section shall be required to recycle or reuse construction or demolition debris produced on site as part of construction or demolition activities by meeting the following requirements:

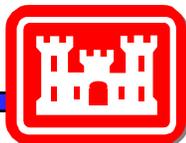
- a. The contractor on a project that is issued a permit with an application date on or after January 1, 2006, but before January 1, 2007, shall cause to be recycled or reused at least 25 percent of construction and demolition debris, as measured by weight, produced on site.
- b. The contractor on a project that is issued a permit with an application date on or after January 1, 2007, shall cause to be recycled or reused at least 50 percent of construction and demolition debris, as measured by weight, produced on site.

3. The following projects are exempt to this section:

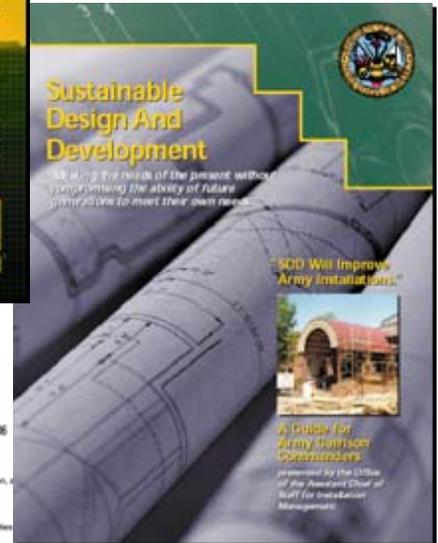
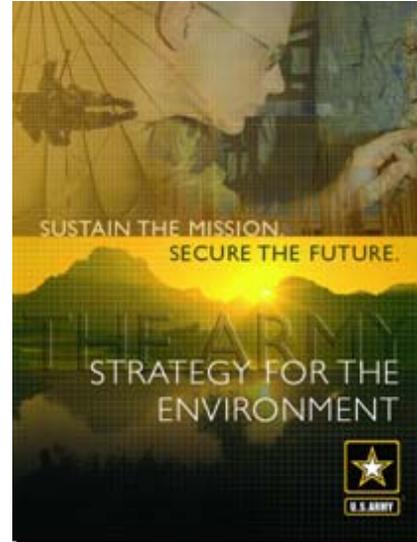
- a. Construction of a new residential building with four or more units.
- b. Construction of a new non-residential building, other than projects for which the total square footage is 4,000 square feet or less.

The National Demolition
Association Reports:

Demolition Industry Promotes
C & D Recycling



- **Army policy**
 - **Strategy for the Environment**
 - **Facilities' Sustainable Design & Development**
 - **Installations' Sustainability Plans**
 - **ACSIM C&D Waste Management Policy**



DEPARTMENT OF THE ARMY
Assistant Chief of Staff for Installation Management
2007-07-11 09:00:00

DAM-FO JUL 11 2006

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Sustainable Management of Waste in Military Construction, Renovation, and Demolition Activities – Supplemental Guidance

1. Reference: ACSM (DAM-DA) Memorandum, 6 Feb-06, Subject: Sustainable Management of Waste in Military Construction, Renovation, and Demolition Activities
2. Enclosed is revised guidance, dated 1 July 2006, which replaces the original enclosure, dated 13 January 2006. The changes, which are underlined, are in response to inquires concerning the initial implementation.
3. My point-of-contact is William F. Cing, william.cing@us.army.mil, 703-600-8827.

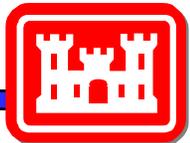
FOR THE ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT:

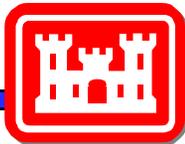
END

Mark A. Corino
MARK A. CORINO
COL, GS
Director, Facilities and Housing

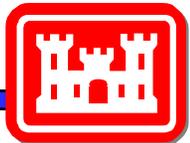
DISTRIBUTION:
Director, U.S. Army Installation Management Agency (DAIM-PWD)
Commander, U.S. Army Corps of Engineers (CEMPC)
Chief, Army Reserve (SMAA)
Chief, National Guard Bureau, Army National Guard Readiness Center (NSB-ARE)
Commander, U.S. Army Materiel Command (DAMCPE-L, Mr. G. Canella)

CF:
ACSIM
DACSIM
ASASIE (PRO) (Mr. D. Spigelmyer)
DASASIE (ASAS) (Mr. A. Vetterli)
DASASIE (ASAS) (Mr. B. Murphy)



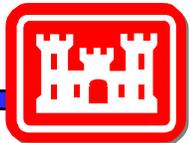


- **Army case studies**
 - *“Liaise Faire”*
 - *Partnerships w/ contracted services*
 - *Definitive diversion criteria*
 - *Contracting for deconstruction*
 - *Incentives / contract options*
 - *Real Property / Recycling Rights sale*



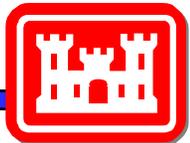
- **Airfield Hardstand Expansion, Fort Campbell**
 - ***MILCON contract***
 - ***Contractor initiated recycling for cost savings***
 - ***Used 37,000 tons of recycled aggregate***
 - ***Less cost than landfilling rubble & purchasing quarried aggregate***
 - ***Completed within contract cost & schedule***
 - ***Results were contingent on Contractor's initiative***





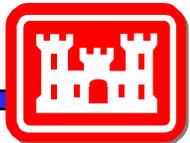
- **Building 501, Tencza Terrace, Fort Myer, VA**
 - **Facility Reduction Program, contracted by USACE**
 - **Contractor initiated recycling for cost savings**
 - **Salvaged & recycled prior to demolition**
 - **Imploded building & recycled rubble as aggregate**
 - **Total debris diversion: 91%**
 - **Contractor saved approx. \$1.1 Million**
 - **\$100K by imploding building**
 - **\$1.0 M by not landfilling & reusing materials on-site**





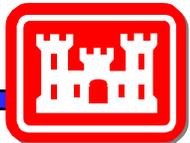
- **Building 125, Wright Patterson AFB**
 - ***MILCON design-build***
 - ***MATOC contractor initiated partnerships w/ USACE, WPAFB BCE & Environmental Division***
 - ***Contractor knowledgeable w/ recycle markets***
 - ***Contractor invited Habitat for Humanity to salvage materials for sale in their ReStore***
 - ***Diverted >60% via partial deconstruction***
 - ***Completed within contract cost & schedule***





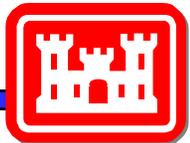
- **Building 227, Fort Carson**
 - ***Facility Reduction Program***
 - ***Fort Carson DECAM requested JOC contractor to deconstruct buildings instead of demolition***
 - ***Contractor agreed; subcontracted deconstruction***
 - ***Diverted >80% building materials, plus gave concrete & masonry to engineering units***
 - ***Completed within contract cost & schedule***
 - ***Contractor is continuing to deconstruct buildings***





- **Lee Village, Fort Campbell**
 - ***MILCON demolition***
 - ***Fort Campbell Environmental Division requested a 40% diversion criterion within specifications***
 - ***Buildings were demolished***
 - ***Demolition contractor diverted 55%; subsequent demolition achieved 62% diversion***
 - ***Completed within conventional demolition cost & schedule***





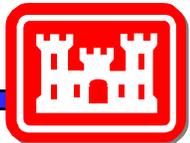
- **Battle Simulation Barracks, Fort Lewis WA**
 - ***MILCON; demolition separate from construction***
 - ***USACE specified minimum 50% diversion, w/ contract options for diversion up to 75%***
 - ***MATOC contractor & deconstruction subcontractor***
 - ***“Hybrid” techniques; panelization, tipping***
 - ***Contractor gave lumber to troop units***
 - ***Total diversion for 12 buildings: 95%***
 - ***Completed within conventional demolition cost & schedule***





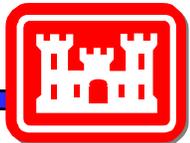
- **Facility Reduction, Fort Monroe**
 - *OMA demolition*
 - *Fort Monroe PWBC added 40% diversion criterion to new task order under existing IDIQ contract*
 - *Later, RFP w/ specific deconstruction language & options for diversion above minimums (60%-plus)*
 - *Diverted 70–90% (avg. 72%) over 58 buildings*
 - *Comparable to conventional cost & schedule*





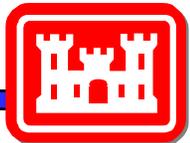
- **Fort Campbell Pilot Deconstruction Project**
 - *OMA demolition*
 - *CERL contracted directly with Austin TX HfH to deconstruct 5 WWII-era buildings*
 - *Project administered as typical demolition project*
 - *HfH achieved 85% diversion*
 - *HfH recovered \$41,000 worth of materials, sold them locally & through the Austin ReStore*
 - *Cost was comparable to conventional demolition*





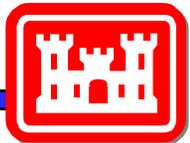
- **Building 919, Fort Hood**
 - *OMA demolition*
 - *USACE Tulsa District contracted directly with Austin TX HfH for deconstruction*
 - *Project administered as typical demolition project*
 - *HfH achieved an estimated 90% diversion*
 - *Salvaged 36,000 BF (45 Tons) of lumber*
 - *Cost was comparable to conventional demolition*





- **Fort Knox, WWII-era buildings & Family Housing**
 - *Facility Reduction & other OMA programs*
 - *A six week window was inserted into demolition schedule*
 - *Sold “Recycle rights” via live auction through QRP*
 - *Over 37 month period*
 - *Deconstructed 258 buildings*
 - *Saved \$2.8M in demolition cost*
 - *Diverted 54,000 tons of debris*

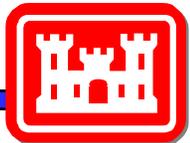




- **GP Warehouses, Fort Gordon**

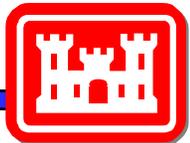
- *Similar process to Fort Knox's*
- *Extensive outreach was performed*
- *Auctioned 4 warehouse bays for \$4,300*
- *Deconstructors retrieved an estimated of \$50,000-worth (retail value) of lumber each bay*
- *Total diversion: 80%*
- *Total cost: 60% of conventional demolition cost*





- **Fort McCoy, WWII-era buildings**
 - ***Real Property transaction was administered through USACE Omaha District***
 - ***Buildings were sold via sealed bidding***
 - ***Deconstructed over 140 buildings***
 - ***Saved roughly \$3.5M over conventional demolition***
 - ***Diverted over 15,000 tons of debris***
 - ***Enough materials recovered to build 300 houses***

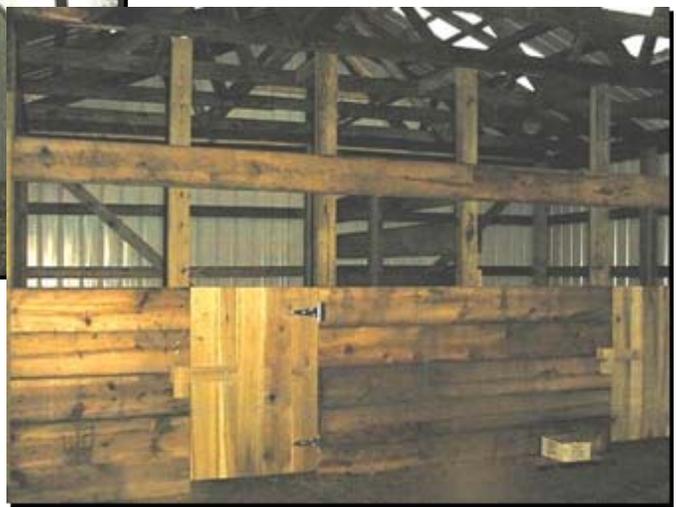


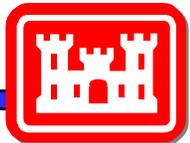


Fort Knox materials (O'Hair House)

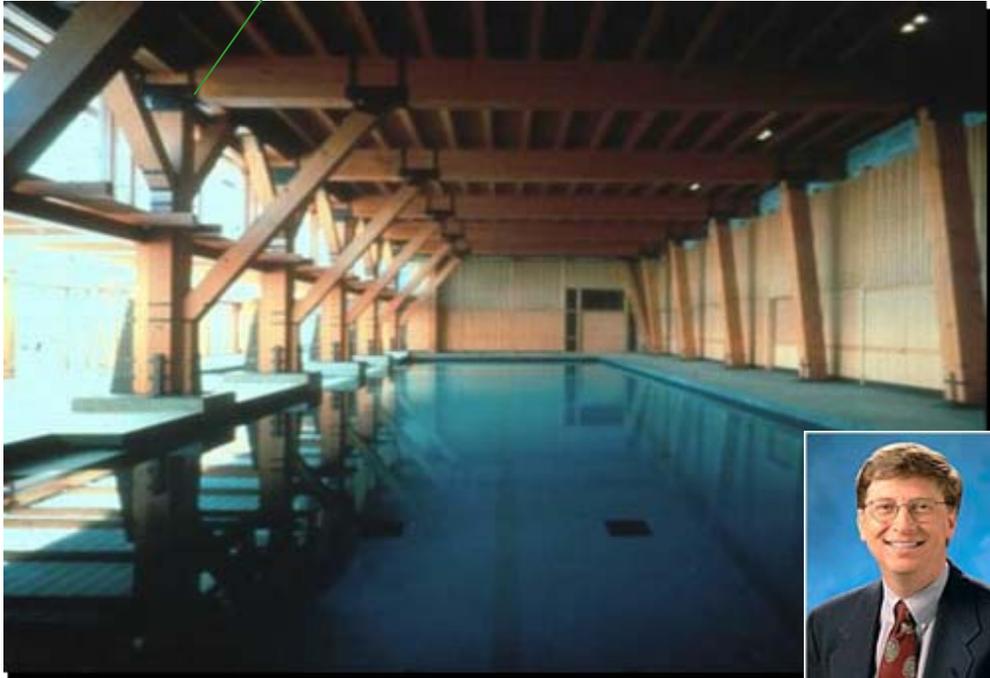


Fort Campbell materials (Carr Stables)



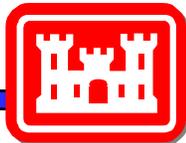


Salvaged Timbers from a Weyerhaeuser mill



- **Gates Residence,
Medina, WA**
– *“Price is no object”*





DAIM-ZA MEMORANDUM:

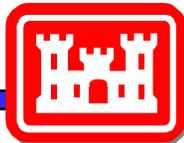
SUSTAINABLE MANAGEMENT OF WASTE IN MILITARY CONSTRUCTION, RENOVATION, AND DEMOLITION ACTIVITIES

Policy Memorandum issued 06 Feb 06 & revised 5 July

Enclosure issued 31 Jan 06 & revised 11 Jul 06



- **Para. 2. Purpose & Applicability**
 - ***Important component of SDD***
 - ***Applies to***
 - ***MILCON (<35% design complete '06 & '07, all '08+)***
 - ***Army Reserve***
 - ***National Guard***
 - ***BRAC***
 - ***Army Family Housing***
 - ***Facility Reduction (2Q '07+)***
 - ***Operation & Maintenance (2Q '07+)***
 - ***Other***
 - ***Encourage application to RCI & other specially funded tenant organizations***
 - ***50% minimum diversion, each project***



- **Para. 6. C&D Waste Program Management Requirements**

- ***Standard contract requirements***

- ***Environmental Protection***
- ***C&D Waste Management***
- ***Demolition***

- ***MILCON Transformation***

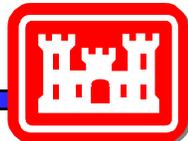
- ***Does not automatically exclude sustainable management of C&D waste***
- ***Can separate demolition activity as an independent contract***
- ***Target contractors more familiar w/ environmental, demolition & materials salvage than conventional construction contractors***



Table 2 - C&D Diversion Data Elements

- Para. 6, cont'd
– *Report through
SWARWeb*

CONSTRUCTION / DEMOLITION SWARWeb PICKLIST			
MAJOR CATEGORY	SUB-CATEGORY	DEFINITION	
Wood	Structural	TBD	
	Finished	TBD	
	Treated	TBD	
	Other (C/D Wood)	TBD	
	Metal	Steel	TBD
	Copper	TBD	
	Aluminum	TBD	
	Mixed Metal	TBD	
	Other (C/D Metal)	TBD	
Masonry/Asphalt/Concrete/Stone	Asphalt	TBD	
	Brick	TBD	
	Concrete	TBD	
	Concrete Block Unit	TBD	
	Stone	TBD	
	Other (C/D Masonry/Asphalt)	TBD	
Land Clearing Debris	Top Soil	TBD	
	Sub Soil	TBD	
	Petroleum-Contaminated Soil	TBD	
	Non-Hazardous Lead-Contaminated Soil	TBD	
	Vegetation/Timber (tree trunks & limbs)	TBD	
	Crushed Stone/Base	TBD	
	Other (C/D Land Clearing)	TBD	
Other	Siding	TBD	
	Composition Roof	TBD	
	Insulation	TBD	
	Doors/Windows/Stairs/Cabinets	TBD	
	Ceiling Tile	TBD	
	Gypsum/Plaster	TBD	
	Plastic	TBD	
	Glass	TBD	
	Paper	TBD	
	Other (C/D Other)	TBD	
	Additional Information		
	Project Number		
Building Number(s)			
Reuse (Installation)			
Reuse (Off-Site)			
Recycle (Installation)			
Recycle (Off-Site)			
Bury (Installation)			
Bury (Off-Site)			
Dispose (Installation)			
Dispose (Off-Site)			
Other			

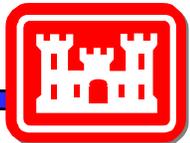


- **Para. 7. Integrated Solid Waste Management Plan ***
 - ***Goal to treat all types of solid waste in a holistic manner; think inclusively and not ignore C&D debris***
 - ***Army & DoD Regulations & Policies; EO's, SDD, & new ACSIM policy***
 - ***Responsible party/parties for managing & reporting C&D waste activities & reporting chain***
 - ***Major new construction & Facility Reduction programs***
 - ***Recycling strategies; C&D waste reduction***
 - ***SWM record keeping; jobsite data, SWAR entry***

**Content Per PWTB 200-1-5 Automated Template
for Integrated Solid Waste Management Plans*



- **Para. 8. Other considerations**
 - ***MCA programming; consideration of benefits even if outside MCA contract***
 - ***Budget considerations***
 - ***Schedule considerations***
 - ***Networking with other installations & organizations***

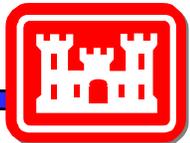


HOW TO ... SOME IMPORTANT ISSUES

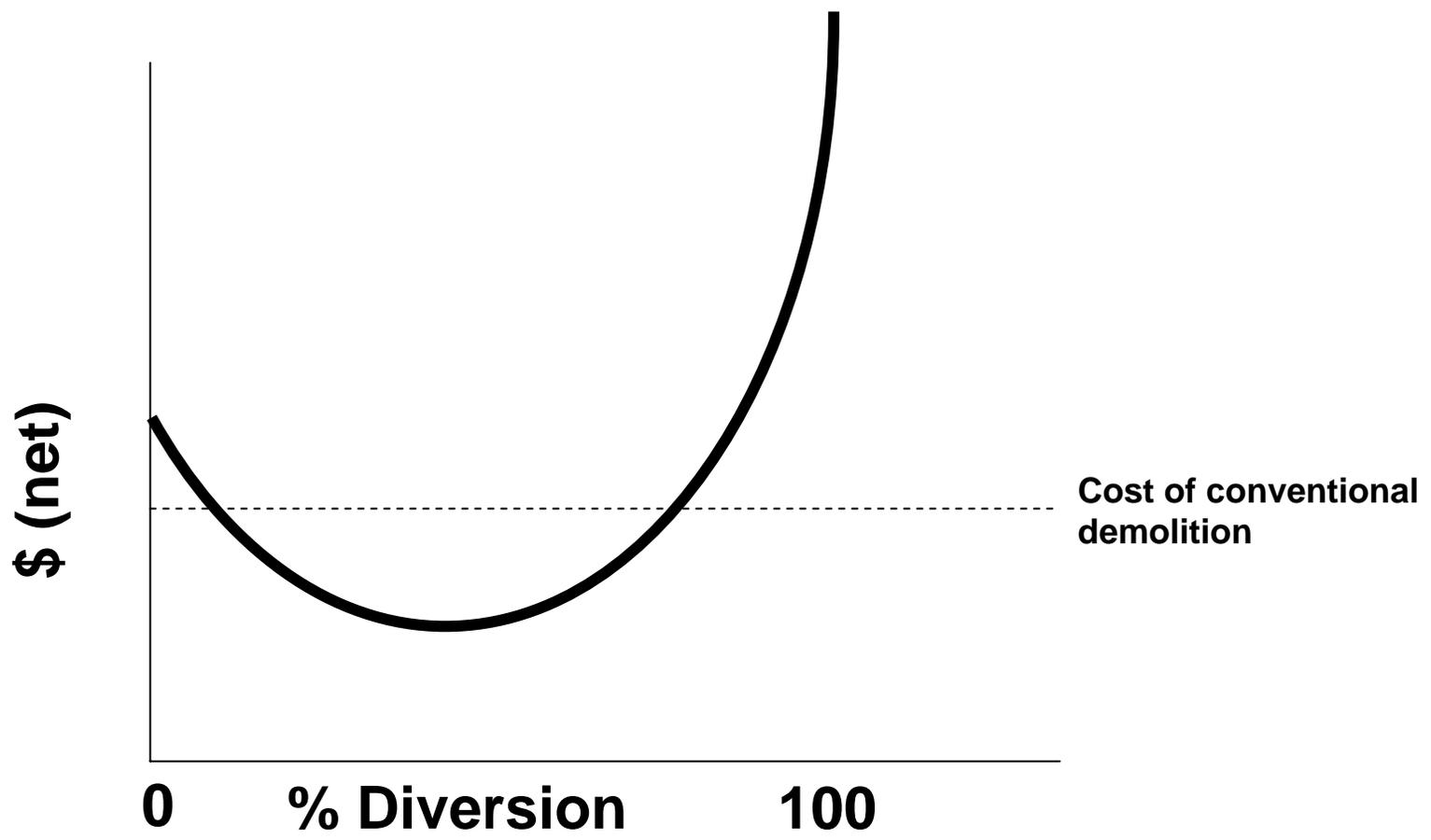


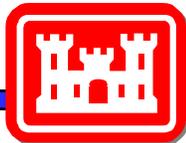


- **Rationale for 50% diversion level**
 - ***Consistent with SDD***
 - ***Public precedent***
 - ***Massachusetts, California, Chicago & others***
 - ***Federal MOU on Sustainable Facilities***
 - ***USGBC / LEED experience***
 - ***82% of Silver projects achieved at least 50% diversion***
 - ***Army / SPiRiT experience***
 - ***70% Army SPiRiT projects achieved at least 50% diversion***
 - ***CERL documented ~2.5 Million SF Army building deconstruction; achieved 60-85% diversion***
 - ***Virtually no negative cost or schedule impact***



“Reasonable” Expectations for Diversion





- **Program considerations**
 - ***MILCON: administered by USACE***
 - ***OMA: administered by the installation***
 - ***FRP: administered by the installation, or USACE Huntsville Engineering & Support Center***
 - ***RCI: Partnership with the Army and installation***



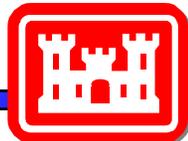
- **Collaboration**

- ***Among installation offices***

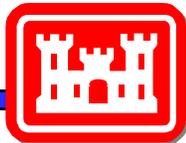
- ***Garrison CDR / Public Works Director***
 - ***Contracting***
 - ***Counsel / SJA***
 - ***Real Property***
 - ***Public Affairs Office***
 - ***Public Works, Environmental***
 - ***Public Works, Engineering / construction / maintenance***

- ***Installation & USACE (as applicable)***

- ***Project Management***
 - ***Engineering***
 - ***Construction***
 - ***Contracting***
 - ***Real Property***

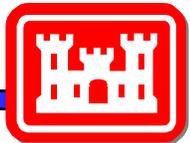


- **Project delivery considerations**
 - ***Don't just lapse into standard practice out of force of habit; consider:***
 - ***Contract scope***
 - ***Demolition***
 - ***Construction, including demolition***
 - ***Demolition and construction, independently***
 - ***Contracting / acquisition***
 - ***Best Value (Source Selection)***
 - ***Competitive Bid***
 - ***IDIQ task***
 - ***Open solicitation***
 - ***Sale to the public***



- **Project participation**

- ***Deconstruction / salvage / recycling services typically do not engage in Government contracting & are typically not known to installations or USACE***
- ***Outreach (beating the bushes) may be necessary to solicit interest from the right types of services, & is highly recommended***



• Project participation, cont'd

BUILDINGS FOR SALE:
Fort Campbell Kentucky is offering
THREE BUILDINGS
for sale through a
PUBLIC BIDDING PROCESS

This sale allows individuals, groups, non-profit organizations, commercial contractors, housing agencies, and other interested parties to DECONSTRUCT the buildings and SALVAGE BUILDING MATERIALS for their own reuse, resale, or recycling.

An information meeting will be held at Fort Campbell on **MARCH 19 2005, 9:00 – 2:00** SSG Glean H. English Education Center, Building 202.



WAREHOUSE BUILDING:

- 8000-sq. wood framed construction
- 10,000 square feet, approximately 40ft. by 170 ft.
- Wood framed floor, wall, and roof structure
- Vinyl siding and aluminum replacement windows



ADMINISTRATIVE BUILDING:

- 4000-sq. wood framed construction
- 4,000 square feet, approximately 40ft. by 110 ft.
- Wood framed floor, wall, and roof structure
- Vinyl siding and aluminum replacement windows
- Light fixtures, gas heaters



OPERATIONS BUILDING:

- 10700 sq. pre-engineered metal building
- 2,400 square feet, approximately 40' by 60'
- Steel rigid frame structure
- Galvalume steel siding
- Deep-grade foundation



"SEE OTHER SIDE FOR MORE INFO"

Building Materials Salvage at Fort Jackson **AVAILABLE TO THE PUBLIC!**



Have an interest in reclaiming old World War II building materials? The above pictured structures are just a **sample** of the eight structures slated for deconstruction that contain good, salvageable products such as framing lumber, windows, doors, hardwood floors, treated lumber, wood siding, and even church pews!

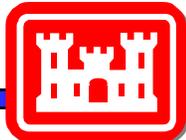
PUBLIC WELCOME!!! Interested?

Plan to attend the informational meeting and see fire previews!
Saturday, July 30, 2005 at 9:00 am
Fort Jackson, Columbia, SC



• Flyers advertising Fort Campbell building sale & Fort Jackson deconstruction

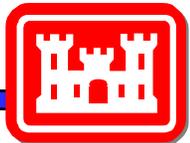
• Contractor briefing & walk-through at Fort Lewis



- Project participation, cont'd
 - ***If contractor is already in-place***
 - ***Trades, services***
 - ***Materials outlets***
 - ***Other resources to support contractor in achieving the required diversion***
 - ***If contractor is yet to be selected***
 - ***Qualified environmental / demolition / salvage / deconstruction contractors***
 - ***Supporting subcontractors, services, & materials outlets***
 - ***If public is invited to bid***
 - ***Small contractors***
 - ***Individuals***
 - ***Non-profit housing organizations***



- **Project participation, cont'd**
 - **Information sources**
 - **Industry directories (BMRA, CMRA, others)**
 - **State & local solid waste management offices**
 - **Recycling directories**
 - **Materials exchanges**
 - **Referrals**
 - **Other state & local agencies**
 - **Local professional organizations (USGBC, AIA, ASCE, homebuilders associations, others)**
 - **Local trade organizations (NAHB, ACG, others)**
 - **“Green” organizations (WasteCap, ReDo, GreenGoat, etc)**
 - **Information outlets**
 - **On-post media**
 - **Local media**
 - **Word-of-mouth**



- **WBDG, Construction Waste Management**
<http://www.wbdg.org/design/cwm.php>

WBDG
Waste Building Design Guide

Home / About / Contact / Site Map / Search

Construction Waste Management

by Tom Napier, Research Architect
U.S. Army Corps of Engineers, Engineer Research and Development Center / Construction Engineering Research Laboratory

INTRODUCTION

Responsibly managing waste on a construction jobsite is a vital component of sustainable building; context, managing waste means minimizing the construction waste or demolition debris (C&D) to jobsite for landfill disposal.

In 1998, the U.S. EPA estimated that 136 million tons of building-related waste is generated in the which is 25% to 40% of the national solid waste stream. A 2003 update shows an increase to 164 tons annually, of which 9% is construction waste, 38% is renovation waste, and 53% is demolition.

C&D waste disposal triggers a sequence of adverse effects that are not always apparent to buildin. These include the loss of useful property, wasted materials and embodied energy, greenhouse gas and environmental stressors associated with producing new materials instead of using existing material. The number of C&D landfills is declining, which means fewer disposal options, greater hauling distance, increased fuel consumption and vehicle emissions. Capping, closing, and monitoring landfills, and leaking or contaminated landfill sites drain public funds.

EPA also estimates that only 20% of C&D waste is being recycled. This suggests an enormous potential for improvement. It also suggests a significant resource is available for future use. In the book Cradl William McDonough draws the analogy to natural systems where waste is food. "Technical waste" is "industrial food."

C&D landfill cell

Selected C&D Waste Management Guides

- California Integrated Waste Management Board
- C&D Guide, Air Force Center for Environmental Excellence
- Deconstruction Guides, National Association of Home Builders Research Center
- "A Guide to Deconstruction," Deconstruction Institute
- King County, WA, Solid Waste Division: [Design Specifications & Waste Management Plans Contractors Guide](#)
- Massachusetts Department of Environmental Protection / Boston Society of Architects
- Residential Construction Waste Management: [A Builder's Field Guide](#), National Association of Home Builders Research Center
- Solid Waste Agency of Lake County, IL
- State of Hawaii, Department of Business & Economic Development
- "WasteSpec," Triangle J Council of Governments, NC
- [Model Specifications for Construction Waste Reduction, Reuse, and Recycling](#)

C&D Recycling Databases and Building Materials Exchanges

- California Integrated Waste Management Board, [C&D Debris Recyclers Database](#)
- Georgia Pollution Prevention Assistance Division, [Recycling & Waste Exchange Resources](#)
- King County, WA Solid Waste Division [C&D materials recycling database](#)
- King County, WA Solid Waste Division [Reusable Building Materials Exchange](#)
- North Carolina Department of Natural Resources, [Division of Pollution Prevention & Environmental Assistance Recycler's World](#)
- Southern Waste Exchange [Information](#)
- U.S. Department of Agriculture, Forest Products Laboratory [Directory of Wood Framed Building Deconstruction and Reused Building Materials Companies](#)
- U.S. EPA national database of [Materials and Waste Exchanges](#)

Selected State, County, and Local Agencies

- Alameda County, CA [Waste Management Authority](#)
- California Integrated Waste Management Board
- City of Austin, TX [Greenbuilder Program](#)
- Georgia Pollution Prevention Assistance Division
- King County, WA Solid Waste Division, [Construction Recycling](#)
- Minnesota Office of Environmental Assistance, [C&D Recycling](#)
- North Carolina Department of Natural Resources, [Division of Pollution Prevention & Environmental Assistance](#)

Recycling and Waste Management Councils



– ***US Army Public Works Technical Bulletins***

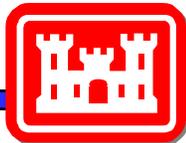
<http://www.hnd.usace.army.mil/techinfo/engpubs.htm>

http://www.wbdg.org/ccb/browse_cat.php?o=31&c=215

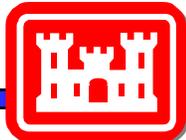
- ***200-1-7 Recycling Interior Finish Materials - Carpet and Ceiling Tiles***
- ***200-1-23 Guidance for the Reduction of Demolition Waste Through Reuse and Recycling***
- ***200-1-27 Reuse of Concrete Materials From Building Demolition***
- ***200-1-40 Characterizing Demolition Debris for Diversion Opportunities: WWII-era Wood Framed and Korean War-era Reinforced Concrete buildings***
- ***420-49-30 Alternatives to Demolition for Facility Reduction***
- ***420-49-32 Selection of Methods for the Reduction, Reuse, and Recycling of Demolition Waste***



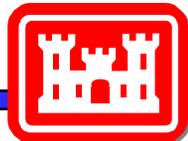
- **Specification Requirements**
 - ***Installation, or USACE, define the services to be provided – the scope of work***
 - ***Consider***
 - ***Type of contract / agreement***
 - ***Types & capabilities of service removing the buildings***
 - ***Capabilities of in-house services***
 - ***Included vs. not-included***
 - ***Abatement***
 - ***Sitework***
 - ***Building removal***
 - ***Debris removal***
 - ***Foundation removal***
 - ***Grading & seeding***



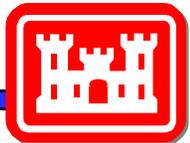
- Specification Requirements, cont'd
 - ***Logistics considerations***
 - ***Which party is responsible for:***
 - ***Drawings***
 - ***Permits***
 - ***Electrical power***
 - ***Debris receptacles***
 - ***Landfill access***
 - ***Recyclable materials receptacles***
 - ***Potable water***
 - ***Toilet facilities***
 - ***Temporary facilities***
 - ***Working hours***
 - ***Other***



- Specification Requirements, cont'd
 - **Safety Plan** *EM 385-1-1, OSHA, or similar*
 - **Statement of safety & health policy**
 - **Administrative responsibilities**
 - **Means for coordinating among contractor's resources**
 - **Safety indoctrination & training**
 - **Inspections**
 - **Accident reporting & investigation**
 - **Emergency response**
 - **Contingency for severe weather**
 - **Jobsite clean-up & safe access**
 - **Local requirements**
 - **Prevention of drug & alcohol abuse**
 - **Hazard communication plan**
 - **Coordinate with Demolition Plan**

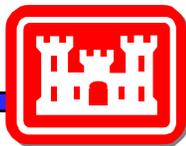


- Specification Requirements, cont'd
 - **C&D Waste Management Plan** UFGS 01 74 19 or similar
 - *Responsible individuals*
 - *Actions to reduce solid waste*
 - *Characterization of waste, by type & quantity*
 - *Landfill facilities*
 - *Local & regional reuse groups*
 - *Specific materials to be salvaged for resale, reuse, or recycling*
 - *Recycling facilities*
 - *Identification of materials that cannot be used or recycled, w/ justification*
 - *Anticipated costs & savings*
 - **Plan the Work, work the Plan**
 - **Coordinate with Environmental Protection Plan, Solid Waste Minimization** UFGS 01 57 20.00 10 or similar



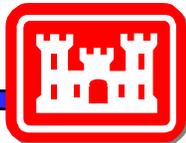
Waste Reduction Hierarchy





- Specification Requirements, cont'd
 - **Demolition** UFGS 02 41 00 or similar
 - **Standard demolition provisions**
 - **Edit as appropriate for the program & project**
 - **Incorporate definitive diversion criteria (i.e. minimum 50%)**
 - **Can provide further qualifications and criteria**

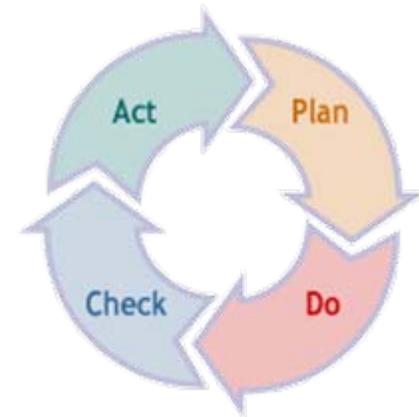


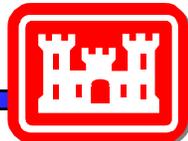


- **Diversion / debris monitoring & reporting**

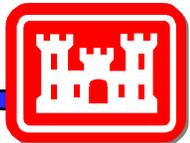
- ***Project QC/QA***

- ***Installation's QA representative***
- ***USACE Project Manager / Project Engineer***
- ***Application of C&D Waste Management Plan***
- ***Documentation of performance at the time***
- ***Project personnel provide data to installation's SW manager for SWARWeb entry***





- **Other considerations**
 - ***Demolition included or not included w/ construction***
 - ***Service Contract Act (where possible)***
 - ***Contractor to benefit from diversion***
 - ***Title to materials***
 - ***Revenues from sales***
 - ***Cost avoidance***
 - ***“Incentives” to increase diversion***
 - ***Bid schedule line items for diversion above 50%***
 - ***Exercised as Contract Options***

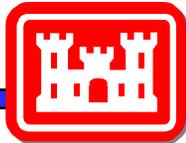


Questions & Comments



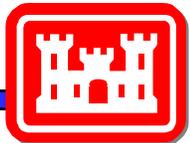
Tom Napier, 217/373-3497

Thomas.R.Napier@erdc.usace.army.mil



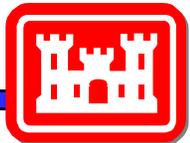
Recyclable / reusable materials

See PWTB 200-1-23, Appendix A



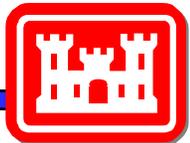
- **Concrete**
 - *Recyclable*
 - *Compacted base*
 - *Engineered fill*
 - *Fill*
 - *Erosion control*
 - *Trails*
 - *Recycling concrete is common, if not universal*





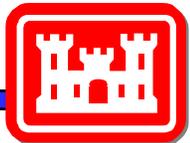
- **Lumber**
 - *Reusable*
 - *Resale*
 - *Value added (millwork, etc)*
 - *Lumber salvage is somewhat niche-market*
 - *Timber salvage market is widely available*





- Lumber, cont'd
 - *Recyclable (clean)*
 - *Mulch*
 - *Engineered wood products*
 - *Boiler fuel*
 - *Wood recycling & grinding services are widely available*

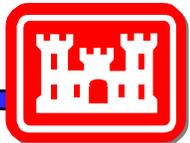




- **Metals**

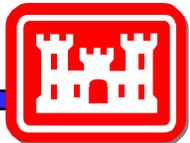
- *Reusable*
 - *Pre-engineered metal buildings most practical*
- *Recyclable*
 - *Structural & sheet metals*
 - *New metal scrap*
- *Metal recycling is the rule rather than the exception*





- **Gypsum Drywall**
 - *Reusable (clean scrap)*
 - *Resale (minimum half-sheets, typical)*
 - *Recyclable (clean scrap)*
 - *Drywall manufacturing*
 - *Soil amendments*
 - *Most recycled GWB comes from construction sites*
 - *Demolition drywall is problematic if LBP-contaminated*
 - *Recycling infrastructure is regional*
 - *Agricultural markets could expand*





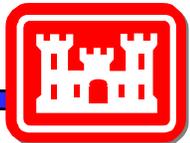
- **Asphalt roofing**

- *Recyclable*

- *Hot mix asphalt*
- *Cold patch*
- *Ground cover*
- *Fuel*
- *New roofing (pre-consumer)*

- *Recycling infrastructure is limited, but expanding*

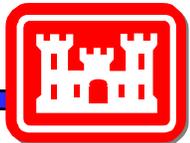




- **Carpet**
 - *Reusable*
 - *Resale*
 - *Restoration*
 - *Recyclable*
 - *New carpet*
 - *Other polymer products*
 - *Waste-to-energy & cement kilns*
 - *Leased as a service*
 - *Recycling infrastructure is limited, but expanding*

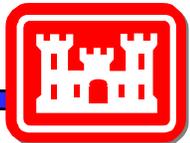


CARPETAMERICARECOVERYEFFORTSM
Developing market-based solutions for the recycling and reuse of post-consumer carpet



- **Acoustic tile**
 - *Reusable*
 - *Resale*
 - *Recycling*
 - *New acoustic tile*
 - *Armstrong World Industries is the only recycler to date*

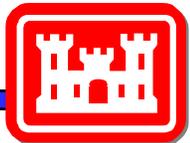




- **Other reusable architectural items**

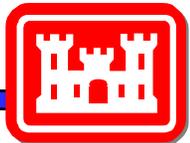
- *Insulation*
- *Vinyl siding*
- *Wood siding*
- *Doors*
- *Windows*
- *Interior paneling*
- *T&G flooring*
- *Etc.*



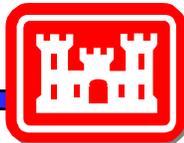


- **Other reusable mechanical & electrical items**
 - *Furnaces & heaters*
 - *Air conditioning units (residential capacity)*
 - *Duct accessories*
 - *Plumbing fixtures & equipment*
 - *Electrical fixtures & equipment*
 - *Etc.*





FREQUENTLY ASKED QUESTIONS



- **FAQ, cont'd**

Q: What is the metric for diversion?

A: Weight; diverted materials / total building weight

Q: Is diverting 50% of materials' weight realistic?

A: Yes

- *Well over 50% debris diversion has been achieved on Army deconstruction projects so far*
- *Concrete foundations alone typically contribute over 40% of typical WWII-era buildings' weights*
- *SPiRiT & LEED acknowledge 50% as a minimum criterion*

Q: Does diverting 50% by weight apply to each building, each contract, or across programs?

A: Not explicit; assume each contract or project



- **FAQ, cont'd**

Q: Doesn't deconstruction take longer?

A: Typically yes; maybe twice as long as mechanical demolition

- *Qualified & experienced crews will reduce time*
- *Consider whether completion time is or is not sensitive*
- *Duration is within the installation's control*

Q: Do deconstruction contractors require escorts?

A: Not typically

- *Similar to any conventional contractor*
- *Job walkthroughs & on-site sales or auctions must be organized by installation personnel*



- **FAQ, cont'd**

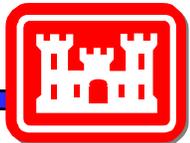
Q: How do we find customers?

A: Outreach (see previous)

Q: Do deconstruction contractors leave work that must be finished by installations?

A: Depends on the installation's preference

- *May be preferable to allow deconstruction contractors to leave foundation, utilities, etc*
- *Consider in-house & contractor capabilities & economies*
- *Installation, or USACE, determines the scope of work & describes in the contract requirements*



- **FAQ, cont'd**

Q: Does the installation's liability increase?

A: It should not, and ought not

- *Installation controls liability through contract or agreement*
- *Similar to any other construction or services contract: scope of work, fiscal security, hazardous materials handling, safety management, quality management, others*

Q: Who is responsible for safety?

A: Contractor, per standard practice

- *Contract requires contractor to develop & submit a safety plan prior to deconstruction; COR approves*
- *Contractor applies & maintains safety plan during the Work; COR oversees*
- *COR can exercise Stop Work provisions, per standard practice*



- FAQ, cont'd

Q: Where are materials stored, & how are they secured?

A: Material handling, protection & security are the contractor's responsibility

- *Preservation of materials is in contractor's interest*
- *Installation ought to allow trailers, fenced areas, etc*
- *Installation may provide covered or secure area, if mutually convenient*
- *If installation wants to keep materials, describe provisions in contract requirements*

Q: If this is such a good idea, shouldn't the contractor determine what is salvaged and what isn't?

A: Yes, but ...

- *Path of least resistance is still wrecking; "feed the machine"*
- *Current Army, DoD, & Federal policy is to reduce waste*
- *Industry is also promoting waste reduction*

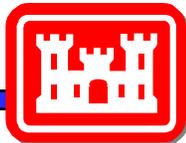


- FAQ, cont'd

Q: Isn't deconstruction, salvage, & recycling more expensive?

A: Not necessarily

- *Can be done economically*
- *Can't guarantee deconstruction will be less expensive*
- *Examples exist in Army & private practice to suggest deconstruction & salvage can be competitive with demolition*
- *Contractors capabilities & expertise can make-or-break*
- *Must consider total cost to the Army*
 - *Initial cost*
 - *Value of salvaged / recycled materials*
 - *Disposal cost avoidance*
 - *Landfill life cycle cost avoidance*

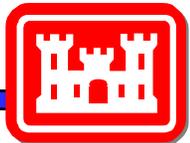


- **FAQ, cont'd**

Q: What about RCI programs?

A: Encourage RCI Partner to divert debris

- *Several RCI developers have initiated recycling operations on their own*
- *Several RCI developers have approached local Habitat for Humanity Affiliates to perform partial deconstruction & take materials for resale*
- *Installations can support RCI Partner by helping to identify services & materials outlets*



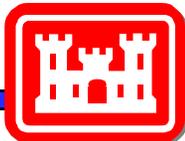
**US Army Corps
of Engineers**
Engineer Research and
Development Center

SOME RESOURCES



• Notable case studies

- *Deconstruction of a house, Portland OR, 1996*
www.smartgrowth.org/library/waste_mgmt_update_4.html
- *Deconstruction of a WWII-era warehouse building at The Presidio of San Francisco, CA, 1996*
www.ciwmb.ca.gov/ConDemo/CaseStudies/Presidio/default.htm
- *Deconstruction of Riverdale Village apartments in Baltimore County, MD, 1997* www.smartgrowth.org/pdf/deconstruction.pdf
- *Deconstruction of eight WWII-era buildings at Fort Ord, CA, 1997*
www.fora.org (Call Stan Cook for a copy, tell him Tom Napier said it's OK)
- *Deconstruction of two WWII-era industrial buildings at Alameda Naval Air Station, CA, 1997* www.conversion.org/cec/dsrr.pdf
- *Deconstruction of Stowe Village apartment units in Hartford CT, 1998*
www.ilsr.org/recycling/deconatwork.html
- *Deconstruction of ten houses in Gainesville FL, 1999-2000*
www.cce.ufl.edu/past/deconstruction/reuse.html



• Organizations

- Austin HfH deconstruction www.re-store.com/deconstruction.htm
- University of Florida Center for Construction and Environment www.cce.ufl.edu/index.html
- USEPA C&D Debris website www.epa.gov/epaoswer/non-hw/debris/
- USEPA WasteWise website www.epa.gov/wastewise/wrr/cbres.htm
- USDA Forest Products Laboratory www.fpl.fs.fed.us/
- Building Material Reuse Association www.building-reuse.org/
- Building Deconstruction Consortium www.denix.osd.mil/denix/Public/Library/Sustain/BDC/bdc.html
- Deconstruction Institute www.deconstructioninstitute.com/
- Construction Materials Recycling Association www.cdrecycling.org/
- WasteCap Wisconsin www.wastecapwi.org/
- California Integrated Waste Management Board (re: C&D debris) www.ciwmb.ca.gov/ConDemo/
- Triangle J Council of Governments www.tjcog.dst.nc.us/cdwaste.htm
- Institute of Local Self Reliance, Waste-to-Wealth program www.ilsr.org/recycling/decon/builddecon.html



- Organizations, cont'd

- Reuse Development Organization www.redo.org/
- The Loading Dock www.loadingdock.org/2005/
- greenGoat www.greengoat.org/
- North Carolina Division of Pollution Prevention and Environmental Assistance www.p2pays.org/
- King County WA, Solid Waste Division, Construction Recycling www.metrokc.gov/dnrp/swd/construction-recycling/index.asp
- Mid-Atlantic Consortium of Recycling and Economic Development Officials www.libertynet.org/~macredo/
- Build Recycled www.build.recycle.net/index.html
- Recycled Materials Resource Center, University of New Hampshire www.rmrc.unh.edu/
- National Demolition Association www.demolitionassociation.com/
- Georgia Pollution Prevention Assistance Division www.p2ad.org/



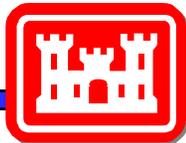
• Various Guides on building deconstruction & materials' reuse/recycling

- *Deconstruction Institute's "A Guide to Deconstruction"*
www.deconstructioninstitute.com/files/learn_center/45762865_guidebook.pdf
- *CIWMB's "Deconstruction Training Manual; Waste Management Reuse & Recycling at Mather Field"*
www.ciwmb.ca.gov/Publications/ConDemo/43301027.pdf
- *Triangle J Council's "WasteSpec"*
www.tjcoq.dst.nc.us/cdwaste.htm#wastespec
- *Residential C&D Waste Guide Information Links*
www.peakstoprairies.org/p2bande/Construction/C&DWaste/infolinks.cfm
- *Center for Construction & Environment's "Advanced Construction & Demolition Waste Management for Florida Builders"*
www.cce.ufl.edu/publications/wordfiles/Advanced_C&D_Waste_Management_for_Florida_Builders.doc
- *Alameda County's "A Builder's Guide to Reuse & Recycling"*
www.stopwaste.org/bg2001.pdf



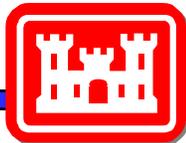
• Miscellaneous references

- EPA’s “Characterization of Building Related Construction & Demolition Debris in the United States” www.epa.gov/epaoswer/hazwaste/sqg/c&d-rpt.pdf
- HUD’s “A Report on the Feasibility of Deconstruction: An Investigation of Deconstruction Activity in Four Cities” www.huduser.org/publications/destech/deconstruct.html
- HUD’s “Building Deconstruction and Material Reuse in Washington, D.C.” www.smartgrowth.org/library/DCdeconreport.html
- Center for Construction & Environment’s “Implementing Deconstruction in Florida: Materials Reuse Issues, Disassembly Techniques, & Policy” www.cce.ufl.edu/past/deconstruction/final_report.html
- EPA’s State-by-State Recycled Materials Exchange Directories www.epa.gov/jtr/comm/exchstat.htm
- Controlled Demolition Inc.’s Website www.controlled-demolition.com/default.asp?
- C&D Recycler magazine www.cdrecycler.com/



• ERDC/CERL publications

- CERL Technical Report “US Army Concepts for Reuse & Recycling of Construction & Demolition Waste”
www.deconstructioninstitute.com/files/learn_center/27449035_LAM_RERE_FLM_post.PDF
- CERL Technical Report “Cost Analysis for Building Removal at Fort Chaffee, Arkansas”
www.cecer.army.mil/td/tips/pub/details.cfm?PUBID=4081&LAB=1
- CERL Technical Report “Deconstructing Buildings at Fort Campbell KY; A Pilot Project” (Coming soon, check CERL website)



- **ERDC/CERL publications, cont'd**

- *Public Works Technical Bulletins (PWTBs) written by CERL*

- <http://www.hnd.usace.army.mil/techinfo/CPW/pwtb.htm>

- *200-1-7 Recycling Interior Finish Materials - Carpet and Ceiling Tiles*
 - *200-1-23 Guidance for the Reduction of Demolition Waste Through Reuse and Recycling*
 - *200-1-27 Reuse of Concrete Materials From Building Demolition*
 - *200-1-40 Characterizing Demolition Debris from WWII-era Wood Framed and Korean War-era Reinforced Concrete buildings (in editing, check TECHINFO website soon)*
 - *200-1-XX Diverting Demolition Debris in RCI Programs (in editing, check TECHINFO website soon)*
 - *420-49-30 Alternatives to Demolition for Facility Reduction*
 - *420-49-32 Selection of Methods for the Reduction, Reuse, and Recycling of Demolition Waste*