ALTERNATIVES TO DEMOLITION

Opportunities to Deconstruct, Reuse & Recycle Building Materials

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“SUSTAINABILITY”

- A definition
  - Meeting the needs of the present
  - Without compromising the ability of future generations to meet their needs
Some other ideas

- Production & consumption
- Damage & restoration
- Extraction & replenishment
- Conflict & reconciliation
- Preservation
- Self-maintenance
- The long view
- The future
- Security
SUSTAINABILITY

- Environmental impacts
  - Air
  - Water
  - Land
  - Ecological habitat
  - Resources
  - Human health
WHAT’S THE RELATIONSHIP BETWEEN “SUSTAINABILITY” AND THE BUILT ENVIRONMENT?
SUSTAINABILITY AND THE BUILT ENVIRONMENT

- Construction materials = 60% of US materials’ flow (US Environmental Protection Agency)
SUSTAINABILITY AND THE BUILT ENVIRONMENT

BUILDINGS CONTRIBUTION TO ANNUAL U.S. BURDEN, RAW MAT’LS
(US Environmental Protection Agency)

- Steel
- Timber
- Clay
- Polystyrene
- Aluminum
- Copper
- Sand
- PVC

0 20 40 60 80 100
SUSTAINABILITY AND THE BUILT ENVIRONMENT

BUILDINGS CONTRIBUTION TO ANNUAL U.S. BURDEN, IMPACT

(US Environmental Protection Agency)

- Resource Use
- Energy Use
- Water Use
- Land Use
- Atmospheric Emissions
- Water Effluents
- Solid Waste
- Others

0 20 40 60 80 100
SUSTAINABILITY AND THE BUILT ENVIRONMENT

Is there really a choice?
SUSTAINABILITY AND THE BUILT ENVIRONMENT

- “Green building”
- USGBC’s Leadership in Energy and Environmental Design (LEED)
  - 62 prerequisites & credits
    - Sustainable Sites
    - Water Efficiency
    - Energy & Atmosphere
    - Materials & Resources
    - Indoor Environmental Quality
    - Innovation & Design Process
  - 52-69 pts. = Platinum
  - 39-51 pts. = Gold
  - 33-38 pts. = Silver
  - 26-32 pts. = Certified
SUSTAINABILITY AND THE BUILT ENVIRONMENT

- **The Army’s built environment**
  - Army installations in the US & Overseas
  - A city, up to 100,000 people
    - Residential
    - Administrative
    - Business
    - Community
    - Recreation
    - Industrial
    - Training
    - Civil infrastructure
    - Others
The Army’s **Mission**

- *Without a sustainable built environment, the mission cannot be accomplished*
SUSTAINABILITY AND THE BUILT ENVIRONMENT

• Army policy
  – Army Sustainability

USACE Environmental Operating Principles

Strive to Achieve Environmental Sustainability: An environment maintained in a healthy, diverse, and sustainable condition is necessary to support life.

Consider Environmental Consequences: Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of Corps programs and act accordingly in all appropriate circumstances.

Seek Balance and Synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.

Accept Responsibility: Continue to accept corporate responsibility and accountability under the law for activities and decisions, and our control that impact human health and welfare and the continued viability of natural systems.

Mitigate Impacts: Seek ways and means to assess and mitigate cumulative impacts to the environment; design systems appropriate to the full life cycle of our processes and work.

Understand the Environment: Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work.

Request Other Views: Request views of individuals and groups interested in Corps activities, actively listen, and form them as perspectives for the search for and innovative win-win solutions to the Nation’s problems, solutions that also protect and enhance the environment.
SUSTAINABILITY AND THE BUILT ENVIRONMENT

• Army policy
  – Installations & facilities sustainability
Please keep in mind the holistic nature of sustainability:
- Across environmental media & performance
- Throughout time & life cycle phase
WHERE DOES CONSTRUCTION & DEMOLITION WASTE COME FROM?
C&D WASTE

- **Response to a requirement**
  - Upgrading capabilities
  - Improving the quality of life
  - Removing obsolete buildings

- A “byproduct” of other activities
C&D WASTE

- **Estimated 136 Million Tons each year** *(US Environmental Protection Agency, 1996)*
  - 40% of some city & county solid waste
  - Diminishing landfill capacity
  - ~$1 Million/acre to operate over landfill’s life

- **30% fewer C&D landfills in the US from mid-1980’s to mid-1990’s** *(US Environmental Protection Agency)*

- **Higher disposal costs in the future**

- **Potential liability**
Demolishing **ONE** WWII-era two-story barracks

- **Debris:** 135 tons
  - **Building mat’ls:** 72 tons
  - **Concrete:** 63 tons
- **Demolition cost:** ~$20,000
- **Hauling cost:** ~$1/ton/mile
- **Tipping fee:** $18-90/ton

*AND ... IT’S AWFULLY DARNED WASTEFUL !!*
C&D WASTE

• One barracks, cont’d
  – Creates > 40 Metric Tons Carbon Equivalent (MTCE)*
  – Creates > 160 Metric Tons CO\textsubscript{2} Equivalent (MTCO\textsubscript{2}E)*
  – Equivalent to > 30 passenger cars / year
  – Embodied energy ~ 960 million BTU*
  – Other life-cycle effects**
    • Soil erosion
    • Depleted CO\textsubscript{2} sequestration
    • Altered habitat

* USEPA W\textsc{a}ste Reduction Model W\textsc{a}RM
** AIA Environmental Resources Guide
• A liability….. or a RESOURCE?

"Waste - A resource in the wrong place"
An old Chinese Proverb
WHAT’S REUSABLE OR RECYCLABLE?
(Hidden Resources)
REUSABLE / RECYCLABLE

Waste Reduction Hierarchy

Source Reduction

Reuse

Recycle

Disposal

US Army Corps of Engineers

Engineer Research and Development Center
• Typical WWII-era Barracks Building

Concrete: 36 T
Reinforcing steel: 0.6 T
Masonry: 385 CF
Framing lumber: 26,100 BF
Board sheathing: 8,200 BF
Roofing (shingles): 3,100 SF
Insulation: 6,400 CF
Wood siding: 4,000 SF
Vinyl siding: 4,000 SF
Soffit, fascia, gutters: 330 LBS
Doors & windows: 43 EA
Gypsum wallboard: 16,400 SF
Acoustic ceiling: 4,700 SF
Plywood paneling: 1,000 SF
Wood T&G flooring: 4,700 SF
Resilient flooring: 4,700 SF
Furnaces: 3 EA
Plumbing fixtures: 16 EA
Duct: 1.7 T
Piping: 700 LBS
Electrical fixtures: 28 EA
Electrical conductor: 960 LF

REUSABLE / RECYCLABLE

POTENTIAL "PRODUCT"
REUSABLE / RECYCLABLE

- **Concrete**
  - Recyclable
    - Compacted base
    - Engineered fill
    - Fill
    - Erosion control
    - Trails
  - ~ 5,000 Concrete crushing & recycling services in U.S. (CMRA)
REUSABLE / RECYCLABLE

- Lumber
  - Reusable
    - Resale
    - Value added (millwork, etc)
REUSABLE / RECYCLABLE

- Lumber
  - Recyclable (clean)
  - Mulch
  - Engineered wood products
  - Boiler fuel
REUSABLE / RECYCLABLE

- **Metals**
  - **Reusable**
    - Pre-engineered metal buildings most practical
  - **Recyclable**
    - 95% of non MSW steel scrap is recycled *(Steel Recycling Inst.)*
    - ~1,400 brokers, processors, & industrial consumers *(US EPA)*
Gypsum Drywall

- **Reusable (clean scrap)**
  - Resale (minimum half-sheets, typical)

- **Recyclable (clean scrap)**
  - Drywall manufacturing
  - Soil amendments
  - Most recycled GWB comes from construction sites
**REUSABLE / RECYCLABLE**

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

- Over 11 Million tons of shingle waste is generated annually; < 10% is recycled
REUSABLE / RECYCLABLE

- **Carpet**
  - Reusable
    - Resale
    - Restoration
  - Recyclable
    - New carpet
    - Other polymer products
    - Waste-to-energy & cement kilns
  - Leased as a service
    - 54,000 tons in 2004 = 2.4% diversion
**Acoustic tile**

- **Reusable**
  - Resale

- **Recycling**
  - New acoustic tile
  - Armstrong World Industries is the only recycler to date
  - AWI will accept any source
  - AWI will collect in whole truckloads (30,000 SF)
  - 20 million SF recycled
    1999 - 2002
• 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.

REUSABLE / RECYCLABLE
A caution; not everything is salvageable

- Availability of working area on-site
- Materials quality, integrity
- Physical damage
- Obsolescence
- Contamination; biological, chemical
- Hazardous material
- Lead-based paint
- Glues and adhesives
- Complexity of disassembly
  - Entanglement
  - Connections
  - Elevation
  - Required equipment
ALTERNATIVES TO DEMOLITION & LANDFILLING
ALTERNATIVES

- Commercial C&D debris recyclers
- On-site waste recyclers
ALTERNATIVES

• Commercial deconstruction & salvage

• Used building materials outlets
ALTERNATIVES

HABITAT FOR HUMANITY RE-STORE (AUSTIN, TX)

The Habitat RE-store
Discount Home Improvement Center

New and Recycled Building Materials
Cabinets
Flooring
Lighting & Fans
Plumbing
Doors
Hardware
Lawn & Garden
Windows
AND MUCH MORE!!

Proceeds benefit Austin Habitat for Humanity.

US Army Corps of Engineers
Engineer Research and Development Center
ALTERNATIVES

COMING SOON!

Watch for details about our ReStore facility opening in the near future. We will be accepting donations of new and saleable used building materials for resale to the general public, the proceeds from which will fund Habitat projects. Call Jeri Kavanaugh (414) 562-6100 Ext. 14 with questions.

We are looking for volunteers to make pickups of donations for our soon to be opened ReStore. These individuals should have good driving records, be able to lift 50 to 100 pounds, be comfortable driving a truck with a trailer and be able to read a map. If interested, please contact Jeri Kavanaugh at (414) 562-6100 Ext. 14.
ALTERNATIVES

- **Public policy & regulation**
  - *Menlo Park CA Ordinance*
    - 60% debris diversion
    - Deposit on total debris
    - Rebate for diversion
  - *Oakland CA Ordinance*
    - 50% debris diversion
    - Required Waste Reduction & Recycling Plan
    - Basis for issuing building permits
  - **Others**
    - Massachusetts
    - New Hampshire
    - City of Chicago
ALTERNATIVES

• **Resources**
  - C&D recycling guides
  - Services directories
  - Materials’ exchanges
  - Business assistance & referrals
  - Community organizations

US Army Corps of Engineers

WasteCap Wisconsin

SWIX

New York WasteMatch

Engineer Research and Development Center
ALTERNATIVES

- Resources

Diverted 76% Const. debris, saved $10,000 in disposal

Diverted 75% Const. debris, saved $15,000 in disposal

Reused 4% & recycled 70% of the building's materials.
ARMY DECONSTRUCTION & DEBRIS REDUCTION EXAMPLES

We’re “Deconstructing” This Building To Reuse and Recycle Its Materials!

A Sustainable Project From Your Directorate of Public Works
• Aircraft Parking Replacement, Ft. Campbell KY
  – Roughly 580,000 SF of new, 14” thick airfield pavement
  – Contractor recycled existing concrete at own initiative
  – 37,000 tons of concrete was recycled as compacted base for new pavement
  – Completed within the Contractor’s budget & schedule
EXAMPLES

• Building 125, Wright Patterson AFB OH
  – Contractor knowledgeable w/ recycle markets & values
  – Contractor invited Habitat for Humanity to take materials for resale in their ReStore
  – Diverted >60% via partial deconstruction
  – Completed within the Contractor’s budget & schedule
EXAMPLES

• Lee Village, Fort Campbell KY
  – Specifications required minimum 40% debris diversion
  – Demolition contractor diverted 55%
  – Subsequent demolition achieved 62% diversion
  – Completed within conventional demolition cost estimate & schedule
EXAMPLES

• Pilot Deconstruction, Fort Campbell KY
  – CERL contracted directly with Austin TX HfH for deconstruction services for 5 WWII-era buildings
  – HfH achieved 85% diversion & recovered $41,000 worth of materials for sale locally & Austin Re-Store
  – Cost was comparable to conventional demolition
EXAMPLES

**Building 227, Fort Carson CO**

- *Fort Carson DECAM requested the contractor to deconstruct instead of demolish; contractor agreed*
- *Diverted >80% of building materials … plus gave concrete & masonry to engineering units for recycling*
- *Completed within contract cost & schedule constraints*
- *Contractor is continuing to deconstruct buildings*
• Facility Reduction, Fort Monroe VA
  – Requests for Proposals (RFPs) required 60% min. diversion, w/ options for increased diversion
  – Diversion ranged from 70 – 90% over 58 buildings
  – Cost was slightly higher than conventional demolition
• Building 919, Fort Hood TX
  – *Tulsa District contracted with Austin HfH for deconstruction services*
  – *HfH achieved an estimated 90% diversion*
  – *HfH recovered 36,000 BF (45 Tons) of lumber*
  – *Cost was comparable to conventional demolition*
EXAMPLES

• WWII-era buildings & Family Housing, Fort Knox KY
  – Building recycling program administered by the installation
  – “Recycle rights” to buildings were sold to the public
  – Over 6 year period
    • Deconstructed >500 buildings
    • Saved >$5 M in demolition cost
    • Diverted >100,000 tons of debris
• 4 Warehouses, Fort Gordon GA
  – “Recycle rights” to buildings were sold to the public
  – Deconstructors retrieved an estimated of $50,000-worth (retail value) of lumber from EACH warehouse
  – 80% of the debris was diverted
  – Total cost was 60% of conventional demolition cost
EXAMPLES

• WWII-era buildings, Fort McCoy WI
  – Buildings were sold to the public
  – Over 10 year period of time
  • Deconstructed > 140 buildings
  • Saved ~ $3.5 M over conventional demolition
  • Diverted > 15,000 tons of building debris, PLUS concrete
  • Recovered enough material to build 300 houses
• **Concrete recycling, Fort Campbell KY**
  - *Clean concrete rubble is collected at the landfill sites*
  - *Installation has contracted with a concrete recycler to crush concrete on a periodic basis*
  - *Contractor produces RCA products per Fort Campbell’s requirements*
EXAMPLES

- Fort Campbell, cont’d
  - 90,000 tons of concrete were recycled in one year
  - Cost to recycle concrete is $5.90/ton, versus cost to purchase virgin aggregate at $8/ton
  - Total operational savings to Fort Campbell > $640,000
  - Landfill life cycle cost savings is $30/ton, or $2.7 Million to date
EXAMPLES

- Badger AAP, Baraboo WI
EXAMPLES

• Badger AAP, Baraboo WI
  – **WasteCap Wisconsin developed deconstruction strategy**
  – **Identified resources**
    • Deconstruction contractors
    • Wood reuse markets
    • Wood recyclers
    • Concrete recyclers
    • Antique & used brick dealers
    • Shingle recyclers
    • Metals recyclers
  – **Badger AAP sold 8 buildings to the public for deconstruction**
  – **Stay tuned for more**
EXAMPLES

- Badger AAP, Baraboo WI
  - Press Houses
    - 154 reinforced concrete “bunker-type” buildings
    - Approx. 2,400 tons of concrete each; 370,000 tons total
    - CERL performing analysis of PCB-containing paint to assess viability of recycling concrete for new road base
SOME PRACTICAL ISSUES

If this is such a hot idea, why isn’t everybody doing it?

- **Demolition** (typical for residential-type construction)
  - Relatively cheap
    - About $2/SF to demolish building
    - About $6/SF total, including abatement & sitework
  - Relatively quick
    - 2-3 days to demolish & haul debris (per building)
    - 1-2 days to clear & grade site
  - Debris disposal is relatively straight forward
    - Hazardous & non-hazardous waste regulations & practices are reasonably well understood
PRACTICAL ISSUES

• Deconstruction for reuse / recycling
  – Perceived more expensive in first cost
    • Limited case study data suggests $4 – $6/SF, building deconstruction only
  – Perceived more time
    • “Weeks”, depending on labor resources
  – Uncertainty
    • Regulatory provisions re: “hazardous materials,” “waste,” “processing,” others
    • Market conditions; demand & value
    • Learning curve
    • Others
INERTIA: "THE ABILITY OF A BODY TO RESIST A CHANGE IN ITS STATE OF MOTION"
CHALLENGES

• Shifting the Paradigm
  – Remove … instead of demolish
  – Resource … instead of debris
  – Incentive … instead of path of least resistance

• Acknowledging other economic factors
  – Cost avoidance
  – Value of recovered materials
  – Life Cycle Cost impacts
CHALLENGES

• **Accommodating Schedules**
  - Planning ahead
  - Alternative building removal strategies

• **Taking advantage of the marketplace**
  - Industry capabilities & practices
  - “Non-traditional” sources of services
  - Marketable materials
  - Costs & values

• **Adjusting business practices**
  - Planning
  - Contract & specification provisions
  - “Mainstreaming” the practice
THE RAINFOREST ANALOGY
• Waste Is Food
  – Biological metabolism
  – Closed-loop systems
  – … the very definition of “Sustainability”
• **Cradle To Cradle** *(William McDonough)*
  – *Human behavior; times of scarcity vs. times of abundance*
  – *Landfilling contaminates resources*
  – *DOWN-cycling vs. RE-cycling*
    • *Simply Downcycling diminishes value*
    • *True Recycling preserves value*
  – *“Less Bad” is no good*
  – *Hanover Principles, 2000*
    • *#4 Accept the Responsibility for the Consequences of Design*
    • *#6 Eliminate the Concept of Waste*
RAINFOREST ANALOGY

• Waste Is Resource
  – “Technical” metabolism
  – “Industrial” food
Cradle to Cradle

- Industrial food?
CRADLE TO CRADLE

- Industrial food?
CRADLE TO CRADLE

- Industrial food?

FORT ORD SIDING MATERIAL

9/16” T&G FLOORING
CRADLE TO CRADLE

- Industrial food?

OFFICE IN FOREST PRODUCTS LABORATORY, MADISON WI, MADE FROM SIDING SALVAGED FROM FORT ORD, CA
CRADLE TO CRADLE?

SALVAGED TIMBERS FROM A WEYERHAEUSER MILL

• Gates Residence, Medina, WA
  – “Price is no object”
AN ETHIC
SCARCITY VS. ABUNDANCE

MAINE TOWNSHIP HIGH SCHOOL, DES PLAINES IL, circa 1929
I’M FROM THE GOVERNMENT, I’M HERE TO HELP

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