CONCRETE C&D DEBRIS DIVERSION
POLICIES, BEST PRACTICES, AND CONSIDERATIONS

OVERVIEW

Concrete construction and demolition (C&D) debris is generally considered a resource and can often be managed/utilized to reduce disposal costs, offset imported backfill costs, and meet Army diversion requirements. Facilities Reduction Program (FRP) projects, whether executed via demolition or deconstruction, typically generate significant quantities of concrete C&D debris. A 2006 Department of the Army Policy, issued on 6 February 2006, requires a minimum of 50% C&D diversion, by weight, for FRP and other projects. The Policy, titled "Sustainable Management of Waste in Military Construction, Renovation and Demolition Activities," should be referenced for additional details and definitions. Normally, the best way to comply with Army Policy is to divert all clean concrete C&D debris, including concrete masonry units (CMU) and other concrete-based building materials. Even in the absence of Army Policy, concrete diversion is generally the most economically viable option as often demonstrated through commercial practice. Modern-day demolition practitioners that cost-compete projects almost always employ some degree of waste diversion often including concrete. Recognizing these facts, many municipalities and state regulatory agencies have recently enacted policies for mandatory concrete C&D debris diversion from municipal landfills.

CONCRETE DIVERSION CONSIDERATIONS

When planning/designing a demolition project, the project manager should evaluate all relevant factors and use the concrete diversion/disposal method that best fits the project. Proper consideration of all these factors will result in the optimum disposal/diversion solution. Basic factors to consider generally include:

- environmental characterization of the concrete debris,
- quantity of concrete debris being generated,
- potential uses for crushed concrete on-site,
- ability to stockpile concrete debris on-site,
- availability and distance to local concrete recyclers,
- cost of transporting concrete debris,
- local market value for crushed concrete,
- local market cost for importing backfill,
- local or state regulations regarding concrete debris, and
- local transportation/tipping fees to dispose of concrete debris in a landfill.

ENVIRONMENTALLY-CONTAMINATED CONCRETE

Diversion of concrete with embedded or adhered hazardous materials such as Asbestos Containing Material (ACM) mastics, adhesives, and paints is problematic for diversion. It may be more cost-effective to dispose of contaminated concrete in the appropriate landfill due to the potential high cost of abating/preparing the concrete to acceptable conditions. Lead-Based Paint on concrete is often misconstrued as requiring hazardous material/waste handling, when in fact, it would rarely (Almost NEVER!) lead to a hazardous waste disposal situation (Refer to FAQs for additional reference). When considering the diversion or disposal of environmentally-contaminated concrete, project managers must compare the local costs for abating/preparing concrete, transportation, hazardous waste disposal fees, non-hazardous tipping (disposal) fees, and regulatory requirements to determine the best course of action. It is beyond the scope of this document and may be best to confer with an environmental professional when concrete contamination is suspected.

CONCRETE DIVERSION AND HANDLING TECHNIQUES

There is often more than one way to divert non-contaminated concrete C&D debris. This section will discuss common methods and describe basic considerations.

On-Site Concrete Crushing

When exploring diversion options, it is generally preferable and most cost-effective to crush concrete debris on-site for reuse. However, the economic feasibility of on-site crushing is generally dictated by the quantity of concrete debris that will be available for processing. Crushing on-site minimizes handling and provides crushed concrete aggregate in various required sizes (6, 3, or 1.5 inch minus) for use as project backfill, grading, stabilization, erosion control, and others. On-site crushing also has the added benefit of "cost- avoidance" by reducing or eliminating the cost of buying and importing backfill. Excess crushed concrete can usually be used elsewhere on the installation or stockpiled for future use. Crushed concrete has a market value and storing the crushed concrete will offset the cost of importing materials at a later date. If a small project generates minimal quantities of concrete debris, consider stockpiling on-site until additional projects generate enough concrete to make on-site crushing cost-effective. Cost effectiveness is dictated by several variables, but a minimum of 1,000 tons will usually be required and up to 10,000 tons may be required to exceed alternative measures. The cost of local aggregate and demand for backfill can also play a significant role in determining cost-effectiveness of on-site crushing.

Off-site Recycling and Alternative Uses

When on-site crushing is not feasible due to local constraints and/or high costs, the next best option is to utilize a nearby concrete recycler. The existence of concrete recyclers varies by region. One useful web site for finding concrete recyclers is *www.cdrecycling.org/.* Concrete recyclers typically crush the concrete and sell it as base material. Transportation, handling, and preparation costs must be considered, in addition to the processing cost levied by the recycler. A recycling center may accept concrete for a nominal fee of $5-10 per ton, but keep in mind that there are hauling costs and the beneficial reuse of the crushed aggregate may be lost by the installation. Another acceptable recycling option is to trim/cut the rebar from the large concrete pieces and use the concrete for stabilization/erosion control.

Processing Concrete Debris

Common procedures used by a demolition practitioner from origin to final destination may include the following general activities.

1. Loose/separated rebar is generally pulled out of the piles of rubble using an excavator equipped with any of several specialized attachments for this purpose.

2. Rebar is trimmed from pieces of concrete with either a shear attachment or a manually operated cutting torch leaving about 6" of the rebar protruding from the concrete piece.
3. Accumulated rebar is collected in piles and shipped off-site to a scrap metal recycler, thus providing a source of salvage income to reduce the overall cost of the project.
4. At this point the concrete can be crushed on-site, hauled to a stockpile area on the installation property, delivered to an off-site concrete recycler, or hauled to a commercial C & D landfill.
5. Concrete needs to be sized to not more than 24" on a side prior to feeding into the typical crushers used to crush concrete whether the crushing is on-site of off-site.
6. Trucking costs can vary considerably, but there will likely be delays when moving in and out of a military installation. If the contractor can haul one load every two hours at an average rate of $80/hr, then additional cost per ton would be $80 x 2 / 20 T = $4.00/T.

On-site concrete crushing is normally accomplished with a portable crusher, usually track mounted, that is brought to the site as a single piece of equipment and can be moved under its own power to wherever the previously prepared concrete is located. Two types of crushers are commonly used, an Impact Crusher or Jaw Crusher. Production rates for the smaller crushers are in the range of 150 tons per hour to 200 tons per hour. Demolished concrete is fed into the crusher using either a loader or excavator and is transported under a cross-conveyor that contains a magnet for rebar removal. Depending on the desired size of the crushed concrete, the oversize may be fed back into the crusher for further size reduction. The resulting product is called Recycled Concrete Aggregate (RCA). Additional crushing information can be found by searching the internet or in the USACE FRP Toolbox Library.

There are several good reasons for crushing concrete:

1. Above minimum thresholds, crushing is usually less expensive than landfilling.
2. Crushed concrete can typically be used for specification-quality road base, building pad base material, or engineered fill material.
3. Many state governments are actively encouraging the use of RCA – over 100 million tons of concrete are crushed for RCA every year.
4. The Army has instituted a policy of diverting at least 50% of C&D debris from demolition projects. In most cases, crushed concrete is the most cost-effective way to achieve this requirement.

FREQUENTLY ASKED QUESTIONS

- What is the cost of crushing concrete? Usually in the range of $5 to $9 per ton. If your concrete is crushed on-site, you generally keep the crushed concrete. If your concrete is taken to a recycler, they generally keep the crushed concrete. Additional costs may also be realized in transporting the concrete to a recycler. However, both methods are generally cheaper than landfilling and meet Army diversion policy requirements.
- How does on-site crushing compare to landfill? The trucking cost and consequential traffic disruptions are greatly reduced, there are no tipping fees, and crushing produces a usable product that can offset the cost to purchase and haul similar materials.

- What about lead-based paint on the concrete? Through extensive testing of crushed concrete at Fort Ord, CA, the Army has determined that there is no deleterious impact from using concrete that has been painted with lead-based paint. Refer to "LBP Concerns in Producing Recycled Concrete Aggregate from Former Fort Ord Housing," Stephen D. Cosper, USACE, CERL.
- What about noise and dust from the on-site crusher? The crushers commonly used today are relatively quiet - well within the decibel limits for construction equipment. Modern crushers also utilize both on-board automatic water spray systems and manual external water spray to minimize dust.
- Can crushed concrete be used to backfill basements and depressions? Yes, the RCA product at 6" minus and smaller makes an excellent fill material. If seeding is required, the top 6" should be a topsoil material.
- Do I need to consider concrete diversion when removing wood-framed structures? Concrete components (foundations, footing, etc.) for a typical wood-framed structure generally equate to less than 50% of the weight of the entire structure. However, there are still meaningful quantities of concrete debris to be diverted. (It will be easier to meet the Army's 50% diversion goal if wood structures are packaged for removal with other predominately concrete or metal buildings.) Current Army policy evaluates compliance on an annual basis for each installation based on data reported through SWARweb.

SUMMARY

- Diverting a minimum of 50% of FRP demolition debris is Army Policy. Army diversion policy can be economically met by crushing and using RCA.
- Creating and using RCA material from a demolition project is environmentally sound and economically feasible.
- Landfills throughout the country and within the properties of military installations are running out of space – recycling concrete is an excellent method to prolong landfill space, as well as extending the life of the Nation's quarries.
- Crushing concrete is a regulatory requirement imposed by some municipal/state agencies that is imposed on many municipal and private projects.