Best Management Practices: Reuse and Recycling of Construction and Demolition Project Debris

Introduction

Construction and demolition (C&D) debris is generated during new construction, renovation and/or demolition of existing buildings and structures, and land clearing. C&D debris includes bricks, concrete, masonry, soil, rocks, lumber, paving materials, shingles, glass, plastics, aluminum (including siding), steel, drywall, insulation, asphalt roofing materials, electrical materials, plumbing fixtures, vinyl siding, corrugated cardboard, vegetation, and tree stumps. Unless recycled or reused, such debris must be disposed, representing both a significant cost and loss in resources.

In California, it is also the law to divert away from disposal the maximum amount of waste materials, but no less than 50% of what is generated. In January 2005, the County of Los Angeles (County) enacted a C&D ordinance that mirrors this mandate. This ordinance was effective as of March 7, 2005. Unless specifically exempted, covered projects must fulfill the specific conditions required by the ordinance including, but not limited to, recycling and reusing (e.g., diversion) no less than 50% of C&D project debris.

The rationale for targeting C&D debris is simple. In 1996, the U.S. produced an estimated 136 million tons of building-related C&D debris that was disposed in landfills. This estimate excludes road, bridge, and land-clearing materials, which can add a significant amount to the total C&D debris discarded. In California, as well as Los Angeles County, C&D debris by itself represents 12% of the disposed municipal waste stream. However, C&D debris can also be one of the more easily diverted materials as evidenced by its generation and compositional characteristics, by emerging markets, by work being conducted in several locales, and by new infrastructure being created by numerous processors and recyclers. There are now many examples of ways that C&D debris is and can be diverted from disposal.

The building industry can manage its waste appropriately, just as it does all other aspects of the business. It takes advance planning, methods to prevent and recover debris, informed assistance from all members of a project, an understanding of the conditions affecting debris management decisions, and most importantly, follow-through. Of these, “methods” is of critical importance and they can be commonly described as “best management practices” (BMPs), which can add significant benefit to a project.

Best management practices (BMPs) are innovative, dynamic, and improved environmental protection practices applied to C&D debris management to help ensure that development and redevelopment is conducted in an environmentally responsible manner. This document is intended to provide guidance to the industry as to the types of practices they could use to develop and implement their debris management programs. It also presents information about how a firm can select and implement such BMPs.

The BMPs listed herein have been found by the County to be representative of the types of practices that can be applied successfully to achieve the 50% diversion mandate. The County further recognizes that there is often site-specific, technical, and cost variability in the selection

of appropriate BMPs, as well as in the design constraints and diversion effectiveness of practices. The list of BMPs is not all-inclusive and does not preclude the industry from using other technically sound practices. Nonetheless, the following information is provided to help the industry to make decisions on the integration of BMPs into standard operating procedures to help comply with the County's C&D debris recycling and reuse ordinance.

Identified Benefits to Reduce, Reuse, and Recycle C&D Debris

Any firm or organization must clearly recognize the benefits of adopting BMPs. Based on the experiences of many businesses, reusing and recycling C&D debris has demonstrative benefits as listed below:

- Minimizes the negative environmental effects of extraction, transportation, and processing of raw materials, which is always a consideration of project environmental impact analysis.
- Reduces project costs through avoided disposal, avoided purchases of new materials, revenue earned from materials sales, and tax breaks gained from donations.
- Helps business comply with state and local environmental mandates.
- Enhances the public image of firms and organizations that reduce disposal.
- Conserves space in existing landfills.

These benefits have been documented in literally hundreds of projects located around the nation. In California, there are many examples where all of these benefits have accrued to local C&D projects as can be seen in several case studies provided in a later section within this guide.

Debris Management Planning

All sound practices emerge from careful and considerate planning. Debris management plans (Plans) must be a nexus of BMPs, project specification, cost and benefit, project management, contractor and subcontractor selection, and site conditions. Debris management planning can be described as a project-related strategy for reducing, reusing, recycling, transporting and disposing of debris generated at project sites with the ultimate goal of achieving the maximum amount of diversion away from landfilling. Issues to consider in developing job-specific Plans include, but are not limited to:

- Size and type of project
- Space constraints
- Recycling equipment capability
- End uses and users (markets)
- Recycling services availability
- Field personnel experience with debris management
- Project timeline, including project phases
- Cost considerations

Each of these issues is briefly described below.

Size and type of project: C&D projects are highly varied, ranging from rural to urbanized locales, spacious to confined, residential to industrial, and new construction to demolition. While size is of itself a common denominator (see also *space on the building site*), the type of

project has a profound impact on the types of BMPs that can be employed. For instance, demolition projects' debris can be more difficult to recycle or reuse because (1) the waste may be contaminated with hazardous or non-recyclable materials such as lead paint or adhesives, (2) materials may be damaged from fire, water or rot, etc., or (3) readily separating waste into individual categories may not be possible due to time constraints. On the other hand, new construction and renovation can yield diversion benefits due to the presence of increasingly more prevalent cardboard as many building component are shipped over long distances.

Space on the building site: Materials recovery is often easiest if the building site is spacious enough to allow on-site sorting of materials. Having separate containers for each type of materials can reduce contamination. Where space is limited, then job site separation, and also reuse, may be restricted. In such cases, offsite processing may be needed.

End users and uses (markets): Contractors can maximize recovery by taking advantage of all available markets for recovered materials. Throughout the County, specialty hauling and processing firms serving the building industries have emerged. These firms have ties with local and remote markets and can assist the industry with materials separation or offsite processing to meet market specifications. To that end, a listing of companies that feature important skills and expertise are provided in a separate section at the end of this document.

Cost-effectiveness: Hauling and disposal costs, the value of recovered materials, and labor costs contribute to whether materials recovery is more or less cost-effective than disposing of materials. Recovery of low value materials may be cost-effective if disposal costs are high and removal and sorting are not labor-intensive. The added labor necessary to remove items for reuse may be offset by savings from both the avoided costs of purchasing new materials and avoided disposal costs.

Generally, costs can be categorized into four components: (1) management (oversight of debris can be as simple as ordering a dumpster from a hauler or as extensive as running a worker training program and making multiple phone calls for each project to identify reuse and or recycling outlets), (2) handling (it reportedly takes about 2 ½ hours **per ton** to gather and carry C&D debris from point of generation to a dumpster or waste pile for the typical project), (3) transporting (trucking costs are often integrated within the dumpster or bin cost, but reflect the cost of hiring an outside party to cart the wastes to a disposal location; what is often overlooked is that recycling can help avoid this cost as the value of the materials may offset the hauling cost for the recycling firm), and (4) disposal (this is the fee charged by the landfill; often, recyclers do not charge as much or not at all depending upon the load's recoverability).

Recycling equipment capability: Normally, the building industry does not maintain recycling equipment capability, but that does not mean that on a project-by-project basis such capability cannot be obtained. Usually, the same equipment that is used for disposal, such as a bin, is the same equipment used for recycling.

Recycling services availability: Similarly to recycling equipment, recycling services can be procured prior to project inception. Early on in the planning process, the recycler and/or hauler should be consulted to assure adequate equipment and services are available as well as any training that is necessary. In fact, some service firms now offer complete planning, management, training, monitoring and reporting services that can simplify project C&D debris management for the building industry.

Field personnel experience with debris management: A critical component of a successful diversion program is trained field personnel experienced with recycling and reuse. If a developer or contractor does not have trained and experienced field personnel, it may have to rely upon outside assistance. Such assistance can be obtained from the hauling and recycling industry, an industry association [such as the Construction Materials Recycling Association (CMRA)], or from a consultant. In any event, it is necessary to assure that the needed knowledge and experience is available and contributes at the earliest planning stages of a project.

Project timeline: Source separation of materials for reuse and recycling can take more time than disposing of all commingled materials, and this can be a detriment since many projects are on a tight schedule due to financing arrangements. Contractors can maximize materials recovery in the time allowed by planning ahead. If necessary, contractors can focus efforts on offsite processing and recycling, streamlining onsite storage and minimizing labor costs.

Typical Steps to Planning BMPs

Listed below are suggested steps that can be used to develop a debris management strategy that addresses the selection of BMPs. Not all steps apply to all firms, and not all approaches fit specific circumstances, so users should review each step and select the best ones for each project situation. Some of the steps may even require changes in approach, so users should understand the inherent flexibility of the steps and are free to modify them as warranted.

Make a preliminary needs assessment for the project

In this step, users should make a preliminary evaluation of the potential for a project to generate debris and how much it will cost. A general sense of the types and quantities of wastes generated on your job sites and the dollars spent to dispose of these materials provides a good starting point. Reviewing past similar projects and identifying how much material and what types were generated for disposal can improve this "sense." Reviewing records of fees and costs, if available, from disposal, can help to quantify wastes. If no records are available, then it may be necessary to utilize some of the generation factors provided in this guide. Users can also research what BMPs were implemented at similar projects and thereby determine appropriate diversion methods for target materials.

The user may also find a need for outside assistance due to project complexities, and there are a number of firms that can provide expert advice about waste generation and diversion. Information about diversion methods, wastes, and disposition will be required to complete the County's Reuse and Recycling Plan (RRP) that is an added step to obtaining a building and demolition permit.

Establish a plan

Once a needs assessment is completed, the user can usually determine if debris management is to be carried out internally or externally. Unless adequate resources are available internally (e.g., with the project manager), then the user should consider hiring a consultant or an outside vendor such as the waste hauler, processor, or recycler. If a consultant is unavailable or not preferred, there are collection, processing or recycling firms that also offer management services to assist the building industry with the planning, operation, monitoring and reporting of debris management programs.

In any respect, there should be a clear designation of a responsible individual or firm to handle all debris management aspects, whether the program is in-house or offsite. Leadership is

critical to successful waste minimization in that the project team must know and understand the commitment that comes from corporate level. It also allows for adequate coordination among the likely many "partners" that a project will involve, including but not limited to, architects, estimators, property owner(s), purchasers, financiers, contractors, subcontractors, carpenters, etc. In this respect, communication and education is absolutely a priority in identifying how materials should be handled and sorted. The plan should also allow for innovation and compensation, in that experimentation can be helpful in overcoming job site "barriers" to recycling, and contractors/subcontractors/workers can be motivated to properly implement programs.

A conceptual plan needs to be written down and kept available for key staff for reference during the project. The Debris Management Plan should be inclusive of planning, execution, and monitoring and reporting elements. The typical DMP components should include:

- Management system from corporate level to front line employees
- Communications and education with all parties and participants, including training sessions
- Contracts and procurement, including purchase of recycled content products and agreements to assure conformance by contractors and subcontractors with recycling goals and procedures
- Waste profile of the jobsite
- Schedule
- Target materials for recovery
- Recovery and disposal options,
- Projections including project economics, waste generation, diversion potential & goal, and disposal estimate
- Monitoring and evaluation (including limitations, & potential problems and solutions)
- Reporting

A sample plan is attached as a guide.

Implement the Plan

Once a project is underway, the debris management plan should be followed as drafted. If warranted, there may be a need to modify it from time to time depending upon site conditions. This is what the monitoring and evaluation component is intended to accomplish. Some key actions to assure your plan is followed:

Manage Your Program

Your designated team leader must be responsible in educating the crew and subcontractors, setting up the site, and coordinating and supervising recycling efforts to prevent the contamination of recycling loads.

Involve Subcontractors

Require subcontractors to use the on-site recycling and disposal bins or require them to recycle their own waste and provide documentation.

Find Appropriate Space

Recycling and reuse efforts require space. Set aside an area of the jobsite to store salvaged building materials and house recycling bins for either commingled or source-separated loads.

Promote and Educate
Communicate your plan to the crew and subcontractors on site. They will need to know:

- How materials should be separated
- Where materials should go
- How often the materials will be collected and delivered to the appropriate facilities

Include waste-handling requirements and expectations in all project documents.

Prevent Contamination
Adopt strategies to prevent contamination.

- Clearly label the recycling bins and waste containers on site.
- Post lists of recyclable and non-recyclable materials.
- Conduct regular site visits to verify that bins are not contaminated.
- Provide feedback to the crew and subcontractors on the results of their efforts.

Monitor and report on progress
Depending upon the schedule of the project, the designated responsible party for debris management should carefully and regularly monitor the progress of the project and whether all plan conditions are being followed. It is prudent to provide field staff with updates either through personal visit or through other communications. It is recommended that monitoring be conducted as least as often as considered necessary. This can be daily or monthly depending upon the skill and training afforded the key personnel, and the jobsite requirements. Keep regular statistics and provide updates to key personnel on the status of progress.

Reuse and Reduce Activities

Many materials can be salvaged from demolition and renovation sites and sold, donated, stored for later use, or reused on the current project. More than 200 used building materials stores around the country buy and/or accept donations of used building materials. Contractors can avoid the cost of removal by allowing private companies to salvage materials from the site. Organizations that have space may want to consider storing high-value materials for later projects. Many building materials may be reusable during renovation projects and projects where a new building is built following the demolition of another. Planners can increase reuse potential by making efforts to use the same size and types of materials as in the old construction. Inadequate storage space for materials during the interim from removal to reinstallation may limit reuse as a materials recovery option. Typical materials suitable for reuse include plumbing fixtures, doors, cabinets, windows, carpeting, bricks, light fixtures, ceiling and floor tiles, wood, HVAC equipment, and decorative items (including fireplaces and stonework).

Recycling Activities

Recycling is easier for construction projects as opposed to demolition and renovation projects. During construction, crews can source separate materials as debris is produced. Demolition and renovation project materials often consist of mixed materials and require on- or off-site sorting. Typical materials recycled from building sites include metals, lumber, asphalt, concrete, roofing materials, corrugated cardboard, and wallboard. Strategies for recovering construction and demolition materials include:

1. **C&D recovery plans in the project design:** Some recovery options may be lost if not considered at the project design stage:

    - Reuse of wall panels, ceiling panels, and doors in an office building renovation was made possible because the architect planned the new interior to use the same size and type of materials as that used in the building before the renovation.

2. **Include recovery requirements and goals in project specifications and contracts:** By including recovery requirements and goals in project specifications and contracts, project planners can signal their commitment to recovery and hold contractors and subcontractors to their responsibilities from the project outset:

    - In its contract, a metropolitan county required its demolition contractor to divert materials from area landfills. That northern Californian county set a diversion goal of 90% based upon research of other similar efforts.

    - The Four Times Square, a construction management firm, hired a project environmental consultant who included contract requirements that construction contractors anticipate packaging materials generated on the project work to reduce them, and document their efforts. Four times Square announced it would withhold payments unless the contractors complied with the contract requirements.

    - Another firm, Whole Foods, did not process payments to its general contractor until all forms summarizing C&D debris recovery efforts were submitted.

3. **Educate contractors and crews on materials recovery and reuse techniques:** Educating contractors and crews on materials recovery techniques and procedures such as sorting and storage methods, recoverable materials, and removal techniques can eliminate contamination problems and increase recovery rates:

    - The materials management plan created for the construction of a major corporation's new headquarters building provided subcontractors with detailed instructions on reuse and recycling techniques, and sorting methods.

    - Besides recovery, crews can be educated to reduce debris generation such as avoiding product damage, using materials more efficiently, estimating material purchase more accurately, and coordinating just in time deliveries.

4. **Provide employee and contractor incentives for recovery:** Providing incentives to contractors and crew can create project buy-in:

    - During the renovation of the Whole Foods' Market Corporate Headquarters Building a portion of revenue from materials sales was used to fund refreshments and a pizza party for the crew.

    - As an incentive to encourage recovery, the owners of the Four Times Square office building chose to allow their contractors to retain revenues and savings from materials recovery.

5. **Think outside the box:** Recovery of C&D materials is a growing field and offers opportunities for creative thinking:

   - When the University of Oregon planned to demolish an apartment structure, Saint Vincent de Paul proposed the unique idea of moving the buildings to a new location and renovating them. The University of Oregon avoided the costs of demolishing the buildings and 30 affordable housing units were created for about half the cost of building new structures.

   - The Hartford Housing Authority undertook the deconstruction of six public housing units as an opportunity to train public housing residents in the building trades and simultaneously divert materials from disposal.

   - Many firms have used the services of local agencies to reuse and reduce debris. Commonly, the Los Angeles County Materials Exchange (LACoMAX) at www.lacomax.com, the California Materials Exchange (Calmax) at www.ciwmb.ca.gov/calmax, and Habitat for Humanity at www.habitat.org are most often referenced as outlets for reusable materials.

   - In Sacramento, the largest state government building project in California's history, the Capitol Area East End Complex, included some significant BMPs including the use of carpet with 53% recycled content, acoustical ceiling tiles with 82% recycled content, and more than 30,000 square feet of salvaged marble flooring from the historic Library and Courts Building was incorporated into the main lobbies of the new complex. Importantly, about 97% of construction waste – more than a quarter million tons – was diverted from landfill disposal.

Below, we present some tips that may be helpful to the user willing and interested to implement best management practices. The tips are provided as a "menu" and users can pick and choose those that fit specific circumstances best.

Methods of debris recycling

- Onsite source separation and delivery of source separated debris to a recycler, or debris recycling facility, or to another job site or end user for reuse and recycling
- Onsite commingled recovery and delivery of mixed debris to a recycling facility, or to another job site or end user for reuse and recycling

Tips on enhancing debris recycling

- Use bins that can be lifted to upper levels for multi-story structures
- Set up more and smaller or mobile bins
- Use bins with divided sections for separation
- Use removable but sturdy signage
- Use clear and easy-to-read signage
- Make sure that all employees can read and understand the language used on signage
- Set up individual bins for all materials
- Avoid damage to recycling bins
- Avoid contamination of segregated materials
- Know what you want to do with materials before they are generated

Tips on reducing costs

- Schedule bins for collecting recyclables only when needed
- Investigate the companies listed in this guide that can recycle some of the debris from both source separated and mixed loads
- Be sure to understand market specifications so that recyclable materials are not rejected or penalties applied
- Include your markets and processors in your planning

Tips on buying environmentally friendly building materials

- Work with product vendors to determine the availability of recycled content products
- Ask your markets where recycled content products can be purchased

Tips on monitoring

- Regularly gather and monitor your trash and recycling invoices
- Track the cost of recycling and waste
- Ask to see sites where your materials are recycled or disposed
- Make a point to regularly inspect your job site for proper implementation and continuing needs

Tips on subcontractor participation

- Assure that contracts are written with diversion goals as a clear objective
- Require a firm commitment by subcontractors to the overall program
- Require full participation in training and assessment
- Require proper purchasing practices
- Solicit input from subcontractors
- Recognize and reward subcontractor participation

Tips on education and outreach for employees, contractors and subcontractors

- Designate a member of the crew or staff that is interested in recycling as the onsite debris management coordinator
- Be sure that the idea of a "clean and uncontaminated load" is the same as that of the recycling service provider
- Develop a communication tool to help inform staff and subcontractors of the plan and progress of the BMPs
- Develop one or more motivational tools to help encourage staff and subcontractor participation

Case Studies

Case studies were prepared through the following three interrelated components: (1) research the available literature for potential case study information, (2) collect anecdotal evidence from current or unpublished projects, and (3) collate, analyze, and develop this information into a case study report. The premise was to identify successful C&D waste recycling programs for eight different types of building related activities common in the County. These eight types include tract homes, shopping centers, bridges and roads, office buildings, apartments, condos and town homes, renovation projects, and industrial projects.