Materials Management MEQ-1

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Purpose: To optimize utilization of site material resources and to facilitate the reduction of waste generated by building occupants that would otherwise be hauled to and disposed of in landfills and/or incinerators.

Action: Implement a Material Management Plan, which coordinates and implements material guideline requirements within the Sustainable Design Guidelines. Describe materials utilized, recycled content, location of manufacture/harvest, agricultural content, sustainable harvest certification expected lifetime maintenance requirements and recyclable/reuse potential at end of useful life. Minimize travel distance for building products and systems and locate sinks for highest recycled use for 'waste' materials in conjunction with MEQ-2 and MEQ-5. Provide infrastructure necessary to implement the recycling requirements of the plan. A central location for appropriately sized recycling facilities must be provided for all buildings. Facilities must include, at a minimum, space for the separation, collection and storage for recycling of paper, corrugated cardboard, glass, plastics and metals, and each of these areas should be clearly identified. Provide easy truck access for the pick-up and removal of recyclables.

Related Guidelines: UEQ-8, SEQ-1, SEQ-7, SEQ-11, EEQ-4, MEQ-2, MEQ-3, MEQ-4, MEQ-5, MEQ-6, MEQ-7

LEED™ 2.1 Requirement: MR Prerequisite 1 (see Submittal Template)

Introduction/Context

In 2004, statistics indicated that buildings consume up to forty percent (40%) of all raw materials in use today, as well as thirty six percent (36%) of total U. S. primary energy: *Pennsylvania Department of Environmental Protection.* When energy used for the development of infrastructure, and for transportation of construction goods is added, this number increases to a staggering 51% of primary energy. Construction and building operations are responsible for the drawdown of enormous quantities of virgin materials, including fossil fuels, depleting the remaining resource base at ever increasing rates. In addition, activities associated with the quarrying, mining and otherwise harvesting of raw materials generate untold amounts of pollution. Transportation, as well as primary manufacturing processes, of these materials contributes to the further degradation of land, air and water resources.

A defining goal of the sustainable design movement is to slow this consumption of raw materials dramatically, eventually achieving a 'cradle-to-cradle' status. In this scenario, all materials that have been removed from their original source (quarry, mine, field, forest, etc.) and have been through at least one manufacturing process will remain in a continuous cycle of use and reuse, relieving the pressure on the resource base. No, or almost no, new materials will be needed to maintain and/or replace existing building stock, construction materials and consumer goods. Once extracted or harvested, raw materials that enter the manufacturing cycle will be salvaged, reprocessed or re-manufactured indefinitely, becoming, through this process of reuse and/or recycling, the raw material base of tomorrow.

This approach to the management of existing building materials and building stock may sound like science fiction, but there are already signs of great success with material programs which have value in today's marketplace, such as in the recycling of metals, which is a generally profitable operation. There is no steel manufactured in the United States today that does not have, at a minimum, recycled steel content of twenty five percent (25%). Logically, the percentages for all metals must increase over time. Other programs are developing, including the used carpet recycling program, where new technologies for the 'up-cycling' of surface nylon into new, high-grade, nylon carpet fiber rather than waste, are having the effect of making old carpet (previously only valued for its backing material) a valuable commodity. It costs less, uses less energy and causes less pollution to re-manufacture practically every known material, than to obtain and convert it from its original raw state.

Specifying materials that are manufactured within five hundred miles of New York City reduces transportation costs as well as fuel and delivery time, and cuts the amount of embodied energy captured in those materials. Subsequently, this strategy reduces the amount of pollution associated with the burning of fossil fuels used in materials transportation. Many re-manufactured products are available within the metropolitan area and its immediate environs, as recycling tends to be undertaken by smaller, regional organizations.

Using products that replace themselves within a ten-year cycle – rapidly renewable materials -- such as poplar, bamboo, linseed oil, cork and wool, among others, or products that are made from by-products or waste from agricultural food production, such as wheat and straw board, makes sense both practically and economically. In addition, so long as these materials are replanted or reproduced as part of the normal food production or consumer goods cycles (wool, silk, flax, etc), a continuous supply of such materials for future use is ensured. Requiring wood and lumber materials, including engineered wood products, to carry sustainably harvested certification and Chain of Custody (CoC) labels, supports the health of the future lumber industry. Further, this strategy supports day-to-day forestry work, creates a livelihood for local and indigenous populations in all parts of the world and ensures a stable future supply of both local and exotic timber. This strategy contributes to fighting global warming: by maintaining value in the forests through the certified wood program, indiscriminate clear-cutting is less likely. Known as the 'lungs of the world' these vast, essential tropical and boreal forest ecosystems circumvent the planet, absorbing carbon dioxide. In this way, they are critical to the planet's well-being, contributing significantly to the management of the carbon cycle, while producing oxygen.

A full materials management program involves more than meeting the specifications of the types of materials noted above. Materials selected also need to contain recycled content and to be recyclable themselves. Each project must include appropriately sized facilities for the sorting and separation of recyclables (LEED offers a table indicating recycling facility size relative to building size). Convenient truck access for the collection of recyclables is also a consideration. The architectural team might consider researching local 'sources and sinks' as part of the materials management plan, in order to ensure that the highest amount of materials come from local or regional manufacturing sources (within 500-miles of the city) and that those leaving the site – C&D waste, for example – are recycled at their highest, best use. Down-cycling (crushing and/or mixing materials for roadbed and other non-discriminatory uses) is discouraged, as the recovery of pure materials suitable to retain in the cradle-to-cradle loop is made more difficult by this process.

Relevant Issues

Ecological

Every day garbage trucks cart-away massive amounts of unsorted materials that contain valuable, reusable resources. These resources are either incinerated or deposited in landfills. In either case, this common and extremely wasteful practice has multiple negative environmental impacts. Finite material resources are lost permanently in this process, as well as the investment in energy and time used to obtain the original raw materials from their sources. Embodied energy used in their transportation cannot be recaptured, nor energy used in their primary manufacturing process. Even more insidious, incineration tends to release toxic gasses such as dioxins and benzo-furans (from phthalates released during the burning of PVC, for example) and vaporized mercury to the atmosphere, while unsorted materials dumped in a landfill often create unpleasant odors and leach toxins into the surrounding land and groundwater, creating brownfield conditions and extreme levels of environmental pollution.

Economic

Comprehensive resource management has significant financial benefits. When materials -- from C&D 'waste', to building products that have reached the end of their practical life-cycle -- are collected for recycling, in many cases the *owner is paid* by the recycling company rather than *paying* the dual cost of removal/transportation and incineration or landfill tipping fees. Using fewer materials and promoting more efficient use of materials also has economic benefits. In a sustainably managed materials program, materials that have been installed and well-used over a number of years, but which have finally reached the end of their usefulness through wear, aesthetics or change of building use, can be viewed as resources rather than waste. Such materials can be salvaged or re-used elsewhere, or re-manufactured through a recycling operation.

Materials from local or regional sources may offer a benefit in terms of reduced transportation costs. In addition, consciously specifying such materials, and following through to make sure that local sources are used, helps to maintain the robustness of the local economy, while use of both local/regional manufacturing facilities and recycling centers supports these newer industries and contributes to the strength of the workforce in the region.

Neighborhood

The adoption of comprehensive resource management practices by the construction industry, as well as by building operators, has significant implications for members of the community. Reuse and recycling of materials creates less pollution, which is beneficial for the health of all who live and work in the community, and these actions conserve finite resources. The need for landfills and neighborhood incinerators is diminished, contributing to better air quality, as well as the protection of open land.

When there is a demand, local manufacturing plants and recycling centers become fully operational, increasing job opportunities in the community.

Methodology

Design Strategies

Design teams may choose to develop a comprehensive Materials Management Plan (see MEQ-01-P), which considers specifying materials that embody a number of the sustainable characteristics discussed above. These include:

- Recycled content
- Composition that offers opportunities for future salvage, reuse or recyclability
- Manufactured at locales proximate to site (500 miles radius)
- Sustainably managed/certified forest products
- Agricultural waste and/or renewable material content
- Low in toxicity (See IEQ-06)

In the design of the building include adequate facilities for the recycling of all office waste. This involves providing separate spaces or recycling areas – at a minimum, one on each floor of the building, plus a centralized location, preferably on the ground floor or basement - for the collection of all recyclables. The spaces must be large enough to allow for the separation of materials, such as white paper, other paper (colored, coated, etc.), newsprint and cardboard, plastics, glass and all metals. More than one recycling room per floor may be necessary in the case of buildings with large floor-plates. A useful strategy in high-rise buildings is to include a chute or chutes for the vertical transportation of recyclables, which generally facilitates recycling efforts by building occupants. Such built-in equipment simplifies collection, and reduces the labor associated with the collection of recyclables.

Means and Methods

During construction, establish a dedicated outdoor space for the separation and collection of all C&D waste and recyclables. Identify and establish contracts with local and regional recycling centers and/or manufacturer's take-back programs for major materials. Programs which up-cycle or reuse materials such as steel, aluminum, concrete, masonry, carpet, drywall, ceiling tile, glass, wood, etc. at their highest use are preferred. 'Highest use' is defined as reusing the material for the same or a similar product as its first use. Programs that down-cycle or consolidate materials by methods such as melting down the top fiber, intermediary layers and backing materials of carpet tile into a solid mass of commingled plastics, or mixing wood chips and plastic to make a new, but commingled material where separation at a later date is difficult, are preferably avoided.

Inside the building, a single vertical chute with multiple openings or a revolving access design, or several chutes, each with its own access door may be used to facilitate recycling by building occupants. These chutes run the length of the building and are accessible on each floor in the recycling rooms. The chutes will terminate at the ground floor or basement recycling facility. Easy access by direct route or freight elevator from this facility to the loading dock should be planned. Newsprint and glass must still be collected manually from each floor recycling room and brought to the centralized recycling facility. Balers for cardboard, corrugated and newsprint located in the centralized facility are helpful in consolidating these materials.

In buildings that include the collection of biodegradable materials, make sure that there is a secure retaining area, with metal bins raised off the ground in order to assist with pest management. Composting is still not permitted in office buildings in New York City, however a centralized World Trade Center composting site might be available. Truck access for all recyclable materials, both during construction of the building and its subsequent operation, is an important factor in the Materials Management Plan.

Case Studies

Home Box Office (HBO) Headquarters, New York City

The management of HBO has made a concerted effort to lessen their negative impact on the environment and save operating costs in the process. As part of the development of their Corporate Policy on Environmental Affairs, HBO has taken various steps to promote environmental stewardship including the efficient management of office materials. An Environmental Focus Group was created within the company, whose primary task is interdepartmental coordination of environmental concerns. This group elected volunteer floor captains who meet twice a month to discuss the manner in which the company's day-to-day operating procedures can be altered to benefit the environment as well as their own bottom-line. By establishing an environmental leadership team with the goal of investigating money-saving opportunities, they have effectively insured that waste prevention is an integral part of decision-making at all levels of the company. Outside of the management of HBO, the involvement of two other groups of people was obtained to make material management a success. The Environmental Focus Group requested that employees at every level of the company provide insight into methods for reducing waste production. The group also worked with their product vendors to trim waste where possible. These suppliers were asked to reduce superfluous packaging, take back and reuse packaging when possible, and provide products that were more durable, reusable, or refillable; more efficient; and less toxic. HBO saves over $150,000 per year on material expenditures because of these efforts.

Reference

Definitions

Down-cycling: This term refers to a process where materials lose their intrinsic value by being commingled, crushed or otherwise adulterated so that reconstitution into a viable 'raw' material state, capable of being 'up-cycled' is permanently lost. Examples include mixed crushed concrete, masonry, glass, etc. used for roadbed fill, and 'plastic' wood.

Up-cycling: This term refers to the highest use of a recycled material. In this process, a post-consumer product may be remanufactured into a new product of a similar nature as the original, or another product of equal or higher value. Examples include the remanufacturing of all parts of nylon carpet, where the previously down-cycled nylon is now made into new nylon fiber for the carpet industry. Similarly, used wallboard and ceiling tile is now able to be reprocessed to form similar products of equal value to the original.

Recycled content: This term refers to materials that contain, as an integral part of their composition, previously manufactured product. They may be made from totally recycled materials or contain a mix of recycled and new materials. There are two types of recycled material to consider as follows:

Post-industrial recycled content: refers to products containing material that has been *recycled*, but not *used* by consumers. Post-industrial content is made up of reprocessed factory waste, such as off-cuts, overrun from manufacturing processes, sub-standard production, broken, damaged, returned or otherwise unusable materials, etc. Products containing post-industrial content are less-highly valued than those with cost-consumer content.

Post-consumer recycled content: refers to material that has been used and is being discarded because it has reached the end of its useful life in that product form. Post-consumer material content is constituted from *remanufacturing* products that have been 'used' by consumers and which require complete reprocessing. Products containing whole or part post-consumer materials are more highly valued than those containing post-industrial content.

Bibliography

New York City Department of Sanitation. "Commercial Waste Management Study". July 2003.

New York City Department of Sanitation. "Cutting Costs and Preventing Waste in NYC Office Buildings and Institutions: Three Case Studies">

Trusty, Wayne B. and Scot Horst. "Integrating LCS tools in Green Building Rating Systems. The Austin Papers. BuildingGreen Inc. 2002. U.S. Green Building Council.

Objective

The Objective of the Materials Management Plan is to coordinate and implement materials' guideline requirements within the Sustainable Design Guidelines in order to optimize material resources and facilitate the reduction of waste. Materials are to be evaluated on a number of criteria including embodied energy, recycled content, recyclability, proximity of manufacture and original source, renewable or agricultural content and toxicity levels. The plan is designed to address waste management strategies for site materials during construction, as well as waste material flows after the building is occupied, which are addressed by the incorporation of recycling facilities.

Plan Components

I. Project Description (Plan Summary)

A. Provide a description of major building materials being considered for the project. Include materials to be used in the structure, envelope and as primary architectural finishes.
B. Provide materials' flow descriptions for the construction process and for the building once occupied. Include descriptions of the materials management facilities and systems, such as receiving and storage areas, segregated area for containers for the collection and separation of recyclable waste materials, location of organic waste disposal, recycling facilities, etc., and any special measures designed to support materials reuse or recycling.
C. Describe local waste handling requirements. Include analysis of local code requirements, city rules and special neighborhood circumstances which will have an impact on this plan.

II. Construction Material Inventory

Evaluate all major materials and products that are to be utilized during the construction process based on the following criteria:

A. <u>Durability</u> -- and expected length of use of material.

B. <u>Recycled Content and Recyclability</u> – The goal is to choose materials, products and systems that both contain a measure of recycled content and that can be recycled into similar or other, high-end uses in the future. Specifying materials with recycled content is a first step in the concept of the 'cradle- to-cradle' or closed loop process that will eventually lead to a significant reduction in the need for the extraction and/or harvesting of virgin materials. Choosing materials for their recyclability completes the circle, creating a 'new source of feedstock' for materials from already processed goods, thereby reducing the impact on the virgin materials resource base. These actions minimize the drawdown of natural resources, and contribute to the preservation of our natural ecosystems. Further, still viable materials are diverted from the waste stream, conserving landfill space and reducing potential pollution caused by landfills and incinerators. This approach stimulates both the national and regional marketplace for recycled products. It also reduces the amount of fossil fuels used along with their associated pollutants, as remanufacturing and reuse of previously processed materials are typically significantly less energy intensive.

C. Proximity – Choosing to use materials that are from sources and manufacturing facilities close to the site offers a number of benefits, both environmental and economical. The reduced use of fossil fuels and their associated pollutants, such as greenhouse gas emissions (carbon dioxide, nitrous oxides, sulfur dioxides, carbon monoxide, and particulates) that are a direct result of the transportation of these goods, protects air quality, while conserving the fossil-fuel base. The local/regional economy and small and start-up recycling and reprocessing industries are supported and encouraged, enhancing both material re-use and the labor base. Specifying locally available materials often reinforces the use of vernacular building materials and the 'sense of place'.

D. Low Toxicity Products – Products with low levels of toxicity are wise choices, protecting both people and the environment on many levels. Understanding the nature of materials and choosing to deliberately avoid specifying those containing chemicals known to adversely affect human well-being and/or the environment will lead to environmentally cleaner manufacturing processes and a reduction in the use of such chemicals. This strategy will minimize the exposure of workers to toxic chemicals in manufacturing facilities, as well as building occupants. In many cases, facilities that produce materials incorporating such chemicals are responsible for toxic releases to the air, water and/or soil, contaminating the environment.

Eliminating demand for materials made with known toxicants will begin to reduce the current levels of contamination in the natural environment and limit adverse effects on habitat. Once a part of the built environment, materials with lower toxicity levels lead to improved indoor air quality (IAQ), which has been demonstrated to increase productivity, reduce absenteeism, and enhance quality of life.

E. Renewable Content -- Today there are numerous materials to choose from which are made either in total or in part with content that can be termed 'rapidly renewable'. The sustainable movement has created a demand for such materials and the manufacturing base has responded with a number of new and exciting products, including a whole range made from agricultural waste materials (agri-products). In addition, manufacturers have revived an interest in marketing older products in this category, such as linoleum and wool carpet. Specifying such materials is important because it allows longer growth cycle materials such as hardwoods to achieve full maturity, and therefore full yields, prior to being harvested. It captures and utilizes materials such as wheat straw and seed husks that were previously burnt as waste, creating huge amounts of air pollution. Materials with renewable content also support an entire labor market, which is engaged in the cyclical process of planting or seeding, tending, feeding, harvesting and subsequently processing these materials, often on an annual, but always on a predetermined, cyclical basis – i.e. the seven year cork tree growth and bark harvesting schedule.

F. Reused/Salvaged Material – Salvaged materials differ from recycled materials in that they are 'found' products at the site (or from other sources), which are reusable without being remanufactured. They may require some repair or restorative work. These materials can be used in the renovation or rebuilding at the site where they are found, or they may enter the salvaged materials market, where they will be stored until required on another project. Salvaged materials may have intrinsic value, or be of historic significance, such as parts of the existing building stonework, terracotta embellishments or brickwork, decorative elements like paneling or millwork -- or they may simply be reusable, as in the case of certain hardware, doors, decorative light fixtures and metalwork, without major processing. This adaptability distinguishes salvaged materials from recycled materials, which must always be reprocessed before being reused.

G. Low-Embodied Energy – The embodied energy of a product includes all of the energy that goes into the realization of that product. It includes the energy used in the extraction or collection of its raw materials, in its processing, packaging and transportation, its installation, and, at the end of the product's usefulness, the energy required to dismantle, recycle or dispose of it. That energy is basically gone – it can never be replaced. The purpose of utilizing materials with low-embodied energy is to minimize the use of fossil fuels, conserve resources and avoid contributing to environmental degradation associated with the extraction and transportation of those fuels, such as spills and soil and water contamination. This strategy also reduces emissions of greenhouse gases such as carbon dioxide, vaporized mercury, nitrous oxides, sulfur dioxides, carbon monoxide, and particulates related to more energy intensive processing and manufacturing methodologies.

III. Management Strategies

Outline project strategies for materials and waste management. Address each of the following categories.

A. Material Flow Management
1. Construction Materials.
   a) Construction Waste Management Plan
   b) Material life-cycle.
      - Use products/materials with recycled content. See chapter discussion of post-consumer and post-industrial content (MEQ-04).
      - A minimum of 20% of all building materials (based on cost) must be manufactured within a 500-mile radius of the project site.
      - At least 50% of the wood products and materials are to be provided from sustainably harvested wood sources and each submission must be supplied with a chain of custody and FSC certification.
      - Teams must demonstrate that they have employed the use of rapidly renewable building materials and products made from plants and

other natural resources, such as wool that are renewed on an annual basis, or are typically harvested within a ten-year cycle, such as poplar trees and cork.

2. Operational Material Flows
   a) Design Considerations
   Provide a central, appropriately sized location for sorting recyclable materials. Facilities must include, at a minimum, space for the separation and temporary storage of paper, corrugated cardboard, glass, plastics and metals. Provide easy access to the loading dock and/or garbage pick-up location, and easy truck access for the pick-up and removal of recyclables

B. Material Maintenance
   a) Select materials that are durable and easy to maintain. Look at the track record of typical materials and specify those that are known to be hardwearing and simple to clean without the use of harsh or toxic chemicals such as chlorine or heavy solvents. Provide the owner with maintenance schedules for all finishes such as carpet, making sure that procedures with the least environmental impact, such as dry cleaning of carpets are included in the recommendations.

C. Material impacts on indoor air quality
Reduce the quantity of indoor air contaminants that are odorous, potentially irritating and/or harmful to the health, comfort and well-being of installers and occupants, by using:
1. Adhesives and sealants with low VOC content: per current version of the SCAQMD Rule 1168.
2. Paints and coatings with low VOC content: per Green Seal GS-11 and GC-03.
3. Carpet, carpet systems and carpet adhesives with low VOC emissions: per CRI Green Label Plus and Green Label Indoor Air Quality Test programs and the SCAQMD Rule 1168.
4. Composite wood with no added urea-formaldehyde such as might be used in the bonding agent.

IV. Targets

Establish and describe project targets for the following

A. Construction Waste Management Plan MEQ-02-P (Plan requirements appear under specific plan).
B. Project material management operations upon completion.
Include at a minimum paper, plastic, beverage containers, cardboard, tenant refurbishments (carpet, furniture etc.) and food (for facilities serving food). Describe facilities in place for receiving, sorting, storing and disposing of materials.
C. 5 year and 10 year plan for project material management.

V. Evaluation

Upon project completion, compare established targets for IV.A and IV.B with results. If targets have not been met, provide explanation and, if necessary, revise 5 year and 10 year plans to accommodate revised results.

(This page is intentionally blank)

Material Managements MEQ-1-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: ______________________

Phase:

SD	DD	CD	FINAL
☐	☐	☐	☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	●	●	●	●	●
		Ⓔ	Ⓔ		

☐ **Required Component:**
A Comprehensive Material Management Plan is attached and includes the following:

- Coordination with and implementation of each of the individual Material Environmental Quality Guidelines of the Reference Manual.
- A description of materials utilized, materials reused, recycled content, location of manufacture/harvest, renewable content, sustainable management certification and CoC number, expected lifetime, maintenance requirements, and recyclable/reuse potential at end of useful life.
- A minimized travel distance of building products and systems with location of sinks for highest recycled use for "waste" materials coordinated with MEQ-2 and MEQ-5.

☐ **Required Component:** *(Note: this will satisfy LEED™ 2.1 Materials and Resources Prerequisite 1: Storage and Collection of Recyclables)*
The necessary infrastructure has been provided to implement the recycling requirements of the Comprehensive Material Management Plan. This includes a central location for the on-going recycling of occupant waste materials, that offers appropriately sized recycling facilities for all buildings. These facilities include, at a minimum, space for the separation, collection, and storage for recycling of paper, corrugated cardboard, glass, plastics, and metals. Each area is clearly defined and easy truck access has been proved for pick-up and removal of recyclables.

Name ______________________ Signature ______________________

Company ______________________ Role in Project ______________________

Date ______________________

(This page is intentionally blank)

Construction Waste Management MEQ-2

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Purpose: To reduce the amount of construction and demolition (C&D) waste going to landfills and/or incinerators and to conserve resources through reuse and recycling.

Action: Implement a Construction Waste Management Plan to divert construction, demolition and land clearing debris from landfill disposal to redirect recyclable and/or recovered resources back to the manufacturing process and to redirect salvageable materials to appropriate sites. Recycle and/or salvage a minimum of 50% of construction, demolition and land clearing waste, calculated by weight. Divert a minimum of 50% of construction waste by weight from landfill.

Related Guidelines:

Potential LEED™ 2.1 Credits: 2 possible with MR 2.1 and 2.2 (see Submittal Template)

Introduction/Context

"About 94% of the materials extracted for use in manufacturing durable products become waste before the product is even manufactured. Overall, America's material and energy efficiency is no more than 1 or 2%". *(Hawken 1997)*

In 1998, according to the EPA, more than 136 million tons of C&D waste, excluding waste associated with infrastructure such as roads, bridges, etc., went to landfill as a result of the indiscriminate dumping of commingled materials from building construction activities. Ninety-two percent (92%) constituted materials directly associated with demolition and renovation of existing structures. With a growing concern relative to landfill capacity issues, and lack of new landfill sites, solid waste management presents an enormous challenge all across the United States today. Added to these problems are rising disposal costs and a greater public awareness and concern about the increasing depletion of natural resources, as well as the pollution of land and ground water, as toxins leach from commingled waste materials in aging landfills and containment structures.

Incineration, once thought to be a solution to the growing waste problem, is in and of itself, extremely controversial. The high-heat incineration process creates significant air pollution, releasing odors and particulate matter, and is always unpopular among community residents. Chief among the complaints is that the burning process releases highly toxic substances such as mercury vapor, dioxins and furans (from phthalates in PVC and other plastics, which are carcinogenic), as well as many other substances known to adversely affect human health.

Solid waste disposal is a problem of great significance to New York City, with landfill sites at capacity, and few new sites or disposal options available. As a result, in October 2004, the city introduced new (draft) legislation addressing a long-term plan (2004 to 2024) for both residential and commercial solid waste management, called the 'New York City Department of Sanitation: Draft Comprehensive Solid Waste Management Plan'. In Attachment IV of the Plan: 'Commercial Waste Quantities and Projections for Plan Period', the following rising statistics for New York City's non-putrescible C&D waste are given:

- 2000: 6.35 million tons
- 2002: 7.90 million tons
- 2003: 8.64 million tons
- Incremental data for the years 2005 through the end of the plan period indicate that the total amount of non-putrescible solid C&D waste in 2024 is expected to climb to a maximum of 10,862 million tons. Of this amount, clean fill accounts for some 67%.

The plan indicates that for the year 2003, the city generated approximately 20,000 to 25,000 tons of non-putrescible C&D waste daily. Much of this waste could have been recycled and retained within the useable materials inventory.

Relevant Issues

Ecological

Source reduction, use of recovered materials or salvaged materials, recycling and the use of products with recycled content all lead to a lesser draw-down of the raw material resource base and a lessening of the amount of materials destined to be land-filled. The energy and labor to extract or obtain and process raw materials may be as much as 95% more than that needed for recycling (i.e. extracting bauxite for aluminum manufacturing versus recycling aluminum). Transportation impacts are also minimized.

It has now been demonstrated that landfills with unsorted C&D waste contain toxic materials such as lead, mercury, PVC, brominated fire retardants, phthalates, arsenic and chromate acids and a huge variety of other noxious substances. Through the natural beak-down overtime by sunlight and water, toxic substances and chemicals are released from their host materials, leaching into the surrounding soil and ground water, thereby creating hazardous conditions for which there is literally no remedy. Recently developed landfills are designed to be 'contained'; however, the containment materials themselves are prone to cracking, allowing for unanticipated contamination. In addition, landfills such as the huge Fresh Kills Landfill on Staten Island create air and water pollution on a scale that has engendered lawsuits against the city.

Use of incinerators to dispose of some types of C&D waste is questionable, as this process is suspected of disseminating toxic fumes and particulate matter into the atmosphere. Incineration facilities are expensive to operate and create air pollution in the local community, where they are often seen as an eyesore as well. As people become more aware of the downside of this disposal system, their presence, and the possibility of building new incinerators, is becoming increasingly challenged. Fumes and smoke generated by the burning of certain materials such as PVC, plastics, foam rubber and pressure treated wood have a seriously adverse affect on air quality, releasing gaseous chemicals including arsenic compounds, dioxins and furans, which are carcinogenic and dangerous to human health.

New laws are beginning to enforce the separation of hazardous or difficult to handle waste materials from regular construction C&D waste and debris. Products such as lighting ballasts that were manufactured prior to 1979 generally contain polychlorinated biphenyls (PCBs), while fluorescent and high intensity discharge lamps and the type of light switches called 'silent switches,' contain mercury. Older thermostats and lighting controls also may contain mercury. (Mercury containing vessels can now be recycled at specials locations). Waste paint containers may contain lead, chromium and other deleterious substances, including heavy amounts of VOC's (solvents). Lead-contaminated waste of any kind must be handled as hazardous waste, as well as pressure treated wood containing CCA, CZCA, creosote and other toxic preservatives. Asbestos containing materials, from shingles to flooring tile, and materials that have been abated from piping etc. in buildings, are hazardous waste. Many states are beginning to offer guidance on the proper removal, transportation and disposal of these materials, which must be separated from regular C&D waste and hauled to sites designated to receive hazardous waste. Enforcement of this law is beginning to clean up the disposal industry, and in the long run will reduce the toxic nature of regular landfills.

Composting of foodstuffs and paper or cellulose products at the building site is an alternative strategy for biodegradable materials, which has environmental benefits. Most of the composting systems approved for use in urban settings are entirely closed, and create no smell. The process eliminates the need to retain spoiling food in bins in or near the building until scheduled pick-up times, and helps to manage the pest problems commonly associated with food waste. It results in rich, clean composting material that can be used at the site for landscaping purposes or exported to neighboring sites.

Economic

Even a few years ago, raw materials were relatively inexpensive when compared with the cost of labor, and supplies were plentiful. There was also readily available space in nearby landfills, making dumping of C&D waste both convenient and inexpensive. All that has changed: Today, with a cost premium for almost all building materials and practically no available landfill space within easy reach of New York City, other solutions to waste disposal must be found. In fact, the City is under enormous pressure to address its solid waste problem. While the city does have long-term contracts to ship garbage to out-of-state landfills in Pennsylvania, Ohio, South Carolina and Virginia, trucking the garbage to distant sites is becoming more and more uneconomical. An evaluation of recycling vs. landfilling suggests that when tipping fees exceed $50.00 per ton, recycling becomes an attractive alternative. Together with trucking costs, the expense of land filling (at a cost of $162 per ton for the full disposal service (2004 figure). (See SEQ-11: Recovery of Resources) to New York City, now greatly exceeds this breakpoint..

The long-term solution to the city's commercial C&D waste disposal problem may lie in simply reducing the amount of construction debris. Strategies that encourage this approach include resource reduction – the conservation and reuse of existing building stock and infrastructure, purchasing only what is needed, as well as paring down the quantity of finish materials. For instance, the cost of a gut and major renovation project is only about two thirds of the cost of building new and conserves a significant amount of materials. Commercial recycling strategies are already in place, and many are economically successful. For instance, ready markets for the recycling of all metals, concrete and masonry, asphalt, paper and packaging materials such as cardboard already exist. Recycling these items -- all either used or left over -- reduces trucking and tipping fees and in addition, many are saleable for hard cash. Further, recycling such materials takes them out of the waste stream and provides the new 'raw' materials base to sustain the many fledgling recycling/re-manufacturing businesses in and around the city, supporting the local economy. While prices for used materials fluctuate with market demand, as recycling becomes a more accepted and 'normal' manner of doing business, cost schedules are being stabilized.

Among more recent sources for reusable materials are the huge 'take-back' programs instigated by national manufacturers. Used and/or demolished items such as carpet, carpet tile, wallboard and ceiling tile are now eagerly sought by the original manufacturers (both their own and similar products made by other manufacturers) to feed the new remanufacturing programs. These corporations have discovered that it is less expensive and less energy intensive to recycle previously manufactured goods than to make new product from raw materials. It has taken several years for such programs to become effective, as considerable infrastructure has had to be built to accommodate the remanufacturing processes associated with the separation of finished materials for remanufacturing, and new manufacturing techniques have had to be put in place. While these programs do not pay out cash to the contractor or owner -- yet, they do take a tremendous amount of the solid C&D waste associated with renovation work out of the waste stream, thereby reducing trucking costs and tipping fees, conserving space in landfills, conserving resources and reducing manufacturing impacts.

Neighborhood
Communities benefit when landfills and incinerators are reduced in number and size. In addition, they benefit as a result of the new, more stringent laws, which prohibit the dumping of hazardous materials in regular fills, and which regulate the types of materials that can be incinerated. When foodstuffs are handled in composting systems at the site, much of the odor and poor air quality may be avoided, both around the building and at the landfill where the material would otherwise have been deposited. These strategies help to maintain higher air quality and to protect land and ground water from contamination.

An informed public is becoming more concerned about depletion of natural resources, as well as the ability to be competitive in difficult economic times. Reducing consumption through conservation strategies – resource reuse and recycling – contributes to mitigation of both of these concerns. Communities based in and near the World Trade Center site will benefit from the protection of the resource base, while the new recycling/remanufacturing industries create local jobs.

Methodology

- **Design Strategies**
  Oregon law has "established a hierarchy for the management of solid waste. The first objective is to prevent the generation of the waste. If that is not possible, reuse is the next best option, followed by recycling, composting, and energy recovery. Safe disposal is the last option, if none of the others is feasible." This approach makes perfect sense and succinctly presents the objectives of an ideal Construction Waste Management Plan.

  Develop a Construction Waste Management Plan that addresses all potential site conditions. Reuse existing buildings and infrastructure on the site where possible, and/or use deconstruction methodologies rather than a gross demolition approach, which results in co-mingled C&D waste when structures must be removed in part or in whole. Indicate that the maximum amounts of materials are to be salvaged for future reuse and identify potential markets for these materials. Track the amount of salvageable material by actual or estimated cost for inclusion in the documentation of project strategies. Include a requirement for on-site equipment in the plan to reprocess (crush) otherwise unusable, stone-like materials, concrete and masonry for use in the project foundations, and/or in developing the surrounding infrastructure: i.e. concrete aggregate and asphalt for roadbed construction.

  The Plan needs to indicate all materials that have a potential to be recycled, and to identify local/regional recycling centers. The objective is to 'up-cycle': that is to reuse materials at their highest potential, rather than 'down-cycle' where materials lose their premium quality and cannot be reused in their original capacity. To achieve this goal, research must be included to determine which recycling centers and/or manufacturers' take-back programs have the capability to generate each specific, reprocessed material and product at a quality commensurate with the original quality. Estimate costs associated with the additional labor for the deconstruction, separation of materials and recycling portions of the work, and include cost-benefits achieved through fees paid to the contractor for materials for recycling, as well as reduced haulage and tipping or incineration fees.

- **Means and Methods**
  In order to achieve effective material recovery and recycling programs, a balance in the supply and demand for recyclable materials is essential. At this point in time most C&D materials collected have some assurance of a market, although prices fluctuate, making it difficult to assess the financial pros and cons of a major, site-wide recycling initiative. Transportation costs associated with a recycling program are also a consideration; however, they do not begin to compare with the high cost of long-distance hauling of waste materials to remote states, which is the current solution in effect in New York City. Commercial recycling programs and procurement policies which create a demand for goods made from recycled material are gaining greater acceptance: the greater the supply of C&D waste materials available for recycling, the more materials are returned to the marketplace with partial or total amounts of recycled content.

Where possible, reuse the foundations and shell of existing buildings around the site that fall within the jurisdiction of the WTC Guidelines. This approach may save up to one third of the cost of building new, and is less disruptive to the community, as less noise is generated and trucking impacts are reduced. This approach captures some of the original embodied energy of the structure and preserves already processed resources. There is little opportunity to use existing, above ground structures at the core of the Trade World Center site; therefore resource reduction must focus on efficiency of planning and ordering, on the optimum use of materials, and on maximum recycling of C&D waste, followed by a rigorous approach to recycling within the completed facilities.

Careful planning will ensure that minimal excess materials are ordered. New materials and products must be stored in safe, dry locations to avoid potential contamination and wet conditions that might adversely affect them, resulting in additional waste and cost associated with their replacement. Minimization of packing materials is an important strategy, contributing to waste reduction. The Construction Waste Management Plan for each project designates the area where C&D materials will be separated, sorted and stored. This area needs to be protected from the elements, and have easy truck access for pick-up. Recycling containers must be clearly labeled in Spanish as well as English. On-site training of construction workers will ensure that all personnel understand, and are able to comply with, the objectives of the waste management plan.

A C&D manager must be appointed early in the design process, by the Construction Manager or General Contractor. Since goods for recycling are measured and paid for by weight in most cases, record keeping is a critical part of tracking achievement in this area of endeavor. Feedback on the operation and success of the plan is essential. Weekly meetings with personnel from each major sub-contractor, and coordination with other meetings/site strategies can help to manage the process and quickly identify problems.

Municipal solid waste and biodegradable materials and food should be kept separate from the C&D containers to avoid contamination and lessen the attraction for pests such as rats and cockroaches. If possible, a site-wide composting program can be used to manage biodegradable waste, eliminating the need for independent project or building storage, as well as the costs of haulage and tipping fees. Hazardous materials must also be kept separate from C&D waste, and clearly labeled in accordance with all legal requirements, prior to shipping to appropriate disposal facilities. Even with all of these strategies in place, a 100% reuse of C&D waste is probably not possible and there will continue to be a need for available disposal options to take care of the residual materials.

Case Studies

<u>Sports Arena, Portland Oregon</u>

A car wash and exhibit hall were demolished to make way for a new sports arena in Portland that began construction in November of 1993. By October of 1994, the project was merely 30% complete but had already recycled 98% of its construction and demolition waste. 35,000 of 36,888 tons of total waste was prevented from being dumped in a landfill. 30, 482 tons of that waste was recovered concrete and *asphalt rubble, which was reprocessed as clean fill and road surfacing. 392 tons of metal were recovered and went to two recycling companies in the Portland Area. 678 tons of wood were diverted from the waste stream, some made into composite particleboard and some burned as fuel in industrial boilers. 6 tons of cardboard were collected and shipped to another local recycler. Site-clearing debris went to a compost company and excavated soil went to various places, including the project site. At this point in the project the contractor had already saved $85,000 in avoided disposal fees and only spent about $8,000 for the actual cost of recycling services obtained. (BuildingGreen.com 1994)*

<u>MIT Media Lab, Cambridge, Massachusetts</u>
During this project 4,519 tons of material was recycled for a total waste reduction rate of 96 percent. Before the demolition of the existing building, the client began searching for ways to donate unwanted interior furnishings and equipment, including office dividers, desks, and blackboards. They donated 20 desks to the Cambridge School System: they also offered surplus items through a chain of recipients that began with faculty and worked its way down to the community at large. After everyone had their chance to take materials they might want, the rest was handed over to the demolition company. A construction waste clause was part of the project contract and helped insure that as much waste as possible would be diverted from landfills. Key tenets of this program included a list of specified materials that were to be reused or recycled, a requirement that reuse or recycling would be mandatory whenever it was less expensive than disposal, and a requirement for the contractor to devise a construction waste management plan. (Massachusetts 2005)

Reference

Definitions

<u>Putrescible</u> waste is organic waste that decays through exposure to natural environmental elements. Food waste is a primary example.

<u>Up-cycling</u>: This term refers to the highest use of a recycled material. In this process, a post-consumer product may be remanufactured into a new product of a similar nature as the original, or another product of equal or higher value. Examples include the remanufacturing of all parts of nylon carpet, where the previously down-cycled nylon is now made into new nylon fiber for the carpet industry. Similarly, used wallboard and ceiling tile is now able to be reprocessed to form similar products of equal value to the original.

<u>Down-cycling</u>: This term refers to a process where materials lose their intrinsic value by being commingled, crushed or otherwise adulterated so that reconstitution into a viable ‘raw’ material state, capable of being ‘up-cycled’ is permanently lost. Examples include mixed crushed concrete, masonry, glass, etc. used for roadbed fill, and ‘plastic’ wood.

<u>Recycled content:</u> This term refers to materials that contain, as an integral part of their composition, previously manufactured product. They may be made from totally recycled materials or contain a mix of recycled and new materials. There are two types of recycled material to consider as follows:

Post-industrial recycled content: refers to products containing material that has been *recycled*, but not *used* by consumers. Post-industrial content is made up of reprocessed factory waste, such as off-cuts, overrun from manufacturing processes, sub-standard production, broken, damaged, returned or otherwise unusable materials, etc. Products containing post-industrial content are less-highly valued than those with cost-consumer content.

Post-consumer recycled content: refers to material that has been used and is being discarded because it has reached the end of its useful life in that product form. Post-consumer material content is constituted from *remanufacturing* products that have been 'used' by consumers and which require complete reprocessing. Products containing whole or part post-consumer materials are more highly valued than those containing post-industrial content.

Bibliography

BuildingGreen.com. "Recycling Success at Oregon Arena." BuildingGreen.com – What's Happening – Environmental Building News. October 1994. BuildingGreen, Inc. 6 October 2004. <http://www.buildinggreen.com/auth/article.cfm?fileName=030504b.xml>

Characterization of Building-Related Construction and Demolition Debris in the United States," U.S. EPA, 1998.

Construction and Demolition Debris: <www.epa.gov/epaoswer/non-hw/debris>

Hawken, Paul., Lovins, L. Hunter, and Amory Lovins. Natural Capitalism Mother Jones, March/April 1997.

Massachusetts Department of Environmental Protection. "Project Description: MIT Media Lab, Cambridge, Massachusetts". Case study: Construction and Demolition Waste Reduction. Massachusetts Department of Environmental Protection. 15 January 2005. <http://www.mass.gov/dep/recycle/files/cdmit.pdf>

New York City Department of Sanitation: Commercial Waste Management Study, 2004

New York City's Garbage Crisis: Concerned Citizens of Cattaraugus County, Inc (Updated 10/28/2004)

US EPA. "Deconstruction on Commercial Renovation Projects: the Victoria Street Presbyterian Church". Region 9: Solid Waste Fact-sheet. United States Environmental Protection Agency. 15 January 2005. <http://www.epa.gov/region09/waste/solid/cd8.pdf

Stephen Lester: ' Incineration Repackaged', and Cancer Action New York: 'Health Damages from Burning Wastes' both from the Gaia Campaigner: Global Alliance for Incineration Alternatives

Construction Waste Management Plan MEQ-2-P

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Objective

The Objective of the Construction Waste Management Plan is to identify and evaluate all resources created during the construction process and to establish plans and areas dedicated to recycling these resources to greatly reduce the amount of material going to landfills and/or incinerators, while encourage the reuse of resources at their best and highest use.

Plan Components

I. Project Description (Plan Summary)

A. Provide a physical description of the project. Include a description of significant construction waste potentials for recycling and re-use.
B. Outline plan for managing construction waste. Include construction timetable, areas set aside for waste storage and sorting, and anticipated transportation requirements to remove materials from site.
C. Provide information on local codes and city construction waste programs/initiatives.

II. Construction Waste Resources Inventory

Provide a detailed list of construction waste resources and potential recycling or reuse centers for the following materials.

A. Metals – Steel, Aluminum, Copper, Zinc, Stainless Steel, Iron, etc.
B. Clean Dimensional Wood
C. Cardboard
D. Plastics - Beverage Containers, Packing Materials, etc.
E. Gypsum Wallboard
F. Ceiling Tile
G. Concrete
H. Masonry
I. Concrete Formwork
J. Gypsum Wallboard
K. Other

III. Management Strategies

A. Research regional construction waste Recycling Centers and identify a minimum of three centers for each type of construction waste.
B. Calculate savings in disposing of materials through recycling centers or vendors interested in material re-use as opposed to landfill and tipping costs.
C. Identify means of protection of materials stored on site.
D. Indicate materials handling procedures

E. Itemize on-site reuse potentials.
F. Itemize off-site reuse potentials.
G. Indicate transportation management strategies.
H. Indicate methods used to handle biodegradable waste
I. Indicate methods used to handle hazardous waste

IV. Draft Construction Waste Management Plan

Provide a draft construction waste management plan incorporating the following;

A. Inventory of proposed jobsite waste as outlined in II above.
B. Inventory of recycling centers and/or alternatives to landfilling waste.
C. Inventory of landfill options.
D. Waste management goals.
For each type of waste material, the report should list the following:
- Quantity
- Destination
- Means of transportation
- Cost of handling and transportation
- Expected revenue from saved materials
- Tipping fee savings resulting from alternative strategies
- Net cost/savings anticipated
- Estimate of comparative cost if materials had been landfilled
- Total comparison of cost or savings.

The report should total all materials at the end and give an overall figure of cost or net savings realized from all alternative strategies to landfilling the project waste.

V. Final Construction Waste Management Plan

Complete a report at the end of construction that calculates the net cost or savings as a result of implementing this plan.

Construction Waste Management — MEQ-2-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: ______________________

Phase:

SD	DD	CD	FINAL
☐	☐	☐	☐

Legend:

- ● Action Required
- ◉ LEED[TM] Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	◉	◉ Ⓔ	◉ Ⓔ	◉	◉

☐ **Required Component:**
The attached Construction Waste Management plan has been designed and implemented to divert construction, demolition and land clearing debris from landfill disposal to redirect recyclable and/or recovered resources back to the manufacturing process and to redirect salvageable materials to appropriate sites.

☐ **Required Component:** *(This will satisfy LEED™ 2.1 Materials and Resources Credit 2.2: Construction Waste Management – Divert 50% from Landfill)*
This certifies that a minimum of 50% of construction, demolition and land clearing waste (as calculated by weight) has been salvaged or recycled. A minimum of 50% of construction waste (by weight) has been diverted from landfill.

☐ **Optional Component:** *(To satisfy LEED™ 2.1 Materials and Resources Credit 2.2: Construction Waste Management – Divert 75% from Landfill)*
This certifies that a minimum of 75% of construction, demolition and land clearing waste (as calculated by weight) has been salvaged or recycled and been diverted from landfill.

Name ______________________ Signature ______________________

Company ______________________ Role in Project ______________________

Date ______________________

(This page is intentionally blank)

Resource Reuse MEQ-3

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Purpose: To incorporate previously used building materials and products into new construction.

Action: In coordination with the Materials Management Plan consider the use of salvaged, refurbished or reused materials and products in the building. Materials for reuse typically include reclaimed lumber and wood such as salvaged wood flooring and wood doors and cabinets, structural metal work such as beams, and miscellaneous metal such as doors, door hardware, etc. Decorative and specialized items such as salvaged wood and glass panels, banquettes, front and back bars and decorative or period lighting fixtures may be used in special public locations such as cafeterias or restaurants, and can contribute to this credit.

Related Guidelines: SEQ-1, SEQ-7, SEQ-11, MEQ-1, MEQ-2, MEQ-4, MEQ-5, IEQ-6

Potential LEED™ 2.1 Credits: 2 possible with MR cr. 2.1 and MR cr. 3.2 (see Submittal Template)

Introduction/Context

The use of salvaged and/or previously used materials and products is an exemplary, sustainable materials strategy. Not only does this action extend the life of such materials, it eliminates duplication of the embodied energy originally consumed to obtain and manufacture them. The draw-down of raw materials that would be necessary to (re)make such materials or objects is avoided. In addition, the energy and costs associated with their disposal need not be expended. For the purposes of this Guideline, strive to use materials that have been salvaged or previously used for 2% of the total value of the project.

Salvaged and refurbished materials, and materials that are reused on a project, differ from recycled materials in that they retain their integrity and are used, essentially, in the form in which they were originally cast. While they may need refurbishment – cleaning, repainting or refinishing, reupholstering -- they do not require to be *remade*. Use of recycled materials, on the other hand, implies the use of remanufactured materials. Because of the 9/11 tragedy, finding salvaged materials at the site may be a challenge for World Trade Center projects; however, this strategy should be encouraged, and the New York area offers plenty of opportunities to acquire interesting and appropriate salvaged materials from other buildings of note and historical sources. Materials such as architectural stonework, figurative terracotta tiles, decorative light fixtures, metalwork, millwork and antique outdoor furniture, urns, cast concrete figures, etc. may well be found at such places as Urban Archaeology in New York City, United House Wrecking in Stamford, CT and the Elemental Garden in Woodbury, CT, among many other reclamation centers.

Relevant Issues

Ecological

Reducing the demand for new materials protects the resource base. Reusing materials that have already been extracted or harvested, transported to manufacturing locations, manufactured or processed and again transported to the site, saves raw materials, energy, fossil fuels, labor and time. The cost and energy of disposal, as well as landfill space, are avoided. Potential atmospheric, land and water pollution contributions are avoided at every step, resulting in cleaner air and a healthier natural environment.

Economic

The economic benefit of resource reuse as discussed in this section is only a small part of the sustainable benefit realized through these strategies. To-date, there is insufficient material, and limited demand, to support many economically significant salvage operations, though such operations do exist in and around New York City. The effort involved in refurbishing can be significant, with a high price tag in some cases. However, the avoided cost in carting and tipping fees, together with the reuse of some of the more available and economically viable materials such as wood flooring, doors and furniture systems, can make a noticeable dent in first costs. Salvaging unique, historical building artifacts and decorative details such as friezes, stonework, decorative cornices, tile work and hardware -- items which are irreplaceable in today's market – can enhance and contribute to a new structure's interest and quality, grounding it in an appropriate historical context.

Neighborhood

The larger community benefits from the reuse of materials and products that have already been assembled or manufactured by the avoidance of the pollution that would be associated with the transportation and manufacturing processes of similar, replacement items. The reduced impact on landfills leaves more room, and more time, before newer facilities must be found for disposal. The reuse of materials and products for the building industry is usually a local/regional business, supporting the local economy and distributing work to smaller refinishing/ refurbishment shops, and local trucking operations. In some cases, use of appropriate 'mementos' or materials that have an intrinsic or historic significance in reference to a particular building that has since disappeared, or to a neighborhood, garden or plaza, may add a clear dimension of commemoration to a particular site, even when used in a new, purely decorative context.

Methodology

Design Strategies

In designing the building, look for opportunities to include used or historical materials, either for basic applications like salvaged wood flooring, or in specialty areas, where appeal and context can be high-lighted through the use of interesting, or even unique artifacts. New York and some of the nearby states offer several sources for such items, including demolition companies, salvage companies and those dealing in building artifacts and historical or decorative stonework, tiles, ironwork, period millwork, hardware and fixtures. Other companies specialize in doors, paneling, window frames, and light and bathroom fixtures.

Building elements such as weathered brick, steel beams and decorative terra-cotta tiles may also be appropriate for use, not necessarily in their original application, but as decorative elements within the design of public spaces, such as main public lobbies, conference centers, cafeterias, and staff break rooms. Indoor and outdoor garden areas can make use of salvaged decorative elements such as benches, statues and even fountains, as well as tiles and stonework. Refurbished furniture and especially furniture systems are readily available commodities, with many sources in the City specializing in such items. In LEED, they contribute to earning this credit for the tenant fit-out. Antique furniture and rugs also qualify as 'used' or salvaged materials under the interiors portion of this credit.

Means and Methods
To determine if the requirements of this credit have been met, the cost of all salvaged, reused and/or refurbished materials must be quantified and reviewed in terms of their collective percentage of the total cost of materials for the entire project. Assess the materials cost for the entire project, excluding labor and installation costs. Develop a spreadsheet listing all materials that have been salvaged, reused and/or refurbished on the project, together with their prices. The sum of the salvaged, reused and/or refurbished materials is divided by the total cost of materials for the project, with the resulting figure being multiplied by 100 to determine the percentage of their cost to the project. To meet the requirements ~~of LEED v2.1~~, the cost of salvaged, reused and/or refurbished materials must represent a 5% value of the total cost of materials for the project for one point, and a 10% value for a second point.

Case Studies
<u>CK Choi Building at the Institute of Asian Research, The University of British Columbia</u>
Over 50% of the building materials used on this project were either salvaged from elsewhere and reused or contained recycled content. 65% of the building's heavy timber structure was salvaged from a building that was demolished across the street. 100% of its exterior brick cladding was salvaged from streets in an older section of Vancouver. Salvaged materials used within this building included: the main stair handrail, atrium guardrails, all doors, sinks, toilet accessories, and some electrical conduits. In addition to a high percentage of salvaged materials, the project demonstrated exemplary use of recycled materials.

<u>CCI Center, Pittsburgh, PA</u>
The adaptive reuse of an existing structure means that the shell of this building is essentially a salvaged material, however this falls under credit MR 1.1 to 1.3 in LEED. As part of the changes made to the existing building other salvaged materials were used extensively including: brick, lumber, the floor and joist system, carpet, windows, kitchen case-work and equipment, and furniture. In addition to salvaged elements, local materials with recycled content were specified whenever possible. The owner also instituted a policy to require the use of materials that are either salvaged, contain recycled materials, or are FSC Certified for all future renovation within the building.

<u>Big Dig Buildings by Single Speed Design, Cambridge, MA, Winner of Metropolis Magazine 2004 Next Generation Prize</u>

This project proposed to salvage and reuse structural elements from sections of the highway in Boston that had been disassembled as part of the Big Dig Project. Rather than merely salvaging material content, the design proposal uses the former highway materials intact, reconstructing them in a different configuration as an apartment building. Steel columns formerly used to support the road now hold up the building's floors. The floors themselves are assembled from concrete panels that once comprised the highway road-bed. Interestingly, the building form, by necessity, takes on the same curvature as the former highway off-ramp, from which its building-blocks were salvaged. Pre-cast concrete panels from the highway are used to create balconies. Other salvaged materials are also planned to be incorporated into the building. Marine-grade plywood once used for concrete formwork, and old timber beams that were buried at the bottom of the harbor, are planned as cladding for the apartment structure.

Reference

Definitions

Salvaged materials: There is often confusion between 'reused' or salvaged and 'recycled' materials. Reused or salvaged materials do not need to be re-manufactured. They may be cleaned and refinished, but they retain their essential integrity and shape, and are used either in their original context, such as in flooring, doors, furniture systems and hardware, etc. or as decorative elements and memorabilia, such as cast iron and terra-cotta building details. Recycled materials, on the other hand, are generally reconstituted or remanufactured from existing products.

Recycled content: This term refers to materials that contain, as an integral part of their make-up, previously manufactured product. They may be made from totally recycled materials or contain a mix of recycled and new materials. There are two types of recycled material to consider as follows:

Post-industrial recycled content: refers to products containing material that has been *recycled*, but not *used* by consumers. Post-industrial content is made up of reprocessed factory waste, such as off-cuts, overrun from manufacturing processes, sub-standard production, broken, damaged, returned or otherwise unusable materials, etc. Products containing post-industrial content are less-highly valued than those with cost-consumer content.

Post-consumer recycled content: refers to material that has been used and is being discarded because it has reached the end of its useful life in that product form. Post-consumer material content is constituted from *remanufacturing* products that have been 'used' by consumers and which require complete reprocessing. Products containing whole or part post-consumer materials are more highly valued than those containing post-industrial content.

Standards

Standards have not been included for this Guideline.

Bibliography

Green Building Alliance. “Case Studies: CCI Center.” Green Building Alliance Case Studies. Green Building Alliance, Pittsburgh, PA. 15 October 2004.

<http://www.gbapgh.org/casestudies_CCI.asp>

Green Buildings BC. “CK Choi Building: A building that teaches respect for the environment.” Green Buildings BC Case Study Series. British Columbia Ministry of Advanced Education, Ministry of Education, Ministry of Health Services, BC Hydro and BCBC. 15 October 2004. <http://www.greenbuildingsbc.com/new_buildings/case_studies/CK_Choi.pdf>

Marshall, Alex. “Single Speed Design: The 2004 Next Generation Winner.” Metropolis June 2004: 154-159.

(This page is intentionally blank)

Resource Reuse **MEQ-3-T**

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: ______________________________

Phase:

SD	DD	CD	FINAL
☐	☐	☐	☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	○	○ Ⓔ	○ Ⓔ	○	○

☐ **Required Component*:***
This certifies statement certifies that salvaged, refurbished, or reused materials and products have been used in the construction of this building in accordance with the Material Management Plan (MEQ-1-P). A list of salvaged, refurbished and/or reused materials is attached. This project strived to provide salvaged, refurbished, or reused materials and products for 20% of the total value of its materials.

☐ **Optional Component:** *(To satisfy LEED™ 2.1 Materials and Resources Credit 3.1: Resource Reuse – 5% requirements)*
This certifies that 5% of the materials used in the building are salvaged. This has been calculated by dividing the total cost of all salvaged materials used in the building by the total cost of all materials used in the building. These calculations and a list of each material or product used to satisfy this requirement have been provided.

☐ **Optional Component:** *(To satisfy LEED™ 2.1 Materials and Resources Credit 3.2: Resource Reuse – 10% requirements)*
This certifies that 10% of the materials used in the building are salvaged. This has been calculated by dividing the total cost of all salvaged materials used in the building by the total cost of all materials used in the building. These calculations and a list of each material or product used to satisfy this requirement have been provided.

Name ______________________ Signature ______________________

Company ______________________ Role in Project ______________________

Date ______________________

(This page is intentionally blank)

Materials with Recycled Content MEQ-4

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Purpose: To incorporate materials with recycled content and increase market demand for building materials and products that incorporate recycled content.

Action: Specify materials with recycled-content in conjunction with the Materials Management Plan. The value of the recycled content portion of materials is to be at least 10% of the total project materials value (mechanical and electrical components are not to be included in these calculations).

Determine recycled content value according to the following formula: For post-consumer recycled content determine percentage of recycled content in the material and multiply by value of material. For post-industrial recycled content determine percentage of recycled content in the material, multiply by ½ and then multiply by the value of the material.

Related Guidelines: SEQ-1, MEQ-1, MEQ-2, MEQ-3, MEQ-5, IEQ-6

Potential LEED™ 2.1 Credits: 2 possible with MR cr. 4.1 and MR cr. 4.2 (see Submittal Template)

Introduction/Context

As recently as a decade ago, the concept of recycling, and especially of buying materials with recycled content, was extremely alien to an American public brought up to understand that ‘new’ was the only acceptable description for high quality goods. While some prescient manufacturers had always absorbed post industrial ‘waste’ material from their production lines into newly manufactured products, there was a certain degree of shame attached to the practice in a society that demanded ‘new’, and few companies admitted that they engaged in such endeavors. However, within a notably short time-span, the picture has changed dramatically. Today, the use of recycled or previously manufactured content is seen to make eminent sense, ecologically, economically and practically. Manufacturers of many common, utilitarian products such as steel, aluminum, carpeting, wallboard, ceiling tile, plastics, etc., struggle to obtain a sufficient backlog of used or ‘waste’ materials to offset the high costs of obtaining and processing virgin materials.

Materials with recycled content are those that contain, as an integral part of their make-up, previously manufactured product. They may be made from totally recycled materials or contain a mix of recycled and new materials. There are two types of recycled material to consider: post industrial recycled content, which is material that has been manufactured but not used by consumers, and post consumer recycled content, which is material that has been used and is being discarded because of wear, fashion change, tenant turn-over, etc. In this case the material may be said to have reached the end of its useful life in one form. Post industrial content is made up of factory waste, such as off-cuts, waste from manufacturing processes, broken, damaged, returned or otherwise unusable materials, etc.

Post consumer material, which is the more highly valued of the two, is constituted from remanufactured products that have been 'used' by consumers and which require complete reprocessing. This group includes items such as remanufactured steel from the steel in cars or from the demolition of buildings, recycled carpet, made from used nylon fiber and carpet backing and reprocessed glass from light bulb manufacturing and the demolition of buildings and vehicle windshields, among many others.

Relevant Issues

Ecological

Recycling materials involves the reprocessing of previously manufactured products into new products, either of a similar nature as the original product (up-cycling), or for a different, possibly less critical use (down-cycling). In most cases, reprocessing requires much less energy than that necessarily expended in the extraction or harvesting of raw materials, their transportation and first processing to acquire useable substances suitable for the manufacturing of recognizable goods. A clear example of this can be seen in the processing of aluminum from bauxite: it takes only 5% of the original energy to 'reprocess' an existing aluminum can into a new aluminum can (Aluminum Now, 2004). For this reason alone, recycling is an effective environmental strategy.

Of equal importance is the minimization of life-cycle impacts of materials as a result of the reuse of those already in production. The world's resource base, though vast, is in fact finite – it is essential, therefore, that the maximum amount of material enters into a cyclical pattern of use and reuse – a concept known as 'cradle-to-cradle', so that the natural environment is not consistently ransacked for materials, and eventually devastated. In addition, through this methodology, enormous amounts of still viable materials are diverted from the solid waste stream, conserving vital space in landfills and avoiding the pollution associated with incineration.

The environmental benefits of recycling and buying products with recycled content are numerous. They include protection of the remaining natural resource base, the capture of embodied energy associated with the primary effort to obtain, transport and process the original materials, and a significant reduction in time and energy needed to remanufacture and deliver these reprocessed materials back to the marketplace in the form of highly desirable new products. By diverting valuable materials from incineration or landfilling, the pollution and degradation of air quality, land and water associated with their disposal is avoided.

Economic

Costs involved with recycling have had a slowing effect on the speed with which these strategies have been adopted. Issues of collection, transportation and processing, especially at the individual consumer level, are significant. In addition, it has taken most industries considerable time to adapt their processes and equipment to handle recycled materials. Many are still in the process of working towards this goal, while others have not yet started. This slow start, along with lack of available materials for recycling, has put several recycling operations at risk of going out of business almost before they have started! However, the growing demand for construction materials and those used in the interiors of buildings with recycled content is having a huge and positive impact. Increasing numbers of industrial and manufacturing plants have been remodeled and retooled to accommodate this 'new' approach to the manufacturing of materials, and as demand grows – in step with the green building movement -- products suitable for recycling become more available and economically viable.

Neighborhood

The community at large benefits from recycling. Once the concept has taken hold, and an economic base for recycling, remanufacturing and reselling is established, the cost of such operations will diminish. Many of the collection and recycling operations are new, small businesses, feeding into large-scale operations, similar to the model of dairy farms and milk collection. Reduced pollution from incineration processes, especially in heavily built-up areas contributes to cleaner air, while diverting materials from landfills defers the need for new or expanded waste facilities.

There is some concern that the reprocessing of materials allows for off-gassing of mixed media materials and products such as adhesives or binders. However, much of the volatile nature of such products has been given up and dispersed in the ten or more years of the previous life of the product. Any remaining chemical binder is probably less volatile than that associated with new manufacturing processes. Manufacturing organizations are cautioned to observe the protective rules of OSHA for all industrial processes associated with the handling of products that may contain volatile organic compounds (VOC's) and other toxic chemicals and substances.

Methodology

Design Strategies

In the early planning of the project, during the development of the Comprehensive Material Management Plan, specify major building and interior fit-out materials with recycled content. As time goes on, this assignment becomes less and less challenging, as many of the most common and highest quality materials and products are now available with varying degrees of post-industrial and post-consumer recycled content. These alternatives include structural steel, aluminum, aggregate and fly ash for concrete mixes, wallboard, ceiling tile, carpet, etc. Specifying large scale, large impact items, especially those with *post-consumer* recycled content, will achieve the goals of this credit, and will have the most positive environmental and community impact.

It is worth noting that in almost all cases, products made using recycled materials, in whole or in part, are indistinguishable in terms of quality and durability, as well as aesthetics, from those made with virgin materials. Further, the availability of recycled materials has encouraged the introduction of many new product lines, in linoleum and rubber tile, vitreous tile, quarry tile and carpet, to name a few, where a unique aesthetic is derived specifically from the inclusion of recycled content.

Means and Methods

It is important to distinguish between materials with recycled content and those that are able to be reprocessed from demolition materials at the site, such as existing concrete slabs and masonry, which may be crushed with a mobile crusher at the site and used as aggregate in the project's concrete mixes for pavement and roadbed. Such materials are essentially 'salvaged', not recycled in this context, and may contribute to achieving credit MEQ-3 Resource Reuse. However, if the concrete source and crushing operation is off-site, they may be purchased as high quality recycled aggregate for all types of mixes, and are considered to have validity under this credit.

The Federal Trade Commission's 'Guide for the Use of Environmental Marketing Claims', 16 CFR 260.7 (e) addresses environmental marketing claims, and defines the meaning of the terms post-industrial (or pre-consumer), and post-consumer. The document lays out the differences between true and false claims relative to the inclusion of one or both of these materials in a product. Since the credit is achieved by the weight and cost of recycled content in materials specified for the project, with differing values indicated for each type of recycled content, it is essential to understand these differences.

Beyond specifying, purchasing and installing products with recycled content, it is also critically important to specify products that can themselves be recycled. To complete the cradle-to-cradle loop, materials must be used, remanufactured and reused in a ceaseless cycle, ensuring a diminishing drawdown of raw materials and the protection of the natural resource base. The project materials need to be easy to maintain, and durable, but at the end of their useful, aesthetic and/or functional life in the building, ideally they must also be able to be recycled. Specifying materials with this sustainable strategy, or endgame in mind, avoids sending viable material to landfills, and maintains the essential cyclical pattern which optimizes the goal outlined in this credit.

Case Studies

<u>Naval Base [at] Ventura County: Building 850 (Port Hueneme Energy and Sustainability Showcase Building)</u>

This building functions as an "Energy Showcase" facility through which the U.S. Navy illustrates cutting-edge strategies in energy-efficient, sustainable facility design, construction, and operation. The structure is located in Port Hueneme, California and is the base-of-operations for the Public Works Department of the Naval Base [at] Ventura County. The client's main objective was to create an environment in which the Naval Staff could experience green building principles first-hand. An effort was made to specify recycled-content materials in the building's construction. Post-consumer recycled materials designed into the building include PET plastic toilet partitions and clothing lockers, gypsum wallboard bought from manufacturers who take-back and recycle post-consumer scrap, mineral fiber insulation, structural steel, carpet with recycled plastic backing, and reclaimed aggregate used as a parking base. An example of post-industrial recycled content incorporated into the project is the fly ash that composes 30% of the building's concrete masonry.

Energy Resource Center (ERC), Downey, CA

The Southern California Gas Company Corporation owns and occupies this building which they maintain as a comprehensive "idea shop" for customers who want to invest in the most efficient, economical, and environmentally sustainable solutions to their energy needs. Roughly 80% of the materials used to construct the building, including interior furnishings and displays, are recycled, contain recycled content, or are made of renewable resources. Building materials comprised of recycled content include steel, glass tiles, and plastic bathroom partitions. The flooring of the lobby was reprocessed from a former Banana Republic warehouse. The rebar in the building's concrete was made from confiscated weapons provided by the L.A. Sheriff's Department. The ERC's owners also participate in a carpet "lease back" program ensuring that their carpet will be reused elsewhere when they are finished with it.

The Public Library of Youngstown and Mahoning County: Poland Branch, Poland, Ohio.

The client's main design goal for this project was to create a prominent example of sustainable architecture as an educational tool for its occupants. The building was to illustrate first-hand, the potentials of recycled materials in order to promote their use to the general public. Many building components with substantial recycled content are showcased by the design. Its Ecostar roofing is composed of recycled rubber and plastic and simulates the look of natural slate. Hardie Plank siding made from recycled wood fibers and cement emulates traditional wood siding. The window and door frames in the building are made of 95% recycled aluminum, and the glass has 15% recycled content. Hardwood flooring on the project was recycled from vintage New England barns. Recycled tires and recycled asphalt comprises the parking surface adjacent to the building. The carpeting used in the building was also made from reclaimed materials.

Reference

Definitions

Reused or salvaged materials: These materials do not need to be re-manufactured. They may be cleaned and refinished, but they retain their basic integrity and shape, and are used either in their original context, such as in flooring, doors, furniture systems and hardware, etc. or as decorative elements and memorabilia, such as cast iron and terra-cotta building details.

Up-cycling: This term refers to the highest use of a recycled material. In this process, a post-consumer, used product may be remanufactured into a new product of a similar nature as the original, or another product of equal or higher value. Examples include the remanufacturing of all parts of nylon carpet, where the previously down-cycled nylon is now made into new nylon fiber for the carpet industry. Similarly, used wallboard and ceiling tile is now able to be reprocessed to form similar products of equal value to the original.

Down-cycling: This term refers to a process where materials lose their intrinsic value by being commingled, crushed or otherwise adulterated so that reconstitution into a viable 'raw' material state, capable of being 'up-cycled' is permanently lost. Examples include mixed crushed concrete, masonry, glass, etc. used for roadbed fill, and 'plastic' wood.

Standards

U.S. Federal Trade Commission. Guide for the Use of Environmental Marketing Claims, 16 CFR 260.7 (e). Washington: USFTC, 1992.

Bibliography

Aluminum Now Online. The Aluminum Association, Inc. January/February 2004. 28 October 2004. <http://www.aluminum.org/ANTemplate.cfm?IssueDate=01/01/2004&Template=/ContentManagement/ContentDisplay.cfm&ContentID=7114>

Ellsworth, Heidi J. "Achieving Excellence Through Recycled Building Materials." Environmental Design + Construction. Jan. 26, 2002. 7 October 2004. <http://www.edcmag.com/CDA/ArticleInformation/features/BNP__Features__Item/0,4120,70794,00.html>

United States Department of Energy: Office of Energy Efficiency and Renewable Energy. "Building 850." HPB Case Study Project – Materials/Resources. 7 Feb. 2003. United States Department of Energy. 7 October 2004. <http://www.eere.energy.gov/buildings/highperformance/case_studies/materials.cfm?ProjectID=51>

United States Green Building Council. "LEED Certified Project Case Study: Energy Resource Center." USGBC – LEED Case Study - Overview. 2003. USGBC. 6 October 2004. <http://leedcasestudies.usgbc.org/overview.cfm?ProjectID=45>

Materials with Recycled Content MEQ-4-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: ______________________________

Phase:

SD	DD	CD	FINAL
☐	☐	☐	☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	◉	◉	◉	◉	◉
		Ⓔ	Ⓔ		

☐ **Required Component:** *(This will satisfy both LEED™ 2.1 Materials and Resources Credit 4.1: Recycled Content – 5% and Credit 4.2: Recycled Content – 10%)*
This certifies that the value of the recycled content portion of materials is at least 10% of the total project materials value (excluding mechanical and electric components). The value of the recycled content portion of materials has been calculated as follows: For post-consumer recycled content the percentage of recycled content in the material has been multiplied by the value of the material. For post-industrial recycled content the percentage of recycled content in the material, has been multiplied by ½ and then multiplied by the value of the material. These calculations are attached.

(Note: WTC Guideline MEQ-4 requires 10% value of recycled content, while LEED™ 2.1 allows for either 5% or 10%, giving 1 Credit for each benchmark. Compliance with WTC Guideline MEQ-4 will, by default, satisfy the requirements for both LEED™ 2.1 Credits.

Name ______________________ Signature ______________________

Company ______________________ Role in Project ______________________

Date ______________________

(This page is intentionally blank)

Purpose: To reduce environmental degradation resulting from transportation impacts by increasing the demand for building materials and products that are extracted and/or manufactured in close proximity to the building site.

Action: Utilize local/regional materials in conjunction with the Materials Management Plan (MEQ-1-P. Use a minimum of 20% of all building materials (based on cost) that are manufactured within a 500-mile radius of the site. Manufactured in this context means the location where 'final assembly' takes place.

Related Guidelines: UEQ-8, SEQ-1, MEQ-1, MEQ-3, MEQ-4, MEQ-6, MEQ-7

Potential LEED™ 2.1 Credits: 2 possible with MR cr. 5.1 and MR cr. 5.2. (see Submittal Template)

Introduction/Context

The requirement to purchase local and/or regional materials offers benefits well beyond the simple cost of transportation, to incorporate important issues relative to reduced atmospheric degradation, reduced roadbed/infrastructure wear and reduced wear and tear on transportation vehicles and tires, as well as being an important fossil fuel(s) conservation strategy. In addition, this approach increases work opportunities for the labor force within the 500-mile radius of the project, and helps to sustain a critically important manufacturing base within the New York City area. Purchasing materials that are regionally extracted, harvested or salvaged, keeps the local economy vibrant and represents a vital link in a healthy economy's chain of supply and demand. This effort can be aided even further by using materials that are 'manufactured', remanufactured or assembled regionally, as well. For the purposes of this Guideline, strive to have 50% of the raw materials that are locally or regionally manufactured also be locally extracted (within a 500-mile radius of the site).

Relevant Issues

Ecological

One of the most important characteristics of buying locally manufactured products, or those that are harvested or extracted within the region centers on the reduced consumption of fossil fuels needed for shorter haul transportation. Burning gasoline, diesel and jet fuel to power trucks and cargo planes, as well as generating steam and electricity from mixed fuel sources for cargo ships and freight trains, contributes considerably to the generation of pollution associated with greenhouse gasses (CO, CO2), acid rain (NOx, SO_2) and even ozone depletion (through the operation of leaky vehicular air conditioning equipment still reliant on chlorofluorocarbon (CFC) technology). Air-borne atmospheric pollution has far-reaching, negative impacts on local air quality and the health of the entire global ecosystem.

Economic

The economics of purchasing local/regional materials and products may be clearly seen in reduced transportation costs, measured in fuel and often, in time saved. In addition, less impact on infrastructure and vehicle repair is a consideration. A major, less obvious economic benefit may be seen through a reduction in smog nationwide, and in New York City in particular. (Smog is created through a mixture of ground-level ozone and VOC's released through the combustion process, and sunlight). Fewer incidents of asthma and other related respiratory illnesses add up to reduced health care costs across the country.

Neighborhood

Materials purchased within the proximity of the building site help to maintain an economic power-base within the community, while contributing to a high employment rate and to maintaining a stable tax base. Strategies to reduce global atmospheric pollution have a wide impact and are recognized as an increasingly important form of social responsibility among industrialized nations. Any reduction in the release of nitrogen oxide and sulfur oxides, chemicals which contribute to the formation of acid rain and which are released through the burning of fossil fuels, helps to minimize damage to vegetation, wildlife habitat and water bodies. Similarly, reductions in the release of vaporized mercury, and mercury particulate matter reduces the introduction of this bio-accumulative poison into water bodies across the North Eastern United States. All of the North Eastern states, including upstate New York and New Jersey have been, and continue to be, affected by pollution-laden wind carrying acid rain and vaporized mercury components. A lessening of the deposition of these chemicals represents a contribution to the well-being of the larger community.

Methodology

Design Strategies

The metropolitan area offers enormous opportunity to achieve the goals of this credit. The South-East corner of New York State is well-situated to draw from the area's rich materials manufacturing base. Strategies to optimize this potential include a pre-design review of possible options and development of a database or listing of all regionally available manufacturing sources for major building materials.

Manufacturing, in this instance, means the final assembly of materials that may, or may not, come from regional raw material sources. All specified materials and products for use under the Sustainable Guidelines must be in keeping with any physical and aesthetic requirements and/or sustainable restrictions already established for the rebuilding of the World Trade Center site.

While the requirements of this credit, the manufacturing or 'final assembly' of materials is not unreasonably challenging in the New York area and for World Trade Center projects, there is a potential opportunity to achieve a further sustainable goal -- the second part of this credit in LEED. This part of the credit requires that 50% of the locally manufactured materials indicated in the first part of the credit, must be obtained via extraction, harvesting or recovery within a 500 mile radius of the site. Achievement of this second point presents a challenge, as most of the raw materials for steel, which are key, large-scale components of this credit, are extracted in locations beyond the 500-mile radius of the World Trade Center site. World Trade Center projects, which are able to achieve this LEED credit may use it as a substitution for the Recycled Content credit – see NYGBTC 638.7(b) Substitution Options 4.

Means and Methods

The success of this credit depends largely upon developing a knowledge base of local/regional manufacturing sources within the 500-mile limits set by the reference documents. The New York City Chamber of Commerce can provide a list of local manufacturers, and there are, in addition a number of city and state agencies for economic development, which may be able to provide additional information. During the pre-planning phases of the project, research to identify local/regional manufacturing and materials' sources, and the appropriateness of their products for each construction project at the World Trade Center site, is critical. Prior to design concept, develop a database of materials suitable for the building site, which are manufactured, or assembled, within the 500-mile radius of New York City. During construction, ensure that the materials specified are shipped from *the specific sources identified*, taking special care to confirm regional sourcing from suppliers who have multiple, often widely distributed and inappropriately distant, manufacturing locations throughout the United States.

Once selected, the cost of these materials is quantified and reviewed in terms of their collective percentage of the total cost of materials for the entire project. Assess the materials cost for the entire project, excluding labor and installation costs. Develop a spreadsheet listing all materials from local/regional sources, together with their prices. The sum of the local/regional materials is divided by the total cost of materials for the project, with the resulting figure being multiplied by 100 to determine the percentage of their cost to the project. The cost of local/regional materials must represent a 20% value of the total cost of materials for this credit to be achieved.

(Note: development of a total materials cost for the project is an important tool, and will serve as baseline information for achieving many of the materials credits.)

The following part of this credit, which is offered as a second point in LEED, with a substitution option in the NYSGBTC, seeks to confirm that 50% of the regional materials used in the project, are extracted, harvested or recovered from within the

500-mile radius of the City. Another calculation to determine if this point is achievable must be undertaken. Develop a second spreadsheet listing all of the materials in this category, together with their costs and determine the collective value. Divide this sum by the total cost of the local/regional materials as identified above and multiply this by 100. The resulting percentage must represent a value of 50% of the cost of local/regional materials to achieve the credit.

Case Studies

Nidus Center for Scientific Enterprise, Creve Coeur, Missouri

61% of the materials (by cost) used in the construction of this building were produced within a 300-mile radius of the project site. These included brick, metal roofing, earth fill, concrete block, steel, drywall, doors, and window blinds. (US EPA 2003) (USGBC 2005)

Viridian Place, Lake Oswego, Oregon

55% of the materials used in this building (by cost) were manufactured within 500 miles of the project site. This included concrete, masonry blocks, metal stairs and railing, wood products and drywall. In addition, 51% of those materials were harvested, extracted or recovered within a 500-mile radius of the project as well. (USGBC 2005 [2])

Reference

Definitions

Definitions have not been included for this Guideline.

Standards

Standards have not been included for this Guideline.

Bibliography

U.S. EPA. “Nidus Center for Scientific Enterprise, St. Louis, Missouri”. Laboratories for the 21st Century: Case Studies. October 2003. United States Environmental Protection Agency. 15 January 2005. <http://www.nrel.gov/docs/fy04osti/34348.pdf>

USGBC. “Nidus Center for Scientific Enterprise.” LEED Certified Project Summary. USGBC. 15 January 2005. <http://www.usgbc.org/Docs/Certified_Projects/Cert10.pdf>

USGBC. “Viridian Place.” LEED Certified Project Summary. USGBC. 15 January 2005. <http://www.usgbc.org/Docs/Certified_Projects/Cert_Reg103.pdf>

Material Proximity — MEQ-5-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: ______________________________

Phase:

SD	DD	CD	FINAL
☐	☐	☐	☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	◉	◉	◉	◉	◉
		Ⓔ	Ⓔ		

☐ **Required Component:** *(This will satisfy the requirements of LEED™ 2.1 Materials and Resources Credit 5.1: Regional Materials – 20% Manufactured Regionally)*
This certifies that a minimum of 20% of all building materials (based on cost) are manufactured within a 500-mile radius of the site. Manufactured in this context means the location where 'final assembly' takes place. A copy of the calculations used to determine this is attached. This project strived to have 50% of its regionally manufactured materials also be extracted or harvested within a 500-mile radius of the site. A list of these materials indicating the total percentage achieved is attached.

☐ **Optional Component:** *(To satisfy the requirements of LEED™ 2.1 Materials and Resources Credit 5.2: Regional Materials – 50% Extracted Regionally)*
This certifies that a minimum of 50% of the materials used to satisfy the requirement above are extracted, harvested or recovered (as well as manufactured) within a 500-mile radius of the site. A copy of the calculations used to determine this is attached.

Name ______________________ Signature ______________________

Company ______________________ Role in Project ______________________

Date ______________________

(This page is intentionally blank)

Purpose: To specify wood which has been harvested according to sustainable forest management principles.

Action: Utilize wood materials certified under the Forest Stewardship Council's Principles and Criteria (FSC) in conjunction with the Materials Management Plan. These materials may include dimensional framing components, flooring, doors, paneling, millwork and furnishings, handrails and trim, etc., as well as temporary lumber and wood construction materials. Request vendor's chain-of-custody certificate number to verify certification.

Related Guidelines: MEQ-1, MEQ-5, MEQ-7, IEQ-6

Potential LEED™ 2.1 Credit: 1 possible with MR cr. 7. (see Submittal Template)

Introduction/Context

Within the context of the sustainable building movement there is no strategy more important than the protection of the great temperate, boreal and tropical forests, which together are known as 'the lungs of the world.' Not only do these huge natural systems retain carbon within their elements, they absorb free carbon (carbon dioxide), helping to restore the essential balance between atmospheric pollution and life-giving oxygen. Forests support and enhance biodiversity, offering habitat for a diverse wildlife, the character, scale and medical import of which is far from being fully realized. The forests of the world provide timber and natural food sources such as nuts, fruits and roots, as well as shelter and the basis of livelihood for many indigenous peoples. They support industrial activities around the globe, providing employment for thousands of people through timber-related industries. Strive to specify wood and wood-based materials harvested according to sustainable forest management principles for 25% of the wood used on the project.

In 1993, the Forest Stewardship Council (FSC) was formed as an independent, not-for-profit organization to generate and oversee international standards for the protection of these valuable, but increasingly vulnerable natural resources. This international body accredits certification organizations in order to guarantee the authenticity of their claims and to "…promote environmentally responsible, socially beneficial and economically viable management of the world's forests, by establishing a worldwide standard of recognized and respected Principles of Forest Stewardship." All participation is voluntary, based on each forest manager's request to be involved, and the program works in parallel with all national and international laws, as well as any local initiatives that may be in place to support responsible forestry practices. The ten FSC international forest management standards, taken together, are known as the FSC Principles & Criteria of Forest Stewardship. They represent a systematic approach dedicated to maintaining the health of the forests through

environmentally responsible management practices, ensuring continued timber productivity and economic viability, while protecting indigenous people's rights, forest biodiversity and wildlife habitat including water, and methodologies for sustaining clean air and water as well as the management of waste.
There is considerable controversy concerning the choice of the Forest Stewardship Council as the single forest management certification program accepted in LEED and by several other mainstream environmental organizations. Most other forestry certification programs are industry based, while the FSC has been set up as an international, independent review body, which accredits other certification organizations once it has been determined, to the FSC's satisfaction, that these organizations are able to consistently meet the established criteria (Policies and Standards). While both LEED and other interested parties are actively reviewing options for broadening the approval basis for this credit, for the meantime, the FSC remains the only organization whose certification is acceptable.

Relevant Issues

Ecological

According to the Policies and Standards of the FSC, "… forest resources and associated lands should be managed to meet the social, economic, ecological, cultural and spiritual needs of present and future generations." Clear-cutting and poor forest management cause untold damage, not just to the landscape, but also to entire ecosystems. Loss of topsoil through erosion, sedimentation of streams and water bodies, reduction of wildlife habitat, and further threats to endangered species, as well as air and water pollution, are just some of the negative environmental impacts that occur as a result of clear-cutting, indiscriminate road-building and irresponsible felling of significant tree stands deep within the forest. The FSC, through its own efforts, and by supporting other certifying bodies, strives to alleviate these practices.

Through its stated principles, which are noted below, and which must be adopted and enforced by all participating programs, the FSC establishes both protective and restorative forestry practices aimed at maintaining the character, cultural resources, habitat and health of participating forest areas, while securing forest resources for the future. Among the many strategies in play, this means that the homelands and livelihood of indigenous peoples are protected, wildlife habitats are preserved and no more timber is cut than is replanted in a rotation that ensures the cyclical availability of mature trees, indefinitely. Endangered tree species are vigilantly protected and propagated under the FSC principles. Roads and trails are carefully designed to minimize destruction, both at the time of building, and during their use in the appropriate harvesting of significant single or remote wild tree stands deep within the forests. Subsequently, the erosion of top soil is controlled and minimized, retaining this vital resource within the forests, protecting water bodies and forest streams from sedimentation (and the terrible fish kills associated with this condition), and protecting air quality.

FSC Principles and Criteria

Principle 1:	Compliance with Laws and FSC Principles
Principle 2:	Tenure and Use Rights and Responsibilities
Principle 3:	Indigenous People's Rights
Principle 4:	Community Relations and Workers' Rights
Principle 5:	Benefits from the Forest
Principle 6:	Environmental Impact
Principle 7:	Management Plan
Principle 8:	Monitoring and Assessment
Principle 9:	Maintenance of High Conservation Value Forests
Principle 10:	Plantations

Economic
Forest products represent a major source of economic wealth for both industrialized nations and third world countries. The worldwide demand for lumber, especially for the construction market is enormous and growing annually, with the needs of emerging markets such as the Eastern European countries, Russia and China increasing demand exponentially. In 1970, international trade in forest products tallied less than $12,7 billion, according to the World Resources Institute's document '*EarthTrends*', while by the year 2002, it had grown to $133,2 billion. Through logging operations, as well as timber transportation, sawmills, veneer operations, the pulp and paper industry and millwork shops, forests and their primary product provide employment for literally millions of people around the globe. The economic import alone, of preserving, growing and maintaining this natural resource, cannot be overestimated.

Energy from wood-based biomass (bark, wood residues, and organic elements such as spent chemical pulping liquors) is an increasing form of renewable energy, still used primarily at pulp and paper mills where up to 70% of the energy used for all related operations comes from these 'waste' sources. While there is a negative air quality impact from the burning of these waste materials – as from burning any fuel -- controls are used to minimize releases. Many of the industries involved in wood processing, such as these, are expected to become net energy producers within the foreseeable future.

The initial cost of FSC certified wood is slightly more than using non-certified wood. The certification process is still in early development; however, with an increased understanding of the issues relative to maintaining healthy, productive forests, more self-certifying bodies are beginning to seek the umbrella categorization of FSC approval, and more certified wood and wood products are becoming available. These actions are already having an impact on certified wood markets, making products both more competitive with non-certified products, and more readily available.

Neighborhood

Mismanagement of forests, such as clear-cutting is now well documented as a destructive and inappropriate approach to lumbering, though it is still practiced worldwide. The slash-and-burn approach used by itinerant ‘farmers’, often the indigenous forest dwellers who have lived for centuries in harmony with their environment, and who have now been up-rooted from their forest homes and traditional livelihoods by clear-cutting, is common in the tropics. The slash-and-burn process, which destroys yet more forest, is sometimes the only way these displaced people can scrape a living from their cleared land. It leads to the erosion of top soil and the swift exhaustion of the shallow, infertile soils of the forest floor, resulting sooner rather than later in failed crops, sedimentation of streams and rivers – which destroys water quality and kills the fish population – and the constant need to ‘move on’, continuing the desperate, uninformed destruction of land best suited to the growth of timber.

On an international scale, forests absorb carbon dioxide, a greenhouse gas largely generated by the burning of fossil fuels, thus helping to reduce the impact of global warming. In addition forests produce – exhale -- massive amounts of oxygen. They provide the raw materials for many industries, creating employment opportunities in multiple industries around the world. In well-managed areas, the livelihood and well-being of native peoples is ensured, as is wildlife habitat and the protection and propagation of endangered species, both flora and fauna.

Plantation tree growing is seen as a way to provide ‘rapidly renewable’ and uniform quality building materials. In addition, it contributes to employment opportunities for local people and as a way to simplify timber harvesting. However, it is not encouraged by the FSC. Where they occur, plantations are evaluated on their ability to contribute towards the protection, conservation and restoration of natural forests. To qualify under the FSC certification program, a plantation has to be part of a carefully organized forest growth pattern in scale and location, supportive of biodiversity, wildlife corridors, and it must preferably be focused on a mosaic of various, indigenous tree species. After 1994, plantations occupying land that has been converted or ‘stolen’ from a natural diverse forest area will not be considered for certification except under special conditions.

Methodology

Design Strategies

It is possible in today’s marketplace to find and specify almost all lumber, engineered wood and finish (veneer and solid) wood materials for a building that carry the Forest Stewardship Council’s certification and a vendor or manufacturer’s chain of custody (CoC) certificate. It is helpful to determine early on in the project planning which wood finishes are appropriate for the project – regionally grown hardwoods such as cherry, ash or maple, or more exotic tropical species -- for example, and then to determine availability of the selected species through a FSC certified source, or sources. On finding the desired product, it may be prudent to pre-purchase specific finishing materials, such as matching veneer flitches for millwork that are required to match, as the supply of certified wood is still modest and tends to fluctuate with market demand.

A further potential strategy is to specify some of the lesser-known tropical species that are becoming available in the US. These woods add variety and character to a project, while reducing pressure on better-known species. Endangered woods should not be avoided -- so long as they are purchased through FSC certified programs and come complete with chain of custody certificates. The practice of specifying limited amounts of these woods encourages small-scale forest industries, as such timber tends to come from trees that grow wild, usually in single stands. It supports the work of local peoples who harvest these remote stands by creating a market for their products.

Low-grade rough lumber from sustainable sources is also available and its use is encouraged. In fact, as a maximum of 20% of all hardwood forest production is graded First and Second (FAS) by the National Hardwood Lumber Association, it is recommended that lower grades of lumber be specified for all concealed applications, provided they meet the structural engineering requirements. In keeping with the intent of this credit, these grades can be specified to be FSC Certified. Consult the Architectural Woodwork (AWI) Institute's handbook and the National Hardwood Lumber Association (NALA) for specific wood grades and appropriate applications.

Means and Methods

The Forest Stewardship Council has accredited a number of forest management certification bodies in America and abroad. The two that are most often referred to as sources for certified wood in the US are the Rain Forest Alliance's 'Smart Wood' program, and Scientific Certification System's Forest Conservation Program. Both are accredited to conduct third-party forest management and chain of custody audits, here and internationally, in accordance with the FSC Policy and Standards.

In addition to these, the FSC has accredited a number of forest management and chain of custody certification bodies around the world. Some of the most significant include the following: The international SGS Group's Forest Certification 'QUALIFOR' Programme, the Swiss Association for Quality and Management Systems (SQS), ICILA, the Italian certification body for wood and furniture industries, and SABS, the South African Bureau for Standards.

The Forest Stewardship Council's website (www.fsc.org) provides links to the list of certified wood providers worldwide. Monthly updates to the certificates issued by FSC accredited certification bodies are provided. These certificates are awarded to forestry managers who oversee forestry practices that meet or exceed the requirements of the certifying organization and successfully complete the FSC forestry practices audit.

To earn a 'Chain of Custody' (CoC) certificate, companies that buy, process, manufacture and distribute products carrying the FSC 'Forest Management Certificate' must demonstrate that these materials are managed in a responsible manner. The companies are required to complete an audit that addresses the correct use of the FSC name and logo, meet minimum requirements for FSC wood fiber in engineered or composite wood products, and maintain storage and production facilities that ensure that certified and non-certified wood materials are appropriately segregated in all manufacturing and distribution systems.

Use of a significant amount of certified timber resources grown in the North-East of the United States, especially New York State, New Jersey, Connecticut, Pennsylvania and Massachusetts, all within 500 miles of the World Trade Center, will allow the project to earn Credit MEQ-5 'Materials Proximity' as well as this credit. Similarly, Credit MEQ-7 'Agricultural Materials' (which includes composite wood materials) may also be considered as contributing to this credit. Specifying recently introduced products, such as *certified* MDF board and plywood, which are being made with *non-urea-formaldehyde bonding agents*, may achieve credit IEQ-6 'Reduced Contaminants from Materials' under the World Trade Center Sustainable Guidelines. For projects undertaking a LEED certification, at a minimum, 50%, by cost, of all new wood products on the project must be FSC certified. Salvaged timber is excluded from the calculation.

Case Studies

Middlebury College, Middlebury, Vermont

3 new buildings were added to this campus in 2002, each using a considerable amount of certified lumber in their construction. Between a residence hall and dining hall, 58,000 board feet of certified wood from five local woodlots was used. A new recycling center was built using 16,000 board feet of certified spruce that was harvested from college land. Local artisans, using only certified wood from Vermont, crafted all of the furnishings for these buildings, including tables, chairs, display cases, and sofas. (US EPA 2003)

Cedar River Watershed Education Center, Seattle Washington

This project established a new measure of success for the use of certified wood. The design pre-dates LEED, however, the design team set a personal goal of maximizing the use of certified wood for two primary reasons: The project consists of a compound of wood-intensive buildings thus making wood a dominant factor in the project's ecological footprint; and a focus on forest management practices is a particularly relevant consideration regionally and harmonizes well with the Education Center's mission of watershed stewardship. To this end, 98% of the wood products used to build this environmental education center originated in certified forests. These elements included formwork, framing, sheathing, trusses, finishes, cabinets, windows, doors and cedar siding from a local Forest Trust. (Cascadia 2005)

Reference

Definitions

FSC Certified Forest: This term refers to a forest or a forest manager who has demonstrated all of the requirements of the Forest Stewardship Council's sustainably managed forest criteria and has completed the requirements of the FSC certification program. Such organizations are permitted to use the labels and logo of the FSC, indicating their forests are sustainably managed and that wood and wood products that come from their forests have been sustainably harvested.

FSC Chain of Custody Certificate (CoC): This system connects responsible forest management practices to end products to consumers. By tracking FSC certified material all the way through the production process, end-users, such as architects and designers, can be assured that their specified woods are in fact, FSC certified. Vendors and suppliers who seek the FSC CoC must demonstrate that they have the ability to identify and control their sources, have the facilities to allow for separate storage of FSC-labeled material from regular wood supplies, and that they use the FSC trademark and labels responsibly.

Plantation: often refers to an estate or area where monoculture, cash crops are grown on a large scale. A tree plantation, as used in the context of sustainable forestry, refers to the planting of specific tree-types, either to provide 'rapidly grown' wood supplies, or to reduce the pressure on, and provide protection for, existing forests by providing supplemental lumber and wood-based products. The FSC questions the use of plantations generally, as they tend to focus on supply only, and not to address the full extent of 'stewardship' embraced by the FSC Principles and Criteria.

Standards

Standards have not been included for this Guideline.

Bibliography

Cascadia Region Green Building Council. Cedar River Watershed Education Center. 15 January 2005. <http://www.ci.seattle.wa.us/util/stellent/groups/public/@spu/@rmb/@shedmgmt/@pubculted/documents/spu_informative/education_200401211405034.pdf>

FAO (Food and Agriculture Organization of the United Nations)

Forest Certification Resource Center. <http://www.certifiedwood.org>

Forest Stewardship Council: 'Policy and Standards'

United Nations: Timber Bulletin LVII (2004) No. 3: 'Forest Products Annual Market Review' 2003-2004.

UNECE (United Nations Economic Commission for Europe)

United States Environmental Protection Agency. "Construction: Using Green Certified Wood." Facilities. April 2003. US EPA 15 January 2005. <*http://www.epa.gov/boston/assistance/univ/pdfs/bmps/MiddleburyCertifiedWood.pdf*>

(This page is intentionally blank)

Wood Certification

MEQ-6-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: ______________________

Phase:

SD	DD	CD	FINAL
☐	☐	☐	☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	○	○ Ⓔ	○ Ⓔ	◉	◉

☐ **Required Component:**
A list of locations and types of certified wood used on this project is attached. This indicates the amount of certified wood used, both as a percentage of all new wood products and as a percentage of the value of all materials used on the project. This project strived to specify certified wood for 25% of the wood materials used. Copies of the FSC certifications for each product, plus the CoC numbers for each item are also attached.

☐ **Optional Component:** *(To satisfy the requirements of LEED™ 2.1 Materials and Resources Credit 7: Certified Wood)*
This certifies that a minimum of 50% of wood based materials and products used are FSC certified. A copy of the calculations used to determine the above percentage is attached, along with the vendor's or manufacturer's FSC chain-of-custody certificate number for all products used to satisfy this requirement.

Name ______________________ Signature ______________________

Company ______________________ Role in Project ______________________

Date ______________________

(This page is intentionally blank)

Purpose: To encourage the specification of materials which are renewable and that grow in such a way as to support biological diversity and the health of the ecosystem.

Action: In coordination with the Materials Management Plan use renewable and rapidly renewable building materials and products. Materials with annual growing cycles or which regenerate naturally within a 10-year-cycle are considered to be rapidly renewable materials. These materials include bamboo, poplar, cork, wool, cotton, jute, sisal, and soy-based products. Agricultural 'waste' materials such as wheatgrass, sunflower seed husks, and straw also qualify under this category. Release agents for concrete forms, which are made from plant oils such as corn oil, are included. Use agricultural compost for site applications, including, but not limited to, turf, plantings and erosion control.

Related Guidelines: SEQ-1, MEQ-1, MEQ-5, MEQ-6, IEQ-6

Potential LEED™ 2.1 Credit: 1 possible with MR cr. 6. (see Submittal Template)

Introduction/Context
There are many ways to reduce the impact of construction activities on the natural environment. One of the less well known, but increasingly significant, centers on the use of natural materials that are typically characterized as 'agricultural waste', and other natural resources that achieve maturity in a short, natural growth cycle. Use of such materials protects the finite, raw material base and allows longer-cycle, natural materials to mature fully, prior to being harvested, while providing a ready supply of high quality, easily replaceable materials for the marketplace. Together, these products, which are briefly described below, are commonly referred to as 'rapidly renewable materials'. Strive to specify rapidly renewable materials for 2.5% of the value of total project materials.

Prior to the sustainable design movement, many of the agricultural waste materials in this category were burned as the easiest method of disposal, thereby destroying a potentially useful, and basically free, supply of raw materials, while contributing to atmospheric pollution and to global warming. Wheatgrass stalks, straw and sunflower seed husks, the remnants left of each crop once all food value had been stripped out, fell into this category. Now, these waste materials are consistently made into attractive, durable panel products, useful in non-structural, construction applications, millwork and furniture design.

The second group of materials includes many that have natural replacement cycles of less than ten years, growing to maturity within that time-span. These include bamboo, with a maturation rate of approximately three years, and which is used for new strip and parquet flooring applications; poplar, which is the basis for much of the orient strand board (OSB) and chipboard in the market place; and cork, with its established seven-year harvesting cycle, and multiple flooring, wall, acoustical and furniture applications.

The third group centers on the use of annually renewable crops – where much of the value is found in the product's intended use for building interiors and architectural projects. Typical materials include fibers such as cotton, flax, sisal and jute. Wool, an annually renewable fiber also falls into this category, as does down, which is heavily used by the furniture industry and silk, used as a high-end finish material. In addition, with a huge surplus in supply, soybeans are also being used to make new architectural products, while other surplus products such as corn and vegetable oils are being developed into non-toxic release agents for use with concrete forms and plastic molds. An exciting new industry, bio-based plastics, which are made from cornstarch, is in development, and is expected to provide environmentally benign alternatives to many petroleum-based plastics in the foreseeable future.

Relevant Issues

Ecological

Because the agricultural materials in this category are grown primarily for their food value, the 'waste' materials, which are purely remnants or by-products, have no *independent* impact on the environment during their growing cycle. After harvesting and removal of the nutritional elements, they form the raw materials for what amounts to a new industry, the manufacturing of 'agri-products'. In most cases these products, primarily panels, are made with urea-formaldehyde free bonding agents, and can be used to replace construction materials such composite or engineered wood panels, which typically have a more demanding life-cycle and greater environmental impact. Elimination of the burning of agricultural waste materials is a positive, contributing factor to cleaner air quality.

Use of rapidly renewable materials encourages farming of specific tree species, creating new opportunities in forestry practices. Rapidly renewable, farmed trees and plants such as poplar and bamboo, can be planted, grown to maturity and harvested for use in a continuing short cycle of supply and demand, while permitting natural, bio-diverse forests to remain intact. As with other 'crops' these trees do well when grown in rotation with other rapidly renewable materials. Clear cutting and/or poor forestry practices are reduced, minimizing damage such as that which occurs during the harvesting of single tree stands in densely wooded forests, and there is a reduction in soil erosion and the subsequent sedimentation of rivers and ground water streams. However, farming of trees, or the concept of plantation growing, must be viewed in association with MEQ-06, Wood Certification, as the Forest Stewardship Council does not always support this practice.

Use of surplus agricultural crop materials for new processes such as the emerging bio-plastics industry, is beginning to create a viable market for alternatives that are environmentally cleaner, biodegradable substitutes for petroleum-based products. Encouraging this strategy preserves the fossil fuel base and also reduces our dependence on domestic and foreign oil.

Economic

Agricultural land, which produces an annual crop providing both food and materials for the new agri-products industry provides a clear economic benefit – a win-win situation. Other short growing cycle materials make more efficient use of the land than regular tree and plant materials, which have as much as a twenty to forty year growing cycle. In the case of hardwood trees, this cycle can extend to more than one hundred years to achieve full maturity. Use of natural materials such as wool, silk and linen that are harvested and naturally replaced every year, reduces the industry's dependence on synthetic fibers, many of which are petroleum-based.

Due to the newness of the agri-products industry, some of these materials are not yet cost-competitive with similar use products. It is important to note that any premium is a first cost issue only, and does not have a negative impact on the life cycle of the product. Bio-based plastics are still fairly rare and not yet in common use. However, as these products become mainstreamed, this discrepancy should disappear. The two new industries that are growing out of these agricultural materials' initiatives discussed above, and that have come to the fore recently -- agri-products, and bio-based plastics – both have enormous potential to modify the negative impact of building-related materials on the natural environment. In addition, they both provide economic incentives and new job opportunities in the less populated areas of the United States.

Neighborhood

The use of agricultural materials and rapidly renewable materials benefits the community by reducing waste and reducing the burning of viable 'raw' materials, resulting in less pollution and cleaner air. The management of the growing cycle – planting, cultivating and/or harvesting – of rapidly renewable and agri-materials provides a sustained work flow in many rural areas where other industry -- and jobs – may be scarce.

The potential to reduce the country's dependence on fossil fuels is a critically important issue relative to this credit. As demand for the bio-based products discussed in this section, grows, so will the potential for these new, alternative and sustainable industries.

Methodology

Design Strategies

Specify wheatboard or strawboard in place of more typical composite wood materials. These boards or panels should not be used to replace plywood because, as with all composite panels, they lack the structural integrity of solid or laminated materials. Include some of the more decorative panels, which may be stained or left natural, and sealed with low-VOC products similar to those used for wood veneer.

Specify lumber from rapidly renewable sources, FSC certified if possible. Bamboo flooring is available with non-urea-formaldehyde adhesives from a number of sources. In addition to its other qualities as discussed here, this material is both naturally insect and moisture resistant.

Use materials that are constituted from agricultural and other natural materials, such as linoleum, which is made in large part from cork, wood flour and linseed oil, with natural (clay) fillers and pigments. Cotton batt insulation with high R-values is readily available, as is wool carpet and wool, linen and silk upholstery fabrics.

Means and Methods

To determine if the requirements of this credit have been met, the cost of all agricultural-based and rapidly renewable materials is quantified and reviewed in terms of its collective percentage of the total cost of materials for the entire project. Assess the materials cost for the entire project, excluding labor and installation costs. Develop the typical MEQ credit spreadsheet listing all materials from local/regional sources, together with their prices. The sum of the agricultural-based and rapidly renewable materials is divided by the total cost of materials for the project, with the resulting figure being multiplied by 100 to determine the percentage of their cost to the project. To meet these requirements, the cost of rapidly renewable and agricultural-based materials must equal a 5% value of the total cost of materials used on the project. When these types of materials are found in a pre-built assembly, making it difficult to separate out the cost, a calculation by weight may be used, per the equation describer in LEED MR-4.

Case Studies

<u>World Resources Institute Offices, Washington, D.C.</u>

Building a work environment that incorporated natural and sustainably harvested materials wherever practical was an important goal for the WRI since one of their main missions is biological resource stewardship. The building's reception area is floored with a bamboo product from China. For the floor in the elevator lobby, the designers used cork, which has been harvested sustainably on the Iberian Peninsula for centuries. Natural linoleum was used for the floors in the kitchen and workrooms. All doors throughout the offices are made from compressed wheat-straw fiberboard. The cabinetry used in the kitchens and workrooms of the WRI building are made from two biofiber materials. The structural walls of the cabinets are made from wheatboard, while the finished surface is Dakota Burl, a composite made from compressed sunflower seeds. The kitchen countertops are linoleum on a wheatboard substrate, while the office worksurfaces are made from a biocomposite comprised of soybeans and recycled newspaper. All of the millwork throughout the building was sealed using polymerized linseed oil. The paint used for accent patterns in the lunchroom was milk protein-based . (World Resources 2004)

<u>Real Goods Trading Corporation Showroom, Hopland, California.</u>

This building, also called the "Solar Living Center", was designed to be a model of sustainable building practices. As such, an effort was made to integrate natural or sustainably harvested materials into the building's design. The largest example of this strategy for this project is the composition of the building's rear wall. It was constructed from straw bales that were then coated with PISE, pneumatically impacted stabilized earth. PISE, a mixture of cement, water, and earth, is applied to walls with a spray gun. Besides being all-natural, these 26" walls have an exceptional R-value of 35 and significant thermal mass. Another sustainably produced product used for this building was Hardipanel, a cement and fiber panel made from natural, sustainably harvested fibers. These panels were used as exterior cladding on the south and west walls and to form the building's soffits. (Van der Ryn 2001)

Reference

Definitions

A renewable material is made from a commodity or resource that is inexhaustible or replaceable by new growth.

Standards

Standards have not been included for this Guideline.

Bibliography

Van der Ryn Architects. “Ecological Design Strategies and Features of The Real Goods Solar Living Center”. Methods. 2001. Van der Ryn Architects. 7 October 2004. <http://www.vanderryn.com/va/methods-strategies.html>

World Resources Institute. “Mission Design: WRI’s Office Environment”. Publications and Multimedia. 31 March 2004. World Resources Institute. 9 October 2004. <http://pubs.wri.org/pubs_description.cfm?PubID=3926>

(This page is intentionally blank)

Renewable Materials

MEQ-7-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: ______________________

Phase:

SD	DD	CD	FINAL
☐	☐	☐	☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	○	○ Ⓔ	○ Ⓔ	◉	◉

☐ **Required Component:**
A list of all renewable, rapidly renewable and agricultural waste materials that are used in the project is attached. The value of these materials is indicated as a percentage of the total cost of materials for the project. This project strived to specify rapidly renewable materials for 2.5% of the total value of project materials.

☐ **Optional Component:** *(To satisfy the requirements of LEED™ 2.1 Materials and Resources Credit 6: Rapidly Renewable Materials)*
This certifies that products made from rapidly renewable agricultural materials have been used for a minimum of 5% of the total value of all materials and products used for the project. The calculations used to determine this are attached.

Name ______________________ Signature ______________________

Company ______________________ Role in Project ______________________

Date ______________________

(This page is intentionally blank)