Materials and Resources (MR)

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Indoor Environmental Quality (EQ)

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Materials and Resources (MR)

GA02 Excerpt MR Overview. LEED BD+C RG v4 - Pgs. 475-480

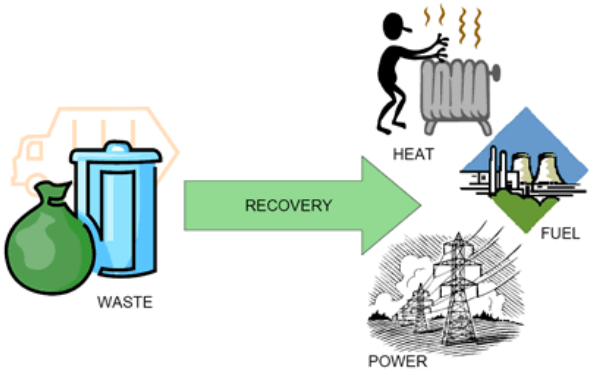
The Materials and Resources (MR) category addresses:

- ❑ Minimizing the embodied energy and other impacts associated with the extraction, processing, transport, maintenance, and disposal of building materials.

The Waste Hierarchy

Construction and demolition waste constitutes about 40 percent of the total solid waste stream in the United States and about 25% of the total waste stream in the European Union.

In its solid waste management hierarchy, the U.S. Environmental Protection Agency (EPA) ranks source reduction, reuse, recycling, and waste to energy as the four preferred strategies for reducing waste.



Life-cycle assessment (LCA)

- ❑ Life-cycle assessment (LCA) provides a more comprehensive picture of materials and products, enabling project teams to make more informed decisions that will have greater overall benefit for the environmental, human health, and communities, while encouraging manufacturers to improve their products through innovation.
- ❑ LCA is a "compilation and evaluation of the inputs and outputs and the potential environmental impacts of a product system throughout its life cycle."

Qualifying Products and Exclusions

- ❑ The MR section addresses "permanently installed building products," which as defined by LEED refers to products and materials that create the building or are attached to it.

  Examples include structure and enclosure elements, installed finishes, framing, interior walls, cabinets and casework, doors, and roofs. Most of these materials fall into Construction Specifications Institute (CSI) 2012 MasterFormat Divisions 3-10, 31, and 32. Some products addressed by MR credits fall outside these divisions.

- ❑ Furniture is not required to be included in credit calculations. However, if furniture is included in MR credit calculations, all furniture must be included consistently in all cost-based credits.
- ❑ Special equipment, such as elevators, escalators, process equipment, and fire suppression systems, is excluded from the credit calculations. Also excluded are products purchased for temporary use on the project, like formwork for concrete.

Determining Product Cost

To calculate the total materials cost of a project, use either the actual materials cost or the default materials cost.

- ❑ **Actual materials cost**. This is the cost of all materials being used on the project site, excluding labor but including delivery and taxes.
- ❑ **Default materials cost**. The alternative way to determine the total materials cost is to calculate 45% of total construction costs. This default materials cost can replace the actual cost for most materials and products, as specified above. If the project team includes optional products and materials, such as furniture and MEP items, add the actual value of those items to the default value for all other products and materials.

Location Valuation

Several credits in the MR section include a location valuation factor, which adds value to locally produced products and materials. The intent is to incentivize the purchase of products that support the local economy.

- ❑ Products and materials that are extracted, manufactured, and purchased within 100 miles of the project are valued at 200% of their cost (i.e., the valuation factor is 2).
- ❑ The distance must be measured as the crow flies, not by actual travel distance.

Example:
A project team purchases 50 doors salvaged from a local deconstruction site and sold through a local Habitat for Humanity ReStore for $500. The value of equivalent new doors is documented at $400 each, or $20,000. Their contribution to the credit is as follows:

$20,000 x 1.0 criterion valuation * 2.0 location valuation = $40,000
$40,000 is the total sustainable criteria value for these doors

Determining Material Contribution of an Assembly

Product value ($) = Total product cost ($) x (%) product component by weight x (%) meeting sustainable criteria

Figure 2. Sustainably produced components of $500 office chair

Table 1. Example calculation for $500 office chair

Chair component	Percentage of product, by weight	Value of component	Percentage of component meeting sustainability criteria	Value of sustainability criteria
Fastening hardware	2%	$10	25% preconsumer recycled content	$1.25
Cotton fabric	5%	$25	100% certified by Rainforest Alliance	$25.00
Plastic component	25%	$125	10% postconsumer recycled content	$12.50
Armrest	5%	$25	10% postconsumer recycled content	$2.50
Metal base	20%	$100	25% preconsumer recycled content	$12.50
Steel post	8%	$40	40% preconsumer recycled content	$8.00
Wheels	5%	$25	10% postconsumer recycled content	$2.50
Total value contributing to credit				$64.25

LEED ADDRESSES THE FOLLOWING ISSUES RELATED TO MATERIALS AND RESOURCES:

- Conservation of materials
- Environmentally, socially, and locally preferable materials
- Waste management and reduction

STRATEGIES FOR CONSERVING MATERIALS THROUGHOUT A PROJECT'S LIFE-CYCLE:

- **REUSE EXISTING BUILDINGS AND SALVAGED MATERIALS.** Selecting resources that have already been harvested and manufactured results in tremendous materials savings.
- **PLAN FOR SMALLER, MORE COMPACT COMMUNITIES.** Reduce the need for new roads and other infrastructure by preventing sprawling land-use patterns.
- **DESIGN SMALLER, MORE FLEXIBLE HOMES AND BUILDINGS.** Use space-efficient strategies, reduce unused space such as hallways, and provide flexible spaces that can serve multiple functions.
- **USE EFFICIENT FRAMING TECHNIQUES.** Advanced framing, in which studs are spaced 24 instead of 16 inches on center, and structural insulated panels, which combine framing and insulation into one rigid component, use less material than conventional framing without compromising performance.
- **PROMOTE SOURCE REDUCTION IN OPERATIONS.** Designate office supply reuse centers. Encourage paper conservation through double-sided and electronic printing.

Environmentally preferable attributes to consider include:

- Support the local economy
- Sustainably grown and harvested
- Have intended end-of-life scenarios that avoid landfill
- Contain recycled content from industrial or consumer sources
- Made of bio-based material
- Free of toxins
- Long lasting, durable, and reusable
- Made in factories that support human health and workers' rights

Product transparency tools like life-cycle assessment (LCA), Environmental Product Declarations (EPDs), and material ingredient disclosures provide a more comprehensive picture of materials and products, enabling project teams to make informed decisions.

STRATEGIES TO PROMOTE SUSTAINABLE PURCHASING DURING DESIGN AND OPERATIONS:

- **IDENTIFY LOCAL SOURCES OF ENVIRONMENTALLY PREFERABLE PRODUCTS.** Using local materials not only reduces the environmental harms associated with transportation, it also supports the local economy.
- **DEVELOP A SUSTAINABLE MATERIALS POLICY.** Outline the goals, thresholds, and procedures for procurement of ongoing consumables and durable goods. Incorporate systems thinking. Evaluate materials based on their upstream and downstream consequences. Monitor compliance to ensure that the policy is effective.
- **SPECIFY GREEN MATERIALS AND EQUIPMENT.** Give preference to rapidly renewable materials, regional materials, salvaged materials, and those with recycled content. Choose vendors who promote source reduction through reusable or minimal packaging of products. Look for third-party certifications, such as the Forest Stewardship Council, Green Seal, and ENERGY STAR.
- **SPECIFY GREEN CUSTODIAL PRODUCTS.** Choose sustainable cleaning products and materials that meet Green Seal, Environmental Choice, or EPA standards to protect indoor environmental quality and reduce environmental damage.

STRATEGIES TO REDUCE WASTE DURING CONSTRUCTION:

- **DESIGN BUILDINGS THAT PRODUCE LESS WASTE.** Use strategies such as designing for dimensional construction materials, prefabrication, or material efficient framing.
- **DEVELOP A CONSTRUCTION WASTE MANAGEMENT POLICY.** Outline procedures and goals for construction waste diversion. This policy should specify a target diversion rate for the general contractor.
- **ESTABLISH A TRACKING SYSTEM.** Ensure that the general contractor provides waste hauler reports and captures the full scope of the waste produced. Designate a construction and demolition waste recycling area. Diligent monitoring will ensure that the policy is effective.

STRATEGIES TO REDUCE WASTE DURING OPERATIONS AND MAINTENANCE:

- **DEVELOP A SOLID WASTE MANAGEMENT POLICY.** Outline procedures and goals for solid waste diversion. This policy should specify a target diversion rate for the facility.
- **CONDUCT A WASTE STREAM AUDIT.** Establish baseline performance for the facility and identify opportunities for increased recycling, education, and waste diversion.
- **MAINTAIN A RECYCLING PROGRAM.** Provide occupants with easily accessible collectors for recyclables. Label all collectors and list allowable materials. Through signage or meetings, educate occupants about the importance of recycling and reducing waste.
- **MONITOR, TRACK, AND REPORT.** Use hauler reports or other reliable data to monitor and track the effectiveness of the policy. Track performance goals and provide feedback to the occupants.
- **COMPOST.** Institute an on-site composting program to turn landscaping debris into mulch. Work with the waste hauler to allow for collection and composting of food and other organic materials.
- **PROVIDE RECYCLING FOR DURABLE GOODS.** Institute an annual durable goods drive where e-waste and furniture are collected on site and disposed of properly through donation, reuse, or recycling. Allow occupants to bring e-waste and furniture from home.

Waste Stream Audit

- ❑ Understanding the content of a waste stream is the first step to improving the waste diversion rate at a facility.
- ❑ Results from the waste audit can reveal opportunities for increasing recycling and waste diversion and be used to adjust the recycling procedures at the facility.

Waste Management and Reduction

- ❑ Solid waste disposal contributes directly to greenhouse gas emissions through transportation and the production of methane—a potent greenhouse gas—in landfills.
- ❑ The intent of LEED credits in this category is to reduce the waste that is hauled to and disposed of in landfills or incineration facilities.
- ❑ In its solid waste management hierarchy, EPA ranks source reduction, reuse, recycling, and waste-to-energy as the four preferred strategies for reducing waste in landfills.
- ❑ Close the life-cycle loop by reusing and recycling on-site materials

GA08 Materials and Resources (MR) - Pgs. 91-112

Materials and Resources (MR)

Adaptation	NC	CS	S	R	DC	WDC	HOS	HC
Total	13	14	13	13	13	13	13	19
Storage and Collection of Recyclables	req	req	req	req	req	req	req	req
Const. and Demolition Waste Mgmt. Planning	req	req	req	req	req	req	req	req
PBT Source Reduction - Mercury	--	--	--	--	--	--	--	req
Building Life-Cycle Impact Reduction*	5	6	5	5	5	5	5	5
BPD&O - Environmental Product Declarations*	2	2	2	2	2	2	2	2
BPD&O - Sourcing of Raw Materials*	2	2	2	2	2	2	2	2
BPD&O - Material Ingredients*	2	2	2	2	2	2	2	2
PBT Source Reduction - Mercury	--	--	--	--	--	--	--	1
PBT Source Reduction - Lead, Cadmium & Copper	--	--	--	--	--	--	--	2
Furniture and Medical Furnishings*	--	--	--	--	--	--	--	2
Design for Flexibility	--	--	--	--	--	--	--	1
Const. and Demolition Waste Management*	2	2	2	2	2	2	2	2

Indoor Environmental Quality (EQ)

GA02 Excerpt EQ Overview. LEED BD+C RG v4 - Pgs. 611-616

The Indoor Environmental Quality (EQ) category addresses:

- ❑ Indoor Air Quality
- ❑ Thermal, visual, and acoustic comfort

High-quality indoor environments:

- ❑ Enhance productivity
- ❑ Decrease absenteeism
- ❑ Improve the building's value
- ❑ Reduce liability for building designers and owners

Cross-Cutting Issues

Floor Area Calculations and Floor Plans

For many of the credits in the EQ category, compliance is based on the percentage of floor area that meets the credit requirements.

Space Categorization

Occupied versus unoccupied space

All spaces in a building must be categorized as either occupied or unoccupied.

- ❑ **Occupied spaces** are enclosed areas intended for human activities.
- ❑ **Unoccupied spaces** are places intended primarily for other purposes; they are occupied only occasionally and for short periods of time—in other words, they are inactive areas.

Regularly versus nonregularly occupied spaces

Occupied spaces are further classified as regularly occupied or nonregularly occupied, based on the duration of the occupancy.

Regularly occupied spaces are enclosed areas where people normally spend time, defined as more than one hour of continuous occupancy per person per day, on average; the occupants may be seated or standing as they work, study, or perform other activities.

For spaces that are not used daily, the classification should be based on the time a typical occupant spends in the space when it is in use.

For example, a computer workstation may be largely vacant throughout the month, but when it is occupied, a worker spends one to five hours there. It would then be considered regularly occupied because that length of time is sufficient to affect the person's well-being, and he or she would have an expectation of thermal comfort and control over the environment.

Examples of regularly occupied spaces include the following:

- Airplane hangar
- Auditorium
- Auto service bay
- Bank teller station
- Conference room
- Correctional facility cell or day room
- Data center network operations center
- Data center security operations center
- Dorm room
- Exhibition hall
- Facilities staff office
- Facilities staff workstation
- Food service facility dining area
- Food service facility kitchen area
- Gymnasium
- Hospital autopsy and morgue
- Hospital critical-care area
- Hospital dialysis and infusion area
- Hospital exam room
- Hospital operating room
- Hospital patient room
- Hospital recovery area
- Hospital staff room
- Hospital surgical suite
- Hospital waiting room
- Hospital diagnostic and treatment area
- Hospital laboratory
- Hospital nursing station
- Hospital solarium
- Hospital waiting room
- Hotel front desk
- Hotel guest room
- Hotel housekeeping area
- Hotel lobby
- Information desk
- Meeting room
- Natatorium
- Open-office workstation
- Private office
- Reception desk
- Residential bedroom
- Residential dining room
- Residential kitchen
- Residential living room
- Residential office, den, workroom
- Retail merchandise area and associated circulation
- Retail sales transaction area
- School classroom
- School media center
- School student activity room
- School study hall
- Shipping and receiving office
- Study carrel
- Warehouse materials-handling area

Examples of nonregularly occupied spaces include the following:

- Break room
- Circulation space
- Copy room
- Corridor
- Fire station apparatus bay
- Hospital linen area
- Hospital medical record area
- Hospital patient room bathroom
- Hospital short-term charting space
- Hospital prep and cleanup area in surgical suite
- Interrogation room
- Lobby (except hotel lobby)*
- Locker room
- Residential bathroom
- Residential laundry area
- Residential walk-in closet
- Restroom
- Retail fitting area
- Retail stock room
- Shooting range
- Stairway

** Hotel lobbies are considered regularly occupied because people often congregate, work on laptops, and spend more time there than they do in an office building lobby.*

Occupied space subcategories

Occupied spaces, or portions of an occupied space, are further categorized as individual or shared multioccupant, based on the number of occupants and their activities.

- ❑ An **individual** occupant space is an area where someone performs distinct tasks.
- ❑ A **shared multioccupant** space is a place of congregation or a place where people pursue overlapping or collaborative tasks.

Examples of individual occupant spaces include the following:

- Bank teller station
- Correctional facility cell or day room
- Data center staff workstation
- Hospital nursing station
- Hospital patient room
- Hotel guest room
- Medical office
- Military barracks with personal workspaces
- Open-office workstation
- Private office
- Reception desk
- Residential bedroom
- Study carrel

Examples of shared multioccupant spaces include the following:

- Active warehouse and storage
- Airplane hangar
- Auditorium
- Auto service bay
- Conference room
- Correctional facility cell or day room
- Data center network operations center
- Data center security operations center
- Exhibition hall
- Facilities staff office
- Food service facility dining area
- Food service facility kitchen area
- Gymnasium
- Hospital autopsy and morgue
- Hospital critical-care area
- Hospital dialysis and infusion area
- Hospital exam room
- Hospital operating room
- Hospital surgical suite
- Hospital waiting room
- Hospital diagnostic and treatment area
- Hospital laboratory
- Hospital solarium
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- Hotel housekeeping area
- Hotel lobby
- Meeting room
- Natatorium
- Retail merchandise area and associated circulation
- Retail sales transaction area
- School classroom
- School media center
- School student activity room
- School study hall
- Shipping and receiving office
- Warehouse materials-handling area

Occupied space subcategories

Occupied spaces can also be classified as densely or nondensely occupied, based on the concentration of occupants in the space.

- ❑ A densely occupied space has a design occupant density of 25 people or more per 1,000 square feet, or 40 square feet or less per person.
- ❑ Occupied spaces with a lower density are nondensely occupied.

Indoor Air Quality

- ❑ The best way to prevent indoor pollutants is to eliminate or control them at the sources.

LEED ADDRESSES THE FOLLOWING ISSUES RELATED TO INDOOR ENVIRONMENTAL QUALITY:

- Indoor air quality
- Lighting
- Acoustics
- Occupant experience

STRATEGIES FOR DESIGNING FOR GOOD INDOOR AIR QUALITY:

- **PROHIBIT SMOKING.** Institute a no-smoking policy for the building and around building entrances, operable windows, and air intakes.
- **DESIGN FOR PROPER VENTILATION.** Consider the number of occupants in each space and the activities they will be engaged in. Make sure that the ventilation system, whether natural or mechanical, is sized appropriately and can provide enough fresh air.
- **PROTECT AIR THAT COMES INTO THE BUILDING.** Locate air intakes away from likely exhaust sources, such as idling vehicles or smoking areas. Use air filtration to remove outdoor air contaminants. The filters should have high minimum efficiency reporting value (MERV) ratings. The higher the MERV rating the greater the particulates captured by the filter.
- **TEST FOR RADON OR OTHER ON-SITE CONTAMINANTS.** If present, include a ventilation system to address possible emissions.
- **DESIGN FOR ENTRYWAY SYSTEMS.** Use grilles, grates, or mats at building entrances to reduce the dust, dirt, and contaminants carried into the facility by people's shoes.
- **SPECIFY LOW-EMITTING MATERIALS.** Use materials with low VOC emissions.

STRATEGIES FOR IMPROVING INDOOR AIR QUALITY DURING CONSTRUCTION:

- **KEEP BUILDING CLEAN DURING CONSTRUCTION.** Follow good housekeeping and dust control during construction.
- **PROTECT MATERIALS AND EQUIPMENT.** Protect materials from moisture exposure, protect and cap ducts and mechanical systems.
- **CONDUCT A FLUSH-OUT.** Before occupancy, flush out off-gassed compounds and other contaminants left behind at the end of construction.

STRATEGIES FOR IMPROVING INDOOR AIR QUALITY DURING OPERATIONS AND MAINTENANCE:

- **ENSURE ADEQUATE VENTILATION.** Operate ventilation systems to supply ample outside air to the occupants. Follow the most recent industry standards, such as ASHRAE Standard 62, Ventilation for Acceptable Indoor Air Quality.
- **MONITOR OUTDOOR AIRFLOW.** Use an outdoor airflow measurement device that can measure and control the minimum outdoor airflow rate.
- **MONITOR CARBON DIOXIDE.** Use monitors and integrate them with a ventilation system that regulates the supply of air based on occupants' demand. With demand-controlled ventilation, air flow is automatically increased if concentrations exceed a setpoint.
- **CALIBRATE SENSORS.** Perform routine preventive maintenance, such as calibrating sensors and monitors, to ensure that accurate data are used to modulate systems.
- **PROHIBIT SMOKING.** Enforce a no-smoking policy in the building and around building entrances, operable windows, and air intakes. Communicate the policy to building occupants through building signage and tenant meetings.
- **DEVELOP AND IMPLEMENT A GREEN CLEANING POLICY.** To minimize the introduction of contaminants, outline procedures and goals for the custodial program at the facility. This policy should specify standards for selecting cleaning products and technologies, such as Green Seal standards, California Code of Regulations, and certification of cleaning equipment from the Carpet and Rug Institute.
- **CONDUCT CUSTODIAL EFFECTIVENESS ASSESSMENT.** Identify opportunities for improving building cleanliness and reducing occupants' exposure to potentially harmful biological and particulate contaminants.
- **USE ENTRYWAY SYSTEMS.** Have grilles, grates, or mats at building entrances to reduce the dust, dirt, and contaminants brought into the facility by people's shoes. Develop cleaning procedures to properly maintain the entryway systems.
- **USE INTEGRATED PEST MANAGEMENT.** A coordinated program of nonchemical strategies, such as monitoring and baiting, will reduce the need for pesticides and other potentially toxic contaminants.

Lighting, Acoustics, Occupant Experience

Thermal Comfort

- ❑ Thermal comfort includes more than just temperature; it also includes humidity and air movement.

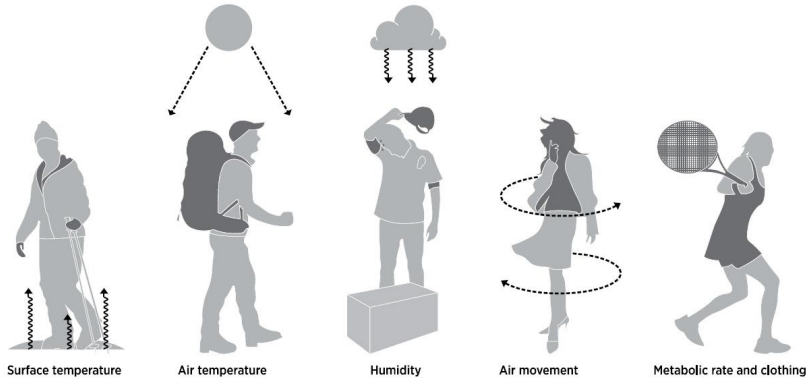

Figure 1. Primary factors that affect thermal comfort

Lighting Levels

Lighting levels and views to the outdoors are other important aspects of the indoor experience. Providing enough lighting for particular tasks is critical to protect occupants' eyesight over time.

- ❑ Studies by the **Heschong Mahone Group** have demonstrated that providing daylighting in classrooms can improve student scores by 7% to 18%.

STRATEGIES FOR IMPROVING OCCUPANTS' COMFORT AND CONTROL:

- **USE DAYLIGHTING.** Design the building to provide ample access to natural light and views for the occupants. Optimize access to views by using low partitions and vision panels.
- **INSTALL OPERABLE WINDOWS.** If possible, provide windows that can be opened to the outside. To save energy, sensors may be included to inform the HVAC system to shut down if a window is open.
- **GIVE OCCUPANTS TEMPERATURE AND VENTILATION CONTROL.** In mechanically ventilated buildings, provide thermostats that allow occupants to control the temperature in their immediate environment. Provide adjustable air diffusers that allow occupants to adjust the air flow as well.
- **GIVE OCCUPANTS LIGHTING CONTROL.** Provide adjustable lighting controls so that occupants can match lighting levels to their tasks. These may be designed in combination with daylight and occupancy sensors to conserve energy.
- **CONDUCT OCCUPANT SURVEYS.** Use valid survey protocols to assess occupants' satisfaction with the indoor environment. Evaluate results to identify areas of dissatisfaction and prepare a corrective action plan to make the necessary operational changes.
- **PROVIDE ERGONOMIC FURNITURE.** Include furniture that is adjustable to prevent repetitive stress injuries.
- **INCLUDE APPROPRIATE ACOUSTIC DESIGN.** Use soft surfaces and other strategies to ensure that sound levels remain comfortable for the activity level of the space.

GA08 Indoor Environmental Quality (EQ) - Pgs. 113-143

Indoor Environmental Quality (EQ)

Adaptation	NC	CS	S	R	DC	WDC	HOS	HC
Total	16	10	16	15	16	16	16	16
Minimum Indoor Air Quality Performance	req	req	req	req	req	req	req	req
Environmental Tobacco Smoke Control	req	req	req	req	req	req	req	req
Minimum Acoustic Performance	--	--	req	--	--	--	--	--
Enhanced Indoor Air Quality Strategies*	2	2	2	2	2	2	2	2
Low-Emitting Materials*	3	3	3	3	3	3	3	3
Construction Indoor Air Quality Mgmt Plan	1	1	1	1	1	1	1	1
Indoor Air Quality Assessment	2	--	2	2	2	2	2	1
Thermal Comfort	1	--	1	1	1	1	1	1
Interior Lighting	2	--	2	2	2	2	2	1
Daylight	3	3	3	3	3	3	3	2
Quality Views*	1	1	1	1	1	1	1	2
Acoustic Performance	1	--	1	--	1	1	1	2