

LEED - AN OUTLINE FOR REINFORCED CONCRETE PIPE

General Overview

"LEED (Leadership in Energy and Environmental Design) is a voluntary, consensus-based national rating system for developing high-performance, sustainable buildings. Developed by the U. S. Green Building Council (USGBC), LEED addresses all building types and emphasizes state-of-the-art strategies for sustainable site development, water savings, energy efficiency, materials and resources selection, and indoor environmental quality. LEED is a practical rating tool for green building design and construction that provides immediate and measurable results for building owners and occupants. The U.S. Green Building Council (USGBC) is a non-profit organization committed to expanding sustainable building practices. USGBC is composed of more than 15,000 organizations from across the building industry that are working to advance structures that are environmentally responsible, profitable, and healthy places to live and work. Members includes building owners and end-users, real estate developers, facility managers, architects, designers, engineers, general contractors, subcontractors, product and building system manufacturers, government agencies, and non-profits." ¹

USGBC's stated objective is "to transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy, and prosperous environment that improves the quality of life... buildings and communities will regenerate and sustain the health and vitality of all life within a generation." ²

While the LEED program is the USGBC's effort to create a uniform national standard for what constitutes a green building and sustainable building practices. The LEED system does not certify products to be used in LEED projects. Rather, the system sets forth a design and construction process through which component products contribute to a project's capacity to achieve LEED points.

A product's ability to help a project to earn LEED points depends upon the extent to which that product has specific qualities considered 'sustainable' or 'green', as set forth by USGBC. No individual product can be LEED certified. However, products can help a construction or renovation project obtain LEED Points by satisfying the LEED threshold specifications. It is the individual producer who must certify that their product satisfies LEED requirements applicable to a given project.

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The LEED System:

The ultimate purpose of USGBC's LEED system is to improve occupant well-being, enhance environmental performance and increase the lifetime economic return of buildings by establishing innovative practices, standards for component materials and technologies based on sustainable and green practices. The system addresses operational and maintenance issues, project development and delivery processes

LEED Rating Systems include, but are not limited to:

LEED - New Construction

LEED - Existing Buildings

LEED - Commercial Interiors

LEED - Core and Shell

LEED - Homes (Residential)

LEED - Neighborhood Development

LEED - Market Sector Rating Systems (Schools, Retail, Healthcare, etc.)

Currently, the most widely implemented LEED Rating System is New Construction and Major Renovation (LEED-NC)

The LEED-NC system is centered around six basic categories:

Site Sustainability (SS)

up to 14 LEED-NC Points Available

- *develop only appropriate sites*
- *reuse existing buildings and/or previously developed sites*
- *protect and conserve natural and agricultural areas*
- *restore damaged areas to provide wildlife habitat*
- *promote biodiversity*
- *reduce the need for automobile use*
- *limit disruption of natural water hydrology*

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Water Efficiency (WE)

up to 5 LEED-NC Points Available

- *eliminate the use of potable water or other natural surface or subsurface water used for landscape irrigation*
- *reduce potable water supply and generation of wastewater by the building*

Energy and Atmosphere (EA)

up to 17 LEED-NC Points Available

- *establish and optimize energy-efficient system performance*
- *support ozone protection protocols*
- *encourage renewable and alternative energy sources*

Materials and Resources (MR)

up to 13 LEED-NC Points Available

- *reduce the amount of materials needed*
- *use materials with less environmental impact*
- *reduce and manage waste*
- *promote the use of material with recycled content*
- *promote the use of regional materials*

Indoor Environmental Quality (EQ)

up to 15 LEED-NC Points Available

- *establish good indoor air quality*
- *manage, reduce and/or eliminate the sources of indoor air pollutants*
- *insure thermal comfort and system controllability*
- *provide for occupant connection to the outdoor environment*

Innovation in Design (ID)

up to 5 LEED-NC Points Available

- *provide an opportunity for projects to be awarded points for exceptional performance above the requirements set out by the LEED system*
- *facilitate the ability to award points for innovative performance in categories not specifically addressed by the LEED system*
- *support and encourage the design integration required by LEED*

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The LEED rating system provides for the accumulation of points for a given project. Various levels of certification have been established by USGBC for the LEED program, thereby providing a set of classifications for rating the sustainability of that project.

LEED sustainability classifications consider the entire project as related to the building structure, including the vertical and horizontal infrastructure, structure(s) footprint, impervious surface area, resource conservation, and energy conservation. There are currently four LEED-NC certification levels, based on points accumulated:

Platinum LEED Certification	52-69 points
Gold LEED Certification	39-51 points
Silver LEED Certification	33-38 points
LEED Certification	26-32 points

The LEED process provides for third-party certification that a project meets the building and performance standards set forth by LEED:

- The project must submit an application through the USGBC and provide documentation throughout the project to receive credit for possible LEED points.
- The points available for each LEEDS category varies from project to project.
- A project checklist is used to allocate LEED points for various specific design and building elements of a given project... such as the types of construction materials used or the efficiency achieved.
- The key to getting LEED points lies in designing for energy efficiency, minimizing the project waste streams and to the extent possible, using renewable materials throughout to create a 'green' project.

LEED - Applications for RCP

Reinforced Concrete Pipe (RCP) is a remarkably versatile building component. It can be used in a wide variety of construction applications with LEED benefits. One of the

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most common is as a construction material in stormwater transmission and control. Since it is typically produced near the job site, using materials originating a short distance from the factory, RCP can receive LEED credits in the Materials and Resources (MR) section. Many progressive producers of RCP incorporate recycled materials in their production processes, thereby earning additional LEED-MR points. RCP's proven durability and reduced bedding requirements accrue Site Sustainability (LEED-SS) points.

Examples - LEED credit with RCP

LEED-NC (SS Credit 6.1) Stormwater Design, Quality Control

- Intent - Limit disruption natural water hydrology by reducing impervious cover, increasing all inside infiltration, reducing or eliminating pollution from storm water runoff, and helping eliminate contaminants.

LEED-NC (SS Credit 6.2) Stormwater Design, Quality Control

- Intent - Limit disruption of natural water flows by managing storm water runoff

LEED-NC (WE Credit 1.1) Water Efficient Landscaping: Reduced by 50%

- Intent - Limit or eliminate the use of potable water, or other natural surface or subsurface water resources available on or near the project site, for landscape irrigation

LEED-NC (WE Credit 1.2) Water Efficient Landscaping: No Potable Use or No Irrigation

- Intent - Eliminate the use of potable water, or other natural surface or subsurface water resources available on or near the project site, for landscape irrigation

LEED-NC (WE Credit 2) Innovative Waste Water Technologies

- Intent - Reduce generation of wastewater and potable water demand, while increasing the local aquifer recharge

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LEED-NC (MR 2.1) Construction Waste Management [1 LEED Point]

Intent - Recycle and/or salvage at least 50% of non-hazardous construction and demolition debris

• *The standard's specific wording: "Divert construction and demolition debris from disposal in landfills and incinerators. Redirect recyclable recovered resources back to the manufacturing process. Redirect reusable materials to appropriate sites"*

• *RCP removed from the project site can be sent to salvage yards or facilities that recycle RCP. The number of points depends upon the portion of construction and demolition debris is salvaged/recycled:*

- 50% (MR 2.1) = 1 LEED Point

- 75% (MR 2.2) = 1 + 1 LEED Points

• *A waste management plan should be in place that identifies materials which can be diverted from disposal, and how those materials will be sorted.*

• *The calculations for this credit can be done by weight or volume as long as they are consistent throughout the project.*

• *Excavated soils or debris from the land clearing cannot contribute to this credit.*

LEED-NC (MR 2.2) Construction Waste Management [1 LEED Point*]

Intent - Recycle and/or salvage at least 75% of non-hazardous construction and demolition debris

(* 1 LEED Point in addition to LEED Point earned in MR 2.1)

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LEED-NC (MR 3.1) Materials Reuse 5% [1 LEED Point]

Intent - Use 5% salvaged, refurbished or reused materials

• *The standard's specific wording: "Reuse building materials and products in order to reduce demand for virgin materials and to reduce waste, thereby reducing impacts associated with the extraction and processing of virgin resources"*

• *LEED Points can be earned by employing salvaged, refurbished or reused RCP on the project, such that the sum of these materials constitutes at least 5% (MR 3.1) or 10% (MDR 3.2), based on the total cost value of all materials on the project:*

- 5% (MR 3.1) = 1 LEED Point

-10% (MR 3.2) = 1 + 1 LEED Points

• *It is also possible for the project to receive an additional LEED Point under the Innovation in Design (ID) section for exemplary performance when a project documents that the value of salvaged or reused materials employed on the project is equal to at least 15% of the total materials cost.*

• *For RCP to help the project obtain LEED-NC Points under this section, the RCP used must typically be salvaged or reused from another site. However, RCP recovered from the project site can often be approved for this application*

• *The cost of the reused material will be either the actual cost paid for the reused or salvaged material or the replacement value of the material which came from the recovery site. LEED specifications allow that, if the actual cost paid for the reused or salvaged material is below the cost of an equivalent new item, the higher value of the new material can be used in the calculations. Also if the cost to reclaim an item found on site is less than the cost of an equivalent*

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new item, the higher cost of the new item may be used in the calculations.

LEED-NC (MR 3.2) Materials Reuse 10% [1 LEED Point**]
Intent - Use 10% salvaged, refurbished or reused materials
(** 1 LEED Point in addition to LEED Point earned in MR 3.1)

LEED-NC (MR 4.1) Recycled Content 10% [1 LEED Point]
Intent - Use 10% recycled content

LEED-NC (MR 4.2) Recycled Content 20% [1 LEED Point***]
Intent - Use 20% recycled content (see *MR 4.1, above*)
(*** 1 LEED Point in addition to LEED Point earned in MR 4.1)

• *The standard's specific wording: "Increase demand for building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials"*

• *LEED Points can be earned through the use of materials with recycled content such that the such of post-consumer recycled content, plus one-half of the pre-consumer content constitutes at least 10% (MR 4.1) or 20% (MR 4.2) of the total materials cost for the project:*

- 10% (MR 4.1) = 1 LEED Point

- 20% (MR 4.2) = 1 + 1 LEED Points

• *An increase in the documented use of recycled materials, as set forth above, to a level of 30% or more can lead to an additional LEED Point under the Innovation in Design section (LEED-ID)*

• *The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly*

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weight is then multiplied by the cost of entire assembly to determine its recycled content value for LEED calculations

Recycled content shall defined in accordance with the International Organization of Standards (ISO) document

ISO 4021 (Environmental Labels and Declarations - Self-Declared Environmental Claims - Type II Environmental Labeling)

- *Post-Consumer Material is defined by the USGBC as the waste material generated by households or commercial, industrial and institutional facilities in their role as end users of a product, which can no longer be used for its intended purpose*

- *Pre-Consumer Material is defined by the USGBC as that material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as re-work, re-grind or scrap generated in a process and capable of being reclaimed within the same process that generated it. (USGBC has determined that fly flash should be considered a pre-consumer recycled content material)*

- *The recycled content value is calculated by multiplying the percentage of the post-consumer recycled content by the material cost plus one-half of the value of the pre-consumer recycled content multiplied by the material cost:*

Recycled Content Value (\$) =

$$(\% \text{ post-consumer recycled content} \times \text{material cost}) + \frac{(\% \text{ pre-consumer recycled content} \times \text{material cost})}{2}$$

- Note that only half of the pre-consumer recycled material counts toward recycled content value

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- *The percent recycled content is calculated by dividing the recycled content value by the total materials cost:*

$$\text{Percent Recycled Content} = \frac{\text{Recycled Content Value (\$)}}{\text{Total Materials Cost (\$)}}$$

- Supplementary Cementitious Materials (SCM) - under LEED-NC (MR 4) the recycled content value of concrete is allowed to be calculated by the mass of the cementitious material only. For example, if the SCM used is fly ash and 150 pounds/cubic yard of concrete is used in the mix, the fly ash would represent only 5% of the material (assuming concrete @ 3,000 lbs/yd). However, LEED-NC (MR 4) allows the design team to calculate the recycled material based on the fraction of cementitious materials only.

- Below are three examples for Reinforced Concrete Pipe design mixes and the calculations that would be performed in determining the LEED-applicable recycled amounts under LEED-NC (MR 4) :

Example 1 Small Diameter Dry Cast Pipe: Vibration System
(based on cubic yard of concrete)

- Type I/II Cement: 745 lbs @ \$113.21/ton
- Grand Blast Furnace Slag: 230 pounds @ \$96.60/ ton
- Type F Fly Ash: 250 pounds @ \$16/ton

Example 2 Large Diameter Dry Cast Pipe: Packer Head System
(based on a cubic yard of concrete)

- Type I/II Cement: 388 lbs @ \$113.21/ton
- Grand Blast Furnace Slag: 185 pounds @ \$96.60/ ton
- Type F Fly Ash: 42 pounds @ \$16/ton

Example 3 - 5000 lb/in² Webcast Pipe or Box Culvert
(based on a cubic yard of concrete)

- Type I/II Cement: 394 lbs (cost \$113.21/ton)
- Grand Blast Furnace Slag: 170 pounds @ \$96.60/ ton
- Type F Fly Ash: 0 pounds @ \$16/ton

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<u>Mix</u>	<u>Mass-Cement</u>	<u>Mass-SCM</u>	<u>Mass-Total Cementitious Materials</u>	<u>Mass-SCM as % Total Cementitious</u>	<u>\$ Value of All Cementitious</u>	<u>Recycled Content Value per Yard³</u> <small>(SCM/2 x \$ Value)</small>
Ex 1	745 lb	480 lb	1225 lb	39.2%	\$55.28	\$10.83
Ex 2	388 lb	227 lb	615 lb	36%	\$30.68	\$5.66
Ex 3	394 lb	170 lb	564 lb	30.1%	\$30.00	\$4.52

- Once the value of recycled cementitious content per cubic yard is calculated, the amount of recycled content in the total amount of reinforced concrete pipe can be computed for the project.

- Reinforcement contained in the pipe should also be calculated as a recycled content value and listed as a line item for the reinforced concrete pipe on that project.

- Project data and calculations are required on a submittal template from the project's LEED coordinator. The data required to track recycled content must include a description of the material, the manufacturer of the material, the product cost, the pre-consumer and/or post-consumer recycled content percentages, and the source of the recycled content data.

LEED-NC (MR 5.1) Regional Materials 10%

[1 LEED Point]

Intent - Use 10% regionally manufactured and/or extracted materials

LEED-NC (MR 5.2) Regional Materials 20%

[1 LEED Point****]

Intent - Use 20% regionally manufactured and/or extracted materials

(**** 1 LEED Point in addition to LEED Point earned in MR 5.1)

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- *The standard's specific wording: "Increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation"*
- *Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site for a minimum of 10% of the total cost of the project's materials value*
- *If only a fraction of a product or material has been extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) may contribute to the project's Regional Value under LEED-NC (MR 5)*
- *Includes only materials that are permanently installed in the project*
- *Regionally Manufactured Materials are defined by the USGBC as materials that are assembled as a finished product within a 500 mile radius of the project site. For the purposes of determining LEED-NC (MR 5) credit, assembly does not include on-site assembly, erection or installation of finished components*
- *Regionally Extracted Materials are defined by the USGBC as materials having their source as a raw material from within a 500 mile radius of the project site*

To calculate the percent of local materials:

$$\text{Percent Local Materials} = \frac{\text{Total Cost of Local Materials (\$)}}{\text{Total Materials Cost (\$)}}$$

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LEED-NC (ID 1.1-4) Innovation in Design [1 LEED Point]

Intent - Earns "bonus" LEED points above the those received from satisfying the standard requirements set by USGBC LEED Green Building Rating System

LEED-NC (ID 2.0) LEED Accredited Professional [1 LEED Point]

Intent - At least principal participant of the project team shall be a USGBC LEED Accredited Professional

• In order to create a system that effectively responds to ever-changing, constantly improving sustainability strategies, the LEED system created the Innovation in Design (ID) Points category. It's aim is to allow projects to gain points and recognition for innovative building practices, design and features which contribute to the body of knowledge in sustainable building. This credit can be used to gain LEED points for project performance that greatly exceeds LEED requirements, as well as to gain LEED points for sustainable building/development benefits not addressed directly by the LEED system. There are a total of four LEED-NC (ID) Points available through the Innovation in Design category

• Reinforced Concrete Pipe (RCP) can be made of several recycled materials that allow the project to claim LEED-NC (ID) Points under the Materials and Resources (MR) section for the materials with recycled content

• Backfill Requirements should be considered when designing a project to achieve LEED credit. Among the advantages that RCP has over competitive products lies in the fact that RCP can be installed using the native material removed by trenching as backfill. In many instances, it is not necessary to extract, process or transport imported fill or reinforcing material