NOTIFICATION

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Living Building Challenge Document

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Cascadia is issuing a challenge to all building owners, architects, engineers and design professionals to build in a way that will provide all of us and our children with a sustainable future.
Why the Living Building Challenge?

The release of The Living Building Challenge has created a great deal of interest and excitement in the green building community. It appears to be the right idea at the right time, although admittedly it is not a program that most projects and project teams will immediately be able to use. Immediate uptake will likely be small due to the difficulty of the standard, but over time more and more projects will comply. It is important then to be clear about the reasons for the release of our standard. In our challenge document we describe the following as context:

Several things have transpired in the short time since LEED 1.0 emerged that put the Living Building Standard in context:

1. LEED has been adopted at a far greater rate than anyone’s expectations and has begun to transform the whole building industry. LEED has continued to evolve and improve and many municipalities have adopted LEED Silver as a baseline standard.

2. Multiple Platinum Buildings have emerged around the country and some with zero or small first-cost premiums, signaling that the market is ready to move beyond Platinum in the near future.

3. The USGBC has begun to explore the idea of LEED V3.0 as a major restructuring of how its system works. The specifics have not yet been determined and the implementation timeline is likely another one to two years.

4. Zero energy and zero waste water buildings are beginning to emerge around the country and the cost of wind, solar and other sustainable technologies continue to drop just as it is becoming clear that we are past the point of peak oil and cheap energy. Carbon neutral construction of buildings will no doubt follow.

5. Most significantly, it is clear that major environmental trends such as climate change are directly linked to human resource use and from the building industry itself. The rate of change and potential disastrous scenarios for our communities and quality of life are increasing. It is also clear that public opinion is finally awakening to that reality as evidenced by the shift in mass media attention of the issue, the Clinton Climate Initiative, the Mayor’s Climate Initiative, the 2030 challenge and governmental efforts led by the State of California and elsewhere.

Because of these issues, Cascadia feels compelled to release The Living Building Challenge to provide a signal to the green building industry where it needs to head in the next few years if we are to address the daunting challenges ahead. Cascadia views this Living Building Standard as an act of optimism and faith in the marketplace to reach high-level goals once they have been set. Cascadia believes that the Living Building Standard described here will be met in the Cascadia bio-region and elsewhere within the next three years, with increasing numbers of Living Buildings appearing within the next five years.

What we are learning from the marketplace is that there are several other compelling reasons to release an ambitious tool such as our challenge. These reasons include the following:
Why the Living Building Challenge?

1. **Inspiration and Poetry** – the green building movement has experienced phenomenal growth over the last half decade, and yet to be successful we must motivate and train significantly larger numbers on how to produce more responsible buildings and projects than our current trajectory. *The Living Building Challenge* is serving a critical role to inspire people to begin the steps necessary to change the built environment. Without ways to inspire people our success will be limited. The reaction to our challenge has been highly positive and new ‘recruits’ are occurring due to the inspiration that has been provided. In the words of one of our correspondents, “the issuance of this challenge is a life-changing event for this architect.”

2. **The Psychology of the ‘end-game’** – People like challenges. Creative and ambitious individuals respond to goals that have been clearly articulated for them. Left to their own devices the market is able to produce incredibly elegant solutions to problems that were seemingly unreachable. *The Living Building Challenge* creates a new benchmark that attempts to use the ‘ideal’ level of performance as its indicator. Without benchmarks there is nothing for the building community to respond to. Now that the level has been codified, living buildings will emerge.

3. **Early Adopters** – As more and more LEED buildings get built the early adopters and leading practitioners need new ‘summits’ to climb to show the extent of their expertise and to differentiate themselves from less knowledgeable competitors. Our tool provides a new and daunting challenge.

4. **Models for the Future** – It is our belief that it will become increasingly apparent that a fundamental shift in the way we design, build and operate our built environment is required. Significant shifts in efficiency and impacts will be required to face the challenges ahead. When this time comes, *The Living Building Challenge* will have delivered by providing multiple built models that showcase the level of performance that is needed for a sustainable future to be realized. When the time comes – we will be ready.

5. **Stirring the Pot** – The green building movement has much to be proud of. From a small fringe movement it has grown into the fastest growing trend in the industry. Significant improvements have been made in terms of awareness and acceptance of green building ideas. And yet, we cannot afford to rest on our laurels as a movement. Too many projects are labeled ‘green’ that have significant environmental impact and only minor improvements. Many have become satisfied or complacent with modest or token progress. The LB Challenge serves as a reminder of how far we need to get to with our building designs in order to be truly successful.

6. **Pulling the Market Forward** – There are many ways to move a market, and one way is to tug at the ‘top end’. Now that the top end has been raised, we believe that it will begin to pull the whole market forward. While we do not foresee a huge number of living buildings being built in the first few years, we do believe that it will result in more overall LEED buildings and more projects willing to pursue higher levels of performance. More projects will move from Silver to Gold, and Gold to Platinum – inspired and encouraged by those that do pursue a LB rating.

“The issuance of this challenge is a life-changing event for this architect...”
– email submission
The document you are reading is intended, like the tool it represents, as a living and continuously improving tool. Each month it is our intention to add to it with additional resources, ideas and tips to help guide the process of designing and building a living building. It begins as a digital document for ease of change, and at certain milestones, dictated by the amount of content created, Cascadia will release bound copies, which can be easily shared by coworkers and design teams pursuing the milestone. We ask you to only print the pages you absolutely need and to rely on the online document. This first version, is a mere skeleton. It releases the first set of rules governing the challenge and provides a framework for the future additions, clearly outlining where we intend to head in the months ahead. We anticipate many questions and issues and welcome the feedback from the whole community. The challenges we face as an industry cannot be solved by any one single organization – even one as diverse as Cascadia.

We welcome your ideas and contributions and are actively seeking diagrams, tools and resources we can use to populate our guide. All contributions will be credited. We look forward to facilitating a community of individuals stretching from coast to coast in both the United States and Canada sharing resources and ideas, examples and lessons learned that we’ll use to build this document and the greater living building site. We predict that living buildings will begin to emerge within a few short years and will play a nascent but pivotal role in redefining the relationship between the built and natural environments for the future. We feel honored to be a part of the process and look forward to the journey ahead with all who read this document.

A National and International Program

The Cascadia Region Green Building Council is excited to launch an international program built on The Living Building Challenge. We will be seeking out projects primarily in the United States and Canada, but will work with other countries interested in carrying the Challenge overseas. Our preferred overseas collaboration will work through organizations linked to the World Green Building Council, but other established green building organizations may qualify.

Within the United States, Cascadia (and our voluntary advisory group) will provide all technical development and support of the program and we will be collaborating with the US Green Building Council for linkages to the LEED Rating system and to a national design competition.

A Call for Technical Reviewers

The Living Building Challenge requires that all projects receive an audit after a minimum of 12 months of operations that occurs on-site. Because of that, we intend to build a network of expert 3rd-party reviewers around the US and Canada to minimize travel distances to any particular project. Technical reviewers will need to have considerable green building experience to qualify. As projects become registered in different locations we will seek to identify qualified reviewers in close proximity to the actual projects. Cascadia will likely need at least three months notice prior to the audit process unless our reviewer infrastructure is already in place in your community. Specific qualifications for the position will be posted on The LB Challenge web site in coming months.

We predict that living buildings will begin to emerge within a few short years and will play a nascent but pivotal role in redefining the relationship between the built and natural environments.
The Living Building Challenge

Any sustainable design tool or program is built upon a central logic that is used to organize and provide structure to it. Traditionally, sustainable design tools/programs were organized from a bottom-up perspective, starting with a conventional project and listing the things that one had to do differently in order to be ‘green’. This approach was typically additive – the more you did, the better you scored and the better rating that was achieved. Flexibility for various project types was handled by allowing people to pick and choose between a long list of preferred features, materials or strategies allowing people to determine how ‘green’ they wanted to be and in what way. The first program of this nature in the United States was the Austin Green Builder program which was awarded a commendation at the 1993 Rio Earth Summit. It was ground breaking and paved the way for residential green building programs all over the United States. These tools and the programs built around it could be voluntary or require some sort of documentation, but few required on-site verification.

The most influential and well-known program of this nature is the LEED Rating system created by the US Green Building Council, that dealt originally with commercial office buildings. Like the Austin program, it was created around an additive and bottom-up logic, which has proven incredibly effective at helping design teams understand how to move from where they are to a better place. LEED required more extensive documentation and reviews than ever before and brought a level of rigor and credibility into the green building industry that was lacking. One of LEED’s more interesting characteristics is a system of ‘pre-requisites’ that are required as a first step before a project can even qualify for the program. This idea is transformational because it suggests that the additive approach is by itself inadequate and that there are some things that all projects need to do in order to call themselves ‘green’.

It is this idea, the idea of the pre-requisite that The Living Building Challenge is built around and takes to a whole different paradigm by making everything a prerequisite. One does not get to pick and choose between energy and water for example. Flexibility is achieved by proscribing the ultimate level of performance as a prerequisite – not what you have to do specifically or how you have to do it, which is left up to the ingenuity of the design team.

In this way, The LB Challenge takes a top-down rather than bottom up approach, starting not with how to be less bad, but rather attempting to define the ideal or ultimate target and making that the only level of compliance. The other main difference is that it is not and additive process, but a temporarily subtractive one by allowing exceptions in a few areas where the market (codes or materials) makes it extremely difficult or impossible to achieve currently. Over time as markets shift and codes mature these exceptions will be adapted or removed.

Key aspects of The LB Challenge logic are explained further below.
Logic of the Tool

No Credits, Just Prerequisites

One of the downfalls of an additive system is that invariably project teams figure out how to exploit the system by chasing the ‘cheapest’ or easiest points. Buildings may in fact get ratings that are poor environmental models in certain areas thereby confusing the market as to what a green building really is. Programs get around this by giving higher recognition (4 stars, platinum ratings etc.) for projects that do a great deal of things better and designing the system so that its impossible to ignore whole areas of impact to get the higher rating.

The paradox however, is that the more you do, the more you also have to do to prove it under an additive, bottom-up system, thereby increasing documentation and ultimately punishing the more progressive projects indirectly. For example, in the LEED rating system documenting a Platinum building takes considerably more time than documenting a certified building; and when time is money in a professional setting the additional documentation can cost considerable amounts to a project.

The LB Challenge approaches this challenge differently since it isn’t designed to take a typical project and make it less bad. The challenge is designed from the beginning to try and help the most advanced projects achieve an ‘ideal’ level of performance based on what is possible today (which admittedly is still not ideal) and making those characteristics all prerequisites. As a result, there is no way to ‘work the system’. A building is either a living building or its not.

Implicit vs. Explicit

Rather than an additive prescriptive approach where we could have listed 387 different things a project had to do to get to an ideal level of performance, we built the system to target ultimate levels of impact thereby allowing us to ‘collapse’ whole groups of strategies and materials into only 16 prerequisites. As Antoine de Saint-Exupery once said “Perfection is reached when there is nothing left to take away.” While we have hardly reached perfection, we have reached a level of simplicity in our system that belies its integrity and level of performance. One of strategies inherent in the logic, is the notion of making things implicit vs. explicit. For example, there is one energy pre-requisite; net zero energy. The Net Zero Energy goal has been made explicit, but implicit in the requirement are dozens of strategies that should be done in order to make the building as efficient as possible prior to using renewable energy. The extreme cost of renewable energy systems provides the catalyst for teams to first reduce their energy requirements. If they don’t choose to – then they will waste a great deal of money, but the result will still be no non-renewable energy used to power the building.

1 This is meant as humor- 387 is a random number… but does characterize the large quantity of things one could do to green a project to the highest level possible.

Perfection is reached when there is nothing left to take away.
- Antoine de Saint Exupery
Logic of the Tool

Performance Based vs. Prescriptive

For all aspects of our program the particular mix of strategies and materials is up to the experience of the design team to figure out—provided that they meet the ultimate level that is explicit. It is implied or taken for granted that best practices will be done on a project that is trying to achieve (and willing to spend the money on) this high level of performance and it is recognized that innovative teams will come up with novel ways to reach a given level of performance if given the opportunity to do so. Prescriptive measures are fine for beginners who are just learning what to do differently, but advanced design teams should be given freedom to be innovative, which we feel will ultimately bring down the cost of building living buildings. The performance based nature of the tool also allows the program to be highly flexible relative to building type and building location, since the mix of strategies can change as needed, provided that the ultimate level is met.

Simpler Documentation

The LB Challenge is challenging enough without the documentation process being overly onerous. Since our standard is built around only 16 pre-requisites, there is inherently less documentation required than many programs. By requiring an audit for every project, the documentation can be streamlined further, since many things can be quickly verified in person that would be harder to prove via paperwork alone. The audits also provide an elevated rigor and integrity since things can be verified more accurately in the field in many cases. The goal of the challenge is to make documentation as simple as possible so that teams spend as much of their time and resources on the project itself.

Chasing the Ideal but with Market Realities

The LB Challenge is intended to get us as close as possible to a truly sustainable building given current market conditions and realities. It is not intended to be a utopian or impossible standard. Because of that, our standard includes a series of ‘exceptions’ that are temporary allowances or loopholes to recognize key realities. For example, health codes all over the country forbid using rain catchment for potable sources such as drinking water. There is an exception to the Net Water prerequisite as a result that acknowledges that reality. As more communities allow for rain catchment (with on-site water testing for quality) to be used for drinking water, then that exception will go away.

An important point to understand however is that The Living Building Challenge is incredibly difficult and many projects will not be able to qualify because there is something inherently unsustainable about the project or the jurisdiction that it resides in. For example, where it is illegal to catch water for building use, a living building would not be possible until those unsustainable regulations go away. In a gentle way our tool signals to the market where changes to the codes are required.
The Petal Process

Achieving all of the prerequisites for The Living Building Challenge on a given project is difficult – extremely difficult. Many projects around North America get quite close, but due to certain constraints aren’t able to achieve all of them. We hope that each of these projects seriously pursue a LEED rating to receive the recognition that they deserve from the US and Canadian Green Building Councils. That said, Cascadia would still like to identify and recognize projects that get close through following our specific protocol requirements.

Projects that are able to meet all the pre-requisites within a given section such as energy or water can be said to earn ‘Petals’ for their project. For example, the Missouri Department of Conservation Discovery Center in Kansas City features a closed loop water system using a living machine to treat all blackwater on site. While being a high-performing green building, it does not necessarily meet the remaining prerequisites and can’t yet be considered a living building – but it should receive acclaim for the significant achievement on the water-side. Projects may apply to receive ‘Petals’ from Cascadia’s International Living Building Program by following the protocols outlined in this user’s guide. Projects must meet all the prerequisites for a complete section to receive a ‘Petal’ and follow the same documentation and audit process.

The Petal Program is designed to showcase cutting edge examples of the Living Building being achieved in sum, by projects in climate zones around North America. Projects that receive one or more petals receive the following benefits:

1. A case study placed in our Living Building web site for the world to see.
2. A mention in our newsletter of the project’s achievement linked to the web site.
3. Mention in our annual conference for the great achievement.

The Petal Program is perfect for existing buildings that would like additional recognition for the level of their performance as well as for projects that pursued The Living Building Challenge yet could not achieve some of the prerequisites.
Updates, Feedback, Questions

Updates

The Living Building Challenge and its user’s guide are a constantly evolving process. Cascadia reserves the right to update and make changes to the documents and tools as it sees fit to further the mission of creating significant change in the built environment. That said, it is our intention to try and gather comments and proposed changes and issue updates on a regular interval so as to provide as little confusion as possible. All documents will abide by a consistent naming convention as follows: 1.1, 1.2, 1.3, etc.

Both the User’s Guide and the Challenge document will bear the same version number for simplicity, even though the user’s guide will continue to be fleshed out more frequently. Once projects have registered they ‘lock-in’ the version their project will qualify under and Cascadia will keep archived versions of the earlier document on file for reference. Projects may choose to ‘re-register’ if the current version makes more sense for the project in question.

The latest version of The Living Building Challenge document will always appear for free download on the Cascadia web site. The User’s guide and archived versions exist only in the subscription site – and are not to be printed in their entirety or distributed to non-subscribers.

Feedback and Questions

Cascadia is constantly looking for feedback from the community on issues that are problematic or require clarification. A dialogue site is made available to the public for free in the first half of 2007 to start the process. This site will then move to the subscription portions. Questions may be posed about any aspect of the program and responses will be given as quickly as possible for the community to see. Occasionally people will propose modifications to the standard that are innovative enough to warrant a new release. We encourage people to help us make the standard as rigorous as possible.

Specific ‘exceptions’ are never granted for a single project – however if a project raises an issue or has a proposal that furthers the goal of the tool we will adopt it for all future releases, and all projects then benefit.
Rules and Procedures

Rates and Pricing

Living Building Rate

Living Building Community Membership - $100.00

Registering allows you participation in our online community forum and a one-year subscription to our ongoing living building user’s guide and tools based on the date of the purchase.

Audit Pricing

Audit pricing reflects the costs necessary for review of documentation, but also to pay for on-site audits to ensure a quality review.

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<th>Project Size</th>
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Documentation Summary

Providing documentation in the Living Building System is intended to be as simple as possible while ensuring integrity and rigor for the standard. This summary outlines the current thinking about how projects will prove compliance with the standard. As such, it is currently undergoing review by our technical committees and will likely change over the next few months before being settled into a set of final documentation guidelines. Once new projects have been operating continuously for at least a year they may submit documentation to start the process. Existing projects in place for more than 12 months may submit at any time for petals or to apply for the whole challenge.

There are three ways that a prerequisite is verified:

1. Verified at Audit, documentation used as reference
2. Partially-Verified at Audit as well as documentation review
3. Not Verified at Audit – verified solely through documentation
Below is a draft version of our current documentation process. Submittal templates will be created soon to make the process easier and examples of acceptable submissions will be shown since many of the submittals could be open to interpretation. Cascadia reserves the right to ask for additional documentation at any time in order to ensure a good audit. Cascadia also reserves the right to change documentation requirements at anytime.

The Audit Process

*The Living Building Challenge* can only be met after a project has been built and operational for at least a year. Projects do not have to be new, in fact it is highly encouraged that older projects adopt the challenge and get retrofitted to perform at the level of the living building. New buildings alone cannot get us where we need to go. The audit process is very straightforward and involves the following steps:

1. **Register Your Intent to Meet *The Living Building Challenge*** – This can be done at any time – in fact the earlier the better so that project teams can participate in the ongoing Living Building community forums that will be incredibly helpful in reaching the level of the standard. Projects may also choose to register just prior to the audit process as well. Either way, a modest registration fee is required and goes towards helping us administer the program.

2. **Submit Documentation** – Your project team is required to submit documentation for all 16 prerequisites if Living Building Status is desired. You may also select to have your project reviewed for single or multiple ‘petals’ if you want to demonstrate significant leadership in some but not necessarily all the sections. Paperwork is intentionally kept simple and as straightforward as possible. Templates will be provided for all submittals to make the process even easier. Once we have received your documentation, an independent, third-party technical group is engaged to review your submittal. In some cases multiple reviewers are necessary to properly review your project and documentation. A review fee based on the project size is required at this phase as well to cover the review time. It is likely at this point that our reviewers will have questions regarding your submission and we will follow up with questions if necessary.

3. **Site Visit and Final Audit** – Once we are satisfied that all written documentation is in order we will send a ‘Living Building Inspector’ to visit your project at a mutually agreed upon time. Key project members and the project owner will need to be available on-site to answer questions should they arise. The audit process will take between 2-8 hours depending upon the size and complexity of the building and the number of ‘petals’ being pursued. The Inspector must have access to all portions of the building and site for the inspection and must be allowed to take photographs.

It is highly encouraged that older projects adopt the challenge and get retrofitted to perform at the level of the living building.
4. **Certification** – Once our audit is satisfied your project team leader will be notified and the following things occur if living building status is achieved:

a) we will send out a press release celebrating the huge environmental achievement of the project

b) we will place a case study of your project on our website and send out a notice to our membership

c) we will award you with a distinctive plaque for your project to demonstrate as you see fit

d) we will send certificates to all members of your project design team congratulating them on the accomplishment.

If for some reason there are items lacking in the project that therefore contradict the submission documents, you will be notified of what actions need to be rectified to meet final compliance. Projects that receive any of the petals will be celebrated in Cascadia’s newsletter and on our website and the project will be added to our user’s guide as a case study.

5. **Corrections and Re-submissions** – Project teams may choose to ‘rectify’ any deficiencies in their project or submissions and re-apply for missing petals and a new audit. Previously accepted petals are not re-audited unless desired. Single petal pricing then applies. Any grievances about the review process and results should be sent directly to Cascadia.

Although highly difficult to achieve, understanding and documenting compliance with our system is inherently easy. No credits to count, models to create and large paperwork to compile. Just sixteen simple and profound prerequisites that must be met.
Scale Jumping

The Living Building Challenge was designed to work as a stand-alone tool for any project, new or existing, of any building type. It outlines significant milestones in six key areas that if exceeded represent the highest level of environmental performance currently possible in the US and Canada. It advocates for projects to have their own ‘green infrastructure’ - because the typical urban, suburban or rural infrastructure is so inefficient, over-scaled and polluting. For example, we transport huge volumes of sewage several miles using water as a medium and then have to expend great amounts of energy and chemicals in order to clean the water. We generate electricity from coal, nuclear and hydro plants, often dozens and sometimes hundreds of miles away from our end uses and create enormous environmental pollution, while wasting significant energy through transmission losses. When something happens to this giant infrastructure thousands and sometimes millions are affected.

Living Buildings as such have their own ‘utility’ generating their own energy and processing their own waste. They more appropriately match scale to technology and end use and result in greater self-sufficiency and security. That said, the ideal scale is not always at the level of a single building. Depending on the technology, the ‘optimal scale’ when considering environmental impact, first cost and operating costs can vary.

Physical constraints, of a particular project may also make it impossible to achieve living building status. Multi-story buildings in dense urban environments will likely have a difficult time achieving net zero status due to neighbors shading their solar apertures or simply not having enough aperture (south facing roof or walls) to begin with.

To address these concerns The Living Building Challenge has created the concept of ‘Scale-Jumping’ to allow groups of buildings or projects to operate in a symbiotic state – sharing green infrastructure as appropriate and allowing for living building status to be achieved as elegantly and inexpensively as possible. In the same way that groves of aspen trees share resources from tree to tree, networks of living buildings may share resources.

The following chart illustrates the concept and provides an alternative pathway for various prerequisites to be met.
Along the top of the matrix are a series of scales and along the vertical axis are the 16 prerequisites of The Living Building Challenge. The four scales identified include:

- **Building Scale**: representing a single building project.
- **Neighborhood Scale**: representing a cluster of buildings, block development or a small subdivision typically under the control of a single developer or a small group of home-owners or business owners. Typically no bigger than 4 city blocks in size.
- **Village/Campus Scale**: representing a college, university, corporate or government campus or a community no bigger than a few thousand people.
- **City Scale**: represents cities and towns of any size.

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<th>Building Scale</th>
<th>Neighborhood Scale</th>
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<td>Construction Waste</td>
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<td>Net Zero Water</td>
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<td>Sustainable Water Discharge</td>
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<td>Civilized Work</td>
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<td>Source Control</td>
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<td>Ventilation</td>
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<tr>
<td>Design for Spirit</td>
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<tr>
<td>Inspiration and Education</td>
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</tbody>
</table>

The matrix shows the progression of prerequisites across different scales, with symbols indicating where each prerequisite applies.
Design Overlays

Scale jumping allows for those prerequisites with arrows sliding from left to right to be met at any scale that the arrows touch. For example, a neighborhood may decide to build a single living machine to treat all the homes wastes collectively, rather than trying to make each home have its own ‘utility’. This has the advantage of allowing costs (both first and operating) to be spread evenly among all homeowners. A small village or campus may wish to purchase a single large wind turbine to provide all its electricity – thus meeting the requirement.

Existing Buildings & Historic Structures: An Overlay

Since The Living Building Challenge is designed as a performance based tool rather than a prescriptive one, it is applicable in any building type and any age of building. Design teams are given the task of figuring out the right mix of materials, systems and strategies to get their project to the level of performance dictated. That said, existing buildings and historic structures pose unique challenges and this quick overlay is provided to guidance. This section will be expanded over time.

The first thing is to understand that it may not be possible for many existing buildings to reach the living building status – although many could easily achieve single or multiple petals and are encouraged to do so. Our ‘Scale-Jumping’ protocol may prove to be the best pathway for many existing buildings if they can become part of a larger network.

What about Renovations?

Partial renovations or new additions cannot apply for Living Building Status on their own unless they operate as independent buildings that happen to be attached to existing buildings. That said, we encourage all renovations to be done in compliance with The Living Building Challenge. Existing buildings that undergo updating and renovations may apply for the challenge.

Exemptions and Modifications for Existing Buildings

- There are some exemptions for existing buildings and automatic prerequisite compliance. If an existing building is being renovated, the renovated portions of the building must comply with all aspects of the challenge. Untouched portions have certain things ‘grandfathered in’.
- Buildings Built prior to 1945 or any building on the National Historic Registry are exempt from Prerequisite One.
- Prerequisite Two is automatically met for buildings built prior to 2006.
- Habitat Exchange must be done for the whole building’s sf regardless of new/old mix.
- Net Zero Energy must account for the whole buildings energy use regardless of the new/old mix.
The Materials Red List must be followed for any new additions or renovations, however existing building areas do not have to rip out and replace materials and can be considered 'grandfathered' in. Buildings older than 1972 typically have lead paint for example, which is difficult to remove. The only exception is that mechanical systems need to replaced if they use CFCs and HCFC’s.

Carbon Offset’s must only be done for the new portions of the building.

FSC wood is only required in the renovated areas. All other wood is grandfathered in and may remain.

The radius distances apply only for new portions of the structure. The existing structure is grandfathered in.

Construction Waste percentages need only be met for the new construction/renovations. Teams do not have to document what was done historically.

Buildings built prior to 1945 or those on the national historic registry do not have to comply with the zero water requirements, although any new addition must do so. The building must however replace all toilets with dual flush toilets that use no more than 1.0 gallons/flush and urinals must be changed to the waterless urinal variety.

Buildings built prior to 1945 or those on the national historic registry do not have to document pre-requisite Fifteen.

Climate Zones

The Living Building Challenge advocates for a bioregional approach to design. Solutions, strategies, materials and designs should be informed by the unique characteristics of the bioregion. Designers should have different design responses based on where a given project is located and take into account local climate as well as cultural and specific site clues. As with the rest of the challenge – how a project team does this is up to them and success is determined by the team’s ability to understand the best response to place, climate and culture. For the purposes of this challenge Cascadia has identified twelve (12) regions within North America where we will be looking for Living Buildings to emerge – expecting different design responses and unique solutions to achieve our stringent criteria.

In determining the 12 regions, Cascadia was informed by previous regional classification work as well as our own experience as a bioregional chapter. We decided to organize the regions based on a mix of climate, ecology, political realities and boundaries – the result being a new hybrid way of looking at North America that we think could help shape future collaborations and possibly the emergence of larger, more effective Chapters in the future that borrow from the Cascadia model and extend into Canada, the US and Mexico. The influences include the following:
Design Overlays

**Cascadia's Success as a Bioregional Chapter**

The people, climate and building industry of the Pacific Northwest have much in common and are better served by sharing across human-made boundaries that divide the States and the Province of BC. Even though the region is actually more than one bio-region, there is enough coherence to bind the region together. A network of local branches support the Chapter. We encourage similar regions to form and share information and ideas. For example, The states and province that border the great lakes need to work together to protect the watershed of one of the most important fresh water sources in the world.

**The Köppen Climate System**

The Köppen Climate Classification System is the most widely used system for classifying the world’s climate and generally coincides with vegetation and soil patterns. The system recognizes 5 major climate types based on annual and monthly averages of temperature and precipitation.
Heating and Cooling Degree Days

We overlaid charts for heating and cooling degree days as part of the analysis to try and shape the divisions since it would influence green design decisions.

Political Units

Where possible we did follow political boundaries where it made sense and didn’t where we felt it didn’t. For example, we suggest California as its own region, even though parts of it could be justified in other regions from a climate perspective. We did this because California tends to have leading political initiatives that influence trends on its own such as Title 24 and vehicle emissions standards and the population size of the state. California is ‘distinct’ enough to be its own region. We also tried to group areas together that had much in common – for example the maritime provinces of Canada + Maine due to climate and cultural factors.

North America Eco-regions

We overlaid the map of North America Eco-regions to help form the twelve regions. The result is the 12 Living Building Challenge Bioregions.
## Design Overlays

### Living Building Challenge Bioregions

<table>
<thead>
<tr>
<th>Region</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cold North</strong></td>
<td>Alaska, Yukon Territory, Northwest Territories, Nunavet, Northern Alberta, Northern Saskatchewan, Northern Manitoba, Northern Ontario, Northern Quebec</td>
</tr>
<tr>
<td><strong>Cascadia</strong></td>
<td>BC, Oregon, Washington, Southern Alaska</td>
</tr>
<tr>
<td><strong>Northern Plains &amp; Mountains</strong></td>
<td>Southern Alberta, Southern Saskatchewan, Southern Manitoba, Idaho, Montana, North Dakota, South Dakota, Wyoming, Colorado</td>
</tr>
<tr>
<td><strong>Great Lakes</strong></td>
<td>Southern Ontario, Minnesota, Wisconsin, Michigan, Ohio, Upstate New York</td>
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<tr>
<td><strong>Southern Quebec</strong></td>
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<tr>
<td><strong>Maritime</strong></td>
<td>Nova Scotia, Newfoundland and Labrador, New Brunswick, Prince Edward Island, Maine</td>
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<tr>
<td><strong>California</strong></td>
<td></td>
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<tr>
<td><strong>Arid South</strong></td>
<td>Nevada, Arizona, Utah, New Mexico, Western Texas, Northern and Central Mexico</td>
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<tr>
<td><strong>Heartland</strong></td>
<td>Nebraska, Kansas, Oklahoma, Iowa, Missouri, Illinois, Indiana</td>
</tr>
<tr>
<td><strong>Northeast</strong></td>
<td>Virginia, West Virginia, Maryland, Delaware, Pennsylvania, New Jersey, Massachusetts, Coastal New York, New Hampshire, Vermont, Rhode Island</td>
</tr>
<tr>
<td><strong>The South</strong></td>
<td>Eastern Texas, Louisiana, Arkansas, Mississippi, Alabama, Georgia, Kentucky, Tennessee, North Carolina, South Carolina, Northern and Central Florida</td>
</tr>
<tr>
<td><strong>Tropics</strong></td>
<td>Hawaii, Puerto Rico, Southern Mexico, Southern Florida</td>
</tr>
</tbody>
</table>

We will be using this overlay as part of our framework to recognize the first projects by region.
Design Overlays

Building Types for The Living Building Challenge

Since *The Living Building Challenge* describes levels of performance rather than prescriptive measures, it is appropriate for any building type, of any size, new or existing anywhere on the planet. We encourage project teams to submit for Living Building Status for any building type. In particular, we identify the following project types that make up our matrix of opportunities, and are open to other additions:

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Cold North</th>
<th>Cascadia</th>
<th>Northern Plains &amp; Mountains</th>
<th>Great Lakes</th>
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<tbody>
<tr>
<td>Single Family Residential</td>
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<tr>
<td>Multi-Family Housing</td>
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<td>Mixed Use</td>
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<tr>
<td>Retail</td>
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<tr>
<td>Museums/Galleries</td>
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<tr>
<td>Visitor/Education Centers</td>
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<tr>
<td>Schools (K-12)</td>
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<tr>
<td>Laboratories/Clean Rooms</td>
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<tr>
<td>University Classroom Buildings</td>
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<tr>
<td>City Hall/State/Courthouses</td>
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<tr>
<td>Theatres/Performance Halls</td>
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<tr>
<td>Office Buildings</td>
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<tr>
<td>Churches/Places of Worship</td>
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<tr>
<td>Industrial/Manufacturing</td>
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<tr>
<td>Athletic Facilities/Community Centers/Aquatic Centers</td>
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<tr>
<td>Police/Fire Stations</td>
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<tr>
<td>Hospitals</td>
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</tbody>
</table>
## Design Overlays

<table>
<thead>
<tr>
<th>Southern Quebec</th>
<th>Maritime</th>
<th>California</th>
<th>Arid South</th>
<th>Heartland</th>
<th>Northeast</th>
<th>South</th>
<th>Tropics</th>
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Introduction to the Modules

New content coming from Jason.
SITE MODULE

*Humanity has co-opted enough land - it is time to draw boundaries and declare it enough.*

**Major Environmental Issues/Prerequisite Intents**

The continued outward spread of development and sprawl threatens the few wild places that remain. The decentralized nature of our communities increases transportation impacts and pollution. As flat, easy-to-build-on land diminishes, more and more development tends to occur in sensitive areas that are easily harmed or destroyed. Invasive species threaten existing ecosystems, which are already weakened by the constant pressure of development. The intent of these prerequisites is to clearly articulate where it is acceptable to build and how to protect and restore a place once it has been developed and degraded.

**Ideal and Current Limitations**

The ideal is to stop the seemingly never-ending growth outward and focus it into compact, connected communities, which is an inherent conservation tool for the natural resource systems that support human health. As previously built-on land is restored, the trend is reversed and nature's functions are invited back into a healthy interface with the built environment.

The intent of these prerequisites is to clearly articulate where it is acceptable to build and how to protect and restore a place once it has been developed and degraded.
Prerequisite One – Responsible Site Selection

Summary

You may not build on the following locations;

- Within 50-feet of Wetlands\(^1\)
- On or adjacent to Sensitive Ecological Habitats\(^2\) such as Primary Dunes\(^3\), Old Growth Forest\(^4\), Virgin Prairie\(^5\).
- Prime farmland\(^6\)
- Within the 100 year flood plain\(^7\)

Documentation

Verification Method – Verified at Audit.

Documentation Required Before Audit

1. An acceptable image must be provided that shows conditions on the site prior to development if the project is new and conditions 5 years earlier if existing. Acceptable images could include: Aerial photo of the project or Google-Earth Close-up of the project or site plan with site information clearly labeled is submitted. This information is not used in the official audit except as a guide.

2. A Letter from Owner stating that prerequisite is met and that the project does not conflict with any of the site restrictions. A template will be provided in the near future.

Potential Additional Documentation

- A Letter from a state or provincial biologist may be required as additional information depending upon adjacent land uses.

- If project is taking an exception related to wetlands and habitat, then copies of conservation program literature must be included in the submission. If the exception relates to farmland – photo’s proving it is a working farm must be included. If it is part of an existing urban core, then aerial photo will suffice.

---

1 Unless the building’s purpose is related to wetland protection or interpretation.
2 Sensitive Ecological Habitats will be defined in the User’s Guide.
3 Unless the building’s purpose is related to primary dune protection or interpretation and demonstrates that the site’s ecological systems are not disturbed.
4 Unless the building’s purpose is related to forest protection or interpretation and demonstrates that the site’s ecological systems are not disturbed.
5 Unless the building’s purpose is related to prairie protection or interpretation and demonstrates that the site ecological systems are not disturbed.
6 Unless the building is related to farming or is a working farm/farmhouse.
7 Unless part of an existing urban core where significant density exists.
Site Module

Case Studies
Forthcoming

Resources
Forthcoming

Helpful Tips
Forthcoming
Prerequisite Two – Limits to Growth

Summary

Projects may only be built on previously developed sites, either greyfield or brownfield.8

Documentation

Verification Method – Verified at Audit through visual inspection.

Documentation Required Before Audit

1. An acceptable image that shows the adjacent properties in 2007 and no later. Development date locked in at 2007. Image must show land-use on all sides of property. Aerial Photos, Google Earth close-ups of the project or Site Plan of the site prior to construction may suffice. Examples of acceptable submissions will be provided in the near future.

Previously developed sites include any site that has existing structures, extensive site disturbance or had at one time. Greenfield sites that are surrounded on three adjacent sides by development may be considered greyfield.

Case Studies

Forthcoming

Resources

Forthcoming

Helpful Tips

Forthcoming

8 Unless the building purpose is related to the protection or interpretation of the virgin land.
Site Module

Prerequisite Three - Habitat Exchange

Summary

For each acre of development, an equal amount of land must be set aside as part of a habitat exchange.

Documentation

Verification Method – Verified through documentation.

1. A signed letter from the owner of the project stating that prerequisite has been met. Template to be provided.

2. A copy of the site plan with site acreage clearly marked. Examples to be provided.

3. A copy of the receipt for the Habitat Exchange donation to one of the authorized Living Building Programs and the amount offset.

Potential Additional Documentation

If the property is on an EPA designated Brownfield, then a letter from the EPA showing the property status, including that the property was properly abated is sufficient to waive this requirement.

A list of accepted Habitat Exchange Programs will be provided shortly.

Case Studies

Forthcoming

Resources

Forthcoming

Helpful Tips

Forthcoming
Energy Module
The Living Building Challenge

User's Guide

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Energy Module

ENERGY MODULE

A living building relies solely on current solar income.

Major Environmental Issues/Prerequisite Intents

The majority of energy generated today is from unsustainable sources including coal, gas, oil and nuclear energy. Large-scale hydro, while inherently cleaner, brings widespread damaging ecosystem impact. The effects of these energy sources on regional and planetary health is becoming more and more evident, with climate change being the most worrisome of major global trends due to human activity. The intent of this prerequisite is to signal a new age of design, whereby all buildings rely solely on renewable forms of energy and operate year in and year out in a pollution-free manner. Since renewable energy sources are inherently more expensive than energy efficiency measures, efficiency as a first step is assumed.

Ideal and Current Limitations

The ideal is simple - a safe, reliable decentralized power grid relying completely on renewable energy powering incredibly efficient buildings. The major limitation currently is cost.
Prerequisite Four – Net Zero Energy

Summary

100 percent of the building's energy needs supplied by on-site renewable energy on a net annual basis.

Documentation

Verification Method – Partially Verified at Audit and also through documentation.

Documentation Required Before Audit

1. Photographs of all renewable energy systems and a two-page summary of how the system works and major components.

2. Letter from owner that intent has been met.

3. A photocopy of energy bills for a continuous 12-month period.

4. A letter from the local utility verifying the amount of energy purchases – and if net metering exists, the amount bought back.

Case Studies

Forthcoming

Resources

Forthcoming

Helpful Tips

Forthcoming

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1 Must include all electricity, heating and cooling requirements. Back-up generators are excluded. System may be grid-tied or off the grid.

2 Renewable energy is defined as photovoltaics, wind turbines, water-powered microturbines, methane from composting only, direct geothermal or fuel cells powered by hydrogen generated from renewably powered electrolysis.
The intent of these prerequisites are to remove, from a health standpoint, the worst known offending materials, and to reduce and offset the environmental impacts associated with the construction process.

MATERIALS MODULE

Safe, healthy and responsible for all species.

Major Environmental Issues/Prerequisite Intents

The environmental issues surrounding materials are numerous and include health and toxicity, embodied energy, pollution and resource depletion. The intent of these prerequisites are to remove, from a health standpoint, the worst known offending materials, and to reduce and offset the environmental impacts associated with the construction process. At the present time it is impossible to gauge the true environmental impact and toxicity of the buildings we build.

Ideal and Current Limitations

The ideal is a future where all materials in the built environment are safe and replenishable and have no negative impact on human and ecosystem health. The precautionary principle guides our materials decisions.

There are significant limitations to achieving the level of the Living Building in the materials realm. The biggest limitation is due to the market itself. While there are a huge number of “green” products on the market, there is a shortage of good data that really backs up manufacturer claims and provides consumers with the ability to make conscious, informed choices. Cascadia recognizes the PHAROS\(^1\) protocol developed by the Healthy Building Network as the best framework for evaluating sustainable materials and the most progressive tool for consumer benefit. Projects are encouraged to eliminate all known persistent bio-accumulative toxins (PBT’s), carcinogens and reproductive toxicants.\(^2\)

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1. [www.pharosproject.net](http://www.pharosproject.net)
2. For more information see: [http://www.healthybuilding.net/healthcare/HCWH-CHD-POP_PBT_list.pdf](http://www.healthybuilding.net/healthcare/HCWH-CHD-POP_PBT_list.pdf)
Prerequisite Five – Materials Red List

Summary

The project cannot contain any of the following red list materials or chemicals.

- No added formaldehyde
- Halogenated Flame Retardants
- PVC
- Mercury
- CFC’s
- HCFC’s
- Neoprene (chloroprene)
- Cadmium
- Chlorinated Polyethylene and Chlorosulfonated Polyethylene
- Wood treatments containing Creosote, Arsenic or Pentachlorophenol
- Polyurethane
- Lead
- Phthalates

The Materials Red List is intended to identify and eliminate the worst in class chemicals and materials from the built environment from a human and ecological health standpoint. All of the materials on the red list are commonly found in building materials and at various stages of their products lifecycle can pose serious risks to human health. Alternative (and safer) products are available as substitutes for all of these materials, although a few are more difficult to replace or avoid than others. A summary of the rationale for including each of these chemicals on the red list follows.

Halogenated compounds: Halogenated compounds are a class of materials consistently associated with some of our most serious environmental health problems.

3 Cascadia is going to adopt an ongoing ‘red-list’ of materials that it believes should be phased out of production due to health/toxicity concerns. This list will be updated as new science emerges.
4 Halogenated flame retardants include: PBDE, TBBPA, HBCD, Deca-BDE, TCPP, TCEP, Dechlorane Plus and other retardants with bromine or chlorine.
5 A temporary exception is made for PVC in wiring applications where it is mandated by code.
6 A temporary exception is made for low-mercury fluorescent lighting.
7 HDPE and LDPE are excluded.
8 An exception is made for solder and off-grid solar battery systems only.
9 Some of the content of this section is excerpted from, “The PBT-free Challenge,” by Tom Lent and Julie Silas of the Healthy Building Network, published in Sustainable Architecture for Health (working title) upcoming from Wiley Press.

http://www.oehha.ca.gov/prop65.html
Materials Module

The ideal is a future where all materials in the built environment are safe and replenishable and have no negative impact on human and ecosystem health.

– from cancer to ozone depletion. Technically speaking these are materials with a halogen element connected to a carbon atom, usually bromine, chlorine, or fluorine. Polyvinyl chloride (PVC), brominated flame retardants (BFRs), and chlorofluorocarbons (CFCs) are examples of halogenated compounds. Many halogenated chemicals are highly persistent (they may take months or years to break down into safer compounds) and bioaccumulative (they concentrate as they work their way up the food chain toward humans). Tiny amounts can travel long distances and build up to highly hazardous concentrations.

Chlorinated Plastics and Dioxins: Dioxins are an unavoidable by-product of the manufacture, combustion, and disposal of materials containing chlorine - most notably polyvinyl chloride (PVC) and other chlorinated plastics on the Red List – and of cement kilns fired by hazardous waste. Dioxins are the most potent human carcinogens; they cause developmental damage, are associated with endometriosis, and can alter the reproductive, immune, and endocrine systems at infinitesimally low doses. Three quarters of all PVC use is in building materials such as flooring, pipes, wall coverings, roofing membranes, furniture, carpet backings, and curtains. As customer demand for PVC-free products is increasing, manufacturers are responding by investing in research, development and product innovation as evidenced by a steady stream of chlorine-free alternatives hitting the marketplace.

Recognized chlorinated plastics include:

- Chlorinated polyethylene (CPE)
- Chlorinated polyvinyl chloride (CPVC)
- Chlorosulfonated polyethylene (CSPE)
- Polychloroprene (CR or chloroprene rubber, also brand name Neoprene)
- Polyvinyl chloride (PVC)

Chlorine and Ozone Depletion: The leading causes of destruction of the ozone layer are all halogenated compounds. The primary ones used in buildings are the fluorocarbons used in air-conditioning equipment and foam insulation. Chlorinated fluorocarbons (CFCs) have been largely phased out, but hydrochlorofluorocarbons (HCFCs) are still in use. While HCFCs have shorter atmospheric life than CFCs, they still release chlorine into the atmosphere and contribute to ozone depletion.

Many polyisocyanurate and polyurethane foam insulation products use HCFCs, though a small number are available that are HCFC-free. Most refrigeration systems in the U.S. have switched from CFCs to HCFCs, with an increasing number of products coming to market that are completely HCFC-free. European countries, however, have moved to replace CFCs and HCFCs with hydrocarbons, which do not include the halogenated

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11 Note that The Living Building Challenge Red list excludes PVC except in the case of PVC wiring products where mandated by code and replacement with polyethylene sheathed conductors in BX or other PVC-free alternatives is not allowed.
chemicals chlorine or fluorine. The U.S. lags far behind.12 The recognized ozone depleters to avoid in buildings include:

- Chlorinated fluorocarbons (CFC)
- Hydrochlorofluorocarbons (HCFCs)

**Halogenated Flame Retardants (HFRs):** Halogenated flame retardants are chemicals used to reduce the flammability of fabrics, foams, and other plastics. Polybrominated diphenyl ethers (PBDEs) and other HFRs are linked to thyroid disruption, reproductive and neurodevelopmental problems, and immune suppression. HFRs are widely used in curtains, drapery and other textiles, mattress and furniture foam padding, and a host of electronics, including computers, fax and copy machines, and other plastic products needing fire protection. As states are beginning to institute bans on PBDEs and other HFRs, manufacturers are actively substituting alternative chemicals, using inherently flame resistant plastics, or redesigning products to avoid needing flame retardants altogether.13

Common HFRs to avoid in buildings include:

- Polybrominated diphenyl ethers (PBDEs) including decabromodiphenyl ether (Deca-BDE);
- Tetrabromobisphenol-A (TBBPA);
- Hexabromocyclododecane (HBCD);
- Tris(2-chloroisopropyl phosphate) (TCPP);
- Tris(2-chloroethyl) phosphate (TCEP);
- Dechlorane Plus; and
- Other flame retardants with bromine or chlorine

**Volatile Organic Compounds and Semi-Volatile Organic Compounds:** Volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) are gases that release from materials into the air and have been connected to a wide range of environmental and human health impacts, from smog formation to respiratory illness and cancer.

**Volatile Organic Compounds - Formaldehyde:** Volatile organic compounds (VOCs) are gases such as formaldehyde, which are readily released into the indoor air by

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12 The EPA’s Significant New Alternatives Policy (SNAP) Program evaluates and regulates substitutes for ozone-depleting chemicals being phased out under the stratospheric ozone protection provisions of the Clean Air Act (CAA Significant New Alternatives Policy (SNAP) from EPA can be found at http://www.epa.gov/ozone/snap/index.html

Materials Module

building materials. VOCs have been associated with short term acute sick building syndrome symptoms such as dizziness, headaches, or eye, nose, and throat irritation, and other longer-term chronic health effects such as damage to the liver, kidney and nervous system and increased cancer risk. There is also some concern that such VOCs may contribute to Multiple Chemical Sensitivity in specific individuals who exhibit reactions to indoor airborne chemicals. VOCs react with each other and other indoor air contaminants, such as ozone, to create additional potentially harmful compounds. VOCs are a component of and off-gas from a wide range of building materials, including carpets, resilient flooring, wall covering, ceiling tiles, furniture, wood products, and just about every other material used in buildings, as well as paints, adhesives, sealants, stains, varnishes and other wet applied products in and out of the building.

The most commonly found VOC in building materials is formaldehyde, a chemical used widely by industry to manufacture building materials and numerous office and household products. It is used commonly in textiles finishes and as a binder in building materials, particularly composite wood.

Recognized VOCs found in building materials include:

- Formaldehyde
- Acetaldehyde
- Toluene
- Benzene

Semi-Volatile Organic Compounds - Phthalates, Perfluorochemicals, and HFRs: Semi-volatile organic compounds (SVOCs) are released much more slowly than VOCs and often will attach to dust and other particles. Whereas VOCs tend to be emitted rapidly in the first few hours or days after installation of a product then taper off over time, SVOCs will be released by products more slowly and over a longer period of time. A range of chemicals of concern used as treatments for fabrics and other building materials, including HFRs and perfluorochemicals (PFCs), are showing up in increasing concentrations in human milk, blood and tissue samples, raising concerns about their growing potential for causing cancer or other health effects. Similarly, SVOCs have also been found in household dust released into the environment from building materials. 14

Recognized SVOCs commonly found in building materials include:

- Halogenated flame retardants (HFRs)
- Phthalates
- Perfluorochemicals (PFCs)

A range of chemicals of concern used as treatments for fabrics and other building materials, including HFRs and perfluorochemicals (PFCs), are showing up in increasing concentrations in human milk, blood and tissue samples, raising concerns about their growing potential for causing cancer or other health effects.
**Heavy Metals**\(^{15}\): Heavy metals such as lead, mercury, and cadmium are often used as stabilizers in other materials, most notably wiring and other PVC products, and can be found in roofing, solder, radiation shielding, and in dyes for paints and textiles. Heavy metals are not synthetic chemicals, they are extracted directly from ores in the earth. Their use in building products, however, leads to the release of these toxins into the environment during manufacture, production, use and disposal and can have serious effects on human and ecosystem health. Because heavy metals bioaccumulate and often can enter the water system, human exposure is of concern.

**Lead and Mercury:** Lead and mercury are potent neurotoxicants, particularly damaging to the brains of fetuses and growing children.\(^{16}\) The reliance on lead and mercury in the building industry has reduced significantly over the past twenty years, but lead continues to be used in flashing, terne, copper and other roof products, solder, and wire insulation jacketing. Major strides have been made to reduce mercury levels in fluorescent lamps, but it also is still used in thermometers, fluorescent lamps, thermostats and other control equipment, and in the manufacture of PVC in some chlor-alkali plants.\(^{17}\)

**Cadmium, Antimony, and Other Metals:** Cadmium, chromium, copper, and cobalt are heavy metals often used as dyes in paints and textiles. Cadmium is also used as a stabilizer of PVC. Cadmium is a carcinogen and can damage the kidney and lungs.\(^{18}\) Chromium and cobalt accumulate in aquatic life where humans can be exposed through the diet. Chromium can cause damage to the kidney and liver, as well as the circulatory and nervous systems. Copper is a significant aquatic toxicant and should be minimized so it is not released into stormwater systems, groundwater, and soil. Antimony, used to make the flame retardant antimony trioxide, is a suspected human carcinogen.

Regulatory agencies throughout the country and internationally have taken action to limit the amount of heavy metals permissible in our water, workplace, and food, including the U.S. Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), and the International Agency for Research on Cancer (IARC).

**Wood Treatments:** Wood treatments are used to protect wood from water, pests, and decay. Many of the common wood treatments used in the U.S., however, are known to have adverse effects on human health and the environment. The most recent controversy surrounded the chemical arsenic, which was the primary chemical in chromated copper arsenate (CCA-treated wood). Arsenic is a notoriously deadly poison, but for twenty years it was in the most common preservative applied to wood used to build playgrounds and outdoor decks in neighborhoods across the United States. Fortunately, the U.S. EPA halted the manufacture and sale of arsenic-treated wood for

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15 Some of the content of this section is excerpted from, “The PBT-free Challenge,” by Tom Lent and Julie Silas of the Healthy Building Network, published in Sustainable Architecture for Health (working title) forthcoming from Wiley Press.

16 Schettler, Ibid.

17 Lent, Ibid.

Materials Module

most residential uses as of January 1, 2004. Not so with two of the other Red-listed chemicals - creosote and pentachlorophenol.

Toxic wood treatments continue to be of concern in the U.S. Creosote comes from wood, coal, and the creosote bush. It can seep into soil and groundwater, especially near wood processing plants. It is also a toxicant for workers exposed, causing skin irritations, chemical burns of the eye, and respiratory effects. It is a known human carcinogen. In the U.K. creosote has been banned since 2003. However, in the U.S. it is still widely used, with the EPA simply regulating it as a “restricted use pesticide.”

Pentachlorophenol is a pesticide and wood preservative that is known to cause birth defects, is a suspected carcinogen, and is suspected of causing central nervous system damage. The EPA has regulated the amount of pentachlorophenol allowed in drinking water, but still permits the chemical to be used as a fungicide and wood treatment.

A number of alternatives to the above mentioned wood treatments exist on the market today. Cedar and redwood are naturally pest-resistant. There are also a wide range of composites made from recycled polyethylene plastic and wood or other cellulose fibers on the market. If wood treatments are required, there are alternative wood treatments, though some contain copper (see heavy metals above).

Case Studies

Forthcoming

Resources

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Documentation

Verification Method – Partially Verified at Audit through visual inspection of non-covered areas- the rest through documentation.

Documentation Required Before Audit

1. Letter from the Owner and Signed and stamped by the Architect stating that the intent of the prerequisite has been met.

2. Photocopy of key sections of the final specifications submitted based on likely places where red list materials would occur. Specific CSI divisions will be requested.

3. Written explanation of what was substituted for key red list materials in common usage areas. (A template will be provided that prompts key questions)

4. Copy of contractor bills related to key areas where red list materials likely to occur.

Helpful Tips

Forthcoming
Prerequisite Six – Construction Carbon Footprint

Summary

The project must account for the embodied carbon footprint of its construction through a one-time carbon offset tied to the building’s square footage and general construction type.

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Forthcoming

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Documentation

Verification Method – Partially Verified at Audit through visual inspection.

Documentation Required Before Audit

1. Letter from Architect showing completed carbon calculation. A simple template calculation is forthcoming; it will make this an easy calculation. It will be based on the square footage of the project, construction type and a multiplier.

2. Photographs clearly showing basic building structure types:
   - Straw/Earth (residential)
   - Wood – light frame (residential)
   - Wood – heavy timber
   - Steel – light frame (small commercial/residential)
   - Steel – heavy frame
   - Concrete

3. Letter from owner stating that carbon offsets have been purchased based on calculations.

4. A copy of receipt from acceptable carbon offset programs showing offset purchase. A list of acceptable programs will be provided soon.

Helpful Tips

Forthcoming

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19 This number can be reduced by 50 percent for retrofits of existing buildings, which will be described in the User’s Guide.

20 It should be recognized that buildings continue to accrue embodied energy as systems are replaced and repaired over time. It is recommended that additional offsets be purchased at 7-10 year intervals; however, this is not currently part of the program.

21 This offset formula will be presented in the User’s Guide.
Prerequisite Seven – Responsible Industry

Summary

All wood must be FSC certified or from salvaged sources.

Why FSC is the best available certification system in the wood industry: It is a commonly held belief that Forest Stewardship Council (FSC) certification is the best available forest conservation and market linkage tool. Most observers hold that FSC is the most rigorous, credible, and valuable certification system of the over 90 options available world-wide. However, the specifics of why this is the case are not as well-known. Here are the reasons why FSC is the strongest and most comprehensive certification system in the market.

Global reach: Wood is traded all over the world and FSC has certified forest management operations, manufacturing facilities, and distributors in over 70 countries. With offices in over 30, FSC has set the standards locally and regionally that reflect local conditions in both developed and developing countries. Over 5,000 companies participate in the program providing the full range of wood and paper products to markets everywhere. No other system has this kind of reach, with locally relevant and accepted consensus standards combined with global brand recognition that guarantees the rigor and integrity of those standards.

Social, economic, environmental balance: Only FSC explicitly balances the social impacts of logging with the environmental outcomes and economic values that well managed forests provide. Not only are social and community values, and labor rights reflected in FSC principles, criteria, and standards, but indigenous peoples and civil society organizations are represented in the FSC membership. Bringing these voices to the table is a distinctive feature of the FSC system. Fundamental issues of resolving who owns the land and full community engagement in decision-making are attributes reflected only in FSC’s process of stakeholder engagement.

Stakeholder diversity and membership: FSC’s standards reflect the holistic nature of the membership that comprises the organization. Major global environmental groups, native tribes, forest products manufacturers, foresters, scientists, and advocates for human and civil rights all contribute to the governance of the FSC system. By bringing this array of perspectives into the fold, FSC strengthens its standards and creates an army of committed individuals prepared to advocate for the importance of the system in the marketplace.

Transparency at every stage: All processes and decisions of the Forest Stewardship Council are open for public review and comment. Even non-members are engaged in the refinement of new policies and standards. Certification assessments are subjected to

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22 Subsequent iterations will include standards for other industries as they become available. All standards referenced must be from independent 3rd party organizations and not standards funded by the industries themselves such as the SFI wood standard.

23 This information is courtesy of Michael Washburn of Washburn Consulting.
Materials Module

Conservation of natural forests: FSC certification is not provided to forest management operations that have converted natural forest stands to ecologically simplified “plantations” since 1994 (FSC’s first implementation year.) No other certification system precludes this practice from being certified. FSC holds that conservation and management of natural forests is a priority. Existing (before 1994) plantations can be certified where they meet high performance standards for protecting and encouraging the restoration of native biodiversity.

Protection of high conservation values: FSC standards include set asides and special measures related to managing forests with high conservation values. The most significant forested ecosystems are identified in every certified operation and care is taken to ensure that values such as biodiversity, sensitive aquatic habitats, unique species and plant and animal communities are all protected. The model put forth by FSC is so strong that major wood and paper buyers often require their suppliers to implement a high conservation value forest inventory in the areas where they operate, even where they are not seeking FSC certification. The rigor of this system is so widely recognized that other certification systems incorporate similar models. Unfortunately, no other system has reached the levels of protection afforded by FSC.

The promise to consumers: The reason FSC is the most trusted label in the certification marketplace is the history of credibility related to claims made within the FSC system. FSC has the most rigorous and consistently implemented chain of custody program in the world. This system ensures, through independent auditing, that product claims can be verified from the forest to the customer. The integrity of FSC’s promise to customers makes FSC the gold standard.

Recognition by credible non-profits trusted by consumers: Other certification systems rest their credibility on expensive ad campaigns supported by the very companies who stand to benefit from customers buying products with that label. While FSC companies also advertise, they are advantaged by an army of stakeholders who publicly endorse and actively market FSC-certified products. Major global environmental organizations have programs where staff spend their days building demand for FSC-certified products. These organizations include National Wildlife Federation, World Wildlife Fund, Forest Ethics, Rainforest Action Network, Rainforest Alliance, Green Press Initiative, Tropical Forest Trust, and many others. This kind of advocacy can only be generated by a system that these organizations trust and are willing to rest their own brands on in the market. Market campaigns routinely feature FSC as part of the demand placed on campaign targets. Less activist NGOs support partnerships where companies are urged to move to FSC. This community is unique. No other system has generated such broad and deep support.

Used by major brands to protect their own brands: When a major consumer brand chooses to co-brand itself with something like a certification label it becomes either an enhancement or vulnerability. FSC is increasingly seen as a brand enhancement by companies who seek to express their environmental and social values by using forest
products from responsible sources. Whether it’s an on product label on an item of furniture or recognition of FSC in a green building standard, or the placement of the FSC logo on an annual report cover, FSC is strengthening brands all over the world. As green building grows, builders and architects proudly specify FSC wood to express their own values which reflects well on their company. The world’s largest paper and wood buyers are committing to increasing levels of FSC in their purchasing practices. You can find FSC on catalogues, reports, marketing materials, consumer products, and more and more within the walls of the world’s largest retail stores. Even financial institutions are using the FSC tool to guide their investment and lending policies. By screening forestry companies using FSC, banks and lenders can reduce their risk by placing their money in responsible businesses and avoiding others who act illegally or destructively.

**Performance versus intent:** There are certainly specific differences among certification systems in terms of their on-the-ground requirements. Many systems require policies or plans for dealing with issues like chemical use or worker’s rights. FSC requires actual performance against standards, not just on-paper intention. Differences exist in types and size of buffer areas that cannot be harvested near streams, the size of areas allowable for clear-cut logging, the requirements for mapping and documenting procedures and so on. The bottom line is when all of this is added up with all of the differences noted above; there are no apples to apples comparison between FSC and any other system. FSC is the largest, oldest, strongest, and most visible system ever devised for linking responsible forestry to markets.

For more information visit [www.fscus.org](http://www.fscus.org).

**Case Studies**

Forthcoming

**Resources**

Forthcoming

**Documentation**

*Verification Method – Partially Verified at Audit through visual inspection.*

*Documentation Required Before Audit*

1. Letter from Architect stating that project meets prerequisite
2. Copies of chain of custody letters for all wood purchases with photographs of where wood occurs in the project.
3. Photocopy of specifications where wood occurs

**Helpful Tips**

Forthcoming
Prerequisite Eight – Appropriate Materials/Services Radius

Summary

Materials and Services must adhere to the following list:

Weight/Distance List

<table>
<thead>
<tr>
<th>MATERIAL OR SERVICE</th>
<th>MAXIMUM DISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideas</td>
<td>12,429.91 miles</td>
</tr>
<tr>
<td>Renewable Energy Technologies</td>
<td>7000 miles</td>
</tr>
<tr>
<td>Consultant Travel</td>
<td>1500 miles</td>
</tr>
<tr>
<td>Lightweight Materials</td>
<td>1000 miles</td>
</tr>
<tr>
<td>Medium Weight Materials</td>
<td>500 miles</td>
</tr>
<tr>
<td>Heavy Materials</td>
<td>250 miles</td>
</tr>
</tbody>
</table>

Documentation

Verification Method – Not Verified at Audit but through documentation.

Documentation Required Before Audit

1. Letter from Architect stating that intent of prerequisite was met. Template to be provided.
2. Summary of where renewable energy technologies are on project and where they were manufactured with names of all systems included.
3. Summary of major building systems and where they came from (template will be provided)
4. Letter from the Owner stating that consultant team met distance limits and a roster of consultants and roles, and office locations. Template to be provided.

Lightweight Materials: Insulation, Carpet, Fabrics

Medium Weight Materials: Wood products

Heavy Materials: Brick, Stone, Concrete

Case Studies

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24 Defined as wind, solar thermal, photovoltaics or fuel cells.
25 Applies only to major project team members including the architect of record, MEP and Structural Engineers of record. Specialty consultants qualify up to 3000 miles.
26 The scale for weight designations will appear in the user’s guide.
Materials Module

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Helpful Tips
Forthcoming

Ideas from around the world

Consultants from a reasonable distance

Prerequisite Nine – Leadership in Construction Waste

Summary

Construction Waste must be diverted from landfills\(^{27}\) to the following levels

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>MINIMUM Diverted/Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metals</td>
<td>95%</td>
</tr>
<tr>
<td>Paper and Cardboard</td>
<td>95%</td>
</tr>
<tr>
<td>Soil, and biomass</td>
<td>100%</td>
</tr>
<tr>
<td>Rigid Foam, carpet &amp; insulation</td>
<td>90%</td>
</tr>
<tr>
<td>All others – combined weighted average(^{28})</td>
<td>80%</td>
</tr>
</tbody>
</table>

- Asphalt
- Concrete and concrete blocks
- Brick, tile and masonry materials
- Untreated lumber
- Plywood, OSB and particle board
- Gypsum wallboard scrap
- Glass
- Plumbing fixtures
- Windows
- Doors
- Cabinets
- Architectural fixtures
- Millwork, paneling and similar
- Electric fixtures, motors, switch gear and similar
- HVAC equipment, duct work, control systems, switches

Documentation

Verification Method – Not Verified at Audit but through documentation.

Documentation Required Before Audit

1. Letter from Owner and Signed by Architect and Contractor that intent of prerequisite was met.

2. Copies of Receipts for all Tipping Fees and Recyclers

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\(^{27}\) Diverted waste includes those that are: recycled, reused, salvaged or composted. Incineration is not permitted.

\(^{28}\) Weighted average is lower to account for lack of diversion markets in certain jurisdictions.
Materials Module

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Water Module
WATER MODULE

A Living Building is water independent.

Major Environmental Issues/Prerequisite Intents

Scarcity of clean potable water is quickly becoming a serious issue in many countries around the world. The US and Canada have avoided the majority of these limitations and problems to-date due to abundant fresh water, but highly unsustainable water use patterns and the continued draw-down of major aquifers portent significant problems ahead. The intent of these pre-requisites is to realign how people use water in the built environment, so that people treat it as the precious resource that it is.

Ideal and Current Limitations

Cascadia envisions a future whereby all buildings are designed to harvest enough water to meet the needs of occupants. Water can be re-used and purified and re-used again. Currently, such practices are often illegal under health code regulations in North America, which arose precisely because people were not properly safeguarding the quality of their water. Reaching the ideal for water use presently is dependent on what is allowable by code. The Living Building Standard acknowledges this reality.
Prerequisite Ten – Net Zero Water

Summary

100 percent of occupants’ water use must come from captured precipitation\(^1\) or reused water that is appropriately purified without the use of chemicals\(^2\).

Documentation

*Verification Method – Partially Verified at Audit through visual inspection.*

*Documentation Required Before Audit*

1. Letter from Owner stating that prerequisite has been met.
2. Photographs of key water systems in the building and where they are located with basic description.
3. Copy of water bill from local utility if applicable or Letter from local utility showing amount of water purchased.

Case Studies

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1 The exception being water that must be from potable sources due to local health regulations, including sinks, faucets and showers but excluding irrigation, toilet flushing, janitorial uses and equipment uses.

2 An exception is made for an initial water purchase to get cisterns topped off. A Living Building only buys water once.
Water Module

Prerequisite Eleven – Sustainable Water Discharge

Summary

100 percent of storm water and building water discharge must be handled on-site.

Documentation

Verification Method – Verified at Audit through visual inspection.

Documentation Required Before Audit

1. Letter from Owner stating that prerequisite has been met
2. Photographs of water retention/detention strategies on-site
3. Letter from City or County stating that compliance has been met.

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Indoor Quality Module
Indoor Quality Module

INDOOR QUALITY MODULE

Healthy for all people.

Major Environmental Issues/Prerequisite Intents

Most buildings provide far less than ideal conditions for maximum health and productivity. As comfort decreases, environmental impact often increases as people often find inefficient and wasteful ways to improve their physical environment. The intent of these prerequisites is not to address all of the potential ways that an interior environment could be compromised, but to focus on the major conditions that must be present for a healthy interior environment to occur.

Ideal and Current Limitations

It is difficult to ensure that indoor environments will remain healthy, vibrant places for people - especially over time, as aspects of human comfort such as indoor air quality, thermal control and visual acuity can easily be compromised in numerous ways. The presence of these prerequisites does not insure a great interior environment due to the unpredictable nature of how people operate and maintain a building.

The intent of these prerequisites is not to address all of the potential ways that an interior environment could be compromised, but to focus on the major conditions that must be present for a healthy interior environment to occur.
Prerequisite Twelve – A Civilized Work Environment

Summary

Every occupiable space must have operable windows\(^1\) that provide access to fresh air and daylight\(^2\).

Documentation

Verification Method – Verified at Audit through visual inspection.

Documentation Required Before Audit

1. Letter from Architect stating that intent has been met.
2. Floorplans for all floors and 2 building sections at 11x17 size

Case Studies

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1 Exceptions being spaces where the absence of daylight is critical to the performance of the space (such as a theatre) or where operable windows could pose a health risk (such as laboratory spaces with fume hoods where air flow could be compromised).

2 Work spaces can be no more than 30 feet from a window.
Prerequisite Thirteen – Healthy Air/Source Control

Summary

All buildings must meet the following criteria:

- Entryways must have an external dirt track-in system and an internal one contained within a separate entry space.³
- All kitchens and bathrooms must be separately ventilated.
- All copy rooms, janitorial closets and chemical storage spaces must be separately ventilated.
- All interior finishes, paints and adhesives must comply with SCAQMD 2007/2008 standards⁴. All other interior materials such as flooring and case works must comply with California Standard 01350 for IAQ emissions⁵.
- The building must be a non-smoking facility⁶

Documentation

Verification Method – Verified at Audit through visual inspection.

Documentation Required Before Audit

1. Letter from Mechanical Engineer that intent of the prerequisite has been met.
2. Photograph of entryways showing dirt track in.
3. One page description of how kitchens, bathrooms, copy rooms, janitorial closets and chemical spaces are vented.
4. Copy of Specifications for selected CSI Division (finishes)
5. Copy of a cleaning plan with chemical use guidelines (more information to come)

Case Studies

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³ Acceptable Dirt track in systems will be defined in the Users Guide.
⁴ South Coast Air Quality Management District http://www.aqmd.gov/
⁵ Based on Title requirements at the time of construction.
⁶ An exception is made for public housing and residential architecture.
Prerequisite Fourteen – Healthy Air – Ventilation

Summary
The building must be designed to deliver air change rates in compliance with California Title 24 requirements.

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A Living Building tells a story.

Major Environmental Issues/Prerequisite Intents

As a society we are often surrounded by ugly and inhumane physical environments. Sustainable design must inspire and elevate our spirits to be successful. If we do not put care into our homes, streets and offices then why should we extend care outward to our farms, forests and fields? We accept billboards, parking lots and strip malls as being aesthetically acceptable in the same breath that we accept clear-cuts, factory farms and strip mines. The Living Building Standard recognizes the need for beauty as a precursor to caring enough to preserve, conserve and serve the greater good.

Ideal and Current Limitations

Mandating beauty is, by definition, an impossible task. And yet, we believe we elevate the level of discussion and, ultimately, the results through attempting difficult but critical tasks. In this case the prerequisite is based merely on intention and attempt. We do not begin to assume we can judge beauty and project our own aesthetic values on others. But we do want to know people’s intention and that there is an effort made to enrich people’s lives with each square foot of construction on each project. This intentionality must carry forth into a program for educating the public about the environmental qualities of their Living Building.
Prerequisite Fifteen - Beauty and Spirit

Summary

The project must contain design features intended solely for human delight and the celebration of culture, spirit and place appropriate to the function of the building.

Documentation

Verification Method – Not Verified at Audit through visual inspection.

Documentation Required Before Audit

1. 2000 word essay written by the architectural team that describes how the project meets the intent of the prerequisite. Essay must be accompanied by photographs, diagrams and drawings that illustrate major ideas.

2. 500 word testimonial by owner describing how building meets prerequisite in his/her eyes.

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We do want to know people’s intention and that there is an effort made to enrich people’s lives with each square foot of construction on each project.
Prerequisite Sixteen - Inspiration and Education

Summary

Educational materials about the performance and operation of the project must be made available to the public in order to inspire and educate. Non-sensitive areas of the building must be held open to the public at least one day per year, to facilitate direct contact with a truly sustainable building.

Documentation

Verification Method – Partially Verified at Audit through visual inspection.

Documentation Required Before Audit

1. Letter from Owner stating that prerequisite has been met and will continue to be met as long as he/she owns the property including keeping the building open at least one day a year to the public.

2. Project web site created that educates people about the project. URL is shared at submission.

3. Interpretive signage placed around building, teaching visitors and employees about the project. Photographs of sample signage submitted.

4. Copy of Building Operations and Maintenance Manual and Video for building. A table of contents will be provided that describes acceptable submissions.

Potential Additional Documentation

For projects over 10,000sf – a simple brochure describing the building design, environmental features and how they can help maintain and operate the living building.

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APPENDIX

Living Building – What’s Next?

Over the course of the next year there will be many new developments that Cascadia hopes will help push the program further and result in the emergence of living buildings. This section summarizes a few of the most promising initiatives:

Living Sites Tool

Building off the logic of The Living Building Challenge, we hope to release a new tool in late 2007 called the Living Sites tool, which will address how landscape projects can reach the same transformational level of performance as the living building. How do you build a living plaza, roadway, park or pier? What prerequisites should determine its ultimate level of performance?

Living Communities Tool

Expanding the scope of The Living Building Challenge to a larger scale is the role of our future Living Communities Tool. This tool will incorporate the scale jumping concept explained in this document and will add new prerequisites that deal with issues of food production, transportation and social/civic qualities. We expect to release it by the first quarter of 2008 in draft form.

Incentives & Code Issues

The Cascadia Region Green Building Council hopes to work with several municipalities throughout the Pacific Northwest to analyze existing codes and identify where it is currently difficult or impossible to reach the level of the living building. We encourage others to do the same in other regions. This study will identify alternative incentives, bylaws and ordinances that not only allow living buildings to emerge, but incentives to make them thrive.

Financial Analysis

In 2001 a multidisciplinary team completed the Packard Matrix, an ambitious study to determine the economic and environmental impacts of multiple levels of environmental performance ranging from a typical market rate building to that of the Living Building. The study showed that given enough time (in this case approximately 30 years) that the living building became not only the lowest environmental burden each year, but also the smartest economic choice as well. It is our belief that a great deal has changed over the last six years and that the cost of building living buildings has dropped significantly. We hope to produce a new economic study of multiple building types in different regions around the continent to show the current first cost premiums and associated paybacks.
Appendix

The International Case Study Petal Project

Each of the prerequisites in the current LB standard have been tested and built on various projects around the US and Canada – just never all together on a single project. We hope to show what is possible by documenting a host of projects that achieve single or multiple ‘petals’ of our system. These case studies will provide insight into how projects met the prerequisites and provide guidance for others.
## Technical Development Team Roster

The following individuals have agreed to serve as members of our technical development team for the development of the Users Guide and continued development of *The Living Building Challenge* standard. Technical Development team members will serve a one-year term. The team is divided up into manageable groups with very specific tasks. A Cascadia staff member is assigned to manage each group and ensure continued progress. The Principal Investigator will meet with each team periodically and oversee development.

<table>
<thead>
<tr>
<th>Principal Investigator</th>
<th>Jason F. McLennan</th>
<th>Cascadia Region Green Building Council</th>
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<tr>
<td>Site Team</td>
<td>Gina Franzosa</td>
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<td>Deb Geunther</td>
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<td>Gail Vittori</td>
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<td>Kath Williams</td>
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<td>Freda Pagani</td>
<td>University of British Columbia</td>
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Appendix

Sponsors

The Kendeda Fund
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Cascadia’s mission is to promote the design, construction and operation of buildings in Oregon, Washington and British Columbia that are environmentally responsible, profitable and healthy places to live, work and learn.