City of Portland, Oregon
Bureau of Development Services
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Alternative Technology Advisory Committee Application Form

For information about the Alternative Technology Advisory Committee, instructions for filling out this application form and a list of submittal requirements please see our web site at www.portlandonline.com/bds/atac

Applicant Information:

Name: Chariti Montez & Mark Lakeman **Company Name:**
Email Address:
Address: 1639 SE 12th Ave
City: Portland **State: OR** **Zip Code: 97214**
Phone No.: (503) 381-5885 **FAX No.: (503) 445-4430**

Project Information:

This application involves (check one):

X **A technology not associated with a specific project**

A specific project currently under review

Project Address:
Tax Account number:
Building Permit No.:
LU Case No (if applicable):

Other (specify):

I. Overview of Technology

A. Proposed Technology: Please describe the material/product/construction method you would like to have reviewed by the committee

Light Straw Clay (also known as Light Clay, Clay/Straw, Slip Straw and Leichlehmbau) is a non-loadbearing infill insulation designed to be installed in various wood frame situations. As the name implies, Light Straw Clay is a mixture of straw, clay and water. For the purpose of this application it is primarily an exterior wall insulation system, although it has been used to insulate both interior walls and ceilings.

B. Application of Technology: Please describe the specific application of the technology. How, when and where will this technology be used?

Light Straw Clay (LSC) is a technology that is appropriate for both new construction and retrofit in residential and commercial applications. Properly constructed as infill between the structural members in a nominal 12" thick wall, Light Straw Clay provides R=22.5, or R=2 per inch.

Light Straw Clay consists of straw, clay and water. The straw shall be barley, wheat, rye, oats or rice. As in compliance with the Oregon code for Straw-Bale Structures, the moisture content of straw bales for use in LSC is not to exceed 20 percent. All straw shall be free of seed, mold or decay. The clay will likely be obtained on site from local clay soils and may be a mixture of clay, silt and sand with a minimum clay content of 50%. When the clay is mixed with water it forms a thick clay slip. Borax can be added to the water to inhibit mold growth at a ratio of 76 oz Borax to 200 gallons water. The clay slip and straw are then mixed thoroughly, either mechanically in a tumbler or by hand with pitchforks, so that all straw is coated with slip and there are no patches of dry straw. This mixture can be used immediately or may be mixed up to 24 hours in advance. In the field, a ratio of 1 part straw : 1 part clay : 1 part water is often used but different straw types and clays may affect the density. See *EcoNest* by Paula Baker-Laporte and Robert Laporte for details.

The framework for 12" thick walls are made of vertical Larsen wall trusses or ladder trusses. Larsen wall trusses are made of a pair of studs with horizontal plywood gussets at 24" on center from the floor to the top plates. The Larsen trusses themselves are placed at 24" on center. When the framework is complete, the interior wall is covered with 3/4" plywood (screwed in to be easily removed later) while pairs of 24" tall removable plywood forms are applied to the exterior wall. LSC mixture is placed in between the first form in 6" lifts which are stomped or tamped in place. LSC shall be free of voids and evenly compressed to 39-40 pcf. After the first form is loaded, the second form is installed above the first and loaded the same way. The first form is later leapfrogged over the second form. Horizontal stabilizing bars are installed every 24" and secured to the structural members. These stabilizing bars can be made of 1/2" bamboo, 1/4" reinforcing fiberglass rod, 3/8" steel reinforcing rod, 3/4" wood doweling, 1 x 1 hardwood or 1 x 2 softwood.

When the wall is fully loaded with tamped LSC mixture, all plywood formwork should be removed. To insure proper drying, formwork should not be left on the wall for more than 24 hours. Walls should be left to dry for 8-12 weeks, depending on environmental temperature and humidity, before the application of plaster or siding. Fans may be used to accelerate wall drying, but care should be given to construction sequencing to allow for adequate drying time. In the case of plaster, 1" thickness is recommended for both the interior and exterior. Earthen or lime plaster may be applied directly to the LSC material, but walls should be furred 3/4" to allow for air flow between the LSC and any wood siding materials.

Other considerations include foundations, roofs, and electrical work. Light Straw Clay is not to be installed below grade and foundations shall be designed so that the bottom of the LSC wall is 6" minimum above exterior finish grade. Roof overhangs shall be adequate enough to slow gradual weathering of plaster and to prevent splash-back onto wall. All electrical wiring in residential LSC walls shall be Type UF or conduit systems. Wiring may be channeled or embedded within the LSC walls at a minimum depth of 1 1/4".

C. Code Conflicts: Please describe any known building code issues related to this technology.

One of the main challenges with LSC is in establishing it's value as an insulation material. We believe that a nominal 12" thick wall will provide an R-value of 22.5, sufficient to meet and exceed the Oregon Residential Energy Code requirement of R-21 for walls. Additionally, using Larsen wall trusses, the lack of thermal bridging in LSC construction brings the whole wall R-value closer to the calculated R-value than conventional insulation products.

Mold and moisture issues can also be a concern regarding LSC construction. In the attached New Mexico State Guidelines for Clay/Straw Construction, it is required that "All wood structural members embedded in exterior light clay shall be of wood of natural resistance to to decay, or shall be treated wood or wood protected with approved coatings, or protective wrap." However, this has been found to be an unnecessary step as clay is inherently hydrophillic (water-loving) and resistant to decay. Clay wicks away moisture from natural fibers including wood and straw, as is explained by the following authors:

“Clay possesses several properties that allow it to act as a preservative for straw, wood, and other biodegradable materials. The first, and possibly the most important, is that regardless of relative humidity levels, the moisture content of clay would be lower than than of the straw [fiber] around it…This makes a clear case for the ability of clay to protect straw [fiber] with which it is thoroughly mixed (as in light-clay walls) (Lacinski & Bergeron, 263-4).”

“The hydrophilic (water-loving) nature of clay also means that it will absorb moisture from building materials, such as wood and straw, and then allow it to safely evaporate into the atmosphere. This will help to retard premature decay. Additionally, it can act as a protective barrier, preventing excessive amounts of water from accessing these materials (Weissman & Bryce, 148).”

Please also see Paula Baker-Laporte's commentary on this subject in the attached September 14, 2009 letter.

II. Sustainability

A. Sustainable Elements: Describe how this alternative substantially reduces the environmental impact on the planet over similar technologies currently allowed by the code*?* ***Please attach any documentation that supports your answer.***

LSC is a non-structural form of insulation. Other non-structural forms include various batts, loose fills, spray foams and panels, with fiberglass batts being the most common insulation in residential applications. LSC is non-toxic, does not off-gas, is not potentially carcinogenic and is not made of petrochemicals, unlike many of the manufactured alternatives. However, it's main advantage over other forms of insulation is that both clay and straw can be harvested locally with minimal processing. Clay is often obtained on site while digging the foundation and laying utilities. Suitable straw is grown all over Oregon and can be found just outside of Portland. Using straw as insulation re-purposes what would otherwise be an agricultural waste product.

For comparison, we can look at Ultra Touch, one of the leading brands of cotton/denim batt insulation. The cotton is post-industrial waste - cuttings from denim factories in Texas and South Carolina. The cuttings are shredded and shipped to a factory in Arizona where they are then mixed with a binder fiber. The whole mix is heated so the binder can melt and the batts can keep their form. It is then shipped across the country for distribution. Unfortunately there is no way of knowing where the cotton originated in the first place, before it was made into denim, nor is there a way to know the growing conditions or how the workers were treated. So while it is an innovative use of a waste product, cotton batt insulation has a much higher embodied energy than LSC. By the time Ultra Touch makes its way to Portland, it has already traveled across the country and potentially half way around the world.

B. Reason for Alternative: Describe why this alternative is desired?

In addition to a considerably lower embodied energy as described above in II.A., LSC is a desired alternative for a number of reasons. To begin with, it is fun! Due to it's considerable ease of use, construction can be a participatory event. It is non-toxic for the builders as well as the occupants. In the future we can imagine lowered health care costs and premiums for workers specializing in LSC construction. Additionally, LSC is a bioregional solution that builds local economy and supports local farmers. As straw is an agricultural byproduct, it can be an additional source of income for farmers. And while Larsen wall trusses on 24" centers use the same amount of wood as conventional framing, LSC walls require little to none of the sheathing or vapor barriers required in conventional walls, further saving precious resources.

Last but definitely not least, LSC walls are beautiful and comfortable. In what is known as the flywheel effect, the thick walls will slowly soak up the sun's warmth during the day only to slowly release that warmth into the house at night. Likewise, the walls slowly soak up the night cool and release that into the house during the day. The result is a naturally regulated indoor temperature and a comfortable living environment.

C. Comparison to Other Technologies: How does this technology provide equivalent life safety and/or fire protection than the current technologies allowed by the code?

Most importantly in regards to life safety, LSC does not create issues of toxicity and sick building syndrome that are associated with other building products. As has been stated above, LSC is non-toxic, does not off-gas, and is non-carcinogenic. Additionally, initial testing shows that LSC resists fire equal to or better than current technologies. In the case studies that follow, Lydia Doleman of Flying Hammer Productions is shown torching a Strawclay Bungalow in SE Portland. The structure remained undamaged.

“The secret to the longevity of this material [light straw clay] is the clay component. A straw that is coated with clay is protected from fire, insects, rodents, and all moisture sources other than standing water (Lacinski & Bergeron, 341).”

III. Supporting Documentation

A. Testing Data: Describe any testing that has been performed on this technology to show how it may be able to meet code requirements. ***Please attach all available testing data.***

In 2003, the U.S. Forest Products Laboratory in Wisconsin tested blocks of LSC for thermal performance. This testing is referred to on pg 113 of *EcoNest: Creating Sustainable Sanctuaries of Clay, Straw, and Timber* by Paula Baker-Laporte and Robert Laporte. They found that a less dense mixture with more straw and less clay has a higher R-value than a more dense mix with more clay and less straw.

In 2004, J. Thornton published a study of LSC funded by Canada Mortgage and Housing Corporation called *Initial Material Characterization of Straw Light Clay*, attached. This research looked at the thermal, moisture, fire, compression and bending performance of the material. Thornton's research shows an optimal density of 625 - 650 Kg/m3 (39-40 pcf) to achieve an average R-value of 2 per inch. Thornton's testing also indicates that Light Straw Clay, given

proper ASTM testing, would likely meet fire resistance conditions of a 4-hour fire wall at a 12" thickness without plaster (p75).

We understand that testing on LSC has been done in Germany, but we don't have access to that research.

B. History of Use: Describe all known instances where this technology has been applied to a constructed building, including approximate date, location and building type. ***Please attach any documentation that supports your answer.***

To help describe an important part of the history of the development of straw clay wall insulation, we point out that Germans have been building with timber frame, wattle and daub infill structures for centuries. After many of their cities were decimated by allied bombing during World War II, Germans began to utilize more insulative leichtlembau (wood fiber) materials as wall infill as they rebuilt using their age-old traditional timber frame construction processes. Where before they would simply use earthen “wattle and daub” infill between structural members, during reconstruction they began to lighten their structures in order to make them easier to build and more efficient. These techniques became widespread and the earliness of their efforts helps account for why Germany is a global leader in green building innovation.

Following are numerous case studies that outline EcoNest Projects, projects throughout Oregon, and other projects in the United States.

Responsibility Statement:

As the applicant submitting this application I am responsible for the accuracy of the information submitted. I have submitted all the relevant information available about the technology I am requesting the Alternative Technology Advisory Committee to review. I believe the information submitted to be a compete and accurate representation of the proposed technology and I am aware that any omission (either voluntary of accidental) could cause the application to be denied. I understand that more information may be requested before the committee can make a recommendation on my application.

I understand that the recommendation from the committee is not binding. In addition a favorable recommendation from the committee is not a guarantee that the Administrative Appeals Board will approve a subsequent building code appeal. The City of Portland and the committee members have no implied or expressed liability associated with the conclusions of the Alternative Technology Advisory Committee. By my signature, I indicate my understanding and agreement to the Responsibility Statement.

Applicant’s signature: _____ **Date:**

Property owner’s signature (if applicable): _____ **Date:**

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