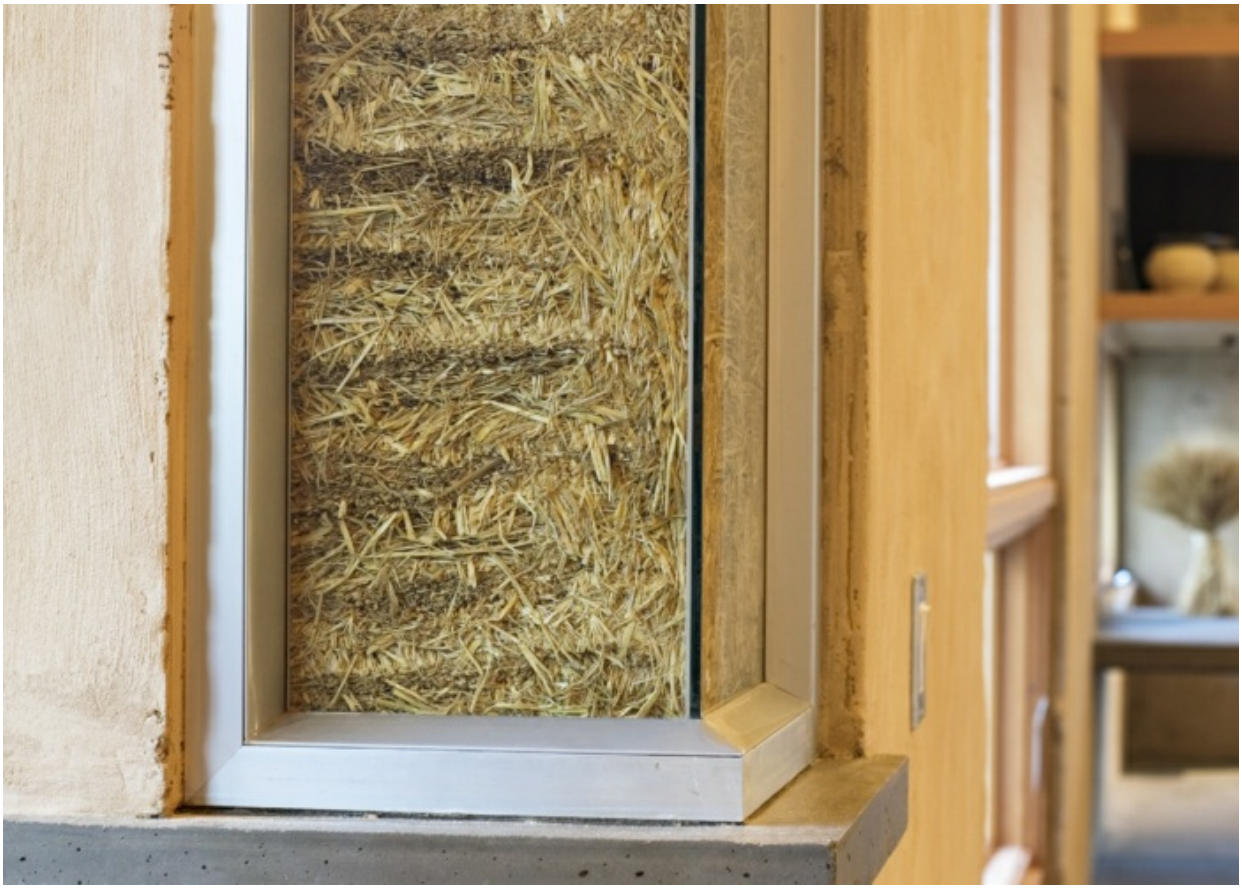
STRAW-BALE

materialspalette.org/straw-bale



- Eastern Sierra Residence Douglas County, NV
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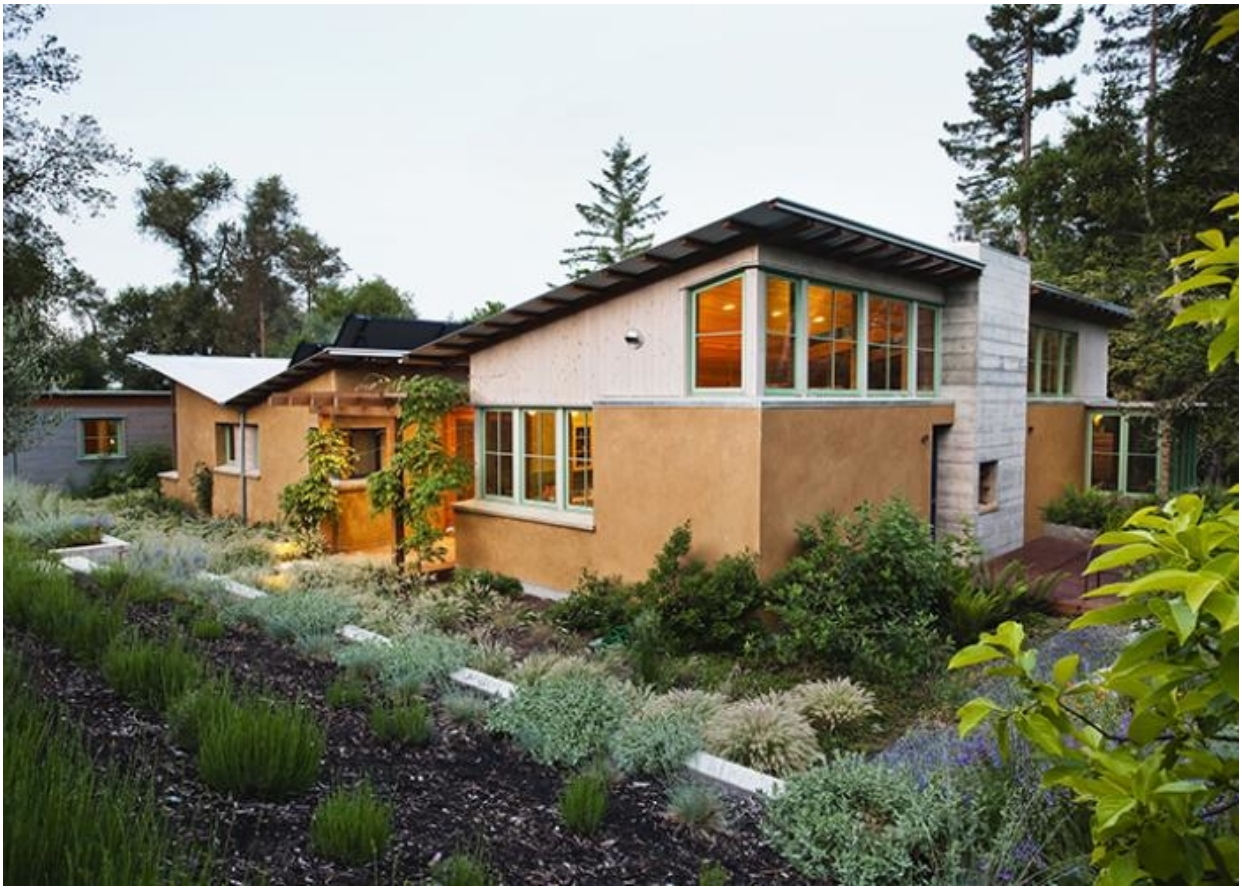

- Vine Hill Straw Bale Residence
  Sebastopol, CA
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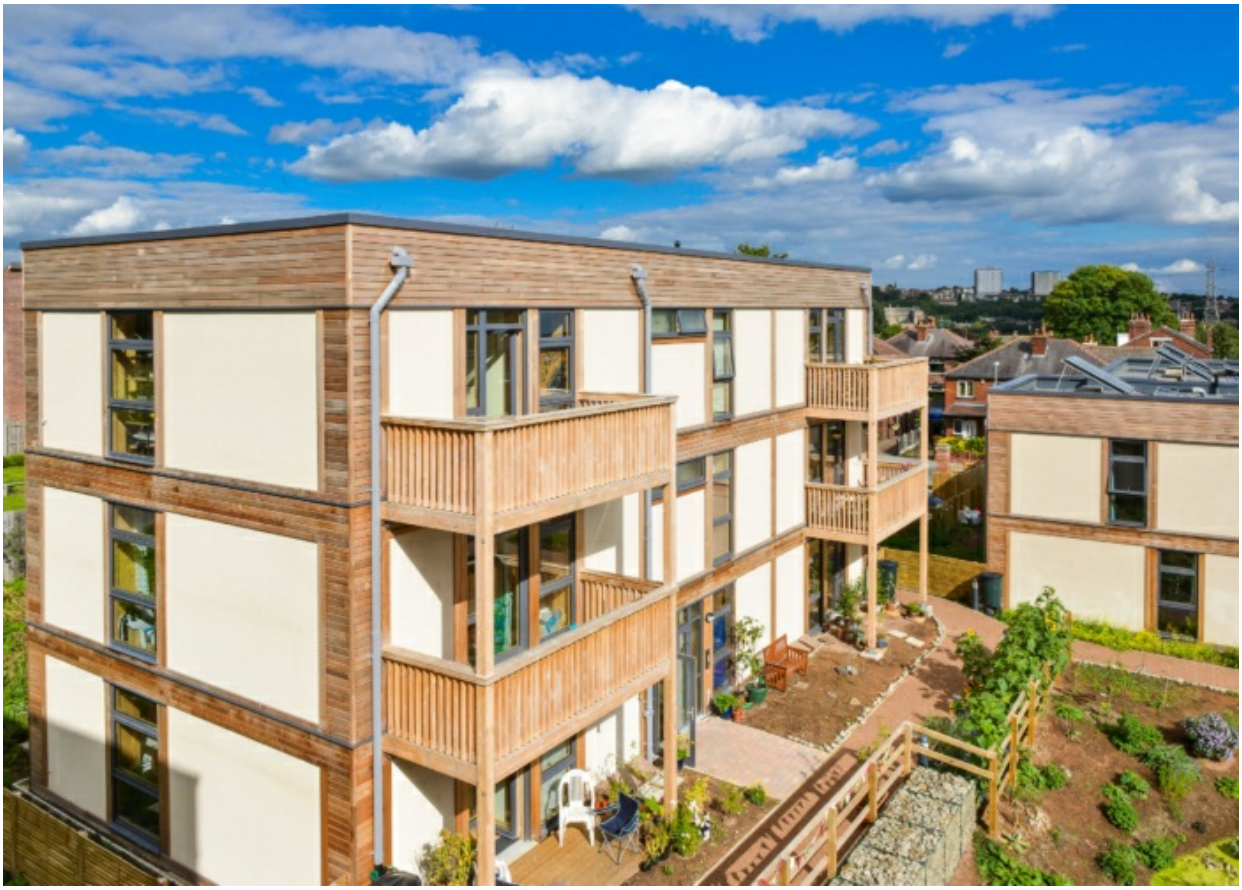
- LILAC Affordable Ecological Co-Housing utilizes ModCell panelized straw wall assembly
  Bramley, West Leeds, West Yorkshire, UK
  Architect: White Design
  Image © ModCell 2018



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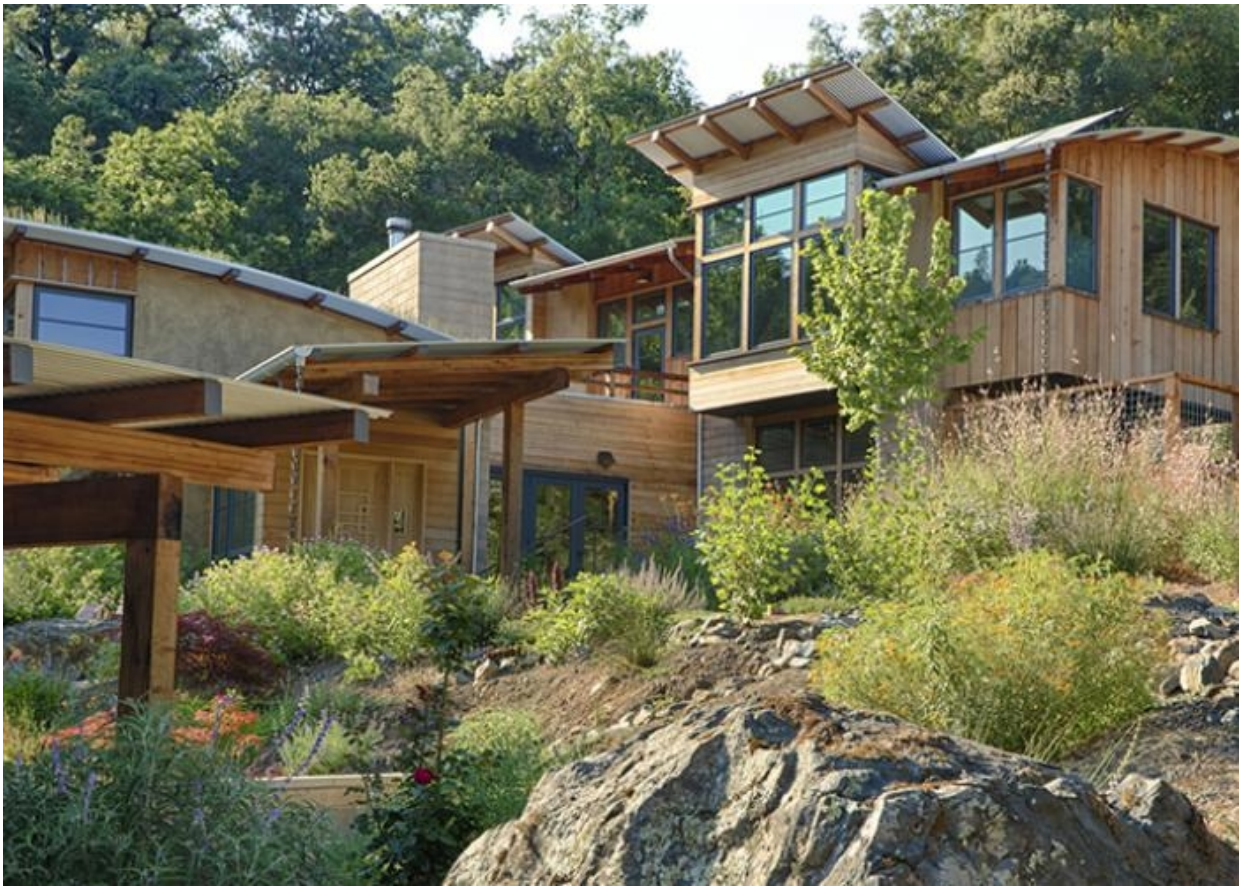

- Watershed Straw Bale Residence
  Healdsburg, CA
  Arkin Tilt Architects
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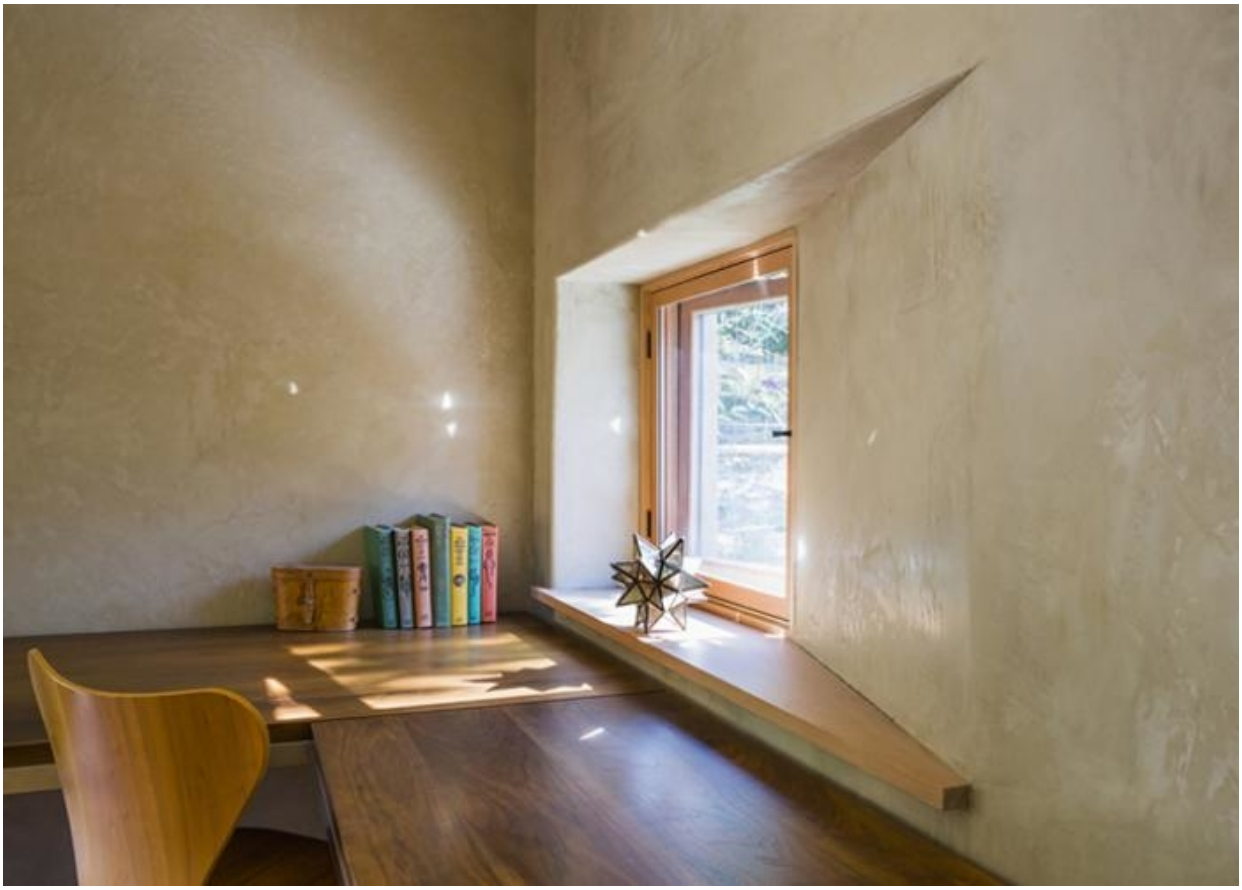

- Watershed Straw Bale Residence
  Healdsburg, CA
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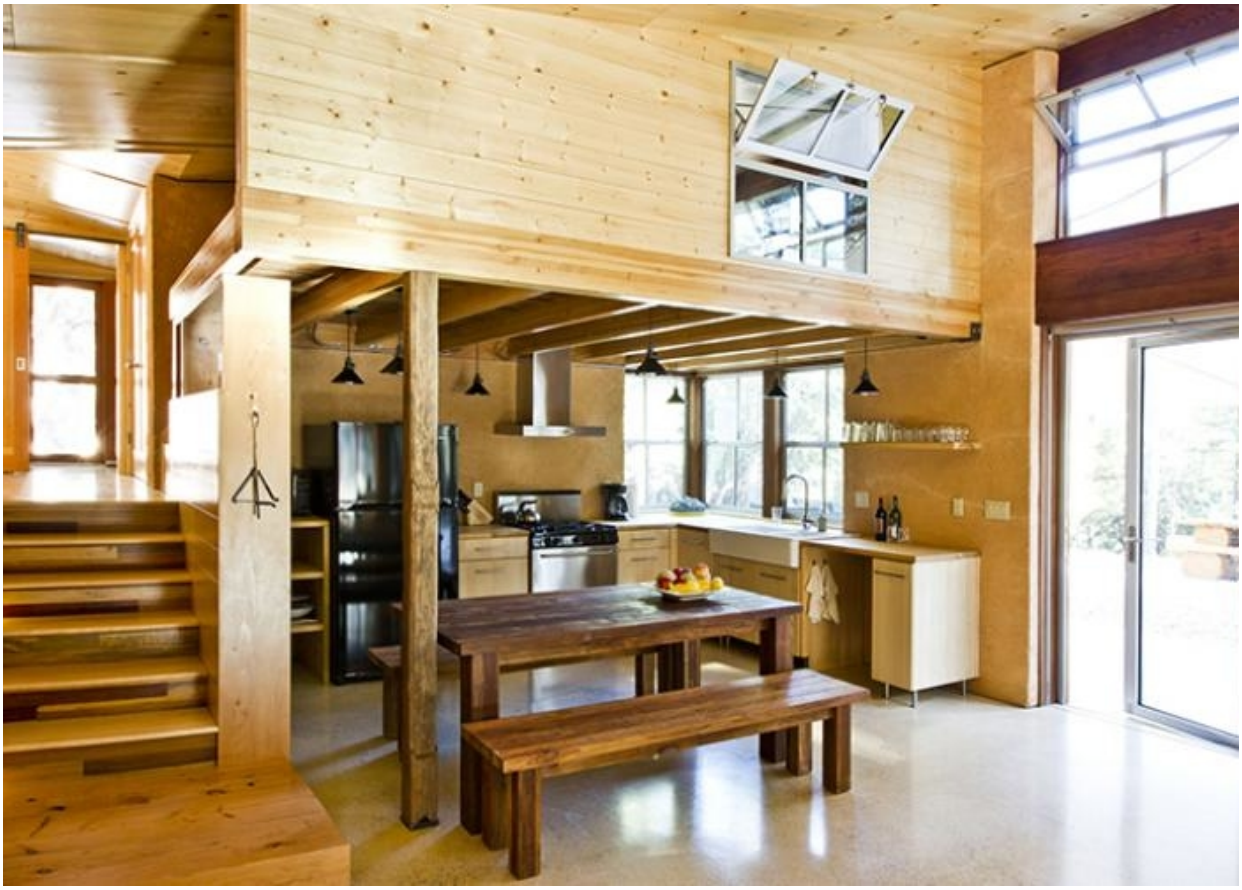
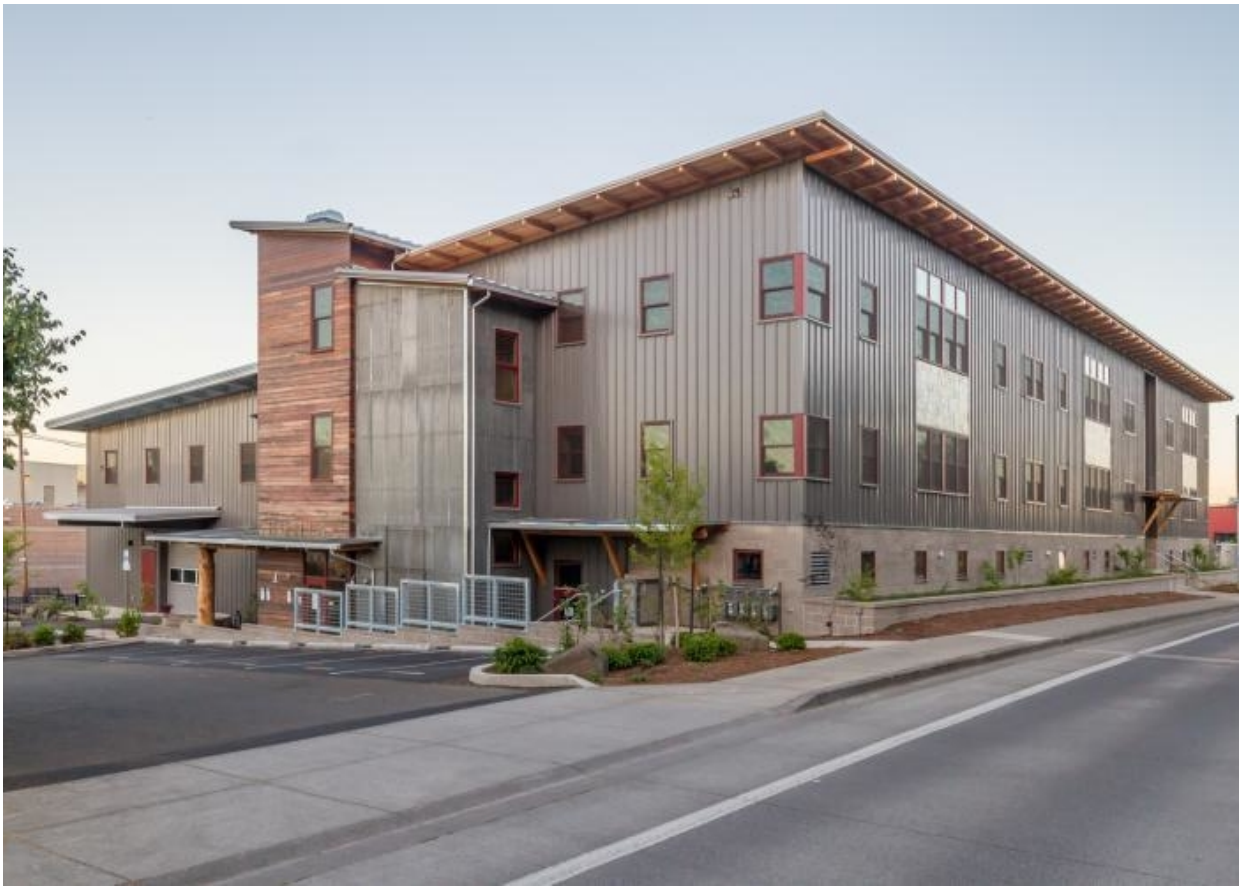


- Chalk Bluff Cabin, Nevada City, CA
  Arkin Tilt Architects
  Photo by Eric Millette Photography



- Mahonia Mixed-Use Building
  Eugene, Oregon
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Carbon Impact of Straw-Bale

Straw-bale construction is a building method that commonly uses straw from wheat, rice, rye and oats, as building insulation. The straw is the stalk of the grain without the grain head. Straw-bale construction has many advantages, including the carbon sequestration of the material, low cost, availability, fire-resistance, and insulation values.

Straw stores sixty times more carbon than is used to grow, bale, and transport to building sites in the same region. North America grows enough grain that if only one-tenth of the residual straw were used for building, over two million 2,000 square foot homes could be built each year (there were fewer than one million new home starts in North America in 2016).

Aside from traditional straw bale construction, which uses the bale itself, there are many products that utilize straw, such as compressed straw agriboard, compressed straw blocks, straw sheet products, straw panelized systems, prefabricated straw bale wall panels, and light straw clay insulation infill.

Statistics:

- A straw bale is approximately 40% carbon by weight.
- With regenerative agricultural practices, which aim to regenerate topsoil and increase biodiversity, the amount of carbon sequestered in straw can be more than doubled.

Carbon Smart Attributes

Straw sequesters carbon

Straw naturally sequesters carbon both in grain stalk itself and by storing carbon into the soil. The amount of carbon sequestered depends on the type of straw, where and how it was grown, and on harvesting methods.

Straw bale construction utilizes a waste material

Straw, as a raw material, is 100% waste of another industries (e.g. the growing of grain for food) and in many cases is otherwise burned, causing air pollution as well as release of carbon back into the atmosphere.

Material Attributes

Straw bale construction helps preserve ecosystems

For single family residences, the substitution of straw-bales for wood can relieve the pressure to log old-growth forests, preserving ecosystems for wildlife habitat, air-quality and soil-stabilization.

Straw bale construction is a proven durable method

Properly built and maintained, straw buildings can have a useful lifespan of at least 100 years. For example, Homesteaders in the Great Plains started building with bales in the late 1800's, and many of these structures still stand today.

Straw bale wall assemblies are naturally high performance

Straw bale construction places all of the wall elements in the right location for high thermal performance: a protective layer on the outside, ample insulation at the center, and thermal mass to the interior. Unlike similar foam-based wall systems, the bales are natural, healthy and rapidly renewable. When laid flat and stacked like bricks in a 'running bond' pattern, a plastered straw-bale wall is ±27″ thick, with an R-value of 1.3 per inch, or R-30 total. Stacked 'on edge', with straw parallel to the plane of the wall, this same R-30 insulation level is achieved in 33% less width (±18″). This is several times the value of typical insulated wood wall.

Straw bale construction can be cost-effective

The cost of construction with straw bales is comparable or less than other thick-walled construction systems.

Straw is naturally fire-resistant

Baled straw is difficult to burn, as tested in an ASTM E-84 flame spread index and smoke developed index, which established it as a viable commercial insulation solution. A lime-plastered straw bale wall assembly has been tested to achieve a 2-hour fire rating.

Straw bale walls are aesthetically pleasing

Straw bale walls can have great aesthetic value, and lend themselves to a variety of styles and finishes. The thick walls present opportunities for niches, deep window sills and seating areas.

Design & Construction Guidance

Straw bale construction now in most US state building codes

Straw bale construction was added to the International Residential Code in 2015, the model code adopted by most US states and recognized around the world. This code constitutes a prescriptive specification for simple buildings, and a set of guidelines for larger and nonresidential projects. Appendix S of the International Residential Code is available with the very helpful Commentary as a free download from the California Straw Building Association[1].

Straw bale is best suited for dry climates, or where the wall assembly can "breathe"

The best way to avoid sustained high moisture concentrations lies in making certain that the bales are able to transpire any accumulated moisture back into the environment. Straw bale construction may not be well-suited for consistently high-humidity climates.

Pay attention to the finish material

The surfaces of straw bales offer an excellent mechanical bond to plaster and stucco, and reinforcement is generally not needed to attach plaster to the walls. Reinforcement may be desired when stucco is used as part of the structural system, or as assurance against hairline cracking. When needed, a variety of techniques can be used to attach netting, including long staples stuck into the bales or wire ties through the bale walls.

Acknowledged Challenges, Questions & Unknowns

Taking straw bale construction to larger scale buildings is not yet prevalent, even though there are many examples worldwide, including a seven story housing project in France, sizable schools and public buildings in the UK, and wineries, office buildings and other examples throughout the USA.

Fungus (dry rot) can occur in straw at sustained high levels of moisture (over 20 percent of dry weight, or relative humidity of 70 to 80 percent)– significant damage occurs when these levels are maintained over a long period of time. Intermittent moisture is not a threat, however.

RESOURCES

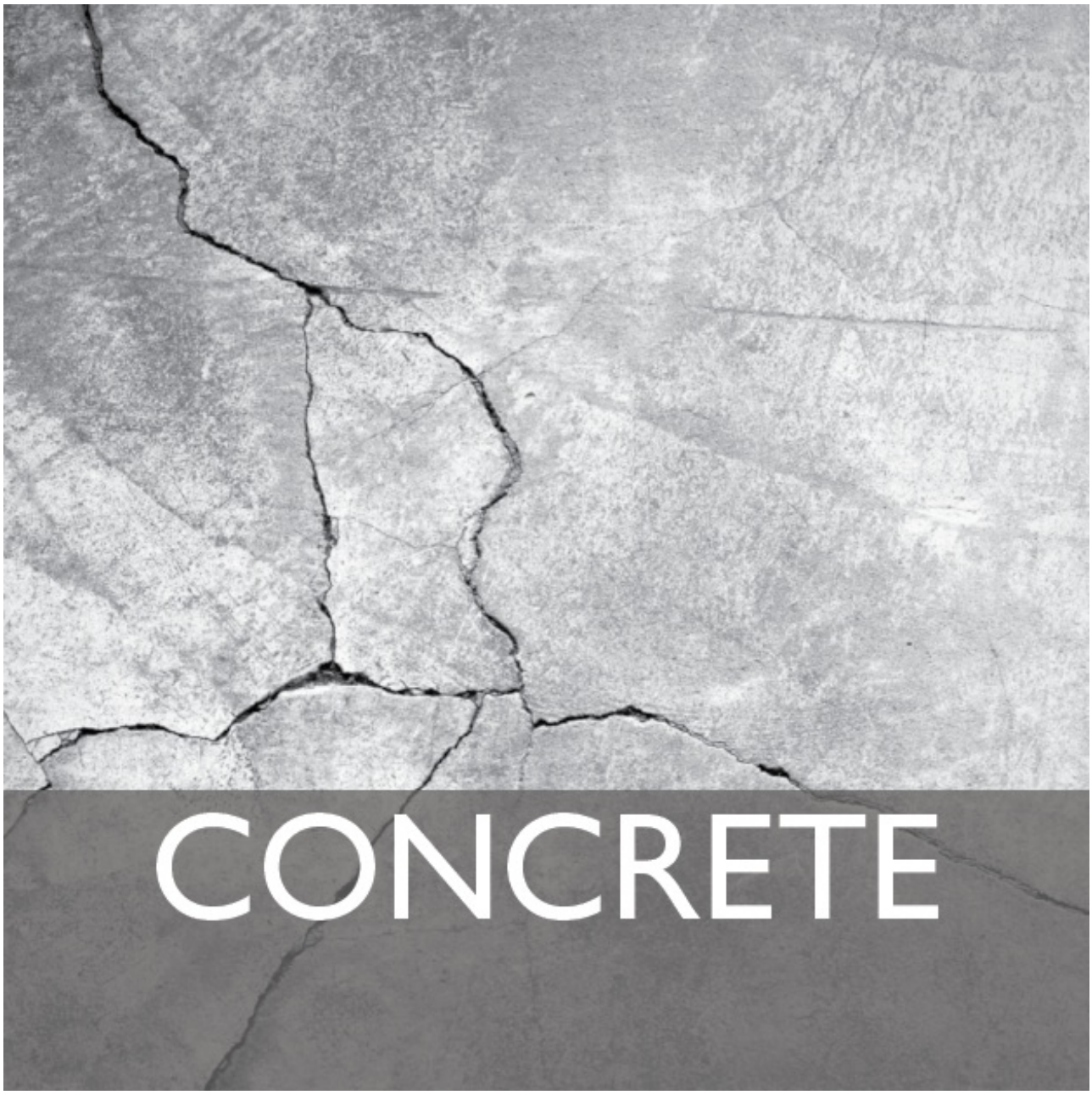
1 | Appendix S – Strawbale Construction with Commentary, CASBA

2 | Essential Prefab Straw Bale Construction, The Complete Step-by-Step Guide by Chris Magwood, 2016

Other Resources:

California Straw Building Association (CASBA) Frequently Asked Questions about Building with Straw Bales

SEE ALSO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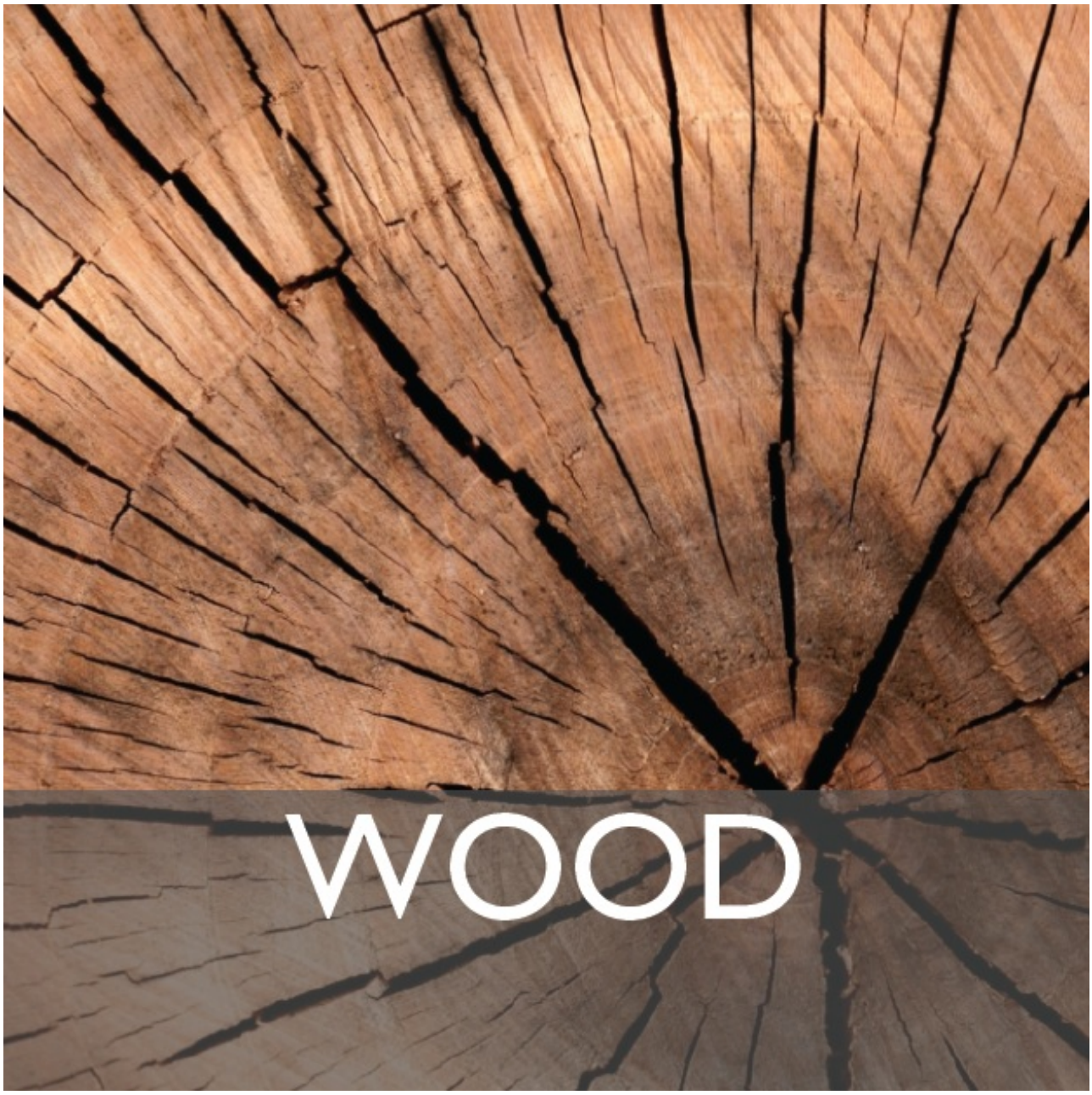
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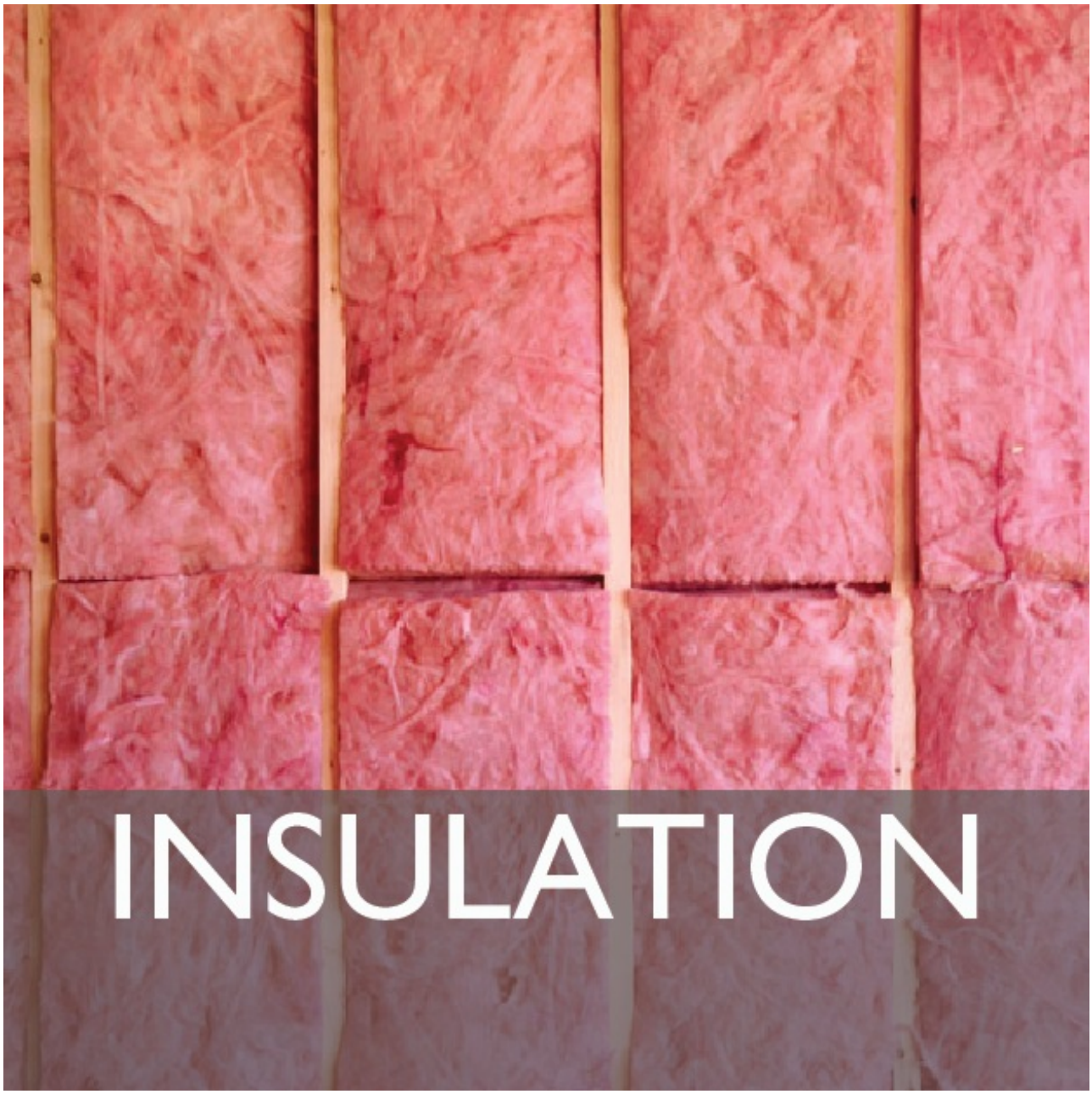
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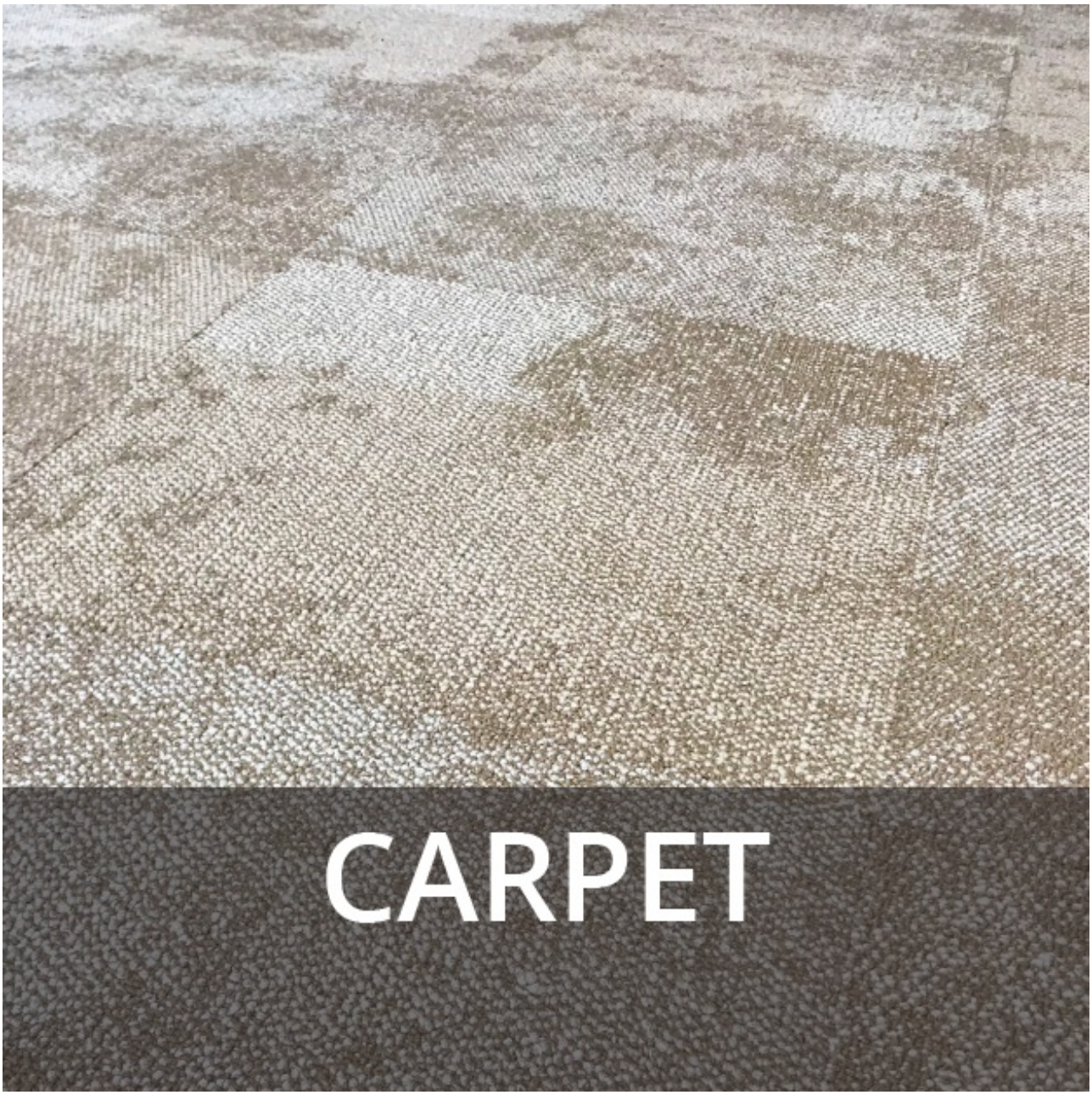
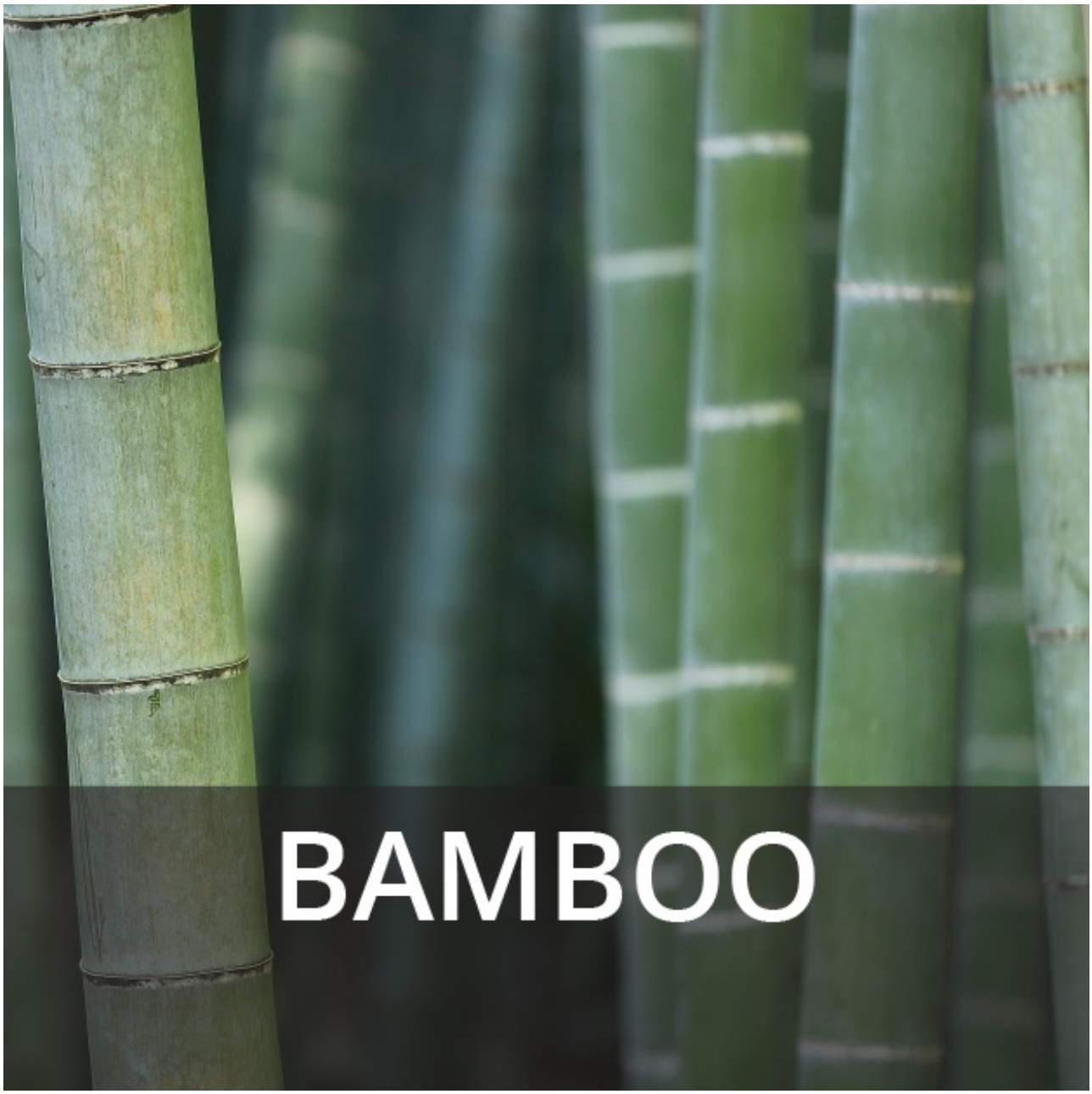
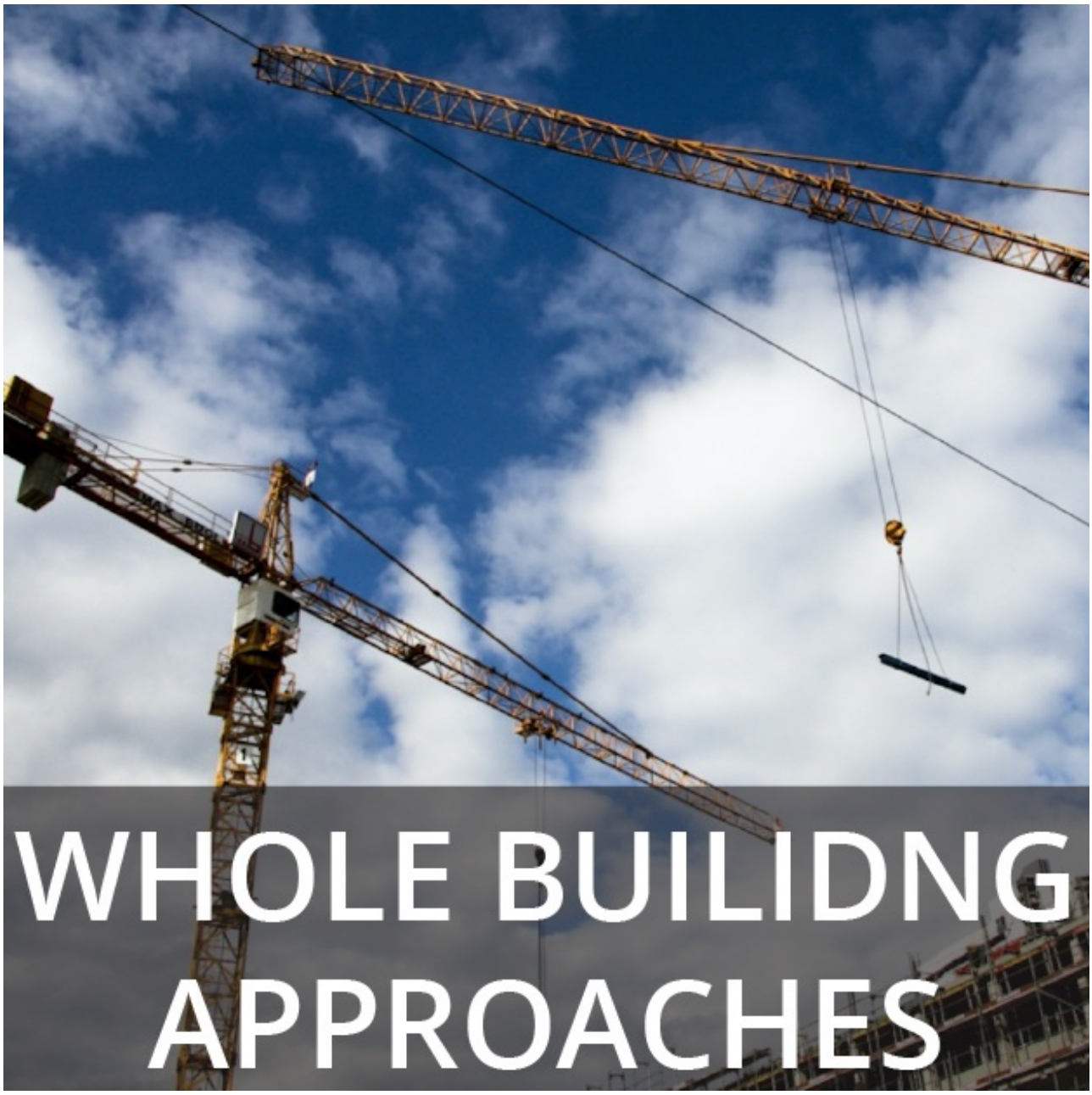

CARPET


GYPSUM BOARD


SHEEP'S WOOL


BAMBOO



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