We will be starting soon!

Thanks for joining us

Building with Hemp – Green Building Speaker Series

Chris Velasco – Dotek LLC

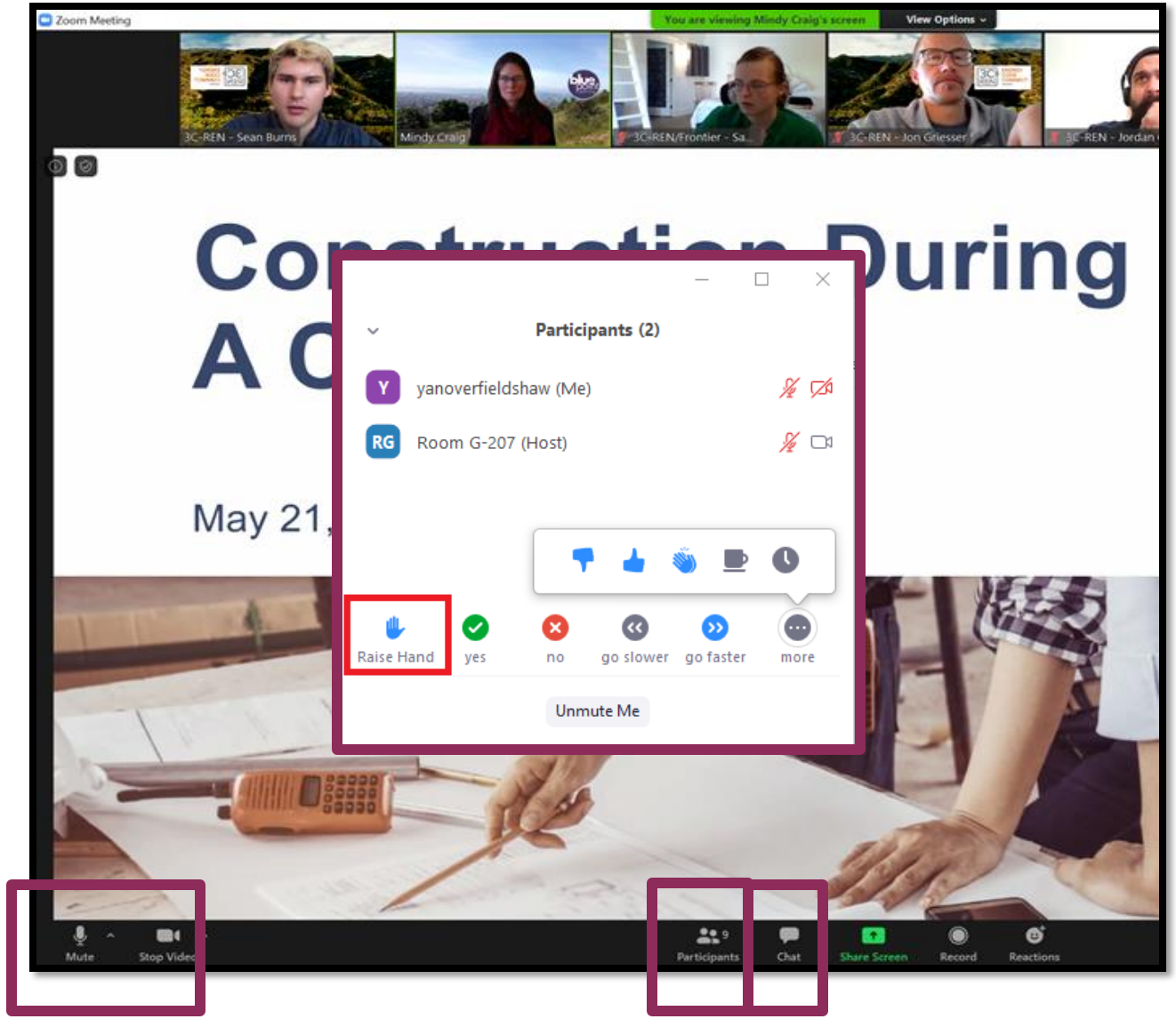
Alex Sexsmith – Sexsmith Architects

Ashley Stallworth – Bio Fiber Industries

April 23, 2024

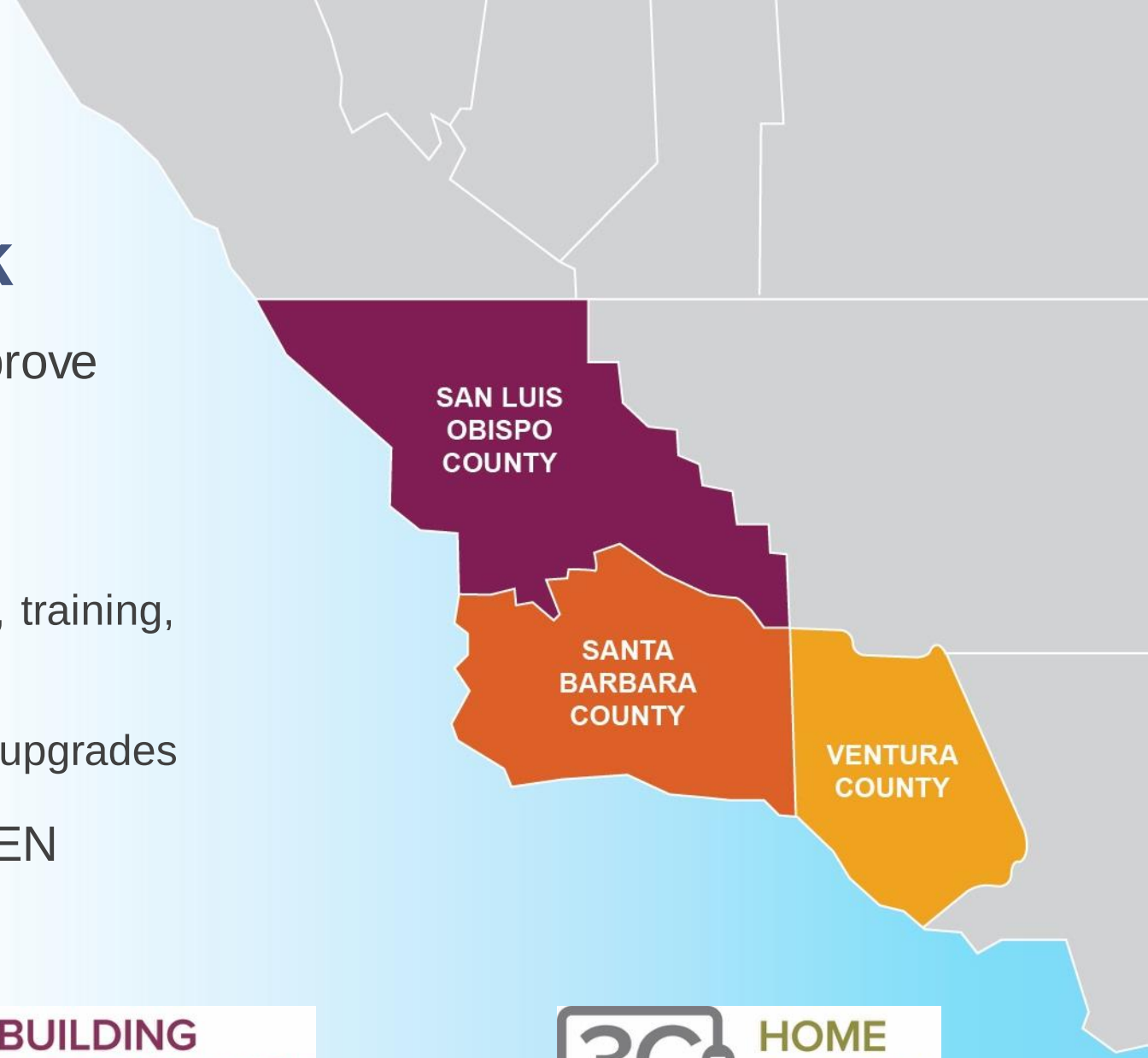
Zoom Orientation

- Please be sure your full name is displayed
- Please mute upon joining
- Use "Chat“ box to share questions or comments
- Under "Participant" select "Raise Hand" to share a question or comment verbally
- The session may be recorded and posted to 3C-REN's on-demand page. Feel free to ask questions via the chat and keep video off if you want to remain anonymous in the recording.



3C-REN: Tri-County Regional Energy Network

- Three counties working together to improve energy efficiency in the region
- Services for –
  - **Building Professionals:** industry events, training, and energy code compliance support
  - **Households:** free and discounted home upgrades
- Funded by ratepayer dollars that 3C-REN returns to the region



3C REN ENERGY CODE CONNECT

3C REN BUILDING PERFORMANCE TRAINING

3C REN HOME ENERGY SAVINGS

3C-REN Programs

- Energy Code Connect (ECC)
  - Industry Trainings and Regional Forums
  - Energy Code Coach: Title 24 Compliance Support Hotline (805) 781-1201
- Building Performance Training (BPT)
  - Industry Trainings & Certification for current and perspective building professionals
  - Helps workers thrive in an evolving industry
- Home Energy Savings (HES)
  - Flexible Home Energy Upgrades
  - Multifamily (5+ units) & Single Family (up to 4 units)

CHRISTOPHER VELASCO

EMAIL: CVELASCO@THEDOTEK.COM

URBAN DEVELOPMENT AND RURAL BENEFITS

INDUSTRIAL HEMP AS AN INSULATION MATERIAL

- **Industrial Hemp** : A sustainable, fast-growing crop with strong fibers and low environmental impact, ideal for building materials due to its excellent thermal insulation, moisture regulation, and carbon sequestration capabilities.

- **Benefits of Hemp in Construction**: Substantial reduction in HVAC costs, hygroscopic nature allows it to naturally regulate indoor humidity, contributing to healthier and more comfortable living environments.

- **Type of Hemp Insulation Materials:**
  - Hemp Batt Insulation
  - Hemp-Lime Insulation

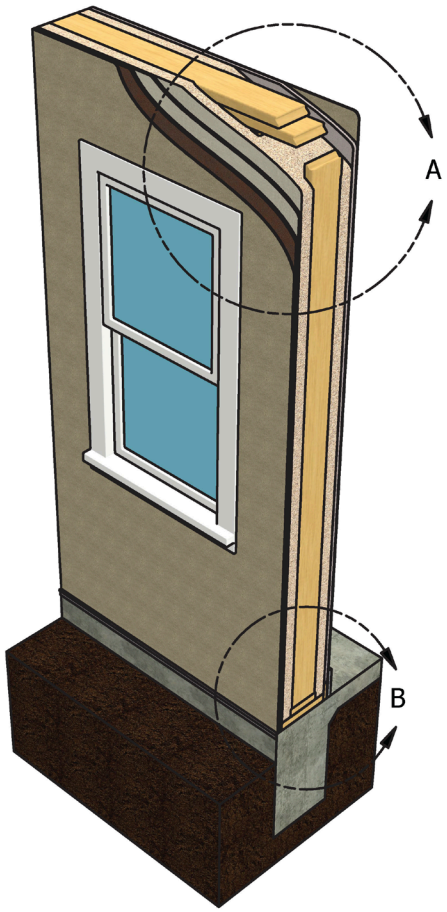
HEMP BATT INSULATION

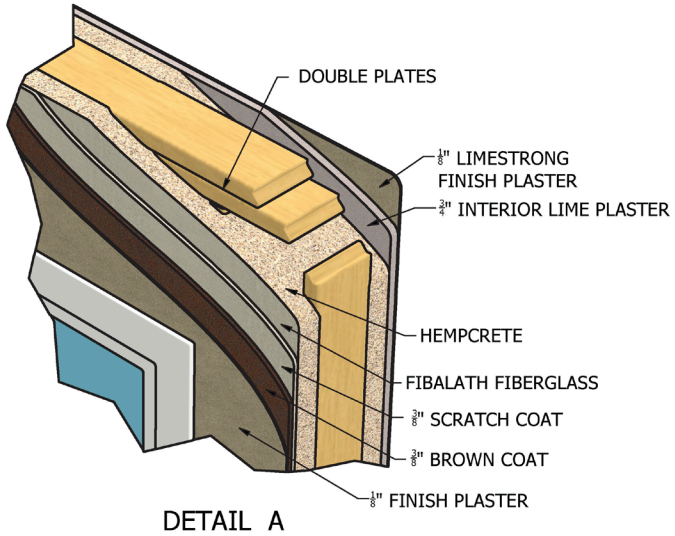
- Harvested fibers are separated, carded, and needle-punched into dense mats without chemical binders
- 1:1 replacement, allowing for integration with existing construction practices
- Approximately R3.5 per inch, does not loose thermal insulation if compressed
- Issue with flammability and not certified for use in California

Photo courtesy of Idaho News 6

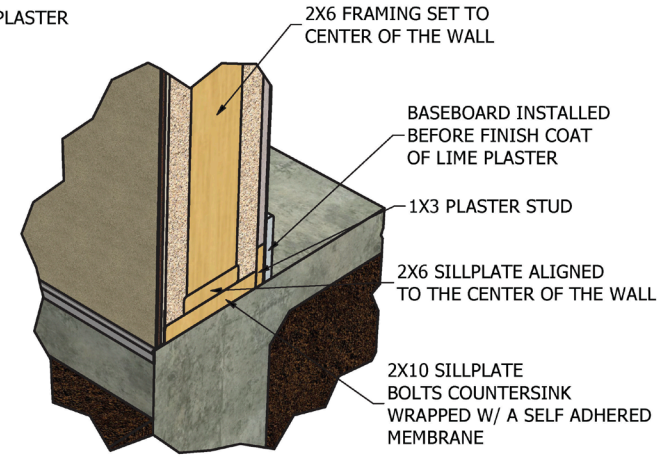
HEMP-LIME INSULATION

- A mixture of hemp Hurd (woody inner core) processed into 10-25mm pieces mixed with water & lime binder
- Replaces wall assembly
- Remarkable reduction in HVAC use
- Discretionary review process, jurisdiction by jurisdiction
- High labor costs, lack of trained workforce





DETAIL A



DETAIL B

HEMPCRETE WALL SECTION DETAILS - 731 Rockwood Avenue ADU

CALEXICO HEMP LIME ADU

- First Permitted ADU using Hemp-Lime insulation in California
- Long, complex entitlement process, issues with first “contractor”
- Located in extreme Climate Zone 15, low-desert with large diurnal fluctuations in daily temperature, extended heatwaves exceeding 110f
- Located in seismically active region (Zone D) with recent swarms, largest measuring 4.8
- 50% + reduction in HVAC use

CALEXICO HEMP LIME ADU

- 50%+ reduction in HVAC use
- +13,000lbs of CO_2 stored within the walls
- Active rental
- Uses passive design to shade house
- Withstood multiple earthquake swarms with no damage

CALIFORNIA LEGISLATION

- **AB 2446:**
  - Completing embodied carbon framework by July 1st, 2025
  - Establishing emissions baseline for the construction industry in 2026
  - Reducing GHG emissions of building materials by 40% from baseline by 2035, with an interim target of 20% reduction by 2030
- **2022 Intervening Cycle** updates to the California Green Building Standards Code (CALGreen) Part 11, Title 24
  - Potential use of hemp insulation, both batt the hemp-lime to reach reuse and 10% reduction in embodied emissions requirements

CALIFORNIA REGULATORY ENVIRONMENT

- No auto adoption of the IRC
- California has unique seismic, climatic and environmental conditions that vary across its geography
- 104.11: Alternative materials, design and methods of construction, and equipment of the CBSC instrumental
- Approach will not work in hostile jurisdictions

PERMITTING A HEMP INSULATED BUILDING

- Manufacturers need to be licensed by the Bureau of Household Goods and Services (BHGS). This includes a specific license category for Thermal Insulation Manufacturers
- Each jurisdiction has its own interpretation of section 104.11 of the CBSC
- Its all about EQUIVALENCY and LIABILITY

VENTURA COUNTY BUILDING CODE SECTION 104.11

…gives the Building Official the authority to approve the use of any alternate material, design, or construction method if the Building Official determines the following:

VENTURA COUNTY BUILDING CODE SECTION 104.11

(a) That the proposed alternate material, design, or construction method would comply with the Building, Electrical, Plumbing, or Mechanical Regulations;

VENTURA COUNTY BUILDING CODE SECTION 104.11

(b) That the proposed alternate material, design, or construction method is at least equivalent to the standards prescribed in the applicable regulation in terms of suitability, quality, strength, effectiveness, fire resistance, durability, safety, and sanitation; and

VENTURA COUNTY BUILDING CODE SECTION 104.11

(c) That sufficient evidence has been submitted to substantiate any claims that may be made regarding the use of any proposed alternate material, design, or construction method

CHALLENGES TO WIDE SCALE ADOPTION

- Lack of supply-chain infrastructure, vast majority of Hurd coming from Mountain West or Midwest
- Lack of knowledgeable builders, due to its relative novelty
- Not yet included in the California Building Standards Code, case by case decision

POTENTIAL FOR ADDED VALUE AGRICULTURE, WATER SAVINGS AND A JUST TRANSITION

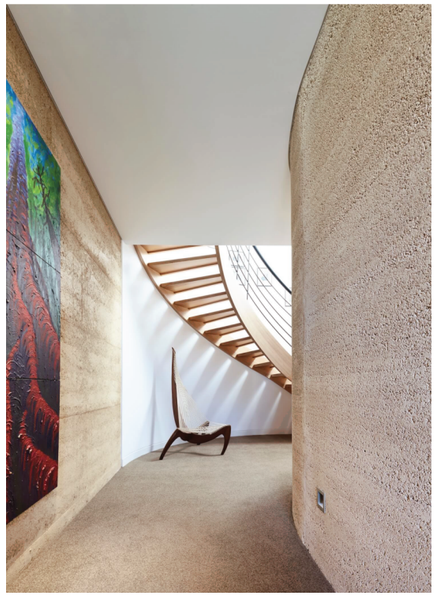
- Potential for economic development in CA's farm belt
- Potential to capture large amounts of carbon if farming was adopted large-scale
- Processing and product manufacturing could support added-value agriculture
- Uses substantially less water than feed crops, can be used in rotation to supplement nitrogen fertilizers
- Farm belt communities among the poorest & most polluted in the State

THANK YOU!

HEMPCRETE CONSTRUCTION IN ARCHITECTURE

MARTINS VAN CAMIERE - GUILLEMIN RESIDENCE

RICHES HAWLEY MIKHAIL ARCHITECTS - CLAY FIELDS HOUSING PROJECT



STEFFEN WELSCH ARCHITECTS

ALEXANDER SEXSMITH, AIA, LEED AP

HEMPCRETE CONSTRUCTION IN ARCHITECTURE

WALLY FARMS - KAJA KUHL

CAPE COD HEMP HOUSE - ESTES TWOBLY + TITRINGTON ARCHITECTS

HILLSIDE SUSTAINABLE LIVING - MOSKOW LINN ARCHITECTS

ASXSMITH@GMAIL.COM

ALEXANDER SEXSMITH, AIA, LEED AP

CARLSBAD HIGH SCHOOL - WITH PERKINS + WILL

JACOBS MEDICAL CENTER - WITH CANNON DESIGN

PRESTON WAY - WITH OX ARCHITECTS

FROST AUDITORIUM - WITH HODGETTS + FUNG

GREAT WALL WINERY - WITH JOHNSON FAIN

CHRIST CATHEDRAL - WITH JOHNSON FAIN

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ALEXANDER SEXSMITH, AIA, LEED AP
AIA SANTA FE - HEMPCRETE IN ARCHITECTURE

WHAT IS HEMPCRETE / HEMPLIME CONSTRUCTION ?

-BIO-BASED MATERIAL DEVELOPED IN EUROPE
-MADE OF HEMP HURD, LIME BINDERS & WATER
-NON-STRUCTURAL, FIRE-RESISTANT, MOLD-RESISTANT MATERIAL
-LOW-CARBON, HIGH PERFORMANCE SOLUTION
-AN OPPORTUNITY EMERGING FROM THE 2018 FARM BILL
-A VAPOR-PERMEABLE, MONOLITHIC ASSEMBLY

ALEXANDER SEXSMITH, AIA, LEED AP

RESTORING TRADITIONAL FORMS OF CONSTRUCTION

MAISON DU TURQUIE

MAISON D’ADAM

MAISON DU TURISME LES TROYES

ALEXANDER SEXSMITH, AIA, LEED AP
AIA SANTA FE - HEMPCRETE IN ARCHITECTURE

WHAT IS HEMPCRETE MADE OF ?

Hemp hurd + **Lime-based binder** + **Water**

SOURCE : HEMPSTONE
https://hempstone.net/catalyst-for-change/faq-hempcrete-explained

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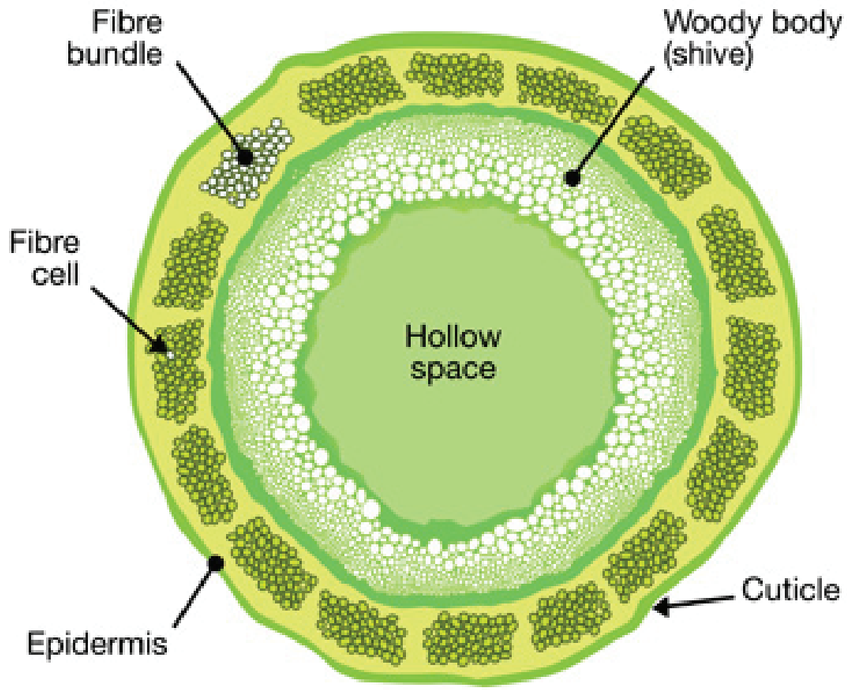
AIA SANTA FE - HEMPCRETE IN ARCHITECTURE

WHICH PART OF THE HEMP PLANT ?



https://livetextiles.online/new-blog/2018/7/16/fibre-research-hemp

SOURCE :
https://www.sneakerfreaker.com/features/material-matters/material-matters-hemp

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AIA SANTA FE - HEMPCRETE IN ARCHITECTURE

COMPARING CBD HEMP TO INDUSTRIAL HEMP

SOURCE :

https://www.wsj.com/articles/hemp-becomes-booming-crop-for-new-york-farmers-11564930800

https://www.ksre.k-state.edu/news/stories/2019/02/industrial-hemp-to-be-grown-in-kansas.html

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ALEXANDER SEXSMITH, AIA, LEED AP
AIA SANTA FE - HEMPCRETE IN ARCHITECTURE

SOURCE : PATAGONIA - SAN LUIS VALLEY HEMP FARM

SOURCE : BUSINESS INSIDER - CANCER ALLEY, LOUISIANA

HONING A DEFINITION OF SUSTAINABILITY AND WELLNESS IN ARCHITECTURE

FROM LESS HARM TOWARD A PARADIGM SHIFT

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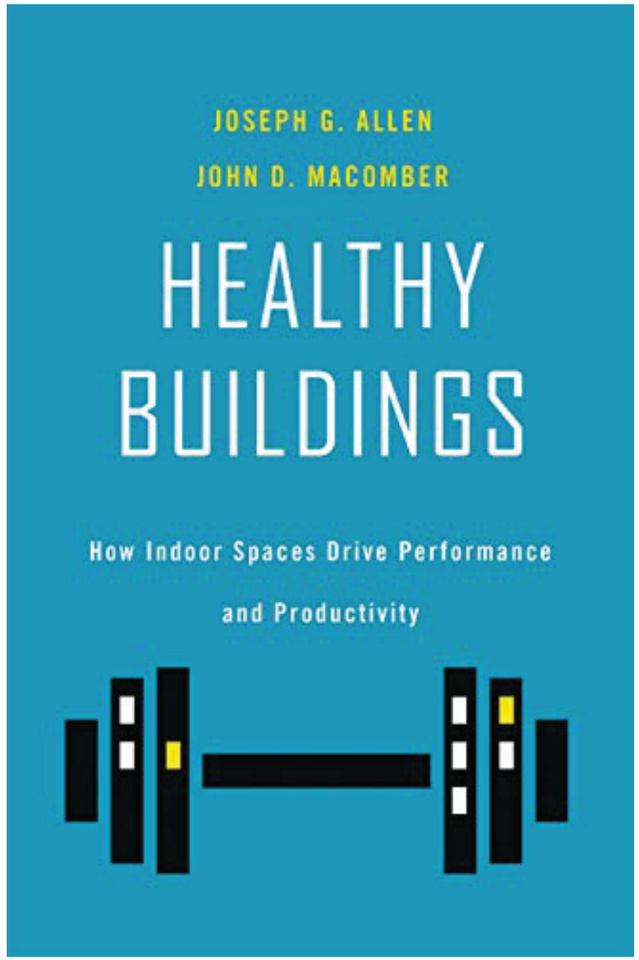
AIA SANTA FE - HEMPCRETE IN ARCHITECTURE

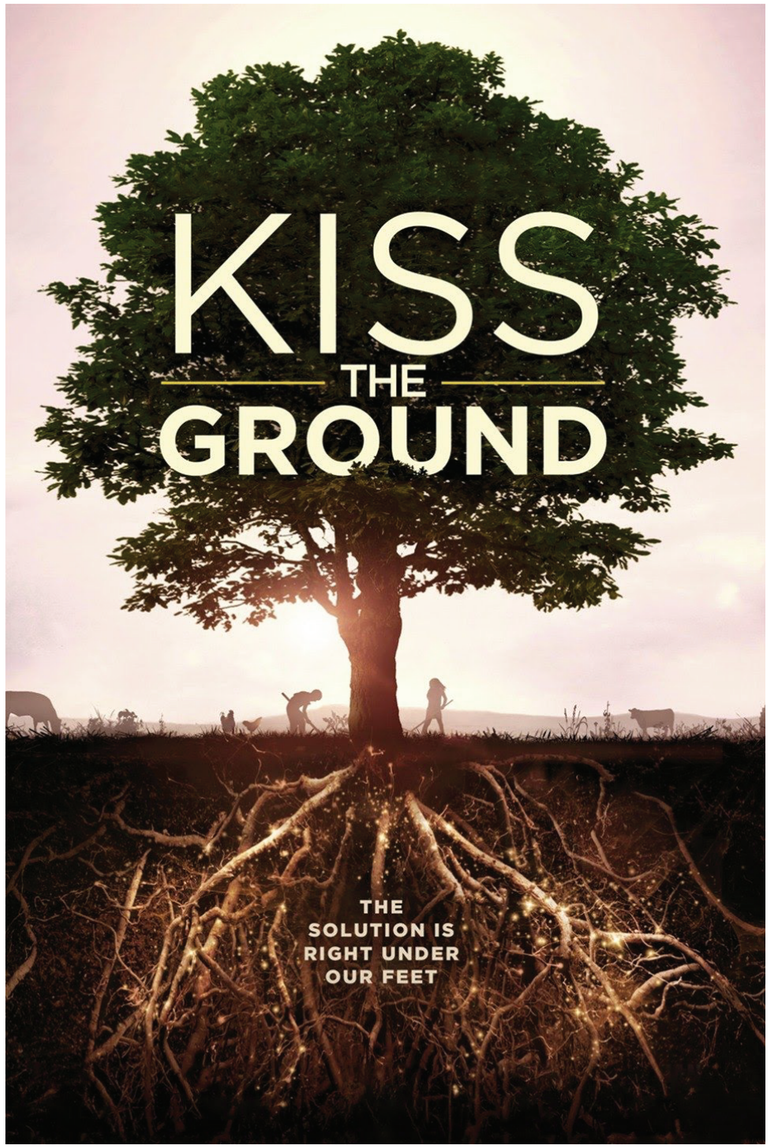
WHICH REQUIRES SHARPENING THE DEFINITION OF WHAT IS REGENERATIVE, AND WHAT IS EXTRACTIVE ?

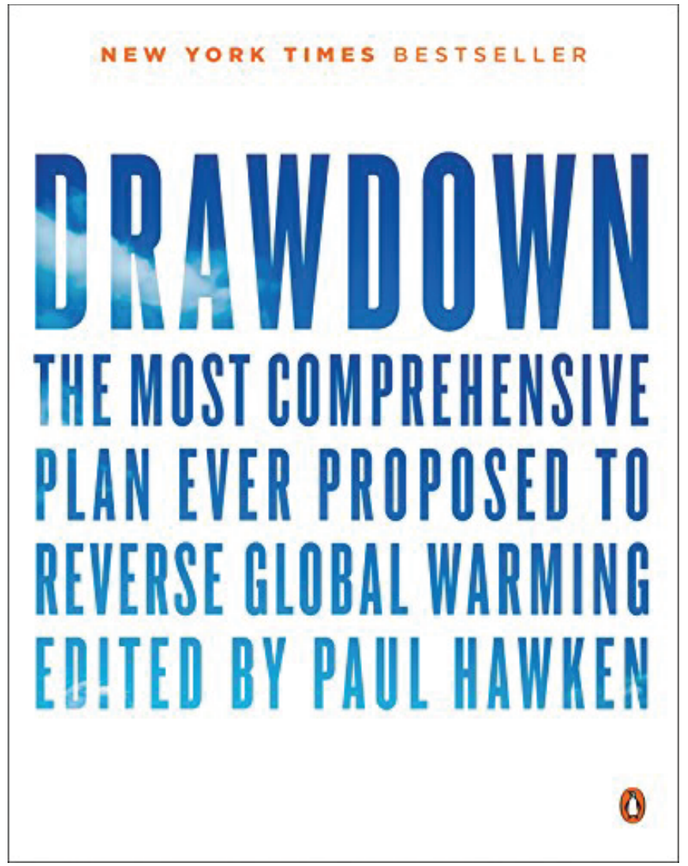
Bamboo matures in 3-5 years

Lithium pit mine

https://www.guaduabamboo.com/blog/bamboo-provides-and-endless-supply-of-timber







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AIA SANTA FE - HEMPCRETE IN ARCHITECTURE




BOULDER BACKYARD BUILD - EXPERIMENTING WITH DIFFERENT TYPES OF HEMP HURD AND BINDERS

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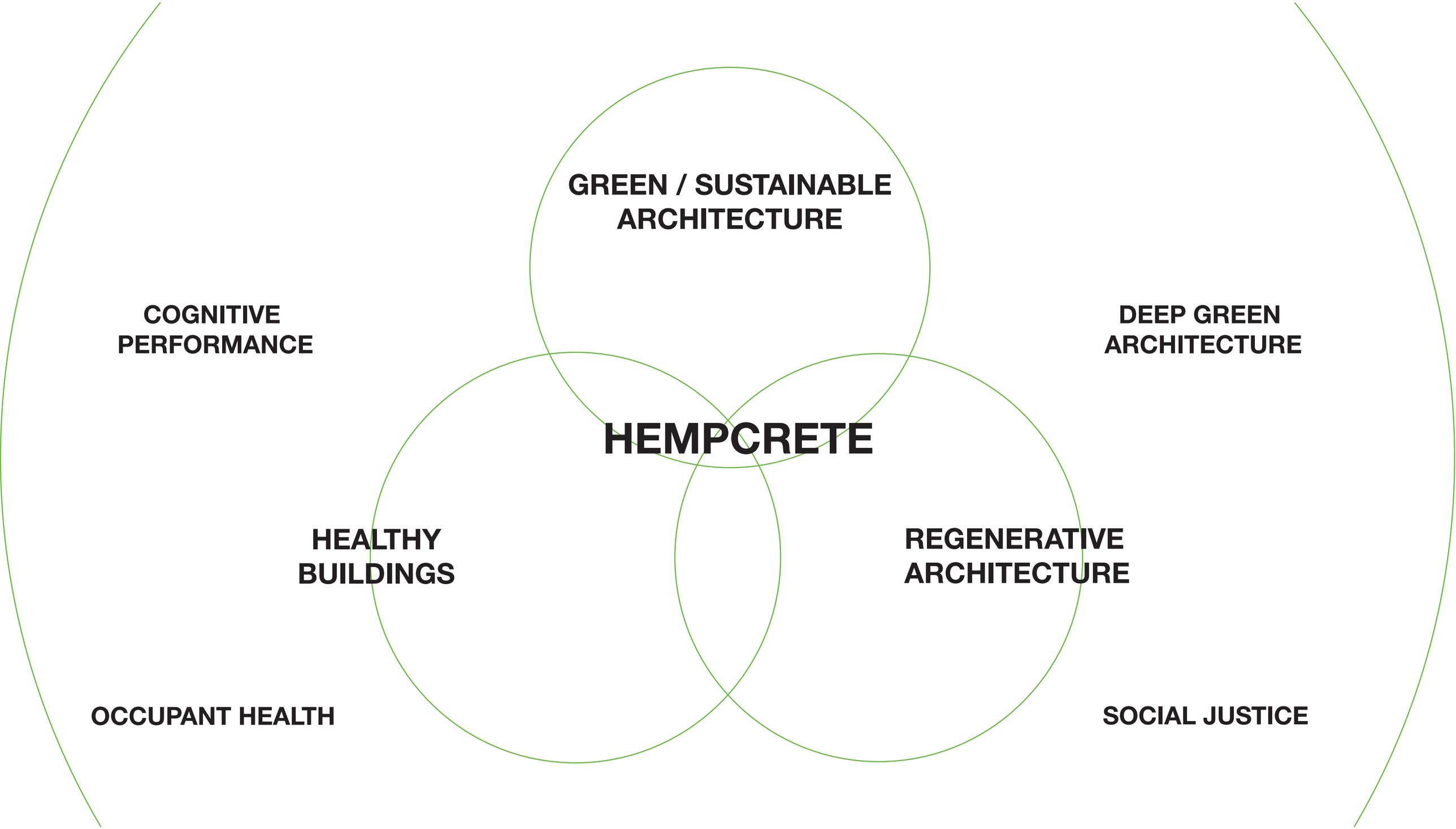
AIA SANTA FE - HEMPCRETE IN ARCHITECTURE

HEMPCRETE FRAME-ON-CENTER WALL CASTING

ALEXANDER SEXSMITH, AIA, LEED AP
AIA SANTA FE - HEMPCRETE IN ARCHITECTURE



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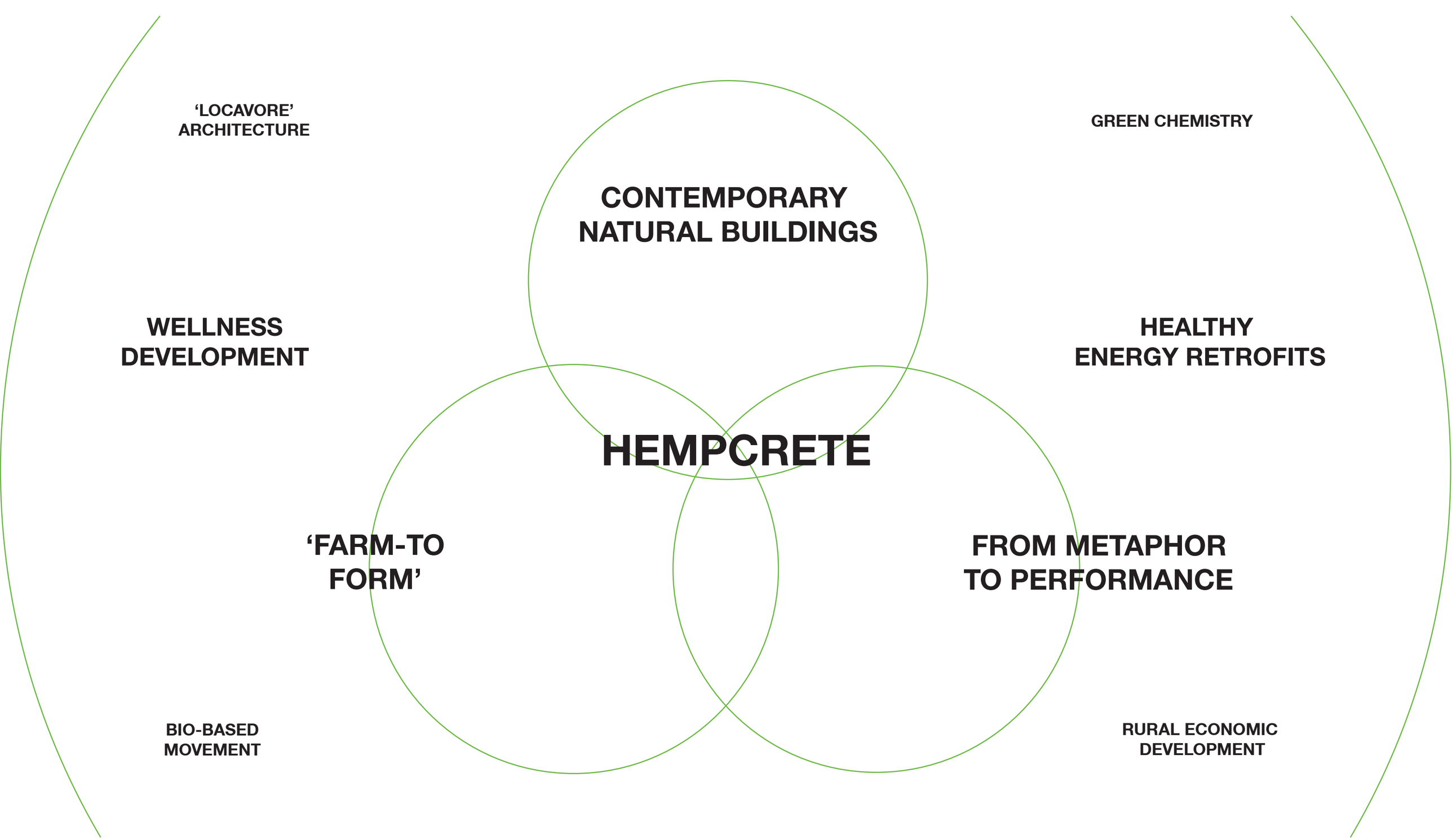

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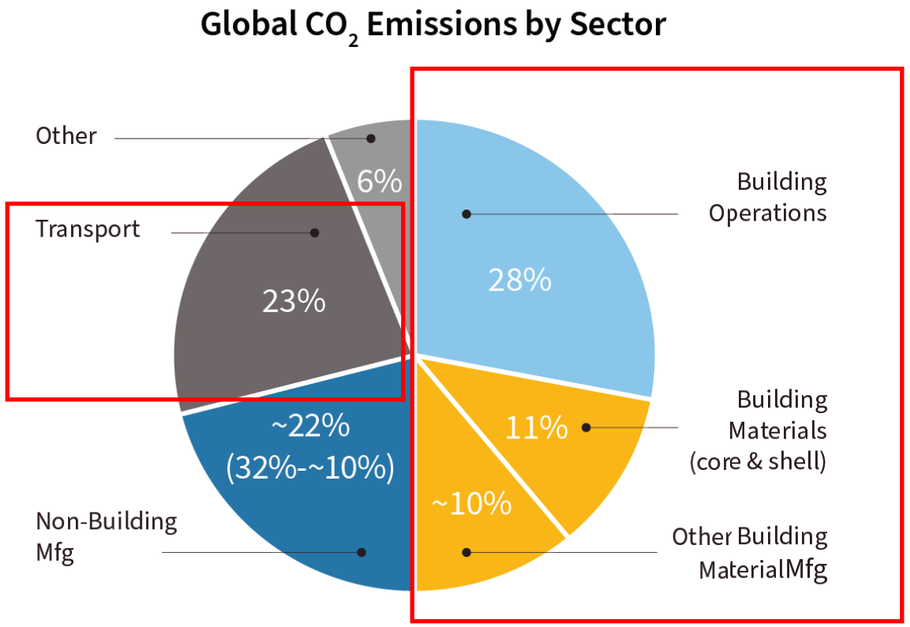
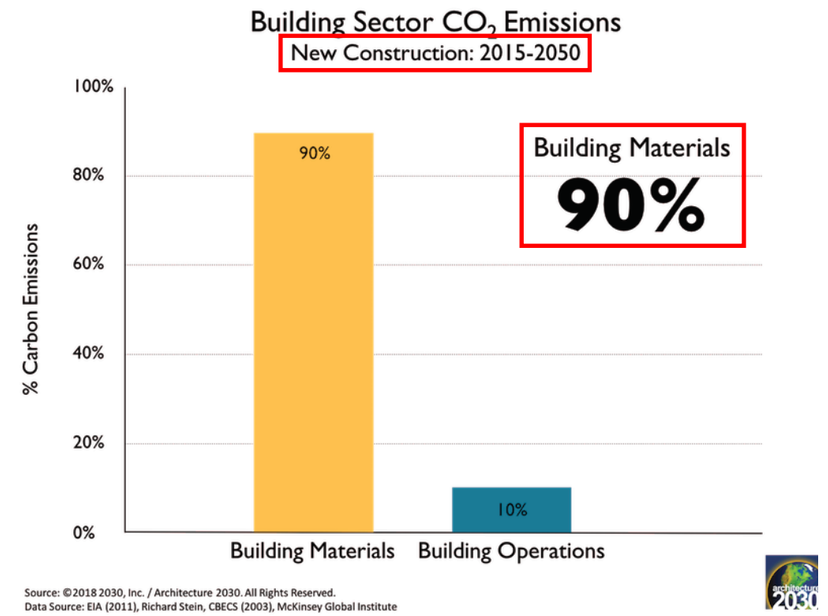
AIA SANTA FE - HEMPCRETE IN ARCHITECTURE



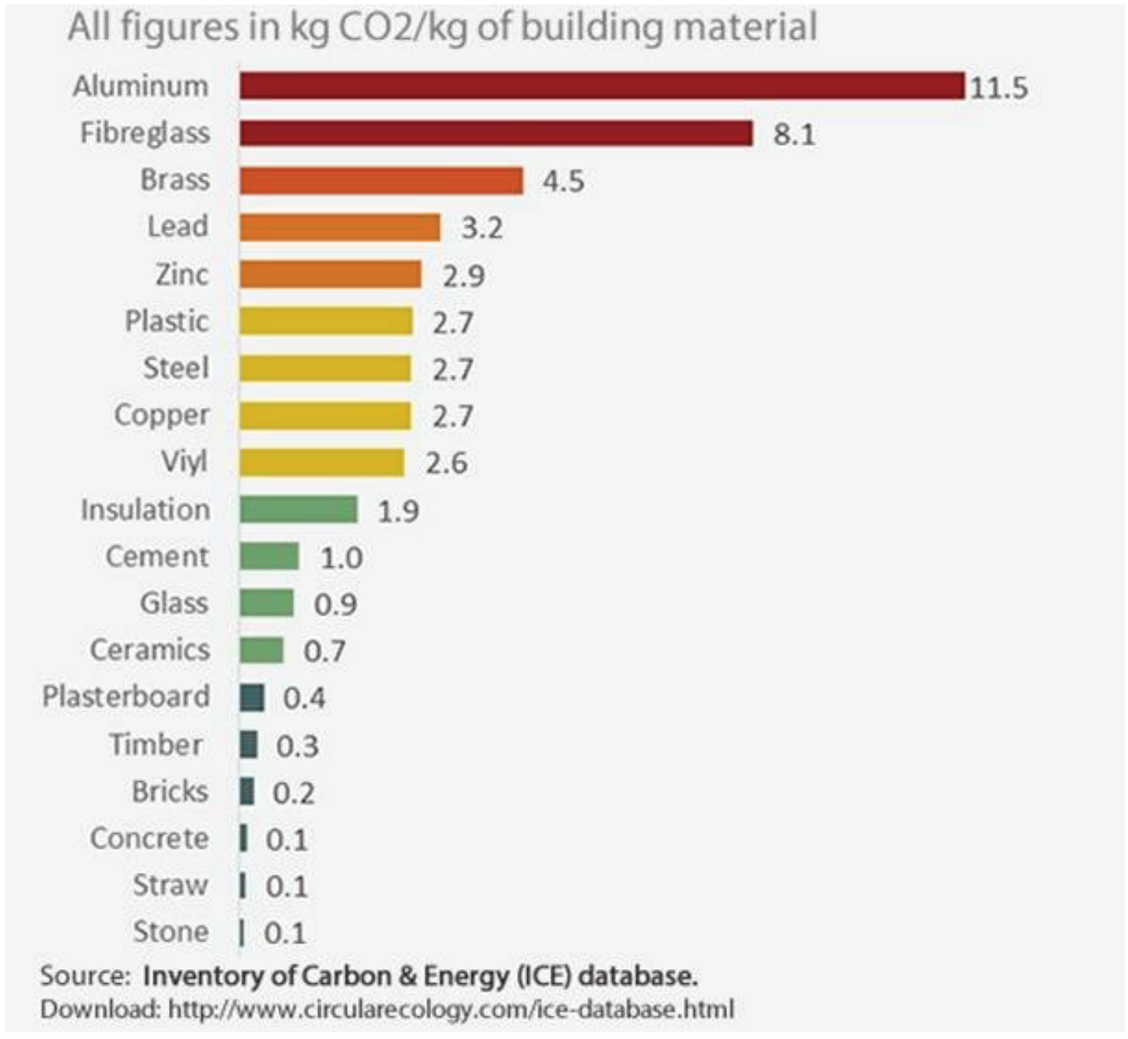
Adapted from 2019 Global Status Report, Global Alliance for Building and Construction (GABC) and Architecture 2030.

- The building and construction sector has a vital role to play in eliminating carbon, as it is responsible for approximately 40% of global carbon emissions.



SOURCE : CARBON LEADERSHOP FORUM

SOURCE : NEW BUILDINGS INSTITUTE / 2030
https://newbuildings.org/embodied-carbon-conundrum-solving-for-all-emission-sources-from-the-built-environment/



https://www.researchgate.net/figure/Embodied-carbon-of-some-building-materials-URL-8_fig5_328654824

Choose carbon sequestering materials. Using agricultural products that sequester carbon can make a big impact on the embodied carbon in a project. Wood may first come to mind, but you can also consider options like straw or hemp insulation, which—unlike wood—are annually renewable.

https://www.aia.org/articles/70446-ten-steps-to-reducing-embodied-carbon

HEMP BASED COMPOSITE SEQUESTERS AND STORES AN ESTIMATED 325 KG OF CARBON PER METRIC TON OF HEMP BASED COMPOSITE

SOURCE - MATERIALS PALETTE - HEMPCRETE
https://materialspalette.org/hempcrete/

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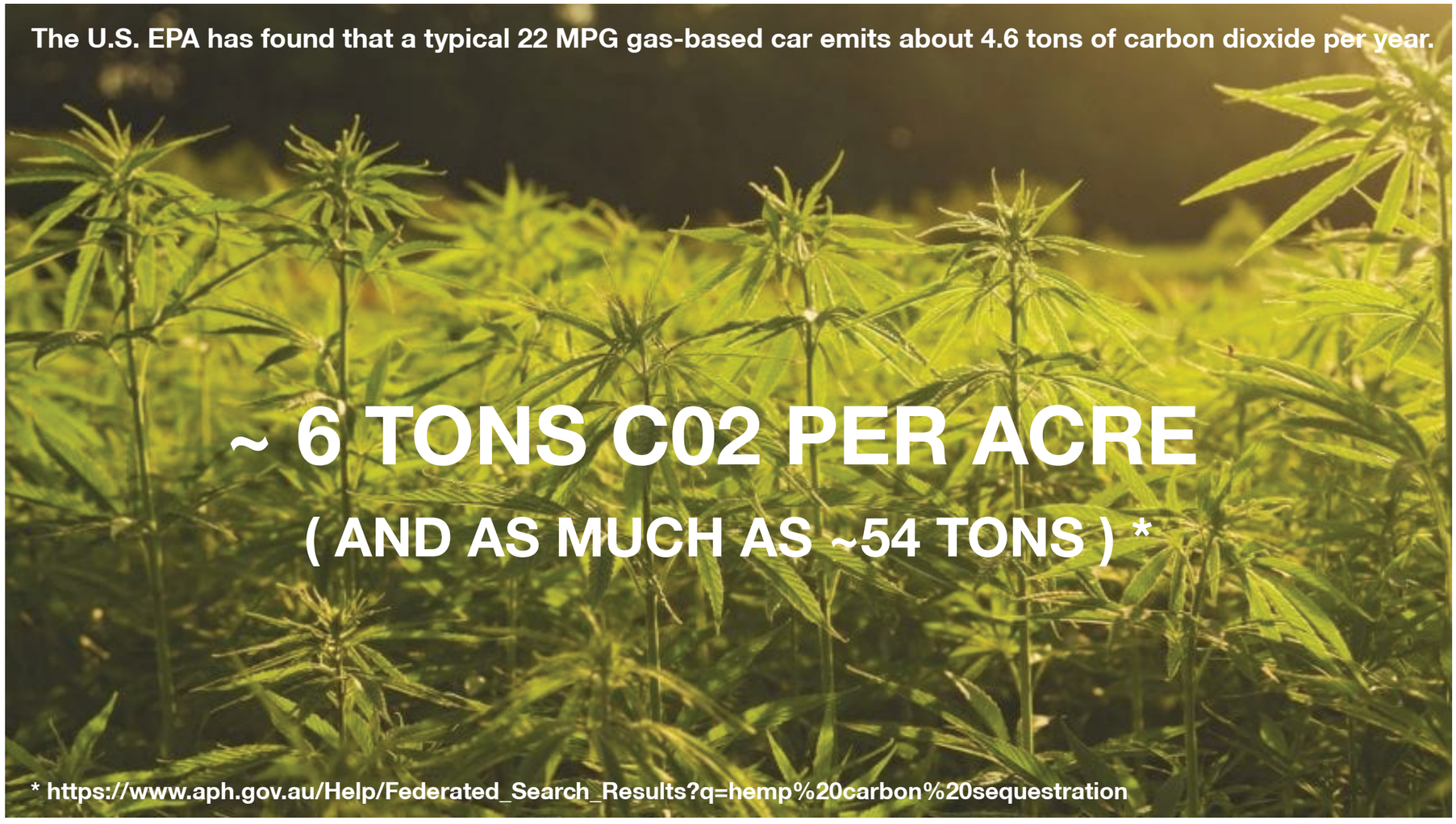
AIA SANTA FE - HEMPCRETE IN ARCHITECTURE



SOURCE - CENTER FOR NATURAL MATERIAL INNOVATION - CAMBRIDGE UNIVSERSITY
https://www.dezeen.com/2021/06/30/carbon-sequestering-hemp-darshil-shah-interview/

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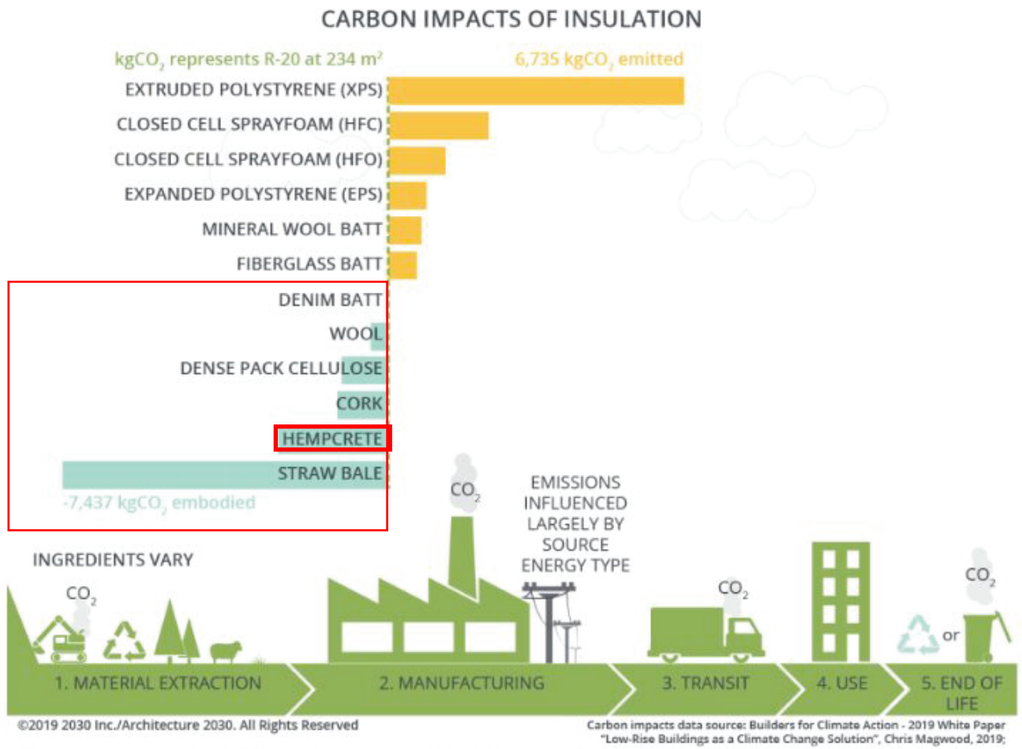
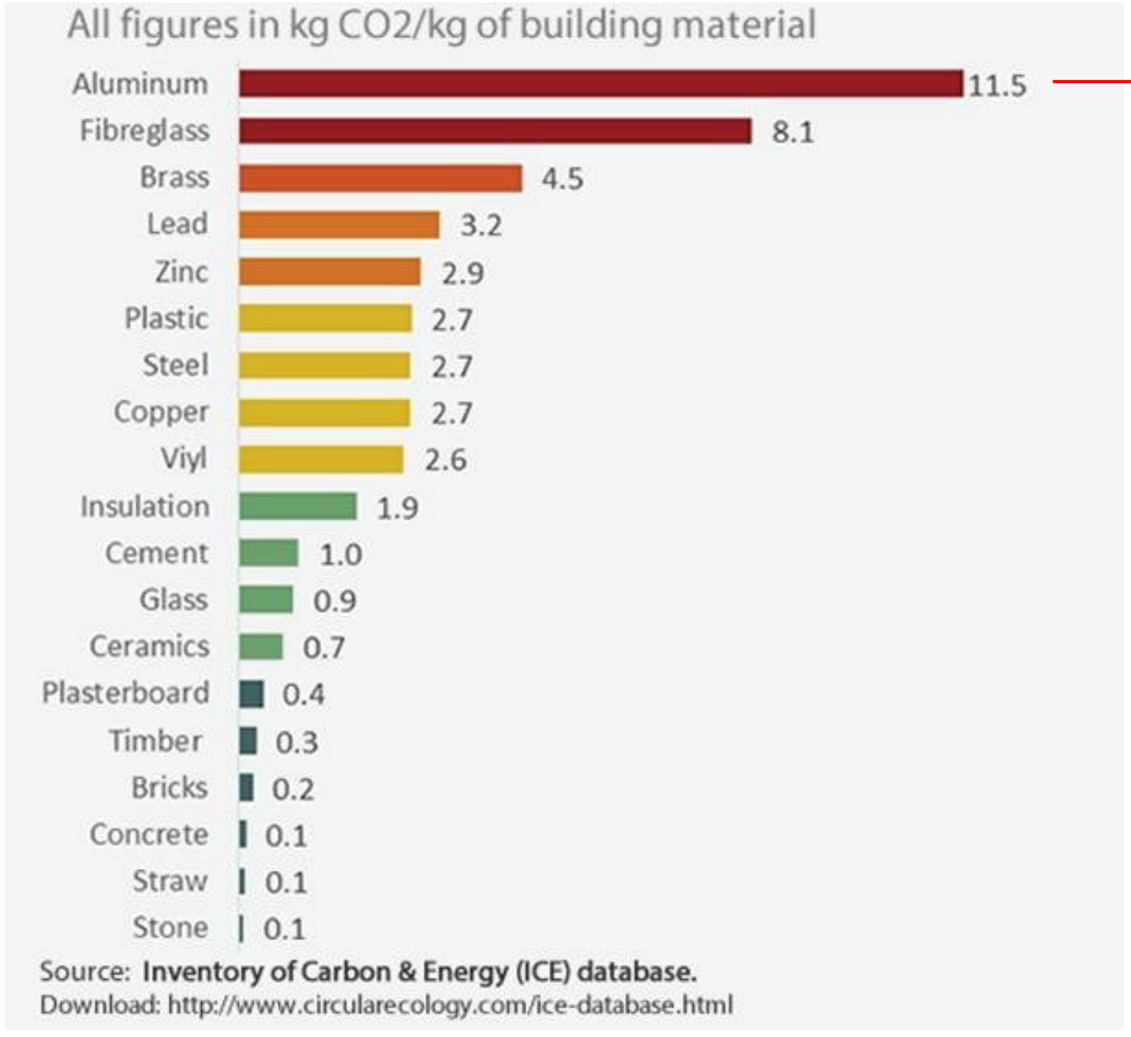


Figure 2. Carbon impact of insulation

Source: Architecture 2030. https://materialspalette.org/insulation



DARK BROWN ALUMINUM
-Aluminum made with coal fired electricity (18 tons C02/ton of Al)

LIGHT BROWN ALUMINUM
-Aluminum made with natural gas (8 tons CO2/ton Al)

LIGHT BLUE ALUMINUM
-Aluminum made with Hydopower (4 tons of C02/ ton Al)

DARK BLUE ALUMINUM
-Aluminum made with the Elysis process (emits Oxygen)

LIGHT GREEN ALUMINUM
-Recycled from pre-consumer waste

DARK GREEN ALUMINUM
-Recycled from post-consumer waste

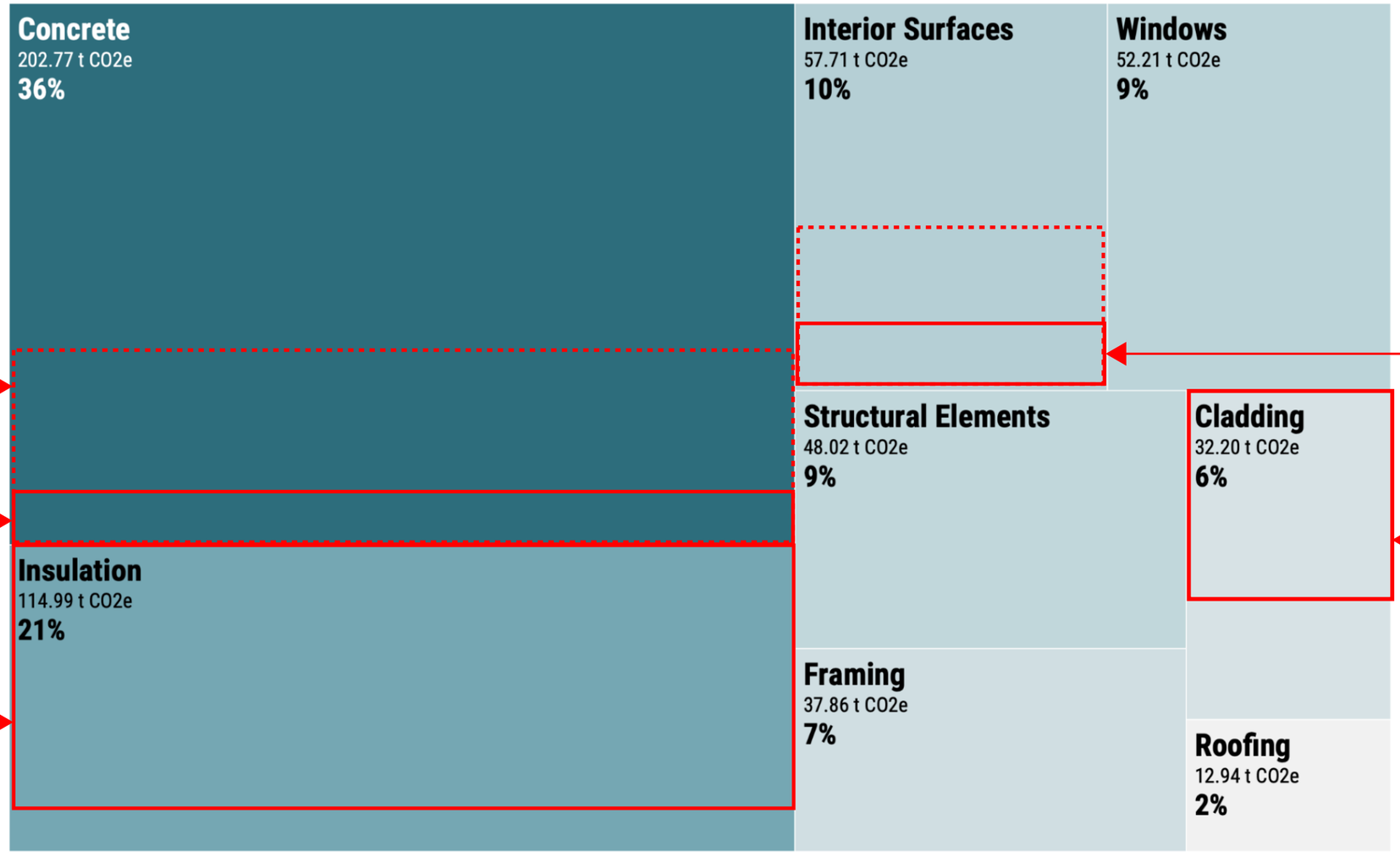
https://www.researchgate.net/figure/Embodied-carbon-of-some-building-materials-URL-8_fig5_328654824

EXAMPLE OF THE EMBODIED CARBON OF DIFFERENT PARTS OF A HOUSE

IMPROVING CONCRETE MIX-DESIGN, AND FOUNDATION DESIGN WITH EMBODIED CARBON IN MIND CAN REDUCE THIS FURTHER

CARBON REDUCTION THROUGH LIGHTER FOUNDATIONS DEPENDING ON DESIGN

BIOBASED INSULATION GREATLY REDUCES EMBODIED CARBON OF INSULATION PER PREVIOUS SLIDE

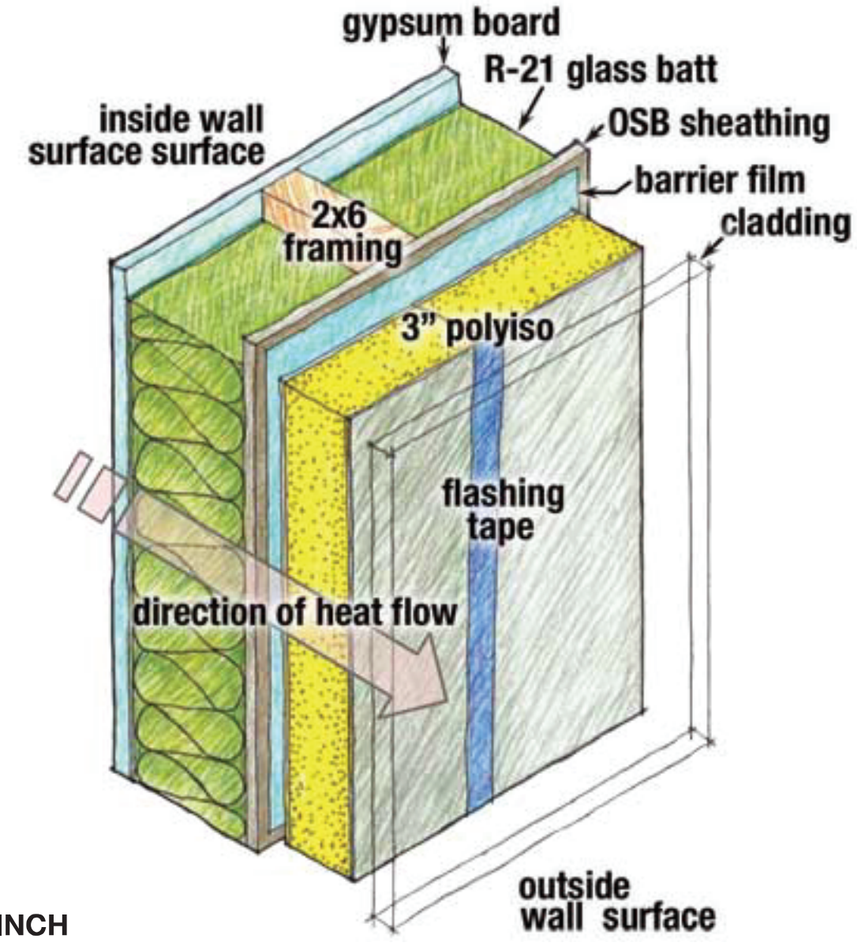


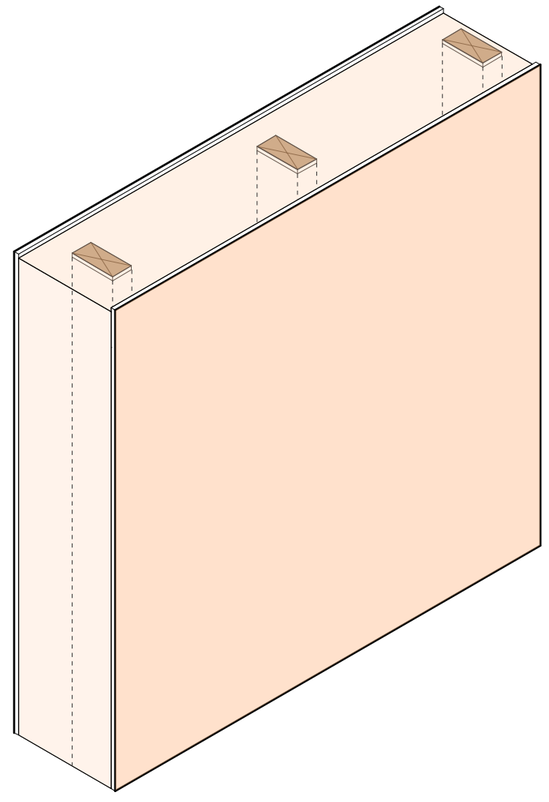
BIO-BASED MATERIALS FOR INTERIORS LEADS TO C02 REDUCTIONS 'HEMPWOOD' , CORK, CLAY PLASTER, WOOD, ETC.

HEMPCRETE IS TYPICALLY CLAD WITH LIMEPLASTER REDUCING MUCH OF THE EMBODIED CARBON

Builders for Climate Action, City of Vancouver Material Emissions Benchmark Study

SOURCE : THE CONSTRUCTION SPECIFIER





R-VALUES PER INCH

POLYISOCYANURATE : 6.5
EXTRUDED POLYSTYRENE : 3.5
HEMPCRETE ~ 2/2.5
STRAWBALE ~ 1.4
ADOBE ~ .2 / .3
CONCRETE ~ .1

2X4 FRAMING , SHOWN 16" OC
PLASTER FINISH AT INTERIOR
AND EXTERIOR
8" CIP HEMPCRETE = R-20

(ASSUMING R2.5 R-VALUE)

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AIA SANTA FE - HEMPCRETE IN ARCHITECTURE

500 MILE RADIUS - LEED LOCAL/REGIONAL MATERIAL CREDIT

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https://www.dezeen.com/2015/10/27/martens-van-caimere-architecten-hempcrete-hemp-render-striated-skin-renovated-house-belgium/

"The clients love nature and, by renovating the house, an opportunity arose for upgrading their way of living, fitting their lifestyle," said Martens. "The brief was quite simple; it is a sustainable low-tech house designed with sustainable materials, and above all anchored in its environment."

http://www.mikhailriches.com/project/clay-fields/#text
SUFFOLK, ENGLAND

The houses are constructed from a structural timber frame and use 'Hemcrete', a sprayed mixture of lime and hemp, to give a breathable and highly sustainable construction which is finished with lime render and lime washed.

FLAT HOUSE - PRACTICE ARCHITECTS
MARGENT FARM

""The radical thing about the building is not so much it's zero-carbon status but more the use of naturally grown materials, the designing out of plastics wherever possible and it's very low embodied carbon when compared to conventional construction,"

https://www.dezeen.com/2020/01/09/flat-house-hempcrete-practice-architecture-margent-farm/

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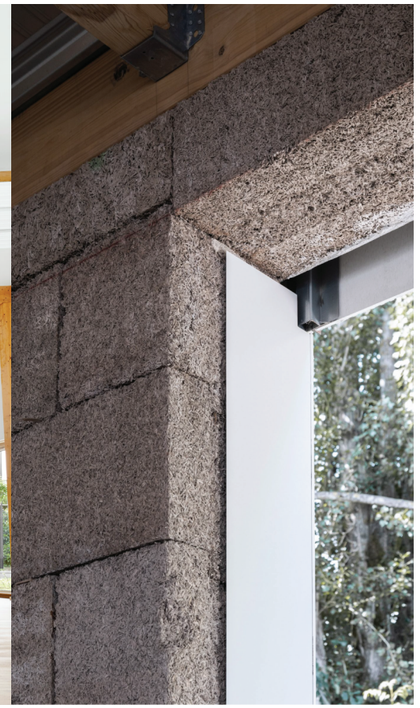
AIA SANTA FE - HEMPCRETE IN ARCHITECTURE



https://www.dezeen.com/2021/08/01/hempcrete-pierre-chevet-sports-hall-lemoal-lemoal/

The exterior of the building is clad in white, cement-fibre panels that protect the hemp blocks. Inside, the building has a wooden, half-vaulted structure that is adjoined to the hempcrete walls for support and provides the interior space with a column-free interior.
"The structure is a mix of timber and hempcrete blocks, wooden half-vaulted porticoes lean against a wall of hempcrete blocks for support," the architect told Dezeen.

CAPE COD HEMP HOUSE
ESTES TWOMBLY + TITRINGTON ARCHITECTS
HEMPSTONE - HEMPLIME CONTRACTORS

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ALEXANDER SEXSMITH, AIA, LEED AP
AIA SANTA FE - HEMPCRETE IN ARCHITECTURE

WHAT KIND OF PROJECTS DO YOU WANT TO BUILD ? WHAT TECHNIQUE ALIGNS BEST ?

ALEXANDER SEXSMITH, AIA, LEED AP

https://fibershed.org/2020/10/22/the-hemp-casita-of-rezolana-rising-up-from-the-ground/

ARNIE VALDEZ - REZOLANA INSTITUTE
SAN LUIS, COLORADO

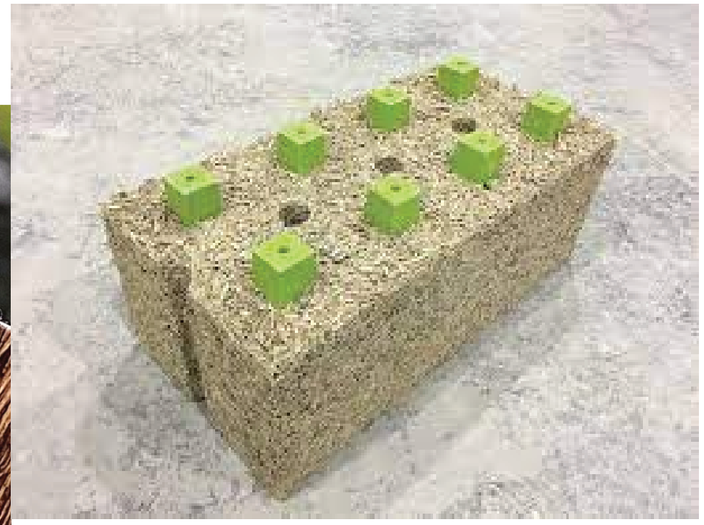
DEMONSTRATION PROJECT : PA HEMP HOME

DON Enterprises, in collaboration with the PA Housing Research Center at Penn State University and Parsons School of Design Healthy Materials Lab supported by grants.

ALEXANDER SEXSMITH, AIA, LEED AP
AIA SANTA FE - HEMPCRETE IN ARCHITECTURE

HEMP WOOL

HEMP WOOD



JUST BIOFIBER

ISOHEMP

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ALEXANDER SEXSMITH, AIA, LEED AP
AIA SANTA FE - HEMPCRETE IN ARCHITECTURE

The project consists of 48 market-rate 1-3 bedroom rental units and a deeply affordable 10 room/SRO shared-kitchen residence throughout 4.5 acres.

HILLSIDE CENTER FOR SUSTAINABLE LIVING
NEWBURYPORT, MA

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AIA SANTA FE - HEMPCRETE IN ARCHITECTURE

TECLA PROJECT - RAVENNA, ITALY
TECHNOLOGY + CLAY

SOURCE - ARCHDAILY.COM
https://www.archdaily.com/966362/is-it-possible-to-mix-local-materials-and-3d-printing

ALEXANDER SEXSMITH, AIA, LEED AP
AIA SANTA FE - HEMPCRETE IN ARCHITECTURE

CONTEMPORARY ARCHITECTURE WITH NATURAL BUILDING TECHNIQUES

IKUBUKU - BALI

DUST DESIGN BUILD - TUSCON MOUNTAIN RETREAT

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THANK YOU

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What is Hempcrete ?

1. A bio-based construction material (gaining traction through innovation)

–Hempcrete is a natural building technique used primarily in Europe – (beginning in 1986 in the restoration of the Maison du Turquie outside Paris)
–Why are we talking about it now ? (3 of many reasons)
–The Architecture and Construction Industries are looking toward Carbon Neutral Buildings, not just Net–Zero Energy
–The Farm Bill made Hemp Legal in 2018, and many people have been trying to figure out how to build an industry around it
–More specifically, Hempcrete was recently approved for the International Residential Code in October 2022.
and so it is hoped it will gain more traction as an alternative building material very soon.

2. What is in Hempcrete ?

–Lime & pozzolanic or cementitious binders, Hemp Hurd, Water
–What is hemp hurd ? – the woody core of a hemp plant
–many times we think of hemp and we think of hemp fibers – rope and textiles – that's the outer fibers
–hemp hurd is the interior – the wood versus the bark, for example
–Hempcrete vs Hemp–Lime : Defining it for the purists (concrete in the binders vs Lime, Pozzolans and other minerals)

3. In terms of Sustainable Architecture and Buildings

–Natural, low embodied energy material (C02 of lime production process balances out over time through C02 absorption of the curing process)
–Insulating (approx. R2.1– R2.5) – roughly 10 times the insulating value of Adobe, but ~ 1/3 as much as Polyisocyanurate aka 'Blueboard'
–Non–toxic, no VOC's (which are bad for our overall health, immune systems, and especially our respiratory systems)
–Vapor permeable (no mold because of alkaline chemistry, and a 'breathable' wall construction; also humidity regulating)
–Local (most of the materials can be purchased within 500–1000 miles) means less energy / emissions to get to a project jobsite
–Can achieve nearly Passive–House standards (with thicker walls) with blower–door tests as low as .6 already achieved in Europe
–Nearly Carbon–Neutral Construction Material when produced with local materials
–Material that can also be formed in bricks and is even being explored as a 3D printed construction material for a range of project types
–Integration of Sustainability (energy and material focused) , Regenerative (buildings giving back to their environment) , and Wellness (human health)
–True Sustainability raises the tide for all – toxic materials are often created in the poorest neighborhoods and communities

4. In terms of Economic Opportunity for this region

–Local or regional production of Hemp (Northern NM, San Luis Valley, Texas, Kansas...)
–Local production of Lime and pozzolans (New Mexico, Texas, Mexico...)
–Local production of wooden structure or frame (Re–looking at local forest stewardship)
–Accessible/Affordable housing – Enabling or facilitating Owner–builders (demonstration or pilot projects)
–PA Hemp Home and example of Habitat–for–Humanitty type approach.
–Workforce Development
–A technique that can be low–tech (cast–in–place) , mid–tech (masonry block infill) or, high–tech (spray or 3D printing in the future)
–Hands–on construction technique that can be utilized by an owner–builder for healthy, affordable homes
–Habitat–for Humanity–type approach to demonstrate/demystify the technique, and build a skilled workforce
–Research worthy of grants (Texas A&M recently received a nearly $4M grant to study 3D printing hempcrete)
–Rural Economic Development – Collaborations between farmers, processors and builders
–Hemp as a rotation crop builds soil (deep root system) and sequesters carbon in the soil (accurate data needs to be gathered)

5. Limitations and Opportunities

–Supply chain build–out (industry growth and of course growing pains)
–Craftsmanship and professionalism (moving beyond the initial leadership of owner–builders towards standardization and industry adoption)
–Potential USDA or DOE grants to study many of the aspects of the industry – data gathering, research, prototypes

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Resources

- Continuing Education Units Available
  - Contact ian.logan@ventura.org for AIA & ICC LUs
- Coming to Your Inbox Soon!
  - Slides & Survey – Please Take It and Help Us Out!
- Upcoming Courses
  - 4/25 Heat Pump Fundamental: Space Conditioning and Water Heating
  - 5/3 High Performance Envelope + Balanced Ventilation (In-Person Santa Barbara)
  - 5/3 Detailing for High Performance Roofs and Walls (In-Person Santa Barbara)
  - 5/8 Energy Code Implementation: Accessory Dwelling Units
  - 5/9 Water Heating Distribution Best Practices
  - 5/14 Thriving with Hemp – Green Building Speaker Series

- For more information about upcoming events please visit: https://www.3c-ren.org/events

Thank you!

For more info:
3c-ren.org

For questions:
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