

# A Review of Alternative Building Materials in Comparison to CMU: Papercrete, Hempcrete, and Woodcrete

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## CHALLENGES:

Construction industry is the 2<sup>nd</sup> largest consumer of raw materials by sector

- Concrete Production:
  - Most utilized construction material in the world
  - 4-5% of world's CO<sub>2</sub> emissions
  - 3<sup>rd</sup> highest source of man-made CO<sub>2</sub> emissions
  - Entirely composed of finite, nonrenewable natural resources

## RESEARCH GOALS:

- Investigate alternative building materials to concrete, to lessen strain on natural resources, decrease negative impacts to the environment, and lower the energy use of the most common building: single family homes
- Compare standard concrete masonry units (CMU) to papercrete, hempcrete, and woodcrete blocks

## METHODOLOGY:

- Mixed-method
  - Quantitative – collection, standardization & comparison of testing data
  - Qualitative – personal interviews with manufacturers and builders

## RESULTS:

- Table providing ease of comparison among most-similar available products comprised of each material, in the most-significant categories:
  - Operational energy performance
  - Life safety performance
  - Workability
  - Cost

## CONCRETE

### CMU



**Mixture**  
14% Portland cement  
42% sand  
42% aggregate  
2% water

**Aggregate**  
gravel, crushed stone:  
the most mined mineral in the world, blasted or excavated from open mine pits



## PAPERCRETE

### GREENSTAR BLOX



25% Portland cement & water  
65% recycled paper  
10% additives

recycled paper material:  
newspapers, phonebooks, and lottery tickets preferred



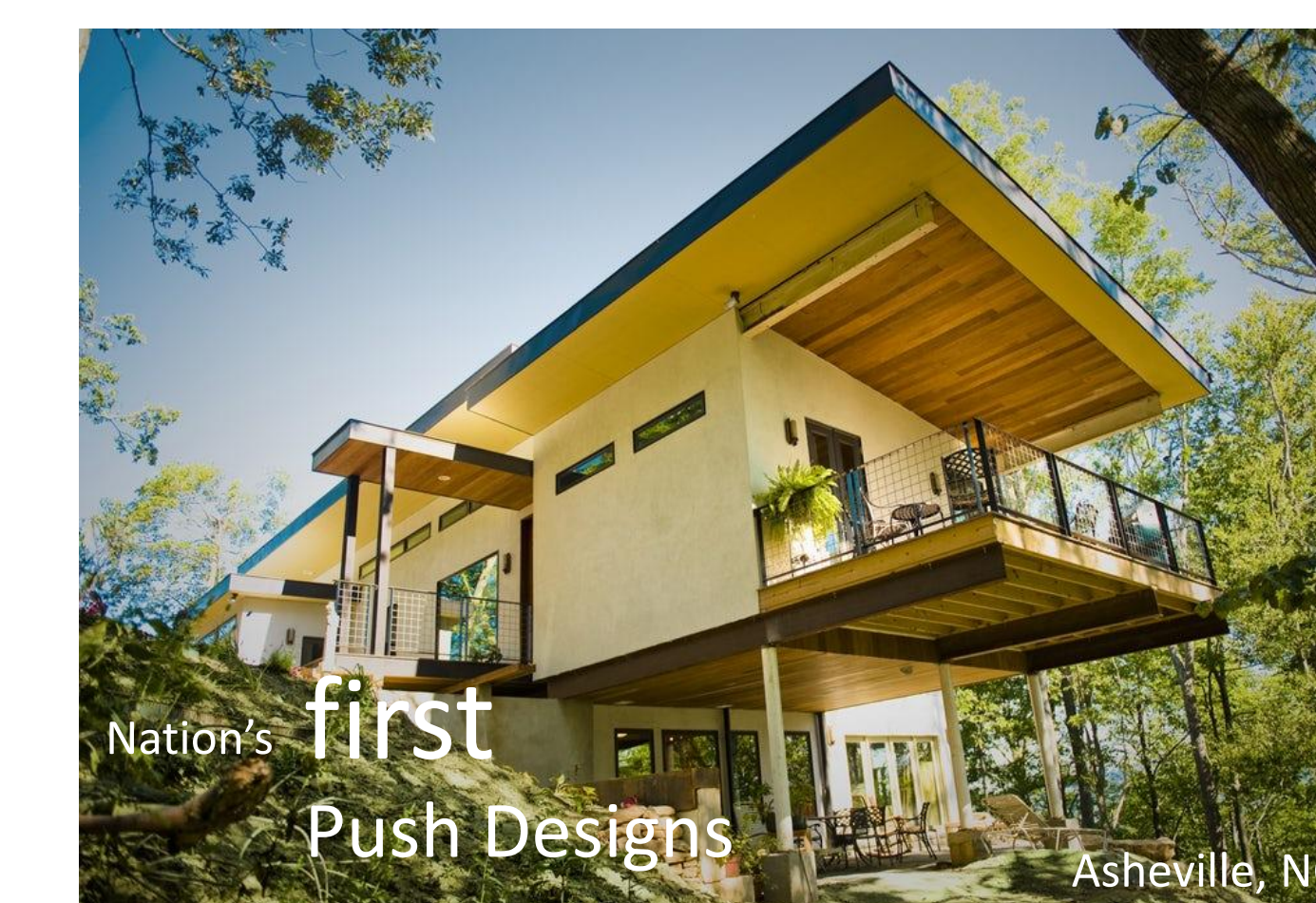
## HEMPCRETE

### JustBioFiber Structural Solutions



34% lime-based binder  
16% hemp shives  
50% water

hemp shives:  
harvested twice annually, one acre produces four times as much raw material as one acre of timber



## WOODCRETE

### FASWALL Insulated Wood Chip-Cement Forms



15% Portland cement & water  
85% wood chips

recycled wood material:  
typically saw dust and scrap wood



| DATA RESULTS                            | CONCRETE            | PAPERCRETE          | HEMPCRETE            | WOODCRETE            |
|---|---------------------|---------------------|----------------------|----------------------|
| Dimensions                              | 8" w x 8" h x 16" l | 8" w x 8" h x 16" l | 11" w x 8" h x 21" l | 12" w x 8" h x 21" l |
| Weight in pounds                        | 30                  | 8.5                 | 22                   | 28                   |
| R-value                                 | R2 (R8 w/foam)      | R26                 | R27                  | R12 (R21 w/foam)     |
| Fire rating in hours                    | 3                   | 2                   | 1                    | 4                    |
| Requires rebar                          | Yes                 | Yes                 | No                   | Yes                  |
| Requires motor                          | Yes                 | Yes                 | Yes                  | Yes                  |
| Easily cut in field                     | No                  | Yes                 | Yes                  | Yes                  |
| Material cost/ft <sup>2</sup> wall area | \$1.46              | \$1.61              | \$17.00              | \$8.37               |

Papercrete, hempcrete and woodcrete are utilized in construction in many forms, by numerous suppliers. In order to make a more clear and relevant comparison, commercially-available block materials were chosen for this research. This does significantly narrow the scope of this comparison, particularly in terms of cost/manufacturer price.