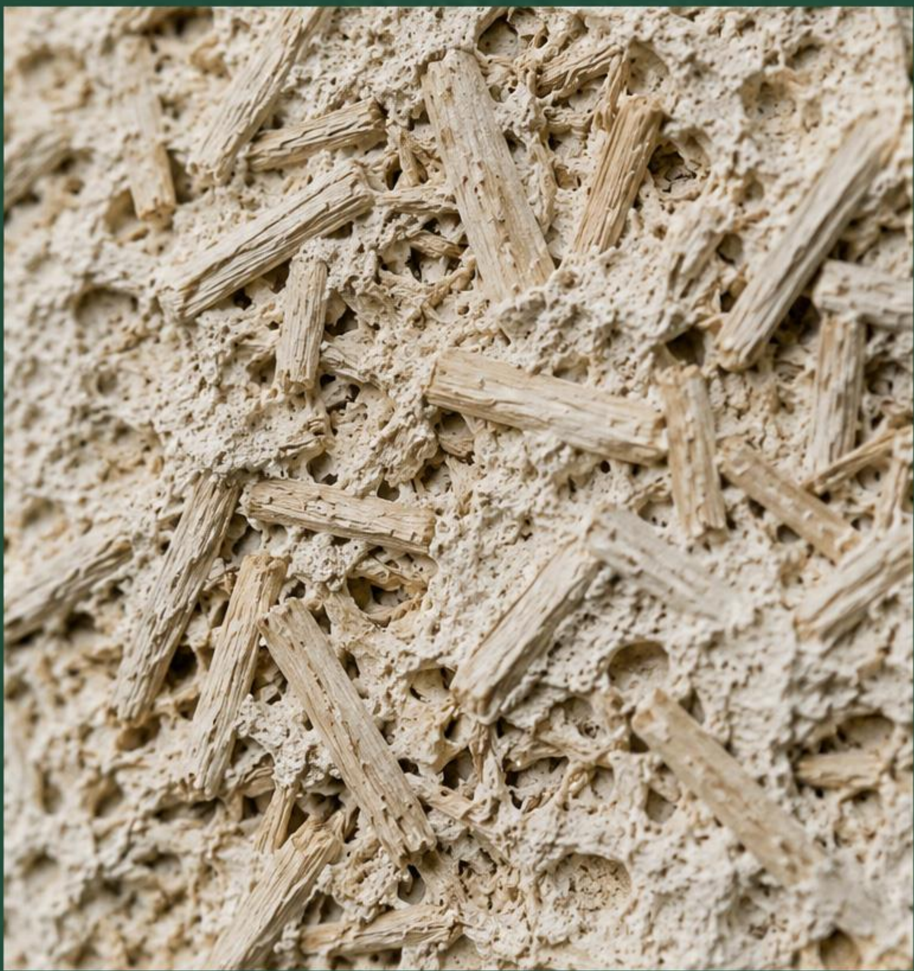
ARCNET.STUDIO

SUSTAINABLE MATERIALS QUICK GUIDE



Hempcrete · Mud Brick · Bamboo · Lime Plaster

Hempcrete · Mud Brick · Bamboo · Lime Plaster · Reclaimed Timber
Rammed Earth · AAC Block · Compressed Earth Block

A practical reference for homeowners, architects and builders choosing low-carbon, healthy building materials.

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How to Use This Guide

Everything you need to know to get started — in one page.

This guide covers 8 of the most important sustainable building materials available today. Each material gets its own dedicated section with the same consistent format — so you can compare apples to apples and make a confident decision for your project.

What Each Material Section Covers

- What the material is and how it is made
- Key performance data — thermal, acoustic, carbon, moisture
- Climate suitability — hot-dry, hot-humid, temperate, cold
- Pros and cons — honest, not promotional
- Cost range and availability by region
- Best use cases and typical applications
- One real-world project example

How to Read the Rating System

Each material is rated across six criteria using a simple three-level system:

Rating	Symbol	What It Means
Excellent	★★★	Best-in-class performance. Strongly recommended for this criterion.
Good	★★☆	Solid performance. Suitable for most projects.
Limited	★☆☆	Acceptable but has constraints. Check specifics before specifying.

Guide Contents

KEY INSIGHT

This guide is designed to sit alongside an architect or contractor conversation — not replace it. Use it to arrive at that conversation with the right questions and a clear sense of your priorities.

Hempcrete

Carbon-negative · Breathable · Climate-adaptive

HEMPCRETE

Hemp hurd + hydraulic lime + water — a bio-composite wall system that stores carbon for the life of the building.

What It Is

Hempcrete is made by mixing the woody inner core of the hemp plant (called hemp hurd or shiv) with hydraulic lime and water. The resulting wet mixture is cast around a structural frame — typically timber, steel, or concrete columns — and tamped in layers to form a monolithic wall.

It is not a structural material. The frame carries the load. The hempcrete provides insulation, moisture buffering, acoustic performance, and — crucially — carbon storage. As the lime cures over months and years, it petrifies the hemp hurd into a hard, durable matrix that locks in the carbon the hemp plant absorbed during its 90-day growth cycle.

Performance Data

Category	Performance	Rating
Thermal Insulation	R-2.5 per inch (~0.17 W/m·K). Excellent for thermal mass + insulation combo.	★★★
Moisture Buffering	Highly breathable (vapour permeable). Self-regulates humidity 50–60% indoors.	★★★
Carbon Performance	Carbon negative. Sequesters 35–110 kg CO_2/m^3 net over lifetime.	★★★
Acoustic Performance	Good sound absorption. Mass + porosity reduce mid-frequency transmission.	★★☆
Structural Capacity	Non-load-bearing infill only. Requires separate structural frame.	★☆☆
Fire Resistance	Excellent. Lime binder does not support combustion. Chars but does not flame.	★★★

Climate Suitability

Pros and Cons

☑ ADVANTAGES	⚠ LIMITATIONS
☑ Carbon negative lifecycle	⚠ Cannot be load-bearing alone
☑ Breathable — regulates humidity naturally	⚠ Requires skilled applicator
☑ Fire resistant (lime binder)	⚠ 15–35% higher upfront cost
☑ Pest and mould resistant	⚠ Long lime curing time (weeks–months)
☑ Non-toxic — healthy indoor air	⚠ Limited supply chain in Asia/Middle East
☑ Excellent acoustic performance	⚠ Not suitable below ground level
☑ Renewable and fast-growing crop	⚠ Regulatory gaps in many markets

Cost and Availability

Region	Availability	Approx. Cost Premium vs. Brick
France / UK	Commercially available	+10 to 20%
Australia	Good availability	+15 to 25%
USA	Growing market	+20 to 35%
India (Uttarakhand)	Very limited — emerging	+30 to 50%
Southeast Asia	Import only	+40 to 60%
Middle East	Import only	+40 to 60%

Best Use Cases

- Infill walls in timber or steel-frame homes
- Renovation and retrofit insulation in old stone or brick buildings
- Passive houses and low-energy homes in temperate climates
- Coastal homes in India and Southeast Asia (humidity resistance)
- Heritage and conservation projects where breathability is essential

Real-World Example

Project Highlight — Normandy, France

A 220m² timber-frame family home in rural Normandy uses hempcrete infill walls 300mm thick. The owners report stable indoor temperatures of 19–21°C year-round without mechanical heating beyond a small wood stove. The hempcrete walls have been in place for 18 years with no maintenance issues.

☑ PRACTICAL TIP

For hot-humid climates (India, Bangladesh, Thailand): specify hempcrete with a breathable lime plaster finish — never painted or sealed with cement render. Blocking vapour movement negates the material's primary climate benefit.

⚠ WATCH OUT

Do not use hempcrete below ground level or in direct contact with standing water. Always include a damp proof course (DPC) and ensure adequate roof overhang and drainage around the building perimeter.

Mud Brick / Adobe

Ancient intelligence · Thermal mass · Zero-waste construction

MUD BRICK / ADOBE

Sun-dried or low-fired earth blocks — the world's oldest and most widely used building material. Locally sourced, carbon-negligible, and thermally exceptional.

What It Is

Mud brick — also called adobe — is made from a mixture of clay-rich soil, sand, and a fibrous binder (typically straw, grass, or animal hair). The mixture is pressed into moulds and sun-dried. No kiln is required for traditional adobe — making it one of the lowest embodied-energy materials in existence.

Fired brick uses the same raw material but is kiln-fired to increase hardness and weather resistance. Fired brick has higher embodied energy (and carbon) but greater durability in wet climates. This section focuses on unfired mud brick — the true low-carbon variant.

Performance Data

Category	Performance	Rating
Thermal Insulation	Low insulation value (R-0.4 per inch) but very high thermal mass. Walls store and release heat across day-night cycle.	★★☆
Moisture Buffering	Good vapour permeability. Clay absorbs and releases moisture. Not suitable for sustained rain without protection.	★★☆
Carbon Performance	Near carbon neutral. Minimal processing energy. Local sourcing typically means minimal transport emissions.	★★★
Acoustic Performance	Excellent. Dense mass absorbs sound across a wide frequency range.	★★★
Structural Capacity	Load-bearing possible for single-storey. Requires engineering review for multi-storey or seismic zones.	★★☆
Fire Resistance	Excellent. Earth does not burn.	★★★

Climate Suitability

Mud brick is exceptional in hot-dry climates. The thermal mass absorbs daytime heat and releases it at night — creating comfortable interiors without mechanical cooling. This is the logic behind centuries of adobe construction in Rajasthan, the Middle East, North Africa, and the American Southwest.

Pros and Cons

✓ ADVANTAGES	⚠ LIMITATIONS
✓ Extremely low embodied carbon	⚠ Poor performance in sustained rain
✓ Excellent thermal mass in hot-dry climates	⚠ Vulnerable to rising damp without DPC
✓ Can be load-bearing (single storey)	⚠ Not suitable for cold climates alone
✓ Fully recyclable — returns to soil	⚠ Requires skilled earthen builder
✓ Available and affordable almost everywhere	⚠ Seismic performance needs engineering
✓ No industrial processing required	⚠ Requires lime or cement render for weathering
✓ Acoustic excellence — dense and absorptive	⚠ Slower construction than masonry block

Cost and Availability

Region	Availability	Approx. Cost vs. Fired Brick
India (Rajasthan, Gujarat)	Widely available	30–50% cheaper
Middle East / North Africa	Traditional craft	20–40% cheaper
Southeast Asia	Variable	20–30% cheaper
Europe / North America	Specialist builders	Comparable or higher (labour)
Australia	Specialist builders	Comparable

Best Use Cases

- Single-storey homes in hot-dry arid climates (Rajasthan, Morocco, Middle East)
- Courtyard houses with interior thermal mass walls
- Heritage conservation and restoration projects
- Low-cost rural housing in developing markets
- Interior partition walls in any climate (protected from rain)

Real-World Example

🏠 Project Highlight — Jaisalmer, Rajasthan, India

A 3-bedroom heritage haveli restored using traditional mud brick construction. The 500mm-thick exterior walls maintain interior temperatures of 26–30°C through summer months when external temperatures exceed 45°C. No air conditioning is used. The project used 100% locally quarried sandstone for the structure and mud brick for the infill and interior partitions.

✓ PRACTICAL TIP

In humid climates, always specify a lime render exterior coat and ensure wide roof overhangs (minimum 600mm) over mud brick walls. Lime render allows the wall to breathe while protecting the clay core from sustained rain.

⚠ WATCH OUT

Mud brick is not suitable as an exterior wall material in sustained monsoon or tropical rainforest climates without significant roof overhang and lime render protection. Unprotected mud brick in a high-rainfall zone will erode rapidly.

Rammed Earth

Monolithic mass · Geological beauty · Low-carbon permanence

RAMMED EARTH

Compacted layers of slightly moist earth — no binder, no kiln, no glue. The most ancient engineered wall system still in mainstream use.

What It Is

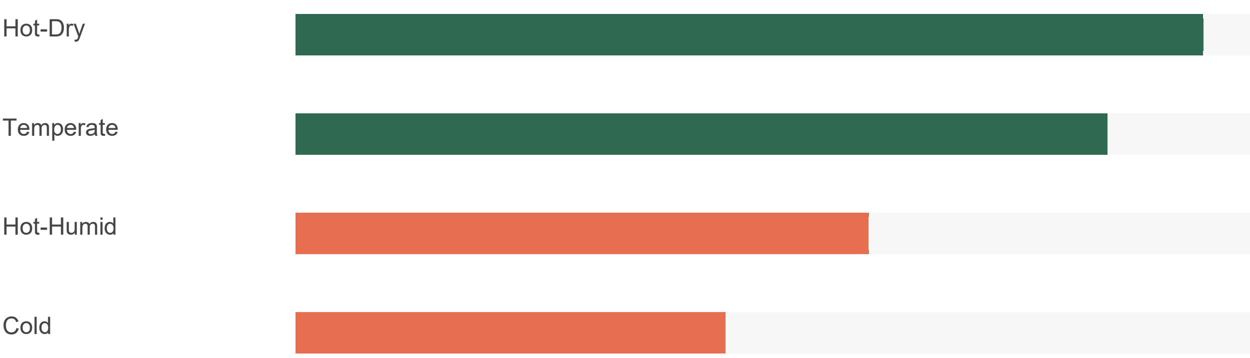
Rammed earth walls are formed by compacting slightly moist subsoil — a mix of gravel, sand, silt, and clay — between temporary formwork panels. The soil is added in layers of 100–150mm and compacted mechanically or by hand until it reaches a dense, stone-like consistency. The formwork is then removed and the wall is complete.

Modern rammed earth often includes a small percentage of Portland cement (3–8%) for greater compressive strength and weather resistance, particularly in wet climates. Unstabilised rammed earth (no cement) has the lowest embodied carbon but requires greater protection from rain.

Performance Data

Category	Performance	Rating
Thermal Insulation	Low insulation value (R-0.4/inch) — very high thermal mass. Best paired with additional insulation in cold climates.	★★☆
Moisture Buffering	Moderate. Unstabilised earth is vapour-permeable. Cement-stabilised is less so.	★★☆
Carbon Performance	Very low embodied carbon (unstabilised). Cement addition reduces carbon benefit significantly.	★★★
Acoustic Performance	Excellent. Dense, monolithic mass provides outstanding sound attenuation.	★★★
Structural Capacity	Can be load-bearing for single and double storey with engineering. Compressive strength 2–4 MPa (unstabilised) to 8 MPa (stabilised).	★★☆
Fire Resistance	Excellent. Earth does not burn.	★★★

Climate Suitability



Pros and Cons

✓ ADVANTAGES	⚠ LIMITATIONS
✓ Extremely beautiful — natural stratified appearance	⚠ Requires specialist contractors and formwork
✓ Very high thermal mass	⚠ Skilled labour — not DIY-friendly at scale
✓ Can be load-bearing	⚠ Cement stabilisation raises embodied carbon
✓ Very low embodied carbon (unstabilised)	⚠ Vulnerable to rain without protection
✓ Durable — 100+ year buildings are common	⚠ Soil must be tested and approved for rammed earth
✓ No waste — any surplus soil can be reused	⚠ High labour cost in many markets
✓ Excellent acoustic performance	⚠ Not suitable alone in cold climates

Best Use Cases

- Feature exterior and interior walls in arid and temperate climates
- Courtyard boundary walls and garden structures
- Commercial and hospitality projects seeking natural aesthetic
- Low-rise load-bearing construction in dry climates
- Thermal mass walls in passive solar design

Real-World Example

Project Highlight — Jaipur, Rajasthan & Perth, Australia

Rammed earth is used commercially in both Indian desert architecture and contemporary Australian residential design. In Perth — one of the world's sunniest cities — rammed earth homes are a significant market segment, with multiple specialist contractors and a mature approvals pathway through the Western Australian building code. Wall thicknesses of 300–400mm provide excellent thermal mass for the Mediterranean-style climate.

✓ PRACTICAL TIP

Always test your site soil before committing to rammed earth. The ideal mix is typically 70% gravel and sand with 30% clay and silt. Too much clay leads to cracking during drying. A soil analysis from a geotechnical lab costs very little and saves significant rework.

⚠ WATCH OUT

In seismic zones, rammed earth requires careful engineering reinforcement — either steel rebar integrated into the wall or a reinforced concrete bond beam at the top of each wall. Consult a structural engineer with specific rammed earth experience before specifying in earthquake-prone areas.

Compressed Earth Block (CEB)

Precision earth · Affordable · Load-bearing · Local

COMPRESSED EARTH BLOCK (CEB)

Machine-pressed earth blocks that combine the carbon benefits of earthen construction with the precision and consistency of a manufactured masonry unit.

What It Is

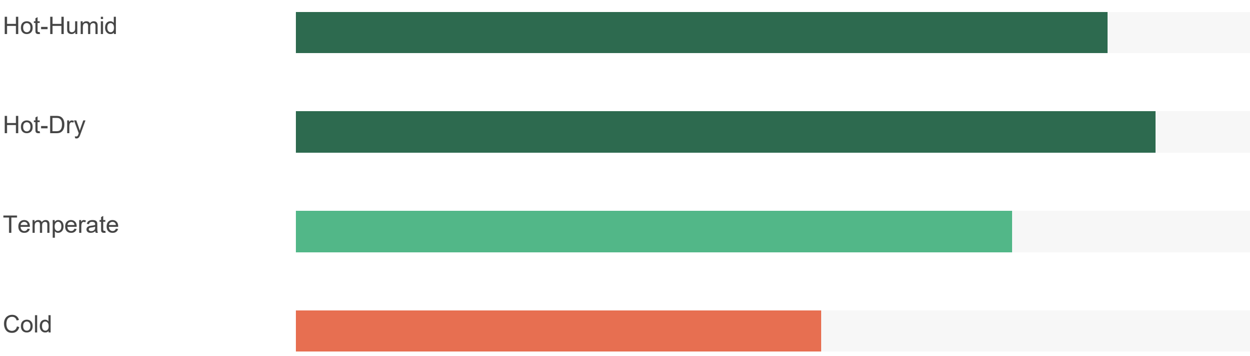
Compressed Earth Blocks (CEB) — also called Interlocking Compressed Earth Blocks (ICEB) or Compressed Stabilised Earth Blocks (CSEB) — are made by pressing a mixture of soil, sand, and optionally a small amount of cement or lime into a mould under high mechanical pressure. The resulting block is dimensionally consistent, high-density, and can be load-bearing without mortar when interlocking profiles are used.

The CSEB production machine is relatively affordable and portable — making it possible to produce blocks on-site using local soil. This dramatically reduces transport emissions and can enable community-based construction in rural and peri-urban areas.

Performance Data

Category	Performance	Rating
Thermal Insulation	Similar to mud brick — moderate insulation, high thermal mass. Better in thick walls (300mm+).	★★☆
Moisture Buffering	Good in unstabilised or lime-stabilised versions. Cement-stabilised reduces breathability.	★★☆
Carbon Performance	Low embodied carbon. Better than fired brick by 60–80%. Worse than unstabilised earth.	★★☆
Acoustic Performance	Good. Dense block provides solid sound attenuation.	★★☆
Structural Capacity	Excellent. Compressive strength 3–10 MPa depending on stabilisation. Fully load-bearing.	★★★
Fire Resistance	Excellent. Earth does not burn.	★★★

Climate Suitability



Pros and Cons

☑ ADVANTAGES	⚠ LIMITATIONS
☑ Load-bearing — no structural frame required	⚠ Cement stabilisation adds embodied carbon
☑ On-site production using local soil	⚠ Machine investment required (~₹3–8 lakh)
☑ 60–80% lower carbon than fired brick	⚠ Soil testing essential before production
☑ Interlocking profiles — no mortar needed	⚠ Not waterproof — needs render or coping
☑ Consistent dimensions — easy to specify	⚠ Less widely known to engineers and approvers
☑ Cost-effective in markets with local soil	⚠ Performance varies with soil quality
☑ Excellent thermal mass	⚠ Lower thermal resistance than hempcrete

Cost and Availability

Region	CEB Machine Cost	Block Cost vs. Fired Brick
India	₹3–8 lakh (manual to motorised)	20–40% cheaper (excl. machine)
Southeast Asia	USD 2,000–8,000	15–35% cheaper
Africa	Well-established	30–50% cheaper
Middle East	Growing market	10–25% cheaper
Europe / USA	Specialist niche	Comparable or higher

Best Use Cases

- Affordable housing projects in tropical and subtropical regions
- Community-built structures using on-site labour and soil
- Low-rise load-bearing buildings in hot-dry and hot-humid climates
- Schools, clinics, and community buildings in rural areas

🏠 Project Highlight — Auroville, Tamil Nadu, India

Auroville — the international township near Puducherry — has been one of the world's leading CEB and CSEB construction hubs since the 1970s. The Auroville Earth Institute has trained builders from over 60 countries in CSEB construction and developed block presses exported globally. Most of Auroville's 400+ buildings use earthen construction — demonstrating the scalability and durability of the approach in a hot-humid tropical climate.

☑ PRACTICAL TIP

In India, the Indian Standards Institution (BIS) has published IS 1725:2013 for soil-based blocks. Specifying to this standard simplifies the approvals process with local authorities. Always include the standard number in your specification documents.

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Bamboo

Fastest growing · Structurally remarkable · Tropical wonder

BAMBOO

A grass — not a tree — that grows up to 1 metre per day, sequesters carbon faster than any structural material, and achieves a strength-to-weight ratio comparable to structural steel.

What It Is

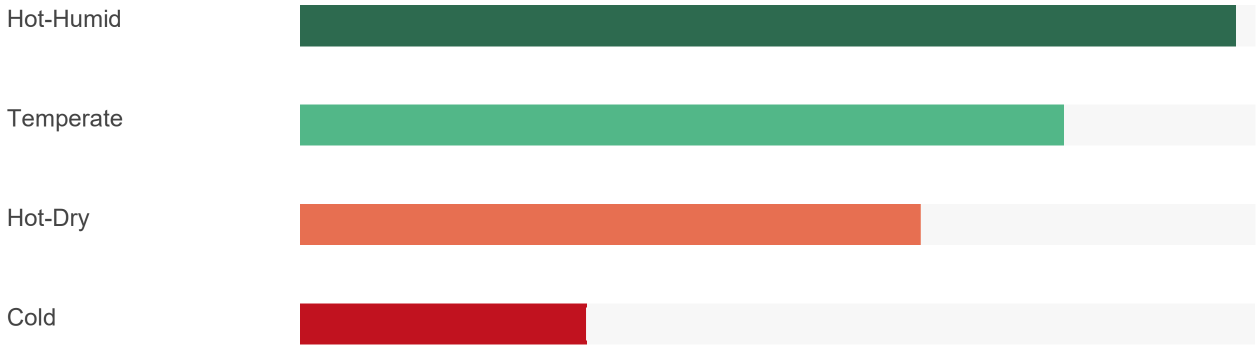
Bamboo is technically a grass, but its hollow culms (poles) have exceptional structural properties. The outer skin (culm wall) is denser and stronger than the inner core, and the natural tube geometry provides high bending resistance with minimal material. Bamboo is used in construction as round poles for structure, as split or woven panels for cladding and infill, and as processed products including bamboo timber (glulam-style engineered boards) and bamboo plywood.

It reaches harvestable maturity in 3–7 years versus 30–100 years for structural timber — making it the fastest-renewable structural material available. Treated correctly, bamboo construction lasts 50+ years.

Performance Data

Category	Performance	Rating
Structural Strength	Tensile strength up to 370 MPa — comparable to mild steel. Compressive strength 40–80 MPa. Excellent strength-to-weight ratio.	★★★
Thermal Insulation	Low thermal mass. Good insulation when used in double-skin or bamboo-composite panels.	★★☆
Carbon Performance	Carbon negative during growth. Harvesting stores carbon in material. Fastest carbon sequestration of any structural plant.	★★★
Moisture Resistance	Untreated: poor. Treated (borax-boric acid or heat treatment): excellent. Treatment is essential for durability.	★★☆
Structural Capacity	Excellent for columns, beams, trusses, frames. Must be engineered. Round poles behave differently from sawn timber.	★★☆
Fire Resistance	Moderate. Hollow culms can transmit flame internally. Treated bamboo performs better.	★★☆

Climate Suitability



Bamboo is fundamentally a tropical and subtropical material. It grows naturally in a belt between 45°N and 45°S latitude. Its natural habitat — and its best performance zone — is in hot-humid climates where it has been used structurally for thousands of years.

Pros and Cons

☑ ADVANTAGES	⚠ LIMITATIONS
☑ Fastest-growing structural material on Earth	⚠ Must be treated — untreated bamboo is vulnerable
☑ Carbon negative — absorbs CO_2 as it grows	⚠ Not suitable in cold climates
☑ Strength-to-weight comparable to steel	⚠ Structural behaviour differs from timber — needs specialist engineer
☑ Versatile — structure, cladding, flooring, furniture	⚠ Connections and jointing require skill
☑ Locally available across tropical Asia	⚠ Limited building code coverage in many countries
☑ Supports rural livelihoods and craft traditions	⚠ Quality varies — species and age at harvest matter
☑ Biodegradable at end of life	⚠ Hollow culm geometry limits some structural applications

Best Use Cases

- Structural frames for low-rise tropical homes
- Cladding, screens, pergolas, and outdoor structures
- Flooring and interior lining panels (engineered bamboo board)
- Emergency and transitional shelter construction
- Hospitality and eco-resort architecture

Project Highlight — Green School, Bali, Indonesia

The Green School in Ubud, Bali — designed by Ibuku Architecture — is the world's most celebrated bamboo building. The main school structure uses giant Dendrocalamus asper bamboo culms in a sweeping vaulted form spanning 38 metres, with no steel connections. The campus has demonstrated that bamboo can meet fire safety, structural engineering, and educational facility requirements at full scale.

☑ PRACTICAL TIP

Specify Dendrocalamus asper or Guadua angustifolia for structural applications — both are the most extensively tested species for structural use. Always source bamboo that has been harvested at 3–5 years maturity and treated with borax-boric acid or heat-treatment before installation.

⚠ WATCH OUT

Never use untreated bamboo in contact with soil or in wet conditions. Untreated bamboo in ground contact will fail within 1–2 years due to insect and fungal attack. Treatment is not optional — it is the difference between a 5-year structure and a 50-year structure.

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Reclaimed Timber

Stored carbon · Embodied history · Zero extraction

RECLAIMED TIMBER

Salvaged structural and decorative wood from demolished buildings, bridges, industrial structures, and old-growth forests — reused rather than extracted.

What It Is

Reclaimed timber is wood salvaged from existing structures — old buildings, warehouses, railway sleepers, ship decking, bridges, and demolished homes. It is graded, de-nailed, dried, and re-processed for reuse in new construction. The embodied carbon of the original tree is already stored in the material — no new extraction, no new processing, near-zero manufacturing emissions.

Reclaimed timber often comes from old-growth forests that no longer exist — meaning the grain density, stability, and character of reclaimed timber is frequently superior to new-growth timber available today. It carries visual warmth and material history that new materials cannot replicate.

Performance Data

Category	Performance	Rating
Structural Capacity	Depends on species and grade. Old-growth reclaimed timber is often denser and stronger than new timber of the same species.	★★☆
Thermal Performance	Similar to new timber. Low thermal conductivity (R-1 per inch). Good insulator in wall assemblies.	★★★
Carbon Performance	Outstanding. Carbon already stored. Near-zero embodied carbon (processing + transport only). No extraction emissions.	★★★
Moisture Resistance	Depends on species and treatment history. Hardwoods are generally more durable than softwoods.	★★☆
Acoustic Performance	Good. Timber density varies — denser reclaimed hardwoods perform better than softwood.	★★☆
Fire Resistance	Moderate. Timber chars but structural core retains integrity longer than steel at high temperatures.	★★☆

Climate Suitability

Reclaimed timber is highly climate-adaptable, but requires careful specification in hot-humid environments where moisture management is critical. Species selection, surface treatment, and air gap detailing are essential in high-humidity zones.

Pros and Cons

☑ ADVANTAGES	⚠ LIMITATIONS
☑ Near-zero embodied carbon — no new extraction	⚠ Supply is inconsistent — project planning needed
☑ Superior character and density to new timber	⚠ Must be graded and tested before structural use
☑ Stores carbon for the building's full life	⚠ May contain nails, bolts, and fasteners
☑ Reduces demolition waste and landfill	⚠ Moisture content must be checked before use
☑ Available in most urban markets	⚠ Less predictable than factory-graded new timber
☑ Often cost-competitive with premium new timber	⚠ Old-growth hardwood is increasingly scarce
☑ Every piece is unique — architectural quality	⚠ Treatment history not always known

Best Use Cases

- Structural beams and columns (where grade allows)
- Feature flooring, cladding, and wall panelling
- Bespoke joinery and cabinetry
- Outdoor decking and pergolas (weatherproof species only)
- Interior partitions and ceiling linings

Project Highlight — Bangalore, India

Several architecture firms in Bengaluru — including Biome Environmental Solutions — have pioneered the use of reclaimed teak and tropical hardwoods salvaged from demolished colonial bungalows. Reclaimed teak beams from 80–100 year old buildings are reused as structural and feature elements in new homes — providing embodied carbon at near-zero cost and connecting new buildings to the material history of the city.

☑ PRACTICAL TIP

Before purchasing reclaimed timber in India, check for active termite infestation (tap the wood — hollow sound indicates damage) and measure moisture content with a handheld meter. Target moisture content below 18% for interior use and below 22% for protected exterior applications.

⚠ WATCH OUT

Never use reclaimed timber from unknown industrial sources without checking for chemical contamination — old rail sleepers (railway ties) are often treated with creosote, which is toxic and carcinogenic and should never be used in living spaces.

AGE 15–16

Lime Plaster

Breathable · Self-healing · The natural wall's best friend

LIME PLASTER

The essential finish coat for all natural wall systems. Lime plaster breathes with the wall, self-heals fine cracks, and creates a healthy, beautiful interior and exterior surface.

What It Is

Lime plaster is made from burnt limestone (calcium carbonate) that has been hydrated to form calcium hydroxide (slaked lime or lime putty). Mixed with sand and water, it is applied in layers over masonry, earthen, or natural-fibre walls. As it cures through carbonation — absorbing CO_2 from the air — it converts back to calcium carbonate and becomes hard.

Lime plaster is the correct and necessary partner for all natural wall systems including hempcrete, mud brick, rammed earth, and compressed earth block. Using cement render over these materials blocks vapour movement and causes trapped moisture damage. Lime render allows the wall to breathe, performs better long-term, and re-sequesters a portion of the CO_2 emitted during its manufacture.

Types of Lime Plaster

Type	Properties	Best Use
Lime Putty (fat lime)	Highest plasticity. Slow curing. Very breathable.	Interior plaster, fine finish work
Hydraulic Lime (NHL)	Sets with water. Suitable for damp and exterior use.	Exterior render on hempcrete, mud brick
Lime Wash	Thin, pigmentable wash. Extremely breathable.	Decorative interior and exterior coats
Lime + Pozzolan	Improved strength. Faster set. More durable.	High-traffic areas, floors, wet rooms

Performance Data

Category	Performance	Rating
Vapour Permeability	Excellent — the most breathable of all common wall finishes. Essential for natural walls.	★★★
Durability	Long-lasting when maintained. Lime plaster buildings standing 500+ years are common in Europe.	★★★
Carbon Performance	Moderate embodied carbon from burning limestone. Partially offset by CO_2 reabsorption during curing.	★★☆
Crack Resistance	Self-healing — fine cracks recarbonate and close over time. Major cracks require patching.	★★★

Finish Quality	Beautiful. Warm, tactile surface. Takes natural pigments. Ages gracefully.	★★★
Application Skill	Requires experienced plasterer. Multiple coats. Slow curing between coats.	★★☆

Pros and Cons

☑ ADVANTAGES	⚠ LIMITATIONS
☑ Breathable — works with all natural wall systems	⚠ Slower curing than cement — each coat needs days
☑ Self-healing micro-cracks	⚠ Requires experienced plasterer
☑ Re-sequesters CO_2 during curing	⚠ Must not be applied in frost or direct sun
☑ Beautiful natural finish quality	⚠ More expensive than cement plaster
☑ Can be pigmented with natural earth pigments	⚠ Multiple coats required (scratch, float, finish)
☑ Durable — centuries of proven performance	⚠ Not suitable for very high-humidity wet rooms alone
☑ Flexible and forgiving over irregular surfaces	⚠ Lime burns — PPE required during mixing

Application Layers

Coat	Name	Thickness	Purpose
1st	Scratch Coat	10–15mm	Key to substrate. Provides mechanical bond.
2nd	Float Coat	8–12mm	Levels the surface. Main body of plaster.
3rd	Finish Coat	3–5mm	Fine texture, colour, final appearance.
4th	Lime Wash	1–2mm	Optional. Decorative. Renews breathability.

🏠 Project Highlight — Kerala Vernacular Homes, India

Traditional Kerala architecture has used lime plaster (chunnam) on laterite and mud brick walls for over 1,000 years. The lime was produced locally by burning sea shells and coral. Contemporary Kerala architects are returning to this tradition — using hydraulic lime plaster over laterite and mud brick to create breathable, beautiful homes that manage the extreme humidity of the monsoon coast without mechanical dehumidification.

☑ PRACTICAL TIP

For best results on hempcrete, apply a first scratch coat of NHL 2 hydraulic lime (low hydraulicity) while the hempcrete is still slightly green — within the first 2–4 weeks. This helps the lime bond mechanically with the hemp hurd fibres at the surface. Never apply cement render to hempcrete.

⚠ WATCH OUT

Never apply fresh lime plaster in direct sunlight, in frost, or when temperatures are below 5°C or above 30°C. Rapid drying causes surface crazing and loss of bond. Shade the work area, mist with water during curing, and allow each coat to cure for a minimum of 3 days before applying the next.

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AAC Block

Lightweight · Fast · Thermally efficient · Industry standard

AAC BLOCK (Autoclaved Aerated Concrete)

Factory-produced lightweight concrete block with millions of air cells — the mainstream sustainable alternative to conventional red brick across India and Southeast Asia.

What It Is

Autoclaved Aerated Concrete (AAC) blocks — sold in India as Siporex, YTONG, Magicrete, and other brands — are made from a mixture of cement, fly ash or sand, lime, and aluminium powder. The aluminium reacts with the lime to produce millions of tiny hydrogen bubbles, aerating the mixture before it is cured under high-pressure steam (autoclaving). The result is a dimensionally precise, lightweight block that is 60–80% lighter than standard concrete.

AAC is the most widely adopted alternative to clay brick across India, Southeast Asia, and the Middle East. It is significantly better than clay brick on thermal performance, construction speed, and waste reduction — though it cannot match hempcrete or earthen materials on carbon performance or breathability.

Performance Data

Category	Performance	Rating
Thermal Insulation	Good. Thermal conductivity 0.10–0.16 W/m·K. Much better than brick. Good for reducing AC loads.	★★★
Moisture Resistance	Moderate. AAC is porous — must be rendered. Will absorb water if left exposed.	★★☆
Carbon Performance	Moderate. Cement + fly ash + autoclaving generates embodied carbon — better than clay brick, worse than earthen materials.	★★☆
Acoustic Performance	Moderate. Low mass limits acoustic performance. Not recommended for party walls without additional treatment.	★★☆
Structural Capacity	Non-load-bearing or load-bearing depending on density and height. Requires engineering review for load-bearing.	★★☆
Fire Resistance	Excellent. Non-combustible. Up to 4 hours fire rating possible.	★★★

Climate Suitability

Pros and Cons

✓ ADVANTAGES	⚠ LIMITATIONS
✓ Far better thermal performance than clay brick	⚠ Moderate embodied carbon (cement content)
✓ 60–80% lighter — faster construction	⚠ Not breathable — must be rendered
✓ Dimensionally precise — clean joints	⚠ Fragile until rendered — chips easily
✓ Fire resistant — 4 hour ratings possible	⚠ Poor acoustic performance
✓ Easy to cut and shape on site	⚠ Not suitable for load-bearing above G+2 without engineering
✓ Widely available across India and Southeast Asia	⚠ Requires factory production — not local craft
✓ Reduced mortar use — cost saving	⚠ Fly ash sourcing varies in quality

Cost and Availability

Region	Availability	Cost vs. Clay Brick (per sqft wall)
India (major cities)	Excellent — multiple brands	10–20% more expensive
Southeast Asia	Good	5–15% more expensive
Middle East	Excellent	Comparable
Europe	Excellent	Comparable
Australia	Good	10–20% more expensive

Best Use Cases

- Non-load-bearing infill walls in RCC-framed buildings — the standard Indian apartment block
- Projects where construction speed and dimensional accuracy are primary drivers
- Retrofit insulation upgrade from brick (AAC has much lower U-value)
- Commercial and industrial buildings

🏠 Project Highlight — Urban Apartment, Mumbai

A 2,200 sqft apartment in a 20-storey Mumbai tower used AAC block infill walls instead of conventional red brick. The result was a 35% reduction in wall weight (reducing structural load), a 25% reduction in air conditioning energy use (from improved U-value), and 18% faster construction. AAC is now the default wall material for most Tier 1 Indian developers.

✓ PRACTICAL TIP

Specify AAC blocks with a compressive strength of at least 4 MPa for all applications, and 6 MPa for ground floor external walls. Always apply cement or lime render — AAC cannot be left exposed to rain as the surface will degrade over 2–3 monsoon seasons.

⚠ WATCH OUT

Do not use standard AAC blocks in below-ground or damp environments — they absorb moisture. Specify moisture-resistant AAC (MRAAC) or alternative materials for any wall with direct soil contact or regular water exposure.

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Master Comparison Matrix

All 8 materials · Side by side · 6 key criteria

Use this matrix to compare all eight materials across the six most important performance criteria. Ratings are ★★★ (Excellent), ★★☆ (Good), ★☆☆ (Limited).

Material	Thermal	Carbon	Moisture	Structure	Acoustic	Fire
Hempcrete	★★★	★★★	★★★	★☆☆	★★☆	★★★
Mud Brick	★★☆	★★★	★★☆	★★☆	★★★	★★★
Rammed Earth	★★☆	★★★	★★☆	★★☆	★★★	★★★
CEB	★★☆	★★☆	★★☆	★★★	★★☆	★★★
Bamboo	★★☆	★★★	★★☆	★★★	★★☆	★★☆
Reclaimed Timber	★★★	★★★	★★☆	★★☆	★★☆	★★☆
Lime Plaster	★★★	★★☆	★★★	N/A	★★★	★★★
AAC Block	★★★	★★☆	★★☆	★★☆	★★☆	★★★

KEY INSIGHT

Green cells (★★★) = Best-in-class for that criterion. Red cells (★☆☆) = Notable limitation. For most homeowners, the right material scores ★★★ on the 2–3 criteria that matter most to your specific climate and project type.

✅ PRACTICAL TIP

A hempcrete or earthen wall that costs 25% more upfront but reduces cooling bills by 30% will typically pay back the premium within 8–12 years — and continue saving for the rest of the building's life.

Climate Quick-Match

Your Climate	Primary Material	Secondary Option	Avoid
Hot-Humid (Kerala, Thailand, Singapore)	Hempcrete	Bamboo + CEB	Unfired mud brick (exterior)
Hot-Dry (Rajasthan, UAE, Morocco)	Mud Brick / RE	CEB	Bamboo
Temperate (UK, Germany, Melbourne)	Hempcrete	Reclaimed Timber	Uninsulated earthen wall
Cold (Canada, Scandinavia, Himachal)	Hempcrete + RE	Reclaimed Timber	Bamboo
Mixed / Subtropical (Bangalore, Sydney)	AAC / CEB	Hempcrete	—

Your Decision Guide

Match your priorities to the right material — then take action.

Step 1 — Identify Your Top 3 Priorities

Before choosing a material, rank these criteria from most to least important for your specific project. Refer to the matrix on Page 19 to find which materials score highest on your top priorities.

Priority	Best Material(s)
Lowest possible carbon footprint	Hempcrete / Reclaimed Timber / Bamboo
Best thermal comfort in hot climates	Mud Brick / Rammed Earth / Hempcrete
Best insulation (cold climate)	Hempcrete + additional insulation
Load-bearing capability	CEB / Rammed Earth / Mud Brick
Lowest upfront cost	Mud Brick / CEB (site-produced)
Fastest construction speed	AAC Block
Healthiest indoor environment	Hempcrete / Mud Brick / Lime Plaster
Best acoustic performance	Rammed Earth / Mud Brick / CEB
Maximum sustainability credentials	Hempcrete + Reclaimed Timber + Bamboo
Widest contractor availability	AAC Block

Step 2 — Check Local Availability

The best material on paper is only useful if you can source it and find someone to build with it. Before finalising your specification, confirm:

- Hemp hurd (shiv) or hemp lime suppliers within 300km of your project
- Experienced contractors — ask for at least 2 completed project references
- Local authority approval pathway — does your material need special documentation?
- Cost comparison — get at least 3 quotes using the same wall area and thickness

Step 3 — Test Before You Specify

For any natural material — hempcrete, mud brick, rammed earth, or CEB — always request a 1m² sample panel built by your proposed contractor before committing to a full specification. This confirms:

- The mix ratio and finish quality your contractor delivers
- The actual appearance of the material in your light conditions
- The contractor's skill level and attention to detail
- The curing time required in your specific climate

Step 4 — Calculate the Real Cost

Upfront material cost is only one part of the calculation. For any sustainable material choice, ask your architect to model:

1. Upfront material + labour cost
2. Estimated annual energy saving (heating + cooling)
3. Payback period (divide premium by annual saving)
4. Carbon saving over 30 years vs. conventional alternative
5. Maintenance requirements and long-term cost implications