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Concrete.ai vs credentialed carbon-sequestration surfaces on structural materials

Concrete.ai applies machine learning to concrete mix design, searching the space of cementitious formulations to lower cost and embodied carbon while meeting strength and durability targets. That optimization decides what to pour. The disclosed approach addresses a different layer: making a carbon claim a lifecycle-persistent, authority-signed property of the poured material itself. It is built on the Credentialed Surfaces, disclosed in U.S. Provisional Application No. 64/050,895.

What Concrete.ai Does

Concrete.ai is a software product that applies machine learning to the design of concrete mixtures. A concrete producer or specifier provides the performance requirements for a pour, such as target compressive strength at a given age, workability, durability class, and the locally available constituents, and the software searches the space of admissible mix formulations to recommend proportions of cement, supplementary cementitious materials such as fly ash or slag, aggregates, water, and admixtures. The stated objective is to reduce both cost and embodied carbon while continuing to satisfy the specified engineering requirements.

This is a genuinely useful capability, and it addresses a real problem. Portland cement is carbon intensive, and the ready-mix industry has historically relied on conservative, over-designed mixes because reformulating carries testing cost and schedule risk. A tool that can propose leaner, lower-clinker formulations that still meet code and that quantifies the expected carbon reduction lowers the practical barrier to specifying better concrete. Concrete.ai operates at the point of formulation, which is exactly the point at which most of a concrete element's embodied carbon is determined, and doing that work well has real value for producers, engineers, and owners pursuing lower-carbon construction.

The output of that process is a recommended mix design and an associated estimate of cost and carbon for the resulting concrete. That estimate is a projection about a formulation. It describes what a given recipe is expected to embody when it is batched and placed.

The Architectural Axis

The axis the disclosed approach addresses is not the choice of mix. It is the status of the carbon claim after the concrete exists.

A mix-design optimizer answers the question "what should we pour to lower carbon and cost." Once the pour is placed, the optimizer's job is essentially finished; the carbon figure it produced is a design-time estimate attached to a recipe, not a property that travels with the physical element through its service life. If the material is later repaired, resurfaced, augmented, demolished, crushed, and reused, there is no structural mechanism in a mix-optimization tool for the original carbon claim to persist across those material flows, to be re-evaluated as the material changes, or to be independently checked by a party who was not present at batching. The carbon claim and the physical mass are decoupled after placement.

This is a difference in layer, not a defect in the optimizer. A design-time tool is meant to end at the design boundary. The gap the disclosed approach names is that a carbon claim about a structural material has no persistent, verifiable home once the material is in the wall.

How the Disclosed Approach Differs

The disclosed architecture treats carbon sequestration as a credentialed property surface of the structural material, on the same footing as its structural, thermal, and fire-performance surfaces. A credentialed structural element carries a carbon-sequestration admissibility surface that is bound to the element's identity by the cryptographic signature of an environmental-credit authority and that composes with the element's other property surfaces under declared composition rules. The claim is not a spreadsheet estimate sitting next to the material; it is a signed surface attached to the material's credentialed identity.

Several mechanisms disclosed in the specification give that surface its persistence. First, the disclosure describes a methane-avoidance attestation issued when organic-waste feedstock that would otherwise decompose and release methane is diverted into the carbonaceous constituent, the attestation declaring the diverted feedstock mass, the applicable emission factor, the resulting carbon-dioxide-equivalent avoidance, and the credentialed identity of the apparatus attesting the diversion. That attestation is recorded in the produced material's lineage chain and is independently queryable by environmental-credit authorities. Second, the disclosure describes a migrating carbon-attestation primitive in which biogenic carbon-credit attestations bound to a substrate migrate with the substrate across material flows and across structural lifetimes, each migration being a credentialed transaction signed by an environmental-credit authority and recorded in the lineage chain. Third, the disclosure describes continuous re-credentialing, in which operational material flows during service life, such as mortar repointing, surface-coating refresh, or topping-slab augmentation, are themselves credentialed events, so that the element's composite profile is re-evaluated against the cumulative material history rather than only at original placement.

The result on this axis is a carbon claim that is authored by a named authority, verifiable by a party who was not at the pour, and durable across the physical events of the material's life. Where a mix optimizer produces a projection about a recipe, the disclosed architecture produces a signed, lineage-recorded property of a specific mass of poured material that can be checked, transferred, or extinguished as that mass changes over decades.

Where They Fit Together

These are complementary layers, and the honest framing is composition rather than competition. A mix-design optimizer decides what to pour; it is the right tool for lowering carbon and cost at the moment of formulation, and it does work the credentialing architecture does not attempt. The credentialing architecture decides how the resulting carbon claim is recorded, attested, and carried forward; it says nothing about which mix is best.

In a combined workflow, an optimizer of the Concrete.ai type would inform the formulation decision, and its expected-carbon output would be one input to the attestation that an environmental-credit authority signs onto the placed element's carbon-sequestration surface. The optimizer improves the number; the credentialing architecture makes the number a durable, checkable property of the physical material. Neither displaces the other, and a party could reasonably want both: better mixes and verifiable, lifecycle-persistent claims about the concrete those mixes become.

Boundary Conditions

The materials science underlying the disclosed approach is pre-existing and is not claimed as newly discovered. Carbonization of biomass, activated and turbostratic carbons, supplementary cementitious materials, and the general chemistry of low-carbon concrete are established fields. What the disclosure contributes is an architecture that treats a carbon claim as a credentialed, composable, lifecycle-persistent property surface of the material, not any new basic science about cement or carbon.

The status asymmetry should also be stated plainly. Concrete.ai is a shipping product used by real producers on real pours today. The disclosed subject matter is a provisional patent disclosure of an architecture. It describes structures and mechanisms; it is not represented here as built, deployed, benchmarked, or independently validated, and no performance, cost, or carbon figures are asserted for it beyond what the specification discloses as ranges and design parameters. A credentialing architecture also depends on institutions that do not yet broadly exist at scale, such as recognized environmental-credit authorities willing to sign carbon-sequestration surfaces and building-code and market frameworks that treat such surfaces as admissible. Those are real adoption boundary conditions, not properties the disclosure can create by itself.

Disclosure Scope

The architecture described here is disclosed in U.S. Provisional Application No. 64/050,895, which discloses credentialed structural building substrates carrying independently credentialed and composable property surfaces, including a carbon-sequestration admissibility surface, together with methane-avoidance attestation, migrating carbon-attestation, and continuous re-credentialing mechanisms recorded in a lineage chain. The description of Concrete.ai, its capabilities, and the broader mix-design and low-carbon-concrete market is provided as external context to locate the disclosed architecture on a single axis; it is not a claim of the filing, does not describe the filing's contents, and should not be read to assert any defect, limitation, or shortcoming in Concrete.ai or any other product. Statements about the disclosed architecture trace to the specification; statements about Concrete.ai reflect its generally known, architecture-level character as a mix-design optimization tool and are offered neutrally.

Credentialed Surfaces (/credentialed-materials)

All 40 steps → (/inventive-steps)

Building surfaces as credentialed agents that participate in the structure's networking and electrical systems.

Provisional application

PRIMARY TECHNICAL DISCLOSURE

- Credentialed Building Materials: Cryptographic Admissibility for Structural Surfaces (/articles/credentialed-building-materials-cryptographic-admissibility-for-structural-surfaces)

SECONDARY TECHNICAL

- Carbon-Sequestration Admissibility Surface (/articles/credentialed-materials/carbon-sequestration-property-surface)
- Composition Rules Governing Surface Interactions (/articles/credentialed-materials/composition-rules)
- Decommissioning And Re-Credentialing Attestation (/articles/credentialed-materials/decommissioning-and-recredentialing)
- Electrical-Distribution Admissibility Surface (/articles/credentialed-materials/distribution-property-surface)
- End-Of-Storage-Life Attestation (/articles/credentialed-materials/end-of-storage-life-attestation)
- Energy-Storage Admissibility Surface (/articles/credentialed-materials/energy-storage-property-surface)
- Lineage Chain Across Material Lifecycle (/articles/credentialed-materials/lineage-chain-across-lifecycle)

- Authority Signatures Block Binding Property Surfaces To Material Identity (/articles/credentialed-materials/master-credential-binding)
- Multi-Authority Signature Block (/articles/credentialed-materials/multi-authority-signature-block)
- Data Network Admissibility Surface (/articles/credentialed-materials/network-property-surface)
- Profile Versioning Continuity (/articles/credentialed-materials/profile-versioning-continuity)
- Structural Admissibility Surface (/articles/credentialed-materials/structural-property-surface)
- Thermal-Property Admissibility Surface (/articles/credentialed-materials/thermal-property-surface)
- Versioned Admissibility Profiles With Lineage Chain (/articles/credentialed-materials/versioned-profiles-with-lineage)
- Water-Coupled Admissibility Surface (/articles/credentialed-materials/water-coupled-property-surface)

APPLICATIONS · GENERAL

- Credentialed Structural Materials for Construction and Civil Infrastructure: Carrying Strength, Mix, and Provenance as Multi-Authority Attestations (/articles/credentialed-materials/construction-and-infrastructure)
- Carbon-Credit-Bearing Building Materials: Sequestration Attestations That Survive Incorporation, Transfer, and Decommissioning (/articles/credentialed-materials/carbon-credit-materials)
- Building-Product Compliance and Code Approval: Property-Surface Profiles as Machine-Evaluable Admissibility Evidence (/articles/credentialed-materials/building-product-compliance)
- Credentialed Building Materials for Real Estate Valuation, Insurance, and Disclosure: A Property History That Binds to the Asset (/articles/credentialed-materials/real-estate-and-asset-lifecycle)
- Recredentialing Recovered Materials: Verifiable Lineage for Reuse and Decommissioning in the Circular Economy (/articles/credentialed-materials/circular-economy-and-decommissioning)
- Energy and Grid-Coupled Surfaces: Crediting Stationary Storage in Structural Mass Without Trusting the Cell (/articles/credentialed-materials/energy-and-grid-surfaces)
- Credentialed Surfaces for Water and Environmental Infrastructure: Signed Performance and Compliance Attestations on Water-Coupled Concrete (/articles/credentialed-materials/water-and-environmental-infrastructure)

APPLICATIONS · SPECIFIC

- Circularise, a blockchain-based supply-chain traceability and digital-product-passport platform for materials vs credentialed material surfaces: attestations bound to the physical material (/articles/credentialed-materials/circularise)

- EC3 (Embodied Carbon in Construction Calculator) by Building Transparency vs a credentialed carbon-sequestration surface bound to the material (/articles/credentialed-materials/ec3-building-transparency)
- CarbonCure Technologies, which injects and mineralizes CO2 into concrete during mixing vs a credentialed carbon-sequestration attestation architecture (/articles/credentialed-materials/carboncure)
- Sublime Systems, maker of low-carbon cement via an electrochemical (ambient) process vs a credentialed carbon-sequestration surface bound to the material (/articles/credentialed-materials/sublime-systems)
- Brimstone carbon-negative portland cement vs credentialed material attestations: process decarbonization or per-element carbon accounting? (/articles/credentialed-materials/brimstone)
- The EU Digital Product Passport (DPP) under the Ecodesign for Sustainable Products Regulation (ESPR) vs credentialed surfaces: a data-carrier standard next to a material-bound attestation architecture (/articles/credentialed-materials/eu-digital-product-passport)
- One Click LCA, a life-cycle-assessment and EPD software platform for construction vs a credentialed carbon-sequestration property surface bound to the material (/articles/credentialed-materials/one-click-lca)
- **Concrete.ai vs credentialed carbon-sequestration surfaces on structural materials (/articles/credentialed-materials/concrete-ai)**

Credentialed Surfaces overview → (/credentialed-materials)