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Water-Coupled Admissibility Surface

A credentialed structural substrate carries energy storage, electrical distribution, data networking, thermal coupling, and carbon sequestration as composed properties of building materials. Each property is declared on its own admissibility surface, and the water-coupled admissibility surface is the surface that authorizes the substrate to participate in a structure's water-related systems. It is a credentialed data structure bound to a structural element by cryptographic signature, declaring property-specific parameters and admission conditions for the water-coupled property category, and composing with the structural, thermal, energy storage, distribution, and network surfaces under signed composition rules. This disclosure describes the structure of the surface, its operational couplings to other credentialed property surfaces, and its role in the disclosed composite-admissibility framework.

Mechanism

The water-coupled admissibility surface is a credentialed data structure bound to a structural element, declaring property-specific parameters and admission conditions for the water-coupled property category. It is one admissibility surface among a plurality of independently credentialed property surfaces, each declaring parameters and admission conditions for one declared building-code-recognized or operationally-recognized property category, the surfaces composing through declared composition

rules to produce a composite admissibility profile evaluable by a building-code authority and by the building energy management system. When a consuming primitive proposes an operating condition, the condition is reconciled against the composite profile, and the water-coupled surface participates in that reconciliation through its declared composition rules.

The water-coupled surface is closely tied to the electrolyte-coupling architecture of the substrate. The disclosure admits a plurality of electrolyte-coupling architecture classes, each declared in the credentialed admissibility profile through a water-phase admissibility surface and selected by the project specification through an electrolyte-architecture-selection composition rule: a native-pore-solution class operating with cement pore solution alone, an open-cell ambient-water-coupled class operating in continuous or episodic contact with an ambient water body, and a closed-cell cavity-bath class operating with an engineered electrolyte phase contained in sealed cavities. The classes are non-exclusive and admit hybrid configurations within a single credentialed structural element.

A credentialing signature block binds the credentialed admissibility profile to the identity of the structural element through one or more cryptographic signatures of credentialing authorities admitted to the disclosed architecture. The disclosure contemplates multi-authority credentialing, in which different property surfaces are signed by different authorities. The credentialed profile travels with the substrate through procurement, installation, and in-service operation, and its lineage chain records pre-installation credentialing, in-service re-credentialing, decommissioning, recycling-grade re-credentialing, and re-installation, each transition performed by an appropriate authority and recorded in the lineage chain.

Declared Parameters And Composition Rules

The water-coupled admissibility surface declares property-specific parameters and admission conditions for the water-coupled property category. The disclosure does not fix a closed list of parameter values; the parameters are those required to evaluate the water-coupled property and its composition with other surfaces, declared in the credentialed admissibility profile and signed by the credentialing authority.

The surface participates in several declared composition rules. A wet-environment storage rule requires the water-coupled admissibility surface attestations to be current before admitting storage operations near wet surfaces. A freeze-thaw-derated capacity rule degrades the storage admissibility surface as a function of cumulative freeze-thaw cycles. A carbonation-tracked-state-of-health rule degrades the storage admissibility surface as a function of cumulative carbonation depth. An electrolyte-architecture-selection composition rule maps application requirements to the admissible electrolyte-coupling architecture classes. Each composition rule is a signed and versioned artifact held in a composition-rule registry.

The substrate's electrochemical state of health is coupled to the structural matrix's mechanical, hydration, carbonation, freeze-thaw, and thermal-cycling state, and the state-of-health attestation primitive records the realized condition as observed by the building energy management system. The water-coupled surface, together with the structural and environmental surfaces, supplies the inputs against which the freeze-thaw-derated, carbonation-tracked, and mechanical-fatigue-derated capacity rules operate on the storage admissibility surface.

The engineered electrolyte phase of the closed-cell cavity-bath architecture is selected for freezing-point admissibility against the deployment climate's design-low temperature, and the freezing-point selection is recorded so that inland closed-cell cavity-bath substrate is admitted across the deployment climate without freeze-induced loss of ionic conductivity. This selection is itself a property the water-coupled surface and the project specification reconcile.

Alternative Embodiments

The disclosed surface admits several variants while preserving the credentialing semantics. In a first embodiment, the surface is materialized for a batch of precast units under a per-batch identity, where the batch shares a single credentialing event. In a second embodiment, the disclosure's per-batch-with-subdivision identity class applies: elements share a batch identity at manufacturing, and subsequent credentialed events subdivide the batch identity into per-element identities through credentialed attestation by the installer authority. In a third embodiment, the surface is updateable through the continuous re-credentialing primitive, which issues a successor profile recorded in the lineage chain, supporting in-service condition assessment and re-credentialing by an appropriate authority.

The substrate population also admits variation. The disclosure contemplates Portland-cement composites and pozzolan-rich formulations including volcanic-ash, fly-ash, calcined-clay, metakaolin, and silica-fume systems, as well as lime-binder formulations; for marine and saltwater deployment, ongoing seawater contact of pozzolan-rich or lime-binder formulations admits progressive long-term crystallization of aluminum-tobermorite phases, producing structural strength enhancement over decadal-to-centennial time scales. Each population is admitted under the same surface schema, with the credentialing authority responsible for the attestation. Surfaces are issued for raw substrate, for retrofit thin-layer cementitious coatings applied to existing structural elements, and for pre-cast modular substrate blocks credentialed at factory conditions, supporting both factory-credentialed prefabrication and in-situ credentialing of conventional construction.

Composition With Other Primitives

The water-coupled surface is rarely consumed in isolation; its principal role is to compose with other credentialed property surfaces under signed composition rules. The most direct coupling is to the energy storage admissibility surface, which the spec treats

as a credentialed surface that authorizes participation in the structure's energy systems rather than a battery device. Through the electrolyte-architecture-selection composition rule, the water-coupled surface declares which electrolyte-coupling architecture class the substrate uses, and through the wet-environment storage rule it requires current water-coupled attestations before storage operations near wet surfaces are admitted.

Composition with the thermal admissibility surface supports the freeze-thaw-derated capacity rule, which degrades the storage admissibility surface as a function of cumulative freeze-thaw cycles. The thermal surface declares a temperature-derated capacity envelope, and the engineered electrolyte phase is selected for freezing-point admissibility against the deployment climate's design-low temperature. Composition with the substrate-as-distributed-physical-state-observatory primitive admits closed-loop observation: the building energy management system observes the substrate's electrical state to detect wet events through capacitance and leakage changes and thermal events through resistance and dielectric changes, each treated as a credentialed observation recorded in lineage. Composition with the carbon-sequestration surface ties the water-coupled and structural state to the carbonation-tracked-state-of-health rule, which degrades the storage admissibility surface as a function of cumulative carbonation depth.

Prior Art And Distinctions

Existing building codes recognize multiple material properties of building components, including structural load ratings, fire-resistance ratings, thermal insulation R-values, sound transmission ratings, and vapor permeability. None of the existing building codes recognize energy storage, electrical distribution, data networking, or carbon sequestration as material properties of structural building components, and existing architectures do not treat the built environment as a single credentialed substrate whose structural, thermal, energy storage, electrical distribution, data network, fire performance, and carbon sequestration properties are independently credentialed but

compositional surfaces of the substrate. The water-coupled property, in existing practice, is not a signed surface that composes with these other properties under a unified admission evaluation.

The disclosed water-coupled admissibility surface differs in that it is bound to the structural element by cryptographic signature of one or more credentialing authorities, it declares property-specific parameters and admission conditions for the water-coupled property category, and it composes with the other credentialed property surfaces through declared, signed, and versioned composition rules to produce a composite admissibility profile evaluable by a building-code authority and by the building energy management system.

Disclosure Scope

This disclosure forms part of U.S. Provisional Application No. 64/050,895 and discloses the water-coupled admissibility surface as one element of a larger credentialed-materials framework. The scope extends to any cementitious or cement-analogous substrate whose water-coupled property is recorded under the disclosed admissibility-surface schema, bound to the structural element by cryptographic signature of one or more credentialing authorities, and made available for composition with other credentialed property surfaces through the disclosed composition rules. Variants that substitute alternative authority structures, analogous cryptographic primitives, or alternative electrolyte-coupling architecture classes, while preserving the signed, composable admissibility surface and its lineage-recorded re-credentialing, are within the disclosed scope.

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

- credentialed-materials/carbon-sequestration-property-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)
- credentialed-materials/end-of-storage-life-attestation (/articles/credentialed-materials/end-of-storage-life-attestation)
- credentialed-materials/energy-storage-property-surface (/articles/credentialed-materials/energy-storage-property-surface)
- Lineage Chain Across Material Lifecycle (/articles/credentialed-materials/lineage-chain-across-lifecycle)
- Master Credential Signature Binding All Property Surfaces (/articles/credentialed-materials/master-credential-binding)
- Multi-Authority Signature Block (/articles/credentialed-materials/multi-authority-signature-block)
- Data-Networking Admissibility Surface (/articles/credentialed-materials/network-property-surface)
- Profile Versioning Continuity (/articles/credentialed-materials/profile-versioning-continuity)
- credentialed-materials/structural-property-surface (/articles/credentialed-materials/structural-property-surface)
- credentialed-materials/thermal-property-surface (/articles/credentialed-materials/thermal-property-surface)
- Versioned Admissibility Profiles With Lineage Chain (/articles/credentialed-materials/versioned-profiles-with-lineage)
- **credentialed-materials/water-coupled-property-surface (/articles/credentialed-materials/water-coupled-property-surface)**

Credentialed Surfaces overview → (/credentialed-materials)