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Composition Rules Governing Surface Interactions

A credentialed structural element's admissibility profile is composed of multiple property surfaces, structural, thermal, energy storage, fire-performance, carbon-sequestration, and others, each independently credentialed by an authority with declared scope. Composition rules specify how these surfaces interact. Each composition rule is a credentialed and signed data artifact declaring a scope of property surfaces and conditions, a composition logic, a version vector, a conflict-resolution policy, and an authority signature. The rules are held in a composition-rule registry consumed by the building energy management system at admissibility-evaluation time.

Mechanism

Composition rules operate over the property surfaces of a credentialed admissibility profile. A credentialed structural element's admissibility profile comprises at least two property surfaces selected from structural, thermal, energy storage, fire-performance, sound-transmission, vapor-permeability, environmental, distribution, network, water-coupled, thermal-coupling, and carbon-sequestration admissibility surfaces. Each surface is independently credentialed by an authority with declared scope: a structural engineering authority signs the structural surface, a thermal-rating authority signs the thermal surface, a fire-marshal authority signs the fire-performance surface, a utility or

building-code authority signs the storage surface, and an environmental-credit authority signs the carbon-sequestration surface. The surfaces compose with one another through declared composition rules.

Each composition rule is a credentialed and signed data artifact declaring: a scope of property surfaces and conditions to which the rule applies; a composition logic specifying how the relevant admissibility surfaces interact under the conditions enumerated; a version vector for deterministic conflict resolution; a conflict-resolution policy selected from latest-signed-rule, declared-precedence-table, and authority-rank-resolution; and an authority signature.

Representative composition rules include, without limitation, a fire-event rule reducing storage admissibility to zero when the fire-performance admissibility surface declares fire-event detection; a thermal-runaway prevention rule constraining storage dispatch during high thermal admissibility surface readings; and a structural-load-vs-storage-cycle rule reducing storage admissibility when the structural admissibility surface reports structural fatigue accumulation above a declared threshold. Each rule's composition logic determines how the relevant surfaces interact when its scope conditions are met.

Further representative rules address environmental coupling and state of health: a wet-environment storage rule requiring water-coupled admissibility surface attestations to be current before admitting storage operations near wet surfaces; a freeze-thaw-derated capacity rule degrading the storage admissibility surface as a function of cumulative freeze-thaw cycles; a carbonation-tracked-state-of-health rule degrading the storage admissibility surface as a function of cumulative carbonation depth; and an electrolyte-architecture-selection composition rule mapping application requirements to admissible electrolyte-coupling architecture classes.

Operating Parameters

Composition rules are held in a composition-rule registry holding signed and versioned composition-rule artifacts. Each composition-rule artifact is signed by a composition-rule authority and declares a scope, a composition logic, a version vector, and a conflict-resolution policy. The registry is consumed by the building energy management system at admissibility-evaluation time.

Each artifact carries a version vector for deterministic conflict resolution. Profile versioning is maintained through monotonically increasing version vectors with conflict-resolution policies declared per the composition-rule architecture, the same versioning structure used for the substrate's admissibility profile. Authority revocation is handled through the credentialed-revocation primitive of the Identity Application; revocation events propagate through the lineage chain and are honored prospectively at admissibility-evaluation time.

The conflict-resolution policy declared by each rule is selected from latest-signed-rule, declared-precedence-table, and authority-rank-resolution. The building energy management system, operating as a persistent semantic agent under the cognitive governance architecture of the Cognition Application, consumes the registry when it evaluates the composite admissibility profile of a credentialed structural element prior to a dispatch or admission decision.

Alternative Embodiments

In one embodiment, multi-authority credentialing of a credentialed structural-storage element is performed by a manufacturer authority, a building-code authority, a utility authority, a carbon-credit authority, and an independent testing authority, producing a composed admissibility profile by which the element is admitted into building-scale operations, building-code review, grid-services participation, carbon-credit issuance,

and independent verification. Each property surface admits independently for its corresponding requirement, and the authority signatures block binds the entire profile to the element's identity.

In a second embodiment, a composition rule resolves conflicting authority claims through its declared conflict-resolution policy. Where the policy is declared-precedence-table, the rule consults a declared table to determine which surface's bound prevails. Where the policy is authority-rank-resolution, resolution follows the relative rank of the signing authorities. Where the policy is latest-signed-rule, the most recently signed artifact within scope governs. The version vector carried by each artifact makes resolution deterministic for a given registry state.

In a third embodiment, the fire-event rule reduces storage admissibility to zero when the fire-performance admissibility surface declares fire-event detection, and the thermal-runaway prevention rule constrains storage dispatch during high thermal admissibility surface readings. These rules express the precedence of fire-and-life-safety conditions over storage operation within the composite admissibility profile.

In a fourth embodiment, the freeze-thaw-derated capacity rule degrades the storage admissibility surface as a function of cumulative freeze-thaw cycles, and the carbonation-tracked-state-of-health rule degrades the storage admissibility surface as a function of cumulative carbonation depth. The storage surface's realized capacity envelope is thereby a function of recorded environmental and material state rather than a fixed nameplate value.

In a fifth embodiment, the electrolyte-architecture-selection composition rule maps application requirements to admissible electrolyte-coupling architecture classes, selecting among the native-pore-solution, open-cell ambient-water-coupled, and closed-cell cavity-bath architecture classes declared in the credentialed admissibility profile.

In a sixth embodiment, a plurality of credentialed substrates federate across multiple properties, neighborhoods, utility territories, or jurisdictions through a federation orchestrator operating under credentialed scope declared by the participating building energy management systems. A cross-jurisdictional federation operates under multi-authority-declared scope, and each participating substrate's composite admissibility profile continues to be governed by the composition rules in its registry.

Composition With Lineage And Verification

The composition-rule registry composes with the substrate's lineage chain. A credentialed structural element's lifecycle is recorded in a lineage chain comprising pre-installation credentialing, in-service credentialed operation, end-of-storage-life substate, end-of-structural-life decommissioning, recycling-grade re-credentialing, and re-installation in a subsequent structural application. Each lifecycle transition is a credentialed event signed by an appropriate authority and recorded in the lineage chain. Because each composition-rule artifact carries a monotonically increasing version vector, the registry state in force at a given event is identifiable from the version vectors recorded with that event.

The architecture admits continuous re-credentialing across operational material flows during a structural element's in-service lifetime. Each material flow is a credentialed event signed by an installer authority and recorded in the lineage chain; the substrate's composite admissibility profile is re-evaluated against the cumulative material flow rather than only at original installation. At admissibility-evaluation time, the building energy management system consumes the composition-rule registry, evaluates the relevant property surfaces against the rules in scope, resolves any authority conflict under each rule's declared conflict-resolution policy, and checks that the proposed action lies within the resolved envelope. The evaluation is performed against signed surfaces and signed rules, and authority revocation events propagate through the lineage chain and are honored prospectively.

Prior Art Distinction

Existing building codes recognize multiple material properties of building components: 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 conventional building codes are documentary artifacts interpreted by humans rather than signed artifacts that compose cryptographically with property claims.

Existing electrical codes treat energy storage exclusively as installed equipment; there is no provision in the existing electrical code for energy storage as a distributed property of structural building elements aggregated by the building's electrical system. More broadly, existing architectures do not treat the built environment as a single credentialed substrate operating across building-material structural elements under one architectural primitive that recognizes structural, thermal, energy storage, electrical distribution, data network, fire performance, and carbon sequestration properties as independently credentialed but compositional surfaces of the substrate. The present primitive is the signed, versioned composition-rule registry whose inputs are substrate-bound property surfaces and whose conflict-resolution policy is declared per rule.

Disclosure Scope

This article elaborates the composition-rules primitive disclosed in U.S. Provisional Application No. 64/050,895. The primitive is the composition-rule artifact, a credentialed and signed data artifact declaring a scope of property surfaces and conditions, a composition logic, a version vector, a conflict-resolution policy, and an authority signature, held in a composition-rule registry consumed by the building energy management system at admissibility-evaluation time. Embodiments are not limited to the representative composition rules or authority arrangements enumerated

above; the inventive concept is the signed, versioned, multi-authority composition-rule registry governing the interaction of credentialed property surfaces of a credentialed structural element.

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

- 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)