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Thermal-Property Admissibility Surface

The thermal admissibility surface declares a building material's thermal mass capacity, embedded hydronic-loop layout, refrigerant or working-fluid compatibility class, heat-pump coupling specification, geothermal-coupling specification, and a thermal-electrical interaction specification, bound by cryptographic signature to a credentialing authority. The surface composes under signed composition rules with the structural, storage, distribution, network, and water-coupled admissibility surfaces, letting one credentialed cementitious-graphene element operate at once as a structural body, an energy storage body, a thermal mass body, and a heat-exchange surface. This disclosure describes the mechanism by which the thermal surface is declared and consumed, its declared parameters, alternative embodiments, composition with other primitives, the relevant prior practice, and the scope of the inventive contribution.

Mechanism

The thermal admissibility surface is one of the credentialed property surfaces carried by a credentialed structural element. In the disclosed thermal-coupling substrate primitive, a single credentialed cementitious-graphene structural element operates simultaneously as a structural body, an energy storage body, a thermal mass body, and a heat-exchange surface. The thermal admissibility surface declares the material's thermal parameters and admission conditions, and composes with the structural, storage, distribution, network, and water-coupled admissibility surfaces under signed composition rules. The surface is bound to the element's identity through the credentialing signature block of one or more credentialing authorities admitted to the architecture, and the binding travels with the material into service.

The disclosed thermal admissibility surface declares thermal mass capacity, embedded hydronic-loop layout, refrigerant or working-fluid compatibility class, heat-pump coupling specification, geothermal-coupling specification, and a thermal-electrical interaction specification that declares how thermal-mass operation composes with the storage admissibility surface's temperature-derated capacity envelope. These declarations are part of the credentialed admissibility profile rather than a paper certificate, so that the building energy management system and a building-code authority can evaluate the composite admissibility profile directly.

Because the thermal surface composes with the storage and water-coupled surfaces, thermal-mass operation is reconciled against the storage envelope and against environmental state. The composition rules of the architecture admit a freeze-thaw-derated capacity rule, a carbonation-tracked state-of-health rule, and a mechanical-fatigue-derated capacity rule operating on the storage admissibility surface as functions of the structural and environmental admissibility surfaces, so that the surface tracks the coupling between the material's thermal-cycling state and its other credentialed behaviors.

Declared Parameters

The thermal admissibility surface declares thermal mass capacity. A typical Portland-cement composite carries a thermal mass of approximately 2.0 megajoules per cubic meter per kelvin. The thermal mass capacity is declared in the credentialed admissibility profile and is the parameter through which the substrate's signed thermal mass enters composition with the other surfaces.

The surface further declares the embedded hydronic-loop layout, the refrigerant or working-fluid compatibility class, a heat-pump coupling specification, a geothermal-coupling specification, and a thermal-electrical interaction specification. The thermal-electrical interaction specification declares how thermal-mass operation composes with the storage admissibility surface's temperature-derated capacity envelope, so that thermal operation and storage operation are reconciled against a single credentialed profile rather than against independent records.

The refrigerant or working-fluid compatibility class admits low-GWP refrigerant heat-pump coupling. Working fluids include carbon dioxide (R-744, GWP 1) operating in transcritical cycles at high-side pressures in the range of approximately 70 to 130 bar, propane (R-290, GWP 3), water (R-718, GWP 0), and ammonia (R-717, GWP 0), exhibiting global-warming-potential values substantially below the high-GWP hydrofluorocarbon refrigerants of the prior art (R-410A, R-134a). Primary working-fluid pressure containment is provided by the hydronic-loop tubing wall, rated for the working-fluid pressure class declared in the thermal admissibility surface; the surrounding cementitious-graphene composite operates as confinement and thermal-coupling medium without serving as primary pressure containment.

Alternative Embodiments

The thermal-coupling substrate primitive admits coupling configurations. In a cold-climate composition, heat-pump waste heat circulates through the cavity manifold to maintain substrate temperature. In a hot-climate composition, the cavity manifold rejects substrate operating heat to a ground-loop or ambient-air radiator. In a geothermal-coupled composition, the cavity manifold extends below the frost line such that the engineered electrolyte phase passively equilibrates with ground temperature. In a Joule-loss-recovery composition, storage round-trip-efficiency loss deposited as heat in the substrate is extracted through the cavity manifold and recovered to the building's space-conditioning or domestic-hot-water systems. In each configuration the cavity fill-and-drain manifold operates simultaneously as the engineered electrolyte phase distribution medium and as a thermal-management hydronic loop.

The signing authority structure admits variation. A single credentialing authority may sign the credentialed admissibility profile, or a federation of credentialing authorities may co-sign, with each authority's signature attached through the credentialing signature block to the surfaces within its competence. Re-credentialing admits issuance of successor profiles as the material accumulates service: the state-of-health attestation primitive records realized in-service performance as observed by the building energy management system, supporting service-life decisions through documented performance.

A data center substrate deployment configures a hyperscale, colocation, or edge data center facility's foundation, lower wall sections, raised-floor structural panels, and inter-rack structural elements as credentialed cementitious-graphene composite carrying the thermal admissibility surface as a direct-to-substrate liquid-cooling heat-rejection interface for liquid-cooled or direct-to-chip-cooled information-technology equipment, simultaneously with the structural, energy storage, distribution, and data network surfaces. Where a material participates in multiple credentialed-materials surfaces, the surfaces are bound to the element identity through the credentialing signature block, and consuming primitives reconcile against the composite admissibility profile.

Composition With Other Primitives

The thermal surface composes with the thermal-coupling substrate primitive: when the credentialed element operates as a thermal mass body and a heat-exchange surface, its declared thermal parameters compose with the building's heat-pump coupling, geothermal-loop coupling, ambient-air radiator, and Joule-loss recovery subsystems through the cavity manifold operating as a hydronic loop. The state-of-health attestation primitive records realized performance as observed by the building energy management system, and re-credentialing issues successor profiles as the material accumulates service.

Composition with the storage admissibility surface is mediated by the thermal-electrical interaction specification, which declares how thermal-mass operation composes with the storage surface's temperature-derated capacity envelope. Composition with the water-coupled and environmental surfaces is carried by the architecture's composition rules: a freeze-thaw-derated capacity rule, a carbonation-tracked state-of-health rule, and a mechanical-fatigue-derated capacity rule operate on the storage admissibility surface as functions of the structural and environmental admissibility surfaces, so that the material's thermal-cycling, freeze-thaw, and carbonation state are reconciled against its other credentialed behaviors under signed composition rules rather than as independent records.

Prior Practice 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. No existing building code recognizes energy storage, electrical distribution, data networking, or carbon sequestration as material properties of structural building components. 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 disclosed thermal surface departs from existing practice by being a credentialed property surface bound to the element identity through a cryptographic signature block of one or more credentialing authorities, declared within the credentialed admissibility profile, and composing with the structural, storage, distribution, network, and water-coupled surfaces under signed composition rules. The signed, composable thermal-coupling substrate primitive, in which one credentialed cementitious-graphene element operates at once as a structural body, an energy storage body, a thermal mass body, and a heat-exchange surface, is the inventive contribution.

Disclosure Scope

This disclosure forms part of U.S. Provisional Application No. 64/050,895 and discloses the thermal admissibility surface as one element of a credentialed-materials framework. The scope extends to any building material whose thermal parameters are declared under the disclosed thermal admissibility surface, bound by cryptographic signature of one or more credentialing authorities, and made available for composition with the other credentialed property surfaces under signed composition rules. Variants that substitute alternative authority structures, alternative thermal-coupling configurations, or analogous cryptographic primitives, while preserving the signed thermal-coupling substrate primitive and its composition with the other property surfaces, are within the disclosed scope.

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)