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BIM-based facility management for complex structures

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Research article Page: 01-17

BIM-based facility management for complex structures utilizes digital twins created during design to centralize asset data, maintenance schedules, and operational metrics, enabling proactive decision-making throughout a building's lifecycle. For intricate facilities like high-rises or hospitals, BIM integrates HVAC, electrical, and structural systems into a single interactive model, allowing facility managers to visualize spatial relationships and track real-time performance via linked IoT sensors. This approach supports predictive maintenance by analyzing usage patterns, reducing downtime by 20-30% and optimizing energy consumption through automated simulations. Space utilization analytics from BIM models aid occupancy planning, while lifecycle documentation ensures compliance and seamless handovers from construction teams. Such integration enhances resilience for aging urban infrastructure, complementing your interests in SHM and multi-hazard design……… [For more click here].

Biomimicry in structural design for energy performance

Ravi Kumar & S. Raheem

Research article Page: 17-29

Biomimicry in structural design for energy performance draws from nature's efficient systems, such as termite mounds for natural ventilation or pinecone-inspired facades that open and close to regulate airflow and solar gain. These bio-inspired envelopes reduce mechanical cooling needs by 30-50% through passive thermoregulation, mimicking animal fur for insulation or lotus leaves for self-cleaning surfaces that minimize maintenance energy. Eastgate Centre in Zimbabwe exemplifies this by using termite mound chimneys for stack ventilation, cutting HVAC costs by 90% while maintaining comfort. Lotus-effect coatings and whale-fin turbines further enhance envelope efficiency and wind energy capture in high-rises. This approach aligns with sustainable materials research, optimizing lifecycle energy in urban structures……. [For more click here]

Hybrid Fiber Reinforcement Strategies for Improving Ductility in High-Strength Concrete

Yuhedur Rahman & Ismoth Zerine

Research article Page: 30-48

Hybrid fiber reinforcement strategies combine macro-fibers like steel (for bridging large cracks) with micro-fibers such as polypropylene or natural fibers (for controlling microcracks), synergistically boosting ductility in high-strength concrete. In ultra-high-performance concrete (UHPC), hybrid systems achieve strain-hardening behavior with post-crack ductility indices exceeding 3-5 times that of plain mixes, alongside compressive strengths over 100 MPa. Optimal volumetric fractions—typically 0.5-1.5% steel and 0.1-0.5% synthetic fibers—enhance flexural toughness by 40-60% and shear capacity by up to 8 times, as validated in beam tests. These improvements stem from multi-scale reinforcement that distributes stresses, delays brittle failure, and improves energy absorption for seismic-resistant structures…… [For more click here].

Life Cycle Assessment of Green Roofs for Urban Heat Island Mitigation

Jan Holnicki-Szulc, Mohammed Nijr Dughaylib Alotaibi, Mana Aziz Awadh Alharbi, Naif Hiji Alrasheedi & Abdulrahim Owaidh Saud Aloufi
Research article Page: 49-72

Life cycle assessment of green roofs reveals substantial environmental benefits over conventional roofs, with reductions in global warming potential by 1-5% and energy savings up to 6% for cooling over a 50-year lifespan. These systems mitigate urban heat islands by lowering roof surface temperatures by 30-56°F through evapotranspiration and shading, while reducing peak ambient air temperatures by up to 20°F. LCA studies account for material production, installation, maintenance, and disposal, showing green roofs offset initial higher costs via extended durability and stormwater management gains. Additional advantages include GHG sequestration, pollutant filtration, and biodiversity enhancement, making them ideal for heat-vulnerable urban areas. …… [For more click here]

Fracture Mechanics Analysis of Cracked Asphalt Pavements under Heavy Traffic Loads

Abdulwahab Owaidh Saud Aloufi, Eisi Ghanem Aljohani, Abdulmajeed Aouidh Alaofi & Amani Abdulmunaem Alhaisoni
Research article Page: 73-89

Fracture mechanics analysis of cracked asphalt pavements under heavy traffic loads employs 3D finite element models to predict crack initiation, propagation, and fatigue life, focusing on top-down cracking mechanisms. Linear elastic fracture mechanics (LEFM) and viscoelastic cohesive zone models characterize stress intensity factors and energy release rates at crack tips, revealing tensile strains from radial tire pressures as primary drivers of surface cracking. Heavy axle loads accelerate damage accumulation, with simulations showing crack growth rates increasing 3-5 times in wheel paths compared to non-trafficked areas, exacerbated by aging and poor interlayer bonding. Mitigation strategies, such as polymer-modified binders (e.g., PG76-22) and thicker asphalt layers (>18 cm), can extend fatigue life by 34-41% by enhancing fracture energy thresholds…… [For more click here].

Reliability-Based Design of Retaining Walls Subject to Pseudo-Static Seismic Forces

Albert A. Groenwold & L. F. P. Etman
Research article Page: 90-102

Reliability-based design of retaining walls under pseudo-static seismic forces integrates probabilistic methods like First Order Reliability Method (FORM) to calibrate load and resistance factors, targeting a target reliability index ($\beta \approx 3.0$ for 50-year service life). Pseudo-static analysis applies horizontal (k_h) and vertical (k_v) seismic coefficients based on Mononobe-Okabe theory, where k_h = 0.5 × PGA/g × γ_I / r, with reduction factor r (1.0-2.0) depending on allowable wall displacements. For external stability (sliding, overturning, bearing), FORM optimizes factors such as ϕ_s = 0.8-1.0 for soil friction and γ_eq = 1.3-1.5 for earthquake loads, ensuring failure probabilities below 10^{-3}. This approach outperforms deterministic methods by accounting for soil variability, wall geometry, and seismic intensity uncertainties, particularly for reinforced soil and gravity walls…… [For more click here].

Rheological Properties of Self-Compacting Concrete with Mineral Admixtures

W. M. Rubio, Md Mainul Islam, Md Rakibul & Haque Pranto

Research article Page: 104-117

Rheological properties of self-compacting concrete (SCC) with mineral admixtures like fly ash, ground granulated blast furnace slag (GGBS), and micro-silica (MS) are characterized by yield stress (τ_0) typically 20-60 Pa and plastic viscosity (η) of 30-100 Pa·s to ensure high flowability without segregation. Mineral admixtures reduce water demand and improve particle packing, with GGFS and fly ash lowering yield stress by 20-40% at 20-40% replacement levels, enhancing slump flow diameters to 650-750 mm. Micro-silica increases viscosity but boosts cohesion, while marble dust or limestone powder optimizes rheology via filler effects, maintaining V-funnel times under 12 s. These admixtures enable sustainable SCC production, balancing fresh-state performance with hardened durability under ambient curing…… [For more click here].

Retrofitting strategies for existing buildings

N. Olhoff & C. Fleury, W. Stadler & Marta Rey-López

Research article Page: 118-133

Retrofitting strategies for existing buildings enhance seismic, wind, and energy performance while minimizing disruption and costs, often combining structural upgrades with sustainability measures. Global shear walls, steel bracing, and concrete jacketing add stiffness and strength, effectively reducing drifts in RC frames and masonry infills by 50-70% under design earthquakes. Advanced techniques like base isolation (rubber bearings), supplemental dampers (viscous, friction), and fiber-reinforced polymers (FRP) provide ductility and energy dissipation without heavy interventions…….. [For more click here]

Spectral finite element methods in dynamics

Haojie Xu, Yuqian Fan

Research article Page: 134-152

Spectral finite element methods (SFEM) in dynamics extend classical finite element analysis by using exact wave solutions and frequency-dependent dynamic shape functions derived from governing differential equations, enabling precise modeling of wave propagation with minimal elements. Unlike polynomial-based FEM, which requires mesh refinement at high frequencies, SFEM employs Fourier transforms to handle broadband excitations, assembling exact spectral stiffness matrices at discrete frequencies for beams, plates, frames, and continua. This approach excels in transient dynamics, structural health monitoring, and seismic analysis, capturing all wave modes……… [For more click here]