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Smart grid optimization for urban energy distribution

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Research article Page: 01-12

Smart grid optimization for urban energy distribution uses advanced sensors and AI to monitor and balance electricity supply with real-time demand in densely populated cities. This approach integrates renewable sources like solar and wind, reducing transmission losses by up to 20% through dynamic load management and predictive analytics. Automated demand response systems shift peak usage to off-peak times, minimizing blackouts and cutting energy costs for consumers. Technologies such as IoT-enabled smart meters and microgrids enhance grid resilience against outages while supporting electric vehicle charging infrastructure. Overall, these optimizations promote sustainable urban growth by lowering CO2 emissions and enabling efficient energy trading. ……… [For more click here]

Optimization of passive solar design in residential buildings

Rahimi Harsini

Research article Page: 13-26

Optimization of passive solar design in residential buildings focuses on south-facing orientation, strategic window-to-wall ratios (20-30%), and overhangs sized for latitude to maximize winter solar gain while blocking summer sun. Thermal mass walls like concrete or masonry absorb daytime heat for nighttime release, reducing heating demands by 30-50% in temperate climates. Direct gain systems prioritize living areas for sunlight collection, complemented by indirect strategies like Trombe walls for controlled heat distribution. Sunspace designs create buffer zones that preheat ventilation air, while proper insulation minimizes losses through high R-value roofs and slabs. These techniques, validated through energy simulations like BEopt, align with sustainable practices for urban residences in regions like…… [For more click here].

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

Yuhedur Rahman & Ismoth Zerine

Research article Page: 27-48

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

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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

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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 $k_h = 0.5 \times PGA/g \times \gamma_I / r$, with reduction factor r (1.0-2.0) depending on allowable wall displacements. For external stability (sliding, overturning, bearing), FORM optimizes factors such as $\phi_s = 0.8\text{-}1.0$ for soil friction and $\gamma_{eq} = 1.3\text{-}1.5$ 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].