Hydrodynamic Modeling of Tsunami Wave Impacts on Coastal Structures

Jakob S. Jensen

Research article Page: 01-15

Hydrodynamic modeling of tsunami wave impacts on coastal structures predominantly employs smoothed particle hydrodynamics (SPH) to simulate violent fluid-structure interactions, capturing bore slamming, run-up, and overturning moments on dikes or piers. SPH models like GPUSPH predict hydrodynamic forces from frontal impact and drag, with circular piers experiencing less violent run-up than square ones due to flow separation, validated against lab data for bridge piers. Non-hydrostatic models integrated with immersed boundary methods quantify surge wave pressures, showing sloped dikes and shelter structures reduce forces by 15-50% via wave dissipation and blockage attenuation. These simulations aid resilient design by resolving unsteady flow fields, bed shear stresses, and dynamic responses under varying wave heights and structural configurations…… [For more click here].

Effect of Fiber Orientation on the Post-Cracking Behavior of SFRC Panels

Ole Sigmund & Ibrahim Abdelfattah Almajali

Research article Page: 16-34

Fiber orientation in steel fiber reinforced concrete (SFRC) panels strongly influences post-cracking behavior, with aligned fibers perpendicular to cracks enhancing pull-out resistance and residual flexural strength by up to 50% compared to random distributions. Flow-induced orientation during casting leads to higher fiber density near formwork surfaces and preferential alignment in the flow direction, increasing fracture energy in bending tests but causing anisotropy in tensile performance. Image analysis and X-ray CT quantify orientation factors ($\alpha \approx 0.4$-0.7), where higher α correlates with improved σ-w relationships and ductility in wedge-splitting or notched prism tests. Panels with optimized fiber alignment exhibit ductile failure modes, making SFRC suitable for slabs-on-ground and industrial floors. …… [For more click here]

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

Yuhedur Rahman & Ismoth Zerine

Research article Page: 35-48

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 $k_h = 0.5 \times PGA/g \times \gamma_I / r$, 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 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]