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SHEAR FAILURE FORM REALIZATION IN CONCRETE

Abstract. The shear is considered as concrete and reinforced concrete elements failure form, which differ significantly in constructive solutions, load transfer schemes and stress-strain state on shear surface. Conditions and criterion for shear failure form realization in concrete are formulated. As conditions, it is assumed that plastic deformation is localized in thin layers on failure surface and that shear stresses τ_n are reached $\sqrt{2/3}$ from their maximum value. Criterion for shear realization in structurally inhomogeneous materials with different resistance to compression and tension is simultaneous limit state existence over entire shear surface. To determine shear realization boundary in concrete, concrete plate destruction process under axial compression is analyzed. «Shear – tear» failure transition region existence is substantiated. Lower concrete destruction boundary by shearing is located in mixed region stresses close to axial compression, and upper boundary is in uneven biaxial compression zone. Kinematic concrete elements destruction mechanism under shear is considered as limit macroscopic structure. Rigid-plastic body concept is used. Plastic deformation is thought to be concentrated in thin layers on fracture surface, and adjacent areas are considered as hard disks. Sufficiently general technique for calculating strength based on mathematical plasticity theory apparatus, variational method with virtual velocities principle application, discontinuous solutions, and upper ultimate load magnitude estimate is proposed. Externally brittle destruction character cannot serve as obstacle to plasticity theory application. As plastic potential, concrete strength condition in revolution paraboloid form is adopted, which has fairly simple notation in tensor form and experimental confirmation. Strength problems solution is to write down virtual velocity principle functional for corresponding kinematic fracture mechanism. Functional is investigated for an extremum, which is equivalent to boundary value problem solution. Stationary state achievement by functional corresponds to plastic deformation power minimum. As an example, solution is given to strength problem of bent fixed from one end concrete (reinforced concrete) plate, simulating keyed joints. Realized kinematic mechanism under shear opens fracture surface direction variation possibility by creating lateral compression, which practical interest is.

Key words: concrete, shear failure form, conditions, criterion, realization mechanism, calculation methods.

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РЕАЛИЗАЦИЯ СРЕЗОВОЙ ФОРМЫ РАЗРУШЕНИЯ В БЕТОНЕ

Аннотация. Рассматривается срез как форма разрушения бетонных и железобетонных элементов, существенно различающихся конструктивными решениями, схемами передачи нагрузки и напряженно-деформированным состоянием на поверхности сдвига. Сформулированы условия и критерий реализации срезовой формы разрушения в бетоне. В качестве условий приняты обязательность локализации пластической деформации в тонких слоях на поверхности разрушения и достижение сдвиговыми напряжениями τ_n уровня $\sqrt{2/3}$ от их максимального значения. Критерием реализации среза в структурно-неоднородных материалах з различным сопротивлением сжатию и растяжению является одновременное существование предельного состояния по всей поверхности сдвига. Для определения границы реализации среза в бетоне