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Pulsating Flow Past a Square Cylinder at Low Reynolds Number: Analysis of Vortex Structures THOMAS FOWLER, IV, FREDDIE WITHERDEN, SHARATH GIRIMAJI, Texas A&M University — Flow past a fixed square cylinder is a canonical problem for investigating vortex-induced vibration and various wake flow physics of interest to several engineering fields. A variant of this problem is that of a pulsating inflow condition. In this work, direct numerical simulations were performed for the case of pulsating flow at Re = 200 over a range of forcing frequencies. As in literature, three regimes are identified: (i) Pre-Lock-in; (ii) Lock-in; and (iii) Post-Lock-in. In Pre-Lock-in, vortex shedding is asymmetric and aperiodic, with the shedding frequency matching that of the uniform case. During Lock-in, vortex shedding remains asymmetric, but becomes distinctly periodic owing to the synchronization of the detachment of the primary and secondary vortices. Here the vortex shedding frequency is determined by the forcing frequency, leading to an increase in the forces experienced by the body. Transitioning to Post-Lock-in, the increasingly strong pulsations lead to symmetric detachment of the primary vortices, disrupting the asymmetric shedding of secondary vortices, and returning to aperiodicity. Spectral analysis then provides further insight regarding the sharp transition into the lock-in regime as opposed to the gradual transition beyond.

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