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Transition time from lower to higher flow between steady flow states in a finite length prismatic channel

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Water-transport channels, such as irrigation canals and rivers, face a transition time (response time) between two steady states when the discharge is increased. Generally, this transition time does not equal either the gravity wave run time or the travel time of a monoclinal wave, but depends on the dynamic storage of the channel-reaches between cross-regulators and the method of operation of said cross-regulators. For a finite length prismatic open channel with a fixed slope and a given head end discharge boundary condition, we show that there is a lower bound on the transition time between two steady flow states. We give examples of the qualitative dependence between transition time and tail end boundary conditions (for an irrigation canal these would correspond to control methods for the tail end structure) and we provide results from a St. Venant equation based computer model to show quantitative dependence on tail end boundary conditions.