

Lift Irrigation Schemes - Need for protection of pumping mains from water hammer phenomena

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The newly formed state of Telangana in India has highly inequitable distribution of water resources. Major rivers pass through this state and enters the downstream state of Andhra Pradesh. To solve this problem of inequitable water resources, lift irrigation projects have been identified as the solution. Lift irrigation projects involve lifting the water from lower elevation where water is available to a higher elevation where water is not available. The quantity of water lifted is enormous which requires high capacity pumps and large diameter conveyance elements. Due to erratic and large demand of electric power for such systems, it is possible that the pumping systems come to an abrupt halt causing various problems described earlier in this chapter. The solutions to these problems, to make the pumping system work as it was planned to work, make this research work significant by analysing the water-hammer pressures and to suggest safety measures from the results obtained in this research.

The water hammer is a detrimental event, would causes mainly by sudden flow changes in confined pipe systems. When it will occur, its effect would be very costly and even if sometimes fatal. Generally, it will happen in a system where the velocity and pressure changes rapidly with time. In general, water hammer may be encountered in the water transmission lines, water distribution networks. Tripping of power to pumps and failure of single pump can also cause water column separation due to negative pressure. But transient events resulting from power failure are more severe than from other causes. Therefore, it needs an essential study to reduce the water hammer problems by properly equipped with adequate transient/surge protection device(s). Thus, in this study Method of Characteristics (MOC) technique with explicit finite difference concept is applied to resolve the water hammer problem. Many lift irrigation projects have been initiated by the governments of Telangana and Andhra Pradesh. For this study, the Pattisam lift irrigation project is considered and it has the pumping capacity of 240 cumecs of water from Elevation (EL) 13.7 m from Godavari river/intake to Indirasagar Polavaram Right Main Canal at Elevation (EL) 41.26 m through 3200 mm diameter pipelines. Under this study, pumps can operate during a transient event of the different quadrants (discharge, head and speed). The transient analysis is carried out using complete characteristics in all quadrants. For this study, the SAP2 software uses best fitting among these curves to fill in the parts of the pump characteristics. The model results have compared with the graphical solutions for the different transient flows. The results entail that the maximum and minimum HGL after providing the surge protection device are above the transmission main line profile, envisages that there is no cavitation and water column separation. The water hammer protection devices like, air chamber, air cushion valves and air relief valves, one -way surge tanks and stand pipes are proposed for these pumping mains.

Key words: lift irrigation schemes, pumping mains, cavitation, surge analysis, method of characteristics.