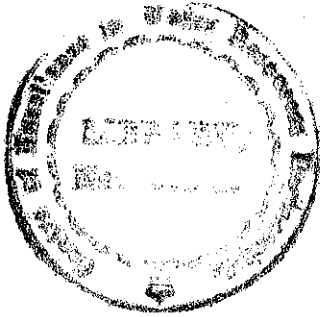
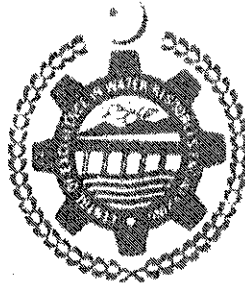


THESIS

**EVALUATION OF REPORTED WIDE SPREAD SUTLEJ RIVER
FLOODING IN DISTRICT KASUR IN 2011**



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Submitted by

Muhammad Zaman
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ABSTRACT

A flood is an anomalous high water flowing, which flows over the embankments along either natural or artificial streams. Floods occur mainly due to intense storms which cause more runoff than the capacity of the stream within its normal channel section. Flooding could also be accentuated due to poor operation of dams and barrages across the river. Effective flood management requires structural as well as non-structural measures. In 2011, District Kasur of Pakistan faced severe flood due to heavy rainfall in the catchment of Sutlej River which directly affected approximately 138 Km² area and 7,139 houses in District Kasur. The area of study is Kasur district upstream of Ferozpur Headworks where Sutlej River caused the severe flooding. The study area populace could not be evacuated during flood and faced property and crop damages.

This study is a post evaluation of the 2011 flood condition of River Sutlej from Barwala to Keekar post reach. Physical survey of the study area was under taken and data related to flood depth and location of inundated villages were recorded. HEC-RAS hydrodynamic model was formulated to simulate flood movement, flood water level and inundation area from 2011 flood. River reach of 50 km with 23 cross sections including 2 Km reach d/s of Ferozpur Headworks with 4 cross sections was evaluated. The downstream boundary condition was assigned as normal depth along with average surface slope of the downstream flooded reach. The HEC-RAS model was simulated and flow rating curve was developed to ascertain the maximum historic flood flow. Further, various gate operations for Ferozpur Headworks i.e. all gates open, partially gates open and only under sluices gates open, were analyzed to reproduce the extent of flooding in the affected villages.

Water level profile simulated by HEC-RAS hydrodynamic model compared with the observed flood record confirmed flood water discharge of 2,300 m³ /s (approx. 80,000 cfs) as reported by I & P department and Media. Flooding was limited to villages located u/s of Ferozpur Headworks only and villages located d/s of Headworks remained dry and safe. All gates open condition of barrage did not produce any flooding condition in the affected villages. Partial gate opening condition resulted in significant flooding condition. Only under sluice gates open condition reproduced a flooding condition very much comparable to observed flooding condition

It is viewed that flood flow of 2300 m³/s, being little more than low flood limit of 1980 m³ /s (70,000 cfs), could not create any flooding condition in the area. India operated under sluices gates only as typically carried for river sediment management and other gates remained closed. This caused flooding in Pakistan territory area. The flooding in various villages in Pakistan territory was caused by ill operation of barrage gates by India contrary to flood handling norms.

It is recommended that Pakistan should seek, under Indus basin treaty, presence of an observer at Ferozpur Headworks for the observation of gate operation during flood season. Gate operation of Ferozpure Headworks should be carried with the knowledge and consonance of Pakistan, Pakistan should chart a safe barrage gate operation policy to ensure safety of various villages against flooding under various flood discharge conditions. Affected villages may be provided with flood proofing for floods and a flood evacuation plan may be charted for exceptional floods to safeguard village against India's sinister plan of intentional and unintentional flooding