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High resolution remote sensing and field measurements for urban flood mapping

A. K. Singh and D. P. Patel

Department of Civil Engineering, Nirma University, Ahmedabad-382481 India, (Email. anupam.singh@gmx.net, Fax. 02717.241917)

There was considerable increase in the occurrence of flood and flood related damages during 2006 globally. The flood events accounted for 55% of all disaster registered and approx. 72.5% of total economic losses world-over as indicated by CRED disaster data. The flood occurrence has increased almost 10-fold during last 45 years, merely 20 events in 1960 to 190 events in 2005. These extreme flood events has caused major damage to property, agriculture productivity, industrial production and infrastructure parallax. Therefore, floods are posing a great concern and challenge to design engineers, re-insurance industries, policy makers and to the government. In India, flood occurs typically during monsoon season due to heavy tropical storms, as a result of low pressure zones. The 2006 floods particularly during August 2006 caused greater damage to personal and property all around Indian sub-continent. The arid regions in Rajasthan and Gujarat to humid regions in North-East were caught with surprise. It is estimated that a single flood event in lower Tapi basin during 7-14 August 2006 resulted in 300 people being killed and Rs20,000 Crore (US$ 4.5 billion) property damage. The human life was stand-still for almost 2-weeks in Surat and Hazira twin cities as well tens of rural villages along lower Tapi basin. Therefore, it becomes prime importance to minimise the property damage, reduce infrastructure disturbances, and identify areas and buildings having greater flood risk. It is therefore at the strategic planning level that the possibility of utilising information available in cartographic forms assumes significant importance for urban flood mapping. However, a major contribution to flood mapping and planning is derived from the information made available by high resolution satellite technology. The evaluation of flood risk are

generally based on a two stage procedure: In first stage, the statistical probabilities of stage-discharge characteristics of river sections are calculated. Thereby bringing about the overbank flow and river sections at which the flow exceeds the carrying capacity of the river channel. In addition, measurements for critical channel sections are undertaken to assess the hydraulically determined characteristics of the section of river course. In second stage, the inhabited areas falling in the greater or lesser flood risk zone are evaluated based on hydraulics and mapped based on high resolution remote sensing imagery. Research on flood risk mapping reveals that three elements such as maximum water level, the velocity of water flow, and the amount of time flood remains in given land area are essential to evaluate possible damage. In this paper high resolution remote sensing images from Google-earth and IRS-1D are combined with hydraulic analysis and digital elevation model (DEM) to identify the flood susceptible areas. The above methodology have been applied to prepare a flood potential and risk map for Surat city, a part of lower Tapi basin. The data on river cross-sections were collected by irrigation department immediately after the August 2006 flood event and river carrying capacity was worked out. More than 200 river channel sections at a mean distance between of 150 - 200m were collected for river between Ukai dam and Magdala weir. The peak discharge analysis reveals that river capacity has been reduced as low as 1.2 million cusecs at Viveknand bridge as being claimed to be 4.5 million cusecs by irrigation department. Therefore, this section increases the flood risk in and around neighbouring areas. Once in eight years there is a likelihood of flood hazard, but has increased during recent decade to one in five years. For quantification of flood prone area thematic map based on Google-earth and IRS-1D data reveals that more than 80% urban area of Surat city can be under flood for a flood event of 50-years of return period. The flood hazard map has been prepared for various zones by multiplying a priori probability map, which indicate the degree of danger and map derived from the analysis of historical events.