188. On the Electronic Analog Computer for Flood Routing

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Japan is confronted with a grave menace of floods, the damages by them amounting to several hundred million dollars every year. It is, now, our urgent problem to establish an economic and efficient flood control project. To achieve this end, we must know, among others, rainfall conditions over catchment basins, topographical and geological features of them, nature of river flow at flood and demands of water utilization. Especially, the flows in natural river channels among them are very complex phenomena; the boundary conditions are incessantly affected by dams, retention pools, tides at estuaries and so on; irregularities of channels and fluctuations of sediment supplies cast their shadows upon the nature of flows. It is almost impossible to find a complete solution of it under such complicated conditions.

According to the Hayami's theory of flood waves [1], however, the basic differential equation of them becomes, approximately,

$$\frac{\partial H}{\partial t}+A\frac{\partial H^{3/2}}{\partial x}=\mu\frac{\partial^2 H}{\partial x^2}, \tag{1}$$

where, H: the water depth, t: the time, x: the distance, and A is a constant determined by the hydraulic resistance and the bottom slope of channel and μ a numerical constant defined by the various irregularities of river reach and the fluctuations of bottom sediment. Recently, an electronic analog computer based on Muskingum flood routing method [2] has been developed and greatly reduced troubles of computation. But there are inherent defects in the Muskingum principle. In order to improve these deficiencies, the authors have designed and constructed a new type of electronic analog computer based on Eq. (1).

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Introducing a quantity Q which means a true discharge per unit width defined by

$$-\frac{\partial Q}{\partial x}=\frac{\partial H}{\partial t}, \tag{2}$$

we get from Eq. (1)