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Stream Flow Measurement: Development of a Relationship between the Float Method and the Current Meter Method

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In diverse developments such as hydropower potential assessment, flood mitigation studies, water supply, irrigation, bridge and culvert hydraulics, the magnitude of stream or river flows is a potential design input. Several methods of flow measurement exist; some basic and some more sophisticated. The sophisticated methods use equipment which, although they provide more accurate and reliable results, are invariably expensive and unaffordable by many institutions that depend greatly on flow records to plan and execute their projects. The need for skilled expertise in the use of these equipment and the associated maintenance problems preclude them from consideration in most projects developed and executed in developing regions such as Africa. For countries or institutions in these regions, there is a need for less expensive, but relatively reliable methods for stream or river flow measurement to be investigated; methods that require no equipment maintenance schemes. One such method is the float method in which the velocity of an object thrown in a river is measured by recording the time taken for the object to traverse a known distance and multiplying the velocity by the cross-sectional area of the river or stream. This method looks simplistic, but when flows obtained from it are correlated with those obtained from the more accurate and conventional methods, reliable results can be obtained. In this study, flow measurements were done at 42 different stream sections using the float method and a more reliable and generally accepted but expensive flow measurement method using a current meter. A statistical relationship was then developed between the flows obtained by the two methods by fitting a linear regression model to the set of data points obtained at the 42 locations on several reaches of selected streams in the western area of Freetown. The study was conducted on streams with tranquil or laminar flow with flow magnitudes in the range of 0.39 m3/s to 4 m3/s in practically straight reaches with stable banks. The material of the stream beds was laterite soil. Thirty-two data sets were used to develop and calibrate the model and the remaining ten data sets were used to verify the model. The current meter method flows were regressed on the float method flows. For a significance level of 5%, the predicted flows of a current meter, given a float method flow, showed a high level of agreement with the observed current meter flows for the tested data set.