# AN OBJECT ORIENTED SIMULATION MODEL FOR IRRIGATION CANAL OPERATION

by

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# CERTIFICATE

This is to certify that the thesis entitled **"AN OBJECT ORIENTED SIMULATION MODEL FOR IRRIGATION CANAL OPERATION"** being submitted by V. Sesha Chalapathi to the **Indian Institute of Technology, Delhi** for the award of the **Doctor of Philosophy,** is a record of bonafide research work carried out by him under my guidance and supervision. The thesis work, in my opinion, has reached the standard, fulfilling the requirements for the said degree. The research report and the results presented in thesis have not been submitted, in part or in full, to any other University or Institute, for the award of any degree or diploma.

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# ABSTRACT

Irrigated agriculture represents the largest demand for water in the world. In many parts of the world, irrigation systems are performing well below their potential. Better performance of irrigation systems is becoming more and more important as growth in world population steadily increases the competition for water. Planning and design have crucial implications for the success or failure of new irrigation systems. Although experts will have different views on the appropriate technology for various irrigation systems, such disagreements may simply reflect the need to adapt to local conditions and to make best use of available resources. There is a unanimous agreement among the irrigation community on the need to improve the operation of existing irrigation systems in order to increase the agricultural productivity. A variety of approaches exist to irrigation management and system operation. One of the approaches frequently mentioned for an irrigation-project-modernization program is a good simulation model for irrigation canals.

In the present study, a mathematical simulation model has been developed to simulate the unsteady flow conditions induced in a canal during its operation. An implicit finite difference scheme known as Preissman's box scheme has been used to transform the Saint Venant equations into a set of linear, simultaneous equations. The double-sweep method has been used to solve the above equations. In order to take the advantages of the benefits of a database system, a generic database of a canal network has been designed and implemented for the model. An attempt has been made to include various static and dynamic data requirements for different reaches and control structures of various shapes.

Many computer models have been developed in the past to simulate the canal operations. To date, real-time operation of irrigation canals with unsteady flow models has

been very limited. It is no longer adequate just to develop models and expect them to be used by the canal managers. It is believed that the development of more user-friendly interaction between the model and its user could reduce gaps between model availability and model usage. By seeing the advantages of Object-Oriented concepts in development of flexible modeling architectures, in the present study an attempt has been made to use them in various components of the model development like database design, code generation, and GUI design. Extensive interactive program features and graphic displays have been provided to enhance the model's utility in field applications.

In the validation part of the study, an attempt is made to ascertain the extent of accuracy of simulation with respect to the real system. The model has been validated using the field data collected from Central Arizona Project (CAP), U. S. A. The validation of the model demonstrates that it can predict the hydraulic response of canal system with reasonable accuracy. The proposed model has been applied to Patna canal of Sone Canal System in south Bihar, India. By doing so it has been illustrated the use of the model on large canal systems. The proposed model, therefore, shall servers as a tool towards better management of irrigation systems and there by shall help in enhanced productivity.

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