OPTIMAL DESIGN OF HOUSING DEVELOPMENT SYSTEM

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A Thesis submitted to the
Indian Institute of Technology, Delhi
for the Award of the Degree of
DOCTOR OF PHILOSOPHY

DEPARTMENT OF APPLIED MECHANICS
INDIAN INSTITUTE OF TECHNOLOGY, DELHI
1988

CERTIFICATE

This is to certify that the thesis entitled, '**OPTIMAL DESIGN OF HOUSING DEVELOPMENT SYSTEM**', being submitted by Mr. **Bibhuti Kumar Chakrabarty** to the Indian Institute of Technology, Delhi, India, for the award of the degree of **DOCTOR OF PHILOSOPHY**, is a record of bonafide research work carried out by him under our supervision and guidance. The thesis work, in our opinion, has reached the standard, fulfilling the requirements for **DOCTOR OF PHILOSOPHY** degree. The research report and the results presented in this 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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ACKNOWLEDGEMENT

The author feels extremely grateful to Prof. S.M.A. Kazimi and Prof. C.V. Ramakrishnan of the Indian Institute of Technology, Delhi for their invaluable guidance, supervision and constant encouragement throughout the course of the present study.

The permission granted by the Housing & Urban Development Corporation(HUDCO) for the doctoral research is acknowledged with profound thanks.

The author got motivated to undertake the research study after he had the opportunity of attending a series of lectures delivered by Mr. Horacio Caminos of the School of Architecture & Planning, MIT, at the University College London in 1978. Thereafter, he got valuable guidance and encouragement from Mr. J.B. D' Souza, ex-Chairman & Managing Director, HUDCO, Mr. H.U. Bijlani, ex-Chairman & Managing Director, HUDCO and Mr. S.K. Sharma, Chairman & Managing Director, HUDCO, which is gratefully acknowledged.

Thanks are also due to the staff of HUDCO who rendered manifold help to the author for completing the thesis.

The author is grateful to his wife and daughter for their constant inspiration and cooperation without which this research study would not have been completed.

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A B S T R A C T

Soaring land price and construction costs are making it difficult to provide housing to the low and medium income families. In view of the severe resource constraint and low affordability of people, it is imperative to ensure cost - effective design of housing development projects. It is difficult to achieve cost-effective design, by the conventional design methods or, by using the models availabale in the literature, since the number of design variables and their possible combinations is quite large and the cost-effectiveness indicators are design-specific values.

In the present work an analytical discussion of the housing development design process has been presented establishing the systems nature of the problem and a module-concept in layout and dwelling design, and the dwelling-layout system design, has been developed. Mathematical models and a design technique have been developed to achieve directly a given and feasible value of at least one quantitative design efficiency indicator (QDEI). In this technique the conventional design process is reversed i.e. first the value of QDEI is chosen and the design fitting with this objective is generated in symbolic terms, which can be drawn at the end of the process. Using this model, sensitivity

analysis has been carried out, showing large variation in the value of the QDEI's, which are affected by a number of interacting variables. Such large variations establish the need for more scientific approach.

Therefore, non-linear programming optimisation models have been developed to achieve the least-cost and maximum-benefit design, covering both the serviced-plot and the dwelling-layout system. Fifteen models incorporating a typology of constraint sets, to cover various design requirements including the geometric compatibility, have been developed including a model for curvilinear layout module. Using the optimisation models, which are independent of the module pattern, a designer could achieve directly a number of quantitative design efficiency-indicators, simultaneously with the minimum - cost or, maximum - benefit design, by assigning appropriate value to the corresponding design parameter. In the dwelling-layout system design models, different room-arrangement matrices have been considered, for optimal design of different types of housing development. The models developed are solved using the geometric programming technique. The degree of difficulty in the problems varies from 3 to 6. Application results have been presented for each of the models showing always consistent and geometrically compatible results.

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