วารสารทางวิชาการ วสท. ปี 2532 เล่ม 2 หน้า 83—96
Technical J. of EIT 1989, 2, 83—96

การพัฒนาการวางแผนด้านการขนส่งในกรุงเทพมหานคร

THE DEVELOPMENT OF TRANSPORT PLANNING IN BANGKOK*

สามารถ ราชพลสิทธิ์
Samart Ratchapolsitte
หลุยส์เบอร์เจอร์ อินเตอร์เนชั่นแนล จำกัด
Louis Berger International Inc.

บทคัดย่อ

สืบเนื่องจากอัตราการเจริญเติบโตอย่างสูงของประชากร และยานพาหนะในกรุงเทพมหานคร ก่อให้เกิดปัญหาการจราจร ซึ่งส่งผลกระทบต่อการพัฒนาด้านเศรษฐกิจ รัฐบาลได้พยายามแก้ไขปัญหาการจราจรมาโดยตลอด อย่างไรก็ตามปัจจัยอย่างหนึ่งซึ่งเป็นอุปสรรคต่อการแก้ไขปัญหาดังกล่าวก็คือ การขาดแบบจำลอง (ด้านคณิตศาสตร์) ด้านการขนส่งที่เหมาะสม การพัฒนาแบบจำลองด้านการขนส่งสำหรับกรุงเทพมหานคร สามารถแบ่งออกได้เป็น 2 ระยะดังนี้

ก. ระยะที่ 1 (พ.ศ. 2513-2523)

- แบบจำลองด้านการขนส่งในรูปแบบ Conventional Four Steps ได้ถูกนำมาใช้ในการวางแผนด้านการขนส่งในกรุงเทพมหานคร
- แบบจำลองย่อยการเลือกยานพาหนะ (Modal Split Submodel) ได้รับการพัฒนาอยู่ในรูปแบบ Trip-End Concept
- ตารางการเดินทาง (O-D Tables) ได้รับการปรับแก้โดยใช้วิธี Screen-Line Check

Paper Prepared for Presentation at the 5th World conference on Transport Research, Yokohama, July 1989.

ข. ระยะที่ 2 (พ.ศ. 2524-ปัจจุบัน)

- แบบจำลองย่อยการเลือกยานพาหนะได้รับการพัฒนา อยู่ในรูปแบบ Trip-Interchange Concept
- ตารางการเดินทาง ได้รับการปรับแก้โดยใช้วิธี O-D Matrices Establishment from Traffic Counts
- แบบจำลองด้านการใช้ที่ดิน แบบจำลองแรกได้รับการพัฒนาในระยะนี้

แบบจำลองดังกล่าวข้างต้นไม่เหมาะสมสำหรับนำมาใช้ในการวางแผนด้านการขนส่งสาธารณะ และการวิเคราะห์ผลกระทบต่อการจราจรอันเนื่องมาจากการจำกัดการเดินทาง (Trip Restraint) ดังนั้นจึงมีความจำเป็นที่จะต้องพัฒนาแบบจำลองใหม่ ซึ่งเรียกว่า Bangkok Transport Planning Unit (BTPU) ให้มีขีดความสามารถดังต่อไปนี้

1. วิเคราะห์ผลกระทบอันเนื่องจากการจำกัดการเดินทาง (Trip Restriant) ต่อการเลือกยานพาหนะ และการติดขัดของกระแสการจราจร
2. วิเคราะห์ผลกระทบต่อการจราจร อันเป็นผลจากการเปลี่ยนแปลงจำนวนรถโดยสารสาธารณะ (Fleet Size)
3. วิเคราะห์ผลกระทบต่อการเลือกยานพาหนะ สืบเนื่องมาจากการเปลี่ยนแปลงค่าโดยสาร หรือค่าผ่านทาง
4. วิเคราะห์ความเกี่ยวพันระหว่างการใช้ที่ดินและการขนส่ง

ABSTRACT

With the high growth rates of population and vehicles in Bangkok, the transport problem began to delay the economic and infrastructure development. The government has been attempting to solve this serious problem. However, one of the difficulties in doing so is the lack of an appropriate transport planning tool that can be used by all transport-related agencies. This paper presents the development of transport planning in Bangkok and the direction in which they should be in the future. The development can be classified into two periods:

(a) Period I (1970-1980): The conventional four-step model was introduced to the Bangkok Transport Planning. The trip generation/attraction model was formulated as a linear function of population, employment and car ownership. The model split model was formulated based on the trip-end approach. The O-D matrices were calibrated by utilizing the screen-line method.

(b) Period II (1980-Present): The trip-interchange modal split model, which is in the form of binary logit, is introduced. The trip generation model is a function of households classified by income groups, whereby the attracted trips are proportional to employment in

different industry sectors. Models in this period utilize the method of O-D Matrix Calibration from Traffic Counts in establishing O-D matrices. The first Bangkok Land Use Model was developed in 1986.

These models do not incorporate methodology for analyzing trip restraint and public transport development strategies. In addition, there are many transport-related agencies in Bangkok. Therefore there is presently an attempt to develop a new model; the Bangkok Transport Planning Unit (BTPU), to be used as a transport planning tool. The following approaches have been proposed to overcome the present inadequacies.

(a) The BTPU model should be able to assess the impacts on mode choice, and traffic congestion which will be resulted from the introduction of trip restraint policies.

(b) Public Transport Submodel should have the capacity to handle the alternative bus networks, minibus networks and MRT networks. Furthermore, the feature which can determine an equilibrium between supply (headway/capacity) and demand (passengers) should be provided to test the effects of changes in vehicle fleet sizes.

(c) Modal Split Submodel should be easily revised to test the effect of changes in pricing policies. The disaggregate approach is suggested in calibrating this submodel.

(d) The interaction between land use and transport should be taken into consideration in developing the BTPU model.

1. INTRODUCTION

The Greater Bangkok Area (GBA) has been growing rapidly during the past decade. One of the problems accompanying this rapid growth is traffic congestion. With the high growth rates of population and vehicles, the transport problem began to delay the economic and infrastructure development of GBA. The government has been attempting to solve this serious problem. However, one of the difficulties in doing so is the lack of an appropriate transport planning tool that can be used by all transport-related agencies.

This paper presents the development of transport planning tools for GBA during the past two decades and the direction in which they should be in the future. The transport and land use models which were developed and have been applied in Bangkok are discussed in Sections 2 and 3 respectively. Section 4 focuses on the proposed modeling approach for the Bangkok Transport Planning Unit which will be developed in the near future to overcome the existing models' limitations. The proposed modeling approach covers trip restraint, public transport modes, pricing effects on mode split and interaction between land use and transport.

2. BANGKOK TRANSPORT MODELS

Over the past two decades, there has been an attempt to apply and develop transport models to Bangkok Transport Projects. Those models were introduced to Bangkok Transport Planning by concerned agencies' consultants. They are based upon the conventional concept of using four submodels which consists of a Trip Generation/Attraction Submodel, Trip Distribution Submodel, Modal Split Submodel and Trip Assignment Submodel. The formulation of each submodel depended on each individual consultant's assumption and, moreover, the data required in simulating the model was inconsistent particularly for the socio-economic data. This socio-economic data, which includes population, employment, vehicle ownership and income distribution, was forecast based on different land use plans. As a result this led to different results of forecast travel patterns from each model. Of all models, two have been recently employed for evaluation of transport projects in Bangkok. Those two models are the JICA model (JICA: Japan International Cooperation Agency) as detailed in (2) and the STTR Model (STTR: Short Term Urban Transport Review for Bangkok Metropolitan) as explained in (1).

The JICA model was mainly modified from the BTS model (BTS: Bangkok Transportation Study conducted by German Consultants in 1975) as discussed in (3) and was applied to evaluate the Feasibility of the Second Stage Expressway System (SSES) in Bangkok. The JICA model uses the Screen-Line Method to calibrate the O-D matrices. This compares the observed traffic volumes crossing the screen line with the estimated ones. The Chao Phaya River was chosen as a screen line and the traffic flows on bridges were compared for such calibration. The JICA model formulates a Trip Generation/Attraction Submodel as a linear function of population, employment and car ownership. Its Model Split Submodel can not be utilized to test changes in fares since it is formulated based upon the trip-end approach which does not take into account the effects of fares on mode choice. Moreover, the JICA model does not include a Public Transport Submodel.

The STTR model is mainly based on the Urban Transportation Planning System (UTPS), it was developed for use on the Metropolitan Bangkok Short Term Urban Transport Review. The STTR model forms a Trip Generation Submodel as a function of households classified by income groups, whereby a Trip Attraction Submodel is formulated as a function of employment in different industry sectors. The STTR model introduces the Modal Split Submodel in the form of trip-interchange concept. It is a binary logit model. However, the attempt in calibrating this submodel was not successful since little or no relationship could be found between the proportion of trips by public transport, by members of vehicle-available households, and for the public/private cost differences. This was due to the poor quality of public transport services in the base year. For this reason, this submodel was calibrated by using data from similar cities; Taipei, Manila and Hong Kong. The STTR model establishes O-D matrices by utilizing the method of O-D Matrix Calibration for Traffic Counts. This method adjusts the estimated traffic volumes on the specified road links to be equal or nearly equal to the observed volumes. Several parts of the STTR model need improvement; such as the Utility Functions of the Model Split Submodel. Moreover, it is necessary to improve the analysis of public transport modes to reflect the variation of fares and fleet size and to incorporate methodology for analyzing trip restraint and public transport development strategies.

3. A BANGKOK LAND USE MODEL

The function of Land Use Model is to forecast such socio-economic activities as population and employment in each study zone. This information is used in forecasting traffic demand. The existing Bangkok Transport Models exogenously obtain the aforementioned data so-called "exogenous variables". They forecast by using simple assumptions and without taking into account the interaction between land use and transport. In fact, land use and transport has effect to each other since land use activities are the sources of producing trips and, on the other hand, accessibility due to the transport improvement has an impact on land use patterns.

There was an attempt to develop a land use - transport analysis system for Bangkok as discussed in (4). The Bangkok Area Land Use - Transport Analysis System (BALUTAS) was developed mainly for assessing impacts caused by improvement of transport facilities. BALUTAS comprises four main models; namely the Residential Location Model (RLM), the Housing Supply Model (HSM), the Business Location Submodel (BLM) and the Transport Model. The RLM and HSM are formulated by using the discrete choice analysis, the former is based upon the consumer theory while the latter is based upon the firm theory. The BLM is a spatial interaction model taking into account neighborhood service and wide-area service. Modified based on outputs from the three other models mentioned above, the transport model is mostly based on a conventional four-step concept which has been widely applied in Bangkok.

The system structure of BALUTAS is depicted in Figure 1. It consists of two parts; land use and transport. The transport part can be performed after the equilibrium of demand and supply of land is reached in the land use part. The system performs recursive predictions which is considered a quasi-dynamic way. It is necessary to note that the BALUTAS assumes the slum areas will be demolished through slum clearance programs and low-income housing will be provided.

The BALUTAS was employed in evaluating impacts of the Cable-Stayed Bridge crossing the Chao Phaya River in Bangkok on land use patterns. The model predicted that new demanders would be attracted to locate in vicinity of the bridge as a result of the accessibility improvement. However, it is necessary to improve some parts of BALUTAS; such as the Housing Submarket Equilibrium which requires to be refined to reflect the present supply and demand of housing. Furthermore, the existing transport model which is integrated into BALUTAS needs to be improved as discussed in the following section.

4. FUTURE TRANSPORT PLANNING IN BANGKOK

There is presently an attempt to develop a new Bangkok transport model; the Bangkok Transport Planning Unit (BTPU), to be used as a transport planning tool by transport-related agencies to formulate their policies, project planning and implementation with acceptable concepts among them. The best characteristics of existing transport and land use models will be incorporated into the BTPU model. An improtant aspect of the modeling approach will be develop a model structure and architecture that will allow evaluation of the various strategies available for restraining private vehicle trips by diverting them to public transport and thereby better controlling congestion conditions on the road network. The author has proposed the modeling approach for the BTPU model to overcome the present inadequacies an discussed below.

4.1 Approach to Trip Restraint

Studies of the expressway needs of Bangkok and experience throughout the world indicates that for most urban areas trip growth rates eventually lead to demand levels in excess of available road capacity. The results is congestion, delays and high operating costs for movement of goods and persons. In this context, over the last ten to fifteen years, a wide range of trip restraint approaches have been developed -- mostly concentrated on the use of the motor vehicle during the peak periods. These constraints have encompassed programs ranging from limiting access to the central area of the city for specific periods to area licensing schemes in which vehicles are required to purchase a special license in order to access the downtown during the morning peak. Parking policies designed to discourage all-day parking and the use of the private vehicle have been implemented to stimulate the use of public transport facilities, and car pooling has been used to increase vehicle occupancy using the special lanes.

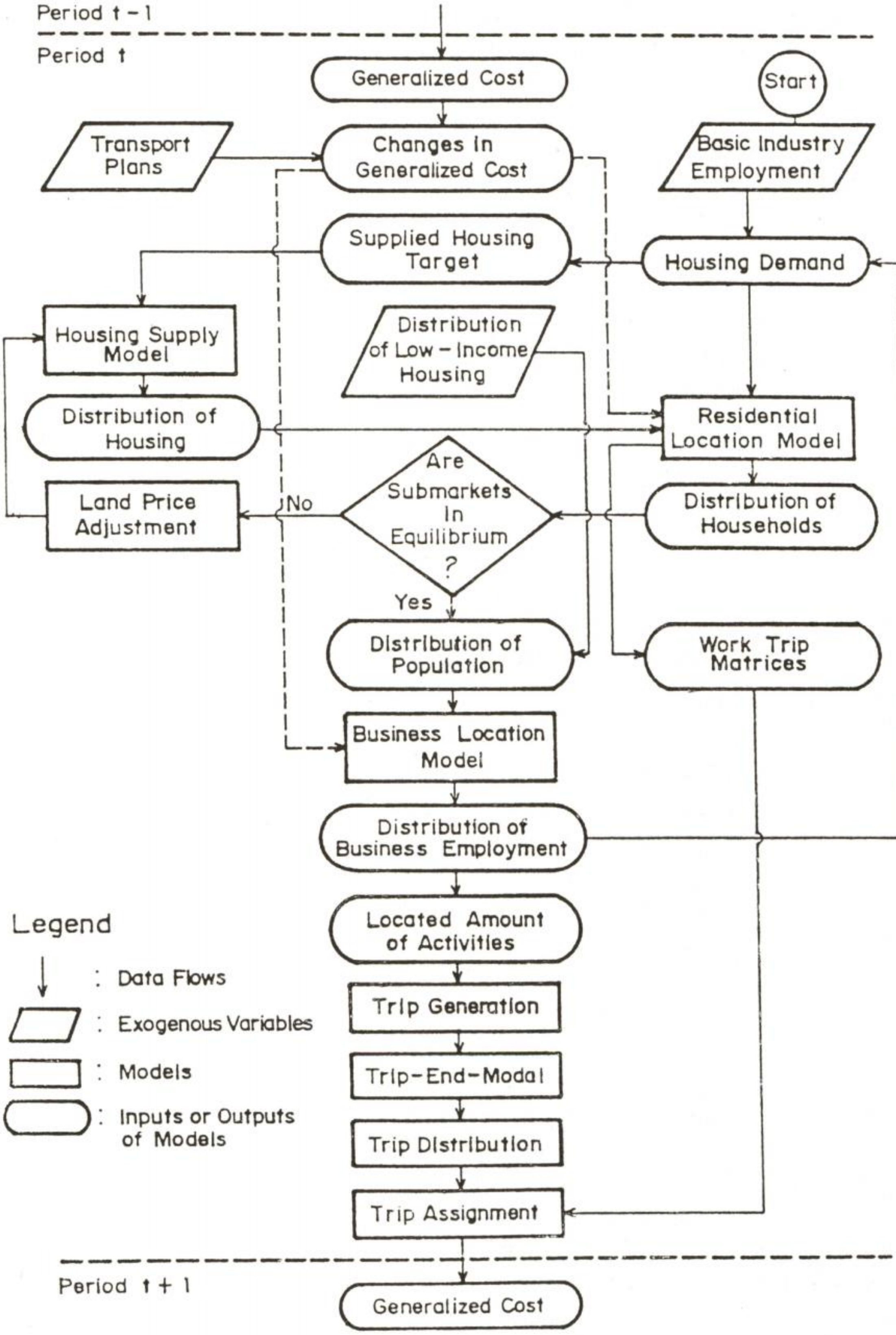
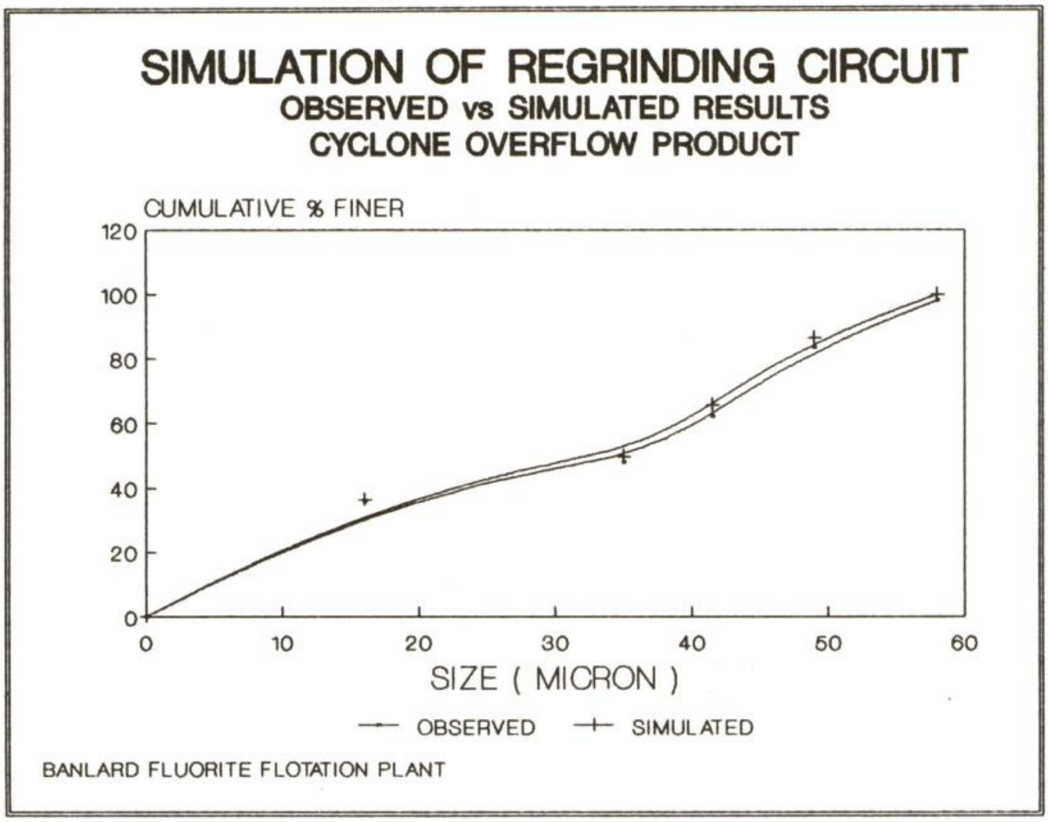
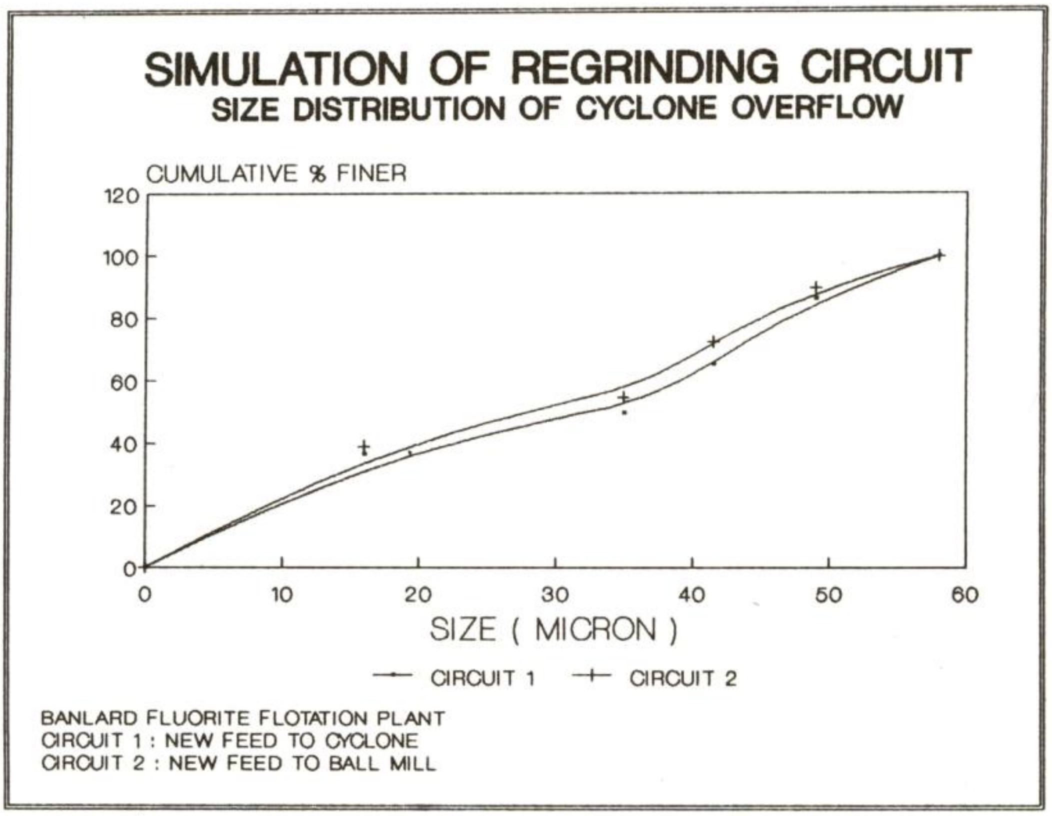


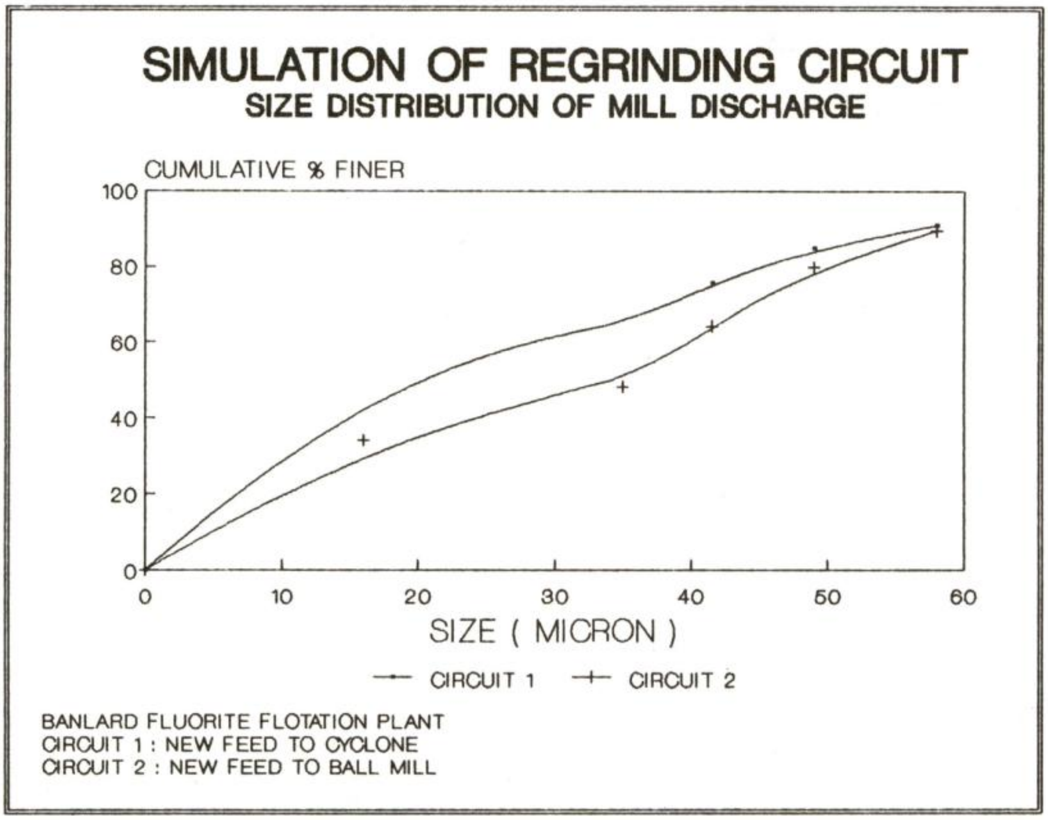
Figure 1 Structure of the BALUTAS



รูปที่ 2 การกระจายของขนาดเม็ดแร่ในCyclone Overflowจากการเก็บตัวอย่างจริง และการเลียนแบบ



รูปที่ 3 การกระจายของขนาดเม็ดแร่ใน Cyclone Overflow จากการเลียนแบบวงจรที่ 1 และ 2



รูปที่ 4 การกระจายของขนาดเม็ดแร่ในMill Discharge

จากการเลียนแบบวงจรที่ 1 และ 2