THE ECONOMIC EVALUATION OF ARCHITECTURAL TECHNIQUES IN COST MINIMIZATION FOR RURAL HEALTH FACILITIES IN KENYA

by

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ABSTRACT

One basic need which has received universal attention throughout the developing world is the improved level of health. Less Developed Countries confront a serious challenge in ameliorating adverse health conditions. A wide range of complimentary health programs are currently being used in many Less Developed Countries to close the lacuna between current health conditions and societal health objectives. Budgetary constraints are still binding, and the policy planner is challenged with devising innovative means towards attaining health goals. Bi-lateral and multi-lateral agencies alleviate some of the resource constraints. However, due to the usual stipulation that these funds be employed for defraying development (capital) and not for recurrent (operational) expenditures, it is often difficult to plan projects which recognize both capital and recurrent constraints.

Initiating clinic-based health care constitutes a substantial commitment of capital resources. In some instances, the required level of financing has been prohibitive. Such a case is the Capital Facilities Expansion Program for rural health services in Kenya, whose project expenditures exceeded the level which a consortium of multi-lateral and bi-lateral agencies agreed to finance. The excessive capital costs were linked to the high building standard used by the Ministry of Works in facility construction. In an attempt to remove this capital cost impediment, planners have entertained the use of indigenous building technologies which require a lower commitment of capital funds.

It is the contention of this study that capital costs alone are an insufficient economic criterion upon which to select a means of a facility construction. Recurrent costs must also be included in an efficiency evaluation. Moreover, any evaluation should account for the opportunity cost of funds in the public sector. This thesis projects an alternative facility type which incorporates indigenous technology while accommodating the functional requirements of a health facility. Through an efficiency evaluation which employs the social discount rate, the more cost effective option between the current facility used by the Kenyan Government and the Alternative developed in this thesis is determined over a range of sensitivity analysis.

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My deepest and most sincere appreciation goes to Dr. Calvin Sinette whose enthusiasm and encouragement was the strongest influence in seeing the study through from a notion to a reality. This experience in the area of rural health delivery in Africa was my greatest resource in defining the scope of this project.

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Thank you, Carliss Baldwin, and Donald Lessard for invaluable help in structuring the economic discussion. Your patience and guidance are much appreciated. A very special thanks to Tunney Lee, Max Bond, and Eric Dluhosch, whose combined experience in the architectural practice of Less Developed Countries laid the context for developing a method testing building systems against minimal performance criteria.

My heartfelt gratitude to some special friends who lent their extraordinary talents to the production:

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Marsha Orent
Yoshiko Ryu

Thanks to all who helped me through this time and a special thanks to Stan, Ioana, Charles and Lenny, my bridges over troubled water.

This thesis is dedicated to my strongest and most constant source of inspiration: my family.

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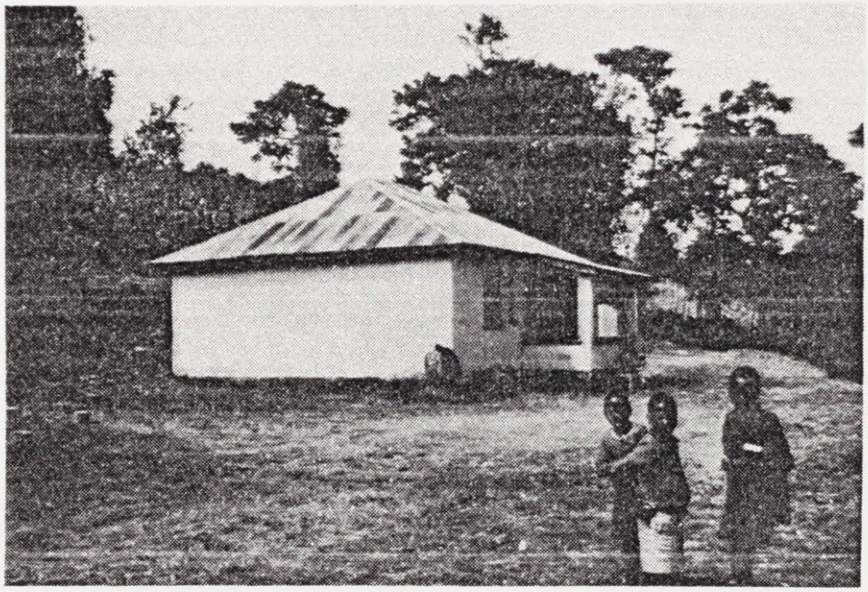


INTRODUCTION

"The maximum return in human welfare must be obtained from the limited money and skill available:

"a) In estimating this return means must not be confused with ends.

"b) Medical care must be adapted to the needs of an intermediate technology."

— Third Maxim: King Medical Care in Developing Countries

1.1 Statement of Problem

Medical conditions in Less Developed Countries continue to be the focus of much attention from world governments, bi-lateral and multi-lateral organizations. Over the broad range of the Less Developed Countries, there are myriad differences in climate, topologic and human settlement patterns which, in concurrance with regional pathologies create a varied and diverse health profile across countries. Nonetheless, compelling reasons exist for grouping the Less Developed Countries within an affinity when discussing the problems of general health and the provision of medical services.

This affinity is broadly defined by the great disparity between the general health of the population in the Less Developed Countries and the more affluent nations. Several quantifiable indicators reveal this discrepancy. One indicator is life expectancy. Appendix 1 shows the progression in average life expectancy for selected countries from 1850 to 1977. While the general trend has been towards longer average life expectancy, substantial differentials are still in evidence.

Infant and child mortality rates account for the short average life expectancy among the developing countries.[1] Half of all children

die within the first year in the most economically depressed regions of the world. For the entire continent of Africa, the average infant mortality rate is one-hundred deaths for every 1000 births. This contrasts sharply with a mortality rate of fifteen per 1000 births in the developed countries. For those children who do survive their first year, the outlook is still dismal. Citing Africa again as an example, most of the recorded deaths occur among children under five years of age.[2] Even in Latin America where the average life expectancy is sixty-one years, the childhood mortality rate is quite high, particularly in the rural regions. Those who survive beyond the first five years of life throughout the developing world can, on average, expect to live up to fifty-three years, or seventeen years less than the average life expectancy in the developed world.

Unfortunately, even this measure understates the health problems confronted by less developed countries. Other indicators such as malnutrition, the incidence of vector borne disease, environmental and sanitation pathologies, and health problems due to lack of family planning all attest to the fact the health outlook in the Less Developed World remains an important challenge for the development of these regions and for the general improvement in the populations quality of life.

In meeting this challenge, developing countries must also confront severe constraints in economic and professional resources. The adverse effect of these constraints is exacerbated by the fact that the majority of the population in Less Developed Countries are located in the rural sector. Health services, however, have coalesced in the urban centers where the medical profession continues to work through

an infrastructure left by colonial powers, based on a European paradigm and targeted to an expatriate population. In Kenya, the national ratio of doctors to population is 1:10,000 whereas it is 1:50,000 in the rural regions. Either figure contrasts sharply with that for the United States; 1:700.

Post independence governments of Less Developed Countries have taken numerous steps towards tailoring health programs to suit their needs. The approach has varied across time, reflecting attitudes which saw health care expenditures either an increment towards productive investment or as a basic service promoting social welfare. The majority of government interventions were based on humanitarian goals. Some countries, such as Kenya, the focus of this study, have implemented health programs on the basis of economic productivity during a number of stages in its development of health policy. In his work, Health Economics, Stan Sorkin notes:

"An important exception to this [humanitarian] policy has been Kenya, where the government has tended to concentrate anti-malarial and other public health measures in areas having high growth possibilities."[3]

As Chapter 4 of this study indicates Kenya has since redirected its health policy to encompass broader goals of social welfare and to address the needs of its burgeoning rural population. In redirecting this health perogative, the Kenyan Government has formulated a clinic-based health program which utilizes professionals, paraprofessionals, and a greater preventative health care component than during previous efforts. (Chapter 4). Economic constraints are still binding, and Kenya has had to go outside its domestic economy to

secure funds for implementing many of these programs.

The particular program of concern in this study is the facility construction which will house clinic based services. Kenya has approached a group of multi-lateral and bi-lateral agencies to secure funds for facility development. As with most foreign aid agreements, these funds have been earmarked for development (capital) expenditures and excluded from defraying recurrent (operational) expenditures. In this particular case, the capital funds were originally scheduled to be deployed for a standardized facility prototype used throughout the country with slight modification depending on circumstances encountered *in situ*. An entire Health Center compound built to the specifications of this prototype is around KS7,120,000 ($800,000). A survey conducted by the World Bank and other lending agencies disclosed that when all the projects to be implemented through the Capital Facilities Expansion Program were valued in aggregation, total capital expenditure were $255,000,000. This figure exceeded the commitment which donors were willing to make and the Government was requested to look at a means of reducing the cost of these facilities.

Towards achieving this reduction in capital costs, the Planning and Implementation Unit of the Ministry of Health has investigated the use of locally indigenous building methods in the construction of health care facilities. These investigations are germinal, yet they promise a viable means of reducing capital costs. Experimental units such as the Appropriate Technology Village for Basic Services in Karen, Kenya demonstrate how local building methods may be adapted to increase their longevity and their fitness for use in particular building types.

Despite the promise of reduced capital costs subsumed in

implementing the Capital Facilities Expansion Program with locally indigenous technologies, this focus is too narrow a basis upon which to select one project or means of implementing that project from among several options: with each application of capital resources, a stream of operating resources is associated. For Less Developed Countries this linkage is particularly important since capital funds and recurrent funds are usually secured from different sources. As previously stated the capital expenditures for many Less Developed Countires is secured through foreign aid. Recurrent expenses, on the other hand, are defrayed through domestic sources. This differentiation in sourcing project funds demands even greater attention to the impact of capital funds commitments on the recurrent budget.

This study will perform an efficiency evaluation which captures the total differential in costs between implementing facility types in the Capital Facilities Expansion Program. In order to assess the economic consequence of selecting one means of building over another, a building which integrates multiple standards in construction shall be projected. Life cycle costing will then be performed to compare the cyclical costs of building and operating the Kenyan facility prototype with those of an Alternative which uses indigenous building methods. The facility to be examined will be a Health Center. While this facility constitutes only an eighth of total project costs, KS1,336,000 ($150,000), it still provides a functional basis for inferring information for the policy planner who must make the final choice between alternatives.

The next chapter outlines the method of economic analysis which will form the basis of the efficiency evaluation performed in this

study. After this discussion, the specific context of the Capital Facilities Expansion Program is presented.

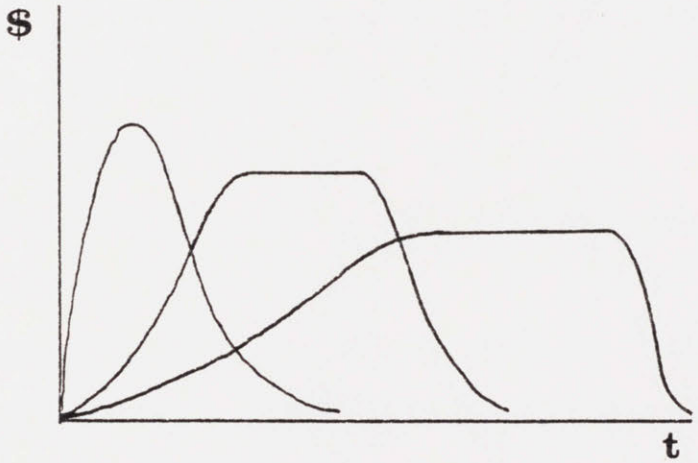
Chapter 1 Footnotes

[1]World Bank [1980] Health Sector Policy Paper. pp.10-14.

[2]ibid.

[3]Sorkin, Alan [1975] Health Economics

Chapter 2



METHOD OF ECONOMIC ANALYSIS

2.1 Introduction

This chapter presents the analytical framework for evaluating capital and recurrent expenditures of alternative building technologies in the Capital Facilities Expansion Program which will extend health services in Kenya's rural sector. The analysis will be structured by:

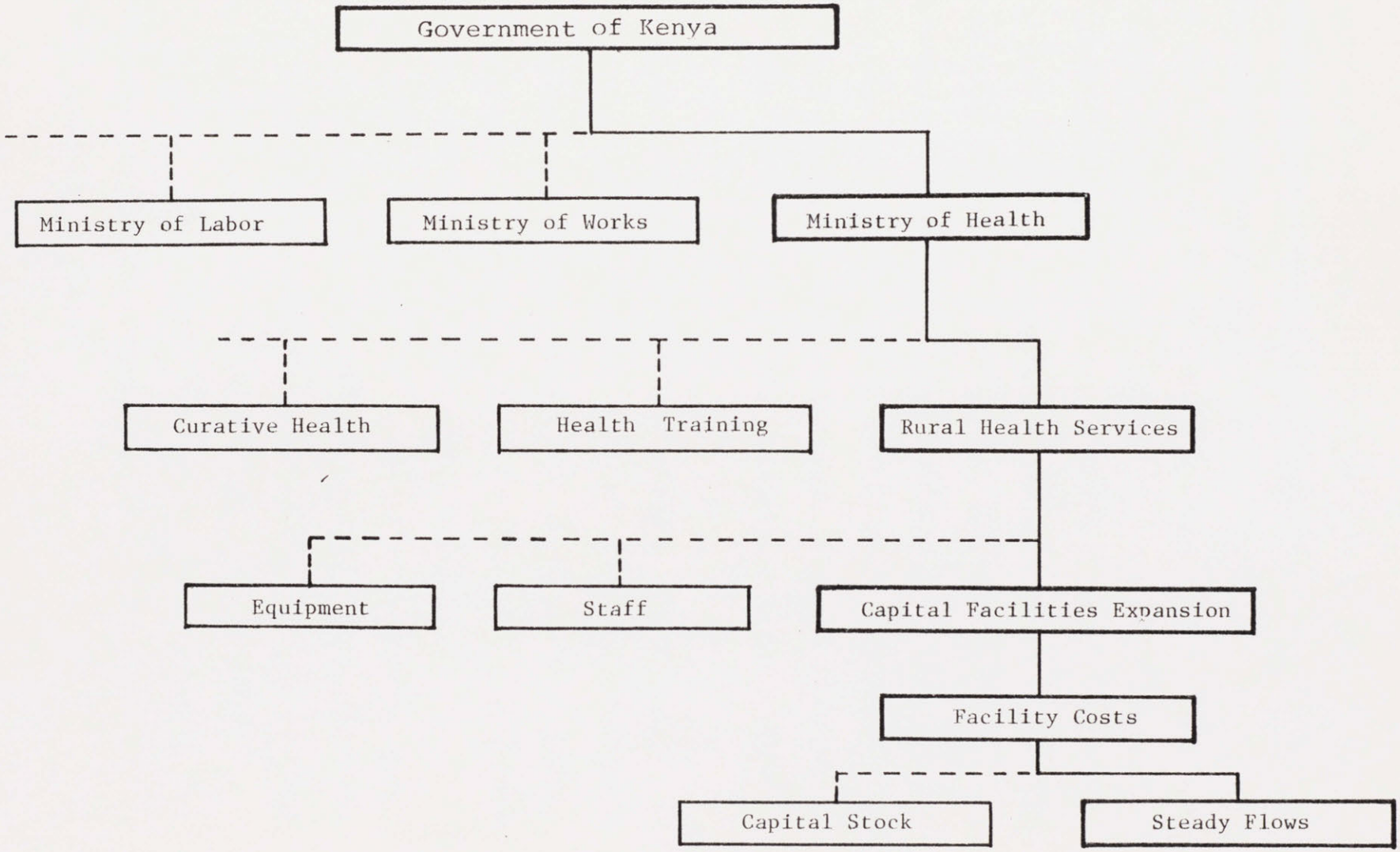
1) the specific projects being evaluated; i.e. buildings with life cycles and maintenance schedules; and
2) the context in which this project is implemented; through the public health sector of a Less Developed Country.

As Fig. 2.1 indicates, this level of investigation is very specific. Nonetheless, it must be viewed within the broader considerations of public sector financing. From an economic perspective, this problem falls within the rubric of capital budgeting for the public health sector. An efficiency evaluation will be used to select the least expensive means of implementing the Capital Facilities Expansion Program from two mutually exclusive alternatives:

1) the current means of constructing health facilities, using a standardized prototype; or
2) the proposed use of locally indigenous technologies in constructing health facilities subject to functional constraints of minimum performance criteria.

The selection between alternatives should be based on a range of considerations. Under circumstances of limited financial resources, an efficiency evaluation of either alternative provides important information in this selection process. Since the implementation of either alternative will provide the same benefit, i.e. an infrastructure for identical clinic-based health care in the rural sector, this evaluation

Figure 2.1


Government of Kenya
Ministry of Labor
Ministry of Works
Ministry of Health
Curative Health
Health Training
Rural Health Services
Equipment
Staff
Capital Facilities Expansion
Facility Costs
Capital Stock
Steady Flows

concerns itself exclusively with reducing the level of total expenditures required to provide this infrastructure. This type of evaluation is referred to as cost/minimization.[1]

Since this efficiency evaluation is performed in the public sector, it falls within the broader scope of social cost/benefit analysis which assesses externalities and resource costs in public sector investment. As a social welfare project administered through the health sector, the Capital Facilities Expansion Program sets its goal as the improved delivery of health services (Chapter 4). In achieving the goal, budgetary and economic constraints are binding, and the opportunity costs of displacing funds from use in other health sector programs for staff, equipment, mobile services, etc., figure prominently in an efficiency evaluation.

The following sections show how each of these considerations will be addressed in the economic analysis. Section 2.2 explains the use of Life Cycle Costing in evaluating expenditures for implementing either building technology. It also provides a brief explanation for structuring capital costs as an annuity rental charge on capital.

Finally, Section 2.3 tailors the evaluation to account for resource scarcity and opportunity costs in public sector projects by advancing the use of a risk-adjusted social discount rate for capturing the time preference for funds which are sourced through the public sector.

It is hoped that through this discussion all of the relevant aspects of an efficiency evaluation between facility alternatives will be presented for the policy planner.

2.2 Life Cycle Costing

Since this study entails the economic and technical comparison of mutually exclusive alternatives for facility construction, any efficiency evaluation must recognize buildings as assets with useful lives and incorporate this information into the assessment of each alternative. Life cycle costing supplies a method of establishing the relative time horizon for each alternative and of evaluating all relevant costs within these horizons. This approach typically separates asset costs into three phases over the life cycle:

1) engineering/design costs;
2) production/implementation costs;
3) operation/maintenance costs.

Figure 2.2 relates the occurrence of these phases (the amplitude and period of these costs are merely illustrative and do not represent a fixed relationship). In many asset valuations engineering/design costs and production/implementation costs are capitalized, while operation/maintenance costs are expensed annually over the assets' life. This is done in order to compute an asset's periodic costs.

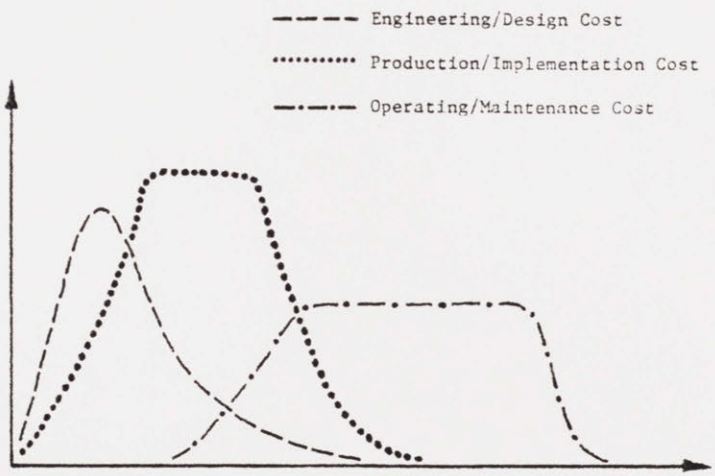


Figure 2.2

Once an asset's useful life has been established, relevant cash flows are usually discounted to a present value. As with any discounting procedure, life cycle costing permits the comparison of assets whose relevant costs occur over different times, a particularly useful feature in applying this approach to the capital budgeting process.

In a discounted evaluation, capital and recurrent expenditures are recognized at the time when they occur. For efficiency evaluations of productive investments, this method of cash flows analysis is quite appropriate. In this study there are compelling reasons for scheduling capital outlays as an annuity rental charge on capital, where the annuity extends over the operational life of the health care facility.

Where capital funds from foreign aid for development are earmarked for use on specific projects, they usually are priced at a shadow cost which is lower than the cost of domestically sourced funds. This inexpensive supply of capital funds has led policy planners in Less Developed Countries to make commitments to finance capital intensive projects (Heller [1979]). If funds were fungible between capital and recurrent expenditures, then the opportunity costs of either use of these funds would be equal and planners could propose feasible strategies for committing a larger portion of project budgets to recurrent expenditures. This built-in bias towards capital intensive development strategies also appears in the Capital Facilities Expansion Program. Table 2.1 presents a breakdown of capital finance by donor. By contrast, the recurrent budget for maintenance is financed entirely through domestic sources.

The application of this foreign aid to capital expenditures, however, does not come without costs. One such cost is the liquidity premium subsumed in committing one's capital to an asset with a protracted

TABLE 2.1: FOREIGN AID FOR CAPITAL FACILITIES CONSTRUCTION

GOK	150,000	337,078	10
SIDA	600,000	1,348,314	40
NETHERLANDS	200,000	449,438	13
IDA	10	22	6.7×10^{-6}
EEC	100,000	224,719	7
DANDA	450,000	1,011,236	30
FINLAND	10	22	6.7×10^{-6}
	1,500,020	3,370,831	100

life cycle, foregoing the opportunity to improve or replace it with a more appropriate technology. Another cost, particularly relevant in this study is the recurrent cost associated with implementing a capital project. From a budgetary perspective, this recurrent cost must be an integral part of any economic comparison between options. In order to provide a complete picture of the annual resource commitment to a facility type, the sum of the annuity rental charge on capital and steady-state maintenance costs permit a quick and cogent comparison. From the perspective of the budgetary planner, the objective function for cost minimization becomes:

$$c_j = ssmc_i + arcc_i \;;$$

where c_j = total annual cost of implementing the facility of building method;

$ssmc_i$ = total expenditures used for maintenance of a given facility type in period i ; and

$arcc_i$ = the annuity rental charge on capital for all facility expenditures in period i .

The annuity rental charge on capital can be derived by the standard annuity formula:

$$arcc = \frac{r}{1 - \frac{1}{1 + r}^{nj}} (K_j)$$

where n_j = the life cycle of technology j ;

K = the capital expenditure associated with technology j ; and

r = the appropriate discount rate which captures opportunity cost of funds used to defray three capital expenditures.

This economic comparison between the two technical building alternatives reduces to assessing the annual costs of committing capital to a specific technology over the facility's operational life and the costs of maintaining the facility during this period. Any decrease in initial capital expenditures for constructing these facilities will be evaluated in conjunction with the corresponding increase in maintenance costs. If a less capital intensive technology results in a shorter facility life cycle, then the annuity rental charge of capital will be based on the shorter life, thus increasing the annual rental charge and perhaps offsetting any gains which were originally perceived through capital savings in implementing less expensive building technologies. Capital and maintenance expenditures need not offset each other in every instance,

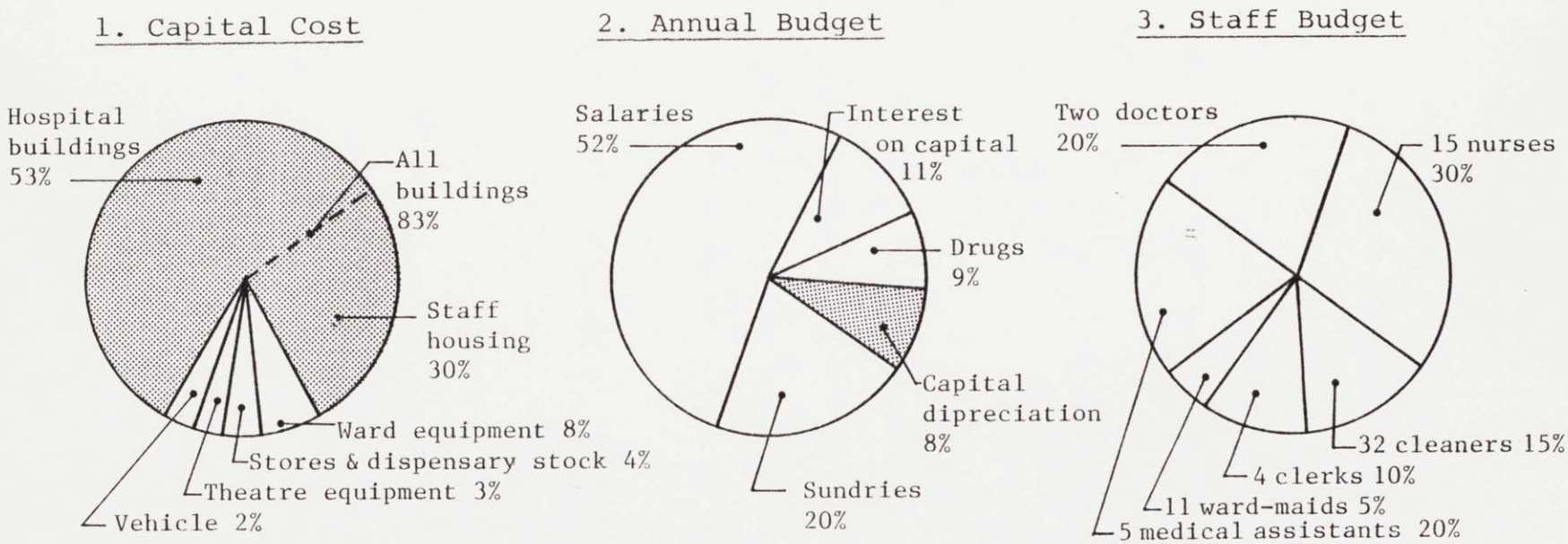
although in most cases, there is strong reason to assume that they will, given the pricing strategies of building components which tend to capitalize reduced costs for maintenance and service.

Although an annualized stream of funds represents the most cogent expression of project cost differentials to the policy planner, this study will also compare the cummulative absorbion of funds between alternatives, taking the appropriate societal opportunity costs into account for construction and maintenance. This information will be communicated through graphs which essentially depict the accumulation of "capital stock" from actual capital expenditures and the capitalization of maintenance expenditures associated with either alternative. This information shows differentiated patterns of capital stock accumulation between alternatives which an annual comparison of steady-state expenditures misses.

2.3 Use of the Social Discount Rate

The cost minimization performed in this study must recognize the opportunity costs associated with funds applied in the public health sector. Even within the financing decisions for clinic-based health care, there are choices which must be made among possible uses of funds. Figure 2.3 illustrates the division between capital and recurring expenditures of a rural health facility. The decision to commit a percentage of funds to equipment certainly reduces the capital available for medical buildings and staff housing. Similarly, within the recurring budget, a decision to staff health facilities with a certain number of doctors and nurses limits budget allocations for drugs and supplies. In the context of this study, it is also important to recognize the

Figure 2.3


1. Capital Cost
Hospital buildings 53%
All buildings 83%
Staff housing 30%
Ward equipment 8%
Stores & dispensary stock 4%
Theatre equipment 3%
Vehicle 2%
2. Annual Budget
Salaries 52%
Interest on capital 11%
Drugs 9%
Capital dipreciation 8%
Sundries 20%
3. Staff Budget
Two doctors 20%
15 nurses 30%
32 cleaners 15%
4 clerks 10%
11 ward-maids 5%
5 medical assistants 20%

tradeoffs between allocating funds between capital and recurrent expenditures for societal projects.

Placing this cost minimization within the framework of social cost/benefit analysis allows the efficiency evaluation to capture the opportunity cost to society of allocating funds among programs which yield societal benefits within the health sector, and between capital and recurrent expenditures.

In the broader area of economic development, social coat/benefit analysis has been readily applied to the evaluation of industrial projects (Harberger [1972]), agricultural projects (Roemer [1975]) and in evaluation of financial incentives to achieve socially desirable increases in employment (Baldwin, Lessard, and Mason [1981]). In each of these cases, the consequence of public sector intervention has had some marketable value, or some value to which a monetary numeraire could be assigned.

In the case of health programs, quantification of benefits is difficult, and often circuitous steps must be taken to assign a monetary value to health services. Therefore, across the range of societal projects, it is difficult to compare health programs with other programs which promise increased levels of productivity or economic efficiency. The decision to implement health projects from among society's entire set of alternatives is usually based on concerns for social welfare. Affinities can be established which group programs providing similar benefits, e.g. infrastructure, employment, health and basic services, etc., and thereby supply a comparative base for capital budgeting.[2]

Within the health sector, therefore, social cost/benefit analysis is a powerful tool for informing decisions in allocating resources

Figure 2.4

TYPE OF EFFICIENCY EVALUATION	MEASUREMENT OF EXPENDITURE IN ALTERNATIVES	IDENTIFICATION OF PROJECT CONSEQUENCES	MEASUREMENT OF PROJECT CONSEQUENCES
Social Cost/ Benefit Analysis	Dollars	Single or multiple effects not necessarily common to both alternatives, and common effects may be achieved to different degrees by the various alternatives	Dollars
Social Cost/ Effectiveness Analysis	Dollars	Single effect of interest, common to both alternatives but achieved to different degrees by alternatives	Natural Units, e.g. life years gained, disability days avoided, permanent handicaps averted, etc.
Social Cost/ Minimization	Dollars	Identical in all relavent respects	None

among projects (see Fig. 2.4). When limited by a certain level of financial support, whether this level is explicit or not, intelligent capital budgeting is fundamental. For a Ministry of Health, the selection of programs may be among an innoculation project, a water treatment facility, or an educational program for environmental health. Some economic measure of committing resources to any of these alternatives is necessary in making a final selection.

Social cost/benefit analysis has been used in two modes within health sectors of developing countries. The first is to document the change in regional productivity after the implementation of palliative programs.[3] Such an approach links the costs of health programs to improved levels of productivity. This linkage permits some degree of health benefit quantification, and is referred to as cost/effectiveness. Employers can look at disability days avoided and the corresponding

increase in worker output. Even increases in marginal revenuse from tourism have been linked incrementally to expenditures in the health sector.[4] In such an instance, when the results of health care programs have a monetary value, a straightforward social cost/benefit analysis can be used.

A more specialized use of social cost/benefit analysis in the health sector is in the comparison of alternative projects which provide the same level of health benefit in their implementation yet which incur different costs. The braodest comparison of this type occurs between curative and preventative programs which address the same health need. The real savings in implementing a preventative innoculation or water treatment program over continued restorative and curative programs can be quantified. Within a narrower focus, two alternatives for implementing the same program can also be compared. This study concerns such a comparison where each alternative for facility construction operates within identical contexts of a rural health program and provides the infrastructure for the same level of services, i.e. cost/minimization.

Since this study uses life cycle costing to assess maintenance and capital costs technologies with different patterns of expenditures over time, an efficiency evaluation in current terms is dependent on a discount rate which reflects society's time preference for money and on the risk associated in realizing the particular benefit from this project. This efficiency evaluation discounts the costs of the two different project alternatives by a social discount rate, ω , which captures the opportunity cost to society of applying public sector funds to social projects. In a straightforward social cost/benefit analysis, the discount rate would be applied to cash flows which represent a project's

social benefits and costs. If the project yields a net social benefit, then the societal perogative to proceed with the program is clear. Since th's study's assessment occurs in the health sector between two projects yielding equivalent benefits for social welfare, the social discount rate shall be applied only in the evaluation of expenditures.

The social discount rate is differentiated from private market discount rates for several reasons. It is maintained that raising funds in capital markets of partially closed economies creates externalties which escape private sector evaluation (Lessard, Baldwin, Mason [1981]). Opportunity costs for displacing projects and changing perception of risk on the part of foreign investors and creditors account for these externalities which are not capitalized in the market. The degree to which an economy is open or closed will determine the magnitude of the divergence between the private and social discount rates.

As in many developing countries, Kenya enacts measures to maintain an artifically high exchange rate and has taken a strong protectionist stand against certain foreign imports. Kenya's economy is also quite small compared to the world capital markets. Although Kenya enjoys a low level of sovereign risk for a developing country,[5] the economy is undoubtedly securing funds at rising marginal costs. When these factors are considered in unison, Kenya meets sufficient economic criteria to assume a wide divergence in social and private discount rates. As increasing foreign claims and project displacement continued, the differential between these rates is widened.

The social discount rate, ω , contains two components which capture the opportunity costs of foreign and domestic finance for public sector projects. A complete analytic derivation of the social discount

rate is beyond the scope of this paper, however a brief exposition is offered in Appendix 3 . For a rigorous derivation, the reader is referred to Harberger (1975).[6]

Arguments have been advanced that the social discount rate should be applied as a universally risk-free rate in the evaluation of public sector projects (Arrow and Lind [1966]). This assertion is based upon an assumption that once a project is managed through a public sector, government, as society's proxy, can spread project risk across the entire population and that this allocation occurs at no added costs. This is correct as long as the yield of a new public sector project is not significantly correlated with fluctuations in national income.

Although idealized private markets make adjustments in expected return on the basis of unsystematic project risk, most proponents for the use of a riskless social discount rate maintain that the risk adjusting structure of capital markets is not analogous to that of the public sector. One fundamental difference between the two sectors cited in support of this stand is that the stream of societal benefits, taken in aggregate, are much less risky than the aggregate incomes of private markets (Arrow [1966]).

Despite these arguments, compelling reasons exist for recognizing differentiated levels of risk among social projects and for incorporating these risks in the social discount rate. Reasons for considering risk in efficiency evaluations have been advanced by Bailey and Jensen [1975] and Baldwin, Lessard, and Mason [1981]. Some of their central propositions can be developed in the context of evaluating the Capital Facilities Expansion Program for rural health care in Kenya. Inasmuch as Kenya's economy is highly specialized for agricultural export, it

seems implausible to assume that projects to expand income in this sector do not contribute to the variability of national income. Indeed, Kenya's national income has a high correlation to the prices of its principal agricultural export, coffee. Although Kenya also exports petroleum products, these two principal exports hardly provide a sufficiently diversified economic base to consider all social projects as equally risky. Thus, public sector investments which provide infrastructure for petroleum products, or principal agricultural exports should be evaluated differently than those which develop a broader economic base through encouraging diversification. This does not suggest that Kenya should abandon its policy of allowing market development in line with its comparative advantage, but rather that Government should recognize the risk associated with social interventions which increase dependence on revenues from principal sectors of the economy. An intrisic capacity for risk diversification in the public sector cannot be advanced as a reason for prescribing use of a riskless discount rate. It would seem, however, that the recurrent project costs of the Capital Facilities Expansion Program can be spread across many different sources and would fall within Arrow Zinds prescription.

2.4 Conclusion

The efficiency evaluation conducted in Chapter 7 will utilize the methods described in this chapter under different project conditions, in order to gauge the behavior of the cost differential between alternatives. The next few chapters lay the context in which the specific efficiency evaluation occurs.

Chapter 2 Footnotes

[1]This term can be used interchangebly with cost effectiveness where effectiveness looks at same level of benefit.

[2]re: Budgetary Envelopes; Baldwin, C.Y. Baldwin, D.E. Lessard, S. Mason, "Control at Indirect Financial Subsidies in Canada's Budget: Diagnosis and Recommendations", Working Paper, Alfred P. Sloan School of Management.

[3]Sorkin, Alan, [1975] Health Economics, Lexington Books, Chapter 6.

[4]World Bank [1980] Health Sector Policy Paper, Chapter 2.

[5]Bonner, J.

[6]Aarberger, A. [1972] Project Evaluation: University of Chicago Press.

Chapter 3

KENYA

3.1 Introduction

This chapter shall present a succinct geographic, political and economic portrait of Kenya. Inasmuch as this thesis calls for an efficiency evaluation of a project financed through Kenya's public sector, a basic understanding of the country's economic situation is essential. For the reader who is unaware of Kenya's socio-political environment, this discussion should provide sufficient background.

3.2 Climate and Topology

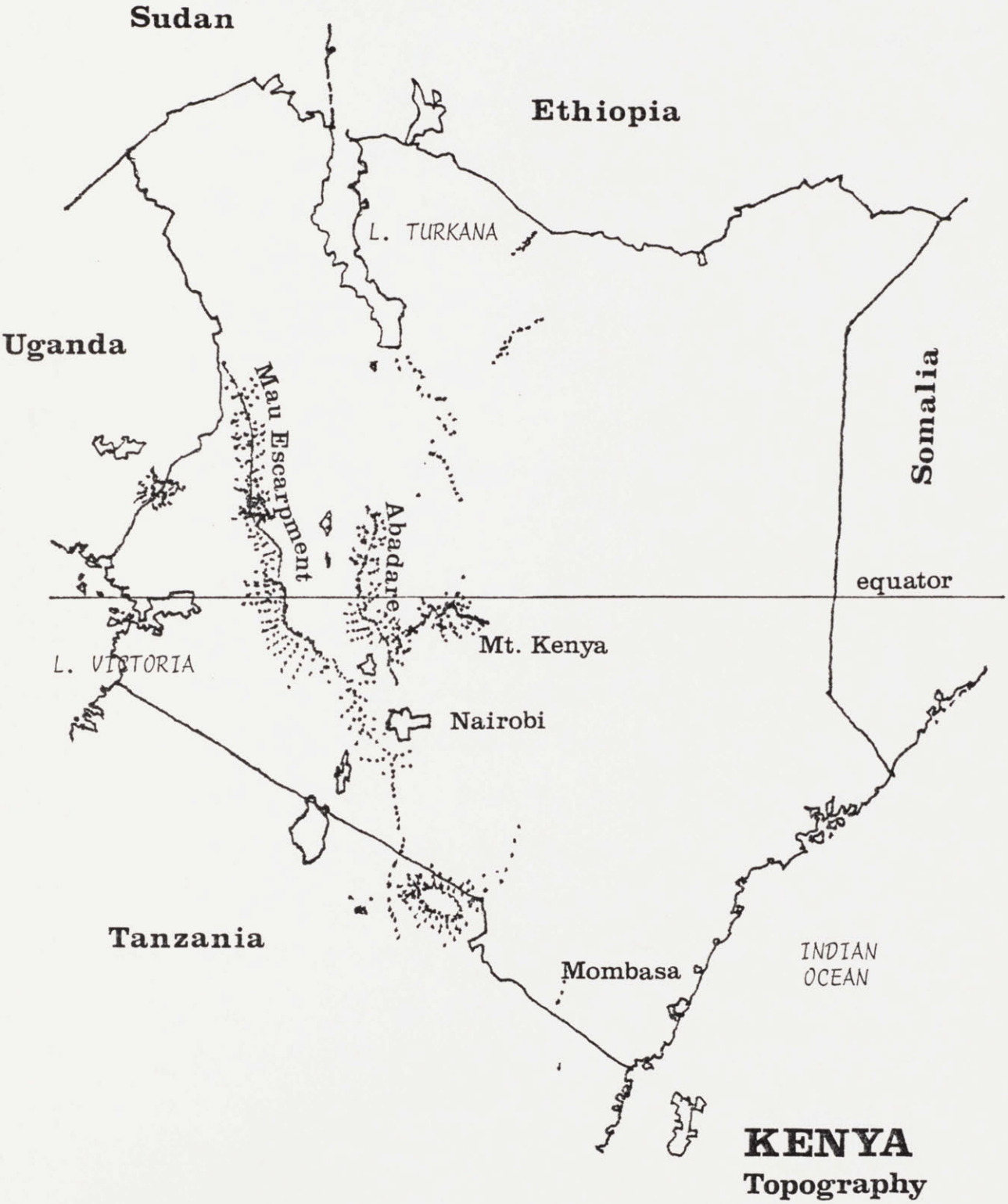
Kenya is located in East Africa (see Fig. 3.1) and is bounded to the North by Ethiopia and Sudan; to the West by Uganda and Lake Victoria; to the South by Tanzania; and to the East by Somalia and the Indian Ocean. The country has a total area of 224,960 sq. miles including 5,127 sq. miles of Lake Victoria, and Lake Turkana. Situated in Central Africa, a little more than a third of the country is located south of the equator. (see Fig. 3.2).

The topology and climate in Kenya exhibit extreme variation for a country of such small geographic area. Kenya's equatorial location and the tumultous geological formations of the Rift Valley account for much of the topological and climatic diversity which is found within its borders. Concurrent with the Rift Valley which runs along a North-South Axis throughout Central East Africa, are Kenya's three major mountain ranges and numerous plateaus climbing above sea level. These mountain ranges are Mount Kenya, the Abadare Range and the Mau Escarpement.

Mount Kenya, the country's largest peak, is approximately 17,000 feet above sea level and is snow capped perennially even though it is 2' south of the equator. The average altitude for the mountain ranges along the Rift Valley is 7,000 ft. above sea level, and they provide central Kenya

Figure 3.1

Figure 3.2



KENYA
Topography

with a moderate climate during the entire year. The mean yearly temperature is 65°F for South Central Kenya.

West of the Mau Escarpement, the Highlands continue and merge into the broad plateaus which border Lake Victoria. Both these Western and Central Plateaus constitute some of the most fertile agricultural land on the African Continent, because of the plentiful rainfall, and intense sunlight.

By comparison the Northern third of the country is an arid expanse of desert which contrasts drastically with the fecund regions in the South. Large areas of Northern Kenya receive less than 10 inches of rainfall per year and are agriculturally unproductive. This arid region is the largest homogeneous topologic and climatic zone in Kenya, and the annual temperatures average 85°F.

The Kenyan Coast along the Indian Ocean is warm during most of the year, with temperatures around 80°F due to the moderating influence of the sea.

3.3 Government

A former British colony, Kenya achieved independence in 1963, retaining affiliation with Great Britain as a member of the Commonwealth of Nations. Kenyan governmental structure is modelled after the British Parliamentary system. The Kenyan Parliament is a unicameral national assembly of elected representatives over whom the President presides. The Ministers of Parliament number 158 and from the ranks this President appoints the Vice-President and the heads of the twenty-nine Ministries and Departments which formulate, execute, and supervise national policy. These policies cross the range of national concern, e.g., Foreign Affairs, Agriculture, Defense, Health, Tourism and Wildlife, etc.

In addition to its centralized national structure, Kenya is divided into

seven provinces which draft and execute local programs in their respective territories. (see Fig. 3.3). A provincial commissioner appointed by the President, and provincial officers appointed by this commissioner plan and administer policy at this level. They usually supervise projects and programs which affect several districts yet which are of insufficient scope to require direct national supervision.

Provinces are further apportioned into districts which are governed by commissioners whom the President appoints to represent his office in local matters. Towns and local governments elect county councils to set municipal policy and to resolve disputes within the jurisdiction of municipal law.

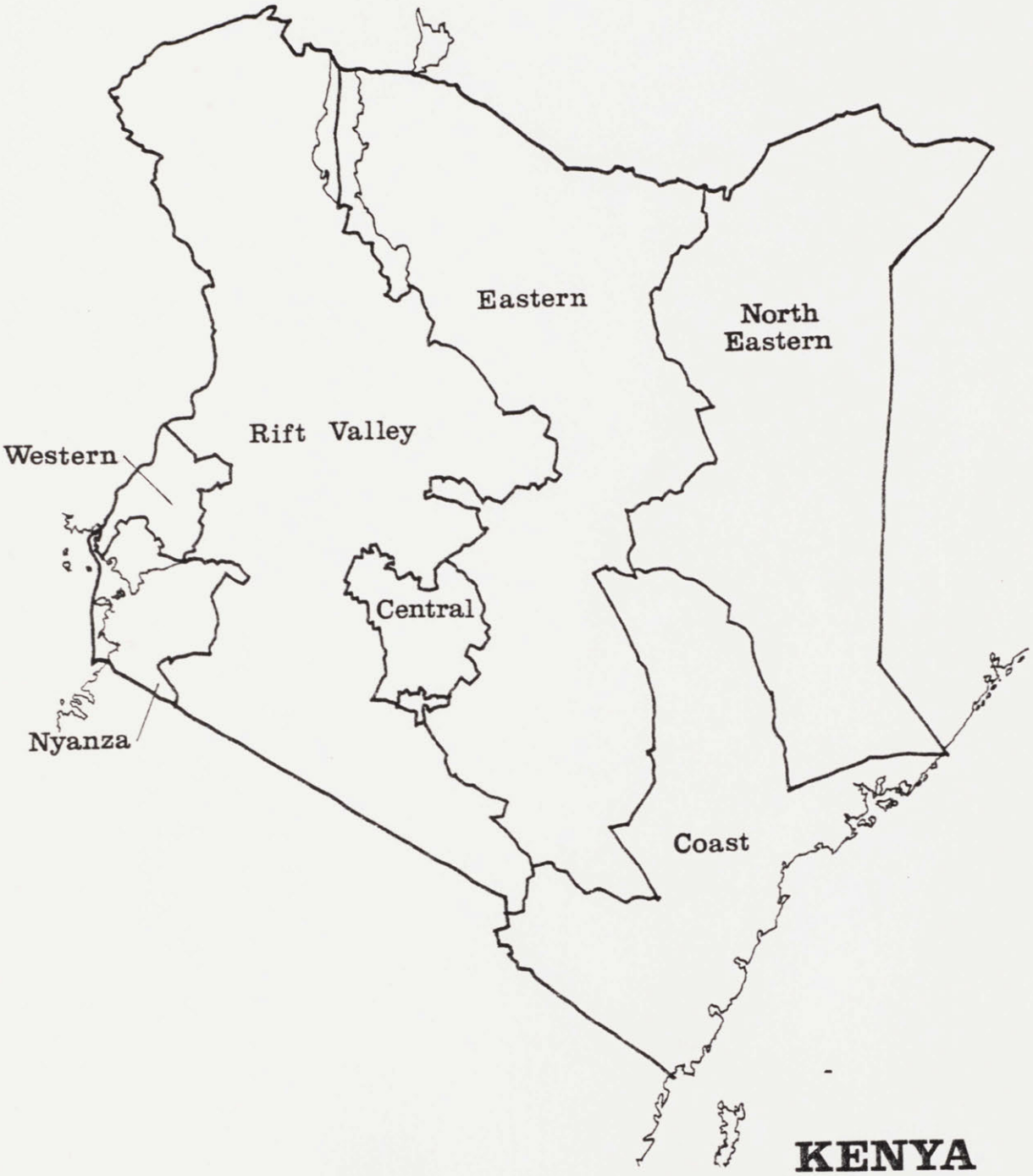
3.4 Population Distribution

The population of Kenya was 16,000,000 in 1980 with a projected annual growth rate of 3.5 per cent. A little more than 10 per cent of the population lives in the urban sector. Nairobi is the largest population center with 50 per cent of total urban inhabitants. Mombasa, the largest harbor in East Africa, follows at 24 per cent. Each of the remaining centers contain less than 4 per cent of the urban population. The primary location of the rural population is in the South Central and Lake Regions which corresponds to the major areas of agricultural production.

3.5 Ethnicity

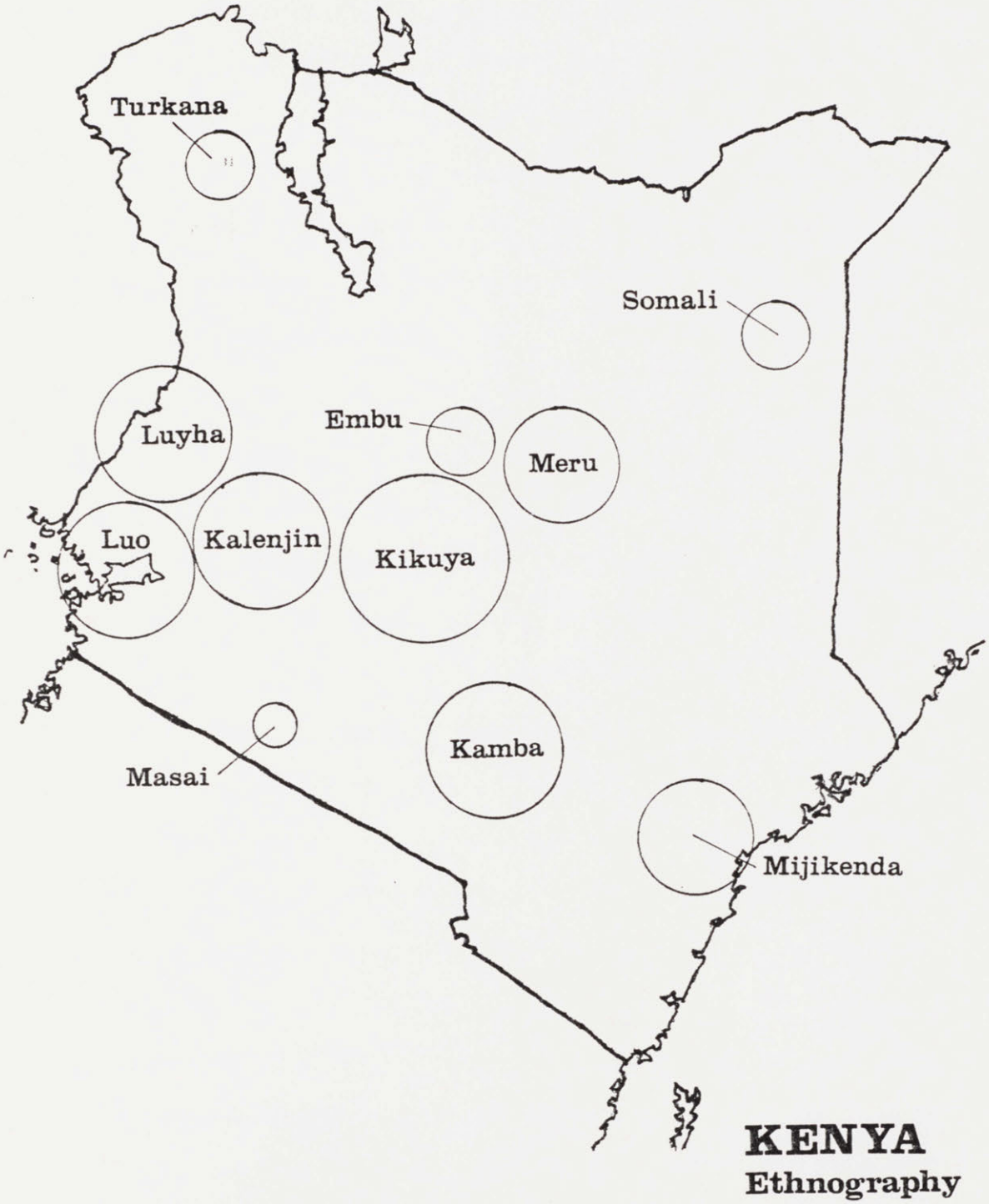
The ethnic composition in Kenya is as diverse as the country's geography. More than thirteen tribes are indigenous to Kenya and fall within three broad classifications: Bantu-speaking; Nilotic speaking farming tribes; and Nilo-Hamitic speaking pastoralists. Fig. 3.4 relates the location of the eleven largest tribes.

Figure 3.3



KENYA
Provincial Boundaries

Figure 3.4


Turkana
Somali
Luyha
Embu
Meru
Luo
Kalenjin
Kikuya
Kamba
Masai
Mijikenda
KENYA
Ethnography

3.6 Kenyan Economy

The countries of Sub-Sharan Africa follow a broad range of economic paradigms. Most of these countries have highly specialized, export-based economies. The exported commodities vary greatly: some are agricultural providing the world market with such staples as coffee, cocoa, and tea; some countries are exporters of minerals used as inputs of manufacturing sectors of more developed economies; and some, primarily Nigeria and Gabon, are exporters of oil. Many African countries have encouraged socialist transformations, promoting the state as the producer and distributor of goods and services. Others have set about emulating the market economies of former colonial powers.

Kenya has taken the latter path and has developed as an agriculturally based, open market economy. The Government has combined a laissez-faire attitude towards capitalism with cautious intervention to provide basic services and the infrastructure necessary to encourage private investment, maintaining this posture since 1963. The first Five-Year-Development Plan published in 1966 outlined Kenya's long term goal of attaining "high and growing rates of per capita incomes, equitably distributed, so that all are free from want, disease, and exploitation." Although the Government has engaged in fine tuning development efforts since independence, the basic laissez-faire relationship between Government and the private sector has remained unchanged over the last two decades.

According to the most visible measures of economic growth, Kenya's approach towards development appears to have largely succeeded. During the first decade since independence, the annual growth rate of Kenya's Gross Domestic Product was 6.0 per cent per annum ranking Kenya's growth rate among the ten highest in Sub-Saharan Africa. These levels of economic

growth exceeded Kenya's staggering birth rate of 3.5 per cent and led per capita G.D.P. to increase at an annual rate of 2.7 per cent. These laudible statistics attest to Kenya's achievement in one area of its economic program, a high rate of growth. Income distribution, however, has not advanced pari passu with economic growth as measured by the G.D.P., and remains a challenge for future development.

The next two sections will present the Domestic and Foreign Sectors of the economy in more detail, providing the economic context in which the public sector expenditures for health must be evaluated.

3.6.a Domestic Sector

Agriculture is the largest producer of revenues in the private sector. In 1978 revenues from this sector were $1,125,000,000 contributing approximately 35% of the Gross Domestic Product and, when services are excluded from the formulation, agriculture provides 60% of the economy's revenues. In Kenya, agriculture operates entirely on market inputs. Fertilizer, seeds, chemicals, and farm equipment are purchased from private firms.

The importance of agricultural production in Kenya transcends its revenue generating capacity, since it is the largest payer of wages in the private sector. More than 20 per cent of domestic wages are paid through agricultural production. Agriculture is also the major source of income for small business. The Government has taken special steps to encourage entrepreneurial involvement in agricultural procuction by opening up many Scheduled Settlement Areas for Agricultural use.

The Urban Formal Sector consists of the industrial production and manufacturing sectors in Kenya which contribute to the Gross Domestic Product. Because of existing Pre-Independence infrastructure and subsequent development policy, the industrial sectors of the economy grew in or around

Kenya's urban centers. More than 50 per cent of total industrial production occurs in Nairobi itself. Although private industries dominate the Urban Formal Sector, Government intervention in this sector includes taxation, controls on imports and regulations on factor prices in production. The wage schedule in the Urban Formal Sector dominates compensation patterns in the economy. Labor legislation, unionization, and housing allowances have contributed to a higher wage rate and also to Kenya's high industrial capitalization. In 1978, industrial production accounted for 16 percent of total output in the G.D.P. From 1974 to 1978, revenues from manufacturing increased by 12 percent per annum and paid out 13% of total wages in the Kenyan Economy in 1978.

The Urban Informal Sector constitutes those enterprises which provide goods and services, yet which have no license to operate and which have limited, differentiated markets. Examples range from the production of sandals to the construction of sub-standard squatter housing. The creation of the Urban Informal Sector is largely attributed to the rural-urban migration and to the inability of the Urban Formal Sector to absorb the ingress of rural migrants into the labor force. Similar phenomena are found throughout the developing countries where urban migration has exhausted the Urban Formal Sector. However, the quantification of reveneus from this sector is difficult, making data such as net contribution to G.N.P. and sector growth rates impossible to derive.

Despite the growth and leadership of the Private Sector in the Kenyan economy, the Government has been a major contributor to the G.D.P. since independence. Approximately 30 per cent of the G.D.P. has come out of the Public Sector over the last two decades where 18 per cent has been contributed by the National Government, and the remainder has been contributed

by local governments and by Kenyan para-statal bodies. In 1978, the Government accounted for 25 per cent of capital formation in the Kenyan economy.

Although the Government has generated sizable revenues from its resourses, it employs only 6 per cent of the labor force. Nonetheless, Government pays out 43 per cent of the national wage. This wage schedule has exacerbated the inequity in income distribution, providing public servants with salaries and wages comparable to successful small scale entrepreneurs.

The Kenyan Government has influenced patterns of public saving, through fiscal policies; and that of business and household savings through taxation. When the current Government assumed stewardship in 1963, it inherited a recurrent budget deficit which it financed through foreign aid. Through its taxation on a burgeoning private sector, Government augmented its revenues from KL 50 million in 1963-64 to KL 144 million in 1972-73. Recurrent expenditures grew at a rate of 11 percent p.a., as the economy pursued its growth goal.

Because of the Government's achievement in increasing revenues, it was able to finance the recurrent budget and contribute 28 per cent to the overall development budget during the 1960's. The balance of development funds were sourced through domestic financial institutions or through concessional foreign loans. By 1970 the government was financing its total budget, recurrent and development, with 80 per cent recurrent revenues, 10 per cent net domestic borrowing and 10 per cent net foreign borrowing. The end of the 1970's saw a drop in recurrent revenues relative to recurrent costs, where 17 per cent of the development expenditures were financed through foreign aid. While the current 1979-1983 Development Plan has seen the level of foreign aid fall to 15 per cent, Kenya has had to rely

increasingly on Central Bank financing for its public sector expenditures. As the Central Bank became an integral part of public sector financing, inflation rose to 11.1 per cent p.a. during the 1970's, from a rate of 15 per cent p.a. during the previous decade. Exogenous shocks from oil price increases also fuel inflation, since Kenya imports all of her crude oil, but the Government is still seeking to reduce dependence on Central Bank loans for public sector expenditures over future periods.

3.6.b Foreign Sector

Within Kenya's foreign economy, agriculture is the largest export. This sector accounts for 60 per cent of the total value of exports on average and has grown at a rate of 19 per cent per annum, from 1971-1978. Coffee, the principal export, accounts for 57 per cent of total agricultural exports and a third of the value of total exports.

The next largest export is tea, accounting for 17 per cent of total export revenues, followed by petroleum products from the refineries in Mombasa, which constitute 16 per cent of total export value. Petroleum exports have risen in value over the last decade at an annual rate of 23 per cent. Europe is the principal market for Kenya's goods consuming 44 per cent of national exports. Other principal markets in descending order of contributed revenues are Africa, North and South America, the Far East/ Australia, the Middle East, and Eastern Europe.

The value of exported commodities has fluctuated over the past decade. Since coffee dominates exports, there is a high correlation between export revenues and coffee prices. Despite a fairly inelastic demand for coffee, price changes have a volatile effect as witnessed by the drop in export value in 1978.

Kenya's former partners in the East African Community have been the

source of substantial losses of recent export volume. Politically destabilized Uganda, traditionally Kenya's largest African market for exports, has been an unreliable source of foreign revenues, as that country undergoes economic reconstruction, and the closing of the Tanzanian border in 1977 pared down exports to Kenya's second largest trading partner on the African continent.

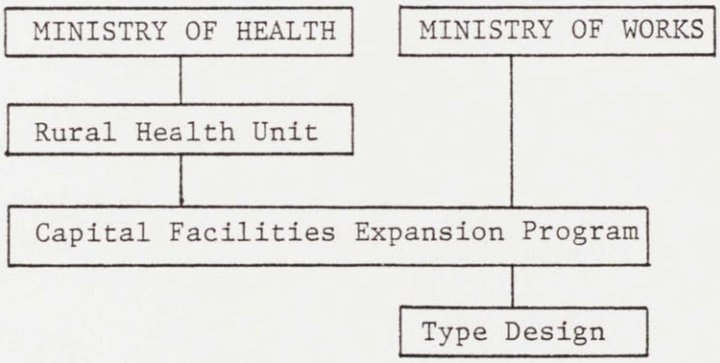
Kenya's industrial sector relies heavily on imports. Machinery and transport equipment compose the greatest import expenditures at 40 per cent of total volume per annum. The largest single import is transportation equipment, e.g. buses, trucks, etc. Kenya imports most of these commodities from Europe. The second largest import is petroleum at 15 per cent of total import value. Through this dependence, Kenya's balance of trade has suffered, as world oil prices increase.

In 1978, aggregate exports and imports left Kenya with a negative trade balance of KL 265,413,000 = $605,422,471. The major source of this deficit occurred in European trade which showed a negative balance of KL 173,467,000 = $389,813,483. The constant erosion of Kenya's balance of trade position has led the Government to the most severe trade restrictions in the nation's history. For example, in 1981, a ban was placed on the importation of all consumer cars.

Other trade restrictions have been made through attempts at developing the manufacturing sector of the economy. Despite these attempts at supporting local industry through protective tariffs, there has been minimal increased contribution to foreign exchange through these protected enterprises, where industrial exports have increased at 8 per cent per annum, as opposed to 19 per cent per annum for agriculture and 23 per cent per annum for fuels and lubricants.

The Kenya Shilling (KS) is the basic unit of currency and is equal to $0.11. There are twenty shilling to the Kenya Pound. In 1979 total net Foreign Reserves of Kenya's central monitary authorities amounted to KL 225,545,000.

Chapter 4



HEALTH FACILITY INFRASTRUCTURE

4.1 Introduction

Although this study examines the specific problem of reducing total project costs incurred in the construction of health care facilities, this problem must be placed in the broader context of improving the level of health in the rural sector. In order to clarify the motivations behind initiating the Capital Facilities Expansion Program, this chapter describes the development of Kenya's rural health policy and how the Ministry of Health and Ministry of Works interact in implementing capital facility projects for clinic-based rural health care. Finally a brief account of the Capital Facilities Expansion Program is presented, outlining the proposed infrastructure which resulted from the collaboration between these two Ministries.

4.2 The Ministry of Health

The Ministry of Health is responsible for six major programs:

1. Curative Health
2. Preventative Health
3. Rural Health Services
4. Health Training
5. Medical Supplies Service
6. Medical Research

As Appendix 4 indicates, the Ministry of Health operates with a relatively small budget allocation compared to other Ministries of Government. A total of KL 249,040,000 ($527,505,747) has been dispensed to the Ministry of Health over the Development Period 1978-1983. This amount constitutes over 7% of the total recurrent and development expenditures for the period. This figure is roughly congruent with that of other developing countries.

The Ministry of Health's budget for all services over the Development Period 1978-1983 is:

K£ '000

	1978/79	1979/80	1980/81	1981/82	1982/83
Recurrent expenditure	30,126	33,126	36,465	39,480	42,751
Development expenditure	10,339	12,091	14,047	15,064	15,551
TOTAL EXPENDITURE	40,465	45,217	50,512	54,544	58,302
Estimated foreign aid	2,460	4,836	5,618	6,025	6,220
Local finance	38,005	40,381	44,894	48,519	52,081

Of this national budget, the following is allocated for the Ministry's Rural Facilities Expansion Program:

K£ '000

	1978/79	1979/80	1980/81	1981/82	1982/83
Recurrent expenditure	2,903	3,560	3,984	4,322	4,688
Development expenditure	1,435	2,645	3,989	4,407	4,707
TOTAL EXPENDITURE	4,338	6,205	7,973	8,729	9,395
Estimated foreign aid	465	1,190	1,795	1,983	2,118
Local finance	3,873	5,015	6,178	6,746	7,277

Through its responsibility for rural health services, the Ministry of Health is the principal actor in the programming of facilities and in projecting the needs for additional facilities in the rural sector. The Ministry's involvement in the delivery of health services in rural areas began in 1970, when it assumed responsibility for the administration of rural health services which had been the previous charge of local authorities and Country Councils. This intervention was necessitated by the heightened expectations for health care by rural populations. As these expectations translated into greater expenditures, local governments found

themselves unable to meet the administrative, financial, and staffing budgetary allocations, whereupon the national Government interceded, consolidating services and placing them within the Ministry of Health. A national review of rural health services uncovered enough inefficiencies to prompt a re-examination of the entire service network. Three areas affecting service required immediate attention: the improvement of physical facilities, an increase in staff, and the improvement of the standards of service. This reappraisal fostered new health objectives as well as suggestions for new infrastructure to support these services. First, it was determined through epidemiological data that the most serious diseases which afflict rural Kenyans were either infectious or were environmental and could be prevented. Since many of these diseases attack young adults and children, it was possible and desirable to reduce the instances of infirmity and death due to infection by placing greater emphasis on preventative care. Most of the relevant preventative treatments had existed for some time before the Government reached this recommendation, however an uninformed public, insufficient infrastructure, and highly differentiated urban-rural markets for health care combined to delay the impact of preventative care in the rural sector.

Even where the local governments had intervened, significant impediments in delivery resulted from economic constraints and from inefficient application of available funds. Logistically, the following factors obstructed effective delivery:

1) many rural people have no medical services within reach of their home;

2) most of the people do not make effective use of curative or preventative services even when they are available;

3) health workers are not using the most effective methods of preventing illnesses and death because:

   a) they have not been trained to do so, and/or;

   b) they are not effectively supervised and encouraged in their practical health work in rural facilities.

In order to assure that preventative and curative medicine would reach the rural populations, an increase in patient-health service contact was imperative. Specifically, the Ministry of Health sought to increase:

1) antenatal and delivery services to expectant mothers from the 128,000 served each year in 1972 to 260,000 in 1984;

2) immunization protection against the most important preventable diseases of childhood from 45,000 newborn babies in 1972 to 500,000 in 1984;

3) regular medical care and preventative services for children aged 1 to 4 years from 81,000 in 1972 to 640,000 in 1984;

4) school health services which did not exist in 1972 for 90% of the children entering primary school in 1984;

5) clean, safe drinking water and good sanitation from a level of 900,000 served in 1972 to 4 million in 1984.

Programs to instruct the rural population in the proper use of medical services have been implemented, as well as extensive training curricula for field health workers. These training programs will occur at specially designated Rural Health Training Centers. This resolution is intended

to close the lacuna in efficient delivery of appropriate services due to user ignorance and staff incompetence.

The largest increment to services for basic health has been in the area of family planning. The Ministry of Health has emphasized these services for demographic and medical reasons. Population projections based on the Ministry of Finance and Planning's surveys in 1970 placed Kenya's growth rate at 3.5% per annum, the highest in the world. Given this robust growth rate, the needs of an increasing population were foremost in national health care planning. The resulting recommendations included birth control programs, environmental health programs, and medical services to reduce the incidence of complicated pregnancies, and maternal illnesses.

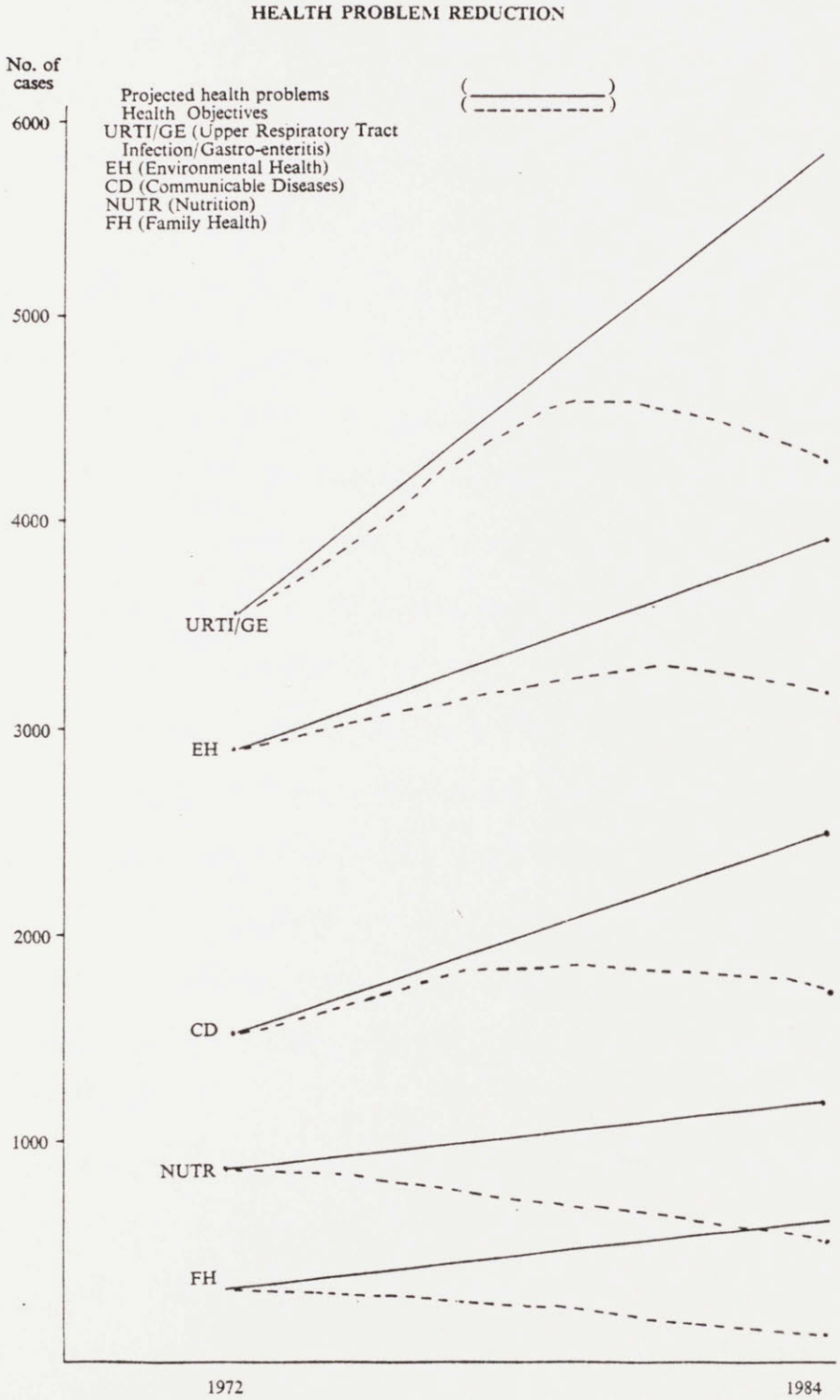
In addition to initiating programs to assuage the effects of population growth, the Ministry of health has isolated four other areas which require attention:

1) upper respiratory tract infections/gastro-enteritis (URTI/GE)
2) environmental health (EH)
3) communicable disease (CD)
4) nutrition (N)
5) family health (FH)

These affinities were constructed along established etiological relationships. The Government's projections for the incidence of these pathologies and its own goals for reducing these levels are presented in graph 3.1. These goals were based upon:

1) population projections for the rural areas up to 1984 and the health projections for the same areas over that period;
2) National and Ministry of Health development policies;

Graph 4.1



SOURCE: Ministry of Health, Kenya

3) the knowledge of the technology available in Kenya to cope with these problems and of its efficacy, as well as the financial resources likely to be available during the project's life.

Given both the health problems and the objectives which the Government had put forth, a study of the constraints upon the existing system of national rural health delivery was performed. This study tested the ability of the rural health care infrastructure to support the new programs which the Ministry of Health had projected. A list of health service disfunctions was generated, where a disfunction was defined as any operational impediment to the delivery of a specific health service in the rural sector. These constraints were measured by evaluating a health service's ability to ameliorate illnesses due to:

1) diseases resulting from environmental conditions;
2) conditions of malnutrition;
3) maternal pathologies and childbirth;
4) communicable diseases (primarily immunizable).

Moreover, the following categories were cited as the constraining factors:

1) technology: medical and health techniques, T;
2) staff: numbers, training, expertise, attitude, S;
3) facilities: number, design, efficacy, equipment, vehicles, materials, F;
4) procedures: administrative, operational, scheduling, assignment, referral, supply, budgeting, and fiscals, PR;
5) policy: governmental and health, PO;
6) other: environmental, cultural, etc., O.

The Ministry of Health itemized the first four categories even further by differentiating between the constraints which occured due to a lack of resources and those due to a misapplication of the resources which were available. The following table relates the number of instances of each constraint and whether each instance was resource or non-resource based.

	T	S	F	PR	PO	O	TOTAL
Resource	11	28	34	2	-	-	75
Non-resource	28	48	13	73	24	13	199
TOTAL	39	76	47	75	24	13	274

Source: Appendices to a Proposal for the Improvement of Rural Health Services, M.O.H., Kenya. 1972.

It is worth noting that of all the categories, only facilities were cited as inhibiting services due to resource constraints more often than they did as a result of non-resource constraints.

There are two ways to circumvent facility related constraints due to a lack of resources. One is to secure more resources where possible. Implicit in this response is the assumption that the current mode of operation is optimal and is inhibited only by a financial constraint. The other response is to change the manner in which resources are used in order to achieve desired benefits from the same level of resources. Within the Kenyan economy, it behooves the facility planner to assume the latter strategy since public funds funds for rural health services have increasing marginal costs. It was in this spirit that the Government assessed all of the constraining factors in an effective rural health delivery network and projected the Rural Health Unit, where each Unit contains an integrated range of facility type, professional staffing, and services.

The Rural Health Unit concept embodies the following goals:

1) to orient heatlh services towards the most important rectifiable health problems; all changes in existing patterns of health services or training schemes are to be based on their contribution to theses objectives;

2) to provide the Ministry of Health with a basis for evaluating the effectiveness of the service and training schemes and restructure them, if actual accomplishments vary significantly from the targets which have been set;

3) to provide the Ministry of Health with a basis for quantified estimates expected to be achieved from the proposed services.

The health problems identified earlier are the focus of services provided through the Rural Health Units. These were: maternal and child care; communicable disease; upper-respiratory infectious disease/gastro-enteritis; and disease conditions resulting from or provoked by inadequate environmental sanitation.

The targeted Rural Health Unit - population ratio will be 1:50,000 - 70,000 with variations occurring according to the availability of staff. Within each Rural Health Unit are smaller service center units which have the following institution/population ratios:

Local Center Serving	5,000
Market Center Serving	15,000
Rural Center Serving	40,000

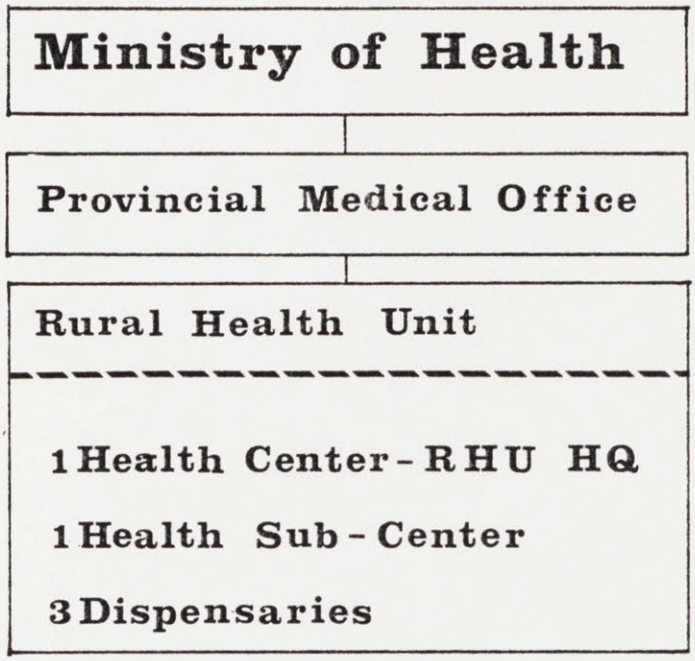
Ideally, these service centers are stationed according to existing patterns of movement and congregation at market places or near other public institutions. In more remote areas, however, such positioning is often impossible.

Each Rural Health Unit is to be organized around a Unit Headquarters which will serve as the nerve center for a number of supporting facilities. The Rural Health Unit Headquarters will provide technical guidance to the supporting facilities and serve as the administrative center for the Unit. Each Rural Health Unit Headquarters will in turn be placed under the District Office of the Ministry of Health for administrative and operational support. In addition to its role as an administrative center, the Rural Health Unit Headquarters will serve as a referral institution from subordinate institutions within its jurisdiction (see Fig. 4.1).

Table 4.1 shows the number of Rural Health Units by province and by district. These Rural Health Units have been delimited and located to attain a desired catchment area and unit-population ratio. The total number of Rural Health Units is 254. Each Unit shall consist of one Health Center, one Health Sub-Center, and three supporting Dispensaries. Whenever the number of Dispensaries exceeds four, one of the supporting facilities shall be upgraded to a Health Center or a Health Sub-Center.

The Rural Health Units shall continue conventional clinic-based health care and shall introduce primary care services through a combination of clinical treatment and community health programs. This procedure follows the paradigm which has been established in several Less Developed Countries over the last decade. In many of the these countries such medical programs are also referred to as Rural Health Units.

Figure 2.4



4.3 Ministry of Works

Although the Ministry of Health determines which facilities it requires in order to execute clinic-based programs, the responsibility for the actual construction of these facilities lies with the Ministry of Works. The Ministry of Works is the service agency for all other Ministries and Departments which require capital facilities in order to provide their respective services. This responsibility has led to a high level of standardization in construction done by the Government Works across a range of projects. This also means that the Ministry of Health must solicit the services of the Ministry of Works just as a private client solicits the services of an architect or contractor. The Ministry of Works

Table 4.1 NUMBER OF RURAL HEALTH UNITS BY PROVINCE & DISTRICT

PROVINCE:	CENTRAL		COAST		EASTERN		NEASTERN		MANZA		RIFT VALLEY		WESTERN	
DISTRICT	Kiambu	9	Kwale	4	Embu	7	Garissa	4	Kisi	14	Baringo	5	Bongom	8
	Kirinyaca	5	Lamu	4	Isiolo	3	Mandera	4	Kisamu	8	Marakwet	4	Busia	4
	Muranga	9	Taita	3	Kitui	6	Wajir	4	Siaya	9	Kajiago	5	Kaiva	2
	Nyandarva	4	Tana	4	Machakas	13			S. Nyanea	21	Laikipia	3	Meca	14
	Nyeri	9	Kiufi	6	Marsabit	3					Nakuru	3		
					Meru	11					Nanda	5		
											Narok	6		
											Sambaru	3		
											Naola	3		
											Turkana	7		
											Gishu	4		
											Pokot	5		
											Kericho	9		
TOTAL		36		21		43		12		52		62		28
254														

provides an estimate of costs for construction and maintenance of the particular project to the Ministry of Health. These pro forma costs are included in the proposal for funding which is submitted to the Ministry of Finance and Planning for approval. This Ministry manages the "purse strings" and when the construction projects of the Ministry of Health fit within the budgetary allocation from the Ministry of Finance and Planning, the Ministry of Health engages the Ministry of Works for construction and supervision of health care facilities.

The Ministry of Works assigns a team of architects and quantity surveyors to project a specific design and cost estimate for initial construction. The project is then submitted to contractors for bids. The contractor with the lowest credible bid is awarded the project with the stipulation that he does not sub-contract any part of the facility construction without approval of the Ministry of Works. Regular site visits assure that construction is proceeding according to the Ministry of Works' building specifications and that the prohibition against sub-tracting is not violated. A typical implementation schedule is presented in Table 4.2.

The Ministry of Health and Ministry of works systematized their method of facility construction by developing a prototype, the Type Design described in Chapter 4, whose specifications adhere to Ministry of Works' guidelines. As a step towards encouraging continued Harambee initiatives, the Ministry of Health also published a set of building guidelines which followed those of this prototype to assure that the Ministry of Works would take on maintenance responsibility after the Harambee construction was completed. The next Section contains a description of the Capital

Table 4.2 FACILITIES: IMPLEMENTATION

	ISSUE OF C.O.N.		APPROVAL OF DESIGN			ACCEPTANCE OF BID	OCCUPATION OF BUILDING
	BRIEFING AND DESIGN			CONTRACT PREPARATION			CONSTRUCTION
INPUTS	Planning Policy Physical Data Population Survey	Brief Site Survey Design Standards research	Sketch Design Standard Drawings	Final Design Detail Survey M.O.W. Standards Spec. Costs	Working Drawings Special Drawings	Working Drawings Bills of Quantity Contract	Working Drawings Bills of Quantity Contract
STAGE	Briefing	Sketch Design	Detail Design	Working Drawings	Bills of Quantity	Tendering	Construction
ACTION	Make Surveys Check Data Planning Meeting Issue C.O.N.	Make Program M.O.W. Visit Site Make Sketch Plans	Discuss Design Approve Inform M.O.H. etc. Prepare Cost Estimate	Check Program Inform Other Branches M.O.H. Prepare Working Drawings	Q.S. Site Inspection Prepare Detailed Cost Estimate	Select Contractors Examine Tenders Accept Bid Order Equip.	Site Visits Payments Final Inspection Handover Equipment
TIME	4W	6W	6+2W	8W	6W	6+6W	4W

Facilities Expansion Program which uses this prototype as its basis for facility construction.

4.4 Capital Expansion Program

The Ministry of Health has projected a substantial facilities expansion program to extend services to rural areas. Since its implementation, the program has included the construction of new facilities, the upgrading of facilities which were designated substandard, the extension of facilities which were to be redesignated through the formation of Rural Health Units and the purchase or replacement of vehicles.

Three types of facilities constitute the greatest expenditure in the Capital Facilities Expansion Program: Health Centers, Health Sub-Centers and Dispensaries. There is also a special classification of Demonstration Centers which serve as educational institutions, training staff for positions in Rural Health Units. Each facility type covers a catchment or service area of a 6 kilometer radius.

The goal behind the improvement of existing buildings and the construction of new facilities is to raise the standard and capacity of rural health care infrastructure to a level commensurate with the new services provided in the Rural Health Unit. Each facility type has a specific program to accommodate patients and staff, and to provide them with adequate space for their interaction.

The Government relied on data from previous plan periods in order to project the demand for future construction in the Capital Facilities Expansion Program. These data indicated that 761 Government rural health care institutions were in service during the late 1970's. The numbers of facilities borke down into the following categories:

191 Health Centers

34 Health Sub-Centers

536 Dispensaries

Complimenting the Government facilities were 316 private and philanthropic institutions which service the health needs of the rural population. These organizations often continue traditions initiated by missions and have established themselves as an integral part of the health delivery network in Kenya. Kenya is not atypical among the Less Developed Countries in this regard and most Non-Government Organizations are subsidized by the Government.

Non-Government rural health facilities numbered:

25 Health Centers

4 Health Sub-Centers

287 Dispensaries

This survey also identified that 90 percent of all rural facilities were in operation and that more than half of those which were not operational were Harambee (self-help) facilities. Institutions begun under the Harambee initiatives were often found to have been built to standards so beneath those of the Ministry of Works, which maintains all Government facilities, that they refused to assume maintenance responsibility of these buildings. Moreover, buildings were often constructed before there was sufficient staff available to manage them.

Other operational deficiencies in the health facilities included the lack of piped water: 75 percent of Health Centers were reported without piped water; and 40 percent of the Dispensaries reported the same situation. Irrespective of its source, 70 percent of the water supply was untreated. Less than 15 percent of all institutions had no electricity supplied, and more than 60 percent were cited for not having proper

facilities for disposal of water and wastes. While 30 percent of the facilities were classified in good condition, more than 16 percent were considered so inadequate that they required immediate emendation. After the Government's survey of capital facilities in the rural sector was completed, the Ministry of Health decided that 70 percent of the existing facilities required some improvement. The program of facility improvement and of new facility construction is presented in Graph 4.2.

A brief description of each facility is given below:

Health Center: The Health Center is the smallest unit providing all aspects of primary care - curative, preventative, promotive, rehabilitative service for outpatients and inpatient facilities for maternity care, emergencies and observation. It serves as the referral institution for Health Sub-Centers and Dispensaries and is the point from which mobile clinics, etc. extend community-based care.

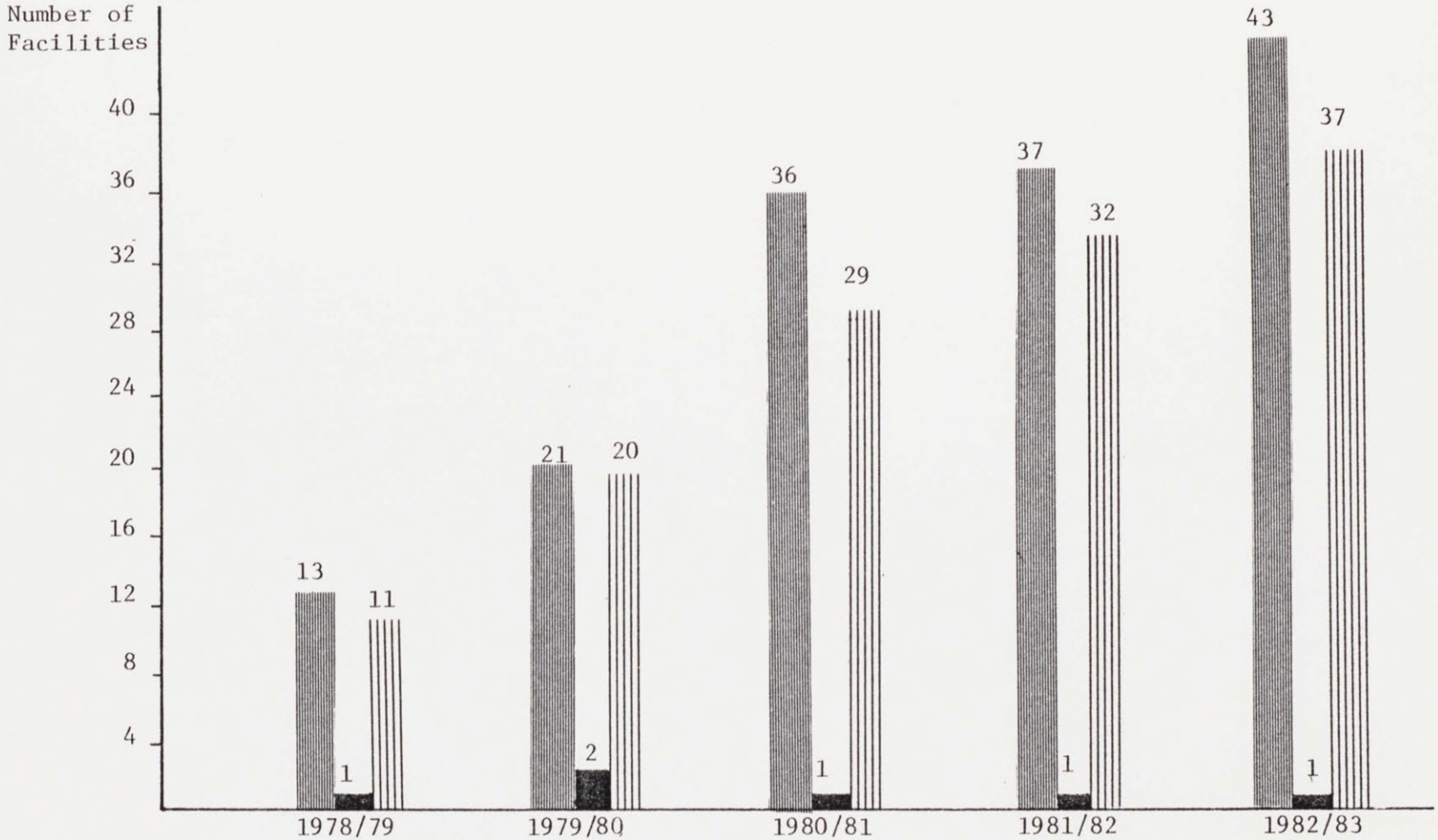
Health Sub-Center: The Health Sub-Center provides the same outpatient services as the Health Center, but has no inpatient facilities. It is intended to serve areas of relatively high population density where augmented outpatient services are needed, but where there is often easy access to inpatient facilities at the health center or hospital.

Dispensary: The Dispensary is the first line primary health care facility providing curative and preventative care with referral to a health center. Three or four Dispensaries are to be situated in every Rural Health

Unit, each with a daily capacity of 110 to 200 outpatients.

Each of these facility types is built to the organizational and technical specifications of the prototype referred to as the Type Design. A description of this prototype and its implementation is offered in the next chapter.

Graph 4.2



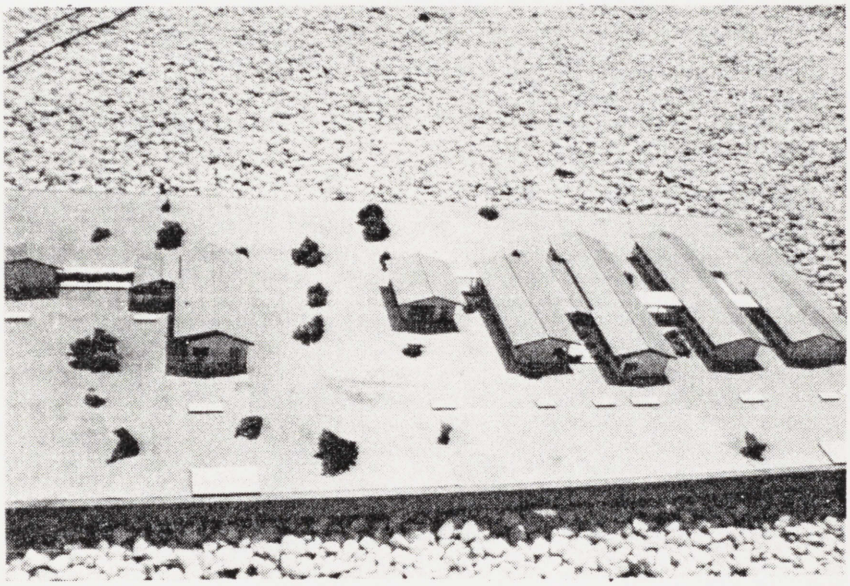
CAPITAL FACILITIES EXPANSION PROGRAM
Facilities Construction Schedule

|||| Health Center

Health Sub-Center

Dispensary

Chapter 5



TYPE DESIGN

5.1 Introduction

This Chapter is presented in three sections. The first presents the Type Design which is currently used for all new health facilities in Kenya. A brief description of the Type Design's plan, technical construction, department functions, and application across facility types, i.e. Dispensary, Health Sub-Center and Health Center, is included.

The second section provides a critique of the Type Design in order to determine minimal performance criteria of the rural health facility. Although the primary focus of this study is to reduce the project expenditures in facility expansion through the use of appropriate technologies, any reformulation of building systems must accomodate the services which are found in a health facility. The identification of user performance criteria (patient and staff) is facilitated through surveys conducted by the Ministry of Health at numerous institutions which were built to Type Design specifications.

The third section presents cases of Type Design construction at four different sites for different facilities. One project, the Ogembo Health Center, shows a substantial modification of the Type Design to accomodate the site. From these cases, problems encountered *in situ* surface, both concerning the Type Design's technical execution and the administrative supervision of construction.

5.2 The Type Design - History and Implementation

The current Type Design for rural health care facilities in Kenya originated in 1977, when the Government retained a Swedish firm of consultants, White Architekter, to devise a prototype which would serve as the basic unit in the Ministry of Health's capital expansion program.

Prior to this initiative, health services operated out of clinics which were built of heavy masonry construction with verandahs. This was the SIMOHNN plan which accomodated inpatient and outpatient services in wards arranged in a "tuning fork" pattern (see Fig. 5.1). The Government required that its new prototype lend itself to incremental expansion, since each Dispensary and Health Sub-Center was to be located in a catchment area and on a site where it might be upgraded to a Health Center, should the need arise. The first implementation of the Type Design has been at sites where operational health care institutions already existed, but where the service capacity of the facility had been reached.

As capital becomes available and the Ministry of Health continues to adapt its health services within the Rural Health Units, new facilities based entirely on the specifications of the Type Design are being constructed. Type Design specifications are also being implemented for staff housing at health facility compounds.

A joint steering committee of the Ministry of Health and the Ministry of Works supervised the formulation of the Type Design, assuring that the Ministry of Health's programmatic intentions and the Ministry of Work's building specifications were both followed. Since the time of the design's inception, a number of Dispensaries, Health Sub-Centers and Health Centers have been built. In view of the highly differentiated terrain, climate and catchment areas throughout Kenya, some adaptations of the Type Design have been necessary. These modifications are minor, however, and usually do not impinge on the basic standards for construction which apply.

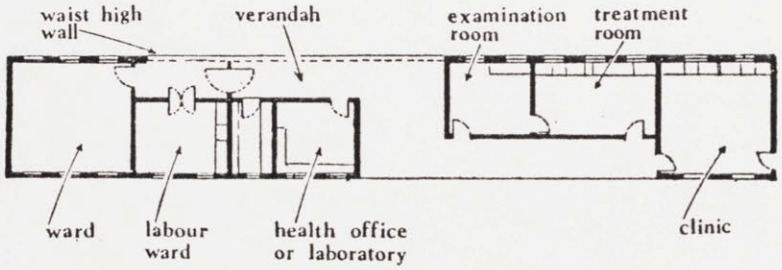
5.2.a General Organization

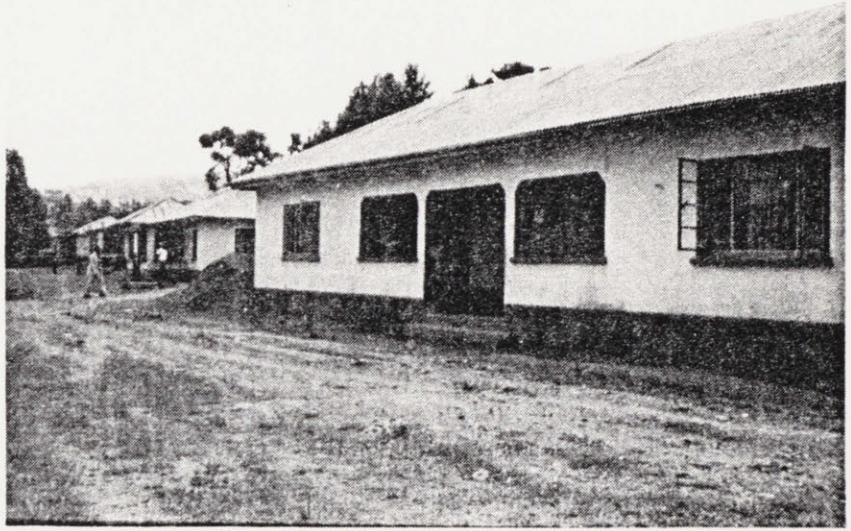
The general organization of this design is arranged around a

Figure 5.1

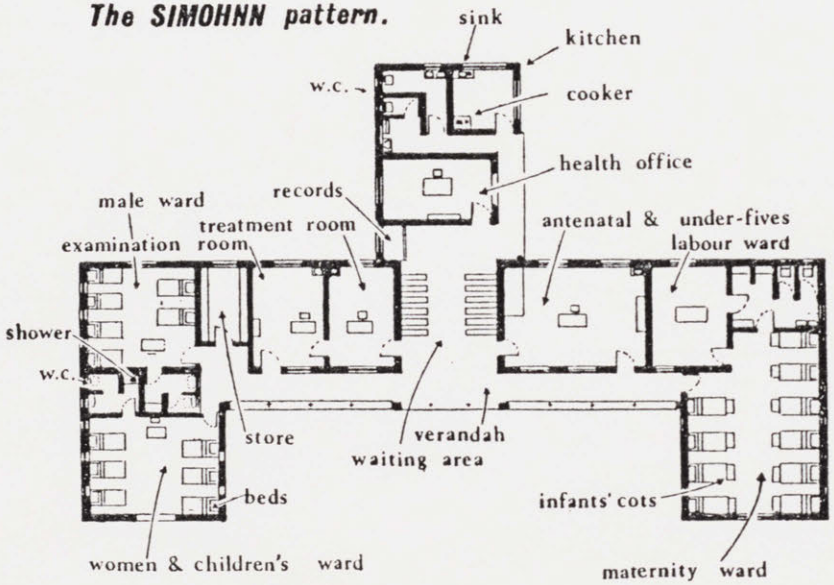
EXAMPLES OF HEALTH FACILITY TYPES PRECEEDING TYPE DESIGN

The EMBU pattern.





The SIMOHNN pattern.



circulation spine off which service blocks have a perpendicular orientation. These service blocks are five contiguous, single story buildings. (See Fig. 5.2). Three of these blocks house medical services: an Inpatient Department, a Maternity-Child Health Care Unit, and an Outpatient Department. The two remaining blocks are service wings where the garage, sanitary and sluice spaces are located. The standardized room type is $11m^2$ (=4m x 2.75). Within one service block, rooms connected by adjoining doors permit the staff to move freely from one office to the next without venturing into the major circulation space. The complete Health Center is 659 sq. meters (7,095 sq. ft.). A detailed breakdown of gross area is presented in Tables 5.1.a - 1.h.

5.2.b Building Units: Structural and Material Standards

All spaces in the Type Design are built to specification for permanent structures; stated briefly, these standards are:

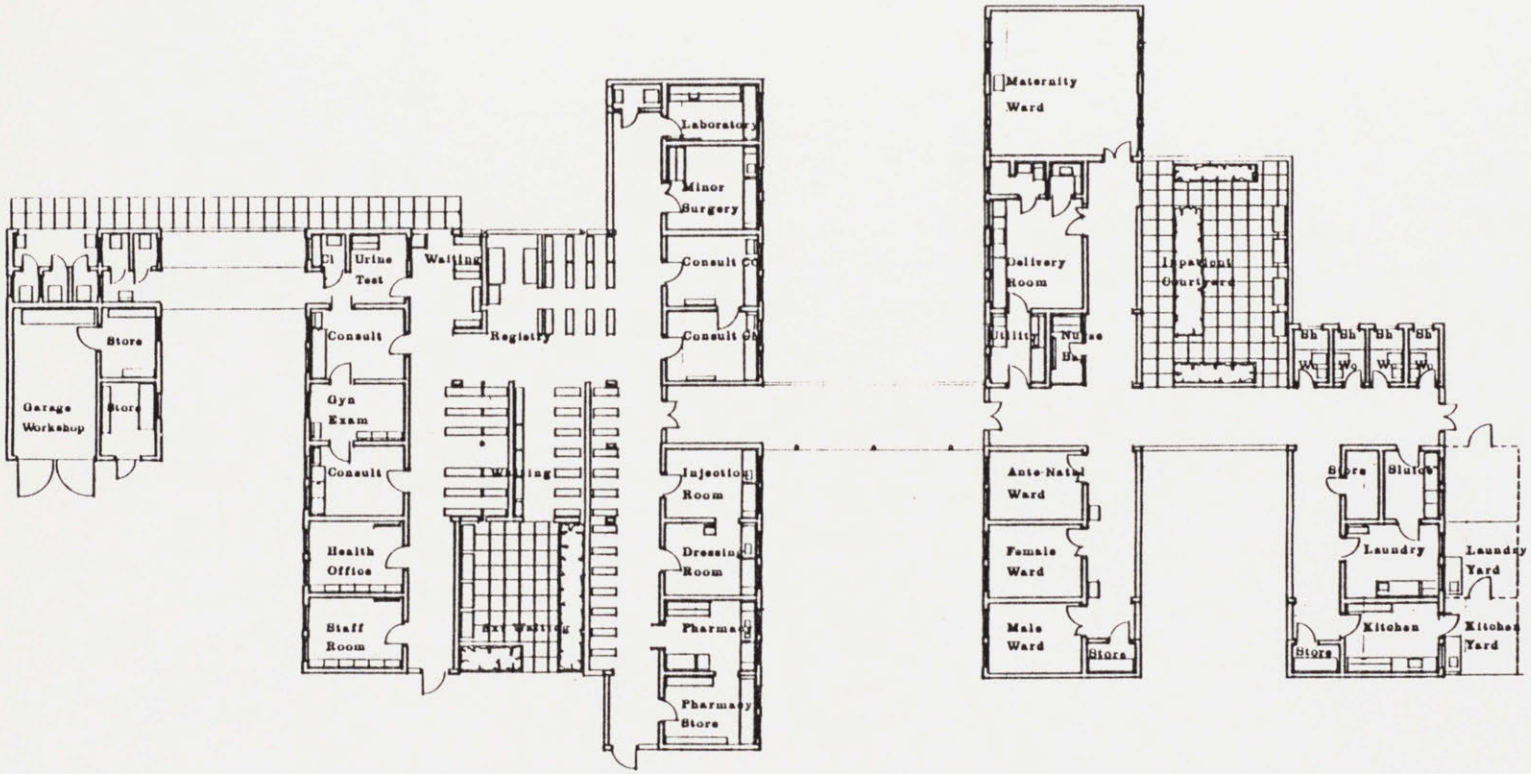
1) concrete foundation strips and walls;
2) reinforced concrete floors with cement screed in all rooms and circulation areas;
3) asbestos roofsheeting, supporting roofstructure of timber;
4) columns supporting roof structure over internal walkways in concrete blocks;
5) roof structure over waiting area supported by steel tube posts;
6) ring beam of reinforced concrete to stabilize lateral loads.

5.2.c Building Units: Standards of Finishes

1) all blockwalls plastered internally and externally;
2) cement painting applied on all exterior plasterwork;

Figure 5.2

KENYAN NATIONAL PROTOTYPE FOR RURAL HEALTH FACILITIES



Type Design
Floor Plan
Health Center

3) washable oilpaints applied on all internal plasterwork and on walls in circulation spaces;

4) ceilings made from polystyrene (for insulation) and 6mm (1/4") asbestos sheet lining;

5) floors with 40mm (1-1/2") cement screed trowelled smooth with steel board;

6) floors in toilets and showers with granulate screeds;

7) all woodwork painted.

5.2.d Building Components: Windows and Doors

1) windows: glass loavered windows, with burgular proofing and mosquito gauze where required, are applied for all climatic zones except for the Upper Highland zone, where steel casement windows are specified.

2) doors: flush doors applied universally, except for doors in garage stores where braced and ledge doors are applied: Upper ventilation openings form part of door frames.

A more detailed list of building specifications for the Type Design is presented in Fig. 5.3.

5.2.e The Outpatient Department

This ward is the heart of the rural health care facility, since it exists in some form of manner in every health outpost, from the smallest Dispensary to the complete Health Center. The reason for the ubiquitous presence of this department reflects documented studies of infectious disease in the rural sector. Illnesses among the rural communities were established largely as being ambulant, i.e. not requiring bed rest to

Figure 5.3 CONSTRUCTION SPECIFICATIONS FOR TYPE FACILITIES

SPECIFICATION NOTES:

FOUNDATIONS

1. All top soil containing vegatable matter should be removed from under the plinth area of the building.
2. Foundation trenches should be dug to a depth at which the ground is solid and undisturbed, the bottoms should be flat and the sides vertical.
3. White ants nests found on the site should be destroyed and filled in properly.
4. Soft spots under the foundations should be filled with mass concrete.
5. Soft spots under the floors should be filled with compacted hardcore.
6. All hard core should be broken stone, well packed, watered and thoroughly rammed down.

FLOOR SLAB

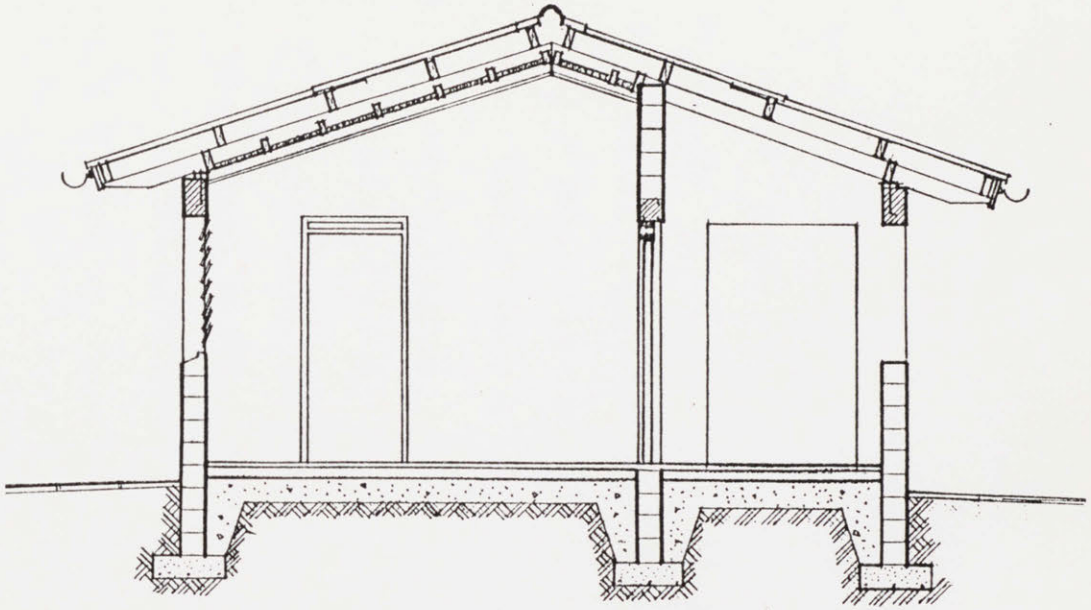
1. Expansion joints should be made as shown on the drawings, i.e. at the junction of slab with external walls and at 2 metre intervals along the verandah.
2. The top of the slab should be trowelled smoothe to provide a finished surface.
3. The concrete must be protected during the first stages of hardening from sunshine and rain by covering with sacking which should be kept wet for 7 days.

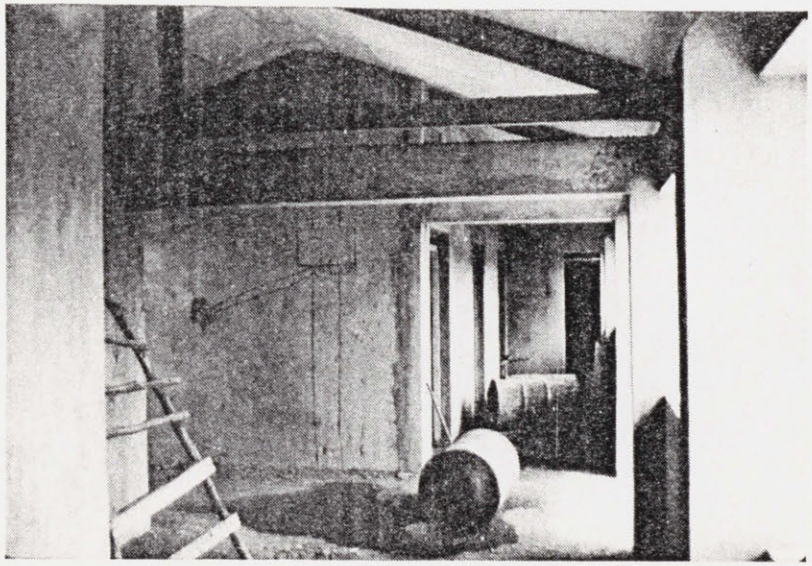
WALLING

1. Concrete blocks should be solid and true to size.
2. All external walls should be 190 x 390 x 190 mm thick. Internal walls should be 190 x 390 x 90 mm thick (140 mm thick if 90 mm blocks are not available).
3. Cement sand 1:5 mortar should be used.
4. Well burnt bricks or dressed stone may be used as an alternative.
5. A D.P.C. of bituminous felt should be installed as shown.

CARPENTRY AND ROOFING

1. All timber should be dry and free of cracks and properly treated with preservative (preferably ordered pressure impregnated).
2. Timbers are generally 'sawn' except for fascias, posts, ceiling battens, frames and skirtings which should be planed.
3. Wall plates should be bedded in cement and secured with 12mm Ø bolts 300 mm long built into the walling at 900 mm centres.
4. Rafters should be secured to wall plates by metal straps 30 mm x 3 mm ( ) thick.
5. G.C.I. roof sheets should not be lighter than 26 gauge.
6. Due to the shallow roof pitch (10°) a minimum end lap of 300 mm should be maintained.
7. Side laps should be 1 1/2 corrugations on the side away from the prevailing wind.





insure recovery. Because the majority of these diseases do not inhibit free movement and because of the psychological benefits of permitting patients to maintain contact with their families and with familiar surroundings, a good outpatient department becomes a critical component throughout the network of rural health facilities.

Another benefit of placing outpatient departments throughout the network of rural health facilities is the ensuing relief of outpatient departments in District Rural Hospitals. Many patients, when left with the option, would approach the rural clinic for their ambulatory complaints rather than travel distances to an overcrowded hospital. The outpatient services available at a rural hospital and a rural clinic are differentiated by greater specialization of services at the rural hospital. Nonetheless, as many as 90 percent of outpatients do not need this level of specialization and can be treated at the Health Center.[1]

In the Type Design, outpatient services are accomodated through three different Units:

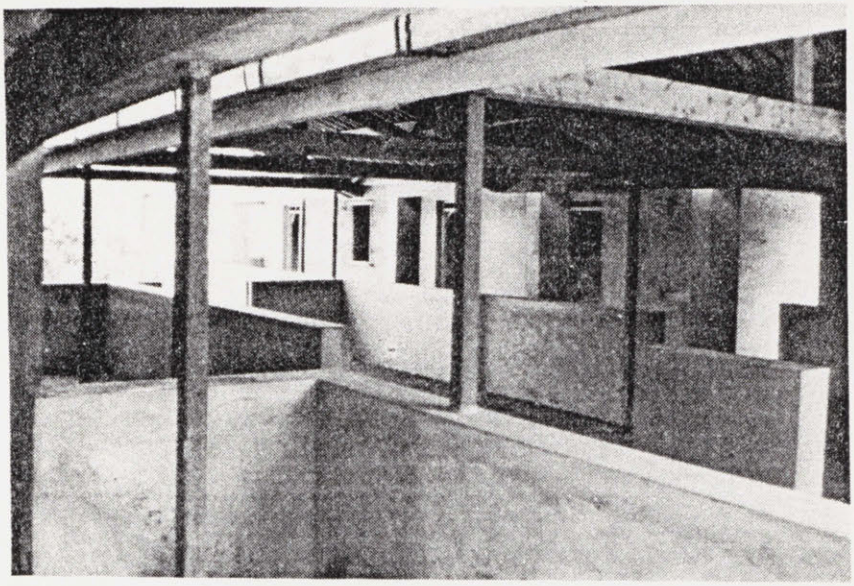
1) Maternity and Child Health Unit
2) Diagnostic Unit
3) Treatment Unit

Diagnostic and Treatment Units are both housed in one single contiguous block, and the Maternity and Child Health Unit is contained in the remaining block of the Outpatient Department (see Fig. 5.2). The Outpatient Department also houses a large waiting space subdivided by 1.15in (3.75 ft.) high permanent concrete walls (see Fig. 5.4). These walls define separate waiting areas for the Maternity and Child Health Unit, the Treatment Unit and the Diagnostic Unit.

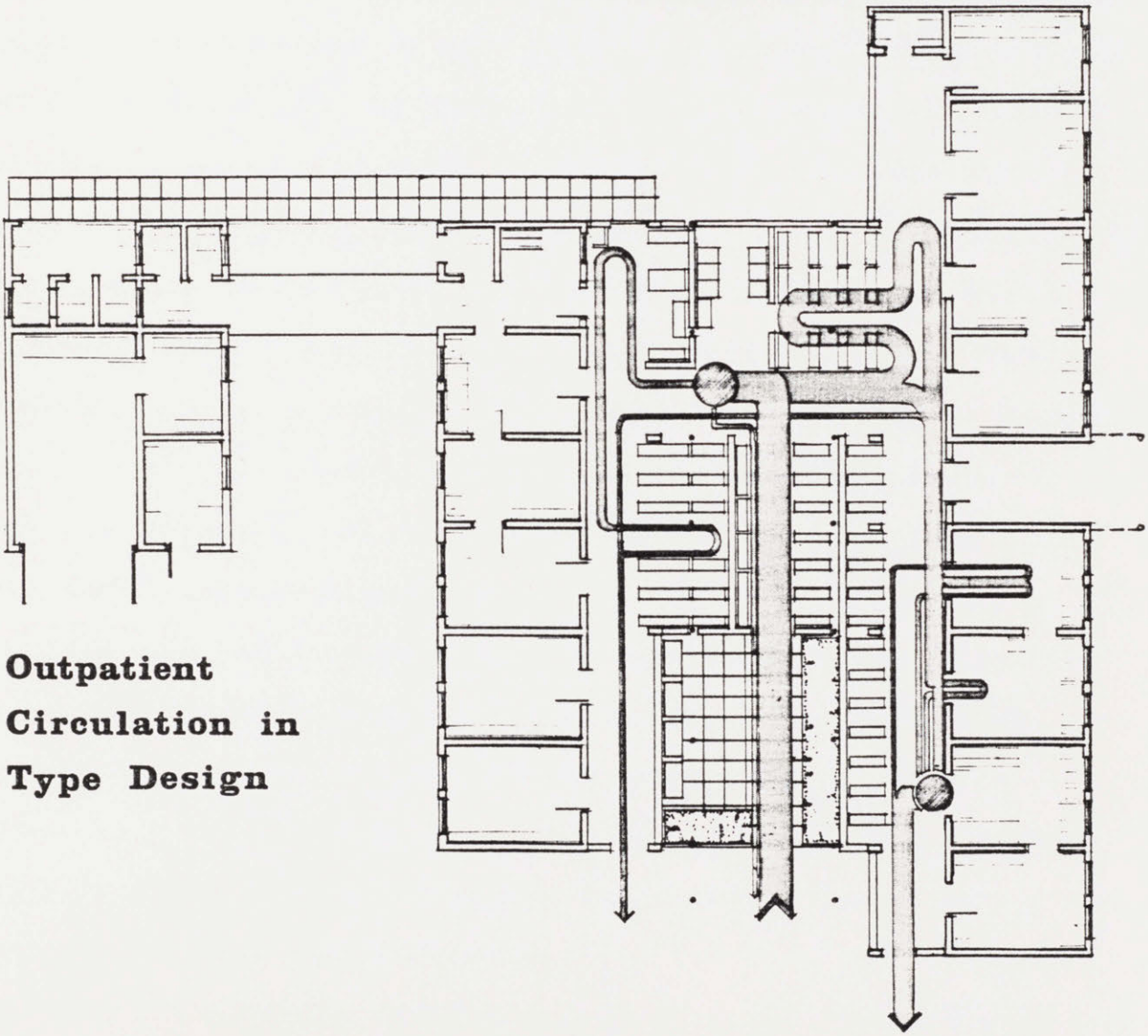
The total area of the Outpatient Department is 325 m^2 (3,490 ft^2) with

Figure 5.4

WAITING AREA/OUTPATIENT CIRCULATION



Interior Waiting Area in Type Design showing permanent partition walls.



Outpatient Circulation in Type Design

the following breakdown:

	m^2	ft^2
Maternity Child Health Care Unit	98	1052
Diagnostic Unit	81	870
Treatment Unit	81	870
Waiting Space	65	698
TOTAL	325	3,490

5.2.f Inpatient Department

The addition of an inpatient department to the outpatient clinic transforms the Dispensary or Health Sub-Center to a Health Center. Because of the requirements for full-time staffing and the ambulent nature of most diseases, these inpatient facilities tend to be small by comparison with outpatient departments. District Hospitals serve as the major repositories for inpatient treatment within the rural health care network. Central facilities like hospitals operate at a scale where the marginal costs of inpatient care are much smaller than those of the Health Center. Moreover, given financial constraints within capital development programs in the rural sector, specialized equipment and personnel are best stationed at a few centralized institutions.

The rural Health Center focuses its inpatient services on maternity care. In order to fulfil this charge, the Type Design specifies the construction of: one Ante-Natal Ward, a Delivery Unit including an Operating Theater, Chemical Toilet and Sluice Space, a six-bed Post-Natal Ward (Maternity Ward), a two-bed Male Ward, a two-bed Women's Ward, a Utility Space, and a Nurse's Station.

The entire Inpatient Department is housed in one contiguous block (see

Table 5.1 with a total area of $171m^2$ (1,840 ft^2).

5.2.g Service Block - Garage Unit

The Garage Unit is housed in a block which is separated from the main complex housing medical services. It is located near the Outpatient Department to facilitate the delivery of supplies. The parking space in the Garage Unit also serves as the Health Center's workshop. In addition, there are two storage spaces for the workshop and yard equipment and four toilets. The total area of the Garage Unit is $57m^2$ (617 ft^2).

5.2.h Service Block - Kitchen/Utility Unit

This Kitchen/Utility Unit houses a laundry, kitchen, sluice space, four showers, four toilets and two storage spaces. This unit is located near the Inpatient Department where it can serve the wards easily, (see Fig. 5.2) and totals $105m^2$ (1,140 ft^2).

5.2.i Circulation and Patient Flow

Waiting spaces and general circulation are prominent components in any health facility plan. The Type Design provides approximately $130m^2$ for general circulation in the Outpatient Department. The Registration Desk is located to facilitate clinic supervision, and the Waiting Areas are integrated with the circulation plan.

The Ministry of Health performed a study on patient arrival and serive patterns at three surveys at Maraqua, Chalambo, and Mariakani. From this study three sets of information were extracted: 1) the outpatient services which are most requested; 2) the sequence in which they are provided; and, 3) the manner in which the Type Design's plan accomodates

this sequence. Patient movement through the Type Design is presented in Fig. 5.4.

5.2j Utilities and Infrastructure

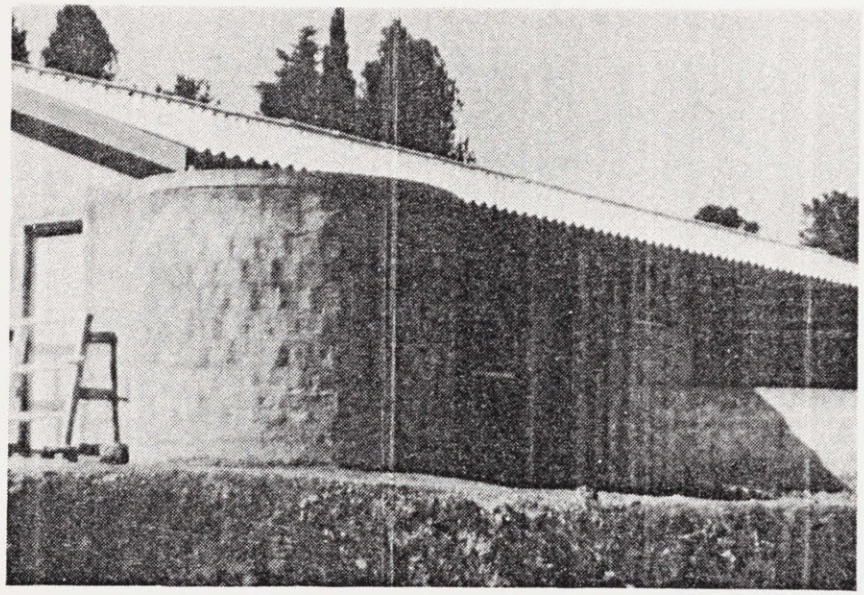
Because of the scarcity of water on otherwise optimal sites, the Type Design provides for the construction of water catchment units. The Type Design specifications for water catchment tanks are as exacting as they are in any other part of the facility. They are built next to the health facility or staff housing and receive water from the gutters along the eaves of the roof (see Fig. 5.5). In addition to these concrete tanks, an elevated tank is used as a backup system and is built on the highest workable point of the site in order to utilize gravity for dynamic force. The Type Design also specifies water-borne sanitation in the form of flush toilets. Sceptic tanks are excavated on site and must be serviced regularly by the Ministry of Works.

Site drainage is provided through surface drains which are lined with small pebbles and imbedded in concrete slabs. A concrete apron surrounds the main building to prevent water seepage around the foundation. All soil which is displaced during site construction is replanted to prevent alluvial eorsion, and soak pits are excavated to expedite drainage on site.

Electricity is the power source for Health Centers. The Health Center limits its use of electricity to lighting for evening clinics between 7-10 pm. Health Sub-Centers and Dispensaries use kerosine or other petro-chemicals as a power source. Because they have no Inpatient Departments these two institutions are able to regulate their hours to daytime service, obviating the need for artifical lighting.

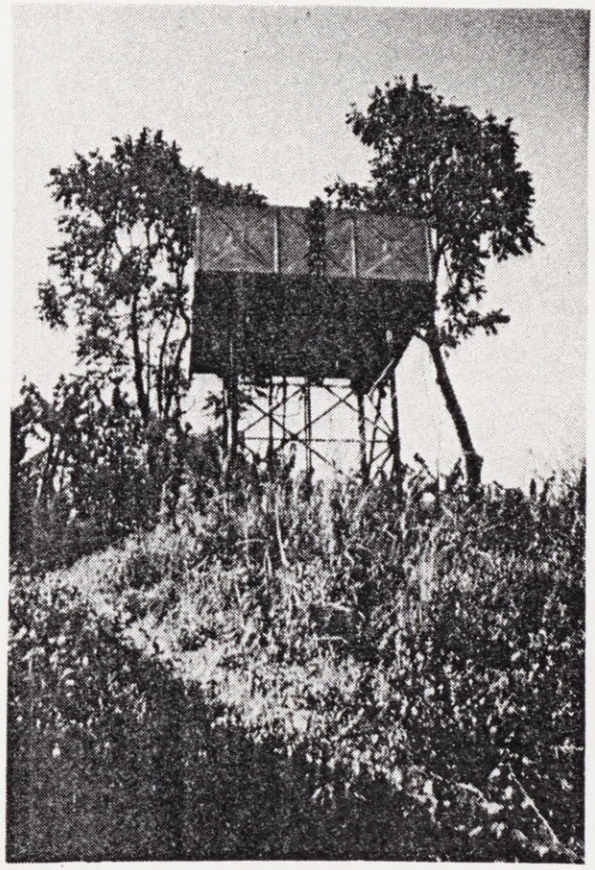
Figure 5.5

SYSTEMS OF WATER CATCHMENT USED ON SITE AT HEALTH INSTITUTIONS



Water Catchment Tank specified in Type Design is located at the gable ends of each facility type. While this catchment system is an integral part of the site infrastructure, it is built to the same standard of permanence as the medical buildings.

Auxiliary Water Tank located at highest buildable point on the site.



5.3 The Type Design - Critique

This critique is presented in two parts. The first part is structured through tables which list the specific room functions within each Department of the health facility. Along with this description, is a breakdown of the spatial dimensions in the Type Design for each room and relevant criticism of these spaces' ability to meet minimal performance criteria.

The second part relates general criticism of the buildings organization and its adaptability under different conditions encountered *in situ*.

5.3.a Medical and Service Unit Critiques

Tables 5.1.a - 5.1.h relate criticism of the Medical Units in the Type Design.

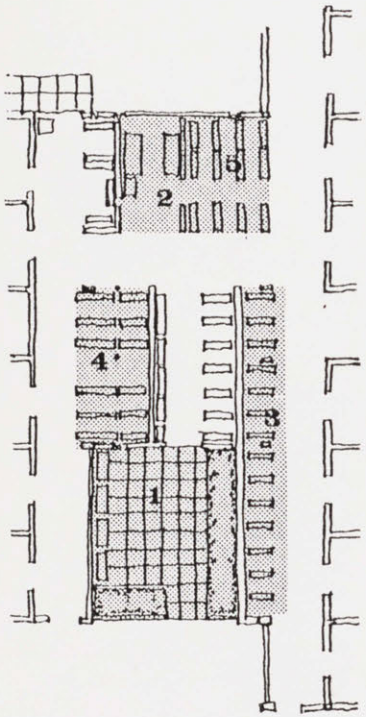
5.3.b General Criticism

In addition to criticism about individual spaces, the Ministry of Health's surveys of the Type Design unearthed comments concerning the buildings overall organization and the specific application of inappropriate construction standards.
inappropriate construction standards.

The spinal organization of circulation and buildings were considered rigid by many of the users. While this reaction may seem essentially aesthetic, the building morphology, combined with standards for permanent structures, creates an intractable environment where spaces cannot be readily modified to suit changing needs. The fact that the Treatment and

Table 5.1a

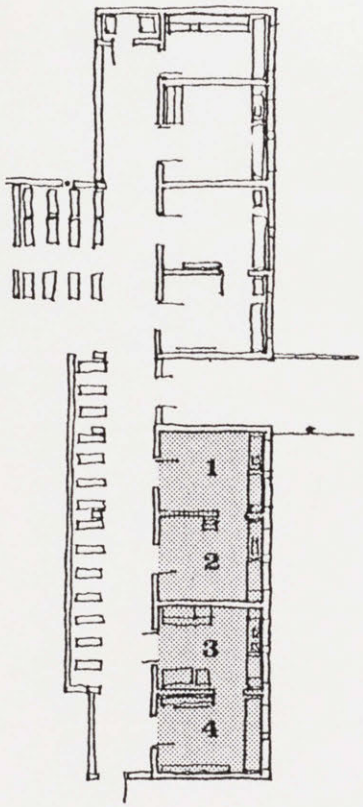
CRITIQUE OF HEALTH CARE CENTER BUILT TO TYPE DESIGN SPECIFICATIONS



Space	Function	Size m²	Comments
WAITING SPACE			
1. General Waiting	1. Used to accommodate flow when specialized waiting areas are filled; also provides a sunlit waiting space. This is the first space patients encounter upon arrival at clinic.	30.0	1. General criticism of the entire waiting area is that it is constrained on either side by permanent structures impeding opportunities for future expansion.
2. Registry	2. Space where patients are screened for use of appropriate outpatient service. Also patient records and files are maintained in this space during clinic hours.	15.0	2. Present location of registration desk fosters an awkward circulation pattern. Its central location between service units and past waiting spaces creates congestion.
3. Treatment Waiting Space	3. Differentiated waiting space for patients who need innoculations, dressing or redressing of wounds, and pharmaceuticals.	28.75	3. Treatment waiting space is undersized.
4. Maternity-Child Health Care Waiting Space.	4. Waiting area for patients who need gynecological pediatric care.	22.0	4. Maternity child health waiting space is oversized.
5. Diagnostic Waiting Space	5. Waiting area adjacent to diagnostic area and registration areas for patients who need minor surgery, or consultations.	22.0	5. Diagnostic waiting space is undersized.

Table 5.1b

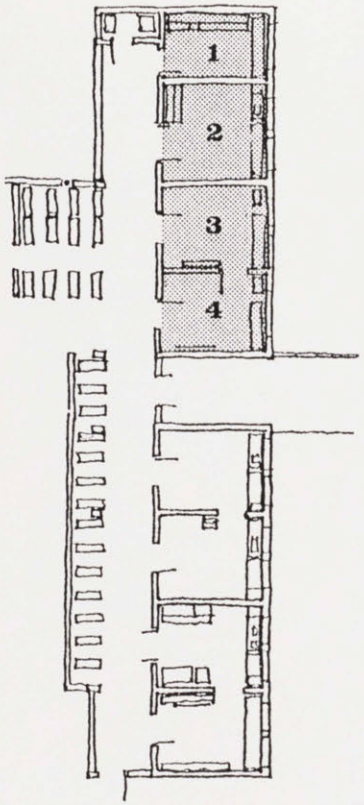
CRITIQUE OF HEALTH CARE CENTER BUILT TO TYPE DESIGN SPECIFICATIONS



Space	Function	Size m^2	Comments
TREATMENT BLOCK			
1. Injection	1. Space used for injections to immunize, administer antiseptics, extract blood samples.	11.0	1-2 It is generally felt that the injections which are done in the treatment block could just as easily be performed in a larger treatment space accommodating another activity, perhaps dressing. Spacial separation could be provided through non-permanent partitions.
2. Dressing	2. Space used for applying bandages, fixing and removing casts.	11.0	
3. Pharmacy	3. Space for the dispensing of drugs to patients and staff upon recommendation of physician.	11.0	3-4 Major criticism is that activity field is constrained by the current $11m^2$ module.
4. Pharmacy Store	4. Drugs are kept and mixed in this room for security and for the additional storage space.	11.0	

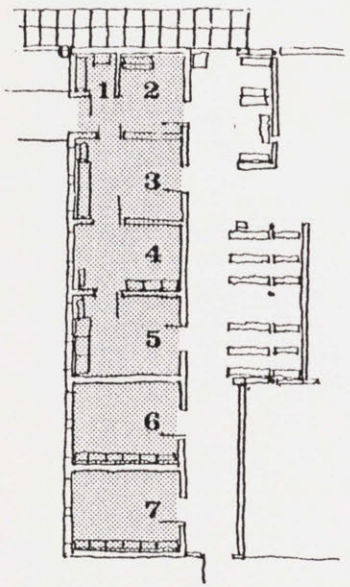
Table 5.1c

CRITIQUE OF HEALTH CARE CENTER BUILT TO TYPE DESIGN SPECIFICATIONS



Space	Function	Size m^2	Comments
DIAGNOSTIC BLOCK			
1. Laboratory	1. Space for haemotologikal and biochemical work: space for urine and stool analysis. Both inpatient and outpatient testing occurs here.	9.75	1. Space is far from Inpatient Department and there is insufficient space for the separation of dirty specimens from clean specimens.
2. Minor Surgery	2. Space needed for minor surgery where antiseptic standards are not very stringent, since no internal surgery is performed, and no operations where general anesthesia are performed.	13.75	2. Since operations are carried out in a non-sterile field, spacial isolation is not necessary. The function could be provided out of another space.
3. Consultation (CO.)	3. Space is used for consultation with the clinic officer.	11.0	3-4 Clinic Officers and Nurses report that this space is too small for the consultation which takes place, often involving more than one patient.
4. Consultation (CN.)	4. Space is used for consultation with the clinic nurse.	11.0	

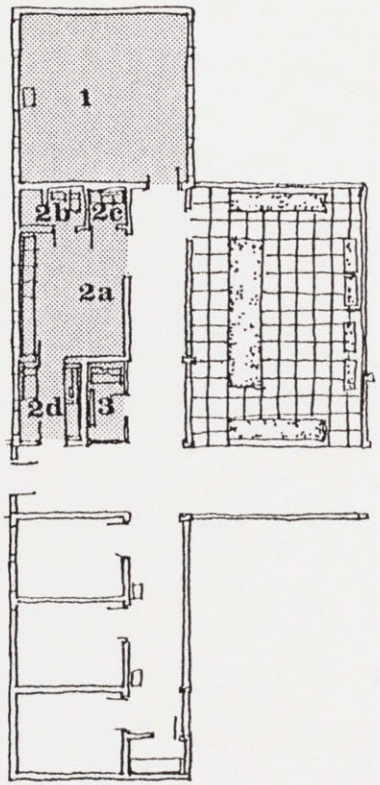
Table 5.1d CRITIQUE OF HEALTH CENTER BUILT TO TYPE DESIGN SPECIFICATIONS



Space	Function	Size m^2	Comments
MATERNITY-CHILD HEALTH UNIT			
1. Water closet	1. Toilet	1.5	1-2
2. Urine test	2. Collection of Urine samples for laboratory testing.	3.75	The need for separate toilet and urine sampling space is questioned. The toilet could be consolidated with another toilet block. Urine sampling could occur in examination space.
3. Consultation	3. Meeting with patients and colleagues over routine matters; examination.	11.0	3-5
4. Gynecological examination	4. Specific use for gynecological patients and physician-prenatal care.	9.75	Two consultation rooms are underutilized. One room could suffice with contingent space provided in examination room.
5. Consultation	5. Meeting with patients and colleagues over routine matters: examination.	11.0	4
6. Health office	6. Health officer for region meets with clinic staff; other health officers.	11.0	Examination room is too small. Should be larger and accommodate space for consultation, urine sampling.
7. Staff room	7. Office within health facility complex where staff meets/retreats.	11.0	6-7
			Health office is underutilized, since health officer is often in the field. This office and staff office could be consolidated.

Table 5.1e

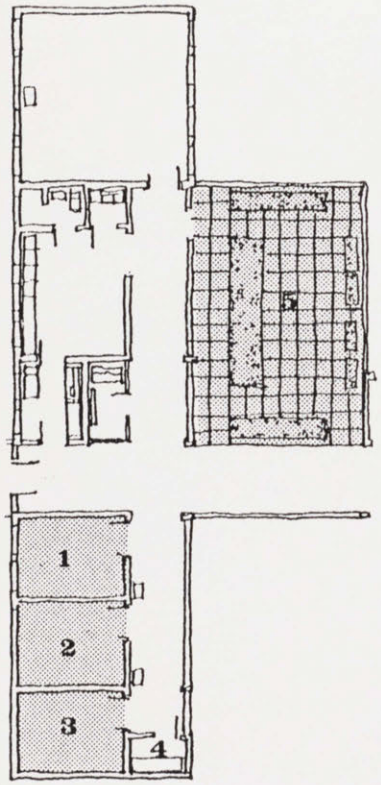
CRITIQUE OF HEALTH CARE CENTER BUILT TO TYPE DESIGN SPECIFICATIONS



Space	Function	Size m^2	Comments
MATERNITY UNIT			
1. Post Natal Ward	1. Room is used for maternity patients after they have given birth. Room is also provided for the children and areas for group demonstration of child care.	36.0	1. Space should be organized to permit post-natal instruction and child care demonstrations.
2. Delivery Suite	2.	24.0	2.
2.a Delivery Room	2.a - Room where deliveries are performed. This space must maintain a sterile operation field.	18.0	2.a - This delivery space is currently too small to accommodate the volume of births which the Health Center encounters. It is suggested that the room be expanded to accommodate a second bed.
2.b Sluice Space	2.b - Room for sterile preparation of utensils and for cleaning of linen. Sterile operating procedure begins here.	3.75	2.b - Direct access should be provided from this sluice space to the Maternity Ward.
2.c Chemical Toilet	2.c - Chemical toilet used during delivery.	3.25	2.c -
2.d Clean Utility	2.d - Space for storage of linen and cloth for delivery room.	7.5	2.d -
3. Nurse Bay	3. Open station for duty nurse of in patient department.	3.75	3. Nurse's station is isolated from the patient wards.

Table 5.1f

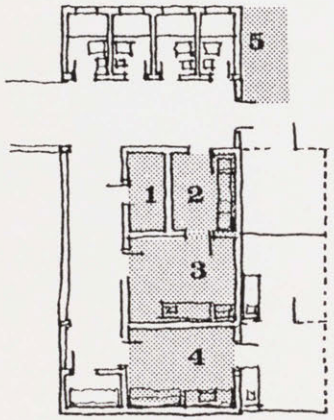
CRITIQUE OF HEALTH CARE CENTER BUILT TO TYPE DESIGN SPECIFICATIONS



Space	Function	Size m^2	Comments
PRENATAL/PATIENT WARDS			
1. Pre/Natal Ward	1. Two bed ward used to accommodate expectant mothers.	11.0	1-2-3 Spacial organization is not criticized, however, major criticism is under-utilization.
2. Women's Ward	2. Two bed ward used to accommodate women afflicted with any infirmity.	11.0	
3. Men's Ward	3. Two bed ward used to accommodate men afflicted with any infirmity.	11.0	
4. Closet	4. Used to store non-medical supplies.	2.0	
5. Inpatient Sunning Yard	5. Outdoor space for inpatients to sun themselves during infirmed period.	54.0	5. Courtyard is enclosed by permanent walls inhibiting possibilities for expansion. Courtyard is not located at each site to take full advantage of natural landscape.

Table 5.1g

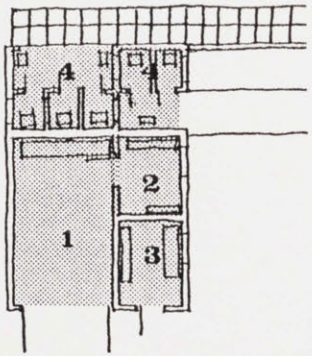
CRITIQUE OF HEALTH CARE CENTER BUILT TO TYPE DESIGN SPECIFICATIONS



Space	Function	Size m^2	Comments
1. Storage space	1. Storage of linen and utensils for kitchen.	4.5	1. Storage is undersized.
2. Sluice space	2. Space for cleansing and sterilizing utensils used in wards, laundry and kitchen.	7.5	2-4-5 General criticism is organizational: Kitchen is considered too close to dirty utility room and toilets.
3. Laundry	3. Washing and cleaning of linen, clothing, etc.	11.0	
4. Kitchen	4. Preparation of food; cleaning of dishes, storage of food stuffs.	11.0	
5. Shower and Toilet Block	5.	4@3.75= 15.0	

Table 5.1h

CRITIQUE OF HEALTH CARE CENTER BUILT TO TYPE DESIGN SPECIFICATIONS



Space	Function	Size m^2	Comments
1. Garage/Workshop	1. Houses the Health Center vehicle and serves as a Workshop for any machining or repairs which can be performed in situ.	21.0	Criticism concerns construction standard to which garage glock is built. This is presented in section 7.2.b.
2. Workshop/Storage	2. Storage space for workshop tools.	7.5	
3. Yard Storage	3. Storage space for compound yard equipment.	7.5	
4. Toilets/Lobby	4. Toilets to be used by Outpatients and Outpatient Department staff.	18.0	

Diagnostic Units of the Outpatient Department, and the Inpatient Department are each housed in 260m long buildings severely limits the site adaptability of the Type Design. With the circulation extending 540m, the Type Design can only accomodate sites with rises of 1 in 10. Steeper inclines require a fundamental reorganization of the Type Design.

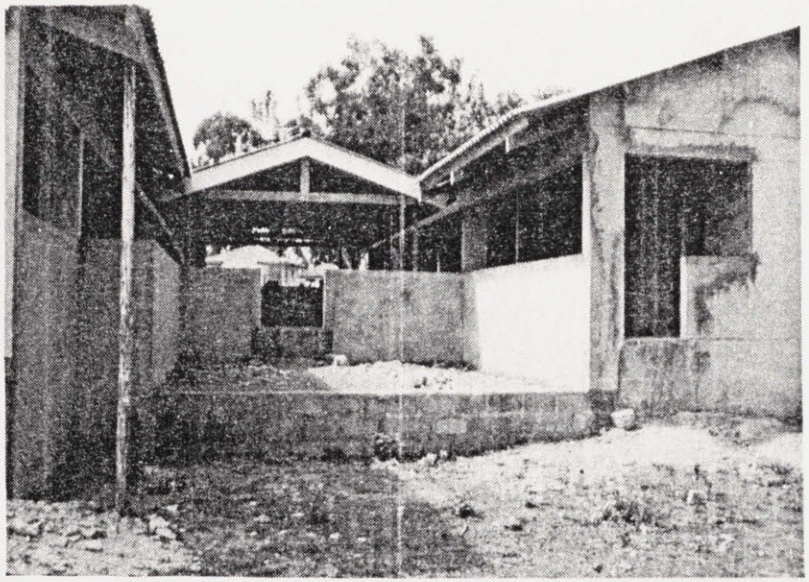
The jutaposition of the Waiting space and the Outpatient Department (see Fig. 5.6) requires 20 meters continuous level land. The Registration Desk is situated at a particularly poor location among the Outpatient Department Units which is exacerbated by its location between permanent structures. The Registration Desk's location creates bottlenecks as patients move from one service to the next. Studies done at Outpatient Departments built to Type Design specification indicate that at least 80 percent of the patients who originally register utilize more than one health service. This means a constant ebb and flow of patients is taking place with the Resigtration Desk functioning as the referral center for patients seeking these services.

Since the Type Design is intended as a national prototype, it should function throughout the country with minimal modification. It is perceived, however, that the Type Design's organization is poorly suited for the arid climate of Northern third of the country. A building morphology which provides shade and protection from wind is optional. The open plan of the Type Design fares poorly by both measures.

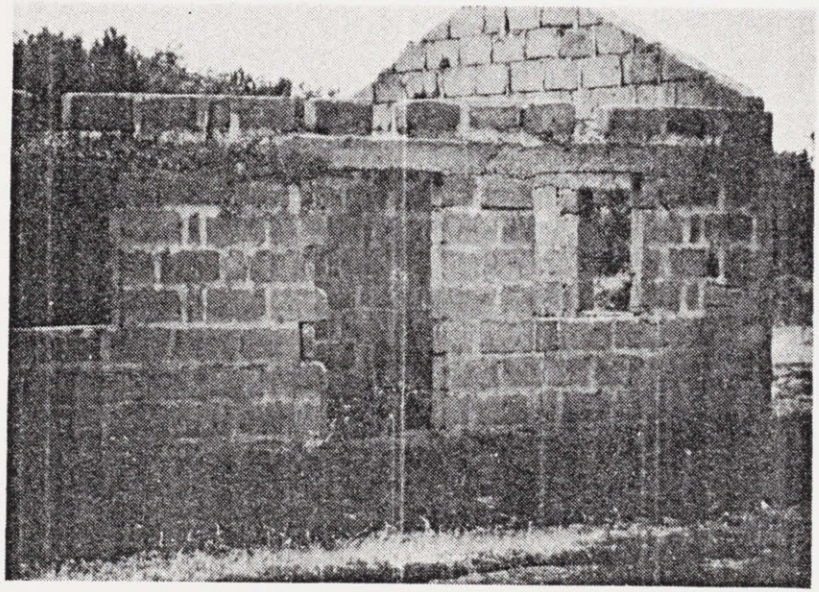
The $11m^2$ room size has been cited as too small for the activities which it shelters. Indeed, as it is uniformly applied, this standardized module forces the users, staff and patients to modify administrative, examination, and medical procedures. Furniture must also be built to

Figure 5.6

EXTERIOR WAITING AREA AND HEALTH BUILDING ABANDONED HARAMBEE



This exterior Waiting Area demonstrates the intractable use of the permanent construction standard in a space which does not require such stringent specifications. In fact, given the changing needs for waiting and registration, this standard does not meet an important criterion for minimal performance: adaptability.



Harambee initiatives have often resulted in facilities which the Ministry of Works refuses to operate (Chapter 4, Section 4.3). This particular staff House fell short of specifications for the ring beam and mortar joint construction.

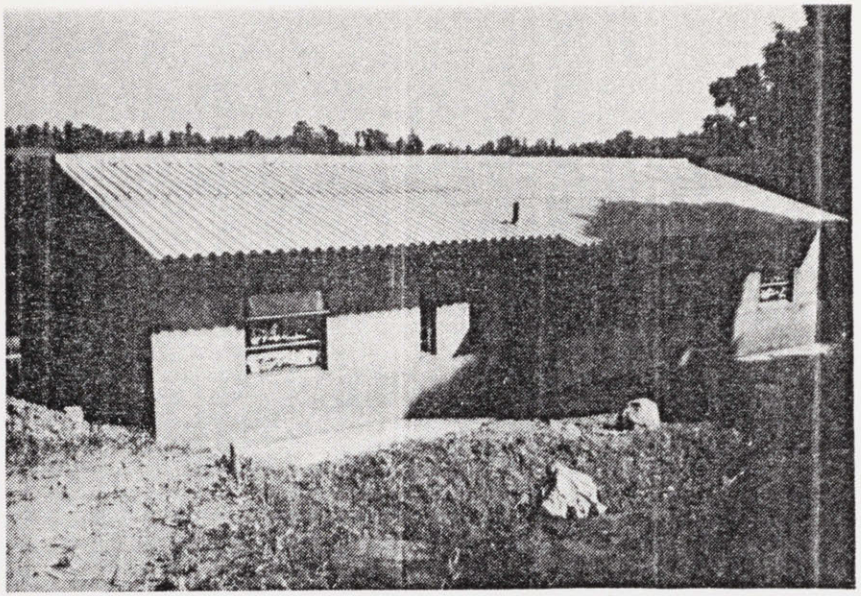
accomodate this room module. Ideally, a space should be built to conform to its functional and physical parameters, and not force users to modify their use. The permanence of building standards imposes on the staff's ability to modify their physical surroundings, and the fact that the module has no differentiation means that this laboratory technician operates out of the same type of space as the gynocologist. While there are rational economic and architectural motives behind some level of spatial standardization, an isolated rural clinic could benefit greatly from a degree of built in fungibility, where the staff could enact minor spatial modifications without requiring major physical or economic expenditures.

Type Design specifications for waterborne sanitation are criticized because water is a scarce and vital resource throughout the functions of a rural health center where medical procedures, laundry and cooking are all important water consuming activities. In addition to the problem of water scarcity, there are basic mechanical difficulties which arise from the use of flush bowls for sanitation. These include:

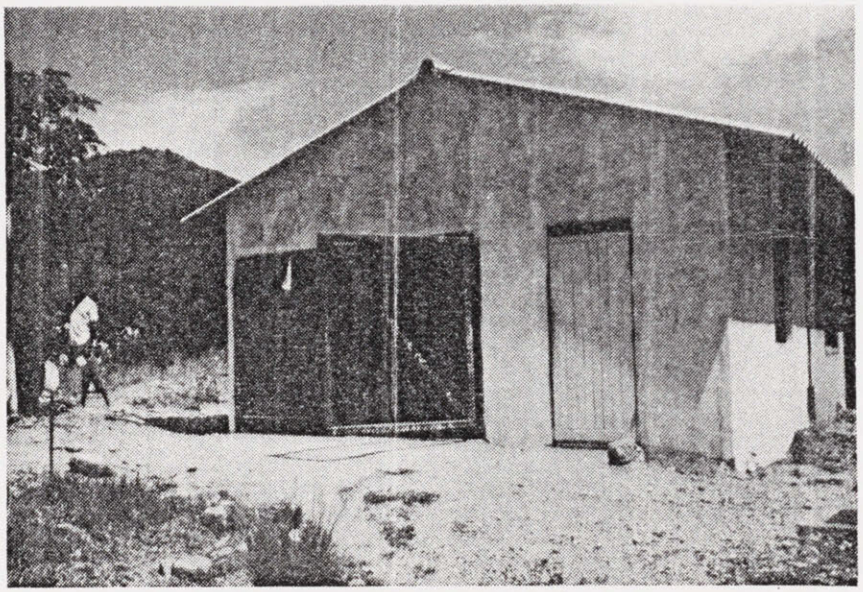
1) the level of water pressure required to fill a flush tank,
2) maintenance of sceptic tanks,
3) blocked sewage pipes.

It has been recommended that the majority of flush toilet facilities be substituted with pit latrines and be upgraded once regular service and water supplies can be assured.

Figure 5.7 : STAFF HOUSE AND GARAGE UNIT BUILT TO TYPE DESIGN SPECIFICATION



Staff Housing, which constitutes even a greater capital expenditure than a complete Health Center, could be easily adapted to using Appropriate Technology, and generate substantial cost savings.



The Garage Unit of the Type Design Health Center typifies a space where an unjustifiably high standard of construction is applied given the budgetary constraint on public sector projects.

5.4 Project Cases: Nyahera, Got Agulu, Ogembo, and Rusinga

This section shall present four cases where rural health facilities are being constructed according to Type Design specifications. Each case demonstrates a different facility type being built under various site conditions. Most aspects of the Type Design implementation are consistent across these examples:

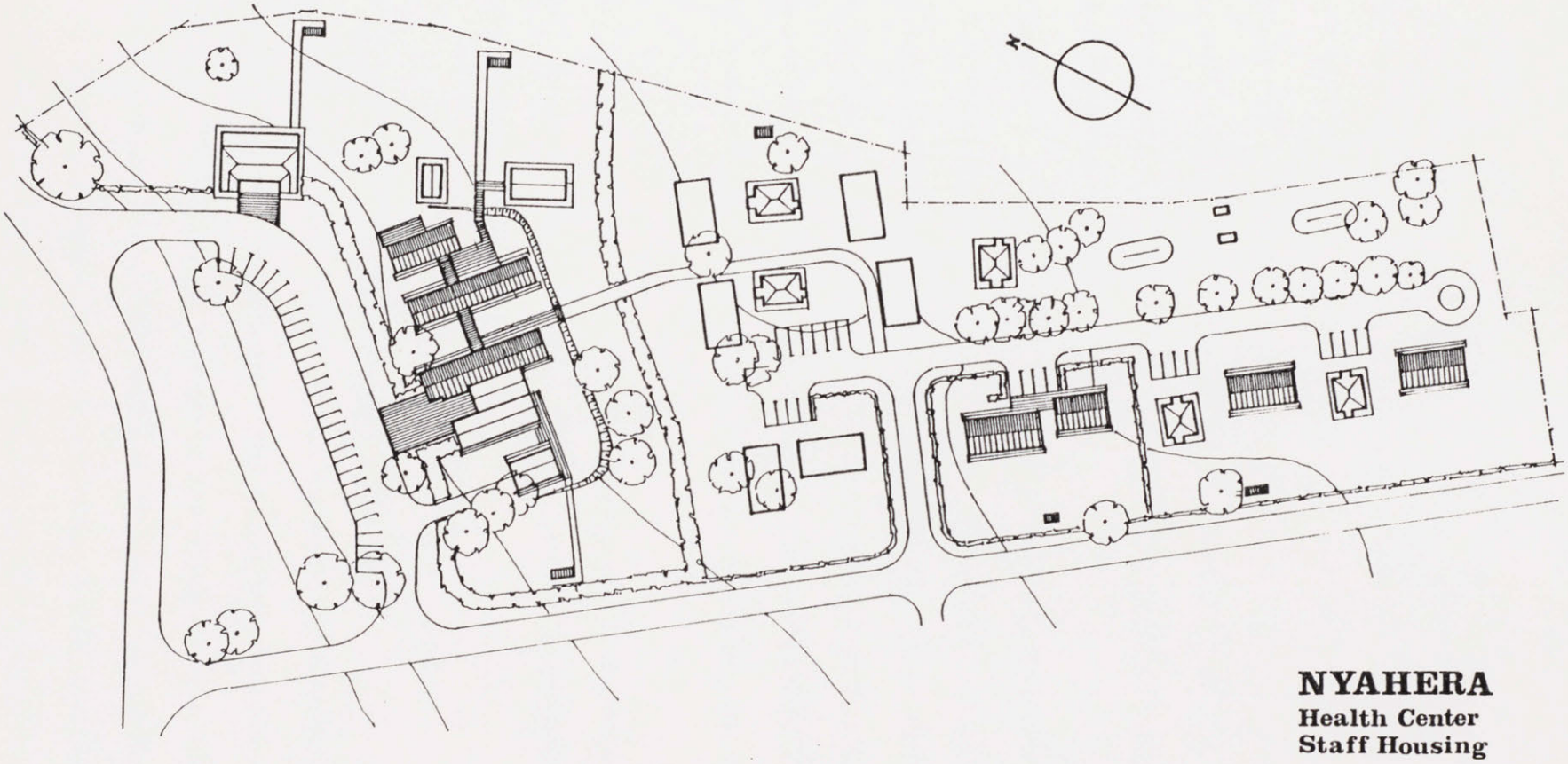
1) All health facilities are organized in compounds consisting of medical facilities and staff houses. The compounds are occasionally fenced off and are always guarded.
2) Each project presented in this section complies with the basic standards for structure, materials, finishes, and components. (See 5.3).

5.4.a Nyahera - Health Center Expansion (Fig. 5.8)

Nyahera is located in West Kenya in Nyanza Province in the Western Highlands. The existing Health Center on this site was designated for upgrading to a Rural Health Unit Headquarters. This upgrading calls for additional capacity for inpatient care, since the existing SIMOHNN facility had reached its operational capacity. The site plan, Fig. 5.8, shows the location of the Type Design Health Center and four units of staff housing. The waiting space and the outpatient department are adjacent to the front tarmac road. The orientation of the circulation spine runs Northeast-Southwest and the medical and service blocks run perpendicularly to the circulation. Thirty parking spaces for the Health Center are located at the front of the facility. Staff parking has been placed at the rear of the site near the staff housing and is reached through a separate service road which runs along the western side of the site. Pedestrians move along a

Figure 5.8

NYAHERA HEALTH CENTER AND HOUSING



perambulatory which connects the staff housing area with the Health Center.

The site is approximately 1,450m^2 and the grade is 1:12. The Type Design is easily assimilated into the site, since the long spine and deep buildings fit onto the contours without major site modifications. The plan presented in Fig. 5.2 is mirrored on this site, and all functional and spacial relationships are preserved as specified by the Type Design plan. The new units of staff housing are integrated with existing housing units on the site. In addition to water borne sanitation, this project calls for pit latrines to serve as back-up units.

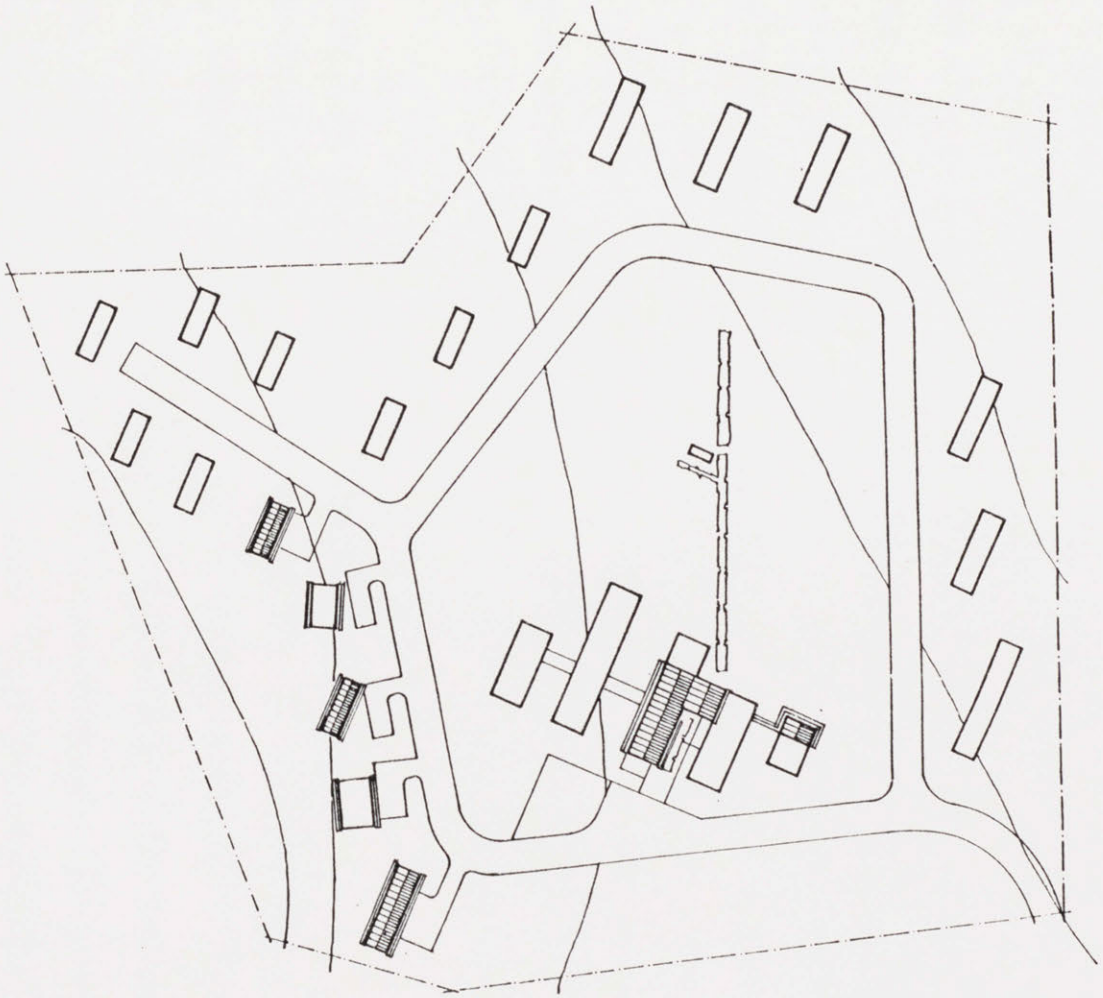
The Nyahera upgrading project shows a straightforward implementation of the Type Design in medical buildings and in staff house construction. Moreover, it typifies most capital expansion projects for rural health facilities, since it entails the extension of an existing institution. Once the new Health Center is complete and operational, the older SIMOHNN clinic shall be renovated into a social center, reinforcing this location as a community focus.

The cost for construction of this Health Center, staff housing, and associated infrastructure is KS 13,540,000 ($1,521,348). The buildings themselves cost KS 8,614,020 ($967,868).

5.4.b Got Agulu - Dispensary - Staff Housing (Fig. 5.9)

This project shows the intervention of the Ministry of Health on a site where a Harambee effort had been initiated. The short term program calls for the construction of a Dispensary, and there are plans for future expansion once the demand and population density necessitate additional capacity. The site has a moderate slope and accomodates both the Dispensary and all plans for future expansion quite readily. At its present stage of

Figure 5.9 GOT AGULU DISPENSARY AND HOUSING PROJECT



GOT AGULU
Dispensary
Staff Housing

completion, this project furnishes a good example of the incremental planning of rural health facilities. The Dispensary is the first facility to be introduced in a catchment area which shall serve 8,000 people. The project also calls for the addition of three new staff houses built to Type Design specifications, and the restoration of three existing housing units. The site, while accessible to several local communities, is fairly isolated and is not adjacent to any other public institution.

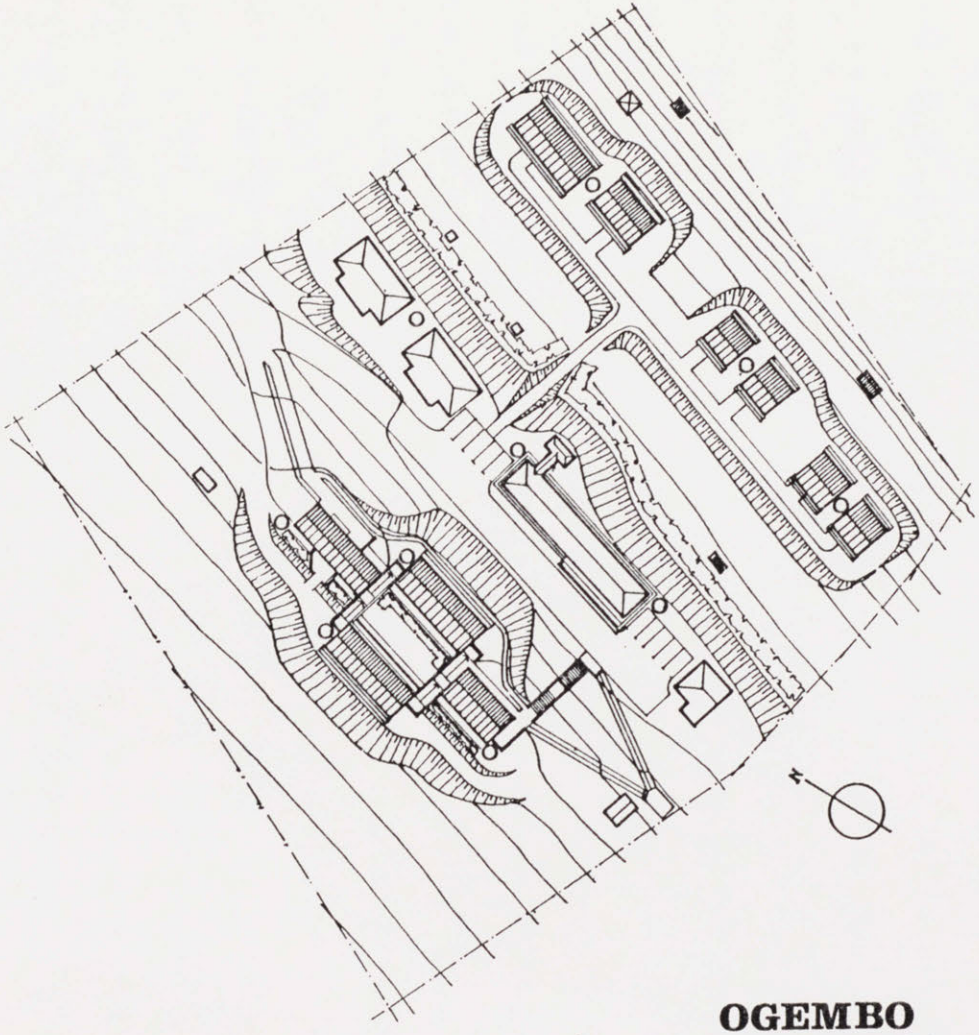
On this site is an abandoned staff house which was constructed through Harambee initiatives. This staff house was not considered for incorporation in the project, because it was constructed without regard for the specifications of the Ministry of Works (see Fig. 5.6). Like Nyahera, this project an extension of an existing health institution which is being expanded as part of a Rural Health Unit. The total projected costs for the Dispensary, Staff Houses, and necessary infrastructure are KS 3,698,340 ($425,545). Of this total, KS 2,366,937 ($265,947) is absorbed by facility construction.

5.4 c Ogembo - Health Center, Staff Houses (Fig. 5.10)

The Health Center at Ogembo required substantial modification of the Type Design organization in order to accomodate this steep site. This site is approximately 1:7 slope and exceeds the adaptability of the Type Design. The site was chosen, because it was the location of an operational Health Center and bounded norrowly by property lines, therefore, physical planners had no option but to modify the standard Type Design floor plan. The extension of the Ogembo Health Center called for the construction of a new Outpatient Department, six new staff houses and the necessary infrastructure e.g. pit latrines, water catchment, sceptic tanks, etc. The existing

Figure 5.10

OGEMBO HEALTH CENTER AND HOUSING



OGEMBO
Outpatient Clinic
Staff Housing

service road was augmented to reach the new facility by placing an additional path at the compound gate directly to the Type Design Garage Unit.

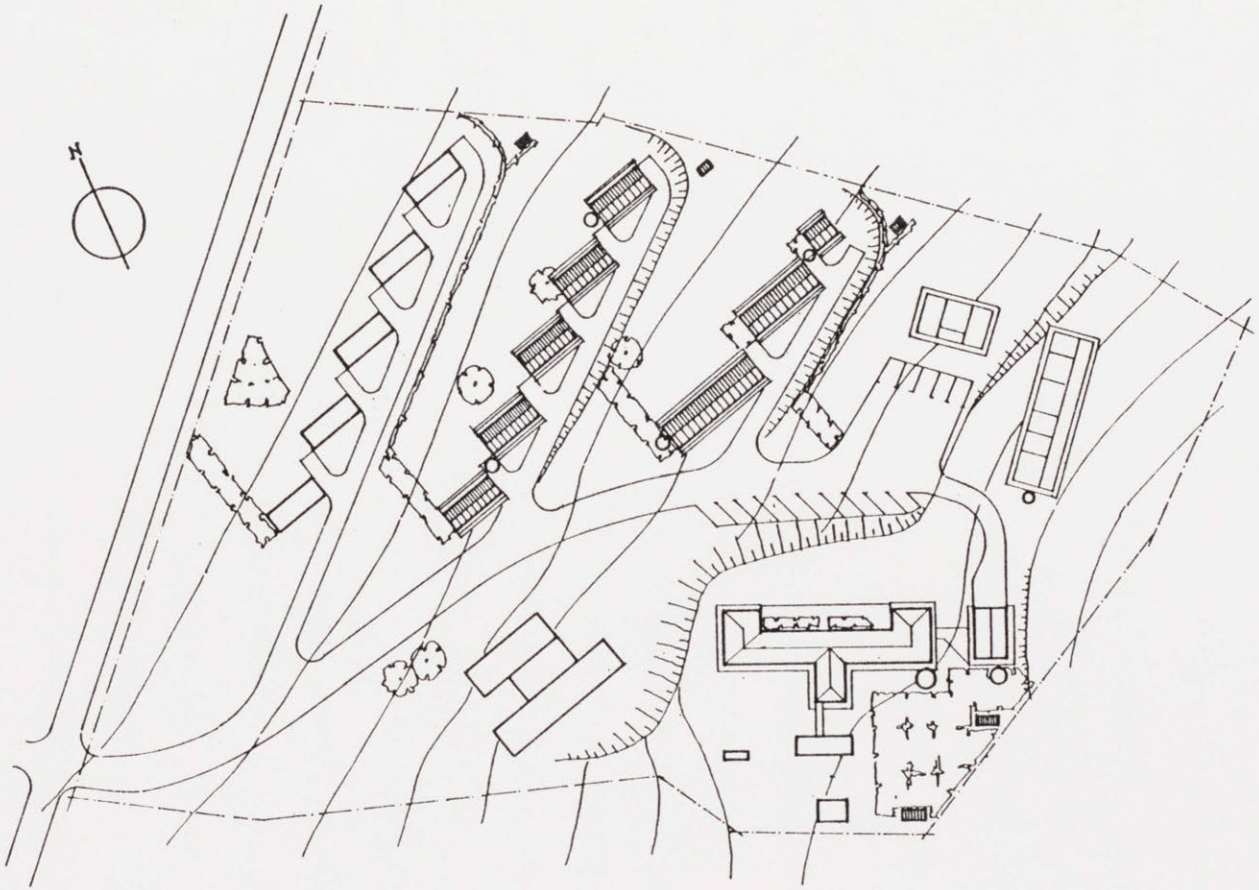
The new staff houses and the water tower were constructed on the Eastern part of the site at the highest point, while the Health Center was placed at the lower Western half. Both clusters of facilities required ponderable site work to provide enough level ground for the floors and the concrete aprons around the buildings. The design of this outpatient center varies significantly from that of the prototype. The plan for the Ogembo Health Center abandons the Type Design spinal organization with in lieu of a courtyard around which circulation and medical blocks function. Because of the rectlinear geometry of the courtyard and the surrounding buildings, this adaptation creates a facility which lies along the contours of the site. The waiting space is placed entirely under the roof of one of the medical blocks. Three foot high walls enclose the courtyard. Existing housing shall continue to be used and the existing SIMOHNN plan outpatient facility shall become an inpatient ward, once the new Type Design is operational.

Capital costs for this project were accumulated largely through site work, since so many site modifications were necessary even after the floor plan for the Type Design had been reworked. Total capital costs were projected at KS 10,442,372 ($1,083,412). Of these costs KS 3,464,252 ($390,028) actually went for facility and housing construction.

5.4.d Rusinga - Staff Housing (Fig. 5.11)

The Rusinga project entails the construction of eight staff houses, one garage block, and five pit latrines. Situated on an island in Lake Victoria, this project posed particular difficulties because of its remote

Figure 5.11 RUSINGA STAFF HOUSING



RUSINGA
Staff Housing

location and the occasional breakdown of the ferry which is the only link to the mainland and suppliers. Excavation for the pit latrines and sceptic tanks was also exacerbated by the heavy bedrock foundation.

Although this project calls for staff housing, a new Outpatient Department shall eventually be constructed on site according to Type Design specifications, leaving the operational SIMOHHN clinic to serve inpatients. The site will easily accomodate the Type Design because of its moderate slope. The capital costs for this project was estimated KS 6,797,604 ($763,546). Buildings constituted KS 1,450,155 ($488,920) of these costs.

5.5 Summary

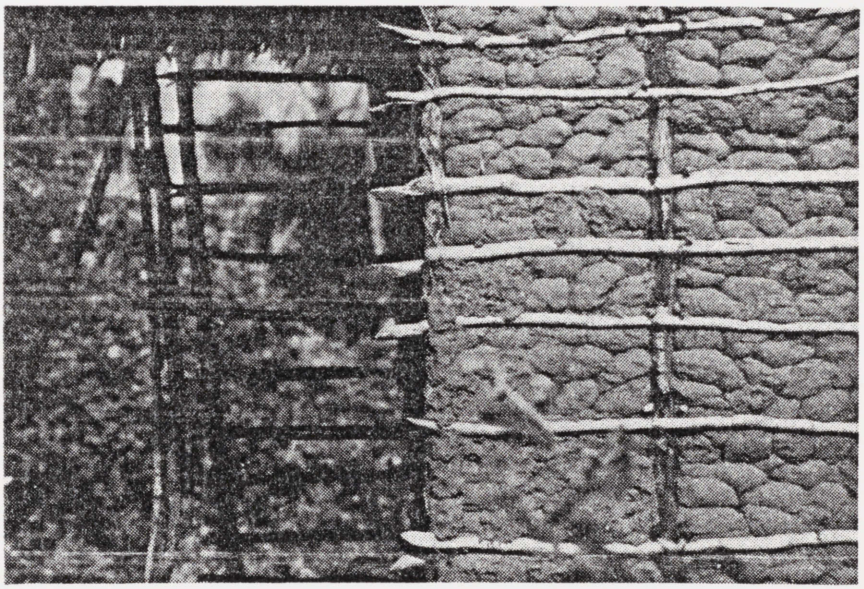
These four projects demonstrate the range of implementation of the Type Design. There were several problems associated with the actual construction, the greatest resulting from poor supervision of labor and the distance of sites from manufacturing centers. Often sub-contracted portions of the facility when they had not secured authorization from the Ministry of Works. The result was that many portions of the facility had to be rebuild, since Type Design specifications were ignored by the sub-contractors who were often local craftsmen unused to this building standard. There were several instances where concrete block was laid poorly at the gable ends of roofs or where retaining walls were poorly constructed. Dowels had often been left out of the ring beam during their casting and holes had to be drilled into the ring beam where dowels were subsequently grouted in order to fasten the sill plate. Each of these problems slowed progress down considerably and construction which had been originally scheduled for three months extended beyond a year.

The adaptation derived at Ogembo demonstrates the basic rigidity of the

Type Design. In this instance, the floor plan had to be radically altered, creating a new set of architectural problems arising from the new plan, namely an unresolved patient circulation, constricted waiting spaces, and drastic site engineering to accomodate the modified design.

These projects also demonstrated the varied costs of facility construction throughout Kenya. Capital cost fluctuations reflect the distance of sites from main supply centers and constitute significant implemtational and economic constraints in increasing the capital base in the rural sector. The next chapter will examine the possibilities of alleviating this constraint by integrating appropriate technologies in construction of health facilities.

Chapter 6



USE OF APPROPRIATE TECHNOLOGY

6.1 Introduction

As a means towards reducing economic constraints in the implementation of the Capital Facilities Expansion Program, this study proposes the integration of locally indigenous building systems with those of a more permanent standard. Such a notion has been advanced by physical planners for health care facilities;

> "...it is neither necessary nor desirable for all medical buildings to be built to the same standard,...." [1]

Unfortunately, few attempts have been made to integrate locally indigenous construction with rural medical facilities, particularly when these facilities are constructed through government agencies. Where the imperative exists for expanded rural clinic based health care, any viable means of making this care economically feasible should be entertained. In the area of facility construction in Less Developed Countries, the selective use of indigenous building systems offers an opportunity to accommodate clinic based services. However, in utilizing these systems functional constraints are as important in the selection process as economic considerations for cost reduction.

These functional constraints reflect the services which are performed in the health facility, the interaction among physicians, staff, and patients and the technical requirements which are inferred from these services. In order for the building system selection process to respond to these functional constraints, minimal performance criteria must be explicit. A minimal performance criterion is defined as the least requirements a building system must satisfy in order to be considered fit for its intended use.[2]

These minimal performance criteria, therefore, delineate the lower boundary in selecting a building system by assuring that the goal of cost minimization does not override the fundamental need for building a functional facility.

This chapter presents a planning process which relies on studies of space utilization to determine the minimal performance criteria which spatial organization, building components, and construction methods must accommodate. Each phase of analysis and recommendation in the planning process considers the facility's program in selecting an appropriate building system for use in the health center.

The phases of the planning process are presented in the following sections. Collectively, these phases project spatial organization or construction methods which achieve goals of:

1) cost minimization;
2) eventual upgrading;
3) incorporation of construction methods which occur over the broad geographic and climatic ranges where facilities will be constructed;
4) fitness for intended use in health care facilities.

The phases of the planning process will be followed chronologically. A program for the facility; Health Center, Health Sub-Center, or Dispensary is given. From the services outlined in the program, affinities are established and lead to the functional grouping of these services. Given the nature of this study, where different levels of technology are integrated into one building, a determination of building standard affinities is also essential. Finally, the capital costs for the facility are estimated,

based upon the selection of appropriate building systems which meet the minimal performance criteria.

This last phase actually represents an assemblage of several iterative stages where the exact building systems are selected among all available options and the associated construction costs are used to project the capital expenditure necessary to implement the project. In practice these steps call for the careful integration among the complementary structural, roofing, enclosure, and walling systems.

The next section applies each phase of the planning process in determining the appropriate use of local technologies in the facility construction. In each phase, the procedure is explained, criteria for solutions are stated and the actual procedure is outlined.

6.2 Phase A - Facility Program Square Footage

This phase presents the pragmatic information for the facility types and their square footage. Adjustments in grass area have been made over those in the Type Design, based upon the pertinent/user critique presented in Chapter 5. The major modification results in increasing the size of service rooms from 11 m^2 to 13.5 m^2 in response to consistent comments concerning the undersizing of rooms. The following breakdown for the Units is proposed.

6.3 Phase B - Standards of Construction

This phase in the planning process establishes the functional affinities among space in the Health Center, Health Sub-Center and Dispensary.

TABLE 6.1 SQUARE FOOTAGE ADJUSTMENTS FOR HEALTH CENTER

	m^2
OUT-PATIENT DEPARTMENT	
Preventative Unit	114
Diagnostic Unit	75
Treatment Unit	121
Waiting and Registration Area	79
IN-PATIENT DEPARTMENT	
Maternity Unit	114
Ante-Natal/General Ward	60
SERVICE UNITS	
Utility Unit	77
Garage Unit	40

Subsumed in this information of affinities are:

1) the specific services to be performed in a space;
2) the spatial relationships desired by the staff in optimizing the delivery of these services;
3) the sequence of services requested by the patients.

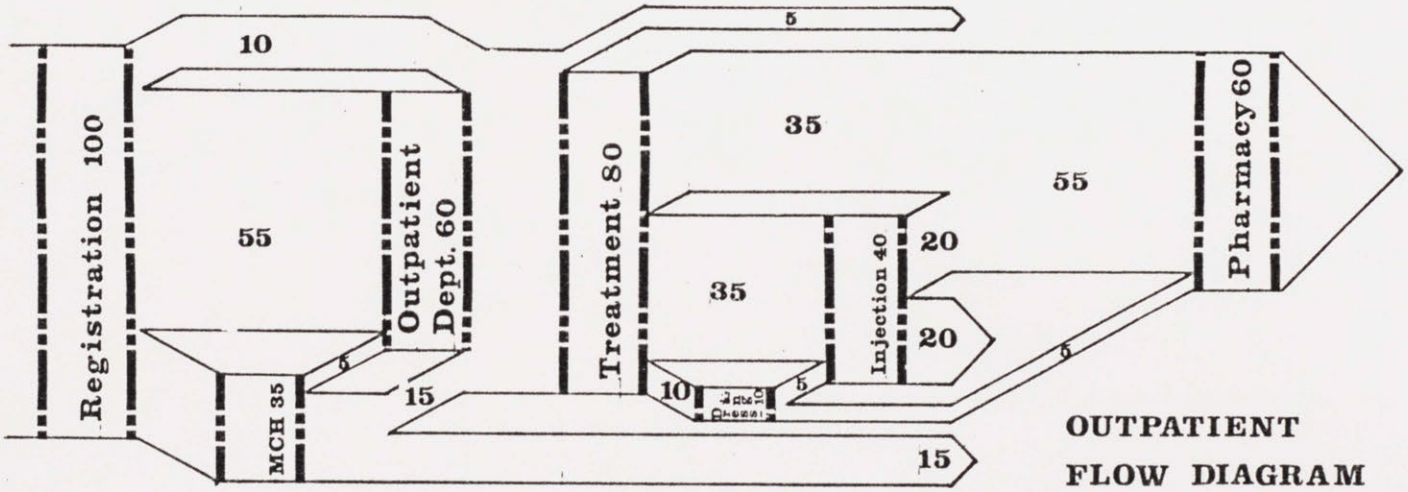
Information in the first category is obtained from the Ministry of Health's program for rural health care facilities. Other sources included Design for Medical Buildings by Phillip Mein and Thomas Jorgensen and the World Health Organization's series entitled Approaches to Planning and Design of Health Care Facilities in Developing Countries. These references provide a detailed account of functional requirements of spaces in medical facilities in Less Developed Countries. The surveys which the Ministry of Health conducted on the Type Design also uncovered significant patterns in patient utilization which edify the formation of affinity groupings.

Information under the second heading was sourced from the surveys where staff pointed out opportunities for improved service through a more efficient spatial organization. The third category relies on data from survey results which related the percentage of patients who utilize specific services during their visits (see Fig. 6.I).

The development of spatial affinities is bounded by the medical units in each department, e.g. Outpatient Department: Treatment Unit, Diagnostic Unit, etc. Since the Outpatient Department of the Health Center and Health Sub-Center are identical, the spatial affinities for this department are illustrated once. The illustration of Inpatient Department affinities refers only to Health Centers.

Figure 6.1 OUTPATIENT FLOW AND UTILIZATION DIAGRAM

This diagram depicts the utilization of outpatient services and the general sequence of service utilization according to surveys conducted by the Planning and Implementation Unit of the Ministry of Health.



Spatial Affinities:

Outpatient Department

m.c.h. care

	CONSULTATION	EXAMINATION	URINE TESTING	PUBLIC HEALTH OFFICE	STAFF MEETING/RETREAT	WAITING/CIRC.
CONSULTATION		0				
EXAMINATION			-			
URINE TESTING		+	0	0		
PUBLIC HEALTH OFFICE		-	-	-	+	
STAFF MEETING/RETREAT		0	-	+	-	
WAITING/CIRC.		0			+	

treatment

	DRESSING	INJECTION	PHARMACY DISP.	PHARMACY STORAGE	WAITING/CIRC.
DRESSING		+			
INJECTION			+		
PHARMACY DISP.		+	0	0	
PHARMACY STORAGE		+	+	+	+
WAITING/CIRC.		0		+	

diagnostic

	SCEPTIC OPERATIONS	CONSULTATION	LABORATORY	WAITING	CIRCULATION
SCEPTIC OPERATIONS		0			
CONSULTATION			0		
LABORATORY		0		+	0
WAITING		-	+		0
CIRCULATION		+		-	

reg.

	REGISTRATION	WAITING/CIRC.
REGISTRATION		
WAITING/CIRC.		+

+ = adjacency desirable

- = adjacency undesirable

0 = neutral

Spatial Affinities:

Inpatient Department

maternity

MATERNITY							
ANTE-NATAL	0						
DELIVERY	+	+					
SLUICE	+	0	+				
NURSES STATION	+	+	+	+			
	0	+	+	-	0		

general

CIRCULATION	0	0	-	0	0		
MEN'S WARD	+	0	0	0	0	0	
WOMEN'S WARD	+	+	0	0	0	+	
TOILET'S	-	+	0	+	0	-	
UTILITY CLOSET	0	0	0	+	0	+	+
SUNNING COURT	0	0	0	+	0	+	-

service

STORE							
SLUICE	0						
LAUNDRY	+	+					
KITCHEN	+	-	0				
SHOWERS	0	-	-	-			
TOILETS	-	0	-	-	-		
	+	-	-	-	-	-	

+ = adjacency desirable

- = adjacency undesirable

0 = neutral

Spatial Affinities:

Garage Block

TOILETS				
GARAGE/WORK SHOP	0			
STORAGE-WORKSHOP EQUIP.	+	-		
STORAGE-YARD TOOLS	0	0	0	
CIRCULATION	0	0	0	+

+ = adjacency desirable

- = adjacency undesirable

0 = neutral

These affinities consider functional relationships and recommend strict adjacencies or separations. The impact of the construction methods on building these adjacencies should also be considered in the planning process.

In order to optimize the full range of technologies which are suited to the minimal performance criterion of the Health Center, three sets of building standards are prepared for this study:

Permanent: Construction methods which comply with performance standards for cleanliness, sanitation, maintenance and comfort which are best met by materials of long maintenance and replacement cycles.

Temporary/ Improvable: Construction methods which comply with performance standards which can be accommodated through using materials with shorter life cycles than those under the permanent heading: yet, which have highest priority for upgrading to permanent construction, as capital becomes available.

Temporary/ Replaceable: Construction methods which comply with performance standards yet which have no requirement for upgrading over the facility's life cycle.

It is understood that within each cohort there are many gradients of permanence represented by building technologies throughout Kenya which have different life cycles. Each of these three categories will encompass many choices, where the final selection will depend upon the available technolo-

gies encountered in situ. Some technologies, particularly the Temporary/ Improvable will result from some innovation on indigenous technologies.

The following considerations form the basis for deciding the appropriate level of building standards:

1) Service requirements: Some services performed in a health facility require a standard of cleanliness or sterility which influence the selection of appropriate building materials.

2) Requirement for infrastructure: Water and electricity are the essential infrastructure components in the rural health facility. Water is used extensively in providing health services; however, not every service requires water to be tapped directly into a room. Those services which do require tapped water benefit functionally from adjacencies "+" or are neutral "0" may, in fact, share a "wet" wall. The minimum standard used in the construction of "wet" walls will vary from one site to the next. One illustrative precedent in this use of appropriate building technology is the Katangi Agricultural Project of the Unduga Society of Kenya. This project grouped all "wet" functions; kitchen, bath and shower, in central cores which were built of permanent materials. In the construction of health care facilities, the location of wet walls would imply logical grouping of certain services and advance the goals of economical construction and maintenance.

3) Utilization: frequency of visits by patients; frequency of use by staff. Throughout the facility there are spaces which are

utilized at different levels. Surveys of the Type Design Outpatient Departments, conducted by the Ministry of Health identified the utilization rate of each service per 100 patients. This information is presented in Fig. 6.I, which also shows the general sequence of outpatient services. When these data are supplemented with the time required to perform each service, a level of space utilization is established. In services which are highly utilized there is a greater opportunity cost associated with time to replace or maintain these spaces than for those which have low utilization rates. This information relates one minimal performance criterion. A permanent structure will permit fewer interruptions in service over the life cycle of the facility. In the case of highly utilized services, e.g., the Pharmacy, the benefit of building a permanent standard is that it permits essential services to be provided, uninterrupted by frequent calls for building maintenance and repair.

Staff utilization should also figure prominently in the decision to use building materials of extended life cycles. As the staff utilized certain spaces which patients do not, the planner must not base the appropriate selection of a permanent, temporary-improvable or temporary-replaceable standard of construction solely on patient utilization.

The following matrices list the facility spaces and indicate the appropriate selection of permanent (P), temporary/improvable (T/I), temporary/

● optimal ● required ● utilization level

⊙ feasible ○ not required

	SERVICE REQUIREMENTS				INFRASTRUCTURE-WATER			STAFF PATIENT UTILIZATION				
	P	**T/I**	**T/R**		**H**	**C**		**Hi**	**Lo**	**Hi**	**Lo**	
REGISTRATION			●		○	○			●	●		
WAITING			●		○	○			●	●		
CONSULTATION	●	⊙			○	●		●			●	
EXAMINATION	●				●	●		●		●		
URINE TESTING		●			○	●			●		●	
PUBLIC HEALTH		●	⊙		○	○			●		●	
STAFF		●			○	○		●			●	
DRESSING		⊙			●	●			●		●	
INJECTION		⊙			○	○		●		●		
PHARMACY DISP.	●				○	○		●		●		
PHARMACY STORES	●				○	○		●			●	
SCEPTIC OPERATION	●	⊙			○	○			●		●	
CONSULTATION		●			○	○		●		●		
LABORATORY		⊙			○	○		●			●	

● optimal ● required ● utilization level

▒ feasible ○ not required

	SERVICE REQUIREMENTS				INFRASTRUCTURE-WATER			STAFF PATIENT UTILIZATION				
	P	**T**	**I**	**TR**	**H**	**C**		**Hi**	**Lo**	**Hi**	**Lo**	
MATERNITY	●	▒			○	○			●	●		
ANTE-NATAL	●	▒			○	○			●	●		
DELIVERY	●				●	●		●		●		
SLUICE	●				○	○		●			●	
NURSES STATION		●	▒		○	○		●			●	
WOMEN'S WARD		●			○	○			●		●	
MEN'S WARD		●			○	○			●			
TOILETS/SHOWERS*		●	▒		●	●				●		
UTILITY CLOSET		●			○	○		●			●	
KITCHEN	●	▒			●	●		●			●	
STORAGE		●			○	○			●		●	
LAUNDRY	●	▒			●	●		●			●	

● optimal ● required ● utilization level

▒ feasible ○ not required

	SERVICE REQUIREMENTS				INFRASTRUCTURE-WATER			STAFF PATIENT UTILIZATION				
	P	**T/I**	**T/R**		**H**	**C**		**Hi**	**Lo**	**Hi**	**Lo**	
GARAGE/WORKSHOP			●		○	○			●		●	
STORAGE - EQUIPMENT		●	▒		○	○			●		●	
STORAGE - YARD TOOLS		●	▒		○	○			●		●	

replaceable (T/R). From studies performed at the Appropriate Technology Village in Karen, Kenya, and from the Undugu Housing Project the following costs per square foot are assumed for the temporary/improvable and temporary replaceable technologies:

Temporary/Improvable	912 KS/m^2
Temporary/Replaceable	450 KS/m^2

The permanent construction standard will assume to be similar to that in the Type Design and therefore accrue the same cost per square meter as that facility.

Permanent	2,006 KS/m^2

These costs will, therefore, be used to compare an Alternative which uses appropriate technology where possible with the Type Design. A range of sensitivities will be explored to determine any advantage one facility type has over the other is invariant under different conditions of opportunity cost of project funds, location of the facility, and the operational life of the facility.

On the basis of the programmatic assessment for technical requirements of health facility spaces, the following areas were determined for each building standard:

Permanent	280 m^2
Temporary/Improvable	271 m^2
Temporary/Replaceable	112 m^2

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Figure 6.2 DETAILS SHOWING THE USE OF MUD BRICK OR CONCRETE BLOCK IN WALL CONSTRUCTION

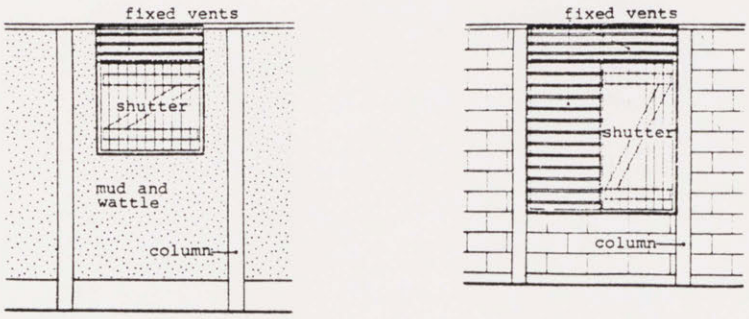
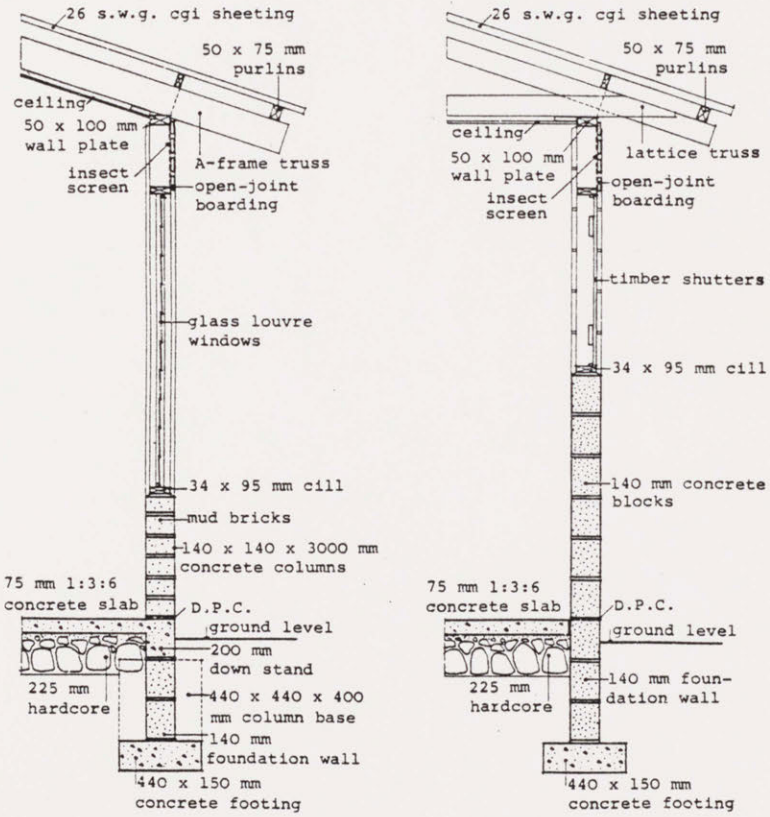


Figure 59 shows two alternative detail sections through the outside wall of a building. These are the kind of drawings from which a contractor could construct the building. They incorporate many of the guidelines mentioned earlier in this chapter such as the inclusion of a D.P.C., a drop of 150 mm between the floor and ground levels and the provision of insect screening to the eaves.



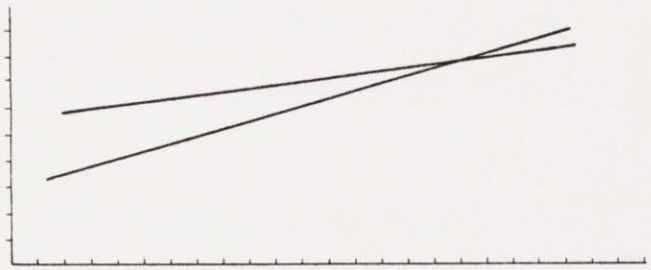
Chapter 6 Footnotes

[1]Mein, J. and T. Jorgenson [1980] Design for Medical Buildings, University of Nairobi Press.

[2]Camous, R. [1972] The Performance Concept and the Evaluation of New Building Products." 1F Journal, Vol. 3, No. 3, February 1972.

Chapter 7

Graph



EFFICIENCY EVALUATION

7.1 Introduction

Having determined the capital costs of constructing either the Type Design or an alternative facility which incorporates locally indigenous technologies, the next step in achieving a strategy for cost-minimization entails translating these costs into an annuity rental charge on capital and determining the stream of steady-state maintenance costs which keep either facility operational.

7.2 Annuity Rental Charge on Capital

For reasons stated in Chapter 2, the standard annuity formula will be used to express the long-term capital commitments to either facility type. In applying this formula to derive rental charges on capital, three pieces of information are needed:

1) the level of capital expenditures which occur over the life of the facility;
2) the period over which the annuity extends; and
3) the appropriate discount rate for an efficiency evaluation of capital expenditures.

The first set of information is given for the Type Design. Although the last chapter also presented an estimate of expenditures for the alternative facility type, this figure represented the capital cost over the first iteration of construction during the facilities operational cycle. If building components of varying life cycles are to be implemented in one facility, then the present value of subsequent capital expenditures must include the discount value of all outlays which occur over the facility's operational life.

The operational life of the entire facility is distinguished from the life cycle of individual building components. An operational life is the period during which a facility is designated to serve a catchment area. This period will be determined by policy planners within the Rural Health Unit or within the provincial or national hierarchy (Chapter 4). On the other hand, the life cycle refers to the useful life of a particular building component. By these definitions, the alternative facility may have an operational life which exceeds the life cycle of its temporary/improvable or temporary/replaceable building components. The Ministry of Health generally considers a standard operational cycle of twenty-five years for its rual health facilities.

For the sake of analysis, the operational life and life cycle of the Type Design are assumed to be equal. This implies a life cycle of twenty-five years for the uniformly permanent building components applied in the Type Design. It also suggests that under similar conditions of maintenance, the permanent standard used in the alternatives will lead to the selection of building components with an equivalent life cycle. Temporary/improvable components are assumed to have a life cycle of ten years based on projections from research on appropriate technology conducted in Karen, Kenya. Temporary/replaceable building components are considered to have a useful life of five years.

The appropriate discount rate for use in the annuity formula is essential in order for the scheduled rental charges on capital to reflect society's opportunity cost. Capital development funds sourced through foreign aid present unique problems in assigning an opportunity cost, if they can be allocated indiscriminately among projects with varying returns. In this instance, however, funds are not fungible and they must be applied

exclusively for defraying the costs of facility development in the Capital Facilities Expansion Program. Since this is the case, the concessional rate of 4% p.a. is used in the annuity valuation to capture society's opportunity cost of these funds.

7.3 Steady-State Maintenance Cost

Any innovation which reduces the current capital expenditures in facility construction must be evaluated with the corelevant changes in the steady-state maintenance costs, if the total project cost is to be assessed. The Ministry of Works applies a 2% charge of capital construction costs as its annual maintenance expense for the Type Design. This study accepts this percentage.

In devising the maintenance expense of locally indigenous building systems, the broad variety of technologies throughout Kenya make the projection of any flat rate impossible. Different physical properties and climatic conditions will determine the magnitude and frequency of maintenance for the temporary/improvable and temporary/replaceable building systems which are deployed at any given facility.

The determination of a present value for all expenditures for facility maintenance requires the selection of an appropriate social discount rate. The opportunity cost of maintenance expenditures is differentiated from that of foreign aid for capital construction because the funds are sourced exclusively through the domestic public sector, and therefore, contain the foreign and domestic components discussed in Chapter 2.

That discussion also advocated the use of a risk adjusted discount rate in evaluating the funds used for societal projects. Under ideal conditions this risk adjustment could be determined by regressing the returns

on the capital invested in this project with the return on capital invested in all societal projects. This formulation results in a "β-coefficient" which is used to determine the appropriate risk adjustment on the social discount rate.[2] The risk adjustment may result in a higher discount rate, signifying a positive correlation between changes in project returns with fluctuations in national revenues. It may also result in a lower rate, where the variation in project returns run counter to changes in national income.

For reasons outlined in Chapter 2, it is often impossible to evaluate returns or benefits of health projects quantitatively.

There are, however, sound intuitive justifications for assuming a low risk adjustment in the social discount rate for facilities maintenance in health care institutions. Once the commitment has been made to implement a facility type, any variance in maintance costs would probably occur with minimal correlation with that of national income. If this is true, then the risk adjustment for this particular project would be zero. One might even contend that the changes in maintenance costs are negatively correlated with the fluctuations in national income. (Suppose during depressed periods of Kenya's economy there is a higher utilization of health care facilities due to greater idle time for patients to visit clinics. Under these circumstances, higher utilization may result in greater wear on the facility and steady-state maintenance costs may increase.)

The International Bank for Development uses a discount rate of 8% in evaluating public sector projects in Kenya. This is a real rate which should be applied on real cash flows. This study assumes an 8% risk adjusted social discount rate in its efficiency evaluation of cash flows for

maintenance and risk adjustments around this rate will show the sensitivity of the cost differential between alternatives to the social cost of funds.

7.4 Other Considerations for Sensitivity

Additional parameters surface from strategic concerns in the Capital Facilities Expansion Program. One of the inputs of key interest in assessing the expenditures of a national program is the cost of transporting building components to the construction site. As Appendix 2 indicates, the Ministry of Works has defined a range of weights for markups on capital and maintenance cost of the Type Design and Staff Houses. As these sites occur further from main supply centers, construction costs increase. This range runs from 1 to 70 percent and must be considered in any efficiency evaluation among alternatives. Upcounty weights will be assigned for all structures which are build to permanent specifications, in order to determine the sensitivity of the cost differentials to the distance from the closest main supply center.

Another parameter which will vary over the Capital Facility Expansion Program is the operational life of the facility. The total project costs in implementing a facility for a short operational term should be considered, before committing scarce resources for building. Varying the facilities operation life shows the sensitivity of the cost differential to another important parameter which reflects strategic perogatives in national health policy.

7.5 Sensitivity Analysis

This section documents the various changes in the cost differential between the Type Design and the Alternative projected in the previous chapter. As the basis for sensitivity analysis, a Health Center is projected to be built at a location where a 9% markup in capital construction and maintenance costs is appropriate. The facility's operational life is assumed to be 25 years. Either facility type would be financed by concessional loans acquired through foreign aid at 4% p.a. Society's opportunity cost on public sector funds is set at 8% p.a. The cash flows for construction and maintenance are presented in Table 7.1. Although this study concerns itself with minimizing the total project expenditures as expressed in a steady flow of funds, i.e., an annuity change on capital and steady-state maintenance costs, this table is offered to relate the actual occurrence of recurrent capital expenditures in the use of the temporary/improvable and temporary/replaceable standards.

Graph 7.1 shows the cumulative level of capital and steady-state maintenance expenditures where the opportunity costs for funding these outlays have been included in the valuation. During most of this period, the alternative facility proves to be less expensive. There is, however, a point at which total project costs associated with the Alternative proves to exceed those of the Type Design. After this time, the alternative facility which originally entailed a less expensive capital allocation actually absorbs a greater level of total project funds than the Type Design.

For the policy planner who must make a decision between these alternatives, total project costs are expressed in Table 7.2 as an annualized cash flow.

Table 7.1 ACTUAL CASH FLOWS FOR CAPITAL AND MAINTENANCE EXPENDITURES FOR BOTH OPTIONS

	Year												
	0	1	2	...	6	....	11	....	16	....	21	...	25
I. Type Design													
A. Permanent Standard													
1. Construction Costs	1,456,240	--	--	...	--	....	--	....	--	....	--	...	--
2. Maintenance Costs		29,125	29,125	...	29,125	....	29,125	....	29,125	....	29,125	...	29,125
II. Alternative													
A. Permanent Standard													
1. Construction Costs	627,536	--	--	...	--	....	--	....	--	....	--	...	--
2. Maintenance Costs		30,575	30,575	...	30,575	....	30,575	....	30,575	....	30,575	...	30,575
B. Temporary/Improvable													
1. Construction Costs	247,965	--	--	...	--	....	247,965	....	--	....	247,965	...	--
2. Maintenance Costs		19,840	19,840	...	19,840	....	19,840	....	19,840	....	19,840	...	19,840
C. Temporary/Replaceable													
1. Construction Costs	50,400	--	--	...	50,500	....	50,500	....	50,500	....	50,500	...	--
2. Maintenance Costs		5,040	5,040	...	5,040	....	5,040	....	5,040	....	5,040	...	5,040

Concession Loan @ 4% p.a.
Risk Adjusted Social Discount Rate @ 8% p.a.
Operational Life @ 25 yrs.
Cost Markup for Distance from Main Supply Center @ 9%.

TABLE 7.2: PROJECT COST DIFFERENTIAL OVER OPERATIONAL LIFE

Concessional Loan @ 4% p.a.

Risk Adjusted Social Discount Rate @ 8% p.a.

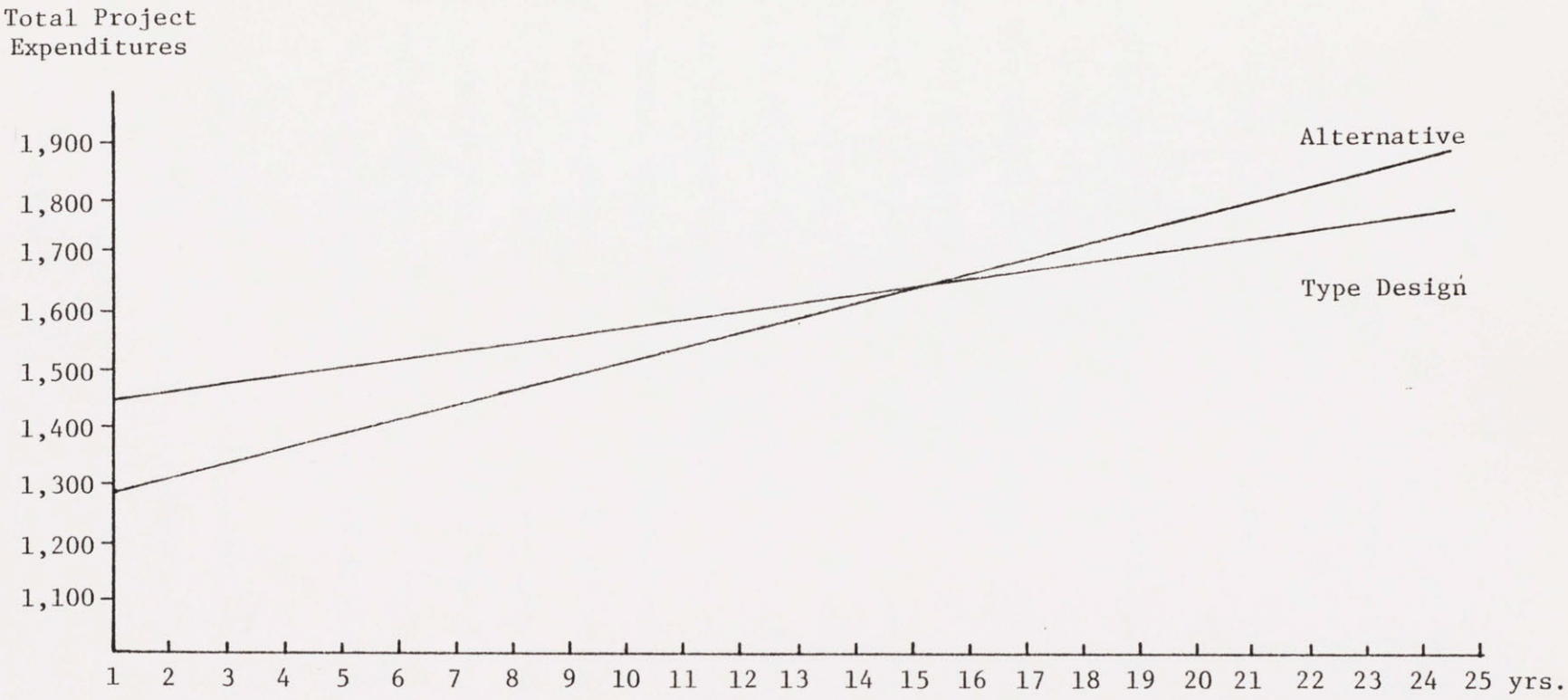
Operational Life @ 25 yrs.

Cost Markup for Distance from Main Supply Center @ 9%.

TYPE DESIGN:		
Annuity Rental Charges on Capital:	93,215	
Steady-State Maintenance Costs:	29,125	
TOTAL FACILITY COSTS:		122,320
ALTERNATIVE:		
PERMANENT:		
Annuity Rental Charge on Capital:	40,170	
Steady-State Maintenance Costs:	31,340	
Total Permanent:		71,510
TEMPORARY/IMPROVABLE:		
Annuity Rental Charge on Capital:	30,575	
Steady-State Maintenance Costs:	19,840	
Total Temporary/Improvable:		50,415
TEMPORARY/REPLACEABLE:		
Annuity Rental Charge on Capital:	11,325	
Steady-State Maintenance Costs:	5,040	
Total Temporary/Replaceable:		16,365
TOTAL FACILITY COSTS:		138,290

Graph 7.1

PROJECT COST DIFFERENTIAL OVER OPERATIONAL LIFE



Concessional Loan @ 4% p.a.
Risk Adjusted Social Discount Rate @ 8% p.a.
Operational Life @ 25 yrs.
Cost Markup for Distance from Main Supply Center @ 9%.

In order to convey project expenditures as both a commitment of funds over the operational life of a health facility as well as a commitment of funds on an annual basis, the following sensitivity analysis is presented as an annual budgetary expense (tables) and as a total commitment of project funds over time (graphs).

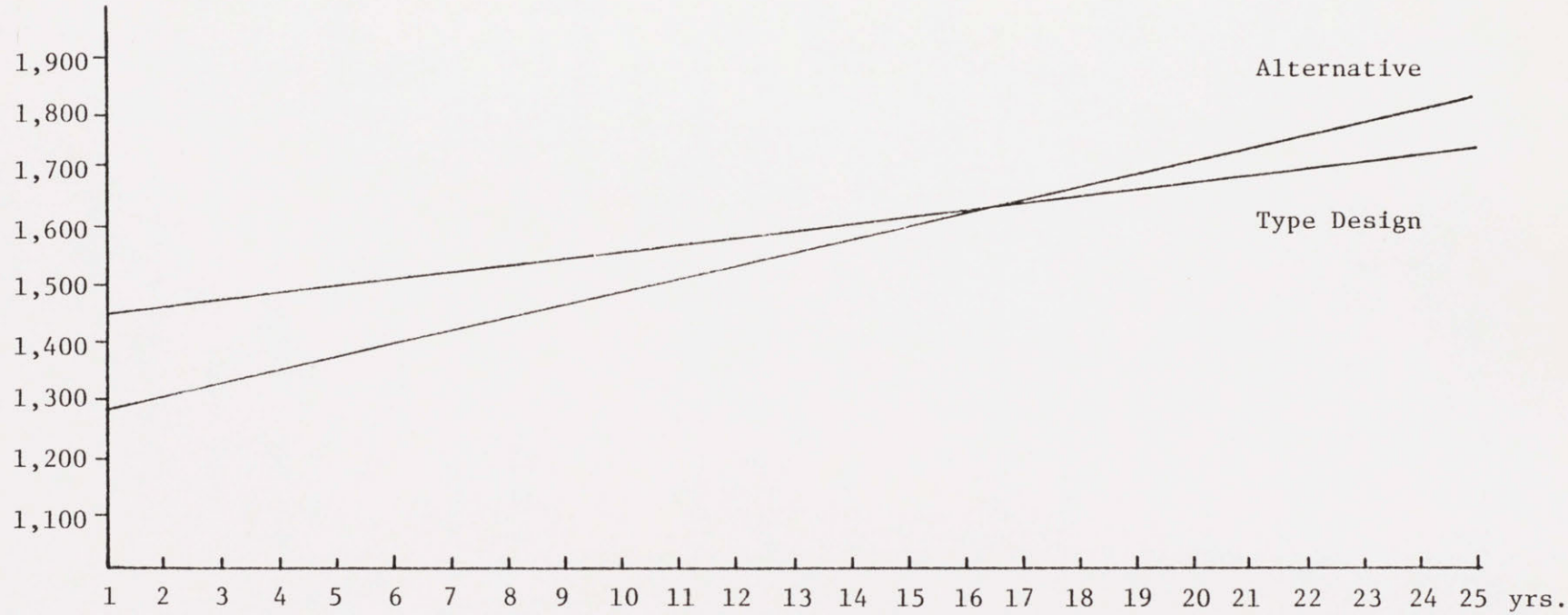
7.5.a Sensitivity Due to Changes in the Social Discount Rate

If all other parameters are held constant, what is the subsequent effect of a change in society's opportunity cost of funds on the cost differential between project options? The most vivid illustration of this effect is Graph 7.2 where the risk adjusted social discount rate is valued at 11% p.a. The time at which the total project expenditures of the Type Design falls below those of the alternative occurs later during the operational life of the facility. As society's opportunity cost for maintenance funds increases, the present value of future maintenance expenditures decrease. This causes total project expenditures to decrease for both options; however, the less maintenance intensive Type Design experiences a greater savings from this increase in the risk adjusted social discount rate. From a budgetary perspective, these total project costs can be expressed on the annual basis illustrated in Table 7.3.

From the viewpoint of the health policy planner who is responsible for optimizing a budget in order to deliver a specific level of service, this comparison of annualized fund commitments and some measure of there current value to society clarifies the tradeoffs between selecting a facility with a lower up-front capital commitment, and optimizing the use of funds which society places at a high opportunity cost.

Graph 7.2

SENSITIVITY OF PROJECT COST DIFFERENTIAL DUE TO CHANGES IN SOCIAL DISCOUNT RATE



Concessional Loan @ 4% p.a.
Risk Adjusted Social Discount Rate @ 11% p.a.
Operational Life @ 25 yrs.
Cost Markup for Distance from Main Supply Center @ 9%.

TABLE 7.3: SENSITIVITY OF PROJECT COST DIFFERENTIAL DUE TO CHANGES IN SOCIAL DISCOUNT RATE

Concessional Loan @ 4% p.a.

Risk Adjusted Social Discount Rate @ 11 % p.a.

Operational Life @ 25 yrs.

Cost Markup for Distance from Main Supply Center @ 9%.

TYPE DESIGN:		
Annuity Rental Charge on Capital:	93,215	
Steady-State Maintenance Costs:	29,125	
TOTAL FACILITY COSTS:		122,340
ALTERNATIVE:		
PERMANENT:		
Annuity Rental Charge on Capital:	40,170	
Steady-State Maintenance Costs:	31,340	
Total Permanent:		71,510
TEMPORARY/IMPROVABLE:		
Annuity Rental Charge on Capital:	30,575	
Steady-State Maintenance Costs:	19,840	
Total Temporary/Permanent:		50,415
TEMPORARY/REPLACEABLE:		
Annuity Rental Charge on Capital:	11,325	
Steady-State Maintenance Costs:	5,040	
Total Temporary/Replaceable:		16,365
TOTAL FACILITY COSTS:		138,290

7.5.b. Sensitivity Due to Equivalent Societal Costs of Project Funds for Construction and Maintenance Expenditures.

As explained in Chapter 2, the contractural obligation to use funds obtained through foreign aid for facility expansion implies that these funds should be valued at that contractual rate in an efficiency evaluation. What effect would an equivalent societal opportunity cost of funds between construction and maintenance expenditures have on the project cost differential between options? As Graph 7.3 illustrates, although the differential in project costs still converges, an equivalent societal cost of funds between capital and recurrent expenditures extends the relative cost efficiency of the alternative during the operational life of the facility beyond that which occurs when capital and recurrent expenditure incur different opportunity costs. The optimal use of equally weighted social funds towards the Type Design is expressed on an annualized basis in Table 7.4.

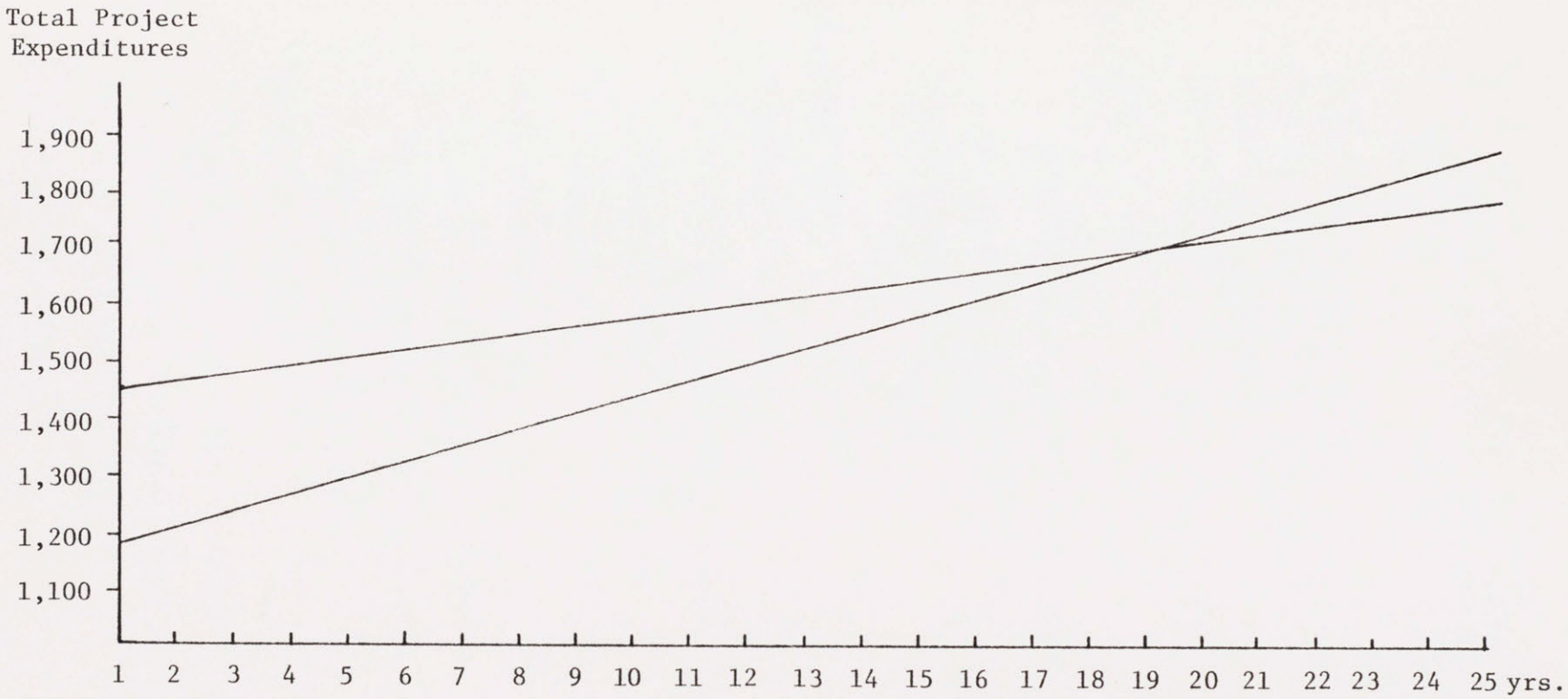
7.5.c Sensitivity Due to Changes in Operational Life

Although the Ministry of Health assumes an operational life of twenty-five years, strategic plans for clinic based health care may project an institution which will actually have a shorter useful life. Such strategic planning may reflect goals for matching facility operational life with a clinic-based health program which addressed some short term regional pathology in a special effort area.

Graphs 7.4 and 7.5 show that as the capital expenditures for either health facility are made over a shorter period of time, the cost effectiveness of the alternative facility extends for a longer period during the operational life. For a Health Center with a projected operational life of fifteen years the alternative facility remains the least

Graph 7.3

SENSITIVITY OF PROJECT COST DIFFERENTIAL DUE TO
EQUAL OPPORTUNITY COSTS BETWEEN CAPITAL AND MAINTENANCE EXPENDITURES



Concessional Loan @ 8% p.a.
Risk Adjusted Discount Rate @ 8% p.a.
Operational Life @ 25 yrs.
Cost Markup for Distance from Main Supply Center @ 9%.

TABLE 7.4: SENSITIVITY OF PROJECT COST DIFFERENTIAL DUE TO EQUAL OPPORTUNITY COST OF CONSTRUCTION AND MAINTENANCE EXPENDITURES

Concessional Loan @ 8% p.a.

Risk Adjusted Discount Rate @ 8% p.a.

Operational Life @ 25 yrs.

Cost Markup for Distance from Main Supply Center @ 9%.

TYPE DESIGN:		
Annuity Rental Charges on Capital:	136,415	
Steady-State Maintenance Costs:	29,125	
TOTAL FACILITY COSTS:		165,540
ALTERNATIVE:		
PERMANENT:		
Annuity Rental Charges on Capital:	58,786	
Steady-State Maintenance Costs:	31,340	
Total Permanent:		90,126
TEMPORARY/IMPROVABLE:		
Annuity Rental Charges on Capital:	36,955	
Steady-State Maintenance Costs:	19,837	
Total Temporary/Improvable:		56,792
TEMPORARY/REPLACEABLE:		
Annuity Rental Charges on Capital:	12,631	
Steady-State Maintenance Costs:	11,325	
Total Temporary/Replaceable:		23,956
TOTAL FACILITY COSTS:		170,875

expensive option for development. This behavior reflects the tendency of the annuity rental charge on capital to increase as the rental period contracts. Where large sums of capital are committed for shorter periods of time, the annuity rental charge shows the greatest increase. Since Type Design calls for greater capital expenditures, then a shorter operational cycle, i.e. a shorter annuity, will result in a higher annual commitment of development funds for constructing this facility. The annualized project expenditures are presented in Tables 7.5 and 7.6.

7.5.d. Sensitivity Due to Distance from Main Supply Center

From the perspective of project implementation, transportation costs in shipping building components from main supply centers constitute a major contribution to overall project expenditures. As Appendix 2 indicates, the broad geographic range which corresponds with cost adjustments or markups can significantly influence the level of funds which must be committed to building an maintaining either facility.

In order to quickly assess the behavior of the cost differential between options as a function of site distance from main supply centers, the cost markup is assumed at 0% and 70%. The sensitivity of the cost differential over both examples is presented in Graphs 7.7 and 7.8. Tables 7.8 and 7.9 indicate that annualized project costs favor use of the Type Design within a closer range of main supply centers. The substantial costs in constructing and maintaining facilities in remote areas bears heavily upon any budgetary constraint in a program such as the Capital Facilities Expansion Program.

TABLE 7.5: SENSITIVITY IN PROJECT COST DIFFERENTIAL DUE TO CHANGES IN OPERATIONAL LIFE

Concessional Loan @ 4% p.a.

Risk Adjusted Social Discount Rate @ 8% p.a.

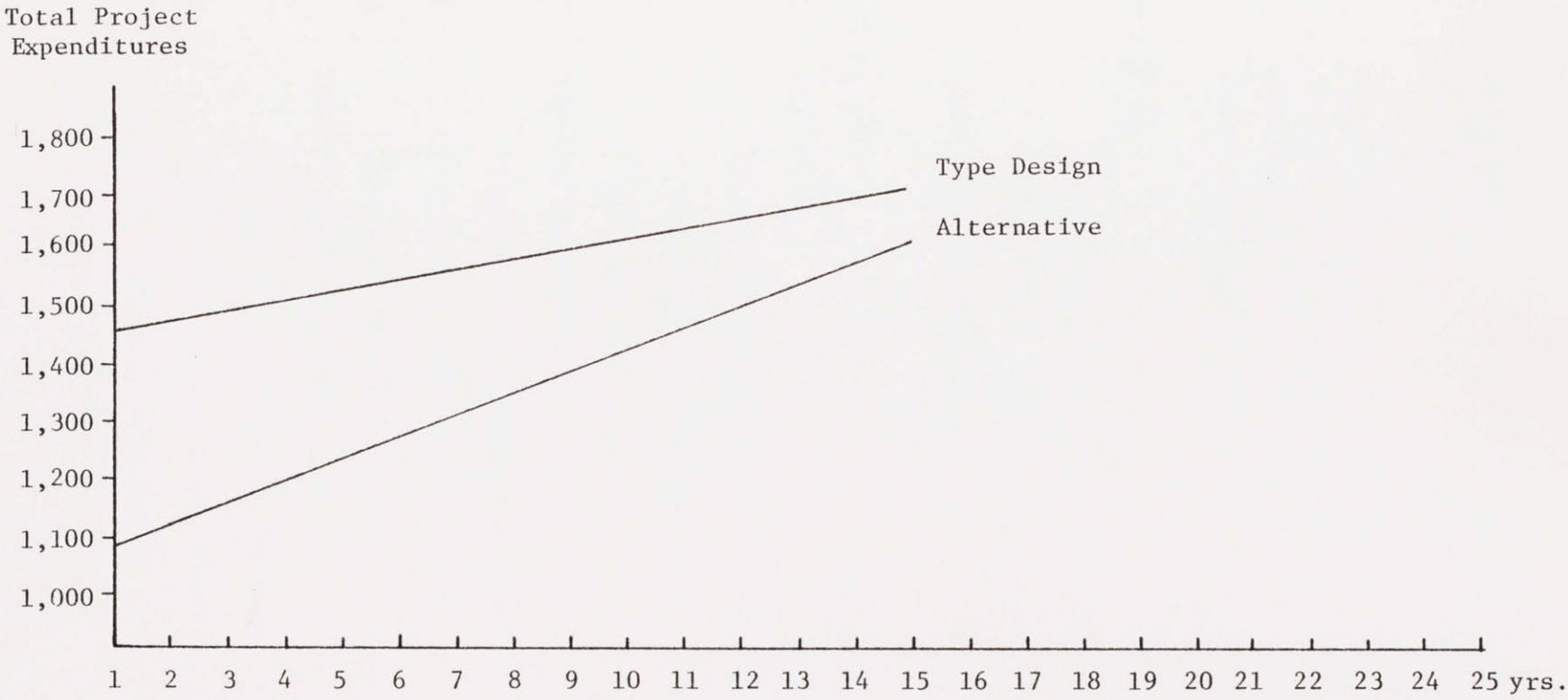
Operational Life @ 15 yrs.

Cost Markup for Distance from Main Supply Center @ 9%.

TYPE DESIGN:		
Annuity Rental Charges on Capital:	130,975	
Steady-State Maintenance Costs:	29,125	
TOTAL FACILITY COSTS:		160,100
ALTERNATIVE:		
PERMANENT:		
Annuity Rental Charge on Capital:	56,485	
Steady-State Maintenance Costs:	31,875	
Total Permanent:		88,360
TEMPORARY/IMPROVABLE:		
Annuity Rental Charge on Capital:	30,520	
Steady-State Maintenance Costs:	19,840	
Total Temporary/Improvable:		50,360
TEMPORARY/REPLACEABLE:		
Annuity Rental Charge on Capital:	11,325	
Steady-State Maintenance Costs:	5,040	
Total Temporary/Replaceable:		16,365
TOTAL FACILITY COSTS:		154,614

Graph 7.4

SENSITIVITY IN PROJECT COST DIFFERENTIAL DUE TO CHANGES IN OPERATIONAL LIFE



Concessional Loan @ 4% p.a.
Risk Adjusted Social Discount Rate @ 8% p.a.
Operational Life @ 15 yrs.
Cost Markup for Distance from Main Supply Center @ 9%.

TABLE 7.6: SENSITIVITY IN PROJECT COST DIFFERENTIAL DUE TO OPERATIONAL LIFE

Concessional Loan @ 4% p.a.

Risk Adjusted Discount Rate @ 8% p.a.

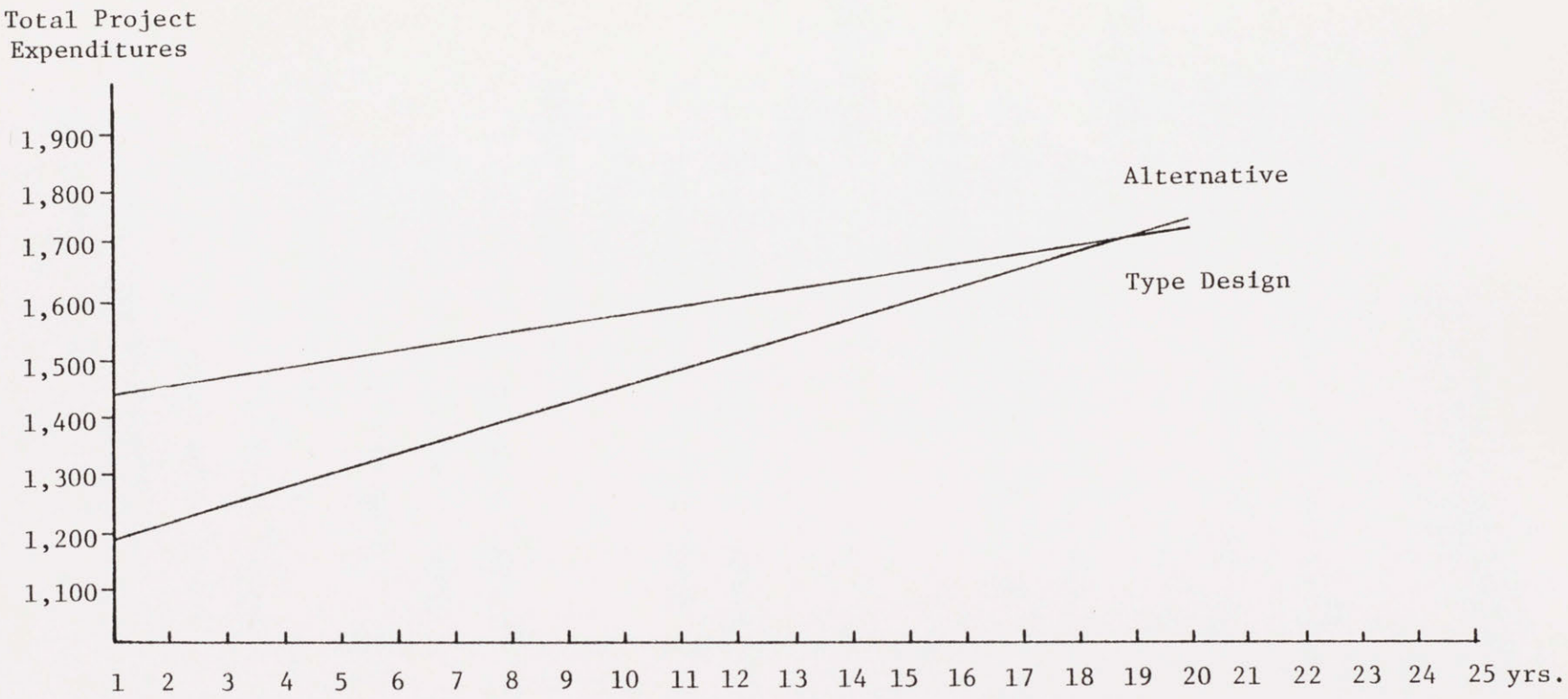
Operational Life @ 20 yrs.

Cost Markup for Distance from Main Supply Center @ 9%.

TYPE DESIGN:		
Annuity Rental Charges on Capital:	107,155	
Steady-State Maintenance Costs:	27,125	
TOTAL FACILITY COSTS:		134,280
ALTERNATIVE:		
PERMANENT:		
Annuity Rental Charge on Capital:	46,175	
Steady-State Maintenance Costs:	31,375	
Total Permanent:		77,550
TEMPORARY/IMPROVABLE:		
Annuity Rental Charge on Capital:	30,775	
Steady-State Maintenance Costs:	19,840	
Total Temporary/Improvable:		50,615
TEMPORARY/REPLACEABLE:		
Annuity Rental Charge on Capital:	11,325	
Steady-State Maintenance Costs:	5,040	
Total Temporary/Replaceable:		16,365
TOTAL FACILITY COSTS:		144,530

Graph 7.5

SENSITIVITY IN PROJECT COST DIFFERENTIAL DUE TO OPERATIONAL LIFE



Concessional Loan @ 4% p.a.
Risk Adjusted Discount Rate @ 8% p.a.
Operational Life @ 20 yrs.
Cost Markup for Distance from Main Supply Center @ 9%.

TABLE 7.7: SENSITIVITY OF PROJECT COST DIFFERENTIAL DUE TO DISTANCE FROM MAIN SUPPLY CENTERS

Concessional Loan @ 4% p.a.

Risk Adjusted Social Discount Rate @ 8% p.a.

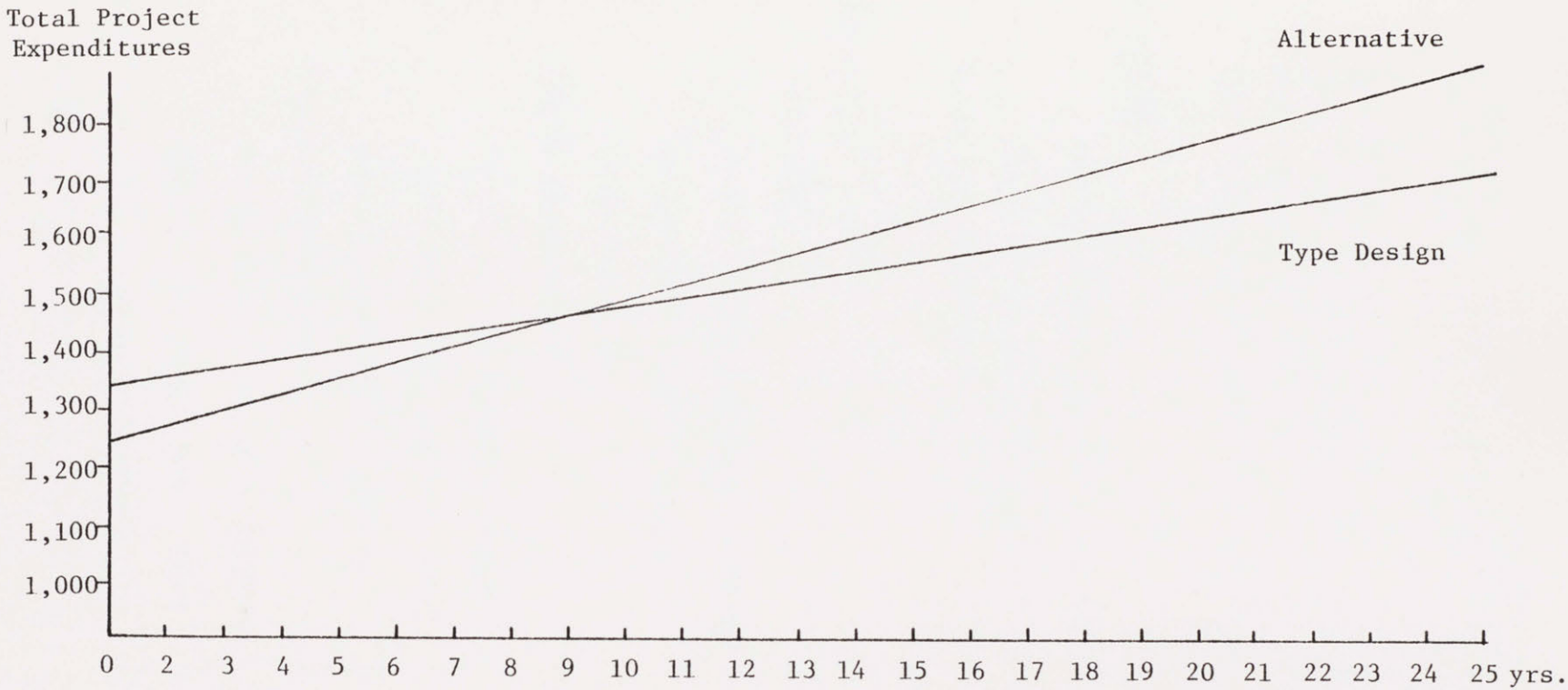
Operational Life @ 25 yrs.

Cost Markup for Distance from Main Supply Center @ 0%.

TYPE DESIGN:		
Annuity Rental Charges on Capital:	85,250	
Steady-State Maintenance Costs:	26,730	
TOTAL FACILITY COSTS:		111,980
ALTERNATIVE:		
PERMANENT:		
Annuity Rental Charge on Capital:	36,850	
Steady-State Maintenance Costs:	11,575	
Total Permanent:		48,425
TEMPORARY/IMPROVABLE:		
Annuity Rental Charge on Capital:	30,760	
Steady-State Maintenance Costs:	19,840	
Total Temporary/Improvable:		49,600
TEMPORARY/REPLACEABLE:		
Annuity Rental Charge on Capital:	11,325	
Steady-State Maintenance Costs:	5,040	
Total Temporary/Replaceable:		16,365
TOTAL FACILITY COSTS:		114,390

Graph 7.6

SENSITIVITY OF PROJECT COST DIFFERENTIAL DUE TO DISTANCE FROM MAIN SUPPLY CENTERS



Concessional Loan @ 4% p.a.
Risk Adjusted Social Discount Rate @ 8% p.a.
Operational Life @ 25 yrs.
Cost Markup for Distance from Main Supply Center @ 0%.

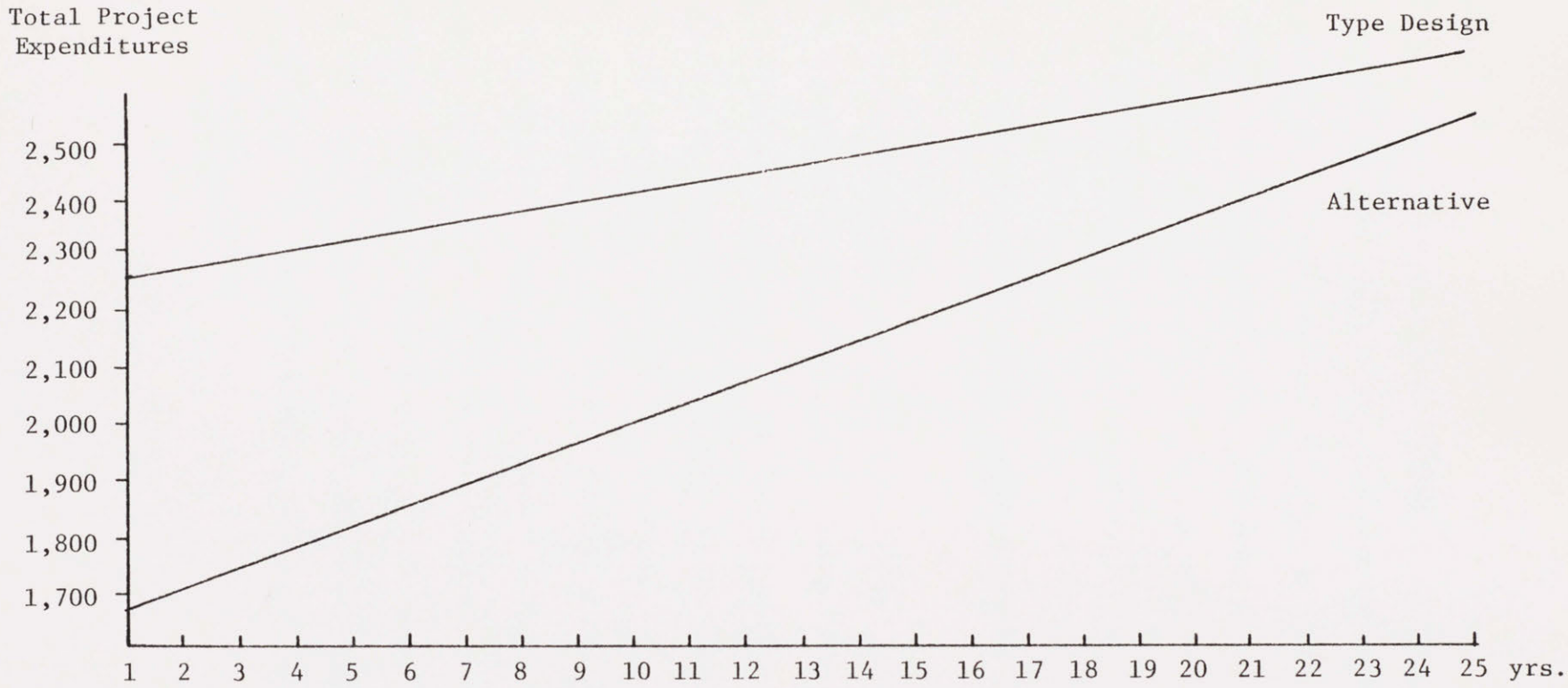
TABLE 7.8: SENSITIVITY OF PROJECT COST DIFFERENTIAL DUE TO DISTANCE FROM MAIN SUPPLY CENTERS

Concessional Loan @ 4% p.a.
Risk Adjusted Discount Rate @ 8% p.a.
Operational Life @ 25 yrs.
Cost Markup for Distance from Main Supply Center @ 70%.

TYPE DESIGN:		
Annuity Rental Charges on Capital:	145,000	
Steady-State Maintenance Costs:	42,425	
TOTAL FACILITY COSTS:		187,425
ALTERNATIVE:		
PERMANENT:		
Annuity Rental Charge on Capital:	64,300	
Steady-State Maintenance Costs:	48,940	
Total Permanent:		113,240
TEMPORARY/IMPROVABLE:		
Annuity Rental Charge on Capital:	30,375	
Steady-State Maintenance Costs:	19,840	
Total Temporary/Improvable:		50,215
TEMPORARY/REPLACEABLE:		
Annuity Rental Charge on Capital:	11,325	
Steady-State Maintenance Costs:	5,040	
Total Temporary/Replaceable:		16,365
TOTAL FACILITY COSTS:		179,820

Graph 7.7

SENSITIVITY OF PROJECT COST DIFFERENTIAL DUE TO DISTANCE FROM MAIN SUPPLY CENTERS



Concessional Loan @ 4% p.a.
Risk Adjusted Discount Rate @ 8% p.a.
Operational Life @ 25 yrs.
Cost Markup for Distance from Main Supply Center @ 70%.

7.6 Summary

As the sensitivity analyses indicates, the selection of the most cost-effective solution depends on any number of parameters. Some of these parameters will reflect the strategic perogatives of the Ministry or Health on Rural Health Unit. For example, the time over which a facility is scheduled to operate will, as shown in Section 7.5.d., impact the cost-effectiveness of one facility-type over another. Similarly, the location of the Health Center from the nearest main supply station will influence the cost of committing funds to one facility over another.

The societal cost of funds supplies another parameter which influences the selection of the most cost-effective facility. This cost will fall outside the ability of the policy planner to negotiate and will often act as exogenous determinants of the optional solution. At the level of the national Government these are opportunities to modify terms of loans through foreign aid and where these terms are modified and the corresponding funds are exclusively designated for health facility projects then the cost of this negotiated term should be used as an evaluation similar to the one presented in the chapter.

The next chapter concludes this study with some observations and suggestions tailoring evaluation and implementation of public sector projects such as the Capital Facilities Expansion Program.

Chapter 8

CONCLUSIONS AND RECOMMENDATION

8.1 Introduction

The information presented in this efficiency evaluation is just one in a locus of data which the policy planner must consider in making a decision to implement a facilities construction program for rural health care. The outcome from each of the sensitive analyses should not be used as a substitute for broader deliberations which include other societal goals in addition to cost minimization. However, this information is extremely valuable in clearly laying out the cost implications to society of selecting one application of funds for facility development over another. Moreover, since the evaluation considered cost inputs from both capital and recurrent expenditures, it discloses the full project "premium" which the Government might be willing to pay in order to implement the Type Design for facilities of short operational lives, or at locations which are prohibitively far from main supply centers.

In concluding this study, several suggestions for structuring the evaluation and allocation of funds to this project are offered. Some strategic policy based on the findings in this study are also presented followed by recommendations for areas of further technical analysis which can make a study of this type even more informative to the policy planner.

8.2 Evaluating Public Sector Expenditures by Affinity - Budgeting Envelopes

Chapter 2 laid out the theoretical reasons which make a broad comparison of health care projects with other societal projects for efficiency, infrastructure, etc. difficult. In order to provide a more

cogent comparison between societal alternatives, one method might assemble all public sector projects by affinities which reflect the social goals behind their implementation. Public sector funds to construct improved harbor facilities in Mombasa could be compared to the returns on a governmental subsidy to individual shipping companies. Similarly, projects which are implemented for social welfare, e.g. education, health, basic services, can be evaluated against each other when the real societal value of each application can be evaluated in an appropriate context. The Canadian government, for one, has structured such a grouping of social projects which is referred to as "Envelopes".[1] Although a developing country like Kenya has many different economic and welfare concerns than a developed economy such as Canada, the budgetary constraint is even greater given the level of societal goals and projects which are needed for social welfare. Less Developed Countries could benefit greatly in the budgetary process by allocating funds among uses which achieve roughly the same goal. The Canadian government has structured its Envelopes to include current fiscal planning, the planning for the subsequent year and three planning years. By emulating this structure of budget appropriation, Kenya, and other Less Developed Countries, would recognize both their resource constraint and the tradeoffs associated with selecting one societal project over another. Essentially these "Envelopes" furnish a budgetary infrastructure which reflects the economic reality of societal projects addressed.

8.3 Social Cost Differential in Capital and Recurrent Expenditures

The differentiated cost of funds secured through foreign aid has

been cited as a main incentive in "over-capitalizing" total project allocations. Since the stipulation that foreign aid be used only for capital expenditures is the source of this differentiated social cost of funds between capital and recurrent expenditures, one means of equilibrating costs would be to remove the restrictions on loan covenants. It must be recognized that these restrictions have served two purposes:

1) to keep foreign aid agencies from commiting themselves to recurrent budgets in developing countries in light of their own annual budgetary constraints,
2) to keep foreign ministries from diverting the funds from projects for social welfare in order to maximize the yield.

One way of circumventing the differentiation of social costs of public funds while retaining some control of the use of these funds would be to create a trust where funds were fungible between capital and recurrent costs.

8.4 Strategic Suggestions

If the health policy planner can utilize the information on project cost differentials due to distances from main supply centers, then one strategy to minimize cost would locate facilities whose program requires a higher standard of building permanance closer to these supply centers. Is the field of operation extends from the supply center, a greater infusion of appropriate technologies can occur in the health facility reflecting the economic advantage of using an appropriate building technology which is economical and appropriate for minimal performance criteria.

8.5 Recommendations for Further Study

The most important information in increasing the usefulness of the efficiency evaluation is in gathering more information on the construction and life cycle costs of appropriate technology. Experimental units such as the Appropriate Technology Village in Karen, Kenya, portend a better understanding of the technical application and the economic ramification of using these technologies in building. A broader sample of locally indigenous technologies suited for building is required and it is hoped that the possible economic advantages to be gained in using these technologies will provide sufficient incentive to document them more thoroughly.

From an analytic perspective, the costs used in this study assumed steady states of maintenance and replacement costs which are optimistic, to say the least, given the market conditions in Less Developed Countries. A more thorough examination of the variance in the supply and price of building components is necessary in order to capture the economic effect of these often prohibitive factors in facility maintenance in Less Developed Countries. Although a rigorous stochastic method is needed to verify these effects, it is probable that these costs will favor the alternative facility which, when built out of a technology which is truly appropriate and indigenous, will provide a more steady supply of materials for construction and maintenance.

Finally, any economic cost comparison should recognize the shadow cost of unskilled labor which will vary between an agricultural wage in the rural sector (Chapter 3) and zero during time of unemployment. From a strategic perspective, scheduling maintenance and capital

replacement of the appropriate facility types during periods when the shadow wage for unskilled labor is low would further optimize the Alternative over the Type Design.

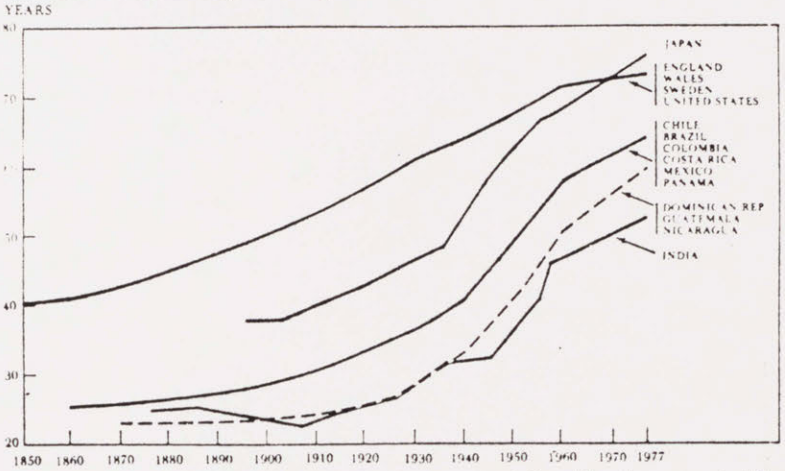
8.6 Summary

This study has attempted to point out to the facility planner for rural health services that there are opportunities to minimize capital and recurrent costs through the use of appropriate technologies in building. More importantly, it has stressed that even in accommodating the directives of foreign aid agencies such as the World Bank, and U.S.A.I.D., the minimization of only capital costs can exhaust total project resources even more quickly than a capital intensive facility (Chapter 7). Where the cost savings can be documented, however, the physical planner is met with the exciting challenge of incorporating one of his country's most natural resources, the skill of building appropriately with one of its most important societal perogatives, the goal of improved standards of health and, hopefully, a better quality of life.

Appendices

APPENDIX 1: STATISTICAL INDICATORS OF HEALTH DIFFERENTIAL BETWEEN LESS DEVELOPED COUNTRIES AND DEVELOPED WORLD

Trends in Life Expectancy in Selected Countries, 1850–1977



(1) Life expectancy in England and Wales for 1977 is approximated with United Kingdom statistics in 1977.

Sources: Arriaga, E. and Davis, K., "The Pattern of Mortality Change in Latin America," *Demography* 6 (3): 223-242, 1969, Tables A-3 and A-4, and World Bank. *World Development Report, 1979*

Life Expectancy at Birth in Some Major Areas of the World
(in years)

Region	1950-55	1955-60	1960-65	1965-70	1970-75
Developing regions	42.5	45.7	48.7	51.3	53.2
Africa	37.5	39.8	42.2	44.5	46.5
Latin America	52.0	54.9	57.2	59.3	61.2
East Asia	47.5	51.7	55.9	59.8	63.3
South Asia	39.2	42.1	44.9	47.4	49.3
Developed regions	64.3	67.2	68.6	69.3	70.3
WORLD TOTAL	47.2	50.1	52.5	54.4	56.0

Source: United Nations. **Demographic Estimates and Projections for the World, Regions and Countries as Assessed in 1978.** Prepared by the Population Division, Department of International Economic and Social Affairs (Provisional Report), 1979.

APPENDIX Z: UPCOUNTRY WEIGHTING FOR TYPE DESIGN - FROM MAIN SUPPLY CENTERS

NAIROBI:

	%	
Namanga	8	
Sultanhamud	3	
Kibweizi	10	
Narok	6	
Lolgorien	13	
Mara	15	
Kilgoris	8	
Sagana	2	
Kitui	9	
Mwingi	8	
Liboi	50	

MOMBASA:

Shimoni	4	(3% F.C.)
Lunga Lunga	6	(3% F.C.)
Malindi	5	
Garson	15	
Witu	19	
Kipini	21	
Lamu	28	(4% F.C.)
Galole	23	
Garissa	35	
Bura	28	
Voi	7	
Taveta	17	

NAKURU:

Kericho	2
Sotik	6
Kisii	16
Lumbwa	3
Maralal	11
Marigat	2
Kabarnet	5

KISUMU:

	%
Lumbwa	2
Oyugis	1
Busia	5
Mumias	6
Bungoma	5
Isebania	11
Kendubay	3
Homabay	5
Kisii	3

MERU:

Garbatula	8
Archer's Post	1
Marsabet	25
*Moyale	50
Muddo-Gashi	16
Habaswein	20
Wajir	29
El-Wak	50
*Mandera	70

KAKAMEGA:

Bungoma	2
Malaba	3

KITALE:

	%
Kapenguria	4
Loru-Kumu	18
*Lokitaung	50
Lodwar	22

NOTES:

1. * These rates included 10% for bad roads.

2. Allow additional 1% per 20 K.M. for bad roads beyond sites listed here.

3. F.C. - Ferry charge included in overall percentage.

   This should apply to Builder's work only and is intended for small housing contracts only.

   Reduce on larger jobs.

C.P.U. July, 1978

Appendix 3: Derivation of the Social Discount Rate

The social discount rate reflects the opportunity cost to society of diverting funds for projects imiplemented through the public sector. These public sector projects will, of necessity, displace funds from projects which would have yielded tax revenues. The opportunity cost of domestically sourced funds, therefore, consists of the rate paid to private investors, r, and foregone tax receipts on displaced investments, τ_I. This cost of capital indicates the minimum return requires for public projects financed through domestic sources:

$$k_d = (r+\tau_I)(z)(K)$$

where

k_d = a domestically sourced funds

r = interest rate paid on funds

τ_I = foregone tax revenues

K = total project expenditures

z = percentage of funds domestically sourced

The remainder of public sector project financing may come from the foreign sector. Society also places an opportunity cost on these funds. The components of this opportunity cost reflect the rising marginal cost of foreign funds, m, and the added withholding taxes which are gained from foreign investment, τ_F. Foreign source funds can be expressed at the following opportunity cost:

$$K_f = (m-\tau_F)(1-z)(K)$$

where

k_f = foreign sourced funds

m = marginal cost of foreign funds

τ_F = withholding tax

K = total project expenditures

$T-z$ = percentage of funds sourced from abroad

From the following equations the total annuitized social cost of a project allocated K units of public sector financing can be derived.

$$k_d + k_f = \omega K = \text{TOTAL EXPENDITURE}$$

$$(r+\tau_I)(z)(K) + (m-\tau_I)(1-z)K$$

$$= \omega K$$

Dividing both sides by K derives the exact cost of project sector funds, the social discount rate.

$$(r+\tau_I)(z) + (m-\tau_F)(1-z)$$

$$= \omega$$

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