

# APPROPRIATE CONSTRUCTION TECHNOLOGY

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The technology most appropriate to the intensive construction programme now in progress in the country has been the subject of discussion in several forums. In this paper, Desmond McNeill, a consultant with the Housing authorities, questions the view that the most appropriate technology for Sri Lanka today is "capital-intensive, using 'modern' materials and methods". To him this view is at best simplistic and at worst wrong and he maintains that, from the economic point of view, it is possible that capital-intensive methods are not in fact faster. His analysis covers the appropriateness of technology for both producer and consumer.

## Introduction

In this article I shall limit myself only to the subject of housing, although much of what I say may have relevance also for other types of construction such as irrigation works and roads. It has been estimated that in recent years housing has accounted for 45% of total construction output. In view of this, and the target of building 100,000 houses by 1983, it is not unduly restrictive to impose this limitation on the scope of the article.

I am concerned with appropriateness in two senses—those of the producer and of the consumer. Construction of a house involves the production of an output from a combination of inputs (particularly labour, capital equipment and materials). From the production point of view an appropriate technology is one which, for a given output, minimises the use of inputs. From the consumption point of view an appropriate technology is one which produces an output which best meets the needs and preferences of the user. I shall discuss first the former sense of appropriateness.

In theory, in a market economy, inputs are so priced as to reflect accurately their scarcity value. The cheapest technology in terms of total cost is therefore also the most appropriate. In practice, however, the market is always distorted and prices are a rather inaccurate guide

to scarcity value. In the theory propounded by the advocates of social cost-benefit analysis, the solution is to calculate 'shadow prices' for those items whose prices are thought to be most distorted (usually labour, foreign exchange and capital) and to recalculate total costs using these 'corrected' prices. Although economists are loathe to generalise, it is frequently thought to be the case in Third World countries that labour is overvalued and foreign exchange and capital are undervalued. Hence the least-cost technology adopted is in fact inappropriate because it does not minimise total costs recalculated so as to reflect resource availability more accurately.

Before discussing the situation in Sri Lanka I would like to clarify one or two conceptual and definitional confusions. Firstly, the term 'appropriate technology' itself begs the question, since none in their right mind would advocate the adoption of an inappropriate technology. What is at issue is not whether or not to adopt an 'appropriate technology' but rather what is the appropriate technology in a particular context.

Secondly, the term 'labour-intensive', which arises frequently in discussions of appropriate technology is fraught with problems. Not only is it difficult to define (labour-intensity could be regarded as the ratio of labour inputs to capital inputs, or to total output, or possibly

some other ratio) it is also difficult to measure. Should it be expressed in terms of man-hours, or in money terms—in which case the issue of valuation arises). This may justifiably concern the theoretician, and indeed has stimulated lengthy and detailed discussion. But for the policymaker, with precious little information at his command, such distinctions are of little moment. The only point that has to be made is that labour-intensive is a relative term. There are no absolutes—simply a range of alternative technologies of varying labour-intensity. A labour-intensive technique is therefore one which, by comparison with others available, productively employs more labour.

Arising out of these definitional confusions is a mistaken view that low productivity of labour necessarily implies inefficiency. This is because if one technique may, by comparison with another, uses more labour but less capital in producing a given output then the productivity of labour is lower. On the other hand the productivity of capital is higher—which might seem to imply greater efficiency. In fact, the respective efficiencies of the two techniques cannot be compared in this manner. Without pursuing the question further it can be safely stated that in a situation of scarce capital and abundant labour, in it is undoubtedly appropriate to use that technique which tends to maximise the productivity of the scarce resource—namely capital.

There is no purpose in dwelling further on issues which lead ultimately only to semantics. Also, despite the complexities that rapidly arise in such discussions, they are nevertheless unduly simplistic in the sense that focussing on cost-minimisation (even with shadow prices) tends to ignore other factors of considerable importance to the decision-maker faced with the problem of selecting a technology.

## The Sri Lankan Context

Many of these issues were raised and usefully discussed at the Workshop on Appropriate Construction

Technology held in Colombo in May 1979 and it is now time to turn specifically to the Sri Lankan context and discuss the questions raised.

At the risk of oversimplification the views of the participants may be summarised as follows: in view of the high level of unemployment and the cost and maintenance problems of capital equipment it would be a very good thing if techniques could be adopted which increased the use of labour and of local materials, while saving on imported equipment and materials. Beyond this, however, opinions differed. On the one hand there were some who advocated the adoption of these techniques. On the other hand there were some, especially those who had been given responsibility for the achievement of very ambitious targets, who regretted that this was not in fact feasible at the present time.

There were three main arguments put forward to support this latter view. The first, and overwhelming reason was the necessity for speed. To quote from the summary of discussion on low-cost and rural housing: "The general consensus of the Workshop was that the choice of technology is very limited since most of the projects are target oriented.... In view of the short-time limits stipulated to complete various jobs people who are responsible for the execution have no choice but to use the methods that consume least amount of time."

The second reason given was the difficulty of obtaining sufficient labour—especially skilled. Because of low wage rates many skilled workers leave the country for more remunerative employment elsewhere. The massive numbers of unemployed are not necessarily willing to become construction labourers. To quote a participant with experience in handling direct labour, mainly in Colombo: "With their relatively high educational qualifications most labour were dissatisfied with their position and were always on the look-out for alternate forms of employment." A representative from the State Engineering Corporation pointed out that "although there is claimed to be much unemployment in the country, he has

found it extremely difficult to get labour replacements at his construction sites from the Job Bank".

The third major reason cited was that the use of more labour-intensive techniques places very heavy strains on the organisational and managerial capacity of the construction agency. To quote from the paper entitled 'The ILO and Appropriate Construction Technology': "The administration of programmes based on the use of labour rather than machines clearly will have to be somewhat different. Often the existing administrative systems are not conducive to the use of labour". Representatives of the State Development and Construction Corporation stressed "the importance of good personnel management and proper motivation techniques if labour intensive technology was to be a success" but described successful experiences in their own organisation.

In summary, then, there was a view expressed by many participants that labour-intensive techniques are fine in theory but not to be recommended in practice—mainly for the reasons given. I will consider these three arguments in turn.

Firstly, the question of speed: it is assumed, but not proved, that capital-intensive techniques are faster. One of the papers presented at the Workshop suggested the reverse. A comparison of traditional, semi-prefab and prefab housing systems led to the conclusion that of the three, "the traditional system is the fastest. In tropical conditions where winter conditions do not exist, there is no advantage of using factory cast panels". More work would have to be done to establish this beyond dispute, but it is regrettable that the assumption, in the absence of reliable evidence, should always be that capital-intensive methods are faster.

The need for speed is self-imposed—the result of extremely ambitious targets. Provided haste is not substituted for speed such targets will serve as an invaluable spur to the development effort. But even if it were shown to be the case that capital-intensive techniques are faster, it is important to ensure that the means adopted for achieving

development are compatible with the end. In this context the 'end' is a better standard of living for all. This may indeed be achieved by the provision of better housing, but it may also be achieved by the provision of more employment, leading to higher incomes, and hence a higher standard of living. The latter approach has the advantage of being self-sustaining and not dependent on government subsidy.

This discussion may, to a large extent, be rendered superfluous if there is simply not sufficient manpower available to undertake the construction programme envisaged by other than capital-intensive techniques. This brings us on to the second argument.

At first glance it may seem ridiculous to suggest that with over a million unemployed Sri Lanka has a shortage of manpower. There exists, however, a 'structural imbalance' in the labour market. To quote from the Seers Report—"The structural imbalance arises because the opportunities for additional work occur at the wrong season or in the wrong place, require special skills or offer too low an income or too low a status compared with what the various types of labour can offer or people will accept."

In the housing sector activity is concentrated largely in urban areas, which reduces the importance of seasonal and locational factors (though not in the building materials industry). The major problems are therefore low income, low status, and the need for special skills. In recent months wages for skilled labourers have been rising rapidly, yet there is still a shortage. The claim that labour-intensive technology is inappropriate in Sri Lanka thus has some appeal at first sight. But what is the alternative? Sophisticated techniques using imported machinery require skilled labour also—and more alien skills than those of carpenter or mason. They also require sophisticated management and supervision skills that are likely to be in even shorter supply.

In summary, there is indeed a shortage of manpower for housing construction—but this would be as severe, if not more so, if more capital-intensive construction tech-

niques were introduced. The solution lies partly in higher incomes, partly in technical training and partly in changing attitudes. The first is already happening to some extent. The second and third take time—and here again is the crux of the problem. The emphasis on speed tends to result in longer term solutions having little appeal.

The third argument against labour-intensive technology—the burdens imposed on managerial and organisational capacity—has already been touched upon briefly in the context of manpower shortages. If the rate of implementation of the construction programme is to be stepped up a heavy strain will be imposed, whatever the technology used, unless the whole exercise is to be handed over to foreign firms without financial control, supervision of work, preparation of design briefs or anything else by the Sri Lankan government. There is no easy way out of the dilemma (although in housing, unlike other construction sectors, there is much that can be done to improve the situation without the government actually building houses at all—by aided self-help schemes, the provision of building materials, supply of land etc.). The choice is between two technologies, each of which will severely strain managerial capacity. Unless Sri Lanka is to become extremely dependent on foreign expertise, it is the labour-intensive technology which will impose the lesser strain.

In the discussion thus far I have concentrated on the question of the relative share of only two inputs—namely capital and labour—to the exclusion of a third, materials. This is an omission common to many debates on the subject of appropriate technology, and the same was to some extent true of the Workshop held in May this year. The issue was, however, raised, and a paper on the subject concluded with the view that “low cost housing materials and techniques perform more efficiently than the conventional constructions built with the material presently produced in Sri Lanka.” In view of the scarcity of skills and of foreign exchange there is a strong case for using locally available building materials—such as cabook or tiles instead of cement blocks or asbestos sheets. This issue

tends, however, to be inevitably subsumed under the labour-intensive capital-intensive debate. This is because, in practice, there is not a continuous spectrum of different construction methods each with varying inputs of labour, capital and materials, but rather a very limited number of techniques each of which is associated with specific types of building materials. Thus, prefab housing is rarely designed to use locally available materials, or, to take a more extreme case, multi-storey buildings are not thatched with cadjan. While more research work may succeed in rectifying this situation, it is likely that the question of appropriate building materials—at least from the production point of view—will continue to be subsumed under the issue of capital-intensive versus labour-intensive technologies.

#### Appropriate Technology—The User's View

I shall now turn to the second aspect of appropriate construction technology, and one which is frequently given less consideration, that concerned with the appropriateness of the output—from the point of view of the user.

Each individual householder has different needs and priorities. Within a given budget constraint he may choose more space at the expense of quality of materials; he may prefer to forego glass windows in order to have better roofing material. These needs and priorities differ not only between individuals within Sri Lanka, but also between Sri Lankans and the West—which differs so greatly both culturally and climatically. The designs of housing in the West and the building materials used are in many cases quite inappropriate in Sri Lanka. In temperate climates ventilation means cold winds, but sunlight is sought after hungrily. Small households are the rule, and little time is spent on the verandah or porch. To import such types of houses indiscriminately into Sri Lanka is wholly inappropriate.

It may be claimed that design is not the same as technology. But the type of building material, the method used for building, and the design are too intricately bound together to allow easy separation. The technology very largely determines the

materials, and the two together restrict design considerably.

Certainly Sri Lanka can take advantage of many of the innovations available from abroad. But this does not mean that traditional methods should be replaced wholesale. Mud brick, for example, is climatically an extremely good building material. Well constructed mud brick walls, protected against erosion by water, can last for decades. The technology is simple and well known, and the materials are readily available. Such bricks can be greatly improved by mixing with a small quantity of cement. Similarly other traditional materials and building methods can be adapted and improved by combination with imports from abroad. The methods of building now used in Sri Lanka have been developed over many centuries, reflecting not only the resource endowments of the country but also its culture, its climate, and the changing needs and aspirations of its people. This tradition should not be suddenly abandoned. This is not for any romantic or sentimental reason, but simply because many of these traditional houses are better from the user's point of view. Insofar as imported technology can improve the situation it should certainly be encouraged, but the principle should be to adapt and improve existing techniques and building material rather than replace them in totality.

#### Conclusion

Sri Lanka is faced with an extremely ambitious target of housing construction. There is a widely held view that under these circumstances everything must be sacrificed to speed. The appropriate technology is the fastest technology—and that means capital-intensive, using ‘modern’ materials and methods.

This view is at best simplistic and at worst wrong. From the point of view of the user, prefabricated or multi-storey housing may well be far less appropriate than housing of traditional design built with improved local materials. From the economic point of view it is quite possible that capital-intensive methods are not in fact faster, and it is probable that the adoption of such techniques is not in the interest of the long-term development of the country.