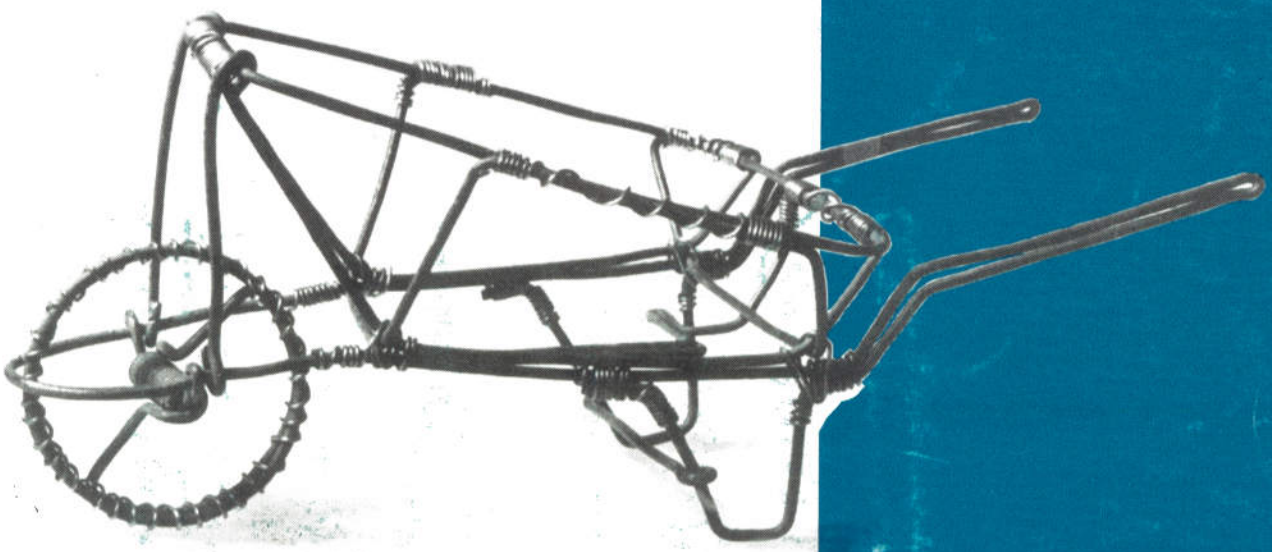
Guidelines for the identification of appropriate building construction methods in developing areas

Construction and development



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CONSTRUCTION AND DEVELOPMENT SERIES

NUMBER 3

Guidelines for the identification of appropriate building construction methods in developing areas

February 1993

Development Bank of Southern Africa

CONSTRUCTION AND DEVELOPMENT SERIES

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PREFACE

The formulation of policies and strategies to promote development in South Africa is arguably as important a product of the Development Bank of Southern Africa as its loan finance and technical assistance programmes.

This series of publications on "Construction and Development" illustrates this point.

Development projects in South Africa have traditionally been undertaken to meet only the physical needs of the recipient community. South Africa's changing social and economic environment demands that such projects be executed in a manner that ensures that the communities' other needs are also addressed. To achieve this projects should be structured so that opportunities for employment and the development of skills and entrepreneurial abilities are maximised.

Construction is an essential sector in any growing economy. In South Africa, it has historically been both an important employer and an industry which typified the over-capitalisation which has bedevilled the economy. These considerations, together with the fact that a large proportion of DBSA's lending goes to construction projects, suggested that it would be helpful to make practical proposals to assist the industry to adapt and contribute to development in the new circumstances.

The publications in this series present an approach to development that focuses on:

- the identification of the broad economic and social needs of communities
- optimal use of resources available to them
- ways in which communities can exploit the opportunities presented by development projects
- approaches to making best use of labour – an abundant but underutilised resource
- appropriate design and methods of building and construction
- the use of, and misconceptions about, building regulations

The publications are thus designed to help alleviate the constraints which have inhibited poorer communities from developing the skills at both individual and community level that can lead to the development of entrepreneurship and genuine empowerment.

This is perhaps the most important message of the series. It is above all through active participation in the process of development that individuals and communities can improve their quality of life. And it is to this end that the series is dedicated.

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MODIFICATIONS AND ADDITIONS

Users and readers are requested to share their comments, recommendations and own experiences. Readers who wish to contribute to further editions should contact the author.

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PART I

1. INTRODUCTION

This paper is written with the intention of drawing the attention of development agencies and the professional consultants who advise them to the advantages of considering all the alternative construction methods available, and choosing the most appropriate.

Part I sets out the criteria for development that the DBSA considers essential and defines appropriate and alternative construction methods in relation to development. Part II recommends an approach for the design of buildings in developing areas.

Ideally, a development project should ensure maximum benefit to the community by making optimal use of the resources that are available locally. An integral part of the design process proposed is the identification of what is available locally and the integration of this into the overall concept wherever this is practical, taking cognisance of the trade-offs that may be necessary to achieve this.

2. CRITERIA FOR DEVELOPMENT

The problem common to all areas of the world where development is taking place is "how does one use the resources available for development to the best advantage?"

This problem is particularly relevant to southern Africa where the financial resources available are dwarfed by the scale of the recognised need to improve the living conditions of the inhabitants and uplift whole areas both economically and socially.

It is a belief of all in the Development Bank of Southern Africa that a building or project is appropriate to the development environment when it:

- is affordable[1]
- is acceptable to the client or end user
- is appropriate to the brief
- answers the needs of the community
- makes best use of local resources
- contributes to the community in economic terms
- is such that the community's resources are sufficient to operate and maintain the facility provided

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[1] The affordability of a project can be the concern of
- the individual
- the community
- the local authority
- the regional authority
- the government

or of a combination of any of these.

Affordability levels can be determined by statistics that will indicate "ability to pay". However, the statistics can be made meaningless by attitudes that determine "willingness to pay". Both the statistics and the attitudes should be established in consultation with the potential beneficiaries of a development project.

While it is difficult to produce buildings that satisfy all the criteria listed, the possibility of doing so is increased by considering all the alternative construction methods that are available, together with all other relevant factors such as locality, climate, economics, resources, aesthetics and, most important, the people and their ability to sustain the proposed development.

The development of an appropriate building design for a community can only be achieved by consulting the people, whose active participation and involvement is a prerequisite for the successful implementation of any project.

3. APPROPRIATE CONSTRUCTION

What is appropriate construction? In relation to development appropriate construction can be regarded as any building medium or method that can be used to construct buildings that meet the development criteria.

4. ALTERNATIVE CONSTRUCTION METHODS

What are "Alternative Construction methods"? This is often answered by saying that these are the methods which one can consider using in place of conventional construction. In this paper, alternative construction methods are considered to be **all** the choices available when considering the design and construction of a building. These alternatives are:

- traditional
- conventional
- innovative
  - * labour intensive
  - * industrialised

Each of these methods of construction can be used to erect a wide variety of buildings. However, most innovative building systems and methods of construction, have been developed in response to the world-wide housing shortage and it is for this reason that the alternatives are discussed in this paper primarily with reference to house construction.

4.1 Traditional Construction

Where a building method or technique is no longer employed in the conventional construction industry but has lingered on in rural areas it can be defined as traditional. These methods include:

- building in stone
- wattle and clay methods of construction
- mud brick construction
- thatched or leaf roof coverings
- beaten and polished earth or dung floors
- "Zenzele" type post, lath and plaster construction, etc.

4.2 Conventional Construction

The construction required by those most conservative of bodies, the building societies, together with the construction described in the deemed-to-satisfy sections of SABS 0400, *The Application of the National Building Regulations*, can be regarded as "conventional". In other words conventional construction is current building practice, which is familiar to us all in:

- cast *in situ* concrete foundations
- cast *in situ* concrete surface beds
- walls constructed of clay bricks, cement bricks or concrete blocks, laid in mortar
- timber roof construction clad with steel or fibre cement roof sheets, clay tiles, concrete tiles, fibre cement tiles or slates

The National Building Regulations also touch on timber frame construction. However, in southern Africa, timber frame construction is not yet carried out on a day-to-day basis and is still sufficiently unfamiliar to the average builder to be regarded as an innovative construction method.

4.3 Innovative Construction

Innovative construction is the use of unusual methods to achieve a satisfactory end product. The driving force behind the development of these construction methods is usually the desire to:

- simplify the building process
- reduce the number and the level of the skills required
- reduce construction time
- reduce costs

Included under this description are building methods, systems and techniques that range from sophisticated industrialised methods where a whole structure or major components of it such as wall panels, roofs, floors, etc. are prefabricated (and possibly pre-finished) in a factory or produced in a casting yard, to labour intensive, site-based operations that use the most basic building materials and tools.

Labour-Intensive construction

Labour-intensive construction should be seen as part of the mobilisation of local resources. Conventional building and traditional building can be made labour intensive. Intensive use of labour does not only mean the employment of large numbers of unskilled labour by construction companies. It also means construction carried out by small contractors, emerging entrepreneurs, community self-help and mutual aid construction, all of which can be carried out without the aid of sophisticated plant or equipment.

While the employment of any of these methods of construction has obvious economic benefits for the community, it has equally important benefits for the project. The community's involvement in the building process reinforces consultative processes for arriving at an appropriate design and assists the community to identify with the project.

The decision to use labour-intensive methods of construction should be taken as early as possible in the inception stage of the project after consideration of a number of factors, such as:

- what labour is available
- whether the project can be designed to enhance the labour content[2]
- whether the scale of the project is sufficient to allow labour to be trained
  * prior to commencement of the project
  * on the job

Experience has shown that it is virtually impossible to introduce labour-intensive construction methods to a conventionally prepared project at construction stage. In view of this, any project that is to be constructed using labour-intensive methods should be designed, documented and managed with a conscious attempt to maximise the use of labour and minimise the use of capital-intensive mechanical plant.

It is widely held that the intensive use of local resources and the use of local labour and small or emerging contractors entail a time and cost penalty. As this method of construction is employed on development projects to benefit the community, responsibilities which include operational and financial responsibilities should be delegated as far as possible to the end user to ensure that the community is imbued with a sense of ownership. On the other hand, it is recognised that the intensive use of local resources requires an increased commitment from project management and that this must be suitably rewarded. Where a labour-intensive project is properly managed and there is a sense of ownership and responsibility in the community, it is quite possible for such a project to compete with a conventional one on time and cost. Case studies that illustrate this are available from the Centre for Policy Analysis of the DBSA.

Industrialised construction methods

Considered by many to be the antithesis of labour-intensive construction, industrialised building has a role to play in development and should be used when appropriate.

Industrialised building makes use of predominantly unskilled labour although obviously not to the same extent as labour-intensive building methods.

Industrialised building can produce buildings more quickly than many of the other construction methods and at the same cost or less than that of conventional construction of a similar standard.[3]

Lightweight industrialised building systems are easily transported to the remoter areas and can provide accommodation quickly. They generally use less labour than heavyweight industrialised building systems and are built so quickly that training opportunities for the local population are minimal.

Heavyweight industrialised construction produces durable buildings. It has been used successfully to produce a wide variety of buildings. When on-site casting

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2 The construction of a four-storey building requires plant, scaffolding, formwork, cranes, hoists, etc. The same accommodation can be provided in simple single-storey structures that hug the ground contours. This simple change makes the latter concept suited to construction by any or all of the labour-intensive methods listed in the first paragraph of this section.

3 Any reduction in construction time is welcome in times of high monetary inflation with its resultant effect on the escalation of contract sums.

yards are established, local people can be employed in these and, of course, in the erection process.

5. COMPARATIVE COST OF BUILDING METHODS

In a large area such as southern Africa the cost of any particular building method will obviously vary depending on a number of circumstances such as where it is intended to build, distance from suppliers, the skills available and what particular resources are available in the area. In view of this it is essential that the professionals charged with responsibility for costing the alternatives have or obtain extensive information on local conditions and circumstances and that, armed with this knowledge, they carry out objective cost/benefit analyses for the alternatives under consideration. The analysis should take into consideration the development impact that may be achieved, and the advantages and disadvantages of each of the alternatives considered.

6. CHOICE OF BUILDING METHOD

How does one choose the correct alternative for a particular project in a particular area?

If your client is a prestigious financial institution and it wishes to erect a suitably prestigious headquarters building in one of the financial capitals of western Europe, then your choice is limitless. You have lots of money to spend and world-wide access to high-tech materials and factories, and skilled workers are readily available at a price. An example is the new Lloyds of London, the most expensive individual office development ever undertaken in London but appropriate to the brief and to the circumstances.

In projects that are undertaken to assist in the development of southern Africa the design of the building, the materials and method of construction must also be appropriate.[4] For this they must comply with the development criteria; that is they must:

- be affordable
- be acceptable to the client or the end user
- answer to the needs of the community
- make optimal use of local resources
- be economically advantageous to the community
- allow operation and maintenance by the community

Part II of this paper deals with an approach to the design of buildings in developing areas that is intended to ensure that these buildings meet as many as possible of the criteria listed and are indeed appropriate to the brief and to the circumstances prevailing in the area concerned.

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4 This is determined for each development project that is submitted to the DBSA through an appraisal of the economic, technical and environmental, institutional, and social and financial aspects.

PART II

1. DESIGN PROCESS FOR IDENTIFYING APPROPRIATE BUILDING CONSTRUCTION IN DEVELOPING AREAS

Appendixes I and 2 summarise, in graphic form, respectively the basic design process, with the additional considerations that should be examined in designing for development; and the concepts used. The elements of this design process are as follows.

NEED (Recognition and proof of need)

Where development is concerned no need is simple. A school may be identified as the community's primary need but the primary need of an underpriviledged community is part of a network of needs that are common to most such communities and include

- the need for employment
- the need for buildings for a variety of uses, possibly:
  - * a community centre
  - * a learning centre
  - * a health centre or clinic
  - * a meeting place
  - * a library

The designer should identify these additional needs and in consultation with the community determine how many of them can also be satisfied by the appropriate design and implementation of the primary need, in this example a school.

INCEPTION

Initial steps to satisfy this need, for example selection of site and contact and discussion with design professionals.

BRIEF

Description of the project derived from the above and establishment of standards. In rural areas lower standards of building and services may be acceptable. In urban areas it is likely that the local authority will demand a higher standard. In either case, the views of the community should be sought and agreement reached at the earliest possible stage.

ACCOMMODATION SCHEDULE

Translation of brief, taking into account areas, volumes, function and special requirements.

DESIGN

The design of the form of the building, taking into consideration all of the above plus site conditions, cost constraints, time available for design, time available to build, specification of the materials, structure finishes, etc.

AFFORDABLE/ACCEPTABLE

The issues of affordability and acceptability should be introduced at the earliest possible moment and all subsequent decisions checked against these two criteria.

There is no point in proceeding with a project no matter how desirable (i.e. no matter how acceptable to the community) if the cost of the project cannot be made affordable to the community or if the community is not willing to pay. This applies equally to the facility's running costs.

Conversely there is no point in proceeding with a project that the community will not or cannot accept. If this is the case, it does not matter how efficient, cost effective or affordable a project is. It will not be a success.

Determination of the community's attitude to these considerations will normally require that the development authority and its design team allow time for community involvement in drawing up the brief and at other stages in the design process. The DBSA has personnel who are specialists in such involvement.

SITE

For a variety of reasons the site chosen for development projects may not be the most suitable. Before conducting the technical investigation that would form part of any design process, it is therefore advisable to take a critical look at the site and consider whether:

- the location of the site is the most suitable for
  - * the purpose
  - * the community or communities that are affected by the project
  - * economic connection to existing infrastructure and services
  - * future expansion
  - * integration with other developments

- there are alternative sites available and their advantages and disadvantages over the chosen site have been considered

- the topography or geological conditions of the proposed site will add to the cost of the project and make construction unnecessarily complicated

ALTERNATIVES

Successful development implies that resources are used optimally. In view of this it is sensible before embarking on a new project to establish if there are any existing buildings that could satisfy the requirements of the development project.

Unused industrial buildings can be converted and upgraded for a wide variety of uses. A community library or a clinic can be accommodated in one or more units of a commercial shopping centre. Dilapidated buildings that are structurally sound can often be upgraded at considerably less cost than building anew. If the upgraded building cannot accommodate all of the proposed development, it can very often form a characterful core to a new development.

AVAILABLE RESOURCES/PERFORMANCE AND MAINTENANCE

The use of local labour, local contractors or entrepreneurs, and local materials or locally manufactured components can be crucial to the development impact of a project, and of course the availability of these resources will to a great extent determine the community's ability to operate and maintain the facility provided.

In assessing the availability of local resources the following questions should be asked with regards to:

Labour

- What labour is available?
- Does it possess traditional skills?
- Does it possess contemporary skills?
- Is it unskilled?
- What training is available?
- What training can be made available?
- Are there entrepreneurs or small contractors who can assist in this?
- What level of support will be required to develop their capacity?

Materials

- What is currently used?
- What has traditionally been used?
- Are there untapped materials at hand?
- Are these exploitable by local entrepreneurs?
- What is imported at present?
- Can local alternatives be substituted?

Components

- Are components made locally?
- Can the manufacturers be assisted or encouraged by the new development?
- Can the development be used to help establish local entrepreneurs?
- Has the community the ability to manufacture components from
  - * local materials
  - * imported materials?

APPROPRIATE CONSTRUCTION

All the different methods of construction should be considered in the design process taking into account all the items listed above and illustrated graphically in Appendices 1 and 2.

2. DESIGN AND CONTRACT DOCUMENTATION

Having determined the construction method most appropriate to the community's needs, means and preferences and available local resources it needs to be ensured that the design of the project and the contract documentation are compatible with this.

A major contract can be split up into several smaller ones which can be advantageously priced and implemented by small contractors. However, this will not happen if the normal approach is taken to the production of bills of quantities

and other contract documentation. Simplified documentation suitable for small or emerging contractors should ideally be used. Case studies and other documentation are available from DBSA.

3. ACCEPTANCE BY BUILDING AUTHORITY

Where a building is to be erected in an area under the jurisdiction of a local or other authority, the building will generally have to comply with the standards laid down by that authority. Professionals should judge these standards against the following information. They should not simply accept all standards as given and they should seek to change standards that are seen to be inappropriate.

If the system of construction chosen is an unusual one, the authority may demand proof of the ability of the system to perform satisfactorily. Many authorities will accept building systems that are covered by an Agrement Certificate or a MANTAG.[5]

Where the National Building Regulations (NBRs) as set out in SABS 0400 apply, no authority may legally demand technical standards that are higher than those set out in the regulations. The NBRs are performance-based and the deemed-to-satisfy rules set out in SABS 0400 describe building methods that will provide buildings with acceptable performance characteristics. Where the building method proposed is not covered by the deemed-to-satisfy rules, the NBRs allow for the acceptance of several different proofs of performance namely:

a) a Test Report from the SABS

b) a Test Report from the CSIR

c) an Agrement Certificate covering the system or method of construction

d) an opinion on the design (verification) by a registered Professional Engineer

e) a MANTAG covering the system or method of construction

This is discussed in detail in the DBSA discussion paper entitled *Development and the Application of Building Regulations.*

4. CONCLUSION

It is hoped that the above has drawn attention to the fact that the intelligent choice between the alternative building methods available or the modification of a design to work within the limitations of a particular method can produce acceptable buildings that meet the development criteria.

Where the DBSA is requested to fund a building project, it is expected that the development corporation or agency involved, and the professional consultants advising these bodies, will now be able to show that both the design and the construction method chosen are appropriate in terms of the process outlined in this paper.

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5 Both certify the performance of buildings erected in accordance with the system.

Agrement Certificates cover many types of building and specify these; MANTAG's apply only to single-storey houses, schools and primary health care facilities.

A Design Process to Identify Appropriate Building Construction in Developing Areas

By Donald MacLeod. Senior Technical Specialist
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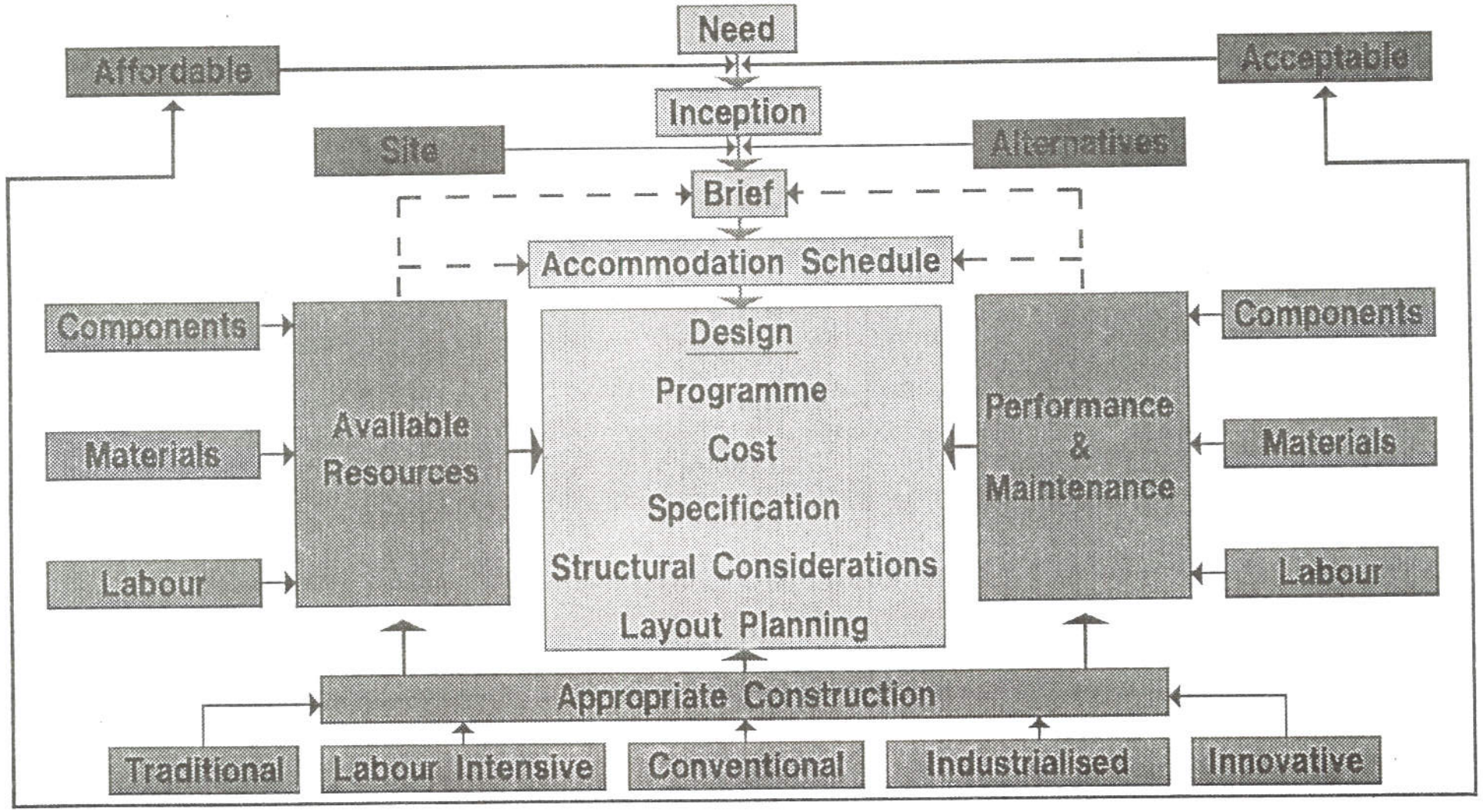
APPENDIX 1



Design Process to Identify Appropriate Building Construction in Developing Areas

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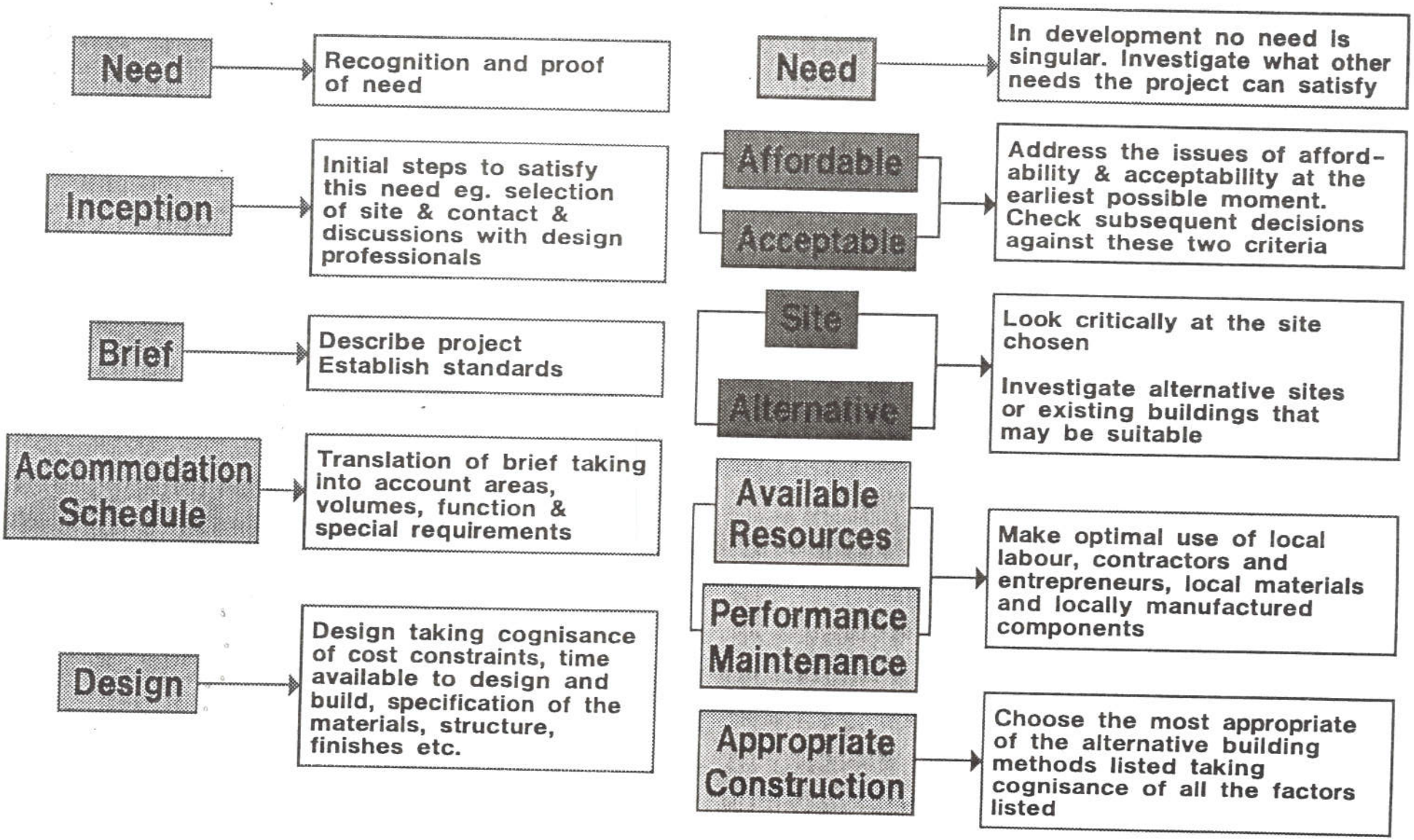
APPENDIX 2



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