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Prof. J.P. de Lange
Chairman of the Main Committee
HSRC Investigation into Education

**REPORT OF THE WORK COMMITTEE:
BUILDING SERVICES**

As Chairman I take pleasure in submitting the report of the Work Committee: Building services to the Main Committee for consideration. The final chapter contains a summary of the report.

F. A. Sonn

MR F. SONN
CHAIRMAN

STATEMENT

This report has been prepared by the Work Committee: Building services instituted by the HSRC Main Committee for the Investigation into Education.

This report reflects the findings, opinions and recommendations of the Work Committee: Building services and, where applicable, those of groups or individuals in the work committee with regard to matters about which there are differences of opinion. The findings, opinions and recommendations contained in this report do not necessarily reflect the point of view of either the HSRC or the HSRC Main Committee for the Investigation into Education.

This report is regarded by the HSRC Main Committee for the Investigation into Education as a submission of the Work Committee: Building services to the Main Committee. The point of view and recommendations of the HSRC Main Committee will be contained in its final report that will be submitted to the Cabinet.

Human Sciences Research Council

Investigation into Education

Report of the Work Committee:

Building services

Compiled by:

Council for Scientific and Industrial Research
National Building Research Institute



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ORIENTATION

THE REQUEST

In June 1980 the Cabinet requested the Human Sciences Research Council to conduct an in-depth investigation into all facets of education in the RSA. The request to the HSRC read as follows:

Your Council, in co-operation with all interested parties, must conduct a scientific and co-ordinated investigation and within 12 months make recommendations to the Cabinet on:

- (a) guiding principles for a feasible education policy in the RSA in order to
 - (i) allow for the realization of the inhabitants' potential*
 - (ii) promote economic growth in the RSA, and*
 - (iii) improve the quality of life of all the inhabitants in the country**
- (b) the organization and control structure and financing of education*
- (c) machinery for consultation and decision-making in education*
- (d) an education infrastructure to provide for the manpower requirements of the RSA and the self-realization of its inhabitants, and*
- (e) a programme for making available education of the same quality for all population groups.*

The investigation must be conducted in the light of, among other things, the present educational situation, the population composition in South African society and the means that can be made available for education in the national economy. The investigation must cover all levels of education, i.e. pre-primary, primary, secondary and tertiary.

In accordance with the South African Plan for Research into the Human Sciences, the following plan of action was decided on:

- (a) Prof. J.P. de Lange, Rector of the Rand Afrikaans University, would be appointed as research leader.*
- (b) After the necessary consultation, a high-level co-ordinating committee would*

be appointed to guide and co-ordinate the investigation and guarantee its scientific character. Members of the committee would include representatives of interested government departments, the private sector as well as eminent scientists from all the disciplines able to make a contribution to the development of education.

- (c) Representatives of education institutions would be invited to serve on the subcommittees and work groups of the investigation.
- (d) All population groups would be involved in the co-ordinated conducting of the investigation.
- (e) The investigation would be conducted in a spirit of positive co-ordination, i.e. the available research manpower both within and outside the HSRC and all research activities which had either already been concluded or were still going on, would be included in the investigation on a basis of voluntary co-operation.
- (f) The HSRC would undertake parts of the investigation itself, but would for the greatest part make its research structure available to contract researchers for the investigation.
- (g) Priority would be given to the most pressing problem areas so that the Investigation could be expedited and interim reports submitted to the Cabinet in good time.
- (h) Where applicable, alternative solutions for problems in education would be submitted.

THE MAIN COMMITTEE

The Main Committee of the Investigation into Education, whose members were appointed by the Council of the HSRC in their personal capacities, was as follows:

Prof. J.P. de Lange (Chairman)	Rector, Rand Afrikaans University
Prof. A.N. Boyce	Rector, Johannesburg College of Education
Dr S.S. Brand	Director, Financial Policy, Dept. of Finance
Dr R.R.M. Cingo	Inspector of Schools, Kroonstad circuit, Dept. of Education and Training
Dr J.G. Garbers	President, Human Sciences Research Council

Mr J.B. Haasbroek	Director, South African Institute for Educational Research - HSRC
Dr K.B. Hartshorne	Centre of Continuing Education, University of the Witwatersrand
Prof. J.H. Jooste	Director, Transvaal Education Department
Prof. S.R. Maharaj	Dean, Faculty of Education, University of Durban-Westville.
* Dr P.R.T. Nel	Former Director of Education, Natal Dept. of Education and Dept. of Indian Education
Prof. A.C. Nkabinde	Principal, University of Zululand
Mr R.D. Nobin	Inspector of Education, Dept. Of internal Affairs
Mr M.C. O'Dowd	Anglo-American Corporation of SA Ltd
Mr A. Pittendrigh	Director, Natal Technikon
**Miss C.C. Regnart	Westerford High School
Dr. P. Smit	Vice-President, Human Sciences Research Council
Mr F.A. Sonn	Director, Peninsula Technikon and President, Union of Teachers' Associations of SA
Mr J.F. Steyn	Hoofsekretaris, Tvl. Onderwysersvereniging and Secretary, Federal Council of Teachers' Associations
Prof. N.J. Swart	Vice-Rector, Potchefstroom University for Christian Higher Education
Mr L.M. Taunyane	President, Transvaal United African Teachers' Association
Dr P.J. van der Merwe	Deputy Director-General, Dept. for Manpower; Deputy Chairman, National Manpower Commission
Prof. R.E. van der Ross	Principal, University of the Western Cape
Prof. F. van der Stoep	Dean, Faculty of Education, University of Pretoria
Prof. H.T. van Loggerenberg	Dean, Faculty of Education, University of OFS and Chairman, South African Teachers' Council for Whites
Dr R.H. Venter	Director, University Affairs, Dept. of National Education
Prof. W.B. Vosloo	Head, Dept. of Political Science and Public Administration, University of Stellenbosch

After the investigation had been in progress for some months, a request was received from the Department of National Education of South West Africa that it be granted observer status on the Main Committee - this was approved. From the fifth meeting of the Main Committee, Mr J.A. de Jager, Secretary of the Department, therefore also attended meetings of the Main Committee.

*Dr H. Askes (in the absence of Dr Nel). Education Planner, Department of Education and Training

**Dr B.A. Dobie (in the absence of Miss Regnart) Senior Lecturer, University of Natal, Durban, Chairman of Natal Teachers' Association.

At the beginning of the investigation Dr S.W.H. Engelbrecht was appointed secretary and Dr F.P. Groenewald co-ordinator of the investigation. In due course the secretariat was expanded with the appointment of Dr D.J. van den Berg, after which the above-mentioned three persons acted as secretary/co-ordinators. Mr C.P. Serfontein was later appointed assistant co-ordinator. During the last phase of the investigation the secretariat was further expanded when Prof. J. McG. Niven of the University of Natal was seconded to the HSRC for three months, from February to May 1981. The administrative staff consisted of Mrs I.S. Samuel, Mrs A. van der Lingen, Miss J.M.M. Botha, Mrs S. van der Walt and other temporary staff.

OPERATIONALIZATION OF THE RESEARCH REQUEST

The operationalization of the research request resulted in the establishment of 18 work committees each being responsible for a different aspect of education. Although all the work committees were not identified at the first meeting, the following work committees were eventually established. (For each work committee the name of the chairman is given who in all cases had to be a member of the Main Committee. The chairman of the Main Committee was ex officio member of all the work committees.)

Educational principles and policy	Prof. F. van der Stoep
Education management	Dr K.B. Hartshorne
Education financing	Dr S.S. Brand
Education system planning	Mr J.B. Haasbroek
Curriculum development	Prof. F. van der Stoep
Guidance	Miss C.C. Regnart
Education for children with special educational needs	Dr J.G. Garbers
Building services	Mr F.A. Sonn
Health, medical and paramedical services	Mr R.D. Nobin
Demography, Education and Manpower	Prof. P.J. van der Merwe
Teaching of the Natural Sciences	Mr J.B. Haasbroek
Mathematics and technical subjects	Prof. N.T. van Loggerenberg
Recruiting and training of teachers	Prof. W.B. Vosloo
Innovation strategies in education	Prof. R.E. van der Ross
A programme for education of equal quality	Mr M.C. O'Dowd
Legal matters	Mr A. Pittendrigh
Educational technology	

Only in the case of the last work committee was the chairman not appointed from the Main Committee. Miss H.J. Otto of the HSRC library compiled the bibliography for each of the work committees.

During the last stages of the investigation a synthesis committee was appointed to consolidate especially the work of three work committees, namely Education management, Education system planning and Education financing. The chairman of the Main Committee of the Investigation into Education was appointed chairman of the synthesis committee.

WORK COMMITTEE : BUILDING SERVICES

(a) The Human Sciences Research Council Investigation

The HSRC appointed the Work Committee: Building services to function as part of its general investigation into education in the RSA. The term of reference were

- (i) the current situation as regards building, site facilities and transportation services;
- (ii) an estimate of future needs;
- (iii) the formulation of universal space and cost norms for building, site and transportation services for all population groups, and
- (iv) building services in other countries.

(b) Committee members

The Work Committee: Building services was gradually expanded and eventually comprised the following members:

Mr F. Sonn
(Chairman)

Director, Peninsula Technikon

Mr J.F. Backman

Department of Internal Affairs
(Coloured Affairs)

Mr J.F. Becker

Transvaal Education Department

Mr A.J. de Villiers	National Building Research Institute
Mr D. Kobe	Department of Education and Culture, Lebowa
Mr N.B.C. Korsman	Department of Community Development and State Auxiliary Services
Mr B.R. Martin	Department of Education and Training
Dr G.K. Nair	Department of Internal Affairs (Indian Affairs)
Mr J.E. Ndlovu	Department of Education and Culture, Kwazulu
Mr V.F. Rabe	Department of Co-operation and Development
Mr C. van Niekerk	Human Sciences Research Council
Dr D.J. van den Berg (Secretary)	Human Sciences Research Council
Mr P.J.T. Hamman (Minute Secretary)	Human Sciences Research Council

(c) NBRI research contract

At the request of the Work Committee: Building services the HSRC appointed the NBRI to conduct a research study on behalf of the work committee. The study was to cover the scope of the terms of reference of the committee, but only with regard to primary and secondary education. It is in these areas that the greatest problems are experienced in terms of building and transportation services. Pre-primary, tertiary and special education were excluded from the study because of the limited time available.

(d) Research contributors

The work committee expresses thanks to the following research staff involved in the project:

Mr A.J. de Villiers	- Project leader
Dr T. le Roux	- Education and statistics
Mrs M. Theron	- Building design and media
Dr T.W. Miners	- Building professional resources
Mr J.S.D. Kitcher	- Building methods

Mr G.H. Lochau-Emden
Mr R.J. Page-Shipp
Dr J.D. Wentzel
Mr T.M. Ferreira
Mr I.J. Boyd
Miss G.H. Fouché

- Availability of materials
- Environmental engineering
- Thermal Environment
- Acoustics
- Lighting
- Secretarial services

REPORT OF THE WORK COMMITTEE: BUILDING SERVICES

1 INTRODUCTION

School buildings, sites and transportation are the outward framework within which an education system must function. It is true to say that we shape our buildings and our services, but thereafter our buildings and services shape us.

Most of the developed countries of the world face the problem of excess space in schools due to a population decline. South Africa, as with the developing countries of the world, faces a heavy population increase for which school buildings and facilities must be provided on an extensive scale. Considering limited resources and the vast need for buildings and services, the main thrust of this committee's work was to find ways and means of optimizing existing and available procedures and resources for school building. Value for money in terms of a functional and educationally stimulating environment designed to provide for the educational, comfort, sociological and recreational needs of teachers, pupils and the local community was the main objective.

1.1 PURPOSE AND SCOPE OF THE STUDY

- 1.1.1 To formulate recommendations for the procurement of school sites, buildings and transportation systems for all, considering
 - (a) the historical background to school building locally and abroad;
 - (b) existing procedures and resources;
 - (c) the number of schools needed for all levels of education;
 - (d) the educational and environmental requirements and standards for building design;
 - (e) the nature and geographic spread of current and future building programmes;
 - (f) the nature and effective utilization of the building industry and the professions for the planning, design and erection of education buildings.

- 1.1.2 The scope of the study was limited to primary and secondary education facilities as it is in this area that the major problems exist. Pre-primary schools, teacher training and other colleges could be the subject of a second-phase research study and technikons and universities a third-phase study. South African post secondary education norms for buildings applicable to all population groups have recently been formulated by the Department of National Education.
- 1.2 THE INTERPRETATION OF THE PRINCIPLES FOR THE PROVISION OF EDUCATION IN TERMS OF SCHOOL BUILDING SERVICES
- 1.2.1 *Equal opportunities for education, including equal standards in education, for every inhabitant irrespective of race, colour, creed or sex, shall be the purposeful endeavour of the state.*
- 1.2.1.1 Equal opportunity for education does not imply that all buildings for the same educational level (e.g. primary schools) should be the same. However, the potential for education opportunity should be the same for all school buildings. Such equality can therefore preferably be expressed in terms of
- (a) the amount of space needed;
 - (b) the quality of space and of the building fabric, and
 - (c) comfort requirements in terms of thermal comfort, lighting and noise control.
- 1.2.1.2 Diversity in terms of structure, materials, finish and appearance will no doubt always occur irrespective of race, colour, creed or sex. Education buildings will differ according to local environmental and technological conditions, such as
- (a) the local climate;
 - (b) the availability of materials;
 - (c) the level and nature of available building technology, and
 - (d) the need for protection in terms of safety and security.
- 1.2.1.3 Common standards for all school buildings could therefore be considered in terms of—

- (a) the amount of space needed - space norms;
- (b) the number of pupils per class;
- (c) the quality of space - cost norms;
- (d) comfort requirements - comfort norms, and
- (e) security requirements.

1.2.1.4 Commons space, cost and environmental norms for all schools would be a positive step towards equivalent standards in education. In some cases additional accommodation such as for remedial or preparation study, will be necessary to reach equivalent standards.

1.2.1.5 The provision of new buildings according to a particular national standard raises the question of what should be done about existing buildings that are below this standard. It would seem advisable to embark upon a renovation or rebuilding programme simultaneously with current and new building programmes. Renovation needs will have to be identified and quantified to establish the extent of such need.

A well planned long-term project with clearly identified short-term priorities will no doubt be necessary.

1.2.1.6 Equal opportunity may also be seen to imply that transport is provided wherever the need exists.

1.2.1.7 Equal opportunity may further imply that the same basis for residential accommodation should apply throughout the education system. Considering the desirability or otherwise of school residences in the context of social needs, centralization and decentralization of facilities, transportation and available funds, a new basis for the provision of residences should be considered.

1.2.2 *Education shall afford positive recognition of what is common as well as what is diverse in the religious and cultural way of life and the languages of the inhabitants.*

1.2.2.1 Norms and standards for education facilities should be based on the common facility requirements only. Allowance must, however, be made for different facility requirements for particular groups within the limitations of cost norms. However, the need for such diversity in terms

of physical facilities appears to be limited and could no doubt be easily accommodated in national building norms and standards.

- 1.2.2.2 The local environment and available building technology and materials exert a greater influence on diversity than the differences between population groups are likely to exert (cf. 1.2.1.2 on page 2).
- 1.2.2.3 A certain degree of freedom in building design particularly in terms of finish and external appearance should as far as possible be maintained. On the other hand, the greater the degree of standardization the more economically the buildings can usually be procured.
- 1.2.2.4 Diversification to cater for the more prominent directions of study in certain areas, will influence building and site requirements at the secondary and tertiary level. School readiness classes and remedial teaching can equally affect the need for extended facilities at primary schools in the poorer areas. The application of norms should be flexible enough to accommodate such diversity in response to specific education needs.
- 1.2.3 *Education shall give positive recognition to the freedom of choice of the individual, parents and organized society.*
 - 1.2.3.1 The procedures for procuring buildings and other education facilities should to a large extent be standardized but nevertheless make provision for parent and community choices as regards their respective interests.
 - 1.2.3.2 Facilities should be so designed as to cater for a wide range of activities and interests for individuals, parents and organized society.
- 1.2.4 *The provision of education shall be directed in an educationally responsible manner to meet the needs of the individual as well as those of society and economic development, and shall, inter alia, take into consideration the man-power needs of the country.*
 - 1.2.4.1 Current standardized school design in South Africa largely makes provision for class orientated teaching and only limited provision for group work and individual work.

While it is no doubt necessary to maintain the classroom as an identifiable separate space, the school should be designed to cater for more group and individual activities. Provision should also be made for a greater variety of activities to cater for individualized education and future needs. To maintain classrooms as in our existing schools and yet provide space for additional activities calls for a reconsideration of existing school design and building procedures. In this way costs could be kept within their current limits.

1.2.4.2 The use of audio-visual media in teaching spaces influences design. While the use of media may be very limited at present, provision should be made in new school buildings for anticipated future development in this field.

1.2.4.3 To cater for the changing man-power and economic development needs of a fast developing country, the school building should be designed for changing requirements without inhibiting current needs. This concept of building flexibility requires careful examination.

The well tried concept of flexible buildings overseas with demountable, moveable and accordial partitions, proved expensive and in many cases unnecessary. Multipurpose space with flexible subdivisions was often difficult to use for specific needs and degenerated into useless space.

Well planned flexibility with a variety of different types of spaces to cater for current and likely future needs, appears to be a more economical and more effective manner of dealing with the problem. Such planned flexibility may well incorporate the use of moveable or operable partitions in specific areas. It should also make provision for a local bias towards a particular subject direction.

1.2.5 *Education should endeavour to achieve a positive relationship between the formal, non-formal and informal aspects of education in the school, society and family.*

1.2.5.1 To achieve and maintain a close relationship between the formal and less formal aspects of education, provision could be made for family and community involvement in the school's programme and for their use of the building facilities.

This would influence the layout and design of the buildings but need not increase the cost of schools except in instances where the community elects to do so at its own expense.

Parent involvement in the school and the controlled and organized use of school facilities very often has an upgrading effect on the local community. It increases the utilization of buildings and site facilities and encourages a sense of pride, interest and ownership in the local community. This can be a very important factor in favour of the community preserving their school facilities should riots and unrest occur.

1.2.5.2 In private and vocational schools there is possibly a closer relationship between formal and informal education. The same design considerations will nevertheless apply.

1.2.5.3 Provision for contributions to the cost of building from the local community would help to foster a closer relationship between the community and the school. Community use of school facilities should be facilitated and encouraged.

1.2.6 *The provision of formal education shall be a responsibility of the state provided that the individual, parents and organized society shall have a shared responsibility, choice and voice in this matter.*

1.2.6.1 The government's contribution to school building costs should as far as is possible provide for a basic range, extent and quality of accommodation necessary to maintain equal opportunities. The space, cost and comfort norms in 1.2.1.3 on page 3 should indicate the extent of this subsidy.

1.2.6.2 Additional funds may be made available as organized school building funds or special project funds to extend or improve the basic subsidized facilities. Such funds could be

- (a) official national school building funds open to the public, or
- (b) local community funds, or
- (c) school funds.

1.2.6.3 The extent and nature of alterations to the initial basic facilities

could be controlled by means of a mapped-out framework and norms within which such improvements can be made. Control of this kind is likely to be necessary as the maintenance and use of all facilities has to be kept within reasonable cost limits. Differentiation between richer and poorer communities should also be limited to a reasonable extent.

- 1.2.6.4 The more necessary alterations to the basic school could be encouraged by a subsidy proportional to the funds raised by the school or the community. Further improvements, considered unessential although desirable, could be undertaken at the school's or the community's own cost.
- 1.2.6.5 Community responsibility and funding of school facilities suggest that the community itself should be permitted to comment as regards the provision of facilities funded by them. Norms and standards should therefore provide for reasonable flexibility in this area.
- 1.2.7 *The private sector and the state shall have a shared responsibility for the provision of non-formal education.*
- 1.2.7.1 School building facilities can to a reasonable extent be used for non-formal education. Provision should, however, be made to extend and improve such facilities according to the particular needs and interests of the local community. The extended accommodation can be made available for the formal education programme as well. The local community would have to bear the costs of such alterations while the department concerned would have the maintenance responsibility.
- 1.2.7.2 The provision of facilities for non-formal education should be encouraged by making subsidies for such amenities available to private organizations. Institutions having benefited by a substantial subsidy could then more readily become part of the general system of educational provision.
- 1.2.8 *Provision shall be made for the establishment and state subsidization of private education within the systems of providing education.*
- 1.2.8.1 State subsidization of private education usually applies to the costs of education and not of buildings. Buildings are usually erected at the expense of the private body concerned.

1.2.8.2 The building of private schools would be encouraged if subsidies for school building as well as for education were made available. This could help to alleviate some of the pressure on the government for the provision of schools.

1.2.9 *In the provision of education the process of centralisation and decentralization shall be reconciled organisationally and functionally.*

1.2.9.1 The advantages of decentralization

- (a) Local needs can be better understood.
- (b) Local building technology can be better utilized.
- (c) Supervision and control of building operations can be handled more effectively and expeditiously.
- (d) Communication between the user department and the building or works department can be closer.

1.2.9.2 Disadvantages of decentralization

- (a) Building programmes are too small to utilize available industrialized technology to the best effect and suited to school building.
- (b) Separate budgets for building for a number of decentralized departments limit flexibility in the allocation of funds to meet national priority needs.
- (c) More manpower is needed to control standards adequately.

1.2.9.3 The advantages of centralization

- (a) The introduction of new building procurement policies and procedures can more readily be applied through a centralized education system.
- (b) Subsequent new trends and developments can be communicated and utilized more readily.
- (c) Research and development work on buildings for education can be undertaken more effectively.
- (d) National priorities in terms of the provision of facilities can be implemented more readily.
- (e) Larger consolidated building contracts to gain the maximum advantages from bulk buying, planned production and construction over a longer

period of time can be negotiated.

- (f) The possibility exists of more effectively utilizing a combination of industrialized and traditional building techniques for larger and more continuous contracts to achieve the standards of building, fittings and finish required according to set national standards.
- (g) Alternative tendering procedures can more readily be considered.

1.2.9.4 Disadvantages of centralization

- (a) The difficulty of controlling and supervising building work over a large geographical area with a variety of regional needs.
- (b) The impersonal nature of a large centralized system.
- (c) Particular needs of local communities may be difficult to identify and not as easy to respond to as with a decentralized system.

1.2.9.5 A combination of centralization and decentralization, structured according to the real needs of the various population groups in terms of geographical regions and administration and control needs, could well combine the advantages of both systems while dispelling their disadvantages.

1.2.10 *The professional status of the teacher and lecturer shall be recognized.*

1.2.10.1 The provision of accommodation, furniture and fittings in technikons, colleges, universities and schools for teachers and lecturers must accord with their professional status, but should be within reasonable limits. Existing standards should be reconsidered in this context.

1.2.10.2 While having to simulate many of the conditions in schools, the college buildings should nevertheless provide an atmosphere conducive to higher learning.

1.2.11 *Effective provision of education shall be based on continuing research*

In many countries of the world, continuing research on design and building for education has proved essential. In the South African context where there are vast and growing numbers of pupils and limited financial resources such research is particularly necessary.

2 THE BACKGROUND TO DEPARTMENTAL SCHOOL BUILDING PRACTICE

At Union in 1910 the provincial administrations were given control over primary and secondary education for all population groups.

2.1 WHITE EDUCATION

2.1.1 School buildings were erected by the provinces but the communities and churches also provided buildings. Most of the schools were traditionally built but sometimes industrialized building systems were used. There was seldom a serious shortage of teaching spaces.

2.1.2 Research on the design of school buildings undertaken in 1953 formed the basis of school planning for all the provincial administrations until the present time. Recently, further research was undertaken on more compact forms of school planning to reduce circulation space and increase education space without increasing the overall area of the school. Provision was made for a wider range of teaching methods and for the use of audio-visual teaching/learning aids.

2.2 COLOURED EDUCATION

2.2.1 A limited number of buildings were erected by the provincial administration for Coloured education. They were practically of the same standard as those erected for Whites. However, the community was responsible for the erection of its own facilities and farmers and churches also erected schools subsidized by the province.

In 1953 there were 1 089 state-supported schools with 157 784 pupils.

In 1963 these numbers grew to 1 340 schools with 196 988 pupils.

2.2.2 From 1964 to 1969 the Department of Community Development was responsible for Coloured schools.

In 1964 Coloured education was taken over by the Department of Coloured Affairs with such a backlog that there were 240 double session classes. Since the take-over considerable progress has been made but the application of the Group Areas Act and the delays experienced by the Department of Public Works further increased the backlog.

2.3 INDIAN EDUCATION

- 2.3.1 The first schools for Indians were opened by Christian missionaries, but in 1894 the responsibility for Indian education was transferred to Natal. There were then 26 schools for 2 452 pupils.

In 1910 education became the responsibility of the provincial administration but although some schools were erected by the province, the various Indian communities had to erect their own schools subsidized by the province. Although there was considerable improvement in the provision of facilities in 1952 there were an estimated 37 000 children that could not be housed in schools. As a result of this the *platoon system* of two classes sharing classroom and outdoor space alternately was introduced.

- 2.3.2 As from April 1966 Indian education was carried over to the Department of Indian Affairs in stages. There were then 33 543 students in *platoon* classes.
- 2.3.3 By November 1980 the school population was 217 598, an increase of 58 000 since 1966. State-aided schools were reduced by 87 to 128 schools and *platoon* classes reduced by 24 200 to 9 343 classes.

2.4 BLACK EDUCATION

- 2.4.1 The first schools were built by missionaries. After 1910 Black education also became the responsibility of the provinces, but while the provinces did build some schools, the responsibility for school building rested on the various Black communities, churches and farmers. By the end of 1953 there were approximately 5 700 schools with 21 000 teachers and 869 000 pupils. This accounted for 40 to 45 % of school-age children.

- 2.4.2 In 1954 Black education was transferred to the Department of Bantu Affairs and in 1958 to the Department of Education and Training. However, from 1954 to 1979 schools were built by local authority administration boards after which the Department of Education and Training took responsibility for school building.

- 2.4.3 As the Black states developed their own education departments they became responsible for education and their works departments for the erection of buildings. The Department of Education and Training was then left the responsibility for Black education in White areas.
- 2.4.4 The budget available for education buildings in the Black states is so small at present that generally speaking less than 10 % of the schools are built by the government. School buildings are largely erected by the Black communities with a limited subsidy from the department. The departments usually only build schools in the towns.
- 2.4.5 Considerable progress has been made in the White and Trust areas. In 1951 only 36,7 % of school-age children were at school, whereas in 1975 the figure had increased to 75,2 %.

Building procurement procedures differ very little from one department to another. However, each department does have its own way of handling matters, although the overall procedures are basically the same.

3.1 ADMINISTRATION PROCEDURES

The provincial administrations and the Black states have separate education and works departments. The departments of Indian and Coloured Affairs have an education section but no works department. These departments depend on the services of the Department of Community Development and State Auxiliary Services. The Department of Education and Training controls and administers its own school planning and building for Blacks.

3.1.1 Establishing the need for facilities

Each department divides its total field into regions and in each region it has a committee, board or official who reports on the needs of that region to his department. In the rural areas in the Blacks states the communities largely determine their own needs and apply for permission to build a school.

3.1.2 Approval procedures

These requests are again dealt with by planning committee or officials who make submissions to the directors, secretaries or director general. When approved, they are submitted to the respective works departments for inclusion in the department's budget and then to the provincial or state executive or to the Treasury for the finance. Rural communities in the Black states build their own schools once permission to use a particular site has been granted.

3.1.3 Education planners

Most of the education departments have full-time planners, usually with an education background. A knowledge of building/procurement procedures has to be learned through experience as no training or suitable literature is available.

3.2 HOW SITES ARE ACQUIRED

3.2.1 When a new township is proclaimed the developer, whether it be a municipality, a private firm or an administration board, must reserve a site or sites for schools. In areas outside the proclaimed group areas, the Coloured and Indian divisions of education find it very difficult to pass transfer of sites because of the provisions of the Group Areas Act. The various departments have different formulae for calculating the area they can claim: the Transvaal requires 48,08 m² per stand and the Cape 5 % of the total area. Natal, the Free State, and the education departments for Indians and Coloureds work on the number of pupils per family on each stand. This number varies from 1,1 to 2. Each department has its own maximum number of pupils for primary and high schools and from this is calculated the areas of the sites required. The area of primary school sites varies from 2 to 5 ha and secondary school sites from 3,2 to 9,5 ha.

3.2.2 Rural communities in the Black states apply to their chief or the local community council for permission to use a particular site for a school building. If approved, the application is forwarded to the state's department of education and culture and then to the Department of Co-operation and Development for approval. The area standards of the Department of Education and Training are generally used as a guide for the size of site to be allocated.

3.3 DESIGN AND DOCUMENTATION PROCEDURES

3.3.1 The provincial administrations have their own works departments which are responsible for the design, documentation and erection of school buildings.

They employ architects, engineers and quantity surveyors whose task it is to

- (a) set space and design standards in collaboration with the education department;
- (b) administer and co-ordinate projects, and
- (c) exercise control.

- 3.3.2 School design is usually done by appointed consultants and based on departmental standards such as standard plans of units or sections of school buildings and standardized bills of quantities and specifications. The degree of standardization and control varies from one province to another. Generally speaking, the greater the degree of standardization and control, the less stimulating the school environment becomes but the lower the cost.
- 3.3.3 The Department of Community Development and State Auxiliary Services fulfils the same works department functions as described above, for Indian and Coloured education. Private firms have also been commissioned to formulate new space and design standards for Indian schools and to co-ordinate and control certain work on behalf of and in collaboration with the department.
- 3.3.4 The Department of Education and Training has a Building and Sites Branch in which space and design standards are formulated for Black schools in White areas. The same standards in the form of standard plans are largely used by all the Black states. For primary and secondary school building design, consultants are generally not used but for the more special schools such as technical, commercial or agricultural schools, consultants are always appointed.
- 3.3.5 The works departments in the Black states do not generally employ professional staff. They administer contracts and supervise or inspect projects using personnel with drafting, building or administration backgrounds. Standard plans are acquired from the Department of Education and Training through the Department of Co-operation and Development. Consultants are however appointed for large specialized secondary schools or colleges. In some cases, depending on the stage of development, these appointments are made through the Department of Co-operation and Development.
- 3.3.6 In the rural areas of the Black states the government departments do not provide schools. The local communities usually obtain the standard plans from the state works department and appoint their own contractors to build their schools.

3.4 CONTRACT PROCEDURES

- 3.4.1 The provincial administrations and the Departments of Internal Affairs (Indian and Coloured Affairs) generally use the Bill of Quantities contract form for school building, using private contractors on the normal tendering basis. Sometimes, particularly for small contracts, the Lump Sum contract form is used.
- 3.4.2 The Department of Education and Training also uses the standard Bill of Quantities contract for large school building projects, particularly in townships. Generally speaking their schools are built by contractors or their own departmental building teams on a labour only basis. Materials are bought on a state contract and, using the above procedures, they are able to reduce their building costs considerably. For maintenance work materials are drawn from bulk material depots.
- 3.4.3 The Black states to a large extent make use of labour only contracts using private contractors and providing materials from their own depots. Some have experienced difficulties with the administration of such depots due to the lack of suitably experienced staff and the responsibilities the department has to assume for the provision of materials on demand from contractors. It is felt that the contractor should carry the responsibility for the supply of materials to prevent time delay claims by contractors as a result of departmental depots not being able to provide materials during times of short supply. On the other hand, bulk buying helps to reduce the costs of school buildings.
- 3.4.4 Rural communities in the Black states build their own schools, usually using local Black contractors on an ad hoc contractual basis.

3.5 BUILDING METHODS

- 3.5.1 All the departments involved with school building prefer traditional building methods to industrialized methods. Light-weight industrialized buildings have generally speaking proved to be unacceptable except as a necessary temporary measure until permanent classrooms can be erected. Due care must however be taken that temporary facilities are not regarded as permanent. Heavy industrialized building systems have proved largely unacceptable to some school building authorities, mainly due to problems experienced in the development stages of the system and

the resultant stigma that has remained. Promises of lower costs and shorter construction periods were not always fulfilled and the quality of the buildings was regarded as inferior to conventionally built schools.

- 3.5.2 While the provincial administrations generally decided on traditional building methods owing to difficulties experienced with industrialized methods, these methods were being applied for Coloured school building to alleviate the drastic shortage of schools in the quickest possible time. Industrialized buildings are considered inferior to White provincial schools by the Coloured community who regard them as second best. On the other hand, heavy industrialized building systems are being used for Black schools in White areas and are causing a high degree of satisfaction among the communities concerned. A large-scale building programme such as envisaged for South Africa might make industrialized building inevitable. Careful consideration must therefore be given to the problems experienced and to the optimum use of such systems.

3.6 FINANCING AND COST OF SCHOOL BUILDINGS

- 3.6.1 School building for all departments including the Black states, but excluding the Department of Education and Training, is financed from works departments' budgets. Maintenance of school buildings is also a works department cost but subsidies for community school building in the Black states are included in the education departments' budgets. Such subsidies are usually on a R for R basis up to a certain maximum value per classroom, usually \pm R2 500. Actual costs of classrooms vary from R3 500 to R9 000, and are usually in the order of R5 000 - R8 000.
- 3.6.2 As less than 10 % of the schools in most of the Black states are built by the government departments, it can be seen that the local communities bear the cost of school building to a very large extent.
- 3.6.3 Generally speaking, building costs in White areas vary between R200/m² and R250/m² as at December 1980 prices. The exceptions are Coloured schools in the Cape at R175/m² and Indian schools in Natal at R184/m². Cape schools are generally more expensive than, for example, Transvaal schools due to climatic considerations and a greater accent on individual school character and hence less standardization.

3.7 THE USE OF AUDIO-VISUAL MEDIA IN SCHOOLS

- 3.7.1 While audio-visual media are being used in schools, their use is still very limited. The overhead projector is the most commonly used medium and to a far lesser extent tape recorders, 35 mm slides, 8 mm and 16 mm cine projection. Television and closed-circuit television are not used in schools.
- 3.7.2 Some school libraries are being remodelled into media centres by making provision for audio-visual media software and hardware. Some of the problems being experienced in this regard and as regards the use of media in classrooms are
- (a) insufficient funds - particularly in schools for Blacks;
 - (b) lack of training and experience on the part of teachers as regards the preparation of materials;
 - (c) limited availability of suitable programmed material;
 - (d) insufficient and sometimes unsuitable space in existing libraries and classrooms.
- 3.7.3 The provision of libraries and media centres in schools ranges from large media centres with a reasonable stock of media software and hardware to no library at all except for a limited stock of book material.

4 CURRENT DEPARTMENTAL SCHOOL DESIGN STANDARDS

4.1 COMPARATIVE STUDY OF AREAS AND AREA PER PLACE

A comparative study of areas of all spaces provided in schools by all the departments concerned was undertaken. The range of areas and the area per place provided for primary and secondary schools are as follows:

4.1.1 Primary schools

- 4.1.1.1 The areas of classrooms some of which are used for special purposes, vary from 43,10 m² to 61,60 m² and from 1,23 m² per place to 2,27 m².
- 4.1.1.2 The areas of the practical spaces, e.g. Art room, Woodwork room, Needlework room, Science rooms, etc. range from 60,20 m² to 120,93 m² and from 2,01 m² per place to 4,03 m².
- 4.1.1.3 The total areas of the resource centres are between 65,03 m² and 308,08 m².
- 4.1.1.4 The total areas of the administration blocks range from 148,77 m² to 362,59 m² and from 0,15 m² per pupil to 0,60 m².
- 4.1.1.5 The general-use spaces range from 22,36 m² to 657,09 m². This tremendous difference is due to the fact that some education authorities provide halls and others do not.
- 4.1.1.6 It is very difficult to compare the areas for factotums and for cleaners because of differences in policy.

4.1.2 Secondary schools

- 4.1.2.1 The areas of the normal classrooms range from 49,00 m² to 57,93 m² and from 1,41 m² per place to 1,95 m².
- 4.1.2.2 The general-purpose rooms which can be used for Art, Typing, Geography, a junior laboratory, demonstration rooms, etc. have areas between 60,38 m² and 92,27 m² and from 1,68 m² per place to 3,28 m².

- 4.1.2.3 The areas of Science laboratories range from 93,47 m² to 194,22 m² and from 2,35 m² per place to 6,07 m².
- 4.1.2.4 The areas for Industrial Arts centres, i.e. rooms for Woodwork, Metalwork and Drawing, range from 327,76 m² to 528,06 m² and from 10,93 m² to 16,50 m².
- 4.1.2.5 The areas for Needlework rooms range from 134,69 m² to 60,74 m² and from 4,56 m² to 2,53 m². The areas for Cookery rooms are between 119,36 m² and 134,68 m² and 5,97 m² and 3,85 m² per place. In the dual-purpose Domestic Science rooms the areas are between 181,10 m² and 60,74 m² and 7,55 m² and 2,53 m².
- 4.1.2.6 The areas of the workshops for technical subjects range from 407,48 m² to 579,29 m² and from 5,46 m² to 11,59 m² per place.
- 4.1.2.7 The total area for administration varies from 165,93 m² to 582,15 m² and from 0,17 m² to 0,71 m² per pupil.
- 4.1.2.8 The areas of the resource centres are between 76,18 m² and 277,78 m².
- 4.1.2.9 The areas of the general spaces of those schools where halls are provided vary between 663,30 m² and 990,06 m² and 0,78 m² and 1,29 m² per pupil.
- 4.2 SCHOOL DESIGN
- 4.2.1 Most South African schools consist of rows of classrooms with a passage on one side giving access to the classrooms. When more space is needed owing to an increase in pupil numbers, additional classrooms are simply added to the existing rows.
- 4.2.2 School planning developments in recent years in some departments and some private schools indicate a move away from formal rows of classrooms to a more compact classroom cluster type of school planning. Natal completed a compact planned development project school in 1979. They are currently redesigning their standard plans to form classrooms on either side of a central circulation and education space.

Indian schools are currently being built on the same basic principle with open educationally usable space between the classrooms. The Transvaal Education Department recently conducted a detailed research study in collaboration with the NBRI on compact planned schools.

4.2.3 The problems experienced with traditional school building are

- (a) insufficient space in the single classroom for differential teaching methods and an expanded education programme;
- (b) limitations on the use of media due to classroom design;
- (c) unsuitable layout and environment for community use of school facilities, and
- (d) a standardized institutional appearance.

5 SCHOOL PLANNING AND BUILDING IN OTHER COUNTRIES

5.1 THE DEVELOPED COUNTRIES

5.1.1 The following educational principles, which appear to be widely accepted, have affected school design:

- (a) All children are different and learn at different speeds and in different ways;
- (b) social and emotional influences affect a child's ability to learn, and
- (c) intellectual development occurs by finding out, thinking out, sorting out by personal discovery.

5.1.2 In England educationally orientated design led to compact planning which gave teachers and children a variety of interrelated spaces. In this open compact planning the building fabric itself separates one activity from another, but in such a way as to create an open flow of spaces into one another. The classroom lost its identity as a space of constant size. Now the open compact school has undergone a gradual change. The openness in primary schools is being limited to specific group areas which consist of a large closed group room, a small closed room and general work spaces. In the new Scottish primary schools the classroom has maintained its identity, but the open plan configuration allows for a variety of teaching spaces. Some states in the USA have designed large open space structures in which the school furniture and *portable* walls give the necessary subdivision between classes or differing activities. This open plan has been said *to serve a lot of needs badly, but none very well*. There is now also a distinctive move towards designing a variety of spaces, some more open than others. In many cases the classroom predominates over the free open space, but there is a free interrelationship between them.

Australian schools are mainly open-designed schools, the amount of openness differing to a certain extent. A typical layout for current school design consists of two home bases grouped together with communal spaces.

Open plan thinking has filtered through to secondary school planning in England and North America, but Scottish secondary schools remain exclu-

sively classroom orientated.

5.1.3 School furniture and equipment is generally regarded as being basic to the educational process and building design. Much of the furniture is now easily moveable and even mobile while fixing to the building is minimized.

5.1.4 Deep-planned schools presuppose artificial environmental and noise control. Air-conditioning and artificial lighting are widely used in the USA. Noise, however, can be a real problem. In Australia there is a swing towards more use of natural ventilation and lighting.

5.1.5 The call for improved facilities is invariably accompanied by a plea for no increase in cost. On the whole the *Systems Projects* in North America and the *Schools Consortia* in the United Kingdom have improved the quality of school building without increasing the cost. In Australia the building methods are traditional.

5.1.6 The schools in the UK, the USA and elsewhere are gradually becoming centres for society and social education. In Australia the designs of some primary schools have been modified to facilitate community use, e.g. use of halls, libraries, etc. In the UK the recommended area per pupil in the primary school is 4,38 m² and 7,71 m² in the secondary school. In Australia the maximum area per pupil for a complete primary school is 6 m² and 9 to 9,25 m² for a secondary school. In the USA one secondary school gave 11,20 m² per pupil, a second one 13,49 m² and one with a community school 16,92 m².

5.2 SCHOOL BUILDING IN DEVELOPING COUNTRIES

5.2.1 Asia

5.2.1.1 The Asian Regional Institute for School Building Research (ARISBR) was founded in 1962 in collaboration with, and funded to a certain extent by, UNESCO. There were 19 member states. Money was scarce and the best possible use had to be made of the existing resources. It was in this field that the advice and assistance of the ARISBR was of the utmost importance. It could not prescribe to any state but could assist when requested.

5.2.1.2 In 1965 the ministers of education and of economic planning approved a document in which the area per place in a primary school was, 1,3 m² and 3,0 m² in a secondary school. Later these areas were amended to a minimum of 1,35 m² of which at least 1,2 m² per pupil should be allowed in the classroom and the rest to provide toilets and staff room. Verandahs were not to be provided except in those countries which had heavy rain during school hours. In secondary schools the area per pupil was: in classrooms with single desks 1,18 m², in Chemistry laboratories 1,7 m², in Biology laboratories 2,1 m², in Physics laboratories 3,4 to 3,8 m², in Domestic Science classrooms 3,37 m². For toilets 0,12 m² per pupil was allowed and an area of 220 m² for the administration of a school for 1 400 pupils.

5.2.1.3 In 1968 from 0,05 to 6,2 % of schools in the various states had libraries. The exceptions were Korea with 45,8 % and Japan with 86,0 %.

The development was gradual as is shown by the areas per pupil in Japan in table 1.

TABLE 1

Areas per pupil in Japan

Type of school	Minimum standards in m ²			
	1945-1952	1953-1957	1957-1972	1973
Primary	2,31	2,77	3,27	3,91
Junior secondary	2,31	3,27	4,12	4,93
Senior secondary	5,28	4,76	6,31	6,31

5.2.1.4 In order to reduce space the ARISBR recommended that the use factors should be: classrooms between 80 and 90 %, laboratories and workshops 75 %. Small schools used multipurpose rooms to reach those use factors and therefore had to make use of moveable furniture. Special attention was also paid to circulation space. This could be reduced by careful planning and by using vertical circulation instead of horizontal in multistorey buildings. Circulation space should not be more than 15 to 18 % of the gross area.

5.2.1.5 ARISBR recommended two controls, namely minimum area and maximum cost per pupil. Most of the teachers are still classroom orientated, but the *activity methods* are being used in a few schools. The ARISBR warned designers to keep these changes in mind when designing new buildings. Changes will, however, be very slow as the number of pupils per class ranged from 50 to 120.

5.2.1.6 Ground is scarce and valuable and sites must be as small as possible. In rural areas a school of 640 pupils gets 2,287 ha for the buildings, parking, gardens, physical education and recreation. In the cities a 640 pupil school gets 0,276 ha. In both cases the school buildings are used by the community and the pupils use the communal sports facilities.

5.2.2 Latin America

5.2.2.1 Countries in Latin America recognized the value of education and like Asia established their own research organization in 1963, the *Centro Regional de Construcciones Escolares Para America Latina*. This organization published a journal entitled Conescal which led to the regional centre becoming known as Conescal. Its main functions were to do research, collect and spread information, give advice, assist states even with their building programmes, train technicians in seminars, work groups, etc. and to arrange courses and conferences.

5.2.2.2 In the Argentine, which in 1965 was the leader in education, schools are erected by the central government, the provinces and by private bodies. In 1914 60,6 % of the children between the ages of 6 and 13 years were in schools and by 1960 the percentage had risen to 86,1. Even though many classrooms had been erected, double sessions were still necessary. Conescal helped the authorities to study the use of space with the result that the area per pupil in the junior secondary school was reduced from 15,2 m² to 8 m² and to even less in the primary school.

5.2.2.3 In Ecuador, Peru, Venezuela and Panama classrooms for 40 to 45 pupils were erected with an area of 0,96 to 1,2 m² per pupil.

5.2.2.4 In Mexico an anthropometric survey was undertaken to determine the sizes of furniture required at various ages. In a prefabricated primary school the areas per pupil were 0,98 m² in the classroom, 0,22 m² for

the administration and 0,43 m² for circulation. The whole school for 900 pupils had an area of 1 693,38 m² or 1,88 m² per pupil. A technical high school had the following areas per pupil: in the classrooms 1,2 m², laboratories 3,12 m², workshops from 2,41 to 5,76 m², library 2,40 m² and the whole school 6,73 m².

5.2.2.5 In all these countries use was made of prefabricated buildings to meet the demand for schooling and a system of double sessions and even triple sessions had to be used.

5.2.2.6 After Conescal had been in existence for 12 years and had had the opportunity of studying areas in the various countries, it recommended the norms given in Tables 2 and 3.

TABLE 2

Conescal space norms for schools

	Areas in m ²		
	Net area per pupil	Net area per group	Gross area per group
Classrooms and multipurpose rooms	1,5	60	81
Science laboratories	3,0	120	162
Workshops for Ind. Arts	5,0	200	270
Domestic Science units	3,0	120	162
Workshops for artisans	4,0	160	216

TABLE 3

Office areas for the staff of primary and junior secondary schools

Principal	15-18 m ²
Deputy principal	10-12 m ²
Secretary	10-12 m ²
Teachers	2-4 m ² each
Librarian	8-10 m ²
Visiting doctor	8-10 m ²

6 SCHOOL BUILDINGS AS REGARDS EDUCATIONAL REQUIREMENTS

6.1 EDUCATION POLICY AS IT AFFECTS SCHOOL BUILDING

- 6.1.1 Act No. 39 of 1967 transferred the formulation of education policy to the central government. In a statement of policy the Minister of National Education changed the organization of schools radically. The twelve years of schooling were divided into four phases, namely:

Primary school:	Phase 1	the substandards and Standard 1
	Phase 2	Standards 2, 3 and 4
Secondary school:	Phase 3	Standards 5, 6 and 7
	Phase 4	Standards 8, 9 and 10

As far as possible the rooms for the classes in each phase in the primary school should be grouped together.

- 6.1.2 Standard 5 is the first year of secondary education but at present the Standard 5 classroom is still usually found in the primary school building. Pupils in Standard 5 have to follow the secondary school syllabus which means that the necessary facilities have to be provided. If these pupils were transferred to secondary schools, they would use the normal facilities in those schools.

6.2 THE ORGANIZATIONAL STRUCTURE OF SCHOOLS AS IT AFFECTS THE DESIGN OF BUILDINGS

6.2.1 The primary school

In a primary school the various classrooms provided should not be similar throughout the school, if the rooms are to be planned around the requirements of the children and the educational activities best suited to children of different ages. The child entering school at the age of six will be very different from the child of 12 or 13 years of age leaving the school. The child enters school, still seeking the security known and given at home. He generally finds learning a thrilling experience. Group activities are easily organized. The children in Standard 5 will have a completely different outlook. They tend to be individuals who recognize leaders among them. In addition the child grows very

rapidly, which means that chairs, tables, writing surfaces, coat hooks and other fittings should be designed to suit the stature of the child at the various ages.

6.2.1.1 Phase one of the primary school

In Phase 1 of the primary school it is essential for each class group to have its own room (home room). The young child coming to school for the first time finds security in his own teacher, his own room and his own seat. He wants to see his teacher from any position.

He is used to the rooms in his home and his classroom must not overawe him, but should be as homelike as possible. He likes bright colours but these should be used judiciously, perhaps only to identify his classroom door, his locker, his towel, etc.

These children get so engrossed in something interesting that they forget their bodily needs and, therefore, the toilets should be as close as possible.

In this phase teachers use many teaching aids: pictures, drawings, charts, cards, models, toys, counters, etc., and adequate storage space must be provided. Towards the end of Phase 1 the bigger children have got to know the school, have met most of the teachers and feel at home anywhere in the school.

6.2.1.1 Phase two of the primary school

In Phase 2 the class group should still have its own classroom in which the pupils keep their belongings and where they can meet their own teacher. They are now more mature and can, at some stage, begin with subject teaching. If the rooms are to be used economically few, if any, additional special rooms should be provided, but any special rooms should also, if possible, be home rooms for class groups. When a class group comes to, say, the laboratory, the class group already there moves out to another teacher. In this way a high use factor can be obtained.

6.2.2 The secondary school

6.2.2.1 If each teacher is given his own teaching space in the secondary school

(Phases 3 and 4), then the use factor will be as high as the percentage of the school hours the teacher teaches - this is usually high. As in the primary school there should be no or very few additional special rooms.

- 6.2.2.2 As is apparent from the above discussion the number of teaching spaces required depends on the staffing scale, and the number of offices on the number of promotion posts allowed on that scale.

6.3 THE POLICY OF DIFFERENTIATED EDUCATION

The policy of differentiated education announced in 1971 implies that children should be educated as individuals according to their specific personalities, talents, abilities and interests. There will always be a measure of class teaching, but its monopoly must be broken. Pupils will be divided into groups each of which will be involved in a different activity. Individuals may also work or study on their own, and furniture will have to be designed accordingly. The size of the furniture will also influence the area of the teaching spaces.

Audio-visual aids are also becoming more important and teaching spaces will have to be designed so that these can be used to the best advantage. This material should be under the control of the librarian which means that the library will have to be enlarged to become a resource centre.

6.4 TEACHING AND LEARNING ACTIVITIES

The methods and techniques of teaching cannot be prescribed because pupils differ and learn in different ways and at different speeds. There are, however, certain basic educational principles which influence the methods adopted. Self-activity is essential for learning: we learn by doing. The pupil must be taught to think, to find out for himself, to arrange facts, to interpret them, to apply them and to record them accurately and concisely.

6.4.1 The primary school

In the primary school the activities may be of a semi-quiet nature as in a classroom, of a quiet nature as in the case of remedial speech training or silent reading, or they may be noisy and messy as in the case of

experimenting with water and sand, painting, model making, etc. Each of these activities requires a suitable space. It is possible to provide these spaces within the areas of the traditional school provided the use factor of the rooms is high and the correct use is made of circulation space.

6.4.1.1 Phase one of the primary school

In Phase 1 children are encouraged to take part in the educational activities thus causing considerable movement in the class space and a variety of grouping arrangements. They move their furniture about, sit and often work on the floor, pin up their own drawings, measure water, balance sand, etc. The scale of the room in relation to the children, the height of fittings and storage space need attention.

Usually these pupils do not go to the library, but get book loans for which storage must be provided.

6.4.1.2 Phase two of the primary school

In Phase 2 the pupils still experiment to discover facts, require the wet messy areas and the quiet spaces. The more mature pupils can be given subject teaching. The school must be designed for this movement. Because their reading ability has improved, they make use of the library. Individuals and/or groups are assigned tasks which they attempt first with the assistance of the teacher and the librarian, but later by themselves.

6.4.2 The secondary school

6.4.2.1 During the first three years of the secondary school phase the pupil is guided by the teacher to discover his talents and interests. He gradually chooses subjects that will have a bearing on his future academic course.

6.4.2.2 At the beginning of Phase 4 the pupil chooses his subjects from a long list and in this way he differentiates. The teaching is still classroom orientated, but this is the period of questioning and wanting to know. Much use is now made of the material in the resource centre. Many pupils are individualists and work on their own, others

again want to belong to a group - they work in a group on a project.

6.4.2.3 Increasing emphasis is placed on the pupil finding out things for himself in the laboratories, workshops and the classrooms. The use of audio-visual aids is very important and the teaching spaces must be designed for their use.

6.4.2.4 The area of the classroom and the furniture should allow for debates, play reading, discussions, etc.

- 7.1.1 School buildings are expensive structures that are built with the taxpayer's money. As the daily and weekly utilization of school buildings by the school is generally low, it would seem reasonable to extend the use of school building and site facilities to the local community as well. This is particularly necessary in areas where there are few community facilities.
- 7.1.2 Community involvement in the provision of school facilities and in the use of facilities leads to
- (a) a greater interest in the school on the part of the community;
 - (b) the recognition of the school as an important centre to community life;
 - (c) a general educational and social upgrading of the local community, and
 - (d) protection of the school by the community against vandalism and during riots.
- 7.1.3 The school provides a base for community education. In underdeveloped areas this is particularly important so that the social and living standards of parents and children are as far as possible raised simultaneously.
- 7.1.4 Provision should be made for adult classes, recreation, constructive or educationally orientated community meetings, controlled use of the media centre and limited use of certain teaching spaces in the school for the development of technical, commercial, artistic or language skills. Provision should be made for recurrent education for everybody and to bring school *drop outs* back into the school via community use of facilities.
- 7.1.5 While it is common practice to allow the community the use of the school hall and in some instances classrooms as well, there is often strong opposition to such use from the principals and teachers. The main objections are that property is destroyed, walls are damaged and articles are stolen. During the school day the principal can exercise control, whereas after hours, during periods of community use, he cannot do so.

- 7.1.6 There is no doubt that community and school use of the same facilities does lead to certain difficulties. However the advantages of and, in the South African context, the necessity for such dual use require the careful identification of the problems so as to set up an adequate organizational framework for schools to function on this basis. The fact that the typical South African school is not designed as a school for community use aggravates the problem.
- 7.1.7 Schools can more adequately be designed to function as limited community centres, and in this way provide a very real service to the local community.
- 7.1.8 Organizational and management details as regards responsibility and control should be referred to the HSRC Main Committee for consideration.
- 7.1.9 The provision and use of facilities by the state and the community should be carefully considered in the context of local needs, conditions and resources and cannot be generalized for all areas.
- 7.1.10 The use of community facilities by schools where such facilities are available should be considered in preference to the provision of separate facilities.
- 7.1.11 Schools should share recreational facilities so that a full range of sports fields and courts are not provided at every school. Every school must, however, be provided with the necessary playground space as suggested in Section 11.

8 SPACE REQUIREMENTS IN SCHOOLS

8.1 TREASURY COMMITTEE FOR BUILDING NORMS AND COST LIMITS

A detailed study is being undertaken by a subcommittee of the Treasury Norms Committee on the formulation of space and cost norms for school building. A study of this nature was not feasible in the limited time available for the HSRC enquiry, particularly considering the scope of the project. The two projects, however, overlap in terms of space and cost studies and the people represented on the two committees. While it is recommended that the areas as suggested below be used as a basis for the formulation of space norms by the Treasury subcommittee, it is furthermore suggested that the detailed formulation of space and cost norms also be left to this subcommittee. The results of their study should be available shortly.

8.2 SPACE STANDARDS FOR THE FORMULATION OF SPACE NORMS

The space standards suggested below were derived from the areas of the teaching spaces of all the education authorities and from past research.

These standards or spaces are applicable to schools with between 600 and 1 000 pupils. In smaller schools, more space may be necessary for administration, the resource centre and the hall.

8.2.1 Primary schools

8.2.1.1 Classrooms and class storage space in Phase 1 - 2,2 m² per pupil in the class group.

8.2.1.2 Classrooms for pupils in Phase 2 - 1,5 m² per pupil in the class group, with the proviso that no room with a fixed chalkboard for class teaching purposes should be less than 25 m².

8.2.1.3 Quiet areas - story telling, silent reading, speech therapy, etc.
Phase 7 - 0,4 m² per pupil in the classroom and 0,6 m² per pupil in Phase 2.

8.2.1.4 Space for practical work, e.g. practical science, arts and crafts, wood-work, etc. - 2,9 m² per pupil in the class group. As it will not be

possible to give every class this additional area, this space will have to be shared with other classes. Furthermore if the classrooms could open out on to a practical area only an additional 1,4 m² would be required.

8.2.1.5 Music -- practice rooms are in units of 9 m² each and class teaching spaces require 2 m² per pupil.

8.2.1.6 Hall and ancillary spaces - 0,75 m² per pupil in the school.

8.2.1.7 Resource centre - 0,3 m² per pupil in the school.

8.2.1.8 Administration offices, staff room, storage, sick rooms, etc. - 0,40 m² per pupil in the school.

8.2.2 Secondary schools

8.2.2.1 Classrooms - 1,6 m² per pupil in the class group.

8.2.2.2 General purpose rooms with storage space for Junior Science, Geography, History, Typing, Art, Guidance, etc. - 3,3 m² per pupil in the class group.

8.2.2.3 Laboratories with preparation rooms - 4,0 m² per pupil in the laboratory.

8.2.2.4 Industrial arts centre (two teachers) with storage and drawing office - 8,25 m² per pupil.

8.2.2.5 Industrial Arts (dual purpose - one teacher) with storage - 7,38 m² per pupil in the group.

8.2.2.6 Needlework room with storage and fitting room - 3,5 m² per pupil in the group.

8.2.2.7 Cookery room with storage - 3,5 m² per pupil in the group.

8.2.2.8 Domestic Science (dual purpose) with storage - 4,0 m² per pupil in the group.

8.2.2.9 Workshops - each with space for the machines, operators and storage

expressed as an area per pupil in the group:

Basic techniques	6,7 m ²
Joinery	7,5 m ²
Electricity	6,8 m ²
Motor Mechanics	10,5 m ²
Fitting and Turning	13,6 m ²
Welding and Metalwork	11,8 m ²
Building construction	6,8 m ²
Electronics	5,0 m ²
Panel Beating and Spray Painting	7,4 m ²

8.2.2.10 Music - Instrumental: units of 9 m² each and theory, singing, etc.
at 2 m² per pupil in the group.

8.2.2.11 Administration - 0,6 m² per pupil in the school.

8.2.2.12 Resource centre - 0,35 m² per pupil in the school.

8.2.2.13 Hall and ancillary spaces - 0,75 m² per pupil in the school.

8.2.2.14 Multipurpose hall for Physical Education, Music, etc. - 1,2 m² per
pupil in the school.

8.2.2.15 Hall combined with separate gymnasium but with shared facilities -
1,75 m² per pupil in the school.

The educational process will be facilitated if the indoor environment satisfies the reasonable requirements of both teacher and pupils.

The three environmental factors that may be affected by the design of the building are acoustics, lighting and temperature or thermal condition. It is very important that these factors should not be separated during the design process. It is unfair to expect the architect to balance all these requirements without the assistance of experts in the various fields. Because of differing building methods and materials it is not possible to give a simple modus operandi. Expert knowledge is, however, available for designing a school with an acceptable indoor environment using practically any building method and materials. Each of the above environmental factors is treated briefly.

9.1 ACOUSTIC CRITERIA FOR SCHOOLS

In every communication process in which sound is involved, acoustics play an extremely important role. The teacher produces speech sounds and these must be distinct when they arrive at the pupil. The acoustic performance of a space is determined by its size and shape, the noise level from outside and the reverberation time. These basic facts must be taken into account during the design process.

For good communication, speech must be heard above any background noise and the reverberation in the classroom must be limited.

9.1.1 Traffic noise

A traffic noise level of L10 50dB (approximately 53dBA), measured in the classroom, is the upper limit of acceptability for ordinary pupils, but not for pupils with learning problems who will find speech difficult to understand against the background noise. Noise levels higher than 55dBA will impede the performance of even the good pupils. Since traffic noise tends to increase, it is best to design for an internal noise level of 40-50dBA as later improvements to cope with increased noise levels may be impracticable or prohibitively expensive.

9.1.2 Reverberation

The clothes of the pupils in a classroom absorb a great deal of sound which reduces reverberation. For normal pupils the conditions in an ordinary classroom could be acceptable, but classrooms for pupils with learning difficulties and for remedial education should be treated acoustically.

9.1.3 Sound insulation

- 9.1.3.1 An important function of the building is to provide a reasonable amount of sound insulation between classrooms. Most of the sound does not pass through the usual dividing walls, but through the open windows. The further the windows are apart, the better. A storeroom between rooms is useful because it ensures that the nearest windows in adjoining classrooms are well separated; alternatively the windows nearest to the dividing wall should not be openable.
- 9.1.3.2 When designing a school building the aspects of acoustics and ventilation cannot be separated. Windows must be open for ventilation which allows noise to penetrate into the room especially from nearby classrooms. Balancing these conflicting requirements is not easy and expert advice is necessary.
- 9.1.3.3 The degree of sound insulation required, depends on the background noise which varies with the activities in the room. In most cases a sound reduction level of 42dB_A between classrooms is considered sufficient, but the NBRI is doing further research in this field. If this figure can be reduced without retarding the learning process, the design of schools will be much easier and costs would be reduced.
- 9.1.3.4 When any criteria are stipulated a distinction must be made between the ideal condition and that which will be permitted by cost and political considerations. There is no information available to show whether different population or racial groups will react differently to noise during the learning process.
- 9.1.3.5 Climatic conditions do not affect acoustic norms except that windows which are open to allow natural ventilation allow sound penetration. In such cases it helps if the internal acoustics of the classroom are

improved.

9.2 THERMAL AND VENTILATION FACTORS

- 9.2.1 Since no detailed evidence is available on the effect of moderate thermal stress on teachers and pupils, comfort and not performance is the criterion most commonly employed. This is a worthwhile subject for further research as it can have an influence on building costs.
- 9.2.2 The comfort of the human body is mainly determined by air temperature, air movement, clothing thickness and activity.
- 9.2.3 At the low levels of humidity normally encountered in the inland areas, humidity is of secondary importance.
- 9.2.4 Since an unwise choice of clothing and the absence of proper ventilation can result in a difference in acceptable temperatures of 8°C , it is clear that building design is not the only factor to be taken into account in setting acceptable temperature criteria. There is no point in designing a building which will damp out the extremes of climate as long as unrealistic attitudes towards clothing, particularly of the male staff, create a micro-climate next to the body which is much more severe than the indoor environment. We know of no evidence which reveals significant comfort differences in acceptable climatic conditions for members of different race groups.
- 9.2.5 The extremes of climate to be catered for are fairly well known from climatic design data. The way in which the design, layout and materials of a structure modify the prevailing outdoor climate to create a given indoor climate is also known and is referred to as the *thermal performance* of a structure. A procedure for predicting the thermal performance of a structure has been developed at the NBRI. This procedure can be used in practice to determine whether the thermal performance likely to be achieved by a building is appropriate to the needs of future occupants in the context of the prevailing climate. Where large diurnal temperature variations are common, a massive structure responds slowly to changes in the outdoor conditions. As thermal performance is dependent on the structure as a whole, the advantages of walls of high mass can easily be neutralized by an uninsulated roof or a large

expanse of sunlit glass. In areas with hot summers and cold winters it is preferable to use mass insulation on the ceiling. Direct sun penetration is not desirable in classrooms. It is therefore the task of the designer to find the optimum compromise between the thermal needs of the occupants, the prevailing outdoor climate and the cost of construction and maintenance.

9.2.6 Heating

- 9.2.6.1 Any recommendation with regard to heating of a building should take into account not only the likely indoor temperature but the time at which it occurs and the period during which unacceptably cold temperatures occur. This is illustrated by the attached graph which reflects conditions that could reasonably be expected to occur in schools over a wide area of South Africa during the winter months. It can be seen that the coldest time of day is at about sunrise, whereafter the outdoor air temperature increases sharply as the sun's altitude increases.
- 9.2.6.2 The indoor air temperature does not fall as low as the outdoor value and responds more slowly to outdoor conditions.
- 9.2.6.3 However, if one accepts that 16°C is an acceptable heating threshold, it can be seen that this temperature is reached, in the example, by about 09h00. Heating could thus be avoided in this hypothetical school if classes were to start at, say, 09h00 or even 08h30 instead of 08h00.
- 9.2.6.4 In any real situation it is necessary to take into account the actual outdoor design conditions and the design of the building itself, which affects the indoor temperature profile. However the option to start school later is a potentially valuable one and should not be neglected.

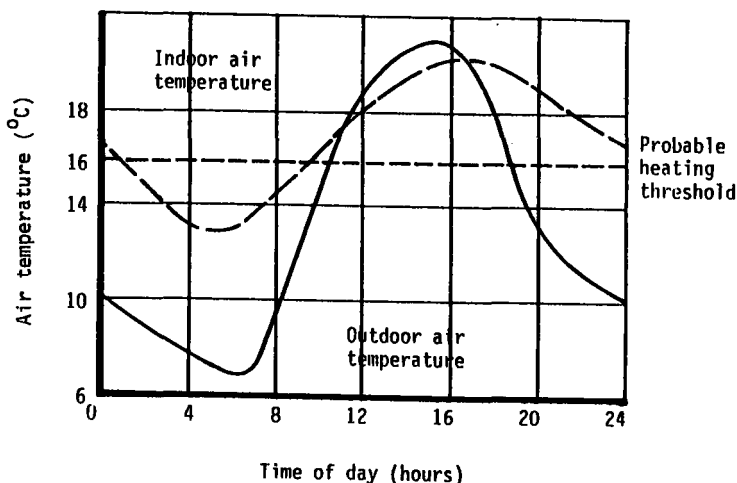


Figure
Typical outdoor and indoor air temperatures of
a school in winter

9.3 LIGHTING

- 9.3.1 Adequate lighting is very important in facilitating the learning process. When young children are learning to read they have to see each component letter clearly. The same applies to older children learning more complex tasks. The amount of light required depends on several factors including the size of detail, the contrast between the components of the task, speed of movement and seriousness of errors.
- 9.3.2 Although task illuminance is the most commonly specified criterion, other factors such as glare and veiling reflections should be kept at a minimum for good seeing conditions.
- 9.3.3 Bright light sources such as poorly shielded luminaires or bright windows in the line of sight of pupils reduce task visibility and are sources of glare which promote discomfort and fatigue. Adequate levels of illumination with light room surfaces and judicious use of colour help to create a cheerful and stimulating environment. Education departments should specify their requirements as regards the use of colour.

- 9.3.4 In most schoolrooms, windows can provide adequate lighting for most of the time. Windows are most suitable when they face north and south, but direct sunlight should be excluded. When artificial lighting is essential the luminaires should be in distinct rows parallel to the window walls.
- 9.3.5 Whenever a task requires more than 400 lux, at least part of the light should be provided by task lights.

TABLE 4

A guide to lighting standards required

Precision machine room and electronics workshop ⁺	800 lux [*]
Needlework room ⁺	630 lux [*]
Laboratories (close work), Art room [*]	500 lux
All classrooms ^{**} offices, practice rooms, libraries, laboratories (general work), finishing workshops	400 lux
Stage, general workshops, halls used for examinations	320 lux
Projection room, strong room, staff room, kitchen, sick rooms, roneo rooms, laundry, interview rooms, fan room	200 lux
Storerooms, armoury, toilets	100 lux

⁺ Consider task lighting

^{*} Good colour rendering required

^{**} Where used for visually handicapped children, particular care is required to eliminate sources of glare and veiling reflections on board and desk

10 SCHOOL DESIGN CRITERIA

School buildings should be designed according to the real needs of teachers and pupils and the intended use of the buildings as a limited community centre.

10.1 DESIGN CONSIDERATIONS

10.1.1 Organizational structure

10.1.1.1 The school building should be designed according to the educational and organizational structure of the school, taking into consideration the relationships between various sections of the school building complex, e.g. the junior primary, senior primary, the media centre, assembly, music, physical education and outdoor recreation space.

10.1.1.2 The areas of community use should be identified, e.g. a hall, media centre, certain classrooms and recreational space. The design of the school should be such as to separate these areas from the rest of the school functionally in an interesting community orientated environment. The clustering of spaces around an interesting courtyard could for example be considered.

10.1.2 Activity requirements

10.1.2.1 School buildings should provide for a wider range of educational activities such as

clean, dry and quiet activities;
wet messy activities;
noisy activities, and
large-scale movement activities.

The activities can be undertaken in different group sizes:

the class group
small groups of 4 to 8 children
individuals
a double class group

- 10.1.2.2 As a certain amount of formal class teaching is always likely to be necessary, a classroom space could be used for clean, dry, quiet and moderately noisy activities for a class group or a limited amount of small group and individual work.
- 10.1.2.3 Additional space is necessary for practical, wet, and messy work for small groups and individuals. A practical space for this purpose could serve three or four classrooms.
- 10.1.2.4 A small quiet and intimate space is necessary for small groups or individuals. This space could also be shared between two or more classrooms.
- 10.1.2.5 Noisy activities such as music or singing, metalwork or woodwork, require separately enclosed spaces away from the quieter areas of the school.
- 10.1.2.6 Large-scale movement such as physical education or drama by small groups or a class group requires a space larger than the normal classroom. Such a space could be provided together with other assembly, music and recreational space to form a combination of spaces that can open up into a single large assembly hall. In this way provision could be made for several activity groups to use a multipurpose hall complex simultaneously instead of one group at a time occupying an expensive facility.

10.1.3 Teaching methods

- 10.1.3.1 Provision should be made for more teaching methods than formal class teaching with a chalkboard alone. Teaching spaces should be designed for the use of audio-visual media, particularly considering the shortage of teachers in certain subject areas and the labour intensiveness of current teaching methods. Provision should be made, particularly at secondary school level, for individual learning using audio-visual media in the media centre or a quiet space adjacent to the classroom.

10.1.3.2

Team teaching could also be facilitated if desired, by clustering class spaces around a common practical area for easy circulation, supervision and control.

10.1.3.3.

Considering the shortage of teachers in Mathematics and Science a cluster of spaces for these subjects could be equipped with audio-visual media, for individual and small group work supervised by a single, possibly unqualified, person.

10.1.4 Environment and appearance

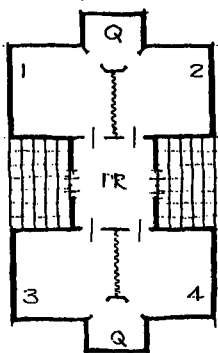
Schools are important centres in the local community and should be designed with an educationally stimulating and interesting environment. The school building should attract local community interest and the community must be proud of their building. To achieve this kind of atmosphere for a particular community situation a certain amount of freedom in design is necessary. Rigid standardization should therefore be avoided.

10.2 GROUPING CLASSROOMS FOR PRIMARY SCHOOLS

10.2.1 Classroom group for Grade 1

Number of pupils: 120

Pupils per class: 30



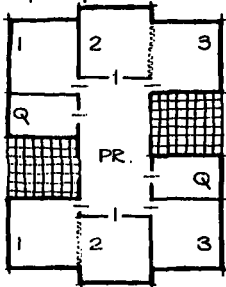
Accommodation

- 4 classrooms
- 1 practical space with storage
- 2 quiet spaces
- 2 verandahs, half covered

10.2.2 Class group for two standards

Number of pupils: 210

Pupils per class: 35



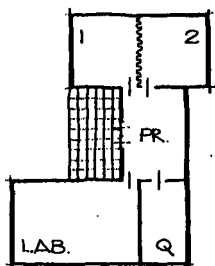
Accommodation

- 6 classrooms
- 1 practical space
- 2 quiet rooms
- 2 verandahs, half covered

10.2.3 Class group for standard 5

Number of pupils: 105

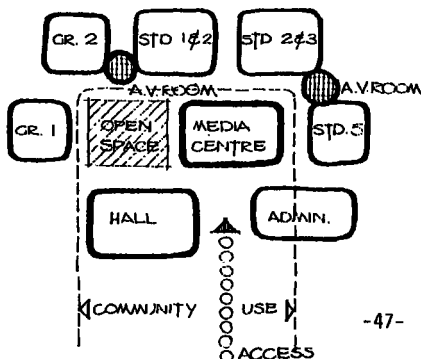
Pupils per class: 35



Accommodation

- 3 classrooms
- or 2 classrooms and a laboratory
- or 3 classrooms + lab + Art
- 1 practical space
- 1 quiet space
- 1 verandah, half covered

10.2.4 Positioning of buildings on the site

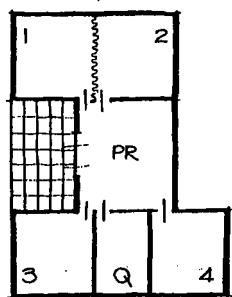


Design considerations

- Facilities open to the community
- Arrangement according to educational phases
- Media centre central, close to senior primary phase
- Spread of audio-visual rooms between blocks

10.3 CLASSROOM GROUPING FOR THE SECONDARY SCHOOL

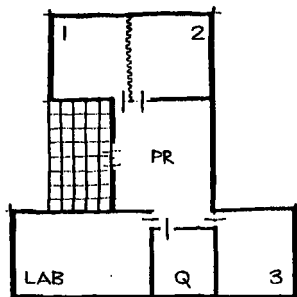
10.3.1 General education block ('Flexible learning unit')



Accommodation

- 4 classrooms
- practical area
- quiet space

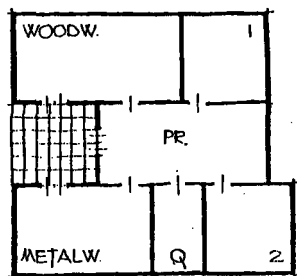
10.3.2 Science block



Accommodation

- 3 classrooms
- practical area
- quiet space
- laboratory

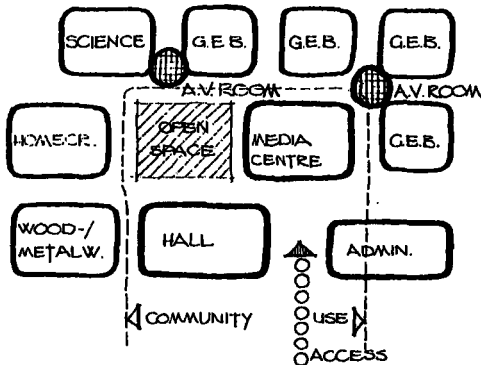
10.3.3 Metal and Woodwork (Domestic Science similar)



Accommodation

- 2 classrooms
- quiet space
- practical space/drawing office
- Woodwork centre
- Metalwork centre

10.3.4 Positioning of blocks on the site



Design considerations

- Facilities open to the community
- General teaching block near the media centre
- Media centre centrally situated in complex
- Audio-visual rooms spread between the general block and the Science block
- Convenient delivery to specialized blocks

10.4 THE AMOUNT OF SPACE PER PUPIL IN THE PRIMARY SCHOOL

10.4.1 Based on the classroom cluster design principle, the recommended total area per pupil in the primary school is 5,20 m².

10.4.2 This suggested area is a mean between a lower and an upper recommended area per pupil, and is based on

- a minimum use factor of 80 %;
- 30 places per classroom in the grades;
- 35 places per classroom in the standards;
- 750 pupils in the school.

10.4.3 Lower recommended limit for area per pupil is 4,56 m² in a primary school comprising

- classroom clusters providing learning spaces for each pupil
 - in the classroom,
 - in a shared practical area,
 - in a shared quiet area,
 - in an outside teaching space;
- a multipurpose hall with a space for Physical Training, as well as some facilities for community use;
- a media centre with teaching space, individualized learning spaces and production spaces;

- an administration block.

10.4.4 Upper recommended limit for area per pupil is 5,57 m² in a primary school comprising

- classroom clusters as above, but one Standard 5 classroom replaced by a laboratory and one art room added;
- a multipurpose hall with additional foyer-cum-music room;
- media centre plus two multimedia rooms, placed between classroom clusters;
- an administration block.

10.5 THE AMOUNT OF SPACE PER PUPIL IN THE SECONDARY SCHOOL

10.5.1 Based on the classroom cluster design principle, the recommended total area per pupil in the secondary school is 7,64 m².

10.5.2 This suggested area is a mean between a lower and an upper recommended area per pupil, and is based on

- a minimum use factor of 80 %;
- 750 pupils in the school.

10.5.3 The lower recommended limit for area per pupil is 6,36 m² in a secondary school with classroom populations of 30, comprising

- four flexible teaching units, each with four classrooms, shared practical or resources area and shared quiet area;
- three specialized units: science unit, home industries unit and wood and metalwork unit;
- a media centre with teaching space, individualized learning spaces and production space;
- a multipurpose hall with a space for physical training, as well as some facilities for community use;
- an administration block.

10.5.4 The upper recommended limit for area per pupil is 8,92 m² in a secondary school with classroom populations of 22, comprising

- four flexible learning units, as above;
- three specialized learning units, as above, plus three additional specialized learning units for Art, Music and Typing and Commerce;
- a media centre, enlarged, plus an additional multimedia lecture room;
- a multipurpose hall as above, plus an additional foyer-cum-music room;
- an administration block.

10.6 UPGRADING AND RENOVATION OF EXISTING SCHOOLS

In the light of a new programme of school building with new standards, existing facilities will have to be reconsidered. It will not always be possible to apply new standards to existing facilities and each project will have to be considered on its own merits. A framework for the assessment of priorities and a renovation and upgrading programme should be formulated, setting out the range and limitations of upgrading at state expense and the scope for further subsidized and community involvement.

The sites selected for school and hostel buildings affect not only the educational process and the school environment but also the greater area of the surrounding neighbourhood or town.

11.1 SITE SELECTION

- 11.1.1 Site selection should be undertaken by a group of people including an educationist, an architect, an engineer with knowledge of soil mechanics and a representative of the parents.
- 11.1.2 Sites should not be near main roads, heavy industries, railways, etc. and should be easily developed, i.e. should not include rocky outcrops, marshy places, etc.
- 11.1.3 The site should be so situated that every child can reach the school easily and safely.

11.2 SIZES OF SITES

The size of a site will depend on its shape and its nature. Rocky outcrops, steep gradients, etc. may affect the area of the site required.

Assuming the site has a gradient less than 1:50 and that it is nearly rectangular, the area required must allow for the buildings, gardens, informal play areas, parking, play grounds for organized games and physical training.

To calculate the actual area required it is necessary to estimate the number of pupils likely to attend the school and the percentages of the pupils who will play organized games which require a large area, e.g. rugby, cricket, soccer, hockey, etc. From a national survey it has emerged, for example, that 45 % of the boys in primary and secondary schools play rugby. The areas of the various playing fields must be calculated and added to the areas required for the buildings etc.

TABLE 5

Suggested areas for primary school sites

Enrolment	Areas in hectares		Total
	Buildings, gardens, etc.	Organized games	
Up to 100	0,24	1,26	1,50
150	0,36	1,65	2,01
200	0,48	1,65	2,13
300	0,72	1,65	2,37
400	0,96	1,94	2,90
500	1,20	1,96	3,16
600	1,44	2,01	3,45
750	1,80	2,01	3,81

TABLE 6

Suggested areas for secondary school sites

Enrolment	Areas in hectares		
	Buildings, gardens, etc.	Organized games	Total
Up to 400	0,96	3,31	4,27
450	1,08	3,31	4,39
600	1,44	4,13	5,57
700	1,68	4,22	5,90
800	1,92	5,13	7,05
900	2,16	5,13	7,29

To determine the areas for the buildings of technical high schools the areas for secondary schools may be increased by 16 %. Where certain technical subjects are offered at secondary schools, the areas of the workshops will have to be added to the area of the secondary school buildings.

11.3 SCHOOLS WITH HOSTELS

A survey has shown that where schools have sufficient fields for organized games, especially tennis courts and a swimming pool, no additional fields are necessary for a hostel: additional area will of course be required for the buildings, lawns, etc.

TABLE 7

Additional areas needed for primary and secondary school hostels

Number of boarders	Areas in hectares
	Hostel buildings, gardens, lawns, etc.
80	0,48
100	0,60
120	0,70
150	0,90
200	1,20
250	1,50
300	1,80
350	2,10
400	2,40
450	2,70

11.4 COMMUNAL USE OF SPORTS FIELDS

11.4.1 Ground is becoming scarce and water must be conserved. An interdepartmental committee with Prof. Tomlinson as chairman found in 1968 that as little as possible arable land should be devoted to other purposes. In 1975 the Minister of Sport and Recreation appointed a committee to study sport. One of its findings was that the existing facilities could be far better utilized.

11.4.2 Sports facilities should be used by both schools and the community. In some towns this is already being done. Sport and recreation facilities could be shared by two or more schools, and in areas where there are existing community sport facilities, schools should as far as possible make use of these before providing for their own.

- 11.4.3 Communal use of facilities results in the cost of maintenance and upkeep being spread over a larger number of people. In this way a better service can be provided.
- 11.4.4 The responsibility for the provision of sport and recreation facilities over and above the levelling of the site, should be that of the local community. A differentiated scale of government subsidy in favour of poorer communities should be considered.

THE UTILIZATION OF EXISTING SCHOOL BUILDINGS

12.1

UTILIZATION OF SCHOOLS

Table 8 shows the use factors of teaching spaces for primary and secondary schools in each of the departments concerned with school building. Using the Black states as a common base for comparison it can be seen that the utilization of space in the Cape and Natal is considerably lower than in the Transvaal and the OFS. The use factors for Blacks, Coloureds and Indians indicates an unreasonable overutilization of space.

The low utilization figures in Table 8 indicate a drop in numbers at many schools. This is usually due to a social or environmental change in the structure of the community or in the area over a period of time. The depopulation of rural areas and movement to towns and cities has this effect, as has the natural pattern of growth of city suburbs from young families to older families and then a reflux of younger families again. Scientifically based projections should be undertaken to establish likely growth patterns so as to avoid the provision of permanent accommodation for temporary bulges in population growth. Such bulges can be provided for by means of temporary buildings.

12.2

EXCESS OR SHORTAGE OF PUPIL PLACES

The excess or shortage of pupil places is calculated according to the total number of classrooms available to a department and the total number of pupils registered in the department's schools. As the geographical spread of the population groups is neither uniform nor static, some schools may have excess accommodation while others may experience a serious shortage of space. The figure in the tabulation is therefore only an indication of areas of relative need.

An excess of pupil places does not necessarily mean that no new school buildings are needed. Temporary classrooms may need to be replaced and new provision may need to be made for population movement to growth points in the country.

The shortage of pupil places as indicated by the negative figures indicates a very real need for urgent action.

TABLE 8 Use factors of classrooms for the various education authorities and the provincial or national average excess or shortfall of pupil places

Education authority	Government schools only								All schools					
	Cape		Natal		Transvaal		OFS		Indian		Coloured		Black	
Type of school	Prim.	Second.	Prim.	Second.	Prim.	Second.	Prim.	Second.	Prim.	Second.	Prim.	Second.	Prim.	Second.
The average number of pupils per room the authority used to calculate the maximum accommodation	24,6	18,8	27	21,5	27	20	30	30	23	22	29	25	40	35
The average number of pupils at present in a teaching space	19,1	14,8	18,5	13,2	25,2	18,5	25,1	24,3	31,7	23,8	34,0	25,1	54,0	55,5
The use factor of the teaching spaces using the maximum accommodation as calculated by the authority	77,4	81,0	68,5	61,4	93,5	93,2	83,7	82,0	113,3	108,4	117,5	100,9	135,0	158,7
In order to make a valid comparison all the pupils per room should be the same. Using the 40 pupils per room in the primary school and the 35 in the secondary school as used by Black education the use factors are	47,7	42,2	46,2	37,8	63,1	56,8	62,7	69,4	79,3	67,9	85,1	71,9	135,0	158,7
Excess or shortage of pupil places	+42 085	+18 860	+28 539	+25 168	+19 672	+12 696	+8 827	+5 650	-13 663	-5 485	-92 872	-1 078	-338 857	-78 380

TABLE 9

Use factors of classrooms for the Black states and the average state excess or shortage of pupil places

Education authority	KaNgwane		Gazankulu		Qwaqwa		Lebowa		Kwazulu	
Type of school	Prim.	Second.	Prim.	Second.	Prim.	Second.	Prim.	Second.	Prim.	Second.
The average number of pupils per room the authority used to calculate the maximum accommodation	40	30	40	40	35	30	40	30	35	30
The average number of pupils at present in a teaching space	111,8	44,1	76,6	38,3	81,3	50,8	69,3	47,5	55,8	57,2
The use factor of the teaching spaces using the maximum accommodation as calculated by the authority	279,6	147,1	191,6	95,8	232,3	172,0	173,1	158,2	159,4	190,7
In order to make a valid comparison all the pupils per room should be the same. Using the 40 pupils per room in the primary school and the 35 in the secondary school as used by the Department of Education and Training the use factors are	279,6	126,1	191,6	109,4	203,3	145,1	173,1	135,6	139,5	163,5
The excess or shortage of pupil places	-52 731	-4 168	-58 415	+954	-29 821	-6 039	-188 211	-32 331	-270 298	-74 139

13 THE CURRENT AND PROJECTED NEED FOR FACILITIES AND COST IMPLICATIONS

13.1 BACKGROUND TO THE FORMULATION OF NEEDS

13.1.1 The statistics of the various education departments and national population statistics were either inadequate or too variable for accurate comparable national projections of the need for pupil places in schools. Calculations could, however, be made for normal population growth, but not for interprovincial, intercity or intraprovincial and intracity population movement.

13.1.2 The current backlog of pupil places was determined at a parity level of 30 pupils per class where existing pupil per class densities exceeded 30. Densities below 30 pupils per class have arisen historically as a result of population movement and had to be accepted at the current levels. A greater utilization of such space could only occur if the schools concerned were consolidated so that some of the underutilized buildings could be made available for population groups experiencing a shortage of space. This latter aspect was not considered in the calculation of the backlog of pupil places.

13.1.3 Current pupil per class ratios used to determine the number of pupil places that could be utilized in schools, are indicated in Table 10.

TABLE 10

PUPIL PER CLASS RATIOS USED TO DETERMINE THE NUMBER OF PUPIL PLACES THAT COULD BE UTILIZED IN SCHOOLS

Department or group	Number of pupils per room	
	Primary	Secondary
Cape education	24,6	18,8
Natal education	27,0	21,5
Transvaal education	27,0	20,0
OFS education	30,0	30,0
Indian education	28,0	22,0
Coloured education	29,0	25,0
Black education	30,0	30,0
Black State education	30,0	30,0

The calculated backlog of pupil places and the projected need for pupil places are given in Tables 11, 13 and 14.

13.2 AREA AND COST CONSIDERATIONS FOR THE PROVISION OF FACILITIES

13.2.1 The recommended area per pupil of school building space as outlined in 10.4 and 10.5, together with lower and upper limits, is as follows:

Primary schools	lower limit	4,56 m ² /pupil
	recommended	5,20 m ² /pupil
	upper limit	5,57 m ² /pupil
Secondary schools	lower limit	6,36 m ² /pupil
	recommended	7,64 m ² /pupil
	upper limit	8,92 m ² /pupil

13.2.2 The cost of school building at current provincial school building standards as at September 1980 in the Pretoria/Witwatersrand area is taken as follows:

Primary schools	R200/m ²
Secondary schools	R220/m ²

13.3 ASSESSMENT OF NEED IN TERMS OF PUPIL PLACES AND COST

13.3.1 Assuming the lower limit of accommodation as that which should be provided by the state for equal education opportunity and the upper limit as indicating potential cost including community involvement, backlog and projected need would be as indicated in Tables 11 to 16.

TABLE 11*

THE TOTAL CURRENT BACKLOG OF PUPIL PLACES AND COST IMPLICATION

Population group	School type	Places needed	Lower limit cost (X R1 000)	Upper limit cost (X R1 000)
Whites	Primary	4 082	3 772,784	4 547,348
	Secondary	4 528	6 335,578	8 885,747
Asiatics	Primary	20 744	18 918,528	23 108,816
	Secondary	9 476	13 258,819	18 595,702
Coloureds	Primary	108 759	99 188,208	121 157,526
	Secondary	28 742	40 215,806	56 403,301
Blacks	Primary	1 450 163	1 322 548,656	1 615 481,582
	Secondary	241 105	337 354,116	473 144,452
TOTALS	Primary	1 583 748	1 444 378,176	1 764 295,272
	Secondary	283 851	397 164,319	557 029,202
TOTAL	Primary and secondary	1 867 599	1 841 542,495	2 321 324,474

*excluding Ciskei, KwaNdebele and independent Black states.

TABLE 12*

ELIMINATION OF THE BACKLOG OF PUPIL PLACES OVER DIFFERENT PERIODS OF TIME

Period of time	Pupil places per year	Lower limit cost per year (X R1 000)	Upper limit cost per year (X R1 000)
1980 - 1985 5 years	373 520	368 308,4	464 264,8
1980 - 1990 10 years	186 760	184 154,2	232 132,4
1980 - 1995 15 years	124 507	122 769,5	154 745,9
1980 - 2000 20 years	93 380	92 077,1	116 066,2

*excluding, Ciskei, KwaNdebele and independent Black states.

TABLE 13*

THE PROJECTED ADDITIONAL PUPIL PLACES NEEDED AND COST IMPLICATIONS 1980-1985

Population group	School type	Places needed	Lower limit cost (X R1 000)	Upper limit cost (X R1 000)
Whites	Primary	2 736	2 495,232	3 047,904
	Secondary	1 573	2 200,942	3 086,855
Asiatics	Primary	5 812	5 300,544	6 474,568
	Secondary	13 172	18 430,262	25 848,733
Coloureds	Primary	0	0	0
	Secondary	27 369	38 294,705	53 708,926
Blacks	Primary	382 501	348 840,912	426 106,114
	Secondary	186 160	260 475,072	365 320,384
TOTALS	Primary	391 049	356 636,688	435 628,586
	Secondary	228 274	319 400,981	447 964,898
TOTAL	Primary and Secondary	619 323	676 037,669	883 593,484

*excluding only the independent Black states.

TABLE 14*

THE PROJECTED ADDITIONAL PUPIL PLACES NEEDED AND COST IMPLICATION 1985-1990

Population group	School type	Places needed	Lower limit cost (X R1 000)	Upper limit cost (X R1 000)
Whites	Primary	0	0	0
	Secondary	0	0	0
Asiatics	Primary	1 581	1 441,872	1 761,234
	Secondary	6 944	9 716,045	13 626,906
Coloureds	Primary	0	0	0
	Secondary	26 922	37 669,262	52 831,733
Blacks	Primary	319 130	291 046,560	355 510,820
	Secondary	213 094	298 161,125	418 175,666
TOTALS	Primary	320 711	292 488,432	357 272,054
	Secondary	246 960	345 546,432	484 634,304
TOTAL	Primary and Secondary	567 671	638 034,864	841 906,358

*excluding only the independent Black states.

TABLE 15*

ANNUAL PROVISION OF SCHOOL PLACES FOR PROJECTED POPULATION GROWTH 1980-1990 AS DETERMINED FROM TABLES 13 AND 14

Period of time	Pupil places per year	Lower limit cost per year (X R1 000)	Upper limit cost per year (X R1 000)
1980 - 1985	123 865	135 207,6	176 718,8
1985 - 1990	113 534	127 606,8	168 381,2

*excluding only the independent Black states.

TABLE 16*

ANNUAL SCHOOL BUILDING COST CONSIDERING THE ELIMINATION OF BACKLOG AND PROJECTED POPULATION GROWTH FOR THE PERIODS 1980-1985 AND 1985-1990

Period of time for elimination of backlog		Pupil places per year	Lower limit cost per year (X R1 000)	Upper limit cost per year (X R1 000)
5 years	1980 - 1985	497 385	503 516,0	640 983,6
10 years	1980 - 1985	310 625	319 361,8	408 851,2
	1985 - 1990	300 294	311 761,0	400 513,6
15 years	1980 - 1985	248 372	257 977,1	331 473,7
	1985 - 1990	238 041	250 376,3	323 136,1
20 years	1980 - 1985	217 245	227 284,7	292 785,0
	1985 - 1990	206 914	219 683,9	284 447,4

*excluding the independent Black states and as regards the backlog, Ciskei and KwaNdebele.

13.3.2 A rough indication of the likely implications of interprovincial movement is given in Table 17.

TABLE 17*

POSSIBLE IMPLICATIONS OF INTERPROVINCIAL POPULATION MOVEMENT

Period	Pupil places needed per year	Lower limit cost per year (X R1 000)	Upper limit cost per year (X R1 000)
1980 - 1985	1 211	1 106,595	1 700,907
1985 - 1990	2 020	2 192,817	2 860,672

*excluding the independent Black states

13.3.3 Intraprovincial population movement is expected to have greater cost implications than interprovincial movement. Unfortunately owing to the unavailability of relevant statistics this cannot be calculated at present.

13.4 CONSIDERATIONS AS REGARDS FUTURE NATIONAL PLANNING

13.4.1 An accurate assessment of needs for national school planning necessitates an inventory of all the school facilities in the country and in-

dividual school statistics for projections of growth. Such statistics would then incorporate the effect of normal population growth, inter-provincial population movement and intraprovincial movement. Tables 11 to 17, based on existing available statistics, can merely be regarded as giving an indication of the order of need based on a parity level of provision which in cost equates current provincial building standards but as regards area, is less than the provincial schools.

13.4.2 The building costs indicated could be reduced by

- (a) better utilization of existing facilities;
- (b) reconsideration of comprehensive school units in terms of more centralized facilities serving a number of schools and less specialized facilities being provided at individual schools.

14 TRANSPORTATION AND ACCOMMODATION OF CHILDREN

14.1 THE PROVINCIAL ADMINISTRATIONS

14.1.1 The provincial administrations provide for the transportation of children by means of subsidized bus transportation systems. Contracts are entered into with private bus owners and children pay to travel in the buses. Where children can make use of municipal bus services a school bus is not provided, but the bus fee is subsidized by the education department. Where children cannot make use of available school buses, and have to use municipal or other transport, a travelling allowance is made.

14.1.2 School hostels are provided at both primary and secondary level although it is generally agreed that primary school children should preferably live at home. Very few hostels are provided at primary level.

14.2 THE DEPARTMENT OF INDIAN AFFAIRS

14.2.1 The Department of Indian Affairs provides for bus transportation where there is no available public transport. It does not have its own vehicles but, as in the case of the provincial administrations, contracts are entered into with private bus owners. There is no charge to pupils who use school buses. A travelling allowance of up to R32 p.a. is available to pupils subject to a means test and if the distance warrants it.

14.2.2 A boarding allowance not exceeding R116 per annum is made for pupils who have to lodge away from their home in order to attend school. The allowance is subject to a means test. Indian communities traditionally do not generally make use of school hostels by preference, although two hostels are now being planned in the Transvaal.

14.3 THE DEPARTMENT OF COLOURED AFFAIRS

14.3.1 The Department of Coloured Affairs provides for a bus transportation system for pupils. There are no departmental buses but contracts are entered into with private bus owners to provide a service at no cost to the pupils. Where pupils cannot make use of the buses and some form of transport is needed, a travelling allowance of up to R32 is made available. The allowance is subject to a means test which creates considera-

ble problems for the education department in administering the system.

- 14.3.2 Hostel accommodation is provided at large schools (800 to 1 000 pupils) in a number of strategically situated towns. Hostels are not provided for primary school children except in special circumstances, such as in the sparsely populated rural areas.

14.4 BLACKS IN WHITE AREAS AND THE BLACK STATES

- 14.4.1 No provision is made for the transportation of Black pupils apart from municipal or local bus services. No subsidy is provided for children to make use of such facilities.
- 14.4.2 School hostels are provided by the Department of Education and Training in Trust areas only. The Black states provide hostels in towns where the need exists but funds are too limited to do this on the necessary scale.

14.5 REQUIREMENTS FOR THE PROVISION OF TRANSPORT AND HOSTEL SERVICES

In all the departments the conditions for the provision of transport or subsidies for transport and the provision of hostels or subsidies for boarding, are defined in considerable detail. The conditions surrounding the appointment of bus contractors are also clearly set out.

It is very important that such conditions should be clearly defined so as to avoid misuse of the services and unnecessary expenditure on them.

All the various population groups have a need for accommodating and a means of transporting children. While the systems and regulations are basically similar for all groups the standards in terms of cost to the state and cost to the pupil vary. To avoid differentiation between population groups it would seem that the same basis for the provision of transportation should apply to all groups. After consideration of the various systems for both hostel accommodation and transportation, the systems used by the provincial administrations with some modifications or cater for specific needs are recommended as a basis for a national approach.

14.6 UNDERLYING PRINCIPLES FOR THE PROVISION OF TRANSPORTATION AND HOSTELS

- 14.6.1 It is generally agreed that primary schools should be decentralized and if necessary kept small so that no provision need be made for either hostels or transportation, except in certain very special circumstances such as may exist in sparsely populated areas.
- 14.6.2 Secondary schools need to be less decentralized and as specialized directions of study may be provided at certain secondary schools, provision should be made for both hostels and transportation. In this respect every school should be considered separately on its own merits. For this purpose a simple but clearly defined national set of rules should be made available covering the needs of all population groups in various types of school areas. Rural areas would have to be considered as different from township and city areas.
- 14.6.3 While the state should provide for transportation and hostel accommodation, the community should have a responsibility as well. State-subsidized transportation and accommodation should therefore be considered in preference to free transport and accommodation.

15 PROFESSIONAL AND INDUSTRIAL RESOURCES FOR SCHOOL BUILDING

15.1 EFFECTIVE USE OF RESOURCES

South Africa is facing a massive school building programme at a time when the building industry is to a large extent fully extended. Careful consideration should be given to the economic and manpower implication, the nature and spread of the building industry and to the efficient use of the building professions. The initiation and execution of the national school building programme should be carefully planned in terms of national standards, the availability of resources, the formulation and interpretation of the design *brief* for each school, type of school or series of schools, and the erection and occupation of buildings. A four-phase system of operation involving centralized and decentralized governments and consultants is outlined in Appendix 1.

15.2 METHODS OF BUILDING

Building methods and procedures develop and evolve in response to needs and available resources. A large national school building need could considerably influence methods and procedures.

In Appendix 2 the resources of the building industry are considered against the broad classification of alternative building methods and procedures as regards cost-effectiveness and appropriate technologies. Traditional, rationalized traditional and industrialized building methods are considered in the context of a large national school building programme in vastly differing geographic regions.

15.3 AVAILABILITY OF BUILDING MATERIALS

The availability of building materials is normally dependent on the level of building and construction activity. During economic boom phases the demand for materials causes considerable delays in delivery. In regions of the country where building activity is limited there may be considerable problems as regards the acquisition of materials. A large-scale building programme extending over the country as a whole should therefore be planned, bearing in mind the availability of building materials. Information in this regard is given in Appendix 3.

16 SUMMARY OF THE REPORT OF THE WORK COMMITTEE: BUILDING SERVICES

16.1 INTRODUCTION

South Africa, like other developing countries, faces a considerable backlog in the provision of school facilities and a heavy continuing population increase for which school facilities must be provided. The purpose of this study was to establish the nature and extent of the need and then to formulate recommendations for national school planning in the context of available South African resources to meet this need.

16.2 THE BACKGROUND TO THE DEPARTMENTAL SCHOOL BUILDING PRACTICE

The state erected school buildings for White children, but most of the schools for the other population groups were erected by the churches, local communities or farmers. When the Union of South Africa came into being the provinces were given control over primary and secondary education for all population groups, but the responsibility for building schools for Asian, Coloured and Black children remained a community responsibility. The provinces did, however, build some schools for these groups. There was such a demand for buildings and so many children with no schooling that it was decided to transfer the education of Non-Whites to central government departments. Black education was transferred in 1954, Coloured education in 1964 and Indian education in 1966. The Department of Education and Training assumed responsibility for buildings in White areas in 1979. Since these transfers considerable progress has been made, but the application of the Group Areas Act necessitated the removal of a number of buildings, the majority of which were however substandard. Later on the National states were given their own education and works department, but subsidized school buildings were erected by the local communities. The subsidy, however, proved inadequate with the result that the local communities were unable to provide sufficient classrooms.

16.3 CURRENT DEPARTMENTAL PROCUREMENT PROCEDURES

Building procurement procedures differ very little from one department to another.

16.3.1 Administration procedures

The provincial administrations and Black states have separate education

and works departments. The Department of Internal Affairs (Indian and Coloured Affairs) have education sections but they are dependent on the Department of Community Development and State Auxiliary Services for the erection of buildings. The Department of Education and Training has planned and built schools for Blacks in White areas since 1979.

Each department divides its total field into regions and in each region the community or board or official determines the need in that area. Requests for schools are sent to the central authority which, if it approves, asks the finance controlling department to budget for the project. In the rural areas in the Black states the communities build their own schools.

All the education departments have full-time planners most of whom have an education background and not a building procurement background.

16.3.2 Sites

When a new township is proclaimed the developer, whether it be a municipality, a private firm or an administration board, must reserve a site or sites for schools. The various departments have different formulae for calculating the area they can claim. Outside the proclaimed townships the Coloureds and Indians find it very difficult to find school sites because of the implementation of the Group Areas Act. In the Black states the rural communities apply through their chief or local council to the magistrate for permission to build a school on a particular site. Application is then made to the education department. The areas the departments require for the same type of school vary by a factor of 1 : 2,5 in the case of primary schools and 1 : 3 for secondary schools. The areas required for school sites are given in Section 11 of the work committee's report.

16.3.3 Design and documentation procedures

The works departments of the provincial administrations employ architects, engineers and quantity surveyors whose task it is to

- (a) set space and design standards in collaboration with the education departments;
- (b) administer and co-ordinate projects, and
- (c) exercise control.

School design is based on standard plans of units or sections of school buildings and sometimes standardized bills of quantities and specifications. The degree of standardization and control varies from one province to another. The Department of Community Development and State Auxiliary Services fulfils the same functions as described above for Indian and Coloured education. The Department of Education and Training has a Building and Sites branch in which space and design standards are formulated for Black schools in White areas. The same standards in the form of standard plans are largely used by some of the Black states, whose works departments do not generally employ professional staff except on large, more specialized secondary schools and colleges. Rural communities in the Black states generally obtain standard plans from their works department and appoint their own contractors to build their schools.

16.3.4 Contract procedures

The provincial administrations, the Department of Internal Affairs (Indian and Coloured Affairs) and the Department of Education and Training use the Bill of Quantities contract form for school building. Tenders are invited from private contractors. The Department of Education and Training uses its departmental building teams and materials bought on state contract. The Black states to a large extent make use of labour only contracts, using private contractors and providing materials from their own depots. Rural communities in these states build their own schools.

16.3.5 Building methods

All the departments involved with school building prefer traditional building methods to industrialized methods. Light-weight industrialized buildings should only be used as a temporary measure until permanent classrooms can be erected. Heavy industrialized building systems are unacceptable to some departments because of problems experienced in the earlier development stages. A large-scale national building programme such as appears to be urgently needed from this research study, may make industrialized building programmes inevitable. Such systems should, however, be used with caution in the light of previous experience.

16.3.6 Financing and cost of school buildings

School buildings are financed from works department budgets except in the case of the Department of Education and Training. More than 90 % of the school building in the Black states is financed by local communities, the departments only providing schools in the towns. The communities'

schools are, however, subsidized by the departments to the extent of approximately 30 % of the cost per classroom. The cost of White schools varies considerably from one province to another.

16.3.7 The use of audio-visual aids in schools

Varying use is made of these aids, especially the over-head projector, in the classroom in South African schools. The change-over from school libraries to resource centres also varies a great deal in the different departments. Some schools have large media centres with a reasonable amount of software and hardware while others have no library and only a limited number of books. These differences are due to inadequate funds especially in Black schools, a lack of skill in the use and production of these aids by the teachers and the inadequacy and unavailability of programme material. The current design of schools does not make adequate provision for the use of some of these aids.

16.4 CURRENT DEPARTMENTAL SCHOOL DESIGN STANDARDS

16.4.1 Comparative study of areas and areas per place

The areas of teaching spaces vary considerably from one department to another. A summary table of the range of variation is given in Table S1.

TABLE S1

THE RANGE OF AREAS AND AREAS PER PLACE IN EXISTING SCHOOLS

Space	Primary schools		Secondary schools	
	Area m ²	Area/place	Area m ²	Area/place
Classrooms	43- 62	1,23-2,27	49- 58	1,41- 1,95
General purpose rooms, Art, Typing, etc			60- 92	1,68- 3,28
Practical areas	60-121	2,01-4,03		
Resource centres	65-305		76-278	
Administration blocks	149-363	0,15-0,6	166-582	0,17- 0,71
General use space - some have halls others not	22-657		663-990	0,78- 1,29
Science laboratories			93-194	2,35- 6,07
Industrial Art centres - some with drawing office			328-528	10,93-16,5
Needlework			135- 61	4,56- 2,53
Cookery			119-135	5,97- 3,85
Domestic Science dual purpose			61-181	2,53- 7,55
Workshops - technical subjects			407-579	5,46-11,59

TABLE S2

SPACE STANDARDS APPLICABLE TO SCHOOLS RANGING FROM 600 TO 1 000 PUPILS

Teaching space	Area per pupil in the class group	
	Primary school	Secondary school m ²
Classroom and class storage in Phase one	2,2	
Classrooms in other phases	1,5	1,6
Quiet areas, Phase 1 - silent reading, speech therapy, etc.	0,4	
Quiet areas, Phase 2	0,6	
Practical work: Arts and Crafts, Woodwork, Science, etc.	2,9	
Music practice rooms - per unit	9,0	9,0
Teaching spaces: singing, theory	2,0	2,0
General purpose with storage for Art, Typing, Geography, etc.		3,3
Laboratories with preparation rooms		4,0
Industrial Arts centre (two teachers) with storage and drawing office		8,25
Industrial Arts (dual purpose - one teacher) with storage		7,38
Needlework with storage and fitting room		3,5
Cookery room with storage		3,5
Domestic Sciences (dual purpose) with storage		4,0
Workshops - with space for machines, operators and storage		
Basic techniques		6,7
Joinery		7,5
Electricity		6,8
Motor mechanics		10,5
Fitting and turning		13,6
Building construction		6,8
Electronics		5,0
Panel beating and spray painting		7,4
Spaces	Area per pupil in the school m ²	
	Primary	Secondary
Administration: offices, staff room, sick rooms, etc.	0,40	0,60
Resource centre	0,30	0,35
Hall and ancillary spaces	0,75	0,75
Hall - multipurpose, e.g. Physical Education and ancillary areas	1,20	1,20
Hall combined with separate gymnasium but with shared facilities and ancillary areas		1,75

16.4.2 School design

Most of South African schools consist of rows of classrooms with a corridor on one side. Recent developments indicate a movement away from this tradition. In Natal an experimental compact planned school was completed in 1979 and the more recent Indian schools have been built according to the new principles. The Transvaal Education Department is also considering compact planning for schools. The problems experienced with regard to traditional school buildings are the lack of suitable learning spaces for pupils and inadequate workspace for the teacher. The design of the school does not reflect the organizational structure of the school, nor does it facilitate community use. Furthermore the schools are not economically designed either. In most cases only 45 % of the gross area of the school is devoted to education and more than 30 % to circulation. The education space within a school can comfortably be increased to 65 or even to 70 % without the use of artificial environmental control.

16.5 SCHOOL PLANNING AND BUILDING IN OTHER COUNTRIES

16.5.1 The developed countries

- (a) The underlying philosophy of education has changed and lays more emphasis on individual work and small group work. This emphasis has affected school design. The rows of classrooms were not flexible enough. In England flexibility was obtained by giving the school a number of inter-related spaces and the classroom lost its identity as a space of constant size. In this open compact planning the building fabric itself separates one activity from another, but allows easy access. In Scotland the classroom maintains its identity but the planning allows for a variety of teaching spaces. In some states in the USA large open space structures have been built to achieve the necessary flexibility, with furniture separating the various activities. Australian schools are mostly open design schools.
- (b) School furniture is basic to the educational process and building design.
- (c) Deep-planned schools presuppose artificial environmental control.
- (d) On the whole the *systems projects* in North America and the *schools consortia* in the United Kingdom have improved the quality of school building without increasing the cost.

- (e) The schools in the UK, the USA and elsewhere are gradually becoming centres for society and social education. Some primary schools in Australia have also been designed for community use.

16.5.2 School building in developing countries

Both in Asia and in Latin America most of the countries did not have unlimited funds for school buildings. With the help of Unesco, institutes for school building research were established in both zones - the Conesca in Latin America and the ARISBR in Asia. Both these institutes did research, suggested areas per pupil, advised governments on how to get the best value for their money, helped them to plan their building programmes, collected and disseminated information, arranged seminars and conferences of a general nature and for technical training. They emphasized that in order to use their resources economically the governments should (1) use classrooms as fully as possible up to 90 % of the time and (2) reduce the circulation space.

As a result of the work of these institutes there has been a steady improvement in the number of classrooms and in the area allowed per pupil.

16.6 SCHOOL BUILDINGS AS REGARDS EDUCATIONAL REQUIREMENTS

16.6.1 Education policy as it affects school building

Act No. 39 of 1967 transferred the formulation of education policy to the central government. The twelve years of schooling were divided into four phases, namely:

Primary school: Phase 1: the substandards and Standard 1
Phase 2: Standards 2, 3 and 4

Secondary school: Phase 3: Standards 5, 6 and 7
Phase 4: Standards 8, 9 and 10

As far as possible the rooms for the classes in each phase in the primary school should be grouped together. Standard 5 is the first year of secondary education, but is usually housed in the primary school building. As it has to follow a secondary course, the necessary facilities have to be provided.

16.6.2 The organizational structure of schools as it affects the design of buildings

(a) The primary school

In Phase one it is essential for each class group to have its own room. The young child coming to school for the first time finds security in his teacher; his classroom should be as homelike as possible with the toilets near at hand. The teachers use many teaching aids which require storage space.

In Phase two the class groups still have their own classrooms but the children are more mature and can begin with subject learning. If the rooms are used fully, few if any additional spacial rooms need be provided.

(b) The secondary school

If each teacher is given his own teaching space then the use factor will be as high as the percentage of the school hours the teacher teaches.

(c) Number of teaching spaces required

The number of teaching spaces required depends on the staffing scale.

16.6.3 The policy of differentiated education

If the children are to be taught according to their talents, abilities and interests, they will require more spaces than just a classroom. There will be class teaching but they will also work in groups or even as individuals. The furniture should be designed to make this possible and the size of the furniture will influence the areas of the teaching spaces.

In the secondary school the first three years are an exploratory period during which the pupil is guided to discover his talents and interests and he then chooses his subjects.

16.6.4 Teaching and learning activities

The methods and techniques of teaching cannot be prescribed. Certain basic educational principles, however, influence methods. Self-activity is essential for learning. The child should be taught to find out for

himself, to think, to arrange facts, to interpret them, to apply them and to record them accurately and concisely.

In the primary school he first experiments with sand and water, works on the floor and later he paints and makes models. He reads silently, he receives speech therapy and listens to stories. Spaces must be provided to allow these activities to take place.

In the secondary school the pupil also has to find out things for himself by making use of the resource centre, the laboratories, the workshops, etc. The area of the classroom and the furniture should make provision for debates, play reading, discussions, etc.

16.7 COMMUNITY USE OF SCHOOL FACILITIES

Although school buildings are expensive structures, their utilization is very low. Considering the shortage or absence of community facilities in many areas, the school building and site facilities could well be used by the community at large. Community involvement in the provision and use of school facilities leads to community interest in the school, the recognition of the school as an important centre of community life, educational and social upgrading and community protection of school facilities.

Community use of school facilities does create certain difficulties. The typical South African school is not designed for community use, which aggravates the problem. However the advantages and, in the South African context, the necessity for such dual use warrants careful consideration.

16.8 SPACE REQUIREMENTS IN SCHOOLS

16.8.1 Treasury Committee for building norms and cost limits

A detailed study on the formulation of space and cost norms for school buildings is being undertaken by a subcommittee of the Treasury Committee. The results should be available shortly.

16.8.2 Space standards for the formulation of space norms

16.9 USER NEEDS IN TERMS OF ENVIRONMENTAL QUALITY

In order to facilitate the educational process the indoor environment must satisfy the requirements of both teacher and pupils. The three environmental factors that can be affected by the design of a building are acoustics, lighting and temperature or thermal conditions. It is very important that these three should be considered together during the design process. Because of the differing building methods and materials it is not possible to give a simple recipe and it would be unfair to expect the architect to realize all the conditions without specialized help.

16.9.1 Acoustics

The teacher uses speech sounds which must be heard clearly by the pupil. The acoustic performance of a space is determined by its size and shape, the noise level from outside and the reverberation time.

(a) Traffic noise

Traffic noise can affect the learning process of all pupils, especially those with learning problems. A certain level of noise is acceptable but it is wise to design so that the level is lower than the acceptable limit as traffic noise may well increase during the life of the building.

(b) Reverberation

In an ordinary classroom the clothes of the pupils absorb sound and reverberation is adequately reduced. Classrooms for remedial teaching require acoustic treatment.

(c) Sound insulation

An important function of the building is to insulate the classroom from noise from other rooms. Most of this noise comes in through the windows and consequently the nearest windows in adjoining classrooms should be as far apart as possible. At the design stage ventilation and acoustics should be treated together as windows have to be opened for adequate ventilation.

The amount of sound insulation required depends on the background noise which varies with the activities in the room.

Apparently all population groups or races react in the same way to noise. Climatic conditions do not affect the norms except that windows that are open for ventilation allow noise penetration.

16.9.2 Thermal and ventilation factors

(a) Comfort

The most commonly used criterion for evaluating thermal environment is comfort. No detailed information is available on the effect of moderate thermal stress on teachers and pupils - this topic merits further research.

The comfort of the human body is mainly determined by air temperature, air movement, clothing thickness and activity. At the low levels normally encountered in inland areas humidity is of secondary importance.

(b) Clothing

An ill-advised choice of clothing and the absence of proper ventilation to create air movement can reduce the maximum acceptable temperature by 8° C. There is no point in designing a building that will damp out the extremes of climate if unrealistic attitudes towards clothing create micro-climate next to the body which is more severe than the indoor environment. There is no evidence of significant differences in acceptable climatic conditions for members of different race groups.

(c) Thermal performance

The extremes of climate to be catered for are fairly well known from climatic design data. The way in which the design, layout and materials of a structure modify the prevailing outdoor climate to create a given indoor climate is also known and is called the *thermal performance* of structure. A procedure for predicting the thermal performance of a structure has been developed at the National Building Research Institute of the CSIR.

16.9.3 Lighting

(a) The amount of light needed

Adequate lighting is very important in facilitating the learning process. Young children learning to read have to see each letter clearly - this also applies to older children learning more complex tasks. The amount of light required depends on the size of the detail, the contrasts between the components of the task, the speed of movement and the seriousness of errors.

(b) Other factors to be considered

Other factors such as glare and veiling reflections should be kept to a minimum for good vision.

Adequate levels of illumination with light room surfaces and judicious use of colour help to create a cheerful and stimulating environment. In most schoolrooms, windows can provide adequate lighting for most of the time but direct sunlight should be excluded. Recommended levels of illumination for the different types of school space are given in Table 4, paragraph 9.3.5.

16.10 SCHOOL DESIGN CRITERIA

16.10.1 Design considerations

(a) Organizational structure

School buildings should be designed according to specific education needs and the needs of the local community. The layout of the school building is affected by the organizational structure of the school taking into consideration the relationships between various sections or spaces. Certain areas in the layout of the school should stimulate community interest and involvement.

(b) Activity requirements

School buildings should provide for the full range of educational activities and group sizes. Provision should be made for formal class teach-

ing in classrooms, but additional practical workspace and small quiet rooms are also necessary. Provision should be made for a large space, e.g. a hall for activities requiring large-scale movement.

(c) Teaching methods

Teaching spaces should be designed for a variety of teaching methods and in particular for the use of audio-visual aids in view of the shortage of teachers in certain subjects. Teaching spaces and the media centre should be designed for individual media use as well as group work.

(d) Environment and appearance

Schools are important centres in the local community and should have an educationally stimulating and interesting environment. Rigid standardization of school buildings should therefore be avoided.

16.10.2 Grouping classrooms for primary schools

A cluster of classrooms around a practical area with provision for quiet rooms and outdoor teaching space provides for the necessary range of teaching/learning activities. The layout of such clusters is shown in 10.2 of the work committee's report. The positioning of clusters in the total building complex is also illustrated.

16.10.3 Cluster arrangements for secondary schools to cater for the full range of education activities are suggested in 10.3 of the work committee's report.

16.10.4 Based on the classroom cluster principle, the recommended total area per pupil for primary schools is 5,20 m² with a lower limit of 4,56 m² and an upper limit of 5,57 m². The range of accommodation is given in 10.4 of the work committee's report.

16.10.5 Based on the classroom cluster principle, the recommended total area per pupil for secondary schools is 7,64 m² with a lower limit of 6,36 m² and an upper limit of 8,92 m². The range of accommodation is given in 10.5 of the work committee's report.

16.10.6 Facilities in existing school buildings should be reconsidered in the light of new standards. A framework for the assessment of priorities

and a renovation and upgrading programme should be formulated, setting out the range and limitations of upgrading at state expense and the scope for further subsidized and community involvement.

16.11 SCHOOL SITES

16.11.1 The sizes of all school sites and the provision of sports facilities could well be considerably reduced without unduly affecting the educational or recreational programme. Sports fields could be used by both the school and the community and two or more schools could share sports facilities.

16.11.2 The area of the site for a primary school of 200 pupils for buildings, parking, gardens, informal play, etc. is only 0,48 ha but it is 1,65 ha extra for sports fields. For a 750 pupil school the respective areas would be 1,80 ha plus 2,01 ha for sports fields. For secondary schools of 400 pupils the respective areas would be 0,96 ha plus 3,31 ha for sports fields, and for an 800' pupil school 1,92 ha plus 5,13 ha.

If the sports fields could be shared, the extensive cost of siteworks would be spread over a larger number of people and the quality and maintenance of facilities could be improved.

The supply of water is often a problem in rural areas, particularly in the Black states. A borehole for the development of school sites and for drinking water should be provided where necessary.

16.12 THE UTILIZATION OF EXISTING SCHOOL BUILDINGS AND THE EXCESS OR SHORTAGE OF PUPIL PLACES

16.12.1 Tables 8 and 9 in Section 12 of the work committee's report show the variation in use factors of teaching spaces in the different departments. The use factor should be in the order of 80 % for both primary and secondary schools, but from the tables it can be seen that the use factors range from 61,4 % to 158 %. From the number of pupils per room and the use factor it appears that in general the White education departments are well provided but that the Indians, Coloured and Blacks are underprovided.

16.12.2 Low utilization figures furthermore indicate a drop in numbers at many schools often due to social and environmental changes in the structure

of the community over a period of time. Scientifically based projections should be undertaken to establish likely growth patterns so as to avoid the provision of permanent accommodation for temporary bulges in the population growth of a particular area. Such bulges can be provided for by means of temporary buildings.

The excess or shortage of pupil places given in Tables 8 and 9 is merely an indication of relative need between departments based on the total available number of classrooms and total number of pupils registered.

An excess of pupil places does not necessarily indicate that no more new school buildings are necessary. Temporary classrooms may need to be replaced and new provision may need to be made for population movement to growth points in the country.

16.12.3 The shortage of pupil places as indicated by the negative figures indicates a very real need for greater utilization of existing unused school space.

16.13 THE CURRENT AND PROJECTED NEED FOR SCHOOL FACILITIES AND COST IMPLICATIONS

16.13.1 Area and cost considerations for the provision of facilities

(a) The amount of space needed

The recommended area per pupil of school building space as outlined in 10.4 and 10.5, together with lower and upper limits, is as follows:

Primary schools	lower limit	4,56 m ² /pupil
	recommended	5,20 m ² /pupil
	upper limit	5,57 m ² /pupil
Secondary schools	lower limit	6,36 m ² /pupil
	recommended	7,64 m ² /pupil
	upper limit	8,92 m ² /pupil

(b) Cost of school building

The cost of school building at current provincial school building standards as at September 1980 in the Pretoria/Witwatersrand area is taken

as follows:

Primary schools R200/m

Secondary schools R220/m

16.13.2 Assessment of the need in terms of pupil places and cost

(a) Statistical basis

Statistics of the various education departments and national population statistics were either inadequate or too variable for accurate comparable national projections of the need for pupil places in schools. Calculations could, however, be made for normal population growth, but not for interprovincial, intercity or intraprovincial and intracity population movement.

(b) Basis for determining the backlog

The current backlog of pupil places was determined at a parity level of 30 pupils per class where existing pupil per class densities exceeded 30. Densities below 30 pupils per class have arisen historically as a result of population movement and had to be accepted at the current levels.

(c) Backlog and projected need

Assuming the lower limit of accommodation 16.13.1(a) as that which should be provided by the state for equal education opportunity, and the upper limit as indicating potential cost including community involvement, the backlog and projected need would be as indicated in Tables S3 to S5.

TABLE S3

THE TOTAL CURRENT BACKLOG OF PUPIL PLACES AND COST IMPLICATIONS

School type	Places needed	Lower limit cost (X 1 000)	Upper limit cost (X 1 000)
Primary	1 583 748	1 444 378	1 764 295
Secondary	238 851	397 164	557 029
Primary and secondary	1 867 599	1 841 542	2 321 324

TABLE S4

THE PROJECTED ADDITIONAL PUPIL PLACES NEEDED AND COST IMPLICATIONS 1980-1990

Period	School type	Places needed	Lower limit cost (X 1 000)	Upper limit cost (X 1 000)
1980 to 1985	Primary	391 049	356 637	435 629
	Secondary	228 274	319 401	447 965
	Primary and secondary	619 323	676 038	883 594
1985 to 1990	Primary	320 711	292 488	357 272
	Secondary	246 960	345 546	484 634
	Primary and secondary	567 671	638 035	841 906

TABLE S5

ANNUAL SCHOOL BUILDING COST CONSIDERING THE ELIMINATION OF BACKLOG AND PROJECTED POPULATION GROWTH FOR THE PERIODS 1980-1985 AND 1985-1990

Period of time for elimination of backlog		Pupil places per year (X 1 000)	Lower limit cost per year (X 1 000)	Upper limit cost per year (X 1 000)
5 years	1980-1985	497 385	503 516,0	640,983,6
	1985-1990	310 625	319 361,8	408 851,2
10 years	1980-1985	300 294	311 761,0	400 513,6
	1985-1990	248 372	257 977,1	331 473,7
15 years	1980-1985	238 041	250 376,3	323 136,1
	1985-1990	217 245	227 284,7	292 785,0
20 years	1980-1985	206 914	219 683,9	284 447,4
	1985-1990			

16.13.3 Considerations as regards future planning

(a) Statistics needed

An accurate assessment of needs for national school planning necessitates an inventory of all the school facilities in the country and individual school statistics for projections of growth. Such statistics would then incorporate the effect of normal population growth, interprovincial population movement and intraprovincial movement. This study, based on existing available statistics, can merely be regarded as an indication of the order of need based on a parity level of provision which in cost equates current provincial building standards but as regards area, is less

than the provincial schools.

(b) Potential for cost reduction

The building costs indicated could be reduced by

(i) better utilization of existing facilities, and

(ii) reconsideration of comprehensive school units in terms of more centralized facilities serving a number of schools and less specialized facilities being provided at individual schools.

16.14 TRANSPORTATION AND ACCOMMODATION OF CHILDREN

16.14.1 Existing provision

(a) Transportation

In all the departments except for Black education departments, some provision is made for the transportation of children. The systems and regulations for the provision of transport are basically the same but the standards in terms of cost to the state and cost to the pupil and also the extent of provision differs from one department to another. Provision is made for bus systems and travel allowances where no school transport is available. Indian education and Coloured education require a means test before allowances are granted, but these create difficulties in administration.

(b) Accommodation

All education departments make provision for accommodating pupils when they live too far away from schools. Hostels are erected and boarding fees paid; a boarding allowance is available when no hostels are provided. The extent of provision differs greatly from one population group to another. The greatest need for hostels at present is in the Black and Coloured communities. The Indian communities generally prefer a boarding allowance to hostel accommodation.

16.14.2 National basis for the provision of hostels and transportation

To avoid differentiation between population groups, the same basis for the provision of housing and transportation should apply to all. The

systems as used by the provincial administrations are recommended as a suitable basis.

Primary schools should be decentralized so that no provision of hostels or transport is necessary except in special cases. Secondary schools should be provided with hostels and transportation where the need exists. Each application should be considered on its own merits according to a national set of rules. Subsidized accommodation and transport are suggested in preference to free services.

16.15 PROFESSIONAL AND INDUSTRIAL RESOURCES FOR SCHOOL BUILDINGS

16.15.1 With a large national school building programme and the need to maximize on financial resources, consideration should be given to the efficient use of the building professions, the building and manufacturing industry and available labour. A four-phase system of operation involving central and regional government departments and consultants is outlined in Appendix 1.

16.15.2 The resources of the building industry are considered against the broad classification of alternative building methods and procedures as regards cost-effectiveness and appropriate technologies in Appendix 2.

16.15.3 The availability of building materials is considered in the light of a national school building programme spread over the country as a whole. Information in this regard is given in Appendix 3.

17 CONCLUSIONS AND RECOMMENDATIONS

17.1 GENERAL

South Africa continues to face a heavy population increase for which school facilities must be provided. The current backlog and projected need for pupil places is extensive. A clear identification of the real national needs and the most efficient possible utilization of available professional, industry and monetary building resources is required so as not to strain the country's industry and economy unnecessarily.

Recommendation 1

That in-depth long-term research and development be undertaken at a national level to establish

- (a) the real needs of education for all;
- (b) the extent and quality of available facilities;
- (c) a framework for upgrading existing facilities;
- (d) the most efficient means of using available labour, industry and the professions for school building in various regional contexts;
- (e) a procedural framework for procuring school facilities;
- (f) the formulation of overall budgeting norms and detailed planning and design norms for school building;
- (g) the design of schools to function as centres for the community and community education;
- (h) comfort and environmental requirements for schools;
- (i) the equitable supply and utilization of available educational planners in a regional context.

17.2 BACKGROUND TO DEPARTMENTAL SCHOOL BUILDING PRACTICE

- (a) As departmental school building practice in South Africa went through its various stages of development in the context of varying social, economic and political conditions, the needs of White education were largely met but those communities classified as Asiatic, Coloured and Black continued to suffer heavy backlogs. Centralized national departments for these groups, however, greatly increased the rate of provision but they still face considerable backlogs.
- (b) The decentralized departmental structure gave rise to differences in standards of building and facilities for transportation and residence.

As the departments are to some extent population group orientated, the varying standards resulted in differences between population groups.

- (c) Variations or diversity in terms of structure, materials, finish and appearance will always occur irrespective of population group. These variations will be based on regional, environmental and technological considerations, such as
- (i) the local climate;
 - (ii) availability of materials;
 - (iii) the level and nature of available building technology; and
 - (iv) the need for protection in terms of safety and security.
- (d) The closer the association between education and works departments, the better they appear to function in terms of providing and maintaining facilities for education. The works department's function is more specifically geared to local regional conditions and requirements, necessitating a devolution of authority for decision-making on a regional basis.
- (e) The division of the education and building budgets between the education and works departments gives rise to planning problems on the part of the education departments. A single budget for education which includes buildings will considerably facilitate the work of education planning departments.

Recommendation 2

- (a) That the responsibility of national planning for building be centralized in a single national education department with devolution of responsibility and decision-making powers to departments on a regional basis in which the interests of all groups are safeguarded. National planning, assessment of national priorities, the formulation of common standards and monitoring the needs and interests of all as regards building facilities would be considerably facilitated.
- (b) That the education and the education building budget be an education responsibility to facilitate national planning for education independently of other public building types.

- (c) That a works branch be considered for education to work in collaboration with national education planners but with considerable authority decentralized at a regional level. That consideration be given to the appointment of private consulting firms, not only for design and documentation, but for supervision, administration and control of a number of projects on a regional basis in collaboration with departmental staff. This could apply particularly to remote areas where there are specific regional needs and resources that must be considered and where it is difficult to attract sufficient professional staff.
- (d) That the building services and works function not be underestimated or unduly limited as building facilities for education are of vital importance to education although only accounting for a relatively small proportion of the total education budget.

17.3 CURRENT DEPARTMENTAL BUILDING PROCUREMENT PROCEDURES

Existing procedures appear to be largely satisfactory and are very similar for all departments except as regards some contract procedures used for building schools for Blacks.

- (a) The records kept by departments of their building facilities and the utilization of facilities vary and do not always provide an adequate basis for the assessment of building needs for national planning.
- (b) The responsibility of education facility planners in education departments, to formulate standards, keep adequate records, establish needs, allocate priorities and to determine and administer school planning programmes, requires a knowledge of education and building procurement procedure. Most planners have an education background but know little or nothing about building procurement and the management of departmental facilities.
- (c) Urgent projects are sometimes extensively delayed owing to the time taken to acquire possession of sites. Several departments are involved in the site acquisition procedures.
- (d) It is sometimes necessary to obtain sites outside a specific group area. However the implementation of the Group Areas Act makes this very difficult.

- (e) The sizes of school sites and the facilities on school sites vary considerably from one department to another. Every school generally has its own facilities.
- (f) The system of using standard plans and private consultants with departmental architects performing an administrative, advisory and controlling function, appears to work well. Shortage of professional staff is however often a problem, particularly as regards the Black states where very often no building professionals are available for departmental employment. While some standardization appears to be necessary, too much standardization tends to result in a lifeless, non-stimulating environment for schools. Standard plans on the other hand reduce the cost of professional services and simplify departmental approval procedures.
- (g) Contract procedures and building methods are not always geared to local conditions in terms of labour, the building industry and materials.
- (h) Variation in the cost of school buildings is largely due to differences in the standard of facilities provided for different population groups, the availability and sophistication of the local building industry, the degree of standardization and control and, where the local community erects schools, the degree of subsidy provided by the state.
- (i) The wide range of variations as regards the use of audio-visual media in schools and the varying standards, trends and developments as regards libraries and media centres, requires some form of rationalization and a national framework for future development.

Word 2

Recommendation 3

- (a) That a computerized national inventory of school building facilities be formulated in respect of

School sites;
buildings and accommodation details;
residential accommodation details;
transportation services;
utilization statistics, and
pupil and staff populations.

Such an inventory, as is not uncommon in overseas countries, will considerably facilitate national planning for education facilities and education per se.

- (b) That an education facility planning course for education department planners be instituted at technikons, and/or universities, covering the full range of the planner's responsibility, particularly in the national and the regional context.
- (c) That site acquisition procedures involving the various departments concerned as far as is possible be streamlined to provide for more rapid transfer of ownership for urgently required projects.
- (d) That the acquisition of sites outside specific group areas where the need exists, be considered by the HSRC Legal Matters Work Committee and that recommendations to facilitate such acquisition be formulated. ~~not to~~ (belye veronder)
- (e) That common minimum standards in terms of the size of school sites be used for all schools and that it should not be necessary for every school to have its own recreation and sports facilities, cf. Recommendation 11.
- (f) That the advantages and disadvantages of standard plans as a means of reducing cost be carefully reconsidered in the light of the wider range of design considerations to satisfy current and future education requirements and the need for schools to function as centres for the community.
- (g) That an efficient system of detailed briefing be considered in preference to standard plans in which common standards, common and specific design criteria and the accommodation needed are clearly outlined. In this context to consider the more efficient use of professional design and building consultants for school design and building and the use of professional consultants to perform a departmental controlling function over a number of schools in a specific geographic area where the need exists.
- (h) That school building contracts, particularly large-scale contracts geared to reduce the current backlog, be planned in the context of careful and sensitive consideration of
 - *the local building industry;
 - *local contractors and the labour force they require to continue to operate, and

*the need for phased development of the local building industry.

- (i) That large-scale contracts which draw labour away from existing small contractors be entered into with great caution so as not to break down the developing local building industry.
- g (j) That the technology used for large-scale projects in the developing Black states in terms of the use of local labour be such as can continue to be effectively used by the locals on completion of the large-scale projects.
- h (k) That common space, cost standards and design criteria be used for all school building to achieve equal opportunity for all, but that provision be made for variation in costs according to prevailing conditions in the local building industry.
- u (l) That a national framework be formulated for the use of audio-visual media in schools considering

*the nature and range of media to be used;

*adequate training in the use of media;

*the design of teaching spaces for the use of media, and

*the function and design of the media centre in schools.

17.4 CURRENT DEPARTMENTAL SCHOOL DESIGN STANDARDS

- (a) The considerable variation in terms of the amount of space provided for the different activity areas in schools is indicative of a need for the formulation of space standards as design guides, according to the real education needs.
- (b) The traditionally built South African school does not provide the range of education spaces needed in the context of the organizational structure of the school, nor does it facilitate community use of school facilities. The proportion of the gross area that is devoted to education activities can be considerably increased.

Recommendation 4

- (a) That space standards as recommended in 8.2 of the work committee's report and 17.8.2 of the Summary be incorporated in design guides as a basis

for determining the area needed for different types of spaces.

- (b) That schools be more efficiently designed in terms of usable education activity space.
- (c) That schools be designed to facilitate current and future education needs and community use of facilities, cf. Recommendation 10 regarding school design and space norms.

17.5 SCHOOL PLANNING AND BUILDING IN OTHER COUNTRIES

- (a) Changes in education in the developed countries resulted in new designs for school buildings. Sudden radical changes in building design often created problems as regards acceptance by the public and teachers. Open school planning in the United States is still having mixed reception, but the trend now is towards a greater degree of compartmentalization of space. The compact interrelationship of different sizes and types of space separated by walls as is used in the United Kingdom appears to be a more satisfactory solution. A similar approach in Scotland but with the use of separately identifiable classrooms seems to come closer to a solution in the South African context. A similar approach together with open planning is used in Australia.
- (b) Overseas trends and developments should be seen in the context of their local social, economic and political background and cannot necessarily be directly applied to conditions in South Africa. However, a considerable amount of experience can be gained from overseas successes and failures.
- (c) Schools in the developed countries are increasingly becoming centres for society, social education and general community use. These developments have met with considerable success in terms of community interest, community participation, community education and the upgrading of communities. The concept could be equally applicable to South African needs.
- (d) Regional building and research institutes were created to optimize the use of available resources in the developing countries so that they could meet their building needs for education. These institutes served a number of states or countries and assisted and advised on standards, design and building. Similar expertise should be made available to South

African education bodies and the Black states in particular.

- (e) Developing countries had to limit themselves to minimum space standards and to the more essential accommodation such as classrooms, which could later be expanded to include libraries, halls and recreation facilities. Double sessions and even triple sessions had to be organized owing to insufficient available classrooms.
- (f) In developing as well as developed countries, communal sports facilities are often used for schools and the community.
- (g) In the developing countries, industrialized building according to local levels of technology is often used to meet the urgent need for classroom space.

Recommendation 5

- (a) That new approaches to school design be introduced with great caution and that the detailed design of the schools as far as possible be developed in close collaboration with the educationists who will use the schools.
- (b) That overseas design methods be considered in the context of local teaching practice and specific local needs. That the classroom remain a separate identifiable space in a compact interrelationship with other needed teaching spaces, cf. Recommendation 10.
- (c) That although South African schools be designed for the formal education of children, provision could be made for limited community use.
- (d) That communal sports facilities be used for both schools and the community.
- (e) That a central national school building research, development and advisory body be established to serve the interests of all the countries in Southern Africa.
- (f) That acceptable industrialized building be considered using local levels of technology to provide needed space more rapidly.

17.6 SCHOOL BUILDING AS REGARDS EDUCATIONAL REQUIREMENTS

- (a) The Education Act (No. 39 of 1967) which lays down a policy of differentiated education has had little effect on the design of school building.
- (b) Schools should be designed according to their organizational structure and the full range of differentiated education teaching methods and techniques. Provision should be made for the different types of activities and a range of group sizes.

Recommendation 6

That school design be reconsidered in the light of current education policy, teaching methods and techniques and that provision be made for changes and developments in education, cf. Recommendation 10.

17.7 COMMUNITY USE OF SCHOOL FACILITIES

- (a) In many communities there is a distinct need for community facilities which can to a large extent be provided by the local school. School facilities lend themselves to such use and schools will no doubt benefit from the additional design considerations needed to make them function as limited community centres.
- (b) School buildings are expensive structures and their low weekly and annual utilization could well be increased to serve the broader needs of the community.
- (c) The difficulties which result from community use of school facilities deserve attention but because of the advantages gained by community interest and participation and benefit, the difficulties should in no way detract from a purposeful endeavour to implement the concept.

Recommendation 7

- (a) That as part of the minimum basic requirements and standards for the provision of school facilities by the state, the schools be designed to function as limited community centres in the context of local needs and interests.

- (b) That the range of community activities that may be provided for, as for example suggested in 7.1.4, be clearly defined by the education authorities and the necessary implications in terms of the design of school facilities be clearly outlined in design brief format.
- (c) That the problems of community use of school facilities be identified and an adequate organizational framework formulated for schools to function on this basis. That the organizational and management details as regards responsibility and control be referred to the HSRC Main Committee for consideration.
- (d) That where community facilities are available that can be used by a school, ways and means be found to use these facilities.

17.8 SPACE REQUIREMENTS IN SCHOOLS

- (a) The detailed space and cost norms being formulated by the Treasury Committee for building norms and cost limits, should be an adequate basis for regional and national planning and budgeting.
- (b) The space standards suggested in 8.2, 16.8.2, 10.4 and 10.5 should form an adequate basis as regards the amount of space needed for the formulation of the Treasury Committee norms.

Recommendation 8

- (a) That the space and cost norms being formulated by the Treasury Committee for building norms and cost limits be considered as a basis for regional and national planning and budgeting.
- (b) That the areas suggested in 8.2, 16.8.2, 10.4 and 10.5 be used as a basis for determining the national space norms.

17.9 USER NEEDS IN TERMS OF ENVIRONMENTAL QUALITY

- (a) Environmental conditions are important in school building design and yet are often neglected. As differing building methods and materials make it difficult to specify all the necessary environmental design criteria, specialist consultants should be used for schools, or groups of schools of similar design in the same geographic area. In the absence of data

on the effect of thermal conditions on the performance of pupils, comfort criteria have to be used. Research to fill this gap is required.

- (b) An environmental design checklist for school designers would help to ensure that the various aspects of environmental design have been considered.
- (c) Information on methods of calculating and assessing likely environmental conditions for a particular building design is available from the NBRI.
- (d) Basic acoustic, thermal, ventilation and lighting design criteria are given in Section 9 of the work committee's report.
- (e) The clothing of children and teachers is an important consideration affecting thermal comfort. Warm dress in winter and cool dress in summer with flexibility of choice during the changing seasons can go a long way towards limiting costly building design considerations in terms of heating and cooling.
- (f) The heating of schools in many areas during cold winter months could be avoided if schools were to start at 09h00 instead of 08h00, owing to the rapid increase in the outdoor temperature between 08h00 and 09h00.
- (g) Colour can be used effectively in schools towards creating more suitable environment for different types of activity.

Recommendation 9

- (a) That environmental requirements in schools be regarded as sufficiently necessary to warrant specialist consultation in respect of different design and building solutions.
- (b) That research be undertaken on the effect of moderate thermal stress on the performance of pupils.
- (c) That an environmental design checklist for designers be formulated and used as part of the departmental requirements for school building design.
- (d) That available basic environmental design criteria be included in school design briefing guides and references be given to information on more

detailed calculation methods.

- (e) That proper consideration be given to thermally comfortable clothing standards for pupils and teachers to limit unnecessary expense on heating and cooling.
- (f) That in certain areas of the country consideration be given to commencing schools an hour later during the cold winter months, to avoid the need for expensive heating for only a small portion of the school day.
- (g) That research be undertaken on the use of colour in schools.

17.10 SCHOOL DESIGN CRITERIA

- (a) Schools should be designed according to their organizational structure, the activity requirements, teaching methods and the nature of the environment required. The cluster design concept as described in Section 10 of the work committee's report goes a long way towards meeting these requirements.
- (b) The amount of space needed for schools designed according to the cluster principle can be expressed in terms of a lower or minimum recommended limit, an upper or maximum recommended limit and a suggested comfortable space norm. The range of spaces provided for each of these limits is outlined in Section 10.
- (c) The suggested space norm provides far less gross area than in most of the provincial schools, but more education space. It is based on a specific range of accommodation which is the suggested basic range that the state should provide for equal education opportunity.
- (d) Facilities in existing schools will have to be reconsidered in the light of new standards.

Recommendation 10

- (a) That the cluster school design concept as described in 10 be considered as a more effective method of providing the necessary range of spaces required for education.

- (b) That the lower recommended space limit form the cost basis of state provision of school facilities as it provides for the minimum space needed to achieve equal education opportunity.
- (c) That the lower recommended space norm be used only until the backlog of pupil places is eliminated, after which the recommended upper limit should be used as the cost basis of state provision.
- (d) That provision be made for local communities to extend the basic provision to that of the upper prescribed limit at the expense of the community, and that provision be made for a subsidy on a sliding scale.
- (e) That facilities in existing schools be reconsidered in the light of new standards and that a framework for the assessment of priorities and a renovation and upgrading programme be formulated, setting out the range and limitations of upgrading at state expense and the scope for further community involvement.

17.11 SCHOOL SITES

- (a) Bearing in mind the site selection criteria in Section 11, an education planner, an architect, an engineer with knowledge of soil mechanics and representative parents should as far as is possible be involved in school site selection.
- (b) Play ground and garden area are necessary for all schools, but sports facilities could be shared by two or more schools. The site areas required for different sizes of schools can be determined from the tables in Section 11.
- (c) Detailed information on school site layout and design is available from the NBRI.
- (d) Sport facilities should be used by both schools and the community.
- (e) The supply of water for the development and maintenance of sites is sometimes a problem, particularly in the Black states.
- (f) While in some cases the state makes a contribution towards the development of school sites, the responsibility to a large extent rests with

the community.

Recommendation 11

- (a) That a framework for school site selection be formulated to aid town planners and education authorities. It should include the disciplines to be involved and the range of school site selection criteria required.
- (b) That all schools be provided with play ground area but that sports facilities be shared between two or more schools depending on geographic accessibility.
- (c) That the areas tabulated in Section 11 be used as the basis for determining school site sizes.
- (d) That school sports facilities be available for community use in the light of Recommendation 7.
- (e) That where community sports facilities are available, and accessible to schools, these be used in preference to building new facilities.
- (f) That where no municipal or regional water supply is available, a fitted borehole be provided as part of basic state provision.
- (g) That the necessary levelling of sites to accommodate playgrounds and basic normal sports facilities according to a site plan be the responsibility of the state. That in addition the state be responsible for the fencing.
- (h) That to aid poorer communities with the development of school sites a sliding scale subsidy or a national fund open to contributions from the private sector be considered.
- (i) That a framework for site development by the community be formulated as guide and a means of ensuring adequate quality to limit unnecessary works department maintenance.

17.12 THE UTILIZATION OF EXISTING SCHOOL BUILDINGS

- (a) The utilization of space in the Cape and Natal is considerably lower than in the Transvaal and the OFS, and the excess of pupil places in the Cape

and Natal is high. While in Natal the growth rate is in excess of the national average growth rate, indicating that the current low utilization may improve, the Cape growth rate is less than the current national growth rate, indicating that the current low utilization is likely to become still lower. The low average departmental school utilization for Whites is largely the result of movement away from rural schools to town and city schools, leaving excess space in the rural schools.

- (b) The need for school places in a given area varies with time. Very often the growth increases up to a maximum and then as the area becomes older in terms of its inhabitants, the number of pupils drops off until new families come into the area. It is necessary to predict this growth pattern so as not to under or overprovide pupil places. Computerized prediction methods are available although more detailed development of these systems may be necessary.

Recommendation 12

- (a) That considering the very low utilization and excess space in some areas where there is also a considerable backlog of pupil places for other population groups, ways and means be formulated whereby the underutilized accommodation can be maximally utilized to reduce the drastic need for building new schools. That a detailed investigation be undertaken in this regard as to the feasibility and potential for such utilization.
- (b) As regards the influence of the Group Areas Act on the utilization of schools:
 - (i) that the provisions of the Act be disregarded as far as education facilities are concerned; or
 - (ii) that the authorities be requested to study the effect of this legislation on the problem of underutilized facilities.

(The work committee was divided on recommendations(i) and (ii) above.)

- (c) That scientifically based statistical projection methods be used to predict growth in new and existing residential areas. That temporary classrooms be used only to meet the need for bulges in pupil numbers that occur for a limited period of time. Such classrooms should never be regarded as permanent.

17.13 THE CURRENT AND PROJECTED NEED FOR SCHOOL FACILITIES AND COST IMPLICATIONS

- (a) Existing statistics regarding school building facilities are inadequate for a national assessment of needs for school planning.
- (b) The current backlog of pupil places is extensive and occurs largely in terms of the classified Black, Coloured and Asiatic population groups. The need for pupil places for Coloured and Asian communities is largely an urban need and schools will have to be built at ruling building industry prices. A considerable proportion of the Black pupil places needed occur in the Black states where, using the local building industry, although to the same recommended common national norms and standards, the cost of school building will be somewhat less.
- (c) The current backlog of pupil places requires a state investment of ± R1 841,5 million as at September 1980 costs. In addition to this, provision has to be made for the costs of site development as mentioned in Recommendation 11.9, of hostels and of the transportation of pupils which have not as yet been quantified.
- (d) The projected future requirement for pupil places for population growth only requires an annual investment of ± R131,4 million, excluding site development, hostels and transport as in (b) above.
- (e) The annual cost of the provision of pupil places for growth and the elimination of the backlog over five years would be R503,5 million; ten years R315,6 million; 15 years R254,2 million and 20 years R223,5 million.

Recommendation 13

- (a) That the estimated costs, based on existing available statistics, merely be regarded as an indication of the order of need based on a parity level of provision which in cost equates current provincial building standards but as regards area is less than provincial schools.
- (b) That innovations in terms of building procurement procedure as suggested in Recommendation 15 be implemented to reduce buildings costs.
- (c) That further research be undertaken to establish the likely cost of hostel accommodation and of the transportation of children, considering

the fact that such facilities should be provided where the need exists.

- (d) That the current backlog be eliminated as soon as possible and to achieve this, other ways of providing the necessary facilities be considered in the context of new educational management structures.

17.14 THE TRANSPORTATION AND ACCOMMODATION OF CHILDREN

- (a) Considering equal education opportunity, all population groups should have the same provision as regards accommodation and transportation.
- (b) The basic accommodation and transportation policy of the provincial administrations provides an adequate basis for provision for all groups.
- (c) While some provision is made for transportation for the communities classified as Asiatic and Coloured, it is inadequate when considered in the light of the actual needs.
- (d) No transport provision is made for Blacks where in fact a very real need exists.
- (e) Asiatic communities tend not to use school hostels and hence have a very low requirement for this kind of accommodation.
- (f) The need for accommodation of Coloured and Black pupils is extensive.

Recommendation 14

- (a) That the existing accommodation and transportation policy of the provincial administration form the basis of provision for all.
- (b) That a detailed research study be undertaken to determine the extent of the housing and transport need.
- (c) That primary schools be erected as near to the homes of children as possible and if necessary kept small so that no provision need be made for either hostels or transportation, except in certain special circumstances such as in sparsely populated areas.

- (d) That provision be made for accommodation and transportation at secondary schools where the need exists and that each application be considered on its own merits in the context of a framework of rules.

PROFESSIONAL AND INDUSTRIAL RESOURCES FOR SCHOOL BUILDING

- (a) The very large schools building programme required to achieve equal opportunities for education throughout the country will have to be superimposed on the *normal* workload of the building industry, the related professions and the client bodies involved in the procurement of school buildings. Identification of future trends in the building industry is therefore of crucial importance since a large new building programme can better be handled, in terms of manpower and material resources, in a period of recession rather than during a building boom. This applies particularly to that part of the schools building programme that is intended to eliminate the existing backlog of schools.
- (b) The widespread construction of schools throughout the country could have a major impact on reducing unemployment which has been shown historically to increase dramatically during periods of economic recession.
- (c) Despite the emphasis in (a) and (b) above on the advantages to be derived from accelerating the building programme during economic recession periods, it is deemed essential that the momentum of the building programme should be sustained during boom and recession periods, and careful long-term planning (especially financial planning) should therefore receive top priority.
- (d) The size of the building programme envisaged will create many opportunities for innovation, not necessarily only in terms of alternative building methods and technology but particularly in the design, management and procurement procedures adopted. Suitable organization structures should therefore be created within client body organizations to encourage the development and fully co-ordinated use of current and new techniques of management of the building process. This is essential if optimum use is to be made of scarce skilled manpower, material and money resources.
- (e) Communications between the key individuals and groups concerned with the schools building programme will have to be very effective to ensure efficiency in the design and completion of particular projects. Con-

sidering past and current innovations in building technology, the size and complexity of the envisaged schools building programme and the mounting pressures of society, it is evident that the need for new and improved techniques of control and co-ordination of the building process will become increasingly urgent.

- (f) The essential and increased participation of the client in building should be regarded as a foregone conclusion, but close attention should still be paid to the actual economics of handling and managing a given school building programme. Care should be exercised in evaluating the benefits in terms of savings in the total cost of building, that will accrue to the client with the introduction of any new procedure. Value for money should always be the criterion when an appropriate organization for building is under review.
- (g) Sight should never be lost of the fact that the erection of a building entails hard work; new techniques and procedures are no substitute for this. The planning, design and erection of hundreds of new schools in South Africa is going to test the resources and capabilities of the building community in this country.
- (h) The extensive use of traditional building methods for the school building programme will be constrained by shortages of skilled (artisan) labour. The severity of this constraint will vary with cyclic movements in the volume of work available to the building industry.
- (i) Emphasis should be placed on the use of rationalized traditional building methods which
 - (i) decrease the skilled labour content of building operations, and
 - (ii) do not aggravate regional unemployment problems by significantly decreasing the demand for unskilled labour.
- (j) Experience has shown that a task force approach to building satisfies the criteria listed in (i) above. In addition, the training programmes that are essential to the concept can contribute towards
 - (i) improving the productivity and upgrading the skills of new entrants to the building industry, and

(ii) alleviating the anticipated long-term shortages of skilled labour in the building industry.

(k) Despite the apparent and understandable prejudice of many public sector agencies towards industrialized building systems, it may be essential to consider their use in, at least, a supplementary role to more conventional methods. Recognition should be given to the fact that the cost-effective use of IB systems demands

(i) contracts of sufficient size;

(ii) an assurance of continuity of work, and

(iii) the development and implementation of innovative procurement, contractual and administrative procedures on the part of client bodies.

Recommendation 15

- (a) Matters concerning both the time scale and the timing of key developments in the envisaged school building programme should be investigated in terms of the *building cycles* which so influence all development in this country.
- (b) As procurement of a large number of school buildings will largely be an exercise in organization and management, specific attention should be devoted to this aspect of the process of building.
- (c) As optimum use of design and other professional skills requires that a *systems* management approach be applied to the ongoing building programme envisaged, consideration be given to the *four phase* school procurement procedure discussed, embracing both *centralized* and *decentralized* functions of a specialized nature.
- (d) In order to reduce the adverse impact of skilled labour shortages on building costs, contracts for the construction of schools to eliminate the backlog should preferably be awarded and executed during periods of recession rather than during building boom periods. Research related to identifying and forecasting future trends and demand patterns in the building industry should therefore be carried out.

- (e) Current and past procedures in public and private sector agencies aimed at a task force approach to building be studied. That the information derived from these studies be used as a base for identifying optimum procedures in the context of the envisaged school building programme.
- (f) Research be carried out to identify the potential role of IB systems in any regional building programme. That cognizance be given to the fact that the extent of use of IB systems should essentially be determined by a trade-off between
 - (i) the comparative ability of conventional methods and IB systems to satisfy demand in terms of construction time, quality, cost and user satisfaction, and
 - (ii) the implications of the use of conventional methods or IB systems on the socio-economic circumstances (e.g. level of unemployment) of the population of a particular region.
- (g) In the light of the envisaged role of IB systems, procurement procedures be identified that will optimize the potential cost and construction time benefits to be derived from the use of such systems.

APPENDIX 1

NATIONAL BUILDING RESEARCH INSTITUTE

HUMAN SCIENCES RESEARCH COUNCIL INVESTIGATION INTO EDUCATION IN THE REPUBLIC OF SOUTH AFRICA

AVAILABLE RESOURCES TO MEET THE NEED: EFFECTIVE USE OF THE BUILDING PROFESSIONS

INTRODUCTION

Data from the South African Reserve Bank indicates that in 1979 R1 246 million was invested in residential buildings, R1 573 million in non-residential buildings and R3 119 million in construction works - a grand total of R5 938 million invested in bricks, mortar and concrete in South Africa. Despite the impact of inflation on figures such as these, total investment in buildings during 1980 and 1981 will be well in excess of the figures available for 1979.

The building industry is therefore fully committed for at least the next 18 months, including not only the factors of physical production but also the resources of the design and related professions as well. The implications of implementing a national building programme for schools as currently envisaged will therefore be most significant indeed. It should be remembered that a large schools building programme to achieve equal opportunities for education throughout the country will have to be superimposed on the existing work load of the building industry. All the evidence from the past has indicated how chaotic matters concerned with building become when a sudden new demand for accommodation is created which exceeds the already stretched resources of supply.

ECONOMIC CONSIDERATIONS

A number of important points relative to a large new schools building programme emerge, all of which have particular significance for the optimum use of professional manpower:

(a) Timing

Future trends in the building industry will be crucial since a large new building programme can better be handled in a period of recession rather than during a building boom.

(b) Time scale

The data available would indicate that the magnitude of a school building programme (backlog, upgrading existing facilities and meeting the needs of population growth) will be large. The time scale selected to solve the immediate problem would then be of enormous economic significance.

(c) Continuity

It is deemed essential that the momentum of the building programme should be sustained and careful long-term planning (specially financial planning) should have top priority.

(d) Employment opportunities

The erection of schools all over the country would have a major impact on unemployment and this aspect should be given further thought.

(e) Innovation

It is believed that the size of the building programme envisaged will create many opportunities for innovation, not necessarily in terms of alternative building methods, but in the design, management and procurement procedures adopted.

WHY INNOVATION?

Society is in a constant state of evolution and change; innovations in technology result in an everchanging pattern of development, and new procedures are continually having to be introduced to meet the demands of new circumstances. One of the best examples of uncertainty and doubt concerning the validity of traditional procedures and practice, in the light of modern conditions, may be found in the field of construction.

Building has an increasingly important part to play in satisfying the desire of the masses for higher living standards and there has been a gradual build-up of

pressure for the building industries of the world to expand capacity by means of greater efficiency. Trends in building are greatly influenced by these pressures, which are largely economic, social and political in nature and are generated by the community at large. To meet the demand for building, far-reaching innovations in the building process have already had to be considered and some implemented in South Africa.

If there is one thing common to all those wishing to build, it is a desire to receive value for money spent. A client may emphasize his need for space at low cost, a prestige building may be of special benefit to him, or the functional performance and the convenience of a building relatively free from subsequent maintenance costs might be of particular interest. However, notwithstanding any specific requirement that is included in his brief, the client will always be concerned with matters relating to finance, and his assessment of the completed building as a whole will be strongly influenced by cost/value considerations.

Traditionally, the task of the professional consultants is to design a suitable building within the cost limitations set by the client, to select a competent builder on a competitive basis to execute the design, and to exercise quality and cost control for the duration of the contract. To achieve all this satisfactorily a complex system of documentation has developed that is linked with well defined methods of procedure. We thus have the pattern of practice and organization emerging, with which all in the building industry are broadly familiar.

Communications between all the numerous individuals and groups concerned with a building project, including bodies in the public sector, have to be very effective to ensure efficiency in the design and final completion of the project. However, with current innovations in building technology, the increased size and complexity of many buildings and the mounting pressures of society, communication appears to be diminishing, so the need for new techniques of control and co-ordination are becoming increasingly urgent. Many experts now agree that the pressing problems of building organization and management overshadow and largely supersede the older technical problems of design and construction.

BUILDING PROFESSIONS

It is felt that the building professions have not effectively been used in the past in the sphere of educational buildings. For one thing, the relatively small annual school building programme in South Africa has been initiated and handled by numerous client bodies (and their respective professional teams),

at both the provincial and central government levels. This state of affairs has arisen largely because of historical developments, and the time is now deemed ripe for major changes in the traditional organizational pattern. Furthermore, the use of private consultants has inevitably been on a random ad hoc basis, with little specialization in the private sector being encouraged. A step in the right direction has been the recent move for certain private firms to be appointed by a client to be responsible for a specific series of school projects, on the basis of a consortium (e.g. Cape Provincial Administration).

INITIATION AND EXECUTION OF A NATIONAL SCHOOL BUILDING PROGRAMME - USE OF PROFESSIONAL STAFF

A review of overseas developments concerning the building of schools, as well as recent developments in this country, would indicate that there are four major phases in providing schools which are both cost-effective, meet educational requirements and generally give value for money. Each of these phases will now briefly be discussed and certain suggestions made concerning their relevance to a national school building programme in this country and how scarce professional skills can best be used:

- (a) The first phase is a centralized function which determines the areas and standards of schools, in terms of agreed educational standards, economic considerations which include the availability of resources (particularly capital), and the policies and priorities of the government. A number of such exercises are already under way at Treasury level (concerning various public sector building types) with a view to the establishment of acceptable norms of accommodation and related cost norms. This phase requires a number of specialists, e.g. educationists, financial experts, architects, quantity surveyors, to work closely together and produce a broad *brief* concerning the design of various kinds of accommodation for schools. The nature of this work requires that the participants be public sector employees, although specialist consultants could be called to advise on an ad hoc basis. A further important function undertaken at this level is the monitoring of results being achieved in the field with a view to the possible introduction of changes in the basic *briefs* being used.
- (b) The second phase is that of research and development which, in the South African context, would inevitably also be a centralized function. A specialized body of building professionals will interpret the *brief* for each school type and develop design solutions in keeping with the

educational requirements and various norms previously agreed upon. There could be specialized task groups, each looking at a specific school type (e.g. primary schools). Although the main objective would be standardized, (but flexible) design layouts, specific attention would also be given to certain special requirements, depending on region, climate, etc. For instance, schools in coastal areas (marine environment), inland areas, exceptionally hot areas, may all have specific design features appropriate to the climate incorporated in the standard design. Similarly, the designs for schools in remote rural areas may have to be modified to optimize the use of available building material and labour resources. Depending on conditions and circumstances, an industrialized system version of a school may have to be developed to meet requirements. The research and development body would have an ongoing task on their hands with a continuous review and modification of design details taking place in the light of feedback from practice. Over time, one may well have, say, a *Mark I* primary school in use, with the relevant design group already well on the way to launching the *Mark II* school which will then be built until, perhaps a *Mark III* design is available. There is no better way in which a skilled and experienced design group can be established to effectively launch a large and continuous building programme of a relatively specialized nature.

- (c) The third phase is a *client* body to be responsible for implementing the school building programme within a given region, e.g. an existing province or national state. Building professionals are needed here to ensure that the right school design is used on a given site. The basis will always be use of the complete design from the *R & D* body with only minor design alterations being permissible in very special cases. A final choice of, say, *external finishes* or *roofs* can then be made depending on the flexibility of the appropriate standardized designs available. The building professionals would also be responsible for implementing the appropriate building management procedures, involving tendering procedures, conditions of contract, financial implications, etc. An important function of these building professions would be to maintain two-way communication channels with both the centralized *norms* body, as well as the *R & D* body. Two or more *client* bodies could form a *consortium* to facilitate the erection of a series of similar schools in an adjacent geographical area, with a special view to *bulk buying*, *serial* tendering, or other cost saving procedures.

(d) The final phase would be the actual erection of the school (or a whole series of schools) on a site. It is felt that not sufficient attention has been given in the past to this crucial stage of building. A *project executive* should be assigned to every school (possibly a series, or group of schools being erected in a geographic area). He would thereafter act as the *client* in supervising the construction work assigned to him. His principal activities would be as follows:

- (1) He would determine the organization needed for technical supervision of the project(s) under construction, e.g. retain the services of the original design team, appoint a site engineer and/or clerk of works, or use a *district* office that may be available.
- (2) He would inaugurate an appropriate financial and cost control system for the project; for instance, from the construction programme and cost plan available, an idea of the *cash flow* during the project could be estimated from the client's point of view. The original quantity surveyor may be appointed to undertake monthly valuations of work in progress, for purposes of payment certificates to the builder, and to prepare reports on the cost implications of all variations before they are approved.
- (3) He would take the chair at all *site meetings* and be responsible for ensuring that all decisions were properly minuted, and acted upon in good time. The project executive would act as the sole communication channel with the client organization; problems arising during construction might have to be discussed with top management, the research and development section, and with members of the original design team. The project executive, however, should not be burdened with purely technical problems, since his function is one of management, and not *trouble-shooting*, in the technical sphere.
- (4) Time control would be one of his most important functions, and he should be in a position to recognize the problems in this field immediately they arise, and constantly seek solutions acceptable to all at the site meetings held. However, he should also be fully aware of the legal implications of the specific building contract entered into, and avoid assuming responsibilities that are not his. The correct interpretation of contract conditions and the legal obligations in respect of all concerned are essential to the whole

function of project management. A construction programme previously submitted by the builder simplifies the task of time control.

- (5) Once the project has been completed and the new building taken over, all data and documentation in the possession of the project executive would be sent to the research and development section for possible study and final storage. An internal report would also be drawn up and circulated in which significant events, as well as unusual problems that arose and their solution, could be recorded and relevant experience fed back into future building projects.

The key role of project executive can cause problems if the wrong man is appointed. It is stressed that a philosophy of building practice within a client oriented organization has been discussed, but not the detailed procedures to be introduced into every office. The approach, however, takes full cognizance of trends in building today and ensures a climate favourable to the effective use of modern techniques, managerial or otherwise, that have now become so necessary in building.

APPENDIX 2

NATIONAL BUILDING RESEARCH INSTITUTE

HUMAN SCIENCES RESEARCH COUNCIL

INVESTIGATION INTO

EDUCATION IN THE REPUBLIC OF SOUTH AFRICA

AVAILABLE RESOURCES TO MEET THE NEED:

METHODS OF BUILDING

1 INTRODUCTION

Building methods and procedures develop and evolve in response to the preceived physical needs of communities and the resources available to satisfy these needs. Both of these parameters are dynamic and subject to periodic change. Short, medium and long-term evolutionary changes consequently occur in methods which were previously regarded as traditional either on a regional basis or within particular societal groups. In essence, *yesterday's* new technology is absorbed into the mainstream of the building process *today* and becomes the traditional or conventional method of *tomorrow*.

With the above concepts in mind, the resources of the building industry will be considered against a broad classification of alternative building methods and procedures. The major characteristics and the probable constraints on the use of the alternatives will be outlined in terms of the need to identify

- (a) cost-effective *technical solutions* for the large number of schools to be built, using
- (b) appropriate technologies that will optimize the use of the labour resources that are available to the building industry within the different socio-economic groups for whom the schools will be built.*

*The availability and the other economic aspects of the materials used in the building process are discussed in a separate report.

The emphasis on the concept of appropriate technology relates to the fact that the envisaged school building programme could be used

- (i) to produce schools at the lowest possible cost commensurate within the quality of education to be provided, and
- (ii) to contribute towards achievement of a major economic goal, namely the creation of sufficient employment opportunities in South Africa.

2 CLASSIFICATION OF ALTERNATIVE BUILDING METHODS

Building methods can be classified into the following three major categories:

- (a) traditional building methods;
- (b) rationalized traditional building methods, and
- (c) industrialized building methods.

It should be noted that there is no clear line of demarcation between the *different* methods of building. Each, to a greater or lesser extent, includes characteristics of the others and is subject to basically similar constraints.

3 TRADITIONAL BUILDING METHODS

3.1 MAJOR CHARACTERISTICS

- (a) Operations such as bricklaying, plastering and carpentry are carried out by skilled craftsmen (artisans) using non-mechanical aids, e.g. trowels, spirit levels, hammers, saws, etc.;
- (b) Extensive use is made of empirically tried and tested materials such as bricks, sand, cement, mortar and timber;
- (c) Material preparation, handling and transport operations are carried out on-site by unskilled labour with a minimum of tools and aids such as shovels, wheelbarrows, etc.;
- (d) In relative terms, the use of traditional building methods by entrepreneurs entering the building industry is not constrained by the technology, capital requirements or demands for high levels of management and organi-

zational expertise. In essence, traditional building methods represent an *available to all* technology.

3.2 MAJOR CONSTRAINTS ON THE EXTENSIVE USE OF TRADITIONAL BUILDING METHODS

3.2.1 The envisaged school building programme will have to be superimposed on the other future demands (e.g. housing and health care facilities) that will be made on the building industry. Because traditional building methods are highly labour intensive, cognizance must be given to the following:

- (a) The building industry is faced with a severe current and future shortage of skilled (artisan) labour which varies in intensity
 - (i) on a regional basis;
 - (ii) according to the different trades being considered, and
 - (iii) with cyclic movements (i.e. *boom or bust* conditions) in the volume of work available to the industry.
- (b) Despite current and future projected levels of unemployment in South Africa, there is also a severe shortage of suitably trained, motivated and productive unskilled labour, i.e. the *quality component* is not present in the supply of unskilled labour.

3.2.2 The major causes of current labour shortages in the building industry are:

- (a) Historic, but gradually decreasing, imbalances in the education and training systems made available to different population groups;
- (b) Restrictive legislation, in particular the job reservation provisions, many of which have recently been repealed, of the Industrial Conciliation Act;
- (c) The resistance of workers among all population groups to recruitment into the building industry* which is caused by factors such as

*The resistance of labour to employment in building has been identified as one of the major reasons for accelerated mechanization and industrialization of building in most developed countries.

- (i) the arduous nature of most building operations and the adverse physical conditions under which the work is frequently carried out;
- (ii) wages which are perceived as *too low*;
- (iii) prospects for advancement which are perceived as *inadequate*;
- (iv) insecurity of employment caused by *boom or bust* cycles and hire and fire practices which are still prevalent to a considerable degree in the building industry.

The problems of labour shortages, in terms of numbers and productivity, are compounded by a high turnover of labour, particularly among the ranks of unskilled workers. In general, the majority of these workers regard the building industry as a source of transitional employment to enable them to move from rural to urban areas and ultimately into the manufacturing industry.*

3.2.3 Recent developments which may have a favourable impact on the future supply of labour for the building industry include

- (a) the various reports of the Riekert and Wiehahn Commissions which have led to the formation of the National Manpower Commission and to the elimination of some of the major restrictions on the mobility and extent and quality of training available to Black labour, and
- (b) an intensive *image improvement* and labour recruitment campaign that is currently being launched by the Building Industries Federation of South Africa.

Despite the above and other related developments, it is unlikely that the future supply of skilled labour will be commensurate with the demand if traditional building methods and organizational procedures are to be used extensively for major, urgently required building programmes. Consequently it can be expected that rationalized traditional methods which reduce the skilled labour content of building operations will be used extensively in the school building programme.

*The use of the building industry for transitional employment is not peculiar to South Africa. It has occurred in all the developed countries of the Western World.

4 RATIONALIZED TRADITIONAL BUILDING METHODS

4.1 MAJOR CHARACTERISTICS

- (a) Building operations and components are essentially similar to those used in traditional building methods.
- (b) The end products of the building process are similar to those of traditional building methods.
- (c) The skilled labour content of the traditional artisan trades is reduced by
 - (i) introducing the concepts of job fragmentation and modular tasks into the building process, and/or
 - (ii) the use of alternative materials, e.g. concrete blocks, and/or
 - (iii) the use of prefabricated components, e.g. factory manufactured roof trusses.
- (d) the unskilled labour content of traditional building operations can be reduced by the use of plant and equipment for material handling, preparation and transportation.

With regard to (d) above, it should be noted that, in essence, the productivity of unskilled labour is increased by substituting machines for men. However, in the context of the South African situation, the large-scale introduction of plant and equipment into those building operations which can be carried out by men could aggravate the unemployment problem.

In the discussion which follows, emphasis is placed on the role of job fragmentation and modular tasks in reducing the skilled labour content of the traditional building trades.

4.2 RELEVANT BACKGROUND

- 4.2.1 As a result of research carried out by the NBRI, the concepts of job fragmentation and modular tasks were applied intensively during the fifties to the construction of low-cost housing by major local authori-

ties who were experiencing problems of shortages and concomitantly high wages of skilled labour. Variations on the methods and procedures developed during the fifties are still used to a greater or lesser extent

- (a) in the building programmes of various administration boards and national states;
- (b) by a few large private sector contracting organizations that specialize in the construction of mass, low-cost housing schemes, and
- (c) in various training programmes currently being developed and introduced by BIFSA.

4.2.2 Application of the concepts of job fragmentation and modular tasks involves the following basic steps:

- (a) Unskilled labour is recruited and is provided with a minimum of *specialist* training in a subtask of a particular building craft or skill;
- (b) The *task specialists* or operatives are introduced into a task force, which operates under skilled supervision and which moves on a repetitive, *assembly line* basis between successive building sites to contribute its particular task to the total work input.

4.3 PREREQUISITES FOR AND CONSTRAINTS ON THE APPLICATION OF A TASK FORCE APPROACH TO BUILDING

4.3.1 Against the above, brief background, the essential prerequisite for a successful task force approach to building schools is the development of an appropriate system of *labour management* to facilitate

- (a) the recruitment of unskilled labour;
- (b) the development and implementation of initial training programmes;
- (c) the introduction of operatives into the task force;
- (d) the development and implementation of intermediate training programmes to facilitate progression to higher levels of skill;

(e) the establishment of differentiated wage structures that

(i) are related to the level of skill and productivity achieved by individual operatives, and

(ii) will serve to encourage advancement up the ladder of skills associated with specific building operations.

4.3.2 The building procurement procedures that are adopted will have a significant impact on the successful development and implementation of a task force approach to building. The need to ensure co-ordination of recruitment, training and re-training and the introduction of workers into a task force can probably be best achieved within the context of direct building programmes, i.e. building based on the use of labour employed by the procuring agency. Conversely, it may be more difficult to achieve the necessary co-ordination of labour management and building procurement if contracts are awarded on a *labour only* basis or on the more conventional basis of supplying labour and material.

4.3.3 The scale of school building requirements in a particular region could have a significant impact on the success or otherwise of the task force approach to building. In this context, the major determinants of scale are

(a) the number of schools to be built;

(b) the distance between the schools, and

(c) the time interval between the construction of successive schools.

Quite clearly, the effectiveness of the construction of schools on a repetitive, assembly line basis will be decreased if

(i) the number of schools is *too small*, and/or

(ii) the distance between the schools is *excessive*, and/or

(iii) similar building operations on successive schools cannot be scheduled to follow each other closely in terms of time intervals.

Conversely, a *favourable* combination of the parameters of scale in underdeveloped or developing areas could attract large private sector firms, capable of organizing and managing the task force concept, into the *schools market*.

In order to create a sufficiently large and continuous regional building programme, consideration could be given to an integrated school, housing and (say) health care facility construction programme.

4.3.4 The development of regional task force approaches to building may require considerable lead times before the production of buildings can commence. If school buildings are urgently required before the task force procedures can be organized, consideration could be given to the use of industrialized building systems.

5 INDUSTRIALIZED BUILDING METHODS

All building methods and procedures are irreversibly committed to an ongoing, evolutionary process of industrialization which results in

- (a) increased mechanization of traditional building operations;
- (b) increased rationalization of traditional building procedures, organization and management, and
- (c) the development of industrialized building systems to increase the productivity of the factors of production that are used in the building process.

Various aspects related to (a) and (b) above have been dealt with, albeit briefly, in Section 3 and 4 respectively. Discussion in this section therefore focuses on industrialized building systems.

5.1 MAJOR CHARACTERISTICS OF INDUSTRIALIZED BUILDING (IB) SYSTEMS

- (a) IB systems tend to exhibit a high degree of technological innovation, and/or put existing technology to a new use.
- (b) The end products of the building process can be identified as being different from those produced by traditional or rationalized traditional methods.

(A typical example of a new use for existing technology that has led to identifiably different products is the comparatively recent application of various forms of precast concrete technology to, for instance, the construction of schools.)

- (c) IB systems are unique to and can be identified with particular building firms, i.e. they have *brand names* attached to them.
- (d) IB systems require the sponsoring firms to invest in capital equipment and in technical and managerial expertise that are not generally required by or readily available to other builders. In the short-term, the ability of builders to adopt a competitor's particular system is consequently constrained, i.e. IB systems do not, in relative terms, represent an *available to all* technology.
- (e) IB systems are marketed as an integrated design and construction service provided by the sponsoring company.

5.2 PREREQUISITES FOR AND CONSTRAINTS ON THE EXTENSIVE USE OF IB SYSTEMS

5.2.1 The development and production of an IB system demands relatively high initial capital investments for

- (a) a factory (on-site or off-site) in which the major building components are produced, and
- (b) the procurement of the specialized plant and equipment generally associated with IB systems.

The entrepreneur's risk can be reduced and the cost-effectiveness of IB systems can be increased if the demand for a particular system is aggregated to create an economically viable market. In this regard the essential requirements are

- (i) continuity of work must be assured, i.e. the number of schools to be built during a given period of time with a particular system must be commensurate with the capital investment required to locate a factory within an economic radius of the prospective school building sites*;

*The relevance of this requirement is obviously reduced or eliminated if production facilities for a particular system already exist in a particular demand area.

- (ii) a high degree of standardization must be accepted in the design and construction of schools with a particular IB system.

5.2.2 The development of and/or commitment to innovative procurement procedures is required from public sector agencies. In addition to the need to aggregate the market to ensure continuity of operations for individual builders, particular attention must be given to

- (a) the effective use of existing procedures for the evaluation and approval of the technical performance of innovative IB systems*;
- (b) the development of tender documentation and adjudication procedures to facilitate equitable techno-economic comparisons between the various IB systems and other more conventional methods of building that may be offered;
- (c) the establishment of contract administration procedures to ensure equitable conditions for both the client body and the builder in for instance, progress payments, compliance with tender specifications, variation orders, etc.

5.2.3 It is relevant to note that, from the point of view of public sector client bodies that, in South African terms, have made extensive use of IB systems, the major advantages over conventional methods have always been essentially related to

- (a) speed of construction, and
- (b) assurance of supply during building boom periods when demand pressures lead to shortages of materials, skilled labour and, consequently, shortages in the supply of *conventional* buildings.

There has in effect been a tendency on the part of client bodies to regard IB systems as a lifeline when faced with the need to produce buildings *yesterday* or when conditions in the building industry are so overheated that tenders from conventional builders are virtually unobtainable. The use of IB systems under these circumstances, coupled with the lack of appropriate procurement, contractual and administrative procedures on the part of the client bodies, has not been

* The well established Agrément certification and post-certification inspection schemes provide the basis for the required procedures.

conducive to ensuring competitive prices or adequate quality control.

A major constraint on the use of IB systems may therefore be related to the understandable prejudice which has developed against them because client bodies' expectations with regard to the *lower cost and comparable quality* of IB systems relative to conventional methods have frequently not been fulfilled.

In essence, the problem of client body prejudice can be summarized by asking two questions: Firstly: Can the client bodies be expected to identify and introduce innovative procurement, contractual and administrative procedures in the absence of an assurance, based on experience, that their *price and quality* expectations will be met? Secondly: Can the suppliers of IB systems fulfil their *price, quality and construction time* promises in the absence of suitable innovative procedures on the part of the client bodies?

- 5.3.2 An additional major constraint on the use of IB systems relates to the fact that they are perceived to be significantly less labour intensive than conventional building methods. Many bodies of opinion believe that the socio-economic circumstances in South Africa demand a labour intensive building industry and that the extensive use of IB systems for the construction of houses and schools is not conducive to meeting this requirement.

The proponents of IB systems counter the above arguments by claiming that

- (a) the total man-hours required for the manufacture and erection of their products are on a par with those required in conventional building, and
- (b) the ratio of skilled labour to semi-skilled or unskilled labour requirements is far lower for IB systems than for conventional methods.

- 5.3.3 An additional consideration in the use of IB systems is related to the degree of acceptance of the end products by the users of the buildings. If the buildings are likely to be perceived as a *second best* or *inferior* techno-economic solution, potential user resistance could be a significant factor in determining the extent of the use, if any, of particular IB systems. Experience in South Africa and overseas has shown that IB

systems cannot be promoted solely on the basis of lower cost, shorter construction time and comparable technical quality*.

*A classic example of user resistance occurred in the Western Cape Province some years ago and forced the then Department of Public Works to abandon the use of light-weight IB systems in the construction of schools for the Coloured population group.

APPENDIX 3

NATIONAL BUILDING RESEARCH INSTITUTE

HUMAN SCIENCES RESEARCH COUNCIL

INVESTIGATION INTO

EDUCATION IN THE REPUBLIC OF SOUTH AFRICA

AVAILABILITY OF BUILDING MATERIALS

The availability of building materials is normally dependent on the level of building and construction activity which, in turn, is influenced by general economic conditions in the RSA. During economic boom phases the demand for building materials is so great that existing manufacturers cannot supply on time and in sufficient quantities to particular areas. This is a regular phenomenon which should be kept in mind when planning for a major school building programme.

The distribution facilities for building materials are not always sufficient due to the large geographic areas over which the South African population is spread. Information on the distribution of material handling organizations is available in terms of the numbers of building material wholesale trading establishments tabled in order of economic main regions, subregions and magisterial districts.

Depending on the particular need for school buildings which will have to be determined on the basis of the numbers and age groups of pupils resident in the various areas, attention could be given as to how wholesale traders and retail suppliers could supply the required building materials.

The very basic materials such as face and stock bricks, sand, coarse aggregate, building blocks and cement are obtained from the manufacturers directly. Large numbers of bricks are used in a school building. An average primary school uses up to 250 000 face and 350 000 stock bricks and a secondary school requires approximately 420 000 face and 600 000 stock bricks.

Face-brick factories are for economic reasons situated near towns and cities such as Bloemfontein, Carletonville, Durban, Germiston, Klerksdorp, Middelburg (Tvl), Potchefstroom and Pretoria. Stock-brick factories can be established where the need exists and the clay deposits are suitable. A list of established brick-works can be provided.

Sandmining operations are relatively simple and can be set up within a short space of time provided the local sand deposits meet the necessary specifications.

The mining of coarse aggregate is capital intensive as a more specialized technology is needed. However, mobile equipment is available to provide the crushed stone ingredients for concrete.

Building bricks made of concrete are manufactured in many different centres throughout the country.

Cement factories are large, capital-intensive, sophisticated manufacturing plants. They are few in number and are situated near the main raw material sources: Slurry (near Mafikeng), Hercules (Pretoria), Jupiter (East Rand), De Hoek (CP), Riebeeck West (CP), Port Elizabeth, Dudfield (Lichtenburg), Windsorton (North of Kimberley), Roodepoort, Phillipi, Lichtenburg and Bloemfontein. A cement milling plant is situated near Durban.

In conclusion it seems fair to say that, depending on the need for schools in particular areas, the availability of building materials will be subject to various distribution costs of which the cost of transportation will be a major factor.

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