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ABSTRACT

PRESENT GUIDELINES AND REQUIREMENTS FOR ASIAN EDUCATIONAL FACILITIES PLANNING, CONSTRUCTION, AND OUTFITTING WITH EQUIPMENT ARE REVIEWED. THE PHYSICAL NEEDS OF FLEXIBLE CLASSROOMS, FURNITURE, SCIENCE FACILITIES, AND LABORATORIES ARE EMPHASIZED IN THE OVERVIEW. EDUCATIONAL BUILDING ABSTRACTS ARE INCLUDED WITH DATA SOURCES ON--(1) HYGIENE, (2) CLIMATIC FACTORS, (3) BUILDING SYSTEMS AND MATERIALS, AND (4) EDUCATIONAL EQUIPMENT AND UTILITIES. (TG)

Asian Regional Institute for School Building Research

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Vol. 3 No. 3

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COLOMBO

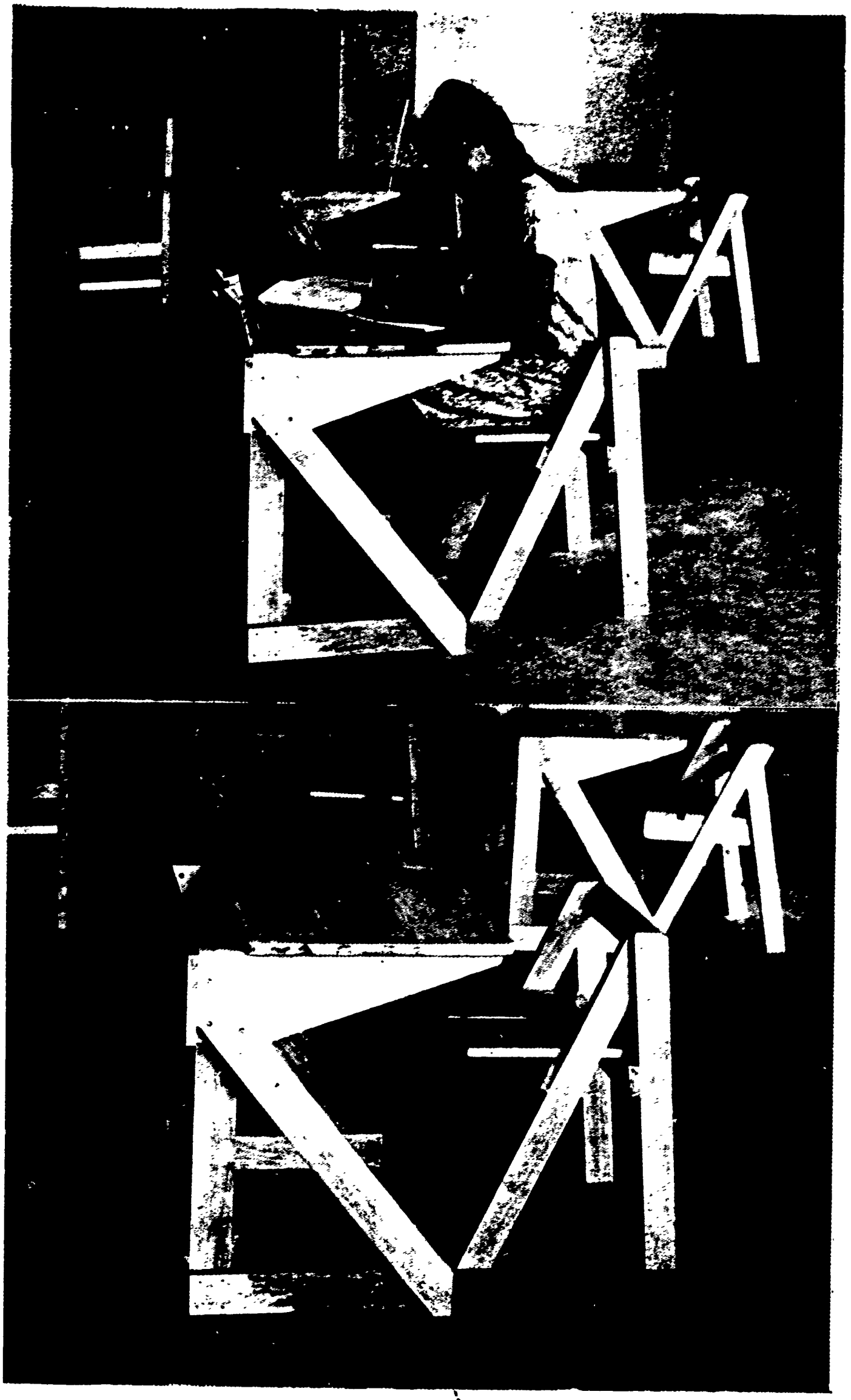


Plate 1

Prototype Classroom desks and chairs designed and constructed in the Institute

I - QUARTERLY REVIEW

THE INSTITUTE'S ACTIVITIES JULY - SEPTEMBER 1969

Regional Meetings

The Institute's Director Mr.H.A.V.Soysa attended the first preparatory meeting for the Conference of Asian Ministers of Education and Economic Planning, to be held in 1972. The Conference will probably include among the topics to be discussed:-

a) The Quality of Education
b) Rural Education
c) Science Teaching

and the programmes of the Institute in 1970 are planned to include studies of these three important aspects of educational development.

Mr.C.E.Finney, Development Group Advisor was present in Bangkok, as the representative of Unesco's Director-General at the Meeting of the ECAFE sub-committee on Housing, Building and Planning, 2 - 9 July 1969 at Bangkok. The sub-committee laid stress on the need for planning and a Regional "Roving Seminar on Regional Planning, Modular Co-ordination and Metric Conversion in the Building Industry", was proposed.

Whilst in Thailand, Mr.Finney also installed equipment in a Bangkok school for one of the Institute's thermal comfort studies.

Studies

A Danish furniture designer, Mr.P.Gammelgaard, spent six weeks in the Institute as a Unesco Consultant in connection with the Institute's programme for the design of classroom furniture for schools in Asia. His work involved a study of material collected by the Institute from the Region including data on children's body sizes, Asian timbers and designs for existing school furniture in the Region.

At the conclusion of this study, Mr.Gammelgaard designed several prototype desks and chairs, all of which were constructed in the Institute's workshops. The final designs are shewn in Plate I.

The Ministry of Education and Cultural Affairs, Ceylon, is now arranging for 160 sets of this classroom furniture to be built by local firms for further study in a 6-month field trial in local schools. The River Valleys Development Board, Ceylon, has also shewn considerable interest in the designs and will make and try-out chairs in schools

constructed in the newly developed, rural areas of Ceylon in which the Board is presently working. Two, School Building Digests 1/ 2/ published in September, give fuller details of the furniture, its sizes and details of its construction.

At the conclusion of his mission in Ceylon, Mr.Gammelgaard left for Thailand and East Pakistan for further study of school furniture design problems in those countries.

His mission will conclude with a study of classroom furniture design at the Regional Educational Building Institute in Africa at Khartoum.

Unesco, Paris will later publish material on classroom furniture design based on Mr.Gammelgaard's mission to Asia and Africa.

Another study connected with furniture and carried out with the kind consent of the Malaysian Ministry of Education by the Institute's Associate Expert Architect, Mr.B.Soderberg, is in connection with the introduction of new trial syllabuses for the teaching of Integrated Science in Malaysian schools. Special furniture for the Integrated Science Laboratories has been designed in the Institute and prototypes built and tested. Mr.Soderberg will later visit Malaysia in connection with field trials of the laboratory design in a selected school.

Meanwhile a laboratory in Ceylon has just been furnished with the Institute's prototype biology laboratory furniture for field trials (see School Building Digest no.2 and Study no.2). The trial of Physics Tables (School Building Digest no.4 and Study no.4) continues in a Ceylon school.

Cost Study Workshops

During 1969 the Institute's Cost Study Team comprising Educationist Mr.P.Senerath and Cost Expert Mr.R.H.Sheath conducted four workshops concluding with the cost study workshop on Ceylon Secondary Schools, held in the Institute in Colombo on 23rd, 24th September.

These workshops are a follow-up of the Institute's Reports to several Governments on the Costs and Space Utilization of their Second-level Schools and are designed to clarify, where necessary, the points made and to give assistance, where requested, in any action the Governments may decide to take in implementation of the recommendations.

1/ *School Building Digest No.6*
2/ *School Building Digest No.7*

Development Group Work

The Institute's Development Group Architect, Mr.C.E.Finney visited Dacca, East Pakistan, in September with a view to discussing the Institute's participation in a scheme for the design of schools for the cyclone affected areas of the country. This work is in pursuance of a Report on the subject, prepared by the Institute and submitted to the Directorate of Education, East Pakistan under ARISBR's 1968 programme.

Publications

Five new School Buildings Digests have been published in the period under review as well as Technical Paper no.1 "The Design of Primary Schools for Hot Dry Asia", and the "Annual Report of the Director 1968".

Ceylon - 100 Years of Education

The month of August in Ceylon was devoted to the celebration of the 100th anniversary of the Education Department. Schools and colleges all over the country were the scene of exhibitions, displays and, in Colombo, the Ministry of Education and Cultural Affairs organised a mammoth exhibition for the entire month. The Institute shewed its activities in an exhibition stand designed by Associate Expert Architect, Mr.B.Soderberg. No count was kept of the visitors to the stand but of the 20,000 copies of a brochure in Sinhalese, Tamil and English, explaining ARISBR and its work, handed out to visitors to the stand, only 2,000 remained at the end of the month!

Ceylon Cost Study Work-shop

A two day Workshop was held in the Institute on the 23 & 24 September to consider the Institute's report to the Ministry of Education and Cultural Affairs, Ceylon on the Utilization and Costs of Ceylon secondary schools. The meeting was attended by the Permanent Secretary to the Ministry of Education & Cultural Affairs, Mr.D.G.Dayaratne, and other senior officials of the Ministry. The Institute's staff, headed by the Director Mr.H.A.V.Soysa, presented the report and, at the end of the 2 days discussion, a series of recommendations was made to the Government of Ceylon.

II - TECHNICAL NOTES

FLEXIBILITY THROUGH FURNITURE

Industrialists now normally demand their factories and offices be designed to provide accommodation for the changing industrial processes and changing patterns of administrative organization that result from continued improvements to machinery, improvements to and changes in office organisation and demands for new or improved products from the markets served.

This has led to the design of both factories 1/ and office buildings in which unforseen, yet inevitable, changes can take place, as and when the need arises.

This design approach has been so popular that building investors now commonly build, on a purely speculative basis, general purpose (G.P.) factories and offices for hire to those who wish to move to larger premises to start a new industry (Figure 1).

The designer's solution to this problem has been to concentrate on the design of suitably shaped large, undivided spaces in which a good environment is provided and which include an adequate range of services, storage and sanitary facilities with internal and external circulation in the form of roads, paths, stairs, lifts and corridors, as appropriate.

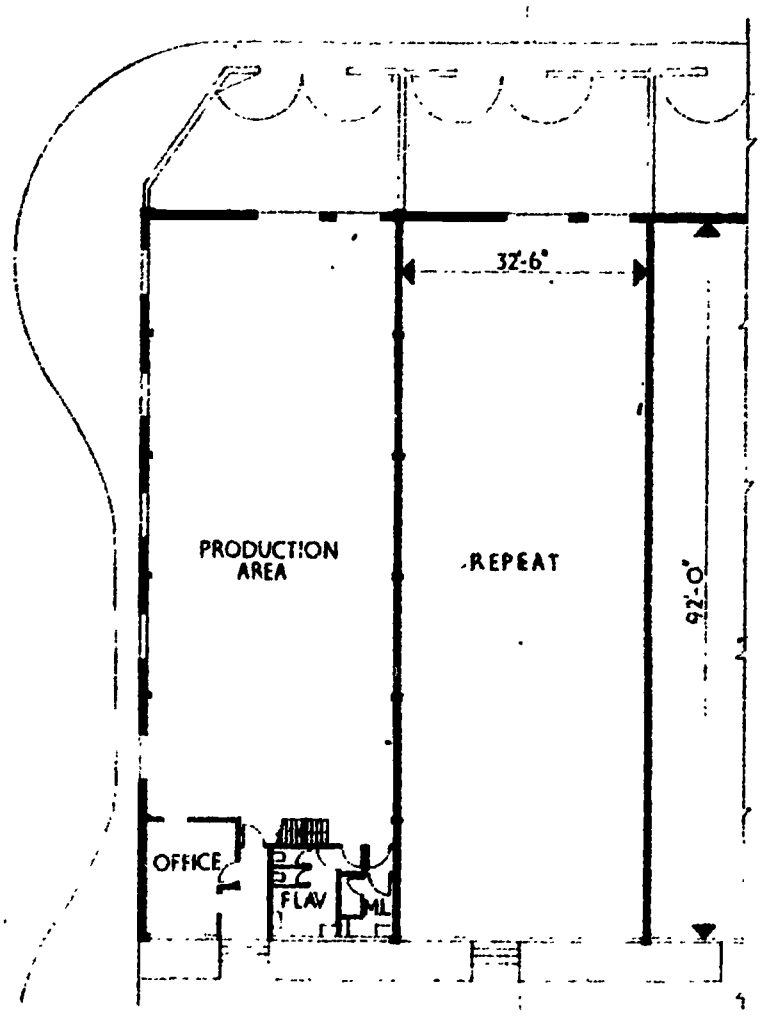


Figure - 1

A high percentage of building in the new industrial estates comprises G.P. factory and office accommodation of this type.

When the accommodation has been let, it is subdivided in accordance with the needs of the occupier, with temporary partitions which can be changed as these needs alter, or should a new tenant take over the premises, can be re-arranged to meet his special requirements.

1/ *Seven post-war factories; a building type appraisal.* Architects Journal, 25 May 1966

Another development of interest and along similar lines is the landscaped office 2/ in which, in a large space, many small groups of office workers including executives, sit, each group divided from the next by shoulder high partitions or banks of potted plants. This meets the need to change seating patterns within office spaces from time-to-time (Fig.2).

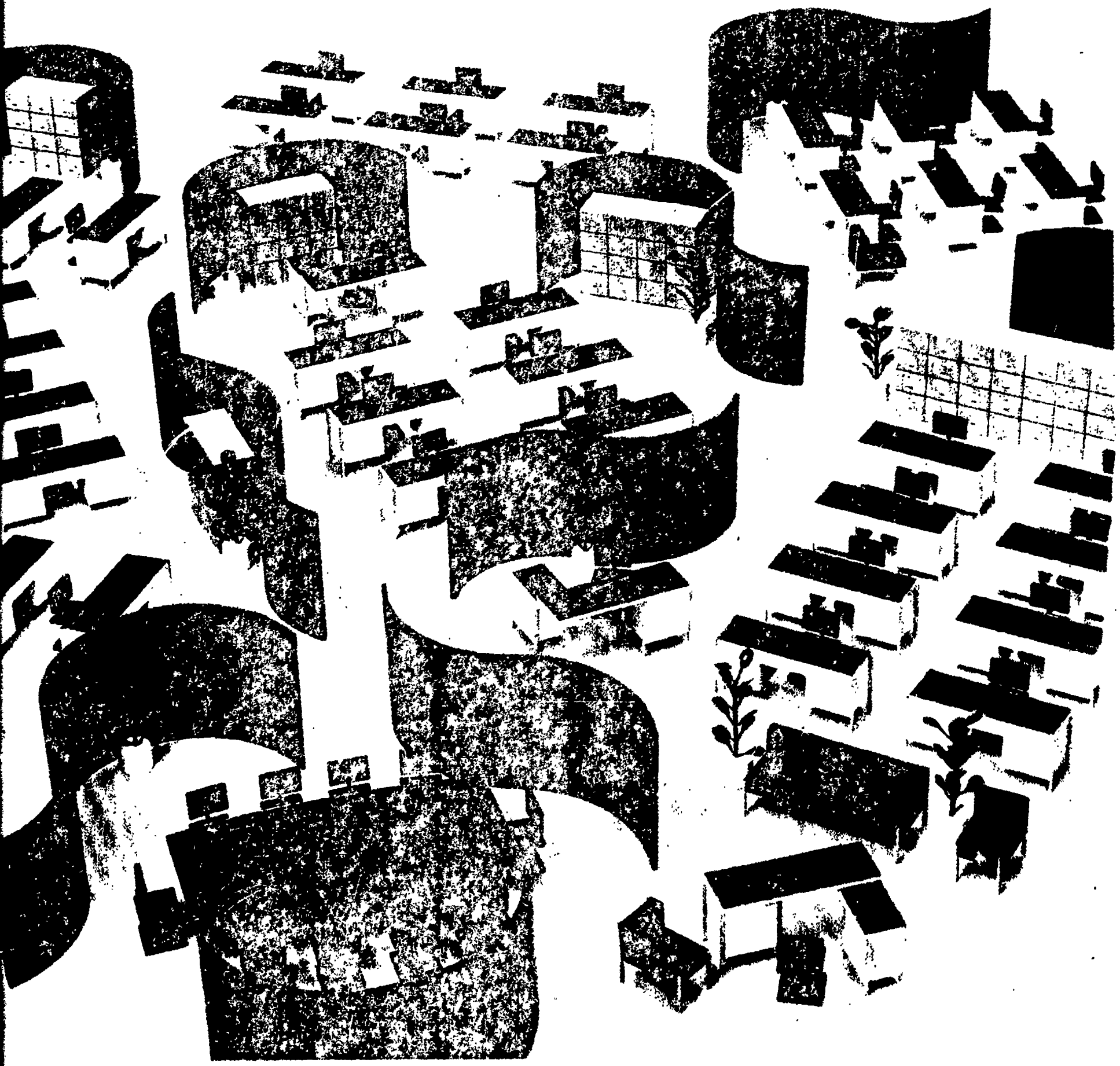


Figure - 2

2/ The Kew Experiment: a new landscape for the civil service. Design (London) No.247, July 1969.

An analogous situation can be said to exist in relation to the :esent needs for educational building in most countries of the Asian egion.

Selected at random from a few of Unesco's Asian Member States are ıe following enrolment patterns at the first and second level of edu- ıtion: are shewn in Figure 3.

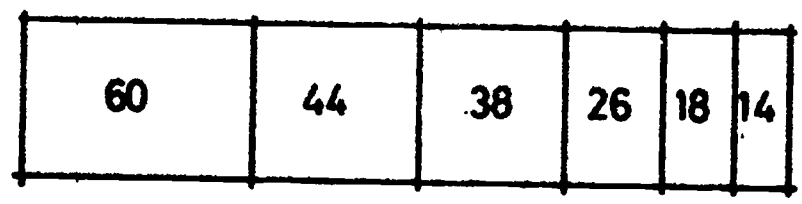


Figure - 3

Clearly in each of these cases one would expect to find teaching spaces proportionate in area to the number of children in each grade. What is in fact found in most of the countries of the Region are schools with classrooms of uniform size in which variously:-

i) There are too many children
or
ii) There is the correct number of children in relation to the room area
or
iii) There are too few children.

But the pattern of enrolment shewn in Figure 3 varies from year to year. The diagram, in every case indicates a substantial fall-off in enrolment after the first year in both the first and second-level examples. Obviously as time passes, and the many planned improvements in education in Asia take place, the numbers of children in classes after the first, will increase until, eventually, the fall-off will be insignificant. When that stage is reached, most schools will have a smaller first year of perhaps 45 children at first-level and 40 at second and, moreover, 45 and 40 children respectively in each grade.

Until that happens (and indeed after, as is argued below) schools that have adjustable or flexible classroom sizes will be needed.

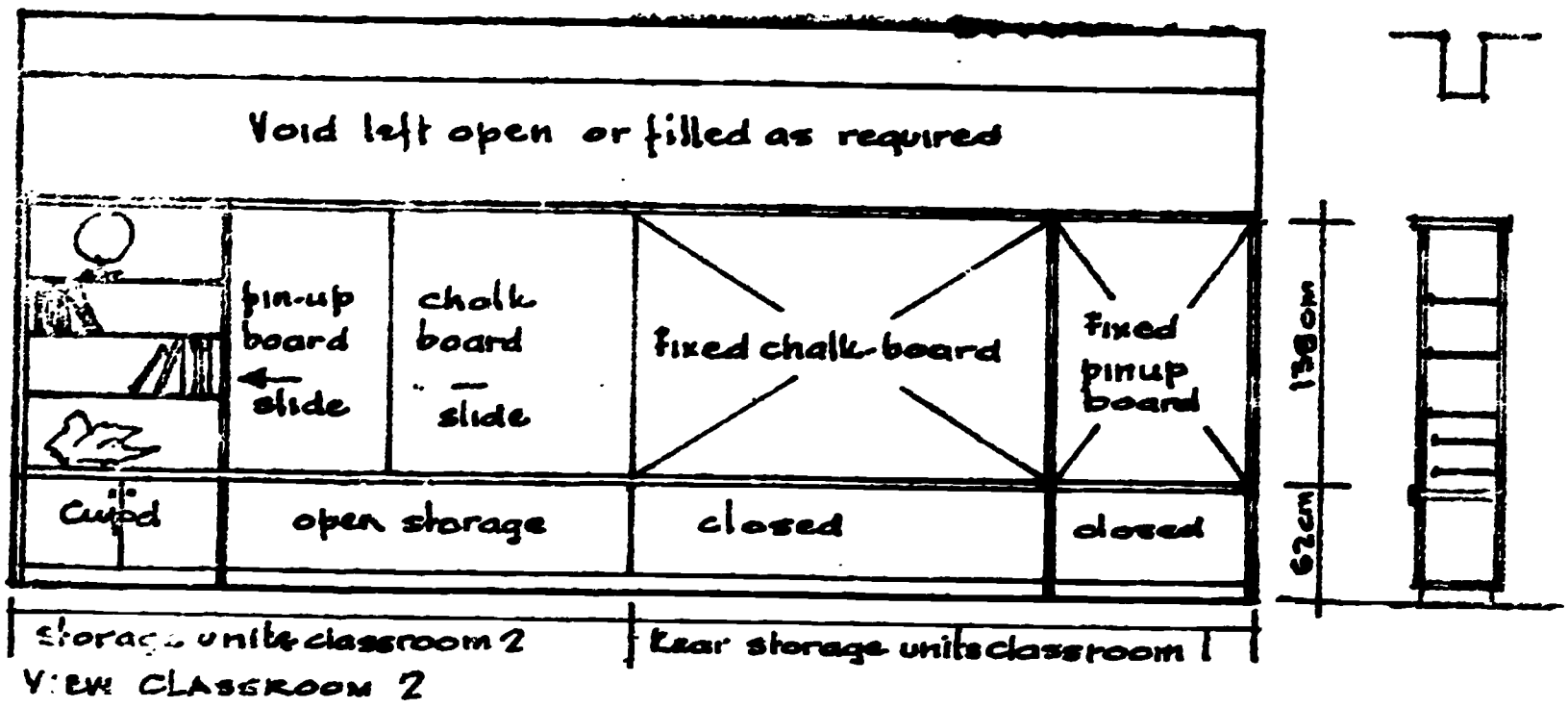
This means that permanent, brick or concrete block divisions between teaching groups may not meet the performance specification, one of the requirements of which is for annual adjustability. 3/

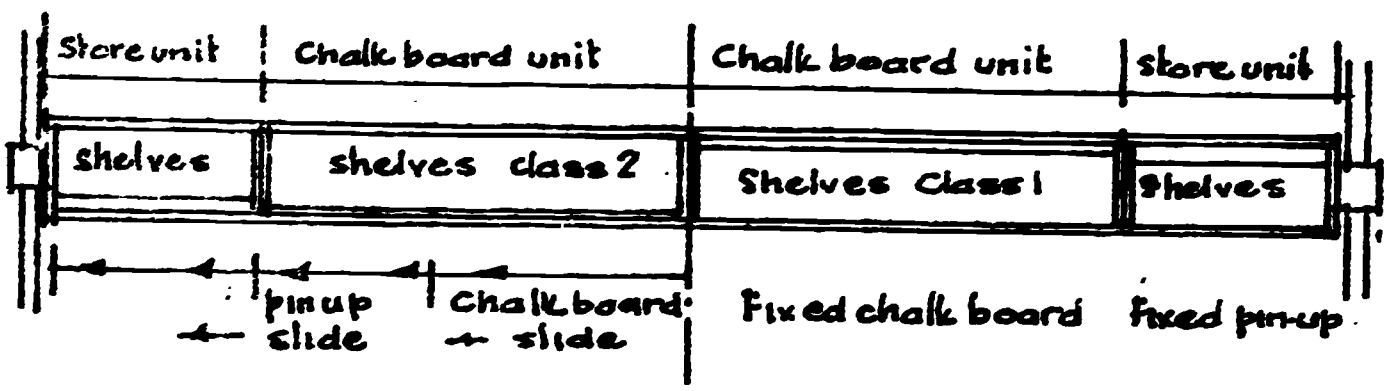
The brick or concrete partition is used mainly to prevent visual distraction between one classroom and another (the diffraction and transmission phenomena prevent it acting as a sound barrier - especially in the humid tropics where windows, if they exist at all, are usually open). The adjustable partition must thus not only be adjustable but must also perform the function of acting as a visual barrier between one teaching group and the next.

As every teacher and group of students need chalkboard, pin-up board and storage space, it would seem logical to combine the need with that of the need for partitioning. The resulting furniture, comprising cheap, light, easily movable modular units, will fulfill the old function in a new and much more useful manner than did the original fixed brick partition which, at most, did little more than provide a visual barrier and a support on which to hang a chalkboard.

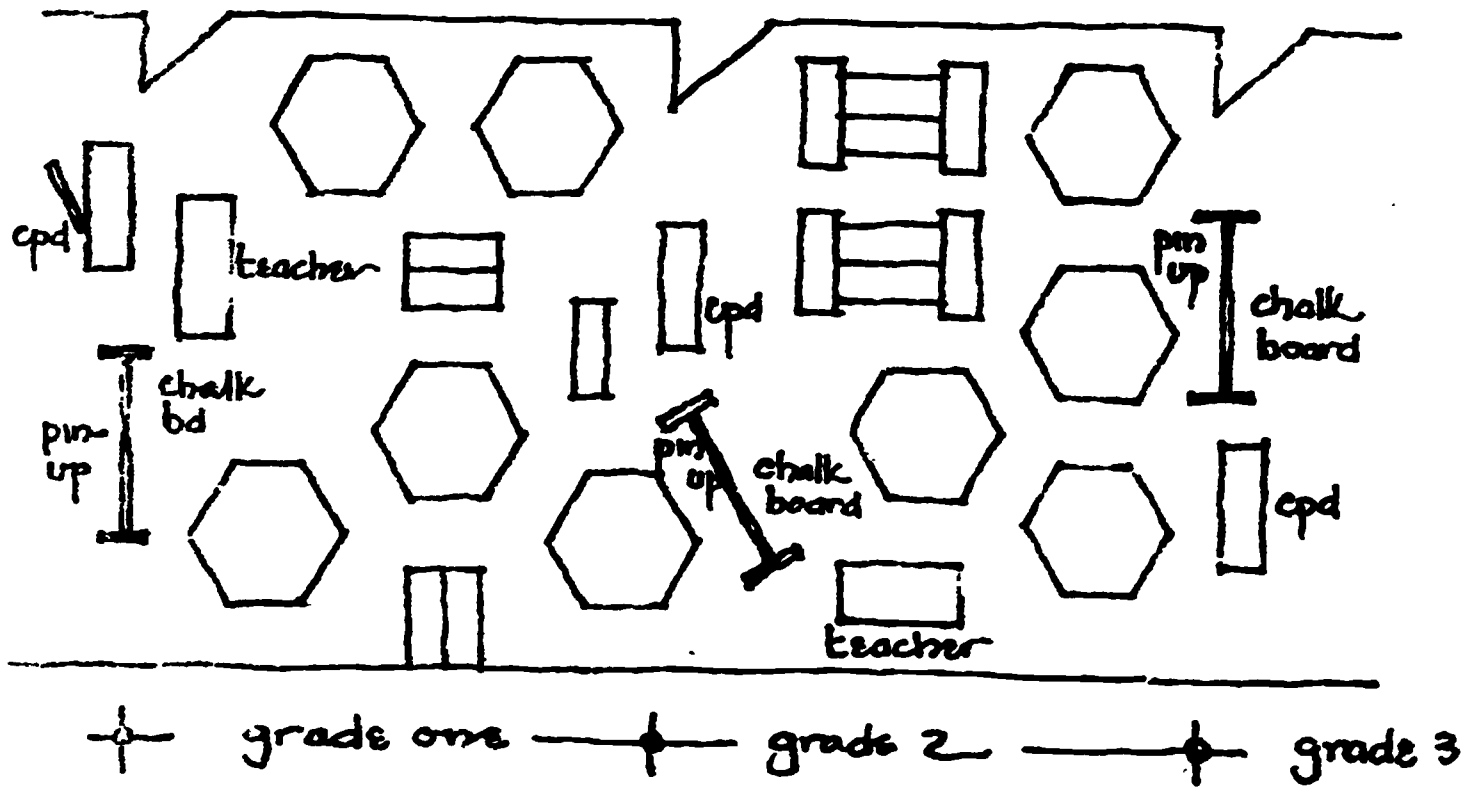
3/ *Buildings for Education*, v.3, no.1 ARISBR, Colombo, March 1969. see Abstract 121. "Knock-out walls for lecture room flexibility"

Two of the many possible design solutions to this problem are shown in Figure 4.





Classroom 2



Future changes in class sizes are not however, the only changes that can be expected. The last issue of this periodical suggested that changes may also take place, depending on the situations in individual countries as follows:-

i) In the duration of education at each level
ii) In the pupil-teacher ratio
iii) In the age ranges of children
iv) In the ratio of trained to untrained teachers.

All of the above have implications for building design, the most important of which is the need to be able to adjust the sizes of the several individual spaces that make up the total space enclosed by the building shell.

The case for adjustable school building is thus overwhelmingly strong. It is made even stronger by the reality of changing curricula and the introduction, albeit slowly, of new teaching methods.

The term, "new curriculum", may include either the old curriculum with improved content or it may include added content in the form of new subjects. As far as improved content and, of course, improved teaching method, is concerned, the changes that have and are taking place in science are significant. The introduction of a substantial amount of problem centred work and a reduction in the proportion of demonstrations, the desirability of working in groups of varying sizes and the ad hoc nature of the experiments within the broad framework of the new syllabuses, indicate a need for laboratories in which the furniture itself reflects the flexibility which typifies the new approach to science teaching. Plates I, II & III shew physics, chemistry and biology laboratory benches designed in the Institute which can be freely moved about the laboratory to meet the varied teaching and learning needs. If adequate storage facilities are provided by way of light modular cupboards, a science laboratory using this furniture, can be set up in literally any part of the total space enclosed by the school building shell.

For more advanced work in science, another alternative is to allocate an area of the building for science activities and provide science bollards containing these services at strategic points across the floor. The loose benches can then be arranged around the bollards as occasion demands (Plate IV) .

Improvements in curriculum content are not of course, confined to the sciences. Subject areas such as Industrial Arts, and the Social sciences typify also the changing situation. Study of the future needs for accommodation in these areas too suggests it would be most unwise to predict fixed accommodation needs for them. Industrial Arts, in particular, is a subject area in which the impact of new materials, methods and power resources of the present world

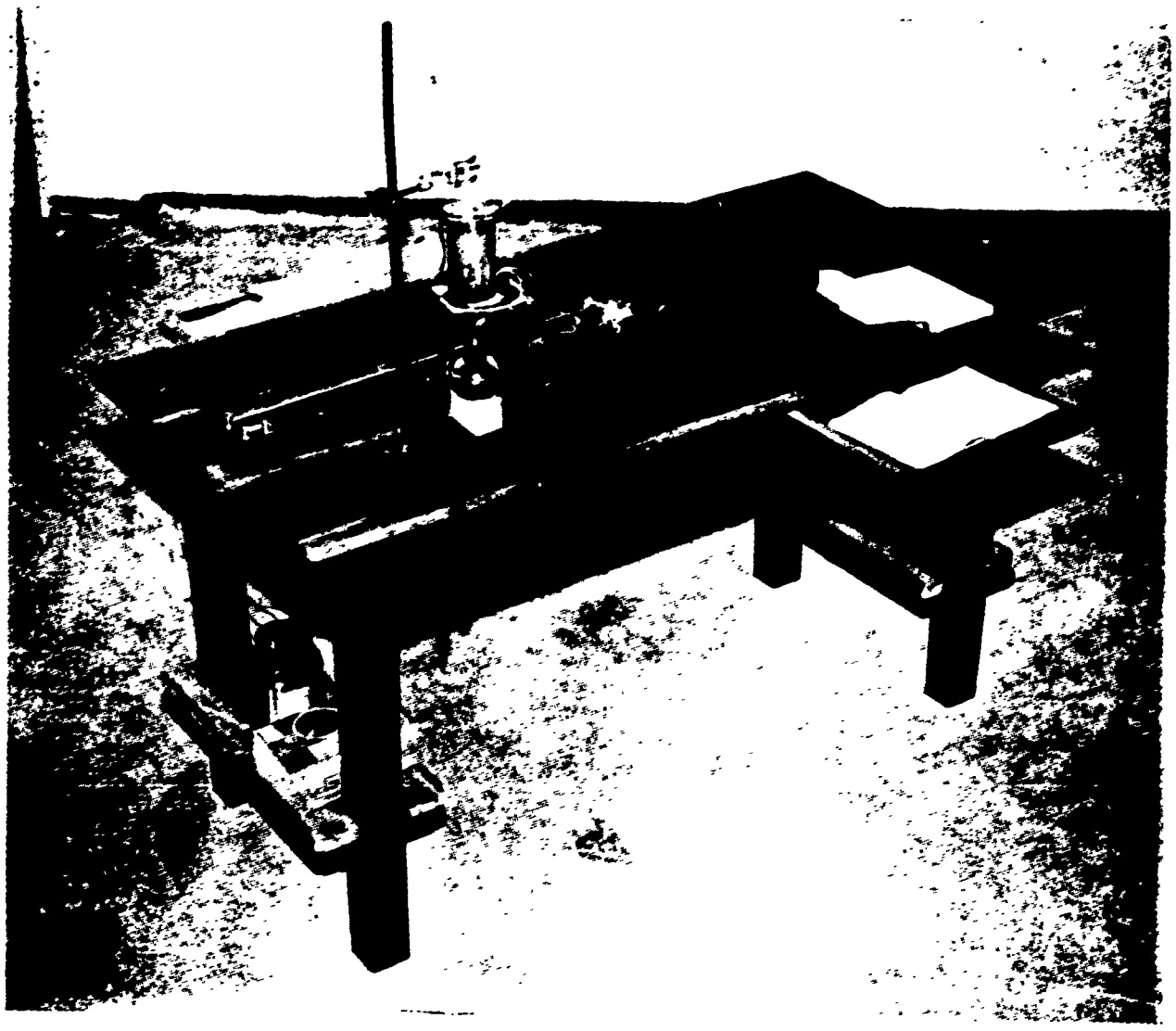


Plate 1

Physics Bench

Plate 2

Chemistry Bench

Plate 3

Biology Bench

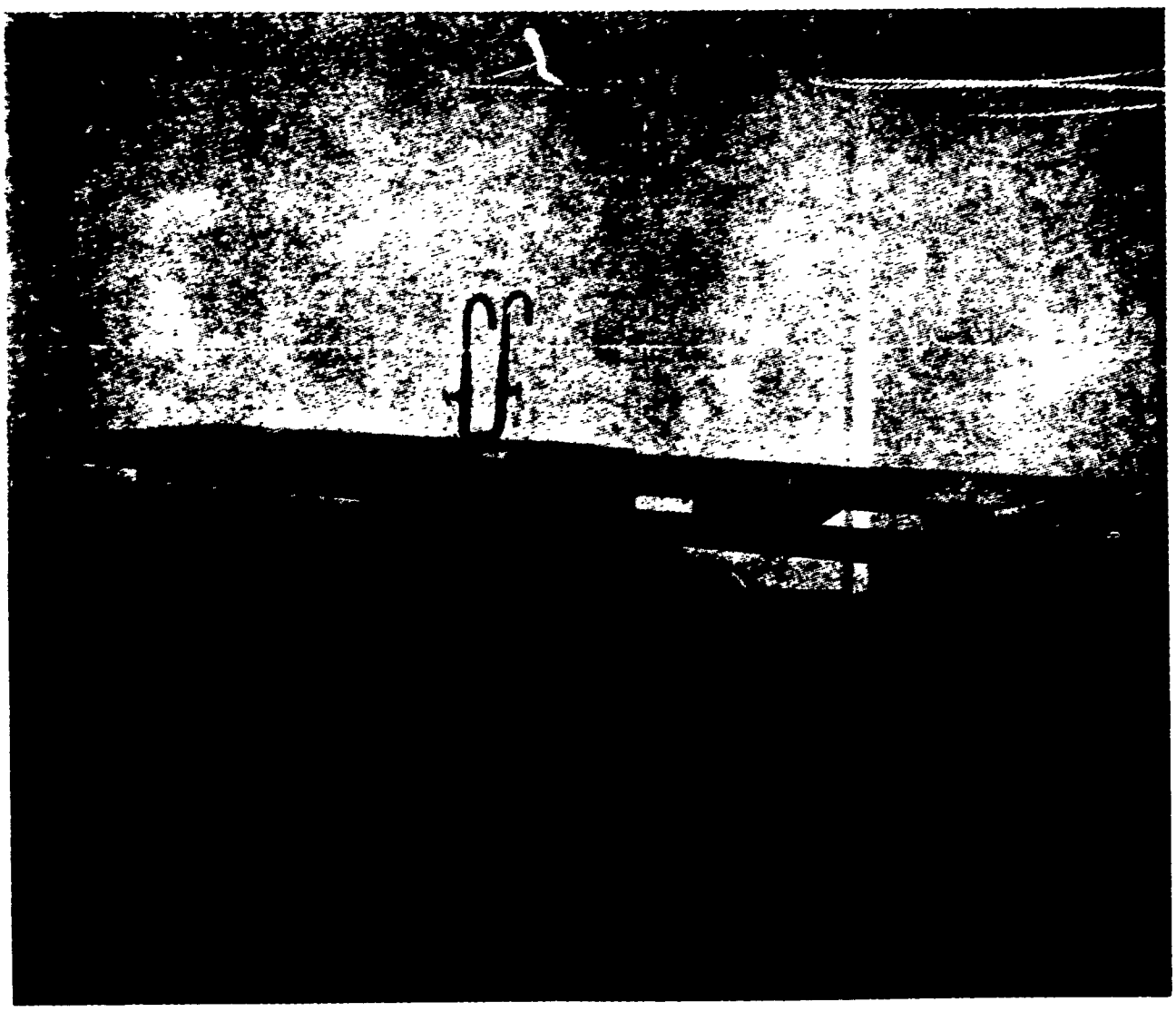


Plate 4

Fixed service bollard in centre with 2 loose benches

will soon be reflected in the schools. The older type of workshop with project centred work on wood and metals, will eventually give way to laboratories in which children experiment rather than copy and where the materials of today - the plastics, new metals, and manufactured boards - are added to the older steel and woods as materials to be experimented with. Projects in production-line techniques, the harnessing and use of power, will also give rise to new accommodation needs. The design solution may be as in the modern factory, a large, undivided space with services, storage and sanitary facilities.

The factory, the office, the school are all buildings which serve the rapidly changing needs of society and in their design they must reflect the transitory needs for which they are provided.

III - EDUCATIONAL BUILDING ABSTRACTS

Aa2 - REFERENCE MATERIAL, ORGANIZATIONS

131. BREALEY, T. B. The use of local resources for building in New Guinea. *Build international*, v.1, no.1 (Sept/Oct) 1968, p.44-48, illus.

A small, but active, Building Research Station has been set up in New Guinea and is concentrating on encouragement of local participation in the manufacture of building materials and components with a view to reducing the drain on resources that results from reliance on imports.

The terraine creates considerable communication difficulties and efforts have thus been made to implement programmes on a cottage industry basis. Cheap machines have been devised for stabilized soil building blocks, whilst hand-operated looms have been developed for weaving standard sized sheets of sago matting for use as wall panels. These are but two of a list of activities which are taking place in carefully selected locations throughout the territory. The Station is assisted in its work by building research organizations in Australia and does not hesitate to borrow ideas which have already been tried in other countries. The Indian chula (cooking stove), developed in Hyderabad, has, for example, been successfully adapted for use.

Much of the work on materials and components has ultimately found a use in very low-cost self help housing.

Aa1 - EDUCATION

132. SIDWELL, NORMAN. Building education over the past five years. *Building*, v.216, no.6570 (18 April) 1969, p.159-162.

There is a slowly developing consciousness of the need for adequate training at all levels within the construction industry to an extent that has never existed before. The constructional complexities inherent in the modern design of modern buildings have to be matched by building processes based on highly sophisticated processes and machines which will demand a higher standard of education and training for construction managers, technicians and operatives.

Very few countries offer degree courses in building, and Singapore is probably the only country in Asia which is offering building studies other than Engineering and Architecture, at university level. At the other end of the scale, in Asia either there is no organised training for operatives at craft or technician level or alter-

Aa7 - EDUCATION (contd)

132. SIDWELL, NORMAN. Building education over the past five years. (contd.)

natively the syllabus is so out of date as to be ridiculous:very few countries for example offer courses in concrete technology.

The writer reviews the complexity of building courses and the confusing level of qualifications of the building courses offered in the UK, and in view of this multiplicity he proposes a three level training and education structure -

i) craft
ii) technician
iii) middle and top management

based on full time (sandwich) courses. That is, the student spends part of the year full time at the educational institute and part of the year with a construction organisation. This pattern would be eminently suitable for Asia.

Ab1 - HYGIENE - CLIMATIC FACTORS

133. GIVONI, B. Review of Hygienic requirements in building as related to climate. *C I B bulletin*, no.3, 1966, p.10-28, illus., bibls.

The paper deals with:-

a) Human requirements from the viewpoint of thermal comfort in summer and winter;
b) Prevention of indoor dampness:
c) Control of air quality.

Summer comfort can be defined relative to manifestations of thermal stress and discomfort which are, in turn, related to the subjective sensation of warmth, the moistness or wetness of the skin and deviations from the norms of sweat and pulse rate and body temperature.

Human responses to the thermal environment depend on the combined effect of ambient air temperature, mean radiant temperature of the surroundings, air velocity and humidity. Individually, none of these factors express the human thermal requirement. A single unit which takes all of the factors into account is thus needed and the various indices developed for this purpose are reviewed in this article; for example, Effective Temperature, the Heat Stress Index, Equivalent Warmth, PASR and Resultant Temperature.

Analyses of these various thermal indices over a whole range of warm climatic conditions has led to the conclusion that none of them are satisfactory, especially in respect of comfort in building interiors. The author has thus devised

Ab1 - HYGIENE - CLIMATIC FACTORS (contd.)

133. GIVONI, B. Review of Hygienic requirements in building as related to climate. (contd.)

a new "Index of Thermal Stress" with a view to improved prediction of both physiological and sensory responses to thermal stress. This permits the computation of the sweat rate required for maintenance of thermal equilibrium between the body and the environment under different metabolic and environmental conditions.

The I.T.S.

$$S = E \left(\frac{1}{f}\right)$$

where S is the required sweat rate, E, the required evaporative cooling and f, the cooling efficiency of sweat evaporation permits calculation of sweat rate required for thermal equilibrium between body and environment under varying conditions of metabolic rate and environment.

Linear correlation was found to exist between sweat rate values from various other physiological investigations expressed as a function of I.T.S.

Ba6 - BUILDING PRODUCTION, SYSTEMS, ETC.

134. ISLINGTON's instant classroom arrives. *Times educational supplement*, (10 June) 1966.

Prefabrication has many advantages. In areas where building skills or building materials are not available, then prefabrication at some more convenient place, with all the controls of quality that result from factory production, may prove a solution. Factory production can continue in any weather whereas site work may cease in heavy monsoon rains, in hill snows or desert dusts.

The schools described in this article are factory produced and are meant for small sites where building operations would seriously have disrupted the running of the existing school. A day or two was sufficient to place concrete ground beams and to winch the completed classrooms from the lorry on to the beam foundations.

The rooms, 18ft x 30ft were completed in the factory with power points, blackboard, coat racks and pin-up boards.

Ba6 - BUILDING PRODUCTION, SYSTEMS ETC. (contd.)

135. PLATT, J. The development of SEAC. *R I B A journal*, (May) 1969, p.200-202.

The difference between SEAC and other building consortia in the United Kingdom is that all the main SEAC members are architects' departments of local authorities and two central Ministries. The consortium thus has to work within national cost limits for schools etc. and relate its activities to the programmes of the authorities of which it is comprised.

Several hundred architects use its results in the form of building systems and new ideas are thus difficult to introduce quickly. On the other hand the feed back from the use, is rapid and aids long-term development.

SEAC has concentrated on the definition of a basic dimensional framework and on attempts to combine with it the best of traditional and industrialised building. Its first programme was started in 1948 and since then the system has changed several times mainly in respect of the basic dimension selected.

The system now has 20 differing components and has had to develop methods of designing and ordering attuned to its £15m p.a. programme which means a rate of production equivalent to one £ 60,000 primary school every working day.

136. ASLEY-SMITH, E.T. The history of SEAC. *R I B A journal*, (May) 1969, p.199-200.

SEAC is a building consortium of three United Kingdom local authorities and the Ministry of Public Building and Works and Department of Education and Science. Its function is the continued development of a building system on a common dimensional basis, of three related structural methods - brick, concrete and steel.

SEAC started with a centralised Development Group having a staff of ten which has now been doubled. The work of the group has been extended to cover engineering services and furniture.

The SEAC system has cost quite a lot to develop but with programmes of £15m per year of schools, welfare buildings etc. it has been possible to "commercialise" it. The system is thus now also sold on the open market with SEAC receiving a royalty in respect of its development work.

D - BUILDING MATERIALS

137. RICHARDSON, B. A. Decay in exterior joinery; alternative methods of applying preservative treatments. *Architects' journal,* v.148, no.47 (20 Nov) 1968, p.1197-1200, illus.

The conversion of immature trees, with a high percentage of sapwood, has become one of the main contributory causes of decay in external joinery. Decay in timber is an indication that the moisture content has exceeded a certain level. Joinery is likely to jam when the moisture content is high, or become loose fitting when it is low.

Decay in joinery more often than not starts at the joints: it is at the point where the end grain butts against the lateral grain that movement of the timber is most likely to occur. This will cause cracking of the painted surface and allow penetration of water by capilliary action, which will spread deeply into the surrounding timber. Neither normal methods of priming, whether by dip process or by hand, nor the conventional painting systems provide adequate protection in these circumstances.

The solution would seem to be to develop a preservative primer which will give adequate preservation and at the same time provide a base for conventional painting systems. An alternative solution could be the application of a suitable preservative in the joinery work followed by the normal priming methods on the site. This will add to the cost of the item but it may be preferable to heavy maintenance costs in the future. The main difficulties with the existing systems result from the properties of the timber rather than inadequacies in the paint system, and a fundamental improvement would be the development of an economical and reliable wood stabilising treatment.

(72) - ROOMS, FIXTURES, EQUIPMENT - GENERAL

138. NEW flexible ranges of children's furniture. *Times Educational Supplement,* (30 Dec) 1966, illus.

Furniture in new materials is now a trial in a number of U.K. primary schools. A large group of paper manufacturers has produced a range of desks and chairs in corrugated fibre board. Use is made of interlocking joints so that no fixing agent is required and the furniture can be packed flat for postal delivery.

(72) - ROOMS, FIXTURES, EQUIPMENT - GENERAL (contd.)

138. NEW flexible ranges of children's furniture.(contd)

A second range of furniture in high density polythene comprises two units - a desk that can be used as a chair and a stool that can be reversed into a table. Finally a new design series of birch plywood furniture has been developed for mass production.

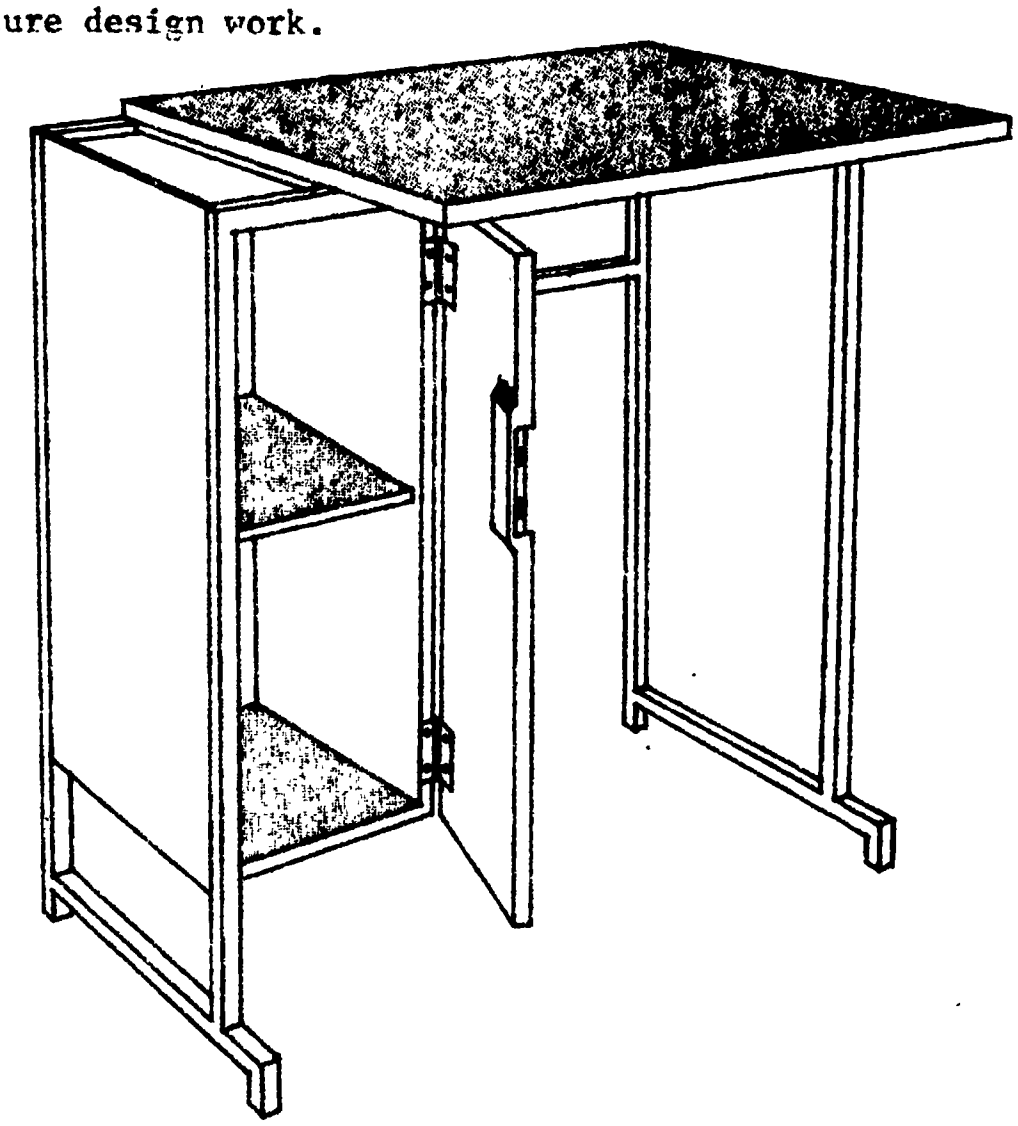
All of the furniture is in bright colours and scaled to fit young children.

139. THINGS of use - and beauty? classroom furniture. *Times Educational Supplement*, (3 June) 1966, p.1768, illus.

The design and development of a U.K. local education authority has, for three years, been working on the prototypes of a new desk and chair for secondary school classrooms. At the conclusion of the development work, 6000 desks and 8000 chairs were produced in square, mild-steel tubing. The chairs have laminated plywood seats and backs, and the desk has veneered block board with a hard melamine polish.

Of particular interest is the conclusion, reached during the development work, that if the chair and desk are of the correct heights for sitting and writing, there is not sufficient space between the top of the thigh and the desk surface to provide any storage space.. This conclusion was reached *inter alia* by ARISBR in 1964 and forms a feature of all ARISBR furniture design work.

The storage problem was solved by the U.K. research and delopment group providing space at the side of the desk (see figure)



(72) - ROOMS, FIXTURES, EQUIPMENT - GENERAL (contd.)

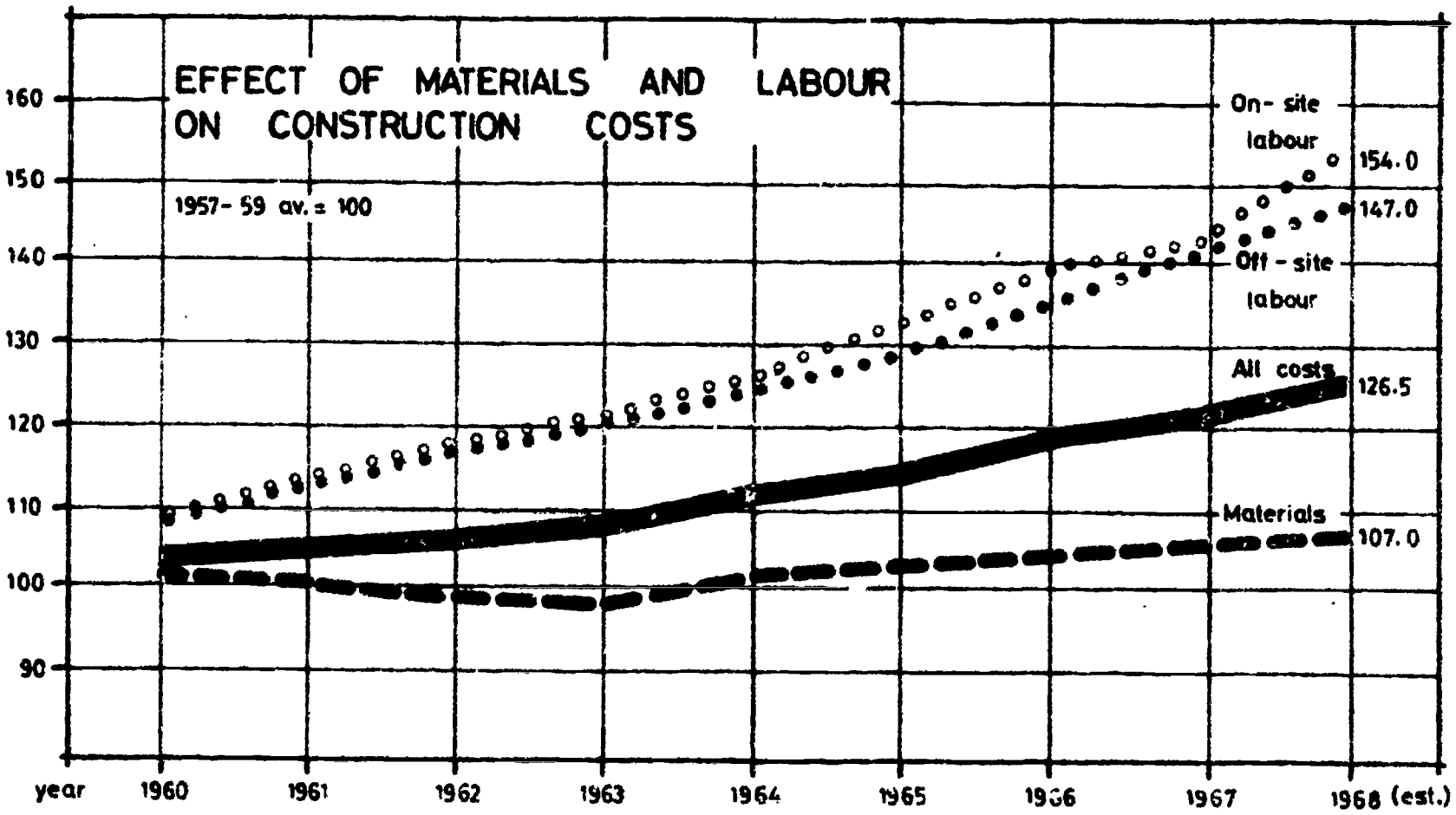
139. THINGS of use - and beauty? classroom furniture. (contd.)

This solution provides an interesting comparison with the Institute's solution to the same problem, illustrated in a plate in Part I (Quarterly Review) of this issue of Buildings for Education.

(97) - EDUCATIONAL BUILDINGS

140. HOW the school dollar is being spent. *School management*, v.12, no.7 (July) 1968, p.45-75, illus.

This edition of *School Management* is devoted to school building costs and contains a vast quantity of statistics relating to school building in the United States. The relevance of these statistics to the Asian Region will derive from the interpretation of the trends in labour and material costs and in the provision of facilities in the schools.

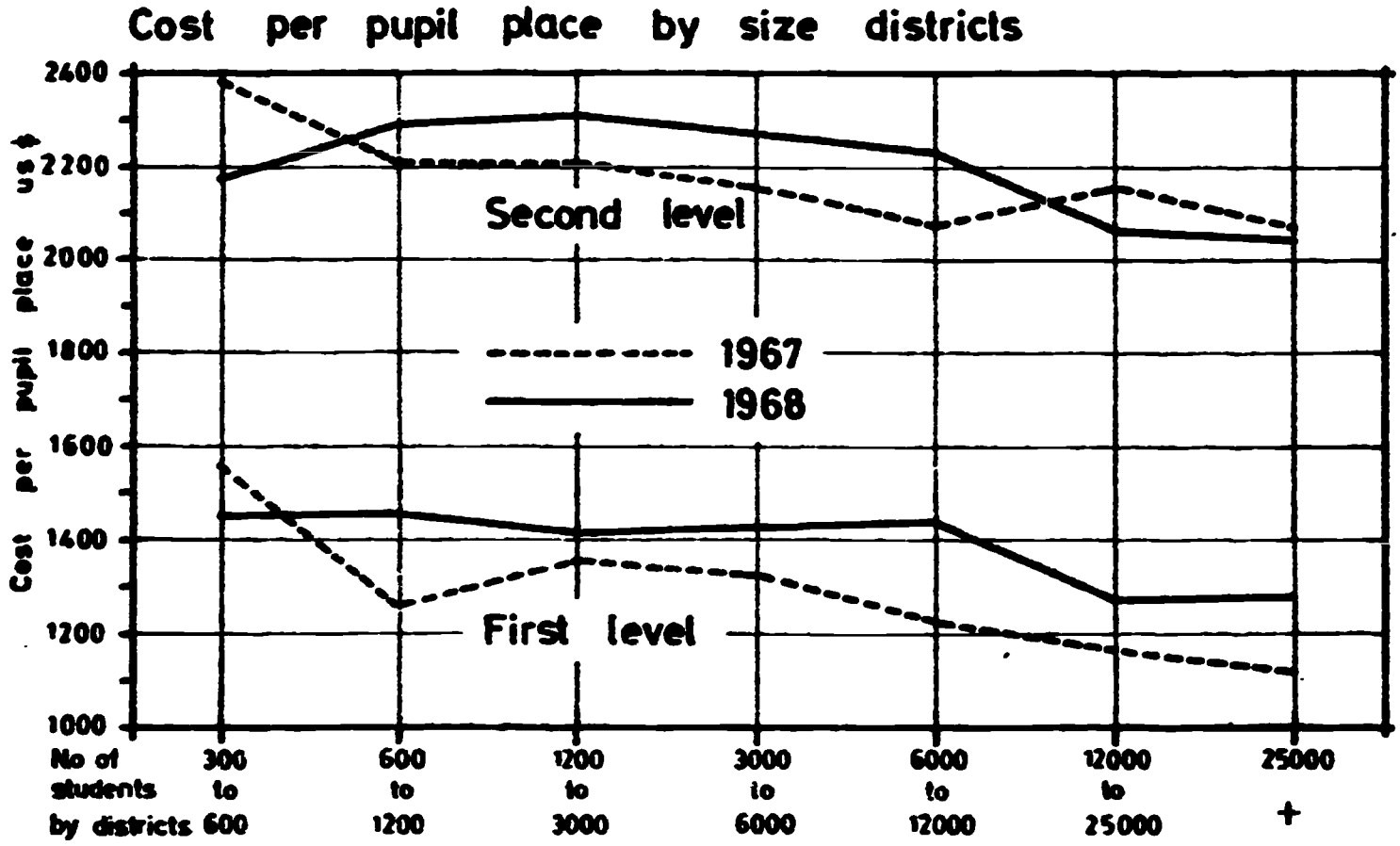


The building cost index graph above, for the U.S., is also typical of most countries. The most striking feature is sharply rising cost of labour and it is significant in this instance that the greatest increase in labour costs is in

(97) - EDUCATIONAL BUILDINGS (contd.)

140. HOW the school dollar is being spent. (contd.)

the common labour, managerial and supervisory categories. This would indicate that if school building costs are to be contained, and better use made of labour, improvement must be sought in the planning and organisation of projects, and this is just as much the responsibility of government administrators as it is of the building contractor.



The above graph shows the cost per pupil place for first and second level schools by size of school district for the year 1967 and 1968. The inference to be drawn from this graph is that the districts having the lowest cost per pupil place and the highest number of students are building larger schools which generally cost less per place. It may also be inferred that the districts having the smallest number of students (Group 7) are centralising their schools thereby effecting some economies that can be gained by building larger schools.

A possible reason for the increase in the cost per pupil place of the first level schools is the considerable increase in the percentage expenditure on facilities for language and science laboratories, workshops

(97) - EDUCATIONAL BUILDINGS (contd.)

140 - HOW the school dollar is being spent. (contd.)

and libraries. This trend can be expected in Asia within the next decade.

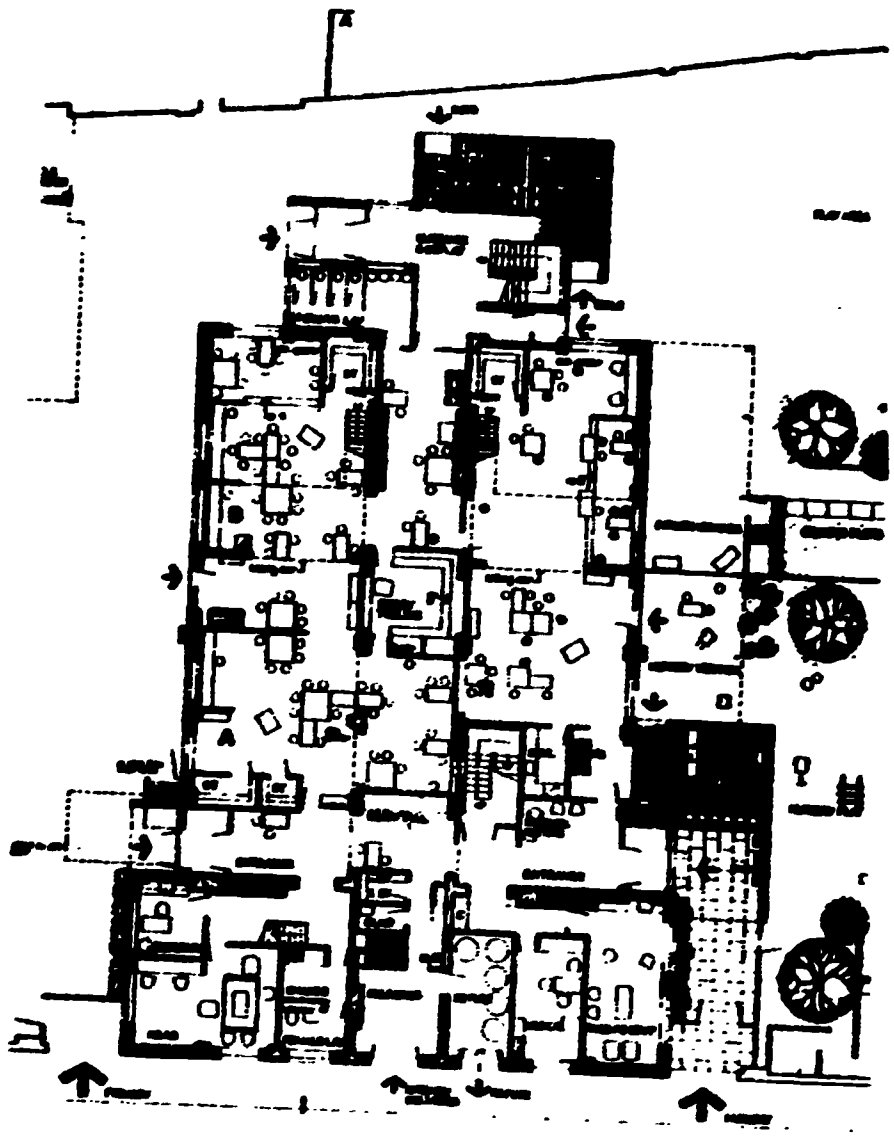
In both first and second levels there is an increase in the percentage expenditure for airconditioning, carpeting and the use of operable walls (i.e. walls that can be dismantled and re-elected in new positions). *This indicates the trend for the need for greater flexibility in school design and construction to meet the development in education and the changes in curriculum.* There is now the need for flexibility in the schools in Asia and although it may not be possible to match the level of sophistication of the methods used by the US, to achieve flexibility in their schools nevertheless, Member States of the Region should be developing ways and means of achieving flexibility without much extra cost. ARISBR has already offered suggestions to some Member States whereby flexibility can be introduced into schools simply and without much additional cost.

141. KAY, JOHN. Improving old school buildings. *R I B A journal*, v.75, no.12 (Dec) 1968, p.560-563, illus.

One of the problems faced in school buildings, and discussed at some length in Part II (Technical Notes) of this issue of Buildings for Education, is that of change of use through restructuring of curriculum and/or change in teaching method. This article entitled *"Improving old school buildings"* illustrates very well the outcome of failure to design and build for change. The primary school described was constructed in 1881 and is three stories high. It is constructed of brick walls and columns on which the floor beams were carried. There were, *fortunately*, few internal load bearing walls. The new design (selected by architectural competition), had to be planned so that *"individual teachers are not shut away in class-*

(97) - EDUCATIONAL BUILDINGS (contd.)

141. KAY, JOHN. Improving old school buildings. (contd.)



rooms with 40 children". The figure illustrates the ground floor plan of the winning solution which is notable for the absence of internal division walls, and the consequent possibilities offered for adaptation or rearrangement of the interrior at any time in the future.

142. SINGLE-STOREY vs. multi-storey: which is best? *School management*, v.12, no.7 (July) 1968, p.76-89, illus.

This is a question to which there is no one answer. Although cost is an important and often the final consideration, there are other factors which must be considered, many of which conflict.

A good rule of thumb to apply, baring unusual site conditions, is that an enrolment of less than 800 indicates a single storey structure, between 800 and 1200 there is an option and above 1200 multi-storey (i.e. two or more stories) is dictated.

(97) - EDUCATIONAL BUILDINGS (contd.)

142. SINGLE-STOREY vs. multi-storey; which is best? (contd.)

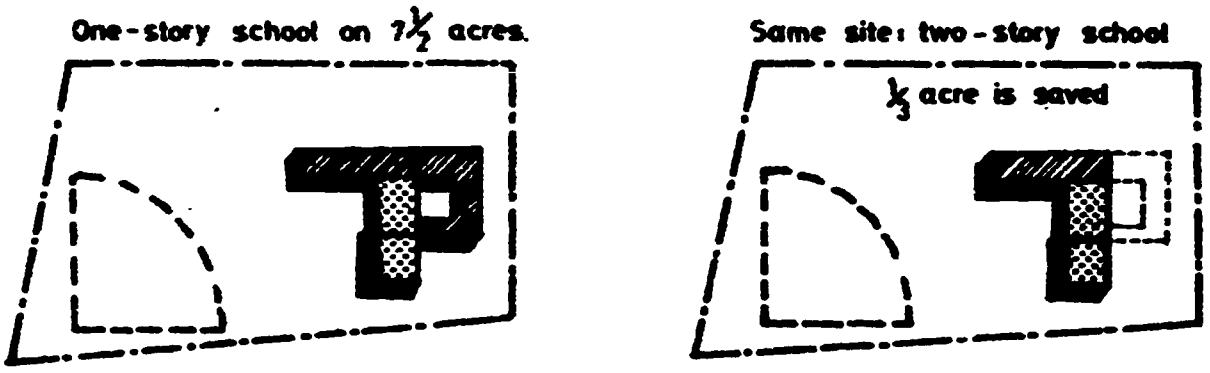
For primary schools one should endeavour to provide an easy transition from the home to the school, and thus in many ways the single storey is more consistent with this objective. But in some parts of Asia children are accustomed to living in multi-storey buildings and playing in confined areas.

The writer also suggests that in second level schools, the education usually involves travel between classes and special rooms and the multi-storey plan keeps distances to the minimum. But studies have shown that it takes twice as long, and more effort, to climb a flight of stairs as it does to travel along a horizontal path.

A flat site lends itself to single storey buildings, whereas a sloping site and particularly a steeply sloping site may dictate a multi-storey building.

Generally it is simpler to provide means of escape in case of fire in a single-storey building than in a multi-storey building. Almost without exception multi-storey buildings cost more than single-storey buildings.

The writer points out that there is only a minor saving of land in one - vs - two storey buildings, if the site is adequate for either (see sketch below) but in urban areas where land costs are high or there is a shortage of land a multi-storey building may cost less (see *Buildings for Education*, v.2, no.2).



The writer sums up ".... it is the aggregate of many other considerations that have to be studies before a decision as to a single-storey versus a multi-storey school can be made. Each school construction project is unique and the physical and educational factors which determine the number of storeys differ from case to case."

Buildings for Education *v.3, no.3 September 1969*

(97) - EDUCATIONAL BUILDINGS

143. TREGENZA, PETER. Vertical circulation systems; results of research into university buildings. *Building*, v.215, no.6542 (4 Oct) 1968, p.93-95, illus., bibl.

As the design height of a building increases above three or four stories the mechanical equipment (i.e. elevators) must carry an increasingly larger portion of the occupants. If the design of a building is changed from a low compact block to a tower block with the same useful area, the capital and running costs of the mechanical equipment will increase, and the proportion of floor area for circulation will increase.

A comparison of six hypothetical schemes to accommodate 1000 persons in buildings ranging from 6 to 26 stories high shows that the cost of lifts would vary from £S 30 per person in the six storey building to £S 145 per person in the 26 storey building and the floor area for circulation increase from below 20% to 32%. Similar results were obtained from plotting costs and areas of circulation from a sample of university buildings.

From this it can be seen that if there is a limit to the capital expenditure then there must be a limit in design to the height and slenderness of the building. Beyond this point it would not be possible to install an adequate circulation system. It is only when the unit cost of the land is high and is included in the overall capital cost that the quality of the mechanical services can be comparable with those which can be provided in a compact building.

The location of the rooms is important in determining the traffic handling capacity that is necessary in vertical circulation elements and the writer states two general principles:

i) Distances of travel within the building should be reduced to a minimum; a journey between floors is equivalent to a longer horizontal journey.

ii) The characteristics of the vertical circulation system must match those of the traffic that is generated. Even type of vertical circulation system has a different Handling capacity.

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