PROTIBESH

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Editorial

The current issue of, the journal of the Department of Architecture is comming out with a different name. The name has not really been changed. The earlier volumes were named the 'Environment'. The present volume bears the name "Protibesh". Protibesh though written in Roman letters, is the Bengali word Environment. As a matter of fact the word in Bengali language is more comprehensive and more expressive. It is not always that a suitable Bengali word translating the English one is readily available. In Bengali there are two similar words Protibesh and Poribesh giving more or less the same meaning as Environment in English. Having nice precise words indicating specific ideas often mean that people speaking the language are very familiar and concious of the full sense of the term. This tempts me to believe that Bengali-speaking people, in general, are aware of their environment i. e., Protibesh. Naturally they are concious of the elements that bring about changes in the environment. Architecture shapes the environment.

The contents of the journal are quite varied. These include topics like Housing, Health facilities, Educational facilities, Industrial Architecture Climate, etc. The topics are indicative of the areas researchers here are trying to deal with. They are also indicative of the future specializations architects aim at. Most of the papers are based on the post-graduate works done by the authors themselves. The research activities of the Department of Architecture primarily constitutes the academic works of the post-graduate students. Under-graduate students also undertake some research work as part of their curriculum. Student works are not yet being presented in the journal. We expect in future students works of significance will be published in the journal of the Department of Architecture.

Blessing of Allah be upon all of us.

Prof. Meer Mobashsher Ali

CONTENTS

Evaluation of hospital buildings in the light of their future development in Bangladesh

DR. RAFIQUL HUSSAIN

Abstract

Evaluation has become an integral part of the design process of buildings in many countries. Especially in the case of complex establishments like hospitals it is imperative that these be evaluated to determine whether they serve their purpose. Evaluation allows a periodical examination and assessment to be made and helps to keep records of successes and failures. Hospitals being very utilitarian buildings these information can be used as resource material for improving designs in the future. But the importance of evaluation is hardly recognized by the authorities in this country. Thus it has never played any role in the programming and design of hospitals. This article attempts to identify the various advantanges of evaluation and how this may be conducted in the case of hospitals in Bangladesh.

Introduction

Although studies on different aspects of health care services have been done in Bangladesh, very little attention has been paid to the evaluation of hospitals or other health facilities. It seems the authorities considered the job done once the hospital was built and commissioned. This has in fact robbed us of the opportunity to test what has been done, so that lessons could be learnt. Since the independence of the country a number of new hospitals have been built, some old ones expanded and renovated as a part of an overall plan of developing the physical

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infrastructure of the health care services. But these developments were carried out in a very arbritrary way, because even till now there exist no clear guidelines on hospital standards. The planning commission did set up a sub-committee in 1979 to recommend space and functional standards for hospitals. The recommendations were put forward in1980, but these were not based on any study and thus had inherent defficiencies (1).Guidelines can only be developed on the basis of adequate information which may be acquired in two ways. One of these is by following standards and methods adapted in other countries. The second way is to develop an information base through the evaluation of our own facilities. Because of the difference in population characteristics, disease pattern and the severe resource constraints it is essential that Bangladesh should recourse to the second way, although it would be more time taking. We may hope that by evaluating our existing hospitals the information base will be realistic and complete. Kekailenen, R. among others have expressed the view that hospital design should be based on research and analysed knowledge (2). One of the ways to acquire this knowledge is by studying the existing hospitals in their functional and physical context.

Benifits of evaluation

The cycle of programming, designing, building and commissioning any project is completed by evaluating (3). The information gathered through such an action may then become the basis for improving the use of the existing buildings as well as a foundation for providing better facilities in the future. Evaluating existing hospital buildings will serve as a designer-user feedback mechanism for hospital building programme in the future. Evaluation can therefore become a decision making tool, a learning tool and a contribution to the knowledge bank on hospitals. According to Postill, J.,monitering the results from a building once it is completed, enlarged or renovated, should be an essential and intrinsic part of health facility development(4).

The objective of any evaluation is to draw lessons from real life situations. It records both the good and the bad features of existing buildings. It identifies many important functional characteristics and how the building responds to these and at the same time helps to reflect popular tastes and habits.

The lessons to be learnt from the early successes and failures are necessary because of the inherent complexities of hospitals buildings. Green J. , and Moss,R., are of the opinion that,

> "................so far as complexity is concerned it is hard to imagine a single building type which involves such a closely interwoven pattern of functions and activities as does a hospital, nor one where the activities depend so closely upon one another"(5).

Post Occupancy Evaluation

The term generally used for the evaluation of a building in used is Post Occupancy Evaluation or POE in short. It notes how a building performs, how the occupants behave within it , whether the users are happy with the environment and so on. Whether the executed layout helps in increasing the efficiency of a particular area or whether it inhibits in any way the activities that need to be performed. POE of hospital buildings is essential to understand the user response which is a vital criterion to judge the suitability of layouts and other aspects.

POE "....... is a process of measurement, comparison and interpretation which should influence the planning and design of new buildings through its impact upon briefing and building guidance, and should also improve the funtioning of existing buildings"(6).

According to Ogodnik , T.M., POEs have two major purposes: (7)

(1) Immediate feedback from a given project;
(2) Development of information for future designs;

This is espicially useful when contemplating the use of prototype plans for a specific building use. A prototype should first be tested to see how it performs before repeating it. No matter how thorough a study was done before the design many shortcommings can only be identified after a prototype is completed, commissioned and then evaluated. Aziz, M. E. B.A. , expresses the view that a large number of buildings of a particular design should not be built until the first one has been evaluated, otherwise mistakes are likely to proliferate (8) Whereas in this country a large number of prototype Upazila Health Complexes and Union Health and Family Welfare Centres have been built without testing the prototypes.

Levels of Evaluation

Evaluation of hospital buildings may be done at the following levels:

(a) Whole hospital building/buildings ;
(b) Selective evaluation of a particular department/departments; and
(c) Selective evaluation of a particular aspect/aspects

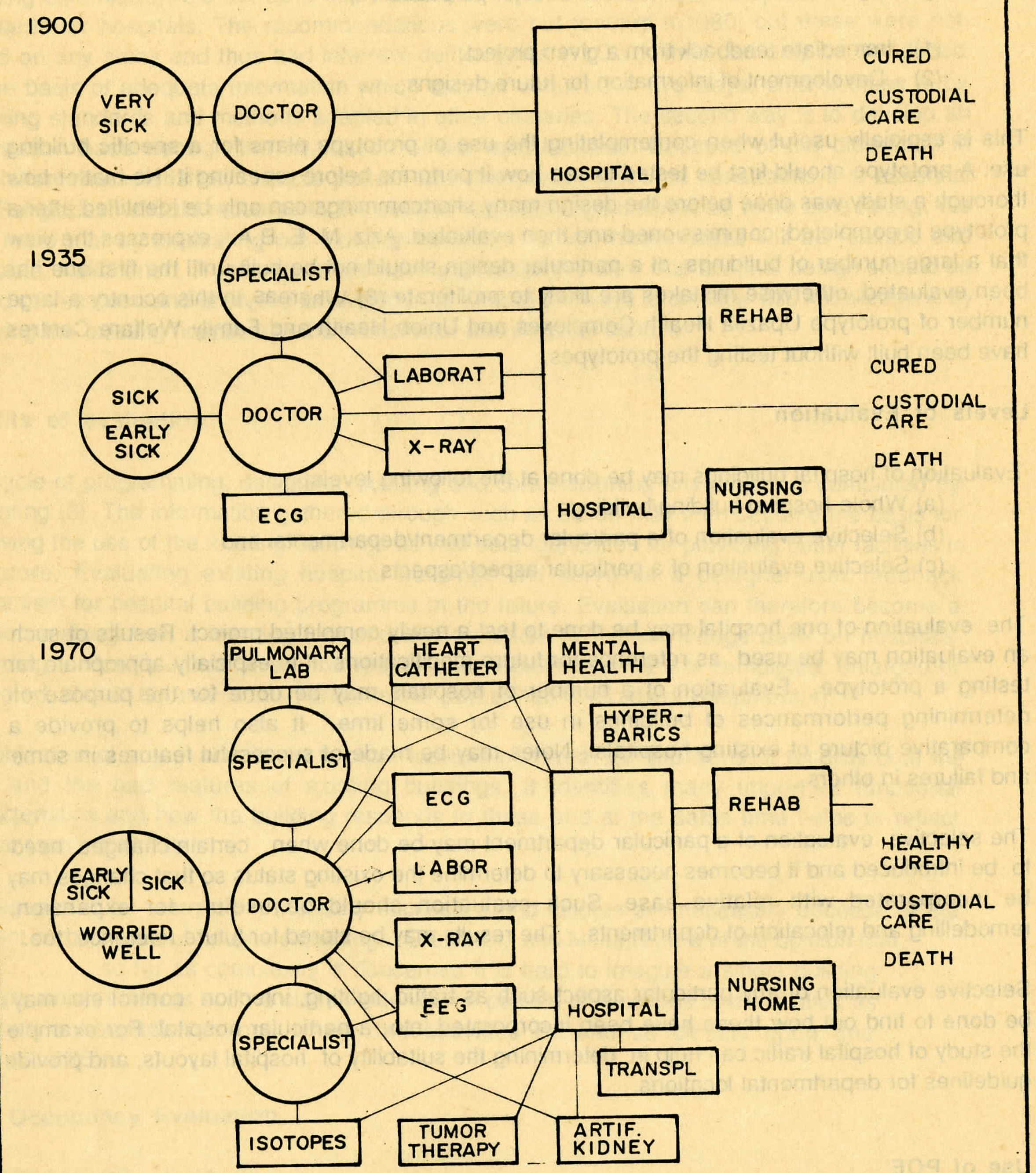
The evaluation of one hospital may be done to test a newly completed project. Results of such an evaluation may be used as reference for future modifications. It is espicially appropriate for testing a prototype. Evaluation of a number of hospitals may be done for the purpose of determining performances of buildings in use for some time. It also helps to provide a comparative picture of existing hospitals. Notes may be made of successful features in some and failures in others.

The selective evaluation of a particular department may be done when certain changes need to be introduced and it becomes necessary to determine the existing status so that changes may be incorporated with relative ease. Such evaluation should be useful for expansion, remodelling and relocation of departments . The results may be stored for future reference too.

Selective evaluation of any particular aspect such as traffic, lighting, infection control etc. may be done to find out how these have been incorporated into a particular hospital. For example the study of hospital traffic can help in determining the suitability of hospital layouts, and provide guidelines for departmental locations.

Use of POE

POE is not just an academic exercise but a useful tool in the hands of hospital planners and designers. Hospital planning and design day by day is increasing in complexity along with developments and changes in medical care (Fig.1). Evaluation is possibly the only means to



SOURCE: PUTSEP (18)

FIG. I. THE CHANGES IN MEDICAL CARE (1900-1970)

keep track of these changes. Sometimes POE is purpose oriented, and at other times it is not. In the case of the former the feedback is immedietly put to use, whereas in the case of the latter, the information is stored.

One of the wellknown examples of hospital design based on POE has been the Greenwich Hospital in London, U.K. one of the important findings observed from four case studies before the design was undertaken, was the seasonal variation in the occupancy of beds according to speciallity. This study resulted in the high degree of flexibility that was incorporated in the final ward layout for the new hospital (Fig. 2). In 1980 a research team in Kenya conducted extensive studies in the functioning of a particular out patient department(9). This led to the reorganization of the layout of such apparently simple areas such as injection rooms, consulting rooms and dressing rooms.

Recently, the World Health Organization (WHO) carried out a series of country based case studies of health facilities in a selected number of developing countries. These were devised as to be of immediate benifit to the countries concerned (10). It may therefore be recognized that POE is an important step in the process of planning and design of hospitals, and the only way to ensure that each new hospital is more successful than the earlier ones.

Long term benifites

Besides the immidiate use, properly conducted research and evaluation will have positive long term benifits. It should help provide guidelines for application to hospital buildings in general, which are as essential for Bangladesh as they are for other countries. These should be based on the available resources and technology, culture, climate and other regional peculiarities. In fact this is hardly ever recognized and Trew, R., writing about health facilities planning in developing countries mentions that "the result is that many health facilities are inappropriate to the conditions in which they must function"(11).

Research and evaluation also help to reveal hidden facts about certain conditions which are either ignored or never considered. For example, the evaluation of 1977 of three wards design spacing more than a century at the St. Thomas "Hospital in London, U.K. revealed information which surprised many. There appeared to be a marked preference of the patients for the antique Nightingale wards over the wards of more recent design(12). Without evaluation people might go on doing things without realizing the need for a change. According to Cammock G.C., who conducted an evaluation of consulting room suites utilization, architects and doctors become conditioned to think that a particular standard is right, simply because that standard may have existed for a long period. Both may be relüctant to change their habits or thoughts of work(13).

Regular evaluation will help introduce the element of dynamism in the approach to hospital planning and design. Changing needs and requirments cannot be understood by pursuing a static design policy based on obsolete and out dated design criteria. The changing world of medicine and health care, and the growing awareness among people is bound to result in a changing pattern of needs which must be recognized, and the only way this can be done is by continually reviewing what is done.

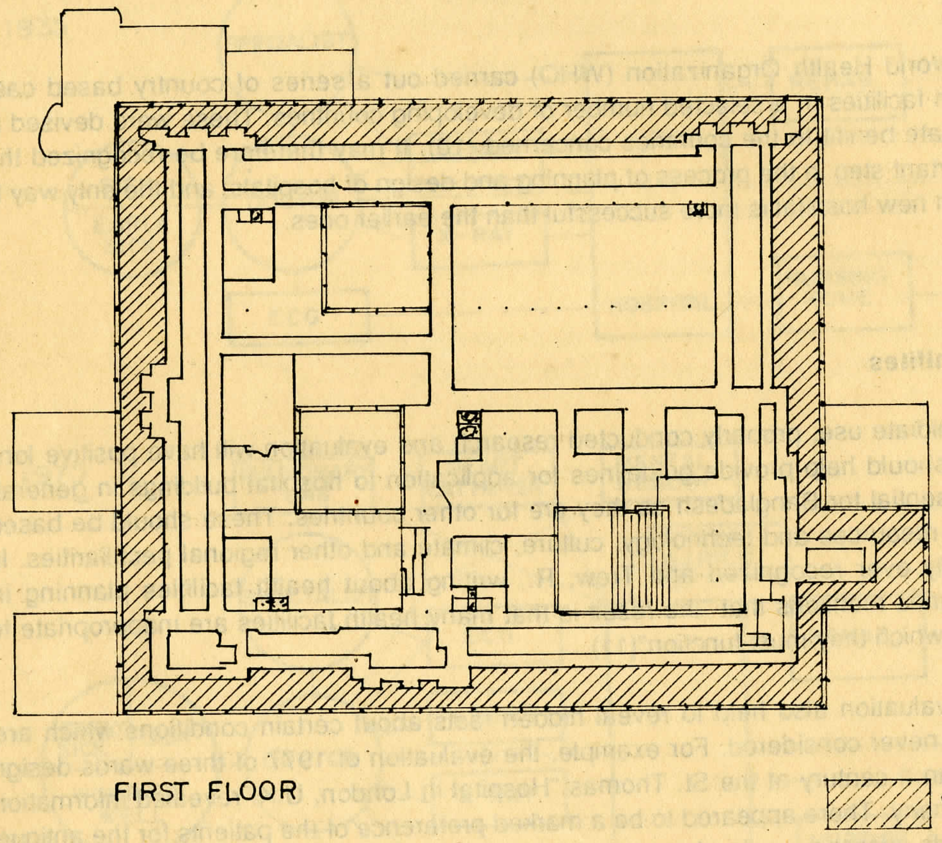


FIG. 2 GREEN WICH HOSPITAL , LONDON

Conclusion

Bangladesh has 0.3 beds for every 1000 person (14) compared to 2.8 beds in government hospitals alone in Sri Lanka (15) and between 6 to 12 bed in many of the industrialized countries (16). Which means that compared even to a similar developing country there is an urgent need for more hospital beds in the country. Thus new hospitals will have to be built alongwith a simultaneous expansion of existing facilities. But there is not enough information to aid hospital planners, resulting in costly mistakes. A study by Rahman, S., of the newly built multistorey wing of the Institute of Post Graduate Medicine and Research (IPGMR) Hospital Dhaka, revealed inherent weaknesses in the ward layouts and the operating department (17).

It is therefore imperative that the authorities initiate a programme to develop an adequate information base through a critical study of existing hospitals. This may than be expected to have a direct and determining influence on the future programming and designing of hospitals.

Such a study should comprise two steps. Firstly, a field investigation of a selected number of hospitals through which all the relevant data could be collected; secondly, measuring, comparing and interpreting the information in a way so that, there emerges a clear picture of the status of those facilities, their success and failures.

It is hoped that information on space utilization, building layout, flexibility, health care policies and procedures, staff utilization, supply and disposal methods, maintenance of buildings and equipment among others could be useful in the formulation of hospital building programmes and design strategies for the future.

References:

(1) HUSSAIN, R., The planning and design of district Hospitals in Bangladesh. An Alternative Approach. Doctoral Dissertation, Faculty of Applied Sciences, Catholique University of Lovain, Belgium, 1988, pp.32-34.

(2) KEKAILENEN, R., Hospital elemention from the architects view point World Hospitals. vol. 21 No. 4, Nov. 1985, pp.62-64

(3) DELRUE, J., & MIKHO, E., Rationalization of planning and construction of medical care facilities indeveloping countries, KLECZKOWSKI, B. M., & PIBOULEAU, R. (eds), Planning and design of health care facilities in Developing areas. vol. 1, WHO, Geveva, 1976, pp. 53-112.

(4) POSTIL, J., physical and functional evaluation of existing facilities, KLECZKOWSKI. B. M. & PIBOULEAU, R. (eds), Approaches to planning and design of Health care Facilities in Developing Areas. vol. III WHO, GENEVA, 1983, PP. 277-294.

(5) GREEN. J., & MOSS. R., Hospitals Research and Briefing Problems, King Edwards Hospitals Fund, London, 1971.

(6) RAWLINSON, C., Health Buildings Evaluation Manual. Medical Architecture Research Unit, Polytechnic of North London, Nov. 1983.

(7) OGODNIK, T.M., The Use of space programming and post occupancy evaluation, World Hospitals, Vol.21 No.4, Nov.1985, pp.58-62.

(8) AZIZ, M.E, B.A., Type plans for small health care facilities: the Sudanese approach, KLECZKOWSKY, B.M. & PIBOULEAU, R. (eds) Approaches to planning and Design Health Care of Facilities in Developing Areas, Vol IV,1983, pp.21-44.

(9) NIMPONO, K., Clinic Building Research in Kenya, s.e., 1980.

(10) KLECZKWOSKI,B.M., Planning, building and operation of health care facilities in the perspective of the devlopment of primary health care : some views based on case studies. KLECZKWOSKI,B.M., & PIBOULEAU, R. (eds), Approaches to Planning and Design of Health Facilities in Developing Areas, Vol.IV, WHO, Geneva,1983, pp.3-20.

(11) TREW, R., Health and Hospitals Facilities in developing countries, Keynote Speech-2nd Planery Session, Seventh Regional Conference of the International Hospital Federation, Manila, Nov. 1978.

(12) NIGHTINGALE, M., Buildings update: Hospitals Part II, Architects' Journal, 28 July 1982 pp. 47-56.

(13) CAMMOCK, G.C., Utilization of consulting suites in health centres, Report to the DHSS, U.K., M.A. R. U.. 3/77, The Polytechnic of North London, 1977.

(14) Statistical Pocket Book of Bangladesh, 1986, Bureau of Statistics Government of Bangladesh.

(15) Statistical Pocket Book of Sri Lanka, 1985, Government of Sri Lanka.

(16) OECD, Public Expenditure in Health under Economic Restraints, Health Accounting in OECD countries, Paris, 1984, mentioned in PFAFF, M. & NAGEL, F., Conseguences for hospitals resulting from demographic, social and morbidity changes: A European Perspective, International Journal of Health Planning and Management, Vol. 1, No. 5, Oct-Dec. 1986.

(17) RAHMAN, S., Health facilities planning and design: Priorities of the profession and urgency of local needs, presented in the Seminar on Architecture and the Role of Architects in Southern Asia, sponsored by the Aga Khan Award for Architecture, held in Dhaka, Dec. 1985.

(18) PUTSEP, E., Modern Hospital : International Planning Practices, Lloyd-Luke, London, 1979.

Housing Urban Poor: Tenement-block, as contemporary house-form

DR. IFTEKHAR MAZHAR KHAN*

1987 has been declared as the 'year for shelter for the homeless' by the United Nations within the larger decadal programme of 'Shelter for All' by the year 2000. The motive is laudable except for the 'semantic disorder' inherent in the slogan. For professionals architects, engineers or planners such rhetorical ambiquity distract them from their primary task of providing housing, be it *shelter* or *home* for the urban poor and underpriviledged. While improvement may be sought everywhere there is little justification in inventing a problem where it does not exist or by redefinition make the problem insoluble. Housing for the urban poor will constitute the major task for planning bodies and institutions, on which will depend stability and continuity of our social fabric.

1. Defining the prolem

Shelter is a 'minimal' physical concept and except in periods of calamity one is reasonably sheltered. Here no aspersion is cast on the physical state or attribute of the shelter except that it offers a minimum protection against the elements. *Home* is personalisation of space evoking very intimate sensations of comfort, security, privacy etc. Thus one can be *'homeless'* even when he is *'sheltered'*, and *'shelter for the homeless'* is more appropriate in draught -striken Ethiopia where a large, dispossessed rural population find succour in refugee camps. But it would be erronous to view these refugee camps (rehabilitation centers) as the permanent home.

Conspicious by its absence in the slogan is house or the larger concept of *housing* with its definite body of theories and practises. If *housing* the uraban poor, in our large metropolies is seen as problem of *shelter* it is perhaps wise to induct the services of foreign

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charitable organisations. If however, it is seen as construction, distribution, supply and delivery of cheap rental residential accomodation, then only it can be of legitimate interest to professionals. In todays Dhaka, this *house* means a residential accomodation for a family of six at a monthly rent of Tk. 500/- or less , located in accessible areas of the city, enoying the minimum amenities and facilities.

If this defination is acceptable then housing solution is devising the suppport system, the mechanism for production and delivery of such house- types. Whether these houses are *homes* or mere *shelter* can best left to the genius of individual dweller or the mechanism of the marketplace.

House-type for Urban poor

House-types for the above target population is present in all major Third World Cities and typologically identified as 'tenement blocks'. They have developed over the last century, in the wake of industrialisation, as a response to the housing need of a vast pool of migrant labour.

They were built by private developer motivated by profit, on private land with a wide variety of 'house solutions'. In each city, they acquired a definite name if not a definite architectural form. In Bombay they are called the *chawl,* (1) Mexico-City is famous for her *'vicendades',* (2) Cairo for *'rabaas' and 'aimaraas'* (3). They are usually 2 to 4 storied single roomed tenement blocks, built around a court with communal toilets and spaces.

Esoterically they are termed 'Compensatory Housing Types' implying perhaps the inappropriateness and adhoc nature of the product, marketed in the absence of a certified commodity.

In any case, it was never seen as legitimate house-form because of its sub-standard (esp. sharing of services) environment and overcrowding. In origin they are little different from the 'bustees', 'favelas' 'kutcha adadies', 'jughee jhonpress', 'kampongs' of today except that they evolved in a period of lesser strain and pressure. But from its humble origin of tenement huts arranged in row on a common access, sharing common toilets placed at a distance,- transformed to a harder, vertically arranged, consolidated form. Today, in these cities, they offer the bulk of in-city, low-rent residential floorspace.

The hardening of the rural form occured either in direct response to rising land value (and the consequent need to hold more unites) or as a result of Rent Control Acts which forced a depreciation in large upper class mansions. Also, rent control drove developers out of upper-class residential market making tenement blocks a reasonable bussiness proposition. Tenements grew in leaps and bounds, either by commission or by conversion much to the Chagrin of city fathers. Only now has the realisation dawned on the extent and worth of this building type in supplying an affordable house for the urban poor.

3. Tenements in Dhaka

In Dhaka, until very recently, single-roomed tenements for menial workers, vendors and day-labours was profusely present within the city. They were in private and public land, huddled behind high walls. In larger concentration they were termed 'colonies' (eg. Ganaktuli Sweeper's Colony) .

With rising land-value and competition from other lucrative uses they have been evicted from city proper to distant pheripheries- across the river to Kamrangir Char or the flood plains in the edge of the city.

The process of eviction is invitable as long as the physical form stays loose and horizontally distributed. The necessary physical transformation to a better organised, vertically arranged urban typology has yet to occur in Dhaka. But the development of such urban typology, is crucial in providing the urban poor with an address within the city.

Dhaka, by the year 2000 will have a population in the region of 6 million and a large portion of this population will be the beneficiary of this house-type.

4. Housing policy-objectives

This brings us back to the slogan and the pious intention of U.N. and our seemingly native faith that 'Shelter for All' by year 2000 is a attainable goal. It will only blur the finer distinction, variety, complexity of our urban housing situation by proposing a flat, one-dimentional house-type and setting unrealistic targets.

The parallel effort of U.N. of 'Health for All' by the year 2000, is already being translated to number of doctors, hospital beds, medical services and pharmaceutical products at the expense of health education, family nutrition, personal hygine, food habit, mother and child-care etc. The drive will follow the beaten track already traversed in affluent societies of the West where 'health care' is manipulated by vasted interest into 'hospital care'. (4)

By analogy, similar scenerio can be drawn in housing sector. Housing concepts have developed in the West viewing house as a self-sufficient package-for a nuclear family. This fixation grew out of middle-class values and has a narrow application in our culture. There, esp. in Western Europe, it developed as a historical necessity, when conscious political decisions were taken to create a 'home-owning democracy'. The remarkable resilience of her liberal and democratic institutions attest to the political wisdom of creating a large middle-class, home-owning constituency.(5)

We, by propagating the concept of home in effect proposing the above arrangement as a natural state in our urban society. Not only such goal is unrealistic but in such scheme of things the only means available to broaden the entrypoint is by reducing the area (floorspace /lotsize). The great variety of income differentiation and house demand is fitted against a linear scale of area (floorspace /plot size). The houses for low-income groups is then produced by making the house (flat or lot) smaller . At the lower end of the scale ot produces obsolate or redundant house-forms. The single dimension of 'area' cannot discriminate control over service packaging . Standard (or high) service infrastructure acts as an affective barrier against low-income groups and conversely sub-standard packaging can create low-income preserves. Varied service packaging is not a novol concept and is present, at least in delivery, even where the service infrastructure is standardised . Tenements, by its specific mix of 'house' and 'service will create a wide range of residential unit exclusively targeted to the urban poor.

5. Conclusion

Architects and planners are often blamed for their inability to notice the obvious or accept the inevitable . 'Tenement-blocks', in whatever nomenclature, whatever built-form will appear in Dhaka, with or without the knowledge or support of the professionals,.Only, if convinced of its vital role in the complex and myriad world urban housing systems we may try to accomodate it in our formal structurtes .

The housing situation in Dhaka appear propitious for the above house-type. As mentioned earlier, rent control acts by default, helped the development of this building type. Similar situation will also result from the escalation of municipal and utility rates, property and personal taxes etc. reducing the bussiness edge enjoyed by high-class residentials. With little incentive, financial support tax moratorium .

Tenements can be made a profitable proposition . The by-law and other urban laws pertaining to building may be adjusted to encourage tenement blocks. Relaxation in set-back regulations, allowing central courtyard, greater build-up and coverage etc. may also be considered. But more important is to understand and accomodate the role played by the private developer, for unlike other housing types here his position is pre-eminent, for only be can make it happen. Planning goals are in essence, offering him a favourable terms of trade.

References :

1. 'Chawls grew as cheap tenements, as lucrative investment by property developers........ with the industrialisation in the east and begining of this century'.

   Gillian TINDALL
   'City of gold'-The Biography of Bombay.
   Temple Smith, London 1982

2. 'Vicendades' - the name for low-cost tenements, are usually organised around a central courtyard with communal services. Usually one or two floors, were built for profit in the areas between the turn of the century and 1940'.

   Tomasz SUDRA, "Low-income housing system in Mexico-City" Unpublished Ph.D. disertation, M.I.T. 1976 .

3. 'Rabaas' - tenements for low-income group usually single storied .
   'Aimeras' - tenements in multi-storied arrangement, usually for low to middle income groups.

Geoff PAYNE - 'HOUSING analysis of Ismailia' Lectures in K.U.L. (Leuven) may 25, 1979

4. Ivan ILLICH - 'Medical Nemesis ' 1975.

   The auther argues that the high life - expectancy in the west owe little to doctors or medicines, more to efficient waste disposal, supply of portable water, ample protein in daily diet etc. He claims that with the expansion of medical facilities and services life expectancy if falling in Western affluent societies.

5. The British proletariat proved petit-bourgeois by not obliging Karl Marx . Throughout the 19th century they were indeed in the avantgarde of proletarian movement. Similar shift is also noticeable in other West European Societies.

The paper was earlier presented in a seminar marking the "World Habitat Day" organised by 'Housing and Building Research Institute (HBRI) on-----

Design Criteria: Community Secondary School

Faruque A. U. KHAN*
Meer M. Ali **

The participation in education is very low in Bangladesh. Only about 58 percent of the present primary age-group children are enrolled in the schools. The rest of the children remain out of the schooing . Only 14 percent of the children attending primary schools go on to the secondary level. Again the secondary education is the terminal education for a large majority of students . At present, there are 8,960 secondary and 2,269 junior secondary schools, out of which only 172 are managed by the government. Rest of the schools are under private management. The government schools are designed and constructed by the Facilities department of the ministry of education. But the design and construction of the majority of the secondary schools are managed by the local school committees .

The occupancy rate of the school campuses are very low. With one shift of classes only, the school buildings are underused. There is a scope for increasing the occupancy rate by about seventy five percent. The community school programmes can make the school campus available for all section of people for a fuller use of it (fig.1) . The community school might be the focal point for many community activities .

To provide employment and meaningful vacational courses along with conventional education for regular, dropouts and out of school children, the administration is keenly interested to introduce community schooling. The provision of education and full employment for all by exploring and utilising local resources is considered a social goal. A community secondery school by its nature would be committed to bring the various conventional courses, vocational trades, development activities and recreational facilities into a closer harmonious relationship, and all working together, requires a new type of spaces in the school.With a veiw to making the community school curriculum relevant to generation of more employment, while considering the local demands, economy culture etc. a number of courses may be arranged, on the common and familiar trades

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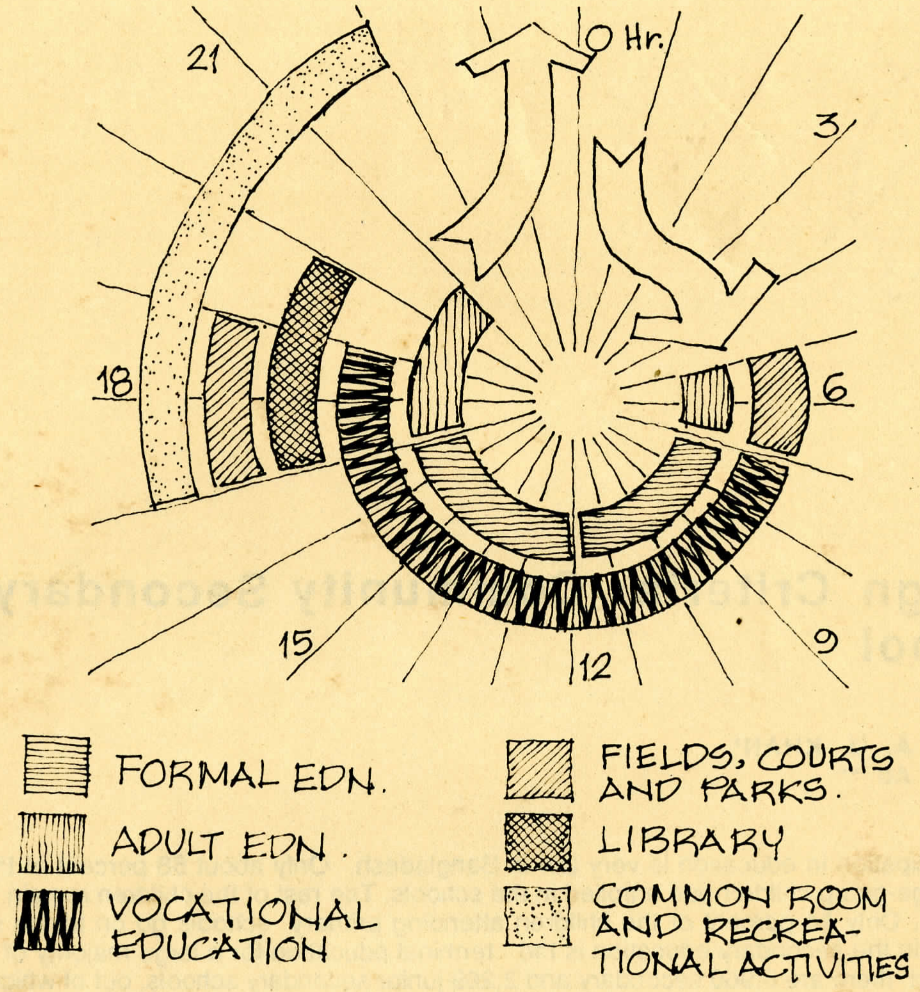

Fig. 1 Occupancy time in community secondary school.

like : a. Agriculture and horticulture b. Farming-dairy, poultry and duckery c. Pisciculture d. Sericulture e. Bee keeping f. Pottery and roof tile/ciramics k. Sewing, knitting, tailoring and garments l. Weaving and dyeing m. Carpentry, masonry and building crafts n. *Mechanical and agricultural equipments o. Electrical and house wiring p. First aid, nursing and drug dispensing. Besides the formaland vocational education, a number of social, economic and development programmes can be initiated. These programmes may include the literacy and adult education, health and family planning programmes, IRDP programmes, co-operative programmes, agriculture extension services programme etc.

Many socio-economic, educational and cultural agencies are working in the localities of the schools for the promotion of socio-economic and other conditions of the people. Coordination of these agencies and linkage with community school programme will minimise duplication.

A set of design criteria can be evoloved and an attempt to standardise secondary school design may be made, giving due importance to indigenous materials, techniques and local needs . Considering the need of vocational training to generate employment for rural youths and making school campus available for all sections of people for its maximum use and making it a focal point for many community activities, a prototype community secondary school design is attempted (fig. 2).

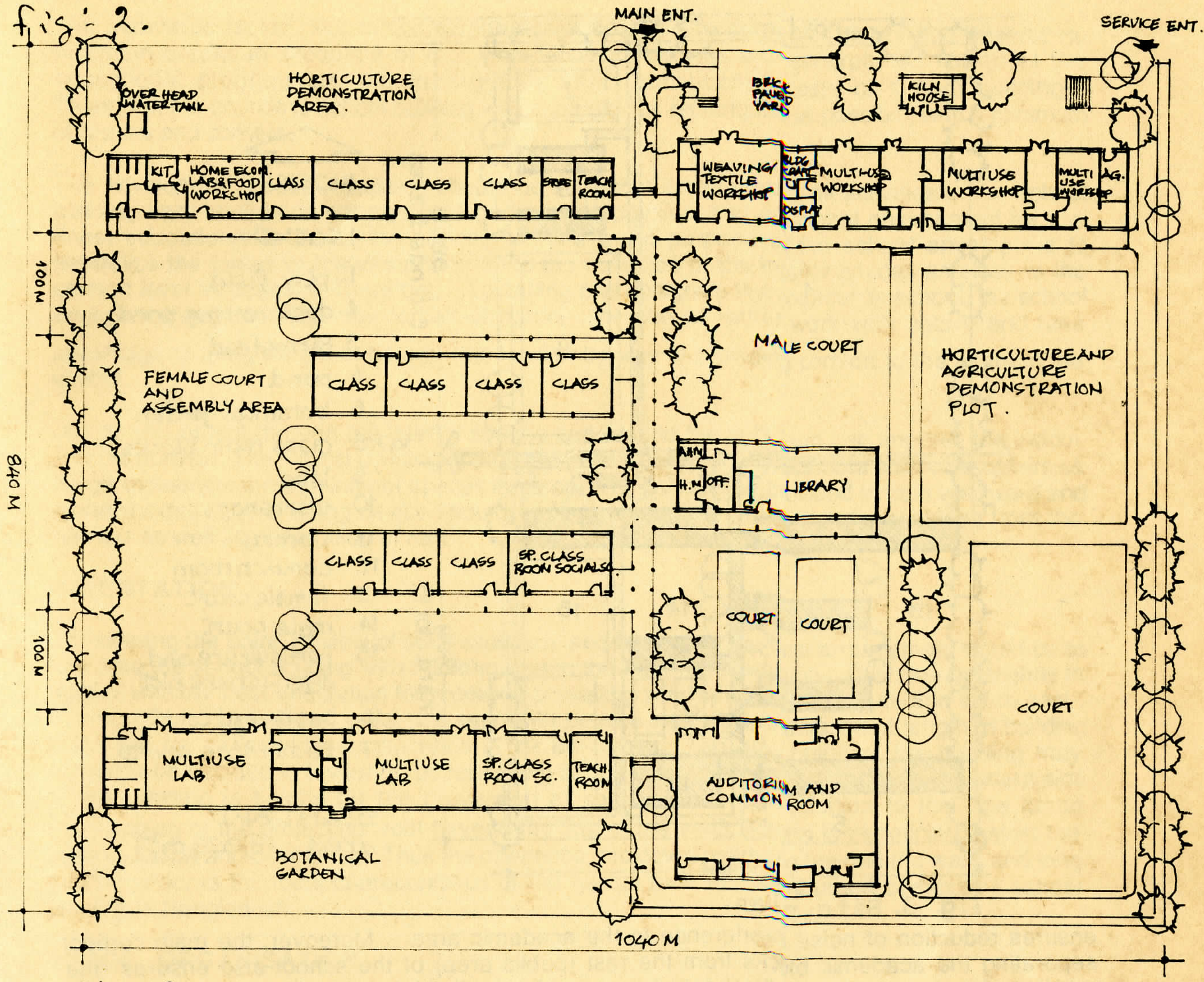

Fig. 2 A prototype community secondary school design

NORTH

COMMUNITY SCHOOL CAMPUS PLANNING

The school campus should be located at a suitable place, easily accessible from all sides either by road or water way. The layout of the community secondary school deserves to be compact for deriving optimum economy. Proper attention should be given on the locational aspect of some of the functions and activities like entrances, workshops, common room, administrative offices, teachers' room, kitchen, kiln house and toilets etc. (fig.3). Primary activities and functions like formal education, administration, library, common room, workshop, outside playing courts, botanical and agricultural gardens etc. should be grouped in an area in a 'hard form'. The other spaces for the play ground, pond, farmstead etc. are to be arranged in the 'extended area' which may be available adjacent and around the school site.

The main corridor might divide the site into two definite zones seperating the formal educational area from the rest of the school site. All the rooms are to be connected by the corridors to the main circulation. The separation of the common room and workshop (source of most noise)

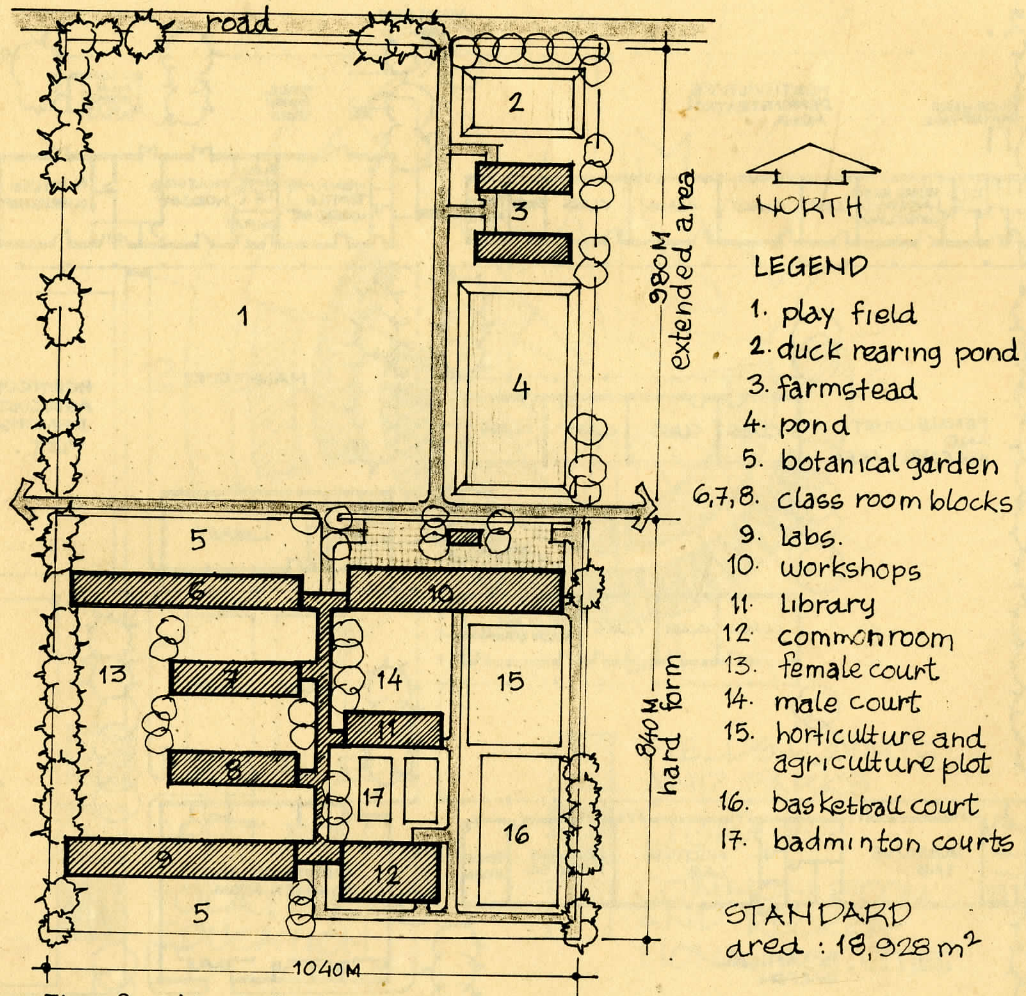

Fig. 3. Site plan.

ensures reduction of noise interference to the academic area. Moreover, the main corridor separating the academic blocks from the rest (public area) of the school also ensures the creation of segregated (quarantine) area beyond which pupils of the afternoon session will not be able to move, untill the morning sessions children leave.

Entries should be on both sides of the main corridor which facilitates access to the school from more than one direction.

DESIGN CONSIDERATION

The school planning should begin with a clear and accurate realisation of the actual physical and emotional needs of the students and should never in any phase of planning compromise in meeting those needs. The school need not be grand and gandy but should be simple in plan while safe and economical in construction. The community school building should provide an environment of maximum attractiveness for students and teachers engaged in learning process and this should be achieved harmoniously within the existing limitation of financial means of the community.

There are some economics of school architecture, independent of type of education. In order to achieve the reduction on initial and maintenance costs, it is necessary to use simple geometry of envelops, simple and common materials and simple construction techniques.

The geometric factors like minimum number of breaks and corners in floors and envelopes, minimum breaks in silhouette of roof lines, low roof ceilings etc. generally do not affect the educational programmes, but they greatly affect construction costs of school buildings. Therefore, the economic school building will be roughly as rectangular as possible, with a minimum of breaks and corners.

The envelope of a school building should be such that it can protect all activities in the school building from environmental exposure and provide physical and emotional environment for the finest educational and working conditions. The basic purpose of the school envelope is to neutralize the forces of natures and to keep the condition of the interior spaces as close to the comfort level as possible. Therefore, in planning and designing the community school, the school designer should not fight the forces of nature ; he should rather work with nature and take advantage of everything that nature has to offer by way of providing comfort to the users of the school.

The air movement through the interior spaces and around the built form can improve the indoor thermal comfort. The school building should received whatever air movement it can. To maximise the air movement through interior spaces large openings should be provided in both windward and leeward sides. The shading device should be large enough to protect all the openings from the sunrays as well as penetration of rain.

ORIENTATION

Considering the point, of view of solar radiation, and heat gain, the best arrangement would be to orientate the school building with the long axis in the east-west direction. This may be slightly in conflict with the best orientation for receiving prevailing wind which is from south and south east . The conflict is not however great and even with precise east west orientation of length of building there will be an insignificant sacrifice of air movement. The orientation of the building may therefore be decided in favour of astronomical fidelity (fig.4). A long corridor at the southern side of the building is helpful for the prevention of solar radiation. In addition to this, the broad overhanging of the projecting roof beyond the line of the vertical walls is beneficial against the solar radiation and driving rain. Thus the openness, projected overhang beyond the walls and long open corridor is the ideal characteristics of the typical rular and semi urban community school building in Bangladesh.

SPACE ORGANISATION

The relationship of different spaces where myriad activities take place is very important in community school. The pupils, teachers and community people using the school at different times are constantly moving from one place to another ; therefore , in every detail of design, these spaces should have a feeling of being related to one another or there will be lack of unity. The design should be made in such a way that there is an order among the spaces, functions, and activities so that there is a feeling of invitation and transition among the different spaces..

MULTIUSE SPACES

In order to reduce the construction cost of school building and to improve the flexibility and intensity of uses of spaces, certain spaces need to be combined, believing that such a combination would not greatly interfere with the educational programmes of the school . A multi-use hall may accomodate several activities like music class, assembly, gymnastic activities, boy scouting and girls guide activities, community gathering and other extra curricular activities where seating of large number of students are necessary . The science subjects taught in the secondary school level need not have seperate laboratory for each subject . In order to achieve better and optimum use of these laboratories, multi-use laboratories for two or more subjects can be designed in community school.

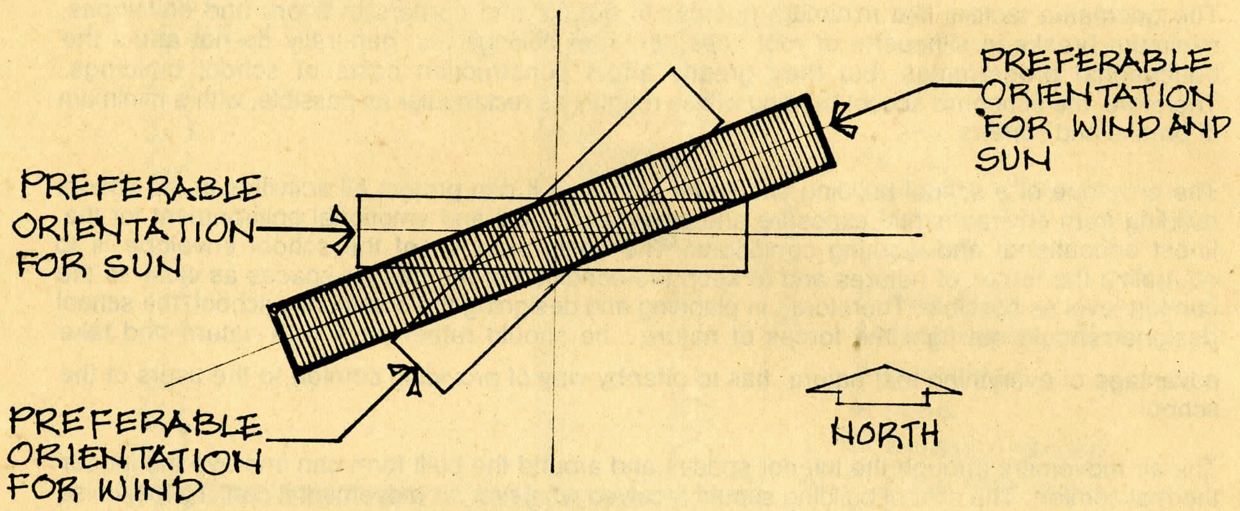

Fig. 4 Preferable orientation of school building.

FORM

The basic form of the community school building is derived from the consideration of the logical arrangement of school activities, easy circulation, flexibility, economy, easy egress, social and cultural heritage of the communities. The simple elongated rectangular form with gable roofing having verandah on one side facing the court (or field) on the south has evolved over centuries to represent the basic (popular) form of the school building in Bangladesh. Ease of layout, art and technique of construction also lend support to this force.

CONSTRUCTION SYSTEM

The use of simple structural system in community school building helps in balancing the construction budget. The structure of the buildings should be such as would allow growth and change within the building. A skeleton type structure is flexible and suitable for this purpose. The skeleton may be of concreate or timber, or combination of both. The frame structure may also be in pre-fab system for modular and versatile use. The infill panels may be from indegenous materials like bamboo, reeds, C.A. sheets, C.I. sheets etc. Bracing against wind and earth quate particularly in pre-fab structures should not be ignored or forgotten and should be adequate.

Temporary materials and components can easily be replaced by more permanent building materials and components. The system of construction and the materials should be such that it is possible to construct relatively inexpensive but more flexible community school buildings which can be progressively improved in stages, when more and more funds are available.

References :

1. William W. Caudill, Towards better design . F. W. Dodge Corporation, N.Y.,1954

2. Lawrence B. Perkens and Walter D. Cocking, School, Reinhold Publishing Corporation, N.Y., 1957

3. Faruque A.U. Khan, An approach to the formulation of design criteria and space standards for community secondary school and designing a prototype in Bangladesh, M. Arch Thesis (Unpublished). BUET. Dhaka, 1984

Architectural Styles and Industrial Buildings

DR. NIZAMUDDIN AHMED*

The first industrial buildings, grim and straightforward as they were, would apparently not qualify as architecture if one adopted the notion that "architecture is the play of light and shade". However, if functionalism is architecture and it is within total architectural integrity for the form to follow function, then these same buildings, flat-faced and monotonous though they may occasionally be, rate highly as architectural accomplishments.

"Industrial buildings have never fitted easily into the history of architecture, a history which so often seems to revolve around great houses and churches". (1) The industrial building, whenever it may have been first erected, wherever and in whatever form, came into being to serve a purpose; that of enveloping the machine and equipment, labour and materials, and the services of the function of production and manufacture. Thus, industrial buildings have always been functional, although the stylistic facades did not bear this message initially and for a long time into the history of Industrial buildings. Over the years efficiency has increased manyfolds, due largely to monumental changes in available building material, appliances and services, and technologically advanced construction methods; and facades, too, have given in to express the changes. A building, industrial or otherwise, is functional when it is constructed primarily with regard to practical necessities rather than to aesthetic considerations. Industrial buildings (factories, warehouses, mills, etc.) have never been anything short of functional for obvious reasons. However, traditional aesthetic styles, despite activities within being quite to the contrary, have often adorned facades of industrial buildings since the earliest days. Like all other building

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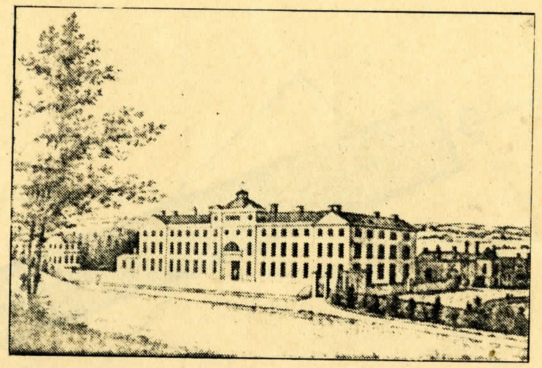

Figure 1. The Soho Manufactory, 1764-66

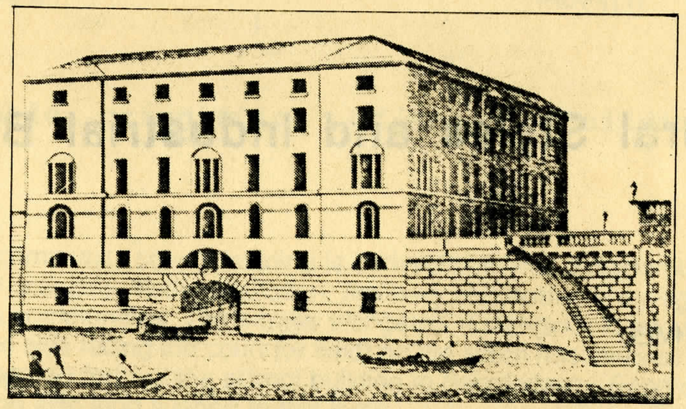

Figure 2. Albion Mill, London, 1783-86

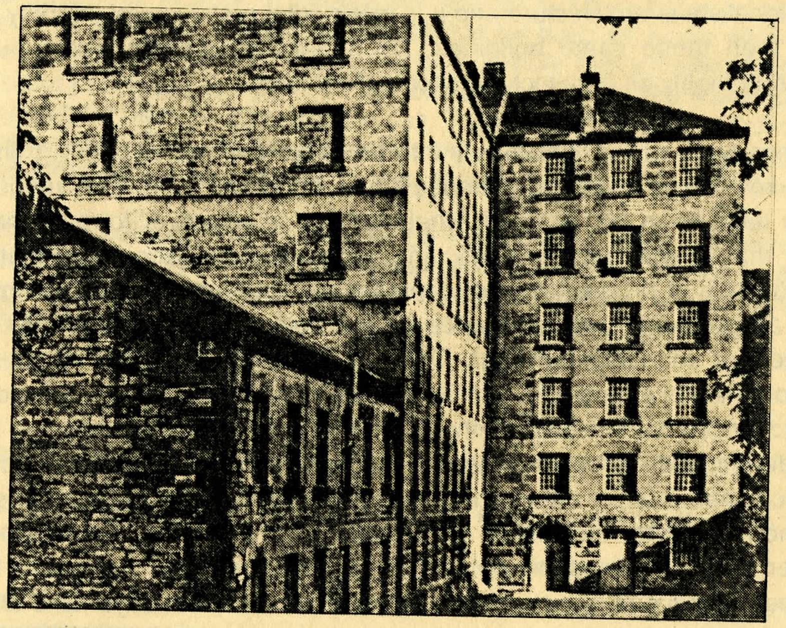

Figure 3. Calver Mill, Curbar, Derbyshire, 1785

types, it took industrial buildings decades to shake off the traditional styles in terms of outward appearances. Although the first industries date back hundreds of years, the expression of the activities inside the buildings on the facade is a feature very much of the present century.

Functionalism and architecture are inseparable since buildings are always erected to fulfill a need. Every building has a particular function or several functions to fufill. In terms of industrial buildings, a warehouse complies the function of storage whereas a factory may have to satisfy a chain of functions. It has been said that recent functional architecture may be traced back, through various architects in Britain's manufacturing areas, to an earlier tradition in which a powerful emphasis on utility arose from the needs of the so-called Industrial Revolution. The argument involved linking together the warehouses, mills,breweries, sheds and bridges erected in the period 1760-1840 and suggesting that functional building did not have its origins in the modern era, but was critically associated with industrialization. (2)

Ancient buildings derive their peculiar charactor not only from the way the challenge of function is met by logical and economical use of materials and technology, but also from the aesthetic ideals of the times. In effect, the character of today's buildings is similarly moulded, but it owes much to the fact that architects have accepted "the principle that the process of designing a building begins with a close analysis of the needs it is to serve". (3) The objective is to fullfill such needs economically and logically. The emphasis is now on the basic geometry of architecture rather than historical styles. In fact, the modernisation of architecture began with building facades expressing truthfully the qualities of the materials and the strength of the constructional techniques employed. Expression was further extended to the quality and character of the space within the building. Thus, the space no longer hid behind the decorative shell or the two-dimensional facades of the historical sytles. Soon the space and the elements which contained it became parts of one entity- -architecture.

The change from historical styles to the styles of structural and functional clarity has also meant a change in the role of the architect. From the role of a mere decorator of non-functional elements, limited to designing the facade of the factory in masonry or brickwork, the architect today plays a pivotal role of executing and supervising the design and construction of a building in all its many aspects.

Previously the engineer held the initiative in the design of industrial buildings. Since the engineer was the designer of the machine and equipment, it was assumed that he knew of how best to enclose them. The engineer's knowledge of new structural materials and construction methods put the architect at a disadvantage. However, as expression of materials, technology and purpose, utility of space, planning, organisation and management and such other aspects which are in the architectural domain became increasingly important, the initiative gradually shifted to the architect. The architect today deals with the engineers on their technical ground, assumes leadership of a group of specialist consultants, co-ordinates their skill and experience to give service to clients, advise clients on new developments and on technical aspects.(4)

The early industrial buildings were eclectic versions of the Greek, Italian, Gothic, Georgian or some other style. Functional expression was almost always compromised to accommodate

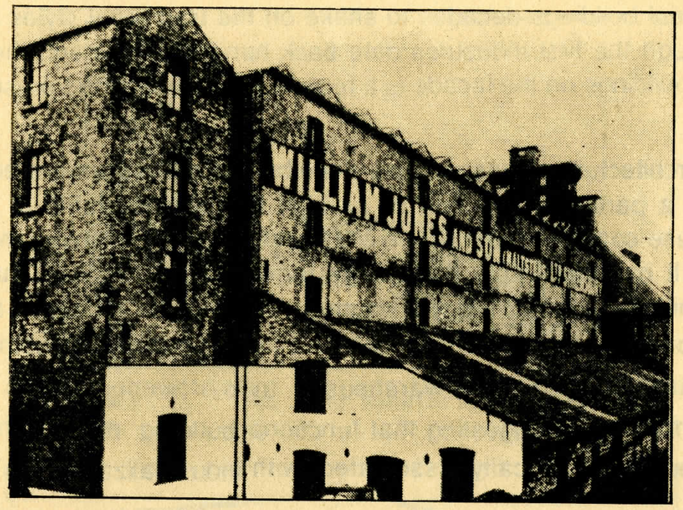

Figure .4 . Benyon, Marshall and Bage Flax Mill, Shrewsbury, 1797

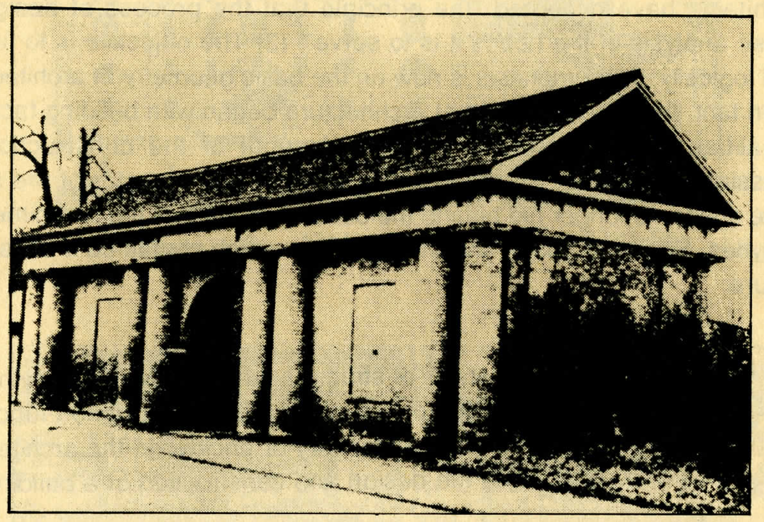

Figure .5 . Brick-built barn, Solihull, 1798

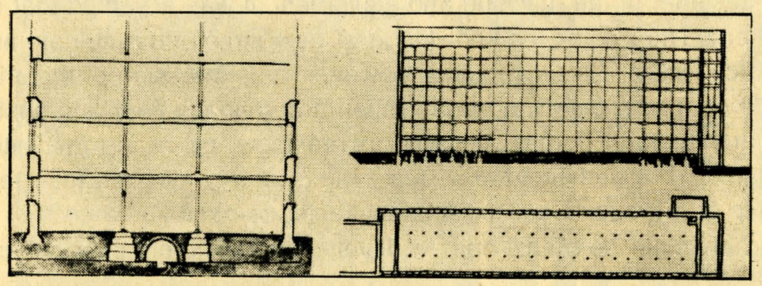

Figure .6 . Plan and section of Boulton and Watt's seven-storied mill, Salford, 1801

decorative motifs and styles. The predominant architectural style in the 17th and 18th centuries was Palladian. Based largely on the buildings of Andrea Palladio (1508-80) in Italy and those of Inigo Jones (1573-1652) in England, the Palladian principle was "effectively applied" to working buildings such as Samuel Wyatt's pitched-roof multi-storied Albion Mill, Southwark, London. (1783-86). (5) Built of brick external walls, timber posts and floors, it was destroyed by fire in 1791.

Richard Arkwright, who went to great lengths to protect the patents of his spinning machines, built the original building of the Masson Mill at Matlock Bath in the English Midlands in 1783. The buildings exemplifies the "immensity of eighteenth century ambition and its hard character". (6) A water mill, dominating the river valley, the building (which exists even today) is a strange layer cake of Venetian windows, bracketted between the larger subsequent wings of red brick.

In 1798 Sir John Soane, the architect of the original Bank of England, designed a brick barn at Solihull, Warwickshire, based on the Greek order. The longer elevation was comprised of four sets of detached double columns standing before windowless walls and supporting a triglyph frieze under a wide-eaved, low-pitched slate-covered, gable-ended roof. A central arched doorway on the longer elevation further pronounced the solidity of the facades. The design was in no way related to any previous farm building. The gatehouse and bridge also had Doric columns. (7)

Engineers' designs were rigidly Georgian or uncompromisingly functional. However, several engineers showed aesthetic sense; for example, John Rennie, who designed the Waterloo Bridge in London. Engineers were in great demand as designers of buildings because they provided the steam engines and machinery. They knew how to provide the structure which supported the long runs of machines, floor by floor, and the brick and masonry walls and timber roofs which enclosed them. The detailed aesthetic treatment was supplied by carpenters and masons who had the experience in classical design. As a matter of fact, during the 18th and 19th centuries; the creative minds were the mill engineers, who, "unhampered by architectural conventions invented metal skeleton construction and the all-glass wall, pioneered artificial heating and lighting, giving us the technological and aesthetic base for the architecture of our own day".(8)

The early 19th century was the age of the polymath virtuoso engineer, of Telford, Rennie, Fairbairn, Paine, the Jessops, the Brunels and the Stephensons. In no other period of English history were there so many engineers in practice whose names are still recognized. (9)

"In the design of industrial buildings, as in the 18th century, it was unusual to involve a major architect--- or even any kind of architect--- unless there was a need for prestige, or for a treatment of special environmental sensitivity" to make the buildings acceptable. Buildings housing industries were functional and rational in design. The element of prestige was sometimes included to impress visitors, client and customers and also to "inculcate in the employee a sense of corporate pride". (10)

The reforming measures and Acts of the early 19th century provided new oppurtunities for the architects, whose role, otherwise, was limited to providing the decorative shell to the more serious pursuits within. The role of the architect became more important because the socially

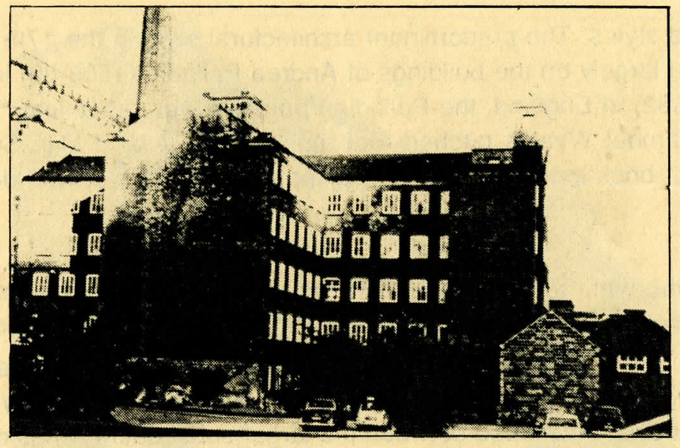

Figure 7. William Strutt's North Mill, Belper, 1803

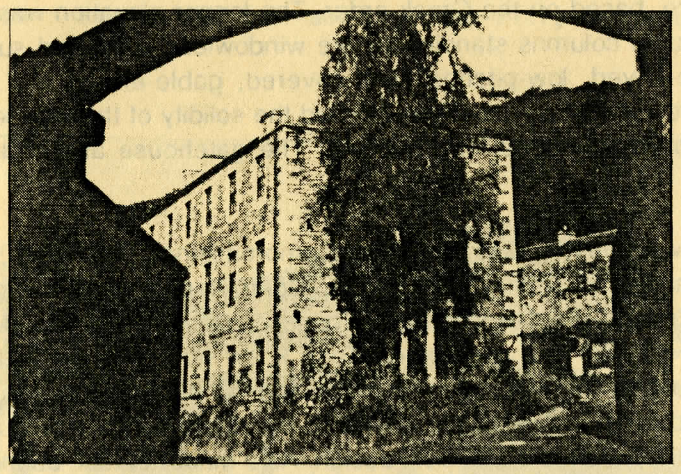

Figure 8 . Robert Owen's Housing for workers at New Lanark, Scotland, 1785-1810

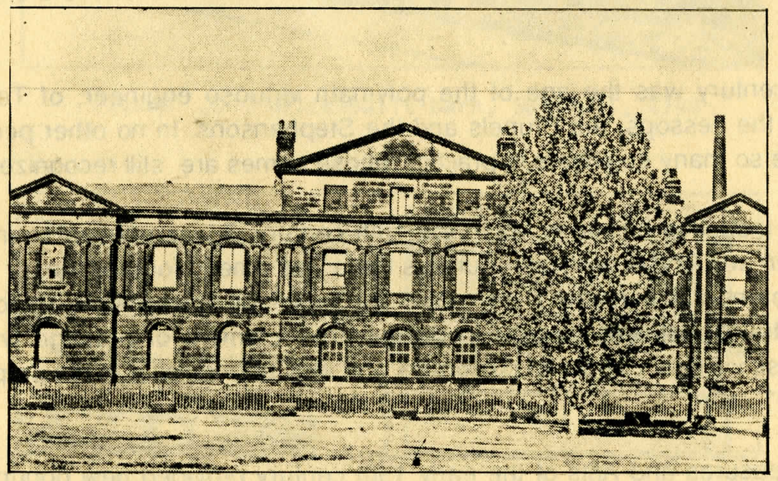

Figure 9. The Globe Works, Sheffield, 1825

ambitious owners found it a matter of prestige to own well-designed buildings and because there was a growing feeling that good conditions inside the factories, when provided, required a decent expression outside.

The socially conscious amongst the businessmen considered it their prestigious responsibility as builders in the new era to maintain the aesthetic ideal of the times and to contribute positively to the environment and the landscape. The earliest signs of architectural impact on industrial buildings can be seen in the Stanley Mill at Stonehouse in the West Country, England, built it 1813. Here, although the classical masonry arches with keystones form the base of the grand building, the structure is expressed with stone plasters dividing brick walls into structural bays. (11) The Kingston Mill, Bradford-on-Avon, England, built five years earlier, exhibited segmental arches showing a development from the four centered Tudor Arch towards a more structurally correct solution.

Industrial buildings of significant architectural interest were being built at a slow but steady rate. In about 1835 a warehouse at New Quay, Liverpool was composed of a series of identical bays in brickwork. The building was 21.34M high and the effect was dominantly columnar. The significance of the building can be understood even more when it is realized that, even in later years, particularly the 20 years from 1841, factory buildings showed a deliberate inclination towards domestic precedents.

James Bogardus (USA) built a cast iron factory in New York, 1848. Prefabricated cast iron components replaced masonry even in the outside wall which obtained a high degree of transparancy. In English factories at that time (mid 19th) and from the begining of 19th century, the load bearing structure consisted of cast iron piers and beams with external walls of masonry. James Bogardus's cast iron factory is the precursor of skeleton frame consturction and of Chicago school.

Architecture during this period was immersed in the study of the traditional styles, as expressed through decoration. Buildings for factories continued to be greatly influenced by Georgian, Greek, Gothic, French and Italian styles. The Saltaire Project (1850-53) at Bradford, England, designed by architect Henry F. Lockwood and William Mawson, borrowed the Italian style to glorify the main features. Saltaire was "Plagiarism tinctured with originality", as were indeed a whole range of buildings of the sixties and seventies. (12)

Few of the buildings designed in the early 19th century have survived the fire, redevelopment or the change in taste. The surviving few illustrate the similarity and solidity of Victorian functional architecture at its best. These buildings were considered dull and plain by the Victorians and when money was available latter Victorian industrialists did not hesitate to adorn their premises with ornate and romantic facades. In 1838-40, John Marshall commissioned the architect Joseph Banomi to design a neo-Egyptian elevation for the main facade, complete. The Egyptian influence was not surprising because Banomi had spent ten years in the land of the pyramids. (14)

An example of the Greek revival filtering into industrial architecture may be identified in the Globe Works, Green Lane, Sheffield, built in 1825 ---" a dignified classical monument". (15)

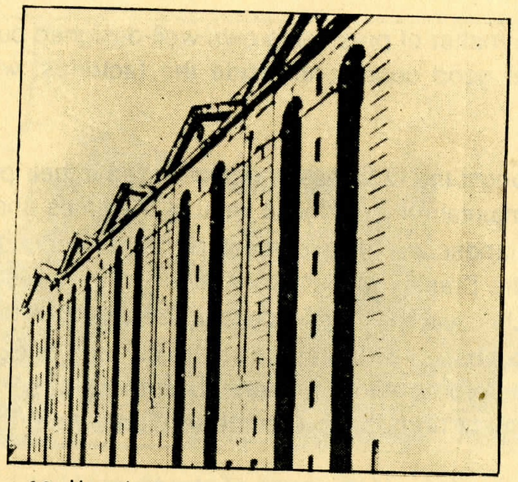

Figure 10 Warehouse, New Quay, Liverpool, 1835

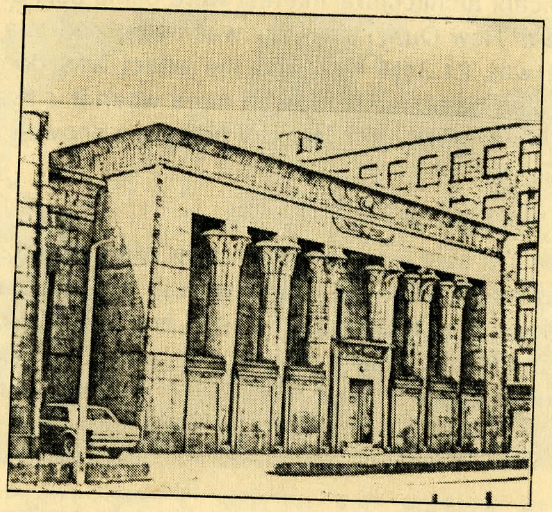

Figure 11. .Temple Mills, Leeds, 18838-40

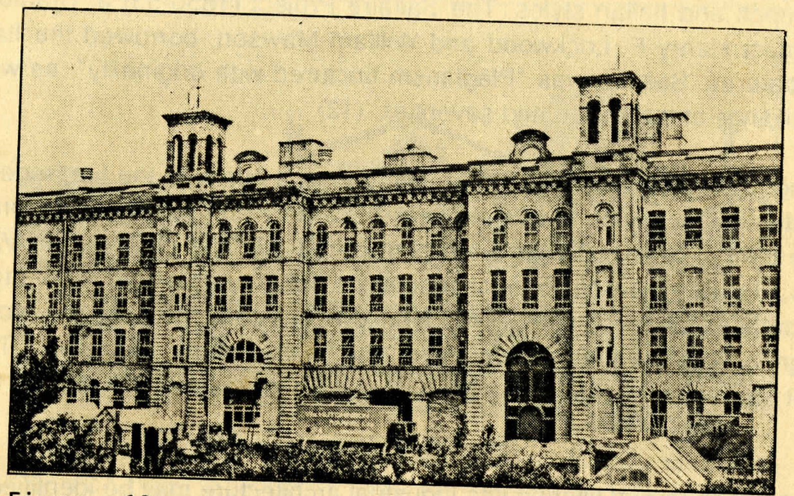

Figure 12 . Titus Salt's Saltaire Mills, 1851-53

Gothic style was rarely adopted in the 18th and even early in the 19th century. Gothic, particularly suited to irregular and intricate compositions, did not attract designers whose requirements at this stage was satisfied by a box-like structure of regular dimensions. However, by the mid-19th century, Gothic motifs were being increasingly employed in industrial buildings. Doge's Palace in Venice, after which was modelled Alfred Waterhouse's warehouse for Fryer and Binyon, was also inspirational in the design of James Templeton and Company's carpet factory, overlooking Glasgow Green, in brightly coloured brick. (16) The popularity of Gothic is also exemplified by laver and Barrand's painted Glass Manufactory (1859-60), London, designed by Robert J. Withers; and also E.W. Godwin's carriage factory (1862) at Bristol. These were examples in High Victorian Gothic. Nevertheless, Gothic never achieved the same popularity as Italianate for mills and warehouses. (17)

Voilet-le-Duc, in his lectures on architecture published in 1881 said of the continual playing with past styles "If we will consent to regard the works of the past as belonging to the past, as steps by which we must pass if we would attain to the knowledge of what is appropriate to our social conditions; if we proceed by way of analysis, and not by that of unreflecting imitation --we shall have opened the way and shall ourselves be able to pursue it". (18) Le Duc's statement may have fallen on deaf ears. Architects continued to pursue old styles so much so that they ignored the organisational aspects of the building which lay behind their flamboyant facades.

By 1860, the "Battle of the Styles" was well under way. Between Gothic and Classical, there was a constant search for a style which would meet the functional and aesthetic requirements of the times, particularly in view of the tremendous and unprecedented technical progress taking place. Architecture was still immersed in furnishing and decorative facade and gave little thought to the internal functions of factories. Indeed, it rarely found opportunities to do so. All that seemed necessary was a covered space with walls, floor and a roof for the machinery to be accommodated and for the work of manufacture to proceed.

While architects and artists tried to ignore the "loathsome nightmare" (19) that was the Industrial Revolution, a non-architect and a non-engineer by the name of Joseph Paxton had created a hall for the Great Exhibition of 1851 in Hyde Park (England) that was to be later considered a "monument to progress in building technology."(20) The Crystal Palace reflects not so much the period in which it was built, but rather an aesthetic and point of view that shares elements in common with its immediate past (the first, Romantic Classic Phase of modern architecture) and of the future (in the more frankly modernistic architecture of the 20th century) (21).

Between 1861-80 the Renaissance style often dominated the features of mills and factories but the homes were adorned by Gothic attributes. Other styles were also in vogue. "Tudor mansions were often raised on the demolished remains of the fine Georgian country houses, manors and farm buildings." (22)

In 1894, Thomas Harris, in his book "Three Periods of English Architecture", said that, contrary to keeping abreast of the times, architects were adopting foreign styles of the past. Harris was convinced that a new style must grow by taking into consideration the new construction. (23).

The design of many warehouses built during the last two decades of the 19th century was approaching eclecticism, with both styles and detail inextricably mixed. Some designs were mere street frontage, marking storage spaces for goods. The architects of the Soho Wharf near

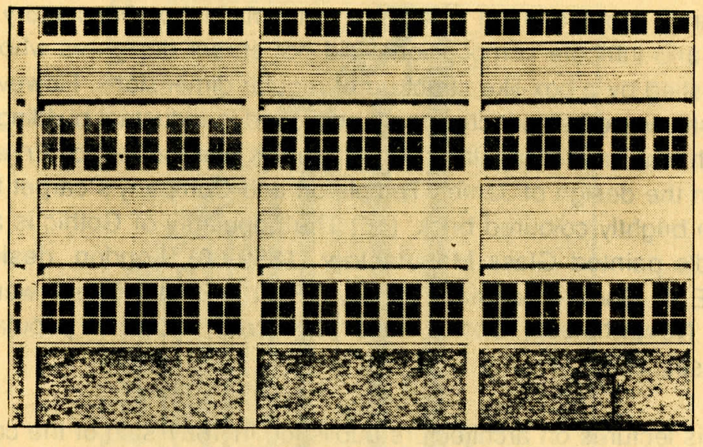

Figure 13 . Sheerness' Boathouse, 1858-60

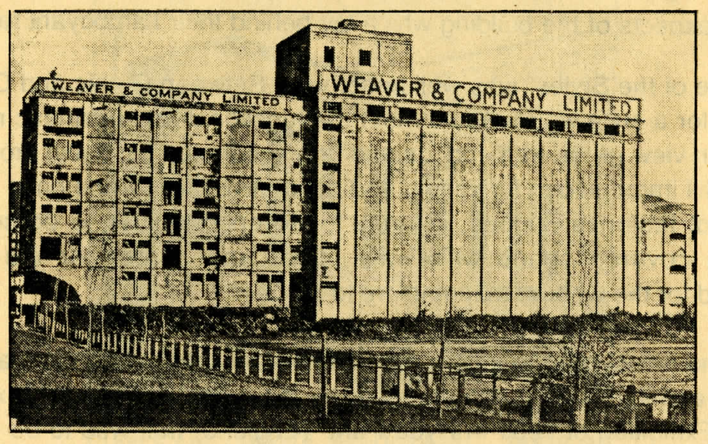

Figure 14 . Britain's first reinforced concrete building: Swansea, 1897-98

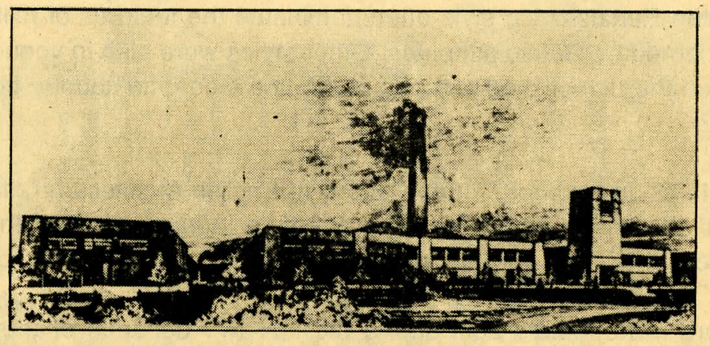

Figure 15 . Engineering Works, Queensferry, Chester, 1901

Westminster Bridge, London, built in 1884, gave enough evidence to show that their work was inspired by Venetian designs, whereas the warehouse at Bloomsbury, built in the same year and designed by Joseph Peacock, showed "simple but frank treatment of the main elements of constructive strength (24). Also in the same year, a warehouse in Star Yard, Carey Street, London desinged by W.F. Unsworth, achieved an exrtremely rich effect by the sensitive use of traceried panels in brickwork in line with the existing fashion in England. The trend was to follow the Belgian late Gothic, with a high gabled front.

Factories and warehouses towards the end of the 19th century showed little sign that their aesthetic apprearance followed naturally from the purposes of these buildings. There was, however, a growing sensitiveness to the demands of function. The techniques of functional planning, later so fundamentally to affect the form of industrial buildings, were beginning to be developed seriously. Concrete remained in the shadows of traditional building materials and was rarely recognised as a major building material by architects. The French used it but scarcely ventured to give any expression to it; it was used as a substitute and accordingly adopted to conventional architectural forms. The philosophical battle between science and art was one of the bitterest controversies of the 19th century and architecture, which evolved as a result of the fusion of both aesthetic and engineering skill attracted much of the fightings. (25)

The period of Edwardian industrial architecture (1900-1914) saw the rejection of "the popular and widely applied Gothic in favour of a host of styles, including a return to classical models. Wrought-iron, cast-iron, bricks and timber were gradually replaced by steel and reinforced concrete". (26)

During the years leading to the outbreak of the First World War, architects were still not involved to a larger extent in the design of industrial buildings. Clients were often of the opinion that employing architects served to increase the cost of such buildings. (27) Although the theory, "form follows function" was being acknowledged with much respect, the resulting functionalism was securely tied, with few exceptions, to the stylistic tradition. However, more attention was now being given to factory plans, and stylistic influences were gradually dying out, "to be replaced be functional influences which were beginning to inform the entire architectural field."

Early in the 20th century the Americans were experimenting with dynamic proposals, many in concrete, but the past styles lingered on. The French and the Belgians were pursuing "art nouveau". The use of traditional bricks in modern form began in Amsterdam but was perfected in Germany. While such rapid and dynamic progress was being made elsewhere "laissez-faire" overtook Britain.

Even at a time when Frank Lloyd Wright introduced "Usonian" architecture using concrete with traditional materials and welcoming the landscape into the house; and when Irving Gill marked the introduction of "cubism" to the States via a house in Los Angeles in 1915, the past continued to creep in. For example, Cram and Ferguson's Gothic-bias in the Canterburian Tower in 1913 at Princeton University. The New York Grand Central Station built in 1903-13, was distinctly Roman Renaissance. (28)

Peter Behrens, architect to the GEC in Berlin, made a positive contribution to industrial architecture in particular and modern architecture in general, relying as he did upon the earlier

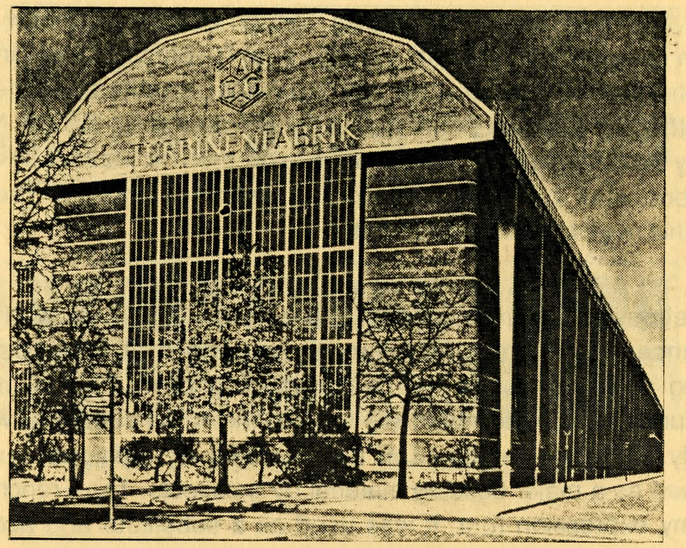

Figure 16 , Behrens' A.E.G. Turbine Factory, Moabit, Berlin, 1909

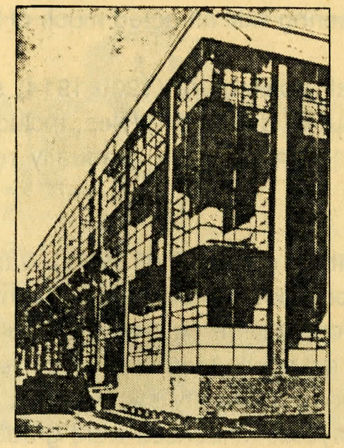

Figure 17 , Gropius and Meyer's Fagus Factory, Alfeld-on-der Leine, 1912

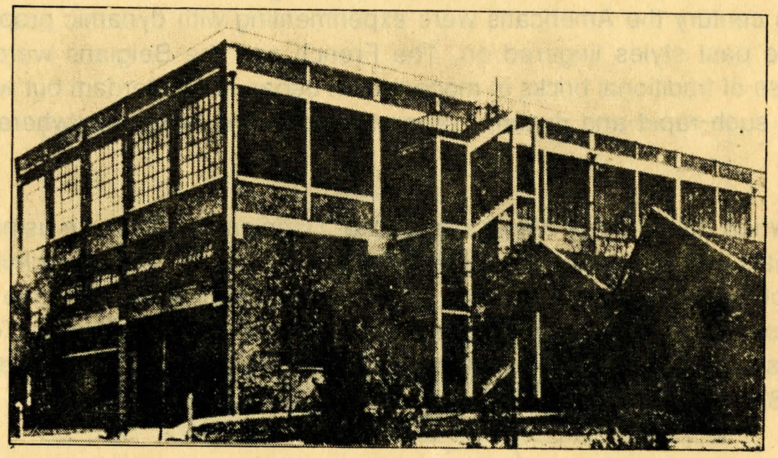

Figure 18 , Factory, Watford, 1921

works of engineers in cast-iron and glass. His turbine factory for AEG in North Berlin erected in 1909, was a huge steel-framed structure, with masonry-enclosed corners and glass infilling giving a tremendous feeling of space. (29) In the word of Behrens himself: (30)

> "All forms of sculptural and ornamental decoration were omitted, firstly because the function of a factory building demands simplicity of form, but more especially because the desired impression of solidity, and the proportions contributing to this impression, could only have been diminished rather than enhanced by it."

Hans Poelzig, in designing a chemical factory at Lubeck in 1911, clearly expressed the structure of the building. Walter Gropius, who earlier worked with Peter Behrens, designed in 1912 the Fagus Shoelace Factory at Alfeld a.d. Leine. The trend of expressing the structure and the materials was in vogue and the work of Gropius was fashionable. The Fagus factory boasted uncluttered orderliness in massing and quality detail. The ingenuity of Gropius' Fagus factory was the "unity between architectural form and structural techniques". H.B. Cresswell's Willens and Robinson's Ferry Engineering Works at Queensferry, Chester in 1901, was an outstanding contribution to industrial design because it gave a certain amount of character to the building in a manner naturally arising out of structure, and without any introduction of superfluous and unmeaning ornament. (31)

The stylistic confusion of the 19th century was even more inappropriate in industrial buildings than that found in churches, banks and office buildings. Architects realized this but did not achieve satisfactory results until the demands of welfare, building legislation and the mechanics of modernisation began to shape forms.

It was evident that a new age was gradually emerging and this was none the more expressive then in industrial buildings which were being erected to meet the demands of a bigger population, now exposed to new products as a result of changing times. Le Corbusier, in his book "Vers Une Architecture" declared in 1923." Thus we have the American grain elevators and factories, the magnificent first fruits of the new age. The American engineers overwhelm with their calculations our expiring architecture."

By the 1920s it was clear that architects were keen to express reinforced concrete, externally. Frank Lloyd Wright's Larkin building, Buffalo, N.Y. 1906, cast its influence to the design of the Witton Engineering Works, near Birmingham, with its bias towards external expression of the new material. The mammoth building, with the shorter street facade about 140m long, was monumentally treated. Massive doorways, crowned by cornices, were flanked by stout square piers. The voluminous staircase pronounced at the corner was lit by a window extending its whole height.

Despite the fact that the Industrial Revolution was staged in England, it was Germany which took the leadership in the application of architecture to industry. Walter Gropius founded the Bauhaus in 1919, which aimed at bringing together art and industry. Le Corbusier who designed only one industrial building, was another architect important to industry . He attended the Deutscher Werkbund, 1911-12, which was founded by Hermann Muthesius in 1907. The Werkbund emphasised on the economic aspect of design. Later Corbusier joined the Bauhaus band. Corbusier worked towards standardization and, therefore, virtually the industrialisation of architecture. He developed a theory of aesthetics based on the iconoclasm in art which led to

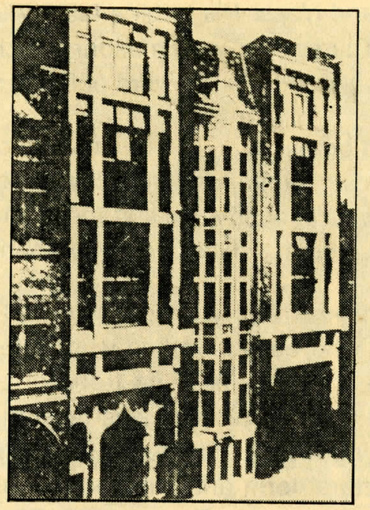

Figure 19 . Warehouse, Leicester, 1923

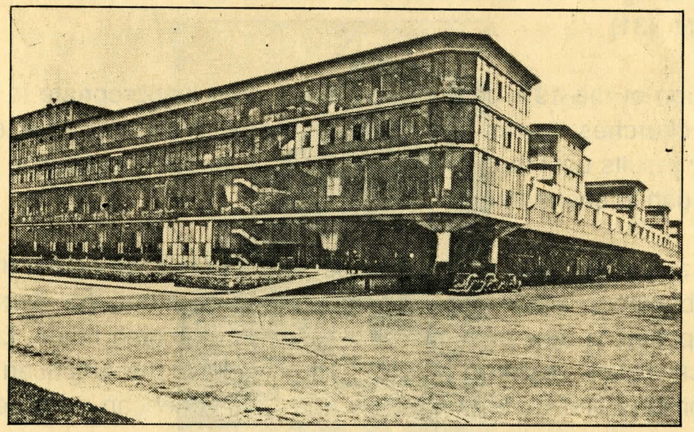

Figure 20 . Owen Williams' Factory for Boots, Nottingham, 1930-32

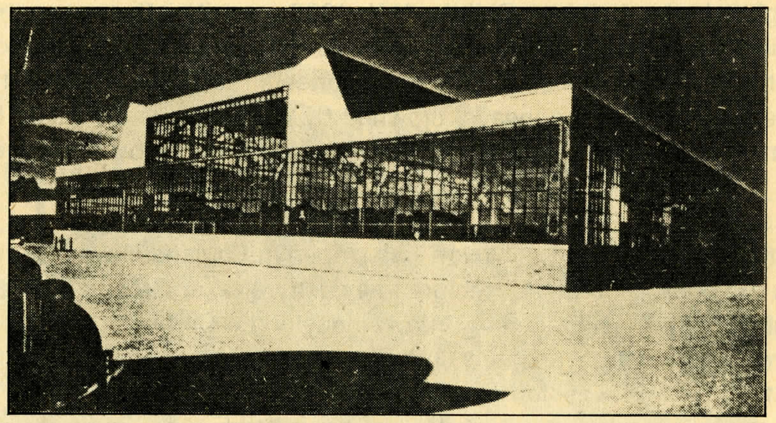

Figure 21 . The Export Building, Chrysler, Detroit, shows the characteristic Kahn roof profile

cubism. Most factory builders endow their building with a sense of meanness and economy, but in the Claude et Duval Factory in St. Die, completed in 1951, Corbusier has imparted his own belief in the nobility of work.

The influence of cubism coincided with the evolution and increase in use of concrete. Many architects, some of whom were artists first, went to the extent of imitating reinforced concrete by plastering brickwork and then painting it white. The importance of concrete was further increased when regulations required that steel used as the skeleton form of a multi-story building "must be protected from its tendency to twist and buckle if attacked by fire". Only in single -storey buildings could architects express the "T," "H" and "I" sections of steel in all its beautiful nakedness. (32) Glass was another material which contributed to the new modern look as was illustrated initially by the Crystal Palace. Later architects employed glazing not only to allow daylight and prevent wind and rain, but also to clearly pronouce the structure.

Engineer Owen Williams, a leading exponent of expressionism, (33) made an outstanding contribution to architecture. He deserves a mention in any discussion of industrial architecture becuase of the merit of one building, his most outstanding work, the Boots Factory at Beeston, Nottingham, built in 1932. In rationally approaching the problem, Williams ignored all building and planning precedents. Built of reinforced concrete and glass, the building, according to the Architects Journal (3 Aug 1932), was "a new species of factory design" because of the "sanity with which these two materials are used and the simplicity, even nakedness, of the design". (34)

During the War, factories in Britain were usually light steel structures covered with asbestos-cement cladding and topped with north-light roofs. In America, the war-time blackout gave a great boost to windowless factories, but twenty years later, although mechanical ventilation and lighting had become the norm, windows were reintroduced because people find it pleasant to look out. Until the end of the 1950s factories with short spans (less than 10m) and pitched roofs (lower than 4m) provided minimal enclosures for simple production equipment. Following the World War II, two major factors influencing factory design were : 1. Providing flexible space for optimising production layout and flow of materials and 2. speed of construction at low cost.

The Americans in the 1950s and 60s had adopted deep plans and air-conditioned windowless spaces for factories. But, in Britain the need for low cost meant that flexibility of the structure was never achieved, the two influences being mutually conflicting. It was in the 1960s that windowless, air-conditioned factories were introduced in Europe. But, the monitor roof, designed to allow a controlled amount of sunlight to do away with the shadow behind the machinery, was favoured for deep plan, air-conditioned spaces. Some factories were purpose- built to suit a particular process, later proving unsuitable for other types of production.

The OPEC crisis of 1973 has been the most important recent influence on industries, stimulating designers towards energy conservation. Long-term industrial disputes have also had an influence on the trend of industrial growth. Moreover, there has been growing evidence that both improved productivity and labour relations result from care taken in the design of the workplace.

The industrial building has come a long way since its humble beginnings. Its journey from cottage industry to the technologically- advanced units of the day is in essence a testimony to necessity and the ability to adopt to changing sources of power, machinery, building materials and methods of construction. Industrial buildings have broken away from meaningless imitation of fragments of the past to have an expresssion which in uniquely "Industrial"

References :

1. POWELL, K., "Facade and Function", Satanic Mills,, M. Binney et al, Save Britain's Heritage, London, 1978. p. 51
2. JONES, E., Industrial Architecture in Britain 1750-1939, B. T. Batsford Ltd., London, 1985, p. 21.
3. RICHARDS, J. M., The Functional Tradition in Early Industial Buildings, The Architectural Press, London, 1958, p. 14.
4. MUNCE, J. F., Industrial Architecture, F. W.Dodge Corp., New York, 1960, p,1.
5. WINTER, J., Industrial Architecture, Studio Vista, London, 1970, p. 23.
6. McINTYRE,A., The Shell Book of British Buildings, David and Charles (publishers) Ltd, London, 1984, p. 310
7. JONES, E. , Op Cit, p. 67
8. WINTER, J., Op Cit., p. 7
9. TRINDER, B., The Making of the Industrial Landscape, J. M. Dent and Sons Ltd., London, 1982, p. 129
10. RISEBERO, B., Modern Architecture and Design, The Herbert Press, London, 1982, p. 230
11. BROCKMAN, H. A. N. , The British Architect in Industry 1841-1940, George Allen and Unwin Ltd., London, 1974 p. 17
12. Ibid, p. 42
13. BAGENAL, P., MEADES, J., Great Buildings, Salamander Books Ltd. 1980, p.132
14. JONES, E., Op. Cit, p. 102
15. Ibid, p. 67
16. TRINDER, B., Op Cit., p. 243
17. Jones, E. Op, Cit., pp. 127-28
18. BROCKMAN, H.A.N., Op Cit., p. 94
19. BAGENAL P., MEADES, J., Op Cit., p. 128
20. BROCKMAN., H. A. N. , Op Cit., p. 44
21. JACOBUS JR., J., "Modern Architecture", World Architecture, T. Copplestone (Ed.), The Hamlyn Publishing Group Ltd., Middlesex, 1963, p.305
22. BROCKMAN, H.A.N., Op Cit., p. 68
23. HARRIS, T., Three Periods of English Architecture, B. T. Batsford London. 1894, p. 157
24. BROCKMAN, H.A.N., Op Cit. p. 81
25. BAGENAL, P., MEADES, J., Op Cit., p. 130
26. JONES, E. Op Cit., p. 198
27. BROCKMAN, H.A.N., op Cit., p. 103
28. Ibid, p. 96
29. MUNCE, J. F. Op. Cit, p 9
30. BEHRENS, P, The Turbine Hall of the AEG", History of Architecture & Design. 1890-1939, Milton Keynes, 1975, pp 56-57.
31. BROCKMAN, H.A.N., Op Cit, p 98
32. Ibid, p. 126
33. JONES, E., Op Cit. p. 205
34. BROCKMAN, H. A. N., Op Cit, p. 159

The role of the Architect in Producing Thermal Comfort in the context of existing conditions in Dhaka

ZEBUN NASREEN AHMED*

Abstract

The building and its elements should be properly utilised to create appropriate building-climate interactions. The end result must be the creation of more comfortable and suitable interiors than existing exteriors. The Architect during the design process is involved in taking various decisions which have a direct impact on this relationship. The approach to these problems, namely those of orientation, shading, internal planning, choice of materials, etc., is dependent on the characteristics of climate that a region is facing. The appropriate approach for Dhaka has been discussed in view of some recent research.

Whereas climatic designing is not the only consideration in the designing of buildings the proper recognition of the effects of climate on the building fabric will ultimately help the Architect to produce better environments more easily.

The achievement of comfort has always been one of the main aims of designers of buildings all over the world. The means to achieve comfort, however, may be varied for different climates, depending on the nature of the problem, i.e. whether it is hot dry, hot-humid or cold.

According to Atkinsons Climate Classification (1), Bangladesh may be placed in a zone called

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Composite or Monsoon' climatic zone. These climates usually occur in large land masses near the tropics of Cancer and Capricorn, which are sufficiently far from the equator to experience marked seasonal variations in solar radiation and wind direction. These climates are normally said to have two distinct seasons, a hot-dry and a warm-humid season, and often a third, best described as cool-dry.

The air temperatures in shade, specified for the different seasons in this zone are found to be in remarkable agreement with the prevailing conditions in Dhaka, as seen by comparing Tables 1 and 2 .

Table 1. Shade air temperatures for Composite or Monsoon, Climate, Specified by Atkinson.

Seasons	Hot-dry	Worm-humid	Cool-dry
Dagtime mean-max	32°-43 C	27°-32 °C	upto 27 °C
Night time mean-max	21°-27°C	24°-27 °C	4°-10°C
Diurnal mean range	11-22 degC	3-6 degC	11-22 degC

Table 2 Shade air temperatures in Dhaka (2).

Seasons	Hot-dry	Warm-humid	Cool-dry
Daytime mean-max	33.6 °C	31.3 °C	26.6 °C
Night time mean-max	21.7 °C	25.4 °C	14. 6 °C
Diurnal mean range	11.9 degC	5.9 degC	12 degC

The means to produce comfort in such a climate is different for the different seasons. Thus, in the hot-dry summer, we would prefer to keep our interiors cool by keeping out the dry and dusty heated air and encourage humidification to a certain extent. In the warm-humid season, on the other hand, we would like to encourage breeze penetration into the interior, thereby supplementing cooling by evaporating the moisture ever-present on our skin surface. Dehumidification would also alleviate discomfort to a great extent.

Depending on the economic condition of the occupant of a space, comfort is achieved by employing different methods, given the same situation. Thus, the more affluent society in this country tend to resort to the use of air-coolers, while others who can afford it are satisfied with the mechanical inducement of air movement with the help of electrical fans. The common mass however depends largely on natural ventilation.

Among other things, the Architect during the design process has control over various design decisions which produce varied climatic responses in a building. The decisions involved are :

- Building orientation
- Window orientation
- Window shading
- External colour
- Coordination of external-internal spaces
- Choice of material

Proper manipulation of these design decisions is bound to produce comfort conditions for the occupant. Once this is done conciously, it becomes possible to achieve the maximum amount of comfort possible for a given site, within the limits set by the climate.

When the conditions are such that natural breeze penetration and radiation prevention are still not adequate in producing comfort, as is often the case in Bangladesh, one could resort to the use of artificial means only then, such as fans and air-conditioners.

But the load on the system could be considerably reduced by proper climatic designing, and thus expenditures could be brought down significantly. This would benefit not only individual owners, but its effect would also be felt on a wider sphere in a reduction of world- wide fuel consumption, which is one of the aims of all designers in this "energy-crisis" era.

Orientation

Proper building orientation is one of the features rightly emphasised from the early stages of design. Often the most coveted orientation for Dhaka, .i.e. north-south, is impossible for a given site, because of the site's geometry and orientation. Givoni's studies in the Middle East (3) show however, that often buildings inclined to the wind produce significantly better indoor air-movement/circulation patterns than buildings which face the prevailing direction of flow directly. In whatever way the architect decides to design the building, however, he should keep in mind that the end result must be an interior where thermal conditions are significantly better than the exterior.

In a recent study conducted by this author in the U.K.(4), window orientation for buildings in Dhaka was studied aiming to exclude solar radiation during the hot periods of the day. It is a known fact that southern and western walls of a building receive huge amounts of solar radiation during the course of each day in our hemisphere. When these walls are pierced by windows, direct radiation from the sun penetrates into the indoor areas, thus creating an even greater source of heat. There are two ways to avoid this, the first being the total avoidance of windows, which of course, is a total impossibility from the ventilation point of view. The other alternative is to properly shade the windows which face those parts of the sky in which the sun will pass. The sun position in the sky can be found from graphical projections of the sky for the latitude in question, among other methods.

Window shading
When a window is provided with shading, the shaded part of the window receives no direct radiation, though it continues to receive its share of diffuse radiation from the sky (5), as seen in

The shading can be internal, eg. curtains and blinds, or external, eg. horizontal overhangs, vertical fins and eggecrate, and they can be fixed or adjustable. Researchers show that external devices are much more efficient than internal ones and can eliminate more than 90% of the heating effect of incident solar radiation when properly utilised. (6)

Table 3. Dimensions and Proportions of Shading

Shading Window orientation	Horizontal over window (x window ht)	Vertical shade beside window (x window width)
North	none	0.5 on West
South	1.19	0.96 on West
East	0.7	none
West	not possible	not possible
North West	none	2.74 on West
North East	0.36	0.36 on East
South West	2.14	11.4 on West
South East	1.07	none

Table 3. shows the dimensions and proportions of external, vertical and horizontal shading devices relevant for buildings in Dhaka, calculated by the author (4), for eight directions. It is clear from the Table 3 that windows facing west in Dhaka are impossible to shade from above or the sides. These windows can be shaded by slanting louvres.

A knowledge of cloud cover of the area in question should also be kept in consideration during shading design. For the skies in Dhaka, which remain predominantly overcast from May/June to October, the sun position may not be the determining factor in shading design. In our overcast skies, glare is often a greater problem than direct solar radiation, as the overcast sky has an illuminance often exceeding 700⁰ candela /m2, where the deep blue sky may have values as low as 1700 candela/m2, according to Koenigsberger et al (7).

When glare from the overcast sky vault is the problem, any part of the visible sky will produce the glare; the higer the area visible, the greater will be the glare. In such cases the view of the sky at the horizon may be acceptable.

For situations where we are faced with clear as well overcast skies, the shading solution has to be thought out with greater care, weighing the pros and cons properly.

Another area directly under the control of the architect during the design process is the external colour of the building.

On testing the internal temperatures of buildings of various colours researchers found (7) that buildings of white exteriors keep considerably cooler than even light grey or coloured ones. Black buildings were found to be extremely heated.

Co-ordination of external-internal space

Probably the Architect is best trained in the proper planning of internal spaces and after years of experience, the manipulation of these spaces for greater thermal comfort comes naturrally and

intuitively to him. In this respect, the architectd is required to keep areas much in use properly ventilated and shielded from the sun. Along with this he must also consider the external-internal space relationship and realise its impact on the overall comport of the occupant. With this in mind, it is important to ensure that the incoming air is not unduely heated, prior to entry, by passing over heated surfaces like external pavings. This would point to the avoidance of large areas of pavings on the southern parts of the building.

Verandahs, which are semi-exterior spaces, should also be placed to cath the breeze, provide shading for the interior and the same time make pleasant seating spaces for the occupants when the need be such. Vegetation and landscaping elements can be made use of as solar shielding devices, both on external paved spaces, as well as critically exposed walls. The courtyard concept, so popular in rural housing in Bangladesh, is an excellent climate nodulator while at the same time being very sympathetic to the social customs prevalent in the area. From the thermal comport point of viewd, these spaces provide natural breeze at the same time as shade. Unfortunately space constraints in the urban scence along with changes in overall social behavior has slowly deleted this element from Dhaka's modern dwellings.

Choice of building material

In the process of decision-making concerning the choice of building materials, the concept of thermal insulation should be kept in mind. Thermal insulation is basically of two types, capacity insulation and resistance insulation.(8)

Materials with high capacity insulation, like stone, insulate chiefly by their mass; thus the thicker they are, the more effective is the resulting insulation. High thermal capacity constructions such as stone, thick walls of concrete, brick or mud, are necessarily heavy-weight constructions and are ideally suited to hot-dry climates where the temperature peaks can be modified to serve thermal needs and the times of these peaks occuring can also be chosen to suit the occupant's activities.

A material with high resistance insulation resists the entry of heat by the very nature of its structure of composition, which is light and porous with plenty of air gaps adding to the overall insulation value, such as insulating timber boards, aerected or light- weight concrete, etc.

Low thermal capacity constructions without insulation respond very readily to external temperature changes (9) and tend to equalise the outdoor-indoor temdperature variation at a rapid rate. Whereas this characteristic may not pose any significant problem during our rainy season, when diurnal variations in temperature are negligible, it will certainly not help in creating pleasant interiors during the hot-dry cool-dry seasons.

As the buildings in Bangladesh have to weather all the three seasons it may be best to choose a material not too low in thermal capacity. 10" brick walls, fortunately appropriate for this purpose.

With small temperature different between indoor and outdoor an improvement in thermal insulation does not bring significant reduciton in the transfer of heat through the building envelope (10). This is the case in Dhaka where wide openings for air ventilation during the humid rainy season almost equalises the indoor-outdoor temperature values. However, certain western walls and the roof, which recieve large doses of direct solar radiation, will be heated to much higher temperatures than more favourably orientated surfaces and these can be considered separately and may be provided with thermal insulation in order to create more comfortable interiors in adjacent spaces.

For those Composite climatic zones which have a short-hot-dry season, it has been suggested by Mahoney (11), that the roofing material should be light-weight and insulated. The choice of whether to use capacity heavy roofs such as thick concrete, or high insulation light roofs should be based ultimately, on comparative analysis of cost and durability along with the availability of material and technical know-how for installation.

Conclusion

The thermal limitations discussed in this paper often pose great problems for the architect an may make design freedom virtually non-existent. However, the problem exists and must be recongnised as such. The designer must consider these problems, place them in their proper perspective and take steps accordingly. Proper recognition of building-climate interaction can only help to produce better environments at reduced prices, probably one of the chief aims, that the architect is forever striving to achives.

References

1. ATKINSON, G.A., Tropical Architecture and Building Standards. conference on Tropical Architecture, 1953.
2. Meterioldogical Station of Bangladesh, Dhaka.
3. GIUONI, B., Man, Climate and Architecture; Elsevier Publishing Company, London, 1959.
4. AHMED, Z. N. ; "The Effects of Climate on the Design and Location of Windows for Buildings in Bangladesh"; M phill Thesis Octd. 1982, Shefieid, UK.
5. JONES; W. P.; Airconditioning Engineering, Third Edward Arnold Publishers Ltd, London, 1985, p 123.
6. GIUONI, B.; op cit, p 216
7. KOENIGSBERGER, O. H., IDNGERSOLL, T. G., MAYHEW, A., SZOKOLAY, S. V. Manual of Tropical housing and Building, Part one, Climate Design, Longman, London, 1974, p. 142.
8. REID D; Understanding Buildings; A Multi-disciplinary Approach;
9. EVANS, M; Housing Climate and Comfort, The Architectural press, London, 1980, p. 101
10. KOENIGSBERGER......op cit p.142.
11. MAHONEY, C; Trends in House Design; Climate and House Design. United Nations Centre for Housing, Building and Planning.