PERFORMANCE APPRAISAL MODEL FOR SCHOOL BUILDINGS

A DISSERTATION

Submitted in partial fulfilment of the
requirements for the award of the degree
of
MASTER OF ARCHITECTURE

By
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CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the thesis entitled PERFORMANCE APPRAISAL MODEL FOR SCHOOL BUILDINGS in partial fulfillment of the requirement for the award of the degree of MASTER OF ARCHITECTURE submitted in the Department of ARCHITECTURE AND PLANNING of the University is an authentic record of my own work carried out during a period from 25th July 1992 to 25th January 1993 under the supervision of Mr. S.Y. Kulkarni.

The matter embodied in this thesis has not been submitted by me for the award of any other degree.

(SOUMYENDU SHANKAR RAY)

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

30/1/93

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DEPT. OF ARCHITECTURE & PLANNING
UNIVERSITY OF ROORKEE

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INTRODUCTION

1.1 INTRODUCTION :

1.1.1 Architecture is much more complex today than it has been before. In order to keep pace with the growing complexities, the practice of professional design has to become more scientific and rational. We often come across the practice of imperfect design methods based on blind guess work, lousy intutions and thumbrules. As a result, buildings often fall prey to excessive energy consumptions, over and under utilization of scarce spaces, environmental and visual discomfort and loss of users stimulation and satisfaction. This ultimately results in perennial loss of the work efficiency, economy and aesthetics.

1.1.2 In order to evolve designs with better performance standards, it is essential to cross examine and obtain feed back data on completed building. But unfortunately, the assessment of buildings in use has received far less research efforts in comparison with the design process, where as these design feed back can always be an important resource to update design knowledge and criteria.

1.1.3 In Architecture today appraisal is the missing link in the design process. Appraisal, programming and design are three linked acticvities. proper analysis of envireonment leads to better design solutions. It is, therefore, essential for the architect to conduct his own surveys into how people use their environment, what they like and dislike about it and what kind of environment users would prefer.

1.1.4 There is general agreement that very little is known about the actual performance of designed environments in comparison to that the designer expects their performance to be. Although several testing procedures have been developed to assess the technical aspects of performance, there is no comprehensive model for judging and comparing from user's point of view.

1.1.5 The performance appraisal model can be only developed by considering a particular type of Building. A School stands as an ideal choice. A school building does have very impressive spaces. Besides, the schools being protoype in nature, it will be easier for the evaluator to compare and analyse.

1.1.6 With the Increasing commecialism, most of the schools today pay no attention to create proper healthy environment, which is absolutely necessary for growth of students. A healthy school environment combines a happy blend of Indoors and outdoors. The indoors should be bright and cheerful, where as outdoors should be carefully planned to encourage them in learning. Hence for the growth of community, it is essential to see that the schools are properly planned. A performance appraisal model can help in developing parametrers to evaluate a school environment.

1.2 IDENTIFICATION OF THE PROBLEM

1.2.1 Keeping a view at the growing comnplexities of modern society , it is acceptable that common sense, intution and practiced experience alone are inadequate to deal with the complex demands of Architectural

2

BACKGROUND STUDIES

profession. Hence the need for a performance appaisal model requires no further elaborartion.

1.2.2 The techniques and models present today are mostly from management science, operation research and sociology. Despite their pit falls these techniques are necessary aids to the understanding of the complex and rapidly changing social and economic environment, But unfortunately, there is no comprehensive model till today developed by architects to measure the qualitative aspects of buildings, in general and schools in particular.

1.2.3 A measure of good design is overall efficiency and economic value combined with high level of amenity and aesthetic quality generating optimum user satisfaction. Hence understanding the needs of users is essential for designed environments. Performance appraisal model can be an innovative kit to maximize user participation in design process.

1.2.4 The models, no doubt, can not replace the designer's judgement. But an appraisal model can provide a frame work for detailed analysis and statistics.

1.2.5 Architecture is a continuous process. If the profession has to grow, we must learn from the mistakes from one project, so that it is

not repeated in the next project. Performance appraisal is absolutely necessary to keep this continuity between projects.

1.2.6 Suggesting one model for all building is an impossible task,m because different buildings types have different functional requirements. Hence, the study is limited to school building because of three reasons. First, it is easier to find out different schools with similar functional needs for comparing and analyzing. Secondly, school has got a collection of different variety of spaces, starting from class rooms to playground and teachers lounge to swimming pool. Thirdly, till today there is no comprehensive Architectural model to evaluate the performance of a school

1.3 AIMS AND OBJECTIVES :

1.3.1 To develop a set of comprehensive appraisal and measurement techniques for school buildings..

1.3.2 To work out a performance scale to compare and rate the design solutions of schools.

1.3.3 To identify the deficiencies related to user needs/functions/spaces/forms/economics and aesthetics along with their implications in school design.

1.3.4 To obtain a feed back data on completed school buildings and modify design process for more effective performance.

1.3.5 To formulate design intentions/decisions to be arrived at in an existing school building to improve its performance standard.

1.4 SCOPE AND LIMITATIONS :

1.4.1 This study aims at assessing current techniques for the post occupation appraisal of performance of school buildings and evolving a process of performance for better adoption into design practice.

1,4,2 In order to set limits to the projects, only techniques related to spatial analysis aspect of schools will be considered.

1.5 METHODOLOGY :

While evaluating a specific building project, the reference materials are comes across are in the form of general guidelines. No single reference material applies exactly to any specific problem and on top of that they are not detailed. Hence, it is interactive to develop a specialised methodology considering the degree of impact and usefulness. Hence, the methodology is,

1.5.1 Comparative study of various models for both qualitative and quantitative measurements and appraisal.

1.5.2 Physical measurement techniques.

1.5.3 Observational aids, check lists, appraisal forms, data forms etc.

1.5.4 Interview, behaviour observation techniques, questionnaire including suitable sampling procedures.

1.5.5 Analytical assessment of available models on the basis of accuracy, time, cost and expertise required.

1.5.6 Modification and development of appraisal model for adoption of school design.

CHAPTER 2 : BACKGROUND STUDIES

2.1 PURPOSES OF PERFORMANCE EVALUATION :

In a general sense performance evaluation provides the logical basis for comparison between alternatives. In that sense, its purpose is singular. However, considering the number of individuals involved in all aspects of design as well as the multiplicity of interests that they represent, it is safe to assume that evaluation may have multiple purposes.

From a behavioral point of view, evaluation is necessary in order to improve our understanding of simple and complex behaviour units. This has usually been simplified as the reciprocal effects that all sociophysical environment has on humans and vice versa.

From a resource expenditure point of view, the King's fund report of 1969 provides the following reasons for the emerging needs for evaluation.

1. Management : bad design is costly.

2. Seeking ways to upgrade old facilities.

3. Improvement of wasteful procedure by design changes.

4. Expectation for increased building activity while there is shortage of information based practical experience, and

5. Pressure for standardization require deliberate assessment.

Further, as the concept of evaluation during the design process becomes operational, additional benefits are accured for both the technical and the resource expenditure aspects of the need for evaluation. The techniques for such a concept, however, must be expanded in order to include the behavioral aspects of design of evaluation during design is to achieve its full potential.

2.2 USE OF APPRAISAL IN DESIGN :

2.2.1 NEED OF APPRAISAL :

In spite of various opinions about design process, there are the most commonly agreed upon division of design process fall under three heads :

- Analysis
- Synthesis
- Appraisal

With the growing complexities of Architectural profession and keeping a view of the vast variation in the nature of architectural projects, a rigid, morphological and descending order of design process as described above often brings defective results. The degree to which a building reflects, its purpose, reflects the profession competence employ. As a result, the shift of emphasis is felt from stereotype designs to designs based on evaluation of behavioural or technical performance. This shifts of attention to performance criteria may be attributed to several reasons such as the increasing social

awareness, the improvement of understanding of human behavioral and the development of techniques to define and measure performance both in human and technical terms.

Hence, the design process must have sufficient emphasis in appraisal for which it has to be interactive and open ended. Hence, a linear system having a scope of obtain a feed back at any level of designing and developing is necessary. The process does have three parts which are inseparable and can occur at any time.

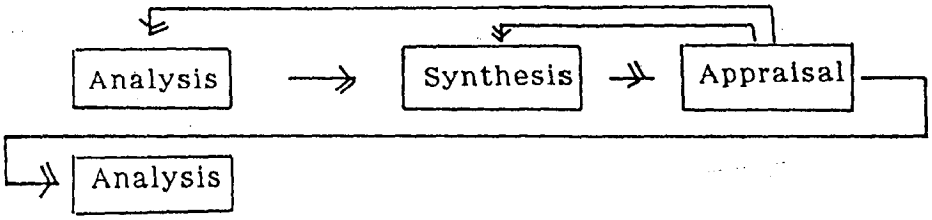


Fig. 1 : Appraisal in the design process

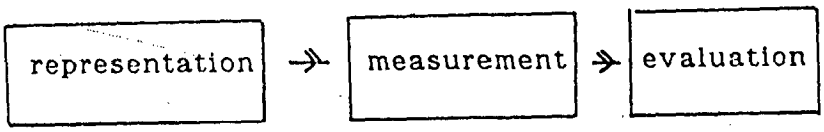


Fig. 2 : Three basic steps of appraisal

2.2.2 ANALYSIS : UNDERSTANDING OF THE PROBLEM :

Analysis includes gathering of all relevant informations the establishment of relationships, constraints, objectives, criteria etc. In short analysis is the imaginative structuring of problem and if well done, can lead to good and imaginative

solutions. The designers pattern seeking and pattern recognition skills are as vital as finding a good solution later. His values and the nature of his concepts, will determine what he observes. The nature of this as a purely rational process has led to many vast and irrelevant, sometimes actually useless, analytic design briefs.

2.2.3 SYNTHESIS : PRODUCING A DESIGN SOLUTION :

The problem structure may suggest part or whole solutions. There is a great body of literature and experience suggesting a rich variety of rational intuitive, ordered and random processes which may be appropriate to different problems and different personalities.

The process may result in a single design or a variety of different designs or a cluster of similar designs. In the search for the best solution the designer either select best from amongst or combines all variants.

The most commonly used process may be predictive or simulation or through multimodal roots.

2.2.4 APPRAISAL : ESTABLISHING THE PERFORMANCE OF THE SOLUTION :

Appraisal is a retrospective ac t by which the designer establishes the quality of his solution. There are three basic steps in appraisal :

- Representation
- Measurement
- Evaluation

i. Representation :
Verbal, Mathematical, Visual, Full Scale

ii. Measurement :
Costs, Environmental conditions, flexibility, space, utilization, Ergonomic effects

iii. Evaluation :
Cost benefit analysis, aesthetics, judgement comparison with ideal, average or statutory performance, conformity to constraints recorded in the analysis.

2.3 SCHOOLS TODAY : AN OVERVIEW :

India has got a very complex educational system. The ancient India had the rich cultural heritage of Gurukul system having residential campuses like Taxila, Nalanda. During the muslim rulkes there was a shift of educational centres from rural to urban areas. But unfortunately during the British rule, the traditional education system was dissolved and emphasis was given on creating employment oriented educational system in stead of personality development. But, however in the post independence period there seems to be a trend to expand and nationalize the education system through central policy.

In order to understand this diversified and complex

nature of educational systems prevailing in the country three schools of different nature were surveyed.

The Schools are :

1. Mussoorie International School :
   a modern school designed by an American Architect and set up with NRI funding.

2. Gurukul Kangri Vidytalaya :
   Situated in Haridwar, the school is based on Gurukul system of imparting education.

3. Navodaya Vidyalaya :
   A standardized school set up by C.B.R.I., Roorkee.

2.4.1 Mussoorie International School :

Mussoorie International School (MIS) is a newly constructed boarding school, situated 4 Km. outside the hill station of Mussoorie (300 Km. north of New Delhi) in a peaceful, romantic and spiritual atmosphere entrancing natural beauty, facing the snow covered range. The school admits 250 girls from all over the world ranging from 6 to 12 years. The school follows British GCE 'O'and 'A' level curriculum.
In this residential school the students are looked after by mostly european teachers, matrons, nurses and a residential doctor.

Designed by an American Architect on a 27 acre site, the school campus possesses a luxurious dormitory, auditorium, well equipped infirmary, library,

computers, laboratory, music room, art room, sports and recreational facilities.

2.4.2 GURUKUL KANGRI VIDYALAYA :

Gurukul system is based on the brahmanic education pattern founded in Bengal at the beginning of 19th century. The Gurukul system emphasizes on following :

1. In Brahmanic system Hinduism tried to reconcile physical and spiritual existence keeping self realisation as its chief aim. Gurukul system based on these ideas, is individualist in spirit but socialist in action.

2. The curriculum and methods of education are based on psychological principles of development of knowing , feeling and willing through 'Karma'

3. The curriculum includes Brahmacharya, Brahmajnana, spiritual science, Mokshashastra, Secular science, Dharma Artha and Kamshastra. Discipline is mantained by love and persuasion.

The relationship between Guru and Chela (student) is a very special relationship and this relationship is maintained in all branches of education.

2.4.3 NAVODAYA VIDAYALAYA :

Navodaya Vidayalaya is a prototype school designed and developed by central building research institute, Roorkee. Besides class room the school contains

laboratory. open air theatre, museum, multipurpose room, first aid, play grounds etc. Class rooms are mostly placed linear in a doubly loaded corridor having a provision for one outdoor class room.

3

ANALYSIS OF EXISTING MODELS

ANALYSIS OF EXISTING MODELS

" The capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for objectively rationality"

- H.A. Simon in `Models of Man'

A performance appraisal model, in the simplest possible definition is some formal structure or method which sets the parameter and criteria for post occupational evaluation of a building. Models and mathematics are often seen to be inseparably linked, and the connection between mathematics and digital links, and the connection between mathematics and digital computer is too familiar. However, there are, valuable uses of the concept of model in both Architectural theory and practice which do not have specific mathematical expression. This chapter deals with the analysis of three existing performance Models for use of school buildings, the models are :

a. PAK , A Mathematical Model
b. Quality Quotient, A theoretical Model
c. PACE, A computerized Model

3.1 BASIS OF ANALYSIS :

There is general agreement that very little is known about the actual performance of designed environments in comparison to what the designer expects their performance of be. Although several testing procedures have been developed to assess the technical aspects of performance, there is no measure for judging and comparing the valve of a physical artifact from the user's point of view. Hence, the models recommended for appraisal are mostly from management science, operation research and sociology. Despite their pitfalls,

these models are necessary aids for the understanding of the complex and rapidly changing social and economic environment.

In this chapter, as attempt has been made to compare effectiveness of three existing models for application to school building. Since all these three models have been developed by westerners and not particularly for school buildings their relevance in Indian context and applicability to school buildings were needed to be verified. Hence, the basis of analysis were as follows :

- Applicability to school building
- Relevance in Indian context
- Validity
- Reliability
- Precision
- Convenience

3.1.1 APPLICABILITY TO SCHOOL BUILDINGS :

Applicability to school buildings has to be given special attention. Specially when models are developed by people from sociology, management science, operation research etc. its utility in the context of Architecture and Schools in particular are a special consideration.

3.1.2 RELEVANCE IN INDIAN CONTEXT :

The aims and objectives of primary education in India is different from western world so also the school design. Since, all the three models have been developed in the west their relevance in Indian context, is needed to be verified.

3.1.3 VALIDITY :

Validity is the degree to which the model outlines and emphasizes on the physical aspect of school projects.

3.1.4 RELIABILITY :

Reliability is the degree to which it is consistent on tried over and over.

3.1.5 PRECISION :

The degree to which it is sensitive to significant variation in what is being tested.

3.1.6 CONVENIENCE :

How convenient and easy the model to apply for a specific evaluation.

The above properties are particularly important when Man himself is the evaluation instrument.

3.2 TYPES OF APPRAISAL MODEL:

If post construction evaluation research is to provide relevant feed back that designers, researchers and clients can learn from. We must closely examine the model that guides the research. The three models presented below very in their cost benefit potential for providing useful feed back to decision makers. The models describe representative points on a continuum of post construction evaluation research studies.

3.2.1 MODEL 1 : NON COLLABORATIVE EMPLOYING : A CROSS SECTIONAL USER STUDY

This approach may not constitute a valid case of post construction evaluation because, though the data is collected at some time after construction in the occupancy life of the building, the researcher uses criteria that are established independent of the design process and they do not focus on concerns that were influential during decision making.

The basic decisions governing the research focus are made by the researcher. It is identified as a cross sectional study. In research terns this means the study does not encompass the extended period of time that preceded the occupancy of the building. Rather, it cuts across a slice of time to study the current uses. This model represents a majority of the user satisfaction building evaluations that currently exists.

3.2.2 MODEL 2 : COLLABORATIVE, EMPLOYING A CROSS SECTIONAL USER STUDY :

The model of post construction evaluation utilizes the data collection approaches to determine decision makers criteria and user reactions. First, discussions with the architect and client are held to identify the major issues, goals and constraints that influenced the design decision making. Second, a cross sectional study with users is done to determine how the building is working relative to these decision makers concern. This strategy introduces collaboration and expands the potential value of the research findings as feed back

3.2.3 MODEL 3 : COLLABORATIVE, EMPLOYING A LONGITUDINAL AND CROSS SECTIONAL APPROACH :

This approach to post construction evaluation is the most comprehensive and complex. It includes a longitudinal and complex. It includes a longitudinal data collecting effort and a close working relationship between the architect, client and researcher once the decision to build has been made. The researcher becomes a participant observer in the actual design and decision making process.

3.3 PAK MODEL :

The Planning Aid Kit (PAK) developed by the buffalo organization for social and technological Innovation (BOSTI) is an attempt to systematically gather and disperse information about the process of mental health programming to aid local communities. PAK has been designed to help community mental health services, sets up a self perpetuating system of user directed information retrieval aimed at establishing a data base for man environment relations.

3.3.1 PLANNING PROCESS :

Planning process is based on five types of specifications :

1. HARDWARE :
   Specifying building hardware and elements.
2. SETTINGS :
   Specifying kind of Human performance it shall support.
3. ACTIVITIES :
   specifying what kind of human problems the

SELECT AND INVITE

PARTICIPANTS

LIST ALL

PROBLEMS

LIST AND GIVE PRIORITIES TO

COURSES OF ACTION

SELECT THERAPEUTICALLY IMPORTANT

ACTIVITIES

SELECT IDEAL

ENVIRONMENTAL CHARACTERISTICS

FIND, MODIFY OR BUILD NEW

SETTINGS

OPERATE

EVALUATE

Planning aid kit (PAK) process.

performance will solve.

4. PROBLEMS :
   Objectives to be met.
5. PROCESS :
   Choosing objectives.

Solving a problem through performance techniques entails putting the problem statement through a series of transformations which converts the statement of the problems to a stated set of activities. The steps involved in carrying out these translations were :

1. Select and invite participants
2. List of all problems
3. List and give priorities to course of action
4. Select therapeutically important activities
5. Prescribe performance characteristics
6. Design settings

3.3.2 PERFORMANCE CHARACTERISTICS :

Performance characteristics is a continuum with no values ascribed to either end. For example, two different physical settings may require extreme privacy or open commonalty and either will be considered a positive value for that setting.

PC 1	Commonalty	privacy
PC 2	Sociopetality	Sociofugality
PC 3	informality	formality
PC 4	familiarity	Remoteness
PC 5	Accessibility	Inaccessibility
PC 6	Ambiguity	Legibility
PC 7	Diversity	Homogeneity

PC 8	Adaptability	Fixity
PC 9	Comfort	Discomfort

MEASURES OF PERFORMANCE CHARACTERISTICS :

If we are to compare and evaluate setting , there must be some way to measure each performance characteristics. For each PC, we will define the continuum, then make a concise statement about one end of the scale and assume the other end it is opposite. Then we will state some measure for the PC. Normally, we measure and achieve performance within the context of Y = f(x) and get result such as 3.57. This is not always possible and in some cases ratios (x, y) and size comparisons (Y x or x Y), are employed. Ultimately we accept(Yes/ No) as a measure. It is in this context that we attempt to develop measures.

A Scale for the Performance Characteristics :

We wish to have a common scale to compare one proposed or actual setting with another. Assuming a scale of 5 increments for all Measures of Performance Characteristics, for each measures we have a scale of , from left to right.

+2.....+1.....o.....1.....2

Finally, $D = f_1 + f_2 + f_n + \ldots\ldots f_n$

where,

D = Diversity

f = formal activity setting

A = No. of f's

3.3.3 Comments :

PAK can be considered as an ideal technique for describing goals and objectives in terms of performance

while permitting the generation of many alternative solution which yield performance.

3.4 PACE :

PACE 1 (PACE = Package for Architectural Computer Evaluation) is intended to the used at the outline proposals stage of the building design activity. The package is written in fortran IV and runs on the time sharing system operated by systemshare limited. As the input and foutput formats will show, the mode of interaction between the designer and the computer is 'conversational' with the machine taking the initiative. The responses from the designer may be typed directly onto.

the keyboard as the programme runs, prepared before hand on paper tape which automatically feeds in data as required by the programme, or written file.

3.4.1 INPUT FORMAT :

```
PROJECT NAME ?
? EXAMPLE
ARE YOUR UNITS IN METRIC ? 0/1
?0
.....
INPUT EXAMPLE
.....
GENERAL INFORMATION
WHAT IS YOUR BUILDING: TYPE ?
1     SCHOOL
2     HOSPITAL
3     OFFICE
4     HOUSE
5     FACTORY
```

```
6      FACTORY (SHIFTS)
WHAT IS TOTAL OCCUPANCY OF SCHEME
?1000
1WHAT IS LOCATION OF SITE
1 = SCOTLAND
2 = MIDLANDS
3 = SOUTH
?1
WHAT IS THE ALTITUDE TO NEAREST 50 FEET
?50
```

```
.............
GEOMETRIC INFORMATION
-- -- -- -- -- -- -- --
TYPE COMPONENT NO., AND ELEMENT NO. ON ONE LINE
AND ON NEXT LINE 6 COORDINATES
DO THIS FOR ALL ELEMENTS FINISH WITH TWO ZEROS
?1,1
-----
?160,40,0,320,200,10
```



```
?2,1
```



```
160,40,10,320,200,20
----------------------
?3, 1
-----
?40,120,0,160,280,20
?4, 1
?40,120,0,160,200,10
--------------------
?5,1
?40,280,0,120,360,20
---------------
```

```
?6,1
--------
?280, 200, 0, 320, 280, 10
?6,2
----
INSULATION DATA
?1,1,1,1,1,1,1
---------------
COMPONENT  4
ELEMENT    1
GLAZING DADA
?2M2M2M2M0
------------
INSULATION DATA
?1,,1,1,1,1,1,
----------------
COMPONENT   6
ELEMENT     1
GLAZING DATA
?2,2,2,2,2,0
INSULATION DATA
?1,1,1,1,1,1
------------
ELEMENT     2
GLAZING DATA
?2..2..2..2..2..2,0
_____________________
INSULATION DATA
?1,1,1,1,1,1,
_____________
.............
ACTIVITY DATA
- - - - - - - -
TYPE COMPONENTS NO. ON ONE LINE
```

AND ON NEXT LINE: ASSOC OF THAT COMPONENT WITH EACH OF HIGHER nO.

WHEN ALL IN TYPE ZERO

?1

?3,5,2,9,3

?2

—

?1,7,6,2

?2

—

?1,7,6,2

?3

?5,2,7

?4

—

?3,3

—

?5

?1

?0

3.5 QUALITY QUOTIENT

3.5.1 TRIAD THEORY :

Caudill Rowlett Scott devised a quick measurement yardstick to grade projects on the basis of the triad theory. Triad theory reflects a deliberate attempt to give equal emphasis to three major elements of a designed product viz. function, form, economy. It is invariably, noticed that an Architect in his effort to create

beautiful forms neglects function and economy. Hence, set of questions were set to be used as evaluation criteria.

3.5.2 FUNCTIONS :

1. Is there a concept (underlying idea), and are the spaces grouped, sized, and the shaped to reinforce the concept ?

2, Do the spaces have affinities which allow people and things to flow with efficiency.

3. Have the shelter considerations and environment controls been reorganized ?

4. Does the building work in the genetic sense as a school helps to teach and a hospital helps to cure?

5. Is the plant buildings and grounds imaginatively conceived ?

6. Have the major operational probelms (Security, maintenance, routine operation) been considered for the future as well as the present ?

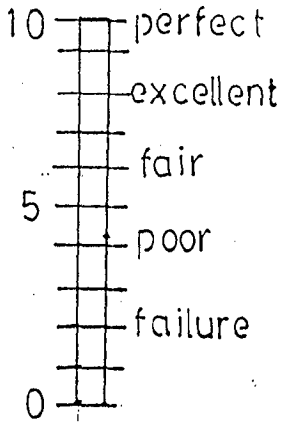
3,5,3 FORM :

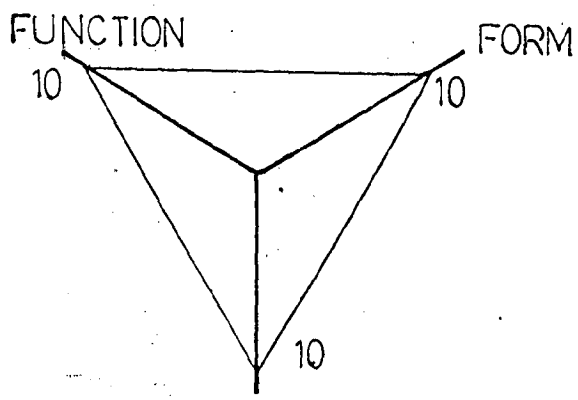
7. Is there propriety in the form and

FORM :

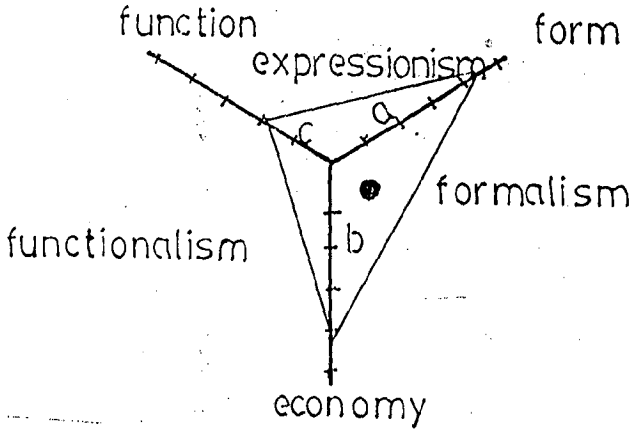
7. Is there propriety in the form and spaces reflecting the concept.

8. Do forms and spaces possess the spirit of the times without being faddish ?





10 -10-10 is the triangle of perfection



the position of centroid indicates tendency

QUALITY QUOTIENT

$Q.Q. = 0.433(ab + bc + ca)$

QUALITY QUOTIENT

FIG-4

9. Do the forms – major and minor together with their connections take advantage of up to date technology
10. Does the composition of form and space contain both variety and unity projecting an aura of architecture ?
11. Are fall forms meaningful – from mass to details ?
12. Is there a systematized integration of structure mechanical and electrical ?

3.5.4 ECONOMY :

13. Are the forms clean ?
14. Do the spaces permit efficient operation capitalizing on the idea of maximum effect with minimum means ?
15. Is there a realistic solution to the budget problem
16. Can this building be changed economically, either through conversion or expansion to meet future requirements ?
17. Has industrialised building method been given serious consideration by saving time and labour on the site.
18. Can this building through its culmination of waste, dignity through restra i nt and simplicity of construction, be classified as most for the money.

Because of this wide range of architectural products cities to buildings to windows there must be a wide range of talent. We need doorknob and we need big city. People working together as a team to make the environment a decent place to live . And due need methods to evaluate the products which these people produce. The question sets help to provide the method.

3.5.5 SCALE FOR SYSTEMATIC EVALUATION :

On the basis of the triad theory a logical approach to evaluate projects with simultaneous consideration of function, form and economy gave birth to a triangular scale `triad in equilibrium'. Each coordinates of the triangle was given `10' point score where "5" was considered fair and `10' was considered excellent. Hence, a 10-10-10 triangle having an area of 129.89 ( Say 130) was considered as absolute and hence designated as `triangle of perfection'. The location of the centroid of the triangle indicated the tendency of the product to functionaolism formalism or expressionism.

- ANALYSIS OF EXISTING MODELS			
Basis of Analysis	PAK	Quality Quotient	PACE
Applicability to School building	Fair	Fair	Good
Relevence in Indian context	Fair	Good	Good
Validity	Poor	Poor	Poor
Reliability	Poor	Poor	Fair
Precision	Fair	Bad	Excellent
Convenience	Excellent	Fair	Good

Fig. 5

4

DEVELOPMENT OF A MODEL

DEVELOPMENT OF A MODEL

4.1 CONCEPTS OF APPRAISAL :

Any serious attempt to develop an appraisal model for school design required combining several areas of disciplinary knowledge as well as professional expertise. As discussed in earlier chapters the traditional methods and criteria used in the evaluation of overall performance of educational facilities design are inadequate in terms of both contemporary expectations and the availability of new scientific knowledge, In the present days, the growing complexities and changing approaches in Design has yielded many appraisal models on mathematical concepts. Besides, a social project like school creates different interest in different types of participators (say Architects, Educationists, Sociologists, Educationists, Students, parents, etc.) and each group has its distinctive perspective and set values of judging or evaluating.As a result, there is a continuous search to find quantitative measure and demonstrate improvement in fields like sociology, planning, psychology as well as mathematics besides Architecture.

Mathematical concepts encourage a tendency to simplify beyond the realities of inherent complexity of the phenomena and the multiple frame works of intellectual and decision making practice. In this process of quantifying and computerizing often there seems to be tendency of neglecting sensitive qualitative behavioral aspects of design. Where as the traditional

methods of qualitative and intuitive judgement still provide the main steam of the on going decision making effort. Hence, in this thesis an attempt is made to improve the provision of qualitative methods so that better decision can be made.

An Architectural project has to be sensitive to its social and environmental (urban or rural) implications. It has to show a serious concern to adaptability to changing needs. Moreover, a school building performance has to be assessed on the basis of expected human performance, especially that directly relating to the quality of environment. Hence, an attempt is made in this thesis to emphasize on following three aspects :

1. Human over technical considerations
2. Physical adaptability changing needs
3. Sensitivity to social and environmental implications

4.2 MAPPING :

In order to have an effective spatial evaluations in school buildings it is proposed to examine only those fields having direct and major human requirements contents. These fields are :

1. External Micro-climate
2. Physical Environment
3. Aesthetic and Emotional Environment
4. User satisfaction

These are inter related as well as related to factors

in other fields, e.g. structure and materials. Each of the above four main fields are broken down into smaller and smaller groups so as to correspond in details to factors considered in making design decision.

4.2.1 EXTERNAL MICRO CLIMATE :

In external micro-climate the emphasis will be given to find out how far the building is responsive to local environmental factors. These will be judged through following parameters.

a. ORIENTATION:

The criteria for this shall be :

a,1 View

a.2 Air flow

a.3 Visual privacy

a.4 Noise insulation

B. ACCESSIBILITY AND CIRCULATION :

The criteria shall be :

b.1 Pedestrians

b.2 Vehicular entry and parking

b.3 Handicapped entry

b.4 Utilities entry and circulation

C. SITE RESOURCES CONSIDERATIONS :

The criteria shall be :

c.1 Natural contour

c.2 Natural Drainage

c.3 Historic value

c.4 Other considerations

D. SITE UTILITIES AND SERVICES :

The criteria shall be :

d.1 Surface Drainage

d,2 Service lines

d.3 Security

d.4 Finishes

4.2.2 PHYSICAL ENVIRONMENT

The parameter for physical environment assessment shall be :

a. Thermal comfort

b. Lighting

b.1 Day lighting

b.2 Artificial lighting

c. Ventilation

d. Olfactory

e. Acoustics

MAPPING

External Micro climate	Physical Environment	Aesthetic & Emotional environment	User satisfaction
a. Orientation	thermal comfort	Form	Compactness
b. Accessibility and circulation	Lighting	Shape & size	Flexibility
c. Site Resources	Ventilation	Colour	Plan efficiency
d. Site Utilities and services	Acoustics	Texture Proportion	Circulation Grounding

Figure 6

4.2.3 AESTHETIC AND EMOTIONAL ENVIRONMENT

The parameter shall be

a. Form
b. Shape and size
c. Colour
d. Texture
e. Proportions

4.2.4 USER SATISFACTION :

The parameters shall be :

a. Compactness
   - a.1 Pop Ratio
   - a.2 Volm ratio

b. Flexibility
   - b.1 Fluidity
   - b.2 Versatility
   - b.3 Convertibility
   - b.4 Expansibility

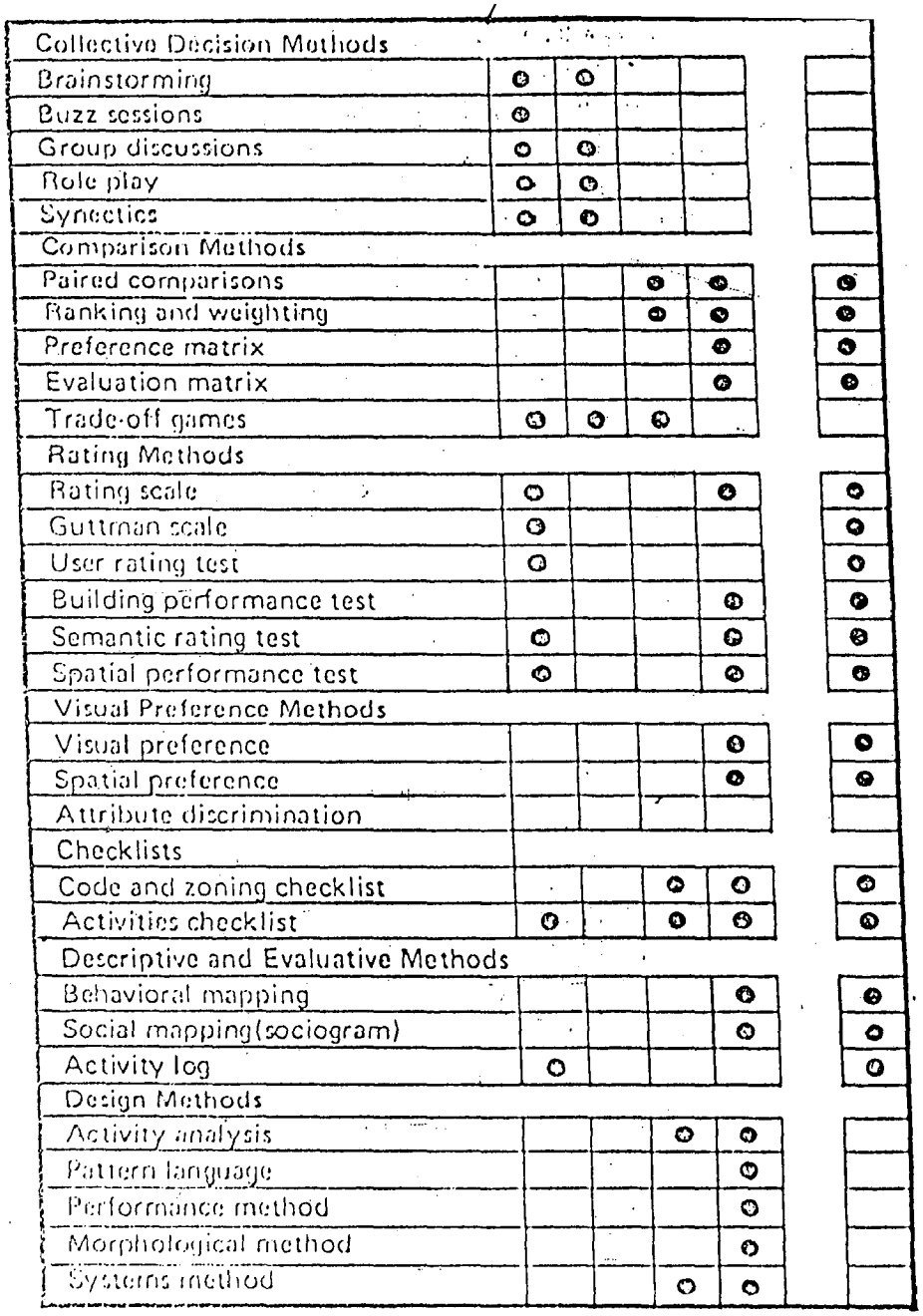
c. Plan Efficiency

d. Circulation
   - d,1 Students
   - d.2 Teacher
   - d.3 employees
   - d.4 Visitors

e. Grouping

4.3 QUALITY QUANTIFICATION :

The evaluation parameters can be broadly classified into two categories :



RITRIEVAL METHODS

source : 'methods of programming' by henry shanoff

FIG - 7

Quantitative and Qualitative

If often becomes complex to qualify the qualitative aspects of performance, Henry Shroff in method of Architectural Programming, identifies different information retrieval methods useful for quantifying for post completion evaluation. They are :

a. Comparison methods :
   - a.1 .paired comparisons
   - a.2 Ranking and weighting
   - a.3 Evaluation matrix

b. Rating Methods :
   - b.1 Rating scale
   - b.2 Guttman scale
   - b.3 User rating test
   - b.4 Building performance test
   - b.5 Semantic rating test
   - b.6 Spatial performance test

c. Visual preference methods :
   - c.1 Visual Preference
   - c.2 Spatial preference

d. Check lists
   - d.1 Code and zoning check lists
   - d.2 Activities check list

e. Descriptive and Evaluative methods
   - e.1 Behaviour mapping
   - e.2 Social mapping
   - e.3 Activity log

4.4 SITE EVALUATION :

In order to evaluate a site property, we must first determine which of its components affect the evaluation and then drive our analysis checklist from those components. Site analysis is divided into two major divisions :

1. Natural characteristics
2. Artificial conditions

4.4.1 Natural Characteristics :

The components and constitute elements are :

A. Structural :
Soil conditions,f Geological considerations, Sub-surface water

B. Physical :
Natural drainage, slopes, contours , views, orientations.

C. Environmental :
Temperature, snow/frost, precipitation,surface water, Natural Surroundings, flora, fauna, conservation, pollution

4.4.2 ARTIFICIAL CHARACTERISTICS :

The components and constitutive elements are :

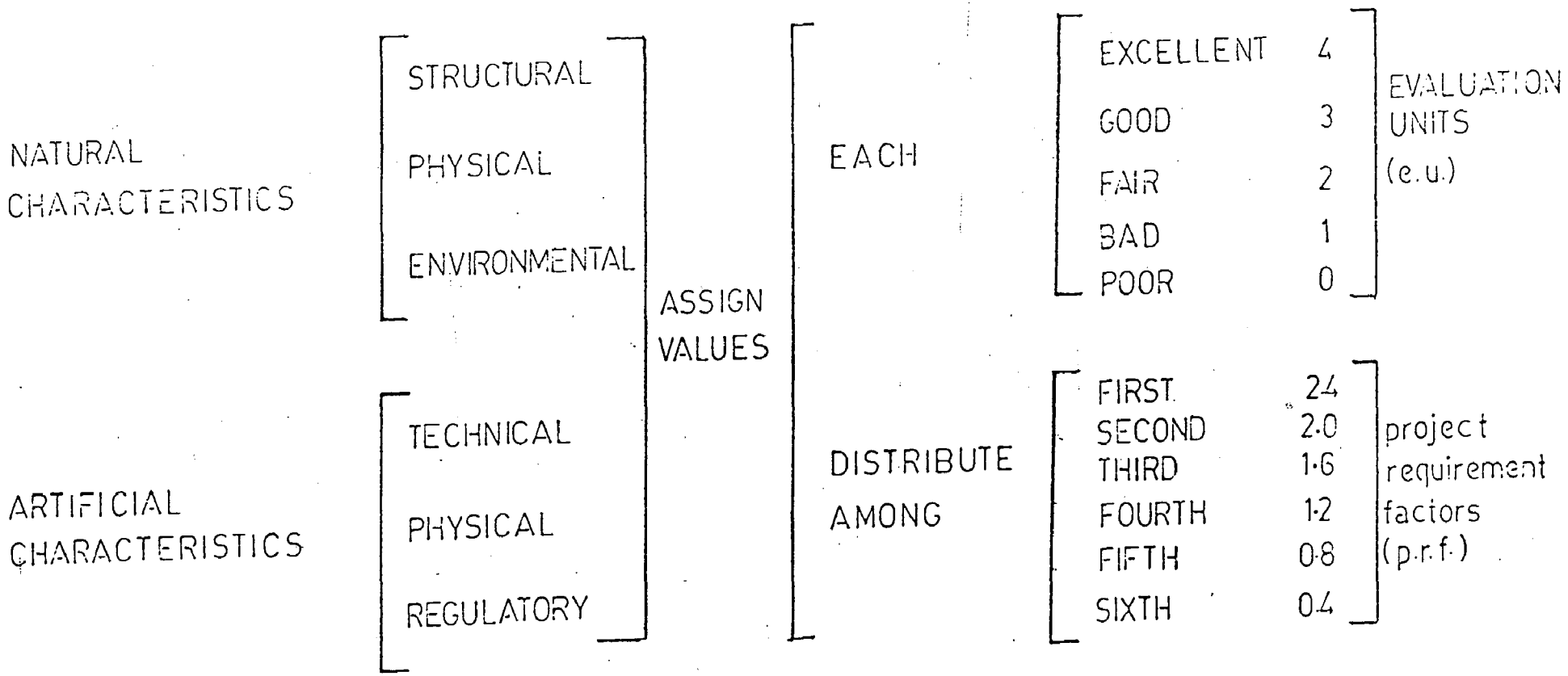
A. Technical
Functional location, historic values, accessibility, circulation.

B. Physical :
Site utilities, existing structures, neighboring, structures, operational factor, maintenance and taxes, sound conditions,improvement

NATURAL CHARACTERISTICS OF SITE

Natural Charact-eristics	STRUCTURAL	SOIL CONDITIONS, GEOLOGICAL COSIDERATION, SUB SURFACE WATER.
	PHYSICAL	NATURAL DRAINAGE, SLOPES, CONTOURS, VIEWS, ORIENTATIONS
	ENVIRONMENTAL	TEMPERATURE, SNOW FOREST, PRECIPITATION, SURFACE WATER, NATURAL SURROUNDINGS, FLORA, FAUNA, CONSERVATION, POLLUTION

Fig. 8



SITE EVALUATION

FIG-10

ARTIFICIAL CHARACTERISTICS OF SITE

ARTIFICIAL CHARACTER-ISTICS	TECHNICAL	FUNCTIONAL LOCATION, HISTORIC VALUE, ACCESSIBILITY, CIRCULATION
	PHYSICAL	SITE UTILITIES, EXISTING STRUCTURES, NEIGHBORING STRUCTURES, OPERATIONAL FACTORS, MAINTENANCE AND TAXES, SOUND CONDITIONS, IMPROVEMENTS
	REGULATORY	PLANNING REGULATIONS, ZONING, BUILDING, FIRE

Fig. 9

SITE EVALUATION CHART										
DESCRIPTIONS		a.r.t.	site designation							
			1		2		3		4	
			e.u.	value prf.x e.u.	eu	value	e.u.	value	e.u.	value
natural characteristics	S									
	P									
	E									
artificial characteristics	T									
	PH									
	R									
TOTAL VALUE										
C O S T										
S.E.R. = cost / total value										

FIG-11

EXAMPLE

SITE EVALUATION CHART

DESCRIPTIONS		p.f.	site designation 1		2		3		4	
			e.u.	value prf.x e.u.	eu	value	e.u.	value	e.u.	value
natural characteristics	S	1.2	2	2.4	4	4.8	2	2.4	3	3.6
	P	2.4	3	7.2	3	7.2	4	9.6	3	7.2
	E	1.8	4	7.2	3	5.4	4	7.2	2	3.6
artificial characteristics	T	0.8	3	2.4	3	2.4	2	1.6	2	1.6
	PH	0.4	2	0.8	3	1.2	3	1.2	4	1.6
	R	1.8	3	5.4	3	5.4	1	1.8	2	3.6
TOTAL VALUE				25.4		26.4		23.8		21.2
C O S T			Rs. 505,000		Rs. 432,000		Rs. 510,000		Rs. 484,000	
S.E.R. = cost / total value			19882		16363		21429		22830	

FIG 12

C. Regulatory:

Planning regulations, zoning, Building, Fire.

4.4.3 EVALUATION:

The site evaluation can be done by assigning a value to each natural or artificial conditions (ranking independently from 4 to 0 – excellent to bad) based on its degree of compliance with the site requirements set forth and is also assigned a project requirement factor valve (Refer Fig. 10)

The PRF represents the degree of importance of the characteristic when applied to a specific project.

The site evaluation ratio (S.E.R.) is obtained by dividing the actual cost of the site by the total value of the site (obtained by multiplying the project requirement factors by the evauation units of each site and adding all the results in the value columnb), The total value of the site can not exceed 31.2 points (minimum value is 0) and site fewer than 20 points should not be considered feasible (Ref. Fig. 11)

4.5 APPRAISAL SCALE :

In order to find out the appraisal of the schools in four different fields, mapped out viz. external micro climate, physical Environment, Emotional Environment and user satisfaction, four different performance scales have been prescribed. In order to take user view into consideration, the semantic rating scales have been used.

In this semantic differential, an adjective pair is placed on opposite ends of a scale with seven divisions. Each division stands for different degrees of intensity. An example of a pair of adjectives with opposite meaning on a semantic scale would be 'simple' and 'complex' (See Fig. 13) the seven steps are defined as extremely, moderately and slightly simple, natural and extremely, moderately and slightly complex.The paired comparison can be :

Pleasant	...	Unplasant
Rough	...	Smooth
Spacious	...	eramped

For the scales presribed in this Chapter, the semantic diffeential adopted is very good. and very bad), the Intermediate stepews being good,barely good, no knowledge, barely bad, bad, very bad. (Fig. 14).

4.5.1 External Microclimate :

The perormance scale prescribed for external microclimate (See Fig.) has four parameters namely orientation, Accessibility and circulation, resources considerations and site services. Four criteria have been prescribed for each parameter. Each criteria has been put in a semantic scale. The ranking of semantic scale very good to very bad us +3 to −3, The score prescribed for seven steps of rating are :−

Very good	(+3)
Good	(+2)
Barely good	(+1)
Barely bad	(−1)
Bad	(−2)

Very bad (-3)

The highest possible score being 48 , any school building having less than 30 shall be considered to have a poor design.

This can be converted to a ten point grade by the formula = Total score/ 48 * 10 =Performance Grade

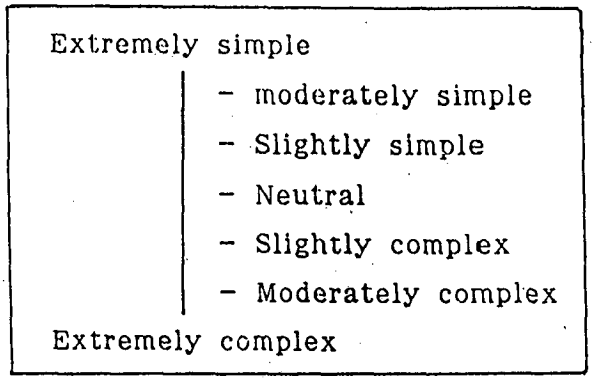
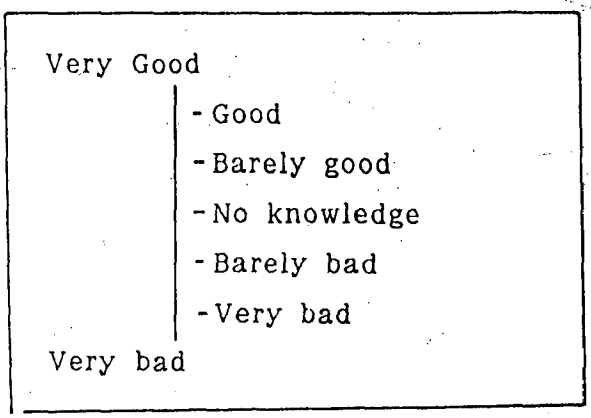


Fig. 13

Semantic Scale



Semantic Scale Fig.14

4.5.2 PHYSICAL ENVIRONMENT :

The performance scale prescribed for physical environment (See Fig. 15) has five parameters

PERFORMANCE SCALE FOR EXTERNAL MICRO-CLIMATE

PARAMETER	CRITERIA				
	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	
ORIENTATION	view	air flow	visual privacy	noise insulation	
	□□□ □□□	□□□ □□□	□□□ □□□	□□□ □□□	score
ACCESSIBILITY & CIRCULATION	pedestrian	vehicular	handicapped	utilities	
	□□□ □□□	□□□ □□□	□□□ □□□	□□□ □□□	score
RESOURCES CONSIDERATION	contour	drainage	historic value	other	
	□□□ □□□	□□□ □□□	□□□ □□□	□□□ □□□	score
SITE SERVICES	surface	service	security	finishes	
	□□□ □□□	□□□ □□□	□□□ □□□	□□□ □□□	score
				TOTAL SCORE	

PERFORMANCE GRADE $= \frac{\text{TOTAL SCORE}}{48} \times 10$

FIG 15

(Thermal comfort, lighting , ventilation, olfactory Acoustics). Since the physical environment has to be assessed through out the school campus, different functional spaces have been identified(entrance foyer, circulation areas, toilets, cafetaria / dining, administrative area, teachers lounge, Humanities class room, science, physical education and performing arts) A seven point semantic differential scoring -3 to +3 has been recomended for each of the five parameters for each functional space. The highest possible score being 150, any school building having less than 90 shall be considered to have a poor physical environment. This can be converted to a ten point grade by the formula.

Total score/150 x 10 = Performance grade

4.5.3 AESTHETIC AND EMOTIONAL ENVIRONMENT :

The performance scale prescribed for aesthetic and emotional environment (See Fig. 16) has five parameters (FORM, SHAPE, AND SIZE, COLOUR, TEXTURE, PROPORTIONS) Different functionbal spaces have been identified, since aesthetic and emotional environment has to be assessed through out the school campus, a seven point semantic differential scoring -3 to +3 has been recommend for each of the five parameters for each functional space. The highest possible score being 150, any school building having less than 90 shall be considered to have good aesthetic and emotional environment.

PERFORMANCE SCALE FOR PHYSICAL ENVIRONMENT

FUNCTIONAL SPACES	thermal comfort	lighting	ventilation	olfactory	acoustics
	very good good barely good no knowledge barely bad bad very bad	very good good barely good no knowledge barely bad bad very bad	very good good barely good no knowledge barely bad bad very bad	very good good barely good no knowledge barely bad bad very bad	very good good barely good no knowledge barely bad bad very bad
ENTRANCE FOYER					
CIRCULATION AREAS					
TOILETS					
CAFETARIA / DINING					
ADMINISTRATIVE AREA					
TEACHERS LOUNGE					
HUMANITIES CLASS RM.					
SCIENCE					
PHYSICAL EDUCATION					
PERFORMING ARTS					

$$\text{PERFORMANCE GRADE} = \frac{\text{TOTAL SCORE}}{150} \times 10$$

FIG 16

PERFORMANCE SCALE FOR AESTHETIC AND EMOTIONAL ENVIRONMENT

FUNCTIONAL SPACES	form	shae and size	colour	texture	proportion
	very good good barely good no knowledge barely bad bad very bad	very good good barely good no knowledge barely bad bad very bad	very good good barely good no knowledge barely bad bad very bad	very good good barely good no knowledge barely bad bad very bad	very good good barely good no knowledge barely bad bad very bad
ENTRANCE FOYER					
CIRCULATION AREAS					
TOILETS					
CAFETARIA / DINING					
ADMINISTRATIVE AREA					
TEACHERS LOUNGE					
HUMANITIES CLASS RM.					
SCIENCE					
PHYSICAL EDUCATION					
PERFORMING ARTS					

$$\text{PERFORMANCE GRADE} = \frac{\text{TOTAL SCORE}}{150} \times 10$$

FIG

This can be converted to a ten point grade by the formula :

Total Score/150 x 10 = performance grade

4.5.4 USER SATISFACTION :

The performance scale prescribed for user satisfaction has five parameters (COMPACTNESS, FLEXIBILITY, PLAN EFFICIENCY, CIRCULATION AND GROUPING).

a, COMNPACTNESS :

The architectural compactbness of a building relates in a general eay initial cost and to a number of other variables such as case of maintenance, running costs, length of service and convenience of circulation. Hene, it is believed that, all other things being equal, a compact plan is a better solution than a sprawling one.

The most compact shape being a circle and most compact form being a sphere two formulae have been adopted to find out the compactness in layout and in volume as well as the plan compactness of any building can be found out by POP ratio and volume compactness can be found out by volume ratio.

a.1 Derivation of POP ratio :

The formfula for the derivation of POP ratio is as follows :

1. find the perimeter of a circle of area equal to area of the building.

Area of a circle (Ao) $= \pi r^2$ therefore $r = (Ao/\pi)^{1/2}$

Perimeter of a circle (P_o) $= 2\pi r$

Hence,

$$Po = 2\pi (Ao/\pi)^{1/2}$$

Since,

Ao = Ab(The area of the building), substitute Ab for Ao

$$Po = 2\pi(Ab/\pi)^{1/2}$$

Which simplified $= 2(\pi\ Ab)^{1/2}$

ii. Divide by the perimeter of the building and express as a percentage :

$$Po/Pb \times 100 = 2(\pi\ Ab)^{1/2}/Pb \times 100\%$$

It makes no difference whether Pb and Ab are masured in metric or Imperial or in any other units, since compactness measure is a ratio, provided that the same basic unit is used for both.

a.2 Derivation of VOLM ratio :

The formfula for the derivation of VOLM ratio is as follows :

The value of Ss can be calculated from the measured Volume of the building (Vb)

Volume of sphere $V = 4/3\ \pi r^3$

Volume of Hemisphere $= 2/3\ \pi r^3$

COMPACTNESS ANALYSIS OF VARIOUS CLASS ROOM SHAPES FOR 25 STUDENTS

Forms	Area in m^2	Perimeter in mt.	Volume in m^3	POP ratio	Volm ratio
Cubic	31.36	22.4	125.4	88.6%	63.3%
Rectangular	31.5	23	126	86.5%	62.3%
Trapezoid	31.5	23.2	126	86%	62%
Pentagonal	31,9	21.5	127.6	93%	65%
Hezxagonal	31.7	21	126.8	95%	66%

Radius of Hemisphere $r = (3Vs/3\pi)^{1/3}$

Surface area of curved part of a hemisphere

$$Ss = 2\pi r^2$$

Subtituting for the valve of r and since Vs = Vb

$$S_s = 2\pi \{ (3Vb/2\pi)^{1/3} \}^2$$

S_b is the measured surface area of building.

a.3 Semantic differential :

Figure 17 shows a comparative analysis of compactness for class room types. Similarly, after surveying a list of schools a semantic differential has been proposed for compactness, in Fig. 18.

POP RATIO	VOLM RATIO	SEMANTIC SCALE
60 and above	65 and above	Very good
55 - 60	60 - 65	Good
50 - 55	55 - 60	Moderately good
45 - 50	50 - 55	Neutral
40 - 45	45 - 50	Moderately bad
35 - 40	40 - 45	Bad
Below 35	Below 40	Very bad

Fig. 18

B. Flexibility :

To find out flexibility four criteria have to be considered. They are FLUIDITY, VERSATILITY, CONVERTIBILITY and EXPANSIBILITY.

In a seven point (-3 to +3) semantic scale all these four criteria have to be considered. The mean has to be applied in the flexibility column in the performance scale (See Figure 20)

c. PLAN EFFICIENCY :

Plan efficiency has been defined as the ratio between the net assignable area of a structure and it's gross area, where net area is the sum of all areas on all floors of a building assigned to or available for the user. Gross area is the sum of all floor areas included within the outside faces of exterior walls for all storeys, or areas, which have floor surfaces.

PLAN EFFICIENCY= net area/gross area

where,

Net area = Total usable area

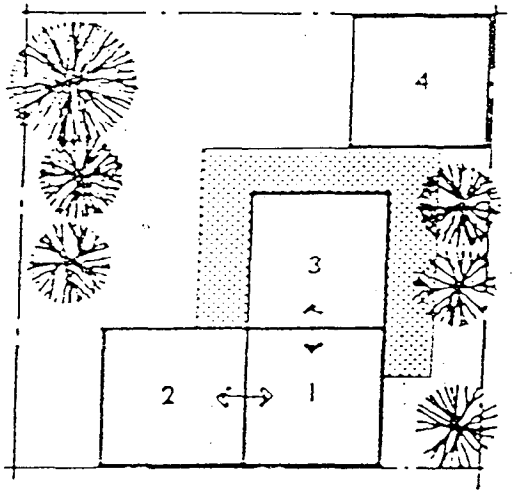
Gross area = Total built area

A semantic scale is recommended for plan efficiency of school building.

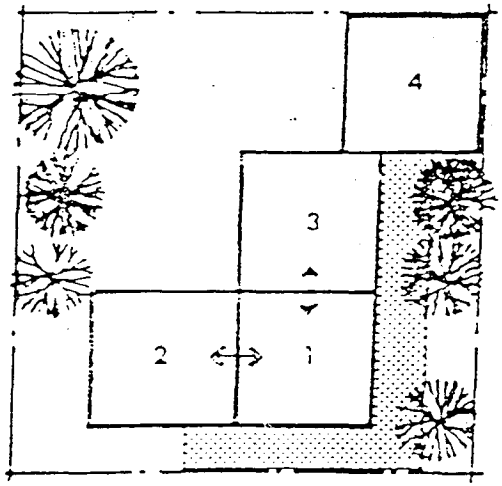
Above 55	:	Very good
52.5 to 55	:	Good
50 to 52.5	:	barely good
47.5 to 50	:	Neutral

PLAN EFFICIENCY STUDY

SCHEME 1

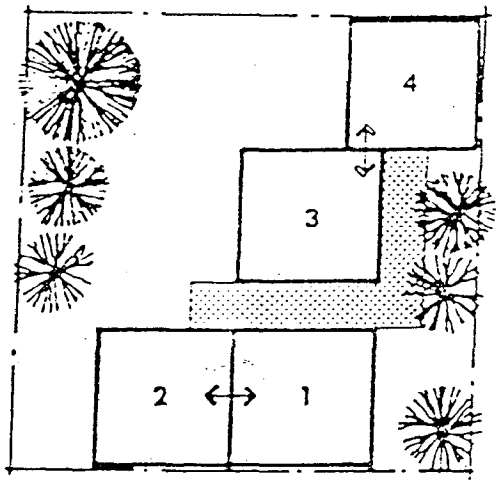


SCHEME 1A ER 72

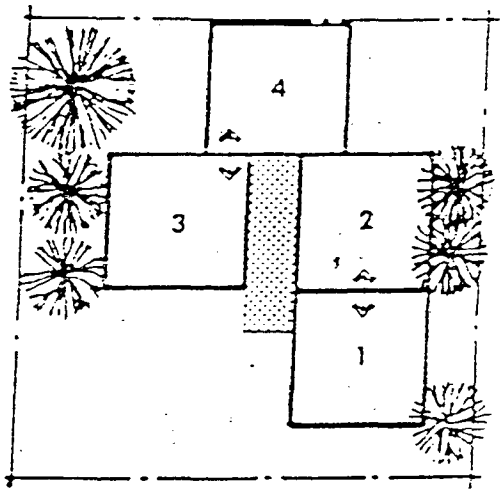


SCHEME 1B ER 77

SCHEME 2

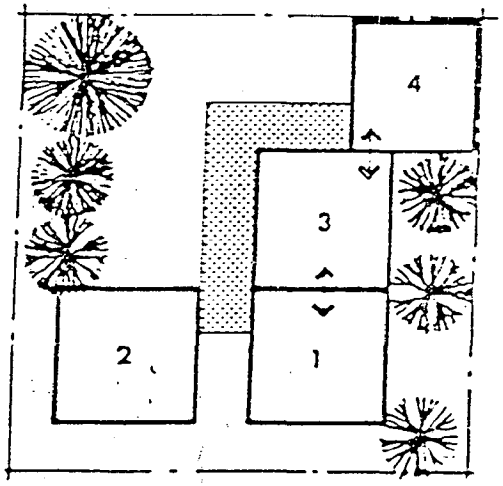


SCHEME 2A ER 81

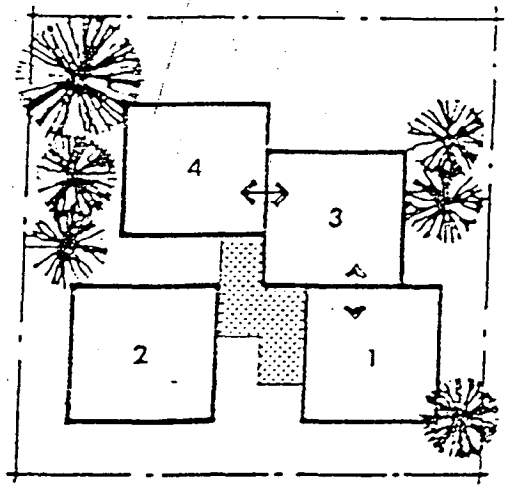


SCHEME 2B ER 90

SCHEME 3



SCHEME 3A ER 83



SCHEME 3B ER 90

FIG-19

45 to 47.5	:	Barely bad
42.5 to 45	:	bad
below 45	:	Very bad

D. CIRCULATION :

The circulation has four criteria (STUDENTS, TEACHERS, EMPLOYEES, VISITORS). The man of the semantic scale (−3 to +3) for all the four criteria will be considered has to be considered for all functional spaces described in Fig. 20.

E. PERFORMANCE SCALE :

A performance scale has been proposed in figure 20. A seven point score card has been recommend for each of the five parameters. As discussed, the individual parameters will be judged by converting to seven point scale. The highest possible score being 150. Any school building having less than 90 shall be considered to have poor user satisfaction.

This can be converted to a ten point grade by the formula

Total score/150 x 10 = Performance grade

4.6 FINAL SCORECARD :

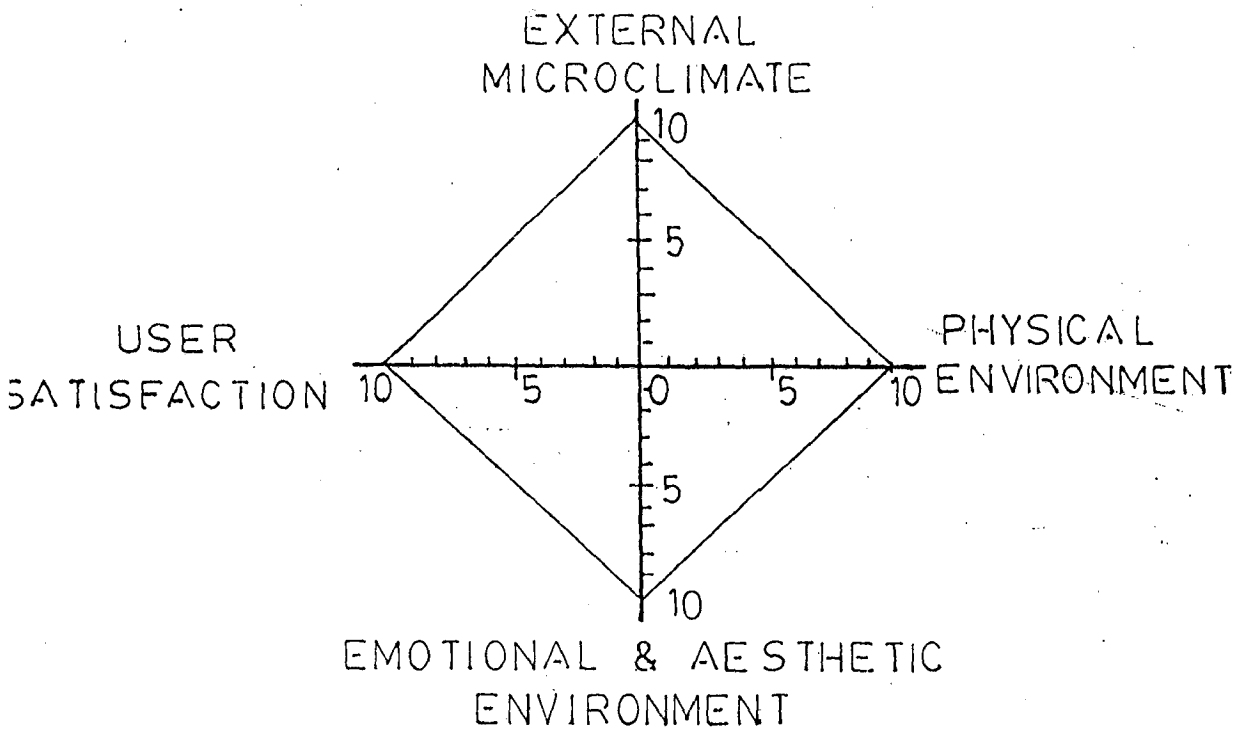
A performance square has been proposed in the Fig. 21 The centroid of square will be considered neutral point. From the neutral point the four axis will represent four ten point scales for external micro climate, physical environment, aesthetic and emotional environment. User satisfaction respectively.

PERFORMANCE SCALE FOR USER SATISFACTION

FUNCTIONAL SPACES	comactness	plan efficiency	flexibility	circulation	grouping
	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad
ENTRANCE FOYER					
CIRCULATION AREAS	consider 10 times	consider 10 times			
TOILETS					
CAFETARIA / DINING					
ADMINISTRATIVE AREA					
TEACHERS LOUNGE					
HUMANITIES CLASS RM.					
SCIENCE					
PHYSICAL EDUCATION					
PERFORMING ARTS					

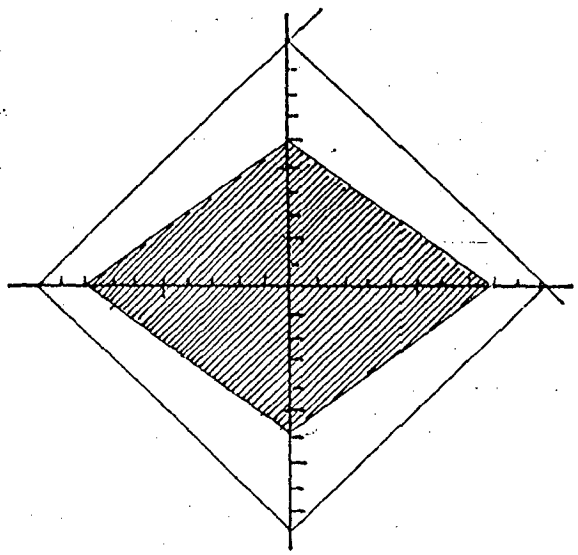
FIG

$$\text{PERFORMANCE GRADE} = \frac{\text{TOTAL SCORE}}{150} \times 10$$



FINAL SCORECARD

FIG 21



$$\text{FINAL SCORE} = \frac{\text{AREA OF TRAPEZIUM}}{\text{AREA OF SQUARE}} \times 100$$

$$= \frac{\text{AREA OF TRAPEZIUM}}{2}$$

In order to find out the performance grade (out of ten) from external micro-climate, physical environment, aesthetic and emotional environment and user satisfaction will be represented in the respective axis. The area of the trapezium formed out of these four score will relate to the performance of that particular building. The area of the performance square being 200. The performance score of the building out of 100 shall

Performance score = Area of trapezium/Area of square x 100

= Area of trapezium/2

Architecturally, the ultimate rating of the school shall be :

75 and above	:	Excellent
65 to 74	:	Good
55 to 64	:	Fair
Below 55	:	Poor

5

APPLICATION OF THE MODEL

CHAPTER 5 APPLICATION OF THE MODEL

Out of the three schools discussed in Chapter 2, Mussoorie International School is found to be most suitable school due to the following reasons :

a. The school is newly constructed and has got better infrastructure.

b. The School having good financial standing has better maintenance and finishes.

c. The school being placd in a sloped land, the external microclimate is found interesting and challenging for evaluation.

5.1 EVALUATION CRITERIA :

In order to find out the quality of functional spaces it is easier to comment by comparing with ideal situation. Hence the functional spaces have been identified and there functional and environmental needs have been descibed in a data form . The spaces identified for appraisal are :

a. Entrance foyer
b. Circulation areas
c. Toilets
d. Cafetaria / dinning
e. Administrative area
f. Teachers lounge
g. Science
h. Physical education
i. Performing Arts

5.1.1 PARKING AREAS

1. OCCUPANTS

1. Students
2. Faculty
3. Staff
4. General Public

2. ACTIVITIES/TIME

1. Parking
2. Vehicular Circulation
3. Research Access to Building

3. OCCUPANT REQUIREMENT

3.1 HEALTH/SAFETY & SECURITY REQUIREMENTS

1. Surveyable from Main Building
2. Well lighted for evening use
3. Well maintained surfaces at appropriate grade

3.2 FUNCTIONAL REQUIREMENTS

1. Accommodate vehicular parking
2. Bus pickup and drop off
3. Vehicular circulation
4. Pedestrian access

3.3 EMOTIONAL AND AESTHETIC ENVIRONMENT

1. Feeling of safety
2. Defined approach to building

4. PHYSICAL ENVIRONMENT

4.1 HEAT/COOL

DNA

4.2 OLFACTORY

DNA

4.3 VENTILATION

DNA

4.4 LIGHTING

As necessary. All areas should be illuminated with general lighting

4.5 ACOUSTICS

DNA

5. LOCATIONAL REQUIREMENTS

Easy access to building entrances

6. OCCUPANT-EQUIPMENT REQUIREMENTS

1. Light standards

7. SPECIAL REQUIREMENTS

1 Access for handicapped drivers
2. Access to parking during regular school hours

8. MATERIALS/FINISHES

1. Asphaltic concrete
2. Reflective paint striping

5.1.2 ENTRANCES AND FOYERS

1.
1. OCCUPANTS

1. Students
2. Staff
3. Public

2. ACTIVITIES/TIME

1. Access and egress from building during ours of operation

3. OCCUPANT REQUIREMENT

3.1 HEALTH/SAFETY & SECURITY REQUIREMENTS

1. Adequately sized , unobstructed doors with panic hardware
2. No level changes at doors
3. Clear direction and exit signs
4. Visibility through entry doors to avoid collision

3.2 FUNCTIONAL REQUIREMENTS

1. Easily visible to occupants and general public
2. Ease in direction finding
3. Transitional zone from exterior to interior

3.3 EMOTIONAL AND AESTHETIC ENVIRONMENT

1. Invitational appearance
2. Should allow general visual transition from exterior
3. Sunlight and lighting allowing easy adaptation from outside to inside is very desirable

4. PHYSICAL ENVIRONMENT

4.1 HEAT/COOL

68 - 78 degrees Fahrenheit
50 per cent humidity

4.2 OLFACTORY

Adequate ventilation of odors

4.3 VENTILATION

Air changes 6/hour

4.4 LIGHTING

1 Natural light desirable
2 Night lighting at entry doors

4.5 ACOUSTICS

Appropriate sound level - 34-40 decibles. Provide good attenuation of outside noise with good seals on doors and sound barriers.

5. LOCATIONAL REQUIREMENTS

Easy direction finding to public areas - auditorium and gymnasium and main circulation route.

6. OCCUPANT-EQUIPMENT REQUIREMENTS

1. Double swinging, self-closing doors
2. Directional signage and maps as necessary

7. SPECIAL REQUIREMENTS

1 Ease of access for handicapped person

8. MATERIALS/FINISHES

1. Easily maintained, non-slip flooring

5.1.3 CIRCULATION AREAS

1. OCCUPANTS

1. Students
2. Faculty
3. Staff

2. ACTIVITIES/TIME

1. Provide access to rooms and areas
2. Access to lockers
3. Continual use during school hours

3. OCCUPANT REQUIREMENT

3.1 HEALTH/SAFETY & SECURITY REQUIREMENTS

1. Adequate lighting
2. Hallways must be surveyable
3. Door swing from offices and classrooms shoould be recessed with no obstructions
4. Non-slip flooring
5. Any level changes should be well indicated

3.2 FUNCTIONAL REQUIREMENTS

1. Circulation to all areas
2. Student locker location

3.3 EMOTIONAL AND AESTHETIC ENVIRONMENT

1. Direction finding graphics or signage is desirable for orientation

4. PHYSICAL ENVIRONMENT

4.1 HEAT/COOL

68 - 78 degrees Fahrenheit
50 per cent humidity

4.2 OLFACTORY

Adequate ventilation of odors

4.3 VENTILATION

Air changes 8/hour

4.4 LIGHTING

Uniform lighting of circulation spaces

4.5 ACOUSTICS

Noisy area, classrooms should be acoustically insulated.

5. LOCATIONAL REQUIREMENTS

As necessary for public circulation with essential adjacency to

Major facilities
Administration
Storage and service areas

6. OCCUPANT-EQUIPMENT REQUIREMENTS

1. Fire doors as necessary with required hardware
2. Illuminated exit signs
3. Lockers for personal student storage

5.1.4 TOILET ROOMS

1. OCCUPANTS

Public restrooms are used by Students, Faculty, Staff and the Public

2. ACTIVITIES/TIME

Urination, excretion, washing, appearance upkeep, all hoursofbuilding operation.

3. OCCUPANT REQUIREMENT

3.1 HEALTH/SAFETY & SECURITY REQUIREMENTS

1. Easily cleaned, maintained and sanitized
2. Avoid sharp objects or easily broken materials used in toilet rooms

3.2 FUNCTIONAL REQUIREMENTS

1. Standard space allowances for specific functions
2. Principal circulation and antaropometric data including handicapped use
3. Ease of maintenance of sanitary units
4. Efficient waste removal

3.3 EMOTIONAL AND AESTHETIC ENVIRONMENT

1. Desirable light and fresh atmosphere
2. Appearance to be clean, hygenic and well kept.

4. PHYSICAL ENVIRONMENT

4.1 HEAT/COOL

68 - 78 degrees Fahrenheit
50 per cent humidity

4.2 OLFACTORY

Waste and cleaning disinfectant odors

4.3 VENTILATION

Ventilation of bathroom odors to the outside

4.4 LIGHTING

Natural daylighting desirable. Artificial lighting level at floor

4.5 ACOUSTICS

Shuld be acoustically isolated from adjoining public areas, 47-56 decibles.

5. LOCATIONAL REQUIREMENTS

As necessary for public circulation with essential adjacency to
Public areas
Entrance
Eating areas

6. OCCUPANT-EQUIPMENT REQUIREMENTS

1. Water closets and urinals
2. Basins with mirrors
3. Soap dispensers, paper towel and toilet paper

5.1.5 CAFETERIA/DINING AREA

1. OCCUPANTS

Students, designated Faculty and Staff

2. ACTIVITIES/TIME

1. Student dining during lunch hours
2. Acts as meeting and activity area for special activities.

3. OCCUPANT REQUIREMENT

3.1 HEALTH/SAFETY & SECURITY REQUIREMENTS

1. Surfaces should be easily cleaned
2. Adequate removal of food waste
3. Other as for genral requirements

3.2 FUNCTIONAL REQUIREMENTS

1. Dining room
2. Special activities area

3.3 EMOTIONAL AND AESTHETIC ENVIRONMENT

1. Friendly, relaxed atmosphere

4. PHYSICAL ENVIRONMENT

4.1 HEAT/COOL

68 - 70 degrees Fahrenheit
50 per cent humidity

4.2 OLFACTORY

Body odors and food smells adequately ventilated.

4.3 VENTILATION

Uniform air movement to the kitchen area

4.4 LIGHTING

Uniform level over eating plane

4.5 ACOUSTICS

Noisy activity area. Ceiling and wall treatments to deaden noise.

5. LOCATIONAL REQUIREMENTS

Central location in school building and proximity to toilet rooms

6. OCCUPANT-EQUIPMENT REQUIREMENTS

1. Clock, intercom, PA system
2. Dining room tables and chairs
3. Drinking fountains

7. SPECIAL REQUIREMENTS

1 Folding tables and chairs for activities and meetings
2. Access to handicapped persons

8. MATERIALS/FINISHES

1. Sound absorbent flooring
2. Furnishings should be selected for comfort and durability - cleanable and stain resistant.

5.1.6 ADMINISTRATIVE OFFICE/CONFERENCE AREA

1. OCCUPANTS

Administrators, secretarial staff,
parents and students

2. ACTIVITIES/TIME

1. Administrative, clerical during regular school hours
2. Group and individual conferences

3. OCCUPANT REQUIREMENT

3.1 HEALTH/SAFETY & SECURITY REQUIREMENTS

1. Personal and administrative security - lockable drawers, lockers
2. Obstacle free circulation
3. Fire exits as required by code

3.2 FUNCTIONAL REQUIREMENTS

1. Reception
2. Secretarial/clerical area
3. Conference
4. Duplicating/storage
5. Principal and Assistant Principal's office

3.3 EMOTIONAL AND AESTHETIC ENVIRONMENT

1. Invitational appearance desirable
2. Personalization of work areas and established territories for workers
3. Vegetation, sunlight and view to outside desirable

4. PHYSICAL ENVIRONMENT

4.1 HEAT/COOL

68 - 78 degrees Fahrenheit
50 per cent humidity

4.2 OLFACTORY

Adequate ventilation of odors and smoke

4.3 VENTILATION

6/hour air changes

4.4 LIGHTING

1. Natural light desirable
2. Artificial light level over work plane

4.5 ACOUSTICS

1. Acceptable level for quiet activities
2. Sound level 34-37 decibles

5. LOCATIONAL REQUIREMENTS

Should be near entry, guidance, health care, Staff Lounge, toilet rooms and major circulation routes.

6. OCCUPANT-EQUIPMENT REQUIREMENTS

1. Communicatioins center - intercom, telephones
2. Office equipment and furnishing
3. Comfortable and attractive waiting/seating

5.1.7 TEACHERS LOUNGE

1. OCCUPANTS

Faculty only

2. ACTIVITIES/TIME

ating, socializing, non-work oriented activities

3. OCCUPANT REQUIREMENT

3.1 HEALTH/SAFETY & SECURITY REQUIREMENTS

As per general requirements

3.2 FUNCTIONAL REQUIREMENTS

1. Faculty dining
2. Lounge
3. Rest rooms

3.3 EMOTIONAL AND AESTHETIC ENVIRONMENT

1. Casual, informal and comfortable appearance
2. Appearance to be clean and hygenic and well kept.
3. Light and fresh atmosphere desirable

4. PHYSICAL ENVIRONMENT

4.1 HEAT/COOL

68 - 78 degrees Fahrenheit
50 per cent humidity

4.2 OLFACTORY

Body, smoke, food/cooking odors

4.3 VENTILATION

Air changes 6-8/hour

4.4 LIGHTING

1. Uniform, diffused, reading spots, day-light optional

4.5 ACOUSTICS

1. As for general requirements

5. LOCATIONAL REQUIREMENTS

Near administrative center

6. OCCUPANT-EQUIPMENT REQUIREMENTS

1. Toilets
2. Food preparation area
3. Comfortable furniture
4. PA system
5. Telephone

7. SPECIAL REQUIREMENTS

1 Water and sewer connections
2. Exhaust vent

8. MATERIALS/FINISHES

1. Fully carpeted
2. Decorative wall appointments

5.1.8-A HUMANITIES CLASSROOM

1. OCCUPANTS

Students, Faculty
Classes at 8-33 students, 21 median number

2. ACTIVITIES/TIME

1. Lecture type classes
2. Group or individual study should be provided
3. Day and evening classes

3. OCCUPANT REQUIREMENT

3.1 HEALTH/SAFETY & SECURITY REQUIREMENTS

As per general requirements

3.2 FUNCTIONAL REQUIREMENTS

1. Seminar rooms
2. Teacher prep. area
3. Large assembly area for department oriented presentations

3.3 EMOTIONAL AND AESTHETIC ENVIRONMENT

1. Desirability light and fresh atmosphere appearance
2. Appearance to be clean and well kept

4. PHYSICAL ENVIRONMENT

4.1 HEAT/COOL

68 - 78 degrees Fahrenheit
50 per cent humidity

4.2 OLFACTORY

Adequate ventilation of odors

4.3 VENTILATION

Air changes 6-8/hour

4.4 LIGHTING

1. Black-out desirable
2. Natural light optional

4.5 ACOUSTICS

1. As for typical classrooms

5. LOCATIONAL REQUIREMENTS

Proximity to Media Center

6. OCCUPANT-EQUIPMENT REQUIREMENTS

1. Reference Material storage
2. Classroom furniture, intercom
3. Provision for AV presentation

7. SPECIAL REQUIREMENTS

1 Department may desire special resources collection
2. Large wall display
3. 3-D artificial display area

8. MATERIALS/FINISHES

1. Warm colors
2. Non-slip flooring
3. Acoustical ceilings

5.1.8.B SCIENCE CLASS ROOM

1. OCCUPANTS

Students, Faculty
Classes at 18-21, 19 average

2. ACTIVITIES/TIME

1. Lab and lecture type classes, daytime all areas
2. Evening school use

3. OCCUPANT REQUIREMENT

3.1 HEALTH/SAFETY & SECURITY REQUIREMENTS

1. Adequate ventilation
2. Fire protective measures
3. Appropriate electrical outlets (Protected from liquid spillage)
4. Wash fountains

3.2 FUNCTIONAL REQUIREMENTS

1. Classroom/laboratories
2. Teacher prep.
3. Extensive storage
4. Resource area(s)
5. Provision for individual study

3.3 EMOTIONAL AND AESTHETIC ENVIRONMENT

1. Appearance to be clean, hygenic and well kept.
2. Desirably light and fresh atmosphere

4. PHYSICAL ENVIRONMENT

4.1 HEAT/COOL

68 - 78 degrees Fahrenheit
50 per cent humidity

4.2 OLFACTORY

Body, chemical, possibly animal odors

4.3 VENTILATION

10-12/hour, labs; 8-10/hour, others
Specific exhaust required for chemistry labs -
1 air change per minute

4.4 LIGHTING

1. Black-out desirable
2. Daylight optional in classrooms
3. Grow lights

4.5 ACOUSTICS

Equipment reverberation and impact noise (Lab activities are "noisy")

5. LOCATIONAL REQUIREMENTS

1. Easy materials delivery
2. Access to the outside

6. OCCUPANT-EQUIPMENT REQUIREMENTS

1. Sinks, tap, slip onhose connections, strainers and traps included
2. Double gas outlet near each sink
3. Fireproof and securable storage cabinets
4. Lab tables
5. AV presentation

7. SPECIAL REQUIREMENTS

1 Gas lines, AC power
2. Grow lights

5.1.8.C PHYSICAL EDUCATION/ INDOOR FACILITIES

1. OCCUPANTS

Students, Staff, general public
Classes at 17-37, 27 median number

2. ACTIVITIES/TIME

Athletic activities during and after school hours
2. Evening school use

3. OCCUPANT REQUIREMENT

3.1 HEALTH/SAFETY & SECURITY REQUIREMENTS

1. Surfaces should be free of projections and sharp corners
2. All apparatus set flush with floor
3. Entries should accommodate traffic flow - doors should open outward.

3.2 FUNCTIONAL REQUIREMENTS

1. Double gym
2. Sub Area I, 5,000 sq.ft.
3. Sub Area II, 2,500 sq.ft.
4. Instructor's offices
5. Changing, drying, showers
6. Team rooms
7. Supply and outdoor storage areas

3.3 EMOTIONAL AND AESTHETIC ENVIRONMENT

1. "Invigorating", bright colors
2. lAppearance to be clean and hygenic and well kept
3. Light and fresh atmosphere

4. PHYSICAL ENVIRONMENT

4.1 HEAT/COOL

68 - 78 degrees Fahrenheit
50 per cent humidity

4.2 OLFACTORY

Body, odors

4.3 VENTILATION

15/hr washrooms; 10 showers; 6-8 gym
Individual control for each activity area

4.4 LIGHTING

Uniform, glare-free, recessed,d wellprotected window are not required.

4.5 ACOUSTICS

Control of excess of 55 decibels sound level

5. LOCATIONAL REQUIREMENTS

1. Access to public entry and playing fields
2. Separation from quiet study
3. Single complex

6. OCCUPANT-EQUIPMENT REQUIREMENTS

1. Athletic equipment
2. Showers
3. Washing machines

7. SPECIAL REQUIREMENTS

1 Flexible space arrangements for different activities
2. Access to handicapped persons

5.1.8.D PERFORMING ARTS CLASSROOMS

1. OCCUPANTS
Students, Faculty

2. ACTIVITIES/TIME

Group or individual performance (day use only)
Classes at 11-41, 23 median

3. OCCUPANT REQUIREMENT

3.1 HEALTH/SAFETY & SECURITY REQUIREMENTS

1. Equipment must be adequately secured
2. Adequate circulation to minimise dropping or upsetting equipment
3. Sufficient and adequately located electrical outlets.

3.2 FUNCTIONAL REQUIREMENTS

1. Orchestra room
2. Band room
3. Chorus room
4. Music lab or ensemble
5. Practice rooms
6. Teacher prep

3.3 EMOTIONAL AND AESTHETIC ENVIRONMENT

1. Desirably light atmosphere
2. Appearance to be clean
3. Freedom from distractions

4. PHYSICAL ENVIRONMENT

4.1 HEAT/COOL

68 - 78 degrees Fahrenheit
50 per cent humidity

4.2 OLFACTORY

10-16 hour practice
10-12 hour band and vocal practice

4.3 VENTILATION

Exhaust and humidity control

4.4 LIGHTING

1. Optimum quality light (for reading music)
2. Black out desirable, windows undesirable

4.5 ACOUSTICS

Primary design consideration - each are should be isolated acoustically. Uniform level of sound throughout.

5. LOCATIONAL REQUIREMENTS

1. Near Auditorium and Main Entrance.
2. Separate from quiet study

6. OCCUPANT-EQUIPMENT REQUIREMENTS

1. Recording and playback equipment
2. Carrels or listening stations
3. Instrument storage (securable)
4. Straight back level seat chairs
5. Sink and drain

7. SPECIAL REQUIREMENTS

1 Ceiling should be 14'-0" high, minimum
2. Non parallel walls
3. Water and drain
4. Access to handicapped persons

5.2 USER FPARTICIPATION IN PERFORMANCE APPRAISAL :

While working out the performance the data have been collected by intutive observations by the author, structured interviews with students, staff, faculty and the project Architects; as well as questionnaire surveys of students, faculty and staff.
While applying the model the technical aspects of scaling like POP, RATIO, VOLM RATIO, PLAN EFFICIENCY, SITE RESOURCES UTILITY has been worked out by the author; Where as the human aspects like Aesthetic and emotional environment and physical environment have been directly recorded by taking the mean of the views expressed by the students, staff and faculty.

5.3 MUSSOORIE INTERNATIONAL SCHOOL :An Overview

Mussoorie International Scool is a newly constructed boarding school, siuated 4 Km. outside the hill station in a peaceful atmosphere facing snowcovered range. The school admits 250 girls from all over the world ranging from 6 to 12 years. The school follows Birtish GCE `0' and "A" level curriculum. This is a residential school and the students are looked after by mostly european teachers. Matrons, nurses and a residential doctor, Desigbned by an American Architect on a 27 acre site, the school campus possesses a luxurious dormitory auditorium, music room, art room, sports and recreational facilities. The cell roofs used in the school goes well with hills as background.

5.4 PERFORMANCE SCORE :

The performance scales filled up have been described in Fig. 22 to 26. These figures are self explantory in terms of performance and the necessity for improvement in the required area.

5.4.1 EXTERNAL MICRO-CLIMATE :

a. The orientation of the building is found proper in terms of view, displaying a projecting image of the form.

b. Since the site is situated in a sloped land, the necessity for warning in abrupt changes in level should have been there. The considerations for handicapped does not seem to be there.

c. The site resources have been properoly utilised by providing split level functional spaces. The cell roof form goes with the hill background very well.

d. The site services in terms of drainage, security, finishes etc. are found to be in order. But the steps and paved area near thge pool area could have been out of non skid surface.

e. The performance grade is found 8.5 out of Ten.

5.4.2 PHYSICAL ENVIRONMENT :

a. Overall survey results indicate satisfaction with the environment.

PERFORMANCE SCALE FOR EXTERNAL MICRO-CLIMATE

PARAMETER	CRITERIA					
	very good / good / barely good / no knowledg / barely bad / bad / very bad	very good / good / barely good / no knowledg / barely bad / bad / very bad	very good / good / barely good / no knowledg / barely bad / bad / very bad	very good / good / barely good / no knowledg / barely bad / bad / very bad		
ORIENTATION	view	air flow	visual privacy	noise insulation	12	score
ACCESSIBILITY & CIRCULATION	pedestrian	vehicular	handicapped	utilities	6	score
RESOURCES CONSIDERATION	contour	drainage	historic value	other	11	score
SITE SERVICES	surface	service	security	finishes	12	score
				TOTAL SCORE	41	

PERFORMANCE GRADE $\frac{\text{TOTAL SCORE}}{48} \times 10 = 8.5$

FIG

PERFORMANCE SCALE FOR PHYSICAL ENVIRONMENT

FUNCTIONAL SPACES	thermal comfort	lighting	ventilation	olfactory	acoustics
	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad
ENTRANCE FOYER					
CIRCULATION AREAS					
TOILETS					
CAFETARIA / DINING					
ADMINISTRATIVE AREA					
TEACHERS LOUNGE					
HUMANITIES CLASS RM.					
SCIENCE					
PHYSICAL EDUCATION					
PERFORMING ARTS					

$$\text{PERFORMANCE GRADE} = \frac{\text{TOTAL SCORE}}{150} \times 10 = \frac{134}{150} \times 10 = 8.9$$

FIG 23

b. All users feel that the noise levels in both the cafetaria dinning area and the gym during peak use are excessive.

c. Light levels are felt to be satisfactory. However, excessive glazing affected extra lighting in the classrooms during April to July. The roof lighting in corridors result well.

d. Odours in cafetaria dining area and in administrartive conference room are found excessive

- the performance grade is found 8.9 out of ten.

5.4.3 AESTHETIC AND EMOTIONAL ENVIRONMENT :

A. The students, faculty and staff feel that the building displays an attractive form and image which reflects the school's goals and accomplishments.

B. The class rooms appeared too huge compared to the students size due to use of vault roof.

C. The building displayed use of bright and pleasant colours.

D. The proportion of the built form looks justified with hill as the background.

- The performance grade is found 8.6 out of Ten.

PERFORMANCE SCALE FOR AESTHETIC AND EMOTIONAL ENVIRONMENT

FUNCTIONAL SPACES	form	shape and size	colour	texture	proportion
	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad
ENTRANCE FOYER					
CIRCULATION AREAS					
TOILETS					
CAFETARIA / DINING					
ADMINISTRATIVE AREA					
TEACHERS LOUNGE					
HUMANITIES CLASS RM.					
SCIENCE					
PHYSICAL EDUCATION					
PERFORMING ARTS					

$$\text{PERFORMANCE GRADE} = \frac{\text{TOTAL SCORE}}{150} \times 10 = \frac{129}{150} \times 10 = 8.6$$

FIG 24

5.4.4 USER SATISFACTIUON (FIG. 25) :

A. Building is not found to be compact. It is a sprawling plan all reason may be due to contour.

B. The building does not show much flexibility in formal spaces. But however, there is a lot of flexibility in informal spaces.

C. Highly polished floor finishes in interior corridors create slippery surfaces, otherwise, the building has a good circulation.

D. Being split vertically and with usable terrace building shows a good efficiency ratio.

- Performance grade is found 8.8 out of Ten.

5.4.5 FINAL SCORE CARD (FIG. 26) :

Final score is found fout by the formula :

Area of trapezium/2 = 151.34/2
= 75.67

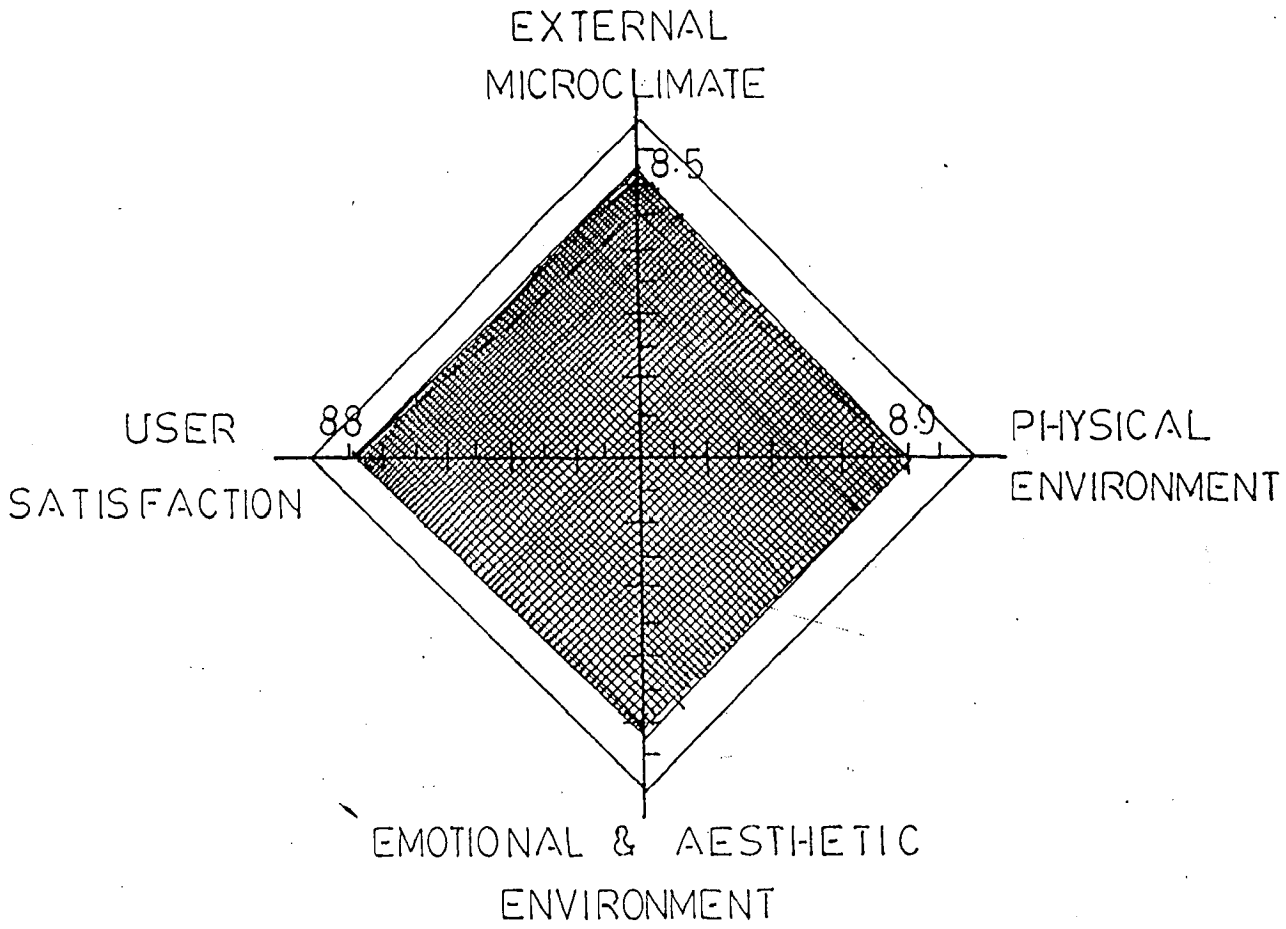
This shows building can be rated as an excellent solution.

PERFORMANCE SCALE FOR USER SATISFACTION

FUNCTIONAL SPACES	comactness	plan efficiency	flexibility	circulation	grouping
	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad	very good / good / barely good / no knowledge / barely bad / bad / very bad
ENTRANCE FOYER					
CIRCULATION AREAS	consider 10 times	consider 10 times			
TOILETS					
CAFETARIA / DINING					
ADMINISTRATIVE AREA					
TEACHERS LOUNGE					
HUMANITIES CLASS RM.					
SCIENCE					
PHYSICAL EDUCATION					
PERFORMING ARTS					

$$\text{PERFORMANCE GRADE} = \frac{\text{TOTAL SCORE}}{150} \times 10 = \frac{132}{150} \times 10 = 8.8$$

FIG 25



$$\text{FINAL SCORE} = \frac{\text{AREA OF TRAPEZIUM}}{2}$$

$$= \frac{151.34}{2} = 75.67$$

FIG 26

6

EVALUATION OF CLASSROOM EFFICIENCY

CHAPTER 6 : EVALUATION OF CLASS ROOM EFFICIENCY

EVALUATION OF CLASS ROOM EFFICIENCY

There are several ways of estimating the efficiency of class room units.

a. By comparison between the gross area available for teaching and the remaining area of the school.

b. By comparison of a number of schools in respect of teaching area taking the strength into consideration

c. By comparing with the school time table

In this chapter an attempt has been made to compare different classroom arrangements by the help of appraisal model developed in Chapter 4. The modules obtained are rectangular, trapezoidal, Hexagonal, belonging to different type of arrangements. The areas have been computed on the basis of accommodation for forty students at 1.2 sq.mt. per student place. The areas have been computed at 1.2 Sq.mt. per student place. The area of one unit is thus 48 sq.mt. Accordingly, the sizes of the different modules are :

Rectangular : 8.0 by 6.0 m

Hexagonal : 4.5 M sides and 8.0 mt. perpendicular distance.

Trapezoidal 5.0 and 7.0 mt. parallel sides
8.0 mt. perpendicular distance

Since the complete information required, is not available from the suggestive modules, the modules evaluated on the basis of user satisfaction aspect of the model. Hence, it is not possibic to derive any score.

6.1 LINEAR :

Linear arrangements can be three types - spread out, semi compact and compact. The semi compact plan is considered the best, because double loaded corridors are not very good for acoustics whereas single loaded corridors are expensive. Hence all the three figures are out of semi compact category.

In Fig. 27 twelve rectangular class rooms are arranged linearly in a semi compact form. The corridors get cross ventilations and class rooms can be noise free. In the centre the pocket is very useful.

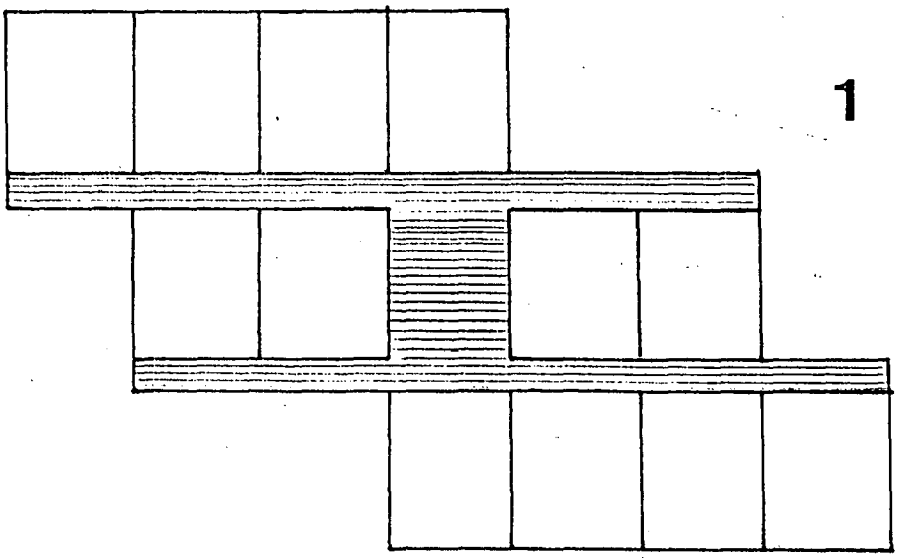
POP ratio = 85%
VOLM ratio = 83.2%
PLAN EFFICIENCY = 72%

Fig. 28 has got six class rooms placed in two wings. Both the wings get bilateral lighting and cross ventilation. Circulation minimizes disturbances to the classrooms:

POP Ratio : 82,1%
VOLM Ratio : 92.6%
PLAN efficiency: 68%

In third alternative (Fig. 29) Hexagonal units have been used. The units being independent from each other tend to cut down on disturbance. In comparison to normal planning the circulation space is huge. But this is an expensive proposition because of huge area it will consume :

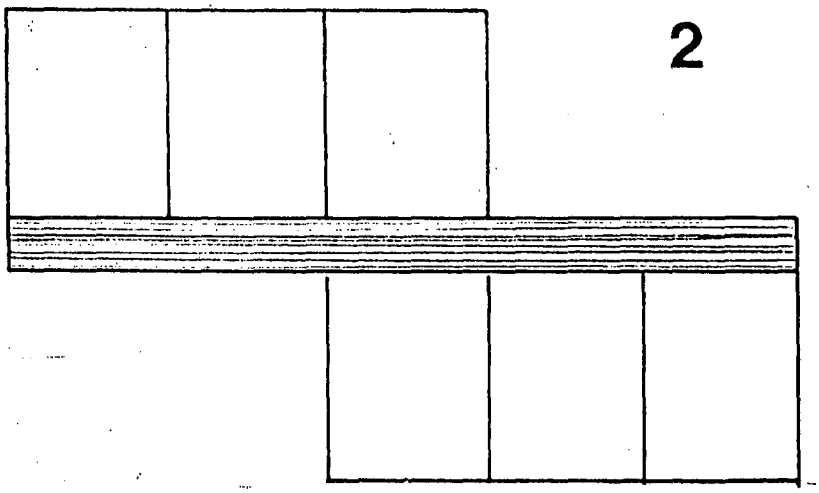
POP ratio : 71%



1

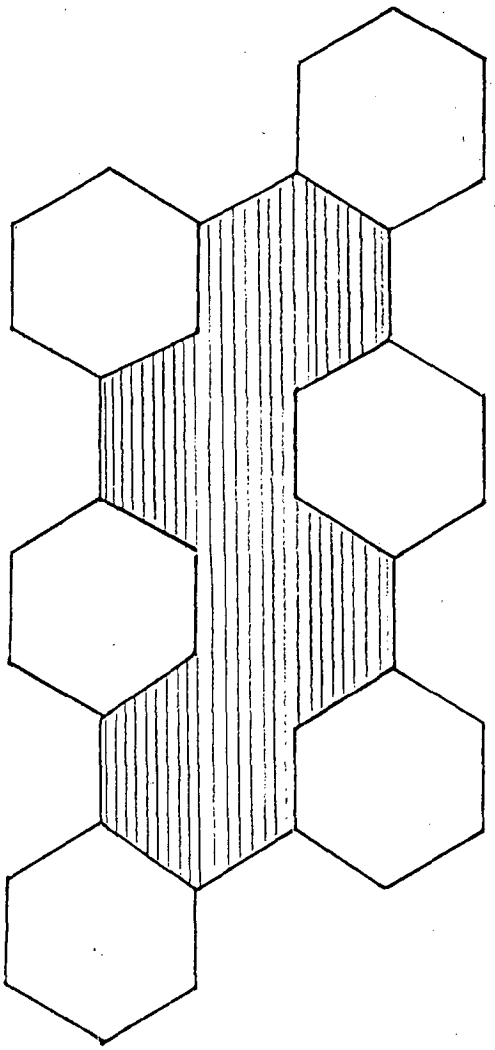
FIG 27

LINEAR



2

FIG 28



3

FIG 29

VOLM ratio : 86%
PLAN efficiency : 52%

6.2 COURTYARD :

The courtyard planning in Fig. 30 provides an intimate space. It is very good for ventilation and acoustics purpose. The courtyard in Fig. 31 is similar only the number of classrooms are more.

Fig. 30
POP ratio : 84%
VOLM ratio : 84.2%
PLAN efficiency : 69%

Fig. 31
POP ratio : 83.8%
VOLM ratio : 83.8%
PLAN efficiency : 71%

6.3 CLUSTERED:

The Fig. 32 has 12 rooms in 3 Units of 4 class rooms. It has a huge indoor general purpose area. Circulation is smooth as each cluster of class rooms have their own circulation pocket.

POP ratio : 91%
VOLM ratio : 82.4%
PLAN efficiency : 55%

Fig. 33 has trapezoidal units in three clusters. The circulation is along the corridor which runs around the courtyard. This is not good for acoustic purposes.

1

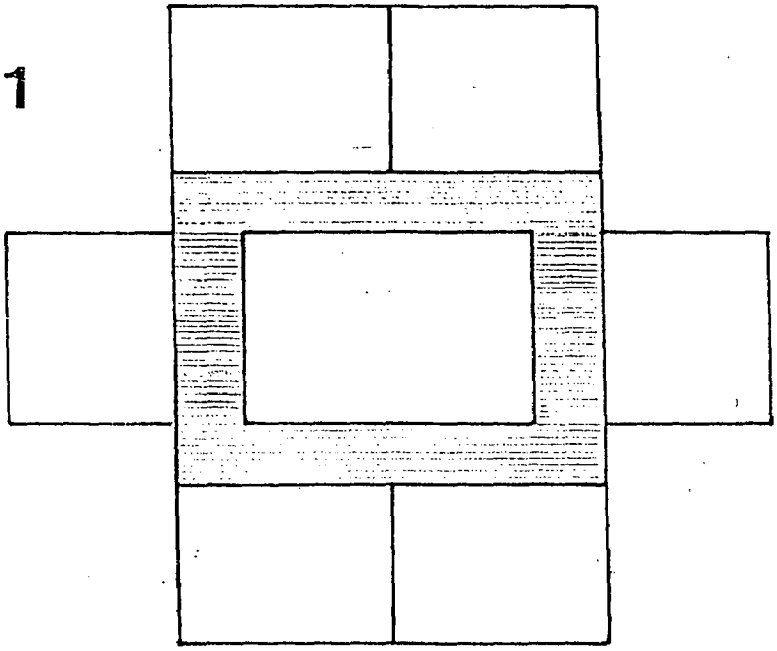


FIG - 30

COURTYARD

2

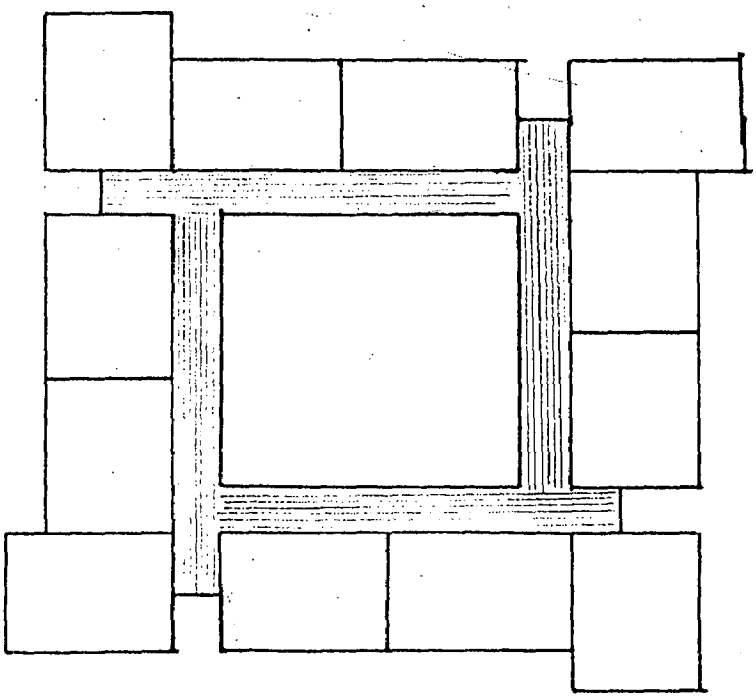


FIG - 31

POP Ratio : 92%
VOLM Ratio : 84.2%
PLAN Efficiency : 49%

Fig. 34 has six class rooms in cluster of three units each. The arrangement is semi compact informal and circulation pockets created in the interior are very functional :

POP ratio : 93%
VOLM ratio : 85.4%
OKAN Efficiency : 68%

6.4 STAGGERED :

In Figure 35, six class rooms have been arranged in a staggered manner. But the circulation space is two large in comparison to linear :

POP ratio : 92%
VOLM ratio : 84%
PLAN efficiency : 59%

In Fig. 36, six class rooms have been arranged in two identical groups of three staggered trapezoidal units. The circulation consists of a huge. Zig-zag central space with accesses to the class rooms provided in niches formed by the staggering of the units :

POP ratio : 88%
VOLM ratio : 62%
PLAN efficiency: 69%

1

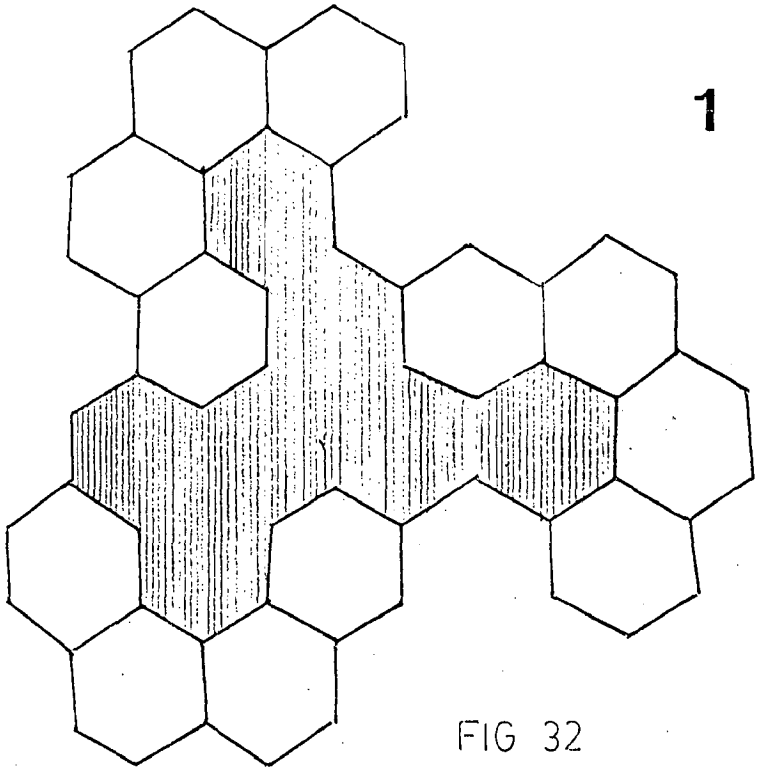


FIG 32

2

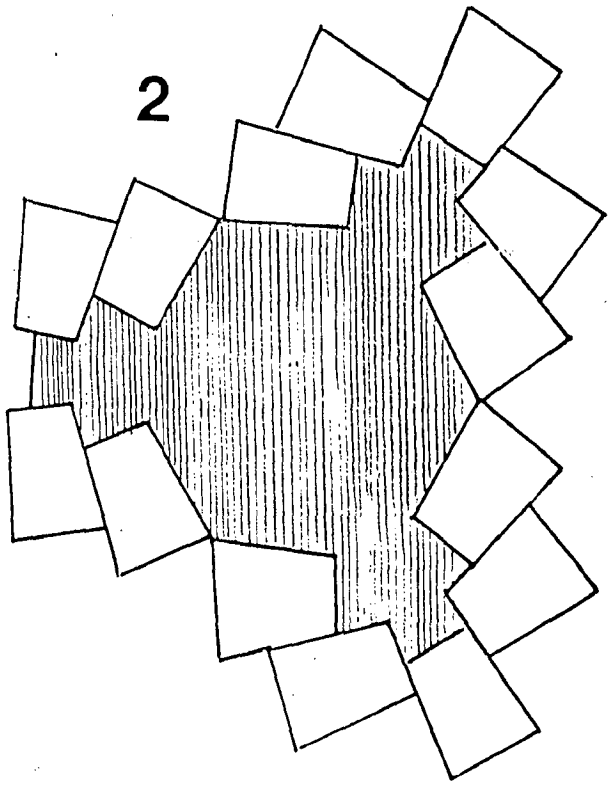


FIG 33

CLUSTERED

3

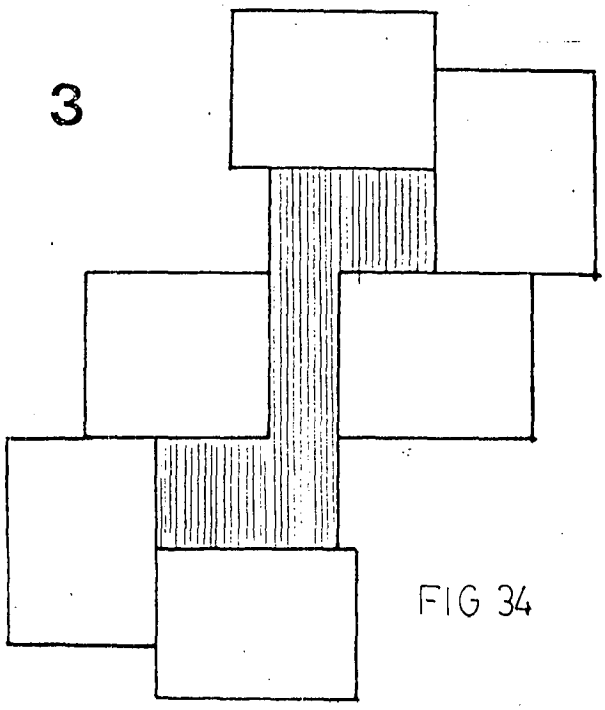


FIG 34

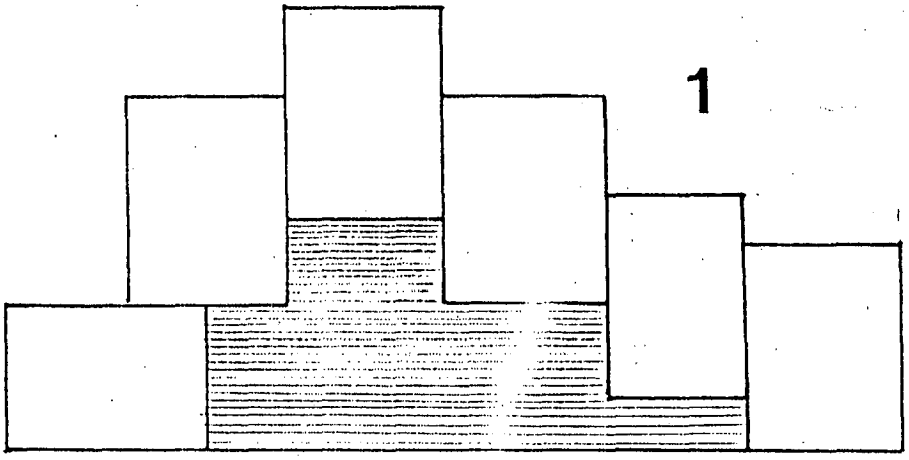


FIG 35

STAGGERED

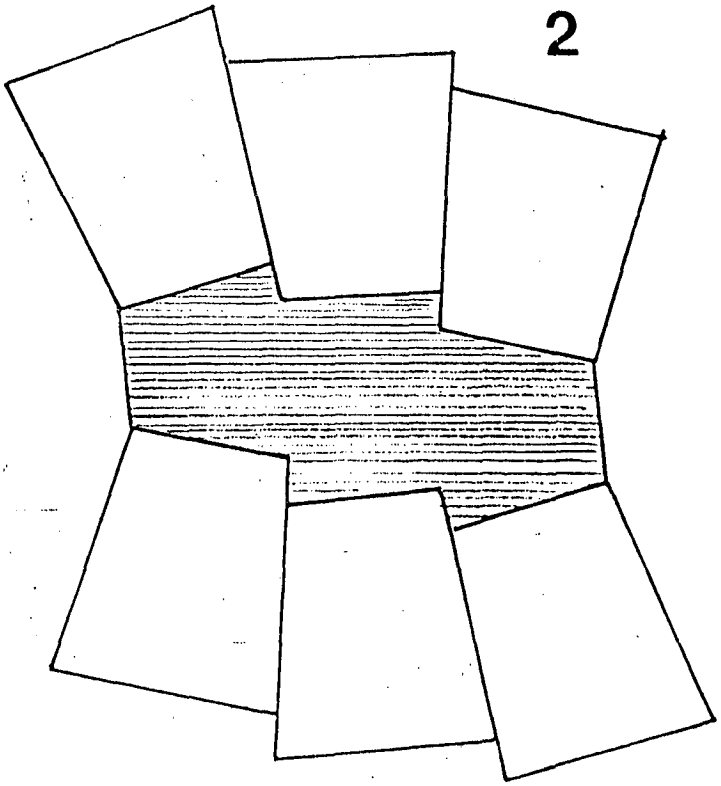


FIG 36

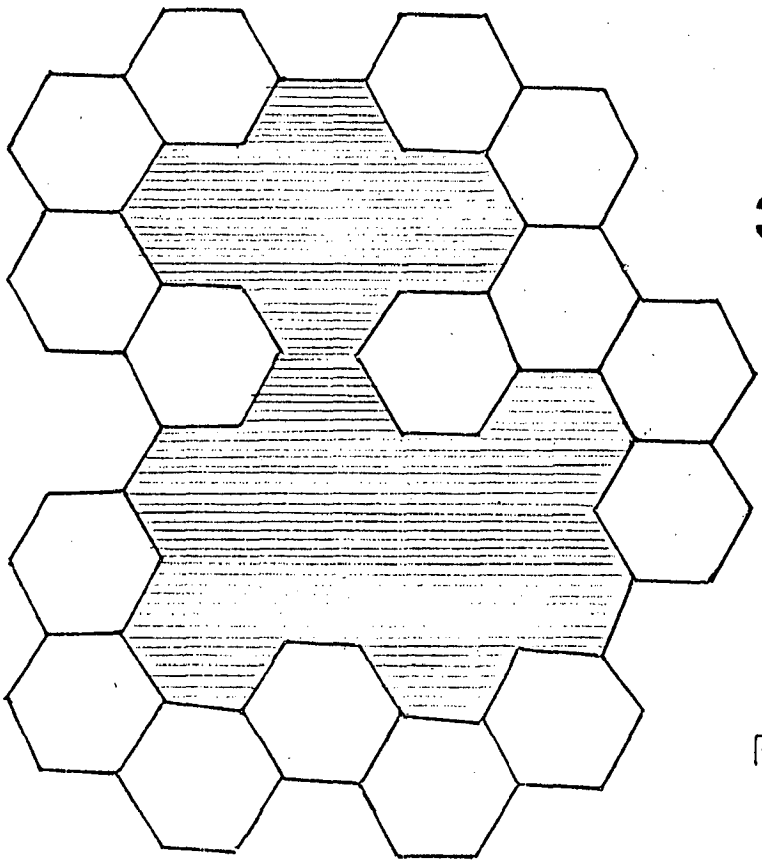


FIG 37

In Figure 37, sixteen class rooms have been arranged in four clusters. The circulation space being too huge is very expensive. The circulation space is almost equal to class room area :

POP ratio	:	96%
VOLM ratio	:	83%
PLAN efficiency	:	43%

7

CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 7 : CONCLUSIONS AND RECOMMENDATIONS

7.1 USEFULNESS OF THE STUDY :

7.1.1 This study establishes that the performance appraisal is absolutely necessary to improve the performance of any building. Cross examining and obtaining feed back data can always be important resource to update design knowlecdge and criteria.

7.1.2 While outlining how post occupation or building in use assessment has received far less research effort, this study focusses on how performance appraisal can be a part of design process through design method description in Chapter 2 (2.3) and through a case study in Chapter 3 (3.3 PAK model). The performance characteristics can be also useful for developing programmes.

7.1.3 A model has been suggested (Chapter 4) to work out the performance of a particular school building. The model can be treated as a tool to find out the effectiveness of a school building.

7.1.4 The model suggested in Chapter 4, can be an important tool to know the user's views on a building.

7.1.5 The evaluation criteria stated in Chapter 5 (5.4) is a comprehensive information about the functional and environmental requirements. This can also be utilized for developing new programme for school building.

7.1.6 The different possible arrangements of class rooms (linear, staggered, cl ustered and courtyard) ;

their advantages and disadsvantages have been discussed in Chaptrer 6.

7.2 USE OF SUGGTESTED MODEL :

7.2.1 A model has been suggested in Chapter 4 which is useful for post occupational evaluation of school building. This model can be also used for compairing alternative solutions of a partiucular school design.

7.2.2 This model also states how to choose the most effective site for a school building. (4.4). The characteristics described can be useful for finding out different aspects of school sites.

7.2.3 This model, as it has been applied in chapter 5 has to be used for assessment with participation of users. The users views can be directly transformed to the score card.

7.2,4 POP RATIO, VOLM RATIO AND PLAN EFFICIENCY ratio described in Chapter 4 (4.5.4) are useful to compare the economy of a school building.

7.2.5 This model can be used with a very human approach without much of mathematical inputs.

7.2.6 The physical, environmental and aesthetic and emotional enviroment performance sheets should be filled by taking the average view of the teachers, students and staff of the school.

7.3 LIMITATIONS :

7.3.1 This model is limited to school buildings only.

7.3.2 This model does not elaborate or specify to any particular climate.While using for any specific climate, the physical environment scale may be further detailed.

7.4 SCOPE FOR FURTHER STUDIES ;

7.4.1 Similar models can be developed for other building types.

7.4.2 This model can be further developed in the form of a computerized programme.

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BIBLIOGRAPHY :

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APPENDIX I

DERIVATION OF POP RATIO:

The formula for the derivation of POP ratio is as follows :

i. Find the perimeter of a circle of area equal to the area of the building.

Area of a circle (Ao) = πr^2

Therefore, $r = (Ao/\pi)^{1/2}$

Perimeter of a circle (Po) = $2\pi r$

Hence,

$Po = 2\pi(Ao/\pi)^{1/2}$

Since Ao = Ab (The area of the building), substitute aAb for Ao.

$Ao = 2\pi (Ab/\pi)^{1/2}$

which simplified = $2(\pi Ab)1/2$

ii. Divide by the perimeter of the building and express as a percentage :

$Po/Pb \times 100 = 2(\pi Ab)^{1/2}/Pb \times 100\%$

It makes no difference whether Pb and Ab are measured in metric or Imperial or in any other units since compactness measure is a ratio, provided that the same basic unit is used for both.

APPENDIX II

DERIVATION OF VOLM RATIO

The formula for the derivation of VOLM ratio is as follows :

The value of Ss can be calculated from the measured volume of the building (Vb)

Volume of a sphere V = $4/3\ \pi r^3$

Volume of hemisphere Vs = $2/3\ \pi r^3$

Radius of a hemisphere,

$$r = (3Vs/2\pi)^{1/3}$$

Surface area of curved part of a hemisphere

$$Ss = 2\pi\ r^2$$

substituting for the value of r and since Vs = Vb

$$Ss = 2\pi\ \{(3Vb/2\pi)^{1/2}\}^2$$

Sb is the measured surface area of the building.