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UNIVERSITY OF ROORKEE,
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Certified that the attached Thesis/Dissertation on Intermediate Colleges Buildings and Land Standards with special Reference to Meerut Division.

was submitted by

Sri Nehru Lal

and accepted for the award of Degree of ~~Doctor of Philosophy~~/Master of ~~Engineering in~~ Architecture

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INTERMEDIATE COLLEGES BUILDINGS AND LAND STANDARDS

with special reference to Meerut Division

A DISSERTATION

submitted in partial fulfilment
of the requirements for the
award of the Degree of

MASTER OF ARCHITECTURE

By

NEHRULAL

DEPARTMENT OF ARCHITECTURE
UNIVERSITY OF ROORKEE
ROORKEE, (U. P.)
October, 1972

C E R T I F I C A T E

CERTIFIED that the dissertation entitled "INTERMEDIATE COLLEGES BUILDINGS AND LAND STANDARDS , (WITH SPECIAL REFERENCE TO MEERUT DIVISION)" which is being submitted by Shri NEHRU LAL in partial fulfilment for the award of the Degree of Master of Architecture of University of Roorkee, Roorkee (India) is a record of his own work carried out by him under my supervision and guidance. The matter embodied in this dissertation has not been submitted for the award of any degree or diploma.

This is further to certify that he has worked for a period of not less than nine months during January 1971 to October 1972 for preparing this dissertation at this University.

October 8, 1972.

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A C K N O W L E D G E M E N T S

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October , 1972. (NEHRU LAL)

PREFACE

The fast expansion of education during the last twenty years could not allow the Architects and engineers to peep into every channel of educational buildings. Intermediate college buildings are one of the victims of the fast speed of all kinds of development. The Land abd Building requirement of Intermediate Colleges of Uttar Pradesh need a thorough study and research work for the qualitative improvement of education and educational system. The author started work with study of existing situation of colleges. Almost thirty colleges have been visited for discussion with the teachers, students and administrators to get their opinion in relation to the above subject. The available data has been collected in the form of performa prepared for the purpose. The survey data could be available from thirteen colleges. Out of which after computing has been cited in this report for eight colleges. The opinion of various persons related

to the intermediate colleges the results of surveys results of reports of various committees, conferences and researches have been brought to a compromise to get the results practicable.

The results in the form of easy expressions and direct figures, (wherever possible) have been expressed. The perfectionof these norms still require the testing, by applying those in practical field which may require the further modifications. At present these are the ready references to make easier the work of architects, Planners and Engineers and Educationists related to this field.

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CHAPTER I

INTRODUCTION

1.1 THE PROBLEM

INTERMEDIATE COLLEGES

BUILDINGS AND LAND STANDARDS

WITH SPECIAL REFERENCE TO MEERUT DIVISION

The objectives of this thesis is to work out the standards for various requirements of educational buildings into its sub divisions as class-rooms, laboratories, Library , Assembly hall, common rooms, offices including outdoor activities, toilets and c irculation etc. and the land requirements for the Intermediate Colleges in Uttar Pradesh. The standards in the form of ready references, which will be helpful to the Architects, Engineers and Administrators in setting up and designing ofnew colleges, expansion of existing High Schools to Intermediate Colleges and improving the existing colleges.

The sphere of the studies of the existing conditions etc., of the colleges, has been limited to Meerut division only.

The fast expansion of educational fields and facilities in the period little over semester of a century of our independence has increased over expectations out of educations. There is cogniziable over crowding and political pressures for admissions to lesser

qualified. The students unrest frustration and disturbances have become as if normal routine matters.

In order to overcome these shortcomings and quality re-instatement three pronged improvement is called for :

1. Allotment of adequate funds.
2. Physical plant with environment.
3. Qualify improvement of teachers.

It is imperative that these betterments should be parallel and hand in hand with developments in other spheres of the National advancement.

1.2 THE THOUGHTS

The provision of adequate education is largely recognised as a healthy means, to the multidirectional development of the society. After the independence of our country the imparallel qualitative expansion of education took place in the last two decades. It caused the high rate of growth of students population and dilution of quality of education. In the past, several leaders of education , thought and took the stand that, the quantitative expansion of education must preceed the qualitative improvement.

The most important consideration is the correct understanding of educational requirement, equally important is the type of education, that will help the students to

develop according to their ability or the field interest. It recognizes the responsibility to meet all the educational needs of the students and to make them competent, to do their share in supplying the demands of the society of which they are to become a part.

The first Prime Minister of India Shri Jawahar Lal Nehru said, " We require such type of education, as may give us men, able to carry out an our national programme and fulfil the social aims of free India".

The president of India Dr. V.V. Giri emphasised on the function and need of education, " Education is essentially a social function, and the measure of good education is the sense of social responsibility, it inculcates in the minds of the pupils".

"Every child in India is free to have the education. Free education upto VIII is available to child. It may be a distant ideal in view of our limited financial resources, but it should be our constant eddeavour to improve our schools and methods of teaching." Dr. V.K.R.V. Rao Union education Minister said, " Unless education is taken as a key input of development the nation would not reach its cherished goals."

More emphasis is being given for the qualitative improvement of education since the end of third five year

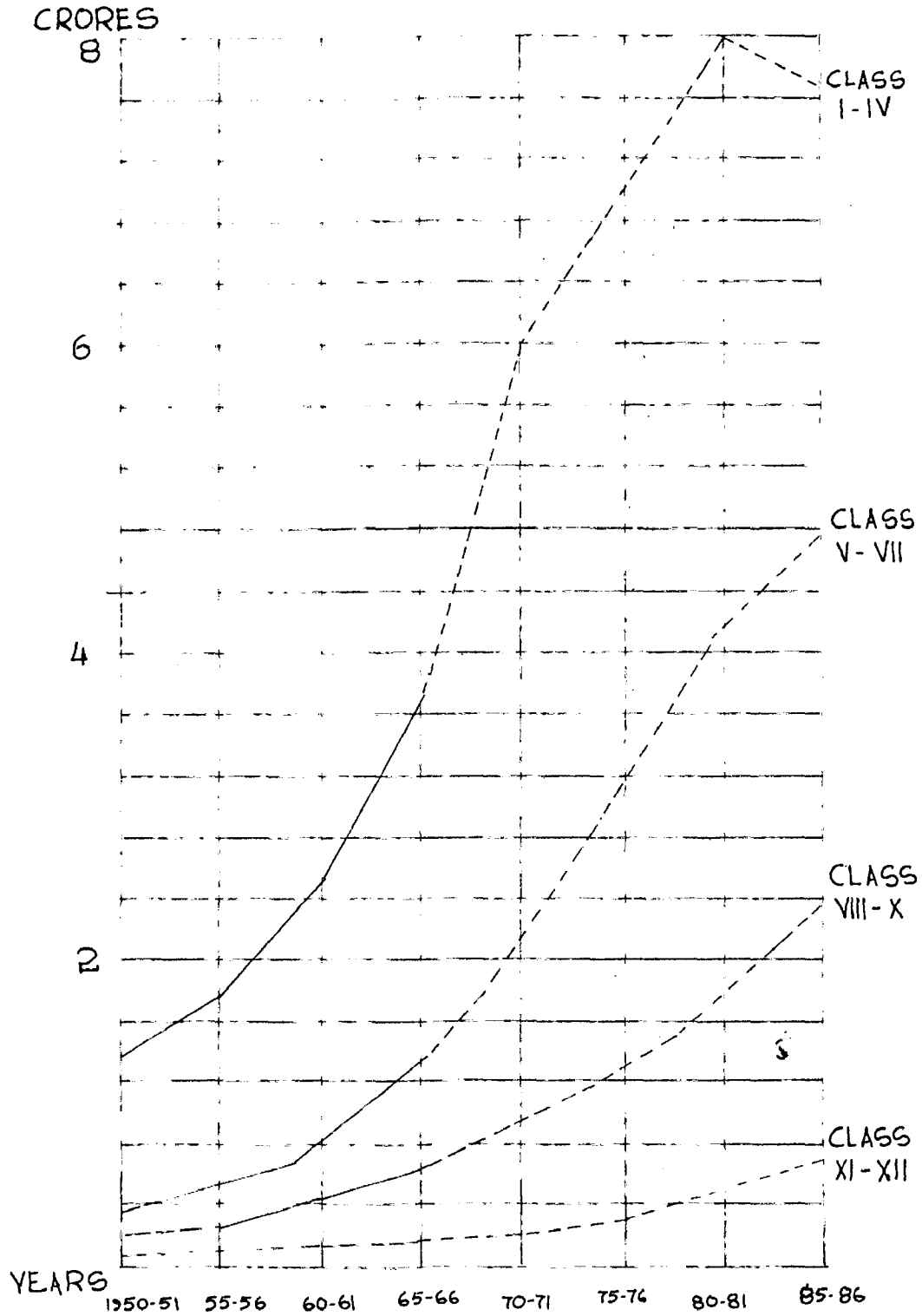
Plan. The students unrest and frustation of education youth has increased the seriousness of the problem.

The Chairman of University Grants Commission, Dr. D.S.Kothari stressed on new educational pattern and system based on the resources available in country instead of an imitation of the educational systems of advanced nations. He said, " The per capita expenditure on education in India is Rs. 15 and in the U.S. Rs. 4,000 in 1964. This gulf would grow further with time when India spent Rs. 30 per capita on education, the American per capita expenditure might be Rs. 10,000. The remedy therefore, lay in evolving a different basis for the Indian Educational system". He further said, that the spiralling triangle of science- Technology- productivity which forned the basis of progress could mean destruction if a fourth corner of wisdom and humanity was not added.

Prime Minister Mrs. Indra Gandhi urged the peoplem " It is not enough to mentally train the young. They should be trained in such a way that they remain students all the time for learning and incuming".

Chief Minister of U.P., Mr. Kamlapati Tripathi said in the inaugural speech of Seminar on Education in 1971 at Lucknow, "The crux of the problem is, what kind of men we need for a society we want to build ? Should there be any further expansion of education? and what should be

EXPANSION OF EDUCATION



ENROLMENTS IN SCHOOLS.

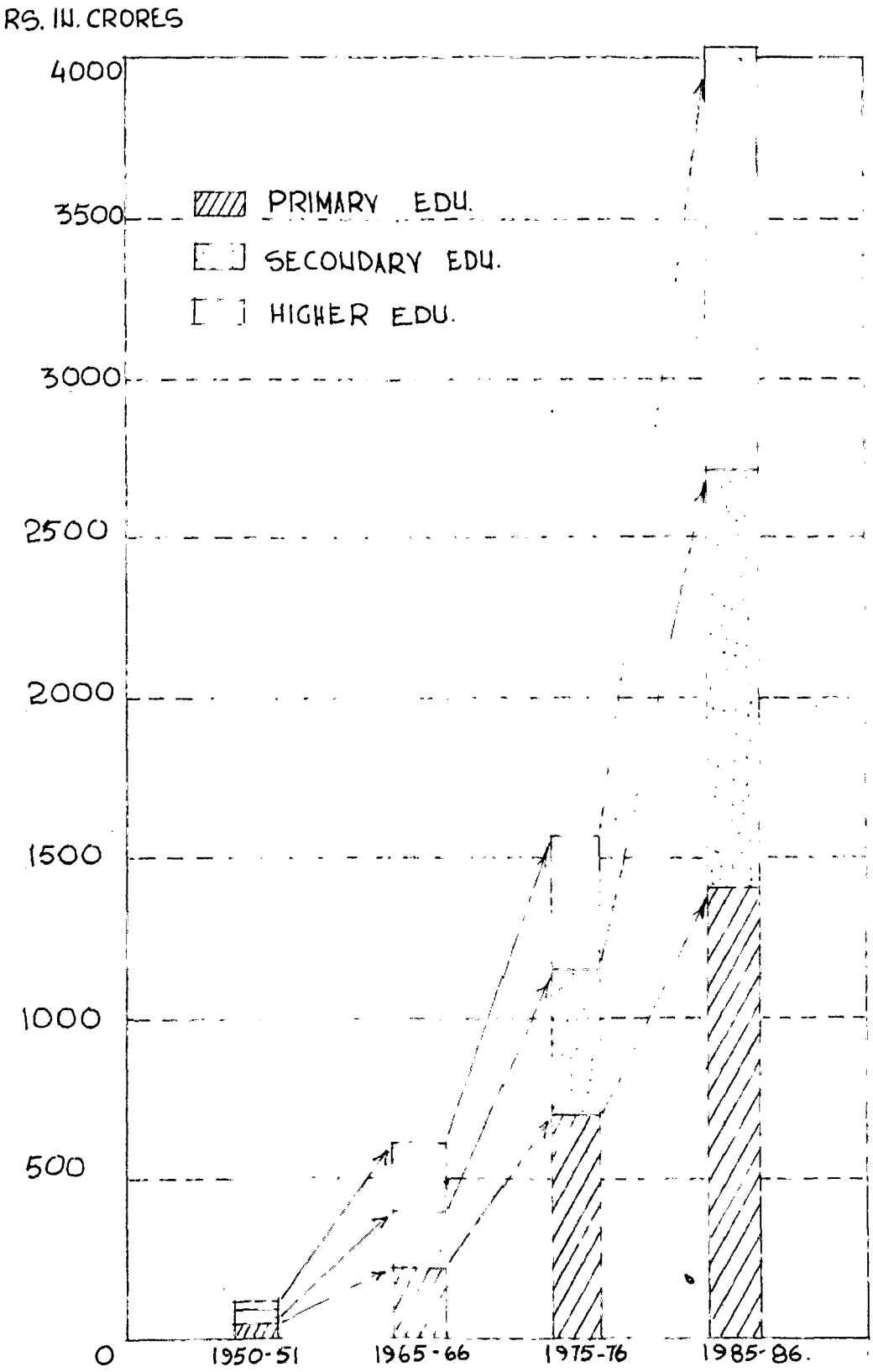
GRAPH: 1·21

EDUCATION COMMISSION REPOR
(1964-66)

the aim of Education? " He said that even the basic education system had failed, state government is spending Rs. 70 crores annually for such education. Over two and a half lakh students appeared for the high school and Intermediate examination in 1971, of these over one and a half lakh students either failed or passed in third division.

The education Commission report says, " An intensive effort should be made to raise standards continually for all stages of education. In order to raise standards it is necessary to secure better coordination between different stages of education and break the isolation in which educational institute generally function. From this point of view Universities and colleges should assist secondary schools in improving their efficiency through a variety of measures".

The education from elementary to University postgraduate and on to doctoral level. The connection between the base and apex of the pyramid has been clear, in its recommendations . Our secondary schools, despite the secondary education commission's reiteration that the secondary school must be treated as a terminus for the great majority of our students, continue to plan their curriculum and teaching in the earnest hope that majority of their students will go upto Universities.



EXPENDITURE ON EDUCATION 1950-85.

GRAPH: 1·22

EDU. COMMISSION (1964-66)

Yet there is no dialogue between the University or college on the other hand, and the secondary or elementary school on the other. Between University and school is great silence. Between the University professor and school teacher is a gulf in status, emoluments and respect.

William Carr in his address to the delegates at the continental meeting, Philadalphia, in 1957, looks forward, to the many sided changes that are likely to take place in education in next 20 years and comments that : " Its outstanding characteristics may be summarised as a subtale, but very important new emphasis on quality. We have been preoccupied in the past that every child gets into school. Now we must ask, too, how much each child gets out of school".

The fast expansion brings in its wake several problems. Administratively it involves starting of new institutions many of which may not have the necessary material and personnel requirements and all of them will have to slowly establish the right traditions. Enrolment on a wide scale tends to change the blance in the parent pupil school relationships. The needs of educati on for democaracy and education in fast-changing society entail a reorientation of objectives which raises the question of defining what quality education means and how it could be achieved ?

* " TEACHING WHICH REALISES TO THE HIGHEST DEGREE POSSIBLE THE EDUCATION PURPOSE WHICH IT IS CALLED UPON TO SERVE."

The conditions with which the above said quality teaching is influenced includes :

(a) Teacher and the methods of teaching and professional growth of teaching.

(b) Quest for learning in students.

(c) Administration and organisation.

(d) Material facilities and requirements

(e) The place of cocurricular activities.

(f) Relationship of parent school and the future, with the present education.

The education centre may prove success in achieving the quality education, while all above factors are organised in such a discipline, which creates the environment for well rounded growth in all phases of Physical, Mental, social emotional and moral development.

All these factors influencing the teaching may be groupped into elements of Scoial and Physical Environment . If we think of the past, the traces and the descriptions of NALANDA and TAXILA tells us the importance of social and Physical environments in relation

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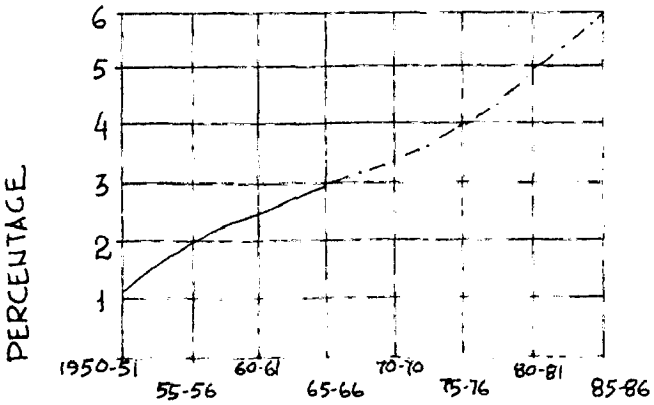
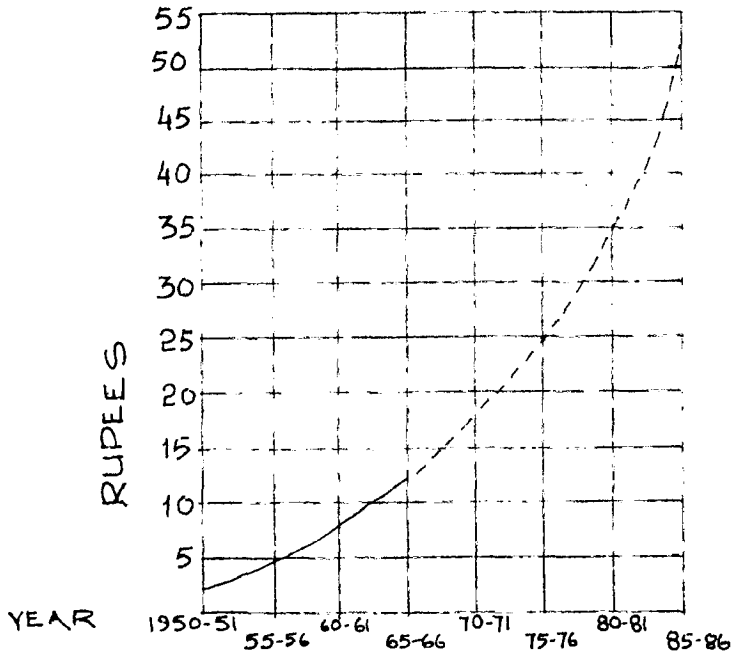
* The theme of Quality Teaching given by World Confederation of Organisations of the Teaching Profession (W.C.O.T.P) -1963.



PERCENTAGE OF NATIONAL INCOME AS EXPENDITURE ON EDUCATION.

GRAPH: 1·23



PER CAPITA EXPENDITURE ON EDUCATION.

GRAPH 1·24

EDU. COMMISSION REPORT (1964 - 66)

to the education. In these institutions not only the mode or system of education but the teacher taught relationship existed very differently and beyond our normal comprehension.

The Environment is a complex variable, effected by a number of forces, which are complex in nature and behaviour. All these forces varying in nature and magnitude, put the positive and negative pulls on to cause the unequilibrium of elements of environment, which keep the minds of teacher and taught both, under the varying stresses and strains effecting the search of knowledge. All of these forces are being increased in numbers which are in direct proportions of the development of science and Technology or all the creations of men. In the times of NALANDA and TAXILA , the will power of men to-wards the educational gains, was stronger in comparison of today's . Now the willpower have been divided into a number of forces of different nature and fields of science which itself increases the importance of the physical factors. The physical elements also keeps on changing with time very largely. The natural factors of climate etc., are dynamically effecting the physical environment. It seems impossible to educate the youth in NALANDA & TAXILA like environment or to create those environments in this atomic age. One can argue in opposite

side of it but there is no doubt about the fact that our economic conditions do not allow us to think of those great centres of learning for all, if the age group of learning . If not the ideal we should make a constant effort to achieve the maximum possible from the limited resources available with us.

The educational concepts and philosophies largely determine the building pattern and the educational environment, which governs the extent of facilities required to meet the educational objectives. Several approaches have been made to translate these objectives into concrete shapes. They have created reactions of different order. The provision of environments is the most neglected aspect of our educational establishment. Environments both of the interiors and exteriors have to play a significant role in learning and teaching * No aspect of school Education has suffered more by neglecte than the provision of suitable school building". A Large number of primary and secondary schools in the country did not have buildings of their own and were housed in totally unsuitable premises. Thought the expenditure on education has been

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* Background Moutes of Annual Convention of the Indian Institute of Architects 1970, Roorkee.

increased from Rs. 153 crores to Rs. 822.66 crores in the fourth five year plan as compared to that of first five year plan. Though several thoughts, approaches concepts and techniques have been developed during the last few years to solve the problem of schooling, yet remains a challange. The increase in students enrolment expected seems to be beyond the financial resources of our country to fulfill the educational objective in building forms. Such conditions will certainly compell, to increase the use hours of the educational buildings, which are doing many of the colleges and schools. The classes takes place in two shifts in day time and some times in the night hours also. Let us not build the new education centres in bulk without due considerations of all environmental factors, but a few, with the real environment required for quality education. This will require the Architects Engineers, Educationists and Administrators to work together . At the same time we cannot ignore the economic conditions of our country but the economy in the buildings for education, cannot be regarded as an independent problem. It is concerned just as much with the puple's education and the environment as with the structure. The aim of school planning should, therefore, be to achieve a trilateral balance between the three capital E's of School Planning, Education, Environment and Economy.

1.3 IMPORTANCE OF THE PROBLEM

In our country the educational programmes have always lagged behind, from the advancements in science and technology. The entire responsibility , goes to the lack of proper environment in all fields of education. Almost negligible importance has been given to environment either at micro or macr o level. Our administrators and educationists could not think of the proper atmosphere for superior exchange of knowledge between the teacher and taught. The economy could be the most important and independent objective but not at the cost of the future of youth*. The cost saving and negligence of environment for education, has lead us to present chaos, as teacher finds no place of solance for his dejections, student finds no place to subdue his dissatisfaction. The parents find educational building as quarters of confinement for their wards. The students mob find no place to be spared, in their vendalism around the institutional buildings, they have more to hate, nothing to love and respect and destroy them with vvigor and zest. Masses feel what else they could do ? Students need to come out of this stage of dislike for buildings and frustration for education. By add-ing and adorning

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* Art Objects as environment setter- by Prof. G.M.Mandalia, and Shri R.K. De, Indian Institute of Architects Convention - 1970 , Roorkee.

the environments with artistic touches, refinements of art effects, addition of sculptures, improving the landscape in addition to the physical comforts etc. could aid in this endeavour to provide avenues for learning with love, care and respect for the school, college or University, where teachers and taughts are engaged in pursuits of learning and advancement of knowledge for the good of the nations and well being of the humanity at large.

If we think of environment at Macro and Micro levels, SHANTINIKETAN is one of the most outstanding and accomplished efforts"* Gurudev Rabindra Nath Tagore was not only satisfied by the compus layout , design of Shantiniketan under the advice of Sir Patric Geddes, the orderly tree plantations, and decorations on buildings, but had provided street furniture and classroom furniture in a lively and befitting manner. The sculptures of the small and large size with themes of realistic, abstracts and mass expression type with miniature building -models of our cultural hemitage . The impact of knowledge, development of culture, impetus to patriotism , pride for the motherland in its multifaced achievement had such a vital contribution in India and abroad in general and on Bengal in particular that it out weights the contribution of all other institutions put together".

If we think and search deeply, it will be found out that education centres having environmen-ts surpass

hundreds of educational establishment of more buildings. What constitutes a really desirable environment is a subject of research itself. Every school, college and University cannot become SHANTINIKETAN, but could be the aim of our efforts, while thinking of any education centre.

The secondary stage of education where the student is full of potentials energies and all the developing powers, standing on the threshold of life, to select his own way and activities, under the pressure of anequilibrium of number of multidirectional forces. A minor change of directionor magnitude of any of these numerous forces may result a diversion in the path of life. These forces may be the impact of surrounding higher and lower educations attached moving cross fertilization of various disciplines, like science, Arts, Commerce , Agriculture and Home Science etc. Further, the impact of coeducation and age groups, impact of system of teaching and examinations , teaching aids and teacher taught ratio. The impact of health development and recreational facilities, impact of hostel life, impact of management and economic conditions educational centre, its structure, spaces and their character, maintenance, visual and thermal comforts etc., and the

impact of future prospects form a comprehensive totality to be given due importance.

All these factors needs a deep study by the experts of respective fields. Every factor cannot be students by one man. Keeping in view the limitations of time, finances accuracy of the date available and the knowledge, the topic here has been taken precisely of the Architectural field with due consideration of other related aspects directly and indirectly concerned with it. The field of the studies has been limited to the plane areas of Meerut division only i.e. BUILDINGS AND LAND STANDARDS FOR INTERMEDIATE COLLEGES, WITH special reference to MEERUT DIVISION.

In the importance of the environmental factors, effecting the physical, thermal and visual comforts will mainly depend upon the building components and the spaces created to perform the teaching activities successfully. The teaching and learning process at Intermediate level changes its mode towards the lecturing. To make this lecturing a successful quality teaching, the importance of ~~x~~ calm and comfortable physical surroundings increases to a higher degree.

To fulfill the land and building requirements of the increasing numbers of colleges to be at par with

speed of national development in the field of education.

Every one of the technical and educational personnel cannot be the expert and specialized Architect in the field of educational building designing. These standards will be of great help, while thinking of expansion of the old or the establishing of the new colleges, to those personnel concerned with this field. These standards will be the ready references for achieving the proper environment for colleges. The standards will be helping in finding out the actual financial requirements of new establishments and the expansions in easier ways, whereas we can make use of the computers also in easier ways.

This problem is of national importance from every angle of considerations. National building organisation has made some efforts in this field. Though the space requirements will not be much effected by the localities of the colleges, but the feasibility of fulfilling these requirements will differ from place to place and also effected by the climatic factors and time scale. The changing ways and means of teaching shall also effect the requirements and will need a periodical changes and reviews. This needs the division of the nation in different educational zones. A zone may be defined by these similar and dis-similar conditions of

CLASS 1 - X. COMPARISON OF VARIOUS COURSES (1965-66)

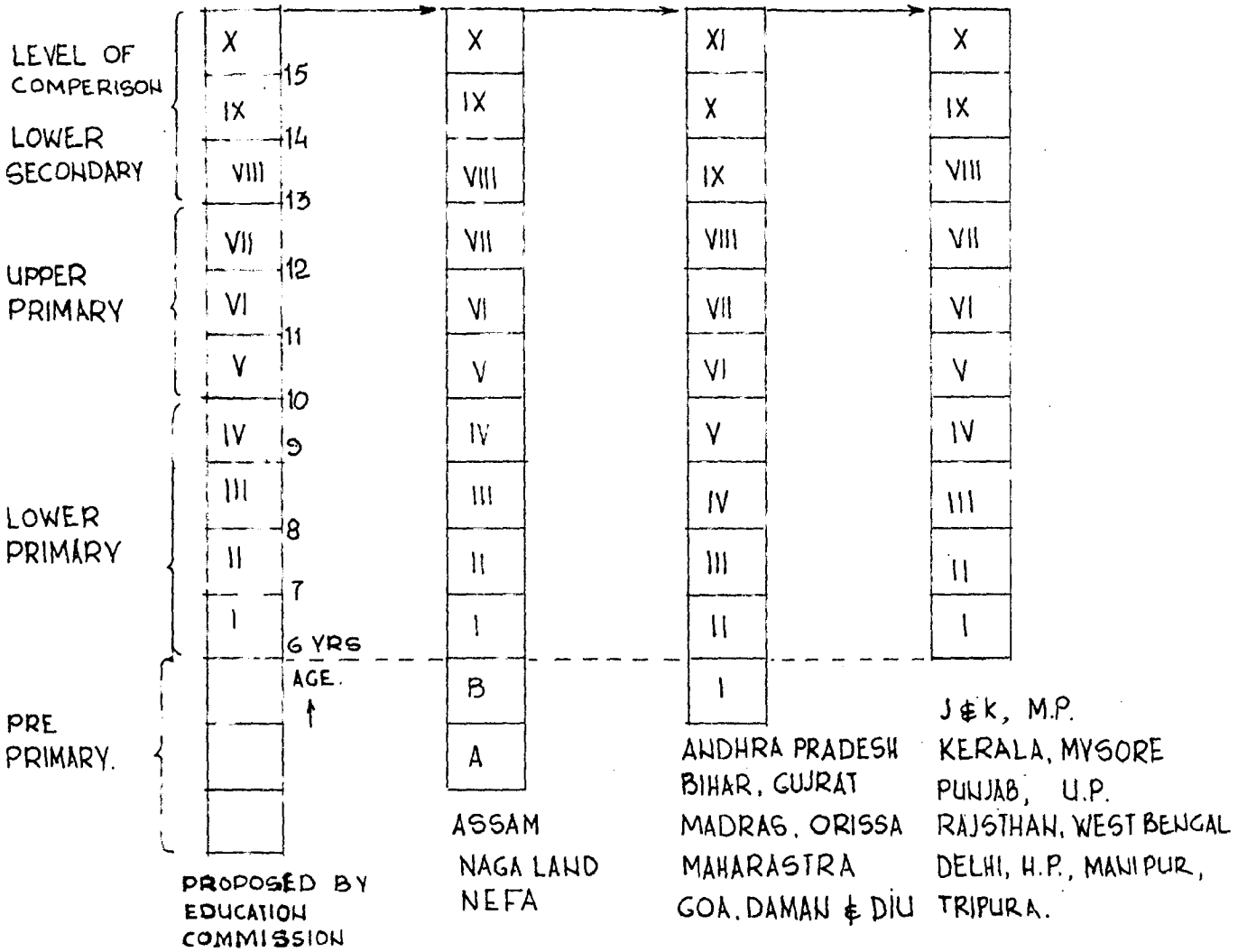
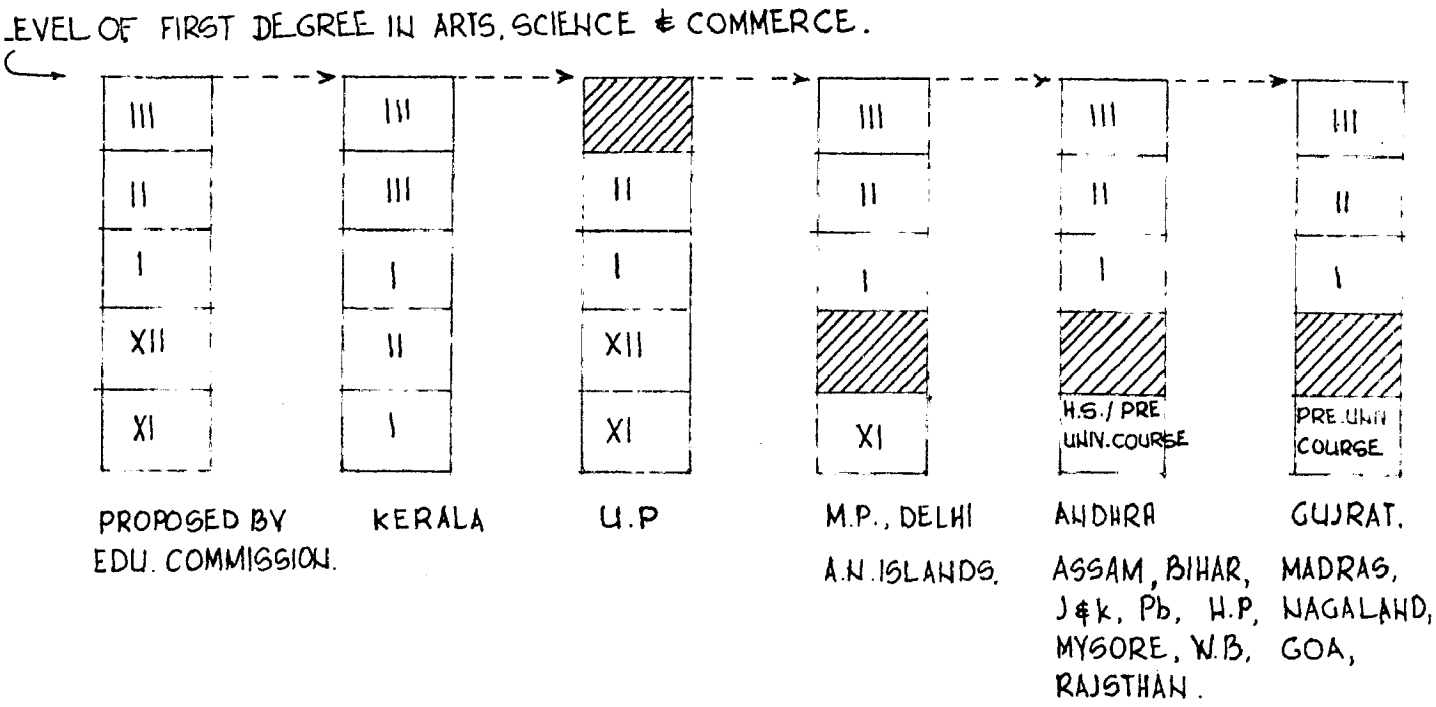


TABLE 1·31

climate, geography and the availability of the materials for building construction. In our country education is primarily the state Governments responsibility, the Union Government coordinates at higher education and takes steps to maintain standards in respect to researches, scientific and technical education through U.G. C. at under graduate and postgraduate. The Union Government also coordinates other sections of education through central advisory board of education. It lays down general educational policy formulates aims and objectives, asses the prevailing position and draws up future plans . Through four standing committees dealing with elementary, secondary, University and social education.

The education commission under the Chairmanship of Dr. D.S. Kothari in (1964-66) made a recommendation for the uniform system of education throughout the country. Even then the states are following the different systems of pre-university education.

The Ministry of Ed ucation has considered the starting year of education equivalent to each other, This bring the different classes of educational standards at par with each other, e.g. the X class of the Uttar Pradesh is High School, X class of Bihar



COMPARISON OF HIGHER-SECONDARY AND FIRST DEGREE COURSE

(1965-66)

TABLE: 1·32

is pre-high school and XI class of Maharastra is High School, XI class of Delhi is Higher Secondary but have been equated to each other.

The education Commission recommended the 12 years pre University education and then a three years degree course in Arts, Science and Commerce. The Commission has mentioned the education of a child should start at the age of 6 years at the primary school. There should be an equivalent examination in all the states at the age of 16 years i.e., after 10 years of school education. This examination should be conducted by an external body, and be called High School Examination. There should be another similar examination at the end of 12 years education. After qualifying this examination at the twelfth year of education should be consddered the minimum educational qualification to under go a three years degree course.

At present a number of states are following the Higher Secondary education pattern i.e. the 11 years education as the basis of first degfee course while others are following the Intermediate education pattern i.e. 12 year education as basis of the first degree course. At degree level the Universities differ from each other by having different

durations for degree courses, some have two years degree course and others have three years degree course (Table 1.32). The commission has clearly divided the preuniversity education in two groups the first being Primary and the second being Secondary These two stages have been further expressed in two stages each i.e. Lower and upper stages or Junior and Higher stages, related with the years of education respectively 1-4 or 1-5 and 5-8 and 6-8 , 8-10 or 9-10 and 11-12 which are called the classes or the study year (shown in Table 1.31).

1.4. THE MAGNITUDE OF THE PROBLEM

*" In the beginning of fourth five year plan there is one secondary school , 5 junior high schools and 28 primary schools within a radius of 5-10 miles. There are 26,000 secondary schools in the country out of which 14,000 are in Rural areas." U.P. Being the largest state of the country has maximum of these secondary schools called here as Intermediate Colleges. There are about 400 intermediate colleges in Meerut Division, nothing has been done in the field of research about the buildings, space requirement or any of the physical factors of the environment. This is the high time when this

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* Report of Education Commission 1964- 1966.

thing must be thought carefully. This stage of education is a link between the school and University education. This bridging stage of education has its directional importance, which may lead the innocent childhood towards the either parth of construction or destruction. It is the age, when the valuable intellectual development takes place- such development starts at the age of fifteen years and tends to maturity at the age of twenty five or thirty. It is the age when the childhood changes to youth.

Most of the research organisations have done a lot of work in the field of Primary and University education and its environments, several agencies have tried to give standards for the land buildinng requirements etc. The important stage of the life of the youth has not been given due considerations to provide the proper environments at secondary and Intermediate level of education. These are the environmental reactions which are being reflected by the yough of the nation, though their activities.

The objective of the secondary education in the fourth five year plan has been mentioned as follows -

"Fourth Five Year Plan will be to enrich the content and improve the quality of secondary education . Detailed district plans will be prepared

The expected increase in students population in fourth five year plan in classes IX to XI is 3.1 million.

The detailed increase in number of students from 1960 to 1968

Class	Nos. of students in Millions	
	in 1960-61	1968
I - V	35	55.5
VI - VIII	6.7	12.3
IX -XI	3.0	6.6

The quality teaching needs the environment and the environment is very much related to the physical factors of the educational centres. It leads us towards the importance of land and building requirements of the colleges. If there is a college, there must be land. For this we will have a number of questions to be asked ourselves . Howe much land, where for what education (type) ? Similarly about the buildings. The proper reply will be the standards in the form of minimum and optimum requirements to start with and kept as constant guidance factors for further developments.

1.5 THE SCOPE AND LIMITATIONS OF PRESENT STUDIES

All the spaces in a college may be divided into several groups of activities like, Academic studies, specialised studies, assembly, administration, library, physical and social activities, storage and sanitary facilities etc.

The basis of each space design should be the function of the activities to be performed there. The class room should be the functionof number of seats to be provided in it. The laboratory design should be the function of the performation of the experiments in place of the number of students which have to perform the experiments.

It has been observed that most of the colleges full of all activities and games are not able to attract or create the interests in more than 15% students towards the sports and games. The large open spaces and the numerious play fields are of no use to all of the colleges of present time. Most of the urban colleges can get the success in its aims, if these facilities could be provided at one place for a group of colleges.

The spacious laboratories, without equipments and proper lighting conditions are of no use. Most

of the colleges have the laboratories with similar types of tables in all dimensions to perform the experiment of finding out the focal length of lenses as well as of Tangent galvanometers. While the first one requires a table of not more than 120 cm x 30 cm with a circulation space alaround and in second case a table of 50 cm x 50 cm size. The general size of the tables provided is 150 cm x 75 cm for each experiment.

We need here a detailed study about the activities and its space requirements with the number of student in need of the facility and the use hours available easily per day.

There is certainly a demarkable difference between the environment of the class rooms of primary school and colleges. This change occurs class by class, which should be well expressed , Through environmental factors, so that the student may realise his upgrading from lower class to higher classes.

Here the laboratories for physics, chemistry Biology and class rooms have been studied in details in light of the existing conditions of the colleges. At present the plinth area of the colleges building

is the main criteria for further expansion of the college and that too, some times shown false on papers, just to get government aids.

The formation of the standards will depend upon two factors (i) the necessity of the space or the covered areas to perform the activity with proper environment. and (ii) The financial capabability of the society.

These two factors up to certain extent will go in opposite directions while calculating the spaces, but there is a certain limit of lowering the space need due to economy desired, What limit will need the mechanical areas in addition to that of circulation areas. Similarly the minimum possible volume of space as well as air and tolerable thermal acoustical and visual comfort and proper lighting inside the safe structures.

It is not possible to achieve the ideal conditions, due to the required economies. There are colleges which has the spaces, but not the students to perform those activities, for which the spaces have been provided and vice versa. So the trial should be done to provide the maximum possible for those who really recuire the spaces but well

equipped and with proper environment. Most of the colleges which have been visited, are single storeyed structures, with 10-12 width of verandahs. The stresses has been given on achieving the predetermined shapes of college building plans. There are hardly 2% colleges the organizers of which could contact the qualified Architects , before starting the building activities of college concerned. The covered areas are not lesser than its actual requirements in more than 75% of the colleges of Meerut division. It is the lack of proper location and organisation of various spaces and building elements. The lighting and ventilations has not been given due considerations scientifically.

In the present study, all these above mentioned factors, have been given due considerations within the frame work of availability of various data, the methods of studies, equipment technical know how and their present importance. The results arrived at have been given in the form of standards, as ready data available to the Architects, Engineers Educationists and Administrators to improve the standard of existing Intermediate college buildings as well for new establishments. The success of these results may be very correctly judged through practical applications with the timely modifications.

CHAPTER II

STUDIES

2.1 EXISTING CONDITIONS OF INTERMEDIATE COLLEGES

2.1.1 General

Intermediate colleges in Meerut division in rural areas ar situated between 5 to 18 miles distance from each other. The author visited 30 colleges in this region. Most of these have single storeyed structures, with sufficient spaces but unplanned. The professionals have been hardly consulted. Whenever the Architect has been consulted, that is merely to supply the drawings to get the aids from Government or any other agencies.

There are hardly 1 to 2% colleges run by the Government. These Government colleges have tolerable buildings and class rooms etc. but not planned properly from orientation considerations or otherwise. The rest of the colleges (98 to 99%) are run and managed by public organisations. Everywhere the managing committees control all the activities of the colleges without having any experts as representatives of any field. The rules and regulations are frequently moulded to suit them. These public colleges are Government aided, the criteria of sanctioning the aids is very flexible. There is a common practice of getting aids sanctioned for one purpose and to utilize that for other purpose. I unofficially is surprising to know that out of the sanctioned grant the

colleges get 80% money.

As far as the land is concerned. There is hardly any college in rural areas, which has not got the sufficient land. In urban areas about 60% colleges have sufficient land and buildings. When we see the buildings in details, most of the colleges we will find inadequate lighting in class rooms and laboratories.

Most of the colleges have 11'-12' wide verandahs, the heights of class rooms are 14' to 18'. The roofs of verandahs and class rooms etc., have been constructed at different heights. Generally the shape of the building plans are predecided by the managing authorities like, E.H.T.L. [ ] shapes from English alfabets. Most of the rooms in a college building are of some dimensions and with same size and numbers of windows, having equal and similar louvers and sunshades, irrespective of their function and orientation etc. Mostly colleges do not spend adequate money on maintenance of the buildings. The lawns and open spaces in majority cases are adequate but without proper maintenance.

Most of the colleges never felt the need for providing boys and girls common rooms. Thus the students are being indirectly forced to spend their lieser times either on roads on in lawns of their colleges.

The libraries with the colleges are not well planned and well equipped. Generally the assembly halls are used as libraries. A large number of colleges do not have the trained librarian even. The periodicals and the new papers are not considered to be the important need of the time and requirement of the educational centres.

The laboratories are not well equipped in most of the colleges. There no proper arrangements of demonstration tables, stores, dark rooms etc. No considerations have been given to the requirements of the experimental performances. The only factor taken into account is the number of students to be engaged in laboratory for practical works. None of the laboratories has been designed to suit the space, furniture and other functional activities requirements, of the experiments to be performed in that laboratory. A number of laboratories are under the tin sheds and do not have the sufficient and proper located windows to achieve the required lighting conditions. The tables etc., have been provided of the same dimension, irrespective of the functional requirement of the different kinds of experiments.

A large number of colleges do not have the proper facilities for games and sports. In the colleges of rural areas generally these facilities are not

properly cared. They issue the balls, Hockeys etc to the students to play in their own villages. Thus they do not take care of maintaining any fields, courts and tracks etc., at the college compasses. They get rid off their duties just by issuing the games and sports articls to the students. The colleges in Urban areas are sufferer of non availability of proper lands, but not to a large extent in number of colleges. The girls colleges either do not have the games facilities. The percentage of the college participants in games and sports does not exdeed 20. In most of the colleges this percentage lies between 10 and 15.

The offices of the colleges are not located at appropriate positions. Some of the colleges are using the Verandahs as the offices, even the office for the Head of the Institution is not find to be in good conditions to fulfil the space, function, dignity of status and other required necessities. The colleges have not given any importance to N.C.C., A.C.C. and P.S.D, N.S.S., Scouting etc. to provide the spaces for office and stores etc.

Students guidance counselling and medical facilities, recreational and common facilities have not been given any importance at this level of the education.

The conditions of the toilets provided in the colleges are very surprising. In rural areas almost all the colleges do not have the water supply so they have the latrines, with manual cleaning system and those too in unsufficient numbers.

Wherever the stairs have been provided, those are not properly designed, therisers of the steps and the width of the stair cases does not suits to the desirability.

The cycle stand is a very important element of the rural as well as of the urban colleges and this has hardly been given any importance at the time of planning the college campus.

2.2 EXISTING CONDITIONS OF INTERMEDIATE COLLEGES

2.1.2 Particular cases and the Results of the Surveys Conducted by the Author

The surveys conducted (from June 1971 to October 1971) of a number of colleges in connection with this study. About thirty colleges were visited at various places of meerut division, in Rural and urban areas. The data information in the form of performa has been collected from about ten colleges oft of these thirty colleges. The opinion of various members of these

colleges, regarding the strength and size of the college and various classes have been collected. Data about the number of students in the last five years class wise, size of class rooms, openings, laboratories, library, assembly hall, offices and facilities for games and percentage of the students using those facilities have been recorded. The following are some of the useful results and data which have been arrived at .

The subjects of study in Meerut division in general are-

High School	Intermediate
Hindi	Hindi
English	English
Sanskrit	Sanskrit
Urdu	Urdu
Mathematics	Mathematics
History	History
Geography	Geography
Economics	Economics
Civics	Civics
Arts	Arts
Agriculture	Agriculture
Science	Science: Physics, Chemistry
Biology	Biology: Zoology, Botany

Home-science	Homescience
Sociology	Sociology
Music	Music
Painting	Painting
Commerce	Commerce, Banking, Shorthand & Typing.

The data which have been collected and expressed here is about the following colleges -

*

1. Rastriya Inter College Shahpur
2. Janta Inter College Saroorpur Khurd
3. Salawa Inter College Salawa
4. D.A.V.Inter College Muzaffarnagar
5. V.V. Inter College Shamli
6. Govt. Inter College Muzaffarnagar
7. D.A.V. Inter College Budhana
8. A.N.S. Inter College Sardhana

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* The serial number with the name of various colleges, will indicate the name of the college also wherever used further in this report.

TABLE 2.1.2.1

THE AVERAGE MAXIMUM AND MINIMUM NUMBER OF STUDENTS PER SECTION

Class / Colleges	VI	VII	VIII	IX	X	XI	XII
1	34-48	33-45	36-48	42-47	36-44	34-43	16-52
2	30-41	33-47	37-47	36-43	34-37	25-30	29-30
3	36-48	35-42	34-41	44-59	34-52	18-21	11-40
4	30-39	34-39	34-42	33-42	38-46	38-43	38-49
5	42-46	48-67	49-61	56-61	57-61	51-60	59-64
6	38-45	38-47	38-44	28-46	25-44	28-36	18-30
7	35-43	30-43	31-43	36-45	37-46	41-49	39-50
8	46-56	49-53	42-54	33-72	33-65	17-30	13-26

TABLE 2.1.2.2

TOTAL NUMBER OF SECTIONS AND CLASS ROOMS YEARWISE, RESPECTIVELY

College \ Year		1966-67	1067-68	1968-69	1969-70	1970-71	1971-72	Number of Laboratories
1.	Sec.	23	22	23	24	25	25	3
	Rooms	21	24	24	26	26	26	
2	Sec.	22	24	22	24	23	22	3
	Rooms	20	22	22	22	22	22	
3	Sec.			13	13	14	14	2
	Rooms			16	16	16	16	
4	Sec	36	35	39	40	40	39	3
	Rooms	22	22	22	23	23	23	
5	Sec.	33	35	35	35	32	39	3
	Rooms	39	39	40	40	40	40	
6	Sec.	16	16	16	16	16	16	1
	Rooms	20	20	20	20	20	20	
7	Sec.	34	30	30	29	27	-	2
	Rooms	31	31	31	31	31	31	
8	Sec.	20	20	21	21	23	-	2
	Rooms	32	32	32	32	32	32	

TABLE 2.1.2.3

THE STAFF STUDENTS RATIO AND RESULTS IN PASS PERCENTAGE IN HIGH SCHOOL AND INTERMEDIATE EXAMINATIONS RESPECTIVELY.

Year → / College ↓		1966-67	67-68	68-69	69-70	70-71	71-72
1	* i	29.9	29.2	29.7	33.3	30.6	34.6
	ii	43.0	62.2	48.0	41.0	40.0	-
	iii	-	25.0	33.0	50.0	68.1	-
2	i	19.1	20.8	20.3	22.1	23.1	-
	ii	44	48	45.0	42.0	67.0	-
	iii	36.0	41	42	40	35	-
3	i	-	-	28	26.7	25	-
	ii	-	-	62	46	50	-
	iii	-	-	36	50	45	-
4	i	22.0	22.8	25.5	25.6	24.6	27.8
	ii	57	74	39	45	53	-
	iii	41	56	52	33	43	-
5	i	29.5	29.2	29.6	30.8	30	33.8
	ii	45.6	37.5	45.2	52.7	55.0	-
	iii	37.5	39.0	42.0	45.1	45.0	-
6	i	15.0	14.2	14.6	16.0	16.4	28.0
	ii	81	84.0	88.4	80.0	77.5	-
	iii		79.4	85.0	76.0	73.0	-
7	i	29.8	25.4	27.2	26.0	31.5	-
	ii	61.8	73.8	63.0	57.0	50.5	-
	iii	32.5	60.0	46.0	41.0	57.9	-
8	i	40.2	31.0	30.7	31.3	30.3	-
	ii	65.5	61.5	60.0	65.0	64.0	-
	iii	60.0	77.0	71.0	64.0	60.0	-

* Refer i Teacher student ratio
ii High School result in %
iii. Intermediate result in %

TABLE 2.1.2.4

FLOOR AREA PER STUDENT (SEAT) CLASS ROOM AND AREA OF OPENINGS IN PERCENTAGE OF FLOOR AREA

Colleges → / Particulars ↓	1	2	3	4	5	6	7	8
Area/seat sft.	12.5	12.6	12.5	15.0	9.6	15.5	13.1	14.4
Sq m	1.25	1.26	1.25	1.50	0.96	1.55	1.31	1.44
Openings % of floor area	7	10	12	12	11.6	13.4	9.3	16

TABLE 2.1.2.5

LABORATORIES FLOOR AREA PER STUDE-NT

Colleges → / Particulars ↓	1	2	3	4	5	6	7	8
Physics sq.m	2.55	5.12	2.4	3.14	1.76	1.6	2.66	3.6
Chemistry "	2.30	4.72	2.4	2.5	1.76	1.66	2.66	2.7
Biology "	1.4	6.0	-	2.3	1.7	1.6	-	-

TABLE 2.1.2.6

LIBRARIES - TOTAL FLOOR AREA AND NUMBER OF VOLUMES OF BOOKS

Colleges → / Particulars	1	2	3	4	5	6	7	8
Total area Sq.m.	150*	28.8*	120*	188*	105	45	150*	67.6
Number of volumes	5935	15000	3258	14495	10000	8000	5508	8500
Number in % of total str. using Lib.	10	12	11	15	9	11.5	13	14

* Assembly Hall is being used as library

TABLE 2.1.2.7

ADMINISTRATIVE AREAS AND COMMON ROOMS ETC.

Areas in Sq.m.

Colleges / Particulars	1	2	3	4	5	6	7	8
Principal's Office	140	216	100	216	240	240	64	480
Staff's common room	500	216	200	-	300	500	240	288
General office	140	288	300	216	400	400	160	480
Boys common room	-	-	-	-	-	-	-	-
Girl's common room	-	-	-	240	-	-	-	-
Number of seats in canteen	14	15	-	-	6	-	-	-
Stores	500	-	20.0	15.0	90.0	38.4	63.2	60.0
Another offices like games etc	30.0	31.5	-	15.0	-	-	-	-
Cycle shed for number of cycles	-	-	-	30.0	40	-	-	175
App. total number cycles	200	200	60	300	260	120	500	200
Total area of college sites in Acres	15	9	5	5	10	20	13	3
App. strength of college	1000	800	500	1300	1900	550	1200	800

TABLE 2.1.2.8

THE FACILITIES FOR GAMES AND SPORTS IN NUMBER OF FIELDS AND APPROXIMATE PARTICIPANTS' PERCENTAGE .

Colleges → / Particulars ↓	1	2	3	4	5	6	7	8
1. Volleyball	2+8*	1	3	2+3*	2	1	1+4*	1
2. Basketball	1	-	-	-	1	-	1	-
3. Kabaddi	2	1	1	2	1	1	1	2
4. Football	1	1	1	1	1	1	1	1
5. Hockey	-	1	-	1	-	1	-	1
6. Lawn Tennis	-	-	-	1	-	-	-	-
7. Races/ Jumps & Throws	1	1	1	1	1	1	1	1
8. Participants percentage	12	8	24	10	0	20	5	10

* The additional number indicates the numbers of balls issued to those students who come from the near by villages.

Most of the principals of these colleges favoured the lesser number of students per section of the class. The difficulties being faced due to lesser number of teachers in college. Almost all the principals expressed the desire to have the number of students below 40, the number 35-36 was favoured more. Some of these administrators as well as the teachers expressed to have 30 students in one section and the college strength of 500-600 , under the control of one principal is favoured.

Most of the teachers expressed the views of tutorial system, for intermediate classes (XI and XII year). They were of the opinion that it is not possible to check the work of students if it exceeds 30, in high school classes (IX and X year) and 25 at junior level.

A few number of the teachers expressed their views , that successful teaching is possible in smaller groups of students only and is irrespective of the college strength. The tabuler representation of the results of the surveys, of a number of intermediate colleges of Meerut division, conducted by the Author indicates the following -

i. There is a continuous increase in the number of students.

ii. There is no upper limit of number of students in a section, though the U.P.Board has specified the number of students for VI- VII - 35 IX-X - 40 , XI - XII - 50 per section.

iii. The number of class rooms and total sections of all classes of the college do not express any definite or well defined relationship. There are examples of teaching of 22 to 40 sections in a college of 20 to 23 class rooms and 20 sections in 32 rooms too.

iv. The aimed teacher taught ratio has been recommended is 1 : 20 in education Commission's report 1964-66. The actual position does not show any considerable change in last years. It is very high in private colleges e.g 1 : 30 and lower in Government colleges e.g. 1 : 15 -16

v The teacher taught ratio does not indicate any clear cut effect on pass percentage of students.

vi There are two interim stages, responsible for the increase or decrease of the classes IX and XI (High school and Intermediate). The first and formost is the class VI. The strength ofthe colleges is filtered out by the Board's examination, the local examinations are ineffective

to the strength of the college.

vii All the colleges take an step to be at safer side, they get the rooms constructed which may accommodate any number of students, upto 65 and 70 even. The number of students specified by board carries no considerable importance practically.

viii Though the desired teacher -students ratio expressed by the Education Commission is 1 : 20 but in most of the colleges it is as low as low as 1 :30.

ix. The laboratories do not have any relationship of floor area with either experiments to be performed or the number of student to work there.

x. The laboratories for Physics and chemistry hawe hardly any physical differentiations.

xi. The libraries are simply the books - stores and those too in multipurpose halls. The real importance of library has been neglected in almost all the colleges.

xii. In the opinion of the establishing and recognising authorities the offices and common rooms have hardly any importance, so these have not been given a considerable thought in any direction.

xiii. The toilets, stores and sta-irs require the considerations from the very basic needs of pla-nning, design and norms etc.

xiv. The openings provided in class rooms have not been given the scientific considerations of imparting the required minimum material requirements for lighting at working plans.

xv The percentage of the students participating in games and sports is very low due to non availability of the proper facilities, coaching and environments.

xvi. It is very important to rethink and prepare the standards for the physical facilities to be provided in the colleges in the light of the present attitude of the development of the educa-tion of the society particularly towards the quality improvement. If not the recognisation of the existing colleges at least the basis -- of the expansion and starting of the new one, when and wherever required.

2.2 CONDITIONS LAID DOWN BY EDUCATION DEPARTMENT AND BOARD OF HIGH SCHOOL & INTERMEDIATE EDUCATION UTTAR PRADESH IN EDUCATIONAL CODE (1958)

The students in all secondary and primary schools are classified according to the stages and instructions as indicated below -

(a) Pre-basic stage - Nursery education

(b) Junior Basic (Primary) stage classes I-V

(c) Senior Basic (Junior High School) stage VI- VIII

(d) High School IX - X

(e) Intermediate XI - XII

Recognised institutions are divided according to the system of control into two categories -

(a) Under Public Management -

i. Govt. institutions are public institutions managed directly by the Education Department of the State Government.

ii. District Board Institutions are Institutions which are managed by a District Board.

iii. Municipal Board Institutions are institutions which are managed by Municipal Board.

(b) Under Private Management

i. Aided Institutions are private but recognised institutions which receive grant in aid from

public funds, either from the Govt. of from the local bodies (Dist. Boards, Municipal Boards etc.)

ii. Unaided - institutions are those which receive no assistance whatsoever from public funds and differ from private institutions mainly in being recognised by the Department.

For the superivision, inspection and control of educational institutions for boys the state is divided into eight regions.

I. Region, Meerut,
II Region, Agra
III Region Bareilly
IV Region Allahabad
V Region Varanasi
VI Region Lucknow
VII Region Gorakhpur
VIII Region Nainital.

Seven of these regions are under a deputy Director or Education seperately with head quarters at Meerut, Bareilly , Agra, Allahabad, Varanasi, Lucknow and Gorakphur. Nainital region is directly under the control of a Regional Director.

RECOGNISED HIGHER SECONDARY SCHOOLS

The courses of study are prescribed, for classes IX to XII by the Intermediate Board, and those for classes VI to VIII by the department and are the same as prescribed for Senior Basic (Junior High) schools.

Every student should receive physical training atleast three periods a week in junior High school classes and two periods a week in Higher secondary school classes. Students who fail to attend the games for less than 60 percent of the periods allotted for the purpose, unless they have been exempted by the Head of the Institution, shall not be promoted to the next higher class.

Games Fees Chareable from Students

Class VI to VIII - 19 Paise per mensem

Classes IX to X - Twenty five paise per mensem

Classes XI to XII Thirty seven Paise per mensem

Except the scheduled caste students.

The school Health Officers er ex-officio school Health officers shall arrange with the heads of the institutions concerned for regular medical inspection in accordance with the rules laid down by the Public Health Department. It is the responsibility of the Head of the institution to ensure that the medical

history sheet is maintained for every student in the institution.

The timings at which recognised higher secondary schools will open and close shall be determined by the head of the institution in consultation with the managing body, if any.

The minimum time of instructions, excluding the time devoted to recess shall be five hours twenty minutes from August to March and four hours thirty five minutes during Summer- April, May and July when the school is held in the morning. The time of instruction shall be divided into two meetings daily as follows-

First meeting will be from the commencement of the time for instruction upto the commencement of the recess.

Second meeting will be from the end of the recess upto the end of the time instruction.

No institution shall hold classes in double shift. Institutions which are already holding classes in double shift shall have to discontinue the system in the manner as may be laid down by the Director.

The responsibility for seeing that the nature and the amount of home lessons set throughout the

institution are suited to the capacities of the students is an important part of the duties of the head of the institution and he should from time to time assure himself that the teachers are acting in accordance with his instructions.

The head of the institution will limit the admissions into any class or sections of a class to the number of students for which there is accommodation in the class room, subject to a maximum classes

VI	- VIII	35 stude nts
IX	- X	40
XI	- XII	50

1/6 reserved for scheduled castes.

Ordinarily no student is admissible to class VI until he has completed his ninth year.

Student shall not be admitted to any recognised institution, if his age on 15th May following the date on which admission is sought will exceed

Class of admission	Age
VI	13
VII	14
VIII	15
IX	16
X	17

PRE REQUISITES OF SCHOOLS AND COLLEGES

1. Pre basic stage or Nursary stage
2. Junior basic (Primary stage)- classes I toV
3. Senior Basic (Junior High School)stage- class VI - VIII
4. High school and Intermediate stage Class IX-XII

Recognition of senior basic schools may be granted provisionally for a specified period not exceeding two school sessions by the Inspector of Schools provided he is satisfied on the following points -

(i) Whether the institution under consideration for recognition is likely to meet the genuine need of the area in which it will be located, considering the number and suitability of the existing institutions ?

ii. In case of private school, what is the constitution and composition of the Managing body?

iii. ~~In case of~~ Whether the financial resources available are adequate for the efficient working of the proposed institution?

iv. Whether adequate facilities exist for teaching the subject in which recognition is applied for ?

v. Whether the buildings and equipment (including land) for the proposed school are adequate and in case of buildings whether they are situated in hygienic surroundings and are well ventilated

and clean ?

vi. Whether the qualifications and pay of the teaching staff are adequate.

vii. Whether adequate provision, financial or otherwise, has been made for providing recreation and facilities for outdoor sports to students and for the maintenance of their health and discipline amongst them ?

viii. Whether adequate provision, financial or otherwise, has been made for the maintenance of a library and reading room in the school.

ix. Whether provision has been made for

(a) five acres of cultivatable land capable of being used as a school farm for teaching practical agriculture to the students

(b) Agricultural implements,

(c) Adequate arrangements for ploughing and preparation of soil and

(d) books worth atleast Rs. 100 on agriculture or allied subjects for the school library.

The admission to any class or section of a class of a junior high school shall be limited to the number of pupils for whom there is accommodation @ 12 sft per pupil and shall not exceed 35 in numbers in any section.

Grant in aid to Recognised Institutions -

No grant is made to any institution unless it agrees to comply with the conditions hereinafter laid down and every institution which applies for grant in aid shall be deemed to have accepted its obligation to comply with these conditions -

(a) It shall be opened to inspection by the inspecting officers of the Department or by such sanitary, medical or other officers as may be authorised by Government to inspect it.

(b) The governing body of the institution shall, unless specially exempted by Government, be registered under the Societies of Registration Act XX-1860.

(c) It shall report any changee in the constitution of the governing body or in the office-bearers thereof the District Inspector or to the Directo.

(d) It shall furnish all information and returns called for by the Department.

(e) It shall make suitable arrangements for the good discipline, health and recreation of students, the supervision of boarders and for the sanitation of the premises.

(f) It shall keep all the accounts of income and expenditure in a form prescribed by the Department and they shall be open to examination by the auditors employed by the Government or the Department.

(g) It shall not open an additional section or close an existing section in any class without the previous approval of the Inspector.

The annual grant shall ordinarily not exceed one half of the whole tuitional expenditure on the institution. No changes on account of management or buildings and repairs, except petty repairs, may be included in the tutional expenditure.

Grants made for the purchase of sites, the eractions, purchase, enlargement, improvement or repair of school or college shall not exceed the total amount contributed for the purpose from other sources. The value of a site acquired or of buildings already constructed without a grant may be taken into consid-eration in deter-mining the amount of the grant.

No grant will be finally sanctioned until the manager certifies that the funds provided from other sources are sufficient with the grant to meet all claims and to close the account.

A manager who has applied for assistance towards the erection of a building, may on his own responsibility

commence work before the question of the grant has been settled, without subsequent prejudice to his application.

Grants no exceeding one half the amount given or devised may be made for endowment of professorships, lecturerships, teachership, scholarships, laboratories, workshops, museums and other educational objects on the following conditions -

(i) The endowment shall consist of Government securities to be invested in the names of trustees approved by the Government.

(ii) The endewment must not be created from moneys devised either directly or indirectly from ordinary fund or school income.

(iii) The trust deemd which must be approved by the Government conveyancer, shall contain a provision that in the event of the object for which the endowment was dreated ceasing to exist, or of the management ceasing to comply with any of the conditions of the trust, the fund shall be distributed as provided therein.

iv. The trustees shall render yearly accounts to the Director in the prescribed form.

2.3 THE STANDARDS

Out mind relates the things with each other. For this purpose there are certain yardsticks or units in our mind to measure the characteristics of all the things. The measures of these yardsticks become the standards while acceptable to considerable extent.

The standards are tried and accepted measures or the laws made to govern self.

Walter Gropius defined the standards as follows -

> " That simplified practical exempler of anything in general use which embodies a fusion of the best of its interior form - a fusion preceded by elimination of the personal content of their designers and all otherwise ungeneric or non essential features".

We cannot always go on experimenting, whatever has been tried and accepted should be adopted. The standards are those measures which we can adopt.

(i) Standards provide the basis of comparison.

ii. Standards specify the performance requirements.

iii. Standards lay down the requirements of safety.

iv. Standard provide the aspect of interchangeability.

v. Standards reduce the variety and reduce the confusion.

Standards for the uniform development of the educational facilities may play its important role in creating the ease in cachieving the required environmental conditions. The standards of the physical facilities to be provided in educational campuses are of the Architectural fields, which have been studied in the subsequent chapters.

2.3 STANDARDS LAID BY VARIOUS AGENCIES

2.3.1 Size of College

The size of the college recommended in terms of strength of the students -

TOWN PLANNING ORGANISATION (Ministry of health)		750	students optimum
Ministry of Education U.K.		600	"
U.S.A.	upto	800	(existing)
Principals and Educationists conference		800	optimum
National Buildings Organisation		960	even higher in case of expert management.
Central Schools (from 6th to 11 th class)			
Buildings.	A	720	maximum
	B	480	
	C	240	Minimum

Committee on plan projects

Delhi School Buildings, Govt. of India. 1960	650 students 16 sec.
	1000 students -25 "

The size of the college in terms of area requirements

National Buildings Organisation Min.	5 acres in all
Minimum	3 Acres (where the open spaces like parks etc. available in nearby localities)
	1.5 acres in addition to above for the future use.

2,3.2 The spaces for various activities

2.3.2.1 Class Rooms

The size of class recommended in terms of number of students-and area per seat.

Authority	Total No. of students per class.	Area per seat. Sft	Sm
Ministry of Education U.K	30	16	1.6
Rules for schools in Italy	30	10.24	1.024
Director of Pub. Inst. Andhra	40	11	1.1
Director of Edu. Delhi	50	-	-
Madras Education Department	40	11	1.1
D.P.I. Asam	-	10	1.0
D.P.I. Kerala	-	8	0.8
D.P.I. Panjab	-	12	1.2
D.P.I. Pondichery	-	11	1.1
Directorate of Education U.P	-	12	1.2
Directorate of Education Tripura	-	10	1.0
Conference of Headmasters of Secondary schools	40	12	1.2
Bombay Municipal Corporation	45	8.8	0.88
Town Planning organisation Ministry of Health	35	16.5	1.65
Experts Committee 1950	-	10 -12	1 to 1.2
Council of Higher Secondary Education	-	12	1.2

Committee on Plant Projects Delhi School buildings 1960	40	10 - 12	1-1.2
Planning by E & OE	30	16	1.6
Planning higher secondary schools (Reinholds Publications)	40	18-25	1.8 to 2
Central School buildings	-	10	1
Schools for new needs (Reinholds publication)	-	25	2.5

2.3.2.2 Laboratories

	Area per student
National building organisation	1.85 sqm (20 sft) in addition to this 80-120 si as the store.
Asian Regional Institute for School building research (ASISBR)	
Colombo . Physics Lab.	@ 2.4 sq.m/st for 40 st.
For Asian Schools Secondary level	
Chemistry Lab	@ 1.7 " for 35 st. (18 sft)
Biology	@ 2.1 " 40 (21.8 sq.ft)
Planning by E. & O.E. Physics Chemistry & Biology.	@ 32 sqft/student
Committee on Plan projects- Delhi School Buildings Govt. of India 1960	30 sft (2.8 sqm)/st.
Committee on Plan projects- Science laboratories in Secondary / Higher secondary schools Govt. of India 1962	26.6 sq.ft (2.5 sqm) per st. and 240 sft (22.2 sq.m) store.

2.3.2.3 Library

Various norms and standards regarding the Libraries for secondary colleges-

Indian Standard Institute

Number of volumes	5000 to 30,000
Periodicals current	20 to 50
Number of readers seat	40 to 120
staff members	2 to 4.

Area required for 15,000 books and 60 seats - 12600 sft.
126.0 sq.m.

Town Planning Organisation (Ministry of Health)

Total area 1,480 sqft for 630 students Library including 200 sft storing space.

Council of Higher Secondary Education.

Library and Reading room area 500 sft Min. or 10x2 5% of the total enrolment.

For the strength of 800 students Library area needed is 2000 sqft.

Head master's and Conference

Reading room space for 40 seats @ 16 sqft / student which comes out to be 640 sq.ft for one school (64.0 sq.m)

Directorate of Pub. Inst. Andhra 625 sft. (62.5 sq m)

The Ministry of Education U.K.

Library area for 600 enrolments 960 sq.ft.

Planning Higher secondary schools (NBO)
Library area 600 to 960 sqft.

Report Libraries in Secondary School by Carnegie U.K. Trust @ 35 to 40 sft/st.

2.3.2.4 Multipurpose Hall

Planning Higher Secondary Schools (NBO) @ 7 sft/st. for 50% strength of school.

This is exclusive of stage area

Planning by E & OE @ 8 sft/st. for 45% to 20% of total strength of the college

Central School Buildings @ 9 sq.ft (0.84 sq.m)/seat.

Committee on plan project-Delhi School Buildings Govt. of India - 1960 3000 to 5000 sft (279 to 325 sq.m)

Hall, Library and staff room .

Hall for 1000 students and Hall for 650 stude

1920 to 720 Balcony = 2640 sft (245 sqm.)

1800 to 1920 sq.ft (167 to 178 sq.m)

2.3.2.5 Areas for Administration

Planning Higher secondary schools(NBO)

Principal's office 200 sft.

Staff common room @ 20 sft/staff member for 75 % of total 200 sft. Minimum

General office, records and accounts etc 200 sft.

Guidance room 200 sft.

First aid or Doctor's room 150 sft.

Committee on Plan Project-Delhi School Buildings .

Principal's office 300 sft(27.9 sq.m)

Staff common room 320 (29.7 sq m)

General Office 500 sft (46.4 sq.m.)

2.3.2.6 Storage area and Sanitary facilities

Planning Higher Secondary Schools (NBO)

Storage area @ of 5% of Teaching area.

Latrines or W.C.	1 for every 100 stude-nts or part thereof.
Urinals	1 for 25 students
Washbasins	1 for 50 students

Director of Public Instructions Andhra

W.C.	8 for 500 boys and 10 for 500 gir ls.
Urinals	6 for 100 boys
Washbasins	10 for 500 students.

Bombay Municipal Corporation

W.C.	4 for 300 students.
Urinals	4 for 300 students.

Education Directorate

W.C.	1 for 50 students
Urinals	1 for 50 students

Madras Education Deptt.

W.C.	8 for 500 boys 20 for 500 girls
Urinals	6 for 100 students.

Town Planning Organisation (Ministry of Health)

W.C. Urinals Washbasins.	4 for first 30 students and @ 1 for next 15 students upto 300 students in addition and than @ 1 add. for each 30 above 300 students.

Directorate of Education U.P.

W.C. Urinals.	4 for the first 400, @ of 2% of the enrolments.

Indian Standards Institute, Ministry of Education,

U.K. and Planning by E & BOE

Wash basins	1 for ev ery 40 boys 1 for every 30 girls
W.C.	1 for 40 each sex.
Urinals	1 per 20 students.

Committee on Plan Project Delhi School Building,

Govt. of India 1960.

W.C.	1 per 40 boys 1 per 25 girls
Urinals	1 per 21 students.
Storage area	2 rooms (160 sqft)for 650 students on each floor 14.9 sq. m. 3 rooms on each floor for 1000 students.

2.4 FACTORS EFFECTING THE LAND AND BUILDING REQUIREMENTS

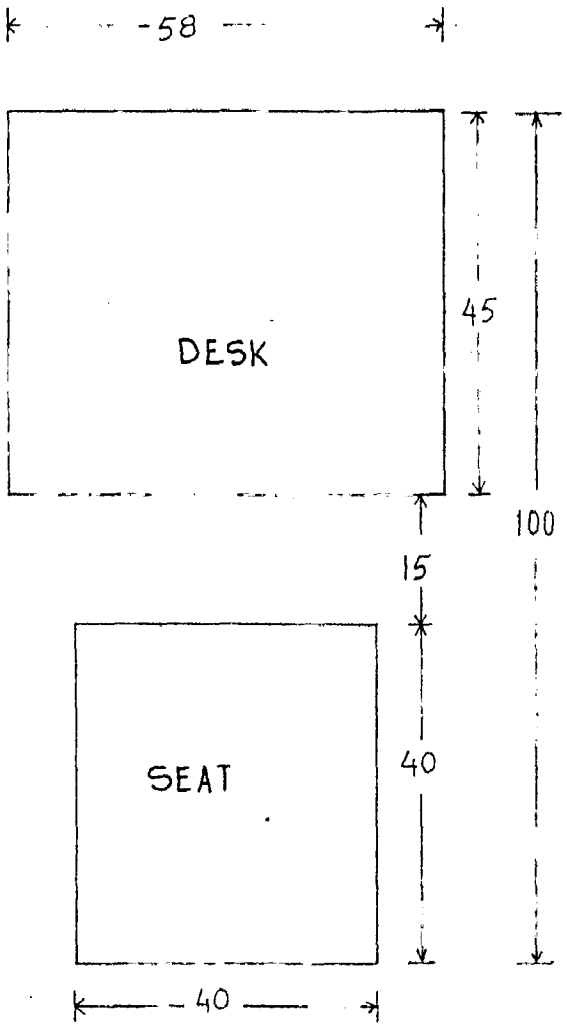
2.4.1 Size of the College

The student is main element of the classes, which in turn are the constituent units of the college. The student and teacher require the environment to fulfil the objectives of the education successfully. This environmental centre constituted by a number of elements in the form of various groups and units etc , to perform the required activities of teaching and learning , is called the college/school.

Its dimensions and magnitude will limit the performances of activities, intake and output in terms of number of students. The size of the college may be expressed in terms of the strength of the students and physical dimensions of the piece of land on which it exists. The size of the college may be arrived at by considerations, either of the population, to which it has to serve or (b) the efficiency of the Teaching and learning to be achieved. In both the cases the physical requirements of the college size will largely be governed by the type of educational activities or the subjects to be taught . These are not of course free from the effect of emotional factors and finances changing with the time. The physical factors do change with time but at a slower rate as

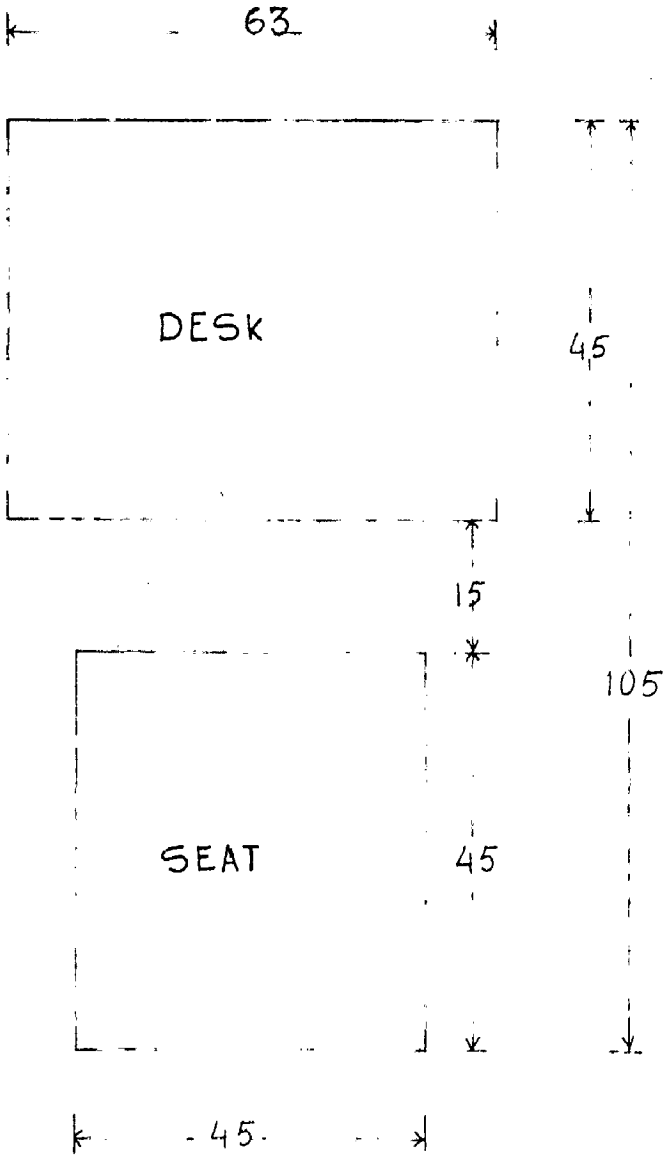
compared to others. These cannot be escaped of the climatic conditions. The factors rapidly changing with time are to be left to decision of planner, Architect, Engineer or educationist, who so ever be responsible at the time of materialisation of the scheme. The remaining factors like, number and sizes of the class rooms, laboratories, library, open areas, facilities for games etc., Administrative areas, toilets, stairs etc. etc. which governs the land requirements, are of Architectural importance.

The analysis and synthesis of these areas and the activities with respect to the environment efficiency and economy may bring us towards the standard formation of various spaces related to the college building . All these activities as well as the spaces are dependent of the number of the students to be enrolled in the particular college. These spaces, facilities and the students may be called interdependable or the function of each other. Either the facilities may be provided for a particular number of students or the number of students is fixed on the basis of the facilities existing in the college. Any how these activities are to take place in terms of the participation of the students and facilities to fulfil the objectives of the education in the college. The facilities to be provided in it,



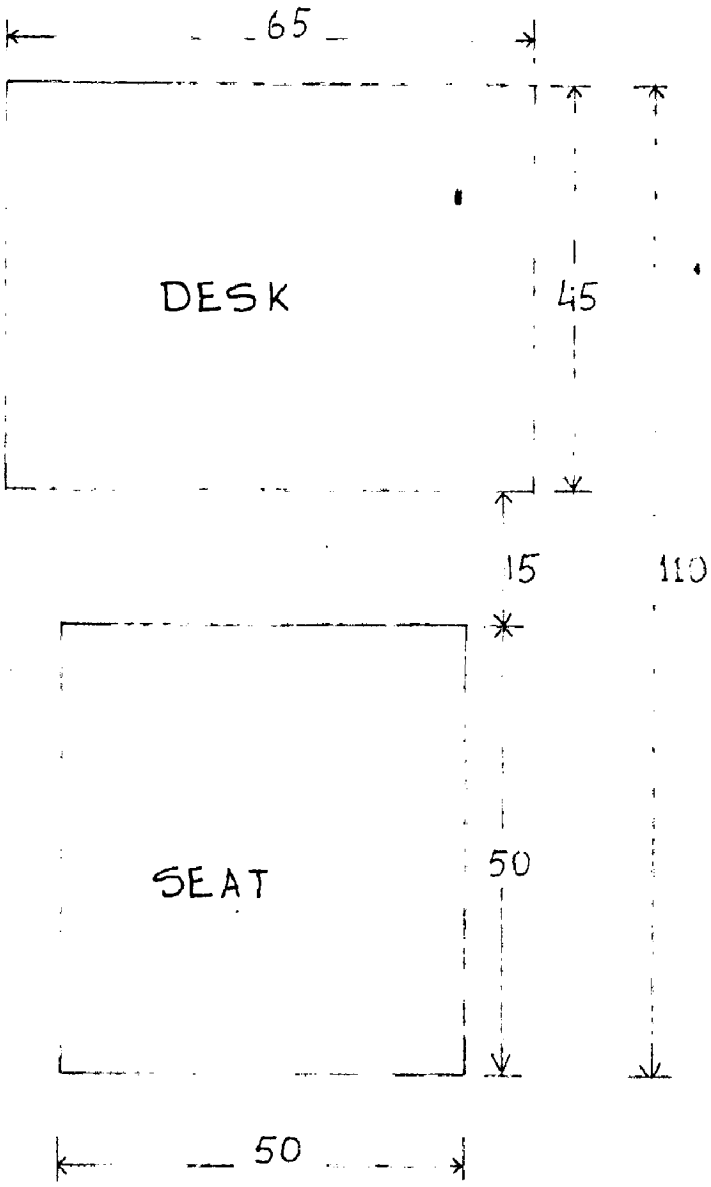
DESK & SEAT FOR AGE GROUP 12 YRS - 13 YRS

FIG: 2·421(a)



DESK & SEAT FOR AGE GROUP 14 YRS-15 YRS.

FIG: 3.42(b)



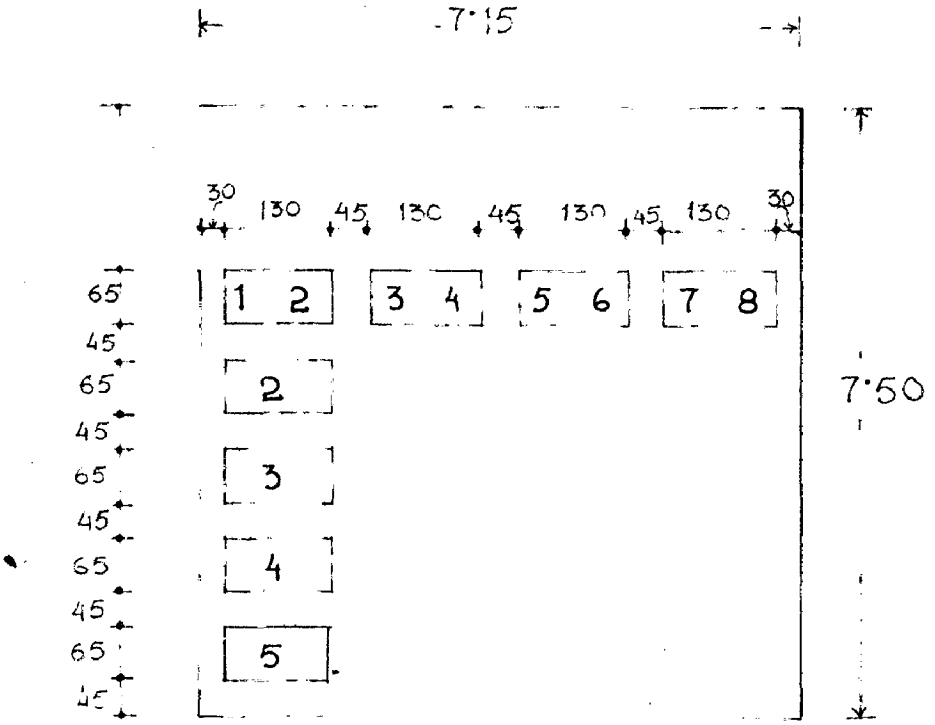
DESK & SEAT FOR AGE GROUP 16 - 18 YRS

FIG 2·421(C)

i.e., for the classes VI to VIII - 35 students per section , IX-X - 40 students for section and XI-XII - 50 students per section. One class room for each section is largely considered to be the basis of finding out the number of class rooms required for the college, but this could not remain the appropriate and economical way. A number of classes are to take place in laboratories and some students may go for optional subjects like Drawing and Arts etc. the classes of which will be conducted in their respective group. It brings us towards the actual requirement which will be definitely less than the apparent requirement. This apparent number of rooms increases the covered space without any functional use, thus the efficiency of the building is reduced.

The acute shortage of the funds for the school buildings compells us to think further to minimise the number of the rooms but not at the cost of educational aims and quality. The life of the building is not effected by its use of efficiency. The ideal efficient and economical is to use the building round the clock, throughout its life span.

The ed-ucation Commission 1964-66 has recommended minimum number of sections two per class for the group which has laboratory courses otherwise may be one. The number of students in a higher secondary



CLASS ROOM ARRANGEMENT FOR 40 SEATS.

TOTAL AREA = 53·62 SQ.M. @ 1·34 SQ.M. PER SEAT.

FIG: 4·422.

school be 300 to 450 with 20 teachers for economic reasons.

(a) Contact Hours

The contact hours of teacher and students has been 900 to 1000 per year, which has been recommended to increase upto 1100 per year in the usual (234) working days or 36 weeks/year.

Number of stude-nt end teacher contact hours $= \frac{1100}{36} = 30$ (approximately)

i.e. taking one period of 40 mts, as recommended.

The period hours per week $= \frac{30 \times 60}{40} = 45$ minu

There will be 7 - 8 periods per day considering 6 days in a week as working days.

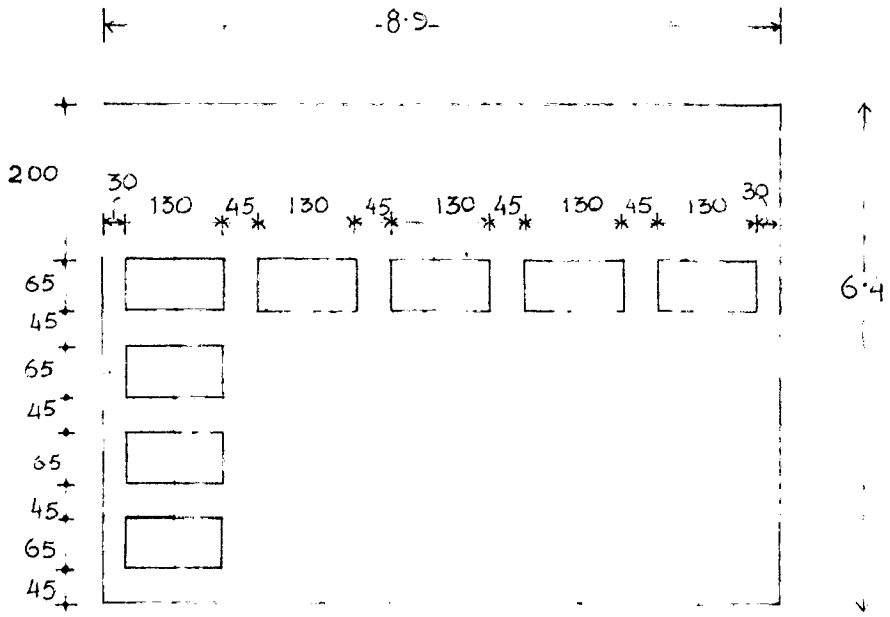
Number of subjects to be studied

i.	For classes	VI to VII	8
ii.	For	IX to X	6
iii	For	XI to XII	5

Hence the hours of studies / subject / week shall be

i.	4	or 240 minutes	= 6 periods
ii.	5	or 300 minutes	= 7.5 "
iii.	6	or 360 minutes	= 9 "

Out of which 50% time in class XI and XII be devoted in the form of tutorials/self studies within the college.



CLASS ROOM ARRANGEMENT FOR 40 SEATS

TOTAL AREA = 56·96 SQ.M. @ 1·42 SQ.M PER SEAT.

FIG 4.423

(b) Working hours of the school/college.

Possibilities of work hours in winter from 9.30 am to 4.30 pm

= 7 hours = 10 periods
40 mts each

in summer 9 a.m. to 5.0 pm

= 8 hours = 10 periods
of 45 mts each.

Hence the maximum use value of one class room = 10 periods/day

This can only be achieved when there is a segregation of class times and time table be adjusted accordingly

For X classes (sections) in a college the total number of rooms required = R will be given by

$$R = \frac{S \; P_s \; x}{P_d \; . \; W}$$

where,

R Total number of rooms required

x Total number of sections or classes.

S Total subjects to be studied at various stages of studies (i) (ii) and iii.

P_s Periods/subject / week, required

P_d Possible number of period to be conducted in one room per day, during working hours.

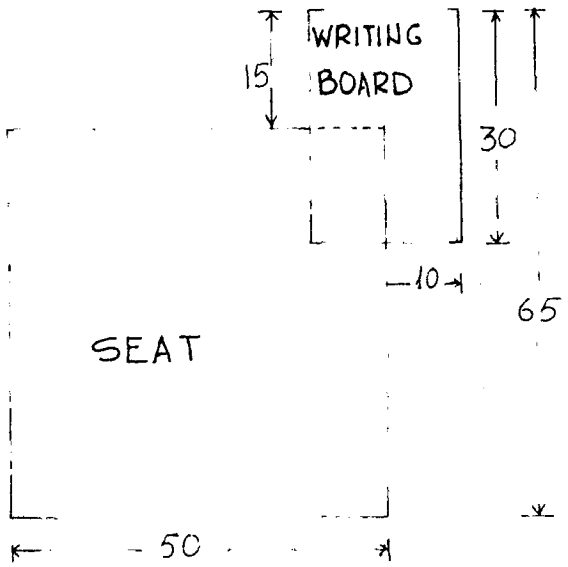
W Number of working days/week.

i. for classes VI to VIII R works out to be 0.8 x

ii for classes IX to X R works out to be 0.75 x

iii for classes XI - XII R works out to be 0.75 x

which is always less than x, while there are 6 working days /week.



DESK & SEAT FOR AGE GROUP 16-18 YRS.

FIG: 2·42 (a)

This also includes the practical periods, whic will be conducted in laboratories . Thus reducing this f igure further to lower values.

Keeping in mind the recommendation of Education Commission (1964-66) the stress laid on self studies in libraries, upto 50% of the total teaching hours in class XI and XII. This will reduce the requirements of rooms further.

Size of Class room - Though the size of a class room will depend upon the number of the seats to be provided in it. Below is the area requirement per seat per student and the teacher.

Mechanical area

i. size of the writing desk/ table

a. 58 cms x 58 cms for age group of 12 - 13 yrs

b. 63 cm x 63 cm for age group of 14 - 15 "

c. 65 cm x 65 cm for age group of 16 -18 "

ii. size of the chair

a. 46 cms x 40 cms

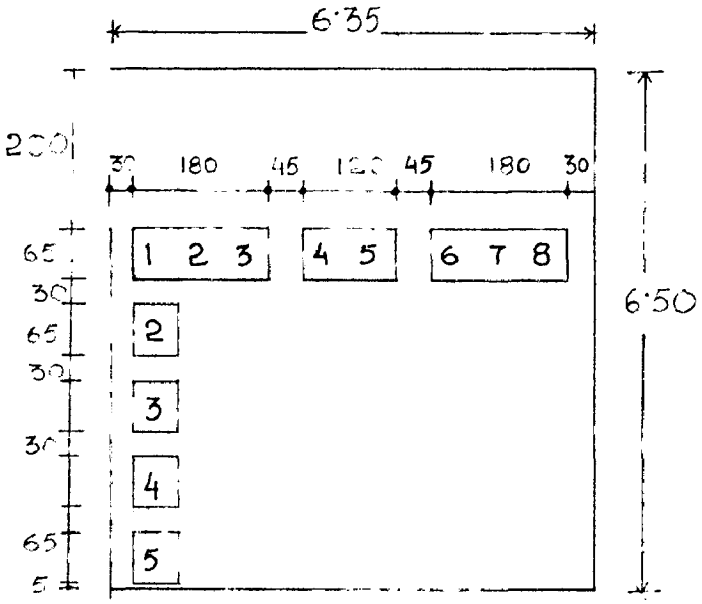
b. 45 cms x 45 cms

c. 50 cms x 50 cms

The analysis of the floor area requirement shall be as follows -

a. Mechanical area reauired for furniture etc.

b. Total area including movements or circulations



CLASS ROOM ARRANGEMENT FOR 40 SEATS.

TOTAL AREA = 41·27 SQ.M @ 1·03 SQ.M PER SEAT.

FIG: 4·426

Mechanical area for a writing desk and chair shall be as follows

For 35 students (seat) in age group of 12-13 yrs

= 35 x 1.00 x 0.58

= 19.30 sq.m. Fig. Nol 2.4.2.1 a

For 35 seats in age group of 14-15 years

= 35 x 1.05 x 0.63

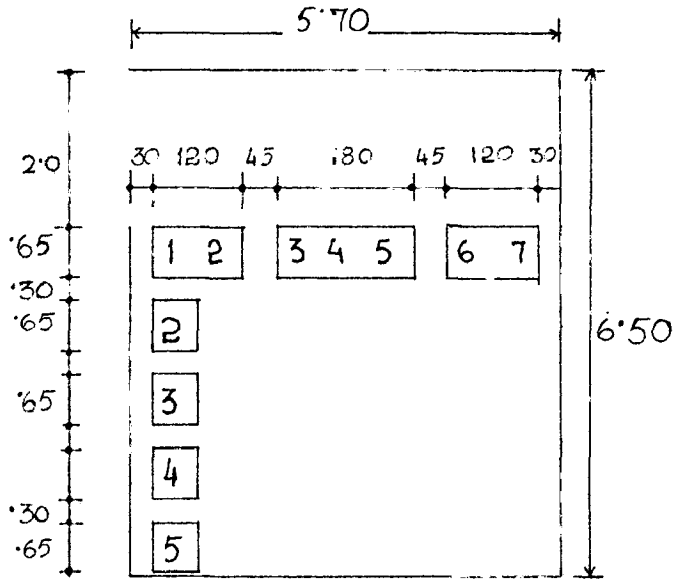
= 23.16 sq. m. Fig. 2.4.2.1b

For 35 seats in age group of 16-18 years

= 35 x 1.1 x 0.65

= 25.00 sq.m. Fig. 2.4.2.1c

Alternatively, since in (XI and XII year stage of teaching the system changes to that of lecturing and student is not required to bring the test books for each and every subject. The survey conducted by the author reveals that in these classes i.e. XI-XII the d esks can be easily avoided by providing a small size writing space on the right hand side of the seat. It is economical in terms of furniture cost as well as interms floor area r equirement per seat. The advantage of the lesser floor area requirement is being taken by colleges in increasing the number of students in a section beyond the specified limits which effects the quality of education. We should consider this point for the class room designs. The provision of floor area for specific classes must be taken into account for just sufficiency. The mechannical area required for this system in case of (iii) group



CLASS ROOM ARRANGEMENT FOR 35 SEATS.

TOTAL AREA = 37·05 SQ.M. @ 1·05 SQ.M. PER SEAT.

FIG: 4·425

of classes will be as follows -

For 40 seats = 40 x 0.60 x 0.65

= 15.60 sq.m.

For 35 = 35 x 0.6 x 0.65

= 13.65 sq.m

For 30 = 30 x 0.60 x 0.65

= 11.70 sq. M

It is 45% economical as compared to the traditional system of providing the desk and stool seperately and the required floor area.

b. Area for Circulation etc.

We can analyse the area required for gangways teacher chalk board etc.

The total area required for 40 seats

= 56.96 sq.m Fig. 4.4.2.2

For 40 seats(alternative arrangement) =56.96 " Fig. 4.4.2.3

But when we use the seats with writing board on its right hand side area required.

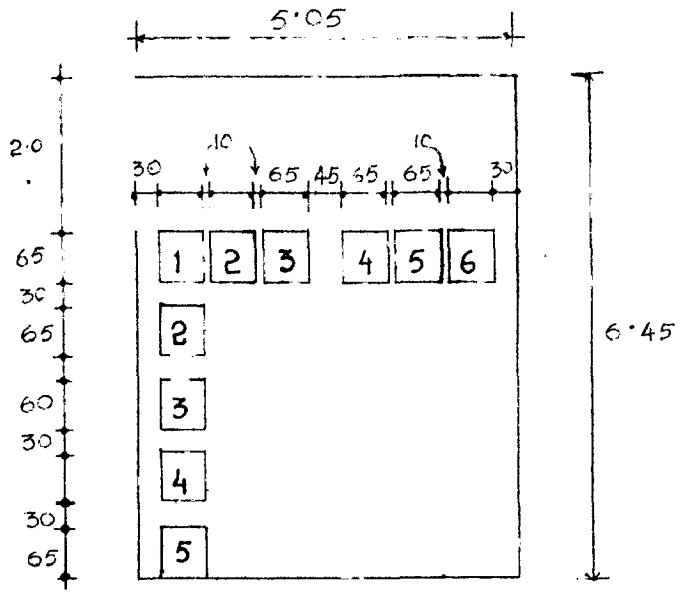
For 40 seats = 41.27 sq.m. Fig. 4.4.2.6

For 35 seats = 37.05 " Fig. 4.4.2.5

For 30 seats = 32.57 " Fig. 4.4.2.4

These figures very clearly indicates the areas which are just sufficient for the class rooms.

As far as possible these rooms should have the fixed furniture and the rooms should be utilised for the specific teaching activities i.e. for lectures and



CLASS ROOM ARRANGEMENT FOR 30 SEATS.

TOTAL AREA = 32·57 SQ.M. @ 1·08 SQ.M PER SEAT.

FIG 4·424

tutorials . This will also discourage the unauthorised expansion of class strength.

As per various arrangements shown the recommended size of class room comes to be

a. 8.9 M x 6.4 M for 40 seats

Alternate arrangements 7.15 x 7.5 M for 40 seats

For desk & chair arrangement

b. For chair with writing arrangement on right hand side

6.5 M x 5.05 M for 30 seats

6.5 M x 5.7 M for 35 seats

6.8 M x 6.5 M for 40 seats

For a strength of 35 the size of room would be 6.5 x 5.7 M which is recommended. ~~Fig~~. Because for intake of 30 student per section and adding maximum 5 seats by way of anavoidable c ircumstances like that of failure etc.

2.4.3. LABORATORIES

The laboratory is a function of the experiments to be performed in it. In Meerut division most of the colleges have laboratories for Physics, Chemistry , zoology and Botany. The laboratories can be divided into two groups viz ,

1. In which different type of experiments are being performed by different students at one time

e.g. Physics lab., where simultaneously the experiment of sound light, electricity and general properties of matter are to be performed.

2. The laboratories in which only one particular experiment is being performed by every individual student like chemistry, zoology and Botany. This can be further divided into two groups

(i) where the students work in standing position and need the supply of gas and water and a sink on the spot like Chemistry lab.

(ii) where the working is done mostly by seating position and the use of buring gas and water supply is not required by individual on the spot but it is needed in a group of students.

The easily possible use value of a laboratory per day = 10 periods.

Two periods are for working and one period for the preparations and checking of the equipment for the next group of students to work there.

Possible number of groups which can use the laboratory per day = 10/3 = 3 Nos. (during college working hours).

Hence per week = 3 x 6 = 18 nos.

30 students can work at time in one group @ of one student with one experiment.

18 nos. working groups / w eek.

If the working week / year = 36

Total working turns possible for one year = 18 x 36

say 540 .

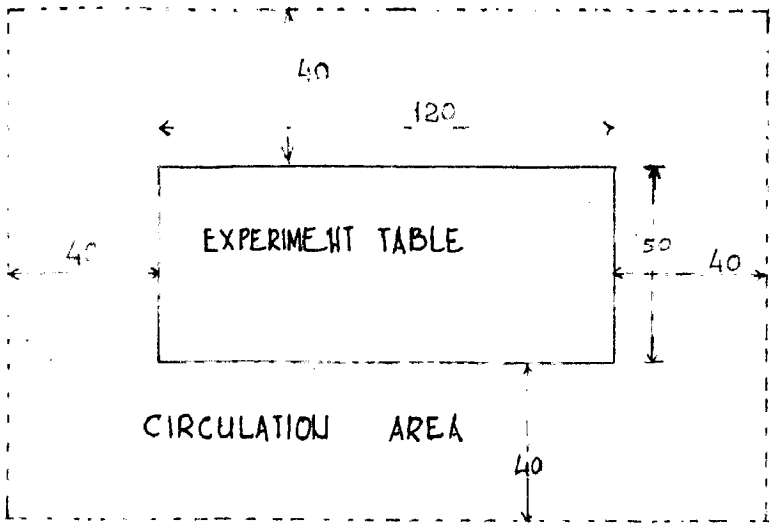
One calss (section) group require two turns /week for practical purposes for one subject. Hence one class may perform 45 experiments easily in one year. If one experiment on average requires 1.5 turn or 6 per ods as total time. Here it is clear that one laboratory will be sufficient for 9 groups (sections) and these 9 section s will be = 9x 30 = 270 students. This number may be doubled for Physics Laboratory as the usual practice in the existing system is going on.

So we should recommend one laboratory for 200 students and the working group in the laboratory should not have more than 30 students at a time in any case.

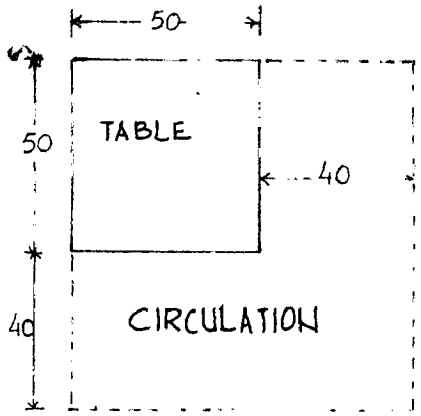
For less than 200 number of the students in one subject must be attached either to other laboratory centre/college or the college should make use of the laboratory for part time and private students.

The analysis of the experiments to be performed in Physics laboratory and floor area requirements etc -

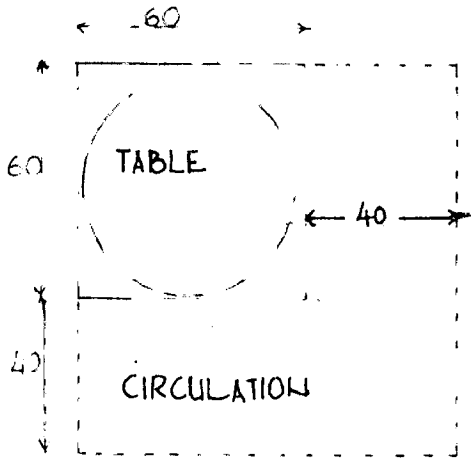
1. General Properties of Matter.	Class of experiment	Nos.
1. Use of vernier callipers	B	2
2. Use of Screw gauge	B	2
3. Use of spherometer	B	2
4. Boyel's law	C	2
5. Young's modulus by Searle's apparatus	B	2
6. Simple pendulum	B	2
II. Heat		
1. Expansion coefficient of a metal rod	B	2
2. Atm. pressure coefficient for a gas	B	2
3. Sp. Heat by Regnauglts apparatus	B	2
4. Newton's law of cooling	B	2
III. Optics		
1. F/L of Concave, Convex mirrors/lense	A	8
2. Refractive index of a liquid by plane mirror and lense	B	2
3. Refractive index of a liquid by Microscope	B	2
4. μ(Refractive ind-ex) by Microscope	B	2
5. μ of a prism by spectrometer	C	2
6. Comparison of illumination of two light sources	A	2
7. Inverse square law in optics	A	2



(a) FOR 'A' GROUP



(b) FOR 'B' GROUP

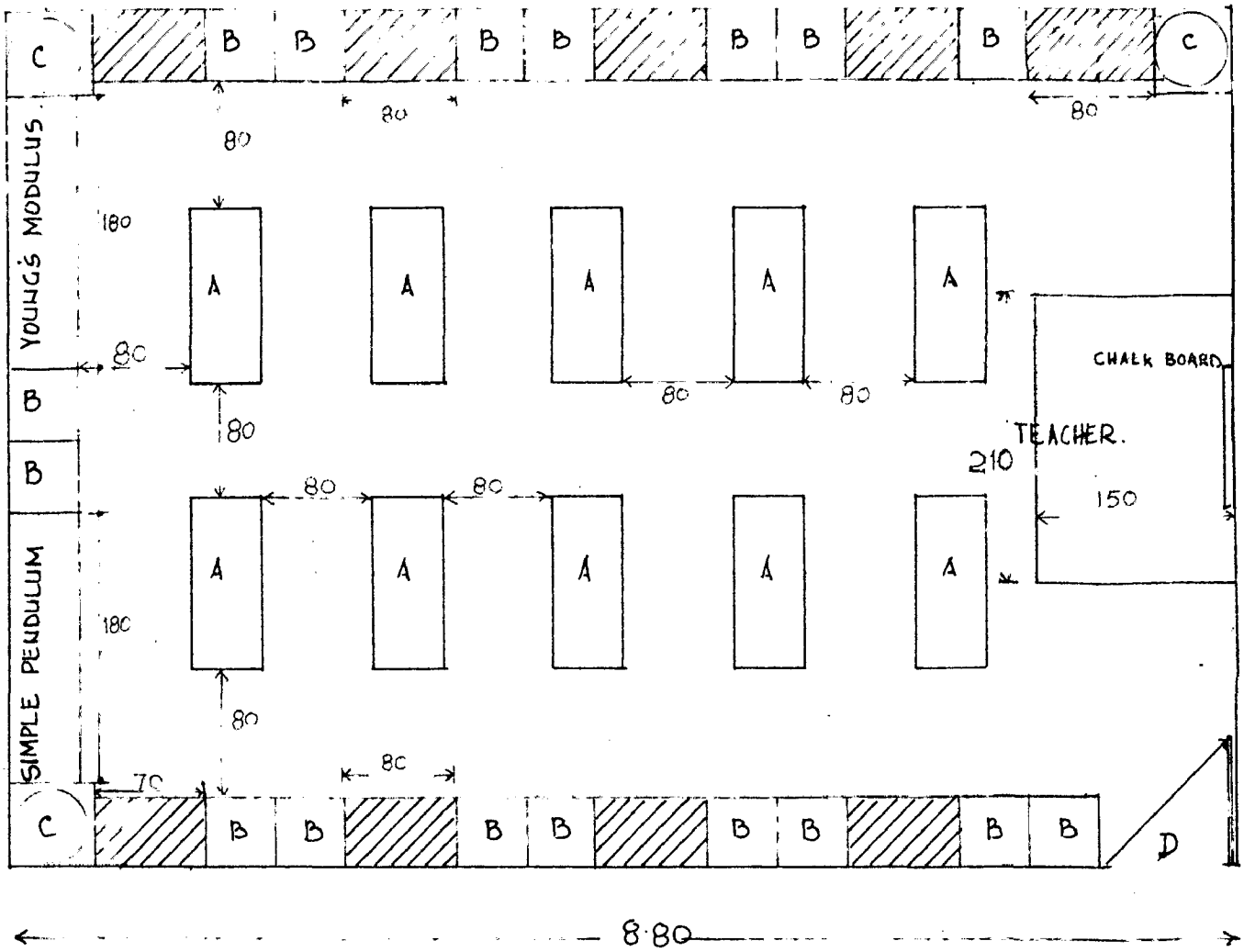


(C) FOR 'C' GROUP.

DETAILS OF A, B, C TYPE OF FUNITURE & CIRCULATION AREA

IV	SOUND		
1.	Velocity of sound by Resonance column	B	2
2.	Density of wire by sonometer	A	2
V	ELECTRICITY		
1.	Ohm's law by Ammeter and voltmeter	B	2
2.	Law of parallel's and series	B	2
3.	Internal resistance of cells' by Resistance Box	B	4
4.	Resistance by Meter bridge	A	2
5.	Resistance by Post Office box	B	2
6.	Use of Tangent Galvanometer	C-	2
7.	Use of Potentiometer	A	2
8.	Joule's calorimeter for value of J	B	2
VI	MAGNETISM		
1.	Lines of forces	B	2
2.	Comparison of Magnetic moments in Tan A and Tan B positions	A	2
3.	Inverse square law	B	2

We conclude that with the above mentioned number of equipments there will be 33 experiments always ready for work thus these may be 66 students at work at a time. This laboratory will facilitate three types of experiments according to space requirements as follows:-



A = 120 x 40
B = 50 x 50
C = 60 x 60
D = 1·10 M.

PHYSICS LAB FOR 32 EXPERIMENTS

TOTAL AREA = 51·04 SQ.M. @ 1·7 SQ.M. PER EXP (SEAT)

FIG: 2·432

Type of experiment	Total no. of experiments	Area of Table	Tables/fixed/ Enclosure/ +Platform			Encl. without platform
A	10	120 x 50 cms	10	-	-	-
B	2 0	50 x 50 cms	7	7	4	2
C	3	60 cms dia	3	-	-	-

The experiments to be performed on tables will reqûire the circulationarea on all the four sides of the table while those on fixed platform will require the circulation on two/ one side of the platform.

Area required for

A	1.8 sq m x 10	= 18 sq. m.	Fig. 2.4.3.1a
B	0.81 x 7	= 5.60 "	Fig. 2.4.3.1b
C	1.00 x 3	= 3.00 "	Fig. 2.4.3-1c
C	0.45 x 12	= 5.85 "	Fig. 2.4.3-1c
Teaching area		= 12.50 "	
	Total	44.95 " say 45 sq. m.	

This may be increased and decreased according to the design of the laboratory and the system of demonstrating the experiment. This will require approximately 45.00 sq. m. floor area at least for 30 experiments in laboratory or for 60 students to work at one time. It is recommended 5 sq. m more for general circulation thant the total area will be 50.00 sq. M.

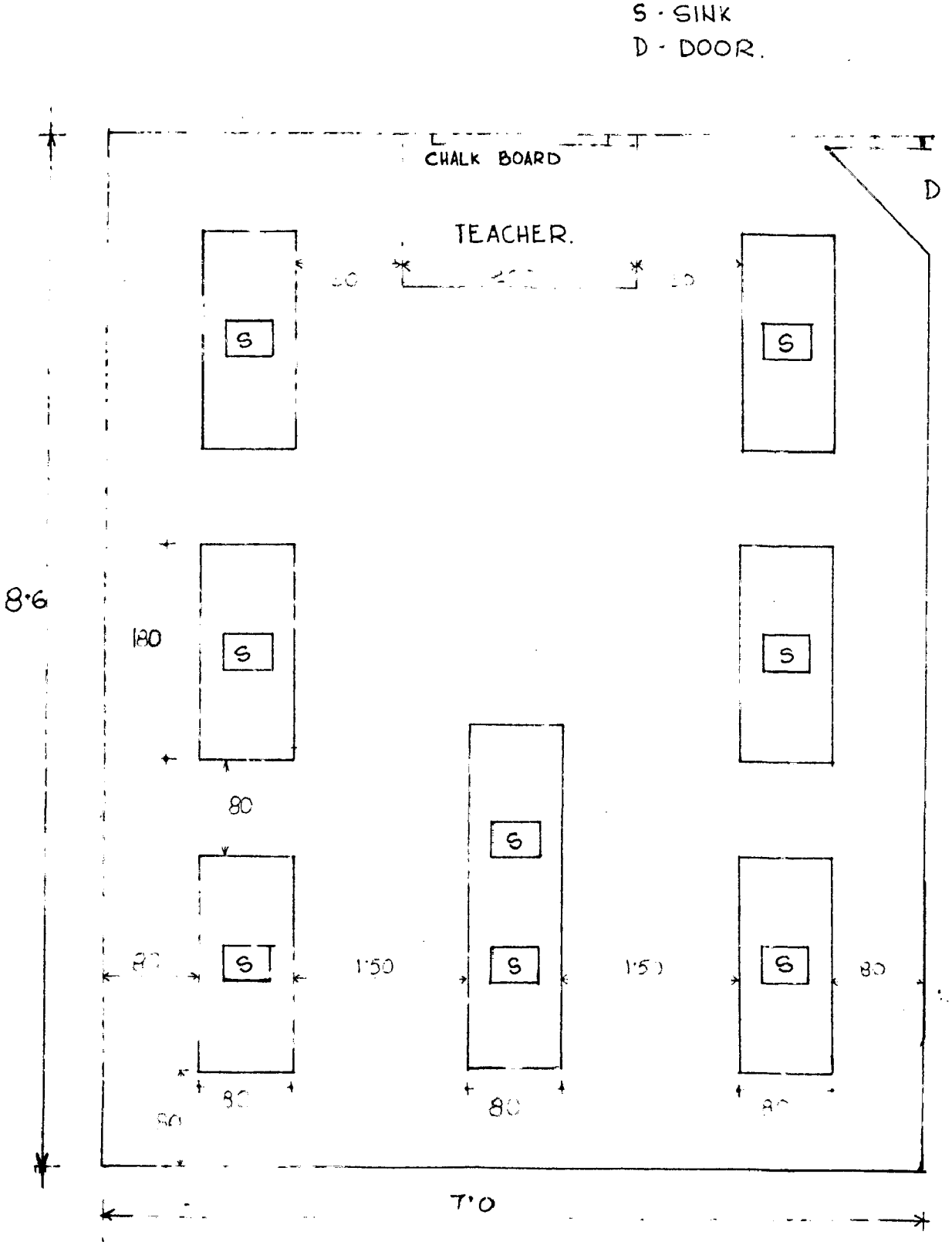


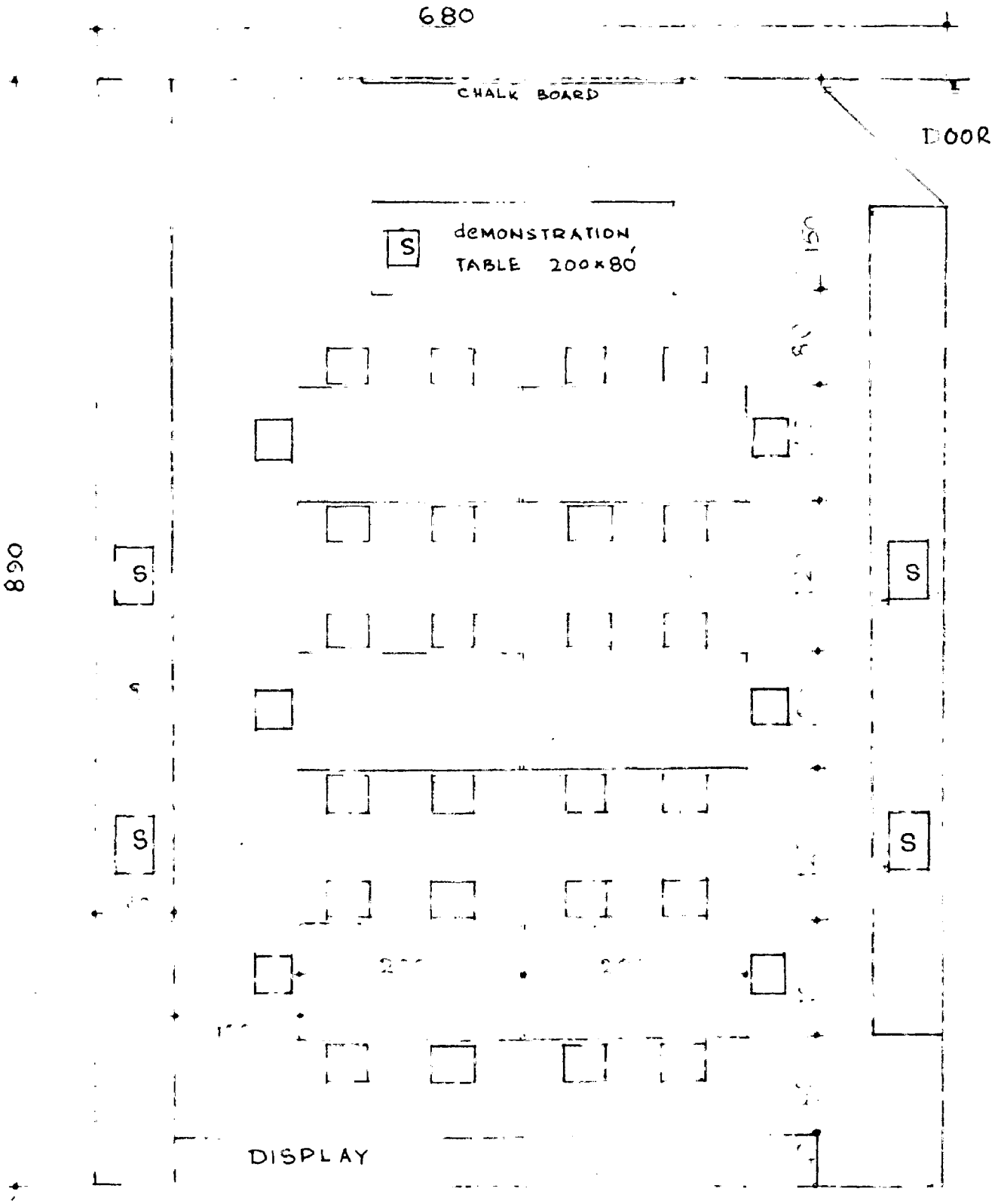
FIG: 2·133 CHEMISTRY LAB FOR 30 EXPERIMENTATION SEATS.

There is hardly any need of dark room but the provision of a small store room upto 1.50 sq. m is a must with Physics laboraory at this level of education.

To design the chemistry and biology laboratories the floor area required per seat will be almost equal in both cases and that may be provided @ 2.00 sq. m / seat Fig. 2.4.3.3. The balance room for 10 blances (1/3 number of total seats in the lab.) should be provided attached with the chemistry laboratory . It is based on the studies and survey conducted by the Author during the month of May - August 1971 of various Intermediate colleges reveals that out of the 30 colleges visited 60% has got the seperate balance room as approximately as 25 % of the lab. area which was quite sufficient for this purpose and therefore it is recommended that 1/3 of the total seats for experiments in the laboratory will be taken as area of balance room . In which non glazed natural light should be provided. Similarly for ~~Biology laboraoty and~~ zoology and Botony laboratories should be provided a pond for frogs and fishes etc and a small garden for various plants etc. to be used for experimentation purposes.

The provision of a laboratory with a college which does not have the sufficient number of the

S : SINK.



ZOOLOGY AND BOTONY LAB FOR 30 EXPERIMENTATION SEATS.

FIG: 2·434

students to make the full use of the laboratories is not economical. This is the main reason, theat the laboratories are not well equip ed with most of the colleges.

In this context if one laboratory is provided for a group of colleges, but well full equipped, will be far far better and the students may be asked separately to work for practicals they may be asked to work in laboratories for one week / month according to their turn allotment. This system will impart a good degree of knowledge of practical work and the practical examination should be treated as an independent subject. In the similar way these laboratories may be used for part time as well as private students. Thus the colleges which cannot have the fully equipped laboratories and its use, may simply be provided the experimental instruments and equipments for explaining purposes to students as the teaching aids.

2.4.4 LIBRARY

Library is the centre of self learning which requires the real environment to attract the stude-nts for studies. Our colleges are mostly the sufferer of the the lac of this type of facility upto the mark.

Either the colleges do not have more than a book store or they have simply one room for all purposes. A number of colleges are using Assembly hall as Library. The conditions of furniture etcc and its arrangements hardly reflect any thing of attraction towards the self studies, while the education Commission (1964-66) has recommended in its report that the students at Intermediate level of education should be attracted to devote upto 50% of their classes time to library and self studies.

Thepresent surveys and oral discussions with the librarians of various colleges, indicate that there are 10% to 15% (Table 2.1.26) students who take interest in libraries. In most the colleges this percentage is low because of non availability of good books and the facilities for self studies. None of the colleges visited by the author have any system of guidance and carrier-counselling. While this seems to be most important need of the prese-nt day. Most of the students informed to the author during the surveys that they do not get the guidance to pursue their further education wither professional or otherwise. Even the teachers some times fail to guide the students for their future on personal level because of not being in touch of latest situations of various competitions etc. There are hardly two three periodicals being purchased by most advanced college

libraries in urban areas the colleges in rural areas do not take care of such important items of the library.

Based on the aims and objectives mentioned in Education Commission 1964-66 report and the existing conditions as am compromise and as per discussion with the teachers and students during the surveys conducted by the author it reveals that minimum 10% will use the library facilities . So there must be a provision of seats for 10% students of total strength of the college.

The strength of a college which has been favoured is around 600 students. The reading space in the library should be provided atleast for 10% of strength of the college. This area will be at the rate of 1.00 sq. m and the total area of the library should be @ 1.00 sq. m multiplied by 30% of the total enrolment capacity of the college. The desire expressed by teachers . At the minimum this area should not be less than 50.00 sq. m. in any case and an additional area for store must be provided between 1.50 to 2.00 sq.m. There must be two staff members to look after the library activities and maintaining and arranging the books and periodicals etc. Intermediate level there are five subjects to be studied by every student. To facilitate 30% and 40% and 50% of the students at three stages of the establishment of the library.

There should be atleast 1000, 1250 and 1500 volumes of the text books of various subhects with the latest editions at three stages of development. So that the students may really be benefited. The total number of volumes minimum should be 6000 and the current periodicals also between 15 to 30. As far as possible there must be seperate sections for periodicals and reference, general text books and a small room for guiding and counselling may also be attached with the library. The reading room should be well furnished with individ-ual seats for self studies the minimum number of seats at the starting time should be 60 and a possibility of expansion of these facilities should left with the design of building. The Building if provided separately, detached from the class rooms etc. w-ill be better. The area of library building as suggested above comes out to be 200 x 1.00 = 200.sq.m.

Area for toilet , store and record office = 5.00 sq.m.

Total area for a college of 600 strength = 205.00 sq.m.

Text books at three stages of development =1,000,1250, 1500

Total volumes Minimum = 6000

Periodicals and papers Min. = 15.

2.4.5 Assembly Hall or Multipurpose Hall

The provision of a hall should be with college building for various functions and meetings of the whole college. About 90% of the colleges visited for the purpose of this study work, have the provision of assembly hall in the centre of the building. The designs have been made without taking into consideration of the college strength of these halls.

In the opinion of the administrators and the organisers of various functions at the college. The presence of the students never exceeds 60% of total strength of college, except that on a film show. Most of them felt the need of provision of a hall atleast with a capacity between 60% to 75 % of total strength of college because the changing attitude of the students towards the games, movies and teleyision programs etc will be helped.

Thus a hall, with every college to provide the seating capacity of 60% of its total strength @ of 0.5 sq. m per seat, must be provided and as far as possible this hall should be close to the entrance point and away from the class rooms etc. It should never be provided in the center of the building as it has been a usual practice. There must be a provision of a stage of approximately 20.00 sq.m area on one side of the

hall. The attachment of the hall with the administrative offices, so that toilet etc may be provided for common use. The provision of the hall very close to the entrance, cycle stand and at one end of the college building will be lasser disturbing to other college activities.

Floor area recommended for a college of

$$600 \text{ students} = \frac{600 \times 66 \times 0.5}{100}$$

$$= 180.00 \text{ sq. m.}$$

TABLE 2.4.5.1

NUMBER AND SIZE OF EXISTS IN RELATION TO OCCUPANTS

Occupants	Nos of exists.	Minimum size	Remarks.
below 50	1	(2'-10") -85 cm	This holds good
100-200	2	(2'-10")-85 cms	in case of class
201-500	2	(4'-6") -135"	rooms and lecture
501-750	3	(4'-6") -135 "	rooms etc.
751-1000	4	(4'-6")-135 "	

* Ref. Building Bulletin no.7 - Fira and the design of schools.

2.4.8 Administrative and General spaces

The area required for college office dependsupon the size of the college and number of staff members. As per desire expressed by the various college administrators to have the college strength of 600 as standard. The staff members at the ratio of 20:1 will be worked out 30 at initial stages and 15:1 ultimately.

1. Staff common room will require @ 2 sqm. for 30 members 60.00 sq.m
2. Principal's office total 25.00 sq.m
3. General office, records & files etc. 20.00 "
4. Office for accounts and fees collection 15.00 "
5. First aid or doctor's room with attached toilet 15.00 "
6. Guidance and counselling room and visitors room 20.00 "
7. Games and N.C.C./P.S.D. etc. (separate officefor each). 15.00 "
8. Storage facilities -

One of the most common deficiency was felt with the most of the college the inadequacy of storage space. This requirement has been neglected at the time of designing of the college building.

In all kinds of instructional areas, storage space is needed so that materials can be laid temporarily for subsequent use. The general practice is to plan the educational spaces and then designate spaces lacking natural light and ventilation as storage. Sometimes these

spaces are either very small or taotally omitted, but the storage space is required even in class rooms and other teaching areas. In add ition separate rooms for storage of teaching equipment sports goods, furniture etc. is needed.

It is advisable that sufficient built in storage space in the shape of cupboards, open shelves, etc., should be provided in class rooms and laboratories. The spaces under the window sills etc should be utilised and similarly on teacher's side the wall should have the spaces for chalk, duster, note books etc. All these must be provided in such a way that it may not increase the wall thickness or the floor area.

The separate storage space may be provided @ 4 to 5% of the teaching area.

9. Common Rooms and cafeteria

Mostly the students feel the necessity of such space where they may keep atleast their books and note books etc. may be a common room or cloak room etc. sitting in common room during vacant periods is not considered to be so important if there is a cafeteria and well spacious library in the college campus.

The staff and the principal etc., in general did not favour the provision of students common room for boys but it is a must for girls with attached toilet facilities.

The cafeteria is felt, by both the group of staff as well as students as a necessity at every college in rural areas. There should be provision of a good room for tea etc. toaccommodate about 30-40 persons at a time. It may be designed @ 1.00 sq.m. per seat . It should be provided with a kitchen 10.00 s .M in areas. in addition to this area.

10. Games and Sports -

The participation of students in games is considerably low. In rural areas principals did not express the desire of having the facilities in bulk. One general ground for various jumps and races. One field for Hockey and football and two field s for volley ball one for basket ball should be provided in college campus. Though it becomes a subject of seperate research , but on the broad lines, keeping in view the above opinion of heads of various colleges and the recommendations of various organisations an area of 3 Acres will be sufficient in rural areas. For the colleges in urban area a centre for all types of games and sports should be developed which will have large fields for team games atleast two each and separate race course. That will have one swimming pool also. This centre will require 10 acres of area.

2.4.7. Stairs, Toilets and Circulation Areas etc.

The ptairs in colleges are not very common in rural areas. Most of the colleges buildings in rural areas are single storeyed high while in urban areas the use of stairs is very common. Usually the stairs are provided at the junctions of two wings of the building. We should have certain important points in mind while designing the stairs for college buildings -

1. The smallest level changes the minimum number of steps should be three together.
2. The riser and tread should not be beyond 15 cms to 17.5 cms. and 25 cms to 30 cms respectively.
3. The staircase generally beprovided at an approach distance between 60 feet (18 M) and 100 feet (30 meters) from the foremost room.
4. The following table will give the width of stairs in relation to the number of storeys and number of users.

TABLE 2.4.8.1

WHERE TWO STAIRS ONLY ARE TO BE PROVIDED

Storeyes	Maximum number of stude nts on upper floors				
2	260	290	330	360	390
3	300	340	380	430	480
4	340	390	440	500	560
Width of stairs	(3'-6" or 105 cms)		(4'-0" or 120 cms)		
	(4'5" or 135 cms		(5' or 15 cms		(5'-6" 165 cm)

*TABLE 2.4.8.2

WHERE THREE STAIRS ARE TO BE PROVIDED

Storeyes	Maximum students on upper floors				
2	470	520	580	640	700
3	540	610	690	770	850
4	610	700	800	900	1000

Width of stiars (3'-6" 105 cms) (4' 120 cms)(4-6" 135 cms) (5' 150 cms) 5'6" 165 cms).

These tables indicate that the maximum width of the stair may be 105 cms (3'-6") and not less than this in any case. The above tables give the definite answer to the designers of college buildings regarding the width of stairs and need not be provided more or less than the required width of stairs.

The use of urinals, W.C. and wash basins or drinking water taps was found as -

Almost all the colleges in rural areas do not have the water supply and they make use of hand pumps for all purposes. The provision of more than the usuable items create the dirty conditions in college campuses.

* Ref. Building bulletin No.7 . Fire and the Design of schools.

As general for all urban and rural colleges W.C's are rarely used, while urinals and wash basins are very frequently used. There are many collgges which provide these sanitary fittings as per described standards by various agencies but fail to maintain those in neat and clean conditions.

Though it is not easy to form the perfect standards for such facilities but we can relate these facilities to the approximate figures of users or expected users if these are maintained well by the college maintenance departments or other organisations .

As it has already been expressed in this study report that there should one toilet attached with the library the other one with administrative building and Assembly hall. These will have two urinals one W.C. and two wash basins each. In addition to those there must be a provision for minimum two and maximum three toilets for students use with a provision of one w.c. and two wash basisn each if the building is single storeyed high. The toilets may be four in numbers if the building is two storeyed high. Similarly there should be two toilets on each floor if we have to go higher than two storeye.

The provision of urinals in total @ of 1 for 30 students upto 50 on the strength of 300 and @ of 1 for 40 for next 200 , than @ of one for 50 for next 200 and uniformly divided in all

toilets.

The drinking water taps should be provided in separate enclosure @ 1 for 25 students. It is also admisable to instal atleast one water cooler in each college to encourage drinking water quantity per head which is good for health considerations.

There are several agencies also gave the norms about the circulation areas in college buildings and most of the recommendations lie between 20% to 30% of the built up areas. It is dependent of the designers skill to reduce the circulation area to minimum possible to achieve the economy in the design but it should not cause any discomfort to the teaching and learning activities.

As prefered by the staff members the double loaded corridors should be avoided in designing of the college buildings because of the increase in noise levels due to the corridors.

To the maximum possible the building should get the sufficient natural light and cross ventilations. If the use of mechanical means of air circulation is easily available the windows at eye level towards the verandahs or passages should be avoided.

The other factors related to the character and aeshtetics of the building should not be governed

by the norms but should be left to the will of the Architect designer of the building.

2.5.1 Daylighting Design

In the class room the need is for the uniform lighting conditions free from shadow and glare. Thus direct sunlight is of no use in class room unless subdued by permanent or temporary obstructions. The solution of the integrated lighting i.e. the daylight integrated by the artificial light is one of the real answers through a costly proposition.

The lighting is an important requirement (light, view and ventilation) of openings in a room. These fixes the size and shape. Light as a functional need leads us to design the opening in a similar way as design of the structural membrain. For this, the factors like sky component for Indian tropics. The place, design criterion, inside room surfaces area and reflection components for interior and exteriors have been taken into account.

In case of class room the second function (view) of window has relatively no importance at all.

Prevailing practices :-

In the past and present the Architects and other building designers, give the window sizes, proportions and areas which are governed by the aesthetical needs as the result of intensive approximation.

The designer does not give proper weightage to the amount of light required. The windows generally give either the higher or lower lumans of light inside leading to the failure of design and functional utilisations.

Adopted Approach and Interpretation :-

Opening in walls and roof allow the entry of day light in direct proportions to their dimensions. In our country (India) where sunlight is available for most part of the year, day lighting of building interiors should be normally restored to seasonal and daily variations of day light which makes the problem of day light design slightly complicated.

The daylight coverage contours are nearly elliptical on the horizontal plane inside the room. The spread and penetration depends upon the visibility of sky area through the window opening on the working plane. It may be calculated as lighted area $= \frac{\pi}{4}$ x penetration x spread (Fig. 2.5.1.1.).

It gives the basic idea of the window requirement in terms of relative proportions of its dimensions and relative positions of windows, upto some extent.

Daylight design criteria for class room :-

Daylight levels, are much higher than the minimum over most of the room area, being lowest at the back of the room and highest near the windows.

In class rooms, where all the students would normally be engaged on the same visual work at the same time in their positions all over the room. It is essential that the minimum recommended should be available for most difficult visual task at every desktop.

*The lighting level required for various spaces and tasks is given in table 2.5.1.4.

The Tropical Design sky :-

Cloudy above 80%	-	over cast
Cloudy above 50%	-	Partially overcast
Cloudy below 50%	-	Clear sky

The sky in India is generally clear, except during the monsoon season. It is reasonable to base the design on clear blue sky. The design should be based on winter conditions when the sunlight availabe is

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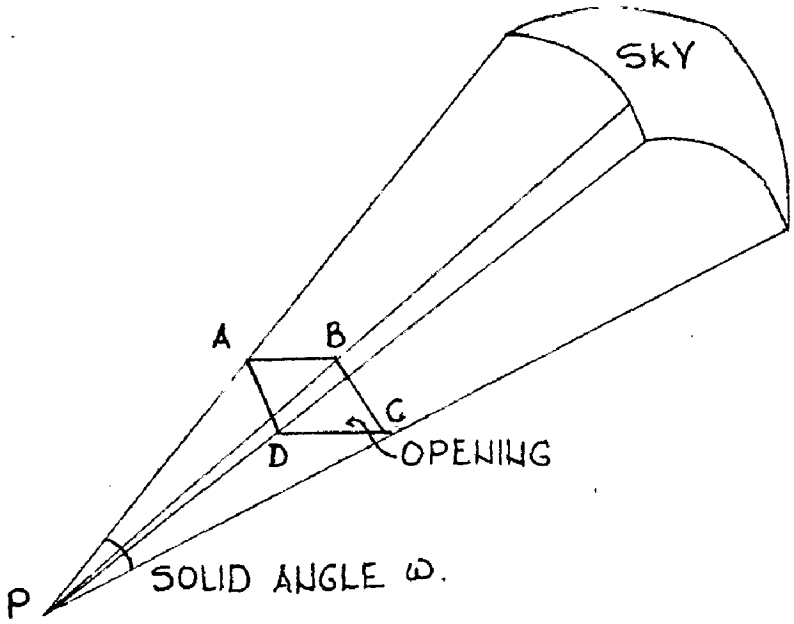
*Ref:- National Building Code of India 1970.



THE SKY COMPONENT AVAILABLE AT POINT P. THROUGH THE OPENING ABCD IS

$\propto$ ω THE SOLID ANGLE

$\propto$ SKY AVAILABLE

FIG: 2·513

minimum (time and altitude of sun). The design should be such as to provide sufficient daylight indoors during the normal working h urs, especially when direct sunlight is not incident on openings.

In the years 1963-64 during winter month measurements were carried out on the luminance distribution on a horizontal surface. Clear sky luminance distribution followed a simple pattern, especially when the sun was at low altitudes.

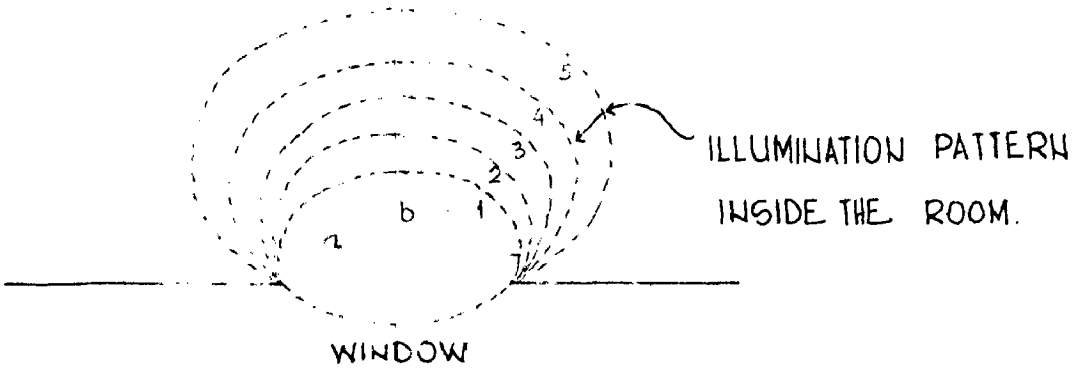
The luminance of the sky from the horizon upto an altitude of 15^{0} was nearly uniform.

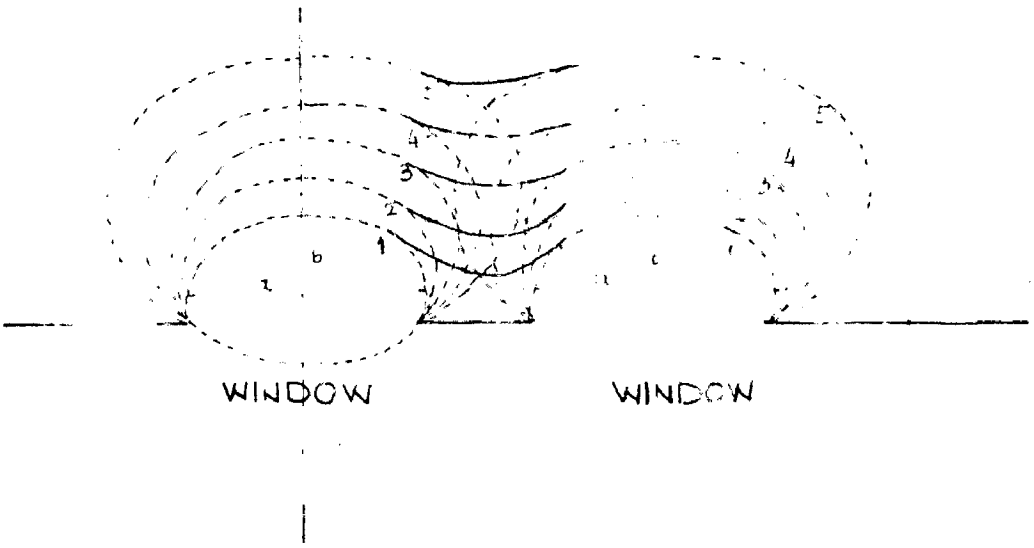
It was also observed that the minimum sky luminance 'L_m' was related to the diffuse illumination D_{-} on the horizontals.

Definitions :-

1. Lux :- The illumination produced at a distance of 1 meter by a standard source (point) of one candela (candle) intensity.

2. Direct solar illumination :- The illumination from the sun (the light from the sky excluded).





ILLUMINATION PATTERN IN SIDE THE ROOM.

FIG: 2·5·1·1

3. Sky component penetration :- The maximum distance of the point at the sill level measured normal to the bottom corner of window upto which a specified sky component contourpenetrates into the room.

4. Sky component spread :- The maximum lateral distance covered by sky component at sill level, measured parallel to the length of window, at half of its penetration depth.

The area of window below working plane does not contribute to the sky component at it, but it contributes to the internal reflection component.

When the working plane is more than (1'-6") 45 cms. below the window sill, it will not get the same sky component.

Source of Daylighting :-

Primary source of light is the sun. The light received on earth consists of two parts - Direct solar illumination and sky radiation. For purposes of daylighting design, direct solar illumination is not considered, and only sky radiation is taken as contributing to the building interiors during the sky.

The external available horizontal illumination for design purpose in India is :-

Latitude	Illumination on horizontal plane in lux.
35°N	8000
32°N	9000
27°N	10000
12°N	15000

Components of Daylight factor :- (DF)

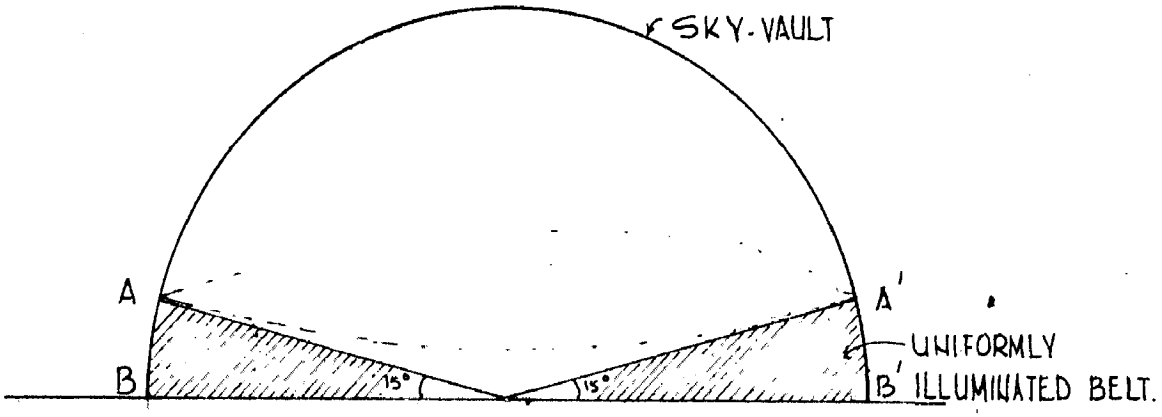
Daylight factor is the measure of total daylight illumination at a point on a given plane expressed as the ratio (or percentage) which the illumination (D) at the point on the given plane bears to the simultaneous illumination(E) on a horizontal plane due to clear design sky at an exterior point open to the whole sky vault. (Digest sunlight excluded)

$$D_F = D/E \times 100\%$$

Daylight factor is the sum of all the daylight reaching an indoor reference point from the sources -

(a) The direct sky visible from the point = x/u

(b) External surface reflecting light directly = y



THE LUMINANCE OF SKY IS UNFORM ALONG THE BELT(ABA'B')

FIG: 2·512

(c) Internal surfaces reflecting and inter-reflecting light to the point = z

$$D_F = \frac{x + y + z}{E} \times 100\% \quad \text{(Fig. 2.5.1.4)}$$

Each of these three when expressed as ratio or percentage of the simultaneous external illumination on horizontal plane, defines respectively the sky component (SC), the External Reflected Component (ERC) and the Internal Reflected Component (IRC)

SC = X/E x 100%

ERC = Y/E x 100%

IRC = z/E x 100%

Design of window :-

The design sky (clear blue sky at 15^0 altitude) - may be taken 8000 lux.

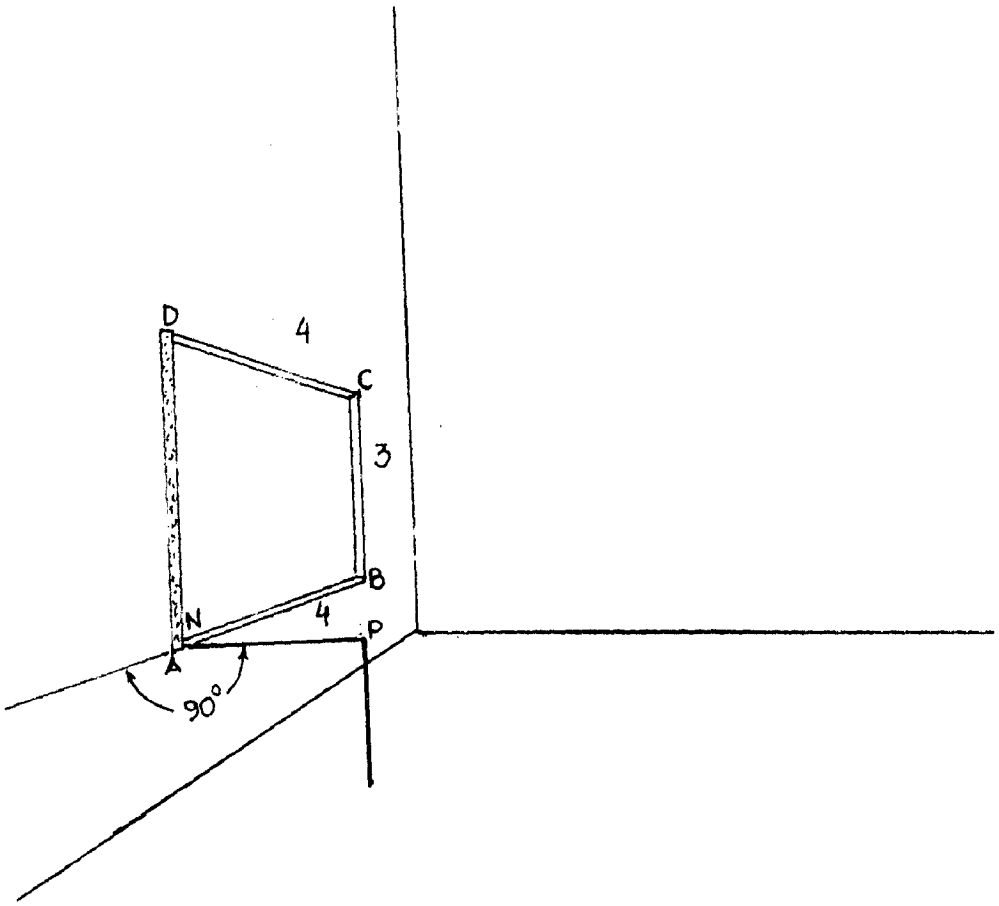
Two types of problems :-

(1) Window design for req. sky component, at a given distance from window plane.

(2) To calculate the available SC (sky component) as given point from the pre-determined window: -

H - Height of window

L- Length of window



EXAMPLE - WINDOW DESIGN

FIG : 2·515

D - The normal distance of a point from window at working plane.

*Example :-

Let D = 4 ft.

L = 4 ft.

H = 3 ft.

So

L/D = 4/4 = 1 and H/D = 3/4 = .75

Sky component from table (IS 2440-Daylighting of buildings) = 6.4 % (Table 2.5.1.1, 2.5.1.2, 2.5.1.3).

(C.B.R.I. Roorkee has developed good nomographs and graphs, to give more informations at a glance and possibi ities of variations of window dimensions and their affects on sky component).

Sky component (+S.C.) :=

The clear visible sky from the point through the window, or it may be defined as the solid angle subtanded by the sky at the point through the window opening (Fig. 2.5.1.3.).

Ref. Building Digest No. 40 = Central Building Research Institute, Roorkee.

Correction factors :-

The values of SC will need the corrections in daylight values due to :-

	Reduction in daylight %
1. Glazing	
(a) Clear glass	10 - 20%
(b) Frosted "	15 - 30%
2. Depreciation due to dust	15%
3. Window sash	
(a) Metallic	10%
(b) Wooden	30%
4. Horizontal louvers	25%
Vertical louvers	50%
5. Combined affect clear glass	
(a) Metallic sash	35%
(b) Wooden	50%

(c) External obstructions - when situated at a distance less than 3 times of height. Reduction in daylight will be 0.2, 0.45, 0.68 and 0.7 for the (distance/height) ratio 0.5, 1.0, 1.5 and 2.0 respectively.

Internal Reflection Component (IRC) :-

The component of daylight factor distributed by reflections from the inside surface is very nearly

constant throughout the room, through slightly more near the window. It varies directly with the window area ~~IRC~~ and inversely with the total internal surface and depends upon the reflection factors of the floor, will, and roof surfaces inside; and ground outside.

It may be calculated by the formule

$$IRC = \frac{0.85\ W}{A(I-R)} \qquad (78\ R_{fw} + 10\ RC_w)$$

W = window area

R_{fw} = Average reflection factor of floor and walls below mid height plane of window (excluding the window wall)

$$R_{fw} = \frac{\Sigma ar}{a}$$

A = Area of all surfaces including window, inside the room.

RC_w = Average reflection factor of those surfaces which are above mid plane of window.

$$RC_w = \frac{\Sigma ar}{a}$$

R = Average reflection factor of all surfaces - floor, walls, ceiling and window

$$R = \frac{\Sigma AR}{A}$$

Recommendations :-

1. Taller windows give greater penetrations of light. This is always related with the room dimensions.

2. Broader windows give better distribution of light, these may also be equally effective when the sill height is raised 30 cm to 45 cms above the working plane.

3. For a given penetration a number of small windows properly positioned laong the same, adjacent or opposite walls will give better distribution of illumination than a single large window.

4. Unilateral lighting from side window will in general be unsatisfactory if the effective width of the room is more than two to two and a half times the distance from the floor to the top of the window.

5. Provision of louvers, etc. increases the window effect, which reduces the window area for daylight achievement.

6. It will minimise the glare and shadows. The windows from top of the room will restrict the use of multistorey construction. In

terms of economy window area will replace the costlier item (roof).

7. The windows in roof will give easy ventilation (air inlets should be provided near the floors) and more diffused light on walls for reflection and inter-reflections which will increase the uniformity of lighting.

8. The solid walls will cut all the distributing noise of outside to inside and vice versa and also the outside view of disturbing activities.

9. The design needs the brightness ratio of the task to its immediate surroundings and distant areas in room should be as 10:3.1.

10. To ensure good level of diffuse lighting, all internal surfaces should be lightly coloured.

Table = 2.6.1.4.

Illumination required for various spaces

Task and space	Illumination required in lux.
1. Assembly Hall	
(i) General	150
(ii) Examination	300
2. Class rooms and lecture rooms:	300
(i) Desks top	300
(ii) Chalk Board	200 to 300
3. Art room	450
4. Laboratories	300
5. Library	
(i) Shelves & Stacks	70 to 150
(ii) Reading tables	300
6. Staff rooms and common rooms	150
7. Corridors	70
8. Stairs	100
9. Toilets	100

Table 2.5.1.1

Percentage Sky Components on the Horizontal plane due to a vertical window for the tropical design sky.

L/D / H/D	.30	.60	.90	1.20	1.50	1.80	2.0	4.0	10.0	INF
0.30	0.9	1.5	1.9	2.1	2.2	2.3	2.3	2.4	2.4	2.4
0.60	2.1	3.8	4.9	5.6	6.0	6.3	6.4	6.7	6.8	6.8
0.90	3.0	5.4	7.2	8.1	8.8	9.3	9.5	0.2	10.3	10.4
1.20	3.5	6.4	8.5	9.9	10.8	11.4	11.7	12.8	13.0	13.0
1.50	3.9	7.1	9.5	11.1	12.2	12.9	13.3	14.7	15.0	15.0
1.80	4.1	7.6	10.1	11.9	13.1	14.0	14.4	86.1	16.5	16.6
2.0	4.2	7.8	10.4	12.3	13.6	14.5	15.0	16.8	17.3	17.4
4.0	4.7	8.6	11.7	13.9	15.5	16.7	17.3	20.1	21.3	21.5
10.0	4.8	8.9	12.1	14.5	16.2	17.5	18.2	21.7	23.7	24.2
INF	4.8	9.0	12.2	14.6	16.3	17.7	18.4	22.1	24.5	26.1

TABLE 2.5.1.2

Perfentage Sky Components on the xxxixxx vertical plane perpendicular to a vertical window for the tropical design sky

L/D H/D	.30	.60	.90	1.20	1.50	1.80	2.0	4.0	10.0	INF
0.30	0.9	2.8	4.7	6.3	7.4	8.2	8.6	10.1	10.7	10.8
0.60	1.3	4.3	7.5	10.2	12.2	13.7	14.4	17.5	18.6	18.8
0.90	1.5	4.9	8.7	11.9	14.5	16.4	17.4	21.7	23.3	23.6
1.20	1.6	5.2	9.3	12.8	15.6	17.8	19.0	24.2	26.3	26.7
1,50	1.6	5.4	9.6	3.3	16.3	18.6	19.9	25.8	28.3	28.9
1.80	1.6	5.4	9.7	13.6	16.7	19.1	20.4	26.8	29.8	30.4
2.0	1.6	5.5	9.8	13.7	16.8	19.3	20.7	27.3	30.5	31.2
4.0	1.7	5,6	10.0	14.0	17.3	20.0	21.5	29.1	33.7	35.1
10.0	1.7	5.6	10.1	14.1	17.4	20.1	21.6	29.6	35.1	37.5
INF	1.7	5.6	10.1	14.1	17.4	20.2	21.7	29.7	35.3	39.2

2.5.2 Ventilation: Acoustics and Thermal Comforts :

Ventilation is required to supply fresh air for respiration, vitiation by body odours, maintainenance of heat balance of body to check discomforts and injury to the health of occupants.

When an enclosed space is occupied by the human beings, the following effects are noticed -

(i) Reduction in Oxygen Contents :-

Fresh air contains about 21.00% of oxygen by volume and when it exhaled it contains 17.00% only. The deficiency of oxygen in the atmosphere causes headache and nausea etc.

(ii) Increase in Carbon dioxide contents :-

Fresh air normally contains less than 0.063% of carbondioxide while the exhaled air contains 5% of it. The average quantity of carbondioxide exhaled by man per hour = 17 litres. This is not toxic and stimulates respiration when present in small amounts i.e. from 4% to 6%. However, when the concentration increases it leads to deeper breathing, panting and finally death beyond 10%.

TABLE 2.5.1.2

Perfentage Sky Components on the xxxiomx vertical plane perpendicular to a vertical window for the tropical design sky

L/D H/D	.30	.60	.90	1.20	1.50	1.80	2.0	4.0	10.0	INF
0.30	0.9	2.8	4.7	6.3	7.4	8.2	8.6	10.1	10.7	10.8
0.60	1.3	4.3	7.5	10.2	12.2	13.7	14.4	17.5	18.6	18.8
0.90	1.5	4.9	8.7	11.9	14.5	16.4	17.4	21.7	23.3	23.6
1.20	1.6	5.2	9.3	12.8	15.6	17.8	19.0	24.2	26.3	26.7
1,50	1.6	5.4	9.6	3.3	16.3	18.6	19.9	25.8	28.3	28.9
1.80	1.6	5.4	9.7	13.6	16.7	19.1	20.4	26.8	29.8	30.4
2.0	1.6	5.5	9.8	13.7	16.8	19.3	20.7	27.3	30.5	31.2
4.0	1.7	5,6	10.0	14.0	17.3	20.0	21.5	29.1	33.7	35.1
10.0	1.7	5.6	10.1	14.1	17.4	20.1	21.6	29.6	35.1	37.5
INF	1.7	5.6	10.1	14.1	17.4	20.2	21.7	29.7	35.3	39.2

TABLE 2.5.1.3

Percentage sky components on the vertical plane parallel to a vertical window for the tropical design sky.

L/D → / H/D ↓	0.30	0.60	0.90	1.20	1.50	1.80	2.0	4.0	10.0	INF
0.30	5.9	10.3	12.9	14.4	15.2	15.7	15.9	16.5	16.6	16.6
0.60	8.9	15.7	20.0	22.6	24.1	25.0	25.4	26.6	26.8	26.8
0.90	10.0	17.8	23.0	26.1	28.0	29.1	29.7	31.3	31.6	31.6
1.20	10.6	18.9	24.4	27.8	29.9	31.2	31.8	33.8	34.2	34.2
1.50	10.9	19.4	25.1	28.7	30.9	32.3	33.0	35.2	35.7	35.7
1.80	11.0	19.7	25.5	29.2	31.5	33.0	33.7	36.1	36.6	36.6
2.0	11.1	19.8	25.6	29.4	31.7	33.3	34.0	36.4	37.0	37.1
4.0	11.2	20.1	26.1	30.0	32.5	34.1	34.9	37.7	38.5	38.6
10.0	11.3	20.2	26.2	30.1	32.6	34.2	35.0	38.0	38.9	39.1
INF	11.3	20.2	26.2	30.1	32.6	34.2	35.0	38.0	39.0	39.2

2.5.2 Ventilation: Acoustics and Thermal Comforts :

Ventilation is required to supply fresh air for respiration, vitiation by body odours, maintainenance of heat balance of body to check discomforts and injury to the health of occupants.

When an enclosed space is occupied by the human beings, the following effects are noticed -

(i) Reduction in Oxygen Contents :-

Fresh air contains about 21.00% of oxygen by volume and when exhaled it contains 17.00% only. The deficiency of oxygen in the atmosphere causes headache and nausea etc.

(ii) Increase in Carbon dioxide contents :-

Fresh air normally contains less than 0.063% of carbondioxide while the exhaled air contains 5% of it. The average quantity of carbondioxide exhaled by man per hour = 17 litres. This is not toxic and stimulates respiration when present in small amounts i.e. from 4% to 6%. However, when the concentration increases it leads to deeper breathing, panting and finally death beyond 10%.

(iii) Rise in temperature :-

A person produces about 166.7 C.H.U. of heat as an average per hour. A considerable portion of it is lost by leakages in structures. The 0.011 C.H.U. of heat can raise the temperature of 28.32 litres of air by 5/9° C, so there is a considerable rise in the room temperature. The body temperature is to be maintained at 37°C. This heat therefore should be continuously dissipated. Higher atmospheric temperature retard the rate of this dissipation and causes the discomfort.

(iv) Increase in the atmospheric Humidity :-

During normal respiration about 45.4 gms (1/10 lb) of moisture is released by himan body per hour. This increases the humidity in atmosphere and retards the rate of evaporation of the sweat from body; which is an essential phenomenon for coding down of body for comfort.

(v) Increase in organic matter contents and odours :-

Organic matter and odours are given off from the skin, clothing and mouths. These causes nausea, loss of appetite and aggrevation of illness.

The ventilation becomes essential for the supply of fresh air and replacement of the used one. It removes the undesirable effects of occupancy mentioned above by :-

(i) Providing the necessary amount of oxygen through the supply of fresh air.

(ii) Removing or diluting carbon-di-oxide in the air.

(iii) Lowering down the atmospheric temperature by removing the used hot air and replacing it by colder one.

(iv) Reducing the humidity by removing the moisture through air drafts. Removing and diluting the body odours.

Factors which govern ventilation :

(1) Wind Pressure :- Air flow causes positive and negative wind pressures on the windward and lenard sides. Intensities of these pressures directly effect the flow of air inside a building. Wind pressure is the result of the following factors -

(a) Average wind velocity
(b) Prevailing wind direction
(c) Seasonal and daily variation in wind velocity and direction
(d) Local wind interference.

The rate of air flow so caused is given by :-

$Q = EAV$

where

Q = Air flow cubic feet/Min.

A = Free area of inlet sq.ft.

V = Wind velocity ft./Min.

E = Effectiveness of opening.

(2) Temperature difference :-

Due to human use and occupancy the inside air temperature is invariably higher than the outside air temperature. This causes gravitional forces and it rises up, because temp. This is said to be

$$Q = 9.4\ A \sqrt{h(ti - to)}$$

where

Q = air flow Cft./min.

A = free area of inlet

h = height between inlet and outlet

ti & to = inside & outside air temperature.

(1) Natural ventilation :

This can be obtained by employing simple and cheap means and is used at most of the places.

(11) Mechanical ventilation :

This consist of forcing the necessary amount of air through the space to be venti ated at the desired rate.

(i) In the extract system exhaust fans are installed near the ventilation in or near the roof.

(ii) In the plenum system fresh air from outside is forced in through the bottom ventilators by means of force fans.

(iii) The balanced system employs both the types of fans (i.e. extract and force) and combines the advantages of the two systems mentioned above.

Effect of Ill-ventilation on human health & efficiency:

There are two types of effects of ill-ventilation on human health and efficiency:

1. Immediate effects
2. Permanent or long term effects

(1) Immediate effects :

If any room or building is ill-ventilated, man does not feel comfortable.

(2) Permanent or long term effects:

If man faces conditions of ill-ventilation and if air pollution continuously, it causes permanent effects on his ealth and efficiency. Effects are:

(i) Acute sickness

(ii) Chronic disease

(iii) Air pollution might lead a person to seek medical attention and relief.

(iv) Discomfort from ill ventilation and air pollution = sufficient to lead individual to change residence or place of employment.

(v) Effect on visibility :

Air pollution decreases the amount of solar radiation which we are getting because of the carbon-dioxide's layer & suspended materials in the atmosphere.

The ventilation required for various types of activities will depend mainly on occupants 20 C.U.M. to 30 C.U.M. fresh air is required per person.

For normal activities 6-12 changes air/hour are sufficient, but there are other factors like dry bulb temp. relative humidity and wind speed which fovern the area opening to be provided in a room for ventilation in proportion to floor are of the particulaf room.

Table 2.5.2.1

Desired Wind Speed for Comfort (Effective Temperature 75°F)
(24°C)

Dry bulb temp. °F	Relative Humidity (Per cent)	Desired sind speed (km./hr.)
80	60	0.40
80	70	1.82
85	30	0.40
85	40	2.5
85	50	5.4
85	60	7,3
85	70	10.9
90	30	9.1
90	40	14.5

Example :-

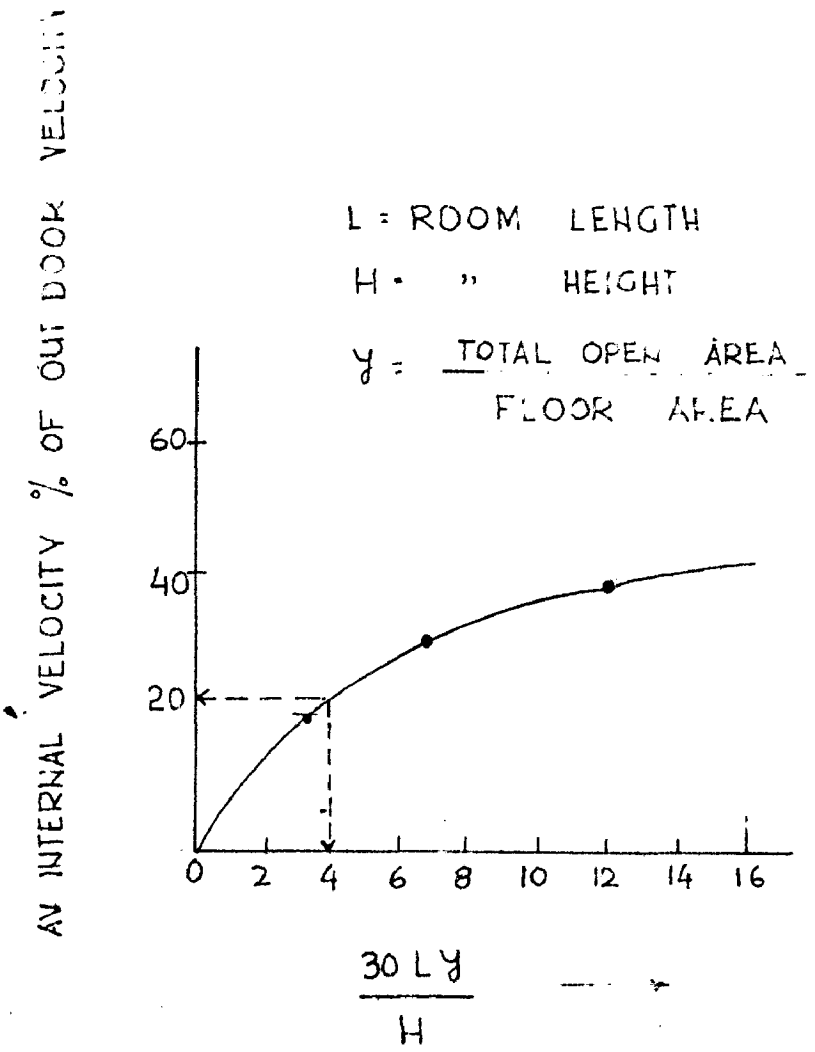
The windows of a habitable room are to be designed on the basis of the following climatological data.

Dry bulb temperature = 26.6°C

Relative humidity = 72%

Outside wind velocity = 8 km/hr.

Inside desired velocity 1 1.8 km/hr.



PERCENTAGE OF OPENING TO FLOOR AREA.

FIG : 2·521

Length of the room (L) = 3.6 m

Height of the room (H) = 3 m

Percentage velocity

$$\frac{1.8}{8} \times 100 = 22.5$$

From Fig. 2.5.2.1 corresponding to 22.5% velocity

$$\frac{30\ Ly}{H} = 4$$

Hence $y = 0.11$

Thus 11% of the open area to the floor area is to be provided to achieve the required indoor velocity.

The above method should be adopted to calculate the sizes of ventilators windows etc. for the purpose of sufficient ventilation for various spaces.

The properly ventilated spaces will achieve the good degree of comfort further it may be helped by the promision of Mechanical ventilation by electric fans. The use of exhaused fan for laboratories and library may also be helpful.

Though there is not much acoustical treatment is needed for allkinds of spaces in a college but even then we should try our best possible to achieve the specified conditions for reverberation time and to achieve the sound reduction level for various spaces as specified in National Building Code of India 1970.

Table 2.5.2.2

Reverberation Time

Room	Min. acoustic reasons when room is full	Maximum noise control when room is empty
	Seconds	Seconds
Assembly Hall	1.0 to 1.25	1.5 - 2.5
Class room	0.75	1.25
Offices	0.5 to 1.00	1.00

Minimum sound reduction classes

Class A = 25 dB

" C or D = 35 dB

" B or E = 45 dB

A Workshop, kitchen, dinning rooms

B Assembly hall lecture room, Music room Typing room

C Class room, Laboratories, offices

D Libraries, studies

E Staff room.

The location of the college should be away from the factories, railway station and line, National

Highway and other point noise so that it may help in achieving the degree of required reduced noise in college campus.

The application on the near wall side of various class rooms easily available sound absorbing materials within the economical limits of the organisation, may also be applied if at all required.

CHAPTER III

C O N C L U S I O N S

3.1 THE RECOMMENDATIONS

The results of this study and research work may be summarised in the following form as ready references regarding the various components of buildings and land requirements of Intermediate college of Uttar Pradesh :

i. One college should be planned for an enrolment of 600 students. However this number may be increased upto 800 on the basis of various local factors. It shall not be economical to establish a college for less than 500 students.

ii. Maximum number of students per section shall not exceed 35 in any case and normally 30.

iii. The class rooms shall be designed to seat 30 students and the seating arrangement and the space provided should be just sufficient.

iv. The floor area per seat for a class room works out to be @ 1.05 sq.m.

v. The total number of class rooms required for the college should be worked out by the formula

$$R = \frac{S \cdot P_s \cdot x}{P_d \cdot W}$$

where,

R = total number of rooms required.

x = Total number of sections (classes)

S = Total subjects to be studied at various stages of studies (i), (ii) and (iii)

P_s = Periods/subject/week, required.

P_d = Possible number of periods to be conducted in one room per day, during working hours.

W = Number of working day/week.

vi. The laboratories for the subjects like, Physics, Chemistry , Botany and zoology should be provided for the strength of Minimum 200 students per subject.

vii. Each Laboratory should be designed for 30 experiments to be performed at one time. The floor area required for various experiments should be calculated individually. For Physics Laboratory it works out to be as an average @ 1.7 sq.m per experiment. However it may be calculated as an approximation @ 2.00 sq. M for chemistry and zoology and Botany laboratories.

viii. The Physics laboratory should not be provided with the dark room but it should have an attached store room with 1.50 sq.m . The Chemistry Laboratory should be provided a balance room for 10 balances i.e. for 1/3 of

total experiment Selves provided in the laboratory in addition to store room. The zoology and Botany laboratories should be provided with a small water tank and a Herberium in addition to the store room.

ix. The furniture should be specifically designed for particular experiments. The general size of the working table for all types of experiments should not be encouraged any more. Whereas it is not economic to provide the laboratories in the college a laboratory centre should be planned for a group of colleges.

x. As far as possible for simgle storeyed buildings the natural lighting in class rooms must be provided from the roofs as in case of industry buildings.

xi. For ventiiation requirements the ventilators should be designed with the help of the formula and Graph (Fig. 2.5.2.1) given in this report and must be provided very close to the floor level and at roof level or in the roof.

xii For two or more storeyed buildings the windows for day lighting must be provided as vertical slits in the side walls which fall on left hand side of the students seats. These may be spaced at a distance of approximately 40 cms from each other without reducing the lighting intensity in the room.

xiii. The window sill hight should be coincident with the level of work plane or table top.

xiv. The size of the room may vary according to the seating arrangement e.g. one arrangement has been shown in Fig. 4.4.2.5 for 35 seats, will require the room size 6.5 M x 5.7

xv. There should be a seperate library building with a floor area of 205 .00 sq. M out of which there should be 10% seats of total strength i.e. 60 nos. in reading areas one store and toilet.

xvi. The assembly hall should be provided to accommodate 60 % of total strength of college i.e. Minimum floor area 180.00 sq.m for a college of 600 strength, As far as possible it should be very near to the main entrance of the college

xvii. An area of 3 acres for individual intermediate college should be provided to accommodate one field for each team game and one rare course in rural areas.

xviii. For urban area colleges a sports and games centre should be provided for a number of college. An area of 10 acres should be provided facilitate all games including one swimming pool.

xix. The stair should be provided in accordance with the table 2.4.8.1, 2.4.8.2 of this report.

xx. There should be minimum two toilets on each floor One toilet should be provided with one W.C., two urinals and two wash basins. However the total number of urinals should be provided @ 1 for 30 students upto 300 strength, @ one for 40 for next 200 and @ one for 50 for next 200 and so on i.e. 17 urinals for 600 strength.

xxi. Drinking water taps should be provided @ 1 for 25 users in a separate encloser.

xxii. The circulation area should be between 20% to 30% of the floor area.

xxiii The floor area for staff common room @ of 2.00 sq.m per teacher i.e. 60.00 sq.m. should be provided.

xxiv. Principal's office 25.00 sq.m floor area and General office 20.00 sq.m one office for accounts with 15.00 sq.m should be provided.

xxv First aid and Doctor's room 15.00 sq.m with attached toilet.

xxvi. Guidance and carrier counselling room - 20.00 sq.m. offices for games, N.C.C. and N.S.S. etc. 15.00 sq.m each, and general storage area @ 4 to 5 % of the teaching area should be provided.

N.B. Here all the recommended figures are in relation to the 600 strength of an intermediate college.

3.2 NEED FOR FURTHER RESEARCH AND TIMELY CHANGES

This subject is very important for national development every individual component of the intermediate colleges itself is subject matter of research.

It is further requires the detailed study and results of practical application of all the results concluded in this report, without these experimental tests the subject is incomplete. This experimentation will require the long time, expenditure and equipments.

The fields of Acoustic, thermal comforts and safety of structure require the association of other disciplines. The visual comforts, colour schemes etc., are also the subjects to be added in the chain of studies.

The fast changing technology and mode of society have the great impact on the systems of education which requires the review of these studies from time to time to suttest the timely changes to these conclusions. So that this study may help in multisided development of the society of that particular period for which it is being applied.

AREA REQUIREMENT FOR A COLLEGE OF 600 STUDENTS

Let there be 20 sections in all	No. of rooms		
4 sections (classes) XI & XII	0.75 x 4	=	3.0
6 sections (classes) IX & X	0.75 x 6	=	4.5
12 sections(classes) VI- VIII	0.8 x 12	=	8.0
			16 rooms

16 rooms area	= 16 x 37.1	=	598.6 sq.m.
3 Laboratories	= 51 x 120	=	171.00 " (Phy,Chem.,Bot.)
Storage	25%	=	43.00 "
Assembly Hall		=	180.00 "
Library		=	205.00 "
Staff room		=	60.00 "
Principal's office		=	25.00 "
General office		=	35.00 "
First aid and Doctor		=	15.00 "
Guidance and counselling		=	20.00 "
N.C.C. and Games etc.		=	30.00 "
Stores		=	40.00 "
Toilets		=	40.00 "
			1493.00 Sq.m
Add 25% for Structural purposes			368.00 "
			1861.00 "
Add 25% for circulation			460.00 "
			2421.00 "

Let the coverage be 25%

Total Area of college site = 9684.00 Sq. m.

This equals to 2.23 Acres say 2.5 acres.

& For Play fields 3.0 Acres

5.5 acres.

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