Modular Planning U/S Fixed-Function Planning
3.0 Introduction

From the time the man tried to collect knowledge in recorded forms a fast and suitable way and place for storage and retrieval of library collections became necessary to him. Especially from the time the library collection found way out of palaces and religious places such as temples, cathedrals, mosques, etc., numerous attempts were made to house the same in suitable places. Since the library collection and the number of users was limited, a simple building was quite suitable for library services. As historical documents show, during ancient times the library collections were housed in the homes of the learned people, priests or in separate rooms in the colleges or universities. Subsequently, as the library collections increased, the strength of students in the colleges and universities began to swell up. It necessitated to add up additional rooms or additional buildings to house the libraries. Planning and architecture of these library buildings was like any other classical building. In other words, these library buildings had not been planned according to the needs of the users, staff and library material as these were built on conventional plans.

Generally, the architecture and planning of library buildings depends on many factors such as, number of users, type of library material, and so on. A very important point to be kept in mind is the relation between the knowledge of architecture and the articulation of space too. Since man has gone through different changes in knowledge and thinking, different library planning and architecture has been evolved so far. John Olley (1997, p.11) states this idea as under:

In the past, the book built the library and its architecture catalogued knowledge. A type with medieval origins was a long shed-like space, into which was introduced a rhythm, illuminated by the regular pattern of windows, structured from above by the bay articulation of trusses of beams, and spatially defined below by book-stacks as they enclosed a scholar’s cell. Each of these book-lined bays or carrels was a room within a room, a library within the library and so easily a category within the expanse of knowledge. This elegant coincidence of structure, daylight, functional space and discipline division has been at the heart of persistent typological framework for the architecture of library, fading and re-emerging over the centuries. But alas, in its more recent history a formalist approach has shed the responsibility to seek a symbiotic relationship between the architecture of knowledge and the articulation of space.
During the nineteenth century, in Europe and U.S.A., some colleges, because of increase in the number of students, were developed into universities. At the same time many more books and other printed material were provided for universities. The need for separate well-equipped library buildings was felt seriously at that time. Therefore, up to the time of The First World War many more separate library buildings were constructed in colleges and universities.

3.1 Fixed-Function Planning

The architecture of the old library buildings was planned on fixed-function basis. Each part of the library building was designed to house one specific activity or function. These parts were not adaptable and flexible to serve as other library activities. Thick and load-bearing walls separated different parts of the library. Fixed imposing staircases, toilets and other fixed rooms provided rigidity and reduced the flexible relation between different parts of the library. In the low ceiling stacks there were some wall shelves and alcoves and sometimes multi-tire shelves. Reading rooms with high ceilings were beautifully decorated to provide an attractive and a pleasant area. Separate rooms for the staff and technical processing had also been provided.

The library equipment and other facilities were not suitable and comfortable either for the users or the staff, but the ceilings were high for better natural light and ventilation. As Michael Brawne (1997, p.8) states, “As reading is so crucially dependent on light, the control of light and particularly daylight has been a fundamental concern of library design for a long time. The relation of desks and shelves at right angles to all windows in medieval and renaissance libraries stems from the need to provide efficient side lighting. As libraries grew ever larger, light from above became important...”. Much of the space of these library buildings was non-assignable because of using thick walls and floors, high ceilings, beautifully decorated staircases and large halls. Generally, the interior parts of the library buildings were not arranged according to the users’ needs and the space was not flexible to allow a change for other library functions in times of an emergency. Ralph E. Ellsworth (1968, p.506), in an article in the encyclopedia of library and information science, enumerates the characteristics of the old libraries as follows:
In the fixed-function buildings, there was little possibility of interchange of use, and unless the ratios between books and readers fitted the changing need of the institution, the building rapidly became obsolete. Ground staircases and elegant lobbies, long flights of exterior steps, and lavish use of material characterized these buildings.

The fixed-functioning of different parts of library buildings was a major fault in the design of the buildings. Libraries have a changing environment, therefore, their buildings should be quite flexible so that all their parts could be used for different library functions. But in the old fixed-function library buildings each reading room, book-stack, reference room, etc. was designed to house one function of the library. Moreover, due to improvement of knowledge and increasing tendency for learning and teaching, libraries were planned with more required rooms but the planning and structure of the buildings was not changed for a long time. Views of Ralph Ellsworth (1968, p. 506) on this issue are as under:

In a fixed-function building the plan of organization determines or should at least do so, the architectural scheme of the building. Before 1940 most all college and university libraries followed a single type of organization. A combination of general reference and reading room, a closed-access book-stack, a separate reserved book room, and special rooms for periodicals and newspapers, rare books, and technical processing was universally used. Seminar rooms were frequently located on the top floors of the buildings.

One of the big problems of the fixed-function libraries was the separation of readers and the book collections. Readers could only approach the collection through card catalogues, bibliographies, different kinds of library lists, and sometimes with the help of the librarians. Almost all the library collections were housed in closed-stacks, which was a big barrier between the readers and library material.

Even in the earlier times, there had been some improvement, although very slowly, in planning library buildings. With the increase in the number of students of the universities, the growth of the book collections of libraries and the need for better and faster library services, the old library buildings were not suitable enough any more. In fact, by the time library collections found their way out of the palaces, temples, cathedrals, churches, mosques etc. a new type of library structure began to evolve. The idea of supplying more books to many readers was the main reason for planning
functional library buildings. So far as the historical documents reveal, numerous library 
buildings with different type of planning were constructed but in all these libraries 
reading rooms were separated from the book-stacks. Generally, the book-stacks used to 
be on the ground floor while other sections of the building use to be on the first floor of 
the library buildings (Fig. 1).

Reading room in front sides and book-stack behind it was another form of the 
library plans. Numerous library buildings were also constructed on this pattern. Book-
stacks in the form of a tower were another major plan used in library buildings (Fig. 2). 
Majority of the libraries with big collections used tower form of book-stacks. Central 
book-stacks with surrounding reading rooms were another type employed for libraries 
(Fig. 3). Central reading rooms with surrounding book-stacks was also another type of 
library plan prevalent during earlier times (Fig. 4).
Separation of readers (i.e. reading rooms) from the books (i.e. book-stacks) was the most unsatisfactory arrangement with these plans. Being contrary to the functional aspect of the libraries, numerous efforts were made to bring books and users together. Ultimately, open-access library buildings emerged as an outcome of these efforts. In fact, this improvement in planning new library buildings was a significant progress, which can be docketed in the history of library buildings. After this improvement, the right/left plan and later on the H, U, L, and V shaped buildings were planned. The right/left plan, which is also common these days, consists of a large rectangular building which is divided into two parts, with circulation desk in the middle. This type of planning is presently in use in many small public and school libraries (Fig. 5).

In 1920 vertical planning became popular. In these libraries, circulation section was on the ground floor and the reference section on the other floors. Other types of plans with different shapes were also popular in library buildings. Numerous library buildings in the shape of square, rectangular, triangular, circular, T-shape and ring plan were also popular. These different shapes of library buildings remained in vogue for a long time. But again, with the increase of book collection, increase of students' population and better functional expectations from the libraries, these library buildings could not cope with the increasing space problems.
Fixed-function planning was also in use up to the end of the 19th century. Although numerous librarians and users complained about inadequacies of the buildings, no serious improvement in the structural changes in the plan of library buildings was made. In 1888, a librarian wrote a poem to express his feelings about the non-functional library buildings. In this poem he tried to prevail upon the architects to study the needs of the librarians while planning library buildings. He wrote:

You have raised costly structure fit to stand for many a year,
But you quite forgot the scholar who seeks for wisdom here;
Will he find it sooner, think you, without help of air or light?
Does it add much to his comfort that the books are out of sight?
When librarians are angels, which they are not all (as yet),
They may be shut off in corners without getting in a jet;
When mechanical assistants are electrically wise,
They may work in "stained-glass attitudes" without much use for eyes.
You have made it fair and lovely anyone may see who looks,
But, the object of a library being principally books,
'T will be like a lovely body without one spark of soul.

Despite the fact that librarians made serious efforts to bring about a change, planning of fixed-function library buildings continued even in the twentieth century. Between the period of The Two World Wars, some minor changes and improvement in library buildings was made. Multi-tiered stacks were used instead of wall shelves and alcoves. In some modern libraries, free-standing stacks were also used. Many more library facilities were provided for the users and the staff. But these libraries were still not flexible enough for various library activities. Generally, the interior parts of the library buildings were not designed according to the users' needs and the space was not adaptable to the changing needs of the libraries. P. Havard Williams and J.E. Jengo (1987, p. 160) believe that these problems of the library building lay during the planning as there was lack of expertise. According to them:

It is depressing to see how many mistakes have been made in designing libraries, and how much money has been wasted. Buildings have sometimes been provided which, with a little expertise, might have served their users better, given easier access to collections, more comfort for study, greater...
Numerous books and articles, which are published with regard to the designing of library buildings, reveal that non-flexible monumental design that characterized library architecture continued almost until the year 1945. For the first time the library building for Iowa State College was designed with the purpose of providing more services to the users and better facilities for the staff. While planning and designing the building, special facilities such as carrels, research study rooms, group study rooms, wide corridors, large reading rooms and staff-rooms were catered for. This unique library building attracted many librarians and architects and gave rise to discussions about its merits and demerits. After this construction, the new concept of planning “modular” library buildings gradually evolved.

One of the most significant improvements that occurred during this time was the close relationship between the architects, librarians and the administrative authorities. Up to this time, architects individually were in-charge of planning, designing and constructing library buildings. But with regard to the new needs of library services, architects co-operated with librarians for planning and designing library buildings. Thus, the planning team of library buildings, which evolved at this time, can be considered as one of the most significant factors in planning well-planned library buildings. New concepts of functional library buildings also came into existence. For instance, Harry Faulkner-Brawne (1979, p.85), a very experienced library architect, laid down a number of desirable qualities for a functional library. These qualities have become widely known as his “Ten Commandments” which are enumerated below:


In relation to the above mentioned concepts, major internal design innovation in modularisation and flexibility, book storage, lighting, ventilation, humidity control, acoustics, audio-visual facilities, micro-filming and computerization came into existence. In view of the growth of higher education in various countries of the world, a remarkable development in planning university library buildings was also made. Fixed-function
library buildings were not suitable to serve as an adaptable place for new requirements of libraries. Hence, the idea of planning and constructing new library buildings came to stay as one of the important responsibilities of librarians. University authorities had realized the important role of libraries in educational process. They had known that a well-planned library building could very efficiently contribute to the intellectual health of the universities. Therefore, the idea of planning functional library buildings, in which readers and library materials could come together at one place, as well as providing a flexible place for inviting different functions, was felt seriously.

3.2 Modular Planning

According to numerous documents, Angus Snead McDonald was the originator of modular concept. He advocated the change from fixed-function to modular buildings for the first time. In 1930s he provided modules in the library of Congress Annexe. Modular library planning began in the United States just before the Second World War. Thereafter, other European countries followed this new type of library planning. McDonald expressed his primary feelings about modular buildings as follows:

When I first used the term modular, I wanted a word to express the rectangular prisms of which a building is made-up, prisms bordered on vertical edges by columns and at the top and bottom by floors. For economy of construction and facility of changing space it is preferable that these prisms be of uniform size, therefore modules. To me, "modular" expresses width, length and height. (ACRL, 1953, p.6)

Association of College and Reference Libraries (ACRL) conducted the “Second Library Building Plans Conference” in Chicago in 1953. In the third chapter of the proceedings of the conference under the title “A New-Fangled Word for an Old Principle: Modular”, different viewpoints of architects and librarians about modular library buildings were presented. In the succeeding paragraphs, some of the preliminarily definitions derived by them were reproduced and discussed. N. B. Hutcheon (1953, p.6), an architect expressed his idea about modular buildings as under:

Our aim... is to provide a functional and economical building in which the basic structure imposes as little limitation as is reasonable on future rearrangements in the basic use of space. This can be achieved by adhering to a relatively simple and regular plan form in which the dimensions of the unit
As the above definition elaborates, the main aim of the new type of planning was to provide flexibility in library buildings, to use the whole space provided efficiently, and to predict the expansion of library buildings. In fact, architects have also been in-charge to plan a suitable building for librarians in order to undertake their library services successfully. Thus, the proposed plan, “modular” was a response to the problems that the fixed-function libraries were faced with.

In another definition, Kirchhoff (1953) introduces modular library buildings as a new type of planning in which its shape is different from the fixed-function libraries, but its other characteristics may be the same as those of other buildings. He stresses on modular planning as a dimensional unit. He says: “I wish we would define modular more carefully, for it has nothing to do with fluorescent versus incandesced, nor has it any direct connection with ventilation, air conditioning, or storey height. Modular means the reapplication of a dimensional unit, a brick is modular, for example.” (ACRL, 1953, p.6)

Maxfield (1953) further defines modular library buildings with some more details. He explains modular library buildings as the new type of planning that provides flexibility and adaptability for library services in the space provided. He explains the details and the targets of a modular library building as under:

“Modular” design among librarians, that is, a warehouse type of construction, with floors supported by columns of steel or concrete and a minimum of vertical obstructions; permitting virtually unlimited horizontal expansion. This modular design calls for floor strength characteristics that allows placement of concentrated book storage loads anywhere in the building, thus providing for interchangeability of reading areas and stack areas. Preference for this type of building design may be interpreted as a reaction to the type of flexible monumental design that characterized library architecture until about 1945. (ACRL, 1953, p.1)

After this new concept of modular planning, larger space was provided for library services. The words “reading-room” and “stack-room” were changed to “reading area:” and “stack-area”. In fact modular planning provided easy interior structural changes for library services. Space problem of libraries could be solved through changeable partitions that were used in different parts of the modular buildings. Therefore, numerous librarians
and architects considered modular planning as a revolutionary action in the history of libraries. Godfry Thompson (1989), who is one of the foremost library planners, also stresses on the flexibility of modular library buildings as a solution for the space problems of library buildings. He defines the characteristics of modular buildings as under:

_In most modern library buildings there is a framework on the exterior, and columns within, the building being without load-bearing wall. (Although exterior curtain walls have been described as non-load-bearing, they are in fact loaded horizontally by wind force and vertically by their own dead weight. The point is that they do not carry the structure, it carries their weight.) Under this method internal walls can be merely divisions, where made of bricks walling of fabric partition: they will be changeable according to the requirements of the brief. (p. 69)_

Rajwant Singh (1983, p.124) has also studied the characteristics of modular library buildings. He also stresses on the flexibility and adaptability of modular library buildings as the best solution for providing suitable space for different library functions. He explains that librarians in the new type of planning are not restricted in fixed size library areas, rather they can manage the space according to the emerging needs, at any require times. He explains the features of the new kind of library buildings as under:

_Against the limitations of fixed construction, it is through modular construction that a high degree of flexibility and expansibility can be effectively achieved through adherence to modular planning in organising the structure.... In modular construction, the ceiling height is kept uniform to meet various purposes. The weight-bearing capacity of each modular is kept the same so that any part of the building may be used for any library function. Movable partitions preferably of glass or wood are used to provide for greater degree of flexibility. Modular buildings are easy to administer and maintain._

The crux of the problem that needs to be gauged pertains to the real characteristics of modular library buildings, their best size of modules, and the best height to be erected for different parts of the library, keeping the size and shape of the columns. Keyes D. Metcalf (1986), one of the foremost library planners explains different characteristics of a modular library building, which will be discussed in the following paragraphs. According to him, modular planning is a kind of building supported by columns at regular intervals. The standard measurement for modular buildings is called a module from the Latin word “modulus”, a measure, which is used in designing this type of library buildings. Although
the outside walls may be weight bearing but the total area inside the library, except toilets, staircases, elevators, heating facilities, ducts and plumbing are free from weight-bearing walls. In other words, every parts of the library building except the columns is movable and flexible for inviting different library services. Thus, modular buildings are described as flexible buildings with infinite expandable space, multi-purpose, convertible or interchangeable buildings that can bring readers, services and storage, all within one fabric that can attain the best and maximum possible use of space at any time needed.

In modular planning every rectangle or square area defined by four adjacent columns is known as a bay. Every modular building is made up of a number of identical bays. These bays can be used separately or some more bays may be used for a special library function. The bays or modules provide satisfactory conditions for furnishing every part of the library and result in well-proportioned rooms. Every part of a library building such as: reading area, book-stacks, reference section, periodical section, technical processing section, etc. are separated from the other parts by using partitions, book shelves, furniture, etc. Therefore, when required, these library areas are flexible enough to be changed for other library functions easily. This feature, i.e. flexibility of the modular buildings is one of the most important characteristics that the changing environment of library buildings was in search of. In fact, after this revolution in planning library buildings librarians are able to move different library parts without extensive or expansive alterations when they cope up with space problems. Frank Lundy (1972, p. 244) also stresses on the flexibility of modular library buildings and explains the main idea of modular planning as under:

*The central idea of a modular building consists of widely spaced interior steel columns for vertical support, instead of load-bearing walls. Typically there are strong floors throughout, capable of holding anywhere at any time any reasonable load of books, readers, or specialized equipment, and any combination or concentration of these... Everything that goes into the building can be moved with a minimum of time, effort, and expense... such a building does not become obsolete.*

Modular planning minimizes the expansion problems that fixed-function library buildings were faced with, but while planning this new type of library buildings, due attention, especially site consideration for future expansion should be taken into account.
Likewise, non-movable parts and elements in modular library buildings should be predicted and placed properly so that at the time of expansion these do not provide enlargement problems. For prevention of the above mentioned problem, Ellsworth (1969, p.434), enumerates seven characteristics of modular buildings that the architects and librarians should keep in mind, when planning and designing library buildings. These are as follows:

1. The layout of the elements be planned in the first unit in order not to encounter the readers with any problems in the expanded part.
2. To predict the prevention of traffic problems, which will be resulted from the expansion of library building.
3. To evaluate the heating, cooling, ventilation, lighting etc. for the parts that is going to be enlarged.
4. To use knockout materials in the exterior walls where expansion will be occurred, in order not to waste the expense.
5. To plan tower, if there is any, at the edge of the platform, so that they could easily be enlarged.
6. To predict the ultimate size of he building in order not to enlarge it more than what has been predicted.
7. To study site problems carefully and be sure to select the most suitable site for future expansion.

3.2.1 Advantages of Modular Library Buildings

Modular planning in library buildings has been considered as a revolution in the history of libraries. It has solved the space problems, which the fixed-function library buildings were faced with for a long time. Metcalf (1986, p.51), enumerates the advantages of the new type of library plannings as under:

1. It simplifies the tasks of estimating costs and makes the result more accurate.
2. It saves time on the site because materials are acquired in suitable sizes, and it largely eliminates cutting, patching, and wasting materials.
3. It simplifies supervision, as much of the work is routine.
4. It should improve the finished product because more of the work is done under factory controls instead of field conditions.
5. It provides more flexible space adapted for any likely purpose.
With prefabrication coming into use more and more, each of these advantages will become more important in the future.

Providing the situation for the advantages mentioned above, is in fact the basic element that should be taken into consideration while planning modular library buildings. This had been neglected in the old fixed-function library buildings. Numerous librarians faced with space management and providing necessary facilities which has been overcome in the new type of library buildings.

3.2.2 Structural Design of Modular Library Buildings

It is worthwhile to remind that the question about the optimum size for a module has not been answered completely up to now. Different library buildings are planned in different sizes. Even inside one library building different sizes of modules are used. Generally, the size of the modules depends on the local conditions and structural and architectural needs of each library building. According to many documents, the size of modules varies from 3ft (using multiples) to 27ft. The size of modules should be standard, keeping in mind the economy and future expansion of library buildings. H.D. Sharma (1996, p.76), also emphasizes this problem, stating that “The standardization should not stop at the module. Every measurement, whether it is different parts of the building or different items of furniture, must conform to a standard to effect economy and case of expansion.”

The size of the modules also depends on the type of the library. Generally, school libraries and small libraries can be planned with smaller size of modules, while research and university libraries should be planned on larger modules. The size of the modules was as low as 13ft to as high as 33ft or more in the past. But now larger modules are being planned. There are even larger modular library buildings in use now-a-days. Likewise, some of these have been planned without any interior fixed columns. Generally, the size of the modules for each type of library building is to be determined according to its specific requirements. Metcalf suggests that one of the sizes, $22\frac{1}{2} \times 22\frac{1}{2}$ ft, or $25\frac{1}{2} \times 25\frac{1}{2}$ ft is desirable for most of the libraries because with these sizes columns are not too many to be destructive while designing library furniture (Fig. 7).
3.2.2.1 Size of Book-stacks

Due to standard size of bookshelves for different kind of libraries, it is essential to determine the size of the bays for book-stacks according to these standard sizes. Therefore, special attention should be taken, otherwise the space provided between the columns may not be suitable to house the right number of book shelves, or useless space may be left in the book-stacks. Moreover, the book-stack can either remain open to users or can be partially closed. Different type of furniture can be arranged in book-stacks also for users. Metcalf suggests ten points to be borne in mind while planning and designing book-stacks in any type of the library building, which are as follows:

1. The size and shape of the supporting columns
2. Arrangement for housing ventilating, mechanical and wiring services
3. The length of the stack section
4. The length of the stack ranges before cross aisles are used
5. The depth of shelves and ranges
6. The width of the stack aisles between ranges
7. The width of the main and cross aisles
8. The direction in which the stacks run, now or at a later stage
9. The clear ceiling heights
10. The type of lighting. (Metcalf, 1986, p.53)

All of the above mentioned points are co-related. Changes in either of them entail one or more changes in the other items. Therefore, while designing the bays of modular library buildings, calculations should be done very carefully otherwise it would lead to the wastage of space and money and other library problems. Keeping their importance in view, each of these ten factors, being the basic elements of every modular book-stacks are discussed in detail.

3.2.2.1.1 Size of the Columns:

Generally, the size of the columns is the most important factor in planning modular library buildings since the size of modules, the designing of different parts of the library and the beauty of the library largely depends on it. The size of the columns depends on the following:
a) The amount of loads to be carried by columns
b) Type of construction
c) Enclosing different library facilities, i.e. ventilation, cooling, wiring, etc.
d) Shape of the columns

Although the size of the columns is determined, keeping in view the factors mentioned above, yet the thicker columns at times create some problems for the library services. An example is of book-stacks, where columns come between the stack ranges and block the aisles. It is therefore to be borne in mind that while designing library buildings, thinner columns be erected, if possible, to reduce the problems of library services.

The thickness of the columns largely depends on the amount of load these can bear. While planning the columns the dead load, i.e. the floors, and the live load, i.e. books, equipment and users should be taken into account. It is logical to place heavy instruments as well as the library collection on the ground floor; where the columns do not bear their load. Hollow columns can also be used to provide the necessary function of air-circulation system without imposing any degree of limitation or restriction upon the flexibility of the building. Because these columns are larger than the other ordinary ones, due care should be exercised. Different other types of columns are also used in modular buildings. However, due to security problems for prevention of fire and collapsing, proper attention should be paid while selecting hollow columns. Likewise, steel columns protected by concrete are thinner but reinforced concrete columns are cheaper. Number of the floors is also a determining factor for assigning the thickness and the type of columns. The columns of lower levels are thicker than those of the top floors where there is less load on the columns.

The shape of the columns is also important in designing modular library buildings. It can affect the space catered for, especially for the book-stacks. Three shapes of the columns are mostly used in modular buildings i.e. square, rectangular and round. Round columns are comparatively cheaper than the other two shapes, but rectangular columns are more suitable for book-stacks because these can be matched with the ranges (Fig. 8).
Fig. 6: Book Stack Arrangement

Fig. 7: Different types of Column Construction
3.2.2.1.2 Arrangements of Columns for Library Services:

In addition to the load of the library, columns can be used for housing different library facilities. For maximum saving of the space, columns can be used for housing other library facilities too. Sometimes lighting, heating, cooling and ventilation of the library is carried thorough the columns. Some architects suggest that due to the fire problems it is better not to use the columns for the above mentioned purposes. Generally, where there is space problem, the columns can be used for housing the facilities enumerated above. Ducts can also be enclosed in the columns to save and enhance the aesthetic look of the building.

3.2.2.1.3 Length of the Stack Section:

The length and the distance between the columns in stack section of modular library buildings are of paramount importance. Although the type of columns depends on many factors, yet the length and the width of shelves is a determining factor. Number of shelves that can be placed between the two columns as well as the number of main and cross aisles needed for users and staff, plus extra space for stack uprights should also be taken into account while planning modular book-stacks.

3.2.2.1.4 Length of the Ranges:

The length of the ranges should be planned carefully so that the long ranges do not provide inconvenience to the users and the staff. Moreover, the ranges should not be too lengthy as these are likely to disturb the library services especially in a busy library. Generally, the longer the ranges, the wider the aisles should be. Therefore, if the book-stack is frequently in use, the ranges should not be too lengthy unless wider aisles are provided. Likewise, the length of the ranges should be a multiple of the section length adopted.

3.2.2.1.5 Depth of the Shelves:

Since the depth of the shelves for different type of book-stacks, reference sections and periodical sections has been standardised, standard shelves should be provided for book-stacks. While designing the columns the standard depth of the shelves should be taken care of, otherwise the columns may come in the way of aisles. In other words, for
using the maximum space provided in stack areas and for providing harmonize aisles, the depth of the shelves, the size of columns and aisles should be catered for accordingly. In brief, while planning/designing book-stacks, length and depth of the shelves as well as the distance between the columns should be studied carefully, otherwise there will be some wastage of space in that part. For safety measure it is suggested that the shelves should also be fastened to the floor.

3.2.2.1.6 Width of the Stack Aisles:

Although there are standard sizes for the aisles width, yet the exact size generally depends on the number of users, library collection, type of the book-stack, (open or closed), and the length of the ranges. Similarly, the aisles should be wide enough for the book trucks, as well as for two persons being able to cross each other and take the books from the bottom shelves easily (Figs. 9 &10). This should be taken into considerations to avoid crowding. Likewise, the width of the aisles should be designed in co-relation to the shelf depth. Libraries with too many users and open stacks need wider aisles. In reference departments, where very big and huge library material is housed, aisles must be wider. Moreover, the width of the aisles should be determined according to the distance between the columns and also number of shelves.

3.2.2.1.7 Width of the Main and Cross Aisles:

As stated above, the width of the aisles depends on many factors. Easy accessibility to books through the main and cross aisles should be considered important while designing the aisles width. Although standard sizes for the aisles have been laid down, yet the exact size depends on the amount of use of book-stack. The main and cross aisles should also be in harmony with each other as well as the other parts of the library building. It is desirable that the librarians do not over- economise in determining the width of the aisles, otherwise it will cause problems at a subsequent stage.

3.2.2.1.8 Direction of the Stack:

Generally, it is desirable to design a flexible book-stack so that it could be run in different sides. In order to provide a well-designed book-stack. The following factors have to be taken into consideration, while designing the direction of book-stacks:
Fig. 8: Width of the stack aisles.
1. The direction of natural and artificial light is of paramount importance.
2. The directions of floor covering should be in accordance with stack direction.
4. Arrangement of suitable traffic pattern.
5. If the windows are predicted for the ventilation, to provide suitable bookshelves in order not to curtail the windows completely.

While designing the stack area, placing the furniture, columns and reading area should harmoniously catered for.

3.2.2.1.9 Ceiling Heights:

The height of the ceiling in modular book-stacks is to be determined according to the height of the shelves. Since an average person can reach up a special height on bookshelves, there is no need to take the ceiling too high in book-stacks. But in some libraries higher ceiling is in use because the top shelves over the standard size can be used for “dead storage” of the books. Moreover, high ceilings can be used for ventilation, wiring, lighting and other library facilities. Therefore, some librarians insist in planning higher ceilings for book-stacks. Multi-tiered book-stacks are not suitable for modular construction. So, while planning book-stacks it is preferable to provide free-standing shelves, since they are more flexible in use.

3.2.2.1.10 Lighting:

While designing the bays, making provision for enough light is an important element for consideration. A book-stack without enough natural or artificial light is of no use. Therefore, while designing book-stacks enough natural and artificial light should be catered for. Artificial light is to be arranged in accordance with the number and direction of aisles. Since direct light is harmful for the library materials, it is essential to plan indirect lighting for book-stacks. Using florescent lighting in long strips and in series provides an equal distribution of light in the area and on the shelves. Because of the changing environment of the libraries, especially increasing number of book collections, it is preferable to install flexible wiring and lighting. In expansion cases or when it is necessary to change the direction of the ranges and aisles, flexible lighting will be
matched easier. In countries where providing electricity is a problem, larger windows should be catered for to provide more natural light during the daytime. At some places lights are embedded in the floor, in the center of each aisle in series, parallel to the ranges also. These provide more light for the lower shelves as well as an interesting sight for book-stacks. Generally, the amount of lighting needed for a stack area depends on the height of the ceiling, number of fixtures and their spacing. Although determining the size of the bays is of paramount importance in planning the book-stacks, other parts of modular library buildings have their special features and need due consideration.

3.2.3 Space Characteristics for Other Areas:

The space characteristics of reading area, circulation desk, entrance door, card-catalogue room, research carrels, librarian’s room, technical services, etc. are also being discussed in the subsequent paragraphs.

3.2.3.1 Reading Area:

The space provided for reading area as well as reference department, periodical section and night study room should be larger, with fewer columns and higher ceilings. Large reading area is necessary for seating arrangements. In case the large area has not been catered for, columns may interfere with long tables and other library furniture. Unlike reading room of fixed-function library buildings, having rows of tables and chairs, large reading area furnished with individual carrels, group study tables and other comfortable furniture in modular library buildings should be designed. In order to provide larger reading area with the characteristics mentioned above, Metcalf points out different methods that can be employed as follows:

a) To place the area in top floor where there is no weight except the roof and the interior columns can be left out.
b) To use heavier beams in the ceiling so that higher roofs could be constructed.
c) To make the column spacing narrower in one direction so that a wider spacing be possible in the other direction.
d) To use heavy roof beams for the upper part of the building.
e) To use one of the new precast-concrete methods which permit larger spans. (Metcalf, 1986, p.64)
3.2.3.2 Area for Circulation Desk:

The size of circulation desk should be determined according to the size of the bays, since columns in front or behind the circulation desk disturb the services of this section. It is logical to house circulation desk inside one full bay. In case the bays are small or larger circulation desk is needed, two attached bays can be used. In this case it is advisable to separate the circulation services into two parts; one for charging and the other for the books to be returned.

3.2.3.3 Area for Card-catalogue:

In large libraries, where still card-catalogues are in use, if a bay size area is not enough for the purpose, card catalogue cabinets can be located in the corridors near the book-stacks and reading areas. With the use of computer in library services, there is no need to cater for additional area any more.

3.2.3.4 Entrance Door:

Generally, entrance door in small libraries can be placed in one module, but in large libraries it is advisable to plan a lobby near the entrance door to reduce the traffic problems. In the latter case, at least one column will fall into the lobby which can be beautifully decorated. High ceiling of entrance area provides a suitable situation for planning aesthetic entrance.

3.2.3.5 Stairwell:

This part can be planned with low ceilings but in large bays. Stairwells should be wide enough to prevent traffic problems, noise pollution and to provide easy accessibility to open air area in emergency.

3.2.3.6 Small Rooms for the Staff and Research Carrels:

With the standard size of bays, rooms for the staff and other library services in different sizes can be provided. Careful attention should be paid in order to avoid wastage of space when providing research carrels or other small rooms for different library services. In other words, columns should cave inside the partitions or as a part thereof, and not inside the rooms.
3.2.4 Problems of Modular Library Buildings:

No doubt, modular planning in library buildings was considered as a revolutionary planning, but it has its faults and drawbacks also. The glaring problem is that, all the bay size modules are not ideal for every library service. Height of the ceilings is another problem. While reading areas need to be planned with higher ceilings for better ventilation and provision of more natural light, book-stacks can be planned with low ceilings. Therefore, the ceiling height sometimes blocks the flexibility of modular buildings. The fixed size modules are another problem for the expansion of libraries. The size, which is selected today, may be inconvenient ten years later and this reduces the flexibility and adaptability of modular library buildings. Thus, the future expansion should be forecasted in advance.

Acoustic disturbance is another serious problems in modular library buildings. Since different parts of the library are divided by partitions, book cases, furniture, etc. they are not adequate barriers to the sound, which is made in different parts of the library. Hence, enough acoustic equipment should be predicted in these library buildings, otherwise there will be noise pollution. Although somewhat expansive, but a solution is there to prevent noise pollution with acoustical treatment and systematically locating different library functions and services.

Fixed columns are another problem in modular library buildings. These may get in the way of stack ranges, aisles, tables, corridors and the like. Therefore, when planning modular library buildings, special size of the columns should be catered for, in order to prevent the said problems. Moreover, the type and size of library furniture, book shelves and other library equipment must be designed according to the space provided between the fixed columns, otherwise some part of the space may be lost.

Windows in fixed-function and modular library buildings are usually provided for ventilation and light. These should be located high enough on the walls to allow wall shelving in different parts of the library building. During 1950s and early 1960s, as Donald E. Thompson (1970) pointed out, glass wall library buildings began to emerge. Numerous modular library buildings were planned in this new form of construction. The glass panes were planned on one or more sides of the library buildings. Although many
librarians and architects advocated glass panes planning but very soon serious problems emerged in these libraries. One of the problems is that the direct rays of sunlight causes glare on the bookshelves as well as library furniture and will destroy them after some time. In such a structural building, cooling and heating facilities cannot be provided completely, unless very modern and expensive equipment is installed. In the areas where electricity is a problem and the weather condition is abnormal, inconsistent temperature will have an effect on the library services. The electricity consumption by these libraries is rather high and preservation cost of the electrical equipment will also be on the higher side. Arrangement of library furniture and designing different parts of the library will be limited and affected by the above mentioned problems. Maintenance and upkeep of wall glasses is difficult and expensive. Therefore, many librarians and architects prefer to have simple and common library windows to prevent the problems listed above.

On the other hand, new generations of architects do not follow modular planning completely. H.D. Sharma (1996) states that architects believe that this type of planning inhibits their creative impulses and results in drab, similarity in structure and repetitiveness. Many modern library buildings are constructed on a mix planning of beautiful and unique looking features of old library buildings, which are implanted in modular bases. In this way many new beautifully designed library buildings will be provided. In fact architects have already done their jobs well to provide functional, beautiful and attractive library buildings.

In spite of the shortcomings enumerated above, modular planning has been selected as a revolutionary alternative for planning and designing flexible library buildings. But in planning this type of library building careful attention should be paid to reduce the above mentioned problems and provide a functional area for the library services. Moreover, future expansion, considering increase in the number of students and book collections, should be predicted systematically and carefully.

Like numerous changes and improvements that have been incorporated in planning library buildings, modular planning is still not the last pen word. Especially with rapid advancement of information technology, it calls for new library needs and perspective planning. Some of the librarians and information technologists predict that the
time is not far when there may be paperless libraries. Therefore, the planning and targets of these libraries will be quite different from the existing buildings. The aim of the planning of such libraries will be to provide a well-equipped, flexible and functional building in order to bring library collection and users closer. Moreover, the idea of “City as a Library” or any other electronical library by using personal computers may affect the existing idea of planning library buildings. But so far as printed materials and architectural aspects are concerned, functional, beautiful and well-planned library buildings would still be required.

### 3.2.5 Modular University Library Buildings in Iran

As it was pointed out in the previous chapters, only a few of the university library buildings in Iran are originally constructed for this purpose. But most of these buildings are planned on modular basis. So far as the data collected reveals (Table 1, Chapter 2), 47.6% of the original library buildings are constructed on modular planning and the remaining ones have been planned on fixed-function or a combination of the two. The people of Iran have always had been foresighted and kept pace with the modernization. The concept of modular library buildings was conceived approximately four decades ago, and the libraries were constructed 30 years back, based on this modern concept. All the same, over the period, swelling strength of the students clubbed with the introduction of new books into modular libraries of Iran is beginning to occupy more space. In other words, the space provided in these libraries has become inadequate and calls for additional accommodation. Since many of original library buildings were constructed more than 20 years ago, therefore, most of these are confronted serious space problems.

Some of the modular library buildings consist of one or two floors, but in big cities where providing suitable space is a serious problem, there are four and five storey buildings too. Because of the shortage of space in Tehran, the Capital of Iran, the library building of Tehran University consists of nine floors. Most of these library buildings are planned on rectangular and square shapes, in order to provide economy of space. Likewise, due to environmental structure of other administrative and teaching buildings in universities of Iran, library buildings are also planned in these two shapes in order to be in harmony with them. There is also a round and a semi-circle library building too.
Expansion of the present modular library buildings has not been predicted in most of the cases. After the Islamic Revolution in 1979, the number of book collection of university libraries and students’ population has been increased drastically. But very few expansions or remodeling have been done in the present modular library buildings. Therefore, most of these libraries face space problems. On the other hand, remodeling or expansion of the present library buildings has not been predicted in most of the cases. So these libraries should spend much more money and time for constructing new library buildings.

In spite of the crucial role of librarians in planning, designing and constructing library buildings, according to the data collected, only a few librarians have been asked to participate in the team of planning their library buildings. Different foreign construction companies planned almost all the modular library buildings, which were constructed before the Islamic Revolution. After the Islamic Revolution, some librarians have been asked to take part as a member of the planning team of libraries. Some of the well-planned modular university library buildings that have successfully come up are discussed in the succeeding paragraphs.

3.2.5.1 Library Building of Tehran University

This library is the oldest, largest and the most famous university library in Iran. The library building was constructed in 1970. The building is rectangular in shape with nine floors. Almost all types of space necessary for a library building has been catered for this library. The whole building is planned on modular basis, providing large areas for different library services. There is a very large and well-decorated conference room on the ground floor and four other separate large rooms are allocated for the books of different fields of study. This famous library building has been planned, designed and constructed by a foreign construction company. Regional and cultural needs of the university and the society have also been taken into consideration. In spite of the very large area provided in this building, librarian and library staff still find the space inadequate to meet the growing demands.
3.2.5.2 Library Building of Sharif University of Technology

Sharif University, which is considered as the most famous university in the field of technology, owns a well-planned modular library building. The building consists of five floors with an external square shape. The present building was constructed in recent years with the co-operation of librarians and Iranian architects. The library is rectangular in shape and consists of five floors. Most of the standard requirements for a library building have been provided through the large bays in this building. The building is planned on identical square bays and maximum use of the space has been catered for different library services.

3.2.5.3 Library Building of Payam Noor University

A foreign construction company constructed the central library building of this university in 1974. The building has been planned in round shape. A beautiful and attractive view has been provided through its panes walls. The building is planned on modular basis without any inside columns. The large area inside the library has provided a very flexible place for different library services. Though the structure is under one roof, yet, floor partitions have been erected within to provide adequate space. The very large area on the ground floor is devoted to reading, reference and stack areas, which is separated by different short and tall free-standing shelves. A large part of the underground floor has been planned as conference room. Because the number of library collection and users’ population is comparatively less and the building is quite flexible and adaptable for different library services, library staff does not face any space problem in this library.

3.2.5.4 Library Building of Shahid Beheshti University

The central library building of this university was also planned on modular basis, in 1970. It consists of two floors with square shape. Very large bays with few columns provide the functional space required for different library services. The building is located on a comparatively higher ground but the future expansion has not been taken care of. Since the librarians face space problems, additional construction has been planned as an extension of the existing library building.