



I L L I N O I S

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

PRODUCTION NOTE

University of Illinois at
Urbana-Champaign Library
Large-scale Digitization Project, 2007.



OCCASIONAL PAPERS

Number 67

March 1963

BUILDING MATERIALS IN LIBRARY CONSTRUCTION

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Introduction

In discussing materials of construction for library buildings, one can quite easily discover that he has selected a subject which is not an accepted conversation piece in librarianship. It would be considered about as mundane as for the College of Cardinals to deliberate about a Sunday School picnic.

Few contemporary librarians have approached the quality or scope of treatment given library buildings by Ralph Ellsworth. In Planning the College and University Library Building, he says, "It is an architect's business to know which materials are best for the building, though he will be expected to give the librarian and the consultant a chance to challenge his choices."¹ It is put a little more bluntly in his The State of the Library Art, where the heading "The Technology of Building" is dispatched with the dogma, "Librarians know nothing about this, nor should they."² Martha Boaz, in setting down the responsibilities of the architect, lists "designing the exterior" and "considering materials and methods of construction."³ However, the librarian, depending upon his prior training and experience, is expected to evidence some degree of interest in the selection and use of those items which will contribute to the efficiency of the completed structure. Without sacrificing any of the artistic treatments, such factors as flexibility, durability, ease of maintenance, and the comfort and convenience of clientele, are among the goals to be sought.

In this paper materials and the associated construction techniques have been grouped into their functional application in library structures. The groupings are arbitrary and are indicative of one way in which more detailed specifications could be organized. Excluded are the following functional groups: heating, lighting, electrical, mechanical, ventilation, air-conditioning, plumbing, acoustical treatments, and floor coverings.

The first seven of these categories were ruled out by reasoning that the engineering and/or equipment aspects are paramount in them and that these items are frequently treated as systems furnished and installed by sub-contractors. The latter two categories were considered to have been quite thoroughly explored in recent library literature. Brief descriptive text deals with the grouping selected. An appendix lists recent applications of exterior and interior facing materials to specific library structures. A select bibliography is included at the end of the paper.

Footings and Foundations

It would seem very easy to ignore the drab aspect of that portion of the library structure which is subsequently hidden from public view. Unfortunately, very serious and costly consequences can develop if inadequate treatment is given to the substructure which is to support the finished building, together with its intended contents and activities. Attention may be focused upon only three aspects--the soil bearing properties, the frost-line, and waterproofing. With rare exceptions, reinforced concrete of the proper quality and composition is the material used for footings, foundation walls, and column piers.

The bearing properties of the soil and its substrata are related to the matter of site selection. As a general rule, a relatively high site with only a moderate slope is to be preferred. It is noted that a number of quite sizable library buildings, both academic and public, have recently been constructed on sites where the slope is such that grade, or ground-level, entry can be provided to at least two levels within the building. If the building is to be more than one floor in height, and unless there is reliable existing evidence, action should be taken immediately following the site selection to ascertain the nature of the strata upon which the footings and column piers are to rest. It is preferable for all footings and piers to be placed upon the same, or upon equally stable, strata. The bearing capacity of the soil is vital in considering provisions for future expansion of the facility--either horizontally or vertically.

The "frost-line" consideration is of primary concern in one-floor buildings. In multi-floored structures, the soil bearing aspect, or the choice of a subgrade floor level, usually obviates this problem. However, with the advent of forced circulation heating and the use of fuel oil or natural gas in lieu of coal, it is practicable to construct--especially the smaller, e.g., branch--libraries of one floor, placed at or near the grade level. Footings for foundations should be placed at a depth in excess of the nominal frost-line because frost damage to footings is more severe where the soil has a higher moisture content.

Any portion of a structure below grade is subject to possible water difficulties. The provisioning of proper and adequate drainage at the level of the footing will materially reduce the severity of the problem.

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Whereas good concrete is impermeable to water, the fact that the footings, foundation walls, piers, and basement floor are not all poured at the same time--hence not monolithic--permits for joints through which seepage can occur. Of the two types of waterproofing used to overcome this situation, the more effective is the "membrane" type which consists in constructing what is essentially a waterproof box, integral with the floor and the walls. Several layers of a crude cloth felt are placed on the subfloor and are mopped with hot asphalt. The finish floor concrete slab is poured over this barrier. Using the same materials, the foundation wall is given similar treatment--the membrane is applied to the outer side of the foundation wall, followed by a light weight brick, concrete block, or thin poured concrete layer. The latter serves to hold the membrane in place and to prevent damage to it during back-filling or other grading operations. The other principal method of waterproofing is known by the generic term of "surface coating." It consists in coating the interior face of walls and the upper surface of the floor with a layer 3/4" to 1" thick of cement-rich concrete which contains liquid or solid additives that render the material very dense and hard. Recently, preformed membranes which do not require a protective wall and film type materials such as polyethylene and polyvinyl chloride have been recommended for waterproofing.

Framework

In library buildings, reinforced concrete, steel and wood, or combinations of these, are the primary skeletons. Except for the basement floor or the ground floor when the latter is designed as a "slab-on-grade," the structural system carries the entire weight of the structure, its contents, and its users. This load, which includes the walls, floors, ceilings, roof, utilities, equipment, personnel, and added resistance to wind and snow, is transmitted to the foundation, footings, and piers.

For many years structural steel was highly favored in multi-storied construction; it is very widely used today in taller buildings and in areas where earthquakes are a potential hazard. Its strength and elasticity, in comparison with its weight and size, are prime advantages favoring its use. The various individual pieces (members of a steel framework) are fabricated at the supplier's plant and are erected and connected on the site. Welding techniques enable that method of joining and connecting to be used in lieu of riveting. Conformance to the American Society for Testing Materials (ASTM) specifications is adequate assurance of quality. The American Institute of Steel Construction and the American Welding Society have standards applicable to the erection of steelwork which can be the basis for the proper quality of workmanship. In library construction where more than a one-floored structure is involved, steel offers the advantages of requiring much smaller columns than would reinforced concrete and would permit thinner overall floor sections, i.e., less ceiling to floor distance, because of narrower girders, beams, and joists. In the building of exteriors which contemplate the use of exterior panel sections, e.g.,

aluminum, porcelain, or cast stone, the steel frame would probably offer greater ease in fastening. Because of steel's inherent tendency to corrode, precautions must be taken to prime-coat all steelwork before erection and to permit access to steel members that are subjected in service to moisture or high humidity. Prefabricated open-web joists are widely used for roof-deck supports and for floor-deck supports where the loading and the spans are moderate.

Reinforced concrete is currently the most widely used structural material in libraries; undoubtedly in many instances it is determined to be the most economical choice. It is advantageous to have footings, foundations, framework, and floors all constructed of the same material since this practice permits use of large monolithic sections, integrally produced. From the standpoint of inspection/supervision, it requires a very considerable amount of effort and vigilance, because of the large number of variables which must be controlled. Rigid standards (principally ASTM) exist for the various constituent materials used in plain or reinforced concrete, as well as for the methods of mixing, transporting, vibrating, and finishing. In reinforced concrete, the positioning and securing of the steel reinforcements are as important as the quantity and quality of the steel used for this purpose. Frequently the use of reinforced concrete for the exterior or interior facing--walls, ceilings, columns--can permit certain economies, but requires high grade workmanship if objectionable flaws/faults, with the subsequent "patched" appearance and greater maintenance problems, are to be avoided. The placing and curing of concrete when the ambient temperature is below 40°F present certain problems. Generally, because of its lower strength, the reinforced concrete structure will be considerably heavier than its steel counterpart and will require larger and possibly deeper foundations. One of the major improvements in concrete design has been the "prestressing" of the steel reinforcing elements (wires), a technique used in precast members intended for use as girders, beams, or joists.

Although cases would occur where reasons of local availability, economy, or a temporary situation might argue for the selection of wood as the frame for a library structure, principal limitation for its use in a public building is, of course, its combustibility. Consequently, its structural use is confined to relatively small buildings and then only for certain components such as beams, trusses, ceiling joist, rafters, and arches. Recent developments in adhesives and in fabrication techniques have produced laminated arches and beams which have attained considerable use, especially in combination with the more fire-resistant materials to obtain pleasing interior effects when the wooden members remain exposed.

Roofing

The present trend in the overall size and shape (floor plan outline) of library buildings is such that most roofs are flat pitched and consequently require a continuous surface, vis a vis overlapping elements, i.e.,

shingles. For these essentially flat roofs the most widely used covering has the generic term "built-up roof" or roofing by which the structural rafters or roof joists support a roof deck which can be of a wide variety of materials, e.g., wood sheathing, steel plates, concrete slab (poured or precast), gypsum slab or panels, plywood, and a variety of laminated composite materials. Over the decking a vapor barrier is applied such as building paper, foil, or plastic film. A layer of thermal insulation--usually rock-wool or glass-wool, in batt or board form--is next placed on the barrier material. Roofing felt is spread over the insulation and is given a number of moppings, usually three, with hot asphalt. The felt may be applied in more than one thickness with each layer being successively mopped with the hot asphalt. The uppermost layer is usually given more than one coating of asphalt. A layer of sand, small gravel, or crushed stone is often spread over the top coating of asphalt to increase the durability of the roof and to prevent excessive softening of the asphalt by reflecting some of the solar heat. This topping also serves to improve the fire resistance property of the roof.

Subfloors

The type of floor covering selected for various portions of a building will have a considerable bearing upon the specifications for the subfloor construction. Depending upon its projected use, it may be desirable to give the basement or below-grade floor only a dust proof concrete coating. If the subfloor thus becomes the finish floor, greater accuracy in workmanship and higher standards of materials are required. If the basement is to be provided with floor drains, it is very important that the floor be uniformly pitched (inclined) to facilitate drainage. Similarly, ground-level entrance floors should be pitched to prevent rain, snow, and run-off water from flowing into or accumulating at exterior doors or vestibules.

Several types of floor deck construction require a continuous concrete subfloor approximately 2 1/2" thick to be poured over the decking. In some types of poured, reinforced concrete framing, this subfloor can be poured integrally with the joist. This practice would be applicable to all floors above the basement. In areas where terrazzo, ceramic tile, quarry tile, or like materials are to be used, the concrete subfloor should be level, even though it can have a coarse finish. For most composition flooring materials--asphalt, cork, rubber, or vinyl--whether in tile or sheet form, the surface must be perfectly smooth and uniform. Generally, the thinner the covering material, the more noticeable are any irregularities in the subfloor. Likewise, irregularities are more accentuated by sheet material than by small tiles of the same material.

Window Frames (or Sash)

Before the material for window frames is selected by the planner, certain other related factors should be explored. An initial study of how much natural lighting is desired should give some concept of the total area involved and the type and quantity of various glazed sections required to admit the desired amount of light at the proper locations.

At that stage of planning a tentative decision may have been made regarding the ventilation or air conditioning system for the building. The size, number, and location of operable window sashes are significantly controlled by such a decision. Parallel to this aspect, the mechanical engineer can advise upon the need for using double glazing to keep heating and air conditioning loads within the desired limits. Operable sashes can be procured with the weather-stripping material installed by the sash fabricator.

The size and weight of individual glass panes bear upon the decision of the sash material to be used. If the frames are of wood or steel, the number of individual panes influences maintenance painting costs. Not to be disregarded is the later problem of interior and exterior window cleaning operations.

If prefabricated wall panels are being considered for exterior walls, it is probable that matching sections with preinstalled sashes can be obtained, if width limitations thereby imposed are not critical to the design.

If it is necessary for the building to harmonize with other non-contemporary buildings in its style of architecture, it may be necessary to use wooden frames. Otherwise, consideration should be given to the use of frames and sashes fabricated from extruded aluminum alloys. With the provision of either forced ventilation or air conditioning, only a minimum number of operable frames need be considered.

Sheet Metal Work

In addition to possible use as exterior or interior wall or other facing applications, sheet metal can be used for roofing, gutters and downspouts, flashings, and miscellaneous small items. The most widely used metallic roofing materials would probably be galvanized steel and tin-plated steel, often called "terneplate." However, unless they are heavily coated, neither of these materials has the permanence required of public buildings. Next in popular usage is copper, which if properly applied will produce a long life roof, but which has the disadvantage of weathering on the surface to produce a green verdigris or patina which will stain adjacent materials. Caution must also be observed that the copper is not placed in contact with other metals where damaging electrolytic corrosion will result. Copper is generally used as a flashing material, especially on roofs, where flashing is needed at all points where the roof intersects a vertical surface and where two parts of the roof intersect.

Zinc, lead, aluminum, stainless steel and Monel metal are all non-staining materials. Because of their low strength, greater weight, and relatively high cost, zinc and lead are seldom used for roofs. Because aluminum cannot be easily soldered or welded in sheet form on the job, it is rarely used, although with recently developed adhesives it may find greater acceptance. Stainless steel and Monel [trade name] can be soldered and welded; however, Monel metal is a "rich" alloy and would be too costly for use on large roof areas. Because of galvanic action, precautions must be observed in the use of stainless steel to avoid direct contact between dissimilar metals.

Galvanized steel, copper, and aluminum are available in gutter and down-spout forms.

Glass and Glazing

There are a goodly number of considerations and decisions associated with the use of any quantity of glass. Under the heading of Exterior Walls, the heat transmission aspects of glass areas are presented. In smaller sections glass functions mainly to admit light; however, as its dimensions are increased it also serves to present a view--a field of vision. In these larger sections one tends to be more observant of its optical properties, particularly of any distortion. In small sections, such as multi-paned window sash, the better qualities of window glass are quite satisfactory. For sizes corresponding to those of a "picture window" or larger, it may become necessary to require glazing grades of plate glass.

Even in mild climates at relatively low levels of relative humidity, moisture condenses on the inside surfaces of glazed areas. To reduce condensation, some form of double glazing is used. If required, insulating glass, composed of two or three sheets of glass with heat absorbing and glare reducing qualities and hermetically sealed at the edges, is a good, although somewhat costly, material.

Special accessories to support and position them in their frames are required in the setting and glazing of large glass sections. Glazing compounds which produce a wind-and water-resistant bond between the glass and the frame are specified. These sealants must be compatible with the frame materials. While the use of caulking is not confined to locations around window frames and its application may be performed by other than glaziers, it is an essential material and procedure. Caulking compounds are similar to some of the adhesive, nonhardening glazing materials. Used around exterior wall openings, caulking seals out air, moisture and dirt.

Painting

Paint should not be thought of as a "cover-up" to mask inferior materials or workmanship, but rather as another means to enhance the effect

being sought. In most cases it would be assumed that the architect would specify a top quality brand of paint or its equivalent appropriate to the material being covered and to the service to which it is to be exposed. Provision should be made to specify the colors desired. A somewhat different approach is for the architect to require the painter to compound the paints from standard quality pigments (white lead), vehicles (linseed oil), varnishes, driers, thinners, and coloring materials, according to a set of recipes.

A considerable amount of painting, particularly of a preservative nature, should take place as construction progresses. During these stages paint may be applied to wood and steel, some of which will be inaccessible after construction is completed. Much of the exposed interior woodwork may be given a "natural" finish by the use of filler, stain, oil (linseed), varnish, shellac, clear lacquer, wax, and other transparent finishes.

For exterior and interior surfaces, three coats of paint are usually called for in new construction contracts. One possible difficulty can arise if the painting contractor is allowed the use of thinners of his choice and in the amounts he may decide. For a given paint there may be only one thinner which is compatible with the other ingredients. Even though the use of unlimited quantities of thinner can reduce the cost of the paint and greatly reduce the cost of applying the paint, it will produce a thin and poor quality coating.

Woodwork

Contemporary library design contains very little woodwork, either as rough carpentry or as trim and millwork. In a few instances where wood roof decking is used it is sometimes left exposed to serve as the ceiling. Except for a few doors which building codes require to be of steel construction as a fireproofing measure, all other interior doors would nominally be of wood, with veneer faces. Standard-sized door openings should be used in all instances unless there is a well established need to the contrary. For "folding" partitions, consideration should be given to the "stacking" variety of movable wooden partitions in contrast with "accordian" type plastic materials. If wood veneers are used in millwork or finish trim, provision should be made to protect the edges and ends of veneered surfaces to prevent tearing or splintering.

Finishing Hardware

In order to have all hardware items matching in design, finish, and material, to have the items available when needed, and to obtain some economy in their procurement, a schedule should be included with the specifications.

The principal choices are between brass or light (silver) colored metals. If brass or bronze is selected, the metal must be solid--not merely plated. Brass and bronze have the disadvantages of tarnishing and of corroding when subjected to perspiration. If nickel or chrome plating is used, the plating must be sufficiently durable. Items from appropriate aluminum alloys offer a suitable selection. The locks and keys for the various doors should be included in the schedule.

Exterior Walls

In few other categories is the choice of materials as varied in its scope as in those now available to use in building exteriors. The literature would indicate that face brick is probably the most commonly used facing for contemporary libraries. Transparent glass areas would rank among the most popular treatments. Cut-stone masonry finds occasional use, but tends to be reserved for special effects and for trim purposes. Limited use has been made of poured concrete exterior walls, some with formed (indentation) designs; however, the appearance is often rather bleak and bare. Increasing in popularity are "cast-stone" and cast terrazzo panels, which are similar in several respects. The backing, or body, of the panels is reinforced concrete, into which are placed clips or fasteners to secure the panels to the structural frame. The "cast-stone" often has a smooth or sandy texture; frequently the concrete is uniformly colored with an additive. Some "cast-stone" is textured with a coarse aggregate (gravel) so that the facing is chiefly gravel. Terrazzo panels, like terrazzo floors, have a surface that is predominantly, e.g., 70 per cent, exposed rock chips; the terrazzo is subjected to grinding and polishing to produce a smooth surface quite similar to that of polished granite or marble.

Stucco is only rarely used for exterior walls; it would have reasonable permanence only in very dry areas. Whereas the use of cut-stone masonry is declining, the increased use of natural stone veneer probably balances the overall use of stone. Granite, marble, and limestone are available in panels as thin as one inch. Transportation charges on natural stone--either as masonry units or as veneers--would frequently make its extensive use prohibitive from a cost standpoint.

Metal panels provide a durable facing which is relatively easy to erect and which has a very low maintenance cost. Of this class, stainless steel is probably the most expensive, and untreated sheet aluminum the least costly. Porcelain enamel coatings are available on steel sheet, and more recently satisfactory low temperature porcelain on aluminum sheet has been utilized. Anodizing treatment of aluminum can produce colored panels; however, at present only a few of the colors are stable in sunlight over long periods.

In addition to its use in windows, transparent glass is widely used as an exterior wall material, mainly in the form of fixed panels, but also as sliding panels which serve as secondary doorways and as a means of ventilation. In some respects it would appear that library architects (and

possibly librarians) have been over-zealous in the use of glass areas. One school of thought argues that glass permits the public to "window shop," or permits the user to absorb the view from the library. Practically speaking, however, "all is not sweetness and light." A liberal amount of glass can be utilized on the northern exposure of the library; for the other three exposures, caution should be exercised. On the ground floor level, sun screens can be provided, external to the building. If the building is a one-storey structure, a wide overhang of the roof or eaves or a portico can reduce the amount of direct sunlight.

Glass has deficiencies other than that of transmitting the sun's brightness or glare. In single sheets it is not a good insulating material, and vast quantities of heat can be lost from the building during the winter months. This property has the reverse effect in summer--the glass conducts heat from the ambient outside air into the structure. Glass, while screening out most of the ultraviolet radiation in the sun's spectrum, is quite transparent to the infrared frequencies. As a result, those parts of a building adjacent to glazed areas which consequently received direct sunlight, are heated--both in summer and in winter. It is now customary to use, for glazing purposes, types of specially compounded and tinted glass--gray, greenish, or blue-green--to reduce glare and to absorb the infrared radiation. It is conceded that an appreciable amount of the difficulty in heating, cooling and air conditioning several recently built libraries results from the large glazed areas which produce an imbalance in the heating loads. Opaque glass has been used as a facing material; however, its inelastic properties render it very difficult to erect and prone to failure.

Only one instance of the use of rigid plastic materials for library exterior facing was found in the recent literature. The sandwich panel was composed of an outer skin of plastic reinforced with fiberglass; the core was polystyrene insulation and a backing of cement asbestos board. The library reported condensation moisture difficulties. It is possible that the sandwich did not contain a vapor barrier such as aluminum foil.

A novel facing is provided by mosaic, glazed, ceramic tile adhesively cemented to cement asbestos board. Fuller use should be made of cement asbestos board, in plain or striated, colored sheets, because this material is economical, durable, and relatively fire resistant. An unusual effect has been obtained with the recent production of "3-D" aluminum sheet. The sheet is deformed in the direction of its thickness to obtain an "embossed," contoured appearance.

Wood is seldom used for exterior siding; again as in framing, only when some local condition makes it the most logical choice.

It has been noted that glass blocks, strongly in vogue some thirty years ago, are seldom used today. There appear to be some applications within libraries where this item can render excellent service. One use would be in providing natural light in stairwells and similar areas. There are numerous instances wherein clerestory windows are installed above exterior wall book shelves. In spite of the fact that the glass blocks would

not provide ventilation, their lower cost, better light diffusion, and improved insulation properties should warrant a "second look."

Interior Walls

One could place the interior walls of today's library arbitrarily into three classes. The inside surface of exterior wall sections would be a large group. A second class could be the relatively permanent, but not necessarily load-bearing walls. Semipermanent or movable walls is a third classification.

In the earlier section on Exterior Walls, only the facing materials were discussed. To make a complete wall section requires a strength and/or stiffness greater than that of the facing material alone, as well as provision for heat and moisture barriers. In many present structures the walls above the grade line are non-load bearing, i.e., curtain walls. For some one-floored structures, portions of the wall may be made stronger (thicker or heavier) and thus serve also as columns in supporting the roof beams, rafters, trusses, and/or ceiling joist. Only in rather rare instances would a single unit wall, e.g., poured concrete, brick or cement block masonry, be utilized for both interior and exterior facings. Masonry veneers--face brick or cut stone-- are "backed" by a masonry wall of concrete blocks, common brick or structural clay tile; the two walls are "tied together" with stripes of reinforcing steel embedded in the mortar of both walls. Normally a space or cavity is left between the two walls which can serve as "dead air space" insulation or which may be filled with mortar.

Plaster can be applied directly upon concrete or masonry walls; structural clay tile and concrete block make better plaster bases than do solid concrete, brick, or stone. The heat-loss barrier (insulation) for walls is frequently in batt, blanket, sheet, or board form, composed of such materials as glass wool, rock wool or cellulose fiber. The moisture barrier can be an asphalt treated paper, a plastic film, or aluminum foil; this vapor barrier should be placed as near as practicable to the inside surface of the wall section. The surface of common brick or concrete block, back-up walls can be used as an interior wall surface. The brick would be dark in color and slightly rough; the concrete blocks would be quite rough. There are paint-type finishes available which can produce a smooth and durable coating for concrete block interior walls. Ceramic wall tile is a possible choice for covering the wainscot portion (3 feet to 4 feet) of the walls. A wide variety of plastic laminates, particularly those in the darker or wood-grained patterns might be considered for wainscoting; some, however, are not recommended for use on the inside face of exterior walls.

Even in the case of optimum use of modular design, there are a few, relatively permanent--but not necessarily load-bearing--walls on each floor level of the modern library. Some of these are elevator shafts, stairwells, toilets, and rooms associated with the mechanical equipment and utilities. Lightweight concrete blocks or structural clay tile, either plaster covered

or given the same treatment as the interior of the perimeter walls, gives the necessary permanence with the desired fire and acoustical control.

The third type of interior wall--the movable partition--seems to pose problems to librarians. It is possible that a certain amount of psychological adjustments to the new concept of "openness" helps confuse the situation. One approach might be to consider the basic function required of the particular "partition." If the function is a simple one, such as traffic control, a suitable handrail could serve as effectively as a solid brick wall. It is presumed that movable bookshelves can be used for partitioning where their use is appropriate--e.g., in indicating the limits of a portion of the collection--a subject class or a type (format) of materials. Certainly the technical services and to a lesser degree the administrative staff areas require partitioning especially in larger libraries. Conference rooms, seminars, studies, carrels, typing rooms, listening rooms, children's areas, and smoking lounges are other functional areas that need varying amounts and degrees of partitioning or separation. In the sense that counters and work space are needed for public service activities--circulation, reference, reader's advisory service, and A-V materials--these too require partitions. For the total or major divisions of technical services, the partitioning can be relatively fixed--lightweight concrete block masonry would offer "maximum" permanence; sectional floor-to-ceiling wall panels with adequate acoustical properties would be quite satisfactory.

Prefabricated wall sections are available in a wide selection of materials and finishes and in a number of standard widths. The principal advantage offered by demountable walls or partitions is that, after initial installation, they can be removed and reinstalled at another location and/or in a different configuration, within the building. Some sections are plain, some with fixed glass sections, others with wainscoting. Door sections come with or without glass panes. Louvered sections are available in wall or door sections. These prefabricated sections can be obtained in less than floor-to-ceiling heights--starting with desk-top level--about 30". In general, because these partitions are not "free standing," they must be secured to the floor and, frequently, also to the ceiling. Some ceiling constructions are not readily adaptable to prefabricated wall panels because of their lack of rigidity or the presence of gross irregularities as in the case of exposed ceilings. In selecting panel sections, a system which can be disassembled and re-erected by building maintenance personnel, rather than requiring a number of different building trades/crafts, is generally preferred.

Various types of grillwork are finding use as space dividers; among these are products of punched or expanded sheet metal and extruded metal sections. Some use has been made of translucent materials such as corrugated plastic sheet material reinforced with fibers of glass, synthetics, asbestos, rock-wool, or metal. Clear glass is a very popular material for interior partitions in contemporary library design. This trend is supported by the greater use of glass in exterior walls, the effort to create the concept of "openness," and the desire to provide for the maximum of surveillance with a minimum staff.

Although plaster is in present use to a very considerable degree, various sectional materials have made inroads upon its use as a ceiling material, especially in suspended ceiling construction and in designs where large areas of translucent materials are illuminated. The greater use of glass both for exterior and partition walls has also effected some reduction in plastering applications. The use of materials requiring lesser maintenance has tended to replace plaster for the lower (wainscot) section of most walls. Plaster does have the advantages of being highly fire resistant, capable of application directly to structural tile or concrete block, and relatively inexpensive.

General

Indeed, much has been done to improve the quality of building materials, especially by trade associations, by governmental agencies, by consumer activities, and by the architectural and engineering professions. Some of these groups have also dealt with the problem of quality of workmanship in the construction industry and the suppliers to that industry. To a very appreciable degree, the quality of the completed structure will depend upon the abilities, attitudes, and integrity of the contractor(s) employed and all of their personnel. Some manufacturers or fabricators quote a warranty period for their products. To a reasonable degree, it may be desirable to include guarantees and performance bonds in the specifications; however, these offer little assurance if the builder does not have a sincere desire to produce a first quality structure.

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APPENDIX

Exterior Wall Materials

Natural Stone

Field Stone

Bishop Br., Inyo County, California
Hawaii County, Hilo, Hawaii
Salinas Public, California
Madison County, Rexburg, Idaho
Moline Public, Illinois

Cut Local Stone

Mount St. Mary's College, Emmitsburg, Maryland
Brigham Young University, Provo, Utah
University of Saskatchewan, Saskatoon,
Saskatchewan, Canada

Cut Stone (Including veneers)

Minneapolis Public, Minnesota
Seattle Public, Washington
Dayton Public, Ohio
St. Louis County, Headquarters, St. Louis, Missouri
Yale University, Rare Books, New Haven, Connecticut
Hyde Park Branch, Los Angeles, California
Colgate University, Hamilton, New York

Limestone (Cut)

Evanston Public, Illinois
Simmons College, Boston, Massachusetts
Bezazian Branch, Chicago, Illinois
Case Institute of Technology, Cleveland, Ohio
Kansas City Public, Missouri
National Library of Medicine, Bethesda, Maryland
Providence Public, Rhode Island
St. Catherine's College, St. Paul, Minnesota

Brick

Face Brick

Sequoyah Branch, Knoxville, Tennessee
Brentwood Branch, Los Angeles, California
Chicago Lawn Branch, Chicago, Illinois
Northtown Branch, Chicago, Illinois
Hamilton Branch, Enoch Pratt, Baltimore, Maryland
Gardenville Branch, Enoch Pratt, Baltimore, Maryland
Shaker Heights Public, Ohio

Brick (Cont'd)Face Brick (Cont'd)

Culver City Branch, Los Angeles, California
 University of Minnesota, Bio-Medical, Minneapolis,
 Minnesota
 Hampden-Sydney College, Virginia
 Francis Bacon, Associated Colleges, Claremont,
 California
 Pike County Free, Waverly, Ohio
 Washington University, Music, St. Louis, Missouri
 Southern Illinois University, Carbondale, Illinois
 Lewis and Clark College, Portland, Oregon
 University of Maryland, College Park, Maryland
 Brooklyn College (Addition), Brooklyn, N. Y.
 De Pauw University, Greencastle, Indiana
 University of New Hampshire, Durham, New Hampshire
 Adelphi College, Garden City, New York
 Purdue University Library, Lafayette, Indiana
 Aurora Public, Colorado
 Wabash College, Crawfordsville, Indiana
 Augustana College, Sioux Falls, South Dakota
 Sunnyside Branch, Linden, New Jersey
 Saint Vincent's College, Latrobe, Pennsylvania

Glazed Brick

Rogers Park Branch, Chicago, Illinois

ConcreteMonolithic

University of South Florida, Tampa, Florida

Stucco

New Mexico College of A and M Arts, State College,
 New Mexico
 Air University, Maxwell Air Force Base, Alabama
 Forest Park Public, Illinois

Pre-cast Panels

Arcadia Public, California
 North Branch, Memphis, Tennessee
 Mark Twain Branch, Los Angeles, California
 Northwood Branch, Enoch Pratt, Baltimore, Maryland
 Washington University, Architecture, St. Louis, Missouri

Pre-cast Panels (Exposed aggregate facing)

West Valley Branch, Los Angeles, California
 Inkster Public, Wayne County, Michigan
 Gwynedd Mercy Junior College, Valley, Pennsylvania

Pre-cast Panels (Terrazzo facing)

Gaston County, North Carolina
 East Texas State College, Texas

Terra Cotta

Barnard College, (Wolkman), Columbia University,
 New York

Wood

Illinois Valley Branch, Grants Pass, Oregon
 Main Public, Grants Pass, Oregon
 Woodstock Branch, Multnomah County, Oregon

Aluminum Panels

Western Michigan College of Education, Kalamazoo, Michigan
 Agricultural, Cornell University, Ithaca, New York
 San Mateo Junior College, California
 United Nations, New York
 Carnegie Institute of Technology, (Hunt), Pittsburgh, Pa.
 Charlotte Public, North Carolina
 Kresge Science, Wayne State University, Detroit, Michigan
 Edith B. Ford Memorial, Ovid, New York

Porcelain Panels

Watts Branch, Los Angeles, California
 Mississippi Southern University, Hattiesburg, Mississippi
 North Branch, Tufts, Weymouth, Massachusetts
 Wellesley Free, Massachusetts
 Baker University, Baldwin, Kansas
 Grambling College, Louisiana
 Warren Memorial, Massena, New York
 Michigan State University, East Lansing, Michigan
 Charleston County, South Carolina

Plastic Sandwich Panels

Regional Headquarters, Cambridge, Minnesota

Glass (Transparent)

Donnell Branch, New York Public, New York
 Yonkers Public, New York
 Richfield Branch, Hennepin County, Minnesota
 U. S. Air Force Academy, Colorado Springs, Colorado
 Douglas College, Rutgers University, New Brunswick, N. J.
 Cornell University Research, (Olin), Ithaca, New York
 Abilene Public, Texas
 Canisius College, Buffalo, New York

Glass (Opaque)

Louisiana State, Baton Rouge, Louisiana
 Wooster College, Ohio

Interior Wall Materials

Plaster

Seattle Public, Washington
 Evanston Public, Illinois
 Shaker Heights Public, Ohio
 Culver City Branch, Los Angeles, California
 East San Gabriel Valley Regional Hqs., Los Angeles
 West Covina Branch, Los Angeles, California
 Forest Park Public, Illinois
 University of Saskatchewan, Saskatoon, Saskatchewan
 Brooklyn College, Brooklyn, New York
 Antioch College, Yellow Springs, Ohio
 Adelphi College, Garden City, New York
 Architectural, Washington University, St. Louis, Mo.

Brick

Illinois Valley Branch, Josephine County, Grants Pass, Oregon
 Brigham Young University, Provo, Utah
 Francis Bacon, Associated Colleges, Claremont, California
 Augustana College, Sioux Falls, South Dakota
 Midland Senior High School, Midland, Michigan

Marble

Southern Illinois University, Carbondale, Illinois
 New Mexico College of A and M Arts, State College, N. M.

High Pressure Laminates

Western Michigan College of Education, Kalamazoo, Michigan
 Gaston County (6 Branches), North Carolina

Ceramic Tile

National Library of Medicine, Bethesda, Maryland
 Bio-Medical, University of Minnesota, Minneapolis
 Case Institute of Technology, Cleveland, Ohio
 Kansas City Public, Kansas City, Missouri
 Pope Pius XII, St. Louis, Missouri

Plastic Sheet (film)

Minneapolis Public, Minnesota
 Kensington Branch (renovation), Brooklyn, New York
 Bennington College, Vermont
 Mississippi Southern University, Hattiesburg, Mississippi
 Carnegie Institute of Technology, (Hunt), Pittsburgh, Pa.

Concrete Block

Madison County, Rexburg, Idaho
 North Branch, Memphis, Tennessee
 Hampden-Sydney College, Virginia

Concrete (exposed)

Village of Inkster, Wayne County, Michigan

Glass

East Lansing High School, East Lansing, Michigan
 Yonge Laboratory School, University of Florida, Gainesville, Fla.
 Yonkers Public, New York
 Simmons College, Boston, Massachusetts
 (Standard Branch Plan), Chicago, Illinois
 St. Louis County Headquarters, Missouri
 Cornell University Research (Olin), Ithaca, New York
 De Pauw University, Greencastle, Indiana
 University of Louisville, Kentucky
 University of Maryland Medical Center, Baltimore, Maryland
 Olivet Nazarine College, Kankakee, Illinois
 Rare Book, Yale University, New Haven, Connecticut

Reinforced Fiberglass

(Branch remodeling), Philadelphia, Pennsylvania

Accordion Doors (Plastic)

Josephine County, Main, Grants Pass, Oregon

Folding/Stacking Doors (Wood)

Georgia Institute of Technology, Atlanta, Georgia
 Wabash College, Crawfordsville, Indiana
 Woodrow Wilson High School, Tacoma, Washington

Wood Veneer Paneling

Weathersfield Public, Connecticut
 Sequoyah Branch, Knoxville, Tennessee
 Richfield Branch, Hennepin County, Minnesota
 Barnard College (Wolkman), Columbia University, New York
 East Texas State College, Texas
 St. Cloud State Teachers College, Minnesota
 Abilene Public, Texas
 Jackson Junior High School, Greensboro, North Carolina

Cork (pressed sheet)

Arcadia Public, California

Cement Asbestos Board

Regional Headquarters, Cambridge, Minnesota

Movable Metal Partitions

Michigan State College, East Lansing, Michigan
Florida State University, Tallahassee, Florida
Air University Library, Maxwell Air Force Base, Alabama

Wire Mesh

University of Kansas Medical Center, Kansas City, Kansas

Louvered Glass Panels

Mt. Royal Elementary School, Baltimore, Maryland
Escambia High School, Pensacole, Florida

Wood (solid timbers)

Woodstock Branch, Multnomah County, Oregon

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