expanded shale

concrete facts

ENGINEERED MASONRY ISSUE

Royal Inn Hotel—
Terre Haute, Indiana

OFFICIAL EXPANDED SHALE CLAY & SLATE INSTITUTE JOURNAL

VOL. 17 No. 2

Published by the Expanded Shale, Clay and Slate Institute whose members produce lightweight aggregate from shales, clays or slates by the rotary kiln process.

Editor's Notebook...

YOU'VE COME A LONG WAY, BABY! The familiar, drab "cinder block" masonry unit pioneered by F. J. Straub shortly after World War I has come a long way since then in both uses and appearance. A major breakthrough came in 1923, when Dan F. Servey of Kansas City introduced the first masonry block using lightweight expanded shale as the aggregate; the new blocks were slightly more than half the weight of the normal weight concrete blocks of the time, and therefore easier for masons to handle, and in addition had excellent acoustical, insulating and fire-resistive properties. Particularly adapted to school construction because of these qualities, but also suitable for residential, commercial and industrial construction, the popularity of the lightweight masonry units increased so rapidly that the present-day demand is estimated at more than one billion blocks annually — enough to build a 60 foot high wall from New York to San Francisco!

From an esthetic point of view, the range of textures available in lightweight masonry units makes them equally useful for exterior walls or interior partitioning, and recent years have seen their increasing use in churches, libraries and school buildings. But the most significant advance in recent years has been the increasing use of engineered lightweight masonry in high-rise structural applications. Described in this issue, for example, are the Royal Inn Hotel in Terre Haute (7 stories), Heritage Apartments in Calgary (a soaring 17 stories), and MORH Housing highrise units in Oakland (12 stories).

Shattering another "tradition" that engineered masonry is suitable only where floor plans repeat themselves from floor to floor, with relatively limited open space, is the Holiday Plaza office building in San Rafael, where an ingenious design scheme has produced open floor areas up to 56' x 100'. Still another tradition has been shattered by the "Tri-Arc" design introduced by Travelodge International and described on pg. 17: whose graceful, contemporary curves and planes dispell any notion that lightweight masonry structures have to adhere to a box-like design.

But what is giving engineered lightweight masonry its biggest push, in these days of high construction costs and uncertain money conditions, is a simple matter of ECONOMICS. Masonry buildings go up faster, are completed and ready for occupancy faster . . . and start putting money back in the till faster. This adds up to lower construction costs through improved crew productivity, lower loan costs, and quicker cash flowback. It adds up to savings; it adds up to profits . . .

. . . and if you still have reservations about engineering, read Tom Holm's article on pgs. 9-16, and our special "ABC's" article on pgs. 22-23. You'll find useful — and profitable — information you can put to work right away!

Lightweight Concrete Information Sheet No. 14
Fire Resistance of Expanded Shale, Clay and Slate Concrete Masonry

In addition to presenting the fire endurance of expanded shale, clay or slate concrete masonry walls, this Information Sheet includes a brief discussion of the ASTM Fire Test Method, fire ratings agencies, and background information helpful in evaluating concrete masonry fire tests. Topics include: fire testing; fire testing and fire rating agencies; load bearing masonry walls; equivalent thickness; moisture content vs. relative humidity; effect of aggregate type and moisture; effect of filling the cores; effect of plaster. Copies of Information Sheet No. 14 are available from your member-supplier listed on these pages, or from:

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FEATURED
IN THIS ISSUE

Lightweight Masonry and Floors = 20% Weight Savings, 2-1/2 to 3% Cost Reduction At Terre Haute Royal Inn

THE recently completed Royal Inn in Terre Haute, Indiana, is still another in a growing list of hotels and motels where a combination of load-bearing lightweight masonry walls plus structural lightweight concrete floors has speeded construction, facilitated early occupancy—and cut costs while improving cash flow and payback.

Strategically located at U.S. 40 and I-70, the contemporary styling and painted exposed masonry have good esthetics and high visibility to travelers. The seven-story hotel tower is of engineered masonry design using high strength lightweight block and site-cast structural lightweight concrete floor slabs. Exterior of the building is painted block. The tower measures 68′x 114′ and contains 100 rooms and suites. Total floor area is 63,389 sq. ft.

The structural lightweight concrete floor slabs were precast at the job site and lifted into place on walls of 3000 psi lightweight block. The 105 pcf, 3500 psi floor units were thus available for erection as required with no delay. Up to the fifth floor, the lightweight masonry walls were solid grouted, using a 7-bag mix pea gravel grout. Above the fifth floor, grout was used only to fill cores containing vertical reinforcement. Horizontal reinforcement was placed in the top, middle and bottom courses where bond beam units were used.

The Terre Haute Royal Inn typifies the reasons why so many hotel-motel chains are specifying load-bearing lightweight masonry walls in conjunction with structural lightweight concrete floor systems. Construction costs aside, a primary consideration is the time required to erect the structure and make it available for occupancy. With masons and other tradesmen working in tandem, it is possible to have lower units completely finished and occupied while they are still completing the upper ones. Foundation requirements are less complex, too, because of the reduced dead load. With a shorter groundbreaking-to-occupancy cycle, investment monies can be used more productively. Earl Gagosian, Chairman and President of Royal Inns of America, recently announced a five-year plan to build 2500 rooms a year with an annual investment of $3 million. "With our cash flow," he said, "the plan anticipates we won't have to sell additional common stock."

But construction cost features of this type of building are extremely attractive, too. The repetitive floor plans typical of hotels and motels lend themselves well to engineered masonry designs by simplifying construction requirements. Vice President-Architecture James L. Haslam of Royal Inns of America estimates that total cost savings on the $1.2 million Terre Haute structure run between 2½ and 3 percent, thanks to the use of high strength lightweight masonry and structural lightweight concrete floor systems. He adds that "improved acoustical and insulation qualities" of the expanded

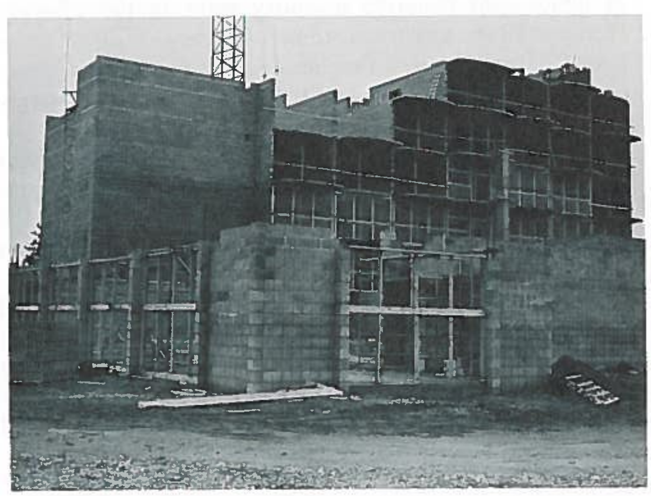
Recently completed $1.2 million Royal Inn at Terre Haute, Indiana features high strength lightweight masonry load bearing walls and structural lightweight concrete floors.

shale aggregate lightweight block and concrete provided additional benefits.

Mr. Haslam also estimates weight savings at 20 percent of the total weight of the tower, and cites the ease of handling the lightweight masonry units. The owner-general contractor reports that this handling ease saves at least 10 percent through increased productivity of masons.

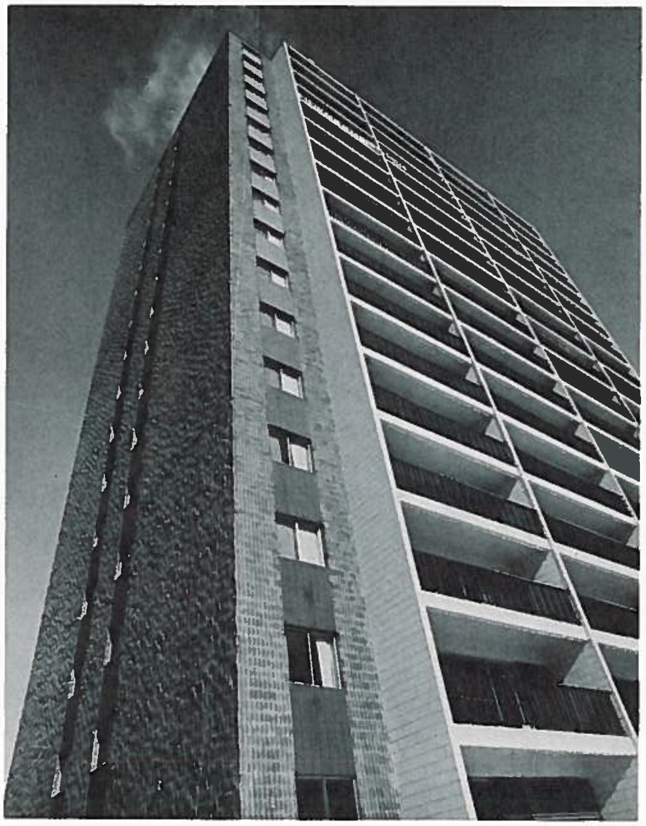
In all, the Terre Haute Royal Inn required approximately 1000 cu. yds. of structural lightweight concrete for the floor systems and 70,000 lightweight masonry blocks. The block producer says that ". . . when the specification of Royal Inns of America required a lightweight unit of high strength, it was only natural" to draw on 44 years of experience with rotary kiln expanded shale aggregates and use this material to meet the requirement.

Owner-General Contractor—Royal Inns of America, San Diego
Architect—James L. Haslam, Vice President-Architecture, Royal Inns of America, San Diego
Structural Engineer—Coneer Engineering, San Diego
Ready-Mix Supplier—Suburban Ready Mix Concrete Corp., Terre Haute
Block Producer—Spickelmier Industries, Indianapolis
Haydite expanded shale aggregate supplied by Hydraulic Press Brick Company, Brooklyn, Indiana

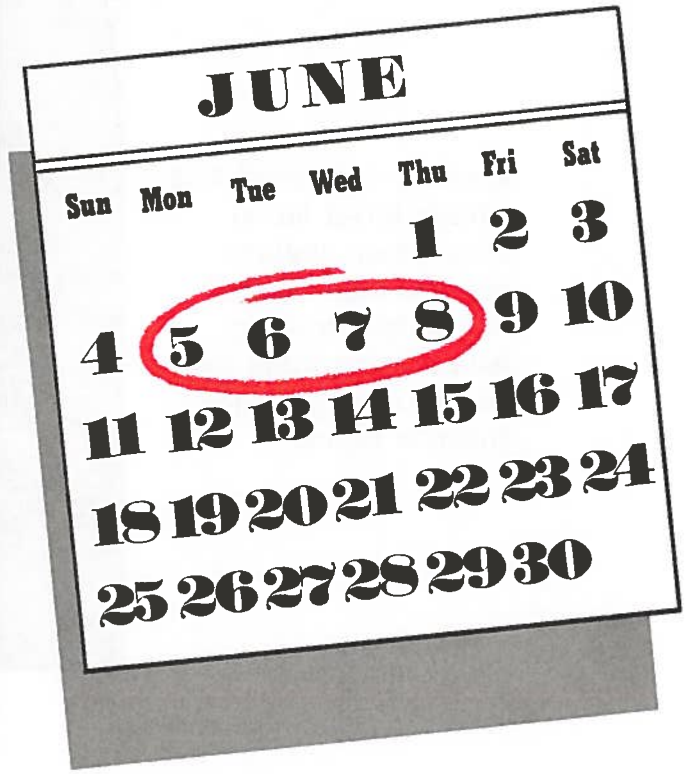


Construction photo shows extensive use of engineered lightweight masonry in Royal Inn, Terre Haute. Approximately 70,000 blocks were used in conjunction with structural lightweight concrete floors. Royal Inn's Vice President-Architecture James L. Haslam credits lightweight combination with total cost savings of 2½ to 3 percent, deadweight savings of 20 percent in tower.

Lightweight Masonry Units Speed Construction On Heritage Place Tower 1 Story Every 4 Days



Seventeen-story Heritage Place apartment tower in Calgary saved two months in construction time and financing charges through use of load bearing lightweight masonry units. Exterior units were integrally colored. Total of 164,000 block were used in construction.



SAVINGS of two months in construction time and two months in financing charges are credited to the use of lightweight concrete masonry walls in the 17-story Heritage Place apartment tower, Calgary. With an average of 11 masons and five laborers on the job, the tower went up at the rate of one story—walls and floor—every four working days.

Rising 201 feet above grade, the 117′8″ x 70′8″ tower contains 137 apartments. Its 175′ x 123′ base contains three levels of parking and commercial space on the street level. Total construction time for the building was 10 months.

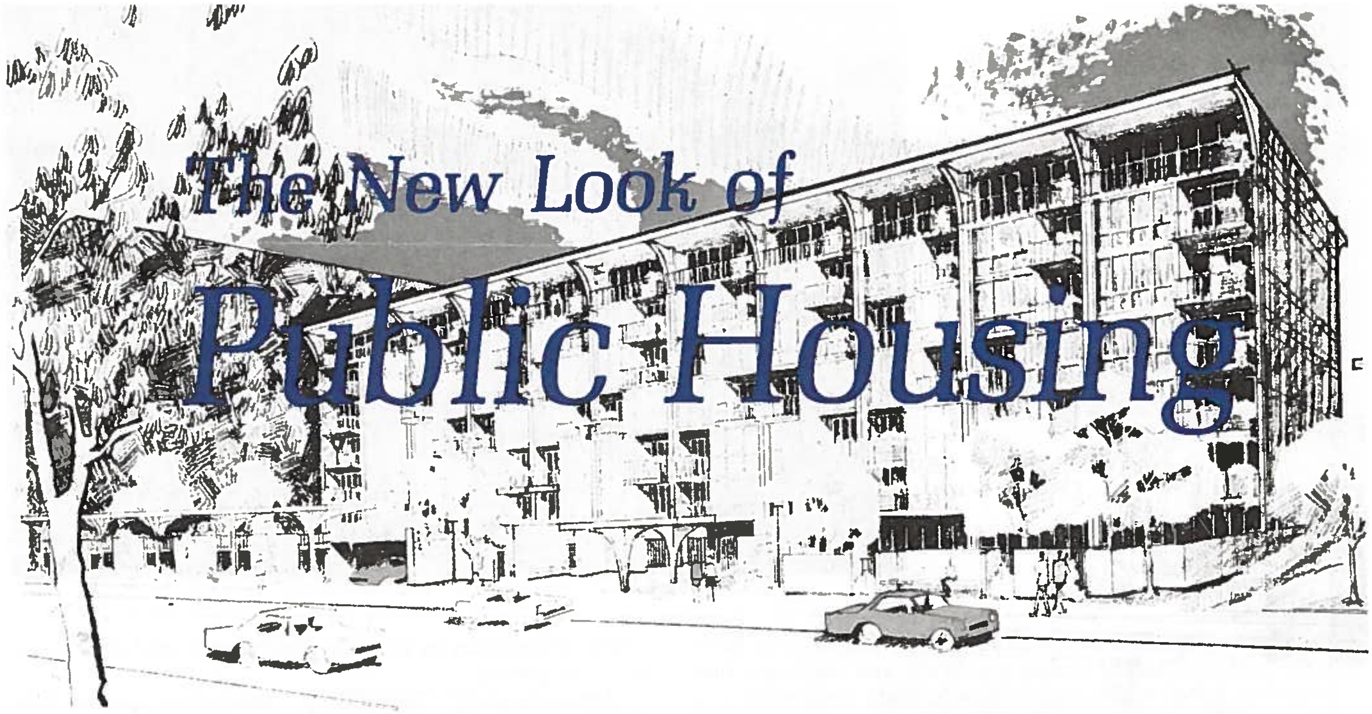
The cores of the lightweight block in the reinforced load-bearing walls are filled with 3000 psi concrete. At the base of the tower all block cores were filled while in the upper floors filling of cores was limited to that required for satisfying lesser demand for bearing wall capacity.

Interior walls in the Heritage Place apartment tower are of 8″ lightweight concrete masonry units. The exterior load-bearing walls use 8″ split-rib block and the non-load bearing walls use 6″ scored lightweight units. In all, approximately 164,000 lightweight block were used in the project. All exterior units were integrally colored so that no exterior finish was required.

Additional benefits were realized from the excellent fire and acoustical ratings of the lightweight masonry units, as well as its high rating for thermal insulation. These factors helped reduce the number of construction operations and thus contributed to the overall speed and ease of construction.

Owner—CJO Developments Ltd., Calgary
Architect and Engineer—Ron Lazar, Winnipeg
General Contractor—C. J. Oliver Ltd., Calgary
Masonry Contractor—Morstead & Son Ltd., Calgary
Herculite expanded shale masonry units supplied by Consolidated Concrete Limited, Calgary

The New Look of Public Housing



NEW EMPHASIS ON ESTHETICS, DISPERSION AND TOTAL ECONOMICS UNDERLINES PRACTICALITY OF ENGINEERED MASONRY BUILDINGS ON WEST COAST

"WE are aiming at much more 'humanized' projects."

This 1969 statement by Evert H. Heynneman, principal planner for the Housing Authority of the City and County of San Francisco, exemplifies the "new look" which has attached itself to public housing in recent years—and which has created an important new role for load-bearing lightweight masonry construction. Beset by the twin pressures of soaring costs on the one hand, and mounting demands for improved esthetics on the other, planners have also had to come to grips with what may be the most urgent problem of all: rapid completion and occupancy.

Two public housing projects in the Bay Area demonstrating the contributions of engineered lightweight masonry construction to this approach are the seven-story, 108-unit senior citizens' structure on Bush Street in San Francisco, and the $8 million MORH low-rent housing project in West Oakland.

The senior citizens' project is an example of the trend toward building more and smaller low-rent buildings in widely scattered areas. The seven-story structure is of load-bearing lightweight block wall construction, with precast prestressed structural lightweight concrete hollow core floor slabs.

High praise for the construction method comes from architect John Sardis. "The process is so simple," he says, "that workers understand it immediately. Construction starts with block walls from the foundation to the first floor ceiling. The precast flooring is then lifted into place to span between the bearing walls. All the interior walls—the room dividers—are also bearing walls. Once the first floor is covered, the other trades can come in and work without interruption in a clean, dry place while the same process is being repeated overhead."

This tandem scheduling of trades, plus the elimination of shoring and minimum use of scaffolding, means rapid completion of construction as well as getting maximum productivity from workers. A 13-story building can be completed and occupied in six months or less. This is about half the time ordinarily required for a comparable framed building: a time savings which is particularly significant in helping to solve the problem of making public housing available quickly. In the senior citizens' project, the load-bearing lightweight masonry units also provide a high level of fire resistance and—of particular importance—meet the problem of isolating noise at the source. The use of lightweight block for all interior bearing walls and partitions also provides excellent opportunities to explore esthetics via color and texture.

Precast prestressed structural lightweight floor planks ready for hoisting into position at MORH low-rent housing project in Oakland. Architect says moderate cost of project could only be achieved through masonry construction.

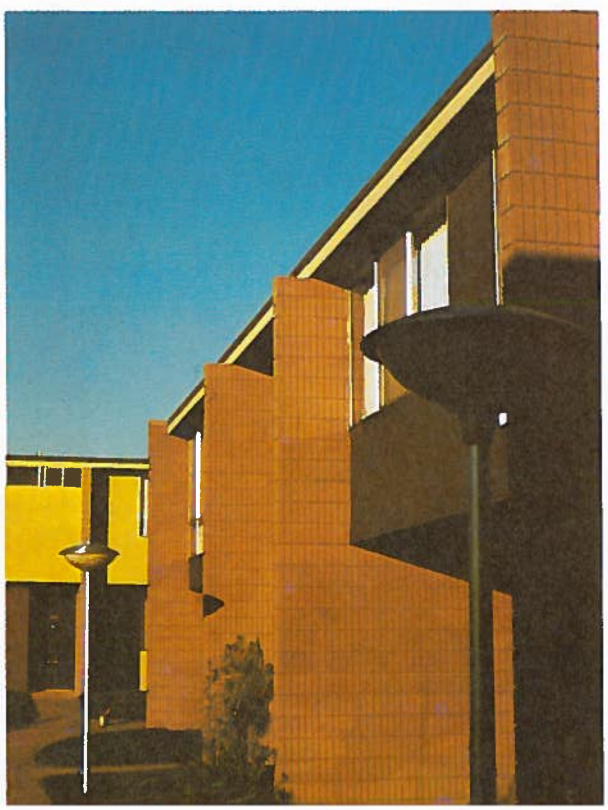
Bush Street senior citizen structure in San Francisco is first high-rise masonry structure in city in 65 years. Building uses structural lightweight concrete blocks and precast floor planks.

The new method of construction is considered to have excellent earthquake resistance. Walls and floors are tied together horizontally and vertically, thus movement . . . sway, drift, vibration and deflection . . . are kept to a minimum. The high strength lightweight masonry units specified for the senior citizens' project have a compressive strength of 3000 psi.

The MORH (More Oakland Residential Housing) project in West Oakland occupies a 10½ acre site and comprises 126 townhouse units and three 12-story high-rise apartment structures. The familiar problem of satisfying esthetic requirements within a tight budget led to the decision to specify load-bearing lightweight concrete masonry walls in combination with precast prestressed structural lightweight concrete hollow core floor and roof slabs. The method resulted in total design and construction costs of $13.50/sq. ft. for the townhouses and $18.25/sq. ft. for the high-rise buildings. The townhouses are four-unit, two-story structures and range in size from efficiency apartments to four-bedroom dwellings. The park-like setting contains "tot lots," open space areas, and parking lots. Architectural differences are achieved in the standard-plan buildings through subtle differences in window placements, and the use of color treatment.

Approximately 750,000 8" equivalent lightweight masonry units were used in the MORH project. These were designed for a net area compressive strength of 4000 psi. The structural lightweight concrete floor system has a compressive strength in excess of 5000 psi. The three high-rise buildings contain about 100 one-bedroom apartments and about 140 two-bedroom units. All walls and partitions are lightweight concrete masonry. Vertically scored units were used on the exterior: another "plus" feature enhancing esthetics which these versatile building blocks offer.

Of particular significance, Housing and Urban Development Secretary George W. Romney has described MORH as the kind of business-community-government partnership urgently needed in solving urban housing problems. The combination of new technology and citizen participation has certainly done much to dispell the traditional image of public housing. Both the senior citizens' and the MORH projects demonstrate what imagination plus new methods can accomplish in a most critical area.



BUSH ST. SENIOR CITIZENS' PROJECT

Owner—San Francisco Housing Authority
Architects and Engineers—John Sardis & Associates, San Francsico
General Contractor—Smith & Haley Construction, Inc., Emeryville, Calif.
Precast prestressed floor planks—Spancrete of California, Irwindale, Calif.
Ki-Lite expanded shale aggregate supplied by Kaiser Sand & Gravel Co., Oakland, California

MORH HOUSING PROJECT

Owner—MORH (More Oakland Residential Housing)
Architects and Planners—Kennard and Silvers, AIA, San Francisco
General Contractor—Trans-Bay Construction Co.
Structural Engineers—Lin, Kukla and Yang
Precast prestressed floor planks—Spancrete of California, Irwindale, Calif.
Block Supplier—Best's Blocks, Union City, Calif.
Ki-Lite expanded shale aggregate supplied by Kaiser Sand & Gravel Co., Oakland, California

MORH low-rent housing project in Oakland had total design and construction costs of approximately $13.50/sq. ft. for low rise units and $18.25/sq. ft. for high rises.

Engineered Masonry With High Strength Lightweight Concrete Masonry Units

by Thomas A. Holm, P.E.
Director of Engineering
Solite Corporation

INTRODUCTION: The widespread usage of engineered masonry has prompted a re-examination of the concrete masonry unit. No longer a mere infill or space separation, concrete block is now an accredited structural material that requires the close engineering scrutiny and sophisticated production controls usually associated with cast-in-place concrete. Engineers and architects designing these practical, economical load bearing projects must therefore have some understanding of the fundamental physical properties of this building element. Block plants producing these higher strength units must also determine the methods of reliably manufacturing concrete masonry units to exacting specifications.

This article is basically addressed to an examination of:

(A) Practical methods necessary to manufacture high strength lightweight concrete masonry units.

(B) Physical properties of high strength lightweight concrete masonry units.

(C) Considerations of testing units and prisms in meeting engineering specifications.

Techniques of structural design are not treated as the reader may refer to specific publications.[1,2] Design manuals[3,4] and tables[5,6] have been recently prepared which eliminate a considerable amount of the routine calculations and wall selections, thus making engineered masonry design even more attractive.

Thomas A. Holm, *Director of Engineering of Solite Corporation, has a Masters Degree in Civil Engineering and is a Registered Professional Engineer in several Eastern states. A member of various national technical committees, Mr. Holm has contributed technical articles to the journals of the American Concrete Institute, American Society of Civil Engineers, and the National Concrete Masonry Association.*

Production of High Strength Lightweight Concrete Masonry Units

The investigation into the manufacturing variables was conducted by actual production of high strength concrete masonry in many block plants throughout the eastern seacoast over a period of the last five years. Our procedure is to request permission from the customers to send in a team of engineers and field service representatives to produce several batches of high strength and conventional block and then conduct strength and laboratory physical testing on blocks produced from these runs. To this date high strength block have been successfully produced in Maine, Massachusetts, New York, New Jersey, Virginia, North Carolina, South Carolina and Florida. From these tests we have compiled the data and are in a position to evaluate and report the factors affecting costs, strengths, production factors and the physical properties of the manufactured concrete.

In the test runs our plan was to produce Batch No. 1 in precisely the manner the block plant manufactures the conventional ASTM C 90 lightweight masonry unit. With this unit as a standard the cement content was increased and as a separate variable the feed and finish times were increased as well. Quoting mix designs and feed and finish times in an industry as broad as ours and where so many factors influence the final product is dangerous and I will avoid specifics. In general we have learned the following facts:

1) Considering all the many runs, the evidence points to a strength level of 3500 psi net as a readily available standard for high strength masonry units. The NCMA committee that produced the report on special considerations for manufacturing high strength concrete masonry units[7] substantiated this criteria and also added an ultra high strength level. It is our experience that testing and production factors develop limitations on the ultra high strength level which unnecessarily complicate the issue for most ordinary projects.
2) The specified strength can be exceeded in some plants by merely varying the mix design but in most cases requires simultaneously increasing the feed and finish time to obtain greater compaction. The interrelationship of feed and finish is not generally understood and close rapport with plant personnel in accounting for this behavior is mandatory. Adequate compaction should be the fundamental objective of the block manufacturer. See Fig. 1 for an example of the strength increase due to increased compaction. Actual production of economical high strength units will determine minimum feed and finish time and will also require running the units as wet as possible short of smearing the texture. In this instance the cheapest ingredient is water.
3) The cost of producing the unit must reflect the greater material costs as well as the slower production rate and the extra marketing servicing and testing costs.
4) High cement requirements will require exacting gradation control in order to minimize rich sticky mixes that are difficult to feed.
5) As in high strength readymix concrete, selection of high performance cements with reasonable air contents is essential for the production of high strength block concrete.
6) Normal curing practices are adequate at this time but should be investigated at each plant in order to optimize the hydration of these rich and well compacted mixes. An increase in preset time for all types of curing on the order of two hours over conventional timing practices is highly desirable.

Physical Properties of High Strength Lightweight Concrete Masonry Units

The high cement contents and increased compactive efforts have produced lightweight concrete masonry units with physical properties substantially different from the conventional C 90 units we have traditionally produced and tested. In some instances these changes require a re-thinking of our usual practices in specification writing, joint reinforcing and architectural detailing. A synopsis of the physical properties is listed below:

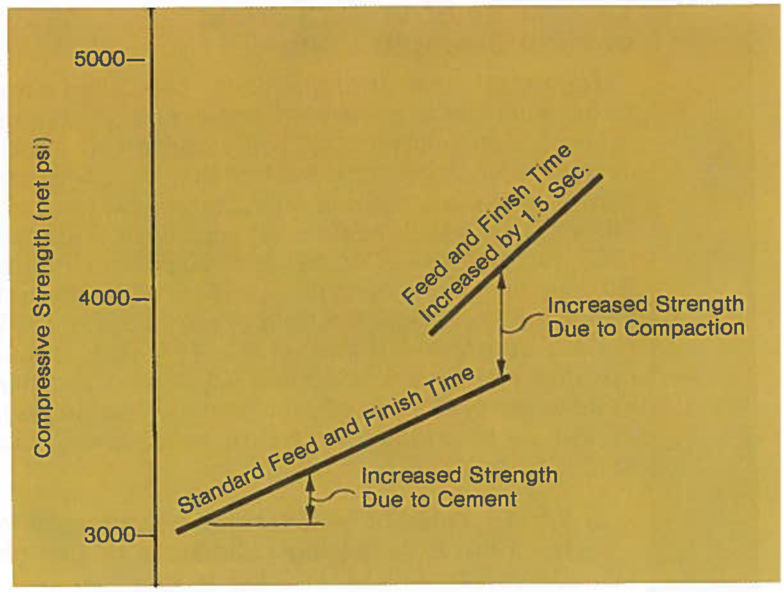
STRENGTH LEVEL The dual requirements of high strength (plus 3500 psi net) combined with the size of the concrete masonry unit mandate the use of an aggregate with the highest strength to weight ratio. Non-structural lightweight aggregates simply will not do! All block producers should make preparation for the advent of supplying high strength engineered masonry projects well in advance of their actual need in order to adequately research the various possibilities of producing a high quality unit. A relationship of strength vs. cement content per cubic foot of concrete is shown in Fig. 1, but caution must be used in an industry where each plant is absolutely unique in regard to the combinations gf aggregate, cement, machine type and cycle and curing condition. Notice the sharp dislocation due to increasing the feed and finish time by 1.5 seconds.

STRENGTH VS. TIME For high strength units, the increase in strength with time is greater than that of traditional units. This is due to the continued hydration developed by the reluctance of highly compacted units to release unchemically combined water. The rich cement contents continue to develop strengths beyond the usual plateau associated with regular C 90 units.

UNIT WEIGHT The extra compactive effort and rich mixes will produce an increase in unit weight averaging 7.4%, the compactability depending on aggregate gradation characteristics, particle shape and block machine cycle and compactive efficiency. The weight of a standard 8x8x16 2-cell hollow unit will typically increase from 1.0 to 3.5 pounds. Specifications and labor restrictions governed by concrete density must reflect these changes.

ABSORPTION The decrease in absorption (See Fig. 2 for this relationship) generally parallels the increase in density with an average decrease of 24%.

SHRINKAGE Linear drying shrinkage of high strength units relative to traditional C 90 units generally increased from 0.005 to 0.010% for various types of curing, the increase of shrinkage being due to the increased paste content of the high strength mixes. In manufacturing high strength units with only slightly increased shrinkage, the producer should clearly emphasize the compaction contribution, thus choosing a slower production cycle with rather moderate increase of binder. The vast majority of engineered masonry buildings along the eastern seacoast are of the "crosswall" type, in which the short dimension of the building is generally composed of two 20 to 30 foot walls interrupted by a center corridor and thus this increase in shrinkage has proven to be of no significance. "Longitudinal wall" type projects, where the bearing walls run the long length of the building, may necessitate close scrutiny in regard to location of control joints.



$$\text{Cement Content} = \frac{\text{Pounds of Cement}}{\text{Cu. Ft. of Molded Concrete (absolute volume)}}$$

Fig. 1—Compressive Strength vs. Cement Content

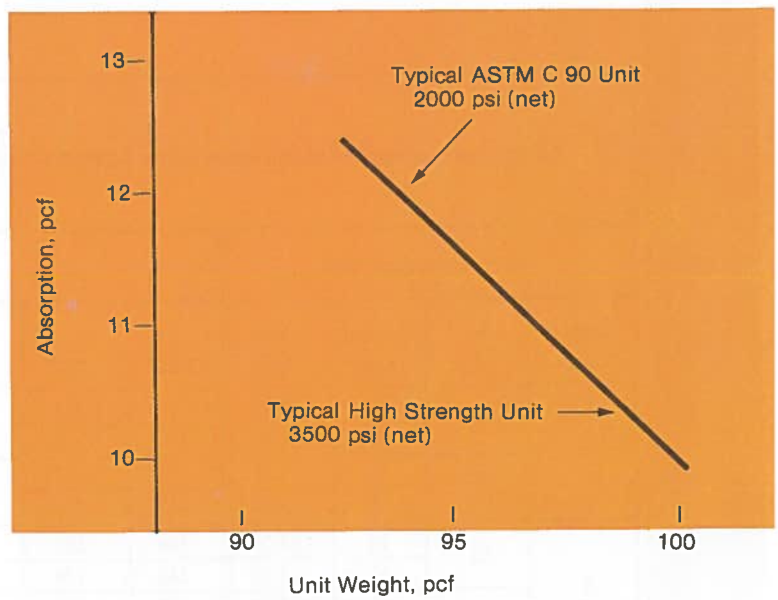


Fig. 2—Absorption vs. Unit Weight of Concrete

Laboratory Strength Testing of High Strength Units

Testing of high strength units, particularly the large solid units, presented some new problems that were eliminated after some concerted effort. The problem stems from the fact that the compression testing equipment of most commercial testing laboratories has a maximum capacity of 300 kips (300,000 pounds—a kip being 1000 pounds). Thus for example in meeting a specified 3500 psi net strength, an average strength of say 3800 to 4000 psi will be produced and an 8"—75% solid could develop 7.62 x 15.62 x 4000 x .75=357^k. In order to adequately document a project in New Jersey, as well as to prepare for future field testing, the following program was conducted:

a) Whole units (12"—75% solid) were tested in the Fritz Engineering Laboratory of Lehigh University with an 800 kip machine.

b) Three units were sawed in half by making several passes with a testing lab saw—3 half units were tested.

c) Prisms of 2 unit high 12"—75% solids were tested. See Fig. 3.

d) At an independent testing laboratory the 12" units were core drilled by a concrete coring machine and the cores carefully centered and tested in compression.

The results of the test may be generalized as shown in Fig. 4.

From the completed testing program the following deductions and observations may be made:

a) For projects involving large size high strength units, saw cutting into half units will provide conservative results that may be tested in ordinary (300^k) testing machines. A listing of machine capacity requirements for various sizes and strengths is shown in Table 1.

b) From an academic concrete technology standpoint the cores relate to the units (approximately 87%) in a manner comparable to our experience in field tests on cast-in-place concrete.

c) The mode of failure in units, cores and prisms is of a shear type and seems to be independent of mold configuration but affected by height to width ratio (within certain limits). See Fig. 5. An earlier anxiety about

Table 1
MACHINE CAPACITY REQUIREMENTS FOR TESTING HIGH STRENGTH CONCRETE MASONRY UNITS (KIPS)

Concrete Masonry Unit				Net Concrete Compressive Strength, f'c (psi)								
Nominal Size	% Solid	Nominal Length	Net Area	2000	2500	3000	3500	4000	4500	5000	5500	6000
6	55	16	48.34	97	121	145	169	193	218	242	266	290
		18	54.53	109	136	164	191	218	245	273	300	327
	75	16	65.92	132	165	198	231	264	297	330	363	396
		18	74.36	149	186	223	260	297	335	372	409	446
8	53	16	63.14	126	158	189	221	253	284	316	347	379
		18	71.23	142	178	214	249	285	321	356	392	427
	75	16	89.36	179	223	268	313	357	402	447	491	536
		18	100.79	202	252	302	353	403	454	504	554	605
10	53	16	79.71	159	199	239	279	319	359	399	438	478
		18	89.91	180	225	270	315	360	405	450	495	539
	75	16	112.79	226	282	338	395	451	508	564	620	677
		18	127.23	254	318	382	445	509	573	636	700	763
12	49	16	89.00	178	223	267	312	356	401	445	490	534
		18	100.40	201	251	301	351	402	452	502	552	602
	75	16	136.23	272	341	409	477	545	613	681	749	817
		18	153.67	307	384	461	538	615	692	768	845	922

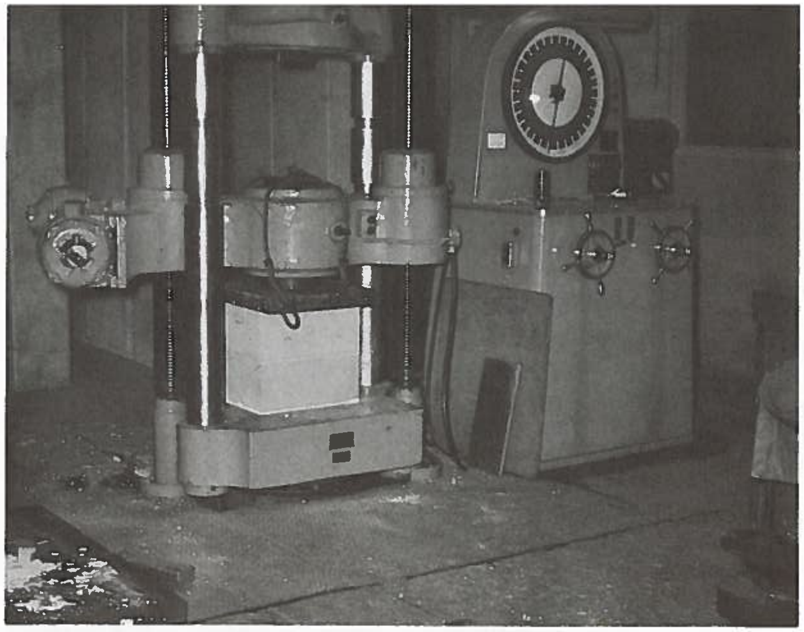
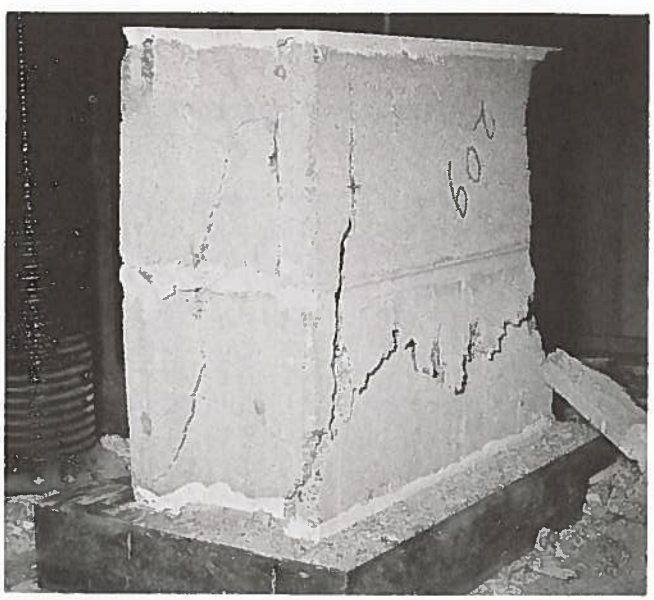


Fig. 3—Test setup for 2-high prisms.

UNIT TESTED	Whole Units	Half Units	Drilled Cores	Two-high Prisms
TEST SPECIMEN				
PERCENTAGE OF SINGLE WHOLE UNIT STRENGTH	100 (Standard)	97	87	71

Fig. 4—Relationship of compressive strength to type of test specimen

Fig. 5—Typical test specimen failure mode



the ability of webs to transfer shear in eccentrically loaded tests was found to be unwarranted. Accurate centering of the units in the testing machine is absolutely essential to avoid bi-axial bending which causes premature failure in one heavily stressed corner or side.

We must not presume that engineers and architects are conversant with all the available block sizes, shapes and strengths. To prevent the possibility of a multitude of combinations of net compressive strengths and sizes, we publish technical literature based upon 3500 psi net concrete strengths and list the wall capacities based upon commercially available block (using the minimum % solid available for a given block shape). Thus engineers are spared the odious task of having to delve into the shape, equivalent thickness, % solid, face shell thickness labyrinth and the producers will benefit by inventorying only one class of high strength block. For an example of product literature which has proven helpful in these respects see Appendix A.

Meeting Strength Specifications of Engineered Masonry Projects

Most codes and reports (e.g. NCMA TR 75A, ACI 531, ANSI 41.2, NYC, BOCA, etc.) allow two different methods for determination of the wall strength. In one method, the wall compressive strength (f'm) is directly related to the concrete block units' compressive strength by an empirically developed code table. This requirement is then met in a direct, straightforward way by the block producer supplying units exceeding the necessary compressive strength (say f'c=3500 psi).

In the other method the engineer may choose to specify only the wall strength (f'm). This approach shifts the ultimate responsibility to the contractor who then must conduct prism tests to develop satisfactory information that combines the variables of unit strength, mortar characteristics and workmanship. Clearly, the introduction of the mortar and mason workmanship factors are beyond the control of the block producer and recognizing this fact he must understand the limits of his responsibility and willingly cooperate with the contractor in achieving the desired prism performance. As an indication of these relationships, as well as that of 7 to 28-day strengths, values developed in a recent investigation are shown in Table 2.

Table 2. High Strength Unit Test Values (psi)

	f'_c (Net Compressive Strength)		f'_m (Net Prism Strength)	
Age, days	ONE-HIGH UNITS		TWO-HIGH PRISMS	
	WHOLE	HALF	WHOLE	HALF
7	4600—	4380	3250	
28		5080	3460	3650

Savoy Plaza—Cliffside Park, N.J.
Architect—J. Virgona
Structural Engineer—M. Catani
Concrete Masonry—Reuther Materials
Solite Expanded Slate Aggregate furnished by Hudson Valley Lightweight Aggregate Corp.

Performance of Engineered Masonry

The market acceptance of engineered masonry projects has been spectacular. Architects and builders who have inspected completed projects have been so impressed that many buildings of a similar format are now on the drawing boards. Of particular importance to most prospective owners is how superbly this type of structure meets the Sound Transmission Class requirements posed by the new administrative building codes. Rigid requirements of a minimum Sound Transmission Class of 45 absolutely mandate substantial separation and inevitably the question is raised—"If you must provide adequate space separation for sound, privacy and fire requirements—why not use the wall for structure as well?" Engineered masonry has thoroughly answered this question and has provided the occupants with the tranquility they deserve.

The economies of load bearing masonry are fundamentally determined by the architect's willingness to lay out the project's wall systems in a systematic, repetitious fashion. Usual layouts for motels, housing for the elderly, dormitories and apartments are easily accommodated. With a precast plank floor system placed on the walls, the system approaches the ultimate in simplicity in that one merely builds a one story structure several times—an appealing concept to the mason contractor and material suppliers. This approach lends itself to extremely rapid construction with all the mechanical and finishing trades following closely behind the wall construction and always working in a waterproof enclosure. In a period of high interest rates on construction money this rapid occupancy is of vital importance to owners and in some cases is becoming the most desirable feature of engineered masonry.

Cost comparisons of engineered masonry with other structural systems on appropriate projects have consistently demonstrated far lower structural costs, generally on the order of 50 cents per square foot. Incidentally, it is of basic importance to consider the following often overlooked fact: the engineer's cost comparison on a per square foot basis must include the addition of partitions to other system frame costs. In the engineered masonry project they are already included!

High strength Lightweight Concrete Masonry for use in engineered masonry is available everywhere to be installed with local masons and will provide:

- Economy
- Rapid construction
- Sound protection
- Thermal protection
- Fire protection
- Enduring beauty

Masonry has performed magnificently throughout history, and now stands upon a new and vigorous rebirth through the combined efforts of architects, engineers, block manufacturers, material suppliers and mason contractors.

REFERENCES

1. Concrete Masonry Structures—Design and Construction—Reported by ACI Committee 531—American Concrete Institute, P.O. Box 4754, Redford Staticn, Detroit, Michigan 48219.
2. Specification for the Design and Construction of Load-Bearing Concrete Masonry—National Concrete Masonry Association, Box 9185, Rosslyn Station, Arlington, Virginia 22203.
3. Design Manual—The Application of Non-Reinforced Concrete Masonry Load Bearing Walls in Multi-Storied Structures—NCMA
4. Design Manual—The Application of Reinforced Concrete Masonry Load Bearing Walls in Multi-Storied Structures—NCMA
5. Non-Reinforced Concrete Masonry Design Tables—H. Toennies, Director of Engineering, NCMA
6. Reinforced Concrete Masonry Design Tables—H. Toennies, Director of Engineering, NCMA
7. Special Considerations for Manufacturing High Strength Concrete Masonry Units—NCMA

The Dunes Motel—Virginia Beach, Va.
Architect—Yates, Boggs, Berkerly and Service
Structural Engineer—Craig and Abiouness
Concrete Masonry—Solite Masonry Units, Chesapeake, Va.
Solite Expanded Slate Aggregate furnished by Solite Corp.

APPENDIX A—Example of Product Literature

BUILT-IN ADVANTAGES OF ENGINEERED MASONRY

Simple—The construction of a multi-story masonry building consists of a series of single story buildings placed one on top of the other. Since few trades are involved scheduling of manpower and materials is easily accomplished.

Economical—Combined with precast lightweight concrete floor planks which are readily available and easily placed, engineered masonry units of high strength provide in a single installation structural capacity, space enclosure, fire walls, conduit space and an effective sound barrier.

Fast—With shoring and scaffolding virtually eliminated progress is very rapid after foundations are finished. When masons complete the floor, mechanical, electrical and finishing trades can go to work immediately inside an enclosed space. The speed of construction results in earlier occupancy and faster return on investment to the owner.

Fire Resistant—Positive separation of spaces provided by inert noncombustible partitions meet fire code requirements for 2, 3, and 4 hour ratings with commercially available units.

Quiet—The substantial walls provided by the structure eliminate the number one complaint of other types of construction—NOISE. High resistance to sound transmission developed by lightweight masonry units provide the occupant with maximum privacy.

STRUCTURAL CAPACITY OF WALLS MADE OF TYPICAL UNITS
FOR PRELIMINARY ESTIMATES—FOR FINAL DESIGN USE LOCALLY AVAILABLE UNITS

UNIT SPECIFICATION		MINIMUM ULTIMATE NET CONCRETE STRENGTH (psi)	MINIMUM ULTIMATE GROSS UNIT STRENGTH (psi)	NOMIN. SIZE	MIN. % SOLID	WALL WEIGHT (psf)	NET WALL AREA in²/ft (1)	MASONRY STRENGTH f'm (psi) (2)	ALLOWABLE COMPRESS. STRESS .2f'm (psi) (3)	ALLOWABLE WALL CAPACITY .2f'm An (kips/ft) (3)	ALLOWABLE WALL CAPACITY 8'0" High (kips/ft) (4)	ALLOWABLE WALL CAPACITY h/t=20 (kips/ft) (4)	ALLOWABLE FLEXURAL STRESS .3 f'm (psi) (3)
HOLLOW	ASTM C-90	2000	1000	6	55.0	30	37.1	1350	270	10.0	9.2	8.8	405
		2000	1000	8	53.0	38	48.5	1350	270	13.1	12.7	11.5	405
		2000	1000	10	52.7	48	60.8	1350	270	16.4	16.2	14.4	405
		2000	1000	12	48.7	54	67.9	1350	270	18.3	18.1	16.0	405
SOLID	ASTM C-145	2400	1800	6	75	40	67.4	1270	254	17.1	15.8	15.0	381
		2400	1800	8	75	54	91.4	1270	254	23.2	22.5	20.3	381
		2400	1800	10	75	69	115.4	1270	254	29.3	28.8	25.6	381
		2400	1800	12	75	75	139.4	1270	254	35.4	35.1	31.0	381
HOLLOW	HIGH STRENGTH	3500	1995	6	55.0	32	37.1	1850	370	13.7	12.6	12.0	555
		3500	1855	8	53.0	40	48.5	1850	370	17.9	17.3	15.7	555
		3500	1845	10	52.7	50	60.8	1850	370	22.5	22.2	19.7	555
		3500	1705	12	48.7	57	67.9	1850	370	25.1	24.9	22.0	555
SOLID	HIGH STRENGTH	3500	2625	6	75	42	67.4	1589	318	21.4	19.9	18.7	477
		3500	2625	8	75	57	91.4	1589	318	29.1	28.2	25.5	477
		3500	2625	10	75	73	115.4	1589	318	36.7	36.1	32.1	477
		3500	2625	12	75	79	139.4	1589	318	44.3	44.0	38.8	477

1. Typical commercial masonry unit, A_n (Hollow)=% Solid x 12 x Actual Thickness
   A_n (Solid)=1.00 x 12 x Actual Thickness
2. f'm (by method no. 2.) Enter NCMA "Specification for the design and construction of Load Bearing Concrete Masonry" Table 3-1—Enter table with Net Strength for Hollow Units*
   Enter table with Gross Strength for Solid Units*
3. Based on engineering inspection (see Para. 3.7 NCMA). Without inspection reduce allowable stresses and wall capacities by 50%.
4. Slenderness correction (see Para. 3.8 NCMA) $\left[1-\left(\frac{h}{40t}\right)^3\right]$

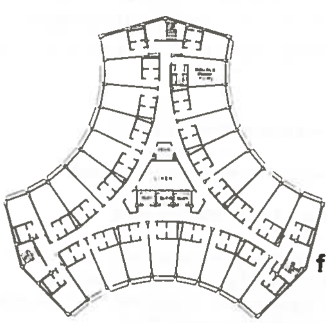
**Type M or S Mortar, Full Bedding*

TRAVELODGE "TRI-ARC" DESIGN CAPITALIZES ON ECONOMY AND VERSATILITY OF LOAD-BEARING LIGHTWEIGHT MASONRY UNITS

Houston, Texas, TraveLodge, showing one arc of "Tri-Arc" design. Development of design proved key to rapid expansion, permits standardization throughout chain and can be easily modified without impairing architectural integrity. Houston structure used 100,000 expanded shale lightweight concrete masonry units for load-bearing walls.

A NEW design concept has triggered a major expansion program in the large motor hotel field. Significantly, this new concept provides important cost savings in construction but, equally important, provides a basic design which can be used in almost any kind of site orientation and thus holds design and construction costs to a minimum.

Called "Tri-Arc," the design concept derives its name in part from the floor plan created when three equally placed wings radiate outward from a central core. It was developed by TraveLodge International for building new facilities worldwide, and makes extensive and innovative use of load bearing lightweight concrete masonry walls. Because it lends itself well to fast, economical construction with good insulation, fireproofing and acoustical damping qualities, lightweight block is becoming almost a standard for walls in buildings with repetitive floor plans. The Tri-Arc design, however, represents its first use in a curved configuration, in this case the concave sides of each wing.



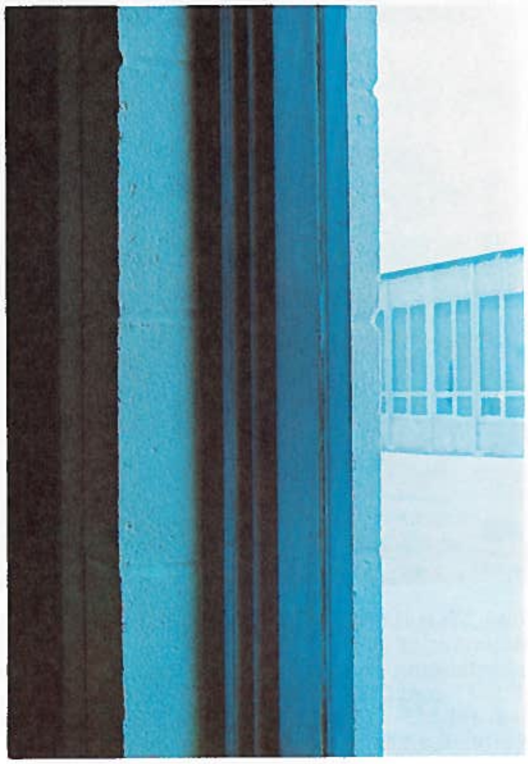
Tri-Arc design developed by TraveLodge International is construction standard for chain, offers numerous advantages over conventional rectangular shapes. Design was selected from among 14 designs on basis of feasibility, cost, compliance with building codes, adaptability and esthetics.

According to TraveLodge chief executive officer Roger Manfred, the Tri-Arc design was selected from among 14 designs which were thoroughly investigated as to "feasibility, cost, adhering to a variety of building codes, adaptability, esthetic qualities and other vital statistics." Standardization will permit numerous economies in planning, and yet modifications are relatively simple: by adding or deleting rooms at the end of the wings the overall size of the building can be adjusted to the site without impairing the architectural integrity or symmetry of the structure. Because of its shape, the Tri-Arc building can be oriented in an infinite number of positions on a site with none of the problems encountered in dealing with rectangular buildings.

A typical construction program will see Tri-Arc construction progressing in a "corkscrew" fashion: as precast concrete floor slabs are being positioned on one of the three arcs, masons are completing load bearing walls on a second, while other trades are following the masons and working on the third. In one such application, a story was completed every six working days.

The Houston TraveLodge shown in the accompanying photograph exemplifies the Tri-Arc design and reflects the economy and versatility of load bearing lightweight masonry construction. In all, some 100,000 expanded shale aggregate lightweight masonry units were used in this striking nine-story structure.

Owner—The TraveLodge Corp., El Cajon, California
General Contractor—The Austin Co., Roselle, N.J.
Masonry Contractor—United Masonry, Inc., Pasadena, Tex.
Block Producer—Texas Industries, Inc., Houston Div., and Hydro Conduit Corp., Houston
Expanded shale lightweight aggregate supplied by Texas Industries, Inc., Arlington, Texas.



Unusual photograph shows uniwall construction of the single load-bearing lightweight block, core filled, at St. Benedict School in Galt, Ont.

Q
Why was engineered lightweight masonry specified instead of the previous method?

A
A large percentage of perimeter walls... economy . . . and an almost impossible completion date.

SCHOOL CONSTRUCTION COSTS \$15.74/SQ. FT.—OWNER, ARCHITECT AND CONTRACTOR CITE SUITABILITY, ECONOMY OF LOAD-BEARING LIGHTWEIGHT MASONRY CONSTRUCTION.

ST. BENEDICT Junior High School in Galt, Ontario, demonstrates the suitability of load-bearing lightweight masonry construction to a condition that is becoming increasingly prevalent in the construction industry: the need for "instant" housing and institutional structures, coupled with pressures for improved esthetics at lower total cost. The school has a total area of 55,357 sq. ft., and virtually all the walls—interior and exterior—are expanded shale aggregate lightweight block.

While the high sound absorbency and fire resistance rating of the lightweight block were naturally important considerations in institutional construction of this type, the major factors in the decision to specify structural lightweight block in this instance arose from building design, the completion deadline and budgetary considerations.

Says architect George W. Beechey of Lingwood/Robertson, Architects/Engineers: "The design requirements of this project required a large percentage of perimeter walls. This factor, plus necessary economy and an almost impossible completion date were the deciding factors . . ." Mr. Beechey adds that construction costs came to \$15.74/sq. ft., including mechanical and electrical costs, and that "maintenance costs are slightly below normal."

Further endorsement comes from Mr. D. C. Howald, Controller of Building and Maintenance for the Waterloo County Separate School Board, who cites the "very good thermal quality" of the block and the ease of painting over. "I have no hesitation in recommending to anyone interested in using these products," he says. In similar vein, Mr. N. W. Wiles of Oscar Wiles and Sons Ltd., general contractors, says: "You may quote me as stating very emphatically that this lightweight block is by far one of the most versatile and beautiful building products in our country."

In all, some 110,000 lightweight masonry units were used in St. Benedict Junior High, with the single block as interior and exterior. The core of the blocks in the exterior walls only was filled with Zonolite to increase insulation values. Exterior walls featuring architectural decorative blocks were sprayed with a plastic paint and interior walls with ordinary paint. Single wythe construction was used throughout. In addition to the testimonials of those associated with this project, the school itself stands as a testimony to the ability of engineered lightweight masonry construction to meet contemporary needs for esthetics in company with efficiency and economy.

Owner—Waterloo County Separate School Board, Kitchener, Ont.
Architects-Engineers—Lingwood/Robertson, Architects/Engineers, Kitchener
Consulting Engineers—Walter, Fedy, McCargar & Hachborn, Kitchener
General Contractors—Oscar Wiles and Sons Ltd., Kitchener
Block Producer—Hogg Fuel & Supply Ltd., Waterloo
Haydite expanded shale aggregate supplied by Domtar Construction Materials Ltd., Mississauga, Ont.

DODECAHEDRON CONDOMINIUMS

Engineered Lightweight Masonry Units Speed Construction, Show Important Economies In Innovative Illinois Building

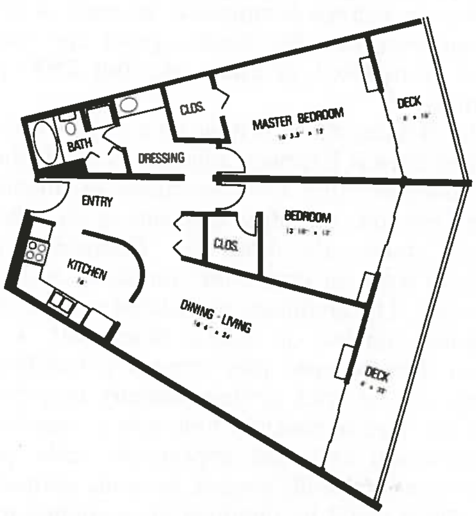
THE Holiday Terrace Condominiums in Lansing, Ill., embody an innovative architectural design and capitalize on the numerous economies and construction advantages of lightweight masonry units.

The 12-sided structure employs a basic module 32 ft. wide at the front, corresponding to a single face of the dodecahedron. A one-bedroom apartment occupies a single module, a standard two-bedroom apartment uses a full module plus 16 ft. of an adjoining one, and a deluxe two-bedroom apartment takes two complete modules. Because of the repetitive floor-to-floor design, the structure is ideally suited to engineered lightweight masonry construction.

The building contains four floors of apartments above ground level parking. The lightweight masonry units were used for both load bearing party walls between apartments—where its excellent acoustical properties were an important consideration—as well as for interior partitions in the individual units. The structural engineer specified two net area compressive strengths for the lightweight block: 4500 psi for the lower two floors, and 3000 psi for the top two floors. Specifications called for 8″ block, 76 percent solid.

The 4500 psi block averaged 38 lbs. each, while the 3000 psi block ran about 1½ lbs. lighter. Approximately 28,000 block were used in the structure, with a weight saving of at least 30 percent over comparable heavy-weight block.

Lightweight concrete masonry construction was selected because it offered several advantages: substantial cost saving, ease and speed of construction by a local masonry contractor, and excellent soundproofing. Holiday Terrace is an outstanding example of how expanded shale aggregate permits the use of high-strength lightweight block in engineered masonry construction in a variety of contemporary designs.



Floor plan for standard two-bedroom apartment.

Owner and General Contractor—Illiana Enterprises, Inc., Lansing, Illinois.
Architect—Charles Vincent George & Associates, Naperville, Illinois
Structural Engineer—Fred Marshall & Son, Park Ridge, Illinois
Masonry Contractor—DeVries Masonry, Lansing, Illinois
Materialite expanded shale aggregate supplied by Material Service Corporation, Chicago, Illinois

OPEN FLOOR AREA

Engineered Lightweight Masonry Provides Maximum Flexibility—Minimum Cost In Coast Office Building

THE Holiday Plaza office building in San Rafael, California is a striking demonstration of the fact that load-bearing lightweight masonry construction is *not* restricted to buildings with top-to-bottom repetitive interior partitioning such as a hotel or motel. In fact, the building concept called for office spaces of a great many shapes and sizes with maximum outside light—which required an open floor plan uninterrupted by walls, but one which could be easily divided into small office units when needed.

The solution to this requirement was a combination of shear walls—the outside walls plus those adjacent to the service core of the building—and columns set in the center of the floor spaced 6′ apart. This latter arrangement made it possible, when desired, to run a central corridor the length of a building wing to create smaller offices with minimum dimensions of 13′6″ x 24′. At the same time, large open floor plans are possible on all floors: 56′0″ x 86′6″ in the West wing, 56′0″ x 100′0″ in the East wing.

The consulting structural engineer, Mr. Roger Singer, describes the building framework as consisting of engineered block wall columns and concrete mullions tied to a concrete floor system, creating a frame which from an engineering point of view spreads out the resistance of the building to overturning from wind or seismic loads. The shear walls are reinforced and use 12″ x 4″ x 16″ expanded shale lightweight open-end block grouted solid. A special transition block was designed to change the end thickness of the wall columns from 12″ to 16″. These 16″ blocks serve as pilasters and have larger cores than the 12″ blocks in order to accept larger size rebars. The lightweight block was specified to have an average compressive strength of 3000 psi on the net area, and the blocks, grout and mortar were tested as required to utilize the full 2500 psi of the assembly.

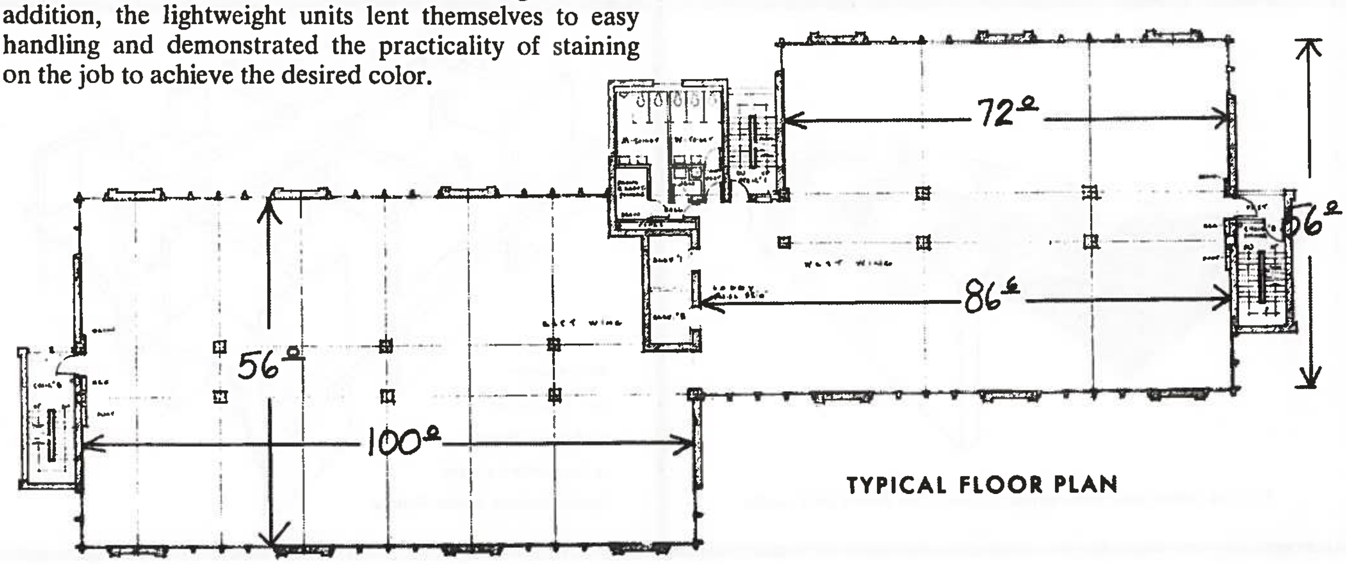
The Holiday Plaza is built on a slope overlooking the Manuel Freitas Parkway adjacent to the Holiday Inn, a 250-room structure also constructed of engineered lightweight concrete masonry. One side of the office building has six stories, the other five. Because of its setting, esthetics were an important consideration in specifying materials. The architects considered several alternatives, including the use of regular block with a coating of stucco. But because they wanted a building with the appearance of brick or unit masonry they decided on a 4″ x 16″ face lightweight unit with a "combed" surface which would be in the appropriate scale, provide the basic structural walls needed, have the desired texture—and which could be obtained in or stained to the color desired. The lightweight aggregate masonry units met all

Holiday Plaza office building in San Rafael, California combines floor plan flexibility of conventional construction, economy and esthetics of engineered lightweight masonry construction. Expanded shale lightweight block was stained on the job to achieve desired color.

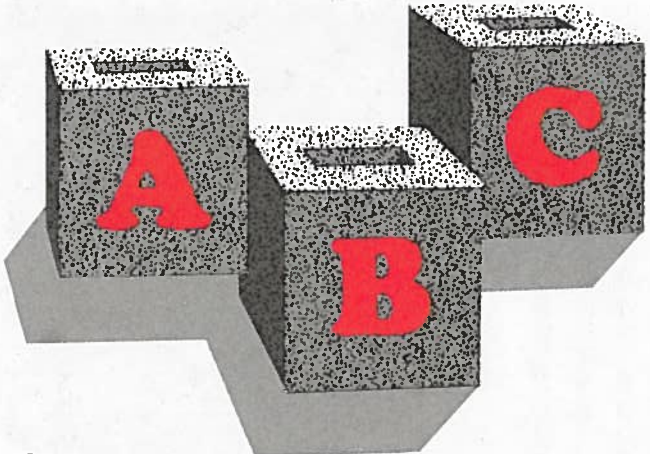
these requirements as well as the basic consideration of cost stressed by Architect Gil Murphy.

While the height of the building was limited by local ordinance to six stories, Mr. Singer observes that a taller building could be designed using the same basic scheme. It satisfies Zone 3 seismic requirements as well as all others set forth in the 1967 Uniform Building Code. In addition, the lightweight units lent themselves to easy handling and demonstrated the practicality of staining on the job to achieve the desired color.

Owner—General Investment Fund Properties, Div. of General Tire Co.
Architects—Bushnell, Jessup, Murphy & Van De Weghe, San Francisco
Structural Engineer—Roger A. Singer, San Francisco
General Contractor — E. D. McGillicudy Co., San Rafael
Masonry Contractor—David Jordan & Sons, Santa Rosa
Haydite expanded shale aggregate and lightweight masonry units supplied by The McNear Co., San Rafael



TYPICAL FLOOR PLAN



'S OF ENGINEERED

LOAD-BEARING masonry walls of one type or another are almost as old as civilization itself, but engineered design in the U.S. dates back only to about 1966. While development of high-strength block and suitable construction techniques were naturally major factors, of almost equal importance were circumstances in the construction industry: skyrocketing costs of labor, materials and money itself; plus a growing market for structures involving generally repetitive partitioning requirements from floor to floor — housing, hotels, motels, office buildings, apartments, condominiums, dormitories, etc.

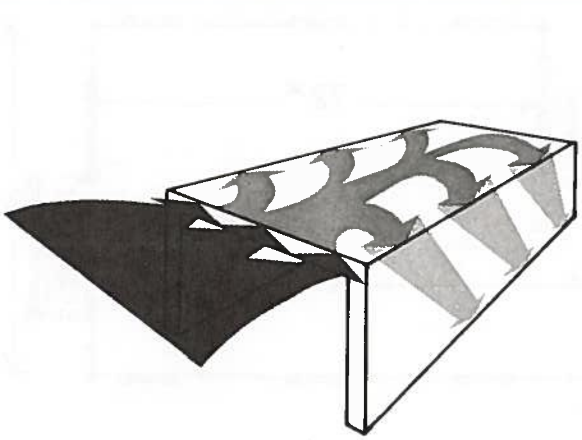
The essential difference between engineered masonry construction and conventional frame construction is in the transmission of vertical loads to the foundations. In frame construction, floor and roof loads are accumulated in columns which carry them to the ground at concentrated points. In engineered masonry construction vertical loads are accumulated in bearing walls which transfer them from the structure to the earth all along the length of the walls rather than at concentrated points. This simplicity avoids the more complex structural connections characteristic of skeleton frame construction.

Construction Economies

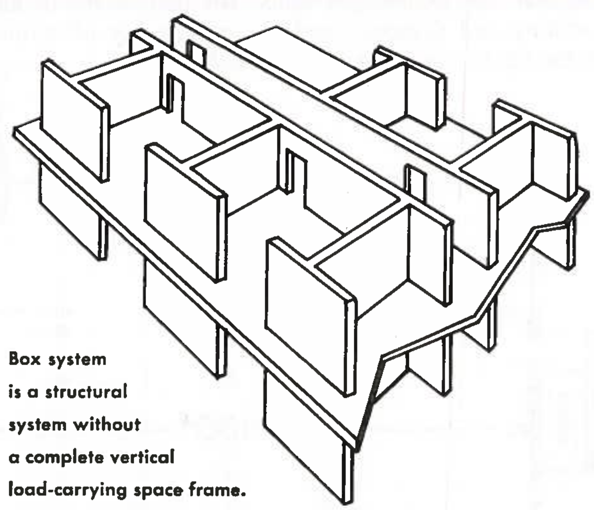
This basic difference between the two types of construction is also the key to the significant economies of engineered masonry construction: a system which often reflects savings of as much as 20% over conventional methods. It eliminates altogether the time-consuming phase of constructing a skeletal frame prior to enclosure of the structure. It also does away with the delays and "crew interference" which can occur in frame construction, where other tradesmen often must be scheduled intermittently and have to work around scaffolding, equipment or other obstructions.

Because load-bearing masonry construction is typically a matter of building one room on top of another and enclosing each floor as work progresses, an assembly-line type of operation saves both time and money. When structural lightweight concrete precast floor slabs are used, as is frequently the case, the masonry contractor can construct the walls to a story height on half the building, then transfer his crew to the other half while the floor slabs are being set by crane on the first half. The crew is then moved back to lay up another story of load-bearing wall on the deck provided by the floor slabs. Meanwhile, craftsmen of other trades are installing utilities and finishing interiors on the enclosed floor below the masons.

This method requires a minimum of scaffolding — a single frame of tubular scaffolding is usually enough — which is easily moved to the next floor as soon as the floor slabs are in place. All work is done on clean, dry, level floors, and masonry work continues without interruption while floor finishers work without obstruction or interference a full level below. Similarly, plumbers, carpenters, electricians, plasterers and painters work steadily in clear, clean, dry areas. The crane used to set



Lateral forces are transmitted through the floors and walls.



Box system is a structural system without a complete vertical load-carrying space frame.

the floor slabs can also deliver the lumber, bathroom fixtures, kitchen cabinetry, and all other material for these crafts.

Time Requirements Slashed

Elimination of frame requirements plus the ability to dovetail trade produces time savings that are little short of spectacular. In a ten-story motel in Portland, Oregon, for example, one story was completed every five working days. A 13-story load-bearing masonry motel in San Diego was completed and ready for occupancy in five and a half months — about half the time required for a comparable frame structure.

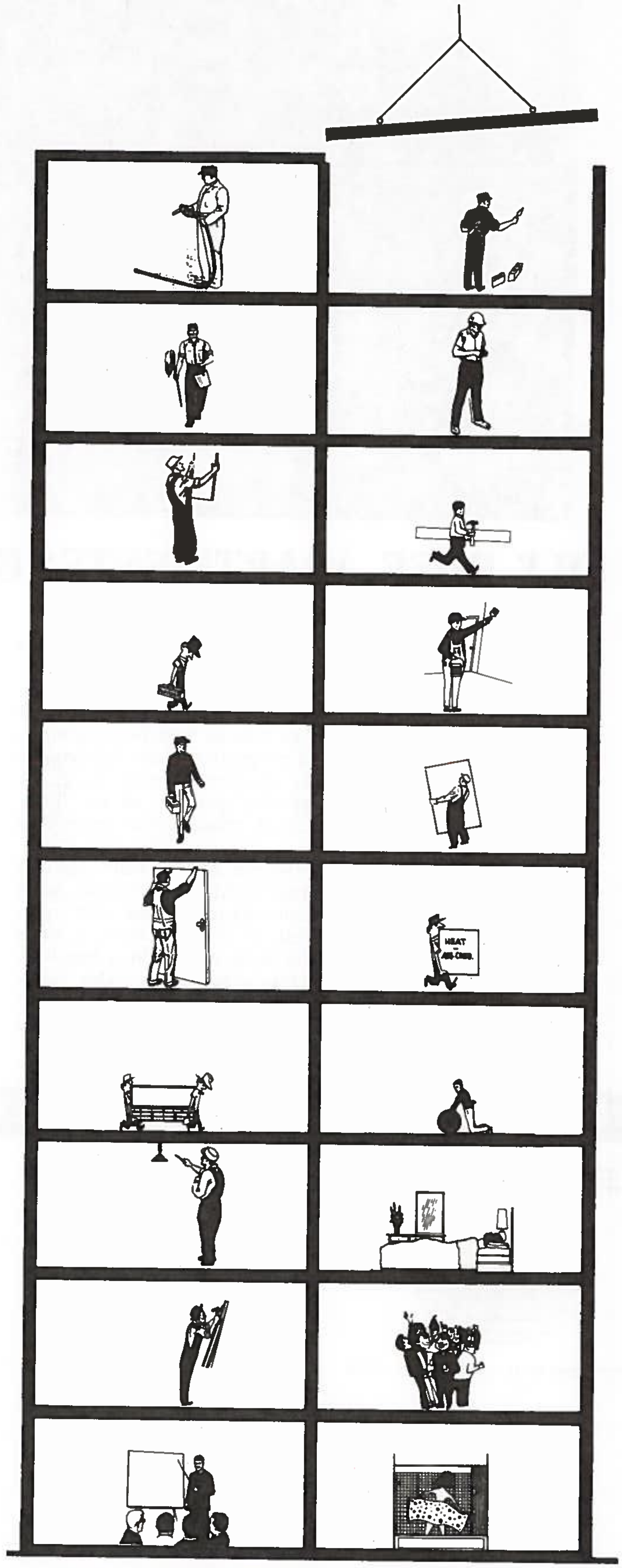
In an industry where time is truly money, time savings of this magnitude are quickly translated into substantial dollar savings. Halving the time required for construction can save $100,000 on a $2 million construction loan taken at an effective annual interest rate of 10 percent. Earlier occupancy of a large hotel or apartment building can bring the owner several times that amount in additional rental income. With contractor's overhead running at $300 a day on a $2 to $3 million project, a six months' reduction in completion time can pare some $40,000 from this cost. And there will also be proportionate savings for subcontractors.

Advantages of Lightweight Block

In addition to the specific construction economies outlined above, expanded shale aggregate lightweight concrete masonry units are particularly suited to structures where fire resistance and sound absorbancy are critical factors. Fire ratings are 30 to 50 percent better than normal-weight concrete blocks of similar equivalent thickness, and sound absorption about 40 percent greater.

Lightweight aggregate masonry units weigh about one-third less than conventional block, which produces significant reduction in dead load and corresponding savings in foundation costs. The lighter weight of individual units also facilitates handling and enhances productivity of masons; it also provides savings in transportation to the building site and in crane and fork lift equipment requirements. In many applications, lightweight units can be used without further finishing, exterior or interior, and most producers offer a wide range of architectural faces. Block can be produced with integral color or stained on site after erection, and although load-bearing masonry construction has been typically associated with box-like structures, the fact is that it is being increasingly used in a wide range of architectural forms, including the "tri-arc" and dodecahedron shapes described elsewhere in this issue.

In short, expanded shale lightweight aggregate masonry units provide all the appearance and performance characteristics required of a wall in a single building element while at the same time yield substantial dollar savings plus improved return on investment of either time itself or money.



LILY ROSE APARTMENTS: ESTHETICS AND ECONOMIES

LILY ROSE Apartments in Regina, Saskatchewan is still another example of the use of expanded shale aggregate lightweight masonry units in engineered masonry construction. This six-story building uses lightweight block in load bearing exterior walls as well as load bearing interior partitions, where acoustical properties of the lightweight block enhance livability of the apartment units. Excellent fire resistance rating and insulative qualities of the lightweight block were also practical reasons for specifying them in this project.

Approximately 50,000 lightweight blocks were used in construction of Lily Rose Apartments. The blocks were made with one large core which was later filled with lightweight concrete. Steel joists rest on the load bearing walls and support a light gage metal deck on which a two-inch thickness of lightweight concrete was placed. This lightweight concrete slab is reinforced, with reinforcing running into the concrete-filled lightweight masonry bearing walls. Exterior of the building is fluted block.

Engineered masonry construction using lightweight block is particularly suited to apartment or housing projects where the earliest possible occupancy is desired, either for revenue purposes or because of housing shortages. The building system is fast and efficient, and productivity of masons is enhanced by using lightweight block. Trades can work continuously once they have begun, with a minimum of interference or hindrance. On a typical high-rise, lower stories may be ready for occupancy at the same time that masons are finishing the upper stories. The Lily Rose Apartments project bears out the important contributions of expanded shale aggregate lightweight masonry units to both esthetics and economies in contemporary housing.

Masonry Contractor—Wascana Masonry Contractors, Regina, Saskatchewan
Ready-Mix Supplier—Redi-Mix Concrete, Regina
Expanded shale aggregate and lightweight block supplied by Cindercrete Products Ltd., Regina, Saskatchewan

EXPANDED SHALE . . . THE FINEST, MOST VERSATILE LIGHTWEIGHT CONCRETE IN THE CONSTRUCTION WORLD

"Symbol of Quality"

ROTARY KILN PRODUCED
EXPANDED SHALE, CLAY & SLATE INSTITUTE
STRUCTURAL LIGHTWEIGHT AGGREGATE

Lithographed in U.S.A. 9-72 40M