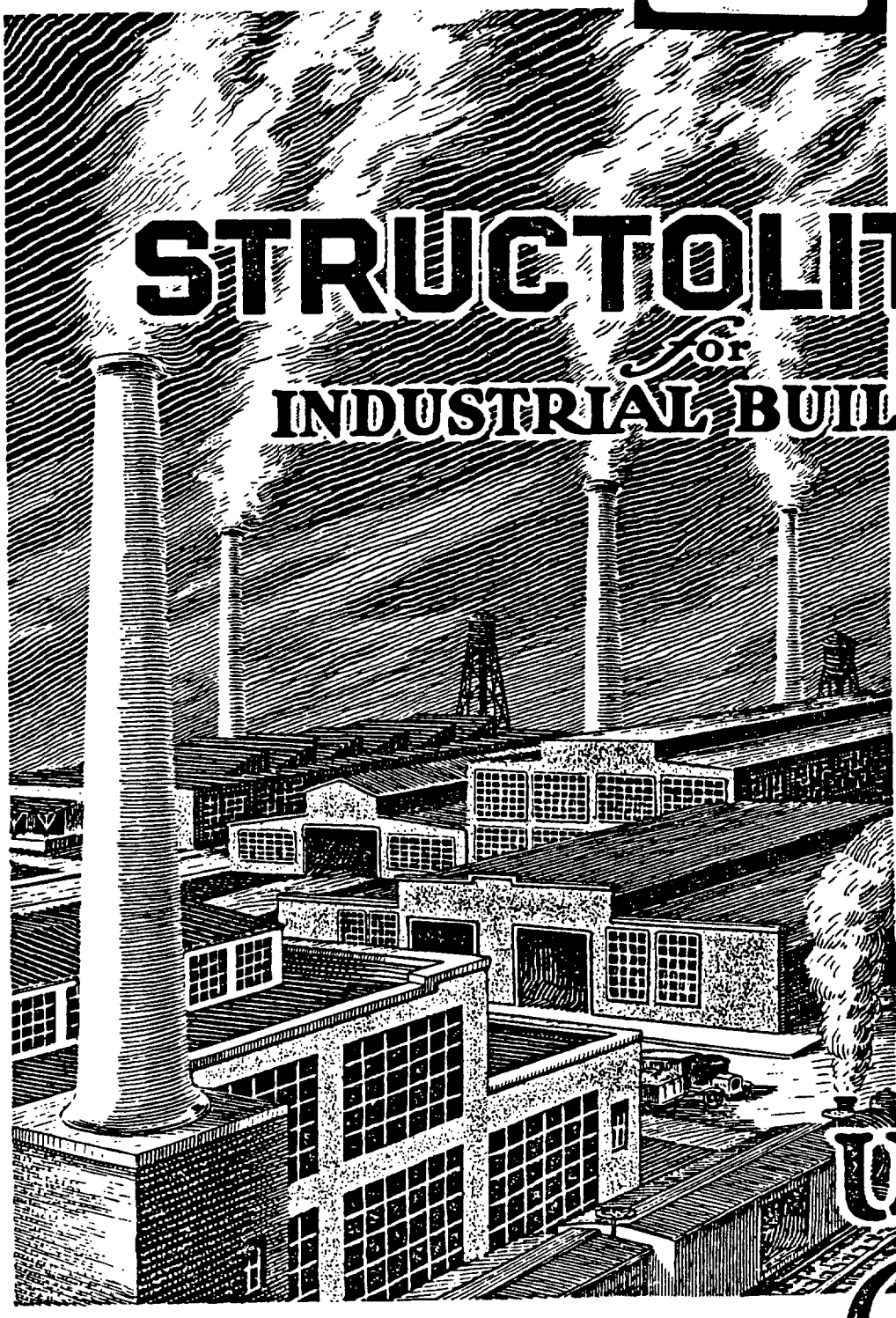
PLAINTIFF'S EXHIBIT

USG-647

E 1 1926



STRUCTOLITE

for INDUSTRIAL BUILDINGS

USG

UNITED STATES
GYPSUM COMPANY
CHICAGO

GP041 2001

FOREWORD

INCE 1916, this Company has been manufacturing Structolite, a light-weight, fireproof, highly insulating, quick setting structural cement, which has been used extensively in the construction of roofs and floors wherever these unique qualities were essential.

Recognizing the demand in the construction field for a material of these special qualities, to be used in the erection of the walls and partitions of industrial buildings, this Company developed the use of Structolite for this purpose. After ten years of proven service in our own plant construction, we now recommend its use, knowing that it will meet fully the exacting requirements of the building public.

ADVANTAGES OF STRUCTOLITE

Fireproof—Protects equipment and stock. Eliminates production interruption from fire loss. Reduces insurance.

Perfect Insulation—Saves coal. Requires smaller heating plant. Cooler in summer. Warmer in winter. Monolithic walls eliminate draughts.

Adaptable—No special equipment required. Permits any exterior or interior wall finish. Ideal for any climate. Readily cast to any design.

Soundproof—Millions of air cells form an ideal barrier to sound transmission. Quiet increases working efficiency.

Economical—Rapid set speeds construction. All materials readily obtainable. Low labor costs.

Permanent—A natural rock cement.

UNITED STATES GYPSUM COMPANY
CHICAGO

GP041 2002

Copyright 1926, by United States Gypsum Company, Chicago

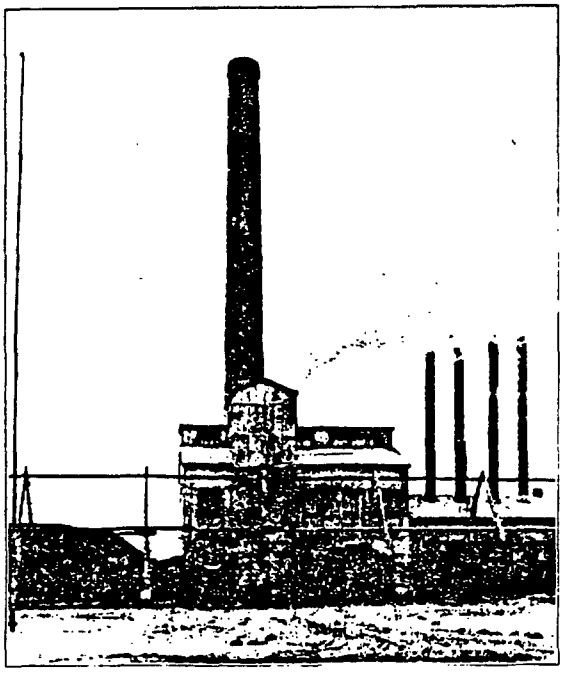
WHAT IS STRUCTOLITE?

STRUCTOLITE is a specially processed, quick setting cement, manufactured from gypsum, and is used in concrete as the cementing material. The concrete is composed of Structolite, sand, and as a coarse aggregate, either steam boiler cinders, blast furnace slag, gravel, or crushed stone. This concrete weighs approximately one-third less than Portland cement concrete. The ultimate compressive strength varies according to the aggregate used and richness of mix and will range from 750 to 1575 pounds unit stress per square inch.

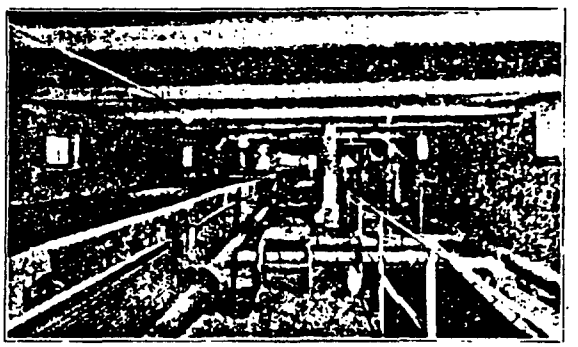
Structolite is a white cement, and the concrete when dry is very light in color, ranging from a light gray to white, governed by the aggregate.

The Exceptional in Structolite

The exceptional combination of high compressive strength and light weight makes it ideal for use in exterior bearing walls, interior partitions in single story industrial buildings; such as service stations, garages, foundries, and other one or two-story buildings, and in multiple story buildings as curtain walls where loads are carried principally by structural steel or Portland cement concrete.



Factory Building with Structolite Walls



Interior of Fireproof Structolite Walls

Cutting Costs With Structolite

The obtaining of a high strength within thirty minutes to one hour after pouring allows the forms to be removed immediately thereafter, saving in form material and labor in making up; equipment can be released sooner for the next operation; large work is shortened by weeks; permits the use of unskilled labor, thus simplifying labor problems; all materials readily available; white walls make lighting easier. These items cut building costs.

Compression Tests

The structural value of this material has been determined by compression tests made at Columbia University, New York City, The Building Dept., Philadelphia, Pa., Washington University, St. Louis, and at our own mills, using various mixtures of different aggregates.

The following tables show the excellent results obtained by the tests conducted in

GP041 2003

the laboratories of the Building Department of the City of Philadelphia on specimens 28 days old.

PROPORTIONS BY VOLUME

1½ Structolite, 1 Sand, 3 Aggregate

Aggregate	Av. Unit Stress per Sq. In.
Gravel	1312
Crushed Slag	1297
Crushed Limestone	1281
Cinders	908

A comparison of the loads and results of all tests shows a safety factor for ordinary construction of not less than 10, and under average conditions from 15 to 25.

Fire Test

The Building Department of the City of New York, co-operating with the Civil Engineering Department of Columbia University, conducted a Fire Test at the University Testing Laboratories in December, 1923. Walls 3″ thick and 9′ high by 14′ long were subjected to a maximum temperature of 1810° Fahr. An average temperature of 1707° Fahr. was maintained within this structure for one hour.

Immediately following this, a stream of water from a 1⅛″ nozzle at a distance of approximately 8 feet, and a nozzle pressure of 30 pounds, was directed against

WASHINGTON UNIVERSITY TESTING LABORATORY

St. Louis, Mo., March 2, 1926

United States Gypsum Co.,
Chicago, Ill.

Dear Sir:

I have this day made for you 2 Tests of "Structolite" for compressive strength, with the results herewith appended. *Very respectfully yours,*

J. L. VAN ORUMM
Per E. O. SWEETSER

N. B.—Tests made daily. Reports copied and kept confidential.

Lab. No.	Mark	Size of Tested Section	Area in Square Inches	Maximum Load Producing Rupture	Maximum Strength in Lbs. per Sq. In.	REMARKS
12775	C4	6.05″ diam.	28.7	38600	1345	Specimens made 2-15-26, 1½—1—3, with cinder aggregate. Age at test 15 days. One week in cool room. One week at 85° F. until no further loss of weight. Test made March 2.
12776	C5	6.05″ diam.	28.7	38150	1330	
00001	C6	6.04″+ diam.	28.7	31200	1085	Specimens made 3-2-26; 1½—1—3 mix, with *cinder* aggregate. One week in cool room. One week at 85° F. until no further loss of weight. Age at test 14 days. Test made March 16.
00002	C7	6.04″+ diam.	28.7	30400	1060	
00003	C8	6.05″ diam.	28.7	29450	1025	
12837	S4	6.05″ diam.	28.7	40200	1400	*Limestone for* Coarse Aggregate — All mixes 1½—1—3 made March 18—Tested April 3. Age at test, 16 days. First 4 days in room (temp. 65° F.); then 12 days in hot room (temp 85°F. to 95°F.) until no further loss of weight. Test made April 3.
12838	S5	6.05″ diam.	28.7	45200	1575	
12839	S6	6.00″ diam.	28.3	41900	1480	
12840	G4	6.05″ diam.	28.7	45000	1570	*Gravel* for Coarse Aggregate
12841	G5	6.03″ diam.	28.6	42500	1485	
12842	G6	6.05″ diam.	28.7	43650	1520	

Copy of these reports to J. S. STRONG, 1415 Chemical Bldg., St. Louis, Mo.

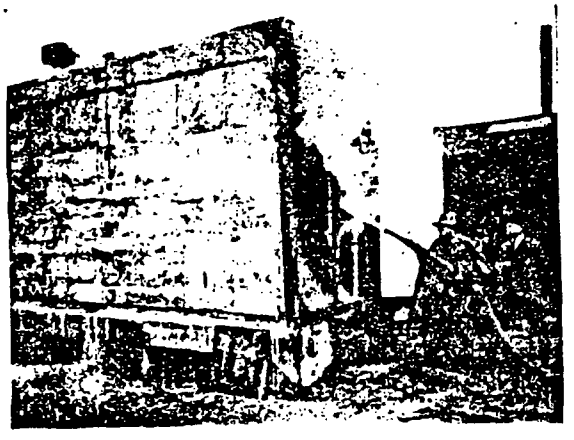
GP041 2004

the super-heated interior walls for 2½ minutes. *The test was an entire success.*

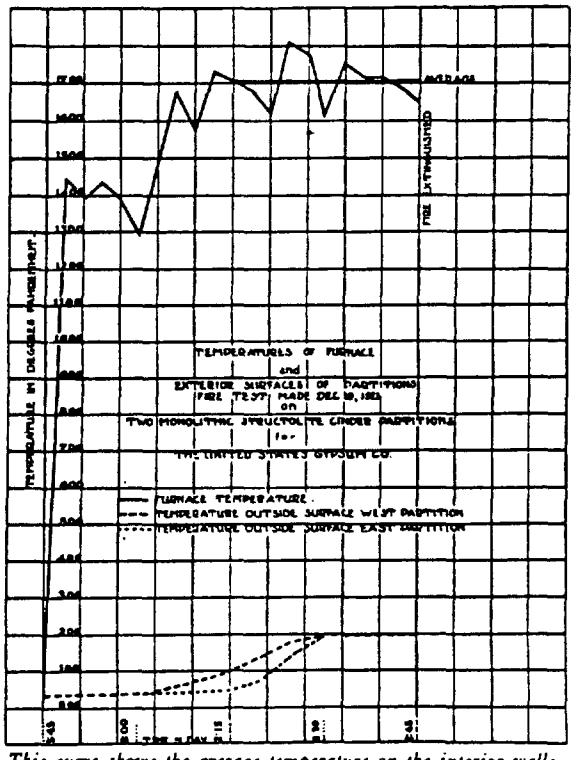
The following day interior and exterior surfaces were carefully examined and found to be in a remarkably good condition.

The Official Report on this test states, "The exterior surface of these partitions, as they appeared on the day following the test, showed no visible sign that they had gone through a one-hour fire and water test." The interior walls where the natural calcination of gypsum would take place, still showed some of the form marks, indicating that calcination from this intense heat and the washing action of the hose stream had not progressed to a depth sufficient to damage materially the structural strength of the wall.

This test was conducted in accordance with the building code of the City of New York, Article No. 17, Section No. 355, Subdivision No. 3, and the Industrial Code of the State of New York, Rule No. 512 of Bulletin No. 7. Upon the satisfactory results of this test, Structolite has been approved for fireproof residence construction by the five Boroughs of Greater New York.



Following the fire test a water stream was thrown against the interior walls. The 3-inch Structolite concrete wall passed this test without material damage.



This curve shows the average temperature on the interior walls, which was maintained at 1707° Fahr. for the required period. The maximum was 1810° Fahr. Notice that the outsides of these walls, only three inches thick, did not exceed 210° Fahr.

Structolite Won't Burn

STRUCTOLITE is a specially prepared gypsum. Gypsum products have long been recognized for their fireproof qualities, and tests by the Underwriters' Laboratories and many other recognized authorities over a period of twenty-five years have established this claim beyond question of a doubt. The temperature of a gypsum wall cannot exceed 212° Fahr. except directly on the surface exposed to a fire. Picture in your own mind this process which must take place; the water of crystallization in the gypsum must be vaporized as the surface slowly calcines, and in this calcining portion, the air cells are filled with steam. In fact, the entire exposed surface becomes a fire-retarding curtain, a thick, steamy mass of gypsum in process of calcination. As Structolite is merely a structural form of gypsum, it possesses this splendid quality so essential in the construction of factory buildings.

GP041 2005

Insulation

Effective insulation is now demanded by owners and builders of factories because they appreciate the saving possible in the heating equipment and fuel consumption, as well as the big advantage gained in better working conditions during winter and summer.

Gypsum has long been recognized as the only structural building material possessing insulation to an efficient degree. Structolite is gypsum treated mechanically and chemically to increase density and compressive strength. Naturally, Structolite possesses all the insulating qualities of calcined gypsum. The principal advantage of Structolite as an insulator is due to the fact that *structural strength and high insulation are combined in the one material*, tending to simplify construction and thereby reduce costs.

The following table is for the purpose of calculating the heat loss in B. T. U.'s (British thermal units) per hour, per square foot, per degree difference in temperature for different materials. The values given here are the results of tests at Columbia University, Pittsburgh Testing Laboratory, University of Illinois, published data by the American Society of Heating and Ventilating Engineers, and tests conducted by Dr. Severinghaus, of Columbia University on Structolite.

Wall Construction	*Conductivity in B. T. U. loss per hour per sq. ft. per degree difference in Temperature*
Siding, sheathing, studs, lath and plaster on inside	.37
Siding, paper, sheathing, studs, lath and plaster on inside	.30
8" Cement block, stucco, plaster on inside	.35
8" Brick wall plastered on inside	.36
8" Brick wall furred and plastered on inside	.28
6" Clay tile stucco, plaster on inside	.46
8" Clay Tile stucco, plaster on inside	.32
6" Clay Tile stucco, furred and plastered on inside	.40
8" Clay Tile stucco, furred and plastered on inside	.30
6" Clay Tile, brick veneer and plaster on inside	.27
8" Clay Tile, brick veneer and plaster on inside	.23
6" Clay Tile, brick veneer, furred and plastered on inside	.22
8" Clay Tile, brick veneer, furred and plastered on inside	.20
6" Structolite, ¾" stucco, ½" plaster on inside	.16
8" Structolite, ¾" stucco, ½" plaster on inside	.127
6" Structolite, ¾" stucco, furred and plastered on inside	.143
8" Structolite, ¾" stucco, furred and plastered on inside	.115
6" Structolite, furred ¾" stucco, ½" plaster on inside	.129
8" Structolite, furred ¾" stucco, ½" plaster on inside	.106
6" Structolite, 4" brick, ½" plaster on inside	.12
8" Structolite, 4" brick, ½" plaster on inside	.0995
6" Structolite, 4" stone, ½" plaster on inside	.152
8" Structolite, 4" stone, ½" plaster on inside	.121
6" Structolite, 4" stone, furred and plastered on inside	.136
8" Structolite, 4" stone, furred and plastered on inside	.111

For a comparison of heat losses through the roof the following table is taken from published tests by Professor G. F. Gebhardt, of Armour Institute of Technology, Chicago. The heat loss is shown in B. T. U.'s per square foot per degree Fahrenheit difference in temperature per hour, including roof covering:

3" Solid Pyrobar (30" Tile)	.25
4" Hollow Pyrobar (30" Tile)	.20
3" Solid Concrete slab (1-3-5 mix)	.65
3" Solid Concrete Slab (1-2-4 Mix)	.75
1" Cement Tile	.99
2½" Concrete slab on metal lath	.69
2" Plank—yellow pine	.38

Table for Figuring Heat Loss

$Q = K\ A\ (t_2 - t_1)$ B. t. u. per hr.

in which Q is the quantity of heat lost through radiation in a wall, window, door, or roof in one hour.

K is the proper coefficient listed below. A equals area of wall, roof, window or door in square feet. T_1 is outside temperature and t_2 inside temperature.

K=walls, roofs, (See tables in preceding paragraph).

K=Glass.

Single windows 1.03.

Double windows .48.

Double glass each window .72.

K=Doors.

1" Wood .50.

2" Wood .46.

Corrections for exposure.

Multiply K by	N.	E.	S.	W.
	1.3	1.1	1.0	1.2

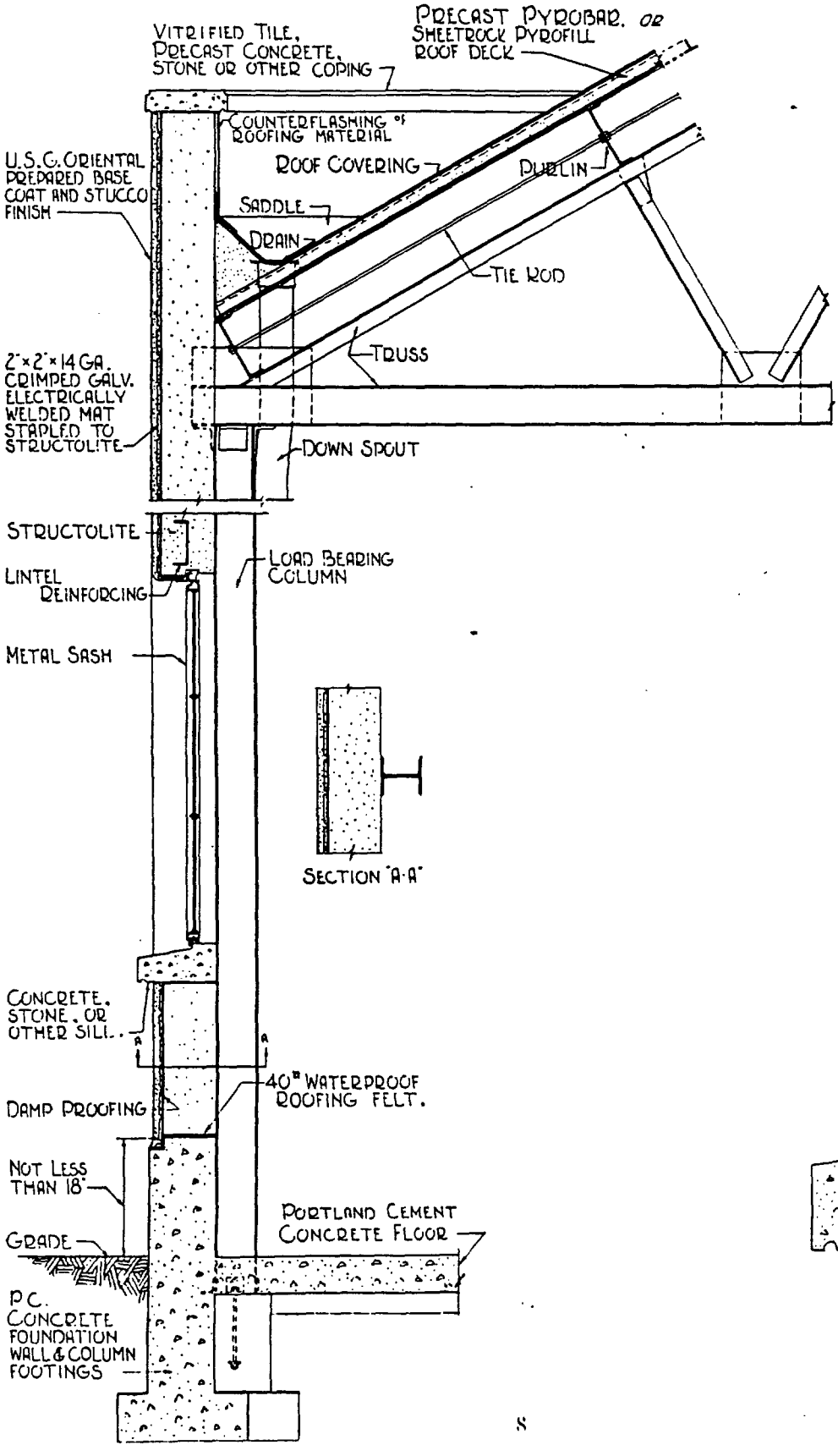
From these comparative values, it is very apparent that Structolite Construction with one of our pre-cast or poured roofs will accomplish the desired results in a most satisfactory manner.

Economy of Structolite

The proof of the economy of Structolite lies in the using. All materials are readily obtainable; a minimum of skilled labor

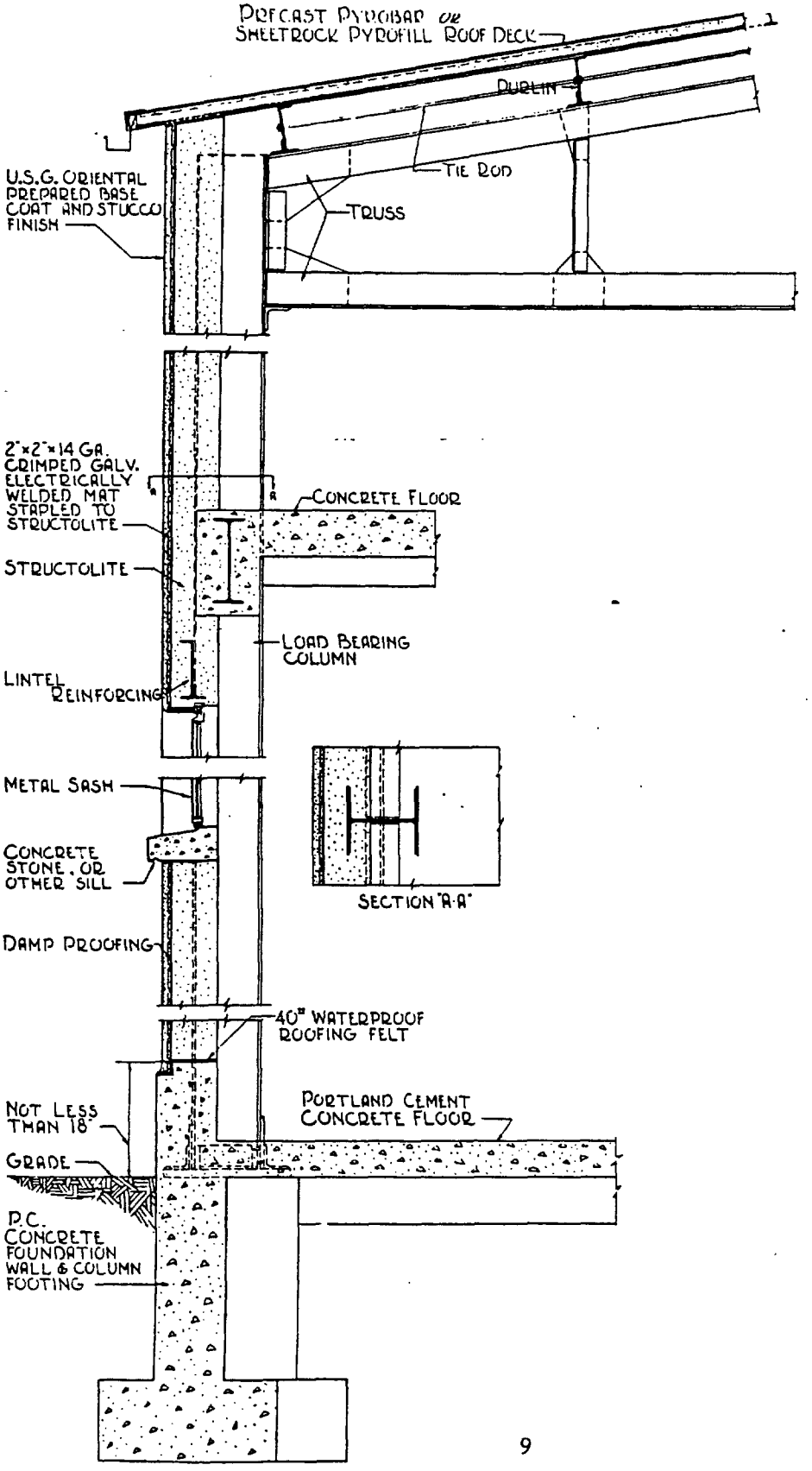
GP041 2006

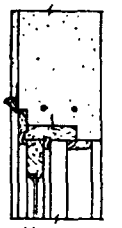
CONSTRUCTION DETAILS

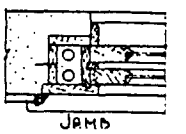


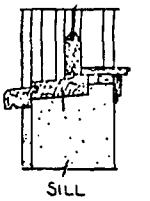
GP041 2007

CONSTRUCTION DETAILS









WOOD SASH DETAILS

GP041 2008

is required; the rapid set of Structolite reduces the period of construction, reduces labor costs, and permits the rapid and frequent re-use of forms; a minimum of treatment is required for both exterior and interior walls; less heating equipment is required; a saving in fuel costs results, and insurance and maintenance savings extend throughout the life of the building.

Do not delay in specifying Structolite for your factory walls. We will gladly cooperate in working out costs, methods and operation procedure, and, if necessary, will put one of our own construction superintendents on the job to assure you of the best results obtainable.

First cost is not the only consideration. Maintenance, upkeep, repair expense, insurance, fuel costs, re-sale value, et cetera, must be balanced against different materials in order to determine their actual cost. In Structolite, you get a maximum return per dollar invested.



A Successful Winter Structolite Job

Cost Table

1. Forms may be purchased through us or in many places rented from our dealers. The investment cost will average out less than 1½c per sq. ft. of wall poured whereas the rental cost will run approximately 3c. The labor cost is figured in the following manner:

2. Figure a carpenter to place spreaders and wire and a laborer to help set up under average conditions. With reasonably regular walls they can set and remove from the wall more than 60 square feet of forms in an hour.

Example using typical labor rates

Carpenter .80 per hour
Laborer .60
1.40

60=2.33c per sq. ft. of form or 4.67c per sq. ft. of wall.

3. On this basis; in an average plant where Structolite delivered at the curb in paper bags costs $17.00 per ton, cinders are procurable for $1.25 per yd., sand at $2.25 per yd., and with the labor rates given above a 6" Structolite wall will cost:

Cinders	$.85 \times \frac{1.25}{27} \times \frac{1}{2}$	
Sand	$.28 \times \frac{2.25}{27} \times \frac{1}{2}$	
Structolite	$.25 \times \frac{17.00}{2000} \times \frac{1}{2}$	.11
Form investment cost		.015
Form labor		.047
Mixing and placing		.06
Damp proofing		.02
Nails, wire and reinforcing steel and felt course on foundation		.01
Mixer, scaffold, material protection and small tools		.03
		.292
Insurance and overhead 10%		.029
Per sq. ft. of wall		.321

Cold Weather Construction

Rapid hydration, and quick hardening brings the Structolite concrete in a few minutes to a point which is beyond serious danger of frost and cracks. In this quick setting, heat is generated which affords further protection against freezing.

GP041 2009

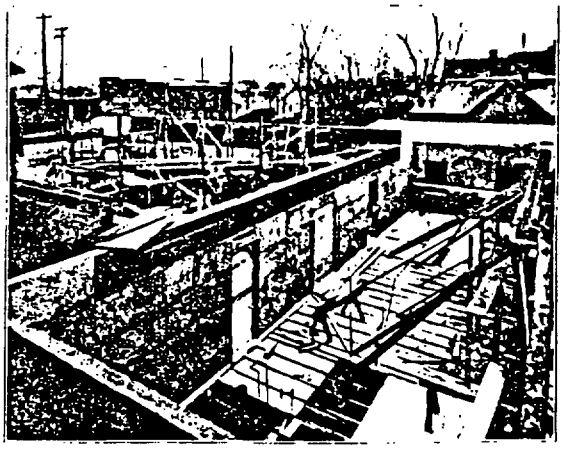
Forms

Forms may be either wood or metal. From our experience with many types of each, we recommend metal forms, because they are more readily handled, very elastic, durable, and rapidly re-set, thereby tending to reduce labor costs. A very smooth wall is obtainable with metal forms.

Metal forms come in 2-ft. square sections with smaller pieces in 1-in. variations to meet required measurements. After these forms are clamped together for the initial pouring course they may be reset in sections from 6 to 30 ft. long without dismantling. Temporary wood spreaders are used which are removed as soon as the forms are filled. The forms are wired to keep them from bulging, by twisting No. 12 galvanized wire through the proper holes. A 2" x 4" is clamped on one side with standard clamps as a whaler and is the only aligner required.

Wood forms can be used with economy whenever desired. They are quickly removed, effect low material costs and low labor because of the small amount made up at one time.

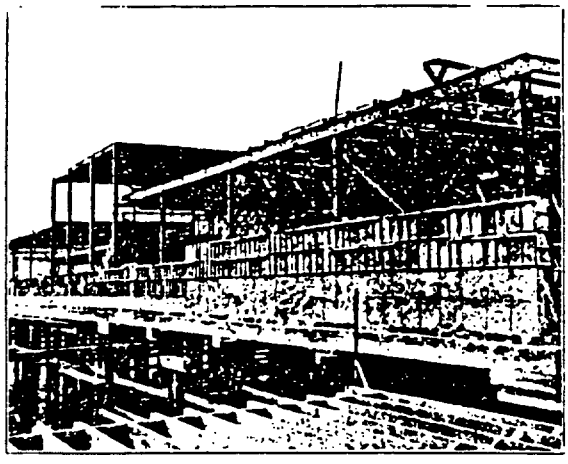
A minimum of bracing is required for either, as the lateral pressure in a quick-setting Structolite wall, erected in 2-ft. courses is very low. Owing to the rapid re-use of forms, only a sufficient quantity is required to take care of a two-hour pouring schedule. Lateral bracing in the form of aligners is required for one side only, and should be 2" x 4" mill dressed material. Separators to maintain uniform wall thickness may be 1" x 1" thick. The inner and outer forms are tied together with wire.



A Good Example of Metal Form Work on Structolite Walls

Mixing

Mixing may be done by hand in a mortar box, or in a tilting drum type concrete mixer which has been found entirely satisfactory, when properly cleaned after each batch. It should not be over-agitated by either method, or over-puddled after being placed in the wall. To facilitate cleaning of mixer, which is essential because of the quick-set, the water required for each mix should be introduced into the mixer before the aggregate, the sand and aggregate second, and the Structolite last. The mixing time should be no longer than necessary to thoroughly incorporate the different materials, and the concrete should be immediately placed in the forms. Tamp or puddle in the forms only enough to eliminate voids or honeycombed sections.



Careful tamping gives a smooth surface which will save finish

What Kind of Foundations

The foundations should be of a stone masonry construction, or Portland cement concrete, and should be carried to

GP041 2010

18" above grade line, the size of the foundations being determined by the load to be carried, and the nature of the soil.



Structolite Curtain Walls on Portland Cement Foundation

What Floor Construction

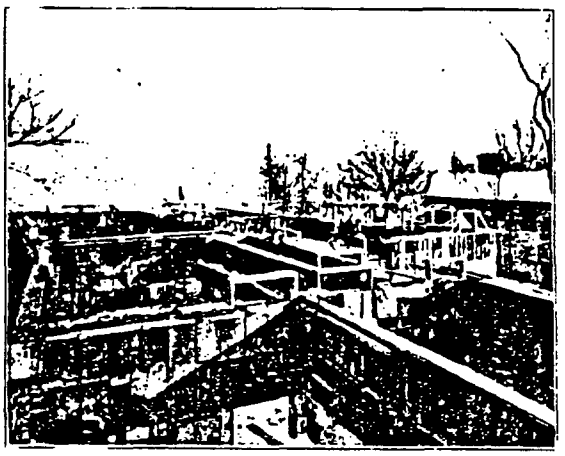
In one story buildings, without basement, the usual Portland Cement concrete slab is placed on a well tamped fill of sand or cinders, and wood floors of any type may be laid on concrete slabs. The second floor may be of wood or, masonry construction such as concrete beam and joists, or steel frame and reinforced gypsum floor slabs.

How to Build It

Structolite walls are erected faster than any other type. Foundation walls, piers or footings of Portland cement concrete, or other masonry, are run up not less than 18" above grade, thoroughly waterproofed, and a strip of 40-pound waterproof felt is laid on top. Wood or metal forms are then properly set and braced, allowing 6" minimum thickness for exterior bearing walls. Experience has shown that a height of two feet is best for each pouring course. Corners are reinforced with ½" rod at least 4 feet long, spaced 2 feet apart.

Immediately upon pouring the first course, an additional set of forms is erected and the second course poured. By the time this is completed, the bottom course will have its initial set, permitting the removal of the lower tiers of forms. These are erected on top of the second tier, and the procedure continued to the required wall height.

All rough bucks for openings and frames for windows are set in place as the forms are erected, and the form work should run past the openings so that as the walls are poured and puddled, the Structolite forms a tight seal on all sides.



A Typical View of this Simplified Construction

At the height of the ceiling, anchor bolts should be imbedded in the walls to secure the wall plate. On this are placed the roof rafters, or second-story joists, and in the case of a two-story building, the pouring continues to the roof plate line.

What Wall Thickness

As the conditions existing in each building vary as to the height of wall, loading involved and manner of application of these loads, it is possible to determine the thickness of a wall only by considering these variables in making design. From the test data given, it will be seen working stresses for compression of 100 lbs. per sq. in. for cinders, and 125 lbs. for gravel or crushed stone Structolite concrete are

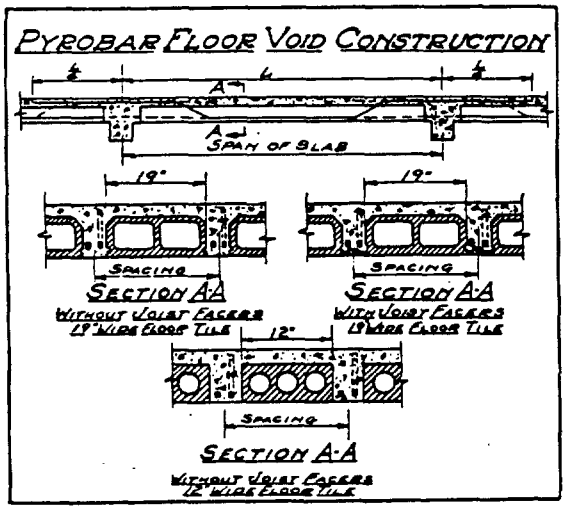
GP041 2011

conservative, and contemplate a safety factor of ten or more. However, these working stresses permit of the average one or two-story buildings being erected without the use of structural steel or heavy concrete frame, except where unusual concentrated loads are encountered.

Structolite Floors and Roofs

Variations of our Sheetrock-Pyrofill, Poured Monolithic, Structolite on Hy-Rib or Precast Floor or Roof systems may be adapted to suit various factory designs. We will be glad to have you consult with our Engineers to determine which type is best suited for your needs.

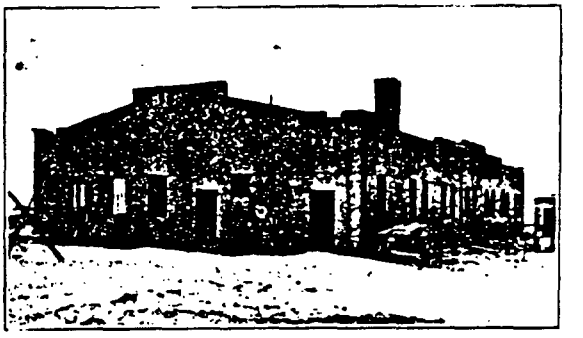
Precast Floor Voids in the concrete joist floor system offers a fireproof floor construction suitable for many buildings, at a minimum cost.



What Exterior Wall Treatment

To obtain best results, the exterior of Structolite walls should be protected by coating with an approved dampproofing and given an exterior finish of stucco, brick, or stone veneer. The United States Gypsum Company's Oriental Stucco lends itself most readily to exterior wall treatment, and offers a variety of mill-mixed permanent colors, and at the job requires only the addition of clean water.

When a stucco treatment is to be applied, a 2" x 2" No. 14 gauge crimped galvanized electrically welded steel fabric is stapled



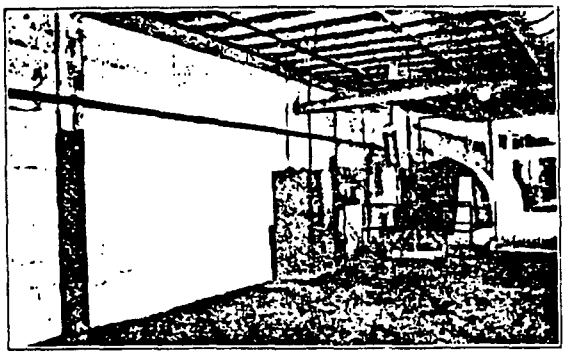
Attractive Service Station Stuccoed With Oriental

to the wall with a 2" staple every square foot. The crimped fabric is self-furring, insuring correct location in the stucco for maximum strength.

If, for any reason, it is desired to furr the exterior wall, the strips may be nailed directly to the Structolite in the manner indicated in the specifications on page 14.

What Interior Wall Treatment

For ordinary factory work, the interior walls do not require any finish. This economy will be realized as greatly in favor of Structolite in warehouses, found-



An Undecorated Interior Wall

ries, forges, or blacksmith shops, etc., where a decorated wall is not required. When metal forms have been used, or care taken in the use of wood forms, the Structolite wall will be found to have a smooth

GP041 2012

2. If sand is used, place sand evenly on the coarse aggregate.

3. Spread over the sand the Structolite cement required.

4. Dry mix the aggregate and cement thoroughly and then add the required amount of water and mix thoroughly.

5. Deposit the Structolite Concrete immediately into the moulds, puddling the mixture during the pouring so as to prevent air bubbles or honeycombed surfaces.

REINFORCEMENT—All window and door openings not exceeding five feet clear span shall be reinforced with not less than three (3) ½" round rods. When the location of the opening is such that the depth of the lintel is less than 18" a steel or reinforced concrete lintel shall be used. Spans in excess of 5 feet shall have steel or reinforced concrete lintels. The rods shall extend not less than 24" beyond the clear opening on either side and shall have hooked ends to provide anchorage. All corners shall be reinforced with ½" round rods located in the center of the wall and extending not less than 24" each way. They shall have hooked ends and shall be spaced 24" on centers.

FOUNDATION WALLS—All Structolite Concrete walls shall start from the foundation walls. Foundation walls shall be carried up to not less than 18" above the grade line. The top of the foundation walls shall be coated with an approved damp-proofing compound. A strip of not less than 40-pound roofing felt or other approved fabric shall then be laid on the top of the wall and another coating of damp-proofing applied over it before pouring the Structolite Concrete.

CHIMNEYS AND FIREPLACES—Chimneys may be built by enclosing the flue lining with Structolite Concrete.

Fireplaces may be built of Structolite Concrete by facing the exposed surfaces with fire brick or other lining.

WATERPROOFING—All exterior Structolite wall surfaces shall be thoroughly coated with an approved damp-proofing compound before any exterior finish is applied.

In bathrooms or elsewhere where a tile wainscot is used or where Portland Cement is used as a plastering material the Structolite Concrete partitions or walls shall be coated with an approved damp-proofing compound and a 2" x 2" galvanized wire fabric of not less than No. 14 gauge wires shall be securely stapled to such walls before applying the cement plaster.

EXTERIOR STUCCO—If an exterior stucco finish is desired a 2" x 2" galvanized welded fabric of not less than No. 14 gauge wires shall be securely stapled to the Structolite Concrete walls, using 2" staples.

WINTER WORK—When pouring is to be done under freezing conditions, the aggregates used must be free from frost. Newly poured walls shall be protected.

Specifications for Oriental Stucco

SCOPE OF WORK—The work required under this section of the Specifications comprises the stuccoing of all exterior walls and chimney surfaces as shown on drawings and as hereinafter described.

PROTECTION OF MATERIALS—All materials used for this work shall be placed in a dry location on the site and shall not be stored on the ground. Materials shall be delivered in the original packages of the manufacturer.

MATERIALS—Materials used shall be United States Gypsum Company's Oriental Base Coat for the scratch and brown coats and United States Gypsum Company's Oriental Finish Number (see Oriental Stucco Color Card) for the finish coat.

REINFORCEMENT—A 2" x 2" galvanized crimped welded fabric, not less than 14 gauge wire, shall be securely stapled to the Structolite walls, using a 2" galvanized staple, spaced not more than 12" apart. This fabric shall be lapped at least 6" around all corners and angles and all horizontal laps shall be not less than 2"

MIXING—The Oriental Stucco Base coats and Oriental Stucco Finish shall be used with the addition of water only. Water used shall be clean, and free from all acids or strong alkalies. The mixing shall be done in a mortar mixing machine of the rotating drum type for at least five minutes, or by hand in a water tight mortar box until the proper consistency has been obtained. There shall not be mixed at one time more mortar than will be used within one hour. No re-tempered mortar shall be used under any circumstances.

APPLICATION—Oriental Stucco shall be applied in three coats. The scratch coat shall not be less than ⅜" in thickness, shall be applied with pressure and then heavily cross scratched before set with a suitable device to provide a strong mechanical key. When thoroughly cured and dried the scratch coat shall be wet down and then followed with a brown coat of not less than ⅜" thickness properly floated to a true surface. The brown coat shall be allowed to thoroughly cure and dry to permit any shrinkage to take place; then wet down before applying Oriental Stucco Finish. If the weather is dry and hot the brown coat should be kept wet down for three days to permit proper curing. The finish coat shall be applied to a thickness of ⅛" to ¼", depending on texture or finish desired.

GP041 2014

Architectural and Engineering Service

OUR architectural and engineering service is always available to assist in working out any problems which may come up involving the use of Structolite in roofs, floors, partitions or exterior walls. Quantity survey of structural materials will be made upon receipt of plans and specifications.



UNITED STATES GYPSUM COMPANY
205 West Monroe Street
CHICAGO, ILL.

GP041 2015