Super-R-Way
Doors and Hardware

Here is doorway equipment that is meeting the most exacting standards of many of the largest railroads and industries. The construction of Super-R-Way doors is exactly suited to the strenuous abuse which most doors in roundhouses, freight houses and warehouses must withstand. Super-R-Way doors are built with a heavy steel frame securely welded. Solid wood members are tongued and grooved and securely spiked together inside the steel T-frame without a spike exposed. Super-R-Way Hardware, either hangers or hinges, is fitted directly to the steel members—"steel to steel" contact. All weight is carried by the steel frame and corner-bracing so there is no possibility of sagging, warping or pulling apart. Both doors and hardware are made to take care of any size opening.

Construction details and catalog of designs will be mailed on request.

Richards-Wilcox Mfg. Co.
"A Hanger for any Door that Slides"

AURORA, ILLINOIS, U.S.A.
An innovation
a year ago—
an established
favorite today!

An insistent demand for an attractive, structural tile which would lay up in an interior load-bearing or partition wall with one or both faces finished, was recognized—and Natco Vitritile was developed to meet it. Its acceptance was immediate—its popularity amazing.

Natco Vitritile is furnished in several shades, ranging from a light buff to a rich dark brown. Its beautiful, glazed, sanitary finish is easily cleaned and kept clean, and requires no plaster, painting or maintenance.

Its field of use is in subways, basements, corridors, gymnasiums, garages and auto sales rooms, hospitals, laundries, laboratories, natatoriums, restaurants, substations and similar applications. Proper units for both 3-3/4" and 8" walls are available for wainscoting, lintels, bullnose corners, etc., making possible practically any desired form of construction. Units are also furnished kerfed or split for furring.

Natco Vitritile is shipped in corrugated wrappers, assuring its arrival in perfect condition. A folder showing sizes, shapes and shade ranges available will be sent on request.

NATIONAL-FIRE-PROOFING-COMPANY

Branch Offices: New York, Platinum Bldg; Chicago, Builders Bldg; Philadelphia, Land Title Bldg; Boston, Textile Bldg.

In Canada: National Fire Proofing Co. of Canada, Ltd., Toronto, Ontario

NATCO VITRITILE

The standard grade of Natco Vitritile is first quality material and comprises a pleasing blending of all shades from a light buff to a dark rich brown.

Individual shade ranges may be obtained in the select grade. They are approved by samples before shipments are made.
A refrigerating system that is efficient for one type of work may prove totally inadequate for another. There is no standard arrangement which may be applied to all conditions. Long experience qualifies YORK engineers to make an accurate analysis of your individual requirements and to recommend a system which exactly will meet them.

The illustration at the right shows the arrangement of hangers and racks in one large fur storage house.

YORK engineers have studied the refrigeration requirements of practically every type of industrial and commercial user. Architects are invited to take advantage of the assistance which these engineers are qualified to offer.

If you would be assured of low-cost operation put your problems up to YORK.
350 Dots=350 Contracts!

Every dot on the above map of the Metropolitan District of New York represents a contract for a Raymond Concrete Pile foundation—a total of 186,000 Raymond concrete piles driven.

Every Raymond pile is poured into a tapering shell of spirally reinforced steel and every shell is left in the ground. Which means—speed—safety—ultimate economy—satisfaction.

RAYMOND CONCRETE PILE COMPANY
NEW YORK: 140 Cedar Street CHICAGO: 111 West Monroe St.
RAYMOND CONCRETE PILE CO., Ltd., Montreal, Canada
Branch Offices in all Principal Cities

A FORM FOR EVERY PILE
A PILE FOR EVERY PURPOSE
STEEL BOILERS

Lower Heating Costs

The right place for plenty of water is in the boiler and not in the steam lines and radiators. The Kewanee boiler style is not cramped, so the steam is delivered dry.

Kewanee provides ample volume of water in rapid circulation in the boiler, it is neither agitated into unmanageable commotion nor forced out into the steam lines by the liberated steam bubbles. It sticks to the job of absorbing heat from the heating surface. That is another reason why Kewanee is able to show lower heating costs.

WATER CONTENT

Water content is large enough to absorb all the heat of combustion without undue disturbance. So the water line keeps steady in the gauge glass.

Kewanee Boiler Corporation

Kewanee, Illinois

Branches in 40 Principal Cities
eliminates form work—a costly item

North Western \( \frac{3}{4} \)" LONSPAN is a two-in-one material—a form work as well as reinforcing. Its use, therefore, saves labor as well as material cost in reinforced concrete construction—roofs, floors, garages, small bridges, culverts, etc.

In addition, you will find \( \frac{3}{4} \)" LONSPAN most desirable and economical for \( 2" \) solid partitions and miscellaneous fireproofing purposes. It is also particularly indicated for use with metal lumber. In fact, judged from any standpoint—design—speed of erection, economy, strength—this North Western Longspan \( \frac{3}{4} \)" Rib Lath is one of the important new building products with which every modern architect and engineer will wish to familiarize himself.

NORTH WESTERN
EXPANDED METAL COMPANY
1234 OLD COLONY BUILDING, CHICAGO
60 silent renting agents
in this new apartment house

Architect decides on
Electrolux—the noiseless
gas refrigerator without
moving parts

The renting value of automatic
refrigeration is an accepted fact.
Automatic refrigeration is a matter
of course in the finest new apartment
dwellings. And architects are rapidly
turning to Electrolux for such instal­
lations. Hardly surprising, when one con­
siders this refrigerator. Electrolux freezes
with heat. A tiny gas flame does all the
work at much less cost. Since nothing moves,
nothing can make any noise; and there are
no moving parts to wear out. Add to these
advantages of gas refrigeration superior
cabinet construction—finest materials and
workmanship.

The new building pictured here is equipp­
ed with sixty Electrolux Refrigerators—
sixty silent renting agents. They will always
be on the job, helping to keep tenants
happy when the apartments are occupied,
helping to rent space when leases expire.

Electrolux is readily adaptable to your
decorative schemes. Besides the gleaming
white finish, Electrolux is available in four
new color harmonies. These are: Biscay
Blue, Crystal Green, Ivory Tan and Silver
Grey.

There is a wide range of standard sizes
and a special low model that can be used
as a table or the base for a gas range.

We shall be glad to send you detailed
specifications and any other information
you wish. Please write: Servel Sales, Inc.,
Evansville, Indiana.

ELECTROLUX REFRIGERATOR
MADE BY SERVEL
FOR six years Aero, the National Radiator, has been warming buildings of all types throughout the United States, Canada, and foreign countries—demonstrating the soundness of the engineering principles on which it is constructed, and steadily building an ever increasing group of satisfied customers. Today Aero is truly "the National Radiator." A host of imitations have appeared. They may approach Aero's distinctive appearance—but they cannot duplicate its record of proved performance. Aero is years ahead.

Specify Aero Radiation, and you specify beauty, warmth, efficiency. Aero, the National Radiator, retains its place as leader in attractiveness and in health-giving comfort.

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Nine Plants devoted to National Service through these Branch Offices and Warehouses:
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AERO
THE NATIONAL RADIATOR
Milvaco Syphon Air Valve
to complete the line

NOW—the Milwaukee Valve Co. introduces the new Milvaco Syphon Air Valve—the result of unlimited experiment and laboratory research—an air valve that overcomes the weaknesses common to Automatic Air Valves.

In line with other Milvaco Products this new valve is constructed of the highest grade materials—rigidly tested and inspected—highly plated and polished—and sold at a price that will beat competition and still show the trade a good profit.

Send For Special Introductory Offer

MILWAUKEE VALVE CO.
MILWAUKEE, WISCONSIN
Why?

1. WHY did over 400 building owners vote 5 to 1 in favor of one type of concrete floor hardener?  
   (Answered on page 8)*

2. WHY did upkeep costs for Northwestern Terra Cotta Company floors amount to only $14 in 15 years?  
   (Answered on page 16)*

3. WHY did floors laid in 1917 save the Richman Brothers Company $7000 in 11 years?  
   (Answered on page 18)*

4. WHY is metal superior to sand in concrete floor finish?  
   (Answered on page 24)*

5. WHY is there so much difference today between two kinds of concrete floors laid side by side in a Pennsylvania Railroad Station in 1912?  
   (Answered on page 6)*

6. WHY did the Ohio State University test prove one type of concrete floor finish three times more wear-resisting than the type in ordinary use?  
   (Answered on page 23)*

7. WHY is "surface treatment" impractical for many types of concrete floors?  
   (Answered on page 9)*

*Answered in the book

"PLAIN TALK ABOUT CONCRETE FLOORS," a survey presenting official tests, expert investigations and performance reports on actual floors in different industries.

Every architect, engineer or building owner with floors to build or maintain should have this book. Sent free to those who return the coupon or request it on their business letterheads.

THE MASTER BUILDERS COMPANY
CLEVELAND, OHIO
Factories in Cleveland, Ohio  
Sales Offices  
Buffalo, N. Y. and Irvington, N. J. in 110 Cities

Facts in This Book—

ENABLED one of the world's greatest tire and rubber companies* to secure a floor finish that would hold their heavy traffic at far less cost than material originally specified. This improved type of cement finish saved them thousands of dollars in initial investment and will save hundreds in maintenance.

Area—300,000 square feet

SATISFIED a very large automobile manufacturer* that a super-wear-resisting concrete floor was exactly what his new plant needed. He used the finish which has proven to be the lowest-cost-per-year floor known.

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SOLVED the floor problem of the largest chain store warehouse* in the Mississippi valley, where experience had shown that only the strongest type of cement floor finish would do. They studied the facts and adopted the floor which the book shows has held traffic like theirs for years.

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*Names on request

These are three out of a long list of builders who have found in this book proven economies they could profit by. That the book must carry important, usable information, is self-evident.

USE THE COUPON—GET THE FACTS

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Send a free copy of "Plain Talk About Concrete Floors" to

Name
Position
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Address
Campbell Union Grammar School, Campbell, Calif., Mr. Wm. H. Weeks, architect, San Francisco. Leland and Haley, heating engineers, San Francisco., Mr. Carl T. Doell, heating contractor, Oakland.

Serves Campbell Union Grammar

In this impressive school building, of recognized architectural excellence, it is fitting that a Jennings Vacuum Heating Pump is to be found on the return line of the heating plant.

A Jennings unit designed for continuous operation that, by closely regulating the steam flow, enables the system to meet elastic heating requirements satisfactorily—to facilitate the distribution of controlled heat over extensive areas—and to maintain comfortable temperatures in every section of the structure.

For specification details, see Bulletin 71.

RETURN LINE AND AIR LINE VACUUM HEATING PUMPS  ◆  CONDENSATION PUMPS ◆  COMpressors AND VACUUM PUMPS FOR AIR AND GASES ◆  STANDaRD AND SUCTION CENTRIFUGAL PUMPS

Jennings Pumps
THE NASH ENGINEERING CO. 12 WILSON ROAD, SOUTH NORWALK, CONN.
Other industries that are large and enthusiastic users of BLOXONEND include:

- Automotive Industry
- Baking Industry
- Chain Store Warehouses
- Meat Packing Industry
- Publishing Industry
- Paper and Pulp Industry
- Railroads
- Textile Industry
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BLOXONEND is rapidly laid over old or new concrete or wood floors without interrupting operations.

Where loads are burdensome and the trucking continuous

The transporting of enormous loads of sheet metal on hand and electric trucks, the moving, dropping and dragging of huge castings—this is the usage to which BLOXONEND is being subjected in the iron and steel industry. That it renders satisfactory service is evidenced by the many repeat orders received.

The American Can Company has placed 29 orders totaling more than one-half million square feet. The Continental Can Company, Link Belt Company, Crane Company—these and hundreds of other well known concerns have increased trucking efficiency and reduced floor maintenance by installing BLOXONEND. Its construction and method of laying insure long life, resiliency and lasting smoothness.

Write for Sample and Specifications

Carter Bloxonend Flooring Co.
Kansas City, Missouri

Branch offices in principal cities

BLOX-ON-END
FLOORING

Bloxonend is made of Southern Pine with the tough end grain up. It comes in 8 ft. lengths with the blocks dovetailed endwise onto baseboards.

BLOX-ON-END
Lay's Smooth
Stay's Smooth
No ALLEY—

AUTOMATIC HEAT—IRREGULAR GARBAGE COLLECTION—Specify INCINOR

"Tell me where your lot is, and I can tell you what you want!"
Isn't it true nine times out of ten?
Very few of the new subdivisions have alleys. Where's the garbage can going?
Some places it has to be carried out to the front door.
Most suburban home builders now want automatic heat. They're not going to be able to cram their garbage, rubbish and trash in the furnace.
And in so many of these rapidly growing communities the garbage service is overtaxed, hit-and-miss.
What can you do about it?

Specify Incinor, the Home Incinerator. Burns all garbage, rubbish, trash—quickly, completely, cheaply—with gas. Reduces bushels of waste at a time to a handful of clean, sterilized ashes.
Installs as easy as a gas range. Uses about 1000 cu. ft. of gas per month. No chute to get slimy, cock-roachy, mousy, or clog up.
The Decent Way to dispose of garbage, rubbish and trash is to burn it with gas. Investigate, and you will specify Incinor.

HOME INCINERATOR CO.
Milwaukee, Wisconsin

Please send me free Architectural File data on home incineration.
Ideally Designed for Stoker Operation

The combustion chamber of the Heggie-Simplex boiler runs the entire length of the boiler bringing a far greater amount of heating surface in direct contact with the fire than is usually provided. A rear-front-rear flue passage for the gases and unrestricted circulation further assure maximum utilization of heat units. These features provide for the most economical and most efficient use of stoker equipment and explain why Heggie-Simplex boilers are seen in such rapidly increasing numbers wherever mechanical firing is employed.


HEGGIE-SIMPLEX
ELECTRIC-WELDED STEEL HEATING BOILERS
WHEN

A Famous Hotel Man Designed
His Own Kitchen

He specified Monel Metal for sinks, tops and trim

THE late E. M. Statler left many lasting memorials to his sound judgment and business acumen. He left hotels that will stand as models of their kind. But he also left in his own home kitchen an enduring record of his preference for Monel Metal.

Mr. Statler had used Monel Metal in the kitchens of his hotels for years and years. He had seen it used—seen it endure—seen it retain its attractive cleanliness through years of use and abuse.

So when he came to design his own kitchen, he profited by his years of rich experience with food service materials and specified Monel Metal for sinks, cabinet tops, trim and other exposed surfaces.

Monel Metal is now used in fine buildings of all kinds—in the most imposing institutions, the best built homes. In every case it is furnishing rust-immunity, corrosion-resistance, steel-like strength. It is adding to equipment's cleanliness, attractiveness, and long life. It is saving labor, repairs and replacements.

Isn't it evident that you protect your client's interests by specifying Monel Metal for food service equipment and decorative metal work?

WRITE FOR SPECIAL ARCHITECTURAL FOLDERS

Monel Metal is a technically controlled Nickel-Copper alloy of high Nickel content. It is rolled, casted, rolled, rolled and machined solely by The International Nickel Company. The name "Monel Metal" is a registered trade mark.

THE INTERNATIONAL NICKEL COMPANY (INC.)
67 WALL STREET, NEW YORK, N. Y.
In Every Detail
As You Would Build It

As an architect you are as much concerned with in-built quality as with outward beauty. Especially in the case of equipment from which service of such vital importance is required as refrigerators must deliver.

Inquire where you will, in the field of refrigerator manufacture the name which commands instant and undisputed respect is McCray. This prestige and position has been won by more than a third-of-a-century—39 years to be exact—devoted to building refrigerators of the highest quality for every business.

In every hidden detail the McCray is built as you architects would build it. Finest materials, expert craftsmanship, soundest methods, everything to insure efficient, enduring service. Pure corkboard insulation is used in every McCray.

Stock models in many sizes and styles to meet all needs in homes, stores, markets, hotels, clubs, hospitals, institutions, florist shops. We also build to order to meet individual requirements. Our engineers will prepare blue prints and specifications based on your sketches, without obligation.

Every architect should have our portfolio on refrigeration for his files, as well as the current catalogs of our various lines. Send now for your copies.

McCRAVE REFRIGERATOR SALES CORPORATION
864 Lake St., Kendallville, Indiana

McCRAVE REFRIGERATORS
Laundries like this one

...for example

This modern, dependable laundry department, installed with the cooperation of "American" engineers, is operated under the direct supervision of Mt. Sinai Hospital's own officials.

THE "laundry bag" at Cleveland's modern Mt. Sinai Hospital is a mammoth one; yet the handling of its vast weekly wash is merely a matter of routine. For Mt. Sinai Hospital has its own laundry—an "all-American" department—right in its own building.

The same is true in the case of so many, many modern institutions. Almost every day architects confer with engineers of The American Laundry Machinery Company in the planning of these indispensable laundry departments. These experienced men know every phase of laundry practice; they can show you floor plans and photographs of "American"-equipped laundries in hospitals, hotels and clubs of all sizes and types. Make use of this helpful "American" service—it is yours for the asking, of course.

THE AMERICAN LAUNDRY MACHINERY COMPANY
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As good as the principle behind it

FREE VALUABLE BOOK
the coupon brings it promptly


STEELTEX reinforces plaster with steel exactly as concrete is reinforced.

* * *

Today, when the trend of architectural style is placing so much emphasis on bringing charm to walls and ceilings, the protection of plaster is vastly more important than ever before.

Architects will be quick to appreciate the value of a material that reinforces plaster by utilizing the same principle that is used to reinforce concrete—rigid steel embedded in the slab. It has a successful record in over 200,000 installations.

STEELTEX is used in place of lath. It is a fabric of rust-proofed (galvanized) cold-drawn steel, attached by a furring wire to a two-ply waterproofed backing. The steel has an average tensile strength of 78,000 pounds and is welded on 2” centers—giving it equal strength against stress from all directions. It comes in sheets 50” x 52”.

Plaster is applied by an ordinary sweep of the trowel and the furring wire provides space for the plaster to spread under the fabric. As a result the steel is uniformly and completely embedded.

Many advantages in one material

The backing not only produces automatic backplastering, but adds effective insulating, damp-proofing and sound-deadening qualities. Naturally it entirely eliminates lath marks. Never before has one material combined all these valuable qualities. The book, “Better Walls for Better Homes” gives complete details.

May we send you a copy?

New—STEELTEX for Floors

STEELTEX for Floors, recently introduced, has already been used in numerous important installations. Heavier than other types of STEELTEX. It is quickly stretched and secured in place over any type of beam or joist. It comes in rolls, not sheets.

Its obvious advantages include maximum construction speed, elimination of forms, prevention of droppings, uniform reinforcement throughout the slab, better curing, etc. The booklet, “STEELTEX for Floors” contains full details with working designs. Send for your copy.

National Steel Fabric Company
2710 Union Trust Bldg., Pittsburgh, Pa.
The world’s largest manufacturers of welded steel fabric

STEELTEX
THREE TYPES—SAME PRINCIPLE—SAME PROTECTION
for plaster...for stucco...for floors and roofs (concrete and gypsum)
NOW PLASTER IS REINFORCED WITH STEEL—EXACTLY LIKE CONCRETE

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Without obligation send
☐ (check) Better Walls for Better Homes.
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Name
Firm
Street
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A house isn’t modern unless it has modern wiring

One of the fundamental differences between a house of ten years ago and a house of today is its electrical wiring. Where two or three convenience outlets were considered enough, today there are twenty or thirty. In the place of the dangling pull chain there is the convenient wall switch—accessible to every door.

Specify a General Electric Wiring System—as the easiest, surest way of providing electrical comfort. This is the wiring that the homeowner has learned to demand through constant national advertising. The fact that it is made by General Electric assures him of lasting and dependable service.

GENERAL ELECTRIC
WIRING SYSTEM
for lifetime service

GENERAL ELECTRIC
These Masonite Tests Speak for Themselves

ANYONE can make claims. Proving them is quite another matter. We let Masonite tests speak for themselves.

Masonite's co-efficient of heat conductivity per inch thick per hour is 0.328 (flat plate test made by Armour Institute).

The co-efficient of sound adsorption of Masonite for C4-512 frequency is .31 according to the tests made by Prof. Paul E. Sabine of Riverbank Laboratories.

The co-efficient of an equal thickness of hair felt under the same test was only .17.

Full reports of these tests, a sample of Masonite, and the Masonite book of Specifications and Details will be sent promptly on request. Address:

MASONITE CORPORATION
Dept. 6108, 111 W. Washington St., Chicago, Ill.
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Masonite
STRUCTURAL INSULATION
Made by the makers of MASONITE PRESSWOOD
This Van Kitchen of the Mercy Hospital, Hamilton, Ohio, is representative of many fine Van Installations throughout the country. It was planned for efficient service today, with provisions for the future requirements of this splendid institution.

Messrs. George Barkman & R. A. Fryer, Architects

Behind Van Equipment is the most authoritative and widespread engineering organization in the world. You are assured of a scientific plan, an economical arrangement and correct equipment.

ARTISANS of many trades contribute their specialized knowledge to the many products of the Van line. Here is shown a metal spinner completing the copper cover of a giant steam kettle. Tasks such as this require the greatest accuracy and skill... the deftness of the craftsman is as important as the precision of the machine. The great Van Factory is practically a city of specialists in Kitchen Equipment.
You Can Put Your Faith in Van Equipment

RELY on Van Kitchen Equipment with all the confidence of a surgeon in his finest instrument. Trust it to perform every duty with precision...with accuracy...and with unfailling sturdiness. Van Equipment fulfills every requirement...today, tomorrow, a generation hence...justifying your faith by the kind of service that is a revelation and delight.

Staunchly built ... of the finest materials for every separate purpose ... designed by leading equipment engineers ... and produced in the greatest and most modern factory of its kind in the world! Such is Van Equipment. It has no superior; we do not know its equal. Superbly constructed, it renders superb service. There is calibre in every inch!

The economy of Van Equipment is an outstanding feature. It begins with the low first cost ... which is surprisingly out of proportion to its quality. Its economy is reaffirmed each year by quiet efficiency, devotion to duty, and freedom from costly interruptions, replacements and maintenance. We invite you to send for the Van Catalog of Kitchen Equipment.
An architect does not add screens to a building to enhance its architectural beauty.

We appreciate the fact that screens are used only when and where they are necessary equipment.

Bearing this in mind we build mechanical excellence into Orange Aluminum Frame Screens. . . . Satisfactory mechanical performance is the most important requirement in a screen.

And next in importance, Orange Aluminum Frame Screens are beautiful, in a quiet way, in so far as it is possible for such a practical article to be called beautiful.

UNITED STATES POST OFFICE, YONKERS, N. Y.
James A. Wetmore, Architect.

This government building, nearing completion, is being screened with Orange Aluminum Frame Screens, fitted out with bronze wire screen cloth.

ORANGE SCREEN COMPANY
515 Valley Street . . . . . Maplewood, New Jersey

Same Aluminum as used in Airplane Construction

Extruded Section

These screens are made of extruded bars of aluminum, a special alloy developed for our use by the Aluminum Company of America, and which is one of the strongest non-ferrous materials made. Because of its lightness and many structural advantages, aluminum such as is used in our screen frames is now used in Airplane Construction.

Complete line of Standard Types

This shows stationary (removable) half-circle screen with double frame screens below pivot-hinged at sides. The hardware is simple, strong, and easy action. We frequently supply small circular screens for yachts that rest at anchor a part of the time in southern waters.

Plain rectangular screen pivot-hinged at top or side, easily installed and removed. When this screen is used in very large double hung windows a cross bar is used at the meeting rail level.

The double frame vertical sliding screen can be used inside or out (as can any of the others shown here) and is used largely with double hung windows.

A triple horizontal sliding screen. Horizontal sliding screens are provided in batteries of two or more frames, and are the ideal screen installation to be used with casement windows that open out.

Odd Shapes

Specially Designed

We recently designed a number of outside screens for an industrial building in which food-stuffs were being handled and canned.

We have designed many screens to be used in connection with pivot and swinging windows and invite your inquiry on any screening problem that you may have, either domestic or industrial . . . write to our Maplewood, N. J., office for information or estimates and we shall instruct our nearest branch office to take care of your inquiry.
ROOF TROUBLES DON’T “BUTT IN”
WHEN THE BUILDING HAS THIS ROOF!

THIS roof never interrupts... never bursts in with a three-figure bill for repairs... never distracts from important matters by forcing the owner to worry about damages or loss of production due to leaks.

"Forget it"—that’s the net of the Barrett Specification story. Here is a roof so trouble-free that the owner never has to give it a thought.

"Forget it." In the owner’s safe is a Surety Bond which gives him full license to dismiss the roof from his mind. He is insured against roof repair and maintenance for the next 20 years—until 1948.

Twenty years is a long, long time for a roof to last without repairs. But Barrett Type “AA” Roofs do it. Furthermore—

Many American business buildings, erected in the 70’s, 80’s and 90’s, are still protected by the original roofs of Barrett Pitch and Felt.

And, because those old Barrett roofs proved themselves so good, the modern Barrett Specification Roofs is recognized today as standard—chosen for our finest modern buildings.

For full details of these trouble-free roofs, dictate a brief note to us.

*The Barrett Company also offers a Specification Type “A” Roof which is bonded for 10 years. This type of roof is adaptable to a certain class of buildings. The same high-grade materials are used, the only difference being in the quantities.

Depend on the Barrett Approved Roofer

Throughout the United States and Canada a limited number of roofing contractors have been approved by Barrett to lay the Barrett Specification Bonded Roof. These men have earned a reputation for doing efficient work—a name for absolute dependability.

Good workmanship is a big part of any good roof. Good workmanship is a certainty when you provide for a Barrett Specification Roof.

THE BARRETT COMPANY
40 Rector Street, New York City
IN CANADA:
The Barrett Company Limited
5651 St. Hubert Street, Montreal, Quebec
A.P.W. PAPER COMPANY, ALBANY, N.Y. U.S.A.

Onliwon towel cabinet, pressed steel finished in white lacquer. Lock to prevent waste and theft. Window to show when refilling is needed.

Why one Onliwon Towel does the work of two

As it comes from the cabinet, each Onliwon towel is folded double. This increases its absorbnenc many times, doubles the strength of the towel - keeps wet hands from tearing through. One Onliwon towel wipes hands or face completely dry. It does the work of two ordinary towels.

What's more, with the Onliwon cabinet a separate effort is necessary to get a second towel. It prevents waste.

Onliwon service is nationwide. Wherever you are, there's an Onliwon distributor nearby.


Onliwon

TOILET PAPER AND PAPER TOWEL SERVICE
IN this age of commercialism, the question of cost has come to be of prime importance in the business of building, and in no case can it be treated lightly. In addition to being an artist and designer, the architect must now be a cost expert and be able to make a fairly accurate estimate of the cost of the building for which he makes the plans. In fact, a very large proportion of modern building is planned on the budget system, which means that it is absolutely essential for the architect to know labor and material costs in order that he may make his client the best possible building and still keep within the limits of the original appropriation. It is probably true that in no other respect is the architectural profession open to so much deserved criticism as on the question of false or inaccurate estimates. Certainly it is easily understood that if a client has been told by his architect that his house will cost $10,000 and then finds, as is so often the case, that it is to cost $15,000, he will lose confidence in his own architect and much discredit will be cast on the profession in general. No doubt there are some cases where misleading estimates are deliberately given by unscrupulous practitioners for the purpose of encouraging clients to go ahead with building, but the general high standard of ethics in the profession makes such cases few and far between, and in the vast majority of instances such estimates are the result of insufficient preparation or lack of thought on the part of architects.

Of course, a really thorough and complete knowledge of estimating may well require a lifetime of study, research, and actual experience, and certainly no one can hope by the mere use of books and printed formulae to arrive at the solution of a problem in which so much depends on local and rapidly changing conditions. Yet a great deal of preparatory knowledge can be gained from a careful study of the printed results of the experiences and researches of others, which, when checked against one's own experience and adapted to circumstances of time and place, will furnish a satisfactory groundwork on which to proceed. The use of the more ponderous collections of data and tabulated information is often discouraged by their very vastness and completeness, and a beginner will be overawed by the great amount of information and the vast variety of different conditions to be complied with. According to a certain great teacher of language, it is better to use "a small grammar, when learning a language, than a big one." And the same is true when learning to estimate or when a person wishes to get a good general knowledge of building costs with-

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out spending the time to go through a mass of detail, much of which would probably have no bearing whatever on the particular work he is doing; and even in the case of one who is able to go more deeply into the subject, such a small volume will furnish a good preliminary training to enable him to make better use of the larger and more complete technical works, which are many.

An excellent little book for such preparation and for use in estimating costs of smaller buildings, such as dwellings, barns, stores and industrial structures of moderate cost, has been written by William Arthur and is called "Estimating Building Costs." It is now in its third edition. It is written as compactly as possible, in simple and direct terms so as not to be confusing even to the most elementary student. The material covers all the different steps of building construction from excavation to painting, and each important class of building material is treated in a separate chapter. There are 91 tables showing the number of hours needed and amounts of work done. As the price of labor varies greatly with locality and season, all labor costs are shown at the rate of $1 per hour for mechanics and 60 cents per hour for laborers, so that they may be readily translated into terms of the prevailing local wage rates. In addition to being a reliable guide for use in estimating, the book contains many bits of useful information, and it even includes a chapter entitled "Hints on Drawing," which is no doubt rather elementary to be of much interest to the average architect but which will be very instructive to the beginner or those builders who are not familiar with architectural customs and practices. It discusses such things as plan indication, architects' charges, and general information on the preparation and printing of plans. In the following chapter, however, there is considerable useful information on building methods and materials which may be of interest and use to the architect as well as to the builder. A list of the chapters will give an idea of the completeness of the work and includes, in addition to the two on drawing and building hints already mentioned, chapters dealing with—Excavation and Piling, Concrete, Brickwork, Stonework, Plastering, Woodwork, Millwork and Glass, Solid and Sheet Metal, Roofing, Painting, Plumbing and Heating, and Miscellaneous Subjects. The treatment under each of these headings is very complete and is made especially effective by the fact that in all cases several easily understood examples are given illustrating the various processes and showing how they are applied to actual building problems. The reviews at the end of each chapter are in the form of questions and will be very useful where the book is used as a text book, especially since the answers to these questions are given in the key at the back of the volume. By the use of these questions and answers it will be possible to condense the study of the most important points in a very effective manner. In looking through the pages of this volume one finds that it is much more than a collection of tables for estimating and is really a very practical guide for the construction of small buildings; and that it contains a great deal of information useful to the specification writer as well as the estimator, and certainly to contractor or builder or to anyone interested in construction.


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STAIR BUILDERS GUIDE


ONE of the most prominent features of almost any building is the stairway. It is seen by everyone; its convenience and beauty are readily appreciated, and its faults and defects instantly detected. Its construction is considered the highest branch of joinery, and far more care and knowledge are required in its planning and execution than in any other part of the building. By the design of the staircase there may be achieved an appearance of grandeur that will characterize the whole interior of a building. The prime utilitarian object in designing stairways is to secure ready access to the upper stories, and they should be planned to give ample head room and facilitate travel from one story to another, while at the same time care should be taken to assemble the various members in a harmonious fashion so that the finished structure will present an appearance that is as beautiful and pleasing as its prominence warrants.

When one looks at a graceful flight of stairs circling and spiraling upwards, it is easy to realize that their construction has been no simple matter, and indeed it is true that the science of stair building has its fundamentals in the solution of the most intricate problems of plain and solid geometry. Some of these have been solved by mathematicians and have resulted in systems of cylindrical handrailing. The foremost exponent of this science was Peter Nicholson, and nearly all work along this line since his time has been merely an attempt to simplify the results of his investigations. These attempts have been so successful that it is said that the art is virtually perfect and that further improvement cannot be expected. The number of mechanics who are thoroughly competent to lay out and erect a set of complicated stairs is relatively small, and it is desirable that the individual who designs and supervises the construction of such stairs have a thorough knowledge of the problems and principles involved in their erection. It is said that the chimney piece is the central motif of a well designed room, and that its design governs the room's scale and treatment, but it is no doubt true that the stairway furnishes the central motif for the entire interior treatment of the building. Being such an important part of the structure, great care should be taken that the design and construction afford the maximum of safety, convenience and aesthetic appeal. In a matter of such importance too much cannot be left to the mechanics, and stairways should always be carefully detailed and their construction supervised by an inspector who is familiar with the principles of scientific stair building.

In the "Stair Builders Guide," by Morris Williams, all the up-to-date information on this important science is presented in short and carefully prepared chapters. The layout of each working detail is carefully considered, explained and illustrated. Plans of many stairways are shown as they are often designed, contrary to all standard and prescribed rules of correct construction, but these defects are pointed out and the correct plans are considered. The author confidently asserts that all those engaged in the building trades will find that this book gives the requisite instructions for becoming proficient in the art of making hand-railing. The book is now in its third edition, and it is considered a standard reference work.

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Over a corner of the office of J. P. Morgan at Wall and Broad Streets, New York City, the New Equitable Trust Building rises 542 feet above the street level. From both architectural and engineering viewpoints, this pile has design and construction details of unusual interest. Of importance to all who have an iron and steel protection problem to solve was the practice followed of painting the steel girders in this building with Dixon's Silica-Graphite Paint. The same assurance of extra years of usefulness and consistently lower maintenance costs that prompted the builders of the Equitable Trust Building to use Dixon's Silica-Graphite Paint has influenced untold numbers of industrial plants, railroads, chemical works, and the like to use this same effective paint film to resist rust, corrosion and process deterioration for more than 65 years.

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THE technical considerations in building are becoming ever more important as the height of structures increases and their design becomes more and more intricate. In the planning of bridges and buildings it is necessary for the architect to cooperate with the engineer and to study the engineering problems involved in their construction. It is not necessary for the architect to go into the problems as deeply or as thoroughly as does the engineer, but he should have an intelligent idea of the principles involved so that he may not only talk intelligently on the subject but may be able to make plans that are plausible and practical from an engineering viewpoint.

Several very useful and usable reference and text books on the technical phases of building have been compiled by George A. Hool, S. B., Consulting Engineer and Professor of Structural Engineering at the University of Wisconsin, and W. S. Kinne, B. S., Professor of Structural Engineering at the same institution. This series consists of volumes on: Foundations, Abutments and Footings; Structural Members and Connections; Stresses in Framed Structures; Steel and Timber Structures; Reinforced Concrete and Masonry Structures; and Moveable and Long-Span Steel Bridges.

The volume on Steel and Timber Structures, which is the subject of the present review, is compiled by a staff of experts who act as associate editors. This staff includes such men as O. A. Bailey, Chief Engineer, Chicago Bridge and Iron Works; W. C. Buetow, State Bridge Engineer, Wisconsin; C. W. Chase, Drawing Room Engineer, American Bridge Co.; Charles D. Conklin, Jr., Civil and Structural Engineer, Cheltenham, Pa.; F. W. Dean of Wheelock, Dean & Bogue, Inc.; F. W. Dencer, Engineer, American Bridge Co.; Henry D. Dewell, Civil Engineer, San Francisco; Phil A. Franklin, Structural Engineer, McClintic Marshall Co.; T. W. Golding, Consulting Structural Engineer, New York; James H. Herron, President, James H. Herron Co., Engineers and Chemists, Cleveland; C. K. Kennedy, Drawing Room Engineer, American Bridge Co.; H. E. Pulver, Associate Professor of Structural Engineering, University of Wisconsin; and Hermann von Schrenk, Consulting Timber Engineer. The volume starts with a section on buildings which consists of a discussion of steel office buildings by F. W. Dencer; steel mill buildings by C. W. Chase and C. J. Kennedy; timber framed floors and roofs by Henry D. Dewell; and slow-burning timber mill construction by F. W. Dean. All these types of construction are thoroughly discussed and illustrated by the use of formulae, tables and diagrams. Section 2 gives a thorough description of roof trusses by W. S. Kinne, under these sub-headings: General Design; Design of Purlins for Sloping Roofs; Detailed Design of a Wooden Roof Truss; Detailed Design of a Steel Roof Truss; Detailed Design of a Truss with Knee-Braces; Arched Roof Trusses; and Ornamental Roof Trusses. Section 3 is divided into two parts, one dealing with steel railway bridges by George A. Hool and W. S. Kinne, and steel highway bridges by W. C. Buetow. Timber bridges and trestles are discussed by Phil A. Franklin in Section 4, and steel tanks by O. A. Bailey in Section 5. The design of chimneys as discussed by H. E. Pulver in Section 6 will be found very useful and highly instructive.

PROVINCIAL HOUSES IN SPAIN

By Arthur Byne & Mildred Stapley

In this volume two well known writers on Spanish architecture and decoration review the various forms which are given to the small or medium sized house in Spain. To render the work as helpful as possible to architects, the authors have included many plans and drawings of different kinds, details of such exterior parts of buildings as friezes, cornices, windows, timber overhangs, soffits and balconies, or such interior parts of the structure as ceilings, fireplaces, doors and stairways. Part of the work deals with the tiles, pottery, ironwork, plaster in relief and the other forms of craftsmanship which contribute so much to the excellence of domestic architecture in Spain. It is a work likely to be invaluable to the designer.

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CONSTRUCTION IN LONDON
From a Pen Drawing by Harold Mundy

The Architectural Forum
THE PROTECTION AND MAINTENANCE OF STRUCTURAL STEEL

BY
FRANK W. SKINNER
CONSULTING ENGINEER

UNDER ordinarily careful treatment, with reasonable conditions and requirements, the steel framework of a building can be relied on for strength and safety. At the same time, it conforms most readily to architectural aesthetic and economic requirements, occupies a minimum amount of space, permits maximum dimensions of construction, rapidity of erection, ease of repairs, and demolition or extension in service. Structural steel for architectural purposes must almost of necessity be designed in accordance with accepted rules and standards. It must conform to well perfected types and details, be entirely fabricated by skilled workmen with machine tools in special shops, and erected by experts with special equipment which largely eliminates the probability, and most of the possibility, of bad workmanship, poor materials, mistakes, accidental damage, or departure from intended structural type.

Although within the 40 years since structural steel became commercially available for architectural purposes there have been no failures of buildings caused by the deterioration of the steel framework, the safety and durability of the latter have been unjustly attacked, and some prominence has been given to untrue statements concerning it. Within a few months metropolitan newspapers have been given currency to a wholly unwarranted statement that the structural steel frameworks of tall office buildings and the like have been found seriously damaged in service. It was said that they are likely to be, or soon to be, in a highly dangerous condition; that their life is very short and that they require very frequent and extremely rigid inspection, overhauling and repairing to avoid disaster. Such is far from being the case. The erroneous statements have been fully refuted in the public press and no contradiction has been made to the refutation. The present standard practice produces steel framework of ample strength, accurately proportioned for the required service and with a high degree of perfection in design, materials, and workmanship that, under proper conditions, insures practically unlimited safety and durability. Under ordinary conditions that govern the design and construction of steel buildings, the steel will never deteriorate through working stresses, because, unlike other materials, it retains its original strength, elasticity and reliability. So much has been achieved by the metallurgist, manufacturer, designer and builder, that it remains for the architect and owner only to insure conditions and treatment that will maintain the original integrity of the structure unimpaired by any anticipated future conditions. The vital points that practically govern the durability and safety of completed structures are: corrosion, fire hazard and the proper inspection and maintenance after erection. Their important practical features are here treated.

Corrosion. Under certain conditions, some of which are often continually present, all materials are subject to deterioration; wood will decay, stone and concrete will spall or disintegrate; brick and metals are subject to chemical changes that may be destructive. Almost the only agent destructive to structural steel under ordinary working conditions is corrosion, which is possible only through the presence of moisture or acids. Its prevention eliminates almost all possibility of deterioration of strength except by reason of accident, abuse or malicious treatment. Fortunately, corrosion can be absolutely prevented by keeping the steel perfectly dry and by avoiding contact with acids, fumes or liquids. Generally this is practically accomplished either by insuring a pure dry atmosphere, by encasing the steel in a solid protecting the mass, or by thorough painting. Unprotected steel should not be imbedded in cinder concrete because elements often contained in the latter are likely to promote rapid corrosion. Stone concrete or cement mortar well rammed around the steel and completely enclosing it gives a most excellent and satisfactory protection when thoroughly waterproofed. When it is applied the steel should not be covered with any oil paint, since the chemical action of the cement tends to sapontify the oil and makes the paint injurious rather than beneficial. Unpainted steel may be covered with graphitic or asphaltic paint, which is often used for steel in footings, in foundations, and when exposed to wet earth. Concrete encasement is also suitable for the protection of superstructural steel when it is desirable for architectural or other purposes and
where it is properly applied, secured and water-
proofed. The first inspection is likely to be the last.

In general, structural steel of all sorts may be sa-

tisfactorily protected by thorough painting. Before
the first coat of paint is applied, the steel should be
throughly cleaned; grease, scale and all dirt, old
paint or other substances removed either by scrapers,
wire brushes, washing or sand blast, and it should
immediately after be treated with one or two coats
of red lead and oil thoroughly applied on a warm,
dry surface. This paint should be protected by one
or two coats of some good elastic paint such as
white lead and oil or other standard metallic paint.

When columns, lintels, girders and other members
are enclosed in outer walls, whether of concrete, or
brick or stone masonry, the latter should be thor-
oughly waterproofed on their outer surfaces. They
should be provided with horizontal water stops over
horizontal members, and the steel members them-
selves should be thoroughly parged with cement mor-
tar and the space between them and the masonry
slushed full of mortar.

Some railroads and certain interests having large
quantities of structural steelwork to preserve have
developed special formulae for their paints. It has
been found that under different atmospheric condi-
tions, different formulae are necessary, since a paint
giving excellent protection in one place may not do
so in another place. Paint for the steelwork en-
closed in buildings is, however, much easier to se-
lect and more durable than that applied to outside
structures such as bridges. When repainting any
structure, it is very necessary to first thoroughly
clean it and especially to remove all dirt and rubbish.
Cavities, pockets and narrow clearances likely to
retain dirt or moisture should be filled with solid
cement or some other waterproof material to protect
the paint and prevent the accumulation of moisture
or the development of corrosive acids from decaying
materials. Where the steelwork is thoroughly pro-
tected by concrete or masonry covering, or where it
is exposed in a dry atmosphere under cover, the
original paint may remain effective for many years,
and practically require renewal only for decorative
purposes; but where the steel is exposed to wet or
salty atmosphere, the fumes of cooking or any other
acid condition, it should be frequently inspected and
have thorough painting as often as the paint may
show signs of deterioration. Originally exposed steel
in the interiors of buildings will not require frequent
painting, but exposed work may require painting
every two or three years or oftener. If thoroughly
painted with good materials and at sufficiently fre-
quently intervals, it will afford complete protection for
the steel against corrosion.

Fire Hazard. Steel is uninjured by ordinary at-
mospheric temperatures. Its strength is normal up
to 200° Fahr, and increases about 25 per cent as

Beams and Girders with Steel Fabric in Place to Receive Pneumatically Applied Cement Fireproofing
the temperature rises to 500°, decreasing to normal at 800°, and to less than half the normal (to approximately the maximum permissible working stress in columns) at 1000° Fahr., above which temperature it should never be called on to carry compressive stresses. Steel is fireproofed by casing it in a complete, durable, strong covering of incombustible, refractory material that may or may not enclose an air space around the steel. Usually the encasing material is brick, tile, gypsum or concrete, with a minimum thickness of from 2 to 8 inches. If concrete is used, it should be reinforced and anchored to the steel. Concrete may be poured in moulds, or may be plastered by hand, or installed by pneumatic pressure, which increases the strength and density of thin bodies of concrete.

Most large American cities and several insurance companies and technical organizations have prepared very careful specifications to govern the fireproofing of steel structures. The specifications recently issued by the American Institute of Steel Construction provide that: “Fire-resisting insulating material shall continue to function within the temperature range of its use, and shall be so applied that it will not crack, spall, or buckle to seriously expose the steel to direct heat from fire. If the insulating of columns contemplates the use of air spaces between the steel and the insulator, there shall be fire stops placed at the floor levels. Steel buildings whose condition of exterior exposure and whose contents under fire hazards will not produce a temperature greater than 800° Fahr. in the steel shall be considered fire resisting without insulating protection for the steel. If the steel has an insulating protection, the safety factor shall be based on the fireproofing material providing protection for a greater period of time than the combustible contents of the building will burn, as shown in Section 3 of this specification; 16 pounds per square foot of combustible materials including wood floor and wood trim, constitutes a 1-hour fire hazard, 30 pounds a 3-hour hazard, 40 pounds a 4½-hour hazard, etc. The safety factor for all skeleton frames and secondary members shall be 1½. For example, if a building contains 10 pounds of combustible material per square foot of floor, and has a fire hazard of 1-hour duration, the steelwork shall be protected against the temperatures here defined for 1½ hours.”

Fire Protection Specifications

The tentative 1927 specifications of the National Fire Protection Association, Boston, require that all structural steel members which support loads or resist stresses shall have a fireproof protection of brick, concrete, hollow building tile or gypsum, plaster being unacceptable. Poured-in-place gypsum or concrete shall be secured by steel anchors. Bricks or blocks shall be accurately fitted and bonded, and the spaces between them and the structural steel shall be filled solid with masonry or concrete. Bricks

Encasement on Beams and Girders is Solid, but that on Truss Members is Hollow, Enclosing Air Spaces
The requirements of the building code of the National Board of Fire Underwriters correspond in general to the specifications of the Fire Protection Association and say that hollow building tiles for fireproofing must have webs and shells not less than 5⁄8 inch thick. Galvanized steel wire, not less than 12 gauge, shall be securely wrapped around block column coverings so that every block is crossed at least once by a wire. The wire shall not be wound spirally, but each turn shall be a separately fastened unit. Interior metal ties or interlocking blocks are preferable to the wire winding. No blocks shall exceed 12 inches in vertical dimension. Hollow tile protection for the lower flanges of beams, etc., shall be dovetailed to or integral with the skewbacks, with solid mortar joints. All concrete protection shall be anchored to the structural steel member with interior pieces securely hooked to the enclosed members.

In discussing the most efficient type of fireproofing for structural steel columns, H. G. Balcom, consulting engineer, recommended a solid jacket of limestone concrete anchored to the column flanges.

Long Roof Trusses of Madison Square Garden in Perfect Condition after 35 Years of Service
A very popular alternative is the use of terra cotta blocks on all sides of the column. He recommended for ordinary beams a solid encasement of anchored concrete integral with the floor or ceiling slabs. For deep girders, the bottom flange may be protected by cinder concrete and the sides by properly secured terra cotta blocks thoroughly joined to the floor slab. Kort Berle of the Gunvald Aus Company, consulting engineers, recommended that beams and girders be fireproofed with solid concrete encasement, and that interior columns be enclosed in a solid mass of concrete or brickwork of a minimum thickness of 2 to 4½ inches respectively. Exterior columns should have one shop coat and one or two field coats of approved paint and in addition should be well parged.

There are various types of commercial fireproofing systems and details, and special provision is made to prevent the running of any pipes, wires or conduits inside the fireproofing jacket of any column or girder, entirely separate protection or chases being provided for them as is required by the building codes. Ordinary standard specifications, construction methods and equipment suffice for fireproofing concrete that is poured in forms, but to secure the durability, strength, hardness, watertightness and greatly decreased volume and weight, fireproofing pneumatically applied to any steel members should be made with the proportions of one bag of Portland cement well mixed with 3 cubic feet of dry screened sand under a minimum pressure in the receiving chamber of 30 pounds, mixed at the discharge nozzle with clean water at 60 pounds, and delivered at right angles to the fireproofed surface. The fireproofed members must be thoroughly cleaned of all paint, grease, rust, etc., and have ½-inch holes approximately 3 feet apart in the webs close to the top and bottom flanges. Anchor rods shall be secured through these holes, and to them longitudinal rods shall be attached and wired about every 12 inches to galvanized welded fabric or expanded metal of required size and weight that has been carefully cut to size and bent over templates so as to closely follow the outline of the member and insure a minimum thickness of ¾ inch of protection.

The outer edges of flanges and stiffeners are squared to true lines by the use of detachable "shooting strips." The main surfaces of girders, beams, columns, etc., are trued before the cement sets, by cutting off all high spots with the sharp edge of a trowel and dragging the surface with a wide, long-haired, wet, whitewash brush. Cement must not be placed during freezing weather, nor against frosty surfaces, and it must be kept wet for at least one week after placing. In no case shall the thickness of the cement be less than 1½ inches on vertical surfaces and above horizontal surfaces, and not less than 2 inches below bottom surfaces and around edges of lower flanges. Thickness shall be measured from the surface of the steel and not from the tops.
of rivet heads. A Columbia University test of a pneumatically built cement slab was made with an average temperature of 1695° Fahr. for three hours, combined with a load test of 40 pounds per square foot, and after cooling, a load test of 200 pounds without failure, the 200-pound load producing tensile stresses of 7,450 and 62,000 pounds per square inch in the concrete and steel, respectively.

**Examples of Steel and Wrought Iron Buildings.**

No deterioration was observed in small wrought iron beams removed after nearly 100 years' service in an old shot tower in New York. The roof trusses over the main shop of the Dominion Bridge Company, Montreal, erected in 1884, have been seriously overloaded, exposed to very injurious smoke and fumes, seldom repainted and never reinforced, yet they are still in service, and are considered to be in good condition. The Woman's Temple, one of the first so-called steel frame buildings in Chicago, was removed after 33 years, and only very slight deterioration was found in any of the steelwork. The Tower Building on lower Broadway, erected in 1888, was called the first steel cage building in New York, and its I-beams were in good condition when removed after 26 years' service. After 30 years' service the steelwork in the Benoist Building, St. Louis, was found as good as the day it was erected. I-beams in the Rand & McNally Building, one of the first tall buildings in Chicago, were recently exposed during its demolition and found uninjured. About 300 tons of steel I-beams were salvaged and re-used in new building construction after 25 years' service in a New York hotel. When recently demolished to make room for modern structures, the steel frameworks of the Savoy, New Netherland, and Delmonico Buildings, New York, were found in good condition. Well protected steelwork, although exposed to dust, moisture, and sulphurous fumes, does not show deterioration in two generating stations and 13 sub-stations about 30 years old of the Brooklyn Edison Company, the framework being now in perfect condition. On a 40th Street, New York, sidewalk, I-beams, only partly waterproofed, showed no deterioration after 20 years' service. Foundation girders in the Samson Building, New York, were painted with graphite and asphalt, and were found uninjured after 22 years' exposure to drip and moisture. Many hundred tons of structural steel and iron were used in the roofs, floors, columns, and great trusses of the famous Madison Square Garden, New York, which was built about 35 years ago. When it was razed in 1925, careful inspection was made of its framework, and except for a very small portion of the ornamental top of the tower (perhaps 1 per cent of the whole) that was exposed, unprotected, seldom or never visited, and entirely neglected, all of the steel and iron was found in perfect condition; as good as new. Large quantities of the I-beams were salvaged for re-use, and the great long span roof trusses were very carefully removed and stored for re-erection in a new building. Generally the I-beams provided by the demolition of old buildings are salvaged, cut to required lengths and sold for erection in new buildings. Columns, girders and other fabricated members could also be salvaged if their details and dimensions were adaptable to new work.

Jacob Volk, New York house wrecker, says: "In the demolition of more than 200,000 tons of structural steel and iron, the condition of the steel has been found, in general, excellent, and 90 per cent of the floor beams are reused." E. A. Prentis, president, Spencer, White & Prentis, New York, who for many years has done a large amount of underpinning, exposing old foundations at and below ground water level, says: "Usually the steel in them is in good condition; never dangerously corroded. In designing thousands of foundation piles made of heavy steel pipe, filled with concrete, an excess of 1/16 inch in thickness is ample to allow for corrosion. That portion of the unpainted pipe driven into clay or firm soil sometimes does not corrode at all, but usually the exterior does corrode a little, and the corrosion ceases, the oxidized steel combining with the earth to form a hard, dense jacket, resembling iron ore, that, when knocked off, discloses a
bright, smooth, clean, uninjured metal surface, apparently free from progressive corrosion. This condition has been repeatedly observed in the oldest piles of this type in New York that have been in service 20 years or more. Answering charges of deterioration of the famous Eiffel Tower, erected in an exposed situation in Paris, M. Hubie, Chief Engineer 16th Arrondissement, Paris, and Secretary of the Eiffel Tower Inspection Committee, recently wrote: “We do not see any reason why the Eiffel Tower should not last indefinitely if properly cared for,” and C. Marc, C.E. Administrator of the Eiffel Tower Society, says: “The Tower is in as good condition today as the day it was built.”

In an exhaustive research of structural steel in the United States and Canada, conducted in 1926 by the writer for the American Institute of Steel Construction, a questionnaire of 63 interrogations on their practice, observation, records, opinions and beliefs regarding the principal features of the deterioration, durability, and best maintenance of structural steel was addressed to more than 1,000 of the most eminent engineers, architects, and builders in this country and Canada. From about 17,000 items of replies received, and from conferences with, and letters from more than 200 prominent architects, engineers and contractors of long experience in New York, Boston, Philadelphia, Chicago, San Francisco and other cities, these details were tabulated:

The safety of a structure in general is not endangered by corrosion.

There need be no fear of serious results from corrosion in well designed and maintained buildings. Serious corrosion in buildings would become obvious to reasonable inspection before the building could be endangered.

The worst peril from corrosion is due to accumulation of dirt and filth, from exposure to moisture, salt air, acid fumes, brine, and other artificial conditions.

All steel may be protected from corrosion.

The protection of buildings from corrosion may be 94 per cent perfect.

The best protection from corrosion is afforded by painting and cleaning.

Very efficient protection from corrosion may be afforded by enclosing it in dense, fine, stone concrete.

Unless buried or encased in concrete, steel should be protected by a priming coat of red lead paint followed by an elastic coat of waterproofing paint. Graphite or asphalt paint should be used rather than oil paint on steel enclosed in concrete.

Exterior walls containing steel members should be waterproofed, and stop courses built over lintels and wall girders.

There is no limit to the life of properly protected steel.

The worst neglect causing corrosion is failure to keep it clean and dry, and failure to provide good and adequate painting.

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Mutual Fire Insurance Companies, the National Board of Fire Underwriters, and the United States Bureau of Standards. They were made to ascertain, first, the ultimate resistance against fire, of protected and unprotected columns as used in the interiors of buildings; second, their resistance against impact and sudden cooling from hose streams when in a highly heated condition. The columns were of ten standard cross sections, with cross sectional areas varying from about 7 to 14 square inches, lengths of about 12½ feet, and designed for working loads of approximately 100,000 pounds. They were tested without protection; partly protected by concreteing interior and re-entrant spaces; protected by 2-inch or 4-inch thicknesses of concrete, hollow clay tile, clay bricks, gypsum blocks; and by single or double layers of metal lath and plaster. The load pressure was uniformly maintained while the columns were heated in a gas-fired furnace whose temperature rise was regulated to conform with a predetermined time-temperature relation. Elaborate measurements were taken of the temperatures of the furnace and test columns, and of the deformations of the latter, due to load and heat.

Fireproofing was applied so as to reproduce, as nearly as possible, conditions obtaining in building construction. The machine-mixed concrete was spaded inside the forms which were tapped with hammers. The overlapping joints of wire lath were wired, the lath was supported on ½ x ¾-inch channels, and the plaster coats were of maximum thickness. Hollow tiles and bricks were set in cement mortar, and when concrete was placed between tiles and column, the tiles were held in place by clamps 2 feet apart. Gypsum blocks were set in 1:3 gypsum mortar. The load pressures were applied by a hydraulic ram of 545,000 pounds' capacity and an accuracy usually within 1 per cent. The 7 x 7-foot brick testing chamber 12 feet high had four primary gas burners in the corners that were supplied through a ½-inch nozzle. The columns in the fire test series were subjected to a constant working load and fire exposure, increasing according to a predetermined time-temperature relation until failure occurred, or until they had withstood the test eight hours or more.

In the fire and water tests, the working load was maintained constantly, and the column exposed to fire for a predetermined period when water at given pressures was applied by means of a hose stream. In case the columns withstood the fire test, they were immediately loaded to failure under full fire exposure. In the fire and water tests, three columns were loaded to failure after they had cooled, and four columns were loaded to twice the applied working load and then reserved for further tests. The time to failure in the fire test extended from the beginning of the test to the time when the column was unable to sustain the working load. The duration of the fire and water test period varied from 22½ minutes to one hour, and that of the subsequent water application from one to five minutes. The length of the maximum period of fire was the time within which the water is generally applied in building fires, estimated at one hour.

Maintenance. In order to insure the continued integrity of the steel framework of a building that has been properly designed, constructed and protected as has been here described, it is necessary that it should receive adequate periodical examinations and such maintenance as is required to prevent any injury or to correct any incipient trouble. Certain portions of the structure,—such as the steelwork in the foundation and footings and the steel embedded in exterior walls scrupulously protected with adequate covering,—are undoubtedly permanently safe, and need never be disturbed, notwithstanding the hysterical demands of a newspaper which insisted that the walls and foundations of important structures should be frequently torn open.

Wherever there is reason to fear the penetration of corrosive liquids, gases or moisture, there should be preventive measures taken. Ordinary corrosion, though it may present a rough and a scaly exterior, is seldom structurally important, unless long continued, and a very rough surface may not indicate the loss of 1 per cent of the original strength and efficiency of the member, an amount which is entirely admissible without impairing the safety of the steel. Extreme cases of excessive and prolonged corrosion may demand the replacing of the member. Usually a casual examination of the most exposed and vulnerable parts of the interior framework will indicate whether corrosion is present, and if found, it generally is necessary to repaint only the member and maintain the required protecting jacket to insure its safety. When local spots of corrosion are detected, they should be removed immediately and the places covered with one coat of red lead and oil plus the application of an additional coat of paint entirely covering the structure or members.

Exterior steelwork must be carefully and thoroughly inspected at intervals of from three months to one year, according to the character of the structure and the conditions obtaining. Two kinds of metal must not come in contact where there is a possibility of there being moisture. There should be no narrow spaces between or around steel members or portions thereof, and there should be no contact with dirt, rubbish, or any other materials at places where moisture or filth can accumulate. If such are inevitable, they must always be frequently exposed and cleaned, unless it is possible to eliminate them by filling with solid waterproof, watertight materials. The greatest care must always be taken to keep steelwork clean and dry. Accumulation of any kind of dirt or rubbish must never be permitted. If it is kept clean, and dry, and well painted, the steel's working life should be unlimited. Proper protective encasing of steel insures its structural integrity.
RESILIENT flooring materials are the outgrowth of a definite need for a suitable and economical floor over wood, concrete and other hard floor surfaces, and for a material which can be easily applied as a replacement floor over old floors of any type. Cork composition products and rubber are the principal flooring materials having resiliency as a dominant characteristic. They have been evolved through many years of development and improvement, and have today reached a state of perfection and quality which places them very definitely in the class of quality materials having distinctive characteristics not present in similar combinations in any other type of floor surfacing material.

We are concerned in this discussion primarily with cork and cork composition floorings, which are known in the trade under the general titles of linoleum, linoleum tile, natural cork tile, and cork carpet. The evolution of cork composition flooring materials from the status of a floor cover to that of a finished flooring material has been slow, and architects have only recently awakened to the intrinsic values which such materials possess as contrasted with their use primarily as substitutes or replacement coverings. It must be acknowledged today that these products have earned for themselves a definite, permanent place in the building field, and that they offer to architects, builders and owners new opportunities for creating special effects in color, pattern and texture and for introducing other values of comfort, quietness, sanitation and maintenance that particularly adapt them to solving many modern flooring problems.

**Types of Cork Flooring Products.** The various types of resilient flooring materials, of which cork in some form is the principal component, each possess special characteristics which make it important to differentiate one from the other, both in this discussion and in the use and specification of such materials. The prevalent use of trade names to distinguish the various types of products is somewhat confusing, and we must go back of the distinguishing and commonly employed trade names and classify the products in another manner. There are three major classes of cork flooring products; (1) cork composition floorings, broadly termed linoleums and linoleum tiles; (2) natural cork tiles; (3) cork carpets. Their characteristics deserve consideration.

**Natural Cork Flooring Products.** Cork tiles are composed of particles of cork, such as the thin shavings of cork which are largely produced as a byproduct in the manufacture of cork bottle stoppers. These particles are compressed under heat in such a manner that the natural gums of the cork are liquefied and form the only binder required to produce a firm, rigid, and homogeneous product. The better grades of natural cork tile contain nothing but pure cork without any of the harder bits of cork bark or other foreign ingredients. The tile forms come in various size, usually in square or rectangular shapes, and in thicknesses ranging from approximately \( \frac{3}{4} \)-inch to \( \frac{3}{8} \)-inch.

Natural cork tiles take their color from the cork itself and from the baking process which is essential to their manufacture. They are thus available only in natural cork browns of various shades, ranging from light to dark, according to the amount of heat applied. The extreme hydraulic pressure usually employed in the manufacture of cork flooring produces a material which is quite resistant to wear and abrasion, and which is at the same time highly resilient, quiet, and pleasant to walk upon.
Embossed Inlaid Linoleum Indicating Adaptability to Definite Architectural Styles

**Cork Composition Flooring, Linoleum.** In this type of flooring, ground cork is a principal ingredient. The cork is pulverized almost to the fineness of flour and is mixed with oxidized linseed oil and various gums, fillers, and pigments. The mixture is compressed under huge heated calendar rolls onto a burlap backing employed as a measure of reinforcement on the underside. A process of curing the cork composition aids in producing a firm, homogeneous material of considerable resiliency which will not buckle or crack and which is practically free from odor. Cork composition floorings are available in many forms and in a number of distinct types. The sheet forms may be classified as Battleship Linoleum, Jaspe, Inlaid Linoleum, Embossed Linoleum and Marbleized Linoleum.

Battleship Linoleum is a high quality, plain color cork composition flooring in sheet form, which earned its name from its original use as a decking material over the steel decks of warships. It is available in various thicknesses from slightly less than $\frac{5}{8}$-inch to a full 1-inch.

Jaspe Linoleum is distinguished by its striated pattern in two tones of a single color, giving a variegated effect and a characteristic appearance of graining. It is otherwise similar to Battleship Linoleum in its composition, and is usually available in three weights. Small insets of contrasting color are frequently used in Jaspe Linoleum with interesting effects.

Inlaid Linoleums have various patterns in which each individual color runs through to the burlap back. In surface appearance these linoleums often resemble a floor laid with individual tiles, but possess the advantage of lower initial cost and considerably lower laying cost because of its sheet form. This type of linoleum is available in many combinations of colors and in a wide variety of patterns, some of the small tiles forming resembling mosaic tiles, and some patterns resemble quarried tiles or blocks of cut stone or slate, as well as other designs.

Embossed Linoleums are usually inlaid linoleums in which an apparent joint is introduced between the tile units of the pattern, and this joint is compressed below the surface of the sheet to give the appearance of a masonry joint in a hard tile floor. The tiles themselves may also be embossed for decorative effects.

Marbleized Linoleums are classified separately because of their special appearance. Ingenious processes of manufacture result in producing a variegated color effect which resembles with remarkable fidelity the color and appearance of fine marbles, there apparently being no limitation to the manufacturing process in the reproduction of all types of colored marbles. Marbleized Linoleums may be in either full sheet forms, in which the marbleizing effect is carried out over the entire sheet, or of the inlaid type, having the appearance of blocks of marble laid in pattern.

The tile forms, which are sold under various distinguishing trade names, are essentially the same as in the sheet forms in composition but are usually available only in plain colors or in marbleized effects. They are in addition a number of newer types constantly being developed which produce various special flooring effects, including a reproduction of wood plank floor, accomplished by using the Jaspe Linoleum with inset joint strips, pegs and butterfly wedges of darker color. The tile forms are in plain colors and in marbleized effects. Some manufacturers are producing an embossed tile for special uses which have the appearance of decorative faience tiles and which are employed to introduce variety and interest in the pattern of a floor. The architect has at his disposal, in these materials, floorings to harmonize with any designs.

**Cork Carpet.** Though frequently classified with linoleum, cork carpet differs somewhat from both cork tiles and linoleums. It is composed of granulated cork using a different proportion of cork and linseed oil from that usually employed in Battleship Linoleum. It is compressed under heat. As the name implies, it is manufactured in sheet forms. It comes in several solid colors, and in thicknesses of approximately $\frac{1}{8}$-inch (polished) and $\frac{1}{4}$-inch (unpolished). Cork carpet has not the density nor therefore the resistance to wear of the several types of cork composition flooring materials, but its great resiliency and relatively low cost give it a very
definite utility for solving certain flooring problems.

These classifications cover the principal standard types of cork composition flooring, but it should be noted that each individual manufacturer is constantly developing new combinations and new patterns which have their special uses from both the decorative and service point of view. The essential features here noted, however, may be applied to the newer forms, and hence an extended discussion of them is not necessary before we proceed to the next consideration.

An important new development in the manufacture of linoleum and cork composition flooring materials is the utilization of pyroxylin or nitrocellulose lacquers to produce a surface wholly impervious to moisture, dirt and to the staining effects of many common materials such as ink, foods, greases, mild acids, and even synthetic glues. The lacquer finish is not merely a surface painting in the ordinary sense, for the leading manufacturers while retaining in secrecy the exact nature of the process employed, claim and demonstrate that there is a certain amount of penetration of the lacquer into the upper strata of the material, although no manufacturers claim complete penetration. The lacquer functions to close the minute pores in linoleums and other cork composition flooring products so that ordinary dirt and dust will not be ground into the surface, vastly simplifying the cleaning and maintenance operations. The nature of the lacquer employed is such that most common substances which will normally stain wood, marble, concrete and other types of flooring will not penetrate into the cork compound, and a spot can be readily wiped off from the surface without leaving any stain or mark. To a large extent the lacquer treatment eliminates or minimizes the need for waxing linoleum floors for their maintenance and preservation, although wax may be applied as usual if desired. Undoubtedly this new development marks a real advance in improving the life and utility of cork composition flooring materials, giving added qualities of sanitation, low maintenance cost, improved appearance and probably greater durability.

Appearance and Service Characteristics. While architects universally appreciate the decorative importance of floors in every type of room where architectural design deserves the least consideration, they also know that the selection of flooring materials must depend also on many service factors, including durability, safety (which means freedom from excessive slipperiness when either wet or dry), ease of maintenance, ease of replacement, sanitation, quietness and comfort, and economy. To a surprising degree, cork composition and linoleum floors possess the qualities of an ideal flooring material. It is hardly necessary to stress the appearance factor. The variety of colors and patterns available, not only in the sheet forms of linoleum, but also through the employment of the tile forms with which the architect can develop individual patterns to meet the specific design problems, is equaled by no other type of flooring. Color in almost unlimited variety is available in all forms except Battleship Linoleum, cork carpet and natural cork tile; the latter being confined to natural brown tones, and the first being available only in a limited number of plain colors, though special colors can be produced on large orders. The use of sheet linoleums and the tile forms in combination, one for the border and the other for the field, and the opportunities for developing special patterns by inlaying the sheet forms with decorative units of almost any required shape and color, gives further versatility to this type of flooring and challenges the ingenuity of the architect to create decorative effects appropriate to every architectural style, and to every design problem.

We have already noted the inherent resiliency of cork composition products, which is responsible for their making an exceptionally quiet and comfortable floor. From the safety angle, linoleum and cork flooring materials possess the well known non-slipping characteristics of plain cork when either wet or dry. The use of a wax finish for maintenance purposes introduces a slight hazard, but if the wax is thoroughly rubbed in and polished it does not pre-
Occasional washing with a mild household soap, washing a small area at a time and following the washing by immediate wiping with clean water, is permissible a few times a year, but the waxing process alone should be sufficient to remove surface dirt and leave a clean and fresh surface. Many of the difficulties that have been encountered with linoleums in the past have been due to the excessive use of water and strong soaps in their daily maintenance. These service characteristics are accompanied by ease of replacement where worn spots must be removed, a feature particularly notable with the tile forms, one or more of which can be readily taken up and replaced without relaying the entire floor. They are also accompanied by the important factor of considerable initial economy, for linoleum and cork floorings are less expensive than any other type of finished flooring material or floor covering, having equal characteristics of quality, durability, resiliency, color and pattern.

Proper Use of Cork Composition Floorings. The selection of flooring materials is properly based upon their characteristics and cost, and it is hardly necessary to itemize the types of floor space for which linoleums, cork composition tiles and pure cork flooring materials are adapted. It is sufficient to note that they have properly come into general use in residences of all types, and in any room, not as a substitute material, but primarily because of their distinctive features which adapt them to both the decorative and service requirements of domestic interiors. They have earned a prominent place in commercial and institutional buildings, particularly those which have concrete structural floors, because of their resiliency, comfort and quietness, their ease of maintenance, their excellent appearance, and their low cost. The Battleship Linoleums particularly make excellent service floors in commercial, industrial and institutional buildings of all types where trucking is not required.

One precaution should be noted in connection with
the use of resilient flooring materials. Heavy furniture standing on small casters or slender legs may compress the flooring and form a disfiguring indentation which will be apparent whenever the furniture is moved. For this reason architects should take care that their clients utilize wide face casters, caster cups, or the newer types of broad faced sliding casters or gliders on all furniture, a matter that is equally important for the protection of fine wood or marble floors.

In specifying linoleum and cork composition flooring materials, the architect should be concerned primarily with two considerations. First, the service characteristics of the floor should be adapted to the traffic which it must bear. The quality of the flooring material should also be related to the service requirements, for as in the case with every other building product, there are wide differences in quality and cost, and usually the best grades are lower in ultimate cost than the cheap products.

The second consideration involves the problem of laying. It is impossible here to describe in detail the correct laying methods for each type of floor, and it is quite unnecessary to do so, for the best results are obtained when the manufacturer's instructions are made a part of the specification and where, if possible, the floor laying contractor is one whose work is approved by the flooring manufacturer. The reason for this lies in the fact that use of correct laying methods produces a far superior result,—to such an extent that the method of laying is often considered of importance equal to the quality of the flooring material. Careless contractors and those who are untrained in the work will not only use inferior cements but will frequently omit the rolling and the use of sand bags or weights to hold the linoleum or tile in place while the cement hardens.

The manufacturer's specifications should also be followed with respect to the preparation of the subfloor surfaces and to the use of suitable flooring felts under linoleums and sometimes of rosin-sized paper under cork tile, where these materials are installed over a wood floor. With these simple precautions and with careful supervision of the work, the architect may be sure of a satisfactory floor. It is never desirable, however, to lay these floors on wood or ordinary concrete in direct contact with the ground, either on or below grade.

In summarizing, it is perhaps worth while to point out the importance of these low cost resilient flooring materials as an alternative for more expensive types of flooring in those cases where the construction budget has been exceeded in the early part of a project, necessitating a reduction in finishing costs.
This circumstance arises so frequently that architects are often put to a severe test of their ingenuity and inventive genius to find materials which will produce a desired decorative effect and at the same time represent a substantial saving over the cost of luxurious or heavier materials having the same appearance.

It is important to bear in mind that the comparative low cost of resilient cork and cork composition floorings, combined with their many excellent characteristics, renders them exceptionally well adapted to the economical flooring of all types of buildings, and in harmony with any architectural style.
GAS is serving the home owner in many ways not dreamed of when public utilities were first incorporated as "The Citizens' Gas Light Company" or under some similar title selected to suggest the scope of usefulness of this product. Executives of many of these utilities were gravely concerned when the use of electricity for illuminating purposes spread through the country like wildfire; they imagined that the knell of the gas industry had sounded. Fate was not so unkind, however, and the use of gas for cooking soon caused demands far in excess of the old lighting loads. Then came the beginning of the present phase,—the era of fluid fuels,—and far-seeing executives have already started aggressive campaigns for house-heating loads as well as for the other uses of gas that are now so much talked about,—refrigeration, incineration, air conditioning, and water heating. Also there came the development of industrial gas applications,—in laundries, bakeries, heat-treating and other metallurgical plants, for brick making, peanut roasting, and un-numbered highly specialized uses. It does seem passing strange that gas company officials wept at the thought of losing thousands of lighting customers who turned to electricity, when today there passes through a single meter, in any one of the great industrial plants, more gas than was registered in a multitude of little meters serving the house-lighting load of those old days,—and payment comes in a single check, in place of in thousands of small cash payments, with the requisite bookkeeping and accounting cost.

This article deals with the use of gas as a house-heating fuel; a second article will discuss the apparently paradoxical use of gas for household refrigeration as well as for the other comparatively recent applications, in the home. House-heating with gas, both natural and manufactured, is attracting the attention of the architect and heating engineer largely through a concerted and nation-wide educational campaign on the part of the organized manufacturers of gas, retailers of natural gas, and the manufacturers of gas-heating equipment. These activities were stimulated, if not initiated, by the tremendously rapid increase in the use of oil as a domestic fuel during the last three or four years. Several far-seeing executives of gas companies, in as many scattered cities, have quietly been working out the problem for the last ten or more years, and many of the
essential factors have been definitely established. The nation-wide campaign for this market has only started within the present year, and the next ten years undoubtedly will see an enormous growth in the ranks of gas users.

Broadly speaking, there are two kinds of gas fuels and two methods of using either. Natural gas, used in the gas areas and in large population centers to which it is piped, contains from 1000 B.t.u. to 1100 B.t.u. per cubic foot, and sells for from 35 to 60 cents per 1000 cubic feet. Manufactured gas is fairly well standardized at 535 B.t.u. per cubic foot, and costs, as a domestic fuel, from 70 cents to $1. Thus it will be seen that the home owner who has natural gas available at the average cost, pays 50 cents per 1,000,000 B.t.u., in contrast to the user of manufactured gas, who has to pay, on the average, $1.50 for the same quantity of heat. Either kind of gas can be burned in a boiler or furnace designed and built especially for the purpose, or a special type of gas burner can be installed in any furnace or boiler designed for coal,—this latter being termed a "conversion" installation. Quite naturally, conversion installations originated in the natural-gas areas, in the early days, when this fuel sold approximately for "a quarter" per thousand. Efficiency was not thought of, and the wastage seems criminal. Even today, in some of these sections, gas street lights are used and allowed to burn all day,—it is cheaper than paying for the labor of lighting and extinguishing!

From the technical standpoint, there are three interesting features of the gas-fired boiler or furnace. Gas is a hydro-carbon, with a large proportion of its contents hydrogen in both free and combined states. The natural consequence of combustion is the combination of this hydrogen with oxygen to form water vapor, in volume about equal to the volume of the gas. Approximately 10 per cent of the heat energy in the gas is represented in this transformation, and this cannot be utilized unless the flue gases are cooled to their dew point,—about 130° Fahr. On account of the large amount of water formed by this condensation, it is usually desirable to keep the fine gases well above this temperature. Conventional combustion practice has been to mix the necessary air for combustion with the gas prior to initiating combustion, producing the characteristic blue flame of the Bunsen burner. Gas burned for illumination, on the other hand, is emitted from a small hole in a burner, and the flame is filled with minute particles of free carbon, heated to incandescence before the oxygen of the surrounding air has an opportunity to combine with it; it is the luminosity of these particles that gives to this flame its high emission of radiant heat. The Bunsen flame, however, produced by gas burners, emits but little radiant heat. As a consequence, in boilers and furnaces designed for gas firing, little or no attempt is made to absorb heat energy radiated by the flame; rather, there is provided a comparatively large amount of flue surfaces, with
Even a Small House, such as this, may be Heated Economically with Gas where Rates are Favorable

This Gas Boiler, in the Small House Illustrated, is about a Foot Square

water on the opposite side in boilers and air in furnaces, for heat transfer from the hot products of combustion. It is this combustion characteristic that has dominated boiler design.

The third feature of the gas-fired boiler lies in the fact that combustion is best promoted when there is virtually no draft. Therefore, when a gas-fired boiler is attached to a chimney, a "draft-breaker" is inserted in the flue pipe, between the boiler and the chimney. This consists of a double-cone-shaped shell of sheet metal suspended in the axis of the smoke pipe, where a section of the pipe, 6 to 10 inches long, has been removed. A "skirt" is fixed to the upper part of the break. Hot gases flowing up the smoke pipe are carried around the double cone and up the chimney by virtue of the draft in the latter. Air is drawn in around the opening, nullifying the effect of the chimney pull on the boiler. If there should be a "back-draft," or downward movement in the chimney, it would be diverted by the cone and would pass out around the opening and not interfere with the functioning of the burner in the boiler. Thus a fixed draft, equal only to the flue action of the boiler itself, is maintained, regardless of fluctuations in the chimney due to combustion or to atmospheric effects. It is obvious that absolute and relatively high efficiencies can be maintained
This Typical Large Residence where Winters are often Severe is Heated Advantageously by Gas-fired Boilers

where gas automatically is fired at a fixed fuel rate, with a non-fluctuating draft, and with all vital conditions controllable for optimum operation. A uniform seasonal operating efficiency of from 80 to 85 per cent is well within reason, as against from 60 to 65 per cent in an oil-fired boiler and from 35 to 50 per cent where coal is hand-fired. It is for this reason, chiefly, that comparatively high-cost fuel can be used universally, especially where insulation is installed, and other controlling factors in minimizing heat loss from the building are favorable.

Conversion installations are not looked upon with especial favor by gas companies where manufactured gas is to be burned, chiefly because of prejudice based on the woefully inefficient makeshift installations which were common years ago in the natural gas fields. In the New York area, for instance, it probably would be difficult to induce a gas company to make a service connection to such a plant. However, in Baltimore, hundreds of gas burners have been installed in boilers and furnaces with very satisfactory results, many of these having a record of ten or more years of service. The reason lies in the careful study that was made when the house-heating load was first considered. The technique was developed until these conversion installations, as now put in, are almost equal in efficiency to a plant using...
ARCHITECTURAL ENGINEERING AND BUSINESS Part Two

Boiler Originally Using Coal Now Converted for the Use of Gas Fuel

a specific gas-fired boiler. To secure satisfactory results when burning gas in a boiler designed originally for coal, it is necessary to simulate, as far as may be possible, the combustion characteristics of coal. To this end a ring-shaped burner is set on the grates, so that the flame is close to the walls of the combustion chamber. A barrel-shaped form of fire brick is then built up on the grate, almost to the top of the combustion chamber, leaving an annular space for the gas flame. The idea is to heat this mass of brick both by the limited radiation from the inside surface of the flame and by convection, so that the radiation from it will act on the walls of the combustion chamber in a way very like that of a bed of red hot coal. If a rectangular boiler is to be equipped to burn gas, the burner follows the walls, and the fire-brick form also is rectangular. The material increase in efficiency when this plan is carefully followed can easily be demonstrated by running a test before and after putting in the bricking.

Realizing the vast number of house-heating plants of the coal-burning type now in use, and the possibilities for conversion, much experimental work is being done along this line, and it is within reason to say that developments recently brought to a head will make possible conversion installations that will equal, if not surpass, the best gas-fired boilers now available. A boiler or furnace using gas as a domestic fuel can probably be brought as near to perfection, on an efficiency basis, as can any energy-transforming device, and on account of the enormous potential annual consumption, this phase of the matter is occupying the minds of many executives, engineers and research workers. Curiously, the absolute efficiency of a boiler is not an exact criterion of its usefulness in the home. For instance, in determining boiler efficiency the heat radiated from the boiler jacket is charged against the boiler as a loss. This is because it represents heat not available at the boiler outlet, in water or steam. At the same time this heat is manifestly useful, in that it warms the basement, especially the ceiling, which is under the living rooms. Cold floors are not desirable, so the heat marked up as wasted by the boiler does serve a useful purpose. By the same token, at least a portion of the heat in the flue gases is utilized in heating the house, particularly if the chimney is inside. It is only necessary to take the temperatures of the flue gas at the bottom and top of the chimney to determine the useful effect of this so-called waste heat. In a certain research study, where a warm-air furnace was used, the net efficiency of the furnace, as computed, was only slightly over 30 per cent. Yet the net heat lost to the house was less than 40 per cent, and the real efficiency of the heating plant, as rated by the heat actually utilized in the house, was more than twice the calculated furnace efficiency. Taking these things into account, it is not unlikely that gas heating can be accomplished with an efficiency above 90 per cent.

Much of the confusion that has grown up in regard to the rating of coal-fired boilers has, happily, been eliminated in the consideration of gas-fired units. The American Gas Association, realizing the

Diagram of a Typical "Conversion" Installation here described
importance of logical and uniform capacity designations to those responsible for making rating recommendations and selection, as well as to owners, has brought about a logical and uniform scheme of rating, whereby products of manufacturers are tested in the Association's laboratory, and rated in B.t.u. available at the boiler outlet. This procedure removes one of the variables which the architect, heating engineer and contractor are least qualified to determine, and greatly simplifies the selection of a boiler for any purpose.

Two interesting considerations now make gas a desirable fuel for larger and better types of houses. Warm-air heating has, in the past, been used almost entirely for the smaller and cheaper houses, especially those built for speculative purposes. The everyday variety of warm-air installation admittedly has been "cheap,"—little more than a glorified stove with a tin can around it. Many furnace manufacturers were content with this class of market, and little progress was made in a half-century, so far as warm-air engineering was concerned. Less than four years ago leaders in that industry, and prime movers in the National Warm Air Heating and Ventilating Association, decided that some real engineering would be a good thing to stimulate development. So a research residence was built at Urbana, Ill., and since its completion it has been constantly in use as a field laboratory, under the direction of Professor

A C. Willard, of the University of Illinois, assisted by a notable staff of research engineers. Professor Willard has turned out to be the modern Moses of this industry, and more real progress has resulted from the efforts of the director and his staff in three years than was made in the quarter-century preceding. For another influence of vital importance to the development of gas heating we must look to the electric refrigerator, the washing machine and the oil burner. Each of these devices utilizes a small electric motor, usually from 1/10 to 1/4 horse power.

With these two thoughts in mind, let us turn back to a consideration of the possibilities of the gas-fired warm-air furnace. In the first place, warm air is an ideal heating medium because, where it is used directly, and not with steam or water as an interposed medium, it can be properly humidified,—and it is definitely established that proper humidity is an essential to optimum comfort. Not only that, but the proper humidity will keep furniture together for many years, whereas, in a dry atmosphere, it will quickly fall apart. On the other hand warm air, as it has been used in the past, was not a satisfactory heating medium, for the simple reason that its movement to the rooms of a house was dependent upon the natural rise of warm air and the tendency of cold air to settle; such plants were called "gravity" systems. The trouble was that, against infiltration from a cold winter wind, the warm air would not rise to the rooms on the windward side of the house; these rooms "never could be heated." So the desirable features of warm air were more than nullified by the fact that it wouldn't go where it was wanted. Enter, then, the idea of using a little fractional horse-power motor. The motor has been proved
Gas-fired Warm Air Furnace, Showing a Type Frequently Installed on the Pacific Coast

reliable by the washing machine, the refrigerator and the oil burner. It would run six to ten or 12 hours a day for an insignificant sum. What could be more simple than to place a fan in the supply duct of the furnace, and to force the flow of air, regardless of infiltration or whatnot? This scheme has been so far developed that residences having as many as 20 rooms and 24 registers have been well heated in the coldest sections of the country. In other words, the market of today for warm-air furnaces is not limited to small houses nor to homes of low cost.

Now introduce gas as the fuel to be burned in one of these modern warm-air furnaces with positive air circulation. This fuel is delivered into the house only as used; considered in this way, it has no appreciable weight. The gas-fired furnace can be built extremely light in weight. It does not, as does the coal-fired boiler, require a 30-foot to 50-foot chimney. Rather, it wants a zero draft. Why should we not, in view of these figurative fingers all pointing the same way, put the gas-fired warm-air heating plant in the attic where it will occupy practically waste space, eliminating the basement altogether, or making it a considerable addition to the livable portion of the house? The objection that "warm air will not flow downward" is silenced by the positive delivery of warm air, by the blower, to any part of the house, up or down. In the summer time a gas-fired refrigerator can be utilized to cool the air that is being circulated through the house. The entire conception is simple, although somewhat striking, merely because it hasn't yet been done.

This, perhaps, is the ultimate in gas "heating." It is not a "pipe dream," because the essentials have been conceived and put into practice by one of the foremost engineers specializing in the field of conditioned air. For over a year nearly a hundred "unit air-conditioning plants" have been in operation in as many homes. The unit for a ten-room house is little larger than an office desk. It is gas-fired, automatically controlled as to heat supply, provides a definite circulation of air that is humidified to just the proper degree, and, in the summer, provides the house with cooled air, dehumidified.

The more general use of gas as a fuel for domestic heating may depend to some extent on the increase in the amount of gas devoted to this use which, in turn, may bring about a lowered price which will enable the owner of a modest home, located within a reasonable range of centers of population, to heat his house with gas economically and automatically.
NEW TREATMENT OF MONOLITHIC EXTERIORS

JOSEPH B. MASON

A SURPRISING number of somewhat imposing buildings, including a representative allotment of churches, theaters, lodge buildings, court houses and other public and semi-public structures, have been designed within the last two years in what, for lack of a better term, has been called the "monolithic" style. Possibly it would be more illuminating to say that they have been designed as monolithic structures in which both the architectural and structural requirements have been met with concrete. In these buildings the columns, floors and walls are cast as a unit, the forms being built so as to include practically all of the architectural details and trim as the work progresses. Such buildings are characterized by solid walls, clean cut lines, tall pilasters which carry the eye from the ground to the sky-line, and interesting relief work, which for the most part is cast in place. They have colorful exteriors, achieved through use of stucco and through varied methods of surface treatment of the concrete walls and columns. A technique has been developed to secure attractive surfaces in the monolithic concrete which warrants especial attention. Whether we approve of the design or not, we cannot help feeling keen interest in the new methods employed.

In reinforced concrete the architect has a medium which flows and may be moulded, and through which form appears in gracefully unfolding stages until the final mass stands revealed. The nature of the work demands special care in concrete mixing, since concrete serves as both the structural and facing material. The fact that the concrete is to be exposed to the elements makes it important that unusual care and attention be paid in making and placing it. Contractors should bid on the concrete at a price that will permit this especially careful attention. It is apparent that the old time 1:2:4 concrete mix does not possess the qualities necessary for all this class of work. No rigid mix can be adapted to given purposes is being made has had much to do with the development of the monolithic type. Today architects and engineers may demand and obtain concrete that will fulfill their requirements, both structural and architectural, with assurance that it will withstand the elements at least as successfully as any other material to be had within the economic limit of his design. Intelligent and constructive research has checked and re-checked theories of concrete design so thoroughly that concrete can now be made to a definite specification.

Concrete for the exposed walls and columns of the monolithic structure must be of a uniform composition throughout the entire exposed area. Size andgrating of the fine and course aggregates should be consistent throughout, so that the class of concrete may be uniform. A water-cement ratio of 6 to 6 1/2 gallons of water to one sack of cement will produce concrete that will resist weathering and prevent the absorbing of moisture in the walls. Consistency and workability are very important qualities, which must be watched. Concrete should be of such a consistency that it will go into all of the corners of the forms without excessive spading. On the other hand, the mix should not be so wet that after the concrete has been in the forms for 10 or 15 minutes water will rise to the surface. Too liquid a mix will cause the cement paste to work to the surface of the forms, so that when the concrete is exposed, a fatty face with an unpleasant, almost polished, surface of pure cement results. Each batch of concrete should have the aggregate and water measured very carefully, so that the density of every batch will be the same.

In the forming of mouldings, projecting bands, recesses, fluting, etc., it must be constantly borne in mind that everything must be designed for the perfect flow of material. It is important that the concrete be evenly distributed along the form so as not to flow by gravity from the point of discharge to any far point in the wall. The forms should be filled evenly and the concrete, where possible, placed in one continuous operation. Any break in the placing should be made at definite lines along the bottoms of window openings. Inequality of surface and elimination of form markings are not desirable.

In the order of present popularity, the principal methods of treating the concrete exteriors of monolithic buildings are: first, stucco; second, surfaces with exposed form marks; third, grinding and rubbing; fourth, special applied finishes. I shall take these up in this order. Stucco exteriors in pure whites, creams and varied colors have been used with success not only on the Pacific coast, where this method of treatment has been widely practiced, but also in other parts of the country. In order to secure a firm bond between the stucco and the monolithic surface, all dirt, grease, oil or other similar matter must be removed. When two- or three-coat stuccoes are employed, it is usually advisable to roughen the surfaces of the concrete before application. This may be done most easily by brushing the surface with wire brushes before the concrete has fully hardened. A special preparation is now obtainable which may be spread on the interior surfaces of forms and which will retard the hardening of the cement mortar at the surface. It may then be easily roughened by brushing. A good bond is also dependent upon good suction. A concrete
saturated with water will have practically no suction; pure or dry concrete will probably have too much.

A single coat of stucco which improves the coarse appearance of the surface of the concrete but which does not completely obscure the form marks is used very often and with considerable success. A mixture made in the proportion of 1 cubic foot of Portland cement to 2 cubic feet of sand has proved very satisfactory when just sufficient water has been added to make a mortar of creamy consistency. This mixture is dashed on the concrete surface with a stiff brush and allowed to harden without troweling. Two- and three-coat stuccoes are used to achieve surface effect beyond the possibilities of the single-coat. Various trowel effects are possible, or the exterior stucco coat may be marked off in the pattern of stones. Some of the most unique effects have been achieved by combing stuccoed surfaces with a stiff wire brush. An interesting effect is obtained by combing alternate blocks at right angles to the horizontal. Commercial Portland cement stuccoes containing, where color is used, thoroughly tested mineral pigment, are recommended. The colors of stuccoes can be controlled very closely.

Probably the most interesting, because of the boldness of the experiment, has been the practice of leaving the monolithic surfaces just as they come from the forms, with no further surface treatment. Without entering into the merits of this procedure, it is sufficient to say that it has been used to produce a number of striking and interesting structures and is worthy of consideration. Surfaces that are to be left as they come from the forms must of course be detailed carefully. Good quality lumber and boards of uniform width, well finished, must be specified for the forms. Careful study should be made to determine the proper widths of form boards to be used. Wide boards tend to make the
structure look heavy and clumsy, while narrow boards warp the design. The form boards must be leveled and carried entirely around the building at the proper elevation, and joints should be so broken that they will not be conspicuous.

Some surface treatment with a portable grinding outfit or carborundum wheel is often made. The grinding should not remove all of the form marks, but should merely even the surface, giving it a more pleasing appearance without destroying the textural effect. The extent to which grinding or rubbing of the hardened concrete surface is carried forward will depend upon the effect desired. Many structures which have proved very attractive received only slight rubbing with a carborundum stone after application of a cement wash. Again, to achieve the desired effect, more intensive rubbing or grinding of the entire surface is often carried out. Bush hammering and other air-tooling treatments of concrete surfaces are in general use over panels and small border areas. Concrete of good quality may be tooled with success, and this provides an interesting variation in the surface treatment. Exposed aggregate surfaces offer interesting possibilities. A surface material made up of specially colored aggregates is applied either as stucco or by casting and applying to the surface of the wall. After this facing material has been applied and allowed to harden, the aggregates are exposed by washing with diluted muriatic acid. This method produces concrete that is very hard and durable and yet permits the carrying out of even the most minute details.

One of the advantages of using the monolithic concrete type is that decorations or embellishments can be cast as integral parts of the walls. Reverse plaster or wooden moulds are built into the forms as they are erected, and are filled with the concrete that is used in the rest of the structure.
Monolithic Concrete with White Portland Cement Stucco Exterior
Derrick Hubert, Architect

Portland Cement Stucco and Cast Stone Trim and Ornament
L. L. Dongan, Architect

Brush Coat of Cream Colored Stucco Trimmed with Cast Stone and Sgraffito
Allison & Allison, Architects

Light Chocolate Colored Stucco Exterior over Reinforced Concrete
Curlett & Beelman, Architects
ARCHITECTURAL USE OF LIME

BY

J. J. HURLEY

CONSTRUCTION ENGINEER

It is well known that modern structures require lime in some form or another, and for certain purposes for which no other material is "just as good." Lime putty is probably the "stickiest" and "slipperiest" cementitious material known. For this reason lime putty sticks where it is put, and as many would say, "it puts very easily." Every variety of lime has its architectural use, but the number of kinds of lime that may be used for each architectural purpose is very small.

First of all, just what is lime? It is the product obtained by heating limestone to its dissociation temperature (1600° to 2100° Fahr.) under such conditions that the carbon dioxide and other volatile matter are expelled. Lime consists primarily of calcium oxide, but may contain magnesium oxide, which in some limes may range in amounts as high as 45 per cent. Small amounts of alumina, ferric oxide and silica, and traces of other impurities are frequently present. The suitability of lime for any particular use depends on its chemical composition and its physical properties. It is here that the architect is forced to depend on established and reputable lime manufacturers to guide him in specifying the kind of lime for the purpose in mind.

History. Lime was probably the first cementitious binder used by man. The technique and practice of its use have been developed by centuries of experiment and observation. The fact that many architectural gems have come down to us from ancient days, and that they have resisted the ravages of the elements for centuries, bears eloquent testimony to lime's lasting qualities and integrity. Lime was first used because of the fact that it hardens from a soft, smooth, easily handled paste into a dense, hard mass. Brick, stone or other building units laid in it are bound together into monolithic, durable structures. The structural details and natural roughness of the construction units can be masked by spreading lime mortar over them in the form of plaster, thus giving a pleasing and hygienic surface.

Any lime manufacturer of recognized standing can be depended upon not to recommend the lime he makes to be used for a purpose for which it is not suitable. It is especially important that the instructions issued by the manufacturer regarding the slaking of the lime he manufactures be followed and emphasized by the architect in his specifications. With some lime it is necessary in slaking it to pour the water on the lime. With other lime, of different chemical and physical composition, it is necessary to put the water in the box and to dump the lime into the water. All of this is necessary in order to obtain the best results, and it is obvious that the architect cannot be expected to know these things unless he has had long experience with the particular brands of lime used in any special given instance.

Specifications. Unless it is wished to confine the kind of brand of lime used to one special make, it is suggested that these short specifications be used: "The lime (quicklime or hydrated lime) shall meet the current standard specifications of the American Society for Testing Materials and shall be used in accordance with the manufacturer's printed instructions. The brand of lime shall be approved by the architect." Modern methods have been applied to the manufacture of lime by the more progressive lime manufacturers. They have been quick to make use of the valuable research work done by the United States Bureau of Standards. The Bureau is the authority for the statement "that any good lump lime pulverized and passed through a 50-mesh screen can be guaranteed not to pit or pop." This is the reason why at least one of the largest lime manufacturers in the country advertises that one of his brands is "guaranteed not to pit" when used for plastering. Pulverized lime has many advantages for the architect, when guaranteed by a reputable manufacturer. When made as directed by the United States Bureau of Standards, the architect does not have to wait for the lime putty to age for from two to eight weeks, as is necessary with lump quicklime putty, or hydrated lime. Putty made from pulverized quicklime so manufactured may be used with perfect safety as soon as it is cold.

The modern manufacturing process of making lime is in accord with exact chemical science in which experienced chemists are regularly employed, and in which mechanical engineers, civil engineers, and geologists are also on the regular payrolls. The modern lime plant is a most interesting place. Everywhere one sees motors, conveyors made of steel pans for handling hot lime, labor-saving devices of all kinds, electrical recording pyrometers for keeping track of the heat of the kilns; modern automatic gas producers; automatic coal-handling machinery for handling coal from cars or barges; barrel plants where wood barrels are turned out complete, almost without human hands touching them; electrical, steam, and gasoline locomotives and all-steel cars for hauling both limerock and the finished product to where they are needed,—and in fact all of the up-to-the-minute appliances of big business.

Hydrated Lime. This lime is a very important architectural material, and it is demanding its increasing place in the architect's mind. Hydrated lime is quicklime with its chemical appetite for water satisfied. It is produced in this way. The lump quicklime to be hydrated is crushed, and then conveyed mechanically to the machine known as the "hydrator." This supplies the quicklime with the proper amount of water to convert it into hydrated...
three types of hydrators are used, differing in detail, but all providing for mechanically mixing the quicklime with the necessary water and for conserving the heat of the chemical reaction in sufficient degree to effectively hydrate the quicklime without "burning." The hydrated lime is discharged from the hydrator as a dry white powder. The modern mill uses air-separation units, conveying machinery where air currents carry the hydrated lime to the bins, devices which measure exactly the predetermined amount of water for every pound of quicklime, and last but not least, careful laboratory tests of every batch so as to be sure that the hydrated lime meets the current standard specifications of the American Society for Testing Materials before it is shipped. Hydrated lime and pulverized quicklime are the lime manufacturers' answer to the incessant modern demand for speed.

Kinds of Lime and Hydrated Lime. The "trade," meaning manufacturers, dealers, masons and plasterers, divide lime into these classes:

(1) Common or masons' lime (quicklime), which is usually lump lime, but may be pulverized, and is run-of-kiln lime without any selection. This is the type of lime that is generally used for masonry of a less important nature, bearing light loads, for rough plastering, and for stucco work.

(2) Finishing lime (quicklime) is the best selected lump or pulverized lime made by the manufacturer. It contains a minimum of core and other foreign matter, and is used for the best class of masonry, all grades of plastering, and stucco work. It is more plastic than common lime.

(3) Masons' hydrated lime may be used for scratch and brown coat plastering, for stucco, for masonry mortars, and as an admixture to Portland cement concrete.

(4) Finishing hydrated lime may be used for any purpose for which masons' hydrated lime may be used, and in addition, it may be used as an ingredient for the final or white coat of plaster. Finishing hydrated lime will have a plasticity figure of 200 or more on the Emley plastimeter, all as outlined in the American Society for Testing Materials Tentative Methods of Sampling, Inspection, Packing and Marking of Lime Products. The Federal Specifications Board has Master Specifications covering lime of all kinds, both quicklime and hydrated lime, which are essentially the same as the "Standards" published by the American Society for Testing Materials. There are 38 varieties of limestone listed by Knibbs, which run from alabaster, through chalk and marble to travertine. Marble is perhaps the purest high calcium limestone that we know today.

Modern Stucco. The architect is much interested today in stucco. The economy of its construction, its durability of surface, fire resistance, low maintenance cost, its use in improvement and repair of unsightly or old surfaces, and the pleasing artistic effects possible with stucco, all find favor with the architect, and with his client as well. The term "stucco," which was formerly used in referring to ornamental plasterwork, whether interior or exterior, is now confined to exterior plastering, either plain or ornamental. Stucco may be defined as a material used in a plastic state to form a hard coating for exterior walls or surfaces. Stucco is a mixture of one or more cementitious materials with sand or other fillers, and with or without other materials such as hair, fiber and coloring matter. Lime stucco is a mixture of properly prepared lime putty or paste, sand and water, with or without the addition of a small percentage of cement. Hair or fiber may be added to assist in forming the "key," depending on the style and character of the background. Coloring matter may be added to obtain the desired tone, although most satisfactory color effects are obtained through the use of selected sands. Different colored (fine or coarse) aggregates may be used for obtaining various effects of colors and surface textures. There are many fine examples of the architectural use of lime stucco in the older states, both of New England and the South, especially in Charleston, S. C., and the missions of California. New Orleans must also be mentioned, as the French influence is most noticeable in the stucco on homes and churches in that fine old city. The economy of lime stucco is due to a number of factors. The ability of lime putty to carry a large amount of sand makes possible a leaner mix, which authorities agree is the best in
stucco work. The high plasticity enables the plasterer to apply lime stucco easily, to spread it with little effort, and to work it thoroughly. Freedom from cracks is one of the special merits of lime stucco. A. H. White, an authority on stucco, says: "Freedom from initial hair cracks can be secured only by using a lean mixture, not richer that 1 part of cementing material to 3 parts of sand by volume."
The manner in which lime stucco hardens prevents the formation of cracks. It hardens slowly enough, due to evaporation of the water and recarbonation of the lime, to permit the lath to which it is applied to adjust itself. Where other backing, such as masonry, is used, there is no movement. While the freshly applied stucco expands and contracts with moisture changes, the fully hardened stucco shows little change, since it will consist of porous bodies in greater or less degree. Waterproofing is unnecessary in properly proportioned, mixed and applied lime stucco. Stucco will absorb in rainy weather—but this is not injurious. The density of lime stucco corresponds closely with mortar used for masonry.

**Plastering.** Plastering involves perhaps the most important architectural use of lime. It is used to shut out drafts, to make for more privacy, and to make dwellings and other structures more sanitary and beautiful. It also affords some protection against fire. There are two kinds of plastering,—good and bad. As everybody seems to be talking about good plastering, it seems to be in order to discuss bad plastering,—at least some of its most glaring faults.

**Plaster Cracks.** In a long and varied experience in a number of states, the writer has seldom heard anyone suggest that the lath or structure itself might be responsible for the cracks, although in over 90 per cent of the cases investigated where severe cracking has been the cause of the complaint, the defects of the structure have been the real reason for the trouble. It must not be supposed that lime plaster does not have defects and cracks which are the fault of the plaster or the way the plaster is applied, for it does. There are map cracks, shrinkage cracks, check cracks, fire cracks, and crazing. There are also the "pitting" and "popping" that, despite the best efforts of the manufacturers and all other persons interested in plastering, will put in their appearance occasionally when unguaranteed lime in lump form is used. All of the defects that can be charged to the plaster can be dismissed from the mind of the architect if a reliable, well established, and experienced plastering contractor does the work, and if a lime that is guaranteed by the manufacturer not to pit or pop is used.

**Efflorescence.** This defect, sometimes called "blotches," is most difficult to avoid. Sometimes areas of considerable size have the appearance of being wet. They dry out after a while, but they come back intermittently over a long period of time. These blotches are caused by certain salts which are soluble and hygroscopic. As the mixing water evaporates, these salts are brought to the surface and deposited. Their hygroscopic property causes them to absorb water from the air, thus keeping the plaster damp. Calcium chloride is one of these salts, and this substance is readily formed by interaction between lime and common salt. This is one reason why sea water or beach sand should not be used for plastering. This is also a reason for not using calcium chloride in the mortar for plastering to reduce the danger of freezing.
The peeling or blistering of paint is almost always due to the presence of water in the plaster. If plaster is painted before it is absolutely dry, trouble may be expected. *Lime or any other type of plaster should not be painted in less than three months from the time the finished plaster is applied, and then only if the plaster is dry.* Paint sometimes "burns" when applied over plaster. Free lime, oxide or hydroxide, will destroy linseed oil, causing the paint film to become brittle. One may expect to find free lime in all green (damp, or wet, newly applied) plasters, whether they be lime, gypsum or cement. If it is not desirable to wait for the free lime to become inert through carbonation, a priming coat may be used. This coat should be prepared by dissolving three pounds of zinc sulphate in a gallon of water. The zinc sulphate reacts with the lime to produce compounds which have no effect on oil. Cold water paint may be used without taking this precaution. All architects want good plastering, because plaster is about two-thirds of the area visible in the usual
room. The plaster should make and continue to give a good impression over a long term of years. This is not possible if the architect permits, for any reason, inferior work. One-coat plaster work is to be especially condemned.

Two-coat Plaster. Two-coat lime plaster on wood or metal lath, when properly done, will give satisfaction. This is especially true if the under coat is put on in two parts and brought out to grounds and well darbied and straightened, and then floated down properly with a wooden float after the plaster has stiffened, but before it is dry. This floating operation is very important, for it fills up all the shrinkage cracks and leaves a mechanically roughened surface for the finish or "skim" coat. The so-called "Boston skim coat," when applied by an experienced plasterer, is a most satisfactory finish over doubled-up, two-coat lime plaster. Boston skim is made of clean, sharp sand and lime putty in about equal parts and troweled to a smooth, hard surface.

Three-coat Work. This represents the proper use of lime plaster, the first or scratch coat being applied and allowed to become absolutely dry before the second or brown coat is applied. The brown coat is also allowed to dry before the finish coat is applied. All this is true, no matter to what kind of lath or masonry backing the plaster is applied. Plastering often seems to be a good detail on which to save money in cutting the cost of a structure, but for the architect's peace of mind, it would be much better to save on some other item, for nothing comes under the observation of owners and tenants quite as constantly as plaster.

The American Institute of Architects in collaboration with the National Lime Association has prepared standard specifications for lime plaster, copies of which can be had by an architect if he will apply to any lime manufacturer, or to the National Lime Association, at Washington. The United States Bureau of Standards is responsible for the statement that in the presence of moisture (and all plaster is subject to exposure to moisture at one time or another), lime plaster preserves metal lath from rusting. This is so because lime has an alkaline reaction. On the other hand, there are some so-called "patent plasters" to be had that have an acid reaction.

Mortar for Brick and Other Masonry. The function of mortar in laying up brick, stone, tile, etc., is twofold. It must provide a smooth bed upon which the building units may be easily laid, and it...
must bind them together into a permanent mass. From the architect’s point of view, it is necessary, in addition, to prevent the entrance of rain, wind, and cold through the spaces between the building units, which must be entirely filled with mortar. It is necessary that the mortar develop a safe compressive strength to resist the load on the lowest mortar bed, and also develop sufficient cohesive and adhesive strength to properly hold the building units in their places while the mortar is attaining its initial strength. The mortar must also finally pass the tests of durability and density. In all these qualities lime mortar or “1:1:6” mortar (made of 1 part by volume of Portland cement, 1 part by volume of lime putty, and 6 parts by volume of sand) properly used, meets the requirements.

Strength of Lime Mortar. The tests of Prof. McGregor, at Columbia University, will serve as an illustration of the strength of varying mixes of mortar from straight Portland cement to straight lime for the cementitious portion and 3 parts of sand, by volume. The graph included here tells the story, and while the cost figures given do not pretend to be accurate for all portions of the country, they are relatively correct, as a substitution of local prices will show. It will be noted in this graph that the greatest compressive strength is obtained by using 70 per cent of Portland cement and 30 per cent of lime putty. The graph also shows that 50 per cent of Portland cement and 50 per cent of lime putty give almost as great strength as the strongest combination shown; that is, that it gives well over 3,000 pounds per square inch.

Costs. It is impossible to give actual costs on mortar for the whole country, but it is easy to point out that lime putty is the cheapest per cubic foot of any cementitious material used for mortar.

Watertight concrete is concrete through which water cannot pass. "Waterproofed" concrete is concrete to the surface of which some treatment has been applied which may or may not prove permanent, to prevent the entrance of water. Hydrated lime is used in making concrete more "watertight." Because quicklime must be made into putty before it can be used in concrete, and because lime putty does not lend itself well to easily mixing with dry Portland cement, sand and other aggregate, hydrated lime is today universally used and is recommended.

### COST OF MORTAR VS COMpressive STRENGTH OF WALL

<table>
<thead>
<tr>
<th>Mortar Mix 1:3 by Volume</th>
<th>Ultimate Crushing Strength - 28 Days</th>
<th>Cost of Mortar Material per cu. yd (Gysalime)</th>
<th>Cost of Mortar per 1000 brick (18 cu. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% PC.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90% PC - 10% L.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80% PC - 20% L.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70% PC - 30% L.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60% PC - 40% L.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50% PC - 50% L.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40% PC - 60% L.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30% PC - 70% L.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20% PC - 80% L.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10% PC - 90% L.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 100% L.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graph based on Columbia University Test Data (McGregor)
THE high standards of living enjoyed by the American people are the results of steadily mounting per capita productivity. Further advances in these standards must be brought about by improving methods and processes, through the elimination of waste in materials and motion in our production and distribution system. Just as 20 years ago we undertook nation-wide conservation of our natural resources, so today we must even more vigorously sustain this campaign for a better utilization of our industrial resources and effort. Wastes in commerce and industry fall into a number of classes. While they are of immediate importance to manufacturing concerns, the business community, and construction engineers, the interests of the general public are involved to an important degree.

In 1921, when the “Hoover Committee on the Elimination of Waste in Industry,” made a survey of conditions in six of our major industries, it found that the building industry stood in fourth place, with 53 per cent waste. Thirty-four per cent was chargeable to management. One of the major causes was lack of simplification and standardization in materials, methods, machinery, and so on. When it is remembered that five billion dollars are spent annually in construction, some conception may be gained of the extent to which this loss reduces the country’s income. Manufacturers and business men are forced to look into their businesses more intensively than ever before for opportunities to cut down costs and yet maintain for themselves a fair profit. They are finding that a prolific source of waste is the reduction of unnecessary variety in sizes and dimensions and other immaterial differences in everyday commodities. This cooperation on the part of the government involves nothing regulatory nor inquisitorial. The service is to help such industrial groups as are interested in reducing waste to get the facts as to waste and to put their corrective actions into practice. Safeguards have been set up to protect the fullest development of individual initiative and invention, as well as to care for the changing trends of business. This is done by providing that the simplified practice recommendations, developed under the auspices of the Division of Simplified Practice, shall be subject to review at the end of such a period as may be fixed by the industry. The re-survey is conducted by a standing committee representative of all factors in the industry, or through another general conference of producers, distributors and organized users. Acceptance by manufacturers, distributors and organized users, representing 80 per cent of the total volume of the industry, is necessary before a program can be published as part of the Elimination of Waste series of the Department of Commerce.

These percentages of reduction in variety have been startling, especially in the application of simplified practice in the building and construction field:

<table>
<thead>
<tr>
<th>Practice Report Items</th>
<th>From</th>
<th>To</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire Drawing Machine</td>
<td>69</td>
<td>17</td>
<td>76</td>
</tr>
<tr>
<td>Common Brick</td>
<td>44</td>
<td>1</td>
<td>93</td>
</tr>
<tr>
<td>Architectural Stone</td>
<td>31</td>
<td>14</td>
<td>56</td>
</tr>
<tr>
<td>Sanitary Surfaces</td>
<td>82</td>
<td>18</td>
<td>80</td>
</tr>
<tr>
<td>Structural Slates</td>
<td>36</td>
<td>20</td>
<td>44</td>
</tr>
<tr>
<td>Roofing Slates</td>
<td>827</td>
<td>138</td>
<td>83</td>
</tr>
<tr>
<td>Lumber</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brick</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay Brick</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sandstone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building Stone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masonry Units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paint and Varnish Brushes</td>
<td>480</td>
<td>143</td>
<td>70</td>
</tr>
</tbody>
</table>

Certainly a major contribution to the stability and prosperity of American business is reflected in the savings which industry has gained from simplification. Industrial leaders estimate that these amount in value to more than $500,000,000 a year.

Elimination of 60 per cent of variety in sizes of softwood yard lumber is estimated to have reduced the extent of inventories formerly carried by four billion board-feet, thus releasing some $200,000,000 of relatively idle capital. Strict adherence to this lumber simplification assures the home builders of the country the production and distribution of standard dimension lumber supported by the united interests of the industry. During the past year, the lumber simplification program was given even greater impetus through the development of grade marking for cut lumber, on the part of many companies.
FIRE RESISTANCE OF BUILDING MATERIALS AND CONSTRUCTION

BY
S. H. INGBERG
SENIOR ENGINEER, BUREAU OF STANDARDS, WASHINGTON

THE fire-resistance activities of the Bureau of Standards have been concerned mainly with research into the fire-resistive properties of materials and members entering into the construction of buildings, the fire hazard of materials constituting the contents of buildings, the severity of fires that can occur with given amounts of combustible building contents, and the protection afforded by devices such as insulated record containers.

Fire-resistance, if in the form of materials incorporated into the building itself, has the advantage of being independent of the human element, upon which fire-prevention of many other kinds must depend. It loses little in effectiveness with age, remaining practically unchanged as long as the structure serves the purpose for which it was built. While general fire-prevention efforts and fire-detective and fire-prevention devices are of value, the building itself must remain as the chief factor in taking care of the margin of danger due to carelessness, ignorance and crime that cannot otherwise be further reduced. Consistent and continuing reduction in life and property loss from fire can be safely premised only on achieving greater fire-resistance of exterior and interior building members, details and finishes, a large gain in which is possible with proper application and combinations of materials now used.

The standard fire test consists in subjecting the material, construction or device to a furnace fire, the intensity of which is regulated so that given average temperatures obtain in the furnace chamber at stated times after the fire is started. By means of this control approximately the same fire exposure can be obtained at different times and in different laboratories. The other requirements will vary with the type of construction or device being tested. Thus, columns are required to support a load approximating what they would carry in a building; floor constructions and bearing walls are similarly required to support loads and also to afford resistance to flame and temperature penetration to an extent that will prevent ignition of materials in contact with the unexposed sides of the walls; incombustible finishes must serve similarly in preventing ignition of the material or construction protected; and insulated containers must preserve their contents. The fire-resistance of the material, construction or device tested is measured by the number of hours and minutes during which these requirements are met in the fire test. Ability to withstand erosion from hose streams, as applied in extinguishing fire, is also required for walls, floors and partitions.

Fire Tests of Building Columns. The initial series of tests undertaken on the basis outlined was...
of columns, one series, comprising over 100 tests, being conducted in cooperation with the Associated Factory Mutual and the Underwriters' Laboratories. Typical rolled steel, cast iron, concrete and timber columns were tested unprotected, partly protected and also completely encased in concrete, hollow tile, gypsum block, brick and plaster on metal lath, applied in different thicknesses. The effect of the protection in increasing the fire-resistance of the columns is evident from the fact that unprotected steel columns failed under load in the tests after from 11 to 21 minutes of fire exposure; columns partly protected by filling the interior or reentrant portions with concrete but with the flanges exposed to fire withstood the test for periods of between 48 minutes and 1 hour, 24 minutes; and columns encased in concrete 2 inches in thickness outside of the metal developed fire-resistance of periods ranging from 1 hour, 47 minutes, to nearly 8 hours. A wide range in effectiveness was found with materials of a given class and applied in the same thickness due to differences in the amount of cracking and similar fire effects sustained. This is evidenced by the range in effectiveness found for 2-inch concrete protection already cited. Similar differences were found for burnt clay products applied as column protection. The results of these tests have been published by the Underwriters' Laboratories, Chicago, as a joint report entitled "Fire Tests of Building Columns," and also by the Bureau of Standards as "Technologic Paper No. 184." The tests deal with a building detail of the greatest importance from the standpoint of maintaining the structural integrity of the building during a fire, and the results are of interest to all concerned with the design or construction.

**Fire Tests of Concrete Columns.** The other series of column tests was conducted at the former Pittsburg laboratory of the Bureau of Standards and comprised fire tests of about 60 typical reinforced concrete columns with strength tests of companion columns at room temperatures. Here also a wide range in fire resistance of columns, similar in all respects except for the sand, stone or pebbles used in making the concrete, was noted. Thus columns 18 inches in outside diameter with 1 1/2 inches of concrete over the reinforcing steel failed under working load after from 3 to 4 hours of fire exposure when the concrete was made with siliceous (quartz, chert, granite) sand and pebbles, while with concrete made with broken limestone, trap rock, blast furnace slag or calcareous pebbles, the columns withstood the 4-hour fire test under working load and at its end under loads from 2 1/2 to 3 1/2 times that applied during the test. The difference in performance was determined as due to the mineral composition of the aggregates used, quartz, chert and granite inducing early spalling of the concrete when exposed to fire, while concrete made with limestone, calcareous gravel, trap rock and slag showed few effects of this kind even from very severe fires. It was further shown that a large improvement with the former type of con-
Crete can be effected by placing metal mesh in the outer portion of the column to prevent large cracks and dislodgment of cracked portions. Covering or replacing the outer concrete with plaster was also found effective in increasing the fire resistance of the column. The results of these tests have been published by the Bureau of Standards in "Technologic Paper No. 272," entitled "Fire Resistance of Concrete Columns."

**Brick Walls.** While fire walls of brick have been long recognized as increasing the fire safety of individual buildings as well as decreasing the community hazard from spreading fires, no quantitative measurement of the protection afforded had been made until fire tests of walls, comparable in size to that of a wall panel in a building, were made by the Bureau of Standards. As subjected to the standard fire test, fire resistance periods from about 1 hour for the 4-inch partition to 9 hours or more for solid walls 12 inches thick were developed. Several types of hollow brick walls made by setting a portion or all of the bricks in the wall on edge were also tested, and while the resistances developed were not as high as for solid walls, they indicated adequacy for a considerable range of fire conditions, provided proper wall thicknesses are used. Articles giving summaries of results have been published in several outside journals, and pending publication by the Bureau of Standards, "Letter Circular No. 228," giving results for clay and shale bricks and "No. 229" for concrete and sand lime bricks have been prepared and are available on request.

**Hollow Tile Walls.** These hollow units of burnt clay vary in size from a unit filling the same space in the wall as two bricks to that of a 12-inch cube. The effects of the fire and the temperature transmission through the wall differ considerably from what obtains for the relatively smaller and solid brick units. The rapid increase in the use of hollow tile as a wall material prompted inquiry as to its fire-resistive properties, and the Bureau was requested to undertake tests of typical wall constructions. The first series consisted of fire exposure tests under load of piers built of tile of typical designs made from representative clays. A wide difference in fire effects was noted, ascribable mainly to differences in the mineral composition of the clay and to a less extent to the design of the unit. A further series of tests of small walls was undertaken to ascertain the effect of certain changes in raw material, manufacturing details and design. In this as in other portions of the work, cooperation with the industry was had through the Hollow Building Tile Association. The final series consisted of about 170 fire tests and fire and water tests of typical hollow tile wall constructions, 8 to 16 inches in thickness, tested (1) bare, (2) plastered or stuccoed, (3) furred and plastered, or (4) faced with brick. Depending on the shape of the unit and the clay from which it was made, fire resistance of from 1½ to 3 hours obtained for unplastered 8-inch walls.
from 3 to 6 hours for 12-inch walls, and from 4 to 12 hours for 16-inch walls. Tile with the greatest number of cells or webs through the wall thickness was found to give the highest fire-resistance. Plaster was found to add 1 hour or more to these periods and also to decrease the fire damage. Plaster applied on split furring gave protection to the load-bearing portion of the wall to such an extent that very little damage resulted from fires of from 4 to 6 hours' duration.

The final report, giving results of all tests made, has been submitted for publication as a Bureau of Standards "Technologic Paper." It is believed that the fire-resistance of this relatively new type of wall construction has been ascertained and defined in all essential respects by these tests.

Theater Proscenium Curtains. Many disastrous fires in theaters have shown the need for a dependable movable partition or curtain for closing the opening between the stage and the auditorium in case a fire originates on the stage. The devices used vary from single-ply asbestos cloth curtains to ponderous steel-framed constructions faced with metal sheets and asbestos boards and weighing, for an ordinary opening, ten tons or more. A number of operation and fire tests were made of the different types in the Bureau's large wall furnace. The heavy constructions, properly installed, were found to be satisfactory from the operation standpoint and to keep back smoke and glow from an intense fire on the stage side for periods of ½ hour. The single asbestos cloth curtains hung between a top and a bottom pipe batten were found to be unreliable in securing closure of the opening, since drafts such as might be caused by a fire or by ventilating fans caused them to bulge and fail to come down, being held by the friction with the proscenium wall. An improved type of asbestos cloth curtain, consisting of wire-reinforced cloth applied on each side of a pipe or structural steel framework, was also tested. This can be hung so that it will be reliable in operation, and in the fire test it was found to prevent smoke and glow from showing on the auditorium side for 15 minutes. This affords time for exit from the auditorium, with a considerable margin of safety. Pending publication of the results, "Letter Circular No. 137" has been prepared and can be obtained on request. It gives a summary of results, recommended specifications for proscenium curtains, and suggestions for improving existing installations.

Fire Tests of Roofing Materials. In efforts to decrease the community fire hazard, most municipalities impose restrictions on the kind of roofing materials permitted within city limits or in certain portions thereof. The scope of such restrictive measures has occasioned much dispute, and at the request of organizations representing producers and users of roofing materials, a comprehensive series of tests of the fire-resistance of all prepared roofing materials in ordinary use was undertaken and was completed during the present year. This has included tests of new and weathered wood shingles, and asphalt prepared roll roofing and shingles, slate, asbestos, metal and tile roofings. Tests have also been made of painted and chemically treated wood shingles, both new and after exposure to the weather.
for periods of up to 12 years. Specimens of weathered wood shingle roofs covered with asphalt prepared roll roofing and shingles or with paint coatings have also been tested. For the combustible roofings, the fire-resistance of the weathered roofings was generally considerably below that of the newly applied materials, although some forms of asphalt roofings showed little decrease in fire-resistance after weather exposures of up to 12 years. Results of the tests also emphasize the general superiority from the fire-resistance standpoint of incombustible roofing materials, such as slate, cement-asbestos, clay and concrete tile, and metal. The results of the tests are being prepared for publication in the Bureau of Standards technologic series.

Copies of a preliminary report, giving the results of tests with new roofings, have been supplied to the officials of a number of cities who requested them in connection with the adoption of roofing ordinances.

Strength of Materials at High Temperatures. In connection with fire tests of building construction, it is often important to know the strength and elastic properties of the constituent materials at the pertaining temperatures. An equipment with which good temperature uniformity and control are obtainable has been in use during the past three years. Tests with structural steel and cast iron have been completed. A paper ("Compressive Strength and Deformation of Structural Steel and Cast Iron Shapes at Temperatures up to 950°C." Proceedings of American Society for Testing Materials, Vol. 26, Part II, pp. 33-51, 1926) giving results with structural shapes has been published. To this there was added a series of tests for obtaining information on effect of length, which has also been completed.

Severity of Building Fires. In order that protection requirements, such as those for structural members, wall openings and record containers, be placed on a definite basis, it is necessary to be able to make reliable estimates of the severity of fires that can arise with typical constructions and occupancies involving given amounts of combustible materials per unit of floor area. This severity would have to be interpreted as equivalent to so many hours of the standard fire test, the fire-resistance of the protections, constructions and devices to be used being measured by this standard.

Since the data obtained from actual fires are inconclusive as it concerns temperatures developed and the length of time they prevailed, some burning-out tests have been conducted in one-story, fire-resistant buildings erected for the purpose, one being 15 by 29 feet and another 30 by 60 feet in plan. These buildings were fitted with old furniture and records to represent light commercial and record storage occupancies, the weight of the combustible contents ranging from 13 to 55 pounds per square foot. Further extension of this work to other typical occupancies is contemplated in order that the effect of any difference due to the character of the combustible materials involved may be had. The results so far obtained indicate the possibility of establishing by this means a basis for applying materials, constructions and devices as resistance against fire with as great a degree of safety and economy as they are being applied for other structural purposes.
The architectural members of the Architects’ Council of the Chamber of Commerce of Pittsburgh recognized the necessity of acquainting the building public with the advantages derived from an architect’s services. The question confronting us was how these messages could best be presented.

After many weeks of discussion, it was decided to first determine the extent to which the local architects would financially support an advertising campaign. To ascertain this it was necessary to make a general canvass among the architects. This was accomplished, and results showed a generous response which assured us of the success of the undertaking. After careful consideration of several mediums, the committee decided on newspaper advertising. We entered into a contract with a local morning paper for display advertising on Thursday of each week.

Notwithstanding the limited space possible in the first year’s campaign, we succeeded in interesting the public, and received many favorable comments which proved the wisdom of our activity. We traced many direct and indirect advantages to the profession from this concerted action. Architects discontinued some of their private advertising that was without merit, and the saving was far greater than their share of our mass advertising. Due to our activity, we are receiving most friendly cooperation from the daily press. We are brought into closer contact with one another, this being most helpful in creating good fellowship. We are now recognized as business men instead of dreamers, especially by the business men of our city. This in itself removes a long recognized barrier that has stood between the practical business man and the professional man. We are showing our fellow citizen the folly of trying to secure good architecture without an architect. We are also convincing him that he cannot obtain reproduction of gems he has found in the larger cities unless he permits us the same liberty and freedom that were given the architect in the larger city. We are convincing our fellow citizen also that the service of a local architect is his best investment. It is not our intention to try to reach the men or corporations associated with important structures, since they are as a rule our clients already; but it is the small man and the small estate, corporation, etc., preparing to build.
AN OPPORTUNITY FOR ARCHITECTS

THE REVISION OF THE NEW YORK TENEMENT HOUSE LAW

BY

ARTHUR C. HOLDEN, ARCHITECT

It has been said that opportunity does not go around wearing a label. Some even contend there is no such thing as opportunity at all, but that opportunity is a way of looking at things. The man of genius will see an opportunity in an apparently usual situation, whereas the ordinary man would pass it by. There are many men in the architectural profession who have genius, though some of them are handicapped by preconceived notions of what an architect should do and how an architect should act. A kind of self-consciousness is a handicap to genius.

There is an opportunity now which lies open to the architectural profession. The Tenement House Law of New York is up for revision. Happily, under the American constitutional system, when one state takes a step in advance, it is possible for other states to go further. Two winters ago the legislature created a Temporary Commission to Examine and Revise the Tenement House Law. Last January the Commission brought in its first report. The architects announced that since they had not had time to study the proposed law, they could not take a position either favoring or opposing it. Several months of controversy followed, and the legislature adjourned without taking action other than to enlarge the Commission and to continue it for another year. A new report will be brought in to the next legislature. Last summer was spent in further investigation by sub-committees and in conferences with civic, social and technical bodies.

The present Tenement House Law has been amended 150 times since its passage in 1901. It is due for a thoroughgoing revision. Its original passage was made necessary by the shocking revelations of the comprehensive report of the Tenement House Commission of 1900. It was the social service organizations, not the architects, who sponsored the legislation. The law was designed to restrain unscrupulous promoters from putting up buildings which were unsafe from the point of view of egress in case of fire and unhealthy because of the lack of proper light and ventilation or because of insufficient provision of sanitary equipment. The immediate purpose of the law was to protect the poorest class of people and to prevent their exploitation by overcrowding in inadequate and unsanitary quarters. The Tenement House Law is, in consequence, a law replete with "prohibitions and minimum requirements."

Since the time of the law's passage New York has doubled in population and assessed realty values have increased amazingly,—from $3,357,224,369 in 1900 to $14,738,806,010 in 1928,—exclusive of the Borough of Richmond. The value of the dollar has been cut in half, and methods of building have been revolutionized. We have just begun to look upon housing as an industry requiring very nice balancing of the art of design, the science of construction, and the economics of housing finance. At the time the present Commission was called into being, economic pressure was working havoc with the enforcement of the law. In all classes of dwellings methods for evading the law had become so well defined that they were reflected in property values. The old definition of a tenement house as a "building occupied by three or more families, living independently of each other and doing their own cooking," exempted from the requirements of the law any building in which theoretically not more than two families did their own cooking, no matter how many families lived in the building. On expensive land it was possible to run a towering skyscraper with practically no courts to provide light and air, if only it were called an "apartment hotel" and if the suites were provided with "pantries" instead of "kitchens." Where there existed old fashioned residences in which it was no longer economical for a single family to live, they could be converted into "studio apartments" with inadequate safeguards against fire, provided that no more than two "hona fide" kitchens were put in the same house. Where the price of land appeared cheap, it was possible to build frame houses within 3 feet of each other and to move large sections of the population into jerry-built districts unequipped with sewers.

In all of the great mass of home building in the United States during the past ten years,—taking it from top to bottom, good, bad and indifferent,—what sort of a role has the architect played? How great has been his influence upon housing construction? Has the architect been a follower or a leader? Of course there are different kinds of architects. A great deal of work is done by a class of men who might be dubbed "archytecks." They make drawings largely for the purpose of "filling" with the various building departments. Their plans show certain essential details, such as the thicknesses of foundation walls, the locations of the houses with respect to building and lot lines, and the plumbing sections. These men also perform the valuable service of getting plans "passed through the department," a labor which requires a great deal of waiting in outer offices, and which the average builder is quite willing to have someone else perform for him. The so-called "high brow" architects are very slightly interested in this class of work. They generally look down upon men whom they call "commercial architects," whose business is drawing out to ¼ -inch scale the apartment plans that have been worked out by the real
Typical two-family, semi-detached houses, with courts between, which are not under the jurisdiction of the Tenement House Law. They represent good construction except for the poor lighting in the narrow side courts, which are garage driveways.

Rapid depreciation, carrying costs, and economic pressure have forced the subdivision of these frame buildings into apartment suites which are not supposed to contain kitchens. These are typical of conversions made in spite of the Tenement House Law from outworn prohibitions and to protect himself against sub-standard competition.

The over-intensive use of land is one of the evils that, unchecked, threatens to lower the standard of public health and decency. Proper sanitary protection and adequate provision for escape in case of fire are no less essential. The architect is constantly told that he must build economically; that he must not sentimentalize, and that he must keep his design close to the minimum standards of light and air, sanitation and safety allowed by law. The reason given is familiar enough to him. “One cannot afford to do better, because construction costs are so high.” But construction costs, as the architect has learned, are not the only costs in producing a building. He has to reckon with the cost of land, which includes the cost of expensive improvements. He has to reckon also with the cost of financing and promotion, which, including sales costs, ranges from 25 cents to over 40 cents on the dollar of cost of the finished housing product. From the vantage point of aerial perspective, the architect would see that by accepting the cost of land and the cost of financing as factors which he is unable to control, he has been compelled with every increase of these costs to either reduce the amount of money available for construction or to crowd his building upon less land than is desirable. Confronted with this dilemma, the architect, assisted by his brother the engineer, has created the skyscraper. By reaching into the upper air above its neighbors, the skyscraper has increased the usable area of the ground on which it stands from 6 to 12 fold, and then to even 20, 30 and 40 fold. The genius of the American architect has been acclaimed around the world. The skyscraper movement, beginning with commercial types, inevitably spread to residential buildings. There is an essential difference, however, in the application. The commercial skyscraper, situated at the mart or business center, maintains its desirability and rentability to a much greater degree than does the residential
Illustration of a typical non-fireproof tenement. On such low value lands it is uneconomical and wasteful to build so intensively. Original rents can be obtained only because of borrowed light and air. The buildings are bound to depreciate when the neighborhood becomes built up.

skyscraper after the neighborhood around it has become built up with similar structures so as to shut off light and air. Business operations can be conducted by artificial light, but so far no one has come forward to urge that homes in which children are brought up are desirable without direct sunlight.

Today in our experience with the 6-story, barracks-like apartments, and, even with the larger 9- and 15-story fireproof buildings, we are experiencing the same tendency to depreciation after the light is shut off as was experienced with the original 6-story, dumb-bell flats erected under the law of 1879. Of course the modern building has not sunk to the low standards of sanitation and health that brought the older buildings into discredit, but the depreciation takes place none the less, and the community pays.

From the architectural observation balloon, skyscrapers,—and in particular residential skyscrapers,—are self-evidently desirable when they are placed alternately with low buildings separating them. It would of course be impossible and inequitable at law to restrict skyscrapers by law to alternate plots of ground. Therefore, the first report of the Commission offered to the legislature in January, 1928, recommended the creation of lot line courts at least 10 feet wide to begin at a point not higher above the street than the width of the street plus 5 feet. This recommendation was the greatest step in advance ever offered for the protection of high value properties against blanketing by abutting lot-line walls. Its provisions were equivalent to a proviso that no skyscraper walls could be carried up nearer to one another than 20 feet, and that in the intervening space no building could be built to a height exceeding the width of the street by more than 5 feet or to a greater depth than 60 feet from the building line. There was a great deal of complaint about this provision on the ground that it worked hardship upon owners of high value property. Such complaint was based on misconception. The Tenement House Law of 1901 limited all walls including lot-line walls to one and one-half times the width of the street. The original recommendations of the Commission permitted greater heights, but required the building to set back away from the property lines so as to protect adjacent property.

Architects are perfectly familiar with the conditions which the skyscraper creates. They know exactly what should be done to make the skyscraper more desirable and to protect it from abuse. Architects are equipped more than any other group to speak for the public good and to say what should and what should not be done. Here is their opportunity to say what good standards should be. If the architects fail in this, and if the advice which they give now is shortsighted, let no architect complain in the future that he can’t do better work, that he has to meet the low standards of commercialism. Rapid obsolescence and depreciation are the direct result of low standards, and the architect has had sufficient experience with these to know that the penalty which they exact is high rates of finance, over-rapid amortization, high discounts and more cash in financing and for land, and less cash for construction proper.

The architect should be the champion of the people in this. He will find them willing followers, once they realize that to follow him means ultimately securing a more stable building industry and more building for the same rent. Landlords are trained in the rule of thumb, they are not analysts; most of them do not realize what the disorganized state of the housing industry means to them. By following the architects instead of the land peddlers, they can assure themselves more stability of income, for the buildings which they get for the same money will be of higher standards, not subject to such rapid obsolescence and depreciation as at present, and therefore a better and safer investment.

The illustrations given here show some of the common types of houses that have been erected since the war. In the recodification of the law the end sought should be reasonable. In certain fields the abuses...
A typical row of recently built frame dwellings. They represent an uneconomic type of construction where full assessment for street opening, paving and sewer will make necessary the ultimate replacement of such housing by a more intensive development.

have been greater than in others; the purpose should always be stabilization of income and desirability from the tenants' point of view.

In trying to be reasonable, it is necessary to take variations in land values into consideration. Some city land is of such high value that it demands a skyscraper type of development with all apartments reached by modern, high speed elevators. Medium-priced land, on the other hand, is susceptible to development with lower buildings of the walk-up, non-fireproof type. Cheap land should involve some approximation of rural or suburban conditions. From the point of view of theory, lower-value land does make it possible to design with wider courts and better conditions of light and air; but from the point of view of law, a really desirable standard of court sizes cannot be set, because such standards might be unreasonably restrictive to higher-value property. As a result, where good standards might easily be possible, competition operates to bring all standards down to the level of the most unscrupulous. The first report of the Commission sought to get around this difficulty by setting two standards for court sizes and for bulk of building—one for high-value and one for low-value lots. Apparently it was a tactical mistake, for this one feature of the report brought opposition from those who claimed to speak for the owners of land. Schooled to think that a permanent "Bull" market for real estate is an economic necessity, they viewed with alarm any restriction at all upon land which would limit its potential development to something less than the limits already attained by other land.

Such a view actually retards improvement, for it begins by discounting possible improvements. The assumption that the land itself will continually increase in value amounts to saying that whatever improvements are made to the land, these improvements must grow rapidly less in value, and that the land will ultimately increase sufficiently in value to offset this rapid depreciation. This is a dangerous philosophy. It ignores the consideration that the basic value of land is derived from the stable income that comes from the land. Any law which in this scientific day and age allows the uneconomical, and unreasonable over-development of land, puts a premium on plunder. The critics of the Commission's proposal to grade the restrictions imposed upon land according to the value of the land, brought in no proposal for a more equitable method. Perhaps, since it is the fools and the "suckers" who continually pay the price of over-rapid depreciation in the form of needlessly high rents, it is outside the province of the law to protect them!

The Commission was also criticized for recommending that all classes of residential buildings should be included under the Dwellings Law. A great deal of misleading information was circulated in order to stir up opposition. Individual owners were told that their homes would be made the subject of tenement inspection in regard to sanitation and cleanliness. It raised incredible alarm. What was really intended was to make it impossible to evade the law on the mere pretext that the building was of a type which did not come within the province of the law. Only by a law which recognizes all types is it possible to encourage the better types, and to put under curb the less desirable types only in cases where abuses have arisen. Whenever a law is drafted in terms that are comprehensive, it is bound to arouse opposition. Such a law cannot be passed (nor could it be enforced, if it were passed) unless it is thoroughly understood. Above all others, the architects are they who should lead in the education of the public. If the architects stand for better types in housing, they will find their leadership irresistible, and the public will give them unqualified support.
Sanitary Design in Modern Buildings
—Cold Water Supply

by
Harold L. Alt

The assurance of a continued water supply at proper pressure is the most important consideration in designing sanitary equipment. While there are many comparatively small installations depending entirely on direct city pressure, the larger buildings almost invariably utilize house tanks. This is because the water reserved in the house tank is usually sufficient to carry over any temporary cut-off of the street supply, and because the use of the tank also insures a constant water pressure on the plumbing fixtures without fluctuation, such as often occurs in the city mains. It will therefore be assumed in this article that a house tank is contemplated. When the tank is made a combined house and fire tank, the capacity is often about 5,000 gallons, which allows a fire reserve of 3,000 gallons and another 2,000 gallons on top of this for building service. These two quantities are prevented from interfering with each other by taking the fire connection off of the bottom of the tank (or from the side near the bottom), and the building supply off the side of the tank three-fifths of the distance up from the bottom of the tank to the water line, as shown in Fig. 1. A 5,000 gallon tank must contain about 700 cubic feet of water, and the sides must carry up about 12 inches above the water line. Thus the dimensions of a 5,000 gallon tank could be 10 feet long by 10 feet wide by 8 feet high. The building supply opening would be on the side three-fifths of 7 feet or 4 feet, 2 inches above the bottom. With the tank full, there is available for fire use the entire contents, but with the tank drained down to the level of the building outlet,—below which it cannot go unless leaving through the fire outlet at the bottom,—there are still 3,000 gallons left for fire service. The piping in such an installation is frequently arranged as shown in Fig. 2. Of course if the fire tank is kept separate from the house tank, the building service would be taken from the bottom of the tank. In some cases the demands of the authorities for water storage are much greater. For instance, in a theater they may insist on 5,000 gallons reserve for sprinklers, 5,000 gallons more for fire standpipes, with whatever amount is desired for house service added to this (usually 2,000 to 3,000 gallons more.) This makes the combined tank capacity between 12,000 and 13,000 gallons.

House tanks must rest on substantial supporting walls or columns, since the weight of such tanks when filled is about 5 tons for each 1,000 gallons. House tanks are usually constructed of steel and are square or rectangular in shape. A middle partition is desirable with duplicate valved pipe connections to each side so that one-half of the tank may be cleaned, painted or repaired without disturbing the water in the other half. A curb angle about 3 x 3 x 3/8 inch is run around the top to stiffen the edges, and vertical angles about 2 x 2 x 1/4 inch or 2 1/2 x 2 1/2 x 1/4 inch are used to prevent the sides from bulging. The middle partition ties the two sides together and must be stiffened against pressure in either direction. Under the tank 12-inch to 18-inch I-beams are placed on edge to permit access for painting and repairs. These beams often rest in a drip pan of steel about 3/8 inch thick, the pan projecting 6 inches outside of the tank all around and turned about 3 inches around the edge. A 2-inch drain is run from the drip pan and connected to the tank overflow pipe so that any condensation occurring on the sides of the tank will run down into the drip pan. The pan is supported in turn on a second set of I-beams which are arranged to come directly under the upper tier of beams. A typical steel house tank is illustrated in Fig. 3.

In order to fill the house tank three different sets of conditions must be considered: (a) whether the normal street pressure is sufficient to fill the tank at all times without the use of a pump; (b) whether the city pressure is sufficient to fill the house tank only part of the time, and at other times is inadequate to raise the water into the tank; (c) whether the city pressure seldom, if ever, is sufficient to raise water into the house tank. In the first case, all that is required is a float valve on the tank to shut off the water whenever the tank is full and to open up the supply line whenever the water level in the tank begins to drop. In the second instance, a pump must be used to keep the tank filled during times of low street pressure. This pump should be of centrifugal type so as to allow the water to flow through it up to the tank whenever the street pressure is sufficient; there must be a float control in the tank which will start and stop the motor on the pump whenever the water line fluctuates, and there must be a ball cock on the discharge into the tank so that the street pressure will not overflow the tank continuously whenever it is high enough to force water into the tank. In the third case, any type of pump with float control from the tank will fulfill the needs.

For buildings over 150 feet in height it is advisable to use a system of water supply with two pressures, so that the water pressure in the lower part will not greatly exceed 50 pounds per square inch. A house tank may be installed somewhat above the middle story to supply the lower portion, and a second tank on the roof to supply the upper stories. These tanks may be filled: (a) by using two house pumps, one for each tank; (b) by using one house pump and pumping all the water to the upper tank with a pipe from the upper tank to the lower con...
trolled by a float valve in the lower tank; (c) by using one house pump to deliver all the water into the lower tank and a booster pump to raise the water for the upper tank from the lower tank level. These three methods will be clearly understood by referring to Figs. 4, 5 and 6. The first method has the objection of requiring four pumps,—two to do the work and two to serve as emergency pumps in case of breakdowns. Owing to the difference in heads on the pumps, it is hardly practical to attempt to use only one pump as a standby. This method does have the advantage of economy in operation, as the water pumped to each level is only the water actually required at that level. In the second method only two pumps are required,—one being a standby,—but all the water required on the lower level must be pumped to the higher level first, and this means a much greater power consumption than in the first scheme. As a substitute for this, the lower tank may be omitted and a pressure-reducing valve placed in the line so as to cut the pressure down to the same pressure as would be obtained with the use of the lower tank. This is illustrated in Fig. 7. The third method also involves use of four pumps, and has the disadvantage of having the pumps far apart. It is seldom used, possibly on account of this drawback.

The Downfeed Cold Water System. With a house tank in the building, this is the most economical method of water distribution. An overhead main is run on or above the ceiling of the top floor, usually in the furred space under the roof, and all cold water lines branch off this main and drop down the side walls or in any other position where they may be required. Branches from this main may be made from a tee turned in any direction, but the most desirable method is shown in Fig. 8. When the construction of the building is such that it does not permit the running of an overhead main, an upfeed system must be employed with the large supply pipe in the basement, and this is the usual method employed in buildings on direct pressure when the water connection from the street enters the basement. Where two pressure systems are in use, an overhead, downfeed system may be used for the upper portion and an upfeed system for the lower portion. This will eliminate horizontal piping and mains in the middle story of the building.

Pipe Sizing. The determining of the necessary cold water pipe sizes for a large installation is a matter of judgment, experience and calculation. Unless some mathematical basis is used, one error may lead to another and seriously affect the whole work. One way to check the diameter of the cold water supply pipe, either main or branch, at any particular point, is to determine the number of fixtures to be supplied and then to take each fixture or group of fixtures and determine what the average load on the line would be. In order to do this, certain factors must be assumed for each fixture according to the size. Thus, fixtures may be divided roughly in this way:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Those with ½&quot; connections (lavatories and sinks)</td>
<td>4</td>
</tr>
<tr>
<td>(b)</td>
<td>Those with ¾&quot; connection (sinks, slop sinks, baths)</td>
<td>4</td>
</tr>
<tr>
<td>(c)</td>
<td>Those with ½&quot; to 1&quot; connection (urinal flush valves)</td>
<td>9</td>
</tr>
<tr>
<td>(d)</td>
<td>Those with 1&quot; or 1½&quot; connection (w.c. connections)</td>
<td>24</td>
</tr>
</tbody>
</table>
The sum of all the factors on the line may then be used to determine the pipe size if this sum is first multiplied by a percentage of use based on the percentage of fixtures likely to be turned on at one and the same time.

The various sizes of pipe are also rated in corresponding factors, these being:

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Factor Allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

To apply this system it is still necessary to size the first few fixtures on the branch by judgment, and then to use the factors for determining the sizes of main branches, risers, or supplies. For example, assume five toilet rooms on a riser, each toilet having...
five flush valve water closets, three flush tank urinals, five lavatories, and one slop sink; what would be the size of the branch to the toilet and what would be the size of the riser?

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Number</th>
<th>Factor</th>
<th>Factor of Use</th>
<th>Net</th>
<th>Factor of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>F. v. water closets</td>
<td>5</td>
<td>25</td>
<td>120</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>F. t. urinals</td>
<td>3</td>
<td>1</td>
<td>33 1/3%</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Lavatories</td>
<td>5</td>
<td>5</td>
<td>25</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>Slop sink</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>152</td>
<td>64</td>
<td>26</td>
<td>100</td>
<td>48</td>
</tr>
</tbody>
</table>

The size of pipe having a higher factor rating than the net factor as computed is 2-inch pipe. It will be noted that the "percentages of use" are based on two water closets out of five being flushed together (or 2/5, which is 40 per cent); one urinal out of three (or 1/3, which is 33 1/3 per cent); three lavatories out of 5 (or 3/5, which is 60 per cent); and that the slop sink is neglected because it is not generally in use when other fixtures are.

Since the branch to the toilet must be 2-inch pipe, the riser size to the top toilet (assuming an upfeed system) must also be 2-inch pipe. But after taking in the second toilet, the riser will begin to have a more equalized load, due to the larger number of fixtures. With a single fixture the size of pipe would have to be based on a "percentage of use" of 100, owing to the fact that when the fixture is turned on it is running at the rate of 100 per cent. But with 1000 fixtures the average use runs only about 33 1/3 per cent because all the fixtures are never turned on at the same instant. As a result of this, the "percentage of use" will constantly recede from 100 and will continuously approach 33 1/3, and, sometimes, be as low as 25 as the number of fixtures is increased. After two toilets are connected to the riser, a total of 26 fixtures is being considered, and this average "percentage of use" should approach the general average of 33 1/3 by reducing the "percentage of use" to, say, 40. Then the total sum of equivalent factors (taken at 100 per cent) must be multiplied by 40 to find out the net factor for each toilet and thus multiplied by 2 for two toilets, thus:

Total equivalent factors,—top toilet...........152

Multiplying by a percentage of 40 per cent equals:

Net factor for each toilet.................. 60
Net factor for two toilets...............120

Size of pipe for this factor............. 3 inches

With three toilets the percentage of use could be reduced to, say, 38% giving

152 x 3 x 38% = 173 factor

which requires 3%-inch pipe, and with four toilets and 35% use the result is

152 x 5 x 33 1/3% or 253 net factor

which also requires 4-inch pipe.

Pneumatic Tank Systems. While pneumatic tanks are seldom used for large buildings, they are sometimes installed in smaller structures and have several advantages. They may be buried with only the heads projecting through the foundation walls, or they may be set in the basements and do not introduce heavy loads at the tops of the buildings. They will give better pressures on the top floor than when a house tank is used unless the house tank is set at a considerable distance above the highest story. They have some serious disadvantages. One of these is a fluctuating pressure on the water line; that is to say when the tank is "pumped up" the pressure is high, and when the tank is "down" or close to the point where refilling must commence, the pressure is low. The less the pressure variation is made, the smaller will be the amount of available water or "storage capacity." The pressure in the tank is due to the air compressed above the water. This air generally occupies about one third of the total tank, as illustrated in Fig. 9, so that this portion of a pneumatic tank can never be used for storage of water and is lost as far as water supply is concerned. But the remaining two thirds, which is filled with water, is seldom all available because before all the water is withdrawn from the pneumatic tank the air has expanded to a point where the air pressure has fallen too low. To overcome this some pneumatic tank manufacturers put an initial air pressure of about 20 pounds, as shown in Fig. 9, on the tank before the water is pumped in. The water is pumped in against this initial air pressure, and the entire amount of water may be withdrawn from the tank before the water pressure (due to the air) falls to 20 pounds. The difficulty encountered in this procedure is that with an initial air pressure of 20 pounds, the quantity of water which may be pumped into the tank without producing excessive pressures is also reduced. In ordinary practice it is customary to decide how much pressure fluctuation it will be safe to permit on the system, and to base the pneumatic tank design on this amount. If it is assumed that 1000 gallons available water storage is desired and that a maximum pressure fluctuation of 20 pounds is permissible, the problem gets down to determining what size of tank will have the air pressure drop 20 pounds when 1000 gallons are withdrawn from it. The size of the tank and
the initial pressure can be easily calculated by the engineer of the tank manufacturer, assuming that the 20 pounds variation will occur between 60 pounds maximum and 40 pounds minimum.

Air Cushions. Every good water supply system has provision made to overcome water hammer and noise in the piping. This danger is minimized and in many cases entirely overcome by (a) employing ample pipe sizes to prevent excessive velocities in the pipes; (b) limiting the maximum pressure under which the water system operates; (c) the judicious and adequate providing of air cushions to absorb the shock of the moving water column when the flow is suddenly stopped. The impact caused by the sudden stoppage of a moving column of water is increased by increasing the velocity, by lengthening the run, by increasing the pressure, or by reducing the pipe size. An air cushion placed at the top of the riser (in a downfeed system) allows the column of water in the riser to shoot up (or down) into the air cushion, which acts to take the impact and bring the pressure to normal. Similar cushions at the end of each branch pipe, formed by turning up the end of the branch a distance of from 12 inches to 18 inches, produce similar results in the branches, and small diameter cushions just back of each fixture are frequently used in first class work. Fig. 10 illustrates a typical pipe installation with the air cushions properly placed.

There are those who argue that air cushions are an unjustified expense because they become waterlogged in time and in that condition are no better than if the pipe were "dead ended" in the first place. It is quite true that the water will gradually absorb the air from a cold water air-cushion, making it useless. The air can be replaced by draining the line and then turning the water on again. Water logging does not occur on the hot water line air cushions, as the hot water constantly gives off air and automatically keeps the air cushion properly filled. There has not been offered a better or more practical solution to the water hammer problem than the use of air cushions. Air cushions are usually installed on the branch from the street to protect the meter from damage when the street pressure may be shut off and then turned on again. Another place where a cushion is particularly desirable is on the discharge side of a pressure-reducing valve to prevent noise from opening and closing of the valve.

Valving of Lines. There are three matters to be kept in view when deciding on locations of valves: (a) to locate valves so that various sections of piping may be closed off for repairs or other purposes; (b) to put in as few valves as possible, and to use one valve for as many purposes as possible; (c) to locate all valves in accessible places, so that they may be manipulated without too much difficulty. It is the general practice to place a stop valve on each fixture, particularly when the fixtures are in large groups in first class work. Stop valves are located under lavatories, in the vertical supplies to bathtubs, and in the flush valves for water closets and urinals. Slop sinks are usually arranged with valves on the supplies somewhere in the slop closet, or the valves may be omitted on this fixture altogether. Sinks may be valved under the fixture or,—as these fixtures are usually set singly,—on the branch to the fixture. A valve is generally employed on the branch from the riser and is placed close to the riser. This valve controls the branch to the toilet room and, consequently, all fixtures on that branch. In cases when the fixture branch only has a few fixtures, such as in the bathrooms of apartment houses or
hotels, it is permissible to omit the fixture valves to save on installation costs. Lavatory stop valves have an advantage in making it possible to regulate the flow from the lavatory faucets to prevent splashing.

The riser itself is usually valved where it leaves the main. This permits cutting off any particular riser in which trouble may develop without affecting any other riser. Frequently the main itself is valved at the various principal branches, but this is often omitted and may be considered as desirable but not absolutely necessary. Of course each piece of apparatus must be valved, and pumps should be valved on both suction and discharge sides, as well as having a check valve placed on the discharge between the stop valve and the pump. Water meters are valved on both sides and are sometimes provided with by-passes. The house tank is valved; the cold water to the hot water heater and the water supply to the boiler are both valved and provided with checks. Wherever a check valve is used, it is highly desirable to have a valve on each side so as to permit opening and examining the check at any time. All valves used on water lines should be of the gate type, owing to the almost negligible amount of resistance which they interpose in the line in comparison to globe valves. Customary practice employs all brass gate valves of from \( \frac{3}{4} \) - to 2-inch size, and iron body valves, bronze mounted on sizes 2\( \frac{1}{2} \) inches and over; they are usually of the screw type up to 4 or 6 inches, but are flanged in larger sizes.

Material of Cold Water Pipes. Cold water piping in the best work, and where character of the local water supplied permits, may be made of brass pipe, iron pipe size, or of red brass or red metal. Brass pipe usually contains about 65 per cent copper, while red brass or red metal runs to 85 and sometimes to 88 per cent of copper. There are some localities where the use of brass and red brass pipe is not practical, owing to the characteristics of the local water, and this matter should be carefully investigated. If cost is a consideration, galvanized genuine wrought iron pipe is used with excellent results. Added first cost reduction may be effected by substituting the spelterized pipe on sizes 4 inches and smaller. Above 4-inch pipe, either genuine wrought iron or steel may be used, the steel being somewhat less in price. The all-steel piping is the cheapest, where water analysis permits, and it will answer the purpose for many years. Fittings for cold water pipe are nearly always made of galvanized cast malleable iron, headed pattern, screwed, up to 6 or 8 inches, and then flanged in larger sizes.

Underground Lines. Where water pipe is run underground and the size is 4-inch or over, regular cast iron water pipe is used, and it is not unusual to raise underground lines of lesser sizes to sizes where cast iron water pipe with calked lead and oakum joints can be employed.

Drain-offs and Drains. It is good practice to provide drains at all low points in the piping system and on risers just beyond the riser stop valve. These drains are nearly always 3\( \frac{1}{4} \)-inch size, with valves having hose threads so that a hose can be coupled on and run to floor drains or pails. To aid in this draining out, it is desirable to pitch all cold water lines back toward the riser, and the riser branches back toward the main, and the main back toward the meter, so that any line may be properly drained.
THE ARCHITECT AS CONSTRUCTOR

PART III—OPERATING A CONSTRUCTION ORGANIZATION

BY

WILFRED W. BEACH

I

N preceding articles on this subject, in The Architectural Forum for May and August the author discussed the possibility and feasibility of members of the architectural profession attempting to circumvent an apparently increasing tendency of general contractors and constructing engineers to include in their proffered services the functions of the architect. Obviously, the services of an architect are essential to the success of a building, if it be of any consequence. Whether or not the services of the general contractor are likewise, may be considered open to question. If either is to survive to the exclusion of the other, it would seem probable that the individual who creates is most likely to be he who will carry on. But we are facing no such extremity.

The pertinent thing we are presumably facing is the loss of particular commissions to contractors who “furnish plans.” If there be owners who prefer this sort of service,—who are convinced that the method is fundamentally sound,—why should it not be the duty of the architect to accommodate them, especially if the architect can convince himself that both client and the architect as builder are to profit considerably thereby? We have therefore shown how it is possible for the architect to acquire new business of this character, and have set forth a contract form to cover an agreement with such a client (The Architectural Forum, August, 1928, Part II). The signing of the first of such contracts by the architect should be indicative of his fixed intent to add field construction to the functions of his office. The departure is too comprehensive to be invoked for a single operation, there to deliberately stop. To be sure, he is burning no bridges by the innovation. So long as he guarantees no costs, he is in no way jeopardizing his status as an ethical architect, nor is he necessarily setting himself at loggerheads with the better class of contractors. They may not approve of his entering their fenced preserves, but they will still (most of them) continue to bid on his work when invited, knowing that he will not ask them to waste time figuring on work which is not intended to be let. In other words, one can be both architect and cost-plus builder without encountering insurmountable obstacles.

Having secured the contract, one proceeds to organize the project while working drawings are being completed. One must determine what work is to be sublet and what is to be executed with one’s own forces, and must prepare specifications accordingly. It will be found that the duties of the office man in charge of contracts and construction have increased many fold, and that he must be prepared to meet them, whether he be the architect himself or an employee. It may be found advisable to bring in a construction manager from outside if no one in the organization has special fitness for the tasks confronting the office. On the other hand, an architect with inclinations in that direction can readily augment his knowledge of the subject by reference to any one of several up-to-date books on construction methods and management. As work increases, one will add departments of purchasing, expediting, accounting etc., always holding down the overhead to its efficient minimum.

The trades most generally handled through foremen are concrete work, masonry, carpentry, lathing, plastering and painting. General excavating had best be sublet, as a rule, because of the special equipment needed and because men in that line generally know what to do with excavated material. Such a contract should not include the necessary hand-digging of pits and trenches, which can better be handled by common labor under the general foreman or a “straw boss.” Piling and deep foundation work, with its necessary shoring, should also be sublet to experienced concerns equipped to do such special work. But by the time the constructing architect is ready to execute large work and heavy construction, he will have gained the necessary preliminary experience and will have found that each commission presents its own problems, beginning with the excavating and continuing through the last detail of the decorating and equipping.

Bids are taken and contracts awarded on the items first needed, as rapidly as drawings and specifications can be issued to bidders. In addition to asking bids of local concerns, if the work be outside a large city, one makes careful canvass of all others available, getting, if possible, three or more bids on each subcontract and material list. The preparation of the latter is, of course, new procedure for the architect. A builder does not hand a set of prints and specifications to a material supply house as he does to a plumber or other subcontractor. Instead, he prepares itemized schedules of lumber, brick and the like, and gets prices accordingly. Contrary to general opinion, there are no standard fixed prices of building materials. There are “list prices” and “quoted prices” and “customary prices,”—and there are also the “prices that are necessary to get the business.” Hence the perspicacious purchasing agent. He is quite likely to find that some of the owner’s “friends” in the building supply business have had their eyes on this particular project for some time,
and have perhaps been avidly anticipating their profits. In this, as in all other lines of commerce, there are two distinct classes, each intent upon doing the "right thing." But to one, it means the right thing for the customer, and to the other the right thing for the dealer. To the latter, a legitimate profit means whatever he can get. The purchasing agent must be able to discriminate, as it is up to him to adequately protect the owner against those of his neighbors who are out to gouge him. Furthermore, they would like to be able to show their regular customers that they exacted toll from the outsider. The owner will give his builder a list of those from whom he wants prices,—he may even secure some of the prices himself,—but he should be explicit as to which if any he wishes to have specially favored. Frequently, the association or connection between owner and purveyor is so close that the former especially welcomes the intervention of a purchasing entity to shoulder all responsibility. The construction architect has no axes to grind but can distribute his favors exactly as he and the owner decide is best for the project. They may decide that the ownership of stock or a position on the board of a company does not warrant buying from the incumbent at fat prices, as a local builder might have to do.

As has been intimated, no one individual is more vital to the success of the undertaking than the general foreman. It is to be assumed that he will be chosen with the utmost discrimination. If new to the organization, he will be brought into the office and made thoroughly familiar with its general practice and with the intended procedure in his particular work. He will take time to familiarize himself with the drawings and specifications, material lists and subcontracts. If he is being merely moved from job to job, he can do this in the field. Nevertheless, it is well to give him time between assignments to come into the home office and be checked up,—to get acquainted with his co-workers. It makes esprit de corps.

In any event, it is essential that the home office shall have prepared a detailed set of instructions to superintendents or general foremen (as they may be called). Oral advice lacks uniformity, adequacy and force,—leaves too much to the judgment of the individual. He has abundant opportunity to exercise his initiative, even after complying with all home office "red tape." After digesting his instructions, his experience will tell him what is mandatory as well as where he is supposed to "use his head." But, for regular procedure, he should be placed in a position to know what is expected of him without having to ask. If he is the right type of man, he will appreciate printed instructions, even though his previous employers have had nothing of the kind, and any advice may irk him somewhat. Some of the best foremen will put all their energy into pushing the work ahead rapidly and capably but, when it comes to keeping their records and correspondence in shape, they will be beautifully "balled up." They are simply not office men. Foremen of that type should, if big enough, be used on larger work where one or more clerks can be assigned to assist in the time keeping, petty purchasing, receiving, storekeeping, expediting, cost accounting (distributing), and correspondence. It is up to the construction manager to determine how much of such "overhead" the work requires. It is easier to provide too much than not enough. There should be no one in the job office whose time is not fully employed,—crowded. Nothing so demoralizes a field organization as lack of employment. If clerks haven't enough to do to keep them busy, their spare time should be given to such manual labor as can be assigned them. If their white collars are inclined to wilt too much in arduous toil, they may as well get out of the building game before they have wasted too much time at it. This applies to foremen as well. The working foreman who forgets to watch his men while he is working with them may be a poorer investment than he who does nothing but oversee them. The most valuable type is the man who can do both efficiently. Foremen's time goes on whether the work does or not. When interruptions occur and men must be laid off, the good foreman allows nothing to slacken, but pitches in at whatever he can do to lessen the expense of the lull, whether it be for a day or a fortnight.

The drawing up of a set of instructions for the guidance of general foremen should deal with fixed office practice as applicable to the average project. Special conditions demand specific rulings, and no attempt need be made to provide for such exceptions in a formal guide. The instructions included here have been in practical use for some time, being revised as was proved necessary by experience.

1. The General Foreman's Responsibilities. The general foreman will act as the representative of the building company on the job and will have entire charge of it under instructions from the home office. He will lay out all the work and superintend all construction and be solely responsible. He will personally sign all payrolls, reports, and correspondence.

2. Drawings and Specifications. The general foreman will be supplied with as many copies of prints and specifications as may be necessary for his own use and for the use of subcontractors and foremen; he must keep careful record of them, and see that they are not mishandled or mislaid.

3. Issues and Revisions. Preliminary prints are sometimes issued for the purpose of starting excavating or foundations before working drawings are completed. When these or later prints are superseded by revised issues, the general foreman shall make careful note of all changes and their effect, if any, on the work already done or laid out, and shall have a distinct understanding with the home office regarding it. He shall also observe due caution that superseded prints are marked "Void" and not left accessible, where they might be subject to misuse.

4. Checking. As soon as prints and specifications are received, the general foreman shall carefully review and compare them and check all features in a
general way. He shall then notify the home office that this has been done, calling attention to errors or discrepancies, if any have been noted. This is important and must not be delayed; it may affect later work.

5. Job Program. As soon as the construction manager has assigned a general foreman to a project, they will confer and outline a job program, by means of which will be determined the sequence for ordering all materials, dates when they should be ready, and the degree of advancement of the whole work at each fortnightly interval. It shall thereafter be the duty of the general foreman to live up to this program or to show reason for each specific lapse.

6. General Purchasing. General purchasing is done through the home office, each order in triplicate;—one to the vendor, one to the general foreman, and one to the home office file. If the owner so requests, a copy is sent him also.

7. Material Lists. The general foreman (or such other person as designated by the home office,) will prepare accurate lists of all materials for the work, except such as are included in subcontracts. If not prepared by the general foreman, they must be checked by him and either approved or criticised before being requisitioned. Lists must cover every material specified, or else adequate reason be given for variation. They must also state the use of each article listed, the time it is needed at site, how it is to be delivered, and whether quantities given are net or whether allowance is made for waste and shrinkage.

8. Requisitions and Expediting. As soon as possible after a project is assigned, program arranged, material listed and checked, the general foreman shall begin requisitioning the home office for material and shall continue doing so in proper time and due sequence until all has been taken care of. Each requisition shall be accompanied by approved material lists, if needed, the number of the purchase order, if one has been issued, and such information as the general foreman has to offer as to the best available source of supply, proper price, etc. He is expected to make all requisitions well ahead of time needed (which shall be stated on requisitions), and to follow up requisitions, not permitting the home office to lose sight of his necessities. Slackness in this particular is much worse than over-in insistence. Whereas the general foreman is giving his whole attention to his particular work, he should bear in mind that it is only one of several in the home office, and hence his is the greater responsibility. If he foresees delay in receipt of anything, he should use his best efforts to expedite it or, if beyond his ability to do so, he should ask the home office for special assistance.

9. Job Purchase Orders. The general foreman (or the purchasing agent assigned) will make such purchases from local dealers as have been previously arranged for by the construction manager. For all such purchases (except items of less cost than $1, bought out of petty cash) a job purchase order must

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**Fac-simile of Purchase Order Blank**

(Original size 8½ by 11 inches)
be written beforehand in quadruplicate. If it is a cash item, one copy goes to job file and three to home office, each receipted by vendor (in place of an invoice). For items to be charged, the original of the four copies shall be given to vendor. Only such charge accounts should be opened as seem absolutely necessary, favoring such dealers as the owner prefers or as make best prices consistent with quality, and as give best service. All job purchase orders must be numbered consecutively, from No. 1 up, and each number accounted for to the home office, even though canceled, in which latter case, the reason for cancelation should be given. Wherever possible, purchase prices should be given on orders.

In all purchasing, note particularly that needs should be studied and lists made of all required materials which can be obtained from a single vendor, and competitive prices secured where possible; then the list should be ordered all at once,—enough, but not too much.

Single rush orders of small items mean added costs, additional bookkeeping and possible delays. Telephone orders should be used only for emergency, and should be followed at once by job purchase orders confirming.

Cash should never be paid for any item to a vendor with whom there exists a charge account.

No general foreman or other employee should open a charge account away from home. They shall pay cash and their credit will not be recommended.

10. Construction Forces. One of the first duties of a general foreman upon arriving at a job will be to examine the local labor situation and report upon it in detail to the home office, advising what can be counted upon, what preferences are expressed by the owner, and any other suggestions of value. He will confer with the construction manager on the subject from time to time and will follow his instructions, employing always the best men available, at rates determined, getting best values at all times. In general, skilled labor should never be employed for work that can be done more economically by common labor. Workmen will be paid only for time actually employed, unless other special provision is approved by the home office. Over-time is only to be used when expressly pre-arranged for or in actual emergency. Foremen are to be employed only when the number of men in any trade warrants. The work done by themselves, as well as by the men under them, should be kept at maximum, just the same as if directly overseen by the general foreman. A week's work will consist of 44 to 60 hours' regular time, depending upon the season and the project's requirements, of which all employees are to be kept informed. Holidays will be observed, except in emergencies (approved by home office), and no pay allowed for them, unless pre-arranged. Pay for transportation or other unusual expenses must also be pre-arranged.

11. Subcontracts. When expedient, subcontracts will be let for specific work. The general foreman will be provided with copies of all such contracts and specifications governing them and will act as inspector of all work included therein; he will see that ample notice is given each subcontractor ahead of time such work is needed (particularly for members to be built into walls and concrete), that all provisions of such contracts are properly fulfilled, that the work is properly correlated with that of others,

This Report must give a complete accounting of all material on hand and received; its use, etc. Record must be carefully kept from day to day; balanced weekly and made out in triplicate each Tuesday. One copy each to Owner, Home Office and Job.

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**THE W. W. BEACH COMPANY**

ARCHITECTS ENGINEERS BUILDERS

SIOUX CITY, IOWA

**WEEKLY MATERIAL REPORT**

FROM:  
TO:  
DATE:

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SIGNED.

SUPERINTENDENT

Weekly Material Report (Size 8½ by 11 inches)
and that amounts of partial payments demanded are proper and duly proportionate. Prior to the letting of such contracts, either by the home office direct or by the general foreman under order from the home office, it is essential to know (1) the general reputation of the party whose bid it is proposed to accept; (2) his equipment and other fitness for the work; (3) the attitude of his employes toward the architect's organization and its probable effect; and (4) the name of his liability insurance company and number of his policy, if the contract is to include labor at the job.

12. Permits and Ordinances. Before beginning a given project, the general foreman must familiarize himself with local and state ordinances and laws relating to the work and shall take out and pay for such permits as may be required, notifying the home office if any bonds are necessary. In general, subcontractors for plumbing, wiring and the like will secure their own permits, but the general foreman must see that those who do such work are properly licensed. Great care must be taken as to street and alley obstructions and occupancy of adjoining property.

13. Insurance, Accidents, Etc. The owner will carry fire insurance on work and equipment, and the company will maintain workmen's compensation insurance, but the general foreman will be expected to do all in his power to prevent fire and accidents, maintaining temporary fences and barricades, danger signs, "No Smoking" notices, red lights and other means of warning employes and the public. He must personally inspect all equipment, hoists, ladders, scaffolding, shoring and other possible sources of danger, known capacities, and see to and
14. Temporary Buildings. Such temporary structures as are directed by the construction manager, built as he instructs, are to be located to the best advantage and constructed as soon as possible after the arrival of the general foreman, who shall bear in mind their possible use in cold weather and also their value and disposition at completion of the work.

15. Daily Construction Reports. Daily construction reports are to be made out in duplicate, the original sent to the home office (mailed on day it records), and duplicates kept in proper sequence in job file. When so directed, a third carbon copy must be provided for the owner. Each detail of required information must be clearly given, and the progress of work from day to day given in percentages on in manner directed by the construction manager. No letter, other than that on the daily report, to the home office is necessary.

16. Job Correspondence. In general, all correspondence relating to a job will be handled by the home office, with copies to the general foreman of such letters as are needed in job file. The general foreman will hold to a minimum all correspondence with outsiders, thus avoiding duplicating the work of others. Emergency matters having to do with expediting, corrections, etc., should be handled promptly by mail, telephone or telegraph, with copy to the home office in each case. All correspondence regarding shop drawings, also their checking, will be handled by the home office, but copies will be sent the general foreman for approval or record. These and all other correspondence records shall be carefully filed. All mail for the work will be directed to the company, for which purpose the general foreman shall promptly provide a street address or will rent a post office box, if preferable.

17. Telephone and Telegraph Service. On day of arrival at a job, the general foreman will call at the local telegraph and telephone offices and make arrangements for prompt service, both day and night. If a job phone is to be installed, the contract should be made at once in the name of the company, so that it can be put in as soon as the office is ready. Unless confirmation is made by job purchase order, all telephone calls of importance must be recorded in duplicate on “Telephone Record” blanks, one copy to home office and one to job file. A third copy must be made of messages of sufficient importance and sent to other party to the conversation for confirmation. Such confirmation may be a deciding factor in some important matter.

18. Changes from the work as laid out by drawings and specifications are always a fruitful source of error and expense and are to be avoided as much as possible. The general foreman must never suggest a change to the owner nor allow another employe to do so. Advice and constructive criticism are always welcomed, but the home office will take care of all business dealings with the owner. The general foreman is sent out to construct the building in accordance with drawings and specifications.
tions and has no authority to make any change whatever without first consulting the construction manager or home office. The home office must receive immediate notification in event of any dispute with or expression of dissatisfaction on the part of the owner, and that portion of the work affected shall not proceed until a decision (permanent or temporary) has been made.

In the same way these important subjects are taken up in order and specific instructions given:

19. Extra Work Orders
20. Payrolls
21. Funds for Payrolls and Incidentally
22. Hauling
23. Returnable Items
24. Transferred Items
25. Weekly Cash Reports
26. Tool Reports
27. Equipment Reports
28. Weekly Material Reports
29. Cost Accounting
30. Cost Schedule.

In General. The loyalty of the home office to the interests of the owner is its first consideration, but the success of its building methods depends largely upon the loyalty of employes to the home office. The first sign of dissatisfaction on the part of the owner is generally found to be due to gossip of disappointed local competitors or of their employes or some one who has been discharged. This should be watched and defeated if possible, the home office being always kept informed. The owner must be shown a whole-hearted attention to his interests that is thoroughly convincing. The general foreman should also keep the home office fully informed as to all other matters relating to the work in hand and regarding any other items of building activity or prospects in the vicinity in which the home office might be interested. While the particular work in hand is supposed to demand all of the general foreman's time (including overtime when necessary) regardless of regular hours, it is assumed also that he will be alive to what is going on around him,—that he possesses something better than a "one-track mind." He will be expected to so conduct himself and his affairs as to obtain these results when the work is completed: A. A first quality structure, as set forth in drawings and specifications. B. Completion according to time schedule or better. C. Closure or complete adjustment of all unsettled matters and accounts preparatory to the final billing. D. A written acceptance by the owner, to be obtained by the construction manager, indicating entire satisfaction.

The foregoing instructions, although apparently somewhat lengthy, will by no means be found adequate for all work. Much still devolves upon the construction manager in the way of advice, and still more upon the experience and initiative of the general foreman himself. In this article, we are dealing only with the duties of purchasing and supervising. Auditing and accounting require the services of an expert bookkeeper. Hence, with proper care in building up his field organization, it should be apparent that the high class architect is at least as well qualified to engage in actual building as is the general contractor to undertake to do his client's planning.
THE BUILDING SITUATION
A MONTHLY REVIEW OF COSTS AND CONDITIONS

The usual summer slump in both the volume of new construction and the amount of contemplated work took place during July and August, although not in sufficient measure to prevent the first seven months of the year from establishing a new record for the total amount of construction. According to the figures of the F. W. Dodge Corporation, the building and engineering contracts awarded during July in the 37 states east of the Rockies amounted to $583,432,400. This represents about 91 per cent of the entire country, and the figure was the highest July contract total on record. It was 9 per cent ahead of the July, 1927 total, but was a drop of 10 per cent from the total for June of this year. Two districts made new high totals for the month of July— the Middle Atlantic States and the Central Western States (which enjoyed the highest monthly totals ever made in these territories, while the New England and the Southeastern States exceeded the volume of construction over July, 1927. In New York state and northern New Jersey, in the Pittsburgh district, the Northwest, and in Texas there was a decline as compared with July, 1927 figures; and only in the Central Western, the Northwestern and in the Southeastern States, did July totals exceed the figures recorded for the preceding month of this year.

The distribution of building construction by types showed $228,734,800 or 39 per cent of the total for residential construction; $157,074,700 or 23 per cent for public works and utilities; $95,696,800 or 16 per cent for commercial buildings; $36,926,400 or 6 per cent for educational projects; and $31,399,800 or 5 per cent for industrial projects. A decided drop in new work contemplated took place during July, the total for the month being $687,682,700, which is a loss of 37 per cent from the amount reported in June, 1928, and a drop of 7 per cent below the amount reported for July of last year. In August construction contracts to the amount of $516,970,200 were awarded in the Eastern States, which is about 11 per cent below the July figure and 6 per cent below the figure for August, 1927. The New England States and the Northwest were the only two districts showing increases over their July, 1928 records, and the Central West, Northwest, and Southeastern States were the districts which showed increases over their records for August of last year. The total amount of new building and engineering work started since the first of the year amounts to $4,545,200,100, an increase of 6 per cent over that of 1927.

ANNUAL CHANGES
MONTHLY CHANGES 1927 1928

These various important factors of change in the building situation are recorded in the chart given here: (1) Building Costs. This includes the cost of labor and materials; the index point is a composite of all available reports in basic materials and labor costs under national averages. (2) Commodity Index. Index figure determined by the United States Department of Labor. (3) Money Value of Contemplated Construction. Value of building for which plans have been filed based on reports of the United States Chamber of Commerce, F. W. Dodge Corp., and Engineering News-Record. (4) Money Value of New Construction. Total valuation of all contracts actually let. The dollar scale is at the left of the chart in millions. (5) Square Foot Area of New Construction. The measured volume of new buildings. The square foot measure is at the right of the chart. The variation of distances between the value and volume lines represents a square foot cost which is determined, first by the trend of building costs, and second, by the quality of construction. 624
The Kohler Duostrainer—Hand Type

(in open position)

Raise cup... water rushes out... cup catches debris... lifts out for easy emptying... sink holds water just like lavatory bowl... hallmark of the ultra-modern sink... available on ALL Kohler apron sinks

The Kohler Duostrainer—Lever Type

Turn lever... drain opens or closes... cup lifts out for easy emptying... regular equipment on all Kohler Electric Sinks

Women are enthusiastic about this Kohler fitting

Women are the best critics of kitchen sinks. They know what they want—at least when they see it! And they have received the Kohler Duostrainer so enthusiastically that it is rapidly replacing the old-style open drain.

No sink installation now need be without this admirable convenience. The complete Kohler line of sinks offers Duostrainer-equipped models suited to every situation.

Your clients, once they know about this new, modern improvement, will be sure to want it.

Kohler sinks are made in the full range of Kohler Colors, and may be had in Kohler Flint-gloss acid-resisting enamel—exceptionally durable and lustrous. And then there are the Kohler Electric Sinks for dishwashing and clotheswashing. A remarkable line!

KOHLER CO., Founded 1873, KOHLER, WIS. Shipping Point, Sheboygan, Wis. Branches in Principal Cities

KOHLER OF KOHLER Plumbing Fixtures
What's the Difference Between a Genuine Vitreous China Urinal Stall and an Ordinary One?

The superiority of vitreous china over other materials being well known—the advantages of specifying Douglas urinal stalls are apparent.—Bear in mind they will not craze or discolor, that they are easily kept clean and absolutely impervious.

Write for Catalogue and list of Buildings where the Genuine Douglas Vitreous China Urinal Stalls are being used.

Manufactured by
The John Douglas Co.
Makers of High Grade Plumbing Fixtures

General Office: Cincinnati
Factories: Cincinnati, O. Trenton, N. J.
Faucets are the vital spots of plumbing

Mueller G-4020 built-in over-rim tub filler with china handles and escutcheons and an overhead shower connection and switch valve for tub or shower.

Built-in equipment by MUELLER means permanent plumbing

The name of Mueller stands for scientifically planned and simplified plumbing equipment.

Simple design and the very highest grade of materials, practically combined, have produced fittings that are a distinct addition to modern toilet appurtenances and that give lasting operating satisfaction to both owner and tenant.

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The American Brass Company, Waterbury, Conn.
Concrete Engineering Co., Omaha, Nebr.
Armstrong Cork Co. (Linoleum Division), Lancaster, Pa.
Truscon Steel Co., Youngstown, Ohio.
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Irving Hamlin, Evanston, Ill.
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Charlotte . . N. C.
Chicago . . . Ill.
Cincinnati . . . O.
Columbus . . . . O.
Cleveland . . . . O.
Dallas . . . . Tex.
Denver . . . . Col.
Des Moines . . . . Ia.
Erie . . . . Pa.
Harrisburg . . . Pa.
Indianapolis . . Ind.
Jacksonville . . Fla.
Kansas City . . Mo.
Los Angeles . . Cal.
Louisville . . Ky.
Memphis . . . Tenn.
Minneapolis . . Minn.
New Haven . . Conn.
New York . . . N. Y.
Omaha . . . . Nebr.
Phoenix . . Ariz.
Portland . . Ore.
Richmond . . . Va.
Seattle . . . . Wash.
Salt Lake City . . U.
San Francisco . . Calif.
St. Louis . . Mo.
Spokane . . Wash.
Syracuse . . . N. Y.
Tulsa . . . . Ok.

Also

London . . . . Eng.
Osaka . . . . Japan.
Havana . . . . Cuba.
Manila . . . . P. L.
SELECTED LIST OF MANUFACTURERS' PUBLICATIONS—Continued from page 158

HEATING EQUIPMENT—Continued
Nash Engineering Company, South Norwalk, Conn.
No. 37, Devoted to Jennings Return Line Vacuum Heating Equipment, electrically driven, and supplied in standard sizes up to 300,000 square feet equivalent direct radiation.
No. 38, Describing Jennings Hytor Condensation Pumps, sizes 6, 8, and 10 sq. in. Illustrated. Data on testing.
No. 39, Illustrating Jennings Return Line Vacuum Heating Equipment. Sizes 6, 8, and 10 sq. in. Illustrated. Data on testing.

National Radiator Corporation, Johnstown, Pa.
Aero Radiators; Beauty and Worth. Catalog 34. Booklet, 6 x 9 in. 20 pp., designing and illustrating radiators and accessories.

Great Six Companies Unite to Form a Great Corporation. Booklet, 27 pp., 4 x 6 in. Illustrated. Values data on heating.

Oil Heating Institute, 420 Madison Ave., New York.
No. 37. Devoted to Jennings Hytor Return Line Vacuum Heating Equipment. Sizes 6, 8, and 10 sq. in. Illustrated. Data on testing.
No. 17. Describing Jennings Hytor Condensation Pumps, sizes 6, 8, and 10 sq. in. Illustrated. Data on testing.
No. 25. Illustrating Jennings Return Line Vacuum Heating Equipment. Sizes 6, 8, and 10 sq. in. Illustrated. Data on testing.

Residence Oil Burning Equipment. Brochure, 6 pp., 8% x 11% in. Illustrated. Data regarding Petro Burner in a bulletin of the types of light for use in homes. Describes use of operating table reflectors, incandescent and multiplate, word reflectors, word reflectors, giving sizes and dimensions, explaining their particular fitness for special uses.

The Pick-Earth Companies, Chicago and New York.
Hospital Applications of Monel Metal. Booklet, 8% x 11% in. Illustrated. Gives complete information on the Merck Metal used, reasons for its adoption, with sources of such material.
The Pick-Barth Companies, Chicago and New York.
Some Thoughts About Hospital Food Service Equipment. Booklet, 21 pp., 7 x 9% in. Illustrated. Data on complete outfitting of hotels.

INVENTORS
Home Incinerator Co., Milwaukee, Wis.
The Decent Way. Burn it with Gas Brochure, 30 pp., 5% x 7% in. inside. Illustrated, incinerator sanitation equipment for residence use.
A. J. A. File, 12 pp., 8% x 10% in. inside. Suggestions for architect on incineration, showing installation and equipment.
Specialized Home Comforts Service Plan Book, 40 pp., 8% x 11% in. inside. Illustrated. A complete outline of the many advantages of incineration.
Blue Star Standards in Home Building, 16 pp., 8% x 8% in. inside. Illustrated, explaining fully the Blue Star principles, architectural heat, insulation, ventilation, and wiring specifications.
Kerney Incinerator Company, 713 E. Water St., Milwaukee, Wis.
Incinerator practice in Domestic Domiciles, Folders, and Builders’ Edition. Size 8% x 11% in. 16 pp. Illustrated. Describes for architects and designers the Kerney Chimneyfixed Incinera-
tor for residences, apartments, hospitals, schools, apartment hotels, clubs and other buildings. Shows all standard models and gives full general information and working data.
Sanitary Elimination of Household Waste, booklet, 4 x 9% in. 56 pp. Illustrated. Gives complete information on the Kerney
ator for residences.
Garbage and ash disposal for Apartment Buildings, folder, 8% x 11% in. 16 pp. Illustrated. Describes principle and design of Garbage Chutes and gives full list of buildings where it has been installed.
Sanitary Elimination of Waste on Hotels, booklet. 4 x 9% in. 12 pp. Illustrated. Shows how this necessary part of hospital equipment is taken care of with the Garberator. Gives list of hotels where installed.
The Generator (Chinese-feng) Booklet. Catalog No. 12, 20 pp., 8% x 11% in. Illustrated. Data on a valuable detail of equipment.

INSULATING LUMBER
Masonite Corporation, 111 West Washington St., Chicago, Ill. Booklet, 15 pp. 8% x 11% in. Illustrated. Data on Insulation vacant data for use of insulating lumber and details of construction involving its use.

The Insulation of Roofs with Armstrong’s Corkboard. Booklet, 36 pp., 8% x 10% in. Illustrated. Describes use of insulating roofs of manufacturing or commercial structures.
Insulation Requirements for Prevent Condensation. Booklet, 20 pp., 8% x 10% in. 36 pp. Gives full data on valuable line of roof insulation.
Filing Folder for Pipe Covering Data. Made in accordance with A. I. A. rules. The Cork-lined House Makes a Comfortable Home. 5 x 7 in. 32 pp. Illustrated.

Heating Equipment Institute, 420 Madison Ave., New York.
Armstrong’s Corkboard. Insulation for Walls of Roofs of Buildings. Booklet, 56 pp., 8% x 11% in. Illustrated and describes use of insulating materials for various purposes.


Phelps Dodge Corp., The, Cincinnati, Ohio.
Carey Asbestos and Magnesia Products. Catalog, 6 x 9 in. 72 pp. Illustrated. Describes use of insulating materials for various purposes.

College Products Co., 4320 South Hope St., Los Angeles.
The Insulation of Boilers. Booklet. 9 pp., 8% x 11% in. Illustrated. On insulating boiler walls, breadings, and stacks to reduce amperage and save fuel.
Heat Insulation Specifications and Blue Prints. Booklet, 20 pp., 8% x 11% in. Illustrated. On approved types of insulation.
St-O-Cel Insulation Materials and Allied Products. Brochure, 16 pp., 8% x 11% in. Illustrated. Important data on insula-
tion.

Structural Gypsum Corporation, Linden, N. J.
Heat Insulation Value of Gypsum. Folder, 4 pp., 8% x 11% in. Illustrated. Data on construction with various types of insulation and plans for standardized outfits.

JOISTS
Bates Expanded Steel Truss Co., East Chicago, Ind.
Catalog No. 4, Booklet, 38 pp., 8% x 11% in. Illustrated. Gives data on truss construction with various types of joisting and specifications for load bearing.

Getz Steel Company, Youngstown, Ohio.
Steel Joists, 8% x 11% in. 32 pp. A. I. A. File Number 19G. Illustrated. Standard specifications for load bearing.

KITCHEN EQUIPMENT
The International Nickel Company, 67 Wall St., New York, N. Y.
Hotel, Restaurants and Cafeteria Applications of Monel Metal. Booklet, 8% x 11% in. 21 pp. Illustrated. Gives types of equipment in which Monel Metal is used, with service data and sources of equipment.

Pick & Company, Albert, 208 W. Randolph St., Chicago, III.
School Cafeterias, Portfolio, 17 x 11% in. 44 pp. Illustrated. An exhaustive study of the problems of school feeding, with original illustrations and blue prints. Very valuable to the architect.

School Cafeterias. Booklet. 36 pp., 8% x 11% in. Illustrated. Data on complete outfitting of hotels.

LANTERNs
Todhunter, Charles, 119 E. 57th St., New York.
Hand Wrought Lanterns. Booklet, 14 pp., 8% x 11% in. Illustrated. In Black and White. With price list. Lanterns appro-
priate for exterior and interior use, designed from old models and meeting the requirements of modern lighting.

LATH, METAL, AND REINFORCING
Genfire Steel Company, Youngstown, Ohio.
Better Walls for Better Homes. Brochure, 16 pp., 7% x 10% in. Illustrated. Metal lath, particularly for residences.
Steeltec for Floors. Booklet, 24 pp., 8% x 11% in. Illustrated. Combined reinforcing and form for concrete or gypsum floors and roofs.

Steeltec Data Sheet No. 1. Folder, 8 pp., 8% x 11% in. Illustrated. Steeltec for floors on steel joists with round top chords.

Steeltec Data Sheet No. 2. Folder, 8 pp., 8% x 11% in. Illustrated. Steeltec for floors on steel joists with flat top flanges.

Steeltec Data Sheet No. 3. Folder, 8 pp., 8% x 11% in. Illustrated. Steeltec for floors on wood joists.

Northwestern Expanded Metal Co., 542 Old Colony Building, Chicago, Ill.
Northwestern Expanded Metal Products Catalog, 8% x 10% in. 20 pp. Fully illustrated, and describes different products of this company, such as Koo-born metal mesh, 20th Century Corrugated, 54-inch Longspan 14-inch Rib Lath. Folder 4 pp., 8% x 11% in. Illustrated. Deals with a new type of V Rib expanded metal.
A. I. A. Sample Book. Bound volume, 96 pp., 11% x 11% in. Includes actual samples of V-Rib expanded metal and complete data regarding their use.

Northwest Metal Lath. Folder, 8% x 11% in. Illustrated. Data on Flat Rib Lath.

Truscon Steel Co., Youngstown, Ohio.
Armstrong's Corkboard installed between the rafters of St. Mark's and St. John's Episcopal Church, Rochester, N. Y.

Reduces Heat Leakage Out or In —

Because of the much larger exposure to outside temperatures, it is even more essential than for other buildings that church roofs be insulated with Armstrong's Corkboard.

In winter, insulation greatly simplifies the quick and uniform heating of a large auditorium. Because of its low conductivity, Armstrong's Corkboard confines most of the heat ordinarily wasted through the roof. As a result, room temperature rises much more quickly and is maintained more uniformly and economically.

In summer, Armstrong's Corkboard on the roof or ceiling protects the auditorium below from the heat of the sun. It keeps the heat outside just as effectively as it keeps it inside in winter.

Year-round comfort, quick heating of the auditorium, and a decided economy in fuel consumption are advantages well worth considering. Armstrong's Corkboard roof insulation assures them all.

Because of the rich brown color and distinctive texture of Armstrong's Corkboard, it presents a very attractive appearance when applied as a ceiling on the under side and left exposed. If desired, it can be spray-treated with paint or tints.

Armstrong Engineers are glad to consult with architects on the use of corkboard. There is no charge for such counsel. Write for filing catalogue containing complete data and specifications on Armstrong's Corkboard. Armstrong Cork & Insulation Company, 132 Twenty-fourth Street, Pittsburgh, Pa.; McGill Building, Montreal; 11 Brant Street, Toronto 2.

Armstrong's Corkboard Insulation

For the Roofs of All Kinds of Buildings
SELECTED LIST OF MANUFACTURERS' PUBLICATIONS—Continued from page 160

LAUNDRY CHUTES

LAUNDRY MACHINERY
American Laundry Machinery Co., Norwood Station, Cincinnati, Ohio. Functions of the Hotel and Hospital Laundry. Brochure, 8 pp., 8 1/2 x 11 in. Valuable data regarding an important subject.

LIBRARY EQUIPMENT


LIGHTING EQUIPMENT


Nickel 2155 Elston Ave., Chicago, Ill. Reflections in detail with architects' specifications. THE PFAUDLER COMPANY'S LIGHTING CHUTES. Contains views of installations and list of representative examples.

ORNAMENTAL PLASTER


MORTAR AND CEMENT COLORS
A. C. Horn Company, Art Craft Division. Catalogue. 854 x 11 in. 8 pp. Illustrated. A complete specification on the subject of painting of Concrete and Stucco Surfaces.

Jacobson & Co., 247 Park Ave., New York City. How to Keep Your House Young. Illustrated brochure, 23 pp., 8 1/2 x 11 in. Complete specifications for painting, varnishing and enameling interior and exterior wood, plaster, and metal work.

MATERIALS

Cinco Anchoring Specialties. Booklet. 20 pp., 8 1/2 x 11 in. Illustrated. A useful work on the upkeep of residences.

PAPER

PARTITIONS
Circle A Products Corporation, New Castle, Ind. Circle A Partitions Sectional and Moveable. Brochure, 8 1/2 x 11 in. 14 pp. Illustrated. A complete specification on the important line of partitions, along with Erection Instructions for partitions of these three different types.

Hauserman Company, E. F., Cleveland, Ohio. Hollow Steel Standard Partitions. Various folders, 8 1/2 x 11 in. Illustrated. Gives full data on different types of steel partitions, together with details, elevations and specifications.


PAPER
October, 1928

THE ARCHITECTURAL FORUM

163

Rivet-Grip Guards a City of Gold
Leading New York Architects use Rivet-Grip for Bank Vaults

The following architects have used Rivet-Grip Bank Vault Reinforcement in notable installations in and about Greater New York:

A. F. Gilbert
Equitable Trust Co., Madison and 36th St., New York

Cass Gilbert
Equitable Trust Co., Madison and 36th St., New York

Ci'dell & Aldrich
Westfield Trust Co., Westfield, N.J.

Crosby & Bihrs
City National Bank, Bridgeport, Conn.

Fellheimer & Wagner
Citi Bank, 40 Exchange Bank, 99 Exchange Bank, New York—Corn Exchange Bank (Grand Central Branch), New York

McKee, Voorhees & Gmelin
Travelers Insurance Co., Hartford, Conn.

McKenzie, Voorhees & Gmelin
Trinity Insurance Co., Hartford, Conn.

Merrill-Smith
Banks of the Manhattan Co., Fearless Bank, L. I. Branch, Fearless Bank, N.Y. Branch

Sloane & Robertson
Chase National Bank, (Grand Central Branch), New York

Stevens & Van Allen
Bank of the Manhattan Co., Madison and 46th St., New York

Trowbridge & Livingston
Equitable Trust Co., New York

Walker & Gillette
Chase National Bank, New York

B. V. White
State Savings Bank, New York

York & Sawyer
Bowery Savings Bank, New York

The RIVET-GRIP STEEL CO., 2404 Prospect Ave., Cleveland, O.

Rivet-Grip
BANK VAULT REINFORCEMENT
SELECTED LIST OF MANUFACTURERS' PUBLICATIONS—Continued from page 162

PUMPS—Continued

The Trane Co., LaGrange, Wis. Trane Small Centrifugal Pumps. Booklet. 354 x 8 in. 16 pp. Complete data on an important type of pump.


RAMPS

Ramp Buildings Corporation, 21 East 40th St., New York, N. Y. Building Garages for Probable Operation. Booklet. 85 x 11 in. 16 pp. Illustrated. Discusses the need for modern mid-city parking garages, and describes the D'Humy Motoramp system of design, on the basis of its superior space economy and features of operating convenience. Gives complete drawings of garages of different sizes, and calculates probable earnings.


REFRIGERATION

The Fulton Sulphon Company, Knoxville, Tenn. Temperature Control of Refrigeration Systems. Booklet, 8 pp. 85 x 11 ins. Illustrated. Deals with cold storage, chilling of water, etc.

REINFORCED CONCRETE—See also Construction, Concrete


Longspan 14-inch Rib Lath. Folder 4 pp., 85 x 11 in. Illustrated. Deals with a new type of V-rat expanded metal.

ROOFING


Phillip Carey Co., Lockeland, Cincinnati, Ohio. Architectures Specifications for Carey Built-up Roofing. Booklet, 9 x 10 1/4 in. 24 pp. Illustrated. Complete data on specifying the different types of built-up roofing to suit the kind of roof construction to be covered.

Carey Built-up Roofing for Modern School Buildings. Booklet, 8 x 10 1/4 in. 16 pp. Illustrated. A study of school buildings of a number of different kinds and the roofing materials adapted for each.


Chinese Mission Tile. Leaflet, 85 x 11 ins. Illustrated. Tile such as are used in Italy and southern California.

Georgian Tile. Leaflet, 85 x 11 ins. Illustrated. Tiling as used in old English and French farmhouses.

Ludowici-Celadon Company, 104 So. Michigan Ave., Chicago, Ill. "Ancient" Tapered Mission Tiles. Leaflet, 85 x 11 ins. Illustrated. For architects who desire something out of the ordinary, this leaflet has been prepared. Describes briefly the "Ancient" Tapered Mission Tiled, hand-made with full corners and designed to be applied with irregular exposures.

Structural Gypsum Corporation, Linden, N. J. Relative Effectiveness of Various Types of Roofing Construction in Preventing Condensation of the Under Surface. Folder, 4 pp., 85 x 11 ins. Important data on the subject.

Gyro Rite Pre-cast Fireproof Roofs. Booklet, 48 pp., 85 x 11 ins. Illustrated. Information regarding a valuable type of roofing.


Sheetrock Pynchol Roof Construction. Folder. 8 x 11 in. Illustrated. Covers use of roof surface which is poured in place.

SEWAGE DISPOSAL

Kewanee Waste Utilities, 442 Franklin St., Kewanee, Ill. Specification Sheets. 714 x 10 1/4 in. 40 pp. Illustrated. Detailed drawings and specifications covering water supply and sewage disposal systems.
A Brunswick Triumph
In Seat Manufacture!

A sheet-covered seat that is guaranteed indefinitely not to split at the edges

As shown below, Brunswick's new White Seat has a heavy reinforced cushion of tough, resilient pyralin right on the outer edges where blows and rough usage are liable to cause white seats to split open. The sheet pyralin on the new Brunswick Seat is welded to this heavy cushion edge of pyralin. The seat edge is thus made 9 times as thick as a single sheet!

Even the roughest usage won't damage this amazing new construction. It enables us to guarantee this edge against defects for an unlimited period.

Our large manufacturing facilities enable us to offer the Brunswick White Seat at exceedingly attractive prices.

In addition to the Whale-bone-ite Seat, and this new White Seat, Brunswick is now manufacturing a complete line of wood seats. Thus in the Brunswick line you can now find seats for every type of installation. Our catalog showing all models should be in your file. Write for it. The coupon is for your convenience.

BRUNSWICK WHITE SEATS
Made by the Manufacturers of the Whale-bone-ite Seat

THE BRUNSWICK-BALKE-COLLENDER CO.  •  Chicago  •  New York
**SCREENS**

- **American Brass Co., The, Waterbury, Conn.**
  - Facts for Architects About Screened Doors. Illustrated folder, 95 x 134 in., giving actual samples of metal screen cloth and data on 8 by screens and screens.

- **Atkin, Geo., 6015 West 65th St., Chicago, Ill.**
  - The Atkin Pergamin Window Shade. An accordion pleated window shade made from translucent Herringbone woven screen cloth, which raises from the bottom and lowers from the top. It eliminates sawdust, affords ventilation, can be dry-cleaned and will wear indefinitely.

- **Orange Screen Co., Maplewood, N. J.**

- **Orceo Screens and Other Products.**
  - Brochure, 20 pp., 8 x 11 in. Illustrated. Door and window screens and other hardware.

**SHADE CLOTH AND ROLLERS**

- **Columbia Mills, Inc., 251 Fifth Avenue, New York.**
  - Window Shade Data Book. Folder, 28 pp., 8½ x 11 ins. Illustrated.

**SHELVING-STELL**

- **David T. Angier Co., Philadelphia, Pa.**
  - Luster Steel Shelving. Catalog E. Illustrated brochure, 40 pp., 8½ x 11 in. Deals with steel cabinets, shelving racks, doors, partitions, etc.

**SKYLIGHTS**

- **Albert Grosser & Co., 1408 Seventeenth St., Detroit, Mich.**
  - Grauer Glass Skylights. Folder, 4 pp., 8½ x 11 in. Illustrated. Data on an important line of wire glass lights.

- **Kawneer Construction in Solid Bronze or Copper.**
  - Booklet, 64 pp., 8½ x 11 in. Illustrated. Contains full sized details of metal screen fronts.

**SOUND DEADENER**

- **Cabot, Inc., Boston, Mass.**

**STAIRWAYS**

- **Woodbridge Ornamental Iron Co., 1535 Algodel St., Chicago.**
  - Pattern Sheet for Stairways—stairways catalog. 36 pp., 8½ x 11 in. Illustrated. Important data on stairways.

**STEEL PRODUCTS FOR BUILDING**

- **Bethlehem Steel Company, Bethlehem, Pa.**
  - Standard Joists and Stanchions. Catalogue. 72 pp., 4 x 6¾ ins. Data for steel for dwellings, apartment houses, etc.

- **Genflex Steel Company, Youngstown, Ohio.**

- **Rigid Metal Lath and interior plastering.**
  - Presto-Mixed Handbook. 8½ x 11 ins., 32 pp. Illustrated. Describes the full line of products manufactured by the Genflex Steel Company.

**WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa.**

- **The Arc Welding of Structural Steel.**
  - Brochure, 26 pp., 8½ x 11 in. Illustrated. Deals with an important structural process.

**STONE, BUILDING**

- **Indiana Limestone Company, Bedford, Ind.**
  - Vol. 1, Series B, Indiana Limestone Library. 6 x 9 in. 36 pp. Illustrated. Giving general information regarding Indiana Limestone, its physical characteristics, etc.
  - Volume 5, Series B, Indiana Limestone Library. Portfolio, 11⅝ x 8½ in. Illustrated. Describes and illustrates the use of stone for small houses with floor plans of each.
  - Volume 6, Series B—Indiana Limestone School and College Buildings. 8½ x 11 in., 50 pages, illustrated.
  - Volume 12, Series B—Distinctive Homes of Indiana Limestone. 8½ x 11 in., 48 pages, illustrated.
  - Old Gothic Random Ashlar. 8½ x 11 in., 16 pages, illustrated.

**STORE FRONTS**

- **Braico Manufacturing Co., 5025-35 South Wabash Avenue, Chicago, Ill.**
  - Catalog No. 21, Series 500, All-Copper Construction. Illustrated brochure, 20 pp., 8½ x 11 in. Deals with store fronts of a high class.

- **Braico Bronze Store Front. Catalog No. 32, Series 202.**
  - Illustrated brochure, 16 pp., 8½ x 11 in. Complete data on an important type of building.

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  - Illustrated brochure, 16 pp., 8½ x 11 in. Complete data on an important type of building.
A Necessity to Modern Buildings

Electrical equipment meeting the present-day high standard of architecture, is necessary in the construction of modern steel and concrete buildings.

Westinghouse CL carbon circuit-breakers prove that unsightliness is no longer necessary for durability and dependability of service. These breakers, through years of the severest service, demonstrate that simplicity, compactness and pleasing lines can be obtained without the use of clumsy rods and levers.

In addition to a balanced design, permanence of appearance is assured by treating all exposed copper with a satin finish. This finish retains its lustre without polishing. Ask for Circular 1705.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pennsylvania
Sales Offices in all Principal Cities of the United States and Foreign Countries
SIGNAL CALL SYSTEMS
FOR BANKS

Signal Call Systems are a tremendous asset to banks where it is so important to have executives within immediate call. These Systems place all executives at the finger tips of the switchboard operator. When one fails to answer his telephone she merely presses a button and the code number assigned to that individual is broadcast quietly throughout the bank. The called party hearing his signal answers at the nearest extension and the call is completed without disturbance and without delay. The adjustable chime signal illustrated below is particularly recommended for banks. Its soft mellow tone is always clearly audible but never annoying.

S. W. Strauss and Company, an organization noted for its efficiency and progressiveness, has installed a Signal Call System in its beautiful Chicago offices.

SELECTED LIST OF MANUFACTURERS' PUBLICATIONS—Continued from page 166

WATERPROOFING—Continued

Sonneman Sons, Inc., L., 116 Fifth Ave., New York, N. Y.
Pamphlet, 34% x 84 in. 8 pp. Explanation of waterproofing principles. Specifications for waterproofing walls, floors, swimming pools and treatment of concrete, stucco and mortar.

Toch Brothers, 110 East 42nd St., New York City.
Specifications for Dampproofing, Waterproofing, Enameling and Technical Painting. Complete and authoritative directions for use of an important line of materials.

The Vortex Mfg. Co., 1932 West 77th St., Cleveland, Ohio.
Per-Lock Specification "Form D" for waterproofing surfaces to be linked with Portland cement or tile. Per-Lock Specification "Forms E and G" membrane waterproofing of basements, tunnels, swimming pools, tanks to resist hydrostatic pressure. Per-Lock Waterproofing. Specification Forms D, E, F and G. Sheets 8¾ x 11 ins. Data on combinations of gun-applied asphalt and cotton or felt membrane, built up to suit requirements.

Par-Lock Method of Bonding Plastic to Structural Surfaces. Folder, 6 pp., 8½ x 11 ins. Illustrated. Data on an important type of waterproofing.

WEATHER STRIPS

Atthey Company, 6055 West 66th St., Chicago.
The Only Weatherstrip with a Clip to Metal Contact. Booklet, 16 pp., 8½ x 11 ins. Illustrated. Data on an important type of weather stripping.

WINDOWS

The Kawneer Company, Niles, Mich.
Kawneer Solid Nickel Silver Windows. In casement and weight-bung types and in drop-down transom type. Portfolio, 12 pp., 9 x 11½ ins. Illustrated, and with demonstrator.

Lupton Pivot and Sash, Catalog A-2A. Booklet, 48 pp., 8½ x 11 in. Illustrates and describes windows suitable for manufacturing buildings.

WINDOWS, CASEMENT

Crittall Casement Window Co., 10951 Hearne Ave., Detroit, Mich.
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Architect—Ralph H. Cameron

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"T"HE world is experiencing a new age," said Henry Ford recently—"the industrial and comfortable age."

A thousand and one influences are educating the average American to a keener sense of leisure and comfort in the home, with a minimum of responsibility and care.

It is the privilege, as well as the function, of the architect to specify these extra hours of comfort. Today he includes automatic oil heat as one of the first and most important accessories of modern living satisfaction. No other convenience offers such complete freedom from drudgery.

To facilitate your selection of equipment which may be depended upon to function effectively the Oil Heating Institute has been organized.

Its province is to provide you and your clients with complete and unbiased information regarding this new day convenience, for this purpose it makes available to you a comprehensive booklet, "Installing Oil Heat," written by an architect for architects. You will find a desirable addition to your reference library. The coupon will bring it to you.

The Oil Heating Institute is prepared to furnish special information on the heating of churches, theaters, hotels, apartment houses and office buildings, and on the various heat treating processes of industry.
THE strong endorsement of Johnson Heat Control is the constantly growing vast number and variety of Johnson System installations — at the suggestion of the architect. The profession may assume a skeptical attitude toward automatic heat control: however, the contrary obtains after the architect's first Johnson System installation. Johnson Heat Control enjoys significant recognition and prestige as a result of forty-three years of unwavering service and architects' repeated experience with its efficiency.

The Johnson System Is Of Permanent, All-Metal Construction: And Is The All Perfect Graduated Intermediate System of Regulation

JOHNSON SERVICE COMPANY
MILWAUKEE . . . . . WISCONSIN
BRANCHES IN ALL PRINCIPAL CITIES
Imagine a heating unit that forces heated air where you want it, when you want it and as much as you want—that eliminates cold corners, and heat pockets from large industrial areas—a unit that can be used for ventilating as well as heating! Imagine a heating unit that can be shut off all night and thrown open in the morning to heat a large area comfortably in less than 30 minutes—a heating unit that occupies the minimum of floor space and is so simple and accessible that it can be taken apart and assembled by anyone with only a few ordinary tools! Imagine a heating unit that will operate year after year with practically no attention whatever; that can be regulated to keep comfortable working conditions regardless of outside weather conditions; that puts waste heat to work and reduces expense in every manner known to scientific heating! Such a unit is the new Sirocco Unit Heater.

Companion to the World Famous Venturafin Unit Heater

Built by the makers of the Venturafin Unit Heater—the Sirocco Unit is of high velocity type for floor and ceiling applications, high or low pressure installations. It fills a decided need for adequate heating equipment in large industrial buildings, warehouses, gymnasiums and other structures of large areas where forced heat at high velocity is desirable or necessary.

New Advantages and Economies

The Sirocco Unit Heater offers many important advantages for heating and ventilating large areas. It has a lower tip speed than any other unit of
UNIT HEATER

ing and Ventilating

equivalent capacity, which assures more quiet and satisfactory operation. It is scientifically designed to reduce waste heat to a minimum and to actually put “waste heat” to work. It is built as only American Blower, with its vast resources, years of experience and complete facilities, builds heating and ventilating equipment. It is the most accessible unit heater on the market. It distributes heat more evenly and over a larger area through the use of specially designed Evase type discharge cowls. It ventilates as it heats—or can be used for either heating or ventilating alone. Made in twenty-eight sizes and capacities to fit every need.

Ventilating Units for schools, offices and public buildings; and Venturafin units for general industrial applications (stores, factories, garages and shops) to the Sirocco Unit Heater for large industrial areas where forced heat at a high velocity is advisable or necessary.

Send for Complete Information

Every user, buyer or dealer of heating equipment, as well as architects and engineers, should have complete information on the Sirocco Unit Heater. Fill out and mail the coupon today and we will send it to you free of charge and without obligation.

A Complete Line of Unit Heaters

The addition of the high velocity Sirocco Unit Heater gives us a complete line of unit heaters ranging in types from the Universal Heating and AMERICAN BLOWER CORP., DETROIT, MICHIGAN

CANADIAN SIROCCO CO., LTD., WINDSOR, ONTARIO

BRANCH OFFICES IN ALL PRINCIPAL CITIES

COUPON

I am interested in the Sirocco Unit Heater for industrial heating and ventilating as applied to the subjects checked on right.

Name: _______________________

Firm: _______________________

Full Address: _______________________

□ Factory □ Warehouse

□ Shop □ Gymnasium

□ Garage of large area

Particularly useful to architects and engineers are the valuable publications being issued by this association of manufacturers of oil-burning equipment and oil companies. The titles of some of them are: "Are Oil Heaters Perfect?"; "Does It Pay to Install an Oil Heater?"; "Making Better Use of the Basement"; "What About the Supply of Fuel Oil?". The particular booklet being noticed here, which deals with the subject from the architects' point of view, is a carefully prepared study, giving data regarding different types of oil-burning mechanism. The brochure is fully illustrated, and it explains the matter well.


The interest which attaches to any building coated with stucco is of course that given by use of appropriate and attractive materials, and this is true with stucco clad in a dress of stucco which by having wholly transformed its appearance has prolonged indefinitely its life and usefulness. There is probably no firm manufacturing building materials which issues publications more practical and useful than the Atlas White Portland Cement Company. Its booklets and brochures have been reviewed many times upon these pages of The Forum because it has long been felt that they carry to architects and builders information which might not be had from any other source. This particular brochure deals with "Houses of Stucco." It shows the wide usefulness of Atlas White in stucco may give. In addition to presenting illustrations in color of surfaces so treated and giving the plainest possible directions as to how to secure the textures and colors, the brochure illustrates a large number of buildings, residences, garages, apartment houses, etc., which have been so treated.


There are not many departments of research which have yielded more practical and valuable results than have the researches which have to do with acoustics—a term which, since it concerns the control of sound, might, perhaps, without stretching its meaning unduly, be taken to mean the prevention of the transmission of sound as well as the improving of the hearing of sound. This brochure on the use of the material known as "Sabinite" deals with this important subject. It confines itself to two of the three major phases of the general problem. The first two are treated here; the third is to be treated separately. The first two of these problems owe the technical name of "Sabinite" to the work by a group of technical men who realized the need for a high grade acoustic material and to the sound insulators, architects and engineers, who have used it. It presents important data which may well have their attention brought to this publication. This company "devotes its facilities exclusively to the manufacture of acoustic insulation for buildings, and to the supplying of specialized engineering service directed solely to the solution of acoustical problems. In 1895 a building was constructed on the Harvard campus, and upon its completion the acoustics were found to be so poor as to actually interfere with the use of the structure. This raised considerable comment among the professors of Harvard University, because this building had been intentionally designed after the manner of another building in Cambridge that was almost acoustically perfect. The Department of Physics was asked to determine what caused the difference in the two structures. After certain experiments had been made, it was discovered that the cushions on the seats of the earlier building contributed to its ideal acoustical conditions. Out of this discovery grew original data and basic formula which are universally used today in predetermining the acoustical quality of any type of interior and the correction of any acoustical faults that exist. The Macoustic Engineering Company, Inc., was organized in 1921 by a group of technical men who realize the need for a high grade acoustic material and authoritative data on acoustical problems. After extensive research and the study of acoustics, these engineers developed Macoustic,—a fireproof, vermin-proof material that produces sound-insulated walls and protects them from the kindling action of children's charcoal fires. After being thoroughly tested, Macoustic is now finding wide application in homes of all types, homes built of wood, stone, brick or concrete. The company also produces "Monel," a metal made of copper, nickel and iron which possesses great plasticity and strength. It is particularly so for the manufacture of utensils which are used in cooking and in the preparation of food products, and thus the material finds extensive use in hotels, restaurants, hospitals, and elsewhere where cooking must be done on a more or less extensive scale. The ingenuity of metalurgists and manufacturers of metal in the making of Macoustic Sound Control. Important data on the subject.

Metal Door & Trim Co., La Porte, Ind. "Hollow Metal Door Construction; Details and Specifications."

The interest which attaches to any building coated with stucco is of course that given by use of appropriate and attractive materials, and this is true with stucco clad in a dress of stucco which by having wholly transformed its appearance has prolonged indefinitely its life and usefulness. There is probably no firm manufacturing building materials which issues publications more practical and useful than the Atlas White Portland Cement Company. Its booklets and brochures have been reviewed many times upon these pages of The Forum because it has long been felt that they carry to architects and builders information which might not be had from any other source. This particular brochure deals with "Houses of Stucco." It shows the wide usefulness of Atlas White in stucco may give. In addition to presenting illustrations in color of surfaces so treated and giving the plainest possible directions as to how to secure the textures and colors, the brochure illustrates a large number of buildings, residences, garages, apartment houses, etc., which have been so treated.

The dictionaries describe monel metal as "an alloy of nickel, copper and iron which possesses great plasticity and strength. It is particularly so for the manufacture of utensils which are used in cooking and in the preparation of food products, and thus the material finds extensive use in hotels, restaurants, hospitals, and elsewhere where cooking must be done on a more or less extensive scale. The ingenuity of metalurgists and manufacturers of metal in the making of Macoustic Sound Control. Important data on the subject.

Architectural designers, no less than those interested in the structural side of architecture, may well have their attention brought to this publication. This company "devotes its facilities exclusively to the manufacture of acoustic insulation for buildings, and to the supplying of specialized engineering service directed solely to the solution of acoustical problems. In 1895 a building was constructed on the Harvard campus, and upon its completion the acoustics were found to be so poor as to actually interfere with the use of the structure. This raised considerable comment among the professors of Harvard University, because this building had been intentionally designed after the manner of another building in Cambridge that was almost acoustically perfect. The Department of Physics was asked to determine what caused the difference in the two structures. After certain experiments had been made, it was discovered that the cushions on the seats of the earlier building contributed to its ideal acoustical conditions. Out of this discovery grew original data and basic formula which are universally used today in predetermining the acoustical quality of any type of interior and the correction of any acoustical faults that exist. The Macoustic Engineering Company, Inc., was organized in 1921 by a group of technical men who realize the need for a high grade acoustic material and authoritative data on acoustical problems. After extensive research and the study of acoustics, these engineers developed Macoustic,—a fireproof, vermin-proof material that produces sound-insulated walls and protects them from the kindling action of children's charcoal fires. After being thoroughly tested, Macoustic is now finding wide application in homes of all types, homes built of wood, stone, brick or concrete. The company also produces "Monel," a metal made of copper, nickel and iron which possesses great plasticity and strength. It is particularly so for the manufacture of utensils which are used in cooking and in the preparation of food products, and thus the material finds extensive use in hotels, restaurants, hospitals, and elsewhere where cooking must be done on a more or less extensive scale. The ingenuity of metalurgists and manufacturers of metal in the making of Macoustic Sound Control. Important data on the subject.
FUEL ECONOMY

 goes with HEATING EFFICIENCY

in

ELECTROL

On the basis of the amount of heat obtained for every dollar spent for fuel, Electrol Automatic Oil Heat costs less than the equivalent amount of heat supplied by any other automatic heating equipment, or by any other fuel, except soft coal.

The advanced principles and design employed in Electrol result in maximum heating efficiency, with ample capacity for the largest homes and buildings.

Fuel economy and heating efficiency are combined in Electrol.

Quiet...All-Electric...Entirely Automatic, Electrol is as fine as engineering skill and exceptionally strong financial resources can produce. It is the oil burner with The Master Control which watches over every phase of the burner's operation, day and night, like a living sentinel always at the furnace door.

Electrol's positive, automatic electric ignition eliminates the need for a gas pilot light. Mechanical fuel atomization, with the scientific mixing of the correct amount of air, produces intense heat with the minimum consumption of fuel. The oil and air supply are controlled separately,—an important part in producing best results.

Correct Installation is Part of the Purchase

When you specify Electrol Automatic Oil Heat you know that the burner will be correctly installed. The Electrol dealer makes an intelligent and conscientious survey of the heating requirements and advises candidly regarding the possibilities with Electrol.

All installations are made by men who have been thoroughly trained at the factory in the correct methods of fitting Electrol to each type of heating plant.

Complete Oil Heating Service

Wherever Electrol is sold you will find a complete oil heating service, backed by a sound, large and growing manufacturing organization. Purchase of Electrol can be financed along with the financing of the new building.

For complete details, write for the regulation A.I.A. Folder on Electrol. Or, if you prefer, consult the Electrol Sales and Service Representative in your city. • Electrol Inc. of Missouri, 179 Dorcas St., St. Louis, U.S.A.

ELECTROL

The OIL BURNER with The Master Control

Listed as Standard by the Underwriters' Laboratories, and bears their label.

Member of the Oil Heating Institute

KNOW ELECTROL BY THE HOMES IT HEATS

Home of H. B. Stanz, Jr., Whitefish Bay, Wisconsin.

Heated by Electrol Model TJ in a hot air furnace.

A Blue Book of Electrol Owners would read like the social register of America. Electrol is heating some of the country's finest homes.

Electrol Inc. of Missouri
179 Dorcas St., St. Louis, U.S.A.

Gentlemen: We will appreciate a copy of your regulation A.I.A. Folder.

Name: ________________________

Address: ______________________

City: _________________________ State: __________
The use of electricity for a great variety of purposes means, of course, provision of countless details of electrical equipment. This publication, one of quite a number issued by the Westinghouse firm, is a cloth-bound volume of almost 1,200 pages, fully illustrated. It presents a complete listing of the supply apparatus and appliances manufactured by the Westinghouse Electric & Manufacturing Company and obtainable through its district offices and agency jobbers. A brief presentation of the company's industrial motors and controllers, power and marine equipment, large switchboards and oil circuit-breakers and railway apparatus is also included; complete information on any of this apparatus will be furnished upon request. For the convenience of users of the catalog, a very complete cross-index is given.

ORANGE SCREEN CO., Maplewood, N. J. "Orasco Screens and Other Products." Important data on several materials.

The study which has been given to the metal screens used for various purposes has resulted in their production in large quantities, at a grade calculated for the purpose, and the "one-way vision screens" often used in banking rooms and ground floor offices to secure privacy. These screens are fully described and illustrated. They are to be had in great variety for windows of different kinds, the double-hung type, casements, pivoted windows, etc., and the booklet deals also with "Orasco" methods of construction, "Interlocking Drum-Tile Moulding," "Corner Construction," "Mortise and Tenon Corner," "Astragal Joint" and with the "Orasco Kiln-Drying Process," "Orasco Rustless Wire," and with the hardware of many kinds used upon screens.

JOHNS-MANVILLE CORPORATION, NEW YORK. "Sound Absorbing Treatment in Banks and Offices." In the planning of banking quarters, one of the problems which must be solved has to do with the prevention of noise,—or rather in most instances with the absorption of noise. It is possible to enter one bank and have one's ears saluted by the din of typewriters, adding machines and other useful and necessary devices, while in another bank there may reign the quiet which is always associated with dignity,—one of the chief qualities or characteristics which a bank is expected to possess. The difference is likely to be due to use in the latter instance of certain materials in walls and ceiling which absorb the sound. "Once produced in a confined room such as a business office or bank, this energy will continue to exist until it is absorbed by the boundary surfaces of the room, the walls, floor and ceiling, or is transmitted to the space beyond. An entirely negligible amount is absorbed in the viscosity of the air itself. It spreads in the form of a spherical wave from its source in all directions, and its loudness or intensity diminishes as the square of the distance from its source. These are simple laws of physics. When this noise or energy is produced in a business office or bank in which the boundary walls, floor and ceiling are composed of almost perfect reflectors of sound, it is evident that by far the major portion of the energy produced by whatever source, such as telephones, bell, typewriter, adding machines, bookkeeping machines or other office mechanical devices, may be considered a considerable process of multiple reflection, from walls to ceiling, ceiling to floor, floor to walls and ceiling again, many times, before the energy or noise has been wholly dissipated." This brochure dwells upon the use of "Akoustikos," an acoustic felt composed of asbestos fiber and hair. "When this material is installed strategically upon the principal reflecting surface of a bank or office, usually the ceiling, it is in effect a blotting paper for sound, absorbing the major portion of the sound energy immediately over its source, and in this way successfully eliminating most of the energy accumulation due to continued reflection."
Tex Rickard says:

"LAPIDOLITH did what you claimed. The floors improve under traffic."

Ten million people, it is estimated, have swarmed into Madison Square Garden since its opening three years ago. Twenty million feet! Pounding, kicking, scuffing the Garden's concrete floors.

What a test for Lapidolith—Sonneborn's Concrete Floor Hardener that protects these floors.

Tex Rickard knows how to pick the winners. When he found that the untreated concrete floors at the Garden gave off clouds of concrete dust, he picked Lapidolith to harden, wearproof and dustproof them.

Just how effectively Lapidolith hardened the 250,000 square feet of concrete is shown in the letter at the left. Lapidolith did its work because of its quick absorption at night without interfering with the operation of the Garden.

If you visit Madison Square Garden, look at the floors. They are hard as flint. The areas subjected to the heaviest traffic are like polished marble. And there is no concrete dust.

And, as Mr. Rickard says, "They improve under traffic."

L. SONNEBORN SONS, Inc.
114 Fifth Avenue, New York City
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OUR National business has become International. Under corporate powers vested in several companies, the latest of these is the C. A. DUNHAM COMPANY, LTD., of London, England.

There are at present more than eighty offices in the United States, Canada and Great Britain, and in addition thereto, there are several agencies in other parts of the World. This forms an active background for the Dunham Differential Vacuum Heating System.

An Organization of Specialists

In each office there are from one to ten members—one or more of whom have engineering training, qualifying them to advise on the proper application of this new heating method.

Certain well defined territory boundaries surround each company office, and all installations are the fixed responsibility of the managing engineer in whose territory these systems may be located.

Such local tie-ups between the company's organization and the Architect's engineer to design the heating, and subsequently with the heating contractor in the installation, is insurance of satisfaction to the owner.

This is a brief picture of the merchandising end of the Dunham organization.

It represents the contact point thru which our message of helpful service is demonstrated;—only on its proper functioning, can the years of rich experience be turned into channels of everlasting profit to the recipient of Better Heating. The reputation and the combined intelligence of the men who are back of this work cannot be questioned; each has a sustaining conviction of his responsibility in helping to make this system possible for a general use.

Its Value Has Been Proved

There is no mistake about the value of heating buildings with low temperature steam which may be varied to meet the needed output to balance the heat loss. Mr. Apple, Superintendent of the Barlum Tower, Detroit, states that the season's cost of heating that forty-story building with this system, was $0.292 per square foot of radiation. The season started September 12, 1927, and ended June 5, 1928; it was a green building and had all the usual handicaps of foreign matter to clear, which invariably attends the first year of any installation. Steam costs were $1.00 per 1000 pounds.

Our own building heating costs dropped from $0.199 the first season to $0.169 the second season's operation per square foot of radiation, and in each case this record was for the entire period between October 1st and May 31st using oil as the fuel.

Chicago apartment buildings show greater savings the second season than for the first, with a radiation operating cost per square foot as low as $0.212 for the full heating period just passed using coal as fuel.

We have records on file of installations in and between Quebec, Canada, and Dallas, Texas; between Rhode Island and Oregon, each reflecting variables in fuel conditions and weather changes. Reports from every installation which was in operation during any portion of the winter, have been uniformly satisfactory and with fuel saving established beyond our most sanguine expectations.

A Most Important Development

Our own engineers, who have been so closely identified with me in this development, admittedly agree that for useful results wherever artificial heat is needed, this system numbers with the most important developments of the present day.

A mere statement that the Differential System properly installed and operated can accomplish the remarkable fuel saving claims, sounds bombastic without the evidence, but it is true—we have the evidence and the proof that the Dunham Differential System will save 25% (or more) of fuel over the standard vacuum return line system in general use today.

C. A. DUNHAM CO.  Dunham Building
450 EAST OHIO STREET  CHICAGO, ILLINOIS
Modern Buildings Need this Modern Radiator

Typical of the fine buildings installing modern McQuay Radiators, is this New York City Apartment at 201 East 35th Street.

Gronenberg & Leuchtag, Architects.
Barron-Hubert Co., Heating Contractors.

Its Beauty Attracts Tenants
--it Cuts Operating Costs

Complete circulation of the heated air—so essential to economical heating—is provided by the McQuay Cabinet Radiator (a complete radiator, not just a cover). For, heated air is impelled out into the room with sufficient velocity to distribute it evenly throughout. A humidifying pan inside the cabinet, provides the moisture needed for healthy, effective heating.

A Complete Radiator Not Just a Cover

McQUAY Cabinet RADIATOR

Actually, because of the adequate circulation, and the greater heating effectiveness of moistened air—the temperature of a McQuay may be kept many degrees below that of old-style radiators. The fuel saving is considerable.

The copper heating unit—a distinctive McQuay achievement—is immune from rust and corrosion, will not "clog" and is practically indestructible.

Also: Concealed Radiators and Unit Heaters to meet any contingency

MCQUAY RADIATOR CORPORATION
General Sales Office: Pure Oil Bldg., Chicago
New York: 2148 Graybar Bldg.
Boston: 164 Federal St.
Newark, N. J.; J. F. McLaughlin Co., 734 Broad St.,
Cleveland: 201 E. 149th St.
Built to be more than “quiet”

ENGINEERS and architects expressed a need for a unit ventilator that would be more than “quiet” in operation—a unit ventilator which they could install, confident that it would run so silently that the occupants of a schoolroom, church or office would be unable to detect its operation.

Sturtevant Engineers set out to build such a unit ventilator. In the Sturtevant Research Laboratories, where ventilating equipment has been evolved to meet the demands of the greatest projects in air engineering, the work was begun. Designs were made—revised—made again. Countless experiments were conducted. Special motors and fans were developed. Finally, the “Silent” Sturtevant Unit Ventilator was produced.

As many installations of the “Silent” Sturtevant have already been made, the nearest Sturtevant representative will gladly take you to a local installation where you can observe this equipment in operation. You will then know why it meets the most exacting requirements for quietness and efficiency.

Bulletin 344-A explains the equipment in detail. Let us send you a copy.
"And silence like a potion, comes to heal the blows of sound."
—Holmes

...with the Silence of Stars

*/* A Scientific Answer to Objectionable Sound Travel — the USG System of Sound Insulation

Architects and engineers are more and more concerned with the problem of objectionable sound travel. Therefore they are urged to investigate the USG System of Sound Insulation.

This distinctly new idea is now a proved and permanent success, as shown by a substantial number of completed jobs. It is applicable to existing structures as well as to new construction.

Before launching this revolutionary improvement, the United States Gypsum Company laid the foundation through years of patient, scientific development.

The USG System of Sound Insulation is not a material but is a method of interior finishing which interposes a “shock absorber” between interior surfaces and the structural floor, wall or ceiling. Time does not lessen its efficiency. Furthermore, the USG materials are fire-proof and vermin-proof.

The USG System has a broad application. It is especially recommended for music studios, dance halls, bowling alleys and other places of amusement when situated in the same building with other units of space where quiet is essential or desired. Its use in the better class of apartment buildings is reflected in increased returns and greater satisfaction of tenants.

The Sound Insulation division of the United States Gypsum Company contracts for the complete installation of this system to insure definite results and undivided responsibility.

Recommendations and estimates of cost, based on plans or on existing structures, gladly furnished without obligation. Descriptive booklet is yours for the asking.

Write to United States Gypsum Company, Sound Insulation Division, 300 W. Adams St., Chicago, Illinois.

USG SYSTEM OF SOUND INSULATION

Guaranteed to eliminate objectionable sound travel

CREATED BY THE UNITED STATES GYPSUM COMPANY