THE NEW YORK ARCHITECT

A NATIONAL MAGAZINE DEVOTED TO THE INTERESTS OF ARCHITECTURE AND THE ALLIED FINE ARTS.

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DONN BARBER, Editor
J. HOLLIS WELLS, Architectural Engineering Editor

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DONN BARBER, Editor

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We have already shown in past issues of THE NEW YORK ARCHITECT some illustrations of the Hôtel-de-Ville, at Tours, France, by M. Laloux, Architect. We are fortunate in having a most complete series of photographs of this notable and most important monument, representing a product of the talent of a modern French master, which we will show from time to to time.

The ceilings shown in this issue recall the superb ceilings of Rome and Venice, and although the building as a whole is thoroughly French in style and treatment, yet the spirit and inspiration of certain parts of the composition show the architect's admiration for, and appreciation of the great works of the Italian masters. One sees in the facade of this building a reminiscence of the Grand Guardia Vecchia, at Verona, and something of the proportions of the Stoppani Palace at Rome, attributed to Raphael.

M. Laloux, architect of the Hôtel-de-Ville, at Tours, France, was born at Tours in 1850. He was a pupil of André while in the Ecole des Beaux Arts, and secured the prix de Rome in 1878, upon a project for a cathedral. His work as a pensionnaire of the French Academy at Rome, is well known through his various interesting envois, among which are the Temple of Venus and Roma, the Farnese Palace ceiling, the Pesaro Palace at Venice, and the door of the Pantheon.

M. Laloux has been, perhaps, more fortunate than other architects in France, having had the opportunity to execute many works of first importance while still in the full vigor of life. In addition to many private buildings, he has built the Christian Basilica and Railroad Station at Tours, the Terminal Station in Paris on the Quay d'Orsay, and more lately the Hôtel-de-Ville at Tours, shown, in part, in this issue.

The effect of this building, which at first glance is startling, pleases as one becomes accustomed to its personality. The details are huge in scale and used with a freedom and fluency that characterize the work of most modern French masters; but the detail is unusually interesting and placed with an idea of producing a sumptuousness that is at the same time extraordinary and quite personal to the architect. Care for the ornamental mass has been consistently kept superior to the delicate carving, resulting in an extraordinary brilliancy of classical decoration.

In the plan of the building the general disposition of rooms and services does not differ materially from that usually adopted in like buildings, but everything has been subordinated to the one idea of producing a setting for commodious and brilliant receptions and to facilitate proper circulation and movement of the crowds using the rooms at official gatherings.

A Plea for the Better Understanding of Bronze

"Doubtless the greatest and most enduring medium for the expression of form in Art and Architecture is Bronze, and as such it is a material that must be approached with reverence; it seems to resent careless handling, and its very nature demands artisanship that shall be characterized by patience, skill, care and a love for the work. To give anything less produces results that must be discarded, patched up, or that have the taint of absolute ugliness. On the other hand there seems to be no limit to the cleverness, skill and labor that may be expended upon its fabrication. Its receptiveness to being 'fussed over' is almost feminine. It may have the most exaggerated allowances used in its working, and still call for further refinements, according to the ideals of designer and craftsman."

This is the gist of some remarks made to me by an old bronze worker before their truth had been impressed on me by many a confirming experience.

Being, par excellence, a material that is a medium for lasting artistic expression, valuable for its plasticity, color, strength and its almost unlimited range of uses, Bronze, when compared with its more precious sisters, Gold and Silver, is, for most practical uses, superior.

If we are living in an age of Steel, we must be rapidly approaching a Renaissance of the Bronze Age, as much greater in proportion to the past as our Age of Steel can be to the Age of Iron.

Believers in the future of a "Commercialized Art," as one of the greatest problems of our times, look to the Architectural Profession as the principal channel through which this future is to gain support and be realized. Among all the branches of Architecture and its allied arts, Bronze-craft must stand among the most useful of the hand-maidens doing the Architect's will, if he would write his story permanently. Archæology has found some of its greatest treasures and most perfect examples of the ancient arts preserved in this material. The great expense of Bronze work has necessarily restricted its considerable use in building to monumental works and those wherein large sums of money have been expended for beauty and permanency, but never before in history has this material been utilized to its present extent.

About eighteen years ago an Ornamental Bronze Contract, amounting to sixty thousand dollars, which was awarded on an important office building, was considered a most lavish display of wealth. To-day, contracts of this size are comparatively common, and single contracts amounting to hundreds of thousands of dollars have been awarded in the past few years; in fact, such work is coming to be quite the thing in the better class of operations. Future ages will know us largely by these architectural monuments, and we must stand judgment on the refinements that are preserved. If, therefore, we have faith in our present advancement, this material, enduring beyond all others, will play no small part in passing our message on to posterity.

Now, those dealing with Bronze find it contains that elusive quality that belongs to most things artistic—that spirit, property or element that chafes at the restrictions of rule, or submission to the Artisan who has not proven himself its master.

There have been few things new in the essential methods of bronze working since the dawn of history; the same principles are used to-day that Phidias, Myron, Angelo and Cellini used when writing their immortal pages in the history of Art with this noble metal. Aside from some few improvements in methods of casting, probably the greatest advancement of modern times in the working of Architectural Bronze is the perfected rolling, drawing and annealing processes, whereby plates, bars, channels, and other sections, are produced under the general classification of "Wrought Bronze Shapes."

The essential methods employed in working Bronze differ entirely from those used with Iron; Bronze is malleable only when cold, Iron when hot; the kneading that refines Iron, hardens Bronze; the tempering process which hardens Iron, softens Bronze. It is, therefore, impractical to work Iron and Bronze in the same shops—they require different tools, different treatment and a different class of artisans. These materials do not belong together—they cannot be worked together—they are naturally opposed to each other, chemically and fundamentally, and the more reputable concerns handling both materials maintain independent organizations for each. The comparatively familiar methods adopted towards the rusty giant will not do for Bronze.

Broadly speaking, Ornamental Iron work is cast, or wrought, cleaned up, rough edges removed, holes or imperfections filled with suitable material, the whole given a coat of paint of desired color, and we have a finished Ornamental Iron job of varying degrees of beauty. There are those who will say that to have reproduced that same design in Bronze would mean but a difference in the cost of material. This is a popular fallacy that has lost many a pretty penny for those in this industry who have not learned to "approach with reverence."

How many readers know that the "fire-skin" must be removed from every inch of the exposed surface of properly finished Bronze, whether cast or wrought, for our lady's beauty is more than skin deep, and the ultimate beauty of the work in this metal depends upon the care, delicacy and skill with which this dermatological operation is performed.

How many readers of this article can give a definition of Bronze, anyway?

I seem to see you all look wise and reply: "Bronze?" Why, Bronze is an alloy of Copper and Tin," or "Bronze is a basic metal," or, "Bronze is an alloy of Copper, Tin and Zinc." Perhaps the very wise will say that "Bronze is an alloy of 90 per cent. Copper, 7 per cent. Tin, and 3 per cent. Zinc."

If, for the sake of argument, I call your Bronze composition "Brass," and challenge you to prove differently, just start in to look it up and see where you arrive. You will find recognized tables of alloys on important works that are rated as "Bronze," as containing properties which on other works are called "Brass," and vice versa. I have heard the suggestion that "Bronze work showing yellow is Brass," and that "High Class Brass Work is Bronze." The use of the term "Bronze" as being an alloy of Copper and Tin, with Copper and Zinc as the Alloy for Brass, is generally accepted; but the point I am trying to make, is that there is no well-defined or authoritative standard established in this country—at least, not to my knowledge, except on some Government specifications. All this may be due to the elusive quality we have noted.

I make the plea, therefore, for a better general understanding of this metal—that it may be used fairly and intelligently and "approached with reverence." The problem of bringing this about must rest largely with the Architectural Profession. You have given protection to crafts that are classed among the more artistic products—why not Bronze? Surely none are worthier or more important.

Bronze is comparatively the most expensive class of work used in building, yet I venture to say that there is no class of special work performed under the restrictions of the Architect's drawings and specifications,—and wherein the manufacturer does not prepare his own proposal,—for which such meagre information is generally given. Certainly none, where the conscientious manufacturer, having set for himself a standard of work below which he will not go, is more handicapped by the competitor who lacks this sentiment.

We are frequently asked, "Why is there such a difference in estimates on Bronze work?" Not infrequently estimates are received ranging to 100 per cent. and even 200 per cent. difference in price, and the low figures may be from a reputable concern at that. Why is this? An illustration is given in the following case: Some time ago an important piece of work containing a large quantity of Bronze Railing was given for estimates by a reputable firm of Architects. The railing was shown at 1/4-in. scale and indicated "ornamentation," but no intelligent idea could be obtained as to the intent of the design. Now, it would have been an extremely easy matter for any draughtsman or estimator to have interpreted this "suggestion" as a piece of work that would range anywhere from $20 to $100 per foot. A firm of Iron Workers, who evidently figured on the difference in cost between Iron and Bronze metal, were low bidders, and were given the contract. They now have had a lesson in Bronze handling "burned" into them to the scant satisfaction of the "Serves-them-right" and "I-told-you-so" brethren, while the Architects may be satisfied in having obtained for their building and clients an Iron job in Bronze metal that won't rust.

Specifications calling for "This work to be executed in Bronze" to "Work to be of cast and wrought Bronze" are the usual thing. Sometimes the more conscientious ones, with a hazy idea of the metal, read thus: "This work is to be executed of Standard Bronze where shown, of an alloy consisting of 90 per cent. pure Lake Superior Copper, 8 per cent. pure Pig Tin, and 2 per cent. Lead or Zinc, all ornamental portions to be cast at least 5/16-in. thick and hand chased. Wherever wrought Bronze is to be used, it shall not be less than No. 10 guage."

What happens to the work done under such specifications? In the first place, the concern securing the contract will probably ignore the alloy specifications and proceed to execute the work according to their own foundry practice, varying the percentage of the alloy as may be necessary for the character of the work handled. The result will be satisfactory, too, and the work be just as good and durable as though the letter of the specification had been followed, for you must know that Bronze is hardened or softened, made tough or brittle, caused to flow easy or slow, by the variations of Tin, Zinc or Lead alloys used. Castings that can be easily run with one alloy are doubtful with another, and this question the experience of the foundryman must largely decide.

Again, the metal must be cast to a practical thickness which may be the specified 5/16-in. or may be 3/16-in. on the small parts, or 1/2-in. thick on larger portions, all according to the foundry economy, experience and requirements, for, as a general proposition, while the best practice will keep the castings as thin as possible (and this, by the way, is evidence of supe-

rior workmanship) at the same time there is a limit of thickness where the hazard and physical obstructions make the thin casting far more expensive than the possible saving of metal, if made thicker.

Moreover, Bronze in Architecture is seldom if ever used from the "constructional" standpoint, or where its strength is really taxed, as it is plastic in nature, so that here again the material protects itself by demanding in its economical handling a sufficient thickness and strength to serve its purposes, according to its size.

Then comes the "Chasing" part of the specifications. Here words fail the manufacturer who has been up against the loosely drawn requirements of inexperienced but exacting supervisors, and who has taken the chance he must needs take in these days of cut-throat competition to get work. After the plain surfaces have been filled and fiddled, ground and polished, matted or scratched, pumiced and finished, comes the chasing of ornamental portions, by which the skin is removed and the spirit of the orignal model preserved through the medium of another craftsman than the modeller. Here are obtained to a great extent the quaint galvanized iron effects in bronze, that enhance many of our most imposing works.

Here is also where the beauty and superrefinements of the metal may be brought out to the uttermost limit of artisanship, for when Bronze work gets to the chaser, economy may be thrown to the winds. The work may be merely cleaned up, the ornament touched up slightly, or a piece of jewelry can be made of it, and it all comes under the general term "hand chased." As this work is done by an expensive class of artisans, it can be seen where an interesting piece of work may easily run away with the artisan, foreman or architect, who sees the added beauties developing under the deft chiselling of a clever chaser. To the irreverent this is a case of "what I can get away with." If castings are fairly clean, the burrs and rough spots may be filed away, a few sharp corners toned up, and the inexperienced superintendent may accept a job that a more conscientious manufacturer would not allow to leave his shops.

These general illustrations of the point I am trying to make might be added to—*ad infinitum*—but enough suggestion has been given to outline the necessity for some concerted action on the part of the Architects and manufacturers, to the end that, so far as possible, the execution of this important branch of building work be placed on some kind of a defined and standardized basis, not only for the protection of the conscientious manufacturer but for the architect as well, for, if the irreverent can be forced to attempt the production of the higher results and standards, he will quickly be brought to a realizing sense that Bronze work means vastly more than the difference in cost of material. Our "Bronze Lady" will protect herself, if she is not brutalized, and this can be brought about by some recognized system of standards. Perhaps such suggestions as the following might help to produce the desired result; that a definite degree of finish to which cast, wrought and ornamental portions are to be brought, be established, and some specific regulations as to any variation from original models.

The guages of wrought metal used on certain classifications of work and within certain specified sizes.

The delivery by Architects of more carefully studied and comprehensive drawings and specifications for this most expensive of all building work.

The standardizing of certain "constructional" features that would insure fabrication as enduring as the material.

It may be said that reputable concerns already have the protection of the Architect, by the practice of giving them preference and in leaving to them largely the details of construction, finish, etc., and that, by suggesting a scheme of standardizing, I am working at cross purposes, and am trying to do the very thing that, earlier in this article, I have said cannot be done with bronze.

To an extent that is true, but the first conditon (that of preference) not infrequently works hardship on the manufacturer of special work, who has had it "left to him," partly because of the liability of misunderstanding, and partly because sometimes he has been given a monetary preference, in which case it may have the boomerang effect of giving the Architect a license to demand about anything he wants on work that has been taken from sketch suggestions, forgetting that there is almost no limit to the amount of labor that may be put on Bronze work.

It will be hard to commercialize or standardize high-grade workmanship, especially the art or ornamental portions of such productions, but as Bronze is being more generously used on commercial buildings, it becomes all the more necessary to establish some standard whereby it can be commercially produced.

If those having the best interests of the building industries at heart—of whom our Architectural brethren must be first—and those of the Bronze-working field, would get together and evolve some method of working along the lines suggested, it would most assuredly work to the greatest benefit of both in the production of this everlasting portion of their handiwork.

Opposition to any such effort may be encountered, not only from Architects, but from reputable Bronze workers as well, especially those who remain a law unto themselves, but I believe that, upon consideration, it will be the consensus of opinion among the majority of those interested, that the time has arrived in this world-old craft, when more modern methods should be applied.

CLARENCE A. FULLERTON.

The Importance of the American Academy at Rome

"Americans no longer need to look to Europe for their education in architecture and the other arts," said Mr. Breck Trowbridge, in an informal interview the other day, "but of course this does not mean that American architects and artists will not still be obliged to go abroad for their inspiration and study.

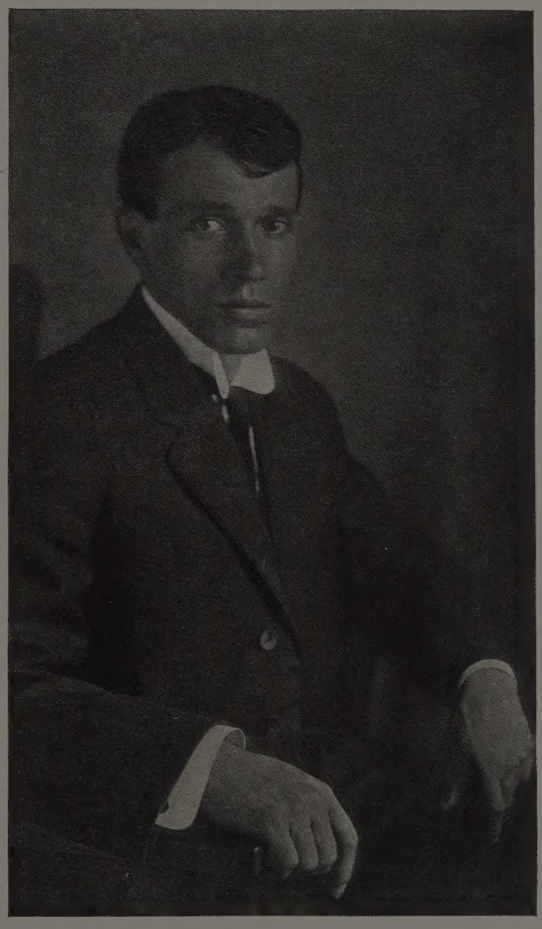
"It is absolutely necessary, in fact, that they should spend some time in the atmosphere of the Old World works of art.

"Greece, for instance, with its memories of the 'Golden Age' of Pericles, is the fountain-head of architectural study, and no student can gain at home from the study of models and pictures the same inspiration that he feels from the contemplation of the actual things themselves as he sees them in their natural settings. The Acropolis at Athens cannot very well be transplanted for the student's benefit. He must ascend it in person and absorb the whole atmosphere and spirit of the wonderful architecture and sculpture of that time as he sees it before him, in order to gain the inspiration his work should have.

"The same is true of the ancient Egyptian, Assyrian and Roman works of art. They should be studied amid their native surroundings.

"The best of it is that those of our American architects who do study abroad bring back the result of their experience and reproduce in America the Old World ideas and ideals revitalized and individualized, so that nowhere now is there any architecture and art more worthy the constantly growing interest and respect that is being paid to American work."

It was to give American art students a chance to gain the opportunities of which Mr. Trowbridge spoke that the American Academy of Fine Arts in Rome was incorporated in 1897 by Americans for Americans, and it is pleasant to record that the results have been so satisfactory that the Academy is now considered to have justified its existence. It is an established institution working along the same lines and for the same end as the French Academy.



ALBIN POLASEK

WINNER OF THE PRIZE IN SCULPTURE

An exhibition in 1904, held in the Villa Aurora, the present home of the Academy, comprised the work of three architects, two painters and one sculptor, and was so highly spoken of by the Italian Government, the Italian academic bodies, the general public and the Press that it gave the Academy a national standing in Europe.

The result of the recent competition held to select the beneficiaries of the Academy for 1910 has just been decided, and the prizes were

HENRY LAWRENCE WOLFE
WINNER OF THE PRIZE IN PAINTING

awarded by the executive committee as follows: Architecture; Richard Haviland Smythe, of New York; sculpture, Albin Polasek, of Philadelphia; painting, Henry Lawrence Wolfe, of New York.

Under the rules of the institution, the recipients of these scholarships become pensionaires of the Academy. They will leave in September for Italy, and will take up their residence at the Vlla Mirafiore, in Rome, for three years, where they will work under the supervision of Mr. Frederick Crowninshield, the Resident Director.

Richard Haviland Smythe, the winner of the prize in architecture, was born in Brooklyn, and is a graduate of the Polytechnic Preparatory. He is also a graduate of Columbia University, where he has received the degree of Bachelor of Arts and followed the course in architecture.

The problem which was given to the forty-seven competitors in architecture was a proposed Government building on the Mall in Washington for a Bureau of Fine Arts.

The jury was composed of Breck Trowbridge, Chairman; John M. Carrere, William R. Meade, Architects; A. A. Weinman, Sculptor; Francis C. Jones, Painter.

The winner of the prize in sculpture, Albin Polasek, was born in Frenstat, Moravia, of Bohemian parents. He came to the United States in 1901, and has studied art at the Academy of Fine Arts in Philadelphia. He has received, during his five years of study, the Edmund Stewardson prize in sculpture, the McClellan prize in anatomy, the Grifly prize in composition, and the Cresson traveling scholarships in 1907, 1908, and 1909.

RICHARD HAVILAND SMYTHE
WINNER OF THE PRIZE IN ARCHITECTURE

The tests for the sculptors were studies in anatomy and drawing, single figures and a large decorative panel in relief.

The jury consisted of Herbert Adams, Chairman; A. A. Weinman, Charles Keck, Sculptors; Breck Trowbridge, Architect, and C. Y. Turner, Painter.

Henry Lawrence Wolfe, the winner of the prize in painting, was born in New York City, received a high school education, and has studied two years under Chase and Beckwith

at the New York School of Art, and four years at the Pennsylvania Academy of Fine Arts, where he received three prizes in composition and the Cresson traveling scholarship in 1908. He has competed for the Lazarus scholarship, and twice received honorable mention in the competition for the Academy of Rome, and this year his persistency has been rewarded by success.

The problems upon which the painters were judged consisted of decorative painting and studies in composition, drawing and anatomy. Mr. Wolfe was chosen from fifteen painters by a jury consisting of H. Siddons Mowbray, Chairman; Charles Breck, former director of the Academy of Rome, and Francis C. Jones, Painters; Breck Trowbridge, Architect, and A. A. Weinman, Sculptor.

By the will of the late Mrs. Hylands, a magnificent property, the Villa Aurelia, with its beautiful gardens overlooking the whole City of Rome, has been bequeathed to the Academy.

Among those who have contributed large sums to its foundation are: J. P. Morgan, William K. Vanderbilt, Henry Walters, James Stillman, Henry C. Frick and Harvard University. The late Charles F. McKim was its founder.

The President of the Academy, William R. Mead, is at present in Europe, and will visit the Academy in September, with Mr. Millet, one of the Executive Committee. It has been the custom for some years for a number of the directors of the Academy, all well-known architects, sculptors, and painters, to visit the Academy in Rome from time to time, keeping in touch with the work which is being done, to the end that this Academy may be, as it has been called, "The Keystone of Art Education in America," and that it may maintain a position corresponding in importance to that of its elder sister, the French Academy in the Villa Medici.

Structural Iron and Steel

Leaving till a later date a discussion of concrete reinforced with steel rods, there is no question but that iron and steel have become the most important structural materials with which architects and engineers have to do in the construction of high buildings. Many were those who early in the history of the skyscraper considered it as a fad to be constructed with advantage only in congested areas of large cities. To-day twelve to twenty-five story buildings of steel construction are to be seen in any city of a hundred thousand inhabitants, and in many of the smaller cities. In Texas the general prosperity of the State has encouraged the building of skyscrapers in Galveston, Houston, Dallas, Ft. Worth, Waco and perhaps elsewhere. In the west such structures are not limited to Denver, San Francisco, Los Angeles, Seattle and Tacoma, but are being built in Salt Lake City, Sacramento, Prescott, Spokane and Butte. Surely the commercial value of being near to the business center, of light, modern improvements, elevator service as compared with even a single flight of stairs, is being exploited and he is bold who will question the business foresight of those who invest liberally in such undertakings.

Comparatively low buildings are, with advantage, built with interior iron or steel columns, and walls self-supporting, and also taking the bearing of floor beams and girders; others somewhat higher are designed with a complete iron and steel frame and walls self-supporting, while the higher buildings require the complete structural steel frame carrying the floors and walls above the lower stories. Technical knowledge is required in the choice of materials and sections as well as in the details of design, and it is the purpose of this article to consider some of the questions relating thereto.

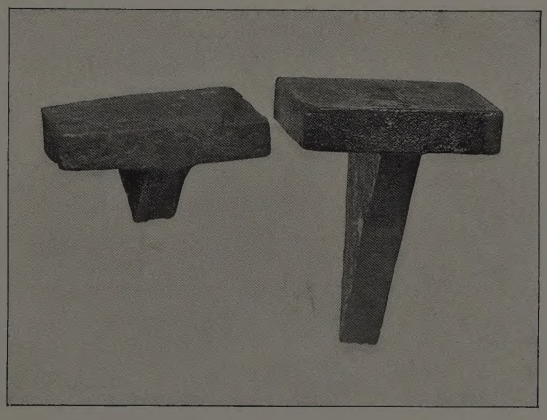


PLATE 1

The term structural iron is now limited to cast iron. Wrought iron is no longer a com-

mercial product for use in building because the development of steel manufacture is such that steel has replaced it as being stronger and actually cheaper per ton. Cast iron is sufficiently well adapted for comparatively low buildings and for column bases where the loads are not too great. For small sections and in some locations it is cheaper than steel but it has many disadvantages. There is always uncertainty as to its uniformity; satisfactory splices cannot be made to give stiff connection suitable to withstand direct dead and live loads from the floors; the provision for proper wind bracing is designed only with much difficulty, and the connection of girders resting on brackets is most undesirable. In the foundry there is danger of shrinkage strains caused by bad design or removing the casting too soon from the sand. In designing cast iron bases the thickness of ribs, top and bottom and barrel should be the same. There should be no cross ribs and all junctions of metal should have easy

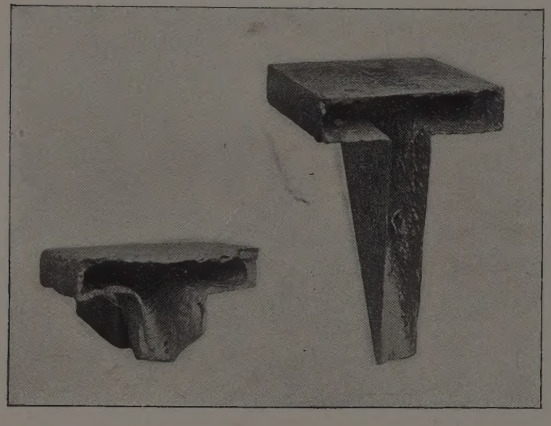


PLATE 2

fillets. Whenever cast iron is used it should be inspected and tested with great care, and particular attention given to the bearings of all joints. All connecting holes must be accurately drilled.

The danger of cast iron comes from poor metal, cold shuts, excessive blow-holes, shrinkage strains, shifting of cores and defective caps, bases and lugs. A curious defect is shown in Plates 1 and 2. The former shows a lug broken from a column which from its surface appears perfectly sound and reliable; the latter shows it to be but a skin of metal about one-sixteenth inch thick. This condition was a defect of casting. The columns were cast horizontally with the lugs on top with a vent leading up from the edge of the lug. The sand of the mould was slightly "green" (damp) and when the hot metal was poured, steam was formed which blew the metal up into the space for the lug and formed this thin shell, stopping the vent. When the body of hot metal reached the lug it could not displace the air as the vent was closed. The defect was readily discovered by an intelligent inspector at the foundry, who sounded the various parts of the column with his hammer, and noticed that the lugs sounded hollow. Several were easily broken off by a blow of a sledge.

Of a lot of large cast bases for an important building, four developed cracks at the site when delivered in zero weather, although carefully inspected at the foundry. These cracks were evidently the result of shrinkage strains, partly due to imperfect design, and probably somewhat to removal too early from the sand. The contraction of the metal in the cold weather developed the cracks.

The defects mentioned do not indicate that cast iron has no place in building construction, but that it has its limitations, and must be designed with knowledge and inspected with care.

Structural steel shapes are well known to designers from the various hand-books, published by the leading rolling mills. Their use in trusses and built girders has undergone no special development for a number of years. A caution to inexperienced designers is necessary in their use, as in fact all steel shapes, that the standard shapes, frequently rolled and to be had in the open market are preferable to special or unusual shapes, which may theoretically show an economy. It should be borne in mind, that the rolling mills are frequently rolling such standard shapes, and that a change of rolls and orders for a considerable tonnage are necessary for special or unusual shapes. So that a delay of several months in delivery may be necessary to secure special shapes, which can at best save only a trifling tonnage. The same is true of special qualities of steel. Manufacturers will not disturb the routine of the mill work to furnish a few hundred tons of special product. It is, therefore, wise to design for commercial material and, if necessary, increase sections and weight rather than have to modify specifications and design later or submit to delay.

The most important development in beams for floor construction is that I-beams of eighteen, twenty and twenty-four inches depth and varying weights can be secured more readily because of the increasing demand and more frequent rolling and the introduction of new sections of more economical design and of depth of twenty-six, twenty-eight and thirty inches. These new sections permit of longer spans and heavier loads.

In columns the most important development is the rolling of H sections varying in dimensions from eight inches web and eight inches

flange to sixteen inches by fourteen and eighty-eight one-houndredths inches with metal varying from thirty-one one-hundredths inches to two inches thick. The lighter sections are punched and the heavier sections drilled for connections. These rolled steel columns are being extensively used, and contracts are frequently let providing for their substitution instead of built columns. Otherwise there is a tendency to use built angle and plates, and channel columns, rather than those of special steel shapes or other design. The Z-bar columns, while of satisfactory character for convenience of connections, are less frequently used than several years ago, because of the difficulty of securing the material for varying sections from the mills and because it is uneconomical when cover plates are necessary, compared with columns of angles and plates or channels.

In the designing of columns shop manufactured must be considered and the sections of material must be chosen and arranged so as to give economy of manufacture. Metal exceeding three-quarters of an inch in thickness requires heavy tools in punching, and to enable tight rivets to be driven the rivet holes should be punched small and reamed to size. Where possible the total thickness of metal through which rivets are to be driven should not exceed two and one-half inches. It is of importance that the material shall be so arranged, particularly at connections, that there is space to drive rivets by power and to be able to secure sound, effective rivets. Where rivet holes are drilled at the shop with connecting parts together or to an iron template, conditions are most favorable for good riveting, but such shop work is expensive, and may warrant a rearrangement of lighter sections which can be punched and reamed or punched and not reamed, even if the tonnage is slightly increased.

From the foregoing it will be evident that the choice of material and the sections thereof for a structural frame are matters requiring some engineering experience and skill while not a part of the purely theoretical design.

P. S. Hildreth.