A 'Purely Practical Science:' William Le Baron Jenney's Contribution to American Building Culture

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> "…the entire system as at present in use evolved itself little by little, each architect erecting a tall building contributing something."
>
> --William Le Baron Jenney, 1894[1]

William Le Baron Jenney's arrival in Chicago in 1867 marked the arrival of a consummate engineer and businessman into a building culture that, to that point, had been anything but professional.[2] The city's rabid real estate climate and frontier mentality had been manifested in shoddy construction, often of scantling timber, inadequate foundations, and dim, maze-like planning. Jenney brought with him an education as engineer and architect, a rare enough qualification in Chicago, but he also brought with him the precision instilled by six years as a military engineer, four of them during the American Civil War. Early in his Chicago career, Jenney built a reputation for ethical practices and thorough calculation and he gained an enthusiastic following among businessmen, city planners, and—crucially—young architects.

Over the next four decades few figures would be so influential in Chicago, or in America, but Jenney's reputation in history has erroneously rested on his attribution as the "father of the skyscraper." This claim—never advanced by him but rather on his behalf by former employers and colleagues—does not withstand casual scrutiny, but it overshadows the very real contributions Jenney made in technical and professional advances to the professions of architecture, engineering, and building. Four areas in particular should earn Jenney a very firm place in the histories of these disciplines: his early use of fireproof flooring systems, his contributions to the development of the skeletal metal frame, his mastery of foundation systems to cope with Chicago's pliable, uncertain soil, his development of early wind bracing systems that reduced structural reliance on masonry, and the professional and technical standards he set for his own office, which proved influential on the generations of architects and engineers who apprenticed under him.

Early use of fireproof flooring

Jenney's first major commercial commission came in the wake of the 1871 fire that consumed much of the city's fire-prone timber construction. The Portland Block of 1872 marked the city's first use of hollow tile flooring, a key element of fire-resistant iron construction and its emphasis on light and robust construction marked an important departure point for commercial building in the city:

> "The new style was outlined in the Portland of 1876, when pressed brick piers, with numerous large windows, took the place of pilasters or pillars, with recessed Italian windows. It was a surprise, indeed, when that building was completed. It won popularity at once as an office building, but the attachments formed for the Renaissance militated against its duplication for six years."[3]

> "The hollow terra-cotta fireclay arch was invented, strong, light and of less cost than the old methods, and more effective. With this material it was easy to entirely cover the I-beam and form a flat ceiling that only required plastering, and to protect the columns; for it could be readily molded into the shapes most convenient for each purpose. We then entered upon an age of iron. All important public, and some private buildings, were of masonry or of iron backed with masonry. The interior columns, girders and beams of iron; the floors and partitions of hollow fireclay tile. One step more and in the outside walls iron columns inclosed in masonry took the place of the old masonry pier."[4]

<u>The Skeletal Frame</u>

> The masonry reduced to the very minimum, not only carrying no weight, but being itself carried by lintels of steel from column to column over each window, as in the Home Insurance building, the Tacoma and the Leiter buildings, the Rand-McNally building, etc. (all in Chicago)."[5]

The five-story building erected by William Le Baron Jenney for dry-goods merchant Levi Z. Leiter at Wells and Madison has traditionally been considered Chicago's earliest skeletal exterior, though it was only a tentative step. The building served as a shop and storehouse, and light was of paramount concern, especially given the shallow corner lot. Jenney worked to reduce the exterior of the building as much as possible by supplementing traditional brick piers with iron columns. The Leiter lot, 82′ x 102′, was not large enough for a light court, and on the north and west sides party and alley walls required significant fire protection. Jenney placed stairs, two elevators, toilets, and plumbing chases against these solid walls, freeing the street fronts on Wells and Monroe. He then divided the plan into four structural bays, with timber girders spanning the short dimension from west to east. Timber was still seen as a reliable choice for beams and floors in 1879 despite improvements in fireproofing, but it sacrificed depth. Iron girders would have been able to carry the heavy floor loads with more slender beams.

Supporting each girder were five cast iron columns that borrowed connection details from mill construction. At the east and west walls, a rectangular cast iron column carried the end of each girder, but these columns were also tied to masonry piers. Iron lintels carried brick stringcourses and sills across window openings at each level. and these were also supported by a combination of brick pier and iron column. On the south, Monroe Street façade, where no spanning girders required support, Jenney did away with cast iron columns altogether. The four brick piers that formed this elevation were backed up with more brick, all of which supported an embedded girder at each floor.

The supplemental iron reduced these piers' weight and size, but the resulting elevations also showed Jenney's understanding of the exterior wall as a grid rather than solid plane. Hybrids of iron and masonry existed by this point mostly as separate systems—in Viollet-le-Duc's influential *Entretiens*, for example, they were shown as separate systems for support (masonry) and span (iron). At the Leiter, however, iron and brick were amalgamated—they shared the same loads and there was no clear distinction about how loads were split. Its structural advance was thus only the small step of making brick piers stronger, and thus smaller in plan, but the architectural consequences were important. Jenney filled the large voids between the now-slimmer brick piers with as much glass as economy allowed, in large double-hung windows that ran nearly floor to ceiling, with only low spandrels at floor level. The enlarged apertures were divided into three equal lights with cast iron mullions between.

The Leiter's grid of undersized brick piers and minimal spandrels may have inspired Frederick Baumann to supplement his theory of isolated pier foundations with an 1884 pamphlet proposing "Concealed Iron Construction of Tall Buildings."[6] Widely circulated, the pamphlet called for a "rigid *skeleton or hull of iron*" to be erected separately from an enclosing skin of "stone, terra cotta, or brick," the latter to be fully supported by the former. While offering few details on connections between the two systems, Baumann recognized that by concentrating structural loads on a skeletal iron frame the exterior structure could be radically reduced: "LIGHT—the most indispensable desideratum with a building," he suggested, would thus be "procured even in the lowest, most valuable stories, where otherwise the necessarily broad piers would be a hinderment." Presciently, he called for stiff connections between girders and columns to "impart firmness to the structure," but his preferred technique, riveting, was not possible in a brittle material like cast iron. Nevertheless, he suggested that a clad frame would enable faster construction, and that above eight stories the savings in masonry would pay for the extra costs of an iron structure. "Were it possible to clothe them with proper elegance, and were they proof against neighborhood fires," his pamphlet claimed, skeletal iron structures would maximize "convenience, *secureness and light;* all this, of course, combined with a shine of elegance."[7] Baumann would design two buildings that employed the skeletal ideal—the Conkey (later Franklin) on South Dearborn in 1887 and the Chamber of Commerce at La Salle and Washington in 1890. Jenney, however, explored this idea more thoroughly, liberated by the skeleton's spatial and constructional efficiency while struggling with its more tenuous proportions and the bulkier masonry fireproofing that concealed its presence.

Earliest among these was Jenney's Home Insurance Building, which was in design as Baumann's pamphlet was circulating. While the building has been the subject of debate as the "first skeleton frame," its structure was only a small improvement over the Leiter's system and it remained a crucial step away from Baumann's skeletal formula. The Home Insurance Company of New York enjoyed an excellent reputation in Chicago for its "prompt and full payment" following the 1871 fire, and by 1883 the company decided to locate a regional headquarters in the Loop.[8] The company purchased a 138 by 96 feet corner lot at Adams and La Salle and selected its architect by competition, a controversial method at the time.[9] Jenney's design called for an eight-story building (later extended to nine) of pressed brick and stone with a raised basement and first floor—similar to the Montauk—with lettable office floors around a light court. For the upper floors, the building committee instructed Jenney to design for the "maximum number of well-lighted small offices." Jenney recalled later that they in fact suggested iron's potential to achieve this, requesting a study of "the method of construction that would satisfy the requirements for stability and for small piers." This directive was matched by the foundation-driven need for less dead weight in the floors above, and in fact Jenney's writings at the time focused more on the weight-saving potential of iron than on its skeletal possibilities.[10]

"When coupled with the condition of a very compressible soil, carrying only a light load per square foot," he wrote, the requirement for daylight "necessitated a different method of construction from those in general use," and it was this method that made the Home Insurance so influential.[11] Jenney laid out a standard frame of iron columns and girders for the building's interior, fireproofed by terra cotta covering. At the lot lines, however, he was obliged to use solid masonry to satisfy City inspectors. These walls were load bearing brick , but for the two street fronts he proposed a new integration of brick and metal. To reduce width and bulk, each masonry pier contained within it an iron column that took at least some of the floor loading. In itself this was not new; iron columns wrapped in masonry had been used by George Post at the Poultry Exchange in New York (1884), suggested by Viollet-le-Duc, and employed even by Jenney himself on a modest scale in two structures in Indianapolis. [12] For the greater height of the Home Insurance, however, Jenney knew that on warm days iron would expand more than brick. The columns would then absorb the entire load of the structure and tear the iron girders away from the brick skin.[13] He thus detailed (or claimed to have detailed) the masonry skin so that each level was carried on iron lintels that framed into columns, leaving the brick to support only its own weight. As the column expanded it would lift not only the interior structure, but the exterior skin as well, preventing differential movement. But to what extent this system of masonry skin supported on each floor was actually realized is uncertain, and was contradicted by Jenney's own writings. At the time of the Home Insurance's construction, Jenney wrote of the resulting exterior elements as hybrid structures and described the iron as reinforcing rather than independently load-bearing: "…a square iron column was built into each of the piers in the street fronts," he wrote, downplaying the importance of the iron leaving its exact bearing status unclear.[14]

Jenney later stated that only the masonry *between* piers, or the top and bottom framing of the building's windows, was actually carried by iron structure, and that the masonry surrounding the column itself was self-supporting.[15] Further evidence for this interpretation comes from details of the cast-iron lintels themselves, which were not bolted to the columns, but simply rested on cast lugs.[16] Jenney also selected hard-burned structural brick rather than cheaper face brick for the piers, and required that joints within the brick piers be filled and packed with high-cement mortar, noting that this could support higher structural loads than standard construction.[17] Collectively, these details make the case that the Home Insurance's brick piers bore substantial load, as there would otherwise have been no reason for the extra expense.

There was no confusion about how the building handled wind loads. Like all of its tall contemporaries it relied entirely on masonry. Charles Strobel, assessing the building's claims to structural innovation in 1896, suggested that the masonry lot line walls "were of sufficient thickness to perform the double duty of carrying their own weight and of staying the building."[18] Jenney attempted to create a stiff metal frame by clamping all joints between columns and girders so that "any movement [would] be transported entirely across the building," and he included large iron hoops to belt the brick structure together. But these were not sufficient to brace the building on their own.[19] Any opportunity for creating as stiff a frame as Baumann had suggested was lost by Jenney's decision to attach the girders to the columns only with single bolts, relying on bent rods to fix these joints for erection purposes.[20] Larson and Geraniotis suggest that this detail arose to allow for wide site tolerances, and it could provide little if any resistance to rotation caused by wind. Indeed, the cast iron lintels were notched to allow the frame to rotate without crushing surrounding brick.[21] The Home Insurance's foundations were also decidedly conservative, with stone pyramids rather than steel grillage.[22] A final, surprisingly traditional detail lay in the granite of the lower two stories, which was load-bearing. The Home Insurance could, however, boast Chicago's first architectural use of steel (in place of wrought-iron). This substitution was proposed by the Carnegie mills, which had supplied the structural iron for the project and were keen to see their new, Bessemer-mill product employed in a high-profile building.[23]

Jenney's elevations for the Home Insurance reflected its mixed structure of stone, iron, and brick and its combination of tradition and experiment. Though its skeletal nature was reflected in an underlying grid of brick and terra cotta lines, Jenney reverted to traditional masonry forms to embellish and ornament the facades. Corner piers, for example, were much thicker than intermediate ones, giving the illusion of greater load-bearing capacity when, in fact, corners carried only half the floor load of other external piers. A profusion of stringcourses, arches, and pilaster capitals also confused the building's expression. Never accomplished at composition, Jenney seemed intent on disguising the stark proportions and simple repetitions of the metal and brick structure.

The Home Insurance was hailed for its size, but its reception as a "first skyscraper" only came long after its completion. In the 1890s a debate emerged regarding the first use of skeletal framing; Jenney was championed by Chicago interests over New York's George Post, whose 1884 Poultry Exchange also featured a hybrid construction of iron and brick. Never fully resolved—or really resolvable—the debate was revived in the early 1930s when the Home Insurance was demolished to make way for the Field Building. At that time, a team of architects and engineers led by Thomas Tallmadge examined the iron structure and concluded that "the Home Insurance Building was the first high building to utilize as the *basic* principle of its design the method known as skeleton construction," a carefully nuanced conclusion.[24]

A more thorough assessment, however, was offered in an independent report commissioned by the Western Society of Engineers. This committee of architects and engineers based its conclusions on five criteria for "modern steel skeleton construction":

1. “We find the steel skeleton was self-supporting.
2. Structural members were provided for supporting the masonry, but on account of the size of the piers it is probable the load was divided between the columns and the piers.
3. The wind load was carried by the masonry as the steelwork was not designed to take wind bending.
4. The masonry work could not be started at an upper floor without providing temporary support for the eight inches of masonry in front of the cast iron columns.
5. The walls were not of the curtain type but were…of the ordinary bearing type. It is apparent that the designer of this building was reluctant to give up the known strength and security of heavy masonry walls and piers for the untried curtain walls and steel wind bracing of the modern skeleton building.”[25]

In fact it would be a decade before new materials and new bracing techniques produced a Chicago tower meeting all of these criteria.[26]

The Home Insurance did demonstrate Jenney’s total mastery of the isolated pier foundation system, a development unique to Chicago that sought to overcome the city’s soft clay underpinnings with a flexible system of support. Jenney had long advocated Baumann’s system of isolated piers, which required calculating each column load and spreading this over a precisely calculated area of bearing soil. As Jenney would write of the Home Insurance:

> “The advantages of a system of isolated piers on a compressible soil is its elasticity, it being impracticable during the construction of a building to keep a uniform load on the foundations, hence the necessity of allowing the parts to settle at different times, counting upon a general uniformity of settlement in the end. A continuous foundation is liable to be broken up and very unequally loaded, therefore, even when the pier foundations touch each other they are kept separate by plank of sheet piling, on the line of junction.”[27]

Interestingly, these foundations and their lack of differential settlement were seen by Jenney as the building’s primary technical achievement, somewhat arguing against its alleged skeleton frame as the structure’s major achievement.

The integration of masonry and iron found an entirely different expression in the post-Home Insurance work of Jenney, which directly explored the transformation of exterior walls into networks of spanning and bearing lines . The Ludington and the Second Leiter Store, both completed in 1891 at the corner of Wabash and 11th Streets and on the block between State, Congress, and Van Buren, respectively, carried the nascent logic of the Home Insurance to more coherent structural and compositional ends. Jenney was a better stylist when faced with tighter constraints, and these structures were both designed to be rapidly built, unpretentious buildings—the Ludington for light manufacture, the Leiter as a lower-end retail emporium. In both, Jenney sought to resolve exterior walls into grids that reflected both structural and constructional logic, though he was less concerned with the articulated distinction between column and spandrel, and more concerned with expressing the hierarchy of vertical elements—that is, the difference between column and mullion. Given limits to the size of plate glass lights at the time, this was an important consideration, because no manufacturer could supply single panes to match the scale of the structural voids obtainable with metal frames. Architects were thus faced with somehow dividing these apertures, and Jenney developed an approach that ordered vertical elements according to both structural and visual logic. At the Ludington, he used spandrel panels as an intermediary to bring column cladding forward and to push simple mullions back; this highlighted the importance of the structural elements and offered a regularity to the façade that was aided by a simple program of cast iron and terra cotta ornament. Faced with a much longer block at the Leiter Store, Jenney blurred the distinction between column and mullion, emphasizing every other structural element in the façade and dividing windows into varying groups of lights depending on their level above the street. Critics have claimed ever since that this approach led to more confusion than expression, however, and the stark lines of the simpler Ludington offered a more articulate model; by reducing the number of façade elements to a logical minimum, its structural and cladding hierarchies were immediately apparent.

The height of rapid, efficient skeletal construction came for Jenney with the construction of the Fair Store, which was built in two phases along Adams Street between State and Dearborn. The second phase, completed in 1897, set records for speed, with over four million pounds of structural steelwork erected in just three and a half weeks.[28] Department stores were, according to Jenney, ideal applications for the skeletal metal frame:

> "The great department stores are necessarily of large capacity—several stories, each floor of large area. The effect on the impression that the store makes upon customers is in proportion to the unobstructed area. This and convenience of business make

> subdivisions or cross walls undesirable in these retail stores, and, notwithstanding the reduction in insurance rates, amounting to a considerable sum on the large amount of property, such walls are exceptional…"[29]

Such openness, however, left mercantile buildings vulnerable to fire, especially given the flammability of merchandise and displays. Jenney therefore used the most advanced fireproofing available for protecting the Fair's skeleton, with a double-layer of terra cotta tiling and an early sprinkler system manufactured by Grinnell.[30] Within the building, electric lighting and plate glass were both deployed in record-breaking quantities, "permitting a flood of daylight to enter the store" and making it "bright as day everywhere."[31]

<u>Foundations</u>

> "…the lightness of this construction enabled the architects to find room on Chicago's soft compressible clay for their footings."[32]

> "The piers must be narrow in order that proper space might be left for windows, the walls must not be as heavy as the old construction would demand, or there would not be sufficient space on the ground for the foundations."[33]

> "About twenty borings on the site of the Home Insurance Building showed a wet clay overlaid by a crust of dry clay, from 3 to 6 feet thick, that would safely carry a permanent load of 4,000 pounds per square foot of foundation surface. Footings of alternate courses of rubble and dimension stones were accordingly constructed as independent piers of the required area, and sustained the iron framework, which was designed to have sufficient elasticity to permit the inevitable unequal settlements during construction."[34]

> Home Insurance: "Careful levels, taken at different times, showed a total settlement of 2-1/4 inches, and an extreme variation of only 11/16 of an inch."[35]

> "The advantages of a system of isolated piers on a compressible soil is its elasticity, it being impracticable during the construction of a building to keep a uniform load on the foundations, hence the necessity of allowing the parts to settle at different times, counting upon a general uniformity of settlement in the end. A continuous foundation is liable to be broken up and very unequally loaded, therefore, even when the pier

foundations touch each other they are kept separate by plank of sheet piling, on the line of junction."[36]

"As early as 1873, Mr. Fred Bauman, one of Chicago's oldest architects, had published a little pamphlet on isolated piers, and their adaptability to Chicago foundations."[37]

These framed buildings all show an attempt to 'skeletize' exterior walls and structures to match the spatial efficiencies of iron columns and girders within. Where interior structures had benefited from such attenuated proportions since early mill construction, reducing the outer wall to similar proportions of solid and void presented technical and architectural conundrums. Exterior walls had formed gravity and lateral bracing systems for generations, and turning these elements into skeletal frames sacrificed considerable rigidity against wind; this was an easier sacrifice for loft buildings wedged between sturdy party walls, but not for free-standing buildings like the Rookery. Despite the push for daylight noted by Jenney, Root, and others, there were material limits to transparency; glass still had to be installed in relatively small lights, and brick's inherent mass meant it could not hew as closely to underlying metal structures as daylighting or skeletal composition might demand. But faced with the need to funnel loads into discrete foundations, Chicago's architects and engineers also recognized the advantages of regular, superstructures that provided easy transitions to isolated piers below. As exterior walls became more skeletal in response to lighting requirements and the enabling opportunities offered by iron reinforcing or structure, architects and engineers discovered both fabricational and planning benefits to aligning girders, columns, piers, and foundations with one another. While 'piers' in the walls of Richardson's Field Warehouse were supported by linear foundations and bore no relation to the structure within, the Leiter Store, the Ludington, and the Home Insurance showed the benefits of such alignment and integration. By treating structure, elevation, and substructure as participants in an overall system with a shared, rigorous planning grid, these buildings demonstrated efficiencies in construction and functionality, and new architectural possibilities of aligning space planning and exterior composition with structural design. Jenney's buildings—the Second Leiter and the Ludington in particular—carried this gridded alignment of structure, elevation, and space even further, but two technical developments—internal wind bracing and new façade materials—would match this rigor with a further liberation of the exterior from its structural duties, enabling the more lightweight, transparent skins that marked Chicago construction in the mid-1890s.

Wind Bracing

These buildings all used the skeletal steel frame to great functional effect, but they were all relatively low and most relied on masonry for their resistance to wind loads. Jenney's work in the 1890s also included important advances in self-bracing steel frames using advanced techniques borrowed from railroad bridge design and relying on the technique of riveting to form tight, reliable connections between steel members. While the Home Insurance in particular showed the limitations of crude, pinned or roughly bolted cast iron connections in resisting wind, riveted shapes made from rolled steel quickly proved themselves as buildings grew taller, and Jenney was a leading figure in developing these techniques.

> "Rolled steel columns are in general use for these tall buildings, all connections being made with hot steel rivets, hence more rigidity as against wind pressure and vibrations of moving loads, like running machinery, than can be obtained with the cast columns and screw bolt connections."[38]

Early efforts to stay building frames against wind used triangular geometry to form rigid panes in otherwise rectilinear frames, either through sway-rods, which criss-crossed building structures to form large triangulated trusses set on their ends, or through knee braces, which triangulated only the joints and therefore relied on stiffer columns and girders to absorb some wind forces. A variant of this last type, portal frames, made more robust, often arched connections between girders and columns that also 'recruited' the material of these vertical and horizontal elements into resisting wind.

The earliest extensive use of sway-rods in Chicago was Jenney's 1890 Manhattan building. At 16 stories it was the tallest office structure in the city until the completion of the Monadnock, yet it sat on a narrow lot between Dearborn and Plymouth Court, making it far narrower than any recommended base to height ratio. Jenney's solution placed planes of diagonal cross bracing in the building's short dimension at regular intervals and relying on the length of the lot to brace it in its long direction. While the building's sway-bracing gained Jenney and the Manhattan credit for an almost uniquely lightweight system, analysis by Harry Weese in the 1970s showed that much of the cross-bracing had actually been removed over time by shop and office tenants seeking to expand—with little apparent effect on the building's stability. A later building by Jenney, the 1894 New York Life Company on La Salle Street, offered an explanation for the Manhattan's survival without these elements. Jenney's engineering was conservative, and he designed on the assumption that the Manhattan's structural frame alone would carry all wind loads on the structure. But this intentionally ignored the significant contribution of hollow tile partitions. With New York Life, Jenney explained that his design for the frame relied on *both* rigid connections and the latent resistance in these partition walls. The Manhattan, like all office buildings of the era, contained numerous tile partition walls in its east-west direction, and these walls alone turned out to be sufficient to carry the wind loads on the structure.[39]

Shorter braces were used in the Isabella Building (Jenney, 1892), but even this revised system interfered with ceiling heights where the knee braces attached to columns.[40]

As early as 1891 riveted connections using drilled and reamed holes had become standard in steel building structures: George Fuller noted that this technique made structures "more solid," while Jenney praised the technique's scientific basis:

> "The columns [in Chicago construction] were at first of cast iron with ingenious devices to tie the beams rigidly to the columns. As soon as riveted steel columns of a proper quality could be manufactured, their superior advantages at once brought them into use, which has now become general. All column connections are now made with hot rivets. The metal for the work is all tested, and the workmanship inspected at the mills by professional inspectors. The same science, and the same superintendence is required in calculating and erecting one of these high buildings as in a steel railroad bridge of the first order."[41]

Writing in 1896, William Le Baron Jenney argued that the switch from cast-iron to steel columns was the most crucial development in the realization of the tall metal frame:

> "Since the Home Insurance Building, the most important improvement that has been made in …Chicago construction…was the introduction of steel-riveted columns, which are now made cheaply and in all respects thoroughly satisfactory. All the assembling at the building is done with hot steel rivets; increased rigidity is secured, as well as a material reduction of the weight of the columns."[42]

By the time of the New York Life Building (1894), the issue of wind bracing had been firmly resolved in Jenney's mind. This building used gusset plates that rigidly connected steel girders and columns to absorb wind forces, a technique that relied on tightly riveted connections that were possible only in steel.[43] Elsewhere, Jenney had begun to speak out against cast iron as a structural material. Because of the casting process, cast iron elements were inherently inaccurate—cooling cast iron shrunk and twisted in ways that were not entirely predictable, and castings could entrain air bubbles that reduced their cross section catastrophically.[44] Here, steel enabled the building frame itself to stand rigidly against wind, unlike the Home Insurance, which required masonry to brace its cast iron skeleton. But New York Life also demonstrated the advances of calculation that had come in the building boom of the 1880s. Jenney noted that 25% of New York Life's wind load was taken up by the inherent stiffness of its interior partitions, elements that had previously been ignored because of the difficulties in calculating loads through multiple, redundant paths.[45] Jenney realized further efficiencies in applying reductions to live load figures on each column based on the common-sense assumption that multiple floors would never be loaded to full capacity at the same time.[46] While such assumptions seemed to critics a kind of sleight-of-hand, the reduction in column size—and the consequent gain in lettable floor area and reduction in foundation-borne weight—quickly bore Jenney's revised process out, and such reductions became standard in column calculations throughout tall construction.

The Utilitarian Ethos and the 'Modern' Architectural Office

Jenney and Burnham echoed Sullivan's dictum that a tall office building was first a problem to be solved, and only then a composition to be refined. Speaking to the Chicago Architectural Sketch Club in 1889, Jenney foreshadowed the modernist obsession with the plan as generator, though his intention was more purely economic:

> "In designing a building it is best to confine oneself, as far as practicable, solely to the plan, with little or no regard for an elevation until a satisfactory plan is obtained. Then design the best elevation the plan will admit of, modifying the plan, if desirable, wherever this can be done without injury, but never sacrifice any part of the plan to the elevation. If you cannot make your elevation what you wish, without injury to the plan, *tant pis* for the elevation."[47]

Chicago architects—especially Jenney—took pride in this largely unspoken but clearly legible utilitarian theory. "You are not pictorial artists," he told the Architectural Sketch Club in 1889, "but architects, and…your art is of little value unless you are practical." Art had its place in commercial practice, but it was limited to articulating an otherwise legible and composed scheme:

> "First, the construction, i.e., the engineering, which, it goes without saying, must be substantial and economical; then the application of art, the adjusting of the proportions, so that the construction is pleasing in its appearance; and then, for further ornamentation, the details of the construction are accented by moldings and carving that is ornamented. The practical is at the bottom of the whole and underlies all that makes claim to architecture. The plan and the entire construction, from turret to foundation stone, is purely practical science, leaving but a small and superficial area for the application of art."[48]

Jenney believed that this process must be scientifically rigorous, and he began this talk by citing Darwin and noting that the "same law of 'survival of the fittest' is just as true of the order *Primates*, genus *Homo*, species *member of the Chicago Architectural Sketch Club*, as of any other animal."[49]

While Jenney's technical legacy—the ideal of a skeletal building frame that informed building exteriors, the use of steel as a spanning material, the rationalization of building plans and the perfection of isolated pier foundations—was enough to cement his legacy, it was Jenney's role as a firm owner and businessman that may have been his most important contribution to Chicago's building culture. Building design and construction in 1870s Chicago was beset by unethical business practices alongside its generally poor construction, and Jenney' sense of business propriety and his skill in managing an office—as opposed to a studio—played a considerable role in his success.

> "Jenney despised worse than anything the grafter, and his manner of dealing with that type of man was effective. Architects have peculiar intimacy with graft because they constantly are running into contact with crooked contractors and builders, and too frequently architects disgrace their profession by dividing with dishonest contractors the fruits of robbery achieved through crooked bidding, or favoritism.
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> "Jenney never countenanced this way of doing business…"

This ethical practice of architecture was not entirely unheard of in Chicago—both W. W. Boyington and the firm of Drake, Asher, and Carter had built up their businesses by a painstakingly honest approach. But Jenney's sense of honor extended, as well, to a genuinely collaborative spirit with engineers, builders, and even competing architects. He was a major force for exchanging knowledge, involved in the founding of Chicago's Western Association of Architects in 1885 and writing constantly for *Inland Architect* and other journals about developments in structural and building techniques.[50] This sense of professional generosity was a hallmark of the city's building professions during his later career, in large part due to the number of major figures in the city who came up through his office. Daniel Burnham, Louis Sullivan, John Holabird, Martin Roche, and Howard Van Doren Shaw all launched careers of their own from Jenney's office, and all took with them his sense of professional ethics and propriety.[51]

Jenney's sense of architecture and building as a profession stemmed from two sources. First, his experience as a combat engineer with Sherman's Union army during the Civil War informed a military sense of discipline in his practice and his daily life. The rigorous and timely execution of design and construction that had been matters of life and death in combat were only slightly less important in the hotly contested real estate climate of Chicago, and Jenney often compared the design and construction of skyscrapers to those of the tenuous and precisely calculated bridges then spanning rivers in the American west:

> "They are calculated with the same science, designed with the same study, inspected and superintended with all the care that is devoted to a steel railroad bridge of the first order."[52]

But this sensibility came through Jenney's office via another source. During his time at the Ecole Centrale, Jenney was exposed to the exquisite professionalism of Parisian architects, and the comparison between their precision in thought, documentation, and execution was for him a standard to which the far looser profession in an American frontier city could nonetheless aspire. Writing in 1889, Jenney told the young architects of the Chicago Architectural Sketch Club that:

> "…the best detail drawings I have seen are those of French architects. I do not mean those from students of the Ecole des Beaux Arts, who have had little or no practice. Far from it, for that is essentially an art school….I refer to details from the offices of French architects in successful practice. Everything is thereon shown or explained, by elevations, sections, bits of perspective, or by written explanations. These written explanations amount often to a full specification for that special work."[53]

Thus, while Jenney's innovations were by his own admission parts of a broad evolutionary process, his signature contribution to Chicago's architecture was the application of French professional standards to the discipline of American military engineering. The formidable result—an office that was supremely competent in designing and precisely executing projects ranging from parks and gardens to skyscrapers and the massive Horticultural Building at the Columbian Exposition—was the precursor to the 20th century American architectural office, which combined technical and stylistic expertise and which came to represent both razor-sharp professionalism and fearless leaps to greater and greater heights and spans over the next fifty years.

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1 W. L. B. Jenney, "Steel Skeleton Building Construction." [Letter to the Editor]. *The Engineering Record.* 6 Jan 1894. 90.

2 "At Fairhaven, Mass., September 25, 1832, the noted architect, W. L. B. Jenney, was born. He died at Los Angeles, Cal., June 15, 1907. 8-9 At the age of 21, he graduated from the scientific at Cambridge, Mass., and in 1854 entered the Ecole Centrale des Arts et Manufactures at Paris, France, where he graduated with a diploma in 1856. It was during this period of study that Richard M. Hunt was appointed by the French government as inspector, and under M. Hector Lefuel designed the Pavilion de la Bibliotheque, opposite the Palais Royal. Mr. Jenney often spoke of how much he was influenced in his after life by the success achieved by Mr. Hunt. During the year 1858 Mr. Jenney again visited France for the study of architecture and art. Upon the breaking out of the Rebellion, he was appointed Captain Additional Aide-de-Camp, U.S.A., and assigned to engineer duty at Cairo, Ill.; served as engineer officer on the staff of General U. S. Grant, from Cairo to Corinth, then at W. T. Sherman's request was transferred to his command and put in charge of the engineer works at Memphis. Accompanied General Sherman as member of his staff on the Vicksburg expedition; was chief engineer Fifteenth Army Corps at the siege of Vicksburg, and continued to serve on the staff of General Sherman until he resigned May, 1866. In the fall of 1868 he came to Chicago and began his professional career." "William Le Baron Jenney." *The Inland Architect and News Record* Vol. L, no. 1. July, 1907. 8-9.

3 I*ndustrial Chicago: The Building Interests.* (Chicago: The Goodspeed Co., 1891). Chapter VI, "Commercial Architecture." 168-
169

4 W. L. B. Jenney, "An Age of Steel and Clay. [Paper read before the Chicago Architectural Sketch Club, Oct. 6, 1890.]" *The Inland Architect and News Record.* Vol. XVI, no. 7. December, 1890. 76.

5 W. L. B. Jenney, "An Age of Steel and Clay. [Paper read before the Chicago Architectural Sketch Club, Oct. 6, 1890.]" *The Inland Architect and News Record.* Vol. XVI, no. 7. December, 1890. 76.

6 Frederick Baumann, *Improvement in the Construction of Tall Buildings.* (Chicago, J. M. Wing & Co.?, 1884). N.p. [attached to copy of Baumann 1873 Foundations pamphlet in UIUC library copy].

7 *Ibid.*

8 "Our Illustrations," *The Inland Architect and Builder*. Vol. IV, no. 2. Sept, 1884. 24.

9 "Synopsis of Building News," *The Inland Architect and Builder*. Vol. III, no. 3. April, 1884. 42. See, too, "Architectural and Building Notes," *The Inland Architect and Builder*. Vol. III, no. 2. March, 1884. 23.

10 W. L. B. Jenney, "The Design of Steel-Skeleton Buildings," (one of a selection of letters) *The Engineering Record*. Vol. XXXIV, no. 6. July 11, 1896. 103.

11 W. L. B. Jenney, "Chicago Construction, or Tall Buildings on a Compressible Soil." *The Engineering Record*, Nov. 14, 1891. 389.

12 Hugh S. Fullerton, "How the First Skyscraper Came to be Built." *Chicago Daily Tribune.* June 23, 1907. E1.

13 "The Design of Steel-Skeleton Buildings," *op. cit.* It is notable that Jenney only published this concern in later essays.

14 William Le Baron Jenney, "The Construction of a Heavy Fire Proof Building on a Compressible Soil." *The Sanitary Engineer*, Vol. XIII, no. {?}. December 10, 1885. 33. Jenney would later note that "…a column in each pier was the natural

solution of the problem," again an unclear formulation that retained the structural term 'pier' for the brickwork, implying that it, too, bore some of the load. "The Design of Steel-Skeleton Buildings," *op. cit.*

[15] Jenney claimed only that "lintels between columns, forming heads of windows, carried the street walls story by story," while Joseph Freitag noted in 1904 that "the exterior piers were made self supporting, but the spandrel portions, between the top of one window and the bottom of the window above, were carried on iron girders placed in the exterior walls and extending from column to column." Jenney, "Chicago Construction," *op. cit.*, 389-90, and Freitag, *op. cit.*, 6. Forensic work done by Sanderson et al during the demolition of the Home Insurance confirmed that the brick elements surrounding the iron columns "were of sufficient thickness to be self-sustaining without the use of columns in the pilasters." J. C. Sanderson, J. L. McConnell, F. J. Thielbar, "Home Insurance Building—A Report on Types of Construction Used." *Journal of the Western Society of Engineers*. Vol. XXXVII, no. 1. Feb., 1932. 8.

[16]These lintels were notched toward their front to avoid interfering with the brick piers; Gerald Larson and Roula Mouroudellis Geraniotis noted in 1987 that this detail alone demonstrates that the structure relied on both iron and masonry to support its own weight "…While the iron lintels carried the weight of the masonry spandrels to the iron mullions and columns, the structure created by the lintel pans, mullions, and columns was far from being a rigid-self supporting iron skeleton that independently carried its masonry envelope at each floor, which the Home Insurance Building was later claimed to have been." Gerald R. Larson and Roula Mouroudellis Geraniotis, "Toward a Better Understanding of the Evolution of the Iron Skeleton Frame in Chicago." *The Journal of the Society of Architectural Historians*. Vol. 46, no. 1. Mar., 1987. 43.

[17] W. L. B. Jenney, "Chicago Construction, or Tall Buildings on a Compressible Soil." *op. cit*. 389. It may be objected that Jenney was here talking about the construction of the party walls, rather than the masonry piers. The depth of the party walls, however, was legislated by code, and Jenney makes no note of any appeal on these walls' depth. See, too, Larson and Geraniotis, *op. cit*., 44.who concur that Jenney was here describing the brickwork of the piers.

[18] C. L. Strobel, "The Design of Steel Skeleton Buildings," *The Engineering Record*, Vol. XXXIV, no. 8. July 25, 1896.

[19] W. L. B. Jenney, "Chicago Construction, or Tall Buildings on a Compressible Soil." *op. cit.* 390 and Sanderson, et. al., *op. cit.*

[20] "As the bolts do not accurately fit the holes, a clamp was introduced to pull the beams close together, so that the least movement is felt at once over the whole beam." W. L. B. Jenney, Architect, "The Construction of Heavy, Fireproof Building on a Compressible Soil." *The Inland Architect and Builder*. Vol. VI, no. 6. December, 1885. 100.

[21] Larson and Geraniotis, *op. cit*. 41-43.

[22] W. L. B. Jenney, "Chicago Construction, or Tall Buildings on a Compressible Soil." *op. cit*. 389.

[23] William Le Baron Jenney, "The Construction of a Heavy Fire Proof Building on a Compressible Soil." *The Sanitary Engineer*, Vol. XIII, no. {?}. December 10, 1885. 33. George Fuller suggested that steel had been used in Cobb & Frost's Opera House, constructed at the same time, but this is not substantiated elsewhere. "Like a City of Steel." *Chicago Daily*. 25 Jun., 1891. 8.

[24] Thomas Tallmadge, FAIA, ed. Th*e Origin of the Skyscraper: Report of the Committee Appointed by the Trustees of the Estate of Marshall Field for the Examination of the Structure of the Home Insurance Building*. (rep. Chicago: Alderbrink Press, 1939). 17.

[25] J. C. Sanderson, J. L. McConnell, F. J. Thielbar, "Home Insurance Building—A Report on Types of Construction Used." *Journal of the Western Society of Engineers.* Vol. XXXVII, no. 1. Feb., 1932. 8-9.

[26] Subsequent scholarship has been less measured in its criticism of Jenney, in particular Gerald Larson and Roula Geraniotis, whose previously cited work suggests that Jenney was influenced by Frederick Baumann's article on iron framing and that Baumann's conception was more advanced than Jenney's system . They also suggest that Jenney may well have been influenced by W. W. Boyington's use of Phoenix columns in the Board of Trade Tower, but these iron columns were not integrated into the masonry fabric of the tower; rather, they appear to have been used within the main space of the exchange floor to prop up the back edge of the tower itself.

[27] W. L. B. Jenney, "Chicago Construction, or Tall Buildings on a Compressible Soil." *The Engineering Record*, Nov. 14, 1891. 389-90.

[28] "New Fair Store is Open." *Chicago Daily.* 12 Sept., 1897. 33.

[29] W. L. B. Jenney, "The Best Fireproof Construction for Buildings Occupied for Mercantile Purposes." *The Inland Architect and News Record*. Vol. XXX, no. 3. October, 1897. 22-26.

[30] W. L. B. Jenney, "The Best Fireproof Construction for Buildings Occupied for Mercantile Purposes." *The Inland Architect and News Record*. Vol. XXX, no. 3. October, 1897. 22-26. See, too, "New Fair Store is Open," *op. cit.*

[31] "New Fair Store is Open," *op. cit.*

[32] W. L. B. Jenney, "An Age of Steel and Clay. [Paper read before the Chicago Architectural Sketch Club, Oct. 6, 1890.]" *The Inland Architect and News Record.* Vol. XVI, no. 7. December, 1890. 76.

[33] William Le Baron Jenney. "The Chicago Construction, or Tall Buildings on a Compressible Soil." *The Inland Architect and News Record.* Vol. XVIII, no. 4. November, 1891. 41.

[34] W. L. B. Jenney, "Chicago Construction, or Tall Buildings on a Compressible Soil." The Engineering Record, Nov. 14, 1891. 389-90.

[35] W. L. B. Jenney, "Chicago Construction, or Tall Buildings on a Compressible Soil." *The Engineering Record*, Nov. 14, 1891. 389-90.

[36] W. L. B. Jenney, "Chicago Construction, or Tall Buildings on a Compressible Soil." *The Engineering Record*, Nov. 14, 1891. 389-90.

[37] W. L. B. Jenney, "Chicago Construction, or Tall Buildings on a Compressible Soil." *The Engineering Record*, Nov. 14, 1891. 389-90.

[38] W. L. B. Jenney, "Chicago Construction, or Tall Buildings on a Compressible Soil." *The Engineering Record*, Nov. 14, 1891. 390.

[39] "Illustrations: New York Life Insurance Company's Building, Northeast Corner La Salle and Monroe Streets, Chicago, Ill." *The American Architect and Building News.* Vol. XLII, no. 933. Nov. 11, 1893. 79.

[40] W. L. B. Jenney, "Chicago Construction, or Tall Buildings on a Compressible Soil," *The Engineering Record,* 24, no. 24 (14 Nov. 1891), 390.

[41] "Chicago's Big Buildings," *Chicago Daily Tribune*, sec. 1, 13 Sept. 1891.

[42] "The Design of Steel-Skeleton Buildings [selection of letters]," *The Engineering Record* XXXIV, no. 6 (11 Jul. 1896), 103.

[43] W. L. B. Jenney, 'History of the Steel-Skeleton Construction': "In 1893, in the New York Life Building, Jenney & Mundie, architects, gusset-plates were first used, to take the wind pressure not otherwise provided for…" "The Design of Steel-Skeleton Buildings," (selection of letters) *The Engineering Record*. Vol. XXXIV, no. 6. July 11, 1896. 103.

[44] "Hence it is easily understood why it is that the steel column is so generally taking precedence. From this day on it will be the rule, and the cast-iron column will only be used in unimportant structures." W. L. B. Jenney, "An Age of Steel and Clay. [Paper read before the Chicago Architectural Sketch Club, Oct. 6, 1890.]" *The Inland Architect and News Record.* Vol. XVI, no. 7. December, 1890. 76.

[45] "The Design of Steel-Skeleton Buildings," (selection of letters) *The Engineering Record*. Vol. XXXIV, no. 6. July 11, 1896. 103.

[46] "The reduction of the live-load on the columns in the different stories of a high building is made on the general assumption that the more stories there are above a column, the less will be the probability of all being loaded to their full capacity: and from this, the less will be the actual live-load per square foot for the total floor-area that comes on this column from all the stories above it." Jenney & Mundie, Architects. "The Constructive Methods Used in the New York Life Building, Chicago." *The American Architect and Building News.* Vol. XLIII, no. 946. Feb. 10, 1894. 71-72.

[47] W. L. B. Jenney. "A Few Practical Hints." *op. cit.,* 7.

[48] W. L. B. Jenney. "A Few Practical Hints." *op. cit.,* 7.

[49] *Ibid.*

[50] *The Inland Architect and Builder.* Vol. VII, no. 3. March, 1886.

[51] "A Veteran Architect Retires." *The Inland Architect and News Record.* Vol. XLV, no. 4. May, 1905. 44.

[52] W. L. B. Jenney, "Steel Skeleton Building Construction." [Letter to the Editor]. *The Engineering Record.* 6 Jan 1894. 90.

[53] W. L. B. Jenney. "A Few Practical Hints [Paper read before the Chicago Architectural Sketch Club, January 28, 1889]." *The Inland Architect and News Record.* Vol. XIII, no. 1. February, 1889. 9.

Home Insurance Building
La Salle and Adams, 1885

"…the entire system as at present in use evolved itself little by little, each architect erecting a tall building contributing something…"

W. L. B. Jenney, "Steel Skeleton Building Construction." [Letter to the Editor].

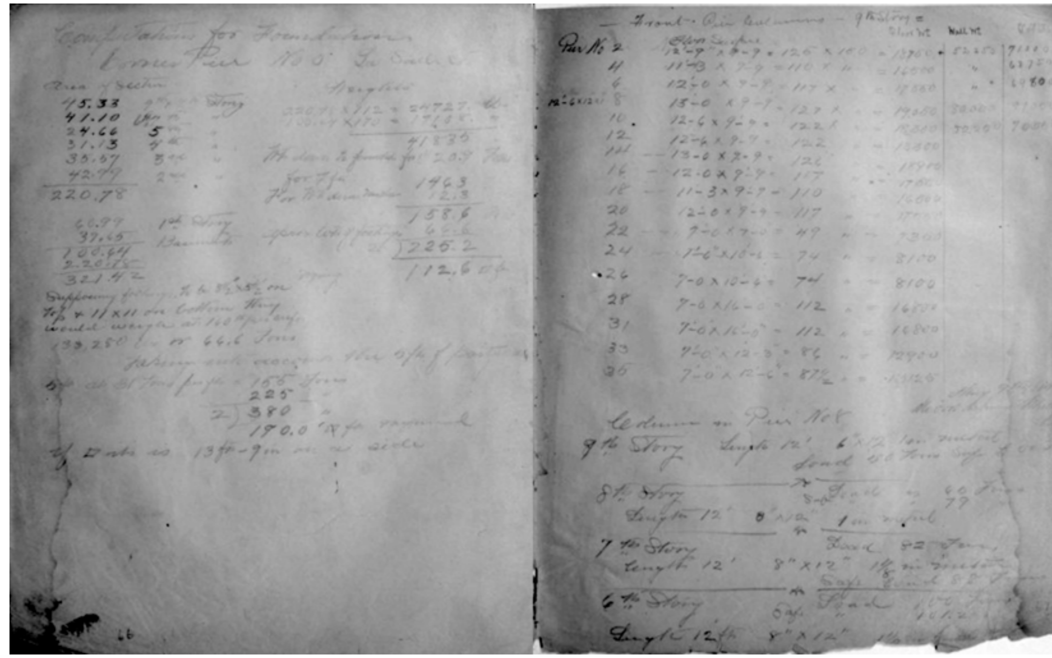
The Engineering Record. 6 Jan 1894. 90.

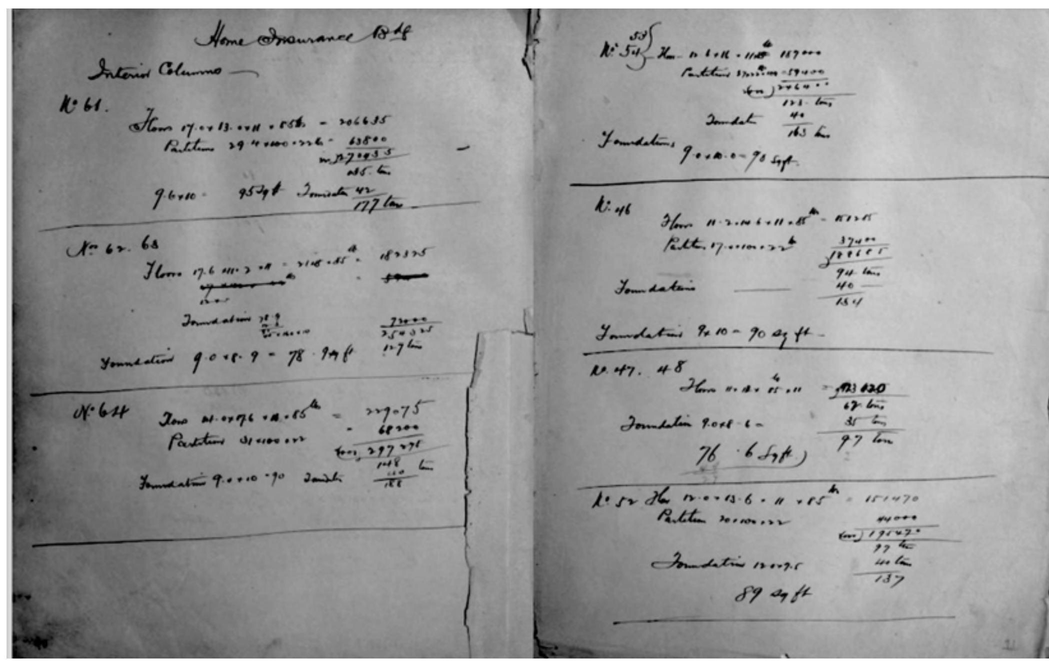
Portland Block
Dearborn & Washington Streets
1872

The French Influence:
Design as a Scientific Practice

"A tall, steel skeleton building is a scientific structure, in which every piece of steel and even every rivet can be accurately calculated from known data. All the strains of load and wind pressure can be determined and provided for with as much accuracy and certainty as in a railroad bridge."

W. L. B. Jenney, "The Dangers of Tall Steel Structures."
Cassier's Magazine. Vol. XIII, no. 5. March, 1898. 413-422

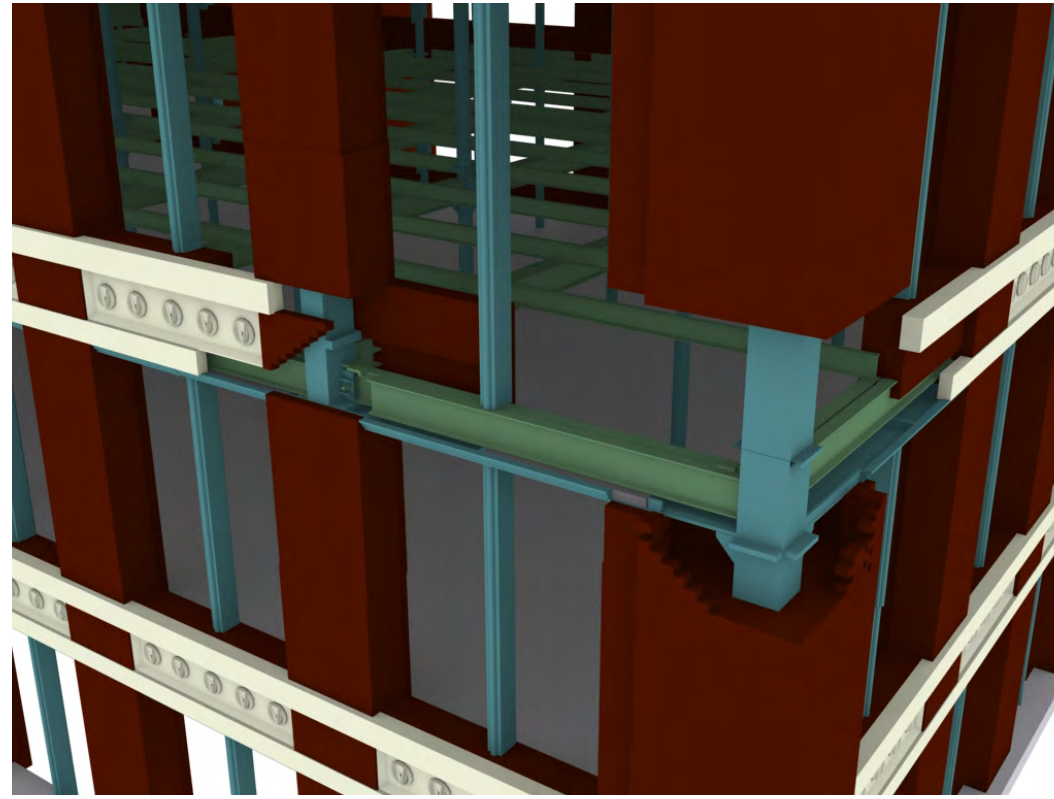


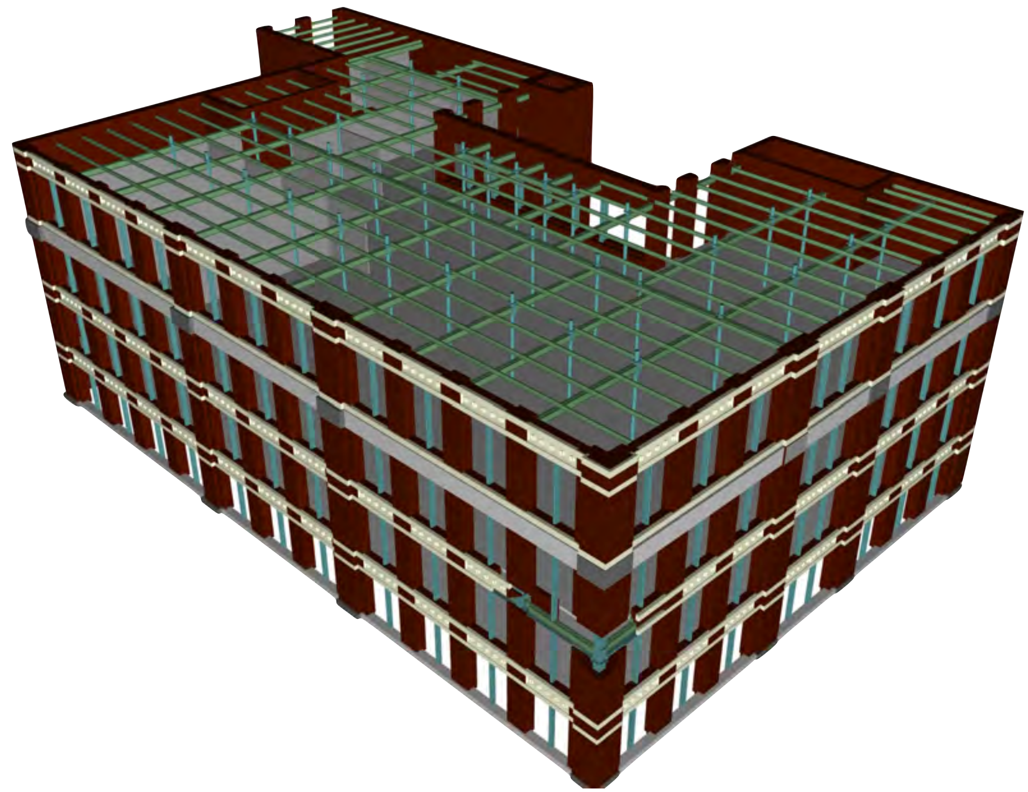


The Skeletal Frame

"The masonry reduced to the very minimum, not only carrying no weight, but being itself carried by lintels of steel from column to column over each window, as in the Home Insurance building, the Tacoma and the Leiter buildings, the Rand-McNally building, etc. (all in Chicago)."

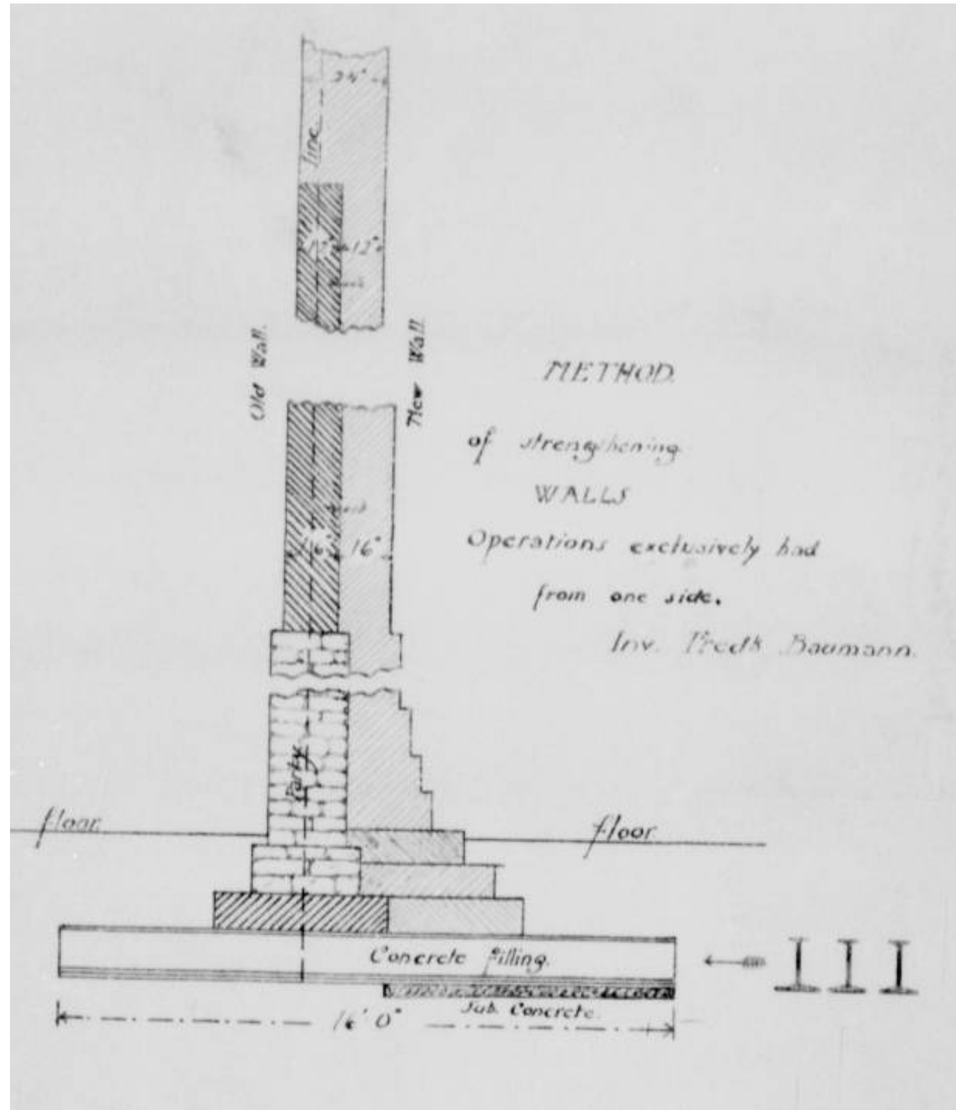
W. L. B. Jenney, "An Age of Steel and Clay.
[Paper read before the Chicago Architectural Sketch Club, Oct. 6, 1890.]"
The Inland Architect and News Record. Vol. XVI, no. 7.
December, 1890. 76. .





Foundations

"The system of foundations adopted is what is known as that of independent piers, each basement pier and each interior column having its independent foundation. A heavy building on such a soil must necessarily settle, the problem being to reduce that settlement to a moderate amount, say from two to three inches, and to make the settlement practically uniform. To this end the weights on each separate foundation were carefully calculated, it being of the greatest importance that the load per square foot of footing course should be uniform over the entire building, otherwise the settlement would be unequal and would cause fractures, breaking of glass, deform the door openings, etc."



W. L. B. Jenney, Architect, "The Construction of Heavy, Fireproof Building on a Compressible Soil."
The Inland Architect and Builder. Vol. VI, no. 6. December, 1885. 100.

Wind Bracing

"All the assembling at the building is done with hot rivets. The wind pressure is a matter of most serious importance and must never be neglected."

W. L. B. Jenney, "Steel Skeleton Building Construction." [Letter to the Editor].
The Engineering Record. 6 Jan 1894. 90.

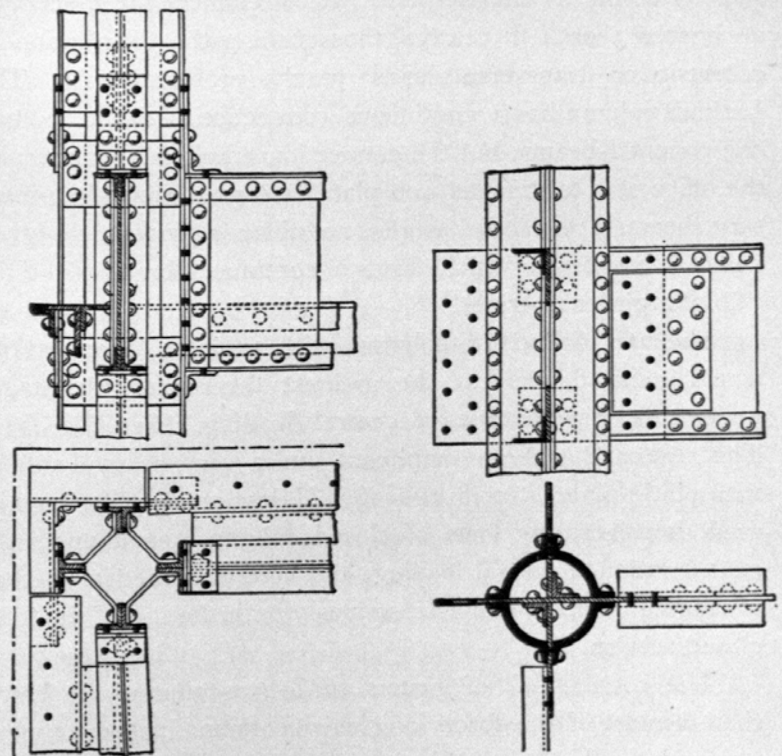


FIG. 118.—Detail of Gray Column and Connecting Girders.

FIG. 119.—Detail of Phœnix Column.

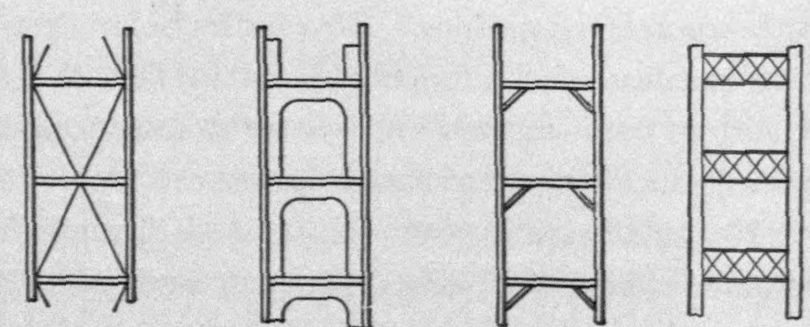


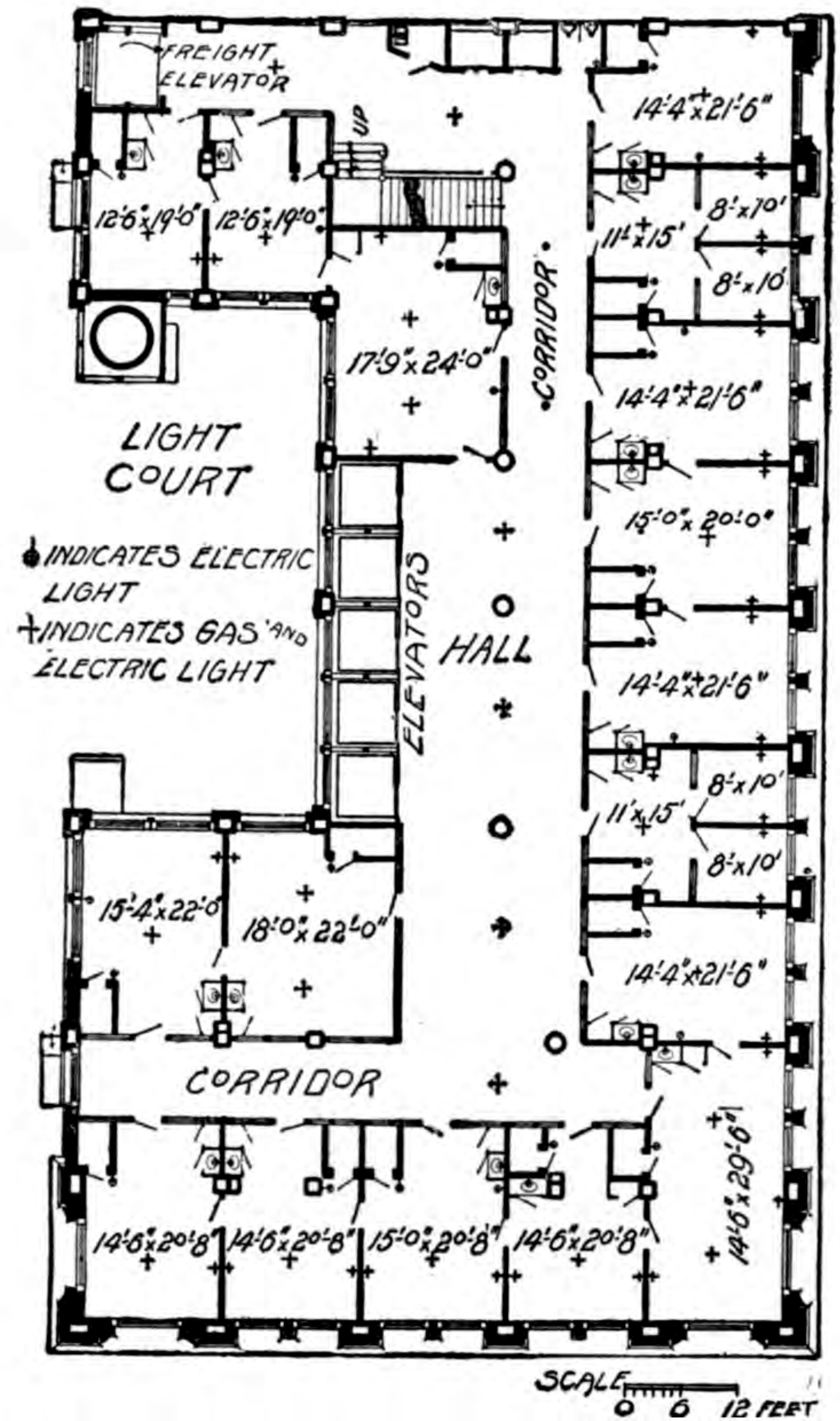
FIG. 144. (2) FIG. 145. (3) FIG. 146. (4) FIG. 147. (5)

Methods of Wind-bracing.

The French Influence—Rationalist Planning

"In designing a building it is best to confine oneself, as far as practicable, solely to the plan, with little or no regard for an elevation until a satisfactory plan is obtained.... The plan and the entire construction, from turret to foundation stone, is purely practical science, leaving but a small and superficial area for the application of art."

W. L. B. Jenney. "A Few Practical Hints [Paper read before the Chicago Architectural Sketch Club, January 28, 1889]."
The Inland Architect and News Record. Vol. XIII, no. 1. February, 1889. 7.



The French Influence—Detail

"…the best detail drawings I have seen are those of French architects. I do not mean those from students of the Ecole des Beaux Arts, who have had little or no practice. Far from it, for that is essentially an art school….I refer to details from the offices of French architects in successful practice. Everything is thereon shown or explained, by elevations, sections, bits of perspective, or by written explanations."

W. L. B. Jenney. "A Few Practical Hints [Paper read before the Chicago Architectural Sketch Club, January 28, 1889]."
The Inland Architect and News Record. Vol. XIII, no. 1. February, 1889. 9.

The French Influence—Professional Ethics

"Jenney despised worse than anything the grafter, and his manner of dealing with that type of man was effective. Architects have peculiar intimacy with graft because they constantly are running into contact with crooked contractors and builders, and too frequently architects disgrace their profession by dividing with dishonest contractors the fruits of robbery achieved through crooked bidding, or favoritism.

"Jenney never countenanced this way of doing business…"

Scott N. Hughes,"Jenney an Honest Architect;: How He Handled Grafters." *Chicago Daily Tribune,* Jul 21, 1907, pp. 1.

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