The labor on top under "setting cradles and placing concrete" was for lowering cradles, mixing concrete and lowering same.

The labor on top under "brickwork" was for lowering brick and mixing and lowering mortar.

The work is being done by contract under the direction of Henry B. Brewster, Assistant City Engineer, to whom we are indebted for the above information.

The Labor Cost of Mixing Gravel Concrete By Hand for a Canal Lock Foundation.

By GEO. P. HAWLEY.*

The following taken from my notebook shows the labor cost of placing concrete in four lock foundations, about 4,000 cu. yds. in all, on the Illinois & Mississippi Canal in 1897. These foundations were composed of piles and a timber grillage and filled in around the tops of the piles and between the timbers was the concrete, which was used in a much drier condition than is the present practice; it was thoroughly rammed.

The mixture used was composed of 1 part natural cement and 4½ parts bank gravel, which was delivered at either end of the lock pit as circumstances demanded or at each end, if possible. The mixing was done on board platforms 14 x 16 ft., which rested on the timbers of the grillage and were moved along as the work progressed; from these mixing boards the concrete was shoveled directly into place and well tamped. The gravel was brought from the piles to the mixing boards in wheelbarrows and the same men kept a pile of cement (in bags) at the board.

Each pit had some seepage water and a steam pump was used to drain it and also supply water to the mixers. There was not enough water to interfere with the concrete.

The usual plan contemplated running two boards at once and keeping count of each batch mixed. This stimulated each gang to do its best and considerable rivalry existed so that the output per board was increased. The usual gang for each board consisted of 4 men wheeling gravel from the pile; 4 turning or mixing; 1 wetting or sprinkling; 2 deposting and leveling; 2 tamping. Ten hours constituted a day's work and the average time for each cubic yard of concrete placed was as follows:

Foreman,	0.210 hour	at	30 cts.	6.30 cts.
Laborers,	3.339 "	"	15 "	50.09 "
Pump runner,	0.129 "	"	20 "	3.58 "
Water boy,	0.087 "	"	7½	.65 "

Total labor cost per cu. yd. . . . 60.62 cts.

* Depere, Wis.

Some Novel Features of Reinforced Concrete Work in the McGraw Building, New York City.

A notable departure in the application of reinforced concrete in building construction is presented in the designs for the McGraw Building, now in progress of construction on 39th St. in New York City. This building is a twelve-story and basement structure, 126 ft. 4 ins. front and 98 ft. 9 ins. deep, and is being built with concrete filled steel columns and reinforced concrete walls and floors. The novel features of the work are the combination of the steel columns and the reinforced concrete slab and girder floor system and the use of a unit frame type of reinforcement of comparatively new invention.

The McGraw Building is being built by the McGraw Realty Co. a subsidiary corporation of the McGraw Publishing Co. The architects are Radcliffe & Kelley, of New York City. The structural design was worked out by the Underwriters' Engineering and Construction Co., of New York City, Mr. Frank B. Gilbreth, President, under the direction of Prof. Wm. H. Burr, M. Am. Soc. C. E., of Columbia University, and Prof. C. L. Norton, of the Massachusetts Institute of Technology. The building is the first reinforced concrete tall office building to be constructed in New York City, and its design meets the very stringent building laws governing the use of reinforced concrete in that city. Its basement, street and second floor will be used for the business of the McGraw Publishing Co., and the floors above will be rented for offices.

The general structural arrangement is shown clearly by the plan and sections of the first floor given in Fig. 1. As will be noted, the column and girder arrangement is kept regular for the most part, the odd girders and slabs coming altogether in the side wall bays. This regularity conduces to economy in the reinforced concrete work in two principal ways: it enables the use of a limited number of standard sizes of reinforcing units and it permits the duplication of the slab and girder forms. In the erection of the building a few complete sets of floor forms will suffice for constructing all the floors. It is also possible to turn out the reinforcing frames in batches of standard sizes at the mill and to ship them complete, leaving their erection the only work to be done at the building.

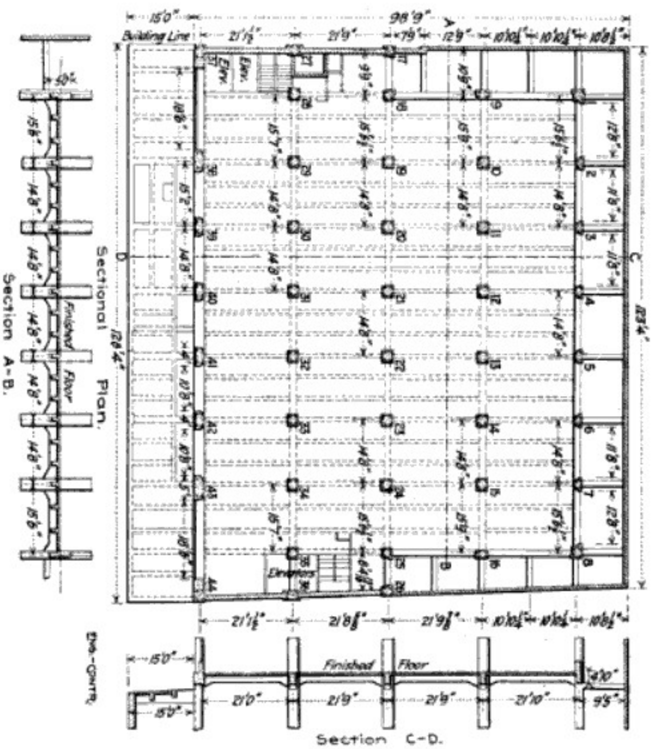

Fig. 1.—Plan and Sections of First Floor.

The columns are a combination steel and concrete construction. They were designed on the supposition that the steel should carry all the dead load with a working stress of 9,000 lbs. per sq. in. in compression only, while the concrete should carry all the live load with a working stress of 500 lbs. per sq. in., figuring only the concrete section inside of

the column. The concrete outside of the steel section is considered to serve as fireproofing only; its minimum thickness on the steel is 2 ins. Fig. 2 shows a first and second floor interior column, and Fig. 3 shows a wall column for the basement and first floor. Specifically, the design shown in Fig. 2 is for the columns marked 10, 12, 14, 20, 22, 24, 29, 31 and 33, while the design shown in Fig. 3 is for wall column No. 27. The drawings show the construction in detail and it need not be explained in the text except in the particular of the girder connection detail which is taken up further on, and of the use of bolted connections at the junction of succeeding sections where ordinarily the work is riveted.

Turning now to the floor construction it will be seen from Fig. 1 that each row of columns parallel to the first face of the building carries a line of main girders. This gives four bays of regular construction besides the three wall bays. The outside columns on the two sides of the building also carry lines of main girders. Considering the regular bays first, it will be seen that they are spanned across by beams so spaced as to divide each column spacing into three panels. This arrangement of girders and beams carries a 4-in. floor slab. In the outside bays the panel arrangement is different, calling for broad span plain slabs as shown. The main girders connect with and are carried by the columns; this is true also of every third line of beams. These beam and girder connections to columns constitute a feature of the design.

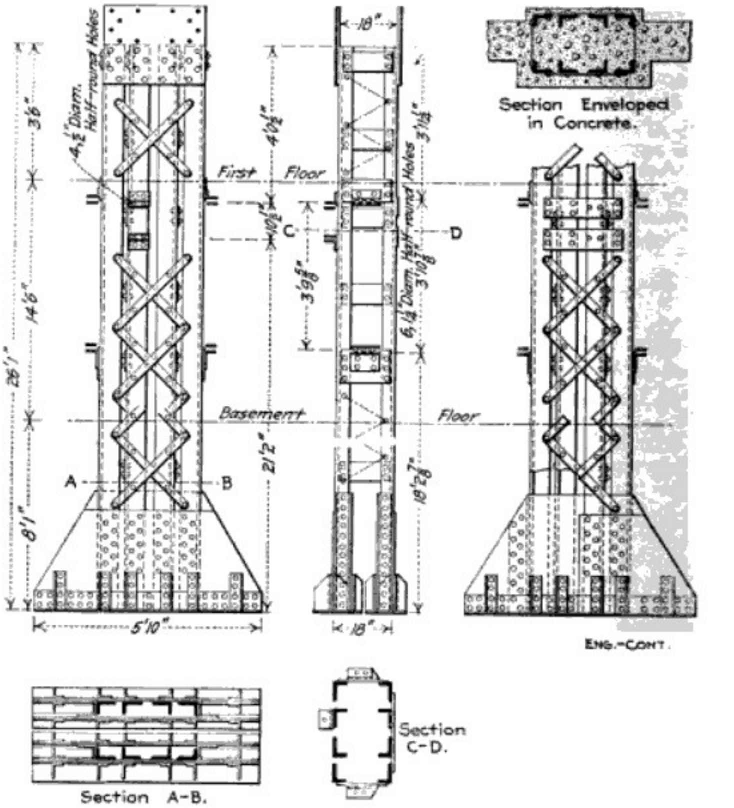

Fig. 3.—Wall Column for Basement and First Floor.

To understand clearly the character of these connections a description of the beam and girder reinforcement is first necessary. Fig. 4 shows three forms of girder reinforcement. The idea, it will be seen, is to get a reinforcing frame that can be constructed and assembled at the shops and shipped and placed as a unit, and also to get continuity of reinforcement across supports. The manner in which both objects are accomplished is clearly indicated by the drawings. In the work being described the necessity of passing the girder reinforcement through the columns makes its erection as a unit frame impracticable, but in ordinary all concrete construction this feature works out perfectly.

Turning to the drawings of Fig. 4, it will be noted that the wall ends of the reinforcing frames are connected by nuts to the wall columns. At the interior columns the reinforcing bars pass through the column and are held to it by special clamps. The drawings of Figs. 2 and 3 both show these column clamps; their arrangement is more clearly indicated by the sketch, Fig. 5, which is simply an enlargement of the detail shown in Fig. 2. The purpose of this clamp is not so much rigidly to connect the girder frame to the column as to insure the fixed position of the frame in respect to the column before and during the placing of the concrete. Of course, the clamp does serve to a degree to bind together the steel of the column and that of the beam, but the real strength of the connection lies elsewhere. As a measure for preserving the position of the reinforcing rods against displacement by any cause the clamp is a certain success mechanically. In watching the placing of these rods, however, the writer saw much reason to doubt the success of the clamp from the cost sheet point of view. In the first place it does away with any possibility of erecting the girder reinforcement as a unit, even were this possible at all with the use of steel columns. The greater objection arises, however, from the large amount of fussy hand work involved in adjusting the rods, clamps and bolts.

A similar condition is met in the use of unit reinforcing frames for the floor slabs. These slabs are for the regular panels 4 ins. thick and they are reinforced by an arrangement of bars exactly similar to that for the girder units shown by Fig. 4, omitting the top bars. In a

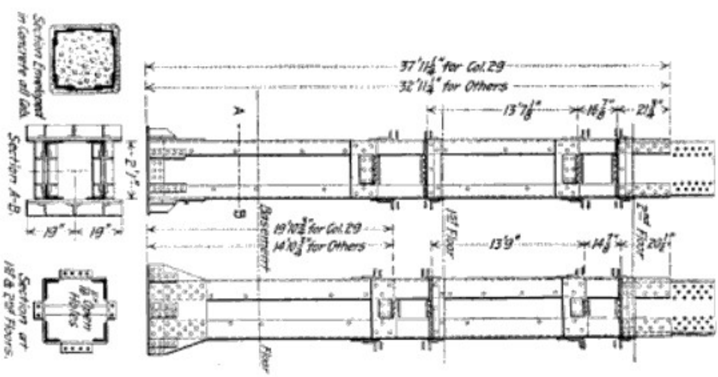

Fig. 2.—Interior Column, First and Second Floors.

word, the floor unit is practically a beam unit made very shallow and broad. Naturally these frames can be assembled much less rigidly at the shops than the girder frames, and because of the lightness of their members are subject to much more distention in shipping and handling. The writer's observation of the work of putting these frames in place impressed him with the very considerable amount of manual labor involved; indeed he does not hesitate to assert that separate bar reinforcement could be placed more easily and cheaply. The frames came to the work distended to a greater or less degree and had first to be hammered back into shape. Another delay came in placing the frame and adjusting the intermeshing bars and finally the intermeshing bars had to be wired to the separators and otherwise connected up. This work of placing the floor slab units involved no great difficulties but it was fussy and took a great deal of time.

The preceding comments must not be misinterpreted. The assembling of girder and column reinforcement into frames which can be set as units has distinctive merits, all of which are familiar to engineers. In the building being described, the steel columns and special connection details described prevented the girder reinforcement from being erected in unit frames, though it was designed to be so erected. In respect to unit frame slab reinforcement, however, the conditions at this building were such as are common to all buildings, and the results of experience here would seem to be of general application. It is never safe to draw a general rule from an isolated example, but where a rod reinforcement is to be used for slabs of moderate spans and thickness, it does not seem likely that much will be saved by assembling groups of these rods into unit frames instead of placing the rods individually.

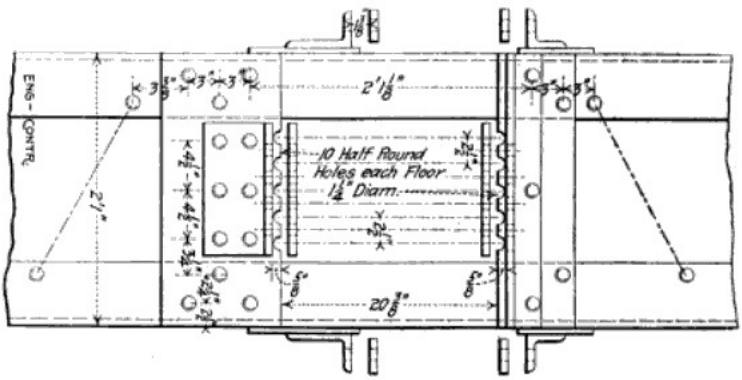

Fig. 5.—Column Clamps.

The distinctive feature of design in the McGraw Building is the combination of what practically amounts to steel column construction with straightforward reinforced concrete floor and wall construction. To one who examines the drawings studiously there can be no question, we think, but that an exceedingly sturdy structure will result from this design.

The method of erection adapted for the McGraw Building can at the present time be described only in respect to its general features. It will be realized from the preceding description that the erection work partakes both of the character of steel building work and of the character of reinforced concrete building work. For erecting the steel column sections a sturdy working platform for derricks was necessary, as the loads to be handled ran quite high—about 7½ tons in the case of some of the columns. Such working platforms could not be had in the successively completed floors, as would be the case in an all-steel building, because the concrete would be in no condition for some time after placing to carry any load at all. It was, therefore, practically essential that the handling of the steel should be done from a working platform wholly independent in structure of the building structure proper. This idea has been actually worked out as follows:

In about the center of the lot a four-legged tower starting from the bottom of the excavation was erected and will be extended upward as the work progresses until it overtops the building roof 12 stories above the street. The tower is square in plan and is divided into stories corresponding approximately to the several stories of the building. At each story a floor is constructed and serves as a storage platform for materials. For hoisting, a 75-ft. boom is swung from each leg of the tower; these booms are shifted higher and higher up the legs as the work progresses, being always kept about two stories above the floor on which work is progressing. Each boom is operated by a separate engine and has a nominal capacity of 5 tons. A load of 7½ tons has, however, been handled by one boom. The four booms cover the whole building area. The building is built up around the tower, it being so located that its only interference with the building structure is in the shape of square holes left in the floor slabs to accommodate the tower legs.

These tower derricks handle all materials, except the stone, sand and cement, taking them from trucks on the street and placing them inside the lot. The concrete materials are chuted into bins near the mixers. There are two mixers, one on each side of the lot at the basement floor level. These mixers discharge into the derrick buckets, which are then hoisted, swung to position and emptied where work is in progress.

The form construction has no very unusual features. After the steel columns are erected they are encircled by timber column forms made up of four side panels clamped together by four-sided yokes. The main girder forms rest in these column forms and in turn carry the inverted

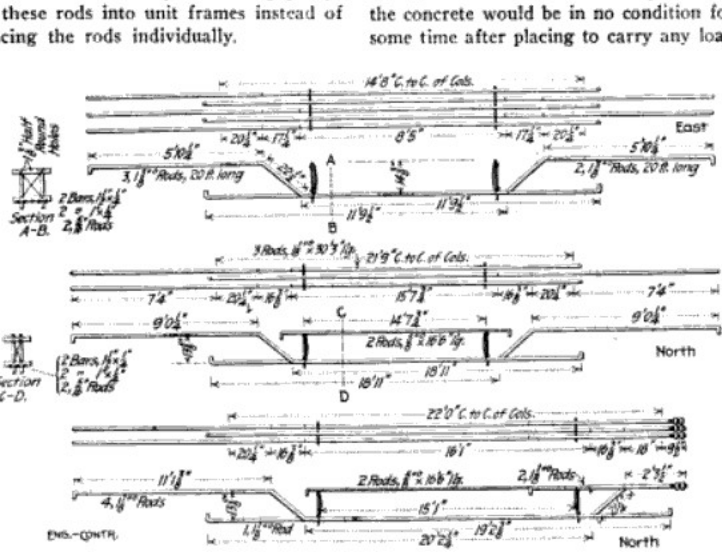

Fig. 4.—Forms of Girder Reinforcement.

trough-shaped forms for the floor slabs and beams.

The contract for construction was originally let to the Underwriters' Construction Co., but was afterwards taken over by the owner, who kept the original organization for the field work.

What Others Have Done.

Tunnel Ventilation.—In the construction of a tunnel for a water supply for Kansas City, Mo., ventilation for the tunnel during construction was secured by means of a 10-in. galvanized sheet iron pipe. The pipe was delivered in lengths about 9 ft. long and was put together like stove pipe. This pipe was supported on light wooden posts and was carried along the side of the tunnel from the face to the shaft. The pipe extended up the shaft behind the guides and through the head house. At the ground landing a small steam jet was turned up the pipe to induce draft. The pipe drew the foul air from the face, fresh air flowing down the shaft and along the tunnel. The only trouble with this arrangement was that occasionally the concussion from blasts would throw down a length of the pipe. The tunnel was 1,125 ft. long and was driven through hard soapstone. Hand machines were used for drilling, the holes being sunk about 6 ft. deep and charged with 3 lbs. of 40 per cent. dynamite.

Pipe Cleaning Device.—A "home-made" pipe cleaning device was used by the Superintendent of Water-Works at Yarmouth, N. S., for cleaning two 12-in. water mains. These pipes had been laid in 1891 and were heavily coated with tubercles. The device consisted of a hexagonal piece of wood, 3 ft. in length, having a disc of wood 1 in. smaller than the pipe bolted on the end. On the front or cutting end was fitted short steel scrapers placed diagonally with the pipe, stiff steel brushes being placed between scrapers and the disc. The scrapers cut the tubercles and the brushes cleaned the pipe. In the center of the stick a 1-in. hole was bored, and through this hole a piece of strong rope with thimbles spliced at each end was passed. With a low head of water it was not possible to force the scraper through by water pressure. Accordingly a small line attached to a block of wood was floated through the pipe and a heavy line attached to the scraper was drawn through. By frequent ramming with the water and eight men hauling on the rope, the scraper was pulled through the pipe. Four hours were consumed in cleaning 2,000 ft. of pipe.

Removing an Old Concrete Foundation.—Hand rock-drills were used in removing an old concrete foundation, preparatory to the erection of the Ritz Hotel in London. In excavating the site the contractor came upon an old raft of concrete belonging to the buildings formerly on the ground. This was 3 ft. thick, but was readily removed with little difficulty, with the aid of these drills. Cartridges, with small charges of explosives, were used for blasting, to avoid any danger or disturbance, and the concrete was broken off in small lumps, which were easily handled.

Draining Running Sand.—In the construction of a 200-ft. long, 2-archway tunnel under a canal on the London & South Western Ry., in England, great care was necessary to secure a good foundation. The work was done in connection with the widening of the railway and the tunnel was a duplication of one which had been some 70 years previously. The foundations came on running sand and were designed to come below the level of the old tunnel.

In order to bring the water in the running sand below the level of the foundations, a sump was constructed. This consisted of cast-iron cylinders, 9 ft. in diameter, sunk 10 ft. below the foundation level. The bottom ring of the cylinder was perforated with numerous small holes, and material to form an inverted filter bed was placed in the bottom of the sump. A perforated circular from plate of nearly the same diameter as the cylinder was placed on top of this filter bed. This plate was in two segments and was secured by a diver to the cylinder by struts against the flange of the bottom ring. The sump was thus secured against any boiling action in the running sand, while at the same time the water was free to flow, without carrying very much sand or silt. A 4-in. centrifugal pump was used to remove the water, pumping being carried on intermittently day and night. The water was conveyed for 500 ft. clear of the work in a wooden trough.

Portable Barracks.—Cars mounted on trucks and drawn by teams are used by the Postal Telegraph Cable Co. as portable barracks for the accommodation of men employed in repair work. A bulletin on the improvement, repair and maintenance of public highways, recently issued by the New York State Engineer and Surveyor, contains some information on similar cars. According to the bulletin a car to accommodate 20 persons can be built for $600. This car would be 33 ft. long, 8½ ft. wide and 6½ ft. high, with a floor of 1-in. Georgia pine, a roof of 1-in. white Carolina ceiling, and having one coat of tar paper and a tin roof. The sides would be made of 2 x 2 spruce ribs with ½ in. by 2½ in. face clear width, both sides to be of Georgia pine or South Carolina ceiling. The car should be provided with one door at the end and five windows on each side, which can be raised or lowered. All outside work should have three coats of paint; all inside work one coat of filler and one coat of varnish. The car should be fitted with 20 cots arranged in tiers; two washstands, camp chairs and a good stove. The car is mounted on a truck and drawn by team from place to place.

Another car costing $650, of the same dimensions and similarly built, should be provided for a kitchen and mess room, and be fitted with dish closets and supplied with enough dishes to feed 20 persons. Bins for materials, tables, benches, camp chairs, ice-chest, one steel range and tinware for cooking, should also be provided, as well as suitable partitions to divide the car into kitchen and mess room. These cars can be drawn on ordinary roads by one team for each car, and can be moved from place to place as the work progresses.

Rock Drilling.—In excavating limestone rock, air for two small rock drills was supplied at from 80 lbs. to 120 lbs. pressure by three 9½-in. Westinghouse air-brake pumps mounted on an old locomotive. The average daily rate of drilling per machine was 31 ft. by day labor, but after piece work drilling had been instituted, increased to about 54 ft. per day.

Finishing Exposed Structures. — In building the factory of the American Oak Leather Co., at Cincinnati, O., the water table, window sills and window caps of concrete molded in place were finished by rubbing them with a piece of freestone as big as a man could conveniently handle with one hand, the application being made after the concrete was thoroughly set. The composition of the concrete was 1-2-4 crushed limestone. It was wet thoroughly and neat cement was used under the scouring brick. The texture of the brick was about that of a medium grindstone. In regard to the work the builders, the Ferro-Concrete Construction Co., of Cincinnati, O., writes: "We think the action is that the brick clears the old cement off the stone and sand which is near the surface and gives the new cement and stone dust which is rubbed off a chance to stick. We always use this same method on the risers of our concrete stairways. We have never kept a record of the cost per square foot, but imagine it would come to about 2 cents. It is quite necessary that the concrete be thoroughly wet through or it will kill the new cement."

During the year ending June 30 last the net earnings of railroad companies operating 220,028 miles of road, or about 99 per cent. of the mileage that will be covered in the final report of the Interstate Commerce Commission, were $787,597,877, nearly $97,000,000 more than the corresponding amount reported for the previous year.