THE CONCRETE AGE

REPRESENTING THE INTERESTS OF MODERN PERMANENT CONSTRUCTION

Entered as second-class matter October 10, 1919, at the Post-office at Dalton, Ga., under the Act of Congress of March 3, 1879.

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The Editor solicits correspondence from readers on matters pertaining to the concrete industry. Descriptions of concrete work done anywhere that is of general interest accompanied by clear, sharp photographs and going into details as to methods employed will be published and paid for if found acceptable.

War Saving Stamps This Year.

Although the war is at an end, War Saving stamps as government securities will be issued again this year. They will be offered for sale together with Liberty Bonds and Treasury certificates under a new organization known as the war loan board. The war saving campaign has attained such great success in creating patriots and transforming the habits of the people from waste and extravagance into thrift that the Government has decided to put the War Saving movement on a permanent basis. Under new organization the War Savings society is expected to be the main agency, selling stamps regularly and continuously.

As to Contracts.

As a rule, those manufacturers who have contracted for the sale of their products ahead are sorry for it and are not inclined to contract further. On the other hand, consumers are not inclined to place orders for future delivery at present prices, because they seem unusually high.

This is a condition which not only holds in the concrete-cement field, but it is found prevalent in practically all lines of industry, because of abnormal conditions, with high prices and no positive assurance of whether prices will go higher or lower.

Taking it altogether, it is a poor year for contracting, and not many are inclined to either place or to accept contracts beyond what there is material in hand to supply. Some agreements are being made to supply needs at future dates at whatever the market price may be at that time, but straightout contracting is a thing that both sides seem to be fighting shy of at the present time, because of the uncertainty as to how long the present conditions may prevail and what may happen next.

Cement Manufacturing Machinery Needed.

A number of efforts have been made to establish the cement industry in Ecuador, all of which have failed to materialize, but recently a limited company under the firm name of "Industrias y Construcciones" has been organized at Guayaquil with a capital of 300,000 sucres (the Ecuadorian sucre at present exchange is fluctuating between $0.25 and $0.27 United States currency.)

Preparations are being made for the installation of a plant with a capacity of 60,000 barrels of cement annually. American manufacturers are requested to send catalogues of cement-making machinery, and notice is given that the machinery selected will be purchased for cash at a fixed rate of exchange that is to be agreed upon The technical director of the company is an American and prefers to buy the machinery in the United States, where he expects soon to make a visit in the interest of his company.

[The name and address of the contractor may be obtained from the bureau or the district and cooperative office by referring to file No. 29367.]

Production of Cement in Denmark.

The production of Portland cement in Denmark in normal times amounted to about 7,730,000 barrels (each of 375 pounds net), of which about 1,000,000 barrels were used in Denmark and the remainder was exported. During the war the production has been greatly reduced on account of lack of fuel, and during 1917 a majority of the plants were closed for this reason. For the past eight months the production has not been sufficient to meet the demands of the domestic market.

There are no statistics as to imports and exports available since 1913. The imports of cement in 1913 amounted to 126,000 barrels, of which about 30,000 barrels came from Sweden and Norway and the remainder from Germany.

The present c. i. f. price of cement is 24 crowns ($6.43) per barrel; the price in normal times ranges from 5 to 8 crowns ($1.34 to $2.14) per barrel. Portland cement is imported into Denmark free of duty.

There is transmitted a list of dealers in and imports of Portland cement and other construction materials, contractors, concreteblock manufacturers, railroads that might buy Portland cement, and municipal departments that purchase cement (copies of which can be obtained from the Bureau of Foreign and Domestic Commerce or its district or cooperative offices by referring to file No. 102949).

In Favor of the Architect.

That an architect in charge of the construction of a building has a right to reject unfit material furnished by a sub-contractor for the construction of concrete forms is the decision in a recent Washington case, says an exchange.

It was contended in this case that there was no lien for the value of lumber used in making concrete forms because the lumber did not become a part of the finished structure, and it was provided in the contract that the concrete forms were to be constructed and removed, and thus the concrete forms should be classified just as tools and appliances to facilitate work are classified.

The court refused to adopt this view, however, saying:

"The use of concrete in modern building operations has become so common that we may almost take judicial notice of the fact that buildings are no longer erected without the use of it, and that from lumber when once used is stained, warped, wired and coated with cement so that it is no longer a commercial commodity and is to be classed as waste. We see no more reason for rejecting form lumber as a subject of lien than we would have for refusing a lien for false work erected to sustain an arch or floor."

Promises Rail Aid Road Building.

The Railroad Administration will provide a remedy for the shortage of freight cars at an early date, according to a statement made by W. T. Testerman, Tennessee state highway commissioner, who went to Washington as representative of the commission to register with the administration a complaint touching the shortage.

The committee of road-building officials from the Southern States which appeared before the administration included M. L. Cunningham, state engineer of Oklahoma; North Carolina, and many other prominent road officials.

Great Future for Concret Blocks.

In discussing the building problem in Great Britain, Trade Commissioner Brock writes as follows from London:

The possibility of finding substitutes for materials which are offered only at prohibitive prices is not being overlooked. A government emmittee has been appointed, which is now examining many suggestions for innovations in building methods, and special attention is given to the use of concrete. It is held by some men of knowledge and experience that there is a great future for building by concrete blocks.

Concrete American Flag.

A popular novelty in Oil City, Pa., is a concrete American Flag at Diamond Park. It is an enterprise of Meadville Lodge 219, B. P. O. E., with consent of Mayor Lawrence, and the contractor was Arthur L. Grindrod.

The flag was built between two large cannon at the south end of the park and on a permanent foundation of concrete. The dimensions are 8 by 12 feet.

The flag is built on an incline facing to the south, and the stars will be raised slightly on the blue field. It was dedicated on Flag Day, June 14.

Silo Forms for Concrete Garage.

Silo forms previously used on a Missouri farm were employed to build a novel circular concrete garage. It cost about one hundred and fifteen dollars and is sixteen feet in diameter, with sufficient space on each side of the car for work-bench and vise. It is entirely of concrete except for the two-part wood doors and window sash. The walls are four inches thick, reinforced with wire netting. The floor and the roof are also of concrete, the latter with a three inch slope to the foot.

Use of Concrete Mains Suggested.

It is understood that the city of Birmingham, England, is contemplating an extension of its water system, which will cost approximately 500,000 pounds ($2,433,250). The proposal provides for the construction of a third pipe on the siphon sections of the aqueduct from the Elan Valleny to Frankley, and the strengthening of the present mains. The following details regarding the Birmingham system recently appeared in a local newspaper:

The aqueduct which connects Birmingham with the Corporation reservoirs of Mid-Wales is 73½ miles in length and consists of cut and cover tunnel and siphon pipe line. The sections in cut and cover and tunnel have been constructed to convey 75,000,000 gallons a day, the full estimated yield of the gathering ground, while the sections in siphon or pipe line are designed for six lines of pipes, two of which have already been laid, each having a capacity of 12,250,000 gallons per day.

But for the war the construction of the third pipe line would have been put in hand some time ago. That being impossible, the water committee completed all the preliminary work. In 1917 the committee reported that, in view of the liability to bursts to which cast-iron mains had proved subject, inquiries had been made respecting reinforced concrete, and the suggestion had been made that, as pipes of that material were not subject to the same limitations of diameter as those of cast iron, it was worth examination whether the provision of a main of double capacity might not be economically advantageous. When the proposal for a main of double capacity was first brought forward, the principal drawback was that it would be necessary to lay the double-capacity main over the whole length of the siphons before any augmentation of the supply could be secured. This difficulty has now been overcome by means of a system of cross-overs designed by Mr. F. W. Macaulay, the Elan supply engineer, by which the new main can be carried out by installments, sections being brought into use as they are completed without waiting for the construction of the main throughout.

The present scheme is for the provision of such lengths of main as will be required for the passing of an additional 4 million gallons per day through the Severn and other siphons. The sections of the new main will be laid in reinforced concrete on the "Bonna" system, the diameter to be 60 inches, which is calculated to provide, when completed, a discharging capacity double that of each of the existing mains of 42-inch diameter. The total length of double-capacity main proposed to be laid is 9.17 miles. It is hoped that the work may be completed in time for use in the summer of 1921.

Will Construct Great Dam.

Another great hydro-electric power dam will be constructed by the Aluminum Company of America at Calderwood, formerly Alcoa, in Tennessee, as soon as business conditions throughout the country are more nearly normal. Announcement to this effect was made by President A. W. Davis, of Pittsburg, before going with his staff on the booster trip of the board of commerce to the mammoth dam at Cheoah.

President Davis stated that the Calderwood dam was assured, and that other dams at strategic places along the streams of East Tennessee, were equally assured. Work on the new dam is expected to begin in the near future.

The Calderwood dam will be practically a replica of the Cheoah structure. Two years were required to build the Cheoah dam. The dam is 350 feet long at its base and 725 feet long at the top. At its base it is 175 feet thick, tapering to a thickness of twelve feet at the top. Over 200,000 yarts of concrete were used in its construction. Twelve hundred men were employed. The dam rivals Niagara Falls and the Roosevelt dam in the west, in the south. It might be aptly called the "Niagara of the South." Over 90,000 horsepower of hydro-electric power are developed —more than ten times as much as is consumed by Knoxville.

The dam backs up the water, making a beautiful lake which is approximately ten miles in length, and which covers thousands of acres. When the dam was completed, it required six days for the lake to be filled to the point where the water ran over the top for the first time. Some had thought that it would take twenty-four days, but the water went over sooner owing to heavy rains.

So important was the project and of such commercial value, that the interests represented in the dam project, actually paid for and submerged one million dollars' worth or more work done by the Southern Railway in building its Tennessee & Carolina Southern branch line into the mountains towards Bushell.

Concrete Hangars Fireproof.

Should an airplane catch fire in one of the government's new-type, fireproof hangars, the building could be so tightly sealed that the fire would virtually be smothered. The material used is chiefly concrete and steel, with a roof of tile, wire-glass windows hung in metal frames, and steel doors of the roller type which are opened and closed with power from an electric motor. The airtight feature is supplied by a system of ventilating windows which may all be closed instantly by throwing a single lever. In addition to reducing gre risk, such well-built hangars will serve until airplanes go out of fashion or change radically in construction.

Good Suggestion for the Contractor.

Here is a most excellent suggestion from the pen of Editor Poe who so ably presided over The Progressive Farmer and which could well be adopted with profit by all concrete workers. So The Concrete Age takes pleasure in passing it along. It is:

It cannot be too often repeated that "the most useful implement on the farm is a lead pencil." Consequently, one of the best New Year resolutions anyone can make is that he will keep a notebook in his pocket all the time hereafter, jotting down jobs for the future as they occur to him and joyously marking each one off the list as he gets it accomplished. The writer would never be able to look after his editorial work or his farm work satisfactorily without such a notebook, and any man who tries to get along without one is unnecessarily lowering his efficiency. On a notebook, too, the farmer may make temporary entries of financial items, transferring them to the regular account book kept on his desk.

When Overhead Expenses Spell Loss.

It is absolutely necessary sometimes to look facts squarely in the face and to ask oneself whether the balance sheet tells the truth about business or whether it has been made to put on "its best face" to satisfy the owner of the business. Figures won't lie, naturally, but they san be persuaded to do many little stunts that give the balance sheet a flattering appearance. Overhead expenses is one of the "goblins" that is not relished on a balance sheet and yet it cuts a very important figure. The concrete plant owner who doesn't count his small expenses—postage, telegraph, telephone, etc., allow for depreciation, count his own salary and the time of his son or daughter if they help out, and bases his profit estimates solely on the cost of raw material and direct labor is riding to a fall and sooner or later will be sure to get it. Fgure it all in—bad accounts and all—and make the trial balance sheet tell the truth. You can "kid yourself" by flattering figures for awhile, but the truth is bound to show up at last.

Good Roads and Civilization.

On account of the activity in road building in the South, especially sanctioned by the government, The Concrete Age is devoting much space in this issue to that subject, going into the plans now being prepared by the several states for work this year.

Road building of the permanent sort means much to the farmer, who has his produce to get to the markets to win wars, without which we could not fiight. Then, as a military necessity, we must have the best kind of good roads.

Method of Oilproofing Concrete

Method of Oilproofing Concrete.

A SERIES of experiments is being conducted by Messrs. Ludwig Bloch and A. D. Hyman, water-proofing engineers for the Water-proofing & Construction Company, Inc., 50 E. 42nd street, New York, to determine the most advantageous method of making concrete oilproof. The experiments, described in "Engineering World," are a continuation of similar experiments performed by Mr. Bloch for the Fougner Concrete Shipbuilding Company, of Christiana, Norway, and of New York, builders of concrete ships to be used as oil carrying tankers. It is said that the results from some of the experiments have had considerable influence on the methods adopted to oilproof the concrete ships that are being constructed.

The experiments are being conducted on cement-sand mortar proportioned about one part cement to two parts—by volume—of natural sand. A course aggregate was not chosen because it is not generally used in ship construction. Gasoline and 30 to 35 degrees Baume fuel oil, contributed by the Standard Oil Company, are being used in the tests. The mortar specimens consist of two by three and one-half-inch cylindrical disks and one by two by four-inch parallelopipedons.

Two general kinds of experiments have been adopted. One consists of subjecting one side of flat specimens to oil under pressure; the other consists of immersing specimens in oil under pressure. The former is intended to determine the ability of the specimens to resist seepage, whereas, the latter is intended to determine the ability of the speciments to resist absorption. The disks are employed in the seepage tests and the rectangular specimens in the absorption tests.

Various kinds of oil-proof are being investigated. The material includes that which is mixed with the mortar as an integral component and that which is applied to the surface of the specimen as a plaster coat or as a brush coat, material which is mixed with cement and sand is usully of an inorganic nature. The material in the plaster and brush, however, is varied. It includes special cements, oxides and other chemical compounds, paints of various kinds, varnishes and shellac. The plaster and brush coats are applied to that side of the specimen which is to be in contact with the oil.

The apparatus employed consists of vertical risers of one-eighth-inch iron pipe, at the tops of which is a glass gauge about two feet long, and at the bottom of which is a container for the specimens. The length of each riser is about 24 feet. When the specimen is in the container, oil is poured in the top of the pipe until the meniscus rises to a mark on the glass gauge. The amount of seepage or of absorption is determined by observing the glass gauge. Beakers are placed under the specimens tested for the seepage for the purpose of collecting any oil that may pass through them.

A feature of the experiments is the method to obtain a tight joint around the disks tested for seepage. Only those who have had experience with permeability tests of concrete appreciate the difficulty of obtaining a perfect tight joint. Some experience is required in fastening the specimen in the apparatus if leakage is to be prevented. It has been observed that the number of leaky joints has diminished as experience in constructing the joint has increased.

To fasten the specimen in the cylindrical container, the top of the container is removed and the specimen is inserted. A rope of oakum is wound around the specimen and tamped solidly into the recess between the specimen and the container. Then the rope of lead wool is wound about the specimen and the lead is tamped thoroughly with a hammer and a caulking iron. The oakum and the lead wool are wound several times around the specimen to prevent the occurrence of vertical joints. Too vigorous tamping is likely to destroy the specimen. An experienced person, however, rarely destroys a specimen by tamping.

The containers have been made, generally, of galvanized iron of various weights. However, experience has shown that the containers made from heavier iron—about No. 20 gauge—are more economical than those made from the lighter iron. The reason for this economy is that the heavier container can be used only two or three times. The necessary tamping of the lead wool causes a stain on the containers so that containers can be used ouly two or three times. What is more important than economy of container, however, is a tight joint around the specimen. This tight joint can be obtained by careful tamping.

Containers to hold the specimens consist of cylindrical drums of one cubic foot capacity. Several one by one by four-inch specimens are inserted in the drum, after which it is closed, and oil poured into the riser until the surface bubbles, the container is shaken gently and then allowed to stand during various intervals. Any absorption by the mortar specimens is indicated by the subsidence of the meniscus in the glass gauge.

View of Piedmont Driving Club of Atlanta, One of the Most Artistic and Up-to-Date Clubs in the South.

View of Terrace, Piedmont Driving Club, Atlanta, Ga.

View of Side Entrance to Piedmont Driving Club.

Construction of Concrete Pavements

THE growing popularity of the concrete pavement and the many contradictory statements which are made in regard to the proper methods of its construction, lead the writer to enter a word of caution at this time, for, while there are many who seem to assume that any one can lay good concrete, it is a fact that comparatively few do lay good concrete for the simple reason that certain of the most elementary details of good concrete construction were so often overlooked, writes J. L. Harrison in the Road Maker.

In the first place concrete is a mixture of aggregate, water and cement, and the first mistakes made in securing good concrete are apt to be made in selecting the aggregate. Unfortunate as this may seem, there is, at present, no well-recognized method by which the manner in which any sand will act in combination with any given stone can be determined except by actually testing them together in the laboratory.

This is unfortunate, but beyond dispute, and the engineer who endeavors to select the sand for a concrete job, though he test it in conformity with the best practice laid down by the largest engineering societies in this country, is in no way thereby insured that it will make good concrete, when combined with the stone which he intends to use. This is due, of course, to the fact that specifications for both coarse and fine aggregate determine the grading of the particles only within very wide limits, and so offer no indication as to the size of the voids in the coarse aggregate, which must be filled by the particles of fine aggregate. In fact, the ordinary specifications for concrete work, including concrete roads, make no variation in the maximum size of the sand particles whether the coarse aggregate must all pass a 1-inch screen and be retained on a ½-inch screen; or whether it must all pass a 2½-inch screen and must all be retained on a 1½-inch screen; or whether it must all pass a 2½-inch screen and must all be retained on a ½-inch screen; though it is patent that the actual size of the spaces between the stones—the spaces which the sand is supposed to fill—will be very different in these different cases.

In fact it is not putting it too strong to say that the sand which shows the best breaking strength when used in briquettes, should be looked on with extreme suspicion as a concrete sand, for it is apt to be too coarse for use with any but the largest sizes of broken stone. The writer has in mind a fine aggregate composed of crushed limestone which he once had tested and which ran well over 350 pounds in the 1-3 mortar test. But it was an absolute failure as a sand when mixed with 1-inch stone, and nothing at all could be done with it until the mix was so recalculated on the basis of the Fuller curves which show that, for practical purposes, the fine aggregate which is less than one-tenth of the diameter of the coarsest particles in the coarse aggregate.

The sand in question ran 45 per cent of particles between ¼-inch and 1-10-inch. A 1:2:4 mixture was required by the specifications. To get two parts of aggregate less than 1-10-inch it was necessary, therefore, to recompute the mix and to use 2 parts of the finer material in order to obtain what was, in reality, one part of fine aggregate. As a result it worked out that the proper mixture for these materials was practically 1:4-2, though it should be borne in mind that the fine aggregate, as originally provided for this work, passed the customary specification for sand and passed the mortar test with a showing of strength much above the average.

The illustration admittedly deals with an extreme case, but nevertheless should serve to show that independent tests of fine and coarse aggregate are just about volueless in determining the probable strength of ordinary combinations of these aggregates in concrete, and the engineer who wishes to secure good concrete roads will, therefore, buy the aggregates for such roads only after careful and thorough tests as to the strength of the concrete which can be produced from these materials.

Nor should these tests be confined to one mixture. The use of too much mortar is a weakness in much concrete now constructed, and a few concrete roads show a surplusage of ¼-inch or more of mortar over the whole surface. This mortar is not as strong as the concrete itself should be and its presence could have been avoided by using a properly proportioned mix.

When samples of aggregate are sent to a laboratory for test they should not, therefore, be tested on the assumption that a 1:2:4 mix or 1:1½:3 mix will be used, but should be sent to the laboratory with a statement that 4½:5:5½, or 6 parts of aggregate are to be used with 1 part of cement, and that the laboratory must determine the proper relation of the coarse and fine aggregate. Thus if 5 parts of aggregate are to be used the laboratory should determine whether the mix ought to be 1:2:3. 1:1¾:3¼, or 1:1½:3½. It is more than likely, especially if gravel is to be used, that the 1:1½:3½ mix will be the strongest as well as the cheapest, but there is no reason for being at all in doubt about such a question as this is one which any good laboratory can determine at small cost.

Some engineers prefer to specify the mortar and leave the determination of the amount of

stone to the laboratory. Thus with a given sand, if it has been determined that a 1:1½ mortar will be used, the laboratory is asked to determine whether 2¾, 3, or 3½ parts of a given stone would produce the best concrete under ordinary field conditions. This method is, however, open to the objection that if the maximum size of stone is small and there is a considerable percentage of coarse material in the sand, the laboratory cannot readily correct for it. Thus, suppose that graded coarse 1½-inch aggregate is to be used, and that the sand contained 25 per cent of particles which are retained on a ⅛-inch screen, it would very possibly develop that in order to obtain a real 1:1½ mortar 2 parts of sand would have to be used with each part of cement. If, then, the stone was low in voids, it might very easily happen that 3½ parts of stone would be needed to take up the mortar produced by the 1:2 mix, in which case the mixing order should read 1:2:3, and the resulting concrete would actually be a 1:1½:3½ concrete. But if such a problem as this is sent to a laboratory with the request for a determination of how much should be used in concrete in which this sand is to be used in 1:1½ mortar, the result would be to obtain instructions to use a mix approximating 1:1½:¾ which would not be what was really wanted, but a richer and a more expensive mix.

The next matter which deserves attention is the amount of water to be used. Excess water cuts down the strength of concrete at a fearful rate. In fact it is very easy to throw away half or two-thirds of the possible strength of concrete by using too much water in mixing it. This use of excess water is usually defended by a pretense that a proper percentage of water will not give a concrete which can be worked into shape back of the mixer. There is absolutely nothing to this. It does require a little more work to handle concrete which contains only the proper percentage of water, and it does require a little more care in distributing it over the subgrade in dumping it, but that concrete containing a proper amount of water can not be handled is the most ridiculous nonsense, and the propaganda of such nonsense is at the basis of most of the poor concrete road work which is to be found in this country.

The twin brother of excess water is under mixing. In fact, excess water is often used to cover up under mixing. Recently in discussing this matter with a man in charge of a good deal of concrete highway construction, objection was raised to the writer's suggestion that better concrete could be secured by increasing the three prevailing mixing period of one-half minute, on the ground that "repeated efforts to increase the length of time in the mixer only served to mix the water all out of the concrete." The writer wonders haw many engineers really have the idea that it is possible to remove any water in this way which is of any value to the mix. As a matter of fact this man was right in one particular at least. If too much water has been used in a batch, a proper amount of mixing will separate it—there can be no doubt of that—but the remedy is not less mixing, but less water.

There seems to be some misunderstanding of the reason for long mixing. In the first place, when the stone and the sand are placed in a mixer with the cement and water, the individual bits of sand and the pieces of coarse aggregate are usually— practically always in fact—more or less covered with minute particles of dust. The sand is also apt to be more or less coated. A microscope will reveal this when the unaided eye will pass these materials as clean. Washing will remove this material only very slowly, if at all, and so it must be ground off in the mixer. The principle is very much the same as that involved in placing a patch on a rubber tire. The surface material may be sound, etc., but cement will not stick to it properly until the dirt on the surface has been cut away and the clean rubber exposed. The grinding action in the mixer cuts through the films of whatever nature they may be, which cover the surface of all particles of aggregate and permits a strong attachment between the cement and the stone.

A second reason for long mixing is to be found in the fact that, when the mixer is only turned a few times and the batch dumped out, a good deal of the water actually exists in the form of globules. Water occupies space in the mixture just as sand and stone do, and when it is not properly distributed by mixing, the concrete in which it is placed will be visibly porous. Undermixed concrete takes more water than properly mixed concrete, because it takes quite a little mixing to break up these globules and spread the water in them, through the mix as a thin film covering every particle of cement and aggregate. If this cement and aggregate were instantaneous, much less mixing would be necessary; but the water film must supplant the air films on the surface of the grains of cement and on the aggregate, and in order to make the substitution complete, time and a good deal of rubbing are necessary.

In short, undermixed concrete is weak, because it contains too much water in the form of minute globules, because the surfaces of the particles of aggregate have not been rubbed clean, and because there is not a proper contact between the water film and the particles of cement and aggregate. Nor can these matters be corrected by any simpler process than by ample mixing. For that reason concrete for pavement purposes should be mixed for 2 minutes or more and it is

an open question whether it would not be enough better to justify the added cost of mixing it 3 minutes.

At first glance it will seem that a batch every 2 minutes will reduce the output per day. In some cases this may be true, but a batch every 2 minutes is 30 batches an hour or 240 batches during an 8-hour day. If a half yard mixer is being used this will provide for 120 yards of concrete pavement 18 feet wide and 6 inches thick every day, which is less than many contractors attain, but more than contractors usually average. Moreover, it should be kept in mind that concrete so mixed will be worth all of any extra cost chargeable to the extension of the period of mixing.

Last, but not least, it should be emphasized that no sort of finishing can possibly take the place of proper mixing and placing. Just now the roller is the fad. Six months from now it may be something else. The roller is a good tool for the finishing of a concrete road, but it will not correct poor proportioning, over watering, or under mixing. At present many engineers seem to be using it under the impression that it will remove excess water and so correct the faults which arise from the use of excess water. The roller does draw off some excess water—but why put in the excess water? Why not mix the concrete right in the first place? It can be mixed right for the state engineers at Sacramento and in other places do mix it right—and with no apparent added cost. Why, then, put excess water enough in the whole of a 6-inch pavement to reduce the strength of the concrete 5 per cent or more and rush it through the mixer in a quarter of the time it needs there, and slap it onto the road and then try to take part of the excess water out of the top inch with a roller?

The roller is a good finishing tool. It makes a nice surface, and its use is entirely justifiable—but engineers should not use it as anything but a finishing tool. If good concrete roads are to be secured they must still be secured by observing first principles in the selection of materials and in proportioning, mixing, and placing the concrete. Good finishing is very desirable, and a roller will help to secure a good finish. But good concrete is a much more important matter and no roller will make a good pavement out of poor concrete.

"It is not an exaggerated statement to say from $10,000,000,000 to $20,000,000,000 is necessary to provide the structural facilties which would have now been in use had not the war occured. Until this construction has taken place the nation must do without conveniences to which it was formerly accustomed."—From Report of Senate Committee on Reconstruction.

Cold Weather Construction.

The following instructions, issued last fall at the Navy Yard, Philadephia, Pa., for the guidance of inspectors and contractors working under the Bureau of Yards and Docks, may be of interest to contractors who have cold weather problems to meet:

1. Sand, pebbles or broken stone, brick, terra cotta, etc., must be free from frost or lumps of frozen materials before incorporated in the work. When the temperature during the preceding night has fallen below 32 F., all such material must be heated before being placed in the work and mixing water shall also be heated at such times.

2. Sand, pebbles, and broken stone may be heated by piling them over a round sheet-iron cylinder, within which a fire is kept burning. Care should be taken not to overheat material by this method. Materials can be heated by piling on steam pipes and covering with tarpaulins. Bricks and terra cotta can be heated by covering with tarpaulins and installing a steam pipe, stove or salamander.

3. Mixing water should be heated to about 150 F., by the use of steam. On small jobs, a tank or large kettle supported above a fire may supply all the heated water that is needed.

4. Forms and reinforcing should be warmed, and ice, snow, and frozen materials removed before proceeding with work. Forms and reinforcement can be warmed and cleaned by steam or by hot water.

5. After materials are placed they must be thoroughly protected. Means for doing this will depend on the location and on the temperatures which may be expected. Canvas or tar-paper covering, sheathing, covering with hay or straw, may be sufficient in some cases; but as a rule there should be installed, in addition, steam coils, stoves or salamanders whenever necessary to prevent injury by frost.

6. Especial care must be taken on reinforced concrete work and on granolithic finish and plastering.

7. The use of salt in mixing water will not be allowed.

So far as contractors are concerned, these represent the minimum requirements, and shall not prevent the use of such further additional precautions, as may be considered necessary. Contractors are responsible for producing proper work during cold weather, and nothing in these instructions shall serve to relieve them of that responsibility. Contractors should at once begin to make adequate preparations toward carrying out these instructions and such other precautions as they may desire to take in order that their work may not be unduly delayed by cold weather.

What is the Future of Building?

OF ALL the problems of readjustment this is perhaps the most important and interesting. It concerns everyone because building activity is the basis of so many other industries and because the building pragram enters into the future plans of almost every organization and individual.

The manufacturer who wants to expand, the school or college that requires more space for students, the growing families who need new places to live in—all these and many others are obliged to study the building problem and try to foresee conditions as they will exist.

Are building costs going to fall to any extent? Are rentals going to remain at the present high figure? What classes and kinds of construction are going to be most active in future building work. These merely indicate a few of the questions which every prospective builder, every architect, contractor, manufacturer and workman in building lines must seriously consider.

Supply and Demand.

In the first place building costs will be governed, as they always have been, by the law of supply and demand. If there is need for one million buildings and there is only labor and material available for nine hundred thousand, the cost is bound to remain high. What then are the actual needs and desires for building at this time?

Homes.

No one will question for a moment that more homes are needed. There is hardly a city or live town in the United States where one can rent or buy a home without long search and payment of what used to seem exorbitant prices.

People not only demand homes, but they demand better homes. The shacks that used to serve to house so many mill workers will not answer since these men and families have had a taste of the comforts that war wages brought.

Moreover, every plant owner has had convincing proof that it pays to give careful attention to the housing of workers in proper homes. Bolshevism is the greatest danger this country has to face and the soundest bulwark against it is the home owner. No man who ownes a home —no matter how humble—will listen long to any doctrine which would take away his prosperity or force him to share it with someone less thrifty.

Thousands of wise manufacturers will plan—are planning today in fact—to build houses which their workers can buy for small payments. These houses will be built in numbers which will make this kind of building most attractive to every architect and contractor, no matter how large his organization.

Nor will home building be confined to less expensive homes. People of means are planning more than ever before. The old residential sections of every city are fast giving away to the suburban districts owing to automobile, rapid transit lines and other improved transportation facilities.

The American people never were as "well fixed" financially as today and they are going to put their money into homes as never before.

Schools.

No city has been able of late years to keep its school buildings up with the demands. Thousands of "portable" wooden buildings were put up to tide over the government released building work. These schools must now be built.

In the country, too, the large centralized school is replacing the little wooden school house, an improvement which will grow by leaps and bounds as improved roads enable pupils to be more easily transported to central points.

Children are going to be kept in school 12 years instead of 6 or 8. Schools are bound to grow and school buildings made bigger and better.

Churches, Hospitals and Institutions.

These buildings for the most part depend upon the generous gifts of interested people. The war has taught the American people the idea of giving on a scale never before approached and the Red Cross, Y. M. C. A., K. of C. and similar campaigns have paved the way for many a future drive to build churches, schools, hospitals, or other community buildings.

Everyone who studied the effect of the war closely knows that there has been a great increase in religious feeling and activity among all people and this in turn resulted in growth of church congregations and in demand for larger quarters.

As to hospitals, there never was a city with too much hospital capacity. It is the ideal way to care for the sick and the economical way as well. There will be a constantly increasing demand for hospitals for years to come.

Farm Buildings.

Here, in our opinion, lies one of the greatest opportunities for future building. It is true that farm populations have decreased enormously by farm boys and girls moving to the cities. But what does that mean? It means that where there used to be 10 million farm people producing eatables and wearables for themselves and a population of only 30 million city people, today the situation is absolutely changed, and 35 million farm people are producing for themselves and for 75 million city and town people as well. The natural result has been higher prices for farm produce and a profit which would enable the farmer to live decently.

Drainage Essential for Good Roads

AN essential feature of an improved road is adequate drainage, according to the specialists of the Bureau of Public Roads, United States Department of Agriculture. Thorough drainage is so necessary that it is practically impossible to maintain satisfactory road unless it be given proper attention. Another prime requirement whenever a hard surface road is to be constructed is a firm and unyielding foundation. As the quality of the soil has an important influence on the proper method of drainage and the type of foundation to be employed, much care and study much be devoted to the nature, type and character of the soils in the section through which it is proposed to build a road.

The most important primary soils are classified as gravel, sand and clay, but often many of the secondary or mixed soils, because of their more general occurrence in connection with road-building operations, are equally important. Such types as loam, marl, gumbo, and hardpan are representative of this order.

In the design of a road the drainage structures are planned to take care of water under three general conditions—rain that falls on a road surface or grade; rain that falls on contiguous land and flows in accumulated volume towards the road; and ground water from any immediate source. To meet these conditions use is found for special structures, including longitudinal side ditches, usually parallel, or approximately parallel to the center line; intercepting ditches to accommodate water whose approach so close to the roadway as the side ditches is likely to cause injury; lateral ditches or culverts to conduct accumulated water away from or under the road; and sub-drains. In order to plan intelligently a system of drainage for any particular road, it is necessary to consider not only the local character of the soil composing the roadbed, but also the topography of the adjacent land, the amount and rate of rainfall, and the availability of material suitable for use in constructing drains.

Provide Surface Drainage System.

Surface drainage systems for roads consist of side ditches along the road, paved gutters (which are a development of side ditches and replace them) open intercepting ditches constructed to prevent water from reaching the road, and lateral or relief ditches to carry off the water which collects in the side ditches or in the intercepting ditches. Culverts and inclosed drains, which are constructed for the purpose of removing storm water from the side ditches or gutters, are essentially a part of the surface drainage system, and are not to be confused with subdrains which serve an entirely different purpose.

Where the grade of a road is so steep that the ordinary earth side ditches can not be maintained satisfactorily at a reasonable cost, or where earth side ditches would be insanitary or appear unsightly, it is customary to provide paved gutters for removing the surplus water. The point at which it is economical to change from earth side ditches to paved gutters on account of the steepness of the grade depends on the character of the soil and the amount of water to be carried.

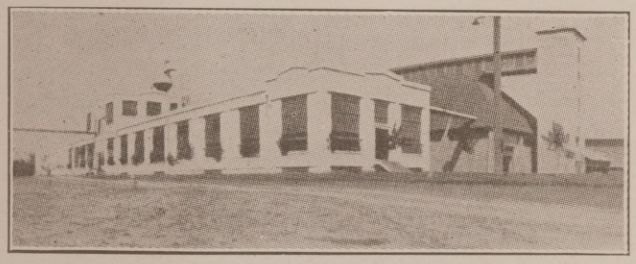
Gutters may be constructed of Portland cement, concrete, brick, cobble stones, angular fragments of stone, or other material. In some case they are formed simply by constructing a curb along the edge of the road surface, as is done sometimes in city pavement construction. This method can be employed only where the road surface is made of material capable of withstanding the eroding action of water and where it is not important that the earth shoulders be kept open to vehicle traffic. Gutters are made from 2 feet to 6 feet wide and from 3 inches to 10 inches deep, depending to a great degree on the type of design, and the size is governed by the same consideration as governs the size of earth side ditches; that is, they should have a cross section sufficient to drain the road without danger of overflow, and in order to determine this cross section it is necessary to consider the area to be drained, the maximum rate of rainfall and runoff and the character and slope of the gutter.

Drop inlets and catch basins are used to conduct water from side ditches or gutters into under-ground drains or culverts. On country roads they are used most freguently on side hill locations where the water collecting in the upper side ditch or gutter can be removed from the road at intervals by means of a culvert across to the lower side. Drop inlets usually are sufficient, and catch basins seldom are used in country road work, except where it is especially desirable to prevent the silt and other foreign material carried by the water from getting into the underground drainage structure.

Concrete Construction for Oil Mills

WHEN H. Landa, President of the Landa Industries, Inc., of New Braunfels, Tex., was confronted with a rebuilding problem in 1917, in connection with his cotton oil mill, he gave careful thought to various types of construction and became convinced that prevailing mill construction had nothing to recommend it except possibly lower first cost. It is easy to prove that low first cost is not an advantage that would offset ultimate saving resulting from permanent construction.

The result was that Mr. Landa decided to replace some of his old buildings with concrete structures. One of these is a seed house, 80 by 400 feet long, and of concrete throughout except for the roof, which it steel rafter and sheet metal construction. The walls of the building are 22 feet high, 10 inches thick at the bottom and 8 inches at the top. The feature of the building it that the roof it pitched to the angle of repose of cottonseed bulk and the building is filled from a conveyor running along the ridge line and



Cotton Oil Mill of the Landa Industries, Inc., New Braunsfels, Texas.

emptied by another conveyor running in a 7-foot tunnel under the center line of the building. This enables handling contents both in filling and emptying without the use of manual labor.

The mill structure is 60 by 400 feet with an 8-foot basement. It is of concrete throughout, including the roof, except that some hollow tile were used in the walls.

These concrete structures have proved a substantial economy from the standpoint of fire-safeness as evidenced in the reduced cost of insurance. A saving in this item of 30 per cent on the building and 20 per cent for its contents have been realized by comparison with the old rate on the seed house, and 40 per cent for the building and 30 per cent for contents over the old rate on the mill. Inasmuch as the seed house alone, when filled, represents a value of from $750,000 to $850,000, it requires but little figuring to prove the annual saving very material. In fact through this saving, these buildings soon earn their cost as well as a tidy annual dividend, through lessened cost of operation.

The Texas Fire Insurance Bureau places the fire ratio for cotton oil mills at almost twice the average ratio for all other kinds of buildings and the ratio of loss for buildings of this type is given as 135 per cent of the average of all building fire losses. There were 1,288 fires in the 220 cotton oil mills in Texas from January 1, 1913, to December 31, 1917, or one for each oil mill each year, with 188 fires extra. Many of these fires probably put a plant out of commission in the busy season.

Annual Meeting U. S. Good Roads Association.

The all-Texas route for the Bankhead National Highway was finally selected at the convention of the Bankhead National Highway Association at Mineral Wells, Tex., April 21. This is known as the southern route, which was recommended by the pathfinders at the convention in Little Rock last year. The length of the all-Texas route is 1,198 miles.

The following officers were elected for the ensuing year: T. L. Plowman, Talladega, Ala., president; J. A. Rountree, Birmingham, Ala., director-general; L. B. Jones, Talladega, Ala., treasurer; W. W. Heton, Tallapoosa, Ala., director at large.

Pathfinders for the route from El Paso to San Diego, Cal., were selected, and left immediately after the close of the convention for El Paso.

The United States Good Roads Association, which met at the same time as the Bankhead National Highway Association, adopted several resolutions on national issues. It endorses the Townsend-Bankhead bill for a national system of interstate highways under a national highway commission. It urged that returning soldiers, sailors and marines be given preference in employment on road work, declared for better pay for highway engineers, urged increased appropriations for highways through the national forest reserves, urged that universities and A. & M. colleges give more attention to the science and art of road building and beautification.

Senator J. H. Bankhead was re-elected president of the United States Good Roads Association; Governor Charles H. Brough of Arkansas, first vice-president; Governor Larazolo of New Mexico, second vice-president; R. M. Hubbard, third vice-president. Mr. Hubbard is chairman of the Texas Highway Commission. Governor W. P. Hobby of Texas, is ex-officio vice-president for Texas. N. F. Smith and Curtis Hancock were nominated by the Texas delegation as directors for Texas.

Both associations will hold their next annual convention in Little Rock, Ark.

Cement Production in France

THE cement employed in the Calais region of France is gray and slowly hardening Portland cement. This district produced before the war 600,000 tons of this material, which constituted one-half of the total production of all kinds of cement in France. The leading cement plants are at Desvres, Dannes, and Neufchatel. The present annual output of the region is approximately the same as before the war. The gray cement is produced by adding the necessary quantity of clay or carbonate of lime to marl. The rapidly hardening cement is not produced in this district, but comes from Grenoble, in southeastern France, which supplies natural Portland in large quantities.

The present selling price (February, 1919) of the gray cement manufactured in this district is 135 francs ($26) per ton on the cars or at the plant. This price does not include the sacks or barrels, which must be paid for separately, and the price of which is reimbursed on their return to the plant.

Under normal conditions France exports annually 300,000 tons of cement to its colonies and imports a negligible quantity. Local cement dealers state that for the time being there is little or no market for cement owing to lack of transportation facilities. It is probable that with the accumulation of stocks due to the continuing output and the lack of shipping facilities the locally produced cement will be sufficient to meet the needs of this section.

The Portland cement used in the Marseilles district is entirely of domestic production, chiefly local. Prior to the war the annual output of the factories in Marseille and immediate vicinity average over 200,000 metric tons, and exports through the port of Marseille about 160,000 tons. These exports were destined chiefly to the French North African colonies, Spain, and Argentina. In 1913, which was the last normal year, the shipments of cement from Marseille amounted to 138,605 metric tons, distributed as follows:

Exports to—	Cement. (Metric tons.)	Cement tiles. (Metric tons.)
Algeria	60,870	695
Spain	27,479	36
Argentina	22,125	---
Tunis	14,095	295
Morocco	11,778	1,160
Turkey	8,553	467
Italy	5,281	---
Other countries	28,911	1,860
Total	179,092	4,513

The local exports of hydraulic lime during 1913 amounted to 109,875 metric tons. According to figures obtained from the Marseille Chamber of Commerce, the cement exports from Marseille during 1918 fell off to only 16,236 metric tons. The shipments to Algeria are not included in this return. There was an enormous decrease in the industrial production during the war, but since the signing of the armistice with the Central Powers there has been a gradual resumption of activity in this industry, which is expected to be shortly in a position to supply the local demand.

Export Price.

One of the leading Marseille firms has given the following prices as of February 7, 1919, per metric ton, delivered quay Marseille, a dnput up in barrels of 200 kilos each:

	Francs.	Dollars (normal exchange).
Artificial Portland cement	125	$24.12
Natural Portland cement	135	26.05
Valentine cement	120	23.16
Roquefort cement	115	22.19

The quotations are somewhat higher for the some product delivered in barrels of 100 kilos each. It is believed that these prices will decline slightly in the near future.

There are four concerns in the St. Etienne district producing gray or white Portland cement: La Societe J. & A. Pavin de La Farge, with offices at Viviers, Ardeche, has an annual output of about 400,000 tons, and sells in this region approximately 40,000 tons. La Societe des Ciments de la Porte de France at Grenoble, Isere, which markets about 25,000 tons locally, produces annually some 200,000 tons. La Societe Vicat, also located at Grenoble, sells from 15,000 to 20,000 tons in this region, but its total output is not known. Then there is La Societe des Ciments at Chaux de Joze, Puy-le-Dome, statistics of whose production are also unavailable. There are no manufacturers of cement blocks, as this kind of material is made by the contractors themselves according to the specifications of each particular building enterprise. Two or three small firms make concrete floor tiles, mosaics, and artificial marble.

Depression in French Glass Trade.

Through the office of the American commercial attache in Paris it is learned that the Societe des Verreries Mecaniques de Bourgogne has been compelled to completely stop its manufacture of window glass on account of present business crisis and the lack of sales. This factory, situated near Chalone-Saone, is one of the finest factories in France.

Concrete Walks and Bridges in a Springfield, Ohio, Park.

Park Stream Protected by Concrete Embankments.

Residence of Daniel Guggenheimer, Long Beach, N. J.
Garrere & Hastings, Architects.

Porch Columns Made by the Hannmann-Sanders Co., Chicago.

COLONIAL
DESIGN

Brogden Residence

at

Jacksonville, Fla.

Reinforced Concrete,

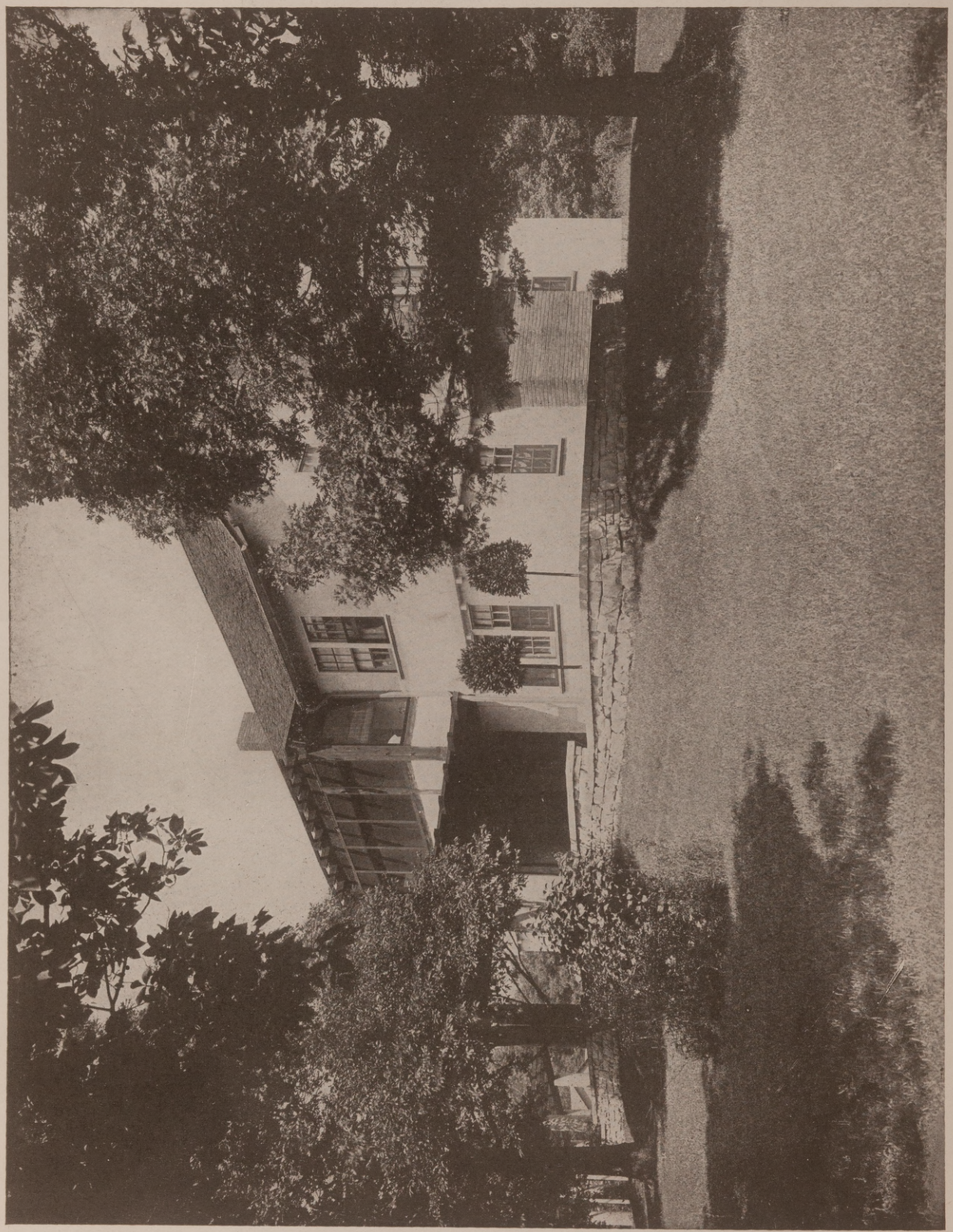
Cost about $25,000.

J. H. W. Hawkins,

Architect.

Jacksonville, Fla.

Effective Uses of Garden Pottery and Concrete Walks.



Stucco House With Trees as an Aid to Beauty and Companionship of Home Life.

Stucco House—The Home of Mr. Henry S. Brophy, at Maplewood, N. J. B. Halstead Shepard, Architect.

Pretty Garden Furniture

AT LAST we Americans are coming to our senses and are beginning to appreciate the pleasure and healthfulness of living more in the open. Consequently we show a growing tendency to treat the garden not as a pleasant place to stroll through, or pick posies in, but as an outdoor living-room. And to that end, we must have some sort of furniture to give the garden the look of an abiding place—something to sit upon, something to furnish shade on a summer's day, writes Henry Fearing in The House Beautiful.

Garden Trellis.

Sun Dial and Pool.

This idea of treating the garden as a living-room is as old as the garden itself. In fact, it is doubtful if much gardening was done in ancient Rome, as we understand gardening; the Greeks did very little ornamental elevating. To these people a garden meant a pleasant spot outdoors, set apart as an outdoor living-room, and therefore made attractive by means of seats, fountains, statuary and ornamental structures of various sorts. Much of the same idea has passed directly down to us in the Italian gardens of mediaeval and modern times, where arrangement is everything, where growing flowers amount to very little, and where every vantage-point and vista is made the occasion for some sort of garden furniture that may tempt the feet to loiter. And as for the old English gardens, no description of them would seem complete without some mention of lodge, bower, bench, or gazebo.

It is not likely in most of our American gardens we shall care to carry garden furnishings to quite this extent. We shall doubtless compromise on inexpensive materials, practical utility, and

Practical Garden Furniture.

enough of artistic quality to preserve the garden's attractiveness to people of cultivated taste; for the garden's chief charm we will depend on what the Americans love best of all—flowers.

But on a great estate, where expensive garden furnishings are not out of place either in the formal farden or in the wilder parts of the landscape, it is quite fitting that the work of ancient and modern artists should be employed. For the man or woman who can afford it, there is just as much fun in collecting antiques for the garden as for the dining-room or hall. Thus far, efforts in this direction have been largely confined to the importation of old seats, well curbs, and carved stone fragments from Italy, and more less fanciful satuary from France. The connoisseur knows that the field has not been half covered, and no doubt the Old World will be robbed of more of its treasures to grace new world gardens. As to the materials, stone is of course the most suitable and the most lively—old gray stone that comes to look like a part of the landscape, with the contrast of glistening white marble in a few appropriate statues.

But most of us cannot afford carved marble, or even fine terra cotta. For us there is the poor man's granite—concrete. Now if there is any one thing that is an offense to the eye in the garden, that is the hall mark of modern bad taste, it is concrete work overdone or crudely moulded. Sharp-cornered curbs and steps, vases that are obviously copies of something better, seats that look hot in summer and cold in winter and hard all the time, objects that appear to be a crass imitation of a nobler material—such things give the garden a bourgeois look that no amount of care or wealth of bloom can hide. Concrete may be made in either shape the designer wishes, and it may be given almost any color and texture of finish. In general, it is possible to produce beautiful things in this medium; but somehow natural depravity of human nature asserts itself when it comes to the use of concrete, and hideous atrocites are much more common than works of art. Perhaps this is because an expert attempts to carve stone, while any man with enough artistic taste and mechanical skill to change his automobile tire seems to be called to mess around more or less in concrete. Hence the danger of getting into bad artistic habits. I have not a word to say against concrete in the garden, but merely sound a word of warning, since I have seen so much of it that is so bad. It is the one material that is at once cheap and enduring; "when it is good, it is very, very good, but when it is bad, it is horrid."

Another direction in which we seem prone to go astray is in the matter of rustic furniture. I have seen gardens so full of this stuff that they looked like a dish of brown and fuzzy macaroni. A rustic arbor, half hidden by morning-glories, a rustic bridge among thick shrubbery and trees, even a rustic chair or two may be tolerated; but to fill the garden and cover the lawn with rustic furniture, as some misguided people do, is like wearing overalls to dinner; it is simply out of place. And rustic furniture, while often displaying considerable ingenuity in construction, is seldom justified in any claim to beauty. Usually the legs of the tables and arms and backs of the settees and chairs writhe and twist about like the serpents of Laocoon.

Still I do not wish to seem to be making a too

sweeping condemnation; I merely wish to sound a warning against a common American fault. Occasionally rustic furniture is proper and attractive. Cedar or locust, with the bark left on, are the most durable as well as the most attractive for this purpose, though cypress, chestnut, and other kinds of wood give satisfaction where available, while hickory produces an effect of sturdiness all its own.

Wooden furniture has recently come into vogue in the garden—chiefly the white painted kind that we first imported from Germany. When the designs are good, and where there is not too much of it, this white furniture looks clean, cool, and inviting, and forms a pleasing contrast with green foliage. The danger is that it may appear harsh in outline and staring in its dazzling white. More attractive in some respects, though less popular, is furniture made of cypress, oak, or chestnut—weathered, stained gray, or left natural. The difficulty is in finding wood sufficiently well seasoned to stand the exposure. On the whole, cypress is the safest to use.

One final word about wooden garden furniture; don't paint it a vivid green. And, of course, let the patterns be always simple.

Iron furniture is also made for the garden—chairs, tables, settees, fountains, etc.—but it is mostly bad. The designers of iron furniture seem to run to curly scrolls and sinuous lines, and there is a certain German beer-garden look about it that is hard to get away from. On the whole, iron furniture may well be avoided; at best it is uncomfortable.

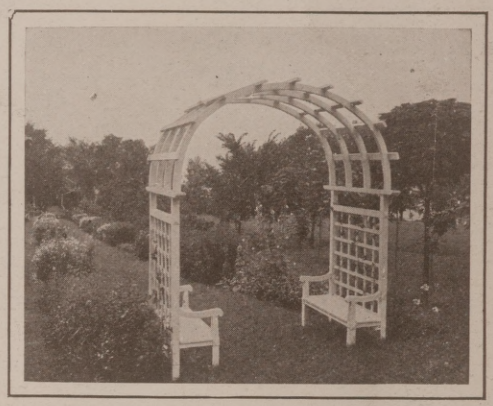
The idea of the outdoor living-room is most directly suggested by the use of tables and seats. A seat always suggests tarrying, and a table represents a vision of tea. The danger lies in scattering these things all over the place. Then it looks as though you were getting ready for a lawn party. Two or three wooden or concrete benches are enough; placed at salient points with some real plan for garden design in mind. Tables seem out of place almost everywhere except under some shady tree or vine-clad pergola.

As to design, the straight lines of the arts-and-craft school seem to be, by a harmony of contrast perhaps, most appropriate for this purpose. In the matter of tables, wooden tops may be expected to warp in time. Painted furniture should never be allowed to get worn or dirty.

Seats and tables suggest the arbor and the summer-house—small living-rooms within the big one. Arches over paths, and arbors at the ends thereof, offer a splendid opportunity for the placing of seats, and when covered with vines or climbing roses they offer shade and a bit of seclusion. White painted lattice work is the most popular material.

Perhaps the most effective as well as the most abused form of arbor is the pergola. It became so suddenly "the rage" that many people adopted it without in the least knowing what it was or what it was for. To those who know that the pergola was originally an Italian grape arbor, there is no garden sight so absurd or bad taste than a heavy-pillared pergola, with rafters as naked as a railway trestle, leading nowhere, shading nobody, meaning nothing. The pergola's only honest excuse for existing is as a support for vines.

Restraint should be exercised, too, in the matter of summer-houses, outdoor tea rooms, etc. It is easy to get the style mixed up. Japanese tea houses, however attractive in themselves, are hardly at home in a colonial garden with an italian pergola and German chairs. A Greek temple is obviously anachronistic. Rustic affairs, minature log cabins, Adirondack camps and other fantastic exotics should be indulged in only when one is sure that they do not obtrude. The safest kind of summer-house or shelter is one built of lattice-



Garden Seats.

work in the same spirit as the furniture and the arbors, painted white, and covered with vines, the thicker the better.

Fountains, pools, etc., while considered as part of the garden furnishings, are really water-garden accessories and perhaps do not fall within the province of our discussion of the outdoor living-room. There are, however, a number of things that may perhaps be classed as garden bric-a-brac. Statues, urns, vases, etc., in various materials, may be properly placed in the garden as the ornaments on the mantlepiece. But they should be used sparingly and unobstrusively. In the matter of statuary the typical thing, of course, is the figure of Diana or the head of Pan. Of late, however, modern animal subjects have become popular—the charging bear, the playing cubs, the wounded binson, etc.—and the contemporary sculptor is given a chance.

Japanes stone lanterns, Buddhas, etc., are very quaint and charming, but there is always the danger of producing a decorative discord when

they are used anywhere save in a consistently Japanese garden.

As a central point of interest in the scheme, the sundial or the gazing-globe may be used with perfect propriety, for they are distinctly and traditionally garden ornaments. Or if a gentle usefulness is to be added to beautify, why not a birds' bath instead?

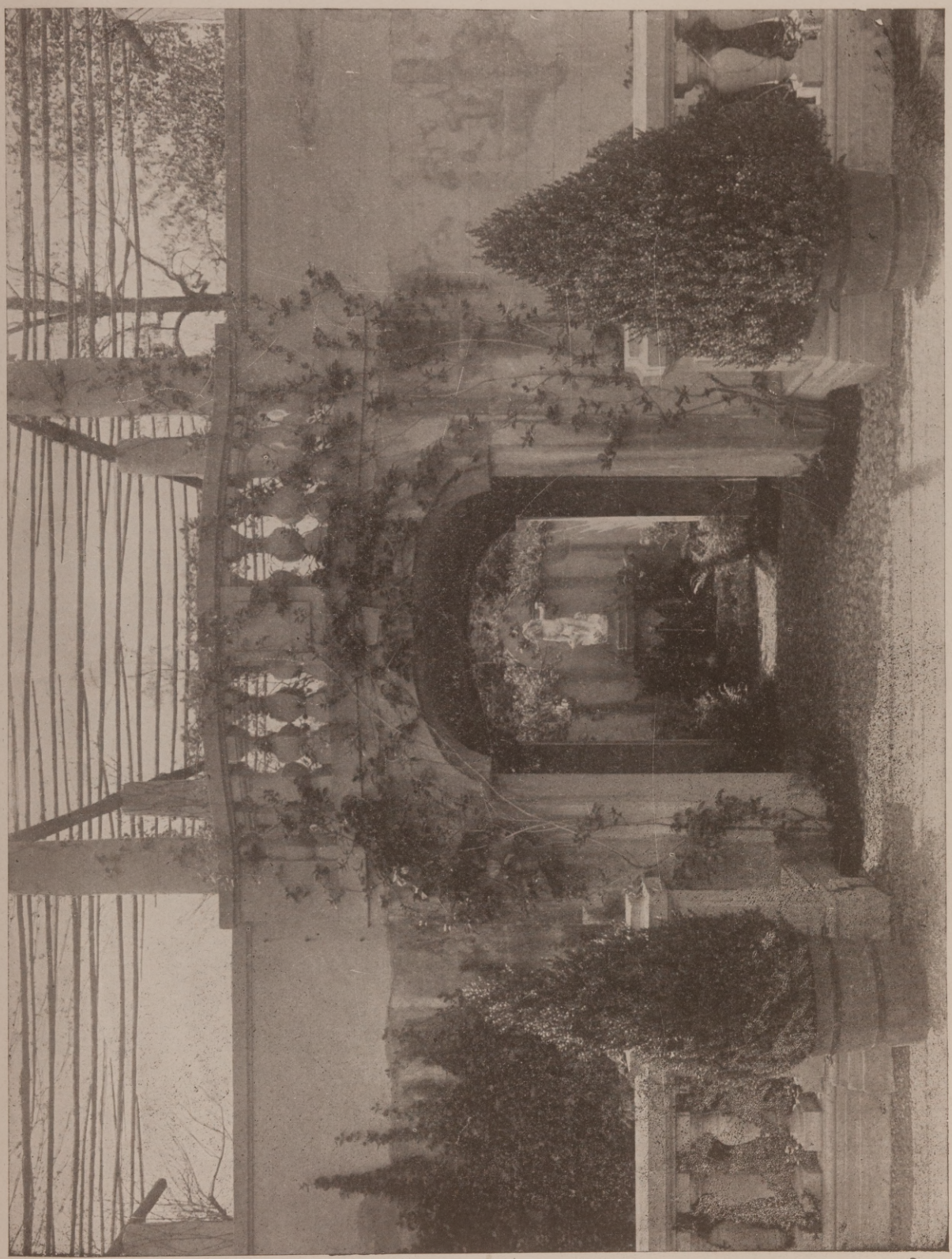
But it is hardly necessary to catalogue all the things that may be put into a garden to help make an outdoor living-room of it. The main point is to learn how to furnish this room effectively and in good taste. The day of the black iron stag and the red gypsy kettle has happily passed, but we have ever with us the human tendency to put the wrong thing in the wrong place and to overdo a good thing until it becomes bad. The safest way is to do a little at a time and to make sure that it is both useful and in good taste.

Gateway of a Picturesque Home with Concrete Entrance.

Some Attractive Garden Suggestions, the Modern Beautiful Home

Cement Entering Largely

A Garden Pergola, Adding Much to the Home Surround ings.



Another Pergola Effect with Garden and Grotto Beyond.

An Approach, in which Garden and Home Vie with Each Other.

An Interesting Bungalow of the Middle West. Tallmadge & Watson, Architects.

Where Concrete Enters Largely in Construction

Residence of Dr. J. Williamson, Tuscaloosa, Ala.

Concrete Residence of J. W. Goldsmith, Atlanta, Ga.

Concrete Construction for Power Plant

CONCRETE construction displays a great deal of its adaptability when used in power house construction. It can be used in practically every part of the plant. Not only the building itself, but floors, machinery foundations, boiler settings, wheel pits and finally, the stack or chimney of the plant may best be built of concrete.

In the matter of plant design there can naturally be no universal standards other than those which apply to good concrete engineering. Every particular industry requires some plant detail not appropriate or necessary to some other industry. Concrete can be used either in the form of a monolithic construction or in the form of block or brick which are laid up as any other masonry. no doubt the monolithic type of construction is most suited to power house requirements. This is certainly true where the influence of vibration is likely to be great. As boiler explosions are not uncommon the monolithic type of structure would also have a greater tendency to resist any possible injury in case of such an unfortunate happening. In fact, there are not wanting numerous records where violent explosions have failed to have any appreciable effect upon a well constructed monolithic concrete building.

There are some particular details of construction of the power plant that are somewhat foreign to other types of structures. There is heavy machinery to be provided for by firm, vibration-proof, unyielding foundations. Especially where electric machinery is in use there must be an exceptional freedom from dust. There must in some cases be wheel pits to accommodate the fly-wheels of large engines, and concrete properly used can meet with 100 per cent success every requirement of power-house construction.

In foundations for heavy engines, for instance especially where the ground is soft and of uneven bearing capacity, concrete is unexcelled, because a reinforcing mat can be put over a large area and the desired bearing power secured. The same applies to foundations or settings for boilers. It is usually inadvisable, however, to use concrete high up for a boiler setting, although in some few cases this has been done. Brick ordinarily is better adapted to the purpose. Extremes of temperature to which concrete will be exposed are likely to cause cracks in the setting which would permit the escape of gases. These cracks being difficult to fill thoroughly and permanently are objectionable. Also it is sometimes necessary to make repairs that call for the removal or partial tearing down of the setting and in such a case brick construction is more easily removed than is reinforced concrete.

Although concrete will withstand for an indefinite period a temperature of 500 degrees Fahrenheit, a temperature of 800 degrees Fahrenheit or more will eventually cause a disintegration of the concrete. It is therefore not a proper material to be used in a fire box or where temperatures are extremely high. In such a case the shell of the work may be reinforced concrete and a lining of brick used to keep direct high heat from the concrete itself.

These remarks in very many cases are true as regards the details of construction that apply to the lower portions of reinforced concrete chimneys where the heat of the gases entering the chimney are high. Some manufacturing industries do not run their plant at such high pressure that the chimney gases have so injurious a degree of heat as in the cases of other industries. Usually fire brick linings are applied to the lower portions of chimneys where otherwise the continued high heat would eventually cause the disintegration of the surface. The effect of heat upon concrete must be anticipated and combatted so far as possible in designing a chimney by specifying the kind of aggregates that shall be used in the construction; this specification being directed towards selecting materials such as trap rock, slag and other aggregate known to have high resistance to the effect of heat.

Chimneys, are built with various details of design all of which have proved stable and durable. Often for ease of construction the shaft is made of a uniform diameter from bottom to top although it is easy to introduce, if desired, a pleasing taper. Concrete chimneys can be built more quickly than those of masonry and can be put into service just as quickly as other types after constructed. Another advantage of concrete in such work is that lower first cost is realized with some other types of construction. Some concrete chimneys have failed but no material can be abused, and such failures have invariably been traced to an improper or careless use of concrete.

In power-house construction considerable attention must be given to the details of concrete floor construction—that is, the details of good concrete practice. Concrete flood failures not only in power-houses but elsewhere have been the cause of many just complaints but these complaints have their origin not in the faults of concrete but in the way that concrete was used.

The most frequent flood trouble encountered is dusting, that is, progressive wearing of the floor under ordinary traffic that releases the particles of which it is composed. This dust floating

in the air is not only injurious to machinery bearings but is objectionable in other ways.

The dusting of concrete floors is due to several causes, all of which are avoidable. Soft sand, or loam or other foreign material in the sand used when proportioning the concrete mixture is one cause for dusting. Using too little cement in the mixture so that the particles or aggregate are not firmly bound together is another cause. Too much time allowed to elapse between mixing and finishing; troweling the mixture while too wet; the use of dryers, that is, dry cement to take up excess moisture so that the surface can be quickly finished; and finally, permitting the sur face to dry out too rapidly after it has been completed, are contributing causes of the dusting of concrete floors.

Strength and wearing qualities in the concrete floor, particularly that resistance to wear of the surface which will prevent dusting, depend very largely upon the quality of the material used in making the concrete, the kind of workmanship displayed in placing and the upper protection of the concrete when the work is finished so that the evaporation of moisture will not rob the concrete of what is necessary to its proper hardening. Satisfactory results can be obtained only when all of these requirements are carefully observed; and if they are observed satisfactory results will follow.

The use of granite screening for aggregate in the wearing course to insure a harder and more homogenous surface has met with considerable success. High resistance to wear and practically complete dustlessness can be obtained if the granulithic surface is properly laid. When the final finish has been given to the surface the floor should be covered just as soon as possible to do so without marring the surface with a moisture-retaining material, such as damp earth or sawdust, and this covering be kept in place and kept moist for ten days or so, thus enabling the concrete to harden under the most favorable conditions, namely, in the constant presence of moisture. When put into use there may be some slight temporary dusting until the surface film of cement coating the aggregate particles in the concrete has worn off. When this has happened the hard, wear-resistant aggregates themselves are exposed and hence receive any wear that there is and dusting can be no greater than the tendency of these particles to wear. Dusting is therefore a matter of materials and workmanship and not of concrete itself.

In setting machinery certain essentials of foundation construction must be observed. Concrete is especially adapted to foundations because it possesses great compressive strength, is moderate in cost, easily mixed and placed, is adaptable to irregular forms and excavations and may be readily reinforced where necessary. Concrete foundations become monoliths and are therefore not susceptible to the disruption that may be expected in brick or stone masonry.

Foundations for smooth running, small engines causing little vibration and no impact should be of concrete mixed in the proportions of one sack of portland cement to two and one-half cubic feet of sand to five cubic feet of coarse aggregate. The grading and other qualities of these materials should be in conformity with details which the writer has already given in a preceding article in this publication.

Foundations for heavy engines not causing excessive vibration or impact should be of a 1:2:4 mixture. Foundations for all engines causing heavy vibration impact should be of a 1:1½:3 mixture.

Factors for Determinating the Area of Engine Foundation:

1. Area of the engine base.
2. Character of the supporting ground.
   (a) Loam—one (1) ton weight per square foot of bearing area—Safe load.
   (b) Wet clay—two (2) tons weight per square foot of bearing area—Safe load.
   (c) Dry clay—three (3) tons weight per square foot of bearing area—Safe load.
   (d) Clean sand—four (4) tons weight per square foot of bearing area—Safe load.
   (e) Gravel—five (5) tons weight per square foot of bearing area—Safe load.
   (g) Ledge rock—thirty-six (36) tons weight per square foot of bearing area—Safe load.

The depth of plain concrete foundations should be at least twice the offset distance. Heavy foundations requiring a bearing area larger than the engine base may have sloped or stepped sides. In any case, the offset should be as above stated. The depth of a reinforced concrete foundation should be determined by actual design according to the weight of the imposed loading and character of foundation for each problem.

Certain problems in power-house construction must be solved in connection with the building of wheel pits. The essential requirements of such construction are not unlike those involved in building underground concrete tanks or cisterns, with the difference, however, that instead of having to withstand pressure from within the construction must be able to withstand earth pressure from without and in some cases if built to a depth below normal ground water level, water pressure will have to be resisted.

In designing a wheel pit to meet the latter conditions it is necessary, of course, to know the head of water that will be encountered so that a sufficinet mass of concrete and the required reinforc-

ing may be specified to resist the pressures that are to be opposed. For ordinary wheel-pit construction a 1:2:4 mixture of a quaky consistency should be used. The materials must be very carefully proportioned and the mixture in every way prepared and placed so that voids or air spaces in the mass will be as nearly eliminated as possible. If a head of water is to be opposed then a 1:2:3 mixture is preferable. Greater resistance to the passage of water can be secured where pressure may be unusual by interspersing layers of watertight membrane in the concrete walls and the floor, that is, in the latter case building in reality two floors separated by a tar or asphalt membrane coat. In pits of this kind it is extremely desirable that concreting once started shall be continuous throughout, thus preventing construction seams in the work which might open up later, thus affording an easy channel for seepage—H. Colin Campbell, in the Operative Miller.

Concrete garden furniture is "coming strong." The concrete products plant operated by the Vocational Education Institute at Mooseheart, Ill., is swamped with orders, according to R. F. Havlik, engineer in charge, and this in spite of the fact that the institute has never done any advertising nor made any special effort to get this kind of business.

The workers under Mr. Havlik's charge turn out nothing but high grade ornamental products. He says: "I am glad that shoddy stuff will not sell." Every piece leaving Mooseheart is well made.

The Mooseheart plant furnishes Marshall Field & Co., of Chicago, with concrete garden furniture. Realizing the importance of this trade, Marshall Field & Co., held an exhibit of ornamental concrete work of this kind during the week of March 24.

When in use, concrete garden furniture occupies conspicuous places and hence largely advertised itself as good or bad, depending entirely on its quality. There is no secret about making good concrete and it is entirely within the ability of the manufacturer to determine the quality of his procuct. Only the high grade stuff will sell and sell more of the same kind. The demand exists. People who want useful and ornamental concrete garden furniture will pay a good price for it. Why not go into this business or at least devote more time to it?

Maintenance of Roads

D. TUCKER BROWN, C. E., Director North Carolina Good Roads Association.

LARGE expenditures are being made yearly for the construction of roads, and the demand for better roads in all sections of the country is continually increasing.

It would appear that with the absolute neglect of maintenance and consequent rapid deterioration of many miles of first-class roads, the public would become discouraged and demand of engineers a road of more lasting qualities than any type thus far has shown. This is not the case, however; the public continues to demand each year more and more mileage than in the previous year, and yet it is not awakened by such vast expenditures to the necessity of proper, efficient and effective maintenance.

It matters not what the type or class or road may be; whether earth, sand-clay, macadam, concrete or any other type, it is absolutely necessary that maintenance begins the day construction ceases, if the road is to prove satisfactory.

The cost and methods of maintaining the different types are as variable and different as those of construction, and the adoption of a suitable and economical method of maintenance has proven a puzzle to most communities. They are not willing to give any method, whether recommended by engineers or not, a long enough test to prove its efficacy.

Road maintenance requires technical skill and practical knowledge, and, consequently, the services of able men in a supervising capacity. The work connected with it and the results of this are not as evident to the layman, as they are in construction work, and, consequently, there are almost invariably objections arising to the payment of sufficient salaries for maintenance, planning and supervision.

It is encouraging to those interested in maintenance to know that the United States government has made it a prerequisite to the participation of any unit of government in the Federal Aid, that each unit has to give satisfactory evidence that the government aid road will be maintained properly. Following in the wake of the United States Government's action a great many States are requiring maintenance on state aid roads, and the action of the central government will eventually awaken the smaller units of government to a full realization of what maintenance means. It will take a number of years to have

any effect upon the care of the local roads built without either government or state aid, especially those unimproved sections of earth roads that are the greater percentage of our total road mileage.

The method of maintenance depends entirely upon the type of road and upon the class and amount of traffic passing over it. It also, of necessity, depends upon the income of the community, but it is poor policy for any community to build so many roads that its income is not sufficient for their maintenance.

It is essential to know what is necessary to be done to maintain a road in the condition that it was left when construction work ceased. In order to give a few suggestions in regard to this, I shall divide the different classes of roads as follows: Earth roads, sand-clay roads, water-bound macadam and gravel roads, concrete roads and bituminous macadam roads of different types.

Earth Roads.

This class of road comprises over 75 per cent of our total mileage and is pre-eminently important. It consists of those roads that have never been improved and of those that have been graded but not surfaced. In the case of roads in this class that have never been graded it is impossible to give them the attention necessary to keep them in good condition the year round. They are not important enough to demand the attention of a patrol, or even frequent visit from a maintenance squad. If they are, they are then in a class of roads that should be reconstructed.

The most that can be done for these roads must be by an annual or semi-annual visit from a repair force. The work of this force should consist in the employment of the first principles of road construction with the idea in view that the work and its results shall be of more or less a permanent nature.

With the roads of this class that have been graded the same principles should apply, except that they need not be observed so carefully as regards location and drainage; these should have been amply considered when the grading was done. It is only necessary to see that the drainage remains uninterrupted and that there is not material deterioration of the cuts and fills.

If any section of road is in such a condition that it will take a considerable expenditure to correct, and if this section of road is at a point where it could be utilized should the road be reconstructed, the repair force should reconstruct such section on ground where it could be utiliztd on a road of a permanent character.

The road should be properly drained; sacrifice everything to this important matter. In order to do this drains should be put under the road where necessary, all ditches should be cleaned out, a proper crown should be given, ledges of rock should be blasted out of the ditches and out of surface, no brush or foreign matter should be put in the depressions in the road, and water should not be allowed to stand or run for any distance in the side ditches. If these suggestions are observed and the road given a good working with the road machine and the drag at proper times it will give excellent service the greater part of the year.

Sand-Clay Roads.

The same principles of drainage that apply to the earth roads should apply to the sand-clay roads. The sand-clay roads are usually located by an engineers before they are built, and in this event they are constructed on a grade and with proper provisions for drainage. It remains for the maintenance force to see that the pipe lines and ditches are kept open. The surface of the sand-clay road requires continual attention, and it should be dragged after every rain or wet spell; it should not be allowed to deteriorate and blow away.

As this class of roads is more expensive than the earth roads are, so is their maintenance more expensive, but, on the other hand, the service they give is much more satisfactory than that of the earth roads. The communities through which they run are usually more enlightened and progressive than those on the earth roads, and therefore are more able and willing to bear the maintenance cost.

Water-Bound Macadam Roads.

There are still a great many miles of macadam road in this country and they are rapidly deteriorating. The cost of maintaining them as water-bound roads is prohibitive, and I suggest that the best thing that can be done for them is to treat them with oil or asphalt and observe the rules of drainage as suggested for earth roads. The surface should be watched carefully and not be allowed to ravel.

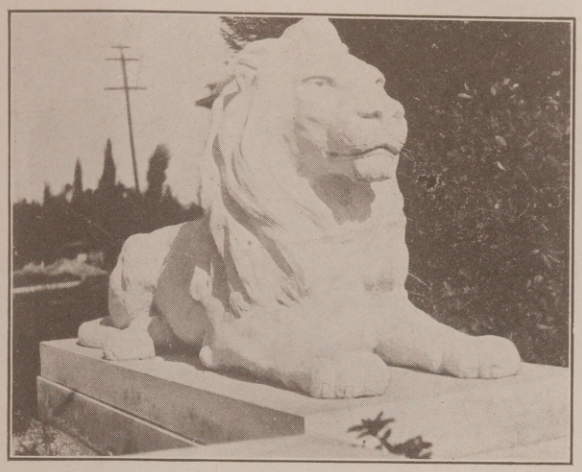
Concrete Roads.

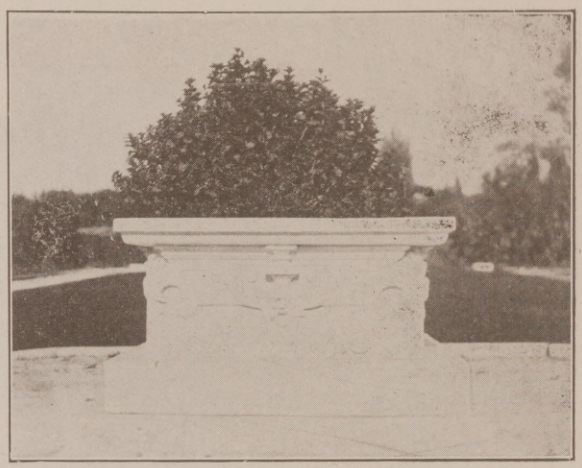
The maintenance of concrete roads consists of observing the same rules of drainage as for earth roads, and in filling with tar any cracks that may develop. Nothing can be done for the surface when it begins to deteriorate and break down. It will serve as a base for some of the higher types of bituminous surface, and I believe that after the concrete has served its usefulness it should be resurfaced with a bituminous wearing surface. The maintenance, therefore, of the surface of a concrete road consists either of t reconstruction or a resurfacing.

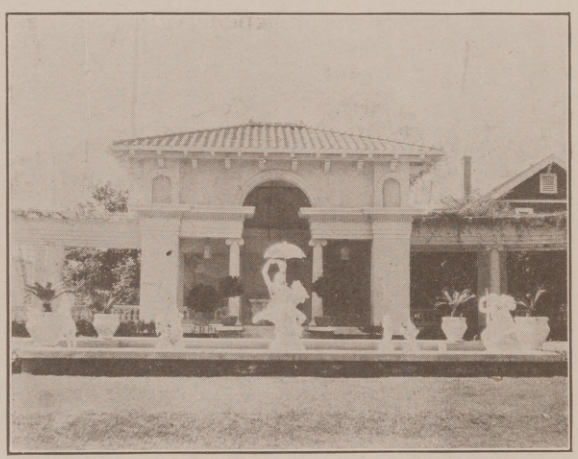
Bituminous Macadam Roads.

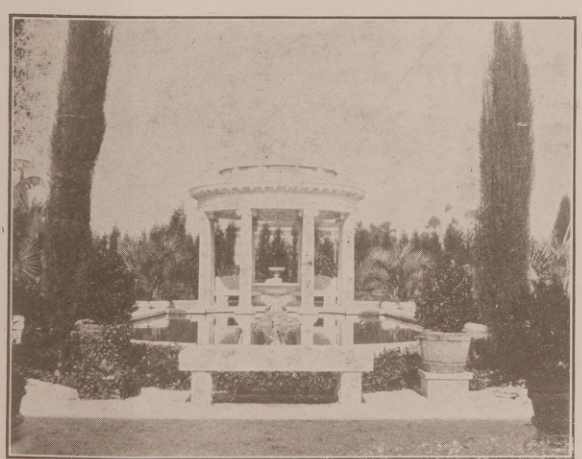
Observe all the rules of drainage. This is very important on this class of road, for any of the bituminous materials deteriorate when exposed to continual moisture.

Showing Decorative Value of Concrete

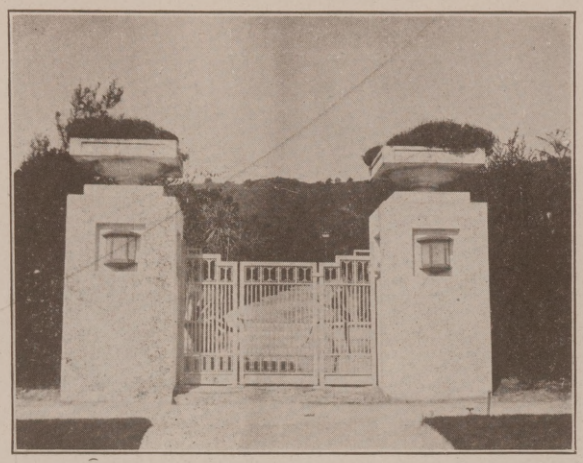








Possibilities of Concrete Entrances



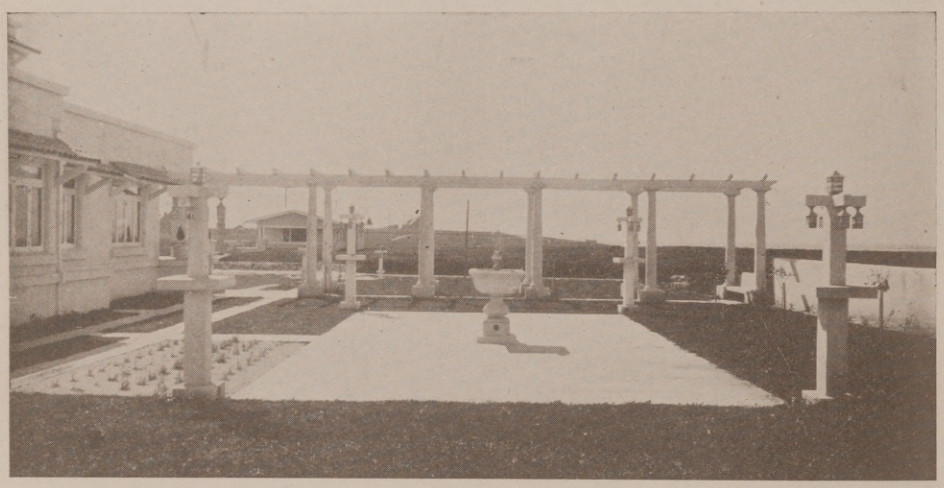
A Mission Bungalow in the Southwest

Detail of Entrance.

This attractive example of bungalow design is from the board of Architects Trost & Trost, El Paso, Texas, who have specialized to an extent in reinforced concrete and stucco work. It is the home of Hugo J. Donau and is located in Tucson, Arizona. The Spanish influence is predominant. The detail of the entrance shows that the structure is far from the ordinary. The straight lines and flat roof make it very impressive.

A Concrete Home With Courts and Pergolas

The Intended Growth of Vines Enveloping the Pergola Columns and Beams Will Provide the Necessary Color to the Garden.



The Entertainment Court.

A Nearer View Showing Approach to House.

Permanent Concrete Improvement on the Farm

A FEW years ago tourists riding through the rice belt, says The Rice Journal, looked out of their Pullman car windows onto a broad expanse of prairie land dotted here and there with desolate unpainted shacks. An occasional spiral of smoke curling from a stovepipe stuck through the roof indicated that these were really inhabited. But on the whole the picture was a dreary one which it was a relief to leave behind as the train sped on.

Had one acquainted with the resources of the rice country, and familiar with its fertile soil and salubrious climate, attempted to impress upon the tourist the possibilities of the section of country both from a home-making and a money-making standpoint he would have been laughed at, for the indications were certainly not preposessing.

But as the rice industry has developed, with a strong organization to look after the growers' interests, with the planting of new and better yielding varieties, and the resultant higher prices and bigger profits, people from all sections of the country, have been drawn into the rice belt and the rice section has gradually taken on the appearance of any other rich agricultural territory.

The modern rice farmer is improving his home surroundings so that his family and he himself can enjoy life, and it as gradually come to be accepted throughout the rice territory that the possibilities for making attractice homes are far greater in the country than in the towns, where many of the rice growers formerly lived, trusting their crops and their farm equipment and improvements to Providence and the tenants —or far worse, to hired labor.

The profits to be made from rice farming today are big enough that a man of means can afford to give it his personal attention, and even though he may live in town and has an automobile to take him to and from his farm, the most progressive rice farmers have found that permanent improvements pay. They enable them to keep a better class of tenants and add far more than their cost to the value of the place.

The use of concrete in making all manner of improvements is each year becoming more general and the following details of the construction of concrete walks on the farm, which the Journal reproduces from the Concrete Builder will be of interest to rice farmers and other farmers as well, planning such improvements:

Probably the farmer's wife appreciates the value of concrete walks more than does the farmer himself, but the comforts and convenience derived from a concrete walk leading from the house to barn or other outbuildings will be appreciated once this usual mudhole is paved. The housewife has plently to do without cleaning up mud and dirt tracked in by the children and menfolks. Such drudgery is made a thing of the past when concrete walks lead to and from the various buildings of the farm group.

On the farm of George Flynn, Owatonna, Minn., there are concrete walks leading from the dairy barn to the milk-house and from the house to the well and the area where the week's washing is hung up.

All of these are appreciated by both men and womenfolks on the farm. The concrete walk from the dairy barn to the milkhouse makes it easy for the workmen to pull a truck loaded with six 100-pound cans of milk. Besides no mud is tracked into the milkhouse and that helps to keep it in clean, sanitary condition.

Well platform and curb also are of concrete. Rats, mice, rabbits and other stray animals cannot fall into the well and thus contaminate the water. Furthermore, children and others are protected from possible accident that might result from loose, rotten plank covers. The comfort from this safeguard alone is well worth the price of concrete curb and platform. Once built, such improvement to all well requires no further attention. Caving, which so frequently occurs when wells are lined and covered with plank, is impossible where concrete is used.

There is hardly a farm that needs less than 500 feet of concrete walk to make access easy to the various buildings. Contractors should not overlook this opportunity to increase their stock of orders on hand. The best time to build concrete walks on the farm is while the contractor is there working on some other structure, and no building should be considered complete until the way between it and some other structure is made mudproof by a concrete walk.

The Best Surface on a Concrete Road

By A. H. Hunter.*

IN SPITE of the excellent riding qualities of pneumatic tires, together with all the experience and skill incorporated in the design of body, springs and wheel base of our automobiles, the automobile public is demanding improvement in the surface conditions of our concrete pavements. This is not because previously constructed pavements were so decidedly inferior, but rather that with the coming of long stretches of improved surface, the novelty of riding on concrete diminishes. The traveler traversing longer units than before becomes more weary and with the accompanying fatigue comes criticism of surface imperfections hitherto unnoticed.

Any road surface, however durable, can scarcely hope to be ultimately successful for use in our through highways unless this wearing surface presents a minimum of jar and vibration. In a properly mixed concrete, such as is used in concrete road work, we have a plastic material susceptible of being molded into a nearly perfect surface. How closely we are to approach this theoretical plane surface depends upon the care and effort put forth by the workmen in finishing. Upon workmanship depends largely the riding quality of surface secured.

The impression is not to be gained, however, that proper design is not essential. It would be utter folly to neglect drainage, crown, or both horizontal and verticle alignment, but fortunately, practice is becoming so standardized that most highway engineers recognize these important features in design. It is most infrequent to find a concrete pavement the poor riding qualities of which may be attributed to poor engineering.

If we are to avert a repetition of past errors, certain construction features must be carefully watched. These features to be considered from their significance as outlined in the specification as well as their application by the layman.

Forms Must Be Rigid.

Too often the layman looks upon the side forms as merely a necessary convenience for holding the concrete, thus losing sight of the fact that the proper grade and alignment of these forms are highly essential if a smooth surface is to result. Not infrequently I have visited construction work and found adjacent form boards out of both grade and line. It is probable that in so far as line is concerned, the earth shoulder will later absorb a fair amount of irregularities, but generally follows that a form setter who does not take enough pride in his work to properly align the boards is equally careless in setting the edge to the proper grade.

In early concrete pavements, wood forms were used exclusively. These when properly used and well taken care of, have given excellent results. When in the hands of careless workmen, they soon warp, split and when not properly cleaned, cause frequent damage to the edge of the green pavement. When placed to accurate grade and alignment they must be thoroughly staked. Too few stakes is fatal. If these forms are not rigid, waves, bumps and depressions inevitably occur in the completed surface.

Once I heard criticism of the large vibratory finishing machines from the standpoint that they impose a larger load upon side forms than was thought advisable. Personally I do not take it as a criticism of the machine but rather of the forms. Make them rigid and the template properly used will cut the surface to the desired shape.

Steel forms are coming into general use. It is probable that specifications in the near future will express a decided preference for them. Many contractors, in an effort to save, purchase too light a weight, with the result that they are soon bent, twisted and unfit for use. In spite of preference for steel forms, they are not to be recommended for short vertical curves or transverse curves of any character. They are too rigid to adapt themselves to the smooth outline necessary in a properly staked curve.

If we are to appreciably improve the surface of our concrete roads. it becomes necessary for the engineer to see that forms are accurately set to grade and alignment and maintained there. They are as essential as the formwork of a building. They are the guide lines of the pavement.

Templates Need Constant Watching.

After the concrete is placed within the forms, it should be struck off with a template having a length slightly greater than the width of the pavement. An excess length of possibly 18 inches will suffice for average highway work on pavement 15 to 18 feet in width. This template to be moved by a combined longitudinal and crosswise motion.

Do not make the common error of cutting the arc of the template to the same dimensions as indicated on the cross-section. It should be cut ¾ inch to ⅜ inch deeper than the theoretical crown; otherwise, the resulting surface will be flat. This correction should vary as the width of the pavement as well as general conditions surrounding the job. The amount of water gen-

*District Engineer, Division of Highways, Department of Public Works and Buildings, State of Illinois. Before the American Concrete Institute.

erally employed would be a factor for it is apparent that soft, mushy concrete would flatten out more readily than that containing a lesser amount of water. This template should be shod with a steel edge, using countersunk screws.

Templates may be made from either one or two boards. If two boards are used, they are held apart some distance by small struts. This style insures a more uniform bearing on the forms but is usually heavy, hard to handle and has a tendency to leave bumps or depressions, as the workmen are reluctant to move it back and restrike the surface.

The writer has seen good results obtained by using a heavy, double-edged steel template drawn by a cable, operated by a drum connected with the engine of the mixer. There is a general tendency to supplant man power wherever possible.

In moving the template along the forms, a slight excess of material must be in advance of the cutting edge at all times. Failure to do this will result in depression or holes. Do not permit the template to ride on stone or gravel on top of the sideforms. In working on grades even as low as 3 per cent, repeated striking must be done if a smooth surface it to result. The concrete being plastic and of more or less non-uniform water content, will flow down the grade. This flow is not uniform but is given to taking the form of alternate humps and depressions which can only be prevented by repeated and continued striking until initial set takes place. Keeping the amount of water in the mix as low as possible assists materially.

Satisfactiory results are obtainable only after pains are taken. The men operating the striker have to have an interest in their work or surface defects will occur. Watch the template! Check it up every few days, making sure that it has not warped or gone out of shape.

This matter of crown of pavement was forcefully impressed upon me several years ago, in connection with the construction of my first concrete road. The template was composed of two striking edges, several inches apart, covered with a plain board on top. At night, after work, it was washed off and placed on the forms behind the mixer. This afforded the night watchman (who, unfortunately for us, was of liberal proportions), or his visitors, a convenient seat. Continued use for this purpose resulted in a reduction in the crown of pavement by approximately ¾ inch. This is no large amount, but it is apparent on pavements designed with a minimum of curvature. Frequently too a template, properly designed and cut to the required arc, develops a sag due to its own weight when placed in position on the forms. In general, templates—home-made devices especially—are not to be trusted. Good surfaces may be obtained, but it is only by exercising care and judgment that satisfaction is secured.

Expansion Joints.

In the first concrete road construction expansion joints were used in varying designs. Many otherwise good pavements had their riding qualities much impaired by these poorly placed points. Unfortunately, highway engineers have not yet agreed among themselves as to what device is best suited to serve the purpose. Until standard practice develops some uniformity, we must expect to have continued experiments with occasional pieces of pavements unsatisfactory.

Generally speaking, any joint or holding device which does not permit the free use of the template it to be condemned. Not that excellent surfaces cannot be secured, but rather that it necessitates special care for the finisher. The elimination of expansion joints altogether or possible acceptance of blind joints, will do much to improve the riding qualities of our concrete surface.

Finishing Surfaces as Recently Developed.

Naturally enough, concrete pavements were first finished with the same tools as sidewalks or building floors. The public approval of a wood float surface led to the general use of a small wood float, 12 to 18 inches long, operated by hand. It was possible for the contractor, at small cost, to finish by hand in a most satisfactory manner. It was a tiresome job for the finisher, operating from a cross plank or bridge. Too frequently the work was intrusted to unskilled men who probably slighted much of the surface, at the same time probably working holes, depressions or flat places at the more accessible portions of the surface. Many excellent surfaces have been obtained in this manner, but substitution of unskilled labor by the contractor in an effort to effect a small saving, together with the drudgery involved, led to development of easier and better methods.

Following the hand float came the easier but unquestionably poorer experiment of placing a small wood float at the end of a long handle. This being operated from sides of the road, permitted the omission of a bridge. It was applicable to narrow pavements, being used with some success on roads up to 12 feet in width. In general, the surface secured was much inferior to the hand method. The central portions of the pavement were neglected with the result that too frequent evidence of laitance, dirt or surface defects occurred near the center.

Engineers had recognized the importance of keeping the quantity of water required in the mix to a minimum but under working conditions a small excess had been permitted for the reason

that concrete of proper consistency was difficult to work. Incidentally, the mixer with spout delivery required an excess of water. Several years back, experimenters in the state of Oregon and Michigan perfected mechanical devices for striking, compacting and finishing concrete, but these, while possessing merit, were heavy, costly and unsuited to operation on short, isolated sections.

It is only recently—not farther back than the construction season of 1916—that two simple operations, developed in different parts of this country, have been brought forward that when combined, resulted in radical changes in specifications and methods of finishing. I refer to the combined use of roller and belt in finishing concrete surfaces.

To an engineer of Macon, Ga., we are indebted for promoting the use of a small hand roller, some 8 inches in diameter and about 6 feet long. This was operated transversely across the pavement by a handle. The old adage that "necessity is the mother of invention" certainly holds true to the method developed for smoothing concrete surfaces. It is told that a contractor in Michigan, during the summer of 1916, was inconvenienced by a strike which occurred among his gang after considerable concrete had been placed, struck off but not finished. It seems that in desperation, he ripped strips of canvas from his tent, dragged them over the surface in a desperate attempt to place the concrete in a condition satisfactory to the engineer and prevent possible loss. The results were astonishing; so much so that hand finishing was afterwards dispensed with and a canvas belt substituted.

During the construction season of 1917, the engineering organization of the state of Illinois, Department of Public Works and Building, Division of Highways, used their influence with contractors and secured their co-operation in experiments sufficient to warrant the department in incorporating this belt-roller finish in the specifications for concrete highways, edition of March, 1918. These specifications representing the consensus of opinion of the entire engineering organization, are based upon experience gained throughout the state of Illinois, with different aggregate, different workmen and varying general conditions encountered in actual practice.

How to Use the Roller and Belt.

The entire operation of finishing specified to consist of three beltings and two rollings, beginning with a belting and alternating until the final belting, the belts to be of a canvas or rubber composition, about 2 feet longer than the width of the pavement. For the first two operations, a width of at least 10 inches is recommended. This belt also should be fairly heavy but pliable enough to conform to the crown of the pavement. No irregularities should be permitted in the edges, for these will cause ridges or depressions in the plastic surface. In both the first and second belting, the operation should consist of long, traverse strokes combined with a relatively slow, longitudinal movement. After the second rolling, the concrete is to be given a final finish, just previous to the initial set of the concrete. The time intervals between placing the concrete to final finish is variably, depending somewhat upon the amount of water in the mix but largely on weather conditions. In other words, a highly satisfactory surface can be secured by final belting when the film of surface water has just disappeared. In the last operation, a light canvas belt about 6 to 8 inches in width, used with short, transverse strokes but with a sweeping longitudinal motion, will produce a uniformly gritty surface.

A satisfactory roller may be made with diameter of 8 to 12 inches and a length of 4 to 6 feet, having a total weight of ¾ pound to 1 pound per linear inch of roller. For roads up to 15 feet in width, it may be operated by a long, light handle. Pavement of greater width requires the use of ropes in place of the handle, operated by a man on either side of the pavement. The first belting following immediately after the strike board, is in turn followed by the roller. The roller being advanced to the opposite side from the operator, is returned in the same track then moved forward for half its length and operated as before. The roller is thus advanced along the length of the road.

The surface should again be belted and, after a lapse of 15 to 20 minutes rolled. The time limit must be somewhat variable and left to the option of the resident engineer. Very wet mixing or cool weather encountered may make it desirable to recommend an additional rolling before final belting. In explanation of the foregoing idea incorporated in specifications, a word of caution in regard to belting is necessary. The first belting is done to smooth up the surface only, remove slight irregularities and facilitate the removal of the surface water in advance of the roller. In general, belting should be a minimum for continued working of the surface results in an excess of mortar. Present practice favors the wear coming upon the large aggregate with only enough mortar present to securely bond the stone and prevent voids.

Possibly the foregoing description of finishing may seem complicated but in reality the physical labor involved is relatively small—much less than required in the old wooden float method. The cost per unit of surface is materially reduced. Surface imperfections are a minimum. The roller eliminates many bumps, by pushing them into the depressions or placing them parallel to the line of traffic where they are unnoticed. Each unit of area receives the same amount of attention and in the end a uniformly gritty surface is obtained, far surpassing in texture, uniformity and riding qualities, the original hand methods.

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