A SYSTEM OF STREET PAVEMENT
for
NAPERVILLE, ILLINOIS

A T H E S I S

Presented By

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To The

PRESIDENT AND FACULTY

OF

THE ARMOUR INSTITUTE OF TECHNOLOGY

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Having completed the prescribed course of study in

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INTRODUCTION

This thesis is an estimate of the cost of a system of street pavements including draining, grading, laying of curb and gutter, and paving in Naperville, Illinois.

Comparative costs are obtained by using two different combinations of pavements; macadam or asphalt in the residence part and brick in the business part of the city.

Asphalt excels macadam in cleanliness, appearance and ease of traction but is more expensive. Macadam, however, is a good pavement for light traffic and because of its cheapness is considered. Brick, because of its better wearing qualities under heavy traffic
is used rather than asphalt or macadam in the business portion. Moreover, it is easily cleaned, has very little tractive resistance, and furnishes a good foothold for horses.

The success of a brick pavement depends on an equality of hardness and strength of the filler and brick which will reduce the chipping of the bricks' edges to a minimum. For this reason Portland cement filler is specified.

On Chicago Avenue and on Jefferson Avenue where the grades exceed six per cent brick is specified in place of asphalt or macadam; asphalt would not give a sufficient foothold for horses and macadam would be too easily washed out.
The contour of the finished surface is to be parabolic. This form of surface gives good drainage inasmuch as it falls more rapidly approaching the gutters.

The street intersections are to be practically flat having just enough slope, from the center to furnish drainage. This form of intersection gives the best appearing system of streets. In a few cases it is impossible to use flat intersections because of steep grades on either side. The grade is decreased, however, as much as possible at these places.

The drainage system specified is of sufficient capacity to easily take care of any rainfall likely to occur in this region. All
inlets are to be placed in the curb a short distance beyond the cross walks in order to prevent the water from flowing over these walks and thus to keep the walks and intersections as dry as possible. All inlets are connected in series with a manhole at each intersection.

To compute the excavation for grading, elevations of the property, curb and center lines of the existing streets were taken at fifty foot intervals and plotted. The parabolic surface of the subgrade as established by these specifications was also plotted. The areas contained between the subgrade and surface and the two curb lines were then measured by a planimeter and the volume of excavation
calculated by the average end area method.

In addition to the computation of quantities and cost a complete set of specifications for each form of pavement was drawn up and appears on the following pages.
SPECIFICATIONS

FOR

DRAINING, GRADING, CURBING

AND

PAVING WITH BRICK.

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INSTRUCTIONS TO BIDDERS.

Sealed proposals for draining, grading, curbing and paving the roadways of the following streets and avenues, to wit:

Columbia Avenue from Chicago Avenue to North Street, Wright Street from Highland Avenue to North Street, Sleight Street from Highland Avenue to North Street, Loomis Street from Chicago Avenue to North Street, Brainard Street from Highland Avenue to North Street, Front Street from Chicago Avenue to the south line of the right-of-way of the Chicago, Burlington & Quincy Railway, Center Street from Benton Avenue to the south line of the right-of-way of the Chicago, Burlington & Quincy Railway, North Street from the east line of Wash-
ington Street to the east line of Columbia Avenue extended from the south, Mechanic Street from the east line of Washington Street to the east line of Columbia Avenue, Franklin Avenue from the east line of Washington Street to Brainard Street and from Loomis Street to the east line of Columbia Avenue, Benton Avenue from the east line of Washington Street to the east line of Columbia Avenue, Liberty Street from the east line of the City Park to the east line of Columbia Avenue, Jefferson Avenue from the west line of Front Street to Loomis Street and Chicago Avenue from the west curb line of Sleight Street to the west line of the alley in Block 3 of Fort Hill Second Addition to Naperville extended north, together with those por-
tions of the roadways on Lewis, Prairie and Ellsworth Streets, which lie south of the north line of North Street, also that portion of the roadways of all public alleys intersecting or joining any of the foregoing roadways, which lie between the nearest curb line and the street line of any of the foregoing included Streets or Avenues, in the City of Naperville, County of DuPage and State of Illinois, will be received at the office of the Board of Local Improvements until 12 o'clock M, May 27th, 1909, at which place and hour the bids will be publicly opened by the Board and read, and the award of the contract will be made to the lowest responsible bidder with adequate security as soon thereafter as practicable.
The person or persons to whom the contract may be awarded will be required to attend at the office of the Board of Local Improvements with the sureties offered by him or them, and execute the contract within five days from the date of the service of a notice to the effect that the contract has been so awarded, and that the adequacy and sufficiency of the security offered has been approved by the Board; in case of failure or neglect so to do, he or they will be considered as having abandoned it, and as in default to the city; and thereupon the work be re-advertised and relet, and so on until the contract be accepted and executed.

All proposals must be accompanied by a certified check payable to the President of
The Board of Local Improvements for an amount not less than ten (10) per cent of the aggregate of the enclosed proposal.

All bids must be made on blank forms furnished by the engineer.

The price must be written in the bid, and also stated in figures, and all proposals will be considered as informal which do not contain bids for all items for which prices are herein called for, or which contain erasures, alterations, or other irregularities, or which contain unbalanced prices for the several items.

Permission will not be given for the withdrawal of any bid or estimate, and the right is expressly reserved by the Board of Local Improvements to reject any or all bids.
Bidders are required to state in their estimates, under oath, their names and places of residence, the names of all persons interested with them therein, and if no other person be so interested they shall distinctly state the fact; also that it is made without any connection with any other person or persons making a bid or estimate for the same work, and that it is in all respects fair and without collusion or fraud; and also that no member of the Common Council or other officer of the City is directly or indirectly interested therein, or in the supplies or work to which it relates, or in any portion of the profits thereof.

Where more than one person is interested, it is requisite that the verification be made and
subscribed by all the parties interested.

Bidders must satisfy themselves by personal examination of the site of the proposed work as to the difficulties to be encountered and such other matters which can in any way influence their estimate, and no information derived from the drawings or specifications or from the engineer or any of his assistants will relieve the contractor from any risks or from the terms of the specifications and contract.

The items and quantities stated in the estimate below are merely approximate and may be altered in part or wholly changed during the progress of the work. They are intended only to indicate the general character
of the work and shall not be made a basis of any claim for extra compensation of profits in case the quantities of the final estimate shall vary from them, nor be regarded as having any relation or bearing whatever upon the quantities of the final estimate.

The engineer's estimate of the nature and extent of the work to be done and the materials to be furnished is as follows:
DRAINS AND CURBING

1680 feet of 18 inch storm water sewer pipe laid complete at
$ .80 per foot $ 1,344.00

620 feet of 15 inch storm water sewer pipe laid complete at
$ .70 per foot $ 434.00

2995 feet of 12 inch storm water sewer pipe laid complete at
$ .50 per foot $ 1,497.50

5140 feet of 10 inch storm water sewer pipe laid complete at
$ .45 per foot $ 2,313.00
<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Rate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>3590 feet of 8 inch storm water</td>
<td></td>
<td>$.35 per ft</td>
<td>$1,356.50</td>
</tr>
<tr>
<td>sewer pipe laid complete at</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2680 feet of 6 inch storm water</td>
<td></td>
<td>$.30 per ft</td>
<td>$804.00</td>
</tr>
<tr>
<td>sewer pipe laid complete at</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>173 inlets in place at</td>
<td></td>
<td>$5.00 each</td>
<td>$865.00</td>
</tr>
<tr>
<td>39 new manholes complete at</td>
<td></td>
<td>$21.00 each</td>
<td>$819.00</td>
</tr>
<tr>
<td>88 old manholes adjusted at</td>
<td></td>
<td>$2.00 each</td>
<td>$176.00</td>
</tr>
<tr>
<td>68,800 feet of combined curb and gutter at</td>
<td></td>
<td>$.50 per ft</td>
<td>$34,400.00</td>
</tr>
</tbody>
</table>

**Total** $44,009.00
PAVEMENTS

BRICK

3,160 cu. yds. of excavation at $0.35 per cu. yd. $ 1,106.00

25,340 sq. yds. of pavement at $2.10 per sq. yd. $ 53,214.00

Total $ 54,320.00

MACADAM

22,500 cu. yds. of excavation at $0.35 per cu. yd. $ 7,875.00

80,000 sq. yds. of pavement at $0.80 per sq. yd. $ 64,000.00

Total $ 71,875.00
ASPHALT

22,500 cu. yds. of excavation at $.35 per cu. yd. $ 7,875.00

80,000 sq. yds. of pavement at $2.00 per sq. yd. $160,000.00

Total $167,875.00
STORM SEWER

Storm sewers shall be constructed along the lines and grades as given by the engineer and shown on the plans and profiles.

QUALITY OF PIPE

The pipe shall be of the best quality of salt glazed sewer pipe of the bell and spigot type. They shall be straight and of uniform diameter throughout their length.

PIPE LAYING

The pipe shall be laid with the
flow line at the elevation and grade as given by the engineer. The joints shall be filled with mortar made of equal parts of an accepted brand of domestic cement and clean sharp sand free from vegetable matter. After making the joint all cement projecting into the sewer shall be removed so as to present an unobstructed flow.

**BACK FILLING**

The pipe shall be covered to a depth of two feet with earth free from stones exceeding three inches in diameter.
MANHOLES

Two ring brick manholes of circular section four feet in diameter at the base and drawn in to two feet in diameter at the top shall be constructed along the line of the sewer as shown on the plans and profiles. The manholes are to be capped with a cast iron manhole curb and cover of the design now in use in the city set to the exact grade of the finished street. The brick shall be of the best quality well burned, perfect shaped, building brick. They shall be laid in Portland cement mortar composed of one part cement to two parts clean sharp sand. The cement shall comply with the requirements for Portland cement given else-
This page contains text that is not legible or recognizable as natural text. It appears to be a mix of letters and symbols that do not form coherent sentences or paragraphs. Without clearer text, it is not possible to transcribe or interpret the content accurately.
where in these specifications.

**CURBING**

Combined concrete curb and gutters shall be constructed along the lines and grades as shown on the plans and profiles. The top of the curb shall coincide with the grade of the street as established by ordinance No. 139.

The curb shall be six (6) inches thick with its roadway face coinciding with the established curb line, the curb being outside of the roadway. The trench as staked out by the engineer shall be excavated to a width of not less than twenty-five (25) inches and to a depth of eighteen (18) inches below the
grade of the street. The subsoil shall then be thoroughly tamped. Any spongy or decaying material in the subsoil shall be removed and the space filled with clean sand or gravel. Upon this finished subsoil shall be spread a layer of gravel free from earthy material and free from stones larger than two (2) inches. This layer shall be of the width of the trench and shall be six (6) inches thick, when consolidated.

Upon this prepared bed shall be constructed the combined curb and gutter as shown in the plans. The curb and gutter shall consist of concrete made in the following proportions: One (1) part of Portland cement as specified on page 25, two and a half (2 1/2)
parts of clean, sharp sand and five (5) parts of crushed stone. The stone shall be of good quality of limestone ranging in size from one-half (1/2) inch to one and one-half (1 1/2) inches. The exposed surfaces of both curb and gutter shall be coated with a half (1/2) inch of mortar composed of one (1) part of Portland cement and two (2) parts of sand the same as used above. Expansion joints shall be made at ten (10) foot intervals.

CEMENT

All cement shall be subjected to the following requirements:
Let \( f(x) \) be a function that is differentiable in the interval \( (a, b) \) and let \( (c, d) \) be a subinterval of \( (a, b) \) such that \( f'(x) \) is continuous on \( [c, d] \). Then \( f(x) \) is differentiable on \((c, d)\) and \( f'(x) \) is continuous on \((c, d)\).
COLOR: Portland cement shall be of a uniform dull gray color.

SPECIFIC GRAVITY: Portland cement shall have a specific gravity between 3.10 and 3.25.

ACTIVITY: The portland cement shall develop initial set in not less than thirty minutes, and hard set in not less than one hour and not more than ten hours. Initial set is that condition when the cement begins to harden. Hard set is when the hardening has reached a point where the mass cannot be appreciably distorted without rupture.

SOUNDNESS: Pats of neat cement
made on glass and brought to a thin edge shall show no checks after setting in boiling water.

**FINENESS:** Portland cement shall be of such fineness that at least ninety-two (92) per cent by weight will pass a No.100 sieve, and at least seventy-five (75) per cent by weight will pass a No. 200 sieve.

**STRENGTH:** Neat Portland cement briquettes shall show a tensile strength as follows:

<table>
<thead>
<tr>
<th>Age</th>
<th>Strength</th>
</tr>
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<tbody>
<tr>
<td>24 hours (in moist air)</td>
<td>150 lbs.</td>
</tr>
<tr>
<td>7 days (1 day in moist air and 6 days in water)</td>
<td>500 lbs.</td>
</tr>
</tbody>
</table>
INLETS

Cast iron inlets of an approved design shall be set in the curb and gutter at points shown on the plans. The inlets shall be connected to the sewer by six (6) inch pipe held in place by concrete.

ADJUSTING MANHOLE COVERS

The manhole covers on the manholes in the sanitary sewer shall be adjusted to the exact grade of the finished pavement.
PREPARATION OF SUBGRADE

The subsoil or other matters (be it earth, rock, or other material) shall be excavated and removed to a depth of eleven (11) inches below the top line of the proposed pavement. The excavation down to a depth within three (3) inches of the subgrade may be done with a plow or scraper, but the last three inches must be removed with pick and shovel. Should there be any spongy material, vegetable or other objectionable matter, in the bed thus prepared, all such material must be entirely removed, and the space filled with clean gravel or sand carefully rammed.

The roadbed shall be truly shaped
and trimmed to the required cross-section and grade, and rolled to ultimate resistance with a roller weighing not less than ten tons; such portions of the roadbed as cannot be reached by the roller shall be consolidated with hand rollers or rammers.

When in the opinion of the engineer the subgrade should be sprinkled before rolling, the contractor shall do same without extra cost.

The subgrade shall be of parabolic cross-section with a rise at the center equal to \( \frac{1}{50} \) of the width of the roadway.
CONCRETE FOUNDATION

A Portland cement concrete five (5) inches in thickness shall be placed upon the finished subgrade. The concrete shall be made of one (1) part Portland cement to three (3) parts of clean sharp sand to six (6) parts of crushed stone. The cement shall fulfill the requirements for cement stated elsewhere in these specifications. The sand shall be clean, sharp, coarse, pit or river sand free from loam or dirt, and all sticks removed. The broken stone shall be of hard and uniform grain. Disintegrated and weatherworn stone from the surface of a quarry will not be accepted. The stone shall not measure more than
(1) The position of a point in space is fixed by a reference system. The coordinates of a point are denoted by the distances from it to three mutually perpendicular axes. These distances are denoted by the letters x, y, and z, respectively.

(2) The position of a point in space is fixed by a reference system. The coordinates of a point are denoted by the distances from it to three mutually perpendicular axes. These distances are denoted by the letters x, y, and z, respectively.

(3) The position of a point in space is fixed by a reference system. The coordinates of a point are denoted by the distances from it to three mutually perpendicular axes. These distances are denoted by the letters x, y, and z, respectively.
two and one-half (2 1/2) inches in any direction.

The concrete shall be mixed by a machine mixer of approved design, to such a consistency that it can be put in place with only a small amount of tamping. The top surface of the concrete shall be struck with a templet so that it shall be smooth and of the exact contour and elevation.

QUALITY OF THE BRICKS

The bricks shall be manufactured from suitable clay containing not more than one (1) per cent of lime.

They must be burned especially for
paving purposes. They shall have a resistance to crushing of not less than 8000 pounds, per square inch on the flat, and must not absorb more than $\frac{1}{500}$ of their weight of water after 48 hours immersion. They must possess such a degree of toughness that when struck a quick blow with a 4-lb hand hammer on the edges they shall not spall or chip.

SIZE AND SHAPE OF BRICKS

They shall be of a uniform size of $3 \times 4 \times 9$ inches, shall be square on the edges, straight, and free from fire cracks or checks; when broken, the fracture shall be smooth and straight, not conchoidal; and the fracture shall
be uniform throughout and not granular.

SAMPLES OF BRICKS

Not less than three bricks of the size, quality, and shape proposed to be used shall be furnished with each proposal, each brick to be labeled with both the bidder's and maker's name and address; these samples shall be deposited in the office of the engineer three days before the time of the opening of bids. They will be subjected to the required tests, and the characteristics of those deposited by the successful bidder will become the standard by which all the bricks furnished by him will be tested, and no deviation from this
standard greater than three (3) per cent in any particular will be permitted in the bricks placed in the work.

**INSPECTION AND CULLING**

The bricks will be inspected after they are brought upon the work, and all bricks which are soft, cracked, checked, overburned, or otherwise defective in quality or dimensions will be rejected and must be immediately removed from the line of work. The contractor must furnish such laborers as may be necessary to aid the inspector in the examination and the culling of the bricks; and in case the contractor neglect or refuse to furnish said la-

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borers, such laborers as in the opinion of the engineer may be necessary will be employed by said engineer, and the expense thus incurred will be deducted and paid out of any money then due or which may thereafter become due to said contractor under the contract to which these specifications refer.

**CUSHION-COAT**

On the concrete foundation a layer of clean, dry, sharp sand, free from loam and pebbles exceeding 1/4 inch in size, will be evenly spread to a depth of 2 inches. A temp-let shall be used for striking the sand cushion to the exact shape of the crown of the
street. This templet shall be made in accordance with the plans and directions of the engineer; it shall be kept whole, true to shape, and in good condition; it shall rest on the curbs or other supports as directed by the engineer, and be drawn forward immediately before the bricks are laid. Particular care should be taken that the sand be perfectly dry when it is being spread.

LAYING THE BRICKS

The bricks shall be set on edge on the cushion-coat in close contact with each other, both on sides and ends; they will be laid in parallel course across the street, with
the length of the bricks at right angles to the axis of the street. All courses shall be started at the curb. The bricks of adjoining courses shall break joints by at least 3 inches. At street intersections the bricks will be laid on the double diagonal as shown on the plans. Whole bricks only shall be used, except in starting a course or making a closure and in paving around street monuments.

The bricks shall be laid by skilled workmen, who shall stand on the bricks already laid, and in no case shall the sand bed in front of the pavement be disturbed or walked on after having been smoothed over and brought to the required crown.

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RAMMING OR ROLLING

The brick next to the curb and street monuments shall be tamped to the proper grade with hand rammers weighing not less than 50 pounds.

The brick will then be rolled with a five ton steam roller in the following manner: The rolling will commence near the curb at a very slow pace and continue back and forth until the center of the pavement is reached, then pass to the opposite curb and repeat in the same manner to the center of the street. After this first passage of the roller the pace may be quickened and the rolling continued until each brick is firmly imbedded in the
sand cushion.

**INSPECTION**

After rolling, the bricks will be inspected and all broken ones shall be removed, the chipped brick shall be turned, and those too low shall be brought up to grade.

**ROLLING**

The pavement shall be swept clean of all spalls and rolled with a five ton roller. The roller shall be started at the end of the block and the pavement rolled transversely at an angle of 45 degrees to the curb and then re-


ELECTRIC

"The electric transparency of the universe is profound, and we can only glimpse its mysteries through the lenses of our knowledge."

TUNE

"Tunes are the keys to unlocking the rhythms of life."

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peated in like manner in the opposite direction.

**EXPANSION CUSHION**

An expansion cushion shall be constructed next to the curb on one side of the street only. The width of this cushion shall be one inch. It shall be made by placing a one inch board next to the curb before the brick are laid. The board shall be removed and the space filled with No. 6 coal-tar distilled at a temperature of 250 degrees Fahr. within ten (10) to thirty-six (36) hours after the application of the cement filler.
After the bricks have been satisfactorily rolled, the joints shall be filled with a filler composed of one part each of clean sand and Portland cement. The sand should be dry. The mixture, not exceeding one-third bushel of the sand, together with a like amount of cement, shall be placed in the box and mixed dry, until the mass assumes an even and unbroken shade. Then water shall be added, forming a liquid mixture of the consistency of thin cream.

From the time the water is applied until the last drop is removed and floated into the joints of the brick pavement, the same
must be kept in constant motion.

The mixture shall be removed from the box to the street surface with a scoop shovel, all the while being stirred in the box as the same is being thus emptied. The box for this purpose shall be 3 1/2 to 4 feet long, 27 to 30 inches wide and 14 inches deep, resting on legs of different lengths, so that the mixture will readily flow to the lower corner of the box, which should be from 8 to 10 inches above the pavement. This mixture, from the moment it touches the brick, shall be thoroughly swept into the joints.

Three such boxes shall be provided for each gang.

The work of filling should thus be
carried forward in line until an advance of fifteen to twenty yards has been made, when the same force and appliances shall be turned back and cover the same space in like manner, except to make the proportions two-thirds Portland cement and one-third sand.

To avoid the possibility of the thickening at any point, there should be a man with a sprinkling can, the head perforated with small holes, sprinkling gently the surface ahead of the sweepers.

Within one-half to three-quarters of an hour after this last coat is applied and the grout between the joints has fully subsided and the initial set is taking place, the whole surface must be slightly sprinkled and all surplus
mixture left on the tops of the bricks swept into the joints, bringing them up flush and full.

After the joints are thus filled flush with the top of the bricks and sufficient time for evaporation has taken place, so that the coating of sand will not absorb any moisture from the cement mixture, one-half inch of sand shall be spread over the whole surface, and in case the work is subjected to a hot summer sun, an occasional sprinkling, sufficient to dampen the sand, should be followed for two or three days.
INTERPRETATION OF SPECIFICATIONS

In case of ambiguity of expression in the specifications, or doubt as to the correct interpretation of the same, the matter shall be submitted to the engineer, whose decision shall be final.

OMISSIONS IN SPECIFICATIONS

Any work or materials that may have been accidently omitted in the description of the work, but which is clearly implied, shall be furnished by the contractor the same as if it had been specifically stated.
Wherever the word "engineer" is used it refers to the chief engineer or his authorized assistants, by whom all explanations and directions necessary for the satisfactory prosecution and completion of the work described in these specifications will be given.

Wherever the word "contractor is used it refers to and means the party or parties who shall have duly entered into the contract with the city of Naperville, Illinois, to perform the work; their duly authorized agents
or legal representatives.

**NOTICE TO CONTRACTOR**

Any written notice to the contractor which may be requisite under these specifications, may be served on said contractor either personally or by mail, or by leaving the same at his last known place of residence.

**PRESERVATION OF ENGINEER'S MARKS**

All engineer's marks and stakes after location shall be carefully preserved without disturbance until permission for their removal or erasure shall be given, and every fa-
OPERATIONS SECTION

[Text continues]

NEW BUSINESS OF THE WEEK

[Text continues]

[Additional text continues]
ility must be furnished for the staking out, etc., of all work to be done under these specifications.

DISMISSAL OF INCOMPETENT PERSONS

Any incompetent person or persons who may be employed on the work shall be removed on the requisition of the engineer; and no person so removed shall thereafter be employed upon any portion of the work.

QUALITY OF MATERIALS

All materials furnished and used under these specifications must be of the best
quality of their respective kinds, free from any and all defects which in the judgment of the engineer may render them unfit for use. Rejected material must be at once removed from the work or conspicuously marked "condemned". If condemned material is used in any part of the work, the same shall be removed and replaced with materials of the quality required by these specifications.

**SAMPLES**

Before any materials are used, samples thereof shall be furnished the engineer by the contractor, said samples, if approved, shall remain in the engineer's office and be
used as the standard with which all like materials furnished under these specifications must agree.

**INSPECTORS**

The work under these specifications is to be prosecuted at and from as many different points on the line of the work as the engineer may from time to time determine, and at each of said points inspectors may be placed by the engineer to supervise the work.
DEFECTIVE WORK

The contractor will be held responsible for the faithful execution of the work in accordance with the specifications. Any defective work that may be discovered by the engineer or his appointees before the final acceptance, or before final payment shall have been made, shall be removed and replaced by work and materials which shall conform to the spirit of the specifications. The fact that the inspector or other person in charge may have overlooked such defective work shall not constitute an acceptance of the same.
MEASUREMENTS

The different classes of work will be measured as follows:

EXCAVATION: of all earth by the cubic yard; the measurement shall be made in excavation. If any case should arise where this may be found impossible, then the engineer shall determine the quantities, making all proper allowance, of which he will be the judge.

CULVERT AND DRAIN: pipe by the lineal foot in place.
CURBING: by the lineal foot in place.

MANHOLES: by number as completed, including all appurtenances and connections.

INLETS: by the number set complete to the proper grade.

STORM SEWER: by the lineal foot in place.

PAVEMENTS: All pavements will be measured by the square yard in place; the space occupied by manhole heads and catch basins, when not exceeding one square yard each, will be included.
The several measurements will be made and computed by the engineer, and his final return of the several amounts shall be the only valid account of the work done and materials furnished. All previous estimates upon which partial payments may have been made are merely approximate, and subject to correction of the final return.

**PARTIAL PAYMENTS**

Monthly estimates shall be made during the progress of the work, and payments to the amount of eighty-five (85) per cent thereof will be made, the retained percentage not being due or payable until the final completion.
of the work. These monthly estimates do not constitute an acceptance of the work, the final estimate and formal acceptance constituting the only valid acceptance of the whole or any part of the work.

**COMMENCEMENT OF THE WORK**

The work to be done under these specifications shall be commenced before the first of July, 1909. Failure to so commence without a good and valid reason therefor will be authority for the engineer to declare the contract forfeited, and the said engineer may proceed with the execution of the work in such manner as may be deemed proper.
TIME OF COMPLETION

The work shall be prosecuted in such a manner as to complete it in accordance with the specifications on or before December 1, 1909. Should the execution of the work be delayed in consequence of any act or omission on the part of the Board of Local Improvements, the condition of the weather, or by any circumstances so unusual that they could not be foreseen previous to or avoided during the construction of the work (all of which shall be determined by the engineer, who shall certify the same in writing), the time during which the work was so suspended shall be excluded, and the time extended by a corresponding num-

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ber of days.

**PROGRESS OF WORK**

and

**FORFEITURE OF CONTRACT**

The Board of Local Improvements reserve the right to declare the contract forfeited, if at any time it should appear to the engineer that the work or any part thereof is being unnecessarily delayed, or that the contractor is wilfully violating any of the conditions of the contract, or is executing the same in bad faith, or if the said work be not fully completed within the time named for its completion; he shall have power to notify the
contractor to discontinue all work or any part thereof, by a written notice to be served upon the contractor either personally or by leaving said notice at his residence or with his agent in charge of the work. And thereupon the contractor shall discontinue said work or such part thereof, and the engineer shall thereupon have the power to place such and so many persons as he may deem advisable, by contract or otherwise, to complete the work, or such part thereof, and to use such materials as he may find upon the line of said work, and to procure other materials for the completion of the same, and to charge the expense of said labor and materials to the aforesaid contractor; and the expense so charged shall be deducted and
paid by the Board of Local Improvements, out of such moneys as may be then due, or may at any time thereafter become due, said contractor on account of work performed under these specifications; and in case such expense is less than the sum which would have been payable if the same had been completed by the said contractor, he shall forfeit all claim to the difference; and in case such expense shall exceed said sum, he shall pay the amount of such excess to the Board of Local Improvements.
DAMAGES FOR NON-COMPLETION

The contractor shall pay to the Board of Local Improvements, as damages for non-completion of the work within the time herein stipulated for its completion, the sum of twenty-five ($25.) dollars for each and every day which may exceed the said stipulated time for its completion, which said sum of twenty-five ($25.) dollars per day is hereby, in view of the difficulty of estimating such damages, agreed upon, fixed, and determined by the contractor and the Board of Local Improvements as the liquidated damages that the city will suffer by reason of such default, and not by way of penalty; and the Board of Local Im-
provements is hereby authorized to deduct said sum of twenty-five ($25.) dollars per day from the moneys which may be due or become due said contractor for work under these specifications.

EVIDENCE OF THE PAYMENT OF CLAIMS

In case of any legal claims being filed with the Board of Local Improvements against the contractor for labor or materials furnished under these specifications, the said Board of Local Improvements shall retain the whole or so much of such moneys as may be due or become due the contractor as may be considered necessary to meet the lawful claims of such persons, until the liabilities shall be
fully discharged and such notice withdrawn.

PROTECTION OF PERSONS AND PROPERTY

The contractor shall during the progress of the work use all proper precautions by good and sufficient barriers, guards, temporary bridges, etc., for the prevention of accidents, and at night he will put up and keep suitable and sufficient lights, and he will indemnify and save harmless the city against and from all suits and actions, of every name and description, brought against it, and all costs and damages to which said city may be put for or on account or by reason of any injury or alleged injury to the person or property of anothe-
er, resulting from negligence or carelessness of the contractor, his agents or employees, in the performance of the work, or in guarding the same, or from any improper materials used in its prosecution, or by or on account of any act or omission of the contractor, his agents or employees; and the Board of Local Improvements shall retain the whole or so much of the moneys due or to become due by reason of the work under these specifications as may be considered necessary, until all such suits or claims for damages as aforesaid shall have been settled and satisfactory evidence to that effect is furnished.
BOND OF FAITHFUL PERFORMANCE OF THE WORK

The contractor shall execute with his sufficient sureties a bond in the sum of fifty thousand ($50,000.) dollars for the faithful performance of the work in accordance with the requirements of the specifications.

POWER TO SUSPEND WORK

The prosecution of the work may be suspended for such periods as the engineer may from time to time determine. No claim or demand shall be made by the contractor for damages by reason of such suspension in the work, but the period of such suspension will be ex-
cluded in computing the time limited for the completion of the work.

The wages of watchmen retained for the public protection during the period of suspension will be allowed.

LOSS AND DAMAGE

All loss and damage arising out of the nature of the work to be done under these specifications, or from any unforeseen obstructions or difficulties which may be encountered in the prosecution of the same, or from the action of the elements, or from incumbrances on the line of the work, shall be sustained by the contractor.
CLEANING UP

All surplus materials, earth, sand, rubbish, and stones, are to be removed from the line of the work as rapidly as the work progresses. At any time within one month after the completion of the work, if so required by the engineer, all material shall be swept into heaps and removed from the line of the work; and unless this be done by the contractor or within forty-eight hours after being notified so to do to the satisfaction of the engineer, the same shall be removed by the City, and the amount of the expense thereof shall be deducted out of any moneys due or to become due to the contractor under these specifications.
PERSONAL ATTENTION

The contractor shall give his personal attention to the faithful prosecution of the work, shall not sublet the same or any part thereof without the consent of the Board of Local Improvements, nor will he assign by power of attorney or otherwise any of the moneys payable under these specifications.

PAYMENT OF WORKMEN

The contractor shall punctually pay the workmen who shall be employed on the work comprised in these specifications, in cash current, and not in what is denominated "store" pay.
PRICES

The prices stated by the contractor in his tender and stipulated in the contract must be understood to cover every contingency, the furnishing of all labor, materials, power, and plant which may be required for the performing and completing of the work described in these specifications, and for maintaining the same in good order for a period of six months.
PAYMENT AND ACCEPTANCE

The contractor shall not be entitled to demand or receive payment for any portion of the work done or materials furnished under these specifications until the same shall be fully completed in the manner set forth, and such completion duly certified by the engineer in charge of the work, and until each and every stipulation hereinbefore specified is complied with, and the work completed to the satisfaction of the Board of Local Improvements and accepted by the City Council, whereupon the city clerk will issue special improvement bonds which must be taken as payment at par value for all money still due to the contractor under
these specifications. This method of paying the contractor shall apply also to partial payments.
SPECIFICATIONS

FOR

AN ASPHALT PAVEMENT
PREPARATION OF ROAD-BED

The sub-surface shall be excavated to a depth of eight (8) inches below the grade of the finished street and shall be finished as described in the specifications for a brick pavement.

FOUNDATION

See specifications for brick pavement.

BINDER

The binder course shall be composed of clean, sound stone all of which shall pass
through a screen having one and one-quarter (1 1/4) inch meshes. The stone shall be heated in heating drums to a temperature not less than 300 degrees Fahr., or more than 350 degrees Fahr. The stone shall be thoroughly mixed with asphaltic cement of the same quality as used in the wearing coat which has been separately heated to a temperature of 300 degrees Fahr. The mixture shall be of such proportions and of such a character as shall be deemed suitable in the judgment of the engineer. While hot, it shall be hauled upon the work and care shall be taken that the temperature does not drop below 250 degrees Fahr. It shall then be spread on the foundation, already swept clean and dry, to such a depth that, when
compacted, it will be one and one-half (1 1/2) inches thick. The binder shall be immediately rolled with a roller weighing ten (10) tons in such manner and to such extent as is satisfying to the engineer. At places not accessible to the roller the compacting shall be done with tampers weighing not less than fifty (50) pounds.

WEARING COAT

COMPOSITION AND QUALITY: The crude asphaltum shall be refined to the satisfaction of the engineer. The flux shall be of maltha of an approved brand. The refined asphaltum shall be melted and heated to a temperature -75-
not less than 250 degrees Fahr., or more than 300 Fahr. The maltha heated to a temperature of 250 degrees Fahr. shall be added in proportions deemed necessary in the judgment of the engineer. The mixer for this work shall be of approved design. The above prepared asphaltic cement shall stand a fire test of 250 degrees Fahr.; shall, at a temperature of 60 degrees Fahr. have a penetration within a range of from 60 degrees to 120 degrees on the Bowen scale, the exact value being set by the engineer and a ten (10) degree variation causing the rejection of the mixture. Samples of the asphalt, flux and asphaltic cement must be furnished the engineer as required.

The sand shall not contain more than
one (1) per cent of clay and shall be of such fineness that at least eighty-five (85) per cent shall pass a 40 mesh sieve and ten (10) per cent of this a 100 mesh sieve. To obtain sufficient fineness stone dust not exceeding fifteen (15) per cent of the amount of sand can be added.

**MANUFACTURE**: The proportions shall be determined by the engineer, so as to best satisfy the conditions and requirements of the locality. The percentage of bitumen soluble in carbon bisulphide shall not exceed ten (10) per cent.

The sand and stone dust shall be heated to a temperature not less than 275 degrees Fahr., or more than 300 degrees Fahr.
The asphaltic cement shall be separately heated within the same limits. The two parts shall be mixed in the required proportions in an approved mixer and worked into a homogeneous mass.

**LAYING:** The mixture shall be hauled to the work in covered wagons and shall not be less than 250 degrees Fahr., or more than 300 degrees Fahr. in temperature, when delivered. It shall be spread with hot rakes to such a depth that, when compacted, it shall be one and one-half (1 1/2) inches thick. This depth shall be constantly determined by gauges by the engineer. The surface shall be immediately rolled with hand rollers and then dusted with hydraulic cement, this to be followed by rolling with a five (5) ton roller and then
finally with a roller weighing not less than ten (10) tons. The rolling shall be continued not less than ten (10) hours for every one thousand (1000) yards of surface.

If for any reason material not of the specified quality or mixture has been laid, it shall be removed and properly replaced at the expense of the contractor.

**PAVING NEAR GUTTERS AND STREET MONUMENTS:** At the juncture of the pavement with gutters and street monuments for a width of twelve (12) inches the pavement shall be coated with hot pure asphalt and ironed smooth with hot irons.
WHEN PAVING SHALL BE DONE: Before the work of laying the asphalt shall begin the curbing and manhole covers shall be adjusted to the grade of the finished street and permission to go ahead shall be obtained from the engineer.

GENERAL SPECIFICATIONS

Starting with the clause entitled "Interpretation of Specifications", the remaining specifications are identical with those under the head of the "Brick Pavement".
THE HISTORY OF COLONIAL RULING

The history of colonial ruling is marked by a series of events that have shaped the modern world. From the establishment of the Roman Empire to the colonization of the Americas, these events have had a profound impact on the development of nations and the course of human history. The legacy of colonialism is still felt today, with ongoing debates about the consequences of past actions and the need for reconciliation.

THE IMPACT OF COLONIALISM

The impact of colonialism has been significant, both positive and negative. On the one hand, colonial rule brought some benefits, such as the introduction of new technologies and ideas, as well as the expansion of trade and commerce. On the other hand, the impact of colonialism was often negative, with the exploitation of resources and the suppression of local cultures.

CONCLUSION

In conclusion, the history of colonial ruling is a complex and multifaceted one, with both positive and negative impacts. As we look to the future, it is important to acknowledge the legacy of colonialism and work towards a more just and equitable society.
SPECIFICATIONS

FOR

MACADAM PAVEMENT
INSTRUCTIONS

By

SAMUEL BARRUS
QUALITY OF STONE

The broken stone must consist of approved limestone, must be of hard and compact texture, and of a uniform grain. The stone must be broken as nearly cubical as possible, and screened through a rotary screen which will produce stone of the sizes herein specified, having rough surfaces obtained by fracture. Water worn, disintegrated, and weather worn stone from the surface of a quarry will not be accepted. The stone for the different courses must be thoroughly cleaned before crushing and well screened, clean and free from injurious matter of every nature. It will be subject to the approval of the engineer in all cases.
EAST IN TUNIS

...
KIND AND SIZES OF BROKEN STONE AND SCREENINGS.

The broken limestone shall be spread in two courses. The bottom course shall be of the required thickness - ( 5 inch) - as shown on plans after rolling and shall consist of limestone broken in sizes varying from a minimum of 2 inches to a maximum of 3 inches in their largest dimensions. Included in this bottom course, but not exceeding one-third of it, shall be the 1/2 to 2 inch product of the crusher, spread in a uniform layer over the surface of the subgrade.

The top course shall be of the required thickness - ( 3 inches ) - after rolling as shown on plans and shall consist of
limestone varying in size from 3/4 inches to a maximum of 2 inches in their largest dimensions.

Limestone screenings will be required as a filler and shall consist of stones not exceeding 1/2 inch in size and shall be free from earth, loam, or vegetable matter and shall contain all the dust of fracture.
SPREADING AND ROLLING

After the subgrade has been completed as specified and passed the inspection of the engineer, a layer of the 1/2 to 1 inch product of the crusher shall be spread in a uniform layer over the subgrade to a depth of 2 1/2 inches. This shall then be covered with a layer of broken stone as herein specified for the bottom course, to such a depth as will, when rolled, make the bottom course of the required thickness - 5 inches. The course shall be of uniform thickness throughout.

This course shall be rolled with a steam-roller weighing not less than five tons and not more than ten tons. The roller shall
first be run along the edge of the stone lapping upon the shoulders about 6 inches, going backward and forward until the stones do not creep or weave ahead of the roller. The rolling, in all cases, shall be continued until it has been performed satisfactorily to the engineer.

Screenings, as herein specified, for the filler, shall be dumped in piles at proper intervals along the side of the roadway. After the bottom course has been rolled satisfactorily, the screenings shall be spread, uniformly to a depth of 1/2 inch by shovels, from the piles placed along the roadway. The screenings shall then be rolled dry and swept with rattan or steel brooms until they have nearly
all disappeared, when another coat of screenings shall be rolled and swept, adding more screenings, if necessary, until no more will go in dry, when the surface shall, if required by the engineer, be wet with a sprinkler, using water freely, until all the voids are filled, leaving the surface free from screenings in all places.

The top course shall then be spread, using cubical blocks of wood to fix the depth and preserve the grade and crown as shown on plans. The top course shall then be rolled until the stones do not creep or weave and shall then be covered with dry screenings about 1 inch deep and rolled and swept dry as before described, after which the road shall be satur-
ated with water following with the roller; sufficient amount of water shall be put on until it shows on the surface, when the rolling shall continue, until a grout has been formed of the screenings, stone-dust, and water. The rolling shall continue until this grout can be pushed in a wave before the wheels of the roller. Filler shall fill all the interstices of the broken stone in both courses, as herein described, and shall cover the metal of the surface when completed. After the wave of grout has been produced over the whole section of the road, screenings or approved coarse sand shall be spread where required to leave them 3/8 inches deep for a wearing surface, which shall be maintained and renewed if necessary until
the whole road has been accepted.

This portion of the road shall then be left to dry, when it shall be opened to traffic.

As soon as any portion has been completed as specified and has dried as described and been opened to traffic, it shall be thoroughly sprinkled at least once a day for 30 days. If at any time before final acceptance, the engineer demands that the finished roadway shall be sprinkled and rolled to improve the road, such work must be performed.
METHOD OF CARRYING ON WORK

The work shall be carried along together wherever practicable. Each course shall be rolled and filled promptly after spreading and travel upon the loose stone shall be prevented.

The use of proper rollers, ramnners, or other suitable implements, shall be substituted for that of the steam roller when the engineer so directs.
GENERAL SPECIFICATIONS

Starting with the clause entitled "Interpretation of Specifications" the remaining specifications are identical with those under the head of the "Brick Pavement."