

Boston Transit Commission.

Tenth Annual Report.



June 30, 1904.

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FROM

THE BOSTON TRANSIT COMMISSION,

*15 Beacon Street,*

GEORGE G. CROCKER, *Chairman,*

CHARLES H. DALTON,

GEORGE F. SWAIN,

THOMAS J. GARGAN,

HORACE G. ALLEN,

*Commissioners.*

HOWARD A. CARSON,

B. LEIGHTON BEAL,

*Chief Engineer.*

*Secretary.*



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TENTH ANNUAL REPORT

OF THE

BOSTON TRANSIT COMMISSION,

FOR THE YEAR ENDING

JUNE 30, 1904.



BOSTON

E. W. DOYLE, PRINTER

1904





# BOSTON TRANSIT COMMISSION.

15 BEACON STREET, BOSTON, June 30, 1904.

TO THE CITY COUNCIL OF THE CITY OF BOSTON:

In compliance with Statutes of 1894, chapter 548, section 24, the report of the Boston Transit Commission for the year ending June 30, 1904, is respectfully submitted.

## EAST BOSTON TUNNEL.

Construction work on the East Boston tunnel is substantially completed with the exception of the street covering for the Atlantic avenue station. The plans for this covering were delayed owing to a controversy between the Commission and the Company as to which party should bear the expense of the installation of the elevators and the necessary machinery. The kind and size of elevators had to be determined before the plans could be made.

At a conference with the Boston Elevated Railway Company in November, it was decided that the structure should be carried high enough so that the elevators could reach a bridge connecting with the elevated railway structure.

November 17, the Company transmitted to the Commission the following opinion from its counsel that the installation of the elevators, including the cages, hoisting apparatus and motors, was the duty of the Commission:

Oct. 29, 1903.

GEN. WILLIAM A. BANCROFT, *President Boston Elevated Railway Co.:*

I reply as below to your request for my opinion upon the question whether the elevators at the Atlantic avenue station of the East Boston tunnel are to be provided by the Company or by the Transit Commission.

In my opinion the proper construction of St. 1897 ch. 500 requires them to be provided by the Transit Commission; principally for these reasons:—

First, because the statute calls for a *complete* tunnel, with complete entrances and stations; and the elevators, under the conditions at Atlantic avenue, are the necessary means of entrance and

exit, and are therefore an essential part of such a tunnel, entrance, and station, as the statute requires.

Second, because the elevators, under these conditions, are in the nature of irremovable fixtures, which being in place would ordinarily become part of the realty; and the statute does not require the Company, nor afford authority for requiring it, to provide anything in the nature of a permanent or irremovable addition to the real estate of the city or the Commonwealth in which it has no title.

A more extended statement of the reasons which have led me to this conclusion may be desired, and is accordingly appended.

(Signed)

A. E. PILLSBURY.

#### THE ELEVATORS.

It now may be taken as settled that the East Boston tunnel is built under the requirements of St. 1897 ch. 500 sec. 17; and not under St. 1894 ch. 548 sec. 26; (174 Mass. 160; 176 Mass. 12, 14; St. 1897 sec. 18; St. 1902 ch. 114; St. 1903 ch. 190).

St. 1897, sec. 17 requires the Transit Commission to construct "a tunnel or tunnels, of sufficient size for two railway tracks, with approaches, entrances, sidings, stations and connections therefor, and for the running of railway cars therein," and "upon completion thereof" to execute a lease of the whole structure to the Company for the statutory term, at a prescribed rental having no necessary relation to its cost, with such other provisions as the parties may agree upon or the Railroad Commissioners determine.

The Commission builds the tunnel in its own way, under no control except such as the courts may have, with such entrances and stations, at such points, as it deems proper. But the statute calls for a *complete* tunnel, with complete entrances and stations. Everything necessary to make the tunnel complete as an avenue for a street railway, or to make the entrances to or stations for the tunnel complete for their respective purposes, plainly is within the requirement and is undertaken by the public. The Company, if it accepts the lease, undertakes to provide, equip and operate a street railway in and through the tunnel, for the prescribed period and on the prescribed terms. So far as the statute goes, these are the respective undertakings of the parties.

If the elevators were to be the only means of entrance to or exit from the tunnel at any station, it would plainly be the duty of the Transit Commission to provide them; as the structure would plainly be incomplete and unfit for use without them. Not only are "entrances" expressly required, but a tunnel without practicable means of entrance and exit at stations is not such a tunnel, and a station without suitable means of reaching and leaving the tunnel through it is not such a station, as the statute requires. I understand that there are to be stairways at Atlantic avenue, as well as elevators. It is equally true that if the stairways were to be the only means of entrance and exit, the Company plainly could not be expected, or required, to provide them. But it seems that the tunnel is sixty feet below the street at this point. This is substantially the height of a six or seven story building. Accordingly, I understand it to be conceded on all hands, as under these conditions it must be, that the elevators are not merely an additional facility, but are the necessary means of entrance and exit. They are the main thing; the stairways are only an alternative, for emergencies, and do not affect the present question.

The situation is, then, that the Commission, properly no doubt, has built the tunnel at a depth and located this station at a point

at which elevators are a necessary means of entrance and exit; and as suitable means of entrance and exit is an essential part of a tunnel built for this purpose, and of an entrance to or station for it, they are not complete at this point without the elevators. In other words, the elevators are an essential part of the tunnel, the entrance and the station which the statute calls for. These structures, under these conditions, would no more be complete without the elevators than a house with its door-sill six feet above the ground would be complete without door-steps. The Commission has built a shaft for the elevators, but this is not by itself a practicable means of entrance or exit. In the case of the house, there is a place for the door-steps, but the house is not complete until the steps are there.

In a broader view of the statute, and the relations of the parties under it, the result is the same. This tunnel is a public avenue for a street railway, built and owned by the public. Upon its completion, it is to be leased to a street railway company for a term of years, for street railway travel. The only relation of the company to the enterprise or to the structure is as lessee for years, for the operation of a street railway. The public undertakes to provide a complete structure, to the use of which for street railway travel nothing remains necessary but the addition of a street railway equipment. This is for the Company to provide, if it accepts the lease; in other words, it must provide and equip a street railway. But the statute no more requires the Company to equip the tunnel itself, so far as any equipment is necessary to make it complete and fit for its use, than to build it. Elevators are not ordinarily any part of a street railway equipment, nor would they be wanted here, except that they are the necessary means of access to and egress from the tunnel in which the railway is to be operated. Being the necessary means of entrance and egress, they are an essential part of the tunnel itself, and of the entrance and the station which the main statute calls for.

The express mention of elevators in the tunnel Act of 1902, ch. 534, may be taken to indicate the legislative view that they are properly part of such structures, built for the same use under similar conditions. Elevators would doubtless have been mentioned in St. 1897 if the necessity had been foreseen. But the terms used are broad enough to include them, and in view of the situation they must be deemed to be included. The cost of the "stations, inclines and steps" is expressly provided for by sec. 18. This cannot exclude elevators merely because they are not expressly mentioned in this section; if it does, the same reason would forbid the Commission to construct at the public expense the "approaches," "entrances," "sidings" and "connections," which are expressly required by sec. 17, because they are not mentioned in sec. 18. The only construction that can be put upon this provision of sec. 18 is that it was inserted for further assurance that the appropriation should extend to the appurtenances of the subway and tunnel, as well as the main structures; and the significance of the word "steps" is in showing that the means of access and egress is considered and dealt with as a proper part, or a necessary appurtenance, of the main structures.

It may be said that the Company must take a lease containing such provisions as the statute prescribes and such as the parties agree upon or the Railroad Commissioners determine: that a lease does not ordinarily imply that the premises are fit for use; that the statute contemplates that the tunnel may be built at such depth that elevators may be a necessary means of entrance and egress; that the Company cannot operate its railway without get-

ting its passengers to and from it; and therefore that the fair implication of the statute is that the Company must provide the elevators as the necessary means of access and egress, or at least cannot properly refuse to accept a lease requiring it to provide them. This line of argument might be sound if the statute were in different terms, but in view of the actual terms, it is untenable; not only because it brings into the statute something which may not be in it, but because it is inconsistent with the plain requirement to construct a complete tunnel, with complete entrances and stations.

It is not certain that the Company is obliged to accept any lease of the East Boston tunnel. Neither this nor any other statute expressly requires it. If the obligation exists, it is only by implication resulting from the general scheme of the statute and the situation of the parties under it and under subsequent legislation. But assuming that the Company is bound or is willing to accept a lease, no matter which, it is not the ordinary lease, with the ordinary obligations, but such a lease as this statute fairly intends, in view of the peculiar conditions; and it cannot be required to accept one compelling it to provide anything which, by the express terms of the statute, the public has undertaken to provide. The public has undertaken to provide a complete tunnel, with suitable and complete means of access to and egress from it, as an essential part of it and of the stations and entrances which also it undertakes to provide.

There is another element in the case, of equal importance. As between private parties, these elevators, under similar conditions, would be fixtures, which, being in place, become part of the realty. If they were provided by the Company unconditionally, they would become and be an essential part of the tunnel structure or system the property of the public. If it should take them out at the end of the term, it would leave the structure incomplete and unfit for use. It may be said that the Company can protect its title to the elevators by stipulation in the lease or otherwise. But this does not affect the question. Apart from the fact that they might be worthless for removal, if the Company cannot be held to provide them unconditionally, it cannot be held to provide them upon any condition to which the public must consent or which it may refuse. This not only sheds light upon the question whether the elevators are essentially a part of the structures which the Transit Commission is directed to provide, but it goes farther. I do not think that the Company is required by this statute, and it is by no means certain that a corporation can be required under any circumstances, to raise and expend capital for an addition to the real estate of the Commonwealth or the city, in which it has no title. Perhaps a corporation can properly be *authorized* to raise and expend capital for adding fixtures, necessary to its business, to real estate of which it is lessee; but that is not the question. To impose such a requirement upon the corporation is a very different thing.

Some provisions of the subway lease of 1896 may be referred to as indicating that the Company should provide the elevators. But the subway lease contained nothing like this; it contained some requirements upon the Company which, in my view, the statute did not authorize; and it is not a precedent here except so far as the parties choose to make it so. So far as the subway lease proceeds, if it does proceed, upon the theory that the Company can properly be required to provide anything which is essential to make the structure itself complete and fit for the use for which it is built, it is inconsistent with the proper construction of the statute. If precedents are wanted, a later one, and perhaps a better, is the

tunnel and subway contract under St. 1902; and if I remember correctly, one of the grounds upon which the Railroad Commissioners modified the form proposed by the Transit Commission was that the Company cannot properly be required, if indeed it can be authorized, to raise and expend capital for the purpose of restoring or rebuilding the subway, being the property of the public, in case of disaster not due to its own act.

It may be said that if the public must provide the elevators, it must also operate them, or provide the power. There is some ground for this view; and it first occurred to me that this might be the necessary result, and that no line could properly be drawn between the obligation to provide the elevators and the obligation to make them effective, as the means of entrance and exit, by propelling them. In the actual use of the tunnel the Company must run the elevators, and on further consideration I think that the statute must be held to intend that when the Company takes the completed structures, it takes them to be used as they are; subject to the burden of this necessary incident of their use, resulting from a feature of their construction which the statute undoubtedly authorizes. There may be, and probably is, some limit to the power of the Transit Commission to cast expenses of this character upon the Company, but I cannot say that this is beyond it.

The following opinion, of a directly opposite tenor, was received, November 24, from Mr. Solomon Lincoln:

Boston, November 24, 1903.

HON. GEORGE G. CROCKER, *Chairman of the Boston Transit Commission:*

MY DEAR SIR: In reply to the request of the Transit Commission for my opinion upon the question whether or not it is the duty of the Commission to provide, at the Atlantic Avenue Station of the East Boston Tunnel, elevator cars and equipment for the operation of the same, I answer as follows:

In my opinion it is not the duty of the Commission to provide elevator cars and equipment.

My reasons for the above opinion may be briefly stated as follows:—

It must be assumed that the Tunnel is built substantially under the authority of Chap. 500 of the Acts of 1897, Sect. 17. I do not find, however, in this Act, nor in any of the legislation relating to the subways and tunnels which the Commission is authorized and directed to construct, nor in any decision of our Court, language which by itself considered can be regarded decisive. The assistance thus obtained is meagre and rather indefinite.

I base my opinion chiefly upon the general scheme of this legislation considered as a whole. From this I conclude that it is the duty of the Commission, on the one hand, to construct and complete the subways and tunnels as permanent structures, with all necessary "approaches, entrances and sidings." I mean by this language to describe a fixed and immovable structure. If the subway or tunnel lies at a considerable depth below the surface so that an elevator would be a reasonable convenience to lift passengers to the surface, I should include in the duty of the Commission that of providing a shaft in which to operate an elevator, as well as stairs leading to the surface, but not the equipment of the shaft nor elevator cars to run in it.

Having thus completed the structure described it is the duty of the Commission to lease it. It is the duty of the lessee, on the

other hand, to equip and operate it, and, in the case of the elevator shaft or well, to equip that for the use of an elevator car, to provide the car, and then to run it.

Throughout the legislation the duties of the Commission and the Company, the lessor and lessee, are distinguished and should be so maintained. The duty of the Commission is to provide the stable and permanent way; that of the Company is to operate it, supplying the necessary fixtures and equipment.

I observe that the word "elevators" is used in the Statute of 1902, Chapter 534, but this is not the Statute under which the East Boston Tunnel is constructed. The Statute of 1897, Chapter 500, contains no direct reference to elevators, and even if it did there would be ground for the claim, when the duty of the Commission is under consideration, that the word "elevators" referred to the permanent shaft only.

The installation of fans for ventilation in the existing Subway, if I am correctly informed as to the facts, illustrates the distinction between the duties of lessor and lessee which I desire to establish. The Commission provides the chambers for the fans; the Company the fans and operates them.

I have read Mr. Pillsbury's opinion with interest. His claim is in substance that the Commission must furnish a *complete* tunnel; that elevators are necessary to a complete tunnel, and hence that the Commission must build them. This contention I think, does not advance us far toward a decisive conclusion as to the relative burdens of lessor or lessee. It still remains to determine what is a complete tunnel. It is no doubt true that, using language in a broad but not accurate sense, an elevator car may be necessary to a complete tunnel, but in a like indefinite use of language a tunnel would be incomplete unless it were provided with rails and cars to run upon them. We are considering the relative duties of lessor and lessee. The lessor has fulfilled its duties when it has provided a structure ready to be equipped; the duty of lessee remains to provide the movable equipment together with such stationary appliances as are needed for the operation of such equipment.

Mr. Pillsbury considers also that the elevators would become part of the realty and hence the property of the City of Boston. I am unable to agree with this view, but whatever its merit any difficulty or injustice of this sort can easily be adjusted in the lease.

The view which I have taken of the whole question seems to me to be in harmony with the general scheme of all the legislation applicable to the question, and to avoid serious difficulties,—for instance those relating to the duty of the Commission to maintain elevators once established and the responsibility of operating them. I concede that the Commission could be protected in these regards by careful provisions in the lease, but possible dangers in these regards tend to confirm the view which I have taken, and to show that confusion of rights and responsibilities is likely to follow unless the distinction I have drawn be observed.

The subject is susceptible of further illustration and discussion, but in order that this opinion may be ready to present to you at your meeting to-day I have expressed myself briefly.

Very truly yours,

(Signed)

SOLOMON LINCOLN.

These opinions were submitted to the City Solicitor, who gave his views in this communication:

BOSTON, November 27, 1903.

BOSTON TRANSIT COMMISSION, 20 Beacon St., Boston:

GENTLEMEN: Your letter enclosing copies of opinions of Solomon Lincoln and Albert E. Pillsbury in regard to elevator cars and equipment for the East Boston Tunnel was received. The matter is not free from doubt, but I am inclined to agree in the opinion of Mr. Lincoln that the subway or tunnel is complete under the statute when it is provided with approaches by means of which the passengers can reach the station. In this sense the station would be complete if it was provided with stairs furnishing an access to it. As the elevator shaft and the entrance to it and exit from it are a part of the station itself which cannot be removed without injury to the station or street the shaft and its approaches would necessarily in my opinion be something to be provided by the Transit Commission.

Mr. Pillsbury thinks that the question as to whether the car or cage would be real estate would throw some light on this question. I do not think it does because I do not look at the tunnel or subway as real estate any more than a gas or water pipe under the surface of a street is real estate. If it is real estate it would be attached to the realty and would belong to the owners of the fee of the street.

The other argument advanced by Mr. Pillsbury in favor of this contention goes entirely too far because the elevator cage or car does not resemble steps and in and of itself does not furnish an approach to the subway. If the car was on the level of the street no person could get into the subway or tunnel from it. If it was on the same level as the subway or tunnel no one could get to the street from it. In order to furnish a means of access to the tunnel from the street for passengers it must be raised or lowered and raised or lowered by power controlled by men. It would follow, therefore, that if it was the duty of the Transit Commission under the statute and lease to furnish all the means by which passengers could get from the street to the tunnel or from the tunnel to the street it would be its duty to furnish, not only the elevator cars, but the engine and the power by means of which the cars would be raised and lowered and pay the men who took charge of the power and who managed the elevator, because the elevator shaft with a cage in it would be no more a means of access to the tunnel without power and men to move it than the shaft alone.

I can see logically no escape for the Commission if it once admits this claim of Mr. Pillsbury from furnishing not only the elevator cars or cages but the engines and machinery to move the cars and the men to operate the machinery and the cars. It follows, therefore, in my opinion that the commissioners' attitude in the matter should be that it would not furnish the cars or cages, power, or men to operate the power and the cars, and that the moving of the passengers who travel on the road, from the street to the station, or from the station to the street, was as much a part of the duty of the Elevated Railway as supplying the cars and rails and moving the cars in the subway.

Yours truly,

(Signed)

THOMAS M. BABSON,  
*City Solicitor.*

P. S.—The best test in regard to anything of this kind seems to be its capability of being taken out or put in without injury to the subway itself.—T. M. B.

Copies of these opinions were forwarded to the Boston Elevated Railway Company. There were further conferences and correspondence. Neither party was willing to recede from its position, but as neither party deemed it wise to delay the construction of the Atlantic avenue station until the question as to the correct interpretation of the law could be determined by the courts, the following agreement was executed:

*Whereas*, by the acts of the year 1897, chapter 500, section 17, it is provided that the Boston Transit Commission shall construct a tunnel or tunnels of sufficient size for two railway tracks, with approaches, entrances, sidings, stations and connections therefor, and for the running of railway cars therein, from a point or points on or near Hanover street in the city of Boston, or such other point or points as said Commission may deem proper for a suitable connection with the subway or subways provided for by the acts of the year 1894, chapter 548, section 25, to a point or points at or near Maverick Square in that part of Boston called East Boston, where a suitable connection with surface tracks may be made, and otherwise as therein provided, and that upon completion thereof the Commission shall execute a lease thereof in writing to the Boston Elevated Railway Company for a term and at a rental fixed by the act, and

*Whereas*, at the station constructed by the Commission under State street near Atlantic avenue, in addition to stairs, elevator wells have been constructed by the Commission, and the question has arisen which party is to provide and install the elevators to be used in said wells, and the Commission and the Company are unable to agree thereon, and

*Whereas*, public interests may suffer if the execution of the lease and the use of the tunnel by the Company should be delayed by such disagreement,

*Now*, therefore, it is agreed by the Boston Transit Commission and the Boston Elevated Railway Company, as follows:

The Commission agrees to contract for and install such elevators, and the Company agrees that such action shall be without prejudice to the rights of the Commission and of the city and that it will repay the cost thereof, with interest at the rate of 3 1-2 per cent. per annum thereon, upon final determination by the court or by an arbitrator agreed on by the parties, assuming for the purposes of this question that it is incumbent upon the Company to take a lease of the East Boston tunnel, in some proper form, as soon as it is completed under the statute, and assuming that elevators are so essential to the convenient use by passengers of the station at the foot of State street that some party is bound to furnish them, under these assumptions, the statutes, and all the circumstances, which party is to furnish the elevators—if such determination is against it—and the Company also agrees to assent to and co-operate in such further action, if any, as may be necessary and proper to bring this question before the court or an arbitrator if one is agreed on, in such manner that it can be considered and determined, as justice may require.

*In Witness Whereof*, the Boston Transit Commission, acting in behalf of the city of Boston, has caused this instrument to be executed in its name by its chairman, and the Boston Elevated Rail-



way Company has executed the same by its president hereto duly authorized.

BOSTON TRANSIT COMMISSION,

By (Signed) GEORGE G. CROCKER,  
*Chairman.*

BOSTON ELEVATED RAILWAY COMPANY,

By (Signed) WILLIAM A. BANCROFT,  
*President.*

BOSTON, March 9, 1904.

The original plan of the Commission as to elevators was to have two for each platform, one about 16x6 feet and the other 8x6 feet, the smaller being considered ample to accommodate the passengers during the hours of least traffic. Several conferences were held with officials of the Elevated Railway Company, and finally bids were asked for on this basis, but subsequent to their reception, at the special request of the Company, it was finally decided that the two elevators in each hoistway should be of equal size. At the earnest solicitation of the Company, upon which would rest the burden of operation and the responsibility for accident, and possibly also the cost of installation, the contract was awarded to the Whittier Machine Company.

The original intention to run the elevators so as to connect with the elevated structure was at one time abandoned because the Company signified that it did not desire such connection, but was subsequently re-adopted, the opposition of the Company having been withdrawn. These complications were not finally settled until late in May, and it was not until then that definite construction plans for the superstructure could be put under way. This work was entrusted to Mr. Charles Brigham, architect, who designed the subway shelters at Scollay and Adams squares.

#### *Additional Exits from Stations.*

In the design of the stations for the original subway, the Commission, so far as practicable, provided exits or entrances at each end of each platform, and they have always realized the advantages of this method of construction. In the original plan for the stations of the East Boston tunnel at Atlantic avenue and at the Old State House, however, the entrance and exit was in each case at one end of the platform. After the accident at Paris the matter of an exit at each end acquired new importance, and was again taken up by the Commission. A report was early obtained (See Appendix A) from the Chief Engineer of the

Paris subway giving the circumstances attending that accident, and the Commission gave consideration to the lessons which it taught, one of these being the desirability of an exit from each end of each platform. The matter had also occupied the attention of the officials of the Elevated Railway Company, who expressed a desire that additional exits should be provided at the stations of the East Boston tunnel.

The conditions, however, in the East Boston tunnel are very much more favorable than in the Paris subway. There seems to be practically no danger of the extinguishment of lights such as occurred in Paris, owing to the variety of sources from which the lights in the tunnel are to be supplied, as shown in the statement of the Company of its plans for lighting equipment. Also, in the East Boston tunnel there is no third rail, and the platforms are low and adapted for surface cars only, so that passengers can cross from one platform to the other in case of emergency. Further, the system of ventilation is such that if a car should get on fire the smoke would be carried away from the station, and therefore in the opposite direction to that in which the passengers would wish to go. Moreover, in the case of the station at the Old State House this station is only 410 feet distant from the nearest entrance to the Scollay square station, which is at the Old Court House.

These matters were fully discussed with the officials of the Boston Elevated Railway Company at conferences and by correspondence. It appeared to the Commission that the safeguards in the East Boston tunnel were ample for any emergency which might arise, but in order to provide an additional safeguard at the Atlantic avenue station the Chief Engineer, at the request of the Commission, proceeded to prepare plans and estimates for an exit at the westerly end of that station. It was the desire of the Commission that this exit should be provided with a single inclined elevator running from a point above the tunnel to the surface of the street, but at the request of the Boston Elevated Railway Company, inasmuch as the exit is to be used only in emergencies, no provision was made for the immediate installation of such an elevator. On May 2 plans for this exit with a seven-foot staircase were approved, and its construction authorized. It is to be so built as to allow of the erection in it of an inclined elevator in the future if desired.

Bids for this entrance were opened June 21, but all were rejected, and new bids were called for to be opened July 7.

In the case of the station at the Old State House the Commission gave consideration to the possibility of providing an additional exit, but there were great difficulties in the way. Such an exit at the easterly end of the platforms would involve either very large expense for private property on State street taken for the purpose, or great and immediate inconvenience to the public if these exits should encroach upon the already overcrowded sidewalks. Considering the proximity of this station to the Scollay square station and the other safeguards above mentioned, and also the fact that in the future, when the subway for surface cars provided for in the act is constructed, it may be connected with the easterly end of this station, the Commission decided that at present there was no necessity for any further exits here.

#### *Lease.*

The statute requires that upon completion of the tunnel, the Commission shall execute a lease in writing to the Company for a term expiring twenty-five years from the date of the passage of the act, June 10, 1897, at an annual rental equal to three-eighths of one per cent. of the gross receipts for each year ending September 30, of all lines owned, leased or operated by the Company, to be paid to the city on or before the last day of November in each year, with the privilege to the lessee to sublet the same, such lease to contain such other terms and provisions as may be agreed on by said Commission and said corporation or, in case of disagreement, as shall be determined by the Board of Railroad Commissioners.

The preparation of this lease was begun in December and has been the subject of frequent conferences between the committee on the part of the Commission and the counsel of the Company. The document is now ready for final consideration and action.

#### *Connection of the East Boston Tunnel with the Subway.*

In the last report it was stated that the Commission had determined to connect the East Boston tunnel with the subway by a grade crossing at Scollay square, the Company having withdrawn its consent to the Commission's plan for a sub-station at that point. June 9, last, bids for

making this connection were received, the contract was awarded to H. P. Nawn, and work under the contract was begun. June 21, the following was received from the Boston Elevated Railway Company:

PRESIDENT'S OFFICE,  
101 MILK ST., BOSTON, MASS., JUNE 18, 1904.

HON. GEORGE G. CROCKER, *Chairman, Boston Transit Commission, 20 Beacon St., Boston, Massachusetts.*

DEAR SIR: The Executive Committee of our Board of Directors would like to present the question of making the curve at the intersection of the East Boston tunnel and the existing subway at Scolay Square of such length as to admit of the passage of cars of forty-eight feet in length and of nine feet in width to and from subway and tunnel, and we understand that it will be agreeable to your honorable Commission to hear our Committee at 11 A. M. on Tuesday, June twenty-first, current.

Respectfully,  
(Signed) WM. A. BANCROFT,  
*President.*

Although the Commission's plans for the connection had previously been submitted to the Company and had been approved by it; although the Company has in use no cars of so large dimensions as those named in the communication and although the appropriation made by the Legislature for the East Boston tunnel was deemed to be insufficient to cover the cost of the proposed alteration, nevertheless, as the connection would not be needed until the new north and south tunnel for elevated trains is completed, and as the Company on its part agreed that it would execute the lease of the tunnel without waiting for such connection, and that if the Legislature failed to make the necessary additional appropriation it would pay the loss to the city resulting from the cancellation of the contract, and also the expense of putting the street in proper condition for public use pending action by the Legislature, the Commission, on June 24, cancelled the contract which it had made. Work on this connection is therefore suspended awaiting legislative action.

#### *Tablets for the Old State House.*

Two bronze tablets have been prepared, to be placed in the passageway under the Old State House, containing the following inscriptions:

1634  
 SITE OF PUBLIC MARKET PLACE  
 1657  
 FIRST TOWN HOUSE  
 BURNT 1711 — REBUILT 1713  
 OCCUPIED BY  
 THE GREAT AND GENERAL COURT  
 AND  
 THE ROYAL GOVERNORS UNDER  
 GEORGE I-II-III

1780  
 JOHN HANCOCK  
 - SIGNER OF  
 THE DECLARATION OF INDEPENDENCE  
 WAS HERE INAUGURATED  
 FIRST GOVERNOR OF  
 THE COMMONWEALTH OF MASSACHUSETTS  
 1780 -- 1798  
 OCCUPIED BY  
 THE GENERAL COURT  
 1830 -- 1839  
 BY THE CITY GOVERNMENT

*Areas in State and Court Streets.*

In January last, the Supreme Judicial Court decided that the construction of the tunnel under State and Court streets is a use of the lands embraced in those streets for the purposes of a public street, and that the owners of the fee of such lands are not entitled to damages as for an additional servitude. The full text of the opinion will be found in Appendix B.

*Winthrop Statue.*

The erection of the Court square covering to the station of the East Boston tunnel necessitated a second removal of the Winthrop statue, and early in July the Art Commission was asked to designate a new location for the same. Up to date that location has not been designated. In the meantime the statue has been removed and stored in the yard of the Commission on Canal street.

*Lighting the Tunnel.*

The scheme for lighting the East Boston tunnel, as set forth in the following communication from the Boston Elevated Railway Company, has been approved:

VICE-PRESIDENT'S OFFICE.

101 MILK ST. BOSTON, MASS. March 31, 1904.

EAST BOSTON TUNNEL — PROPOSED PLAN FOR LIGHTING.

HON. GEO. G. CROCKER, *Chairman, Boston Transit Commission, 20 Beacon St., Boston, Mass.*

DEAR SIR: By direction of our Executive Committee, I beg to submit for your consideration and approval proposed plan for lighting the East Boston Tunnel, and shall be pleased to furnish any further information desired regarding the same.

*Plan for Lighting East Boston Tunnel.*

1. The lighting of the stations and tunnel sections shall be controlled locally instead of from a central switchboard as now in service for the present subway.

2. The wiring to be so laid out as to have three sources of power supply: i. e., Central Power Station, Lincoln Power Station and the Edison Electric Illuminating Co.'s system.

3. At the stations a sufficient number of lights shall be constantly fed from the Edison Company's system and so distributed as to prevent total darkness on platforms, stairways, exits and entrances in case all power is lost in the Railway Company's circuits.

4. The tunnel sections shall be lighted with two rows of lights throughout, the lights in each row being spaced from 20 to 24 ft. and staggered so as to give one 16 c. p. lamp every 10 to 12 feet of tunnel.

5. One row of lights throughout the tunnel and stations which shall always be fed from the Railway Company's power stations, shall be installed with grounded circuits, using only one lead-covered wire as the main feed. The other row of lights throughout, shall be wired so as to make it possible to supply current from either the Railway Company's system, or that of the Edison Electric Illuminating Co., also having one side of the circuit grounded and using a lead-covered main feed cable.

6. Supplementary connections shall be made so that certain circuits may be thrown on and fed from the trolley wires in emergencies or changes.

Very respectfully,

(Signed)

C. S. SERGEANT,

*Vice-President.*

*Ventilating Apparatus.*

On June 14, the officials of the Company notified the Commission that they claimed that the ventilating fans and motors for their operation came under the same category as elevators in regard to installation. An agreement relating

to ventilating apparatus similar in form to that which had been previously made with relation to elevators is under consideration at the date of this report.

### NEW TUNNEL.

At the date of the last report, the Commission had decided upon the "May place-Devonshire street-Union street route," so called, for the tunnel authorized by chapter 534 of the acts of 1902. July 2, the Company availed itself of its privilege under the act and applied to the Board of Railroad Commissioners for a revision of the determination of the Commission in the following terms:

*To the Board of Railroad Commissioners:*

The Boston Elevated Railway Company respectfully represents that it has been notified by the Boston Transit Commission, June 29, 1903, of its determination of an important question arising in the course of the work provided for by chapter 534 of the Acts of the Legislature of the year 1902, upon which the Company had previously requested a hearing and which has been the subject of several hearings and conferences between the Commission and the Company, namely, the question of the route of the tunnel to be built thereunder, for the use of elevated cars or trains. A copy of the notice is hereto annexed.

Believing that the route designated by the Transit Commission will not furnish the best facilities for public travel, the Company feels in duty bound to apply to the Board, in conformity with the provisions of section 13 of the Act referred to, for revision of such determination of the Commission, to the end that the Board may consider and finally determine the question.

It was agreed that the reasons governing the action of the Commission and of the Company should be submitted by each, in writing. On July 21 the following was submitted as the brief of the Commission:

BOSTON TRANSIT COMMISSION,  
20 BEACON STREET, BOSTON, July 21, 1903.

*To the Board of Railroad Commissioners  
of the Commonwealth of Massachusetts:*

GENTLEMEN: In the matter of the application to your Board made by the Boston Elevated Railway Company for a revision of the determination by the Boston Transit Commission as to the route of the tunnel for the accommodation of two tracks especially for use by elevated cars or trains, the construction of which was authorized by Chapter 534 of the acts of the year 1902, the said Commission, pursuant to your request, submits herewith the following plans, studies, details, estimates and findings:

- EXHIBIT A.—Pamphlet containing legislation, court decisions and contracts.
- EXHIBIT B.—Plan showing district within which the tunnel and subway may be built.
- EXHIBIT C.—Plan showing some of the routes for the tunnel which have been considered.
- EXHIBIT D.—Plan indicating the route for the tunnel as determined by the Commission June 29.
- EXHIBIT E. Study of May place-Devonshire and Union streets route and of Washington and Union streets route on scale of fifty feet to the inch.
- EXHIBIT F.—Estimates of cost and curvature.
- EXHIBIT G.—Letter from the Boston Elevated Railway Company dated March 30, 1903.

The act authorizing the construction of the tunnel, hereinafter called the act, is Chapter 534 of the acts of the year 1902.

The contract referred to in Section 10 and subsequent sections of the act was executed under date of the 25th day of September, 1902. A copy of such contract is embodied in the pamphlet herewith marked "Exhibit A."

The act was accepted by a majority of those voting thereon at the Municipal election in the City of Boston, held on the 9th day of December, 1902.

The act authorizes the Boston Transit Commission to construct in the City of Boston a system of tunnels and subways so designed as to be adapted for the accommodation of two tracks especially for use by elevated cars or trains and two tracks especially for use by surface cars between points and within an area specified in the first section of the act, which area is shown with substantial accuracy on plan herewith, marked "Exhibit B," and is colored green on said plan.

The act requires that the structure for two tracks especially adapted for elevated cars or trains, called the tunnel, shall be begun immediately after the acceptance of the act by the voters of the city and that the structure for the remaining two tracks, called the subway, shall be begun at a later period to be determined as therein provided, unless the Commission deems it expedient and the company, by its board of directors, consents to the earlier building of the structure or structures for all four tracks or any part or parts thereof.

On March 30, 1903, the Boston Elevated Railway Company, by William A. Bancroft, its president, by letter, a copy of which marked "Exhibit G" is hereto annexed, notified the Commission that, in its opinion, it was inexpedient to build the subway until after the completion of the tunnel, and that the rental burden involved by building both tunnel and subway together would be so heavy as in itself to make it impossible for the company to assent thereto. The Commission thereupon discontinued the consideration of the expediency of building the tunnel and subway in whole or in part at the same time and proceeded to select and determine upon a route for the tunnel.

If it had been agreed that the tunnel and the subway should be built at the same time, the saving of expense would have been an argument in favor of building them on the same route. As they are not to be built at the same time it appears that they should be built on different routes, so that the resulting benefits may be distributed to the many rather than lavished upon the few.



# MAP OF THE CENTRAL BUSINESS DISTRICT CITY OF BOSTON

James T. Hill, Draughtsman.  
JULY 1900  
SCALE



ROUTE DETERMINED  
TO THIS POINT  
JUNE 29, 1903



EXHIBIT "D"  
PLAN INDICATING THE ROUTE FOR THE  
TUNNEL AS DETERMINED BY THE COMMISSION  
JUNE 29, 1903

EXHIBIT D

1870

CITY OF BOSTON

# CITY OF BOSTON

1870



The tunnel and the subway should not duplicate but should supplement each other. If built on different routes, they will facilitate access to a larger district, will give greater opportunities for business growth, and more equitably distribute real estate values.

Some of the routes for the tunnel which have been under consideration are shown on plan herewith marked "Exhibit C."

After a long study of the problem and many conferences with the officials of the company the Commission selected the May place-Devonshire and Union streets route and so notified the company in writing on the 29th of June, 1903. For this route as compared with the other proposed routes east of Washington street the officials of the company at a recent conference with the Commission expressed a preference.

It is to be noted that the Commission has located stations at Summer and State streets, and has not yet determined where other stations, if any, are to be located.

The officials of the company have stated to the Commission that they did not deem it expedient to have a station on this route between the southern terminus of the tunnel and Summer street.

The following considerations, among others, influenced the Commission in selecting the May place-Devonshire and Union streets route in preference to the Washington street route:

1. Washington street is now, and for some time has been, seriously choked with traffic. It is the most congested mile of thoroughfare in New England. More people cannot use the sidewalks with comfort. Furnishing additional facilities for traffic under the street without the removal of the surface tracks would still further intensify the congestion, which will be unnecessarily increased because people will have to go to Washington street simply to get to and from the tunnel stations. This is well expressed in the letter of the Elevated Railway Company dated March 30, 1903, above referred to and marked "Exhibit G."

2. Washington street is served by surface cars. This service is slow and unsatisfactory, but it is better than the transportation service now rendered for the area between Washington street and Atlantic avenue. In this area there is no through continuous street or car service north and south.

3. The importance and demand for transportation facilities of the office and business district east of Washington street is growing rapidly. This growth has taken place in spite of the fact that the district has been suffering from the inferiority of its traffic facilities, as compared with the district immediately adjoining Washington and Tremont streets. A tunnel on the route selected would conveniently serve this district. It would serve it better and meet its special requirements better than a subway for surface cars. Its operation would not increase the congestion of traffic on the Washington-street sidewalks.

4. By Section 12 of the act the company, upon the completion of the tunnel and appurtenances, is required to remove its elevated cars or trains from the existing subway, and thereupon any alterations therein or in the approaches thereto necessary to readapt the present subway to the use of the surface cars are to be made by the Commission. This phraseology clearly indicates that the present subway is to be reserved for the use of surface cars, and that no important part thereof should be taken and used for the elevated trains or cars. The selection of the Devonshire and Union-streets route renders it possible to avoid such taking. The selection of the Washington-street route would necessitate a breaking into and a taking of a considerable section

of the present subway, between Adams and Haymarket squares, unless the tunnel were diverted from a direct line under Washington street to Union street, thereby materially increasing the amount of curvature, or unless the tunnel should be carried under the present subway in Washington street, and be brought to a connection with the elevated structure on Causeway street by an incline about 1,000 feet in length, which is considered objectionable by the company and by the Commission.

No part of the present subway can, without violating the rights of the parties to the contract for the use of the subway (see "Exhibit A," page 83) and their assigns, be used for the tunnel tracks.

5. The clause excluding the elevated trains or cars from the present subway does not bar its use by surface cars which may be brought to it through the new subway, the construction of which is provided for by the act. The Washington-street route appears to be well adapted for the construction of such subway. The provision of the act relating to the removal of the surface tracks from Washington street at any time after the expiration of one year from the completion of the subway (Section 14) indicates that the subway and not the tunnel is to be regarded as the substitute for the Washington-street surface tracks and naturally points to Washington street as the route of the new subway.

The Commission is therefore of the opinion that the construction of the tunnel under Washington street for the use of elevated trains, while it may be for the interest of the company, would neither be consistent with the letter and spirit of the act nor the interests and needs of the public.

BOSTON TRANSIT COMMISSION,

By GEORGE G. CROCKER,

*Chairman.*

EXHIBIT G.

*(Exhibits A to F inclusive are plans and prints).*

PRESIDENT'S OFFICE, 101 MILK ST.,

BOSTON, MASS., March 30, 1903.

BOSTON TRANSIT COMMISSION, GEORGE G. CROCKER, *Chairman*, 20 Beacon St., Boston, Massachusetts.

DEAR SIR: We beg to acknowledge the receipt of your favor of February 28th.

If it were deemed advisable to have, when built, both a tunnel for the Elevated trains, and a subway for the surface cars under Washington Street, then it would probably be necessary, or at least, desirable, to build both at this time. We do not understand that this is deemed advisable, but, on the contrary, that various reasons make it desirable that when both a tunnel and a subway shall have been built, the tunnel shall be to the east of Washington Street; some of the reasons being:

1. That Washington Street is already congested by foot passengers and the giving of additional facilities under that street would but add to that congestion.

2. That the large office district is growing very rapidly, and likely in future to grow more rapidly, and that traffic would not only be removed from Washington Street by a tunnel to the east of Washington Street, but would be more conveniently served thereby.

Under the provisions of the Acts of 1902, chapter 534, if but two tracks are to be built at once, they must be in a tunnel, so-called. If this tunnel is to be to the east of Washington Street, we believe that it would not be expedient to build the subway until after its completion, as we estimate that such a tunnel would add at least 75 per cent. to the north and south subway carrying capacity of the City, which would take care of the present congestion and the natural increase for at least several years, and to such an extent as to give time after it had been in operation, to form a clearer judgment than can now be formed, as to the building of the subway.

We are, therefore, for these reasons of the opinion that it is expedient at this time to build only the tunnel, but we feel that we should say to you also that the rental burden involved by the building of both the tunnel and subway at this time, would be so heavy as in itself to make it impossible for us to assent to the building of the subway at this time.

Yours very truly,

BOSTON ELEVATED RAILWAY COMPANY,

(Signed)

By WM. A. BANCROFT,

*President.*

The Company's brief was:

BOSTON ELEVATED RAILWAY COMPANY.

PRESIDENT'S OFFICE, 101 MILK STREET,

BOSTON, MASS., July 30, 1903.

*To the Honorable Board of Railroad Commissioners, 20 Beacon Street, Boston, Massachusetts:*

GENTLEMEN,—In support of the application of the Boston Elevated Railway Company to your Board, made July 1, 1903, for a revision of the determination by the Boston Transit Commission of the route of a tunnel for the use of elevated cars or trains, via May Place, Otis Street, Devonshire Street, Union Street, as authorized by chapter 534 of the Acts of the year 1902, we submit the following:—

1. The law provides for two underground railways, one for elevated trains, the other for surface cars. Under the law either may be deep or shallow. The one for elevated trains is termed a "tunnel": the one for surface cars is termed a "subway." Elevated trains will carry at least twice as many people to their destinations as will surface cars in a "subway," and will carry them with much greater speed. Washington Street always has been, now is, and always will be the street to which the largest number of people want to go. Therefore, the route for elevated trains should be under Washington Street in a shallow\* "tunnel." The route for surface cars should be east of Washington Street, so as to provide a station near the surface at Post-office Square. It was found not practicable to provide such a station at Post-office Square for elevated trains, but it was found practicable to provide such a station in a "subway" for surface cars. Such a route for surface cars is tentatively shown on plans herewith submitted marked "B and B1."

2. The route for elevated trains must be as nearly straight as possible. The route for surface cars may turn angles as sharp as street corners. Washington Street is straight enough to permit

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\* "Shallow" is used to mean "near the surface."

a route for elevated trains directly under that street; therefore, its stations may be close to the surface. No route for elevated trains could be found east of Washington Street, which could follow the street lines. On the contrary, either the Devonshire Street route or the Post-office Square route must go deep under private property, and therefore must have deep stations, the objections to which are overwhelming. But the "subway" for surface cars can follow the street lines, as does the present subway,—can therefore be close to the surface, and its stations can be close to the surface. Post-office Square is the centre of a large and rapidly growing office district, and for it a station should be planned,—and a shallow one. This can be provided only by the "subway" for surface cars.

We believe now, as we believed when our letter of March 30, 1903, was written, that one of the two underground railways provided by chapter 534 should be built under Washington Street and the other under Post-office Square. We now know, what we did not know then, that it is not practicable to build a route for elevated trains with a station near the surface at Post-office Square. But, as it is practicable to build a route for surface cars with a shallow station at Post-office Square, it should be built there. Not only did the Post-office Square route prove impracticable for elevated trains, but we found upon further investigation that the best route for elevated trains was under Washington Street: and that is so, even if it were feasible to build such a route elsewhere with shallow stations: and it is so, even looking only for relief from congestion.

3. If the route for elevated trains were built east of Washington Street and the route for surface cars under Washington Street, the territory included by Washington and Tremont Streets would contain two subways for surface cars and no elevated line; and the territory east of Washington Street would contain two elevated lines (Atlantic Avenue and a "tunnel" for elevated trains) and no subway for surface cars. This arrangement would place the more efficient service in the territory to which the smaller number of people resort, and the less efficient service in the territory to which the greater number of people resort. Each of these territories should contain both kinds of service.

The route for elevated trains will be the north and south trunk line of the system, because the rapid service, large capacity, and extensive terminal facilities of the elevated lines adapt it to that purpose.

With a trunk line for elevated trains under Washington Street and a subway for surface cars to the west under Tremont Street, and a "subway" for surface cars, when built, to the east under Post-office Square and other points, providing shallow stations, together with the East Boston tunnel and the proposed route for elevated trains to Cambridge, running east and west, the community would have a well-nigh ideal system, furnishing connections both underground and above, which an easterly "tunnel" route could not furnish.

4. The route for elevated trains under Washington Street should have a station at the old State House, another at or near Summer Street, another at or near Boylston Street, thus serving the office district, the shopping district, the hotel district, and the theatre district. The Washington Street route for elevated trains supplies all these stations. The Devonshire Street route does not.

5. A deep "tunnel" for elevated trains under Devonshire Street and a "subway" for surface cars under Washington Street would not be so efficient as a shallow "tunnel" for elevated trains under

Washington Street and a "subway" for surface cars under Post-office Square and other streets, located as we have indicated on plans marked "B and B1," for the reason, among others, that two stations at the Old State House, provided by the former plan, would not furnish as much accommodation as would one station at the Old State House and a shallow station at Post-office Square, provided by the latter plan.

6. The number of people who could use two shallow stations on Washington Street, one at or near Summer Street, and one at or near Boylston Street, would be much greater than the number who could use one deep station at the junction of Summer and Otis Streets, or than would use one such station and another deep station further south—the one further south, in order to be approximately near the district which would be served by a station at Boylston and Washington Streets, must be near the existing elevated station at Beach Street; and experience has shown that such a station would be very little used.

7. One of the important purposes of the "tunnel" is to relieve Washington Street of congestion. The immediate, as well as the future, relief of congestion will be greater by means of a "tunnel" under Washington Street than by means of a "tunnel" under Devonshire Street. If the "tunnel" were built under Devonshire Street, with a station at Otis and Summer Streets, it would increase sidewalk congestion by inducing all its shopping district passengers to go to one station. It would increase the blockades by compelling more persons to cross the street.

If the "tunnel" is built under Washington Street, it will reduce sidewalk congestion by providing two stations in the heart of the shopping district, thus distributing instead of concentrating the walking. It will reduce street congestion by reducing the number of surface cars on that street. It will reduce the blockades by relieving many persons of the necessity for crossing that street or for waiting on the sidewalk for surface cars. Moreover, if the "tunnel" were built on the Devonshire-Otis Streets route and the station were at Summer and Otis Streets, most of those who wish to go toward Washington Street and further west—and they will be by far the largest number using the station—will pass west on Summer Street; whereas, if the station is at Summer and Washington, part will go east and part will go west.

A "tunnel" under Devonshire Street and a "subway" under Washington Street would mean two stations at the Old State House, in addition to the East Boston Tunnel station. Such a condition would cause more congestion than any other plan which has been suggested.

8. The proposed station at Summer and Otis Streets is a deep station. The proposed stations at Summer and Washington Streets and at Boylston and Washington Streets are shallow stations. Shallow stations are absolutely essential to comfort and convenience. Deep stations with long and tedious staircases are objectionable to all, but especially so to women, who constitute most of the riders in the shopping district and a large portion of those in the other districts.

9. The theatre and evening business would be best served by the Washington Street route. Such business is entirely on or west of Washington Street. It centres in the neighborhood of Boylston Street. A shallow station at Boylston and Washington Streets would serve this important and rapidly growing traffic most conveniently. If a station is not provided at this point, a very great opportunity to serve a large number of people is disregarded. Such

a station could not be provided by a Devonshire Street route for elevated trains.

10. A "tunnel" ought not to be built to the east for the purpose of trying to compel people to abandon Washington Street as a centre of business. As Washington Street and its adjacent streets have been for generations, and are now, the streets most resorted to in this community, so, by all human experience, they will continue to be; and, to carry this larger number of people to Washington Street where they wish to go, the most efficient service should be provided.—to wit, a route for elevated trains.

11. In considering the question of route, we have confined ourselves to the district where the greatest number of people wish to go; namely, between Adams Square and Boylston Street. The route north of State and Court Streets is important. Union Street, selected by the Transit Commissioners, is practicable. North Washington Street is far preferable, and, if it should prove that any technicalities prevent its use, they can undoubtedly be removed. (Letter of Transit Commission dated June 12, 1903, a copy of which is herewith annexed, marked "E.")

Respectfully,

BOSTON ELEVATED RAILWAY.

By WILLIAM A. BANCROFT,

*President.*

The following exhibits are herewith submitted:—

- A. Map of City by Ball, scale 250' = 1 inch.  
Showing Transit Commission's line in black and Washington Street line in red.
- A-1. Photograph of the above.
- B. Map of City by Ball, scale 250' = 1 inch.  
Showing Washington Street route in red, present subway and proposed subway in yellow.
- B-1. Photograph of the above.
- C. Blue print, scale 50' = 1 inch, showing study for Devonshire-Union Street route in black and Washington Street route in red.
- D. Blue print, scale 50' = 1 inch, showing study for Washington Street-Union Street route, and connection of the proposed subway with existing subway.
- E. Letter of Transit Commission, dated June 12, 1903 (printed).

EXHIBIT E.

BOSTON TRANSIT COMMISSION,  
20 BEACON STREET, BOSTON, June 12, 1903.

WILLIAM A. BANCROFT, *President, Boston Elevated Railway Company:*

DEAR SIR,—Your letter of June 8th was duly received, and its suggestions have been considered by this Commission.

You write that it seems to your Board of Directors desirable "to have the technicality in the bill of 1902 removed so as to permit the Commission to use, if desirable, two tracks of the existing subway north of Adams Square for elevated trains on condition of the replacement for the use of surface cars of the two tracks so taken."

You further state that your Company favors the Washington Street route for the tunnel for elevated train service, and you ex-



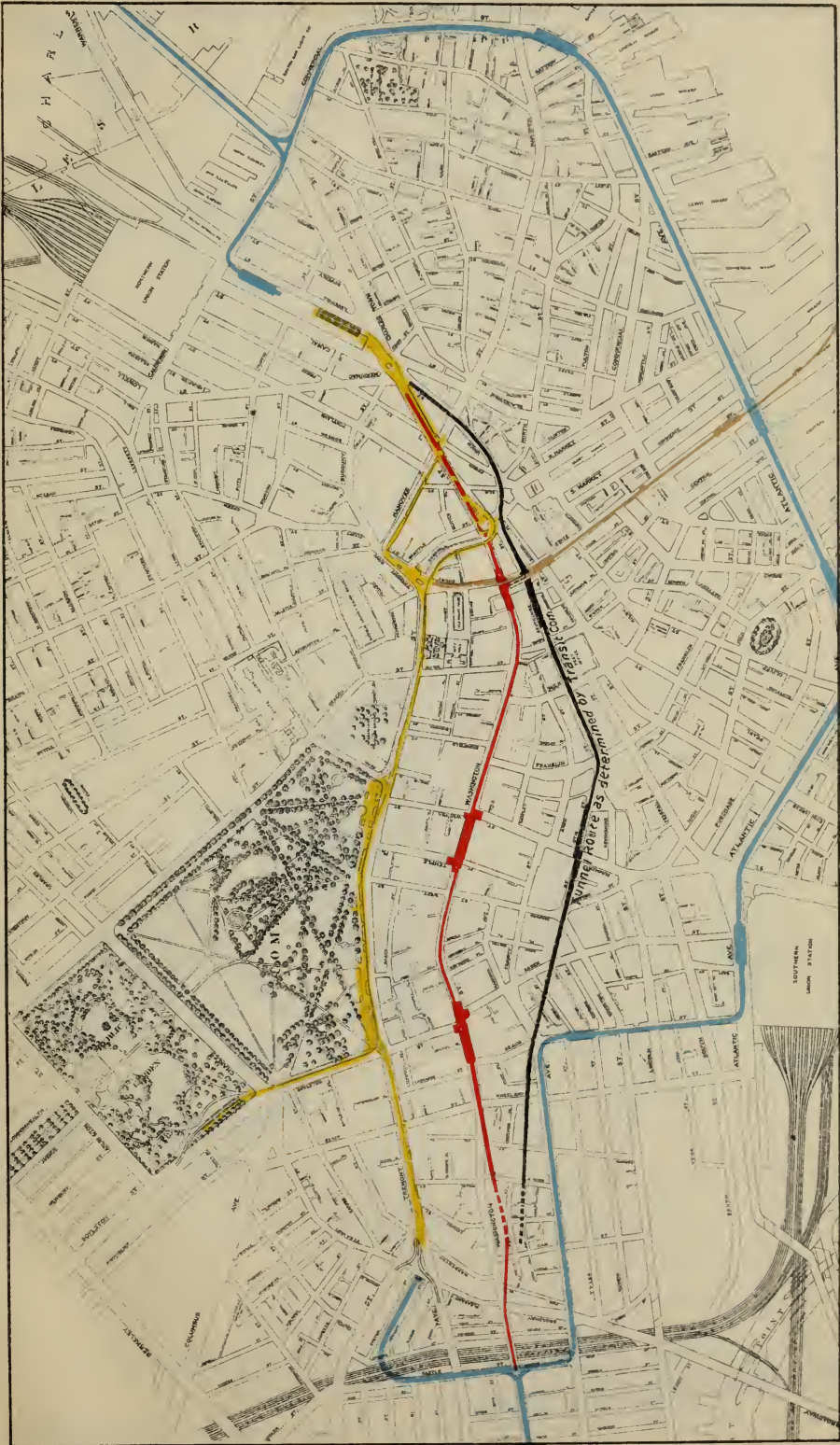


EXHIBIT A.  
ACCOMPANYING BRIEF OF BOSTON ELEVATED RAILWAY COMPANY.  
TRANSIT COMMISSION'S LINE IN BLACK AND WASHINGTON-STREET LINE IN RED.

THE BOUNDARY OF THE COUNTY OF ...  
AS SHOWN BY THE ...  
...



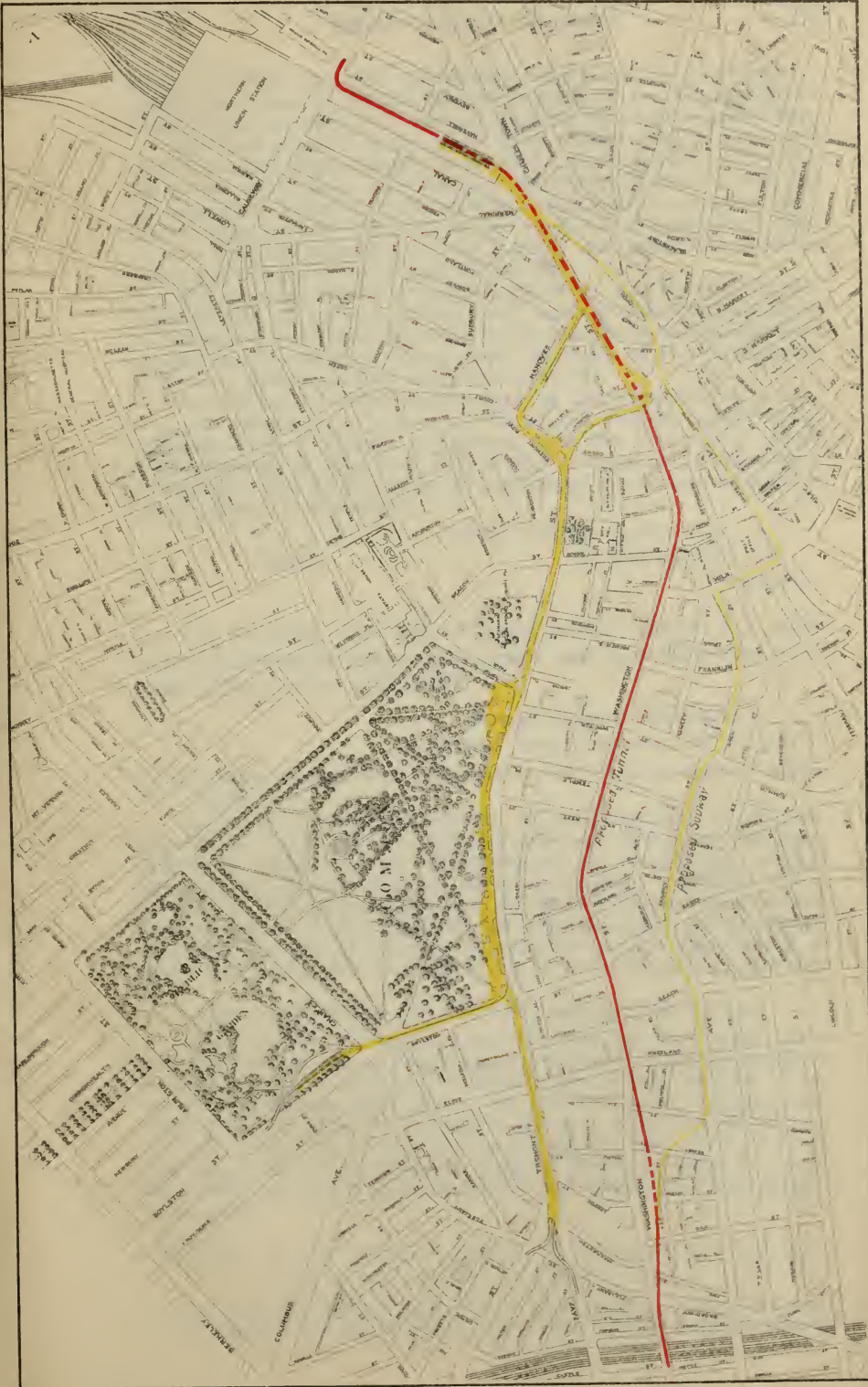


EXHIBIT B.  
 ACCOMPANYING BRIEF OF BOSTON ELEVATED RAILWAY COMPANY.  
 WASHINGTON-STREET LINE IN RED. PROPOSED SUBWAY AND PROPOSED SUBWAY IN YELLOW.

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press the wish that this Commission might see its way clear to asking the Governor at the present session of the Legislature to apply for an amendment of the act granting the desired permission.

The Commission, on the other hand, deems that a route east of Washington Street should be selected. In connection with such route the Commission may deem it expedient, though it will not be necessary, to use for the elevated train service between Haymarket Square and Causeway Street two of the tracks now used for the northern approach to the subway and substitute therefor equivalent tracks on the Canal Street side.

If this course should be deemed desirable, and if, upon further consideration of the act of last year, such a substitution should be thought to be beyond the scope of the powers of the Commission, application for an amendment could be made to the Legislature at its next session without delaying the work.

Such being the views entertained by the Commission, it cannot with propriety, at the very end of the session, apply to the Legislature for a change in the law, and the Commission, after reconsideration of its vote of 29th of May relating to the expediency of asking at the present time for additional legislation, adheres to the conclusion then reached.

BOSTON TRANSIT COMMISSION,  
(Signed) By GEORGE CROCKER,  
Chairman.

In October, the Board expressed a desire for additional information from each party, and the following communications were submitted:

BOSTON TRANSIT COMMISSION,  
20 BEACON STREET, BOSTON, Oct. 29, 1903.

*To the Board of Railroad Commissioners of the Commonwealth of Massachusetts.*

GENTLEMEN: This Commission, as supplementary to its communication dated July 21, 1903, submits the following additional facts and suggestions in the matter of the application to your Board made by the Boston Elevated Railway Company for a revision of the determination by the Boston Transit Commission as to the route of the tunnel for the accommodation of two tracks especially for use by elevated cars or trains, the construction of which was authorized by Chapter 534 of the acts of the year 1902.

#### WASHINGTON STREET THE MOST FREQUENTED THOROUGHFARE.

More people use Washington street than use any single north and south street east of Washington street, but Washington street is now and until a subway is built under it will continue to be served by a surface line, and is only 500 feet on the average from Tremont street with its four track subway. With a tunnel service 700 feet to the east of it, a four track subway 500 feet west of it, and two tracks on its surface, or better still two tracks in a subway under it, it will have the best traffic facilities of any section of the city.

#### COMPARISON OF THE TRAFFIC CAPACITY OF A TUNNEL FOR ELEVATED TRAINS AND A SUBWAY FOR SURFACE CARS.

On Aug. 17, 1903, a count was made in the present subway of the number of persons going south from Boylston street station

on the elevated trains, and on the surface cars, in the hours of greatest traffic, namely, between 4.30 and 6.30 P. M. For the maximum sixty minutes' traffic between the hours mentioned, the count was as follows:

Surface.		Elevated.	
Passengers.	Cars.	Passengers.	Cars.
6,959	226	4,353	124 <sup>1</sup>

The maximum capacity of the subway for surface cars may be put at 240 cars per hour, though this number has sometimes been exceeded. The standard closed car seats 34 passengers, the 9-bench open car seats 45 passengers, and the lately built 12-bench car seats 60 passengers:

$$240 \times 34 = 8,160 \quad 240 \times 45 = 10,800 \quad 240 \times 60 = 14,400$$

If the elevated railway terminal platforms, now 180 feet long, and the way station platforms, now 160 feet long, were lengthened to 254 feet so as to accommodate 6-car trains, and if it is found that thirty 6-car trains can be run in an hour, then the seating capacity of the elevated trains would be  $180 \times 44 = 7,920$ .

If the platforms at the terminals and way stations were lengthened to 348 feet so as to accommodate 8-car trains, and thirty of these trains can be run in an hour, their seating capacity would be  $240 \times 44 = 10,560$ .

Owing to the long inclines necessary in passing between the level of the elevated structure and the level of the subway and the grade crossings at the junctions at Castle street and Causeway street, it is questionable whether 30 trains of 8 cars can be run through the tunnel in an hour.

The standing room in a 25-foot box car is 87 square feet, exclusive of platforms.

The standing room in an elevated train car is 157 square feet, exclusive of platforms.

There is no standing room on an open car except the platforms.

ABSTRACT FROM THE "EQUIPMENT" STATEMENT OF THE BOSTON ELEVATED RAILWAY COMPANY TAKEN FROM ITS ANNUAL REPORTS DATED ON SEPTEMBER 30 OF EACH YEAR.

SURFACE CARS.	1897.	1898.	1899.	1900.	1901.	1902. <sup>2</sup>
Box cars, 16 ft. bodies,	70	65	55	51	51	51
20 " "	335	330	330	330	330	330
25 " "	761	884	933	1,157	1,182	1,182
Open cars, 7 or 8 benches,	580	568	568	563	568	568
9 benches,	567	677	747	747	747	747
10 "	47	47	46	46	46	46
12 "	..	..	31	81	181	181

The surface cars of other corporations which have begun to run into the city within the last year, such as the Waltham, Auburn-dale, Hyde Park, Blue Hill, Boston & Worcester, are mostly large high-speed modern cars equipped with powerful motors and air brakes.

<sup>1</sup> 31 trains of 4 cars each.

<sup>2</sup> The statement for this year includes also 150 box cars for the elevated equipment.

## COMPARISON OF THE SPEED OF ELEVATED TRAINS AND SURFACE CARS.

The motive power of the present surface cars of the company is less in proportion to the weight of the car than that of the elevated train car, and the surface car cannot attain as high speed as the elevated train, but the ability to run at high rates of speed counts for little or nothing where stations are as close together as they are in the present subway, or as they should be along the Washington-street route. Not infrequently a surface car running in the subway from Scollay square will reach the North Union station on the street level as quickly as the train starting at the same time reaches its elevated platform.

## COMPARISON OF THE DEPTH OF THE STATIONS ON THE ROUTE SELECTED BY THE TRANSIT COMMISSION, OR THE EAST SIDE ROUTE, WITH THOSE WHICH COULD BE CONSTRUCTED ON THE WASHINGTON-STREET ROUTE.

As a rule, the less the depth of a station platform below the surface the greater will be its convenience for the public, and the less the operating expense for the company.

The following table shows the practical depth of tunnel platforms below the surface on the two routes, as furnished by Chief Engineer Carson:

*On Washington-Street Line.*

Station.	South End.	Middle.	North End.	Average.
Boylston street . . . . .	18'	18.5'	18'	18.16'
Summer street . . . . .	19.5'	17'	21.5'	19.33'
State street . . . . .	37'	37'	37'	37'
Average . . . . .				24.83'

*On May Place-Otis-Devonshire Street Line.*

Station.	South End.	Middle.	North End.	Average.
Beach street and Harrison avenue	21'	20.5'	20'	20.5'
Summer street . . . . .	21.5'	20'	20'	20.5'
State street . . . . .	32'	34'	29'	31.66'
Average . . . . .				24.22'

Omitting from consideration the Boylston-street and Beach-street stations, because on the east side route a station at Beach street may not be needed, there being already a station at the corner of Beach street and Harrison avenue, on the elevated loop line, the averages would be as follows:

Washington-street line, 28.16 feet. May-place, etc., line, 26.08 feet.

## THE THEATRE AND EVENING BUSINESS.

If but one underground railway was to be built there would be a strong argument for placing it under Washington street to accommodate the theatre and evening business. The act, however, provides for the construction of two underground railways,—a tunnel for elevated trains to be built at once, and a subway for surface cars in the near future. The Washington-street route seems to the Commission to be the appropriate route for this subway.

## CURVATURE.

Curvature means slower transit and increased expense of operation. The east side route for the tunnel has practically the same amount of curvature as the Washington-Union-street route, but the route suggested by the Commission for the subway, namely, Washington street, has much less curvature than the subway route suggested by the company; in other words, the Commission proposes a route for the tunnel and a route for the subway which are about equally straight. The company proposes a route for the tunnel as straight as that proposed by the Commission, but a comparatively crooked route for the subway.

## ADAPTABILITY OF A TUNNEL TO THE REQUIREMENTS OF THE EAST SIDE TRAFFIC AND OF A SUBWAY TO THE WASHINGTON-STREET TRAFFIC.

The motors of the elevated trains are of greater power and can propel at higher speed than those of the surface cars. Speed is more important for an office and business district, such as that along the Transit Commission's tunnel route, than it is for the shopping and theatre district along Washington street from Boylston street to Milk street. Washington street is the great shopping street of the city. On it frequent stops are more desirable than great speed. A rapid train service for the east side district, and a surface car service for the Washington-street district seems more appropriate than the reverse arrangement would be.

When a subway is built under Washington street, its benefits could be distributed by building sidewalks on each side of the tracks, thus making, as it were, a continuous station. The stopping places for the surface cars could then be as frequent as might be desired. They might even be changed from time to time to work greater equality. To such conditions a surface car service would be better adapted than a train service. The surface car service in the subway would then be only a reproduction of the service on the surface, except that the tracks would be free from interference from other traffic, and would also in winter be free from ice and snow.

As a possible development, the basements of the stores might have openings on these sidewalks and, perhaps, display windows, and thus an underground street be provided for the exclusive use of surface cars and people on foot. The abutting estates would reap the benefit of more valuable basements. The street above would be relieved by the use made of the sidewalks in the subway, and shoppers using these sidewalks in the subway for access to the basements of the stores would frequently be able to make their purchases without climbing any stairs whatever. Such sidewalks would be of special convenience in wet, snowy, severely cold, or uncomfortably hot weather. The company would in some measure get the advantage of the profitable short distance traffic of which it would otherwise be deprived by the removal of the tracks from the surface.

BOSTON TRANSIT COMMISSION,

By GEORGE G. CROCKER,

*Chairman.*



## BOSTON ELEVATED RAILWAY COMPANY.

PRESIDENT'S OFFICE, 101 MILK STREET,

BOSTON, MASS., NOV. 18, 1903.

*To the Honorable Board of Railroad Commissioners of the Commonwealth of Massachusetts:*

GENTLEMEN,—Supplementary to our communication of July 30, 1903, we wish to add:—

1st. Washington Street, being the most frequented thoroughfare, should have the *best possible* traffic facilities, not merely the "best of any section of the city." The best possible facilities in either a "tunnel" or subway are afforded *only* by a train service because of its greater capacity and speed.

2nd. The Transit Commissioners' count of south-bound elevated traffic at the Boylston Street subway station for the maximum hour on August 17 shows a number of passengers sufficient to fill only three-fourths of the seats in the trains, whereas during that hour many persons are obliged to stand. This result is due to the inclusion of trains bound for Atlantic Avenue, which are practically empty when leaving the subway, although later heavily loaded with passengers for Charlestown. The "rush hour" loads of elevated trains sometimes reach the number of 120 to 140 passengers per car.

In computing the traffic capacity of a surface car subway, the closed car must be taken as the standard, because it is the only one that can be used during the greater part of the year. To reckon the seating capacity of the open car as always available is therefore unwarranted. 240 surface cars, each seating 34 passengers, supply 8,160 seats per hour; 60 elevated trains of 6 cars each, or 360 elevated cars, each seating 48 passengers (not 44, as stated by the Transit Commission) supply 17,280 seats per hour. A "tunnel" for elevated trains would therefore provide a maximum seating capacity double that of a subway for surface cars. Besides the advantage in seating capacity, the elevated cars provide double the standing room of surface cars. A train every minute is entirely possible in a suitably constructed "tunnel." In New York six car trains are operated at less than one minute intervals. In Chicago trains running through interlocking junctions at intervals of 45 seconds have been found to be practicable. Moreover, trains are not limited to 6 cars. The "tunnel" should have its stations designed for eight-car trains. The present subway affords no measure of the capacity of a "tunnel" especially designed for elevated traffic.

The Transit Commission designates certain out-of-town cars now run into the city as "mostly large high speed modern cars." The Boston & Worcester cars are so large that they cannot be run in the subway or generally upon the surface tracks in Boston. The cars of all the other companies mentioned are of the same size as our standard cars, and but one of the lines—the Blue Hill—is equipped for greater speed. Greater speed capacity is valueless for surface cars in that part of Boston through which they must pass to enter a subway, because our cars are capable of the greatest speed permitted by law.

A subway for surface cars cannot be served with larger cars than can be safely run upon the surface tracks connecting with such subway. Increase in size and speed of surface cars operated singly necessarily diminishes the number which can be safely operated.

3rd. So far as speed is involved, the elevated trains do in fact run faster than surface cars between the present subway stations,

but the principal superiority of a "tunnel" for elevated trains over a subway for surface cars lies in the opportunity for elevated trains to make high speed outside of the "tunnel," whereas the speed of surface cars outside of a subway is restricted by other street traffic. On the elevated structure, trains running between given points take less than one-half the time of surface cars running underneath them between the same points. Passengers can be carried between Washington Street stations and the elevated terminals in elevated trains, using a "tunnel," in less than half the time required for surface cars using a subway.

4th. The station depths given recently by the Transit Commission on the May Place-Otis-Devonshire Street line are not in accordance with the depths shown on profile No. 5967, furnished to this company by the Transit Commission, dated June 18, 1903. The depth given for the Beach Street Station is 20.5 feet, while the profile shows 25 feet; that at Summer Street is given in the statement as 20.5 feet, and on the profile as 27 feet. There is no material difference at State Street.

It is evident that if the "tunnel" should be built at the depths given in the recent statement of the Transit Commission, it would be necessary to introduce impracticable grades or construct it through the basements of the valuable store properties on the southerly side at Bedford Street, which would be very expensive and would add greatly to the estimates of cost already presented by the Transit Commission.

The difference in level named for the two stations at State Street, 5.34 feet, is unimportant, because both are deep stations and, most unfortunately, will probably require elevators. The depth of this station is much to be deplored, for this will be a station of heavy traffic. The north and south traffic will far exceed the east and west traffic, and a shallow station at State Street on either route would have been feasible, had the East Boston tunnel been built at the lower level; but this plan was not followed.

5th. It is not necessary that a subway with a station at Post-office Square should follow the route tentatively suggested by us, if it is worth while to go to the expense of making the alignment straighter by going under buildings. It is entirely possible, physically, to do so; for a subway for surface cars is feasible anywhere that a "tunnel" for elevated trains is feasible, and in many places where a "tunnel" is not feasible.

6th. A station at Post-office Square is feasible in a subway for surface cars, and is not feasible in a "tunnel" for elevated trains. We deem such a station very important. If the easterly route were selected for the "tunnel" and Washington Street for the subway, this advantage would be lost, and congestion would arise by the concentration of three stations at State Street. Congestion would also arise because the easterly route for the "tunnel" would limit the useful stations in the heart of the city to two in number.—namely, State Street and Summer-Otis Street; whereas the Washington Street route for the "tunnel" provides three stations.—namely, State Street, Summer Street, Boylston Street, and incidentally an additional station at Post-office Square for the subway. The distribution of traffic among three stations, instead of concentrating it in two stations, would reduce the delays at stations and expedite the movement of trains.

7th. We have not considered the provision of an underground street to be within the scope of the legislation upon which this appeal is taken. If it is within its scope, such a street can be provided in connection with a Washington Street "tunnel" as well as in connection with a Washington Street subway.

8th. The Transit Commission states that "speed is more important for an office and business district than it is for the shopping and theatre district." We fail to see why occupants of offices are entitled to any more consideration than shoppers and those who serve them. We think they are both entitled to equal consideration and to the best possible service, which is furnished by our plan, and is not furnished by the Commission's plan.

9th. Our plan, therefore, provides in the street of greatest traffic three stations supplied with a service of double the capacity and of double the speed of a subway service.

10th. A tunnel for trains in Washington Street with three stations as proposed by the company will accommodate the short-distance travel as well as a subway with three stations for surface cars, and will accommodate the long-distance travel much better. No more than three stations in the business district could possibly be operated if the surface car subway were provided.

11th. The proposed "tunnel" stations on the Washington Street route are as frequent as would be desirable in a subway and as frequent as those in the present subway. Indeed, the Tremont Street stations would be exactly reproduced on Washington Street, except that the latter would be much more convenient in design and size.

12th. A subway operated by surface cars entering it from the streets does not afford a system of rapid transit, but merely an improvement in station facilities and a mitigation of street congestion. Its station platforms must be larger than are required for a train service because persons wait for cars for a particular point instead of being removed by each train as it arrives. Still further, its service is limited in capacity by the capacity of the approaches, in size of cars by the size of cars that can be safely run over the approaches, in regularity of service by the natural street obstructions which make all surface car service irregular. For these reasons alone such a service should not be considered at all where the advantages of train service are possible.

To recapitulate, we wish to point out:—

1. Washington Street is the most frequented thoroughfare. It should have the best possible traffic facilities. The best possible facilities are afforded only by a fast train service.

2. A station at Post-office Square is most important. Such a station cannot be provided in a "tunnel" for elevated trains, but can be provided in a subway for surface cars.

3. A "tunnel" for elevated trains ought to be substantially straight. Such a tunnel can be built directly under Washington Street. If a straight "tunnel" is built to the east of Washington Street, it must go under buildings and must be either deep or costly. A subway need not be as straight as a "tunnel," and it is entirely feasible to follow street lines for a subway east of Washington Street. If it is worth while to build it straighter, it can be done by paying the cost.

4. If the "tunnel" were built east of Washington Street, the more efficient service would be placed in the territory having the less volume of business.

5. The Washington Street route for the "tunnel" serves the office district, the shopping district, and the hotel and theatre district. The easterly route serves only a part of these districts, and locates the service where it will be practically useless during the evening.

6. More and better station accommodation is furnished by the Washington Street route for the "tunnel," and the stations are much more conveniently located.

7. A much larger number of persons would be accommodated by the two shallow stations in Washington Street, one at Summer Street and one at Boylston Street, than would be accommodated by the Summer-Otis Street station, whether deep or shallow, or would be accommodated by that station and another, that "may not be needed," near the elevated station at Beach Street.

8. The "tunnel" route under Washington Street is the most efficient method of relieving the congestion of streets by pedestrians, as shown in paragraph 7 in communication of July 30.

9. A "tunnel" to the east of Washington Street would involve an attempt to compel people to abandon Washington Street, the centre of business.

10. A "tunnel" is more suitable than a subway for Washington Street traffic, because *it will carry more than double the number of passengers, and carry them in less than half the time.*

Respectfully,

BOSTON ELEVATED RAILWAY,

By WILLIAM A. BANCROFT,

*President.*

November 29, the Board rendered its decision in favor of the Washington Street route in the following terms:

COMMONWEALTH OF MASSACHUSETTS.  
IN BOARD OF RAILROAD COMMISSIONERS.

November 19, 1903.

Acting under chapter 534 of the Acts of 1902 the Boston Transit Commission has selected what it designates as the May place-Devonshire street-Union street route for the tunnel to be constructed in Boston for the elevated trains of the Boston Elevated Railway Company.

The company, feeling aggrieved at the selection of this route, has taken an appeal to this Board under section 13 of said chapter.

Were it right that we should decide this appeal in accordance with the view which we entertain as to the thoroughness, skill and disinterestedness of motive which have characterized the inquiry by the Transit Commission we should endorse all that has been done and decide that the route selected must stand. We believe, however, that in the meaning of the statute the final responsibility for the selection of a route for the tunnel has now devolved upon us as a matter of independent judgment. While aware that a different view from the one held by men of such eminent ability and undoubted devotion to the public interests can only be justified as the result of thorough investigation and careful study, we are of the opinion that upon the whole the public interests will be best served by the selection of a Washington street route for the tunnel. The grounds for this opinion may be briefly stated:

1. As far as it is reasonably possible to bring it about the wish of people to be carried to points of destination by the most direct and the quickest route compatible with safety and convenience should be gratified.

2. The congestion which results where great numbers of people seek the same places of arrival or departure may be relieved by providing more abundant facilities for direct and rapid transportation and quick distribution.

3. While a single problem is now presented, it is to be considered in connection with a general view of the whole field of

transportation within and about the city and is to be decided in a manner consistent with the development of a general plan for meeting other present and future needs.

4. Although engineering skill is equal to almost any undertaking, in the choice of methods of construction consideration is to be given to the public interests in respect to cost and to the public preferences for one method rather than another.

Certain findings rest upon these principles:

1. The largest part of the street travel in Boston seeks Washington street and the localities to the west of it. Owing to the fixed location of attractive centres such as hotels, theatres and churches, and the shopping district, the growth of travel will in all probability continue in this direction. Washington street, therefore, is and is likely to be a main artery of travel. On the other hand, travel in the territory immediately covered by the Devonshire street route, though considerable during the day, nearly ceases after business hours.

2. Taking everything into consideration, the elevated trains furnish beyond doubt the largest facilities for giving an effective service to the greatest number of people. Such a service is peculiarly needed in Washington street.

3. The route for a tunnel to accommodate elevated trains should be as nearly straight as practicable. The wastefulness to the company and discomfort to patrons in the use of the present subway by elevated trains shows the importance of avoiding curves in the construction of the tunnel.

4. A route under the highway such as that proposed beneath Washington street is more generally desirable from the standpoint of the public interests and preferences in travel than a route like the Devonshire street route which is carried for a considerable distance through private property beneath a surface covered by buildings.

5. Relief from the conditions which choke travel upon Washington street is certainly needed. The building of the tunnel under Washington street is consistent with the adoption of measures that are likely to bring such relief.

A subway for surface cars could readily be constructed to the east of Washington street. The curves occasioned by following the course of streets in building it, though undesirable were it to be occupied by elevated trains, would be of comparatively little significance in connection with the operation of surface cars.

Under the statute, after a year from the completion of the tunnel steps to secure the construction of such a subway can be taken if the public interests require it, and opportunity may thus be afforded for the removal of surface cars and for other improvements directed to the relief of the congestion upon the streets.

The Transit Commission in fixing a route stopped at the junction of Union street and Haymarket square.

We think it advisable to stop at the junction of Washington street and Adams square, for the reason that further legislation may be desirable to permit such changes in the present subway and approaches as may be requisite to properly connect the tunnel with the rest of the railway system.

(Signed)

JAMES F. JACKSON,  
GEORGE W. BISHOP,  
CLINTON WHITE,

*Commissioners.*

A true copy.

Attest:

(Signed) CHARLES E. MANN, *Clerk.*

It will be noted that the final paragraph of the decision recommends legislation for completing the tunnel from Adams square, and in accordance with that recommendation the Legislature of 1904 enacted chapter 167, being "An Act Relative to the Construction of a Tunnel for Elevated Cars or Trains in the City of Boston," which will be found in full in Appendix C.

Since the promulgation of the opinion of the Board of Railroad Commissioners the Commission has had before it many studies for the arrangement, size and grades of the platforms, and the locations and methods of exits and entrances at the proposed stations which may be generally designated as the Boylston street, Summer street and State street stations. These have been the subject of numerous conferences with the officials of the Boston Elevated Railway Company. It has been deemed advisable to avoid making an open incline in Washington street which would necessitate the taking of front property on either side to compensate for the width of the street taken up by the incline, and the location finally adopted for the incline lies to the east of Washington street practically as a continuation of the line of that part of Washington street between Boylston and Kneeland streets. The descent from the elevated structure going north at a five per cent. grade reaches the surface opposite Nassau street, where the work of the Commission begins. This grade, with the surface of Oak street lowered slightly and that of Bennet street raised slightly, will do away with the necessity of closing those two streets.

Between Nassau and Bennet streets the incline cuts through the middle part of several estates. If covered, its roof will be above the surface. Between Bennet and Kneeland streets its roof will be below the surface, and it will occupy only the front portion of the basements. From Kneeland street north the tunnel will be under the street.

As a fire occurred in the building at the corner of Bennet and Washington streets March 4, it was deemed that a saving could be effected by taking that property forthwith, and accordingly, on March 10, 1904, the front lot belonging to Reuben Sherburne, containing about 7,700 square feet, was taken. May 16 the Commission took what was necessary from the remainder of the estates between the Sherburne estate and Nassau street, taking all from a line

about 64 feet easterly from Washington street through to Ash street, including the following parcels:

Louis F. Foster et als., buildings and 550 square feet.

Elizabeth Ballard et al., buildings and 2,755 square feet.

Harriet M. Lillie et al., buildings and 1,160 square feet.

Tappan E. Francis, buildings and 125 square feet.

Livingston Cushing, trustee, buildings and 3,670 square feet.

A settlement has already been effected with the Ballard estate. The tenants of these estates have been notified to vacate August 1, and on or about that date the work of demolition will begin.

#### *Stations and Their Entrances.*

Consideration of the volume of traffic on the sidewalks and streets in connection with the width of those sidewalks and streets has convinced the Commission that it would not be expedient to take any portion of the sidewalk or the roadway on either Washington street or the side streets for entrances to the stations. It was determined in all cases to make the entrances in private property, and so far as possible, on side streets. The stations will not be equipped, as in the subway, with island platforms, but there will be a separate platform for the traffic in each direction. At Boylston street, the only station the details of which are in any degree determined, the north bound platform will extend from a point about 22 feet northerly of Hayward place to a point about 40 feet southerly of Essex street; the south bound platform will extend from a point about 7 feet northerly of Boylston street to a point about 28 feet southerly of La Grange street.

#### *Sewers and Washington Street Water Main.*

As a preliminary to the work of construction of the tunnel many sewer changes will be necessary on Washington street. The first contract for this work was made June 16 with Patrick McGovern.

The relocation of a large part of the Washington street water main will be made necessary by the construction of the tunnel, and after conference with the Water Department the Commission has agreed to pay \$36,000 toward the cost of such relocation, which is now in progress.

*Sidewalk Areas.*

The following communications were sent to the Mayor and the Superintendent of Streets in the matter of the occupation of sidewalk areas:

Boston, December 18, 1903.

HON. PATRICK A. COLLINS, *Mayor*:

DEAR SIR: As the Washington street route has been selected for the tunnel for elevated trains, as authorized by chapter 534 of the acts of the year 1902, this Commission suggests that area permits should not be granted along this route unless, upon examination by this Commission, it is found that they will not occupy space which may be needed in the construction of said tunnel. A similar course was followed when the Tremont street subway was built.

The matter is brought to your attention for such action as you may deem to be appropriate.

Yours respectfully,

BOSTON TRANSIT COMMISSION,

By (Signed) GEORGE G. CROCKER,  
*Chairman.*

Boston, April 22, 1904.

HON. JAMES DONOVAN, *Superintendent of Streets*:

DEAR SIR: The following was passed at a meeting of this Commission held to-day:

"*Voted*, that the Superintendent of Streets be requested to grant no area permits within the limits within which the new tunnel and subway may be constructed, according to chapter 534, acts of 1902, as shown in green on plan published in the eighth annual report of this Commission, until after consultation with this Commission."

A true copy.

Attest: (Signed) B. LEIGHTON BEAL,  
*Secretary.*

I enclose a copy of the plan referred to in the foregoing vote.

Yours respectfully,  
(Signed) B. LEIGHTON BEAL,  
*Secretary.*

### SUBWAY.

The contract with the West End Street Railway Company for the use of the subway provides that if, in any one quarter, the amount of tolls computed on the basis of 5 cents for each car of 25 feet body length passing through the subway in either direction exceeds the rental which the Company would pay on the basis of 4 7-8 per cent. annually upon the net cost of the subway, the Company shall pay such excess.

October 24, 1903, the following was received:



## AUDITOR'S OFFICE,

101 MILK ST. BOSTON, MASS. Oct. 24th, 1903.

MR. B. LEIGHTON BEAL, *Secy.*, *Boston Transit Commission, 20 Beacon St., City:*

DEAR SIR: Enclosed herewith please find our voucher No. 12239 for \$4,546.36, together with a check on the Shawmut National Bank for that amount.

This is for additional rental which is due the City of Boston for use of the subway for the quarters ending with June 30th and Sept. 30th, 1903. The rent for the two previous quarters more than equalled the sum computed at 5c. per trip for the cars which ran through the subway under the terms of the lease.

Very truly yours,

(Signed)

H. L. WILSON.

*Auditor.*

Enclosures.

For additional amounts due for the use of the subway for the quarters ending June 30 and September 30, 1903:

June 30, 1903:		
1,102,782 single trips run as provided in lease		
at .05 each .....	\$55,139.10	
Amount of bill rendered on basis of 4 7-8		
cent. of cost .....	53,354.08	\$1,785.02
		<hr/>
Sept. 30, 1903:		
1,122,313 single trips at .05 each .....	\$56,115.65	
Amount of bill .....	53,354.31	2,761.34
		<hr/>
Total .....		\$4,546.36

Last year the sum of \$5,623.04 was received on the same account, making a total of \$10,169.40 thus far paid on account of the operation of the toll system.

*Pleasant Street Entrance.*

A wooden fence, more permanent in its character than the old one, has been erected around the Pleasant street entrance.

*Ventilation.*

The following correspondence is self-explanatory:

BOSTON, October 16, 1903.

BOSTON ELEVATED RAILWAY CO., WILLIAM A. BANCROFT, *President:*

DEAR SIR: The disaster in the subway in Paris leads us again to call your attention to the importance of continuously operating, during business hours, the fans in the various ventilating shafts in the subway. These shafts have been placed between stations and the fans have been arranged to exhaust the air through them from the subway. If the fans are continuously operated and a car should get on fire between stations, the smoke would be drawn towards and out through the ventilating shaft, while passengers

leaving the cars would go towards the stations. As the Commission has notified you several times, it deems the continuous use of the fans to be desirable for the purpose of securing proper ventilation. It now calls your attention to the importance of such operation as a protection against loss of life in case a fire occurs in the subway.

(Signed) Yours very truly,  
 GEORGE G. CROCKER,  
*Chairman.*

PRESIDENT'S OFFICE,  
 101 MILK ST. BOSTON, MASS. October 19, 1903.  
 BOSTON TRANSIT COMMISSION, GEORGE G. CROCKER, *Chairman* :

DEAR SIR: I have your letter of October 16th, current, concerning ventilating fans in the subway. The Company has had a great deal of trouble in getting the contractor to comply with his undertaking, but it is hoped that we shall be able to obtain compliances which will provide for a constant operation of fans.

(Signed) Yours very truly,  
 WM. A. BANCROFT,  
*President.*

BOSTON, January 12, 1904.  
 WILLIAM A. BANCROFT, *President, Boston Elevated Railway Co. :*

DEAR SIR: I am instructed by the Commission to ask what progress is being made toward the obtaining of appliances with which to provide for the constant operation of fans in the subway, in accordance with your letter of October 19, 1903.

(Signed) Yours respectfully,  
 B. LEIGHTON BEAL,  
*Secretary.*

PRESIDENT'S OFFICE,  
 101 MILK ST. BOSTON, MASS. January 15, 1904.  
 BOSTON TRANSIT COMMISSION, GEORGE G. CROCKER, *Chairman, 20 Beacon Street, Boston, Massachusetts :*

DEAR SIR: In response to the letter of your Secretary of January 12th, current, I am instructed to say that we have had a good deal of trouble with the motors provided for the operation of fans. Instructions have been given to repair those that are now out of repair, so that they can be operated at the earliest possible moment. All of the new fans are working. The fans located on Hanover Street near Marston's, and on Hanover Street near Jaynes' cannot be operated to expel the amount of air which was planned because of the fact that the gratings for the discharge of air are in the sidewalk. The result of their full operation caused so much complaint from women whose clothing was disarranged when they passed over these gratings in the sidewalk, that their operation had to be restricted. Some modification has been made in the openings, but the discharge of air is very much less than was ordinarily planned.

It is the opinion of the operating officials of the Company that the proper ventilation of the subway does not need the constant use of all the fans.

(Signed) Respectfully,  
 WM. A. BANCROFT,  
*President.*

## EXHIBIT AT LOUISIANA PURCHASE EXPOSITION.

The exhibit made by the Commission at the Paris Exposition and the Pan-American Exposition has been brought up to date and sent to the Louisiana Purchase Exposition at St. Louis.

## SINKING FUND.

The following sums have been received during the year by the Commission and deposited with the City Collector to the credit of the Rapid Transit sinking fund, East Boston Tunnel loan :

1903 :		
Oct. 16.	Rebate, Belmont Iron Co., Contract No. 165	\$50 00
	Sale of old material . . . . .	32 36
“ 24.	“ “ “ “ . . . . .	313 67
Nov. 13.	Rebate on insurance . . . . .	34 40
Dec. 3.	Sale of plan . . . . .	25 00
“ 12.	“ “ “ . . . . .	25 00
1904 :		
Apr. 21.	“ “ “ . . . . .	2 00
May 11.	“ “ old material . . . . .	55 96
	Total . . . . .	<u>\$538 39</u>

The following is the condition of the debt and of the sinking funds for the various divisions of the work of the Commission at the date of this report :

## SUBWAY (INCLUDING ALTERATIONS).

(Debt, \$4,416,000, outside debt limit.)

Amount of fund, July 1, 1903 . . . . .	\$591,049 90
Interest on bank deposits, July 1, 1903, to date, \$1,328 37	
Interest on investments, July 1, 1903, to date, 24,665 00	
Revenue received, July 1, 1903, to date . . . . .	48,146 62
	<u>74,139 99</u>
	<u>\$665,189 89</u>

## CHARLESTOWN BRIDGE, No. 1.

(Debt, \$750,000, inside debt limit.)

Amount of fund, July 1, 1903 . . . . .	\$85,465 95
Interest on bank deposits, July 1, 1903, to date, \$376 75	
Interest on investments, July 1, 1903, to date, 3,689 50	
Requirement for debt . . . . .	8,620 00
	<u>12,686 25</u>
	<u>\$98,152 20</u>

## BOSTON TRANSIT COMMISSION.

## CHARLESTOWN BRIDGE, No. 2.

*(Debt, \$805,000, outside debt limit.)*

Amount of fund, July 1, 1903 . . . . .		\$94,691 27
Interest on bank deposits, July 1, 1903, to date, . . . . .	\$277 99	
Interest on investments, July 1, 1903, to date, . . . . .	3,059 00	
Revenue received, July 1, 1903, to date . . . . .	970 67	
Requirement for debt . . . . .	8,097 00	
		<u>12,404 66</u>
		<u>\$107,095 93</u>

## EAST BOSTON TUNNEL.

*(Debt, \$3,018,000, outside debt limit.)*

Amount of fund, July 1, 1903 . . . . .		\$22,284 53
Interest on bank deposits, July 1, 1903, to date, . . . . .	\$374 98	
Interest on investments, July 1, 1903, to date, . . . . .	350 00	
Revenue received, July 1, 1903, to date . . . . .	538 39	
Premium on loans . . . . .	1,766 21	
		<u>3,029 58</u>
		<u>\$25,314 11</u>

## BOSTON TUNNEL AND SUBWAY.

*(Debt, \$1,000,000, outside debt limit.)*

Premium on loans . . . . .	\$8,901 50	<u>\$8,901 50</u>
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## AMOUNTS PAID FOR RENTAL OF THE SUBWAY.

The following sums have been paid during the year by the Boston Elevated Railway Company for the use of the subway:

Sept. 30, 1903 :

Net cost of subway . . . . .	\$4,134,550 92	
One quarter's rental . . . . .		\$50,389 84
Alterations : net cost . . . . .	243,238 77	
One quarter's rental . . . . .		2,964 47

Dec. 31, 1903 :

Net cost of subway . . . . .	4,134,550 92	
One quarter's rental . . . . .		50,389 84
Alterations : net cost . . . . .	243,238 77	
One quarter's rental . . . . .		2,964 47

March 31, 1904 :

Net cost of subway . . . . .	4,134,606 99	
One quarter's rental . . . . .		50,390 52
Alterations : net cost . . . . .	243,238 77	
One quarter's rental . . . . .		2,964 47

June 30, 1904 :

Net cost of subway . . . . .	4,134,758 05	
One quarter's rental . . . . .		50,392 36
Alterations : net cost . . . . .	243,238 77	
One quarter's rental . . . . .		2,964 47

		<u>\$213,420 44</u>
Received on toll account . . . . .		<u>4,546 36</u>

## STATEMENT OF EXPENSES.

The following is a classified statement of the expenses of the Commission for the year ending June 30, 1904 :

## SUBWAY.

## ENGINEERING DEPARTMENT.

Office supplies . . . . .	\$11 00	\$11 00
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## SECTION FIVE.

Labor . . . . .	\$40 25	
Field supplies . . . . .	137 06	
	<hr/>	177 31

## SECTION TEN.

Labor . . . . .	\$8 31	
Field supplies . . . . .	56 07	
	<hr/>	64 38

## EAST BOSTON TUNNEL.

## General Expenses :

Office—Repairs . . . . .	\$47 17
Furniture . . . . .	19 25
Supplies . . . . .	482 40
Stationery and printing . . . . .	839 45
Fuel and light . . . . .	233 16
Rental . . . . .	1,500 00
Stenographers . . . . .	2,439 06
Messenger . . . . .	954 00
Clerks . . . . .	954 00
Janitor . . . . .	274 28
Salaries of Commissioners and Secretary . . . . .	28,300 00
	<hr/>
	\$36,042 77

Transferred to Boston Tunnel and Subway . . . . .	22,617 33
	<hr/>

Balance General Expenses, East Boston Tunnel . . . . .	\$13,425 44
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Proportion of Salary of Chief Engineer . . . . .	4,500 00
	<hr/>

17,925 44

## ENGINEERING DEPARTMENT.

Rooms—Repairs . . . . .	\$19 24
Supplies . . . . .	627 24
Stationery and printing . . . . .	1,637 89
Fuel and light . . . . .	132 14
Rental . . . . .	937 50
Janitor . . . . .	173 27
	<hr/>

<i>Carried forward</i> . . . . .	\$3,527 28	\$18,178 13
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<i>Brought forward</i>	\$3,527 28	\$18,178 13
Messenger	405 32	
Stenographers	1,211 80	
Instruments	30 20	
Skilled service	17,253 11	
	<hr/>	22,427 71

## MISCELLANEOUS.

Legal and expert advice	\$3,024 00	
Teaming	3 70	
Field supplies	3,074 93	
Advertising	117 98	
Labor	237 83	
	<hr/>	6,458 44

## SECTION A.

(*In Maverick square and Lewis street, East Boston, to a point 100 feet southwest of Webster street.*)

Office supplies	\$3 67	
Construction	847 82	
Field supplies	1,061 67	
Inspection	16 10	
Legal and expert advice	31 50	
Teaming	23 00	
Labor	608 94	
	<hr/>	2,592 70

## SECTION B.

(*From a point in Lewis street 100 feet southwest of Webster street, East Boston, under harbor between South Ferry slip on the East Boston side and Long wharf on the Boston side, State street.*)

Boston Tunnel Construction Company	\$92,845 00	
Patrick McGovern (Contract No. 200)	7,329 26	
Construction	8,350 97	
Office supplies	281 68	
Field supplies	3,053 17	
Advertising	7 88	
Labor	4,156 14	
Teaming	89 10	
Legal and expert advice	464 10	
Skilled service	394 41	
Inspection	3,319 78	
Instruments	6 00	
Rental	240 00	
Water pipes	353 03	
Stenographer	48 00	
	<hr/>	120,938 52
<i>Carried forward</i>		\$170,595 50

*Brought forward* . . . . . \$170,595 50

## SECTION C.

*(Under State street from India street to near Atlantic avenue.)*

Patrick McGovern (Contract No. 188)	\$87,658 54	
Gow & Foss	979 12	
Coleman Bros. (Granolithic)	393 73	
Construction	9,813 77	
Office supplies	213 91	
Instruments	2 48	
Insurance	253 04	
Advertising	10 50	
Field supplies	2,751 80	
Labor	5,490 82	
Teaming	750 74	
Inspection	578 08	
Water pipes	1,071 78	
Skilled service	70 56	
Rental	166 68	
Legal and expert advice	103 80	
		110,309 35

## SECTION D.

*(In State street between India street and Congress street.)*

H. P. Nawn	\$1,311 26	
Patrick McGovern (Contract No. 188)	10,980 31	
Patrick McGovern (Contract No. 192)	4,409 76	
Gow & Foss (Contract No. 174)	326 38	
Advertising	46 25	
Construction	4,316 48	
Field supplies	391 33	
Office supplies	6 35	
Legal and expert advice	125 10	
Teaming	63 33	
Labor	1,020 14	
Inspection	248 82	
Skilled service	51 00	
Water pipes	117 20	
Instruments	1 05	
		23,414 76

## SECTION E.

*(Station under the Old State House near the head of State street.)*

H. P. Nawn	\$1,807 83	
Woodbury & Leighton	23,650 37	
G. W. & F. Smith Iron Co.	570 82	
Coleman Bros. (Granolithic)	726 93	
Patrick McGovern (Contract No. 192)	4,409 77	
Gow & Foss (Sewer, Old State House)	26 65	
Eastern Bridge & Structural Co.	54 39	
Construction	17,739 77	
<i>Carried forward</i>	\$48,986 53	\$304,319 61

<i>Brought forward</i> . . . . .	\$48,986 53	\$304,319 61
Office supplies . . . . .	104 72	
Field supplies . . . . .	1,459 19	
Advertising . . . . .	5 25	
Labor . . . . .	2,279 93	
Inspection . . . . .	538 30	
Skilled service . . . . .	142 45	
Water pipes . . . . .	215 14	
Insurance . . . . .	270 00	
Electric conduits . . . . .	256 95	
Legal and expert advice . . . . .	71 50	
Teaming . . . . .	84 20	
	<hr/>	54,414 16

## SECTION F.

(From the westerly end of the Old State House across Washington street and along Court street to near Tremont street.)

Coleman Bros. . . . .	\$130,940 05	
Patrick McGovern (Contract No. 188) . . . . .	950 70	
New England Structural Company . . . . .	1,453 76	
Woodbury & Leighton Company (Contract No. 199) . . . . .	12,450 00	
Harrington, Robinson & Company (Contract No. 202) . . . . .	1,203 41	
Labor . . . . .	837 37	
Construction . . . . .	32,679 40	
Inspection . . . . .	5,718 13	
Office supplies . . . . .	576 12	
Field supplies . . . . .	3,048 74	
Skilled service . . . . .	518 63	
Teaming . . . . .	76 85	
Advertising . . . . .	164 72	
Legal and expert advice . . . . .	1,007 20	
Stationery and printing . . . . .	118 87	
Instruments . . . . .	18 83	
Water pipes . . . . .	2,323 70	
	<hr/>	194,086 48

## BOSTON TUNNEL AND SUBWAY.

## General Expenses :

Amount transferred from East Boston tunnel, general expenses . . . . .	\$22,617 33	
Proportion of salary of Chief Engineer, Office — Stationery and supplies . . . . .	7,500 00	
Furniture . . . . .	17 50	
Printing . . . . .	58 93	
Stenographers . . . . .	5 00	
	<hr/>	30,232 31
<i>Carried forward</i> . . . . .		\$583,052 56



Brought forward . . . . . \$583,052 56

## ENGINEERING DEPARTMENT.

Rooms—Lighting . . . . .	\$112 68	
Furniture . . . . .	65 00	
Fuel . . . . .	27 26	
Stationery and supplies . . . . .	1,004 89	
Printing . . . . .	49 17	
Rental . . . . .	562 50	
Janitor . . . . .	101 00	
		<hr/>
		1,922 50

## MISCELLANEOUS.

Legal and expert advice . . . . .	\$2,505 00	
Instruments . . . . .	79 10	
Testing . . . . .	212 16	
Skilled service . . . . .	15,727 28	
Stenographers . . . . .	1,292 69	
Messenger . . . . .	392 18	
Tools . . . . .	1 75	
Labor . . . . .	2,691 85	
Teaming . . . . .	15 15	
Field supplies . . . . .	60 02	
Insurance . . . . .	54 00	
Advertising . . . . .	9 25	
Test pits . . . . .	1,622 36	
Paving . . . . .	545 24	
Counting traffic . . . . .	143 96	
Borings: Labor . . . . .	263 25	
Materials . . . . .	3 25	
Property damages: Takings . . . . .	65,500 00	
Repairs . . . . .	7,795 81	
		<hr/>
		98,914 30

## CHARLESTOWN BRIDGE.

Field supplies . . . . . \$6 50                      6 50

## INTEREST.

East Boston Tunnel . . . . . 67,912 50

Grand Total . . . . . \$751,808 36

## SUMMARY.

	From beginning of work to June 30, 1903.	June 30, 1903, to June 30, 1904.	Total.
Subway.—Subway Com- mission . . . . .	\$14,131 16		\$14,131 16
Part of General Ex- penses . . . . .	117,473 24		117,473 24
Engineering and Mis- cellaneous . . . . .	407,433 06	\$11 00	407,444 06
Carried forward . . . . .	<u>\$539,037 46</u>	<u>\$11 00</u>	<u>\$539,048 46</u>

	From beginning of work to June 30, 1903.	June 30, 1903, to June 30, 1904.	Total.
<i>Brought forward</i> . . . . .	\$539,037 46	\$11 00	\$539,048 46
Section One . . . . .	240,651 71		240,651 71
Two . . . . .	364,892 05		364,892 05
Three . . . . .	308,033 66		308,033 66
Three and one- half . . . . .	9,479 39		9,479 39
Four . . . . .	475,340 37		475,340 37
Five . . . . .	388,135 23	177 31	388,312 54
Six . . . . .	327,494 86		327,494 86
Seven . . . . .	234,883 42		234,883 42
Eight . . . . .	99,890 26		99,890 26
Eight and one- half . . . . .	77,401 99		77,401 99
Nine . . . . .	304,668 85		304,668 85
Ten . . . . .	259,940 15	64 38	260,004 53
Eleven . . . . .	270,310 57		270,310 57
Interest . . . . .	258,575 60		258,575 60
<b>Total</b> . . . . .	<b>\$4,158,735 57</b>	<b>\$252 69</b>	<b>\$4,158,988 26</b>
<b>Alterations.— Part of</b>			
General Expenses . . . . .	\$28,945 53		\$28,945 53
Section Three . . . . .	2,568 26		2,568 26
Four . . . . .	163 42		163 42
Five . . . . .	30,233 01		30,233 01
Seven . . . . .	179,085 95		179,085 95
Nine . . . . .	3 00		3 00
Ten . . . . .	534 04		534 04
Interest . . . . .	1,905 56		1,905 56
<b>Total</b> . . . . .	<b>\$243,438 77</b>		<b>\$243,438 77</b>
<b>Bridge.—Part of General</b>			
Expenses . . . . .	\$53,820 57		\$53,820 57
Construction, etc. . . . .	1,516,370 91	\$6 50	1,516,377 41
<b>Total</b> . . . . .	<b>\$1,570,191 48</b>	<b>\$6 50</b>	<b>\$1,570,197 98</b>
<b>East Boston Tunnel.—</b>			
Part of General Ex- penses . . . . .	\$135,503 88	\$17,925 44	\$153,429 32
Engineering Expenses . . . . .	140,180 09	28,886 15	169,066 24
Section A . . . . .	95,468 63	2,592 70	98,061 33
B . . . . .	954,724 81	120,938 52	1,075,663 33
C . . . . .	334,216 62	110,309 35	444,525 97
D . . . . .	215,481 96	23,414 76	238,896 72
E . . . . .	131,927 10	54,414 16	186,341 26
F . . . . .	12,243 76	194,086 48	206,330 24
Interest . . . . .	103,861 10	67,912 50	171,773 60
<b>Total</b> . . . . .	<b>\$2,123,607 95</b>	<b>\$620,480 06</b>	<b>\$2,744,088 01</b>

	From beginning of work to June 30, 1903.	June 30, 1903, to June 30, 1904.	Total.
Boston Tunnel and Sub- way.—Part of Gen- eral Expenses . . .	\$17,883 31	\$30,232 31	\$48,115 62
Engineering Expenses . . .	7,357 81	100,836 80	108,194 61
Total . . . . .	<u>\$25,241 12</u>	<u>\$131,069 11</u>	<u>\$156,310 23</u>
Grand Total . . . . .	<u><u>\$8,121,214 89</u></u>	<u><u>\$751,808 36</u></u>	<u><u>\$8,873,023 25</u></u>

## OFFICES OF THE COMMISSION.

The premises which the Commission has occupied since August, 1895, were not fireproof and did not afford adequate and proper accommodation for the employees and the plans and other valuable combustible material which had accumulated in the work of the Commission during the past ten years, and on the date of this report the tenancy of the Commission ceases. The eighth and ninth floors of the new fireproof building, No. 15 Beacon Street, have been leased, and as the lease was made while the building was in process of construction, the rooms have been arranged to meet the needs of the Commission.

The report of the Chief Engineer is appended.

GEORGE G. CROCKER,	} <i>Boston Transit Commission.</i>
CHARLES H. DALTON,	
THOMAS J. GARGAN,	
GEORGE F. SWAIN,	
HORACE G. ALLEN,	

## REPORT OF THE CHIEF ENGINEER.

BOSTON, June 30, 1904.

GEORGE G. CROCKER, CHARLES H. DALTON, THOMAS J. GARGAN, GEORGE F. SWAIN, HORACE G. ALLEN, *Boston Transit Commissioners:*

GENTLEMEN: The work of the Engineering Department during the last year has been mainly that of planning and supervising under your direction the completion of the East Boston tunnel and of making studies and plans for the additional tunnel and subway in and near Washington street provided for in the Statutes of 1902.

Valuable aid has been received from the assistant engineers on the work, from Professor S. Homer Woodbridge in relation to ventilation, from J. R. Worcester, consulting engineer, in regard to steel structures, from Professor Charles L. Norton concerning the protection of steel and wood, and from C. S. Sergeant and George A. Kimball, respectively Vice President and Chief Engineer of the Boston Elevated Railway Company, in relation to the general plans and details of the work.

The names of all assistants who have been employed for more than one month during the last year are given in Appendix D. Appendix E gives the names of nearly all the contractors and in some cases of their principal foremen.

BRIEF SKETCH OF PROGRESS ON THE EAST BOSTON TUNNEL  
DURING THE YEAR ENDING JUNE 30, 1904.

The East Boston tunnel, as stated in earlier reports, was begun in May, 1900. At the date of the last annual report, June 30, 1903, it had been, with the exception of a slight gap at Atlantic avenue, substantially completed from the terminus in East Boston to Washington street in Boston proper, and on July 16th of that year the Governor of Massachusetts accompanied by members of the Commis-

sion and others walked through the tunnel from Maverick square to the Old State House.

It was the original intention of the Commission to have that portion of the tunnel in State and Court streets west of the harbor completed at least as soon as the portion under the harbor, and this intention was carried out as far as State street was concerned. The portion in Court street, however, was delayed, as stated in last year's report, on account of conferences and negotiations with the Elevated road that were practically required by law. It had been intended that this portion should turn to the north, pass under the subway and connect with the proposed subway and elevated road to Cambridge. As a result of the negotiations just referred to, that plan was radically changed. The tracks will turn to the south, and connect at grade with the old subway in Tremont street. The short portion in Court street—Section F—has been completed during the past year, as far as it could be without disturbing the movement of trains in the subway. As soon as the track laying is completed, cars may pass through the tunnel in either direction between Maverick square in East Boston and the new station near the former site of the Winthrop statue in Court street, and passengers may pass by an underground passageway between this new station and the old subway station in Scollay square.

Another cause of delay in completing the East Boston tunnel was the question as to who should provide the elevators for carrying passengers up and down between the surface of the street at the Atlantic-avenue station and the platforms 56 feet below. It was not until March, 1904, that it was finally decided that the Commission should install the elevators and possibly be reimbursed later on for the cost of such installation. It is not probable that the elevators and the building for housing them will be completed before late in the fall of this year. It will be quite possible, however, to operate the cars in the tunnel without regard to the completion of this station.

In the following pages details are given, made largely from the reports of my assistants relating to:

Completion of the Section B tunnel contract,  
Pumping from the East Boston tunnel,  
Ventilation of the East Boston tunnel,  
Atlantic-avenue station, elevators, etc.,

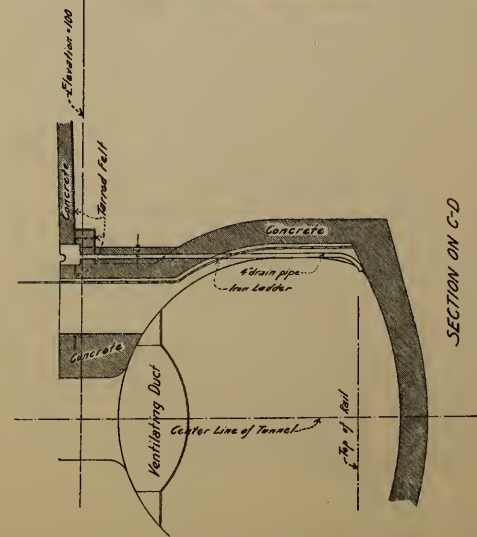
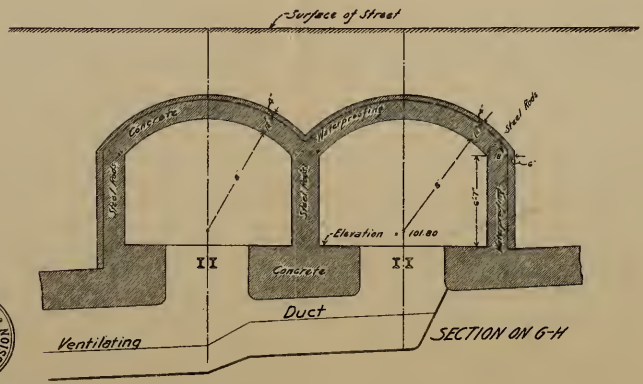
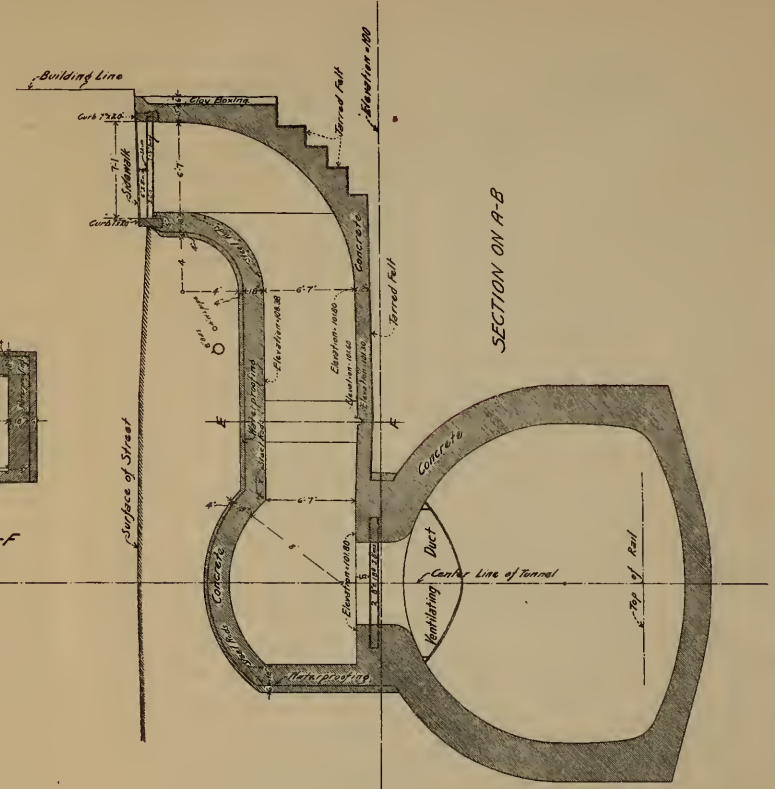
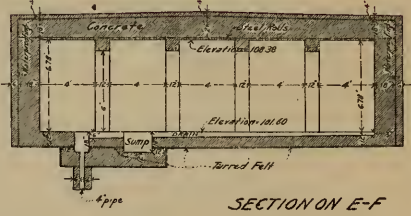
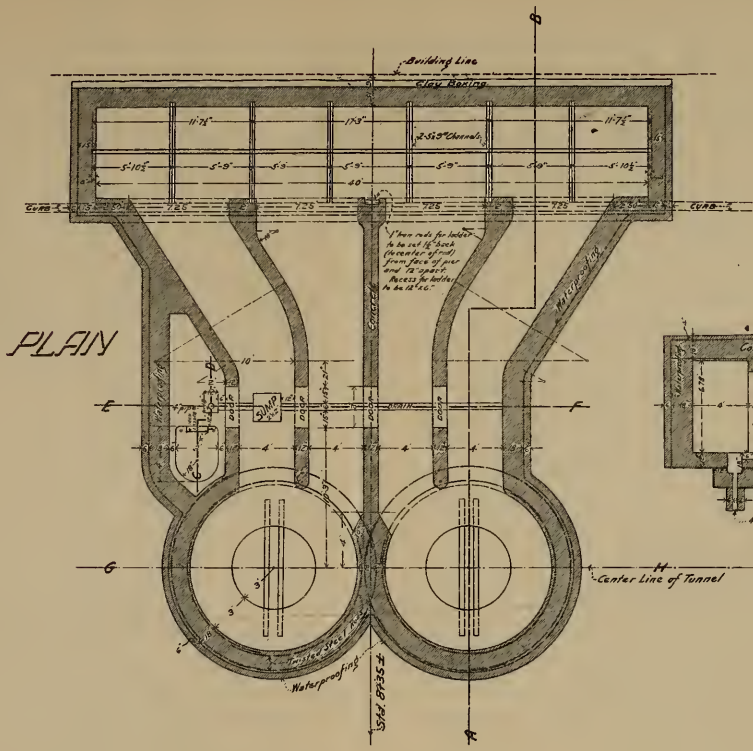
Completion of Section C tunnel contract,  
 Completion of Section E, the Old State House section,  
 Section F, Court street,  
 Replacing sidewalks and pavement on State street,  
 Relocation of pipes and conduits,  
 Concrete beam tests.

*Completion of Section B Contract of the East Boston  
 Tunnel.*

A year ago, June 30, 1903, there remained to be done 20 feet of side walls, 63 feet of arch, and 77 feet of invert. These were completed respectively July 12, August 25, and August 14. On July 4th the south drift heading was broken through into Atlantic-avenue Chambers, thus establishing a connection between Boston and East Boston by tunnel. As stated in last year's report the compressed air necessary for effectively excluding the infiltration of water was lost June 19, 1903. The completion of the tunnel, under the circumstances, was attended with some delay. Work was done mainly at low tides and the entering water caused some settlement of the street at Atlantic avenue. An additional pump with a three-inch discharge was installed at the pump well to take care of the increased amount of water. Two of the posts of the Elevated Railway directly over the tunnel were kept at their proper elevation only by daily screwing up the jacks on which they had been placed by Messrs. Isaac Blair & Company working for the tunnel contractor. When the cutting edge of the shield reached the back of the wall of the Atlantic Chambers July 28, the work was immediately begun of removing the hydraulic jacks and of cutting out such portions of the shield as came inside the intrados of the arch, it being thought unobjectionable and cheaper to leave as much as possible buried in the concrete rather than to remove it to be sold as junk. The last arch was keyed up August 27th. The next two months were spent in removing the working tracks, air locks, winding engines and accumulated rubbish from the tunnel.

The compressing plant in Lewis street, being needed for pumping until the first of February, was left intact until the first part of March, 1904. The street was cleaned, repaved and open to traffic May 2nd.





VENTILATING CHAMBER  
SECTION B, EAST BOSTON TUNNEL

H.A. Cullen Chief Engineer



The ventilating chamber on the East Boston side, a structure of reinforced concrete, (see Plate 5) was built in the Lewis street shaft between October 5th and December 12th. Two holes 6 feet in diameter were left in the roof of the tunnel; the fan chambers, 12 feet in diameter, are over these openings. Four passageways, about 4 feet wide and 6 feet 9 inches high, conduct the air to an opening, 40 feet long and 6 feet 7 inches wide, in the sidewalk on the northerly side of Lewis street. This opening is covered with an iron grating.

No serious accident happened during the year. On July 23rd the body of Peter Carline, who was killed at the time of the blow-out of compressed air described in the Ninth Annual Report, was found about two feet above the drift where he was working at the time of the accident.

The buildings on Long Wharf and Lewis street, which were settled by the construction of the tunnel, have been raised and repaired.

*Tunnel Portion of Section B.—Progress.*

Items.	Excavation.	Concrete.	
Date of beginning.....	Aug. 13, 1900	Sept. 19, 1900	.....
Date of completion.....	Aug. 14, 1903	Aug. 27, 1903	.....
Amount of work done previous to June 30, 1903.....	cubic yards 99,840	cubic yards 33,960	Linear feet 4,274
Total amount of work done.....	101,527	34,574	4,351
Amount of work done between June 30, 1903, and date of completion.....	1,687	614	77

*Atlantic Avenue Chambers.* — As soon as the earth and lumber, blown into the Chambers at the time of the blow-out of compressed air, described in the Ninth Annual Report, had been cleaned out, the Contractor again began setting the steel frame work for the elevator wells and floors. This was completed about the first of August and work on the concrete floors was immediately begun. The ventilating chamber at the east end of the structure, wrecked by the blow-out, has been entirely rebuilt; the new structure, practically of the same shape and size, is sup-

ported by ten spruce piles driven to within a foot of the tunnel roof.

The walls, which had been cracked by the inward movement on account of insufficient bracing, have been repaired.

*Progress on Atlantic Avenue Chambers. — Section B.*

Items.	Excavation.	Concrete.	Steel.
Date of beginning .....	Dec. 5, 1901	Feb. 6, 1902	.....
Date of completion.....	June 10, 1903	Oct. 26, 1903	.... .
Amount of work done previous to June 30, 1903... ..	cubic yards 6,675	cubic yards 1,200	tons 6
Total amount of work done.....	6,675	1,711	78½
Amount of work done between June 30, 1903, and date of completion .....	.....	511	72½

*Pumping from the East Boston Tunnel.*

All water from leakage or otherwise that gets into the tunnel drains into the pump wells which have been described in previous reports. They are located under the harbor, on each side of the tunnel, 2,129 feet from the entrance in Maverick square. On September 14, 1903, the leakage of the entire tunnel as measured at the pump wells was 25 gallons per minute; this included some water coming in at the Lewis street shaft (where the arch had not been turned), and at Atlantic Chambers where the elevator wells and stairway openings were yet uncovered. In Section B there were many places where a small amount of water percolated through the concrete, the majority of these places being in the roof. A considerable force of men was kept busy from the time the concrete arch was finished (August 27th) until late in January, 1904, grouting these leaks, gradually reducing the amount to less than 8 gallons per minute. This is for a tunnel wide enough for two tracks and nearly a mile and a half in length, more than half a mile of which is directly under the harbor. When we compare the leakage with that in other subaqueous tunnels of like size, the East Boston tunnel may be considered as practically water-tight.

Permanent machinery for pumping this leakage and other water was installed in the north pump chamber in February, 1904, and consists of two 4 in. x 6 in. Goulds triplex plunger pumps, geared to 2 horse-power 580 volt direct current Holtzer-Cabot motors. The operation of the plant is automatic, the motors being controlled by switches which are operated by floats in the pump well. The combined efficiency of pumps and motors is 47 per cent.

The pumps have a capacity of 32 gallons per minute each, or altogether about eight times the amount of the leakage. They pump the water into the harbor on the East Boston side through a 4-inch discharge pipe which leaves the tunnel through the East Boston Ventilating Chamber. Power is obtained from the lines of the Boston Elevated Railway Company:

If there should ever be occasion for it there is ample room in the two chambers for pumps of several hundred times greater capacity than those now installed. It is as probable, however, that the leakage will diminish as that it will increase.

The pump wells have an emergency storage capacity of 4,000 cubic feet. Should both pumps break down this would be sufficient to store the normal leakage for  $2\frac{1}{2}$  days. Under ordinary conditions rainwater from the East Boston incline is diverted into a sewer by a dam across the tunnel invert.

#### *Ventilation of the Harbor Portion of the East Boston Tunnel.*

A duct to be used in ventilating the tunnel extends from near Webster street in East Boston to and under the harbor and to the Atlantic-avenue station. It has a cross-section of about 48 square feet, and is formed in the upper part of the tunnel by means of a diaphragm 1 inch thick made of expanded metal enclosed in cement mortar. This diaphragm is attached to the tunnel walls by steel rods and plates which are themselves encased in concrete. A partition midway between the two ends divides the duct in two portions. On each side of the partition there are 14 openings each 4 feet long and 1 foot 5 inches wide in the flat portion of the duct; and at intervals of about 550 feet there are other groups of openings, diminish-

ing in number as they approach the fan chambers. These openings are fitted with doors which can be opened or closed from the tunnel below. When the movement of the air in the tunnel is not affected by wind only the two groups of openings close to the middle partition will be kept open. When the movement of the air is so affected the various openings will be used in such a manner as to best promote the even ventilation of the different parts of the tunnel.

Fresh air will enter the tunnel from the portal at East Boston and through the station near Atlantic avenue. This air will move to near the middle of the tunnel and pass through the openings into the duct referred to above. The air will then be drawn to the east and west and will leave the tunnel at the fan chambers at Atlantic avenue and at Lewis street in East Boston. A diagram rudely indicating the movement of the air is given on Plate 6. The duct (illustrated on Plates 7 and 8) was built during the first three months of 1904. A section 335 feet long was first built directly by the Engineering Department for experimental purposes. Patrick McGovern was awarded the contract for constructing the remainder (about 4,000 feet). He had a day gang and a night gang, each composed of about 35 men, and completed the work in seven weeks.

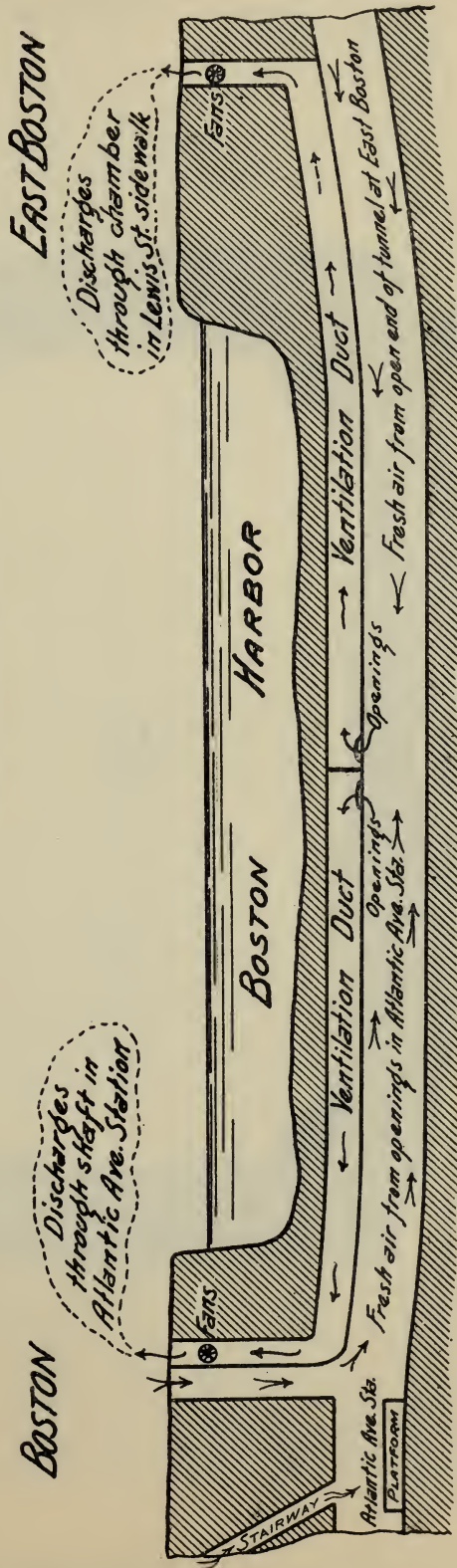
#### *Elevator Plant, Atlantic-Avenue Station.*

The Whittier Machine Company of Boston has been awarded the contract for an elevator plant for the Atlantic-avenue station. This plant is to consist of four electric elevators which will run from the platforms to the street level, a vertical rise of about 56 feet, and to a landing about 14 feet above the street. A bridge will connect this landing with the present State-street Elevated Station. The elevator cars travel from the platforms below on each side of the tracks to a station which is in the middle of the street at the surface. In order to leave a roadway on each side of this upper station it is necessary that the cars while traveling a vertical distance of 56 feet should have a horizontal travel of about 6 feet. They will run on curved guides arranged to keep the car floors level at all times. The cars will have a maximum speed of 250 feet per minute. Each will have a platform area of about 60 square feet, and a capacity of from 40 to 50 passengers.

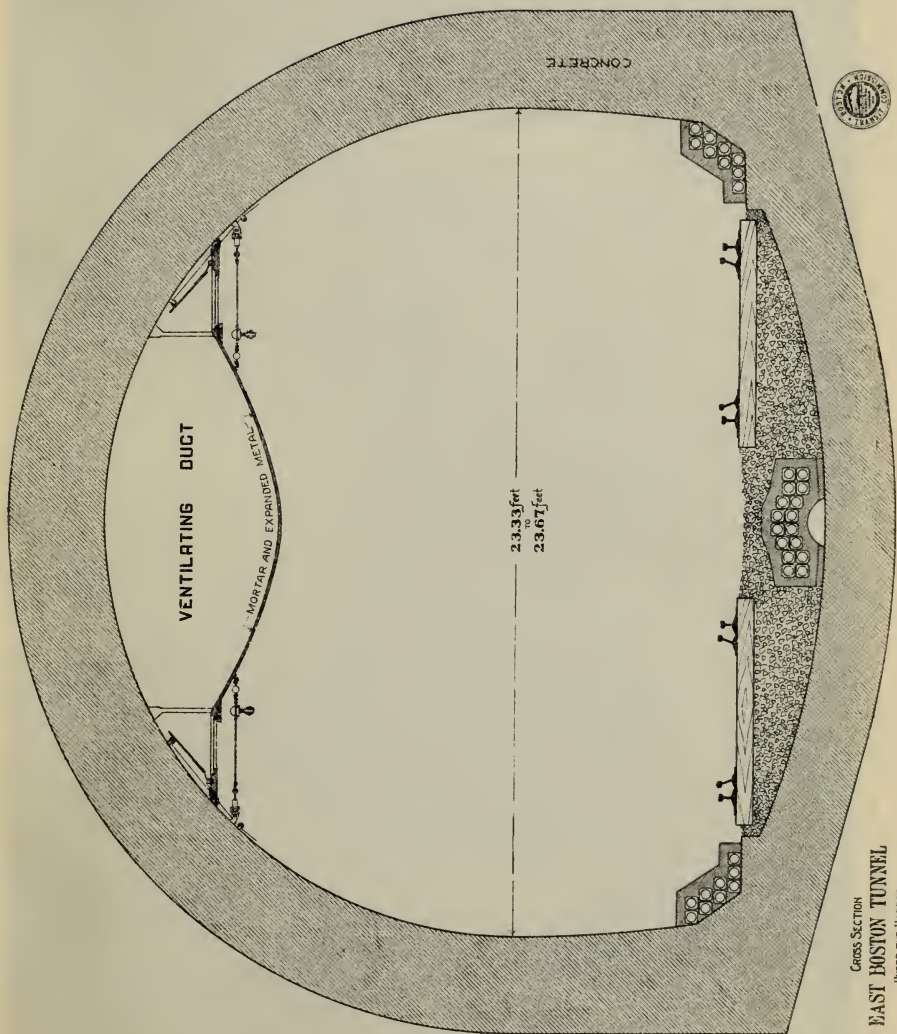
# SKETCH DIAGRAM

Showing method of ventilating East Boston Tunnel.

Not drawn to scale







Cross SECTION  
EAST BOSTON TUNNEL  
UNDER THE HARBOUR  
Wm. Schmitt, Engineer







SECTION B OF THE EAST BOSTON TUNNEL,--SHOWING AIR DUCT IN ROOF. FEBRUARY 8, 1904.

(LOOKING SOUTHERLY.)



*Completion of Section C of the East Boston Tunnel.**Progress on Contracts.*

	Date of Contract.	Date of Beginning.	Date of Completion.
Construction .....	Jan. 20, 1903	Jan. 26, 1903	Aug. 28, 1903
Rib Tiling .....	Oct. 9, 1903	Oct. 12, 1903	Dec. 8, 1903
Glazed Tile .....	Oct. 29, 1903	Dec. 7, 1903	Jan. 19, 1904
Granolithic work .....	Nov. 25, 1903	Jan. 24, 1904	Feb. 10, 1904

*Progress on Construction.*

	Excavation.	Concrete.	
Date of beginning.....	Mar. 17, 1902	Apr. 22, 1902	
Amount of work done previous to June 30, 1903 ..	Cubic Yards 19,874	Cubic Yards 6,524	Linear Feet 707.00
Amount of work done from June 30, 1903, to date of completion Aug. 28, 1903	985	393	41.25
Total work done.....	20,859	6,917	748.25
Estimated quantities.....	20,813	6,778	

The contract for the excavation and for the rough walls of the tunnel and station was substantially completed in August, 1903. The methods of construction of the tunnel proper were fully described in the Eighth Annual Report, and the construction of the passenger station was described and illustrated in the Ninth Annual Report.

A ventilating chamber has been constructed at the shaft near the Custom House, the details of which are substantially shown on Plate 6 of the Eighth Annual Report. This shaft has been partially closed up with the exception of a small opening left for the Boston Elevated Railway Company to get in stock and ballast. The passenger station at Atlantic avenue is now complete with the exception of the work in the Chambers. The walls and arch have been covered with rib tiling (1,180 square yards), and this has been covered with enameled

tile. Three hundred and thirty square yards of granolithic platforms have been laid.

*Completion of Section E of the East Boston Tunnel,  
Old State House Station.*

The construction of this section was practically finished on the date of issue of the Ninth Annual Report, in which a description of the work will be found. Woodbury & Leighton were, however, engaged until December 24, 1903, upon the completion of the alterations and additions to the Old State House, and upon various extra work incidental thereto, including changing over steam heating plant, and, at the request of the Public Buildings Department, making new entrance from street to boiler room.

Rib tiling has been laid on the walls of this station and glazed or enameled tile has been placed over the rib tiling. The ceiling has been covered with enameled tile. Six hundred and twenty square yards of rib tiling and 2,400 square yards of enameled tile have been laid.

*Section F of the East Boston Tunnel.*

*Contractors for Excavation, Masonry, Granolithic, etc.*—Coleman Brothers.

*Transit Commission Assistant Engineer.*—H. S. R. McCurdy.

Date of Contract.	Date of Beginning of Work.	Date of Final Certificate.
July 21, 1903.	July 18, 1903.	Jan. 4, 1904.

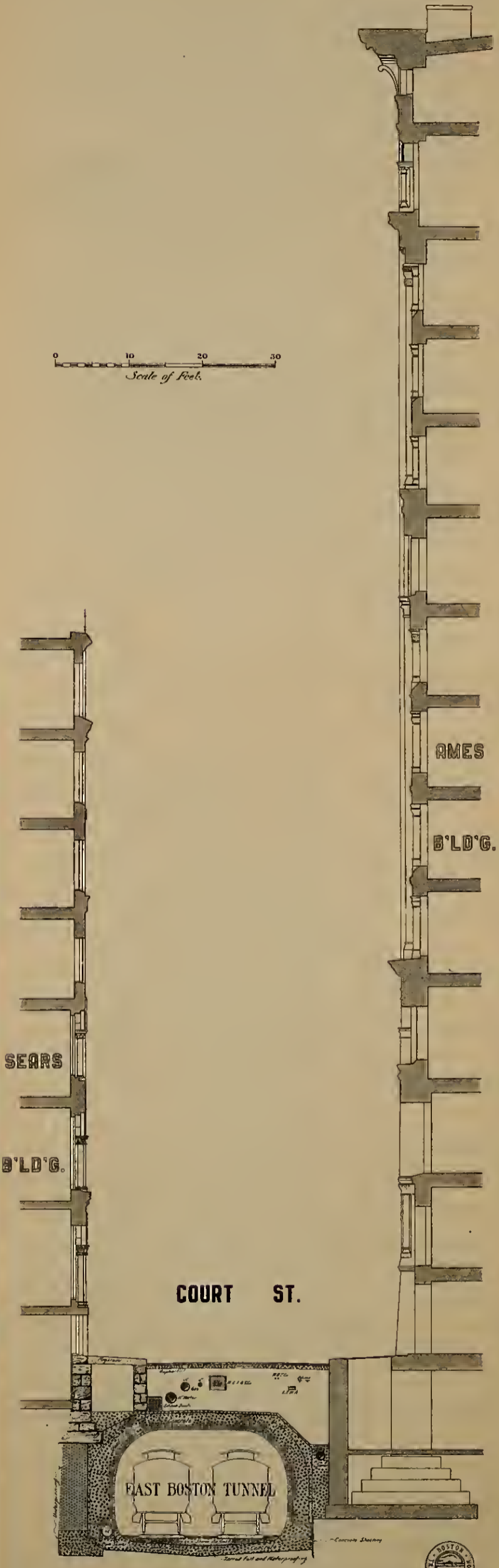
*Contractor for Tile Work.*—Boston Tile and Mantel Co.

Date of Contract.	Date of Beginning of Work.	Date of Final Certificate.
Jan. 27, 1904.	Feb. 4, 1904.	June 18, 1904.

*Location.*—This section extends from a point about on the easterly side line of Washington street, along Court street, to within about 10 feet of the subway in Scollay square, and is about 500 feet long.

*General Description of Structure.*—From the beginning of the section for a distance of about 244 feet the flat-arch type of construction, similar to Section D, was used. Plate 9 of this report and Plate 15 and 16 of the Ninth Annual Report illustrate it.

About 112 feet of the northerly side wall of the tunnel in front of the Ames Building was constructed by the Commission prior to letting the contract for the remainder of



CROSS SECTION OF COURT ST.  
ABOUT 24 FT. WEST OF WASHINGTON ST.

H. C. Allen Chief Engineer





BUILDING OVER STAIRWAY TO EAST BOSTON TUNNEL IN COURT STREET  
NEAR SCOLLAY SQUARE, NEAR FORMER SITE OF WINTHROP STATUE.  
THE ROOF IS OF GLASS.

(LOOKING EASTERLY.)





the section, and is described in the Ninth Annual Report. Westerly from the flat-arch construction the roof is a circular arch with a span of about 18 feet, a rise of 2 feet 4 inches and a thickness at the crown of 18 inches. Every 12 feet the roof is strengthened by concrete ribs, integral with the arch, running transversely from sidewall to sidewall. These ribs are 15 inches thick and extend from the intrados of the arch down to the clearance line. Steel tie-rods 2 inches square were placed in the arch about 2 feet 3 inches on centers.

At a point about opposite the middle of the Old Court House the tunnel widens into a station with the tracks between two opposite platforms. The northerly platform is about 120 feet long with a 9-foot stairway at the westerly end leading to the street in Scollay square. The southerly platform is about 130 feet long with a 10-foot stairway at its easterly end reaching the street on either side of the Old Court House steps. That part of the roof of the station which lies over the tracks is a continuation of the circular arch with the concrete ribs. The roof over the platforms is of concrete reinforced with  $\frac{3}{4}$ -inch steel rods, and is supported, together with the arch over the tracks, by steel columns placed about 12 feet apart. At the westerly end of each platform is a 4-foot stairway which leads under the tunnel invert to a sub-passageway 7 feet 6 inches wide, passing under the invert of the old subway, and making connection between the platforms of the Court-street station of the East Boston tunnel and the platform of the Scollay-square station of the subway.

A 15-inch and a 12-inch pipe sewer were laid in connection with and for some distance actually within the sidewalls of the tunnel, the former on the south side and the latter on the north side, to take the place of existing sewers displaced to make room for the tunnel.

*Details of Construction.* — The excavation, building of the masonry, and backfilling were carried on in such a way that the movement of vehicles and pedestrians in the street was interfered with only on nights and Sundays and at these times only long enough to put in the necessary bridging. The sewer, water and various other underground services were also maintained. After the concrete arch had been in place 30 days the core was taken out and the invert put in place; all the excavated material being handled through shafts located at convenient intervals.

The work of underpinning the wall of the Sears Building proceeded as follows:—The trench for the sidewall of the tunnel was dug along the wall of the building and carried down nearly to the bottom of the foundation. A small cross drift just wide enough to take three or four I-beams was then driven under the bottom of the wall and I-beams about 20 feet long were inserted under the bottom course of the foundation. Another set of I-beams parallel with and close to the wall were placed above the first beams, their ends being supported by wooden blocking, and the first were suspended from the others by iron bolts. Finally wooden cribwork loaded with earth was built upon the outer end of the lower beams forming a cantilever, with the foundation of the building resting upon the short arm. A stretch about 10 feet long was then carried down to grade under the foundation, and the brick wall carried up and the foundation pinned off. A core of earth about 10 feet long was left under the foundation wall between every two stretches of underpinning and was taken out only after the foundation had been pinned up on each side. All this work was carried on under the bridging of the sidewalk and street, and as no shores were used above the street level, there was absolutely no interference with traffic on the street or sidewalk.

In the construction of this section concrete sheeting was used in every case where the excavation passed close to and at a lower level than the building foundations.

*Character of the Excavated Earth.*— For the most part the excavation was through pockets of gravel and sand upon an underlying stratum of blue clay, which, however, was close enough to the surface in many places to be penetrated by the excavation. The material in general was firm and hard and contained but little ground water.

Granolithic surface has been put on the platforms and stairways of the Court-street station, and in the sub-passageway. This work was done by Coleman Brothers as a part of their contract.

Terra-cotta rib tile has been laid on the walls and under the stairways of the Court-street station, and on the walls and under the platform and stairways of the sub-passageway. Enamelled tile has been laid on the walls of the Court-street station, on the walls and roof of the sub-passageway, on the walls and roof of the stairway leading

to Scollay square, and on the walls and roof of the stairways leading to the street at the Old Court House.

*Replacing Sidewalks and Pavement on State Street.*

After the temporary pavement on State street, west of the Atlantic-avenue station, had sufficiently settled, the edge-stones were reset, the sidewalks replaced and substantially all of the pavement permanently relaid before winter.

*Section B.*— The pavement around the shaft at Atlantic avenue and over Atlantic avenue was raised from time to time and was finally permanently replaced by the contractors for Section B on a concrete base in May, 1904.

*Section C.*— Between the Atlantic-avenue station and Commercial street the street surface, which had settled considerably, was restored to its original position by the contractor for Section C. The street was repaved, as formerly, with granite blocks laid with gravel joints on a gravel base. Around the shaft at Section C the paving blocks were temporarily replaced on a gravel base with gravel joints in anticipation of further settlement.

*Sections D and E.*— Between Chatham Row and Washington street the edgestones were reset, the sidewalks raised and replaced where settlement had occurred and the street repaved with granite blocks with pitch joints on a concrete base. This was done chiefly at the expense of the Transit Commission, but in intersecting streets where, on account of the extensive pipe and conduit changes much extra paving was necessitated, the expense was shared by the principal companies making such changes, the Commission assuming the liability for paving connected with the relocation of sewers and water pipes. The owners of abutting new buildings paid half of the cost of relaying the sidewalks in front of their buildings.

The edgestones and sidewalk flagstones were reset and the paving done by Patrick McGovern. The artificial stone sidewalks were replaced by the W. A. Murtfeldt Company. Austin Ford & Son replaced broken North River Bluestone flagging in the sidewalk in front of the Fiske Building.

The Board of Aldermen in September, 1903, established new sidewalk grades on the south side of State street between Kilby and Broad streets at the request of the Commission, and that portion of the sidewalk was replaced at much better grades than were formerly there.

The repaving on Sections D and E was done in blocks, and but one block at a time was closed to travel. Between Congress and Devonshire streets where the traffic was very heavy one side of the street or the other was kept open all the time. The street car tracks here were relaid by the Boston Elevated Railway Company in connection with the work of repaving. The best of the old paving blocks were relaid, but between Congress and Devonshire streets 716 square yards of new Cape Ann granite blocks were used.

The concrete base was made in the proportion of 380 pounds of Portland cement, 10 cubic feet of sand and 22 cubic feet of crushed stone.

The work of repaving was done under the supervision of an inspector from the Street Department.

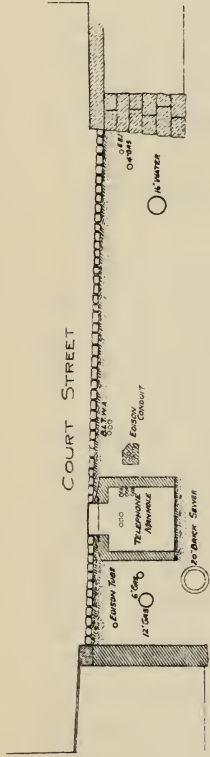
*Relocation of Pipes and Conduits during the Year  
ending June 30, 1904.*

The work of relocating underground structures, made necessary by the East Boston tunnel, was carried on in State street and Court street and, except at Scollay square, the whole work is now completed.

In State street it consisted of completing the work of relocation between Commercial street and Washington street, of which a description was given in the Ninth Annual Report, in relaying pipes and conduits around the shaft at Atlantic avenue where considerable settlement of the ground had occurred, and in relocating telephone and telegraph conduits which interfered with the construction of the stairway and incline at the westerly end of Atlantic-avenue station.

In Court street substantially all of the pipes and conduits were either relaid or relocated between Washington street and Scollay square, and are now arranged in a more compact and orderly manner than formerly. At the lower end of Court street the tunnel roof lies about seven feet below the surface of the street and interfered with but few of the underground structures in the street. For various reasons, however, the companies and departments deemed it advisable to relay practically all of the pipes and conduits at this place. The Commission bore the expense of the relocation of only such water pipes and sewers as was made necessary by the construction of the tunnel.

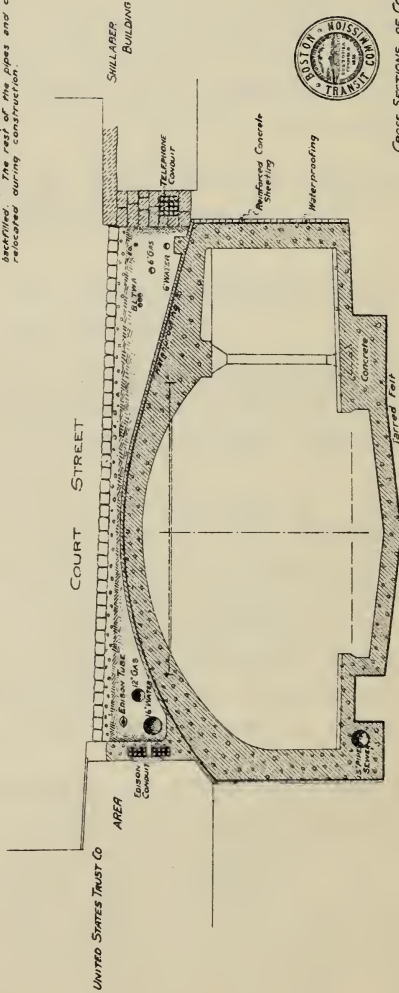




CROSS SECTION AT STA 73+81  
BEFORE CONSTRUCTION OF EAST BOSTON TUNNEL

12" Gas

Note - All of these pipes and conduits were removed and re-laid as shown below. The pipe was relocated in the center of the tunnel construction. The gas pipes were removed as soon as they were exposed and re-laid after the street was repaved. The water pipes and conduits were re-laid during construction.



CROSS SECTION AT STA 73+81  
AFTER CONSTRUCTION OF EAST BOSTON TUNNEL

CROSS SECTIONS OF COURT ST  
AT STATION 73+81  
SHOWING COURT STREET STATION  
and  
RELOCATION OF UNDERGROUND OBJECTS



Scale 1" = 10' 1/2  
July 1904

H. C. C. Chief Engineer

Between Young's Hotel and Scollay square the outside of the tunnel arch rises to within 18 inches of the surface of the street, and here it was found necessary to relocate every pipe, conduit and house service. The cross-section, Plate 11, shows the general arrangement of the underground objects between Court square and Scollay square. This arrangement, which was somewhat similar to that in State street, may be described as follows:—Two deep sewers were built, one on each side of the tunnel, alongside of or in the tunnel wall or under the station platform as the exigencies of the case required. Two water pipes and two gas pipes, one of each on each side of the street, were laid where the tunnel arch rose too high for cross service pipes. The conduits for high and low potential wires were laid on opposite sides of the tunnel. After the completion of the tunnel catch basins were rebuilt in their old locations as nearly as was possible. On the north side of Court street, opposite the Old Court House, it was necessary to take a portion of the sidewalk areas for locations for a catch basin and for the six-inch water pipe.

An unusual method employed in constructing electric conduits was to place them in the area walls for considerable distances where space in the street was limited. Where this was done, the area wall was generally removed and rebuilt enclosing the conduit, the sidewalk flagstones being in the meanwhile supported. In the case of the Edison conduit at the United States Trust Company, in order not to break into the area containing the vaults of the Trust Company the outer portion of the wall was removed, leaving only four inches of brick-work between the area and the street. This wall was then waterproofed with asphalt and the ducts placed in position against the asphalt after which the remainder of the wall was restored; the area wall at no time having been broken through.

All the work of relocation was done under the direction of the Transit Commission, which designated the location of new structures and the order in which they were to be constructed. This work was carried on simultaneously with the construction of the tunnel, the contractor and the various companies and departments co-operating to that end. The tunnel contractors built the sewers and set the water pipes in position the joints of the water pipe being caulked by men from the Water Department.

The work of relocation was done to the satisfaction and approval of the Water Department and Sewer Division.

The gas pipes and electric conduits were laid by the various companies. The gas in the old pipes in Court street was shut off at the beginning of operations and small temporary pipes were laid to supply the company's customers during construction. After the street was back-filled new permanent pipes were laid.

In order to inconvenience the public as little as possible, much of the work of relocation was carried on after 6 P. M. and on Sundays and holidays, and as stated in last year's report the service from all the underground structures has been practically continuous during working hours.

During the year the Boston Elevated Railway Company completed vitrified clay duct lines which extend throughout the entire length of the tunnel. Connection with the outside is made through the incline at East Boston, the Atlantic Avenue Chambers, and at the Old State House.

The cross section, Plate 7, shows the arrangement of ducts underneath the harbor.

#### WASHINGTON-STREET TUNNEL.

At the time when the construction of the Tremont-street subway was under consideration many conferences were had with the officers of the company which was to be the lessee. It was deemed important that their valuable experience and good judgment should be embodied in the work and all plans of importance had their concurrence. In like manner the general scheme for the Washington-street tunnel and all the details of the proposed structure are being discussed with the officers of the Elevated Company. This involves making a large number of plans, studies and sketches and consumes a great deal of time, but it is believed that it will in the end be of advantage to all concerned.

The following will probably be some of the features of the new Tunnel:—

There will be an incline south of Causeway street and one north of Broadway, each having a gradient of about 5 per cent.



For about half the distance between Adams square and Broadway the track will be straight; for about one-quarter of the distance it will have a curvature of 5,000 feet radius; for the remaining parts the lengths and radii will be about as follows:

280 feet, 3,000 feet radius.

350 feet, 500 feet radius and upwards.

200 feet, 350 feet radius and upwards.

A portion of the platforms will be on curves of about 5,000 feet radius.

On account of the narrowness and crookedness of the street the platforms will be staggered, that is to say, those for the north-bound track will not be opposite those for the south-bound.

Each platform will be at least 350 feet long, or long enough for trains of 8 cars of the present Elevated type.

Each end of each platform will have one or more stairways to be used for entrance and exit. These stairways will be in what is now private land.

There will in general be posts in the middle of the cross-section between the north-bound track and the south-bound track. This arrangement was objected to by the Commission in the old subway, but is less objectionable here for the reason that the north-bound track and the south-bound track will in general be at different levels at any particular locality.

Plate 1 shows a study for this tunnel, and for a changed location of the subway north of Cornhill.

*Borings.*—Thirty-one borings have been made during the year, in addition to the 46 previously made for the Washington-street tunnel. A small amount of the preliminary work has been done in Washington street.

*Test pits.*—To ascertain the locations of the various underground objects in Washington street 36 test pits were dug at various places across the street between Harvard street and Water street. The test pits were dug by Coleman Brothers, and were repaved by John T. Shea, Jr.

*Water Pipes.*—A 24-inch water pipe, the main fire supply of the business section of Boston, laid prior to 1848 runs through Washington street from Boylston street north. In order to avoid the danger of the bursting of this old pipe during construction, and to do away with the constant shutting off of the water during the relocation of long

portions of it, the Commission, as stated on page 35, has arranged to have the pipe removed from the street. A smaller low service water pipe is to be laid in Washington street to take its place. The Water Department has begun the work of relaying this pipe in side streets between Boylston street and Water street.

### *Sewers.*

The construction of the tunnel will require a reconstruction of the sewerage system of Washington street. In place of the sewer which is at present near the center of the street, two sewers, one on each side of the street, adjacent to the side walls of the tunnel will in general be substituted.

At Bennet street and at Summer street, the proposed grade of the tunnel is such that sewer crossings can be built under the tunnel without siphoning.

The Bennet-street sewer will take a large portion of the sewage from Washington street and westerly thereof which now drains into the Kneeland-street sewer. Work in connection with this is now under way, a contract having been awarded, June 16, 1904, to Patrick McGovern for building a new sewer from the vicinity of Kneeland street through Washington street, Bennet street, Harrison avenue and Harvard street connecting with the existing sewer at the intersection of Harvard and Tyler streets.

An overflow sewer through Harrison avenue from Harvard street to Kneeland street is also included in the contract. The sizes of the new sewer will in general be: In Washington street 2 ft. 4 in. x 3 ft. 6 in.; in Bennet street 2 ft. 6 in. x 3 ft. 9 in.; in Harrison avenue between Bennet street and Harvard street 2 ft. 10 in. x 4 ft. 3 in. The outlet down Harvard street will be a 24-inch pipe and the overflow, mentioned above, a 3 ft. circle. At the crossing under the proposed grade of the tunnel in Bennet street, the section will be a 4 ft. x 3 ft. reinforced concrete structure. The remainder of the sewer will be brick excepting the 24-inch pipe in Harvard street. Mr. McGovern began operations on this contract June 18, 1904.

The new Summer street sewer will take the sewage from Washington street and westerly thereof which now drains into the existing Summer and Bedford street sewers, and a portion of that which drains into the Kneeland street

sewer. It will be necessary in order to get an outlet to construct a new sewer through Summer street to Dewey square and there connect with the city interceptor and overflow. Plans are being prepared for this work.

*Tests of Concrete Beams. — 1903.*

It is well known that there is a very wide and increasing use of structures made of Portland cement concrete. In order that this valuable material may be used to the best advantage numerous experiments have been made in different parts of the world, and many more will be required. The Commission has made some slight contribution to this work. Appendices G to G—6 relate to the reinforcement of concrete by the use of imbedded steel rods. The breaking-beam tests referred to therein were made by Assistant Engineer G. D. Emerson. The tests reported in Appendices F and F—2 in relation to the preservation of steel were conducted by Mr. Charles C. Johnson.

Respectfully submitted,

H. A. CARSON,  
*Chief Engineer.*



## APPENDIX A.

[Accident of Aug. 10, 1903.]

## NORTH METROPOLITAN CIRCULAR LINE.

## REPORT OF THE CHIEF ENGINEER OF THE METROPOLITAN SERVICE.

PARIS, Aug. 17, 1903.

Without entering into any details as to responsibility, which the legal inquest now being held will alone have the power to fix, it is possible at this date to understand the essential facts of the catastrophe of August 10, 1903, with a sufficient degree of accuracy and to deduce from them the chief causes and to state the conclusions to which they give rise.

A train (No. 43) made up of eight (8) cars, of which the first and last were motor cars, had at 7.05 P. M. just reached the "Boulevard Barbès" station, when fire was discovered on the head motor car. After the passengers had alighted, the train crew appears to have been satisfied with summarily extinguishing the flames by means of the train fire extinguishers, and the empty train continued on its way propelled by the two motor cars. Two stations, "Rue de la Chapelle" and "Rue d'Abervilliers" were passed without incident, but at the station "Rue d'Allemagne," the last on the viaduct (1.6 kilometers from the station "Boulevard Barbès"), the fire broke out anew: it was extinguished in the same manner, and the train reached the station of the "Combat," where the fire once more broke out and was again extinguished. Orders were then given to prepare the siding at Belleville, situated a little further along, to put the train out of commission. The head motor car was electrically disconnected from the rest of the train, but without raising its contact shoes, and the motorman went to the rear motor car, but the train could not be moved, and aid was requested from the following train.

This train (No. 52), composed of four (4) cars, had arrived at the preceding station, "Rue d'Allemagne." The passengers, among whom were those who had been left by Train No. 43 at the "Boulevard Barbès" were made to alight and Train No. 52, empty, came to the station of the "Combat" to be placed behind No. 43, in order to push the latter along. The two trains coupled together, started toward the "Place de la Nation," the shoes on the damaged train still being in contact. It did not stop at the point of the siding, nor at the stations "Rue de Belleville" and "Rue des Couronnes." At a point 25 meters before the station "Rue de Ménilmontant" was reached, a new and brisk fire appeared in the same car. The head of the train had just reached the entrance of the station (3.6 kilometers from the "Boulevard Barbès"); vain efforts were made to extinguish the fire which increased with extreme violence, attacking the entire train, so that all employees were obliged to flee. The motorman on Train 43 saved himself by following the tunnel as far as the next station of "Père-Lachaise," which he reached

wounded. Some other persons who were on the platform of the station "Rue de Ménilmontant," quickly followed him toward "Père-Lachaise." The other employees on the burning train turned back in the tunnel and fled toward the station "Rue des Couronnes."

At this station was a third train (No. 48) which had stopped at the end furthest from the "Rue de Ménilmontant." This train had taken aboard the passengers left en route by the two preceding trains, and was following close upon them. It was crowded, and probably carried, in the four cars of which it was made up, about 300 people.

The employees at the station, seeing the fire in front and the smoke coming from that side, had already requested the passengers to alight. But the passengers, many of whom had already been twice transferred, protested, and probably very vigorously. A certain number left the train and started toward the exit, demanding the return of their fares. (Already the money had been refunded to 22 passengers and 40 tickets had been stamped to extend their validity.) Others remained on the platform or near the doors of the cars, surrounding the guard and arguing with him. The arrival of the employees from the burning train followed almost immediately by smoke, started a general rush to get out. At the same time that the smoke began to fill the station, the lights went out, and a general panic ensued in the darkness. This disastrous phase of the situation appears to have been at about 7.40 P. M. Certain passengers, with the operating employees, gained the exits; a small number, guided possibly by an employee coming from "Belleville" toward the rear of the train, saved themselves by passing through the tunnel toward "Belleville"; seventy-six passengers were asphyxiated in the station. Only two bodies were found in the train. Several fell some 30 meters from the exit stairway, situated at the end toward "Ménilmontant," i. e. in the direction from which the smoke was coming. The greatest number, about fifty, were heaped up at the end of the station opposite the stairway, having fled intuitively in the dark, away from the smoke. One body was found in the tunnel itself, toward the "Rue de Belleville," the victim having moved too slowly to escape the smoke.

At the station "Rue de Ménilmontant" were found seven bodies either on the stairway or in the distributing room, which was just above the principal point of the fire. It seems as though these persons had waited to look at the burning train or had even attempted, in spite of the employees, to enter the tunnel after the beginning of the fire.

From the outline which precedes, the causes of the catastrophe seem to be beyond question. These were:

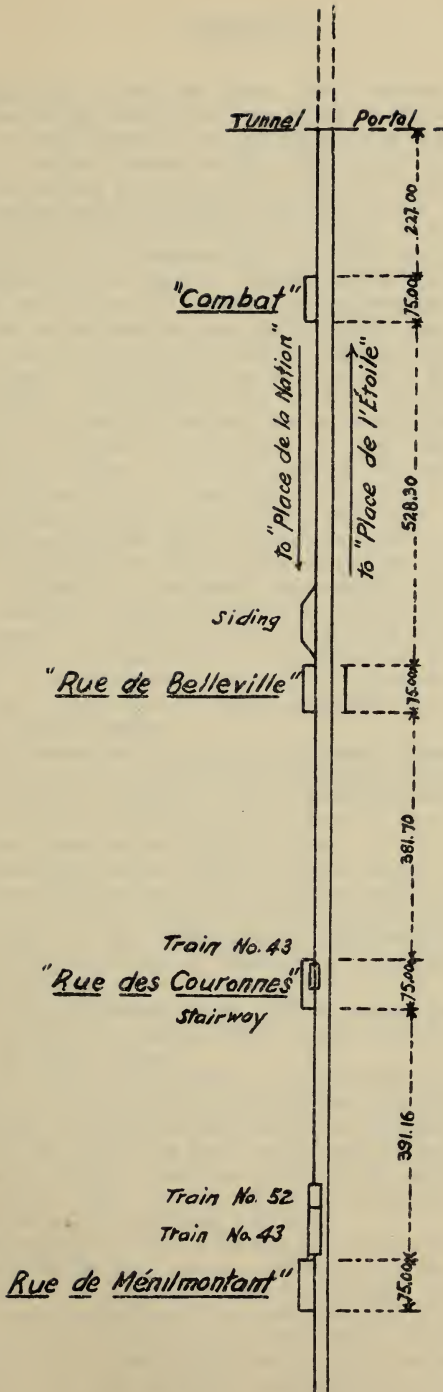
The primary cause.—the burning of the motor car.

The determining cause.—the mistake made in running this motor car through the tunnel without even having attempted to render it harmless, instead of side-tracking it.

The direct cause.—the obstinacy shown by a large number of passengers in not leaving the threatened station.

Also an aggravating cause, namely, the extinguishing of the lights in the station at the moment when the danger became extreme.

The exact time of the accident cannot fail to be interesting in that it concerns the direct cause, and it is comparatively easy to determine. It has been seen that the employees on the burning trains had returned toward the station "Rue des Couronnes"; they had therefore covered about 350 meters walking on the ballast where their speed was certainly not equal to six kilometers per hour,



(Note: Distances given in meters)

DIAGRAM OF PARIS SUBWAY, SHOWING LOCATION OF TRAINS  
IN ACCIDENT OF AUG. 10, 1903.





and they had not taken less than four minutes to make that distance. The alarm must have been given in the station "Rue des Couronnes," at the latest, at the moment when the employees left their train; it seems almost certain that some moments elapsed between their arrival at the station and the extinguishing of the lights. The passengers had then from five to six minutes at least between the time when they were asked to leave and the time when the real peril surrounded them. That was ample time for the 300 persons on the train to ascend the nineteen steps at the top of which they would have found themselves in safety.

As to the extinction of the lights, that was caused by the breaking of the wires which carried the current above the location of the fire; these wires were burned after some little time. This was a deplorable circumstance, for it is to be presumed that if the light had not failed, the seventy-six remaining passengers would have been able, in spite of the smoke, to save themselves by one last, well directed effort. On this account the advisability of an emergency lighting system is suggested. Outside of this particular point, it remains absolutely beyond a doubt, that the plant of the Metropolitan, such as the city of Paris has built or approved, has in no way contributed to the seriousness of the catastrophe. The city, which can incur no material responsibility in the affair, can likewise be claimed to incur no moral responsibility.

The outlook for the future cannot fail to be reassuring; the actual misfortune resulted from a combination of causes so improbable that it is impossible that such a combination could again arise after the application of such remedies as will prevent the recurrence of these causes.

Before all should be removed the primary cause, which is the short circuiting in the motor cars, by the improvement of the rolling stock. The electric equipment can be perfected so that short circuits would become very infrequent, and so that short circuits, when produced, could not set fire to the car.

The determining cause will be easily gotten rid of by the strict observance of the operating rules, amended where necessary, which will never allow a motor car in danger of conflagration to be kept in the midst of the movement of other trains; an additional guarantee will be found in the advance in the technical knowledge of the operating staff.

Finally, the education of the public, dearly purchased, aided perhaps by simple luminous signs in the stations, would have eliminated the direct cause.

These are the true remedies. Nevertheless opinion seems to incline toward safeguards in construction, regarding fire as an unavoidable evil; it is well to see what these safeguards may be.

A continuous walk has been suggested, which shall be built from station to station along the wall of the tunnel at the floor level of the cars. Such a walk, very far from being a means of safety, would in itself constitute a danger.

The construction of air shafts has also been suggested. These can be considered in two aspects, either as an exit for smoke in case of fire, or as a means of hygienic ventilation. In regard to fire, we believe them more likely to cause damage by the additional draught than to have any appreciable effect in diminishing the smoke. In regard to ventilation, very complex experiments which will be carried on, will perhaps demonstrate the local utility of air shafts; but if they were built with this end in view, it would mean a sacrifice in favor of hygiene, to the detriment of precautions against fire.

A more serious question is that of the exits from the stations. It is certain that at the "Rue des Couronnes" the existing arrangements are equal to the traffic, and that they would have been amply sufficient even for a hurried exit, in case of danger, if the public had wished to use them. Yet it is possible that if the frenzied victims who were pushed in the darkness against the end of the station had found there a staircase, some, at least, might again have seen the light of day. The establishment of additional means of egress will merit consideration, and will be followed up in cases where difficulties are not encountered, which are out of proportion to the end sought, but there will be questions to be solved in each particular case, involving special studies.

There is also the question of emergency lights, whose utility, if not necessity, was demonstrated by the event at the "Rue des Couronnes." These lights must be electric, because only such can operate in an asphyxiating atmosphere; but it is necessary that the feed wires be sheltered from every cause of injury that might develop in the tunnel interior, and consequently they must be placed outside. A lighting system of this nature, combined in a way to attract the attention of the public toward the direction of the exit, would very likely dispense with any additional exit, when the regular ones are in themselves ample.

The installation of an emergency lighting system is the only additional general and immediate work which seems to be called for. The Company has declared itself fully ready to establish the same.

The fire caused an interruption of service, which still exists between the station of the "Combat" and the "Place de la Nation," and occasioned appreciable damage to the general work of the tunnel. This damage is fortunately only superficial. The solidity of the masonry appears in no way to be impaired. Repair work will consist mainly in cleaning the walls, which are covered with soot from one end of the station to the other; replacing parts of plastering and tile; in the examination and repair of the tracks; and finally in a general restoration of the distributing rooms. The Company, which has just been authorized to resume possession of the tunnel, is desirous of starting the work.

It seems likely, in a very few days, to re-establish the continuity of the line and to resume the work toward the "Place de la Nation." The two stations "Rue des Couronnes" and "Rue de Ménilmontant" ought to remain closed to the public while they are being put in order.

CHIEF ENGINEER,

CHIEF OF THE METROPOLITAN SERVICE,

(Signed)

BIENVENUE.

## APPENDIX B.

[184 Mass. 586.]

JOSHUA M. SEARS *vs.* GEORGE G. CROCKER & OTHERS.MERCHANTS NATIONAL BANK *vs.* SAME.JOHN C. GRAY & OTHERS, TRUSTEES, *vs.* SAME.

SUFFOLK, December 9, 10, 1903. — January 6, 1904.

Present: KNOWLTON, C. J., MORTON, LATHROP, BARKER, &amp; LORING, J. J.

*Way, Extent of public easement. Boston.*

*Semble*, that the owner of land taken for a street holds it subject to the right of the Legislature to appropriate the space above and below the surface as well as upon it, in any reasonable way, for the purposes of public travel, without providing compensation.

Under St. 1894, c. 548, and later statutes, the construction of the subway beneath the surface of Court Street and State Street in Boston imposes no additional easement on land owned by the abutters to the centre of those streets, and the Boston transit commissioners lawfully can construct such subways without taking in fee the land under the streets.

The provision in St. 1902, c. 534, §19, that the city of Boston "shall have, hold and enjoy in its private or proprietary capacity, for its own property," the several subways and the tunnel built and to be built under that and former statutes, gives a title to the subways and tunnel merely as structures, and confers on the city no ownership of the land lawfully occupied by those structures.

THREE BILLS IN EQUITY, filed January 2 and March 20, 1903, by the owners of property on Court Street and State Street in Boston, owning the fee to the centre of those streets, to restrain the Boston transit commissioners from constructing a subway or tunnel through the land of the petitioners by authority of St. 1894, c. 548, St. 1895, c. 440, St. 1897, c. 500, and St. 1902, c. 534, without recording in the registry of deeds for the county of Suffolk a description of the land to be taken as required by St. 1894, c. 548, §32, for any taking by right of eminent domain.

The cases came on to be heard before *Morton, J.*, who, at the request of the parties, reserved them upon the bills, answers and agreed facts for determination by the full court, such decrees to be entered as equity and justice might require.

*John Chipman Gray & E. W. Hutchins*, for the plaintiff in the first case.

*L. S. Dabney & E. G. Loomis*, for the plaintiffs in the second and third cases.

*T. M. Babson*, for the defendants.

KNOWLTON, C. J. These three cases present the same questions, and they may be considered together in one opinion. They are bills in equity to obtain an injunction against the defendants as members of the Boston transit commission, to prevent the construction of a subway and tunnel from Scollay Square to East Boston through public streets in front of the premises of the several plaintiffs, without a formal taking of land in the streets. The plaintiffs contend that the construction of the tunnel or subway, without a formal taking of land in the streets, is unauthorized and illegal, because it would impose an additional servitude upon lands previously taken for streets and in that way would deprive the plaintiffs of property as owners of the fee in parts of these streets, and because the St. 1894, c. 548, §31, provides for the taking of property "held under or by title derived under eminent domain, or otherwise." They also say that their position is established and their contention confirmed by the provisions of the St. 1902, c. 534, §19, that "The city shall have, hold and enjoy in its private or proprietary capacity, for its own property, the existing subway, the East Boston tunnel, the Cambridge Street subway and the tunnel and subway built under this act," etc.

The question whether the construction of the tunnel will create an additional servitude upon the plaintiffs' lands in the public streets lies at the foundation of these cases, and should be answered at the outset. The rules and principles applicable to such questions have often been considered by this court. *Attorney General v. Metropolitan Railroad*, 125 Mass. 515. *Pierce v. Drew*, 136 Mass. 75. *Lincoln v. Commonwealth*, 164 Mass. 1. *Howe v. West End Street Railway*, 167 Mass. 46. *White v. Blanchard Brothers Granite Co.* 178 Mass. 363. *New England Telephone & Telegraph Co. v. Boston Terminal Co.* 182 Mass. 397. *Eustis v. Milton Street Railway*, 183 Mass. 586. In the last two cases the doctrine was stated broadly, in accordance with previous decisions, that this public easement includes "every kind of travel and communication for the movement or transportation of persons or property which is reasonable and proper in the use of a public street." In the early settlement of the country and in the location of streets in later times, these ways were appropriated to the use of the public for the movement of persons and property from place to place, just as the adjacent lands were appropriated to the use of private owners. The original proprietors of lands in Boston and the original proprietors of lands in New York did not foresee the growth of population and business which has induced landowners in the largest cities to erect buildings fifteen or twenty stories high, or more, and to excavate under them basements and cellars and sub-cellars to be ventilated by the use of engines, to be lighted by electricity, and filled with merchandise. They did not think that the surface of the streets would be insufficient for the use of the people with convenience and comfort in moving to and fro and passing in and out in the transaction of business or the pursuit of pleasure. It is now a fact of common knowledge that the streets of those parts of Boston which are most crowded are entirely inadequate to accommodate the public travel in a reasonably satisfactory way if the surface alone is used. Our system, which leaves to the landowner the use of a street above or below or on the surface, so far as he can use it without interference with the rights of the public, is just and right, but the public rights in these lands are plainly paramount, and they include, as they ought to include, the power to appropriate the streets above or below the surface as well as upon it, in any way

that is not unreasonable, in reference either to the acts of all who have occasion to travel or to the effect upon the property of abutters. The increase of requirements for the public within the streets of our large cities has probably equalled, if it has not surpassed the increase of requirements for business along the streets.

The Legislature, the guardian of public interests and of private rights, has determined that the space below the surface of certain streets in Boston is needed for travel. The question is whether action under the statutes involves an acquisition of a new right as against the landowner, or only an appropriation and regulation of existing rights. It hardly can be contended that this is an unreasonable mode of using the streets in reference either to travellers or abutters. If it is not an unreasonable mode of using them, the mere fact that it deprives abutters of the use of vaults and other similar underground structures in the streets, which they have heretofore maintained, is of little consequence. Abutters are bound to withdraw from occupation of streets above or below the surface whenever the public needs the occupied space for travel. The necessary requirements of the public for travel were all paid for when the land was taken, whatever they may be, and whether the particulars of them were foreseen or not. The only limitation upon them is that they shall be of a kind which is not unreasonable.

In the present case the travel which is being provided for is from place to place within the city. There are stopping-places on the subway at convenient points. In that respect it is different from a tunnel designed only or chiefly for travel for long distances. The new method is a substitution in part of a subterranean use of the streets for a use of their surface for the same general purpose. It is impracticable to have direct communication between the premises of abutters and the cars in the tunnel, but by going a short distance access to them may be had from any place. We are of opinion that this use of the streets is within the purposes for which the lands were taken and that no additional servitude is created by it.

The cases bearing upon this subject which have been decided in other courts differ so much from this in their facts and in the legislation to which they relate that they are not very important. See *Ramsden v. Manchester, South Junction & Altrincham Railway*, 1 Exch. 723; in re *New York District Railway*, 107 N. Y. 42, 52; *Hodgkinson v. Long Island Railroad*, 4 Edw. Ch. 411; *Adams v. Saratoga & Washington Railroad*, 11 Barb. 414; *Chicago v. Rumsey*, 87 Ill. 348; *Summerfield v. Chicago*, 197 Ill. 270, 282; *Baltimore & Potomac Railroad v. Reaney*, 42 Md. 117.

The authority to take lands, conferred upon the defendants by the St. 1894, c. 548, §31, although it includes land taken and held under the right of eminent domain, does not imply that there is no right to use the public ways without such taking. Indeed, the first part of the section gives the right to use these ways before it refers to the subject of taking. It then goes on to authorize the taking of private property, and closes by giving a broad general authority.

Nor is the St. 1902, c. 534, §19, so significant in their favor as the plaintiffs contend. It declares that "the city shall have, hold and enjoy in its private or proprietary capacity, for its own property," the several subways and the tunnel built and to be built under the statutes that have been passed. This is in accordance with the previous intimations of this court as to

ownership of the subway first constructed. *Mahoney v. Boston*, 171 Mass. 427, 429. *Browne v. Turner*, 176 Mass. 9, 13. But it does not purport to give a private proprietary right to anything more than the subways and tunnels as structures. It does not deal with the rights of the public to use the streets, or with any right of private property in the streets themselves. It leaves the subways lawfully resting in the public streets by virtue of the rights of the public therein, and it gives the city the same kind of ownership of the structures that gas companies and electric lighting companies have in their pipes and conduits, except that the city is charged with certain special trusts in the ownership of these subways. This provision of the statute does not purport to take from landowners on the streets any part of their property.

The statute gives damages to all persons injured in their property by the acts of the commission, but the question whether these plaintiffs are entitled to damages under this provision is not before us.

Bills dismissed.

## APPENDIX C.

## [Chapter 167.]

COMMONWEALTH OF MASSACHUSETTS.

*In the Year One Thousand Nine Hundred and Four.*AN ACT RELATIVE TO THE CONSTRUCTION OF A TUNNEL  
FOR ELEVATED CARS OR TRAINS IN THE  
CITY OF BOSTON.*Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows: —*

SECTION 1. The structure for two tracks especially adapted for elevated cars or trains for which provision is made in chapter five hundred and thirty-four of the acts of the year nineteen hundred and two, therein called the tunnel, may be located and constructed by the Boston Transit Commission northerly of the junction of Washington street and Adams square, in and through the existing subway; and in connection therewith such changes may be made within that part of said subway as may be necessary for the accommodation of surface cars; and at any time after the completion of the tunnel the commission may make such further changes in or additions to the existing subway between Adams square or Scollay square and Causeway street as may be necessary for the accommodation of surface cars. In all action hereunder the commission shall, so far as may be necessary, have all the powers conferred by the above-named act and shall be subject to the provisions of section thirteen thereof. All expenses incurred hereunder, including any charges or expenses occasioned by reason or in consequence of the laying out of the tunnel through a part of the subway as above provided, shall be deemed a part of the cost of the tunnel under said act.

SECTION 2. This act shall take effect upon its passage. [*Approved, March 21, 1904.*]

## APPENDIX D.

EMPLOYEES IN THE ENGINEERING DEPARTMENT WHO HAVE WORKED ONE MONTH OR MORE DURING THE YEAR ENDING JUNE 30, 1904.

(Arranged in Alphabetical Order.)

NAME.	INDICATION OF DUTIES.
AIKEN, ROY C.,	Inspection of concrete, etc., Sections B and F.
BABBITT, JOHN V.,	Assisting on the inspection of concrete, etc., Sections B and F.
BELL, DANIEL S.,	Assisting on line and grade work, Section F, and surveys for Washington Street Tunnel.
BELL, WILLIAM H.,	Assisting on inspection of concrete on Section B. Line and grade work and miscellaneous office work.
BROWN, C. LEONARD,	Inspection of concrete, Section F.
BROWN, MOSES L.,	Inspection of concrete, Section B, and draughting in office.
BURNS, JOHN J.,	Draughting.
CARTER, ARTHUR B.,	Clerk to the Chief Engineer.
CROWLEY, ERNEST M.,	Draughting.
DAVIS, EDMUND S.,	Oversight of office and field work.
DAVIS, WILBUR W.,	Draughting, Boston Tunnel and Subway.
EAGER, FRANK J.,	Inspection, Sections E and F.
EMERSON, GEORGE D.,	Designs for structures, draughting and experimental work.
FANCY, CLIFFORD R.,	Assisting in line and grade work, Section F, and surveys for Washington St. tunnel.
FARWELL, ROBERT B.,	Designs for sewer changes and surveys for Washington street tunnel.
FLAWS, JAMES B.,	Draughting, blue printing, etc., in office and assisting on surveys for Boston Tunnel and Subway.
FLETCHER, FREDERICK W.,	Inspection of concrete, Section F.
FRAME, JAMES T.,	Inspecting, Section F, East Boston Tunnel and surveys for Washington St. tunnel.
GLEN, JOHN M.,	Assisting on work for pipe changes, etc.
HALL, JOHN H. M.,	Assisting on the inspection of concrete, Section F, and surveys for Washington St. tunnel.
HOLMES, ALBERT J.,	Assisting in line and grade work, Section B.
HOWE, LEONARD B.,	Draughting and designs for structures.



JOHNSON, CHARLES C.,	Testing cement, concrete beams and other material.
JOYCE, ARTHUR E.,	Inspection of concrete, Section F.
LEWIS, WILLIAM W.,	Designs for structures, etc.
LOVELAND, CHARLES P.,	Inspection of concrete, Section B, and draughting in office.
LUCY, ARTHUR E.,	Inspection of concrete, Section B.
MACINTYRE, DANIEL J.,	Assisting on inspection of concrete, Section F.
MANLEY, LAURENCE B.,	In charge of pipe changes, Section F, and Washington St. tunnel.
MASON, JOHN E.,	Assisting on the inspection of concrete, Section B.
MCCURDY, HARRY S. R.,	In charge of construction of Sections E and F, and making studies for Washington St. tunnel.
MCDONALD, FRANCIS A.,	Assisting in testing cement, blue printing, etc.
McMAHON, ROSE A.,	Stenographer.
MCNEIL, NORMAN C.,	Assisting in line and grade work and draughting for pipe changes.
MURPHY, JEREMIAH L.,	Messenger.
MURPHY, FREDERICK F.,	Assisting in line and grade work, pipe changes, Section F, and for Washington St. tunnel.
O'BRIEN, PATRICK F.,	Surveys and estimates for Boston Tunnel and Subway.
PALMER, JOHN E.,	In charge of construction of Sections B and C.
PARKER, ALFRED W.,	Inspection of steel work.
RAFTUS, PETER J.,	Assisting on line and grade work, Washington St. tunnel.
RICE, EDMUND A.,	Draughting and assisting on surveys for Washington St. tunnel.
RYCROFT, CHARLES J.,	Inspection, Sections B, C and D.
STEARNS, GEORGE H.,	Designs for structures, etc.
STEARNS, RALPH H.,	Assisting in line and grade work, Sections E and F.
STILES, FREDERIC W.,	Photography and office work.
STREET, L. LEE,	In charge of line and grade work, Section C, and making studies for Washington St. tunnel.
WELLINGTON, WILLIAM O.,	In charge of line and grade work, Section B, and making plans for Washington St. tunnel.

## APPENDIX E.

SOME OF THE CONTRACTORS WHO HAVE DONE WORK FOR THE COMMISSION  
DURING THE YEAR ENDING JUNE 30, 1904.

NAME.	CONTRACT.
THE BOSTON TUNNEL CONSTRUCTION Co., 23 Lewis St., East Boston. Robert A. Shailer, <i>President</i> . Charles F. Taylor, <i>Treasurer</i> . Principal foremen: John Boyle; William McLaughlin.	Section B of the East Boston Tunnel.
G. W. & F. SMITH IRON Co., Gerard St., Roxbury.	Two sidewalk gratings over ventilating chambers, Sections B and C.
GOULDS MANUFACTURING Co., S Oliver St., Boston.	Pumping outfit for East Boston Tunnel.
WHITTIER MACHINE Co., 53 State St., Boston.	Elevators for Atlantic-avenue Station.
WILLIAM H. SMITH, 101 Tremont St., Boston.	Enameled tile-work in Atlantic-avenue Station and Old State House Station.
PATRICK MCGOVERN, 99 Hutchings St., Roxbury. Superintendent on Section C. Charles R. Gow. Principal foremen: A. E. Weaving; Patrick Porter; A. I. Negus; James King; Michael McGovern; Patrick Travers.	Completion of Section C of the East Boston Tunnel. Paving State Street from East side Chatham Row to Washington Street. About 3700 linear feet of ventilating duct of Portland cement mortar and imbedded metal fabric in the upper portion of Section B. New sewers required on account of the Washington St. tunnel.
W. A. MURTFELDT Co., 31 Milk St., Boston.	Artificial stone side-walk on State Street between McKinley Square and Devonshire Street.
WOODBURY & LEIGHTON, 166 Devonshire St., Boston. Principal foremen: Geo. O'Brien; John Skuse.	Tunnel at the head of State Street and making alterations and additions to the Old State House, Section E. Shelters over Section F.

- |  |   |   |
|--|---|---|
| COLEMAN BROTHERS,<br>15 Court Square, Boston.<br>Engineer for Contractor,<br>John A. Starr.<br>Principal foremen:<br>Henry Strupney; Charles P.<br>Horton. | } | Section F of the East Boston<br>Tunnel.<br>Granolithic platforms in Sta-<br>tion in State Street near At-<br>lantic-avenue, in Old State<br>House Station and in Court<br>Street Station. |
| BOSTON TILE & MANTEL Co.,<br>361 Boylston St., Boston  | } | Enameled tile-work in Section<br>F.   |
| ISAAC BLAIR & Co.,<br>444 Harrison Ave., Boston.   | } | Moving statue of John Winthrop<br>from Scollay Square to yard<br>of Commission at 75 Canal<br>Street, Boston.   |
| HARRINGTON ROBINSON & Co.,<br>272 Franklin St., Boston.  | } | Steel for connection between<br>the East Boston tunnel and<br>the Subway at Scollay Square.   |

APPENDIX F.

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EXPERIMENT TO INDICATE WHETHER IRON RUSTS WHEN IMBEDDED  
IN CONCRETE.

Nine strips of sheet iron (2 in.x6 in.) were cleaned till their surfaces were bright and free from rust. Then they were imbedded in concrete, moulded into the form of a hollow cylinder, the outside dimensions of which were 14 in.x20 in., the walls being three inches thick. This cylinder, when hardened, was kept filled with water, and was placed in the tunnel. At first the water percolated through the concrete very readily, but the amount of percolation gradually diminished so that at the end of about two months the cylinder became practically watertight. At the end of two years the sheet iron strips were removed from the concrete and examined. They were found to be free from any rust, and in as bright condition as when placed in the concrete. The concrete was proportioned as follows:—

- 1 barrel of Portland cement;
- 9 cubic feet of stone dust, and
- 11 cubic feet of broken stone.

## APPENDIX F—2.

EXPERIMENT TO INDICATE WHETHER STEEL IMPERFECTLY CLEANED IS PRESERVED FROM FURTHER RUSTING BY IMBEDDING THE SAME IN CONCRETE.

A square plate (4 in.x4 in.x1-2 in.), which had become badly rusted, was cleaned by filing till its general surface was bright, but the rust still remained in the numerous small pits. This plate was then surrounded by about 1 1-2 inches of concrete, moulded in the shape of a square block. The concrete was proportioned as follows:—

- 1 barrel of Portland cement;
- 9 cubic feet of stone dust;
- 11 cubic feet of broken stone.

The concrete block, when hardened, was placed in water for three or four days, then taken out and dried in air for three or four days. This process of first wetting and then drying was continued for two years, and then the plate was removed from the concrete and examined. The portion of the plate that was bright had remained unchanged. There was apparently no increase of rust in the small pits, but in some of them the color had changed from the originally reddish brown to a yellow. Prof. Norton of the Massachusetts Institute of Technology judges this to be merely a change in the composition of the old rust, and not a formation of new rust. Two other pieces of steel treated in the same way gave the same results.

## APPENDIX G.

## TESTS OF REINFORCED CONCRETE BEAMS.

The size of the beams and the various methods of reinforcing them are shown on Plate 12. The results of the tests are given in the tables on pages 84 to 88. Photographs showing the different forms of failure are reproduced on Plates 13 to 18. From each batch of concrete two prisms were made which were sent to the Watertown Arsenal to be tested. The results are tabulated on page 89. Other data is given in the accompanying plates and tables, showing deflections of beams, modulus of elasticity of the concrete, characteristics of the steel used for reinforcing, etc.

The beams and prisms were made in the proportion of 380 lbs. of Vulcanite cement, 4 cubic feet of coarse sand, 4 cubic feet of fine stone dust and 12 cubic feet of broken stone. In mixing the materials and filling the moulds no attempt was made to secure better work than can be obtained in ordinary practice. The beams were left in the moulds about two days and then buried in damp sand until a few days before testing.

The average weight of the beams with small amounts of reinforcement was about 305 lbs. Those with larger amounts of steel weighed correspondingly more.

All loads were applied at the center. The loads given in the tables do not include the weights of the beams.

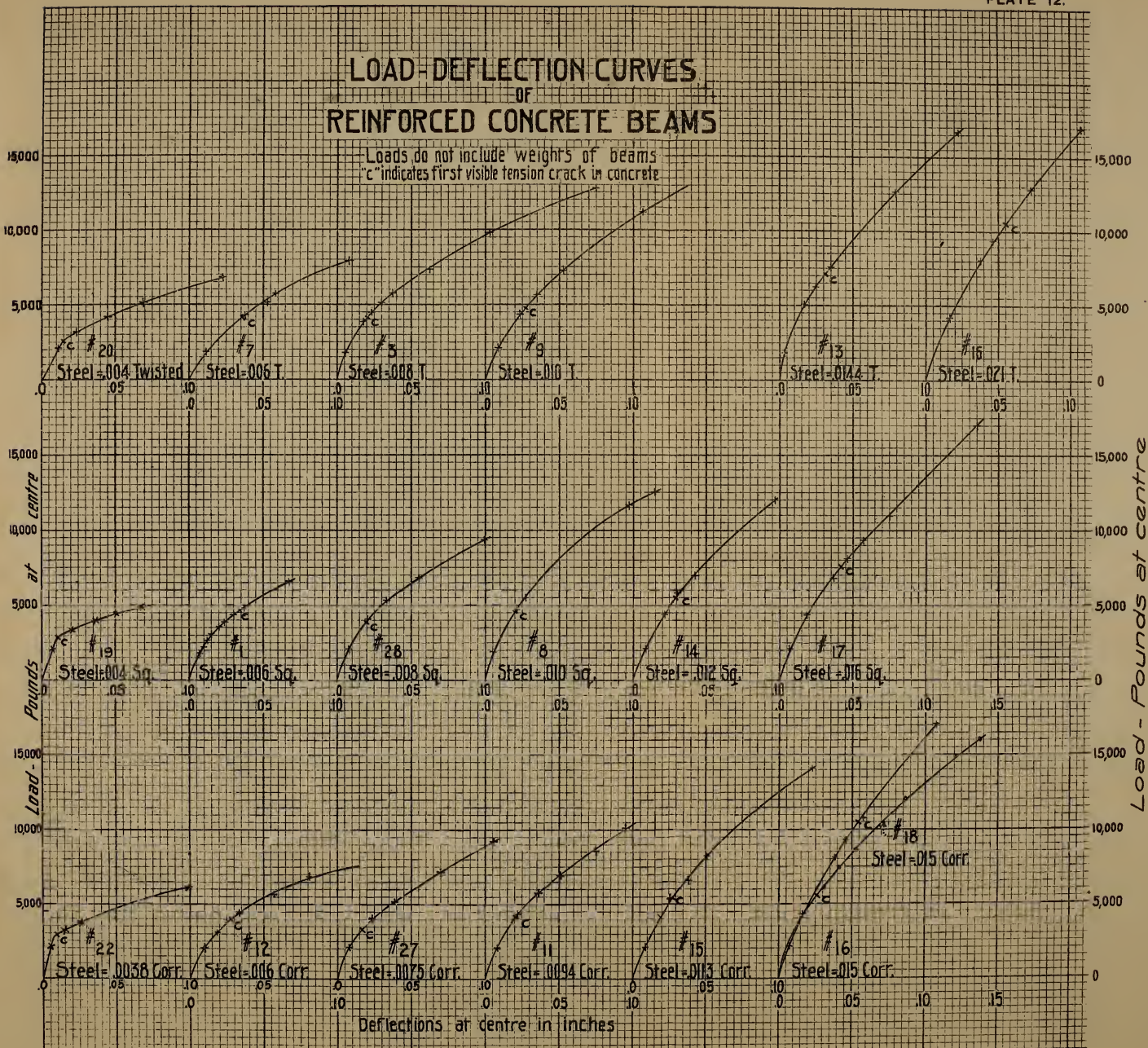
Measurements of deflections and sets were taken in nearly all cases, and were made as follows:—Small brass plugs were set in the beams half way between the top and bottom above the supports and a fine German silver wire was stretched over them. At the center of the beams a small wood plug carrying a brass screw was set in just below the wire. The terminals of a battery with an electric bell in circuit were connected to the wire and to the brass screw. Measurements were then taken with a micrometer between the top of the wire and the bottom of the screw head, the electric bell making it possible to obtain quite accurate settings. Deflections were taken on both sides of the beams. The measurements were discontinued after the steel was stressed beyond the elastic limit.

The loads given in the tables as corresponding to the elastic limit of the steel are the loads at which the fine tension cracks in the concrete start to visibly open out and probably correspond to a tensile stress in the steel of from 2,000 to 4,000 lbs. per square inch in excess of the elastic limit.

The deflections of the beams reinforced with corrugated (Johnson) or twisted (Ransome) bars and failing in tension were very large before the ultimate load was reached, in some cases being as much as 4 inches. (See illustration No. 73.) In the beams reinforced with plain bars the margin between the load at the elastic limit of the steel and at ultimate failure was very much less than in the beams having deformed bars. This is to be partly attributed to the difference in the stress strain diagrams of the high and low elastic limit steels.

# LOAD-DEFLECTION CURVES OF REINFORCED CONCRETE BEAMS

Loads do not include weights of beams  
"c" indicates first visible tension crack in concrete









NO. 73 SHOWING STEEL SKELETON.



NO. 16  
REINFORCED CONCRETE BEAMS.





NO. 11 HOLDING A LOAD OF 12,770 LBS.



NO. 15



NO. 27

HELVETIA, 1911, SYSTEM

REINFORCED CONCRETE BEAMS.





NO. 47

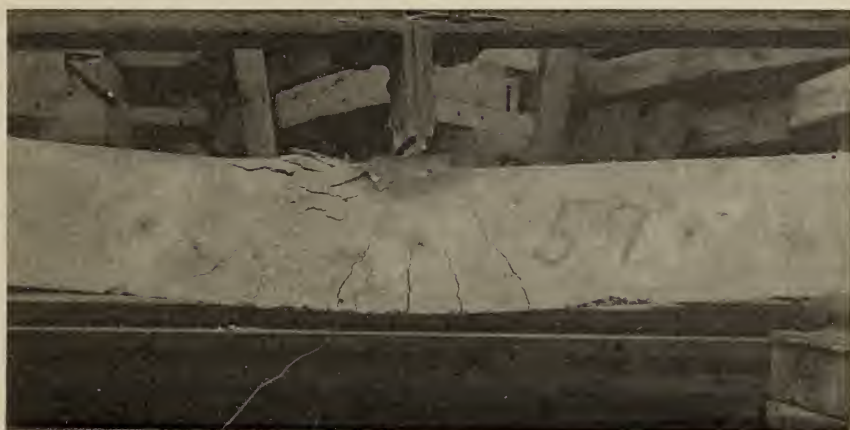


NO. 52  
REINFORCED CONCRETE BEAMS.





NO. 44



NO. 57



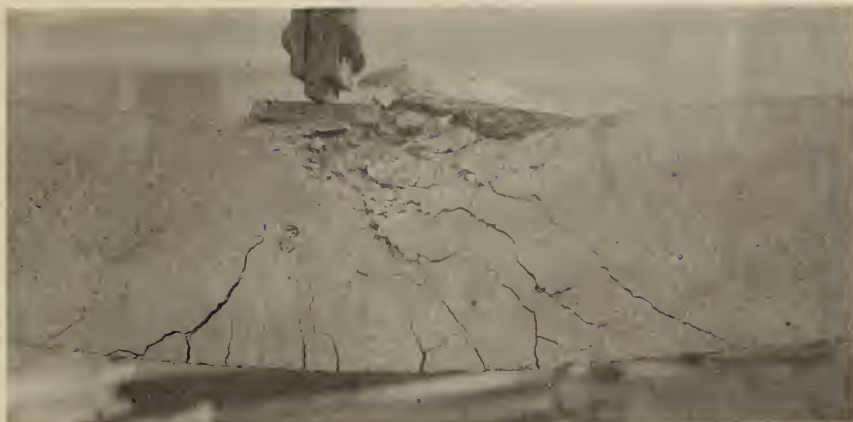
HELIOTYPE CO., BOSTON

NO. 60

REINFORCED CONCRETE BEAMS.







NO. 61



NO. 64



NO. 71

REINFORCED CONCRETE BEAMS.





NO. 73 HOLDING A LOAD OF 28,400 LBS.



NO. 75



NO. 76

HELIOTYPE CO., BOSTON

REINFORCED CONCRETE BEAMS.



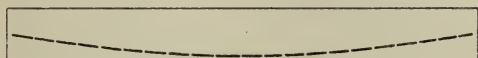
ARRANGEMENT OF STEEL IN CONCRETE-STEEL BEAMS.



"A"



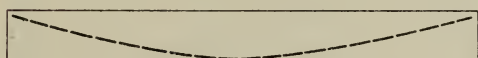
BEAMS NO. 1-30, 56, 58, 60, 62, 64, 66.



"B"



BEAMS NO. 43, 47-50, 54.



"C"



BEAMS NO. 44-46, 51-53.

72"



"D"



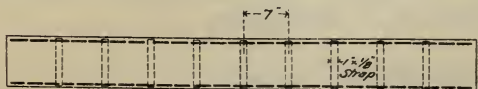
BEAMS NO. 55, 57, 59, 61, 63, 65.



"E"



BEAMS NO. 68, 70, 72, 74, 76, 78.



"F"

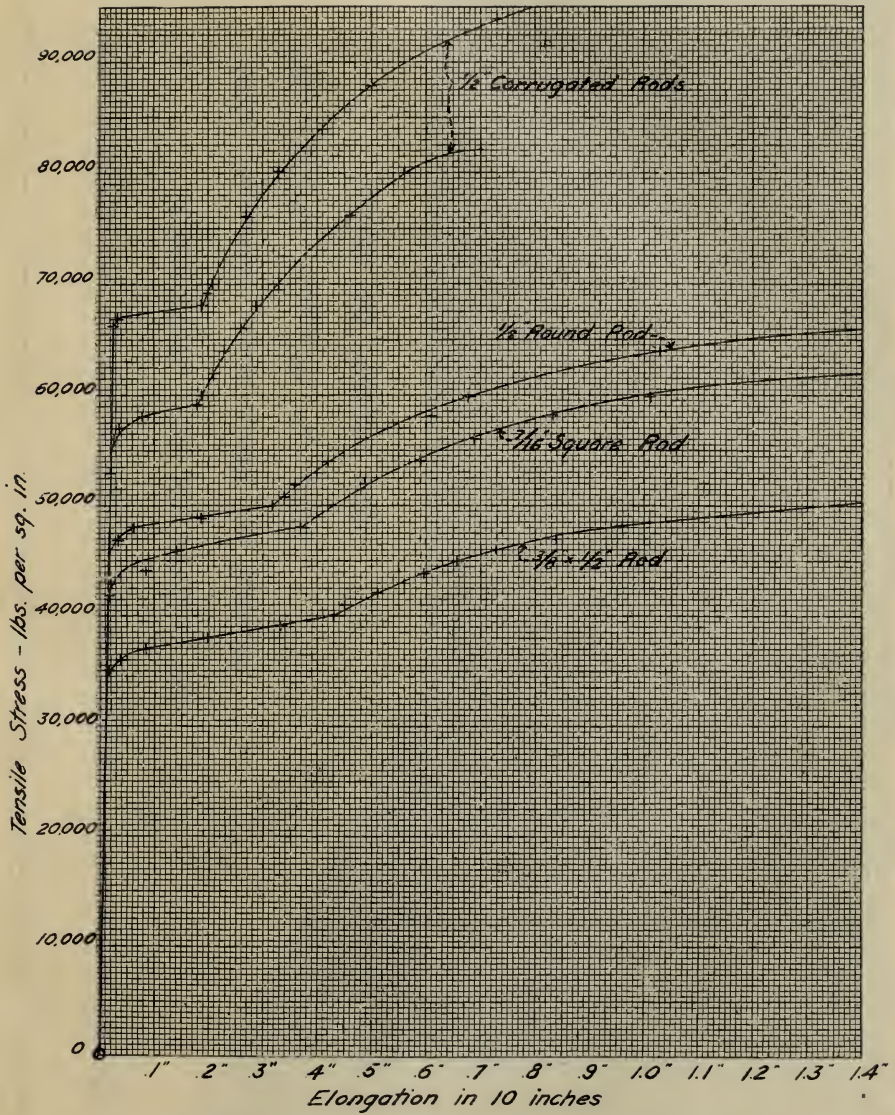


BEAMS NO. 67, 69, 71, 73, 75, 77.



Scale in feet





STRESS-STRAIN CURVES OF STEEL USED FOR REINFORCED CONCRETE BEAMS. TESTED AT WATERTOWN ARSENAL - MAY, 1904.



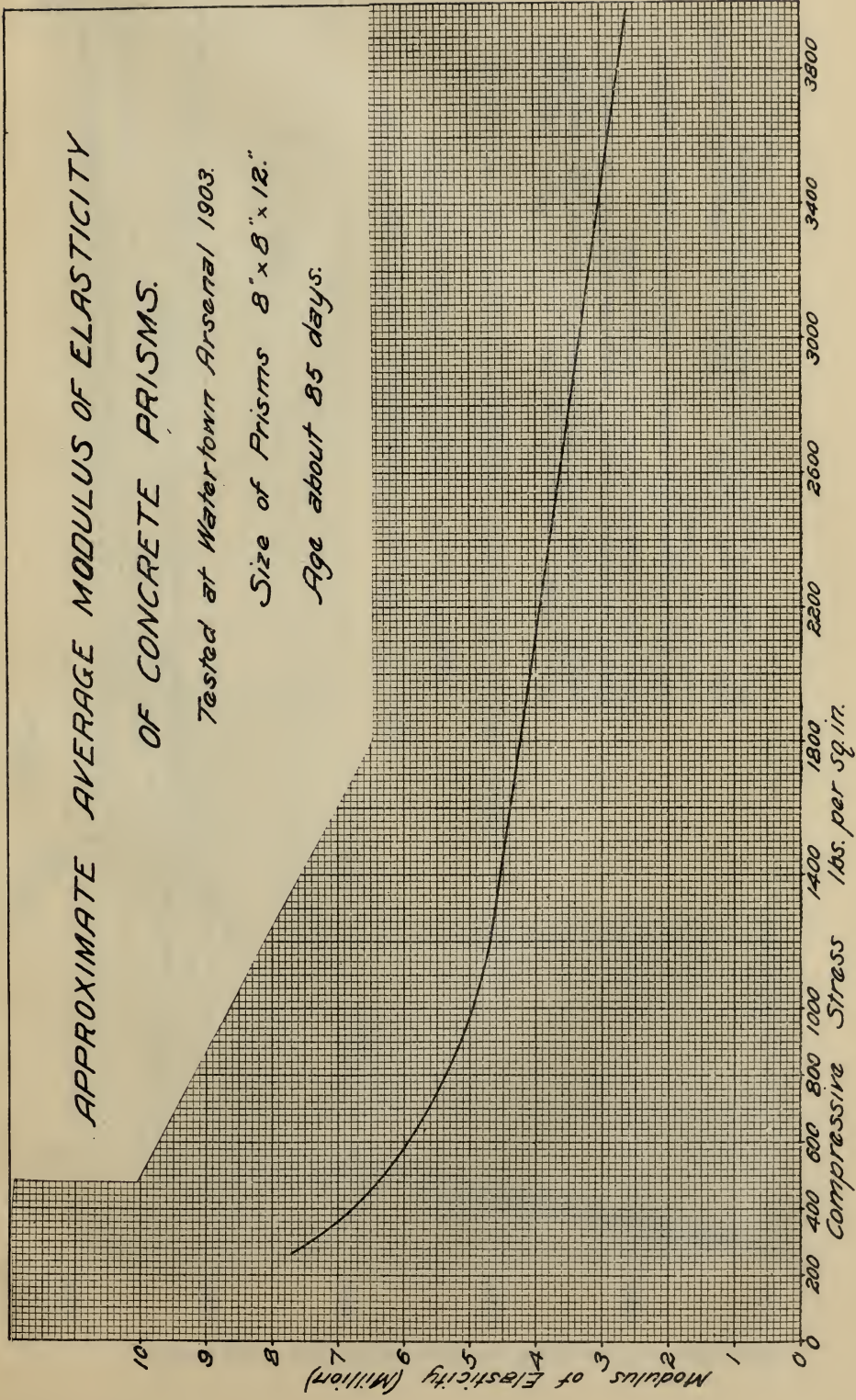


APPROXIMATE AVERAGE MODULUS OF ELASTICITY  
OF CONCRETE PRISMS.

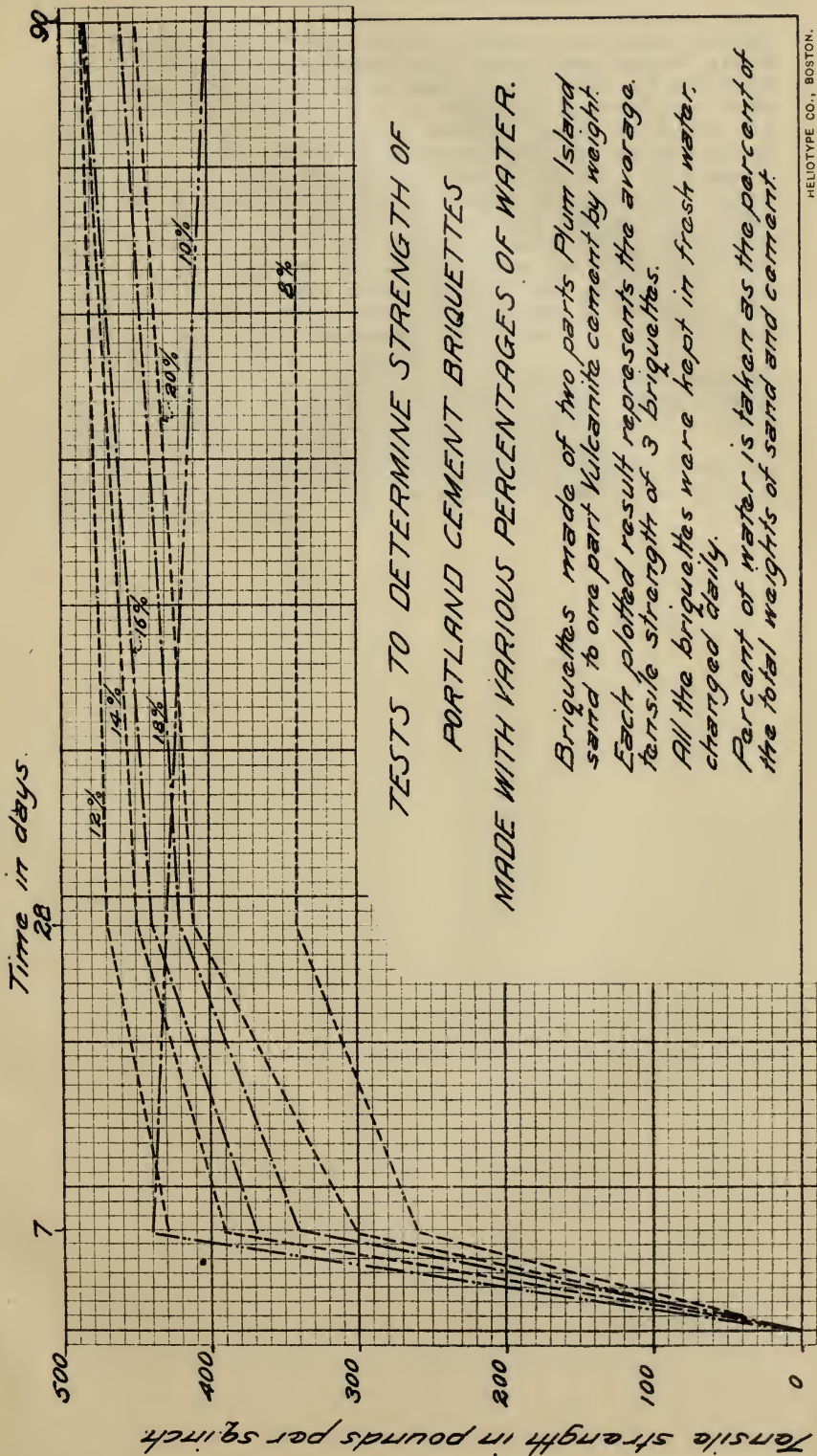
Tested at Watertown Arsenal 1903.

Size of Prisms 8" x 8" x 12."

Age about 85 days.







TESTS TO DETERMINE STRENGTH OF  
 PORTLAND CEMENT BRIQUETTES  
 MADE WITH VARIOUS PERCENTAGES OF WATER.

*Briquettes made of two parts Plum Island sand to one part Vulcanite cement by weight. Each plotted result represents the average tensile strength of 3 briquettes. All the briquettes were kept in fresh water. Percent of water is taken as the percent of the total weights of sand and cement.*



The first tension cracks in the concrete were quite variable, both as to the loads and deflections at which they occurred and in the rapidity with which they extended up the sides and across the bottoms of the beams, and were influenced somewhat by slight vibrations caused by Elevated Railway trains passing in the vicinity. In every case where horizontal shear just above the rods occurred it was only a secondary cause of failure. The diagonal crack due to shearing forces would start about half way between the top and bottom of the beam at the point marked "C" in illustrations Nos. 15 and 16, and would gradually extend toward the center at the top and the nearest support at the bottom until failure occurred. The piece above the rods and outside this crack would then suddenly break away from the rest of the beam. The shape of these cracks corresponds very closely to the theoretical resultant stress lines in the beam.

Beams Nos. 47, 60, 63-66 were accidentally broken, probably while being removed from the moulds. These initial vertical cracks extending through the beams seemed to have no effect whatever on the failure of the beams when tested.

For more complete data on the modulus of elasticity of the concrete see the report for 1903, on Tests of Metals, etc., made at the Watertown Arsenal.

APPENDIX G—2.

EAST BOSTON TUNNEL.

TESTS OF REINFORCED CONCRETE BEAMS, 1903.

No. of Beam.	Age in Days.	Steel Reinforcement.				Pounds at Center.			Failure similar to Illustration Number.	First Sign of Failure (Shear Cracks, Elastic Limit or Crushing.)	Ultimate Failure.	Remarks.	
		No. of Rods.	Size.	Area, Sq. In.	Area, Per Cent.	Kind.	Load at First Visible Crack.	Load at First Sign of Failure.					Ultimate Breaking Load.
1	58	1	$\frac{1}{2}$	.287	.6	Square	4,818	7,814	7,814	Tension	$\frac{5}{16}$ " rod slipped in concrete at ultimate load.		
2	59	2	$\frac{1}{6}$	.382	.8	"	4,896	9,634	9,634	"	One center crack opened.		
3	59	2	$\frac{1}{6}$	.382	.8	Twisted	4,190	11,446	13,066	Shear	Concrete splintered below rods.		
4	56	2	$\frac{1}{6}$	.360	.75	Corrugated	4,696	11,000	15,064	Tension	Concrete slightly splintered near center, below rods.		
5	38	1	$\frac{1}{2}$	.180	.38	"	3,000	6,500	8,180	"	Concrete splintered below rod.		
6	46	1	$\frac{1}{6}$	.191	.4	Twisted	3,482	6,252	6,708	"	"		
7	51	1	$\frac{1}{6}$	.287	.6	"	4,436	9,088	11,556	"	Concrete splintered below rod, near center.		
8	61	2	$\frac{1}{6}$	.478	1.0	Square	4,670	10,190	10,190	"	One centre crack opened.		
9	65	2	$\frac{1}{6}$	.478	1.0	Twisted	4,776	13,350	13,350	Shear			
10	61	1	$\frac{1}{6}$	.191	.4	Square	3,506	5,186	5,186	"			
11	66	2 $\frac{1}{2}$	$\frac{1}{2}$	.450	.94	Corrugated	4,192	12,118	14,140	Tension	One center crack opened.		
12	64	1	$\frac{1}{2}$	.270	.6	"	4,040	8,000	9,914	"	Concrete splintered below rods.		
13	59	2	$\frac{1}{6}$	.691	1.44	Twisted	7,030	19,026	19,026	Shear	"		
14	61	3	$\frac{1}{6}$	.573	1.2	Square	5,600	13,714	13,714	"			
15	68	3	$\frac{1}{6}$	.540	1.13	Corrugated	5,404	14,540	15,036	Tension	One center crack opened.		
16	65	4	$\frac{1}{6}$	1.00	2.1	Twisted	10,448	18,476	18,476	Shear			
17	67	4	$\frac{1}{6}$	.764	1.6	Square	7,600	15,012	18,184	"			
18	67	4	$\frac{1}{6}$	.720	1.5	Corrugated	5,600	16,100	17,948	Tension	Shear cracks at ultimate load.		
									Shear				

Span for all beams 60." Reinforcement—straight rods in tension side. (Arrangement "A")

## APPENDIX G—3.

## EAST BOSTON TUNNEL.

## TESTS OF REINFORCED CONCRETE BEAMS, 1903.

No. of Beam.	Age in Days.	Steel Reinforcement.					Kind.	Pounds at Center.			Failure similar to Illustration Number.	First Sign of Failure (Shear Cracks, Elastic Limit of Steel or Crushing).	Ultimate Failure.	Remarks.
		No. of Rods.	Size.	Area, Sq. In.	Area, Per Cent.	Load at First Visible Crack.		Load at First Sign of Failing.	Ultimate Breaking Load.	Failure similar to Illustration Number.				
19	68	1	1 $\frac{1}{2}$ "	.191	.4	2,980	4,020	5,160	11	Tension	Tension	One center crack opened.		
20	68	1	1 $\frac{1}{2}$ "	.191	.4	2,800	8,332	8,926		"	"	Two center cracks opened.		
21	68	1	1 $\frac{1}{2}$ "	.196	.41	2,716	5,004	5,230		"	"	Rod slipped in concrete at ultimate load.		
22	67	1	1 $\frac{1}{2}$ "	.180	.38	2,960	6,800	8,174	11	"	"	Concrete splintered below rod near center.		
23	67	1	1 $\frac{1}{2}$ "	.248	.52	3,000	5,040	6,130	11	"	"	Two center cracks opened.		
24	67	2	1 $\frac{1}{2}$ "	.496	1.03	3,680	10,304	12,422	11	"	"	"		
25	70	2	1 $\frac{1}{2}$ "	.382	.8	3,126	9,306	12,576	15	"	Shear	"		
26	70	1	1 $\frac{1}{2}$ "	.187	.39	3,680	5,086	5,086		"	Tension	Center crack opened.		
27	69	2	1 $\frac{1}{2}$ "	.360	.75	3,126	10,500	13,236	27	"	Tension and Shear	Concrete splintered below rods.		
28	72	2	1 $\frac{1}{2}$ "	.392	.82	3,788	10,312	10,312		"	Tension	One centre crack opened.		
29	76	2	1 $\frac{1}{2}$ "	.374	.8	4,680	7,600	8,164		"	"	"		
30	72	2	1 $\frac{1}{2}$ "	.382	.8	3,640	10,456	10,456		"	"	"		

Span for all beams 60." Reinforcement—straight rods in tension side. (Arrangement "A")





APPENDIX G—5.

TESTS OF REINFORCED CONCRETE BEAMS, 1903.

No. of Beam.	Age in Days.	Steel Reinforcement.				No. of Rods.	Kind.	Area, Sq. In.	Area, Per Cent.	Arrangement.	Pounds at Center.		Failure similar to Illustration Number.	First Sign of Failure (Shear Cracks, Elastic Limit or Crushing.)	Ultimate Failure.	Remarks.	
		Load at First Visible Crack.	Load at First Sign of Failure.	Ultimate Breaking Load.	Failure similar to Illustration Number.						First Sign of Failure (Shear Cracks, Elastic Limit or Crushing.)	Ultimate Failure.					Remarks.
55	64	4	.72	1.5	D	21,200	19,900	57	Tension	Crushing	Crushing						
56	108	4	.72	1.5	A	18,800	18,220	16	Shear	Shear	Crushing						
57	63	3	.54	1.13	D	18,300	14,486	57	Tension	"	Crushing						
58	109	3	.54	1.13	A	18,280	17,280	15*	"	"	Shear						
59	64	2	.36	.75	D	12,728	10,212	11	"	"	Tension	Initial crack through beam 8"					
60	108	2	.36	.75	A	12,944	10,000	60	"	"	Shear	right of center.					
61	109	4	.72	1.5	D	23,556	18,000	61	Tension and Shear	"	Crushing						
62	108	4	.72	1.5	A	19,132	18,400	16	Shear	"	Crushing						
63	108	3	.54	1.13	D	17,876	15,204	11	Tension	"	Tension and Crushing	Two initial cracks through beam 15" right and 7" left of center.					
64	109	3	.54	1.13	A	15,680	14,000	64	Shear	"	Tension and Shear	Initial crack through beam 9" right of center.					

\* With open tension cracks near center.

Reinforcement—Straight rods in tension side. { Arrangement A—without stirrups.  
" D—with " " "

Span for all beams 60".

65	109	2	.360	.75	D	21,628	16,584	44	Tension	Shear and Tension	Initial crack through beam 14" left of center.
66	109	2	.36	.75	A	19,248	16,000	44	Shear	"	Initial crack through beam 3" left of center.

Span for beams Nos. 65 and 66 = 40".



## APPENDIX G—7.

## CONCRETE PRISMS, 8''×8''×12''.

No. of Prism.	Age in Days.	Crushing Strength Pounds per Square Inch.	No. of Beams Made from Same Batch of Concrete.
1	87	4,680	1-7
2		4,890	
3	86	4,330	8-12
4		4,570	
5	83	2,940	13-19
6		2,840	
7	82	3,650	20-25
8		3,330	
9	81	3,650	26-30
10		4,280	
11	168	5,680	31-36
12		5,600	
13	167	4,150	37-42
14		4,730	
15	77	3,550	43-47
16		3,770	
17	75	3,430	48-54
18		3,340	
19	74	4,590	55-60
20		3,610	
21	160	4,100	61-66
22		4,960	
23	92	3,420	67-72
24		4,350	
25	90	4,630	73-78
26		4,530	

Tested at Watertown Arsenal, 1903.

## STEEL USED FOR CONCRETE STEEL BEAMS.

Kind.	Size.	Elastic Limit.	Tensile Strength.
Corrugated (Johnson).....	$\frac{1}{2}$ ''	60,100	87,680
Twisted (Ransome).....	$\frac{7}{16}$	67,570	84,860
“ “ .....	“	69,730	87,570
Thacher .....	$\frac{9}{16}$	40,760	56,300

Tested at Watertown Arsenal, 1903.

APPENDIX H.  
 CANVASS OF BIDS FOR CONSTRUCTING SECTION F OF EAST BOSTON TUNNEL. BIDS OPENED JULY 7, 1903.

BIDDERS AND ADDRESSES.	a	aa	3a	b	d	e	ee	f	ff	g	gg	h	i	j	Totals.
Met'n Contracting Co., 95 Milk St., Boston.	\$8,500.00	\$2,250.00	\$15.00	\$15.00	\$18.00	\$2.00	\$2.00	\$40.00	\$25.00	\$0.80	\$30.00	\$0.50	\$0.40	\$43,500.00	\$223,170.00
H. P. Nawn, 82 Savin St., Boston	6.75	4.00	6.00	14.00	25.00	0.50	0.50	12.00	15.00	0.75	25.00	0.50	0.30	56,000.00	217,755.00
Jas. J. Coughlan, 19 Worthington St., Boston	6.00	3.30	10.00	13.50	20.00	3.00	2.50	18.00	18.00	0.50	16.00	0.50	0.30	40,000.00	191,365.00
Jones & Meehan, 1 Beacon St., Boston.	6.00	2.50	20.00	14.00	20.00	1.00	1.00	10.00	10.00	0.50	25.00	0.60	0.40	40,000.00	188,200.00
Shailer, Dunfee & Taylor, 23 Lewis St., E. Boston.	5.25	4.25	20.00	14.50	20.00	2.50	2.00	15.00	15.00	0.75	25.00	0.50	0.15	27,600.00	174,200.00
F. W. Everson & Co., L St., So. Boston.	4.00	3.00	20.00	12.00	20.00	2.00	2.00	100.00	50.00	0.60	30.00	0.50	0.25	34,000.00	158,600.00
Patrick McGovern, 159 State St., Boston.	5.00	5.00	10.00	12.00	15.00	1.50	1.50	25.00	20.00	0.50	25.00	0.40	0.15	16,000.00	150,475.00
Coleman Bros., Union St., Everett.	4.00	1.75	20.00	10.50	20.00	1.00	1.00	10.00	20.00	0.50	30.00	0.50	0.25	15,000.00	121,500.00

a 12,000 Cu. Yds. Earth Excavation.  
 aa 3000 Cu. Yds. Earth Excavation from Core, Disposed of via Tunnel.  
 3a 10 Cu. Yds. Concrete Masonry Removed and Disposed of.  
 b Furnishing and Putting in Place 4200 Cu. Yds. Concrete, Portland Cement Mortar.  
 d Furnishing and Laying 40 Cu. Yds. Brick Masonry Manholes, Piers for Waterpipes, etc., Portland Cement Mortar.  
 e Laying 500 Ft. 15 In. Vitrified Pipe. Furnished by Commission.  
 ee Laying 250 Ft. 12 In. Vitrified Pipe. Furnished by Commission.  
 f Setting and Securing 60 Tons Steel Lbs. per Ft. Weighing Less Than 6 Lbs. per Ft. Furnished by Commission.  
 ff Setting and Securing 60 Tons Steel and Iron, Weighing 6 Lbs. or More per Ft. Furnished by Commission.  
 g Furnishing, Repairing and Applying 4000 Sq. Yds. Portland Cement Mortar, ½ In. Thick.  
 gg Furnishing, Repairing and Forcing Into Void Spaces Back of Sheeting 10 Cu. Yds. Grount, 1 Cement to 1 of Sand.  
 h Preparing and Applying to Structure 4000 Sq. Yds. Water Proof Coating, ½ In. Pitch or Asphalt. Furnished by Commission.  
 i Preparing and Applying to Structure 6000 Sq. Yds. Tarred Felt, Pitch, etc., in 3 or More Layers.  
 j Underpinning Court Street, Side of Sears Building; Supporting and Protecting the Same and All Other Buildings on Line of Work.

## APPENDIX H—2.

CANVASS OF BIDS FOR GRANOLITHIC SIDEWALKS IN STATE ST., BETWEEN  
MCKINLEY SQ. AND DEVONSHIRE ST. BIDS OPENED AUG. 6, 1903.

BIDDERS AND ADDRESSES.	325 ± Yards.	Time of Completion.
	Bid Per Yard and Total Amount.	
Thomas J. Hind.....	\$2.20 715.00	Sept. 1, 1903
Simpson Bros. ....	1 95 633.75	Aug. 25, 1903
W. A. Murtfeldt Co.....	1 40 4.55	Six Working Days.

All of the bidders were from Boston.

APPENDIX II—3.

CANVASS OF BIDS FOR PAVING STATE ST. FROM EAST SIDE CHATHAM ROW TO WASHINGTON ST. BIDS OPENED SEPTEMBER 23, 1903.

BIDDERS AND ADDRESSES.	a		b		2b		c		d		2d		e		f		g		h		Total.	Total (Alternative).	Date of Completion.	
	Furnishing 1,000 sq. yds. Granite Blocks.	Alt.	Laying 50 sq. yds. Block Paving, Gravel Base.	Alt.	Laying 5,000 sq. yds. Granite Block Paving, Pitch Joints, Concrete Base.	Alt.	Furnishing 75 sq. yds. Flagging Crosswalks.	Alt.	Laying 10 sq. yds. Flagging Crosswalks, Pitch Joints, Concrete Base.	Alt.	Laying 400 sq. yds. Flagging Crosswalks, Pitch Joints, Concrete Base.	Alt.	Setting 50 lineal ft. Granite Edge-stone.	Alt.	Furnishing 10 sq. yds. Sidewalk Brick.	Alt.	Laying 20 sq. yds. Brick Sidewalk.	Alt.	Resetting 12 Manhole Covers.	Alt.				
Booth & Co., Inc., 50 State St., Boston.	\$2.00	\$2.00	\$1.50	\$1.33	\$3.50	\$2.93	\$3.75	\$3.75	\$1.50	\$1.33	\$3.50	\$2.93	\$0.25	\$0.75	\$0.75	\$0.25	\$0.25	\$0.25	\$3.00	\$3.00	\$21,332.25	\$18,244.05	Nov. 1	
Albert A. Libby & Co., 79 Milk St., Boston.	1.75	1.75	0.50	0.50	3.00	2.90	3.60	3.60	0.50	0.50	3.25	3.00	0.10	0.65	0.65	0.45	0.45	2.00	2.00	2.00	2.00	18,394.50	17,794.50	Nov. 15
H. Gore & Co., 54 Kilby St., Boston.	1.80	1.80	0.50	0.50	2.39	2.35	3.50	3.50	0.50	0.50	2.35	2.35	0.15	0.62	0.62	0.40	0.40	3.00	3.00	3.00	3.00	15,056.25	14,840.25	No time
William J. Rafferty, 35 Chalmers Street, South Boston.	1.80	1.80	0.45	0.45	2.18	2.18	3.35	3.35	0.45	0.45	2.20	2.20	0.18	0.65	0.65	0.45	0.45	3.00	3.00	3.00	3.00	13,918.75	13,918.75	5 weeks from start
D. J. Kiley, 36 Hancock Street, Boston.	1.90	1.90	0.65	0.65	2.00	2.00	3.20	3.20	0.75	0.75	2.10	2.10	0.20	0.75	0.75	0.25	0.25	3.00	3.00	3.00	3.00	13,078.50	13,078.50	
James & Meehan, 1 Beacon St., Boston.	1.80	1.80	0.50	0.50	1.95	2.20	3.20	3.20	0.50	0.50	2.00	2.00	0.26	0.50	0.50	0.35	0.35	3.00	3.00	3.00	3.00	12,681.00	13,931.00	Oct. 15
Benj. M. Crann, 6 Beacon St., Boston.	2.00	2.00	0.60	0.60	1.88	1.88	3.75	3.75	0.75	0.75	2.00	2.00	0.25	0.65	0.65	0.35	0.35	3.00	3.00	3.00	3.00	12,606.75	12,606.75	
Patrick McGovern, 623-624 Beacon Bldg., Boston.	1.85	1.85	0.50	0.50	1.80	1.80	3.50	3.50	0.50	0.50	1.85	1.85	0.20	0.50	0.50	0.25	0.25	1.00	1.00	1.00	1.00	11,914.50	11,914.50	Oct. 25

NOTE: Alternative figures indicate bids when contractor may close to travel one block of State St. at a time during progress of work. Other figures indicate bids when contractor must maintain an open way of travel through the entire length of State St. during progress of work.

## APPENDIX H—4.

BIDS, OPENED SEPTEMBER 24, 1903, FOR MOVING STATUE OF JOHN WINTHROP, AND ALL PERTAINING THERETO ABOVE GROUND, FROM SCOLLAY SQUARE TO THE YARD OF THE BOSTON TRANSIT COMMISSION AT 75 CANAL STREET, BOSTON, AND THERE SETTING THE DIFFERENT PARTS SEPARATELY UPON BLOCKING (FURNISHED BY THE SAID COMMISSION) AT SUCH A HEIGHT AS TO ADMIT OF READILY RELOADING.

BIDDER.	Price.
The John Cavanagh & Son Building Moving Co., 166 Devonshire Street, Boston, Mass.....	\$932.00
Isaac Blair & Co., 444 Harrison Avenue, Boston, Mass.....	550.00

## APPENDIX H—5.

BIDS, OPENED OCTOBER 22, 1903, FOR TWO SIDE-WALK GRATINGS OVER VENTILATING CHAMBERS, SECTIONS B AND C, RESPECTIVELY, IN ACCORDANCE WITH PLANS 6072 AND 6073, AMERICAN MASON SAFETY TREAD.

BIDDER.	Lump Price for Two.	Delivery.
American Mason Safety Tread Company, 40 Water Street, Boston, Mass.....	\$1,295	60 days
Smith & Lovett, 125-129 Albany Street, Boston.....	1,170	56 days
L. M. Ham & Co., 150-160 Portland Street, Boston.....	1,092	42 days
G. W. & F. Smith Iron Co., Gerard Street, Roxbury, Mass.....	1,086	14 days



APPENDIX H—6.

CANVASS OF BIDS FOR GRANOLITHIC PLATFORM IN OLD STATE HOUSE STATION AND IN STATION IN STATE ST. NEAR ATLANTIC AVE.  
BIDS OPENED DECEMBER 1, 1903.

BIDDERS.	945 Sq. Yds. of Granolithic Platform.		50 Sq. Yds. of Granolithic Base on Vertical Walls.		Total Bid.	Time of Completion.	
	Rate.	Amount.	Rate.	Amount.		Old State House Station.	Station in State St. near Atlantic Ave.
	Thomas J. Hind.....	\$2.70	\$2,551.50	\$4.75		\$237.50	\$2,789.00
Simpson Bros. Corp.....	1.66	1,568.70	6.75	337.50	1,906.20	Dec. 17, 1903	Jan. 11, 1904
Carr & Andrews Corp.....	1.67	1,578.15	3.57	178.50	1,756.65	Dec. 21, 1903	Jan. 12, 1904
W. A. Murtfeldt Co.....	1.74	1,644.30	1.74	87.00	1,731.30	Dec. 25, 1903	Jan. 15, 1904
Warren Bros. Corp.....	1.59	1,502.55	3.59	179.50	1,682.05	Dec. 19, 1903	Jan. 16, 1904
Coleman Bros.....	1.25	1,181.25	1.85	92.50	1,273.75	Jan. 1, 1904	Jan. 20, 1904
F. R. Taylor & Co.....	1.24	1,171.80	1.89	94.50	1,266.30	Jan. 5, 1904	Feb. 6, 1904

All the bidders were from Boston.

## APPENDIX H—7.

CANVASS OF BIDS FOR TILEWORK, SEC. F. BIDS OPENED JAN. 19, 1904.

ITEMS.	BIDDERS AND SUMS BID.	
	Jones & Meehan, Boston.	Boston Tile & Mantle Co. Boston.
Setting on Vertical Walls and Stairs 810 sq. yds. 2''×12''×12'', Half-ribbed Terra Cotta Tiles	\$2.00 1,620.00	\$0.50 405.00
Furnishing and Setting on Vertical Walls 370 sq. yds. 3''×6''× $\frac{3}{8}$ '' Pardee Tiles.....	4.70 1,739.00	4.35 1,609.50
Furnishing and Setting on Ceiling 650 sq. yds. 3''×6''× $\frac{3}{8}$ '' Pardee Tiles.....	5.20 3,380.00	5.08 3,302.00
Setting at Stairways 270 sq. yds. 4''×12''×1 $\frac{1}{2}$ '' Tiffany Tiles or 4''×9''× about $\frac{1}{4}$ '' Opalite Tiles .....	2.60 702.00	1.50 405.00
Time of Completion.....	6 weeks	9 weeks
	\$7,441.00	\$5,721.50

## APPENDIX H—8.

CANVASS OF BIDS FOR BUILDING 3700 LINEAR FEET OF VENTILATION DUCTS OF PORTLAND CEMENT MORTAR AND IMBEDDED METAL FABRIC (FURNISHED BY THE COMMISSION) IN THE UPPER PORTION OF SECTION B OF THE EAST BOSTON TUNNEL, PARTLY UNDER BOSTON HARBOR. BIDS OPENED JANUARY 25, 1904.

BIDDERS.	Rate Per Foot.	Total Bid.
Roebing Construction Co.....	\$3.86	\$14,282.00
Simpson Bros. Corp.....	3.69	13,653.00
C. F. Taylor.....	3.48	12,876.00
Gow & Palmer.....	2.98	11,026.00
Coleman Bros.....	2.35	8,695.00
Frank A. Foster.....	2.00	7,400.00
Jones & Meehan.....	1.95	7,215.00
Patrick McGovern.....	1.94	7,178.00

All of the bidders were from Boston.

The time of completion stated in the specifications was March 14, 1904.

## APPENDIX H—9.

CANVASS OF BIDS FOR THREE STAIR COVERINGS AT SCOLLAY SQUARE AND  
AT THE OLD COURT HOUSE, SECTION F OF THE EAST BOSTON TUNNEL.  
BIDS OPENED JAN. 25, 1904.

BIDDERS AND ADDRESSES.	Amount.
L. D. Willcutt & Co., Boston .....	\$20,000.00
C. A. Dodge & Co., Boston .....	19,180.00
Norcross Bros., Boston .....	18,846.00
Woodbury & Leighton Co., Boston .....	18,265.00

## APPENDIX H—10.

CANVASS OF BIDS FOR CONNECTION OF EAST BOSTON TUNNEL WITH SUBWAY AT SCOLLAY SQ., STEEL WORK. BIDS OPENED MAY 4, 1904.

BIDDERS AND ADDRESSES.	For 44± Tons.
	Price Bid Per Ton and Total Amount.
American Bridge Co., Boston.....	\$96.00 4,224.00
Boston Bridge Works, Boston.....	82.00 3,608.00
Berlin Construction Co., Boston.....	80.00 3,520.00
Belmont Iron Works, Phila., Pa.....	77.90 3,427.60
New England Structural Co., Boston.....	76.00 3,344.00
Eastern Bridge & Structural Co., Boston.....	75.00 3,300.00
Buffalo Structural Steel Co., Buffalo, N. Y.....	63.55 2,796.20
Harrington, Robinson & Co., Boston.....	58.00 2,552.00

## APPENDIX H—11.

CANVASS OF BIDS FOR CONNECTION OF SUBWAY WITH EAST BOSTON TUNNEL AT SCOLLAY SQ. BIDS OPENED JUNE 9, 1904.

BIDDERS AND ADDRESSES.	a	aa	b	c	d	e	f	ff	3f	4f	g	h	i	Totals.	Time of Completion.
Woodbury & Leighton Boston.	\$5.00 3,500.00	\$35.00 10,500.00	\$12.00 4,800.00	\$2.00 30.00	45 Lm. Yds. Brick Ma- sonry. Sewer. Pipe	3 Tons Steel and Iron, Weighing Less Than 6 Lbs. per Lm. Ft.	44 Tons Steel and Iron, Weighing 6 Pds. or More per Lm. Ft.	10 Tons Steel to be Re- moved and Reset.	20 Tons Steel to be Re- moved and Carted to Canal St. Yard.	300 Sq. Yds. Coating Portland Cement Mortar.	5 Cu. Yds. Grout.	370 Sq. Yds. Water- proof Coating.	700 Sq. Yds. Tarrad Felt, Pitch, etc.	\$21,788.00	Oct. 1, 1904
McGowley & Coughlin, Boston.	5.50 3,850.00	24.00 7,200.00	12.50 5,000.00	2.00 30.00	45 Lm. Yds. Brick Ma- sonry. Sewer. Pipe	3 Tons Steel and Iron, Weighing Less Than 6 Lbs. per Lm. Ft.	44 Tons Steel and Iron, Weighing 6 Pds. or More per Lm. Ft.	10 Tons Steel to be Re- moved and Reset.	20 Tons Steel to be Re- moved and Carted to Canal St. Yard.	300 Sq. Yds. Coating Portland Cement Mortar.	5 Cu. Yds. Grout.	370 Sq. Yds. Water- proof Coating.	700 Sq. Yds. Tarrad Felt, Pitch, etc.	18,732.00	Sept. 15, 1904
E. W. Everson & Co., Boston.	6.00 4,200.00	11.00 3,300.00	12.00 4,800.00	2.00 30.00	45 Lm. Yds. Brick Ma- sonry. Sewer. Pipe	3 Tons Steel and Iron, Weighing Less Than 6 Lbs. per Lm. Ft.	44 Tons Steel and Iron, Weighing 6 Pds. or More per Lm. Ft.	10 Tons Steel to be Re- moved and Reset.	20 Tons Steel to be Re- moved and Carted to Canal St. Yard.	300 Sq. Yds. Coating Portland Cement Mortar.	5 Cu. Yds. Grout.	370 Sq. Yds. Water- proof Coating.	700 Sq. Yds. Tarrad Felt, Pitch, etc.	16,800.00	Aug. 15, 1904
Coleman Brothers, Boston.	6.00 4,200.00	10.00 3,000.00	15.00 6,000.00	2.00 30.00	45 Lm. Yds. Brick Ma- sonry. Sewer. Pipe	3 Tons Steel and Iron, Weighing Less Than 6 Lbs. per Lm. Ft.	44 Tons Steel and Iron, Weighing 6 Pds. or More per Lm. Ft.	10 Tons Steel to be Re- moved and Reset.	20 Tons Steel to be Re- moved and Carted to Canal St. Yard.	300 Sq. Yds. Coating Portland Cement Mortar.	5 Cu. Yds. Grout.	370 Sq. Yds. Water- proof Coating.	700 Sq. Yds. Tarrad Felt, Pitch, etc.	15,840.00	Aug. 10, 1904
Patrick McGovern, Boston.	5.00 3,500.00	15.00 4,500.00	12.00 4,800.00	3.00 35.00	45 Lm. Yds. Brick Ma- sonry. Sewer. Pipe	3 Tons Steel and Iron, Weighing Less Than 6 Lbs. per Lm. Ft.	44 Tons Steel and Iron, Weighing 6 Pds. or More per Lm. Ft.	10 Tons Steel to be Re- moved and Reset.	20 Tons Steel to be Re- moved and Carted to Canal St. Yard.	300 Sq. Yds. Coating Portland Cement Mortar.	5 Cu. Yds. Grout.	370 Sq. Yds. Water- proof Coating.	700 Sq. Yds. Tarrad Felt, Pitch, etc.	15,233.00	Aug. 24, 1904
H. P. Nawn, Roxbury.	6.00 4,200.00	6.00 1,800.00	11.50 4,600.00	0.50 22.50	45 Lm. Yds. Brick Ma- sonry. Sewer. Pipe	3 Tons Steel and Iron, Weighing Less Than 6 Lbs. per Lm. Ft.	44 Tons Steel and Iron, Weighing 6 Pds. or More per Lm. Ft.	10 Tons Steel to be Re- moved and Reset.	20 Tons Steel to be Re- moved and Carted to Canal St. Yard.	300 Sq. Yds. Coating Portland Cement Mortar.	5 Cu. Yds. Grout.	370 Sq. Yds. Water- proof Coating.	700 Sq. Yds. Tarrad Felt, Pitch, etc.	13,022.50	Aug. 10, 1904

NOTE: This work has been postponed.

APPENDIX II—12.

CANVASS OF BIDS FOR NEW SEWERS REQUIRED ON ACCOUNT OF WASHINGTON ST. TUNNEL. BIDS OPENED JUNE 16, 1904.

BIDDERS AND ADDRESSES.	Totals.										Time of Completion	
	a	b	c	d	e	f	g	h	i	n		
Gow and Palmer, Boston.....	420 Cu. Yds. Earth Exca- vation.	330 Cu. Yds. Brick Ma- sonry.	420 Cu. Yds. Concrete Ma- sonry.	250 Lin. Ft. 24 In. Pipe Sewer.	20 Lin. Ft. 20 In. Pipe Sewer.	10 000 Ft. B. M. Lumber for Sheeting and Shor- ing Per M.	10 000 Ft. B. M. Lumber for Than Sheetng and Shor- ing. Per M.	1 Ton Steel Rods, Set and Secured.	50 Pipe Branches.	50 Cu. Yds. Gravel Filling.	\$30,785.00	Sept. 10, 1904.
William J. Barry	4.75 19,950.00	16.50 5,445.00	7.00 2,940.00	3.75 937.50	3.00 60.00	25.00 250.00	35.00 350.00	20.00 20.00	1.00 50.00	2.00 100.00	30,102.50	Aug. 15, 1904.
Coleman Bros., Boston.....	4.00 16,800.00	16.00 5,280.00	9.00 3,780.00	2.00 500.00	2.00 40.00	15.00 150.00	40.00 400.00	30.00 30.00	1.00 50.00	1.50 75.00	27,105.00	Aug. 10, 1904.
H. P. Nawn, Roxbury.....	4.00 16,800.00	16.00 5,280.00	8.00 3,360.00	1.00 250.00	1.00 20.00	20.00 200.00	40.00 400.00	10.00 10.00	0.20 10.00	1.50 75.00	26,405.00	Nov. 1, 1904.
E. W. Everson & Co., Boston.....	3.00 12,600.00	20.00 6,600.00	10.00 4,200.00	0.50 125.00	0.50 10.00	18.00 180.00	50.00 500.00	50.00 50.00	1.00 50.00	2.00 100.00	24,415.00	Aug. 1, 1904.
John J. Falvey & Co., Somerville, Mass.....	3.50 14,700.00	16.00 5,280.00	8.00 3,360.00	0.60 150.00	0.50 10.00	25.00 250.00	40.00 400.00	40.00 40.00	2.00 100.00	2.00 100.00	24,390.00	Oct. 1, 1904.
J. J. Coughlan, Roxbury.....	3.50 14,700.00	14.00 4,620.00	9.00 3,780.00	1.00 250.00	1.00 20.00	25.00 250.00	40.00 400.00	40.00 40.00	1.00 50.00	2.00 100.00	24,210.00	Sept. 4, 1904.
Patrick McGovern Boston.....	2.45 10,290.00	15.00 4,950.00	11.00 4,620.00	1.00 250.00	1.00 20.00	23.00 230.00	23.00 230.00	25.00 25.00	1.00 50.00	1.00 50.00	20,715.00	Sept. 1, 1904.

APPENDIX H—13.

CANVASS OF BIDS FOR STAIRWAY AND INCLINE AT WESTERLY END OF ATLANTIC AVE. STATION OF THE EAST BOSTON TUNNEL, SEC. C.  
BIDS OPENED JUNE 21, 1904

BIDDERS AND ADDRESSES.	Totals.										Time of Completion.
	a	2a	3a	b	f	g	h	i	j		
	650 Cubic Yds. Earth. Excavation by Open Cut.	250 Cubic Yds. Earth. Excavation by Tunneling.	10 Cubic Yds. Concrete Masonry to be Removed and Disposed of.	300 Cubic Yds. Concrete Furnished and Put in Place.	23 Tons Steel Rods Set and Secured.	60 Cubic Yds. Coating Portland Cement Mortar.	100 Square Yds. Water-Proof Coating of Pitch or Asphalt.	800 Square Yds. Tarred Felt, Pitch, etc.	700 Linear Feet Spruce Piles.		
Gow & Palmer, Boston	\$7.50 4,875.00	\$9.50 2,375.00	\$40.00 400.00	\$18.00 5,400.00	\$55.00 1,265.00	\$0.75 45.00	\$0.80 80.00	\$0.55 440.00	\$0.80 560.00	\$15,440.00	Oct. 1, 1904
Patrick McGovern, Boston	7.00 4,550.00	10.00 2,500.00	40.00 400.00	18.00 5,400.00	50.00 1,150.00	1.00 60.00	0.75 75.00	0.50 400.00	0.80 560.00	15,095.00	Sept. 25, 1904
Woodbury & Leighton, Boston	5.00 3,250.00	10.00 2,500.00	30.00 300.00	18.00 5,400.00	30.00 630.00	0.60 36.00	0.50 50.00	0.40 320.00	0.40 280.00	12,826.00	Sept. 1, 1904
Foster & Ferguson, Boston	2.75 1,787.50	6.50 1,625.00	10.00 100.00	12.00 3,600.00	15.00 345.00	1.50 90.00	0.50 50.00	0.50 400.00	0.60 420.00	8,417.50	Sept. 15, 1904

All bids were rejected.



## APPENDIX I.

## EAST BOSTON TUNNEL.

SUMMARY OF STRUCTURES RELOCATED IN STATE STREET AND COURT STREET  
DURING YEAR ENDING JUNE 30, 1904.

	REMOVED.			RELAID.		
	Linear Feet.	Manholes.	Services.	Linear Feet.	Manholes.	Services.
Conduits for electric wires...	2696	13	16	22,870	103	15
Water pipes.....	475	...	10	700	...	10
Sewers .....	829	4	9	850	10	9
Gas pipes .....	1593	.	9	1,564	...	9
Steam pipe, 16-inch.....	30	...	...	30	...	...
Total.....	5623	17	44	26,014	113	43



## APPENDIX I—3.

## EAST BOSTON TUNNEL.

WATER MAINS RELOCATED BY THE BOSTON TRANSIT COMMISSION DURING  
YEAR ENDING JUNE 30, 1904.

Size.	Linear Feet Removed.	Linear Feet Relaid.
4-inch	7	11
6 "	74	234
8 "	26	52
12 "	....	5
16 "	13.5	Temporary, 13.5
16 "	355	384
Total	475.5	699.5

One 6-inch gate and one 16-inch gate relocated.

One 16-inch hydrant relocated.

Services reconnected to mains . . . . . 6

Services relocated on account of other pipes . . . . . 4

Total services relocated . . . . . 10

## APPENDIX I—4.

## EAST BOSTON TUNNEL.

SEWERS RELOCATED DURING YEAR ENDING JUNE 30, 1904.

REMOVED.		RELAI'D.	
Size.	Linear Feet.	Size.	Linear Feet.
20'' × 27'' egg .....	18	15'' pipe.....	488
20'' brick ... ..	150	12'' pipe.....	362
12'' brick .....	198		
15'' pipe.....	463		
Total.....	829	Total.....	850

Manholes removed.....4  
 Catch-basins " .....

House connections relocated.....9  
 Manholes built.....7  
 Lamp holes built.....3  
 Catch-basins relocated .....

Drop-inlet built .....

## APPENDIX I—5.

## EAST BOSTON TUNNEL.

GAS MAINS RELOCATED BY THE BOSTON GAS LIGHT COMPANY  
DURING THE YEAR ENDING JUNE 30, 1904.

Size.	Linear Feet Removed.	Linear Feet Relaid.	
24-inch	....	120	
18 "	....	...	
12 "	646	603	
6 "	670	713	
4 "	239	....	
3 "	38	5	
2 "	....	Temporary, 42	
1½ "	....	" 81	
Total	1593	1564	

House services relocated . . . . . 9

















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