AN INTERCITY BUS TERMINAL FOR BOSTON

A Thesis

PRESENTED TO THE FACULTY OF THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
BACHELOR OF ARCHITECTURE

Signature redacted

Jeffrey D. Heller

Signature redacted

Lawrence B. Anderson, Head
Department of Architecture,
M.I.T.

Cambridge, Massachusetts
March 23, 1964
Pietro Belluschi, Dean  
Department of Architecture and Planning  
Massachusetts Institute of Technology  
Cambridge 39, Massachusetts

Dear Dean Belluschi:

I hereby respectfully submit this thesis, entitled "An Intercity Bus Terminal for Boston", in partial fulfillment of the requirements for the degree of Bachelor of Architecture at the Massachusetts Institute of Technology.

Respectfully yours,

Signature redacted

Jeffrey D. Heller
A bus terminal is a building type that is not really new. Man has had the transportation station for a long time. A terminal for busses is just a reinterpretation with a vehicular system. Although we are not dealing with railroads or ships, there must be an order of arrival and departure which clarifies and enhances the often uncomfortable task of using public transportation. The bus is merely another form of our transportation facilities. It is for a certain type of traveler in the intercity role, although bus companies are now trying to expand the levels of operation.

Transportation has changed to the extent that is becoming an increasingly important facet of life. The bus terminal must grow from the open stop, to an organized system paralleling, in spirit at least, the great movers of our country, railroads and aircraft. By a careful analysis of bus travel, and its connected services, one can turn the terminal concept from one of personal trial, to one of convenience and excitement. Not only does this type of thinking make the idea of organized travel more encouraging, but it helps expand the scope of the system as well.
ON THE PRUDENTIAL MASTER PLAN

In conclusion, with reference to the lack of transportation facilities within the site.

"Had the rail and bus companies not been negative much could have been done to reduce automobile congestion in the area."
ACKNOWLEDGEMENTS

I would like to thank the Staff in the Transportation Section of the Boston Redevelopment Authority, especially Mr. Murphy, for the help I received on this problem.

I would also like to thank the Thesis Committee for their help and information.
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BACKGROUND
When the bus was invented, its use was limited to short haul service. It ran in small routes through the city or in longer hops to the country. In the midwest and west, the distance was considerably greater merely because of the increased distance between population centers, large and small. Still, the bus never impinged on railroad business, but merely went its way in places between the main lines that rails did not reach. The roads were poor, and the trip slow.

As the automobile became increasingly important, the road system developed. Soon enough the bus became a more important traveler. In the late thirties and all through the forties, expansion was slow in bus transportation. There was the war and further expansion of railroads to cope with. Besides, one had to wait in an uncomfortable (if even existant) shanty that was a depot for an often behind schedule bus that was noisy, bumpy and generally uncomfortable.

By the late forties and early fifties, however, most cities had regular bus terminals with waiting space and
food counters, and the busses themselves were technologically much improved. At this time the busses began to first compete with railroads, but so did airplanes.

While bus terminals became more common and complete, and the busses became well scheduled and increasingly popular, the airplane grew in leaps and bounds. Short jumps by air were, and are, common. Air terminals became sophisticated complexes with every conceivable service. Travel got cheaper while people became richer. All the time the railroad was collapsing as a passenger mover because of the new competitors.

Since the airplane is still such a powerful force, most of the bus travelers are still lower income. Although the service in, and to, major cities is complete, there is still an image of an uncomfortable meagerly equipped system. While bus ads claim luxurious service in sophisticated busses, people still have trouble getting to terminals, finding anything to like about them, or appreciating any advancements in their operation.
The bus terminal as we know it today, is essentially the same as it has been for the last ten to fifteen years. At first only large cities had terminals with varied facilities, but now many cities with populations over one hundred thousand have terminals with snack counters, souvenir stands, and waiting areas, within the complex. Larger cities, such as New York City, have very large terminals with separate levels for busses and pedestrians. One enters such a terminal at ground level and arrives first at a large concourse. This is, in many ways, similar to a railroad station, where, on the main level, tickets are sold, people wait, and most services are available. There may be a lunch counter or restaurant used by people from outside the terminal as well as people using the busses. There may be a bar. There is always the souvenir counter.

In a large city there are manager's offices, baggage depots and more extensive concessionaires. In the buildings studied, the lack of customer amenities was obvious. In both large terminals in New York, the concourse provided no rest. This may have encouraged the use of the
facilities, but the result was a bit harsh. In Boston there is some provision for seating, which becomes important because of its scarcity. However, extreme conditions (snow, rush hour tie ups) make for an unpleasant situation.

In all instances (New York and Boston) the movement of passenger to and from bus was clear enough, though completely uninteresting. In New York, one took the appropriate mechanical stair to the appropriate dock. In Boston, the passenger moves through the doors of the terminal (by number) to his bus. For long haul busses the loading of baggage is intermixed with the passengers (the proximity of functions makes it necessary) and in no case is this really a bother. A great help is the baggage check system, wherein all baggage is taken to the baggage room, and distributed from there.

In all cases it must be remembered that the bus terminal is not on the same scale or level of operation as the air terminal or railroad terminal. Therefore, services that should be provided should not fall dangerously close to the exact duplication of the larger systems. It is costly and unnecessary.
In summation then, today's bus passenger is of a lower income group, who may be traveling near or far. His trip to the terminal, in most instances, is an unpleasant one, because the terminal is within the city pattern, and can provide only at great expense a place to park or stay (unless on foot). This is only remedied by public transportation access, or closeness to a parking area. In the case where short term, live parking is available, it greatly helps the situation.

On entering, the passenger is presented with a space transient in appointment, and purposeful in nature. He buys his ticket, is told when he will leave and by what channel. Then, if no other problem presents itself he may be left to choose between sitting in the waiting area (if existant) or going to get a bite to eat, a book to read, or a drink to drink. (In more complete stations, he may check his bags to be taken by the baggage truck.) Usually the traveler times this for a quick getaway to the bus.

As an aside, one should remember the bus driver. True he is the employee, but he must be able to get his bus to its dock. The frantic moments of loading and unloading are greatly reduced in a clear parking system.
A specific building type investigated was the Port Authority's bus terminal on 125th Street in New York. The building was designed by Luigi Nervi, and was completed last year.

The terminal is organized on four levels. On the top are the short haul busses from New Jersey. The next level down (one level above the street) is the concourse. This is a low open space, with many shops. The first level is for long haul busses, terminal storage and servicing. The underground level is for the subways and highway underpass.

The building is very accessible from the surrounding area it serves by both auto and public means. Once there, however, there is no place to park, and one must rely on the fates for a legal parking space.

The entry is quite unimposing, and the main concourse level is merely a large circulation space with no seating. This forces people to the shops and restaurants for relief. The terminal offices are hidden, and the way to the busses is obscure. There is good circulation throughout, but no handling of baggage, which must be carted from place to
place, and nowhere to go while waiting. The whole experience leaves little to be appreciated, for there is nothing to relate to in the entire building. Because of this situation, the act of purchasing tickets and finding busses is in no way a part of a trip, but merely a phase that must be passed through.
THE PROBLEM
There are three major problems with the present bus facilities in Boston. They deal mostly with the relation of the terminals to the city plan. The difficulties arose, no doubt, from lack of planning, and difficulty of deciding on a site. With the new road system now reaching completion, a whole new answer to the terminal problem can be found in the terms of the faults of the existing system.

Firstly, the separation of services, mainly Trailways and Greyhound, have resulted in a confusion for the bus user. The bus transport system is confused and difficult for him because he must find out how to get where, when. The companies claim their desire to remain autonomous, but their competitive attitudes result in uncomfortable situations for the customers and poor system images. A formidable terminal would for these reasons be a more desirable solution. Other cities have shown this to be so.

Secondly, the terminals are difficult to reach. The busses have difficulty getting through the city to their destination. The automobile traffic not only has a bad time, but once at the terminal finds it impossible to
park. Because of the split in the bus stations, there is no pooling of energies, and the public transportation systems of the city randomly flow about the terminals. There are no direct connections.

Thirdly, terminal facilities, although varied, are not wholly complete. The terminal structure is old and dirty. The services are not particularly good, and the general condition is a very poor one. There is no feeling of being a part with the city or the transportation system.
The site selection was based on the design considerations it satisfied. The image of the bus transportation system was based on the people, the access, the city, and the available services.

Specifically, the area that bus users would most likely be interested in (Fig. 1) indicated an area between the Prudential and the downtown area south of Beacon Hill towards Washington Street. It was ascertained that people of the income group concerned would be interested in this area for the tourist catering, and the hotel accommodations.

The new turnpike extension (Fig. 2) will link the Turnpike to South Station through the Prudential Center. This access will be very important in terms of bus travel, because it is the link through Boston, of north and south. On this road, busses will be able to go quickly through the heart of the city so that what once was a tedious traffic battle can be completely eliminated. Further, the proposed southeast extension (along the New Haven Railroad tracks) will further amplify the importance of this system.

The connection of the site to the city fabric and its effect on it will also be important. If the terminal were to become a building within the city complex as it is now,
there would be difficulty in finding a good site that was available in the downtown section. Further, any conventionally placed structure would make the bus complete its trip in a torturous battle through city streets. It can here be re-emphasized that this final connection of station to city can become an asset rather than a liability in that it can add to the trip. By this I mean the trip can be much faster (high-speed travel directly to destination), and more exiting through the nature of the point of arrival.

Finally, consideration of the bus user's next step, his connection between terminal and final destination is a very important point. In that promotion of public transportation is the first major step that can be made toward a solution of the traffic problem, one can see how important this link can become. The fact that the driver has no place to park when going to the bus terminal can be relieved in proper siting, but the availability of nearby public transportation will bring him that much closer to choosing to leave the car behind.

For the out-of-town arrival, there must be a complete service that will take him where he wants with a minimum of bother. If he does not have this he will choose another
way to travel (or choose not to come at all). For the departing traveler, the availability of good public transport will encourage his enthusiasm for using the facility by eliminating the normal traveling confusions. For those who can have someone bring them to the terminal, there should be some live parking to accommodate the act of dropping off or picking up a passenger.

II

The areas studied for possible siting were along the expressways in Boston. The first thought was that the buses should be able to avoid using the tight congested city streets. In addition, the Turnpike extension and the Southeast Expressway passed alongside important tourist and business areas. A location near the government center was thought of but abandoned for lack of contact with the amusement and hotel areas. The South Station also was considered but discarded because of its remoteness to important areas.

The site finally chosen is directly south of Copley Square, above the turnpike extension. This site simultaneously solves many of the problems now existant in the
Boston bus terminals. It provides the direct connection with the fast road system. Both public and private transportation link up with the site. Busses cross right by to all city points. The subway is two short blocks away (right into Copley Square).

These facets of the problem, though, are important functions that must be solved. In order to advance, even on the most rudimentary level, the art of this form of travel, these things must be. This comfort of connection, the ease of mind and real pleasure that can be gotten from a clear, effortless system, adds greatly to the image that bus travel presents.

There is far more to this site, though, than the fortunate coincidence of services. There is a proper visual aspect to the site that makes it a place to arrive at. It is a point that can be called Boston! The face of the terminal looks at an uninterrupted view of the Christian Science Church, the Prudential Tower, the Hancock Building, and Copley Square. Stepping out into such a space can only lead to real satisfaction at the culmination of a trip. It is as pulling into a harbor from the ocean, for a real point out of the evenness of the trip is reached. There is focus of space to always relate back to. It need
no more be said that the terminal is between such and such streets, or so many turns left and right down the way. From Copley Square the face of the terminal shows. It would enclose a subspace, yet open it to points of the city, and reflect it back to Copley Square. The site further is merely airspace over the road. It leaves the major area of the cloverleaf to other interests, yet takes an important place on the high-speed road system.
OTHER ASPECTS
The site chosen is a node, both visually and circulationwise on the Turnpike extension. Using as a basic module, the bus parking requirement, for the bus station, a regular spanning system in two directions of 50' x 50' can be developed. This system allows for a comfortable allotment to turning radius of the busses, and adequate cantilever for walking and driving ramps.

The terminal pedestrian structure will be of a smaller span in one direction but will facilitate vehicle arrival below. The direction of the building will be along the axis of the road. This will accommodate ramping and provide a more efficient use of the site. The terminal proper will parallel this structure so as to provide a face to the plaza below Copley Square.

By using this approach, the open space of the interchange is left to further development, and the terminal links to both the road and the city.
DESIGN
The considerations of the design were developed around two things: people and busses. Aside from the interrelationships there must be a working system that accommodates the bus such that its operation is efficient, and the people so their passage may be made comfortably.

A bus can turn in a minimum diameter of 110 feet and must have a 22-foot wide surface to turn on. It can climb a grade of 10 per cent. Since the bus is a tired vehicle, it can intersect its path easily or make crossings or mergings unimpeded (except for traffic considerations).

Therefore, if the bus system is completely controlled, as in a terminal situation, one can afford to take advantage of these aspects of the vehicle with complete control. To reiterate an earlier point, although the bus driver is an employee, his performance is related to his conditions. Because of this, scheduling can be simplified and trip time made quicker. The overall structure resulting from these ideas, can be more efficient requiring less space and fewer ramps.

The handling of terminal passengers is a problem which can be solved in lines similar to other modern terminal.
situations. People move more slowly than the vehicles they use. They have a harder time changing levels, and their paths are more varied and irregular. In addition, people get cold and wet, but as opposed to the machine, this disturbs their well being. Also, they are more important, they are the users, the customers. In terms of design, there should be adequate space heat and light for their comfort. The human circulation system should be made to ease their movement. A sequence of architectural spaces must accommodate their arrival, movement, waiting, eating and departure. People are not always calm in new situations, and should be assured by the clarity of the system and the ease of its use.

The above alone, would be a great improvement over the present situation. There is much more, however, that can be realized. This terminal can be imposing not only to its users, but to anyone coming in visual contact with it. From the site, the building can merge the rapid travel of the highway below with the slower movement of the pedestrian above. The static terminal structure can link with the vigorous ramps and horizontal slashes of concrete. By completely acknowledging the road systems its uses, the whole building can float over its various extensions. From
the street level one can see the slow moving parking area sitting under terminal structure, while at the same time look down on the high-speed road moving under the lighter, more open bus parking. This transition can be internal as well as external. From the open static space of the waiting room, the passenger must move through long low tubes that bring him to his bus without change of scale until the last moment. Finally taking a hint from modern air travel, a secondary accommodation can be made at the final point of departure. Then, those who desire, may wait at the loading dock, in comfort, to wait for their bus. A revised ticket system would take advantage of this by arranging seating and class.

As a closing note, the crucial linking of terminal to road and city becomes a problem of showing that the system changes from a system to a place. Moving from the dynamic ramps of the vehicular terminal to the static spaces of the pedestrian section must necessarily become a change in structure and form. By a linked change of pace in the terminal this can be accomplished from bus to ramp to open space.
THE PROGRAM
Within the program, aside from the regular assigned square footage, is a large amount of circulation area. Because of the amount of confusion that a bus user can be faced with, there must be a clear, straightforward method of departure. In addition, to ease the work of the bus driver, there must be a logical system of movement within the system so that there is never a wasted motion or movement of the bus. Therefore, much of the circulation space both pedestrian and vehicular will be omitted from the general tabulation of square footage (except in an estimated sense), because this is a matter of the tightness or openness of the plan (in this case tightness). The amount of singular services needed for passengers, in order to simplify their effort, will also be considered. Other conditions like baggage handling can be integrated with the bus parking areas with common usage for maneuvering. Finally, many of the smaller services, such as trip insurance machines, post card displays, etc., are all provided for in the main waiting space.
Bus Parking - Depart 30 bays 18,000 sq.ft.
Arrive 8 bays 4,800 sq.ft.
Estimate of Passenger Circulation to these Spaces 10,000 sq.ft.
Estimate of Bus Circulation to these Spaces 20,000 sq.ft.
Waiting Area (terminal) 6,000 sq.ft.
Baggage Handling 1,000 sq.ft.
Estimate of Circulation to Busses for Baggage 500 sq.ft.
Concessions
Magazines, Souvenirs 200 sq.ft.
Eating 2,000 sq.ft.
Bar 1,000 sq.ft.
Offices
Including Secretary Space 600 sq.ft.
Manager Space 300 sq.ft.
Drivers' Facilities 1,000 sq.ft.
Dispatcher (3 levels) 1,000 sq.ft.
Tickets and Information 1,000 sq.ft.
Mechanical and Toilets 3,000 sq.ft.
Including Facilities in Terminal and Bus Area
TECHNICAL ASPECTS
The Boston Climate is as follows:

- Average temperature (winter) Oct.-May 37.6°
- Average temperature (summer) May-Oct. 80°
- Design temperature (winter) 8°
- Coldest Temperature -18°
- Wind from the west 11.7 mph
- Design temperature (summer) 92°

This information implies that there must be winter heating protection from the terminal straight through to the bus. Summer conditions are not as drastic and require cooling in the terminal proper only. There will be shading on all levels, and wind protection provided.

Acoustic requirements are not extreme. The data on bus noise is as follows:

Starting Noise:

<table>
<thead>
<tr>
<th>Distance</th>
<th>db at 20'</th>
<th>db at 40'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>87</td>
<td>82</td>
</tr>
<tr>
<td>In speaking range</td>
<td>68</td>
<td>63</td>
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</table>

The noise spectrum is as follows:

<table>
<thead>
<tr>
<th>Frequency (cps)</th>
<th>db</th>
</tr>
</thead>
<tbody>
<tr>
<td>75-150</td>
<td>75</td>
</tr>
<tr>
<td>150-300</td>
<td>68</td>
</tr>
<tr>
<td>300-600</td>
<td>60</td>
</tr>
<tr>
<td>600-1200</td>
<td>55</td>
</tr>
<tr>
<td>1200-2400</td>
<td>4800-...</td>
</tr>
<tr>
<td>2400-4800</td>
<td></td>
</tr>
<tr>
<td>4800-....</td>
<td></td>
</tr>
</tbody>
</table>

Passengers will always be 40' from engine. Since the terminal building is isolated structurally and distally, then there is no real noise problem there.

Structural requirements are classed in two ways. The span of the bus accommodation and the span of the pedestrian accommodation. A fifty-foot module is chosen because of its relation to the parking and turning distances required, and its relation to the highway width. The bus handling structure will be a 2-way slab 50'x50' with a line load of 100 psf. The pedestrian terminal will have a one-way span of 50' for the street width, but a shorter span in the other direction for the reduced scale of space. It will be designed for 80-100 psf.
STRUCTURAL CALCULATIONS

Pedestrian Terminal girder calculations

\[
200pgf \ LL \ OD \ l=52'
\]

\[
M= \frac{200pgf \ LL \ OD \ l}{8} = 1875k
\]

\[
d=\frac{1875}{225x3} \ b=13\frac{4}{5}
\]

\[
d=53''
\]

\[
A_s = \frac{1875x12}{20x.374x53} = 24.3
\]

16\# 11 bars for both girders (8 each)

T beams 6' wide with 2' span between 16'' roof LINTEES

20''floor LINTEES

Bus Terminal structural 2 way slab Total depth 3''

girder

50' span transverse \(M=1750k\)

\[
d=5'
\]

\[
b=\frac{1750}{225x4.5} = 29.6
\]

longitudinal beam=15''
21 G - VIEW WEST TOWARDS PRUDENTIAL
AN INTERCITY BUS TERMINAL FOR BOSTON

B. of ARCHITECTURE
JEFFREY D. HELLER
4 / 1964
SECTION CC

ELEVATION LOOKING WEST

MIT B ARCH 4/64
scale 1"=16'-0"
Jeffrey Heller
RAVEL TOPPING 3 PLY ROOFING 2' INSULATION BOARD WATERPROOF SUPPLY DUCT ZONED SYSTEM FLASHED

PLEXIGLASS ALUMINUM FELT

GRANITE TERRACE 3 PLY ROOFING 2' INSULATION BOARD WATERPROOF SUPPLY DUCT ZONED SYSTEM FLASHED

LONG SECTION TRANSVERSE SECTION

BUS TERMINAL TRANSVERSE SECTION

MIT B-ARCH 4/64
scale 1 : 2'-0"
Jeffrey Heller
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