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Dear Dean Belluschi:

In partial fulfillment of the requirements for the degree of Master of Architecture, we hereby submit this thesis entitled, "Places of Interchange in the Northeast Corridor Transportation System."

Respectfully,

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II.

PLACES OF INTERCHANGE
IN THE NORTHEAST CORRIDOR TRANSPORTATION SYSTEM

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IV.

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(Volume II - Case Studies of Interchanges)
STATEMENT OF THE PROBLEM

I. THE TASK

The task was described in an opening statement to the graduate students in architecture participating in the Interdepartmental Systems Design Group as follows:

... to investigate the impact of growing mobility -- where man has gone from the immemorial speed of walking to the unlimited speed of machines -- to the dimensioning and shaping of the new urban environment. The great change in scale in our metropolitan growth requires reconsideration of many values, mechanically applied as our experiences, based on urban forms of the past. Everything has to be called into question again to restore a natural rhythm to civilized human life.

In 1946 after his visit to the United States, Le Corbusier wrote the following:

Thus, ... the detestable gift of unlimited means of transporting and ideas: mobility turned into a disease ....

Everything rolls here; motors roar on water, on highways, on railroads, and in the air; men are on wheels; they have wheels under their bottoms and thus they transgress the law of nature -- of human nature, which is eminently alternating and not continuous; footsteps, the beating of heart and arteries, the closing of eyelids, the breathing of the lungs, and the formulation of speech, etc. ... For the philosophic spectator, the end of the road quickly appears: as things are, the cycle of the actions of life is not carried out, or not fully, or with pain and loss, in the irremissible period of time of each day. That is the judge, that is the touchstone: daily life. And here is the verdict: incompleteness, dissatisfaction, injury written into the over-crowded solar day, recurring each day and impoverishing each day, and consequently in the whole life of man. 1
In the next 20 years population projections indicate a nearly 50% growth for the northeastern coast of the United States. This increase, from 1960 to 1980, from 37 million to 55 million, will commit large new areas to urbanization from Norfolk to Boston, including 38 metropolitan areas, 10 states and the District of Columbia. This region, which has been called the "Megalopolis," is the area of interest in a study initiated by the Federal Government. The objective of this government-sponsored project was to develop, through broad research, a new form of ground transportation network to operate on the long haul, as well as local and commuting speeds in the Northeast. A system of this sort, with some imaginative effort in rethinking the total hierarchy of transportation, will be a substantial component of the new urban development on the northeastern seaboard, and might, in fact, be one of the most important elements in shaping our lives in the future.

Not unlike the past history of our cities, the points of collection and distribution for goods and people will generate particular foci of urban developments. The cross roads and river junctions, the arrival of major rivers to the sea, the railroad lines and terminals in the nineteenth century, airline terminals, etc. in the twentieth century, dramatized these locations and generated a particular kind of urban environment. With the advent of the automobile, temporarily the rhythm of collection and distribution at particular points of interchange seemed to be replaced by a continuous dispersal of almost unlimited individual mobility. This euphoria finally reached a point of rapidly diminishing return.
In densely settled metropolitan areas new ways of handling the automobile and reconnecting its usefulness into a logical network of transportation systems are urgently begging answers.

The task, then, is to develop within a systematic proposal for a new transportation network the physical form of the projected architectural environment at the particular locations where the change in mode of travel will be the generator of activities.

II. THE OBJECTIVES

The objectives of the thesis are fivefold:

1. The search for means of coordinating the variety of dimensions (function, circulation, sequence, space, scale and texture) which define a harmonious architectural environment.

2. To make a contribution, through close cooperation with other graduate groups throughout the Institute, to the important undertaking of the High Speed Ground Transportation Study.

3. To experience and evaluate the architect's role in the decision-making process in a group effort of this nature.

4. To incorporate methodological systems analysis into the process of architectural design.

5. To discover:
   a. How system design fosters creativity and serves as a source of inspiration in conceptual thinking.
   b. How the human content, a quality of traditional concern to the discipline of architecture, can influence system design.
III. THE APPROACH

A period of research in the design process was supplemented by lectures given by the Interdepartmental Systems Design Group of MIT. During this period the class acquired general knowledge and background for developing one or more hypothetical systems. This period demanded an organized group effort where specific architectural aspects of the problem were studied in context. At the end of the research period, definite design assumptions were made concerning the new transportation system. With the establishment of a hypothesis, each student chose a point within the hierarchy of a particular system and proceeded to program and develop the design of the place of interchange. The locations of the individual interchanges were so chosen as to define a range of major types of interchanges.

Thomas Jon Rosengren
THE INTERDEPARTMENTAL SYSTEMS DESIGN PROGRAM

I. INTRODUCTION

For the last few years, MIT has conducted design projects in which students of several departments within the School of Engineering have participated. A long standing policy of the Institute encourages interdepartmental activity of this sort. This year two projects were offered: the design of a vehicle for a manned expedition to Mars, a project similar to those of past years; and the design of a High Speed Ground Transportation system for the Northeast Corridor of the United States.

The HSGT Project is an outgrowth of an interest of the Federal Government in improving transportation in the Northeast between Washington and Boston. In his State of the Union message in 1965, the President mentioned his concern, and in February, he sent a special message to Congress requesting funds for research into possible improvements. The MIT Center for Advanced Engineering Studies has been consultant to the Department of Commerce on a program for research and development to advance the technology of high speed ground transportation. Most of the faculty members in charge of the student project have also been involved through the Center with the Department of Commerce project.

Because of the broad implications and the necessity of investigating a range of problems, students from departments outside the School of Engineering were attracted to the HSGT project, and the departments of Economics, Political Science, City Planning and Architecture were represented, as well as Electrical, Mechanical and Civil Engineering. As a
collaborative design situation, this project brought together diverse disciplines into a challenging exercise in which each group came to recognize an interdependence upon the others. In such a situation the relationships of architecture to other social sciences and to technology were questions inevitably raised.

II. ARCHITECTS AS PARTNERS IN A COMPREHENSIVE, COLLABORATIVE EFFORT

What is the relation of the architect to the engineer and to all professionals whose work affects the environment? What is the role of the architect in an increasingly complex, specialized and mechanized society? Is the architect to be a specialist, with answers to specific questions, or is he to be a generalist, not so much concerned with answering general questions as with asking questions both specific and general in nature? Can or should he be some combination of both -- a generalist whose special concern is always ultimately with the visible, three dimensional form of the environment?

In 1923 in Towards a New Architecture, Le Corbusier presented a rather idealized picture of the engineer and a poetic conception of the architect when he wrote:

The Engineer, inspired by the laws of economy and governed by mathematical calculation, puts us in accord with universal law. He achieves harmony.

The Architect, by his arrangement of forms, realizes an order which is pure creation of his spirit; by forms and shapes he affects our senses to an acute degree and provokes plastic emotions; by the relationships which he creates he wakes profound echoes in us, he gives us the measure of an order which
we feel to be in accordance with that of our world, he determines the various movements of our heart and our understanding; it is then that we experience a sense of beauty. 2

Writing in 1952 in Architectural Forum, Walter Gropius had this to say of the architect and his challenge:

Whether the architect shall be able personally to reach the high historical aim of his profession to integrate through his work all social, technical and esthetic components into a comprehensive, humanly appealing whole, that will depend on his creative vision. I say his "aim" for whether he actually is the master depends of course on his performance within the collaborating team. He cannot claim leadership as such, for the best man in a team should lead. But the historical mission of the architect has always been to achieve the complete coordination of all efforts in building up man's physical surroundings. 3

Le Corbusier suggests, then, an architecture which visually and sensibly is the result of what he considered to be the basic and analytical approach of the engineer. Although Gropius' statement is grounded in tradition, the "historical mission" of which he reminds the architect has never been so complex or so demanding, because man's physical surroundings have never been worked upon so furiously by so many forces. In it one may detect an indication of the philosophy which helped to establish just a couple of years later the program of urban design at Harvard.

In May of this year, Jerzy Soltan was invited to participate in a discussion of this project with the students, and the insight he contributed helped to illuminate the issues of collaboration. He defined the duty of the architect in this sort of venture as being to express "the human concern." He felt the architect should begin by questioning
the need of high speed travel, the sanity of peak hour crushes and the logic of population dispersion. In a collaborative effort, no other group, by training or inclination, may be prepared to do so. And in a collaboration of diverse interests, when a challenge is made or a conflict occurs, "the battleground is one of values and not of facts."

Others have expressed views similar to those of Soltan. One suggestion was that the architect's contribution may not be in the realm of design at all, but rather that he may look for a place in the basic process of making decisions concerning visual considerations. Not all observers see the architect in such a general and wide ranging role. Those who think of him as a specialist insist that his concern is with buildings alone, and that even considerations of the urban environment are beyond his domain.

While Le Corbusier's and Gropius' statements were poles around which most opinion centered when the project began, Soltan's analysis touched what seemed to be the crucial issue in any such collaboration. Regardless of degree of participation, methods of approach or status within the collaborative group, a primary contribution of the architect would be the statement of his values and of his concern with our environment.

III. PARTICIPATION IN THE HSGT DESIGN GROUP

There were several reasons for joining with the Interdepartmental Design Group in the HSGT study. Principally there was the desire, of
course, to study places of interchange in such a transportation system, and to investigate the urban activity and growth generated at these nodal places of collection and redistribution. This participation also afforded the opportunity for studying the variety of dimensions necessary and the way in which these dimensions can be coordinated into the urban environment. The design group also provided the chance to study transportation in general, and its impact on urban and regional growth.

Another reason for participating in the HSGT design group was to contribute where possible to the design of the transportation system itself. The formulation of the philosophy and objectives of the systems, the consideration of the impact of the HSGT on urban and regional growth, and the evolution of the system configuration were areas in which the results were affected in a general way by the involvement of the architects.

However, many specific facets of the total problem which might have been interesting subjects for investigation were passed over in order to concentrate on the design of places of interchange. It would have been possible, for instance, to study the trip as a sequence of visual experiences of the passenger. With this approach, the effects of such tremendous speeds as 350 miles per hour on the limits of visual perception would have received much more attention than actually given. Also, the implications of extended below ground travel on tunnel design, vehicle design or even interchange design, could have been given much more than the passing treatment they received. It would also have been
possible to cooperate on the design of the vehicles themselves, both inside and out, or in the design of above ground guideway structures which will be such an important incident in the landscape. Most of these subjects could have led to extensive research studies. Instead, the term's work centered around the interchange itself and its vital aspects. Rather than the sequence of passive experiences of the passenger, the concentration was on the active experiences of the pedestrian moving through the interchange, and rather than the guideway structures in the landscape, attention was focused on the form of the interchange and its ancillary activities in the cityscape.

Within the Interdepartmental Design Group, the HSGT system evolved rather slowly, predictably so due to the complexity of the problem. In order to proceed with the design of places of interchange, then, it was necessary for the architects to make assumptions concerning the system, and to design, in fact, their own system in a general way. As the design group approached its conclusions, these assumptions were modified where feasible so that the two systems in the end were compatible and very similar. The organization of assumptions and the design of a preliminary system made it possible and necessary for the architects to pursue their secondary interests in urban growth and the impact of transportation on urban form and to apply these interests advantageously.

IV. SYSTEMS DESIGN

Participation in the Interdepartmental Design Group has also afforded an opportunity to observe and to be involved in the design
process as practiced in disciplines other than architecture. This experience has led to two conclusions:

First, that just as the creative process may be the same for all creative people regardless of their field of interest, the design process is essentially the same in both engineering and architecture. There are important differences, however, in the way the design process is approached and practiced. Engineering students are very concerned with the methodology of design and with the use of analytical techniques and quantifiable data. Architecture students, on the other hand, are better able to deal with non-quantifiable factors -- values -- and with the process of synthesis based upon an organization of assumptions. Although people with different interests and abilities are attracted to and advance in the educational programs of the two disciplines, the programs themselves are largely responsible for these diversions.

Second, that both engineering and architecture have a vital need for the person of broad interest and abilities, the generalist whose special talent is design. The introduction to the final report of the HSGT study group underscored this need:

Systems engineering is a reaction against overspecialization. The motivation is toward an over-all understanding of basic processes and their relation to one another -- as opposed to more preoccupation with infinite detail. It describes an integrated approach to the synthesis of entire systems, and it views a system of components as an entity rather than simply as an assembly of individual parts.

Ralph Tolbert
PLACES OF INTERCHANGE IN THE URBAN FORM

I. DEFINITION OF "INTERCHANGE"

The word "interchange" was first used to designate a railroad transfer point in 1887 and on the surface this use of the term seems appropriate enough to the present study of interchanges in regional transportation systems. But, upon probing more deeply into the nature of interchanges, we are led to a more generic definition of the term, one which dates back to 1559 -- "alternate or varied succession in time, order, or space."

Still, it is perhaps the very vagueness of this definition which makes it fit the concept of a contemporary system of transportation. In order to make the fit significant and meaningful, we must specify more fully the sorts of successions involved.

What kinds of successions must be dealt with in the context of today's transportation systems? And what are the elements that we as architects must concern ourselves with in order to design the physical environments where changes in mode of travel occur?

In the first place, it is likely that our successions will be varied rather than alternate, for the latter would seem to imply a transportation system insufficiently complex to incorporate the varied modes of travel today with their varying speed and space requirements. In
the second place, we will need to interpret "time, order, or space," broadly enough to include (in full account) the notion of coordination, and integration of a variety of dimension, scale, function, sequence, and speed in dealing with the interchange problem.

Yet even here, though the areas of concern are familiar, the traditional range within which the architect must work will, as we shall presently see, have to be expanded.

II. HISTORICAL CONTEXT

Historically we are able to distinguish between the influences of intercity and intracity modes of travel on the basic forms of the city. The locations of many cities were largely determined by their accessibility to other cities, i.e., by the type of interchange connection possible to an available transportation system. Thus cities were often located by rivers and oceans, while cities of the plains grew up along trade routes, at the junctions of highways and along railroads. The intercity interchanges of these settlements where the transfer of modes of travel took place were the ocean harbors, the river docks, the local inns and the railroad stations.

With respect to intracity transportation, most cities may be classified in terms of their major means of internal transportation. Consider the following four orientations:

1) A hundred years ago the limits of city boundaries were determined by the distance people could walk, or, in the case of the
privileged few, the distance they could ride. This generally resulted in a dense area of mixed usage whose boundaries, even at their widest point, were no more than a half mile from the center of the town. At this most fundamental level of transport, there was no change in mode of travel and consequently no important interchanges.

As the complexity of the urban environment increased, the emphasis shifted from private forms of transportation to public. The change first took place in intercity travel and then as urban densities increased, within the city itself. The result in terms of interchanges was an increased emphasis on the intercity interchanges and more organized public intracity interchanges.

2) In special situations, a city such as Venice did overcome the limitations of size by the use of waterways instead of roadways for its main channels of intra-transportation. The interchanges in this situation were the many and dispersed public and private landing docks.

3) Mass transit on a local level came with the introduction of horse car lines into New York City in 1832, and later developed into the express subway trains. The result was an enlargement and separation of the living area of the city into distinct residential areas and work areas. The interchanges now were public and the result of their systematized spacing was the familiar star pattern of urban form.

4) Within the first half of this century, the automobile has played the largest part in the complete dispersion of all land uses.
The one exception being office space -- and just as in earlier days --
the limit of size of a community was determined by walking distance,
so a similar but more extended limitation continues to surround the
city -- time, 40 minutes -- the riding limit beyond which people are
reluctant to go. Under the impact of the automobile the continually
increasing importance of the public interchange as a point of collec-
tion and dispersion was diminished. Once more as in earlier periods,
many private and small interchanges at the origins and destinations of
travel were in evidence.

III. CONTEMPORARY CONTEXT

Today there is dissatisfaction among planners with society's great
dependence on the automobile for all types of trips. Terms such as
"urban sprawl" are used with derogatory connotation to describe the
effect on new urban growth of the extreme reliance on this single mode
of travel. (See planners report -- ISDG -- page VI-3, articles 6-5-1
to 6-5-3). The most current proposals (see planners report -- ISDG --
page VI-4, articles 6-5-5 and 6-5-6) call for the balanced use of various
modes of transportation, adjusted to meet the specific needs of a par-
ticular situation. Concurrent with this emphasis is the attempt to use
the interchanges of such a balanced system as catalysts for new develop-
ment, realizing that the spacing and alignment of the secondary network
interchanges will, because of their tendency to promote development,
have considerable impact on the future form of the central city, its
surrounding communities and on the total urban pattern of the region.
IV. CRITERIA FOR INTERCHANGE DESIGN

The interest of the architectural study group in the interdepartmental design program was the interchange points between circulation systems in the transportation network of the region under consideration.

Assuming that points of interchange, because of their accessibility in terms of time, are the natural places of growth, then these places of interchange between the different circulation systems become the vital joints in the urban anatomy as well as being places in their own right.

In dealing with the places of interchange in the northeast corridor, the design group's criteria of the interchange design in the urban structure were:

1) the sequential experiences of arrival to and departure from the interchange. Although it was realized that the sequential experiences occasioned by the total trip would eventually need to be taken into account, the architectural group limited its concern to the sequential experiences during arrival to and departure from the interchange by all the various modes of travel, below, on, and above ground. These points of arrival were considered to be important incidents in the experience of travel and significant places for orientation and decision making. The emphasis was placed on the drama of arrival and direct clear means of departure.

2) the methods by which the physical forms of the interchange could be modified to accommodate growth of activity which would be
expected to develop both within and without the interchange point. The advantages of an open ended design system in contrast to a closed design system were noted.

3) the basic functional criterion of orientation. The ability to perceive and comprehend one's relationship to the environment and then to distinguish easily the route to follow to transfer from one mode of travel to another was considered to be more than just a direct function of the circulation system. The essential choice of destination can be clarified at the decision points between the distinct realms by controlling speed, scale and character transitions. In all cases there should be a continuity of flow -- collection and dispersion -- both within and without the interchange.

4) the criterion of scale. In dealing with the design of the interchange, the scale of the car, the buildings and the human must be coordinated so that each is appropriate to all the parts of its own realm and not in conflict with each other at their points of interaction because of incompatible dimensional contrasts. An example of such an incompatibility would result from the use of a large parking structure as a dominant face of a pedestrian plaza.

5) the criterion of speed. The speeds of travel which must be coordinated within an interchange include the speeds of a pedestrian walk, a mechanical sidewalk, a private vehicle and high and low speed mass transit vehicles. In all cases there must be a natural graduated
transition between velocity and repose. In no case should there be a conflict of realms as would result by placing a pedestrian walk immediately adjacent to a high velocity private vehicle channel.

6) the criterion of grouping of like functions. Such grouping is both natural, as evidenced by financial and retail areas in existing cities, and desirable, since such concentrations allow maximum interaction and choice as well as creating districts of distinct and varying character. However, discretion must be exercised on this issue as over concentrations of one function can be as anti-urban as suburban sprawl.

7) The last and most encompassing criterion is the congruency of all the preceding criteria. The appropriate and harmonious relationships of speeds, dimensions, scales, and sequences to each other, such that the entire interchange becomes a unified and consistent entity.

There are many examples of discrete program requirements causing conflicts of the above criteria at the expense of the total design. The need to move people quickly is in conflict with the time and dimensions required by humans for orienting themselves and making decisions at points of interchange. The need to make a building dimension appropriate to its function may be in conflict with a program requirement to use it either as a significant landmark or with a desire to make it a subordinate design element. The desire for a character of intimacy may be in conflict with the symbolic importance a space should assume in its position in the total interchange design.
In general the designer must take care to avoid the many incongruities which arise in an enterprise of the scope and complexity of this one.

Harold A. Hanen
I. INTRODUCTION

The general problem of every discipline participating in the Interdepartmental Systems Design effort was to deal with one particular part of a total system without knowing the constraints of other parts of the system. This predicament made it necessary for the architects to develop a network system hypothesis as a working assumption.

The first step was to locate the components, among them interchanges, within a greatly generalized but fairly sound and realistic context on the basis of available information. The evaluation of early alternatives of network system design led to a network system hypothesis. This hypothesis was compressed into a system "Manifesto" which is close to being in complete agreement with the workings of the network proposed by the Interdepartmental Systems Design Group. (See appendix, ISDG Report).

II. DEVELOPMENT OF A NETWORK SYSTEM HYPOTHESIS

Several considerations leading to the development of a network system hypothesis were:

1. To integrate all modes of transport into a comprehensive system, (including private transport).

2. To influence land use and growth patterns.
3. Improve intra-metropolitan transport.

4. To make the system flexible, adaptable and extendable.

5. To be a positive aesthetic experience for the traveler.

6. To provide high speed from door to door.

7. To be easy to use, and have a clear map image.

Possible additional considerations were:

a. To serve all elements of society.

b. To help solve social problems.

c. To serve diverse uses.

From these considerations two early alternatives or models of network systems were developed. Model A is a network system consisting of: (figure #1)

1. A vertical below ground hierarchy of speeds. The higher the speed the greater the depth below ground.

2. A 700 mph main line (HSGT) connecting only major metropolitan centers in the N.E. corridor. (Boston, New Haven, New York City, Philadelphia, Baltimore, and Washington, D. C.)

3. 300 mph secondary lines (HSGT) which consists of:
   a. Radial lines which connect metropolitan centers to metropolitan sub-centers, airports and seaports.
   b. One loop which surrounds each of the metropolitan centers and connects the metropolitan sub-centers, airports and seaports.

4. 70 mph existing regional transport (railroads, buses and
automobiles) which connect local centers, metropolitan sub-centers, and metropolitan centers.

5. 3 to 25 mph intra-metropolitan transport. (pedestrians, automobiles, taxis, and buses)

6. Each center of urban activity is served by one interchange. Therefore, each metropolitan center, metropolitan sub-centers, and local centers are served by a single interchange.

7. There are two types of interchanges:
   a. Interchanges involving a change in vehicle in order to change lines.
   b. Interchanges incorporating switches to change lines.

Model B is a network system consisting of: (figure #2)

1. A vertical above ground hierarchy of speeds. The greater the speed the lower the density and the higher above ground the line (HSGT).

2. Each metropolitan center (Boston, New Haven, New York City, Philadelphia, Baltimore and Washington, D. C.) is surrounded by three concentric loops. These are connected radially by intermediate loops.

3. The outer concentric loop is connected to the mainline (HSGT).

4. The system has four constant speed components:
   a. 500 mph main line.
   b. 350 mph outer concentric loop.
   c. 150 mph middle concentric loop.
   d. 70 mph intra-metropolitan loop.
5. The intermediate loops are of variable speed connecting one constant speed concentric loop to another. This connection is made by mechanical switching.

6. Interchanges occur along the concentric and intermediate loops.

7. All interchanges on a particular loop are similar since the loop and therefore the interchanges serve areas of similar density.

III. EVALUATION OF SYSTEM MODELS A AND B

The main difference in Models A and B is the assumption of what doors are served, i.e., where trips are generated. Model A emphasizes the center of metropolitan areas and assumes the greatest number of trips will originate and terminate in the center of these areas. Model B assumes that the center of metropolitan areas is no longer the origin and destination of the majority of travelers, and it incorporates a distributive network throughout the metropolis and region.

The geometrical configuration of both models are similar in that each conforms to the geometry of the metropolitan area: each recognizes the center and employs a form of radial distribution from the center. The two models differ, however, in the way the parts are joined together to form a complete system. They also emphasize different aspects of transportation, one stressing the collective (Model A), and the other the distributive (Model B).
When invited to comment on these two proposals in a discussion early in the semester, Aaron Fleisher made these observations: "Model A may be relying on what the metropolitan center can never be again, for today, after 5:00 pm, the center is a dead end and nothing can revive it. Without an integrated regional line the mainline is nothing."

Model A does not serve the whole region as an integrated network. It emphasizes only metropolitan centers and gives a very close communication between them. This would appear, however, to solve the problem that airports have in being far away from metropolitan centers. While Model A calls for a completely underground operation, the spaces necessary for switching at an interchange which is at the confluence of many metropolitan and regional lines cannot be feasibly structured below ground. (We know how to build tunnels below ground, but we do not know how to construct vast "roundhouses" below ground).

Model B emphasizes the regional and metropolitan network as a physically integral part of the total HSGT system. There would be fast communication between metropolitan centers, metropolitan sub-centers, and local centers. Inherent in this system is an improvement in the total transportation system. In terms of growth, Model B emphasizes dispersion and makes it more convenient for people to live outside the metropolitan centers and yet rely on the center for certain special services or employment. Model B is consistent in the hierarchy of lower speeds in higher densities and higher speeds in lower densities.
IV. MANIFESTO

An analysis of early systems proposals led to the recognition of certain principles which were applicable to this project. The articulation of these principles we have termed to be a "Manifesto," and it represents a method of coordinating the components into a workable and consistent HSGT system. As a set of rules it governs the design of the system and influences the location of places of interchange within the system.

1. The system will be a door to door or integrated network which will serve entire regions or metropolitan areas with directly related secondary systems. We are opposed to a point to point or center to center network which would serve only regional centers or centers of metropolitan areas with one interchange.

2. The system will affect urban growth and therefore, should be designed to encourage desirable land use patterns and growth forms. Growth will center around interchanges; in existing urban areas this growth will manifest itself as a change in the environment; in new settlements, themselves an instrument of effecting desirable regional expansion, vitality and growth will depend not only upon the HSGT but upon the transportation system in general.

3. The system is primarily designed as a public transportation system but transport of private automobiles may be incorporated though not stressed.
4. The speed of travel of the HSGT is proportional to the length of the component of the system since the greater the distance between interchanges the higher the speed which can be achieved. The speed is inversely proportional to the density of the area served by the component since the greater the population density, the greater the number of interchanges required. There are positive implications of this proposition on the physical form of the areas served: where building mass concentrations and densities in case the network systems above ground are high and spaces confined, speed should be low. Conversely, where densities are lower, it is possible to achieve greater speeds without adversely affecting the environment.

5. There should be no integration of incompatible scales. As was indicated in the previous statement, there should be a correlation of densities and speeds, and of spaces and uses.

6. The system must be flexible and adaptable to fit not only its original purpose but to accommodate itself to changing circumstances and changing demands. It must be capable of extension to future centers of population, and it must be able to be constructed in phases and used as each phase is completed.

7. An interchange is a place of orientation and decision making. It is a place where an individual orients himself to his immediate surroundings and to his destination and where he chooses an appropriate mode of travel.
8. A switch is a place of mechanical decision making. It is a part of the fully automated mechanical HSGT system, in which destinations are programmed, prior to departure and appropriate routes are selected automatically.

9. An interchange never occurs where a switch occurs since switching is of a mechanical nature and an interchange involves human decision making. The velocities and dimensions involved at switching points and the zero velocity and pedestrian scale of interchanges make it undesirable and unfeasible for them to be located together.

10. Interchanges involving automobiles will occur only where the mobility and speed of the automobile may be used to its best advantage. Therefore, automobile interchanges will occur outside the metropolitan centers where the space is adequate for the requirements and where population densities are low. Automobile interchanges (similar to highway interchanges) will generate no significant activity.

11. There will be no interchanges serving more than one speed component of the HSGT system.

12. All interchanges on a particular speed component are similar since the speed component and therefore the interchanges serve areas of similar densities.

V. DESCRIPTION OF ARCHITECTS' PROPOSED HSGT NETWORK SYSTEM (Figure #3)

This network system is an outgrowth of system models A and B and is in accordance with the Manifesto.
FIGURE 3

SYSTEM NETWORK

- passenger interchange
- automobile interchange
- switch
- direction of travel
- HSGT thru-line

VERTICAL DISPOSITIONS
The network system in final form consists of:

1. Each major metropolitan center is surrounded by two concentric loops. These are connected radially by intermediate loops.

2. The outer concentric loop is connected to the main line (HSGT)

3. The system has three constant speed components:
   a. 350 mph main line (2-way).
   b. 150-250 mph outer concentric loop (2-way).
   c. 70 mph intra-metropolitan loop (2-way).

4. The intermediate loops (1-way) are of variable speed connecting one constant speed concentric loop to another. This connection is made by mechanical switching.

5. Interchanges occur along the concentric and intermediate loops.

6. All interchanges on a particular loop are similar since the loop and therefore the interchanges serve areas of similar densities.

F. CONCLUSION

The architects' proposed network system is not in complete agreement with the system proposed by the Interdepartmental Systems Design Group. The I.S.D.G. network system is of a pragmatic or expedient nature, having been greatly concerned with economic and political implications. Our network system tends to be more idealistic and contains a greater differentiation of system components. The I.S.D.G. system
is composed of primary or main lines (350 mph) and secondary (100-150 mph) loops serving each of several regions. This system does not differentiate urban areas by giving them their own speed component but rather serves major cities with one or two interchanges in much the same fashion as it serves metropolitan sub-centers of those cities. In contrast the architects' network system has speed components serving areas of similar density and tends to have a greater number of interchanges throughout the system.

There are contradictions in our network system concerning the vertical disposition of the various loops. Particular vertical disposition alternatives (figure #3) do not use gravity as an agent for deceleration from a higher to a lower speed component. These particular alternatives also have to overcome gravity in both acceleration and deceleration.

The visual experiences afforded by the various alternative vertical dispositions of the loops are contradictory. The great speeds at which the vehicles move above and near ground complicate the passenger's visual experience by obscuring his near field of vision. On the other hand, the slow speeds within the dense urban situation which would allow detailed experience are forced below ground in the system as presented.

Jerry Gibson
GENERAL PROGRAMMING OF THE INTERCHANGE

I. GENERAL PROGRAMMING FACTORS

Programming the HSGT interchange proceeds from certain factors established either through basic collaborative decision making by the graduate students in architecture or by the other disciplines involved in the Interdepartmental study. The most important of these was the Manifesto, established to set forth the desired high speed, door-to-door HSGT network which was seen as possible only through the integration of this new mode with all other existing transportation modes within interchanges.

Mechanical engineers from the Interdepartmental Systems Design Group developed the physical means for realizing this network through the design of vehicles and guideway. Two vehicle types, a bus module (40 x 10 x 8 high) and a taxi module (18 x 6 x 5 high) were established to fulfill three distinct functions; six-passenger capacities programmed for non-stop travel to any point in the total HSGT system, forty-passenger capacities programmed for stops along metropolitan or regional loops, and forty-passenger capacities programmed for specific city origins and destinations along the Corridor. The buses servicing the loops have two identities; during commuter rush hours they may be programmed for specific destinations -- during off hours they make stops at all points along the loop served. An auto module (22 x 10 x 8 high) was developed
as well for placing automobiles directly upon the HSGT system.

Though it might be somewhat confining to label the application of private automobiles onto the HSGT auto module system as purely a switching process, nevertheless, in terms of the accepted definitions of the Manifesto, places where such connection are afforded were seen as places largely of machine decision making. It is unlikely, therefore, that parking plazas from which people in cars would be maneuvered mechanically upon the HSGT system would be capable of generating any significant local activities. Such places should be located within metropolitan regions but outside the city cores in less densely built areas where the necessary space and appropriate dimensions can be provided. Here the mobility of the automobile can be used to its best advantage as well. To best fit their functions, it was decided that such connections between the HSGT system and major metropolitan or regional roadways were to be separate and distinct from HSGT interchanges.

The locations for HSGT interchanges and guideway rights-of-way were established only in the broadest terms. Tunneling in toto was found to be too expensive, but in dense urban areas acquiring above ground rights-of-way would be more costly than tunneling operations. Some felt strongly that the entire system must operate above ground if the trip experience was to be at all tenable; they proposed air rights utilization over circumferential highway belts for HSGT operation in cities. Those content to place the HSGT circulation at the interchanges below the earth found
GLIDEWAY  INTERCHANGE  SYSTEM

FIGURE 4
it necessary to locate it as much as one hundred and fifty feet below ground, as in the case of Boston where new tunneling could only be constructed beneath the forest of deep piles upon which a large portion of the city rests. Such depths of operation rule out all but the elevator as means of vertical circulation. 7

II. CONFIGURATION OF HSGT CIRCULATION

Figure #4 represents one feasible configuration for circulation of HSGT vehicles at the center city interchanges where passenger demand is great. Acceleration and deceleration lines of suitable length switch off the constant velocity main line and lead to and from a series of HSGT parking docks, the prime generators of a linear interchange form. Electrical switches envisioned by the mechanical engineers are extremely expensive; the faster a vehicle moves through the switch the greater the number of windings necessary in establishing a magnetic field large enough to repel the vehicle into the desired direction. Thus the HSGT vehicles are to be moved and switched through the interchange by a mechanical tow type system after having decelerated to approximately five miles per hour. One bus module or two taxi modules are brought to a full stop within a dock. In the plan configuration presented in Figure #5, loading and unloading of passengers occur on opposite sides of the vehicle upon island platforms. Stairs or escalators from the islands lead to continuous concourses above (or below) the vehicles. Circulation to ground level would be by several banks of high speed elevators serving the concourse(s). Such elevators should be grouped
with one another and with the sizeable mechanical ducts into a minimum of vertical shafts. This necessity makes it impossible to dispense with the redundant below ground concourse(s) by serving each island with an individual elevator. Dispensing with island platform configurations greatly increases the required width of the extremely expensive space below ground. The system may be in an above ground location and the interchange modified accordingly.

HSGT service to the less densely built areas where demand is much smaller and where above ground rights-of-way are more easily and economically acquired can be accomplished simply by building near ground sidings off the main lines.

Though the configuration for HSGT circulation may be looked upon as a given, a considerable degree of flexibility exists in both plan and section in terms of how one chooses to organize the circulation flow and in terms of how one chooses to organize the two sets of docks (two directions of travel) into one ensemble.

III. CAPACITY

Several assumptions have been made in calculating the capacity of the HSGT dock configuration described above. First, a one minute full stop is being allowed for the loading and unloading of passengers and luggage to occur concurrently. Secondly, it is assumed that vehicles may be programmed off the main line in such a way that there will always be an open and appropriate dock space for it. Thirdly, it is to be
assumed that the maximum ratio between taxi and bus modules shall be 60:40. Thus during the peak commuting hours it is likely that one and one-half times as many 40-passenger bus modules will be in operation than will be the 6-passenger taxi modules.

Based on these assumptions, ten docks in each direction could handle a flow capacity of from 15 to 30 thousand people per hour, depending upon the varying ratio between module types in use.

To better give an idea of the size such docking configurations might reach in actual operation, assume that five interchanges serving equal passenger demands are to be built on a center city loop beneath Boston; these might be established as University (near Harvard), New North Station, Logan, South End, and Back Bay (near Prudential Center).

It is estimated that one out of every three citizens of metropolitan Boston will take an intercity trip to New York each day in 1980. If one assumes total intercity trips as three times that figure, some 150,000 people out of the 4 million estimated population for 1980 will take such trips daily. If the HSGT system is used by 15% of all future intercity travelers, an optimistic estimate, about 5,000 of such daily trips will originate from each of the five Boston interchanges. Boston, of course, will be the destination for as many trips originating elsewhere in the Corridor.

Assuming ten times as many commuter trips per station, over 100,000 arrivals and/or departures must be expedited in each of the five interchanges
daily. If a commuting peak of 36,000 people/hour (600 people/minute) is reached and if a 60:40 operational ratio is held between bus and taxi modules which are nearly filled to capacity, 20 taxis and 5 buses in each direction must arrive or depart each minute. The fifteen docks thus required in any one direction would establish a total interchange length of 640'. (A comparison of existing terminal capacities to the HSGT interchange envisioned above is included in the Bibliography). 10

IV. INTERCHANGE OPERATIONS - A PERFORMANCE SPECIFICATION

1. General Specifications

Those interchanges in which automobiles are not to be applied directly onto the HSGT system should be located so as to relate to as many of the existing and proposed modes of transportation as is possible. Figures #6 and 7 give some indication of the many scales of mode, some of which might be integrated within a single interchange. The desire to establish a continuity between so many modes generally presupposes a central city or central regional location. In the face of city traffic congestion and in light of the expressed desire to utilize the HSGT system as a component part of an attractive, truly door-to-door network, interaction with the private automobile would best be limited to dropoffs and a minimum of expensive, short-term parking.

The many changes in mode of travel involving human orientation and decision making accommodated within an interchange will provide important foci of urban development. Such a collection and distribution of people
FIGURE 6

- Baby Carriage: 4'-4" to 1'-0"
- Bicycle: 6'-0" max to 3'-5" max
- Scooter: 7'-3" to 3'-2"
- Forklift: 4'-9" to 7'-10"
- Fire Equipment:
  - Pumper: 11'-0" to 15'-9"
  - Ladder: 4'-8" to 6'-0"
  - Combination: 4'-0" to 5'-9"
  - Truck: 2'-0" to 3'-9"
- Martinetti's Truck: 33'-0" average to 8'-0" average
- Van: 14'-11" to 18'-3" to 8'-4" to 10'-6" to 7'-7" to 12'-0" to 8'-5" to 8'-0" usual
- Min. Radius Inside: 25'
- Min. Radius Outside: 42'
- Min. Radius Inside: 33'
- Min. Radius Outside: 55'
FIGURE 7

SINGLE ROTOR

TANDEM ROTOR

LIMITED USE, RAISED PLATFORM, SMALL HELICOPTER AREA

TAKEOFF & LANDING

APPROACH DEPARTURE PATH FLARES OUT TO 1000' AT 2000' FROM TOE OF SLOPE (1:8)

Heliport facilities on ground: 2-200' x 200' areas, one for landing and one for takeoff plus ramp space, loading space, takeoff and landing areas, and terminal-service areas.

Supersonic Transport

Present Aircraft

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<th>Length</th>
<th>Wingspan</th>
<th>Height</th>
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<td>105'</td>
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<tr>
<td>B-707</td>
<td>140'</td>
<td>130'</td>
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</tr>
<tr>
<td>DC-7</td>
<td>110'</td>
<td>115'</td>
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<tr>
<td>DC-3</td>
<td>55'</td>
<td>90'</td>
<td></td>
</tr>
<tr>
<td>Cessna 310</td>
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<td>36'</td>
<td>105'</td>
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<tr>
<td>Piper Cub</td>
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<td>36'</td>
<td>75'</td>
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</tbody>
</table>
at a particular point will be a generator of activities. Thus, while the place of automobile - auto module interaction is likely to remain a static form, the interchange may be looked upon as the nucleus of a growth form, i.e., capable of establishing certain dimensions beyond itself.

Thus the general interchange design problem is manifold. An architectural organization must be established to support the desired continuity of movement between the many transportation systems embraced within the interchange. This calls for a clear spatial envelope within which to orient the traveler. On a larger scale, expression must be given to the particular type of urban environment generated by the interchange. On yet a larger scale, the interchange should take on roles both as a symbol and as a city organizing element, expressing the excitement of the new HSGT mode, while yet communicating clearly how the traveler's circulation ways are organized for him. This is particularly critical at the scale of the entire Northeast Corridor, where the interchanges become regional gateways within which the intercity traveler must reorient himself upon leaving an HSGT environment which, of necessity, may become subterranean near and beneath the city.

2. Particular Operational Specifications

A completely random programming of dock spaces is impossible in the operation of the HSGT bus modules for several reasons. First, only a few docks in each direction are to be serviced by automatic luggage handling. (Because of the great expense in building such places below
ground, luggage handling should be built into the dock configuration, rather than establishing a plan space of its own. It has been proposed to carry luggage by conveyor belt to a point directly beneath the vehicle in full stop so as to accomplish loading and unloading of luggage and passengers concurrently.) This luggage capacity is to be utilized largely by the intercity bus modules which must be scheduled in time and space. The great influx of peak late afternoon commuters could best be expedited if the location of vehicles programmed for certain metropolitan or regional loop stops were established at specific departure locations each day. (Note that the morning commuter crush raises no such functional problems, being simply a disgorging of people at the interchange in a completely random way.) Ticket operations, described below, also necessitate specific locations for certain bus module types. Furthermore, during off demand hours when most of the docking spaces will be unused, it would be best to concentrate all arrivals and departures in one area of the interchange.

The 6-passenger taxi modules, on the other hand, programmed for non-stop travel to any part of the system throughout the Corridor, could utilize the docking spaces in a completely random manner.

Decision making thus involves which of the two directions of travel should be taken, where the scheduled intercity buses arrive and depart, and from where, during afternoon peak rush hours, commuter buses for specific loop stops are departing. These same buses, serving all stops along a given loop during the off hours should be programmed for specific locations. People desiring to use taxi modules have no
such decisions to make; they need only take any elevator to the HSGT concourse from where an appropriate vehicle may be reached which will either be waiting or will be arriving in less than one minute.

In addition, the connection of all other modes of transportation within the interchange to each other and to the vertical circulation elements leading to the HSGT system must be as clearly expressed as is possible to establish the desired continuity of movement between them, for only thus is the HSGT to become a part of a door-to-door network. While graphics will necessarily play an important role in orienting the traveler to the many choices open to him, they cannot be enough; only in conjunction with a powerful spatial organization is the potentially bewildering environment of the interchange to be processed coherently by the traveler. All elevator connections to one direction of HSGT travel, for example, might be disassociated by level from those connecting to the other direction of travel.

In any case, nearly all of the orientation and decision making must take place before the traveler reaches the HSGT concourse, whether it be located above or below ground. There must be little waiting here; during the afternoon commuting rush a smooth, continuous flow of people must be approximated. Thus the only choice which should face one upon entering the concourse level is to which of two or, perhaps, three island platforms he should descend (or ascend).

If human mistakes are made, and no way exists to program them out
of existence, the HSGT interchange system must have "short-circuits" built into it. It must be possible for a person to return to the surface without having taken a trip. Also cross-connection between the two directions of travel should be afforded at the HSGT concourse levels.

The control problems evoked by such necessities are largely a matter of how ticket and billing operations are arranged. Insight into the nature of this problem can be given by outlining one possible solution in which tickets and control are placed at the main concourse level at (or near) grade.

Several ticket acquisition areas would be necessary involving both human and machine operation, coin operated machines dispensing tickets for bus module trips on metropolitan and region loops and HSGT employees dispensing tickets, making change, and giving information for trips involving the use of passenger modules and intercity bus modules. Credit cards, for those using the system often, would be accepted and charges recorded for monthly billing by both ticket dispensing machines and personnel. Once tickets are acquired, the people are taken to the HSGT concourse levels above or below the vehicles, having been sorted out as to trip type in only the most rudimentary way. (Vehicles arrive randomly except for those buses scheduled for general docking locations and specific departure times.)

Assuring that people take the trip for which they have paid is a matter of establishing different ticket types corresponding to trip
types. Passenger module tickets are also the programming cards for sending the vehicle to the desired destination -- they must be inserted into a computer-controlled console aboard. Tickets for intercity buses are checked by the "operator" on board whose function during the trip is one of policing. Trip destinations recorded on all tickets for loop bus module trips are checked at destination turnstyle arrangements built outside the elevators on the main concourse levels at grade. All people arriving at their destinations from any HSGT module type must present their tickets at these turnstyles. It is assumed that all such checking can be accomplished with devices which scan information which has been programmed onto the ticket at the origin. Once an invalid ticket has been sensed by the scanner, an HSGT employee must be dispatched to clear up the problem.

The safety aspect of the HSGT control problem involves several considerations. A partial encapsulation of the platform islands is necessary. An automatic closure of dock space to vehicular entry might be established automatically once an object has fallen into it. Closed circuit television scanning could supplement an HSGT policing force located on the concourses. Such personnel would be on call if a vehicle were to be suddenly shunted into the interchange for emergency reasons. (All vehicle module types have control devices which upon activation will direct the vehicle to the nearest interchange and alert personnel of their arrival in the event of emergency.)

Ronald Lindgren
REFERENCES


6) For a complete technical description, see Appendix - ISDG Group Report, Chapters 4, 5, and 8.

7) See Sweet's Architectural Catalog File, $\frac{23a}{H_{a}}$ - p. 11 and $\frac{23a}{M_{n}}$ - p. 14.


10) Interchange and terminal capacity comparisons:
   a) New North HSGT interchange 90,000 passengers/day
   b) North Station, Boston - 1922 100,000
      - 1959 30,000
   c) Tokyo Railway Station, Japan - 1959 400,000
   d) Tokaido High Speed Rail Terminal - 1975 130,000
I.

PLACES OF INTERCHANGE
IN THE NORTHEAST CORRIDOR TRANSPORTATION SYSTEM
(Volume II - Case Studies)

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE
DEGREE OF MASTER OF
ARCHITECTURE

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(Volume I - Group Research)
A PLACE OF INTERCHANGE IN A NEW METROPOLITAN SUB-CENTER

Jerry Gibson

I. INTRODUCTION

In accordance with the Manifesto, interchanges will effect growth at new urban areas by generative process. It is desirable to locate interchanges in new urban areas or new metropolitan sub-centers, (new towns), which will have in their beginning some degree of planning and design control. These new towns should be regional as well as local centers of activity. A new town center would then become a nucleus for both regional shopping and for the area served by the interchange.
The Washington, D. C., metropolitan area envisions a rapidly expanding population that will reach five million by the year 2000. In an effort to control the continued expansion, a plan was developed to create new urban communities, (metro-towns), within the region to accommodate a majority of the expanded population growth. These developments will occur in corridors radiating from the central city outward. This solution was selected for the advantage of its efficient access to the central city by rapid transportation which would result in giving growth potential to the employment center in the central city.

The largest and most complex metropolitan area in the United States, a 22 county expanse which takes parts of three states but which, for convenience, has been termed the New York Metropolitan Region. A study group was formed, for the study of this region, whose task was to analyze the key economic and demographic features of the New York Metropolitan Region and to project them to 1965, 1975, and 1985. The project is neither a blueprint for action nor an analysis of metropolitan government. No recommendations are made about the form of the government bodies there. At the same time, it is a necessary prelude to future planning studies of the region and to well considered recommendation for governmental
action. Its end product is an analysis of the Region's probable development.

Presently the major growth of the Boston metropolitan region is along existing routes of major highways, (Diagram A), which radiate from and surround it. However, at this time, wide-spread sprawl exists in this area and can be expected to accelerate. A plan, not unlike the Washington, D. C., and the New York Metropolitan Region studies, could be evolved to control sprawl in this area.

New towns with planning control are opposed to sprawl, (see planners report), and could be used to firmly establish a desirable planned growth in the N. E. corridor if they and their interchanges are built at desirable locations. The HSCT can influence new growth only if the secondary loop network is constructed and can be used to influence desirable growth only if interchanges are located in new or existing towns which have planning control. The actual locations of the new towns would be the result of political, social, and economic decisions, but it could be that these locations would exist on the present major highway routes. This would entail constructing the secondary network loops along, or near the established highway network.

3.
In 1980 only one loop of the secondary network would be constructed. This loop would be built as a trial or on an experimental basis to determine the feasibility of controlled urban expansion using the influence of the secondary network.

My objective as a part of the total HSCT network system is to design a new town center incorporating a regional shopping center and an HSCT secondary loop interchange. An advantage of incorporating a regional shopping center in the new town center is that the daily shoppers in the form of the local population, supplement the activity of the weekly regional shoppers. The inclusion of local and regional shopping, pedestrian access to the center, vehicular access to the center by automobiles, taxis, local and regional bus service, and a secondary loop interchange, make the entire new town center an interchange. An interchange for the secondary loop involving automobiles was excluded from the center (see Manifesto). The new towns as a nucleus for their regions, and the interchanges at that nucleus, will require a strong supporting vehicular connection with the region. This connection will be made by private automobiles and a regional bus service on regional distribution roads.
The growth of the new town and the major residential area, the location of industry, and the distribution of recreational areas are developed only on a diagrammatic basis. Only the commercial center at its first stage is designed. The first stage growth figure of 30,000 is large enough to constitute an urban nucleus for the various smaller population of existing towns in the region. Consideration was given to the fact that an individual should have the greatest variety of goods, services, and facilities readily accessible to him. Also, it must be easy for the individual to recognize and inter-relate between intensive and less intensive areas of congregation. The resultant new town center should augment a clear definition between components which relate to a well patterned flow system.
II. NEW TOWN CENTER

The first major decision in evolving the design of the center was to make a complete separation of the pedestrian and automobile. This is advantageous both in facilitating the traffic flow of each, and creating a desirable environment in which to shop. This also allows a richer expression of architecture in which one scale is perceived by the pedestrian and another by the automobile.

The town center contains a variety of uses which give it a high amount of activity. There are cultural, community, entertainment, local government facilities, shops, offices and residential uses at the center. By intermixing the residential and commercial uses, the center is assured of activity both day and night. This activity is necessary to give the center a desirable urban environment.

An open ended system, (Diagram B), was incorporated which would have, inherent in itself, the complete separation of the pedestrian and automobile. The total system is divided into three major, (a), components which are parking bays. They
OPEN ENDED SYSTEM
(DIAGRAM B)

- MAJOR OPEN FACE
- OPEN SPACE
- MAJOR OPEN SPACE
- ARCHITECTURAL SOLID
- MAJOR RESIDENTIAL ST.
- MINOR RESIDENTIAL ST.
establish the complete mechanical side of the center. Each bay is a unit, the size of which is determined by an optimum or desirable walking distance from car to shop, and is designed for the purpose of orientation of pedestrians from the bay to the entrances of the center and, upon return, easy location of their automobiles. The horizontal distance at maximum is 500 feet, but varies in most cases between 150 and 200 feet. Each parking bay is 420 feet wide, 300 feet deep, and holds at maximum 200 cars. Three bays in vertical disposition constitute a complete package and have a maximum 600 car capacity. In this design, only three packages in horizontal placement are designed. This gives an approximate 1200 foot length to the center. This length is a reasonable walking distance of six minutes and gives a linear form to the center. This linearity has several distinct advantages. The pedestrian will always be able to relate himself to the street. The linear system lends itself easily to expansion. In the future, the center may be enlarged as the population of the new town and its region increases by the addition of major components, (parking bays), to either end, or new packages above existing packages. The total number of packages needed for the first stage of the new center is unknown, but by the incorporation of a complete mechanical side to the center with adequate open space to back it up, (for
ramping of automobiles), the packages may be added immediately, or as needed, and will not interfere or conflict with the center itself.

Each major component has a major open face. The open faces become the entrances to the center from the parking bays and occur at the middle of each bay. Two major open faces share a major open space. The two major spaces contain the community and major entertainment functions. The more dominate of the two, (the community space), will contain the town hall as an architectural solid in the space, and a hotel with public entertainment facilities. The other major space will contain a theater which will be the dominant architectural solid. High priced specialty shops and cinemas occur at both spaces. The major stores located on all three segments of the street on the residential side, and the specialty shops on the mechanical side, will draw activity along the street from one end to the other. The interchange of the secondary loop is located between the two major spaces on the mechanical side of the pedestrian street. It has a strong and immediate connection both visually and in accessibility from the mechanical side and the pedestrian street. This location is desirable because it creates a flow of
activity to it from drop off areas, through the major spaces, and along the street.

The major spaces are open ended. Two open ended dimensions inside, (of the major spaces), relate to three open dimensions outside. The open dimensions outside become residential pedestrian streets. The streets directly relating to the major spaces are shared by two minor residential pedestrian streets. The minor pedestrian streets are directed to the major pedestrian streets by means of architectural solids. The spaces occurring at the ends of the linear street are also open ended in the linear direction. Presently this will allow activity to be achieved through the open ends to recreational facilities, and later as the center expands will keep the linearity of the street. This center, as an open ended system, will lend itself to a variety of residential solutions which could be designed to conform to and relate closely in architectural expression.

Diagram C shows the land use, the residential and regional vehicular circulation and the secondary loop connection to the new town center. The road labeled (1) is a major or limited access highway. It connects to regional distribution
LAND USE AND CIRCULATION

(DIAGRAM C)

- CENTER
- WHOLESALING WAREHOUSING
- PARKING
- LOW DENSITY
- RESIDENTIAL
- INDUSTRY
roads, (2), which flank and run perpendicular to the new town's linear center. They connect to another regional distribution road which parallels the pedestrian street. This traffic exits on the side away from the residential sector onto a controlled access road, (4), which parallels the pedestrian street and feeds the three parking bays. There is also another controlled access road, (5), to the center from the residential sector and the region. Along this road will be drop-off points for buses, taxis, and automobiles. Controlled access roads from the residential sector, (6), connect to a road which connects to the flanking regional distribution roads. Industry which is located on the mechanical side of the new town is accessible by a controlled access road, (3), which is also connected to the flanking regional distribution roads. Wholesaling and warehousing is located on the regional side of the new town and occurs along the regional distribution road which parallels the pedestrian street. The secondary loop, (8), of the HSCT parallels the major highway and is connected to acceleration and deceleration lines (9). These lines connect the new town interchange. Service to the new town center enters from either end of the center by a service road, (7), which ramps down to the service level.
III. PROGRAM

This program is for the new town center and is presented for only the first stage of 30,000 population.

Stage I - 1980 @ 30,000

Service Facilities:

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<td>2. Police station</td>
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<td>3. Two Fire stations</td>
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<td>4. Post office</td>
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<td>5. Library</td>
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</tr>
<tr>
<td>6. Community Center and Auditorium</td>
<td>70,000</td>
</tr>
<tr>
<td>7. Exhibition gallery</td>
<td>20,000</td>
</tr>
<tr>
<td>8. Health clinic</td>
<td>10,000</td>
</tr>
<tr>
<td>9. Hospital</td>
<td>38,000</td>
</tr>
<tr>
<td>10. HSCT Secondary Loop Network Interchange</td>
<td>16,000</td>
</tr>
<tr>
<td>11. Intra-regional bus interchange</td>
<td>20,000</td>
</tr>
</tbody>
</table>

Industrial:

Indicate some method of industrial location and its connection to the new town.
Business and Commercial:

Provide for a system of local business and commercial activity.

Include in this system a regional shopping center for surrounding communities.

A. Local

1. Commercial

   sq. ft.  250,000

2. Business and offices (including professional offices and company offices)

   sq. ft.  350,000

   TOTAL  600,000

Note: Items 1 and 2 may interchange areas, but their combined net area should be the same.

B. Regional Shopping Center:

1. Commercial (including two department stores, one theatre, and three banks)

The inclusion of a regional shopping center in this business and commercial center can be expected to add another 700,000 sq. ft. to the center. Approximately 650,000 of it would be commercial area and 50,000 would be business and office space.

   TOTAL  700,000
C. Service:

20% of the net business and commercial area must be added for service areas.

\[ \text{TOTAL} \quad 260,000 \]

The order in which the program is presented does not necessarily indicate a method in which the various elements are to be composed in the final scheme. It is, instead, a categorized statement of the basic elements to be included in the planning of the new town center. The program is a guide; deviations are expected as suits the purpose of the design.
BIBLIOGRAPHY


A PLACE OF INTERCHANGE IN A NEW METROPOLITAN SUB-CENTER

MAIN COMMERCIAL LEVEL
2ND LEVEL PARKING
A PLACE OF INTERCHANGE IN A NEW METROPOLITAN SUB-CENTER
I. Background

At the outset of the thesis research period it was apparent that, before an interchange could be designed, it was necessary to arrive at an understanding of what would constitute a desirable growth pattern for the northeast corridor region. This seemed necessary for, if the transportation system was planned without some cognizance of a desirable growth pattern, not only would the opportunity to promote and reinforce a desirable pattern of development be lost, but the system might foster development
which would aggravate many of today's major problems.

These problems, of slums, traffic congestion, segregation, sprawl, increasing population, visual chaos, extended commuting, poverty, and decaying central business districts, appeared at a cursory glance to be amenable to the influence of this type of study. However, investigations into possible patterns of urban growth along the northeast corridor region did not make readily apparent solutions to the above problems. This was probably because research studies isolating and expressing the relationships of these problems to land development patterns were not available. Lack of time or training, or perhaps the scale of the design, may also have played a part.

Without considering areas of professional responsibility or political and economic factors in detail, several density patterns within a lineal regional land pattern were investigated. In these studies an attempt was made to realize the potential inherent first, in the location of the "megalopolis" at the edge of the continent, and second, in the region's distinctive natural topography. By containing the densest new urban development, aside from that related to existing metropoli, in a lineal belt inland parallel and at right angles up the valleys to the main axis of the corridor -- see figure 1 -- the coastline proper was retained as a low density
recreation zone. Access was provided from the coastline to the major lineal urban development paralleling the coastline through open land reserves. These reserves extended through the corridor axis to the interior valley development. Also, in an attempt to realize an efficient density to transportation capability relationship, the densest urban development was located adjacent to the primary transportation routes. As the distance from the primary routes increased, the densities decreased -- see figure 2. A similar development, based on the general concept of lineal growth, was proposed by the planners to the interdepartmental project at the conclusion of the study.

In an effort to see an effect of these early investigations, a portion of the total corridor was developed. One of the considerations motivating the design was compactness of settlement. This would help minimize sprawl, create meaningful urban spaces, conserve open land reserves, and minimize extended commuting. A second consideration was a balanced system of transportation in which each medium would have its special role. Thus the highly regulated mass transit system lines are coincident with the highest densities at the cores, and are in contrast to the mobility of the car at the less dense peripheries. A third consideration was controlled growth, where new development could easily be integrated into existing land patterns and
transportation facilities. The resultant general scheme -- see figure 3 -- was based upon residential communities of approximately thirty thousand people, spaced a minimum of one to two miles apart and separated by belts of open recreation land. Each community had two foci: a commercial center providing an interchange facility to the intercommunity transit system which might take the form of a disengaged H.S.G.T. vehicle, and a civic center served by a local bus system. The density within each sector would vary considerably, from a maximum near the commercial center of perhaps two hundred and fifty people per acre, which would be realized in three story walk-ups or high rise apartments, to a minimum, at the furthest distance from the prime transportation routes, of sixty people per acre, corresponding to the one story atrium dwelling. With the introduction of other factors, there would be variants within this general progression. Using a fifteen minute walking time radius, and the average gross density, communities accommodating about thirty thousand people would be three-quarters of a mile square.

Four communities related to an industrial and regional service sub center. The sub centers were a minimum of five miles apart, linked to present limited highway access points and to the H.S.G.T. tertiary loop. These service sub centers would be vehicle oriented, and would have a tendency toward less dense and changing
development, less complex services, and lower taxes. Such a center would be a loosely knit agglomeration of a variety of functions which need large, contiguous floor areas and organizations. The sub center might contain parking storage for H.S.G.T. commuters, business and industry not requiring close personal interaction, highway oriented markets, mass spectacle stadia, metropolitan zoos, heat and power services, educational facilities requiring large land areas and good access, motels, and other high density residential accommodations.

Several sub centers would relate to a regional center located on the H.S.G.T. secondary loop. Because of the speeds implicit in the secondary loop, the centers would be a minimum of twenty miles apart. This spacing of the interchanges, based on the assumption that residential, commercial, and industrial activity would develop at the points of interchange, would create important regional shopping centers. It was a center at one such point of interchange that was developed in further architectural detail.
REGIONAL GROWTH PATTERN  

DENSITY - TRANSPORTATION RELATIONSHIP

fig 1

fig 2
LAND USE DIAGRAM

- regional shopping center
- regional service center
- recreation
- industry
- community settlement

5 miles
1 mile
expansion

ATLANTIC OCEAN

fig 3
metropolitan center
regional shopping center
regional service center
community settlement

INTERCHANGE SPACING

fig 4
II. The Program

It will be remembered that the pattern of growth selected for the corridor was lineal. This form was adopted because it allows for easy growth, large continuity of open land reserves, an efficient transportation to population density relationship, and relates well to the natural topography of the region. Other growth forms are, of course, possible, such as even development throughout, or a ringed development outside of existing metropoli, but they fail to offer some of the advantages offered by the lineal form, e.g. the easy assimilation of new growth into the system.

Within the lineal form, once the relationships between such components as the smaller local centers and the larger regional centers were described, their general organization could be applied to specific situations. Naturally, though, the actual forms may vary in accordance with particular environmental factors. For example, the number of community developments relating to a given service center, the populations of each, and their placement relative to each other would be subject to variation, depending upon the presence of different types of industry, differing natural topography, or differing socio-economic conditions of the population.

The design of this interchange in the projected transportation
system for the northeast corridor is based on the assumptions that: (1) a new intersection point of major circulatory systems is a natural point for the development of a new regional focus; and (2) cities will continue to have an inner focus or core, a place of maximum urbanity, variety, choice, and convenience.

The regional center here proposed is located at an interchange point on a secondary loop of the H.S.G.T. system. Consistent with the earlier investigations, this loop parallels the present major traffic routes concentrated along the axial belt of the northeast corridor. The spacing of the interchanges on the secondary loops dictated by the speeds of the H.S.G.T. system recommended that the interchange point serve as a regional as well as a local center. Hence, a strong connection between the center and the region's vehicular circulatory system is important. In addition the center, because it would be a prime focus for the local community, had to have a strong visual and pedestrian connection to the residential areas of its local environs.

Because it was conceived as an integral part of a new town development in the densely developed urban belt of the corridor, the center could provide advantages not associated with scattered development or typical one purpose centers. In particular,
(1) People could park once and then walk from destination to destination. This is in contrast to the present typical suburban trip which requires several starts and stops by car.

(2) The center could be served by fast and frequent public transportation as well as expressways. Only cars and local streets can serve present scattered facilities.

(3) The center could have more varied and specialized goods, as one activity in the center attracts people to another.

(4) The facilities could be shared among activities — parking, libraries, etc.

(5) Real estate taxes could be increased, for land values would increase as a result of the center's presence.

(6) Natural open space could be conserved elsewhere.

In addition to satisfying the above standards, the center had to satisfy the criteria mentioned and amplified in the earlier chapter of the report: "Places of Interchange in the Urban Form". These criteria are (1) appropriate sequential experience of arrival and departure; (2) phaseability of growth; (3) orientation; (4) appropriate uses and coordination of varying speeds; (5) grouping of like functions; and (6) congruency of all design elements into a unified and consistent entity.
III. Programmed Areas

Stage I -- 1980 -- population 30,000

A. Service Facilities:

- Municipal office building: 15,000 sq. ft.
- Police station: 10,000
- Two fire stations: 20,000 ea.
- Post office: 20,000
- Library: 20,000
- Community center and auditorium: 70,000
- Exhibition gallery: 20,000
- Health clinic: 10,000
- Hospital: 38,000
- H.S.G.T. secondary loop network interchange: 16,000
- Intra-regional bus interchange: 20,000

B. Business and Commercial:

1. Local

   Commercial (including two theatres and three banks): 250,000

   Business and office (including professional offices and company offices): 350,000

   Total: 600,000
2. Regional shopping center

<table>
<thead>
<tr>
<th>Commercial</th>
<th>sq. ft.</th>
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<tbody>
<tr>
<td></td>
<td>650,000</td>
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</table>

<table>
<thead>
<tr>
<th>Business and office</th>
<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>50,000</td>
</tr>
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</table>

Total 700,000

C. Service:

20% of business and commercial area 260,000

The order in which the program is presented does not necessarily indicate a method in which the various elements are to be composed in the final scheme. It is, instead, a categorized statement of the basic elements to be included in the planning of the new center. The program is a guide; deviations are expected as suits the purpose of the design.
LAND USE & CIRCULATION DIAGRAM

expressway

hsgt. main line

distributor road

hsgt. secondary loop

local road

commercial focus
commercial parking
residential

industrial reserve
recreation reserve
civic focus

fig 5
IV. The Design

The city center contains a variety of uses which will give it an intense level of activity: entertainment, cultural, government, offices, shops, and residential uses are provided for.

The major physical elements of the center -- residential, commercial, and parking, are arranged in a linear form and separated by levels which follow the slope of the land. All activity is distributed along one main pedestrian street. The linear system and the system of level separation of major forms were both chosen for their organizational clarity. The pedestrian will always be able to relate himself to the main street regardless of where he enters from. Also, the linear scheme lends itself to expansion. By adding units to either end of the street the center may be enlarged as its supporting population increases.

The street is completely the realm of the pedestrian. The separation of vehicular and pedestrian traffic facilitates the traffic flow of each, and permits a richer, more coherent expression of each scale and character.

The center is divided into four horizontal bays. Each bay is a parking unit. The design of the parking units was determined by
the following assumptions: (1) The optimum walking distance from car to destination varies from three hundred feet to five hundred feet; (2) The largest size unit of parking that is easily comprehensible is a unit of six hundred cars; (3) The largest size sub-unit from which one can readily select his own vehicle is a unit of two hundred cars; (4) Because mechanical car storage equipment is now not fast enough to process commuter peak hour demands, a self parking system is mandatory; (5) The maximum desirable vertical expansion of self parking garages is six levels; (6) Because of the unpredictability of future demands on the H.S.G.T. system and the nature of future private transportation, parking facilities should be as flexible as possible in terms of growth.

Each parking sub-unit is four hundred and twenty feet by three hundred feet and holds two hundred cars. Three levels of each sub-unit comprise a package of six hundred cars. Future vertical expansion would be visually separated from the lower units and bring the maximum capacity to eight units, that is, to four thousand eight hundred cars. If additional parking facilities were required, the criterion of optimum walking distance would have to be modified to accommodate a measure of time rather than distance. The parking garages would then have to be expanded horizontally and would require mechanical conveyances to transport
the passengers to the center.

Most of the enclosed spaces opening to the main public pedestrian street are occupied by shops and offices. Special functional concentrations such as the H.S.G.T. concourse, the hotel, the entertainment facilities, the major department store, and the civic institutions give the three major spaces a distinct and varying character. The street itself is organized to accentuate the slope of the land to the south. This is done by activating two levels on the north side and only one level on the south side.

Separating the center from the residential units to the south is a continuation of the greenway associated with the elevated H.S.G.T. system. This greenway reinforces visually the lineal qualities of the corridor development by paralleling it, and also acts as a seam between these different land uses.

The system of circulation has been conceived so that the majority of local inhabitants will enter the center from the south pedestrian side, while those visitors from the region will enter from the north mechanical side. The major architectural spaces are directed toward the residential areas. The scale of the center on the residential side is small and pedestrian in character, and on the regional side is larger and related to the automobile.
PARKING PAYS

fig 6

VERTICAL DISTRIBUTION OF ACTIVITY

fig 7
Bibliography


A PLACE OF INTERCHANGE IN CENTRAL BOSTON

Ronald Dean Lindgren

I. HSGT System Context

The New North HSGT interchange is envisioned as but one of five on an inner city Boston loop. The interchanges would be established as New North (near North Station), Logan, South End, Back Bay (near Prudential Center), and University (near Harvard). The circulation of HSGT vehicles in the city is to be below ground. (Because much of Boston rests on a forest of deep piles, a depth of 150' is necessary for new tunneling if it is not to damage existing buildings.)

The decision to establish a subterranean operation stemmed from several reservations as to the effect of an above ground HSGT circulation on the city. With a 50-70 mph inner city loop speed component of the HSGT system, it is doubtful whether an appropriate width of right-of-way
and height of elevated superstructure could be built in the dense urban situation which would establish a visually meaningful trip. The dense concentration of building mass in the city and the necessary scale of open space required to expose it in both meaningful detail and scope to an encapsulated traveler moving at 70 mph are, in this designer's opinion, incompatible. The necessary elevated structures would establish artificial districts within the city or force a status quo onto the ever-changing pattern of district boundaries.

As part of a door-to-door network established through the integration of all transportation modes within interchanges, interaction with the private automobile is to be limited to dropoffs and a minimum of short-term parking spaces. Long-term parking facilities should only be established as may be necessary to serve the activities generated by the various Boston interchanges.
II. Site Context

The decision to utilize a tract of land in the present North Station commercial area for an HSCT interchange involved several factors. Of greatest significance is its proximity to Government Center, the showcase for what has been labeled as the New Boston. (See Figure #1, Location of Area in Central Boston.) Such a concentration of government, Boston's most important and fastest growing industry, will generate a considerable white collar demand for public transportation on local, regional, and intercity levels. Location in this area will also mean location near the hub of downtown, whose center of gravity has been drawn northwards by the Government Center.

While nearly all surrounding districts have been connected into Government Center through the planners' efforts, no good link with the North End exists because of the Central Artery. (A tangle of on-and-off ramps fill some 500 feet of Artery right-of-way where the Hanover Street link once existed.) Such attractions as the Salem Street Peddler's Market have drawn people into the North End and will help join the two districts. It is intended that the HSCT interchange and the particular kind of urban environment generated by it should establish another link between the North End and Government Center through the North Station commercial area. (See Figure #2.) This area is likely to become a link between Government Center and a new residential-parkway development envisioned as being built once the extensive North Station railway yards and terminal facilities are phased out. Thus the interchange site offers
the opportunity of knitting several districts together if the disruptive effect of the Artery can be obviated.

A third favorable factor of this particular location is the 3,000 car municipal parking garage to be built across the street from the proposed interchange; this will significantly lessen the need for providing parking space.
III. Program

The facilities programmed below reflect both those which will be generated by the interchange and those which will be supported by its particular location in which, it is hoped, a common link will be forged between several districts. The actual square footage depends on what appropriate uses are made feasible by the three-dimensional configuration of the site and what the particular functional requirements of the uses entail.

A. HSGT Interchange

Though the New North Interchange is located close to the Government Center, it is faced with the bulking presence of the municipal parking garage which forms a very real visual barrier between them. The sense of arrival into a New Boston is hampered thereby. It is hoped that a focus of arrival will be developed in terms of a plaza given over completely to bus, taxi, and auto dropoffs. Thus the traveler will be faced with the movement and activity of the many vehicles to which he may wish to transfer after entering the city on the HSGT system. If the traveler is to have a sense of mastering the vehicular place before him, he should be divorced from it and above it.

All orientation, decision making, and interaction with other modes will be staged from a main concourse above the vehicular plaza. Once a person has disassociated himself from the city by entering elevators leading to the HSGT concourses below ground, he will
have entered a one-way, continuous flow leading directly to the vehicles, a condition particularly critical to establish during the afternoon commuting rush hours. The one-way arrival and departure movements must be segregated if such a smooth and continuous flow is to be approximated. The interchange is to be planned for connecting as many as 24,000 people/hour (400 people/minute) to the HSGT system. (This requires at least 10 HSGT vehicle docks in each direction of travel.)

Since Boston is located at the end of the HSGT Corridor network, it is likely that extensive computerized dispatching facilities will be housed there. Because the computer requirements for operating such facilities have not been defined clearly, it can only be stated that such a control center within an interchange and the power facilities to support it would be sizeable.

1. main concourse level
2. HSGT concourse levels below ground reached by elevator (8 elevator banks each with 2-30 passenger cabs - total HSGT vertical circulation is thus capable of handling 480 people/minute during rush hours)
3. bus, taxi, and auto dropoff accommodated in a common vehicular plaza
4. subway entrance(s)
5. control center (computerized dispatching) and attendant power facilities (electric substation)
6. HSGT administrative offices
7. tickets and information
8. display and concession
9. waiting area(s) and public facilities

B. Hotel
1. 200 rooms
2. restaurant and coffee shop
3. ballroom
4. meeting space (rental)

C. Retailing, Service, and Entertainment Facilities
1. newstand(s)
2. drugstore
3. liquor store
4. travel agency
5. ticket agency
6. cleaners
7. bar(s)
8. cinema

D. Specialized Retailing (showroom facilities)
1. art gallery
2. business machines, sales and service
3. import-export house

E. Offices
1. branches of national corporations, headquarters of New England industries and regional wholesaling offices utilizing HSGT system
2. Boston offices of manufacturing plants located elsewhere in the state and accessible through the HSGT system

3. consulting offices and business services

F. Parking

1. short-term parking for 100 cars

2. long-term parking for 200 cars, (municipal parking garage will be utilized as well)
A PLACE OF INTERCHANGE IN CENTRAL BOSTON
MASTER IN ARCHITECTURE THESIS

SITE PLAN
A PLACE OF INTERCHANGE IN CENTRAL BOSTON
MASTER IN ARCHITECTURE THESIS
A PROTOTYPE PLACE OF INTERCHANGE IN A METROPOLITAN CENTER

Asghar Talaye Minai
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I. Abstract

A. Basic Criteria

1. HSGT line itself is far below ground.

2. Design of a prototype downtown interchange (800 feet x 1200 feet)

3. Pedestrian scale determines site of interchange.

4. All modes of transportation are available at interchange.

5. There are auxiliary facilities to serve HSGT.

6. Clear circulation based on:
   a. parallel, not cross, circulation,
   b. passenger circulation distances as short as possible,
   c. clear division between primary and secondary circulation spaces.

7. Direct orientation for people to all modes of transportation and auxiliary facilities.
   a. clear choice to all modes and to auxiliary facilities such as shops, restaurants, hotels and offices.

8. Psychological character of arrival and departure is important.
   A person coming from confined space below ground wants an expansive open space as an introduction to the city and vice versa.
   a. Generous space is provided at the interchange for future expansion and for the function performed there.
   b. Space to emphasize the importance of arrival.

B. Specific Objectives

1. Main interchange space is solely a decision making and circulation space.
2. There is only one decision place and that is at the level of the city.

3. There is clear differentiation between different modes of travel and auxiliary spaces.

4. Main interchange space is one-half level below ground level.

5. The main interchange space is open, not enclosed:
   a. In order that, by being part of the street rather than an enclosed building, buses, cars, and subway can also participate with their outside functions.
   b. Because the HSGT operates every minute and people's movement is continuous, there is no waiting unless in the enclosed auxiliary functions.
   c. Because of its functions, the HSGT is open rather than enclosed so that it can integrate with other modes of transportation which are open.

6. There is one linear line of elevators:
   a. In order to give a clear parallel circulation between different modes of transportation.
   b. Because a linear rather than a non-linear, centralized function can integrate with other modes of transportation.

7. The place must be monumental and symbolic.

8. There should be one place for arrival and departure.
   a. In order to give only one choice for people who want to use HSGT or those who come by HSGT using other modes with no confusion.
   b. Because it saves elevators time to stop one place rather than two.
C. **Justification of Roof Form**

1. The outside shows one dominant space.

2. The outside is a form which invites people into the main space.

3. The form opens more toward the center of the city, subway and auxiliary facilities; and less toward the outside of the city and vehicular access.

4. From inside, the roof clearly differentiates between the elevators and the spaces between the elevators and emphasizes the latter.

5. The slope of the under surface of the roof leads the person coming from the city through the circulation space to the elevators; it leads the person coming from HSGT through the circulation space to the city and to the other modes of transportation and auxiliary facilities.

6. The roof creates an emphasis on the space without drawing particular attention to its own design.
II. Introduction

A. The HSGT System

In being asked to participate in the design of a new system for high speed ground transportation and define its interchanges for the Northeast Corridor, the first question is whether we need such a transportation system? How can it be accomplished and where can it be located? What are the objectives of having such a system of transportation? Answering the questions one begins by listing the system's objectives. It should:

1. integrate all of the existing modes of transportation into a comprehensive system.
2. influence desirable land use and growth pattern.
3. improve the existing methods of transportation.
4. be flexible, adaptable, and extendable.
5. be a positive aesthetic experience for the traveler.
6. provide higher speed in transportation.
7. be easy to use.
8. serve every element of society.

Now, how can the HSGT serve as an answer to the difficulties and problems in existing transportation? So far, the speed has always been dependent upon the density; the greater the density, the lower the speed. The length of the line of transportation and the dimensions needed for interchanges are also dependent upon the scale of the speed; the higher the speed, the longer the length of the line and the larger the dimensions of the interchanges.

The problem with transportation is that men want and need to have higher speed and more convenience in travel. Human beings have always
wished to have the freedom of individual modes of transportation and of using all speeds at every point. Even if men had wings enabling them to fly 1,000 miles per hour, they would still want to have the freedom of traveling 1,000 miles per hour on the ground. But the problem is that it is not at all possible to have every speed at every scale of the environment. Even after a speed of 1,000 miles per hour, a person has to slow down step by step to come to a human scale of movement. This is the only possible way.

B. Alternatives for the Location of HSCT Lines and Interchanges

These new speeds, because of their scale, cannot be integrated with the area or level of human activity. For example, when planes came into existence they had to be received outside of the city centers. There was no other way to do it. Now, the problem is that if transportation is outside of the center of activity, how can we get to it? Going to the airport takes as much time sometimes as a long trip; thus planes seem to be useful for only very long trips.

Considering the above problems, the choice of having such great speed on the ground level of the city centers is absolutely impossible. The choices are:

1. using locations outside the city centers for the purpose of new high speed transportation and stabilizing the interchanges as a point of transfer to the existing modes of transportation in the cities.
2. making a new level in the cities with a different scale from the existing city level; one which is above the cities.
3. utilizing the unused ground below for the purpose of the new scale environment, just as we are using the space above for airplanes.
In analyzing the above alternatives, it is apparent that the first case by itself cannot answer our problem because it has the same conflict as the airplanes have. The second case, because of its interference with the existing cities, is not possible. In the designs of new cities, the problem of having a city with two levels of different scale could be studied. In that case the existing horizontal hierarchy of scale of the metropolitan area would be changed to a vertical hierarchy of scale.

In the third case, the interchange in the city center has to be complemented by interchanges outside the city center to serve automobiles. This means the design of two types of terminals: one in the metropolitan center which would not have any parking facilities serving the individual motorist, and the other type, outside of the metropolitan center, which would primarily serve individual drivers. Depending upon the level of arrival, one or more interchanges in the metropolitan center have to be under the ground. But those interchanges which are outside the metropolitan area can be above or below the ground level. What I have designed is a prototype for downtown metropolitan centers. Designing a prototype is reasonable since such a great public urban design needs a great deal of study, and, in terms of its concept, it
cannot be based on pressures created by available leftover sites. The proposed place of interchange (which includes the interchange itself) is three blocks by two in a downtown area, 800 feet by 1200 feet. These two dimensions are a result of several factors:

1. The longitudinal direction as a desirable dimension for vehicular movement and circulation.
2. Horizontal and vertical sight lines as regulators for defining spaces.
3. The largest comfortable walking environment.
III. Design Analysis

A. The Place of Interchange

The major principles which have strong influence on the design for a place of interchange are as follows: Who is going to use it? Where is it going to be located? In what kind of environment should it be? What major characteristics should it have? The people who use it are:

1. the people of the city not necessarily involved in traveling.
2. fast travelers, those who come to this place only to use HSGT or change their mode of transportation from one type to another. These people only use the terminal, not the other facilities.
3. businessmen without any baggage.
4. ordinary people traveling places or visiting friends with baggage.
5. visitors, the people who come to the city to stay for a few days and want to find the facilities they need at the place of interchange.

Since the place of interchange is going to be located downtown, it should have a pedestrian scale for sequences with new experiences for those coming from the city and from below ground. It should be a place with circulation and orientation for people and all modes of transportation. On the other hand, it should have facilities serving passengers as well as for users from the downtown area.

B. Auxiliary Facilities

These facilities can be:

1. a hotel serving visitors arriving in the city by HSGT and also downtown people.
2. offices which, like the hotel, serve both visitors and city people.
3. a restaurant.

4. movie, theatre, exhibition area, conference halls, and sports.

Site plan - A two block by three block downtown area is the site considered for a place of interchange. The site for the place of interchange is subdivided into several areas, each of which has its own functions, as follows:

1. The central (G) dominant space in which on one side the main object (terminal form) is faced. This space is also opened to the smaller spaces on three other sides.

2. The streets coming toward the site from four sides are terminated by the spaces which are open to the central space.

3. The north (Section B) side of the site is an access for all of the vehicles (taxis, buses, cars, and trucks) with ramps in this section leading underground for short-time parking and service for the HSGT and shops.

4. In Section E, offices are opened onto the area which opens to the central space. The vehicular access and dropoff for the offices are on the two adjacent streets. There is also a high building for offices to relate the scale of the site to the larger scale of the other side of the street (downtown).

5. Section D is a hotel and recreation area consisting of a hotel and its functional elements. It has a theatre, movie, and conference rooms. The hotel is a high building facing on the central space serving similar aesthetic purposes as the office building.

6. Sections C and F consist of administrative offices for the terminal and shops which terminate the linear building and its corners. They also defend the central space and connect
the interchange building with the rest of the site. They are links between the place of interchange and the other buildings.
C. The Interchange

A short list of the design objectives of the interchange are: providing service; convenience; economy; quicker ticketing and baggage service; shorter, protected walking distances; pleasant waiting and meeting places; dining facilities; convenient parking and dropoff; and good access to the interchange. Since the capacity of the future HSGT transportation might increase, the processing and circulation within the interchange must be able to handle larger groups of people and baggage in the future. The terminal is an interchange point for people between many different modes of transportation. Circulation within the terminal area, for both underground and above ground pedestrians and all kinds of vehicles, is of greatest importance. The basic principles for the circulation at places of interchange are as follows:

1. an order of parallel rather than cross circulation.
2. clear choice for people in a hurry in terms of orientation to all modes of transportation. Those standing in the main space can see the subway on one side and the other vehicles on the other side.
3. providing supporting facilities and functions as shops, restaurants, etc. in the secondary circulation areas, but visible. Standing in the main space, you can see shops around, but going to them you have to decide and step down.
D. Above Ground Modes of Transportation

The following are the vehicles using the interchange classified by vehicle type and user.

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobile</td>
<td>private passenger, visiting employee</td>
</tr>
<tr>
<td>Trucks</td>
<td>service, mail, cargo</td>
</tr>
<tr>
<td>Rapid Transit System</td>
<td>subway</td>
</tr>
</tbody>
</table>

Each of these vehicles has unique traffic characteristics, the major ones being:

1. access route into and from the interchange.
2. interchange points of goods and people to and from vehicles.
3. short-time parking in close proximity to the interchange.

The basic principle for each of these parts is that vehicles should be grouped together when they have the same characteristics, but they must be separated when their characteristics are different.

E. Passenger and Baggage Circulation

The basic principle of passenger circulation is that it be as short, convenient, and as safe as possible. The maximum walking distance within the interchange should not be more than 800 feet, while the distance the passenger must carry his luggage should be at a minimum. There should be no cross circulation and as few vertical changes as possible. Following is a diagram and description of each:

a. Ticket counters are located in front of each stair beside the elevators. Checking baggage with adjacent offices is provided for at the two ends of the central space, one for each direction (north, south).
b. The baggage is taken from below ground by the two end elevators.

c. There is a variety of dining and refreshment areas. These range from fine restaurants to coffee shops, and sandwich counters are provided along with cocktail lounges, bars, and soda fountains which can be used either from inside the terminal or outside. Although the location of each eating place depends upon its nature, all should be convenient from inside and outside the terminal, but not directly in the flow of circulation.

d. Among the conveniences and services are included restrooms and telephones which should be convenient throughout the terminal. Other necessities are information booths, traveler's aid, police, and first aid.
IV. Circulation

A. Orientation of People to the Different Modes of Transportation

I believe the best way of orientation to an environment is to see the whole environment first, and later to go through the parts of it. For example, for a tourist who is interested in seeing a city, it is best to see it from a helicopter or a high building first. I also believe that for any circulation pattern which involves a crowd, a hierarchy of dimension in relation to the placement of its components and movement of people has to be provided.

Assuming this is true:

1. There should first be a public circulation flow between the three components. (In the design the HSGT ring space which is surrounding the elevators is a public circulation and relates the three modes.) (Even in a little home you arrive in a foyer.)

2. One should be able to orient himself to the whole and what is happening when he is in the public circulation, which is far enough to see different modes and to choose his way of travel. In other words, we should not open the subway in a specific HSGT circulation (some place between the elevators or close to one and apart from the rest); but before one gets to a specific elevator, he should have the chance to see the whole and choose his destination.

3. If the HSGT elevators are a linear line, the two other modes should be a linear line parallel with the elevators. Otherwise the above purposes cannot be resolved.
B. Alternatives for Relating the Different Modes of Transportation

There are two alternatives for putting different modes of transportation together:

1. Putting the three components as close as possible. In other words, mix them up. The advantage of this is that at night or during the unbusy hours one has a short walk from one to another. Because there is not a crowded flow of movement, one can easily find his interest elevator. The disadvantage in this is that during the busy and rush hours everyone will be mixed up. For example, the subway would open to a private part of the HSGT circulation and when a person came to the circulation flow he would be in a secondary step of circulation. In other words, he is in a place where those specific people who have chosen their interest elevator are.

2. In distinguishing different modes of transportation and separating them from each other, the advantage is that a person coming from each mode can easily orient himself to the whole and all happening and decide where to go. The disadvantage is that the walking distances between the modes are longer than in the first alternative. The designed circulation is based on clear circulation, direct orientation, and clear areas of decision making, rather than shorter distances to walk.

Now the question arises as to whether we should have direct relation between the subway level, which is two levels below ground, and the
HSGT concourse far below ground or bring the people from the subway to the main space for using the HSGT.

If we open the HSGT elevators to the subway level, the disadvantage is that the people coming by subway who want to use HSGT elevators must come up to the main space and cannot go directly down below ground to the HSGT concourses. But the advantages in bringing the people who want to use HSGT up to the main space are:

1. There is only one space for decision making.
2. Bringing the people from the subway to the main space makes it alive and more significant.
3. It saves elevator time to stop in only one place.
4. There will be no decision making in the elevators (whether it is on the subway level, the city level, or the HSGT below ground level).
C. Alternatives for Composing the Different Modes of Transportation

Assuming we want to have one and only one place of decision making for the use of all modes of transportation, there are three major alternatives for integrating the modes of transportation participating in the interchange. They are as follows:

1. Non-linear centralized system.
   In this case, non-linear composition of the system creates a situation in which a part of the system (because of its being centralized) will be separate and more emphasized than the rest. In other words, the center will celebrate more than the other parts while performing the same function. Thus there will not be a clear circulation and clear choice of decision making.

   ![Diagram of a non-linear centralized system]

2. A linear system which is a composition of linear elements which is interrupted or terminated by one or more other linear systems (like buses or subways). In this case

   ![Diagram of a linear system]

   a person coming from the subway or bus will not have the same
opportunity to use all the elevators equally; in other words, he will find himself closer and more specifically directed to one elevator than to the others. Also the distances for a person coming from buses or the subway to different elevators are tremendously different.

This composition also gives cross circulation with the people coming from longitudinal sides.

3. A linear system which is solely a composition of linear components arranged linearly.

In this case there is a differentiation between the modes of transportation and there are three linear lines which are composed linearly. Thus, people coming from one mode to another will almost have equal access to all the elevators or vice versa.
D. Characteristics of the Interchange Space

The line of transportation is under the ground in the city centers. Psychologically, the character of the interchange would be like subways and would give the impression of going down. The alternative areas for decision making are above ground or below ground. My system depends upon all choices being made above ground. There one can choose among all modes of transportation available at the interchange. Thus the space above ground has the possibility of being a dynamic, attractive place where one can find all the facilities, since this above-ground space at the interchange becomes also the point of decision for those who want to travel underground. Before one goes down, he makes his decision and finds the suitable elevator leading to the desirable vehicle below. It also means that the point of arrival and departure is the space above ground.

E. Alternatives for Using the Linear System of Circulation

As has been recognized in most terminals, circulation is the point which must be considered before everything else. Clarity in choosing one's way of travel is very important. Everyone should be able to use the interchange easily and orient himself to everything happening in the space in terms of decision making. The alternatives for a circulation system are as follows:

1. bringing people from one side and leading them to the destination on the opposite side. This gives a clear system of circulation back and forth between the two sides. Airports and railroad terminals usually work this way.
2. having the elevators in the middle and feed to the space surrounding the elevators from both sides. In this case, the people come from both sides to the space, and circulation will occur back and forth between the two sides and the center.

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↑ ↓ + + ↓ + + ↓ + +
↑ + + + + + + + ELEVATOR
↓ + + + + + + +
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These are the only alternatives for a clear system of circulation. Any other system would have some trouble with crossing circulation. In any case in which entries and destination occur on both sides, circulation is generating. This might work for shopping centers or places where people are not in a hurry, but not for a system involving high speed ground transportation. Even in the second alternative, the problem of the impression of passing through could occur since the entries are opposite each other. The answer to this problem is in the change of levels.

F. Reasons for the Change of Level in the Interchange

By changing the level, I could do three important things.

1. Bringing people down by changing the level of the central space, I can give the psychological expectation which everyone has when he arrives.

2. The departure will be close to the subway, as well as to other modes of transportation. Thus it can be equally used by all.

3. Psychologically, when coming down by the stair on one side
the other stair, in front, will have a different meaning in terms of exit or entry. Also, coming down toward the only dominant element in front of the stairs, one will look for his destination and the stair on the opposite side will seem to be the exit.

In my design, each of the stairs arrives on a solid side of an elevator which changes one's direction to the space surrounding the elevators. Then, from that surrounding space, one will arrive at the smaller spaces to which the elevators open.

The ticket and control centers are located in front of the stairs from which everyone comes. All of the modes of transportation (taxis, subway, buses, and cars) will arrive at the stairs to the space.
G. Circulation Patterns

A person coming into the central space from the city can visually understand the different available modes of transportation. Arriving under the roof Point A he can see the HSGT elevators in the main space and also the buses and taxis on the other side of the interchange. The large opening to the subway concourse is a dominant element in the main space and clearly shows the location of the subway. The person looking for the subway with his psychological expectation about the subway can easily recognize the entrance.

Now he can choose the desired mode, buses or taxis, or HSGT or subway. Since while he is on the ground level he still cannot see the subway, but only the opening to the subway concourse, traditionally he knows it should be down below; when he comes down to the HSGT space level, he will be able to see the subway.

A person coming from buses or taxis can see the elevators and the subway and choose his desired mode of transportation. From the main space one can see auxiliary facilities like administration and travel offices, shops, etc., in the secondary circulation. These are continued from under the roof toward the city center and are terminated by hotel and office high buildings.
A person coming by HSGT getting out of the elevators can see everything that is happening. On one side he can see the buses and taxis and on the other side, auxiliary facilities and pedestrian access. The form of the roof also helps; it opens to both sides, with emphasis on the side toward the city center and pedestrian access. He can also see the subway concourse which is open to the main space. Going closer to it, he can see the subway from the main space.

There are two ways in which luggage can be handled:

1. If one has small luggage which he can carry himself, he may do this or check the luggage at one of the two ends of the main space according to his direction of travel, north or south.

2. If the luggage is heavy and is carried by car or taxi, he should drive in from the ramp located in the vehicle side of the site to one level below the HSGT level and check it. The operation is the same as in (1.) above. Northern and southern directions are separated.

Those who are driving and want to accompany their friends for a few minutes should drive to the parking lot (which is a short-term parking lot), park, and come to the main space which opens on the parking lot from both sides.

The parking lot is broken up into two parts with a half level difference between them at the places where the parking lot opens to the main space. Thus everyone in every place in the parking lot can
see the changing level and light coming to the parking lot at the places where he should go.

Vertical pedestrian circulation for the parking lot to the main space is again two linear lines parallel with the elevators. This gives a short walk to the main space for everyone from the parking lot, and vice versa. Vehicular circulation in the parking lot is in a one way pattern, like an island, with a ring circulation around it.
V. Form

A. Characteristics of Form of Interchange Structure

The form of the interchange structure is chosen to create a symbolic, dominant form for the place of arrival in a city. This is done in order to celebrate the drama of arrival to the city, because the interchange is a major urban public facility, and because of its function and future growth which need a generous circulation space. After traveling underground, this form performs two functions: One is to invite the people to the space and to the city after coming from down below. The second is that it can be recognized as a characteristic symbol of the interchanges in the metropolitan centers. In spite of some people who believe that the city is a growth of a neutral pattern without any symbol, my belief is that architecture is not a growth of structural units or dimensions of utilities, but a growth of functional points. The growth in architecture can be carried out when the unit is a single, functional point, rather than structural units.

B. Philosophy of the Form

Architecture, for me, is an art. It is music, a composition of functional points, not a victim of technology. Those who are trying to bring architecture into a static structural order will find it impossible. They had better try to make one good composition of functional elements, dedicating it to the future, rather than make architecture technology or science. The units and elements for a growth in architecture, as in music, are the sounds coming from one point of the environment and being touched by every human being's feeling. Order in music comes from the feeling of a human being as a musician, not as an engineer. People may
try to find a technological order for architecture, but they know that such an order changes every day or every second. Even if they do find an order, it is only for a while, not forever. I believe we, as do musicians, would do better to make architecture based on human beings' feelings and not be bothered if it changes. Even if it changes, each period will have its own quality like all the periods of the past.

C. Alternatives for General Roof Form

The form designed for my interchange was objected to by some of the critics for being monumental. They were not only objecting to this design, but to any kind of curvature which has not the same geometry as the rest. They obviously were looking for a rectangular form rather than a curvature. Let us analyze the dimensions of the environment to which a human being can relate himself. Or in music, let us see what the lowest sound or note is which can be heard by a human being. This dimension is a point at which he can see the texture of a surface or color. It was also observed that architecture is not sculpture, but let us not forget that the treatment of plastic forms is one of architecture's main preoccupations. Let us consider the function of forms and look at the two following forms for the interchange.

Arriving at Point A in the cross section of the two forms, what do you expect the next point to be? Your thought is changing and expecting something different because you are closer to the destination.

If Point B is going to be like A, how much longer do you expect
point A to continue? Or is there a breaking point for the destination? If there is, why is there suddenly that break without any transition in the design which is a curve arriving at point A? The next point B changes because you are one point closer to the destination and the composition of the functional parts results in a form which invites you and shows you your destination.

It is also true, for example, in theatres and churches that the form is a result of function. In churches or theatres, the area of action is important and different from the rest. Every point which is closer to that area is different from the next point. A person sitting and looking at the ceiling of a theatre when it is like form A can feel the end of his sight. He can easily concentrate on the action. But in form B there is not this emphasis on the action. The form takes you away from the area of action because that area is the same as the rest. You like the wall at the end of the theatre in front of your sight. You never want a ceiling on which you could see the roof floating and see the sky through it.

I think the growth structural pattern or straight lines can occur in some special buildings with smaller spaces like residential buildings or in making a background for some special, symbolic public object. These symbolic objects should have a different manner, depending upon their function, from the rest which makes them more important and significant.
D. Alternatives for Physical Form of Interchange

Assuming the HSGT line is under ground, the elevators or any vertical circulation coming from under ground has to be defined.

The alternatives for defining the elevators are:

1. Vertical definition: Putting a superstructure on the elevators and using them as a transition between the superstructure carried by elevators, the ground, and the HSGT level.

This is not feasible because the superstructure on the elevators will become the most important object and it will seem that the elevators are only a transition in terms of circulation, construction and visual experience between the ground and the superstructure, which is not true.

2. Horizontal definition:

There will be two cases.

a. Leaving the elevators free standing and having the auxiliary facilities surrounding and defining the elevators at a distance from them.

In this case there will not be relation between the elevators and surrounding objects, and they will become a desert or cemetery.

b. Composing the elevators with other auxiliary facilities.

In this case two situations may arise.

1. The other auxiliary facilities surrounding the elevators are high and the same problem as in alternative 1. above
will occur in that elevators will seem a transition to those objects.

3. Defining the elevators by a roof and other auxiliary facilities far enough from the elevators, but related to the roof.

In this case there is no important object above the elevators but the roof, which also emphasizes the space and the elevators. The other auxiliary facilities also feed to the space. With the space and elevators defined by the roof and other objects, the major objects, the elevators, can be seen free standing and are only a transition between ground level and HSGT level below ground.
E. Form of Interchange

Looking at the environment from the space in front, you will see the roof, the main and most important element, around you. The straight edge line of the roof invites you to the space under it. Coming closer, you will see a few stairs along the terminal defending the space which is also terminated by one story of offices and a restaurant at the two ends. These two buildings also terminate the corners inside of the terminal. Arriving under the roof, the arrival ground level space surrounds an open area. One level below ground is the place of departure where you can see and experience the whole space and everything which is happening. Standing on the departure level, one level below ground, you can see the two sides. One is open to vehicles, taxis, cars, and buses. On the other side you can see the space opening to shops and to the subway. You can see all of those activities and orient yourself to everything. The people coming by subway to the terminal can also easily orient themselves to the terminal because the subway is open to the main spaces.

The interchange is a directional because in metropolitan areas the interchanges form a loop around the city and the side which opens to the space is toward the center of the city and open to pedestrians. The other side is just for vehicles, taxis, buses, and cars.
F. Form of Roof

There are two functional forms in the cross section of the roof.

Figure A shows that the form of the parts of the roof which are above the elevators invites you from two sides and points to the elevators in the center. These come up from the ground and you come close to them, almost touching them. Figure B shows the forms of the parts of the roof which are above the spaces between the elevators and the enclosed form of the ceiling. The longitudinal section of the roof has two functions as are described above, coming down on the elevators and going up on the space between the elevators.
### HSGT Main Space

<table>
<thead>
<tr>
<th>Description</th>
<th>Sq. Ft.</th>
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</thead>
<tbody>
<tr>
<td>Tickets, Luggage</td>
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</table>

### Dropoff Lines

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<thead>
<tr>
<th>Description</th>
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<tbody>
<tr>
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<td>600,000</td>
</tr>
<tr>
<td>Subway Platform</td>
<td>500,000</td>
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</tbody>
</table>

### Support Functions

<table>
<thead>
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<th>Description</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Administration and Travel Offices</td>
<td>150,000</td>
</tr>
<tr>
<td>Related Shops</td>
<td>135,000</td>
</tr>
<tr>
<td>Restaurants</td>
<td>50,000</td>
</tr>
</tbody>
</table>

### Facilities Supported by Interchange

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
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<tr>
<td>Offices</td>
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<tr>
<td>Movie</td>
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<tr>
<td>Conference Hall</td>
<td>6,000</td>
</tr>
<tr>
<td>Exhibition and Commercial</td>
<td>150,000</td>
</tr>
<tr>
<td>Parking</td>
<td>500,000</td>
</tr>
</tbody>
</table>
UNITED AIR LINES

Luncheon
PLEASE BE OUR GUEST:

UNITED AIR LINES SPECIAL
VERY DRY MARTINI
(GIN OR VODKA)
BOURBON
OLD FASHIONED
DAIQUIRI
SCOTCH
CANADIAN WHISKY
GIN
VODKA
BLOODY MARY
SPANISH SHERRY
TOMATO JUICE
SALTED NUTS
SOFT BEVERAGES

MIXES:
CLUB SODA
GINGER ALE
TONIC
COLA

This menu prepared in United Air Lines Flight Kitchen
at Chicago—O'Hare International Airport,
Edwin Wirz, Chef.
Member, Chefs de Cuisine
THE PLACE OF INTERCHANGE IN THE CENTRAL CORE OF BOSTON

Thomas Jon Rosengren

I. THE SYSTEM

This interchange is a component of the transportation network developed by the students of the Department of City and Regional Planning as their contribution to the Interdepartmental Study Design Group at MIT. This proposal consists of a primary main line connecting the extremities of the corridor and a secondary loop system which facilitates the metropolitan region of each major node along the route (see diagram 1).

The regional loop for each node is modified for the particular situation which exists, i.e., topography, growth pattern, geological conditions, trip origin concentration, and the demand of city
HIGH SPEED GROUND TRANSPORTATION SYSTEM
NORTHEAST CORRIDOR

source: Department of City and Regional Planning, MIT

Diagram 1
center usage as opposed to suburban usage. The regional loop which services the interchange (the Boston Region) is illustrated in diagram 2. There are six places of interchange at significant junctions along the loop. The planners estimate that from 17 to 32 minutes can be saved in commuting time on trips to the central core. In this system the city center becomes one of the six places of interchange along the regional loop, whereas in the system proposed by the architects the city center is serviced by its own loop containing from 4 to 6 places of interchange. The primary ramification of the planners' regional loop is that the interchange facilitating the center city location must have a far greater capacity than any one of the interchanges facilitating the architects' metropolitan loop. Furthermore, the one-stop city-center interchange must be strategically located so as to service the central core of Boston and its immediate metropolitan area in a maximal way.

II. THE SITE
The site which best lends itself to servicing the central core as a transportation center and supporting activities which will occur as a result of its location and function is the present North Station area in central Boston (see diagram 3). The location of a transportation node in this area is in keeping with the traditional use of this particular parcel of land as a major place of arrival in the city. Historically, during the development of the urban
S.

STATION ARA

TRANSPORTATION SYSTEM

BOSTON REGIONAL LOOP

HIGH SPEED GROUND TRANSPORTATION SYSTEM

NORTHEAST CORRIDOR

Diagram 2

source: Department of City and Regional Planning, MIT
form of Boston when the Shawmut peninsula was being topographically transformed, the area was reclaimed from the sea and almost immediately developed into a place of collection and distribution of goods and people. This phenomena reached its peak in the late 19th century when rail commutation was the major mode of transportation. Since the automobile has changed this picture and the intensity of activity at North Station has gradually dwindled, proposals have actually eliminated the North Station completely, either excluding rail transportation or diverting it elsewhere. These proposals have also undertaken to resolve the disposition of the Central Artery and its connectors into a more workable and less offensive way (see diagram 4). This interchange design incorporates some of these vehicular and traffic routing proposals as follows:

1. The Central Artery becomes a double-decked configuration before and while crossing the Charles River and utilizes relocated ramps for entrance and exit in Charlestown instead of North Station in Boston. The connection with Storrow Drive takes place via the proposed modification of Leverett Circle. The artery becomes a component by connecting with the interchange but does not connect with the city at this point.

2. The rail yards in Boston are eliminated, either to be diverted to South Station or phased out entirely.
3. The present above-ground MTA to Lechmere Point is eliminated. The present below-grade and another proposed below-grade subway continue underground and become components of the interchange.

4. Commercial Avenue has been extended through the interchange, becoming a component, and connecting with Leverett Circle, thus forming a circumferential boulevard around central Boston.

5. Some existing structures have been removed and where necessary their functions relocated.

The location of the place of interchange in the North Station area is not only ideal in terms of an appropriate place for the collection, transfer and distribution of pedestrians in the central core of Boston, but with support and ancillary functions that will arise as a result of the activity of interchange, it also introduces the opportunity of developing the North Station parcel into a richer and more positive component of the urban environment.

III. THE OBJECTIVES

It is an objective of this design proposal to contribute not only to the development of the High Speed Ground Transportation System, but also to make a contribution to the visual and functional qualities of the central core of Boston. It is a goal to relate the development of the North Station parcel with existing and proposed designs for adjacent areas and thereby establish a
coherent and harmonious expression from the Charles River Basin to the North End.

In the context of the above goals, the primary objective of the place of interchange is to perform that traditional and necessary function of providing the gateway to the city for a pedestrian arriving via any one of the full range of transportation modes. Simultaneously it must perform the function of orientation for the departure. Consequently, as set forth in the Statement of the Problem and the Introduction, the interchange must be a place of collection and distribution, a place of gathering and a place of decision-making.

The process of transfer from one component mode to another component mode in the transportation network must be clearly defined so as to minimize confusion and maximize efficiency. Intermodal transfers must be visually linked from control points which are strategically composed in a central space associated with arrival.

The place of arrival must serve not only as a channel for collecting and distributing, but also as a milling space where various support functions may play their roles.

A final criterion concerning arrival and departure deals with the inside/outside movement of pedestrians. While all other transfers
are organized around the internal space of arrival and departure, the transfer of people from the interchange to the city deserves special attention. In this way, the interchange must perform the symbolic act of introducing the pedestrian to the city.

IV. THE PROGRAM

The design of the interchange did not result from following a predetermined program for a specific site. Rather, the site and the program were coordinated in such a manner that the design process was more of a give and take dialogue between the two. The starting point was the specification set up as a result of defining the High Speed Ground Transportation component. Through coordination with the planners and other groups in the Study Group, approximate figures were reached which programmed a peak load for the HSGT component. This figure approaches 50,000 people per hour. A working dimension was established for the HSGT vehicles and their transfer docks which produced the interchange length in excess of 800 feet.

The HSGT component for the interchange was relegated an underground stratification for the following reasons: (1) incompatibility of the scale of high speed travel with the scale of travel in the city center, (2) the visual holocaust which structures for the guideways might cause, and (3) difficulty in acquiring rights-of-way for guideways above ground. Finally, the HSGT component was
located at a depth of approximately 150 feet below grade to avoid conflict with existing structures and utilities. Since this conflict would occur only in the city center the guideway could be placed above ground when it reaches the periphery of the city.

To expedite people from 150 feet below the surface a series of 20 banks of elevator cores each with two large, high-speed elevators would service the HSGT sub-concourse.

The following square footage of components and functions comprise the interchange:

Main arrival concourse 90,000
   (including stairs, elevators, escalators)
HSGT sub-concourse 40,000
   (including escalators, elevators)
Total concourse 130,000

Regional Parking: 3,300 cars 1,000,000
   (including roadways, drop-offs)
Parking for short-time uses: 200 cars 5,000
   (from the city streets)
Office space flanking parking 500,000
   (including circulation)
Subway 9,000
   (including platforms, circulation)
Bus, taxi, auto drop-off 100,000
   (including roadways)
Service 70,000
   (including docks, roadways)
<table>
<thead>
<tr>
<th>Support functions</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
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THE PLACE OF INTERCHANGE IN BOSTON
HIGH SPEED GROUND TRANSPORTATION STUDY

MASTER IN ARCHITECTURE

THESIS

MIT STUDIES 1969

DANIEL L. E. COHEN
CHAPTER X

ECONOMICS OF THE GLIDEWAY SYSTEM

10.0 ABSTRACT

The ultimate ticket prices derived from the cost accounting are noted. These are discussed in light of the competitive position in which they place the Glideway System. The economics of travel demand are discussed. Then the fixed and operating costs of the Glideway mainline are considered. Finally, the economic aspects of the proposed secondary networks are analyzed.

10.1 INTRODUCTION

Almost anything can be built for a price — the question usually is, should it be? The economist's contribution towards answering this question is couched in a cost-accounting of the proposed system and a judgement as to its probable annual return on money invested. If the return is as high or higher than the prevailing return on capital, the system looks good from the economist's point of view. If the predicted return is low, the straightforward economic judgement would be to turn down the proposed system. This judgement can be modified in some cases by welfare economic arguments which contend that the true social worth of the system is higher than the predicted annual rate of return would indicate.

Our cost accounting of the Glideway system indicates that it would be a good investment in economic terms if it is not substantially taxed. This conclusion is in no part based on arguments from welfare economics. We find that the system could be financed with 4% corporate bonds and would require no Government subsidy if our cost and demand calculations are closely realized in practice — but there's the rub. Conversations with MIT Faculty members experienced in the cost-accounting of novel projects brings out the fact that we will be lucky if our cost and demand figures fall within ± 30% of the ultimately realized value. In the present case I would put the probable error of the all-important demand figures much higher, because there is so very little data to work with.

The United States Commerce Department is currently setting up some experiments to alleviate this lack of demand data. Until the results of these experiments are available, we cannot and should not draw any firm conclusion about the economic feasibility of the Glideway system.
A PROTOTYPE PLACE OF INTERCHANGE OF AN ABOVE GROUND INNER LOOP
OF THE REGIONAL HSGT NETWORK

Ralph H. Tolbert, Jr.

I. INTRODUCTION.

This thesis is a study of a place of interchange along the innermost loop of the HSGT system. It proposes, for a metropolis such as Boston, that the inner loop be above ground and share the right of way of the inner belt expressway system. It is also, then, an investigation of the relation of high speed transportation to urban form, concerned with the traveler's visual experience and with the effect of such travel on an urban environment.
II. STATEMENT OF THE PROBLEM.

The prospect of a system for High Speed Ground Transportation opens up for investigation a new concept of travel and a whole new set of space/time relationships. Although the top speed proposed for the HSGT is less by one-half than that common in air travel, it presents a serious challenge on or near the earth's surface. And although the speed is reduced to seventy miles per hour in the HSGT inner loop, to the designer of the system, and especially to the designer of the urban environment in which the system operates, such a speed might seem to offer more problems than possibilities.

One solution is immediately obvious—that of placing the system below ground, where visual contact with the city is traded off for a status quo with the environment. Although some users may think it exciting to be sped through earth far below ground, and a few may even find the loss of orientation strangely exhilarating, this arrangement would negate for many the act of traveling, and would remove the possibility of a rewarding visual experience. This is transportation reduced to a shipping problem, with the lapsed time between origin and destination being a liability, and with the skill of packaging for shipment determining the quality of the operation.
To locate the system on or above ground obviates the problem of the visual deprivation of tunnels, and instead raises questions of how this visual experience can be made worthwhile. It also resurrects the question of the effect of such a system on the environment. Both of these issues will be dealt with in more detail later in this report.

Another crucial problem in locating the system on or above ground is that of acquiring the right of way for a continuous loop through the city. The costs of land taking could be so exhorbitant as to make a deep rock tunnel of similar configuration economically feasible by comparison. If in Boston, however, the HSGT could be located on the existing and proposed right-of-way for the inner belt expressway, cost as a deterrent to above ground travel would be virtually eliminated. The HSGT and the inner belt might share not only the same right-of-way, but be contained in the same structure as well. The 50 MPH design speed of the expressway and 70 MPH speed of the HSGT are not an incompatible combination, although some modification would be required to the existing Central Artery portion of the inner belt.

It appears reasonable, then, for the HSGT loop to be located above ground and to be combined with the inner belt expressway. Just as the crucial issues of the HSGT in an urban context center around the visual experience of the traveler as he moves through the city and the effect of this movement and its supporting structures on the urban
environment, so do these same issues exist for the automobile expressway. By combining the two modes of travel into a common structure, it also may be possible to make a more positive and meaningful contribution to the urban environment than either could make alone.

At the places of interchange of the HSGT system, a conjunction occurs between the experience of movement and the effect of movement on the environment. Here, these issues become one. Through a continuous sequence a person moves from being affected by the experience of travel to being exposed to the environment responsive to this force of movement—and in this way experiences a totality of architecture.

The places of interchange along the HSGT system will exert a generative force on their environment, for here desirability of locating near a transportation node will encourage development and activity. The place of interchange will in effect become an urban sub-center and should be conceived in terms favorable to growth.
III. THE EXPERIENCE OF HIGH SPEED TRAVEL IN AN URBAN ENVIRONMENT.

If one reason for locating the HSGT above ground in urban areas is that of exposing the traveler to the city, this visual stimulation must be worthwhile if it is to be justifiable. The visual form of the trip must be structured and organized so as to be revealing, informative and pleasurable.

In a similar way, the expressway users should be afforded a route which is rich in its visual form. Professors Lynch, Appleyard and Myer, in their book The View from the Road, describe their techniques and the results they obtained in trying to produce such a hypothetical route for the inner belt. Although the roadway they envision would be modified by the addition of a structure for the HSGT, many of the main conclusions would remain unchanged. The method of analysis they describe also would appear to be appropriate for a similar study of the HSGT route, although no such study has been attempted here.

This is not to say that the subject, the traveler, would find the visual form the same from both modes. Several conditions act to make this visual exposure different: the design speed of the expressway is 50 MPH and that of the HSGT around 70 MPH; on the roadway the driver must make decisions at high speed; the roadway would be lower and have a greater vertical variation; and the HSGT, for acoustic isolation and
protection from weather and vandals, might be enclosed in a tube contain-
ting closely spaced windows, while the roadway would be relatively
open and unobstructed in a typical section. This last point defines
one of the most important differences between the two modes—the
limited and oblique field of vision from the HSGT compared to the
frontward and less restricted view from the automobile.

As an example of the degree of exposure of a HSGT passenger to the
environment, at 70 MPH an object or point 150 feet away from the line
of travel moves through the field of vision (say, from 30° to 90°) in
2 seconds. This time is sufficient for a fast scanning of the object,
although the passenger has no warning of its approach. If, however,
the object were 600 feet from the path, it would be in view 8 seconds.
This implies that distant objects would receive more attention, and
that objects close to the guideway would be focused on less frequently.
By contrast, the automobile traveler has a generous view of the approach
of objects. Those close to the roadway are seen as moving closer against
a background of static objects. The close and approaching object there-
fore tends to be given more attention, especially at low speeds. This
suggests that, first, the HSGT should be above the roadway so as to
afford its users a longer view, and second, where it is possible to
control or manipulate the environment, that low buildings are appropriate
adjacent to the right of way, while taller ones are more important
visually if they occur several hundred feet away.

6.
Figure 1. shows the routes studied for the Boston inner belt expressway by consulting engineers under contract to the State. The currently recommended location has been outlined in red.

Figure 2. is taken from *The View from the Road* and is that proposed by Lynch, Appleyard and Myer as affording a well structured and valuable visual exposure to the city. It encloses the city in a tighter loop than the state route, and emphasizes the three main directions of approach by creating apexes in an eccentric loop. It, too, is shown in red. This configuration, because of the better definition it gives to the core and because of the possibility of a more generous exposure of the city, will be used as a general guide in the development of this thesis.
FIGURE 2  Route Suggested in *The View from the Road*
IV. THE EFFECT OF HIGH SPEED TRAVEL ON URBAN FORM.

The visual needs of a person moving quickly through the city can be answered in part by a careful selection and design of the route, and in part and where possible by a control or design of the environment through which the traveler moves. Even more important than the traveler, however, is the person who uses and experiences the city in more conventional ways, the person whose life is tied to and affected by the city. For this person the instruments of high speed travel, the speeding vehicles and their sweeping structures, must not be allowed to defile the city or render it unpleasant and useless.

In general and judging from existing evidence, the engineering structures required to support high speed travel are incompatible with the urban environment. In places and from certain vantage points, these structures can be very handsome, dynamic and expressive. Such places are usually open and natural, where man's ingenuity overcomes nature's barriers, and the vantage points are usually at a distance and include generous amounts of picturesque surroundings. But to dismiss such structures as inherently wrong and disastrous to the city is inadequate. Based on the standard of past performance, however, there is certainly a necessity to scrutinize the concept of such structures, their place in the urban environment, and their relation to urban form and activity.
The inner loop/inner belt will physically and symbolically define the core of the city. Such a definition by these important elements of transportation seems justifiable, for the HSGT especially will be a means of restructuring and unifying the public transportation network of the region. To achieve such a definition, the effect that the HSGT and inner belt will have on the physical form of the city could be used to advantage, and the existence of their structures and the activities they support would take on a doubly significant meaning.

The relation of the structure for the HSGT and inner belt to the urban environment is a very crucial consideration. As the structure defines the center of the city, for the most part it must cut through the fabric of the city. But this need not be a brutal act. If the structure can define as well the boundaries of smaller sub-components of the city, the neighborhoods, districts and areas of special land use, its effects need not be so detrimental to established patterns of activity. It may in places serve to positive advantage by producing a decisive break between incompatible areas, separating predominately residential neighborhoods from adjacent industrial or heavy commercial areas for instance.

Even as this separation occurs, however, there must be connections re-established between areas, and these must be natural and convenient continuations of existing streets and pedestrian ways. These connections
are desirable so as to avoid stagnant, unused pockets, and so that the natural process of activity and growth in the city will be impaired as little as possible.

Certain connections naturally will be more important than others. The important radial streets, perpendicular to the inner loop/inner belt, will feed activity both in and out of the city. Those whose predominate purpose is for vehicular movement would connect to the inner belt, while HSGT interchanges would be located at those radials which can support intensive pedestrian-related activity.

The desirability of continuing the existing streets at frequent intervals across the route of the inner loop/inner belt suggests that the structure for the HSGT and expressway be raised above the existing infra-structure of the city. This would be consistent with the desire to expose users of the HSGT and expressway to the city as generously as possible. Another advantage of raising the HSGT and expressway structure is that not only the perpendicular streets, but their flanking activities as well, can be carried beneath the structure and through to the other side. In other words, the ground rights beneath the structure would be available for shops, parking, light industry or a variety of other uses.
An important qualification should be made, however, to the uses of the space beneath the structure. Streets themselves should not be allowed to run beneath and parallel to the structure of the roadway. This would only perpetrate the gravest of the evils of the elevated structures built to date. The long, dark tunnels which have been created in this way have resulted invariably in depressed property values and in an environment absolutely unsuited for normal human activity.

Not only would it be possible to exploit the ground rights beneath the structure for a variety of uses, but in certain areas it is reasonable to expect the development of the air rights above as well. This would be especially feasible at the place of interchange of the HSGT. Here the availability of a variety of modes of transportation would establish attractive forces, encouraging such development. The growth generated by these forces would not be limited to the use of air and ground rights alone, however, but could be expected to extend out into the city in all directions. (See Figure 3.) The place of interchange can, indeed, be thought of as a potential urban sub-center, an important node in the city.

If the places of interchange of the HSGT system can be expected to support a considerable amount of development, the interchanges with the inner belt would likely produce much more limited growth. Because of the mobility of the automobile, the development would tend to be more dispersed and less intensive. Here, the speed of the automobile, the area
TO OUTER METROPOLITAN AREAS

TO CITY CORE

FIGURE 3   Potential Impact of HSGT Interchange on Urban Growth
required for on- and off-ramps, and the dimensions necessary for a volume of traffic suggest the need for open and unencumbered space. The use of air rights then does not appear desirable at automobile interchanges, although parking garages may be appropriate below the structure.

In areas containing a great deal of high speed vehicular activity, no development should be allowed to occur. The three areas recommended for switching the HSGT inner loop into the intermediate loops and for connecting the inner belt to its main feeder/expressways would be such undeveloped sites. Instead of placing such high speed switches in existing urban areas, it would be best if they occurred in open areas which then could be generously landscaped. In Boston, it may be possible to use rail marshalling yards for each of these switching areas. If so, existing urban areas could be spared the ravage of the bulldozer.

At places other than the interchanges and switches, a variety of development could occur. In a few areas, where dramatic or informative vistas are possible, growth might be limited or restricted. Where activity and development are already intense or could be expected to become so, the HSGT and expressway may actually tunnel through building complexes, walled off so the speed of movement would not be incompatible with the confined spaces of such environments.

It should be emphasized that, while the structure of the inner loop/inner belt is conceived as being a wall around the center of the city,
the various forms that its development take will modify it to the areas through which it passes. If it supports intense commercial development in some places which are favorably suited for such activity, in other places it may include parks or recreation space along its rights of way. While it will be a unique element in any of the areas along its route, it will not necessarily be a discrete thing but may, as tunneling through building complexes suggests, become a part of its surroundings. Where frequent cross connections are unnecessary, the structure may be on grade and may be treated with massive earth forms as Lawrence Halprin has suggested.
Structure as a Seam between Districts Showing Inner Belt Interchange

Structure as an Edge of City or of District

FIGURE 4
Structure in City with Continuous Activity along Street passing under.

Structure in Dense Urban Environment.

FIGURE 5.
V. THE PLACE OF INTERCHANGE FOR THE HSGT.

The traveler arriving on the HSGT in Boston will experience what could be a dramatic sequence of movement through an urban environment, and will receive a visual introduction to portions of the city from the raised guideway. It will be at the place of interchange, however, that he will become an active participant in the life of the city. This transition from passive observer to active partner will be a very significant occasion. The interchange should respond to this occasion, and should become a fitting place. It is, in a figurative sense, a gateway to the city.

Because the structure of the inner loop/inner belt will form a wall around the center city, the important incidents in this wall will be those where major penetrations into and out of the city can occur. These places then will be the literal gateways to the city. It will be at several of these gates, where urban transportation and pedestrian related activity occur, that the HSGT interchanges will be located. (See Fig. 6.)

In Boston there may be from six to ten interchanges for the HSGT. The exact number would depend on the volume of commuter travel to be expected, the extent to which the MBTA modifies or improves its rapid transit, subway and bus operations, the exact route selected for the
FIGURE 6  Plan of Boston Showing Possible Interchange Locations
innek loop/inner belt, and other factors of economics, politics, etc. Once the route is selected and interchanges established, the number of interchanges could be increased as a means of enlarging the capacity of the system. In some places, however, it may be desirable to extend and enlarge the interchanges themselves, although the former alternative seems preferable.

As has been suggested, at the place of interchange the experience of the traveler changes as he moves in a continuous and sequential transition through the interchange. It should be conceived, then, as a place of continuous movement between the HSGT, other modes of transportation and the city. And because the place of interchange will be a vital transportation node in the city, it should be thought of as the heart of an urban sub-center, supporting growth and development around it.
VI. THE PROGRAM.

It is not the purpose here to list anything more than the general requirements of a prototype place of interchange in an urban setting. The considerations which have already been outlined should serve as primary determinants for locating the routes and selecting the sites of the interchanges, although the sites themselves can be expected to modify somewhat such things as the extent of development around interchanges. Areas and quantities given for particular functions, then, depend as much upon visual and formal considerations as upon a hypothetical real estate analysis.

TRANSPORTATION

HSGT: 16 docks in each direction for 25000 to 50000 people per hour

Subway: 1 platform in each direction 300 feet long

Busses, Intra-city: 4 docks

Busses, Inter-city or intra-regional: 8 docks

Taxis: stands for 20

Automobiles: public garages within 2 minutes walking distance for 500 cars.
SUPPORT FUNCTIONS

Generous areas for circulation and adequate areas for transportation offices, ticket and commutation pass sales, control, waiting, toilets, telephones, refreshments, newspapers and magazines sales, etc.

FUNCTIONS ATTRACTED BY PROXIMITY TO TRANSPORTATION

Hotel - 200 rooms with convenient public parking.

Offices - 200,000 to 400,000 SF

Cinema - 1 or 2, at 5,000 - 7,000 SF

Residences - 20 to 50 units (optional)

Other activities of a demand nature such as restaurant, coffee house, luncheonette, drugstore, bar or night-club, etc.
VII. DESIGN CRITERIA.

Several criteria have emerged as foundations upon which the interchange design is based. Some have already been discussed or alluded to and could be considered important in the specific concept of this interchange; others are more general in nature and applicable to the design of any place of interchange.

1. The HSCT and expressway should be raised above the activity level of the city. This enables the normal circulation of the city to remain unimpeded and provides travelers a more generous view of the city, and this requires that the interchange connect to above ground HSCT platforms.

2. The wall formed around the inner core of the city by the HSCT/expressway structure will have as major gateways the HSCT interchanges, for these interchanges will be located on principal radial streets of the city. Each interchange, then, should reflect the symbolic importance of this point of entry to the city—for the person who has traveled between cities as well as for those moving within the city. The interchange would be organized around the radial street, and the activity of the interchange would focus on this street.
3. The interchange is a place of collection and redistribution, and it must provide its users with adequate spaces for orientation and decision making. Major decisions, that is the choice by travelers of their modes of transportation, should occur in major spaces, and these spaces should be those of principal orientation. It follows that the number and magnitude of decisions should decrease as the travelers approach the vehicles which will transport them. While a traveler should be provided the opportunity to make progressively finer decisions as he nears his transportation, the opportunity to change his plans or correct his mistakes should never be wanting.

4. In moving through the interchange, the transition between modes and the city should be continuous and unbroken. This movement should be a spatial experience, and if it is to be uninterrupted, vertical circulation within the interchange should be by escalators and stairs rather than by elevators.

5. The physical structure of the interchange should be capable of supporting the growth of activity which can be expected to develop around the interchange. The interchange is conceived of, then, as a socket into which building elements can be plugged at some future time. Extensive development at the interchange would require that growth be possible not only around the interchange, but on top as well. It is reasonable to expect, then, a new public level to occur above
the interchange, complete with certain demand facilities normally found at ground level. Vertical circulation is then a crucial aspect of the development, and the cores supporting this circulation could be major links, not only between building elements and the ground, but between elements themselves.
BIBLIOGRAPHY

Appleyard, Donald; Lynch, Kevin; and Myer, John: The View from the Road, MIT Press, Cambridge, 1964.

A PROTOTYPE PLACE OF INTERCHANGE

ON AN ABOVE-GROUND URBAN LOOP OF A HIGH-SPEED GROUND TRANSPORTATION SYSTEM

A PROTOTYPE PLACE OF INTERCHANGE

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