TAIPEI TERMINAL RAIL STATION: Creating an Urban Gateway

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B.A., Wellesley College 1989

SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE DEGREE
MASTER OF ARCHITECTURE AT THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
JUNE, 1991

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ABSTRACT

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by May Deanna Tsai

Submitted to the Department of Architecture on 10 May 1991, in partial fulfillment of the requirements for the Degree of Master of Architecture.

Access is a key issue in the design of railway stations. The evolution of the train station typology, has resulted in many types of stations based on the development of the stations' access. Since rail travel on a larger scale is a system of access between cities, it is important to look at the rail station as a key component to the entire rail system.

Rail transportation is a primary means of entering the heart of the city. Unlike other forms of transportation such as air travel, the ability for the train to enter the center of the city and interact with the city provides an opportunity to create a dialogue with the people of the city and to create a gateway for the city.

The understanding of the station as a gateway and a civic gathering place within the city, must be acknowledged through the development of a reference plane, vertically as well as horizontally. The vehicle for my explorations -- the Taipei North Gate Rail Station -- hopefully will allow me to further examine these issues, and propose a solution for the city's transportation hub.

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Title: Lecturer, Department of Architecture
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ACKNOWLEDGEMENTS

For my parents.
Thank you for all your support and love.

I would like to thank the following people for their help and inspirational critiques:

Thanks Mrs. Loren Stein for your friendship.
I'm glad we stuck together and had the persistence to 'get it done on time'.

I would especially like to thank Ann Walters for keeping things in perspective throughout the whole process. Her undying support, music, and friendship helped me to retain my sanity throughout the semester.

Thanks again Loren and Lucas! We did it!
RAILWAY STATION TYPOLOGY

The railway station as a type has had very little, if any, other functional precedents to rely upon previous to its introduction in the early nineteenth century. The Industrial Revolution sparked the development of a new system of transportation for the masses. This new rail system was a development from the iron tracks used in sixteenth century mining and also from the ancient Assyrian military trackways. The concept was to use similar systems to create transportation system for passengers, as well as, freight. The station became an essential part of this new transportation system, and had to reflect the impact of technology on the new found mobility of the masses.1

The railway station had its beginnings as a mere ticketing office to service the rail. It was a variation of the highway toll houses. The first stations were unpretentious, heavy masonry buildings. No special buildings were developed for the passengers. Local inns were used as departure points for coaches and cabs to the railway station. Train sheds first appeared on the Crown Street Station in Liverpool, England in the 1830's. The shed's main function was to provide cover and protection for the passengers going to and from the station and the trains. A few years later in Lowell, Massachusetts, the train shed appeared in American railway station architecture. An imitation of the classical style of European stations, the station in Lowell was a small temple with columns and a pediment. During this highly experimental stage of station development, many different types were invented.
In 1846, César Daly, editor of the *Revue Générale de l'Architecture*, made an attempt to simplify the different station types into categories. He claimed that there were only four such categories:

1. head type, arrival and departure in a single building across the end of the tracks;
2. two-sided or twin type, with arrival and departure handled on opposite sides of the tracks;
3. "L" type, with arrival at the end of the tracks and departure at one side or vice versa;
4. one-sided combination type, with arrival and departure on one side of the tracks.

The engineer Isambard Kingdom Brunel was the inventor of, yet, another type that was noted for saving passengers from having to cross tracks by switching trains into the station platform. This however was only used in smaller train stations that had lower volumes of passengers.

As railway traffic increased, certain train station types became obsolete. People needed to be moved more quickly through to their trains. Trains were more frequent and as more departures and arrivals were set in a day, station organization created a problem for designers. The two-sided and twin type station was the preferred type because of its ability to load, unload, and move the trains quickly. By the 1850's and 60's, the volume of train travelers increased steadily. Convenience was a major factor for
the development of the train station. The train shed extended itself to bring the passengers by omnibus directly under the cover of the train shed. Henri Focillon once remarked that the train shed typified the inventive spirit of the nineteenth century. This view was held by contemporary critics. As one American critic stated at the end of the century, railroad station architecture was the characteristic architecture of the time.

The use of new materials and new methods of fabricating the sheds, brought on a new expression. Structural innovations lead to new forms. Iron truss construction was clearly dominant toward the end of the nineteenth century. The engineers competed to create the most inventive structures, and were inspired to design increasingly wider and more daring spans.

The diversity of the different train-shed types is evident in the examination of the first few decades of the station buildings. Their experimental nature has defined different degrees of protection and cover for the passengers. Originally constructed of wood, many of the trusses in the early train-sheds deteriorated rapidly because of the exposure to sulphurous train steam. To avoid constant maintenance problems, metal trusses were widely implemented. As the material change was taking place, a new problem of expression came about as a result of the evolution of the building type of the railway station.
In the 1830's, the question was “which station had the right look?”, but as the building type of the station was rapidly evolving, the argument was “a railroad station should look like a railroad station”. The functionalist critics argued about which element of a train station should dominate. Should it be the shed, the terminal, or perhaps a hotel? The way people looked at railroads with wonder, astonishment, and awe has made the buildings of the railways the symbol of the age. The railroad station was to become the gate into the modern city. The symbolism of the gateway was implemented in the station as the “Grand Hall”.

One of the stations in the United States that is a good example of the use of the “Grand Hall” for the symbolic entry for the station is New York City’s Grand Central Station. The lack of the visibility of the trains on the street level is overcome by the great waiting hall that receives the travelers. The great entry hall suggests some civic meeting grounds and recalls the spatial qualities of the great British rail stations before one enters the tunnels that lead to the subterranean train levels.

The “Grand Hall” in the British rail station was a symbol for the great entry way to the trains. The symbolic meaning of the gateway was transformed into a literal great archway in Euston Station. Critic, William Cubitt said, “a good station could be built at King’s Cross for less than the cost of the ornamental archway [sic] at Euston Square.” This commentary directed to architect
Philip Hardwick’s design of a classical pediment and column façade, is an example of the literal transformation of the “gateway” and monumentality of the entry into the city. It however seems quite strange to use an ancient symbolic gesture to relate to a modern technological innovation such as the railway. It seems the form of the gateway was simply borrowed from the classical reference, and does not reflect in any way the materials or technology of that time period.

When Euston Station was built, it was regarded as a spectacle not as a railway station. The most violent attacks came from A.W.N. Pugin. Pugin said:

The architects have evidently considered it an opportunity for showing off what they could do instead of carrying out what was required. Hence, the colossal Grecian portico or gateway, 100 feet high [sic] for the cabs to drive through, and set down a few feet further, at the 14-inch brick wall and sash-window booking office. This piece of Brobdignaggian absurdity must have cost the company a sum which would have built a first-rate station, replete with convenience, and which would have been really grand from its simplicity.3

Some people questioned whether any traditional motives could be appropriately associated with the railway. There was no connection to the application of columned porticoes to the
purpose of the railways. This problem of expression was examined from different viewpoints by the French and English. The French claimed that the terminals had a distinctive architecture of its own. To the French, the principal façade was a monumental clock, as well as, a great arch and pediment expressing the great roof of the train-shed. The English on-the-other-hand, located a different function at the head of the tracks as a façade element. This typically was a hotel with a great entry hall. These different attitudes towards the symbolic meaning of the train station and its function reflect the changing typology of the railway station. The transformation of the train station into more than a ticketing office has changed its organization of spaces, as well as its structure.

The most original and efficient part of railroad station architecture was the train-shed. The materials remained heavy, and the massive masonry foundations were used until the twentieth century when concrete, glass and metal were gaining acceptance. The expression of the train station in later years was still clinging on to the memory of the past. What role does the precedence of the old train stations have with the design of more modern stations--stations of our time? Do we build on the symbolic meaning and emotions that train stations have always evoked? Or do we examine the new meaning of rail travel, the new functions, the new technology and ideas?
The literal "gateway" ideas stem from the idea that the train is to be celebrated and recognised for what it really is -- a civic meeting grounds. Although the past stations such as Euston Station were too literal in their design of the gateway, the 'gate' to the trains should exist, while still informing the people of the technology of the railway system as an important means of transportation for the city.
The Taipei Terminal Rail Station is a major stop for the island train system. The railway is still a major transportation route to the other cities on the island, since rail travel is significantly cheaper than air travel and much more comfortable and expedient than travel by bus.

Originally placed at what was once the North gate into the old city of Taipei, the railway station is a central point of gathering for travelers on the island. It is also an integral part of the master plan designed by Sasaki Associates in Watertown, MA, along with Haigo Shen Associates in Taipei, Taiwan. This master plan is integrated with a subway system and bus system and provides retail, offices, and a city garden park. The development is a central hub to the transportation system of the entire island.

The creation of a more ideal gateway into the city of Taipei is the agenda of my thesis exploration. This gateway must inform the people of the technological advances and ideas of the future, that are so important to the economics of the country. While examining the possible design strategies, we must also keep in mind that the Chinese culture is very different than anything one might imagine in the Western world. Iconography and symbolism is an important means that the Taiwanese use to communicate ideas of public spaces and civic meeting areas.
CRITIQUE OF EXISTING STATION

The existing train terminal building currently houses office and retail functions in addition to the large interior courtyard that serves as the ticketing/waiting area.

Designed by a collaboration of Taiwanese architects (lead by Mr. C.K. Chen), this building was to 'embody the real Chinese spirit'. This was attempted by creating a building that was based on experiential spaces, like those which are common to traditional Chinese architecture. The large interior courtyard serves as the main space with the surrounding spaces programmed as retail and office space. The completely symmetrical building incorporates several Chinese architectural elements such as screened facades and a Chinese sloping roof. The station is a focal point of the entire terminal site and represents an important element within the city.

The courtyard idea stems from the play of solid and void--the yin and yang of Chinese basic thought. The interior courtyard is the most important space and is protected by the four 'building' walls. An interview with Mr. Chen revealed his intentions of creating an experiential architecture to mark time. He tried to create an architecture to give people many surprises, thus, reducing the formality of the building. The building is a cluster of simply designed buildings that form a courtyard, and the roof acts as a sunshade to the courtyard. His many references to Chinese palaces, Tonghai University, and traditional Chinese architecture gives some basis for his design for the existing station.
The choice of the site of the rail station is reasonable because of its centralized location within the city, but issues that address the relationship between the rail station and the surrounding site are ignored. With the four entrances to the building being identical, it is odd to find one entrance takes you to an elevated highway, while the others lead to a park, a busy street and a pick-up/drop-off area. These site conditions should have some effect on the form of the building. Another good example of the lack of a connection with the site is the entrance to the trains. The escalators that lead down to the mezzanine level, and eventually to the trains (3 floors below grade), are positioned on the perimeter of the great interior courtyard underneath the retail and office blocks. It seems that the trains are not an important part of the station itself. There is no celebration of the train as it enters the city and the escalators are, in fact, the same escalators that lead upward to the mall-like retail rings that make up the upper levels of the station building.

The intentions of the architects to reduce the formality of the building is contradicted by the actual form of the station. The bi-axial symmetry enhances the formal quality of the station. The important central “void” space does not appear to be the most obvious element in the station. The building mass, seems to overwhelm every other part of the station. The surprise one gets from the architecture is that the “grand” building is merely a shopping mall. Even though the existing station appears to be a grand landmark within the fabric of the city, in reality, it is a
shell--void of all meaning. The "void" space, or inner courtyard, is not important--it is one large neutral zone that lacks definition. This lack of definition is evident in the zones between the retail and offices above and the trains below. The lack of any vertical connection and integration makes the "grand" space of the rail station very uninviting and lifeless.

The importance of vertical layering of uses in the development of the programs of many buildings in Taipei is directly related to high density building and the lack of actual buildable/developable land. The program for the station with offices and retail suggests integration of all use spaces, but it is not clearly evident just as the entrance to rail is unclear. The important interior courtyard area ("void" space) becomes a grey area where people enter and wonder 'what is this place?' There is a lack of places to sit and wait for people to mysteriously pop out of any of the eight escalators that lead to the below grade train mezzanine. One might venture below to the train mezzanine to find a corridor and a set of turnstyles--entrance to yet another bank of 'down' escalators, or one might set forth to the second level to find vendors of food and places to sit and eat, balconies to lean against and watch all the confused travelers looking for some clue for entry to the trains. The large central volume of negative space does not interact with the mall above, nor does it convey the feeling that it could support the traffic of travelers greater that of New York's Grand Central Station. The escalators are not grand

"So I kept walking up this hill. I saw two pagodas, one on each side of the street, as though they were the entrance to a great Buddha temple. But when I looked carefully, I saw the pagoda was really just a building topped with stacks of tile roof, no walls, nothing else under its head. I was surprised how they tried to make everything look like an old imperial city or an emperor's tomb. But if you looked on either side of these pretend-pagodas, you could see the streets became narrow and crowded, dark, and dirty. I thought to myself, why did they choose only the worst Chinese parts for the inside? Why didn't they build gardens and ponds instead? Oh, here and there was the look of a famous ancient cave or a Chinese opera. But inside it was always the same cheap stuff."

---The Joy Luck Club, (p. 297) Amy Tan, 1989
stairways to the real waiting place above, nor is it a grand entrance for the city.

Since most of the program of the entire Taipei Terminal site integrates the retail and office functions, the need for more retail and offices in the station is questionable. Perhaps the functions can be compressed into a beacon tower to announce the station's location within the city. The connection of the station to the city also speaks of time and the future. Many of the old rail stations conveyed an element of time by the use of a clock tower. It was understood that the train was a step towards newer technology and the future. Although air travel has surpassed the train as a mode of transportation for travel throughout the world, the train has remained a major means of travel on the island of Taiwan. The image of the City of Taipei is important to understand when one arrives in the city. The intense development of technology of the City of Taipei and the importance of the railroad should be reflected in the design of the station.
PROGRAM

Scope of Project

The ultimate intention of this project is to create a more ideal "Gate" into the City of Taipei. The program compresses existing retail and office space into a beacon tower while the station opens below to the trains to create a visual link between the trains and the city. By opening up the ground area of the existing station, the exhaust problems are alleviated by natural venting and the unsightly vents are reduced in size and number allowing for less complications in other land developments.

Program:

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<th>Service</th>
<th>Sq. Ft.</th>
<th>Sq. M.</th>
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<tbody>
<tr>
<td>Waiting/Reception area</td>
<td>65,000</td>
<td>6,000</td>
</tr>
<tr>
<td>Ticketing booths</td>
<td>5,000</td>
<td>400</td>
</tr>
<tr>
<td>Information desk</td>
<td>1,000</td>
<td>100</td>
</tr>
<tr>
<td>Support space</td>
<td>20,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Train mezzanines</td>
<td>55,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Tower (retail + office)</td>
<td>16,000</td>
<td>1,500</td>
</tr>
<tr>
<td>each level</td>
<td>1,500</td>
<td>100</td>
</tr>
<tr>
<td>(35-40 levels)</td>
<td>1,000</td>
<td>100</td>
</tr>
<tr>
<td>max. tower total</td>
<td>640,000</td>
<td>60,000</td>
</tr>
<tr>
<td>Total area of Station</td>
<td>786,000</td>
<td>73,000</td>
</tr>
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"Picture yourself on a train in a station with plasticine porters with looking glass ties. Suddenly someone is there at the turnstile, the girl with kaleidoscope eyes...."

-- The Beatles', *Lucy in the Sky with Diamonds* (words and music by John Lennon and Paul McCartney, 1967)
CREATING THE GATEWAY

IDEAS/REFERENCES:
the echoes of the great hall
it makes us feel so small
and vulnerable,
but protected by the massive walls
here we wait and watch,
maybe to catch a glimpse
of family and friends
among the busy travelers
commuters, luggage
were just part of a whole

the waiting hall
the sounds of this great hall
this place is special
i can feel it by the volume
by the announcer's call
so many people
waiting, walking around
disappearing into the tunnels
the entrances to the underground
the gateway to other worlds.
where is that entrance?
where does it go?
i can feel the trains' vibration
but where did the trains go?
it's so clear to me
where I have to be
to catch the train
on platform No. 3
from the mezzanine I can spy
the person I was waiting for
over there,
with the stare
who waits in anticipation
the gentle arch held
in by the buttress walls
barely arching,
adding volume
to the space below
the strong bar buildings
doing their work
holding the thrust
clearing the span below
Isometry of supermarket cut away to expose structure on true scale.
DESIGN IDEAS:
Site Map of Axis Relationships:
The excavation of the trains extends itself to be in line with the axis of the old walled city grid. This sight line extends itself along Kung Yuan Road past Taipei New Park to terminate with the old South gate of the old city of Taipei. This is perpendicular to the sight line created between the President's Palace and the East gate of the old walled city.
The First Impressions:
The tower and vault hovering above the excavated tracks. Vertical and horizontal components to relate to the excavation creating a continual visual connection to the trains. issue:

What is the relationship between the tower and vault?

The Separation of Function and Use:
The massing of different use elements; the tower, the station, the walkway as a connector the third element, the hinge issue:

What is the relationship between the tower and vault?
The Development of the Masts and "Bar" Building Extension from Tower:
The concept was to create a relationship between the tower and the vault. By suspending the arc roof panels by a mast at one end, and supporting the other end on the massive elevator and stair cores of the bar building, the bar building would act as a buttress for the uneven load created by the sensitivity to the direction of the sun and need for the light to penetrate to the depths of the train tracks below.
The Bar Building:
The bar building is suspended by structural exterior columns and the massive elevator and stair cores. This allows people to observe the station from the north underneath the bar building. Since the load of the roof is uneven, more of the load needs to be supported by the mass of the bar building and the shear walls within the building.

Programmatic link:
The supporting bar building is programmed for the support offices for the rail station.
Masts and Cable Stays:
The concept behind the masts was an attempt to create a second tall element to reinforce the idea of the gateway. The masts and cable stays purpose is to hold and balance the roofs of the pedestrian walk with the roof of the station.

Lower Roof at Main Entrance:
The idea of the lower roof at the park entrance to the station waiting area was to heighten the experience of the grand vaulted space.
Facade Element:

For the traffic on Chung Hsiao West Road, the masts create a symbolic gateway with a modern expression of the traditional Chinese gate. It announces the station as a civic grounds and creates an important symbol for the area.
DESIGN SCHEME:
Site Context with Roof Plan
Bird's-eye View (with roof removed):
The waiting and ticketing area hovers over the excavated rail tracks allowing constant visual reference to the trains three stories below. The gentle curve of the south side openings recalls the forms from the park to the west, leading one through the station, to pass underneath the tower and on to the museum. A piece of the park makes its way through to the entrance, where the information booth guides the travelers through the station.
Approaching the Trains:
There are many ways to approach the tracks below.
The most obvious is the skylit elevator and stair cores that support the roof trusses.
The box trusses casting shadows on the floor, leading the way to the trains below.
The two main outdoor ticketing buildings also house cafe and resting areas. These buildings guide the travelers into the volume of the station.
The Box Trusses:
The four open box trusses are glazed above to create a skylight effect to light the path to the elevator cores that hold up the roof.

From this elevation, we can cross through from the bus station and street onto the bridges that takes us over the trains below, onto the station's waiting area.
The Masts of the Past—they are not lost: The extensions of the colossal columns that support the roof are an important part of the image of the station as a gateway. The feeling of the trains and travelers being able to detect at all times the movement between two obvious objects that form the gateway, is created between the large sculptural columns and the mass of the bar building and tower.
The Screen Enclosure:
The screens protect the station patrons from the occasional bursts of nature. The screen is hung from the roof structure and hovers over the waiting platform. Since the rail tracks are open to the weather, fresh air is freely circulated between the station and the outdoors.
The screen-like enclosure of the main entrance defines the area between outdoor and indoor, but does not restrict movement between the two. The open truss above the entrance acts as a partial cover—that gray area between outdoor and indoor. The courtyard created by the ticketing buildings and the enclosure becomes an extension of the park from the west.
Plan at Waiting/Ground Level
South Elevation
AFTERWORD:
This is my vision for the Taipei Terminal Rail Station. Unfortunately, the existing station was constructed just last year and it will be another 10 to 20 years until anyone even thinks of changing anything.

Eventhough the rail system in the United States has seen better days, the importance of the rail system in many countries throughout Europe and Asia as a local form of transportation makes the idea of the station as a "gateway" even more important to the image of a city.
ADDENDUM:  
acoustical considerations

The traditional great halls of railway stations serve as symbols of entering a city—a gateway to the city. These large voluminous, highly reverberant spaces are often filled with the noise of the travelers, the announcements of train arrivals and departures, and not to forget, the trains themselves. We have grown accustomed to the noise level of this waiting area and great hall. We have come to accept the fact that we will not be able to hear many conversations, even the ones close to us without raising our voices. We expect not to be able to hear the announcement of arrival, or worse, the departure of a train. Instead, we ask the person sitting next to us, "was that the call for the train to New York?"

There are certain feelings that the large, reverberant, live space invokes. The train station is a civic meeting grounds. There is a special quality about the station and the reverberant sound enhances the quality of being in a large communal meeting space. Although the space is highly reverberant, one would not expect the space to be just the opposite—that is, completely dead.

Combining the trains and waiting/reception area by encompassing both functions under one large roof structure can create a variety of exciting acoustical conditions. It can also enhance the spatial qualities of the different architectural spaces as one moves through the station. As an unconventional type of station, the open spaces that allow the uninterrupted observation of the trains for the various waiting spaces and mezzanine
platforms also allows the noise from the trains to resonate through the station. As a result, many acoustical considerations must be examined to enhance such things as speech intelligibility, as well as the overall ‘feeling’ of the station.

The potential noise and vibrational isolation problems of a train station is increased by the integration of the various public spaces and the actual train area. In such an open system, the noise and vibration is allowed to propagate through the structure. Isolation of the path of the sound and vibration is essential to reducing unwanted vibration of the structure due to the engines of the trains, as well as reducing the sound source, namely the wheel to rail interaction of the trains.

Isolation of the path of the sound and vibration is achieved by introducing resilient materials to the structure of the train station. Materials such as metal springs and mesh pads of rubber, cork, and felt are often used for the common isolation problems of mechanical rooms and heavy machinery in buildings, but to isolate the structure of the colossal columns that carry the waiting/reception level of the train station, huge neoprene pads used as ‘base isolators’ can be an effective means to isolate the energy. By merely reducing the vibration, the psychological effects of the noise level of the station’s waiting area is reduced. If one cannot feel the strong vibrations of the trains, the noise will seem further away. Yet another means to reduce the noise level in the ‘open’ rail station is to examine the possibility of isolating
the track bed. Much of the source of the noise and vibration in
the station stems from the interaction between the rails and the
train wheels. Newer technology of reducing the rail to wheel
interaction noise has allowed for quieter trains. The governing
principle behind reducing the noise and vibration caused by the
rail to wheel interaction is similar to the isolation of the
structural system. Insertion of hydraulic shock absorbers placed
in parallel with the normally fitted carriage spring, as well as the
mechanical isolation of the tire rim from the axle of the train
wheel can greatly reduce the noise in almost 2-3dB(A).4

Some other solutions for the noise and vibration created by the
rail to wheel interaction are found in forms such as shrouds or
skirts fitted over the wheels (used by the Japanese National
Railways), use of continuous welded rails as found by Bender and
Heckl that has been proven to reduce the noise level by 8 dB, to
the use of pneumatic tyres and elastomeric coatings on both tyre
and rail heads. The drawbacks mostly consist of lower load
carrying capacities, guiding-mechanism requirements, and the
higher cost and safety issues. With the respect to the different
track systems, the difference between the conventional sleeper
attached to ballast system and the slab track system is still
questionable with regards to a noticeable noise reduction.5

With all this in mind, other major acoustic issues should also be
examined. The shape of the roof structure predictably will not
cause too much noticeable focusing because of the arc's relatively
flat shape. Although the arc does not cause extreme focusing, it is reasonable to use materials that can ensure the acoustic quality of the main space, as well as acoustic treatment of the lower mezzanines where we can expect to use more absorption. Materials such as perforated metals and acoustic batting concealed behind the metal panels can customize the reverberation times for the different spaces. In general, the activity noise coupled with the residual train noise, needs to be controlled especially in the lower mezzanine areas where people are closer to the trains, and the sound waves have a better chance of reflecting on the surfaces which are closer and more compact (15-30 feet between floors). In the lower mezzanines, the acoustic treatment should provide more absorption to make the space more 'dead'. This could be accomplished by using acoustical tiles or sculpting the perforated metal to retain the 'high-tech' quality of the station in its detail while concealing the acoustical batting behind the metal panels.

The acoustic treatment in the main waiting/reception area is much different. Since the height of the roof structure is nearly 100 feet high, the sound waves will be diffuse—not un-like being outdoors. Harder surfaces with less absorption can be used to enhance the reverberation time of the 'great entry hall', with banners or other hanging panels providing additional absorption in areas that require more speech intelligibility. The use of glazing in parts of the roof structure will not greatly effect the reverberation of the main waiting area, but it will have positive
effects such as allowing light into the space. The large three-dimensional trusses that support the roof structure will not have an overall effect on the noise quality, but can prove to be helpful to the suspension of the sound system for the public address system.

The precise deployment of the sound system is crucial to speech intelligibility, namely the announcements of departures and arrivals of the trains, as well as the type of speaker used and the type of system used. An 'automatic gain' controlled system to override the sound of an incoming train could prove to eliminate most of the speech intelligibility problems commonly found in rail stations by monitoring the general noise level of the space, and increasing the amplification of the public address system accordingly. The speakers in the main waiting space would be like those found in larger sports arenas and would be less frequent. In the lower mezzanines, where the floor to ceiling height ranges between 15-30 feet, the speakers would be more frequent and smaller in size. The following plan layouts show possible sound system locations in different regions of the station.
NOTES:


2 Meeks, p. 30.


5 Hothersall and Salter, p. 194.

PHOTO CREDITS:


page 7. Le Temps des Gares, p. 95, fig. 7.

page 8. Copenhagen Station. Le Temps des Gares, p. XXIV, fig. 1.
page 9. (top) Bewdley, Worcestershire, tollhouse, 1801. The Railroad Station, fig. 3.


page 10. Early Types of Station Plan. The Railroad Station, p. 30, Text Fig. A.

page 11. Early Types of Train-shed, with identification. The Railroad Station, p. 37, Text Fig. B.


page 14. (top) Le Temps des Gares, p. 85, fig. 3.


page 33. (left) New York, Grand Central Station. Le Temps des Gares, p. 35, fig. 3.

page 33. (right) London, Euston Station, “Grand Hall.” The Railroad Station, fig. 41.

page 35. New York, Second Grand Central Station (sectional view). The Railroad Station, fig. 142.


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BIBLIOGRAPHY


Barman, Christian. *Introduction to Railway Architecture*.


The Art of Chinese Gardens.
one last question...

Loren and May, you've just finished your master's thesis, what are you going to do now?

*Loren:* "I'm goin' to Disney World!"

*May:* "I'm goin' to Austin, Texas to meet Eric Johnson!"