I, Dan Zhu, hereby submit this original work as part of the requirements for the degree of:

Master of Architecture in College of Design, Architecture, Art and Planning

It is entitled:
Space Syntax Meets Peter Eisenman: Designing the Beijing East Rail Station at Tongzhou

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Space Syntax Meets Peter Eisenman:
Designing the Beijing East Rail Station at Tongzhou

A thesis submitted to the
Graduate School of University of Cincinnati

In partial fulfillment of the requirements for the degree of
Masters of Architecture, 2009

In the School of Architecture and Interior Design
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Dan Zhu
B.S.Arch., University of Cincinnati, 2007

Committee Chair: Tom Bible
Committee Members: Jerry Larson
Michael McInturf
In the design of a commuter rail station at Tongzhou (near Beijing, China), it is highly relevant to consider the theory of “Space Syntax” for the purpose of designing a physical space that would enhance the experience of the estimated 45,000 passengers who will use this station daily. Space Syntax, as defined by Hillier and Hanson, is a process of breaking spaces down into components, analyzing the networks connecting these components, and using maps and graphs to describe the relative connectivity (“permeability”) and integration of these spaces. The design process used here recognizes that many of the theories referred to above are originally conceived of as two-dimensional analytical tools. In order to use them in the design of a rail station, it is necessary to develop a design process that incorporates their diagramatic presentations but extends them into three-dimensional spatial manipulations. The process outlined here extends the approach adopted by Peter Eisenman, making use of many of his operations on diagrams through successive superimpositions. The final building form results from the sculpting effects of both interior and exterior forces applied on it, while the transit functions are assigned.
I wish to express my gratitude to Professor Tom Bible, my mentor for this thesis, for his patience, sound advice, support and encouragement throughout its elaboration. I also thank Professors Jerry Larson and Michael McInturf for helpful discussions. I am grateful to my husband Marc Wathelet and my mother Xiufen for always being there for me.
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**Figure 4.09**  Typical rail station parti. Edwards, Brian, *Modern Rail Station*, page 76.

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Rail stations are one of the most complex modern building types. They have multiple collective functions: beside serving as access for different forms of transportation, they also host commercial retail and entertainment facilities and constitute urban landmarks.

Six basic typologies of rail station architecture are described in Brian Edwards’ book *The Modern Stations: New Approaches to Railway Architecture* based on their function in a rail network. They are rail termini, interchange stations, airport rail stations, suburban stations, underground stations and light-rail stations (see schematic in Figure 1.01).

In the modern world, the single transportation function of the traditional station has given way to multi-functionalism; more complex station forms are created to accommodate new functions, such as the Kyoto Station building, combining station facility, shopping mall, hotel, movie theater, department store and several local government facilities all in one building (Figure 1.02).

Rail stations also act as urban landmarks or city gateways and their design incorporates monumental forms and public gathering places around their entrance. In the design of the Canary Wharf station by Nor-
<table>
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| TERMINI          | - large size  
                     - traffic stops here  
                     - at city center  
                     - front serves as a landmark/urban gateway  
                     - great gathering place  
                     - links pedestrian  
                     - locked into city dense network |
| INTERCHANGE      | - large size  
                     - multiple traffics intersect here  
                     - within urban context  
                     - 2 fronts  
                     - use vertical circulation for interchange  
                     - complex flows |
| AIRPORT RAIL     | - medium size  
                     - outside of the city  
                     - linked to airport/integrated within airport  
                     - designed for needs of airport travel (extra space for large luggage and signs in different languages) |
| SUBURBAN RAIL    | - small size  
                     - easy access from neighborhood  
                     - min impact on surface landscape  
                     - use vertical circulation  
                     - dark, no fresh air |
| UNDERGROUND      | - small size  
                     - elevated from ground  
                     - easy access from neighborhood |
| LIGHT RAIL       | - small size  
                     - elevated from ground  
                     - easy access from neighborhood |

**Figure 1.01** Six different station typologies. Produced by the author based on the information in *The Modern Station: New Approaches to Railway Architecture* by Brian Edwards.
Figure 1.03  Canary Wharf Station by Norman Foster and Partners.  http://espvisuals.blogspot.com/2007/11/amazing-office-spaces.html

Figure 1.04  Lyon-Satolas Station by Santiago Calatrava.  http://architecturerevived.blogspot.com/2008/08/satolas-tgv-in-lyon-france.html
man Foster and Partners, the entrances are amplified by the curved glass carapaces that set the station apart from surrounding buildings on the open landscape (Figure 1.03). At the Lyon-Satolas station designed by Santiago Calatrava, the striking dynamic roof structure would contrast with any urban landscape, standing out as a landmark (Figure 1.04).

Unlike most of the rail stations in the western world, Chinese rail stations typically segregate arrival and departure levels as is done in airports. Due to a large volume of passenger flow, it is preferable to separate passengers vertically and thus avoid the potential for intermixing in great cross-current flows (Figure 1.05). The four existing major rail stations in Beijing are shown in Figure 1.11, along with the site for construction of the Beijing East Rail Station in Tongzhou.

The first rail station in Beijing was built in 1906 (Figure 1.06). It was located at a narrow site that is between the southern inner city wall and the city moat. Until 1959, it served as the most important rail station in Beijing thanks to its strategic location which was an easy access from the south gate of Beijing and the embassy zone. It has been preserved as a rail museum since the Beijing Central Rail Station was inaugurated.

In 1959, Beijing Central Rail Station opened at a very central location in Beijing, 2.4 kilometers to the west of the Forbidden City. With 80,000 m² and 8,000 people maximum capacity (Figure 1.07). It has been

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**Figure 1.05** A diagram showing controlled uni-directional and bi-directional vertical circulation typical in large scale rail stations in Chinese cities. Produced by the author.

**Figure 1.06** Old Beijing Rail Station, now Beijing Rail Museum. http://bbs.chinaue.com/html/2006-4-20

**Figure 1.07** Beijing Central Rail Station. http://en.wikipedia.org/wiki/Beijing_Railway_Station
the nation’s busiest transportation hub, as a terminal and as a transfer point for major domestic and international rail lines. Due to the heavy traffic and increasing passengers load, additional rail stations and expansions of existing stations were planned.

The Beijing West Rail Station opened in 1996 (Figure 1.08). Located 6.3 kilometers to the west of the city center, it occupies a 510,000 m² site and has a total floor area of 170,000 m². It acts as a terminal for some of the major rail lines from the southern and western regions of China and serves 800,000 passengers daily. The Beijing West Rail Station alleviates a large fraction of the traffic and passenger loads from the Beijing Central Rail Station.

The Beijing South Rail Station was originally built in 1897 and experienced several expansions. The latest expansion was completed in 2008 just before the Beijing Olympic Games. The new Beijing South Rail Station occupies a site area of 500,000 m² and has a total floor area of 310,000 m² (Figure 1.09).

The Beijing North Rail Station was opened in 1906. It initially was functioning mainly as a transit point for goods. In order to accommodate the increasing traffic and passenger flows in Beijing Central Rail Station, the expansion of Beijing North Rail Station was completed in 2009 (Figure 1.10). With the new addition, the total floor area extends to
<table>
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<th>Total Flr Area (m²)</th>
<th>Bldg Dimension (m)</th>
<th>Plaza Area (m²)</th>
<th># of Platforms</th>
<th>Capacity (people)</th>
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<td>1956</td>
<td>250,000</td>
<td>80,000</td>
<td>218 x 124</td>
<td>40,000</td>
<td>8</td>
<td>8,000</td>
<td>200,000</td>
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<tr>
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<td>1996</td>
<td>510,000</td>
<td>170,000</td>
<td>634 x 267</td>
<td>90,000 N</td>
<td>10</td>
<td>?</td>
<td>147,000</td>
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<tr>
<td>South</td>
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<td>500,000</td>
<td>226,000</td>
<td>491 x 341</td>
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<td>82,000</td>
<td>21,000</td>
<td>96 x 87</td>
<td>15,000</td>
<td>11</td>
<td>5,000</td>
<td>11,000</td>
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<td>East</td>
<td>not built</td>
<td>420,000</td>
<td>?</td>
<td>340 x 320</td>
<td>?</td>
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<td>?</td>
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Figure 1.11  Data chart of the four existing rail station in Beijing and the proposed Beijing East Rail Station. Produced by the author.
The Beijing Central, West, South and North Rail Stations are the major transportation nodes within the city. Along with the planned Beijing East Rail Station at Tongzhou and the new Fengtai Rail Station as secondary transportation nodes, these stations create an important modern rail network for the capital and its suburban areas (Figure 1.12).

According to “Beijing Urban Planning 2004-2020”, the new Beijing East Rail Station is proposed to open at Tongzhou, one of the three satellite towns of Beijing. Located 50 kilometers to the east of Beijing, it is an important eastern gateway for the capital Beijing. Many inter-city freeways intersect here with the inner ring-freeway of Beijing. Major rail lines to the region of eastern China also go through Tongzhou. Currently Tongzhou is under development with few residential blocks, many old factories and villages. Tongzhou is aiming to establish a strong culture and art industry base and to promote its related services as attractions to outside visitors. A new Beijing East Rail Station will inevitably bring a certain amount of traffic load and a flux of commuters to Tongzhou, accompanied by opportunities and prosperity.

In the design of a commuter rail station at Tongzhou, it is important that the collective functions of a rail station be considered along with the experience of the estimated 45,000 passengers who will use this 20,000 m².
station daily. A method is needed to anticipate how design of the physical space will impact the experience of commuters.

In chapter 2, possible spatial configurations are quantified and analyzed using a mathematical method known as “Space Syntax”. The result of this mathematical analysis will reflect the integration of the space and forecast the potential usage of the space. This quantifying method becomes a prime analytic tool to assess the proposed Beijing East Rail Station site and its surrounding context. A series of line graphs are generated to predict the movement of people. This movement prediction is essential at the start of the design process for a mass-travel rail station, because much evidence has accumulated that indicate that the actual movement of people is essential for conducting business, engaging in social contact, and contributing towards cultural well-being. A major limitation of this quantifying method is that only two-dimensional planar spatial relationships are examined. Unmodified Space Syntax cannot perform as a design tool in the design of interchange rail station, in which three-dimensional circulation is critical.

In order to complement limitations of the original Space Syntax methods, I propose in Chapter 3 an adaptation of the design process adopted by Peter Eisenman, making use of many of his operations on diagrams through successive superimpositions. This design process
extends two-dimensional spatial analysis based on Space Syntax into three-dimensional spatial manipulations. The design strategy encompasses a comprehensive collection of quantitative diagrams, including those produced by using the Space Syntax theory. The selected diagrams will be defined as interior/ exterior forces in the preliminary design of Beijing East Rail Station. The final building form results from the sculpting effects of both interior and exterior forces applied on it, while the transit functions are assigned.
Chapter 2
Quantifying Space

Space Syntax includes a set of techniques for analyzing spatial configurations. Bill Hillier and Julienne Hanson conceived the theory of Space Syntax in the late 1970’s and early 1980’s. The general theory of Space Syntax and the associated techniques have been considered to provide very helpful tools for architects and planners in their designs because strong correlations are found between its measurements and the observed pedestrian movement patterns. To analyze complicated passenger flow patterns around and through the site of the Beijing East Rail Station, these graphic-based measurements will be working as maps to reveal the fundamentals of the nature of flow for this site. The station should be designed to respond to the nature of this flow and this can be achieved in various ways: accommodating the flow patterns into the actual floor plans, landscape and roof configurations.

There are three basic spatial concepts introduced by Hillier in Space Syntax:

An isovist (popularised by Michael Benedikt at the University
Figure 2.02  Isovist or visibility polygon. Isovist diagram of Mainstreet at the University of Cincinnati. As a pedestrian walks along the Mainstreet from a to b to c, the visibility polygon is changing. The shapes of the visibility polygons at point a, b and c are defined by the edges of the buildings along the Mainstreet. Produced by the author.
of Texas) or viewshed or visibility polygon, is the field of view from any particular point. As a pedestrian walks within an urban space, his/her visibility polygon framed by the edges of the building is changing constantly (Figure 2.02).

**Convex space** (popularized by John Peponis and his collaborators at Georgia Tech) is an occupiable void where no line between two of its points goes outside its perimeter; in other words, all points within the polygon are visible to all other points within the polygon$^2$ (Figure 2.03).

**Axial line** (popularized by Bill Hillier at University College London), is a straight sight-line and possible path (Figure 2.04a). Hillier suggests that strong correlations are found between graphed-based configurational measurement of street networks, represented as lines, and the observed movement patterns.

To understand these basic spatial concepts, Hillier introduces an unconventional method (non-metric measurement) defining spatial elements and their relationships with space. This method approaches space and human movement primarily from the perspective of two-dimensional representations (Figure 2.04a-d).

Figure 2.03  Convex shape and non-convex shape. Produced by the author, originally from *The Social Logic of Space* by Bill Hillier.

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Figure 2.04 The Victoria Station in London, one of the research projects of Space Syntax Research Laboratory. Investigations on pedestrian movement patterns and pedestrian activities are explored both in computer simulations and real-world observations.

a) Axial Map
Spatial integration’ analysis of urban context (warm colors indicate high levels of integration, cool colors indicate lower levels), Victoria Station, London.

b) Passenger Flows
Observation study of existing passenger activity (yellow dots represent people, green lines represent passenger trajectories), Victoria Station, London.

c) Visual field
Analysis of the visual field of the Victoria Station concourse (warm colors indicate higher levels of visual connectivity, cool colors indicate lower levels).

d) Current Movement Flows
(warm colors indicate high levels of pedestrian movement through the concourse, cool colors indicate lower levels).
Defining Configurational Relations

In architecture, a configurational relation is defined as adjacency or permeability between any pair of elements in a complex. This relation is affected by the co-presence of at least a third element. Any change of one element in a configuration can change the configurational properties of many others; and the overall characteristics of a complex can be changed by changing a single element.

Hiller explains this relation by presenting a series of simple cubes in different settings. As shown in Figure 2.05, in the group on the left, two cubes \( a \) and \( b \) independently sit on a surface, they are symmetrical. In the group in the middle, \( a \) and \( b \) are brought together with a shared face in between; they remain symmetrical. In the group on the right, \( b \) is above \( a \), \( a \) is below \( b \), the relation of \( a \) and \( b \) is asymmetrical. Then we add a base element \( c \). Now the corresponding adjacency diagrams are shown below the three groups. In the first group \( a \) and \( b \) are both connected to \( c \) independently. In the middle group, not only are \( a \) and \( b \) connected to \( c \), but \( a \) and \( b \) are also connected directly to each other. In the group on the right, \( b \) is connected to \( a \), but only \( a \) is connected to \( c \). In order to quantify the configurational relation of one element to all others in a complex, a term is introduced -- *universal distance*. It is the sum of total depth from one element to all others in a complex.

Figure 2.05 Configurations of elements. Hillier, B., *Space is the Machine*, page 97.

Figure 2.06 Total depth of the elements in their complex. Hillier, B., *Space is the Machine*, page 97.
The value of the elements universal distance is shown in Figure 2.06 (i),

depth from a = ac + ab = 1 + 2 = 3

depth from b = bc + ca = 1 + 2 = 3

depth from c = ca + cb = 1 + 1 = 2

By using the same method, the total depth is calculated in Figure 2.06 (ii) and (iii). Since the value of that total depth is affected by the number of total elements in a complex, a normalization formula is introduced to create values that are independent of the size of the complex (this will not be further explained here).

The common concept of “distance”, metric distance, refers to the specific distance between two elements, and it is measured by some unit (meter, feet, etc). However, since metric distance does not measure topological and cognitive distances, it is unlikely to be the best criterion for navigational choice in a network.

The concept of universal distance will be further applied in the graph of a street network. Further discussion on the pattern of nodes and links of a spatial system, and how the distance between nodes is to be calculated, will be addressed in the section “Configuration of a Street Network”.

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Integration of a Space

Let us see an example of different arrangements of the same number of elements. In Figure 2.07, there are twelve different shapes that consist of eight identical squares. The numerical figure in each square is its *universal distance*, which is the sum of total distance from that square to all other squares. We take four shapes as examples for further analysis. As shown in Figure 2.08, for all shapes, all the squares are marked with their total depths -- *universal distance*. On the right, a “node graph” shows a depth map of each square in the shape. By comparing these depth maps, we notice that the smaller the value of *universal distance* for a square, the shallower its depth is. It indicates that from a square with a smaller universal distance, less effort is required to go to all other squares in the complex. Therefore, such a square is in a relatively integrated position in the complex. Back to Figure 2.07, we might make the approximation that the smallest values are located close to the geometric center of the shape. We also note that the smaller the *universal distance*, the more integrated the square is within the shape; and the more linear the shape, the less integrated the overall space is.

Let us further look into some regular shapes, like a circle, a square, a rectangle and a line. In Figure 2.09, a tessellation is applied to

*Figure 2.07*  Eight squares arranged into twelve different configurations. Hillier, B., *Space is the Machine*, page 101.
Figure 2.08  Depth graph. Comparing the graphs, we notice that within a same configuration, the cells with smaller value of universal distance have shallower graph than those with higher value. Hillier, B., *Space is the Machine*, page 102.

Figure 2.09  Integration pattern in different shapes. Hillier, B., *Space is the Machine*, page 109.
each regular shape. A mean depth is calculated for each cell and its value is shown by the density of the black dots. The darker the cell, the greater the integration. All the shapes show greatest integration at their geometric center. The circle shows weak integration around its circumference. The square shows weaker integration along its four edges and the weakest integration points at the four corners. The rectangle shows stronger integration at the center of its longer edges and weaker integration at its shorter edges. The line shows diminishing integration from center to both ends.

Plan as Shaped Space

A complex floor plan is not a regular shape such as a circle, square or rectangle, but a collection of various elements such as rooms, corridors, halls and so on (Figure 2.10); these elements can be seen as convex elements (Figure 2.08).

As in regular shapes, the greatest integration overlaps the shape’s geometric center, but in irregular shapes such as floor plans, the focus of integration is displaced from the geometric center to a function center. According to Hillier, the size of each convex elements of a floor plan also has an influence on the distribution of the integration, that is the larger the size of the element, the greater the integration.

Figure 2.10  A floor plan as a collection of various convex elements. Hillier, B., *Space is the Machine*, page 83.
As noted in *Space is the Machine*, people move in lines, or approximate lines in more complex routes. Wherever the observer is along the line, there must be a convex space in which any point is visible to every other point. While a pedestrian is moving within an urban system, all the open space can be seen to be made of many convex spaces (Figure 2.11).

In reality, there are urban structures with regular grids and with deformed grids (Figure 2.12). They are both made up of building islands surrounded by continuous open space. There are two types of deformations to a grid: firstly it is linearly or axially deformed, in that lines of sight and access do not continue right through the grid from one side to the other, as they would in a perfectly regular grid, but continually strike the surfaces of the building blocks and change direction as a result; secondly it is convexly deformed in that two-dimensional spaces continuously vary in their dimensions and shape, making a pattern of wider and narrower spaces. The visibility field at any point in the space for someone moving in the grid will be made up of both kinds of elements. Wherever the observer is, there will always be a local convex element of some kind, in which every point is visible from every other point, plus the shape made by all lines of sight passing through the point\(^5\).

Two types of analysis are suggested by Hillier, based on the two types of grid deformations: axial line and convex element. One-dimensional line can extend linearly and exhaust its limit of visibility and permeability in a ‘global’ layout, while two-dimensional convex space is more a local element. Back to Figure 2.11, we can see this evidence: lines have access to multiple convex elements.

Hillier further suggests that movement can be predicted from the axial analysis in which the line matrix is formed with only the longest and fewest lines needed to cover the whole system. Each axial line therefore will be an extreme extension of a street. In a larger urban structure, some streets appear to be used by more people and some by few people. Hillier argues that a street with a high value of integration is not determined by its local urban attractors but mainly by its ease of access from other streets.

**Figure 2.12** Regular grid and deformed grid. In the regular grid system, the lines of sight extend without obstacles. However, in the deformed grid system, the lines of sight are terminated at the edges of shifted building blocks. Produced by the author, originally from *The Social Logic of Space* by Hillier.
As noted by Hillier et al., the configuration of a street network is the major determinant of movement flow (both vehicular and pedestrian). His research is supported by representing the street system with a network of the fewest lines that cover the system. This representation is then translated into a graph in which lines are the nodes and the intersections are the links. A term y-map is given to this type of graph that is an inverse representation of an axial map (see below, Figure 2.15).

The concept of distance shapes human movement. Visual, geometrical and typological properties of a system impact on the choice of a route. In an urban setting, people move in lines and their visual field is framed by the edges of the buildings, the visual field can only be extended where there is a directional change. Similar as in a maze, the more directional changes it takes, the more difficult it is for a person to reach his/her destination. It is more the degree of directional change, i.e., the cognitive challenge, than the metric distance that determines the level of difficulty in moving from one point to another in an urban space.

The concept of total depth, universal distance, can be extended into a larger urban space. Integration measures how many turns one has to make from a street segment to reach all other street segments in

Figure 2.13 An example of a street network. Produced by the author, originally from *The Social Logic of Space*. The figure above each street indicates the total number of turns from that line to all other streets.

Figure 2.14 Axial lines showing different levels of integration of the streets at the Greater South East of England. The black dots represent the actual number of pedestrians counted at different areas. Produced by the Space Syntax Research Laboratory.
the network, using shortest paths. (Figure 2.13) The first intersection of a street segment requires only one turn, the second two turns and so on. The street segments that require the least number of turns to reach all other streets are described as ‘most integrated’. Theoretically, the integration measure shows the cognitive complexity of reaching a street, and is often argued to ‘predict’ the pedestrian use of a street. It proposes that the easier it is to reach a street, the more popular it should be. The greater integration means more connections to the network because the most integrated lines are those from which all others are shallowest, and the most segregated are those from which they are deepest. Integration values are usually shown in different colors from red (high value) to violet (low value) (Figure 2.). Integration is the focus of the axial map analysis. The distribution of movement—both vehicle and pedestrian—that passes through each line is strongly dependent on its integration.

Translating this notion into interior spatial design for a multiple-level transit station, visual permeability or accessibility is the essential guide for passengers’ movements. In terms of wayfinding, the metric distance that passengers have to travel within the building becomes less significant than the cognitive information extracted from visual permeability/accessibility of the complex.

Figure 2.15 b-f
Analytic diagrams over the urban structure of Brigittenau at Vienna by Space Syntax Research Laboratory. These diagrams further explain the concept of Convex shape, Axial line and y-map. http://architektur.stangl.eu/social_logic_of_space/text.html

b. The closed space
c. The open space
d. Convex map
e. Axial map
f. y-map
Nature of Human Movement

By analyzing human movement for transportation travel, path selection criteria are suggested: shortest path, shortest time, shortest distance, least cost, minimum turns, fewest obstacles\(^8\).

Urban space is seen as being made of fixed elements (building blocks) and moving elements (people). Most urban space use is perceived through movement. As noted by Hillier, the structure of the urban grid, rather than the presence of specific attractors or magnets, determines the movement densities along the lines.

While people are moving within an urban structure, they are making choice on the streets to take. This choice measure is easiest to understand as ‘water-flow’ in the street network. Imagine that each street segment is given an initial load of one unit of water, which then starts pouring out of the starting street segment onto all the other segments that successively connect to it. Each time an intersection appears, the remaining value of flow is divided equally amongst the splitting streets, until all the other street segments in the graph are reached. For instance, at the first intersection with a single other street, the initial value of one is split into two remaining values of one half, and allocated to the two intersect-

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\(^8\) Golledge and Gärling, 2001, “Spatial Behavior in Transportation Modeling and Planning”.
ing street segments. Moving further down, the remaining one half value is again split among the intersecting streets and so on. When the same procedure has been conducted using each segment as a starting point for the initial value of one, then a graph of final values appears. The streets with the highest total value of accumulated flow are said to have the highest choice values. Choice analysis can also be thought to represent the amount of intersections that need to be crossed to reach a street. 

\[9\] http://en.wikipedia.org/wiki/Space_syntax
Limitation of the Space Syntax Analytical Tools

As noted earlier, the theory of Space Syntax and the associated techniques provide very helpful tools for architects and planners in their designs because strong correlations are found between its measurements and the observed pedestrian movement patterns. However, some of the simplifications introduced by the theory limit its applicability and need to be taken into consideration. These limitations have been noted and are summarized below.

The axial map and curves
A slightly curvy street of the same length would typically not be counted as a single line, but instead be segmented into individual straight segments, which makes curvy streets appear less integrated in the analysis.

The axial map and building height
In his paper “Urban texture and space syntax: some inconsistencies”, Carlo Ratti points out that the analytic tools in space syntax do not take into account building height and land use, and its sensitivity to boundary conditions. “a simplified representation of urban texture in just two

dimensions, which does not take into account the dimensional property of streets but only the way they connect to each other…it is not possible to tell so many things about the urban environment with such a limited amount of information.” Building heights change from one location to another, thus modifying movement (taller buildings acting as generators of movement—because of higher density of people).

The axial map and land use

Batty et al., stated that: “[Space syntax] accessibility measures, although providing indices associated with forecasting trip volumes, are not based on models which simulate processes of movement and thus do not provide methods for predicting the impact of locational changes on patterns of pedestrian flow. In short although these indices can show changes in flow due to changes in geometry and location of entire streets, they are unable to account for comprehensive movement patterns which link facilities at different locations to one another”¹¹. For example, at a transit site, the movement pattern of people is not purely generated from street flows but heavily impacted by actual local train schedule, because the volume of the passengers and the frequency of the arriving/departing trains are independent from the configuration of the surrounding streets.  

The axial map and 3D movement
Axial analysis discards any vertical movement, which is as significant as horizontal movement in an interchange transit station.

The axial map and urban attractors
Space syntax only emphasizes the urban grid, not urban attractors as the determinant of pedestrian movement. “In urban systems configuration is the primary generator of pedestrian movement patterns, and, in general, attractors are either equalisable or work as multipliers on the basic pattern established by configuration”\textsuperscript{12}. An interchange transit station, collecting and distributing passengers, on the contrary is a significant urban attractors.

Axial maps and convex isovists can be used as general analytical tools for spatial assessment in a large urban space. However, because of their limitations, they cannot serve as the only parameters in the design of the Beijing East Rail Station; in other words, design decisions cannot be made based only upon axial map or convex isovist analysis, but also must incorporate other quantitative information such as land use and actual passenger movement patterns.

In order to overcome such limitations, the Space Syntax techniques will be modified to serve as the basis of design. Using existing conditions, I will create axial maps and isovist maps which will be manipulated and combined to create generative geometries.

The generative geometries will be further operated on, using processes explained by Eisenman in *Diagram Diaries* as a way to integrate the diagrams into more complex geometries and three-dimensional forms that I can then use to organize the design.

Eventually, the final design will be analyzed using these techniques (axial maps, isovist maps, etc) to demonstrate how these designs alleviate overcrowding and wayfinding confusions.
Eisenman and his Diagrams

“In architecture the diagram is historically understood in two ways: as an explanatory or analytical device and as a generative device… The diagram is not only an explanation, as something that comes after, but it also acts as an intermediary in the process of generation of real space and time. As a generator there is not necessarily a one-to-one correspondence between the diagram and the resultant form.”

--Peter Eisenman, 1999, *Diagram Diaries*

In his design process, Peter Eisenman has developed a unique method of superimposing multiple diagrams to generate space and form as he described in his book *Diagram Diaries*. This method is possibly influenced by two sources: first a transformation technique called morphing used in contemporary cinema as identified in Luca Galofaro’s book *Digital Eisenman*, and second the earliest parchment of architectural drawings, in which the inked final drawings overlap with the etched diagrammatic schema. In both processes, intriguing overlapping figures and tracings are found. By using this design method, diagrams evolve through a number of operations and generate architecture.
There are different types of diagrams used by Eisenman in his projects: architectonic, philosophical-scientific and mathematical (functional or typological diagram). Diagrams from other disciplines are also imported, like those using interference of waves (Nordliches Derendorf), showing synaptic activities (Geneva Library), and revealing the behavior of liquid crystals (BFL Software Ltd.)\(^1\). When describing the genesis of a project in Eisenman’s office, Galofaro points out that the knowledge Eisenman gains from studying theories and principles from other disciplines (fractals, chaos theory, catastrophe theory, DNA, Leibnizian atoms, the behavior of liquid crystals) guide the deformation and development of spaces. The reason for using diagrams from other disciplines, according to Galofaro, is “because architecture cannot provide suitable models to describe the complexity of the world”\(^2\).

The analysis of the following three projects are based on the information provided in *Diagram Diaries* by Peter Eisenman and *Digital Eisenman* by Luca Galofaro. The main focus is on the sources of the diagrams and the operations applied on the diagrams.

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Regarding the nature of the project and its cultural context, this project must reflect the dualism of Indian society; the strong contrast between the public and private spheres is an example of the interstitial space between two different states. Technology is present through the activities of liquid crystal molecules (Figure 3.01-03) and tradition is represented by a nine-grid mandala (Figure 3.04). The grid is positioned on the site according to the principles in the Hindu ancient book, while the liquid crystals deform the grid and start to shape the building\(^3\) (Figure 3.05-06).

Sources of the diagrams:

1. Liquid crystals have special physical properties. There are three common states of matter, solid, liquid and gas, and the molecules in each state have different degree of order - liquid crystals are an intermediary state of matter between liquid and solid where small perturbations in the external conditions shift the equilibrium towards either solid or liquid (Figure 3.01 -- extrinsic).

2. Mandala is a grid in ancient Hindu architecture, used to organize the building (Figure 3.04 -- extrinsic).

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Patterns of liquid crystal molecules under the influence of an electric field.

The diagram, under the influence of an electric field, shows several common ordering patterns of liquid crystal molecules with defects (a few molecules, shown as black dots, which do not behave in the same manner as most of the molecules in the group). These ordering patterns are possibly borrowed by Eisenman and applied on the site. www.doitpoms.ac.uk
Figure 3.05  Operation process.
Eisenman, P., *Diagram Diaries*, page 155

Figure 3.06  Final building form of BFL software Ltd. Galofaro, L., *Digital Eisenman: an Office of Electronic Era*, page 45.
Operations applied to the diagram (Figure 3.05-06):

1. Striation
2. Interweaving
3. Superimposition
4. Warping

Library in Place des Nations, Geneva

In describing the process of designing the Geneva Library, Ga-
rofalo describes a diagrammatic structure that represents some of the op-
erations of human neurological activity (Figure 3.07). Selected diagrams
of cerebral functions are then superimposed on the site grid. Eisenman
records the different elements (memory & emotional intensity levels at
different frequencies) and transforms them into design constraints, incor-
porating them in the mechanical process that generates the object directly
from the site.

Sources of the diagrams:

1. Site grid (intrinsic)
2. Cerebral functions (extrinsic)

Operations applied on the diagrams:

1. Superimposition (Figure 3.08 from top to bottom, left to right)
Superimposition of the activity separation frequencies on the site grid.
Superimposition of the tracings of intense memory and emotion states on

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**Figure 3.07** Frequency of the synaptic activities.

The highlighted frequency of the synaptic activities is used in the
initial diagram because this particular frequency (theta) is associated with memory
and emotions. The intensity of the waves reflects high or
low level of learning.

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**Figure 3.08** Process diagram.

Eisenman uses the highlighted frequency diagram (Theta waves), be-
cause these waves are associated with memory and emotions in synaptic
activities. Lower frequency represents low-memory functioning, and
higher frequency represents high-memory functioning. Diagrams from
*Diagram Diaries*, page 157, text by the author.

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Theta waves ► memory & emotion ► library
Figure 3.09  Process of superimposition.  
Eisenman, P., *Diagram Diaries*, page 156.  (left)

Figure 3.10  Resulting building form derived from diagrams.  
site grid. Superimposition of tracings and frequencies on site grid. Superimposition of all diagrams on the triangular site.

2. Warping

Once the relations between the tracings and the frequency have been established, they are transformed into a 3D relationship of solids and voids.

3. Striation

_Nordliches Derendorf (Tours Arts Center)_

The morphing process, explained in the _Diagram Diaries_, begins “at the two existing buildings at the site, one from the eighteenth century and one from the nineteenth century, and they are seen as boundary conditions... a figure can be produced through combining the two characteristics of both buildings...Tours Arts Center becomes that between figure” (Figure 3.11). A series of waves are generated from the two buildings on the site. Two sets of bent-grids are formed from the waves and one is superposed on the other. The grid lines influence the folding operation and determine the location of ridges and valleys (Figure 3.12).

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5 Eisenman, P, _Diagram Diaries_, page 201
Sources of the diagrams:

Interference

Operations applied on the diagrams:

1. Morphing
2. Grafting
3. Interference
4. Superposition
5. Folding

Conclusion

For each project, Eisenman seeks diagrams from different sources, some are from specific site context which he refers to as *interiority*; some are from the theories that interest him in other disciplines, and some are from his own philosophy and theories which he refers to as *exteriority*. A third type, *anteriority*, which derived from relevant architectural historic sources, is also used occasionally. In the process used in my design all of the sources are derived from conditions of *interiority*. I feel that the selection of *interiority* diagrams can be more easily defended and that they should be sufficient to produce the design.

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6 Eisenman, P., *Diagram Diaries*, page 44
7 Eisenman, P., *Diagram Diaries*, page 164
Through the entire design process, multiple operations are applied to evolve architectural space and form. Among the long list of operations used in Eisenman’s projects, I find that these specific operations might be relevant for my design process:

1. **Morphing**
   
   Morphing is a special effect in motion pictures and animations that changes (or morphs) one image into another through a seamless transition.

2. **Interference**
   
   In physics, interference is the addition (superposition) of two or more waves that result in a new wave pattern.

3. **Striation**
   
   In geology, a striation means linear furrows generated from fault movement. The striation’s direction reveals the movement directions in the fault plane.

4. **Imprinting**
   
   Marking by or as if by pressure.

5. **Projection:**
   
   The process or technique of reproducing a spatial object upon a plane or curved surface or a line by projecting its points.
6. Nesting
Forming a hierarchy, series, or sequence of each member, element, or set contained in or containing the next.

7. Folding
Folding is the operation of bending or curving one or a stack of originally flat and planar surfaces; as a result they become deformed.

8. Layering
Placing a layer on top of.

9. Voiding
Making empty or vacant.

10. Superimposition
Superimposition is the placement of an image or video on top of an already-existing image or video, usually to add to the overall image effect.

The diagrams of the transit site of the Beijing East Rail station that were produced in the following section are purely physical information display, responding to the complexity of the world. However they do not provide any formal relationships between their given geometries and the function or structure of an architecture. It is the architect’s respon-
sibility to create a set of arbitrary connections between diagrams and the interiority of the architecture, such as the project of Bibliothèque de L’IHUEI. It began with the introduction of an arbitrary text in an attempt to blur (make implicit) the iconic significance of the project. As shown in the earlier analysis, this arbitrary text of the library was produced from the wave-functioning graph of the human brain.

The diagram becomes the intermediary tool carrying the nature of complexity to the making of architecture. Architecture should have an ability, and even a responsibility, to speak about the conditions of its making (its interiority and its anteriority). The diagram, during the process of manipulation, does not necessarily transform itself directly into a physical reality. As we have seen in some of Eisenman’s works, “diagrams seem to disappear from the built work...it becomes more or less a virtual entity rather than being made explicit in the projects...the diagram becomes more of an engine in the projects”.

In addition, during Eisenman’s diagramming process, the order of operations is undefined in his text, or rather, arbitrary.

8 Eisenman, P., *Diagram Diaries*, page 202
9 Eisenman, P., *Diagram Diaries*, page 201
At the beginning of my diagramming process, some diagrams (axial line and passenger flow) naturally suggested themselves for further manipulations, because their nature relates to the problem statement behind the whole thesis.

As mentioned at the end of Chapter 2, the graph-based analysis from the theory of Space Syntax has its limitations, but nevertheless it represents some critical aspects of the complex nature of human movement in an urban system. It becomes important to use the design process proposed here to transform the diagrams generated through Space Syntax along with other diagrams of similar nature into intermediary tools for the making of a final transit hub design.
Site Investigation

1. Background

Tongzhou, one of the five satellite suburban districts of the capital Beijing, will house the future Beijing East Rail Station (Figure 3.13). Located 20 kilometers east of Beijing, Tongzhou is one of the most developed and mature suburban areas near Beijing, featuring its mechanical-electrical industrial parks and local art industrial villages.

Tongzhou’s climate is defined as “continental monsoon”, characterized by four distinct seasons. The average temperature throughout the year is 11.8 Celsius degree. The coldest month is January with an average temperature of -4.6 Celsius degree and the hottest month is July at an average temperature of 26.1 Celsius degree. Occasional sand storms occur in spring and autumn.

The rail station site is located at the center of the city, near Jing-Hang canal, which is the most influential man-made canal in Chinese history (Figure 3.14). New public projects are currently under construction along the levees of the canal. The proposed site of about 2 hectares ($20,000 \text{ m}^2$) will accommodate a transit hub for train station, subway, light-rail and buses. Geographically, this new Beijing East Rail Station will be an important gateway to eastern China; it will alleviate the

Figure 3.13  Strategic location of the Tongzhou district in relationship with Beijing and other important cities in the entire eastern region of China. Produced by the author.
Figure 3.14 Proposed master plan of the Tongzhou District. Red color shows the rail lines and future rail station site, black color shows the future subway line and lightrail line. Produced by the author.
passenger-handling burden of existing Beijing Central Rail Station by 20-30%. The new Beijing East Rail Station will dispatch and receive passengers within the eastern region of China, which includes important cities such as Tian Jin, Tangshan, Qin Huang Dao, Cheng De and Bao Ding (Figure 3.13).

The shape of the site is nearly rectangular with dimension of 1150 m by 325 m. Compared with New York, the site is about three lengths of New York city blocks (Figure 3.15). It is immediately surrounded by very large areas of residential zoning (existing and proposed) at the eastern and western boundaries, commercial strips (proposed) and schools at the northern boundary, and commercial strips and parking at the southern boundary.

Existing rail tracks cut through the site along the east-west axis (Figure 3.16 a-b). A proposed light-rail line goes through the site but the proposed subway line is offset by one block to the south, challenging a seamless transition between the different transit modes (Figure 3.16 c).

There are five major roads adjacent or through the transit site (Figure 3.16 d). They are expected to carry a very heavy traffic load thanks to the nature of the transit hub and surrounding urban context, especially the road near the southern boundary. It shows a higher connectivity than other roads in a larger urban context (Figure 3.16 h) and this

![Figure 3.15](image-url) Block size. The size of the site comparing with urban blocks from other cities at same scale. Produced by the author from Google maps.
Figure 3.16 e
Land use

Figure 3.16 f
Activity intensity

Figure 3.16 g
Visual integration

Figure 3.16 h
Connectivity
high level of connectivity is represented by a warmer color (yellow).

Based on the estimated traffic flows in the surrounding context, we can identify relative flow intensity of car and pedestrian at six adjacent intersections (Figure 3.16 b). In general, a higher level of intensity falls along the busy southern road, especial at the south-west corner near the transit site. This first-hand site information is further applied in the site analysis using a mathematical approach.

2. Station Typology
As described in Chapter One, in his book *The Modern Station*, Brian Edwards identifies six basic typologies of railway station: termini, interchange, airport rail, suburban rail, underground rail and light rail. The definitions and diagrams are shown in Figure 1.01. Interchange rail station typology meets the basic needs at the site of Beijing East Station. One of the most unique aspects about the interchange station is that vertical circulation plays an important role to unify all the layers of different transit modes. To analyze different types of flows, including horizontal and vertical flows, it becomes critical to maximize the efficiency of the transitions from one platform to another. On the site, the transit building should accommodate five basic levels according to different functions (from top to bottom): light-rail level, departure level, rail platform level,
Figure 3.17  Section cut through the site, showing vertical circulation. Produced by the author.

a. Position of section cut

b. Vertical flow control through different levels.
Figure 3.18  Pedestrian & vehicle approaches. Produced by the author.
Figure 3.19  Platform constraint, showing the relationship between three sets of tracks. Produced by the author.
arrival level and subway level (Figure 3.17). Directions of the flows are controlled to segregate departure and arrival flows due to the high volume passenger flow (37,500 passengers per hour at the peak is anticipated in the case of the new Beijing East Rail Station).

Other related studies, pedestrian & vehicle approach and relationship between the platforms, are shown in Figure 3.18-19.

3. Interference

Based on the estimated traffic flows in this context, we can identify relative flow intensity of cars and pedestrians at six adjacent intersections. In general, a higher level of intensity falls along the busy southern road, especial at the south-west corner near the transit site. The six traffic intersections surrounding the transit site are considered as boundary conditions (Figure 3.20 a). The transit building can be seen as a figure within this blurring zone influenced by its boundary conditions. A series of waves emit from the intersections, the scale of the amplitudes of the waves correlate with the intensity of each traffic intersection (Figure 3.20 b). These interference patterns are then translated into a series of operation studies (Figure 3.21)
Figure 3.20 b  
Interference studies.  
Produced by the author.
Figure 3.21 Interference operation studies. Interference patterns from Figure 3.20 were subjected to five separate operations. Produced by author.
As mentioned in the introduction, because in many Chinese cities crowding is the most common phenomenon present, it is mandatory to understand the basic crowding behavior in a macroscopic and microscopic manner, in order to guide crowds into a harmonious relationship with the space they navigate.

Macroscopic approach:

Based on the data obtained in a real-world observations, two unique patterns are found in bi-directional crowd flows: lanes and clusters (Figure 3.22). This can be incorporated with the types of movement in station buildings (see below, Figure 3.25).

Microscopic approach:

If we consider one particular individual, there are four basic types of behavior regarding the relation with others, which are: passing through, approaching, following and avoiding (Figure 3.23, 3.24).

One way to estimate the passenger flow is to calculate the number of trains according to the available train schedule. A table is generated showing the average number of passengers in a given period. On a daily basis, the peak hour appears between 7 am and 8 am (Figure 3.26).
<table>
<thead>
<tr>
<th>Type of Movement</th>
<th>Facility</th>
<th>Description</th>
<th>Area Req (sq m per pass)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-way Passageway</td>
<td>Linear Movement</td>
<td>0.46</td>
<td>Area requirements based on peak flow at density of 2.14 pass per sq m</td>
<td></td>
</tr>
<tr>
<td>Two-way Passageway</td>
<td>Linear Movement with reverse flow conflict</td>
<td>0.36</td>
<td>Assumes a 15% flow reduction due to reverse flow, consistent with a reverse flow in the region of 10% to 20%</td>
<td></td>
</tr>
<tr>
<td>Shallow Merge/Diverge i.e. escalator concourses such as Knightsbridge and Bond Street</td>
<td>Semi-linear - potential conflicts dependent on run-off length and flow volumes</td>
<td>0.66</td>
<td>Crossover space allows for some under utilised space and merging/diverging area</td>
<td></td>
</tr>
<tr>
<td>90 degree Merge/Diverge i.e. Victoria Line escalator concourse</td>
<td>Linear Main Flow with minor/major flows merging and diverging</td>
<td>0.80</td>
<td>Space needs rise as direct conflicts increase and assists in providing improved sightlines and reaction space</td>
<td></td>
</tr>
<tr>
<td>Three or Four way Junction i.e. Oxford Circus base of 2x2 escalators from TH</td>
<td>Complex merging and diverging in confined space</td>
<td>1.20</td>
<td>Extension of 90 degree merge/diverge</td>
<td></td>
</tr>
<tr>
<td>Open Concourse i.e. Victoria TH</td>
<td>Complex crossing movement in open space</td>
<td>1.50</td>
<td>Space requirements are for a situation in which capacity is maximised. Higher densities are possible but movement becomes seriously impeded. Equates to LOS A/B for queuing areas.</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 3.25** Types of movement in station buildings, from the book *Railway Stations: Planning, Design and Management*, edited by Julian Ross, 2000, page 127.
Figure 3.26  Passenger flow data chart, based on the train schedules of the Beijing Central Rail Station. Produced by the author.

- On a daily basis, the peak hour appears between 7 am and 8 am
- In a longer time frame, the peak season appears from January to February

<table>
<thead>
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<th>multiplier factor</th>
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</tr>
</tbody>
</table>

*Note: during peak season, the # of passengers will increase 50-60%*
a). In a longer frame of time, the peak season appears from January to February (Figure 3.26 b); and during the peak season, the number of passengers will increase by 50-60%.

5. Universal Distance

Regardless of the surrounding urban layout, the site is seen as a self-contained shape. To analyze this shape as a configuration, the “universal distance” theory is applied (Figure 3.27). First a tessellation is created in the shape, second each square in the tessellation is labeled with a value that represents the sum of the distance from that square to all others. When all the squares are labeled with proper values, we notice that the lowest values (represented in warmer color) concentrate at the center of the shape in a circular manner, and the values increase towards the edges of the shape, the highest values spread near the shorter edges (cooler color). This result indicates that the center of the shape is highly integrated because of its smaller total distance to access the other squares within the shape, thus it is “shallow” in the shape. Less integrated spaces are located toward the edges, they are “deep” in the shape.

6. Visual Integration/ Permeability

In a larger urban context, the visual connectivity analysis of the site is
determined by its physical connectivity with the adjacent roads (Figure 3.28). The colors indicate how visible that space is when approaching from outside. The warmer color represents more visible space; cooler color represents less visible space. According to Hillier and Hanson, the space with high visual connectivity tends to have high concentration of pedestrian in a real world.

7. Axial map

Hillier and Hanson define an axial map as a representation of the continuous structure of open space in a larger urban context. Lines are generated along all the roads and spaces (Figures 3.29-30). The warmer color of the line represents more connections it has with other lines, and it tends to have higher density of pedestrian movement along that line. However, no particular social meaning is attributed to the axial map\(^1\).

In the first figure, the red lines cut through the site are expected to be the busiest routes in the larger urban context. If we only derive the axial lines at the transit site and simplify them, we can get the result shown in the second figure (Figure 3.29). This allows further operations on the axial map on the site in a less complex manner. In this simplified axial map, from yellow to blue, the density of pedestrian movement

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Figure 3.29  Axial map of the proposed transit site.  Produced by the author.
**Figure 3.30** Axial map operation studies.
Produced by the author.
The diagrams that were discussed above are site-related quantitative representations. They reflect the complexity of the physical site, especially the diagram 5, 6, 7 (the universal distance, visual integration and axial line). The understanding and manipulation of these metrics will allow the designer to deal effectively with problems of over congestion. These diagrams will be the source for the generative diagrams that come from the operations derived from *Diagram Daries*. Some of the diagrams are selected for further operations, because they suggest one of the most important aspects essential to a transportation design: flows. In Chapter 4, in order to transform the selected diagrams into three-dimensional forms, they will be subjected to different operations, as described by Peter Eisenman.
The design process starts with a collection of site-based quantitative diagrams described in the preceding chapter. These diagrams are then transformed into more complex geometries through the application of operations, a unique diagramming process that was developed by Peter Eisenman. The resulting building form will be sculpted from both interior and exterior by the forces applied on it, and the transit functions will be assigned (Figure 4.01).

**Figure 4.01** Design process. Produced by the author.
Based on the quantitative/mathematical diagrams from Chapter 3, a diagram matrix concludes the selected diagrams and applied operations. The original diagrams are “movement between platforms”, “passenger flows”, “interference”, “universal distance”, “visual integration”, and “axial line”. These diagrams will be the source for the generative diagrams that come from Diagram Daries.

The first selected diagram is a combination of “movement between platforms” and “passenger flows”. The second diagram is “axial line”. They are selected because they have strong correlations to the organization of different flows in the transit design. Diagram 1 and diagram 2 then receive a series of operations, changing their two-dimensional shapes into three-dimensional forms. Interstitial space is generated through this process (Figure 4.02).
Figure 4.02  Diagram matrix. Produced by the author.
Operations

Diagram 1: internal flow

According to the information in the diagram “movement between platforms” and “passenger flow”, an “internal flow” diagram is created to obtain a general three-dimensional flow relationship between the train, the light-rail, the subway and the street. The red color represents the flow for train passengers, yellow for light-rail, blue for subway and green for street. The thickness of the flow strands are proportional to the number of passengers using each mode of transportation, and the arrows indicate the flow directions (Figure 4.03).

Figure 4.03  Internal flow between train, light-rail subway and street. Produced by the author.
Figure 4.04 Operation on internal flow diagram. Produced by the author.
Figure 4.05  Operation on internal flow diagram. Produced by the author.
Diagram 2: axial line

Axial lines are the representation of potential pedestrian paths on the site. To simplify the operation process, only the most dominant lines are extracted (Figure 4.06).

Figure 4.06  Extracted axial lines.
Produced by the author.
Figure 4.07  Operation on axial line diagram. Produced by the author.
Figure 4.08  Operation on axial line diagram. Produced by the author.
Most of the modern rail stations follow a certain parti for programs organization (Figure 4.09). Program elements for Beijing East Rail Station are arranged based on the internal flow diagram (Figure 4.03). Most of the station related service programs are concentrated around the intersection of the train line and the light-rail line, such as ticketing facilities, baggage facilities, telephone/internet facilities, information center, tourist center, offices and post office. These programs are placed within the ‘blob’ enclosure at the main concourse level. Major train passenger programs such as the waiting area, queuing area and the special lounge area are placed immediately under the main concourse level. Secondary programs like shops and restaurants, the security department and employee facilities are located outside of the ‘blob’ at the main concourse level.

Cars and buses approach distinct entries at separate levels, and underground parking space is also provided for patrons.

Since the subway line is located off the transit site at the southwest corner, an underground passway connects the subway station to the main train & light-rail station.
Figure 4.10  Programs and their relationship with circulation. Produced by the author.
site plan
roof structure

‘blob’ structure

roof configuration studies
interior perspective (view from platform level)
### Books and articles


### Online Sources

http://www.bjrailwaystation.com.cn
http://en.wikipedia.org/wiki/Beijing_Railway_Station
http://webdoll.com/china/beijing09.htm
http://baike.baidu.com/view/361762.htm
http://www.spacesyntax.com
http://architektur.stangl.eu/social_logic_of_space/text.html
http://architektur.stangl.eu/social_logic_of_space/text.html
http://en.wikipedia.org/wiki/Liquid_crystal
http://www.borobudur.tv/survey-1.htm
http://thebrain.mcgill.ca


Appendices
北京通州新城功能区规划新亮相 标准超过浦东
2006年07月27日 07:25:08  来源：中经网

运河功能区将建“通州浦东”
- 通州新城五大功能区规划亮相
- 运河城市段主打文化产业

26日，通州拿出新城商务总部、运河城市段等五大功能区规划，向外商推介“后奥运”预招项目。其核心区运河城市段七大项目建设标准超过上海浦东。

通州新城：规划五大功能区

作为北京重点规划新城之一，通州将担负北京未来发展的城市综合服务职能，成为中心城行政办公、金融贸易等职能的补充配套区。面对2008年北京奥运会的发展机遇，通州率先拿出“后奥运经济布局”，规划商务总部功能区、运河核心功能区、主题休闲功能区、行政服务功能区、医疗康体功能区等五大功能区。还有一个是为中央行政单位预留的办公区。

26日，在通州投资环境及项目推介会上，通州拿出五大功能区的预招商项目与近期赶到的60多名来自美国、德国等国的驻华使馆商务官员、商会领导、外资企业代表进行洽谈。北京市通州区投资促进局局长李金玺介绍说，这些项目都是预招商项目，将拉动“后奥运”经济时期的通州发展。

运河城市段：招商主打文化产业

京杭大运河城市段项目，是通州规划中的重点部分。15.8平方公里的七大项目，包括世界文化交流中心、演艺走廊、湿地广场、探梦中心、金融城等。按照规划，这个运河城市段项目的建设标准超过上海浦东。

该项目一期开发的15.8平方公里共7个功能区的地块将于2007年底进入土地交易市场，投资者可以通过招标、拍卖或者挂牌3种方式取得土地的使用权。

运河城市段项目预招商的项目以文化为主，除了世界文化交流中心、演艺走廊、湿地广场、探梦中心、金融城等，还有五星级酒店、艺术博物馆、文化艺术品交易中心、时尚艺术街、艺术家工作室、国际特色餐饮；媒体广场包括媒体制作公司、设计公司、游戏制作公司等；探梦中心包括数字娱乐体验馆、购物中心、主题展览中心等；金融城包括跨国金融公司驻华总部、跨国保险公司驻华总部和跨国文化公司驻华总部。

60多名来自美国、德国等国家的驻华使馆商务官员、商会领导、外资企业代表先期来到通州发掘商机，他们认为通州五大优势极具吸引力。区位优势：通州是距北京母城最近的新城区，地处京沪京广京九铁路之间，是北京通往天津、唐山、大连等华北和东北地区的枢纽；交通优势：通州的公路网密度居全国之首，每平方公里2.6公里，5条高速公路穿境而过，轻轨直达市区；资源优势：通州总面积907平方公里，新城规划155平方公里，开发面积达到64平方公里，开发区数量居北京市各区县之首；环境优势：通州地处位置优越，有良好的生态环境和文化底蕴，为新城建设提供了优越的自然条件和人文条件；发展与市场优势：通州中心城位于长安街延长线的东端，是北京东西轴与东部发展带的交汇处，作为长安街实轴上的北京新城区，具有其他地区无法比拟的发展和市场优势。

附录1

New Urban Structure For Tongzhou District of Beijing

外商青睐：五大优势极具吸引力

60多名来自美国、德国等国家的驻华使馆商务官员、商会领导、外资企业代表先期来到通州发掘商机，他们认为通州五大优势极具吸引力。区位优势：通州是距北京母城最近的新城区，地处京沪京广京九铁路之间，是北京通往天津、唐山、大连等华北和东北地区的枢纽；交通优势：通州的公路网密度居全国之首，每平方公里2.6公里，5条高速公路穿境而过，轻轨直达市区；资源优势：通州总面积907平方公里，新城规划155平方公里，开发面积达到64平方公里，开发区数量居北京市各区县之首；环境优势：通州地处位置优越，有良好的生态环境和文化底蕴，为新城建设提供了优越的自然条件和人文条件；发展与市场优势：通州中心城位于长安街延长线的东端，是北京东西轴与东部发展带的交汇处，作为长安街实轴上的北京新城区，具有其他地区无法比拟的发展和市场优势。

相关新闻

东关、运河大桥10月即可通车

通州新建的东关、运河大桥10月即可通车。昨天，北京北运河土地开发管理有限公司负责人透露，运河沿线景观布置基本完成，投资已达12亿。

该公司执行董事胡克诚介绍说，运河全长46.4公里，已由原来的80米拓宽至200米。沿运河布置17个亲水平台，并在京杭运河沿线城市中选取天津、沧州、徐州等地的风物地标，制作成地面浮雕供游人欣赏。运河文化广场码头处，还人工建造了一条仿古船，有3层，共200平方米。

胡克诚说，运河上规划的5座桥已建成2座，分别为东关大桥和运河大桥。这两座桥10月份通车后，将替换原有的两座旧桥。新运河桥不但设计精美，而且长330米，双向6车道设计，符合日后运河上通行游船的要求，每座桥造价都在6000万元以上。（来源：华夏时报）
Appendix 2
China Railway Network
Produced by China Railway Bureau
Appendix 3
Greater Beijing Urban & Suburban System
Journal “BEIJING PLANNING REVIEW”, 2006.1
Appendix 4
Adjacency Map
Magazine “BEIJING PLANNING REVIEW”, 2006.1
Appendix 5
2005-2020 Planning Proposal For Tongzhou
Magazine “BEIJING PLANNING REVIEW”, 2006.1
Appendix 5 (continue)
Appendix 5
(continue)
Appendix 6
Current Site And Its Landuse
Appendix 7

Daily Passenger Flows Between Rail Station, Light Rail Station And Subway

Produced by the author