

A research on the inhabited viaduct architecture in Tokyo.

Focusing on its contribution to the vitality of the city center

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Introduction

One striking element in modern metropolis Tokyo is the dense superimposed infrastructure onto the urban landscape, resulting in unplanned or consequential spaces where infrastructure directly meets architecture. Within a radius of 12.5 km Tokyo (23 districts) Tokyo encompasses almost 60 kilometers of elevated railways viaducts. The construction of infrastructure such as the rail viaducts onto existing old areas such as Chiyoda resulted in blocks being dissected and divided, neighborhoods being cut into two, loss of urban sights and buildings, but also in new streets, new commercial areas and new urban activities.

As a result of building elevated railways (viaducts) an unusual architectural typology of spaces within viaducts was created. These spaces and how they transformed the adjacent areas are the main focus of my study. Because of these inhabited spaces the viaduct plays a dual role of a divider and a magnate at the same time.

Hypothesis

The insertion or juxtaposition of a viaduct into an existing urban landscape results in a large urban - infrastructural element with a dichotomy role as a divider but also as a new anchor or magnate; divider in the sense of disturbing a long established land use and urban order and a magnate in the sense of a new linear lively commercial & social urban element. I believe that the magnate features are stronger than the divider and therefore the viaduct contributes and enhances the vitality of the city center.

Methodology

The thesis is broken into 4 chapters, each dealing with the phenomena of the inhabited viaduct on a different scale:

- XL – Global scale** of historical context in terms of inhabited infrastructure. Objective to provide an overview of multi-function infrastructure of built and un-built projects. Research done by literature & maps.
- L – Metropolis scale** of the viaducts of Tokyo. A survey of the overall situation of rail viaducts within the metropolis in terms of uses of the spaces below the viaducts, length; areas and potential. Research done by filed survey; photographs; literature and Google & Zenrin maps.
- M – Urban / town scale** of the case study at Kanda. Objectives: historical summary of the area;

historical summary of the rail viaducts passing through Kanda; urban analysis of the superimposed viaduct. Research done by site survey; reference materials and literature; maps of before and after the construction of the viaduct.

- S – Architectural scale** – case study of the spaces below the viaduct in Kanda. Objectives: To understand the unique attributes of the spaces below the viaduct and how these attribute contribute to the vitality of the adjacent areas. Research done by site survey; CAD plans and sketches; interviews; literature and maps.

Chapter 1: Infrastructure of multiplicity

Infrastructure which does more than its core function such as inhabited bridges, rail viaducts with commercial spaces below and utility plants with adjacent parks have been constructed through history.

			Secondary function (architecture/open space)							
			Retail	Leisure, food &	Companies, offices	Residential	Landscape, open space, parks	Storage	Parking	Urban icon / political symbol
Primary function (infrastructure)	linear structures	Aqueduct								
		Railway - viaduct								
		Highway								
		Streets / roads								
		Bridges								
	individual structures	Canals								
		Power plants								
		Railway - station								
		Airports								
		Telecom. antennas								
Ports										
Dams										

Six categories inhabited infrastructure:

- Inhabited aqueducts and viaducts.



Figure 1- Residences below the Erova aqueduct, Portugal



Figure 2- Residences below the Oimachi viaduct, Shinagawa

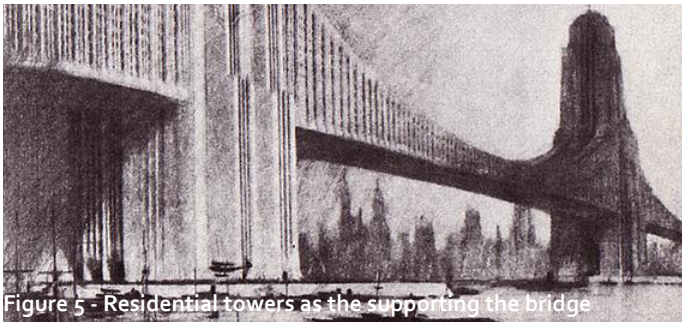
2. Inhabited bridges.



3. Road and highway multiplicity.



4. Utopian ideas of infrastructural cities.



5. Linear cities



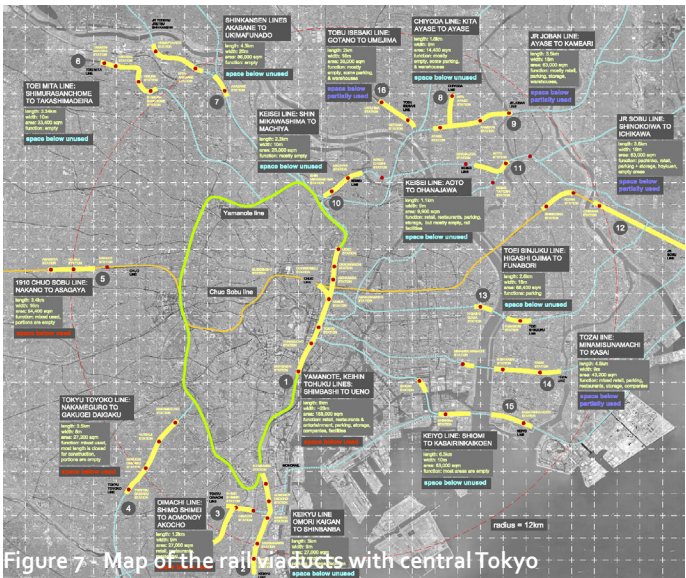
Conclusions:

1. The inhabited infrastructures of medieval Europe proved to be highly beneficial for their time.
2. The inhabited viaducts in Tokyo can be seen as a partial manifestation of the utopian ideas of merging infrastructure, urban planing and architecture.
3. When planning infrastructure within a dense megalopolis such as Tokyo multiple functions and urban engagement considerations must be taken into full account.

Chapter 2: TOKYO'S RAILWAY VIADUCTS - AN OVERVIEW

In Tokyo there are more than 50 km of elevated rail tracks or viaducts, in which the structure is elevated on pillars. This total length equals to about 750,000 sqm of space (at ground floor only), not including areas for stations. Out of

23 stretches of elevated tracks, only 4 have an extensive use of their spaces below. From observations done using Google Earth street view and walks along the viaducts, it is assumed that only 40% of the spaces below are actually being utilized (this figure does not include uses of park-



Map #	Line's name	Company	Year of construction	Stations	Zoning / land use of adjacent area	Distance of elevated tracks	Functions	Level of use of spaces below the viaducts
1	Chuo line & Yamanote line	JR East	1910	Shinjuku, Yamanote, Kanda, Akabane, Okachimachi, Ueno	Commercial, some residential	5,800 m	Retail, restaurants, nomiyas, entertainment, companies, parking, logistics, tickets	Highly used
2	Keiyo Main Line	Keihin Electric Express Railway	1905	Shinbashi, Samezu, Tachigawa, Omori-Kagan	Residential, some commercial	4,700 m	Parking, logistics, fast food restaurants	Very low
3	Tokyo Oimachi line	JR East	1927	Shimo shimmei, Oimachi	Residential	1,050 m	Retail, restaurants, nomiyas, entertainment, companies, residential	Highly used
4	Tokyo Toyoko line	Tokyo Corporation	1926	Naka-Meguro, Yutenji, Gakugaidai, Toritsu-dai	Residential	3,200 m	Retail, restaurants, nomiyas, companies, parking, logistics	Low use
5	Chuo Sobu line (west)	JR East	1910	Koenji, Asagaya	Residential	2,800 m	Retail, restaurants, nomiyas, private companies, parking, logistics	Medium use
6	Toei Mita line	Tokyo Metro	1968	Shimura-Sanchome, Hasune, Nishidai, Takashimadara	Residential	3,400 m	Parking, logistics	Low use
7	Tohoku Joetsu shinkansen	JR East	1982	Utsunomiya, Kita-Akabane, Akabane	Residential, some commercial	3,800 m	Parking, logistics	Low use
8	Chiyoda line	Tokyo Metro	1979	Kita Ayase	Residential	1,600 m	Parking, logistics	Low use
9	Joban line	JR East	1889	Ayase, Kamari, Kanamachi	Residential	3,300 m	Retail, restaurants, companies, parking, logistics, pachinko	Medium use
10	Keisei main line	Keisei Electric Railway	1978	Shinjikawashima, Machiya	Residential, some commercial	4,600 m	Parking, fenced area	Low use
12	Chuo - Sobu line (east)	JR East	1932	Ichikawa, Koiwa, Shinkawa	Residential, some commercial	6,900 m	Retail, restaurants, companies, clinics, parking, logistics	Medium use
13	Toei Shinjuku line	Tokyo Metro	1978	Funabori, Higashi Ojima	Residential, park / leisure	1,400 m	Parking, logistics	Low use
14	Tozai line	Tokyo Metro	1964	Kasai, Nishikasai, Maumusunamachi	Residential, some commercial	3,400 m	Parking, logistics, retail	Low use
15	Keiyo line	JR East	1974	Shiomi, Shinkiba, Kasairinkakoen	Residential, park / leisure, industrial, expressway	4,200 m	Parking, logistics, storage, restaurants	Low use
16	Tobu Iseaki line	Tobu Railway	1899	Gotano, Umejima	Residential, some commercial	2,000 m	Storage, retail, parking	Low use

Table 2: Survey of 23 sections of viaducts along 16 metro and train lines

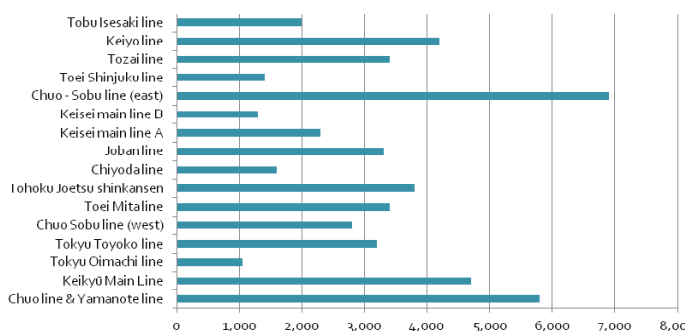


Table 3: Length of viaducts within 16 lines
Observations per the survey of viaducts within a 12.5 radius in Tokyo:

1. Correlation between the year the line was constructed and the level of use of the paces below: There's a clear correlation between the level of use of the viaducts paces below and the year it was built. The newer the viaduct is, the less likely that the spaces below are in high use (does not include functions such as bicycle and car parking).

2. Correlation between location of the line was constructed and the level of use of the spaces below: The further the lines are from the center of Tokyo the more likely the spaces will be less used.

3. Residential uses of the spaces below: Except for Oimachi line and most residential functions have been removed from the viaducts.

4. The closer the viaduct is located towards the outskirts of Tokyo the more likely it will be situated along an expressway or a wide road and therefore have the spaces below the viaduct empty or for parking functions only.

Three main characteristics of the rail viaducts in Tokyo

1. Dissecting thru a dense residential area:

- No easement
- Spaces below the viaduct not used
- Extreme tightness with the adjacent buildings



Figure 8 - Chuo west between Koenji & Asegaya

2. Engaging the surrounding:

- An easement or a street runs along the viaduct
- The spaces below the viaduct are inhabited
- Easy crossing and access.
- Human scale of the viaduct
- A pedestrian friendly commercial street runs along the viaduct



Figure 9 - Chuo line at Kanda

3. Alienating the surrounding:

- Viaducts is situated along an expressway or a busy road.
- Structure is of an industrial scale, large span and high ceiling.



Figure 10 - Tozaki line viaduct

Conclusion 1: Level of urban engagement

About 75% of the rail viaducts in Tokyo pass through residential areas with great variety of the way they engage the city on the local scale. The survey in this chapter indicates that the rail viaducts in Tokyo have great variety of architectural and urban expressions. This variety can be valued and categorized on terms of the physical situation:

1. Scale of the structure
2. Structural span and construction technology
3. Distances from the adjacent buildings and streets
4. Existence, variety and intensity of functions below the viaduct
5. Height of structure
6. The existence of an easement along the viaduct
7. The existence of a road or street along the viaduct.

All of the above influence the degree in which the viaduct engages the local settings, the urban life of the neighborhood and if it results in contribution to the vitality of a city center or to the opposite – a drain on city life and an urban division. In these cases the viaduct is perceived as an urban utilitarian element just as pipes in an apartment building, passing through the city with a singular function.

Conclusion 2: Under utilized spaces below the viaducts

Out of 23 stretches of viaducts with open spaces below, 5 lengths are situated within a commercial or industrial surrounding. The rest of the viaducts surveyed are all within residential areas. It is estimated that about 780,000 square meters of space are empty or used for parking only; a staggering large area in a city where real

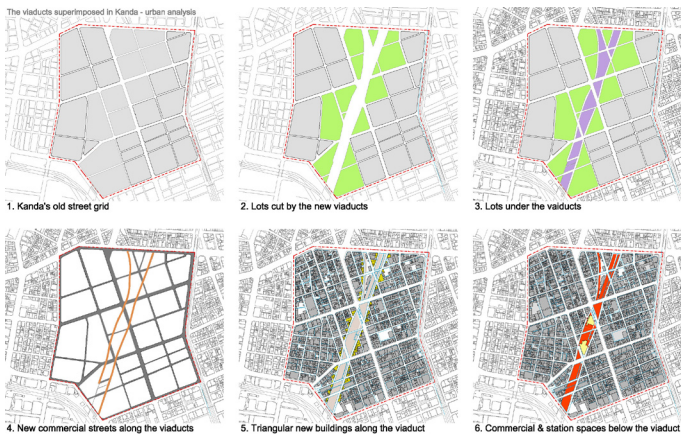
Chapter 3: CASE STUDY – KANDA TOWN BEFORE AND AFTER THE SUPERIMPOSED ELEVATED RAILWAY

Kanda ward goes back to early Edo times and therefore has an established history and tradition. Kanda is the focus area of my research for the following reasons:

- History: Almost 500 years going back to the beginning of Edo era.
- Urban density prior to the construction of the viaduct.
- The street grid: A fixed urban system of an orthogonal street grid which was aggressively cut by the diagonal direction of the viaducts.
- Two distinct viaducts: Kanda's viaducts were built in two phases – 1st part the Chuo line - a brick arched structure running along the west side and later the Yamanote viaduct – a concrete and steel structure running along the east side.

Urban diagrams:

Unlike most rail viaducts in Tokyo which followed an existing canal or an existing road, in Kanda the viaducts had a much more severe impact due to the fact that they run along a diagonal line cutting the old orthogonal grid and dissecting many lots.



The urban transformation of Kanda along the viaducts:

1. The old orthogonal grid.
2. The lots cut by the two viaducts.
3. The new lots below the viaducts - confirm to the city grid.
4. The new commercial streets along the viaducts.
5. The new triangular buildings on both sides of the viaduct.
6. The inhabited areas below the viaduct.

Conclusions:

1. While the viaducts cut and in a way destroyed some of the old fabric of Kanda, they also let the city grid continue underneath and by thus created a merged urban spine of the old and the new. This urban intervention can be considered as a creative destruction.
2. By including a narrow street easement along the two sides, a pedestrian friendly promenade was created which propelled the development of functions not just within the viaducts but also along the opposite sides and the streets leading towards the viaduct.

Chapter 4: CASE STUDY – THE INHABITED SPACES UNDER THE VIADUCTS OF KANDA

There are two viaducts running parallel which form the Kanda GA DO SHITA, the first built in 1910 as part of the viaduct of Chuo line connecting Shimbashi to the old station of Manseibashi. The Chuo line viaduct was built based on the S-Bahn of Berlin - an arched brick structure and concrete. The functions of spaces below the viaduct were not planned ahead and therefore corresponded to the needs of the local surroundings as businesses entered lease agreements with JR East. The complexity of the structure, crossing streets, rail facilities - resulted in a large variety of spaces in terms of sizes, width & quality. Allowing for much freedom within the grid, the spaces can be considered a type of vernacular architecture.



Figure 11 - Functions within and on the opposite side of the viaduct

Function	Tenants	Spaces %	Area GF	Area 2nd fl *	Total area	Area % (GF)	Average area per space
1 Izakaya/restaurant	121	45%	4,160	2,707	6,867	24%	34
2 Nomiya/bar	33	12%	774	190	964	5%	23
3 Pachinko / karaoke / manga	24	9%	1,655	162	1,817	10%	69
4 Retail	11	4%	962	40	1,002	6%	87
5 Travel/tickets	5	2%	636	30	666	4%	127
6 Business/kaisha	34	13%	3,931	927	4,858	23%	116
7 Warehouse	27	10%	3,233	0	3,233	19%	120
8 Parking	12	4%	1,777	0	1,777	10%	148
Total	267	100%	17,128	4,056	21,184	100%	64

*Based on assumptions of 2nd floor occupation and area

Table 4: Functions below the viaduct

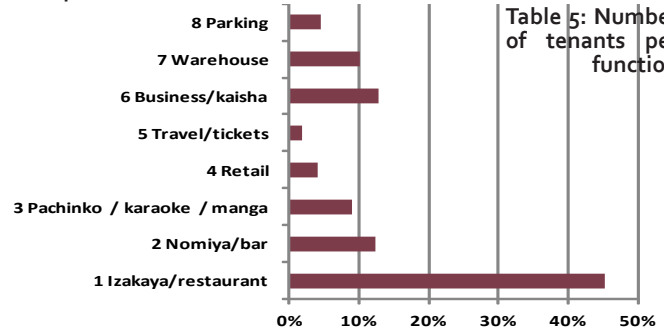


Figure 12: Variety of spaces per area size

Why & how Kanda's inhabited viaducts contribute to the vitality of the city center - thesis conclusions:

1. While the viaduct is a megalopolis infrastructure element it is manifested on a **local and human scale**.
2. As a **non planned zone** the area below the viaducts was allowed to grow in an organic manner and therefore provided the real local needs of its surroundings.
3. The combination of a **rigid structural element with a flexible policy** of functions and layout enabled the creation of a rich variety in terms of quality of spaces; rent gradation; area scale; and architectural expression.
4. The **easement of a narrow street on both sides** of the viaducts ensured the development of a commercial district along both sides of the viaducts and connections to the existing commercial zones adjacent to the viaducts.
5. Laid out in a diagonal direction, breaking lots of the orthogonal grid, the viaducts actually respected the city grid by letting it continue underneath. This resulted in a **stronger immersion of the viaducts into the existing fabric of the city**.
6. Large portions below the viaducts can be considered as **low grade spaces** – partially dark; narrow or too small; noisy; industrial finishes – but it is exactly these type of low end spaces with lower rent which allow for small, local businesses to start and to open a business.
7. **The viaduct as an urban spine is a sort of an urban trellis** allowing for the anchoring of new city activities along and in perpendicular - branching into the city.