

## Supplementary Material 1 - The detailed information

Table 1: Cases selected

Stations	Size	Demand fluctuation	Performance for fluctuation	Nation
Beijing West RS	Large	Large	Poor	China
Beijing South RS	Large	Large	Poor	China
Shanghai RS	Large	Large	Good	China
Rotterdam Central Station	Large	Middle	Good	The Netherlands
Utrecht Central Station	Large	Middle	Good	The Netherlands
Bijlmer Arena RS	Middle	Large	Good	The Netherlands
Zandvoort Station	Small	Large	Good	The Netherlands

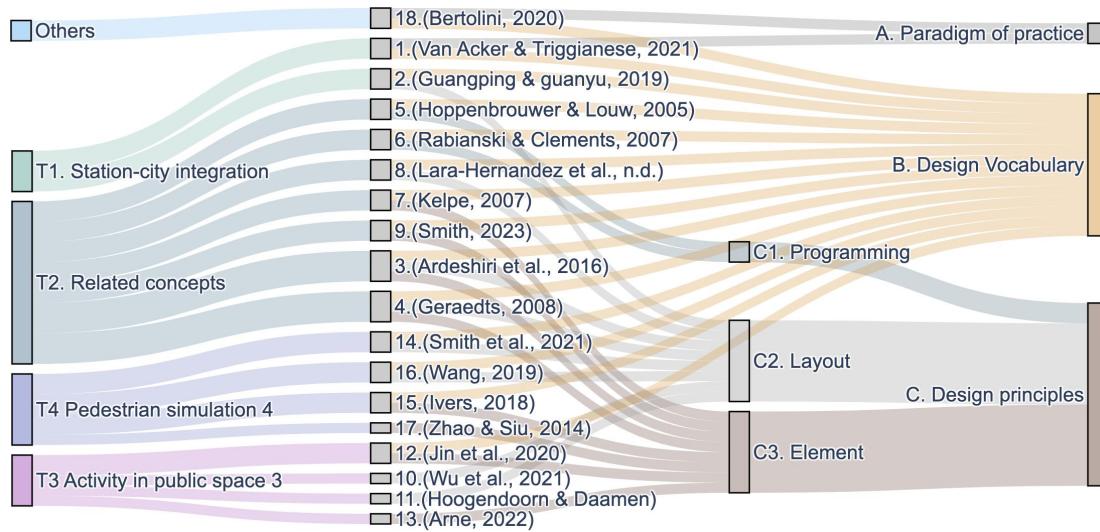


Figure 46: The literature selected and the relevance to the research findings

Table 1. Data processing

		Objectives						Dimensions						Relevant design principles	
		Problem-oriented (Macro-level)			User-based (Micro-level)			Spatial			Management-Spatial?				
		Overcrowding? (Potential) overcrowding?			Empress? (Potential) empress?			Layout-Element? Path? Flow? Experience?			Access			Event	
		—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	Beijing West	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	Beijing South	○	○	○	○	○	○	○	○	○	○	○	○	○	○
3	Rotterdam	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4	Utrecht	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5	Bilimer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	Zandvoort	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cases	7	Beijing West	Beijing South	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht
	South	Shanghai	Rotterdam	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht	Utrecht
	Other cases(s)	Guangzhou station	Shanghai South	Allianz arena	—	—	—	—	—	—	—	—	—	—	—
	1	Beijing West vs Beijing South	—	—	—	—	—	—	—	—	—	—	—	—	—
	2	Beijing West vs Shanghai	—	—	—	—	—	—	—	—	—	—	—	—	—
	3	Beijing West vs Rotterdam	—	—	—	—	—	—	—	—	—	—	—	—	—
	4	Beijing West vs Utrecht	—	—	—	—	—	—	—	—	—	—	—	—	—
	5	Beijing West vs Bilmer	—	—	—	—	—	—	—	—	—	—	—	—	—
	6	Beijing West vs Zandvoort	—	—	—	—	—	—	—	—	—	—	—	—	—
	7	Beijing South vs Shanghai	—	—	—	—	—	—	—	—	—	—	—	—	—
	8	Beijing South vs Rotterdam	—	—	—	—	—	—	—	—	—	—	—	—	—
	9	Beijing South vs Utrecht	—	—	—	—	—	—	—	—	—	—	—	—	—
	10	Beijing South vs Bilmer	—	—	—	—	—	—	—	—	—	—	—	—	—
	11	Beijing South vs Zandvoort	—	—	—	—	—	—	—	—	—	—	—	—	—
	12	Utrecht new vs Bilmer old	—	—	—	—	—	—	—	—	—	—	—	—	—
	13	Rotterdam new vs Rotterdam old	—	—	—	—	—	—	—	—	—	—	—	—	—
	14	(Beijing West/Beijing South/Zandvoort)	—	—	—	—	—	—	—	—	—	—	—	—	—
	15	(Rotterdam/Utrecht/Bilmer/Zandvoort)	—	—	—	—	—	—	—	—	—	—	—	—	—
	16	(Beijing West/Beijing South/Zandvoort)	—	—	—	—	—	—	—	—	—	—	—	—	—
	17	(Van Aken & Tiggiani, 2021)	—	—	—	—	—	—	—	—	—	—	—	—	—
	18	(Arrestijn et al., 2016)	—	—	—	—	—	—	—	—	—	—	—	—	—
	19	(Genaeels et al., 2009)	—	—	—	—	—	—	—	—	—	—	—	—	—
	20	(Houben et al., 2005)	—	—	—	—	—	—	—	—	—	—	—	—	—
	21	(Rabbers & Clements, 2007)	—	—	—	—	—	—	—	—	—	—	—	—	—
	22	(Kapteijns, 2007)	—	—	—	—	—	—	—	—	—	—	—	—	—
	23	(Lara-Hernández et al., n.d.)	—	—	—	—	—	—	—	—	—	—	—	—	—
	24	(Smith, 2023)	—	—	—	—	—	—	—	—	—	—	—	—	—
	25	(Wang, 2019)	—	—	—	—	—	—	—	—	—	—	—	—	—
	26	(Zhao & Sui, 2014)	—	—	—	—	—	—	—	—	—	—	—	—	—
	27	Relevant design principles	—	—	—	—	—	—	—	—	—	—	—	—	—

Legend: Primary examinations Not examined — Not relevant ○ Examinated, but no relevant findings □ Has relevant findings ✓ Has relevant and positive findings ✓- Has relevant and negative findings  
Notes: Click the comment of each cell to see the detailed description.

Figure 47: Examine relevance and compare cases

Table 2. The evaluation of design principles

Index	Name	Objectives								
		Problem-oriented (Macro-level)			User (Passenger)-based (Micro-level)					
		Reduce Overcrowding?	Reduce Emptiness?	Add city value?	Reduce use conflicts?	Safety	Speed	Ease (Wayfinding)	Comfort	Experience
1	Align open spaces with main paths	o	✓	o	o	o	o	o	o	✓
2	Space for humans	o	✓	o	o	o	o	o	o	✓
3	Add installations and facilities	Depend on the context ↓		✓	o	o	o	o	✓	✓
4	Reconfigurable elements	✓	✓	o	o	o	o	o	o	o
5	Stairs as stages or seats	o	✓	o	o	o	o	o	o	✓
6	Shortcuts or optimizing paths	✓	✓	o	✓	o	✓	✓	o	o
7	Reduce level change by landscape design (District-level)	✓	o	o	o	✓	o	o	o	o
8	Changeable or moveable building	✓	✓	—	—	—	—	—	—	—
9	Reduce bottlenecks to ease flow (District-level)	o	✓	✓	o	o	✓	o	✓	o
10	Connect and share with neighborhoods	✓	✓	✓	o	✓	o	o	✓	o
11	Redundant spaces	✓	↓	o	o	↓	↓	o	o	↓
12	Redundant spaces + compact network + regulate path	✓	✓	o	✓	✓	✓	o	o	o
13	City passage (Element)	o	✓	✓	✓	—	—	—	—	—
14	Scattered mobility nodes to increase capacity	✓	o	o	o	✓	o	↓	o	o
15	Set apart bottlenecks	✓	o	—	o	✓	o	o	o	o
16	Set apart non-transport function	✓	o	o	✓	✓	o	✓	o	o
17	Scattered mobility nodes to vibrate city environment	✓	o	✓	o	o	↓	↓	✓	✓
18	Programming considering flexible uses in temporal dimension	✓	✓	✓	o	o	o	o	o	o
19	Regulate path by temporary or reconfigure elements	✓	—	—	—	✓	o	o	o	✓
20	Suitable general layout of the station and city	Depend on the context		Depend on the context		Depend on the context				
21	Reduce bottlenecks to ease flow (Building-level)									
22	Reduce level change by landscape design (Building-level)									
23	Positioning City passage (Layout)									

Figure 48: The evaluation of design principles

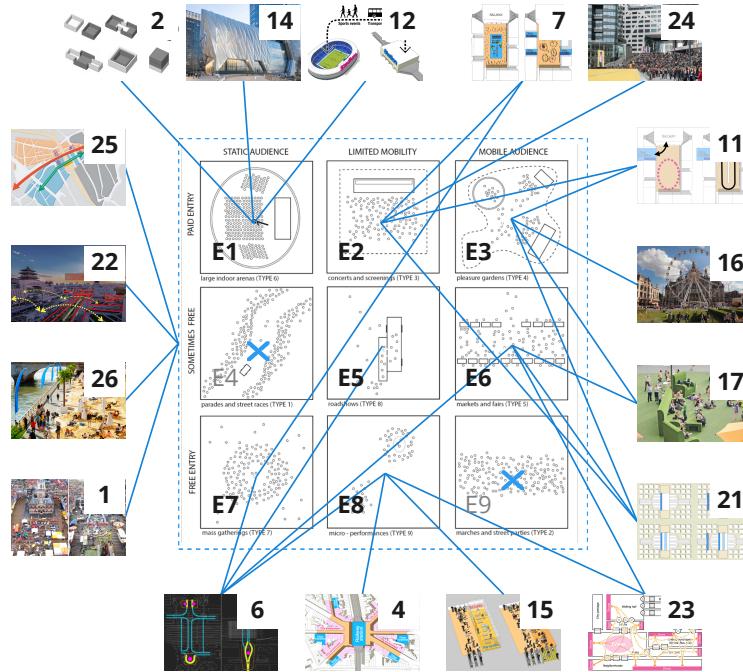


Figure 49: The design principles related to the event typology

## Supplementary Material 2 - Sources of figures

Table 2: Sources of Figures

N	Figure and Caption	Source
1	Overcrowding and emptiness in railway stations areas.	Left - <a href="https://www.163.com/dy/article/DLED9I020524TFU4.html">https://www.163.com/dy/article/DLED9I020524TFU4.html</a> ; Right - <a href="https://www.sohu.com/a/386779398_640391">https://www.sohu.com/a/386779398_640391</a>
2	A conceptual basic unit of passenger flow.	By authors
3	The mechanism of overcrowding and emptiness in Beijing West railway station area.	By authors
4	Spatial relevance shown by an example case of Beijing West Railway Station.	Original photo sources: Left - <a href="https://www.meipian.cn/">https://www.meipian.cn/</a> ; Right - <a href="https://upload.wikimedia.org/wikipedia/commons/5/5b/Beijing_West_Railway_Station_20170506_124557.jpg">https://upload.wikimedia.org/wikipedia/commons/5/5b/Beijing_West_Railway_Station_20170506_124557.jpg</a> . Drawings by authors
5	Temporal scales.	By authors, inspired by (de Jonge and van der Voordt, 2002, p. 38, fig. 13)
6	Spatial scales of station areas.	By authors
7	Architectural and urban design proposals for Amsterdam Sloterdijk station.	Upper - (Triggianese et al., 2019); Lower - (Andrianos, 2023)
8	This paper is part of a PhD project at the intersection of three topics.	By authors
9	The process of developing design principles.	By authors
10	The station at the district and building levels.	By authors
11	The configuration of the station.	By authors
12	Data sources.	By authors
13	An example of research by design.	By authors
14	Sources of heuristics.	By authors
15	The design principles (patterns) within a network.	By authors
16	The design principles viewed from different perspectives.	By authors
17	The design principles related to the event typology.	By authors
18	Flexible use.	<a href="https://www.stadsstrand.nl/paris-plages/">https://www.stadsstrand.nl/paris-plages/</a> (Qi and Lu, 2019)
19	Different general layouts of the station and city.	<a href="https://www.santenco.nl/portfolio_page/stationsplein-oost/">https://www.santenco.nl/portfolio_page/stationsplein-oost/</a>
20	Set apart non-transport function.	By authors
21	Vibrate city environment by scattered mobility nodes.	By authors
22	Increase transport capacity by scattered mobility nodes.	By authors
23	Alignment between open spaces and main paths.	By authors
24	Human-oriented spaces versus vehicle-oriented spaces.	By authors
25	The old and the new Rotterdam central stations.	Upper-left - <a href="https://commons.wikimedia.org/wiki/File:Nieuw_Centraal_Station_in_Rotterdam_aangetast,_Bestanddeelnr_908-5455.jpg">https://commons.wikimedia.org/wiki/File:Nieuw_Centraal_Station_in_Rotterdam_aangetast,_Bestanddeelnr_908-5455.jpg</a> ; Upper-right - <a href="https://internaathetposthuis.nl/raldus.html">https://internaathetposthuis.nl/raldus.html</a> ; Lower-left - <a href="https://indebuurt.nl/rotterdam/nieuws/salsa-doe-gratis-mee-met-deze-gigadans-voor-rotterdam-centraal-311821/">https://indebuurt.nl/rotterdam/nieuws/salsa-doe-gratis-mee-met-deze-gigadans-voor-rotterdam-centraal-311821/</a> ; Lower-right <a href="https://mvsaarchitects.com/en/news/nos-rotterdam-central-receives-a-score-of-8-and-is-the-most-popular-large-train-station/">https://mvsaarchitects.com/en/news/nos-rotterdam-central-receives-a-score-of-8-and-is-the-most-popular-large-train-station/</a>
26	Connect with neighborhoods.	By authors
27	Smooth level changes by landscape design at the district level.	<a href="https://m.thepaper.cn/newsDetail_forward_5348462">https://m.thepaper.cn/newsDetail_forward_5348462</a>
28	Smooth level changes by landscape design at the building level.	<a href="https://www.unstudio.com/en/page/12109/arnhem-central-masterplan">https://www.unstudio.com/en/page/12109/arnhem-central-masterplan</a>
29	Adaptive redundant spaces with path regulation.	By authors

Table 3: Sources of Figures (continued)

N	Figure and Caption	Source
29	Path regulation using reconfigurable elements.	By authors
30	Programming considering the time dimension (for flexible use).	By authors
31	Shortcuts or optimizing paths.	By authors
32	A changeable building - the Shed.	<a href="https://www.architecturaldigest.com/story/the-shed-finally-opens-new-york-city-hudson-yards">https://www.architecturaldigest.com/story/the-shed-finally-opens-new-york-city-hudson-yards</a>
33	Changeable building components.	By authors
34	Add installations and facilities.	<a href="https://www.flickr.com/photos/87453322@N00/7561351848">https://www.flickr.com/photos/87453322@N00/7561351848</a>
35	Reconfigurable elements.	(Ivers, 2018)
36	Reconfigurable spaces.	Left - <a href="https://www.shutterstock.com/image-photo/vie-w-delft-market-square-nieuwe-kerk-1206141775">https://www.shutterstock.com/image-photo/vie-w-delft-market-square-nieuwe-kerk-1206141775</a> ; Right - <a href="https://nl.pinterest.com/pin/546342998538754823/">https://nl.pinterest.com/pin/546342998538754823/</a>
37	Redundant spaces or setting apart bottlenecks at the district level.	By authors
38	Redundant spaces or setting apart bottlenecks at the building level.	By authors
39	Position city passages (at the district level).	By authors
40	The city passages (at the building level).	<a href="https://www.amsterdam-viptours.com/blog/cuypers-passage/">https://www.amsterdam-viptours.com/blog/cuypers-passage/</a>
41	Barriers that hinder the flow at the district level.	By authors
42	Reduce barriers to ease flow at the building level.	By authors
43	Stairs as stages or seats.	<a href="https://architectenweb.nl/nieuws/artikel.aspx?id=43948">https://architectenweb.nl/nieuws/artikel.aspx?id=43948</a>
44	Two city axes were planned during the redevelopment of the Utrecht Central Station area.	Structuurplan, Stationsgebied Utrecht, December 2006
45	Station typology implied by the cases.	By authors
47	Examine relevance and compare cases.	By authors
48	The evaluation of design principles.	By authors
46	The literature selected and the relevance to the research findings.	By authors