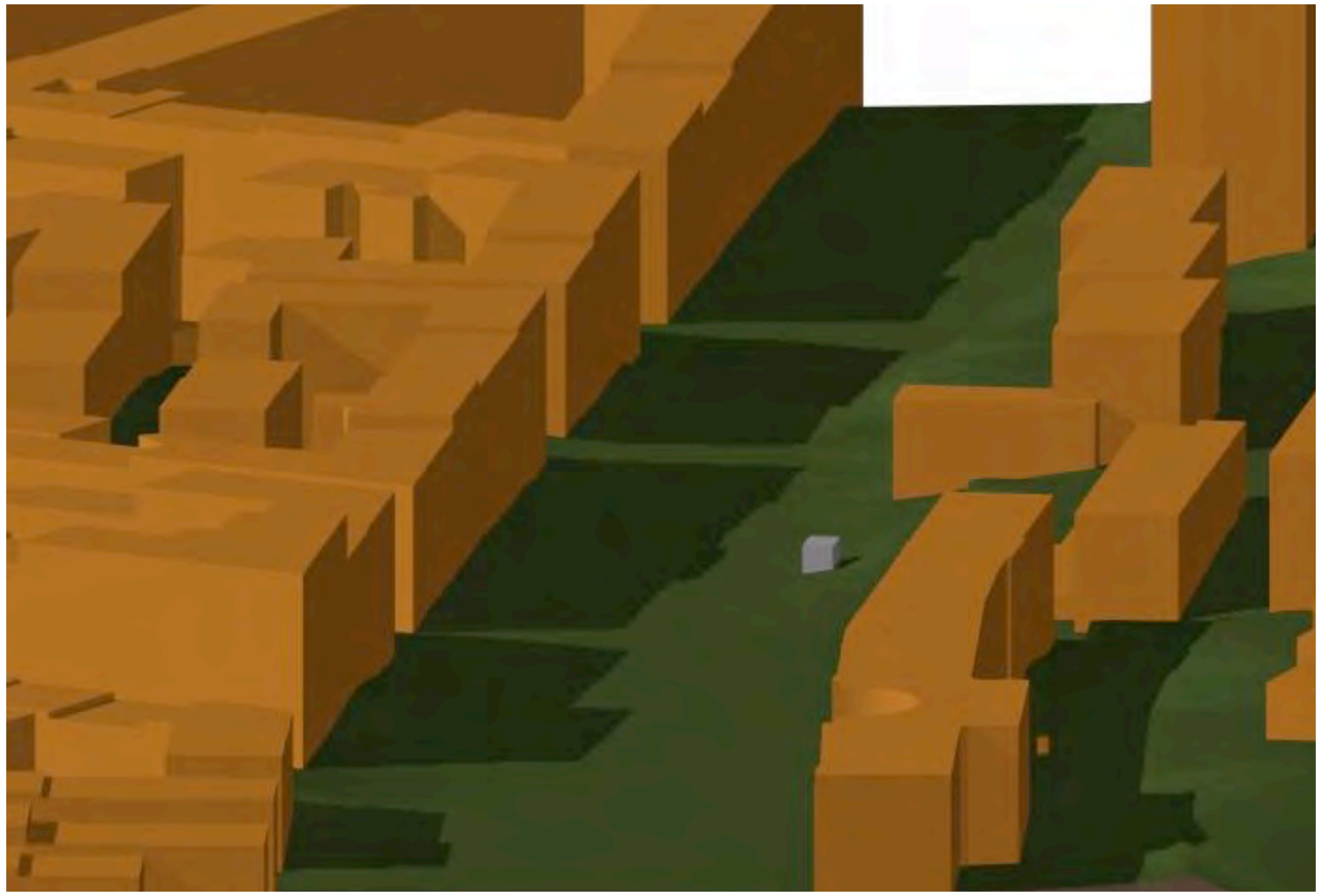

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Walkability Index implementation and Analasys of Valhallavägen Stockholm, Sweden

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UPPSATS I FORT- OCH VIDAREUTBILDNINGSKURSEN:
Att utvärdera arkitektur och stadsbyggnad, AD242V, 7.5 hp
Arkitekturskolan, Kungliga Tekniska Högskolan, KTH, Stockholm, VT 2014

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Introduction and theory

Baseline

Within urban space physical elements in streets where different modes of transportation share space has a problematic relationship to how its form relates to human beings choice of mode of transportation between destination within a urban framework. As global warming and a energy scares future faces human civilisation the urban form of our cities particular transportation networks is a key factor in order to shift towards sustainable transportation. Sustainable transportation means more energy and space efficient as well as less climate impact modes such as walking, bicycling and public transportation.
As urban space is always a large structure the form of its transportation networks is rarely constant as transportations start and destination overlaps different design configurations reliable quantitative evaluation methods is limited.
Therefore this paper will explain, implement and discuss the results of a case study based on Sungjin Parks Walkability checklist which is a quantitate study of urban design configuration and its impact on the choice of urban transportation.

Purpose

The purpose of this text is to examine Walkability through physical factors which is measurable and therefore can be implemented in a urban analysis.
A case study of a Section of Valhallavägen in Stockholm Sweden will be used to show how the analysis can be conducted.

Method

First explain two researchers definition of the construct of Walkability and secondly connect the qualitative definition of Southworth and the Quantitative definition of Sungjin Park and why certain factors will not be implemented.
Third the factors which are to be implemented will be presented, how they are calculated within a illustrative diagram.
Fourth the checklist of Walkability will be implemented in a case study of Valhallavägen, Stockholm, Sweden of a 300m section.
Fifth the results will be discussed on how they where examined and the limitations to the results and how the results should be interpreted.

Delimitation

This study will only examine physical elements which is measurable in urban space. The elements and measurements which will be used will directly be derived from Sungjin parks Walkability study as the objective of this project is to examine a section of Valhallavägen on how likely a human being will chose to walk as a transportation method through that street section. A street section will always be 300m accordingly to fit the derived factors which Sungjin Park found within his study of Walkability factors.

Theory

Walkability is a quality which is not well defined. But it has to to with how the built environment encourages and supports walking through variables such as travel-time and qualities such as visual interest. Level service which is a community dedicated to gather information of Walkability defines it as following,

> "The extent to which the built environment is friendly to the presence of people living, shopping, visiting, enjoying or spending time in an area"(Level of Service 2014)

Important to achieve above stated construct seems to be visual quality through the pedestrian network. Where physical elements such as street trees could be a contributing factor to this quality. But also a variety in the environment but with a continuance parallel to what Kevin lynch stated for ¨Strong paths¨. Safety is also important where crossings with other modes of transportation has to be safe for all citizens independent of age and degree of mobility(Southworth 2005, Lynch 1960).

Distance is another factor which has an impact on the choice to walk. This does not relate to detailed spatial design but more configuration of the larger network of paths (in this case streets). Utilitarian access of walking and its length was found to be affected and lengthened if the quality of the routes street segments was high. High quality means a high level of correspondence of walkability factors (Park 2008).
As mentioned walking paths is set within a configuration which is often hard or slow changing therefore the quality of the network can be more easily worked with. Below Southworth has stated some qualitative factors for walkability which will be explained and compared to Sungjin parks quantitative framework(Southworth 2005).

¨1-Connectivity of path network, both locally and in the larger urban setting;

2-Linkage with other modes: bus, streetcar, subway, train;

3-Fine grained and varied land use patterns, especially for local serving uses;

4-Safety, both from traffic and social crime;

5-Quality of path, including width, paving, landscaping, signing, and lighting; and

6-Path context, including street design, visual interest of the built environment, transparency, spatial definition, landscape, and overall exploitability.¨(Southworth 2005)

Connectivity
Is determined by the amount of sidewalks but also continuance in the pathways without significant obstacles. Also the design of the grid pattern seems to be important where a small block size and high deity of connecting points in paths can relate to a high level of connectivity. This could be put into relation with measuring distance with "as the crow flies"¨. The finer the grid and connecting pathways, the closer is the distance between start and destination. Therefore getting closer to "as the crows flies" measurement.
Boundaries which lower connectivity can be dead end streets, cul-de-sacs, busy roads, railroads, right of way rivers and power-lines(Southworth 2005).
Even if it is stated that walkability is something that is to be planned from the beginning of a new development it is possible to retrofit and make areas more walkable. This by overcoming barriers by traffic calming, overpasses, underpasses etc, depending on the barrier. Cul-de-sac can be reconnected to surrounding areas and so forth(Southworth 2005).

Linkage
Linkage can be stated as linking the pathways regularly throughout the city to other modes of transportation such as trams, buses, trains or subway. This is to connect the local area to the larger city and region. Usually a distance of 200-400m and an estimated walk-time of 10-20 minutes is acceptable between these linkage points. It is about creating easy transfers between different modes of transportation. For example a person should be able to go from bus to train to flight without any difficult changes. Important is also that the concept of˙pedestrian pockets¨ has to be taken into account. Where a local area no matter how pedestrian friendly it is, it will not reduce car usage if it is not linked.to the city through the above mentioned modes of transport, but also if the area is located and possesses.a mix-usage of buildings. (Southworth 2005).

Variated land-use
Walkability is also determined by the accessibility of daily activity and services, serving daily needs. According to these needs this can include shops, bank, cafés, laundries, elementary grammar schools, libraries and fitness centres etc. A high level of accessibility of these services means they can be reached within 10-20 minutes walking time approximately within a distance of 800 meters(Southworth 2005) pp250.
An elementary school is a good example of a local service that is essential to be reached in walking distance. Especially considering safety which I will continue describing in the next category. For example elementary schools have been identified as a general problem in the USA. Because of locations tend to limit walkability because of the distance from the pupils homes, therefore favouring car-use. Even if this is not necessarily applicable to European situations it is interesting to note what effect location of services has on the chosen mode of transport. (Southworth 2005).

Safety
Safety is perhaps one of the most developed and accepted factors regarding walkability (Southworth 2005). In the USA a term called Jaywalking was formed up until the 1930s when private vehicles increased and safety of pedestrians became an issue(Norton 2007). It basically means that pedestrians crossing any road, highway or street on non designated crossings is a Jaywalker. (Norton 2007)

> “One who crosses a street without observing the traffic regulations for pedestrians.”(Norton 2007, pp.358)

Since pedestrians runs 23 times more likelihood of getting killed than automobile passengers This lead to a debate whether it is the pedestrians or vehicles that have the responsibility in traffic situations especially crossings (Southworth 2005; Norton 2007).

To address safety issues a number of handbooks has been created regarding standardised crossing times, handicapped needs, traffic speeds and so on. But more recently so called traffic calming has been used to slow down traffic and thus making roads and streets more pedestrian friendly. These methods include narrowed streets, rough paving, chokers, chicanes, speed-bumpers, raised crosswalks, roundabouts, landscaping among others(Southworth 2005).

Path Quality
There are several factors determining the walkability of paths. Negative factors to path quality may include: polluted air, noisy traffic, few designated crosswalks, frontages of buildings are poorly defined, large parking lots in front of buildings, sidewalks which are constantly interrupted by driveways to parking(Southworth 2005, p.251).
Positive affects may include: continuance in path (less interruption), smooth surface, wide enough for 2-3 people to be able to pass each-other or group walking. But also wider in more urban situations. Terrain is also important for walkability and needs to be address in certain way for example with hand rails. If the path is able to accommodate less mobile people then it is more walkable. It is also about channeling pedestrians by defining the path for example with trees, flowers and verges. This together with adequate street lighting may improve sense of safety and induce walking even at night (Southworth 2005, p.251).

Path context
Monotonous paths will not induce walkability rather prevent it,

> ¨If we wish to encourage walking we need to deal with more than connective- pity, land use patterns, safety, and quality of the path itself. A safe, continuous path network in a monotonous physical setting will not invite pedestrians. The path network must engage the interest of the user. Many aspects of the path context can contribute to a positive walking experience: visual interest of the built environ- meant, design of the street as a whole, transparency of fronting structures, visible activity, street trees and other landscape elements, lighting, and views(Southworth 2005, p. 251).

Shopping malls, large parking lots, office clusters and electronic communication has contribute to a less readable and transparent city. Transparency is described as most important for walkability. Where todays traffic analysis over large areas on a macro scale does not pay attention to characteristics on a smaller scale, which is important to evaluate and create strong walkability. I high value of path context is
dependant upon variation in architectural style, quality of path flooring, greenery such as bushes trees and plantations, small scale services along pathway, higher density of buildings, narrower less trafficked streets, straighter streets with a oversight of where the destination is. Transparency the ability for the pedestrian to have a sense of where it is heading is important(Southworth 2005, pp. 251-254).

Even though there is no such thing as applicable theories and templates that can be imposed on a standard basis. The stated physical properties seem to have a positive affect on walkability to an unstated degree. Social aspects are also important as such people prefer paths where other people are for example sitting on cafés, walking, or couples on benches(Southworth 2005, pp.254-255). But since I will not handle the social aspects in this project more then in relation to physical form I will not discuss this further.

Distance is also important for how walkable a path is, where some researchers argue that some of the stated properties above result in a perception of longer distance even though its not. For example, more variety and features such as building styles, amount of furniture on path, greenery as such(Southworth 2005, pp.254-255).

Is it possible to accommodate the above stated features without cluttering the space? Pedestrians seem to want to view other people and value these paths higher, but also paths with greenery, direction and interesting features. One must try to create defined space within the paths that can accommodate transportation walking and people who wants to reside. Without compromising interesting features, continuance in characteristics, greenery and other mentioned features.

Sungjin parks Walkability Index
Sungjin Park is an American Doctor in Philosophy in city and regional planning. His Phd project was conducted to test following hypothesis.

> **Hypothesis 1:** A higher level of path walkability will increase transit users' likelihood of choosing walking over driving to the transit station.
> **Hypothesis 2:** A higher level of path walkability will increase the distance transit users will walk to the transit station. (Park 2008 pp4)

He first carried out a literature research about which factors does matter for walkability. These was then tested within a case study of Mountain View, California. Three surveys was conducted, one of 249 transit users by collecting socioeconomic data, trip origins and transit mode choice. The second was 68 transit users which evaluated their walking route to the station. The rout was evaluated through 30 Walkability indicators derived from the literature study and the 249 transit users. In total 370 segments of street was evaluated. (Park 2008)
A street segment is defined as:

> ¨**Length of Segment:** The surveyor recorded the length between the centre points of the two intersections along the street segment.¨ (Park 2008)pp44

41 Indicators of Walkability was discovered and proven through a comparative analysis of the conducted surveys. A Walkability Index is later produced in order to Quantify Walkability indicators. A presentation of the 41 indicators will be presented on next page. Maximum and minimum values extracted from street segments within the case study, which scored highest in Walkable conductive indicator will also be presented.

I will first demonstrate the walkability indicators which he has found had an impact on the choice to walk over other transit options and walking distance, Also in which direction each value should go in order to be Walking conductive.
Second I will show a list of max/minimum values that is derived from the 270 observed street segments.
Third I will narrow down the amount of indicators which I will use in my proposal.

Identify Walkability

Walkability indicators from Sungjin parks cases-study

The list Below shows the Walkability Indicator list. The values is max, minimum and average values of all the 270 observed street segment within the case study. The reason why this is showed is to extract the maximum and minimum values which was observed to be walking conductive street-segments.

	A. Path Walkability Indicators Related to Curb-to-Curb Roadways	Min.	Max.	Mean	Std. Dev
	Length of Route (mile)	0.09	2.10	0.76	0.46
	Length of Route (ft.)	493.0	11077.5	4003.2	2441.8
(1)	Average Width of Curb-to-Curb Roadway (ft.)	29.0	80.4	52.0	12.0
(2)	Average Width of Traffic Zone (ft.)	15.9	70.5	38.1	13.1
(3)	Average Number of Traffic Lanes	2.0	5.0	2.9	0.9
(4)	Average Width of Through Traffic Lanes (ft.)	7.7	17.7	12.6	2.0
(5)	Number of Traffic Calming Elements / 500 ft. Block Length	0.0	4.6	0.9	1.0
	B. Path Walkability Indicators Related to Pedestrian Crossings	**Min.**	**Max.**	**Mean**	**Std. Dev**
(6)	Pedestrian Crossing Coverage Rate	0%	100%	48%	0.3
(7)	Pedestrian Signal Coverage Rate	0%	100%	35%	0.3
(8)	Pedestrian Crossing Facility Design Index	0.2	5.0	2.4	1.2
(9)	Number of Mid-block Crossings / 500 ft. Block Length	0.0	1.3	0.1	0.3
	C. Path Walkability Indicators Related to Buffer Zones	**Min.**	**Max.**	**Mean**	**Std. Dev**
(10)	Average Width of Buffer Zone (both sides together) (ft.)	3.8	18.6	11.2	3.3
(11)	Average Width of Landscape Strip (both sides together) (ft.)	0.0	7.2	2.1	1.5
(11-1)	Existence of Landscape Strip I (one or both = 1, none = 0)*			0.5	0.5
(11-2)	Existence of Landscape Strip II (both = 1, one or none = 0)*			0.1	0.3
(12)	Average Width of Bike Lane (both sides together) (ft.)	0.0	5.8	1.2	1.8
(12-1)	Existence of Bike Lane I (one or both = 1, none = 0)*			0.2	0.4
(12-2)	Existence of Bike Lane II (both = 1, one or none = 0)*			0.2	0.4
(13)	Average Width of On-street Parking (both sides together) (ft.)	1.0	15.7	6.7	3.3
(13-1)	Type of On-street Parking (diagonal or perpendicular = 1)*			0.1	0.2
(13-2)	Existence of On-street Parking I (both = 1, one or none = 0)*			0.9	0.3
(13-3)	Existence of On-street Parking II (both = 1, one or none = 0)*			0.7	0.5

	D. Path Walkability Indicators Related to Sidewalks	Min.	Max.	Mean	Std. Dev
(14)	Sidewalk Coverage Rate (%)	55%	100%	96%	0.1
(14-1)	Existence of Sidewalk (binominal dummy variable)*			1.0	0.2
(15)	Average Width of Walking Zone (ft.)	2.8	7.9	5.1	1.0
(16)	Average Length of Sidewalk (ft.)	162.0	1097.5	442.4	156.1
(17)	Average Number of Driveway Curb-Cuts / 500 ft. Sidewalk	0.3	4.8	2.2	0.8
(18)	Percentage of Sidewalk Length with Special Pavement (%)	0%	100%	30%	0.4
(19)	Average Route Steepness**				
	E. Path Walkability Indicators Related to Sidewalk Facilities	**Min.**	**Max.**	**Mean**	**Std. Dev**
(20)	Percentage of Sidewalk Length with Visual Nuisance (%)	0%	100%	64%	0.3
(21)	Average Numbers of Street Furniture / 500 ft. Sidewalk	0.0	5.4	0.9	1.3
(22)	Average Number of Intermediaries / 500 ft. Sidewalk	0.0	25.0	3.2	5.2
(23)	Average Number of Street Trees / 500 ft. Sidewalk	0.7	15.0	5.9	3.3
(24)	Percentage of Sidewalk Length Covered by Tree Canopies (%)	15%	67%	39%	0.1
(25)	Average Ground-Level Luminosity after Sunset (fc.)	0.1	1.7	0.4	0.3
	F. Path Walkability Indicators Related to Street Scale and Enclosure	**Min.**	**Max.**	**Mean**	**Std. Dev**
(26)	Average Building-to-Building Distance (ft.)	0%	100%	64%	0.3
(27)	Average Building Height (ft.)	0.0	5.4	0.9	1.3
(28)	Average Skyline Height (ft.)	0.0	25.0	3.2	5.2
(29)	Enclosure Ratio I (Bldg.-to- Bldg. Dist. to Bldg. Height)	0.7	15.0	5.9	3.3
(30)	Enclosure Ratio II (Bldg.-to- Bldg. Dist. to Skyline Height)	15%	67%	39%	0.1
(31)	Street Enclosure Index I (abs(Enclosure Ratio I - 3.3))	0.1	1.7	0.4	0.3
(32)	Street Enclosure Index II (abs(Enclosure Ratio II - 3.3))	0%	100%	64%	0.3
(33)	Average Building Width (ft.)	0.0	5.4	0.9	1.3
(34)	Percentage of Sidewalk Length with Building Façades (%)	0.0	25.0	3.2	5.2
(35)	Average Building Setbacks (ft)	0.7	15.0	5.9	3.3
	G. Path Walkability Indicators Related to Nearby Buildings and Properties	**Min.**	**Max.**	**Mean**	**Std. Dev**
(36)	Average Pedestrian-Level Façade Transparency	1.6	4.5	2.9	0.7
(37)	Average Number of Street-Facing Entrances / 500 ft.	1.3	15.9	4.8	2.8
(38)	Average Number of Upper-Level Windows / 500 ft. Sidewalk	0.0	40.7	10.3	7.7
(39)	Fence Coverage Rate (% of Sidewalk Length with Fence) (%)	0%	55%	14%	0.1
(40)	% of Walking-Conducive (1st floor) Commercial Uses (%)	0%	100%	26%	0.3
(40-1)	Commercial (1st floor) Use of Adjacent Buildings (com.= 1)*			0.4	0.5
(41)	% of (1st floor) Residential Uses (%)	0%	97%	49%	0.3
(41-1)	Residential (1st floor) Use of Adjacent Buildings (R = 1)*			0.5	0.5
(42)	Mixed Use (1st floor) of Adjacent Buildings (mixed use = 1)*			0.0	0.1

* Binominal dummy variables

** Steepness was calculated only at the route level by using secondary data (DEM)

(Park 2008) pp74-75

Identified max/minimum values of Walking conductive indicators

Walking conductive maximum and minimum values has been extracted from the segment observation list on page 21. Walking conductive values goes in both direction which is stated below.

Below more specific explanation is showed how each indicator is calculated. Further info is needed on 5 indicators. These are marked in the list as FigA-E and can be viewed on page 23-24.

To the far right the specific values are shown. They are not to be used fundamentally but are values which indicate walkable street -segments. (Park 2008)

Legend

🔴 Represents indicators which is hard to regulate through spatial planning

🟢 Indicators that can be implemented through spatial planning

Explanation
For more information see FIG A-E on page 4

Walking conductive values

Factor	Path Walkability Indicators	Walking Conducive	Driving Conducive		Explanation	Walking conductive values	
Sidewalk Amenities	(22) Average Number of Intermediaries / 500 ft. Sidewalk	more	less	🔴	Number of items between commercial operations and pavement end, Such as chairs and tables/150m	25/150m	max
	(9) Number of Mid-block Crossings / 500 ft. Block Length	more	less	🟢	Number of pedestrian crossings between two Crossings/150m	1,3/150m	max
	(21) Average Numbers of Street Furniture / 500 ft. Sidewalk	more	less	🔴	Number of street furniture Such as mailboxes, benches, sculptures, etc., / 150m	5,4/150m	max
	(38) Average Number of Upper-Level Windows / 500 ft.	more	less	🟢	Number of windows facing the street on floors above ground floor/150m	40,7/150m	max
	(37) Average Number of Street-Facing Entrances / 500 ft.	more	less	🟢	Number of Entrances on buildings to segment / 150m	15,9/150m	max
	(25) Average Ground-Level Luminosity after Sunset (fc.)	higher	lower	🔴	How illuminated a path is after dark. This is measured in luminesce	1,7ifc	max
	(28) Average Skyline Height (ft.)	higher	lower	🟢	Average skyline height, Is total building hight/ total length of segment (7,5m)	7,5m	max
	(5) Number of Traffic Calming Elements / 500 ft.	more	less	🟢	Number of traffic calming elements such as traffic bumps /150m	4,6/150m	max
	(40) Percentage of Walking-Conducive Commercial Uses	higher	lower	🔴	Percentage of walking conductive commercial uses (FigA)	100%	max
	(36) Average Pedestrian-Level Façade Transparency	higher	lower	🟢	Average transparency of ground floor building in direct connection to street segment(B)	4,5	max
	(15) Average Width of Walking Zone (ft.)	wider	narrower	🟢	Average with of walking zone of the street segment	2,41m	max
	(27) Average Building Height (ft.)	higher	lower	🟢	Average value of total building height of buildings directly adjacent to street segment	1,65m	max
	(13) Average Width of On-street Parking (ft.)	wider	narrower	🟢	Average with of total parking area along the street-segment (both sides)	4,7m	max
	(34) Percentage of Sidewalk Length with Building Façades	higher	lower	🟢	Percentage length of paths bordered by buildings facades	25%	max
	(18) Percentage of Sidewalk Length with Special Pavement	higher	lower	🟢	Percentage of pavement Which has a special coating (FigC)	100%	max
	(39) Fence Coverage Rate	lower	higher	🟢	Percentage of length of street-segment lined with fences higher than 1.2 m	0%	min
Traffic Impacts	(7) Pedestrian Signal Coverage Rate	lower	higher	🟢	Number of signal regulated pedestrian crossings/Number of possible crossings for pedestrians	100%	min
	(3) Average Number of Traffic Lanes	less	more	🟢	Average number of traffic lanes for motor vehicles within street segment	2	min
	(8) Pedestrian Crossing Facility Design Index	lower	higher	🟢	Total value of crosswalks with respect to the Index over various standardized crossings (FigD)	0,2	min
	(33) Average Building Width (ft.)	narrower	wider	🟢	Average with of adjacent buildings to street-segment	0m	min
	(6) Pedestrian Crossing Coverage Rate	lower	higher	🟢	Average number of possible pedestrian crossings / existing. Maximum 6 per segment	100%	min
	(1) Average Width of Curb-to-Curb Roadway (ft.)	narrower	wider	🟢	Average width of sidewalk to sidewalk. May include cycle path, and parking	8,84m	min
	(2) Average Width of Traffic Zone (ft.)	narrower	wider	🔴	Percentage use of adjacent buildings Ground floor is used as dwelling/s.	4,85m	min
	(41) Percentage of Residential Uses (1st floor frontage)	higher	lower	🔴	Percentage length of sidewalks or walkways covered by a tree crown	97%	max
	(24) Percentage of Sidewalk Covered by Tree Canopies (%)	higher	lower	🟢	Average cycle path width along the observed segment	67%	max
	(12) Average Width of Bike Lane (both sides together) (ft.)	narrower	wider	🟢	Enclosure index 2 is short average street width / average height of buildings. (FigE)	0m	min
Street Scale & Enclosure	(4) Average Width of Through Traffic Lanes (ft.)	narrower	wider	🟢	Enclosure Index 1 is average building to building distance straight across the street.	2,35m	min
	(30) Enclosure Ratio in Cross Section II (BB Dist to Skyline)	lower	higher	🟢	Average width between buildings along street-segment	67%	min
	(29) Enclosure Ratio in Cross Section I (BB Dist to Bldg. Ht.)	lower	higher	🟢	Average of forecourt land to buildings along street-segment	4,5m	min
	(26) Average Building-to-Building Distance (ft.)	narrower	wider	🟢	Average number trees/150m along the street segment area designated for pedestrians.	100%	min
	(35) Average Building Setbacks (ft)	smaller	larger	🟢	Average with of Traffic dividing elements between motor vehicles and pedestrian designated area.	0,21m	min
Land-scaping Elements	(23) Average Number of Street Trees / 500 ft. Sidewalk	more	less	🟢	This can be trees, grass, etc.	15	max
	(11) Average Width of Landscape Strip (both sides) (ft.)	wider	narrower	🟢	Average with of traffic buffer zone along street segment. This may include same as above but also	2,19m	max
	(10) Average Width of Buffer Zone (both sides together) (ft.)	wider	narrower	🟢	parking with and other non ¨green¨ elements	1,16m	max

(Park 2008) pp138-139}

(Park 2008) pp138-139

(A) Walking conductive comercial services

Number of walking conductive commercial activities /tot number of comercial activities

Appendix 2. List of Walking-Conducive and Non-Walking-Conducive First-Floor Uses

Walking-Conducive Commercial Uses Found in My Study Site

- Retail Offices: (banks, Insurance agencies, travel agencies, law firms, real estate agencies)
- Non-Academic Classes: (aerobics, gymnastics, martial arts, ballet, yoga)
- Beauty & Style: (hair salons, nail shops, skin cares, barbers)
- Home improvement and house wares: (kitchenware, carpet, coin-laundry, furniture)
- Specialty Shops: (quilts, antiques, souvenir, gift shops, cigar shops, pet shops, Jewelers)
- Health Services: (dentistry, acupunctures, fitness, opticians/eye clinics/ vision cares/ glasses, chiropractics)
- Restaurants: (fast foods, cafes, coffee shops, restaurants, pizzas, pubs)
- Food-related Retail: (liquor stores, convenient stores, groceries, supermarkets, bakeries, ice cream stores)
- Other Small Retail Stores: (photo shops, locksmiths, flowers, watch repairs, computer stores, copy shops, book stores, cell phones)

Non-Walking-Conducive Commercial Uses Found in My Study Site

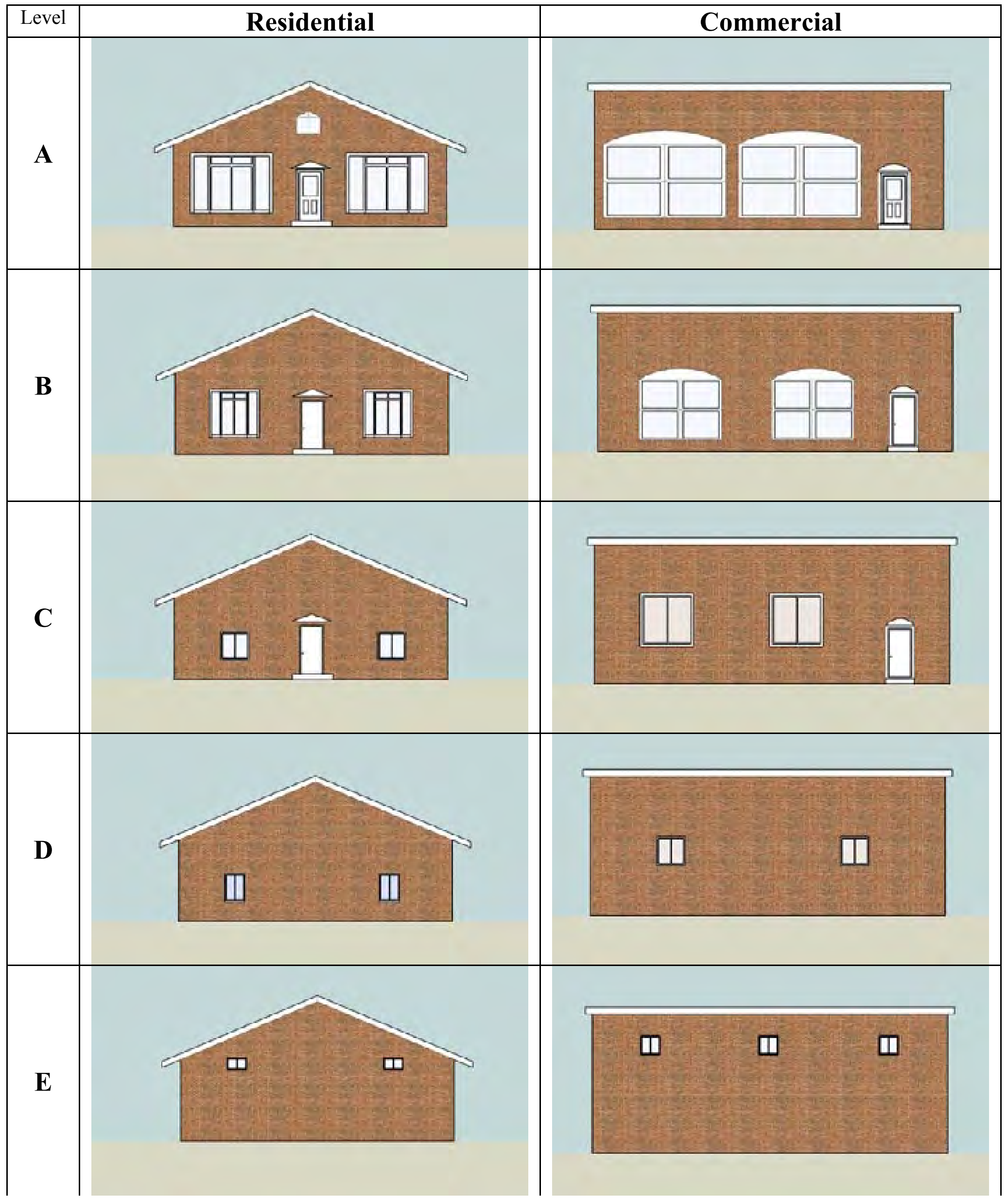
- Construction-Related Businesses: (building materials, construction equipments, paint stores, glass shops, construction consultants)
- Auto-related businesses: (car washes, body shops, auto dealers, rental cars, oil changers, parking structures, gas stations)
- Warehouses and Storage Buildings

(B) Transparancy grading

Each facade is given a value regarding to the picture it most correspond.

A-E is given a value of A=5,B=4 and so forth.

The added value is divided by the total number of facades



(C) Sidewalk special paving

Percentage of sidewalk covered in special paving which means all other material then asphalt or solid concreete

(Park 2008) pp138

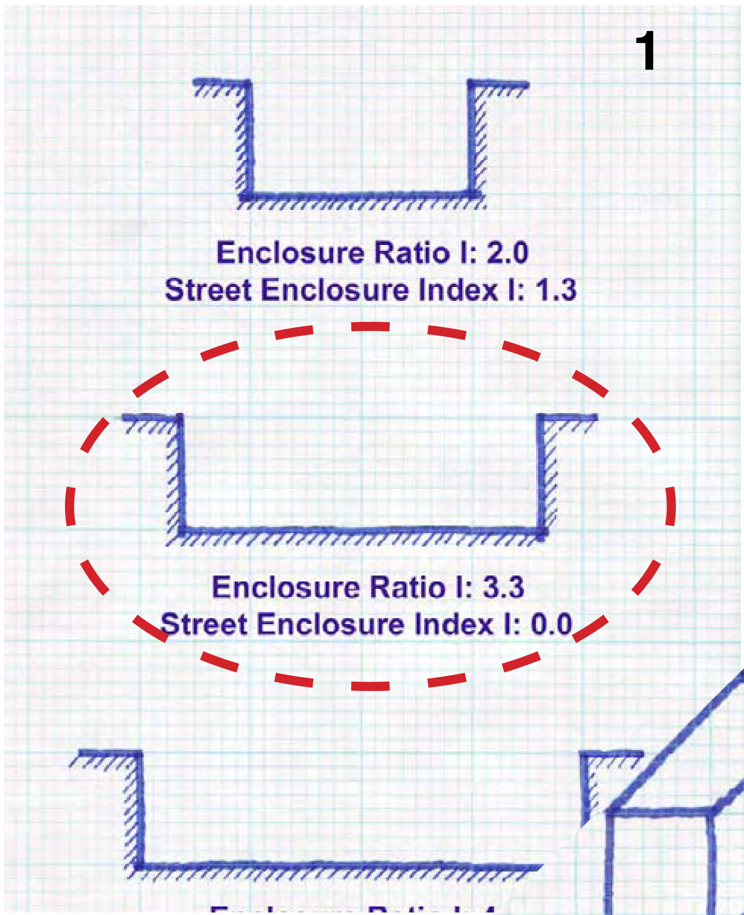
(D) Pedestrain crossing index

This is a standardised index over diffrent types of pedestrain crossings within a street segment. Each crossing is given a value regarding to the description that fits best with the description. The total value is added up and divided with the total ammount of crossings in the street-section.

Points	Description:
5	Crossing with traffic lights for pedestrains
4	Marked with stop signs
3	Marked with Zebra stripes
2	Marked with lines crossing traffic lanes
1	Stop-sign only

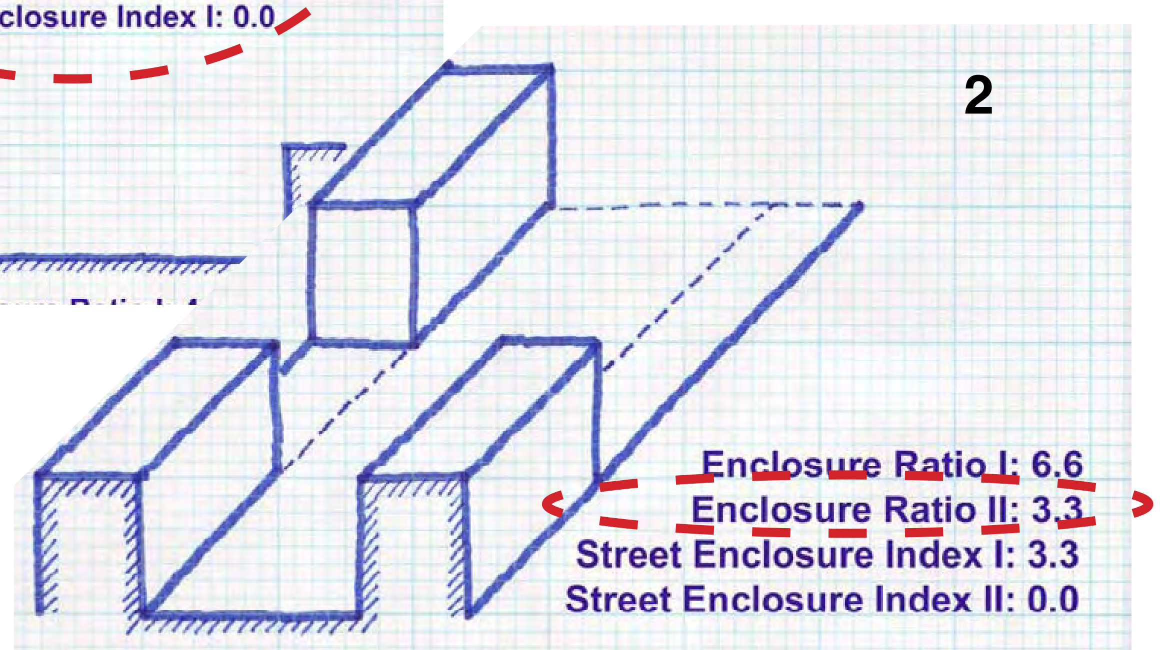
(E) Enclosure Index 1

This measures the avarage of building to building distance/ building height along segment. As shown below, a walking conductive value should be not to low nor high. 3,3 is recomendede.



Enclosure Index 2

It is measured in the same way as 1 but instead of building height its the avarage skyline hight



(Park 2008) pp136-138

Pros and cons of Walkability

Pros

Walkability promotes an urban environment which can accommodate less environmentally straining transport.

People will come closer together physically by concentrating them on less space. Thus giving a higher chance of encounters with others.

Promotes a denser urban environment which can accommodate more people on less space. Thus creating a higher level of demand for local services.

Third party meeting point will increase with walkability. As discussed these can be for example Bars, Cafés or a gym. These places has been shown to be important for integration since they are both formal and informal.

A more walkable urban design can accommodate more green-space contributing to better air quality.

Daily exercise will be greater due to promotion of non motorised transportation. Thus contributing to better health within the community. People that live in more walkable neighbourhoods tended to conduct significantly more physical activities than car dependant areas. (Eriksson 2014)

Closer between goals and destinations because of mixed use development. Which means less transportation and less environmental impacts(Park 2008).

More space in the built environment will be left to use for recreational purposes such as parks. This because of less or limited traffic.

A safer traffic environment with lower speeds for motor-vehicles or none where its possible. Street design will be conducted so that it physically states whom has priority. For example heighten crosswalks to the same hight as sidewalks. (Southworth 2005)

Cons

Walkability is hard to measure, there is no universally proven method that can quantify factors. Thus only factors which has more or less importance for walkability can be presented and implemented.

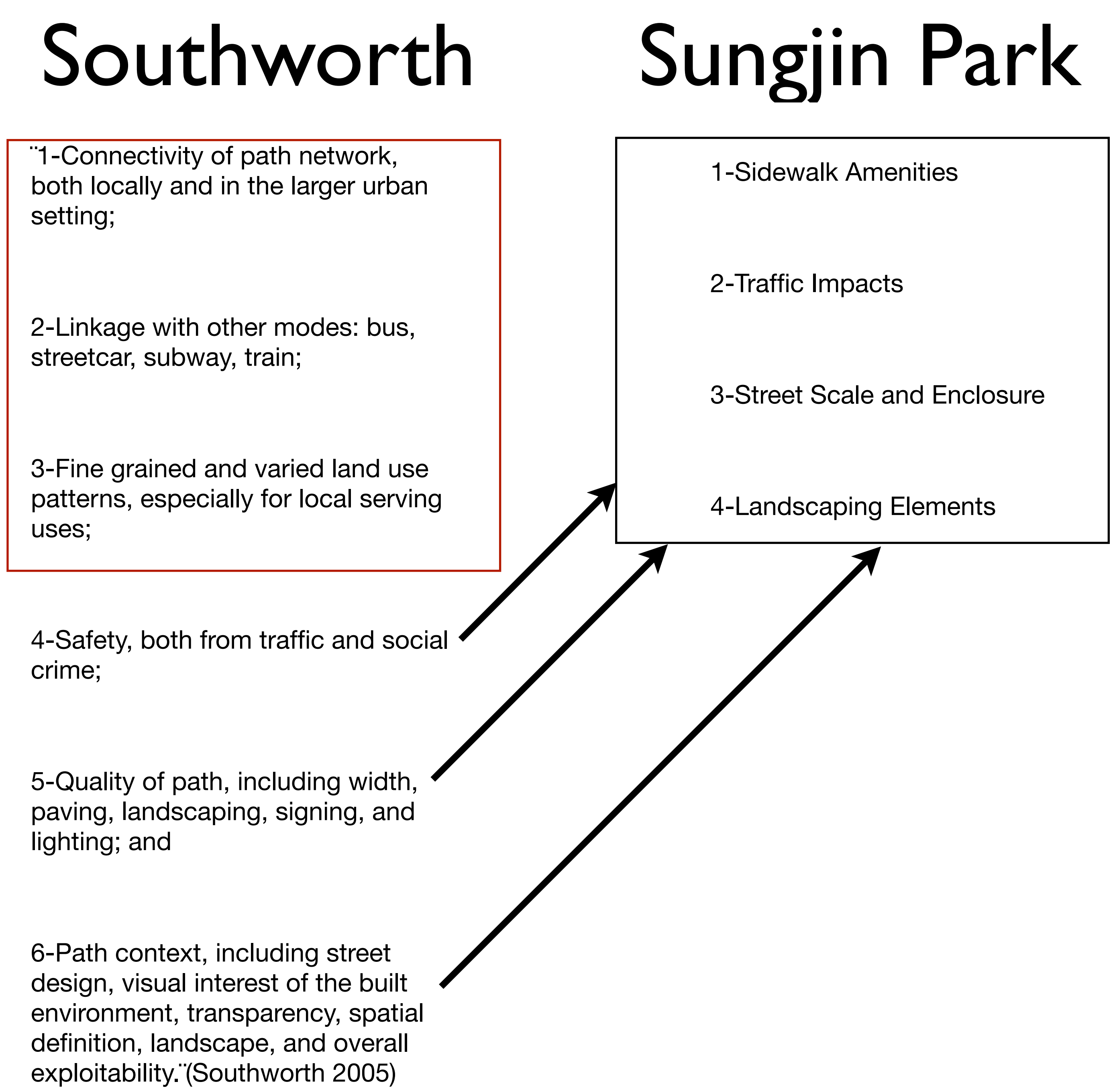
It has been shown that certain factors of walkability differ in-between countries and continents. For example vegetation and street trees makes a neighbourhood more walkable. But still some European cities like Bologna has limited vegetation and instead its the life in the streets that promotes walkability. (Southworth 2005)

Walkability as a construct is wide and un precise and lacks a scientific unified definition. Therefore making it difficult to implement and reproduce.

Since a local area never on its own can be walkable without being a pedestrian Island, It will be hard to change already built environments. (Southworth 2005)

Climate does have an impact on Walkability where a colder climate makes people walk less.

Walkability originates from North America and such most of the recommendations of the construct. It is therefore uncertain if the same factors could be applied for example in Europe.



Discussion

Walkability is uncertain as a planning construct to aid in urban planning and design schemes. Since researchers points towards strategic implementation from planning authorities without a definition such strategies may vary over time. Thus creating uncertainty among authorities making it unappealing. A solution could be to quantify data both of peoples perception locally what they perceive what a walking friendly street or area consists of.

Walkability as a construct has its main focus on built design and does not involve much of social factors such as age or income. This gives the concept both its limits and weak side. There might be other opinions on what is a walkable area within different communities locally. Researchers like Sungjin Park has proven that Walkability can be quantified at-least locally by comparing local preferences of walkable environments to academic research. By this he created a Walkability index which can quantify the built environment and certain factors. He proved that certain factors is more important than others in terms of physical elements. His research is particular interesting in my project because he examines choice of mode of transportation to and from a station. He found that Walkability indicators will be of significant importance for choice of transportation. Instead of uncertain claims he has proven these factors.

But within a new development some of the indicators as shown are harder to implement. Since his walkability Index is first and foremost a analytic tool of street segments. (Park 2008).

What physical elements in urban environments makes walking more attractive as a mode of transportation?

The indicators of walkable conductive measurements extracted from Sungjin Parks research is proven to affect mode of transport within his Case study. As mentioned walking conductive elements are not universal but factors such as few designated crosswalks, frontages of buildings are poorly defined, large parking lots in front of buildings, sidewalks which are constantly interrupted by driveways to parking, has similarities to his indicators.

Transparency of buildings, speed-bumpers, raised crosswalks is also similarities stated by Southworth regarding element which improves walkability.

The question is broad which makes it hard to answer but strong similarities between Sungjin Park and Southworth exists. The only difference is that Sungjin Park has quantified the elements whereas Southworth gives a broader direction.

The extracted indicators will therefor be viewed in this paper as physical elements which does make walkability more attractive as a mode of transportation.

Graphical walkability chart

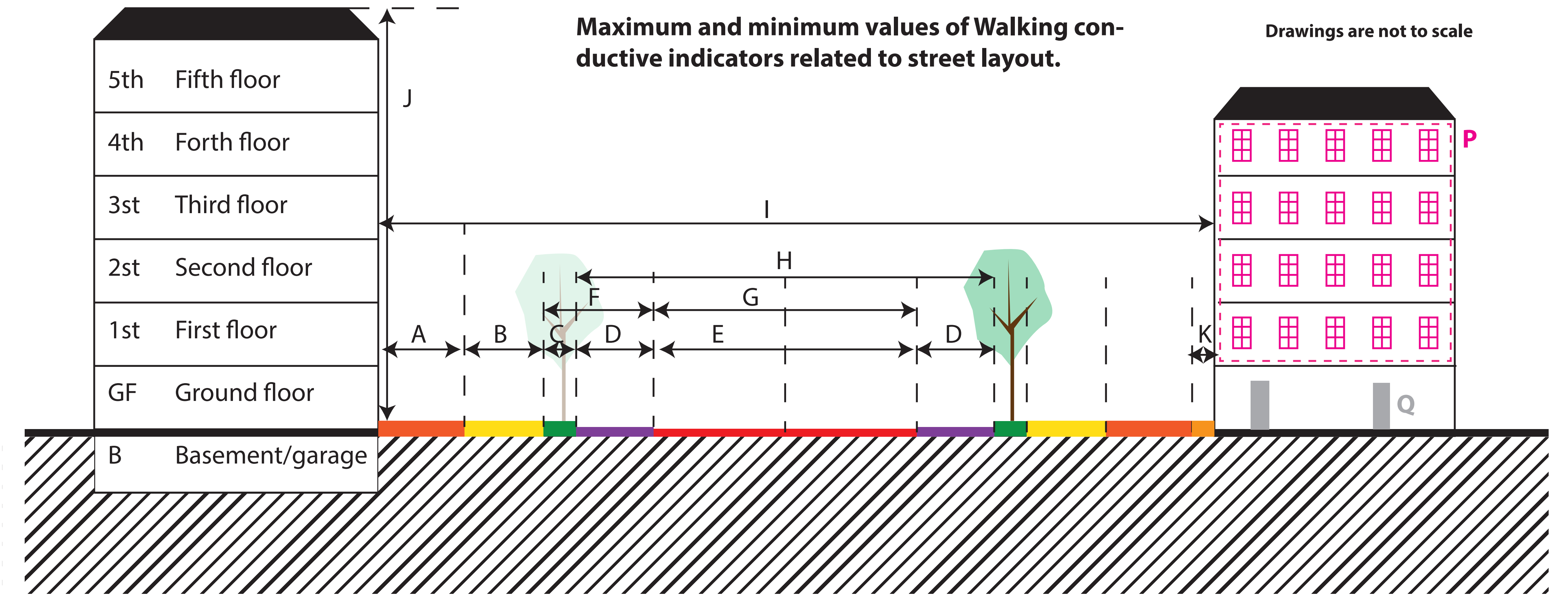
Now the factors found with green indicators on page 5 are presented graphically to the left of this page together with related values.

The following pages will analyse each indicator named with letters. The equation used will be presented to the left of each chart related to the indicators. Within most of the equations its about finding the average value therefore some standard values will be presented below:

L=Section length=300
A=Area
W=which
N=Number of polygons/Elements
Wn=Average width= (W=A/L)/n
Wd=Average distance of curb to curb= (W=A/L)

Maximum and minimum values of Walking conductive indicators related to street layout.

Drawings are not to scale



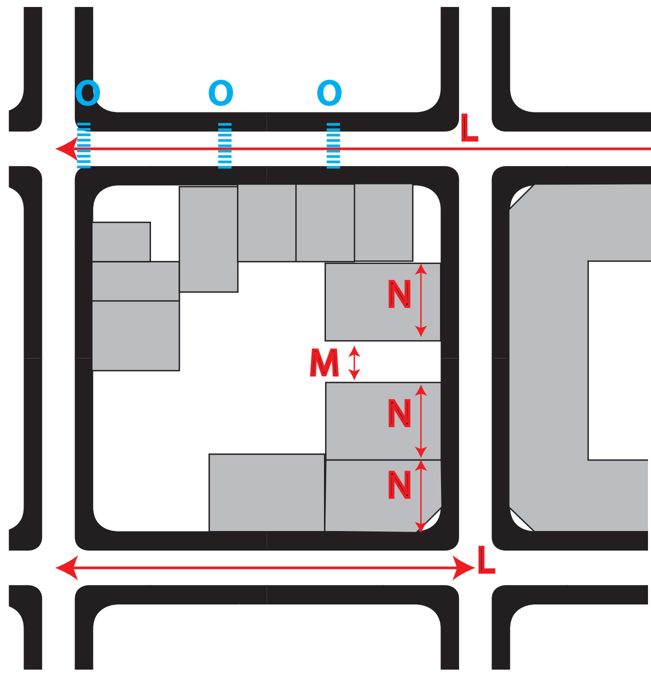
Legend street element

(above arangement is just an example)

A- With of walking path
B- With of Cycling path
C- Traffic dividing element
D-With of Parking
E-Number of Traffic lanes
F- With of bufferzone
G-With of motorvehicle traffic space
H-Curb to curb traffic zone
I-Enclosure index 1, With between buildings
J-Hight of buildings
K-With of building setback
Q-Tot ammount of entrances to segment

Related guidelines

A	>=2,41m
B	=0m
C	>=2,5m
D	>=4,5m
E	=2 traffic lanes
F	>=2,19
G	=6,02m
H	=8,4m
I	100%(See FigE)
J	67%(See FigE)
K	<=0,21m
L	Undefined
M	(less)
N	(less)
O	100% 6/6 crossings/150m
P	40,7/150m
Q	>=15,9/150m



L-Street segment (section of street between the middle of 2 crossings. the sections length is not limited

M- With between buildings

N-With of building fasad, All fasades together divided with section length gives fasad coverage (%).

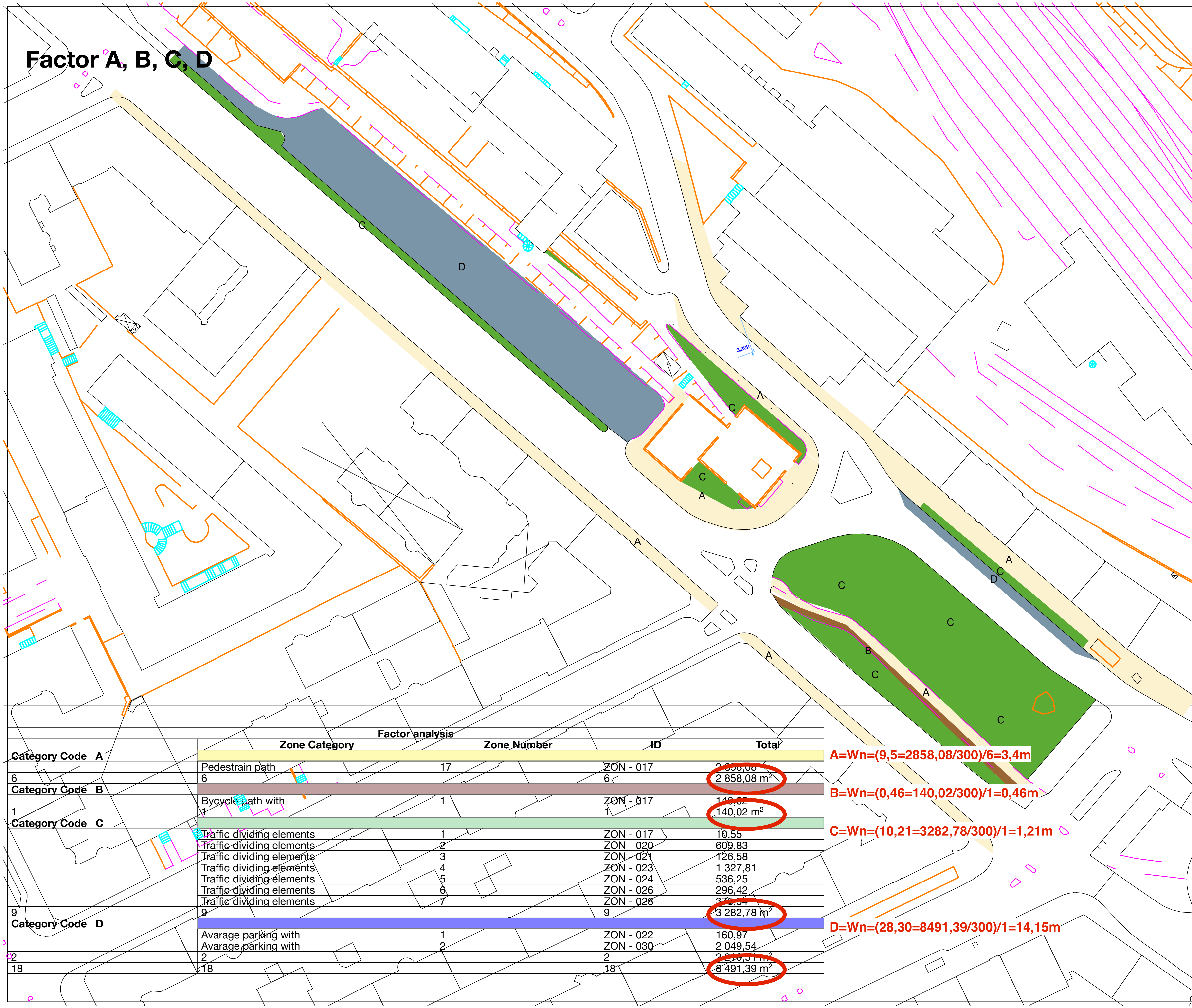
O-Pedestrain crossing

P-Avarage amount of windows on upper level of buildings along segment

Analyze a street section of Valhallavägen


Usage map
A
B
C
D
E
F
G
H
I
J
1
2
3
4
5
6
7
8
0
25
50
100
1:1000
(22)
Groundfigure and usage map
Appartment buildings
Traffic space
Parking
Green space
Tree
Refuges
Space not included in analysis
Brick walls
Pedestrain paths
Pavement
Analysis boundary
Street section boundary
Forecourt soil

Factor A, B, C, D



Factor analysis				
	Zone Category	Zone Number	ID	Total
Category Code A				
	Pedestrain path	17	ZON - 017	2 858,08
6	6		6	2 858,08 m²
Category Code B				
	Bycycle path with	1	ZON - 017	140,02
1	1		1	140,02 m²
Category Code C				
	Traffic dividing elements	1	ZON - 017	10,55
	Traffic dividing elements	2	ZON - 020	609,83
	Traffic dividing elements	3	ZON - 021	126,58
	Traffic dividing elements	4	ZON - 023	1 327,81
	Traffic dividing elements	5	ZON - 024	536,25
	Traffic dividing elements	6	ZON - 026	296,42
	Traffic dividing elements	7	ZON - 028	375,34
9	9		9	3 282,78 m²
Category Code D				
	Avarage parking with	1	ZON - 022	160,97
	Avarage parking with	2	ZON - 030	2 049,54
2	2		2	2 210,51 m²
18	18		18	8 491,39 m²

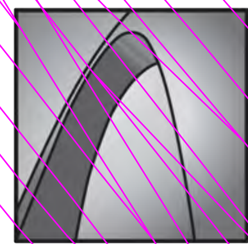
A=Wn=(9,5=2858,08/300)/6=3,4m

B=Wn=(0,46=140,02/300)/1=0,46m

C=Wn=(10,21=3282,78/300)/1=1,21m

D=Wn=(28,30=8491,39/300)/1=14,15m

Cours and Project name



Att utvärdera Arkitektur, Kungliga Tekniska Högskolan

Job Title

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Drawing Name

Factors ABCD

Drawing Status

#Project Status

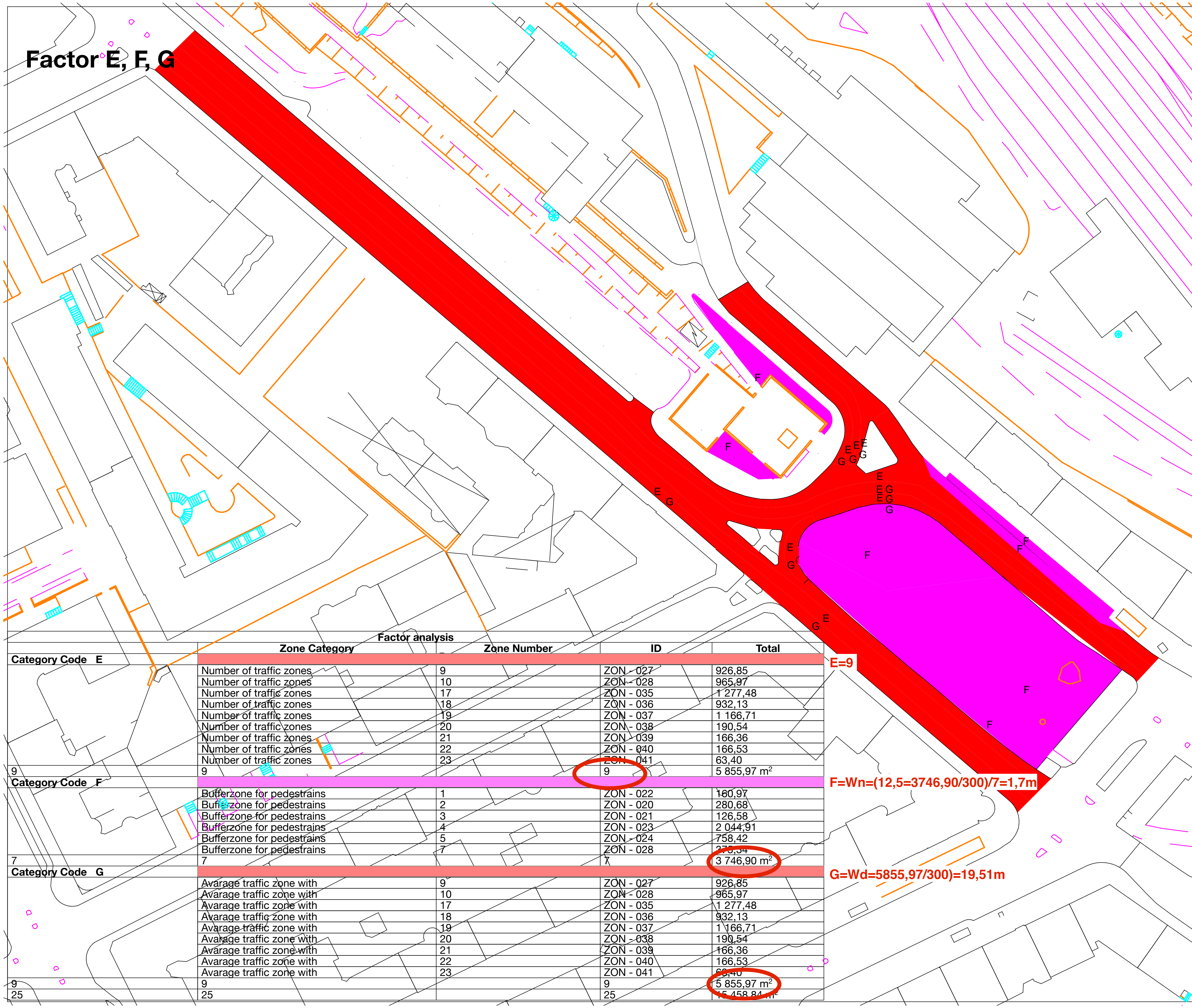
Drawn by **David Olsson Jones** Date

Checked by Date

Drawing Scale **1:1000**

Layout ID **A.01** Status Revision

Factor E, F, G



Factor analysis

	Zone Category	Zone Number	ID	Total
Category Code E				
	Number of traffic zones	9	ZON - 027	926,85
	Number of traffic zones	10	ZON - 028	965,97
	Number of traffic zones	17	ZON - 035	1 277,48
	Number of traffic zones	18	ZON - 036	932,13
	Number of traffic zones	19	ZON - 037	1 166,71
	Number of traffic zones	20	ZON - 038	190,54
	Number of traffic zones	21	ZON - 039	166,36
	Number of traffic zones	22	ZON - 040	166,53
	Number of traffic zones	23	ZON - 041	63,40
9	9		9	5 855,97 m²
Category Code F				
	Bufferzone for pedestrains	1	ZON - 022	160,97
	Bufferzone for pedestrains	2	ZON - 020	280,68
	Bufferzone for pedestrains	3	ZON - 021	126,58
	Bufferzone for pedestrains	4	ZON - 023	2 044,91
	Bufferzone for pedestrains	5	ZON - 024	758,42
	Bufferzone for pedestrains	7	ZON - 028	[illegible]
7	7		7	3 746,90 m²
Category Code G				
	Avarage traffic zone with	9	ZON - 027	926,85
	Avarage traffic zone with	10	ZON - 028	965,97
	Avarage traffic zone with	17	ZON - 035	1 277,48
	Avarage traffic zone with	18	ZON - 036	932,13
	Avarage traffic zone with	19	ZON - 037	1 166,71
	Avarage traffic zone with	20	ZON - 038	190,54
	Avarage traffic zone with	21	ZON - 039	166,36
	Avarage traffic zone with	22	ZON - 040	166,53
	Avarage traffic zone with	23	ZON - 041	[illegible]
9	9		9	5 855,97 m²
25	25		25	15 458,84 m²

E=9

F=Wn=(12,5=3746,90/300)/7=1,7m

G=Wd=5855,97/300)=19,51m

Cours and Project name

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Factors EDF

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Drawing Scale

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Layout ID | Status | Revision

A.01

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Factor H, K, Q

Factor analysis

	Zone Category	Zone Number	ID	Total
Category Code H				
	Avarage pavement to pavement distance	4	ZON - 023	2 325,93
	Avarage pavement to pavement distance	5	ZON - 024	758,42
	Avarage pavement to pavement distance	9	ZON - 027	926,85
	Avarage pavement to pavement distance	10	ZON - 028	965,97
	Avarage pavement to pavement distance	17	ZON - 035	1 353,70
	Avarage pavement to pavement distance	18	ZON - 036	932,13
	Avarage pavement to pavement distance	19	ZON - 037	3 699,35
	Avarage pavement to pavement distance	20	ZON - 038	190,54
	Avarage pavement to pavement distance	21	ZON - 039	166,36
	Avarage pavement to pavement distance	22	ZON - 040	166,53
	Avarage pavement to pavement distance	23	ZON - 041	63,40
11	11		11	11 549,18 m²
Category Code K				
	Avarage forecourt distance	26	ZON - 044	1 515,97
	Avarage forecourt distance	27	ZON - 045	433,39
	Avarage forecourt distance	28	ZON - 046	270,80
	Avarage forecourt distance	29	ZON - 047	143,10
	Avarage forecourt distance	30	ZON - 048	105,71
	Avarage forecourt distance	31	ZON - 049	160,49
	Avarage forecourt distance	32	ZON - 050	671,28
7	7		7	3 300,74 m²
Category Code Q				
	Total ammount of entries facing street	33	ZON - 051	153,66
	Total ammount of entries facing street	35	ZON - 053	30,06
	Total ammount of entries facing street	37	ZON - 055	70,56
44	44		44	254,28 m²
62	62		62	15 104,20 m²

H=Wd=11549,18/300)=38,5m

K=Wn=(11=3300,74/300)/7=1,57m

Q=62

Cours and Project name

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Factors EDF

Drawing Status

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Drawing Scale: 1:1000

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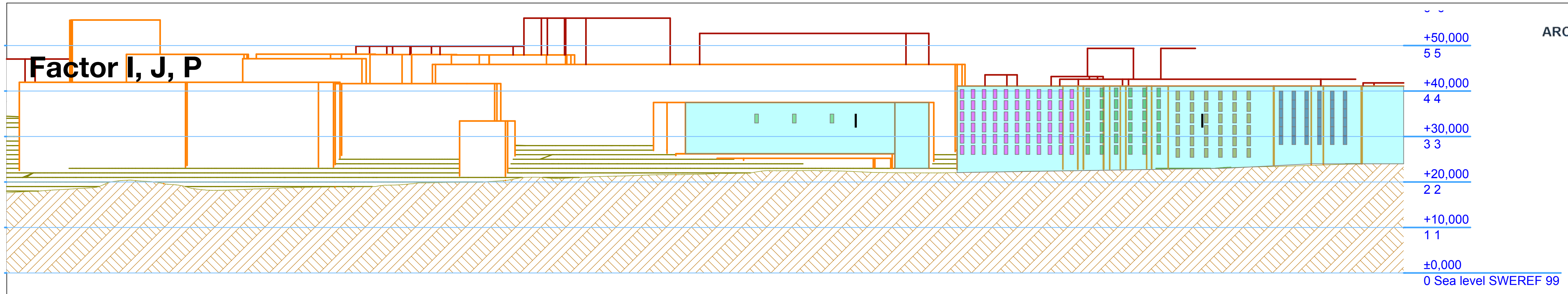
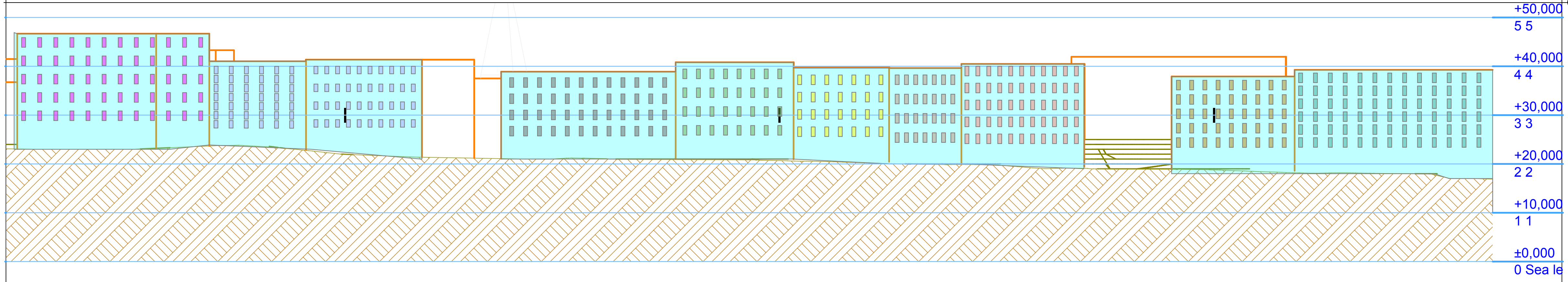
Factor I, J, P



1:1000 NORTH ELEVATION



1:1000 SOUTH ELEVATION

P, Avarage above ground floor windows facing street segment	
	Area+ number of windows/building
ID 3	
	4,74
	3
ID 4	
	104,28
	66
ID 5	
	56,88
	36
ID 6	
	56,88
	36
ID 7	
	56,88
	36
ID A	
	123,24
	78
ID B	
	71,10
	45
ID C	
	86,90
	55
ID D	
	44,24
	28
ID E	
	44,24

P, Avarage above ground floor windows facing street segment	
	Area+ number of windows/building
	28
ID F	
	50,56
	32
ID G	
	75,84
	48
ID H	
	49,20
	40
ID I	
	51,66
	42
ID J	
	94,80
	60
	633

Note
633 is the total amount of windows facing the street section.
P=633/16=39,5

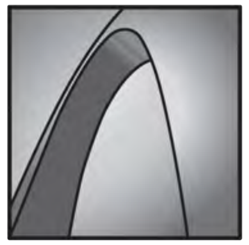
I, Enclosure Index 1, Total Fasad Area/ Total Segment area	
	Area of Fasades along segment
ID SFI - 041	
	5 426,93
ID SFI - 046	
	519,51
ID SFI - 047	
	108,32
ID SFI - 048	
	1 773,32
	7 828,08 m²

Note:
7828m2 is divided with the total analysed area of the segment which is 60,2x306=18421m2

7828/30509=0,25
I=0,25

J=16m

Cours and Project name



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Drawing Name
Factor I, P
Enclosure index(I)
Avarage above ground floor windows(P)

Drawing Status

Drawn by
David Olsson Jones
Date

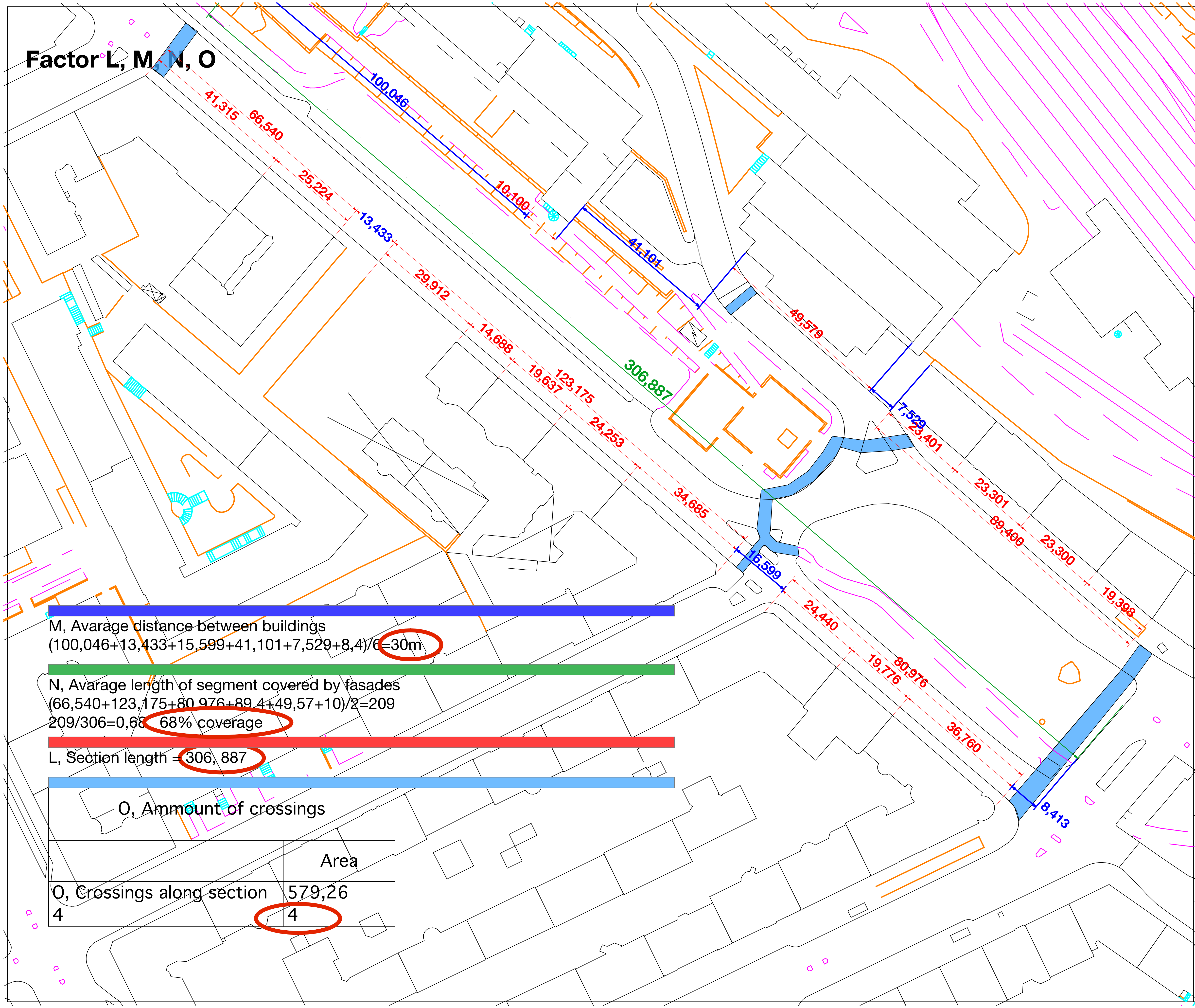
Checked by
Date

Drawing Scale
1:1000, 1:1

Layout ID
Status
Revision
Factor sheet 4

ARCHICAD EDUCATION VERSION
GRAPHISOFT

Factor L, M, N, O



M, Avarage distance between buildings
(100,046+13,433+15,599+41,101+7,529+8,4)/6=30m

N, Avarage length of segment covered by fasades
(66,540+123,175+80,976+89,4+49,57+10)/2=209
209/306=0,68 68% coverage

L, Section length = 306, 887

O, Ammount of crossings

	Area
O, Crossings along section	579,26
4	4

Cours and Project name

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Drawing Name **Factor M, N, O, P**

M,Avarage with between buildings
N, Avarage Fasade coverage length
O, Section Length

Drawing Status

Drawn by Date
David Olsson Jones

Checked by Date

Drawing Scale
1:1000, 1:1

Layout ID Status Revision

Factor sheet 5

Results and Discussion


facades
prefix: 1


Facade prefix:
2, Rating= E


Facade prefix:
3, Rating= B
OMEGA
DÄCKSERVICE


Facade prefix:
4, Rating= A


Facade prefix:
5, Rating= A


Facade prefix:
6, Rating= A
DINO


Facade prefix:
7, Rating= A


Facade prefix:
A, Rating= C
Mr. CAP


Facade prefix:
B, Rating= C
PIERCING

Results of the ground level transparency test

Accordingly to Transparency index the lower part of the section had a low transparency rating due to lack of buildings. The average transparency being the value of each building =49/16=3
This means that the analysed street section has a middle value of 3 which could be improved with more buildings with openings towards the street section. The north eastern buildings contributes mostly for the mediocre rate.

Results of factors

The meaning of each factor can be found on page 14 graphical diagram together with the further explanations on page 9-11. Each factors equation for the results are showed next to each diagram on page 16-21.

A=3,4

The average with of the walking paths was fairly moderate where the sidewalks was narrow on the western side of the section and this is also where improvement might need to be done even though the results did achieve guideline.

B=0,46m

Within this street section theres only one cycling path running in the middle section of the street. Bicycle paths counts only if they are directly adjacent to pedestrian paths accordingly to Sungjin Park. Surprisingly bicycle paths are now walking conductive and even with this low medium with it fails the guideline.

C=1,21m

The traffic dividing elements in the section are composed of a green space between traffic with trees and bushes. This is complemented by smaller trees in the north eastern sidewalk while the northern section lacks traffic dividing elements. This indicator fails due to its number of different traffic dividing zones being high but fairly narrow on average.

D=14,14m

Except for some sidewalk parking in the north east this section only has a large parking lot to the north it does meet the guideline limits. However accordingly to sungjin park for it to be walking conductive it has to function as a buffer-zone between pedestrians and traffic which it does not today.

E=9

Fairly high number as such doesn't meet the guidelines. The section is heavily trafficked and functions as one of the main arteries to the city of Stockholm.

F=1,7m

Buffer-zone does not meet guidelines this is due to the lack of protective space between Pedestrians and traffic. North eastern sidewalks are directly connected to heavy traffic which poses safety concerns.

G=19,51m

The average with of the motor-vehicle traffic zone within the segment extents greatly above the minimal value of 6,02m due to the heavy traffic and amount of lanes in the segment. Quick turns and the speed of traffic requires more space. With a lower speed the space used could be limited together with the amount of lanes.

H=38,5m

Within the average curb to curb traffic zone distance the parking lot to the far north was included together with the inaccessible southern green-space. The reason for this was that I found that the parking space has a flat paved surface not on pedestrian curb level with traffic that enters and exits on north and south ends making it a drive through. The greens-pace to the south was also counted because it has little or nothing to do with the pedestrian paths adjacent to the buildings. However its hard to determine its role in the street section is it a part of buffer-zones or a part of traffic-zone. However this factor does not meet guidelines even if the greens-pace would be counted.

I=0,25

The street enclosure index is low which means it does not meet the requirements. The distance between the north and south building facades are to great together with the gap of buildings to the north. The northern hotel is not counted as a facade due to its relative setback from the rectangular section of the street as showed on page 15.

J=68%

Does correspond to guidelines but could improve if the north eastern section was developed with more buildings facing the street segment.

K=1,57m

Setback of buildings does not correspond with guidelines due to the space between pedestrian paths in the northeast part of the section mainly as well as middle section.

L=300m

Length of section which is standard for Sungjin parks factors.

M=30m

Average building gap with is high but as mentioned before it has to do with the building gap to the north east and one small north-east.

N=27,8m

N=tot length of facades/n of facades. Since theres is no particular length stated to be walking conductive Sungjin park has stated a lesser width is preferable. Variation in urban space is walking conductive as such are a higher volume of buildings which are smaller giving the pedestrian visual interest.

O=4, 75%

The amount of crossings does not correspond with the guidelines. The count has only been done for the crossings that lets the pedestrians cross the whole traffic space as defines on page 18. The north eastern section need more pedestrian crossings.

P=39,5

Upper level amount of windows facing the street segment doesn't meet guidelines as such due to the building gap to north-east. There is also an issue with the concrete building facade showed on page 23 which poses 49,9m of the total facade length of the segment but only has 3 windows.

Q=62

Entrances towards the street segments are above guidelines even though theres a gap in the amount of buildings facing to the north-east.

Discussion

The results showed that there was a lack in buffer-zones between pedestrians and traffic.
Traffic area of the section is significantly wide compared to surfaces available to pedestrians.
Enclosure of the street section is low due to the lack of facades meeting the section at the Eastern part.
The neo-classical facades towards the street section has open ground floors with transparent above level arrangement of windows. It is the more modern development to the North-East that lacks entrances, windows and transparency. They are also characterised by large set-back from pedestrian paths.
Natural height differences in the northern part of the section does impose difficulties to develop close to the existing Valhallavägen therefore one can understand why the form is built as it is.
The parking loot could be developed with mixed use development and with the high land-value new parking could be arranged underground. Buffer-zones between Pedestrians has to be arranged together with widening of the north-west sidewalk to make more efficient use of the existing commercial ground-floor facilities.

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