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Central Station Hubs Design and Principles
Case of Ramses Station Cairo, Egypt

A thesis submitted in partial fulfillment of the requirement of the M. Sc in Urban Planning Engineering

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I the undersigned, hereby declare that this dissertation submitted to Ain Shams University, Faculty of Engineering for the degree of M. SC in Urban Planning. The work included in this thesis was carried out by the author in the department of Urban Planning.

No part of this thesis has been submitted for a degree or qualification at any other university or institution or to achieve any degree and that all the references to the work of other authors have been duly acknowledged.

Fatma Ibrahim Mohamed

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List of Abbreviations

NDP: National Democratic Party

NOUH: National Organization For Urban Harmony

CBD: Central Business District

LRT: Light Rail Transit

TOR: Terms of reference

ENR: Egyptian National Railway

CTA: Cairo Transportation Authority

NAT: National Authority of Transportation

Introduction

Introduction

The transportation system consists of a complex array of roads, highways, bridges, ferries, ports, public station, and bike and walking paths that allow people and goods to get from one place to another. These systems, along with their design and construction, help shape communities and affect the health of the people who live, work, and play in them.

The intent of Station Planning and Design is to provide a mechanism that simplifies the approach to station planning also to provide a comprehensive framework to ensure consistency and clarity of station design. The Guidelines also outline the optimal requirements for the building of efficient, functional, and harmonized station areas. To provide for a comprehensive understanding of the approaches and framework requirements, the guidelines steer the reader from the broader goals and objectives down to the specific building blocks that help achieve the common system requirements.

For many years the consensus on Station design principles has been carried out by different organizations and institutions to develop how to measure progress towards station design.

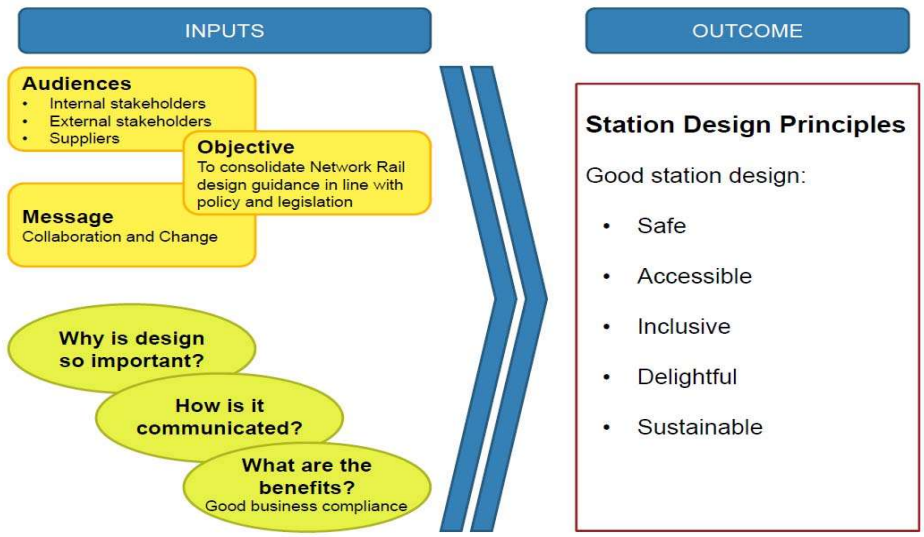


Figure 1: What make Good Station Design?
Source: DfT Better Rail Stations Report 2009

Keywords:

Transportation hub - Smart transportation - Urban Environment - Station Typology

Problem Definition

Ramses Square as the focal point of major movement for transportation modes and networks in Cairo, has different zones of influence, suffers from population increase, traffic congestion, confusion of uses and functions, therefore a different negative impacts of existing physical elements like:

- The intersection between 6th. October flyover, Roads Network, Metro Line, and buses line create Noise, traffic, and chronic accidents.
- Negative physical impacts on the space of the square from the 6th. Of October flyover which was constructed in the seventies, and also bottlenecks through the pass way of the flyover taking into consideration the difficulty of extending the width of the flyover in some points on the station route for solving these problems, so a change on the route of 6th. October flyover shall be considered.
- Negative impact of the new overhead pedestrian bridges which were constructed in the square and did not succeed in fulfilling their purpose to facilitate the movement of pedestrians in all directions. This problem leads to a rethink of other alternatives instead of these bridges.
- Bad condition of the current parking lots, in terms of location, capacities, their entrances and exits, which are not satisfying for the traffic loads and the movement of pedestrians.
- Disorganization of pedestrian traffic in the square, which requires reorganization and consideration from the entrants who can study the possibility of using the existing underground pedestrian tunnels in their proposals.
- Ramses station at Ramses square is Cairo's major railway terminal, however the station buildings and platforms need upgrading in many aspects.

Problem Identification

1. ***Research Questions:-***

The new wording in that research need to be define as we study the hubs in different fields also we need to focus in the design process and the principles and

main criteria of the transportation & central station hubs, so that we would answer the main research question

- Why Hub & Why Ramses Area?
- What are central station hubs mean and what are its objective and main principles?
- What is the difference between central station and central station hubs?
- What is the impact of the central station hubs in cities planning?

2. Hypothesis:-

The central station hub as a main transport hub which interfacing and interconnecting a variety of public transportation system to cover the city agglomeration and new suburbs with different mode of activities and Facilities leads to crowds & travel fatigue overcome, It also helps in solving the traffic congestion for the cities center, so that it attract the inhabitants and leads to urban development.

3. Research Justification:-

The main aim of this research is to develop a set of principles suitable to the context of Ramses area. Therefore, it can be a guiding tool for decision makers, donors and concerned authorities in design, monitoring, development and assigning the available assets of Ramses station to act as central station hub.

To realize this aim, as well as to alleviate the drawbacks and gaps in current attempts of Ramses area, which will be explained in detail in the part of the case study, there are four main objectives the research attempts to realize, as follows:

1. Defining the design guidelines of station in the literature review in terms of identifying sustainability goals and objectives within the various station types.
2. Developing a model, which predicts the current processes for a typical station hub and addresses the interrelationships between the various system components in terms of designing, environmental, economic, social and formal components.

3. Developing a set of principles suitable to the context of Ramses area in order to design a multimodal passenger transport interchange hubs, also develop guidelines and recommendations to assist the government in the planning, design, and operation of these interchange hubs.

4. Examining the impact of the interchange hub principles which should be managed based on three major stages: (i) overall project planning stage, which works toward project approval (project proposal); (ii) regulatory detailed planning stage, which should be combined with the project feasibility study; and (iii) implementation stage.

Methodology:-

Accordingly the methodology of the research includes a research methods and research tools that have been used to answer questions and the implemented of the objectives.

First, **Analytical Approach "**method of collecting primary data", through using facts or information already available or has been collected, and analyze these to make a critical evaluation of the material and this is to be achieved by the review of the central station hub and its origin, situation, vision, designing process and principles.

Second, **Deductive Approach** "the process of reasoning from one or more statements (premises) to reach a logically certain conclusion**"**[1] will then be used to conclude the most suitable principles and indicators to be applied in ***Ramses Station*** to help the city achieve its intended objectives analyzing different international examples and their relation to the case study.

Third, **Application method** will be implemented in applying the chosen tools and criteria which are define by asking passengers on the case study of ***Ramses Station.***

Research Scope

The research will review the theoretical background of the central station hubs with special focus on the case study of ***Ramses Station***. The study will then explore three main examples that were able to overcome relevant negative changes in the city center in the international experience and support their development plans and criteria focusing on the socio-economic impact of the

[1] Patton, M.Q. "Qualitative Research & Evaluation Methods", (3rd edition). Thousand Oaks, California: Sage Publications, 2002.

different tools. The study concludes the relevant criteria of hub design based on the three successful case studies. These criteria will be used to assess Ramses station.

Research Structure

The research is composed mainly of two parts illustrated as follows:

Part (1) Theoretical Background and Design Principles:

Chapter (1): Approach to Design Sustainable Transportation Hub

This chapter describes the optimal design elements and conditions for the eight typical station types. Station design guidelines begin by describing the over-arching framework for station design and introduce the different station types. The guidelines stress the importance of accessibility and functionality by incorporating diagrams that indicate basic relationships and components of the various station types.

Chapter (2): Principles of Central Station Design

This chapter aims to explore the key issues related to station design. It examines a number of Principles, which intended to enhance and complement existing operators' design and service delivery standards and other legal and discretionary requirements. The aim of this examination is to assess the sets individually, to declare a definitive approach can be identified, also to provide frameworks used for formulating the indicator sets, highlight pitfalls and problems facing such kind of projects, point out to the areas where projects fail to fulfill the guidelines.

Chapter (3): Analysis of International Central Station Hubs

This chapter focuses on the application of transportation hub principles on the central transportation stations planned and designed worldwide, three case studies were chosen by the researcher which will lead to set the main criteria and principals whatever these criteria will be used to assess Ramses station.

Part (2) Application Study:

Chapter (4): Ramses Station Theoretical Background

This chapter introduces the theoretical framework and understanding the theories and concepts for Ramses Square area. The theoretical framework stresses the importance of urban context and location.

Chapter (5): Testing Central Hub Principles on Ramses Station

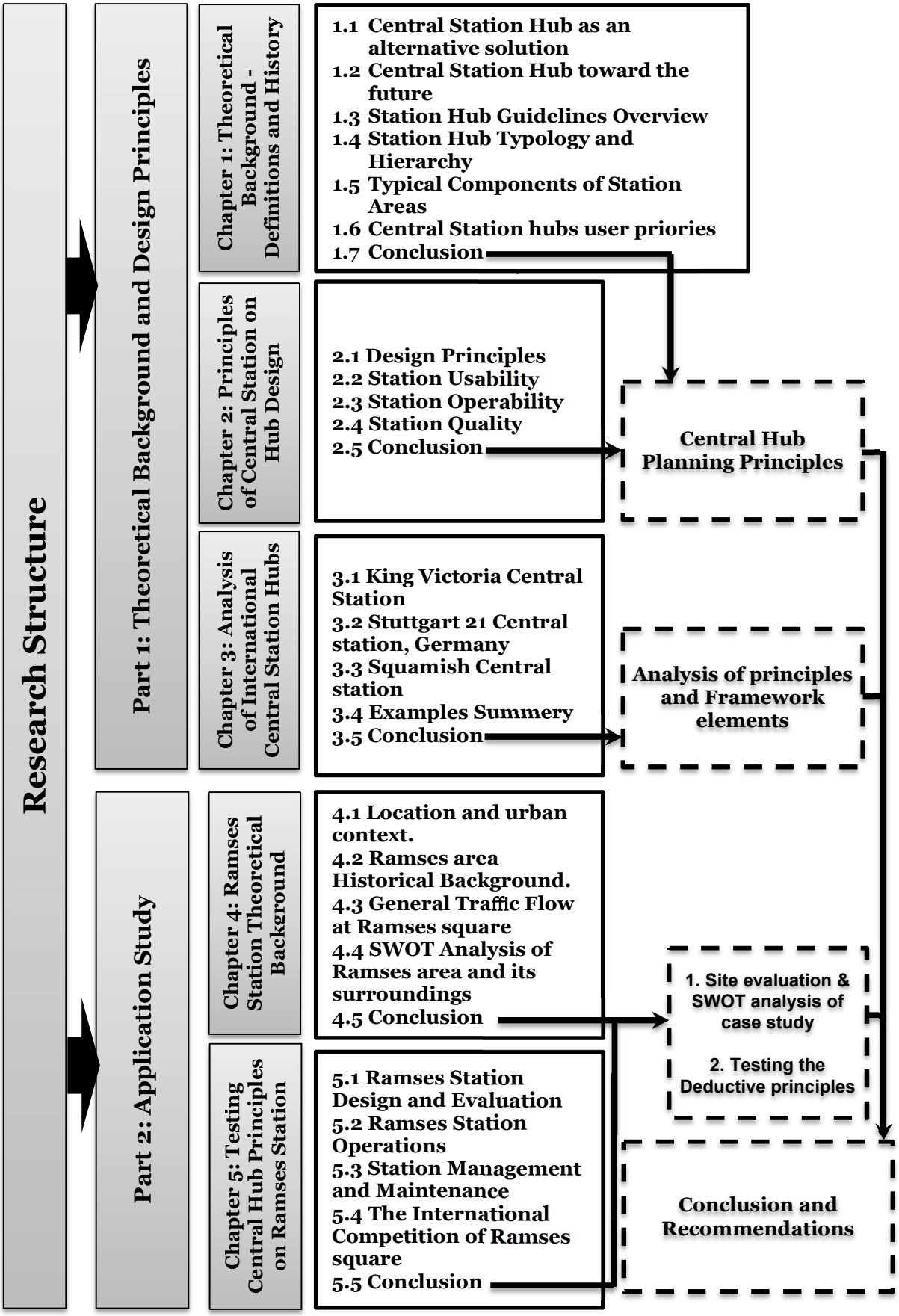
This chapter focuses on testing the Central hub Design and Principles on Ramses station, the critical station in the Public transportation system.

The station was chosen according to certain criteria based on the following:-

- Ramses station is one of the most important public transport stations in Cairo.
- A number of transport facilities exist within Ramses Square.
- Ramses station is directly connected to the central Cairo.

Conclusions and Recommendations

Figure 2: Research Structure
Source: Author



Chapter 1:

Approach to Design Sustainable Transportation Hub

Part 1: Theoretical Background and Design Principles

Chapter 1: Approach to Design Sustainable Transportation Hub

Introduction

The intent of the Station Planning and Design Guidelines is to provide a mechanism that simplifies the approach to station planning also provides a comprehensive framework to ensure consistency and clarity of station design. The Guidelines also outline the optimal requirements for the building of efficient, functional, and harmonized station areas. To provide for a comprehensive understanding of the approaches and framework requirements, the guidelines steer the reader from the broader goals and objectives down to the specific building blocks that help achieve the common system requirements.

Station today faces multiple challenges that have to balance ridership needs with ongoing operating and maintenance costs. Additionally, a dedicated revenue source is crucial. Several key factors that go into a successful station system include an integration into an overall multi-modal connectivity framework, including linkages to other forms of connectors that range anywhere from sidewalks and dedicated bicycle pathways to interstate highways to trolley and bus station systems.
Throughout the process, however, a balance also has to be achieved with a need for sustainable and best management practices as well as a pleasant and sometimes even engaging experience for the user.

This chapter describes the optimal design elements and conditions for eight typical station types. Station Design Guidelines begin by describing the over-arching framework for station design and introduce the different station types. The guidelines stress the importance of accessibility and functionality by incorporating diagrams that indicate basic relationships and components of the various station types.

1.1 About Central Station Hub

The Central Station Hub is the network of rail corridors that link and cross in and around the center of the city. The Central Station Hub is the most significant rail bottleneck in the city. It limits the capacity, performance, and connectivity of commuter and longer distances passenger services terminating in the city or passing through the Hub. It therefore adversely affects journeys between the city's regions.[2]

The Central Station hub consists of:-

- Mixed-use development with residences and offices
- Bigger station car park with more spaces
- Integrated transport hub with interchange facilities with drop-off points for buses and taxis
- More convenient and accessible pedestrian route
- linking to city center cycling path linking

Figure 1-1: Life Hubs: A New Concept for Urban Planning and Transport
Source: http://www.sustainablecitiescollective.com/david-thorpe/1006096/life-hubs-new-concept-urban-planning-and-transport
Posted October 22, 2014

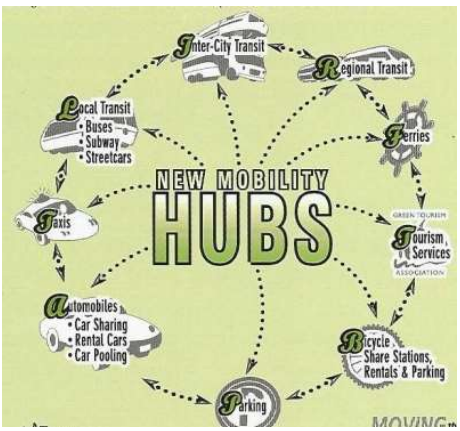


Figure 1-2: the New Mobility HUB Concept
Source: (Moving the Economy, 2006)

[2] http://www.sustainablecitiescollective.com/david-thorpe/1006096/life-hubs-new-concept-urban-planning-and-transport Posted October 22, 2014

Central Station Hub owns and operates the city infrastructure and aims to provide a quality and range of facilities across the stations that will ensure stations continue to contribute to the success of transportation in this country. Stations, their facilities, and amenities, together with the multi-modal transport connections they offer, form an essential part of their passengers' overall journey experience; they also perform an important role for local communities, which regard them as civic buildings in their own right.[3]

Specially speaking, this issue discusses some common concepts; hub, typology, and robustness. Some literature describes the Hub, in the area of computer science, as "the central portion of a wheel, propeller, fan..., through which the axle passes", (Collins, 2005) and (Grammarly, Inc., 2013), Figure 1. In addition to another concept, the hub is "… a hardware device to network multiple computers together. It is a central connection for all the computers in a network Information sent to the hub can flow to any other computer on the network...."(Hub Definition). In Urbanization field, the hub concept is the network of urban corridors that link and cross in and around a city or town. Hub functions, namely, interchange with other modes of public transport, where traffic exchanged across several modes of transportation.[4]

The Central Station as a Hub is the most significant bottleneck in the city. It limits the capacity, performance and connectivity of commuter and long distance passenger services terminating in the city or passes through the Hub, (Henry). It, therefore, adversely affects journeys between the city's regions. It also limits the number of trains, from across the district and beyond, that can serve to the airport, as well as those that can access relevant distribution centers for freight. Smart hub networks various transportation moods in a safe, efficient, and environmentally sound manner. Hubs, as an interface structure, provide a greater versatility within the transportation system, through a concentration of flows, (Siemens Mobility, 1996).

1.1.1 Central Station Hub as an alternative solution

[3] Henry, L. (n.d.). Intermodal Surface Public Transport Hubs. Retrieved May 27, 2013

[4] Hub Definition. (n.d.). The Tech Terms Computer Dictionary. Retrieved May 27, 2013

The goal of the central station hub is to improve the user experience of sustainable transportation through improvements in information accessibility, integration of multiple modes of transportation, and the addition of conveniences at transfer points while increasing the visibility of these improvements through the creation of a recognizable brand symbolizing these improvements.[5]

The alternatives were evaluated on the following:

- Natural Environment,
- Socio/Cultural Environment,
- Economic Environment, and
- Technical/Technological.

In short, the use of private automobiles for personal transportation is a significant sustainable development challenge on a global scale, and the adoption of sustainable personal transportation is imperative. Personal transportation choices, however, can be difficult to understand and to change, and are tied up in infrastructure, convenience, habit, and culture. Since 80% of buildings standing today were built in the last 50 years (Kunstler, 1993) when the private automobile became the dominant mode of transportation in developed countries, only a few areas of some cities were designed in a way that facilitates station, cycling and walking for utilitarian transportation. Invariably, municipal and regional station systems have problem areas with infrequent service, long distances between the nearest service and peoples' destinations, municipal boundaries requiring a second fare payment, lack of schedule and route information, or uncomfortable waiting areas. [6]

The goal of the new transportation Hub is to close these gaps and lower barriers to sustainable transportation by making it simple and convenient to combine regional station, municipal station, cycling, taxi, and shared cars in a single trip.[7]

[5] Jones, B. (2006). Feasibility Report for a Network of New Mobility HUBs in the Toronto Region. Toronto: Moving the Economy.

[6] Transportation Research Board, "Intermodal transfer facilities research needs," Transportation Research Record 505, 43-46, 1974.

[7] http://crcresearch.org/case-studies/case-studies-sustainable-infrastructure/transportation/mobility-hubs-toronto-ontario

1.1.2. Central Station Hub toward the future

Central Station hubs are becoming extremely important. As nodes, they must intelligently network various transportation systems so that people and goods can be transported in a safe, efficient, and environmentally sound manner. European transport companies are predicting that public transportation will increase by as much as 45 % in some countries until 2030. In many developing economies, public transportation infrastructure still needs to be created (Siemens AG, P6, 2011).

In view of the literature, most studies have focused on selecting the location of a single inter-modal passenger transfer facility with the pioneering works dated back to the 1970's (Demetsky et al., 1976; Demetsky et al., 1977; TRB, 1974). Since then, key issues, technologies, experiences and priorities on developing selection criteria have been shifted and evolved. For instance, Horowitz and Thompson (1995) constructed a list of 70 generic objectives for evaluation of an intermodal passenger transfer facility after extensive literature review and interviews with users. They found that safety, security, and ease of transferring were among the highest-ranked station agency objectives. On the other hand, Seneviratne (1995) proposed a set of quantitative criteria, including availability, reliability, accessibility and productivity to measure the efficiency of intermodal terminal performance. Nevertheless, one still needs to properly determine the weighting factors attached to each of those evaluation criteria.[8]

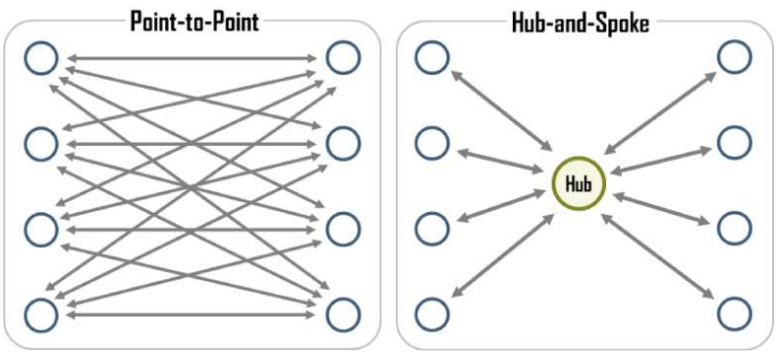


Figure 1-3: The Concept of Transportation Hub,
Source: (Rodrigue, 1998)

[8] Yu, J., Liu Y., Yang, X., "Cluster-based Optimization of Urban Transit Hub Locations: Methodology and Case Study in China," Transportation Research Record 2042, 109-116, 2008.

1.1.2.1. The hubs of tomorrow: sustainably intermodal

Shifting a large proportion of goods and passenger transport from the roads to greener modes of transport is at the core of sustainable transport policy. Although cars will continue to be used for a large share of private journeys in the future, car-sharing models and intelligently expanded public transport systems are desirable alternatives, particularly in cities and their catchment areas. These services will be a feature of tomorrow's transport hubs, experiencing especially high demand at train stations and airports. This means that multimodal, perfectly ¬harmonized transport services, short distances and intelligent guidance and booking systems are essential. Passengers' journeys are made even more convenient by integrating transport hubs geographically and functionally into their urban environment – incorporating trade and commerce as well as places of work, residence, and relaxation with appropriate areas for temporary container storage.[9]

1.1.2.2. The hubs of tomorrow: Urban Integration

The railway stations of tomorrow will offer multimodal transportation options and shorter routes. Additional comfort and convenience for passengers will be achieved by integrating stations into the urban environment, with links to trade and industry, and by providing employment, housing, and recreation opportunities. Public transportation and mobility options, including bicycle and electric car sharing, will exist side by side and be supplemented by intelligently linked information offerings and innovative services.

1.1.3. Station Hub Guidelines Overview

The role of the station today spans many facets of day-to-day lives and creates positive and lasting effects through social, visual, economic and environmental impacts.

A) Civic/Cultural Crossroads:-

Development trends in the last few decades indicate that investment in the station and the resurgence of downtown areas continue to rise with shifting market demands and lifestyle preferences. As urban areas continue to grow, so does the

[9] http://www.mobility.siemens.com/datapool/industry/mobility/news/customer-magazine/como/como07_2011-10_en/index.html#/28/zoomed

demand for convenient travel modes that provide alternatives to congested highways and roadways. This shift toward denser and what is known as "station-oriented development" has allowed the station to once again become an integral cultural element in many communities across the country. Station Oriented Development, or TOD, is defined as "compact mixed-use development near station facilities and high-quality walking environments." Through various funding mechanisms, TODs have become economic engines which are helping revive investment of station systems within communities across the country. [10]

Today, station centers and stations experience the intermingling of the masses and serve as vital links. Station's role was best described by David Moffat in his publication, The Art of Modern Station Design, "Extensions of the cities around them, they (station stations) provide common ground for a common purpose and they give dignity and excitement to thousands of individual ceremonies of departure and arrival each day".

B) Iconic Form and Urban Identity

Today, station centers and stations experience the intermingling of the masses and serve as vital links. Station's role was best described by David Moffat in his publication, The Art of Modern Station Design, "Extensions of the cities around them, they (stations) provide common ground for a common purpose and they give dignity and excitement to thousands of individual ceremonies of departure and arrival each day". [11]

C) A Sustainable Future:

Along with being integral elements of the connective tissue within station systems, station stations also often incorporate connective layers between multiple modes of transportation. The hierarchy of connections occurs mostly at main station centers within dense urban areas and these centers, therefore, become opportunities for expression of iconic form and distinct design. Iconic-precedent stations such as Grand Central Station in New York City and Union Station in Washington, D.C. offer a nexus of transportation networks, which support public services and design, and culminate in iconic public spaces. Memorable iconic public spaces spark redevelopment and economic revitalization.

[10] http://chennaicityconnect.com/knowledgebase/wp-content/uploads/2013/07/Florida-Station-Design-Guidelines-Final-122309.pdf from http://tri-railcoastallinkstudy.com/

[11] http://chennaicityconnect.com/knowledgebase/wp-content/uploads/2013/07/Florida-Station-Design-Guidelines-Final-122309.pdf from http://tri-railcoastallinkstudy.com/

1.1.3.1. Literature Review

Transport systems are an expression of spatial structures (Hoyle & Knowles, 1992a). They have a form, offer distribution, and are subject to regulations. Wherever economic activities are distributed in space, transport systems create transactions supported by distribution systems (Black, 1993).

According to Peeters et al. (1998), the structure and regulation of the transport system are likely to be influenced by the spatial structure of the territory. Transport is one of the factors that reinforce spatial inequality by linking a priori the most productive places. This is because when a set of economically concentrated areas interacts at the regional level, they reinforce the regional spatial inequality of accessibility by corridors of interactions (Rodrigue, 1996).

Urban transportation aims at supporting transport demands generated by the diversity of urban activities in a diversity of urban contexts. A key for understanding urban entities thus lies in the analysis of patterns and processes of the transport / land use system. This system is highly complex and involves several relationships between the transport system, spatial interactions, and land use:[12]

Transport system: considers the set of transport infrastructures and modes that support urban movements of passengers and freight. It generally expresses the level of accessibility.

Spatial interactions: Consider the nature, extent, origins and destinations of the urban movements of passengers and freight. They take into consideration the attributes of the transport system as well as the land use factors that are generating and attracting movements.

Land use: Considers the level of spatial accumulation of activities and their associated levels of mobility requirements. Land use is commonly linked with demographic and economic attributes. The fundamental environmental benefits of station[13]

[12] Demetsky M.J., Hoel L A, Virkler M R, "A procedural guide for the design of transit stations and terminals," U.S. Department of Transportation, DOTTST-77-53, 1977.

[13] Demetsky M.J., Hoel L A, Virkler M R, "A procedural guide for the design of transit stations and terminals," U.S. Department of Transportation, DOTTST-77-53, 1977.

1. Reduce land consumption for roadways
2. Decrease the use of automobiles, which improves air quality, and reduces consumption of natural non-renewable resources and fossil fuels (coal, oil, gasoline, etc.)
3. Compact development methods encourage land conservation and decrease travel demand
4. Reduce greenhouse gas emissions from roadway construction and expansion projects
5. Improve safety for pedestrians and cyclists
6. Diminish auto-dependency, saving energy and reducing roadway congestion

1.1.3.2. Station Design Parameters

Station planning and design are comprised of six principles delineating the parameters of a successful station. The methods include integration into the contextual fabric, accessibility via multiple modes, functional simplicity, security, comprehensive systems sustainability, articulation of form and identity and finally the incorporation of arts in the station.

A) Integration into the Contextual Fabric

One of the basic components of station design factors where a station responds to its surroundings through architectural elements. These surrounding factors include appropriate design measures to provide protection from environmental and climatic elements such as the wind, rain, heat, etc. In addition, station design should also be sensitive to its context and associated cultural factors. A well-integrated station works symbiotically with its context to provide facilities and amenities to the passengers as well as surrounding residents and business owners.

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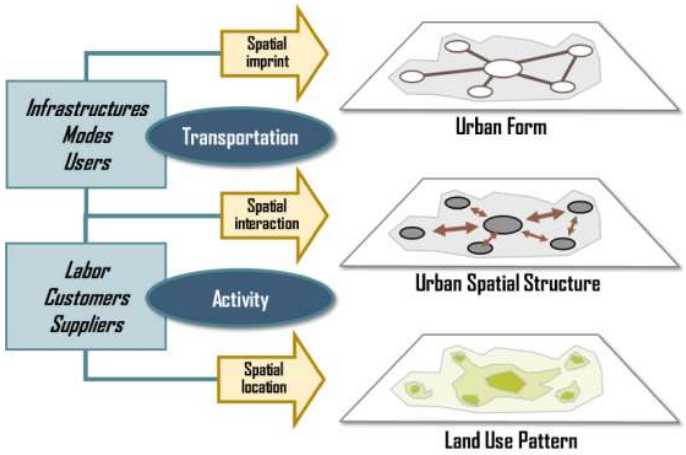


Figure 1-4: Methodology of Transportation, Activity Systems and Land Use
Source: http://people.hofstra.edu/geotrans/eng/ch6en/conc6en/activityuse.html
Posted by Jean-Paul Rodrigue (2013), New York: Routledge,

The station also plays an important role in the development and redevelopment of communities, and their existing networks, on both a local and regional scale. These networks usually consist of multiple modes of mobility ranging from pedestrian pathways, bicycle routes, railroad corridors, and major arterial roadways. While station covers a range of modes, its basic premise involves the movement of people and goods.

B) Location and Design of Hubs

Design hub stations to enhance connectivity between different modes of transportation while supporting a positive user experience. As convergence points of community mobility and activity, they should be designed to contribute to a positive neighborhood identity and to integrate within their surroundings.

Station Hubs are important centers of activity that can help to strengthen the relationship between the surrounding community and station network. They are gateways providing supportive amenities and information for travelers and in many cases act as a connecting point between multiple modes of transportation. Stations are the traditional hubs of many of our towns and cities and their presence has historically had a significant influence on the way our communities have grown and developed. Ensuring that new and existing stations are designed to integrate with their surroundings is an important strategy towards enhancing

station access for a wide range of users and contributing to a pedestrian-friendly environment that will support station ridership.[14]

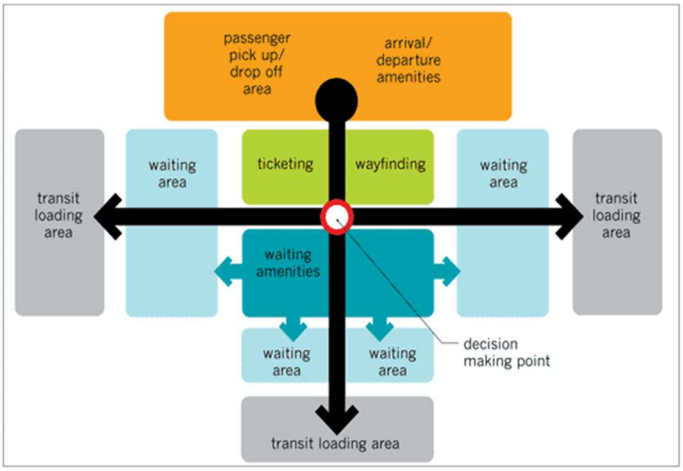


Figure 1-5: Methodology for the Design of transit stations to enhance connectivity,
Source: http://www.mto.gov.on.ca/english/transit/supportive-guideline/enhancing-access-transit.shtml
Posted by Ontario Ministry of Transportation, 2012

A rational progression of facilities with clear and direct routes that take passengers from their arrival point to their mode of the station with few decision-making points will help people to find their way around the station quickly and easily. [15]

(Table 1.1) Location and Design Strategies

Source: - http://www.mto.gov.on.ca/english/station/pdfs/station-supportive-guidelines.pdf,2012

Presented by: - Author

Location & Access	As important community and transportation hubs new stations should be located where they can enhance access to the station network, create more efficient intermodal connections and act as catalysts for new station-supportive development.
	Design stations to integrate into their surroundings by providing connections for a range of users including pedestrians.

[14] http://www.mto.gov.on.ca/english/transit/supportive-guideline/enhancing-access-transit.shtml,2012

[15] http://www.mto.gov.on.ca/english/transit/pdfs/transit-supportive-guidelines.pdf,2012

	Station agencies should work with local land owners to secure pedestrian and cycling connections to and through adjacent developments for users going to and from the station.
Design treatments	Design larger station sites to support long-term intensification by establishing development parcels and preserving land for the creation of new streets and open spaces that strengthen connections to surrounding areas.
	Encourage station design excellence. High-quality design can create a landmark for the local community and raise the profile of station services.
	6. Extend station design beyond the platform and waiting areas to encompass the wider public realm of the station area and its surroundings.
legibility	Design stations to be easily navigable, or "legible" to users with clearly defined areas related to station functions. Provide clear, direct routes between station facilities and the various converging transportation modes.
	Develop a level of design consistency at larger stations to increase user familiarity with station facilities and enhance station legibility.

C) Enhancing Access for Pedestrians in Station Areas

Station and station areas should be designed to prioritize pedestrian access while accommodating the needs of other users such as cyclists, station, and motor vehicles. The movement of people in and around stations or transferring between different transportation modes requires an emphasis on the design of the pedestrian realm. Station stations and station areas should have adequate capacity to accommodate peak pedestrian volumes safely and comfortably. While efforts may be made to support pedestrian movement on the way to the station, if provisions are not made for pedestrians within the unique environment of a station it can affect user satisfaction and deter ridership.[16]

[16] http://www.mto.gov.on.ca/english/transit/supportive-guideline/enhancing-access-transit.shtml

Ensuring that people can move safely, efficiently, and comfortably within or around a station is, therefore, an important strategy to enhancing user experience and promoting greater ease of use.

Figure 1-6: A) Pedestrian circulation
B) The pedestrian plaza at the Stratford Station in London, UK,
Source: http://www.mto.gov.on.ca/english/transit/supportive-guideline/enhancing-access-transit.shtml

(Table 1.2) Access for Pedestrians in Station Areas

Source: - http://www.mto.gov.on.ca/english/station/pdfs/station-supportive-guidelines.pdf,2012

Presented by: - Author

Pedestrian connections	Treat the sidewalks in and immediately adjacent to a station as pedestrian priority areas. They should contain a higher level of pedestrian amenity than surrounding areas, including: • signage and way finding to inform users where they need to go to reach the station and area destinations; • *pedestrian-oriented lighting* for enhanced visibility and safety; • seating and waste receptacles for convenience; and • Landscaping for pedestrian comfort and enjoyment.
	Organize sidewalks and pathways within station areas so they provide continuous, direct connections to area destinations and pathways outside the station area.
	Provide a broad pedestrian through zone with a suggested width of 2.4m or more, for sidewalks in station areas with wider sidewalks, with a suggested width of 3m or greater, at stations with high levels of pedestrian activity.
	Minimize conflicts between pedestrians and cyclists by locating bicycle storage facilities close to the road, so that cyclists will not be encouraged to ride across pedestrian areas.
Station buildings	Situate station buildings as close as possible to surrounding developments and areas of pedestrian activity to minimize walking distances. A pedestrian flow analysis can ensure that adequate room at station entrances is provided.

Open space	Pedestrian plazas or open spaces can act as important organizing elements within a station area. They help facilitate transfers between modes, act as receiving points for pedestrians and contain a range of amenities for users.
Way finding	Locate way finding maps at all major entrances indicating where the user is within the station area and the location of major station destinations. Supplement these signs with a wider context map directing pedestrians to important local destinations.
Waiting areas	To avoid pedestrian conflict and promote station *legibility*, ensure pedestrian waiting areas are clearly identifiable and delineated from areas of pedestrian circulation.
	User comfort in outdoor pedestrian waiting areas can be enhanced through the use of year-round plantings that provide shelter from the wind in winter months and shade during hot summer months.
	Design outdoor waiting areas to increase passenger safety and comfort with clear sightlines to the station building and surrounding areas, and ensure areas are well-lit, clean and cleared of snow in winter.

D) Way finding for Station Facilities

Establish a consistent and intuitive wayfinding system to assist riders in navigating through station vehicles and facilities.

Station systems can be complex and intimidating, so an effective way finding system is necessary to make the system more comprehensive, usable and convenient. Not knowing where and how to access station vehicles, stations and terminals can be a source of confusion and frustration to travelers and a barrier to station use. Without an intuitive and consistent wayfinding system, including signage, maps and visual and audio cues, travelers may get lost and experience delays and missed connections. These negative experiences can result in reduced rider satisfaction and ridership.

Clear and consistent ways finding system will save riders time and reduce frustration. This, in turn, increases the appeal of the station. A comprehensive

wayfinding system should be consistently applied to station interiors, station areas, surrounding streets and parking facilities to help orient station users and direct pedestrians toward station facilities.

Wayfinding systems should be designed for station users of varying abilities by applying accessible formats to signs and all information displays this will help station systems to be welcoming to all riders as well as ensuring station agencies meet the accessibility standards of the Accessibility for Ontarians with Disabilities Act.[17]

(Table 1.3) Way finding for Station Facilities

Source: - http://www.mto.gov.on.ca/english/station/pdfs/station-supportive-guidelines.pdf,2012

Presented by: - Author

Symbols & cues	Develop a coordinated system-wide way finding plan so that logos, symbols and cues used on vehicles, at stops and in stations are consistent and complementary.
	Each sign should indicate, at a minimum, the bus route number and name, direction of travel, map and timetable. Additional information can be accommodated by providing telephone numbers and websites where more information can be accessed.
Vehicle exteriors	The exterior of the station vehicle should identify the route name, number and the direction of travel. Identifiers should be placed, at minimum, at the boarding point. If a person with a disability, a newcomer or a tourist cannot properly interpret the signage, the operator should be prepared to offer information to passengers upon request.
legibility & accessible formats	In station stations and on vehicles, signs should be designed to be highly legible with accessible displays.
Building maps & directories	For larger station systems with complex stations, building maps, floor plans and directories should be provided to help orient users to their immediate surroundings.

[17] Weisman, J. (1981). Evaluating Architectural Legibility: Way-finding and the Built Environment, *Environment and Behavior*, v. 13(2): 189-20

	Use pedestrian flow modeling to plan retrofits of stations and to improve effectiveness of entrances, exits and connections to the street.
	Place signs at nodes or decision points (a physical space where two or more paths diverge) in a facility. Use only the information necessary for a user to make a decision. Use maps at key decision points to supplement directional information. At nodes or intersections, place signs such that they may be seen from all directions.
Community way finding	Provide information and maps indicating walking and cycling trails, station routes and local destinations at station stops, station areas and key destinations as appropriate.
	Way finding signage should be placed on streets around station areas to assist people travelling to the station. Information should include: • the station system logo; • the direction of the station; • the station route name(s) and number(s) and station name; and • The distance to the station.
Technology	Consider developing smart phone applications, which provide information on the location of station stations or stops.
	Over longer distances, signs should be repeated to reinforce the information.
audio information	Visual way finding information should be complemented with audio information, and vice versa to assist people with visual and hearing impairments.
customer service attendants	Place station personnel strategically throughout the system to answer questions and provide guidance.

1.4. Station Hub Typology and Hierarchy

The station types were identified by the types of communities where they are located, as well as those requirements based on service and access needs. These station types have been grouped into a hierarchal group that ranges from Anchor Stations which are major destination stations, to Key Stations and Intermediate Stations. [18]

1.4.1. Station Hub types and Groups

The following is a list of the station types and groups[19]

Anchor Stations:

1. City Center
2. Airport/Seaport

Key Stations:

3. Town Center
4. Regional Park and Ride

Intermediate Stations:

5. Neighborhood
6. Employment Center
7. Local Park and Ride
8. Special Events Venue

1.4.1.1. Anchor Stations: - A) City Center Stations

Located within a dense urban area and serving as a gateway for the heavy volumes of downtown commuters and city bus routes, the City Center is primarily a destination station. Accommodating large volumes of pedestrians and connections with taxis, buses and another high volume station in this area is a key. Wider sidewalks and an entry plaza with added visual interest, i.e., special paving details, landscape beds, etc., should frame the entrance to the City Center Station and the platforms. People should be funneled from on street activities and the bus drop-off area into the station's amenities, for example, the ticket booth, restrooms, plaza with seating and/or food kiosks. The surrounding buildings should serve the users at the station through additional ground-level pedestrian amenities such as restaurants and shops.[20]

[18] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2. from: www.sfeccstudy.com

[19] South Florida East Coast Corridor (SFECC) Transit Analysis - Station Design Guidelines by Gannett Fleming, Inc. , 2012

[20] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2.

Station Area Zoning	Station Requirements
• Commercial Zoning: **Floor Area Ratio greater than 10** • Residential Zoning: **Greater than 25 Dwelling Units per Acre** •Parking Restrictions: **Less than space per 1,000 Square Feet**	**•Site Acreage:** Less than one (1) Acre **•Station Access:** All services **• Parking:** No dedicated parking

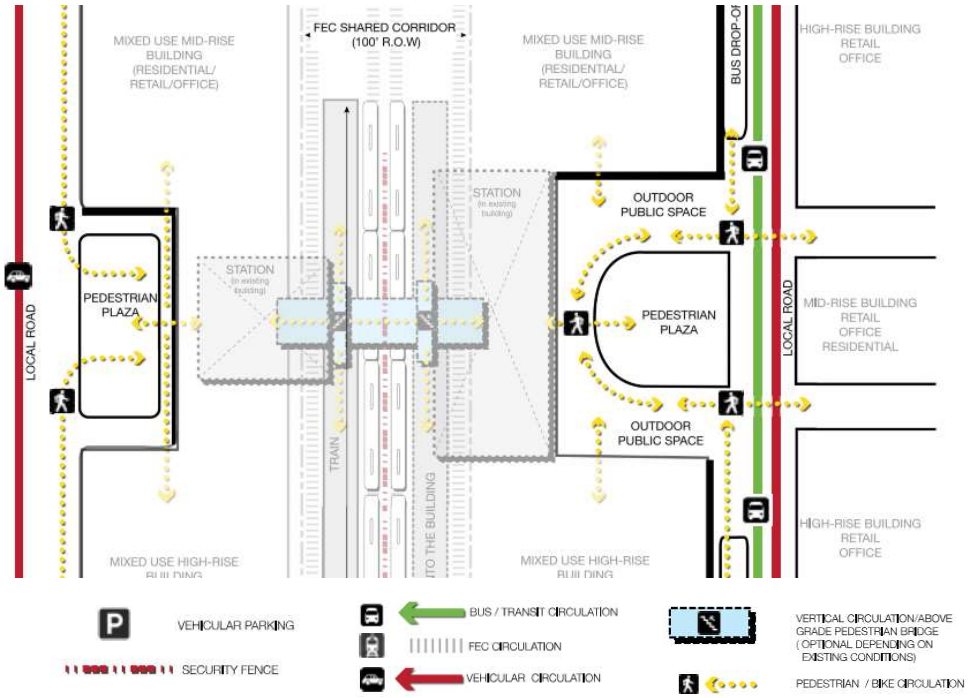


Figure 1-7: The Functional Diagram for commuter rail city center station
Source: Station Design Guidelines by Gannett Fleming, Inc.

1.4.1.1. Anchor Stations: - B) Airport/Seaport Station

These stations are often both 'origin' and 'destination' stations. They serve travelers such as tourists and visitors, as well as employees and other local passengers. Shuttle drop-off and waiting areas are directly linked to the station and also connect passengers to the airport/seaport facility. Where plausible, a vegetation buffer may separate the station from the collector road.

To assist travelers, especially those with luggage, an ideal layout for the station area would provide a more direct connection between the station and the airport/seaport facility via a moving walkway. However, existing conditions may not always allow for this convenience.[21]

Station Area Zoning	Station Requirements
No zoning requirements unless combined with another station type	•**Site Acreage:** Less than one (1) Acre •**Station Access:** Local and Express services •**Parking:** No dedicated parking

[21] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2. from: www.sfeccstudy.com

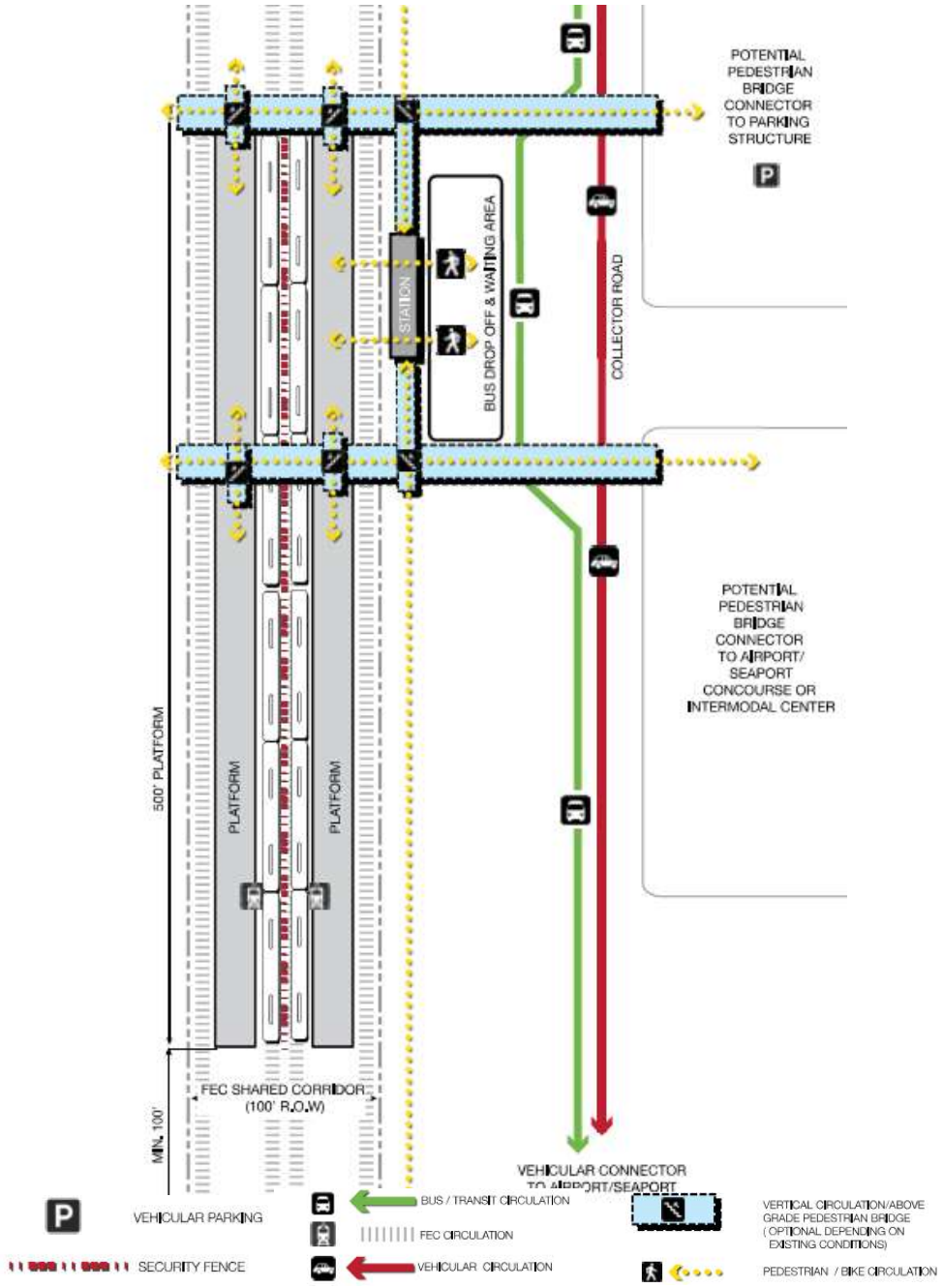


Figure 1-8: The Functional Diagram for commuter Airport/Seaport Station
Source: Station Design Guidelines by Gannett Fleming, Inc.,2012

1.4.1.2. Key Stations: - A) Town Center Stations

Located on urban collector roads that form "Main Streets" of smaller urban areas, these stations are both 'origin' and 'destination stations. These stations are typically walked able and offer a multitude of pedestrian amenities (for example, restaurants, ticket booths, restrooms, and areas for outdoor commercial activities), they should be located and incorporated into an existing environment that has a network of sidewalks promoting pedestrian accessibility. The Town Center accommodates multitudes of transportation types, thus offering Kiss and Ride, taxi and bus drop-off areas.

Limited parking that does not block any drop-off areas should be provided on the surrounding streets. Shared surface parking and /or structure parking should be made available in lots behind all support buildings. Pedestrians on foot can then walk through the additional amenity areas within the support buildings.[22]

Station Area Zoning	Station Requirements
• Commercial Zoning: **Floor Area Ratio greater than 2.5** • Residential Zoning: **Greater than 15 Dwelling Units per Ac.** •Parking Restrictions: **Less than 1.5 spaces per 1,000 Sq. Ft**	•**Site Acreage:** 1/2 - 2 Acres •**Station Access:** Local services, Express services • **Parking:** 50-200 spaces (surface or structure)

[22] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2. from: www.sfeccstudy.com

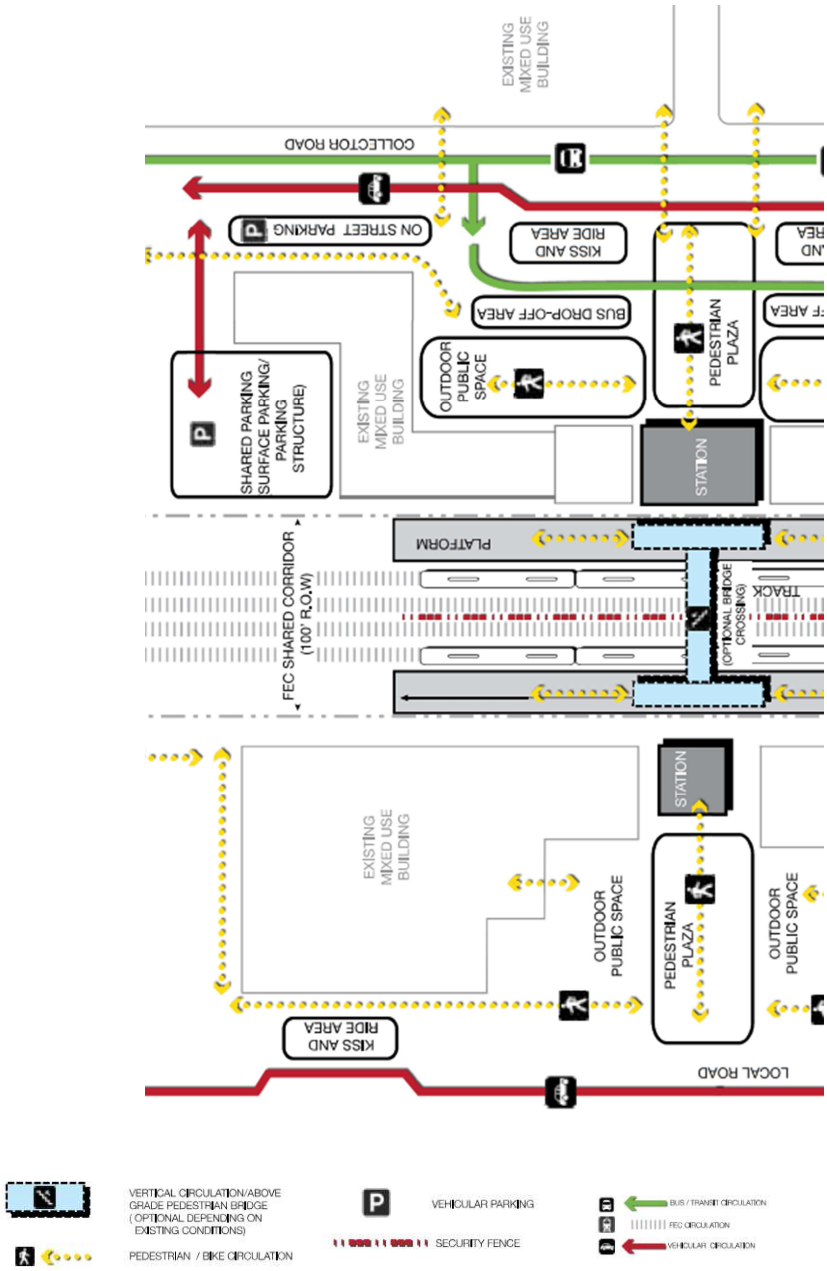


Figure 1-9: The Functional Diagram for commuter Town Center Station
Source: Station Design Guidelines by Gannett Fleming, Inc.,2012

1.4.1.2. Key Stations: - B) Regional Park-Ride Station

These stations are located on principle arterial roads with close connections to larger highways and interstates. Regional Park and Ride Stations serve large volumes of riders from outlying communities. Similar to local Park and Ride Stations, safe pedestrian connections must be designed to circulate people from drop-off areas and parking lots/structures to the station entrance. Kiss and Ride and Bus Drop-off areas should be placed closest to the station entrance followed by parking. As vehicles and buses are diverted from the major arterial road, separate one-way roads help minimize traffic congestion around drop-off areas.

Sites suitable for large at-grade parking lots do not exist within the study corridor; therefore, structured parking options within station types, such as the Regional Park and Ride, need to be examined. Land dedicated to parking requirements can also be an opportunity for future redevelopment. Areas for surface parking should potentially incorporate the feeder bus routes which may be rerouted into the station to provide convenient passenger transfer.[23]

Station Area Zoning	Station Requirements
• Commercial Zoning: **Floor Area Ratio greater than six (6)** • Residential Zoning: **Greater than 25 Dwelling Units per Ac.** •Parking Restrictions: **Less than 1.5 spaces per 1,000 Sq. Ft**	•**Site Acreage:** Five (5) Acres or greater •**Station Access:** Local services • **Parking:** 600-2000 spaces (surface or structure) >2000-space parking structure required

[23] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2. from: www.sfeccstudy.com

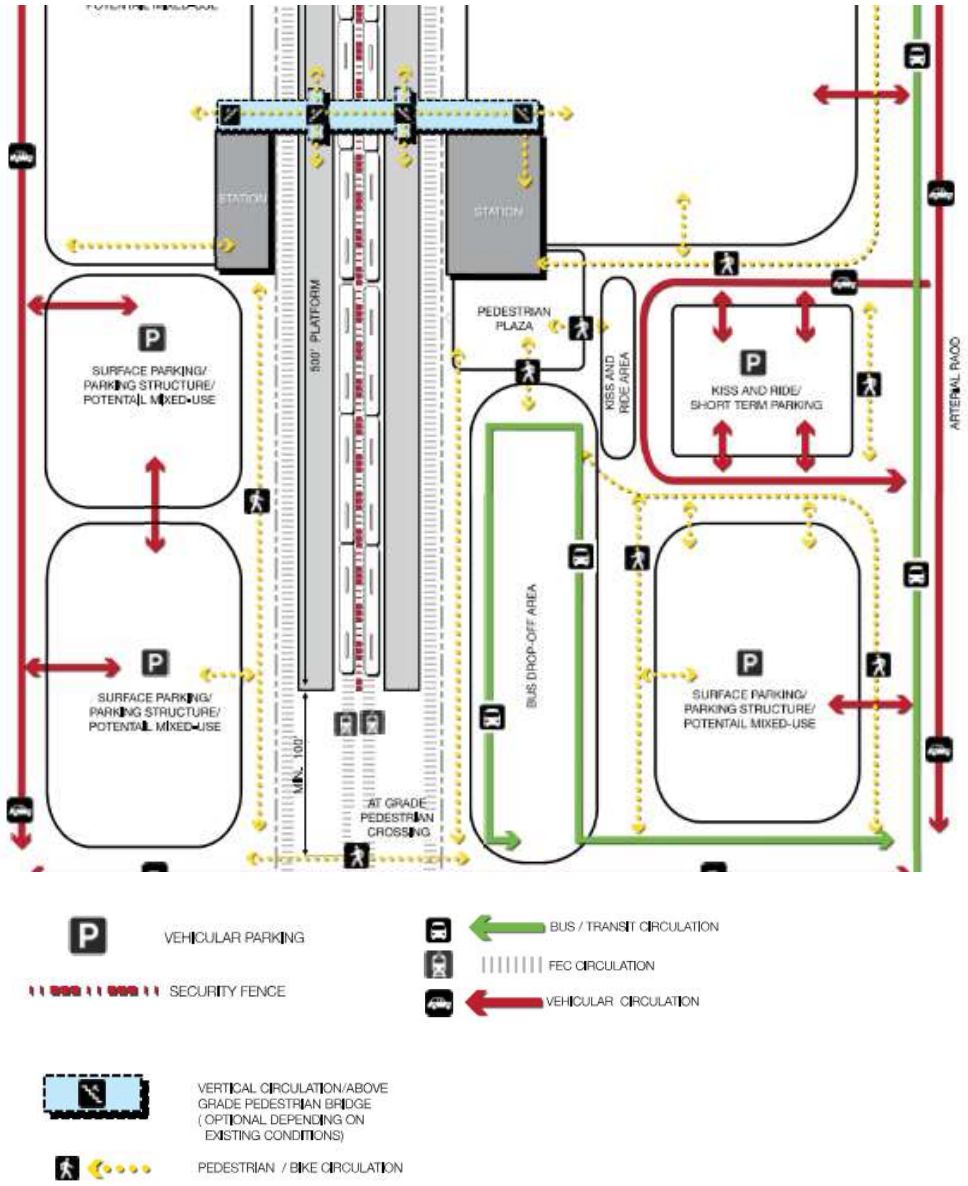


Figure 1-10: The Functional Diagram for commuter Regional Park-Ride Station
Source: Station Design Guidelines by Gannett Fleming, Inc.,2012

1.4.1.3. Intermediate Stations: - A) Neighborhood Station

The Neighborhood Station is located on local roads within a residential area. It is an 'origin' only station and services a relatively low volume of people from surrounding communities, the residential neighborhood itself and convenience retail services.

The users are filtered into the station and platform area, either on foot via the surrounding sidewalk network system, or through the bus drop-off area. Drop-off for a local circulator can also be provided with a direct connection to the station. Parking will be provided on surface lots at a scale which will fit into the surrounding community and not create traffic issues on local streets.

Pedestrians can then cross local traffic lanes and access the station entrance. Preferably, the surface parking should be shared with any multi-use commercial/residential development, or institutional use such as a church.[24]

Station Area Zoning	Station Requirements
• Commercial Zoning: **No requirements** • Residential Zoning: **Greater than Eight (8) Dwelling Units/Ac** •Parking Restrictions: **No requirements**	•**Site Acreage:** 1/2 - 1 Acre •**Station Access:** Local services • **Parking:** 50-100 spaces (single-use surface)

[24] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2. from: www.sfeccstudy.com

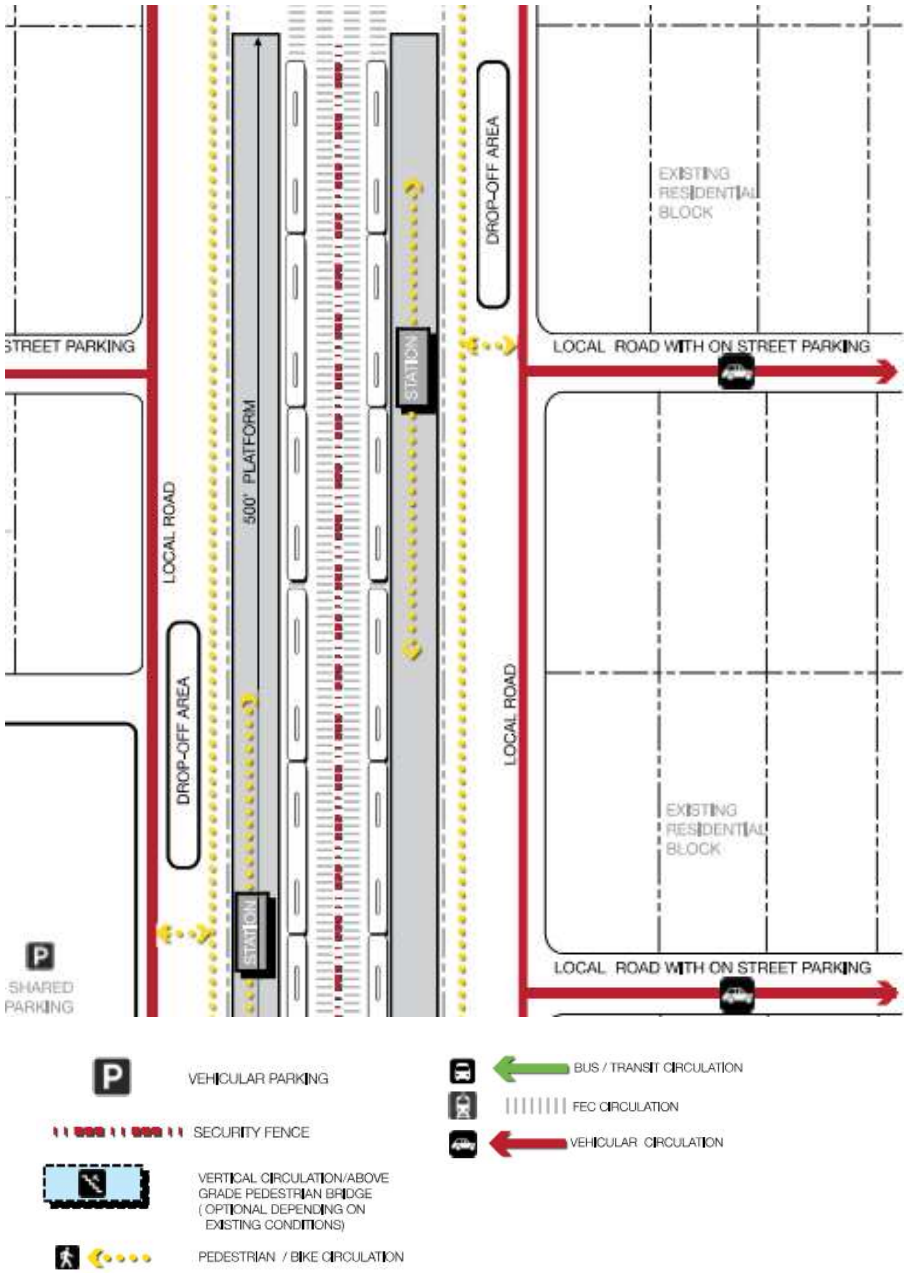


Figure 1-11: The Functional Diagram for commuter Neighborhood Station
Source: Station Design Guidelines by Gannett Fleming, Inc,2012

1.4.1.3. Intermediate Stations: - B) Employment Center Stations

These destination stations serve suburban centers of employment, for example, office parks, hospital complexes, college campuses, large mixed-use centers, and shopping centers. Employment centers close to the station will require direct sidewalk connections for pedestrians while those further away may not walkable, but would be within shuttle bus access. A plaza area should be incorporated into the front of the station and the surrounding bus and shuttle drop-off areas. Due to high traffic volumes at these stations which tend to be at peak periods during the work week, morning arrival, lunch, and evening departure, the station plaza can accommodate a larger proportion of people in a short period of time.

Since this station is predominantly a destination station, no dedicated parking is required. If desired, parking should be available in the surrounding existing parking structures.[25]

Station Area Zoning	Station Requirements
• Commercial Zoning: **Floor Area Ratio greater than 2.5** • Residential Zoning: **Greater than 25 Dwelling Units per Acre** •Parking Restrictions: **Less than 2.25 spaces per 1,000 Square Feet**	•**Site Acreage:** Less than one (1) Acre •**Station Access:** Local services • **Parking:** No dedicated parking

[25] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2. from: www.sfeccstudy.com

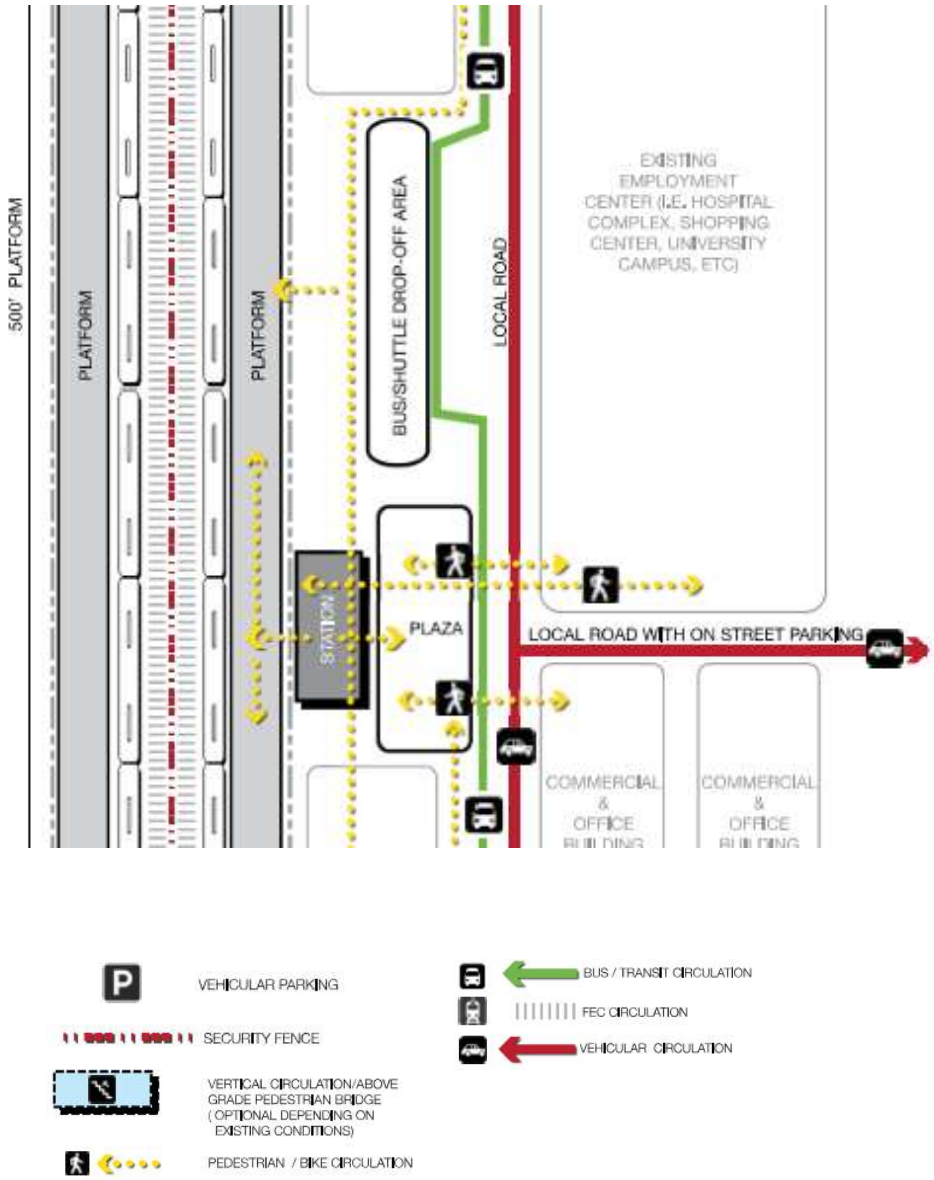


Figure 1-12: The Functional Diagram for commuter Employment Center Stations
Source: Station Design Guidelines by Gannett Fleming, Inc,2012

1.4.1.3. Intermediate Stations: - C) Local Park and Ride Station

Located on collector roads, these stations handle moderate volumes of traffic, mainly accessible by cars and buses. Safe pedestrian connections must be designed to circulate people from drop-off areas and parking lots or structures to the station entrance. Kiss and Ride and Bus Drop-offs, should be placed closest to the station entrance followed by short-term parking. As vehicles and buses are diverted from the major arterial road, a one-way road helps minimize traffic congestion around drop-off areas. Surface and structured parking for the station should be buffered by buildings where possible.

Parking and drop-off areas may also incorporate appropriate vegetation buffers separating vehicular, bicycle and pedestrian areas. The surface parking should incorporate the feeder bus routes. Also, zoning should be updated to encourage Station Oriented Development/TOD around stations in the future. Thus, parking lots could be future development sites for TOD within appropriate regions.[26]

Station Area Zoning	Station Requirements
• Commercial Zoning: **Floor Area Ratio greater than 2.5** • Residential Zoning: **Greater than 15 Dwelling Units per Acre** •Parking Restrictions: **Less than 2.25 spaces per 1,000 Square Feet**	•**Site Acreage:** Two (2) to six (6) Acres •**Station Access:** Local services • **Parking:** 200-600 spaces (surface or structure)

[26] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2. from: www.sfeccstudy.com

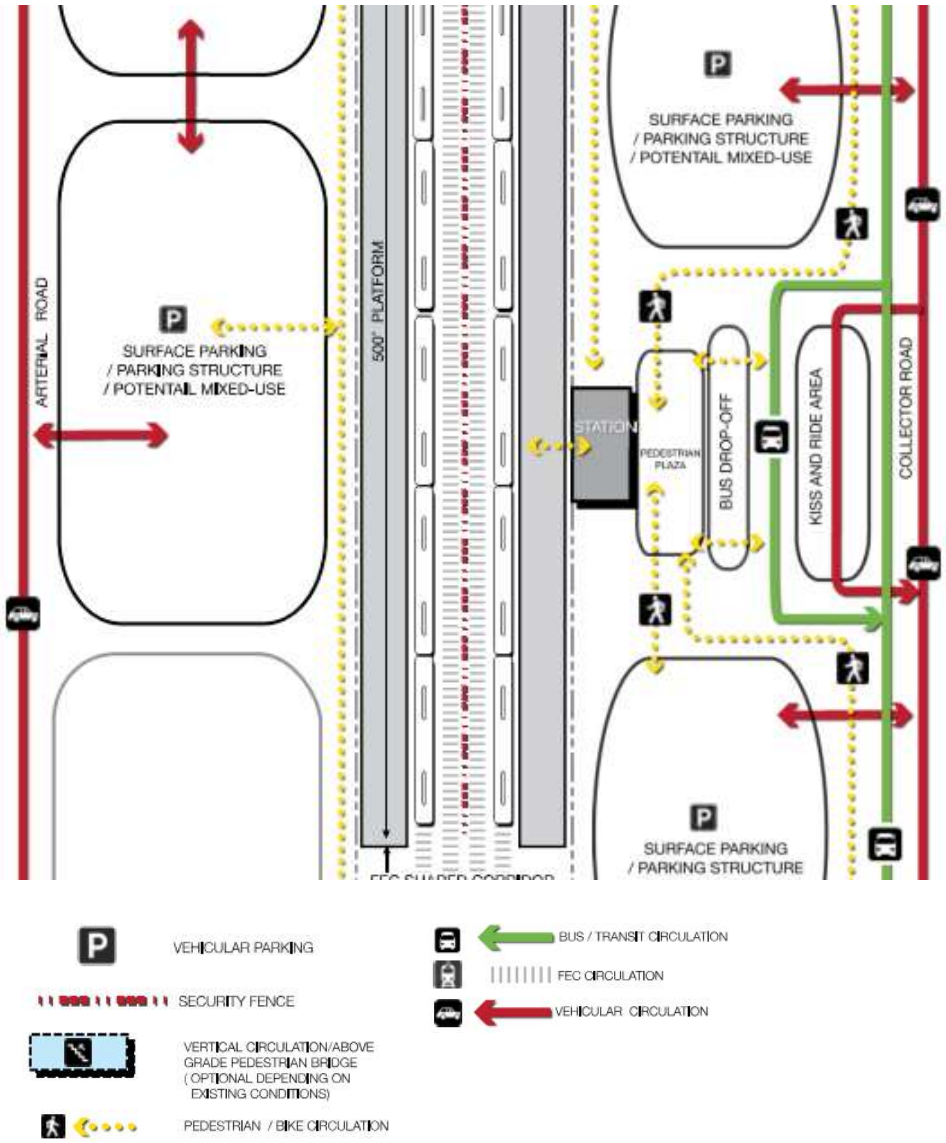


Figure 1-13: The Functional Diagram for commuter Local Park and Ride Station
Source: Station Design Guidelines by Gannett Fleming, Inc,2012

1.4.1.3. Intermediate Stations: - D) Special Events Venue Station

These stations need to be expressly designed to accommodate the specific venue they facilitate, i.e., a stadium or arena. The station and surrounding areas will have to simultaneously manage large crowds for short periods of time. Pedestrian bridges can be used to link people from the stadium and/or venue building to the station and platforms.

No station-related parking is necessary unless the station functions as another type in addition to serving as an events venue. If the stadium or venue is located within a dense mixed-used urban environment, parking may be shared with other surrounding structured parking. If possible, a pedestrian bridge should be used from the parking structure to the station and the stadium or venue.[27]

Station Area Zoning	Station Requirements
No zoning requirements unless combined with another station type	•**Site Acreage:** No dedicated acreage requirement •**Station Access:** Local services and express services • **Parking:** No dedicated parking

[27] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2.
from: www.sfeccstudy.com

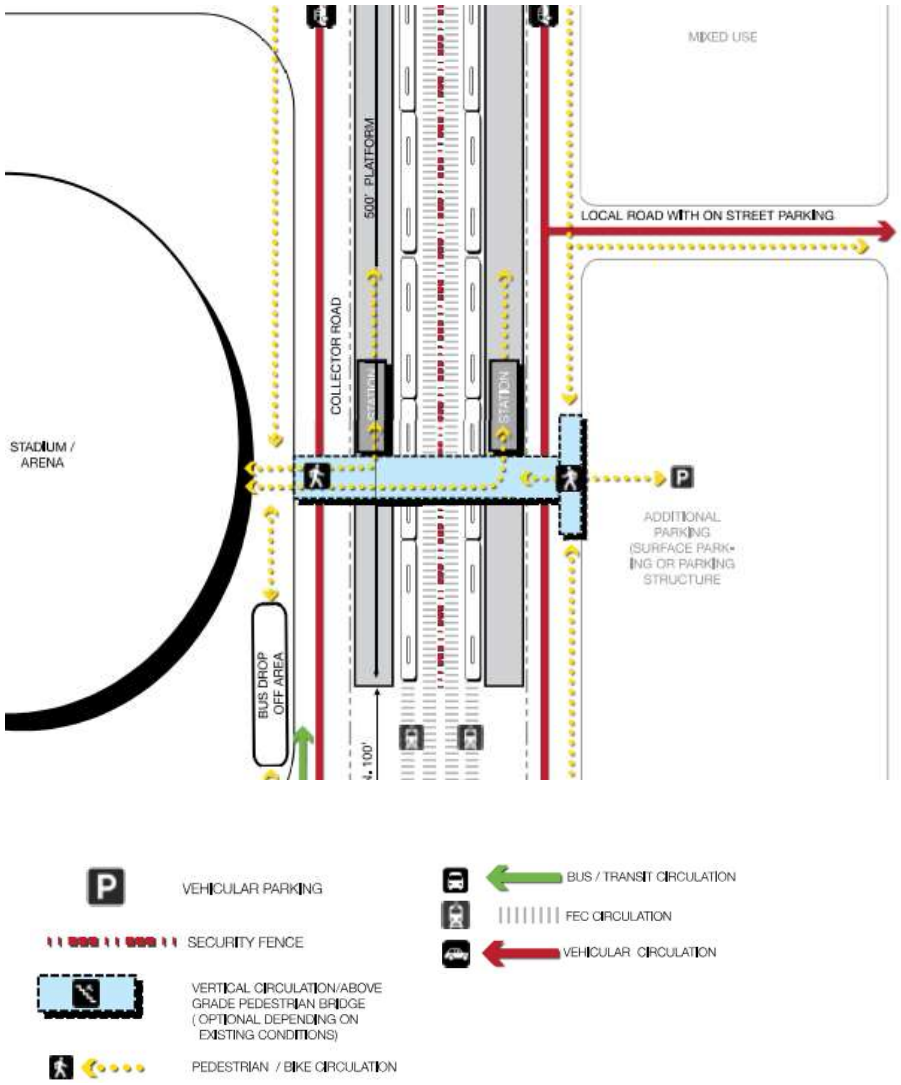


Figure 1-14: The Functional Diagram for commuter Special Events Venue Station
Source: Station Design Guidelines by Gannett Fleming, Inc,2012

1.4.2. Typical Components of Station Areas

This section deals with the typical components of the station area: the arrival area and the travel corridor. All access/arrival modes lead to the station and platform area from the gateway into the station experience. The user enters into the station experience and becomes a passenger in the "arrival zone." While arrival modes vary, the ultimate goal is to reach the desired destination, accessible via the station platform. Therefore, the station and platform become the second part of the sequence called the "travel zone." The various "arrival zone" components and the "travel zone" components work synergistically within the station system to provide a logical, clear, and seamless passage for users.[28]

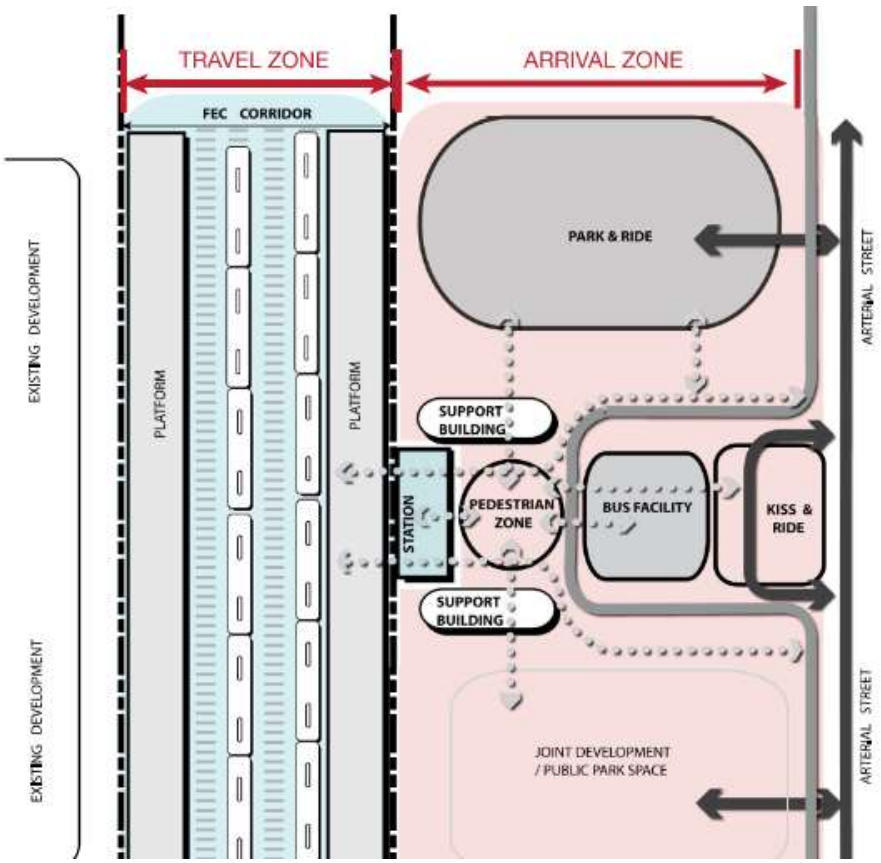


Figure 1-15: The Functional Diagram for Arrival Zone and Travel Zone
Source: Station Design Guidelines by Gannett Fleming, Inc,2012

[28] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2. from: www.sfeccstudy.com

1.4.2.1. Station Areas - Arrival Zone

Each day, station stations are witness to "thousands of individual ceremonies of departure and arrival." The station experience is primarily comprised of two fundamental parts; the "arrival" or access, and the departure, or "travel zone."

The first part of the station experience deals with the arrival zone where multiple user types utilize a variety of modes and methods to reach the station. Principles of access will be described in greater detail for various user groups in the next few pages. Depending on the chosen mode, the arrival experience into the station area varies for different individuals.

The following are components of the arrival zone, with the highest priority given to pedestrian access, then bus/station circulation, followed by Kiss and Ride, and finally to park and ride access..[29]

The Pedestrian Zone: Nodes and Circulation Network

Pedestrians are the most important component in the arrival zone since all users' station to on-foot access as they enter the station and platform area. The pedestrian zone also needs to provide a sense of place and fit into the surrounding context. Pedestrian zones consist of a network of street level pathways interjected by gathering nodes and spaces.

A pedestrian node, such as a plaza, is the part of the station area that collects passengers arriving from various modes, i.e., pedestrians on foot, bicyclists, bus or Kiss and Ride drop-off passengers, Park and Ride passengers, and allows them to partake in minimal activities, such as eating and people watching, before proceeding onto the platform for their train. Where possible, it is important that cover is provided for stationing passengers in walkways and waiting areas.

The station area may be ameliorated with supporting retail and other commercial uses that help generate greater foot activity and offer services to the station user. Outdoor dining areas and cafés generate additional activity which makes the station area more attractive and user-friendly. A focal point, such as a water feature or an art sculpture, not only helps draw attention to the plaza area, but to

[29] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2.
from: www.sfeccstudy.com

the station entrance. Shade trees and other landscape elements can also be incorporated into the pedestrian node design, but must not impede the main circulation route people use to enter the station. Trees and landscape beds can provide shaded areas for gathering/seating and frame the space by adding a sense of enclosure, creating a more intimate atmosphere similar to that of a comfortable courtyard. Vegetation can provide shade and help reduce the overall heat- island effect; and porous surfaces increase infiltration rates of storm water runoff. [30]

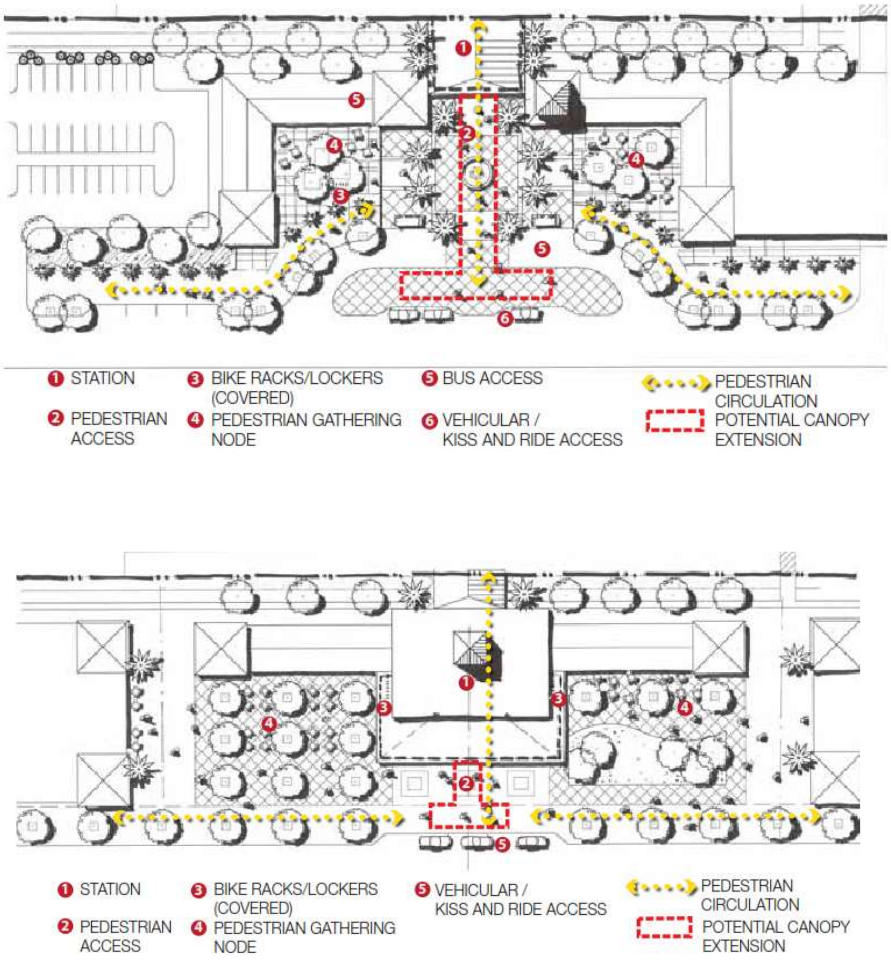


Figure 1-16: The Functional Diagram for Pedestrian Zone - Gathering Space (typical)
Source: Station Design Guidelines by Gannett Fleming, Inc,2012

[30] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2. from: www.sfeccstudy.com

The Bus Drop-off

In terms of accessibility, after pedestrian circulation, bus/station circulation is given priority. Bus Drop-offs, located at major employment centers or in collaboration with Park and Rides, serve as major access points as they carry a larger volume of users at scheduled times (based on bus schedules).

It is important to distinguish between the Kiss and Ride/vehicular drop-off and bus drop-off because they serve two separate users.

Bus drop-off areas should be given access priority often by the implementation of a loop road (in larger stations such as Park and Rides and large employment centers), and should be located in closer proximity to the station entrance area. Bus drop-off areas should be of adequate size for one to two bus lengths at a minimum (more depending on per-station and site-specific needs), and not allow bus queuing to impede pedestrian flow at station entrances where possible, pedestrian waiting areas and connections between bus drop-off platforms and the station should be covered with overhead canopy to protect passengers from the elements (rain, sun, etc.). Following are additional considerations when planning bus access and circulation into station areas.

• One way counter clockwise loop bus lane circulation is preferable. Two-way circulations should be avoided.

• Lanes for bus storage should be located in proximity and within view of the bus bays to allow layover buses to move to their assigned locations.

• Center-island bus bays to be used when there are significant bus-to-bus transfers. A central- median corridor can be utilized to accommodate sidewalks that extend from the bus drop-off areas to the station area. In high-intensity areas, access sidewalks can be moved outside of bus circulation areas. The median area also has an opportunity for the implementation of sustainable green spaces with storm water and runoff catchment/ treatment areas such as bio-swales and/or retention ponds.

• Pedestrian crossings across bus lane should be avoided. If crossings are unavoidable they should be located at the end of the bus staging areas. Vertical circulation elements such as pedestrian bridges can also be used to reduce conflicts between buses and passengers.[31]

• Appropriate signage, lighting, and landscape treatments help make the transfer experience more seamless, safe, and enjoyable.

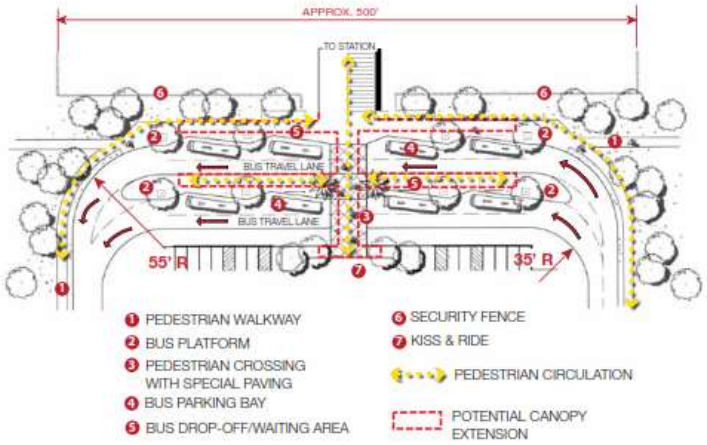


Figure 1-17: Typical Bus Drop-Off Diagram
Source: Station Design Guidelines by Gannett Fleming, Inc,2012

The Vehicular Drop-off: Kiss and Ride

In terms of accessibility, following pedestrian and bus/station circulation, Kiss and Ride is given priority. Vehicular drop-offs function similarly to bus drop-offs; however, they cater to smaller- capacity vehicles such as cars, vans, taxicabs and shuttles, etc. Therefore, Kiss and Ride areas should not be located farther than 600 feet from the station and platform area. Vehicular drop-off facilities can be incorporated along streets as simple pull-in facilities or as loop roads with short- term parking. Kiss and Ride facilities typically include areas for taxi cabs and shuttle queuing areas for vehicles waiting to pick up or drop off passengers. The automobile drop-off should allow for stacking of two to three cars, and should not allow for automobile queuing to impede pedestrian flow toward the station platform entrance. In larger-volume stations, taxi queuing and shuttle drop-off areas (par station vehicles) can also be provided adjacent to platform areas and in close proximity to the station entrance area. Taxi stands

[31] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2. from: www.sfeccstudy.com

should be separate from vehicular drop-off areas in larger-volume stations to accommodate efficient passenger transfers.

Pedestrian circulation should be separate from drop-off areas or be provided in such a way as to reduce any vehicular and/or pedestrian conflicts. Special paving can be used to highlight pedestrian crosswalks and the connections between the station and short-term parking lots. Evenly spaced bollards, or a security fence, can also be used for added separation between pedestrian and vehicular areas increasing passengers' safety while directing passengers toward the station entrance[32]

[32] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2. from: www.sfeccstudy.com

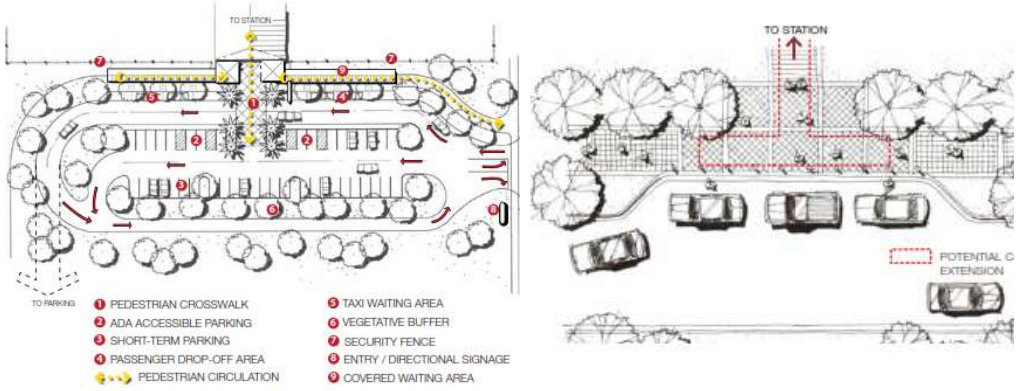


Figure 1-18: Kiss and Ride with on-street Vehicular Drop of Diagram
Source: Station Design Guidelines by Gannett Fleming, Inc,2012

Kiss and Ride areas are typically located along roadways as pull-off bays where vehicles can stop temporarily either to drop off or pick up passengers. The diagram above illustrates a Kiss and Ride area dedicated for short-term parking and taxi queuing.

Park and Ride

The Park and Ride component allow station users to park and have direct pedestrian access to the station entrance within a maximum of 1500'. The surface lot or structured parking facility should circulate vehicles in an efficient and logical manner throughout without dead-end parking.

Structured parking is more likely to occur in the corridor since little land is available for large surface parking lots. These parking structures can function as multistory and multi-use buildings, or as stand-alone structures. Liner buildings or green walls should be encouraged to prevent blank walls from being constructed adjacent to pedestrian walkways. In addition, parking garages should be set back from street fronts and aligned behind buildings, especially at ground level. This can reduce the visual scale and mass of the structure while also providing shade onto sidewalks. Elevated pedestrian crosswalks, or catwalks, can also be employed from parking structures directly into station areas in order to reduce pedestrian and vehicular conflicts.

Clearly distinguishable areas should be provided for pedestrian crosswalks, and conflicts between pedestrians and vehicles should be kept to a minimum. Variable special paving materials and applications can further aid the visibility of

pedestrian crosswalk areas. Where possible, all pedestrians waiting and connecting walkways to the station should be covered.[33]

1.4.2.2. Station Areas - Travel Zone

The "Arrival Zone" and access modes lead to the station and platform area which funnels the user into the station experience. Here the user becomes a passenger waiting to board the station system. While arrival modes may vary, the ultimate goal is for a passenger to reach his/her destination which can be accessed via the station platform. Therefore, the station and platform become main components of the travel zone.

After understanding the components of the arrival and travel zone, it is important to recognize both works together to provide a seamless passage to the users' ultimate destination. The following pages describe the components of the travel zone in greater detail.[34]

The Station

The station is the first of two components within the travel zone, giving priority to the pedestrian circulation within and around the area.

The term 'Station' often refers to the entire station experience at a particular stop that facilitates access and use of the station system. Depending on density and volume (case-by-case scenario) the station area could include a station building that serves as the gateway between the arrival area and the travel zone or it could simply be a centralized stational space.

A) Station Building[35]:

The main function of the station building area is that it spatially funnels people from surrounding access routes and pedestrian gathering areas through a secure checkpoint with a ticket booth or machine, onto the platform. If possible, restroom facilities should be connected to the station and platform area with

[33] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2. from: www.sfeccstudy.com

[34] The SFECC Phase 1 Report and 5 modes/transit technologies being further studied in Phase 2. from: www.sfeccstudy.com

[35] www.urbanrail.net

a semi-covered walkway or located in a structure attached directly to the station and platform area.

Architecturally, there is an opportunity for the station to become a focal point to the station area and the surrounding urban context. Architectural variety and articulation of building facades can add to the public realm experience and aid in orienting users toward the station platform entrance. In major community and urban centers, the station building often embodies elements of iconic architecture that give character and identity to not only the station but also its surrounding community and context. Within less dense environments and lower-volume stations, functions of the station, such as ticket sales and amenities (snack vending machines), often are incorporated into the platform area itself and reduce the need for additional building structures.

Figure 1-19: American Plaza in San Diego is an example of a transit station built into an existing structure.
Source: Photo (Left): http://washaw.files.wordpress.com/2008/12/__america_plaza.jpg
Photo (Right): http://www.urbanrail.net/am/sdie/OR-America-Plaza-01.JPG

B) Restrooms[36]

Restrooms will be provided for employees and station users at most stations (may be offered according to need at smaller Neighborhood Stations or as a joint facility with surrounding development).

Restrooms will be fully accessible and meet all ADA requirements as to size and fixture requirements. Single-occupancy restrooms require approximately 36 square feet. In additional, restrooms will have:

• ADA-accessible toilet and grab bars (number of stalls determined by station volume)

[36] & [37] Gannett Fleming Technical Memorandum on Station Guidelines, 2009 from www.sfeccstudy.com

• ADA-accessible lavatory and mirror
• Slip-resistant floor tile and fully tiled walls
• Standard accessories
• Floor drain

C) Ticketing Booth[37]

As needed, and possibly in conjunction with Tri-Rail, Amtrak, Metro Rail or other intermodal facilities, ticket offices, must meet the following requirements:

• Area of approximately 300 square feet
• Handicapped accessible counters
• Bullet-resistant glazing and window frames with security and storm shutters
• Bullet-resistant speakers
•Bullet-resistant doors, frames, and hardware with access for employees only
• Video surveillance equipment
• Weapon-resistant deal trays

Figure 2-20: Integrated station ticketing facilities - Charlottesville's new transit center.
Source: http://www.ecosafetyproducts.com/CharlottesvilleTransit-Center-s/435.htm
Posted; 2003

D) Interior Waiting Spaces

Future stations may offer interior waiting spaces, possibly in conjunction with Tri-Rail, Amtrak, Metro Rail or other intermodal facilities, where applicable. These areas require 14-15 square feet per passenger. Public restrooms also need to be provided.

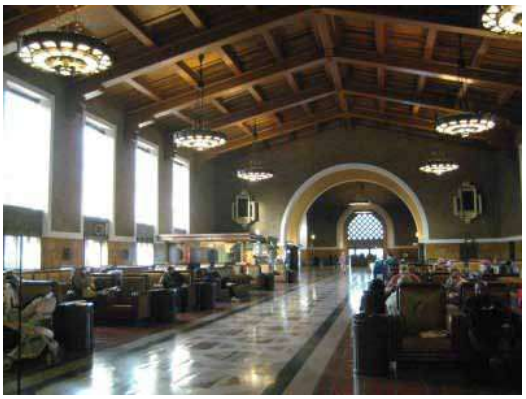


Figure 2-21: Interior Waiting Spaces- Union Station in Los Angeles.
Source: http://frenchybutchic.blogspot.com/2008/11/greatlos-angeles-walk-2008.html

E) Concessions

Concession buildings may be desirable features in many or all future stations as a service to commuters and as a potential source of income. Anticipated space will be leased to one or more concession operators who will provide finishes and equipment as deemed necessary. Approval from the SFECC is required. Ticketing services may be combined with concession areas to encourage better use. Typical program elements for concession areas include:

- Approximately 400 square feet
- Handicap-accessible counters
- Vandal-resistant windows with both security and storm shutters
- Vandal-resistant ceiling
- Secure access for employees
- Employee access to restrooms
- Floor drain

The Platform

The platform is usually the area where passengers wait to board the station system and the area where they also enter as they get the station system. The platform, depending on the chosen mode, variable system requirements (track configurations, service requirements, etc.) and site-specific conditions can either be designed as a side platform or a central platform. Typically, platforms should be 500' in length for commuter rails (616' for elevated Rapid Rail platforms, and 300' for LRT) and 25' wide for center platforms and 20' for side platforms.[38]

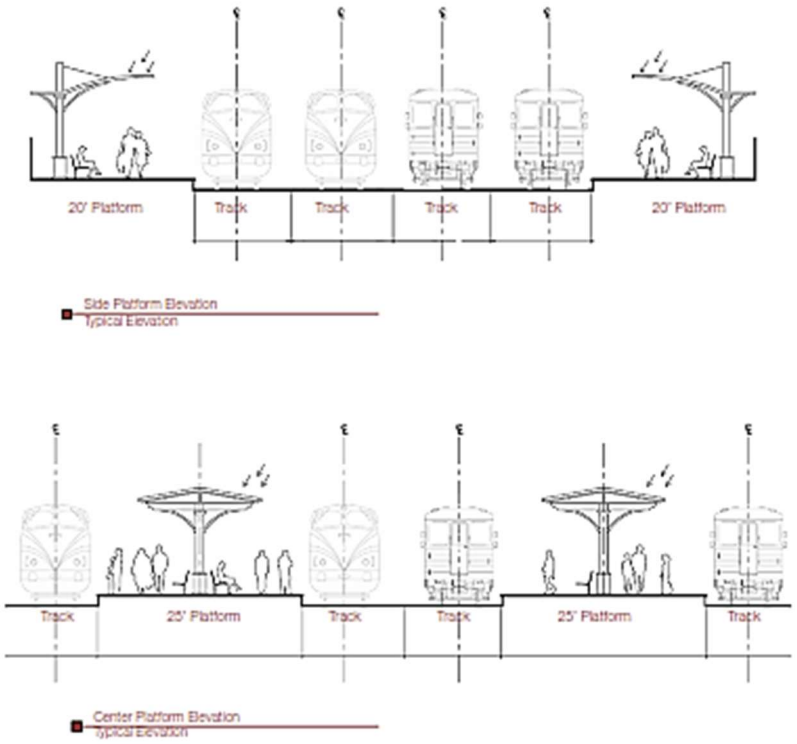
Both center and side platform configurations should include a central gathering area that contains the station's core facilities. For example, in the case where space restrictions do not allow a separate station building that stations the arrival areas into the travel zone, the central platform can house ticket kiosks where passengers can obtain information on the system, schedule, and destinations, etc, as well as purchase tickets. Depending on the size of the station and area, the center platform could also contain other public amenities such as restrooms, vending machines, newspaper stands, customer information desk, etc.

[38] Gannett Fleming Technical Memorandum on Station Guidelines, 2009 from www.sfeccstudy.com

In order to make the central amenities a focal point, different architectural, signage, and paving features, can be employed to direct attention to the central space and make it more easily recognizable to users.

Finally, an integral element to the platform area is the track crossing, which allows a passenger to move from one platform to another at grade, and is based upon setbacks and mode of technology. In most stations, pedestrian - grade crossings can be employed outside of the platform area. Special consideration must also be given to the mobility - and sensory-impaired population.

Figure 1-22: Typical Side Platform & Center Platform Elevation
Source: Station Design Guidelines by Gannett Fleming, Inc,2012



1.4.3. Central Station hubs user priorities

Station designs need to cater for a broad range of activities and should be resilient to the changing conditions experienced within a station, both during the operational day and throughout the year. Depending on context, station design may also need to accommodate a range of operational scenarios, such as major events, changes to service, or adverse weather conditions.

The design of a station must recognize the differing needs and aspirations of the station's varied stakeholders and user groups. As a minimum requirement all users should expect a clean, efficient, accessible, reliable, safe and legible facility but over and above this, individual user groups may have particular expectations or needs. Some of the most relevant are outlined here.

Commuters gain familiarity with a station through daily use. With low dwell times on stations, the overriding objective is to minimize journey time. They require:

• Reliable services supported by real-time information on delays and service disruption.
• Efficient transfer.
• Direct access to and from station thresholds, including access to car parking and taxi pick-up and drop-off points.
• Fast and efficient ticket collection.
• Convenient retail facilities.
• Real-time information displays for onward travel.

Business Travelers are frequent travelers, used to first-class facilities and high levels of comfort. Periods of time spent on stations will vary, often according to connecting services or modes. They require:

• High-quality, comfortable waiting areas.
• Clean, efficient and functional facilities.
• Direct access to and from station thresholds, including access to car parking and taxi pick up and drop off points.
• Fast and efficient ticket collection.
• Convenient retail and food and beverage outlets.
• Real-time information displays for onward travel.

1.4.4. Central Station hubs Maintenance Guidelines[39]

Maintenance guidelines are provided to present a series of general criteria and specific requirements for maintaining all interior and exterior building and site elements for the light rail stations. Most areas on the stations are subject to high visibility and use. The areas to be maintained include buildings, platforms, and walkways including site furnishings, parking lots and access roads, landscape areas, irrigation systems.

These guidelines provide recommendations for specific problems that might occur, however, other unexpected problems may arise and need to be accounted for.

1.4.4.1. Buildings

Lobby, hallways, ticket booths, waiting rooms will require cleaning each evening, seven days a week. Cleaning shall include removal of trash from all waste containers and relined with a new bag. The floors shall be swept clean and damp mopped, including the side molding and floor runners inside the doors. Public restrooms shall be cleaned once daily seven days a week. On a monthly basis, all plumbing fixtures and plumbing should be checked.

1.4.4.2. Hardscape Surfaces

On a monthly basis all walkways, concrete, porous concrete, stone pavers or unit pavers, shall be swept clean and checked for uneven of lifting in sections. Expansion joints will need re-caulking and must match existing color. Gum, food or other spills shall be cleaned with proper detergents and disinfectants. On a reported basis, powers wash all Hardscape surfaces, particularly to remove graffiti.

1.4.4.3. Site Furnishings and Lighting

Site furnishings on platforms and walkways will be cleaned with water or a mild, non-phosphorous soap to remove food, gum, graffiti, bird feces, and dirt. Inspect for chipped or cracked paint and rust spots. Inspect all hardware, and tighten if

[39] Guidelines for Station Site and Access Planning: Washington Metropolitan Area Transit Authority's Department of Planning and Information Technology Office of Business Planning and Project Development, August 2005

necessary. Specifically examine metal parts for chipped paint and rust spots. Replace with the same make and model, if available, if deemed necessary.

1.4.4.4. Landscape Areas

Landscape maintenance activities include planting, mowing, trimming, weeding, and fertilizer application. All of these maintenance activities have the potential to contribute pollutants to the storm drain systems, and potentially pollute surrounding watersheds.

- Maintain an attractive and user friendly landscape.
- Protect and enhance the natural landscape and native planting.
- Minimize water and material waste.

1.4.4.5. Equipment

The following equipment is recommended for use (purchase or rental) by maintenance personnel.

A) Power Equipment:

- Truck
- Riding Mulch Mower: To be used for lawn areas where feasible
- Power Trimmer: To be used for cutting grass where a mower cannot reach
- Power Edger: For redefining lawn edge along walks, driveways and planted areas
- Power Core Aerator: To be used for aeration of lawn areas
- Power Lawn Vacuum: For vacuuming up aeration of lawn areas
- Power Thatcher: For thatch removal of lawn areas
- Chipper: For breaking down woody material to be composted onsite or hauled away as green waste.

B) Manual Equipment:

- Cultivator/Fork: For turning material at onsite compost facility
- Gloves: Leather and cloth
- Hand Tamper: For compact natural drainage area soils, particularly in swales.

- Long-reach Pruners: For areas not easily accessible. Choose pruners with a 4’ to 5’ long handle and ‘cut and hold’ feature.
- Loppers: For pruning shrubs and smaller tree branches.
- Manual Edgers: For redefining lawn edge where power edger is not possible.

1.5. Conclusion

This chapter has tried to summarize the relevant literature relating to transport stations, transportation hub and multimodal transport toward designing sustainable hub stations.

The high importance of safety/ security, information to passengers, car parking facilities, buying tickets and waiting for models in reasonable comfort, the Hub station project comprehensively addresses the ecological, social and economic issues in the context of its surroundings. The sustainable approach would be to concentrate on; successful connectivity in the intermediate area, ensuring safety for traffic and pedestrian circulation, assessing the environmental design requirements for the intermediate project, ensuring equitable passenger services, and revitalizing economically healthy downtown areas and suburban centers.

The goal of the new transportation hub is to close these gaps and lower barriers to sustainable transportation by making it simple and convenient the intermodal transportation hub is a sustainable, world-class transportation facility linking commuter and regional rail service as well as intercity bus, taxi, and a local station.

The railway station has to be modernized for high-speed trains and the reorganization of inner-city bus lines, extended tram lines, taxes and parking space in connection with the relocated highway in the form of a new building a central hub is one of the proposals. The train station of the future is more than just a transport hub: it is a part of urban life.

Finally, the Hub Study involved a wide range of technical work carried out by technical staff and consultants.

Chapter 2:

Principles of Central Station Design

Chapter 2: Principles of Central Station Design

Introduction

For many years, the consensus on Station design principles has been carried out by different organizations and institutions to develop how to measure progress towards station design. The principles highlight a range of user requirements that must be incorporated into the construction and refurbishment of stations, and can be applied to existing stations as well. However, to what extent these principles succeeded in fulfilling the main purposes for which they have been established and what are the advantage of their practical implementation, are what this chapter attempts to investigate.

This chapter aims to explore the key issues related to station design. It examines a number of Principles, which intended to enhance and complement existing operators' design and service delivery standards and other legal and discretionary requirements. The aim of this examination is to assess the sets individually, to declare a definitive approach can be identified, also to provide frameworks used for formulating the indicator sets, highlight pitfalls, and problems facing such kind of projects, point out to the areas where projects fail to fulfill the guidelines.

The Station Principles is important to be settled to provide advice on how Central station development and redevelopment projects can better reflect the expectations of users and communities and enhance the places in which they are located.

2.1. Design Principles

The goal of the design Principles is to improve the overall aesthetic character and visual unity of the Station as a whole. Each new project will contribute to this goal through an integrated design approach that creates a desirable sense of place and reflects the appropriate scale, image, functionality and integration of building and open space. These design Principles represent the station's commitment for future projects to create a more cohesive environment. This Principle will be relevant to new or enhancement projects as well as to major renewals or maintenance projects and will help to meet the needs of all stakeholders. It can be used on all design stages of a project, from developing the design brief to evaluating an existing station or assessing proposed design solutions.[40]

2.1.1. Design Framework and Themes

A framework has certain responsibilities in the functioning of an application. These responsibilities are; Menu Management, Form Management, Security Management, Communication Management, and Data Access Management.

Designing a framework is not a small undertaking. There are many considerations to be addressed by the design. Using an effective design can mean the difference between success and failure on a development project.

The design Framework for the subject site identifies that the Central Station will be [41]:

- A place that provides a seamless and integrated station node that recognizes the primacy of the transportation function in accommodating those arriving and departing by foot, by bicycle, by car, by bus, and by train.
- A place that is mixed in terms of land use activities with opportunities for retail shops, offices, residences, civic uses, community facilities, visitor accommodations, among other uses, that supports activity throughout the day in a safe, secure and comfortable fashion.

[40] Guide to Station Planning and Design, Issue 1 July 2011

[41] Design and Engineering Manual, Department of Transportation, 2004.

- A place that is sensitively integrated into the built fabric.
- A place that sensitively protects and incorporates the existing built heritage on the site for a future, long-term use that supports the mixed-use character of the Station Hub.
- A place that is a landmark within the city and the region in terms of form and function, easily seen and identified as a prominent addition to the Kitchener skyline with an architectural style and form that distinguishes, yet complements the surrounding heritage fabric.
- A place that is universally accessible to all users, including those arriving by various modes of transportation, arriving from different directions to the site, as well as those with different special mobility needs.
- A place that incorporates green and sustainable choices in terms of both building and site design opportunities in respect to energy, water, and air quality considerations.
- A place that provides a grand presence from the street for visitors arriving in Kitchener and that leaves a lasting impression for visitors.
- A place that includes a series of interconnected vibrant spaces that are animated with activities and spaces throughout all times of the day and that are legibly linked between activities and different transportation modes.

Table (2.1) Design Framework and Themes indicators for central station hub
Source: - Urban Design Brief, Region of Waterloo Multi-Modal Station Hub,2013

1. Main Buildings	
Building Orientation	Site the base portion of all buildings. Locate principal building entrances so that they are clearly visible and directly accessible. Generate activity along ground floor façades by maximizing transparency, minimizing blank walls, and incorporating active ground floor uses, such as retail, restaurants, cafes, and uses catering to station users. Orient buildings close to street to reinforce the street edge, while ensuring sufficient space for pedestrian movements.
Massing and Scale	Develop a block structure that balances site circulation patterns with the emphasis on pedestrian movements. Scale the building's base section with considerations for the scale of adjacent or surrounding buildings. Use techniques on the building's middle and top sections to limit visual and shadowing impacts on surrounding buildings. Use a mix of materials. Provide continuous pedestrian weather protection along the base portion of all buildings where there are active uses.
Character and Style	Reinforce and emphasize the "landmark" nature of the site, featuring the highest quality architecture and innovation in its design features. Follow the rhythm, balance and proportions of surrounding industrial heritage buildings in designing buildings on the site, particularly for the base and middle sections of the building.

	Provide an appropriate stationing in color, materials and texture to soften building mass and add visual depth to the building elevation.
Signage	Incorporate fascia signage for ground floor retail uses as an integral component of the storefront architecture Locate fascia business signage in a more traditional sign band, the horizontal section which divides the storefront windows from the upper façade. Use simple lettering that is clear and easy-to-read and complement graphics that relate to the business function.
2. Circulation	
Pedestrians	Provide multiple building entrances to ensure connectivity and encourage station use. Ensure that all pedestrian connections are direct, convenient, safe, comfortable, and barrier-free. Incorporate clearly defined pedestrian linkages reinforced by appropriate landscape materials, paving materials and pedestrian scale lighting. Clearly separate loading, servicing, drop-off areas from pedestrian circulation routes. Provide appropriate separation for pedestrian movement and circulation along the railway tracks. Provide clearly defined pedestrian linkages in all underground parking facilities.
Vehicles	Locate all off-street parking within structured facilities, whether underground or above-ground. Ensure parking entrances are fully integrated into site design through appropriate architectural design.

	Incorporate preferential parking spaces for carpools, car sharing, and ridesharing to help reduce vehicle parking demands and the necessary overall parking capacity.
Station	Fully integrate station into the site's development through special paving materials and architecturally enhanced station shelter designs. Consider the location and integration of station stops and shelters in the design process to ensure sufficient space for station riders and pedestrians Ensure building entrances are located nearby street side station stops together with supportive uses.
Wayfinding	Incorporate a comprehensive wayfinding system for station users as part of the development. Consider as part of the wayfinding system directional signage, static station information displays, and real-time station information displays. Ensure wayfinding signs and features have a common template (color, materials, fonts, etc) so that the system reads as a comprehensive package and is easily recognizable by station users. Consider designing signs and features in keeping with the industrial character of the development and surrounding Warehouse District. Ensure directional signage is located both along the route and at key "decision" points along the route to ensure ease of use. Signage should be clearly legible from a distance and include easy to read and unambiguous symbols/arrows. Design all wayfinding features in keeping with universal Design principles to maximize accessibility, and usability for all station users. Particular

	considerations should include the location, placement, height, font, and color to ensure usability for those with particular needs, whether visual, physical or otherwise.
3. Circulation	
Plaza	Incorporate an active and animated gathering space as the entrance to the principal building that enhances the function of the "grand entrance". Consider opportunities for seating, water features, public art, bike racks, waste and recycling and other related site furnishings. Ensure a primary pedestrian route through this entrance plaza that is direct, barrier-free and unobstructed.
Walkways	Site buildings to ensure that at least a 4.0 meter sidewalk and boulevard can be provided along the street for easy and unobstructed pedestrian movements. Use surface materials for all walkways and paved surface areas that provide barrier free access and through the site, such as poured concrete. Incorporate universal design features along the streetscape walkways that are suited to users with visual limitations, including such features as textured banding, bus stop detection strips, and corner curbs and ramps.
Plantings	Reinforce the pedestrian circulation system through generous landscaped sidewalks, clearly defined, and landscaped, pedestrian linkages, unique markers at street entrances and decorative street furniture.

	Ensure landscaping is used in a balanced fashion with unobstructed views to spaces and buildings so as to not create potential hiding areas.
Furnishing and Amenities	Incorporate site furnishings including waste receptacles, bike racks, and pedestrian light standards. Consider opportunities for public art in the public realm, both outdoors along the street and indoors in the central concourses and station platforms.

2.2. Station Usability

Stations and their surroundings incorporate a number of different functions. They offer public transport services arriving and departing from different locations, ticketing facilities, waiting areas, retail, and catering opportunities, and onward travel by bus, cycle, taxi or on foot. The movement of passengers, public transport vehicles and non-users through a station can be complex. Therefore, it is important to plan and design safe, legible and accessible spaces that make the use of our stations intuitive, attractive and accessible for all users.

The dominant approach in design theory is that for designing good, useful, user-friendly products, it is important to understand user needs and characteristics. However, technologies in use shape and transform user needs and behavioral routines. To improve usability, the focus must not be exclusively on user needs and characteristics, but also on the complementary aspect of how technology changes people. The movement of passengers, public transport vehicles and non-users through a station can be complex. [42]

The design theme of Usability is covered by four design principles:

1. Movement
2. Access and Inclusivity
3. Wayfinding and Passenger Information

[42] Guide to Station Planning and Design, Issue 1 July 2011

4. Comfort and Attractiveness

2.2.1. Station Movement[43]

A station is a dynamic environment, involving movement and potential conflicts between ranges of station users. Movement within and around the station environment should be logical, comfortable and optimized to minimize conflict now and into the future

2.2.1.1. Plan spatial capacity

Spatial planning, articulation of built elements, and circulation system design are commonly the Responsibility of architects, site designers, the engineering team, interior designers, and building owners and administrators. The design team should always include experts in environmental information and, especially in more complex settings, wayfinding design. Informed spatial planning defines buildings that work and the success or failure of future building users (Evans and McCoy, 1998). Establish the capacity, configuration and spatial sequence needed to support predicted volumes of movement up to an agreed future year.

- Establish the capacity, configuration and spatial sequence needed to support predicted volumes of movement up to an agreed future year.
- Identify existing and planned internal and external origins and destinations and establish predicted levels of demand for passengers and non-travelling users.
- Analyze potential patterns of future demand via stakeholder consultation, known industry statistics and local area plans.
- Provide sufficient capacity to meet current and expected levels of activity and movement between key points within the station and its surrounding context.
- Design for development integration so that station capacity, operations, and internal circulation requirements can be maintained or enhanced.

[43] Saelens B, Sallis J & Frank L, 2003. Environment correlates of walking and cycling: Findings from the transportation, urban design and planning

- Design to minimize cross flows at decision, entrance and exit points.
- Provide sufficient capacity where movement spaces meet, such as at entrances, exits, decision spaces or gate lines, and design areas to be clear of unnecessary obstructions.
- Locate information, TVs and ticket windows where passengers using the information or facilities do not obstruct the movement of others or interfere with essential station operations.
- When appropriate, consider the use of analytical techniques or computer aided modeling software to validate station users' movements and capacities, particularly at passenger decision points, queue locations, and cross flows.

2.2.1.2. Design legible spaces

Legibility of space: Ease of use in organizing visual information in space into a coherent basis for action. "The ability to find one's way into, though, and out of a building is clearly a prerequisite for the satisfaction of higher goals" according to designer Jerry Weisman in 1981.

A legible space is one that is uncomplicated in design and simple for users to understand. Legible spaces help to remove the anxiety caused by a complex or unfamiliar environment and enhance the user's enjoyment and experience.

- Identify principal destinations in order to establish the station's internal movement structure. Direct, safe, attractive connections between key facilities help create more convenient and comfortable places.
- Design to minimize potential conflicts between different flows and provide an intuitive environment. Provision should be made for those moving against the predominant flow.
- Provide direct sightlines between principal destinations, uncluttered spaces with consistent environmental design and a positive use of lighting and color.

- Plan pedestrian routes to maximize spatial efficiency and minimize the transfer penalty by following natural desire lines (the route by which a user is most likely to use to get between principal destinations).

2.2.1.3. Permeability in access and movement

Permeability is the number of alternative ways through an environment. A permeable environment allows people to move around with greater ease and with more choice of routes.

Stephen Marshall[44] has sought to differentiate the concepts of "connectivity" and "permeability". As defined by Marshall, "connectivity" refers solely to the number of connections to and from a particular place, whereas "permeability" refers to the capacity of those connections to carry people or vehicles.

Integrity stations should, where possible provide multiple points for pedestrian and vehicular access. [45]

- Design station layouts to maximize the number of direct connections to streets, 'transport hubs' and destinations within the surrounding context to provide the greatest route choice for all users and increase the potential for mixed-use areas within and around the station.
- Ensure issues of severance with the local context and barriers from transport functions are mitigated or removed altogether, through intelligent and best practice design.
- Quantify the scale of movements to and from existing and planned surrounding communities (residential, employment, retail or leisure areas.
- Re-size existing, and open new, through routes to improve access into the whole station and allow people to move in straight lines rather than diverted paths.

[44] MARSHALL, S., 2005. Streets and Patterns. Spon Press

[45] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

- Ensure the design and location of access points adhere to the principles of Crime Prevention.
- Install way-finding signage that utilizes heads-up displays
- Highly interconnected path network providing choice of walking and cycling routes that lead to local and regional destinations.

2.2.1.4. High quality lighting for passenger movement

Lighting plays a central role in creating comfortable, safe environments for customers, staff and other station users. Lighting that is appropriate to location and function will result in increased safety, legibility, accessibility, security, ambiance and, therefore, public satisfaction.[46]

- Provide high quality station lighting that meet passenger demand and capacity requirements.
- Provide consistent illumination through indirect lighting/ lighting of all surfaces (walls, ceilings and floor).
- Design lighting to minimize reflected glare and avoid highly reflective gloss finishes.
- Use lighting to define routes between places and highlight important features and destinations without the need for additional infrastructure. Lighting from retail and other commercial outlets should not detract from these positive effects.
- Illuminated routes should be evenly lit, avoiding sudden changes in lighting levels, glare, dark spots or pooling that could create confusion for visually impaired users.
- Integrate managed, natural lighting where possible to minimize energy consumption.
- Design a task-based lighting strategy to deliver light where and when it is needed appropriate to location and function.

[46] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

2.2.2. Station Accessible and Inclusive

Accessible station design is about making places easy to use for all passengers and station users. Users include people with visual or cognitive impairments, those in wheelchairs, older people, people with heavy or bulky baggage, young children and their careers, and those with bicycles. The accessible design relates to stations, their amenities, surrounding context and information systems that support movement, use and understanding.[47]

The design guidelines for Accessible and Inclusive are presented in three sections, covering the following topics:

1. Obstacle and step-free spaces.
2. Optimizing lift and escalator locations and capacities.
3. Provision of mobility assistance buggies.

2.2.2.1. Obstacle and step-free spaces

Providing an accessible environment means making movement routes the same for all users, not requiring passengers with mobility or other impairments to follow circuitous routes away from principal passenger flows.[48]

- Ensure that the environment is clutter free and that there is an appropriate tonal contrast between floor and wall surfaces.
- Locate step-free routes in intuitive locations that are not isolated from the main pedestrian flows, with long sightlines highlighting their suitability.
- Locate wide, at-grade crossing at inter-modal connections set on desire lines and avoid level changes for underpasses and footbridges.
- Identify all hazards such as platform edges, change of grade at stairs and ramps with high contrast finishes, and ensure uniform lighting to minimize possible risk of accidents.

2.2.2.2. Optimize lift and escalator locations and capacities

[47] Code of Practice for Design For Access and Use of Buildings and Facilities by Disabled Persons. New Zealand S4121, 1985.

[48] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

Lift and escalator locations should be positioned so that they remain in close proximity to existing movement spaces and desire lines. This will optimize journey or connection time for all users, reduce the risk of conflicting passenger flows and, by avoiding isolated areas, harnesses a greater sense of safety and well-being for the user.[49]

- Locate lifts and escalators directly on passenger desire lines rather than in locations that would lengthen journeys or raise personal security fears.
- Evaluate waiting areas and capacities at lift entrances to avoid conflict with pedestrian movements in adjacent areas.
- Locate lifts such that entry/ exit routes and waiting areas have good natural surveillance and consider the use of glass/ transparent structures.
- Consider the provision of alternative accessible routes in the event of planned or unplanned lift or escalator maintenance.

2.2.2.3. Provision of mobility assistance buggies

Mobility buggies support the movement for mobility-impaired passengers. Mobility assistance buggies are available at major stations to support mobility-impaired passengers to gain access to and from train services and facilities.[50]

- Identify convenient locations for mobility assistance buggies avoiding impacts on station operations.
- Consider ancillary measures such as help points and signage from which assistance can be requested.

2.2.3. Wayfinding and Passenger Information[51]

[50] Inclusive Mobility: A guide to Best Practice on Access to Pedestrian and Transport Infrastructure (2005) Department for Transport Available at: www.dft.gov.uk/transportforyou/access/peti/inclusivemobility

[51] Weisman, J. (1981). Evaluating Architectural Legibility: Way-finding and the Built Environment, *Environment and Behavior*, v. 13(2): 189-20

Adopting principles of accessible and legible design for passenger information and wayfinding from the outset will result in places that are easy to use, require minimal signage and are well integrated with their surroundings.

The philosophy underlying signing and passenger information at stations should be that of clarity, consistency, and coherence in order to guide people through the stations in a steady, convenient and safe manner helping to ensure station users have a positive, stress-free experience. This philosophy supports a well-planned and well laid out station, and is integral to its design. Information is a fundamental requirement for a positive passenger experience. Information can serve multiple uses including rail services, station, and facility opening hours, maps of the local area and information for interchange modes. Information should be delivered across the full range of media including audio, visual and tactile to meet the needs of all interchange facility users.

The design guidelines for Wayfinding and Passenger Information are presented in four sections, covering the following topics:[52]

1. Provide service information
2. Consistent wayfinding and signing, integrated with the built design.
3. Inclusion of wayfinding information beyond the station footprint.
4. Accessible information.

[52] Arthur, P.and Passini, R. (1992), Wayfinding: People, Signs, and Architecture, Ontario: McGrawHill Ryerson Ltd. Reissued as a collector's edition in 2002 by Focus Strategic Communications, Inc.

2.2.3.1. Provide service information

Information needs vary by passenger type and journey stage. For example, regular commuters may value timely warning of disruptions or delays more than detailed timetables, visitors, on the other hand, benefit from simple service, ticket, and location information that enables them to understand the journey options available to them.[53]

- Provide for passenger information and announcements across the station environment including within concourse, platforms, retail, food & beverage and waiting areas electronically and through staff and static signage – to ensure that passengers are aware of general information and information on service disruptions.

- Consider the use of audio and visual displays as well as mobile phones, audio loops, portable sound and near field technologies to provide passengers with timely information where and when they need it.

- Ensure that traditional communication channels, including the use of printed information, tactile information and station staff are consistent with dynamic information including: (Service departure information; Identification of interchange facilities and accessible routes to those facilities; Safety information and instructions; Warning, prohibition and mandatory actions).

- Use an appropriate 'tone of voice' to help the passenger understand the relative importance of different pieces of information.

[53] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

2.2.3.2. Consistent wayfinding and signing, integrated with the built design

It is essential that signs be positioned where people need them most. These locations are generally routed decision points, such as entrances, exits, and junctions. Decision point signs normally provide directional information to way out routes, inter-modal transport connections, platforms and key facilities. Integrated wayfinding minimizes physical obstructions to movement and helps station users see the station and its surroundings as part of one cohesive system.[54]

- Avoid excessive signage, which may be counterproductive and may create unnecessary clutter.
- Design wayfinding to be seamless to help passengers move between different locations, using all modes of transport in one continuous journey.
- Design routes to be simple and legible requiring minimal signing by integrating spatial planning, lighting and surface finishes alongside other building elements such as public art and landscaping.
- Wayfinding signage must always take visual priority over other information and its view must always remain unobstructed from key reading directions.
- Locate consistent and simple wayfinding information at station entrances. Exits and decision point to confirm route choice.
- Clearly define and sign principal routes between the station and principal external destinations, particularly other transport modes.

2.2.3.3. Inclusion of wayfinding information beyond the station footprint

Stations form just one part of a passenger's journey and wayfinding information should be included for those destinations beyond the immediate vicinity of the station. This supports movement between stations and surrounding destinations, including streets, footpaths, bike routes and public spaces, to help ensure continuity of movement, which in turn optimizes journey times and manages potential conflicts in pedestrian flows.[55]

- Plan for seamless information provision to allow passengers to see the station and its surrounding urban context as part of one cohesive system.

[54] www.networkrail.co.uk/Guide_to_Station_Planning_and_Design.pdf.2012

[55] Weisman, J. (1981). Evaluating Architectural Legibility: Way-finding and the Built Environment, Environment and Behavior, v. 13(2): 189-20

- Include directions to/from major destinations at station entrances to highlight routes and locations for pedestrians and cyclists.
- Integrate with and adopt consistent terminology and naming from third party wayfinding systems in adjacent areas where possible.
- Facilitate the display of information related to external facilities within the station, including town/city maps or guidance and directional signage consistent with third party local wayfinding strategies where possible.

2.2.3.4. Provide accessible information throughout the station

The provision of accessible information that takes into account passengers with impairments, cultural and/ or language differences benefits all users as signs and information will be easier to use and understand.[56]

- Provide optimum legibility and distinctiveness between different design elements by using high contrast color within a clear hierarchy.
- Loops, mobile and near-field technologies to provide information for visually impaired users.
- Clearly locate and sign passenger assistance help points for the benefit of all users.
- Design the typeface to be large enough to be read by users with different visual abilities at a range of distances. Though not all type can be made large enough for everyone for reasons of practicality, the majority of users should be catered for.
- Design accessible information for those who have any difficulty with language, whether through learning difficulties or not speaking English as a first language.
- Consider the use of icons, consistent use of naming and language, color coding and other aspects of intuitive design not based on textual language.

2.2.4. Comfort and Attractiveness

Comfortable, clean, well-maintained stations provide an attractive environment that protects users from uncomfortable climatic conditions and unpleasant sensory

[56] Weisman, J. (1981). Evaluating Architectural Legibility: Way-finding and the Built Environment, *Environment and Behavior*, v. 13(2): 189-20

experiences such polluted air, dirt or noise and provides users with a sense of security and safety. Amenities should be included, where appropriate, to fulfill basic needs and add value to the passenger experience.[57]

The design guidelines for Comfort and Attractiveness are presented in three sections, covering the following topics:

1. The provision of facilities, amenities and spaces.
2. Guidance for climate protection and control against unpleasant sensory experiences.
3. Developing space for waiting areas.

2.2.4.1. The provision of facilities, amenities and spaces

Stations fulfill different functions according to their size, location and levels of train service. Facilities, amenities, and spaces for activities should be appropriate to the station environment and their context.[58]

- Consider the range of users, the daily footfall, the location and context of the station.

- Design public facilities and amenities to include a range of:

Shops and retail kiosks - food and beverage outlets – telephones - cash machines - waiting areas - left luggage areas – seats - luggage trolleys - public art - safe, clean and accessible - toilet facilities

2.2.4.2. Guidance for climate protection and control against unpleasant sensory experiences

The inclusion of noise mitigation techniques and design of effective climate protection through platform canopies and covered pedestrian routes will ensure that station users are protected from unpleasant experiences and provide a positive ambiance and journey experience for all.

[57] Rail Vehicle Accessibility Regulations (Northern Ireland) 2001 (SI No. 264) Available at: www.opsi.gov.uk/sr/sr2001/20010264.htm

[58] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

- The design of stations should ensure that passengers are protected from extreme weather conditions (the wind, rain, snow, sun, and extreme heat and cold).
- Consideration should be given to managing to delight for regularly occupied spaces to maintain consistent lighting levels and minimize energy consumption.
- Consider sun shades and air conditioning.
- Provide lighting levels and fixtures that are functional and aesthetically pleasing; this allows good visibility and additional security.
- Ensure thorough cleaning at regular intervals to eliminate stains and odors, particularly in lifts.
- Mitigate risks arising from climatic conditions for reasons of safety and ease of use.
- Minimize background noise levels in selected customer environments.
- Consider the need for resilience to climatic change and extreme weather conditions.

2.2.4.3. Developing space for waiting areas

Waiting spaces include formal waiting rooms, station concourses, retail and other amenities. These spaces provide opportunities for seating, standing and leaning. This allows station users to dwell on the station in relative comfort for periods of time. [59]

- Design and locate waiting spaces to be appropriate to the size and function of the station.
- Locate waiting spaces for convenient access from station facilities and movement routes.

[59] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

- Include appropriate levels of seating based on the size and function of the station, anticipating user needs and dwell times.
- Allow for regular maintenance and servicing checks and provide a prompt response.

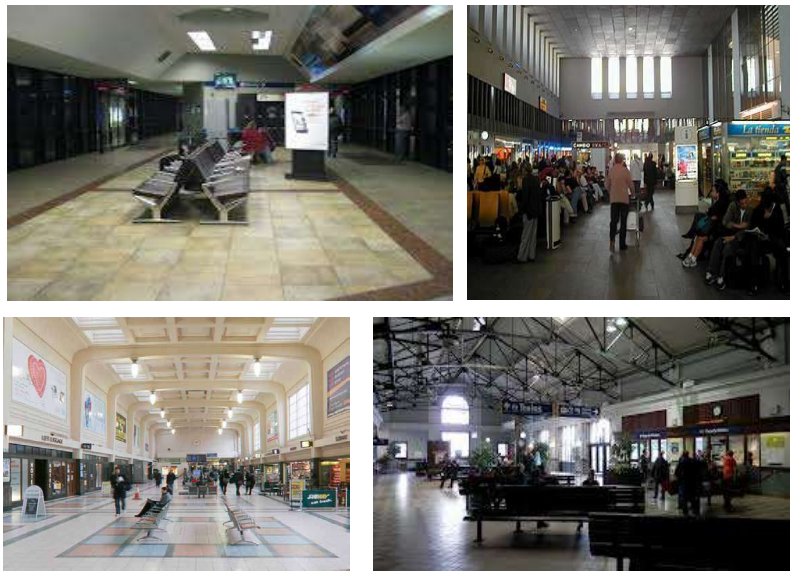


Figure 2-1: space for waiting areas inside rail station
Source: - https://www.google.com.eg/search

2.3. Station Operability

The design of station facilities and their immediate surroundings should promote efficient operations and maintenance in an environment that is functional, comfortable and safe. An efficient station design helps deliver a positive passenger experience, minimizes delays and disruption, supports modal integration and results in cost savings for asset managers and station operators over the full course of a station's life. Planning of station improvement projects should also take account of the ongoing operational requirements of a live rail network and ensure that the integrity of operations and passenger safety are not impaired over the term of the project. Operability includes consideration of

service coordination, operating costs, integrated ticketing, maintenance, safety, and servicing.[60]

The design theme of Operability is covered by four design principles:

1. Station Operations
2. Management and Maintenance
3. Safety
4. Be Secure by Design

2.3.1. Station Operations

Station operations require integrated and optimized operation of the fleet, infrastructure and facilities to provide easy access for transport services, seamless movement across modes and effective maintenance. Efficient stations ensure cost savings for operators and owners.[61]

The design guidelines for Station Operations are presented in four sections, covering the following topics:

1. Providing appropriate spatial capacity for all station functions.
2. Guidance on coordinating modal integration.
3. Providing for efficient service and delivery vehicle access and storage.
4. The provision of appropriate and convenient facilities for station staff

2.3.1.1. Providing appropriate spatial capacity for all station functions.

Ensuring there is adequate space in a station's design to meet its current and future needs for transport operations, servicing, commercial facilities, passengers and other users minimize delay and disruption. This enables passengers to move freely and comfortably to/from and around the station and accommodates future growth in demand.[62]

- Plan to maintain capacity for efficient station operations over the lifetime of station improvement projects.

[60] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

[61] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

[62] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

- Plan and design internal passenger and vehicular access routes to cater for predicted activities, movements and capacities now and into the future while avoiding conflict with passengers, transport services and other station users.
- Plan and design for passenger movements and use of facilities, including the capacity of access and exit routes to the station.
- Plan spatial allocation to provide for the needs of equipment and vehicles such as, bicycles, luggage trolleys and goods vehicles.
- Identify operational thresholds so that boundaries between spaces for different uses are clearly indicated and readily understandable.
- Ensure clarity of spatial priorities to minimize potential conflict between vehicles, cyclists and pedestrians, leading to safe and efficient station operations.
- Ensure appropriate revenue protection and boarding control between transport modes.

2.3.1.2. Guidance on coordinating modal integration

The efficient connection between transport modes and services is a core function of stations. The design of connections should balance model and functional priorities, using safe, direct routes that minimize conflict with other passengers or vehicles. Not only does this minimize passenger journey times, but it also ensures efficient connections that allow passengers to make their onward journey as easily and as logically as possible.[63]

- Engage with third party operators of local transport services to ensure spatial provision meets with current and future needs.
- Allow for sufficient capacity to deal with different conditions at different times based on a detailed understanding of the likely future demand for movement between each mode at different times of the day.

[63] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

- Priorities access by feeder modes such as walk, cycle, taxi or bus, to meet with passenger and operational needs. This will ensure passengers do not experience undue delay through extended waiting times for connecting services.
- Provide coordinated information and signing to and from intermodal connections.
- Where possible, provide intermodal movements under cover.
- Design lighting strategies for intermodal routes to meet with minimum requirements and integrate with third party lighting systems where routes extend beyond station thresholds.

2.3.1.3. Providing for efficient service and delivery vehicle access and storage

Efficient service vehicle and delivery access and storage must be provided to meet a station's many needs. Appropriate access and storage minimize disruption to passengers and transport operations while ensuring safety, security and environmental responsibilities can be met. Consider the means by which goods and materials will be delivered to the station and the impact different modes of delivery will have on station activity. Ensure any interference with passengers and day to- day station operations is kept to a minimum.[64]

- Delivery and service plans should seek to enter into consolidation strategies to minimize the number of servicing and waste collection trips and increase efficiency.
- Over-site developments should minimize and control servicing and waste activity from streets in the immediate vicinity of station entrances.
- Servicing and waste collection activity should occur within the station to minimize impact on surrounding highways and passenger movements.
- Plan for servicing and waste management to be carried out safely, and in an environmentally friendly way. Compliance with all relevant and

[64] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

appropriate local authority guidance should be reflected in the delivery and service plan.

- Recognize that storage facilities will serve different functions and may be required to be located in different areas of the station and design safe, secure storage accordingly.
- Minimize and control the conflict between servicing and waste activity. Coordinate with existing station functions and main passenger movements.
- Remove visual obstructions to provide easily understood movement between facilities and services.
- Ensure existing on-street servicing activity on key pedestrian routes to and from the station is minimized, or restricted, over the course of peak pedestrian movements to and from the station.

2.3.1.4. The provision of appropriate and convenient facilities for station staff.

Staff facilities appropriate to the size, location and function of the station enable staff to work effectively within the station environment, optimizing day-to-day operations and allowing them to best meet station user requirements.[65]

- Ensure early engagement with the different operators to address any corporate requirements.
- Provide adequate accommodation for station management and operational staff and for station functions including: station control rooms, storage, operational equipment, waste handling, maintenance, etc.
- Ensure design of staff facilities gives due consideration to the health and safety of all staff and contractors spending extended periods working within the station environment.

[65] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

- Provide adequate lighting and ventilation for those who work in an enclosed space and ensure noise levels fall within safe and comfortable limits.
- Locate operational accommodation away from prime retail space, unless current contracts so dictate. In such cases, liaise with stakeholders to seek beneficial relocation as appropriate.
- Locate customer support staff in facilities that are both visible and readily accessible to passengers.
- Consider the welfare of staff associated with other public transport modes that serve the station, enabling them to make effective use of the station facilities, such as wash and mess rooms.
- Consider consolidation and flexible planning of staff accommodation where appropriate.

2.3.2. Management and Maintenance

Effective station management and maintenance practices help sustain the quality of the station environment. This maintains the longevity of the station, while also making it more appealing to users and realizing the benefits of whole-life cost assessments.

The design guidelines for Management and Maintenance are presented in four sections, covering the following topics:[66]

1. Facilitating efficient station maintenance and cleaning.
2. Establishing the rights and responsibilities of stakeholders.
3. The use of robust and resilient materials.
4. Heritage Asset Management process.

2.3.2.1. Facilitating efficient station maintenance and cleaning

Station maintenance should be undertaken efficiently and without compromise to train services or customer experience. An efficient maintenance regime

[66] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

minimizes impacts on passenger experience, train service reliability, and operations.[67]

- Minimum maintenance standards must always be met and exceeded where possible.
- Plan and design to allow for the cleaning and maintenance of public areas without the need for closures or possessions. These activities should have no impact on the day-to-day operation of the station. If this is unavoidable, select self-cleaning materials with long life and low maintenance.
- Use standardized and modular products, and design for simple maintenance and cleaning wherever possible; these should meet with the required functional and aesthetic qualities expected by users.
- Conceal ducting and cabling from public view and, where applicable, mark or paint them to match the backgrounds.
- Locate signing and information displays to deter vandalism, and keep them clean and free from graffiti.
- Maximize efficiency of regular maintenance and cleaning regimes. For example, equipment and seating should be designed and placed to allow easy access for cleaning under, over and/or around the feature.

2.3.2.2. Establishing the rights and responsibilities of stakeholders

Station facilities are often the responsibility of more than one occupier or owner. Establishing the rights and responsibilities of all stakeholders with regard to maintenance management, servicing, and emergency procedures enable coordination of activities to avoid disruption to passengers and services while ensuring consistent standards of condition throughout the station and its adjacent spaces or buildings.[68]

[67] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

[68] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

- Engage with local authorities, landowners and other agencies to establish coordinated maintenance and management responsibilities for public spaces and access routes in those areas immediately surrounding stations.
- Agree a maintenance plan that will allow all parties to coordinate activities and ensure consistent standards of condition throughout the station and adjacent locations.
- Promote segregation and recycling of waste materials by entering into consolidation strategies as part of delivery and service plans.

2.3.2.3. The use of robust and resilient materials

The use of durable materials that deter vandalism allows for ease of maintenance and repair, helping to discourage repeat crime. [69]

- Ensure a balance between the visual and physical qualities of materials used. While they are to be durable, they should remain pleasing to look at and to use.
- Specify and construct fixtures and fittings to deter vandalism.
- Use materials that are tamper-proof and minimize maintenance or repair.
- Use graffiti-resistant materials or finishes so that it is easy to remove graffiti.
- Place lifts in positions of maximum natural surveillance to deter vandalism.
- Use vandal-resistant light fittings by location, type and construction.

2.3.2.4. Heritage Asset Management process

A variety of heritage assets exists across the rail network including buildings, sites, and spaces. As such, a heritage asset management process may be necessary to ensure a strategic and systematic approach to the management of existing assets

[69 & 70] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

is followed, helping to achieve value for money and safeguarding the special interest of the historic environments.[70]

- Understand the heritage significance of the assets to help inform the design process, establish the extent of repair, alteration, management, re-use or disposal, and help reconcile conservation and other objectives. Consideration should be given to operational requirements, rationalization of facilities, security and reduced energy use.

- Undertake regular condition surveys to enable work to be planned in a cost-effective way.

2.3.3. Safety

Considered design and maintenance of infrastructure can minimize the risk of accidents and conflicts. It can also tackle perceptions of safety and increase passenger satisfaction and enjoyment. Clean, well-maintained infrastructure and places create a sense that the environment is safe, controlled, managed and cared for – this reduces the fear of crime or accidents for all users.[71]

The design guidelines for Safety are presented in two sections, covering the following topics:

1. Ways to design facilities and spaces to minimize the potential for accidents, conflicts and collisions.
2. Guidance on ensuring full compliance with all statutory emergency requirements.

2.3.3.1. Ways to design facilities and spaces

Spaces and facilities should be designed to minimize the potential for accidents, conflicts and collisions. Through effective planning and design this maximizes the use of available space, while optimizing pedestrian flows by removing potential impediments and maintaining passenger safety.[72]

[71 & 72] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

- Assess the requirements for and appropriate placement of street furniture, seating, bins or other infrastructure, carefully locating them to minimize obstruction and maximize use of the available space.
- Design and operate stations to minimize conflict between vehicles and pedestrians, locating parking provision for cycles, private cars, taxis and buses as close as possible to station entrances, in areas clearly marked out. This provision should not impinge on pedestrian movement and should not put pedestrians or other users at risk.
- Place ancillary equipment, such as temporary information, air conditioning equipment, cash machines and storage lockers, in areas where they will not: (reduce capacity for movement; increase the risk of accidents; provide concealed spaces where objects can be hidden).
- Introduce low speed limits and other constraints for vehicles in areas where conflict with pedestrians is highest and consider options for physical restrictions to speed control.
- Use anti-slip flooring that meets with the relevant standards appropriate to location and use.
- Identify all hazards such as platform edges, change of grade at stairs and ramps with high-contrast finishes and uniform lighting to minimize possible risk of accidents.

2.3.3.2. Ensuring full compliance with all emergency requirements

It is mandatory for station design and operation to comply with all statutory emergency requirements. In the event of any emergency, this ensures that access can be gained by the emergency services and suitable measures can be implemented to priorities the safety and wellbeing of all station users.[73]

- Clearly identify emergency exits to enable station users to move outside quickly and directly.

[73 & 74] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

- Design appropriate acoustics to allow passengers to hear public address announcements on platforms and help control excess noise and vibration.

2.3.4. Be Secure by Design

Station design must consider public security against a range of different threats, both man-made and natural. All stations face a certain level of risk associated with various threats be they the result of natural events, such as flooding and accidents, or through malicious practices.

The design guidelines for Be Secure by Design are presented in four sections, covering the following topics:[74]

1. Assessing and minimizing the risk of natural or man-made threats through secure and sensitive design.
2. Ways to follow Crime Prevention through Environmental Design principles.
3. Designing usable, active and secure facilities and spaces for day and night use.

2.3.4.1. Assessing and minimizing the risk of natural or man-made threats through secure and sensitive design.

The risk of malicious practices should be reduced through the design process. Stations all face a certain level of risk, but developing an appropriate secure and sensitive design helps to mitigate the potential loss of life, property or function.[75]

- Ensure early dialogue with crime prevention professionals to help 'design-in' a predictive element to schemes which, through application of specialist crime and disorder knowledge, will future-proof projects and prolong scheme benefits for end users.

- Identify the range of threats to the station through a Threat and Vulnerability Risk Assessment. Threats to both the operator and user must be considered.

[75 & 76] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

- Provide sensitive mitigation of vehicular accidents through measures engineered to resist vehicles. These include: setbacks and bollards, planters, incursion barriers and street furniture, and may also include suitably resistant structures and cladding.
- Consider the need for resilience to climatic change and extreme weather conditions.

2.3.4.2. Prevent crime through environmental design

Deterring crime, disorder or disruption on the rail network, as well as the perception of this occurring, is reassuring to both passengers and employees, limiting the prospect of crime and helping to deal with incidents of antisocial behavior.[76]

- Design environments with high levels of natural surveillance to encourage people to observe the spaces around them.
- Promote informal or natural surveillance opportunities for station users by creating a visual connection between the street and station facilities.
- Design environments to clearly delineate private space and create a sense of ownership among neighborhood residents. Design and locate buildings, fencing, pavement, signs, lighting and landscape elements to express ownership.
- Design to minimize the opportunity for the discreet placement of devices.
- Locate lift lobbies, waiting areas and information boards in sites with good natural surveillance or within view of staff locations.
- Locate seating and other features to encourage movement and social interaction

2.3.4.3. Designing usable, active and secure facilities and spaces

Facilities and spaces in and around stations should be designed to discourage crime throughout the day and night. Crime and the fear of crime can be greatly

reduced by removing isolated areas and ensuring locations are well lit and visible to others.[77]

- Encourage mixed land use active spaces and frontages will add vitality at different times of the day or night and foster a sense of wellbeing.
- Ensure a visible staff presence to increase the level of natural surveillance and locate staff facilities, ticket offices and control stations in areas where the greatest proportion of the station are directly visible. Duty locations can be varied across the day to reflect concerns over security and staff
- Patrol routes and schedules should be devised to offer the greatest coverage.
- Avoid locations that are poorly lit or not directly visible from parts of the station in which staff is present or other passengers are more numerous.
- Design in a way that minimizes opportunities for the discrete placement of devices.

2.4. Quality

Providing high quality station environments will improve all aspects of a station user's experience. Design of high quality facilities is based on a combination of performance, accessibility and function, all of which form an essential part of a user's experience. Designing stations to integrate with their surrounding context can create active and vibrant public spaces and can influence how these areas are perceived by passengers, operators and others. Concentrating mixed-use developments within and around rail stations may make them destinations in their own right, presenting opportunities to enhance the user experience, adding value and encouraging investment and socio-economic and physical regeneration in surrounding areas.[78]

The design theme of Quality is covered by four design principles:

[77] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

[78] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

1. Integration with context
2. Promote good design
3. Sense of place

2.4.1. Integration with context

Stations that are well integrated with their surrounding urban context help to create thriving places that are well designed, well built, well run, well connected, and well served, while remaining inclusive, safe and environmentally sensitive. Context sensitive station design can deliberately shape and animate surrounding public spaces, and in turn, create buildings that are active, integrated fixtures within their local communities.[79]

The design guidelines for Integration with Context are presented in three sections, covering the following topics:

1. Designing station facilities to integrate with the surrounding public realm.
2. The development of an interconnected network of streets, footpaths, bike routes and public spaces.
3. Encouraging provision of active and animated public spaces in surrounding areas.

2.4.1.1. Designing station facilities to integrate with the surrounding public realm

Railway stations and railway lines often form a barrier that results in severance of local communities. As a result, station facilities should be designed to integrate seamlessly with the public realm, including adjacent office buildings and shopping facilities, and to facilitate cross-, as well as through-movement. Creating a strong relationship between the station and its surrounding context delivers a richer and more fulfilling environment, enhancing local character and providing a sense of place for its users. [80]

- Minimize barriers and integrate the station within its context by involving key stakeholders and community groups in the design process from the

[79 & 80] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

outset. This should seek to improve integration, support local economic ambitions and identify opportunities for development.

- Design stations and the surrounding public realm to respect the local context and be appropriate to the character and topography of the site in terms of layout, scale, proportion and palette of materials.
- Where possible orientate buildings and maintain or open sightlines to key local landmarks or natural features to aid passenger orientation and way finding.
- Integrate lighting, landscaping (hard and soft), and public art to make external spaces pleasant, legible and accessible.

2.4.1.2. Design for an interconnected network

An interconnected network of transport, streets, footpaths, bike routes and public spaces helps connect people with destinations. This enhances accessibility throughout the local area, providing a familiar and consistent network to encourage users to travel by more sustainable transport modes. [81]

- Design high quality pedestrian access routes to stations with efficient lighting, direct connections and clear sightlines.
- Integrate with local way finding systems.
- Priorities pedestrian movements in surrounding streets through traffic calming and pedestrian priority measures, such as level surfacing, speed tables and landscaping, to create spaces with a human scale.
- Plan and design cycle access routes with convenient cycle parking to connect with surrounding cycle networks.
- Address congestion relief in streets and squares: improve pedestrian walk times around the station by designing new routes.

[81] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

- Design pedestrian and cycle way lighting strategies that are sensitive to the station's urban context, with reasonable use of outdoor lighting for night time safety, security, activity and commerce.

2.4.1.3. Provision of active and animated public spaces

Sensitive integration of the public realm enhances the local character and encourages natural surveillance and animation around stations. It can help bring a station to life, encouraging vibrancy throughout the area by providing attractive and welcoming links between internal and external spaces while fostering a sense of place and deterring antisocial behavior.[82]

- Establish local needs and ensure that station design proposals are in social, physical and functional accord with their local community context.
- Consider how best to reflect the history and cultural diversity of the station and its area.
- Ensure sensitive integration of commercial frontages that line station movement spaces and zones. This will give 'life' to the station and provide an attractive, welcoming link between internal and external spaces.
- Balance the provision of retail frontage with signing, advertising and information to avoid visual clutter.
- Design surface materials and street furniture so they play a significant role in creating attractive spaces that reflect their local character and encourage people to linger.
- Consider introducing public art and natural features, such as tree planting. These can make stations more attractive public places, provide natural shade and make waiting or transferring between modes more enjoyable.
- Ensure none of the features obstruct pedestrian routes or provide screens for anti-social activities.

[82] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

- Take advantage of opportunities to aesthetically enhance necessary and functional architectural and structural spaces and elements. Consider color, texture and the rhythm of all elements.

2.4.2. Promote good design

Worldwide experience demonstrates that public transport systems that are user-friendly are of high quality and which 'put the passenger first', are able to attract significantly wider economic benefits and revenues than less well focused or integrated systems. This benefits operators and passengers, as well as the surrounding communities, developments and environment.[83]

The design guidelines for Promote Good Design are presented in three sections, covering the following topics:

1. Designing for appropriate scale, massing and orientation of buildings and spaces.
2. Designing welcoming station environments where people want to work, shop and travel.
3. Guidance on using high quality materials and finishes appropriate to station context and function.

2.4.2.1. Consider scale, massing and orientation of buildings and spaces

Scale, massing and orientation of buildings and spaces should be appropriate to a station's context and function. The relationships between the elements of the built design are complex; to ensure the future success of station design it is important that any development should be planned to enable densities to change in response to need. [84]

- Consider the surrounding built form – particularly the height and massing of properties, as well as the impact of any overlooking tall buildings.
- Where possible, orientate buildings to relate to local networks and destinations, open up views and sightlines, and maximize opportunities to optimize energy consumption (e.g. by making the most of natural daylight

[83] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

or ventilation) without compromising operational efficiency or the passenger experience.

- Review the densities of the surrounding buildings and the impact any new development may have on the context and function of the station.
- Designs should meet with the need of different development types should the station form part of wider development proposals.

2.4.2.2. Design station environments and amenities

Station environments and amenities should be designed as welcoming places where people want to travel, shop and work. A station fulfills a different function for each user so it is important to minimize any conflict between these functions. This can be achieved by the efficient use of space and operations.[85]

- Identify the zones and nature of the commercial environment for optimum integration into the station environment.
- Recognize the need for 'right sizing' and acknowledge that the balance of functions and facilities will be different for each location.
- Quantify the patterns of movement between each function and how these change across a day or a week. Understand the characteristics of the people making these movements.
- Design architectural finishes for consistency throughout the station so that passengers do not experience 'tidemarks' as they pass between areas controlled by different operators.
- Promote a modern business image by incorporating materials that are hard wearing, easily cleaned, economically maintained and that are sympathetic to the existing fabric of the structure.

[84 & 85] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

2.4.2.3. Use high quality materials and finishes

Materials should always be fit for purpose and meet with all health and safety requirements. High quality materials that provide an attractive appearance and meet with functional requirements should be used when possible. High quality investments at locations that support high volume station usage are both affordable and cost-effective and can significantly enhance the function, performance and aesthetic of a station. Designers should consider whole life costs when specifying high quality materials, recognizing that high quality design does not need to cost more.[86]

- Ensure a sustainable balance between function, performance, sustainability and cost efficiency, as well as ease of use, quality of appearance and an attractive aesthetic.
- Ensure that the design is both achievable and deliverable and sits within a framework of sound management and governance. This will ensure quality is retained at an affordable cost.

2.4.3. Sense of Place

A sense of place refers to a characteristic that some geographic places have and others do not, but to which an individual can relate; it also refers to a feeling or perception held by people through belonging or attachment. Stations and the urban environment within which they sit mean many different things to many different users. It is important that good design harnesses these perceptions to maintain and ultimately enhance the area to instill a positive sense of place for all.[87]

The design guidelines for Sense of Place are presented in three sections, covering the following topics:

1. Locating and designing stations to promote a positive image and identity.
2. Considering landmark design where demand or status provides justification.
3. Adding value through landscaping and public art.

2.4.3.1. Locating and designing stations to promote a positive image and identity

[86] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

[87 & 88] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

Station planning and design should give consideration to the local context of the station in order to promote a positive image and identity. A station design that responds to local characteristics and identity will provide added value to both the station and the surrounding area, encouraging users to travel, work in and visit the location.[88]

- Understand the location and function of a station, and how best it should be placed.
- Ensure that facilities are right sized and appropriate for the context, function and use of the station.
- Reflect the history and cultural diversity of station locations, linking stations to their local communities.
- Identify qualities and characteristics of local architecture and the public realm that should be reflected in station design.

2.4.3.2. Consider landmark design where demand

Where there is social, economic and environmental justification, distinctive, landmark design may be considered. This can add value and improve sense of place. Distinctive design can help encourage businesses to locate there, boost tourism and encourage visitors, all of which has a positive effect on the local economy. [89]

- Designs should promote a distinctive identity that respects the local context while conforming to network-wide standards referred to within this Guide.
- Consider distinctive and contemporary design solutions that enhance local heritage and architectural styles through scale, massing, location and color rather than replicating existing building forms.
- Employ imaginative and innovative design where local architecture is indistinct or of poor quality – this improves the visual and functional quality of the local area.

[89] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

- A high quality finish can provide added value in landmark projects by helping to communicate a sense of place or create a station that can become a destination in its own right adding social, economic and environmental value, and instilling a sense of civic pride in those who visit and use it.

2.4.3.3. Add value through landscaping and public art

Integrating landscape elements and public art in the spaces surrounding stations creates added value. Giving wider consideration to a station's character and identity enhances the quality of the station and its facilities.[90]

- Consider developing a framework to engage with local stakeholders at the outset of a project.
- Consider opportunities for hard and soft landscaping within and around stations to provide for the incorporation of public art, for example:
- Sculpture - murals and displays - water features and fountains - lighting features and displays - banners, flags, mobiles and suspended features.
- Consider use of materials for public art works and features that they are durable, safe, attractive and consistent with local streetscape maintenance requirements.
- Consider introducing natural features in surrounding areas, such as tree planting to provide natural shade and make waiting or transferring between non-rail modes more enjoyable. Due regard should be given to safety risks to passengers and the operational impacts that may arise as a result at different times of the year.

[90] www.networkrail.co.uk/Guide_ to_Station_Planning_and_ Design.pdf.2012

2.5. Conclusion

This chapter has tried to summarize the approach to design sustainable stations. It is based upon an understanding of design principles of the station by design a framework and guidance plan; these frameworks are strategic planning tools that set out an integrated design vision for the desired future development of the stations hub.

Design framework is essentially about bringing a design approach to how stations and hubs are analyzed and developed. It provides a useful tool to enable performance-based planning to be implemented. A design approach unlocks creativity and allows physical design outcomes to be given a higher profile in planning. It also allows ideas to be tested through design and reviewed for their possible impacts or potential synergies.

Framework is a key element in the development of the station. To ensure community support for the strategic vision and subsequent physical projects, consultation with stakeholders and incorporation of their feedback throughout the process is essential. Design framework is a consultative, interactive and responsive process that embraces the notions of:

- Strategy or the significance of considering within a broader, strategic frame.
- Sustainability, which considers the long-term viability and impacts of development on economies and ecological systems, natural resources and urban communities.
- Synergy, or the advantages of resolving issues of public and private benefit, land use, built form and urban systems in relation to each other, with a high level of coordination.
- Responsiveness, or the benefits of considering station interventions in relation to ‘the particular characteristics, aspirations and cultural identity of the community’ and the specific image, built form characteristics and development dynamics of the urban environment.
- Specificity or the acceptance of each urban situation as unique in time and space, where different degrees of change and intervention are more valid than generic solutions.
- Quality or the recognition of the importance of well-considered visual and functional resolutions to urban issues and situations.

Chapter 3:

Analysis of International Central Station Hubs

Chapter 3: Analysis of International Central Station Hubs

Introduction

This chapter focuses on the physical application of transportation hub principles on the central transportation stations planned and designed worldwide, three case studies were chosen by the researcher for the following reasons:

- **King-Victoria Station Hub, Waterloo, Canada:** The site is situated at the northeast corner of the King Street and Victoria Street intersection at the northern end of Downtown Kitchener, as a principal intersection of two arterial streets within the city that is geographic heart of Waterloo Region. It is located within the Kitchener Urban Growth Centre, as per the Places to grow legislation, and is intended to accommodate a significant proportion of the Region's future population and employment growth in a compact, dense and transit-supportive fashion. The site is well connected to the surrounding transportation network, including transit, driving, cycling and walking options, with a number of central neighborhoods within an 800 meter walking distance.

- **Stuttgart 21 Central station, Stuttgart City:** It is a railway and urban development project in Stuttgart, Germany. Its core is a renewed Stuttgart Central Station; Construction works began on February 2010. As of March 2013. Stuttgart 21 includes the rearrangement of the Stuttgart rail hub with four new stations and 57 kilometers of new track. The terminus in Stuttgart will become an efficient through station. At the same time, Stuttgart will have a once-in-a- century opportunity to undertake extensive urban development: the old track system can be completely removed, making around 100 hectares of space available for urban development in the very heart of the city.

- **Squamish Station Hub, Canada:** The District of Squamish is located between the Vancouver metropolitan area and the Resort Municipality of Whistler. Squamish is located at the meeting point of the Squamish River

with Howe Sound, and is surrounded by a beautiful natural environment. Once dominated by resource-based industry, Squamish is now also capitalizing on its recreational and other assets.

3.1. King-Victoria Station Hub

The Regional Municipality of Waterloo ("Region") is planning a new multi-modal station facility at the intersection of King Street and Victoria Street North in Downtown Kitchener. Through the acquisition of a number of former commercial and light industrial properties at this prominent intersection, the Region has created a parcel approximately 1.6 hectares in size that will be redeveloped as a multi-modal station facility and mixed use development ("Site").

3.1.1. Study Background

The King-Victoria Multi-modal station Hub ("the Station Hub") will serve as the focal point of Waterloo Region's higher order station services, a result of the development of a new light rail station line from north Waterloo to south Kitchener, the extension of GO Station rail service to the region, and the continued role of Kitchener as a major intercity station hub. In addition to its role in the transportation system, the station Hub will also serve as the key anchor along Waterloo Region's Central Station Corridor, with an opportunity to integrate station functions with a mixed-use destination. There are very high expectations for the hub to succeed both from a transportation perspective and a development perspective. The hub will play an integral role to the continuing evolution and revitalization of the Innovation District of downtown Kitchener, which retains and enhances the highly walk able and urban character of the city core.[91]

3.1.1.1 Stakeholder and Public Consultation

The draft preliminary site plan and access plans were presented at this open house, as well as information related to the Official Plan Amendment and Zone Change applications associated with the Station Hub. A formal presentation was made during this Open House, which offered an opportunity for project staff to guide participants through the station design, the process, and implications, as well as a chance for questions and answers. This open house attracted over 250 residents

[91] Region of Waterloo Multi-Modal Transit Hub Planning Report
from http://www.regionofwaterloo.ca/en/gettingAround/resources/MMTransitHub-PlanningReportFINAL-August292012.pdf

who actively engaged staff with detailed questions about the site, but no objections were received.[92]

Main points of discussions raised during these consultation centers included:

- Pedestrians and cyclists should be prioritized;
- Station modes should be seamlessly integrated; and,
- The final design should be market-real and achievable.

In addition to the public open houses, specific stakeholder consultation sessions were held with the Active Transportation Advisory Committee, Rapid Station, Metrolinx and adjacent property owners, including Kaufman Lofts, the University of Waterloo, Momentum Development, Zehr Group, and Perimeter Development.

3.1.1.2 Site Location and Community Context

The Site is immediately adjacent to the existing Canadian National Railway line, which is currently used by GO Station and Via Rail, and will intersect with the future Regional LRT line proposed along the King Street corridor. The Site is also easily accessible to pedestrians and cyclists, as well as automobiles. The Site is located within the City's "Warehouse District", a policy designation based on the historical industrial uses located within the area generally defined by Weber Street East, Breithaupt Street, Joseph Street and Victoria Street. A number of buildings in the area have been identified by the City of Kitchener for their heritage value, and have been redeveloped and/or restored to preserve and enhance their historical significance.

[92] Region of Waterloo Multi-Modal Transit Hub Planning Report
from http://www.regionofwaterloo.ca/en/gettingAround/resources/MMTransitHub-PlanningReportFINAL-August292012.pdf

Figure 3-1: Site Location and Community Context of King-Victoria Station
Source: - http://www.regionofwaterloo.ca/en/gettingAround/transithub.asp
Posted; 2011

3.1.2. Site Context

The King-Victoria Station Hub will be located on the northeast corner of King Street and Victoria Street in downtown Kitchener. The site, which was acquired by the Region of Waterloo between 2011 and 2012, includes the properties between the rail corridor and Victoria Street between King Street and Duke Street.

The site plays a prominent role in downtown Kitchener – it is a major intersection for travel through the city while serving as the western gateway into the downtown. Downtown Kitchener is undergoing significant redevelopment and revitalization. Public investment in the area, such as the University of Waterloo's School of Pharmacy, the revitalization of King Street, the Communities business accelerator, the Museum, the new Kitchener Market, and Wilfred Laurier University's School of Social Work have helped to catalyze increased activity and development interest in the downtown. New residential developments have followed, while retail, restaurants, and other services are expanding to meet the needs of downtown residents, workers, students, and visitors.[93]

[93] Region of Waterloo Multi-Modal Transit Hub Planning Report
from http://www.regionofwaterloo.ca/en/gettingAround/resources/MMTransitHub-PlanningReportFINAL-August292012.pdf

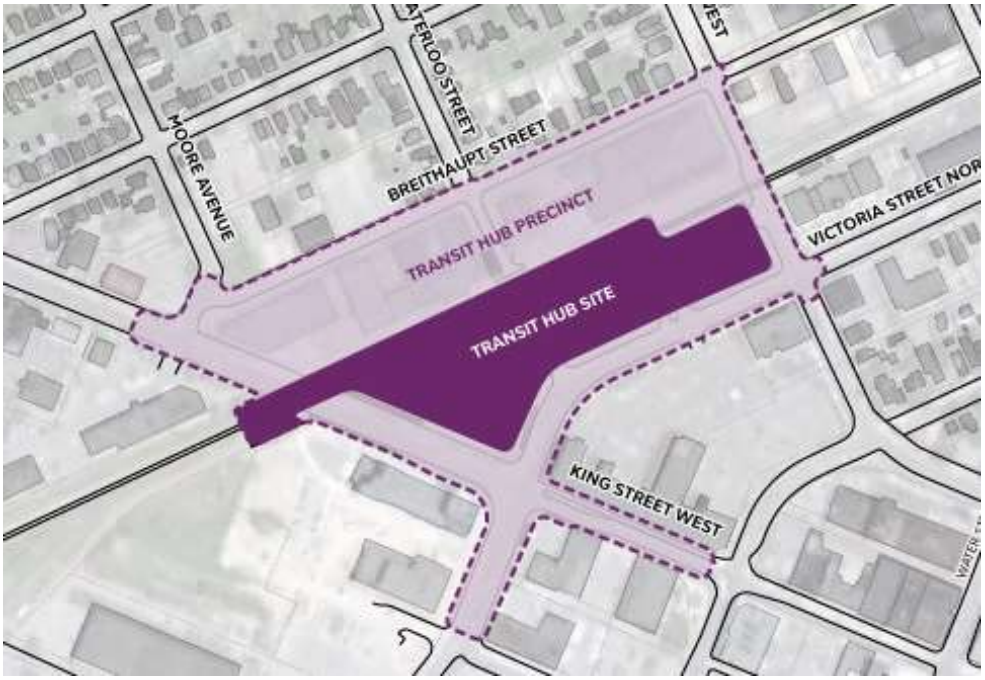


Figure 3-2: Site context of King-Victoria Station
Source: - http://www.regionofwaterloo.ca/en/gettingAround/transithub.asp
Posted; 2011

3.1.2. Multi-Modal Transportation Context

The King-Victoria intersection already plays a significant transportation role as the intersection of two major arterials at the geographic center of the cities of Kitchener-Waterloo. As such, there are heavy volumes through this intersection by car, by station, and by walking and cycling. The Region's main rail corridor, on which VIA Rail and GO Station rail services run, traverses the Station Hub site. Facilitating access to and from the Station Hub precinct is of utmost importance to its success.[94]

- Keep the transportation system functioning efficiently while ensuring that all users are safely accommodated through a Complete Streets approach; and,

[94] Region of Waterloo Multi-Modal Transit Hub Planning Report
from http://www.regionofwaterloo.ca/en/gettingAround/resources/MMTransitHub-PlanningReportFINAL-August292012.pdf

- Create a high quality pedestrian and cycling environment to encourage walking and cycling access.

3.1.2.1. Pedestrian Access

Pedestrian access will be the priority mode of access and circulation within the Station Hub and will require the provision of direct linkages, high quality pedestrian environments, and most importantly, safe and accessible sidewalks and crosswalks.
There are many identified needs related to pedestrian access as it relates to the preliminary design of the Station Hub and station access. These include: - [95]

- Identifying and improving direct pedestrian connections to the Station Hub from nearby destinations and trip origins;
- Providing generous sidewalks, particularly where pedestrian activity is anticipated to be high directly around Station Hub, such as desire lines between station modes and to/from major destinations;
- Creating active frontages along major pedestrian routes, such as King Street and Victoria Street, to increase visual interest, provide passive surveillance, and increase street-level activity; and,
- Providing weather protection along linkages between station modes and at station stops.

Key elements of the pedestrian realm identified in the Pedestrian Realm diagram include:

A. **Two public plazas**, one at the main entry at the corner of King Street and Victoria Street, and the second adjacent to the northbound LRT platform. These public spaces will provide gathering and rendezvous space, create focal points for pedestrian circulation, and provide opportunities for formal and informal street level activity. Retail spaces fronting onto the plazas could help create a permeable interface between the plaza and indoor spaces at the Station Hub with patios, moveable glass walls, and other design features;

[95] Region of Waterloo Multi-Modal Transit Hub Planning Report
from http://www.regionofwaterloo.ca/en/gettingAround/resources/MMTransitHub-PlanningReportFINAL-August292012.pdf

B. A pedestrian-sensitive built form, where the massing of buildings is designed to not overwhelm pedestrians and create bright and open spaces;

C. Special design considerations for pedestrians through the King Street Grade Separation, which includes a review of the horizontal and vertical section of the underpass of the rail corridor to improve pedestrian conditions and maximizing light and space on the sidewalk. The location of rail platform entrances and the creation of the Station Plaza are two key design elements to achieve these objectives; and

D. A new pedestrian underpass along the Waterloo Street corridor, which will serve as the main entrance from the surrounding residential area into the Station Hub. Treatments from the underpass and through the Station Hub could be extended to Breithaupt Street to form a strong pedestrian connection through the Hub site (the Waterloo Street Pedestrian Corridor).

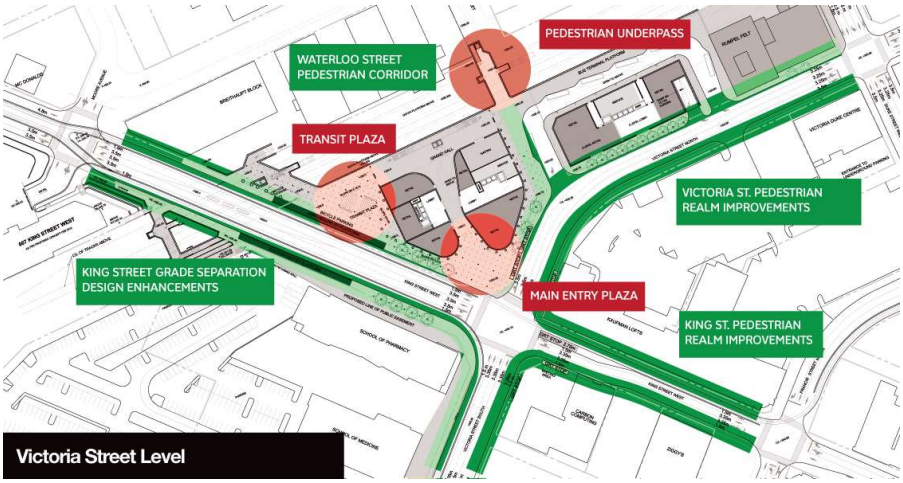


Figure 3-3: Pedestrian Access of King-Victoria Station
Source: - http://www.regionofwaterloo.ca/en/gettingAround/transithub.asp
Posted; 2011

3.1.2.2. Cycling Access

Cycling can play a major role in accommodating access to the station Hub, provided safe, direct, and maintained routes are available to and from surrounding areas. There is a high potential for cycling – many nearby streets are calm and attractive cycling environments, there is a density of destinations at the station Hub, and the mix of residential, commercial, and employment uses in the vicinity reflect a high proportion of short, bike able trips.

Some of the needs identified for cycling in the station Hub district include:

- Confirming King Street as a main corridor for cycling, which many cyclists identified as the preferred route as it was more direct and accesses destinations;
- Ensuring safe access through King Street grade separation by providing bike lanes or cycle tracks;
- Provide additional linkages across the rail corridor;
- Develop linkages to regional multi-use trails such as the Iron Horse and Spur Line Trails; and,
- Ensuring an adequate mix of short- and long-term bike parking at the Station Hub that reflects the different uses on the site.

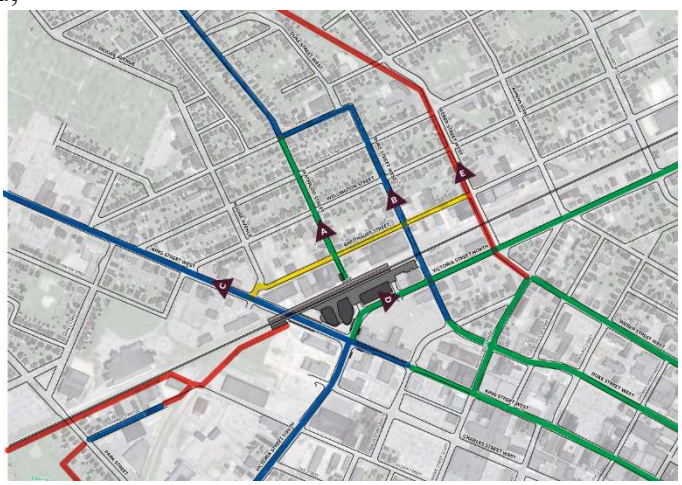


Figure 3-4: Cycling Access of King-Victoria Station
Source: - http://www.regionofwaterloo.ca/en/gettingAround/transithub.asp
Posted; 2011

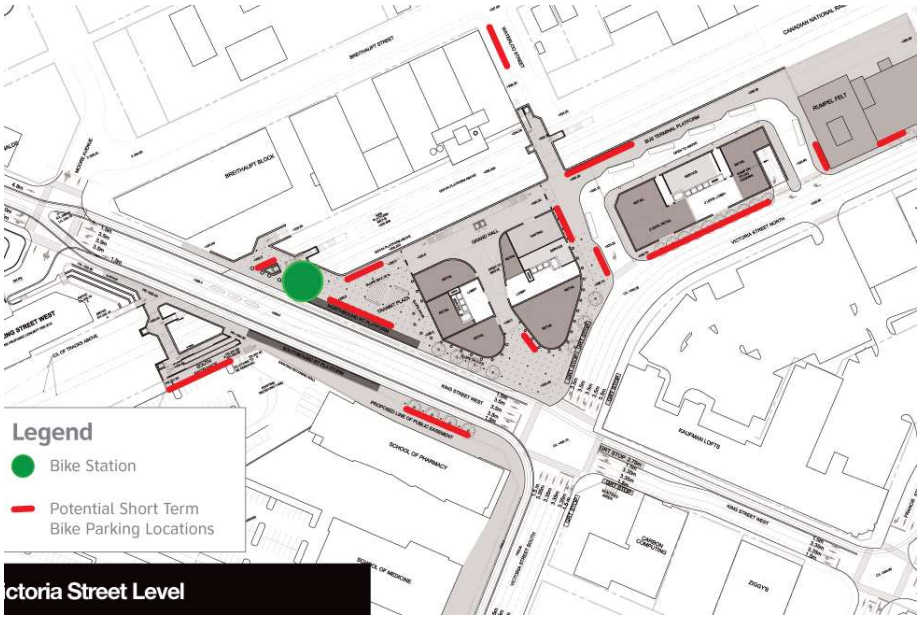


Figure 3-5: Cycling in the station Hub district of King-Victoria Station
Source: - http://www.regionofwaterloo.ca/en/gettingAround/transithub.asp
Posted; 2011

3.1.2.3. Station Access

The Station Hub will be the main transfer point between local, regional, and intercity station services in Waterloo Region while also playing a role as a gateway into downtown Kitchener and nearby destinations. In addition, the

Station Hub will be a destination in itself for access station services. As such, the Station Hub will need to:

- Be designed to allow for safe and efficient movement of station vehicles into, out of, and through the Station Hub;
- Create short, clear, direct, and seamless connections between station modes;
- Providing redundancy in barrier-free routes between station modes to ensure accessibility at all times;
- Direct, barrier-free, access into the Station Hub from northbound and southbound LRT platforms; and,

- Clear demarcation of running way and pedestrian realm to reduce conflicts between modes.[96]

For local station, there are several considerations identified for the Station Hub:

- Accommodating on-street transfers between bus services and between bus and LRT at the King and Victoria intersection to provide fast transfers between services and to eliminate need for off-street looping like at Charles Street Terminal;

- Providing station priority measures, particularly as bus service increases, to speed up bus movements through the hub; and,

- Ensuring that multiple points for specialized station (i.e. MobilityPLUS) drop-off and pick-up are available at the Station Hub within close proximity to sheltered waiting areas and customer service.[97]

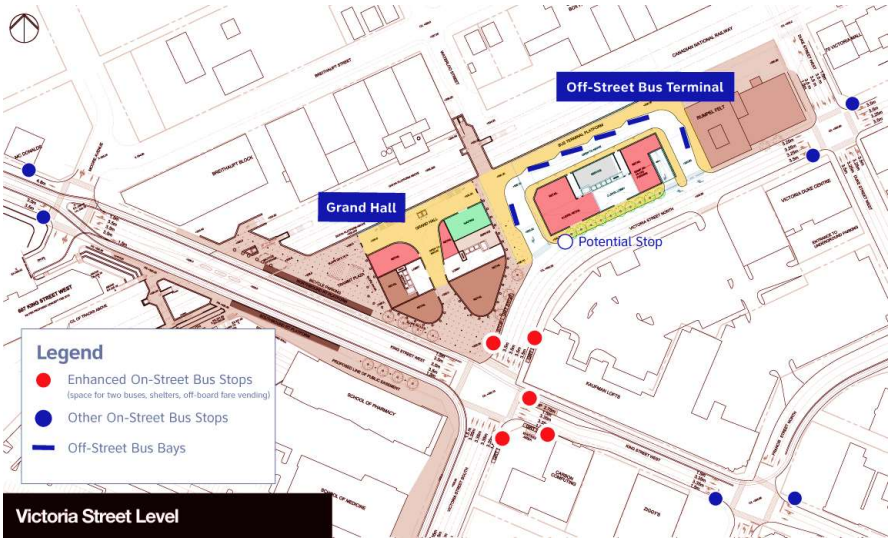


Figure 3-6: Transit Access and Stops of King-Victoria Station
Source: - http://www.regionofwaterloo.ca/en/gettingAround/transithub.asp
Posted; 2011

[96] Region of Waterloo Multi-Modal Transit Hub Planning Report from http://www.regionofwaterloo.ca/en/gettingAround/resources/MMTransitHub-PlanningReportFINAL-August292012.pdf

[97] Region of Waterloo Multi-Modal Transit Hub Planning Report from http://www.regionofwaterloo.ca/en/gettingAround/resources/MMTransitHub-PlanningReportFINAL-August292012.pdf

3.1.2.4. Vehicular Access and Parking

Vehicular access must also be considered at the Station Hub, which includes station customers using the kiss and ride, and by people accessing the Station Hub or other nearby destinations for other purposes. There will be on-site parking to accommodate some degree of park and ride demand; however, the majority of parking will be provided to meet the needs of commercial, retail, and residential development at the Station Hub.

Vehicular access needs at the Station Hub identified include:

- Adequate site access to on-site parking and to passenger pick-up and drop-off facilities;
- Managed parking supply, including potential shared parking, reduced parking standards, and intelligent parking technologies in order to reduce the need for on-site parking and associated traffic impacts;
- Integration of delivery and service areas and accesses, including loading docks and service vehicle parking; and,
- Mitigation of traffic impacts from LRT and development at the King-Victoria Intersection, including diverting traffic to other corridors, such as Weber Street.

Vehicular access needs are dependent on a number of factors including:

- Density of development on the site;
- Type and mix of uses;
- Amount of commuter parking provided; and,
- Extent of use of off-site parking.

As a general direction, the goal for this site to maximize development potential and provide a responsible amount of parking; that is enough parking to support development needs as per the zoning requirements, but not so much as to encourage auto use. For commuter parking, the direction is to provide for essential station hub needs only.[98]

[98] Region of Waterloo Multi-Modal Transit Hub Planning Report

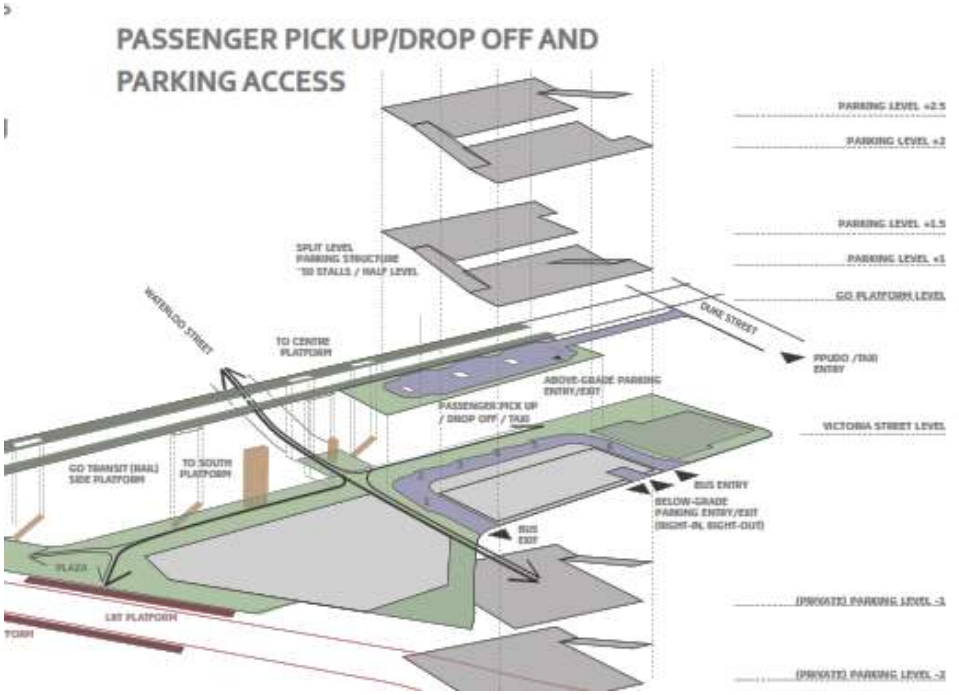


Figure 3-7: passenger pick-up/drop-off and parking access of King-Victoria Station
Source: - http://www.regionofwaterloo.ca/en/gettingAround/transithub.asp
Posted; 2011

3.1.3 The Station Hub Development Proposal

Emphasis will be placed on creating attractive and functional public spaces at the Hub to serve the large number of people who will use the site daily. Strong connections between the neighborhoods and the station facilities will be made, with seamless connections where possible between the various modes of travel. The principal public spaces will be along King and Victoria Streets and wide sidewalks will be provided in all high traffic area along with seating, shelters and other pedestrian amenities. A 'great hall' between the building podium at King and Victoria and the railway will be an important part of the station experience.[99]

[99] Region of Waterloo Multi-Modal Transit Hub Planning Report
from http://www.regionofwaterloo.ca/en/gettingAround/resources/MMTransitHub-PlanningReportFINAL-August292012.pdf

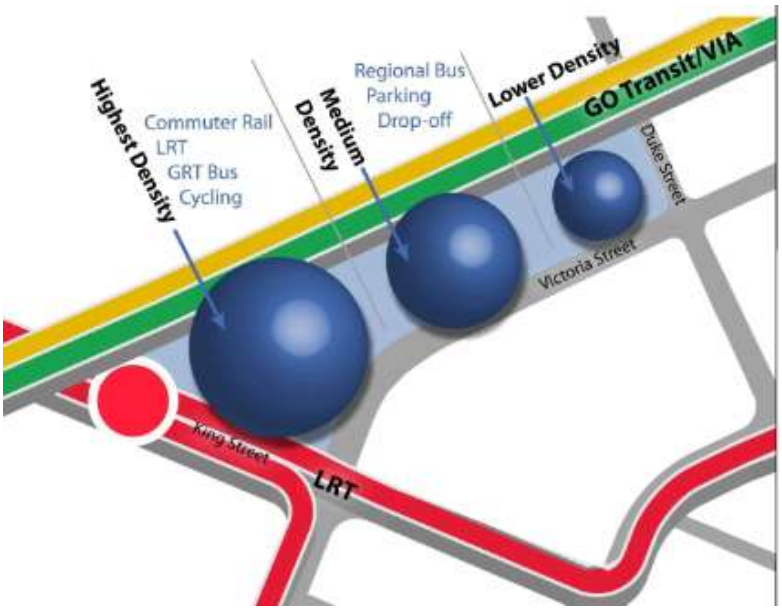


Figure 3-8: Development Concept of King-Victoria station Hub
Source: - http://www.regionofwaterloo.ca/en/gettingAround/transithub.asp
Posted; 2011

A specific development proposal has not been prepared at this time, nor will be until the Region has a development partner. Preliminary development models have been prepared in conjunction with the transportation infrastructure and access design to test and illustrate possible development scenarios and provide rationale for these planning applications. Depending on real estate market conditions and the mix of uses, as well as the phasing of development, it is anticipated that the Site could develop with up to approximately 92,000 square meters (1 million square feet) of building floor space which could comprise office, residential, hotel, institutional and conference/community space, with ground floor commercial uses.[100]

The key elements and principals of the development concept are as follows:

i. **An integrated facility that accommodates a full range of transportation modes.** The proposed Station Hub will accommodate intra-regional commuter station (GO Rail and VIA), light rail station, local buses (GRT), inter-city buses (such as GO and Greyhound), taxis,

[100] Region of Waterloo Multi-Modal Transit Hub Planning Report
from http://www.regionofwaterloo.ca/en/gettingAround/resources/MMTransitHub-PlanningReportFINAL-August292012.pdf

bicycles, cars, car share, and pedestrians. A seamless flow between these different transportation modes is a key principle for the facility's development.

ii. **A grand entrance at the King Street and Victoria Street intersection with a central concourse leading to and from the rail platform.** This entrance would be the "front door" to the Station Hub. Well-designed outdoor spaces would provide pedestrian access from the LRT and local buses to the concourse through the main complex, and to the rail platform and to bus loading facilities.

iii. **A principal complex located between King Street and Waterloo Street that is the central point of the station facility.** The principal building would contain a large amount of the floor space on site, through a combination of office, residential, commercial and hotel uses, among others, and is the tallest building of the complex. Parking for the development would be provided underground.

iv. **A secondary complex located between Waterloo Street and Duke Street that supports the station elements within the principal complex.** The secondary complex would contain bus, taxi and drop-off areas, and support the uses of the principal complex with further opportunities for commercial, community, conference, hotel, education and other similar uses. Undergrounding parking is also assumed for the secondary complex, with the option of additional above-grade structured parking.

v. **The Rumpel Felt complex located to the east of the secondary complex, abutting Duke Street.** A number of different commercial, office and/or institutional uses could be developed in the Rumpel Felt complex, a portion of which is a heritage resource.

vi. **A new train platform along the rail line.** The rail platform for intra-regional commuter rail (such as GO and VIA) could be a partially enclosed space that creates a comfortable and visible waiting area for station users. The architecture of the platform structure would complement the character of the overall development, providing an inspiring impression to those arriving in the City.

vii. **An interconnected transfer system with the future light rail station and bus stops along the abutting streets.** Light rail station platforms and local bus stops/shelters along King Street and Victoria Street would provide easy and direct connections to and from the Station Hub. This connectivity would be accommodated through a combination of ground, upper floor, and underground connections.

viii. **A system of commuter parking and drop-off locations integrated with the station platforms**. The Station Hub would contain some parking for station users arriving to or departing from the site by car. The development would contain an appropriate capacity of commuter parking, incorporating TDM practices, located in underground parking facilities. Additionally, the secondary complex would contain accommodations for passenger drop-off as well as designated spaces for taxis. Car share spaces could also be accommodated as part of the development within the underground parking facilities.

Figure 3-9: The Station Hub Concept of King-Victoria
Source: - http://www.regionofwaterloo.ca/en/gettingAround/transithub.asp
Posted; 2011

1 The Transit Hub will be served by two rail platforms for both GO Transit and VIA Rail

3 The King Street Grade Separation forms part of the Hub with linkages through the precinct for pedestrians and cyclists

2 The LRT operates in the curb lane on King Street, with platforms integrated with sidewalks

4 An off-street bus terminal that serves intercity buses, GO Transit buses, and GRT buses that terminate at the Transit Hub. The terminal could also allow for MobilityPLUS pick-ups and drop-offs

5 Passenger pick-up and drop-off (Kiss and Ride) could be facilitated on the upper (track) level from Duke Street, providing direct access to the rail platforms

7 Mixed-use development integrated with the Transit Hub, with office, retail, residential, and other uses at a higher intensity forming a landmark in downtown Kitchener

6 Waterloo Street could be closed to accommodate the Transit Hub; pedestrian linkages and station access would be maintained with an underpass through the Hub

8 The original Rumpel Felt Building has cultural heritage value and is intended to be adaptively reused as part of the Transit Hub plan.

9 A new public space at the entry into the Transit Hub Grand Hall with active uses fronting on it to create a vibrant place and gateway to downtown Kitchener

Figure 3-10: 9 photos for different means of the proposal station hub in King-Victoria
Source: - http://www.regionofwaterloo.ca/en/gettingAround/transithub.asp
Posted; 2011

3.2. Stuttgart 21 Central Station Hub

The Stuttgart–Ulm rail project is S21: the complete restructuring of the Stuttgart rail node plus the construction of a new line between Wendlingen and Ulm. It is the largest upgrading concept for public rail transport in Baden-Württemberg since the 19th century. The present terminus station in Stuttgart will be replaced by a through station with eight tracks located underground and running at right angles to the present building. Although it will have only half the number of tracks, the new station will be able to serve a significantly higher number of trains.

Skylights which admit daylight to the train hall are a striking architectural feature which will transform the new station into a flagship building for the city. Another special feature: it will be possible to walk on the station's roof, which will form the new urban space of "Straßburger Platz" immediately next to the Schlossgarten Park.[101]

Figure 3-11: Stuttgart 21 Central Station Hub
Source: - http://www.bahnprojekt-stuttgart-ulm.de/english/media library/mediaParameter/mediathekStage/Medium/
Posted; 2011

[101] http://www.bahnprojekt-stuttgart-ulm.de/english/details/new-stations/stuttgart-main-station, 2011

3.2.1. Study Background

The heart of the Stuttgart–21 rail project is the new Stuttgart Main Station, which is rotated through 90° to the present terminus and runs at a depth of about eleven meters. It comprises a total of eight tracks at four central platforms, each of which is 420 meters in length. The existing station building, named "Bonatzbau" after its architect Paul Bonatz, will be retained together with the tower and the large station hall as a reception building and will be given a new platform hall. The future station will form a new complex in an interaction of historic and modern architecture.

Stuttgart 21 includes the rearrangement of the Stuttgart rail hub with four new stations and 57 kilometers of new track. The terminus in Stuttgart will become an efficient through station. At the same time, Stuttgart will have a once-in-a- century opportunity to undertake extensive urban development: the old track system can be completely removed, making around 100 hectares of space available for urban development in the very heart of the city. Numerous changes and improvements will be 0created for Stuttgart and Baden-Württemberg: around 75 per cent of the population of Baden Württemberg lives in rural districts which will benefit from the shorter journey times and increased numbers of direct connections offered by the rail project. In addition, the Stuttgart–Ulm rail project is part of the important European long-distance corridor from Paris to Bratislava, which is being developed into a high-speed route.[102]

3.2.1.1 Site Location and Infrastructure

A) Stuttgart 21: New stations and 57 kilometers of new track: The Stuttgart 21 projects goes far beyond the widely acclaimed conversion of Stuttgart Main Station: the entire Stuttgart rail hub will be rearranged and expanded and passenger movements accelerated. There will be 57 kilometers of new track for long-distance, regional and suburban trains as well as four new stations.

[102] http://www.bahnprojekt-stuttgart-ulm.de/english/overview/what-is-the-stuttgart-ulm-rail-project/ 2011

B) The New Main Station as Centerpiece: At the heart of the project is the new Stuttgart Main Station. Lying at right angles to the present track system, the station connects eight platform tracks and eight adjacent through tracks with around 50 sets of points. The above-ground railway infrastructure can be dismantled and the space made available for urban development.

C) Optimal Connection via a Railway Ring: The new main station will be connected to the existing network via short sections of a predominantly underground railway ring. New holding sidings will be built on railway land in Untertürkheim.

D) Railway Traffic flowing through an Efficient Rail Hub: Most of the arriving long-distance and regional trains are presently guided into the main station via two tracks – from Bad Cannstatt and Feuerbach – which allow maximum speeds of only 30 to 40 km/h in the area of points and platforms. Many departing trains also have to cross the path of arriving trains, for which they have to briefly utilize the arrival tracks. In order to cope with the current volume of trains, over 50 regional trains have to be slotted in between suburban trains every day, the latter operating at an interval of one every five minutes. The resulting "jams" at the entrance to Stuttgart Main Station are therefore an annoyance, especially for commuters. The rail hub has long since reached its maximum capacity under practical operating conditions during the rush hour.[103]

The new through station will have half as many platform tracks as the current terminus– and yet will be able to handle far more trains with fewer delays. There are three critical reasons for this:

1. Arriving and departing trains will no longer get in each other's way
2. The number of platform tracks for long-distance and regional trains will rise from five to eight
3. Where the present speed limit is just 30 to 40 km/h, trains will in future be able to arrive and depart at 60 to 100 km/h

[103] http://www.bahnprojekt-stuttgart-ulm.de/english/overview/what-is-the-stuttgart-ulm-rail-project/ 2011

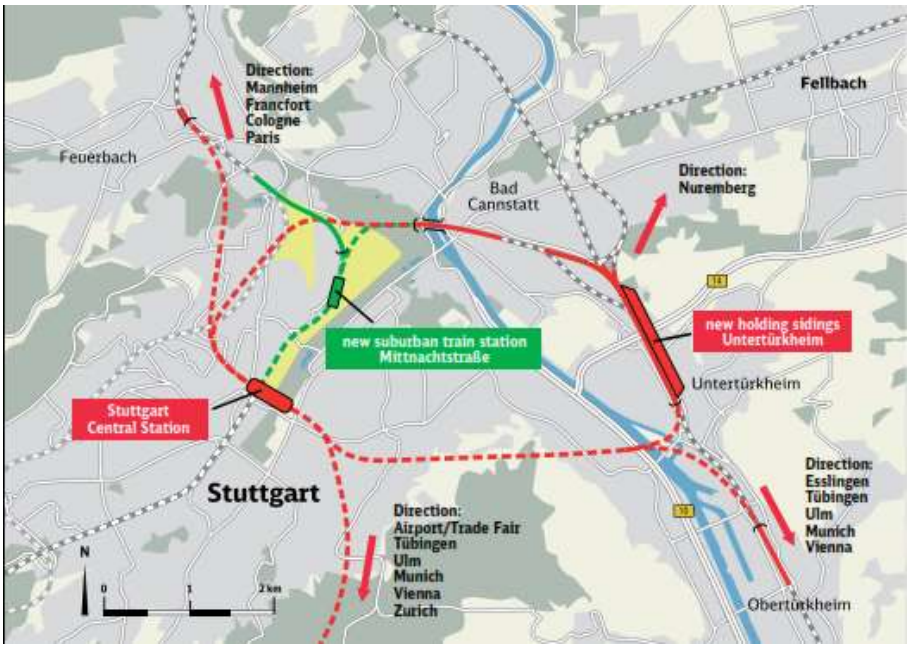


Figure 3-12: the new Infrastructure in Stuttgart 21 Station
Source: - http://www.bahnprojekt-stuttgart-ulm.de/english/media library/mediaParameter/mediathekStage/Medium/
Posted; 2011

E) The New Airport and Trade Fair Station "The Transport Hub in the Filder Area": A new station for long-distance and regional trains is being built in the Filder area between Stuttgart Airport and the trade fair centre. The journey time from Stuttgart Main Station to the airport will be cut from 27 to eight minutes. In future, it will be possible to travel to many parts of the country from here without the need to change trains. In addition to the ten million or so airline passengers and more than a million exposition visitors each year, roughly a quarter of a million people living within the catchment area of the new station are set to benefit from it. With the new long-distance station and a dedicated city railway connection, a unique hub will be created between rail, road and air. In future, trains of the Gäubahn railway arriving from Zurich/Singen will call at the airport. The time needed to cover the associated detour to Stuttgart Main Station (3 km) will be offset by the highspeed tracks of Stuttgart 21. Trains coming from Zurich/Singen and continuing in the directions of Ulm/Munich and Reutlingen would be able to bypass the entire Stuttgart basin.[104]

[104] http://www.bahnprojekt-stuttgart-ulm.de/english/details/new-stations/airport-and-trade-fair-station/2011

The modern, underground station will be located opposite the airport's main building, very close to the existing Terminal station. The tracks will run through a tunnel, as they will have to pass under the A8 motorway and trade fair grounds to reach the station. Amenities at the new station will include a DB travel centre and other services to make it easier for passengers to get their bearings and continue their journey, and the airport's departure hall will be just a brief walk away along a connecting corridor. [105]

Figure 3-13: Stuttgart's airport and trade fair grounds by train
Source: - http://www.bahnprojekt-stuttgart-ulm.de/english/details/new-stations/airport-and-trade-fair-station/2011

3.2.1.2 Short and Barrier Free Distance for Fast Transfers

Passengers will have a more convenient way to reach their trains. The new Stuttgart Main Station can be accessed along short and barrier-free distances from all points of the compass. Passengers enter the station at ground level from "Königstrasse", the "Schlossgarten", and the city railway station at "Staatsgalerie" and from Kurt-Georg-"Kiesinger-Platz", where they arrive at the three distribution concourses, which are located above and connect the four platforms. This enables convenient and fast transfers over short distances. Seven

[105] http://www.bahnprojekt-stuttgart-ulm.de/english/details/new-stations/airport-and-trade-fair-station/2011

escalators, five stairways and three panoramic lifts lead to each platform. Each platform also has direct access to the suburban trains. This considerably shortens walking distances compared to the terminus.

All of the main service facilities, such as the DB travel center and the DB information office, are located on the same level and can be accessed without barriers from "Schillerstrasse".[106]

3.2.2 The Station Hub Urban Development Proposal

Stuttgart has a unique opportunity to grow in its center. As the train tracks will in future run underground, around 100 hectares in the middle of Stuttgart city center will become available for development – an area the size of 140 football fields. Twenty hectares of this will be turned into parkland. This will noticeably improve the climate in the city center. In the middle of the city center, urban development opportunities exist for exemplary, ecological and energy-efficient living. The north of Stuttgart will move closer to the Schloss-garten and the east of Stuttgart. In the new areas of the city, interconnected spaces and short distances will create a pleasant environment in which to live and work. The present bisection of the city by the existing railway infrastructure will be swept aside by Stuttgart 21. The quality of life in the existing districts will improve. Two new districts will be created in the center of the city: the Europaviertel and the city district of Rosenstein.[107]

Stuttgart 21 is a project that includes the redevelopment of Stuttgart's rail junction and central station as well as the urban development of a central area in the inner city. The project opens up a vision into the 21st century for the evolution of Stuttgart and its surrounding region. Railway works and city planning within the Stuttgart 21 project require a detailed environmental study on the basis of various advisory questions. The used methods range from computer-based model calculations and simulations to experiments with a full-scale model in the wind tunnel and to measurements, drilling, mapping and nature observation in the plan area and its surroundings.

[106] www.bsu.link/s21/stuttgart-main-station/2011

[107] http://www.bahnprojekt-stuttgart-ulm.de/english/overview/the-projects-benefits/

3.2.2.1 The Framework Plan as the Planning Basis

The urban development plan is based on the Stuttgart 21 framework plan adopted by the city of Stuttgart in 1997, which is based on the design of Trojan, "Trojan + Neu" in Darmstadt. This was preceded by an international urban development competition, in which renowned offices participated, as well as an intensive public discussion process, in which Stuttgart's citizens, city planners, politicians and associations were involved.

The framework plan highlights possible distributions and focal points of use in the new city districts. The ideas exposed in the framework plan will be developed further, made more concrete and, if necessary, corrected, in the urban development plan. They become legally binding insofar as they become part of a binding urban development plan. The framework plan was the result of a public consultation process about feasible and reasonable development possibilities for the planning area. It contains a wealth of ideas and suggestions for the further planning and discussion.[108]

3.2.2.2 A Boost for Trains, the Greenest form of Transport

Over 90% of trains are powered by electricity, making rail travel by far the most environmentally friendly mode of transport. Thanks to infrastructure projects such as Stuttgart 21, train travel's appeal will be enhanced still further. Shorter journey times, a larger number of direct connections and optimized timetables will all ensure that passenger comfort increases as energy consumption decreases. Today, for example, the express train to Tübingen has to travel through Bad Cannstatt, Esslingen and Plochingen despite the fact that it doesn't stop at any of these stations. Stuttgart 21 will result in a new rail node that enhances the efficiency of scores of connections and radically reduces the need for train shunting. In the case of the connection to Tübingen, trains will be able to take the direct route via the Filder Tunnel to the airport and rejoin the existing line at Wendlingen. This will save time - and energy.

[108] Stuttgart 21 [online], available http://en.wikipedia.org/wiki/Stuttgart_21 [30 June 2012].

Track length in total		**121 km**
of which:	Stuttgart 21	57 km
	New Wendlingen-Ulm line	64 km
Length of high-speed line		**90 km**
Tunnel tracks		**63 km**
of which:	Stuttgart 21	33 km
	New Wendlingen-Ulm line	30 km
Estimated maximum speed		**250 km/h**
(various feeder lines 160 km/h)		
New stations		
• Central Stuttgart station with eight tracks		
• Station for new airport/exhibition centre line		
• Mittnachtstraße urban railway station		
[new holding sidings in Untertürkheim]		

Figure 3-14: Stuttgart-Ulm line project key data
Source: -http://www.eesc.europa.eu/resources/docs/jachim-fried-en.pdf/2012

3.2.2.2 Stuttgart Main Station Promotes Ecological Innovations

Studies have revealed that the rail project will shift millions of passenger trips from road to rail each year. The additional capacities created by the Stuttgart–Ulm rail project will also benefit goods traffic because in future it will be possible to transport more goods by rail on the existing track through the Filstal valley instead of by road.[109]

I. Protecting Resources: Less need for space and energy

The new Stuttgart Main Station also preserves resources: the air that flows in from the adjacent tunnels keeps the temperature in the platform hall at a comfortable level all year round, avoiding the need for any kind of artificial heating. Scarcely

[109] http://www.bahnprojekt-stuttgart-ulm.de/english/details/new-stations/airport-and-trade-fair-station/2011

any artificial light is required during the daytime either, as the light eyes in the roof deliver sufficient daylight to the interior of the platform hall.

II. Park Extension: More Green Spaces in the Heart of Stuttgart

Stuttgart's mineral springs enjoy special legal protection. For the construction of the new Stuttgart Main Station, The rail project is creating splendid new green spaces in the heart of Stuttgart. The approximately 60 hectares of net construction land available in the city center will also prevent any further spread of development into Stuttgart's peripheral districts. As a direct consequence of Stuttgart 21, 62 hectares of development land on Greenfield sites have been removed from the Stuttgart zoning plan.

III. Noise Reduction : Tunnels as Natural Silencers

In future, residents of the Stuttgart basin – the large natural depression in which the city sits will hear almost no more noise from passing trains. This is because the layers of soil above the newly built railway tunnels function as a natural silencer. However, the weight of even the quietest trains can send vibrations through the surrounding area. For this reason, the platform structures on sections of track susceptible to vibration will be equipped with the so-called mass-spring system or similar technologies that reduce the vibrations caused by train movements to the lowest levels possible.

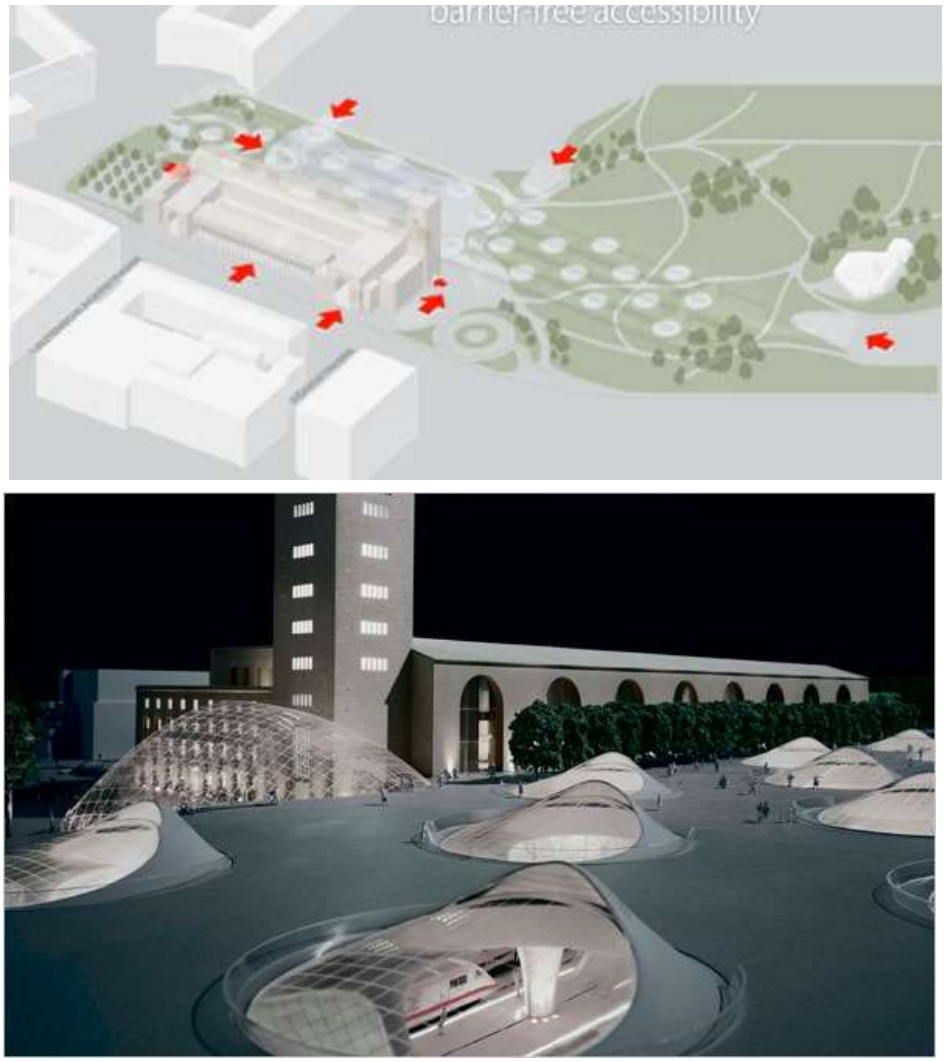


Figure 3-15: (A & B) Stuttgart 21 Main Station- by Aldinger & Wolf
Source: - www.bahnprojekt-stuttgart-ulm.de/en/english/2011

3.3. Squamish Transportation Hub

Squamish is essentially an auto dependent community with around 90% of all journeys undertaken by private automobile. Also, around one-third of trips out of Squamish go to Whistler and another third go to the lower mainland. These statistics provide incentives and opportunities to encourage more sustainable movement patterns.

A design workshop was held on April 9, 2008 in Squamish and was attended by a wide range of interested parties, including the District staff, Councilors, general public, activity groups and people from a wide range of professional backgrounds. The workshop identified preferences on location, complementary uses and supporting measures to introduce of a central downtown hub.[110]

3.3.1. Study Background

To provide a framework for the next stage of the design process, this example will provide guidance on the following:

- Identify site options for a central downtown hub and indicate possible satellite hub locations.
- set out the range of transportation options that should be provided
- Advise on the design criteria for layout
- Identify complementary land uses
- Make policy recommendations to support the design
- Establish measurable targets for walking, cycling, transit and auto use.
- Recommend options for possible funding (government, developers, etc.)

The aim is to produce a set of design guidelines to progress the multi modal transportation hub to the implementation stage, and to establish a range of transportation and land use measures to make meaningful changes on how people in Squamish move around in a more socially engaging, sustainable and healthy manner.[111]

[110 & 113] http://squamish.ca/assets/PDF/3.11-Transportation-Hub-Report-Bunt-March-2009.pdf

3.3.2. Study Planning and Design

The purpose of this section is present planning and design options for the development a multi-modal transportation hub. This exercise is based specifically on the central downtown location, but it can be applied to other locations in Squamish.

3.3.2.1. Planning Vision

Key to any project is develop a vision on how the multi-modal transportation hub will look at the start, how it can be developed overtime and what it will ultimately look like once complete.[112]

- At the start, use a section of street in the downtown to focus regional and local bus services, preferably located close to existing amenities and transit corridors.
- Acquire land adjacent to this focal point and in the short term use existing buildings or provide temporary structures for shelter and supporting amenities (tickets, kiosk, bike repair, etc.). Part of the site should be used for bus waiting areas and the remaining part could be used for parking, including the location of car sharing and rental vehicles.
- Overtime as new transit connections are developed, for example a ferry service or new bus services, ensure that they are coordinated with existing services at the hub and that integral improvements to the hub are developed, for example, adding real time information on transit services.
- The final stage should be the development of an iconic building (based on height, mass and materials) on the site to accommodate bus transit demands

3.3.2.2. Planning Objectives

Future travel demands in Squamish need to be accommodated in the most efficient manner given the population growth projections, circa 15,000 to 28,000 people, including potentially 12,000 in the downtown.[113]

The following sets out the objectives for the planning and design process:

[112] & [113] http://squamish.ca/assets/PDF/3.11-Transportation-Hub-Report-Bunt-March-2009.pdf

- Minimize new road construction /widening to reduce the cost burden on residents and local businesses.
- Reduce parking demand and hence supply requirements to encourage more sustainable and compact developments
- Encourage a more socially orientated & healthy environment
- Minimize environmental pollution, including GHG's
- Reduce fossil fuel consumption (in an environment of increasing costs)

3.3.2.3. Guiding Principles

A set of guiding principles have been developed that are high level and should be inspirational to the design process. These are:

• Supportive of Smart Growth design.
• Bring together local and strategic transportation connections
• Scalable so that it is reactive to changing demands and opportunities
• Iconic building that is a focal point / center of activity in downtown Squamish
• A catalyst for changing travel behavior and providing genuine choice
• Provides a seamless connection between transportation modes that is competitive with the private automobile
• Increases awareness of transit and other sustainable travel modes[114]

3.3.3. Key Design Features

Transportation hubs should be iconic places where people want to be and feel safe. So often, conventional wisdom has engineered that such places be purely functional in design and layout, and with no consideration on how it integrates within the existing urban fabric.

Therefore as guidance, the following key features for the design have been proposed to develop the central hub.[115]

- Public Plaza
- Waiting Area: weather protected / semi- enclosed concourse
- Local art features
- Retail / local services at street level and employment on upper levels
- Pre-purchase ticket facilities

[114] & [115] http://squamish.ca/assets/PDF/3.11-Transportation-Hub-Report-Bunt-March-2009.pdf

- Minimize bus layover requirements at hub (local services terminate at satellite hubs)
- Decide on the level of enclosure for the waiting areas bearing in mind ventilation issues
- Information board / Way-finding signage / GPS
- Need to accommodate 3 to 6 buses
- Kiss & ride
- Taxi stand

3.3.3.1. Location Criteria and Functions

Two forms of hub have identified:

- Central Hub (indicated with a star): a fully multi-modal site with an off-street waiting area for buses and a designated building

- Satellite Hubs (indicated with dots): a lower key on-street facility with complementary adjacent land uses and partly multi-modal

At this stage of the process, the central hub description is used for one location in downtown, although other locations could be considered, depending land use and transportation changes in Squamish.[116]

In general, hubs should preferably close to:

[116] https://prezi.com/gn6o1vbmsqfe/dos-summer-research-presentation/2014

- Regional transportation connections (Rail, Ferry, Regional bus services)
- Higher density residential & employment locations
- Commercial and retail uses
- High activity centers (hospital, university)

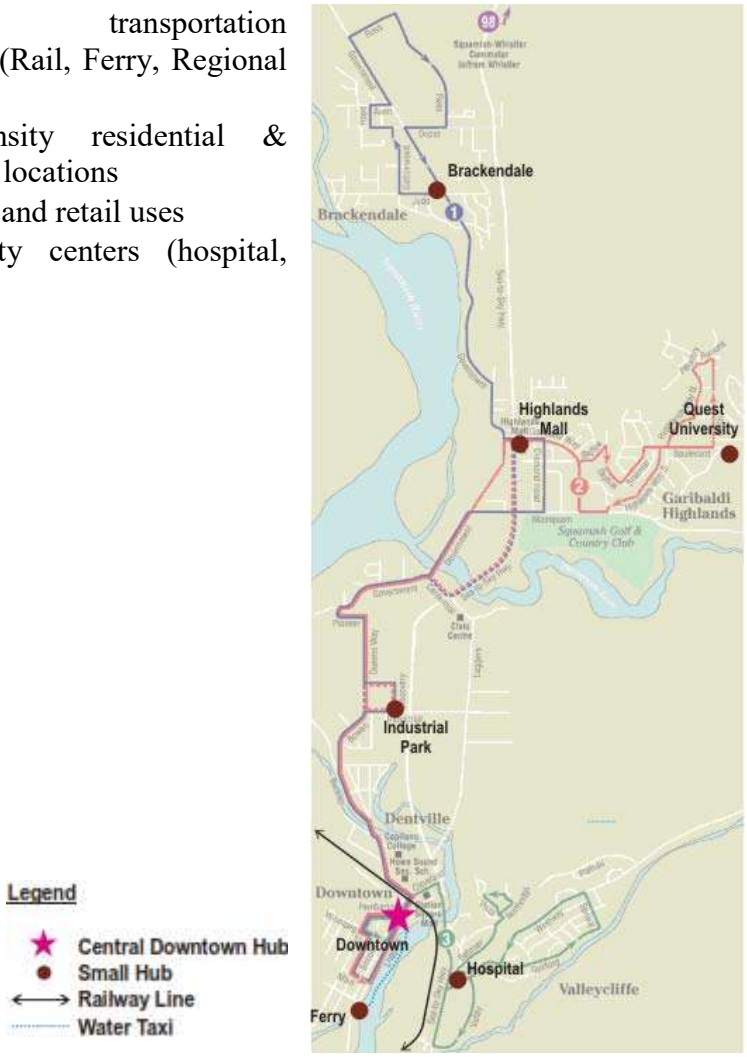


Figure 3-16: Squamish Hub Location Criteria and Functions
Source: - http://squamish.ca/assets/PDF/4.2.3-SqDowntownNeighbourhoodPlan-Draft.pdf,2008

3.3.3.2. Complementary Uses

A new central hub represents the opportunity to create a focal point of higher intensity uses in the downtown through Smart Growth planning. It also creates the opportunity for synergies between related uses so that a person's day-to-day needs can be met as part of a trip with other activities. Set out below is range of options which should be considered in the design:[117]

Figure 3-17: Squamish Central Hub Location Selection
Source: - http://squamish.ca/assets/PDF/4.2.3-SqDowntownNeighbourhoodPlan-Draft.pdf,2008

- Tourist Information
- Message board (highlighting all transportation options)
- Cafe / Restaurant
- Kiosk / Shops
- Bike Shop (repairs, rental)
- Employment / Office (to increase density)
- Focus higher intensity uses nearby
- Tourist Attractions
- Grocery Store

3.3.3.3. Transportation Planning and Design

A central hub should provide a range of transportation options for people to move about:

[117] http://squamish.ca/assets/PDF/3.11-Transportation-Hub-Report-Bunt-March-2009.pdf

A) Walking

- Maximize population within 800metres (8-minute walk)
- Design for people first, i.e. accept lower Level of Services for vehicle movements and avoid designing for the largest vehicle
- Street design - narrow travel lanes, shared streets, etc.
- Urban design - street fronting, high activities, minimal surface parking, etc.

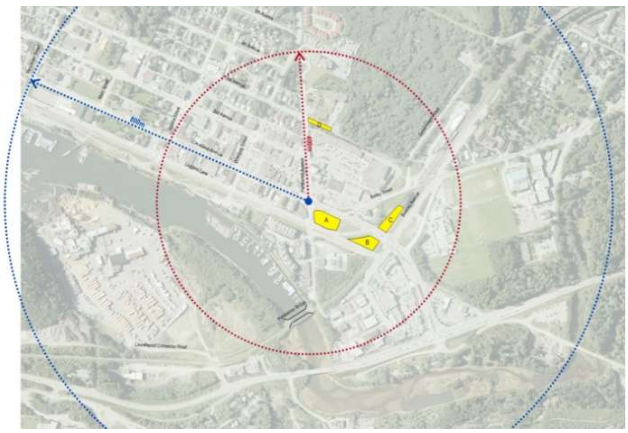


Figure 3-18: Squamish Central Hub Location - Walking
Source: - http://squamish.ca/assets/PDF/4.2.3-SqDowntownNeighbourhoodPlan-Draft.pdf,2008

B) Cycling

- Connect with existing routes
- provided ample and secure bike storage facilities
- Introduce a public bike scheme
- Bike rental shop with repair facility

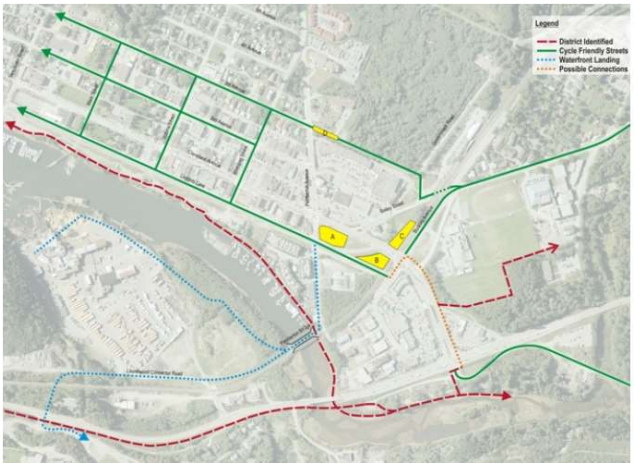


Figure 3-19: Squamish Central Hub Location - Cycling
Source:http://squamish.cc/extranet/SquamishCommunityEnergyAction/Workshops%20and%20Background/TranspoHubOverview%20April9.pdf2008

C) Transit

- Bus: Connecting local (BC Transit) and regional services (Greyhound, Perimeter)
- Rail: convenient proximity to access future services
- Ferry: connect with possible future passenger / vehicle ferry services

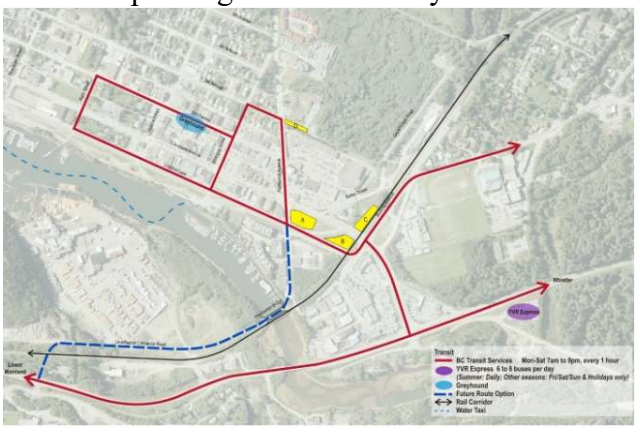


Figure 3-20: Squamish Central Hub Location - Transit
Source:http://squamish.cc/extranet/SquamishCommunityEnergyAction/Workshops%20and%20Background/TranspoHubOverview%20April9.pdf2008

D) Automobile

- Taxi waiting zone,
- Car rental vehicles available
- Kiss'n'ride pick up / drop-off
- Ride-sharing portal
- Car-sharing vehicles

3.4. Examples Summery

These cases of the international examples have demonstrated a number of interchange gaps which caused congestion at the front of the station. However the redesign process of the interchange it has been possible to mitigate the congestion problems and provide enhanced public transport facilities at the station.

Table 3.1 Analysis of Station Access Zone
Source: - author

The Access Zone	
the area of and surrounding the station where departing rail travelers arrive at the station, or where people who have just arrived by train commence the next leg of their journey.	
Toolkit for station gaps	Solution through redesign process
1. Conflicts may exist between people arriving or leaving the station and other users or modes of transport.	A) Separate conflicting flows of people by clear directional signage. Or B) Investigate whether conflicts can be resolved by relocation of facilities.
2. Manually operated entrance doors to station buildings may constrain flows of people, especially those with luggage, prams or restricted mobility.	A) Investigate whether automatic doors would ease the problem. Or B) Leave doors open.
3. Infrequent public transport provision may cause people to remain at the station longer than is necessary.	A) Improve the information provision on the station providing timetable information, improved wayfinding signage to nearest bus stops, or real time information about bus, tram or Underground services within the station. Or B) Improve the interchange facilities for example by providing or improving the bus stop facilities.

Toolkit for station gaps	Solution through redesign process
4. Lack of covered waiting area for taxis, buses or other pick-up areas may cause users to wait in the station building during inclement weather.	A) Consider the provision of additional shades and/or shelters.
5. Car parks which require the issue of a ticket on entry may cause queues.	A) Consider usage of different technology, such as e-ticketing payment for car parking. Or B) Consider whether pay-and display, with no entrance/exit control, is more suitable.

Table 3.2 Analysis of Station Facilities Zone
Source: - author

The Facilities Zone	
The area of the station (typically, but not exclusively, the concourse or booking hall) where users gather information, make purchases, or otherwise avail themselves of the facilities on offer. In many stations the Facilities Zone may also include a waiting area.	
Toolkit for station gaps	Solution through redesign process
1. Long queues forming at the ticket office.	A) Promote a higher take-up of purchase of season tickets, or multi-journey cards. Or B) Supplement ticket office facilities with roving ticket-issuing staff at peak times. C) Increased ticketing capacity at origin stations in order to avoid queues at excess fares windows at destinations.
Toolkit for station gaps	Solution through redesign process
2. Congestion between different types of station users eg. between retail users and passengers.	A) Concourse space may need to be created by the relocation of retail units to

	de-clutter the station, removing obstacles to passenger circulation.
3. Limited space for users to dwell and/or congestion at key points such as in front of Customer Information System (CIS)	A) Relocation of CIS or increased real time information provision. Or A) Revise the layout of the station, for example by providing additional concourse space or extra entrances and exits to reduce congestion.

Table 3.3 Analysis of Station Platform Zone
Source: - author

The Platform Zone	
The area, users alight from trains, wait for and board trains, or interchange between trains.	
Toolkit for station gaps	Solution through redesign process
1. Passengers may assemble near departure screens, especially during times of disruption.	A) Consider implementing a queuing system for specific services to manage passengers during disruption. Or B) Consider 'Station Zoning' of the station to make the signage and information easier and more logical for passengers to find.
Toolkit for station gaps	Solution through redesign process
2. In inclement weather, passengers congregate under the canopy, causing congestion and increased station dwell time if all the train doors are not used.	A) Extend the canopy further along the length of the platform, or provide shelters.

3. Arriving trains may already be crowded making it difficult for passengers to board.	A) Consider whether the calling pattern of trains on the route and at the station is optimal for matching demand. Or B) Use CIS to inform passengers where the less crowded part of the train is likely to be. C) Consider whether additional trains should be timetabled.
4. Congestion at platform exit/entrances.	A) Directional signage on stairs and entrance ways or variable signage or other means of separating flows of passengers. Or B) Provide new platform to relieve congestion.
5. Congestion on subways and over bridges.	A) Provide improved real time information to help passengers find their onward connection and reducing congestion at points of information. Or B) Expand over bridge or subway. C) Creation of additional entrances to the over bridge or subway.
Toolkit for station gaps	Solution through redesign process
6. Passengers interchanging between trains may result in congestion.	A) Optimize connectional margins to ensure travelers remaining on the station no longer than expedient. Or A) Ensure signage directs people efficiently to the right connecting platform.
7. Platform overcrowding.	A) Platform allocation of services could be reviewed in order to reduce congestion. Or

	B) De-clutter the platform by moving, for example, structures or retail units. C) Extend the platforms to accommodate longer services.
8. Lift of insufficient capacity causing congestion.	A) Sign users to alternative facilities. Or B) De-clutter/increase the waiting space for the lift provided. C) Replace with higher speed lift or bigger lift. Additional facilities increase the capacity to move passengers potentially reducing congestion,

3.6. Conclusion

This chapter has tried to summarize and analyze the principles and framework elements of the station hubs through the international examples, also to develop an alternative transportation model that makes community sustainability the focus of the transportation planning process versus availability or feasibility of one location or another in terms of cost and engineering efficiency. Under this model, the overall goal of any transportation system should be to develop an integrated, multimodal transportation system that serves neighboring communities and thus more diverse socioeconomic groups and that is also efficient and differ by level of service, safe, and affordable for all. To achieve this comprehensive goal, we should address the following objectives in the plan and design of the city station system:

A. Enhances and creates community character.
B. Builds upon existing commercial districts along routes.
C. Serves first those dependent upon public station.
D. Extends station to locally underserved low to moderate income populations.
E. Provides linkages to existing community-based social and cultural centers, churches, schools, and neighborhood level population centers.
F. Promotes pedestrian activities along routes, particularly at hub locations.
G. Increases and augments commercial development along route segments.
H. Creates for more green space along route segments.
I. Provides better access to jobs within the City boundaries.
J. Minimizes physical environmental impacts.
K. Ensures safety and welfare of riders and non-riders.

The Station Hub is consistent with the objectives of the Provincial Policy Statement and the Growth Plan for the Greater Golden Horseshoe, which both promotes the creation of livable, sustainable and completes communities through efficient development patterns and an appropriate mix of land use. In addition, the Station Hub will facilitate the intensification and redevelopment objectives and

targets for existing built-up urban areas as identified in these provincial documents.

The Station Hub conforms to the Regional Official Policies Plan as it represents the type of high density, mixed-use development anticipated within station corridors and around rapid station stations.

The Station Hub also conforms to the intent and objectives of the City of Kitchener Municipal Plan. At this time, amendments are required to broaden the ranges of uses and increase the density permitted on the Site. Changes to local and provincial planning policies, a regional desire to create more sustainable communities, and a significant investment in Regional public transportation systems, provide the rationale for the requested policy changes.

In summary, the development of the station hub provides an excellent opportunity to maximize the use of land at a station, and optimize the services and infrastructure available in the downtown.

The proposed planning to provide for mixed-use, high density development are consistent with recent redevelopment projects within the immediate vicinity of the Site, and are compatible with the surrounding neighborhoods. The proposed Station Hub and associated development is consistent with provincial, regional and local planning policy goals and represents sound land use planning.

Finally, the implementation of these objectives may lead to promoting better quality of life for the citizens and visitors to the city as we know limited station options not only impact individual residents but also relate to the economic development opportunities of a community.

Part 2:

Application Study (Case of Ramses Station)

Chapter 4:

Ramses Station Theoretical Background

Part 2: Application Study (Case of Ramses Station)
Chapter 4: Ramses Station Theoretical Background

Introduction

Cairo is the capital of Egypt and the largest city in the Arab world and Africa. Its metropolitan area is the 16th largest in the world. Located near the Nile Delta, it was founded in 969 AD. Nicknamed "the city of a thousand minarets" for its preponderance of Islamic architecture, Cairo has long been a center of the region's political and cultural life. Cairo was founded by the Fatimid dynasty in the 10th century AD, but the land composing the present-day city was the site of national capitals whose remnants remain visible in parts of Old Cairo.[118]

Cairo is one of the most densely populated capital cities in the world with a population of approximately 17 million people spread over 453 square kilometers (Cairo-Egypt population, 2007-2011). The increasing pressure of the population on the existing built environment and infrastructure called for a significant urban and spatial change.

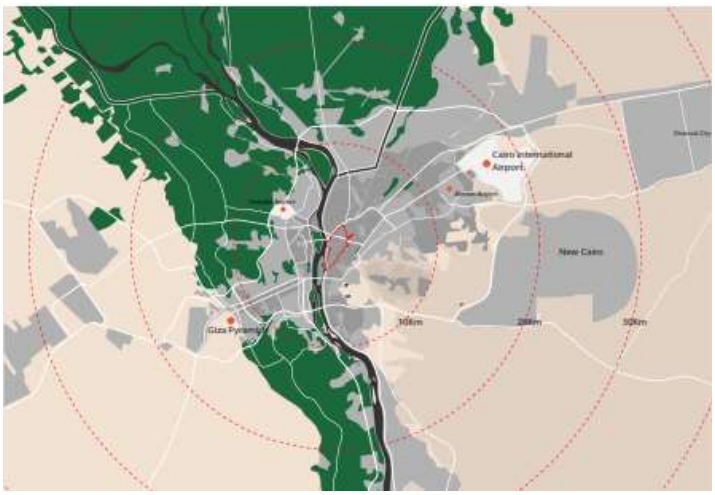


Figure 4-1: Cairo GCR Map, Egypt
Source: https://en.wikipedia.org/wiki/Ramses_Station#/media/File:Ramses-Station.jpg,
Posted: August 2013

[118] http://en.wikipedia.org/wiki/Cairo

This chapter introduces the theoretical framework and understanding the theories and concepts for Ramses Square area. The theoretical framework stresses the importance of urban context and location.

Public space of the down town is dominated by high density and traffic: [119]

1. **El-Tahrir Square**

(Liberation Square): is a major public town square in Downtown Cairo, Egypt. The square has been the location and focuses for political demonstrations in Cairo, most notably those that led to the 2011 Egyptian revolution which led to the resignation of President Hosni Mubarak. The square is the northern terminus of the historic Qasr al-Ayni Street, the western terminus of Talaat Harb Street, and via Qasr al-Nil Street crossing its southern portion it has direct access to the Qasr al-Nil Bridge crossing the nearby Nile River. The area around Tahrir Square includes the Egyptian Museum, the House of Folklore, the National Democratic Party-NDP headquarters building, the Mogamma government building, the Headquarters of the Arab League building, the Nile Hotel, Kasr El Dobara Evangelical Church and the original downtown campus of the American University in Cairo.[120]

2. **Ataba Square and El-Azbekyya Garden:**

The area around the Azbekyya Gardens was once a vast lake but was drained in 1837. The area was constructed in accordance with a rigidly enforced plan. This was all done under the instructions of the Khedive, who loved entertainment and there was originally a circus, theater and opera house in the southern gardens. In earlier times, this was the hotel district, with such well known establishments as the famous Shepherds. There were a number of consulates located here, and it was a favorite district for European visitors. Near to El-Azbekyya garden was once the Midan Opera west to Midan Ataba, where modern Egypt meets medieval Cairo.

3. **Ramses Square**

North from Midan Ataba on Sharia Clot Bey (Sharia Khulud), named for a French physician, Antoine Clot (Klute Bey) who was one of the founders of modern medicine in Egypt. Up ahead, the minaret belongs to the El-Fath Mosque, which marks our current destination (Ramses Square).

[119] The National Organization For Urban Harmony (NOUH) - Ramses Competition TOR Data, 2008

[120] https://en.wikipedia.org/wiki/Tahrir_Square,2011

The square is named Ramses Square after the statue of Ramses II which was transported there around 1950. The statue is now relocated to a new site, close to the Grand Egyptian museum. The square is surrounded by the building of the railway station built in 1893 (upgraded in 1955) and the Kobry El-Lymoon Bridge and the railway museum from 1932. The original railway station was built as the terminal of the first rail from Alexandria to Cairo in 1856.To the west the tallest Minaret of Cairo from El-Fath Mosque is dominating the whole area. To the south the vast space is enclosure by some historic buildings of the medieval town.

Ramses square in the heart of the urban center of Cairo with a variety of transportation modes interacted with highly boiling over dynamic urban fabric is a greatly obvious sample for a multimodal nodal area, which can be a glary application as a hub solution example. It is located with a variety of means of transport, such as[121]:

- National Station of train
- Regional Station of train
- A huge Metro station for two existing underground metro lines (line 1 and 2)
- Major road axes, such as the fly-over of 6th October and Ramses Street.
- Surface Tramway: linking this area with Heliopolis and Nasr city (Cairo east zone) which does not exist now removed from the whole area.
- Bus stops
- Minibus stops
- Microbus stops and terminals

[121] Marwa A. Khalifa and Mohamed A. El Fayoumi / Procedia - Social and Behavioral Sciences 68 (2012) 879 – 893

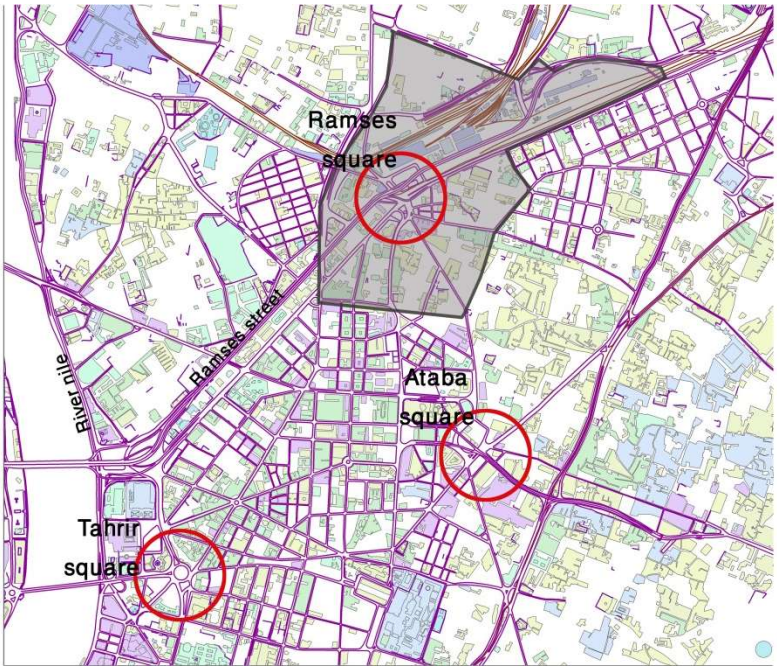


Figure 4-2: Map for Majors Squares at the Study Area
Source: The National Organization for Urban Harmony (NOUH) - Ramses Competition TOR Data, 2008

This site has come to a saturation point today. Here are few numbers regarding the site (BECT/AREP,2009):

- 30 000 Car figure per day
- 240 000 Passenger figure per day
- 23 000 Motion figure per day
- Hour of Traffic congestion

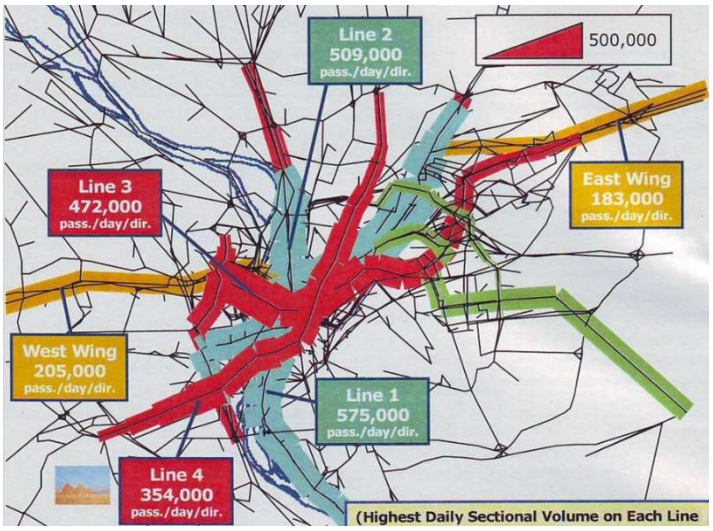


Figure 4-3: Daily Traffic Volume in Ramses square
Source: The National Organization for Urban Harmony (NOUH) - Ramses Competition TOR Data, 2008

4.1. Ramses Square Area, Cairo, Egypt

Ramses Square area is the name of the large square fronting Cairo's main railway station Ramses Station and the district of streets and neighborhoods surrounding it. It is located immediately north of the city center, Medan Tahrir. Ramses Square is not considered the most attractive part of modern Cairo as it is a core point of Cairo's transportation system, notorious for swirling traffic and massive crowds at peak hours, though many tourists leave out of the station on overnight trains to southern Egypt.[122]

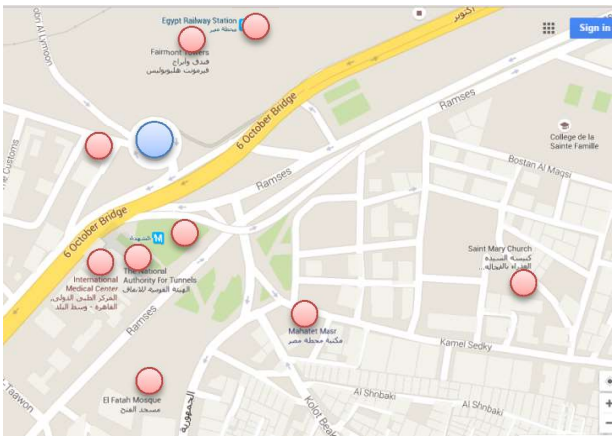


Figure 4-4: Ramses Square Area, Cairo, Egypt
Source: https://www.google.com.eg/maps/@30.0610546,31.2460823,17.5z
Posted: August 2015

Ramses station in Cairo is the main rail entrance and the main station for transportation in Cairo where commuters arrive and leave all year round. North east of the railway station lies a former warehouse (a brownfield land) area. This brownfield zone displays exceptional potential for urban transformation. Conscious restructuring of the existing rail service buildings and creative urban planning approaches could lead to freeing approximately 7.28 hectare of land. This is a tremendous opportunity towards the urban upgrade of the suburb and if wisely used could lead to a sustainable urban development in the area.[123]

[122] http://www.touregypt.net/featurestories/ramsessquare.htm,2011
[123] Radwan, G., & El-Shahat, M. (2012). Transformation through Sustainable Qualification

Figure 4-5: Railway Station in Ramses – Interior Picture, Cairo, Egypt
Source: Author, 2015

This section will identify the location of Ramses area within the city and the urban context, in addition to, its relation of Ramses Square. This followed by, a historical background of the area and the historical eras that affected it. Then, the study goes through the SWOT analysis to reveal the various Weaknesses of Ramses square itself and the study area, and moreover, to point out the opportunities and potentials for the new development approaches.

4.1.1 Ramses Square Location and urban context

Ramses is located in the heart of Cairo; it includes a railway station and a square that bare the same name. Ramses area went through a history of urban changes, which resulted in a diverse built environment and urban pattern. The resulting heritage and varied urban fabric act as a challenge when attempting to plan a homogenous urban neighborhood in the area. The study area starts directly from the north eastern edge of the Ramses station and extends along the rail lines, as a strip land, of 250 meter width and almost 1100 meter long, to cover a total area of 7.28 hectare.

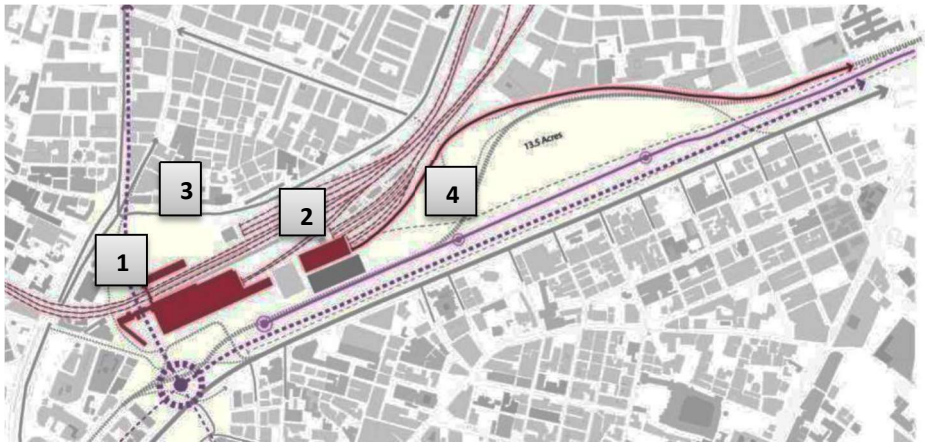


Figure 4-6: Map for Ramses Station and the surrounding context
Source: Ramses international competition report, AREP + BECT, 2009

4.1.2 Ramses area Historical Background

In the late Islamic period, Ramses area was the northwest edge of the mediaeval town and the main entrance to the historic Islamic city. (Abu-Lughod, 1971) The train station was built in the first half of the 19th century, in front of this entrance. The area acquired its name from the Ramses II statue that stood till year 2005 in the middle of the square. Nowadays, Ramses square and its surroundings are a vital part of Downtown Cairo CBD). They act as a meeting node between the western Khedive areas, south-eastern Islamic historical areas and the northern quarters (Shoubra district) beyond the tracks. Consequently, it is the crossing point of various public transportation means, private cars, and thousands of commuters every day.[124]

[124] Radwan, G., & El-Shahat, M. (2012). Transformation through Sustainable Qualification

Figure 4-7: Ramses II Statue stayed in the square till 2006
Source: Ramses international competition report, AREP + BECT, 2009

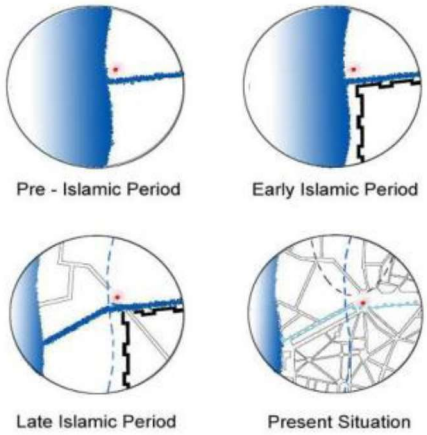


Figure 4-8: The development of the gate of (Ramses square) from pre-Islamic period to the present solution
Source: Bott, Gangler& ElShahat (2009)

4.1.2.1 Historic Development of Ramses Square (Bab ElHadid)

Ramses Square Area was known as Bab el-Hadid (steel gate). Here in Bab el-Hadid, one is likely to encounter all manner of pedestrian and vehicular behavior. It functions today as a point of intersection between different modes of transportation in the city. Elevated roads (6th of October Bridge) that snake through the square date back to the 1970's with 280000 pedestrians and 2 million vehicles passing through it every eight hours. The approach is now to transform this overcrowded and extreme noisy place into a public space for both: to stay and to move.

The history of Ramses Square goes back to the early Islamic extensions of the Fatimid city. This area was the north-western corner of the fortified city in direct neighborhood of the old course of the river Nile. In the late Islamic period this course moved to the west where the quarter of Bulaq was arising with the old port. A canal between the Nile and the northern boundary of the city served the inhabitants with water and a gate leading directly to this canal and to Bulaq. Today this canal has been transformed into one of the urban highways (Ramses Street).

Connecting Bulaq and the northern parts of the city gained the area extra importance as a market place in front of the gate. A kind of buffer zone between the fertile oasis and the city growth extended more and more into the agricultural land. A first Plan was developed under the rule of Mohammed Ali who created a large park in 1844.[125]

In the process of re-planning Ramses Square, many urban design proposals, have taken place. In 2007, a parking garage was built in front of the square's train station. Through all historic periods the use and the functions of public space have changed. In medieval times the area in front of the historic gate was more or less the edge of the city, but the square in front of the station plays an important role as the entrance to the city in the 20th century.

Figure 4-9: Flyover 6th of October crossing the square
Source: Bott, Gangler& ElShahat (2009)

[125] Ramses Competition, 2008

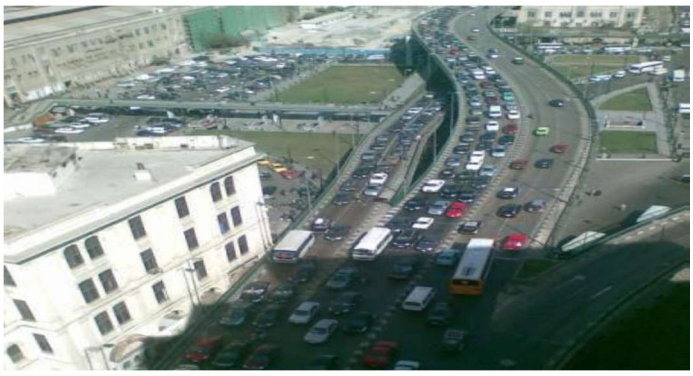


Figure 4-10: Aerial view of Ramses square area
Source: Radwan & El-Shahat, 2012

4.1.2.2 Spatial Axes and Focal Areas - City center

The consequences of stationing to the information society on urban and spatial development as well as the transformation of a city in its historic and current cultural context under the conditions of metropolitan development, globalization and climate change. Strategic planning for sustainable urban development has to be improved and it aims to explore visions for this major area of Cairo.

- The interaction between the Nile and Downtown and the interaction between Downtown and the historic city should be strengthened, the attractiveness of the cultural and commercial areas improved, and
- New functions and traditional quarters should be harmonized.

The Fatimid city as a world culture heritage site and Downtown Cairo with all the buildings of high architectural value (landmarks) and the mixed use aims to re-provide the city with their multi-functional character and to valorize the cultural heritage in order to improve the quality of life.

One of the main objectives is also a better connection and accessibility to the northern quarts. A rehabilitation and renewal concept for the northern quarters aims at enhancing the priority of a sustainable urban development planning.

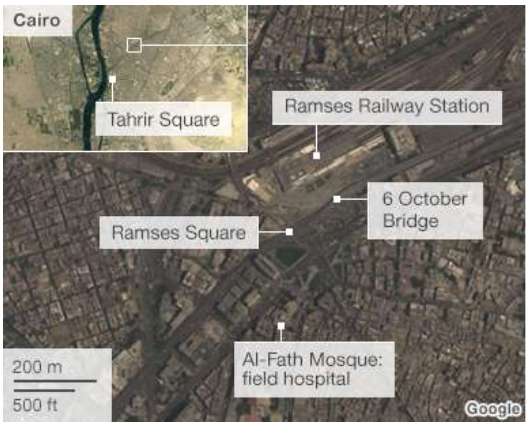


Figure 4-11: The focal area of Ramses square
Source: http://www.bbc.com/news/world-middle-east-23725086,2011

In consequence, the process results in the definition and implementation of long-term strategies and concrete projects ensuring sustainable urban development planning, as well as enhancing sustainable economic development and reducing social disparities.

4.1.2.3 Ramses Square Site Studies

Elevated roads became the main dominating urban elements cutting Ramses square into different undefined spaces and mostly for the uses as parking area and streets. Also railway museum became invisible and inaccessible through the different elements hiding it following some of the site plan and area studies maps showing the site analysis.

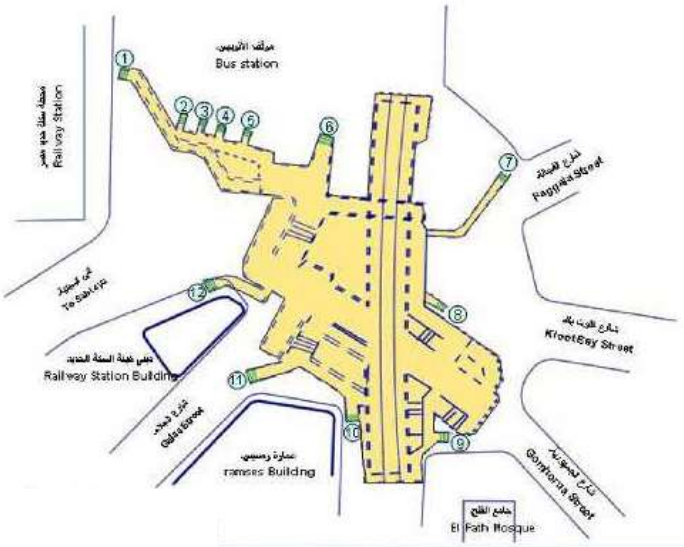


Figure 4-12: Entrances to Mubarak (El Shouhada Station) at Ramses square
Source: The National Organization for Urban Harmony (NOUH) - Ramses Competition TOR Data, 2008

One of the exits from the underground metro station – El Fath Mosque

Underground Metro Station

Underground Metro Line (1) El Marg - Helwan

Metro Line 2 (Shoubra - El-Moneeb)

Underground Metro Line (2) Shoubra - El-Moneeb

Figure 4-13: Underground Metro Line (1, 2, & 3), Cairo, Egypt
Source; https://en.wikipedia.org/wiki/Cairo_Metro#/media/File:Cairo_Metro_map.svg
Posted; 2013

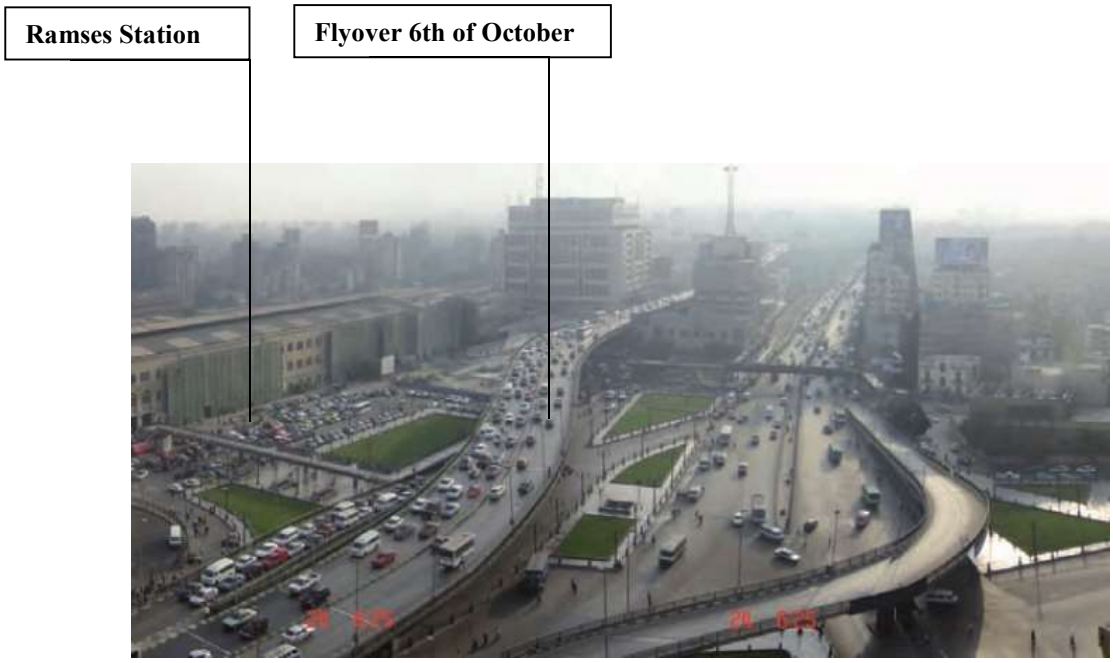


Figure 4-14: Ramses square current situation
Source: http://www.uni-stuttgart.de/si/stb/publikationen_pdfs/KAIRO_WEB.pdf

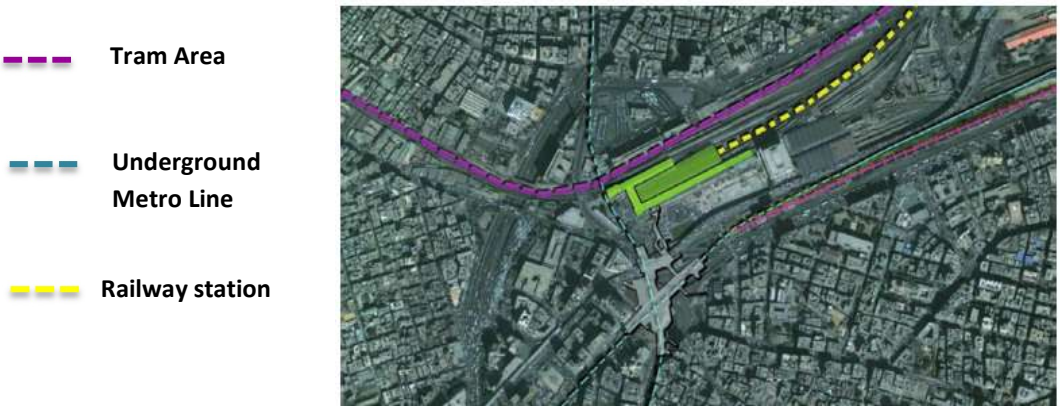


Figure 4-15: Ramses main station: transit area for tram, underground Metro and Railway station
Source: http://www.uni-stuttgart.de/si/stb/publikationen_pdfs/KAIRO_WEB.pdf

4.1.3 General Traffic Flow at Ramses square

With the introduction of motorized traffic the urban fabric of the Old City as the patterns of the extensions of the 19th / 20th century and the further extensions to the north have been changed dramatically. In all areas open space has become mainly determined by the demands of easy traffic flow, rather than contributing to the social and cultural life of residential neighborhoods.

4.1.3.1. Individual Traffic - Urban Express Highways

Highways, the elevated bridge (6th of October) and railway trucks cut the present center of Cairo into separate quarters and are destroying the boarders of the Nile. The creation of an order of different categories of individual traffic axes is one of the tasks defined by the National Organization of Urban Harmony (NOUH).

Strengthening the Inner City Ring and connecting it with the Ring road of Cairo is one of the main objectives. Only a few important urban express highways should guarantee the accessibility of Downtown Cairo.

Figure 4-16: Flyover 6th of October - individual traffic axes
Source: http://archiseek.com/2009/quilligan-architects-placed-second-in-ramses-square

A) Public Transportation

The improvement of the public transportation system is of high priority. As in other big cities the central station should be connected with high speed trains with different regional destinations and the airport. The new metro lines and their junctions are initial interventions for sustainable urban development. They are focal points for new recreational areas between the dense structure of Downtown and the Nile - like Tahrir Square and the new public space between the Old City and Downtown – like Ataba Square. Ramses Square`s main role is to serve as a traffic junction for all categories of traffic.

The World Bank continue to argue that the public transport systems should not be

"Viewed as only for the poor, as the importance of public transport to all income groups in many rich European cities demonstrates. Improving efficiency in public transport must be concerned not only with keeping costs down but also with providing a flexible framework within which the less poor as well as the very poor can use public transport with confidence and comfort".[126]

[126] Japan International Corporation Agency (JICA), December 2003, Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region, A.R.E. (CREATS), Phase 2, Final Report, Volume 3

4.1.3.2. Individual Traffic - Urban Traffic Network

The development of a new traffic management concept leads to the improvement of environmental conditions and to regain the atmosphere of the characteristic network of representative boulevards and typical squares of the late 19th century.

B) Pedestrian Network

The Area is suffering from:

• Rising traffic congestion.
• Undefined pedestrian paths and meeting points for public activities and residents of the area
• The loss of identification of the plaza as main entrance to Cairo from Train Main Station.
• Limited green spaces

One of the main objectives is to establish a traffic balance between the different interests of traffic flow, pedestrians and to recover car-free pace and squares. The impact of traffic should be reduced and the net-work of footpaths repaired. A tourist trail has to be established.

The neglect of the inner urban areas over the last decades has sharpened tension and created an imbalance in the cities. Comprehensive surveys and analysis are important for the development of sustainable Strategic Plan. Concerning the qualitative land-use, the National Organization of Urban Harmony (NOUH) has provided some surveys. Different levels of land use are visible:

- Mixed Use (commercial – administrative – residential)
- Religious Buildings
- Historic Monuments and Landmarks
- Private and public space – cemeteries - undefined open space and recycling areas.

4.1.4 SWOT Analysis of Ramses area and its surroundings

The main urban components of the centers of great cities, those components may be not exist in the rest of the city, such as the historical heart that represent the oldest part of the city, CBD, the main stations for public transportation networks,

and many other urban components. Ramses area represents the main stations for the public transportation networks and the historical heart of the city center; Ramses area offers immense potential of abandon former railway territory for new city development. As previously mentioned, this area is considered as a Brownfield that could be reused and transformed into a sustainable neighborhood with high quality of life. Hence, it is not a matter of planning a modern urban revitalization of such area contributes to sustainable urban development; as it makes better use of the land and creates a more attractive area for companies to settle down. The surrounding areas of Ramses square and the city Centre (CBD) will pave the road for a sustainable future. The Green spaces, historical buildings, commercial areas, metro line transportation, in addition to, the existing railway station, are some of the key opportunities in the development of the new railway neighborhood.[127]

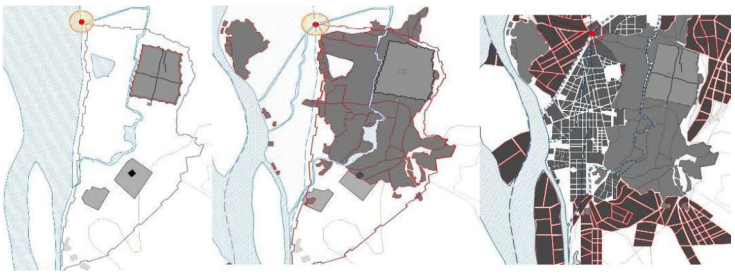


Figure 4-17: The development of the gate of (Ramses square) from pre-Islamic period to the present solution
Source: Bott, Gangler & ElShahat, 2009

4.1.4.1. Ramses square area Weakness and Threats

Ramses square is the busiest square in Egypt; 28 000 Pedestrians and nearly 2 million cars and microbuses pass the square every eight hours. The current situation of this important site is on functional aspects chaotic and in terms of its spatial quality a disaster. A lot of problems have emerged throughout the previous decades on different levels: (Morsi, 2008)

Multi layers of traffic network: an elevated highway and looped ramps dismember the spatial continuity of the square. Highly frequented traffic lanes separate the main station and its square from Downtown Cairo and Old Cairo. The underpasses

[127] *Gehan Ahmed Nagy Radwan and Manal M. F. El-Shahat / Procedia - Social and Behavioral Sciences 68 (2012) 481 – 503*

- leading to the underground stations and to the main train station building- are littered, poorly light and lack ventilation.

Accessibility and Pedestrian Network: the Current traffic system disregards the pedestrian flow entirely. This is evident in the undefined pedestrian paths and lack of meeting points or spaces for public activities. Visual aspects: on the visual level; the whole space lacks unity. The main elevated highway cuts through the space blocking any visual continuity. Pollution and environmental damage: the environmental damage is caused by littering from the pedestrian, the emissions from transportation in the square and the limited green spaces. Informal jobs and street traders: the place brings crowds of people together and so it is a strategic location for informal jobs and trades. Currently, the square is a jungle of informal traders. Parking spaces: There are no suitable parking spaces with the capacity to suit all users of the area.

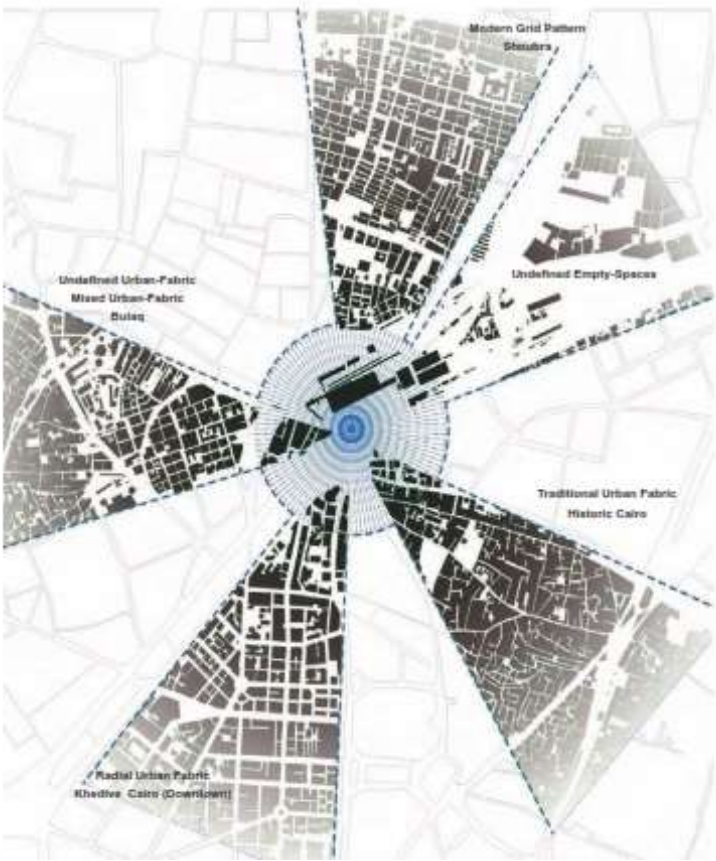


Figure 4-18: Different Urban Fabric Patterns Surrounding Ramses Square
Source: Bott, Gangler & ElShahat, 2009

4.1.4.2. Ramses square area potentiality & Importance

Ramses Railway station in Cairo is the main rail entrance and the main station for transportation in Cairo where commuters arrive and leave all year round. North east of the railway station lies a former warehouse area. This brown field zone displays exceptional potential for urban transformation.

- To connect heterogeneous realms of Central Cairo.
- To open up a link to the Western and Northern quarters beyond the tracks
- And offers huge areas of abandoned former railway territory for A new city development

Above all, a redesign offers the chance to create new open space for the surrounding areas, settled in extreme high density without sufficient green open space[128]

The buildings surrounding Ramses Square are partly of high quality, above all the main station building itself and some others like the Railway Organization Building and the National Post Building near to Railway Museum. But to a large extent the spatial boundary of Ramses Square is indistinct and of bad quality. To improve the situation means hard work for the future, but offers many chances not only for the station itself, but for the whole inner city.[129]

4.1.4.3. Ramses square area Opportunities and Strengths

The strategic location of the Ramses area and the presence of the railway station in it make it the most qualified area in Cairo to be converted into a sustainable railway neighborhood. This encourages the concept of sustainable mixed uses activities district connected to the Central Cairo. The new building structures, as well as, the central location of Ramses will make it an attraction point for active companies at regional and national level.

The new structures should be complementary to the existing old structures both function and form wise. On terms of Accessibility, Transportation and mobility; The Ramses Station area has the potential to connect heterogeneous realms in Central Cairo and open up a link to the Western and Northern quarters beyond the tracks. (Morsi, 2008) It also has strong links with all major squares in the city

128 & 122 Ramses Square International Competition, Downtown Cairo – Ramses Square, Prof. Dr.-Ing. Helmut Bott, 2010

center, namely Tahrir and Ataba squares, especially after the relocation of the Statue of Ramses II.

Figure 4-19: Ramses Square before relocation of the Statue of Ramses II
Source: https://www.flickr.com/photos/28356093@N08/5700834730/2002

Table (4.1) Problems of the situation in Ramses square area
Source: *(TOR)*, International Competition For Urban Design And Harmony Of Ramses Square, The National Organization for Urban Harmony (NOUH), URL: www.urbanharmony.org.

Sr.	Problems	Parameter
1.	***Traffic & pedestrian circulation***	Near the terminal and on Ramses Road next to the tramway terminus.
		Near the station (trigger neck congestion).
		At the Entrance and Exit points.
		Mini busses and shared taxis generate huge congestion.
2.	***The situation of the LRT station***	The existing Heliopolis metro terminus station, inadequate platform length and a lack of pedestrian's amenities.
3.	***The Egyptian National Railway Station***	The station building and platforms need upgrading in many aspects.
		Parking area is insufficient the occupancy percentage

Table (4.2) SWOT analysis of Ramses Square
Source: Radwan & El-Shahat, 2012

STRENGTHS	**WEAKNESSES**
Good Infrastructure Network	Lack of Green Spaces
Central Location in Cairo City	Different and opposing Urban tissue
Various existing facilities in the Square	The pressure of population growth
Already existing Train stations	The pressure of traffic growth
Transportation Network	Transportation Network
OPPORTUNITIES	**THREATS**
Presence of many company headquarters	Physical Barriers
Presence of many commercial facilities	Noise and Ecological pollution
historical and cultural values	Poor connections for pedestrians
Great tourist attraction	Complex history that needs preservation
Has the ability to be a Transportation Network Hub	Lack of service facilities

Chapter 5:

Testing Central Hub Principles on Ramses Station

Chapter 5: Testing Central Hub Principles on Ramses Station

Introduction

Ramses station in Cairo is the main rail entrance and the main hub for transportation in Cairo where commuters arrive and leave all year round. North east of the railway station lies a former warehouse (a brownfield land) area. This brownfield zone displays exceptional potential for urban transformation. Conscious restructuring of the existing rail service buildings and creative urban planning approaches could lead to freeing approximately 7.28 hectare of land. This is a tremendous opportunity towards the urban upgrade of the suburb and if wisely used could lead to a sustainable urban development in the area.[130]

This chapter focuses on testing the Central hub Design and Principles on Ramses station, the critical station in the Public transportation system.

The station was chosen according to certain criteria based on the following:-

- Ramses station is one of the most important public transport stations in Cairo.
- A number of transport facilities exist within Ramses Square.
- Ramses station is directly connected to the central Cairo.

5.1 Ramses Station Analysis: Design and Evaluation

Ramses station is a critical station in the Public transportation system in Egypt; new designs have been conducted for Ramses station which incorporates sustainable issues. A number of transport facilities exist within Ramses Square including one of the main ENR (Egyptian National Railway) stations, elevated pedestrian walkways, and entrances to the underground Cairo Metro (Mubarak station, Metro Lines 1 and 2). A series of changes had been implemented under the sponsorship of Cairo governorate involving road closures and the relocation of shared taxi and CTA (Cairo Transportation Authority) bus facilities from within the Ramses Square area to a new public transport terminal located

[130] Radwan, G., & El-Shahat, M. (2012). Transformation through Sustainable Qualification

immediately North of the ENR tracks. Major road facilities within the square include Ramses Street and the elevated 6th of October Expressway.[131]

5.1.1. Ramses Square Area Study Background

Ramses station has the necessary infrastructure and structure to operate as an intermodal terminal, Railway, metro; tramway, bus and shared taxis are linked via the elevated pedestrian way and via the metro passage. However, major traffic problems occur near the terminal and even further on Ramses Road next to the tramway terminus, Ramses railway terminal has huge problems at the entrance and exit points. Arriving traffic via the small street in front of the NAT building (minibuses and shared taxis) gets stuck and starts unloading its passengers at that point or at any free space around the removed statue. In particular shared taxis use the road in front of the railway terminal to avoid entering the terminal. This chaotic situation negatively affects traffic on all access points and hinders through-traffic.

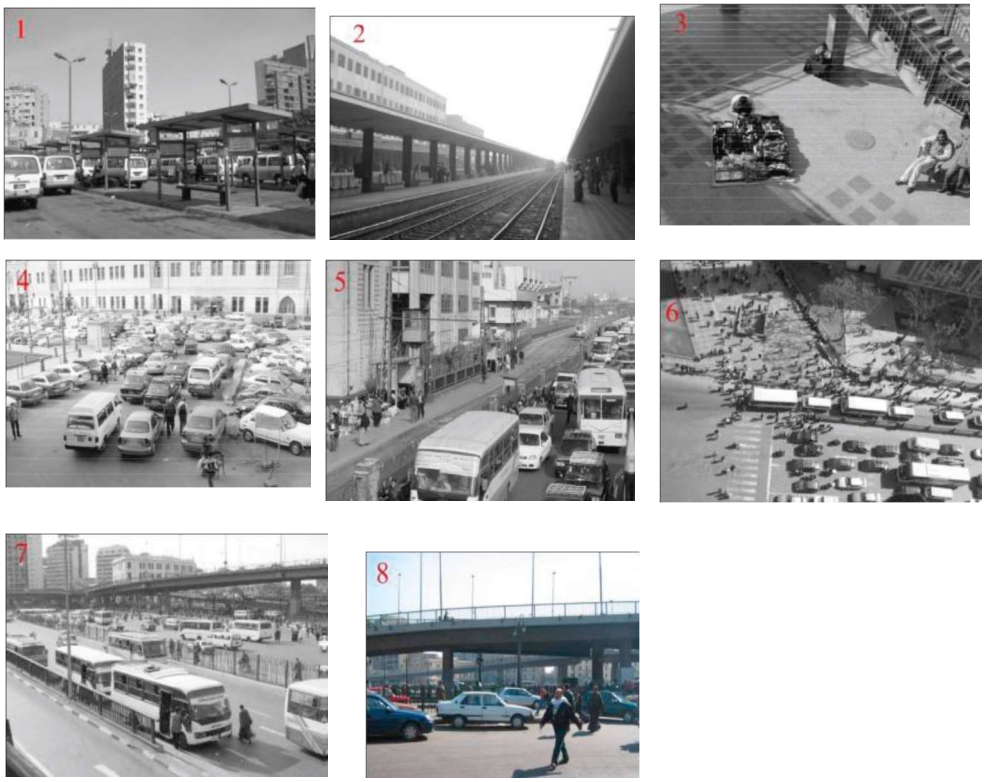
Ramses square zone, as a case study example in the heart of the urban center of Cairo with a variety of transportation modes interacted with highly boiling over dynamic urban fabric is a greatly obvious sample for a multimodal nodal area, which can be a glary application as a hub solution example.

The following sections illustrate the adopted approach by an Egyptian and French Architectural offices/companies; BECT & AREP for solving the problems of Ramses square zone using the concept of a transportation hub (Multi Modal Platform). This solution has won the first prize in the International competition for urban design and harmony, organized by the National Organization of Urban Harmony in Egypt, in 2009.[132]

[131] NOUH (2008), *Terms of Reference (TOR)*, International Competition For Urban Design And Harmony Of Ramses Square, The National Organization for Urban Harmony (NOUH), URL: www.urbanharmony.org.

[132] BECT/AREP. (2009). International competition for urban design and harmony, first prize. Cairo: National Organization of Urban Harmony.

Figure 5-1: Ramses sq. zone (Google earth map), 8 photos for different means of transportation in Ramses square
Source: - BECT/ARER, 2009



5.1.1.1. The situation of the LRT station

The configuration of the existing light rail station terminus station is insufficient for use by a modern LRT system from a number of perspectives, including inadequate platform space, insufficient platform length and a lack of pedestrian amenities. The current location is seriously constrained to the south by Ramses street and to the North by NAT building complex.

5.1.1.2. The situation of the Egyptian National Railway (ENR) station

The ENR station at Ramses square is Cairo's major railway terminal and is of a high relative importance for the whole country of Egypt. However the station buildings and platforms need upgrading in many aspects. The station has got 24 platforms of varying lengths and breadths. Many of the platforms need to be extended and widened. Ticket desks are insufficient in number. Seats and shelters are insufficient and need modernization. Messages revealed through the announcing systems are not clear. Toilets and cafes need renovation. Information displays and orientation signage are insufficient and need modernization. Parking area is insufficient while the entire road section in front of the terminal is used by taxi and private cars for loading and unloading zones. More space for Kiss and ride facilities need to be provided. The status of the tunnels crossing under the platforms is good in respect of lighting and ventilation and also with respect to the materials used in walls ceilings and floorings.[133]

[133] NOUH (2008), *Terms of Reference (TOR)*, International Competition For Urban Design And Harmony Of Ramses Square, The National Organization for Urban Harmony (NOUH), URL: www.urbanharmony.org.

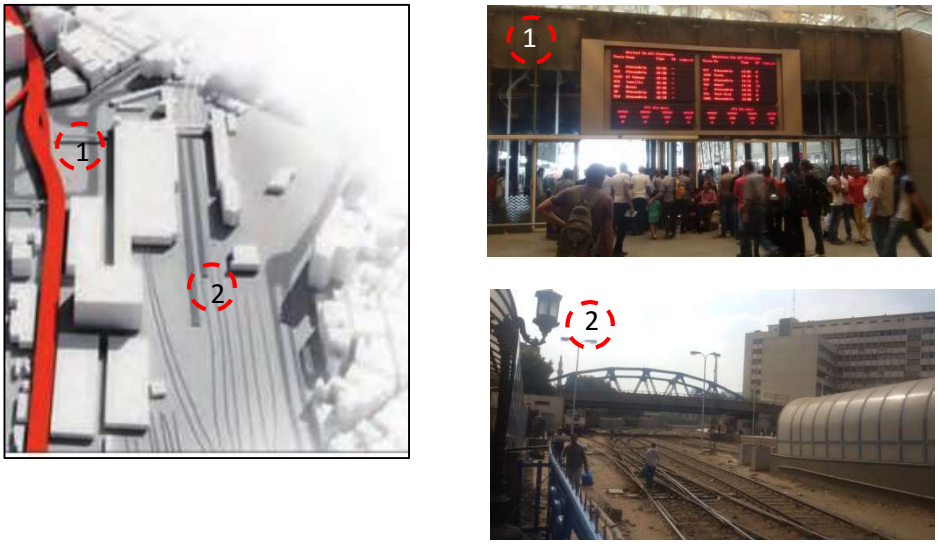


Figure 5-2: Ramses Station (ENR) main building and platforms.
Source: Author

Table (5.1) Site evaluation criteria for the location of Ramses station
Source: Shneider, Jerry B., (2004). [134]

Sr.	Item	Parameter	Ramses Station
1.	Proximity to major facilities & destinations	how easy or hard is to reach highway facilities and important destinations from a particular station site	Yes
2.	Community Impacts	• Safety and security in/ around station, • conformance with local comprehensive (land use) • functional compatibility	Yes

[134] Shneider, Jerry B., (2004), The Design of Intermodal Stations for a High Speed Transportation System,

		• urban design integration potential, • visual intrusion/ integration potential, • socio-economic benefits, • possible land acquisition problems	
3.	Environmental impacts & traffic mitigation	• Environmental Impacts include noise, air quality and water quality concerns. • Traffic Mitigation will deal with the local traffic capacity improvements required	Yes
4.	Potential funding sources and costs	• operated by a public agency, • additional complexities • a joint development component	Yes

Table (5.2) Quality Requirements of Public Transport System on Ramses station,
Source: Shneider, Jerry B. (2004), The Design of Intermodal Stations for a High Speed Transportation System, U.S.
Presented by Author based on Passenger questions

Sr.	Item	Parameter	Ramses Station
1.	Station Accessibility	Needs of people with reduced mobility	**Yes**
		Physical design of rolling stock	**N/A**
		Link with public transport	**N/A**
		Link rural and peripheral regions	**N/A**
2.	Affordability	Fare Levels	**N/A**
		Socially desirable services	**N/A**
3.	Safety and security	Safety standards	**Yes but need adaptation**
		Quality of lighting	
		Qualification of staff	
		Number of staff on duty	
4.	Travel convenience	Journey times	**Yes**
		Reliability frequency	**Yes but need adaptation**
		Clean and comfortable	
		Information dissemination	
		Integrated ticketing	
		Flexibility	**N/A**
5.	Environmental impact	Emissions	**Yes**
		Noise	
		Infrastructure	

5.2. Ramses Station Analysis: Station Operation

Ramses station has the necessary infrastructure and structure to operate as an intermodal terminal, Railway, metro; tramway, bus and shared taxis are linked via the elevated pedestrian way and via the metro passage. However, major traffic problems occur near the terminal and even further on Ramses Road next to the tramway terminus, Ramses railway terminal has huge problems at the entrance and exit points. Traffic wanting to reach the terminal needs to cross the access

ramp toward 6th of October expressway and gets blocked at the entrance hindering other traffic on the street.[135]

5.1.1. Safety Requirements for Traffic and Pedestrian Circulation

One of the most critical safety problems in any street system involves the interactions between vehicles and pedestrians as in any contact between a pedestrian and a vehicle; the pedestrian is at a disadvantage. Intermodal stations which provide connections to commuter trains and numerous bus lines are often heavily used and located in commercial areas, thus safety requirements is a main concern in the design process.[136]

Design elements that must be considered

- Safety
- Provisions for emergency vehicles and bicycles
- Sight distance
- Street lighting
- Maintenance
- Landscape components

[135] BECT/AREP. (2009). International competition for urban design and harmony, first prize. Cairo: National Organization of Urban Harmony.

[136] Roess, Roger P., PRassas, Elena S., Mcshane William R., (2005), Traffic Engineering, Third Edition, Pearson Prentice Hall,Pearson Education International.

Figure 5-3: (4 Photos) Pedestrian Circulation at Ramses station.
Source: Author

Table (5.3) Safety Requirements for Traffic and Pedestrian Circulation on Ramses Station,
Source: Roess, Roger P., PRassas, Elena S., Mcshane William R., (2005), Traffic Engineering, Third Edition,
Presented by Author based on Passenger questions

Sr.	Items	Parameter	Ramses Station
1.	Vehicles & pedestrians guidance	A) Channelization	Yes
		B) Crosswalks	Yes but need adaptation
		C) Curb alignment	
		D) Signal timing	
		E) Orientation signage	
		F) Floor finishes	N/A
2.	Crossing safety at intermodal stations	A) Passenger bridges	Yes but need adaptation
		B) Pedestrian tunnels	
3.	Accessing other levels	stair design, ramps, lifts, escalators	Yes but need adaptation
4.	Design of platforms and loading bays	A) Station Platforms	Yes but need adaptation
		B) Bus Runways and Loading Bays	
		C) Platforms shelters	
5.	Turnstiles and Entrance/Exit Controls	Stations entrances and exits must be designed to allow for the numbers of passengers	Yes
6.	Parking facilities	Park/Ride Facilities	Yes
		Bicycle Motorcycle Facilities.	N/A
7.	Lighting and energy efficiency	Natural Lighting	Yes
		Artificial lighting	Yes but need adaptation
8.	Ventilation in station buildings	Natural ventilation	Yes
		Mechanically Assisted ventilation	Yes but need adaptation

5.2.2. Providing circulation needs within intermodal station areas using environmentally benign technologies

Some way need to be devised to mitigate the congestion and parking problems that an intermodal hub generates. Circulating buses and vans often cannot offer frequent and fast service to and within these hubs because of slow roadway speeds and very significant signal delays at most intersections. Moreover, these vehicles add to the air pollution problem and have high continuing labor costs.

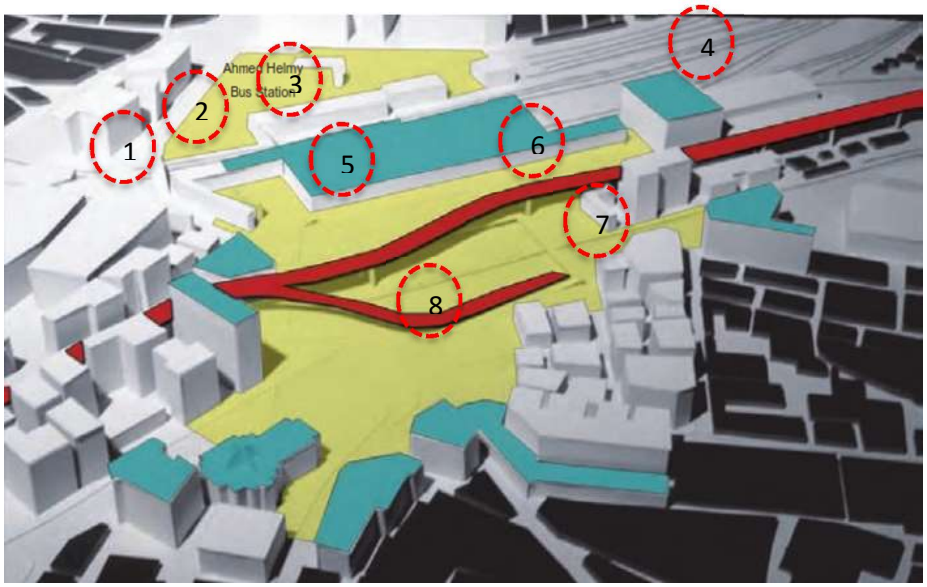
A high tech bus should be formulated and evaluated for example, a clean fuel vehicle with high tech on-board and on-street electronics, reserved lanes, priority signal controls and special loading facilities. In most cases buses and vans would also require special elevated facilities and they would be quite expensive and difficult to build in highly congested areas or adjacent to existing stations. What is needed is a circulator system that would produce reductions in congestion and delay, air pollution and parking problems, especially near the ground transportation hub. Several technologies exist today that could be used to provide such a service. Many are currently providing circulation services within airport terminals.

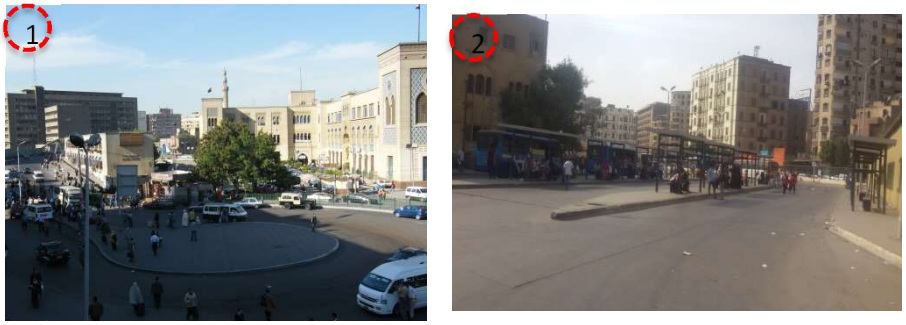
5.2.3 Separation of movement at different grades. (Vertical separation)

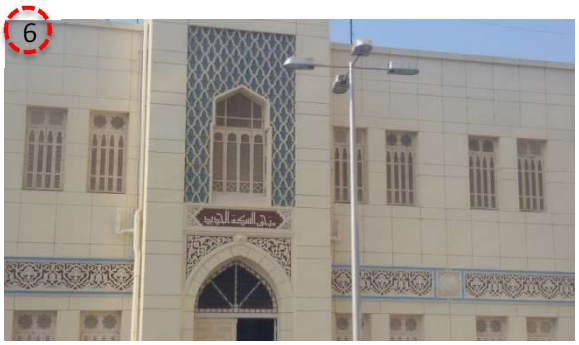
Design solutions adopted for the intermodal system varies, these can be divided into four groups of clearly different consideration, grade level, below grade, cantilevered and tunnel. The first solution where the traffic is on street level is the one which has the greatest impact on the surrounding area which can be overcome by constructing bridges. The second solution is the below grade in an open trench, this leads to a clear separation between two types of roadway since the central expressway is sunk below street level and the lateral lanes are on the same level of the surrounding areas. This solution obviously favors the integration of pedestrian and traffic bridges, making it possible for them to fit seamlessly into the urban structure.[137]

[137] Cerver, Francisco Asensio, (1992), Urbanismo, Road Systems, Fransisco Asensio Cerver Registered Office, Spain.

Figure 5-4: A) Vertical Separation for the Pedestrian Circulation at Ramses station.
B) Grade Level and Pedestrian Tunnel at Ramses station.
Source: Author







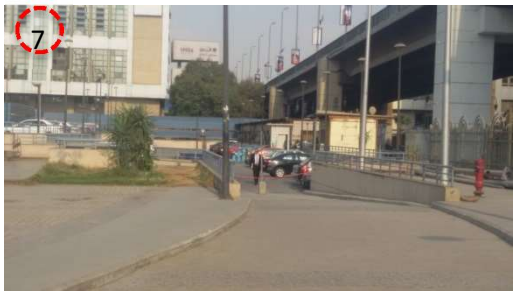


Figure 5-5: 8 Photos show Ramses Station Access and Surrounding Area.
Source: Author

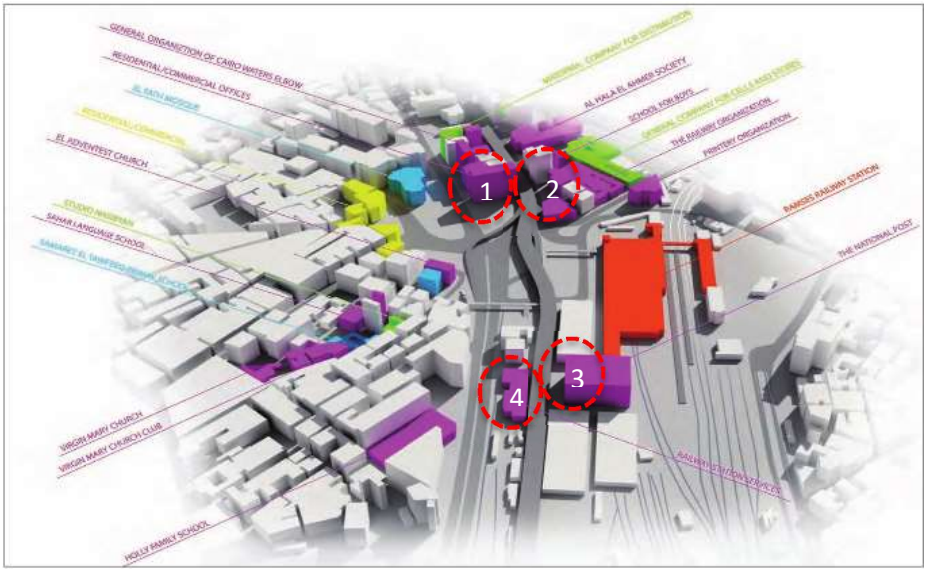
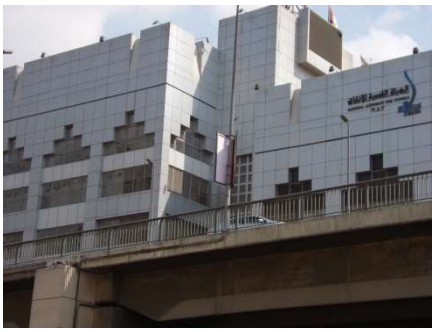


Figure 5-6: Important Buildings at Ramses Station.
Source: Radwan, G., & El-Shahat, M. (2012). Transformation through Sustainable Qualification



5.2.4 Public amenities at passenger activity spaces at station sites

One of the principle purposes of station design is to generate in the traveler a sense of security. This is achieved in four main ways: - by careful attention to layout and detail, by design that encourages people to adopt a territorial attitude and exercise surveillance, by good lighting and by the use of CCTV.

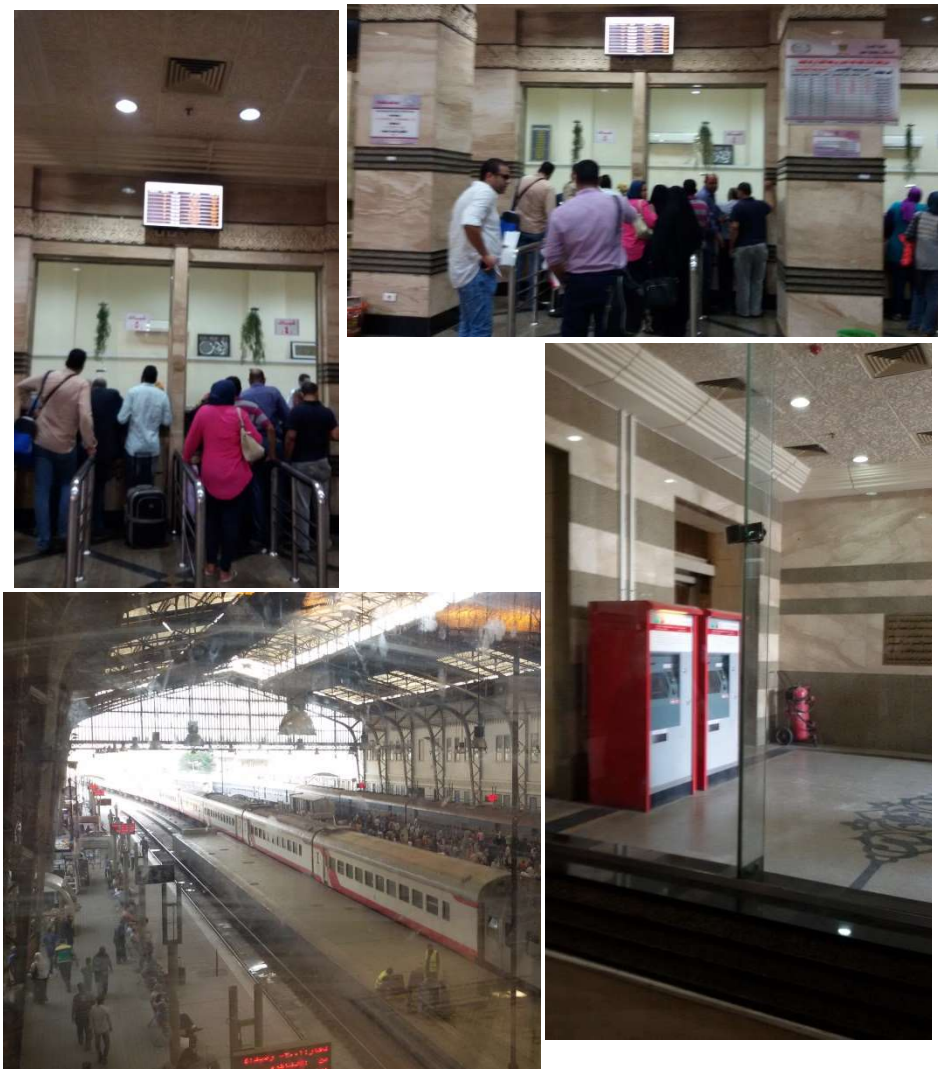


Figure 5-7: Passenger activity spaces at station sites.
Source: Author

Table (5.4) Application of passenger activity at station sites on Ramses Station, **Source: author based on Passenger questions**

Sr.	Items	Parameter	Ramses Station
1.	Security and Fire protection	CCTV Alarm System	Yes but need adaptation
2.	Passenger information systems	A) Posters and fixed notices	Yes but need adaptation
		B) Electronic displays	Yes but need adaptation
3.	Passenger service facilities	A) Waiting areas	N/A
		B) Toilets	Yes but need adaptation
		C) Communication equipment	N/A
		D) Concessions	N/A
4.	Ticket office design		Yes but need adaptation
5.	Design for the physically handicapped	Site Plan & layout	Yes but need adaptation
		Car parking	
		Station entrances	
		Station signs	
		Station navigation	
		Station surfaces	
		Changes in level	
		Toilets	

5.3. Station Management and Maintenance

Station management and Maintenance are stages within a continuous process of asset stewardship. During the first stage the theoretical and political foundations are laid. During the second stage practical details are developed, and the assets themselves constructed and commissioned. The third and longest stage, management, oversees a process of alteration, maintenance, and repair that will continue throughout the life of the station. The management stage will, itself, contain elements of planning and design in order to realize alterations.[138]

[138] http://www.amazon.com/Railway-Stations-Planning-DesignManagement/dp/0750643765

5.3.1. Station Management

Stations are becoming increasingly automated and their systems more integrated. Included in typical Station Management Systems (SMS) are the various sub-systems required for efficient station operation, for example:

- CCTV
- Passenger information displays and PA systems
- Help points
- Access control
- Ticketing
- Communications management
- SCADA systems
- Alarm systems

All systems have to be effectively managed and require appropriate computers to achieve this Management Systems.

Barrier free facilities should be equipped to assist handicapped and aged people for convenience at Ramses intermodal station such as slope, lift, and toilet. The ENR station will require CCTV systems mainly at platforms. Ensuring adequate levels of lighting at distant platforms is necessary. A modernized passenger information system is needed to be applied at the ENR station and the bus terminal. The terminal can also be designed to accommodate feasible space for small business catering to users, including convenience stores, branch banks, coffee shops and snack restaurants, newspaper and magazine vendors. Commuter parking facilities are also a potential source of revenue for mass station operations. Providing additional parking lots in the form of underground lots is essential.

Figure 5-8: Security System using Surveillance Camera, Ramses Station
Source: Author

5.3.2. Station Maintenance

The fashion for glass station roofs raises the obvious question as to how they are to be cleaned, maintained and repaired. Health and safety regulation place restrictions upon methods of cleaning and lay down standards at the design stage regarding access. Designers of glazed structures need to address at the conceptual stage how maintenance is to be carried out- both for replacement and regular cleaning. One system adopted is similar to a car wash that travels the length of the train roof on a wheel gantry.[139]

Cleaning the inside surfaces of glass is equally important. The dust and fumes from trains quickly discolors glass, specially the areas directly above railway tracks. Brake dust is toxic, discoloring and adheres to glass. Regular cleaning is essential if the station is to retain its bright image. Durability and maintenance are also related factors. Where painted steelwork is employed designers need to provide the means for regular repainting. Steel structures above glazed roofs pose a particular difficulty; the specification for steel work in some stations consists of four coatings, the final one being applied on site. Within the life of a typical station, the protective coatings on steel structures will need to be renewed, how this is to be undertaken without disrupting the life and operation of the station is a design question, not merely a maintenance one.[140]

Attention to how building is cleaned to prevent the introduction of harmful chemicals into the indoor environment. Alterations and renovations of the building should be carried out with the same level of care as was the construction process to ensure that high level of IAQ is maintained in spite of changes to the building.

Materials that have been exposed to moisture and contamination while being stored during construction can negatively affect IEQ. Materials should be checked for moisture infiltration prior to their installation to verify if they do not contain excessive levels of water and later they might contribute to mold and mildew in the building.[141]

Because the HVAC system plays an important role in indoor environmental quality it is imperative that it should be installed and maintained properly. Certain

[139] HackelBerger, Christoph, (1997), U-Bahn Architecture in Munchen, Subway Architecture in Munich, Prestel - Verlag. Munich. NewYork.

[140] Edwards, Brian, (1997), The Modern Station, New Approaches to Railway Architecture, E & FN Spon, An imprint of Chapman and Hall.

[141] Kibert, Charles J., (2005) Sustainable Construction, Green Building Design and Delivery, John Wiley & Sons, Inc., Hoboken, New Jersey.

components of the HVAC can be more easily contaminated than others, particularly porous ductwork linings that are used for insulation and sound control. Protection of HVAC systems prior installation and during construction should be considered to avoid contamination. Proper maintenance of HVAC systems is necessary to maintain good IEQ.

5.3.3. Intelligent Transportation System (ITS)

Intelligent Transportation System is an integrated transportation management solution that provides traffic monitoring & control, travel information, convenient public transportation, etc.

- Alleviate traffic congestion and carbon generation by efficient traffic management
- Improve safety and user convenience through incident management and traffic information

<u>But in Ramses square we have</u>

Figure 5-9: Current Situation of the Transportation System in Ramses square.
A: Ramses Station Platform
B: Ramses Railway Station Main Building
C: Ramses Metro Station
D: Microbus stops and terminals (Ahmed Helmi Microbus)
Source: Author

5.5. Design Recommendation & Conclusion

5.5.1. Design Recommendation

When addressing public transport from a central transportation Hub perspective, the key points of attention are:

- Integrated use of different transport modes;
- Efficient connections & accessibility
- Improved coordination; and,
- Available information

The improvement of the surrounding areas of the Ramses square needs a good connection between the Ramses Railway Station, and the other public transport systems as buses, taxi, tram and metro and the pedestrian axes to the north and south. The reuse of open space or recycling areas is another aspect. In the area to the east, along the railway trucks and the relocated highway, a new urban structure is planned. Mixed business and commercial uses combined with residential use and recreational areas creating new urban life and enhancing the whole area.

The conversion of the northern surrounding of the railway station into a central city district requires renewal and rehabilitation strategies and starts with a huge building complex. To the north, the design concept consists in providing a good connection between the Ramses Railway Station and the relocated highway, the bus-station and parking space in a new building complex – named (Hub).

The reorganized bus station is planned at ground floor level and a direct accessibility to the trains. The three upper levels are used as parking space with around 1200 parking spots and the possibility to be extended for more than 800 spots into two underground levels. The parking areas have direct accessibility on the third level to the highway. All levels are connected with ramps, staircases and elevators.

To the south of the station, the extended tram lines and the taxis are connected under a light roof construction to serve the station. The different levels of the two metro stations are connected with the public space on level -1. The exits and

entrances to the metro stations are becoming visible by the circular square and they are integrated into a leading system per day and night.

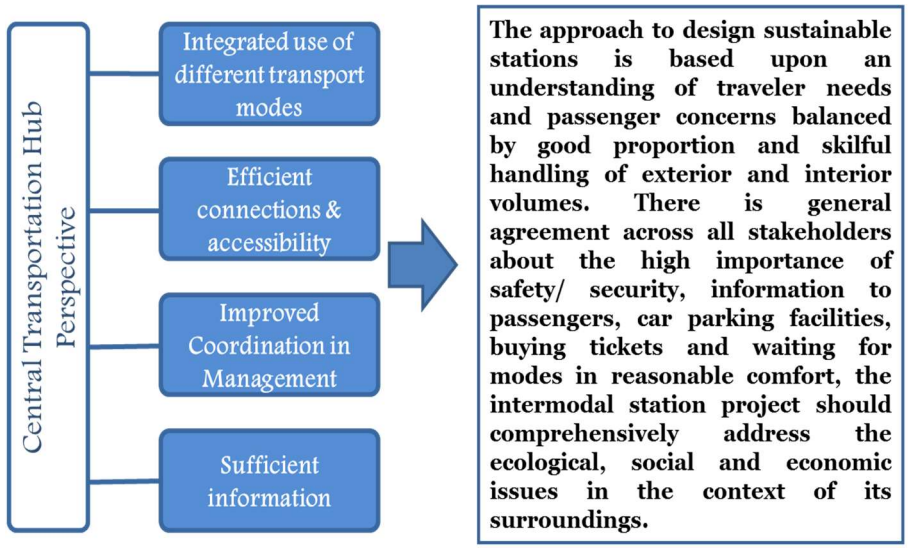


Figure 5-15: Central Transportation Hub Perspective

Figure 5-16: Universal Design Principles for Transportation Hub
Source: - Metrolinx; IBI Group; Provincial Representatives; Arcturus Reality Corporation. (2011). Mobility Hub Guidelines: For the Greater Toronto and Hamilton Area. Toronto: Metrolinx.
Presented by: Author

	Universal Design for Urban Transportation	Smart Transportation	The Principles from intersected field of professional practice
The Principles	• Equality • Providing for seamless continuity • Way finding assistance • Negotiating level changes in terminals • Negotiating level changes in terminals • Vehicle loading • Ticketing and security	· Multitude of mode of transportation · Land Use · Financial · Community · Environment · Station Accessibility · Affordability · Safety and security · Travel convenience · Emissions and Noiseless	SEAMLESS MOBILITY: · Seamless integration of modes at the rapid transit station. · Safe and efficient movement of people with high levels of pedestrian priority. · A well-designed transit station for a high quality user experience. · Strategic parking management. PLACEMAKING: · A vibrant, mixed-use environment with higher land use intensity. · An attractive public realm. · A minimized ecological footprint. SUCCESSFUL IMPLEMENTATION: · Effective partnerships and incentives for increased public and private investment. · Flexible planning to accommodate growth and change.

5.5.2 Conclusion

This part summarizes the conclusions from the research and explores to what extent the research findings fulfilled their aim and objectives as well as answering the research questions. Then, it reflects on the significance of the research through showing how the findings contribute to current academic debate and practical schemes applying central station hub. It sheds light on what it has realized and what remained unachievable. Following this is a reflection upon the approaches employed in this research to carry out the different steps of the design and process to develop and create central station hub concept in the center of the cities.

5.5.2.1 Reflections on the Research

To conclude the research, it is significant to coming back to the main objectives as well as the research questions and explores what extent the research succeeded in achieving them. While setting out the research questions, Hypothesis, and Methodology in the introductory chapter. In this section, the order will be reversed; research findings will be presented in direct relation to the main research objectives, and then fulfilling to answers the research questions.

The first question: Why Hub & Why Ramses?

For the first part of this question is fulfilled in chapter (1). Hub is a transport–transfer nexus created to gather and distribute passengers as efficiently as possible by linking outward-bound urban passenger transport facilities, such as railway stations, airports, coach stations, or port terminals, as well as various inner-city transport systems, such as subways, buses, taxis, and cars. Modern interchange hubs also feature people-oriented amenities and services (e.g., restaurants, cafes, barrier free facilities, entertainment, Internet connectivity, and others) to make the travel experience more enjoyable.

The second part of the question is fulfilled in chapter (4) Ramses square in the heart of the urban center of Cairo with a variety of transportation modes interacted with highly boiling over dynamic urban fabric is a greatly obvious sample for a multimodal nodal area, which can be a glary application as a hub solution example. It is located with a variety of means of transport.

The Second question: What are central station hubs mean and what are its objective and main principles?

This question is fulfilled in chapter (2). Key issues related to central station hubs design has been identified along with a number of Principles, which intended to enhance and complement existing operators design and service delivery standards and other legal and discretionary requirements; also the research provide a frameworks used for formulating the indicator sets to fulfill the guidelines. The chapter has tried to summarize the approach to design sustainable hub stations. It is based upon an understanding of design principles of station hub by design a framework and guidance plan; these frameworks are strategic planning tools that set out an integrated design vision for the desired future development of the stations hub.

It is important to identify that **Design framework** is essentially about bringing a design approach to how stations and hubs are analyzed and developed. It provides a useful tool to enable performance-based planning to be implemented. A design approach unlocks creativity and allows physical design outcomes to be given a higher profile in planning. It also allows ideas to be tested through design and reviewed for their possible impacts or potential synergies.

The third question: What is the difference between central station and central station hubs?

Answering of this question is fulfilled in chapter (1). Part of chapter has been illustrate the main issues related to central station hub typology and hierarchy; also describes the optimal design elements and conditions for the eight typical station types. Station Design Guidelines begin by describing the over-arching framework for station design and introduce the different station types. The guidelines stress the importance of accessibility and functionality by incorporating diagrams that indicate basic relationships and components of the various station types.

central station hubs are important centers of activity that can help to strengthen the relationship between the surrounding community and station network. They are gateways providing supportive amenities and information for travelers and in many cases act as a connecting point between multiple modes of transportation. Stations are the traditional hubs of many of our towns and cities and their presence has historically had a significant influence on the way our communities have grown and developed. Ensuring that new and existing stations are designed to integrate with their surroundings is an

important strategy towards enhancing station access for a wide range of users and contributing to a pedestrian- friendly environment that will support station ridership.

The fourth question: What is the impact of the central station hubs in cities planning?

Answering of this question has been described in chapter (1 & 3). Those chapters have been illustrating the main issues and the importance of the central station hubs in cities planning through the transportation hub as an alternative solution and Central Station Hub toward the future. In chapter 3 through the international examples, also to develop an alternative transportation model that makes community sustainability the focus of the transportation planning process versus availability or feasibility of one location or another in terms of cost and engineering efficiency. Under this model, the overall goal of any transportation system should be to develop an integrated, multimodal transportation system that serves neighboring communities and thus more diverse socioeconomic groups and that is also efficient and differ by level of service, safe, and affordable for all.

The fifth question: Does the central station hub application can be achieved in Ramses Station?

Answering of this question has been described in chapter (4 & 5). Those chapters have been illustrating the main issues and the importance of Ramses station. In chapter (4) has been discussed all the theoretical framework and understanding the theories and concepts for Ramses Square area; while in chapter (5) discussed and tested the central hub design and principles on Ramses station.

The approach to design sustainable stations is based upon an understanding of traveler needs and passenger concerns balanced by good proportion and skillful handling of exterior and interior volumes. There is general agreement across all stakeholders about the high importance of safety/ security, information to passengers, car parking facilities, buying tickets and waiting for modes in reasonable comfort, the intermodal station project should comprehensively address the ecological, social and economic issues in the context of its surroundings.

The Hub Study involved a wide range of technical work carried out by technical staff and consultants, including:

- Transportation needs assessment.
- Urban design analysis, option generation and concept plan preparation.
- Urban Design Panel workshop.
- Traffic and parking analysis.
- Preliminary Street and intersection design.
- Structural feasibility study and costing.
- Real estate focus group.
- Development pro-forma analysis.

The sustainable approach would be to concentrate on; successful modal connectivity in the intermodal area, ensuring safety for traffic and pedestrian circulation, assessing the environmental design requirements for the intermodal project, ensuring equitable passengers services, and revitalizing economically healthy downtown areas and suburban centers.

To achieve this comprehensive goal, we should address the following objectives in the plan and design of the city station system:

A. Enhances and creates community character.
B. Builds upon existing commercial districts along routes.
C. Serves first those dependent upon public station.
D. Extends station to locally underserved low to moderate income populations.
E. Provides linkages to existing community-based social and cultural centers, churches, schools, and neighborhood level population centers.
F. Promotes pedestrian activities along routes, particularly at hub locations.
G. Increases and augments commercial development along route segments.
H. Creates for more green space along route segments.
I. Provides better access to jobs within the City boundaries.
J. Minimizes physical environmental impacts.
K. Ensures safety and welfare of riders and non-riders.

The implementation of these objectives may lead to promoting better quality of life for the citizens and visitors to the city as we know limited station options not only impact individual residents but also relate to the economic development opportunities of a community.

Finally, The connection with the network of regional traffic and inner urban traffic in the mid of the city is of high value to regain the centrality of Downtown. The railway station has to be modernized for high speed trains and the reorganization of inner-city bus lines, extended tram lines, taxis and parking space in connection with the relocated highway in form of a new building A Central Station Hub .

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Appendix: Field Survey Study

1- Studies of the C.B.D

2- Survey Traffic Volumes of Ramses Sq.

3- The International Competition for urban design and harmony of Ramses square, Cairo, Egypt

The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

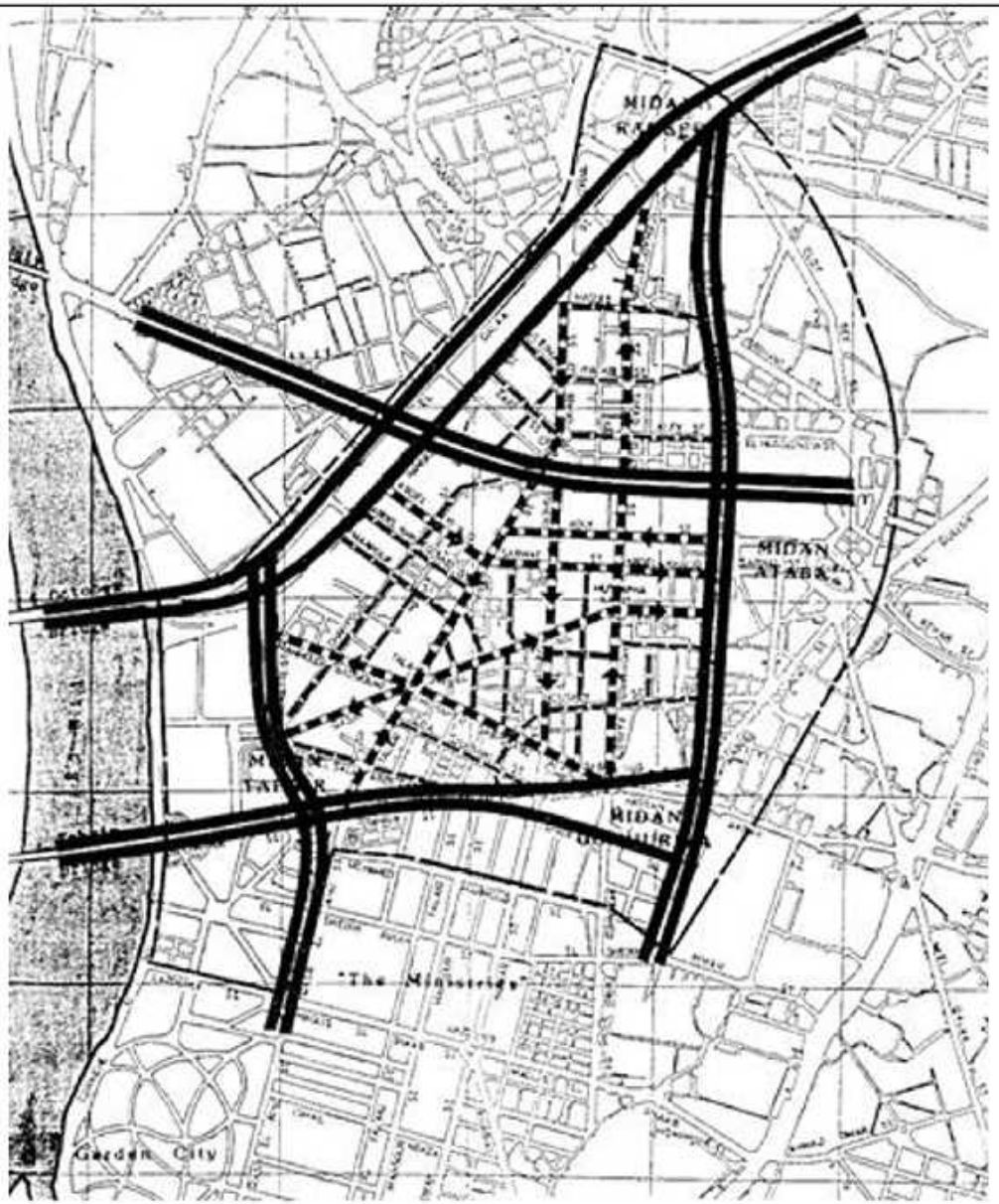
Main Axes

Local Primary

Local Sacandry

Title

CBD Routes Network

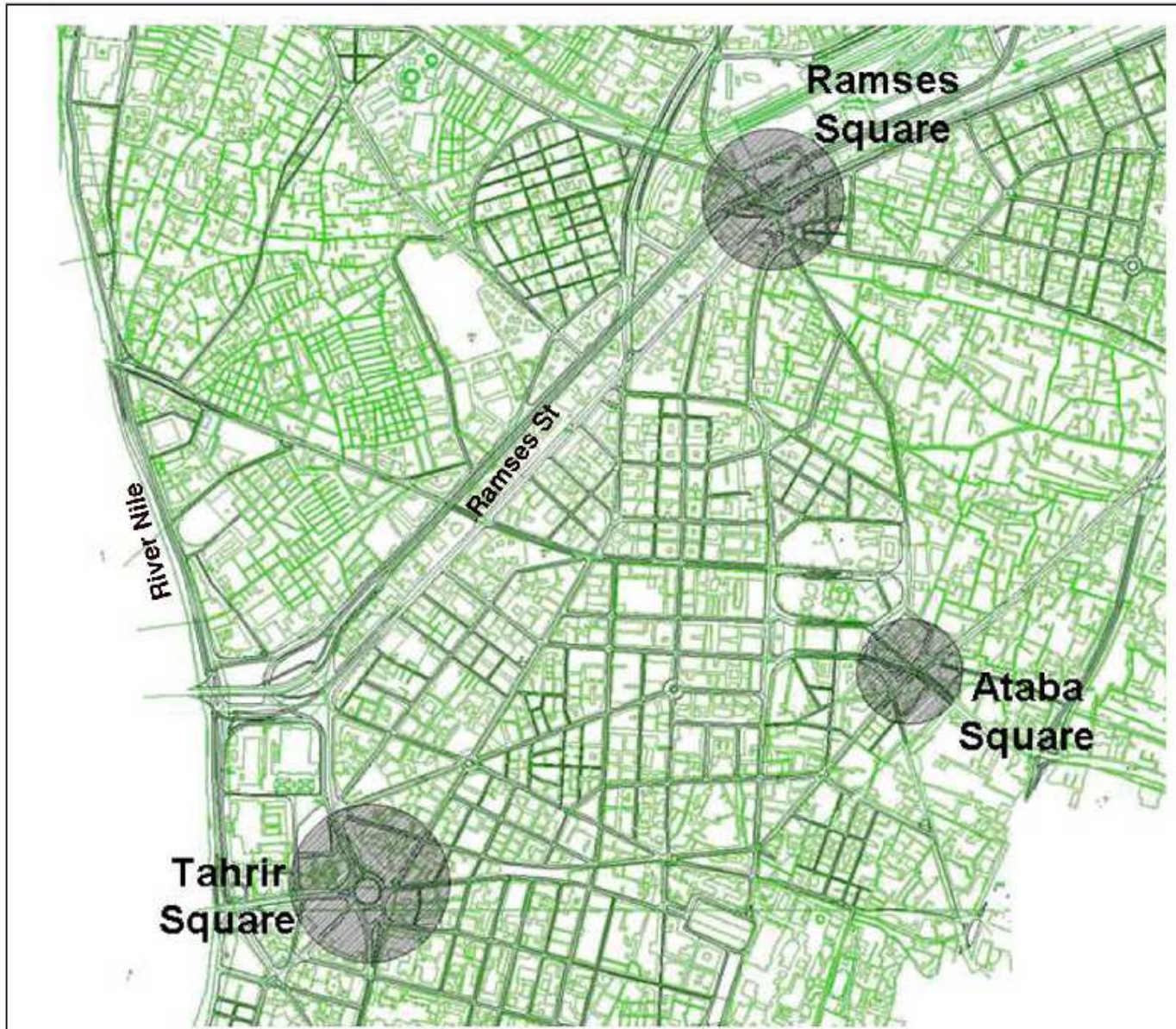


The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

Title

Major Squares of the Study Area

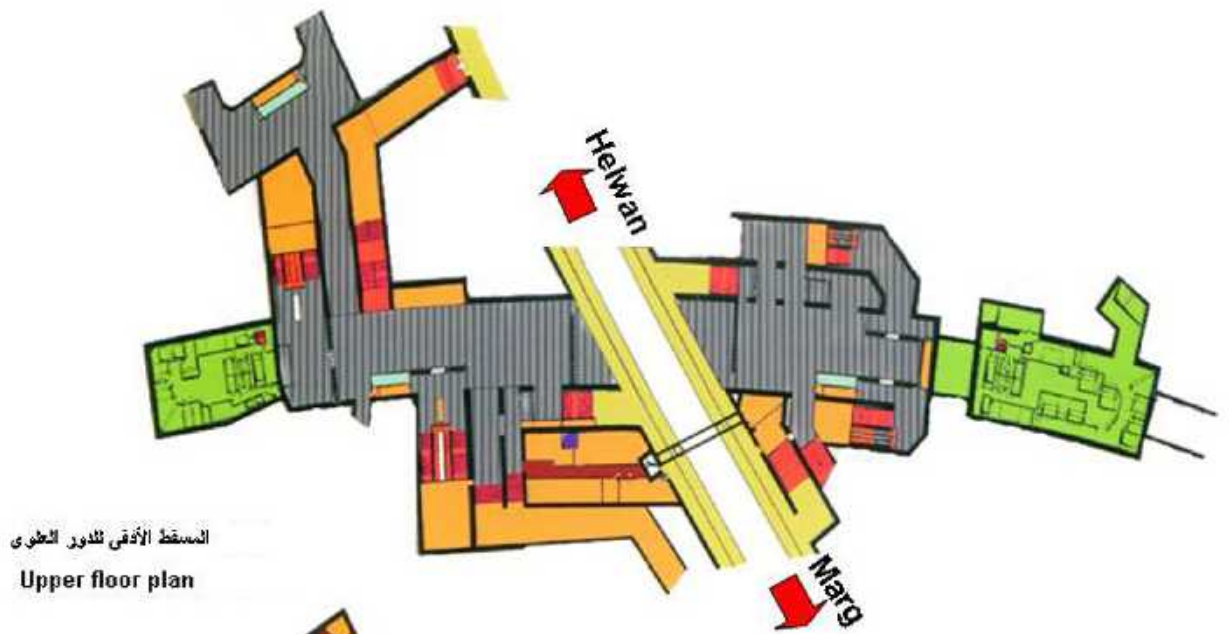


The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

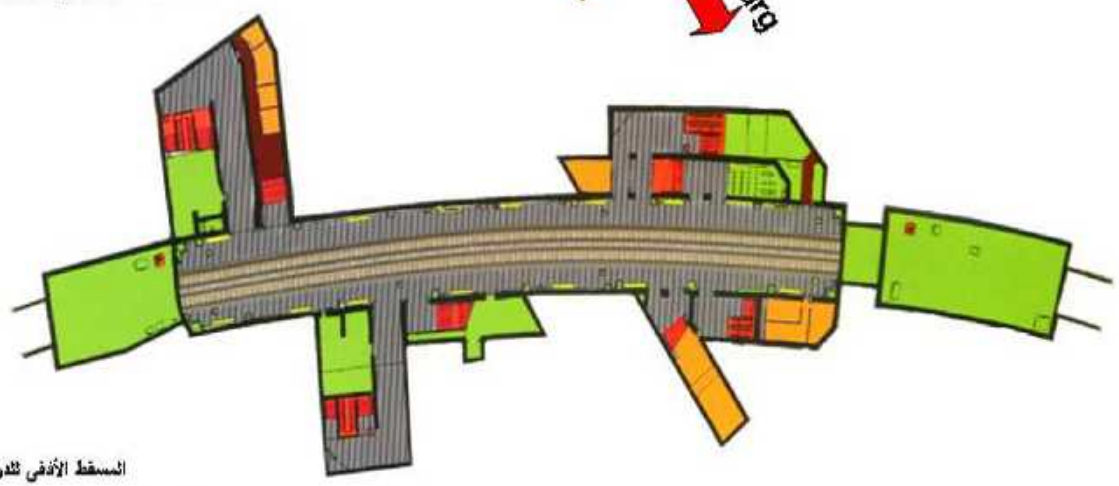
Title

Mobarak Station Plan
(At Ramses Square)



المسقط الأفقى للدور العلوى

Upper floor plan



المسقط الأفقى للدور السفلى

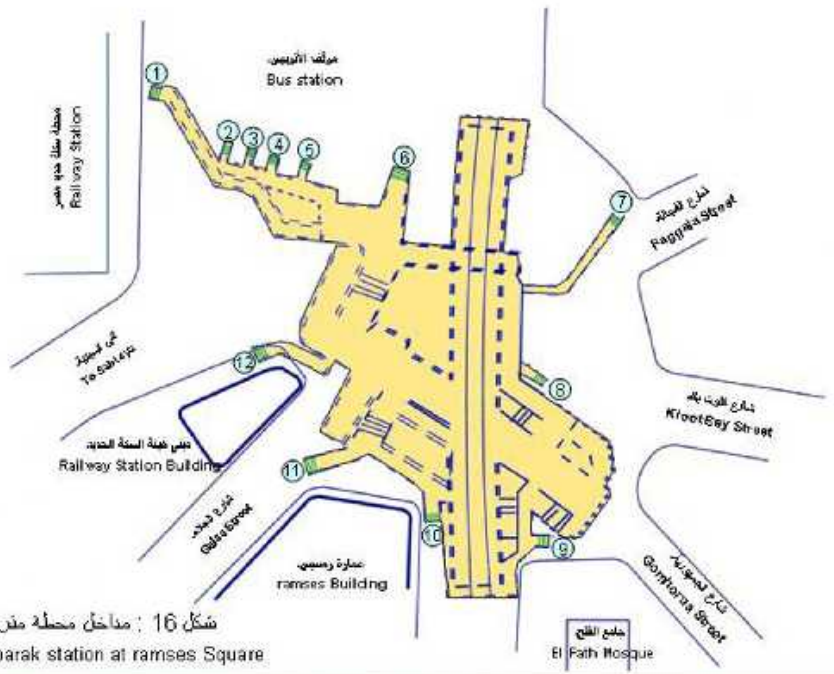
Basement floor plan

The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

Title

Mobarak Station Lay Out
(At Ramses Square)



شكل 16 : مداخل محطة مترو مبارك بميدان رمسيس

Fig 16 : Entrances to Mobarak station at ramses Square

The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

Inter-City Primary Highway
Regional Primary Highway
Urban Expressway
Urban Primary St.
Urban/Regional Secondary St.
Railway

Legend for Urban Expressway Projects
Proposed Urban Expressway Projects
Proposed Interchanges

Title

Detailed Expressway Network

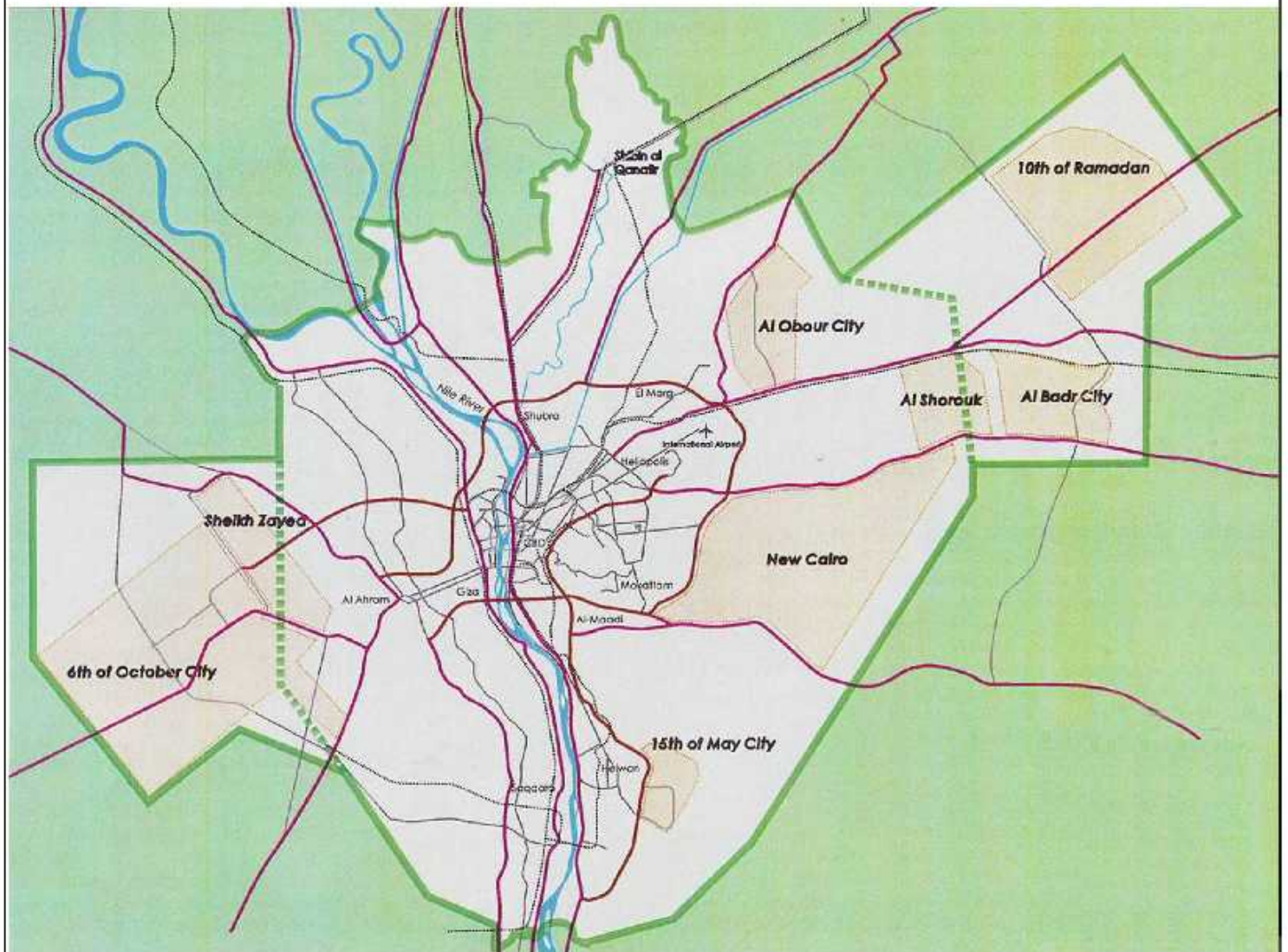
The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

- National Road
- Regional Road
- Primary Road
- Railway
- New Community

Title

The New Community



The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

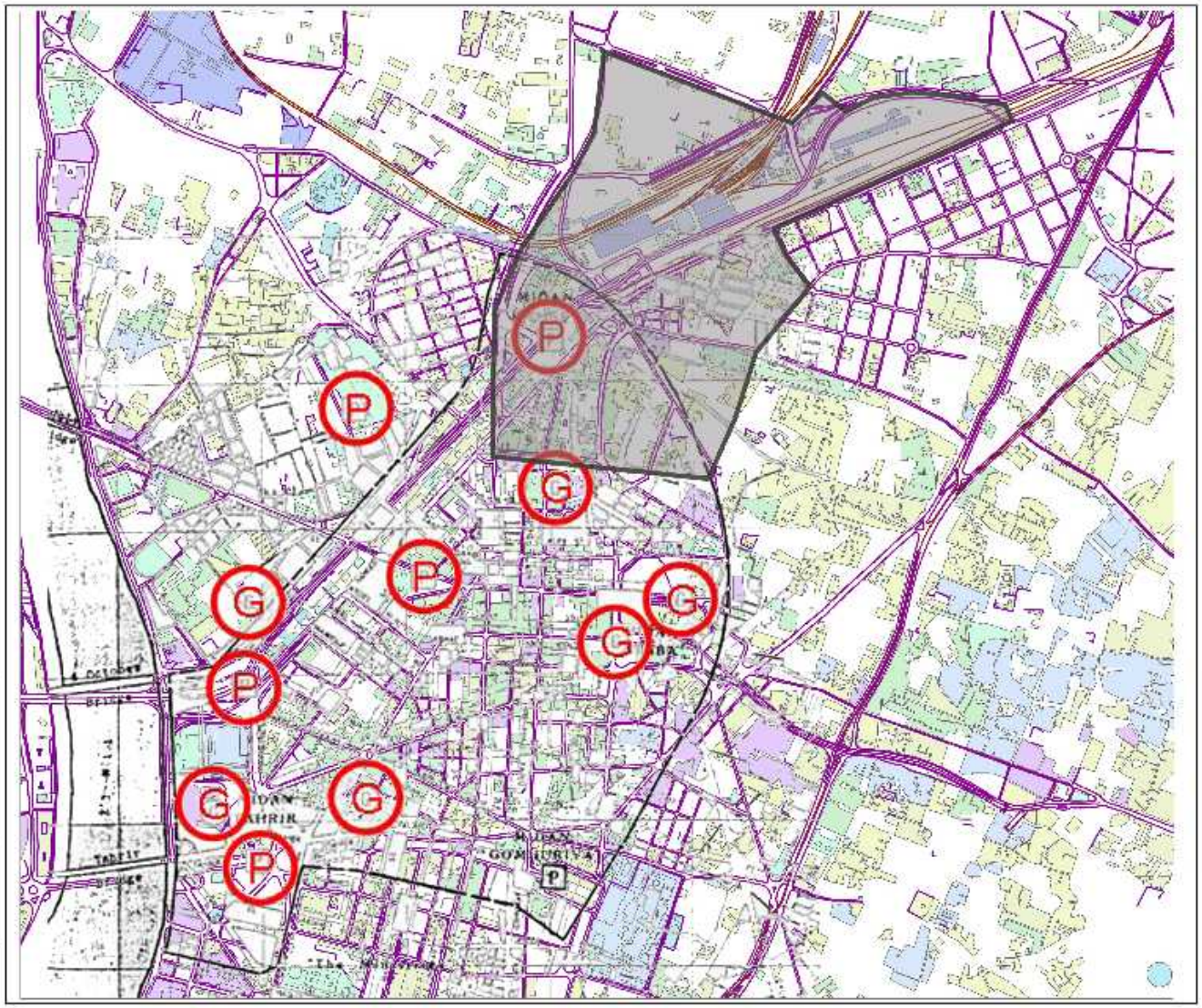
Ramses squre boundry zone

G Garage

P Parking

Title

Surface Parking And Garages



The International Competition for Urban Design and Harmony of Ramses Square - Cairo

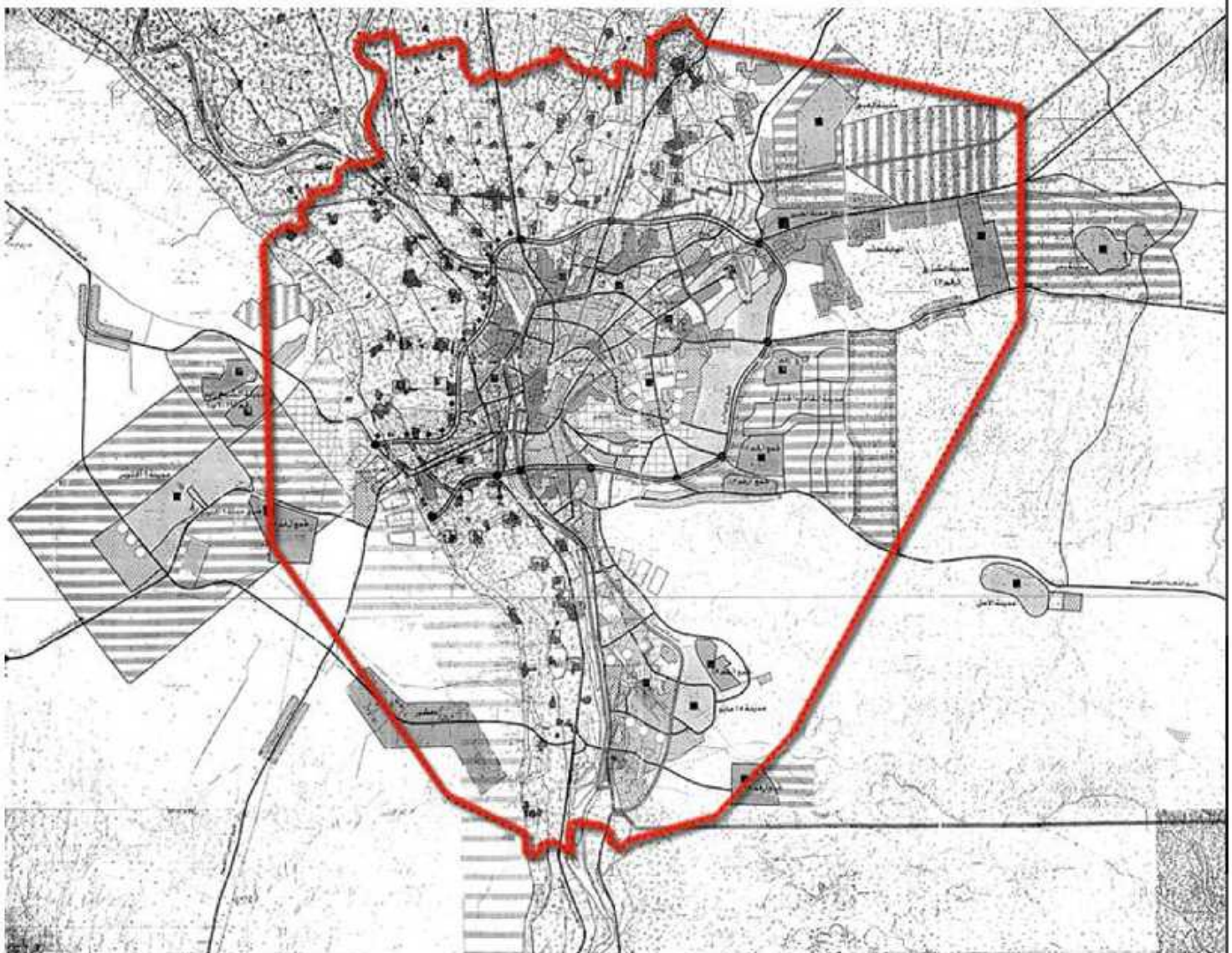
Key

Border Of Region

Title

Greater Cairo Region

(Long Term Development Plan 1997)



The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

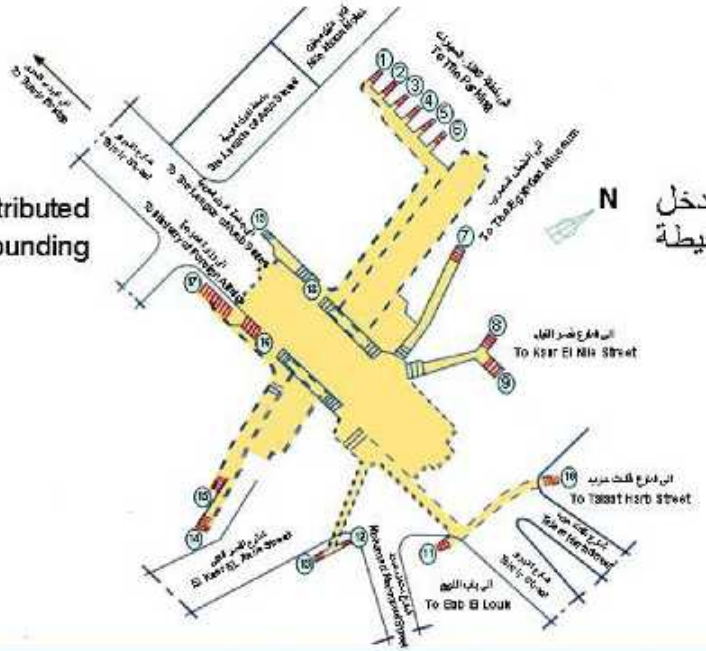
Title

Sadat Station Plan
(At Tahrir Square)

19 entrances are distributed along the roads surrounding the station .

يخدم المحطة عدد 19 مدخل موزعة على الشوارع المحيطة بالمحطة.

N



The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

Title

The Second Line of Metro
(Shubra El Kheima-Giza)

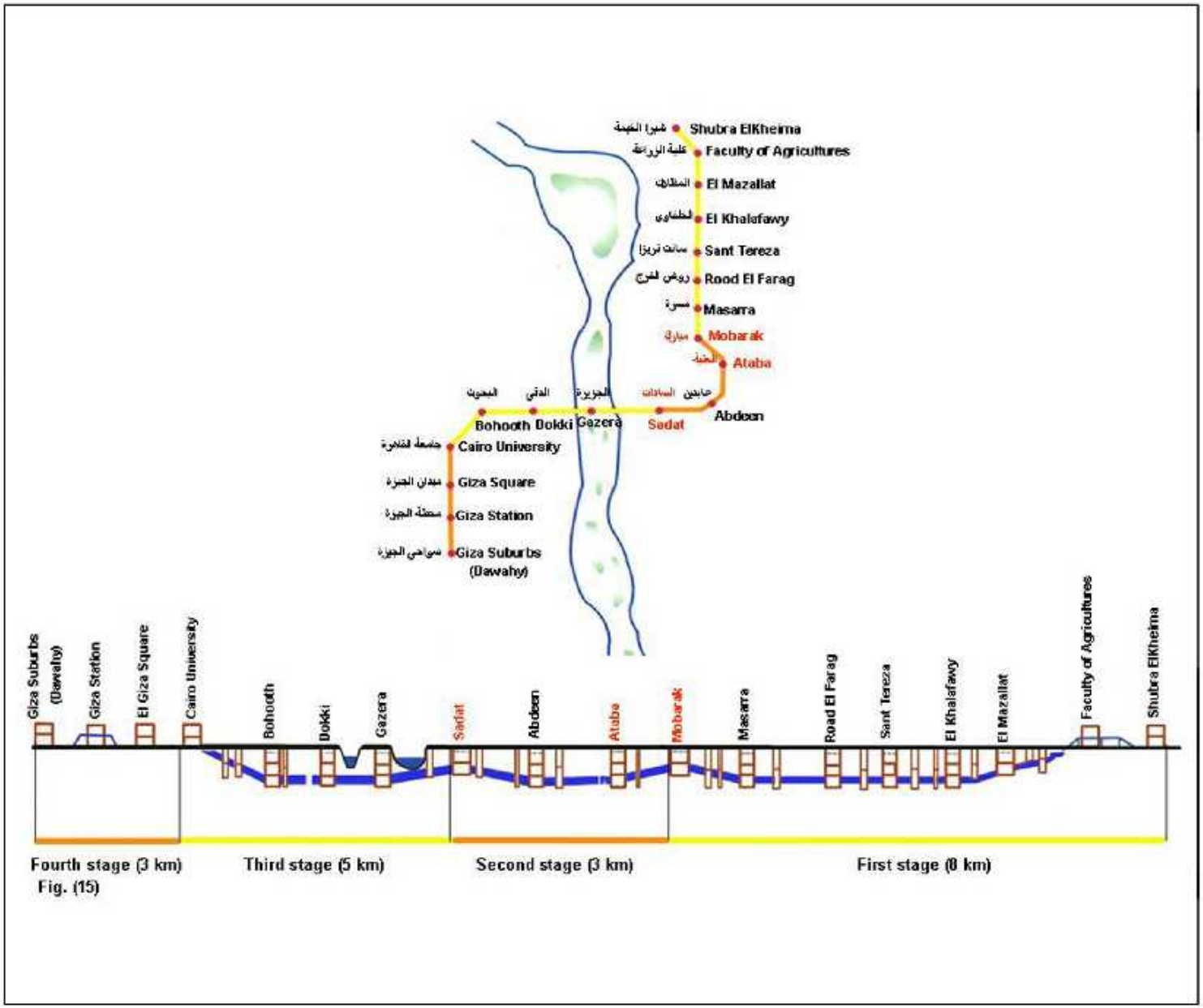
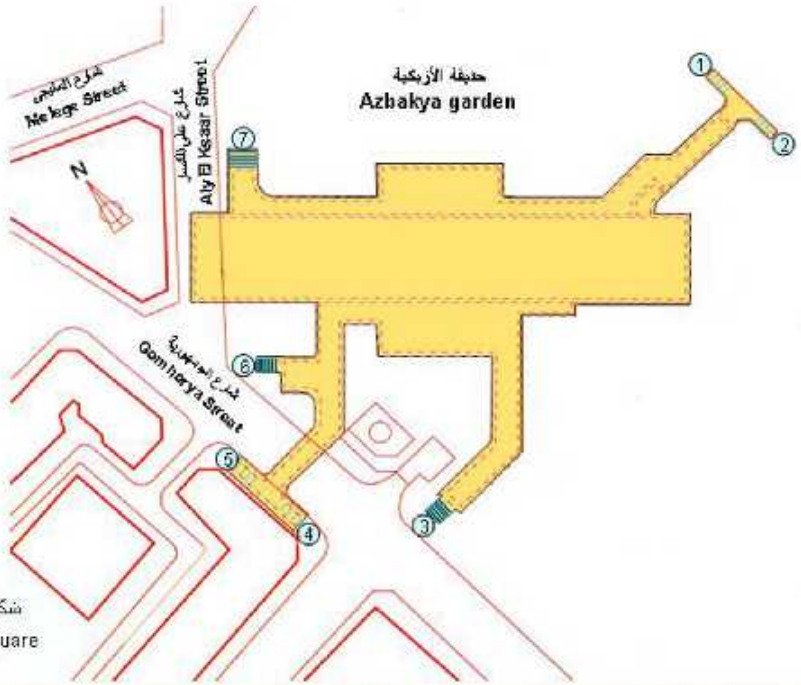


Fig. (15)

The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key



شكل 19 : المداخل إلى محطة مترو العتبة بميدان العتبة

Fig. 19 : Entrances to Ataba station at Ataba Square

Title

Ataba Station Lay Out

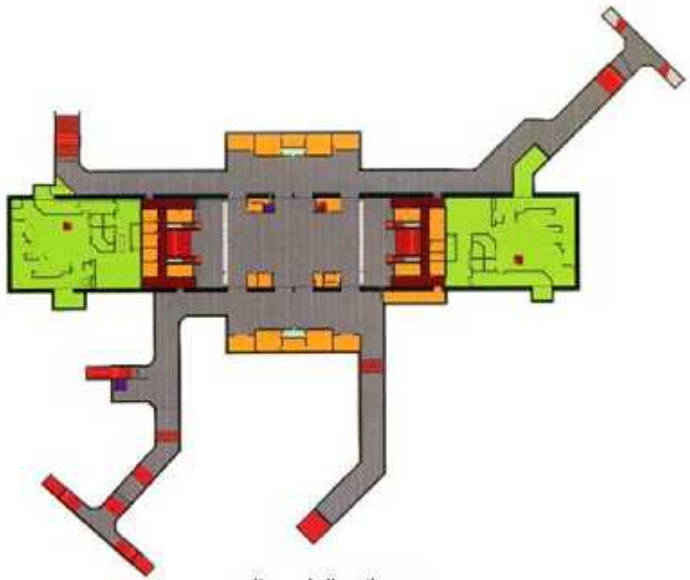
(At Ataba Square)

The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

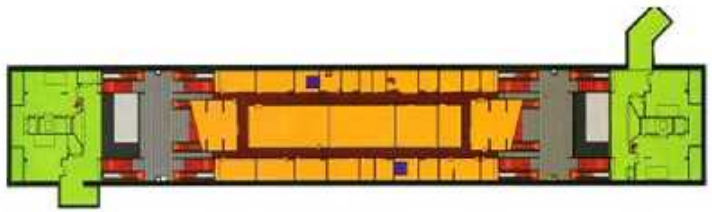
Title

Ataba Station Plan
(At Ataba Square)



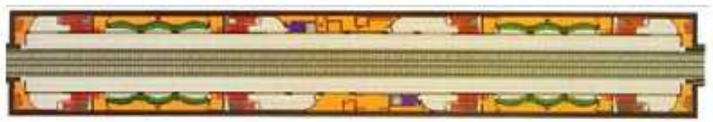
الدور الاول تحت الارض

Under ground first floor



الدور الثاني تحت الأرض

Under ground second floor



الدور الثالث تحت الأرض

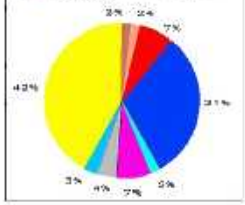
Under ground third floor

The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

Ramses squre boundry zone

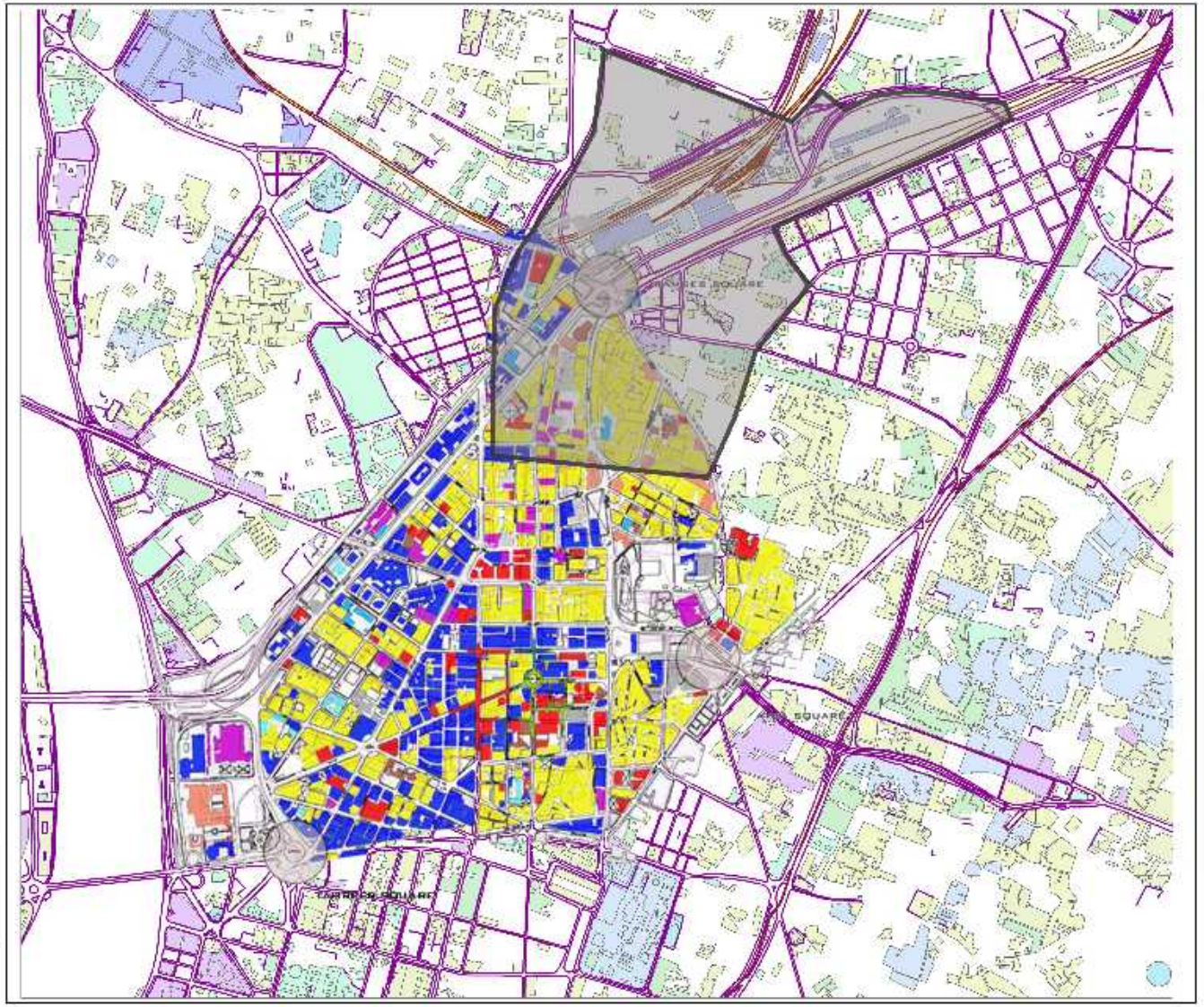
Administration	31 %
Commercial	7 %
Educational	2 %
Religious	2 %
Residential	42 %
Health care	3 %
Utility services	4 %
Recreational	7 %
Touristic	2 %



Title

CAIRO BUSINESS DISTRICT (C.B.D)

First Floor Uses

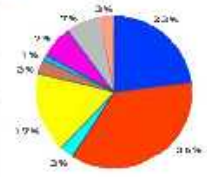


The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

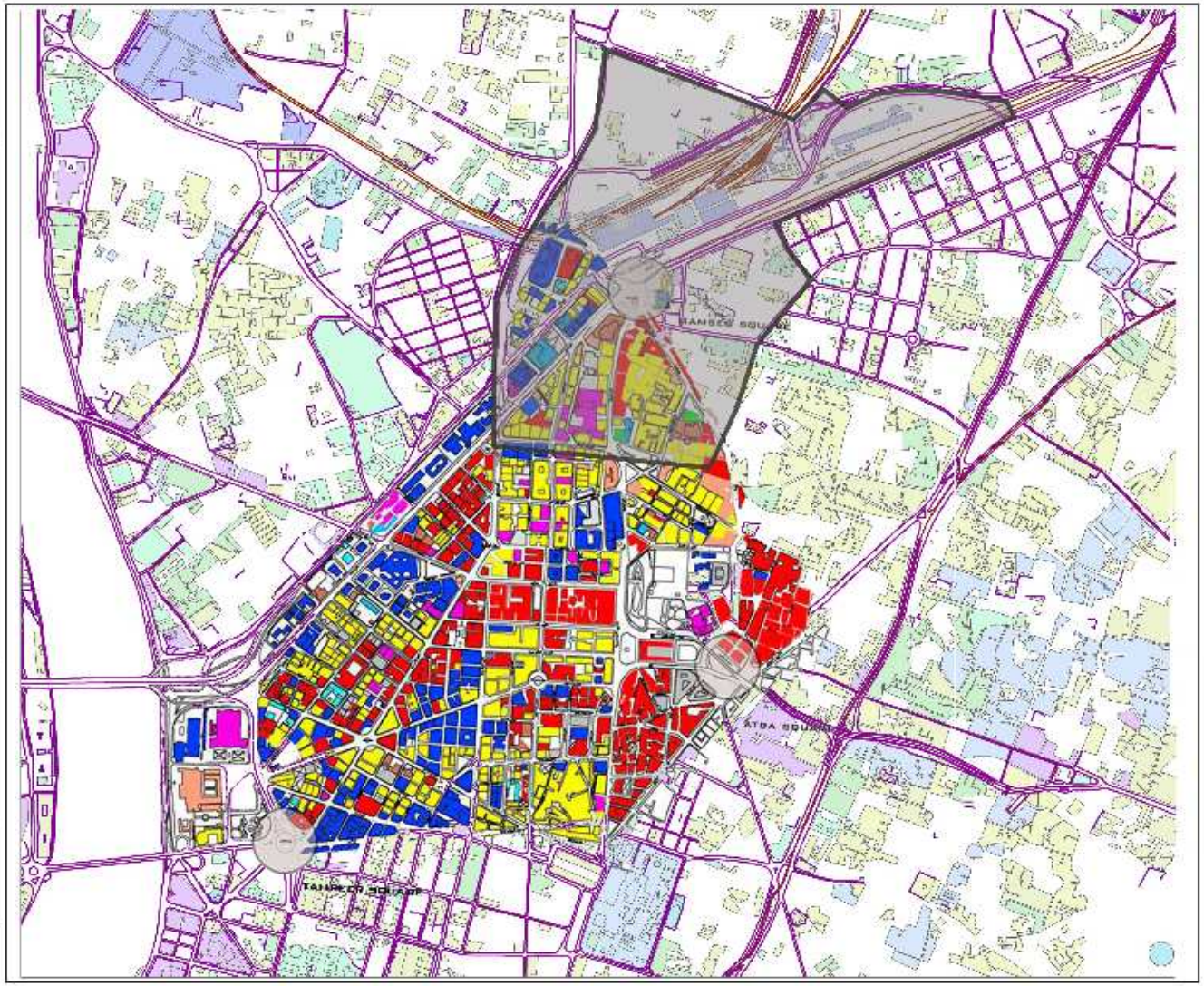
Ramses squre boundry zone

Administration	23 %
Commercial	36 %
Educational	3 %
Religious	3 %
Residential	17 %
Health care	1 %
Utility services	7 %
Recreational	7 %
Touristic	3 %



Title

CAIRO BUSINESS DISTRICT
(C.B.D)
Ground Floor Uses



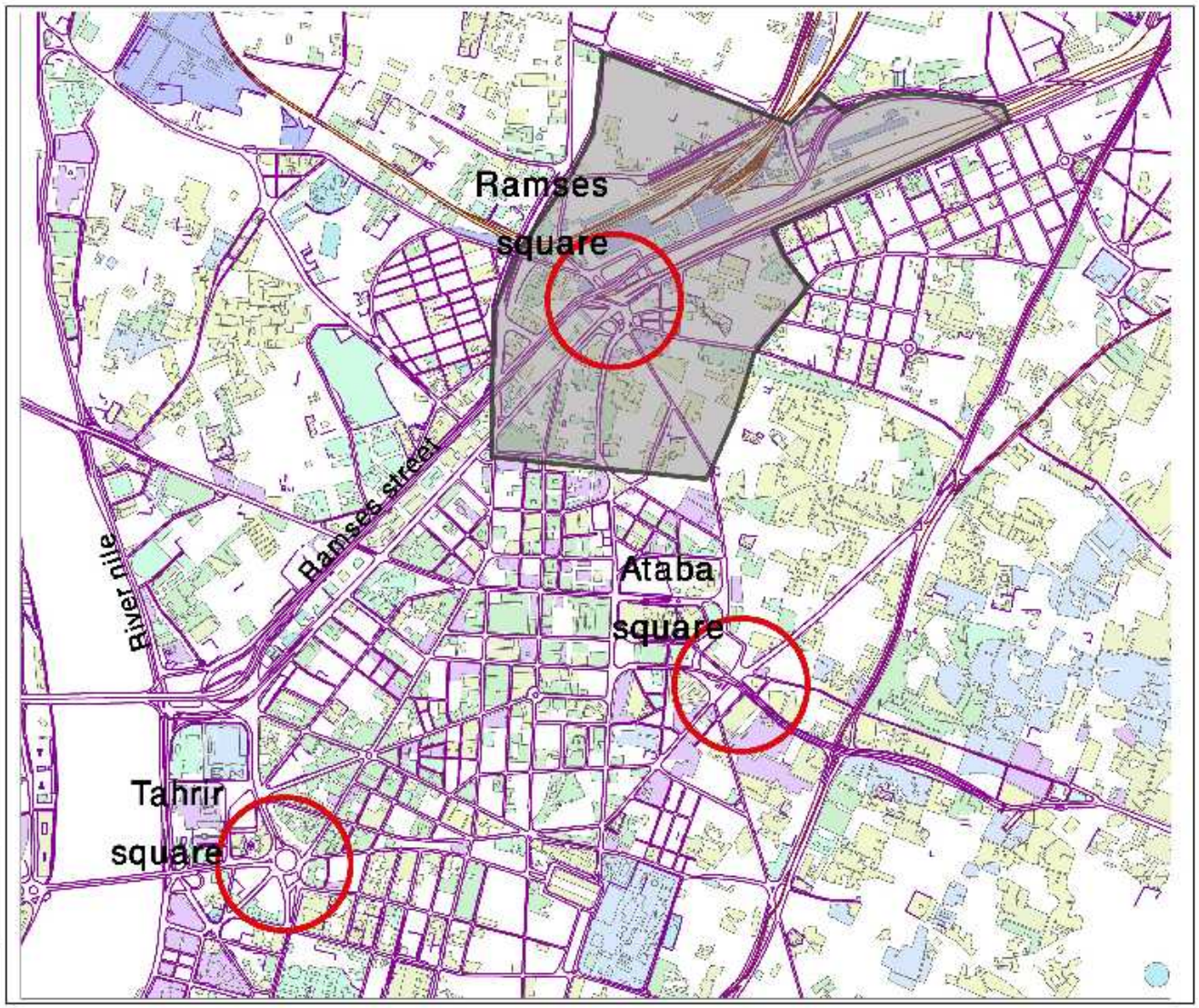
The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

Ramses squre boundry zone

Title

Major Squares of the Study Area



The International Competition for Urban Design and Harmony of Ramses Square - Cairo

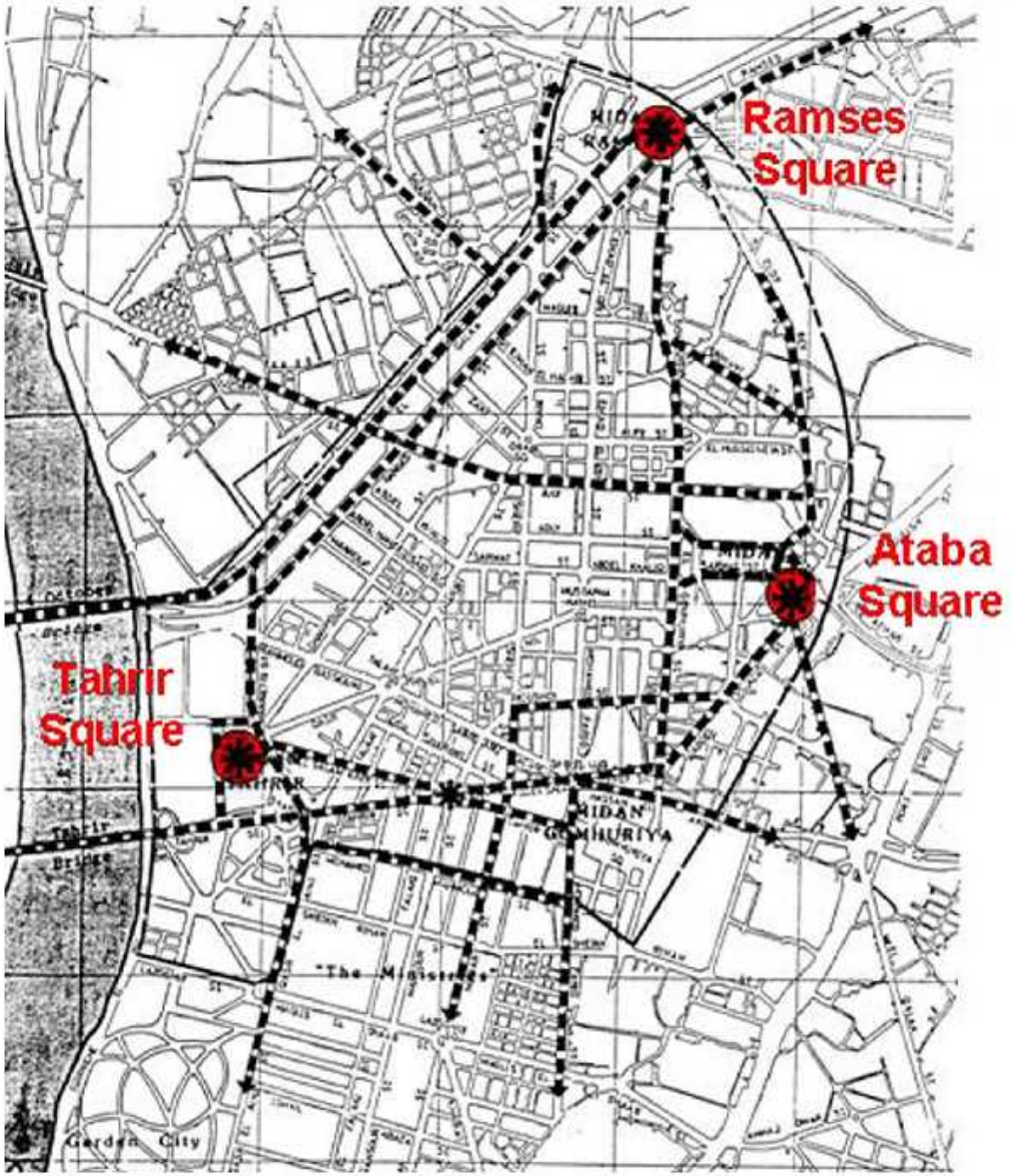
Key

------ Roads

Terminals

Title

Poblic Bus Network and Bus Stations

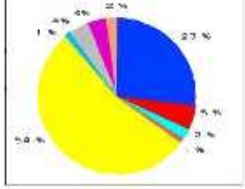


The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

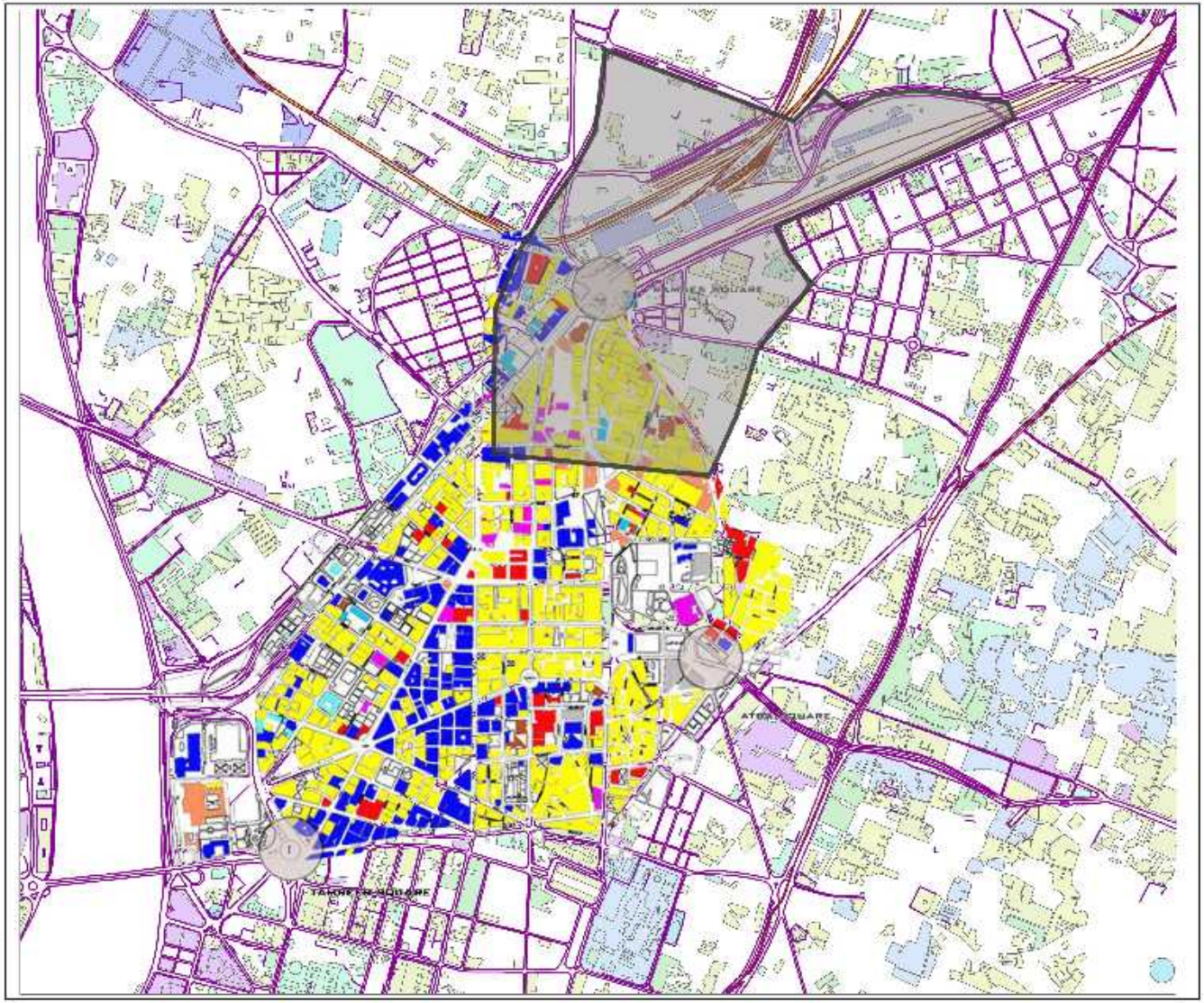
Ramses squre boundry zone

Administration	27 %
Commercial	5%
Educational	2 %
Religious	1 %
Residential	54 %
Health care	1 %
Utility services	4 %
Recreational	4%
Touristic	2 %



Title

CAIRO BUSINESS DISTRICT
(C.B.D)
Typical Floor Uses



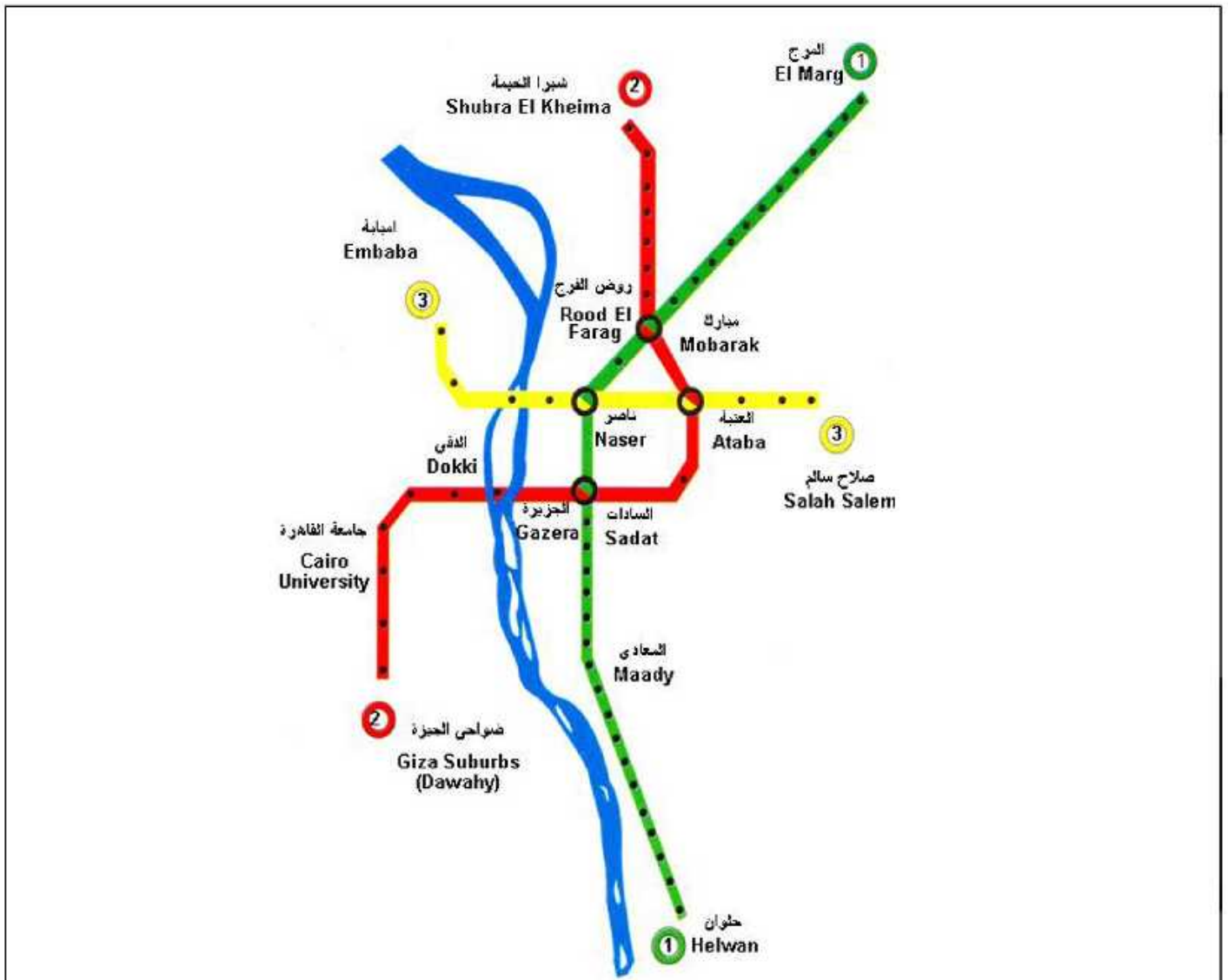
The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

- 1 The first line in service
- 2 The second line in service
- 3 The third line under construction
- Linking Stations

Title

Greater Cairo Metro Network



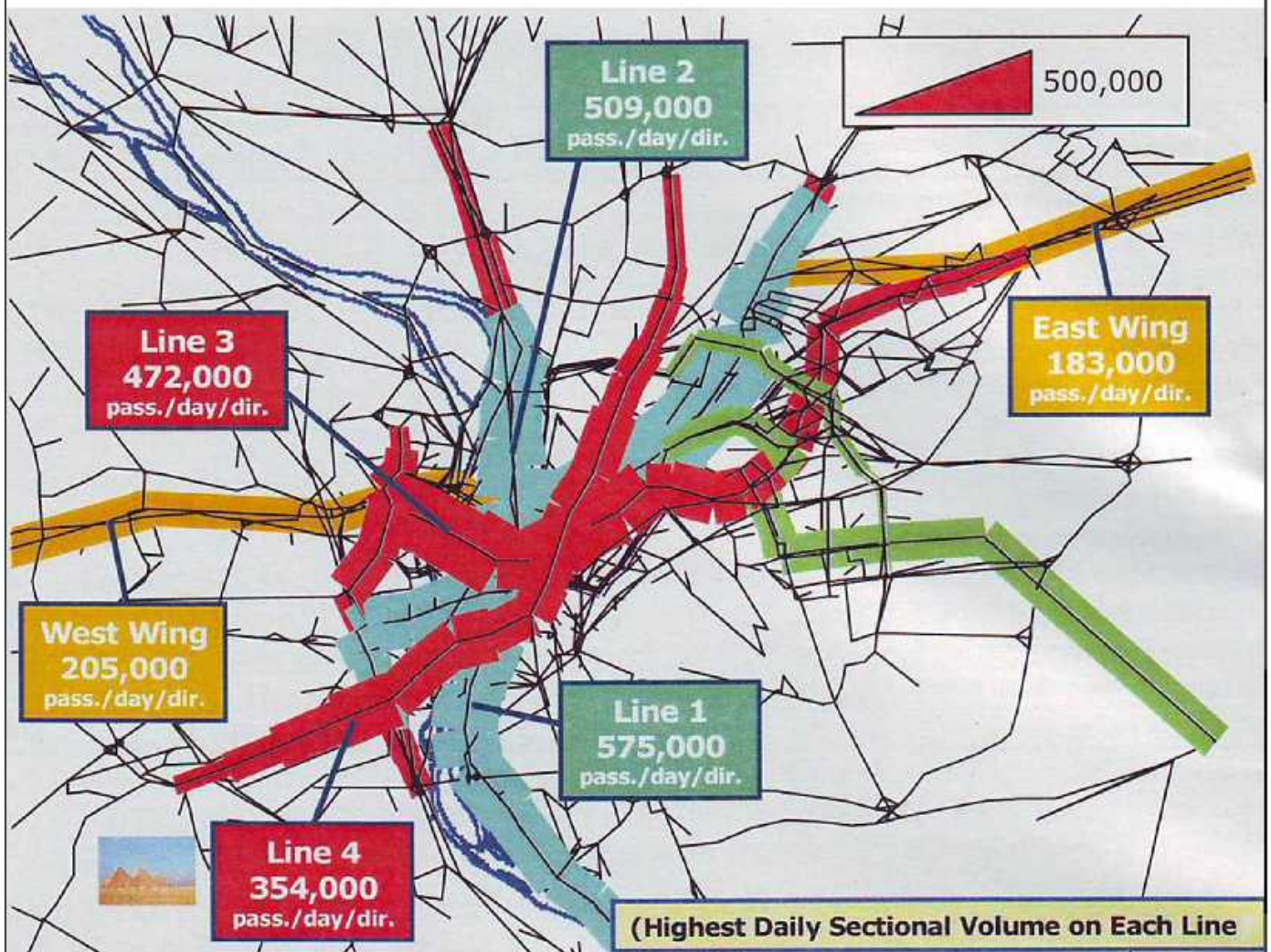
The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

Title

Dally Traffic Volum

Second s Primary Road



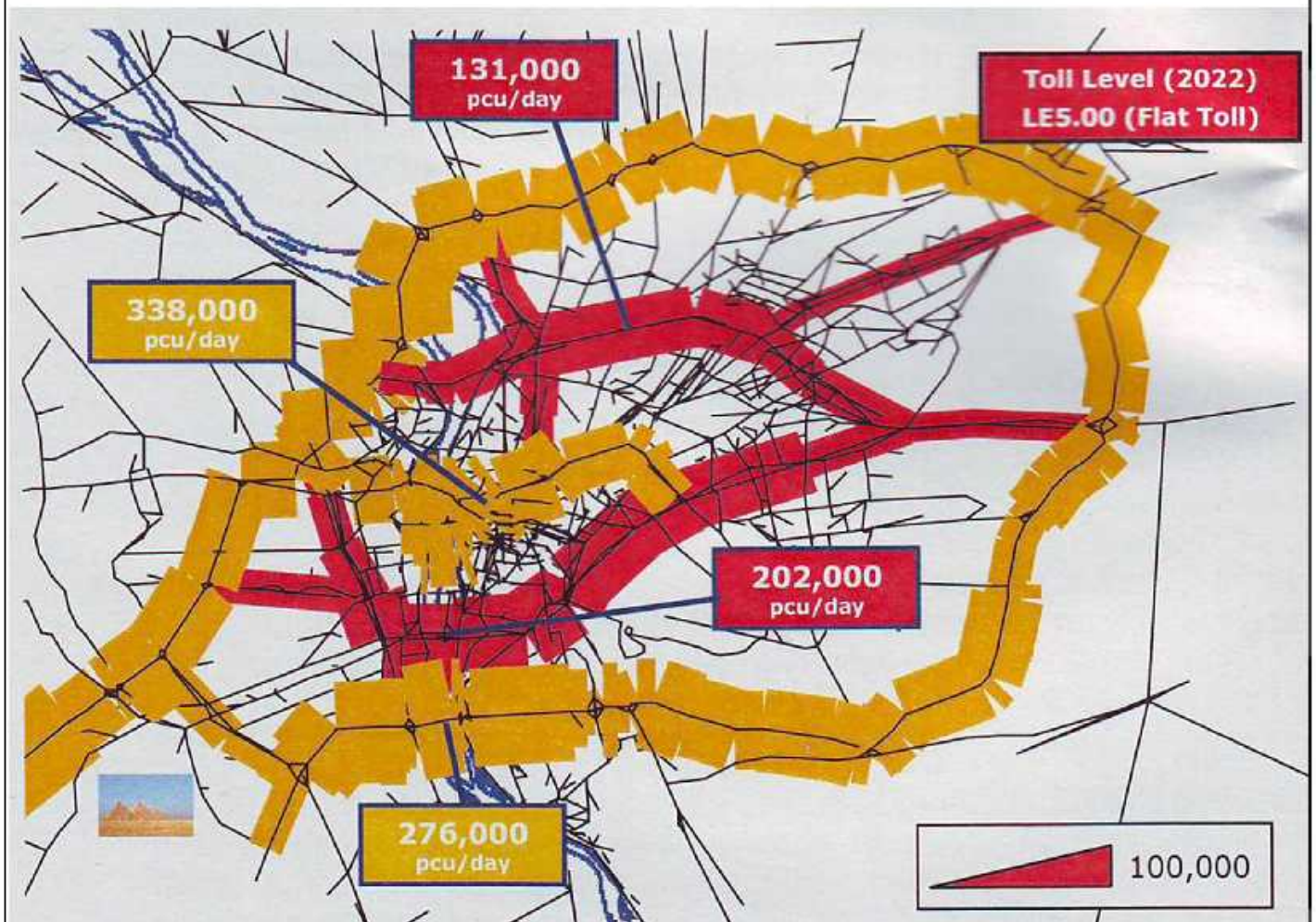
The International Competition for Urban Design and Harmony of Ramses Square - Cairo

Key

Title

Dally Traffic Volum

Expressways and Major Roads



Survey Traffic Volumes Of Ramses Sq.

٢٠٠٢

Exit Of 6October Bridge (Tharwat) Direction Ramsis Street

Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	3070		2635	1625	2080	1016	784	570	687
Microbus	483		429	429	543	921	472.5	375	345
Minebus	222.7		195.5	255	226.1	238	229.5	221	272
Bus	611.1		456.75	529.2	459.9	469.35	488.25	330.75	519.75
Light trucks	120.6		189	194.4	205.2	124.2	225	108	162
Heavy trucks - Lorry	66		72.6	79.2	33	29.7	62.7	29.7	42.9
Motorcycle	42		73	44	22	35	35	16	29

Ramsis Street coming from Mahmoud Bassiouni street									
Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	439	368	408	454	399	358	318	288	306
Microbus	3	3	28.5	6	1.5	7.5	6	3	4.5
Minebus	0	0	18.7	6.8	3.4	1.7	6.8	1.7	1.7
Bus	0	3.15	3.15	3.15	0	6.3	3.15	0	0
Light trucks	91.8	75.6	102.6	144	113.4	106.2	117	97.2	90
Heavy trucks - Lorry	303	0	6.6	0	19.8	6.6	16.5	0	9.9
Motorcycle	18	22	23	25	13	19	30	23	23

coming from Abdelmonem Read Sq Ramsis Street (left)									
Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	930	1060	1165	703	769	795	810	875	856
Microbus	300	352.5	172.5	307.5	114	156	114	61.5	82.5
Minebus	59.5	119	30.6	96.9	73.1	47.6	3.4	17	28.9
Bus	378	630	866.25	819	378	519.75	510.3	274.05	475.65
Light trucks	41.4	30.6	46.8	41.4	23.4	16.2	19.8	25.2	16.2
Heavy trucks - Lorry	6.6	0	0	16.5	0	0	0	0	0
Motorcycle	45	30	22	21	6	11	8	30	11

Coming from Oraby Street from Shubra Tunnel Left To Ramsis Street									
Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	496	440	440	488	423	414	417	644	725
Microbus	168	132	69	66	57	82.5	81	96	75
Minebus	3.4	0	0	32.3	5.1	37.4	18.7	30.6	20.4
Bus	204.75	126	110.25	207.9	72.45	116.55	103.95	107.1	113.4
Light trucks	162	81	81	102.6	99	61.2	100.8	99	64.8
Heavy trucks	9.9	0	0	0	0	0	0	0	6.6
Motorcycle	19	11	34	22	28	14	33	23	13

Coming from Ramsis Street Right To Oraby Street									
Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	211	228	220	260	188	186	140	188	153
Microbus	16.5	3	3	6	4.5	10.5	4.5	28.5	18
Minebus	0	1.7	0	5.1	1.7	5.1	1.7	8.5	1.7
Bus	0	0	0	0	0	0	0	9.45	9.45
Light trucks	55.8	54	27	25.2	39.6	16.2	5.4	10.8	3.6
Heavy trucks	0	0	0	0	0	0	0	0	0
Motorcycle	12	10	11	19	17	12	2	12	7

Coming from Emad Elddin Street To Shubra Tunne									
Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	724	540	431	550	455	421	343	380	270
Microbus	375	258	255	303	300	303	252	212	272
Minebus	163	187	214	138	233	173	221	128	153
Bus	737	482	419	592	539	593	567	252	394
Light trucks	131	117	175	108	68	162	106	140	133
Heavy trucks	36	59	26	7	36	33	23	3	7
Motorcycle	90	52	66	39	56	64	30	44	75

Coming from Shoban Moslmeen Street Right To Ramses Street									
Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	540	505	555	445	470	430	365	425	325
Microbus	112.5	52.5	52.5	85.5	82.5	142.5	57	240	127.5
Minebus	221	204	238	88.4	170	178.5	238	119	144.5
Bus	315	330.75	283.5	315	425.25	315	283.5	645.75	283.5
Light trucks	99	18	99	54	117	315	144	153	171
Heavy trucks	0	0	0	0	0	0	0	0	0
Motorcycle	2	7	10	20	5	17	39	21	25

Coming from Abdel Hameed Street Right To Ramses Street									
Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	98	180	185	187	126	135	123	113	105
Microbus	12	24	42	48	34.5	45	40.5	30	0
Minebus	8.5	0	1.7	0	1.7	1.7	5.1	0	0
Bus	0	0	0	0	0	0	0	0	0
Light trucks	9	12.6	0	1.8	1.8	0	1.8	0	0
Heavy trucks	0	0	0	0	0	0	0	0	0
Motorcycle	5	10	18	7	30	21	15	10	6

Coming from Ramses Street Right To Abdel khalek Tharoot Street									
Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	813	863	947	1037	691	543	502	510	342
Microbus	93	120	84	148.5	96	97.5	57	3	0
Minebus	13.6	10.2	23.8	40.8	51	34	13.6	0	0
Bus	6.3	31.5	28.35	31.5	116.55	72.45	6.3	6.3	0
Light trucks	46.8	9	12.6	124.2	590.4	349.2	108	10.8	16.2
Heavy trucks	23.1	6.6	0	6.6	0	0	6.6	0	0
Motorcycle	33	31	20	33	31	38	43	26	21

Coming from 26Jul Street Right Ramses Street									
Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
rivate / Taxi ca	305	506	620	374	552	440	422	666	629
Microbus	33	7.5	13.5	21	15	21	10.5	19.5	43.5
Minebus	10.2	8.5	8.5	6.8	0	5.1	5.1	23.8	18.7
Bus	15.75	9.45	6.3	0	18.9	9.45	3.15	9.45	9.45
Light trucks	39.6	54	109.8	75.6	66.6	72	27	117	43.2
avy trucks - Lc	3.3	9.9	0	3.3	16.5	9.9	9.9	9.9	0
Motorcycle	7	4	7	4	16	5	3	7	18

Coming from Ramses Street Left To 26 Jul Street

Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	295	276	216	227	237	140	159	220	197
Microbus	30	61.5	78	72	82.5	70.5	136.5	87	69
Minebus	8.5	13.6	13.6	6.8	3.4	5.1	5.1	1.7	6.8
Bus	3.15	3.15	6.3	0	9.45	6.3	6.3	0	6.3
Light trucks	18	37.8	45	36	39.6	43.2	23.4	19.8	12.6
Heavy trucks - Lorry	0	0	0	3.3	3.3	0	3.3	0	0
Motorcycle	5	9	15	25	18	17	13	8	5

Ramses Street After elshaheed Sq.

Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	1370	1530	1680	1460	1775	1990	1350	2210	2200
Microbus	381	337.5	405	345	615	447	262.5	375	315
Minebus	251.6	204	234.6	221	314.5	217.6	170	204	187
Bus	677.25	598.5	642.6	551.25	740.25	472.5	472.5	504	595.35
Light trucks	129.6	90	90	72	171	90	39.6	45	36
Heavy trucks	0	16.5	19.8	6.6	0	13.2	9.9	0	0
Motorcycle	47	45	52	25	65	27	26	35	31

From Ramses Sq. To Elgomhorea Street

Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
rivate / Taxi ca	690	705	635	715	495	485	515	620	823
Microbus	817.5	765	607.5	577.5	420	321	322.5	577.5	465
Minebus	467.5	365.5	357	170	190.4	187	306	246.5	399.5
Bus	78.75	47.25	63	441	371.7	110.25	135.45	78.75	220.5
Light trucks	306	306	117	108	54	72	36	81	63
- Heavy trucks	0	0	3.3	0	0	0	0	0	0
Motorcycle	30	31	45	55	25	60	30	30	34

Exit of 6 October Bridge To Ramsis Street

Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	456	476	545	495	435	391	364	329	387
Microbus	79.5	94.5	97.5	94.5	99	91.5	52.5	52.5	85.5
Minebus	34	22.1	45.9	35.7	44.2	39.1	52.7	23.8	37.4
Bus	9.45	3.15	22.05	15.75	66.15	22.05	31.5	12.6	12.6
Light trucks	9	10.8	5.4	1.8	3.6	3.6	3.6	9	1.8
Heavy trucks - Lorry	0	0	0	3.3	3.3	0	0	0	0
Motorcycle	24	39	30	18	12	10	10	15	5

Out Of misr railway station

Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	307	500	293	275	211	262	315	275	415
Microbus	307.5	417	262.5	292.5	307.5	450	375	0	0
Minebus	76.5	25.5	17	34	68	255	76.5	0	0
Bus	53.55	47.25	63	126	236.25	567	472.5	1	3
Light trucks	5.4	5.4	36	36	36	54	45	9	9.45
Heavy trucks - Lorry	3.3	6.6	3.3	16.5	33	6.6	3.3	0	0
Motorcycle	2	7	10	10	5	0	2	1	10

Coming from klot bik street

Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	292	226	330	274	265	235	240	270	345
Microbus	181.5	108	367.5	292.5	322.5	330	247.5	255	270
Minebus	0	0	25.5	17	18.7	15.3	10.2	8.5	18.7
Bus	0	3.15	6.3	0	12.6	0	0	0	3.15
Light trucks	129.6	52.2	30.6	27	18	36	19.8	10.8	9
Heavy trucks - Lorry	0	0	3.3	3.3	6.6	0	0	0	0
Motorcycle	43	17	4	80	50	54	48	57	85

comming from ghamra left to elfath mousq

Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	380	415	280	295	365	460	410	235	265
Microbus	307.5	360	390	292.5	322.5	352.5	442.5	240	315
Minebus	0	0	187	161.5	178.5	255	348.5	93.5	212.5
Bus	409.5	551.25	160.65	126	236.25	236.25	349.5	78.75	173.25
Light trucks	126	171	135	99	144	135	189	90	9
Heavy trucks - Lorry	0	0	0	16.5	0	0	85.8	16.5	0
Motorcycle	0	0	0	0	0	0	0	0	0

entry of elgalaa street

Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	505	445	385	425	445	400	**45**	**43**	**50**
Microbus	240	277.5	202.5	262.5	300	300	**0**	**0**	**1.5**
Minebus	127.5	127.5	127.5	187	263.5	136	**0**	**0**	**0**
Bus	913.5	897.75	708.75	771.75	834.75	771.75	**0**	**0**	**0**
Light trucks	0	63	99	63	63	72	**30.6**	**30.6**	**34.2**
Heavy trucks - Lorry	0	0	0	0	0	0	**0**	**0**	**0**
Motorcycle	0	0	0	0	0	0	**21**	**16**	**21**
	1786	1811	1523	1709	1906	1680			

coming from ghamra street to ramses sq

Evening	Evening	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Morning	Morning	Time
09:10	08:09	05:06	04:05	03:04	02:03	01:02	10:11	09:10	Hour
1100	1055	1260	1365	1195	860	790	835	781	Private / Taxi cap
0	0	0	0	0	202.5	0	0	79.5	Microbus
110.5	119	119	127.5	105.4	59.5	20.4	74.8	112.2	Minebus
519.75	403.2	374.85	292.95	267.75	163.8	144.9	229.95	220.5	Bus
10	3.6	0	12.6	0	0	5.4	14.4	1.8	Light trucks
0	0	0	9.9	0	0	6.6	0	6.6	Heavy trucks - Lorry
0	0	0	0	0	0	0	0	0	Motorcycle
1740	1581	1754	1808	1568	1286	967	1154	1202	Total

go to fgala street

Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	761	605	430	459	460	420	433	384	360
Microbus	90	76.5	22.5	105	52.5	55.5	67.5	163.5	105
Minebus	35.7	0	0	0	8.5	0	0	0	0
Bus	0	0	0	0	15.75	0	0	0	0
Light trucks	243	297	279	324	270	262.8	183.6	135	11
Heavy trucks - Lorry	0	0	0	0	0	0	0	0	0
Motorcycle	50	54	47	51	53	50	36	20	15

Coming from emad eldin right to ramses sq									
Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	316	410	466	624	750	852	833	536	386
Microbus	120	127.5	109.5	136.5	183	189	157.5	118.5	88.5
Minebus	68	34	6.8	28.9	37.4	28.9	39.1	25.5	37.4
Bus	37.8	34.65	12.6	22.05	40.95	53.55	28.35	28.35	28.35
Light trucks	7.2	12.6	9	16.2	9	16.2	18	12.6	12
Heavy trucks - Lorry	0	0	0	0	0	0	0	0	0
Motorcycle	8	13	14	30	28	31	28	23	29

coming from ghamra street right to ramses sq									
Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	480	525	496	571	535	492	458	468	505
Microbus	307.5	163.5	154.5	112.5	99	150	127.5	64.5	69
Minebus	35.7	11.9	18.7	22.1	34	42.5	44.2	27.2	61.2
Bus	56.7	53.55	34.65	34.65	78.75	44.1	44.1	31.5	47.25
Light trucks	68.4	120.6	82.8	59.4	59.4	88.2	63	93.6	13
Heavy trucks - Lorry	0	6.6	0	3.3	6.6	0	0	3.3	6.6
Motorcycle	15	2	11	4	12	14	15	22	20

coming from Bridges infront of post Building to elgala street									
Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	410	460	270	363	355	380	368	368	293
Microbus	285	348	165	211.5	270	268.5	150	150	67.5
Minebus	5.1	0	27.2	6.8	0	0	15.3	0	23.8
Bus	69.3	135.45	50.4	31.5	59.85	103.95	56.7	37.8	85.05
Light trucks	158.4	138.6	117	156.6	131.4	120.6	178.2	108	14
Heavy trucks - Lorry	0	0	0	0	0	0	16.5	0	0
Motorcycle	55	33	32	45	45	38	35	28	45

Comming from ghamra To elgalaa Street									
Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	677	587	514	488	491	574	409	286	270
Microbus	400.5	328.5	277.5	276	337.5	301.5	171	291	336
Minebus	219.3	246.5	154.7	197.2	202.3	183.6	219.3	142.8	96.9
Bus	450.45	491.4	324.45	428.4	412.65	485.1	548.1	255.15	217.35
Light trucks	14.4	57.6	57.6	36	16.2	7.2	14.4	9	15
Heavy trucks - Lorry	0	0	0	0	0	0	0	0	0
Motorcycle	37	55	26	47	54	42	31	9	39

Coming from Ramses street lefft to Emad Eldin Street									
Time	Morning	Morning	Afternoon	Afternoon	Afternoon	Afternoon	Afternoon	Evening	Evening
Hour	09:10	10:11	01:02	02:03	03:04	04:05	05:06	08:09	09:10
Private / Taxi cap	1102	957	830	643	685	765	560	642	510
Microbus	442.5	252	217.5	193.5	130.5	76.5	108	171	114
Minebus	229.5	168.3	85	134.3	93.5	37.4	52.7	107.1	81.6
Bus	277.2	28.35	103.95	132.3	12.6	110.25	63	69.3	148.05
Light trucks	648	365.4	189	212.4	237.6	189	234	185.4	16
Heavy trucks - Lorry	0	6.6	6.6	0	0	0	0	0	0
Motorcycle	21	22	9	8	7	19	32	16	7

The International Competition for urban design and harmony of Ramses square, Cairo, Egypt

Ramses Square which is of important historical and urban value needs to be redeveloped in order to meet with the existing urban and traffic conflicts, therefore the Egyptian Government decided to issue an international planning & urban design competition in order to reach the best solution of the Square in the light of a comprehensive planning vision of Cairo City Center which is of great historical, urban and cultural value.

The ministry of Cultural affairs has commissioned the National Organization for Urban Harmony (NOUH) to tender this competition in line of the guidelines and regulations of the Union of International Architects (UIA) and other relevant local agencies and authorities in Egypt.

The aim of the competition is to produce an urban design plan for Ramses Square within a comprehensive vision for the city center of Cairo on various levels. This should be done after thorough definition of the principle problems facing Cairo city center especially traffic problems, confusion of uses and all types of pollution (Audio, visual and environmental).
Entrants can also consider the rehabilitation and reuse of buildings, empty properties and open spaces in and around the square to get the best benefit out of it.

BECT, AREP the 1st prize

Design Objective

This will be implemented through focusing on three elements:-

- Emphasizing that putting an end to the traffic congestion in the square, particularly in the Ghamra, Ramses and Shubra areas, was the scheme's main aim.

- A second aim of the scheme was to reduce the visual pollution that was destroying the atmosphere of the square. Removing the 1.3km-long section of the 6 October flyover connecting Ghamra to Al-Asaaf will reduce the visual pollution, as will removing the pedestrian bridges and the neglected building belonging to the railways authorities in the square and presently used as storage spaces and workshops. Removing these things will restore the square's visual connections with the surrounding areas, he said, which have been submerged for years under flyovers and ugly buildings.

- The third goal of the scheme is to convert the newly freed-up area, some 18 feddans of space, into a leisure zone for the area's inhabitants. The area would be divided into two parts, the first of which would be a two-feddan area set aside for retail and other activities. The second area, the remainder of the 18-feddan space, would be turned into an urban park complete with a lake, restaurants and an activity area for children. The concept is designed to create "a second lung for Cairo similar to the Al-Azhar Park. However, there will also be a little twist in the architectural design, in order to fit the area in with the square's original style," he said. The whole of Ramses Square would be a pedestrian zone.

Figure 5-10: A & B) space for waiting areas inside rail station
Source: - BECT/ARER, 2009

Figure 5-11: Master plan for the proposed project
Source: - BECT/ARER, 2009

The jury has made the following comments

This project creates a true urban plaza.

Some of the qualities of this project are:

- Diverting 6th October flyover section located between two interchanges into a 1.5 km tunnel under the square.
- Leaving the square free of traffic, making the metro station and its access a genuine public pedestrian space.
- Modifying Ramses Street in a two-way route between two interchanges.
- Transforming "Kobry Laymoon" bridge into a pedestrian route.
- Submerging the "6 of October" Flyover under the new Ramses Square offers a major improvement liberating urban space and integrating the adjacent neighborhood to the South adding landscape to the North of the Station will

Also help from an environmental point of view.

The proposed concept for the area to the East of the station between Ramses Street and Ahmed Helmy area offers an important contribution to the area. The addition of new cultural institutions and activities in a context of green is essential to invigorate the area creating a new node of attraction in the city while at the same time it offers a controlled park.

One important aspect of this project is the emphasis on the importance of public transportation and thus the inclusion of a higher rail system.

However; Traffic problem are not sufficiently addressed, it requires major restudy especially in the following:

- Study the feasibility of the proposed Ramses Tunnel in its relation to the levels of the metro station and lines also comparing that proposal with the rerouting of the flyover and its economic and urban viability.
- Local surface traffic has not been addressed in a satisfactory manner especially traffic from North to South.
- Entrance and exits to underground garages need further study.
- Differentiation between pedestrian and traffic roads should be clarified.

Quilligan Architects the 2nd prize

Design Objective

The key objective is to define Ramses square physically and give a sense of place to the remodeled square by reinforcing the edges, removing the high level traffic, and reorganizing the surface traffic. The design should also upgrade and provide new attractions to the square in the form of shopping, cafes, public events with music, and films. The urban design layout will also provide a variety of development opportunities in making the plan shape and this will draw in private investment into the scheme.[145]

Key Design Drivers

- Divert the 6th October overhead motorway north of Ramses square and clear away all overhead pedestrian walkways.
- Provide half level underpass for Ramses street local traffic and tunnel for Ramses street thru-traffic.

[145] Quilligan Architects. (2009, Nov. 20). Ramses Square : International Competition in Cairo, Egypt, Africa. Retrieved July 1, 2013, from http://www.e-architect.co.uk/egypt/ramses_square_cairo.htm

- Provide raised terrace at half level over the Ramses street local traffic, with the terrace allowing access to all new shopping and commercial buildings. The terrace is lined with local trees, and cafes to give a relaxed atmosphere.
- A solar projecting glass porte-cochere to the west end of the train station will provide a new drop off and reception point for all rail passengers.
- New buildings are proposed to provide the necessary commercial and social activities to the square and to provide the municipality with some income.
- A considerable amount of thru traffic will be diverted away from the square by diverting or the underpass. The other local traffic will be traffic-calmed and organized around a main island to the west end if the square. This long island will also assist with pedestrian access to the square from points to the west and south.
- Some space has been brought back into the Mosque environs and planted to increase the feeling of enclosure and contemplation. The Mosque square can now relate visually to the main square.
- Access to the metro is provided for and organized by a metro plaza with a large ticket hall and access to trains.
- A softer approach to landscaping is defined at the east end of the square where the 'park' is laid out in a grid with squares of grass trees and water.
- The finish of the square generally would be of local stone in large scale slabs laid out in a geometric pattern. The pattern of the stone terrace can change to provide variety.
- The existing tram terminus would face onto a small 'square' and the trams themselves would have a new terminal to the back of the new building at the east end of the square.[146]

[146] Quilligan Architects. (2009, Nov. 20). Ramses Square : International Competition in Cairo, Egypt, Africa. Retrieved July 1, 2013, from http://www.e-architect.co.uk/egypt/ramses_square_cairo.htm

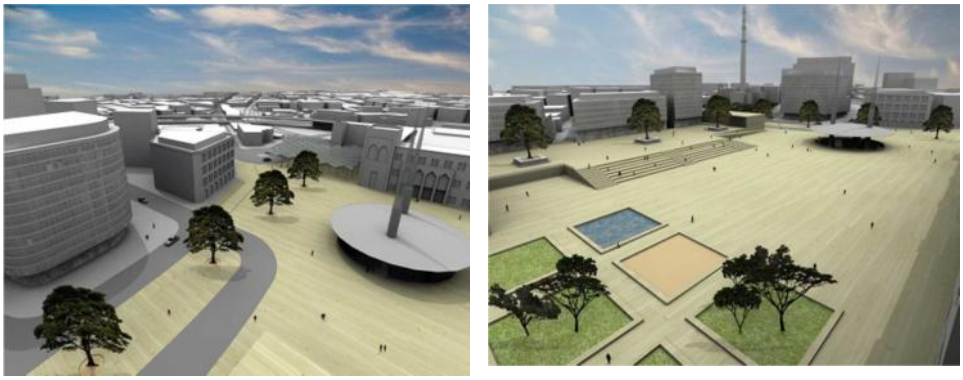


Figure 5-12: The key objective in the project of Ramses square
Source: - http://www.e-architect.co.uk/egypt/ramses-square-cairo

Key Traffic Objectives

Our approach to the traffic issue is to provide alternative routing with divert or underpass for thru-traffic from the three squares and traffic calming local traffic around the squares.

- Alternative routing by providing an inner ring route with controlled access which will organize the traffic into quarters.
- Underpass routes for each square to allow thru-traffic to pass without affecting the square.
- Traffic calm local traffic which will encourage pedestrians to use the squares again.
- Tunnel the road along the river for a section as it passes the center city. This will provide access to the river and encourage development along the river.

The jury has made the following comments:-

In spite of its simple presentation and elaboration it has clear, simple and largely feasible proposals.

A clearly confined public space for Ramses Square, at least the front of the station itself and the new alignment of buildings opposite and an enlarged urban pedestrian space

A feature that is unique among all the entries of the competition – rare quality of the proposals. Ramses Street is covered with a lifted part of the square. These terraces bring all the desired peace and freedom from traffic noise, hustle and pollution to the public, vastly crowded, realm for the tens of thousands pedestrians.

As with almost all the other entries, problems of individual car traffic poses questions not answered to the full, especially the tunnel of Ramses street needs to be restudied in terms of level and routing as it would intersect the metro and would be impossible to realize. The jury did not put much emphasis on this crucial "issue", because the route of this covered street could be modified to address this issue.

Turkish Group represented by Nimat Aydin the 3nd prize

Design Objective:

A - Dealing with the traffic issue.
B - Re-joining the plaza to Prospect Park.

The project turned to the issue of attracting people to the plaza by providing interest, activity, relaxation and a little excitement. The main intention is to present a design that has unity and closely shows one space with various elements within it. When the traffic is removed from the space it can be seen that the arch is the most important element in the G.A.P. As a counterpoint to this dominant element we are proposing two glowing beacons which also form the structure for the cable car.[147]

The fundamental change was required to solve the problem of the chaotic traffic choked roads that encircle the plaza; Traffic is roofed over at roughly the height of the berms. The various inter-changes required are provided in a covered traffic plaza below. Part of the

[147] Quilligan Architects. (2009, Nov. 20). Ramses Square : International Competition in Cairo, Egypt, Africa. Retrieved July 1, 2013, from http://www.e-architect.co.uk/egypt/ramses_square_cairo.htm

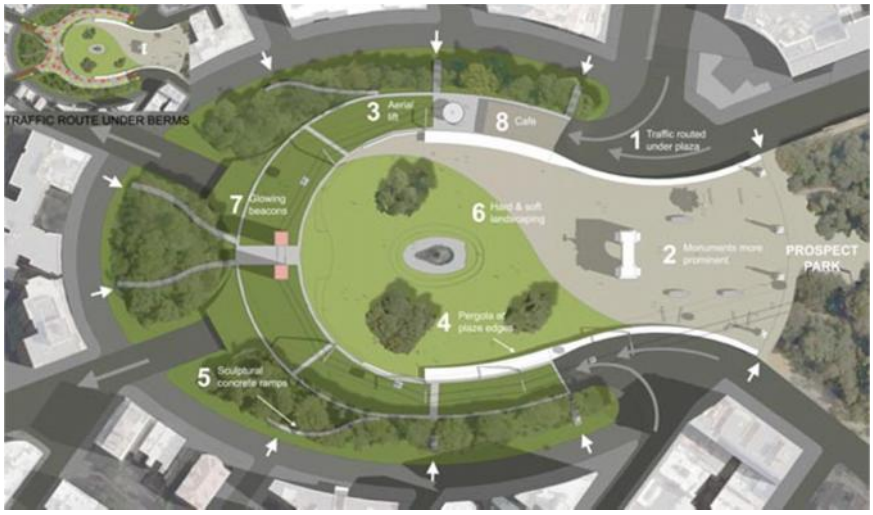
berm is removed to achieve this but they are then extended over the cut and covered road system. The plaza can be then be reunited with Prospect Park and it becomes a design issue as to how this can be reinforced visually.

The final element in the scheme is an aerial lift that unites the Plaza with Prospect Park "This is a fun idea and in practice will link G.A.P with all of Prospect Park. It will also include in the design a modern spectacular element with cutting edge engineering. Two glowing beacons will provide the terminus structure for the cable car as well as a focal point in the surroundings. Also such an installation will draw people to the Plaza and bring all parts of Prospect Park into easy reach. The popularity of these installations make them self-financing. It will also contribute to the viability of other commercial elements proposed for the Park by drawing numbers to the Plaza i.e. cafes, theatre, open air markets & other community activities.[148]

Key Design Drivers

This project is based on:

- Transforming the square into a pedestrian plaza.
- Linking the proposed route for the 6 October flyover and the extension of North Gamalya Axis through four exits.
- Transforming the route of the flyover behind the Station, Ahmed Helmy Square.
- Three parks in front of Ramses Building, Al-Fath Mosque and the approach to Kamel Sedky Street.
- Changing a section of Al-Galaa Street to a pedestrian route.
- Two sub-squares, the first is Ahmed Helmy Square (residential commercial zone) and the second is the railway yards, multiuse buildings.



148 Quilligan Architects. (2009, Nov. 20). Ramses Square : International Competition in Cairo, Egypt, Africa. Retrieved July 1, 2013, from http://www.e-architect.co.uk/egypt/ramses_square_cairo.htm

Figure 5-13: Overview of proposed development in the proposed project of Ramses square, the pedestrian plaza.
Source:http://www.quilliganarchitects.ie/news/index.php?subaction=showcomments&id=1221250623&archive=&start_from=&ucat=&

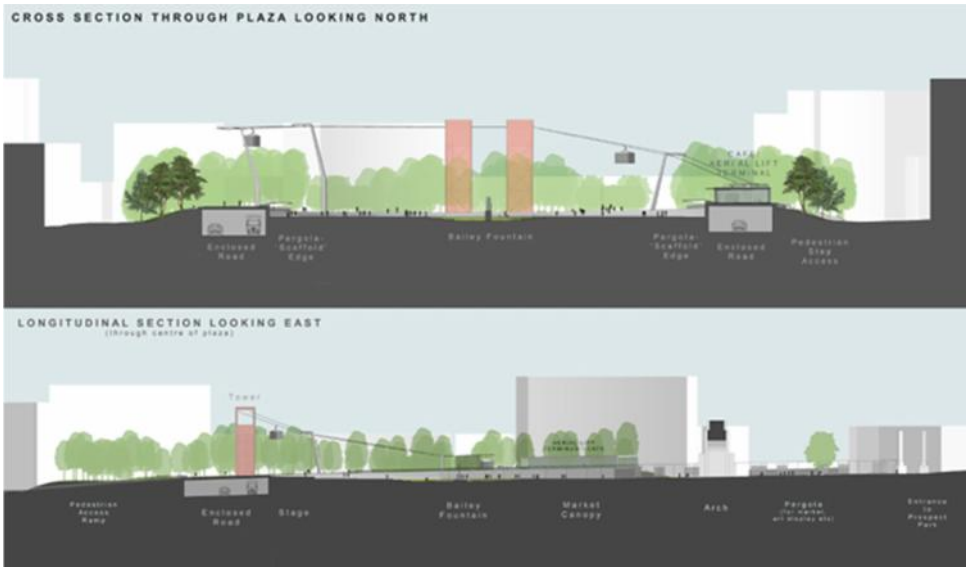


Figure 5-14: Overview of proposed development in the proposed project of Ramses square, the pedestrian plaza.
Source: http://archiseek.com/tag/quilligan-architects/2010

The jury has made the following comments:-

- The project did not solve the traffic problem.
- The pedestrian public space area is divided in two parts, which does not favor movement and visual perception.
- This is a very strong proposition with a very well defined square which is separated from the surrounding streets by an open structure that acts as a filter between the pedestrians and the movement of traffic while not obstructing views.
- The Square itself has been carefully treated integrating hard surface with green and a substantial water fountain.
- To the East and connected to the Square by a green street, the project proposed a residential development where fabric and green are integrated.
- These were doubts about the possible “wall” effect of the open structure surrounding the Square.

ملخص الرسالة

1. مقدمة :

1.1 التعريف بالمشكلة : يعتبر ميدان رمسيس بؤرة رئيسية ومحورية لتلاقى محاور الحركة الرئيسية بمنطقة وسط القاهرة، ولكن يعانى ميدان رمسيس من العديد من المشكلات المرورية منها التكدس والاختناق المرورى والخلط بين الاستخدامات والوظائف ، وبالتالى تنتج بعض الاثار السلبية للعناصر المتواجدة داخل نطاق الميدان ومنها:

- التقاطعات بين كوبرى 6 أكتوبر العلوي، شبكة الطرق، خطى المترو، وخطوط الاتوبيسات والتى تنشئ العديد من المشاكل منها الضوضاء، والمرور، والحوادث المزمنة.

- التأثيرات السلبية الملموسة على الحيز العمرانى داخل الميدان والناتجة من كوبرى 6 أكتوبر العلوي .
- التأثير السلبي لجسور عبور المشاة العلوية الجديدة.
- الفوضى المسيطرة على حركة المشاة داخل الحيز العمرانى للميدان.
- سوء الوضع الحالى لمواقف انتظار السيارات من حيث الموقع وطاقة استيعابها ومداخلها ومخارجها.

2.1 نطاق البحث :

يعتمد هيكل البحث كما مبين بالشكل المرفق لهذا الملخص على تسلسل الفواصل للوصول الى اجابات الاسئلة البحثية وتحقيق اهداف الدراسة وينقسم البحث الى باب اول وباب ثانى. يناقش الباب الاول الخلفيات النظرية والتعريفات ومعايير التصميم الخاصة بالمحطات المحورية والمركزية وينتهى بدارسة شاملة لثلاث امثلة عالمية والتعرف على قدراتهم للتغلب على التغيرات السلبية لهذه المحطات وكيفية دعم الخطط والمعايير التي تركز على الآثار الاجتماعية والاقتصادية ، بينما يعرض الباب الثانى الدراسة التطبيقية لمنطقة ميدان رمسيس وينتهى بدراسة كيفية تفغيل المعايير والاشتراطات التصميمية لمحطة رمسيس لتحويلها الى محطة محورية.

2. الباب الاول – الفصل الاول : معايير تصميم المحطات المحورية Principles of Central Station Design

الهدف الرئيسى لهذا الفصل هو استعراض العناصر الرئيسية لتصميم المحطات. ويدرس ايضا عدد من المبادئ والمعايير، التي تهدف إلى تعزيز واستكمال تصميم المشغلين الحالى ومعايير تقديم الخدمة وغيرها من المتطلبات القانونية والاستنسائية. والهدف من هذه الدراسة هو تقييم المجموعات بشكل فردي،لإعلان وتحديد نهج حاسم ونهائى، وأيضا لتوفير الأطار المستخدم لصياغة مجموعات من المؤشرات، تسليط الضوء على المخاطر والمشاكل التي تواجه مثل هذا الانواع من المشروعات، مشار الى المناطق التى يصعب لها تطبيق وتفعيل المعايير التوجيهية.

ويدرس الفصل الاولى النقاط الاتية:

- تصميم أطار العمل والافكار الرئيسية
- المعيار الاول - سهولة الاستخدام للمحطات :مناقشة كل القضايا المتعلقة بالحركة خلال المحطة، كيفية الوصول إليها ، استكشاف مسارات الحركة والمعلومات الخاصة بالركاب واخيرا دراسة اساليب الراحة والجاذبية.

- المعيار الثانى - قابلية التشغيل للمحطات :مناقشة جميع القضايا المتعلقة بالتشغيلية للمحطة، الإدارة والصيانة ، السلامة، واخيرا كيف يمكن للمحطة أن تكون آمنة من خلال التصميم.

- المعيار الثالث - جودة المحطة : مناقشة كل القضايا المتعلقة بقدرة المحطات لتكون متكاملة في السياق العمرانى، وكيفية تحقيق أو تعزيز التصميم الجيد للمحطات.

- الخلاصة والاستنتاج.

3. الباب الاول – الفصل الثانى : منهاج لتصميم محاور المواصلات المستدامة Approach to Design Sustainable Transportation Hub

يصف هذا الفصل عناصر التصميم والظروف المثلى لثمانية أنواع من النماذج الاسترشادية لتصميم المحطات المحوارية .معايير تصميم المحاور تبدأ بوصف الإطار الأول لتصميم المحطة وإلتعريف بأنواع المحطات المختلفة. وتؤكد المبادئ التوجيهية على أهمية إمكانية الوصول والأداء الوظيفي للمحطات عن طريق دمج المخططات التي تشير إلى العلاقات والمكونات الأساسية لمختلف أنواع المحطة.

ويدرس الفصل الثانى النقاط الاتية:

- حول محاور المحطات المركزية (دراسة شاملة للتعاريف والخلفية النظرية)
- النوعيات والتسلسل الهرمي لمحاور المحطات
- الخلاصة والاستنتاج.

4. الباب الاول – الفصل الثالث : تحليل الامثلة العالمية للمحطات المحوارية Analysis of International Central Station Hubs

الهدف الرئيسى لهذا الفصل هو التركيز على التطبيق الفعلي للمبادئ الخاصة بتصميم محاور النقل والمواصلات داخل المحطات المركزية والمحوارية المخططة والمصممة بالفعل في جميع أنحاء العالم، تم اختيار ثلاث حالات دراسية ممثلة للتطبيق من قبل الباحثوهما كالاتى :

1. King-Victoria Station Hub, Waterloo, Canada

2. Stuttgart 21 Central station, Stuttgart City

3. Squamish Station Hub, British Columbia

ويدرس الفصل الثالث النقاط الاتية:

- خلفية منطقة الدراسة.
- مكان الموقع والسياق المجتمعي
- سرد لخطوط المواصلات المتاحة

- المقترح الجديد لمشروع المحطة المحوارية
- الخلاصة والاستنتاج.

5. الباب الثانى – الفصل الرابع: الخلفية النظرية لمحطة رمسيس Ramses Station Theoretical Background

يعرض هذا الفصل الإطار النظري والخلفية النظرية وكافة المفاهيم المتعلقة بمنطقة ميدان رمسيس ويخص بالذكر محطة رمسيس .ويؤكد الإطار النظري على أهمية المحيط الحضري والموقع المتميز فى حدود وسط المدينة.

ويدرس الفصل الرابع النقاط الاتية:

- خلفية منطقة الدراسة (ميدان رمسيس الموقع والمحيط الحضري)
- الخلفية التاريخية لمنطقة رمسيس
- تدفقات ومسارات الحركة المرورية الشاملة لمنطقة ميدان رمسيس
- تحليل " SWOT" لمنطقة رمسيس والمناطق المحيطة بها.

6. الباب الثانى – الفصل الخامس: اختبار مبادئ المحاور المركزية على محطة رمسيس Testing Central Hub Principles on Ramses Station

يناقش هذا الفصل تحليل واختبار المعايير التصميمية للمحطات المركزية على محطة رمسيس، كونها المحطة الحاسمة والبالغة الاهمية لشبكة النقل العامة داخل الميدان .وقد تم اختيار محطة رمسيس وفقا ضوابط ومعايير محددة مبنية على الآتي:

(1) محطة رمسيس هي واحدة من محطات النقل العام الأكثر أهمية في القاهرة.
(2) يتوافر العديد من مرافق النقل والمواصلات داخل ميدان رمسيس.
(3) ترتبط محطة رمسيس ارتباطا مباشرا بوسط القاهرة.

ويدرس الفصل الخامس النقاط الاتية:

- تحليل محطة رمسيس : طبقا للتصميم والتقييم.
- تحليل محطة رمسيس : طبقا لقابلية التشغيل.
- السياسة المقترحة لادارة وصيانة محطة رمسيس.
- المسابقة الدولية لوضع تصميم عمرانى وتنسيق حضارى لميدان رمسيس بالقاهرة، مصر.
- توصيات التصميم والاستنتاج.

جامعة عين شمس

كلية الهندسة

قسم التخطيط والتصميم العمرانى

معايير واشتراطات تصميم المحطات المحورية
(دراسة محطة رمسيس - القاهرة- مصر)

رسالة مقدمة الى كلية الهندسة – جامعة عين شمس

كجزء من متطلبات الحصول على درجة الماجستير في التصميم الحضرى

اعداد:

فاطمة ابراهيم محمد ابراهيم

بكالوريوس الهندسة المعمارية – شعبة التصميم العمرانى

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2015

جامعة عين شمس
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(دراسة محطة رمسيس - القاهرة- مصر)

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الموافقة:

التاريخ: / / الختم:

موافقة مجلس الكلية: **موافقة مجلس الجامعة:**

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