EU Grand-Atium Project
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2013
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To understand European Union (EU) and to get an overview of its future, we must critically look at European history along with its political and urban past condition. The European Union itself is a long historical process, which based its ideology in the idea of “Europe”. EU can reflect and recognize itself through the term of “Europe” which indeed the term itself gained its meaning through the conflict and distinction of ideology. It is not defined by borders. Europe in its nature characteristic is a constantly changing pattern and systems which can be traced back to its city-state histories through the emergence and vanish of several countries. It contains conflict between East and West, between religions which dominated the region long time ago thus, it is the source for Europe’s awareness and political emergence. Europe should be considered as a political territory as Pier Vittorio Aureli has explained that seems the border between East and West is a political line, while the border between North and South is an economic line (Aureli 2007, 27). The Crusade, World Wars, Cold War era and also the economic crisis nowadays in Europe are few examples. Afterwards, came the ideology of peace to reduce the conflict and focusing the development of social and economic. EU tries to promote these unity and solidarity with its concentration of different cultures in the same place. The omission of “border” between the EU countries is the ultimate manifestation of this value.

Thus, as the result of this open border and integration of many aspects, the cities in EU region are constantly experiencing the struggle for its identities affecting by “new diversity” of this openess. Since the beginning of its formation in 1951, there is “no official plan and no debate has ever existed regarding how to represent the institutions of the EU urbanistically and architecturally” (Aureli 2007, 37). There is no clear guidance about the image representation of EU institutions and also how they are positioned in the area, city and region. The offices which host the EU’s councils and commissions are scattered between Brussels, Luxembourg, Frankfurt and Strasbourg. Even in those cities themselves, the sprawl can be seen. It is noticeable from the separation of the institutions from the rest of the city. There is no connection with the communities and urban condition. The offices are just being “injected” into the available spaces in the city. Indeed, they did not have the ambition to set up active guidelines for their architectural representation, which can be seen from the rental of office’s spaces despite the immense need for space and the selection of the buildings of the EU. They are typical corporate headquarters or office buildings with the economic as influential factor. Their target values, such as transparency, communications, efficiency and stability, degenerate into the generic story of corporate enterprise architecture. However, Europe has a long tradition for the ability of generating innovation and reinventing themselves, thus, in order to rearticulate the interaction between architecture and the idea of Europe in such a way, we must first reinventing the idea of the city itself. In the age of technology, digital and consumerism, the representation of European architecture’s idea cannot be detach from them especially with the competition tension with America and Asia in establishing its identity and gain more influences.

**Etymology of Europe**

The etymology of Europe is uncertain. Some theories suggest its origin:

- **Ancient Greek Mythology:**
  - Europa, a Phoenician Princess whom abducted by Zeus

- **Homer, poet of ancient Greek:**
  - Europe, a mythological queen of Crete, not a geographical designation

- **Greek:**
  - Eurus, Wide / Broad

**Europe as Continent**

Area : 10.180.000 km²
Population : 740 millions (2011, 11% of the world)
Pop. Density : 72.5/km²

Europe is first used as a geographical term in the 6th century BC to place the boundary between Asia and Europe along the Phasis River (the modern Rioni) in the Caucasus.

Europe is first used for a cultural sphere in the Carolingian Renaissance of the 9th century to designate the Western Church to the Islamic world.

The modern convention, enlarging the area of “Europe” somewhat to the east and the south-east, develops in the 19th century.
Important Timeline

- Roman empire was split
- Constantinople was founded
- French Revolution, 1789
- Wars of Napoleon Bonaparte
- Holy wars
- Cold Wars
- Germany Re-unification
- World Wars
- EU flag
SOLIDARITY
PEACE
SECURITY
SOCIAL
CULTURE
GROWTH
VALUES
IDENTITY
EDUCATION
FREEDOM
STABILITY
UNITY
DIVERSITY
ECONOMIC
European Union

The European Union (EU) is an economic and political union of 27 member states. Its origins from the European Coal and Steel Community (ECSC) and the European Economic Community (EEC), formed by the Inner Six countries in 1951 and 1958.

Establishment:
- Treaty of Paris, 23 July 1952
- Treaty of Rome, 1 January 1958
- Treaty of Maastricht, 1 November 1993

Political centres:
Brussels (capital), Luxembourg, Strasbourg

The Coal and Steel Community, 1950

The fall of Berlin Wall, 1989 enabled further expansion of the EU

Single currency Euro Zone, 2002
European Integration - Council of Europe

Council of Europe was founded in 1949 by the Treaty of London, after the World War II, has 47 member states. It is an international organization promoting co-operation between all countries of Europe in the areas of legal standards, human rights, democratic development, the rule of law and cultural co-operation. Its headquarters are in Strasbourg, France.
The political differences have primarily divided through the Council of Europe and European Union in Western and Central Europe and Commonwealth of Independent States in Eastern Europe and most of former Soviet countries.
Economic Differences in Europe

Most of the richest countries are located in the western part of Europe. Notably, in the Northern part of it like in the Scandinavian countries.

GDP per capita in 2011, source: International Monetary Fund
European Union Members

- European Union
- Member states joining the EU in 2004
- Member states joining the EU in 2007
Institutions of the European Union

- European Parliament (legislative, lower house)
- European Council
- Council of the European Union (legislative, upper house)
- European Commission (executive)
- Court of Justice of the European Union (judiciary)
- European Court of Auditors (financial auditor)
- European Central Bank (monetary executive)
Relations in general between the Council of Europe and the EU
Competition for Masterplan
EU Quarter - 2009
...as the crossroad of Europe

Brussels as available hub (propaganda for Brussels as the Crossroad of Europe, 1958)
Hi-Speed Train Connection
With the Treaty of Nice, Brussels has been confirmed by the European Council as Capital of Europe. It was one turning point for EU and Brussels to inventing and defining their direction urbanistically and architecturally. Brussels itself “full” with differences such as social, political, and cultural differences which makes the city ideal to gain its new status in Europe and world. As expressed by Aureli that if “Europeanness” can only be expressed through “urbanity”, then the actual complex form of Brussels is the potential representation - in miniature - of Europe (Aureli 2007, 11). Regardless the opportunity, the city struggled within itself. As notice, Belgium is a federal state composed of three communities, three regions, and four linguistic regions. Likewise, Brussels contains similarity in its urban and social structure. It is mostly inhabited by foreigners and it is the city of poor and rich melting together. The centre is scarcely inhabited and EU’s offices are one of the generating factors for the city life.

With the making of masterplan for EU headquarter by Christian de Portzamparc, the desire to have a more definite direction for EU development in the future found its starting point. Moreover, it tries bridge the differences of separated members and specifically wants to be accessible and recognizable urban setting to the people of Brussels in order to make it as a veritable representation of Europe. Previously, the European institutions still show a hesitance expression to really “stay” comfortably in the city. Their institutions are rented office spaces and in fact, triggers Brussels’s real estate fluctuations, contributing to the city’s urban planning and development. Over the last decades, this process has resulted in a decay of the city fabric and an erosion of urban qualities in large portion of the city, not mentioning the fragmentation caused by it as well. Although, the willingness to move forward into a more integrated working environment and representation is now establish, still require a lot of effort to really define what EU wants to be expressed in its buildings. It political presence must use a specific architectural expression to stimulate civic participation, one of EU’s value, and inspire a common fondness through urban experience. The new proposal must be able to propose an urban project that is capable of reframing the existing city, of articulating its patterns and accesses, of celebrating its collective rituals of public life. It must be This project addresses the mixture of ways of living, an integration into the space of the city by activating participation of different communities to share space. It must provides the right to participate in collective events and to gain access to public spaces. The access to these places is what concretely defines the sense of people’s belonging to the collective events of inhabiting the common space of the city. It integrates and orchestrates the relationship between parts of the city which through its architectural form manifesting a definition and usage of public space. It is a shared space which given its sense of public collectiveness without emphasizing on public versus private debate. The architecture representation of EU must addressing this and enacting the participation of the people without sacrificing its basic functions.

Reference
Rue de la Roi - old time

European Quarter

Rue de la Roi - present time

European Quarter
### Building Height Statistic - Brussels

<table>
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<tr>
<th>#</th>
<th>Building Name</th>
<th>City</th>
<th>Height (meters)</th>
<th>Height (feet)</th>
<th>Year</th>
<th>Material</th>
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Source: [http://skyscrapercenter.com/](http://skyscrapercenter.com/)

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**Sources:**

- [Council of Tall Buildings and Urban Habitat](http://www.ctbh.org)
- [CTBUH Tall Buildings Database](http://www.ctbuh.org)
- [National Fire Protection Association](http://www.nfpa.org)
- [Emporis](http://www.emporis.com)

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**City Maps:**

- [1960-1969](#)
- [1970-1979](#)
- [1980-1990](#)
- [1990-1999](#)
- [2000-2009](#)
- [2010-2019](#)

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**Building Details:**

- [1960-1969](#)
- [1970-1979](#)
- [1980-1989](#)
- [1990-1999](#)
- [2000-2009](#)
- [2010-2019](#)

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**Further Resources:**

- [Building Height Database](http://skyscrapercenter.com/building-height/)
Existing EU Buildings
European Quarter
Building of EU in Brussels
(Post) Modernistic buildings > 1995 (built or redeveloped)
(Post) Modernistic buildings < 1995
Classical / neo classical / traditionalist buildings

Most of the office buildings (west on the map) are from before 1995. Most dwellings (north and south on the map) are classical and neo-classical. The buildings around the Wetstraat are relatively new.
Morphology Location

Existing morphology

Morphology part demolished

Morphology future with realised masterplan

Heights future with realised masterplan
Main Road - Rue de la Roi
How to design a EU building that integrates with urban fabric and enhance the quality of public space especially at street level?
"To fully appreciate a high density social urbanism, cities must increase the quality and quantity of well-planned public spaces that are human in scale, healthy, safe and lively" (Meyer 2012, 24).
EU Quarter's Masterplan
by C. de Portzamparc
Masterplan for EU headquarter by Christian de Portzamparc:

- Tries bridge the differences of separated members
- Specifically wants to be accessible and recognizable urban setting to the people of Brussels
- To stimulate urban regeneration
- Use a specific architectural expression to stimulate civic participation, one of EU's value, and inspire a common fondness through urban experience.

- The new proposal must be able to propose an urban project that is capable of reframing the existing city, of articulating its patterns and accesses, of celebrating its collective rituals of public life.

dovides the right to participate in collective events and to gain access to public spaces.

Phase III (2018 – 2025)
EU Working Mode

Example: European Commission (Executive)

DGs = Directorates-General

EU Meeting System

FORMAL

FORMAL

FORMAL

INFORMAL
Current EU's Office Problems

- There are no plans or clear guidelines on how to represent EU urbanistically and architecturally (Aureli 2007, 37).
- Rent offices are scattered between Brussels, Luxembourg, Frankfurt and Strasbourg. Even in the cities themselves.
- The offices are just being 'injected' into the available spaces in the city.
- There are separation of the institutions from the rest of the city and community.

Interviews & Surveys of EU's Office

Main Points:
- Every department has their own small library apart from central library.
- Every floor has small and medium meeting room (up to 20 people) with central photo copy room
- Training room
- Canteen provides good and cheap food for staff is important.
- Pantry is also important for heating the food, make beverages, and especially because of the regular meetings. They also have regular snacks and drinks every morning for the staffs.
- Central control for ME and HVAC, with limitation to operational time (10 pm)
- Paper work still needed, thus there must be available adequate archives/ files storage.
- Interaction between people in the building happens only in the canteen and cafe which make it difficult to know people from other floor levels, departments, etc if they do not have any similar work or business.
- Not all the staffs have private office. There are also share / open office spaces.
- Need for director/head room which is connected to secretary room and staffs with its waiting area.
- The walking distance in one floor between their working space and facilities is not the main issue as they prefer to walk and move in some period instead of sitting for the whole day.
- There is a need to work closely with their team / group work to make coordination among them easy though they have their own private rooms.
- Open office space is needed also to increase the cooperation and sense of team in their work as they come from different cultures and need to involve in the work immediately which it requires a lot of connections with other departments.
- Because of the variety of cultures and working habits of the staffs from different countries, thus there are certain time periods that they must be present in the office for work coordination. Outside those periods, it depends on them to manage their work and rest time.
- There is also need for separation between working life and private life.
- Most of the staffs are from outside Brussels or Belgium and they do not feel connected with the local communities.
Problems From The Highrise

- The design of Office & Residences are not emphasizing on Human interaction, sociability, and community sense

- It needs plaza level as meeting and melting point in tall building

- In some office, the floor plan makes people who working in it sometimes do not see the sky / sun light for the whole day

- Less attention to the less commercial / gain profit programme. Less attention to the comfortable and needs of common staffs / employee

- Some boundaries of building make dead space related to the surroundings

- Do not considering the effect on the traffic around

- Less concern on sustainability issue
How to design a building for EU that addresses the complexity of Europe?

How to design a EU building that integrates with urban fabric and enhance the quality of public space especially at street level?
How to design a good quality office space that can enhance working environment social interaction?
Pier Vittorio Aureli:

Reduce Boundaries

Urban Fabric Integration.

People
Connectivity of Different Street Level Accessible Public Space and Circulation Event Space
Metropol Parasol

Location: Seville, Spain
Architect: Jurgen Mayer - Hermann
Case Studies 3

COMMERBANK HQ

Location: Frankfurt, Germany
Architect: Foster and Partners
Case Studies 4

British Museum London

Location: London
Architect: Foster & Partners
Research ideal plan for the programme

Organization of Office Tower


Occupancy capacity: is calculated based on the number of workstations per square metre of net rental area. the layout module, the smallest possible individual office space with roughly 2.7 x 40 m, is a good unit which to base the calculation

Office organization and Building Grid

In times when only modular offices or open-plan offices were known, there were two fundamentally different grid typologies:
- two rows of modular offices with central corridor and standard clear building depth of roughly 12.0m, a facade grid of roughly 1.2m to 1.8m and room widths of 3.6m for double rooms. Table depths of roughly 80cm as well as file storage in built-in closets set along the corridor wall were standard features for modular offices prior to the introduction of computers in the workplace.
- Open-plan offices on a single floor level with a variety of structural and facade grids.

The introduction of the combination office in Germany in 1987 offered the opportunity for new solutions. Modular office, group office and combination office are competing office concepts that are suitable for different work requirements.

1. The Modular Office

   The standard layout is to arrange single and double rooms along the facade. Double rooms are often used to accommodate three employees for lack of other space.

2. The Combination Office

   Combination of workstations in single rooms with direct link to a common central core suitable for a variety of uses - the combination zone. The individual workstations are single offices with room-height divisions set along the facade, each with a small conference or meeting area. Each workstation offers:
   - a direct visual contact with the outside.
   - individual control of the work environment conditions,
   - ergonomic workstation design, adaptable to user requirements.
   - all furnishing and features used by several employees are located in the combination zone. It is available as a common area for all additional functions (printer, copier, mail room, group filing, additional or temporary workstations, meeting areas, cafe and beverage counter). The combination office facilitates close contact between the individual and their team at any time, while at the same time offering each employee a well-screened area to prevent acoustic distractions and provide the prerequisite for focused work. To fulfill this dual function, the offices are glazed on the side facing the combination zone. Daylight penetrates as far as the central zone, which also provides visual contact with the outside.
   - To avoid excessive circulation and the distractions this creates for the employees seated in the area, two typical ground plans have been developed:
     - the comb: combination office areas are arranged along an access wing that accommodates the cores, utility areas and in some cases additional offices - usually modular offices,
     - the star: combination office areas radiate out from a central core or atrium. The combination office concept offers a solution for the dilemma posed by conventional room arrangements by linking rooms that offer a quiet work atmosphere and focus, while facilitating the desired information exchange with the help of communication in defined areas.
Experience has shown that combination offices - regardless of the grid - are at least as area efficient as typical modular offices with functional workstations set along the facade in a single row as result of the highly efficient work area in the facade area and the use of the central zone for all additional functions. The area efficiency rises even further when double combination offices are created.

Wherever routine work is the order of the day with little need for internal and external meetings and few communal facilities, modular offices are a suitable and even desirable option. Hierarchical traditions and conventions are most likely the principal reasons why this concept is chosen, rather than functional requirements.

Where constant interaction alternates with focused individual work and the opportunity for communication and conversation as well as the need for many communal facilities are in the foreground - requirements that will be universal and standard in future - the decision should always be in favor of the combination office.

Group rooms (open-plan rooms) are generally not very popular among employees, and will in future be preferred for special tasks (e.g. distribution groups, call centres, drafting and construction offices).
Design Strategy & Concept Design
Guides For Passage - Atrium Design

Maximize Natural Light
- Skylit if possible

Vertically Proportioned Space

Graphics

Multiple Levels

High Visibility From Street

Ample Seating
- For customers and non-customers
- Various seating types
- View of action

Open To Street
- Doors open in good weather

Entertainment
- Special events
- Music

Active Water Features

Quiet Places

Landscaping

Retail Mix
- Include general services and flower, news, and magazine vendors

Places to Eat
- Brown bag lunch
- Food vending
- Restaurants
Development Strategy From HRW

HRW Design

Pull further the tower, combine residence & hotel masses

Existing Building Block

Connection with existing building

Connectivity

Building Footprint with connection around the site
Design Strategy
Concept Design Exploration

Existing building block

Connection with existing block

Connecting the neighbourhood

New blocks
Conceptual Mass Studies
Fire Escape Stairs Studies

Examples of Building Code Influence on Exit Stairs' Location

OFFSET CORN
- creates large travel distance to exits and, therefore, should not be used in large buildings. It also violates the common-sense definition of remote exits.

CENTRAL CORN
- remote exits are used for stair location. This results in good code compliances but creates problems when the elevator core drops off in upper floors, as one stair will tend to float.

END CORN
- have no dead-end corridors created by stair locations and are perhaps the safest solution. An additional advantage is that elevator lobbies can have windows. The main drawback is the loss of exterior office space. This is also good for the bioclimatic skyscraper as the sunken cores are at the floor plate's periphery.

= indicates the preferred configuration for the bioclimatic skyscraper

The designer has certain obligations regarding his design. Regardless of whether the prevailing code sets a maximum dead-end corridor, permits no dead-end, or allows any length of corridor.

SENSOR STAIRS
- make sense only when floor areas need not be subdivided, or when in a very small building. This problem is thrown up in a large building with multiple tenants: first, the exits are not remote by any common-sense definition; second, the maximum travel distance to the stair becomes excessive; third, the maximum dead-end corridor length becomes excessive. The creation of a ring corridor around the core solves the dead-end problem, but creates a real estate developer's nightmare in terms of lost rentable space.

Methods to Improve Efficiency of Space Use (Bay Width Ratio) in the Skyscraper

- The skyscraper is a subdivided building type and because of its vertical space and ease in getting the design correct at the outset before completion. Unlike low-rise buildings, restrictions of building design are more critical or otherwise impossible during construction of the buildings.

- The efficiency of the skyscraper can be improved in the following ways:

- Location of the service-cores and escape stairs
- Location of shafts for singularity reasons, which can be entered directly from the tenant's space (NB: efficiency can be increased by as much as 5%).

- Prescience of partitions, walls, etc.

- Natural ventilation for all elevators, stairs, and lobbies to reduce the need for mechanical pressurization.

- Addition of skylights on the exterior, which may improve on the permissible plot ratio and gain additional marketing features to the building and improve net areas.

DIAGRAM SHOWING STAIRS AND PROTECTED LOBBY
Elevators Planning

The first essential step in elevatoring a building are pedestrian flow planning and pedestrian queuing reduction; that is, determining how many people will require transportation, what will be the peak traffic, and how will it occur—all up, up with partially down traffic, or equally up and down simultaneously. Basic considerations are on how people arrive at the building, the number or occupants and visitors, their distribution by floors, and the times and rates of arrival, departure and movements.

The pedestrian planning considerations in elevatoring cover the process of locating elevators in a building, providing proper access and queuing space to passenger elevators, designing and shaping them to best accommodate people, and determining door sizes and lobby arrangements, to make sure the optimum use and benefits is gained from the total elevator plants in a building. Indeed, efficient elevatoring requires minimizing the time factors to maximizing services.

Locating elevators in the geometric centre of the population on each floor in a building allows all part of each floors to be equally accessible to the elevator core. It is often proposed to provide two elevators cores, serving the same floors at separate locations, to avoid a long horizontal distance to a central elevator core.

The walking distance from the elevators to the farthest office or suite should not exceed 60m, with preferred maximum distance of about 45m.

Group of six elevators are often found in large office buildings, public buildings and large hospitals. The arrangement of six cars, three opposite three, is the preferred architectural core scheme. The waiting passenger can see all six elevators simply by turning around. The distance to the next arriving elevator is a minimum, and the car need be held at a stop for a minimum time. The lobby width for a six-car group of elevators should be from one and three-fourths to two times the depth of an elevator but no less than 3m. If the lobby is to be used as passage for other than elevator passengers (never recommended at the main floor), its width should be no less than 3.6m.

Commercial buildings have definite vertical transportation requirements, because the arrival and departure of their populations are usually concentrated within certain periods of the working day. High-density horizontal transportation may be provided by a transit terminal near a building. As the trains arrive, groups of people enter the building, most people timing their transit trip to arrive almost at the time they must start to work. With a train capable of discharging hundreds of people in a short time, the building's vertical transportation system is subject to severe incoming peak demands. The other extreme of horizontal traffic reflecting a building's elevators is evident in a suburban office building with remote parking. Demand on the building's elevators maybe directly related to the time required for people to park their cars and walk to the building. If there are local coffee shops, the potential elevator passenger may arrive earlier, have breakfast, then enter the building. If eating facilities are provide in the building, the people may go to their desks and immediately return to the coffee shop.
SUGGESTED ELEVATOR CAPACITY

<table>
<thead>
<tr>
<th>HEIGHT</th>
<th>COMMERCIAL</th>
<th>HOTEL</th>
<th>APARTMENT</th>
<th>CAR-PARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 ft (10 persons)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>1500 ft (15 persons)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>2000 ft (20 persons)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>2500 ft (25 persons)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>3000 ft (30 persons)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

Lobby zoning arrangement for incoming traffic: (a) poor arrangement; (b) acceptable arrangement.
Incoming traffic -
Office

Suggested Building Population Factors Related to Building

Height—Based on Net Usable Area

- 0 to 10 floors: 125 ft² (12.5 m²) per person
- 0 to 20 floors: Floors 1 to 10: 125 ft² (12.5 m²) per person, Floors 11 to 20: 140 ft² (13 m²) per person
- 0 to 30 floors: Floors 1 to 10: 125 ft² (12.5 m²) per person, Floors 11 to 20: 140 ft² (13 m²) per person, Floors 21 to 30: 160 ft² (14.5 m²) per person
- 0 to 40 floors: Floors 1 to 10: 125 ft² (12.5 m²) per person, Floors 11 to 20: 140 ft² (13 m²) per person, Floors 21 to 30: 160 ft² (14.5 m²) per person, Floors 31 to 40: 150 ft² (15 m²) per person

Other Commercial Space

- Professional buildings: 200 ft² (20 m²) per doctor's office
- Self-parking garages: 300 ft² (30 m²) per garage, 1.2 persons per auto
- Stores: Customer density of 10 to 40 ft² (1 to 4 m²) per net selling floor
- Industrial buildings: Factories, drafting: Depends on manufacturing layout and product

Elevator people handling—typical incoming traffic flow.
Suggested Elevator Capacity (pounds)—Commercial Buildings

<table>
<thead>
<tr>
<th>Class of Building</th>
<th>Type of Building</th>
<th>Small</th>
<th>Average</th>
<th>Large or Prestige</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offices, suburban</td>
<td>2500</td>
<td>3000</td>
<td>3500</td>
<td></td>
</tr>
<tr>
<td>Service elevator</td>
<td>4000</td>
<td>4500</td>
<td>5000</td>
<td></td>
</tr>
<tr>
<td>Offices, downtown</td>
<td>3000</td>
<td>3500</td>
<td>4000</td>
<td></td>
</tr>
<tr>
<td>Service elevator</td>
<td>4000</td>
<td>4500</td>
<td>6000</td>
<td></td>
</tr>
<tr>
<td>Professional offices</td>
<td>2500</td>
<td>3000</td>
<td>4000</td>
<td></td>
</tr>
<tr>
<td>Service elevator</td>
<td>4000</td>
<td>4500</td>
<td>5000</td>
<td></td>
</tr>
<tr>
<td>Service elevator</td>
<td>3500</td>
<td>4000</td>
<td>4000</td>
<td></td>
</tr>
<tr>
<td>Service elevator</td>
<td>4000</td>
<td>4500</td>
<td>6000 to 8000</td>
<td></td>
</tr>
<tr>
<td>Service elevator</td>
<td>2500</td>
<td>3000</td>
<td>3500</td>
<td></td>
</tr>
<tr>
<td>Service elevator</td>
<td>4000</td>
<td>4500</td>
<td>4000</td>
<td></td>
</tr>
</tbody>
</table>

Metric equivalents: 2500 lb = 1200 kg 3000 lb = 1400 kg 3500 lb = 1600 kg 4000 lb = 1800 kg 4500 lb = 2000 kg 5000 lb = 2300 kg

Suggested Elevator Speeds

<table>
<thead>
<tr>
<th>Class of Building</th>
<th>Office buildings (including professional offices)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5 floors</td>
<td>200 fpsm 150 fpsm</td>
</tr>
<tr>
<td>5 to 10 floors</td>
<td>150 fpsm 100 fpsm</td>
</tr>
<tr>
<td>10 to 15 floors</td>
<td>100 fpsm 50 fpsm</td>
</tr>
<tr>
<td>15 to 25 floors</td>
<td>50 fpsm 10 fpsm</td>
</tr>
<tr>
<td>25 to 35 floors</td>
<td>10 fpsm 5 fpsm</td>
</tr>
<tr>
<td>35 to 45 floors</td>
<td>10 fpsm 10 fpsm</td>
</tr>
<tr>
<td>45 to 60 floors</td>
<td>10 fpsm 10 fpsm</td>
</tr>
<tr>
<td>over 60 floors</td>
<td>10 fpsm 10 fpsm</td>
</tr>
<tr>
<td>Service</td>
<td>100 fpsm 50 fpsm</td>
</tr>
</tbody>
</table>

Metric equivalents: 150 fpsm = 0.75 mps, 100 fpsm = 0.5 mps, 50 fpsm = 0.25 mps, 10 fpsm = 0.05 mps

Notes:
- * indicates hydraulic acceptable.
- ** indicates that the design should be considered for this height.

Typical traffic flow—diversified office building traffic observed on and off elevators at the lobby.
Traffic flowcharts—traffic in and out of elevators at a main lobby. (a) Hotel—hotel convention type; (b) apartment building.

### Residential Buildings

<table>
<thead>
<tr>
<th>Type of Building</th>
<th>Population Criteria</th>
<th>Recommended 5-min Capacity (%)</th>
<th>Interval Range (sec)</th>
<th>Inefficiency Factor (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>1.5 to 1.9 people per room</td>
<td>12 to 15</td>
<td>40 to 60</td>
<td>10</td>
</tr>
<tr>
<td>Motel</td>
<td>1.5 to 1.9 people per room</td>
<td>10 to 12</td>
<td>40 to 60</td>
<td>10</td>
</tr>
<tr>
<td>Apartments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downtown</td>
<td>1.5 to 1.75 people per bedroom</td>
<td>5 to 7</td>
<td>50 to 70</td>
<td>15</td>
</tr>
<tr>
<td>Development</td>
<td>1.75 to 2 people per bedroom</td>
<td>6 to 7</td>
<td>50 to 90</td>
<td>20</td>
</tr>
<tr>
<td>Dormitories</td>
<td></td>
<td>200 ft² per person</td>
<td>15</td>
<td>50 to 70</td>
</tr>
<tr>
<td>Residence halls</td>
<td>Same as dormitories</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior citizen</td>
<td>1.25 to 1.5 people per bedroom</td>
<td>6</td>
<td>50 to 90</td>
<td>25</td>
</tr>
</tbody>
</table>

### Suggested Elevator Size

<table>
<thead>
<tr>
<th>Type of Building</th>
<th>Passenger Elevators Size, Door Type and Size</th>
<th>Service Elevators Size, Door Type and Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>3500 lb 48-in. center-opening</td>
<td>4000 lb 48-in. center-opening</td>
</tr>
<tr>
<td>Motel</td>
<td>2500 to 3000 lb 42-in. center-opening</td>
<td>3500 lb 48-in. center-opening</td>
</tr>
<tr>
<td>Apartments</td>
<td>2500 lb 36-in. single-slide</td>
<td>2500 lb 42-in. two-speed</td>
</tr>
<tr>
<td>Dormitories</td>
<td>3000 lb 42-in. center-opening</td>
<td>Use passenger elevators at off-peak times</td>
</tr>
<tr>
<td>Residence halls</td>
<td>2500 lb 42-in. two-speed</td>
<td>Suggest 4000 lb hospital type</td>
</tr>
<tr>
<td>Senior citizen</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Use traction or hydraulic elevators.

**Building Height**
- Hotels-Motels: 2 to 6 floors 150, 6 to 12 floors 300, 12 to 20 floors 400 to 500
- Apartments and Senior Citizen Housing: 150
- Dormitories and Residence Halls: 200 to 250 floors 500, 25 to 30 floors 700, 30 to 40 floors 1000 to 1200

For buildings of this height, local and express elevators should be considered.
Elevator Calculation Based on System Provided by KONE Elevator
A. High zone Office Elevator (Level 40th-51st)

Data
- Elevator transfer lobby at level 40th
- Floor gross area: 1,685m²/floor
- Net usable area: 85% from gross area: 85% x 1685 = 1.433m²/floor
- Population factor in office (>40 floor): 15m²/person
- Population/floor: 1.433 / 15 = 96 people/floor
- Number of floor in high zone: 11
- Total population: 1056 people
- Floor to floor height: 3.8m
- Number of stops: 11

Parameter
- Up peak handling capacity for office with 10% down traffic: 11-12%
- Suggested elevator speed (acceleration rate): 2,5m/s (500fpm)
- Travel time: 50m / 2.5 = 20s
- Elevator acceleration type: normal

Calculation Result
- Maximum Handling capacity: 11.3%
- Average transit time at 11% 5HC: 48.9s
- Average waiting time at 11% 5HC: 25.4s
- Average time to destination at 11% 5HC: 74.4s
- Thus, elevators needed: 3 elevators, @16 person capacity load, @2.5m/s (500fpm) elevator speed, with time to destination 73.7s.
B. **Middle zone Office Elevator**

1. **Level 21st-39th**

**Data**
- Elevator transfer lobby at level 21st
- Floor gross area: 1.852m²/floor
- Net usable area: 85% from gross area: 85% x 1852 = 1.575m²/floor
- Population factor in office (>40 floor): 15m²/person
- Population/floor: 1.575 / 15 = 105 people/floor
- Number of floor in middle zone: 18
- Total population: 1890 people
- Floor to floor height: 3.8m
- Number of stops: 18
- Travel for the distance: 72m

**Parameter**
- Up peak handling capacity for office with 10% down traffic: 11-12%
- Suggested elevator speed (acceleration rate): 3.5m/s (700fpm)
- Travel time: 72m / 3.5 = 21s
- Elevator acceleration type: normal

**Calculation Result**
- Maximum Handling capacity: 12.1%
- Average transit time at 11% 5HC: 49.5s
- Average waiting time at 11% 5HC: 19.2s
- Average time to destination at 11% 5HC: 68.7s
- Thus, elevators needed: 6 elevators, @16 person capacity load, @3.5m/s (700fpm) elevator speed, with time to destination 66.1s.

2. **Alternative to split the elevator in middle zone into 2 smaller zone (short distance)**

a. **Zone Level 21st-31st**

**Data**
- Elevator transfer lobby at level 21st
- Floor gross area: 1.852m²/floor
- Net usable area: 85% from gross area: 85% x 1852 = 1.575m²/floor
- Population factor in office (>40 floor): 15m²/person
- Population/floor: 1.575 / 15 = 105 people/floor
- Number of floor in middle zone: 10
- Total population: 1050 people
- Floor to floor height: 3.8m
- Number of stops: 10
- Travel for the distance: 42m

**Parameter**
- Up peak handling capacity for office with 10% down traffic: 11-12%
- Suggested elevator speed (acceleration rate): 2.5m/s (500fpm)
- Travel time: 42m / 2.5 = 16.8s
- Elevator acceleration type: normal

**Calculation Result**
- Maximum Handling capacity: 12.4%
- Average transit time at 11% 5HC: 50.4s
- Average waiting time at 11% 5HC: 16.8s
- Average time to destination at 11% 5HC: 67.2s
- Thus, elevators needed: 3 elevators, @16 person capacity load, @2.5m/s (500fpm) elevator speed, with time to destination 65s.

b. **Zone Level 31st-39th**

**Data**
- Elevator transfer lobby at level 21st
- Floor gross area: 1.852m²/floor
- Net usable area: 85% from gross area: 85% x 1852 = 1.575m²/floor
- Population factor in office (>40 floor): 15m²/person
- Population/floor: 1.575 / 15 = 105 people/floor
- Number of floor in middle zone: 9
- Total population: 945 people
- Floor to floor height: 3.8m
- Number of stops: 9
- Travel for the distance: 31m

**Parameter**
- Up peak handling capacity for office with 10% down traffic: 11-12%
- Suggested elevator speed (acceleration rate): 2.5m/s (500fpm)
- Travel time: 31m / 2.5 = 12.4s
- Elevator acceleration type: normal

**Calculation Result**
- Maximum Handling capacity: 15.7%
- Average transit time at 11% 5HC: 46.8s
- Average waiting time at 11% 5HC: 10.4s
- Average time to destination at 11% 5HC: 57.2s
- Thus, elevators needed: 3 elevators, @16 person capacity load, @2.5m/s (500fpm) elevator speed, with time to destination 51.7s.

C. **Low zone Office Elevator**

1. **Level Ground Floor-20th**

**Data**
- Elevator transfer lobby at level Ground Floor
- Floor gross area: 2.510m²/floor
- Net usable area: 75% from gross area: 75% x 2510 = 1.883m²/floor
- Population factor in office (>40 floor): 15m²/person
- Population/floor: 1.883 / 15 = 126 people/floor
- Number of floor in low zone: 20
- Total population: 2520 people
- Floor to floor height: 3.8m
- Number of stops: 20
- Travel for the distance: 85m

**Parameter**
- Up peak handling capacity for office with 10% down traffic: 11-12%
- Suggested elevator speed (acceleration rate): 3.5m/s (700fpm)
- Travel time: 85m / 3.5 = 24.3s
- Elevator acceleration type: normal

**Calculation Result**
- Maximum Handling capacity: 12%
- Average transit time at 11% 5HC: 49.1s
- Average waiting time at 11% 5HC: 19.7s
- Average time to destination at 11% 5HC: 67.8s
- Thus, elevators needed: 8 elevators, @16 person capacity load, @3.5m/s (700fpm) elevator speed, with time to destination 67.7s.
2. Alternative to split the elevator in middle zone into 2 smaller zone (short distance)
   a. Level 7th-20th

   Data
   Elevator transfer lobby at level Ground Floor
   Floor gross area: 2.510m²/floor
   Net usable area: 75% from gross area: 75% x 2510 = 1.883m²/floor
   Population factor in office (>40 floor): 15m²/person
   Population/floor: 1.883 / 15 = 126 people/floor
   Number of floor in low zone: 14
   Total population: 1764 people
   Floor to floor height 3.8m
   Number of stops: 14
   Travel for the distance: 50m

   Parameter
   Up peak handling capacity for office with 10% down traffic: 11-12%
   Suggested elevator speed (acceleration rate): 2,5m/s (500fpm)
   Travel time: 50m / 2,5 = 20s
   Elevator acceleration type: normal

   Calculation Result
   Maximum Handling capacity: 11,5%
   Average transit time at 11% 5HC: 46,1s
   Average waiting time at 11% 5HC: 21,4s
   Average time to destination at 11% 5HC: 67,6s
   Thus, elevators needed: 5 elevators, @16 person capacity load, @2,5m/s (500fpm) elevator speed, with time to destination 65,8s.

   b. Level Ground Floor-6th

   Data
   Elevator transfer lobby at level Ground Floor
   Number of floor in low zone: 5
   Floor to floor height 4m
   Elevators
   Maximum Handling capacity: 11%
   Elevators needed:
   - At office tower area: 3 elevators, @16 person capacity load, @2,5m/s (500fpm) elevator speed
   - At hotel tower area: 2 elevators, @16 person capacity load, @2,5m/s (500fpm) elevator speed

   D. Shuttle Elevator
   Elevator transfer lobby: GF, 6th, 21st, 40th
   Elevators needed: 2 elevators, @22-25 person capacity load, @9m/s (1800fpm) elevator speed

E. Hotel zone Elevator
1. Level 8th-17th, Hotel business

   Data
   Elevator transfer lobby at level Ground Level
   Room: 270 rooms
   Population criteria: 1,5-2 persons/room
   Total Population: 270 x 2 = 540 people
   Floor to floor height 3.8m
   Number of stops: 10
   Travel for the distance: 68m

   Parameter
   Up peak handling capacity for hotel business: 12-15%
   Suggested elevator speed (acceleration rate): 2,5m/s (500fpm)
   Travel time: 68m / 2,5 = 27,2s
   Elevator acceleration type: normal
   Interval range for hotel: 40-60s

   Calculation Result
   Elevators needed: 3 elevators, @16 person capacity load, @2,5m/s (500fpm) elevator speed.

2. Level 18th-20th, Service apartment

   Data
   Elevator transfer lobby at level Ground Level
   Room: 42 rooms
   Population criteria: 2 persons for 1st room, 1 person for each additional room
   Total Population: 42 x 3 = 126 people
   Floor to floor height 3.8m
   Number of stops: 3
   Travel for the distance: 80m

   Parameter
   Up peak handling capacity for apartment: 5-7%
   Suggested elevator speed (acceleration rate): 2,5m/s (500fpm)
   Travel time: 80m / 2,5 = 32s
   Elevator acceleration type: normal
   Interval range for hotel: 50-70s

   Calculation Result
   Elevators needed: 2 elevators, @10 person capacity load, @2,5m/s (500fpm) elevator speed.
Proposed Programme

Office 66.453 m²
Commercial 20.327 m²
Conference / Meeting 8.238 m²
Hotel 10.783 m²
Serviced Apartment 2.768 m²
Public 9.810,5 m²
Culture 4.636,5 m²
Sport 1.285 m²
Other 565,5 m²
Parking 41.870 m²
Service, circulation, core 70.763 m²

Gross Floor Area : 237.500 m²
Net Floor Area : 166.737 m²
Zoning of Programme

Parking

Commercial

Commercial in relation to existing

Conference & Meeting
<table>
<thead>
<tr>
<th>Name</th>
<th>City</th>
<th>Country</th>
<th>Illustrator</th>
<th>Status</th>
<th>Floor</th>
<th>Use</th>
<th>Antenna</th>
<th>Spire</th>
<th>Roof</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tour du Midi</td>
<td>Brussels</td>
<td>Belgium</td>
<td>Martins</td>
<td>Built</td>
<td>38</td>
<td>Office</td>
<td></td>
<td>150 m</td>
<td></td>
</tr>
<tr>
<td>Tour Finances</td>
<td>Brussels</td>
<td>Belgium</td>
<td>THEc</td>
<td>Built</td>
<td>36</td>
<td>Office</td>
<td></td>
<td>145 m</td>
<td></td>
</tr>
<tr>
<td>UP-site</td>
<td>Brussels</td>
<td>Belgium</td>
<td>Yojo</td>
<td>Under construction</td>
<td>42</td>
<td>Mixed use</td>
<td></td>
<td>142 m</td>
<td></td>
</tr>
<tr>
<td>Dexia Tower</td>
<td>Brussels</td>
<td>Belgium</td>
<td>Steamboy</td>
<td>Built</td>
<td>2006</td>
<td>Office</td>
<td></td>
<td>136.9 m</td>
<td></td>
</tr>
<tr>
<td>Belgacom Towers</td>
<td>Brussels</td>
<td>Belgium</td>
<td>Steamboy</td>
<td>Built</td>
<td>1986</td>
<td>Office</td>
<td></td>
<td>134 m</td>
<td></td>
</tr>
<tr>
<td>Madou Plaza</td>
<td>Brussels</td>
<td>Belgium</td>
<td>THEc</td>
<td>Built</td>
<td>2004</td>
<td>Office</td>
<td></td>
<td>102 m</td>
<td></td>
</tr>
<tr>
<td>North Galaxy tower B</td>
<td>Brussels</td>
<td>Belgium</td>
<td>Steamboy</td>
<td>Built</td>
<td>2004</td>
<td>Office</td>
<td></td>
<td>120 m</td>
<td></td>
</tr>
<tr>
<td>North Galaxy tower A</td>
<td>Brussels</td>
<td>Belgium</td>
<td>Steamboy</td>
<td>Built</td>
<td>2004</td>
<td>Office</td>
<td></td>
<td>107 m</td>
<td></td>
</tr>
</tbody>
</table>
Level -5th
(-15m)

ME Room, Pump Room,
Services

ME Room, Pump Room,
Services
Level -4th (-10m)
Level -1 & -3
(-2,5m & -7,5m)
Level -2nd
(-5m)
Level Ground Floor
(0m)

Connection for different height street level
Level Ground Floor
( 0m )

Connection with existing building
Private - Public Space
Level 1 & 2
(4 & 8m)
Level 1 & 2
(4 & 8m)
Level 4
(16m)
Typical Office Floor Plans
South Elevation
North Elevation
Schematic
Vertical Zoning & Distribution of Lifts

Core
Low-Middle-High Zone

Core
Low-Middle Zone

Core
Low Zone

Core Rent Office

Core - Hotel

Core - Public
Office Tower Core Design

1 = Express Suttle Lifts
2 = Viewing Deck Lifts
3 = Office Lifts
4 = Fire Brigade / Service Lift
5 = Service Shaft
6 = Service / ME Room
7 = Service Lift

Hotel Tower Core Design

1 = Serviced Apartment Lifts
2 = Hotel Lifts
3 = Public Lifts
4 = Fire Brigade / Service Lift
5 = Service Shaft
6 = Service / ME Room
Loading & Unloading Services Routes

Level -4
(-10m)
Foundation System

Sub-structure
Raft pile foundation
Reason: high water level in Brussels

Brussels lays on the loam soil which is bad for foundation, especially high-rise buildings. It has the characteristics:
- Low shear force especially when it contains more fluid
- Elastic, shrink when dry and expand when wet
Factors to consider when selecting a structural system for tall building:
- Safety
- Occupant comfort
- Economic

Structure & Constructions

The shear truss, typically consisting of diagonal wide-flanged, angle, T-shaped, or tubular members, is located in the central core area or at the perimeter. Columns are typically spaced 4.5 m (15 ft) to 9 m (30 ft) on-center.

Outrigger trusses, typically at least one story tall (preferably two stories tall), are used to interconnect the central core and perimeter frame. Outrigger trusses typically consist of large wide-flanged or built-up members. Belt trusses, located within the perimeter frame at the same level as the outrigger trusses, are used to distribute forces fairly evenly from the outrigger trusses to the perimeter frame. Column spacing typically ranges from approximately the floor-to-floor height to twice the floor-to-floor height (generally, spacing varies between 4.5 m (15 ft) and 9 m (30 ft)).

Column spacing typically ranges from a dimension slightly less than the floor-to-floor height to approximately equal to the floor-to-floor height (generally, spacing varies between 3.0 m (10 ft) and 4.5 m (15 ft)).
Interior tubular frames or shear walls are combined with perimeter tubular frames. These frames or shear walls provide additional strength and stiffness to the tubular system.

Shear walls within a tower are most commonly centrally located around service areas, including elevators, mechanical spaces, and restrooms. Shear wall spacing locations vary, but they are generally located 9 m (30 ft) apart to allow for a double bank of elevators and an elevator lobby. Link beams are used to interconnect wall segments where doors or mechanical openings are required in the core. Frames are combined with the shear walls to increase strength and stiffness. Column spacing typically ranges from approximately the floor-to-floor height to twice the floor-to-floor height (generally, spacing vanes between 4.5 m (15 ft) and 9 m (30 ft)).

Column spacing approximately matches the floor-to-floor height, while aligning with interior partitions/exterior wall mullion modules (column spacing typically 4.5 m (15ft)). The taller the building, the greater the need to use deeper rectangular sections for beams and columns and closer column spacing, with rectangular column sections orientated to provide greatest bending resistance.

### Table 6.5: Comparison of various building materials [4]

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Reinforced concrete, Normal-strength concrete</th>
<th>Reinforced concrete, High-strength concrete</th>
<th>Steel construction</th>
<th>Composite construction method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction costs</td>
<td>+</td>
<td>++</td>
<td>O</td>
<td>+</td>
</tr>
<tr>
<td>Weight of construction</td>
<td>O</td>
<td>+</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Stiffness</td>
<td>++</td>
<td>++</td>
<td>O</td>
<td>+</td>
</tr>
<tr>
<td>Flexibility of plan</td>
<td>O</td>
<td>O</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Behavior in fire</td>
<td>++</td>
<td>++</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Construction time</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Usable area</td>
<td>-</td>
<td>+</td>
<td>++</td>
<td>+</td>
</tr>
</tbody>
</table>

Structural Material Quantity vs. Number of Stories

General limit of number of stories = 65 and height = 266 meters (872-9')

General limit of number of stories = 75 and height = 300 meters (1003-7')
The efficiency of the building structure may be improved by about 30% by using horizontal belt trusses to tie the frame to the core. The trusses are fixed rigidly to the core and are simply connected to the exterior columns. When the shear core tries to bend, the belt trusses act as lever arms that put direct axial stresses into the perimeter columns. These columns, in turn, act as struts to resist the deflection of the core. That is the core fully develops the horizontal shears, and the belt trusses transfer the vertical shear from the core to the facade frame. Thus, the building is made to act as a unit, very similar to the cantilever tube.

The building can have one or several belt trusses; the more trusses used, the better the integration of core and facade columns. They can be placed at locations within the building where the diagonal bracing will not interfere with the building's function (e.g., at mechanical levels). The structural principle of employing belt trusses at the top and center of a building seems to be economical in applications up to approximately 60 stories (Schueller 1977, p.99).

If the frame is tied to the core by a belt truss, however, ny rotation at the top of the system is restricted, since the perimeter columns tie the belt truss down; there is no bending moment in the columns.

The strength and stiffness of the system is further increased by adding additional belt trusses at intermediate levels within the building. At each trussed level the system is restrained from rotating (Schueller 1977, p.100-101).

Matrix: load-bearing structures of towers
**Structure Concepts & Principles**

- **Structural system**: concrete shear wall, rigid frame
- **Material**: steel frame, concrete
- **General column module**: 8100 x 8100 mm
- **Floor system**: bubble deck floor
- **Sub-structure system**: raft pile system

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**Structure for podium**

**Structure for large span**

Function Hall & Atrium
Structural System - Tower (upper part)

Upper-structure
Steel and concrete column composite
Steel framing
Concrete shear wall
Bubble deck floor
Floor System

Floor system: bubble deck floor
- 280mm, 390mm, 450mm
Raised floor floor office, 180mm
Concrete core activation (office)
Sustainability

Climatic Data:
Location:
Geographic position:
Climate classification: Temperate
Prevailing wind direction: West-Southwest
Average wind speed:
Mean annual temperature:
Average daytime temperature during the hottest months (June, July, August):
Average daytime temperature during the coldest months (December, January, February):
Day/night temperature difference during the hottest months:
Average relative humidity:

Low Energy Building
- minimize solar gain/optimize daylight
- efficient building plan (shape/size)
- efficient facades
- mitigate wind pressures to allow natural vent.
- Thermal flues to enhance natural ventilation
Breath-in sky gardens
- fresh air inlet
- air exhaust
- heat wheel air handling unit

Heat wheel air handling unit
- the typical efficiency is over 79%
- the cooling or heating equipment size can be reduced
- freeze protection is not an issue
Atrium Climate System

Summer Condition

Roof top controllable openings

Wind catcher

Controllable openings

Winter Condition

Heat recovery ventilation system

Air door curtain system

Heat recovery ventilation system
Office Indoor Climate System

Hotel Indoor Climate System
Facade Concept

Goal + Ambition:

Simple & Elegant Facade - Do not compete with buildings surrounding to it

Reflecting the prestige of EU

Easy in Installation & Dismantling

Provide adequate internal comfort for its users
Material: Fritted Glass

**Reasons & Benefit:**

- Aesthetic Purposes
- Energy savings incorporating with daylighting systems
- Controlling solar heat gain and glare
- Providing privacy
- Strengthened Glass
Case Studies:

IAC Building
Location : Manhattan, New York
Architect : Frank Gehry
Completion : 2007
Case Studies:

Tokyo H&M Store’s
Location : Tokyo, Japan
Architect : Jun Mitsui & Associates Inc. Architects
Completion: 2007
Facade Type:

Ventilated Facade: Climate Facade

Advantages:
- The internal climate is less subject to disturbing influences of the external climate
- Convective heating is not required internally. In other words a less extensive heating system
- More usable space
- A more compact facade
- A more sound insulated facade
- Less possibilities of sound flashing through the facade
Construction Type: pre-fabricated panel system
Facade Panel's Sizes
Hotel Room
Serviced Apartment
Sky Lobby Area
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Appendix

Study on Position of Tower(s) Relating to Its Site

1. Solitaires - Monument
   Examples: Kingdom Centre (Riyadh), Moscow State University, Burj Khalifa (Dubai)

2. Solitaires - Tower in block
   Examples: Norddeutsche Landesbank (Hanover), Torre Agbar (Barcelona), Seagram Building (New York), Torre Velasca (Milan)

3. Solitaires - Tower as block
   Examples: Commerzbank Tower (Frankfurt), Transamerica Pyramid (San Francisco)

4. Solitaires - Tower as team player
   Examples: Tokyo Metropolitan Government Building, Thyssen-Haus (Dusseldorf), United Nations HQ (New York)

5. Solitaires - Twin Tower
   Examples: Petronas Tower (Kuala Lumpur), Marina City Towers (Chicago), Puerta de Europa (Madrid)

6. Clusters - Integrated in existing city fabric
   Examples: Rockefeller Centre (New York), Riverside Centre (New York)

7. Clusters - Towers as urban pattern
   Examples: Quartier du Palais (France), Jianwai SOHO (Beijing), Stuyvesant Town (New York)
8. Clusters - Linear clusters
Examples: Sheikh Zayed Road (Dubai), Rue de la Roi (Brussels)

9. Clusters - High-rise compound
Examples: Moms and Pop Moma (Beijing), Marina Baie des Anges (France), Icon Brickell (Miami)

10. Clusters - Towers in nature
Examples: Unite d Habitation (Marseilles), Newton Suites (Singapore)

11. Clusters - Towers on podium
Examples: Front de Seine (Paris), Jumeirah Beach Residences (Dubai), Tour 9 (Montreal), Taman Anggrek Kondominium (Jakarta)

Five Energy Generations of Tall Building


A number of trends affecting tall-building energy performance and its shape throughout history:
1. Primary energy in first-generation buildings (1885-1916) was predominantly consumed in the heating of occupied spaces and providing vertical transport, as other technologies were not yet developed. These towers benefited from their compact and bulky shape (large volume vs. small surface area) reducing winter heat loss through the building envelope, which also contained a high degree of thermal mass.

2. Second-generation buildings (1916-1951) were increasingly slender (small volume vs. large surface area): a direct result of the New York Zoning Law of 1916. This change in shape would increase winter heat loss, but at the same time allow for a greater level of daylight penetration at the upper floors. Like first-generation buildings, these towers also benefited from thermal mass within the envelope construction.

3. Third-generation buildings (1951-1973) were heavily influenced by the development of glazed curtain walls; 50-75% of tall building facade area in this generation consisted of glazing, compared to 20-40% in the previous two generations. Subsequently, facade U-values increased due to the high proportions of single glazing used. Tall buildings of this generation were hermetically sealed boxes, totally reliant on mechanical conditioning and artificial lighting: despite high levels of facade transparency, tinted glazing and deep floor plans significantly restricted daylight penetration. At the same time, office illuminance recommendations were significantly higher in this era than at any other time.

4. Fourth-generation buildings (1973 to the present day) benefited greatly from a widespread switch to double-glazing and increased technological developments in curtain wall facades. While envelope glazing percentages remained high, facade U values decreased from around 3.0 - 4.2W/m²K in third-generation buildings, to levels of 1.0-1.5W/m²K. The majority of tall buildings constructed today continue to demonstrate the characteristics of fourth-generation buildings: compact shape (surface area to volume ratios of around 0.07 m²/m³-0.12 m²/m³), high levels of facade glazing (40 - 85%) and a reliance on air-conditioning.

5. Fifth-generation buildings (1997 to the present day) are still relatively rare, at least in completed form. Generally these towers have a high surface area to volume ratio (often achieved by the use of large atria) and high quantities of envelope transparency, allowing for excellent levels of daylight penetration, but at the cost of higher winter heating loads. The use of natural and mixed-mode ventilation strategies are also common in these towers. Lastly, buildings of this category have recently begun exploring the potential to harness on-site energy generation from low- and zero-carbon sources.
This graduation project is about designing a complete district of mixed functions and embeds it into the urban pattern with its main program is office high-rise building along with its supporting facilities for European Union in Rue de La Roi, Brussels, Belgium. The challenging problem from this project is that the site has different level of contours which requires special attention from the architect to connect four streets around it with different characteristics. Additionally, there are existing buildings on the site which by Christian de Portzamparc (the master planner for this area) are proposed to be retained. One of it is considered as a conservation building. Generally high-rise design demands high efficiency and compactness which providing not enough communal area, neither good working and living environment, nor natural daylight and air flow in its design. Therefore, the integration of public spaces in the tower become important if the building wants to embrace human qualities in order to enhance its user's perception and experience. In fact, for the reason of efficiency, structure, and so on, the design of tall building pays less attention to its internal architecture, public space, view and users' experience. Indeed, there is a tendency that tall building becomes a "soulless" large spaces stacking high on top each other to be inhabited by people. We cannot find in tall buildings the same public life characteristics or atmosphere like we found at street level of the cities. With regards to those notions above, working and living in high-rise building should not make people disintegrate with its natural environment and community. It should not seclude in its own "height" but its design should enhance the connection between its users and enhance their experience and perception to be there likewise in the lower level. Therefore, those are the notions that I would like to achieve in my graduation project where the public spaces in tall buildings become the critical decision factors in the design process and result.

**Problem Statement**

Primarily, the issues that I would like to research in this graduation project are the notion of public space at street level where tall building meets with ground as well as in higher level of the tower and the notion of materiality and perception of users in those spaces. Then, by learning from case studies that have been built so far combine with my own experiences working and living in high-rise buildings, I started to pose questions relating the issues of public spaces and natural environment integration in high-rise building (tower) in order to enhance its user's perception and senses. On the lower level, the question to consider is the connection of the tower to the ground with different levels contours and how to extend the public domain beyond the street level. How to connect and place the high-rise tower(s) related to the urban fabric surrounds it where most of the buildings are still low. Thus, on the higher level or in the tower itself, the question is how to integrate public space into floors space design in order to create a better working and living environment for its users while still maintaining its efficiency and functionality. Including, on how the experience and perception of the users in these spaces can be enhanced by the exploration of material, detail and construction techniques.