L-Università ta' Malta
Faculty for the
Built Environment

M.Eng. Year 1 - Design Workshop
CVE5101-1 (Structural Engineering)
CVE5103A-1 (Structural Engineering with Project Management)
Multi-Storey Building Project

Unit Co-Ordinator:

Professor Marc Bonello

Design Project Mentors:

Professor Marc Bonello, Professor Spiridione Buhagiar, Dr Jeanette Mireille Muñoz Abela, Dr Adrian Mifsud, Dr Nathan Vella, Dr John Valentino, Professor Rebecca Dalli Gonzi & Prof.Ing. Simon Paul Borg.

Design Brief:

Your client requires you to propose a preliminary architectural and structural design concept for a 25-storey high-rise mixed use residential/commercial building complex above ground level.

The proposed multi-storey building shall have:

(a) Three basement car park levels. The first level of basements (Level -1) shall have a clear usable height of not less than 4.50m for the access of service vehicles, whilst Level -2 and Level -3 shall each have a clear usable height of not less than 2.50m. Parking is to be two-way searching, and car bins are to be 2.5m wide by 5.0m long. The width of the passage ways are to be 6.0m wide. You are to design the ramps leading down to the basement levels and the car parking layout. The grid spacing of your columns must allow for a two-way searching scheme, and it must allow for adequate car parking bins as indicated. The vertical building service core/s must also fit between the passage ways. The perimeter of the underground car park may extend beyond the perimeter of the overlying residential/commercial development up to the perimeter of the building site.

(b) A double height commercial development at Ground Floor Level, with a total gross footprint area not exceeding 3,600 sq.m., including the building structure. The Ground Floor must have a clear finished floor-to-soffit height of not less than 8.50m. The Ground Floor commercial area must also accommodate a mezzanine floor having an area of not more than circa 25% of the proposed total Ground Floor footprint area. The commercial development can have any desired geometrical shape on plan. The overlying residential building may intersect the commercial space at any location you may decide, so long as it is bounded within the footprint of the commercial area.

(c) 20 in No. additional residential floors within a tower above the commercial development. An adequate number of floors are to be dedicated to building services plant and equipment. The total footprint area of each residential floor plate must not exceed 1,600 sq.m.. The typical floor plate may take any desired geometrical shape on plan. An appropriate mix of 1-bedroom, 2-bedroom and 3-bedroom residential apartments, including duplex and triplex apartments and suites, is to be provided within the residential tower.

(d) Vertical building service core/s must provide for a sufficient number of passenger lifts, fire escape staircase/s, wet, dry, electrical and ventilation shafts for building electro-mechanical services, as well as adequate service facilities on each floor. The vertical building service core/s must pass through the commercial and basement levels of the proposed building development.

(e) Emergency staircases are to be provided as may deemed to be necessary.

Design Constraints:

(1) The fully-detached building site is to be located within a busy touristic zone on a site, which is currently being used by an existing hotel complex, and which is very close to main road, Triq il-Korp tal-Pijunieri, and to the Buġibba Waterfront in St.Paul's Bays. The project site is bounded on the North-West by Triq il-Ġifen, on the North-East by Triq l-Ibħra, on the South-East by Triq il-Mistrieħ and on the South-West by Triq Ċensu Tanti, as shown in the site plan (Figure 1) and the aerial photograph (Figure 2).

(2) The ground geotechnical conditions of the site need to be determined from the Geological Maps of the Maltese Islands and information on ground conditions obtained from the vertical excavated faces within the project site as well as recent construction projects within the area.

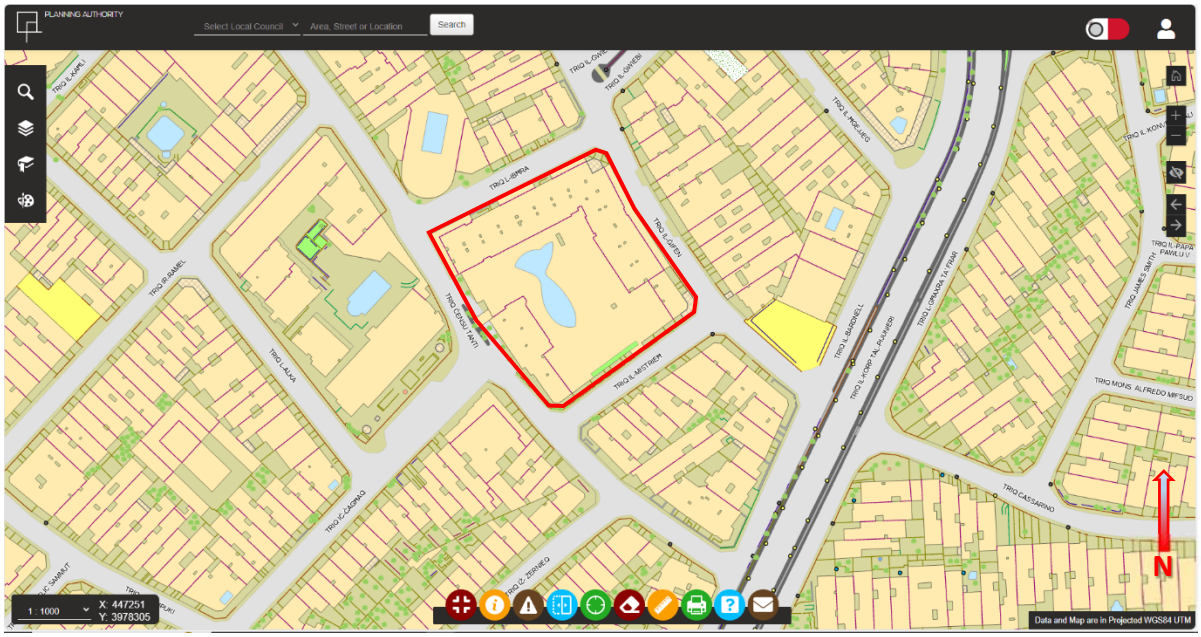

Figure 1: Site Plan of Proposed Multi-Storey Building Complex at Buġibba in St.Paul's Bay

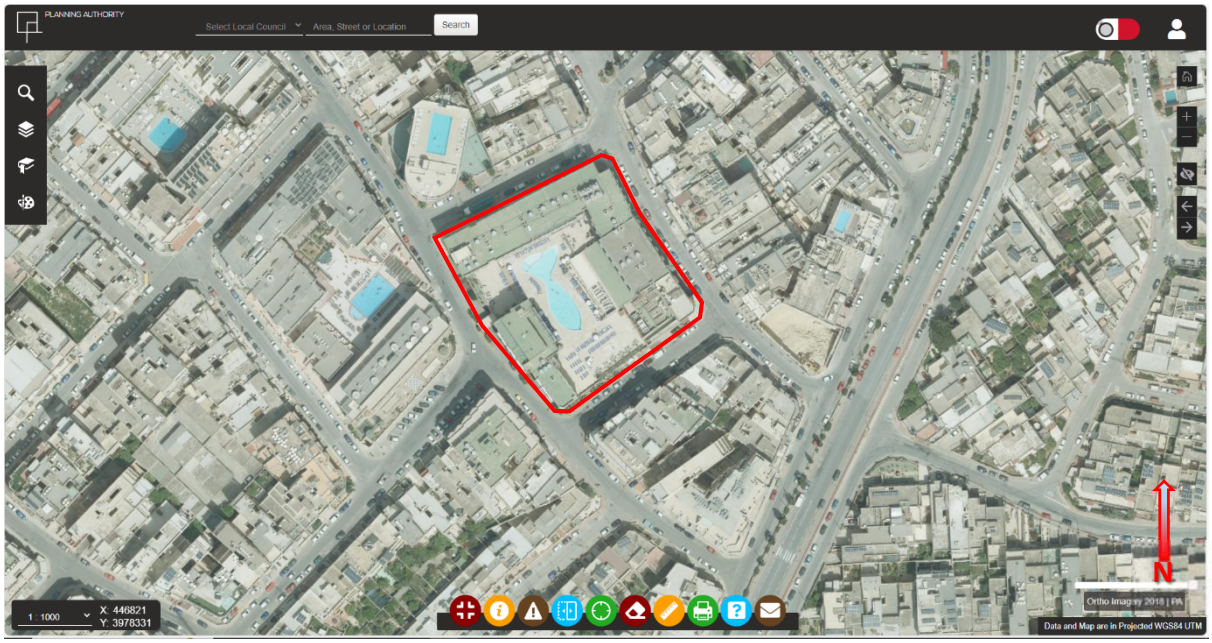

Figure 2: Aerial Photograph of Proposed Multi-Storey Building Complex at Buġibba in St.Paul's Bay

(3) An adequate Minimum Fire Rating for the multi-storey building complex is to be provided in accordance with local and international fire safety engineering standards.

(4) The basic design wind speed may be assumed to be 31 m/s. You are also to assume that the building complex is located within a coastal terrain at the edge of the town of Buġibba in accordance with the requirements of Eurocode 1 (EN 1991).

(5) Dead (Permanent) and Live (Variable) loads are also to be considered in accordance with the requirements of Eurocode 1 (EN 1991).

(6) No seismic horizontal and vertical loading needs to be considered within this preliminary structural design concept project.

<u>The emphasis on this Design Project will be placed upon</u>:

(a) The quality of your conceptual ability to solve this structural design problem. Quality aspects should deal with:

(i) Clarity of design principles.

(ii) The basis for your choice of structural materials and the quality of construction detailing.

(iii) Stability considerations of your structural design proposals.

(b) The choice of alternative design proposals and the rationale behind your choice of structural systems.

(c) Your ability to prepare and present a MS Power Point Presentation.

(d) Your ability to prepare a concise structural design report.

(e) Your ability to prepare working structural drawings.

(f) Your ability to answer questions related to your design proposals.

Submissions:

Your Client would like you to prepare:

(i) A Masterplan for the development within the building site (showing the position of the multi-storey building complex, the entry and exit pedestrian and vehicular access points to and from the site as well as external hard and soft surface landscaping at street level).

(ii) A 3-D physical and/or digital working model.

(iii) A structural design report.

(iv) 2 in No. X A0 presentation boards.

(v) A short 15-minute MS PowerPoint Presentation (not more than 30 slides).

(vi) Preliminary structural analysis and design calculations.

The complete presentation must highlight the structural and constructional benefits of your final choice of form and structure for the multi-storey building complex. Furthermore, your structural design report should have a length of about 30 in No. A4 pages, and it should include **<u>two design concept schemes</u>, one for a concrete frame building and another for a structural steelwork frame building.**

Each of your two design concepts schemes must take into consideration:

(i) The vertical and lateral (horizontal) loading regime.

(ii) The overall lateral sway-stiffening strategy for your building.

(iii) The effect of the structural core and its location within the building.

(iv) Ground conditions and foundation design.

(v) Effects of lateral loads on the building envelope.

(vi) Spatial requirements for a high quality mixed use residential/commercial multi-storey building complex (i.e. minimum floor-to-soffit height, etc.).

In addition, you should select the preferred structural design concept and explain why you would recommend either a concrete or a structural steelwork frame building by making reference to:

(1) Your final choice of structural flooring system.

(2) Your choice of foundation system.

(3) The final location of the vertical building service core/s, and the reasons for its/their position/s within the building envelope.

(4) The final height of the building above street level.

Your structural analysis and design calculations for your selected preferred structural option should include:

(i) A set of hand structural analysis calculations that have been carried out by means of using approximate methods of structural analysis.

(ii) Structural analysis calculations carried out by means of using structural analysis computer software.

(iii) Preliminary structural design calculations indicating the member cross-sectional sizes of the typical structural elements of the building, namely the columns, beams, slabs, walls, structural core, and foundations.

(iv) You are also required to determine the overall lateral displacement of the vertical building service core/s due to horizontal wind loading (you are not required to consider horizontal and vertical seismic loading). In addition, you are required to determine the inter-storey drift for each floor level of the building.

(v) Finally, you are to compare and comment upon the results obtained from the hand and computer software structural analysis calculations of the core.

Informal Deadlines:

Commencement Date:	Friday, 4th October 2024.
End Week 2 (18th October 2024):	Structural plan and section layouts for the building.
End Week 5 (8th November 2024):	Preliminary hand structural analysis calculations.
End Week 8 (29th November 2024):	Computer software structural analysis calculations.
End Week 10 (13th December 2024):	Preliminary structural detailing and project presentation.

Formal Deadlines:

Submission Date on UM VLE:	Friday, 13th December 2024 at 23:59 Hours.
Oral Presentation & Design Reviews:	To be communicated in due course.

Design Studio Sessions with Design Project Mentors:

Professor Marc Bonello:	To be communicated in a schedule of design tutorials.
Professor Spiridione Buhagiar:	To be communicated in a schedule of design tutorials.
Dr Jeanette Mireille Muñoz Abela:	To be communicated in a schedule of design tutorials.
Dr Adrian Mifsud:	To be communicated in a schedule of design tutorials.
Dr Nathan Vella:	To be communicated in a schedule of design tutorials.
Dr John Valentino:	To be communicated in a schedule of design tutorials.
Prof. Rebecca Dalli Gonzi:	By appointment.
Prof.Ing. Simon Paul Borg:	By appointment.
Other Lecturers:	By appointment.

Learning Outcomes:

The Design Project workshop envisages the following learning outcomes:

- The student should **demonstrate a thorough knowledge of the principles of engineering and good engineering practice**, based on the handling of technical information and statistics, mathematics, physics, material science, fabrication technologies and other technical/earth sciences appropriate to the disciplines covered in the Master's Programme.
- The student should be able to **use this knowledge to propose innovative and creative solutions to specific multi-disciplinary complex engineering problems**, selected following the specific Master's Degree Programme, in full respect of cultural, societal, sustainability and aesthetic constraints.
- The student should **demonstrate the ability to develop and use theoretical models and new technologies** by which the behaviour of the proposed project can be predicted**, and to show that independent technical judgement can be applied through analysis and logic**, applying principles of good design to facilitate manufacture, assembly, maintenance, and quality, at economical cost.
- The student should **demonstrate that, depending on the project theme, civil, structural, constructional, environmental, and other engineering problems, including project management issues, associated with the proposal have been addressed**, keeping in mind cost, quality and time issues.
- The student should **demonstrate an adequate knowledge of the construction and fabrication industries, organisations, regulations and procurement procedures** involved in translating design concepts into buildings and integrating plans into overall planning.
- The student should **demonstrate that resource management issues and the provision of infrastructural support systems can be addressed**, keeping in mind sustainability and resilience principles, respect for the engineering profession, for the engineer's responsibility to colleagues, to employers and/or clients, to the community and to the environment so as to ensure well-being**, and also that those technical, financial and human considerations in the management of engineering projects, can be competently and independently addressed, and be communicated effectively.**

Assessment Criteria:

Assessment of the individual student design projects will be carried out by means of an oral examination following a MS Power-Point presentation by the students of their individual design

project deliverables submitted on the UM VLE online facility by the deadline for submissions. Every student will be allocated a maximum of 15 minutes for the oral presentation, following which there will be a 5-minute Q & A (Question and Answer) session with the design project examiners. The assessment marks, which will be assigned by the examiners, will be based upon the following assessment criteria:

Learning Outcome	Mark
Demonstrate a thorough knowledge of the principles of engineering and good engineering practice.	***10***
Use this knowledge to propose innovative and creative solutions to specific multi-disciplinary complex engineering problems.	***10***
Demonstrate the ability to develop and use theoretical models and new technologies, and to show that independent technical judgement can be applied through analysis and logic.	***10***
Demonstrate that, depending on the project theme, civil, structural, constructional, environmental, and other engineering problems, including project management issues, associated with the proposal have been addressed.	***50***
Demonstrate an adequate knowledge of the construction and fabrication industries, organisations, regulations and procurement procedures.	***10***
Demonstrate that resource management issues and the provision of infrastructural support systems can be addressed, and also that those technical, financial and human considerations in the management of engineering projects, can be competently and independently addressed, and be communicated effectively.	***10***

Plagiarism & Collusion:

When writing their Technical Design Report, students should be mindful of the regulations on plagiarism and collusion of the University of Malta, which may be consulted online at:
Student Conduct - Office of the Registrar - L-Università ta' Malta (um.edu.mt)

Furthermore, while students are allowed to work within student groups, it is important for students to keep in mind that their design projects will be marked only for individual academic effort. In this respect, students are strongly advised to avoid submitting an individual design project, which is essentially identical, or very similar, to another or other design project/s, since such design project submissions will be heavily penalised by the examiners for collusion.