



L-Università ta' Malta

Faculty for the
Built Environment

B.Sc.(Hons) in Built Environment Studies
BEN3102 – Design Workshop
OCC_A – Roof Canopy Project

Unit Co-Ordinator:

Professor Marc Bonello

Tutors:

On a weekly basis:

Dr Nathan Vella, Perit Carmelo Barbara, Dr Konrad Xuereb & Perit David Xuereb.

On an ad hoc basis:

Prof. Ing. Simon P. Borg may be consulted for any building engineering services requirements of the design project.

Specific Instructions:

Date Assignment Set: Thursday 14th November 2024

Presentation Date: Wednesday 15th January 2025

Deliverables: At least, 1 in No. (physical or digital) working model, 2 in No. A0 sheets, an A4 Design report (not exceeding 30 in No. pages), preliminary structural analysis and design calculations for **the proposed structural design solution** of the roof canopy structure and its foundations, and an MS PowerPoint Presentation (maximum 20 in No. slides).

Credits Assigned: 3 ECTS

Method of Assessment: Design Project Portfolio Assessment & Oral Examination

Description of Assignment:

Programme:

This Design Workshop will have an 8-week duration, starting on Wednesday 20th November 2024. The Design Project Deliverables for this Design Workshop are to be submitted on UM VLE by Wednesday

15th January 2025 at 23:59 Hours on the BEN3102 OCC_A study-unit area of UM VLE. The date of the Oral Presentation and Final Design Review for this Design Workshop will be communicated in due course.

Objective:

The Tal-Qroqq National Pool Complex at Msida is a popular venue for local and international waterpolo and swimming sport events. These events attract sizeable crowds of spectators to the Complex, which has two spectator stands, namely the main spectator stand alongside Regional Road and a smaller spectator stand on the opposite side of the swimming pool (*vide* attached site plan and aerial photographs).

In line with international standards for indoor swimming pool complexes for competitive sports, the management of Sport Malta responsible for the operation of the National Pool Complex intends to construct an all-weather roof canopy over the existing outdoor pool and both spectator stands, in order to provide adequate comfort and protection from the external climatic conditions to both the swimmers and spectators.

In this respect, you are required to propose and design an elegant and functional all-weather roof canopy enclosure over the existing pool and both spectator stands. In the proposed structural design solution:

- (i) The supporting columns are to be kept, as close as possible to the perimeter of the site extents (as shown in yellow in the attached aerial photograph), that is, no columns are permitted within the spectator stands or the pool area.
- (ii) There is to be no encroachment on to the public roads around the site.
- (iii) The roof canopy, its supports and its foundations should be designed in such a way as not to interfere with the sight lines of the seated spectators.
- (iv) The design of the project must include considerations of access for all.
- (v) An adequate Minimum Fire Rating for the sports complex is to be provided in accordance with local and international fire safety engineering standards.
- (vi) The rainwater drainage of the roof canopy is to be properly managed and harvested.
- (vii) The choice of structural system of the roof canopy needs to consider the end-of-life use of the structural and finishing materials used to construct the roof canopy.

- (viii) The choice of structural system of the roof canopy also needs to consider sustainability issues, which may be relevant for this type of structure, including possibly the generation of alternative energy, which could, as far as possible, lead a nearly net zero carbon footprint for this sports facility.
- (ix) Due consideration of the existing ground conditions should also be taken into consideration during the structural design of the roof canopy and its foundations.
- (x) The geological formation of the subsoil in the site may be deduced from the Geological Map for the Maltese Islands.
- (xi) The roof canopy should be designed for a basic wind speed of 31 m/s. You are also to assume that the building complex is located within an inland terrain at the edge of the town of Gżira in accordance with the requirements of Eurocode 1 (EN 1991).
- (xii) Dead (Permanent) and Live (Variable) loads are also to be considered in accordance with the requirements of Eurocode 1 (EN 1991).
- (xiii) No seismic horizontal and vertical loading needs to be considered within this preliminary structural design concept project.
- (xiv) All the structural design of the roof canopy and its foundations is to be carried out using Eurocode structural design codes.

Learning Outcomes:

This design project workshop envisages the following learning outcomes for the roof canopy design project:

- An ability to **identify, formulate and solve engineering problems**, to select and apply relevant methods from established analytical, computational and experimental methods, to recognise the importance of non-technical – societal, health and safety, environmental and industrial – constraints.
- An ability to develop and **design engineering structures and systems in detail** to meet established requirements, that can include an awareness of non-technical considerations, and to select and apply relevant design methodologies.
- An ability to conduct searches of literature, to consult and to critically use scientific databases and other appropriate sources of information, to **carry out structural simulation and critical analysis** in order to pursue detailed investigations and research of technical issues.
- An ability to consult and **apply design codes of practice and safety regulations**.
- An **understanding of applicable materials, equipment and tools, engineering technologies**, and their limitation.

- An ability to **communicate effectively** information, ideas, problems and solutions.
- An ability to **function as a member of a design team** and to cooperate effectively with peers.

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:

<i>Learning Outcome</i>	<i>Mark</i>
Identify, formulate and solve engineering problems	10
Design engineering structures and systems in detail	50
Carry out structural simulation and critical analysis	10
Apply design codes of practice and safety regulations	5
Understanding of applicable materials, equipment and tools, engineering technologies	10
Communicate effectively	10
Function as a member of a design team	5

Tasks:

As usual, the design process will commence with the production of a Pre-Design Document, which may be prepared either individually or in groups of students. This document should address the following thematics in separate sections:

- a) Site Analysis / Desk Study of the site, including all relevant issues.
- b) SWOT analysis comparing different alternative design strategies.
- c) Applicable provisions of design codes of practice, particularly, the relevant Euronorms and Structural Eurocodes.
- d) Technological research, including case studies, of:
 - different structural engineering design solutions
 - alternative structural materials
 - building services engineering, including renewable clean energy generation
 - construction methodology, including proposed assembly and erection process
 - life cycle assessment

- traffic and pedestrian access, including accessibility for all
- fire safety engineering considerations

Every student must then individually prepare a Technical Design Report consisting of the following sections:

- (a) Case studies of similar building projects.
- (b) Selection of the most appropriate architectural and structural engineering design solution, and justification for such choice.
- (c) Structural analysis and design calculations of primary structural members of roof canopy for the selected architectural and structural engineering design solution.
- (d) Structural engineering and building construction sketch details.
- (e) Appropriate geotechnical solutions.
- (f) Construction and de-construction options.
- (g) Integration of building engineering services with the proposed structural system.
- (h) Design for accessibility for all.
- (i) References and bibliography demonstrating the extent of research work carried out.

Design Methodology:

It is intended that this Design Workshop would be an opportunity to study the holistic DESIGN PROCESS, starting from an understanding of the Site, an understanding of the functional requirements of the design project, and a survey of case studies– examples of similar existing roof canopy structures from which to learn.

The first two weeks of the Design Workshop will be devoted to this part of the design process, which will be undertaken on the basis of group work in order to prepare the Pre-Design Document, and which will be concluded by the First Intermediate Presentation/Seminar to be held on Wednesday 4th December 2024. At the same time, as explained earlier, each one of you will individually develop one structural design concept, which will be explored and assessed.

The aspects of structural stability are obviously important, and the opportunity should be taken to integrate principles of structural behaviour at the conceptual design stage.

Basic structural concepts for the proposed structural design solution of the roof canopy structure will be presented at the end of the fourth week, in a Second Intermediate Presentation/Seminar to be held on Wednesday 18th December 2024.

The Design Project Deliverables are to be submitted online on UM VLE (BEN3102 OCC_A Study Unit Area) at the end of the eighth week on Wednesday 15th January 2025 at 23:59 Hours. Finally, the Assessment of this Design Workshop will be carried out in a Final Oral Presentation at a date to be communicated in due course.

Your Design Project Deliverables should include, as a minimum:

- (a) At least, 1 in No. (physical and/or digital) working model of your final design concept for the proposed structural design solution of the roof canopy structure.
- (b) Not more than 2 in No. A0 sheets. The submission of drawings should include an architectural plan, an architectural elevation and large-scale detailed longitudinal and transverse sections of your proposed structural design solution of the roof canopy structure, including its foundations and connection details.
- (c) An A4 Design report (not exceeding 30 in No. pages), including the following:
 - (i) Introduction and scope.
 - (ii) Case studies and discussion on structural design concepts.
 - (iii) Schematic conceptual proposal for the proposed structural design solution, as explained earlier, including design sketches, and the considerations influencing your choice of structural design proposal.
 - (iv) **The structural design solution** of the roof canopy structure, including structural justifications for your design proposal.
 - (v) Structural materials to be adopted within the roof canopy project, and preliminary sizing of structural members.
 - (vi) Finishing materials to be employed within and over the roof canopy structure.
 - (vii) Methods of construction, including the proposed assembly and erection process.
- (d) Preliminary structural analysis and design calculations for **the proposed structural design solution** of the roof canopy structure and its foundations.
- (e) MS Power Point Presentation (maximum 20 in No. slides) providing a brief overview of the main functional, aesthetic, technical and engineering design considerations of the proposed roof canopy structure, so as to convince the Client that you have successfully addressed the main functional and engineering design issues involved within the design project.

Suggested Further Reading:

Leach, John, *Understanding Long Span Roof Design*, Institution of Structural Engineers, London, April 2021 - [Understanding long span roof design - The Institution of Structural Engineers \(istructe.org\)](https://www.istructe.org) (Accessed on 07 November 2022).

Schlaich, Jörg & Bergmann, Rudolf, *Conceptual Design of Long Span Roofs*, IABSE Report, Zurich, November 2022. - [Conceptual design of long-span roofs \(e-periodica.ch\)](https://www.e-periodica.ch) (Accessed on 07 November 2022).

Plagiarism:

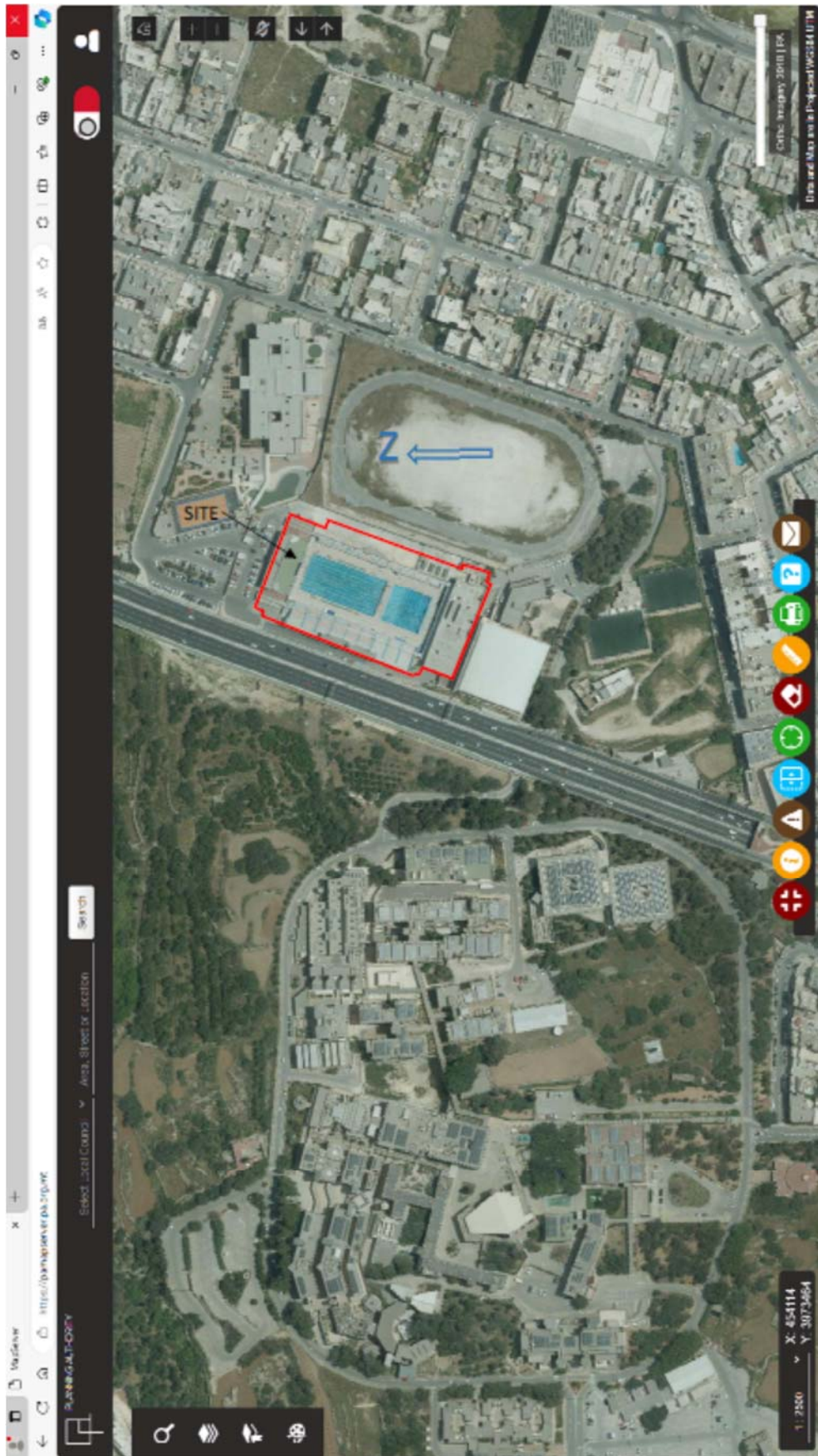
When writing the Technical Design Report, students should be mindful of the regulations on plagiarism and collusion of the University of Malta, which may be consulted online at:

[Student Conduct - Office of the Registrar - L-Università ta' Malta \(um.edu.mt\)](https://www.um.edu.mt)

SITE PLAN OF EXISTING NATIONAL POOL COMPLEX



AERIAL PHOTOGRAPH OF EXISTING NATIONAL POOL COMPLEX



AERIAL PHOTOGRAPH OF EXISTING NATIONAL POOL COMPLEX



AERIAL PHOTOGRAPH OF EXISTING NATIONAL POOL COMPLEX



AERIAL PHOTOGRAPH OF EXISTING NATIONAL POOL COMPLEX

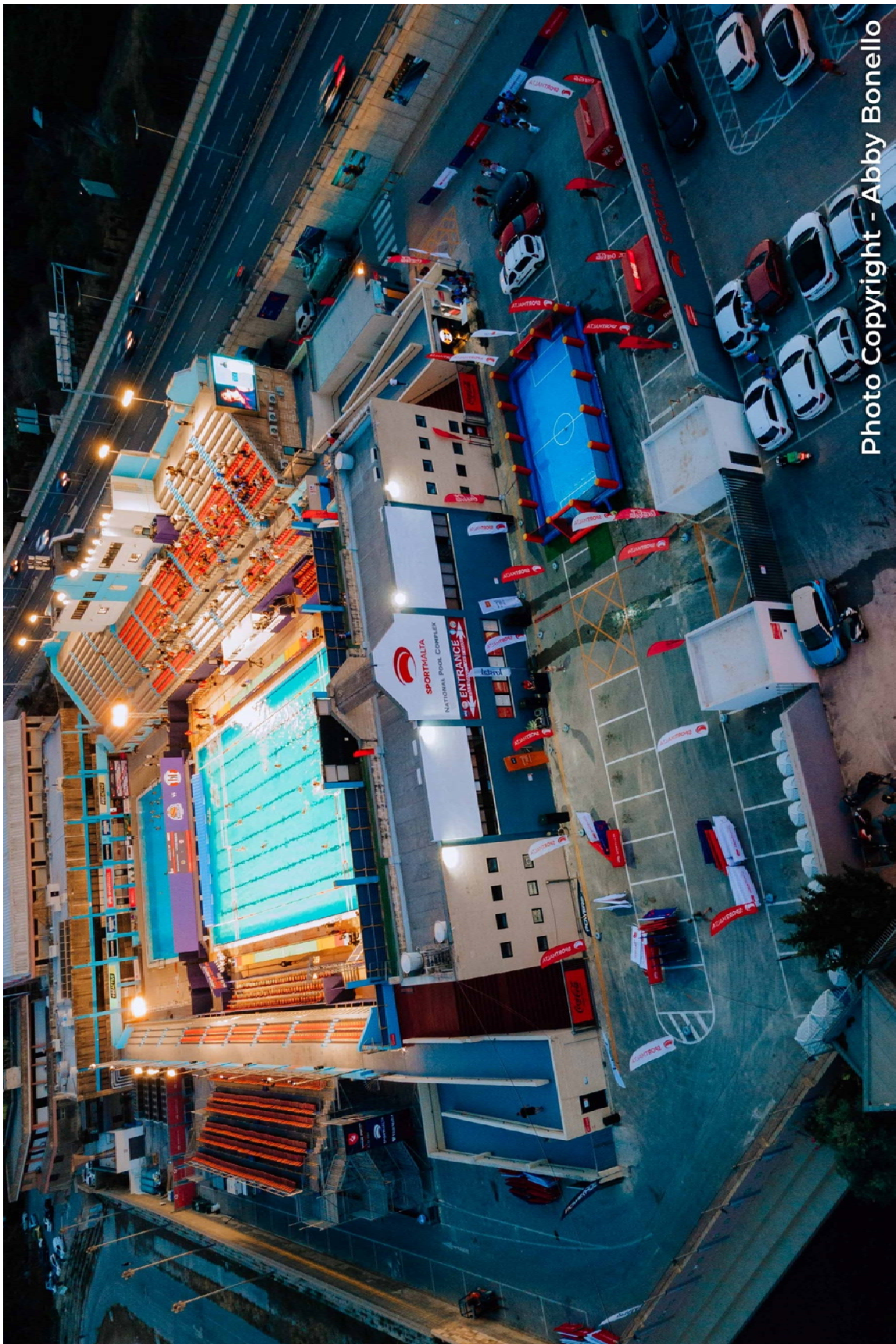


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AERIAL PHOTOGRAPH SHOWING SITE EXTENTS IN YELLOW

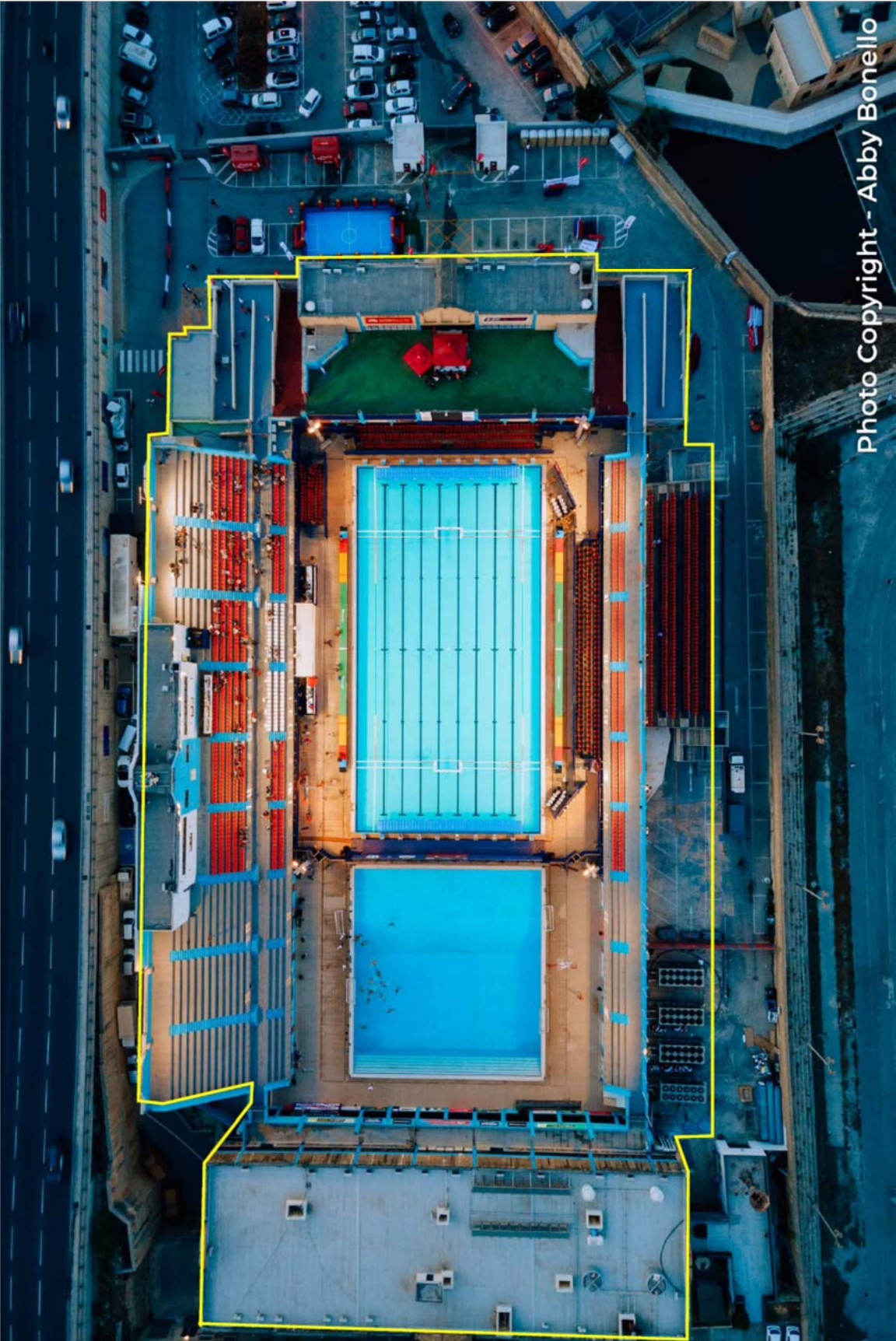


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