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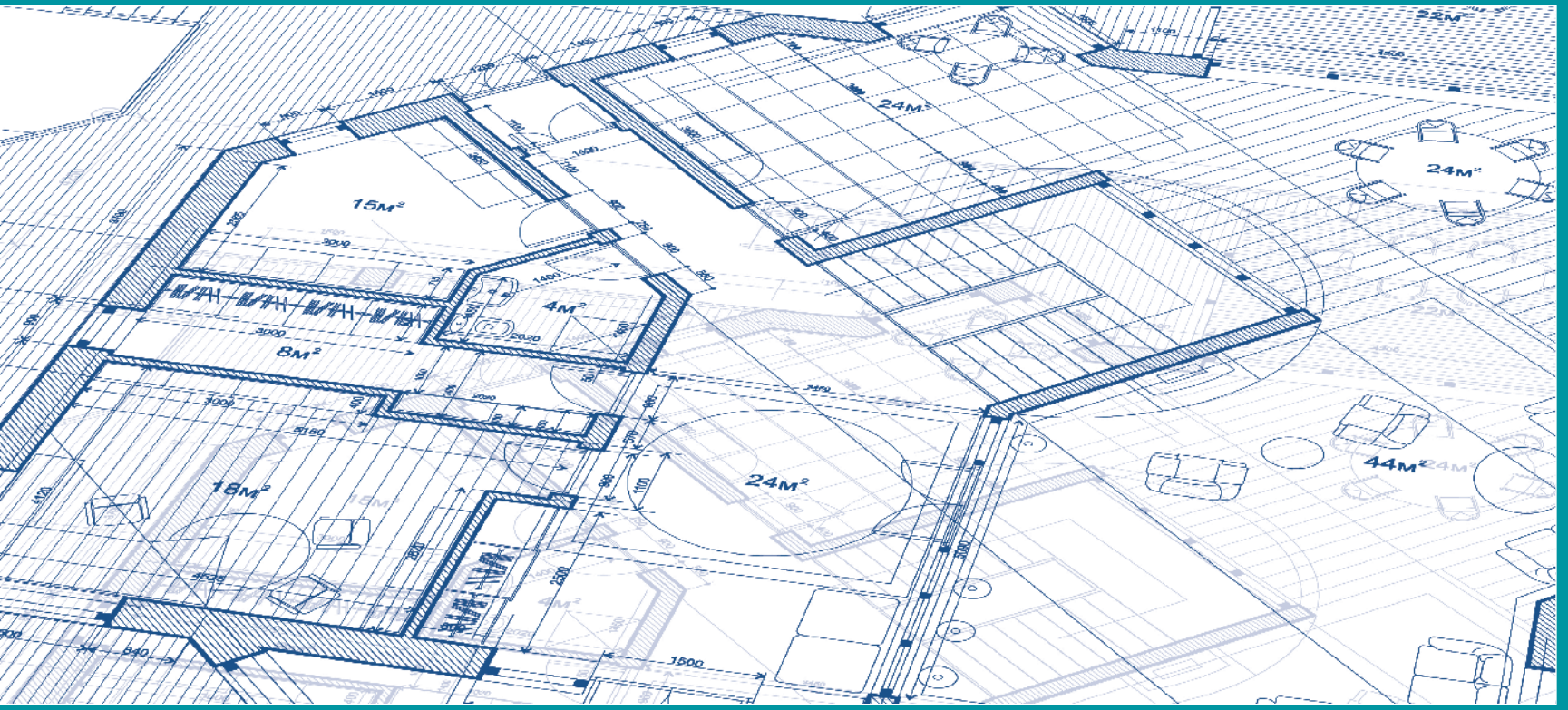
Structural Concrete 2021



The Concrete Centre Student Design Competition

Contents

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The Concrete Centre is the central development organisation for the UK cement and concrete industry. Its objective is to assist all those involved in design and construction to realise the full potential of concrete as an adaptable and sustainable construction material.

For more information on The Concrete Centre visit **www.concretecentre.com.**

The Concrete Centre is part of the Mineral Products Association, the trade association for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar and silica sand industries.

LAING O'ROURKE

Laing O'Rourke is a globally diverse engineering and construction group with a commitment to delivering Excellence Plus performance, founded on over 170 years of experience. They fund, design, manufacture, construct and maintain the modern world – providing the buildings and infrastructure to accommodate, educate, employ, transport, care for and sustain communities.

Their business model comprises the full range of engineering, manufacturing, construction and project management services. Their fully integrated offering delivers bespoke solutions to meet the particular requirements of some of the world's most prestigious public and private organisations. Their collaborative approach combines discipline in delivery with the continuous pursuit of innovation: engaging with customers and partners at the earliest stages, advising on and providing the best ways to complete projects with certainty and achieve greatest value for all stakeholders – employees, customers, communities and shareholders. Their long-term strategy aims to create sustainable growth by meeting the economic, social and environmental challenges of the rapidly changing world.

Their pursuit of engineering excellence is supported by their investment in innovative industry-leading precast concrete and offsite manufacturing facilities.

More information is available online at: **www.laingorourke.com**

Introduction

Structural Concrete 2021 sets a demanding challenge for all students studying structural design as part of UK University BEng, MEng and MSc degree courses in Civil and/or Structural Engineering.

This student design competition aims to encourage interest and raise competence in designing with concrete. The competition offers a stimulating and fun challenge to students, while supporting the curricula of civil and structural engineering departments of UK universities. The main benefit for a student is in being able to present their work to prospective employers, some of whom are involved in setting and judging the competition. The national winners will be presented with their prizes at an event in London where their award winning entries will be shown. There will also be a sustainability award for the student who demonstrates the best understanding of this subject in their submission.

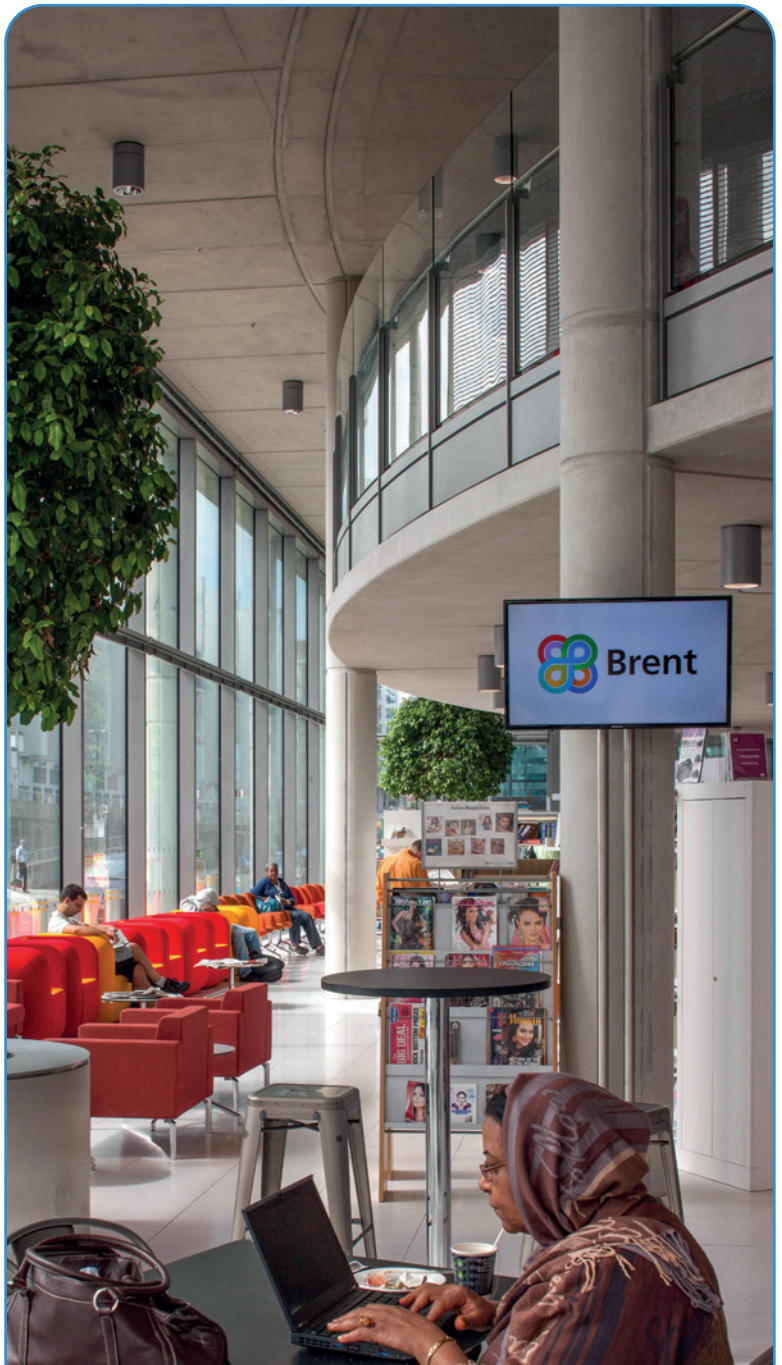
These awards reflect a significant commitment from the judges who, together with The Concrete Centre, have carefully developed this year's competition. Initiative, creativity, aesthetic appreciation and accuracy are called for, and will be assessed by the judges. Above all, this competition has been designed to stretch the technical competence of the students taking part.

Because it is so flexible, Structural Concrete 2021 can easily be incorporated into existing university curricula, with content that reflects an independent project, a group project or a module assessment run over the first, second or both semesters of the academic year.

This year's challenge…

The 2021 project is to design a civic centre comprising a library and council offices in a new garden town in the north west of England.

The client has requested bids from design-and-build contractors for the construction of the building and its maintenance over the next 30 years. One of these contractors has commissioned an initial design for the new building at Porchester New Town, from a firm of consulting engineers. Entrants must respond as though they are the structural engineer responsible within the consultant's team.



BREEAM Outstanding Brent Civic Centre has proved itself a sustainable concrete exemplar. Cement replacements were used in the foundations, slabs, columns and walls with recycled aggregates used in the concrete used for the frame.
© Arcaid Images / Alamy Stock Photo

1. Project brief: Porchester Civic Building

The new building at Porchester comprises a five-storey building with the lowest storey being the new library and the four upper storeys being the council offices. The building is to be located on a side of a hill so that the offices are accessed from ground level on one side of the building and the library is accessed at the lower level on the other side of the building.

A contractor is bidding for a contract to design and build the civic centre. The contract includes ongoing responsibility for the operation of the new facility, including maintenance and energy use. The contractor wants to offer a scheme that meets the client's brief, is architecturally appealing and will allow them to offer a bid for the entire contract that will compete on cost. The contractor prefers to use heavyweight materials to gain the benefits of acoustic separation, fire resistance, thermal mass etc.

You have been appointed by the contractor to develop a structural design for the project.

The new building is to be built on a green field site to form part of the infrastructure for the new town.

The four storeys of offices are L-shaped on plan and sit on the library , which has a larger footprint. The offices are to be open plan as is the library. Figures 1 (page 6) & 2 (page 7) show the typical floors and section through the building.

The client requires a minimum 3.3m floor to soffit height in the offices including an allowance for exposed lighting and services distribution. In the library a minimum 4m floor to soffit height also including an allowance for exposed lighting and services distribution is required. The services engineer is proposing to use the thermal mass of the building in their heating and ventilation strategy.

The roof over the library is to be an outside terrace for the offices. The roof over the offices is to be used for plant. Access is required to the office roof from a goods lift in order to facilitate replacement and maintenance of the plant.

The toilets and circulation spaces (lifts and stairs) should take up about 15% of the floor area. The stair and lift core(s) can be used for stability. One lift should be designated as the goods lift and this should go from the library, through the offices to the plant area on the office roof. Other lifts do not need to go between the library and the offices. The circulation spaces should be positioned to allow easy exit from the building in the case of fire.

The change in level across the site means that the north wall to the library is a retaining wall. This should be integrated into the structure, with thought given to how it is to be waterproofed. The sensitive nature of the library stock means that the waterproofing should be to 'habitable' grade (BS 8102).

2. Design data

Verification of structural viability should be carried out in accordance with current Eurocodes. Entrants should clearly state in their submission which documents have been used in their calculations. Material specifications should be defined to current British Standards.

2.1 Loadings

Dead loads of structural elements: as found.

Imposed loadings:	
Terrace over library	10 kN/m^2, including an allowance for paving etc.
Other areas of roof	1.5 kN/m^2
Offices	3.5 kN/m^2
Stairs	4.0 kN/m^2
Library	10.0 kN/m^2

These loadings include an allowance for lightweight partitions, raised floors, ceilings and services where appropriate.

All values are characteristic values.

The retaining wall should be designed for horizontal loads as given in Figure 3 (page 7).

2.2 The site

Exposure conditions

The site is currently in open countryside, 30km from the sea. The fundamental basic wind speed should be taken as 23m/sec (based on the 10 minute mean wind speed as given in BS EN 1991-1-4:2005).

Snow loading may be neglected.

Ground conditions

The ground at the site comprises approximately 0.5m of made ground overlaying firm silty clay becoming stiff at depth. The geotechnical engineer has given a safe bearing pressure of 200kPa. No groundwater was encountered.

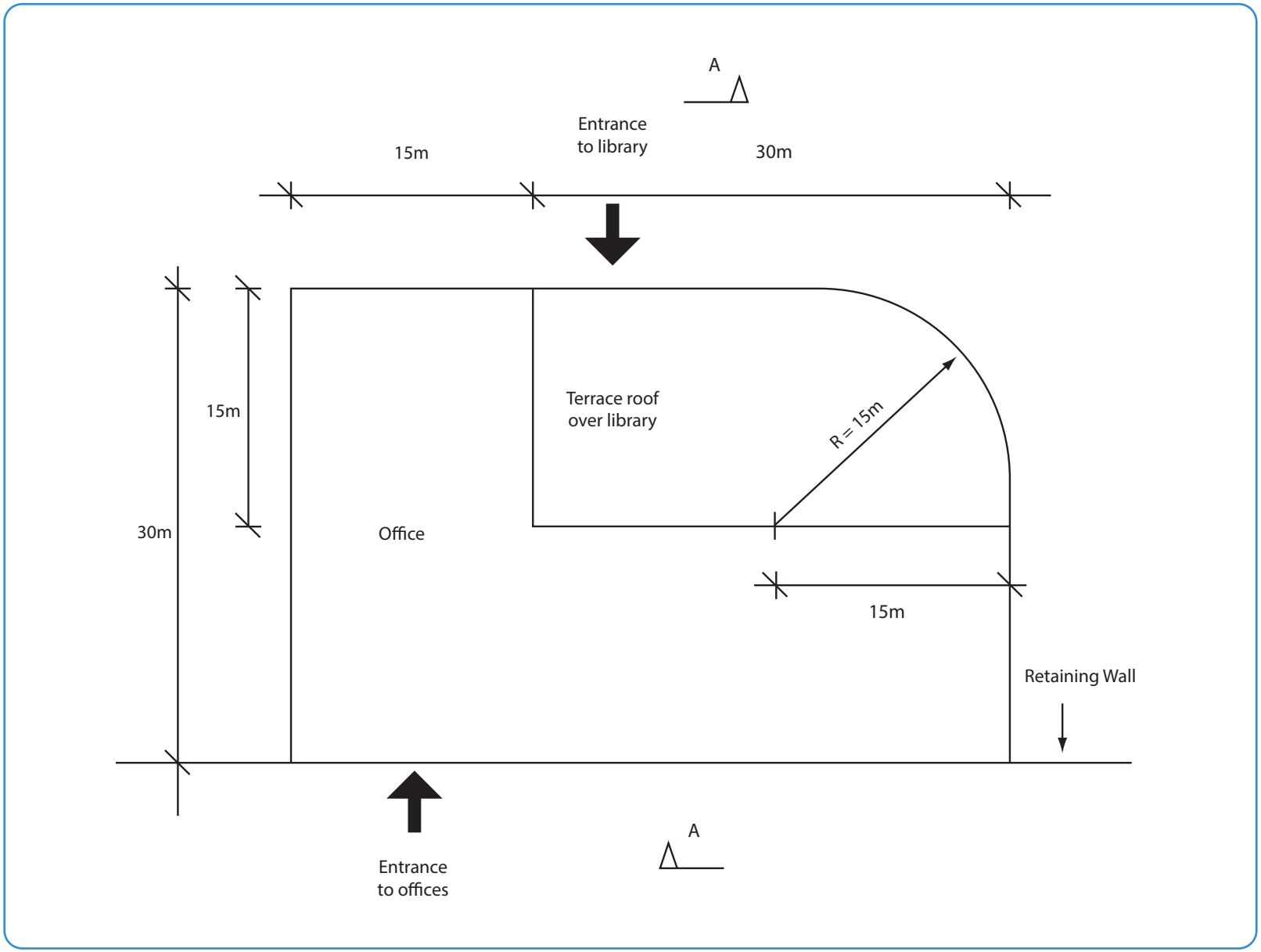


Figure 1: Plan at ground floor (dimensions may be taken to be to the centre line of structure (walls or columns)).

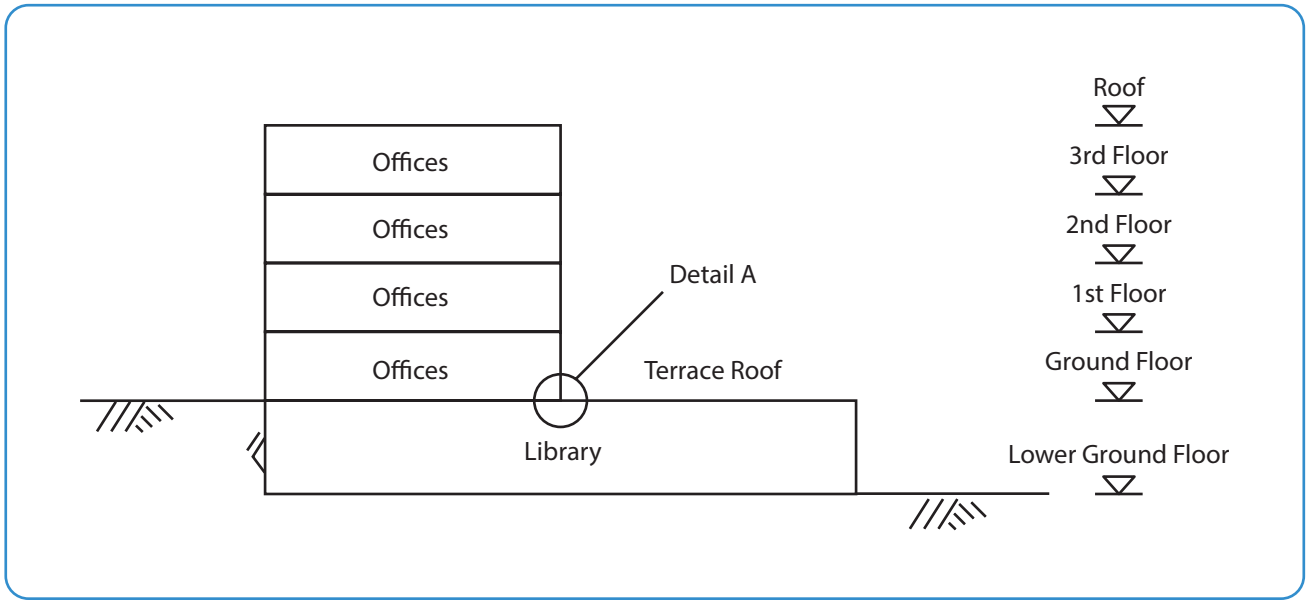


Figure 2: Section A-A

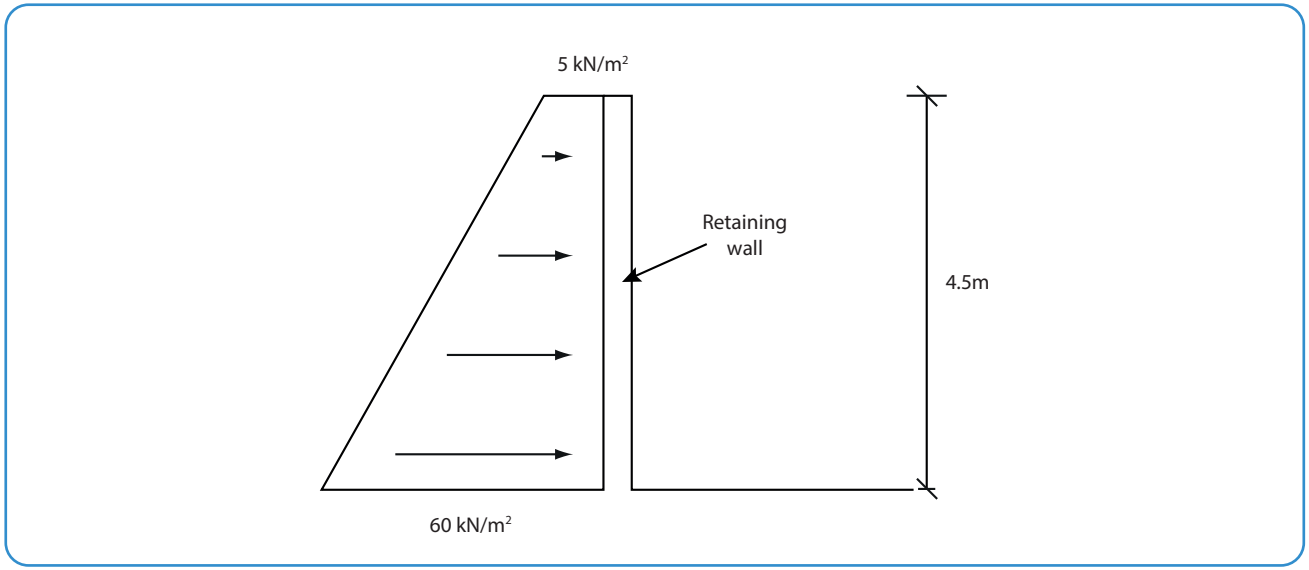


Figure 3: Characteristic horizontal loads on retaining wall

3. Submission requirements

The submission is to comprise four components:

i. A conceptual design report

ii. Appendix 1 containing design calculations for the selected scheme superstructure

iii. Appendix 2 containing the drawings of the selected scheme superstructure

iv. Appendix 3 containing a sustainability report.

The submission must not exceed 60 single sided A4 pages and three A3 size drawings. Only one copy is needed.

3.1 Conceptual design report

A maximum of 30 pages, of either 1.5 line spaced text in a maximum 11pt font, or neatly hand written in black ink, which should include:

i. An appraisal of two distinct and viable structural solutions for the construction, together with their associated column/wall layouts. The appraisals should include sketches with supporting notes outlining the intended load transfer mechanisms, framing and stability functions, and the construction methodology

ii. An evaluation of the merits and disadvantages of the two solutions. The evaluation should identify significant differences such as cost or buildability between the two alternatives, and make a recommendation in favour of one solution

iii. A description of the structural solution adopted for the slabs and a rationale for the selection

iv. A description of the foundation scheme adopted for the preferred solution, with a rationale for the selection

v. An outline specification for the structural concrete and reinforcing materials to be used

vi. A method statement for a safe construction procedure for the building

vii. A statement on the robustness of the building to avoid disproportionate collapse.

3.2 Verification of structural viability

The verification of structural viability of the structural scheme should be demonstrated in the Appendices to the conceptual design report to make up the balance of the report.

Appendix 1 should contain sufficient design calculations by hand to establish the form and size of all structural elements for the chosen scheme. Entrants should decide how best to convey this information within the space constraints imposed.

Calculations for individual elements should enable a checker to understand clearly their contribution to the strength and stability of the whole structure, and the load paths assumed. Hence, if computer output is presented, validation by (approximate) hand calculations is also required. Consideration should be given to performance at both serviceability and ultimate limit states.

3.3 Drawings

A3 drawings should be included. Drawings may be prepared using appropriate CAD software, or by hand. In either case, notes and dimensions should not be smaller than the equivalent of an 11pt font.

Drawings should be to an appropriate scale. The drawings should show the following:

i. General arrangement of the foundation scheme

ii. General arrangement of the lower ground floor

iii. General arrangement of the ground floor

iv. General arrangement of a typical upper floor

v. Section through the building

vi. Section through the retaining wall

vii. Detail A shown on Figure 2.

3.4 Sustainability report

The Council require that the building be BREEAM 'Excellent'. You have been asked to prepare a short report (maximum three single-sided pages) for the team. This should detail what aspects of sustainability the structural engineer can influence and how your design has improved the sustainability of the project.

4. Assessment criteria

4.1 Local

The competition will operate on two levels. Firstly, all submissions made at each university will be judged by the academic tutor(s) involved with the project. The winning submission from each university should then be entered for the national level of the competition by the tutor.

Only one entry from each university can go forward for final judging at a national level.

4.2 National

The winning entry from each participating university will be judged at national level using the following generic assessment criteria:

- Compliance with the project brief
- Safety, function, stability and robustness
- Buildability, constructability and maintainability
- Speed of construction and cost effectiveness
- Imagination, flair, aesthetic appreciation and innovation.

The interpretation of the above criteria by the award judging panel will be final and feedback will not be provided.

5. Awards

5.1 University level

The winning entry from each university will receive a prize of £250. The winning entry will go forward to compete at national level.

5.2 National level

The winner(s) of the national competition will receive a certificate(s) and a prize of £1,250. Runner(s) up will also receive a certificate(s) and a prize of £750. *The judges may decide on joint prizes in which case the above prize money will be divided up by the judging panel at its discretion.*

A special commendation, certificate and prize of £250 will be available for the best sustainability report.

The prize-winners' universities will also receive certificates.

5.3 Presentation

The prizes and certificates will be presented to the winner(s), runner(s) up and winner(s) of the special commendation at an awards ceremony in September 2021 in London. This will be part of a seminar for practising engineers who will be able to review the winning entries. The prize-winners will be notified of further details.

5.4 Eligibility

Structural Concrete 2021 is open only to students studying for a degree at a UK university. Entries can be single, joint, or from teams of up to four students. Although the competition is aimed at students in their final years of study, entries from any other appropriate undergraduate and/or postgraduate stages will also be considered at the discretion of the academic tutor(s).

6. Rules

I. To enter the competition the university academic tutor(s) should register the university's intention to participate by either filling in the online form at www.concretecentre.com/competition or emailing The Concrete Centre at **info@concretecentre.com**. Registration will enable The Concrete Centre to provide supplementary information and/or assistance if needed.

II. The completed entry form naming the local winner should reach The Concrete Centre by either submitting online, via post or email by Friday 11 June 2021. On receipt, The Concrete Centre will issue each competitor with an entry reference number.

III. Complete design entries must be received by post, by the final deadline of 4pm on Friday 9 July 2021. The entry reference number should be clearly marked on all items forming the design entry, and on the outside of the package. **No other form of identification or distinguishing mark should appear on any part of the submission.**

IV. A successful competitor may be required to satisfy the judges that he or she is the bona fide author of the design that he or she has submitted.

V. Competitors should retain the originals of the designs and drawings submitted. The organisers cannot be held responsible for loss or damage to submissions which may occur either in transit or during exhibition, storage or packing. The organisers regret that submissions cannot be returned to candidates after the competition.

VI. Any entry shall be excluded from the competition if:

- The competitor does not meet the eligibility requirements detailed in Section 5.4
- The entry is received after the competition closing date in rule III above
- The competitor discloses his or her identity, or that of the university, in the submission
- The competitor attempts to influence either directly or indirectly the decision of the award judging panel.

Only one copy of each competitor(s)' design is to be sent in a single package to:

Structural Concrete 2021
MPA The Concrete Centre
Gillingham House
38-44 Gillingham Street
London
SW1V 1HU

Email: info@concretecentre.com

VII. A pdf copy of the submission, including the drawings, must be emailed to info@concretecentre.com on or before Friday 9 July 2021.

The winning team of the 2019 Structural Concrete Competition, from Imperial College, presented with their awards.

Entry Form

Structural Concrete
Student Design Competition 2021

To be submitted by no later than 11 June 2021. This form is to be completed only for the entry which has been marked and selected by the academic tutor(s) for submission to the national competition. Only one entry will be permitted from each university.

University	
Name and email address of Academic Tutor(s)	

1. *I/We have complied with and accepted the rules which apply to this competition
2. *I/We agree to accept the decision of the judges as final, and agree to permit free publication and exhibition of *my/our work
3. *I/we declare that the design is *my/our work and that the drawings have been prepared by *myself/ourselves.
4. *I/we agree that any part of this work may be reproduced in publicity or other materials by The Concrete Centre as required.

*Delete as applicable

Signature student(s): .....

Signature academic tutor(s) .....

This form is to be completed by the competitor(s) and academic tutor(s), placed in a sealed envelope and returned to the address given below. An entry reference number will then be given, which should be marked clearly on all items forming the design entry and on the outside of the package. **No other form of identification or distinguishing mark should appear on any part of the submission**.

The following student or student team will represent the university:

Student Name			
Home Address			
Email			
Phone		Year	

Student Name			
Home Address			
Email			
Phone		Year	

Student Name			
Home Address			
Email			
Phone		Year	

Student Name			
Home Address			
Email			
Phone		Year	

Please return to:

Structural Concrete 2021,
The Concrete Centre, Gillingham House,
38-44 Gillingham Street,
London SW1V 1HU
or by email to info@concretecentre.com.

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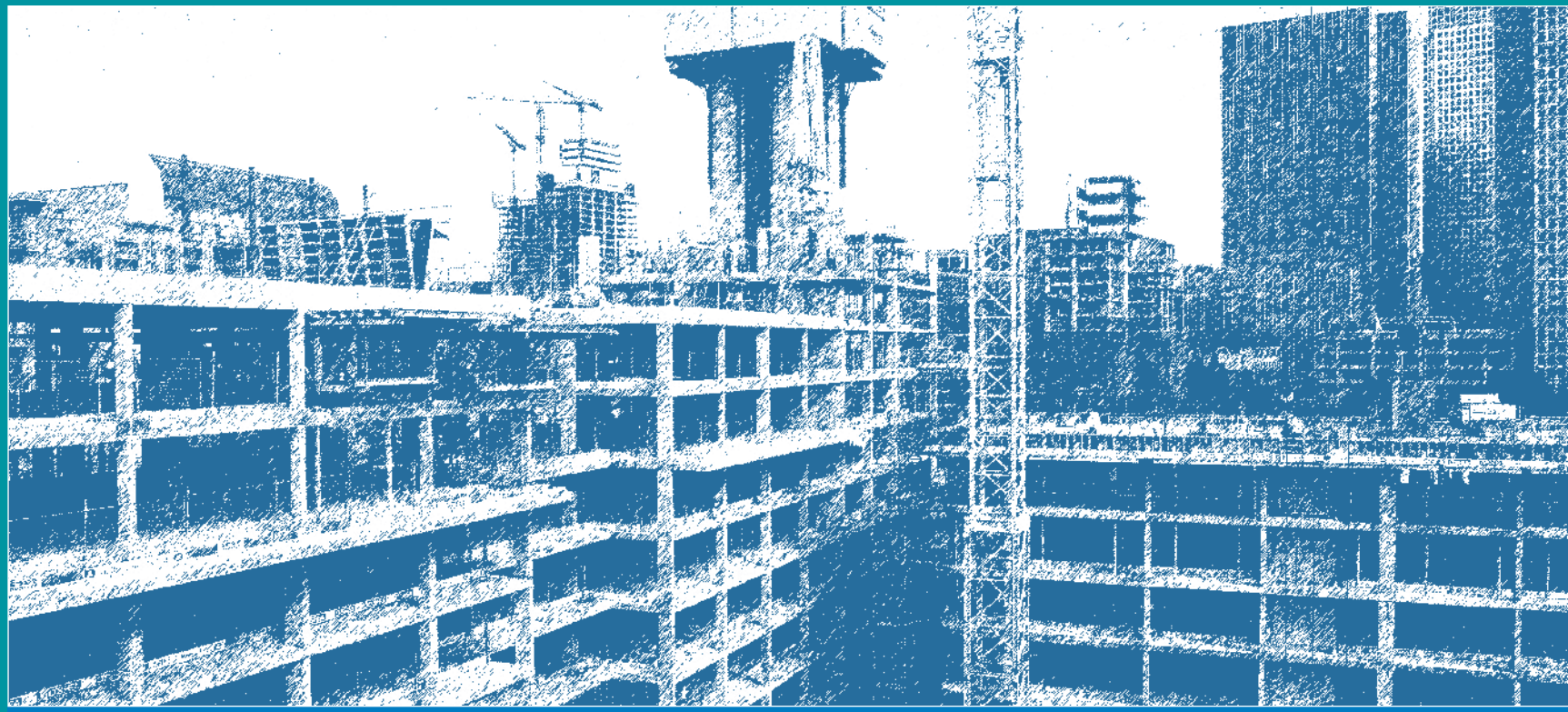
www.mineralproducts.org



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