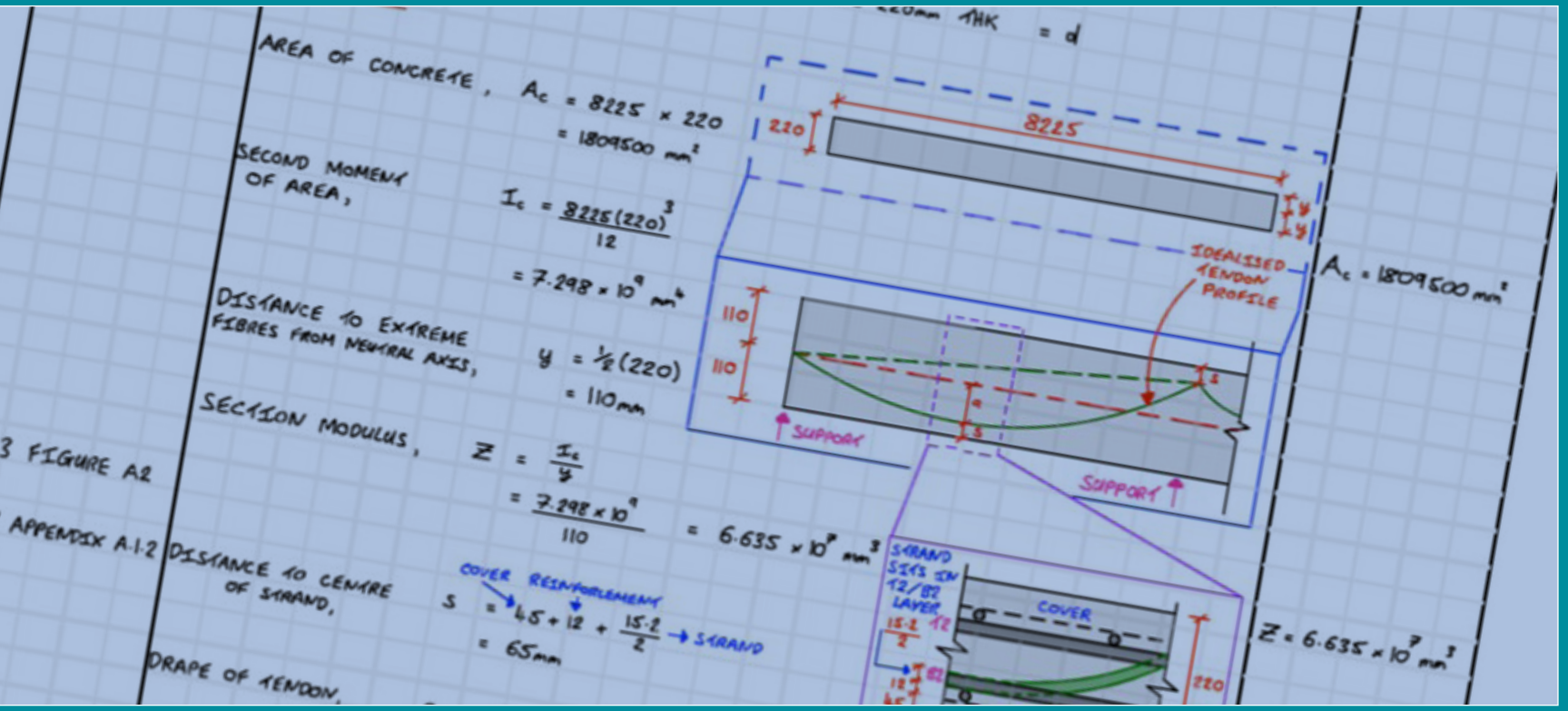
# Structural Concrete 2025




The Concrete Centre Student Structural Competition

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mpa The Concrete Centre

**The Concrete Centre** provides material, design and construction guidance. Its aim is to enable all those involved in the design, use and performance of concrete to realise the potential of the material as a long lasting and sustainable choice. The Concrete Centre provides published guidance, seminars, courses, online resources and industry research to the design and academic communities. 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 industrial sand industries.

CARES

CARES is the leading independent international constructional steels product certification body delivering confidence in the performance, provenance and quality of safety-critical reinforcement products entering the construction supply chain. With a proud track record of providing assurance to users, designers, consultants and specifiers spanning four decades, CARES' data-led inspection and certification services provide valuable transparency into the provenance and sustainability characteristics of constructional steels moving across complex global supply chains.

Clients and specifiers can specify CARES-approved reinforcement suppliers with confidence that the product will comply with the relevant product standard without the need for costly, on-site testing.

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# Introduction

**Structural Concrete 2025 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 presented to the audience.

There will also be a sustainability award for the student/team 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 2025 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.

DOWNLOAD ENTRY FORM

## This year's challenge…

**The 2025 project is to design a hotel building which is to be constructed as part of the redevelopment of a former dock area on an estuary close to the centre of a large UK town. The client, a hotel owner and operator, has commissioned an initial structural design from a firm of consulting engineers for the 4-star hotel that is to be known as the Port Aspdin Hotel. The building is to include a conference centre/banqueting suite, a feature restaurant projecting over the water, as well as bedroom accommodation on five floors. Entrants must respond as though they are the engineer responsible within the consultant's team.**

*The Standard Hotel, London.*
*Courtesy of Tim Soar Photography.*

# 1. Project brief: Port Aspdin Hotel

**Port Aspdin Hotel is to form part of an extensive redevelopment of a former docks site on an estuary close to the centre of a large UK town. The building has to include a conference centre/banqueting suite, a feature restaurant projecting over the water, and bedroom accommodation on five floors. The client, a major hotel owner and operator, has commissioned an initial structural design from your firm of consulting engineers.**

The new building is to be developed on the edge of a dock basin which is to form the basis of a maritime heritage centre. The client envisages exploiting this location by offering customers the view over the basin, in particular through a feature restaurant at first floor level which is to extend out over the water. The water level in the dock basin is maintained at a constant level of approximately 0.5m below ground level by means of a lock which connects to the tidal estuary and the basin walls are constructed of massive masonry blocks which are in good condition. The long façade of the building is to run parallel to the edge of the dock. A basement is not considered feasible due to the high water table and proximity of the dock basin.

The ground floor of the hotel is to provide space for a reception, conference centre, banqueting suite and all their associated services, (see Figure 1). The minimum clear height at ground floor level is 4.5m, which includes an appropriate allowance for services beneath the first floor. The minimum internal spacing of vertical structural elements within the ground floor is to be 8m. There is no minimum spacing for the vertical structure on the external facade. Access to bedroom floors is via a bank of lifts or staircases at each end of the building. The restaurant is accessed via lift and/or stairs near the centre of the building.

At first floor level, the feature restaurant is to project 20m out from the face of the hotel over the water in the dock basin, (see Figure 2). The restaurant is to be extensively glazed on three sides to provide unobstructed views. The projecting restaurant may, if desired, be supported on a single row of columns (parallel to the long façade of the building) sited in the water, (see Figure 3). The location of the row (if provided) is to be determined by the structural designer. To enhance the outlook from bedrooms on the main block, the restaurant is to be covered by a green roof, but with access restricted to maintenance staff. The restaurant kitchen is to be situated in the main hotel block adjacent to the restaurant itself.

The remainder of the floor is to be occupied by bedroom accommodation. The finished floor to soffit height at first floor is to be a minimum of 3.5m, including an appropriate allowance for services. Floors two to six are to comprise bedroom accommodation, together with central access corridors and stair/lift enclosures at each end of the building, (see Figure 4). The client wishes to allow for future changes in demand for various types of room (single/double/suite) and hence requires a structural arrangement that will not compromise their ability to alter the width and mix of room compartments, although they have agreed that the central corridor arrangement will not be altered. The finished floor to soffit height on these floors is to be a minimum of 2.6m in bedrooms and 3.1m in corridors, including appropriate allowances for services.

At roof level, all servicing plant including water tanks, heating boilers and lift mechanisms are to be located on top of the stair/lift towers at the ends of the building. Car parking is to be provided adjacent to the hotel at ground level over an area of approximately 1800m$^2$. This area will be made available to the contractor during the construction period.

Durability considerations dictate the use of faced precast concrete cladding panels on the façade of the main block. The depth of floor construction plus services needs to be as small as practicable to minimise the overall height of the building and therefore reduce the cost of cladding.

The client would welcome proposals from the structural engineer that might enhance the visual appeal of the building, which is being targeted at 4-star hotel clientele.

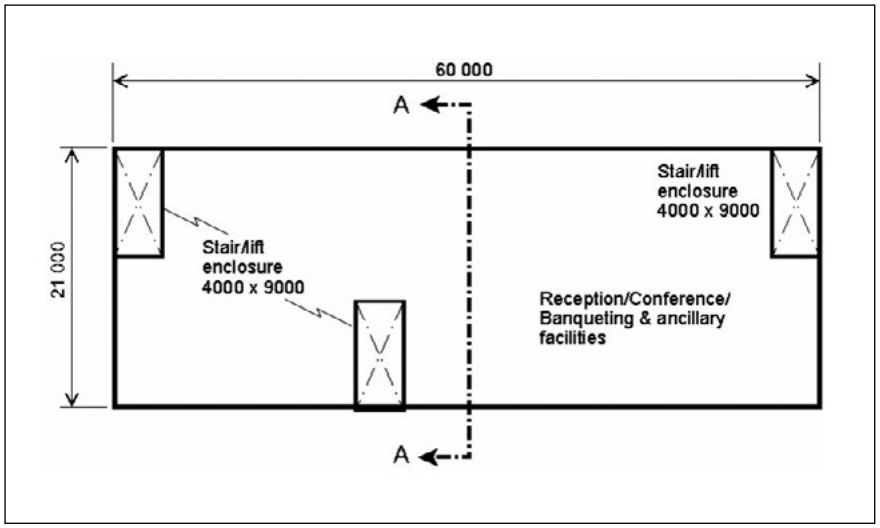


Figure 1
Ground Floor Plan - General Arrangement

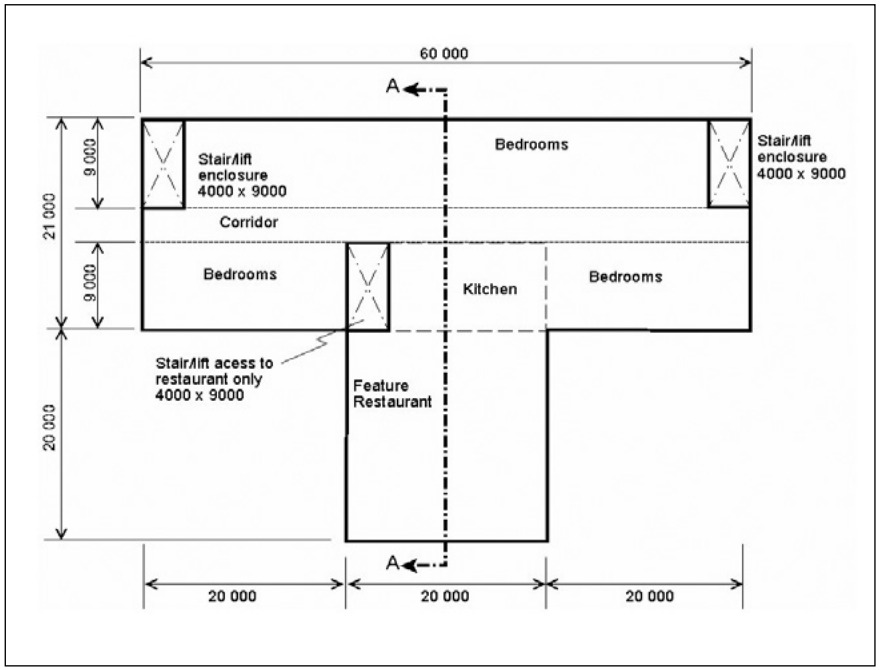


Figure 2
First Floor Plan - General Arrangement

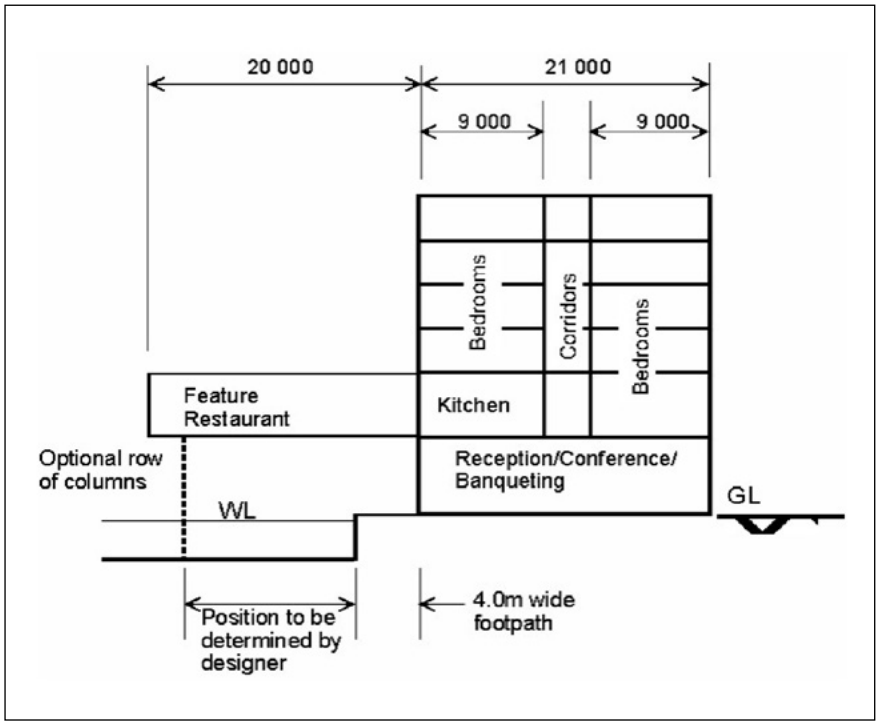


Figure 3
Section AA

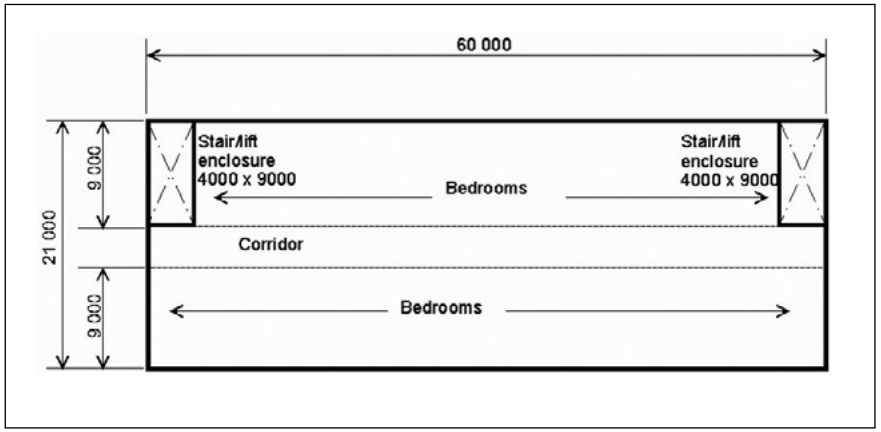


Figure 4
Tyical Bedroom Floor Plan - General Arrangement

# 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. Materials specifications should be defined to the current British Standards. Fire resistance of 90 minutes is required.**

## 2.1 Loadings

### 2.1.1 Dead loads

Dead loads of structural elements: as found.

Cladding: an average value of 2.4kN/m$^2$ of elevation may be taken.

### 2.1.2 Imposed loadings

- Plant areas at roof level 7.5kN/m$^2$
- Other areas of roof not zoned for plant 0.75kN/m$^2$
- Bedroom floors; excluding corridors and stairs 2.0kN/m$^2$
- Bedroom floors; corridors & stairs 3.0kN/m$^2$
- Restaurant 2.0kN/m$^2$
- Kitchen 3.0kN/m$^2$
- Restaurant green roof 2.5kN/m$^2$
- Ground floor 4.0kN/m$^2$

These loadings include an allowance for raised floors, internal partition walls, ceilings and services.

All values are characteristic values.

## 2.2 The site

### 2.2.1 Exposure conditions

The site is coastal with the principal axis of the building oriented in an east-west direction.

The fundamental basic wind velocity at this location should be taken as 22m/sec (based on the 10 minute mean wind velocity as given in BS EN 1991-1-4: 2005).

Snow loading may be neglected.

### 2.2.2 Ground conditions

| Description | Depths below ground level | Soil data |
|---|---|---|
| Made ground | GL to 2.5m | |
| River terrace deposits (sand and gravels) | From 2.5m to 5.0m | N=20<br>Density 1940kg/m$^3$ |
| Stiff clay | 5.0m and below | Cu=150KPa |

Ground water level should be taken as water level in basin, at 0.5m below ground level. Within the dock basin, a 0.3m layer of mud overlies a 0.3m thick layer of puddle clay from 2.5m to 2.8m below ground level. The puddle clay overlies the river terrace deposits.

# 3. Submission requirements

**The submission is to comprise four components:**

**i. A conceptual design report**

**ii. Appendix 1 containing calculations for the selected scheme**

**iii. Appendix 2 containing the drawings for the selected scheme**

**iv. Appendix 3 containing a sustainability appraisal.**

**The submission must not exceed 60 single sided A4 pages and three A3 size drawings.**

## 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 design solutions in structural concrete for the building, together with their associated slab, beam, column, wall and roof layouts. The appraisals should comprise sketches of typical bays with supporting notes, outlining the intended load paths, framing and stability functions, and some brief notes on construction methodology. The appraisal should include consideration of any uplift forces on the structure.

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

ii. A description of the foundation scheme adopted for the preferred solution, with a rationale for the selection. A fully detailed design for the foundation scheme is not required.

iv. An outline specification for concrete and reinforcing materials.

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

vi. A statement of how robustness to avoid disproportionate collapse is satisfied.

## 3.2 Verification of structural viability

The verification of structural viability of the selected scheme should be demonstrated in Appendices to the conceptual design report to make up the balance of the report. (The maximum total length of the design report, sustainability appraisal plus Appendix is 60 pages A4. This does not include references or title pages.)

The Appendices 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.

Note: Calculations are not required for stairs.

## 3.3 Drawings

A total of three 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. These drawings need not be counted in the 60-page limit.

Two of the A3 drawings should be used to present general arrangements, sections and elevations of the building to show the layout, disposition and dimensions of structural elements for estimation purposes. Drawings should be to an appropriate scale and must be dimensioned. Reinforcement details should not be shown on these two drawings.

The third drawing should show annotated details of the construction within the zones marked as A, B and C, (see Figure 5), with outline reinforcement clearly shown. The details should be approximately to scale but need not be fully dimensioned.

## 3.4 Sustainability plan

You are now in the year 2075. Construction of Port Aspdin Hotel was completed in 2028 and the structure has given satisfactory service to date. The owner has decided the hotel no longer fits his business plan and intends to dispose of the building. However, the current Regulations impose a heavy financial penalty for demolition on any grounds except structural safety.

Your new client, a property redeveloper, is negotiating the purchase of the building for use as serviced office accommodation, which entails an increase in imposed loadings for the bedroom zones from 2.0kN/m$^2$ to 3.5kN/m$^2$ (imposed loadings are unchanged elsewhere).

Additionally, as a result of climate change, a revision to standard procedures for the determination of wind loading increased design wind velocity for the site by 20% to 26.4m/sec (48m/sec for equivalent 3 second gust). Your client therefore wishes to explore the possibility of strengthening the structure and verifying that it will be fit for a further 50 years of service life.

Prepare a short report presenting an appraisal of the issues to be considered, together with examples of possible processes that might be implemented in order to achieve this objective.

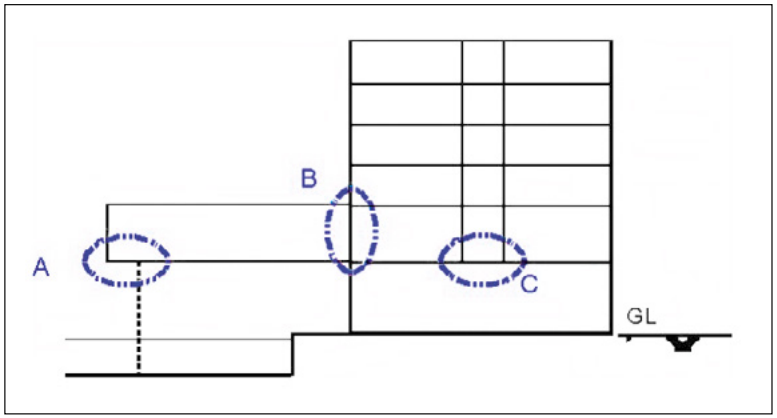


Figure 5
Details required

# 4. Assessment criteria

## 4.1 University

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 or a member of the team.

Only one entry from each university can go forward for final judging at a national level and the entry form must be signed by the appropriate tutor.

## 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. This 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 winners will be announced in a webinar to be held in August 2025. The prizes and certificates will then be presented to the winner(s), runner(s) up and winner(s) of the special commendation at an awards ceremony 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 2025 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 competitions@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 or email by Friday 13th June 2025. On receipt, The Concrete Centre will issue each competitor with a unique entry reference number.

III. Complete design entries must be received by email or into The Concrete Centre Dropbox (details will be provided to those submitting an entry), by the final deadline of 4pm on Friday 11th July 2025. The entry reference number should be clearly marked on all items forming the design entry. 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. 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

# Entry Form

## Structural Concrete
## Student Design Competition 2025

To be submitted by no later than 13 June 2025. 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) and submitted online or via email to competitions@concretecentre.com. An entry reference number will then be given, which should be marked clearly on all items forming the design entry. **No other form of identification or distinguishing mark should appear on any part of the submission**.

**Please return to:**
competitions@concretecentre.com

The following student or student team (maximum of four students per team) will represent the university:

| | | | |
|---|---|---|---|
| Student Name | | | |
| Home Address | | | |
| Email | | | |
| Phone | | Year | |

| | | | |
|---|---|---|---|
| Student Name | | | |
| Home Address | | | |
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| Student Name | | | |
| Home Address | | | |
| Email | | | |
| Phone | | Year | |

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mpa
The Concrete Centre

1st Floor,
297 Euston Road
London
NW1 3AD

www.concretecentre.com

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