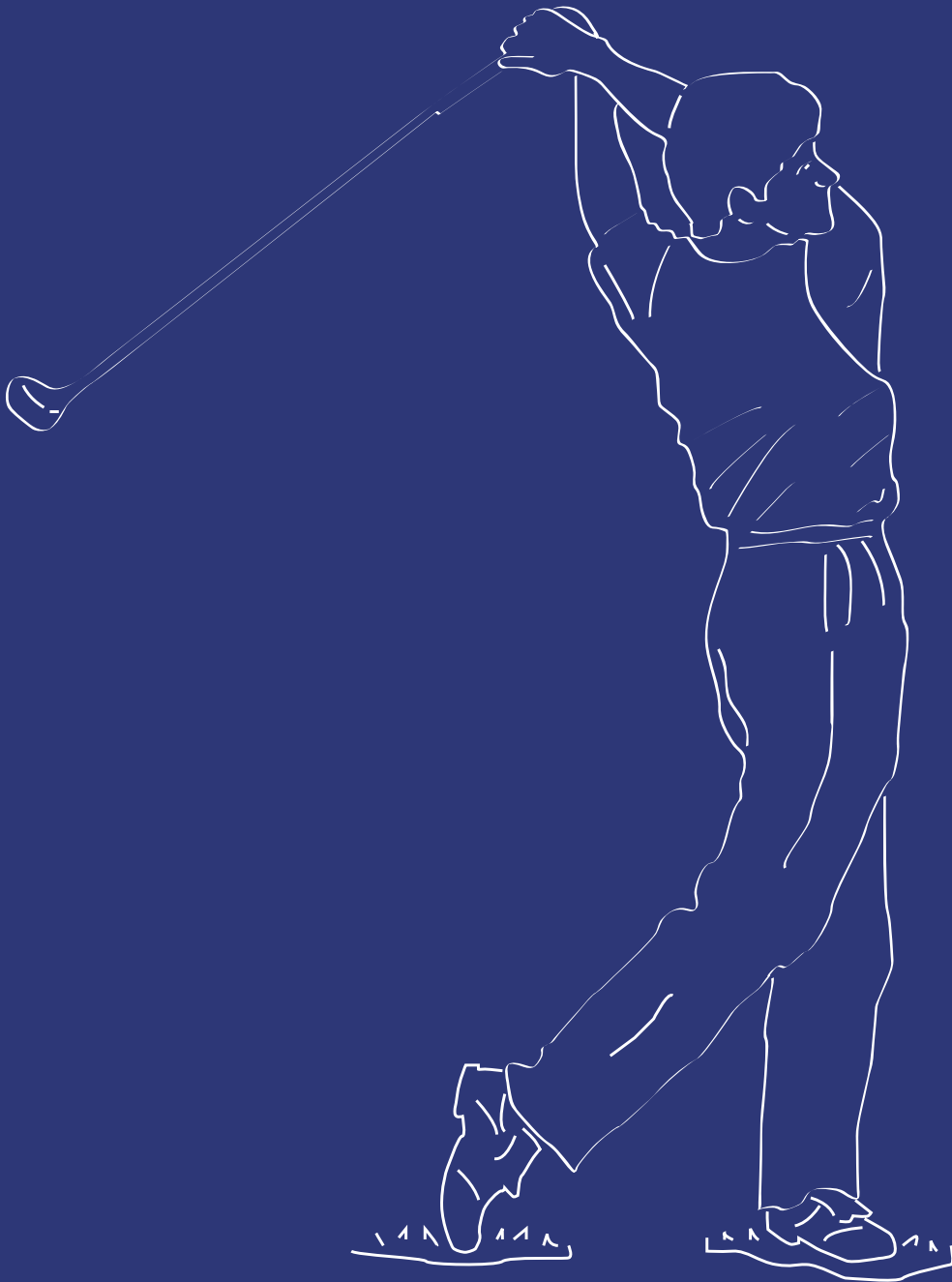


STUDENT DESIGN COMPETITION - STRUCTURES 2012

For further information visit:
tatasteelconstruction.com/sdc



TATA STEEL



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Foreword

The Tata Steel / BCSA Student Awards Structural Steel Design has been organised by The Steel Construction Institute, with the sponsorship of Tata Steel / BCSA, and is one of two popular Undergraduate Prize Award Competitions. The other competition covers steel bridge design. The objective of this competition is to encourage engineering design skills in the use of structural steelwork in an innovative structural solution. The brief has been formulated to encourage the entrants to realise the full structural, economic and aesthetic advantages offered by the use of both open and tubular structural steelwork profiles.

The competition is open to undergraduates. The project brief has been finalised in consultation with course tutors and those actively involved in designing, detailing and constructing steel structures.

The brief this year is to prepare an outline design for a structure to enclose a golf driving range to be constructed in a Gulf state. In addition to the driving range, the sponsor wishes to receive initial proposals for a structure in the form of a giant golf ball proposed as an iconic statement. Entrants are expected to demonstrate individuality and flair in this competition, in addition to showing an understanding of structural design, and to communicate their ideas in a written report with calculations and drawings.

The brief was compiled by:

Mr D G Brown	The Steel Construction Institute	<i>Secretary</i>
Mr P Benwell	Rowecord Engineering Ltd	
Dr J B Davison	The University of Sheffield	
Mr M Denham	Elland Steel Structures Ltd	
Mr A Hughes	The Steel Construction Institute	<i>Chairman</i>
Mr A C Jones	Sinclair Knight Merz	
Mr C Smart	BCSA	
Mr F E Weare	Consultant	

The award will be judged by:

Mr D G Brown	The Steel Construction Institute	<i>Secretary</i>
Mr P Benwell	Rowecord Engineering Ltd	
Mr M Denham	Elland Steel Structures Ltd	
Mr A Hughes	The Steel Construction Institute	<i>Chairman</i>
Mr A C Jones	Sinclair Knight Merz	
Prof D A Nethercot	Imperial College of Science, Technology & Medicine	
Prof R G Ogden	The Steel Construction Institute	
Mr N Seward	The University of Wales, Newport	
Mr C Smart	BCSA	
Mr F E Weare	Consultant	

Tata Steel / BCSA and The Steel Construction Institute would like to express their gratitude for the continuing support of all those concerned.

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1 THE BRIEF

1.1 INTRODUCTION

A very wealthy golf enthusiast wishes to construct a golf driving range. As the proposed location is in the Gulf, the driving range must be enclosed to protect users from the extraordinary heat and the desert winds. With apparently unlimited financial resources, the client is also considering an iconic structure in the form of a giant golf ball, housing internal usable space over several storeys. Whilst committed to the enclosed driving range, the client recognises there may be structural challenges with a giant golf ball and for that reason wishes only to have some preliminary concept design completed at this stage. Despite his wealth, the client still wishes to see a cost effective structural solution, and is concerned that construction is as environmentally friendly as possible.

1.2 APPOINTMENT AS CONSULTANT

You have been appointed as a structural engineer for the project and have been asked to work with the Client to prepare preliminary designs for a suitable structural solution for the structures. An outline design is required for the golf driving range; only a concept design is required for the giant golf ball.

1. A description of the structural arrangements for the golf range structure. The report should outline with concept sketches the design process by which the final scheme was reached, and should describe the alternative schemes considered, and why these were rejected. The description of the structural arrangements must explain (with sketches as necessary) how lateral loads are transferred to the foundations, and demonstrate how lateral stability is maintained.
2. The location of the facility is important. The design should pay attention to the opportunities to minimise heat build up and energy requirements for cooling by careful choice of orientation, structural form, thermal mass, insulation and glazing.
3. A **clear recommendation** to the Client about the scheme selected, with reasons for your choice.
4. A **detailed structural design** for representative parts of the structure, including primary members and bracing. The calculations must include an assessment of the elastic critical load factor for the structure, in appropriate directions.
5. A **schedule of loads** for foundation design.
6. A **concept design** for the golf ball structure. This should outline the proposals for the structural form, how the loads are transferred to the foundations and preliminary sizes for key members, such that the client can make a considered judgement whether to proceed to the detailed design stage.

1.3 DETAILS OF THE PROJECT

1. Site

The site is a “green field” site, though this is in fact a desert site. There are no limitations on the footprint of the building. The site is level, with no constraints on storage during construction.

2. Space requirements – driving range

The plan of the structure is shown in Figure 1. Only the primary structure needs to be considered at this stage. The necessary buildings that will house the cooling plant, the offices, catering and welfare facilities do not form part of this brief.

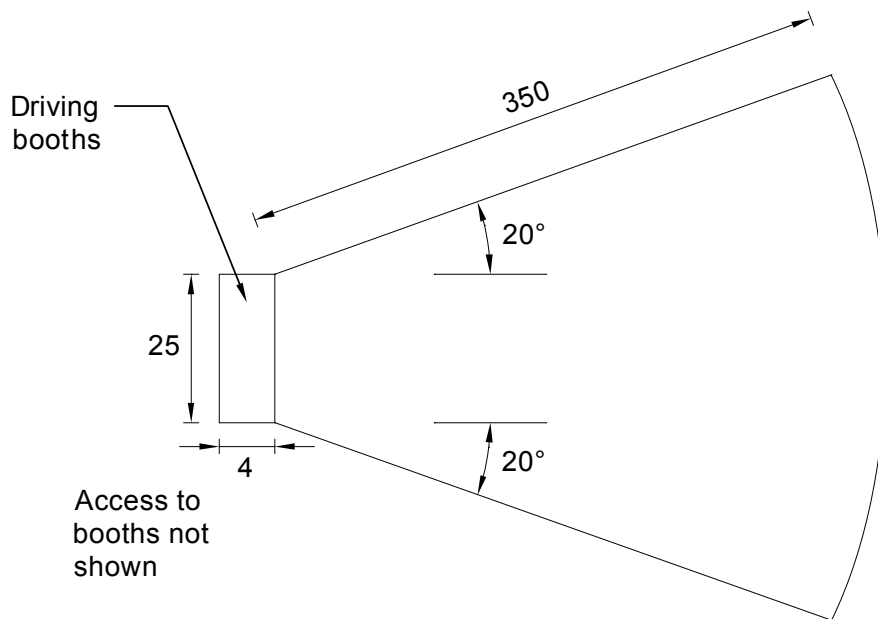


Figure 1 Plan of golf driving range

The cross section through the driving range facility is shown in Figure 2. The booths used by golfers are stacked three high, with a minimum floor to ceiling height of 4m. Access to the rear of each driving booth will be required – the client wishes to see appropriate proposals.

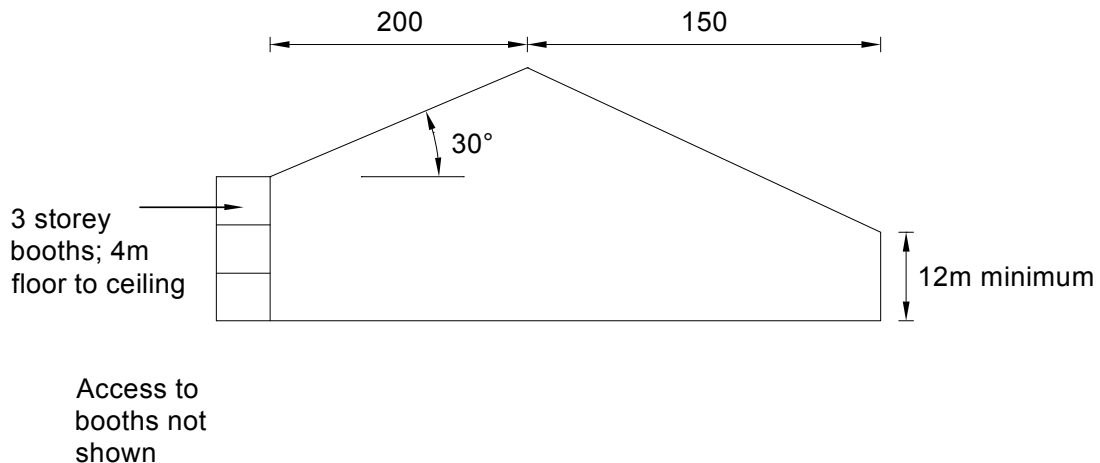


Figure 2 Cross-section on range centre-line

The profile of the enclosure over the range itself is the minimum requirement, and structure cannot be proposed within the clear space.

The same minimum longitudinal profile is required over the entire driving range.

3. Space requirements – golf ball

The client only has outline ideas, but is imagining a ball of 50 m diameter. This could contain a number of floors. The structure could include some form of viewing platform at a high level, an imax cinema, a club and other facilities. The client would be delighted to receive proposals.

Structurally, only outline arrangements are required at this stage – detailed space planning and detailed structural design are certainly not required. The structural concept should be explained, and how loads are transferred to the foundations. Key members should be considered, with estimated sizes. In a desert location, the cladding and insulation will be important, and should be discussed.

The client appreciates that erection of such an unorthodox structure may be difficult – outline plans should be provided.

4. Construction

It may be assumed that there are no site constraints that affect construction. Storage on site is readily available, and access straightforward.

1.4 BASIS FOR DESIGN

a) Standards

Both structures are to be designed in accordance with the requirements of BS 5950-1:2000 or Eurocode 3: Part 1.1: 2005.

b) Materials

The structure should be designed using Advance rolled sections (S275 and/or S355) or Celsius hollow sections.

c) Loading

i) Dead

Self-weight of the structure as calculated.

Throughout the facility, a minimum service load of 0.25 kN/m² should be allowed.

ii) Imposed Load

Although snow need not be considered, the imposed load on any roof should be taken as 0.4 kN/m². Imposed roof load need not be considered on any slope steeper than 30°.

iii) Imposed floor load

The imposed floor load should generally be taken as 2.5 kN/m². Any crowd loading should be taken as 5.0 kN/m². If dynamic activity is anticipated, comments should be made on the structural solution though no calculations are needed at this stage.

d) Wind

A dynamic pressure of 0.9 kN/m² is to be taken. Pressure coefficients may be determined from BS 6399-2 or from BS EN 1991-1-4.

e) Deflection

Deflection limits may be taken from BS 5950, or from the National Annex to BS EN 1993-1-1

f) Other Design Requirements

Frame stability must be checked in accordance with BS 5950 or EC3, and λ_{cr} (α_{cr} in EC3) calculated in appropriate directions.

Special attention must be paid to arrangements to resist lateral loads and provide frame stability,

g) Construction

Submissions should contain a description of the erection method, highlighting any critical phases during construction.

1.5 ADDITIONAL RESOURCES

The following resources are available for reference:

www.tatasteelconstruction.com/en/products/structural_steel/

www.tatasteelconstruction.com/en/products/roofs/

www.tatasteelconstruction.com/en/products/walls/

www.tatasteelconstruction.com/en/products/floors/

www.tatasteelconstruction.com/en/reference/publications/envelope/

www.tatasteelconstruction.com/en/reference/publications/structural_steel/corrosion/

www.tatasteelconstruction.com/en/reference/publications/structural_steel/advance/

www.tatasteelconstruction.com/en/reference/publications/structural_steel/tubes/

All SCI resources are available via www.steelbiz.org

2 SUBMISSIONS

2.1 SUBMISSION CONTENT

The submission is to be a single copy of the report, calculations and drawings, for which you have been commissioned (see Section 1.2) and should not exceed a total length of 70 single sided A4 pages plus two drawings.

The submission should include the following:

a) Report

A **maximum** of 35 pages of double spaced text, either printed with a minimum font size of 11 pt or neatly hand written, to include:

(i to vii cover the driving range)

- i) A description of the structural arrangements for the structure, including in particular the means of transferring lateral loads to the foundations;
- ii) An outline of the design process, which led to the development of the final scheme;
- iii) A demonstration that energy use has been properly considered in the arrangement, form, orientation and materials used in the structure.
- iv) A demonstration that the sway sensitivity of the structure has been assessed, and accounted for if necessary;
- v) A brief description of the proposed methods of construction should be given. These need not be quantified or described in detail but they must be feasible; the problems that might be encountered during construction should be discussed, together with the steps that might be taken to overcome them;
- vi) Detail design of the primary members. Typical connections should be shown;
- vii) A schedule of foundation loads;
- viii) An artist's impression, sketch or image (which may be freely used by the sponsors), which conveys the essence of the recommended scheme. The graphic must be A3, should be rolled, not folded, and must not disclose the identity of the competitor.
- ix) For the golf ball structure, a concept design, including comments on the stability system and erection method.

b) Calculations

A **maximum** of 35 pages of calculations, which must include detailed calculations to confirm the adequacy of the main steel members proposed. This should include the detailed design of typical connections.

c) Drawings

One print of each of two A1 drawings, which should be rolled, not folded. Originals of drawings should NOT be submitted. The drawings must indicate all relevant dimensions, and must show:

Drawing 1 Plans, elevations and cross sections of the proposed structure, at appropriate scales. It should show relevant member forms and sizes, and give general specification clauses covering material, workmanship, corrosion protection, etc.

Drawing 2 Typical details e.g. connections, cladding and glazing interfaces (if any), at an appropriate scale of.

d) Other submission requirements

- i) All calculations must be submitted on sheets in the format of the calculation sheet shown on page 12. A calculation sheet may be downloaded from the 2011/2012 Undergraduate Prize Awards discussions area of the SCI's web site at: <http://discus.steel-sci.org>
- ii) If a computer analysis is used, then the main members should be checked by hand calculations and these calculations must be submitted with the report. Where appropriate, computer input and summary results for the final run should be included.
- iii) Computer drawings using a CAD system are acceptable.
- iv) No sheets or drawings of any entry should contain the identity of the competitor or of the university represented. Total anonymity must be maintained in all submissions.
- v) Note the requirements for an A3 graphic, described in Section 3.1(a) viii.

2.2 SUBMISSIONS AT THE UNIVERSITY

All students intending to submit an entry for this competition should inform the academic tutor in charge of the project at their university, who should submit a Notice of Intent form (page 15) by **Friday 20 January 2012**.

Completed submissions should be handed to the tutor in sufficient time to allow for the selection of the best entry from the university.

2.3 SENDING SUBMISSIONS TO THE SCI

The chosen submission from each university must be received at the SCI by **4:00 pm on Friday 8 June 2012**. Late submissions will not be accepted.

3 CRITERIA FOR JUDGING

3.1 LOCAL

The competition will operate at two levels. The academic tutor(s) involved with the project at that university will first judge all submissions made at each university locally. The winning submission at each university will then be entered for the national competition. A certificate will be issued to all those reaching the national final.

Only one entry from each university will be considered to go forward for final judging at national level.

3.2 NATIONAL

All winning local submissions will be judged at national level using the following criteria:

- (a) The exploration of alternative structural forms and the discussion leading to the selection of the chosen scheme.
- (b) The discussion leading to the chosen scheme.
- (c) The stability, structural integrity and aesthetics of the chosen scheme.
- (d) The imaginative and innovative use of structural steelwork.
- (e) The buildability and safe construction sequence of the scheme.
- (f) The clarity and conciseness of the report and the drawings describing the proposed structural schemes.
- (g) Effectiveness in communicating the proposed scheme to the client.
- (h) Compliance with the Brief.

Note that the structural solution will carry a high weighting during judging. Entrants should ensure the structural concept and arrangements are clearly described.

The interpretation of these criteria by the Judges will be final.

Marks will be lost for failure to cover all the requirements set out in the brief. No marks will be gained for the inclusion of features not called for in the brief.

4 THE AWARDS

4.1 UNIVERSITY LEVEL

A certificate will be issued to all those reaching the national final.

4.2 NATIONAL LEVEL

The winners of the competition will receive certificates and prizes up to a total of £2,500. The exact division of the prize money will be decided by the Judges and will depend upon the standard of the submissions received. Generally, the judging panel will seek to award up to three prizes. The winners' universities will also receive certificates.

4.3 PRESENTATION

The prizes will be presented at the Structural Steel design Awards, to be held in early July 2012. (Date and location to be advised). The winners of the first, second and third prizes, with their tutors, will be invited to the ceremony.

4.4 ELIGIBILITY

Individual entries, or team entries from a small group of students, will be accepted. Although the competition is aimed at final year students, entries from students at any other appropriate stages will also be considered at the discretion of the course tutors.

No family member of staff from the sponsoring body or the judges, nor any partner, associate or employee from their companies or practices, shall be eligible to enter the competition or to assist a competitor. Assistance is available through the competitions website, <http://discus.steel-sci.org>



Steel Knowledge

**Tata Steel / BCSA Student Awards
Structural Steel Design 2011/2012**

CALCULATION SHEET

Job No.	Sheet	Of	Rev
Job Title			
Subject <i>Golf driving range</i>			
Client	Made by	Date	
	Checked by	Date	

[Grid area for calculations]			
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How to Enter

1. To enter the competition the academic tutor(s) at your university should firstly complete the enclosed **Notice of Intent** form and return it to the competition organiser at the address given below by **Friday 20 January 2012**. This will enable the SCI to provide supplementary information should this be necessary.
2. Any questions that competitors wish to ask should be submitted via the Undergraduate Prize Awards discussions area of the SCI's web site at <http://discus.steel-sci.org> All competitors should review the questions and responses posted to the site; automatic notification can be set up via the user profile.
3. The completed **Entry Form and Authorship Declaration** (contained in this booklet) should reach the competition organiser at the address given below by **Friday 4 May 2012**. On receipt of this, the SCI will issue each competitor with an entry reference number, which should be marked clearly on all items forming the design entry and on the outside of the package in which the entry is submitted. **No other form of identification or distinguishing mark should appear on any part of the submission.**
4. A successful competitor must be able to satisfy the judges that he or she is the bona fide author of the design that he or she has submitted.
5. 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.
6. Design entries must be received by **4.00 pm on Friday 8 June 2012**.
7. The designs awarded first, second and third places will be exhibited at the Structural Steel Design Awards, to be held in July 2011 (date to be confirmed).
8. Any entry shall be excluded from the competition if:
 - i) the competitor does not meet the eligibility requirements detailed in Section 4.4;
 - ii) the entry is received after the competition closing date, **4.00 pm on Friday 8 June 2012**;
 - iii) the competitor shall in any way disclose his or her identity or that of their university;
 - iv) the competitor attempts to influence either directly or indirectly the decision of the judges;
 - v) in the opinion of the judges, the design does not substantially meet the requirements of the brief.

Only one copy of each competitor's design is to be sent in a single package, carriage paid to:

The Competition Organiser
Tata Steel / BCSA Student Awards Structural Steel Design
The Steel Construction Institute
Silwood Park, Ascot
Berkshire, SL5 7QN

Tel: 01344 636525
Fax: 01344 636570

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Document comprises 20 sheets in total, to allow for double-sided photocopying



Notice of Intent

(to be submitted by Friday 20 January 2012)

TATA STEEL / BCSA STUDENT AWARDS STRUCTURAL STEEL DESIGN: 2011/2012

If you wish to enter the competition, the academic tutor(s) at your university should complete this form and return it to the address given below in a sealed envelope.

Name of academic tutor(s)

.....

email(s)

Telephone No.

University

Address

.....

.....

.....

We expect approximately individual entries, and/or

..... team entries

to take part in the competition, of which one will be selected by the university for submission.

Signature(s)

.....

Please return to:

The Competition Organiser
Tata Steel / BCSA Student Awards Structural Steel Design
The Steel Construction Institute
Silwood Park
Ascot
Berkshire
SL5 7QN

Tel: 01344 636525
Fax: 01344 636570

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Entry Form and Authorship Declaration

(to be submitted by Friday 4 May 2012)

TATA STEEL / BCSA STUDENT AWARDS STRUCTURAL STEEL DESIGN 2011/2012

*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 **BLOCK CAPITALS PLEASE***

University
Name of academic tutor(s)
Email address(es)

The following student(s) have been selected to represent my university in the above competition.

Student's name Year
Tel. no.
email
Home address

Student's name Year
Tel. no.
email
Home address

Student's name Year
Tel. no.
email
Home address

Student's name Year
Tel. no.
email
Home address

1. *I/We have complied with and accepted the regulations and conditions 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 design.
3. *I/We declare that the design is *my/our work and that the drawings have been prepared by *myself/ourselves.

Signature, student(s) Date

Signature, academic tutor(s) Date

This form is to be completed by the competitor(s) and the 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 in which the entry is submitted.**

Please return to: The Competition Organiser
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Design
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Tel: 01344 636525
Fax: 01344 636570



Steel Knowledge

The Steel Construction Institute