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Civil Engineers: Shaping the World

# Bridge Building Competition

## Ambassador Brief

## Competition overview

The competition format will ideally comprise of a team of 3 learners from years 8, 9 or 10 building a small wooden bridge under the supervision of ICE/Construction Ambassadors which will then be loaded to destruction to test its load carrying capacity.

The bridge building kits consist of 25 sticks of 4mm nominal thickness x 600mm long and a pack of Pratley Clear quickset glue.

The anticipated duration is 4 hours over a 4 week period, although this can be varied to suit individual schools, time available and the age of the pupils. It is expected that the students will have to carry out some of the work as ‘homework’.

The aim of the competition is to introduce the students to Civil Engineering through their interaction with the ICE/Construction Ambassadors and hopefully peak their interest in pursuing Civil Engineering as a career. We envisage this competition being aimed as students who are already in a STEM club, or who have expressed an interest in STEM subjects.
The areas of the curriculum which might be covered are as follows:-

- connections
- compression
- tension
- stresses
- strain
- moments (bending)
- shear
- arches

## Competition Format

### Stage 1 – Lecture & Handing out Kits

It is anticipated that a representative from the ICE (ideally a Lecturer in Civil Engineering Structures from one of the local universities, or colleges) will visit the school and give the students who will be participating in the competition a ½ to ¾ hour talk/lecture on structures.
This lecture will comprise of explaining forces, moments, compression & tension in members and some basic details on bridge design, ie: what shapes work best and why!

Alternatively, this part of the competition could be carried out by any ICE, or Construction Ambassador.

After the talk/lecture the students will need to be sorted into groups (ideally 3 persons per group), the competition rules explained and the bridge building kits handed out.

### Stage 2 – Design & Build

At this stage it will then be up to the individual schools/teachers to decide on how much time the students have to design and construct the bridges, and when these activities will take place. This could be homework based, lessons could be allocated during school time to carry out these activities, or as an 'after school' club activity.

Ideally the design & build stage should comprise 3 one hour sessions, all overseen by an ICE, or Construction Ambassador. The second session would look more at bridge design and the students could start planning/sketching out their bridges. Sessions 3 & 4 would comprise of cutting up the sticks and finally gluing them all together.

### Stage 3 –Testing

Depending on the number of bridges which have been built and the number of teams taking part, this could either be a single, or two stage process. If the number of bridges is 6, or less from one group it is recommended that all the testing is carried out in one stage and a winner declared.
If there are a number different groups taking part, each with a number of teams then initial testing to reduce the number of teams to go forward to the 'finals' will need to take place. This activity could be staggered, so all the children are not present at the same time. At this stage it will need to de decided on how many teams go through to the finals. We would suggest 6 as a maximum. We would envisage this stage taking place during school time.
Alternatively, irrespective of the number of bridges, all the bridges could be tested over a period of time and a winner declared.

### Stage 4 – Finals (if necessary!)

The winning teams then need to refine their designs and re-build their bridges for final testing of their bridges to take place. Again, it is up to the individual schools/teachers to decide when this stage is carried out. From past experience, it is recommend that it takes place in the evening, and if possible in the school hall. Parents, and the remainder of the class, should be invited, and encouraged to attend.

If possible, some sort of prize, or trophy, should be awarded to the winning team.

## General information

## Year Group

It is anticipated that this particular bridge building competition is aimed at Year 8, 9 or 10 students. If for some particular reason, or to tie in with a particular module in the curriculum, ie: bending moments, it could be pushed up to Year 11.

**NB:** This activity would qualify the students for a Quest Discovery Award Certificate.

## Resources

The wooden sticks and the quick-set glue will need to be purchased by the schools themselves.
The stands for testing and the testing 'hangers' will be supplied by CRL (Michael Balletta, mobile: 07827 894 583, e-mail: mballetta@crl.eu.com).

The wooden sticks can be obtained from:-

TRUSTLEAF

Unit C4
33 Thorby Avenue
March
Cambridgeshire
PE15 0BD

E-mail: sales@trustleaf.co.uk

Web site: http://www.trustleaf.co.uk/60cm-lengths-of-pine-block-and-strip-4182-p.asp

The wooden sticks cost £5.00/25no. Post and packaging will cost between £5.00 and £10.00 depending on the amount ordered. It is best to e-mail Anita with the order as the 600mm length is not a standard/stock size for them.

The, PRATLEY Quickset Clear Glue 40ml Pack, can be obtained from:-

JEANI Accessories

Castle Lane
Melbourne
Derby
DE73 8JB

Tel: (01332) 865 055

E-mail: Tony@jeani.co.uk Web site: www.jeani.co.uk

The glue costs approximately £3.00/pack with post and packaging costs varying according to the number of packs ordered. Ordering is pretty straight-forward through the website.

NB: With both of the above resources, if the quantities are minimal they can be purchased directly from Michael Balletta, mobile: 07827 894 583, e-mail: mballetta@crl.eu.com

## Rules

The Bridge kits will be as those as specified in the Competition Overview and detailed below. No other resources will be allowed to be used.

Depending on the number of bridges there will be an initial round of testing to determine which teams go through to the finals. The finals will take place at a later date to be agreed upon.

Material kits shall consist of 25 No. timber sticks (nominally 4 mm x 4 mm x 600 mm), a Pratley Quickset Clear glue package and this competition information. *Please note that entrants may not split the sticks along their length.*

All models will be incrementally loaded until they fail. Please pay considerable attention to the diagram showing how the loading apparatus projects through the sidewalls of the bridge (See Figures 1 and 3).

All bridges must conform to the following dimensions:-

1. Each bridge must span 780 mm clear (See Figure 2), and the bridge should be at least 820 mm long overall to allow for the supports.
2. The width of the bridge is not to exceed 150 mm (See Figure 3)
3. The height of the bridge above the roadbed is not to exceed 90 mm (See Figures 2 and 3.).

All bridges must provide for a 100 mm horizontal passageway called the bridge deck, which must span the entire length of the bridge. The loading apparatus must rest on the roadbed of the bridge. The design of the passageway must allow for the clear passage of vehicles and must be a minimum of 50 mm high and 100 mm wide. The surface of the roadbed must not be more than 20mm above the supports. The bottom of the bridge must be not more than 100 mm below the roadbed (see Figures 2 and 3).

The bridge will not be allowed to butt up against the supports. Only "simple" supports will be allowed (see Figure 4).

Members of the bridge cannot be laminated together. The allowable overlapping of one member to another is 10 mm. Parallel members will be glued only where they come into contact with cross members. Except at joints, spacing between cross-members and or spacers must be at least 25 mm or more. (See Figures 4 and 5).

Painting or coating or treating any of the materials will not be allowed and no substitute or additional materials will be permitted. Large "blobs" and infills of glue may result in disqualification.

Each model bridge will be inspected on the day of the contest. Any violations of the above rules will be cause for immediate disqualification.

A selection of completed bridges will be weighed and any bridge containing additional weight may be disqualified.

The decision of the judges will be final and binding.

**NOTE:**

1 Dimensions on all drawings are in millimetres.

2 Drawings are NOT to scale (dimensions CANNOT be measured off drawings)

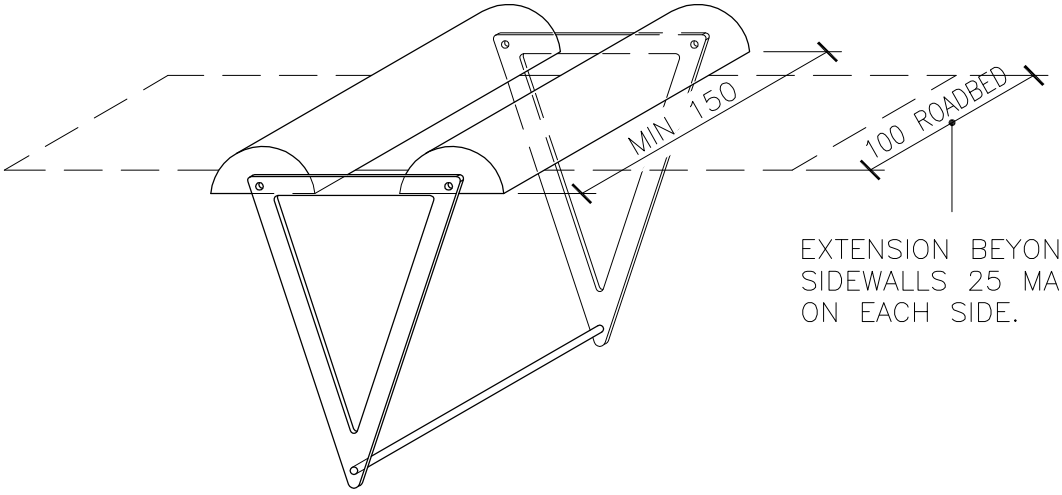
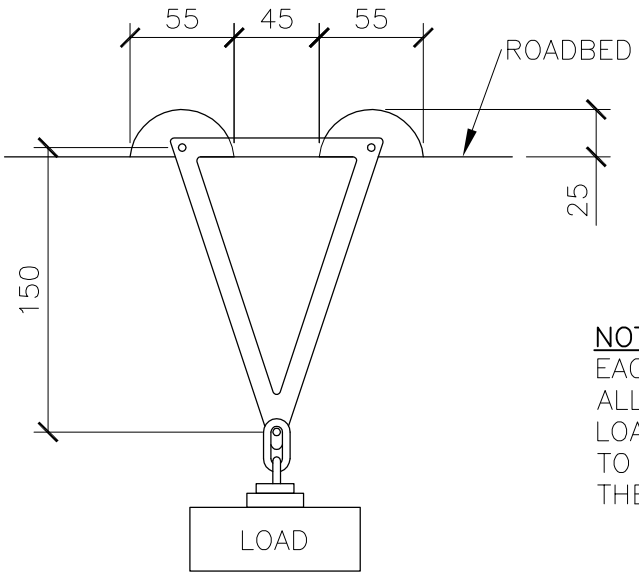



FIGURE 1a




NOTE
EACH BRIDGE MUST ALLOW FOR THE LOADING APPARATUS TO PASS THROUGH THE SIDEWALLS

FIGURE 1b

# LOADING APPARATUS
# FIGURE 1

NB
1. DRAWINGS ARE NOT TO SCALE
2. ALL DIMENSIONS ARE IN MM

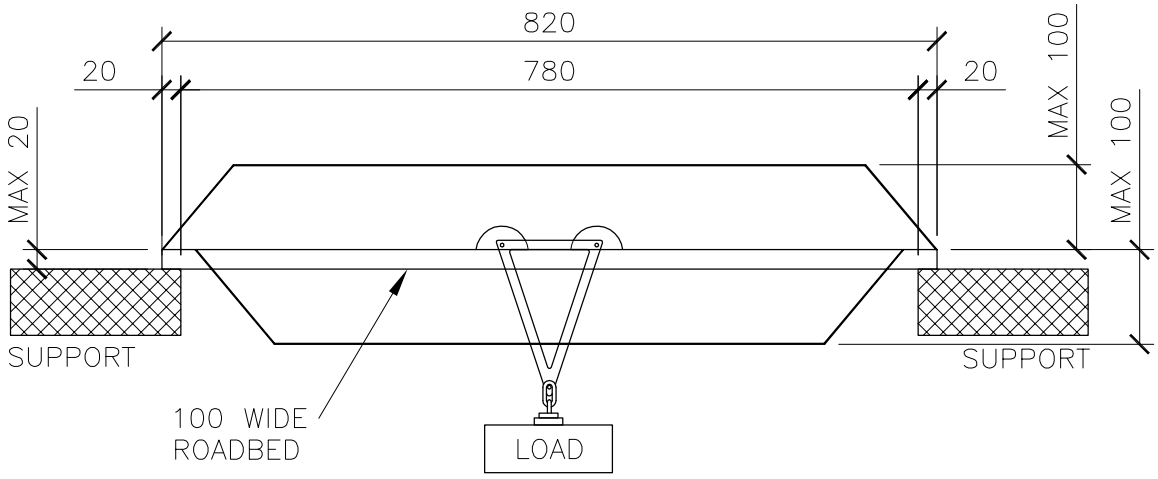



FIGURE 2
SIDE ELEVATION OF BRIDGE

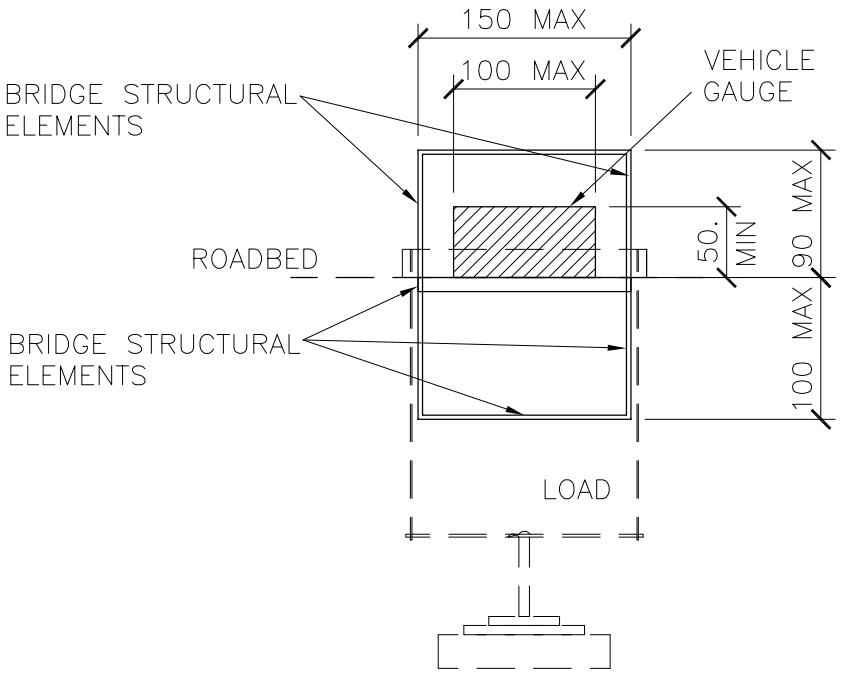



FIGURE 3
CROSS–SECTION THROUGH BRIDGE

NB
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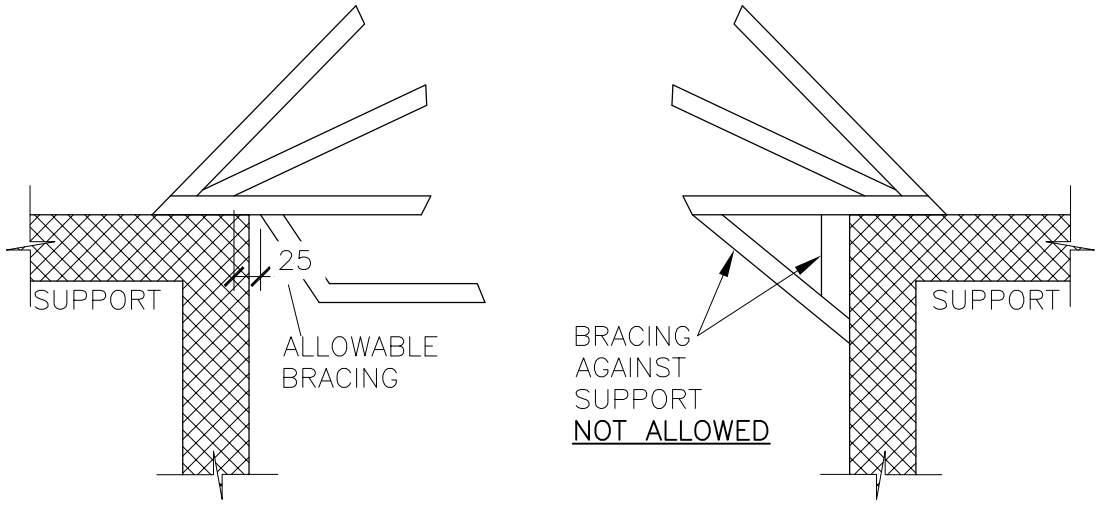



FIGURE 4

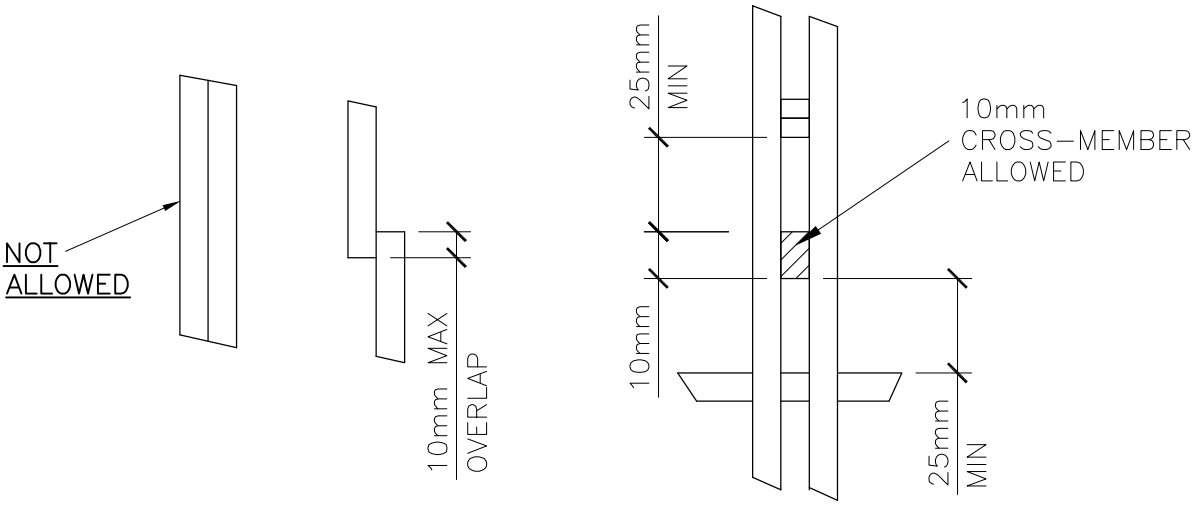
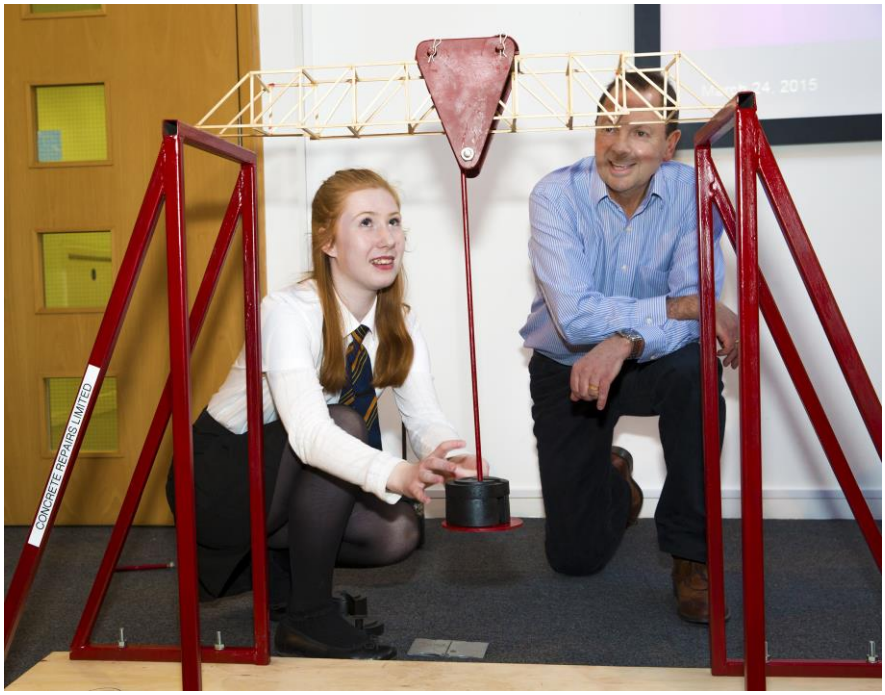



FIGURE 5

NB
1. DRAWINGS ARE NOT TO SCALE
2. ALL DIMENSIONS ARE IN MM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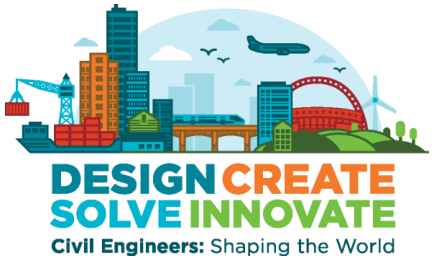


**Our vision**

Civil engineers at the heart of society, delivering sustainable development through knowledge, skills and professional expertise.

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- To develop and qualify professionals engaged in civil engineering
- To exchange knowledge and best practice for the creation of a sustainable and built environment
- To promote our contribution to society worldwide

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