

International Conference on Timber Bridges (ICTB) 2025



NEW ZEALAND
TIMBER DESIGN
SOCIETY



Bridge Competition



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1. Introduction

The International Conference on Timber Bridges is pleased to introduce the Bridge Competition, a unique opportunity for university students and junior engineers to showcase their skills and creativity in timber bridge design. This competition aims to promote timber bridge construction in New Zealand by challenging participants to create innovative, sustainable, and resilient timber bridge models on a specified scale, using only the provided materials. Through this hands-on experience, participants will deepen their understanding of timber as a construction material, bridge engineering principles, and sustainable design practices.

This information package provides an overview of the competition's structure, guidelines, and key deadlines. Participants will find detailed specifications, judging criteria, and submission requirements that outline the path to a successful competition entry. We encourage participants to explore the unique qualities of timber, apply their engineering and design knowledge, and demonstrate teamwork and problem-solving skills. We hope this competition inspires the next generation of timber bridge builders in New Zealand and beyond.

1.1. Objectives

- Promote timber usage in bridge applications in New Zealand
- Connect future engineers to structural engineering firms
- Expose participants to the common materials in timber construction by providing a hands-on experience.
- Expose students to real project experience elements by understanding logistics, project budgeting, and constructability constraints.

1.2. Schedule

Jan 31, 2025	Competition Information Package released
Feb 21, 2025	Expression of Interest submission deadline (Stage 1)
Mar 7, 2025	Acceptance into Stage 2 announced
April 11, 2025	Deadline for detailed design and construction submission (Stage 2)
April 24, 2025	Finalist teams announced
June 29, 2025 (Sunday)	Bridge construction (Stage 3)
July 1, 2025 (Tuesday)	Bridge test and winner announcement (Stage 3)

1.3. Eligibility Requirements

Team Composition: Each team shall consist of 4 members including:

- A maximum of two junior engineers (with less than five years of experience) from a single engineering firm.
- A minimum of two post-secondary students from a single university, college, or trade school enrolled in undergraduate or graduate programs. (Teams are encouraged to include students from engineering, architecture, and science disciplines.)

An academic staff (faculty) advisor is required for teams consisting only of students (not included in the 4 team members).

Team Leader: Each team must designate a team leader to serve as the primary contact person throughout the competition.

Multiple Teams from One Institution: Institutions are allowed to enter more than one team into the competition, provided each team meets the specified requirements.

2. Framework

The competition is structured in three stages to guide teams from the initial concept to their bridge models' final construction and testing. Each stage builds upon the previous one, challenging participants to apply their technical skills, teamwork, and creativity in developing a functional timber bridge design.

The bridge is a 1:20 scale model of a timber highway bridge.

2.1. Expression of Interest (Stage 1)

Teams begin by forming a group and submitting an Expression of Interest. This includes a list of team members, a brief description of their bridge design idea, and a signed acknowledgment of the competition's terms.

Each team is to submit a written Expression of Interest with the following information (maximum 2 pages):

- Names of the institutions wishing to participate in the competition.
- Name, email, phone number, institution of each team member (indicate the team leader).
- Name, email, and phone number of the team's academic staff (who can serve as the contact of the participating educational institution).
- A short description of bridge design concept(s).

Each team member must submit the following documents:

- Curriculum vitae.
- Terms and conditions acknowledgement (APPENDIX A); must indicate whether the member is available to compete in Stage 3 at the conference.

2.2. Design (Stage 2)

Once approved, teams move to the design phase. Invited teams will focus on researching, designing, and analysing their selected timber bridge concepts. This includes preparing technical documents, construction plans, and any required analysis that adheres to competition specifications. Teams are encouraged to consider structural stability, load-bearing capacity, and sustainability in their designs. The documentation prepared during this phase will be evaluated to determine the competition finalists.

2.2.1. Design Brief

Teams will design bridges meeting the requirements and constraints specified in Tables 1 and 2. The bridge structure must be symmetrical about the mid-span centreline.

Table 1. Scale bridge dimensions

Description	Model scale	Full scale
Span between abutments	1.6 m	32 m
Clear width of deck	0.3 m	6 m
Minimum clear traffic height above the deck	0.3 m	6 m
Maximum vertical distance from abutment to the bottom of the bridge assembly	0.6 m	12 m
Maximum height of bridge structure above the abutment	0.6 m	12 m
Maximum length of bridge (excluding end cables)	2.4 m	48 m
Maximum width of bridge structure	0.75 m	15 m

Table 2. Provided materials

Description	Grade (or code)	Dimensions (width x thickness x length in mm)	Qty
Radiata pine	MoE 8GPa	40 x 20 x 1200	10
		20 x 20 x 1200	20
		20 x 10 x 1200	20
Plywood	F8	100 x 7 x 2400	4
Stainless steel wire	Type 316	1mm dia. X 8000 mm long	2
Wood screws (Rothoblass)	HTS320	3 mm dia. X 20 mm long	500
	HTS3540	3.5 mm dia. X 40 mm long	250
	HTS445	4 mm dia. X 50 mm long	200

- The CLT abutments (provided), loading apparatus, required mid-span clearance, and other dimensions are shown in Figures 1 to 5. Note that:
- The provided abutments may be somewhat different if the anchor points are not required.
- The abutments will be free-standing with no connection to the floor of the testing venue.
- There shall be no fixings between the bridge and the abutment other than at the anchor points shown.
- A mid-span clearance of 650mm is required to allow for the insertion of plate weights below the deck.
- Teams must provide two 10mm holes located 150mm off the centreline of the bridge. One of these holes will be randomly selected and used for loading the bridge.
- **The use of 90x45 horizontal ties shown on the sketches is optional. These ties may be installed to fix the distance between the abutments if necessary. However, there will be a 10 point deduction from the final score if these ties are used.**

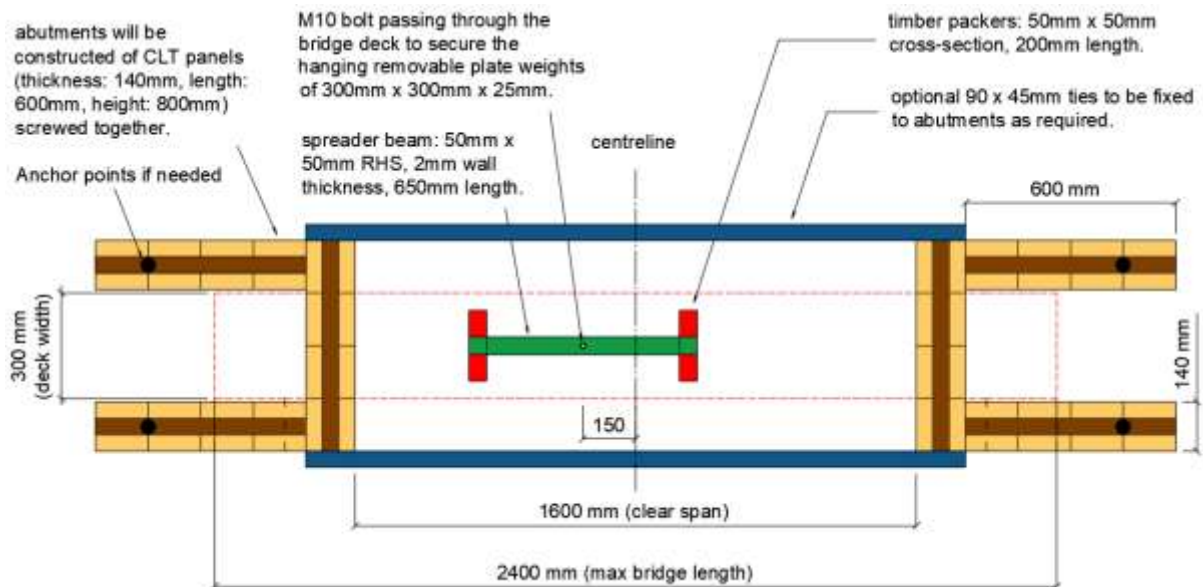


Figure 1. Plan view of the bridge loaded 150mm to the left of the centreline.

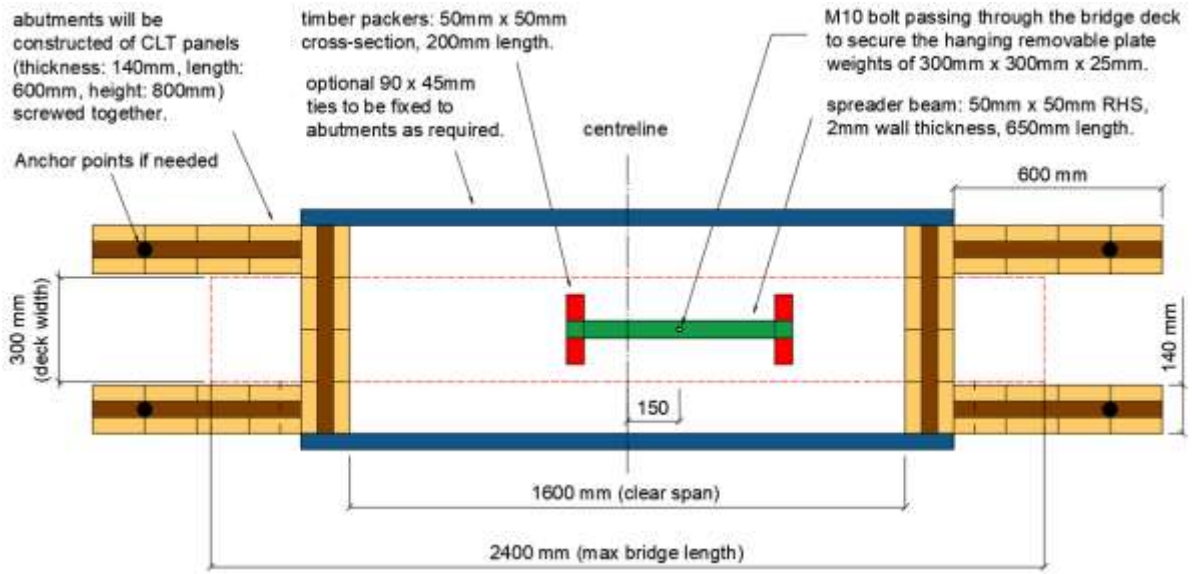


Figure 2. Plan view of the bridge loaded 150mm to the right of the centreline.

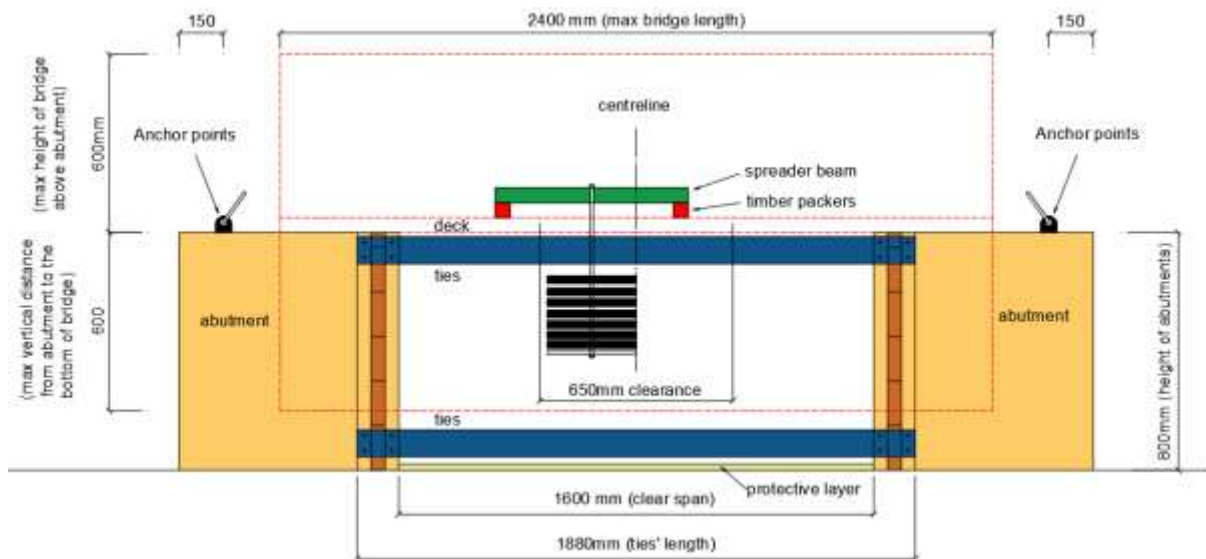


Figure 3. Side view of the bridge loaded 150mm to the left of the centreline.

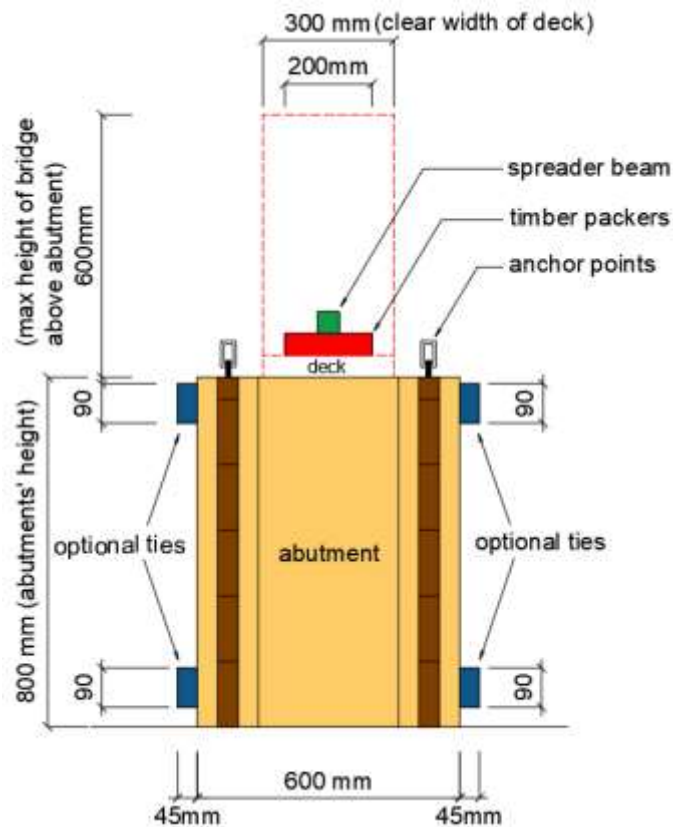


Figure 5. End view of the bridge dimensions

2.2.2. Design and Construction Document Submission

Each competing team is to submit the following documents.

- Literature survey on the chosen bridge design (maximum 2 pages)
- Design calculations (must include the following items)
 - Connection designs
 - Mid-span deflection estimation under the 10kg load
 - Maximum load capacity estimation
 - Expected failure mechanism
- Construction drawings
 - 1 Concept sketch (compulsory)
 - 1 Plan view (compulsory)
 - 1 Elevation view (compulsory)
 - 1 Connection detail (compulsory)

Notes: Additional drawings such as section cuts that help reviewing the bridge design are encouraged. Necessary annotations (i.e. grid system, identification of materials, identification of elemental sizes, etc.) are expected.

3. Construction and Testing (Stage 3)

The finalists (as many as six teams) will be invited to the ICTB 2025 venue, where they will construct and test their scaled timber bridge models. Teams will have a set time to assemble their designs on-site, using only the materials provided. After assembly, each bridge model will

be exhibited for 2 days at the conference, before being tested to destruction to evaluate its structural design and performance. Final judging will be based on the bridge's performance, design innovation, and construction accuracy, and the winning team will be recognized at the conference dinner.

3.1. Construction

The construction process requires teams to assemble their bridges on-site at Red Stag CLT factory, Rotorua. The following outlines the details for this phase:

3.1.1. Venue and Timing

- **Location:** Red Stag TimberLab CLT factory
- **Duration:** 9:00 AM to 2:00 PM (Teams must complete their assembly within this timeframe.)
- **Supervision:** Technical staff from Red Stag and competition organizers will supervise the construction process to ensure compliance with rules and safety standards.

3.1.2. Work Area

- Each team will be allocated an assembly area for construction. This area will be marked.
- All assembly activities, including material handling, must occur within this area. Any work outside the designated space is prohibited and may result in penalties.

3.1.3. Materials and Tools

- Teams are limited to using only the materials provided by the competition (Table 2).
- No pre-assembly of components is allowed before the official start of construction.
- Only tools provided by the organizers can be used during assembly. External tools or modifications to materials are strictly prohibited.
- The following tools will be provided to each team (to be confirmed closer to the time):
 - Power drill / screwdriver x 2
 - Hand saw x 2
 - Clamp x 4
 - Pliers for cutting and fixing wires

3.1.4. Procedure

- **Preparation:** Teams will be assigned to a work area, collect required materials, and set up their workspace.
- **Construction:** Construction will begin upon the organizer's announcement.
- **Supervision:** Judges and supervisors will monitor construction. Unsafe practices will result in a request to halt construction, and teams may appeal such decisions.
- **Cleanup:** Teams are expected to leave their work area clean and free of damage after construction.

3.1.5. Inspection

- After assembly, judges will inspect each bridge to verify adherence to the competition's dimensional, material, and design requirements.

3.1.6. Coordination and Transportation

- Transportation to the construction venue will be coordinated by the ICTB 2025 Bridge Competition team. Teams will be picked up from the conference venue at 8:00 AM and transported to the construction site by 8:30 AM. Lunch will be provided.

3.1.7. Safety Precautions

- All participants must wear personal protective equipment (PPE) during construction and during testing, including gloves, and safety glasses, which will be provided.
- All participants must wear covered shoes.
- Unsafe practices, such as running, improper handling of materials, or deviation from guidelines, will result in penalties or stoppage of construction.

3.2. Exhibition

3.2.1. Display

After construction, bridges will be transported to the exhibition area and displayed under sustained vertical loads. Each bridge will be placed on abutments with a 10-14 kg CLT wood block (0.3m height x 0.15m thickness x 0.5m length) at the mid-span, simulating real-world loading conditions. This setup emphasizes the functionality of the bridges, showcasing their structural behaviour and design to judges and attendees.

3.2.2. Posters

Each team must prepare a printed poster (A1 sized) for display at the conference. The poster should visually and concisely represent the project's objectives, design process, and key takeaways. This visual medium allows teams to highlight the most important aspects of their project, making it accessible and engaging for judges and attendees. Suggested items to be included in the poster are as follows:

- **Project Title and Identification:** Display the project title prominently at the top, along with the name and insignia of the institution(s), and names of all team members. This section should also include acknowledgments for mentors, advisors, sponsors, and collaborators who contributed to the project.
- **Introduction and Objectives:** Provide a brief overview of the structure, location, and purpose of the bridge model. Include the overall goals, unique design challenges, and innovative solutions that were integrated into the project.
- **Bridge Specifications and Composition:** Outline the bridge's structural composition and materials. This may include information on connection details and any specific engineering techniques used in design or construction.
- **Key Findings and Analysis:** Present the main structural analysis results, including load-bearing capacities, deflection analysis, and any performance outcomes observed during the design phase. Emphasize how these findings contribute to the bridge's overall stability and resilience.
- **Insights and Learnings:** Describe any valuable insights gained during the project, such as lessons learned in timber construction, project management, or teamwork dynamics.

3.3. Testing

The testing phase evaluates the structural performance of the bridges under vertical loads. This final stage is critical in determining the competition winners.

3.3.1. Preparation

- **Weighing:** Bridges will be weighed before testing.
- **Safety Supports:** Safety supports will be placed under each bridge to prevent falling loads from causing damage or injury.

3.3.2. Vertical Load Testing

- **Load Application:** Weights will be added incrementally to the hanging rod in 10kg or 5kg increments until the failure occurs. The imposed forces will be transferred to the bridge deck through the spreader beam and timber packers, as illustrated in Figures 1 to 3.
- **Deflection Measurement:** Deflection will be measured at mid-span of the bridge deck. Excessive deflection or failure will result in the termination of testing.

3.3.3. Safety Protocols

Only team members (maximum 2) handling the testing process are allowed near the bridge. All others must observe from a safe distance. Testing will stop immediately if:

- Signs of imminent collapse are observed.
- Structural failure occurs.

3.3.4. Judging Criteria

Bridges will be evaluated based on:

- **Deflection Performance:** Mid-span deflection under a combined load of 20kg (two 10kg weights).
- **Load Capacity:** Maximum vertical load sustained at failure.
- **Construction Accuracy:** Precision in following design specifications and guidelines.
- **Innovation:** The originality and quality of the bridge design and construction.
- **Support of abutments:** There will be a 10 point deduction from the final score if horizontal ties are used to fix the distance between the abutments.

The judging criteria details are found in the scoring rubric (Appendix B).

4. Sponsorship

Red Stag TimberLab CLT is the major sponsor for the competition, including:

- Workspace and tools for construction
- All materials for the bridges,
- CLT bridge abutments
- Transportation of bridges
- Supervision and safety
- Red Stag sponsorship will also cover conference registration for competitors, some assistance with transport to Rotorua and accommodation, especially for student teams. Details will be provided in due course.

It is expected that junior engineers from engineering firms will be sponsored by their employers.

Rothoblaas is the sponsor for connections, including:

- Screws and other fasteners
- Power tools

Appendix A – Terms and Conditions

1. General Rules

- Teams must register and submit all required documentation before the deadlines.
- Each team must designate a team leader as the primary point of contact.
- A minimum of three members of each finalist team must attend the ICTB and participate in the bridge competition Stage 3.

2. Safety Regulations

- All participants must wear personal protective equipment (PPE), including gloves, safety glasses, and covered shoes, during construction.
- Teams must comply with instructions from technical staff and competition organizers during construction and testing phases.

3. Submission Guidelines

- All documents, including the Expression of Interest, design submissions, and construction details, must adhere to the specified formats and deadlines.

4. Testing and Judging

- Bridges will be tested for load capacity, deflection, and strength-to-weight ratio under controlled conditions.
- Judges will evaluate bridges based on the scoring framework (Appendix B) provided in this document.

5. Intellectual Property

- All designs, models, and documentation remain the intellectual property of the respective teams.
- The competition organizers reserve the right to use photographs, videos and submitted materials for promotional and educational purposes, with proper credit to the team.

6. Dispute Resolution

- Any disputes during the competition will be reviewed and resolved by the judging panel and competition organizers.

7. Unforeseen Circumstances

- The organizers reserve the right to modify the competition schedule or format in response to unforeseen circumstances, such as natural disasters or pandemics.

8. Liability Disclaimer

- Participants acknowledge that they are responsible for their actions during the competition.

By signing below, I confirm that I have read, understood, and agree to the terms and conditions of this agreement.

Participant Name (Print): _____

Signature: _____

Team Name: _____

Date: _____

This signed agreement must be submitted as part of the competition registration process.

Appendix B – Scoring

The competition will evaluate teams across five core areas, each reflecting critical skills and competencies required to design, construct, and test a high-performing timber bridge. The scoring system totals 100 points, ensuring a fair and transparent process with detailed criteria for non-compliance.

1. Conceptual Design and Innovation (15 points)

This section evaluates the originality, creativity, and alignment of the bridge design with sustainable principles.

- **Originality and Creativity (10 points):**
Innovative solutions to technical challenges and high aesthetic quality.
- **Sustainability and Environmental Impact (5 points):**
Design considerations that minimize environmental impact.

2. Technical Design and Documentation (20 points)

This category assesses the depth and clarity of the poster, including analysis and drawings.

- **Structural Analysis and Calculations (10 points):**
Comprehensive and accurate evaluation of load capacity, deflection, and failure mechanisms. Clear justification of design assumptions, load considerations, and material properties.
- **Construction Drawings and Documentation (10 points):**
Professional-quality technical drawings, including plan views, elevations, sections, and connection details.

3. Construction Execution (15 points)

This category assesses how well teams execute their design during the construction phase.

- **Accuracy and Build Quality (10 points):**
Precision and adherence to dimensional/material specifications.
- **Workspace Compliance and Safety (5 points):**
Organized workspace, adherence to safety protocols, and proper material/tool handling. Clean and organized workspace left free of damage or debris.

4. Bridge Performance (50 points)

This section evaluates the bridge's structural performance.

- **Load Capacity (15 points):**
Bridges are scored based on the maximum vertical load sustained without failure:

$$Score = \left(\frac{\text{Team's maximum load}}{\text{Highest maximum load}} \right) \times 15$$

- **Deflection (10 points):**
Lowest deflection under a specific load (20kg) receives the highest points:

$$Score = \left(\frac{\text{Lowest deflection}}{\text{Team's deflection}} \right) \times 10$$

- **Strength-to-Weight Ratio (10 points):**
Ratio of load capacity to bridge weight to reward lightweight, strong designs:

$$Score = \left(\frac{\text{Team's S/W ratio}}{\text{Highest S/W ratio}} \right) \times 10$$

where, S/W is the ratio of maximum load to bridge weight.

- **Aesthetic Quality (15 points):**
Visual appeal of the final bridge.

Note: Support of abutments—A **10-point deduction** will be applied to the final score if horizontal ties are used to fix the distance between the abutments.