2026 APT PETC SPECIFICATIONS

The Timber Bridge

APT Preservation Engineering Technical Committee Student Design-Build Competition

Over the past 200 years of North American history, timber bridges have been used as quick, cost effective, and practical solutions to provide river crossings. While varying greatly in their design, many of these bridges remain in use. In order to understand how they work and they can be preserved, it is critical to develop an understanding of how these types of bridges were originally built.

In This Package

This package provides information about this year's Student Design-Build Competition hosted by APT's Preservation Engineering Technical Committee. In this document you will find background information, an overview of the competition phases, as well as the specifications and competition requirements. ***Take a look to see if you and your team are inspired to enter!***

Quick Dates Guide

The following schedule is preliminary and may be subject to change. PETC will notify teams should dates or deadlines change.

DATE	ITEM	DEADLINE/INFO
November 24, 2025	Competition Information Announced via Webinar	Info
January 12, 2026	Specifications Package Released	Info
February 22, 2026	**Teams submit Phase 1: Notice of Participation and Bridge Selection**	**DEADLINE**
March 1, 2026	PETC notifies teams that will move from Phase 1 to Phase 2	Info
April 15, 2026	Team requests for PETC to clarify any questions regarding Phase 2	Last Day
May 10, 2026	**Phase 2 Teams submit Financial Plan**	**DEADLINE**
May 10, 2026	**Teams submit Phase 2: Report and Construction Documents**	**DEADLINE**
June 5, 2026	PETC notifies the teams that are invited to the Phase 3 Finals	Info
October 5, 2026	Requests for clarification of Phase 3	Last Day
October 26-30, 2026	**Phase 3 Competition**	**Finalists Compete at APT Conference in Indianapolis, Indiana**

If teams are concerned about meeting any of the above deadlines due to external factors (access to lab space and equipment, exams), please contact APT-PETC a minimum of 2 weeks before the deadline to discuss accommodation.

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APT Preservation Engineering Technical Committee Student Design-Build Competition

1 Introduction

Conservation of historic structures is a multi-billion-dollar industry in North America, with an ever-growing demand for qualified and capable designers and trades people. Timber is a traditional building material which has been used in a variety of applications in buildings and infrastructure. This year, the Association for Preservation Technology (APT) Preservation Engineering Technical Committee (PETC) Student Design-Build Competition will focus on the Timber Bridge similar to one that would have been constructed between 1840 and 1890, highlighting the intricacies of timber construction and the technologies used for their preservation.

Teams will be tasked with studying an existing Timber Bridge – and if they make it to the competition finals – building a scale Timber Bridge of their own design. Along the way, teams will gain skills in evaluating the bridge's structural performance, creating construction drawings, and devising a preservation plan which allows these structures to withstand the test of time.

1.1 Past Competitions

APT PETC's Student Design-Build Competition was first held in 2016 with the Timber Bridge at the San Antonio conference. Two schools, Texas A&M University and Carleton University, competed in the finals that year. The competition grew in 2017 to five teams competing at the Ottawa conference and competed in the first Masonry Arch competition. From there, the competition continued to grow in popularity and has become a staple of the annual APT conference. The theme of the competition has alternated between the Timber Bridge (San Antonio 2016, Buffalo 2018, Edmonton 2020, Detroit 2022, and Montreal 2024) and the Masonry Arch (Ottawa 2017, Miami 2019, Washington DC 2021, Seattle 2023, and Providence 2025). This year, the competition returns to the Timber Bridge. PETC looks forward to your submissions!

1.2 Competition Objectives

The key objectives of this competition include:

1. Expose students to the fundamentals of researching and analyzing an historic Timber Bridge.
2. Expose students to the materials common in timber construction and preservation by providing hands-on experience.
3. Introduce students to preservation engineering fundamentals, using a real structure as a case study.
4. Promote "out of the box" learning and problem solving.
5. Promote interaction between students and APT members through mentoring during the on-campus work and networking during the conference finals.
6. Expose students to real project experience elements by understanding logistics, stakeholders' interactions, project budgeting, and constructability constraints.

1.3 Desired Learning Outcomes

1. Understand the value of multi-disciplinary teams
2. Learn to manage a team
3. Build networks to engage external professionals

4. Understand the basics of traditional timber design and construction
5. Transfer design to physical construction
6. Design and execute a laboratory testing procedure
7. Learn from conference presentations and other activities

1.4 Competition Framework

The competition is structured with three main phases. In Phases 1 and 2, teams will work at their home campuses on identification, analysis, and design-build components. Phase 3 will culminate with the finals at the 2026 APT Conference, and will include team presentations of research, an on-site build competition, and answering preservation challenges in front of the APT community live at the conference. *Refer to the Technical Specifications and Appendices for details*.

- Phase 1
  - Notice of Participation
  - Bridge Selection and Reporting
- Phase 2 – In-House Research & Design
  - Research Report
  - Design and Analysis of an Historic Timber Bridge
  - Development of Construction Documentation
- Phase 3 – Finals
  - Present and Display Posters at APT Conference
  - Build and Testing of Timber Bridge at APT Conference
  - Answer Preservation Problems

1.5 Conference Schedule

APT's Annual Conference is scheduled to be held in Indianapolis, Indiana from **October 26-30, 2026**. Phase 3 of the Student Design-Build Competition will occur during the conference, and PETC will communicate the specific dates and schedule in mid-2026 once the full conference agenda is established. The Phase 3 Finals activities will generally include:

- Presentation of Poster and Phase 2 research and design analysis to the conference audience
- A student seminar, with presentations from industry professionals, either at the conference or as a virtual presentation before the conference
- Preservation Problems assigned and worked on by teams during the conference to provide further learning and networking opportunities
- Team dinner and/or other social events
- Teams attend conference paper sessions
- Teams build and test their scale-model Timber Bridge structures during the conference
- Announcement of winners at the APT Annual Awards Ceremony

Note that APT PETC is assuming that the conference will be held in person and is planning accordingly. Accommodation for a virtual competition will be arranged if circumstances dictate.

2 Introduction

2.1 Team Members

Teams are to be formed from post-secondary students from a single university (undergraduate or graduate program), college, or trade school. Students must be enrolled as a student at their respective institution for at

least one semester throughout the duration of the competition. Teams are recommended to include engineering, architectural, and conservation/preservation students. Teams are to have a minimum of 4 people and a maximum of 6 people. Each team must name a Team Captain to liaise with PETC. An institution can have more than one team enter the competition.

If a team member must drop out of the competition after the Phase 1 team roster is submitted, the team is to notify PETC with a student substitution, if desired.

2.2 Faculty Advisors

Each team must have at least one Faculty Advisor, with more as desired. Their role is to advise students on technical and design issues, and to support and monitor the on-campus bridge construction. Faculty Advisors also serve as a formal link to the institution for educational, construction, and/or safety matters.

2.3 Mentors

During Phase 2, PETC will assign teams to an APT-provided mentor who is typically a preservation practitioner in a related field. Out of respect for the mentors' time, PETC provides the following direction regarding team interactions with mentors:

- Teams will be student driven, and mentors will serve as sounding boards for ideas.
- Teams are expected to touch base with their mentor every week or two for discussion.
- Teams will be responsible for scheduling meetings and being prepared for meetings with their mentors.

Each student team is encouraged to interact with their team mentor and other professionals throughout the competition. The goal of these interactions should be, in part, to provide opportunities for the students to gain constructive feedback on their methodology and craft at critical steps throughout the competition. The teams are encouraged to self-assess their practice area strengths; determine where additional professional mentoring and guidance could be best served.

2.4 Contacts

The Team Captains should contact the PETC Competition Committee via email for any questions or support. Answers will be issued to all Team Captains, to ensure all teams receive the same information.

- Team contact for PETC competition communications: **aptpetc@gmail.com**

2.5 Media

The PETC Student Design-Build Competition has no restrictions on talking to the media, and teams are encouraged to promote their work. PETC asks that articles, photographs, quotes, etc. are professional and in good taste. PETC asks to be sent a copy of any published (written or digital) articles in which the competition is discussed.

Be sure to include **#APTPETC** on social media posts.

The PETC Conference Committee will provide updates to APT members and the greater preservation community about the competition and teams. Please share photos and updates of the Phase 2 process throughout your team's work for inclusion in APT's social media platforms, APT's emails to members, and in PETC's e-blasts!

3 Phase 1 – Notice of Participation and Bridge Selection

There will be two submissions for this first phase: The Notice of Participation memo and the Bridge Selection and Structural Description narrative.

3.1 Notice of Participation

Each team is to provide a written Notice of Participation which shall be a 1-page submission with the following information:

- Name of the institution wishing to participate in the competition
  - Note: If multiple teams from a single institution are submitting proposals, please provide an individual identifier (for example, specific campus location, name of bridge, team number, Team Captain's surname, etc.) so as to distinguish them from other teams within the same institution.
- Name, email, and phone number of each team member
- Year and program of study of each team member
- Identification of Team Captain
- Name, email, and phone number of the team's Faculty Advisor(s)
- Desire to compete in Phase 3 **at the conference**

3.1.1 Bridge Selection

Teams are to select a Timber Bridge design similar to those designed between 1840 and 1890 to use as the basis for their work. The selected bridge can be an existing bridge found locally, or a non-local bridge found through research. The selected bridge is to use historic construction methods that would have been used between 1840 and 1890.

The Timber Bridge Selection submission is a 1-2-page report (double-spaced). The report is to include the following:

- Name and location of the selected structure
- Date of construction (approximate if not possible to find the exact date)
- General information on the Timber Bridge's history and construction, including its historical significance or designations
- A structural description of the bridge
- Original materials used in its construction
- References for the literature used to understand the history and construction of the structure
- References for the historic codes that will be used to analyze the structure
- Three to five images of the bridge and surrounding structure (Note: The images are not included in the page length.)

Teams returning to the competition are encouraged to select bridges that are unique and different from previous submissions by their institution; approval of the selection of a similar bridge will be at the discretion of the PETC Competition Committee. If a team is unable to locate a Timber Bridge that meets the given criteria outlined above, a non-local bridge may be selected, or the team can contact the PETC Competition Committee for alternatives.

Teams are to notify the PETC Competition Committee if they have not received notification on receipt of Phase 1 documents by the committee ***within one week*** of their submission to ensure transmittal of the information to PETC was successful.

Once the team submissions are received, the PETC Competition Committee will provide feedback and/or approval of each team's submittal. Teams should prepare to respond promptly to any feedback provided by the Competition Committee's questions during the review period. PETC will notify the teams that will move to Phase 2.

4 Phase 2 – In-House Research & Design

Phase 2 of the competition takes place at the team's home campus and consists of:

4.1 Report

The Phase 2 report assesses the bridge selected in Phase 1 and consists of the following four components:

- Historic Research and Design Review
- Structural Analysis
- Preservation (Conservation) Plan
- Construction Documents

See Appendix A for specific report format requirements and Appendix C for Scoring Criteria

4.1.1 Historic Research and Design Review

In the first part of the report, teams will build upon the information presented in their Phase 1 Bridge Selection narrative and prepare a more detailed report including:

- Date of construction and architect/engineer (if known).
- Significance of the selected structure, including its architectural, cultural, or technological values. Historic literature and reference materials should be used as a guide.
- Identification and description of the structural system used.
- Original materials used in construction, composition, connections, and assembly.
- Archival or current photos and/or drawings.

4.1.2 Structural Analysis

The second part of the report demonstrates an understanding of the structural behavior of the selected Timber Bridge. Teams will assess the Timber Bridge by utilizing methods and principles likely used in its original design and construction. The items within the following clauses are to be included in the report:

4.1.2.1 Define Relevant Loads and Assumptions

Teams are to identify the relevant loads or conditions used in the evaluation, as well as any load combinations (if applicable). Discussion may include:

- What loads have been selected and why?
- Were any loads intentionally not evaluated?
- Is any specialized load evaluation required?

Teams are also to describe any assumptions made in their analysis regarding material properties, boundary conditions, limitations etc.

4.1.2.2 Evaluate Performance

Teams will evaluate the bridge's performance and potential (or observed) failure mechanisms. Teams shall undertake their evaluation using any **two** of the following approaches:

- Empirical Design (Classical Approaches)
- Nineteenth Century Analytical Models (Graphic Statics or Similar)
- Contemporary Structural Engineering Analytical Software

Teams must justify why at least one of the selected approaches would provide a safe analysis and comment on any limitations of **each** selected analysis method.

The findings from the structural evaluation of the bridge shall be discussed and should include the following discussion points:

- What is the ultimate load capacity of the bridge? Is the bridge able to resist the applied loads?
- What are the general failure mechanisms of Timber Bridges?
- What are the visible signs that a Timber Bridge has become over-stressed? Are there any signs that your team's selected "real world" bridge is over-stressed?
- What structural interventions would you recommend to address any structural deficiencies. Are there any interventions visible on the bridge which correspond to your analysis?
- Consider any recommended intervention's compatibility with the existing building materials and heritage characteristics, reversibility, cost-effectiveness and durability or resilience.
- Comment on how some of your assumptions may impact the capacity or failure mechanisms of your bridge.
- Other noteworthy observations from your analysis.

4.1.3 Preservation (Conservation) Plan

The final part of the report is to provide a preservation (conservation) plan for the timber structure over the next 25+ years. If the bridge has undergone a recent rehabilitation, discuss the evident recent repairs, the durability of those repairs, the risk for future similar deterioration, or alternate preservation approaches that your team would have recommended.

The built environment is subject to external forces that often wreak havoc on the condition, materials, and structural integrity of historic structures. As preservationists, it is our responsibility to assess the condition and provide guidelines for owners on how to best conserve and maintain their assets.

> *Building pathology refers to the study of decay, deterioration, and defects of a building material or assembly. Deterioration can be caused by natural forces such as water and wind erosion, poor maintenance, or an inherent vice in the building design. Understanding this science is important for maintaining a structure's health and prolonging its service life. This involves identifying the root causes of decay and prescribing appropriate treatments or repairs.*

Teams are to identify three different components of the bridge structure which may be prone to pathological conditions. For each component identify a possible pathological condition and include the following:

- Name of the pathological condition
- Location on the bridge
- Cause of the pathological condition

- A judgement on the severity of the pathological condition: Is it in good, fair, or poor condition? Is it urgent to fix, or can be fixed in the short or long term?
- Proposed repair, treatment, or monitoring program for the condition
- One photo demonstrating the condition

Pathological conditions may fall under the umbrella of structural issues, moisture issues, materiality, compatibility, aesthetics, and issues related to poor maintenance. The three pathological conditions must impact the Timber Bridge directly (e.g. wood rot, overstressing) or indirectly (e.g. poor water-shedding). Pathological conditions which only impact non-structural elements are not allowed.

4.1.4 Report Appendix

The report appendix does not count toward the report's word count or illustration limits, and shall include the following:

- Supplementary calculations from Timber Bridge analysis (refer to Section 4.1.2)

4.2 Construction Documents

Teams are to develop construction documentation of their bridge design in the form of full-size drawings that would be typical of professional project deliverables. Teams will be judged on the final documents' clarity, attention to detail, accuracy, and following of drafting conventions. Mentors and other committee members can provide examples of such level of documentation upon request.

Drawings are to consist of the following:

- (1) Plan View
- (2) Elevation Views: (1) Transverse and (1) Longitudinal
- (2) Section Cuts: (1) Transverse and (1) Longitudinal
- (2) Detail Connections, to be chosen by the team
- Additional detailing, such as isometric views or other visuals that can be added to the drawings to better identify structural design and detailing intent, is encouraged

Each of the seven drawings shall be annotated and provide the following information:

- Grid system, including grid dimensions
- Overall layout
- General dimensions (length and width of structure)
- Intermittent dimension to clearly identify lengths of individual members and components
- Elevations, heights, etc.
- Identification of materials
- Identification of elemental sizes
- Identification of detailing components (size, dimensions, material, fasteners, etc.)

Refer to Appendix A for more information on formatting for the report and construction documents

5 Phase 3 – Finals

Based on their Phase 2 scores, as many as five teams may be selected to take part in the competition finals during APT's Annual Conference. The finals provide the teams with an opportunity to meet and network with the Competition Judges, PETC members, and other conference attendees. The finals are also an opportunity for teams to demonstrate their presentation, communication, and teamwork skills.

5.1 Posters

The Phase 3 competition finalists are to prepare a poster for presentation during the APT conference (hard copy printed poster and digital version). The poster will act as a "guided tour" through the team's project and should be a condensed version of the Phase 2 report. The poster should follow the general guidelines given in Appendix B.

5.2 Preservation Problems

Teams will select a pair of preservation problems during the conference (two total questions). The selection of problem pairs will be done as follows:

1. The PETC Competition Committee will show all problem pairs to all teams.
2. Teams will select their problems in order, based upon their ranking from Phase 2.

Teams are encouraged to engage conference attendees to discuss information to develop solutions for their selected preservation problems.

Teams will have until their presentation to develop their solutions. Each team will give an oral presentation of their solutions to the preservation problems. All team members must participate. Visual solutions (sketches, etc.) to show during the Presentation Problem presentation are encouraged.

Once the presentations are concluded, the judges will deliberate, tally up their judging cards, and provide some constructive feedback to the teams.

5.3 Presentations

The team will give a presentation of their Phase 2 project and solutions to their preservation problems to a panel of judges at the conference. Presentation requirements include:

- **Maximum length** –Approximately 10 minutes – Total time for presentation to be confirmed with final conference schedule.
- **Format** – PowerPoint (or similar) presentation slides with verbal presentation by student team members. Each student is to introduce themselves and speak for at least 1 minute.
- **Content** – The presentation should briefly summarize information from the Phase 2 report (historic research, structural analysis, conservation plan, and construction drawings), provide any new learning or understanding of the bridge since the Phase 2 submission, and detail the solutions to the assigned preservation problems.
- **Questions** – After each presentation, the team will have approximately 6 minutes for a live Q&A session with the judges and conference attendees. Total time for questions to be confirmed with final conference schedule.
- **Judging Criteria** – The presentations will be judged on both content and quality/professionalism. All team members are encouraged to participate in the presentation and the Q&A session, and this will factor in scoring.

5.4 Historic Timber Bridge Design-Build

Each competing team is to build a model of a bridge inspired by the Phase 2 bridge concept which meets the Phase 3 model specified dimensions. Teams selected for the finals will erect their bridges at the conference which will then be tested for stability, strength, and serviceability using APT standardized lateral and vertical loads.

The bridge for Phase 3 should be based upon the Phase 2 bridge but can be a unique design to meet the requirements of the competition.

Teams are to ensure all requirements and intent of the specifications are met. Scoring criteria and penalties for violations can be found in Appendix C.3.

5.4.1 Dimensions

The following specifications must be met:

- The maximum footprint of the scaled bridge is to be 8'-0" (2440 mm) long by 3'-0" (915 mm) wide.
- The minimum clear span between piers shall be 5'-0" (1524 mm).
- The minimum bridge length shall be 5'-6" (1676 mm) to ensure a minimum of 3" (76 mm) of bearing on each pier.
- The bridge shall have a decking surface that is continuous over the full length of the bridge that is at least 1'-6" (457 mm) wide. Note that the surface must be continuous, but the decking material shall not be a single continuous piece (see Section 5.4.2.1 for member dimensions).
- The bridge shall have a minimum 1'-0" (305 mm) high clear space from the top of the deck surface to any bridge truss or bracing members through which a theoretical user of the bridge could pass.
- The top of the bridge assembly shall not extend more than 2'-0" (610 mm) above the top of the piers.
- The bridge shall provide access for safely placing load anywhere on the deck (i.e. the bridge should not be covered and the layout of the truss and bracing members should allow for weights of the shape and size defined in Section 5.5.1 to be placed onto the bridge deck from the top of the bridge).
- The underside of the bridge shall not extend below the line of the top surface of the piers.
- Decking shall not distort the bridge from its as-built condition.
- The bridge shall not be anchored or tied to the floor or piers.
- Parts of the bridge shall not extend beyond the vertical plane defined by the ends of the piers.

Refer to the diagrams below for a visual representation of the dimensional requirements.

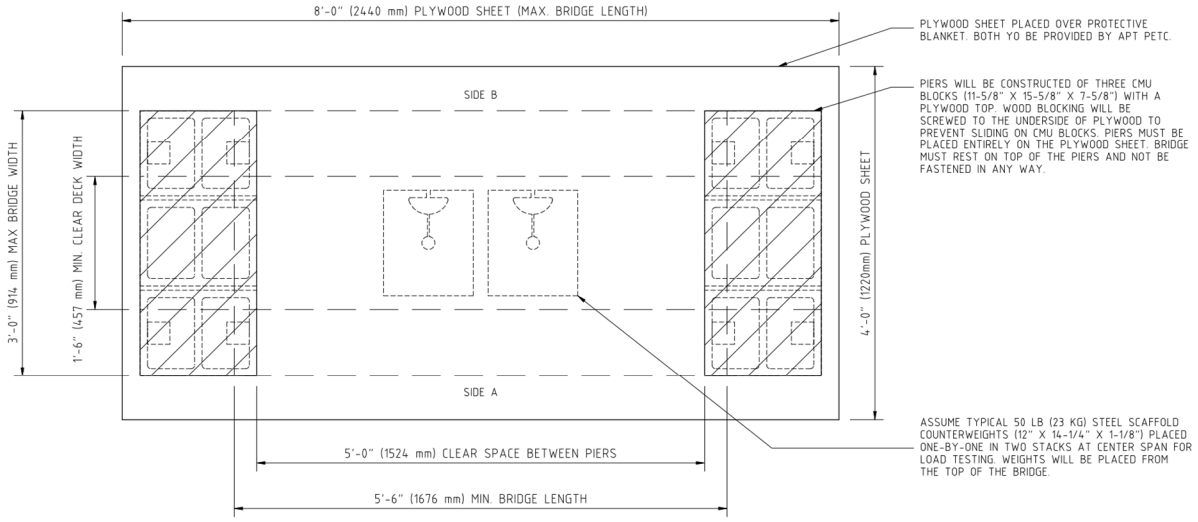

Figure 1: Plan view of bridge dimension and load placement

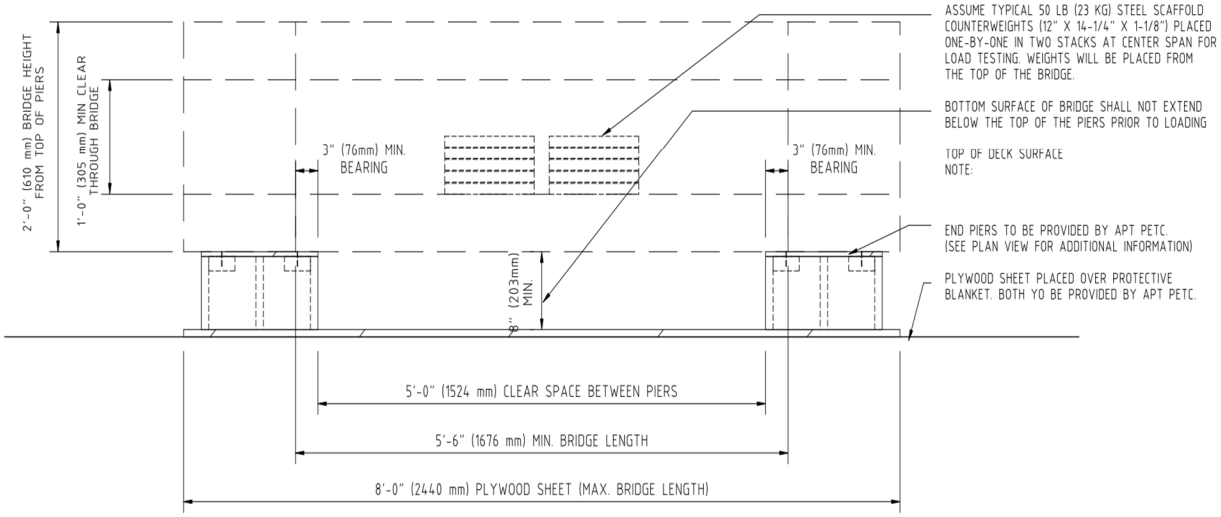

Figure 2: Side view of bridge dimension and load placement

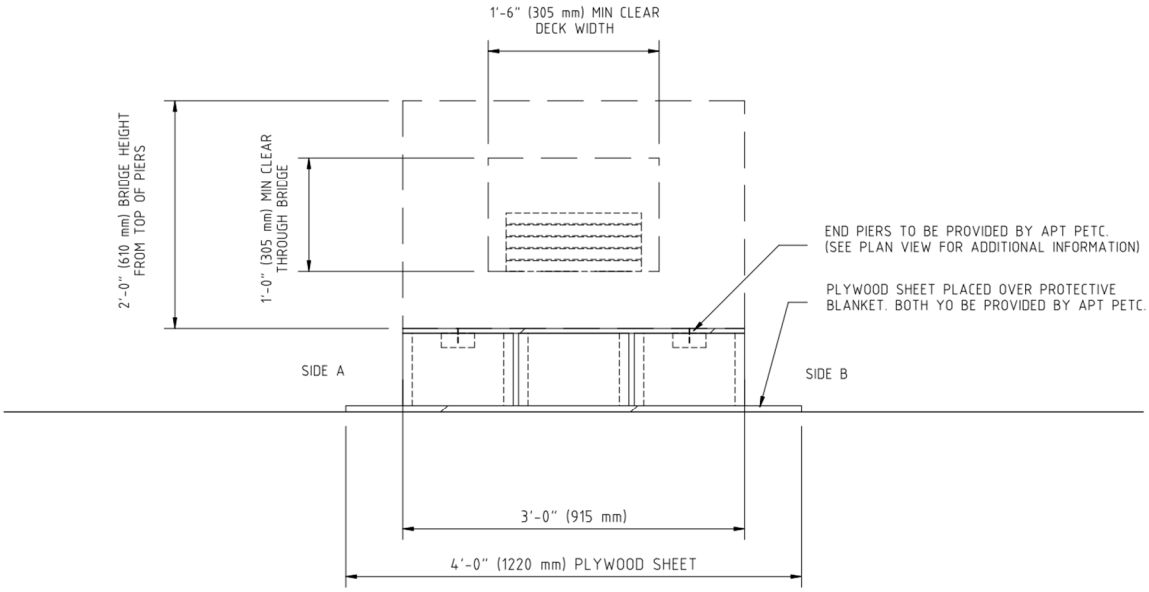

Figure 3: End view of bridge dimension and load placement

5.4.2 Components

5.4.2.1 Members

- A member is a rigid component. Members with moving and flexible parts are prohibited. Exception: Deformations caused by mechanical strain (e.g., bending, stretching) during construction and load testing are not violations.
- Members are to be pre-cut for on-site assembly. No pre-assembly of individual components is allowed prior to the start of the build.
- Maximum member size is 1-1/2" x 1-1/2" x 2'-6" (38 mm x 38 mm x 762mm).
- The bridge decking shall also comply with the maximum member size (i.e. a single continuous deck surface such as a sheet of plywood is not allowed).

5.4.2.2 Volume and Weight of Material Restrictions

The competition finals are designed to provide some practical allowances for teams travelling various distances. Therefore, restrictions have been placed on material allowed:

1. The maximum weight of the constructed bridge is 50 lb (22.7kg).
2. All materials, tools, and equipment to be used in the bridge build must fit inside 4 cases (boxes/containers/suitcases) that would each be accepted as a checked-bag item. Cases shall have straps or handles that will allow them to be weighed using a hanging (i.e. fish) scale. That is, maximum dimensions of 62 inches (1580 mm) (length + width + height) and maximum weight of 50 lb (23 kg). These 4 cases may contain materials for falsework and tools for use during erection, so long as the size and weight limits are met. Materials that are not used in the assembled bridge will not count towards the weight limit outlined in clause (1).

Before construction, each of the cases used by the teams will be weighed and recorded. Except for PPE and materials provided by APT, nothing to be used for construction can be outside the cases. The weight of the bridge material will be included in the final judging score.

5.4.3 Materials

5.4.3.1 Composition

The bridge is required to be 90% timber by weight. Other materials, including modern day substitutions for materials that would have been readily available at the time of construction (i.e. steel for wrought iron), are allowed in combination with timber so long as they meet other competition requirements.

5.4.3.2 Alternatives

If any material used in the model bridge was not available for construction purposes between 1840 and 1890, the team is to provide justification for design decisions in using the alternative material. If questions arise during judging, it is the responsibility of the team to defend material use. For example, obtaining wrought iron may not be practical so materials similar to it (e.g. carbon steel) may be used instead; the teams will be expected to justify this decision. Similarly, use of any modern connections is to be justified. Substitutions with dissimilar modern materials chosen solely to reduce the overall weight of the structure (e.g. epoxies or fiber reinforced plastics) should be avoided.

5.4.4 Weighing Procedure

The procedure for weighing bridge materials shall be as follows:

1. In advance of the bridge build teams shall place only bridge materials intended to be a part of the final constructed bridge (including members, connections, and decking) inside one or more cases. Cases shall have straps or handles that will allow them to be weighed using a hanging (i.e. fish) scale. Total weight will be recorded.
2. Team will remove any non-timber materials from case(s), and they will be re-weighed and recorded.
3. Team will remove all remaining materials from case(s) and weight of case(s) alone will be recorded.
4. Teams shall place all materials, tools, and equipment to be used for the bridge build inside up to 4 cases (as described in Section 5.4.2.2). Total weight for each case will be recorded for compliance.
5. After the bridge build is complete all unused bridge materials as outlined in clause (1) shall be placed inside one or more cases and be re-weighed and recorded.
6. Team will remove any non-timber materials from case(s), and they will be re-weighed and recorded.
7. The difference in weight recorded before and after the bridge build will determine final weight and material ratio of the constructed bridge.

Recorded weights will be used to verify that bridge materials meet the 90% timber by weight requirement in Section 5.4.3.1. Any non-timber materials will be limited to connections and fasteners. Weights of case(s), tools, temporary support and construction supplies will only be required to demonstrate that they can be brought to the competition within 4 airline compliant checked bags to ensure regional equity and will not count toward the total weight of the bridge. PPE will not count towards weight totals, and PPE is not required to fit within the 4 cases noted above.

5.5 Construction of the Timber Bridge

Teams are responsible for ensuring the safe erection of the bridge. Teams will have a **maximum** of 1 hour to complete the build of their bridge. Due to this time restriction teams are encouraged to practice building their bridge in advance of the conference to earn maximum points (See Appendix C.3). All conference construction work will be carried out under the supervision of PETC.

5.5.1 Equipment

APT will provide the following at the conference:

- Protective blankets for each team's work area
- One 4 x 8-foot (1220 mm x 2440 mm) plywood sheet for each team's work area
- Two end piers:
    - Each pier constructed of three (3) un-grouted 12" (305 mm) concrete masonry units (CMU) blocks, actual dimensions 11-5/8" w x 15-5/8" l x 7-5/8" h (295 mm x 397 mm x 194 mm) with a plywood top.
    - Wood blocking will be screwed to underside of plywood top to prevent top from sliding on CMU blocks.
    - Piers will not be anchored to 4 x 8 plywood sheet base in any way.
- Measurement Devices and Weights
    - Measurement devices to check bridge dimensions, deflection, and sway.
    - Deflection and sway targets
    - Scales to weigh bridge components and for lateral load testing.
    - 50 lbs. steel scaffold counterweights (12" x 14-1/4" x 1-1/8" thick or 305mm x 362mm x 28.5 mm) to be used as load increments. Weight increments may be modified based on available weights at the conference.
- Safety Supports

5.5.2 Work Area

Teams are to clearly mark off the construction area surrounding the bridge. The maximum work area for each team is to be 12 ft. (3660 mm) by 10 ft. (3050 mm) but may be smaller due to conference venue limitations. All materials and tools during assembly, including the bridge, must fit within this area.

No assembly outside the work area is allowed. No power tools are permitted during assembly. Teams are expected to leave no mess or damage at the competition site.

PETC will provide protective blankets and plywood for each team, over which the teams build their bridges Tt. Before construction, the building materials will be weighed as per Section 5.4.4.

The CMU blocks acting as piers are to be set-up before the timed build.

5.5.3 Procedure

The timed construction procedure is as follows:

1. Prior to construction, all materials should be inside their respective cases.
2. All personnel to be involved with the bridge construction and loading are to have proper PPE, which includes work gloves, safety glasses, and steel-toed boots.
3. Construction will begin with the organizer's announcement. All builds will be timed.
4. All bridge members are to be assembled and put in place one at a time, as is done in conventional practice. No pre-assembly is allowed.
5. If competition organizers or judges feel that a team's construction practices are unsafe, they will request that the team halt construction. Teams will be allowed appeal to the judging panel for any requested stop; however, the time will continue during this process. If the appeal feels that safety has been adequately considered, then teams may continue the build. If the construction is deemed unsafe, the team must disassemble and reassemble or receive last place in the conference build.

a. If teams believe they must implement a construction practice that may be deemed unsafe or result in a safety/PPE violation, it is recommended to coordinate their procedure and proposed mitigation measures with the Judges in advance of the build to limit risks or delays to assembly.

6. When all bridge elements have been assembled, the timer stops. If teams have not completed their build after 1 hour, they must stop construction at 1 hour. Completion of bridge build beyond 1 hour may be permitted prior to load testing for safety reasons and resulting penalty at the judges discretion.
7. After construction, judges will verify that the bridge meets the dimensional requirements set out in Sections 5.4.1, 5.4.2 and 5.4.3.
8. The bridge shall not be modified or distorted from its as-built condition to conform to these specifications.

5.6 Testing

5.6.1 Safety Precautions

It is the responsibility of each team to effectively employ all safety precautions. Competitors should follow the same precautions when proof testing bridges on-campus in preparation for the competition build and testing. *Bridges may collapse suddenly without warning, and a failure may involve only one side so that the load tips sideways.* The intent of these provisions of this section is to prevent personal injury if a bridge collapses. Teams shall follow the following precautions:

- Competitors who are not participating in loading, faculty, advisors, and other spectators shall observe from a safe area. No more than three competitors shall participate in each load test.
- Load testing shall be done by competitors wearing the required personal protection equipment (PPE).
- No one shall reach, crawl, or step under a bridge while any portion of vertical load is in place. If safety supports must be adjusted during loading, the load shall first be removed without disturbing the bridge, adjustments made, and the load replaced as it was before being removed.
- Bridges that inhibit safe placement of loading plates shall not be tested.
- Teams shall observe sway carefully during vertical load testing. If sway exceeds 1” (25 mm), loading shall cease and load shall be removed carefully.
- Teams shall observe vertical deflections carefully. If deflection at any target exceeds 3” (75 mm), loading shall cease and load shall be removed carefully.
- Teams shall observe the behavior of the bridge. Loading shall cease and the load shall be removed carefully if collapse is imminent.

5.6.2 Testing Preparation

The team captain shall observe the load tests and may handle load. A captain who does not handle load does not count toward the three-person limit.

- The team shall designate the “A” side of the bridge. The “B” side is opposite the “A” side. “Left” and “right” ends are determined by facing the “A” side from the outside of the bridge.
- Teams shall accept imperfect field conditions such as bent decking, sloping floors, and unfavorable floor surfaces.
- At the discretion of the judges, a penalty may be imposed for a bridge that incorporates parts having the primary function of interfering with placement of targets, decking, load, or measuring devices. If the bridge cannot be loaded safely, or sway or deflection cannot be measured in accordance with the

provisions of this section, the bridge shall not be load tested and is not eligible for awards in any category.

- "Sway" is translation in any horizontal direction. Typically, sway is determined by using a plumb bob attached to the bridge at a specified target. A sway requirement is failed if any part of the bridge causes the displacement of the plumb bob at floor level to exceed the specified limit, even if the plumb bob is not attached to that part.

5.6.3 Lateral Load Test

- Refer to Figure 4 and Figure 5 for a visual representation of the lateral load test procedure.
- Lateral load test is conducted by placing 100 lbs (45.5 kg) of weight on the decking near the "B" side of the bridge at the center. This load is intended to restrain the bearing surfaces of the bridge from lifting off the piers when lateral load is applied. No additional uplift restraint will be used, even if bearing surfaces lift.
- Bearing surfaces are prevented from sliding by lateral restraint applied (i.e. students hold bridge). This lateral restraint shall not restrain rotation or uplift. The restraint is applied on the "A" side of the bridge as close to the piers as possible. The lateral load test is failed if the bridge is restrained in other than the lateral direction, or if the restraint is not applied close to the piers, or if the restraint is not effective.
- A sway target is established for measurement on the "A" side of the bridge, at centre span.
- A 35-lb (156 N) lateral pull force is to be applied and the maximum sway is to be measured. The pulling force is located on the "A" side of the bridge as close as possible to the decking and not more than 2" (51 mm) from the sway target. To pass the lateral load test, the sway must not exceed 1" (25 mm).
- If the bridge does not pass the lateral load test, it is not approved for further testing and is not eligible for awards in this category. No further load testing will be permitted.

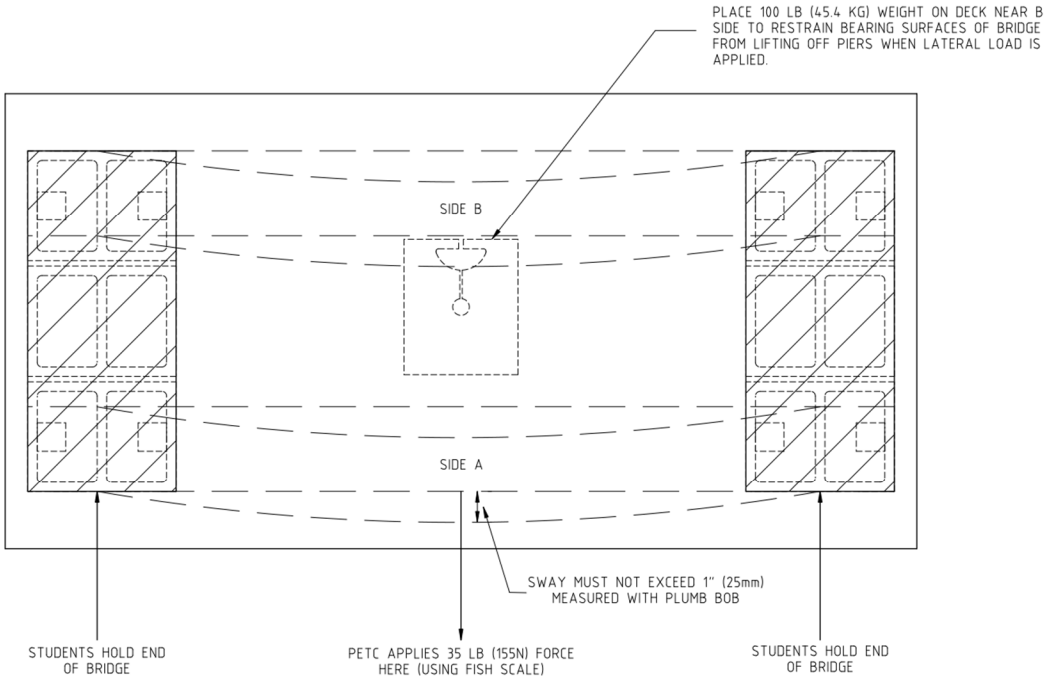

Figure 4: Plan view of lateral loading testing procedure.

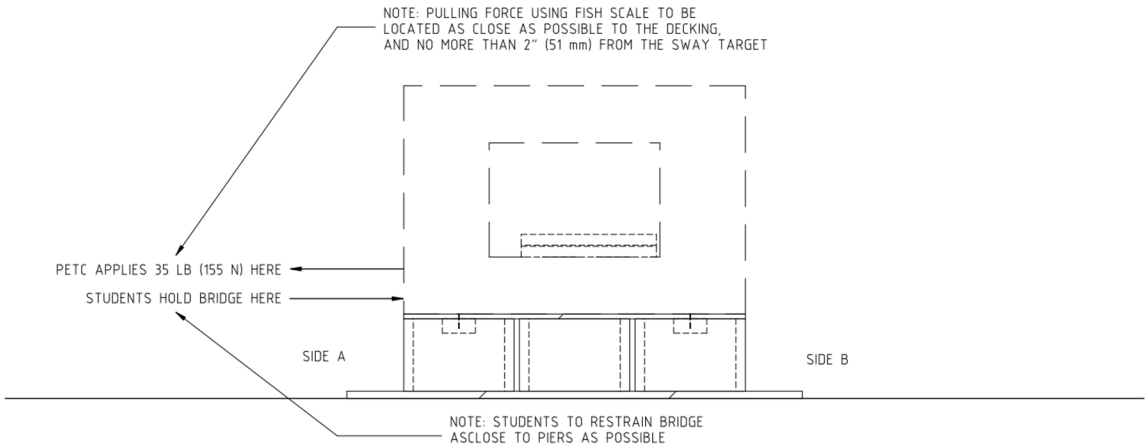

Figure 5: End view of lateral load testing procedure.

Vertical Load Test

- Refer to the diagrams in Section 5.4.1 for a visual representation of the approximate placement of load during the vertical load test.
- For design purposes, it should be assumed that the entire load will be placed approximately within the center two feet of the span.
- Three vertical deflection targets are located as close as possible to the decking, then position measuring devices on the three vertical deflection targets.
- Compute aggregate deflection as the sum of the three deflection measurements, rounded to the nearest 1/8" (3mm).
- Load the bridge and measure the deflections, using the following procedure:
    - Initialize the sway measurement device (i.e. plumb bob).
    - Initialize the three vertical deflection-measuring devices or record the initial readings.
    - Competitors load incrementally on the bridge deck (increments may vary based on load materials available to each team). Load is laterally centered on the decking and is placed as uniformly as possible at all times during loading. Load shall be placed at a steady pace, without hesitation.
    - Loads to be placed so that they do not contribute to the bridge stiffness (i.e. stacks of weights shall not touch).
    - As the load is being placed, observe the deflection and sway targets. Stop loading if any of the following occurs:
        - Sway exceeds 1" (25 mm)
        - Deflection at any deflection target exceeds 3" (76 mm) downward
        - Decking or any part of the bridge, other than the intended bearing surfaces, comes to bear on a safety support or the floor
        - A decking unit or some of the load falls off the bridge
        - All 500 lbs (227 kg) of available load are used
        - The bridge collapses or a dangerous collapse is imminent
    - Loads will be places in 50 lb (22.7 kg) increments until target load is reached.
- If the bridge passes, record the final deflection and sway readings at each recording location.

Appendix A Report Format

The report should clearly identify the following:

- Project Title
- Name of institution, individual team members, Faculty Advisor(s), and mentors
- References (educational references, literature, etc.)

The report should be formatted as per below:

- Word count: approximately 4,000 but not greater than 4,500
- Page size: Letter (8-1/2 inches x 11 inches), portrait orientation
- Font sizes:
    - Title/Headings: Calibri, size 14
    - Subheadings: Calibri, size 11
    - Body: Calibri, size 11
- Alignment: Left aligned
- Standard margins and headings
- Six to ten labeled illustrations (including tables)

    - Each illustration must have its own number (Fig. 1, Fig. 2, not Fig. 1a, 1b) and its own caption. Please indicate illustration reference at end of each caption (if not produced by the team). Images should be referenced within the body of the report.
- For endnotes, bibliography, and other matters of style, authors should follow the Chicago Manual of Style.
    - Endnotes, if applicable, must be numbered consecutively throughout the text in superscript, then placed at the end of the paper.
    - A bibliography should be included and does not factor into the word count.

Submit one electronic .pdf file of the report with all embedded photos, figures, and attachments.

Construction Documents Format

The drawings should be produced via a computer-aided design and drawing (CAD) software, such as AutoCAD or Revit, or may be hand drafted, and formatted as per below:

- Page size: 24”x 36”, or A1 in Landscape Orientation
- Consistent title block with the following information:
    - Project Title
    - Name of institution and team name
    - Views (elevation, plan, etc.) shown on individual sheets
    - Scale
    - Sheet number
- Scale:
    - Plan: ¼” = 1’-0” (1:50) minimum
    - Section Cuts: 3/4” = 1’-0” (1:16) minimum
    - Elevations: ¼” = 1’-0” (1:50) minimum
    - Details: 1 ½” = 1’-0” (1:8) minimum

Submit one electronic .pdf file of all construction documents in a separate e-mail from the report. It is recommended to submit drawings in pdf.

Appendix B Poster Content

Teams are to bring one printed poster with them to the conference and one digital copy (in pdf format) provided prior to the conference. The poster should clearly identify the following:

- Project title
- Name and insignia of institution
- Names of team members
- Acknowledgements: Names of Faculty Advisor(s), APT mentors, collaborators, donors, etc. who aided in the work (including funding, materials, and other resources)
- References (educational references, literature, etc.)

The purpose of the poster is to provide a brief introduction to the bridge that was studied and analyzed in Phase 2, including clear identification of the following:

- Name of structure
- Location of the structure
- Date of construction and construction methods
- Overall bridge design and material composition (both historic and scale model)
- Interesting information learned during the design-build process

Most of the poster should present the Phase 2 structural analysis findings. Provide 4-10 photos, sketches, figures, or charts to convey findings. Provide a brief statement of the Preservation Plan from the report. Any information that is not printed directly onto the poster will not be considered poster content.

B.1 Poster Format

- Poster Size: 36 inches (91.4 cm) high x 48 inches (121.9 cm) wide, landscape orientation
    - Printing, transportation, and set-up of the poster is the responsibility of the team. Teams are to supply poster board for mounting their posters on an easel or table provided by APT and submit the PDF poster file in advance of the conference.
- Font: Readable font with sizes below:
    - Title/Headings: size 130 (minimum)
    - Subheadings: size 54 (minimum)
    - Body: size 32 (minimum)
- Four to ten illustrations (including tables):
    - Each illustration must have its own number (Fig. 1, Fig. 2; not Fig. 1a, 1b) and its own caption. Indicate citation at end of each caption (if not produced by the team). Images should be referenced within the narration of the poster.
    - Illustrations should be a minimum of 100 dpi and imported at the same size they will be on the poster (or smaller). Ideal resolution for poster presentations is 150 dpi (smaller resolution will create pixilated images while larger resolutions create large file sizes).
    - Illustration size is at the discretion of the team but should be large enough to be read/interpreted clearly. Many institutions have examples of research poster presentation templates and tips are available online.

Poster Tip: Keep presented information simple. This poster will be read by judges and conference attendees who want to know only the most important aspects of the project. The viewers should be able to review the poster within 5 minutes.

Appendix C Judging Criteria

Submissions will be reviewed by the PETC Competition Committee and the Competition Judges. The Committee and Judges will act in good faith to conduct objective and fair evaluations to the greatest extent possible. Final scoring will be at the Judges' discretion. Numeric score or weighting may be changed by PETC; if so, PETC will notify all teams in writing in advance of the relevant Phase submission deadline.

Teams must pass Phase 1 to proceed to Phase 2. Teams will be notified via email of their Phase 1 acceptance. Phase 2 submissions are evaluated to determine the finalist teams for Phase 3. Phase 2 ranking also determines the order of Preservation Problem selection during Phase 3.

During the APT Conference, a group of selected professionals from different sectors of the design and construction industry will form the Judges' panel. The Judges will evaluate the Phase 3 posters, Preservation Problems, and the conference build.

C.1 Phase 1 Scoring

Deliverable	Criteria	Score
Notice of Participation	Submission includes all required team and team member information	Pass/Fail
Bridge Selection	Submission narrative document includes all required information, including references and images	Pass/Fail

C.2 Phase 2 Scoring

Deliverable	Criteria	Total Points Possible
Report	**Historic Research and Design Review** - All specified information in Section 4.1.1 is included - Points awarded for quality and detail of report content - Points awarded for quality of report format	15
	Structural Analysis - Relevant loads and assumptions documented as discussed in Section 4.1.2.1 - Loads, load cases, and assumptions are documented - Two analysis methods implemented, each analysis method is clearly described, and each analysis method provides required calculations and/or graphics - Discussion of structural analysis findings as mentioned in Section 4.1.2.2 - Supplemental calculations and additional analysis are presented in Appendix	40
	Preservation Plan - Three pathological conditions identified - Discussion of the root causes, severity, and proposed treatment of each pathological condition	20
	Construction Documents - All seven required drawings (1 plan, 2 elevations, 2 sections and 2 connections) are included - All drawings are legible, detailed, and clearly annotated - All drawings follow drafting format in Appendix A.	25
	Late Submission - 5-point deduction for each day past the submission deadline. - If teams are concerned about meeting the Phase 2 deadline due to external factors (access to lab space and equipment, exams) please contact APT-PETC a minimum of 2 weeks before the deadline to discuss accommodations.	
	TOTAL POSSIBLE SCORE	**100**

C.3 Phase 3 Scoring

Deliverable	Criteria	Total Points Possible
Poster	- Digital and paper formats conform to the specification. - All required content is provided on the poster. - Posters are legible and readable. - Content is engaging and describes the team's project and unique features.	10
Presentation	- Each team member presents a portion of their Phase 2 research, structural analysis, preservation plan and construction documents. - Points will be credited for clarity, relevance, interest, and staying within the time limit. - Points will be deducted for going over the time limit.	20
Bridge Build and Loading	Speed of Build: - First team completed (T1) will receive 10 points. - Other teams will receive points based on their build time (TX) relative to the fastest time (T1) (i.e., T1 / TX * 10 points) - Bonus + 5 points if build is completed in under 15 minutes. - Bonus + 2 points if build is completed in under 30 minutes. - Deduction -2 points for every 5 minutes greater than 60 minutes that is required for build completion.	10
	Strength to Weight Ratio: SW ratio = Highest Vertical Load Sustained / Total Bridge Weight * As determined in Sections 0 and 5.4.4 - Highest S/W ratio: 25/25 - All other teams receive points based on their SW ratio relative to the highest SW ratio o SWx/SW1 * 25 points - Sustains self-weight 2/25 - Does not sustain self-weight or incomplete 0/25	25

Deliverable	Criteria	Total Points Possible
	Deflection: * As measured by the aggregate three deflection targets described in Section 0 - Team with the lowest aggregate deflection 5/5 - 2nd lowest aggregate deflection 4/5 - 3rd lowest aggregate deflection 3/5 - 4th lowest aggregate deflection 2/5 - 5th lowest aggregate deflection 1/5 - Exceed maximum deflection of 6 in (152 mm): 0/5	5
	Penalties: - Safety/PPE violations (-5 points) - Dimensional violations under Section 5.4.1, 5.4.2 or 5.4.3 (-3 points for each type of violation) - Material violation in Section 5.4.3 (-5 points) - Judges may administer additional penalties for safety and compliance violations at their discretion	
Preservation Problems	- Points will be awarded for correct responses and thoroughness of responses. Credits will also be given for connecting a response to a real-world situation, such as elements researched or observed from their selected bridge.	30
	PHASE 3 TOTAL	**100**

C.4 Final Scoring

The final score for the Phase 3 finalists is calculated as follows:

$$FinalScore = \frac{1}{3}(Phase2Score) + \frac{2}{3}(Phase3Score)$$

Appendix D Financial

PETC will pay the APT conference registration fee (non-ticketed events) for up to 6 students, and up to 3 hotel rooms, for each team selected to attend the Phase 3 Finals. A travel stipend will be provided for each of the 6 students for the selected teams. Details will be provided for Finalist teams. All other expenses (extended stay, additional lodging, food, competition materials, etc.) are the responsibility of the teams. The PETC will not financially support any Faculty Advisors or mentors.

Each team is to raise money for their expenses. One of the values in a competition of this nature is that it allows and encourages students to reach out to companies to ask for support, and while doing so, make connections that may be of future value. The PETC Competition Committee can provide a general list of potential sponsors to share with the teams upon request to assist in finding potential sources of sponsorship, especially pertaining to the timber industry for this year's competition. Teams are encouraged to define their own ways in which to acknowledge the support they received (sponsored T-shirts, posters, etc.).

Each team is to develop their own financial plans, including all anticipated costs and anticipated funds raised, to be included in the Phase 2 submission if the team intends to vie for travel to the APT Conference. The Competition Committee will use these plans to help teams that may be short of travel funds.

Teams should make their own travel arrangements and are responsible for travel visa applications and costs if required. APT may be able to support or sponsor a visa; please contact the PETC Competition Committee if this is needed.