

HISTORIC COVERED
TIMBER BRIDGES IN
SWITZERLAND

ASSIGNMENT



CASE STUDIES ON BUILDING ARCHAEOLOGY AND CONSTRUCTION HISTORY

ORGANISATION

The case studies are worked on in groups of 4 students each. Each group examines one historic timber bridge and prepares a construction survey and documentation of the findings. Each group is individually supervised by a tutor. The dates of the supervision are to be agreed individually between the group and the tutor.

1. FIRST CONSULTATION:

This takes place on site at the object. The students have already worked on the object for at least 2 days and have already produced all the plans. The status of the work should be such that at least approx. 80% of each individual drawing is available. Students must have the plans at hand in the required scale and are responsible for bringing a ladder and flashlight so that the tutor can show details.

2. FINAL SUBMISSION:

All plans and the report are submitted personally by the group at the institute. All lent resources, tools and equipment are to be returned. There is no "final critique" or presentation of the results.

The latest possible dates for 1 and 2 can be found on our website:

<https://holzer.arch.ethz.ch/studium/fallstudien.html>

The participants of the course transfer all rights to use plans to the institute (licence with attribution, Creative Commons CC-BY).

PROCESS

The course starts with the group assignment and distribution of the objects. This is followed by two compulsory lectures and a joint site visit. Dates can be found on the website.

All objects for selection can be reached from Zurich HB within a maximum of approx. 2 hours by public transport, plus a short walk if necessary. Before leaving for the object, the position of the relevant transverse and longitudinal sections and details must be coordinated with the tutor (based on photos/sketches).

Absolutely necessary on site:

- a powerful flashlight for each group member. The built-in lamp of the cell phone is not sufficient!
- a transportable ladder of at least 3 m length, per group. Appropriate telescopic ladders can be borrowed at the institute. Also for the 1st supervision the group must arrive with a leader! The tutor will not bring a ladder, but will need one to show connection details on site, if necessary.
- a metal ruler (thin, min. 15 cm) to poke/measure connection details (one per group, better one per participant). Such a metal ruler is shown in the introduction and can be purchased e.g. in the ETH Store. A metal ruler must be brought to all on-site appointments. Without a ruler, the joint details cannot be explored.
- Distance measuring devices: One laser distance meter per group can be borrowed from the institute. Furthermore, one double meter (folding rule) per group member is essential.
- Drawing equipment: firm support, possibly a camping table or board, stool, pencils, pencil sharpeners, erasers, rulers and drawing triangles, sufficiently thick paper of the specified size.
- a sufficiently capable photographic equipment per group. Cell phone cameras are insufficient, but digital compact cameras are usually adequate. It is strongly recommended to take a tripod with you (photos in the dark interior of the bridge). A camera with a telephoto lens (zoom) is very useful for exploring inaccessible details on the underside of the bridge, otherwise bring binoculars!
- warm clothes, also gloves and cap, picnic if necessary. Some bridges are remote with no food supply. Some bridges are particularly exposed to the weather (wind) due to their topographical location.
- Explore the location of your bridge in advance on map.geo.admin.ch. There you can also switch to "Background satellite photo". This saves you the hassle of searching for the bridge in the field. In addition, the closest public transport stops can be displayed, which makes it easier for you to plan your journey.

Precautionary measures on site:

- Never stand alone on the ladder! Another group member secures the ladder. Never put yourself at risk!
- Watch out for traffic! Cyclists also often come at high speed.
- Don't fall into the river and don't let any measurement drawings fall into the river! When climbing on and under the bridge no unnecessary risks should be taken!
- Please show respect to the people using the bridge.

ASSIGNMENT

The following tasks must be completed on site at the object. All plans are to be drawn by hand with pencil (HB recommended) on drawing cardboard (min. 150 g/m²). Sketches, measurements and notes of all drawings must also be submitted. Scans, reduced copies of the drawings, drawings on too thin paper, CAD drawings on the screen and the like will NOT be accepted at any consultations and may result in the disqualification of the group.

The original sketches for all drawings must be submitted in their initial condition (even if stained, crumpled or unclean). Please do not attempt any cosmetic work on the original hand sketches. If the hand sketches are missing, the corresponding drawing will be assessed 0 points.

In all cases, the state of the bridge as it was found at the time of the survey is depicted. Damage, additions, retrofits and defects are also drawn in the plan. No components or details are reconstructed or added. Visible deviations from the horizontal, from the right angle or from the straight line are to be recorded. In addition, observations made on the object on site are marked as findings on the drawing in the form of short notes. Concealed construction parts (such as internal connections) are drawn as a dashed line, cut components with a thicker line (no hatching). Non-measurable structural parts (such as parts of the bridge structure under the carriageway that are not accessible and can therefore only be explored from a distance) must be identified with a fine dotted line. All drawings must be provided with a plan header.

The aspects of this assignment are to be taken very serious, the scope of the work is based on the credit points (4) and should not be underestimated (approx. 120 h of work in total per participant). There is no leeway in the interpretation of the individual processing steps and parts of the assignment. "Building archaeology and construction history" is primarily a positivistic science that starts from the observation and documentation of "objective" facts that can be verified at any time and strives to bring the observed facts into a contradiction-free context through a system of logical conclusions. It is therefore not a "soft" formulation of a design task, but a concrete instruction on how to proceed.

Approximately 40% of the total score is awarded for the independence of the work on site and the integrity of the documentation, both before the consulting appointment.

A. CROSS-SECTION (M 1:25) AT A DEFINED POSITION, SHEET SIZE A2

The section plane of the bridge cross section is determined together with the supervisor. As a rule, a cross section on a hanging column should be selected approximately at the quarter point of the span. It is important that the viewing direction always starts from the joinery side (make sure before starting to draw!). For the cross-section, all dimensions must be measured to within 5 mm and drawn to a scale of 1:25. The dimensions of the beams must also be indicated as inscription. The visible dimension is underlined and mentioned first, the bar thickness perpendicular to the sheet plane follows with a slash (e.g. 15/22). The entire cross-section must be measured in detail; the drawing is always done on site at the object in order to be able to immediately notice measurement errors and missing mass and to be able to verify the correctness of the drawing directly at the object. In principle, all construction elements located on the underside of the carriageway must also be measured. Connection details have to be explored by poking with the metal ruler. If necessary, insights into the connection can be gained at analogous places on the bridge. The quality and assessment standard for the cross-section to be drawn is the greatest possible completeness and dimensional accuracy.

Additionally, the evaluation criteria for the cross-section are:

- Cross section measurements of all timbers (in cm)
- Specification of technical terms for all construction elements (e.g. "Streckbalken", "Hängesäule", "Kopfband")
- Main dimensions as measuring chains vertical/horizontal (including clear width and height, height of the roof, height of the construction parts below the roadway)
- Consistency/compatibility of the drawing with the other drawings. Longitudinal section, cross section and isometry must show the same details in all details. Lack of conformity will result in significant point deductions. If work is divided up, the group members are responsible for checking the conformity of the individual drawings before the final submission.

B. ISOMETRIC EXPLOSION OF ALL JOINT DETAILS AT DEFINED POSITION (M 1:20), SHEET SIZE A2

At a defined position of the cross-section (usually on the inside of a hanging column) all joint details are drawn on a scale of 1:20. These are to be displayed as true-to-scale isometrics (120° crosshairs, all axis directions unshortened) in an exploded view. All joints such as lap joints, tenons and mortises, wooden nails, wedges, joints etc. are to be shown here. The corresponding crosspieces are also to be shown (including the roof attachment). In order to be able to "look inside" the connections, it is recommended to poke into the joints with the narrow metal ruler and read off the dimensions. For a better understanding of the construction method, it is also very helpful to have a closer look at the analog joints at other parts of the bridge, because sometimes the joints there are more accessible or slightly open and therefore more visible. In any case, the "rule execution" of the respective node has to be considered. If the execution at the exemplary selected node differs from the otherwise encountered form, this deviation has to be marked on the drawing by a corresponding note (e.g. if the tenon of a joint is accidentally broken or sawn off: the tenon is not drawn, but the following is indicated by a caption: "tenon missing here").

The drawing to be submitted can also be made at home; in any case, sketches must be made on site and all measurements (including those of details such as pegs, offsets, toothings, metal parts) must be taken and noted. At home, the individual sketches are converted into a complete, uniform exploded drawing. Alternatively, everything can also be drawn on site (better, because it can be checked immediately if something is unclear). In any case, in addition to the finished isometric exploded drawing, the on-site construction sketches must also be submitted to the tutors and handed in at the final delivery.

Evaluation criteria for the isometric explosion drawing are:

- clear and comprehensible overall layout of the drawing
- complete and correct representation of the "inner life" of the joints
- correct and complete explosion, but no separation of continuous, one-piece components (beams, bolts, iron clamps)
- Indication of the diameters of iron bolts, iron nuts, washers, iron clamps and wooden nails on this drawing.
- Consistency/compatibility of the drawing with the other drawings. Longitudinal section, cross section and isometry must show the same details in all details. Lack of conformity will result in significant point deductions.

C. LONGITUDINAL SECTION WITH ELEVATION OF THE TRUSS STRUCTURE (M 1:25)

For the longitudinal section, a view of half of the load-bearing structure of the entire bridge from the abutment to beyond the center of the bridge is drawn on a scale of 1:25 (the middle yoke of the bridge is to be drawn completely!). If the total length of the bridge is less than 20 m, the entire bridge is to be drawn, not just one half. The sectional plane runs directly in front of the construction (line of sight from inside towards the supporting wall), the roof space is therefore not shown. The construction must be clearly visible from the drawing. The bridge must be shown to scale with the most important dimensions. All the important linear dimensions must be given as dimensional chains (e.g. distances of the suspension columns from each other, heights).

The details of the joints must also be included in the drawing. The construction elements underneath the carriageway must also be shown. This may require remote sensing by binoculars, telephoto lens or drone. All cut beams must be visible on the drawing (highlighted in the drawing). Two drawing cardboards A2 may be joined together if the entire longitudinal section does not fit on a single sheet. The quality standard of the drawing is the completeness and correctness of the content of the construction. Great importance is attached to the cleanliness of the drawing, complete dimensional chains and clear marking of cut beams and view edges. Improvements and obviously later additions are to be marked by notes on the drawing.

The longitudinal section is cut directly in front of the supporting structure. The planking of the bridge deck is not shown. The stretching beam of the bridge and the bridge cross beams are shown in the drawing!

Evaluation criteria for the longitudinal section are:

- Specification of the cross section dimensions of all timbers (in cm)
- Main dimensions as measuring chains vertical/horizontal (especially distances of the suspension columns, height of the supporting walls, clearance of the supporting structure)
- Consistency/compatibility of the drawing with the other drawings. Longitudinal section, cross section and isometry must show the same details in all details. Lack of conformity will result in significant point deductions.

D. MAPPING OF THE CARPENTER'S MARKS ETC. FOR THE ENTIRE BRIDGE AS A TOP VIEW (M 1:100)

The mapping of the assembly marks (or carpenter's marks) is done for the entire bridge construction. It is useful to draw a schematic floor plan and/or longitudinal section of the entire bridge (required in any case). In these, all existing assembly marks are to be indicated at the corresponding position. Numbering of findings or an overview table simplify the comprehension of the documentation. In addition, all inscriptions, graffiti observations must be documented in this drawing.

The plan should be cleanly drawn and include the most important system dimensions. In addition, the intersections of the longitudinal and the cross section should be drawn in. Furthermore, a north arrow as well as the indication of the flow direction of the watercourse are part of the joinery mapping.

Evaluation criteria for the mapping are

- Floor plan with supporting walls folded outwards (schematic)
- All carpenter's marks located at the correct position
- Assembly mark reproduced true to original
- Main dimensions of the construction given as dimensional chains
- Reproduction of all inscriptions with exact indication of the place where they were found (especially dating inscriptions, no graffiti from recent visitors)

E. FINAL REPORT

You will write an illustrated final report that complies with the following outline and the corresponding specifications:

1. Location and history of the bridge (750–1500 characters incl. spaces)
2. Description of the bridge existing today:
 - a. Construction time and possible later modifications of the existing bridge (500–1500 characters including spaces)
 - b. Main specifications: total length, clear width and height, number of openings, clear width of all openings (max. 500–1500 characters incl. spaces)
 - c. Description of the main supporting structure of the bridge (2000–4000 characters including spaces)
 - d. Explanation of the system of carpenter's marks (approx. 1000 characters)
3. List of all sources and literature used (in particular also www.swiss-timber-bridges.ch, IVS, www.bernd-nebel.de, Werner Stadelmann, Werner Blaser, Hanspeter Buholzer, Josef Killer, Yves Weinand; from these named sources may neither be copied nor quoted verbatim, but you must write your own texts!)

Further instructions:

- For each section 2. a-d a maximum of 2 digital photos are to be integrated into the report. Reference can be made to the measurement drawings.
- The report can be written in German, English, Italian or French.
- If the report is written in English, Italian or French, please include the German technical terms in brackets!

A glossary with numerous technical terms can be found on our website:

<https://holzer.arch.ethz.ch/studium/richtlinien-des-idb.html>

F. FINAL SUBMISSION OF THE PLANS AND THE REPORT

All plans must be submitted on paper in the original, as must the report. The report must be submitted stapled or bound. Format of the report is A4. All original sketches for the entire project must also be submitted in addition to the final drawings.

Please indicate the names of the editors on all sheets. You will not receive your original materials back. If you wish to keep the material, please scan it yourself beforehand. We scan your plans for our own purposes and reserve all rights to use the plans (with indication of authorship) in lectures, scripts and publications. You explicitly assign all rights to us with your participation in the course. We would be grateful if you would provide us with important photos of the bridge digitally.

MISCELLANEOUS

Please make use of the possibility to evaluate the course.
Only the feedback of previous student years has enabled us to further develop the course.