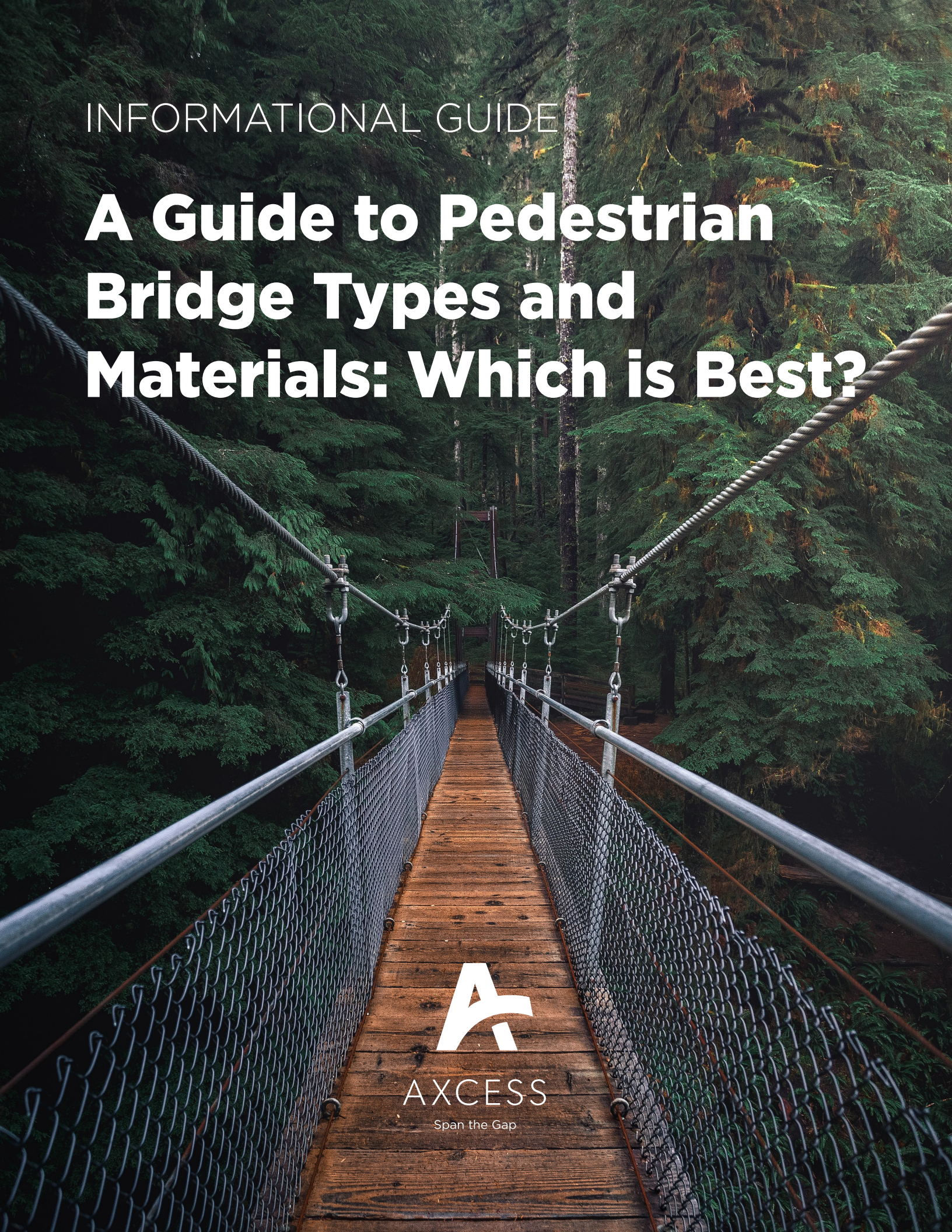

INFORMATIONAL GUIDE

# A Guide to Pedestrian Bridge Types and Materials: Which is Best?

AXCESS

Span the Gap

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# Pedestrian Bridges Introduction

Pedestrian bridges can stand out against the landscape as a significant visual feature or subtly blend in with surroundings. When we're riding in a vehicle over a bridge, most of us aren't thinking about the bridge's construction or design details. On foot, however, our slower speed helps us notice things like architectural style, color, and material.

Pedestrian and smaller-scale bridges can be designed in many ways, such as decorative, dramatic, historical, practical, utilitarian, or combining a few styles. Whether it's part of a trail or crossing over a stream, pedestrian bridges allow access to nature and help simplify transportation on foot. Many can even accommodate horses, cyclists, and the occasional vehicle.

We find bridges in many settings: roadways, parks, neighborhoods, highways, golf courses, municipal trails, walkways, and even residential areas for driveways or landscape design. But how do you determine the best solution for your site? This guide to bridge types and construction materials will tell you what you need to know to make an informed decision when designing a new bridge.

# Types of Pedestrian Bridges

All bridges must effectively and safely transfer the load (i.e., weight on the bridge) of the deck to the ground to be safe and secure. There are several types of bridges, and each one accomplishes this in different ways.

A bridge's type is described by its construction and the structural elements that support and transfer its load. While there is usually more than one option for the type of bridge in most settings, in some cases, the span or site dictates the type of bridge required.

The list below covers the most common types of pedestrian bridges and their characteristics.

## Beam / Stringer Bridge

The supports on a beam (or "stringer") bridge sit below the main structure. With a beam bridge, the support beams run parallel to the direction of traffic. These bridges also have a walking surface or deck that sits on top of the beams and transfers the load into the main support beams.

Because the supports are below the bridge deck, it's essential to allow adequate height to clear any rising water that might touch the supports. Therefore, additional elevation may be required to mitigate the risk of water contact. In addition, the railings are separate from the main structure, which provides many decorative options that can give an added architectural look, such as tension cables or spindles.

**QUICK FACTS ABOUT BEAM/STRINGER BRIDGES:**

- Support sits below the structure
- Maximum span is 60 feet
- May be more expensive than a truss bridge at longer spans

## Truss Bridge

The structural supports on a truss bridge extend above the deck on either side. As a result, the supports are highly visible and do not allow for a separate railing. Depending on aesthetic goals and existing obstacles in the surrounding area (e.g., other bridges, walkways, or buildings), a truss bridge may be more challenging to coordinate and integrate visually.

Because most of the bridge's structure is above the platform, a truss bridge can be a good choice for spanning waterways as there is less chance of the supports encountering rising water. Truss bridges are also better at withstanding the force from flooding water. The open steel truss design offers more places for water to flow through.

**QUICK FACTS ABOUT TRUSS BRIDGES:**

- Supports are highly visible
- Maximum span is 200 feet
- Economical choice for longer bridge spans

## Suspension / Cable-stayed Bridge

These bridges look similar to truss or beam-styled structures, but have slight differences in how the cables support the load. Suspension and cable-stayed bridges create a distinctive visual effect and cost more than other options in some settings – you'll likely pay a premium for the look. For extremely long spans or remote areas, they sometimes are the only suitable option.

- In a suspension bridge, the cables connect the deck to a longitudinal cable stay that runs across the tops of the support towers parallel to the deck. These two main support cables are then secured to the ground at each end of the bridge (the Golden Gate Bridge is a famous example).

- In a cable-stayed bridge, the cables directly connect from the deck to the support towers. These support towers serve as the primary load-bearing structures and can be arranged in many ways.

Both suspension and cable-stayed bridges can span long distances, though they require larger foundations at either end to support the cables and can have a larger structural footprint and width as a result. Due to the nature of the suspended deck, they can sag in the center, so it may become necessary to elevate the ends or place foundations further out to avoid the floodplain.

There are some disadvantages to these types of bridges. Some users may find them less stable underfoot because the deck is not rigid, and there is usually some side-to-side movement. Traffic is generally limited to pedestrians only, so equestrian and light vehicle traffic are typically not accommodated. They can also be prone to damage by rising water due to their lower lateral strength.

**QUICK FACTS ABOUT SUSPENSION/CABLE-STAYED BRIDGES:**

- Distinctive architectural style
- Strictly pedestrian use
- May be an economical choice for spans over 80 feet

## Culvert Bridge

Culvert bridges are usually made of aluminum or concrete, formed into an arch, and then backfilled with soil over the top. A road or walkway typically will run over the top of the arch. The ditch or depression the culvert spans must be deep enough that the culvert does not create a hill or incline.

**QUICK FACTS ABOUT CULVERT BRIDGES:**

- Suitable for spans of 20 feet or less
- Soil is backfilled over the top
- Can accommodate extensive widths

## Arch Bridge

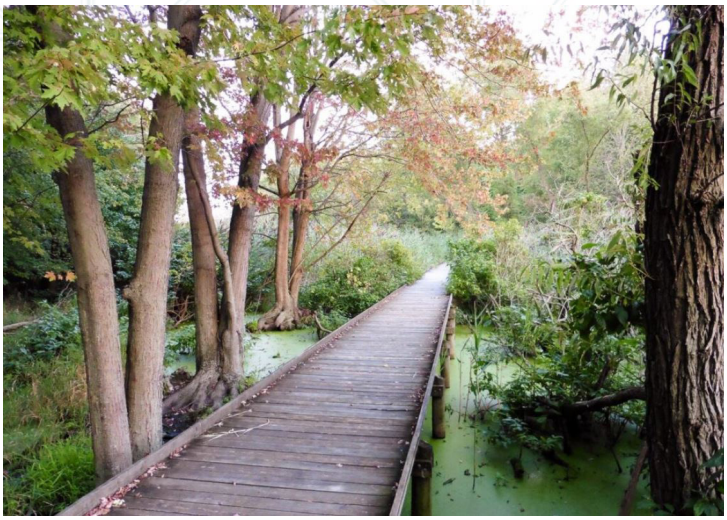
Arch bridges are similar to culverts in shape but at a higher elevation and without the soil backfill. They are usually labor-intensive to construct but can result in a unique, arching visual effect.

**QUICK FACTS ABOUT ARCH BRIDGES:**

- Can be labor and material intensive
- Visually distinct
- May be a more expensive option for bridge construction

## Boardwalk / Duckboard

Boardwalks are essentially a low beam bridge concept, with or without a railing. In most cases, boardwalks are selected where an elevated walkway is needed over a long distance, such as a marsh or wetland. Beam construction is standard for this application, and the decking is often made from treated or plastic lumber.



**QUICK FACTS ABOUT BOARDWALKS/DUCKBOARDS:**

- Boardwalks usually cover a large area
- Not as elevated compared to most bridges
- Railing and decking are often made of the same material

## Covered Bridge

A covered bridge is usually a beam bridge built with a straightforward “house” structure extending from the decking.

**QUICK FACTS ABOUT COVERED BRIDGES:**

- Treated or plastic lumber is an excellent and durable option for material
- Includes frame construction walls and a roof instead of a standard railing

# Materials for Pedestrian Bridges

There are so many material options for pedestrian bridges that it can be challenging to choose the best fit for a new project. Fortunately, it's usually possible to find something that can fit your visual and structural needs with today's modern materials.

When selecting materials, consider the initial cost and the costs of any future maintenance or replacement. Sometimes, materials that are less expensive upfront can have a shorter lifespan than those that cost more. It all depends on your site, budget, and resources for upkeep.

The options below have many applications for pedestrian bridges and are available at several price points.

## Steel

Steel options include weathering (ASTM A588), painted, galvanized, and stainless. Weathering steel may appear rusty, but this oxidized surface layer stabilizes the metal by blocking further corrosion from moisture. It is a popular choice for pedestrian bridges

because it requires virtually no maintenance. Painted steel will eventually require repainting and may corrode if the paint job chips or wears away. Shiny galvanized steel has a sleek appearance but is vulnerable to corrosion if it is damaged. Stainless steel is a durable option but can also be expensive.

**QUICK FACTS ABOUT STEEL:**

- High strength and stiffness for structural members
- Maintenance and upkeep requirements can vary for different types
- Weathering steel beams are manufactured to block corrosion

## Fiber Reinforced Polymer (FRP)

FRP is lightweight and robust. It is an economical and durable choice for bridge trusses, decks, or railings when low or no maintenance options are prioritized. Because it is light, this material can be carried on foot to remote sites.

**QUICK FACTS ABOUT FRP:**

- Manufactured off-site in many shapes, then installed on-site
- Can be made into small pieces for easy transport
- Highly corrosion resistant

## Treated Lumber

Treated lumber is often selected for decking or railings. It is lightweight and economical, but not as strong as FRP or composite lumber.

**QUICK FACTS ABOUT TREATED LUMBER:**

- Shorter lifespan than FRP or plastic lumber
- Requires maintenance and replacement over time

## Aluminum

Aluminum can be formed into many shapes and is lightweight and corrosion-resistant. As a result, it's considered an excellent choice for railings.

**QUICK FACTS ABOUT ALUMINUM:**

- High prices can make it cost-prohibitive for structural members
- Rigid and strong material
- Quick to assemble and install

## Composite Lumber

Sometimes referred to as plastic lumber, composite lumber is corrosion resistant and virtually maintenance-free. It has a similar appearance to wood and easily fits natural settings like parks or trails.

**QUICK FACTS ABOUT COMPOSITE LUMBER:**

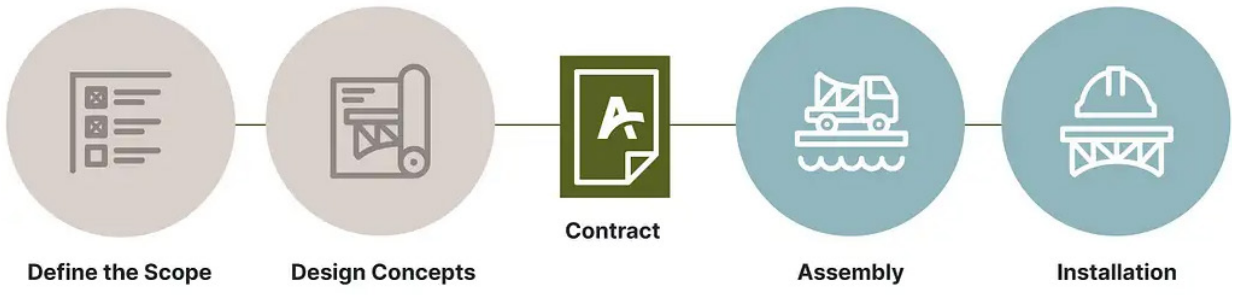
- Manufactured in planks, so it may take longer to install
- Lightweight material
- Can be less strong than other material options

## Concrete

Most pedestrian bridges are not constructed with concrete. It is primarily used for abutments to anchor the ends of the bridge to the ground. Some soil conditions and bridge sizes also require concrete footers, although helical piles can be a viable option for pedestrian bridges.

# Steps for Buying a Pedestrian Bridge

1. **Vendor**
    - Always ask for and follow up with referrals for vendors
    - Determine if you want to work with a “turnkey” model vendor or several vendors for each stage
    - Depending on how your funds are allocated, you may opt to have one vendor for design and another for construction/installation
2. **Scope**
    - Select the location of the bridge, including the exact point of any waterway crossing
    - Determine your budget for construction, including future maintenance or upkeep
    - Set a timeframe for construction or when the finished bridge is needed (factoring in weather, an important date or event in the future, etc.)



- Review your resources and plans for maintenance and longevity of materials
- Look at examples online and in your area for inspiration
- Learn about available materials and types of bridges

3. **Type, materials, and overall design**
    - Determine the aesthetics and visual elements you want the bridge to convey
    - Make decisions about any limiting factors (budget, materials, aesthetics) based on your priorities for the bridge
    - Review drawings and plans provided by your vendor
4. **Contract**
5. **Assembly**
    - Most components are constructed off-site and transported in for installation
    - Depending on site conditions and access, the bridge can be constructed in smaller segments and delivered ready to reassemble
6. **Installation**
    - Helical piles and concrete abutments are installed first
    - Once the bridge is complete, final landscaping, lighting, benches, signage, etc. are installed

# Tips and Considerations for Decision Making

In bridge building, having more options means making more decisions. Here are some questions to think about as you're planning your bridge project:

- What's the top priority for the project? Aesthetics? Price? Maintenance requirements? Improving access? Your priorities should guide all other decisions.
- How much are you willing or able to pay to achieve a particular visual effect? What options are acceptable to you at different price points?
- Take notice if your bridge vendor presents several options and lets you pick what's best for your needs. In contrast, does the vendor seem tied to a single solution or product?
- Remember, your choice of bridge type may be limited by the span or other site conditions.
- What resources (i.e., time, staff, budget) are available for maintenance and repair/replacement? Longer-lasting materials may be more expensive upfront but may also result in low or no maintenance in the future. For example, plastic lumber is twice as expensive as treated lumber but lasts twice as long. Replacing wood will also include labor costs.
- Consider the visual impact of materials. For example, weathering steel is usually the least expensive among metals, though painted or galvanized steel is only slightly more expensive. Weathering steel lasts longer but has a far different appearance.

# Key Bridge Terms and Concepts

**Abutment.** The concrete foundations that join the bridge platform to the land on either end.

**Deck/decking**. The walking (or driving) surface of the bridge. The deck type can be made of treated or plastic lumber planks, a continuous FRP surface, or even concrete. Color and anti-skid coatings can be applied.

**Floodplain.** The ground beyond the banks of a waterway where water spreads during flooding. Water rising over the banks moves more slowly, so the floodplain usually sits higher than the bank. Bridges are generally designed to handle some amount of hydraulic flow (i.e., flood water); although, the first line of defense is to build the bridge high enough not to get caught in hydraulic flow at all.

**Helical pile.** Traditional footings are oversized concrete blocks that are installed several feet into the ground to anchor the bridge to the ground. Instead of footings, many pedestrian bridges are anchored with helical piles. Similar in appearance to an oversized wood screw, helical piles are long shafts of metal with helical flanges that twist into the

ground. They can be used in any soil that is not excessively rocky. A site visit will include a soil evaluation to determine the best footing option.

**Hydraulics.** Hydraulics refer to the force of moving water. Hydraulic forces are more significant at low water levels, such as in a ravine, as opposed to water overflowing the banks of a stream or river. Bridges should be designed with the maximum water level in mind to avoid contact between the water and supports. For example, beam bridges sit lower than truss bridges because most of the structural elements of a truss bridge are above the deck.

**Loading.** Loading refers to the weight of pedestrians or other objects on a bridge, added to the weight of the bridge structure itself. A dead load is stationary, such as a bench, railing, or the bridge itself. “Live” loads are those that move across the bridge, such as a pedestrian, bicycle, or horse. Live loads transfer weight to different areas of the structure at different times. Both types of loading must be accounted for in the design of the structure.

**Siting.** This refers to the terrain, floodplain, and any elevation changes around the bridge. Features like ramps or stairs can be used to accommodate elevation changes. To maintain accessibility for all users, backfilling and adding long ramps is becoming a popular solution for elevation changes.

**Span.** The distance between the banks of a stream or between the edges of whatever gap the bridge will cross. An additional 5-10 feet are often added to each end of the bridge to keep the abutments away from the gap’s edges.

**Stringer.** Stringers are the supports that run under a beam bridge to stabilize the bridge deck and transfer the loading to the abutments. They run parallel to the direction of traffic.

**Truss.** Trusses are the supports on a truss bridge, which extends vertically from the deck. Several styles of trusses are common, each with different combinations of horizontal, vertical, and diagonal members to balance tension and compression forces.

# Additional Resources & Links for Pedestrian Bridge Building

**Types of bridges:**

- What are the Different Types of Pedestrian Bridges?
- How to Choose the Right Pedestrian Bridge
- A Guide to Bridge Types and Materials (Britannica online)

**eBook:**

- Pedestrian Bridges Made Easy (free download!)

**Video:**

- Installing a Helical Pile

**Materials:**

- FRP in Pedestrian Bridges
- Railing Terminology
- Favorite Sources of Bridge Inspiration

At Axcess, LLC, we know buying and building a bridge involves a lot of decisions with long-term implications. That's why we're committed to helping you make an informed choice on a bridge you'll enjoy now and for years to come.

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