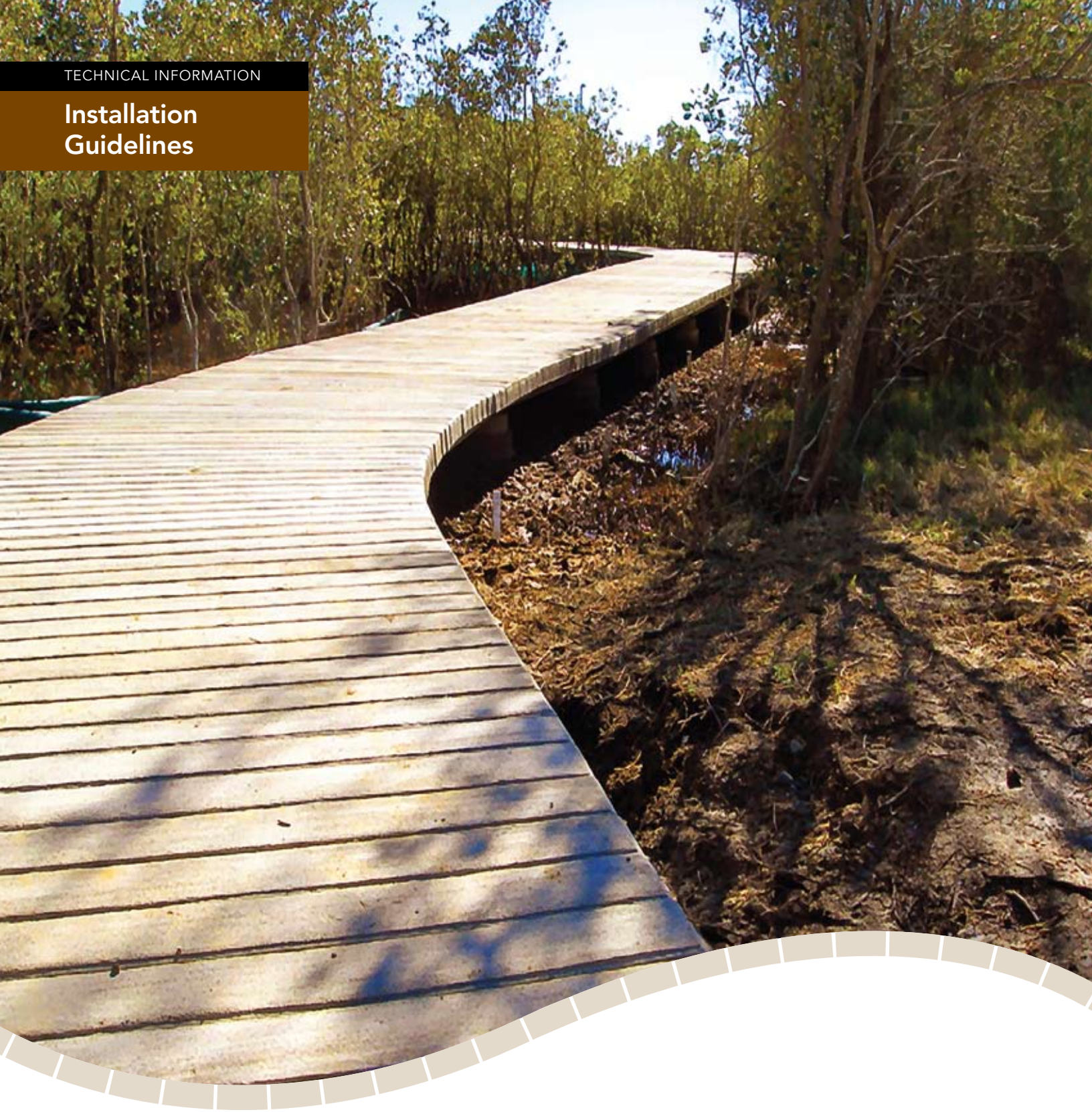


TECHNICAL INFORMATION

Installation Guidelines

PermaTrak™
NORTH AMERICA

Precast concrete boardwalk system

1. Introduction

PermaTrak™ North America's precast boardwalk system consists of quality precast, modular concrete components that can be quickly and simply assembled to form boardwalks, decks, jetties, piers and pedestrian walkways.

Reinforced concrete provides strength, design flexibility and long term durability that will not twist, warp, lift, split, rot, burn or splinter.

Installation of the PermaTrak™ system requires moderately skilled laborers and minimal equipment and tools. On-site power is not required. Disturbance during construction is minimal and the system is well-suited for preserving landscape features and wildlife habitats.

This publication has been prepared in the interests of allowing boardwalk designers and asset owners the opportunity to take advantage of the many benefits offered by PermaTrak™. It is offered as a practical guide to achieving optimum performance in the field and should be used in conjunction with specialist structural/geotechnical engineering advice, as many boardwalk locations are associated with extremely poor soil conditions.

2. Components

There are 5 key components to the PermaTrak™ system:

2.1. Abutments

Abutments provide at-grade termination points for the elevated boardwalks. Each is a standard 3'-9" in length. When placed end-to-end in groups of two, they form the ends of a typical 7'-6" wide boardwalk. Wider boardwalk widths are achieved by placing additional abutments side by side.

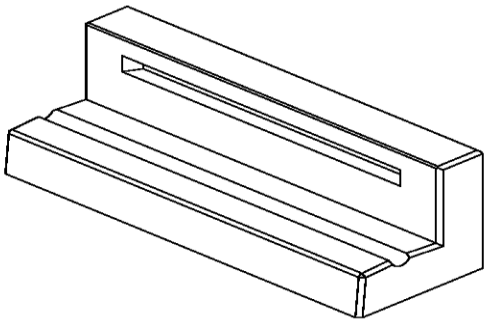
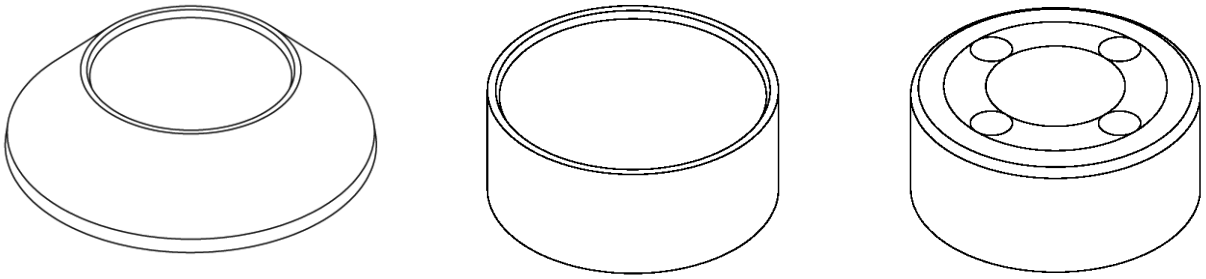


Figure 1: Standard Component - Precast Abutment

2.2. Precast Piers

Precast piers consist of bases, risers, and caps. Each pier typically has one base and one cap with a varying quantity of risers. The required pier height will determine the quantity of risers. The precast base is the foundation section of the pier and distributes the load to the subgrade. Precast caps are the top component of the pier and form the bearing surface for the precast beams (see section 2.3). Circular divots in the tops of the caps provide connection locations for the mushroom pins (see section 2.5) which connect the beams to the cap.



Base **Riser** **Cap**

Figure 2: Standard Component - Precast Pier Sections

2.3. Beams

Beams form the backbone of the PermaTrak™ system and are available in nominal 6'-8" or 10'-0" spans. They are always placed in parallel pairs, each supported by a precast pier which it shares with the next beam.

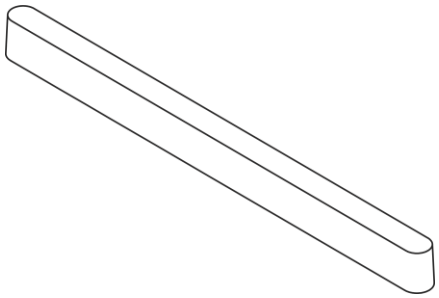


Figure 3: Standard Component - Precast Beam

2.4. Treads

Treads are placed on the beams and form the running surface of the boardwalk. They are locked together by a unique reversible "tongue & groove" arrangement, which provides for consistent longitudinal spacing and offers some lateral flexibility. Standard tread lengths are 3'-9", 7'-6", and 11'-3", thus allowing for walkway clearances of 3', 6' and 10', respectively. Treads can be tapered and placed in pairs for curved alignments. Color and texture options are also available.

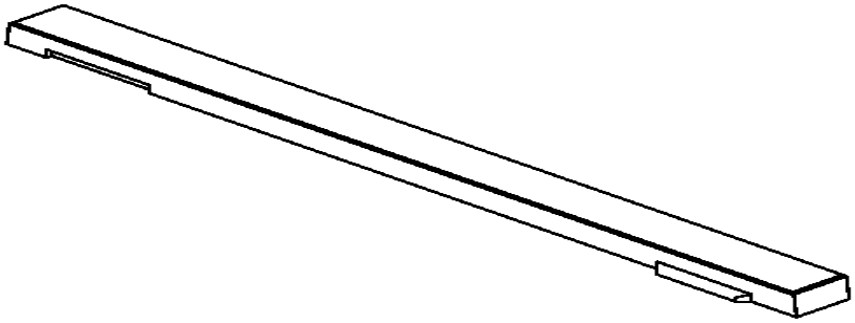
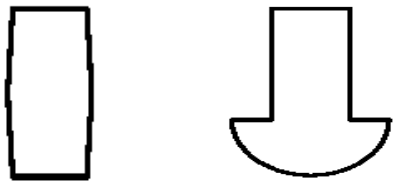


Figure 4: Standard Component - Precast Tread

2.5. Connector Pins

Connector pins made from high-density polyurethane are used to locate and secure the various concrete components. Ball pins secure beams to abutments and caps, while barrel pins locate treads onto the beams. Only one barrel pin is required for every five planks.



Barrel Pin **Ball Pin**

Figure 5: Standard Component – Connector Pins

3. Design Considerations

3.1. Design Loads

All precast components are designed in accordance with *LRFD Guide Specifications for the Design of Pedestrian Bridges*. Concrete design follows AASHTO LRFD design approach.

The design live load vehicle for most boardwalks is decided by each municipality or agency. Presented herein are some examples of typical live load vehicles. These are simply presented here as examples and not prescribed requirements. Ultimately, it is the designer of record's responsibility to decide upon the chosen design live load vehicle.

Typical live loads for PermaTrak™ applications include the following:

1. Vehicular Live Load
    a. Small maintenance/access vehicle such as a John Deere® Gator HPX 4x4 Diesel weighing 2873 pounds with a wheel base of 75.2 inches (direction of travel) and a 48 inch tire spacing per axle. (show load diagram)
    b. Small vehicle weighing 5,000 pounds, 2500 pounds per axle with a minimum 96" wheel base (show diagram)
    c. AASHTO HL-5 vehicle weighing 10,000 pounds, 8,000 pound and 2000 pound axles with a 72" wheel base.
2. Pedestrian live load of 90 psf
3. Equestrian live load of 1000 lbs distributed over a square of 4 inches by 4 inches

3.2. Geotechnical Considerations

The PermaTrak™ system is effectively a superstructure solution and, as such, requires a firm surface or foundation on which to be erected. As with all new structures, engineering tests should be conducted under the direction of a Registered Geotechnical Engineer to determine the type of substructure necessary to support the stumps and risers. A minimum bearing capacity of 1000 psf is recommended under each standard precast pier. The ground conditions determine the support requirements and, regardless of the foundation selected, installation of PermaTrak™ is the same for all applications once the stumps and risers have been suitably founded.

3.3. Changes in Grade

The PermaTrak™ system can follow the contours and grade changes of a site, within reasonable limits. A recommended maximum gradient change between modules should be limited to 5%. Where the ground is significantly undulating, it may be preferable to position the boardwalk on the median levels of the terrain. This can be accomplished by varying the pier heights. It may also be necessary to slightly vary the horizontal location of the boardwalk in order to achieve a compromise between alignment and grade.

Sometimes the best drawings and layout plans have to be modified on-site, in consultation with the designer, to ensure consistency and desired effects. It is also important to be aware of external influences such as tides, wave action or flood levels that may control the level of the boardwalk. It is recommended that a maximum height for piers not exceed 48 inches. Heights exceeding this limit will need to be considered by a Structural Engineer as part of the substructure solution. Also note that boardwalks constructed in excess of 30 inches above the adjacent terrain may require railing which are easily accommodated with this system.

3.4 Curved Alignments

Curvilinear stretches of boardwalk can be achieved using tapered treads with standard rectangular planks. Typically, a tapered tread will have one skewed face and one non-skewed face. A turn is made by placing tapered treads in pairs. (See Fig 6). It is advised that the skewed surface of a tapered tread be place adjacent to the skewed face of the following tread. (See Fig 7). This will ensure a better fit from tread to tread.

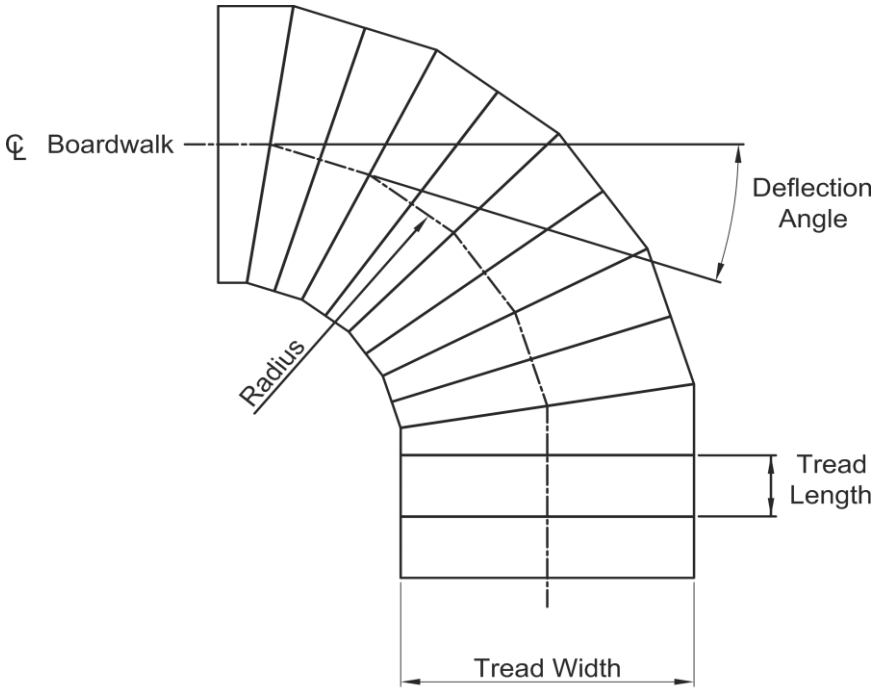


Figure 6: Typical Curved Layout

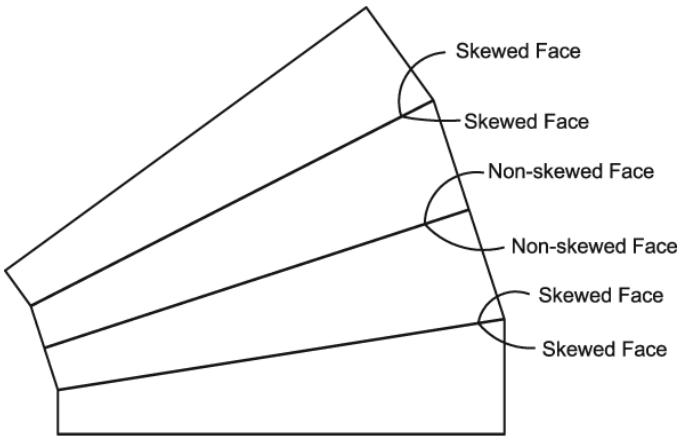


Figure 7: Typical Skewed Placement

4. Installation Requirements

4.1 Site Supervision

The PermaTrak™ system components can be easily assembled by unskilled labor. However, it is essential that adequate site supervision be provided in order to ensure a quality finish. A field representative from PermaTrak™ North America will be present to offer recommendations for improved installation. In particular, supervision should address the following aspects of the site works:

- Accurate survey of center-line, and spacing and leveling of headwalls and stumps.
- Ensure adequacy of compacted base material or substructure.
- Correct integration of tapered treads with straight treads to achieve desired alignment.
- Treads should be tightly locked together to maintain standard gaps.
- Treads are uniformly aligned to produce a consistent flush edge along the entire boardwalk.

4.2 Tools and Equipment

In order to keep the number of components to a minimum, and thereby reduce complexity, PermaTrak™ components require the use of mechanized lifting equipment for unloading, handling and assembly. A lightweight, rubber-tired excavator with a lifting harness could be utilized, or alternatively, a small skid-steer loader. A span-over-span method of construction is recommended so as to minimize the impact on the local environment.

Apart from a large crowbar to lever beams and treads into position, no power tools are required for assembly of the superstructure. Of course, properly-fitting safety footwear and gloves would be worn at all times by the installers.

4.3 Placing of Abutments

Abutments form the interface between the at-grade portion of the walking surface and the elevated boardwalk. Place the abutment vertically on a firm compacted base, ensuring that the joint of the two headwall pieces aligns with the proposed boardwalk center-line, which should also be at 90^{o} to the back face of the headwall. The top should be flush with the final design elevation of the pavement surface. The stationing and control points for the piers are established from this beginning abutment. Backfill behind the headwall after the treads for the first set of beams have been installed.

4.4 Precast Piers

Once the center-line has been identified and clearly marked, the next phase is critical to any project and will ultimately determine the final success of the boardwalk. While there may be wide tolerances in actual center-line location, pier positions need to be located accurately to ensure the correct span and separation of beams. It is recommended that a pier cap spacing template be created for this purpose. This would consist of merely a rigid piece of straight timber, with the exact ball pin spacing clearly marked. A ball pin permanently glued into one end allows for arcs to be scribed where changes of direction are proposed. Found the stump firmly and evenly, ensuring that it is stable. Check that the level of each stump is consistent with those immediately adjacent.

4.5 Placing Beams & Treads

Upon setting the abutment and piers of the first span, place the beams parallel to each other onto the pier caps, using the ball pins. The ball shape of the pin faces downward and fits into the circular depression in the top of the abutment or pier cap.

Figure 3: Ball Pin in Position

Position the first tread on top of the beams, ensuring the overhang on either side is the same. Slide the tread back towards the abutment so the tongue enters the groove on the leading face of the abutment. Check that the gap between the edge of the tread and abutment is approximately ¼ inch across the full deck width. Place the next and all subsequent treads in the same way, ensuring the tongue and groove fits together snuggly.

At approximately one-third distance along the beam, a barrel pin will need to be placed in the bottom of the tread at that location. This pin effectively limits the sideways movement of the treads. Another barrel pin is positioned at the two-thirds position on the adjacent bearer. Ensure all edges of the treads are evenly aligned and backfill behind the headwall to complete the installation of the first span.

When laying the treads, ensure that the treads are "blended" as some color variation will occur from pallet to pallet. "Blending" simply entails treads being taken randomly from different pallets and mixed as they are laid on the beams.

Where a curve is encountered, replace the straight treads with tapered treads in the proportions required for the deflection angle, as per the installation and shop drawings.

4.6 Final Abutment

As the final span includes the terminating abutment located at-grade, some modifications to the ground may be necessary at this point. As the two beams resting on the abutment must finish in-line and at 90^{o} to the end face of the abutment, some planning must be undertaken when constructing the final few sections of the boardwalk. As beams ends become misaligned when bends are introduced, some balancing of the horizontal geometry, such as producing a final bend to bring the bearers back into alignment, may be required. An alternative to boardwalk re-alignment may be to re-align the at-grade section of adjoining pavement, or a combination of both.

4.7 Disposal of Waste

Ensure that all waste is removed from site and that it is disposed of in the correct manner.