Grade Separation Systems

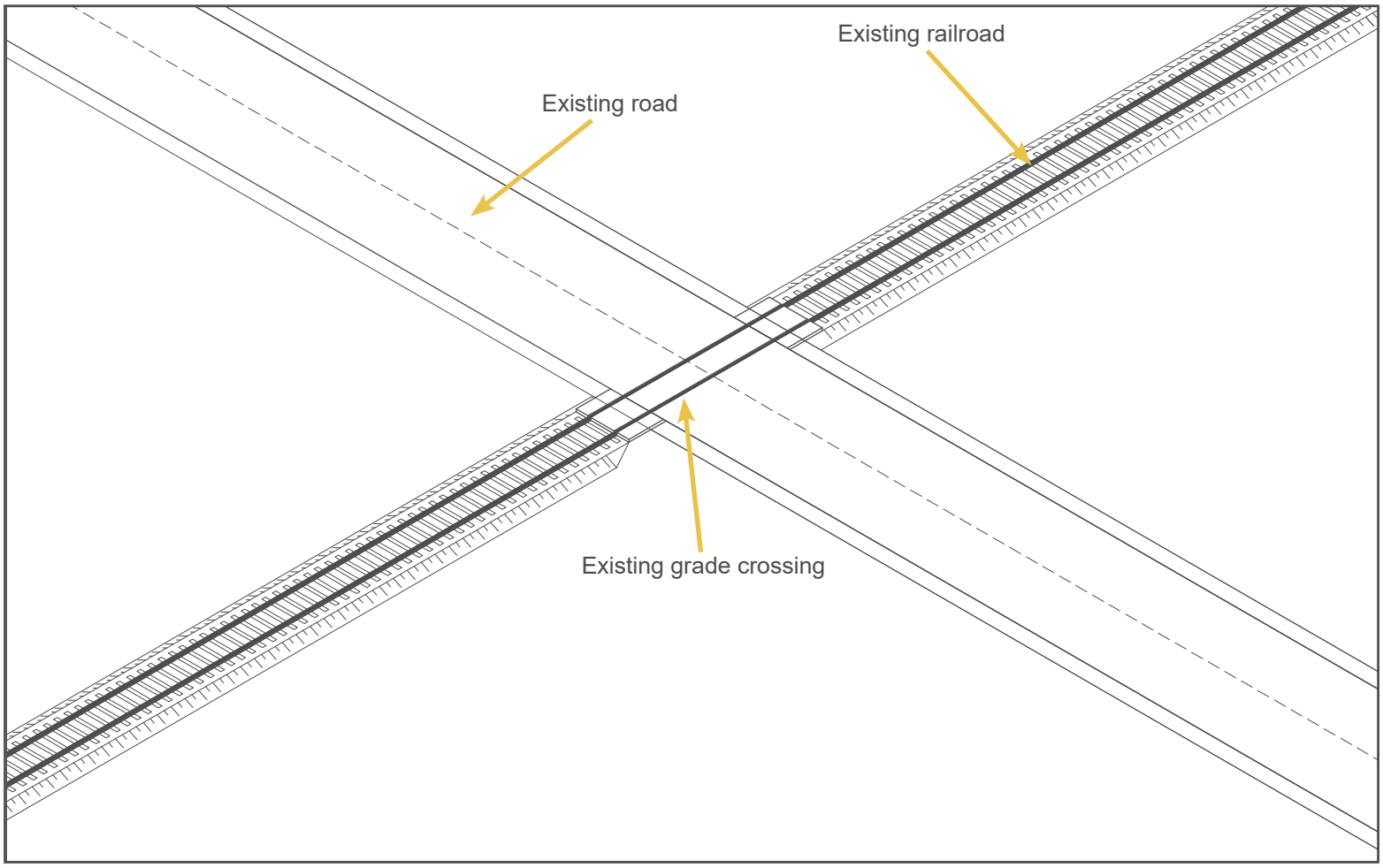
Single-Span Rail Bridge Construction Procedure

An innovation from

art engineering inc.

GSS Single-Span Example

Shown: An existing railroad grade crossing.



Goal: To separate the grades by constructing a single-span rail bridge and an under-passing roadway.

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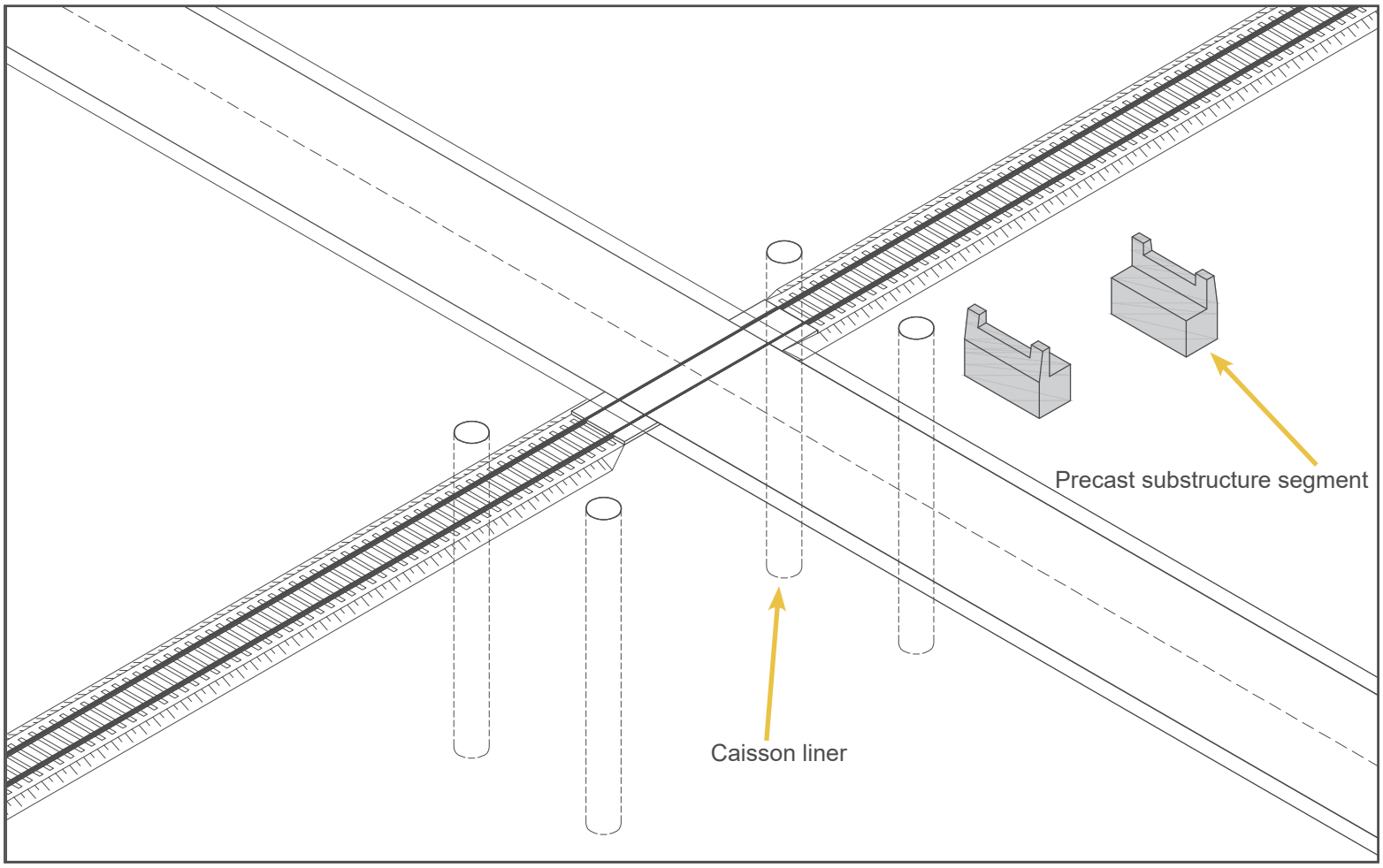
Preliminary Work

- Install caisson liners
- Precast substructure segments
- Detour road (optional)



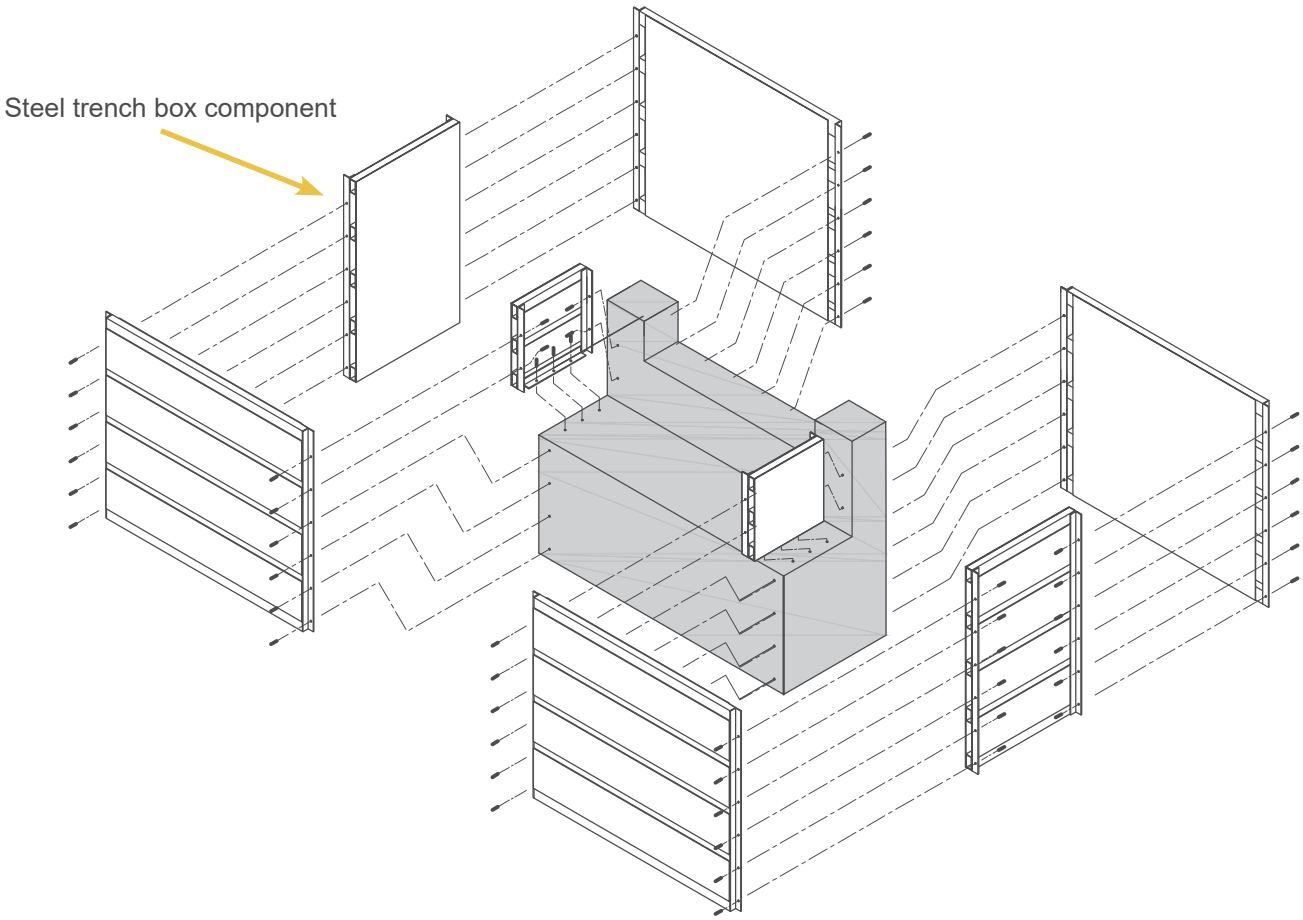
Caisson liners are installed outside of the rail clearance envelope, a minimum of 9 ft away from the centre line of the track.

Substructure segments are precast in shop or on site. These segments are components of the permanent bridge structure and will be built up into the abutments. They weigh approximately 35 tons.

The roadway is detoured, closed, or otherwise dealt with, but rail traffic is unaffected.

Assembly Preparation

- Join trench boxes to precast



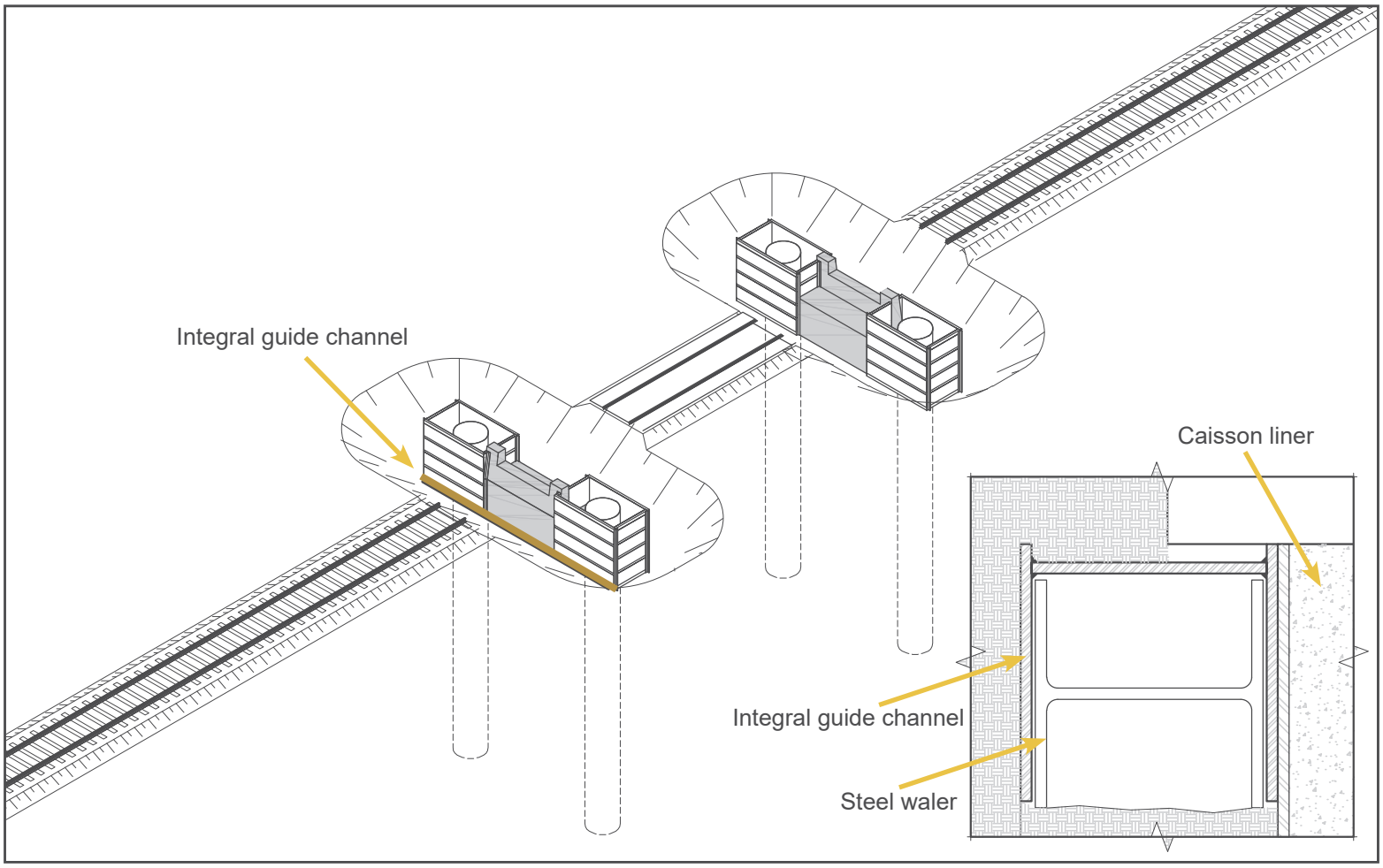
Steel GSS trench boxes are bolted directly to the precast substructure segments with threaded rods or bolts.

These trench boxes are designed to match the given precast substructure segment and to withstand train and soil loads.

GSS trench boxes will provide a safe working area for construction so that the railway can continue to remain in operation. They also will serve as formwork.

First Rail Closure

- Close track for 4 hours
- Dig trench
- Place guide channel
- Place Assembly
- Open track



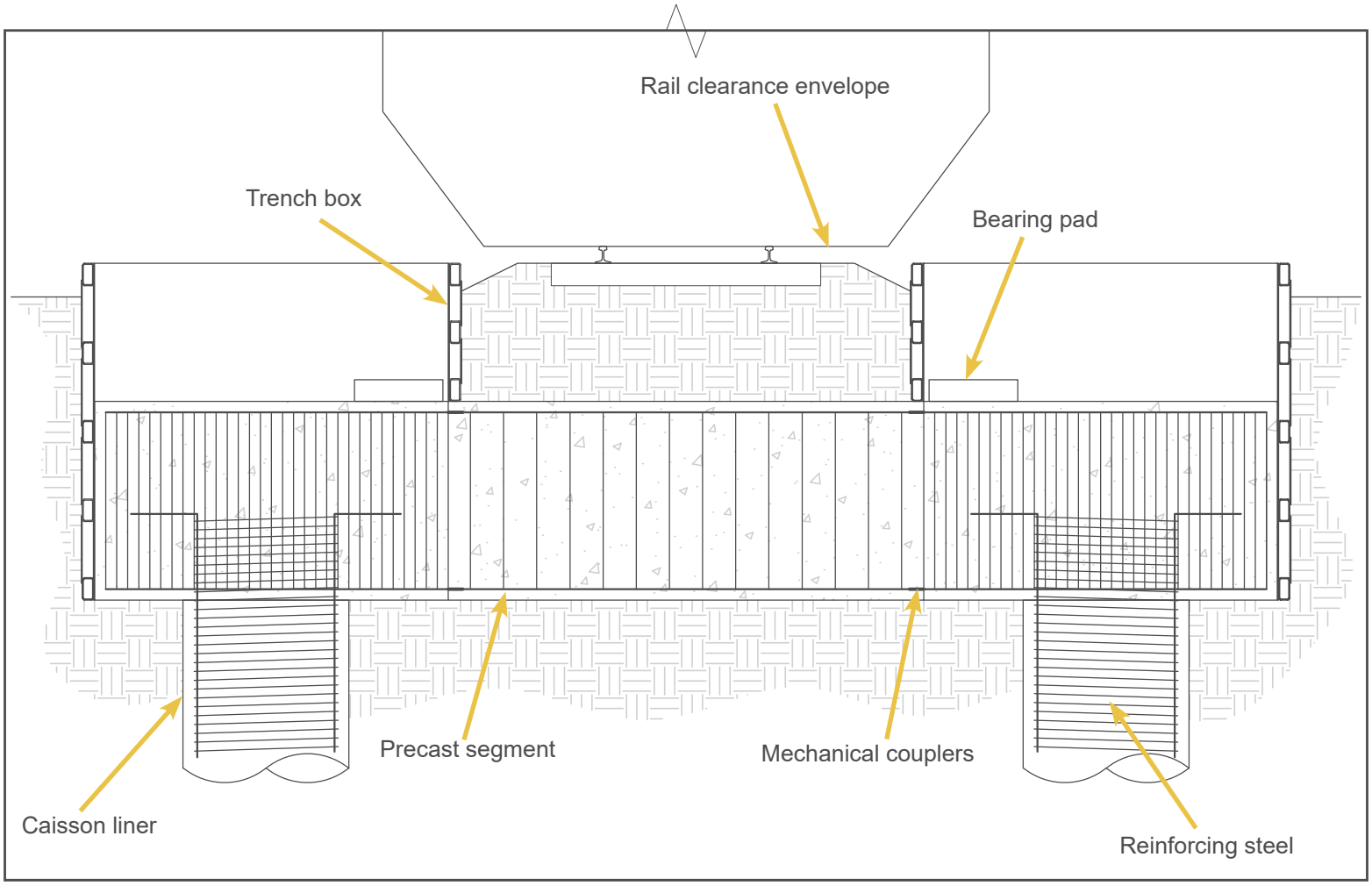
The track is closed for a four hour period and a trench is dug across the tracks. Most rail companies can easily accomodate overnight for this closure period.

A guide channel is tack welded to the caisson liners beneath the location of the future abutments. This guide channel will simplify the vertical excavation process.

The precast assembly is then lifted into place where the abutments will sit permanently. The completed assembly weighs approximately 35 tons and can be lifted with a 100 ton crane. The ground is then ballasted and the track can be re-opened.

Trench Boxes

- Cut off caisson liners
- Install reinforcing steel
- Pour caissons
- Extend abutments
- Place bearing pads



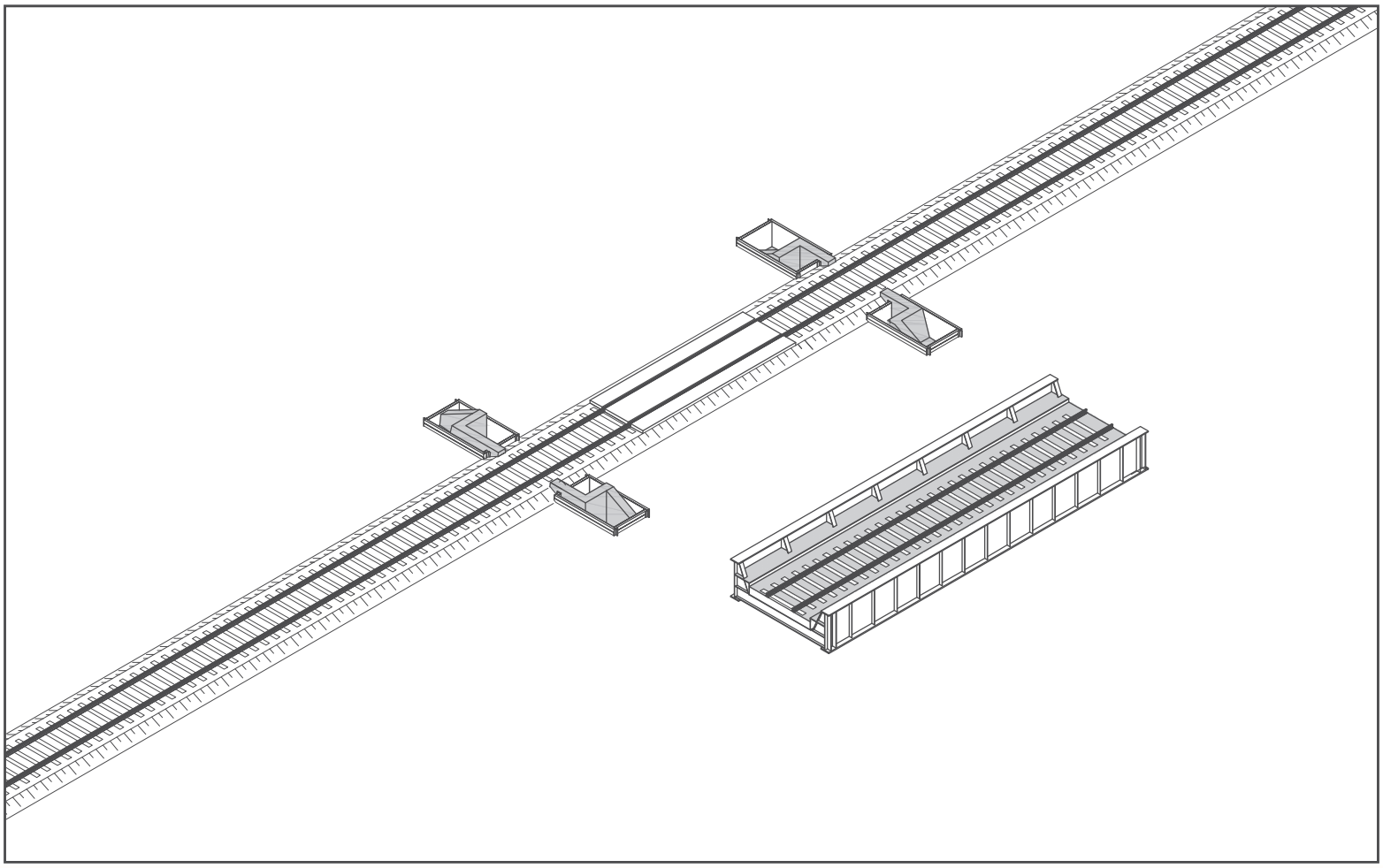
The caisson liners are cut off at the designed elevation and work continues within the trench boxes. The railroad can continue to operate at full capacity as work is performed outside of the rail clearance envelope.

Reinforcing steel is placed throughout the liners and integrated with the segment through mechanical couplers or post tensioning. The caissons are then poured.

The abutments are extended and the bearing pads are installed outside of the cold joint. This precise placement eliminates a significant amount of steel from the design.

Bridge Span Assembly

- Assemble bridge span



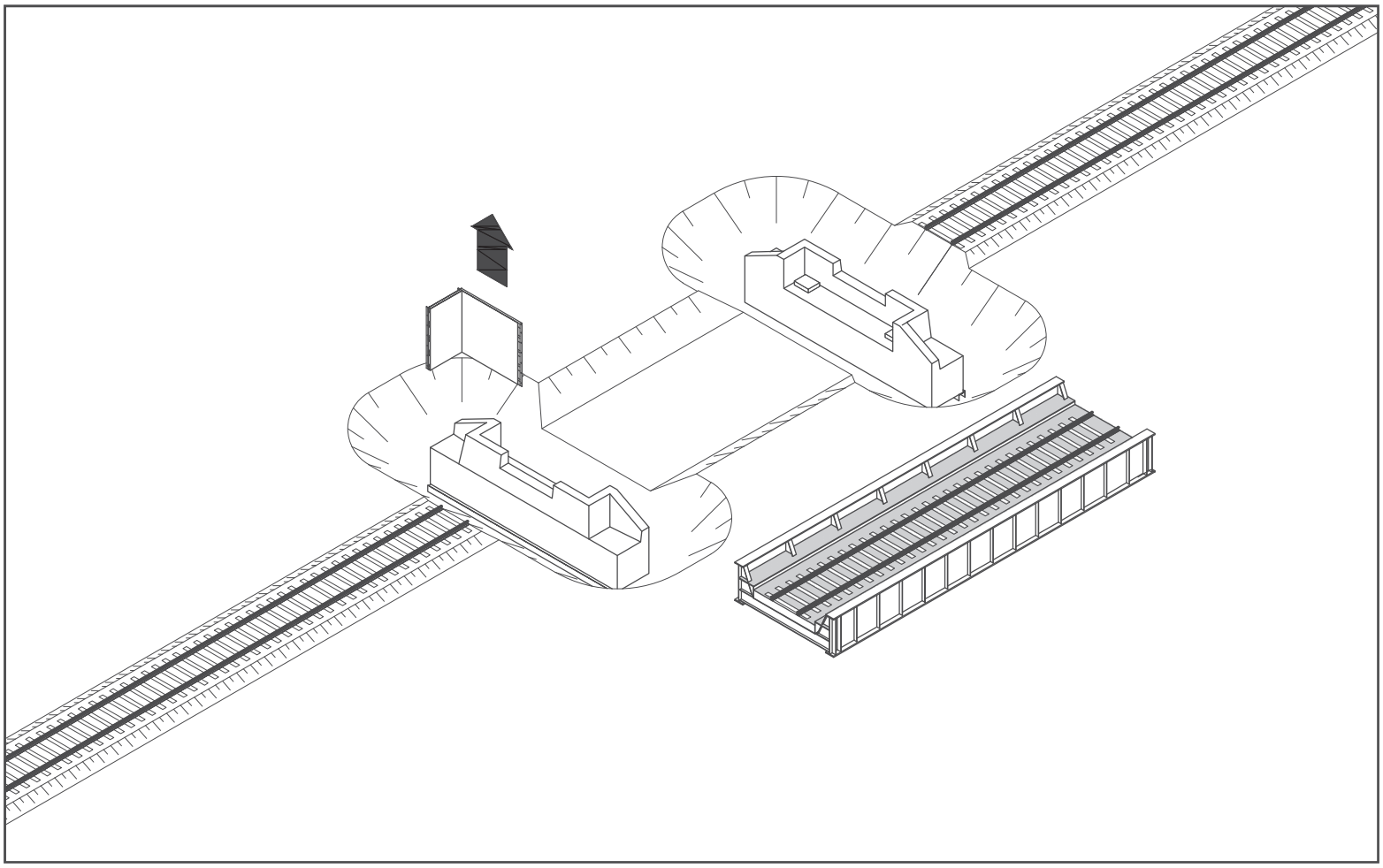
While work continues within the trench boxes, the bridge span is assembled to the side of the track.

A 19 m long bridge span complete with ballast and rails weighs approximately 100 tons.

Although a steel girder bridge with steel plate decking is shown, the GSS method can accommodate any bridge span design.

Second Rail Closure

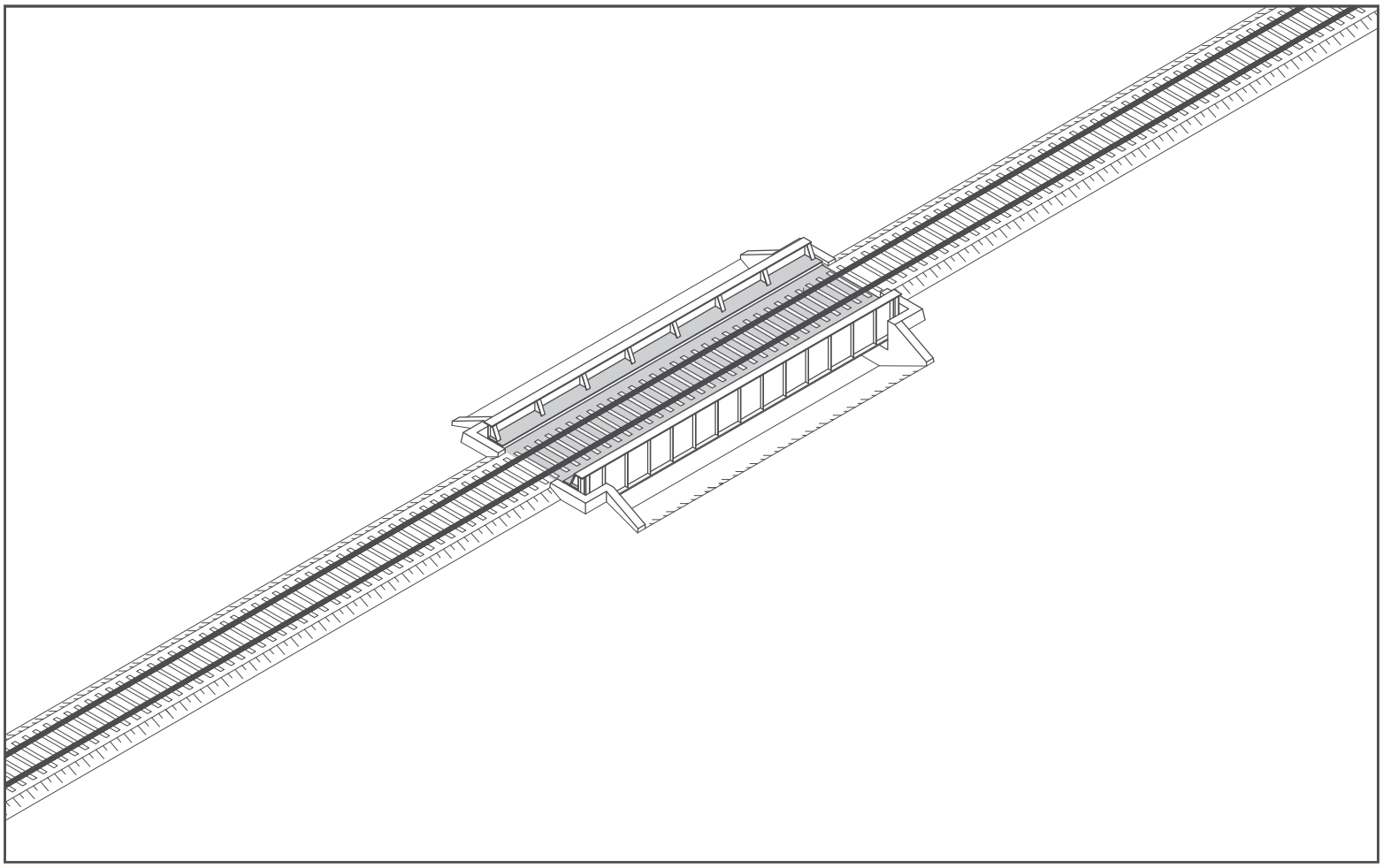
- Close track for 4 hours
- Dig trench
- Remove trench boxes



The track is closed for a second four hour period and a trench is dug between the two completed abutments. The trench boxes are then removed. These trench boxes are reusable to help cut down on wasted material.

Second Rail Closure

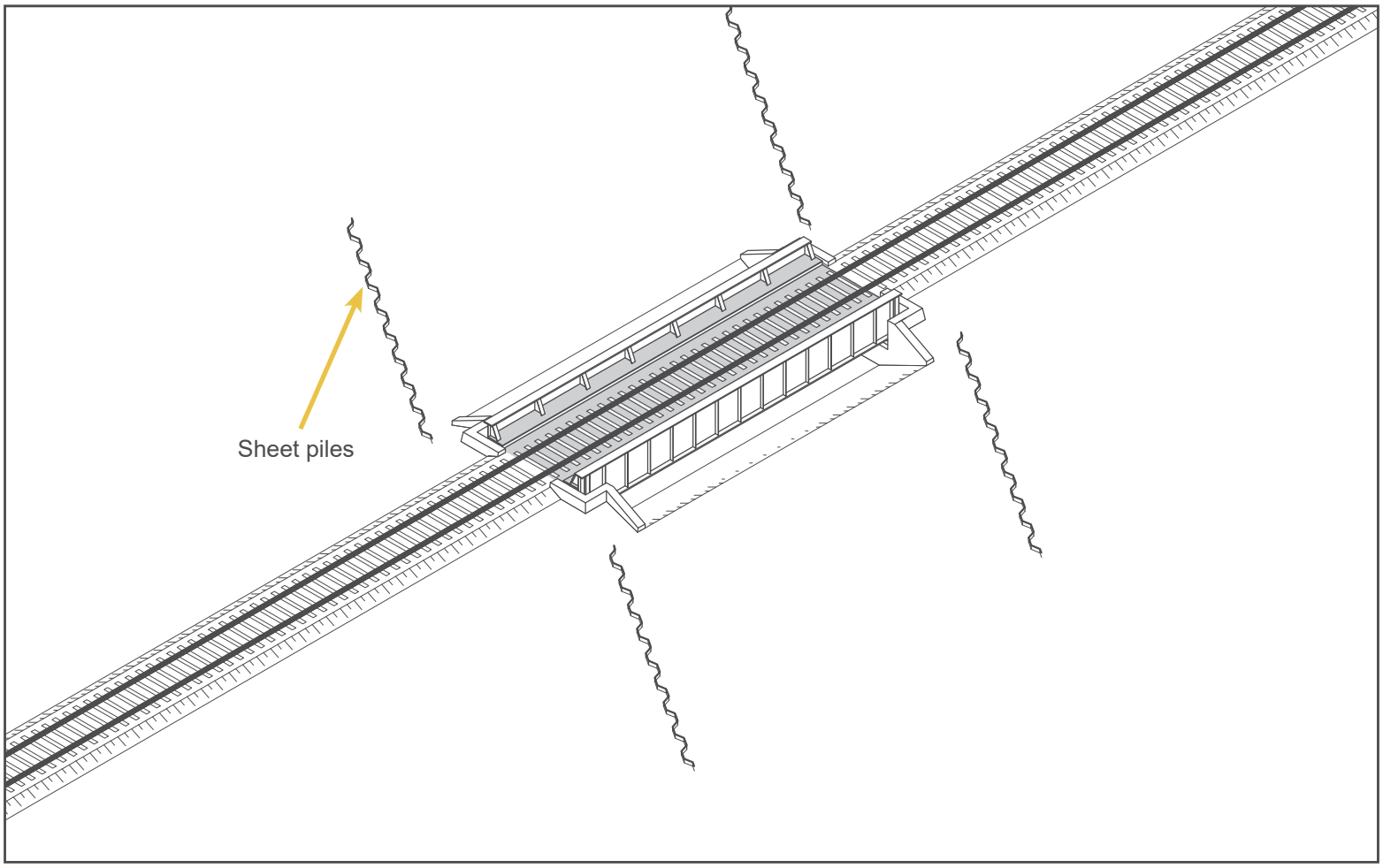
- Place bridge span
- Open track



The completed bridge span is then lifted into place to sit on the bearing pads. The span can be lifted with two 300 ton cranes or a lateral slide. The tracks are then connected and the rail bridge can be permanently opened.

Excavation Preparation

- Drive sheet piles
- Excavate to guide channel depth

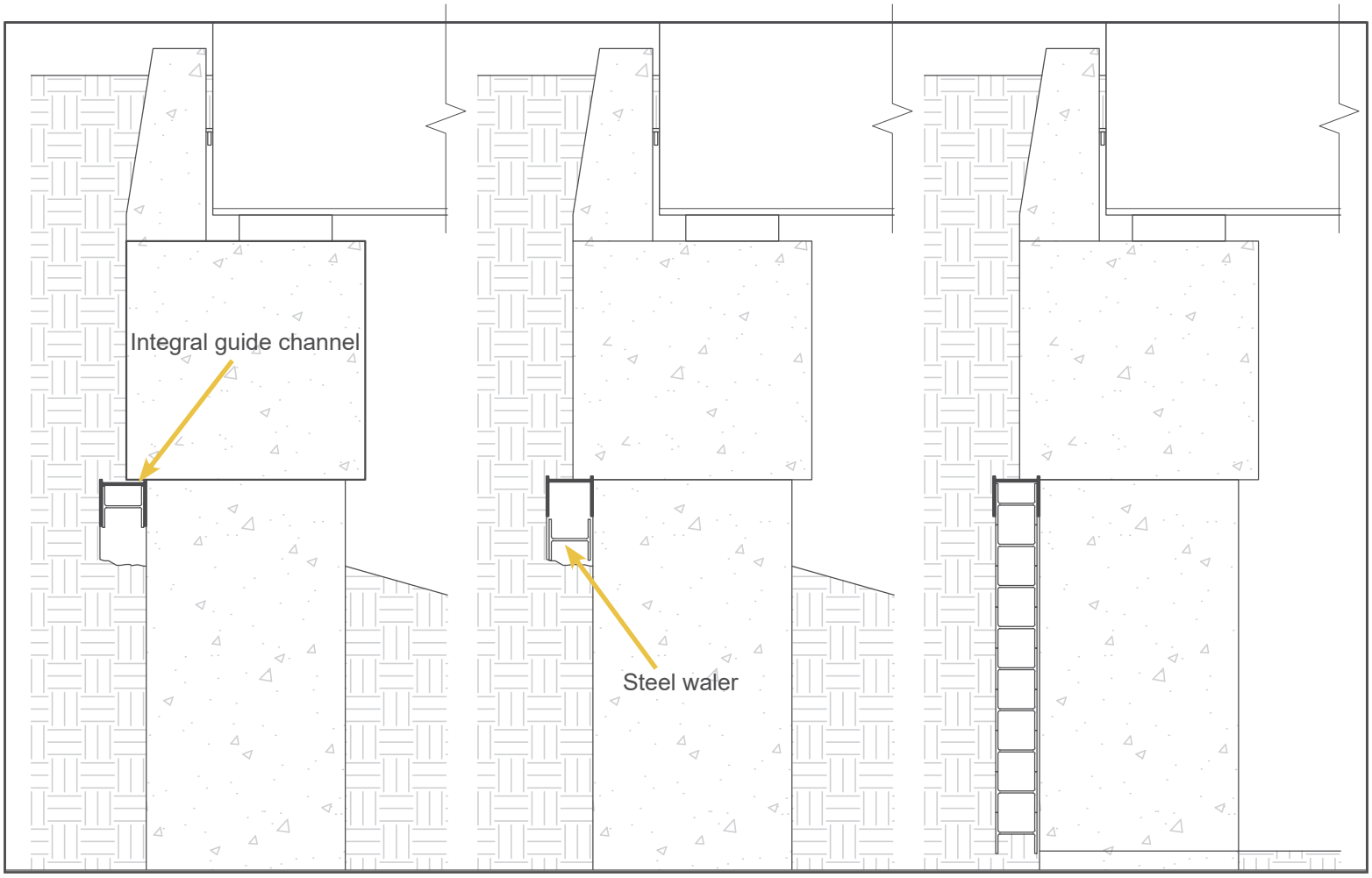


Sheet piles are driven at the corner of each abutment before excavation. This ensures a safe working area throughout the construction of the underpass.

Excavation then begins beneath the bridge span to the depth of the guide channel. A steel waler is housed within this guide channel and will serve as soil protection behind the substructure.

Vertical Excavation

- Excavate locally
- Drop waler
- Install next waler
- Repeat process

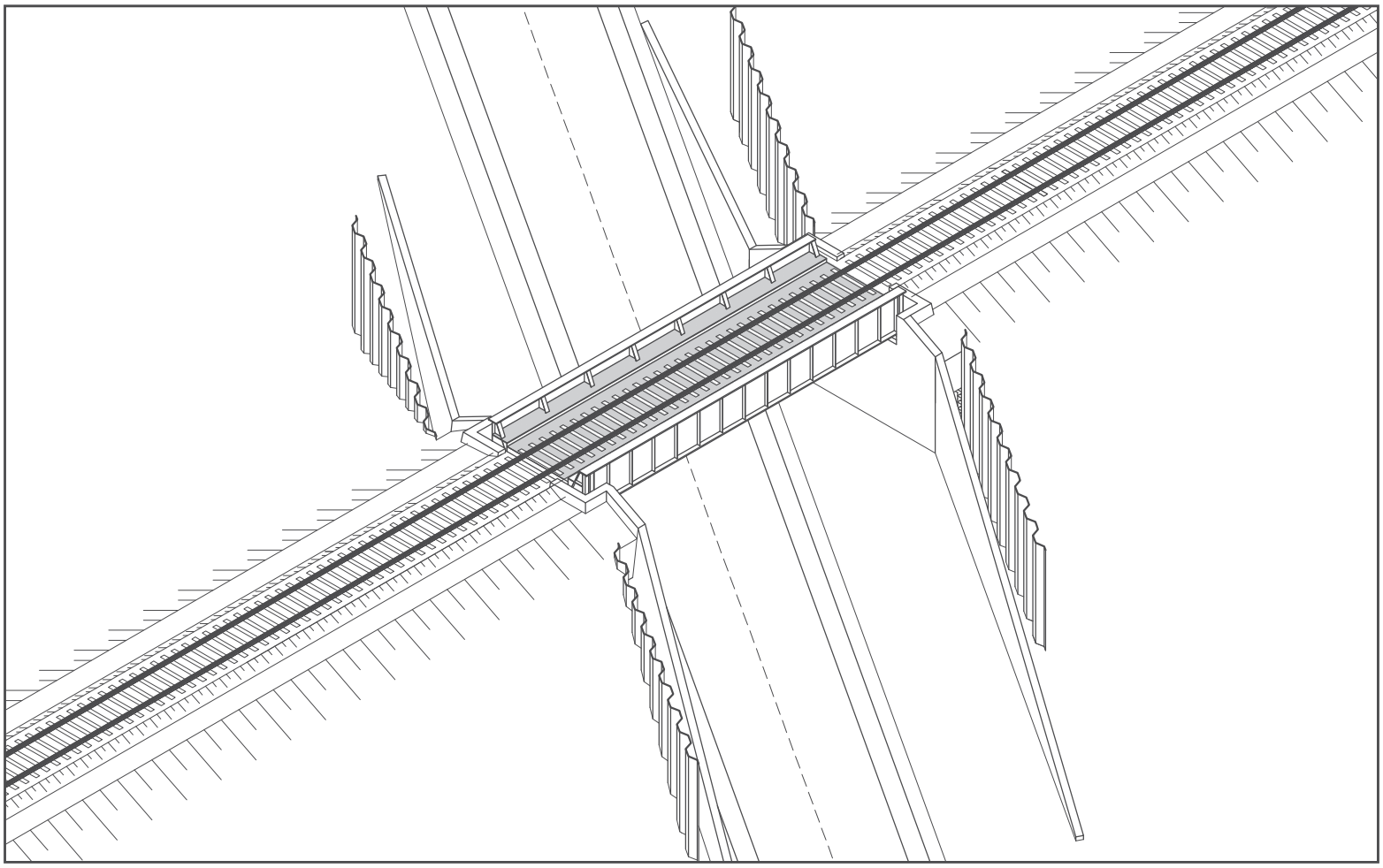


One foot below the waler is locally excavated so that it drops directly below its former position. A second waler replaces the first within the guide channel. Another foot is then excavated so that both walers drop together. This process is repeated until the designed excavation depth is reached.

This “foot-at-a-time” approach allows for constant soil protection throughout excavation. To facilitate integration and sliding, guide plates can be welded onto the walers prior to their placement within the guide channel. The walers will drop due to their self weight or can be lowered with a hydraulic jack if required.

Underpass Construction

- Construct walls
- Construct road

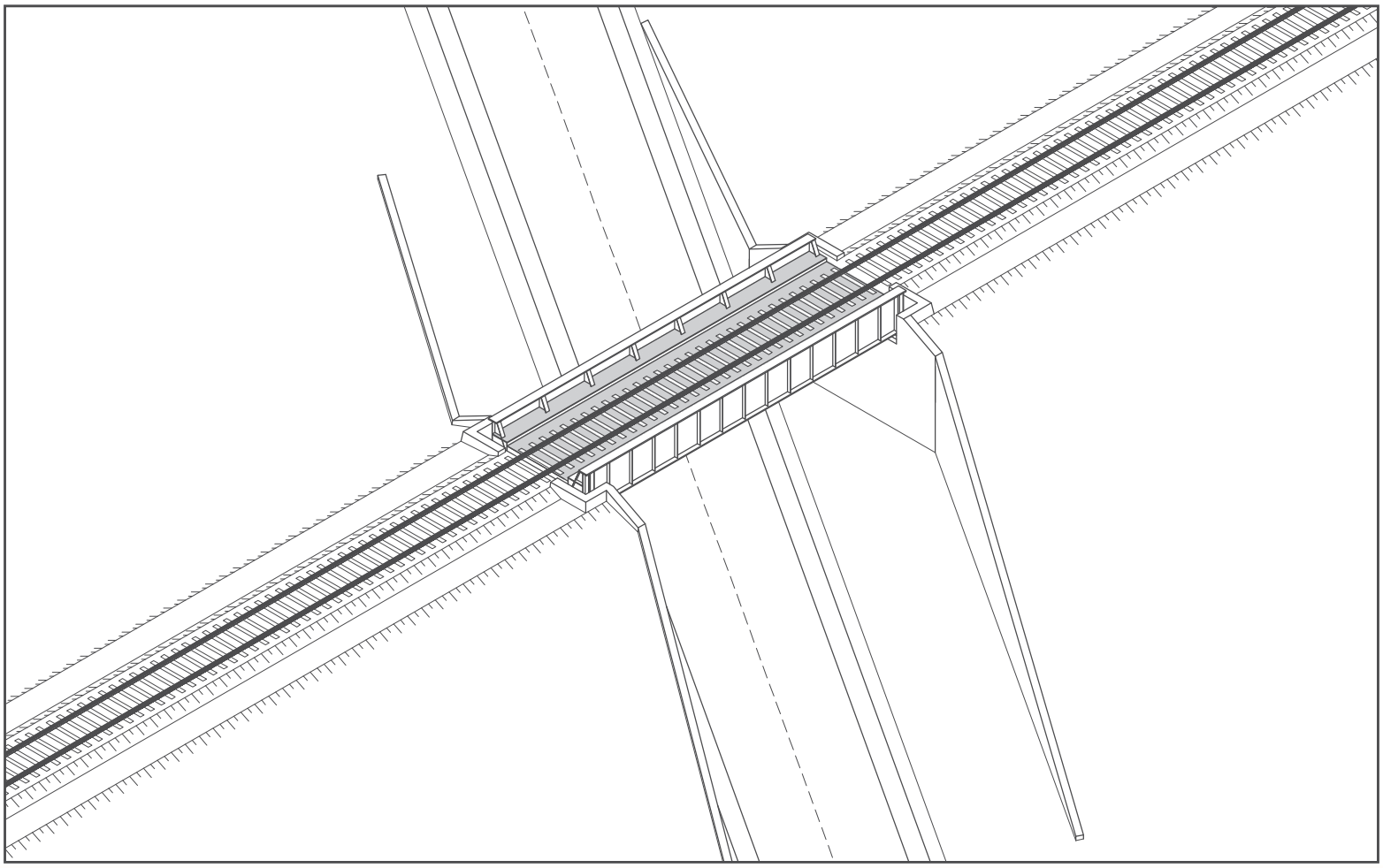


Once excavation is complete, the abutment walls are poured. The steel walers can serve as the back formwork for the abutment walls. The retaining walls are then formed.

Now that the permanent retaining system is in place, the under-passing roadway is constructed.

Completion

- Backfill structure
- Open roadway



The sheet piles and walers are removed, voids are grouted, and the structure is back-filled. The roadway can now be permanently opened.

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