

T-WALL® RETAINING WALL SYSTEM *From Concept to Completion*

LARGE UNIT | 5' x 7'6" RAILROAD CONSTRUCTION MANUAL



 **THE NEEL COMPANY**

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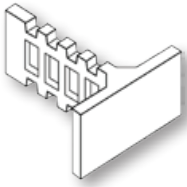
NOTE TO THE READER

This manual has been prepared as a guide to building T-WALL® Retaining Wall structures. Its contents should be thoroughly reviewed by the contractor and the superintendent responsible for construction prior to the delivery of the T-WALL® units to the job site. The Neel Company and/or its Licensed Producers will provide job site technical assistance to help the contractor implement correct construction procedures. Compliance with this manual does not relieve the Contractor of the responsibility to adhere to contract plans and specifications. The T-WALL® Retaining Wall System should never be built without approved T-WALL® drawings stamped by a Professional Engineer.

*Front Cover: North Milliken Ave. Grade Separation,
Ontario, CA*

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The T-WALL® Retaining Wall System is Patented



T-WALL® RETAINING WALL SYSTEM

LARGE UNIT CONSTRUCTION MANUAL

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Part I: EARTHWORK

THE STRUCTURE DEPENDS ON IT!

The concrete T-WALL® units are only half of the retaining wall structure - earth is the other half. It is the combination of T-WALL® units and specified select backfill that allows for the success of the wall.

IMPORTANT EARTHWORK ITEMS

FOUNDATION

The owner's engineer must inspect and approve the foundation before the leveling pad is poured. If the foundation is soft the wall will settle.

SELECT BACKFILL GRADATION

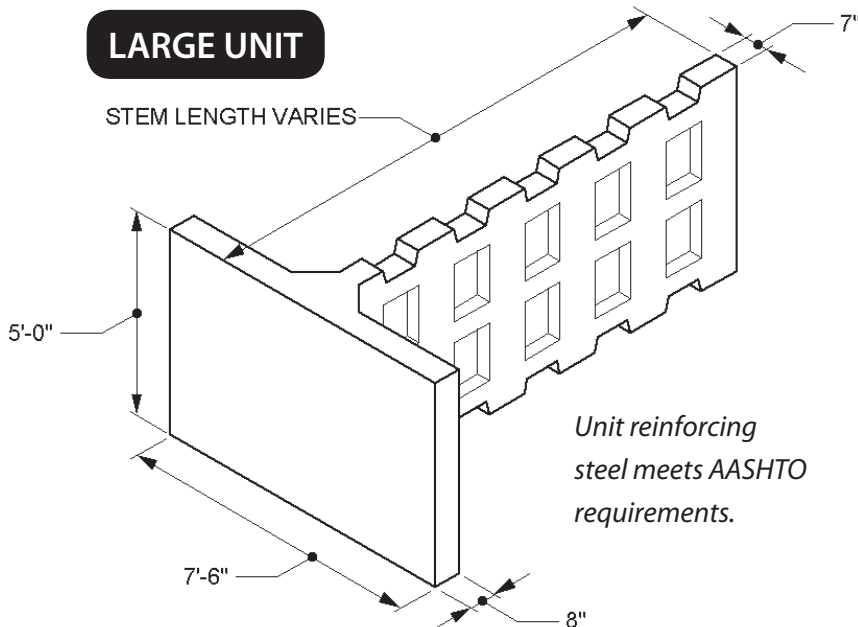
Proper backfill gradation is critical to the T-WALL® structure's stability. Requirements are listed on the shop drawings for each project. It is important that gradation tests be performed throughout construction to ensure that the backfill meets project specifications. Select backfill gradation affects stem friction, drainage, and settlement.

COMPACTION

Proper compaction of the backfill between and behind the stems is required to prevent settlement, which affects any paving at the top of the wall.

*** Failure to follow the specifications and notes in the approved T-WALL® shop drawings for your project may result in wall movement.**

UNIT DIMENSIONS AND WEIGHT TABLE



LARGE UNIT DIMENSIONS*

FACE SIZE (ft)	STEM LENGTH (ft)	UNIT WEIGHT (lbs)
5' x 7.5'	8'-0"	6,900 lbs
5' x 7.5'	10'-0"	7,600 lbs
5' x 7.5'	12'-0"	8,300 lbs
5' x 7.5'	14'-0"	9,000 lbs
5' x 7.5'	16'-0"	9,700 lbs
5' x 7.5'	18'-0"	10,500 lbs
5' x 7.5'	20'-0"	11,200 lbs

* Stem lengths as required by design up to 32' and top units up to 10' high. (see approved shop drawings for unit weights)

*Other standard sizes available for railroad loading: Small unit - 2.5' x 5.0' and Double unit - 5.0' x 5.0' (Refer to the standard T-WALL® Construction Manual for unit weights, dimensions and installation instructions for these units. Copies of the manual may be downloaded at: www.neelco.com)

Part II: GENERAL OVERVIEW

WORK TO BE PERFORMED BY THE CONTRACTOR:

- **Site preparation**, including excavation and compaction, if required
- Forming and pouring the 2 **leveling pads**
- **Wall construction** - including the **backfill** process
- Testing: backfill **gradation and compaction**
- Installation of **fences, guardrails**, and/or other necessary items

CREW SIZE: 4-5 PEOPLE

- A typical wall erection **crew includes**:
 - One **excavator/crane operator** for setting units and placing backfill
 - One **working foreman** to check alignment
 - **Two men** for setting units, shear keys, and joint materials
 - One **front-end loader and operator** to move backfill and T-WALL® units

PRODUCTION RATES:

- Construction rates for T-WALL® depend entirely upon the rate at which select **backfill** can be delivered, placed, and compacted

BASIC CONSTRUCTION PROCEDURES:

- **Form** and **pour** leveling pads
- **Compact fill** between leveling pads
- Set **first course** of units
- Place and compact **select backfill**
- Place **joint material** and **shear keys**
- Set **second course** of units and **repeat cycle**

EQUIPMENT, MATERIALS, AND TOOLS SUPPLIED BY THE CONTRACTOR:

- T-WALL® unit lifting equipment: **backhoe** or **crane**
- Equipment for hauling, dumping and spreading backfill: **dump trucks, front-end loaders**, and **dozers**
- Compaction equipment: small walk-behind **vibratory roller** or **Rammax®** type equipment
- **Tools**:
 - **Instrument level** to check the grade of the leveling pad
 - **Broom** to sweep the leveling pad
 - **Lifting beam**
 - **Lifting hooks** for connecting to inserts
 - **Chalk line**
 - **Shims**
 - **Pinch bar**
 - **Four foot level** (*minimum*)
 - Smooth, **18" long 1/2" steel rod** - (*for gauging vertical joint*)
 - **Crow bar**
 - **Short ladder**
 - Construction **adhesive** (*such as Liquid Nails®*), with cartridges and gun(s)
 - **Hammer drill** with 10"x 3/4" carbide bit - (*for drilling bolt holes in corner units- when required by design*)

MATERIALS AND SERVICES SUPPLIED BY THE NEEL COMPANY AND/OR THE PRECAST MANUFACTURER:

- On-site **technical assistance**
- **Engineering** and **design** of the structure
- **Delivery** of the following wall materials to the site:
 - Precast concrete T-WALL® **units**
 - **Shear keys** and shear key **wrap material**
 - **Neoprene blocks** for horizontal joints
 - **Filter fabric** for horizontal and vertical joints
 - **Connection hardware** (*when required by design*)

..... PART III: CONSTRUCTION PROCEDURES FOR SINGLE-SIDED STRUCTURES



Excavated site



Pouring of second leveling pad



Lowering a unit into place

SITE PREPARATION

- **Excavate the site** to the elevation shown on the contract plans for the entire footprint of the T-WALL® structure (including the area covered by the select backfill between the stems). Under special conditions the excavation may be done in increments to minimize the amount of open cut.
- All unsuitable materials below subgrade must be removed and replaced with **select, compacted backfill** at the direction of the owner's engineer.
- **Compact the subgrade** to 95% standard proctor and **proof roll the foundation** in accordance with the project specifications.
- The foundation is to be **inspected and approved** (in writing) by the owner/owner's engineer for required bearing capacity as shown on the approved T-WALL® drawings.
- Excavate for the leveling pads. **Large units require both front and rear leveling pads.**
- Where possible the **width of excavation** should allow sufficient room to set the longest stem and still leave space to access the area between the stems.
- Any **under-drains, drainage piping, or drainage blankets** should be installed at this time.
- Bring the **subgrade to the top of the leveling pads** and compact before setting units.

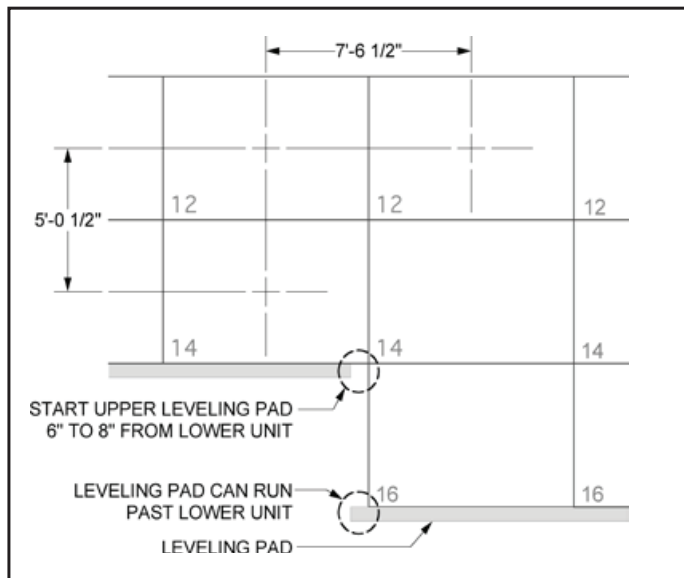
LEVELING PAD CONSTRUCTION:

- The leveling pads are to be **15 inches wide and a minimum of 6 inches deep** unless otherwise shown on the approved shop drawings.
- **Form the leveling pads** similar to forming a sidewalk. The edge forms are the screed rail. They must be checked with a level to assure proper elevation and tolerance. Finished surface tolerance is 1/4" in any 10' length with no more than 1/4" overall.
- **Check for alignment.** The leading edge of the front pad should be about 3" outside the front face line of the wall.

LEVELING PAD CONSTRUCTION (CONT.)

- **Check the project drawings** for the location of the rear leveling pad.
- The leveling pads are for construction alignment only. The concrete may be **low strength, 2,500 psi, without rebar in the leveling pads.**
- Check the leveling pad forms for line, grade, and tolerance with a level. If the forms are out of tolerance, **make corrections** at this time.
- **Pour the leveling pads.** Leveling pads are to be checked with an instrument after removing forms. High spots are to be corrected. The concrete surface finish must be smooth and flat. A steel trowel finish is desired.

STEPS IN THE LEVELING PADS



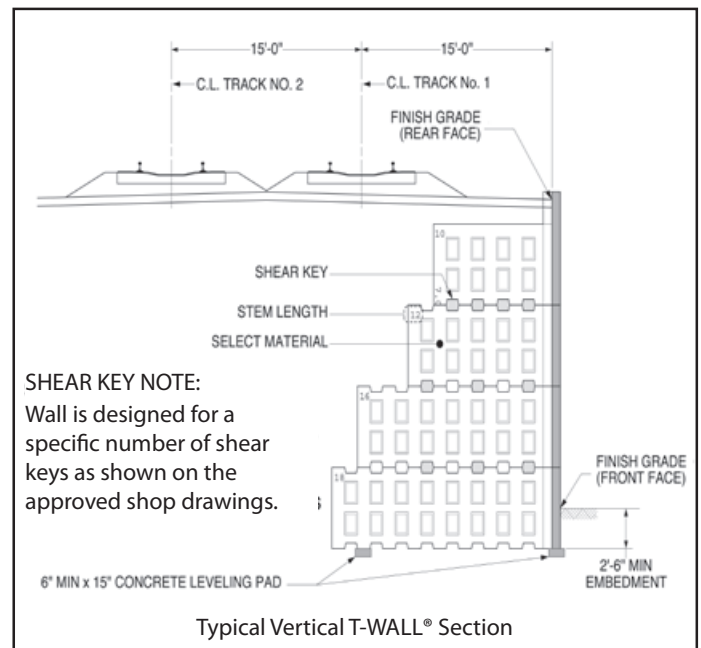
Front face of units on stepped leveling pads

- **Construct the lower leveling pads.** Leave an 8" gap before constructing the higher pads. This gap will assure that the higher pads do not interfere with the placement of the units on the lower pads.
- For a vertical wall, the typical step (change in elevation) is **5' 0 1/2"**.

PRECAST LEVELING PADS

- Where necessary, **precast leveling pads** may be used - if approval (in writing) is given by The Neel Company.
- Precast leveling pads are cast with rebar to prevent cracking and lifting inserts for ease of placement. **Pads must be of uniform thickness.**
- **Compaction and grading** under precast leveling pads is extremely important because any settlement or tilting will result in an unacceptable joint pattern or spalling of the concrete units.

WALL ALIGNMENT



- To establish wall alignment, **snap a chalk line** on the surface of the front leveling pad approx. 3 1/2" from the leading edge. The line marks the front face of the wall and will center the unit on the leveling pads.
- **Grade fill material** level with the pads for the entire stem length.



Units on truck



Lifting insert in stem of unit



Lowering a unit into place



Setting a unit

T-WALL® UNIT DELIVERY

- Prior to the start of construction, the contractor and the precast manufacturer should develop a **schedule for material deliveries**.
- This timetable will allow the producer to **match unit production with the construction schedule**.

UNLOADING THE UNITS

- Under normal circumstances a **two hour maximum unloading time** is allowed for each delivery.
 - During this period of time the units may be unloaded and stacked on the ground using the lifting device.
 - If time allows, the units may be placed directly into the wall structure.
- A typical **truck load is 4 – 5 units**.
- Care must be exercised during unloading to **protect the units and joint materials** from damage.



Units unloaded and stacked

Do not stack units more than two high.

- **Dunnage and plastic edge guards** are the property of the precast manufacturer and must be collected and returned as soon as possible.

ERECTION OF THE FIRST COURSE

- Always begin erecting T-WALL® at a **fixed point** such as a corner, step, or an existing structure tie-in point. If there is no fixed point, simply start on the lowest leveling pad. Using a smooth 1/2" diameter, 18" long steel rod create a **1/2" vertical space between the units.**
- No joint material is required between the leveling pad and the precast units.
- Set the first units on the leveling pads, **aligning the front faces to the chalk line guide.**
- **Plumb the front faces** of the units by adjusting the rear elevation of the stems.
- After aligning the front faces, **check the tops for correct level and height** relative to the other units in the course. If the top of a unit is irregular, place the level on the line where the top of the front face is chamfered. Shim as necessary. Continually check alignment, level, and plumb as one unit may be disturbed while adjusting others.
- Finally, step back and sight down the tops of the units. This visual check allows you to **fine tune the alignment.**
- Every effort should be made to ensure that the first course of units is properly aligned and level.
- Construct the wall in horizontal lifts.



First course of units on leveling pad



More courses



Putting units into position

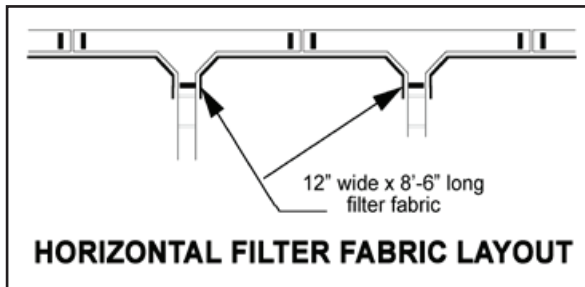
Walls have a tendency to grow or shrink in length depending on the amount of care taken to properly layout and align the first course!



Filter fabric covering vertical joint on the back of the face



Filter fabric covering horizontal joint on the back of the face



Neoprene blocks

CONSTRUCTING SUBSEQUENT COURSES AND BACKFILLING

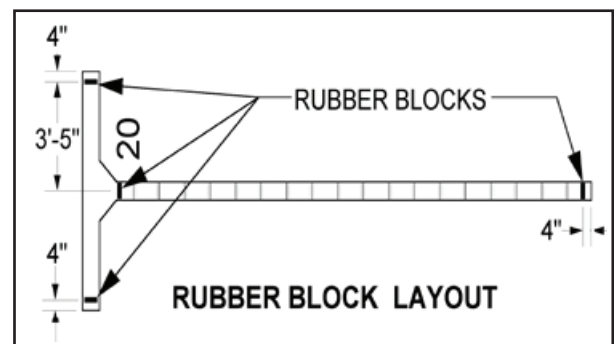
VERTICAL FILTER FABRIC:

- Prior to the initial backfilling, **cut the 12" wide filter fabric** into lengths equal to the height of each vertical joint.
- **Center the cut strips** over the 1/2" vertical joints on the interior faces between the units. This procedure prevents migration of the backfill material through the vertical joints.
- Throw any **excess filter fabric over the front face** of the units during backfilling, then pull it back over the backfill during setting operations.

HORIZONTAL FILTER FABRIC:

- Place a **second strip of filter fabric** over the horizontal joints between the stacked units on the interior face. Backfill material migration is now prevented through the horizontal joints as well.
- **Adhesive** may be placed in spots on the units to hold the fabric during back-filling.

HORIZONTAL JOINT MATERIAL:



- **Four neoprene blocks** act as a cushion to prevent concrete-to-concrete contact.
- Place two of the four neoprene blocks on each end of the horizontal joint between the unit faces, flush with the rear edge.
- Place two neoprene blocks on the top of the stem, one at the front where it meets the haunch and one at the rear.

CONSTRUCTING SUBSEQUENT COURSES AND BACKFILLING (CONT.)



Shear keys wrapped in joint material

- **Shear keys**, wrapped twice with the provided shear key wrap, should be placed between stem teeth where the unit above will meet the unit below.
- Approved T-WALL® shop drawings of the project sections show the required **number of keys** per unit.
- The purpose of the shear keys is to:
 - Provide an **alignment** guide
 - **Prevent movement** of the unit during backfill and compaction
 - Provide additional **pullout resistance** at the top of the wall
- It may be necessary to **plumb the units by placing shims** between the rear stem ends. Shims may be pieces of standard asphalt shingles, plastic, or hardwood.
- If you encounter a unit that is out of square it is best to **use the face as an alignment guide**. Keep in mind that this is purely an aesthetic concern, not a structural problem. Difficulties with plumbing and alignment should be reported to The Neel Company.
- **Dump the select granular backfill** material directly on top of the stems. Dumping in this manner will fill both sides equally and prevent lateral movement of the unit. **It is mandatory that the backfill material meets the gradation specification shown on the project drawings.**



Placing the backfill

- **Do not stack the units** more than one unit high without backfilling. It is unlikely that the subgrade will support the point load of the stem, causing the front face to be out of plumb by the time backfill is placed.
- **Backfill and compact each course** of units completely before starting the next course. The loose lifts of backfill should not exceed 12 inches before compaction. Each lift must be thoroughly compacted before more fill is placed. Failure to adequately compact the backfill can jeopardize the stability of the wall.
- **Backfill and compact the fill in front** of the wall as soon as possible. This procedure must be accomplished before the wall is 20' high.



Spreading the backfill

STAGED CONSTRUCTION

T-WALL® should be constructed horizontally, one course at a time. However, there are some situations where staged construction may be necessary.

Be aware that if the vertical height difference between adjacent columns is greater than one unit, the vertical joints will open due to the unbalanced earth pressure.

In order to avoid problems with the wall alignment when planning for staged construction contact The Neel Company for specific instructions.



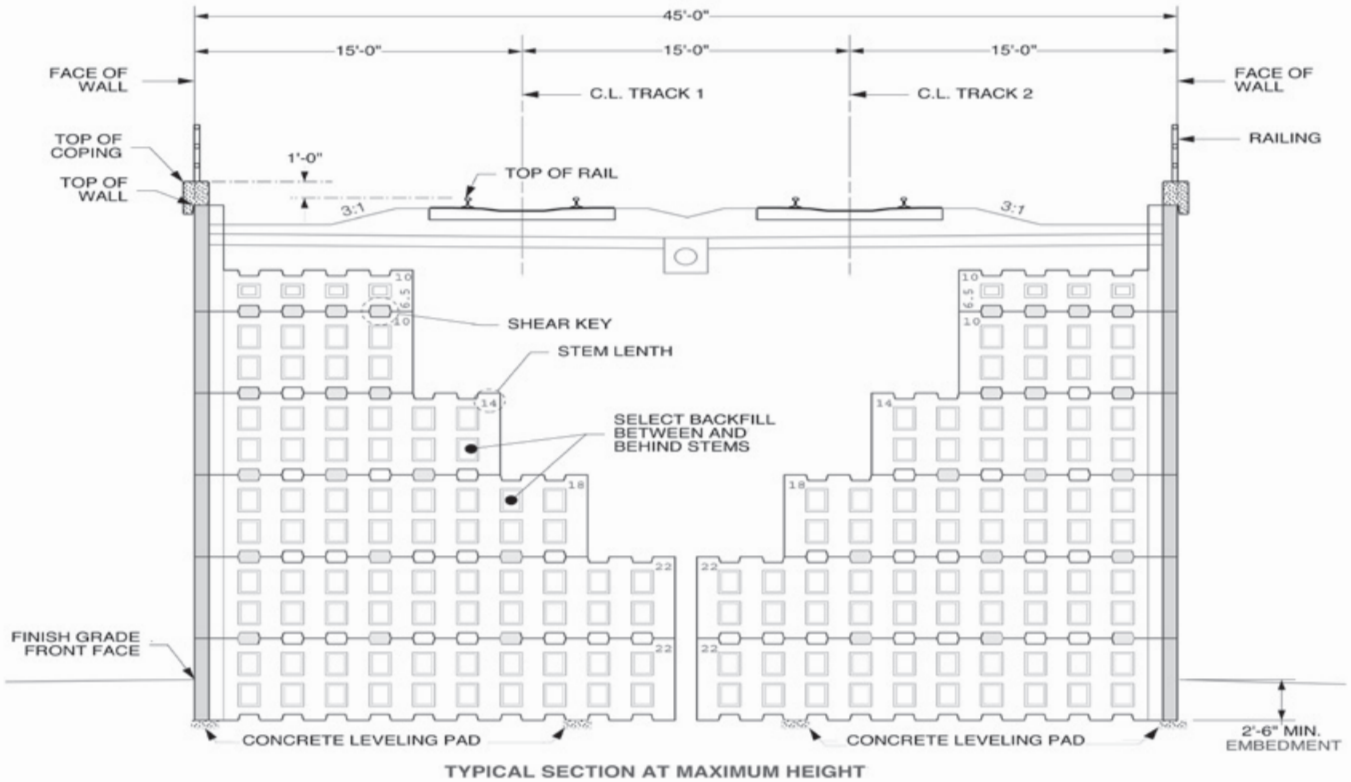
COMPACTION EQUIPMENT EXAMPLES



..... **PART IV: CONSTRUCTION PROCEDURES**
FOR DOUBLE-SIDED OR TIGHT RIGHT-OF-WAY STRUCTURES

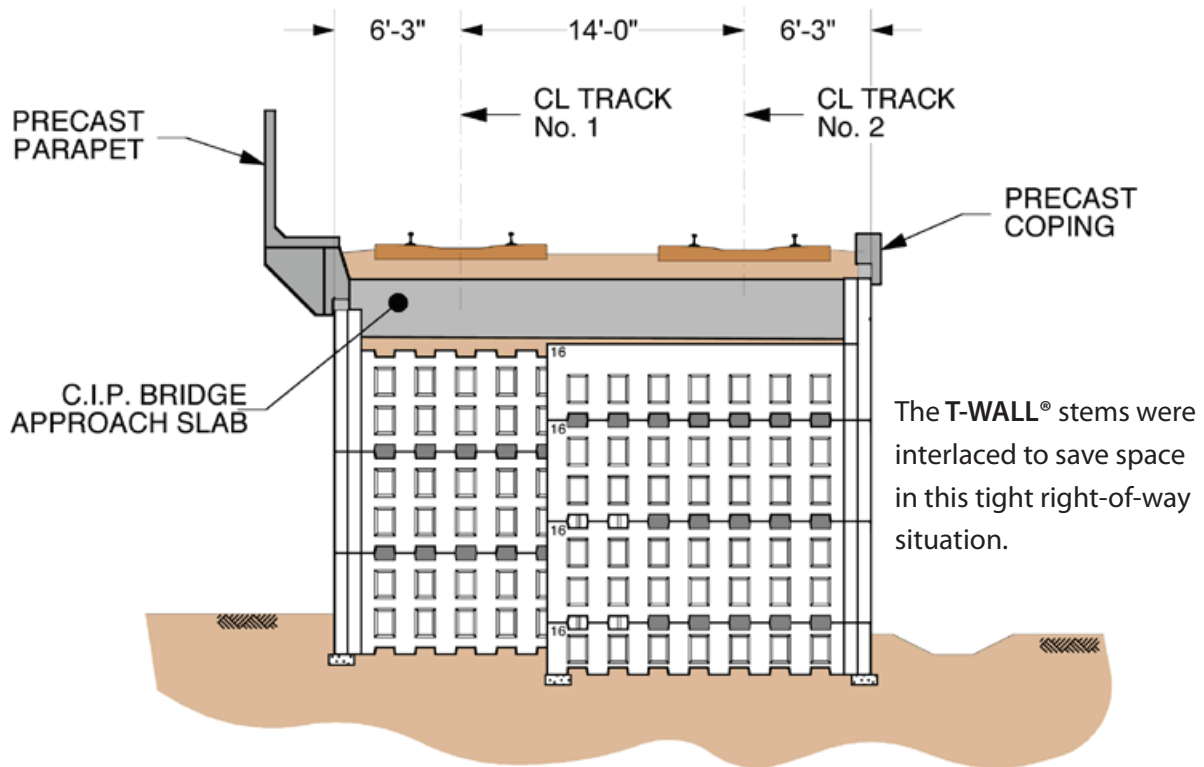
Construction procedures for double-sided structures follow the same construction methodology as that defined for single-sided structures.

Following are two examples of double sided or tight right-of-way structures:





This T-WALL® bridge approach has a live train track on one side and a major highway on the other.



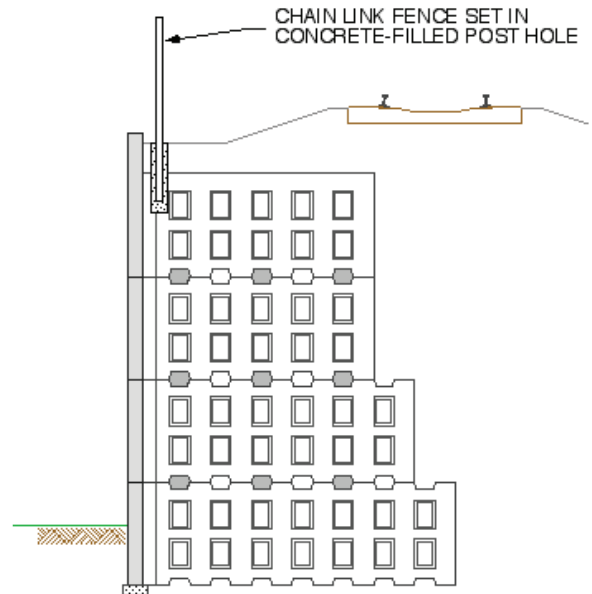
A cantilevered walkway was built on the trackside of the approach to allow maintenance crews access to the new rails.



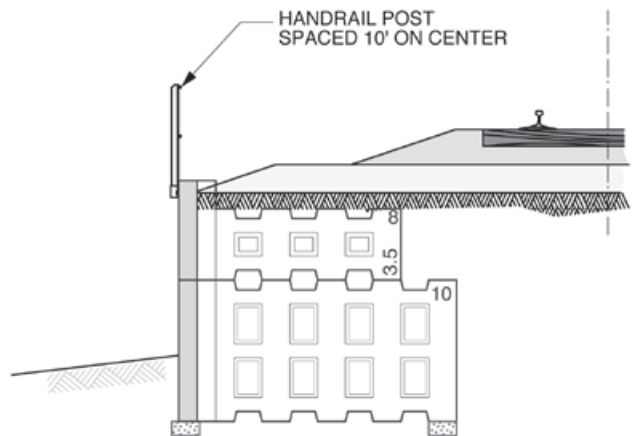
..... **Part V: CONSTRUCTION DETAILS**

FENCES, RAILINGS, AND BARRIERS

CHAIN LINK FENCE INSTALLED BEHIND THE WALL FACE:



HAND-RAIL POST INSTALLED ON WALL FACE:

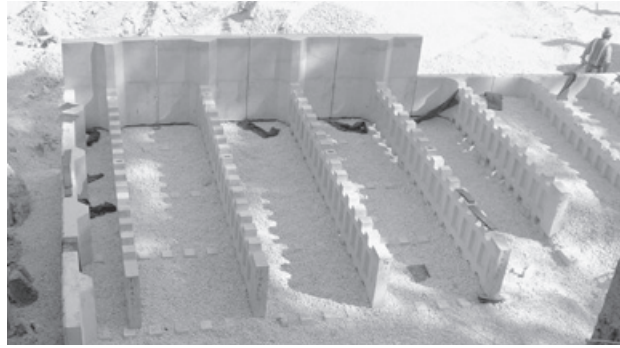


CORNERS AND ANGLE POINTS

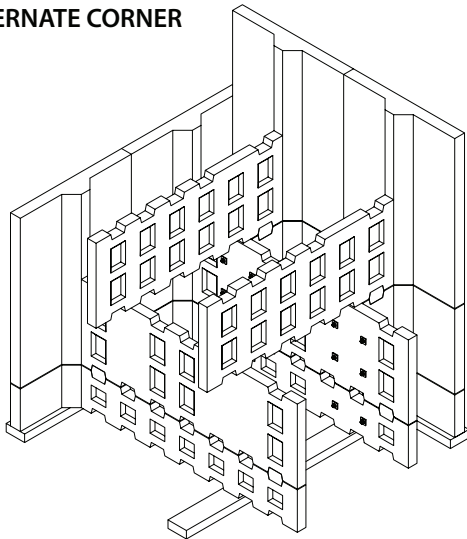
CORNER



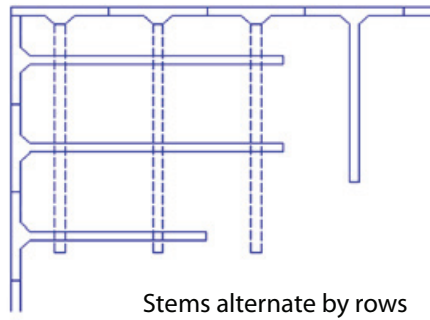
CORNER DETAIL



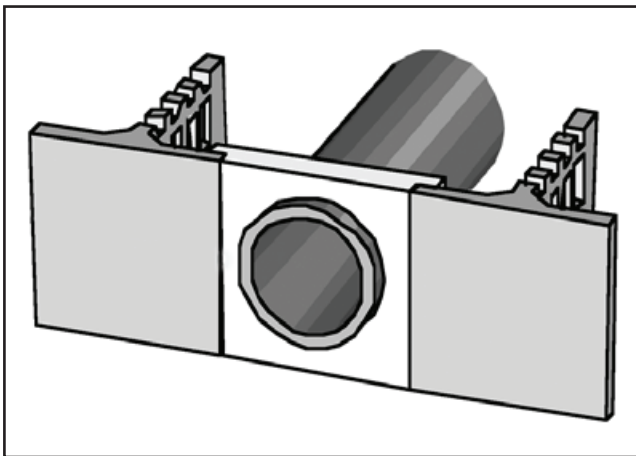
ALTERNATE CORNER



ALTERNATE CORNER DETAIL



LARGE PIPE PENETRATIONS



HANDLING, BACKFILLING, & COMPACTION OPTIONS

HAULING UNITS TO WALL

SETTING UNITS INTO WALL

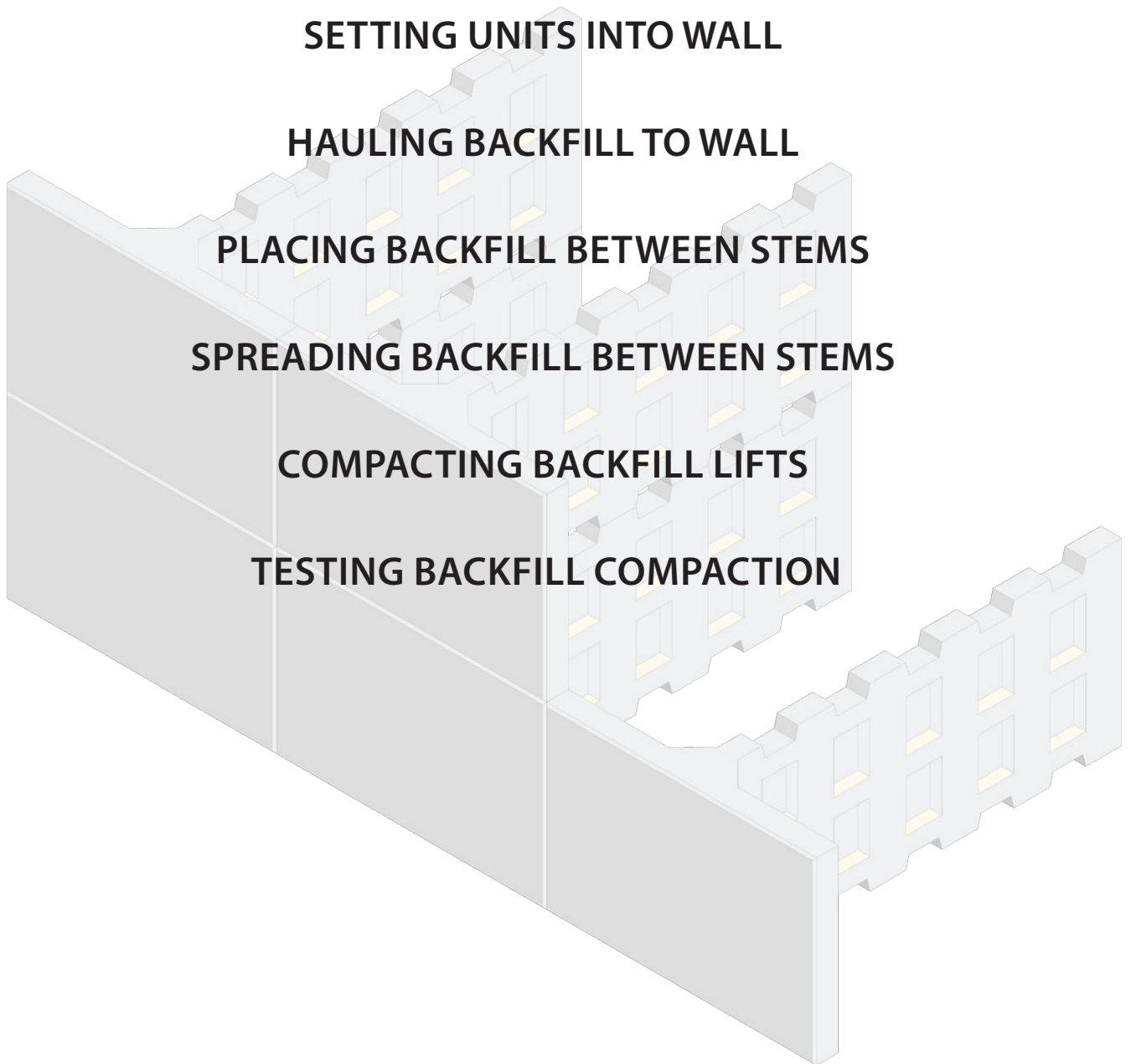
HAULING BACKFILL TO WALL

PLACING BACKFILL BETWEEN STEMS

SPREADING BACKFILL BETWEEN STEMS

COMPACTING BACKFILL LIFTS

TESTING BACKFILL COMPACTION



HAULING UNITS TO A WALL

Large semi-truck
averaging 4 to 5 units per load



Small flat bed truck
where access is restricted



Front end loader where
access is very restricted



SETTING UNITS IN PLACE

Excavator with slings
- working behind the wall



Excavator with lifting beam
- working in front of the wall



Large excavator with lifting beam
- on top of back-to-back walls

*Note the large timbers used to protect the top of the stems from the excavator's tracks



HAULING - PLACING – SPREADING OF BACKFILL

Front end loader



Rubber tracked skid steer loader spreading sand backfill between the stems.



Excavator – back-to-back walls



Excavator - working on top of a completed back-to-back wall



HAULING -PLACING AND SPREADING OF BACKFILL

Long boom excavator
– working in front of
the wall and working on top of the
back-to-back walls



Excavator with reversed bucket



Two excavators working at the same time -
one setting and one backfilling



HAULING - PLACING - SPREADING OF BACKFILL

Placing backfill with a telebelt



Placing backfill with a converted excavator placing conveyor

1. Front end loader fills hopper
2. First belt elevates material
3. Second belt swivels and places material between the stems of the T-WALL® units in even lifts



Placing backfill with a towed conveyor belt placing machine



COMPACTING LIFTS OF BACKFILL

Compacting with vibrating plate compactors

*Note water truck and hose for moisture control



Close-up of vibrating plate compactors working between stems.



Front view of large vibrating plate compactor



COMPACTING LIFTS OF BACKFILL

Articulated trench roller type compactor

A Rammax trench roller is very maneuverable and effective



Operator driven smooth drum vibrating compactor working between the stems.



Small jumping-jack type compactor



A nuclear density gauge is used to monitor compaction

Each lift should be tested



T-WALL® RETAINING WALL SYSTEM
From Concept to Completion

LARGE UNIT | 5' x 7'6"
RAILROAD CONSTRUCTION MANUAL

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