
V-PANEL ALUMINUM SYSTEM

OWNER'S MANUAL



July 2020

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For a full detailed assembly video visit our YouTube channel or click on the link below.

Video Link: https://youtu.be/g_PBIXYeJ9Q

SAFEGUARD SERIES – ALUMINUM TRENCH BOXES

The SafeGuard series lineup was designed to meet all of your shoring needs for maintenance and repairs. From lightweight equipment, that allows you to install by hand, to patented technology that allows you to effortlessly shore around multiple existing utilities.

With today's high demand for safety and versatility, Kundel has you covered.



SAFEGUARD SERIES

The V-Panel is part of Kundel's SafeGuard Series. This lightweight, modular solution offering customized vertical adjustment in the trench. Our patented V-Panel is the only aluminum extruded panel in the industry with 'on the fly' independent, vertical adjustment. It's ideal for congested utility areas. Each panel can be individually adjusted (up and down) without leaving the ditch to accommodate any pipe configuration.

The V-Panel Aluminum Shield System is an affordable modular-component system that is assembled by hand. The modular system consists of aluminum V-Panels, walers, and fixed or adjustable spreaders in a variety of lengths. These parts are fastened together using clamping mechanisms - creating a strong frame that is easily place into the trench.

Unassembled components stack away in a limited space giving you the opportunity to pick and choose the right stuff to quickly meet the job requirements. Therefore, you can actually change the length of your shoring equipment.

Each V-Panel kit comes with a two side frame consisting of (4 or 6) walers and numerous vertical aluminum panels. The width is determined by your choice of spreader beam length. Spreader beams come in a set of (4 or 6) including pins and keepers. Spreader beam adjusters and fixed length stuts. Other forms of panels are also available: TimberShor, Finn Form, and Ply-wood.

OSHA DEFINITIONS

What is A, B, and C Soil?

OSHA defines:

Type A Soil means:

Cohesive soils with an unconfined compressive strength of 1.5 tons per square foot (tsf) (144kPa) or greater. Examples of Cohesive soils are: clay, silty clay, sandy clay, clay loam and in some cases Silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil can be Type A if;

- (i) The soil is fissured ; or
- (ii) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
- (iii) The soil has been previously disturbed; or
- (iv) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or

The material is subject to other factors that would require it to be classified as less stable material.

Type B Soil means:

- (i) Cohesive soil with an unconfined compressive strength greater than .5 tsf (48 kPa), but less than 1.5 tsf (144 kPa) ; or
- (ii) Granular cohesionless solid including; angular gravel (similar to crushed rock), silt, silt loam and sandy loam and in some cases, silty clay loam and sandy clay loam.
- (iii) Previously disturbed soils except those which would otherwise be classified as Type "C" Soil.
- (iv) Soil that meets the unconfined compressive strength or cementation requirement for Type "A", but is fissured or subject to vibration; or
- (v) Dry rock that is not stable ; or

Material that is part of a slope, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H: 1V), but only if the material would otherwise be classified as Type "B".

Type C Soil means:

- (i) Cohesive soil with an unconfined compressive strength of .5 tsf (48 kPa) or less; or
- (ii) Granular soils including gravel, sand and loamy sand: or
- (iii) Submerged soil or soil from which water is freely seeping; or
- (iv) Submerged rock that is not stable; or
- (v) Material in a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H: 1V), or steeper.

CERTIFICATION SHEET - STANDARD/EXTRA CLEARANCE

Engineer's Statement: This certifies that the V-Panel System has been designed in accordance with the requirements and guidelines promulgated by the occupational safety and health administrations rules and regulations for construction standards for excavations (29) part 1926.650-.652 subpart P.

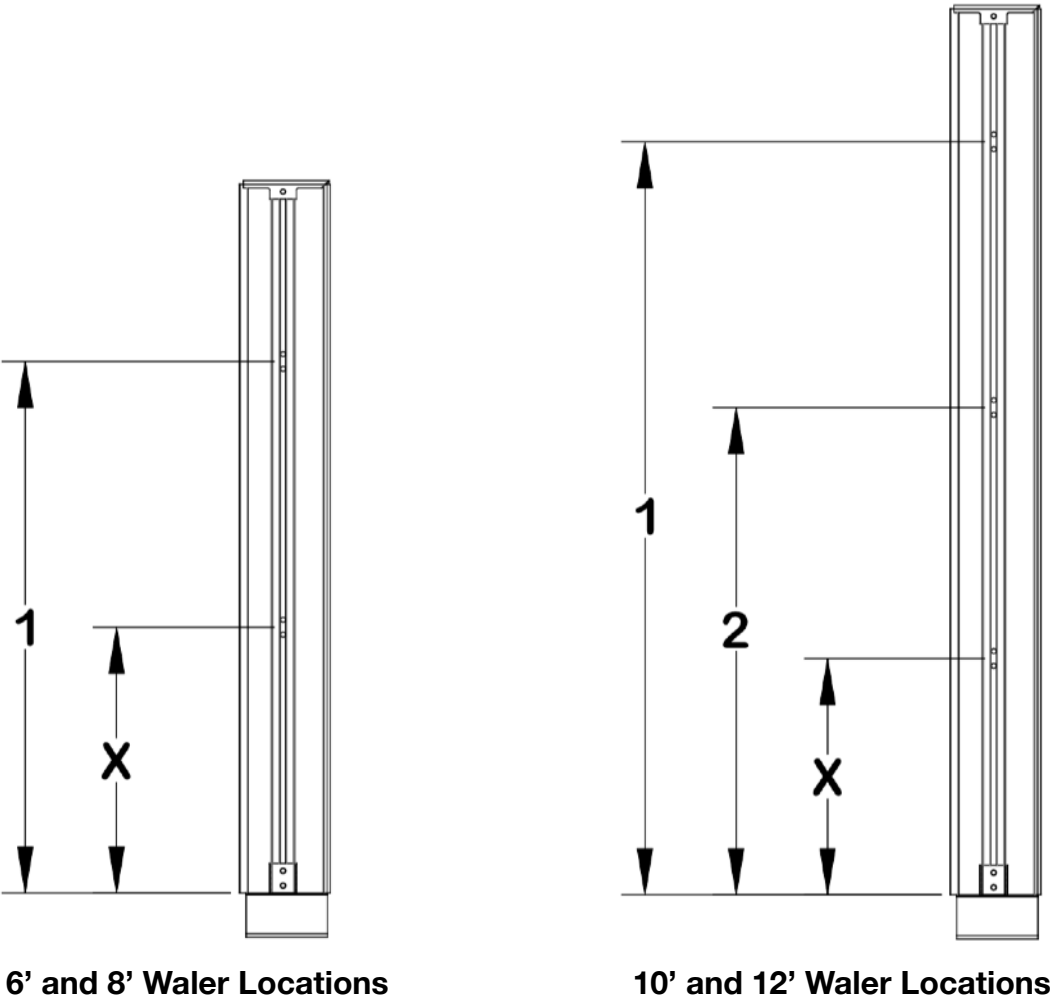
Michael J. Venetta, P.E.
Ohio Registration # E-46015
Henry Venetta, P.E.
Ohio Registration # E-25091



Manufacturer's Statement: Kundel Industries Inc. hereby certifies that all materials and processes involved in the manufacture of each and every V-Panel System strictly and stringently follow every material, production and design specification put forth by Venetta Engineering to ensure that each and every V-Panel System is in full accordance with the requirements and guidelines promulgated by the Occupational Safety and Health Administration.

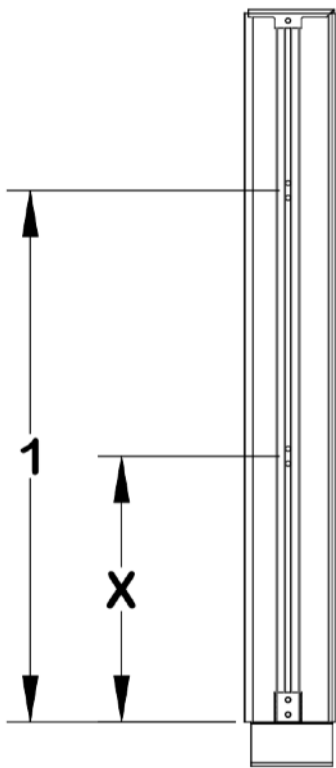
Robert Kundel, President
Kundel Industries, Inc.

Standard Waler Location - Depth Chart

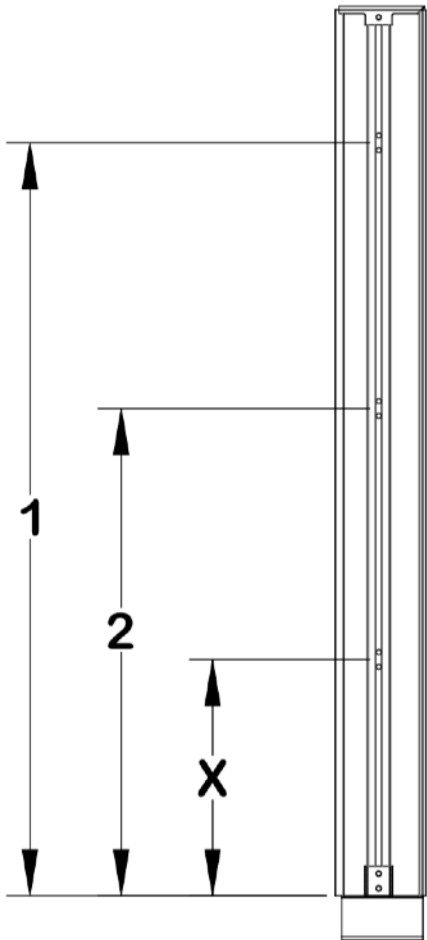


Pressure Rating & Allowable Loads							
Motel No.	Waler Locations			Allowable Pressure (PSF)	Depth Rating (FT)		
	"X"	2	1		A	B	C
VP - 6' X 6'	24"	n/a	60"	1740	69	39	29
VP - 6' X 8'	24"	n/a	60"	1320	52	29	22
VP - 6' X 10'	24"	n/a	60"	1020	40	23	17
VP - 6' X 12'	24"	n/a	60"	780	31	17	13
VP - 8' X 6'	36"	n/a	78"	1620	64	36	27
VP - 8' X 8'	36"	n/a	78"	1200	48	27	20
VP - 8' X 10'	36"	n/a	78"	900	36	20	15
VP - 8' X 12'	36"	n/a	78"	720	28	16	12
VP - 10' X 6'	32"	66"	102"	1740	69	39	29
VP - 10' X 8'	32"	66"	102"	1380	55	31	23
VP - 10' X 10'	32"	66"	102"	1080	43	24	18
VP - 10' X 12'	32"	66"	102"	840	33	19	14
VP - 12' X 6'	32"	78"	126"	1680	67	37	28
VP - 12' X 8'	32"	78"	126"	1260	50	28	21
VP - 12' X 10'	32"	78"	126"	1020	40	23	17
VP - 12' X 12'	32"	78"	126"	780	31	17	13
Maximum Allowable Strut Load:					18,000 lb.		

Raised Lower Water Locations - Depth Chart



6' and 8' Water Locations



10' and 12' Water Locations

Pressure Rating & Allowable Loads							
"X" (IN)	Waler Locations			Allowable Pressure (PSF)	Depth Rating (FT)		
	X	2	1		A	B	C
VP - 6' X 6'	24"	n/a	60"	1740	69	39	29
VP - 6' X 8'	24"	n/a	60"	1320	52	29	22
VP - 6' X 10'	24"	n/a	60"	1020	40	23	17
VP - 6' X 12'	24"	n/a	60"	780	31	17	13
VP - 8' X 6'	48"	n/a	78"	1620	40	22	17
VP - 8' X 8'	48"	n/a	78"	1200	40	22	17
VP -8' X 10'	48"	n/a	78"	900	31	17	13
VP - 8' X 12'	48"	n/a	78"	720	24	13	10
VP - 10' X 6'	44"	66"	102"	1740	45	25	19
VP - 10' X 8'	44"	66"	102"	1380	45	25	19
VP -10' X 10'	44"	66"	102"	1080	38	21	16
VP - 10' X 12'	32"	66"	102"	840	31	17	13
VP - 12' X 6'	44"	78"	126"	1680	45	25	19
VP - 12' X 8'	44"	78"	126"	1260	45	25	19
VP -12' X 10'	44"	78"	126"	1020	38	21	16
VP - 12' X 12'	44"	78"	126"	780	28	16	12
Maximum Allowable Strut Load:					18.000 lb.		

What you've purchased

Kundel's Support: Our support for our customer begins at purchase with the owner's manual. This manual provides critical real-world usage information designed to guide the user through the complexity of O.S.H.A.'s regulations. The manual allows our customer to put their boxes to use correctly and as quickly as possible. Our support continues with on-line technical support staff available to answer questions and solve problems particular to your situation.

Physical Support: Our boxes are designed and built to a level of quality that includes, **free standard features** that other manufactures would expect you to pay extra for. We design and build our boxes to a level of quality that includes the use of materials that will provide **maximum strength, durability, and integrity** over time. All Steel Construction **No Wood is ever used in Kundel boxes.** Wood has a tendency to degrade, weaken, and rot over time when exposed to the elements.

Certified to Stand On Their Own: This means that our boxes do not have to be "tied in" to the bottom of the excavation to provide the needed strength. This also allows all vertical protection to be used - not buried in the ground.

Finally, all steel components are painted "safety" orange to make it clearly visible and easy to spot. The painting also helps provide rust protection.

Aluminum Trench Boxes include:

- | | |
|---|---|
| 1. Certification: <ul style="list-style-type: none">i. <i>Exceeds O.S.H.A. requirements</i>ii. <i>Certification Plate with Serial Number</i>iii. <i>Owners Manual with tabulated data</i> | 4. Spreader Sockets <ul style="list-style-type: none">i. <i>SOLID cast sockets</i>ii. <i>Tapered for Racking</i>iii. <i>Steel surrounded</i> |
| 2. Push Pads <ul style="list-style-type: none">i. <i>Up to 1/2" Thick</i>ii. <i>Placed on corners of horizontal shield kits, or on the tops of each vertical panels.</i>iii. <i>Durability for EASY PUSHING</i> | 5. Panel Connectors <ul style="list-style-type: none">i. <i>High tensile strength steel</i>ii. <i>NO PINS</i>iii. <i>Reinforced</i> |
| 3. Stacking Lugs (on horizontal shields) <ul style="list-style-type: none">i. <i>Easy pin on design</i>ii. <i>SOLID steel connections</i>iii. <i>Inside the box for the operators safety</i> | 6. High Taper Bottom <ul style="list-style-type: none">i. <i>Up to 18" High</i>ii. <i>Tighter trench, SAVES bedding Material</i>iii. <i>EASY PIPE ALIGNMENT</i> |
| | 7. Lifting Rings <ul style="list-style-type: none">i. <i>Solid Steel Rings</i>ii. <i>Perfectly positioned</i>iii. <i>EASY HANDLING</i> |

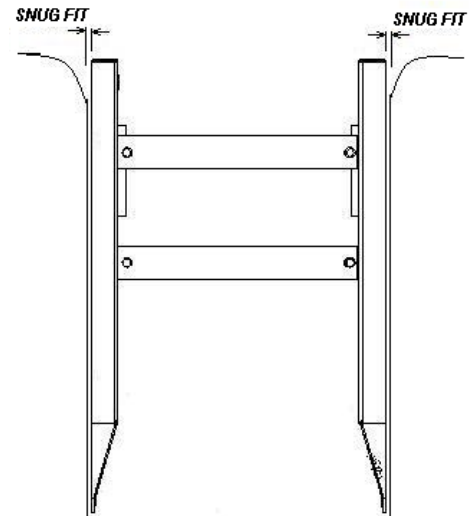
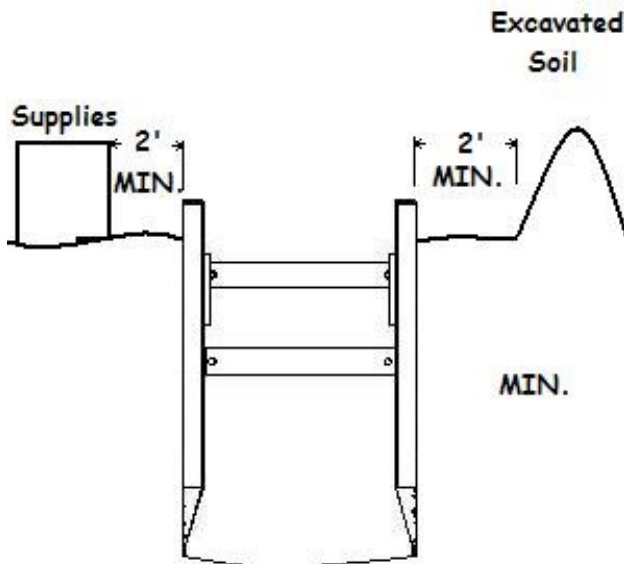
8. Engineering

- i. *Extruded Aluminum panels with steel connections*
- ii. *Engineered to perform*
- iii. *Lighter yet durable*

9. Racking

- i. *Corners move independently*
- ii. *Shields stay plum*
- iii. *Forged steel pins*

Safety Guidelines



Protect The Employees

The Trench Box should be kept 18" above ground level when equipment and material are stored outside the trench. Keep excavated soil materials or equipment a minimum of 2 feet away from the edge of the excavation.

Shield must be installed to restrict lateral or other hazardous movement.

OHSA ~ 1926.652 (g – 1, ii)



**IMPROPER USE OF THIS EQUIPMENT WILL RESULT
IN SERIOUS INJURY OR DEATH.**

- Before beginning to using this product please read the owners manual Entirely.
- Before beginning excavation, locate all utilities. Contact your locale utility company or call the National Call Before You Dig Hotline, 888-258-0808.
- Carefully assemble, and install your trench safety equipment to assure your safety while working in the trench.
- Be sure you have the proper Safety Equipment at all time. Do not enter the trench without protective helmet.
- For trench 4 feet and deeper, access ladders in protection area are required every 25 feet of lateral, to assure your safety.
- Be sure to properly barricade all areas around your excavation to protect anyone from falling into the excavation, and to warn all traffic that the trench exists.
- Close Proximity to heavy traffic, railroads, airports, buildings, and bodies of water. All of these situations can, and will create added pressure to trench walls. Consult a professional engineer, or call us for t.e.d. (Trench Engineer Division) for these or any special applications.
- DO NOT work in a excavation where water has accumulated or is accumulating.
- NEVER work beyond or go outside of protected trench area.
- NEVER stand or work beneath loads handled, lifting, or digging equipment.
- All Supplies and soil must be stored no closer than 2 feet from the walls of the trench.

FOLLOW ALL FEDERAL, OSHA, STATE, AND LOCAL REGULATIONS FOR THE PROPER USE OF THIS EQUIPMENT.

O.S.H.A. INDEX

This section is an index to O.S.H.A. definitions and terminology. It is taken directly from O.S.H.A.'s publication of Construction Standard for Excavations, with some additional explanations following some of the terminology. Knowledge of these terms is essential to understanding constructions work that deals with excavations and safety. These are the terms and concepts that are used every day by everyone from contractors to engineers to the manufacturers and dealers of safety equipment.

Note: The following applies to all open excavations made in the earth's surface. Excavations are defined to include trenches.

Terms:

Accepted engineering practices: those requirements, which are compatible with standards of practice, required by a registered professional engineer.

Aluminum Hydraulic Shoring: a pre-engineered shoring system comprised of aluminum hydraulic cylinder (cross braces) used in conjunction with vertical rails (uprights) or horizontal rails (walers). Such system is designed, specifically to support the sidewalls of an excavation and prevent cave-ins.

Bell-bottom pier hole: a type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a "belled" shape.

Benching (Benching System): a method of protection employees from cave-ins by excavation the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

Cave-in: the separation of a mass of soil or rock material from the side of an excavation, or the loss of from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or other wise injure and immobilize a person.

Competent person: on who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. **Specifically and additionally...** this person must be able to recognize hazardous trench/excavation conditions such as vibrations, cracking, spalling and sluffing soil, visual and manual tests of soil. This person must be able to make inspection of the excavations and recognize changes in conditions. If using tabulated data or a Registered Professional Engineer's design, this person must know installation, use and limitation requirements.

Cross braces: the horizontal members of a shoring installed perpendicular to the side of the excavation, the ends of which bear against either uprights or wales.

Excavation: any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

Face or sides: means the vertical or inclined earth surfaces formed as result of excavation work.

Failure: the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

Hazardous atmosphere: means an atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritation, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

Kickout: the accidental release or failure of a cross brace.

Protective system: a method of protection employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems, and other systems that provide the necessary protection.

Ramp: an inclined walking or working surface that is used to gain access to one point from another, and is constructed from earth or from structural materials such as steel or wood.

Registered Professional Engineer: a person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "Tabulated data" to be used in interstate commerce.

Sheeting: the members of a shoring system that retain the earth in position and in turn are supported by another member of the shoring system. A frame is set up and sheeting is driven or pre-driven into the ground as excavation proceeds. This type of shoring system is good for excavation work close to utilities.

Shield (Shield System): a structure that is able to withstand the forces imposed on it by a cave-in and thereby protects employees within the structure. Shields can be permanent structures or can be designed to be portable and move along as work progresses. A shielding system may still allow some ground movement. Restrictions - must protrude 18 inches above bottom of slope trench; no employee in box while being moved; the box can be held up only 2 feet above bottom of trench. Shields can be either pre-manufactured or job-built in accordance with O.S.H.A. 1926.652 (C)(3) or (C)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields." The box is inserted in the trench snugly and dragged along into the pre-excavated trench. (trench shields are used mostly in main line construction work.)

Shoring (Shoring System): a structure such as metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins. The sidewall of a shoring box can be adjusted out through the use of screw jacks or hydraulic jacks. Example 1: in A or B soil, the excavation is made first and the box is then inserted and the sidewalls extended to hold the ground from moving. This is a use for compaction or work near to existing utilities. Example 2: in C soil, the boxes are driven into the ground as the earth is excavated - this is known as "close excavation."

Sides: see "Faces"

Sloping (Sloping System): a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

Stable rock: natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

Structural ramp: a ramp built of steel or wood, usually used for vehicle access. Ramps made of soil or rock are not considered structural ramps.

Support system: a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

Tabulated data: tables and charts approved by a registered professional engineer and used to design, and construct a protective system.

Trench (Trench Excavation): a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structures to the side of the excavation to 15 feet (4.6 m) or less (measured at the bottom of the excavation), the excavation is also considered to be a trench.

Trench box: See "Shield"

Trench shield: See "Shield"

Upright: the vertical members of a trench shoring system placed in contact with the earth and usually positioned so that individual members do not contact each other. Uprights placed so that individual members are closely spaced, in contact with or interconnected to each other, are often called "Sheeting"

Wales: horizontal members of a shoring system placed parallel to the excavation face whose sides bear against the vertical members of the shoring system or earth.

Trench Shoring

Safety and Health Regulations for Construction, Excavations

- **Standard Number:** 1926.650
- **Standard Title:** Scope, application, and definitions applicable to this subpart.
- **SubPart Number:** P
- **SubPart Title:** Excavations

(a)

Scope and application. This subpart applies to all open excavations made in the earth's surface. Excavations are defined to include trenches.

(b)

Definitions applicable to this subpart.

"Accepted engineering practices" means those requirements which are compatible with standards of practice required by a registered professional engineer.

"Aluminum Hydraulic Shoring" means a pre-engineered shoring system comprised of aluminum hydraulic cylinders (cross-braces) used in conjunction with vertical rails (uprights) or horizontal rails (wales). Such system is designed specifically to support the sidewalls of an excavation and prevent cave-ins.

"Bell-bottom pier hole" means a type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a belled shape.

"Benching (Benching system)" means a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

"Cave-in" means the separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so

that it could entrap, bury, or otherwise injure and immobilize a person.

"Competent person" means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

"Cross braces" mean the horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or wales.

"Excavation" means any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

"Faces" or "sides" means the vertical or inclined earth surfaces formed as a result of excavation work.

"Failure" means the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

"Hazardous atmosphere" means an atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

"Kick-out" means the accidental release or failure of a cross brace.

"Protective system" means a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and

other systems that provide the necessary protection.

"Ramp" means an inclined walking or working surface that is used to gain access to one point from another, and is constructed from earth or from structural materials such as steel or wood.

"Registered Professional Engineer" means a person who is registered as a professional engineer in the state where the work is to be performed.

However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for

"manufactured protective systems" or "tabulated data" to be used in interstate commerce.

"Sheeting" means the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

"Shield (Shield system)" means a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either pre-manufactured or job-built in accordance with 1926.652(c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

"Shoring (Shoring system)" means a structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

"Sides". See "Faces."

"Sloping (Sloping system)" means a method of protecting

employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

"Stable rock" means natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer. "Structural ramp" means a ramp built of steel or wood, usually used for vehicle access. Ramps made of soil or rock are not considered structural ramps. "Support system" means a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

"Tabulated data" means tables and charts approved by a registered professional engineer and used to design and construct a protective system.

"Trench (Trench excavation)" means a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6 m) or less (measured at the bottom of the excavation), the excavation is also considered to be a trench.

"Trench box." See "Shield."

"Trench shield." See "Shield."

"Uprights" means the vertical members of a trench shoring system placed in contact with the earth and usually positioned so that individual members do not contact each other. Uprights placed so that individual members are closely spaced, in contact with or interconnected to each other, are often called "sheeting."

"Wales" means horizontal members of a shoring system placed parallel to the excavation face whose sides bear against the vertical members of the shoring system or earth.

- **Standard Number:** 1926.651
- **Standard Title:** Specific Excavation Requirements.
- **SubPart Number:** P
- **SubPart Title:** Excavations

Surface encumbrances. All surface encumbrances that are located so as to create a hazard to employees shall be removed or supported, as necessary, to safeguard employees.

(b)
(b)(1) Underground installations.

The estimated location of utility installations, such as sewer, telephone, fuel, electric, water lines, or any other underground installations that reasonably may be expected to be encountered during excavation work, shall be determined prior to opening an excavation.

(b)(2) Utility companies or owners shall be contacted within established or customary local response times, advised of the proposed work, and asked to establish the location of the utility underground installations prior to the start of actual excavation. When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours (unless a longer period is required by state or local law), or cannot establish the exact location of these

installations, the employer may proceed, provided the employer does so with caution, and provided detection equipment or other acceptable means to locate utility installations are used.

..1926.651(b)(3)

(b)(3)

When excavation operations approach the estimated location of underground installations, the exact location of the installations shall be determined by safe and acceptable means.

(b)(4)

While the excavation is open, underground installations shall be protected, supported or removed as necessary to safeguard employees.

(c)

Access and egress -

(c)(1)

Structural ramps.

(c)(1)(i)

Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person. Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design, and shall be constructed in accordance with the design.

(c)(1)(ii)

Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent displacement.

(c)(1)(iii)

Structural members used for ramps and runways shall be of uniform thickness.

(c)(1)(iv)

Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping.

..1926.651(c)(1)(v)

(c)(1)(v)

Structural ramps used in lieu of steps shall be provided with cleats or other surface

treatments of the top surface to prevent slipping.

(c)(2)

Means of egress from trench excavations. A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 feet (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) of lateral travel for employees.

(d)

Exposure to vehicular traffic. Employees exposed to public vehicular traffic shall be provided with, and shall wear, warning vests or other suitable garments marked with or made of reflectorized or high-visibility material.

(e)

Exposure to falling loads. No employee shall be permitted underneath loads handled by lifting or digging equipment. Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped, in accordance with 1926.601(b)(6), to provide adequate protection for the operator during loading and unloading operations.

..1926.651(f)

(f)

Warning system for mobile equipment. When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system shall be utilized such as barricades, hand or mechanical signals, or stop logs. If possible, the grade should be away from the excavation.

(g)

Hazardous atmospheres -

(g)(1)

Testing and controls. In addition to the requirements set forth in subparts D and E of this part (29

CFR 1926.50 - 1926.107) to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, the following requirements shall apply:

(g)(1)(i)

Where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation shall be tested before employees enter excavations greater than 4 feet (1.22 m) in depth.

(g)(1)(ii)

Adequate precautions shall be taken to prevent employee exposure to atmospheres containing less than 19.5 percent oxygen and other hazardous atmospheres. These precautions include providing proper respiratory protection or ventilation in accordance with subparts D and E of this part respectively.

(g)(1)(iii)

Adequate precaution shall be taken such as providing ventilation, to prevent employee exposure to an atmosphere containing a concentration of a flammable gas in excess of 20 percent of the lower flammable limit of the gas.

..1926.651(g)(1)(iv)

(g)(1)(iv)

When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted as often as necessary to ensure that the atmosphere remains safe.

(g)(2)

Emergency rescue equipment.

(g)(2)(i)

Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, shall be readily available where hazardous

atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment shall be attended when in use.

(g)(2)(ii)

Employees entering bell-bottom pier holes, or other similar deep and confined footing excavations, shall wear a harness with a lifeline securely attached to it. The lifeline shall be separate from any line used to handle materials, and shall be individually attended at all times while the employee wearing the lifeline is in the excavation.

(h)

Protection from hazards associated with water accumulation.

(h)(1)

Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.

..1926.651(h)(2)

(h)(2)

If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations shall be monitored by a competent person to ensure proper operation.

(h)(3)

If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Excavations subject to runoff

from heavy rains will require an inspection by a competent person and compliance with paragraphs (h)(1) and (h)(2) of this section.

(i)
Stability of adjacent structures.

(i)(1)
Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

(i)(2)
Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted except when:

(i)(2)(i)
A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure; or

(i)(2)(ii)
The excavation is in stable rock; or

..1926.651(i)(2)(iii)

(i)(2)(iii)
A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity; or

(i)(2)(iv)
A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.

(i)(3)
Sidewalks, pavements and appurtenant structure shall not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

(j)
Protection of employees from loose rock or soil.

(j)(1)
Adequate protection shall be provided to protect employees

from loose rock or soil that could pose a hazard by falling or rolling from an excavation face. Such protection shall consist of scaling to remove loose material; installation of protective barricades at intervals as necessary on the face to stop and contain falling material; or other means that provide equivalent protection.

..1926.651(j)(2)

(j)(2)
Employees shall be protected from excavated or other materials or equipment that could pose a hazard by falling or rolling into excavations. Protection shall be provided by placing and keeping such materials or equipment at least 2 feet (.61 m) from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary.

(k)
Inspections.

(k)(1)
Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.

(k)(2)
Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees shall be removed from the

hazardous area until the necessary precautions have been taken to ensure their safety.

(l)
Fall protection.

(l)(1)
Walkways shall be provided where employees or equipment are required or permitted to cross over excavations. Guardrails which comply with 1926.502(b) shall be provided where walkways are 6 feet (1.8 m) or more above lower levels. [59 FR 40730, Aug 9, 1994]

- **Standard Number:** 1926.652
- **Standard Title:** Requirements for protective systems.
- **SubPart Number:** P
- **SubPart Title:** Excavations

a)
Protection of employees in excavations.

(a)(1)
Each employee in an excavation shall be protected from cave-ins by an adequate protective system designed in accordance with paragraph (b) or (c) of this section except when:

(a)(1)(i)
Excavations are made entirely in stable rock; or

(a)(1)(ii)
Excavations are less than 5 feet (1.52 m) in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

(a)(2)
Protective systems shall have the capacity to resist without failure all loads that are intended or could reasonably be expected to be applied or transmitted to the system.

..1926.652(b)

(b)
Design of sloping and benching systems. The slopes and configurations of sloping and benching systems shall be selected and constructed by the employer or his designee and shall be in accordance with the

requirements of paragraph (b)(1); or, in the alternative, paragraph (b)(2); or, in the alternative, paragraph (b)(3); or, in the alternative, paragraph (b)(4), as follows:

(b)(1)

Option (1) - Allowable configurations and slopes.

(b)(1)(i)

Excavations shall be sloped at an angle not steeper than one and one-half horizontal to one vertical (34 degrees measured from the horizontal), unless the employer uses one of the other options listed below.

(b)(1)(ii)

Slopes specified in paragraph (b)(1)(i) of this section, shall be excavated to form configurations that are in accordance with the slopes shown for Type C soil in Appendix B to this subpart.

(b)(2)

Option (2) - Determination of slopes and configurations using Appendices A and B. Maximum allowable slopes, and allowable configurations for sloping and benching systems, shall be determined in accordance with the conditions and requirements set forth in appendices A and B to this subpart.

(b)(3)

Option (3) - Designs using other tabulated data.

(b)(3)(i)

Designs of sloping or benching systems shall be selected from and in accordance with tabulated data, such as tables and charts.

(b)(3)(ii)

The tabulated data shall be in written form and shall include all of the following:

..1926.652(b)(3)(ii)(A)

(b)(3)(ii)(A)

Identification of the parameters that affect the selection of a sloping or benching system drawn from such data;

(b)(3)(ii)(B)

Identification of the limits of use of the data, to include the magnitude and configuration of slopes determined to be safe;

(b)(3)(ii)(C)

Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

(b)(3)(iii)

At least one copy of the tabulated data which identifies the registered professional engineer who approved the data, shall be maintained at the job-site during construction of the protective system. After that time the data may be stored off the job-site, but a copy of the data shall be made available to the Secretary upon request.

(b)(4)

Option (4) - Design by a registered professional engineer.

(b)(4)(i)

Sloping and benching systems not utilizing Option (1) or Option (2) or Option (3) under paragraph (b) of this section shall be approved by a registered professional engineer.

(b)(4)(ii)

Designs shall be in written form and shall include at least the following:

(b)(4)(ii)(A)

The magnitude of the slopes that were determined to be safe for the particular project;

..1926.652(b)(4)(ii)(B)

(b)(4)(ii)(B)

The configurations that were determined to be safe for the particular project;

(b)(4)(ii)(C)

The identity of the registered professional engineer approving the design.

(b)(4)(iii)

At least one copy of the design shall be maintained at the job-site while the slope is being constructed. After that time the design need not be at the job-site, but a copy shall be made available to the Secretary upon request.

(c)

Design of support systems, shield systems, and other protective systems. Designs of support systems, shield systems, and other protective systems shall be selected and constructed by the employer or

his designee and shall be in accordance with the requirements of paragraph (c)(1); or, in the alternative, paragraph (c)(2); or, in the alternative, paragraph (c)(3); or, in the alternative, paragraph (c)(4) as follows:

(c)(1)

Option (1) - Designs using appendices A, C and D. Designs for timber shoring in trenches shall be determined in accordance with the conditions and requirements set forth in appendices A and C to this subpart. Designs for aluminum hydraulic shoring shall be in accordance with paragraph (c)(2) of this section, but if manufacturer's tabulated data cannot be utilized, designs shall be in accordance with appendix D.

..1926.652(c)(2)

(c)(2)

Option (2) - Designs Using Manufacturer's Tabulated Data.

(c)(2)(i)

Design of support systems, shield systems, or other protective systems that are drawn from manufacturer's tabulated data shall be in accordance with all specifications, recommendations, and limitations issued or made by the manufacturer.

(c)(2)(ii)

Deviation from the specifications, recommendations, and limitations issued or made by the manufacturer shall only be allowed after the manufacturer issues specific written approval.

(c)(2)(iii)

Manufacturer's specifications, recommendations, and limitations, and manufacturer's approval to deviate from the specifications, recommendations, and limitations shall be in written form at the job-site during construction of the protective system. After that time this data may be stored off the job-site, but a copy shall be made available to the Secretary upon request.

(c)(3)

Option (3) - Designs using other tabulated data.

(c)(3)(i)

Designs of support systems, shield systems, or other protective systems shall be selected from and be in accordance with tabulated data, such as tables and charts.

(c)(3)(ii)

The tabulated data shall be in written form and include all of the following:

(c)(3)(ii)(A)

Identification of the parameters that affect the selection of a protective system drawn from such data;

..1926.652(c)(3)(ii)(B)

(c)(3)(ii)(B)

Identification of the limits of use of the data;

(c)(3)(ii)(C)

Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

(c)(3)(iii)

At least one copy of the tabulated data, which identifies the registered professional engineer who approved the data, shall be maintained at the job-site during construction of the protective system. After that time the data may be stored off the job-site, but a copy of the data shall be made available to the Secretary upon request.

(c)(4)

Option (4) - Design by a registered professional engineer.

(c)(4)(i)

Support systems, shield systems, and other protective systems not utilizing Option 1, Option 2 or Option 3, above, shall be approved by a registered professional engineer.

(c)(4)(ii)

Designs shall be in written form and shall include the following:

(c)(4)(ii)(A)

A plan indicating the sizes, types, and configurations of the materials to be used in the protective system; and

(c)(4)(ii)(B)

The identify of the registered professional engineer approving the design.

..1926.652(c)(4)(iii)

(c)(4)(iii)

At least one copy of the design shall be maintained at the job-site during construction of the protective system. After that time, the design may be stored off the job-site, but a copy of the design shall be made available to the Secretary upon request.

(d)

Materials and equipment.

(d)(1)

Materials and equipment used for protective systems shall be free from damage or defects that might impair their proper function.

(d)(2)

Manufactured materials and equipment used for protective systems shall be used and maintained in a manner that is consistent with the recommendations of the manufacturer, and in a manner that will prevent employee exposure to hazards.

(d)(3)

When material or equipment that is used for protective systems is damaged, a competent person shall examine the material or equipment and evaluate its suitability for continued use. If the competent person cannot assure the material or equipment is able to support the intended loads or is otherwise suitable for safe use, then such material or equipment shall be removed from service, and shall be evaluated and approved by a registered professional engineer before being returned to service.

(e)

Installation and removal of support -

(e)(1)

General.

(e)(1)(i)

Members of support systems shall be securely connected together to prevent sliding, falling, kick-outs, or other predictable failure.

..1926.652(e)(1)(ii)

(e)(1)(ii)

Support systems shall be installed and removed in a manner that protects employees from cave-ins, structural collapses, or from being struck by members of the support system.

(e)(1)(iii)

Individual members of support systems shall not be subjected to loads exceeding those which those members were designed to withstand.

(e)(1)(iv)

Before temporary removal of individual members begins, additional precautions shall be taken to ensure the safety of employees, such as installing other structural members to carry the loads imposed on the support system.

(e)(1)(v)

Removal shall begin at, and progress from, the bottom of the excavation. Members shall be released slowly so as to note any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation.

(e)(1)(vi)

Backfilling shall progress together with the removal of support systems from excavations.

..1926.652(e)(2)

(e)(2)

Additional requirements for support systems for trench excavations.

(e)(2)(i)

Excavation of material to a level no greater than 2 feet (.61 m) below the bottom of the members of a support system shall be permitted, but only if the system is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the support system.

(e)(2)(ii)

Installation of a support system shall be closely coordinated with the excavation of trenches.

(f)

Sloping and benching systems. Employees shall not be permitted to work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment.

(g)

Shield systems -

(g)(1)

General.

(g)(1)(i)

Shield systems shall not be subjected to loads exceeding those which the system was designed to withstand.

(g)(1)(ii)

Shields shall be installed in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

(g)(1)(iii)

Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields.

..1926.652(g)(1)(iv)

(g)(1)(iv)

Employees shall not be allowed in shields when shields are being installed, removed, or moved vertically.

(g)(2)

Additional requirement for shield systems used in trench excavations. Excavations of earth material to a level not greater than 2 feet (.61 m) below the bottom of a shield shall be permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the shield.

- **Standard Number:** 1926 Subpart P
- **Standard Title:** Authority for 1926 Subpart P
- **SubPart Number:** P
- **SubPart Title:** Excavations

AUTHORITY: Sec. 107, Contract Worker Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); Secs. 4, 6, 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12-71 (36 FR 8754), 8-76 (41 FR 25059), 9-83 (48 FR 35736), or 1-90 (55 FR 9033), as applicable.

Section 1926.651 also issued under 29 CFR Part 1911.

SOURCE: 54 FR 45959, Oct. 31, 1989, unless otherwise noted. [59 FR 40730, Aug. 9, 1994]

- **Standard Number:** 1926 Subpart P App A
- **Standard Title:** Soil Classification
- **SubPart Number:** P
- **SubPart Title:** Excavations

a) Scope and application - (1) Scope. This appendix describes a method of classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils.

(2) Application. This appendix applies when a sloping or benching system is designed in accordance with the requirements set forth in 1926.652(b)(2) as a method of protection for employees from cave-ins. This appendix also applies when timber shoring for excavations is designed as a method of protection from cave-ins in accordance with appendix C to subpart P of part 1926, and when aluminum hydraulic shoring is designed in accordance with appendix D. This Appendix also applies if other protective systems are designed and selected for use from data prepared in accordance with the requirements set forth in 1926.652(c), and the use of the

data is predicated on the use of the soil classification system set forth in this appendix.

(b) Definitions. The definitions and examples given below are based on, in whole or in part, the following; American Society for Testing Materials (ASTM) Standards D653-85 and D2488; The Unified Soils Classification System; The U.S. Department of Agriculture (USDA) Textural Classification Scheme; and The National Bureau of Standards Report BSS-121.

"Cemented soil" means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.

"Cohesive soil" means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical side-slopes, and is plastic when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay and organic clay.

"Dry soil" means soil that does not exhibit visible signs of moisture content.

"Fissured" means a soil material that has a tendency to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as

tension cracks, in an exposed surface.

"Granular soil" means gravel, sand, or silt (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

"Layered system" means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.

"Moist soil" means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

"Plastic" means a property of a soil which allows the soil to be deformed or molded without cracking, or appreciable volume change.

"Saturated soil" means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or shear vane.

"Soil classification system" means, for the

purpose of this subpart, a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B, and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the characteristics of the deposits and the environmental conditions of exposure.

"Stable rock" means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

"Submerged soil" means soil which is underwater or is free seeping.

"Type A" means cohesive soils with an unconfined, compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam.

Cemented soils such as caliche and hardpan are also considered Type A.

However, no soil is Type A if:

(i) The soil is fissured; or

(ii) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or

(iii) The soil has been previously disturbed; or

(iv) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or

(v) The material is subject to other factors that would require it to be classified as a less stable material.

"Type B" means:

(i) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or

(ii) Granular cohesionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.

(iii) Previously disturbed soils except those which would otherwise be classed as Type C soil.

(iv) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or

(v) Dry rock that is not stable; or

(vi) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope

less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

"Type C" means:

(i) Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or

(ii) Granular soils including gravel, sand, and loamy sand; or

(iii) Submerged soil or soil from which water is freely seeping; or

(iv) Submerged rock that is not stable, or

(v) Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper.

"Unconfined compressive strength" means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing, or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

"Wet soil" means soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

(c) Requirements - (1)

Classification of soil and rock deposits. Each soil and rock deposit shall be classified by a competent person as Stable Rock, Type A, Type B, or Type C in accordance with the definitions set forth in paragraph (b) of this appendix.

(2) Basis of classification. The classification of the deposits shall be made based on the results of at least one visual and at least one manual analysis. Such analyses shall be conducted by a competent person using tests described in paragraph (d) below, or in other recognized methods of soil classification and testing such as those adopted by the American Society for Testing Materials, or the U.S.

Department of Agriculture textural classification system.

(3) Visual and manual analyses. The visual and manual analyses, such as those noted as being acceptable in paragraph (d) of this appendix, shall be designed and conducted to provide sufficient quantitative and qualitative information as may be necessary to identify properly the properties, factors, and conditions affecting the classification of the deposits.

(4) Layered systems. In a layered system, the system shall be classified in accordance with its weakest layer. However, each layer may be classified individually where a more stable layer lies under a less stable layer.

(5) Reclassification. If, after classifying a deposit, the properties, factors, or conditions affecting its classification change in any way, the changes shall be evaluated by a competent person. The deposit shall be reclassified as necessary to reflect the changed circumstances.

(d) Acceptable visual and manual tests. - (1) Visual tests. Visual analysis is conducted to determine qualitative information regarding the excavation site in general, the soil adjacent to the

excavation, the soil forming the sides of the open excavation, and the soil taken as samples from excavated material.

(i) Observe samples of soil that are excavated and soil in the sides of the excavation. Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil that is primarily composed of fine-grained material is cohesive material. Soil composed primarily of coarse-grained sand or gravel is granular material.

(ii) Observe soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular.

(iii) Observe the side of the opened excavation and the surface area adjacent to the excavation. Crack-like openings such as tension cracks could indicate fissured material. If chunks of soil spall off a vertical side, the soil could be fissured. Small spalls are evidence of moving ground and are indications of potentially hazardous situations.

(iv) Observe the area adjacent to the excavation and the excavation itself for evidence of existing utility and other underground structures, and to identify previously disturbed soil.

(v) Observe the opened side of the excavation to identify layered systems. Examine layered systems to identify if the layers slope toward the excavation. Estimate the degree of slope of the layers.

(vi) Observe the area adjacent to the excavation and the sides of the opened excavation for evidence of surface water, water seeping from the sides of the excavation, or the location of the level of the water table.

(vii) Observe the area adjacent to the excavation and the area within the excavation for sources of vibration that may affect the stability of the excavation face.

(2) Manual tests. Manual analysis of soil samples is conducted to determine quantitative as well as qualitative properties of soil and to provide more information in order to classify soil properly.

(i) Plasticity. Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as 1/8-inch in diameter. Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two inch (50 mm) length of 1/8-inch thread can be held on one end without tearing, the soil is cohesive.

(ii) Dry strength. If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder, it is granular (any combination of gravel, sand, or silt). If the soil is dry and falls into clumps which break up into smaller clumps, but the smaller clumps can only be broken up with difficulty, it may be clay in any combination with gravel, sand or silt. If the dry soil breaks into clumps which do not break up into small clumps and which can only be broken with difficulty, and there is no visual indication the soil is fissured, the soil may be considered unfissured.

(iii) Thumb penetration. The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. (This test is based on the thumb penetration test described in American Society for Testing and Materials (ASTM) Standard designation D2488 - "Standard Recommended Practice for Description of Soils (Visual - Manual Procedure).") Type A soils with an unconfined compressive strength of 1.5 tsf can be readily indented by the thumb; however, they can be penetrated by the thumb only with very great effort. Type C soils with an unconfined compressive strength of 0.5 tsf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure. This test should be conducted on an undisturbed soil sample, such

as a large clump of spoil, as soon as practicable after excavation to keep to a minimum the effects of exposure to drying influences. If the excavation is later exposed to wetting influences (rain, flooding), the classification of the soil must be changed accordingly.

(iv) Other strength tests. Estimates of unconfined compressive strength of soils can also be obtained by use of a pocket penetrometer or by using a hand-operated shearvane.

(v) Drying test. The basic purpose of the drying test is to differentiate between cohesive material with fissures, unfissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil that is approximately one inch thick (2.54 cm) and six inches (15.24 cm) in diameter until it is thoroughly dry:

(A) If the sample develops cracks as it dries, significant fissures are indicated.

(B) Samples that dry without cracking are to be broken by hand. If considerable force is necessary to break a sample, the soil has significant cohesive material content. The soil can be classified as an unfissured cohesive material and the unconfined compressive strength should be determined.

(C) If a sample breaks easily by hand, it is either a fissured cohesive material or a granular material. To distinguish between the two, pulverize the dried clumps of the sample by hand or by stepping on them. If the clumps do not pulverize easily, the material is cohesive with fissures. If they pulverize easily into very small fragments, the material is granular.

you OSHA hand book for further information pertaining to you job. Kundel Industries, Inc. makes no claim concerning the implementation of these regulations

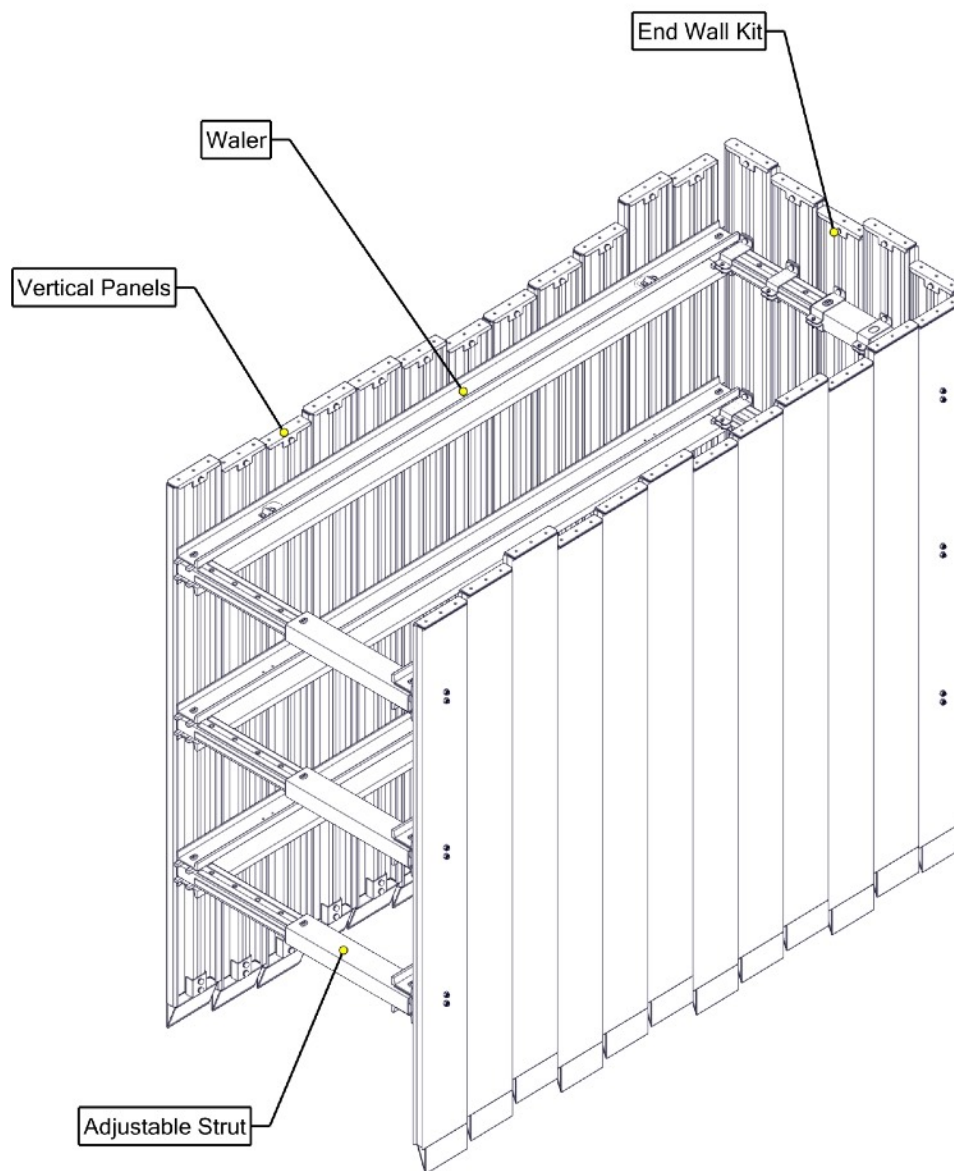
Note: Above information is a reprint of OSHA regulation. This is only a small portion OSHA Regulations. You should refer to

V-Panel Assembly Instructions

The Following illustrations are only guidelines, that is, intended to provide an outline for the use of Kundel V-Panel Shield. These items may not apply to all situations, and the illustrations themselves may not exactly reflect the dimensions or all aspects (options, design differences, etc.) of your particular system.

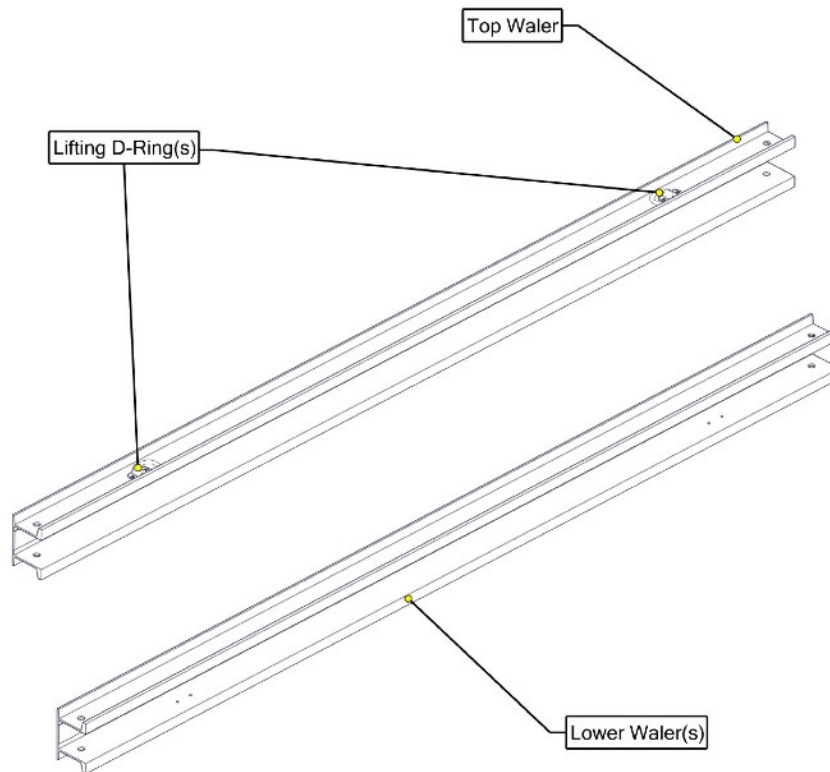
Structural Components

Here's a list of basic components and the break down of the subcomponents.



V-Panel Aluminum Waler - used for support the independent aluminum planks and maintain the required separation between components to help maintain the form of the hole while working in the trench/hole.

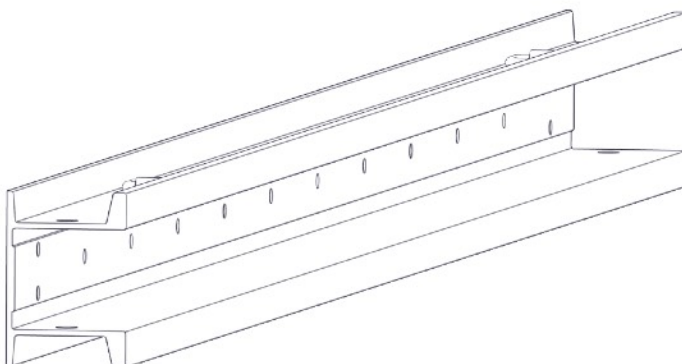
There are two different types walers sections for the V-Panel System.



Each system comes with 2 - **Top Walers** that includes 2 - D-Rings each for lifting the system in and out of the trench/hole with a four-legged sling.

Each system also comes with an additional pair(s) of **Lower Walers** based on the height of the system.

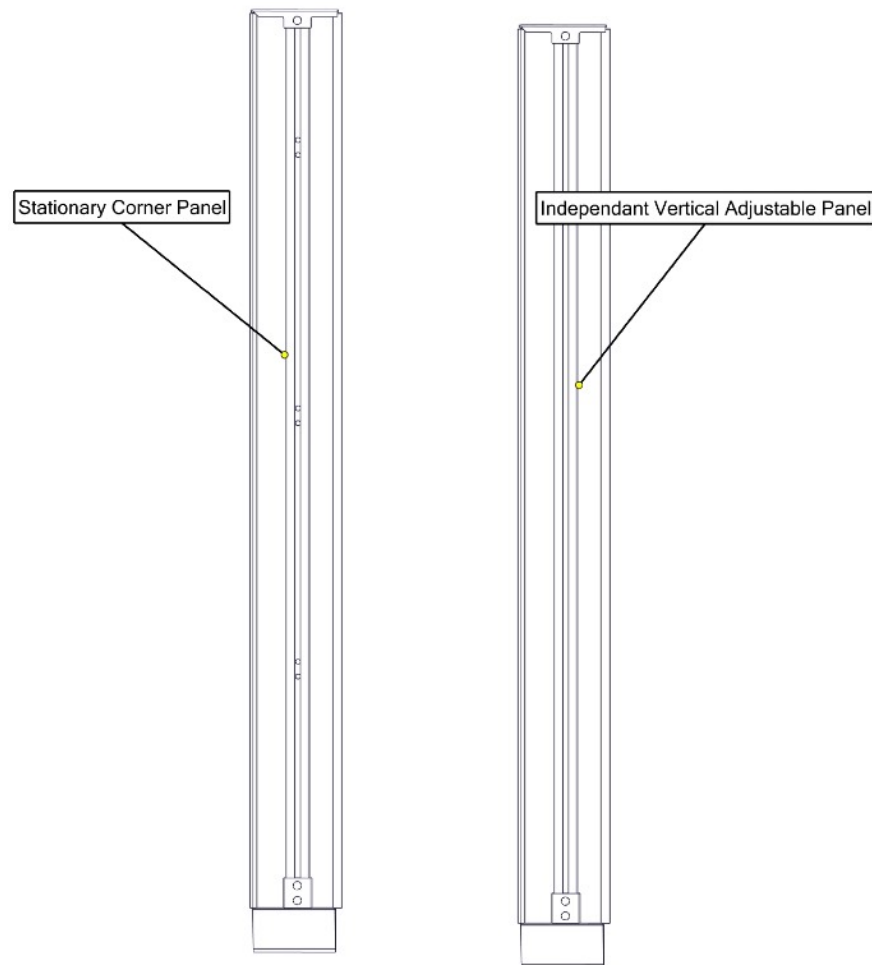
6' and 8' tall V-Panel systems come with 4-total walers, and 10' and 12' tall systems come with 6-total walers.



Each waler comes with a series of holes to attach the vertical panels

V-Panel Vertical Panels - the panels are independently attached to the outside of the walers as a liner to support the surrounding loads from entering the work area of the trench/hole. The panels are independently adjustable to make way for crossing utilities.

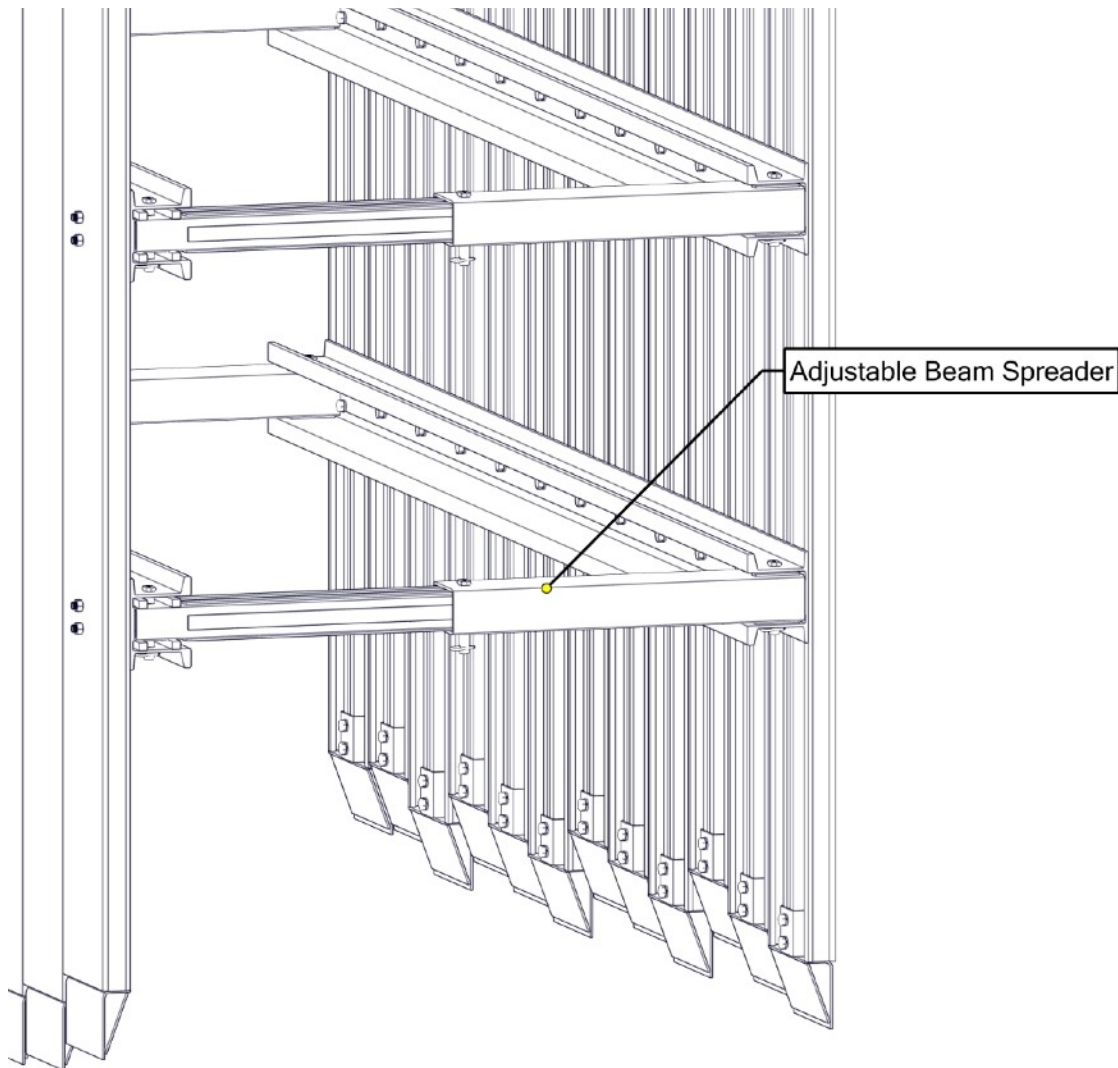
There are two different types of Vertical Panels



Each system comes with 4-**Stationary Corner Panels**, where they are used to keep the walers uniformly spaced for a fixed ridged box. These panels will have a series of holes down the center of them fastened to the horizontal walers.

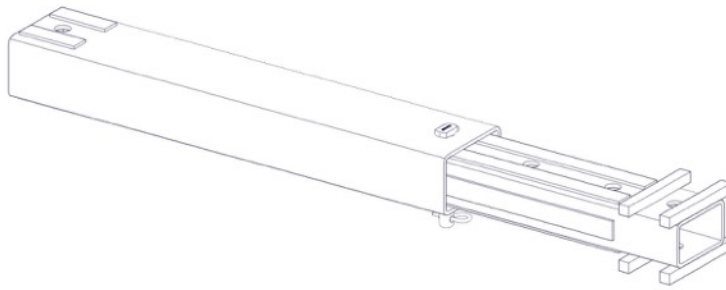
Each system also comes with a series of **Independent Vertical Adjustable Panels**. The design behind the panels is to independently slide up and down by simply loosening or tightening the panel clamps to adjust its elevation. The independent movement allows for adjustment vertically for crossing utilities without exposing large areas of the trench/hole, allowing the soil to flow into the work area.

Adjustable Beam Spreader - telescope steel adjustable spreaders, are intended to be used to support the V-Panel System walls when pinned to the Aluminum Walers.



Together they help support the surrounding soil from spilling in and injuring those inside the work area.

Available Adjustable Spreaders

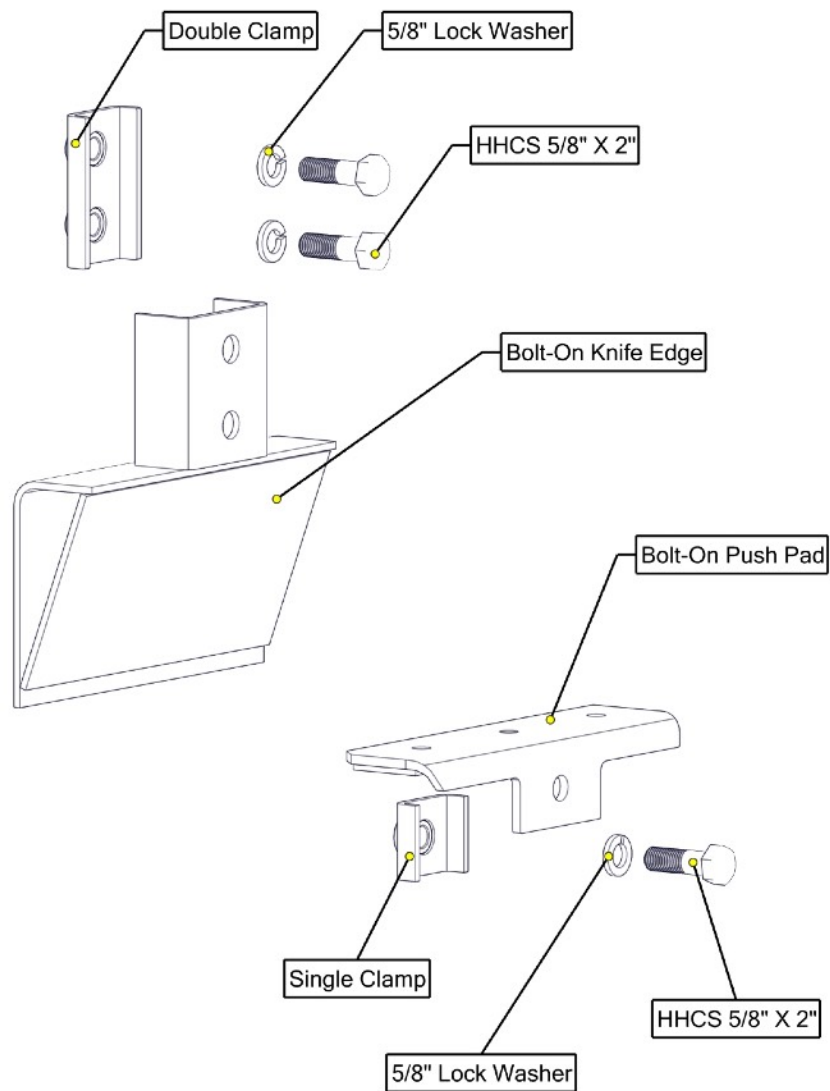


These adjustable beam spreaders come in a variety of sizes. The lower number is when the spreaders are collapsed fully, and the top number is once the inner tube is at the max extension. The range of the spreader adjustments is in 6" increments.

Adjustable Beam Spreader Sizes
17" / 27"
22" / 36"
25" / 42"
34" / 56"
40" / 64"
52" / 88"
96" Fixed Beam Spreader
120" Fixed Beam Spreader

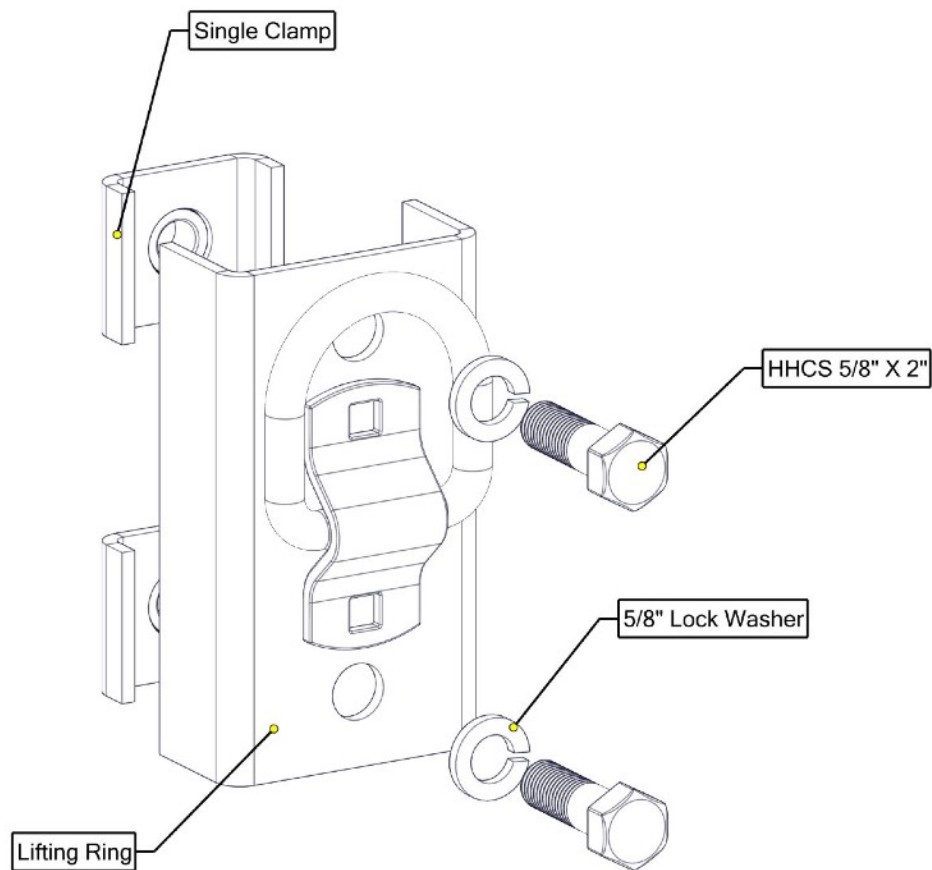
Individual Sub-Components

Knife Edge & Push Pad Assembly Components



Both the Knife Edge and Push Pad come pre-assembled on every vertical panel when shipped from the manufacture.

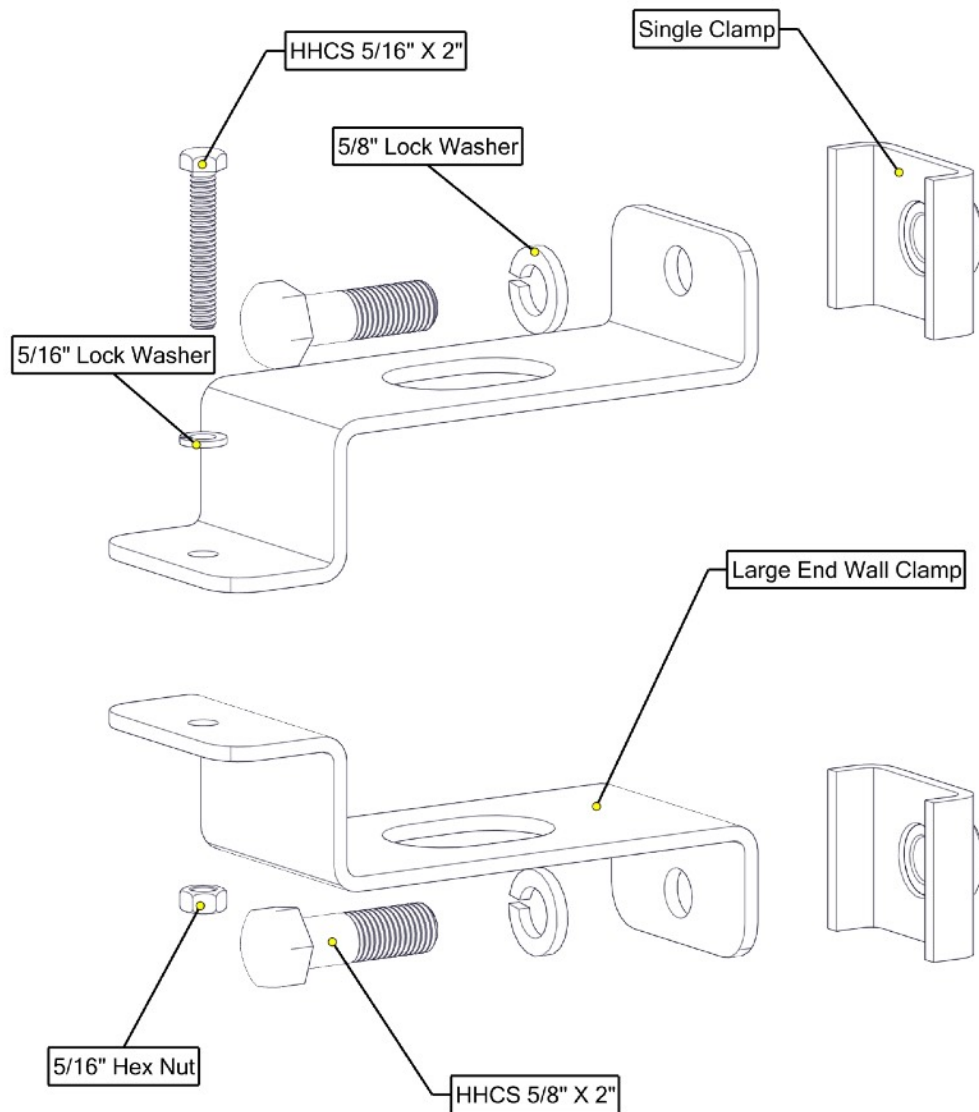
Panel Lifter Ring Assembly Components



Each V-Panel Kit comes with two **Panel Lifting Ring** Assemblies. The ring is designed to be attached to individual vertical panels that need lifting out of the way crossing utilities.

- Removal of push pad is required for installation

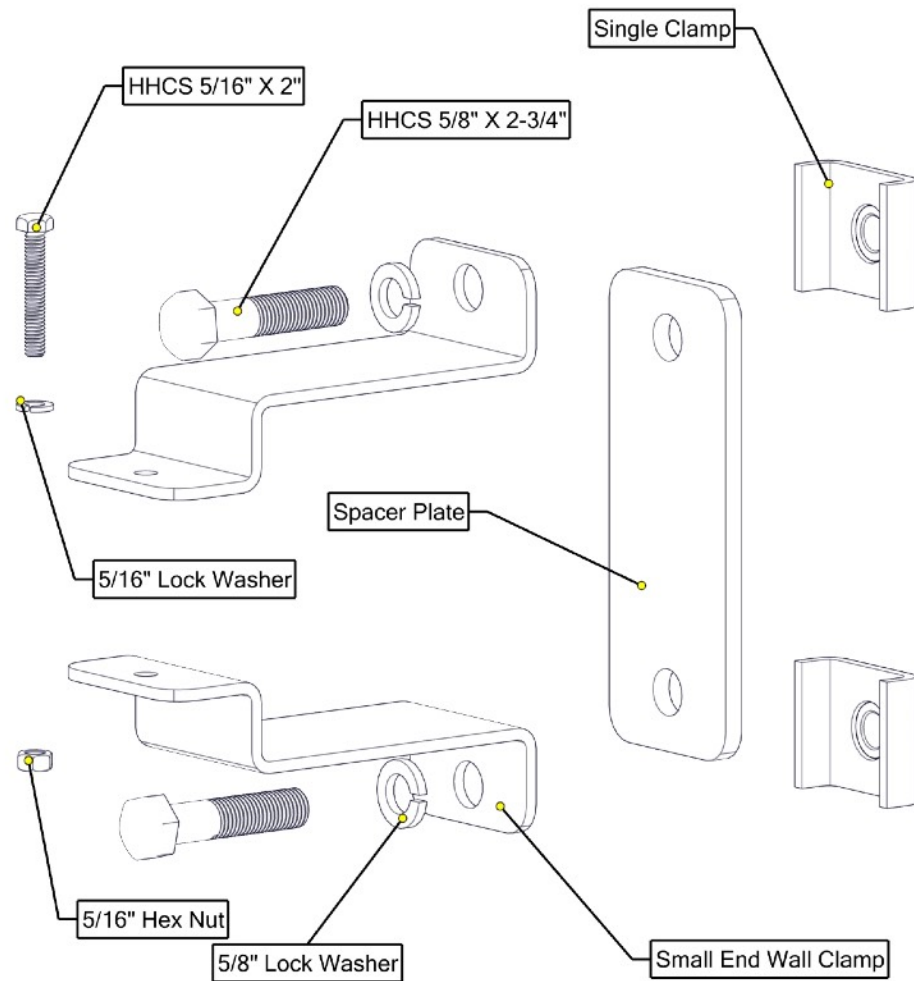
End Wall Large Clamp Assembly Components



When you purchase an **End Wall Kit**, with your V-Panel system it comes with a group of two different types of end wall clamps. These clamps are designed to clamp around each Adjustable Beam Spreaders and bolt onto the individual vertical panels.

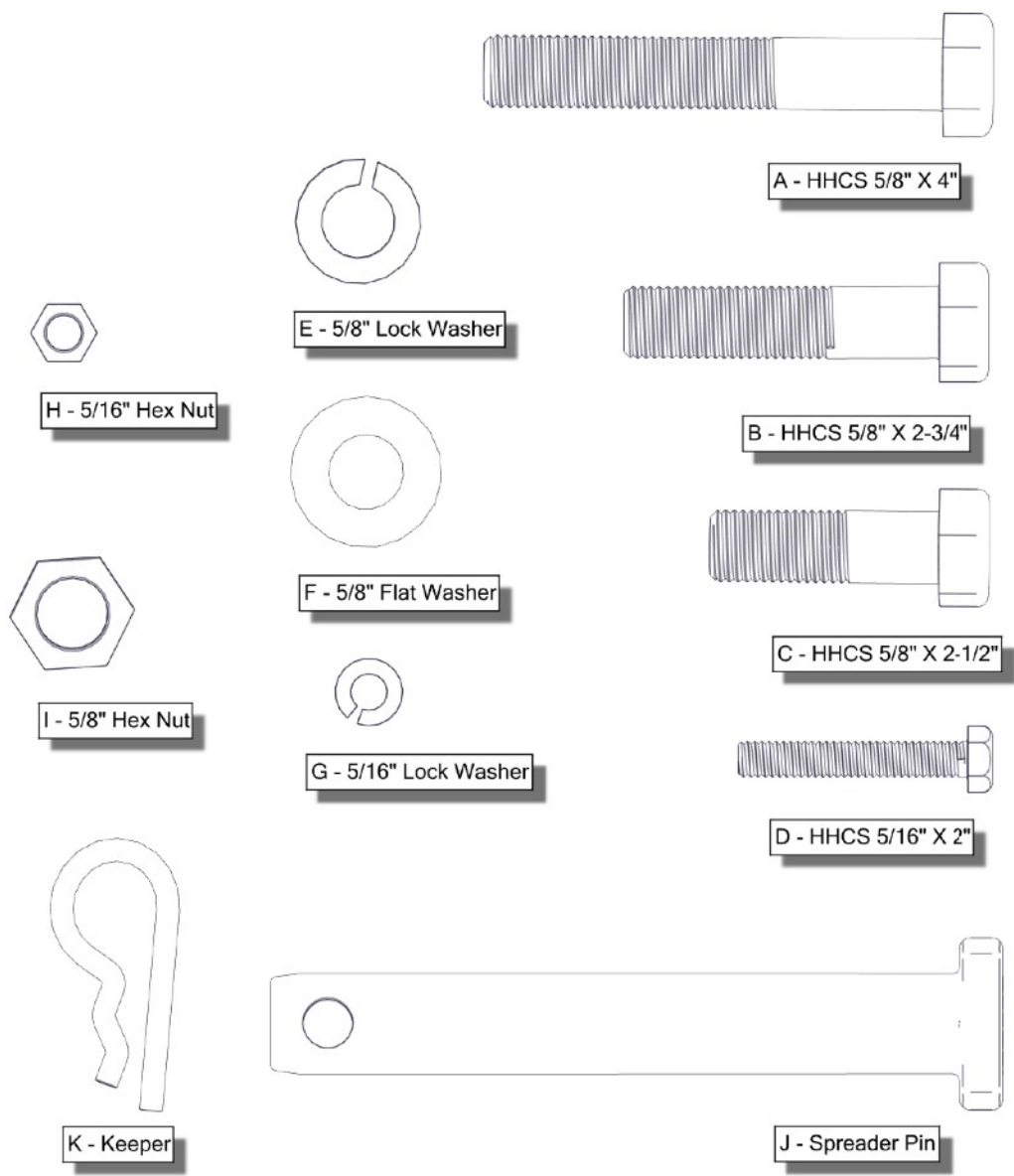
The Large End Wall Clamp Assembly is designed to be clamped onto the outer sleeve of the adjustable beam spreader.

End Wall Small Clamp Assembly Components



The Small End Wall Clamp Assembly is designed to be clamped onto the inner sleeve of the adjustable beam spreader. This assembly has a Spacer Plate to create a tight fit for the vertical panels on the end wall kit.

Loose Piece Components

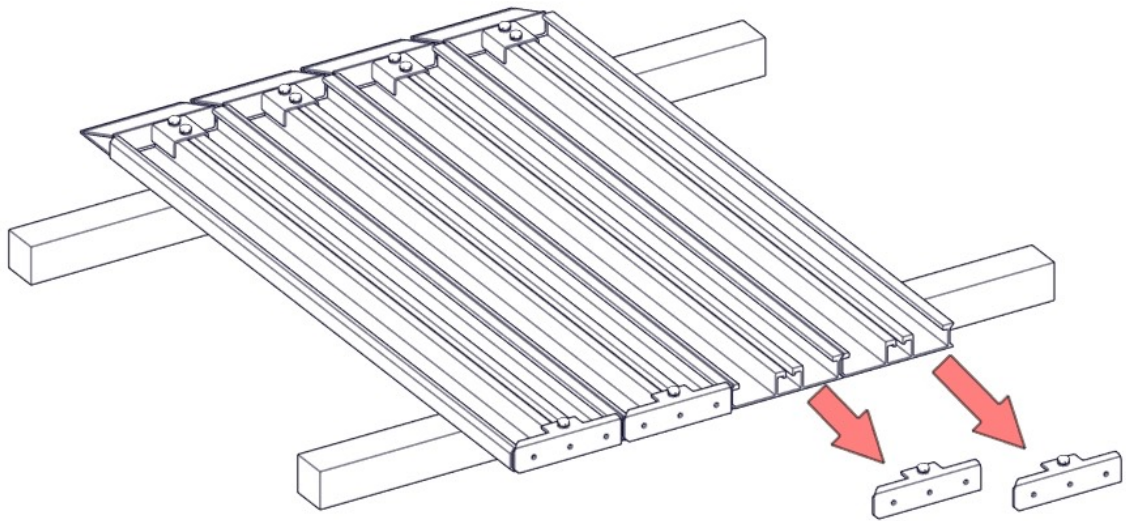


Side Shield Panel Assembly

When assembling your V-Panel Shield you will find it much easier when assembling it up in the air on either a table or a set of saw horses. If this is not an option it is highly suggested that you at least assemble it on some wood cribbing blocks.



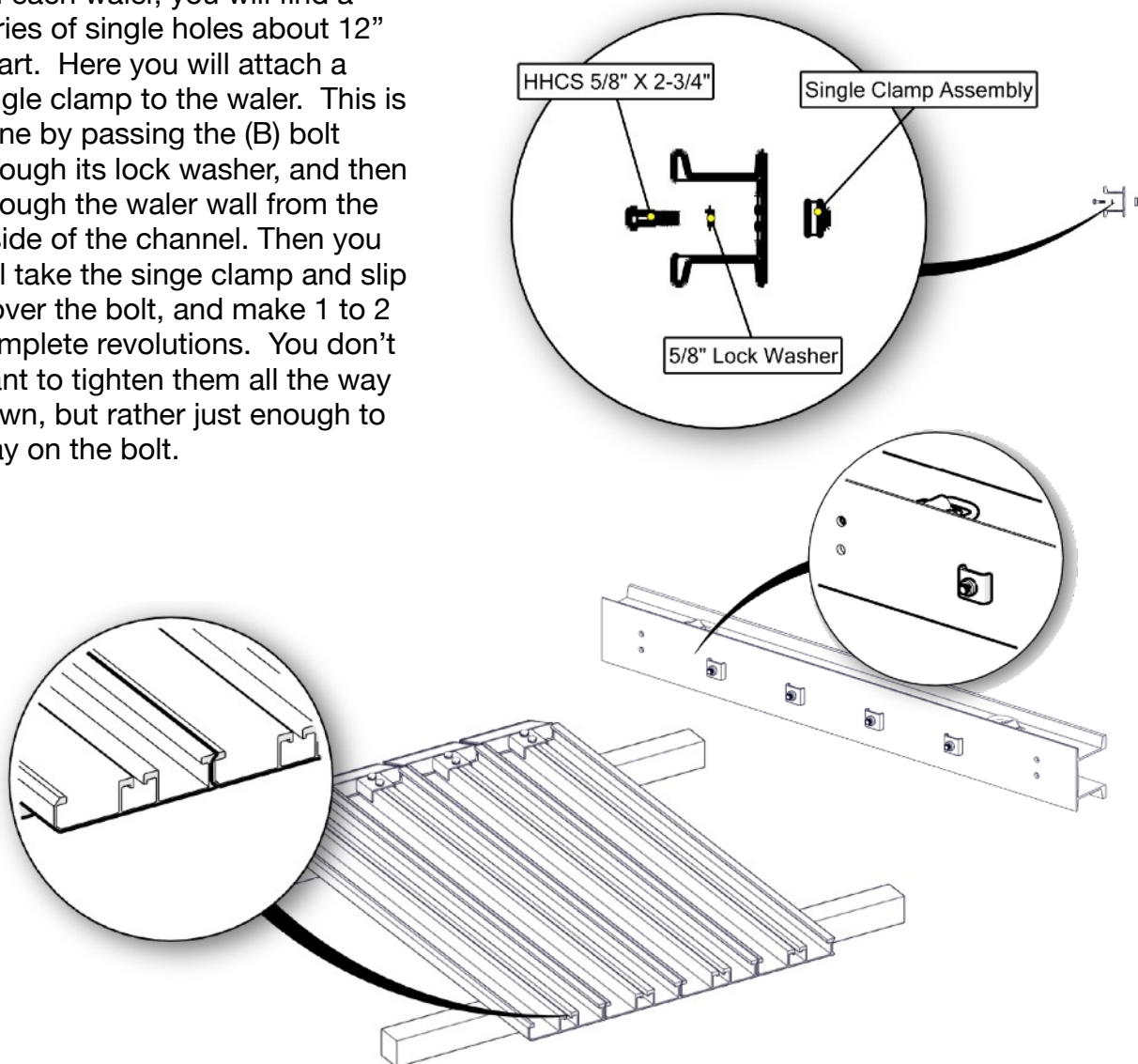
Start by gathering half of the sidewall Independent Vertical Adjustable Panels. Lay them side-by-side so they tightly nest together. Be sure to line the knife edges together at one end, and the push pads together. Reminder, the Adjustable Panels are solid without any holes running down the panel.



Once all of the Independent Vertical Adjustable Panels are aligned, carefully remove the bolt-on push pads. Simply loosen the 5/8" hex head cap screw. Doing so will loosen the grip that the single clamp has on the vertical panel. Then you can simply slide them off their panel. Be sure to do this for each of these panels.

The next step is to prepare each waler by assembling the single clamps to them.

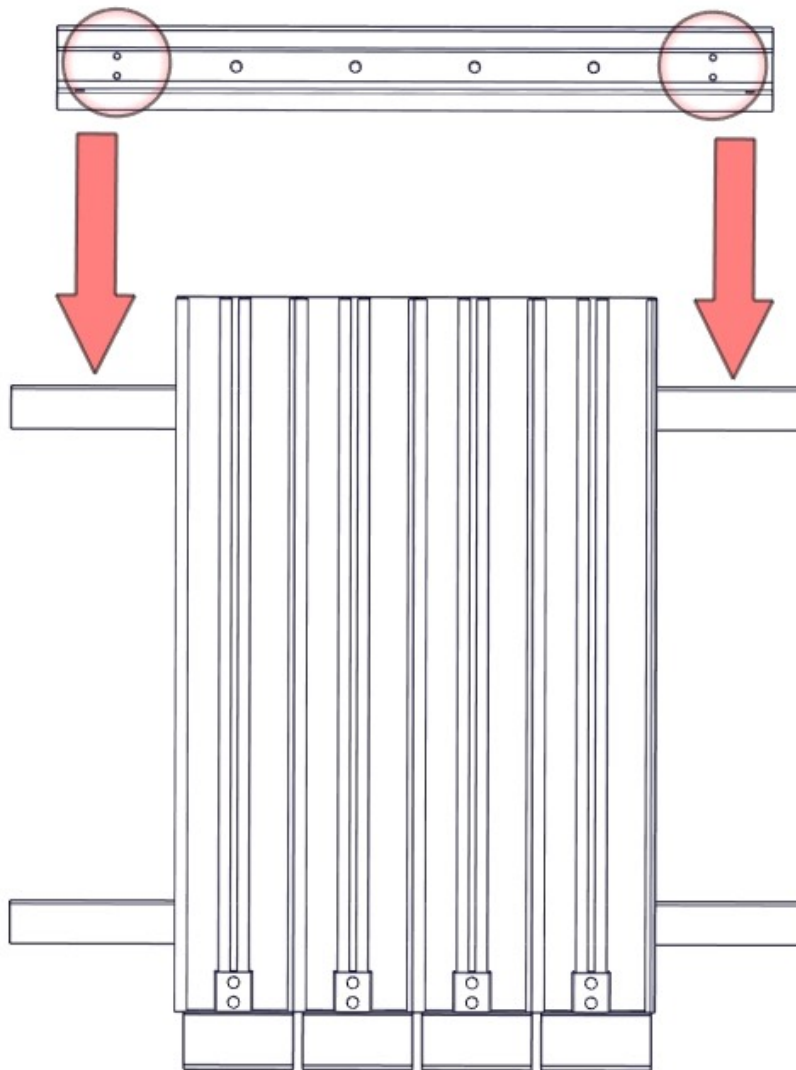
On each waler, you will find a series of single holes about 12" apart. Here you will attach a single clamp to the waler. This is done by passing the (B) bolt through its lock washer, and then through the waler wall from the inside of the channel. Then you will take the single clamp and slip it over the bolt, and make 1 to 2 complete revolutions. You don't want to tighten them all the way down, but rather just enough to stay on the bolt.



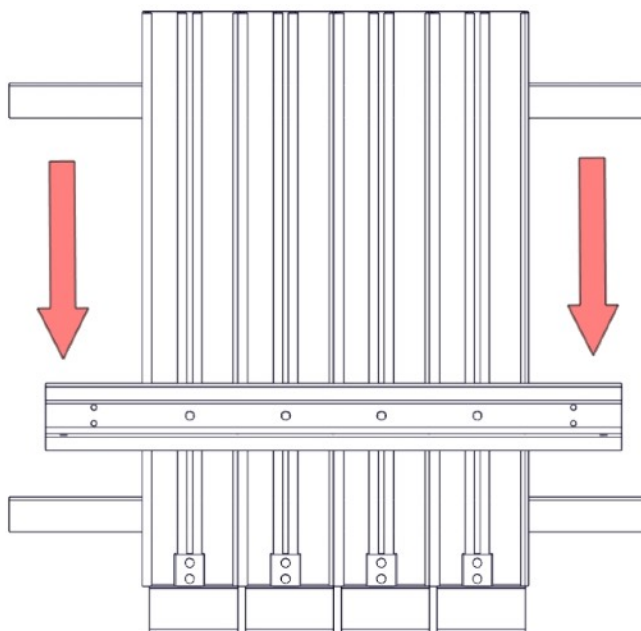
When assembling the single clamps to the walers be sure to align the c-shape of the clamp so they are perpendicular to the waler channel. When rotating the clamps be sure to loosely tighten them. Over tightening the single clamps on the waler will result in prohibiting them from sliding onto the individual vertical panels.

Note, there will be no single clamps on the end of the waler. These pairs of holes are reserved for the Stationary Corner Panels, See Circles.

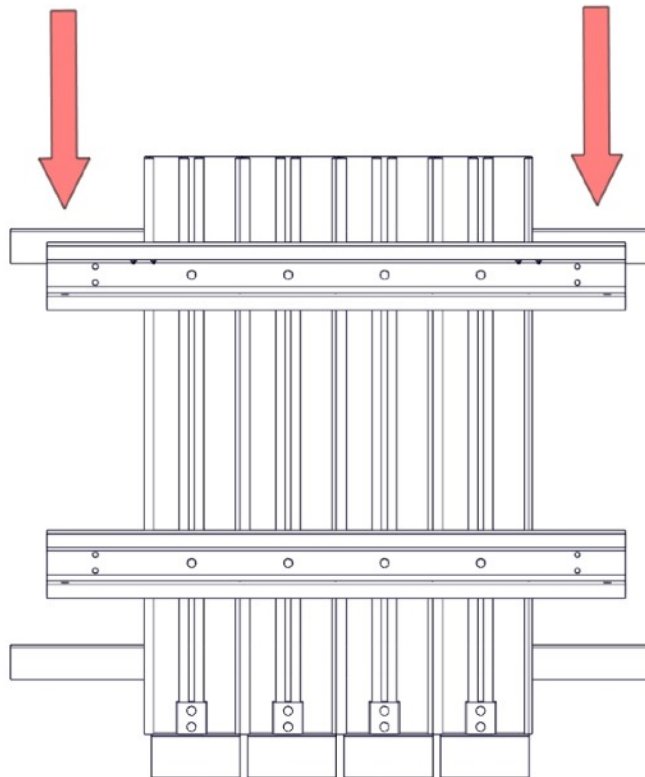
With the single clamp in line with each of the grooves on the vertical panels, you will slide the lower waler on first.



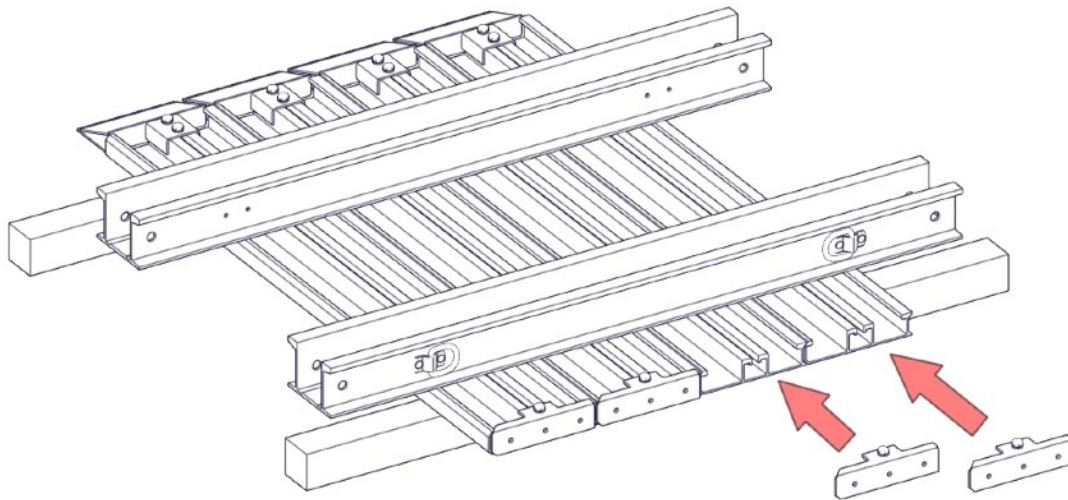
You will want to push the waler down to the lower 3rd of the sidewall.



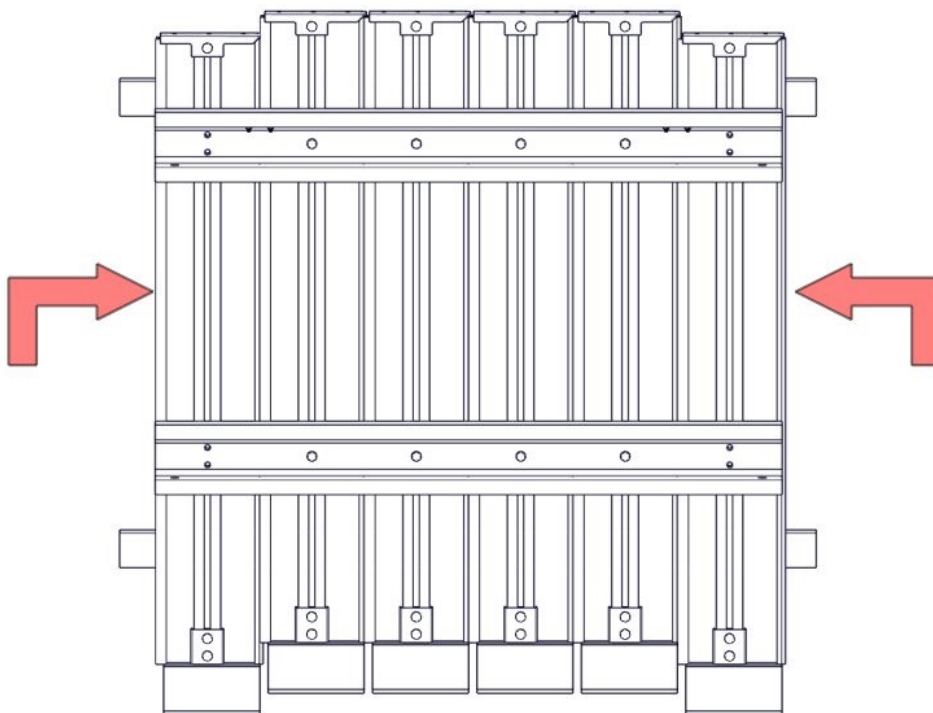
Just like the lower waler, you will slide the next waler on and into its position.



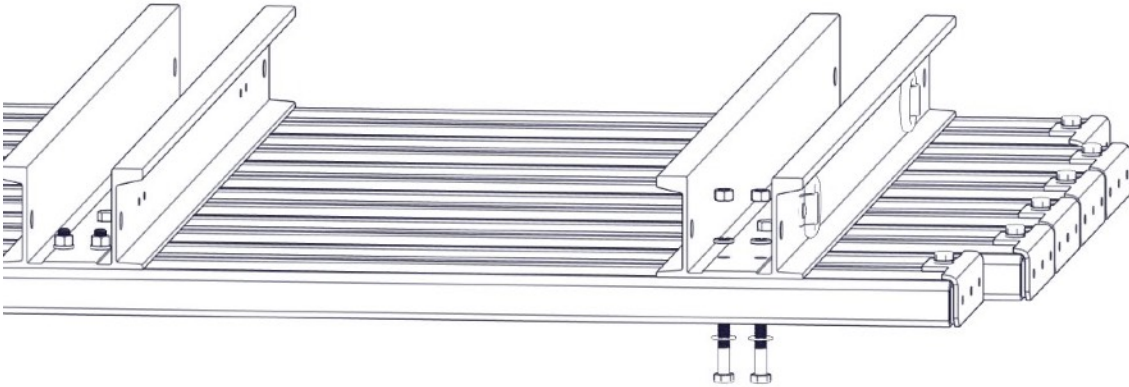
Once the walers are in their proper position you can return the Bolt-On Push Pads to their vertical panels. Be sure to tighten the bolt for the single clamps on each of the Push Pads, so they remain secured.



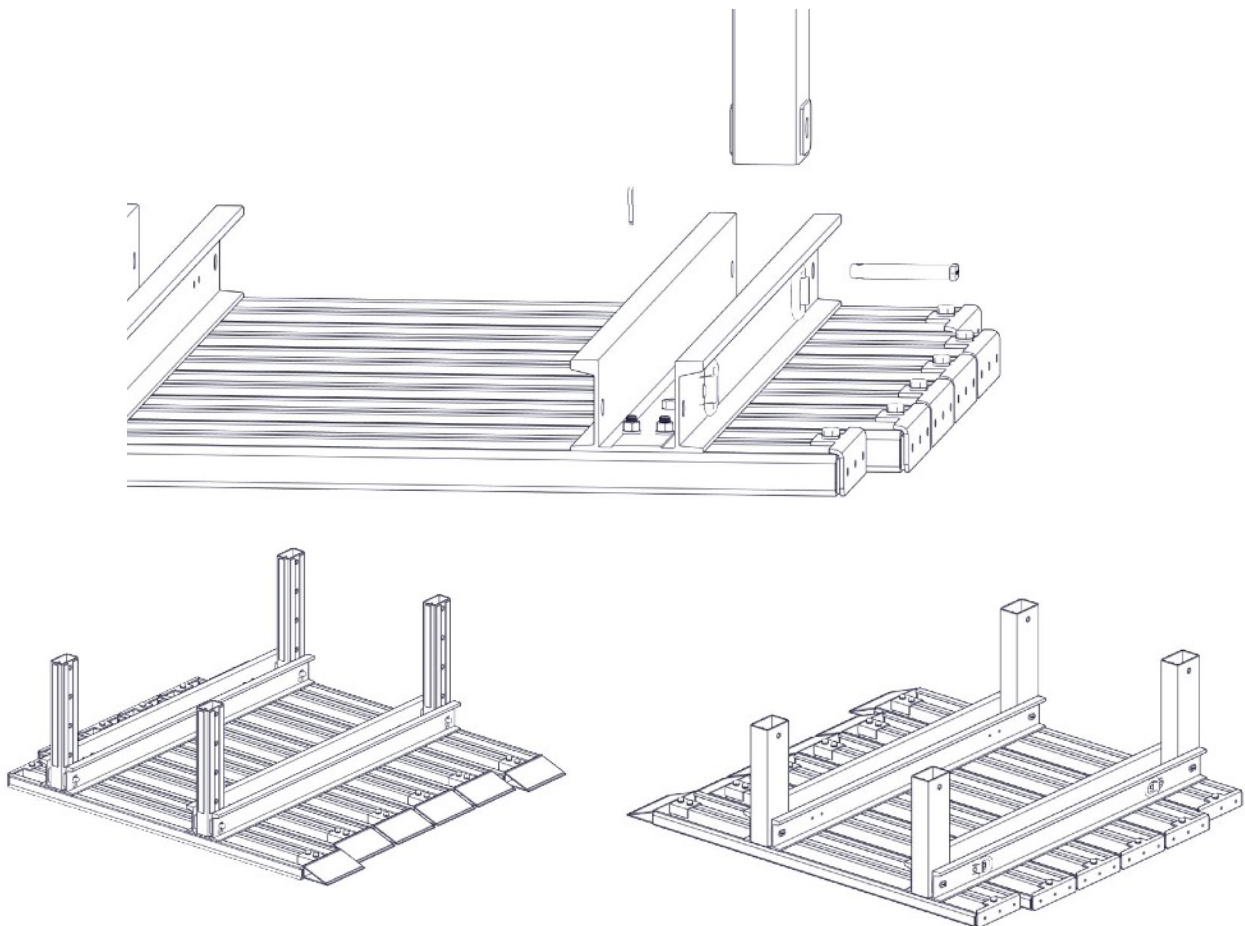
The next step is to move in the Stationary Corner Panels sliding them under the walers.



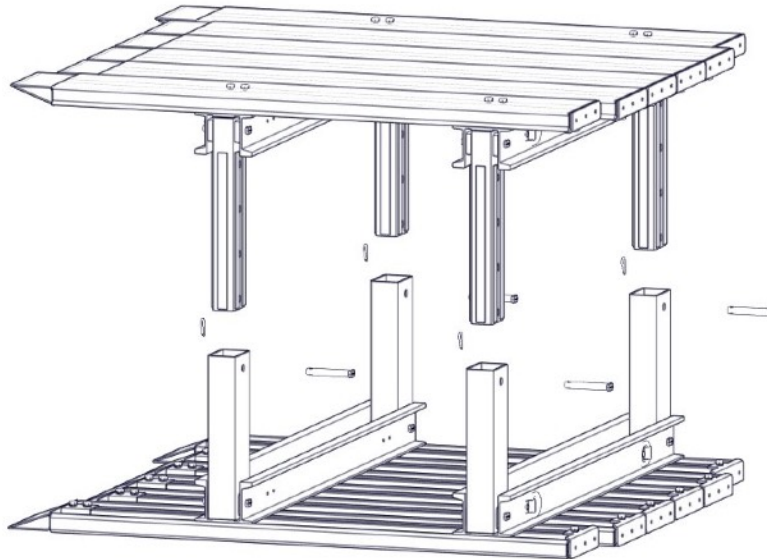
Matching the holes on the panels up with the holes on the walers you will bolt the two together with the (A) Bolt, (F) washers, (E) lock-washer, (I) nuts.



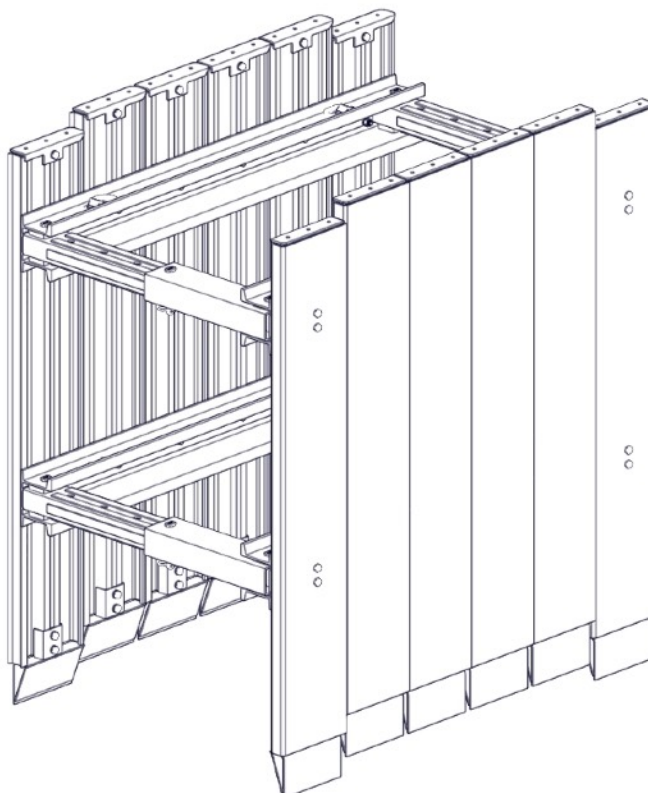
Next, follow the same steps to assemble the other wall half. Once both sidewalls are completely assembled you are ready to join the two walls together. The easiest way to do this is to start by pinning the outer adjustable beam spreaders inside the walers of one of the sidewalls. Then repeat the same process for the Inner Adjustable Beam Spreaders.



Once both sides are assembled, you will then use your machinery with rigging to flip the panel over and then lower the inner adjustable beam spreaders into the outer beam spreaders. Be sure to slowly lower them in, so you can then pin them into place with the spread (J) pin and (K) keeper.

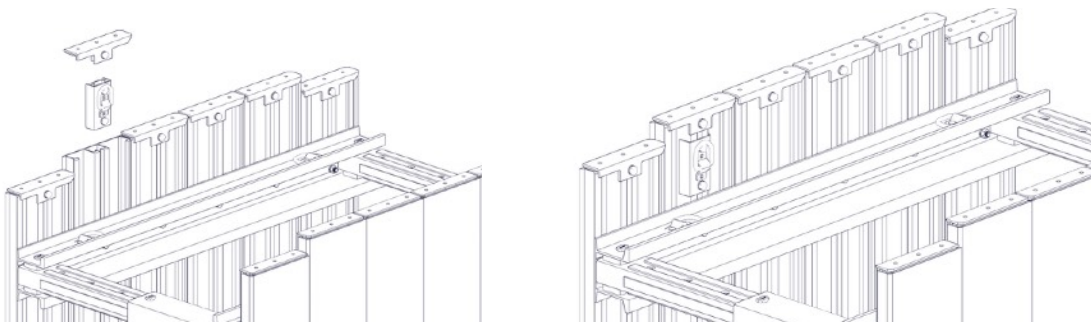


Once all Adjustable Beam Spreaders are secured you can hook the rigging up to the D-Rings on the top walers, and lifting the box to an upright position.

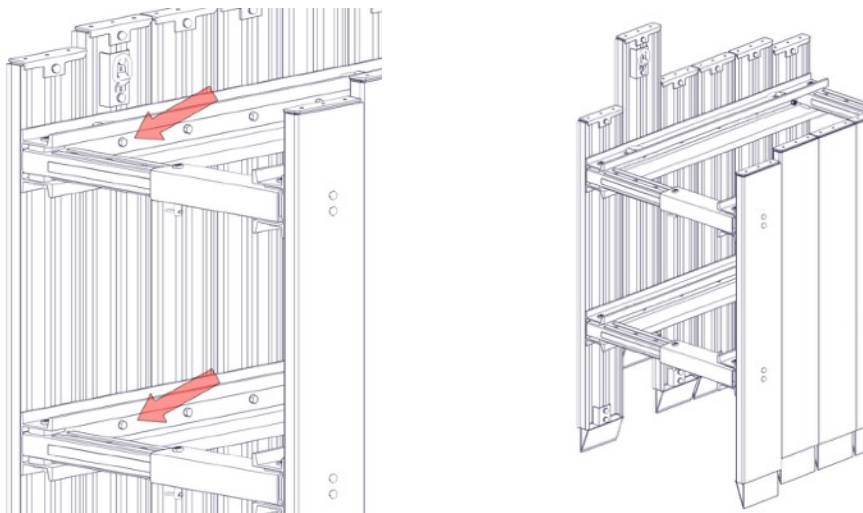


Panel Lifting Ring Assembly

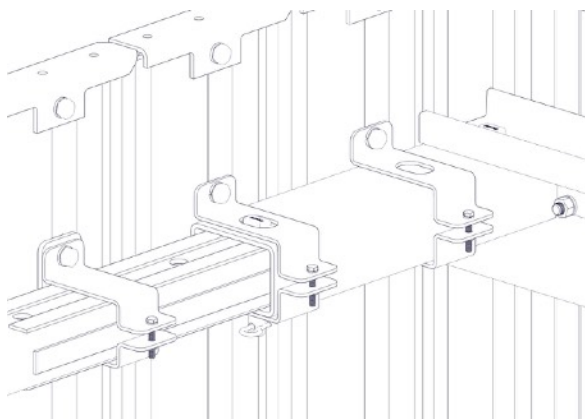
In the field you may have crossing utility lines where a opening in the box would come in handy. The Panel Lifting Ring is a tool needed for moving the individual vertical panels up and down. Prior to placing the box into the trench/hole, you will need to remove the Bolt-On Push Pad from the inner adjustable vertical panel that is obstructing utility would be crossing under. Once remove loosen the single clamps on the back of the panel lifting ring assembly. Make it loose enough to slip onto the vertical panel and into place. Then tighten the single clamps again on the panel lifting ring. Next, return the bolt-on push pad to the vertical panel. Be sure to tighten the single clamp on the push pad securing it to the panel.



Once the lifting ring is in place loosen the single clamp for that panel on each of the horizontal walers it is attached too. Once it is loose enough you will then hook your sling to the lifting ring and lift it to the required clearance height of the crossing utility. Once the panel is at its required height, you will then tighten the single clamps on each of the horizontal walers again. If it requires that more than one panel needs to be moved, you will need to remove the panel lifting ring assembly and repeat the process for all required panels. Once the Vertical panels are in their proper position, then you can lower the box into the trench/hole.



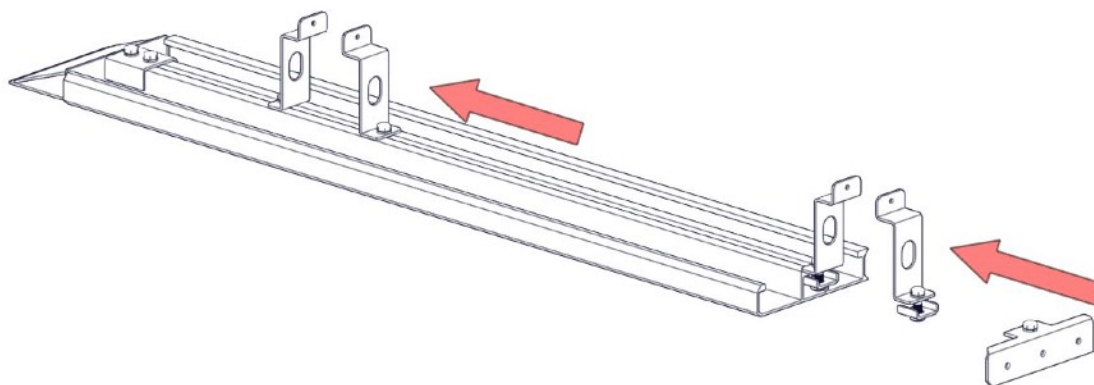
End Wall Assembly



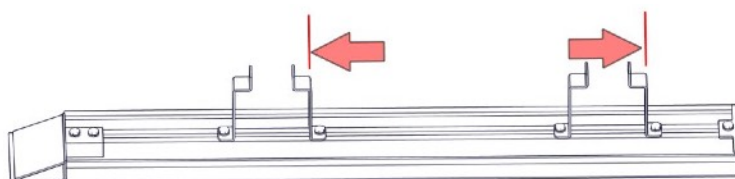
When assembling and installing the vertical panels of the End Wall Assembly, it is important to identify the different types of panel clamps and understanding where they're required. There are two different types of end wall clamps; Large End Wall clamp designed to clamp around the outer adjustable beam spreader, and the Small End Wall Clamp designed to clamp around the inner adjustable beam spreader.

When assembling your end wall kit it is important to start by assembling one of the end wall panels that clamp to the outer beam struts. Start by locating the components for two of the End Wall Large Clamp Assembly Kits. (See page 34) You will know you have the correct clamp pieces because there is a large oblong hole on each of the clamp pieces. This hole is designed specifically for the placement of the first vertical panel over the adjustable pin when attaching it to the large outer beam strut.

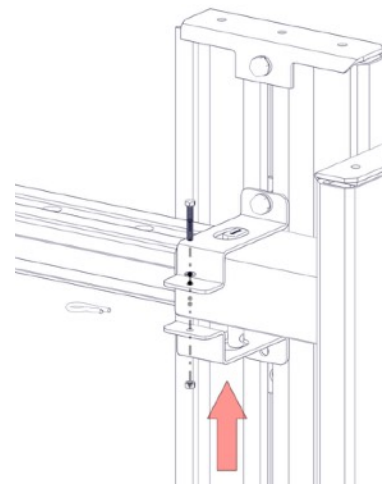
Next, take one of the independent vertical panels, and loosen the bolt-on push-pad. Once loosen remove the push-pad from the panel, slide each section of the end wall clamps onto the vertical panel, one at a time, putting spacing between each piece. Then return the Bolt-On Push-Pad.



Once both sets of the strut clamps are installed you will then want to separate the top half base of the spacing for the Adjustable Beam Spreaders. Once they are in position, you will want to tighten the top half. This will prevent the panel from sliding down as you are trying to assemble the vertical panel onto the beam strut.

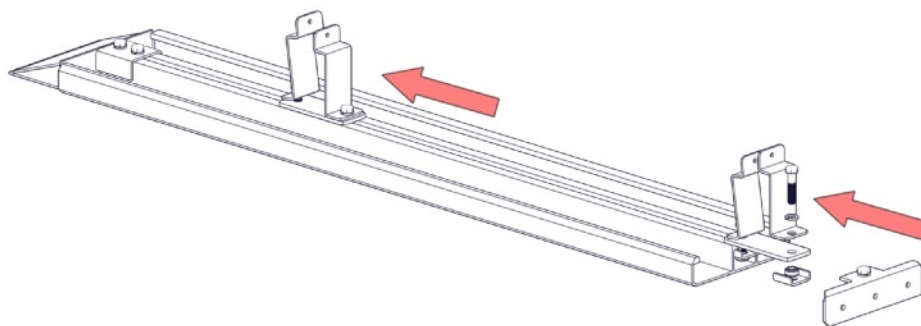


After tightening the top clamp half you can now lift the panel and rest each of the top clamps on each on the outer beam strut. For the first vertical panel, you will want to move the hole from the top clamp directly over the adjustable spreader pin. Then one Strut at a time you will want to remove just the spreader pin's keeper. Once the keeper is removed you will then slide the bottom half of the end wall clamp up so the two hafts touch. Then you will want to tighten the single clamp from the bottom half of the assembly. Next you will want to bolt the two half together using the (D) bolt along with the (G) lock washer and (I) nut.

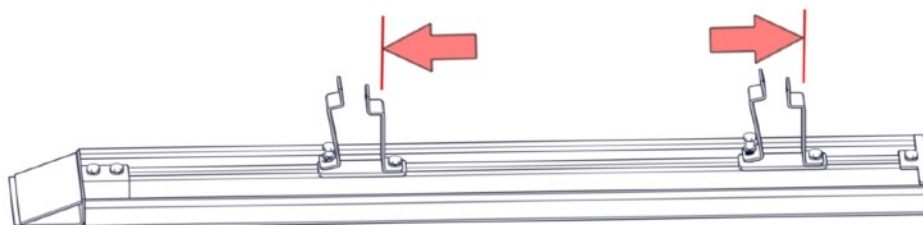


Next, you will want to locate the components for two of the End Wall Small Clamp Assembly Kits. (See page 35) You will know you have the correct clamp pieces because there are no holes in the clamp pieces, and you will find a spacer piece that keeps them evenly separated. The spacer is designed to keep a snug fit around the Inner adjustable beam spreader section.

Start by loosely assembling the small end wall clamp kits. Be sure to keep the single clamps loose enough so it can be easily slid onto the vertical panels. Loosen and remove the bolt-on push-pad from the top of the vertical panel, and slide each half of the small end wall clamp half onto the vertical panel one at a time, then return the Bolt-On Push-Pad.

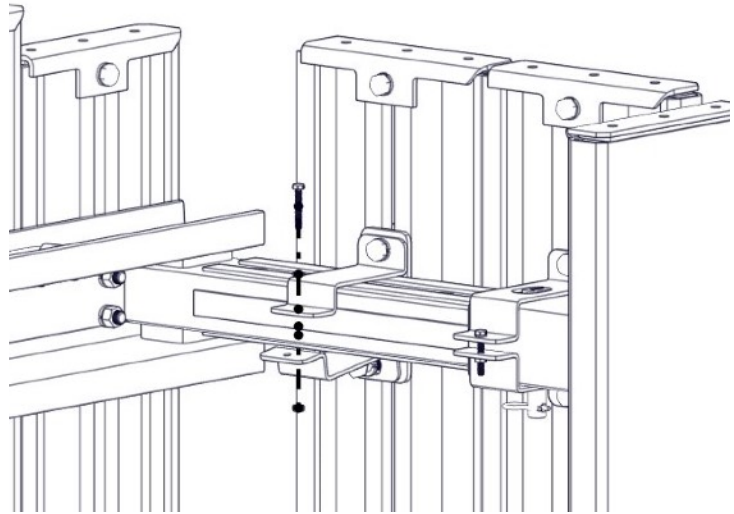


Once both sets of the strut clamps have been installed, you will then want to separate the top half base of the spacing for the adjustable beam spreaders. Once they are into the position, you will want to tighten the top half. Doing so will prevent the panel from sliding down as you are trying to assemble the vertical panel onto the beam strut.



After tightening the top clamp half, you can now lift the panel and rest each of the top clamps on each of the inner beam strut. To do this you are going to need to spin or pull the bottom clamp way from the spacer plate. This will create space enough to slip clamps over the adjustable beam strut. Be careful when doing this, because you can possibly pinch your hand/finger when doing this. We suggest that you install these panels as a team. Once in place push the vertical panel up tight against the prior panel installed.

Then one at a time tighten the bottom single clamp. This will draw the bottom half of the end wall clamp up so the two halves touch. Next you will want to bolt the two halves together by using the (D) bolt along with the (G) lock washer and (H) nut.

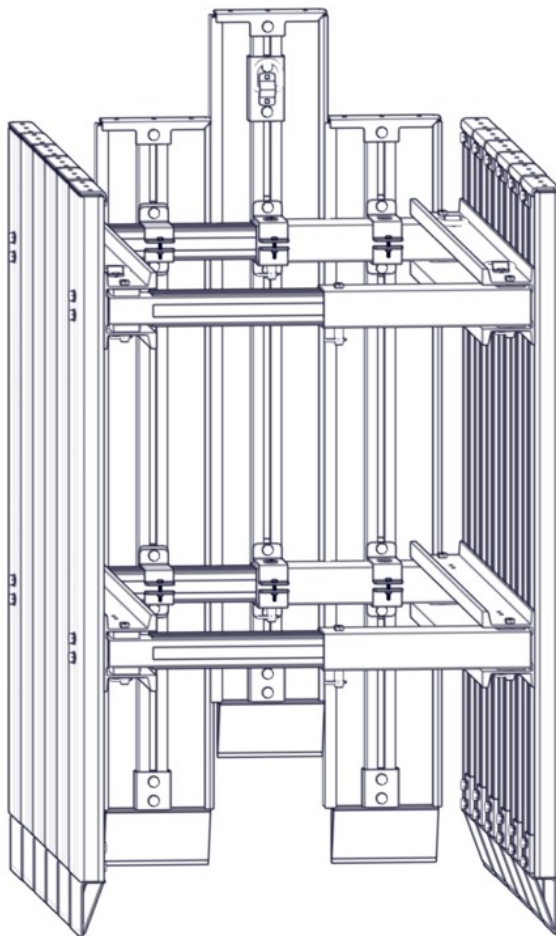


Repeat the process for any additional end wall panels to close off the entire end wall kit. The number of vertical panels required will vary based on the size of the required opening from the adjustable beam spreaders.

End Wall Panel Adjustment

In the event the crossing utilities need to pass through one of the end wall closer kits, each panel can easily adjust as well. Follow the basic instructions by using the Panel Lifting Ring Assembly (pg. 44). Once the lifting ring is in its place, you will loosen just the single clamps from each of the end wall closer clamps. Make sure it is just enough that when you pull up on the panel lifting ring, you can raise the panel into its place and tighten each of the single wall clamps back in place.

Once your box is completely assembled, and all panels are in place for your work area, you are now ready to place the box into the trench/hole.



Thank you for your purchase of the V-Panel Aluminum System. This modular system is here to offer you a variety of customization setup solution for the endless number of utility situation you will come up against. Here at Kundel we know first hand the challenges that comes up daily when working in the trench, and we are here to support you with a full line of trench safety equipment for all your needs.

If you have any questions about V-Panel System or other products we have to offer, give us a call. (330)259-9009

For a complete step-by-step instructional video of how to put together the V-Panel Aluminum System visit our YouTube channel at www.youtube.com/kundel



Video Link: https://youtu.be/g_PBIXYeJ9Q

