



Installation Manual



www.cmilc.com

TABLE OF CONTENTS

BEFORE YOU BEGIN	4
PREPPING THE SITE.....	4
ANCHORING.....	4
BUILDING A DRIVING GUIDE.....	6
SHEET PILING	8
MATERIALS.....	8
EQUIPPING FOR THE JOB.....	11
INSTALLATION.....	12
TURNING A STANDARD CORNER.....	15
MAKING A NON-STANDARD TURN.....	17
PREPARING FOR THE NEXT STEP.....	18
TIMBERGUARD POLES	20
MATERIALS.....	20
APPLICATIONS.....	21
INSTALLATION.....	23
WALES	24
ARMORWARE/GEOGUARD.....	21
Materials.....	21
Installation.....	27
Hanging your ArmorWare/GeoGuard Wale.....	27
Turning a corner with your ArmorWare/GeoGuard Wale.....	32
TIMBERGUARD.....	39
Materials.....	39
Installation.....	41
Hanging your TimberGuard Wale.....	41
Turning a corner with your TimberGuard Wale.....	46
TIE RODS	53
ARMORWARE.....	53
Materials.....	53
Installation.....	55
CAPS	58
ARMORWARE.....	60
Materials.....	60
Installation.....	62
Attaching your ArmorWare Cap.....	62
Turning a corner with your ArmorWare Cap.....	72
FINISHING UP	82
BACKFILLING.....	82
FINAL WALL TUNING.....	83
CAD DRAWINGS	85

Before You Begin

WARNING

No two walls are the same. The numerous job site variables make it impossible to provide specific construction designs without careful analysis of each variable and the effect it will have on the structure. This analysis should be left up to an architect, professional contractor, or engineer. This manual lists typical installation techniques for demonstration purposes only, and in no way represents any recommendations on how to approach your particular project. Please rely on your engineer for specific design recommendations. Because of the complexity of geotechnical loading calculations and the susceptibility to extreme change of soil loads with minor changes in local site conditions such as soil parameters, water levels, surcharge loads, etc., we strongly recommend the use of design professionals who are familiar with local wall construction to determine the required wall parameters, design techniques, and applicable installation methods and procedures.

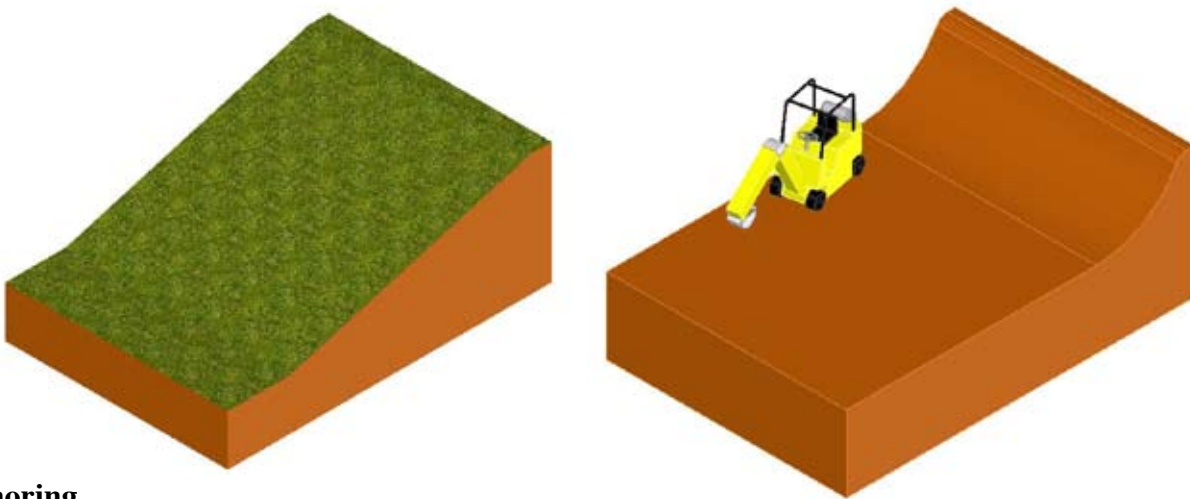
WARNING

This manual does not address any safety or regulatory issues associated with its use nor the installation of CMI products. It is the user's responsibility to establish and ensure that all regulated and appropriate safety and health practices are followed. It is also the user's responsibility to ensure that any and all applicable permits and permissions have been secured before installation of any CMI product.

Before You Begin

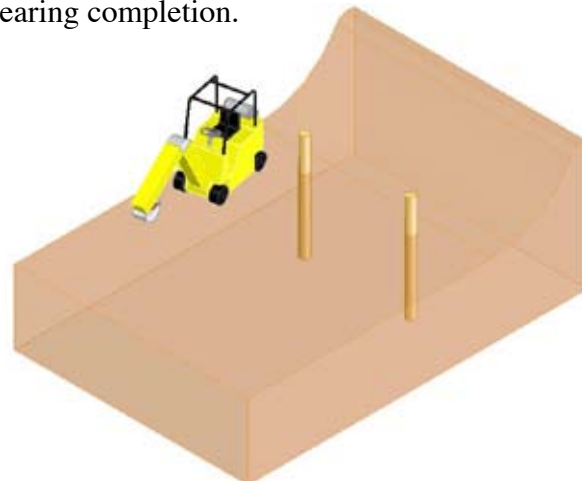
Prepping the Site

There are many types of sheet piling structures that serve many different purposes. We cannot hope to cover every situation here but rather, show some fundamental ideas. Most scenarios are going to involve some preparatory work before you begin the construction of your structure. Many situations require excavation. Whether it is to have more mobility in construction, for burying anchors, or ultimately changing the landscape, preparatory work will need to be done first. This might be a good time to more closely investigate the soil and its properties to ensure that your wall has been properly designed. A simple, anchored, earth retaining wall situation is shown here for illustration purposes.

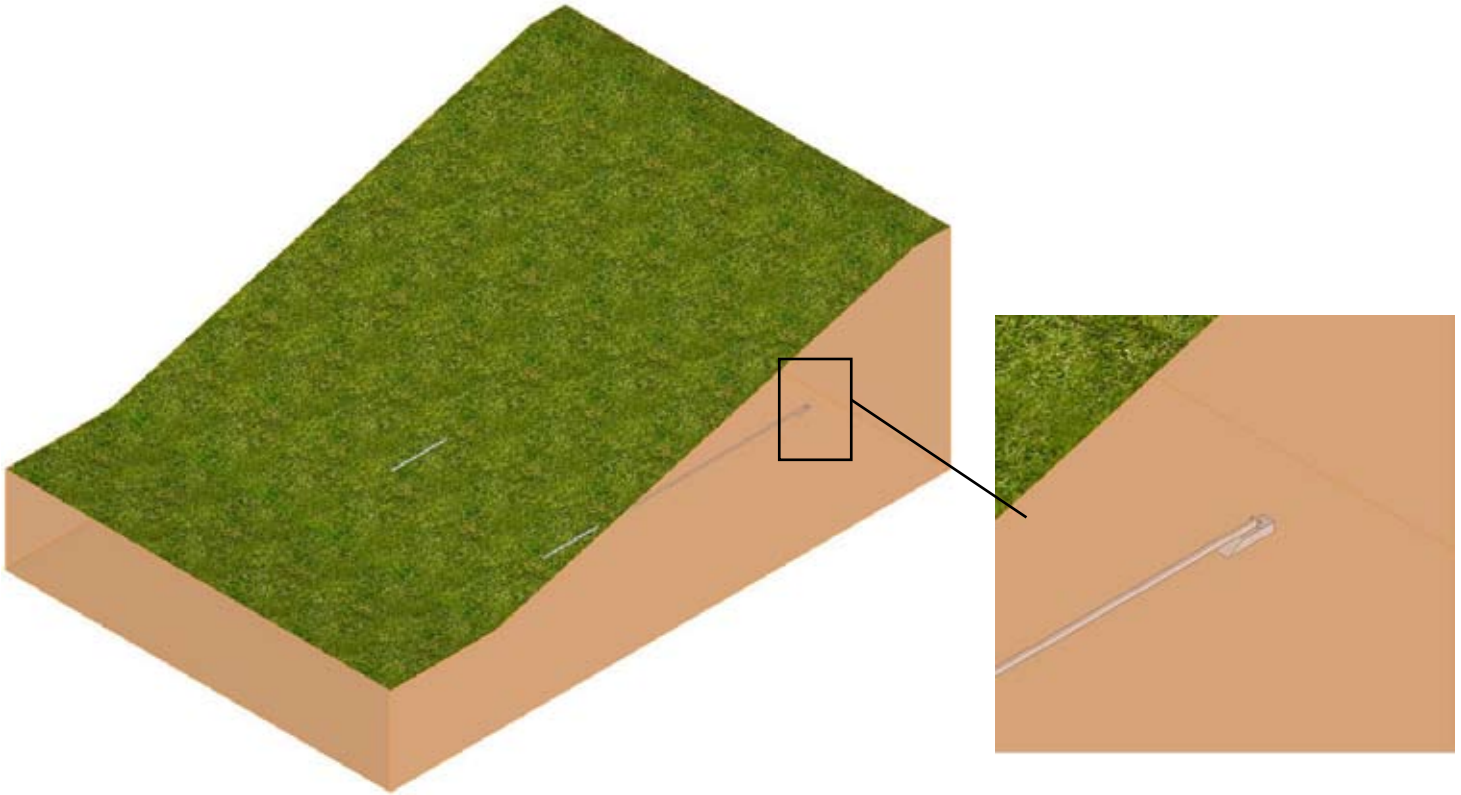


Anchoring

If you will be anchoring your wall, there are many types of anchors to choose from. The most popular anchoring method involves driving or burying large bodies in the ground with which to secure your wall. This method involves excavation which may not be possible or feasible in every situation. Different people use different materials and different layouts to achieve their preferred anchoring system. Shown here are TimberGuard poles used as anchor piles. It is important that, whatever anchor system you use, the anchor be buried outside of the slip plane or active wedge of the soil. This is the angle that the dirt settles to, naturally, if left unsupported. It is this falling of the dirt that you are trying to counteract with a retaining wall. The wall designer should designate the distance and depth that your anchors should be, in relation to the wall. Make sure to plan so that you have access to the anchor for attachment to your wall when nearing completion.

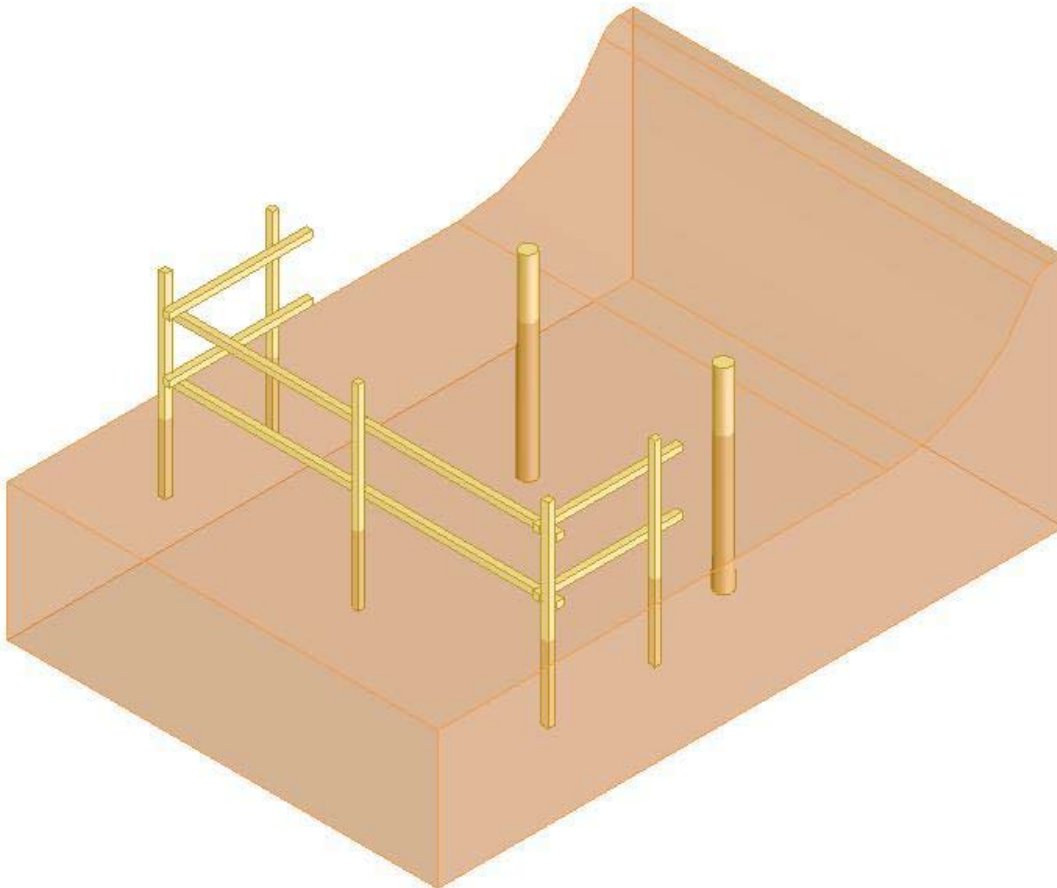


In cases where excavation is undesirable, there are other types of anchors that can be driven or screwed into the ground, leaving the exposed topside virtually undisturbed. The type pictured below has a mechanism that extends when sufficient pressure is applied to the rod, securely holding itself in place. These types of anchors can also have load checking devices, to ensure that they are installed with a firm footing.



Building a Driving Guide

A temporary driving guide is highly recommended for building a straight wall. By assembling a driving guide before you begin installation, you establish an accurate wall position and provide a surface to drive against that keeps the sheet piling plumb. Construction should be fast and simple. There are many methods and techniques out there. For example: If you are re-facing a wall, then you may be able to use the structure you are replacing as your guide. You will need to find the method that best suits you and your situation. You may incorporate your wales and poles, if they are in your design, into your driving guide. This can save you a great deal of time and effort. If you decide to do this, you should construct your wale system as you would for final installation (see **Wales**). This will be the backbone of your finished wall. ArmorWare and GeoGuard wales may be clamped or temporarily lagged to your posts. Use your wales as the horizontal members and poles as the vertical posts for your temporary driving guide. Ensure that an adequate number of posts are used so the guide does not move when you begin driving your sheets. Also, two points of contact for your sheet piling (as shown below) provide for more accurate driving than one alone. If you choose not to incorporate wales or poles into your driving guide, then the guide will need to be removed after the sheet piling is installed. However, if you construct your guide on the back side of your wall, you may be able to simply bury it after completion.



Now you are ready to begin installing your sheet piling.

Sheet Piling

WARNING

No two walls are the same. The numerous job site variables make it impossible to provide specific construction designs without careful analysis of each variable and the effect it will have on the structure. This analysis should be left up to an architect, professional contractor, or engineer. This manual lists typical installation techniques for demonstration purposes only, and in no way represents any recommendations on how to approach your particular project. Please rely on your engineer for specific design recommendations. Because of the complexity of geotechnical loading calculations and the susceptibility to extreme change of soil loads with minor changes in local site conditions such as soil parameters, water levels, surcharge loads, etc., we strongly recommend the use of design professionals who are familiar with local wall construction to determine the required wall parameters, design techniques, and applicable installation methods and procedures.

WARNING

This manual does not address any safety or regulatory issues associated with its use nor the installation of CMI products. It is the user's responsibility to establish and ensure that all regulated and appropriate safety and health practices are followed. It is also the user's responsibility to ensure that any and all applicable permits and permissions have been secured before installation of any CMI product.

Sheet Piling

Materials

We offer many different profiles of sheet piling in two different materials, vinyl and FRP (fiber reinforced polymer). The many profiles offered fall into two basic categories, “Z” sections and “box” sections. These two basic shapes are shown here respectively. Z sections have a slightly larger strength rating for their size but don’t install as easily and quickly as box sections



“Z” Section
















“Box” Section



Your application may also require corners. They are available for turning 90 degree angles with all products and 45 with most.

Our current line of sheet piling and corners consists of the following products:





ShoreGuard and C-Loc Sheet Piling

	
C-Loc 2500	C-Loc 4500
	
ShoreGuard 225	ShoreGuard 300
	
ShoreGuard 325	C-Loc 9000
	
ShoreGuard 400	ShoreGuard 425
	
C-Loc 9900	ShoreGuard 550
	
ShoreGuard 650	ShoreGuard 750
	
ShoreGuard 950	




GeoGuard Sheet Piling

	
GeoGuard 20	GeoGuard 30



ShoreGuard Sheet Pile Corners

	
ShoreGuard 225-425 Corner (use with SG 225, SG 300, SG 400, SG 425)	ShoreGuard 550 Corner (use with SG 550)
	
ShoreGuard 650-750 Corner (use with SG 650, SG 750)	ShoreGuard 950 Corner (use with 950)

C-Loc Sheet Pile Corners

		
C-Loc Universal Corner (use with CL 9000, CL 9900)	C-Loc Four Way Corner (use with CL 2500, CL 4500)	C-Loc 90 Degree Corner (use with CL 2500, 4500)

GeoGuard Sheet Pile Corners

	
GeoGuard 20 Corner (use with GG 20)	GeoGuard 30 Corner (use with GG 30)

Equipping for the job

Synthetic sheet piling does not require specialized driving equipment. It can be installed with conventional driving practices and equipment. Commonly used equipment for driving includes water jets, excavation equipment, drop hammers, vibratory hammers, and vibratory plate compactors. The equipment you use will need to be appropriate for the soil, site conditions, and the sheet piling that you will be using.



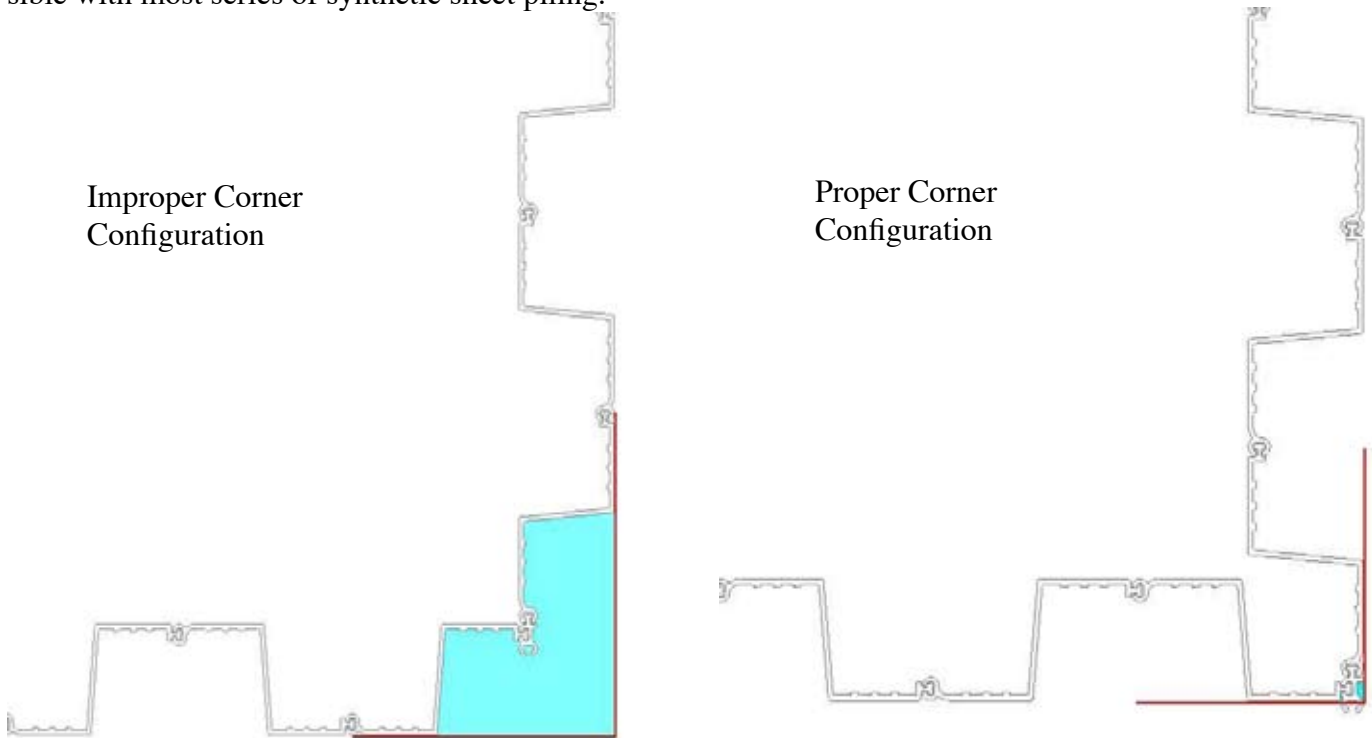
Installation

Sheet piling has been around for many years. There is no one correct installation method. Everyone has their own technique that works best for them. Here, we will cover the basic elements and tips for a successful installation.

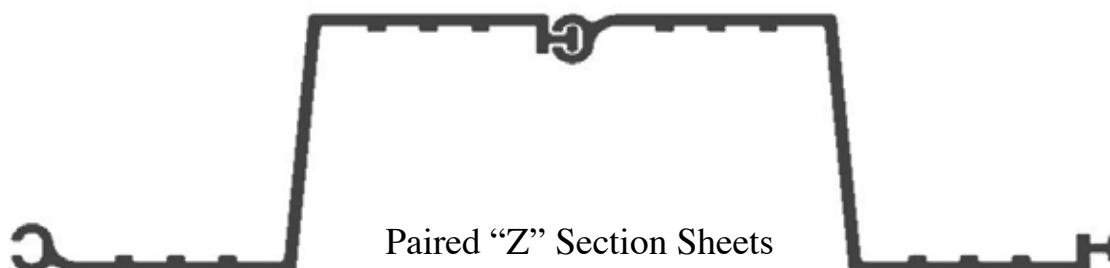
In order to achieve the full performance of your structure, your sheet piling must be driven to the depth specified by the wall designer. You may want to mark your desired driving depth on your sheet to ensure that it is sufficiently driven.

Some forethought needs to be given to the sheet orientation before you begin. First, the most popular way to drive is with the male lock leading; the rationale being that the female lock has a tendency to fill up with soil and hinder driving if used as the leading edge.

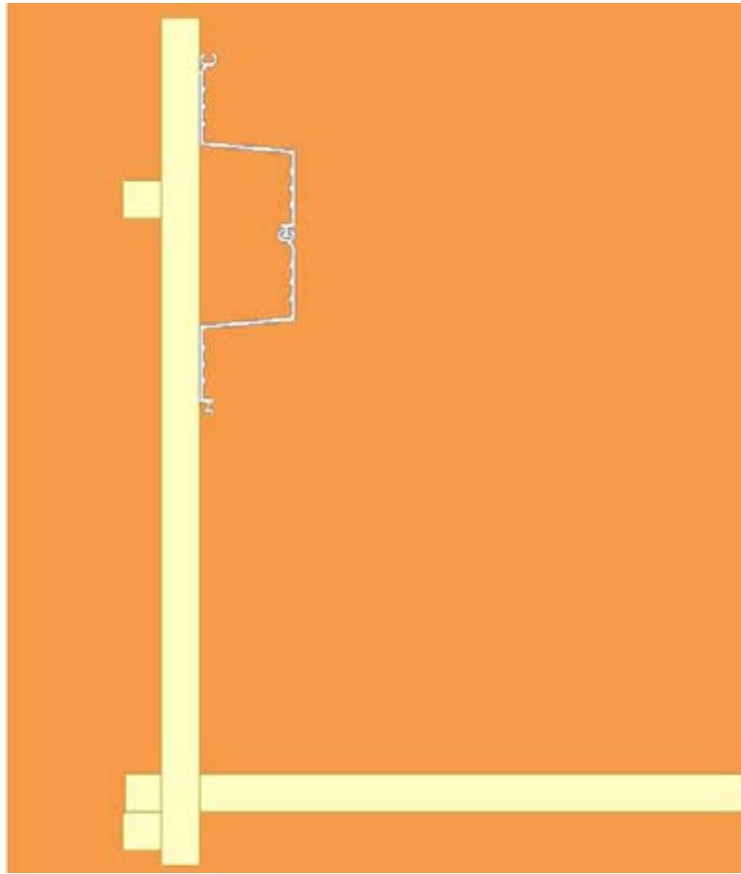
It is also a good idea to orient your sheets so that any outside corners are configured as shown in the drawing below whenever possible. Orienting your sheet piling in this way maximizes the strength of your wall in the corners, by eliminating as much of a void as possible between the sheet piling and the cap and/or wale, and reduces the induced stress on the corner joint. If you look closely at the corner, you will see that there is sometimes an attachment point in the corner piece for possible future additions to the wall. Additions will be possible with most series of synthetic sheet piling.



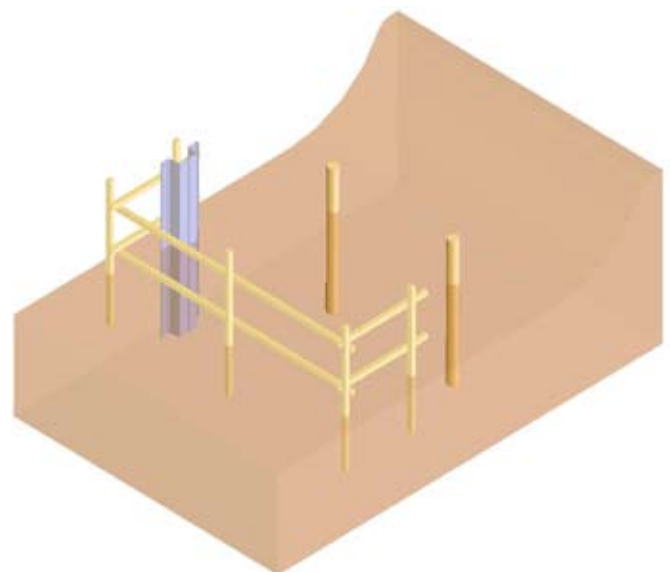
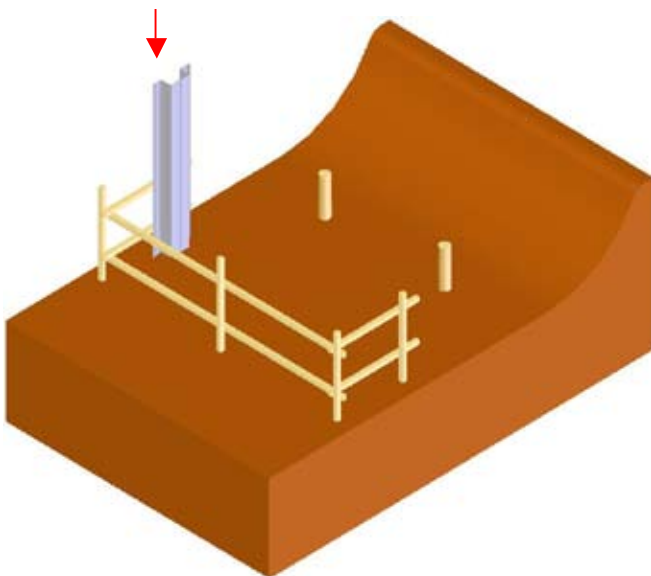
After you are satisfied that your sheet orientation is correct, you are ready to begin driving. You will want to drive your sheets as full box sections. If you have purchased a box section sheet, then you are ready to go. If you have Z section sheets, then you will want to pair them before driving.



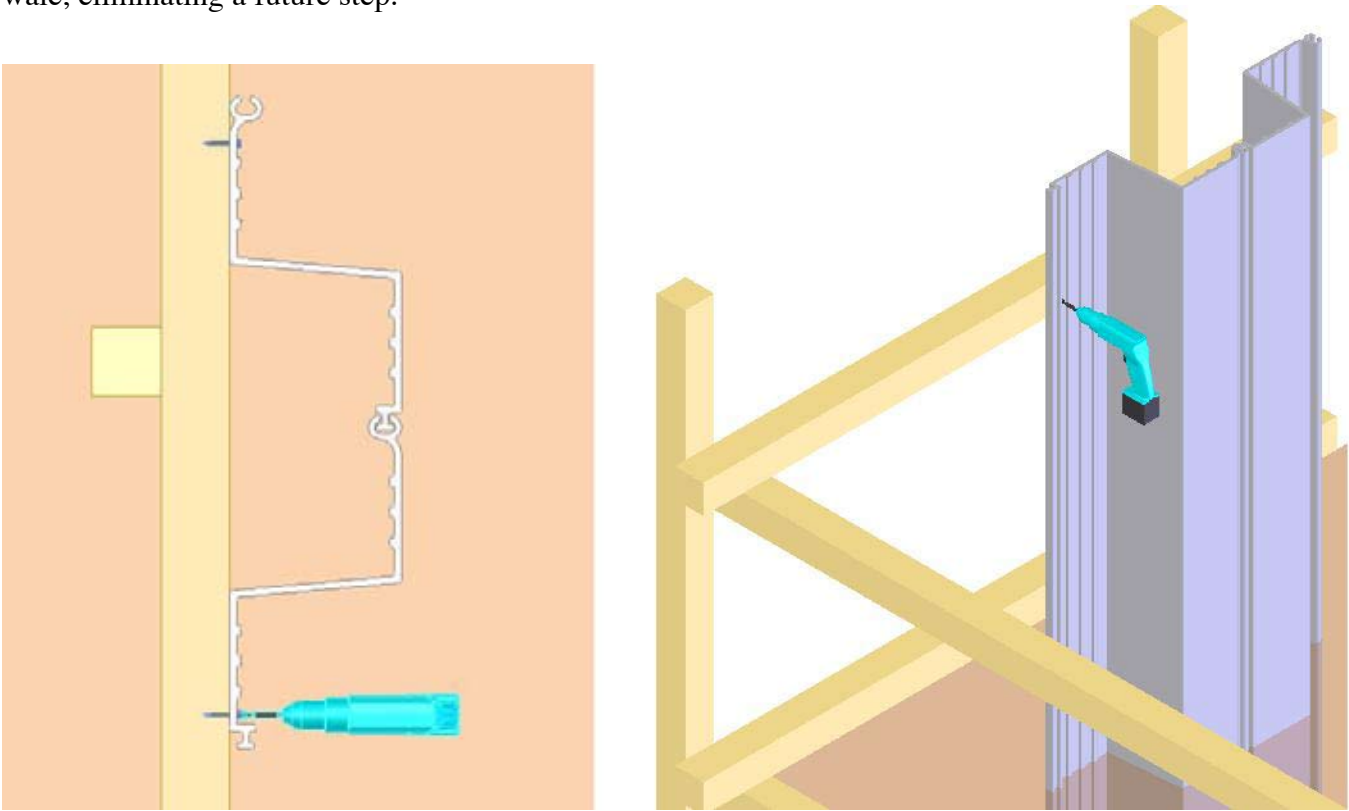
Place your first sheet or pair of sheets on your driving guide and make sure they are in the proper location and orientation for driving. Again, sheet piling installation varies from person to person. The starting location is up to you. It is important, however, to drive your first section plumb, because it will act as a vertical guide for the following sheets.



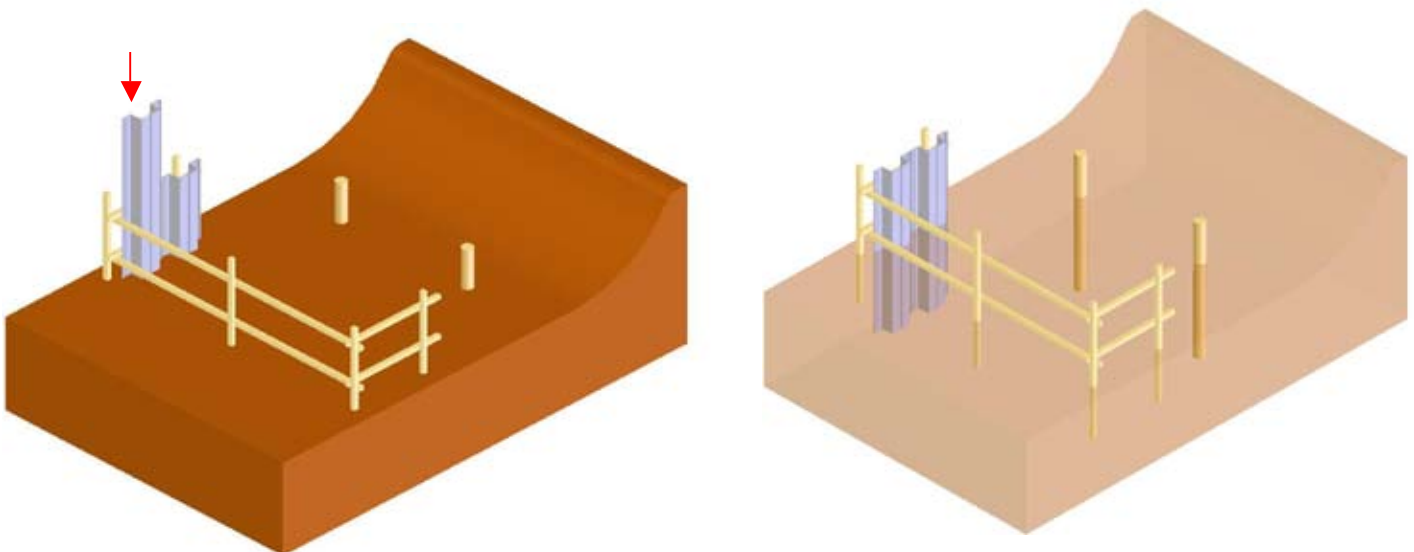
Drive your sheet to the specified depth.



Whether or not your guide includes wales, it is a good idea to lag each sheet to the driving guide after you are satisfied with its position. Lagging your sheets as you go will ensure that your driven sheets will remain plumb as you continue to drive, as well as prevent them from being overdriven as you drive subsequent sheets. If your situation has allowed you to incorporate wales into your guide, then you will be lagging the sheet piling to the wale, eliminating a future step.

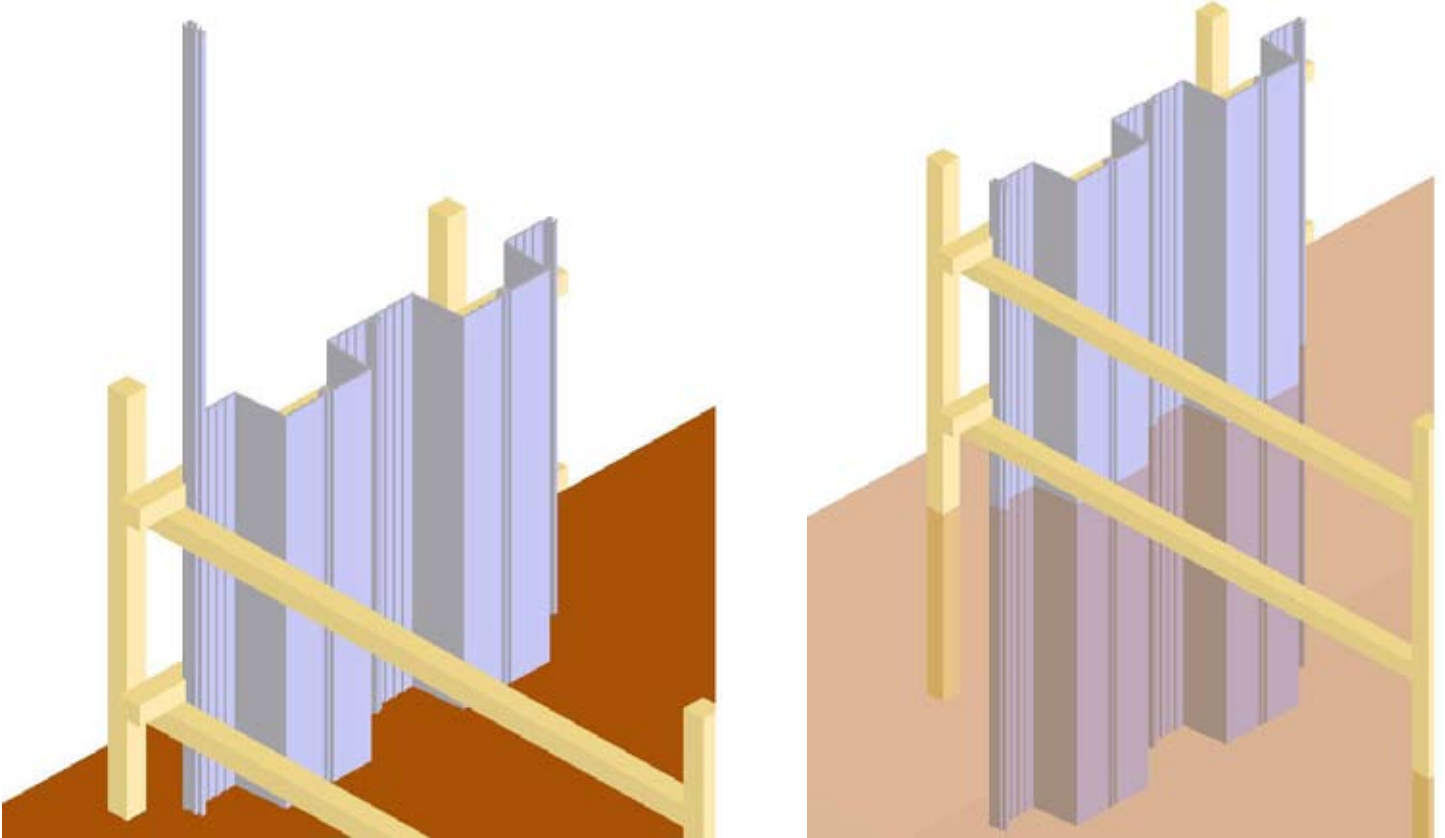


Continue this process for the first straight run of your wall. There should be enough play in the locks and flexibility in the sheets to ensure that each sheet can install in the proper position.

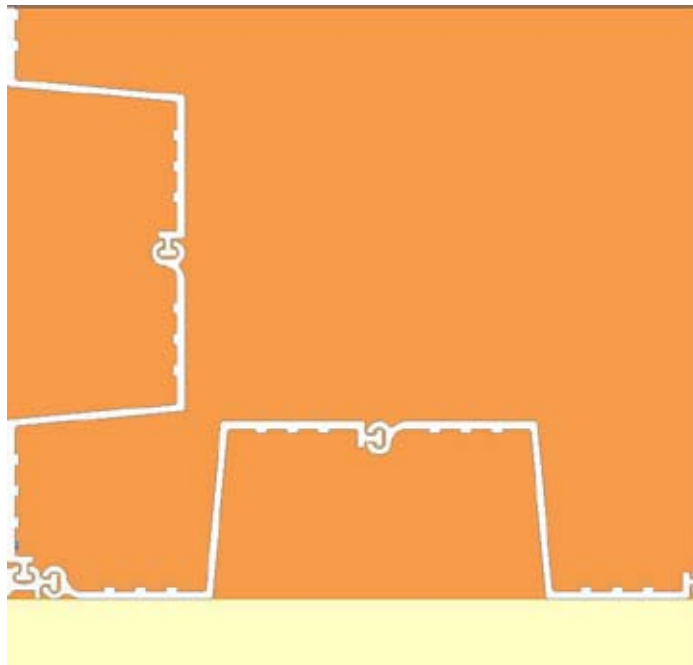


Turning a Standard Corner

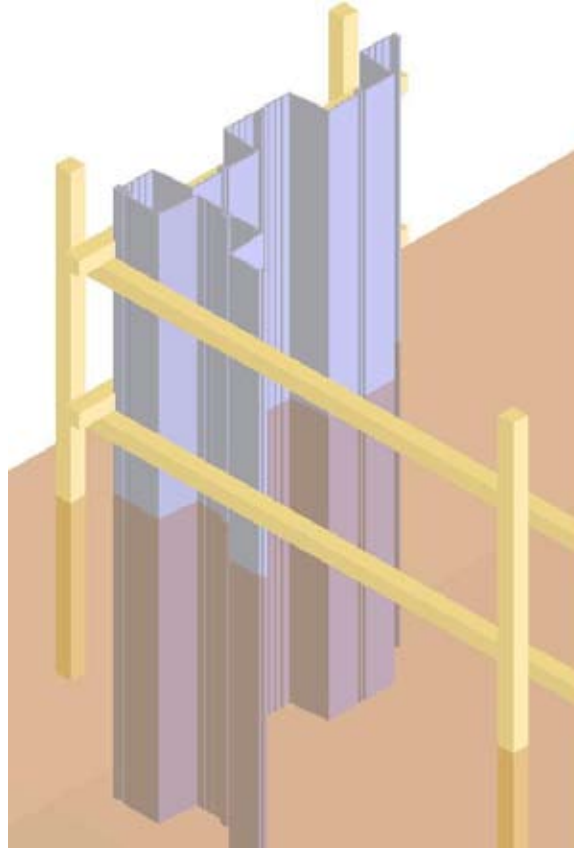
Corner pieces are available for any sheet piling that you might purchase. These pieces come in 90 degree angles, and in most cases, include 45 degree bends as well. Drive these just as you would sheet piling. Alternatively you can thread your corner piece on the leading lock of the last sheet to be driven and drive the sheet and the corner piece together.



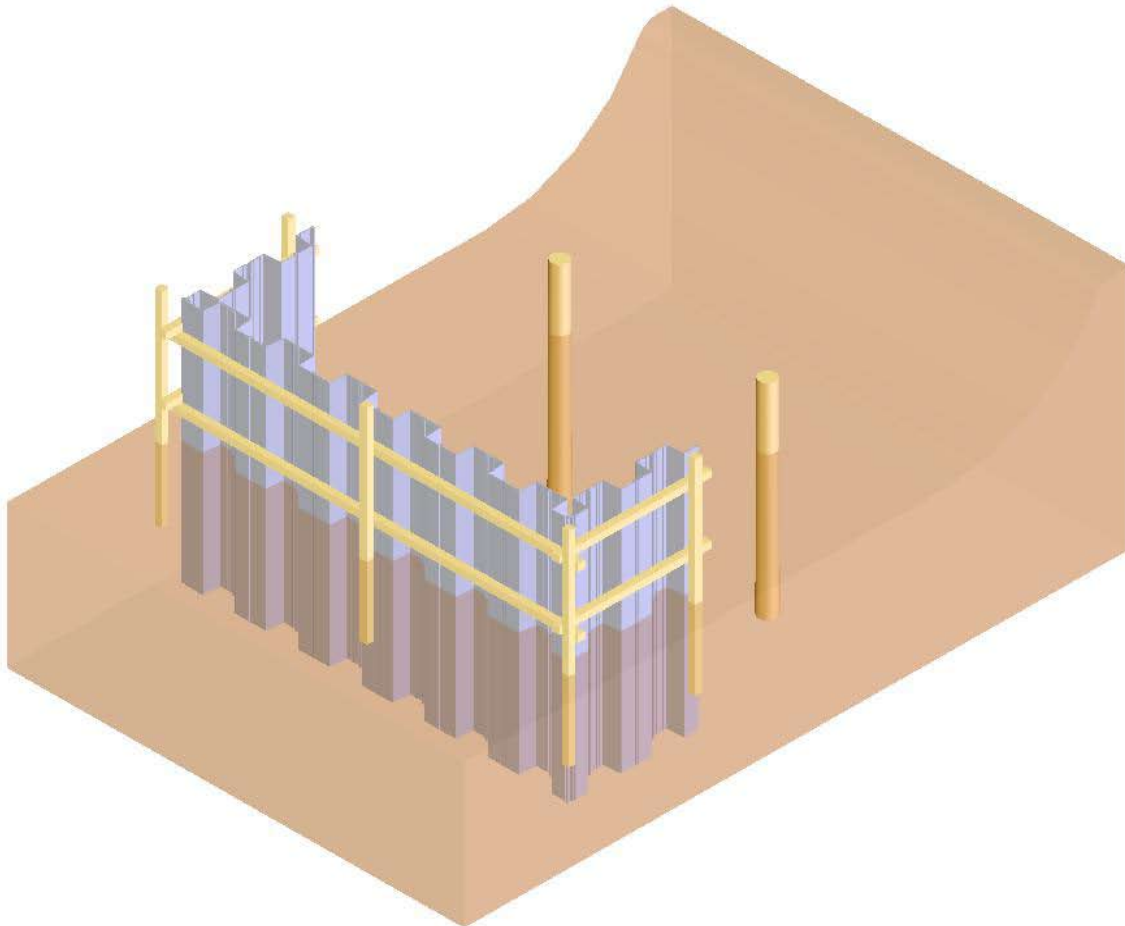
After you are satisfied that your corner is in position, drive your next box section, lining it up, using the corner's male lock and your driving guide.



After you are satisfied that this sheet is properly positioned, secure the sheet to your guide.

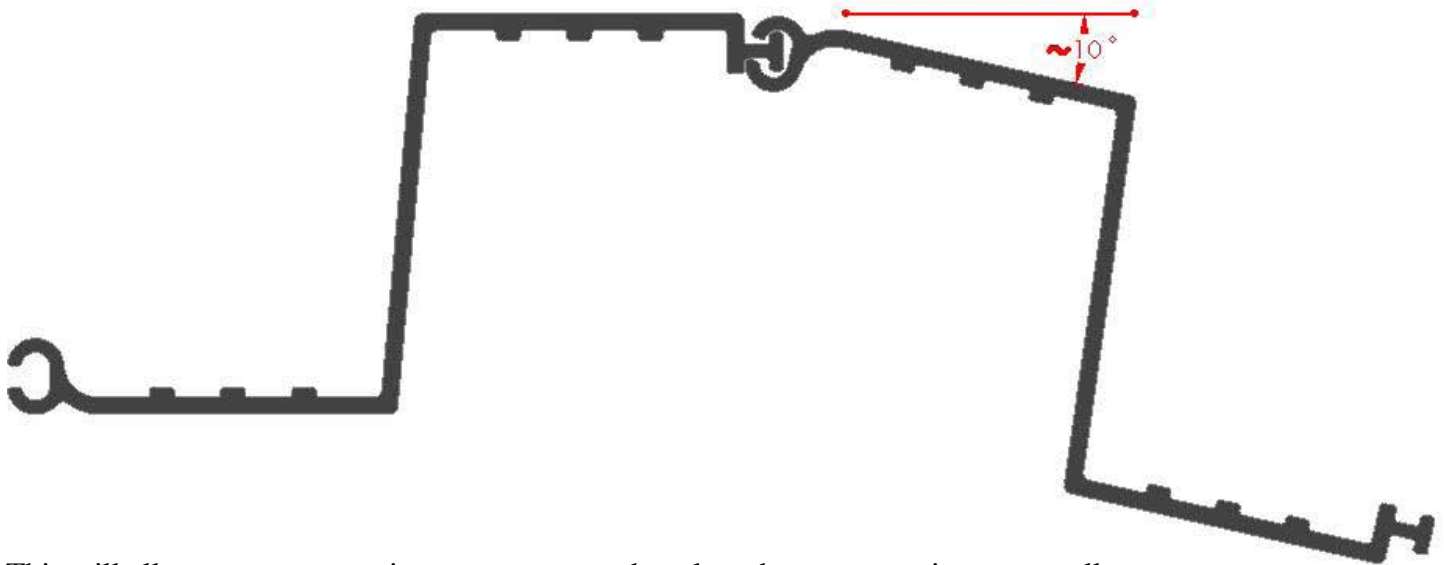


Repeat the steps learned in this section to complete your wall.

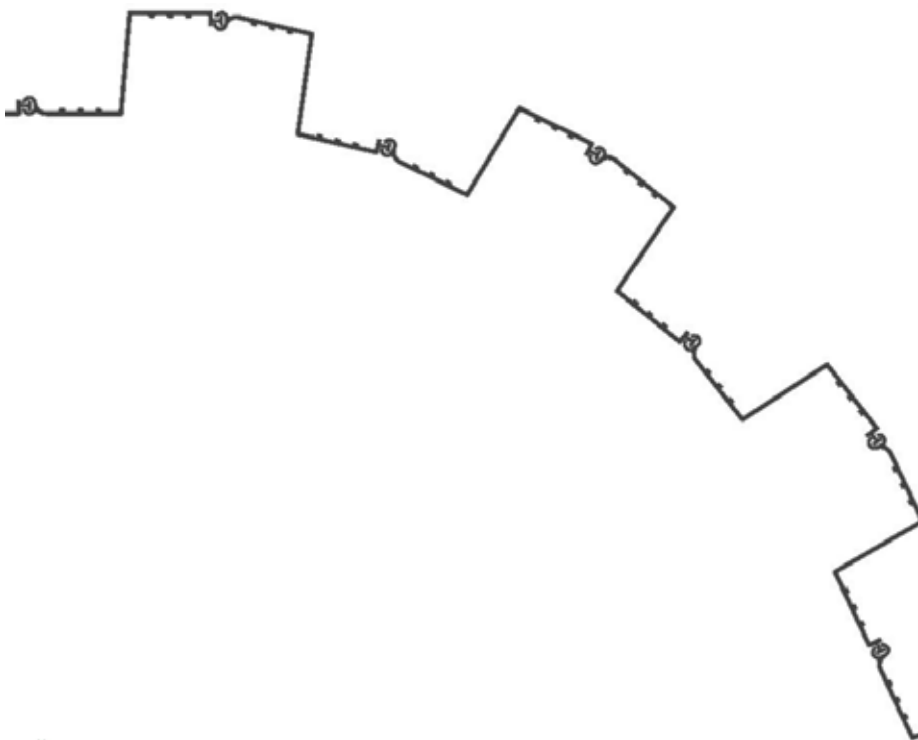


Making a Non-Standard Turn

If you need to make a gradual curve or turn an angle that your particular corner piece does not allow, you can do so by curving the sheets. The tolerance in the locks allows for turns of up to approximately 10° per interlock. (This angle may be greater or smaller, depending on the particular sheet used.)

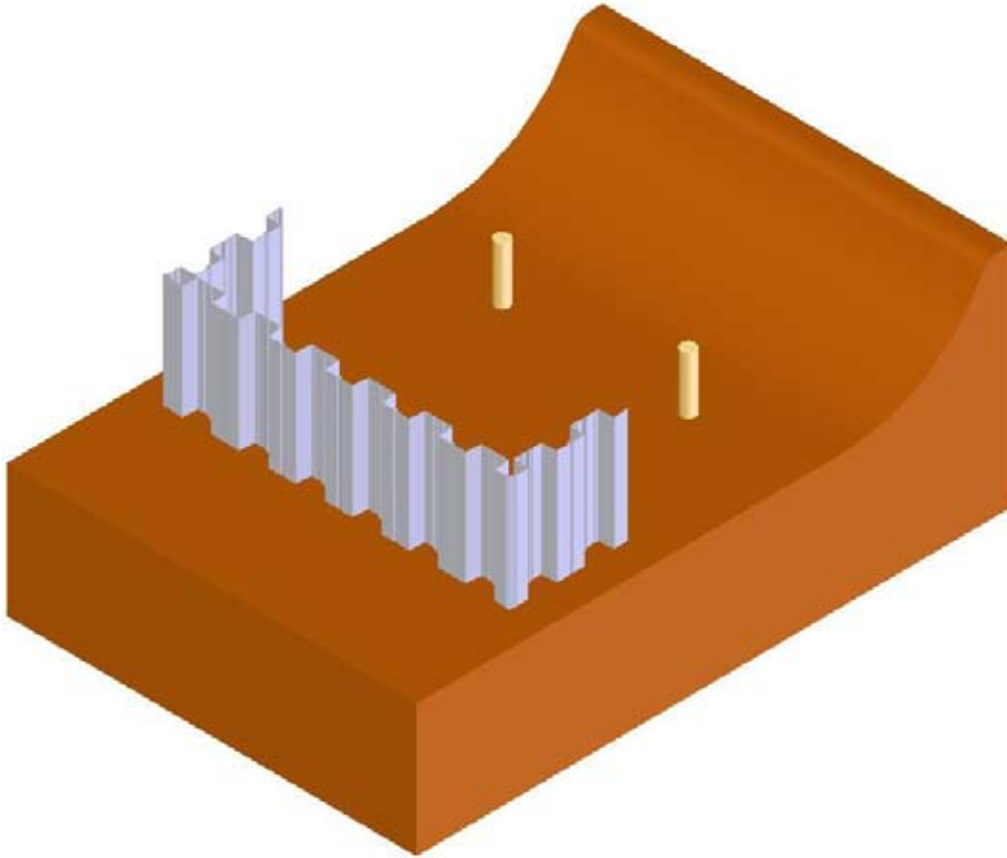


This will allow you to customize your curves and angles when constructing your wall.



Preparing for the next step

Depending on your situation, you will probably need to dismantle your driving guide to some degree. If you incorporated your wales into the guide, then you will only need to remove the posts. If you constructed it with wales and poles, or if it is on the back side and will be buried, then you are already prepared to move on to the next step.



TimberGuard Poles

WARNING

No two walls are the same. The numerous job site variables make it impossible to provide specific construction designs without careful analysis of each variable and the effect it will have on the structure. This analysis should be left up to an architect, professional contractor, or engineer. This manual lists typical installation techniques for demonstration purposes only, and in no way represents any recommendations on how to approach your particular project. Please rely on your engineer for specific design recommendations. Because of the complexity of geotechnical loading calculations and the susceptibility to extreme change of soil loads with minor changes in local site conditions such as soil parameters, water levels, surcharge loads, etc., we strongly recommend the use of design professionals who are familiar with local wall construction to determine the required wall parameters, design techniques, and applicable installation methods and procedures.

WARNING

This manual does not address any safety or regulatory issues associated with its use nor the installation of CMI products. It is the user's responsibility to establish and ensure that all regulated and appropriate safety and health practices are followed. It is also the user's responsibility to ensure that any and all applicable permits and permissions have been secured before installation of any CMI product.

TimberGuard Poles

Materials

TimberGuard poles are very popular because they install similar to wood but have a plastic barrier to provide added protection from the elements and the harsh marine environment. The plastic sleeve does not bond to the wood; it is extruded and vacuum molded around the wood in a patented process. This process allows for expansion and contraction of the wood independent of the plastic sleeve.

It will be up to you to decide what fasteners and peripherals you will need to secure your TimberGuard pole to your structure. It is notable that stainless steel fasteners last longer in most pressure treated wood than other, more corrosive steels.



You may want wrap and/or sealant for covering holes in the plastic sleeve due to fasteners, cuts or any accidental damage. Wrap, and sealant are available for purchase and come in standard TimberGuard colors. TimberGuard Poles are available in the sizes listed below.

TimberGuard Piling	Lengths (FT)
8" Butt	16, 20, 25, 30
10" Butt	16, 20, 25, 30, 35, 40, 45
12" Butt	16, 20, 25, 30, 35, 40, 45

What is included with your order:

TimberGuard Pole	1 - TimberGuard Pole	
------------------	----------------------	---

Available Accessories:

TimberGuard Sealant	1 - Caulk Tube of TimberGuard Sealant	
TimberGuard Wrap	1 - Roll of Wrap (18" x 25') or (18" x 50')	

Applications

Like wooden poles, there are many applications for TimberGuard Poles. You can use them in the same situations as you would regular wooden poles. Some popular applications are included here.

Docks:



Navy Style Seawalls:



Anchors:



Installation

You will not have to re-equip to use TimberGuard. TimberGuard can be driven and installed using conventional construction methods and equipment. Shown here is a very typical installation, using a vibratory plate compactor. TimberGuard's polymer skin is very robust and can stand up to harsh environments and even harsher driving conditions. However, it is a good idea to take some measure to shield it from extremely high impact scenarios as well as impact with sharp objects like the teeth on a backhoe or forklift. Again, vibratory plate compactors are very common, but other types of equipment, such as drop hammers, are often used. If possible, water jetting can greatly increase the ease of driving. It is also very common for poles to be incorporated into driving guides for sheet piling.



Oxygen and light are two of the primary factors that contribute to marine borer survival and rot. Therefore, when accidental or intentional breach of the TimberGuard's polymer skin occurs, you may utilize a roll of TimberGuard wrap or TimberGuard sealant. The wrap is very useful for wrapping splices or large cuts. Wrap the desired area and secure it with fasteners such as screws. Sealant may be used for small holes and to seal up any fasteners that have been installed. Apply it as you would standard caulk. A putty knife is useful for smoothing the sealant out to create a more seamless look. Shown below (left) is a TimberGuard Pole that has had the top cut off and been treated with TimberGuard Sealant. Shown below (right) was a damaged TimberGuard Pole that has also been treated with TimberGuard Sealant.

For the aesthetics and the peace of mind that comes with knowing that your TimberGuard pole is more completely covered it is a good idea to use wrap or sealant. However, breaches in the polymer do not necessarily compromise your product. Even with some minor holes in the polymer protection, the vast majority of the pole is still covered and the amount of oxygen and light allowed to penetrate the wood is very limited.



Wales

WARNING

No two walls are the same. The numerous job site variables make it impossible to provide specific construction designs without careful analysis of each variable and the effect it will have on the structure. This analysis should be left up to an architect, professional contractor, or engineer. This manual lists typical installation techniques for demonstration purposes only, and in no way represents any recommendations on how to approach your particular project. Please rely on your engineer for specific design recommendations. Because of the complexity of geotechnical loading calculations and the susceptibility to extreme change of soil loads with minor changes in local site conditions such as soil parameters, water levels, surcharge loads, etc., we strongly recommend the use of design professionals who are familiar with local wall construction to determine the required wall parameters, design techniques, and applicable installation methods and procedures.

WARNING

This manual does not address any safety or regulatory issues associated with its use nor the installation of CMI products. It is the user's responsibility to establish and ensure that all regulated and appropriate safety and health practices are followed. It is also the user's responsibility to ensure that any and all applicable permits and permissions have been secured before installation of any CMI product.

Wales

ArmorWare/GeoGuard













Materials

After deciding that you will use either ArmorWare or GeoGuard UltraComposite wales, you will need to decide if your application requires STR or standard aluminum inserts. The standard option comes with an 18” splice kit. This kit includes an 18” piece of aluminum insert for every 20’ wale piece, for the purpose of splicing adjacent wale sections. If your application requires a stronger and more rigid beam, then you can upgrade to the STR option, which includes a 20’ aluminum insert for every 20’ wale section to run the entire length of your wale. If you will be turning corners, you should consider buying prefabricated corner inserts. These inserts are roughly 18” in length (from each direction of the angle) and come in 45 and 90 degree angles. These options save fabrication time and provide better stability at the corners, where you need it most. Mounting hardware is included, so you will only need to provide the appropriate tools for wale installation. In order to show clarifying details, non-standard wale lengths are used in the figures for this manual.








Recommended Tools:

- o Drill with a 3/8” hex head socket for hanging the wale with included lag screws
- o Chop saw or any mitering saw that can accommodate the dimensions of the wale
- o Blades appropriate for the material selected (For ArmorWare a blade suitable for cutting the aluminum wale and inserts is required. For GeoGuard a masonry blade or diamond blade is recommended. Because FRP is abrasive, you will need to be prepared to have backups if a standard masonry blade is used.)
- o Measuring and leveling devices for proper wale placement
- o Aluminum Welder, if you will be making non-standard turns or custom inserts

What is included with your order:

ArmorWare Wale 6	1 - 20' ArmorWare wale section	
	1 - 18" aluminum wale insert	
	10 - HDG self tapping lag screws 2.5" long with a 3/8" head	
ArmorWare Wale 6 STR	1 - 20' ArmorWare wale section	
	1 - 20' aluminum wale insert	
	10 - HDG self tapping lag screws 2.5" long with a 3/8" head	
GeoGuard Wale 6	1 - 20' GeoGuard UltraComposite wale section	
	1 - 18" aluminum wale insert	
	10 - HDG self tapping lag screws 2.5" long with a 3/8" head	
GeoGuard Wale 6 STR	1 - 20' GeoGuard UltraComposite wale section	
	1 - 20' aluminum wale insert	
	10 - HDG self tapping lag screws 2.5" long with a 3/8" head	

Available Accessories:

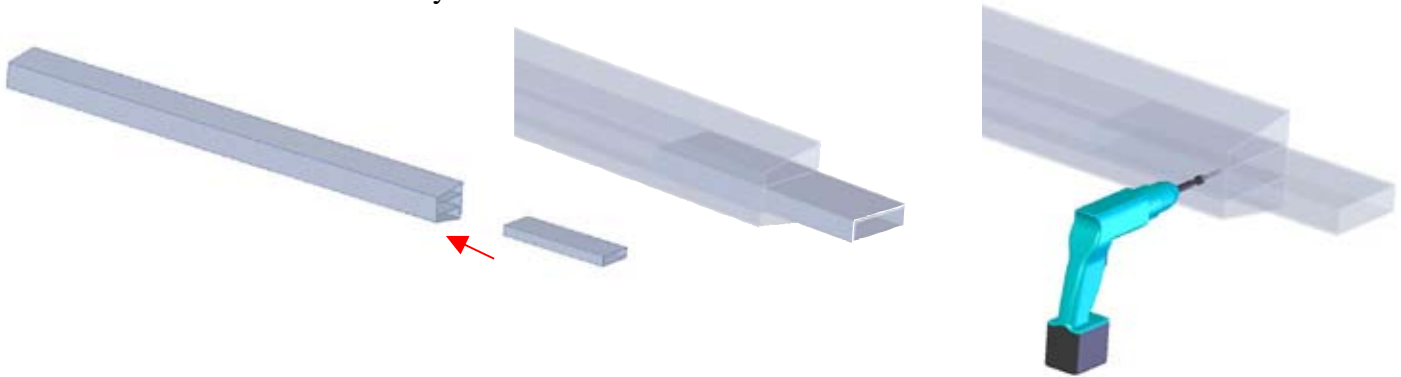
45 degree corner insert	1 - 45 degree corner insert	
90 degree corner insert	1 - 90 degree corner insert	
90 degree corner bracer kit	1 - SS Threaded Rod, 1/2"-13 x 16"	
	2 - Coated Bracer Washers	
	2 - SS Nuts, 1/2"-13	
	2 - SS Washers, 1/2" ID, 1 1/2" OD	
ArmorPaint touch up kit	1 - 12 oz. can (Bronze, Grey, Clay)	

Installation

Hanging your ArmorWare/GeoGuard Wale

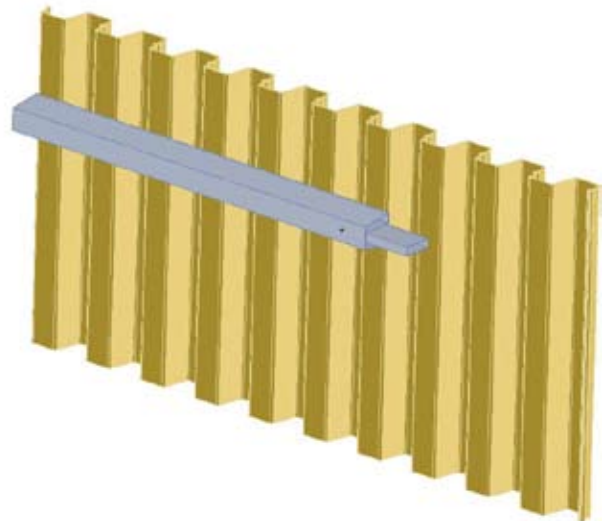
Step 1 – Prepare your wale for hanging

Before you start attaching your wale to your sheet piling, it is a good idea to position your wale insert half in, half out of the wale section as shown, and secure the insert using one of the provided self-tapping screws. We will refer to this as a wale assembly.

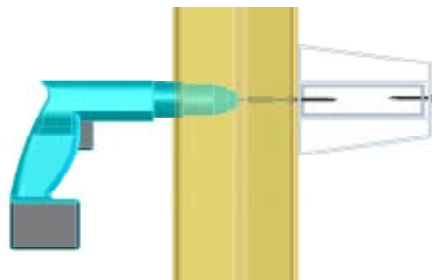


Step 2 – Hanging your first wale section

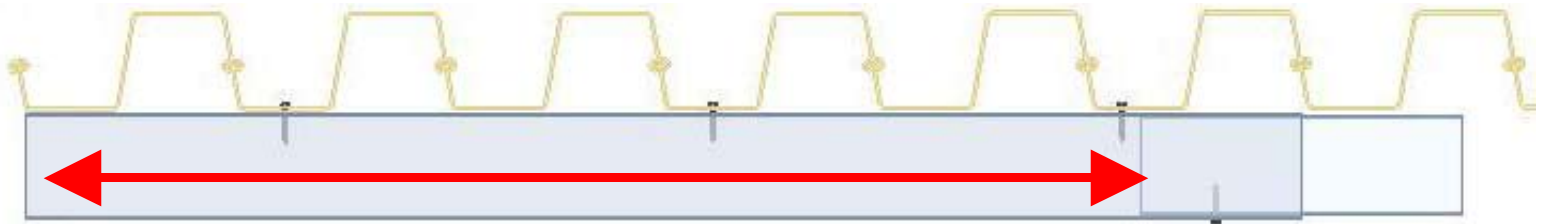
Place this wale assembly on your sheet piling in the desired position for attachment, ensuring that it is level and that the larger parallel face (we will call this the back) contacts the wall. You will probably want to start at one end of your wall and work to the other end. The wale assembly is oriented such that the insert is on the leading end. We will work from left to right for this example.



Secure your *wale assembly* to the sheet piling from the back with the remaining self-tapping screws.



Evenly space the remaining 9 screws over the length of the wale section that does not house any insert (3 shown here). These screws will not be load bearing. They primarily act as a placeholder for your wale until the anchor system is connected.

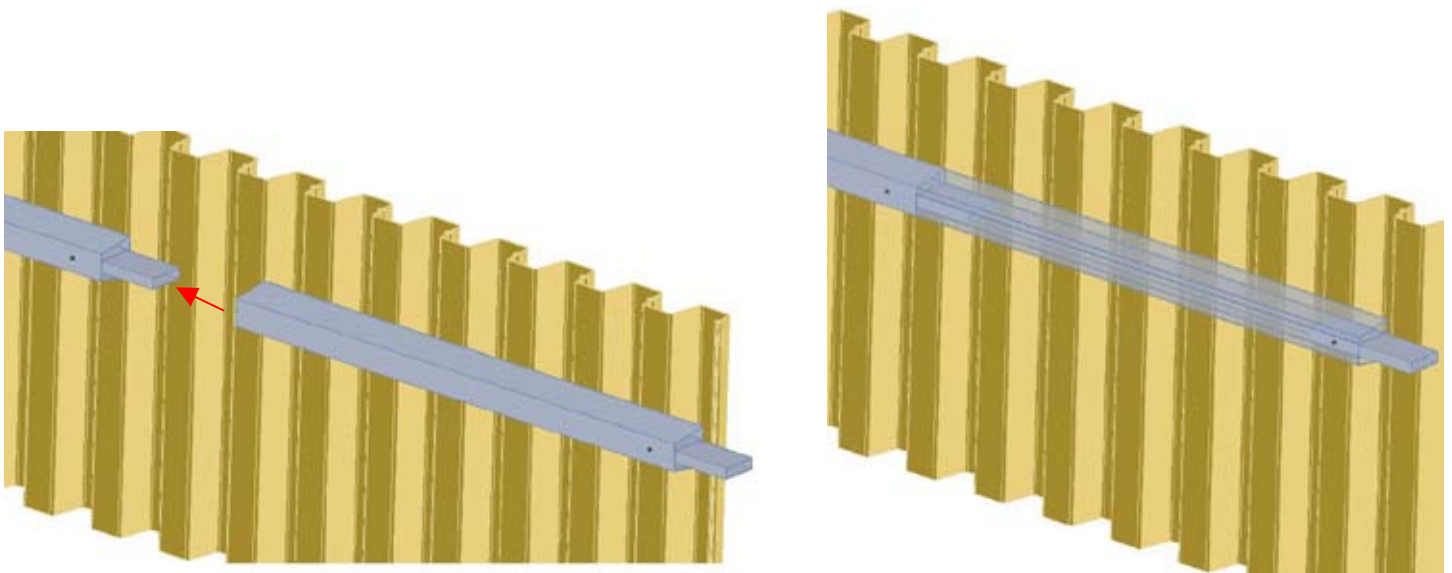


Step 3 – Hanging intermediate wale sections

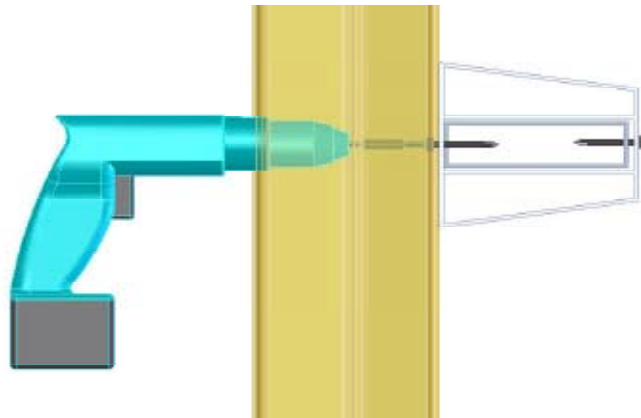
Repeat Step 1 for each intermediate section, creating a wale assembly.



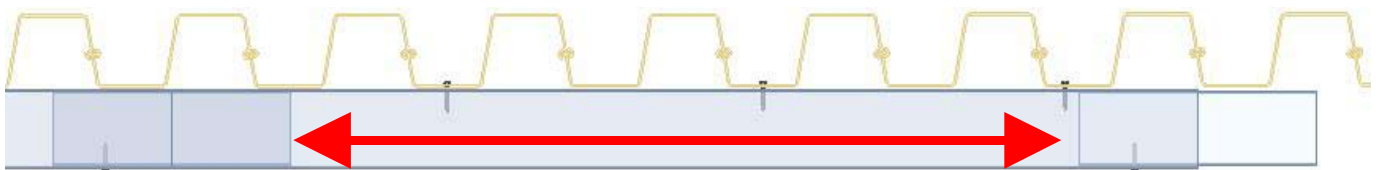
Slide your newly-created wale assembly over the exposed insert section of the previously-hung wale assembly. You will use each hung wale assembly as a guide for the following wale assembly. You will still want to ensure that each is correctly positioned and level before attaching to your wall.



As in the previous step, secure your newly-positioned *wale assembly* to the sheet piling from the back with the remaining screws.



Evenly space the screws over the length of the wale that does not house any insert.

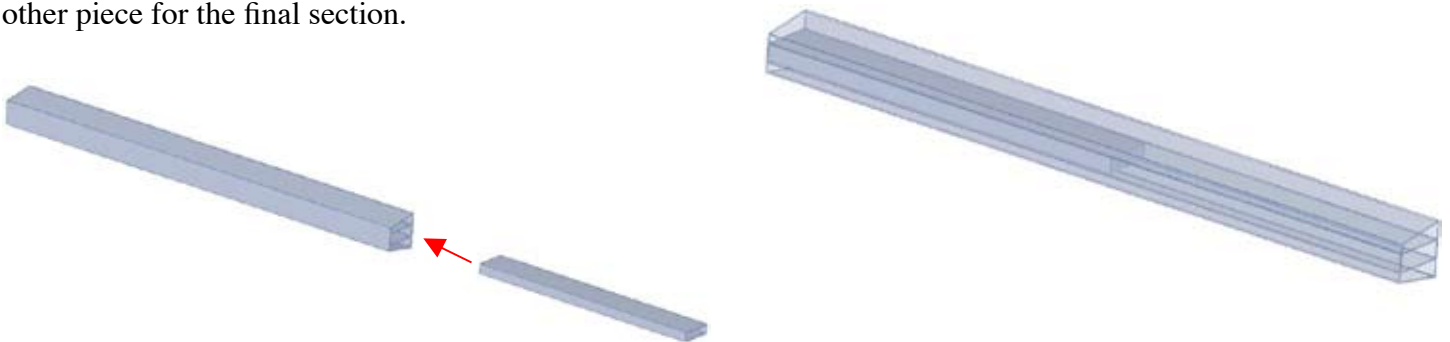


Now repeat this process for all the straight runs of your structure.

Step 4 – Modifying your installation for ArmorWare/GeoGuard Wale STR

Choosing to use the STR package will allow your wale system to more closely approximate a continuous beam than the standard package. The only difference between the two is that the STR package includes a 20' insert in place of the 18" standard insert. This results in the insert running the whole length of your wall, adding strength and rigidity. The STR package is also slightly easier to install than the standard one.

It is recommended that you cut your first 20' structural insert into two 10' lengths for easy installation. Insert one of the 10' lengths into your first wale section so that it is flush with your outside end. You will save the other piece for the final section.



Secure this piece through the front with a self-tapping screw. This is just to keep the insert from moving inside the wale section.



Slide an uncut 20' insert into your wale. Because you have made this 10' piece, every other insert will be half-in, half-out.

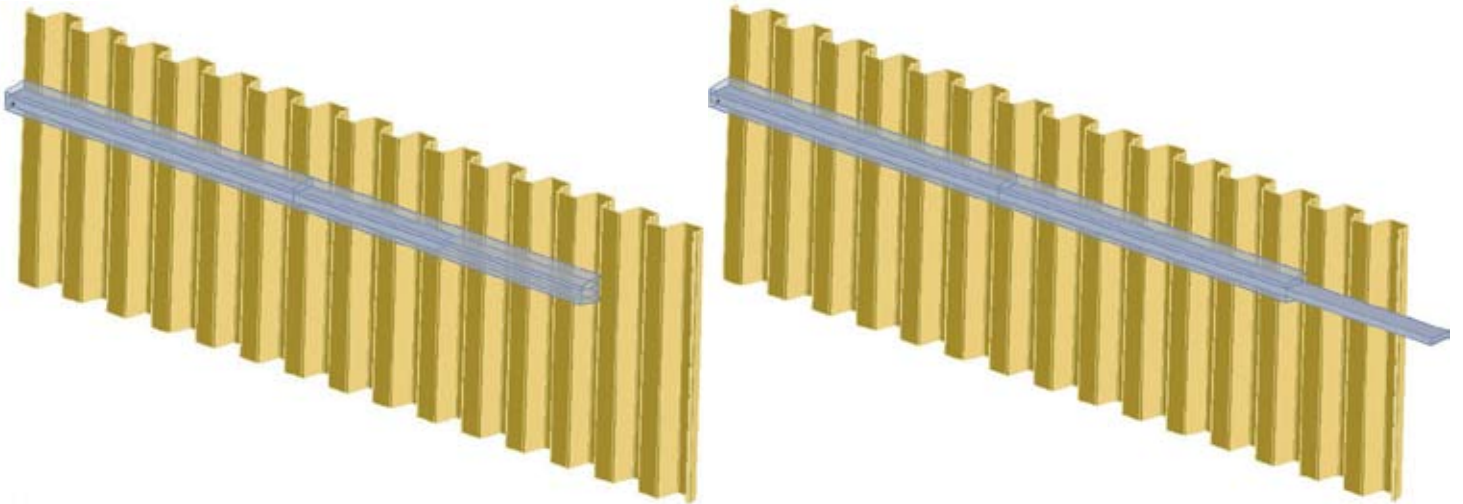


As in Step 2, place this assembly on your sheet piling in the desired position for attachment, and ensure that it is level. You will want to start at one end of your wall and work to the other end.

Secure your newly-positioned assembly to the sheet piling from the back with the remaining 9 screws. Be sure not to screw through the exposed insert, or the next wale section cannot slide over.



Slide a new wale section over the exposed insert section; then, slide in another 20' insert section.



At this point you will secure your unattached wale and insert to the sheet piling. From the back, fasten your unattached wale and insert by evenly spacing all 10 of your self-tapping screws. While you can penetrate the inserts, do not attach the exposed section of the insert, so the next wale piece can slide over the insert.

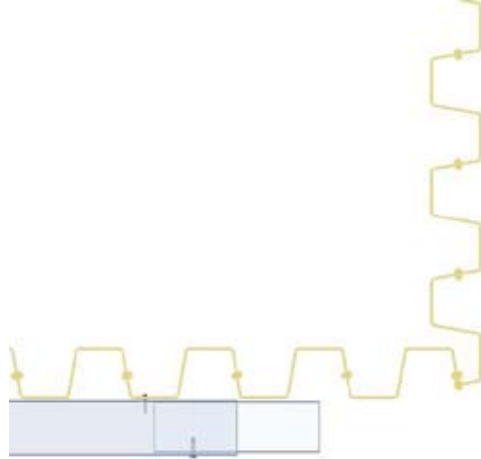


Repeat this process for all the straight runs of your structure.

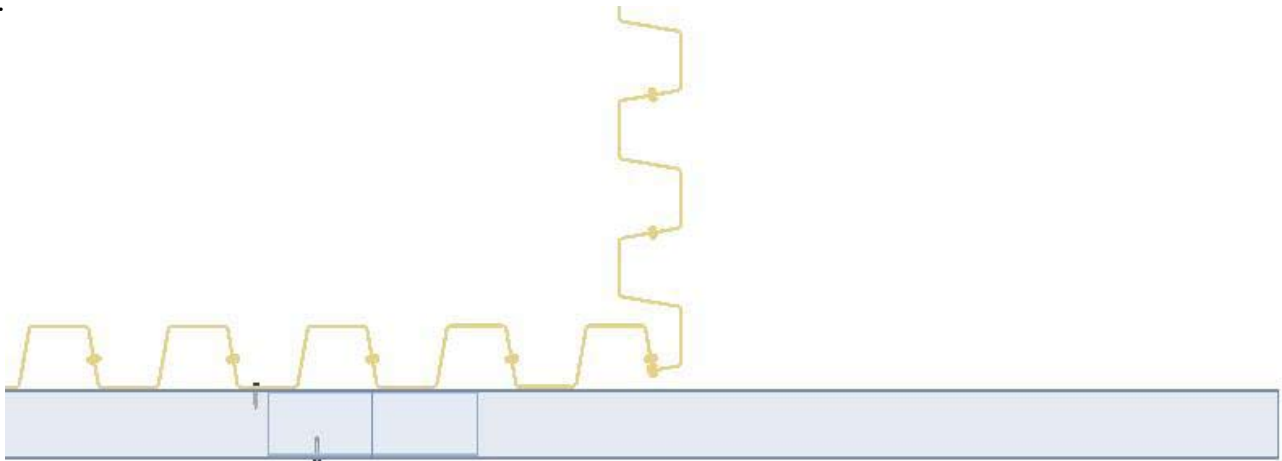
Turning a corner with your ArmorWare/GeoGuard Wale

Step 1 – Preparing to turn a corner

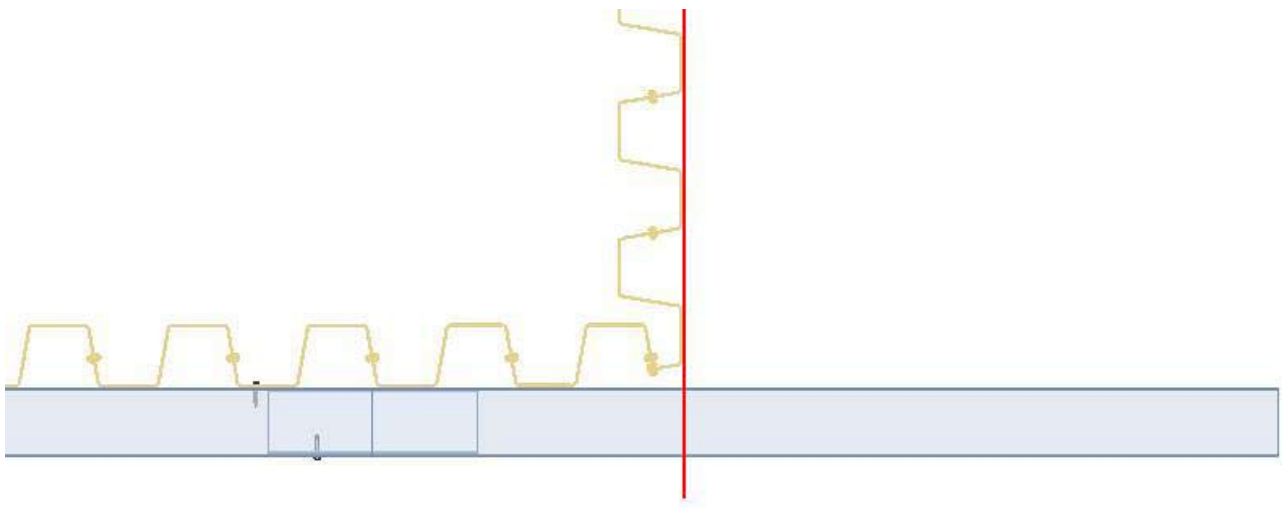
For this example we will show the standard ArmorWare/GeoGuard Wale package turning a 90 degree corner. This process will use a 90 degree corner insert. CMI also offers 45 degree corner inserts, but the process for turning a 45 or a 90 degree corner is fundamentally the same. When you reach a corner, you will want to stop so that your last *wale assembly* fits within the straight section of the wall. You should plan so this does not happen too close to the corner.



You will want to slide the next wale section on, in order to identify and mark where your miter cut needs to be made.

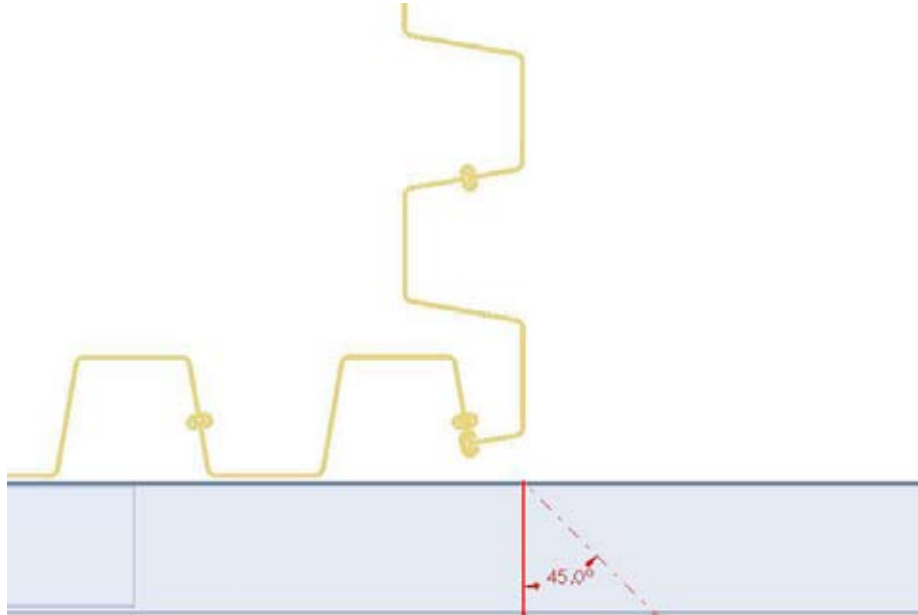


Extend a line from the angled face and transfer a construction line to the wale section using a marking device.



Step 2 – Making your cuts

Since this will be a mitered cut, your cut angle will be 1/2 of your actual turned angle. For this example of a 90 degree turn, we will cut at a 45 degree angle from our construction line. For a 45 degree turn, the cut would be made at 22.5 degrees and so on. For accurate cutting, you should use a chop saw, miter box, or have them professionally mitered. It is important to note that the wale is angled, and can be very hard to make an accurate miter cut. This should not be attempted without using appropriate mitering equipment.

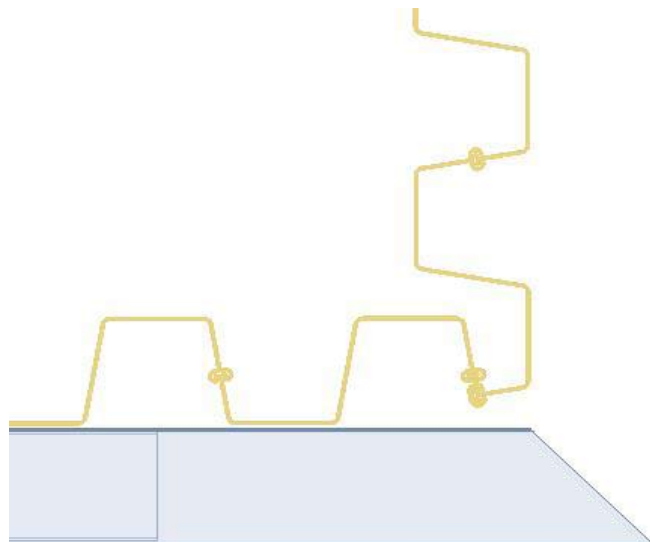


Slide off your marked wale section and cut your angle. You might want to go ahead and cut your other miter corner piece as well, since you are already cutting. You should make your second corner piece from a new 20' section so that the next splice occurs as far from the corner as possible. For this cut you will make the matching miter cut 22.5 or 45 degrees from perpendicular, respectively, for a 45 or 90 degree turn.

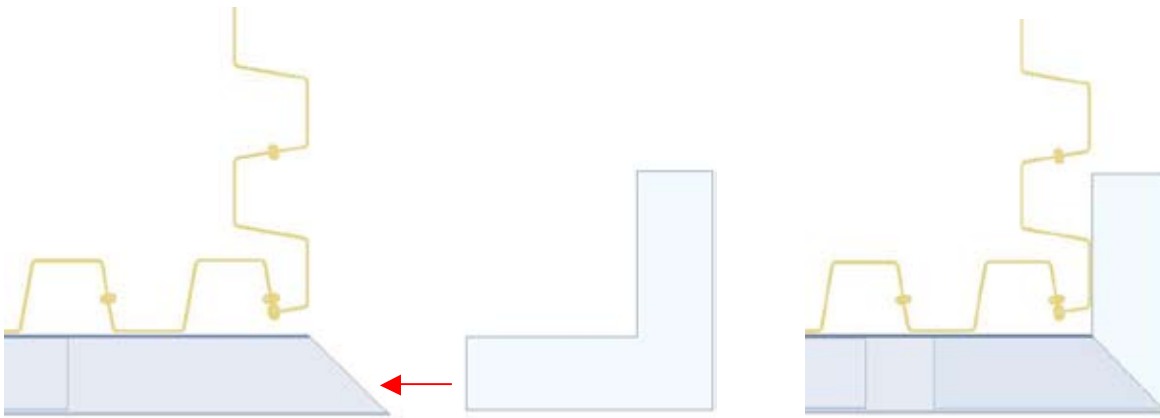


Step 3 – Installing your corner

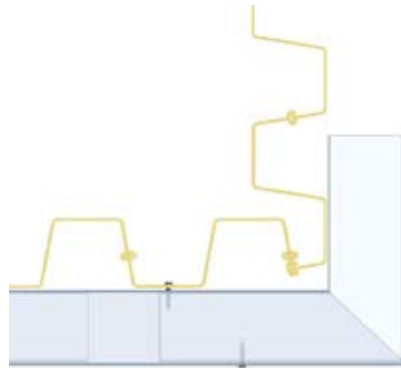
After you have made your cuts, you are ready to assemble your corner. Slide your first cut wale section onto the exposed insert.



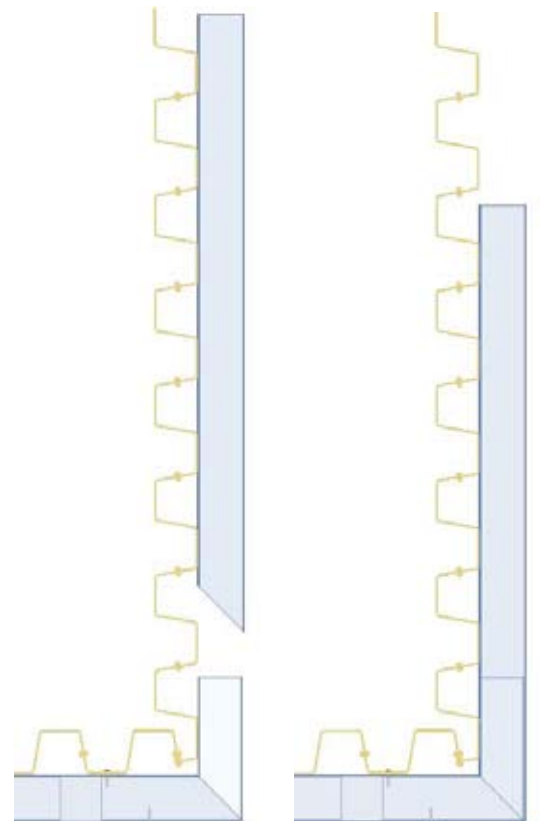
Insert the appropriate corner insert, in this case a 90 degree corner insert, into the wale section.



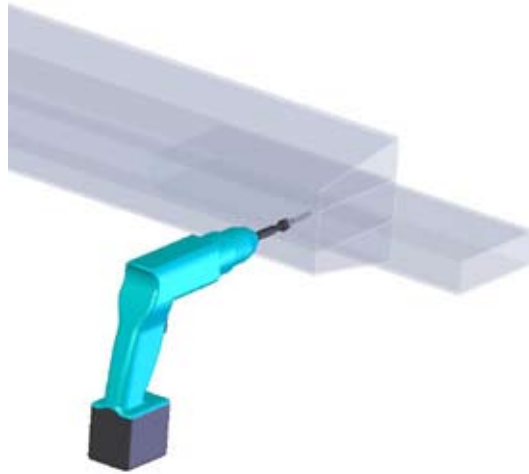
You will use the same attachment principals learned in the **Hanging your ArmorWare/GeoGuard Wale** section. You will secure the insert to the previous wale and use it as a guide for the next. It is a good idea to temporarily slide your second cut wale section on to mock up your corner before you attach it. Secure the first cut wale section and corner insert with the provided self-tapping screws. You are provided 10 screws for every 20' of wale, so you should gain some extra screws in the corners.



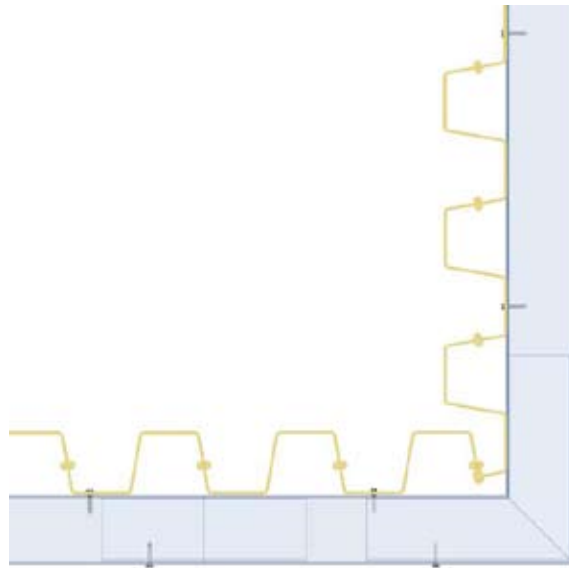
Slide your second cut wale section onto the exposed corner insert.



If you are going to continue wale placement on this wall face, you might want to create a wale *assembly* (**Step 1, Hanging your ArmorWare/GeoGuard Wale**) with this wale section for easier future installation.



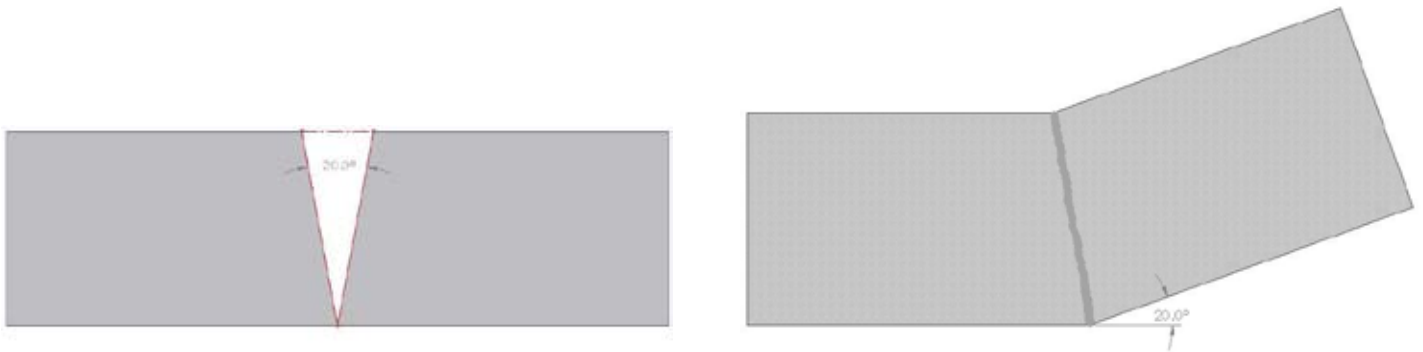
Attach this wale section or wale *assembly* to the wall as you would have in the **Hanging your ArmorWare/GeoGuard Wale** section.



It is important to note that this installation scenario requires that the load on the corners not be excessive. Excessive load on the corners can be avoided by placing your anchor tie rods as closely as possible to the corner. Otherwise, all of the load at the corner would transfer to the screws, as it tries to spread. These screws are not made for carrying load. If you anticipate a significant load concentration in the corner, other support options need to be considered, such as a braced corner as described later.

Step 4 – Modifying your installation for non-standard turns

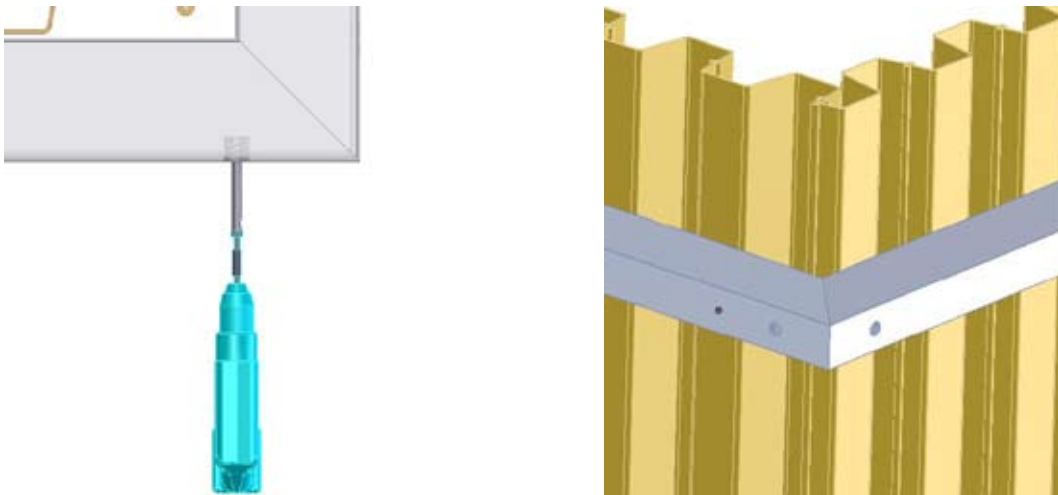
If you will be making a turn other than 45 or 90 degrees, the process is identical, only you will need to fabricate your own corner inserts. You can use a provided splicing insert for this. Miter cut the insert using the same process and at the same angle as you would cut your wale sections. Weld the two mitered aluminum insert pieces together to create your own custom corner insert, and the corner turning process is the same as above.



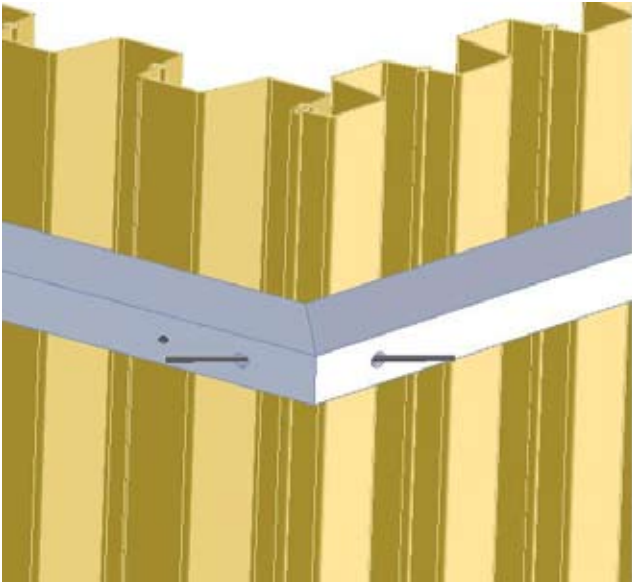
Step 5 – Modifying your installation for a Braced Corner

If you anticipate a need for more stability on your 90 degree corners, then you will want to consider the use of a 90 degree corner Bracing Kit. This kit helps hold your corner together under load.

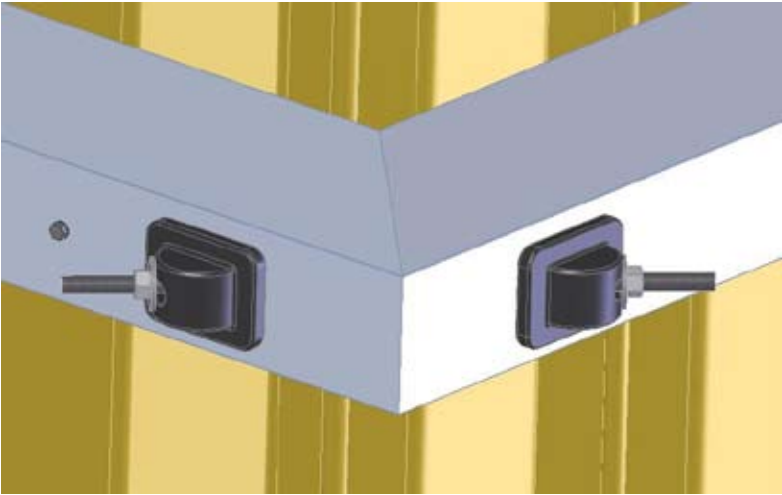
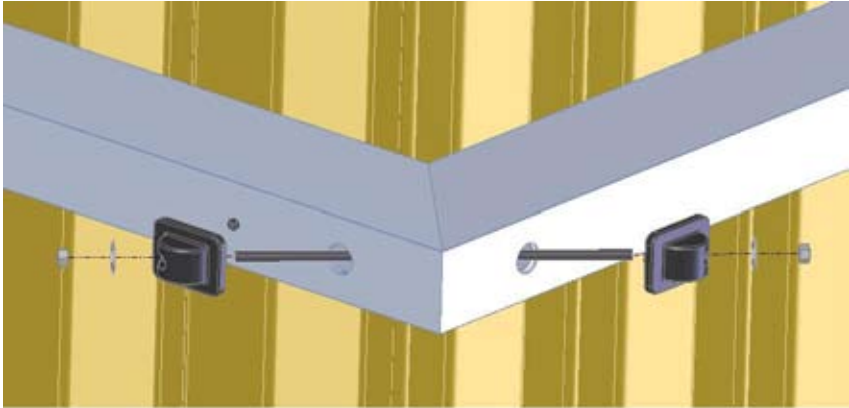
Drill two vertically centered 1 1/2” holes, one on each side of the corner joint and straight into the face. Place the holes approximately 6” from the joint or just line them up with the inside corner of the wale. These holes only need to penetrate the outer face of the wale section and the corner insert piece inside. A couple inches will do it.



Insert the 16" threaded rod through both holes



Attach included washers and nuts, oriented as shown. Tighten the nuts.



Touch Up and Maintenance of Your ArmorWare Wale

Although ArmorWare Wales and inserts are made from high quality marine grade aluminum, as is the case with all metallic material, there is a possibility of corrosion in some cases. It is always a good idea to carefully inspect your structure for any area that may be susceptible to corrosion.

Wherever the anodized coating on the cap has been damaged it is necessary to buff the area and apply a fresh layer of touch-up paint. It is also important to grind down and buff any jagged edges and apply a fresh coat of touch-up paint.

Periodically through the life of the structure it is advisable to closely inspect all the components of your structure. If there is any evidence of damage to the wale coating or the onset of corrosion, you can dramatically increase the life of your structure by buffing the area, removing any corrosion and applying a fresh coat of touch-up paint.

TimberGuard

Materials

TimberGuard wales are very popular because they install similar to wood but have a plastic barrier to provide added protection from the elements and the harsh marine environment. The plastic coating does not bond to the wood; it is extruded and vacuum molded around the wood in a patented process. This process allows for expansion and contraction of the wood independent of the plastic sleeve.

For the most part you can treat TimberGuard generally as you would wood for installation purposes. It will be up to you to decide what fasteners and peripherals you will need to use for lagging the TimberGuard Wales to the sheet and splicing them together. It is notable that stainless steel fasteners last longer in most pressure treated wood than other, more corrosive steels.


You may also need end caps, which are plastic caps used to cover any exposed ends that you may create. You may want wrap and/or sealant for covering holes in the plastic sleeve due to fasteners, cuts or any accidental damage.. Caps, wrap, and sealant are available for purchase and come in standard TimberGuard colors. TimberGuard dimensional lumber is available in the sizes listed below.

Timber Dimensions	Color Options	Lengths (FT)
2" X 6"	Clay, Grey, Brown	16, 20
2" X 8"	Clay, Grey, Brown	16, 20
3" X 8"	Clay, Grey, Brown	16, 20
4" X 4"	Clay, Grey, Brown	10, 18
4" X 6"	Clay, Grey, Brown	16, 20
6" X 6"	Clay, Grey, Brown	16, 20
6" X 8"	Clay, Grey, Brown	16, 20
8" X 8"	Clay, Grey, Brown	16, 20
10" X 10"	Clay, Grey, Brown	16, 20

Recommended Tools/Hardware


- o Tools and fasteners needed to lag wale to the sheet
- o Saw for cutting wale joints
- o Measuring and leveling devices for proper wale placement
- o Drill with standard bit for drilling through wood/vinyl
- o Through bolts with nuts and washers for connecting wale joints
- o Appropriate fasteners for securing corners


What is included with your order:

TimberGuard Wale	1 - 16 or 20 ft TimberGuard Wale	
------------------	----------------------------------	---

Available Accessories:

TimberGuard End Cap	1 - TimberGuard End Cap	
---------------------	-------------------------	--

TimberGuard Sealant	1 - Caulk Tube of TimberGuard Sealant	
---------------------	---------------------------------------	---

TimberGuard Wrap	1 - Roll of Wrap (18" x 25') or (18" x 50')	
------------------	--	---

Installation

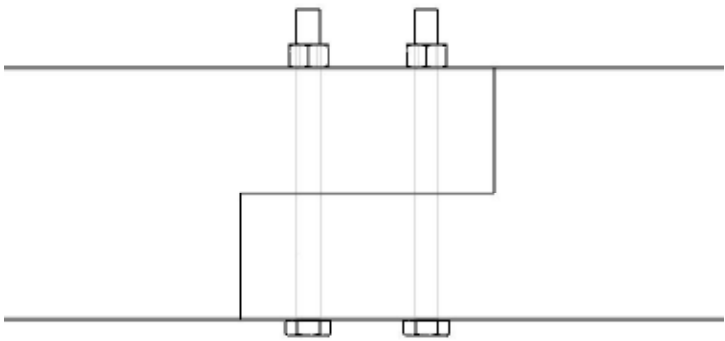
Hanging your TimberGuard Wale

Step 1 – Prepare your wale for hanging

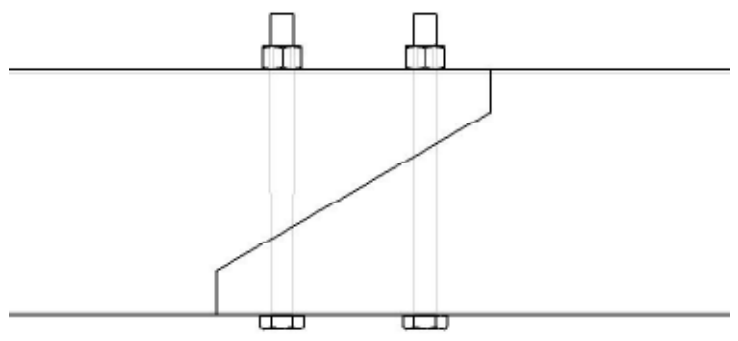
There are many different ways to approach wooden wale installation. For example, many people incorporate their wales into their false work, so that they can also be used as a driving guide. Our guide follows a generic example. For more details on wale installation, see the section titled ArmorWare/Geo-Guard Wales.

Step 2 – Prepare your joints

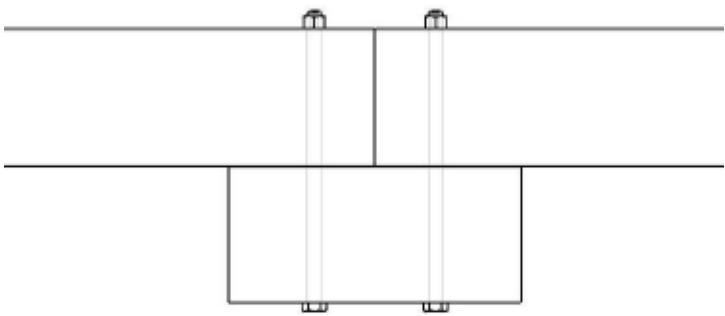
There are also many types of joints in woodworking. Several are shown here. Finding a balance between aesthetics, structural requirements, and ease of installation for your application will dictate what type of joint you will use.



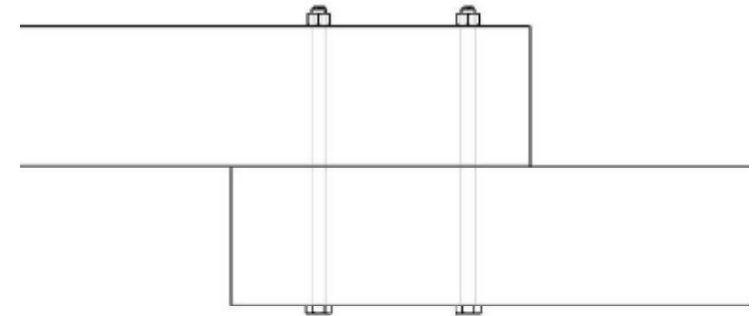
“Standard Shiplap”



“Angled Shiplap”

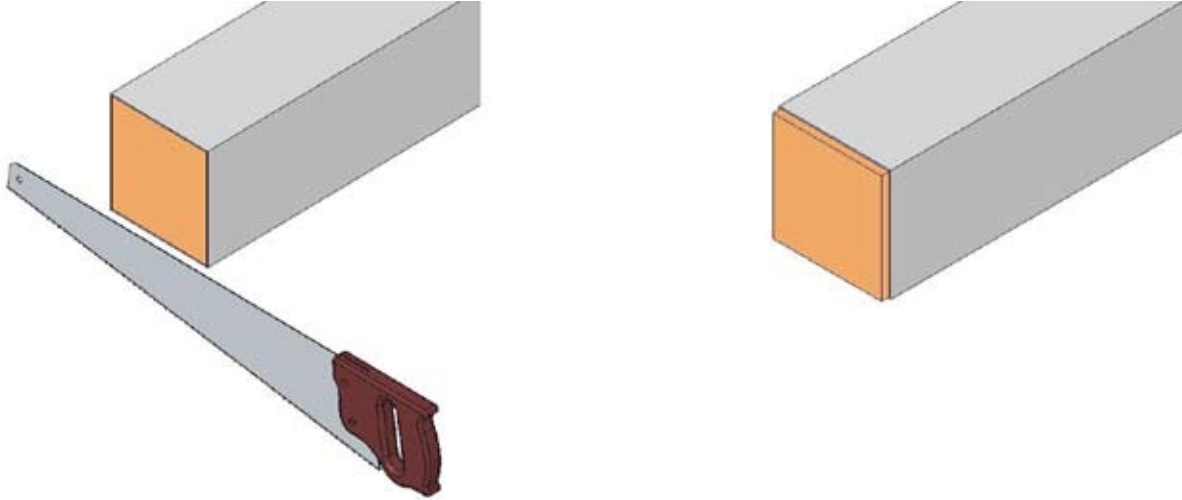


“Butt Blocked”

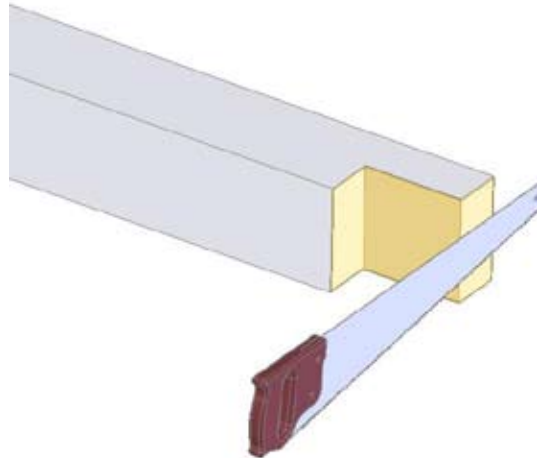


“Vertically Staggered”

Due to the vacuum molding process, the plastic coating is tightly stretched around the wooden core. Because of this, when TimberGuard is cut, the plastic tends to relax and pull back slightly from the newly cut face. One effective method to ensure that you have a clean looking joint is to allow the plastic coating to relax before your joint is cut. Precut your TimberGuard wale to allow the plastic coating to find its natural resting place.



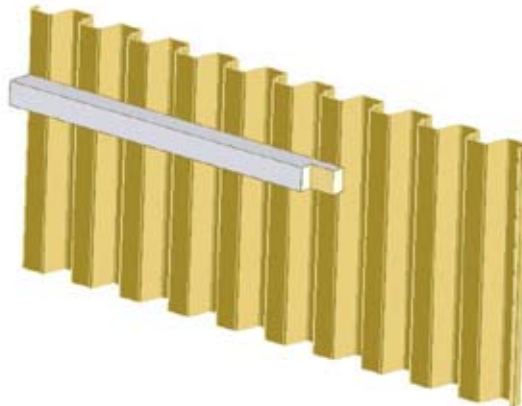
Now cut your joint, and the plastic will be flush with the newly cut wooden face. You can plan ahead and precut all your TimberGuard or cut each joint as you go.



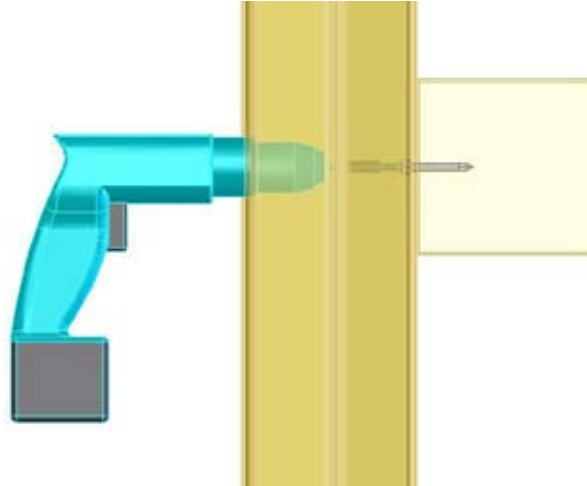
Step 3 – Hanging your first wale section

Place your TimberGuard wale on your sheet piling in the desired position for attachment, ensuring that it is level. The orientation of the joint depends on the situation but primarily on personal preference. We will use the first joint shown above, a standard shiplap, for our example. This joint is very universal. The same joint shape can be used to turn 90 degree corners as well.

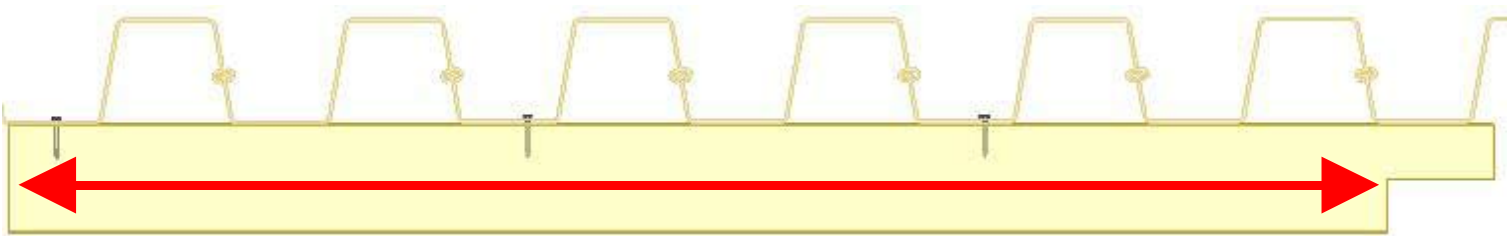
You will probably want to start at one end of your wall and work to the other end.



After aligning and leveling your first section, secure your TimberGuard wale to the sheet piling from the back with evenly-spaced lag screws. You do not want to penetrate your joint with screws because you will be securing it with bolts in a later step.

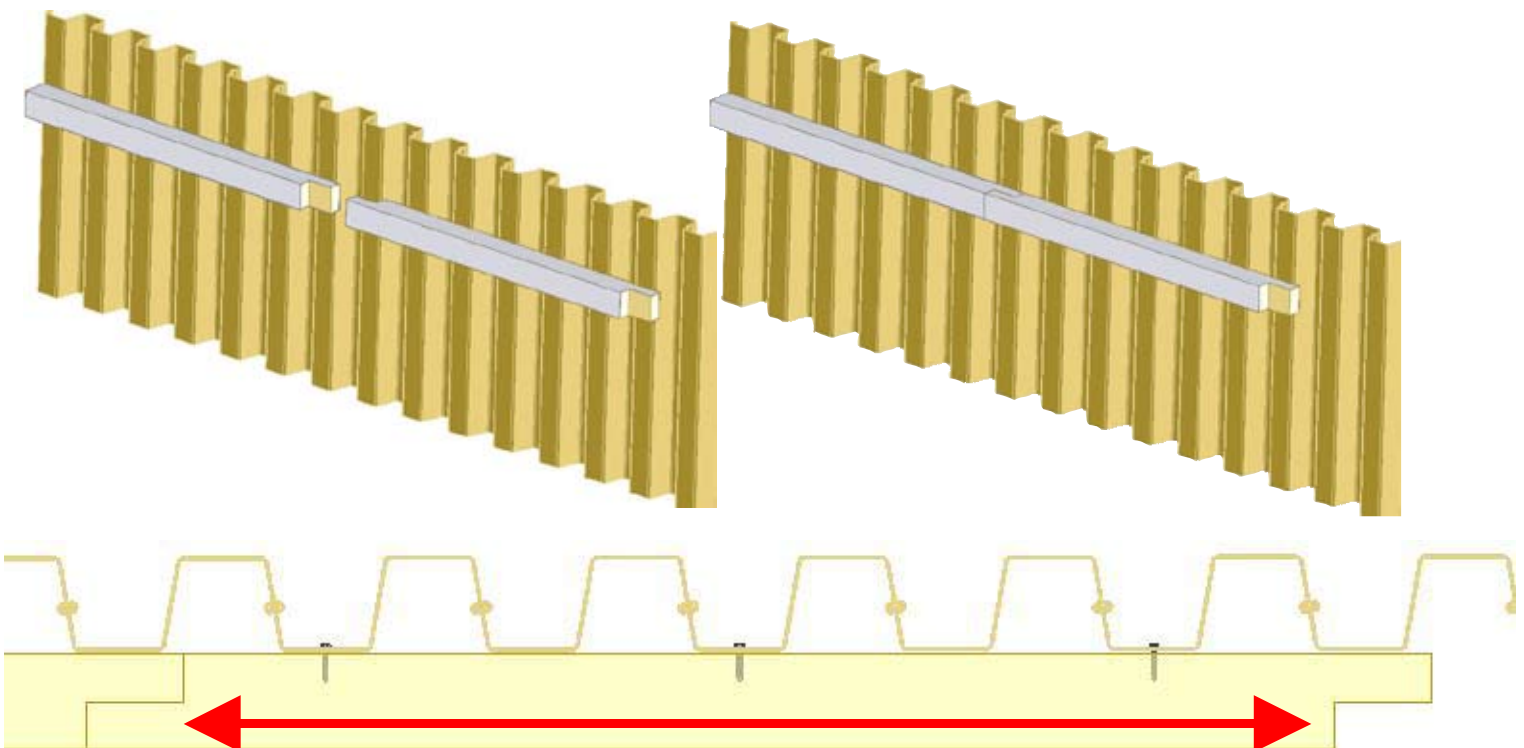


These screws will not be load bearing. They primarily act as a placeholder for your wale until the anchor system is connected.



Step 4 – Hanging intermediate wale sections

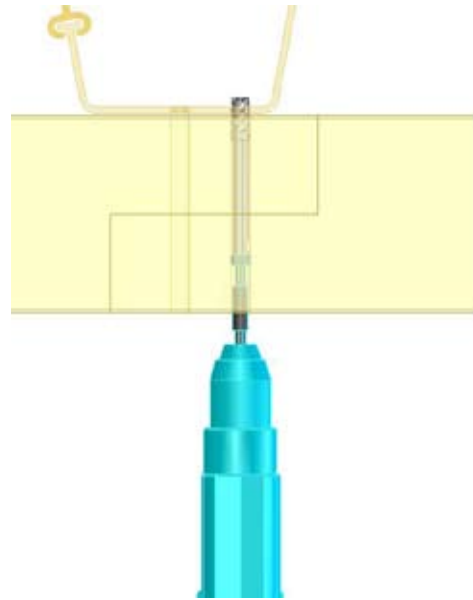
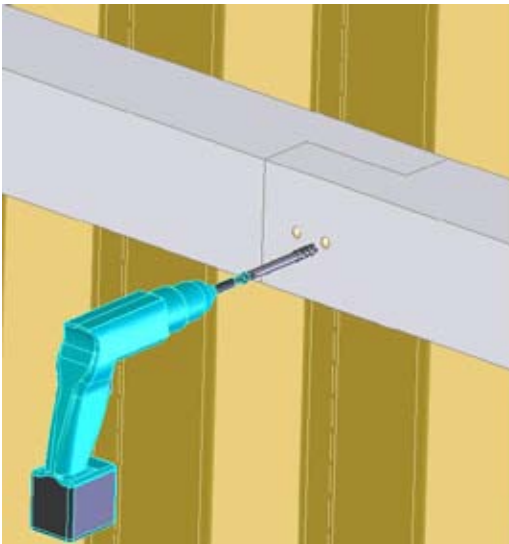
You will need to cut two joints for each internal wale piece, one on each end to match your previously-hung wale section and your next wale section to be hung. Properly position this wale section on your wall and lag screw it through the back as you did in Step 3. Again, it is a better idea not to lag through joint sections.



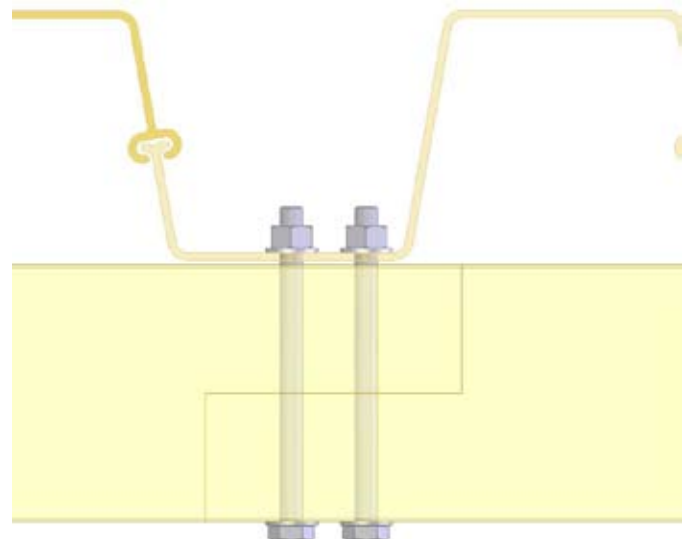
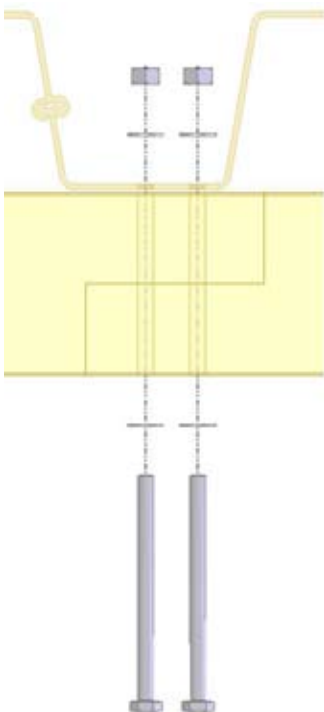
Step 5 – Securing your joint

At this point, your joints are the weakest part of the wale. You want to eliminate these weak spots by securely binding them together. The wall type, joint type, and personal preference will dictate how you accomplish this. One of the easiest ways to lock them together is with bolts, nuts, and washers. Since these bolts will be load bearing, you will need to make sure that the fasteners you select are capable of withstanding all of the forces that will be applied to it. The joints are easier to secure when they fall on either a flat face or a gap within the sheet piling corrugation. If at all possible, try to keep them from landing on web sections for simpler bolt installation.

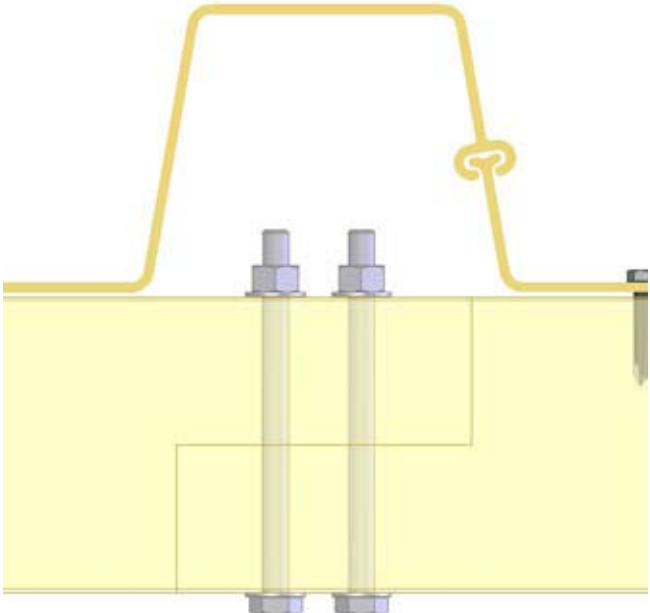
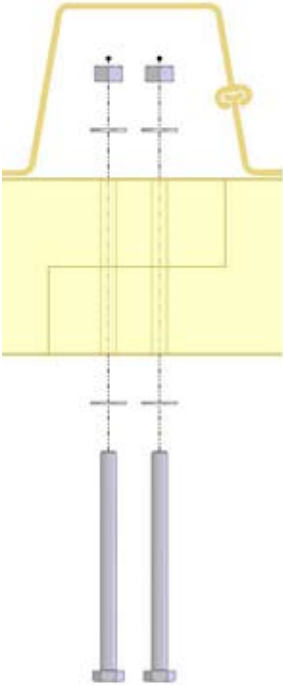
When the joint falls on a flat face, you will want to drill the bolt holes all the way through the TimberGuard and your sheet piling.



Assemble your fasteners and tighten the nuts.



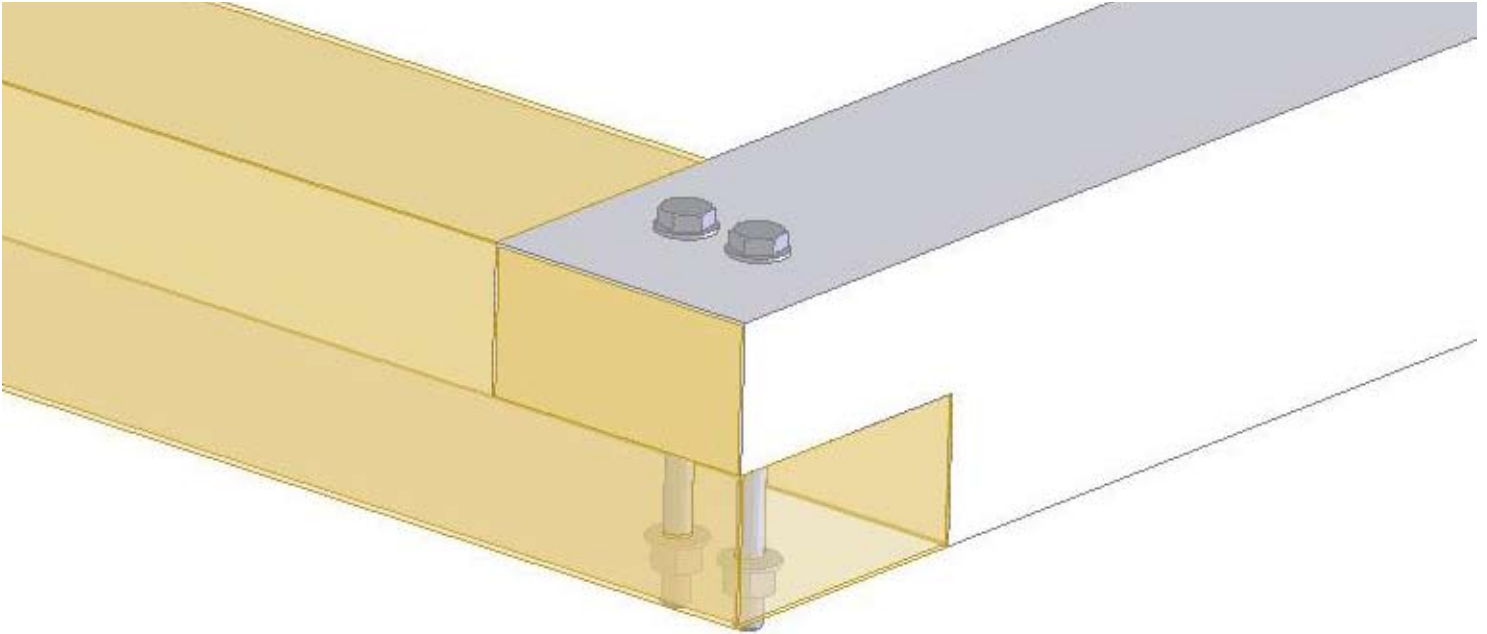
The process is the same if your joint lands on a gap. However, you will only bolt through the TimberGuard, not the sheet piling.



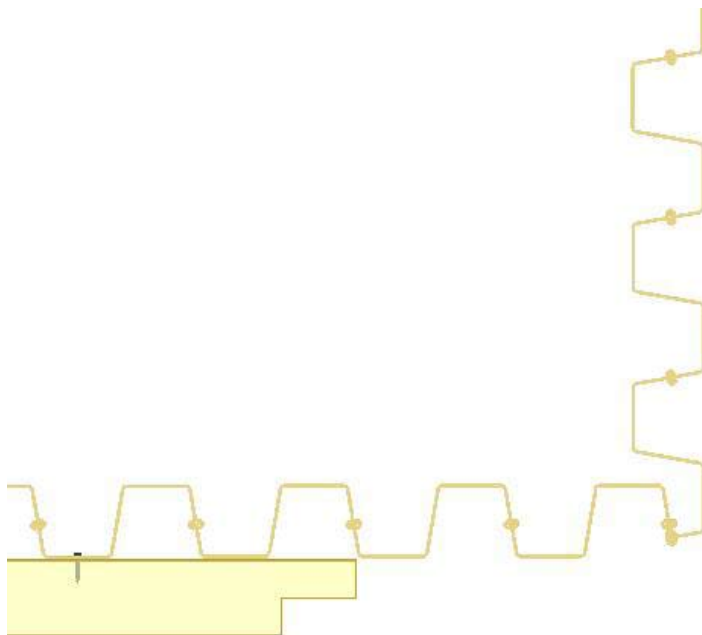
Turning a corner with your TimberGuard Wale

Step 1 – Preparing to turn a corner

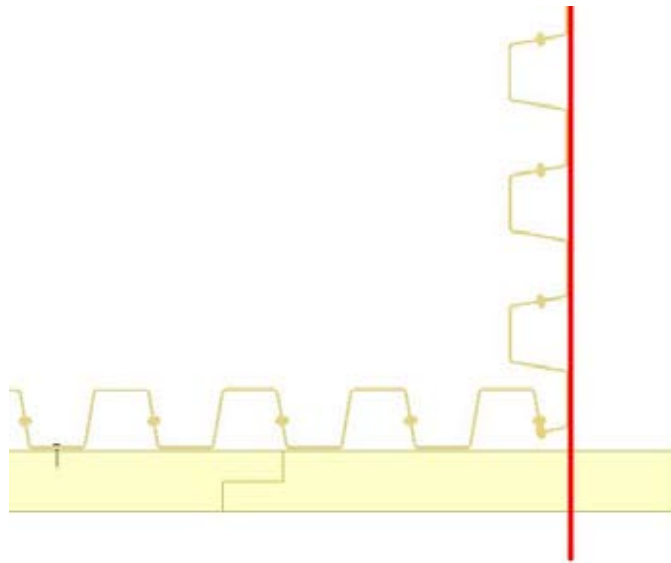
There are many ways to turn a corner with TimberGuard, as many as there are for wood. For a common 90 degree turn, one of the easiest corners can be made using the same standard shiplap joint as was used in the previous section, only with a different orientation.



Another aesthetically-pleasing option is a mitered corner. For this example, we will show the steps to create a mitered corner for a 90 degree turn, although you can use this method to create any angled turn by adjusting your cut angle. When you reach a corner, you will want to stop so that your last wale section fits within the straight section of the wall. Make your face joints as far from the corner as possible.

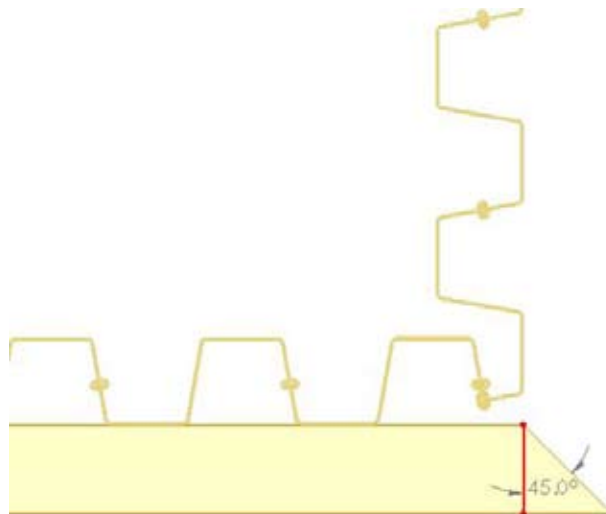


If you haven't already done so, you will want to take your measurements for cutting your first corner wale piece. An easy way to do this is to use a section on which the joint cut has already been made. Place it on the wall as if you were going to connect it to the previously hung wale section. Extend the line from the angled face, and transfer a construction line to the wale section using a marking device.



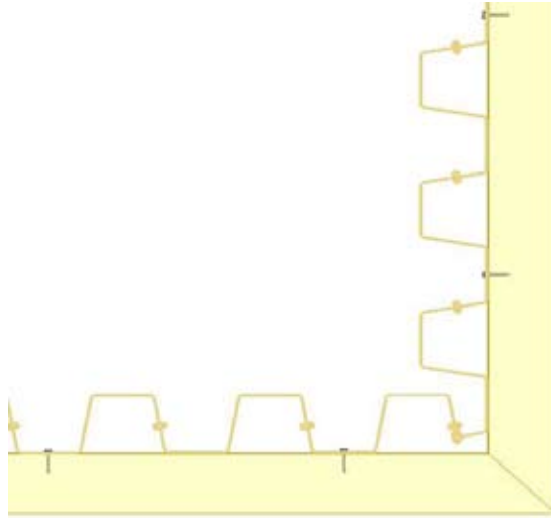
Step 2 – Making your cuts

Since this will be a mitered cut, your cut angle will be 1/2 of your actual turned angle. For this example of a 90 degree turn, we will cut at a 45 degree angle from our perpendicular construction line. For a 45 degree turn, the cut would be made at 22.5 degrees and so on. For accurate cutting, you should use a chop/miter saw, miter box, or have them professionally cut. If you have a small enough wale and skilled woodworkers, you could use a circular saw and a protractor.



You might want to go ahead and cut your other mitered corner piece as well, since you are already cutting. You should have enough material to cut from a new section so that your face joints are as far from the corner as possible. For this cut you will make the matching miter cut 22.5 or 45 degrees from perpendicular, respectively, for a 45 or 90 degree turn.

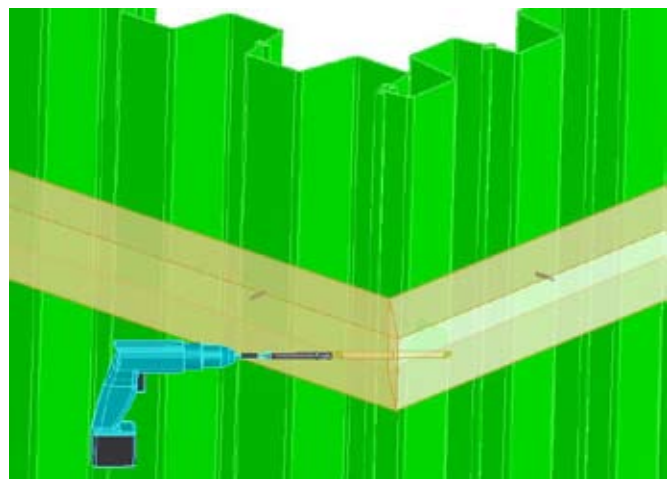
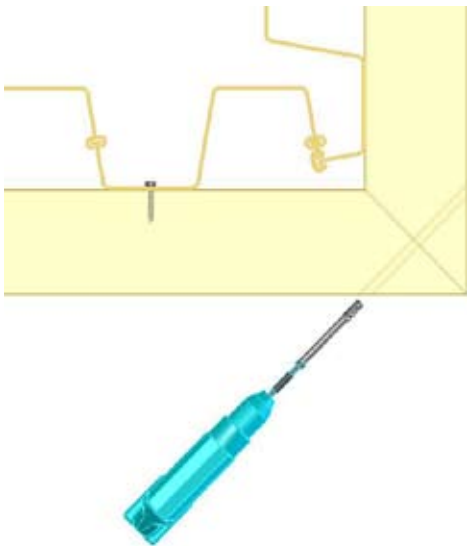
Ensure that the pieces are level and properly positioned on the wall. Secure the two corner pieces to your wall as you have done before with lag screws.



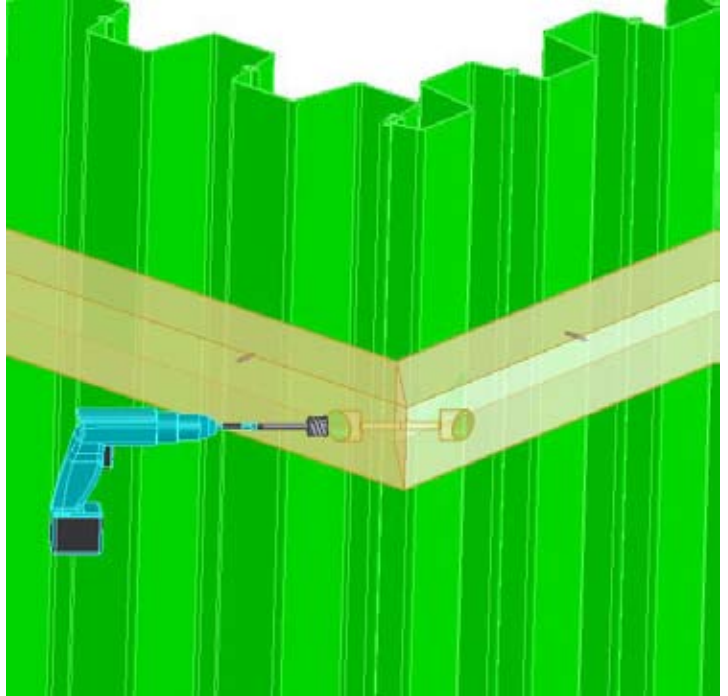
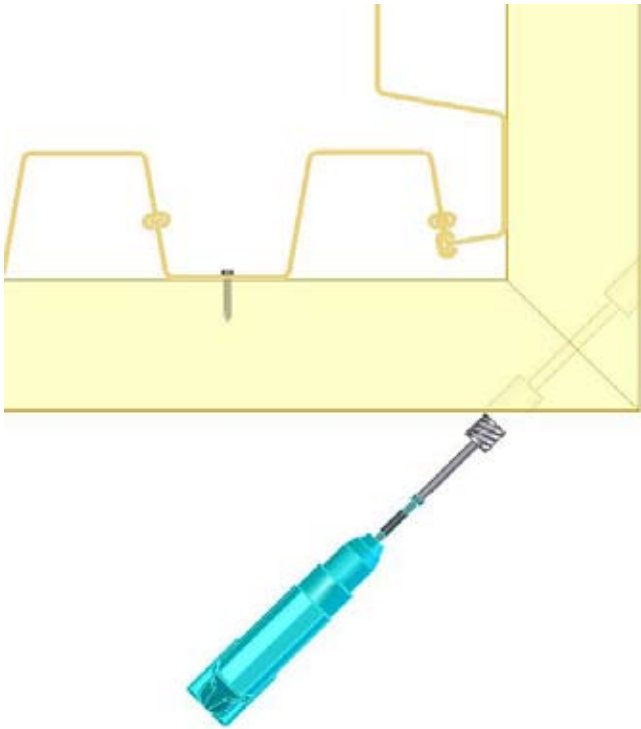
You will need to join your corner to keep it from separating after backfill. There are many ways to achieve this. One example is as follows:

Step 3 – Securing your corner

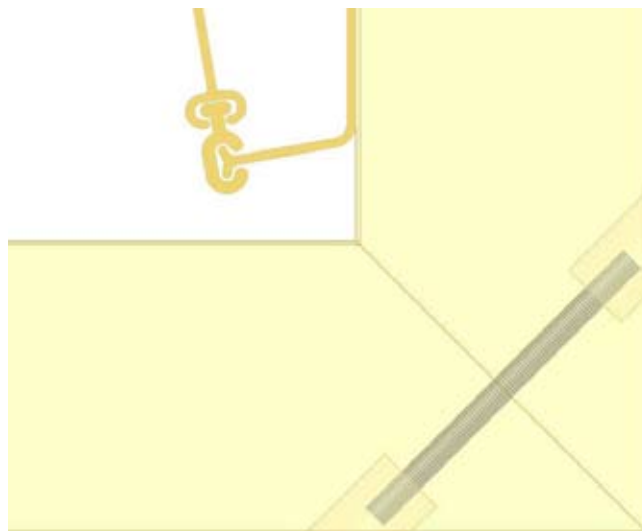
Again, there are many ways to join your corner. The following is one method that is aesthetically pleasing and common. For this particular corner, you will need a threaded rod with two matching nuts as well as two washers. After your corner is held in place with lag screws, drill a through hole perpendicular to the miter cut and all the way through your corner. This hole should be centered vertically and placed so that the hole intersects the miter cut faces as closely as possible to their center. This hole is made for your threaded rod, so its diameter should be chosen accordingly.



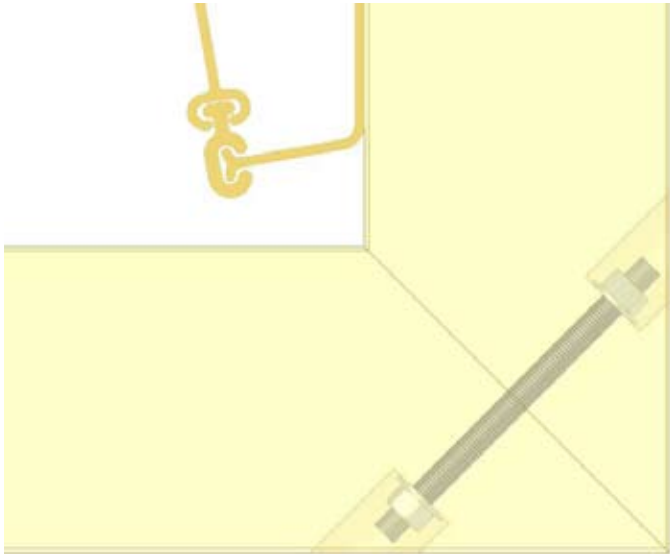
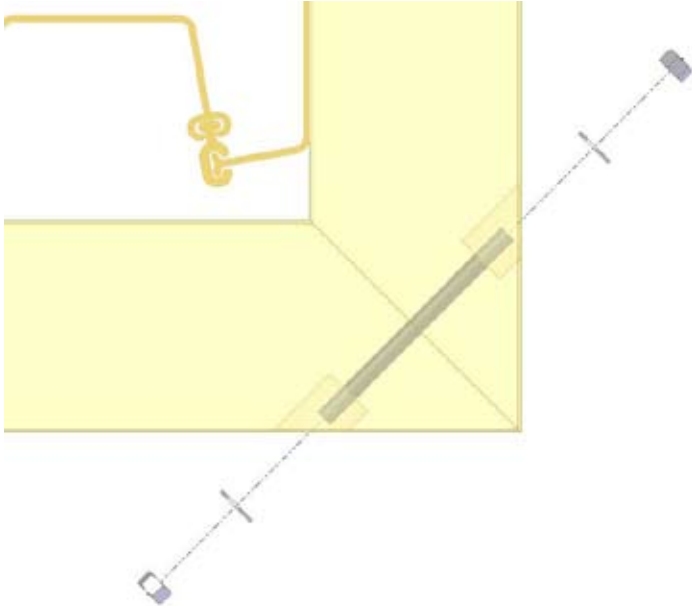
Make a countersunk hole concentric with the hole that you just drilled, and deep enough to house the nuts and washers. It should be wide enough to accommodate the washers you have chosen.



Insert the threaded rod into the drilled hole. It is a good idea to make sure the ends of the rod do not extend outside your wale. You may want to consider cutting them off if they do. Removing this extrusion will help protect the rod from the elements, as well as improve the aesthetics of your wale.



Attach washers and nuts, oriented as shown.



Oxygen and light are two of the primary factors that contribute to marine borer survival and rot. Therefore, when accidental or intentional breach of the TimberGuard's polymer skin occurs, you may utilize a roll of TimberGuard wrap or TimberGuard sealant. The wrap is very useful for wrapping splices or large cuts. Wrap the desired area and secure it with fasteners such as screws. Sealant may be used for small holes and to seal up any fasteners that have been installed. Apply it as you would standard caulk. A putty knife is useful for smoothing the sealant out to create a more seamless look. You may want to save this finishing step for the very end. Shown below is a TimberGuard wale that has been installed with an angled shiplap joint using the pre-cutting process described earlier and TimberGuard Sealant.

For the aesthetics and the peace of mind that comes with knowing that your TimberGuard pole is more completely covered it is a good idea to use wrap or sealant. However, breaches in the polymer do not necessarily compromise your product. Even with some minor holes in the polymer protection, the vast majority of the wale is still covered and the amount of oxygen and light allowed to penetrate the wood is very limited.



Tie Rods

WARNING

No two walls are the same. The numerous job site variables make it impossible to provide specific construction designs without careful analysis of each variable and the effect it will have on the structure. This analysis should be left up to an architect, professional contractor, or engineer. This manual lists typical installation techniques for demonstration purposes only, and in no way represents any recommendations on how to approach your particular project. Please rely on your engineer for specific design recommendations. Because of the complexity of geotechnical loading calculations and the susceptibility to extreme change of soil loads with minor changes in local site conditions such as soil parameters, water levels, surcharge loads, etc., we strongly recommend the use of design professionals who are familiar with local wall construction to determine the required wall parameters, design techniques, and applicable installation methods and procedures.

WARNING

This manual does not address any safety or regulatory issues associated with its use nor the installation of CMI products. It is the user's responsibility to establish and ensure that all regulated and appropriate safety and health practices are followed. It is also the user's responsibility to ensure that any and all applicable permits and permissions have been secured before installation of any CMI product.

Tie Rods

ArmorWare Rods

Materials

Tie rod selection is an important decision. A large portion of the load acting on a tied back wall is carried by the tie rods to the anchors. Rod specs as well as spacing need to be given careful design consideration. Since tie rods play such an important role in the life of your wall, you want to make sure that they can handle the job that you need them to do. Many walls fail because the tie rods or anchors fail. Most of the tie rod is covered in soil, therefore protecting it from harsh and corrosive environments. The first few feet, however, can be exposed to air and water which can accelerate corrosion of the rods. ArmorWare tie rod head sections are coated in plastic to protect them from the harsh environment in these critical first few feet.






All of the most common hardware for tying back your wall comes with the ArmorWare Tie Rod package. Use the table below to select the package that is right for you. There are several available accessories that should be considered. If you are going to angle your rods, which is normally the case, we carry ArmorWare beveled washers. It is recommended, for GeoGuard and ArmorWare wales and caps in particular, that you use beveled washers when assembling your tie rods. Because of the angle, the rod head would not lie flush with the wale face if beveled washers are not used, and point loading can be a potential problem for this scenario. Using a beveled washer will distribute the load on the angled rod head evenly to the wale face. ArmorWare beveled washers come in a 5 degree angle, and two can be stacked together to achieve a 10 degree angle. It is highly recommended that you use a GeoGuard plate washer when tying back through a GeoGuard UltraComposite wale. Due to the particularly high rigidity of FRP material, you want to distribute the load from the tie rods as much as possible to minimize point loading. This large, thick nylon washer will do just that.

ArmorWare Rod	Head Diameter	Total Length	For Use With
3/4"	1.5"	15'	ArmorWare 575, 575 STR Caps
3/4"	1.5"	20'	ArmorWare 575, 575 STR Caps
3/4"	2.5"	15'	ArmorWare 850, 850 STR, 855, 1075, 1075 STR Caps ArmorWare Wales GeoGuard Wales TimberGuard Wales
3/4"	2.5"	20'	ArmorWare 850, 850 STR, 855, 1075, 1075 STR Caps ArmorWare Wales GeoGuard Wales TimberGuard Wales
1"	2.9"	15'	ArmorWare 1075 and 1075 STR Caps ArmorWare Wales GeoGuard Wales TimberGuard Wales
1"	2.9"	20'	ArmorWare 1075 and 1075 STR Caps ArmorWare Wales GeoGuard Wales TimberGuard Wales



Recommended Tools:

- o Appropriate drill for drilling holes through your wale, wall, and anchor, depending on anchor type
- o Drill bits appropriate for the material and tie rod diameter selected. Bits will need to be slightly over sized in order for the holes to be large enough to accommodate the plastic coating.
- o Measuring and marking devices for proper tie rod placement
- o Heavy wrench or device for tensioning your tie rod with the turnbuckle

What is included with your order:

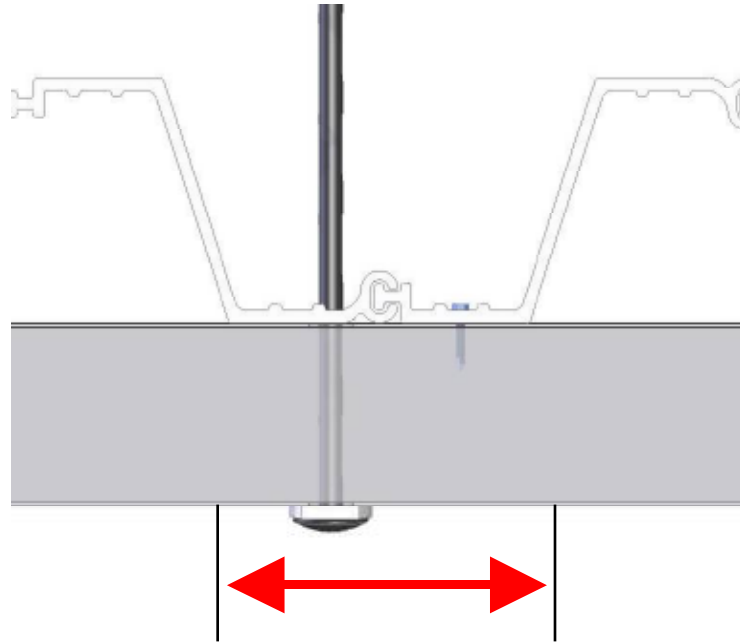
ArmorWare Rod	1 - Coated Tie Rod Section	
	1 - HDG Uncoated Tie Rod Section	
	1 - HDG Turnbuckle	
	1 - HDG Nut 3/4"	
	1 - HDG Washer 3/4"	

Available Accessories:

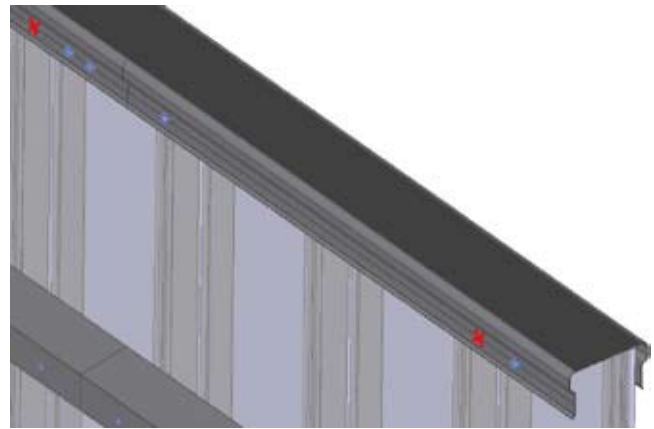
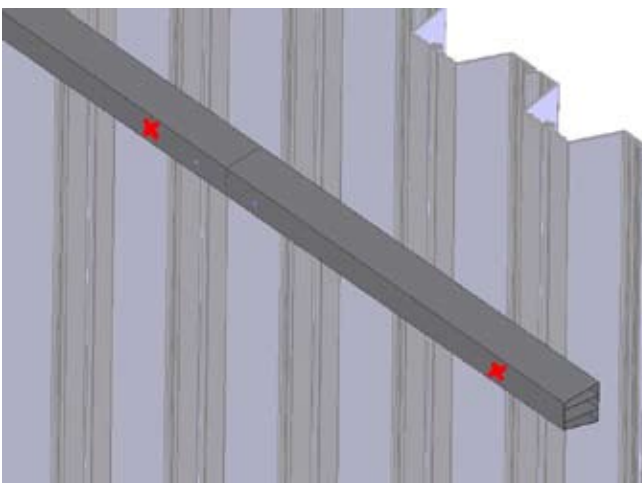
ArmorWare Beveled Washer	1 - 5 Degree Beveled Washer	
GeoGuard Plate Washer	1 - Heavy Nylon Plate Washer, 4x4	

Installation

The rod spacing should already have been determined by the wall designer. It is a good idea to lay out where your rods will be placed by marking hole locations on your wale or cap. As much as possible, you should have your tie rods fall on the flats of outer wall faces.

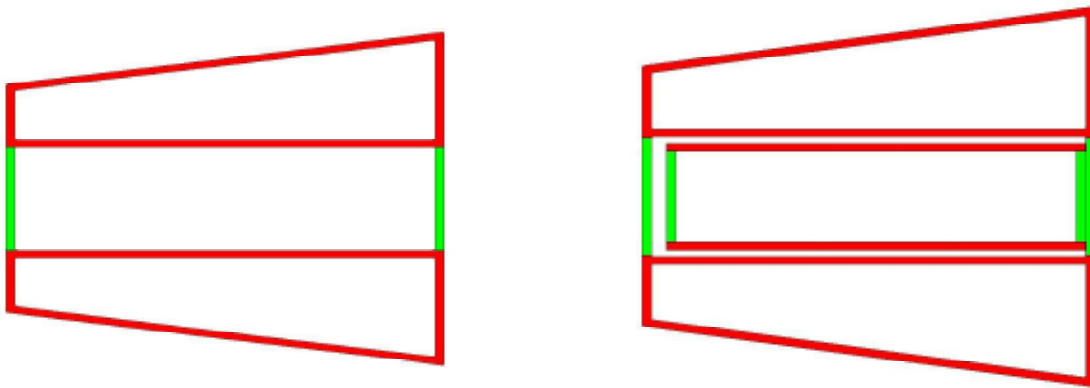


Temporarily mark your hole locations so that the rods can be positioned in the most effective manner before you begin drilling. After you are satisfied with your rod layout, you are ready to drill your holes. If tying back through wales, your holes should be centered on the outer vertical face as shown. If you are tying back through ArmorWare caps, you should also center your holes on the front, flat, vertical face as shown, the same face where your cap bolts are located. It is important to note that if you are planning on tying back through your caps, you must use the ArmorWare Cap STR package.

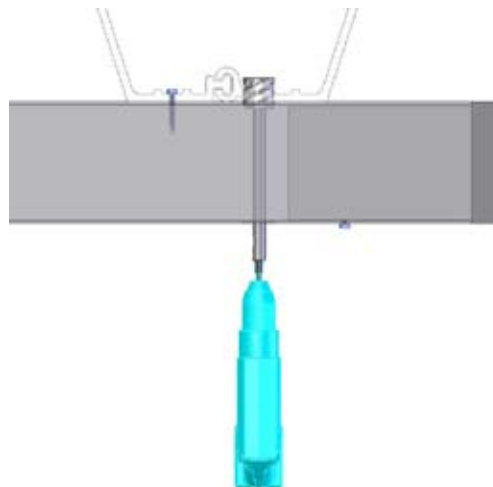
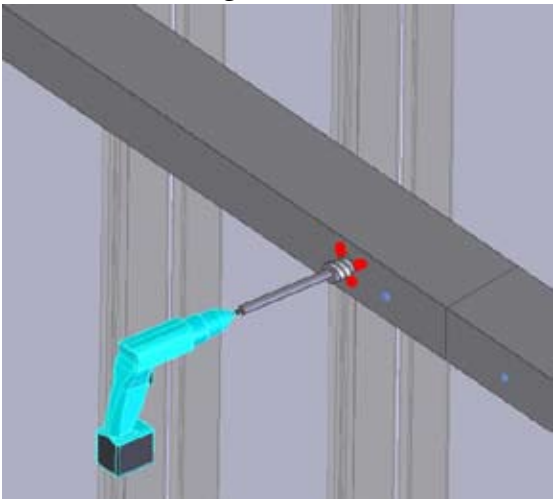


You will have to drill through different materials in this process with as many as three material transitions. This can be very harsh on the drill operator if done in the field. For instance, when drilling through rigid aluminum wales, as soon as the relatively soft plastic is penetrated, it tends to grab the bit, transferring all the torque to the operator. With careful planning, the hole locations can be determined prior to construction, and the drilling process can be done in a safer and more efficient way. If the hole locations are determined ahead of time, at least one component of the wall, can be drilled separately, predrilling the wale with a drill press for example. This way there are no material transitions, making the process quicker, less abrasive, and making it easier to use the appropriate bit for each material. You will want to drill all the way from the outer face of the wale or cap through the back of your wall and whatever lies in between.

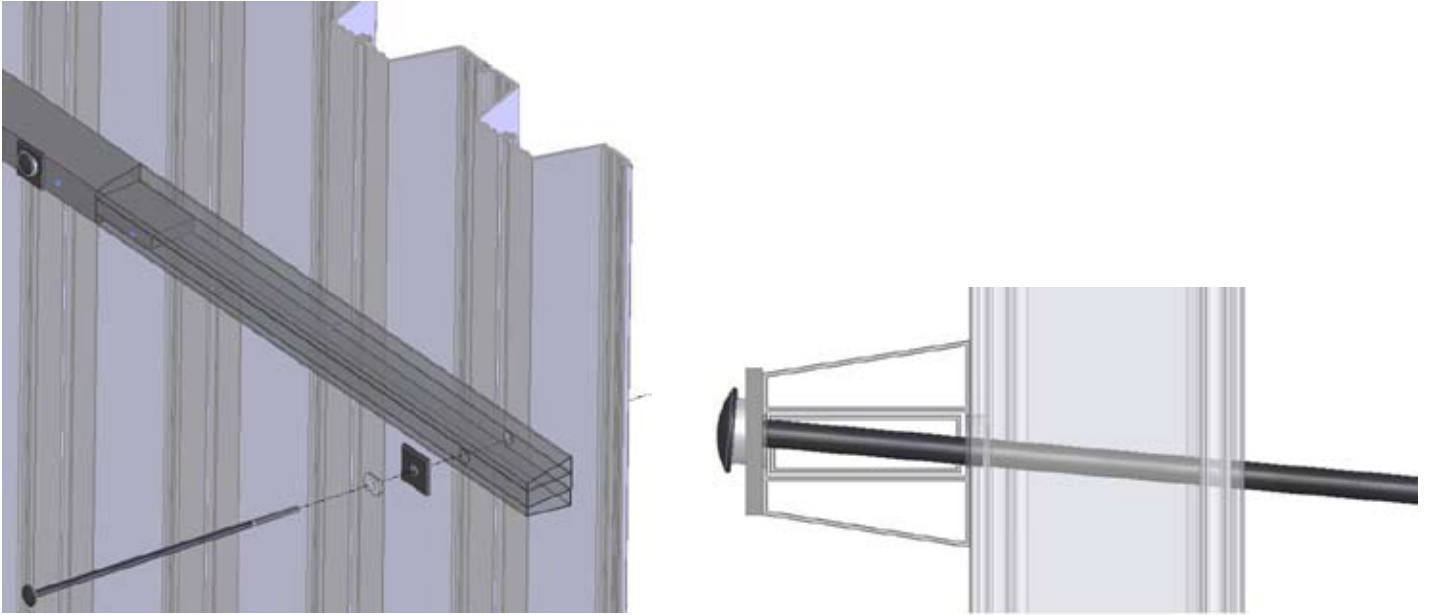
It is important that you not drill through the inner web sections of an ArmorWare or GeoGuard wale or their inserts. Limit all drilling to vertical faces only. If you drill through any horizontal sections, the strength of the beam is weakened. It is a good idea to penetrate green areas only, and leave the red areas completely intact. Profiles are shown for the standard ArmorWare wale and the STR package. Your drillable area is slightly less in the STR package due to the insert.



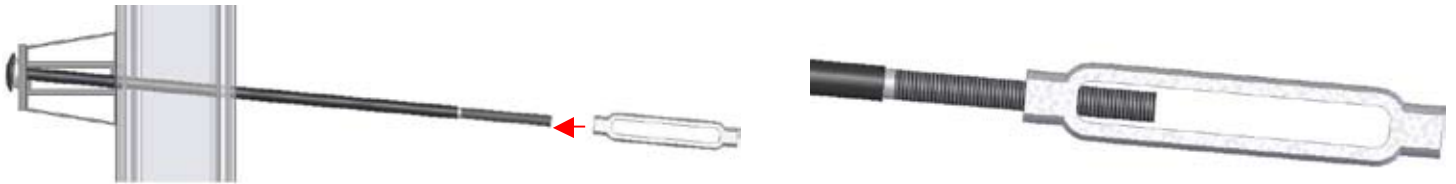
Most designs will call for you to angle your tie rod with a slight downward slope through the wale or cap, which will allow for a deep anchor. Because TimberGuard, like wood, is relatively soft and has a pretty homogeneous cross section, there is little worry about point loading and structural damage with the drilling of such a hole. There are virtually no more constraints with TimberGuard on maximum angle and hole location than with typical lumber, though you will generally want to keep the holes centered. ArmorWare and GeoGuard wales, however, are more restricting. Because of the limited drillable area, there is a maximum possible angle of between 5 and 10 degrees, depending on your wale setup and rod diameter. To achieve your desired angle, you will either need to drill your hole at the desired angle or straight in. If you choose to drill straight in, then you need to make the hole larger than the diameter of the rod to allow room to adjust to the desired angle.



Insert your ArmorWare coated rod through whatever washer assembly you will be using and into the holes that you have drilled. Shown is a 3/4" diameter ArmorWare Rod, tied back through the wale, with one ArmorWare beveled washer and one GeoGuard plate washer.



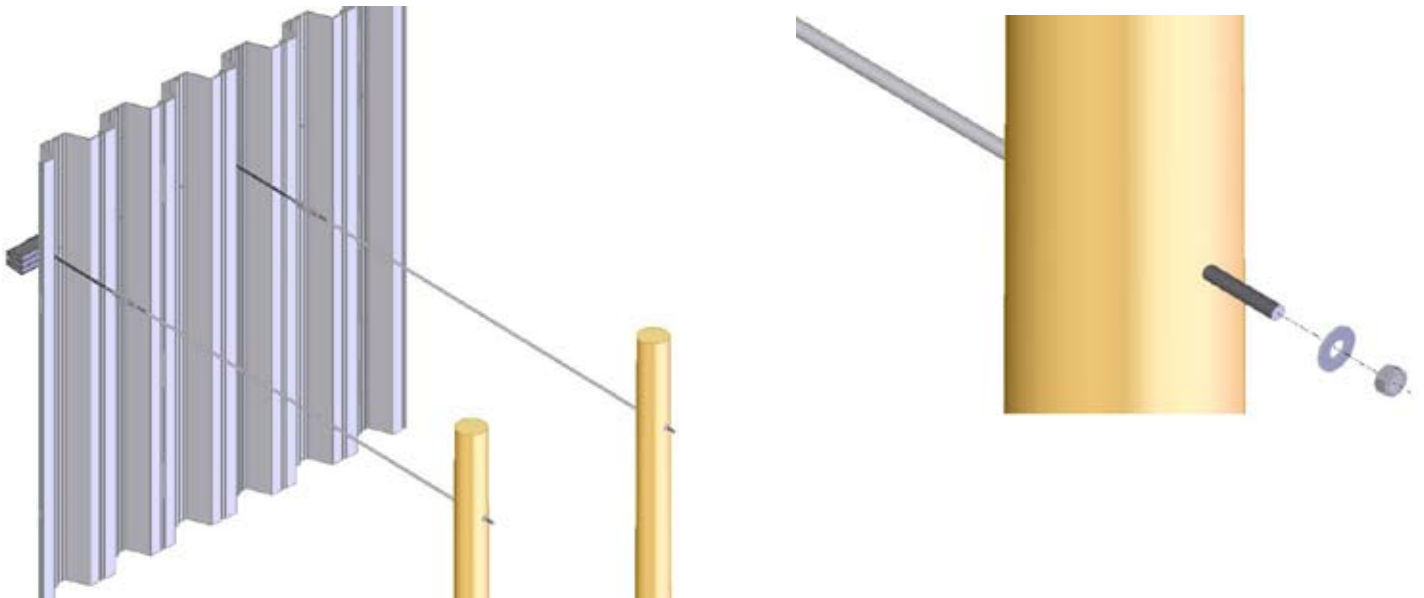
Screw the appropriately threaded end of the included turnbuckle onto the threads of the coated ArmorWare rod. The coated rod section is reverse-threaded to allow your tie rod system to be tightened with the turnbuckle after assembly.



Next, screw the long uncoated rod into the opposite end of the turnbuckle. This will be regular right-hand thread. It is important to maximize thread contact area here as the rods and turnbuckles will be carrying a large portion of the load on the structure. Be sure that the rod head and tie rods are screwed all the way through the threads of the turnbuckle.



Secure your ArmorWare tie rods to your anchors with the included nuts and washers. One very common anchor system is shown here, using TimberGuard piles.



After all of your tie rod components are assembled, use the turnbuckle and a wrench to tighten to the desired tension.

Caps

WARNING

No two walls are the same. The numerous job site variables make it impossible to provide specific construction designs without careful analysis of each variable and the effect it will have on the structure. This analysis should be left up to an architect, professional contractor, or engineer. This manual lists typical installation techniques for demonstration purposes only, and in no way represents any recommendations on how to approach your particular project. Please rely on your engineer for specific design recommendations. Because of the complexity of geotechnical loading calculations and the susceptibility to extreme change of soil loads with minor changes in local site conditions such as soil parameters, water levels, surcharge loads, etc., we strongly recommend the use of design professionals who are familiar with local wall construction to determine the required wall parameters, design techniques, and applicable installation methods and procedures.

WARNING

This manual does not address any safety or regulatory issues associated with its use nor the installation of CMI products. It is the user's responsibility to establish and ensure that all regulated and appropriate safety and health practices are followed. It is also the user's responsibility to ensure that any and all applicable permits and permissions have been secured before installation of any CMI product.

Caps

ArmorWare

Materials


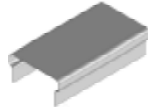




After deciding that you will use ArmorWare caps, you will need to decide whether or not your application requires aluminum STR inserts. The standard option comes with a splice kit. This kit includes an 18” piece of aluminum insert for every 20’ cap piece, for the purpose of splicing your cap. If you are planning on tying back through your cap, then your application will probably require a stronger and more rigid beam, and you should upgrade to the STR option, which includes a 20’ aluminum insert for every 20’ cap section to run the entire length of your cap. If you will be turning corners, you should consider buying prefabricated corner inserts. These inserts are roughly 18” in length and come in 45 and 90 degree angles. These options save fabrication time and provide some reinforcement at the corners, where you need it most. Touch up paint is available in most ArmorWare colors. Though our aluminum alloy is designed for resisting corrosion, using this paint to touch up or seal off damaged or exposed areas will cut down on unprotected surfaces available and extend the life of your wall. Mounting hardware is included, so you will only need to provide the appropriate tools for wale installation. Use the table below to select the cap package that is right for you.







ArmorWare Cap	Sheet Piling Options
575	ShoreGuard 225 C-Loc 4500, 2500
575 STR	ShoreGuard 225 C-Loc 4500, 2500
850	ShoreGuard 550, 425, 400, 300, 325 GeoGuard 20, 30
850 STR	ShoreGuard 550, 425, 400, 300, 325 GeoGuard 20, 30
855	ShoreGuard 550, 425, 400, 300, 325 GeoGuard 20, 30
1075	ShoreGuard 750, 650 C-Loc 9900, 9000
1075 STR	ShoreGuard 750, 650 C-Loc 9900, 9000

Recommended Tools:




- o Drill with a 3/8” bit for drilling bolt holes through aluminum and wall material
- o 9/16” socket and/or wrench for tightening nuts and bolts
- o Chop saw or any mitering saw that can accommodate the dimensions of the cap
- o Blades appropriate for cutting the aluminum cap and inserts are required
- o Measuring and leveling devices for proper cap positioning
- o Aluminum Welder, if you will be making non-standard turns

What is included with your order:

ArmorWare Cap	1 - 20' ArmorWare Cap Section	
	1 - 18" aluminum Cap insert	
	10 - Hex Bolts, 2" x 3/8"	
	10 - Hex Nuts	
	20 - Steel Washers	
	20- PVC Washers	

ArmorWare Cap STR	1 - 20' ArmorWare Cap Section	
	1 - 20' aluminum Cap insert	
	10 - Hex Bolts, 2"x 3/8"	
	10 - Hex Nuts	
	20 - Steel Washers	
	20 - PVC Washers	

Available Accessories:

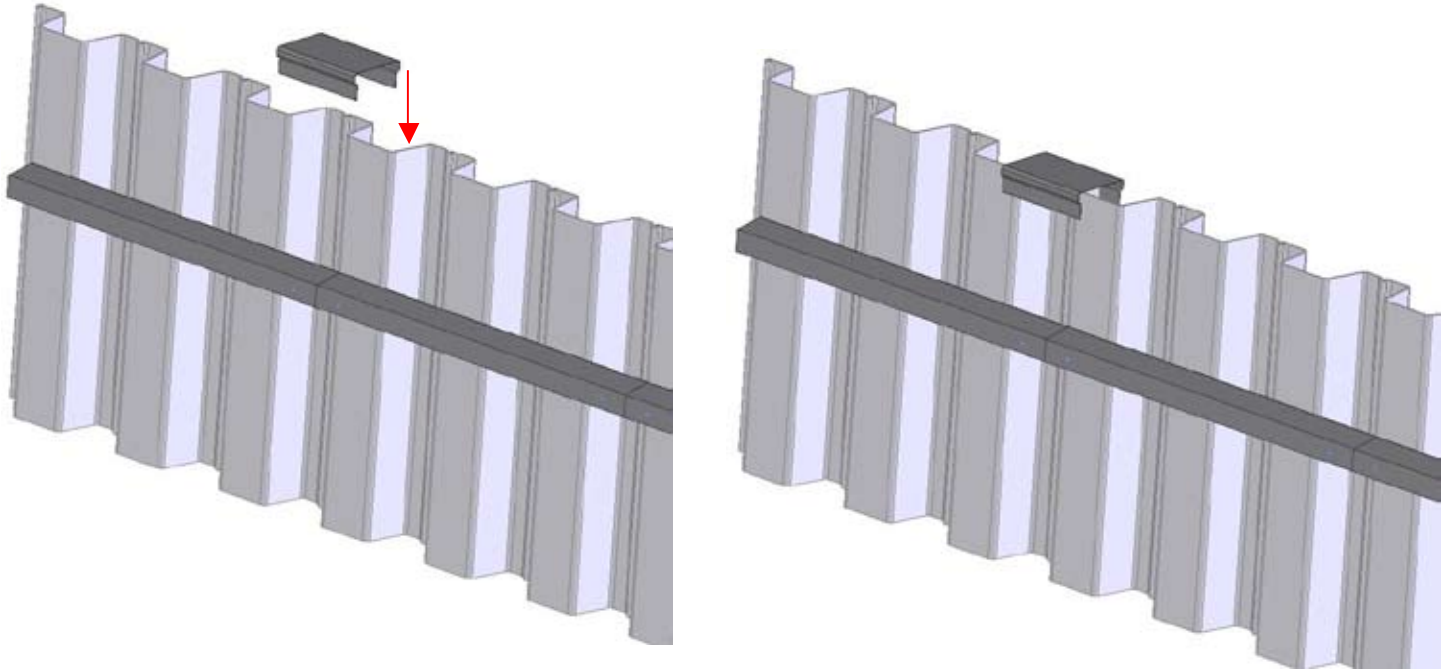
45 degree corner insert	1 - 45 degree corner insert	
90 degree corner insert	1 - 90 degree corner insert	
ArmorPaint touch up kit	1 - 12 oz. can (Bronze, Grey, Clay)	

Installation

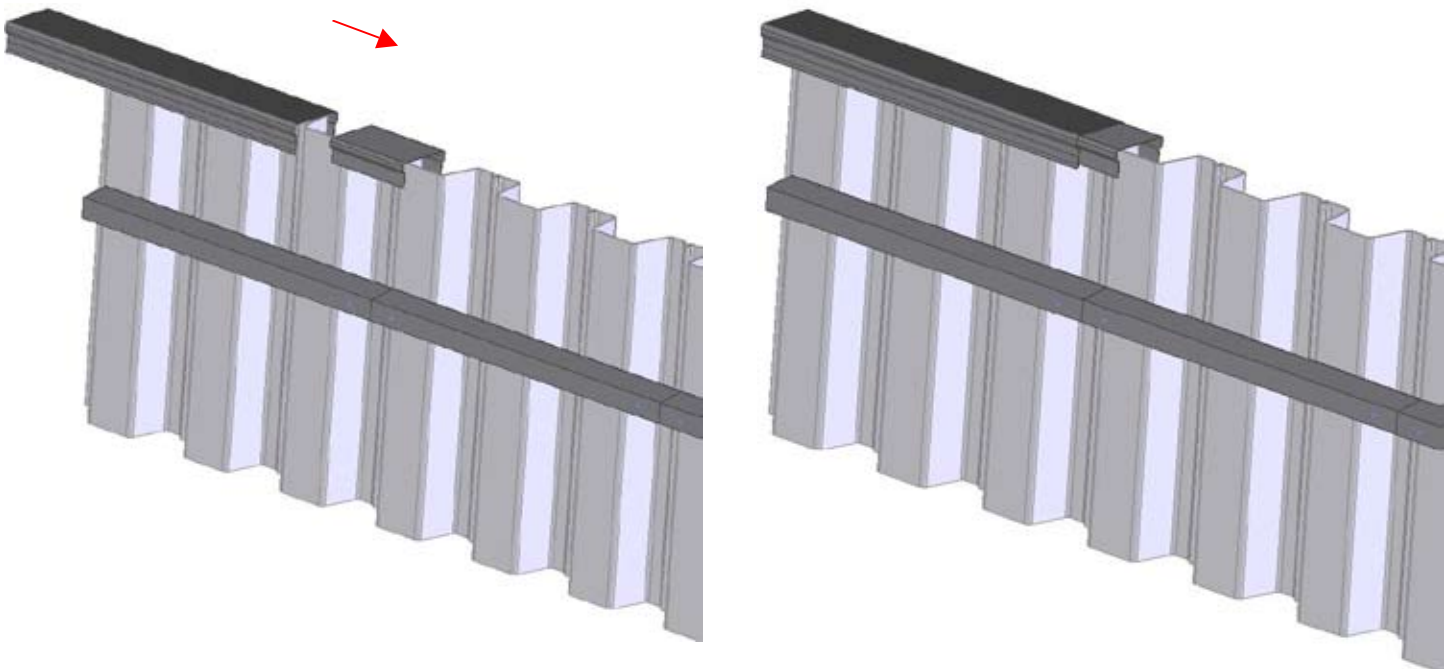
Attaching your ArmorWare Cap

Step 1 – Positioning your first ArmorWare Cap section

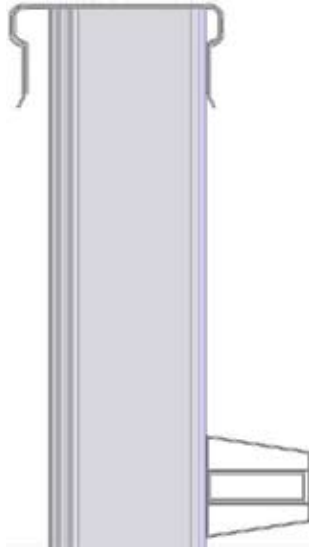
First, place your 18” insert on top of the wall approximately 20’ from the beginning of your wall. You will probably want to start at one end of your wall and work to the other end. We will work from left to right for this example.



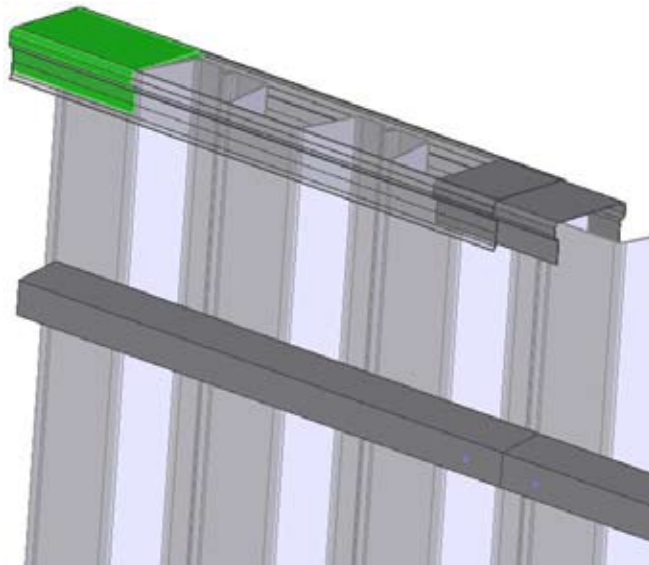
Next, slide an ArmorWare Cap section onto the insert. The cap acts like a roof on your wall, so you want to make sure that no wall is left exposed underneath the outside end of your cap.



The cap is designed to be wider than the sheet piling wall that it houses. This allows for easy installation and overhanging material for increased protection. Throughout this entire capping process, you will probably want your cap's contact with the sheet piling to be on the front face (exposed side). This is a must if you are planning on tying back through the cap, and this is the way it will be shown throughout the manual. There will also be some instances where there is no gap between the sheet piling and the cap. This will result in a very tight fit. The fit of the cap will be dependant on several variables such as the straightness of your structure. It is common to have to use some force to install the cap.



After you have made sure that your cap section is flush with the outermost end of your wall, you want to position your insert for attachment. Like the wale inserts, you want the cap insert to be half in, half out of the cap section. This will leave 9" of cap insert exposed. Before taking steps to secure the cap insert to the cap, you need to make sure that everything is properly positioned and level. Since your 20' cap section is only sitting on the 9" of cap insert, leveling the cap can be awkward. A tip to easily overcome this is to temporarily slide another cap insert on the outside edge of the cap section to give it a level base.

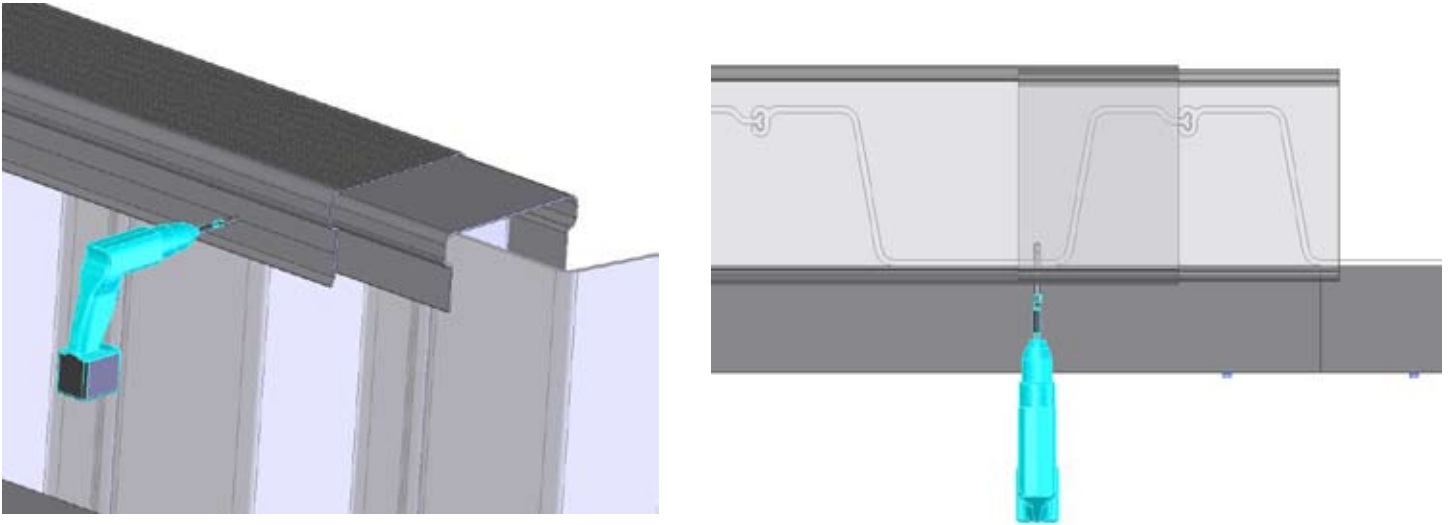


After you have secured the cap to the wall in a level position, you will need to remove the temporary leveling insert as you will be installing it at a later time.

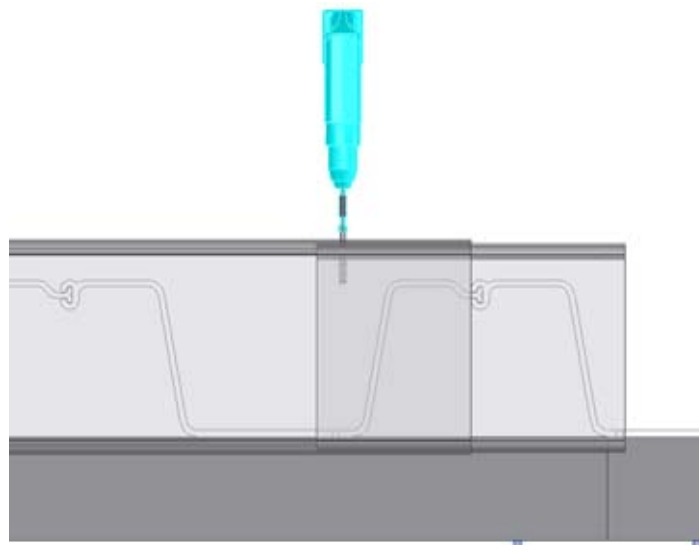
Step 2 – Attaching your Insert to the ArmorWare Cap section

After you are satisfied that the cap and insert are correctly positioned, you are ready to secure the insert to the cap section. Drill one hole for a 3/8” bolt through the front side of the cap and insert. This hole should be located in the center of the lower flat face of the cap. To add a little more sturdiness to your assembly, you can

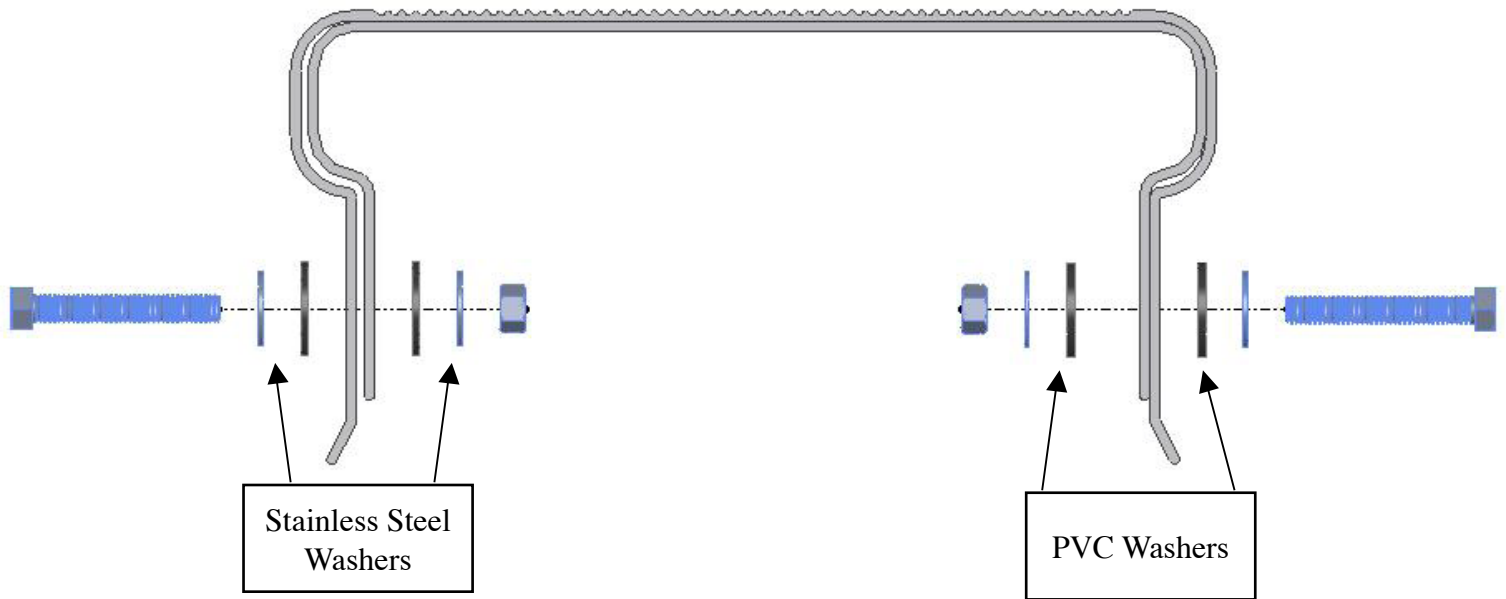
also drill through the wall (as shown). This can only be done if part of the insert falls on an outside flat face as it does in this scenario. This will be the case more often than not, depending on the type of sheet that you use. The main objective of this step is to secure the ArmorWare Cap section to the insert, not to secure the cap to the wall. If this does not conveniently fall on a flat face, only drill and secure through the cap and insert.



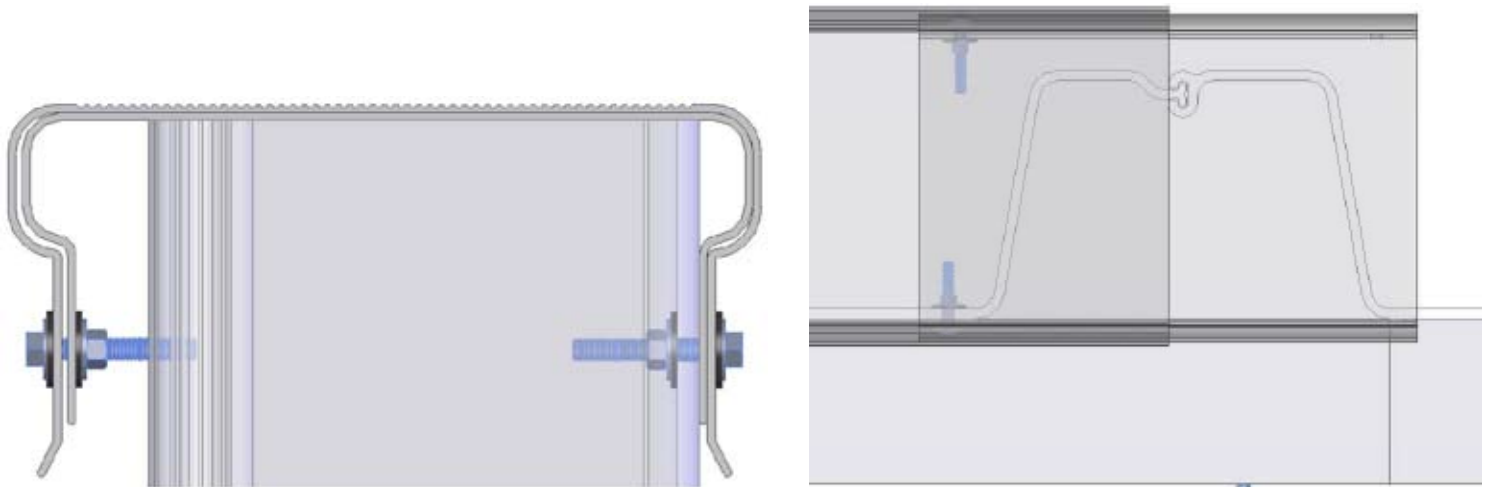
Repeat this process for the rear of the wall. In this case, however, you want to make sure that you do not drill through the wall, only the cap and insert so that they can be securely fastened, and the cap will remain flush with the front wall face.



After both holes have been drilled, secure them with the cap bolts and washers, in the order shown. The PVC washers are included to provide a galvanic corrosion barrier between the stainless steel washers and the aluminum cap.

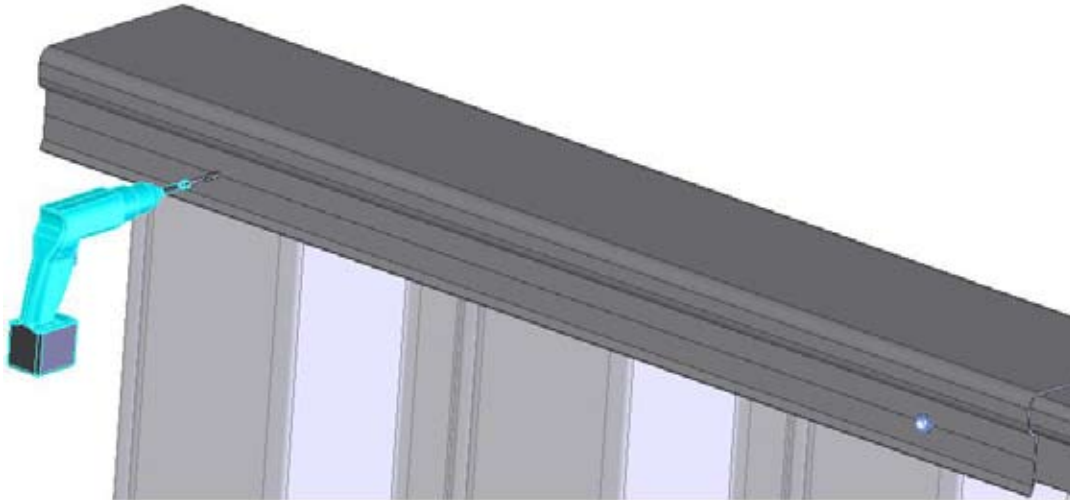


Hand tighten the front side first to ensure good solid contact, followed by hand tightening the rear side, and then fully tightening both. In this scenario, we have chosen to sandwich the front face of the wall in as well.

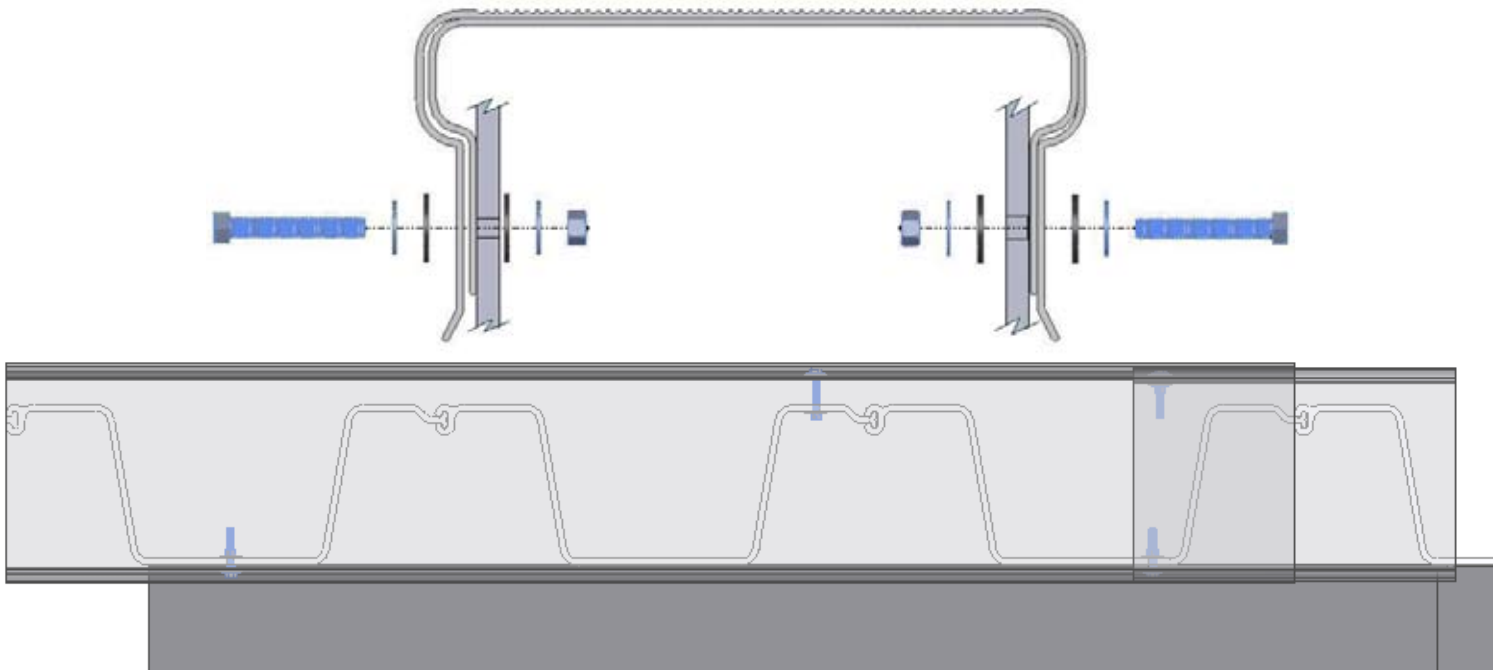


Step 3 – Attaching your first ArmorWare Cap section to the wall

After you have secured the insert to the cap section, you will attach your cap to the wall using the remaining bolts. As before, you want to drill your holes in the center of the lower flat face of the cap. Position your holes so that they fall near the center on the flat outer faces of the wall. Drill through the cap and the wall face.

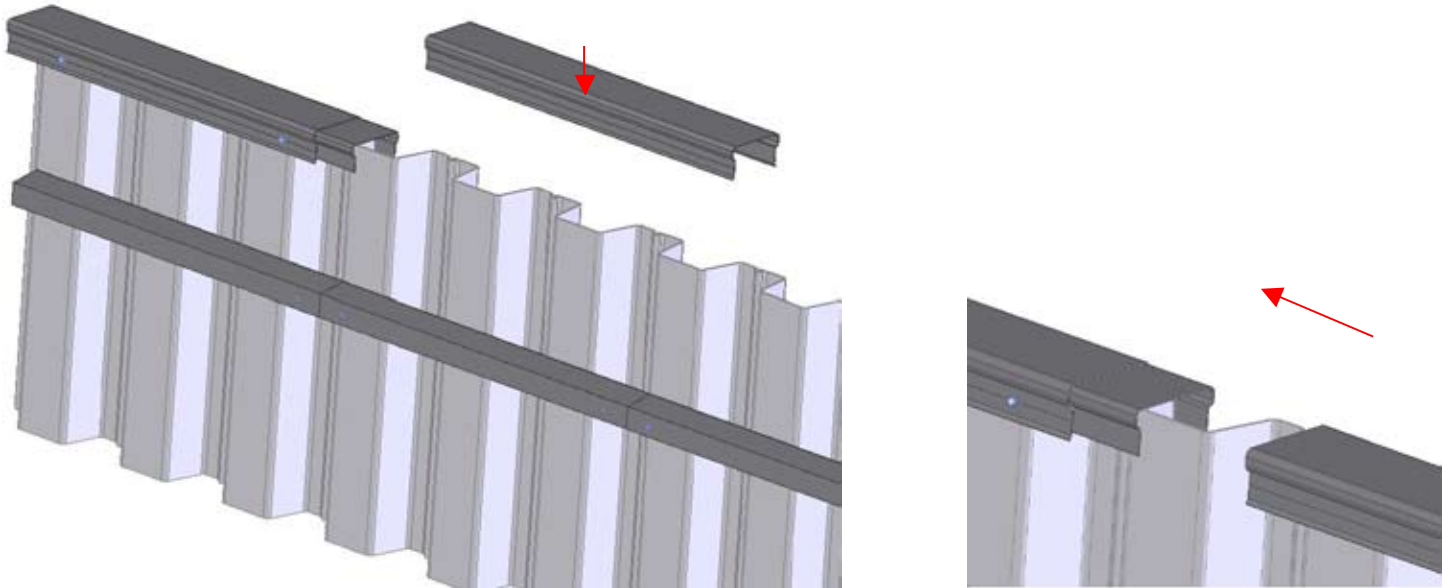


Evenly space your bolts and washers along the length of the cap, half on each side of the wall. Attach them as you did before, with the cap and wall between the washers on both sides. Hand tighten the complete front side first to make sure that the cap is in direct contact with the front face, and then fully tighten all nuts. In cases where there is a significant gap between the cap and the back surface of the sheet piling, it may be advisable to fill the gap with some kind of blocking material such as left over sheet piling material or wood.

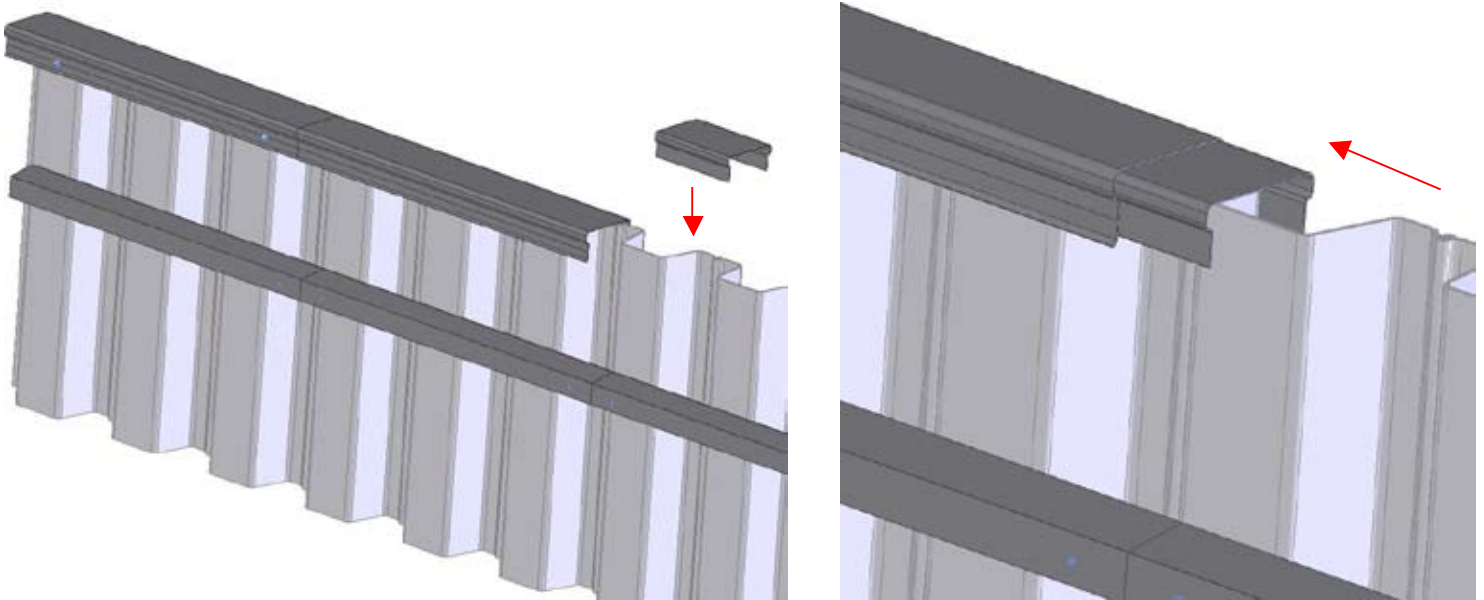


Step 4 – Installing intermediate cap sections

Slide your next cap section onto the attached, exposed insert. You will use each attached cap section and insert as a guide for its following cap section.

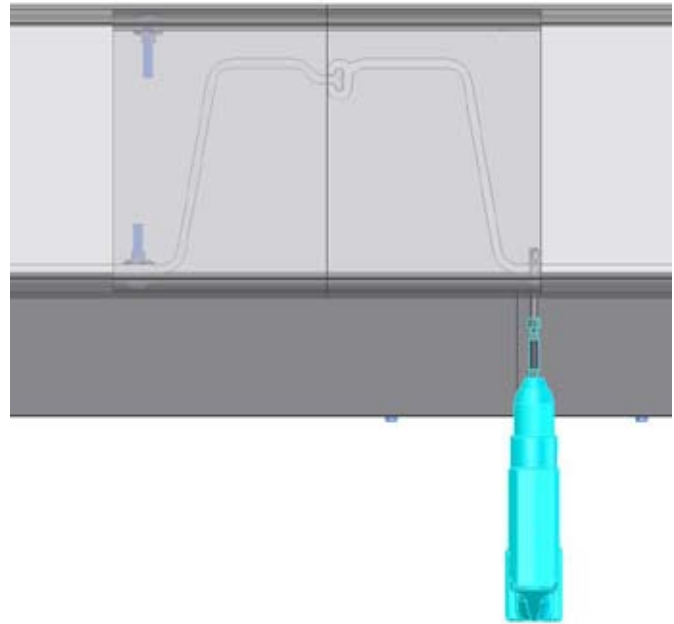
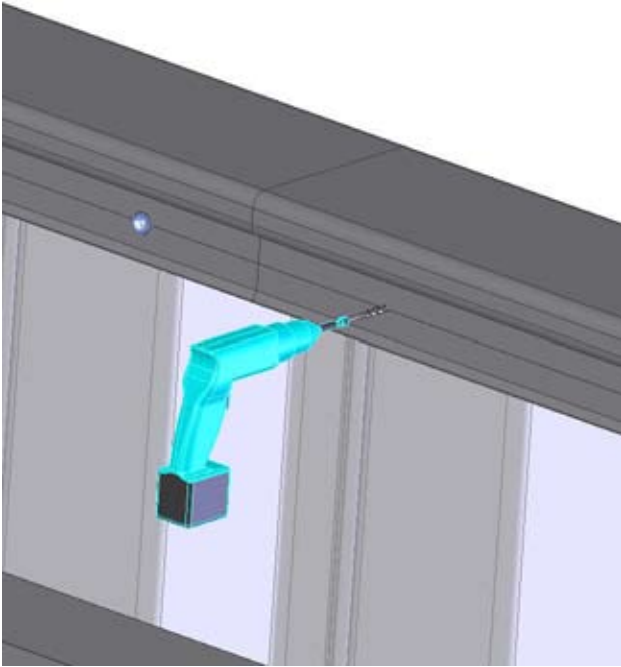


Slide your next cap insert into this cap section, half-in, half-out. This will level the cap section and leave you in a position similar to that in Step 2.

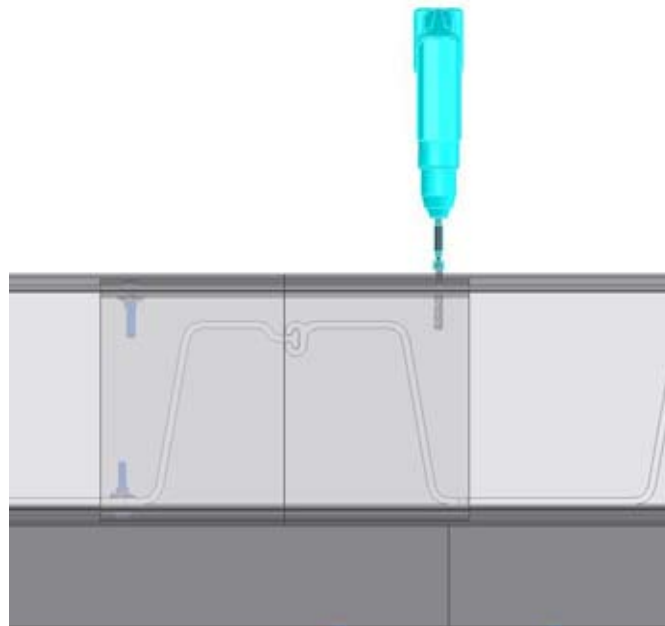


You will need to secure the insert on both sides of the cap section rather than just the leading end. You will begin attachment by securing the trailing end of the unattached cap section to its corresponding (partially

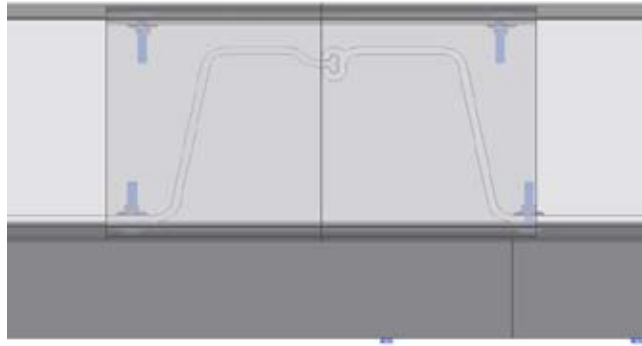
installed) insert. You will use the same installation principals and methods as you learned in Step 2. Drill one hole for a 3/8" bolt through the front side of the cap and insert. This hole should be located in the center of the lower flat face of the cap. As in Step 2, to add a little more sturdiness to your assembly, you can also drill through the wall (as shown). Remember from before, this can only be done if part of the insert falls on an outside flat face as it does in this scenario. This will be the case more often than not, depending on the type of sheet that you use. The main objective of this step is to secure the ArmorWare Cap section to the insert, not to secure the cap to the wall. If this does not conveniently fall on a flat face, only drill and secure through the cap and insert.



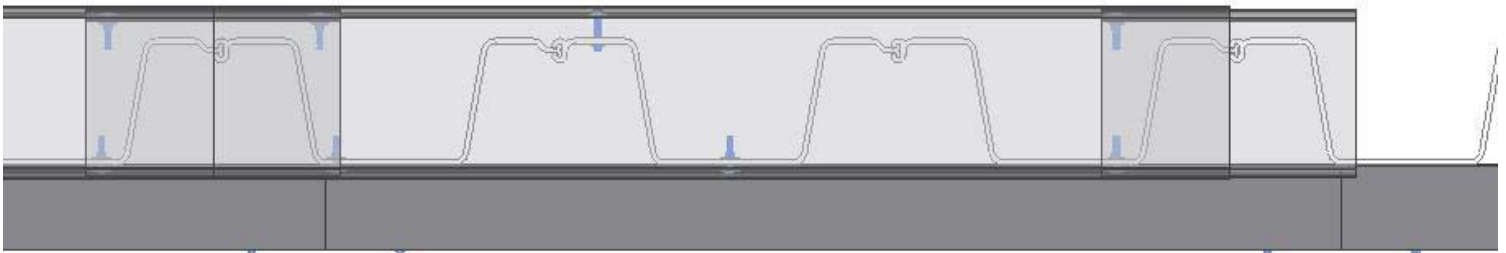
Repeat this process for the rear of the wall. Again, in this case, you want to make sure that you do not drill through the wall, only the cap and insert, so that they can be securely fastened, and the cap will remain in direct contact with the front wall face.



Hand tighten the front side first to ensure good solid contact, followed by hand tightening the rear side, and then fully tighten both. Remember, in this scenario, we have chosen to sandwich the front face of the wall in as well.



Follow Steps 2 and 3 to finish securing your cap and insert to each other and then to the wall.

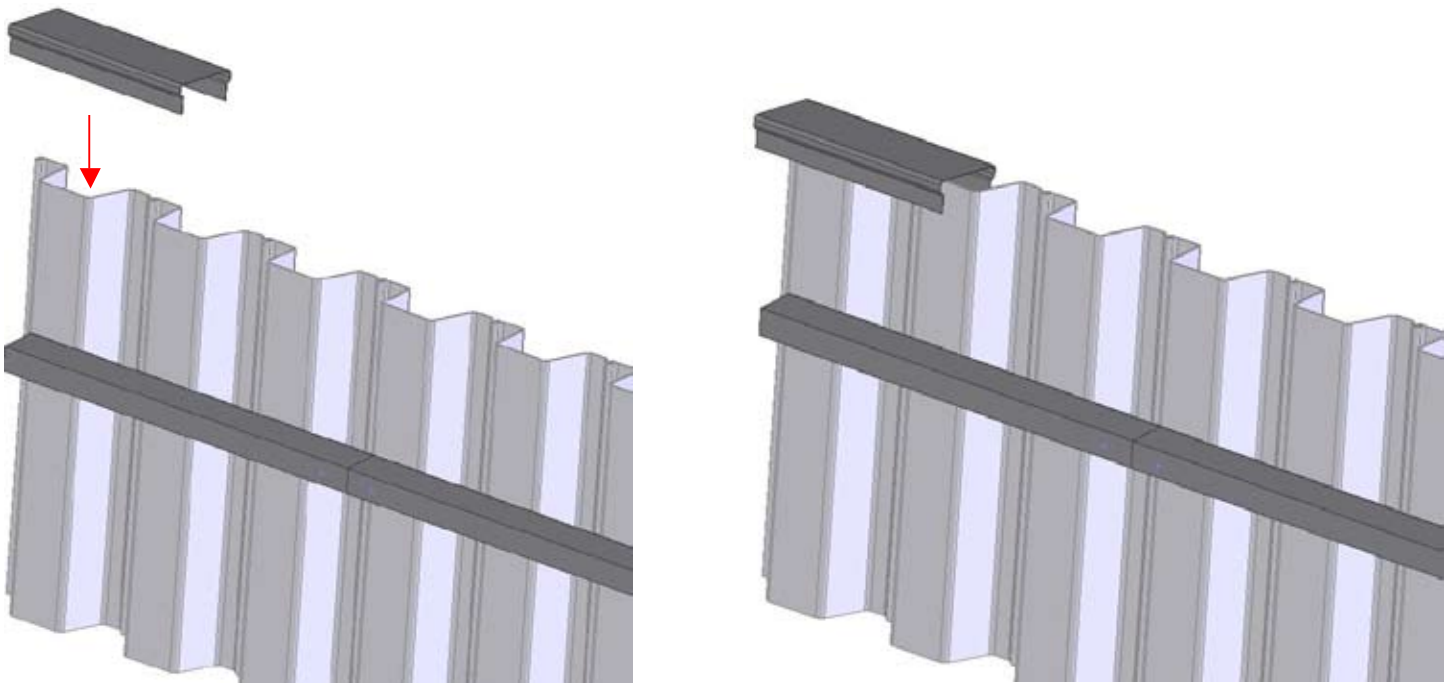


Repeat this process for all the straight runs of your wall

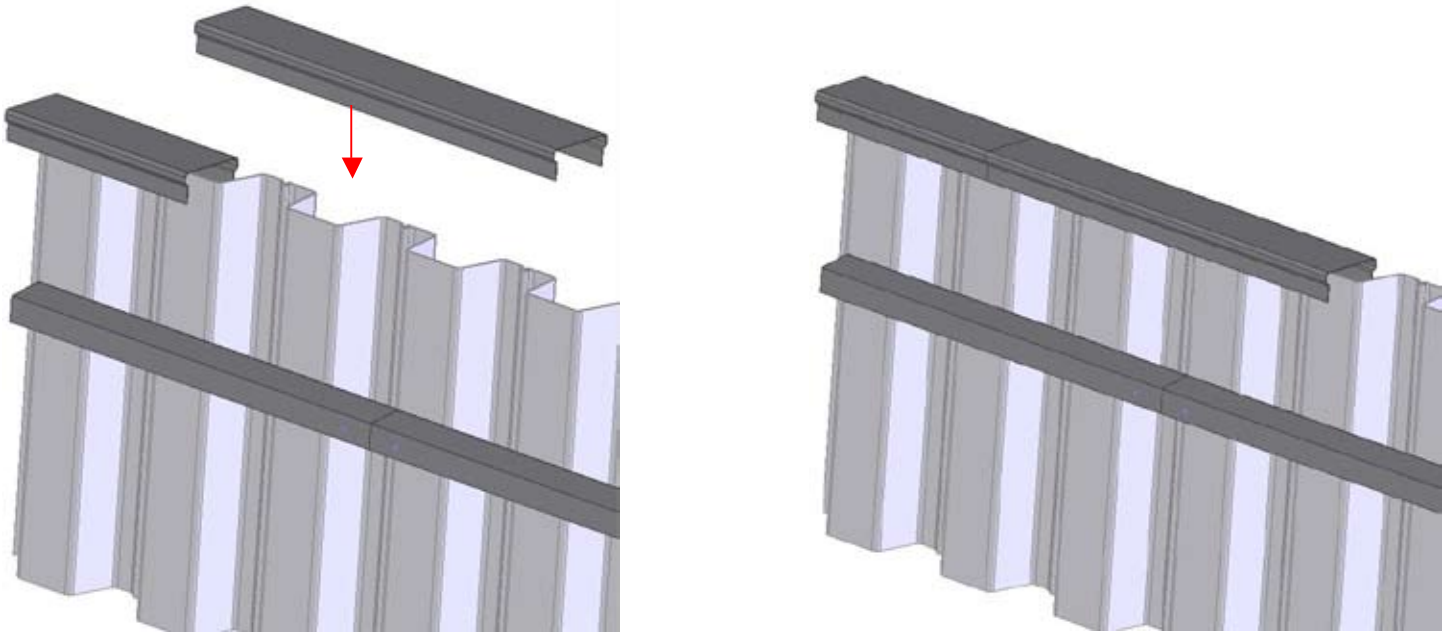
Step 5 – Modifying your installation for ArmorWare Cap STR

Choosing to use the STR package will allow your cap system to more closely approximate a continuous beam than the standard package. The only difference between the two is that the STR package includes a 20' insert in place of the 18" standard insert. This results in the insert running the whole length of your wall, adding strength and rigidity. The STR package is also slightly easier to install than the standard one.

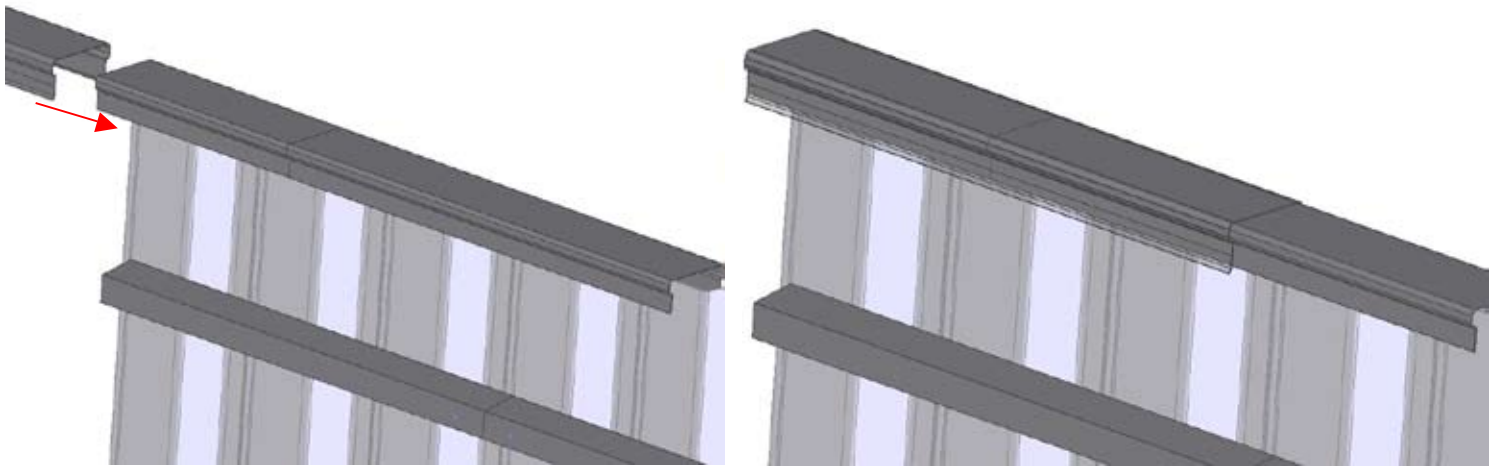
It is recommended that you cut one of your 20' structural inserts into two 10' lengths for easy installation. Place one of the 10' lengths onto your wall so that no wall is left exposed underneath the outside end of your insert. You will save the other piece for the final step of your installation.



Place a 20' insert onto the wall so that it touches your already positioned 10' insert.

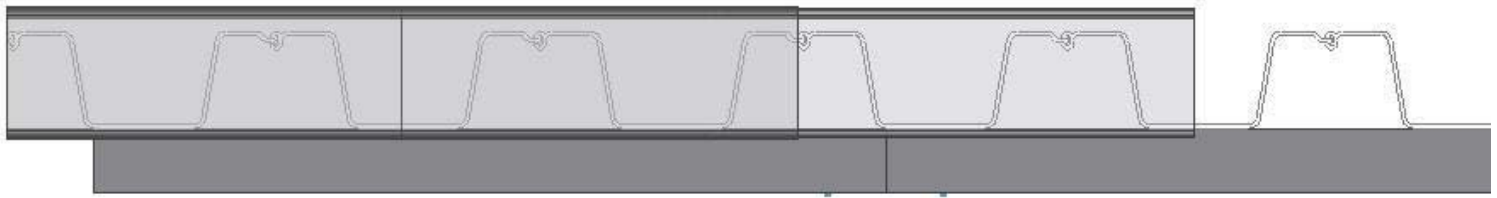


Slide a 20' cap section onto the cap inserts. Because your cap system acts like a roof, be sure that the outside end of your wall is completely covered by the cap section. Because you have made this 10' insert piece, every other insert will automatically be half-in, half-out of the cap for optimal placement.

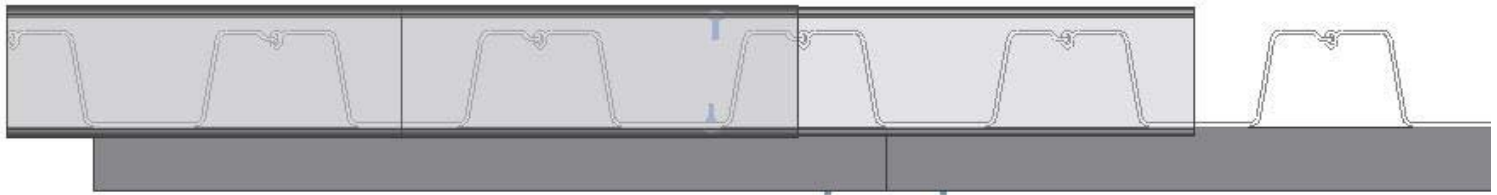


After this helpful setup, the rest of the install process is the same as with the standard package. Follow Steps 2-4 from above to complete the installation for the faces of your wall.

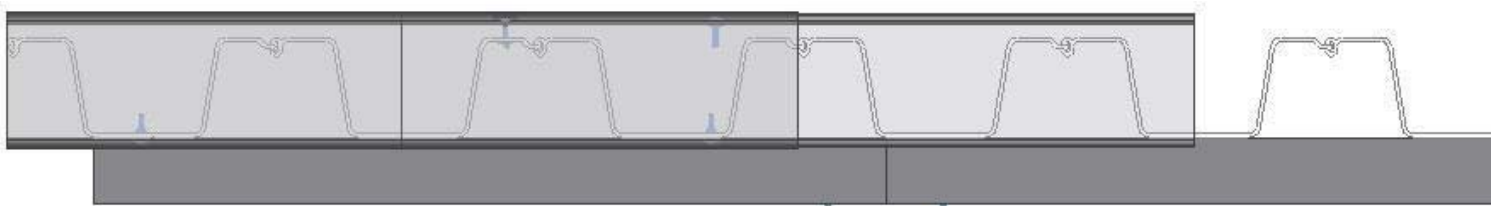
To summarize:



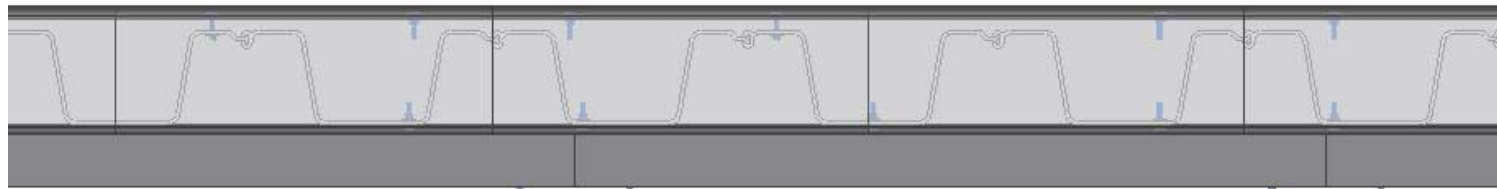
Secure the 1st cap section to the insert.



Secure the cap and insert to the wall.



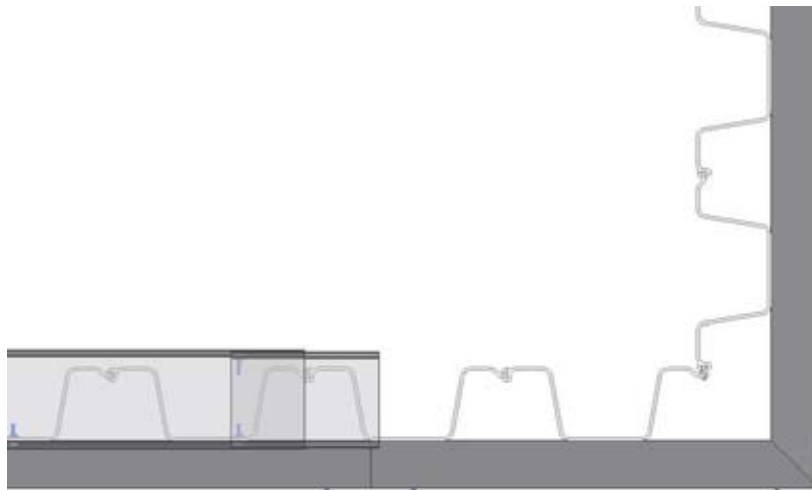
Secure the next cap section to inserts at both ends, followed by securing the cap and insert to the wall.



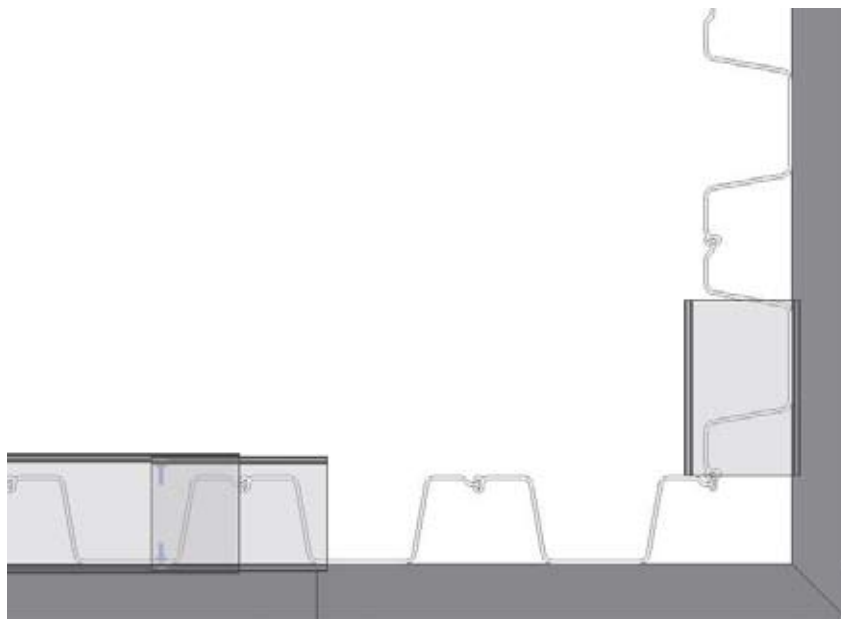
Turning a corner with your ArmorWare Cap

Step 1 – Preparing to turn a corner

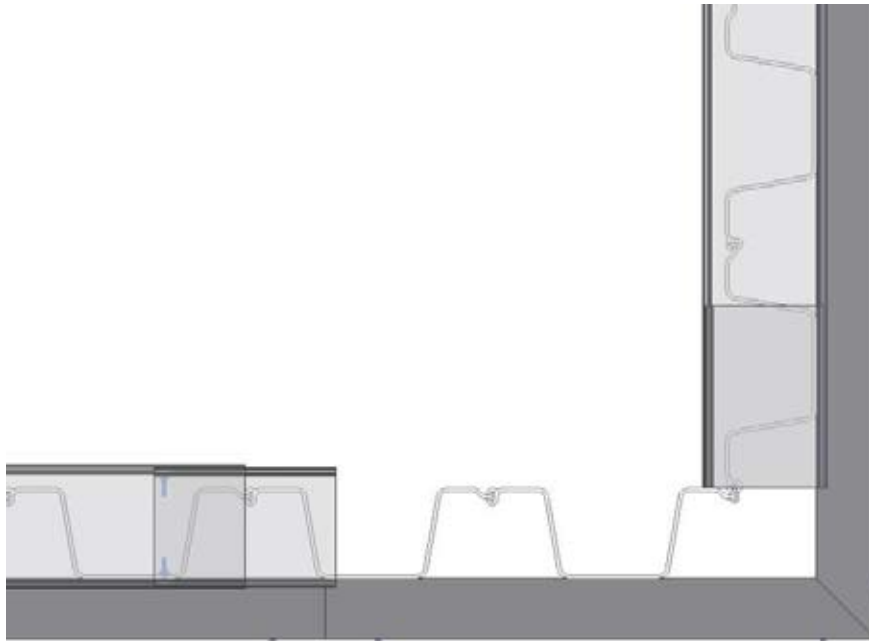
For this example we will show the standard ArmorWare Cap package turning a 90 degree corner. This process will use a 90 degree corner insert. We also offer 45 degree corner inserts, but the process for turning a 45 or 90 degree corner is fundamentally the same. When you reach a corner, you will want to stop so that your last cap insert is still within a straight section of the wall. You should plan so this does not happen near the corner.



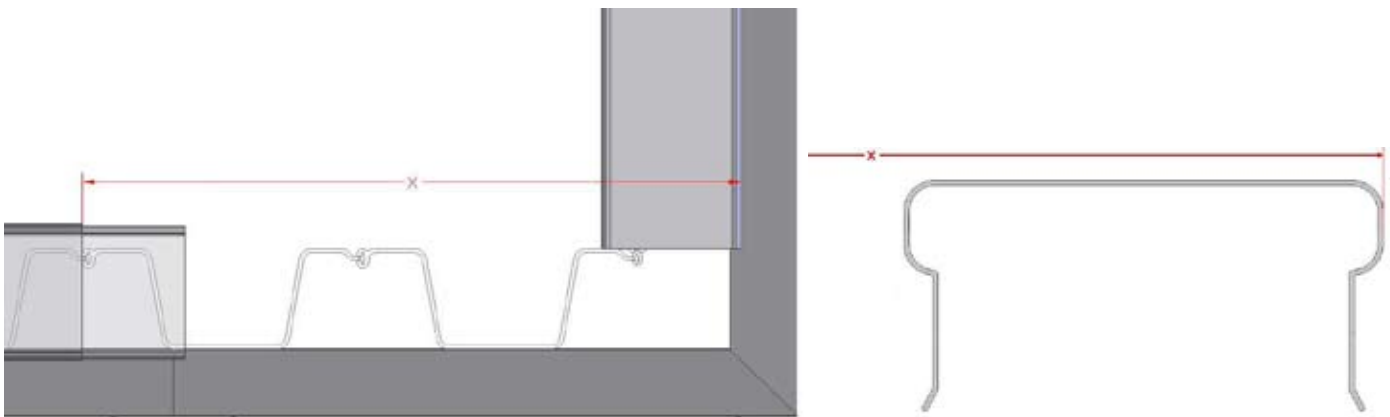
Identifying the proper location for your miter cut is very important for a quick, simple, and attractive wall. There are many ways to accomplish this, but one of the simpler ways is as follows: Place a cap insert onto the turned wall section and slide it as far into the corner as possible.



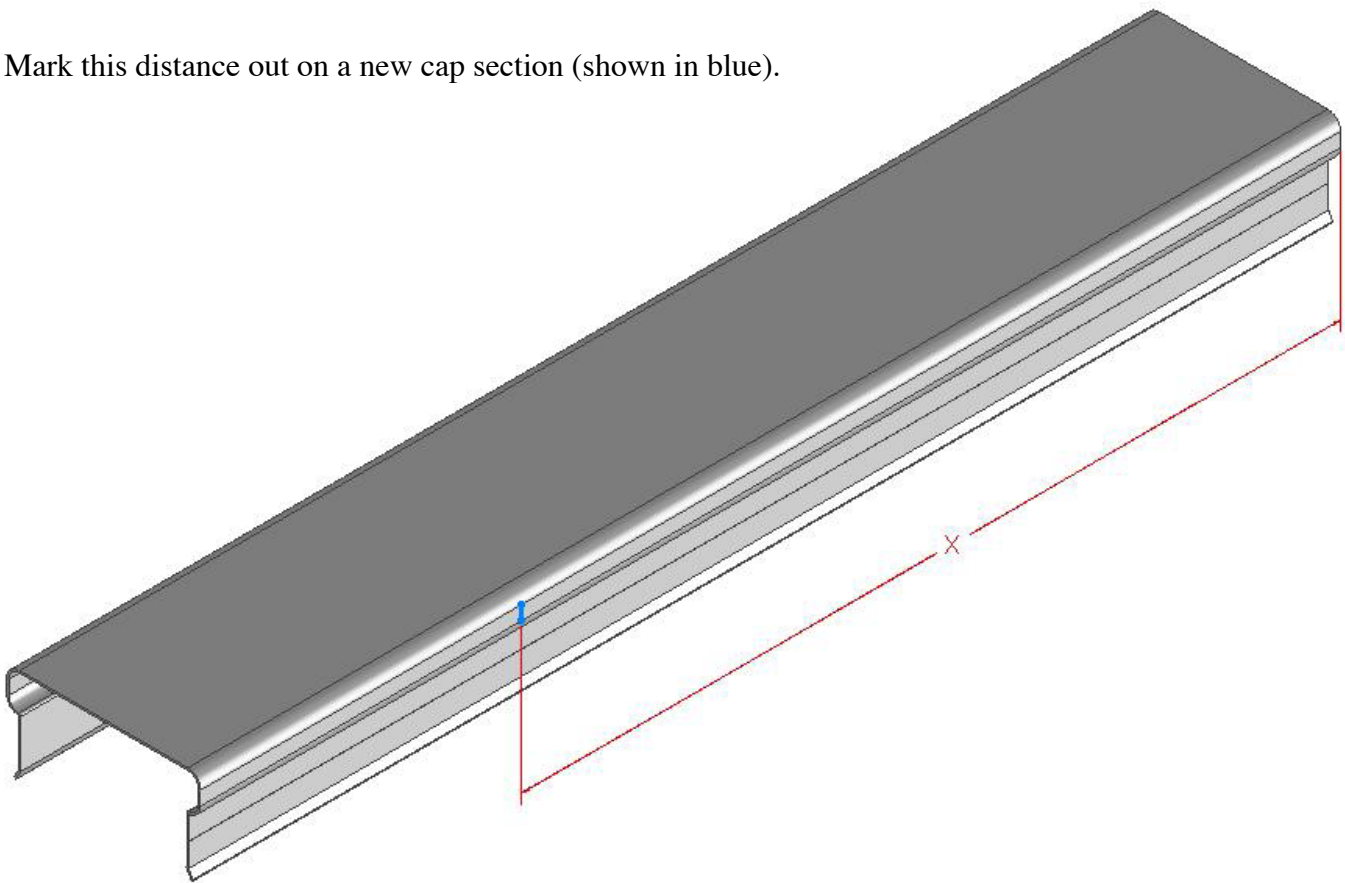
Slide a cap section onto the insert and up to the corner as well. Position these just as you would for final installation. This ensures, in this particular situation, that the cap and wall tightly sandwich the insert on the front side and are hanging over the back just as before.



Measure the distance from the farthest point on the cap that you just positioned (this will be the upper flat section) to the last cap section on the flat of your wall.



Mark this distance out on a new cap section (shown in blue).

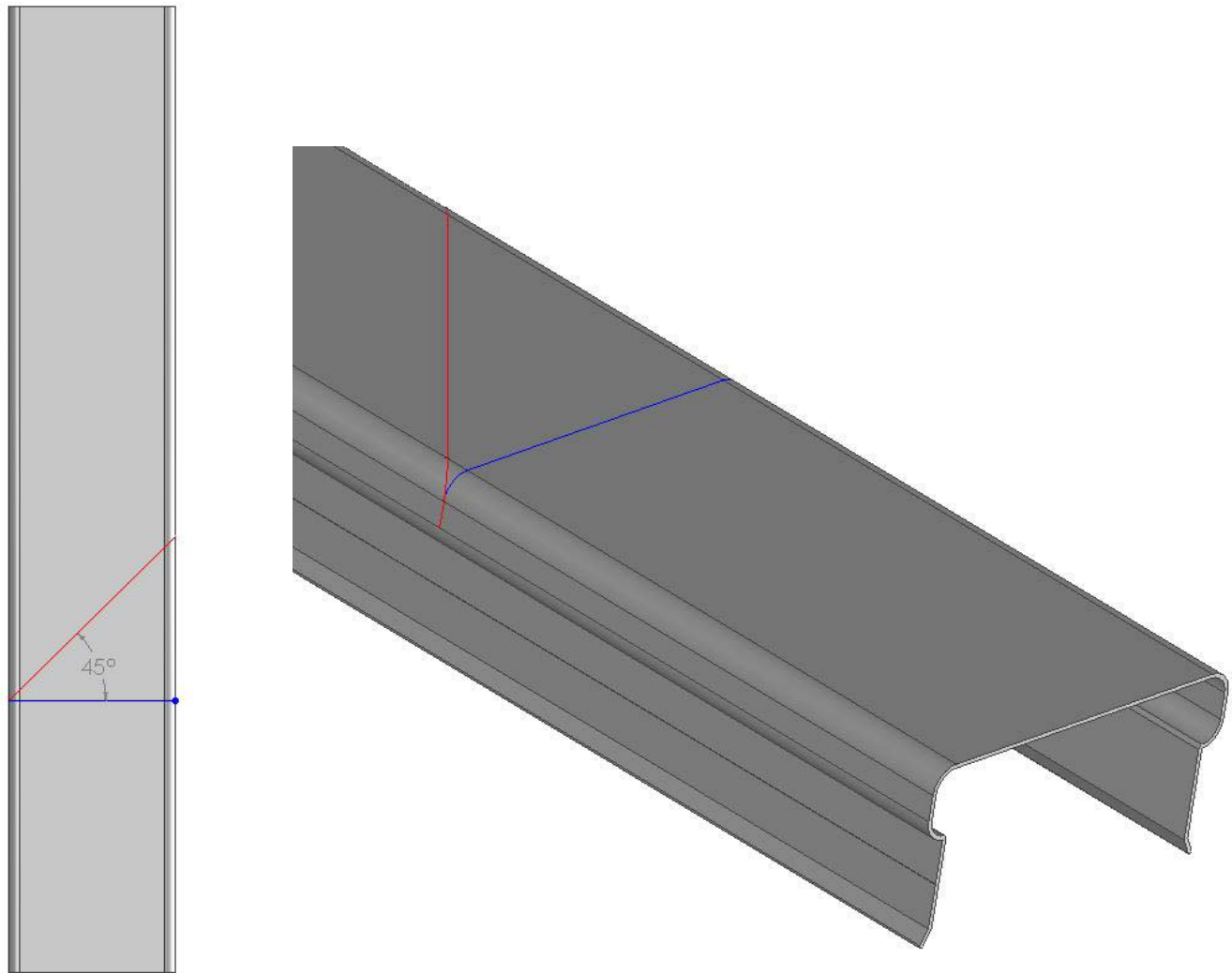


Extend this point across and around to the opposite side of your cap to get a baseline for your cut (shown in blue).

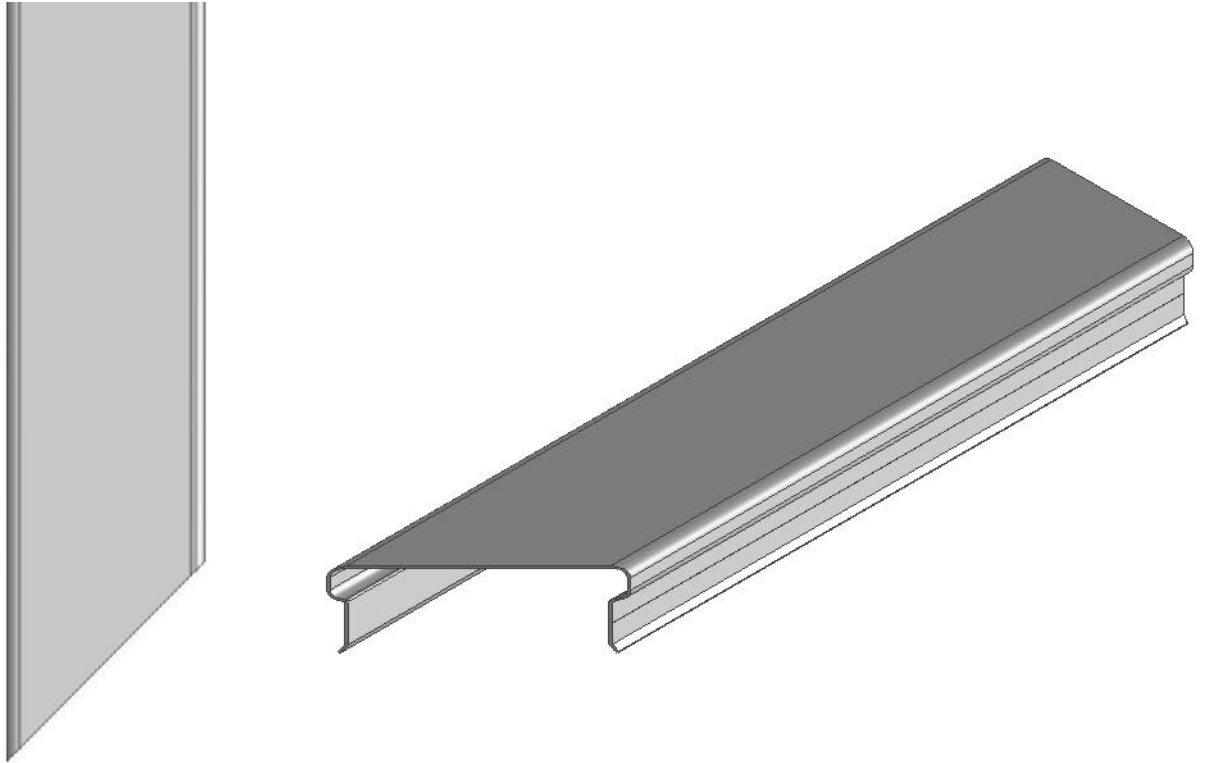


Step 2 – Making your cuts

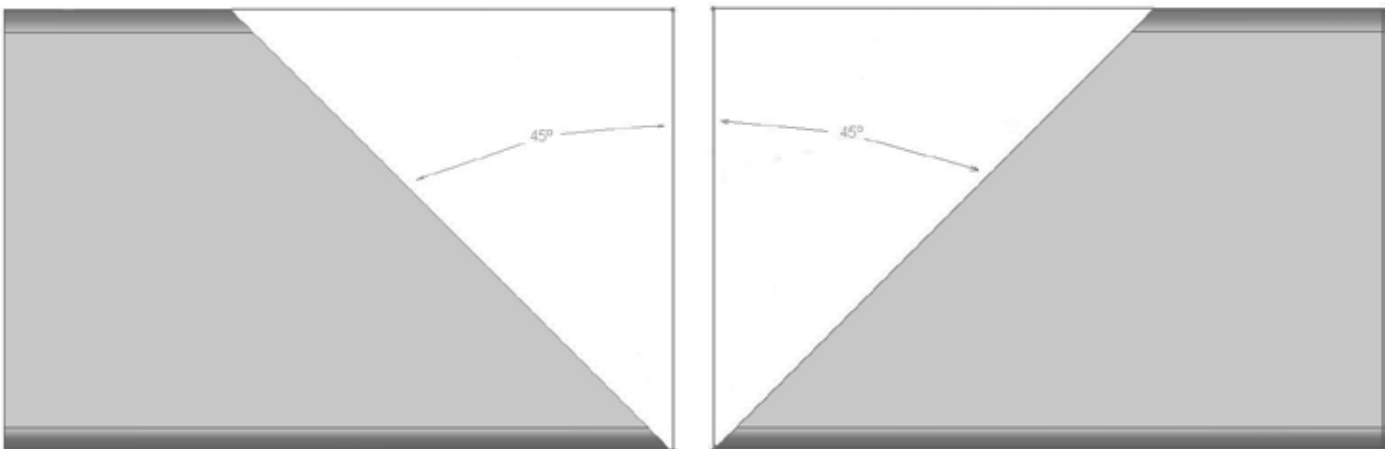
Since this will be a mitered cut, your cut angle will be 1/2 of your actual turned angle. For this example of a 90 degree turn, we will cut at a 45 degree angle from base line. For a 45 degree turn, the cut would be made at 22.5 degrees and so on. For accurate cutting, you should use a chop saw, miter box, or have your cap sections professionally mitered. The corner will be a focal point for your wall, and you will probably want to take care to make sure that you have accurate angles and clean cuts. Make your angled cut line (shown in red) from the baseline (blue) in the appropriate orientation. The baseline represents the outer corner of your finished wale, so your cut line will always be pointed away from the end that you intend to use as the corner. Remember that this is a projected line, over the curved sections of the cap, so a string might help keep the line.



Make your cut by following the red line with your saw.



You might want to go ahead and cut your other miter corner piece as well, while you are already cutting. You should make your second corner piece from a new 20' section so that the next splice occurs as far from the corner as possible. For this cut, you will make the matching miter cut 22.5 or 45 degrees from perpendicular, respectively, for a 45 or 90 degree turn. This cut can be made from the end so that no measurement is necessary.

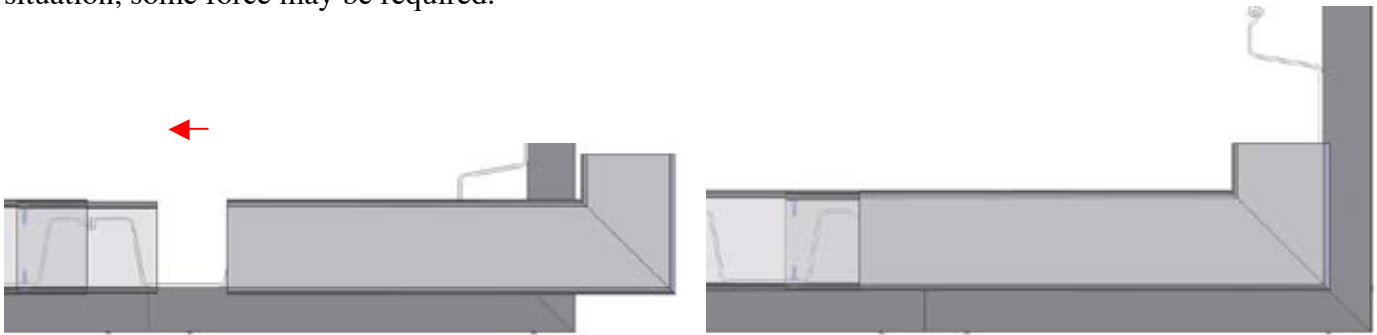


Step 3 – Installing your corner

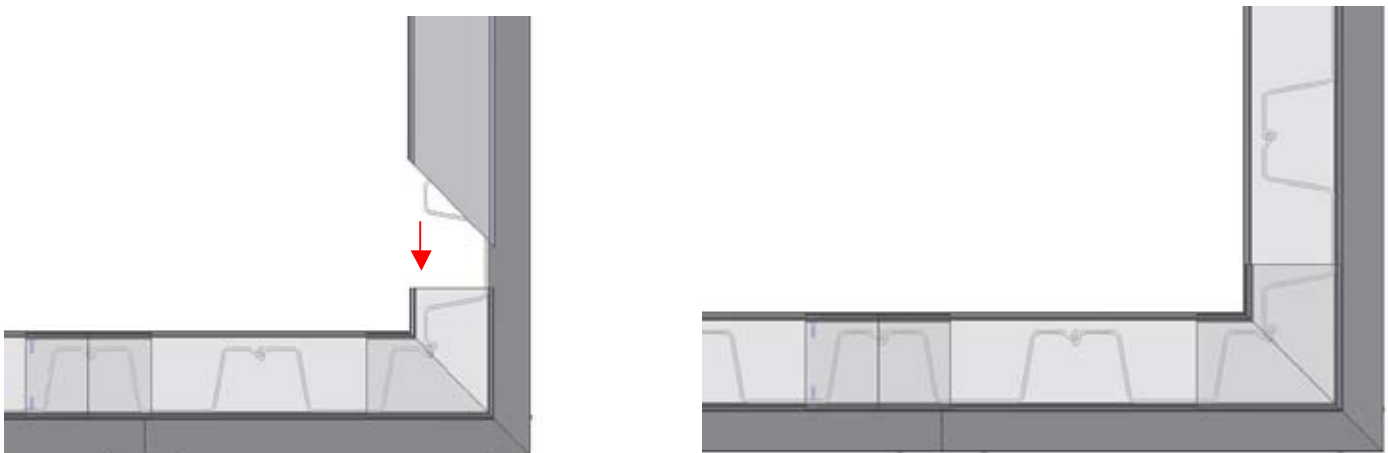
After you have made your cuts, you are ready to assemble your corner. Since there are some precision cuts used here, it might be a good idea to “mock up” your corner to ensure that everything fits together to your satisfaction before fastening. Slide your appropriate corner insert, in this case a 90 degree corner insert, into the first cap section (the one with the measured cut).



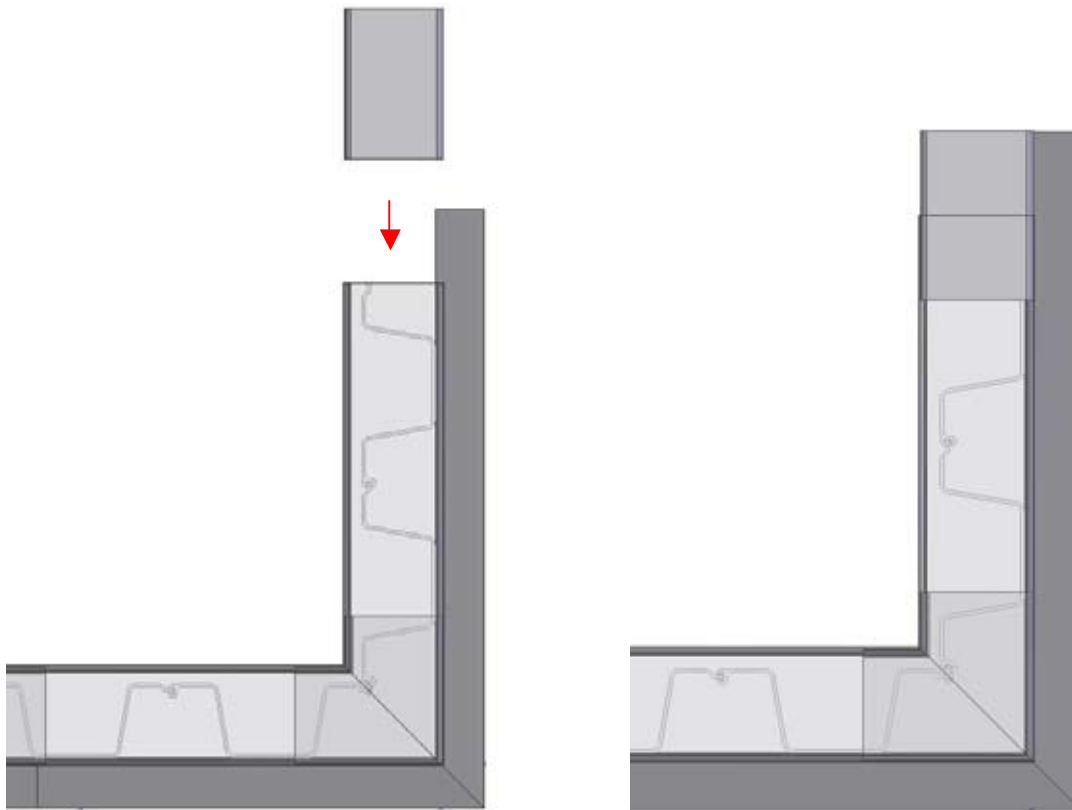
You will now need to slide this onto your last insert on the wall face while at the same time positioning the corner insert piece on the corner of the wall. You will be doing two things at once here, so depending on your situation, some force may be required.



After your cap section and corner insert are in place, slide your matching miter cut cap section (the one from a new 20' section) onto the exposed insert.



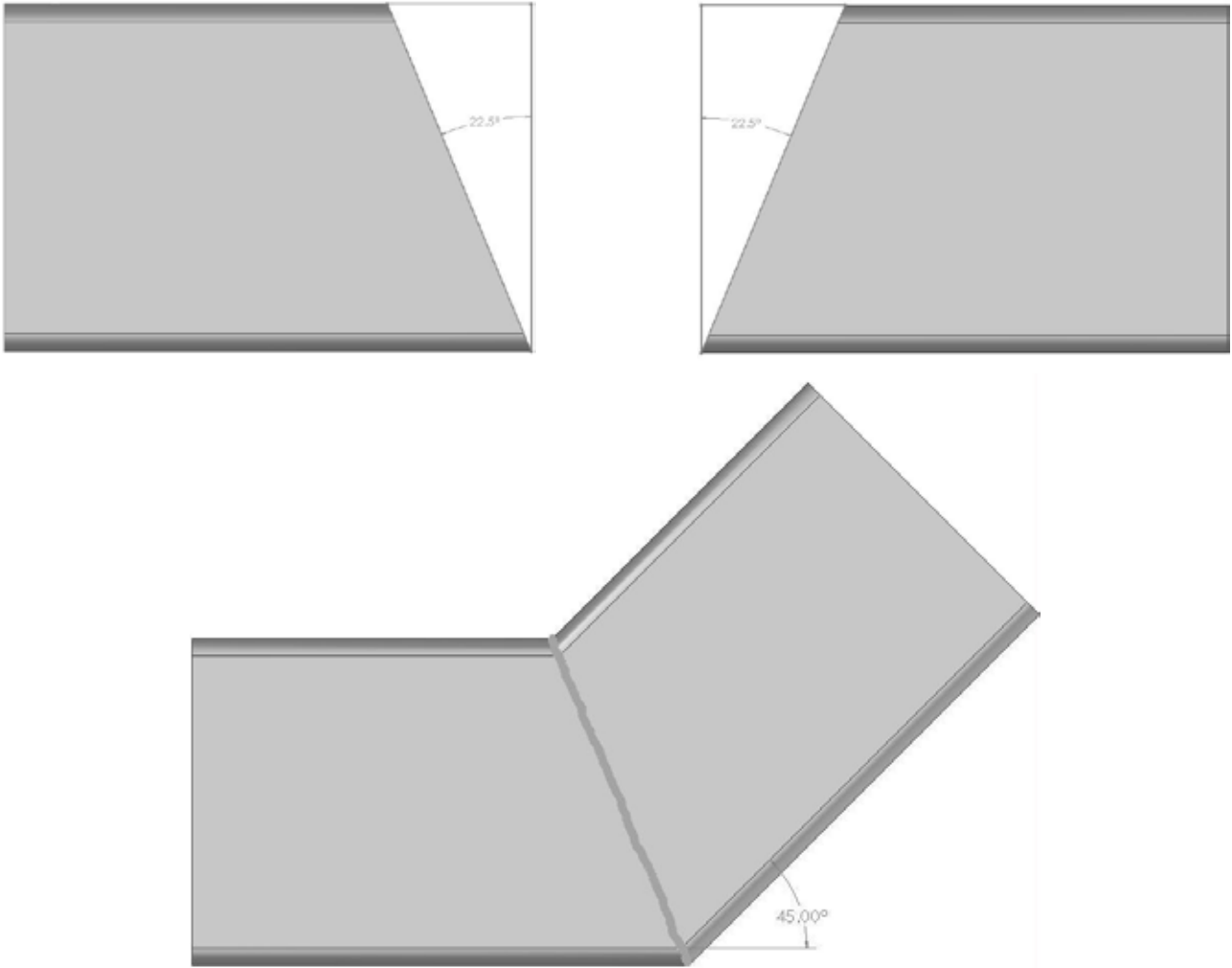
Slide in an 18” insert half-in, half-out of the last cap section. If you will be continuing your wall, this will be used to connect your next cap section. If your wall stops here, then this insert will aid in leveling your cap.



You should make sure that everything fits together properly and no more finishing is required before fastening. When you are satisfied that the cap is level and everything is in contact on the front face, you are ready to fasten the components. You will use the same attachment principals that you have learned throughout this section.

Step 4 – Modifying your installation for non-standard turns

If you will be making a custom turn, the process is identical, only you will need to fabricate your own corner inserts. You can use two of the provided inserts for this. Miter cut the inserts at the same angle as you would cut your cap sections. Weld the two mitered insert pieces together to create your own custom corner insert (45 shown here). Now you have your non-standard corner insert, and the corner turning process is the same as above.



Touch Up and Maintenance of Your ArmorWare Cap

Although ArmorWare Caps and inserts are made from high quality marine grade aluminum, as is the case with all metallic material, there is a possibility of corrosion in some cases. It is always a good idea to carefully inspect your structure for any area that may be susceptible to corrosion.

Wherever the painted or anodized coating on the cap has been damaged it is necessary to buff the area and apply a fresh layer of touch-up paint. It is also important to grind down and buff any jagged edges and apply a fresh coat of touch-up paint.

Periodically through the life of the structure it is advisable to closely inspect all the components of your structure. If there is any evidence of damage to the cap coating or the onset of corrosion, you can dramatically increase the life of your structure by buffing the area, removing any corrosion and applying a fresh coat of touch-up paint.

Finishing Up

WARNING

No two walls are the same. The numerous job site variables make it impossible to provide specific construction designs without careful analysis of each variable and the effect it will have on the structure. This analysis should be left up to an architect, professional contractor, or engineer. This manual lists typical installation techniques for demonstration purposes only, and in no way represents any recommendations on how to approach your particular project. Please rely on your engineer for specific design recommendations. Because of the complexity of geotechnical loading calculations and the susceptibility to extreme change of soil loads with minor changes in local site conditions such as soil parameters, water levels, surcharge loads, etc., we strongly recommend the use of design professionals who are familiar with local wall construction to determine the required wall parameters, design techniques, and applicable installation methods and procedures.

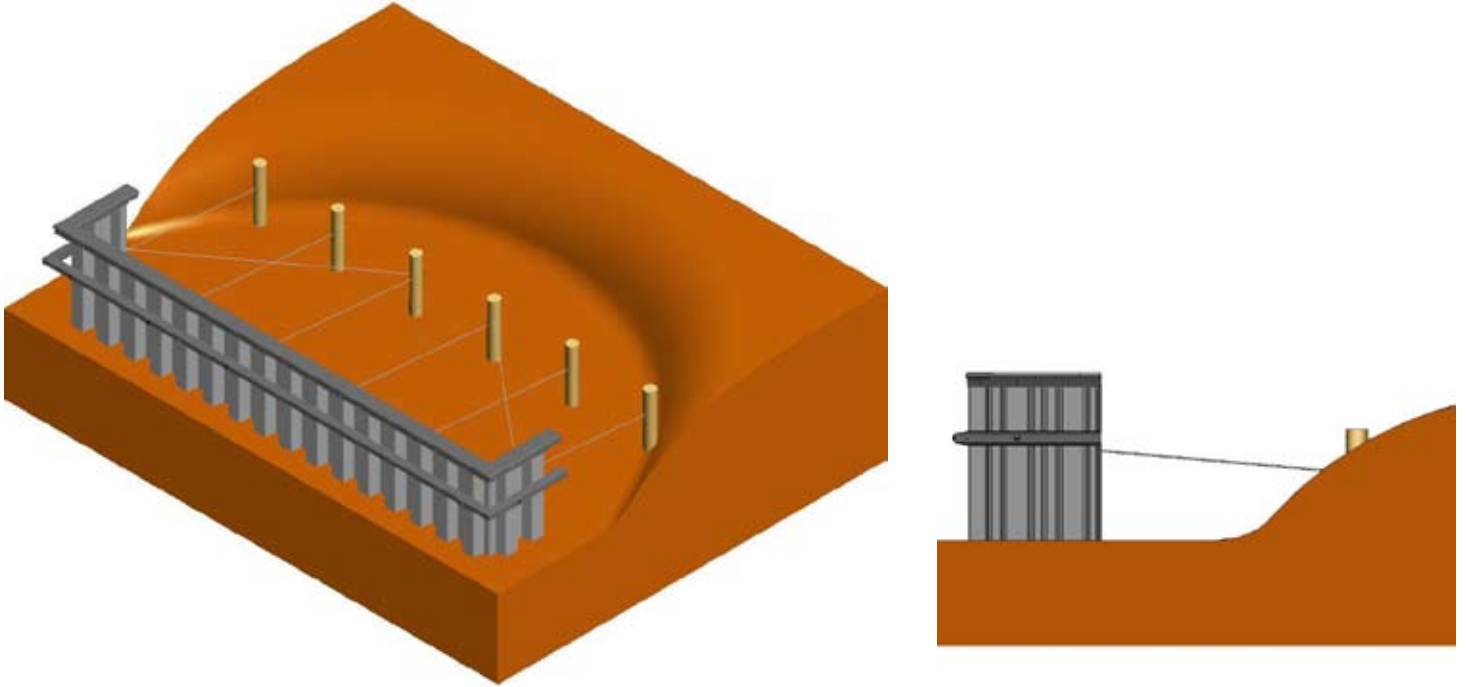
WARNING

This manual does not address any safety or regulatory issues associated with its use nor the installation of CMI products. It is the user's responsibility to establish and ensure that all regulated and appropriate safety and health practices are followed. It is also the user's responsibility to ensure that any and all applicable permits and permissions have been secured before installation of any CMI product.

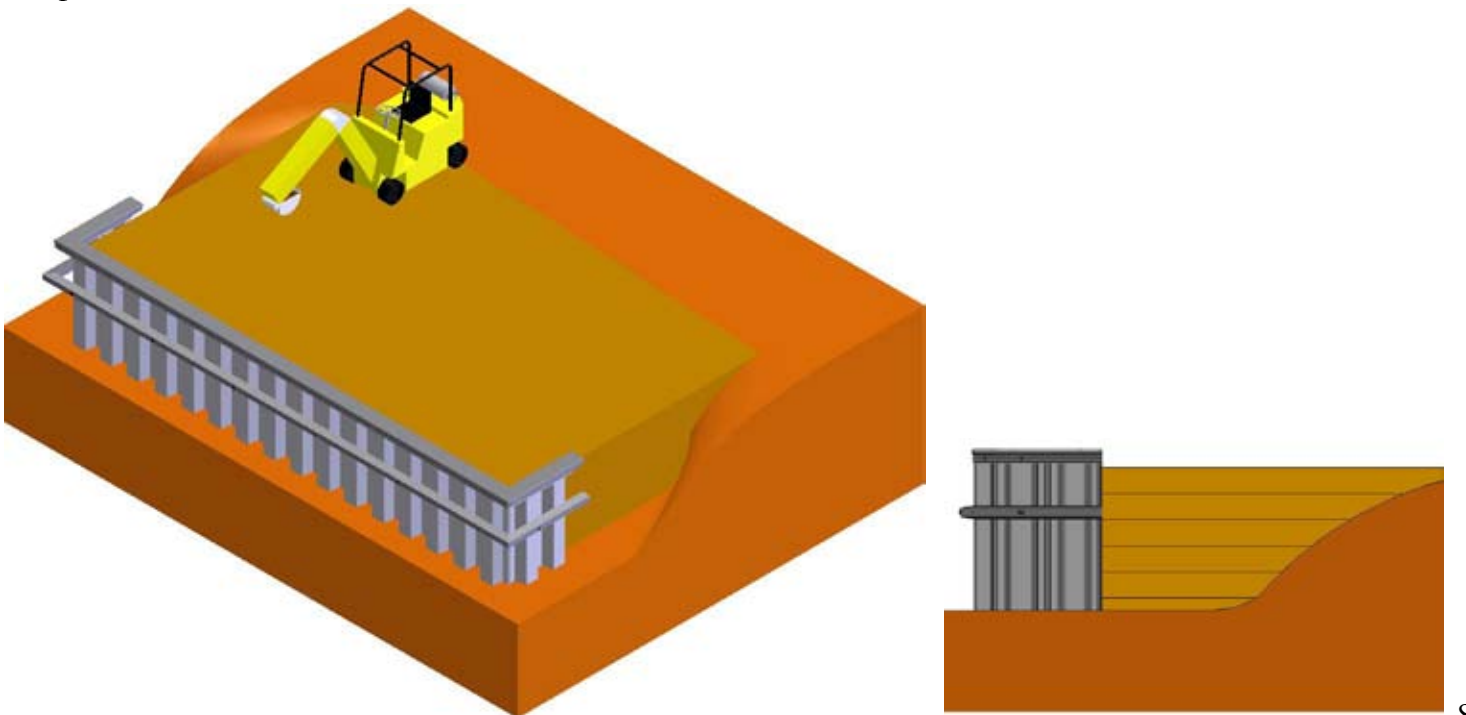
Finishing Up

Backfilling

The type of backfill you use is a very important decision that is often overlooked. Your choice in backfill influences your wall structure more than any other single factor. Hydrostatic pressure behind a wall causes more failures than any other factor. You should use granular, free draining backfill. If site conditions permit, the use of drainage or weep holes is also recommended. Often times the designer for your structure will specify in detail what type of backfill and drainage is required.

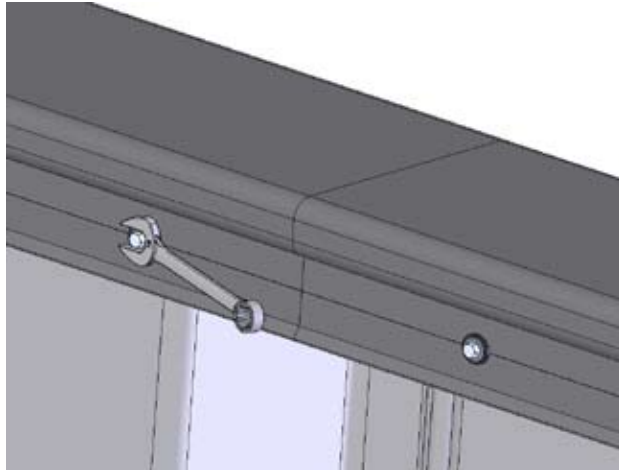


It is a good idea to backfill in lifts or layers of 1-2 ft., compacting the soil at each layer. It is very important to make sure that there are no voids in the backfill and that it has good contact with the entire surface of your wall. This is particularly important in the corners, where it may take some extra effort to ensure good backfilling and compaction.



Final Wall Tuning

After all of your components are installed and you have backfilled, you will now want to tighten all nuts and bolts on your structure.



If you have used TimberGuard components and would like to wrap or seal any openings to give it a finished look, you can do this now. We have suggested that you save this step for last because it is primarily a polishing step to touch up the aesthetics of your wall. You may, however, do this at any point that you wish in the construction process. Shown below is a TimberGuard wale using TimberGuard wrap to conceal the joint.



Finally, after your retaining structure is complete, it is a good practice to periodically check back to make sure that everything is aging as expected and no maintenance is required. Though the metals used are designed for marine environments, all metals corrode eventually. You should make sure that no premature corrosion is taking place, and if found, the corroded material should be removed and sealed to prevent damage to the integrity of the structure.

With the fundamentals learned in this manual you should be well on your way to constructing synthetic sheet piling structures to protect your investments for years to come.



CAD Drawings

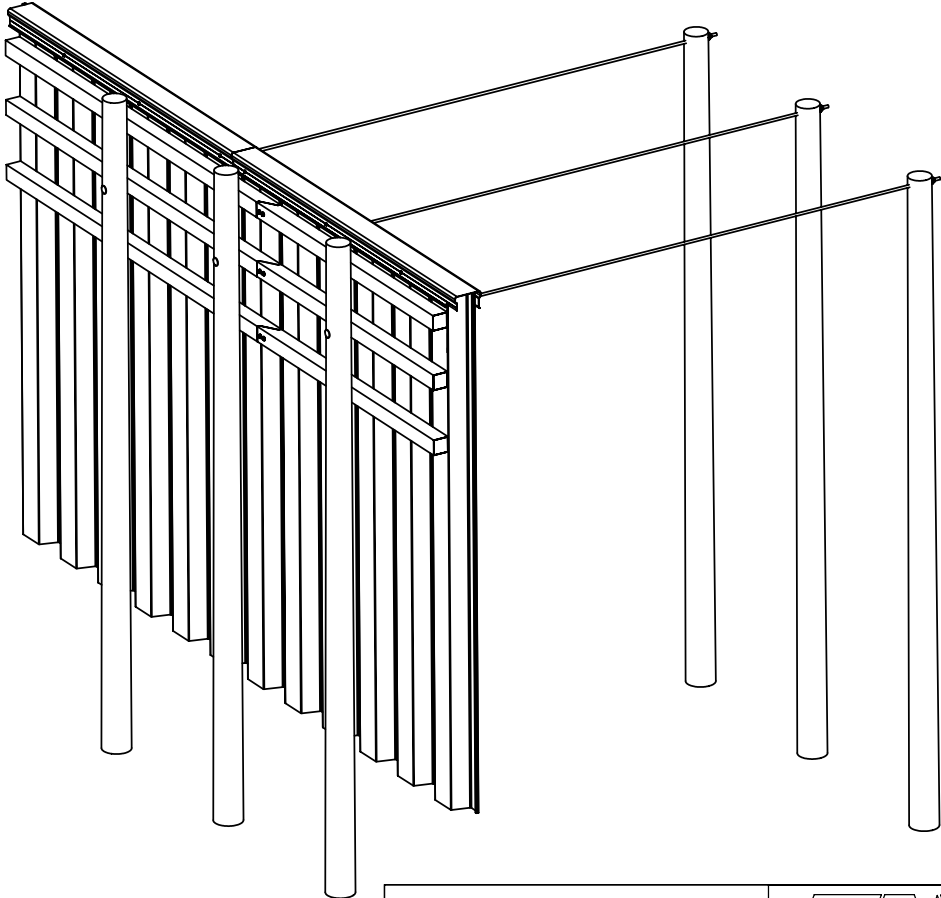
WARNING

No two walls are the same. The numerous job site variables make it impossible to provide specific construction designs without careful analysis of each variable and the effect it will have on the structure. This analysis should be left up to an architect, professional contractor, or engineer. This manual lists typical installation techniques for demonstration purposes only, and in no way represents any recommendations on how to approach your particular project. Please rely on your engineer for specific design recommendations. Because of the complexity of geotechnical loading calculations and the susceptibility to extreme change of soil loads with minor changes in local site conditions such as soil parameters, water levels, surcharge loads, etc., we strongly recommend the use of design professionals who are familiar with local wall construction to determine the required wall parameters, design techniques, and applicable installation methods and procedures.

WARNING

This manual does not address any safety or regulatory issues associated with its use nor the installation of CMI products. It is the user's responsibility to establish and ensure that all regulated and appropriate safety and health practices are followed. It is also the user's responsibility to ensure that any and all applicable permits and permissions have been secured before installation of any CMI product.

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED
IN THIS DRAWING IS THE SOLE
PROPERTY OF CMI LTD. ANY
REPRODUCTION IN PART OR AS
A WHOLE WITHOUT THE WRITTEN
PERMISSION OF CMI LTD. IS
PROHIBITED.

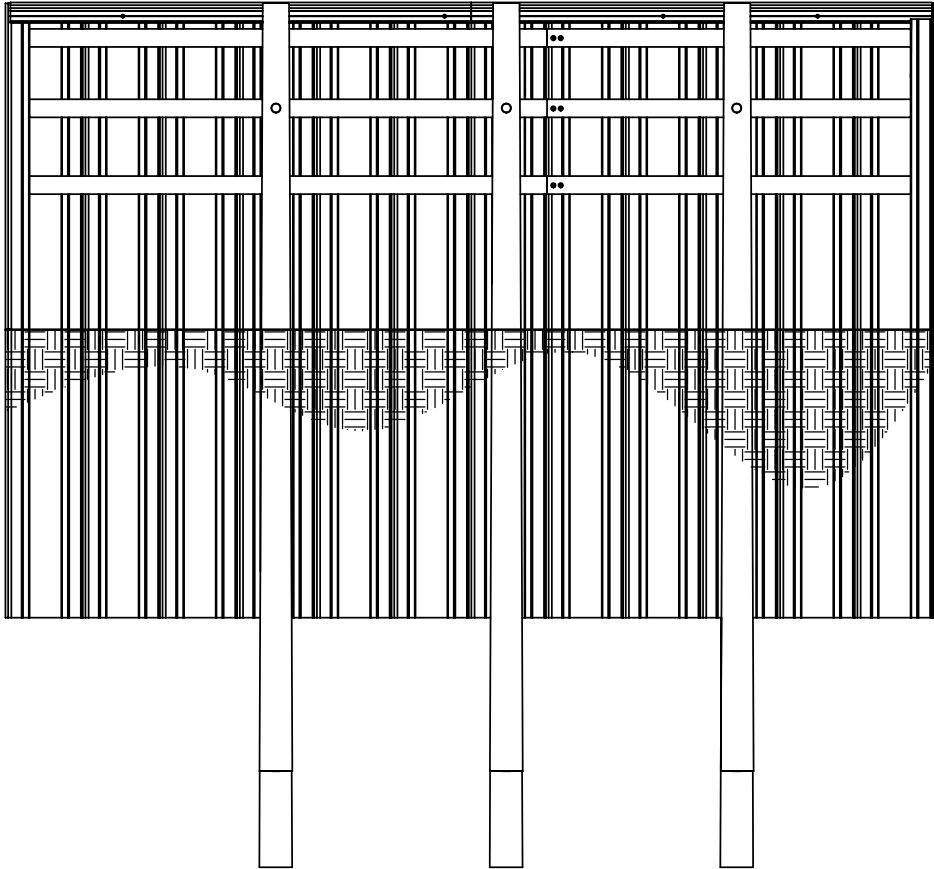


CRANE MATERIALS INTERNATIONAL

Navy Style Standard Drawing-ISO

SIZE A	DATE 08/09/05	FILE Navy Style Std Dwg-ISO 072005.DWG	REV REL
SCALE NA	DRAWN CBB	SHEET 1 of 4	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CMI LTD. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CMI LTD. IS PROHIBITED.

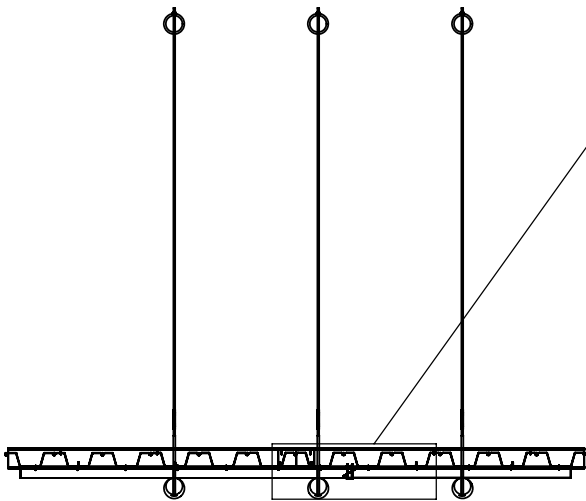
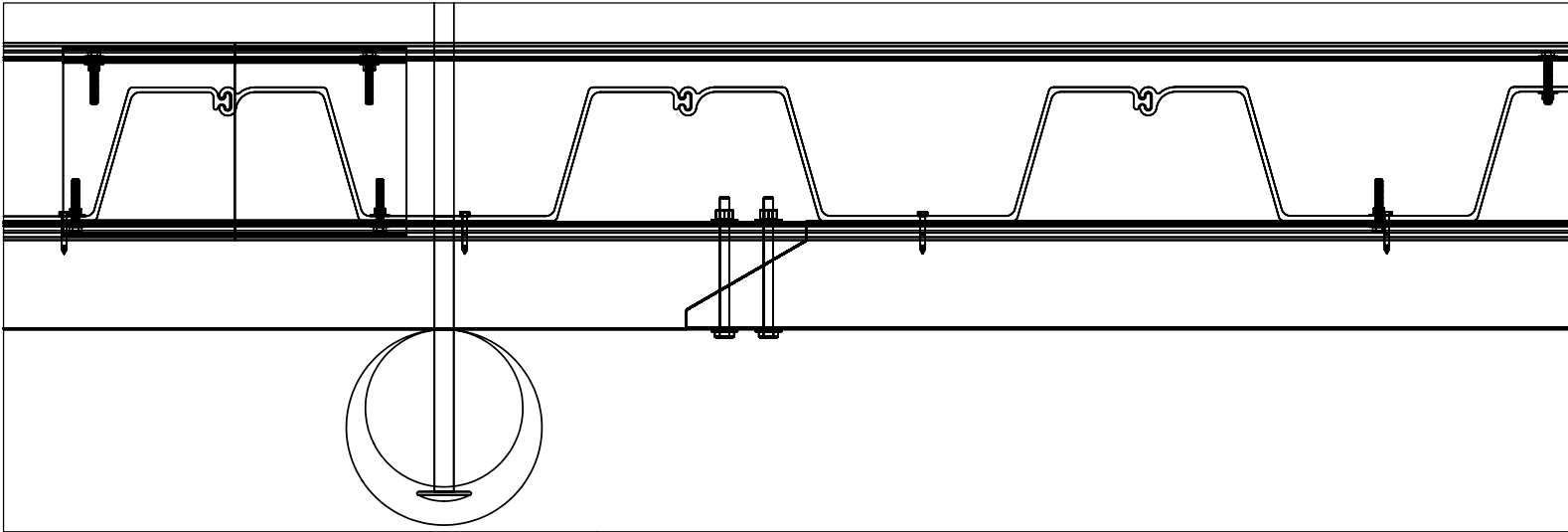


CRANE MATERIALS INTERNATIONAL

Navy Style Standard Drawing— Front Elevation

SIZE A	DATE 08/09/05	FILE Navy Style Std Dwg-Front Elevation 072005.DWG	REV REL
SCALE NA	DRAWN CBB	SHEET 2 of 4	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



PROPRIETARY AND CONFIDENTIAL

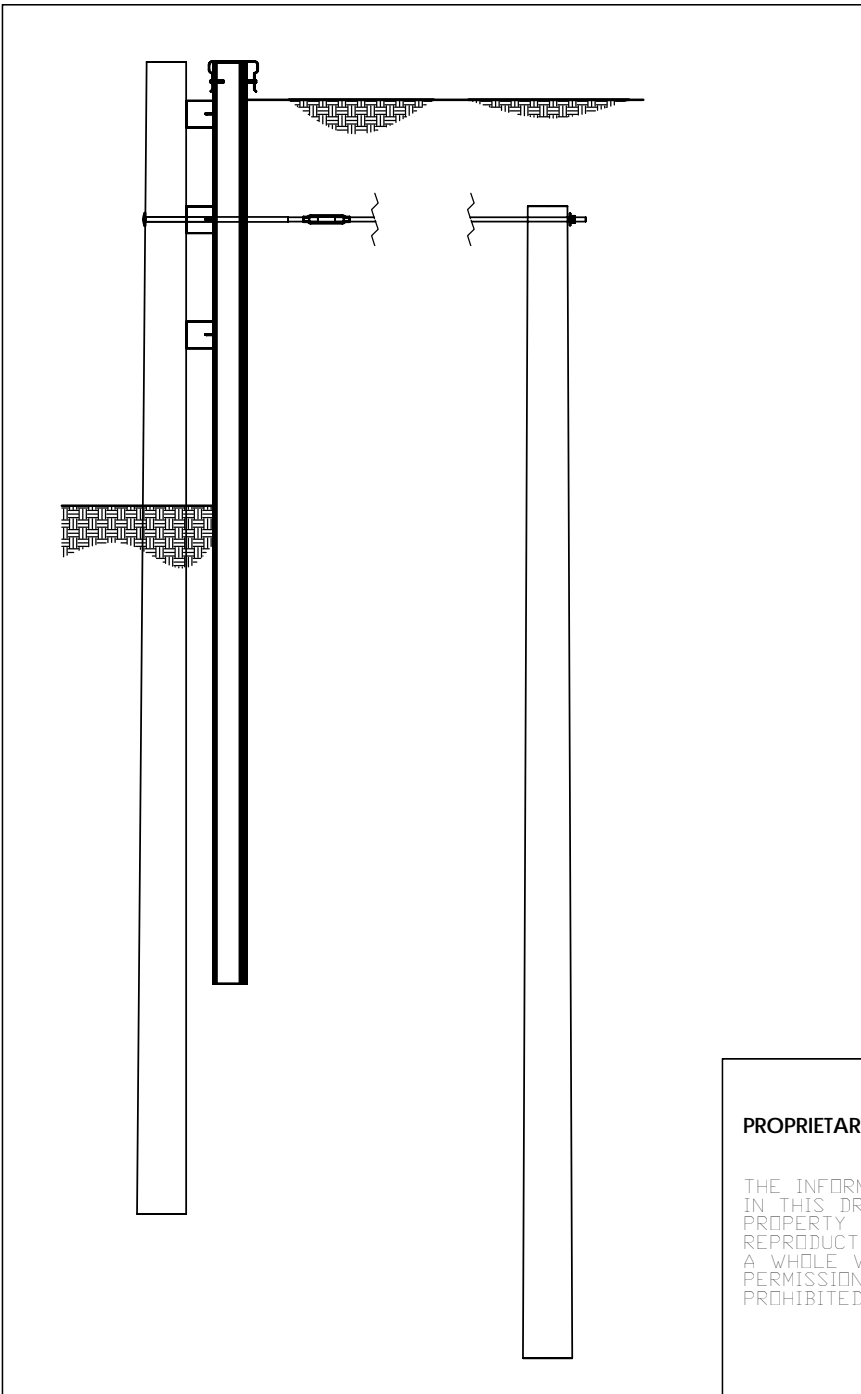
THE INFORMATION CONTAINED
IN THIS DRAWING IS THE SOLE
PROPERTY OF CMI LTD. ANY
REPRODUCTION IN PART OR AS
A WHOLE WITHOUT THE WRITTEN
PERMISSION OF CMI LTD. IS
PROHIBITED.




CRANE MATERIALS INTERNATIONAL

Navy Style Standard Drawing— Top Plan View

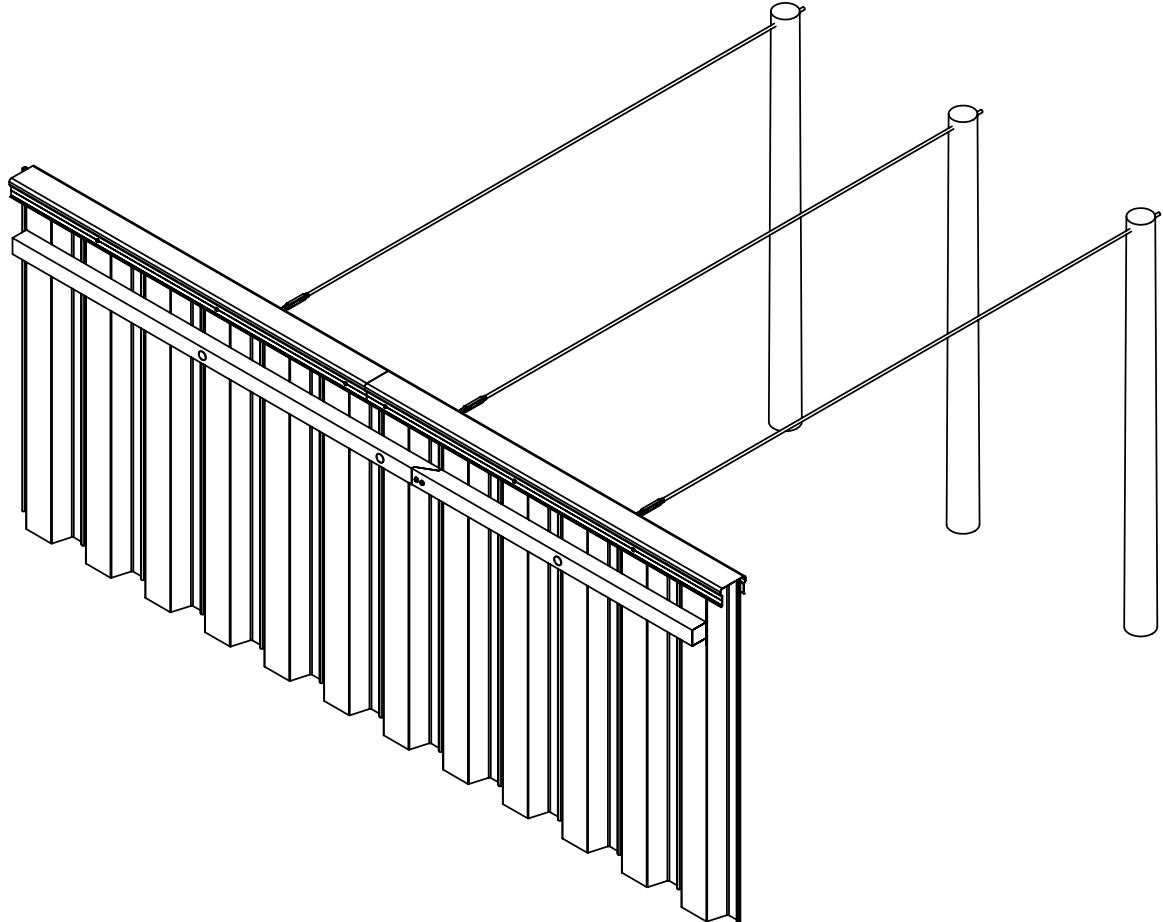
SIZE A	DATE 08/09/05	FILE Navy Style Std Dwg-Top Plan View 072005.DWG	REV REL
SCALE NA	DRAWN CBB	SHEET 3 of 4	



REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

<p>PROPRIETARY AND CONFIDENTIAL</p> <p>THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CMI LTD. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CMI LTD. IS PROHIBITED.</p>			<p>CRANE MATERIALS INTERNATIONAL</p>	
	<p>Navy Style Standard Drawing— Side Elevation</p>			
	SIZE	DATE	FILE	REV
A	08/09/05	Navy Style Std Dwg—Side Elevation 072005.DWG	REL	
SCALE	NA	DRAWN	CBB	SHEET 4 of 4

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED
IN THIS DRAWING IS THE SOLE
PROPERTY OF CMI LTD. ANY
REPRODUCTION IN PART OR AS
A WHOLE WITHOUT THE WRITTEN
PERMISSION OF CMI LTD. IS
PROHIBITED.

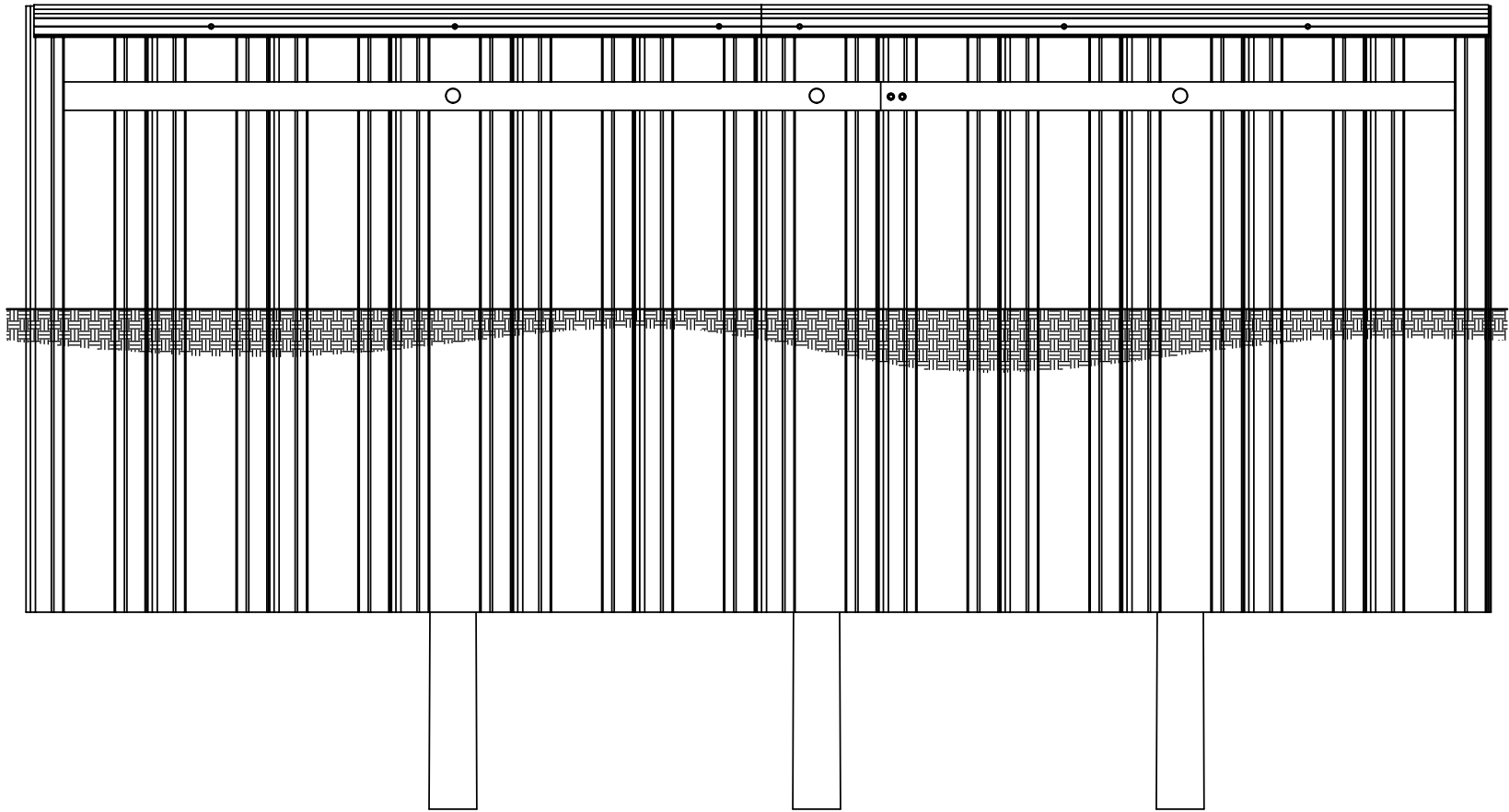


CRANE MATERIALS INTERNATIONAL

Drop Wale Standard Drawing-ISO

SIZE A	DATE 08/09/05	FILE Drop Wale Std Dwg-ISO 052405.DWG	REV REL
SCALE NA	DRAWN CBB	SHEET 1 of 4	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CMI LTD. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CMI LTD. IS PROHIBITED.

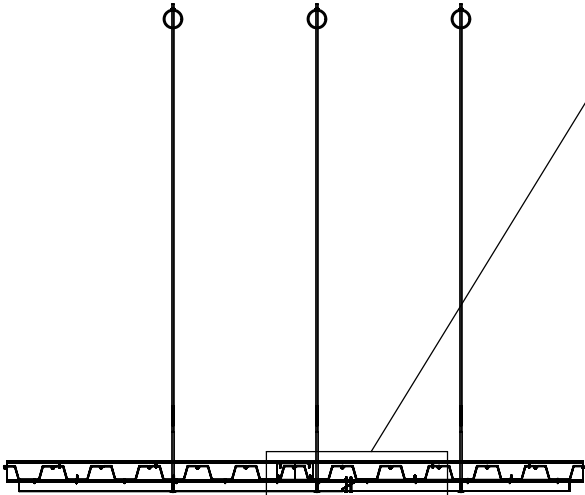
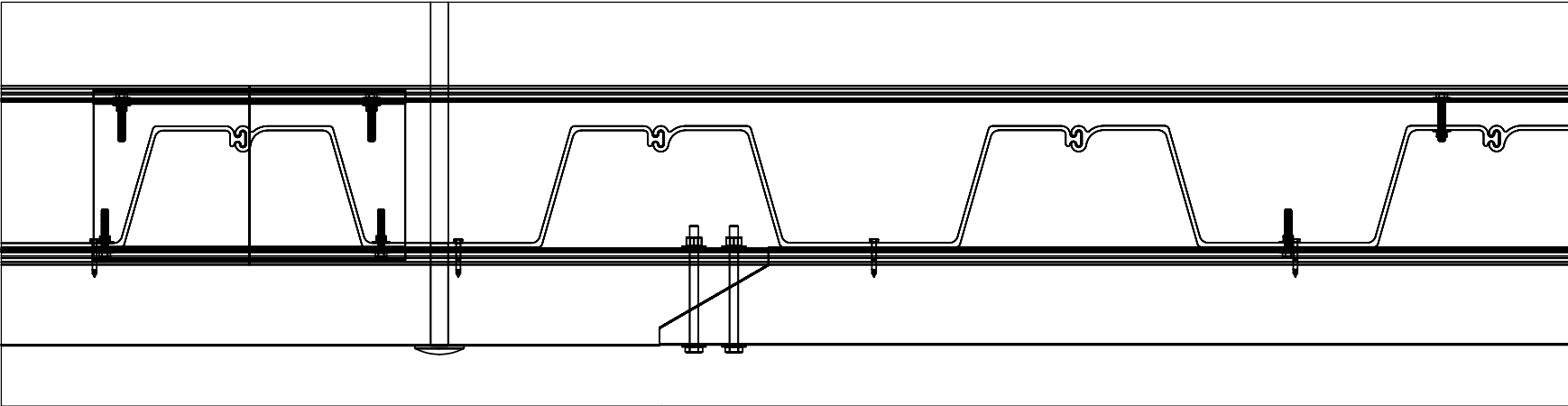


CRANE MATERIALS INTERNATIONAL

Drop Wale Standard Drawing— Front Elevation

SIZE A	DATE 08/09/05	FILE Drop Wale Std Dwg-Front Elevation 052405.DWG	REV REL
SCALE NA	DRAWN CBB	SHEET 2 of 4	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



PROPRIETARY AND CONFIDENTIAL

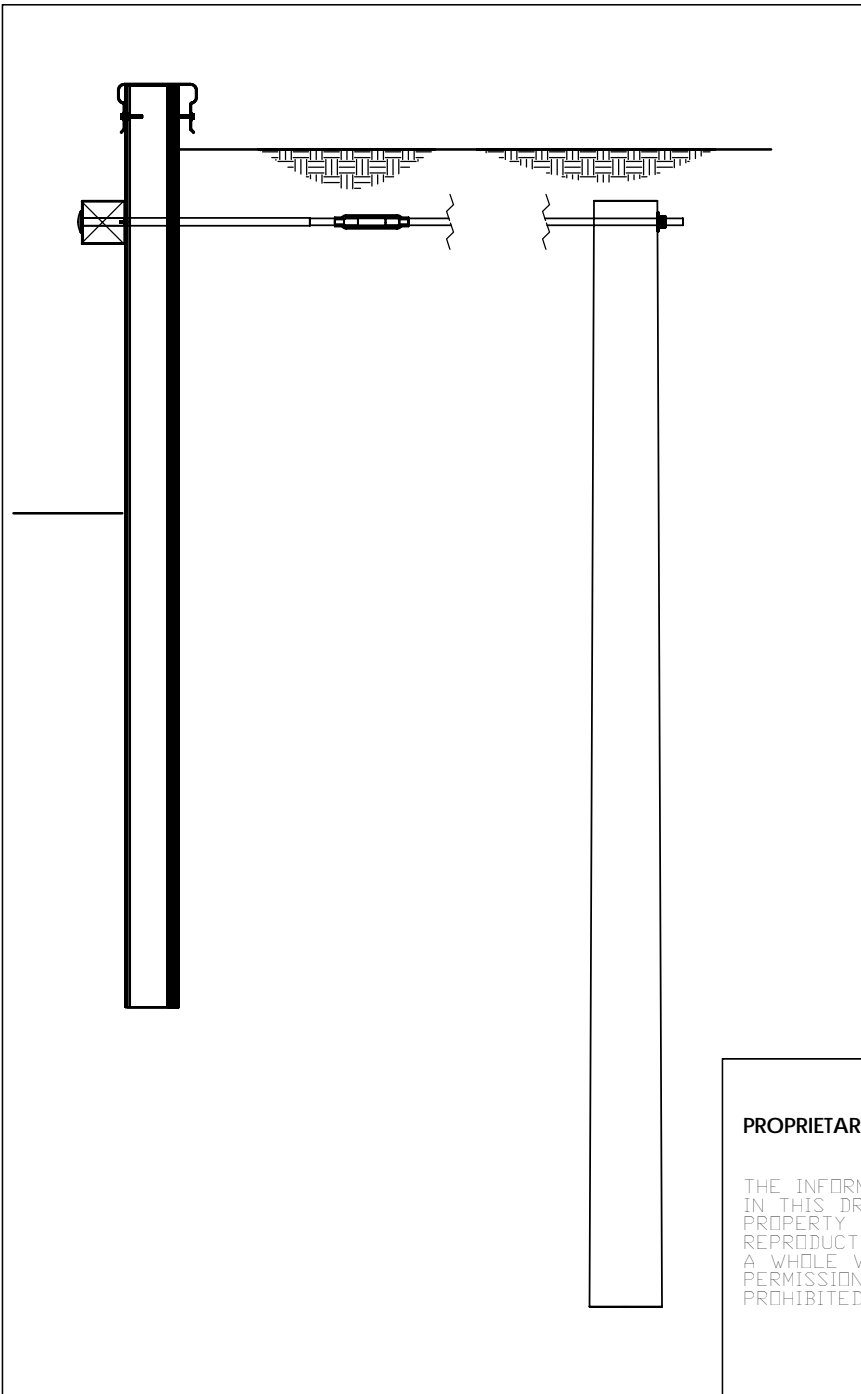
THE INFORMATION CONTAINED
IN THIS DRAWING IS THE SOLE
PROPERTY OF CMI LTD. ANY
REPRODUCTION IN PART OR AS
A WHOLE WITHOUT THE WRITTEN
PERMISSION OF CMI LTD. IS
PROHIBITED.




CRANE MATERIALS INTERNATIONAL

Drop Wale Standard Drawing—
Top Plan View

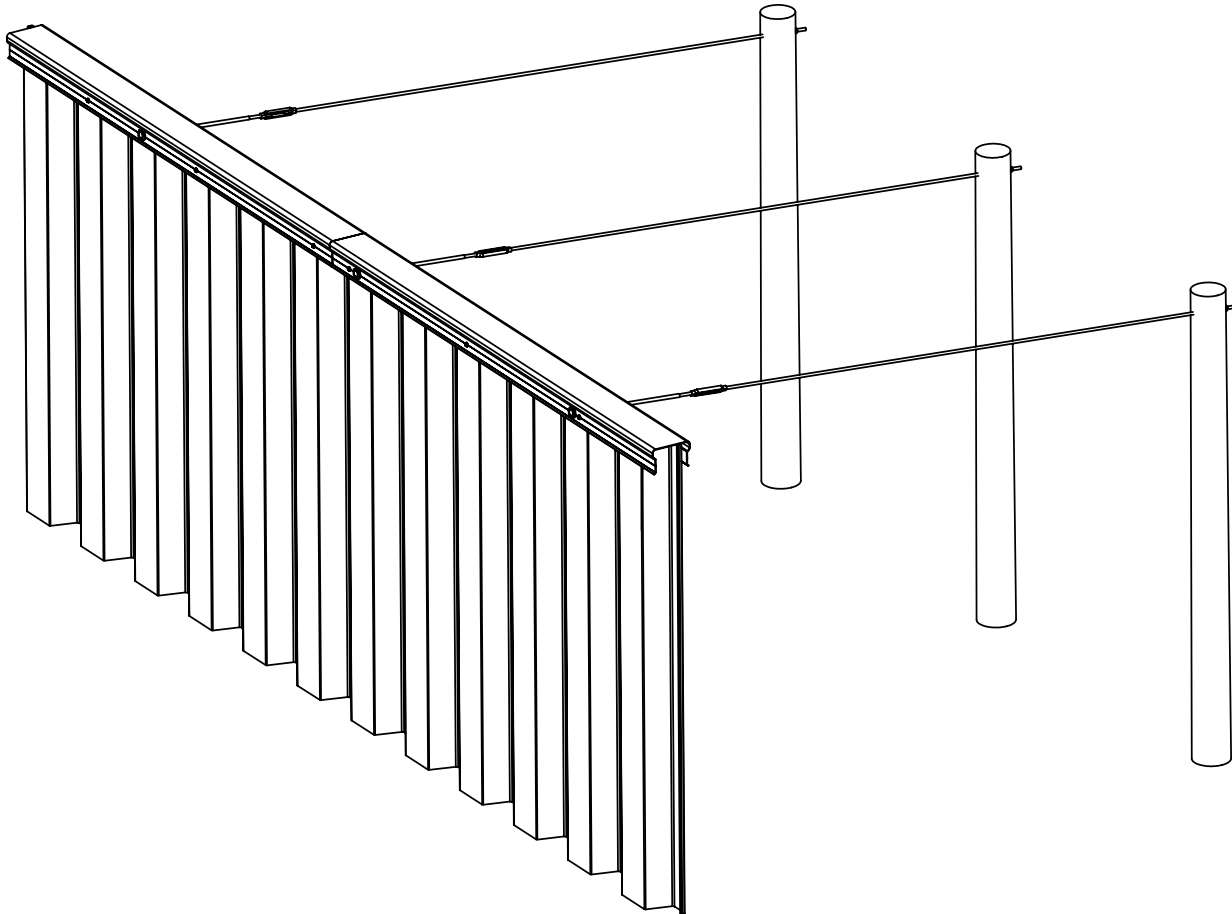
SIZE A	DATE 08/09/05	FILE Drop Wale Std Dwg-Top Plan View 052405.DWG	REV REL
SCALE NA	DRAWN CBB	SHEET 3 of 4	



REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

<p>PROPRIETARY AND CONFIDENTIAL</p> <p>THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CMI LTD. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CMI LTD. IS PROHIBITED.</p>	 CRANE MATERIALS INTERNATIONAL		
	<h2>Drop Wale Standard Drawing— Side Elevation</h2>		
	SIZE A	DATE 08/09/05	FILE Drop Wale Std Dwg—Side Elevation 052405.DWG
SCALE NA	DRAWN CBB	SHEET 4 of 4	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CMI LTD. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CMI LTD. IS PROHIBITED.

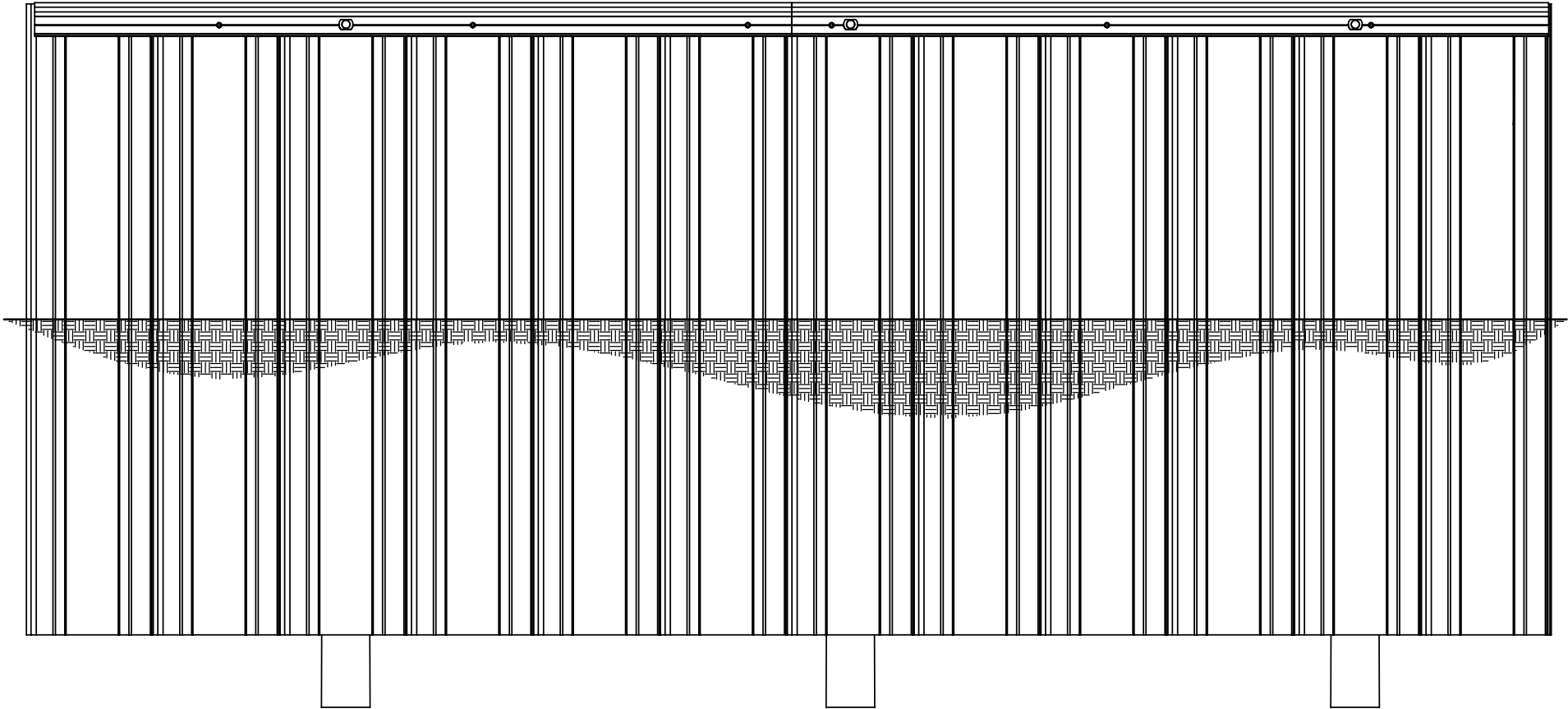


CRANE MATERIALS INTERNATIONAL

Tied Through Cap Standard Drawing-ISO

SIZE A	DATE 08/10/05	FILE Tied Through Cap Standard Drawing-ISO 071905.DWG	REV REL
SCALE NA	DRAWN CBB	SHEET 1 of 4	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CMI LTD. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CMI LTD. IS PROHIBITED.

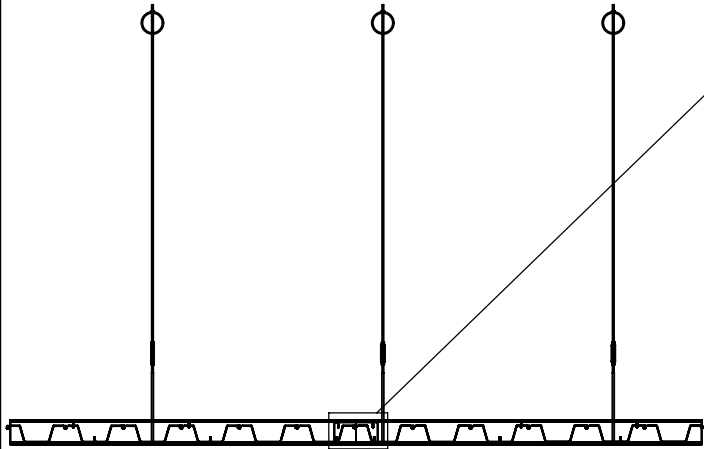
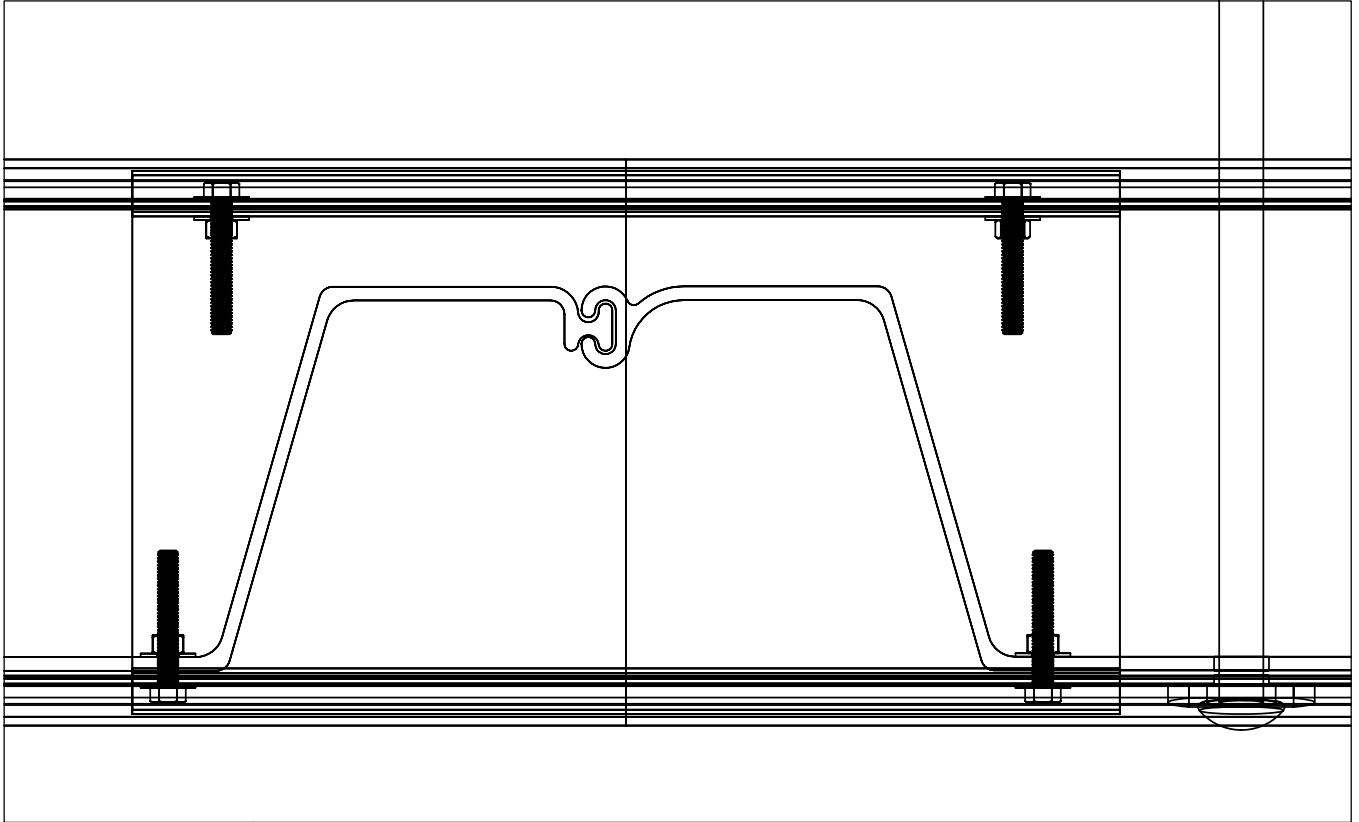


CRANE MATERIALS INTERNATIONAL

Tied Through Cap Standard Drawing—
Front Elevation

SIZE A	DATE 08/10/05	FILE Tied Through Cap Std Dwg— Front Elevation 071905.DWG	REV REL
SCALE NA	DRAWN CBB	SHEET 2 of 4	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



PROPRIETARY AND CONFIDENTIAL

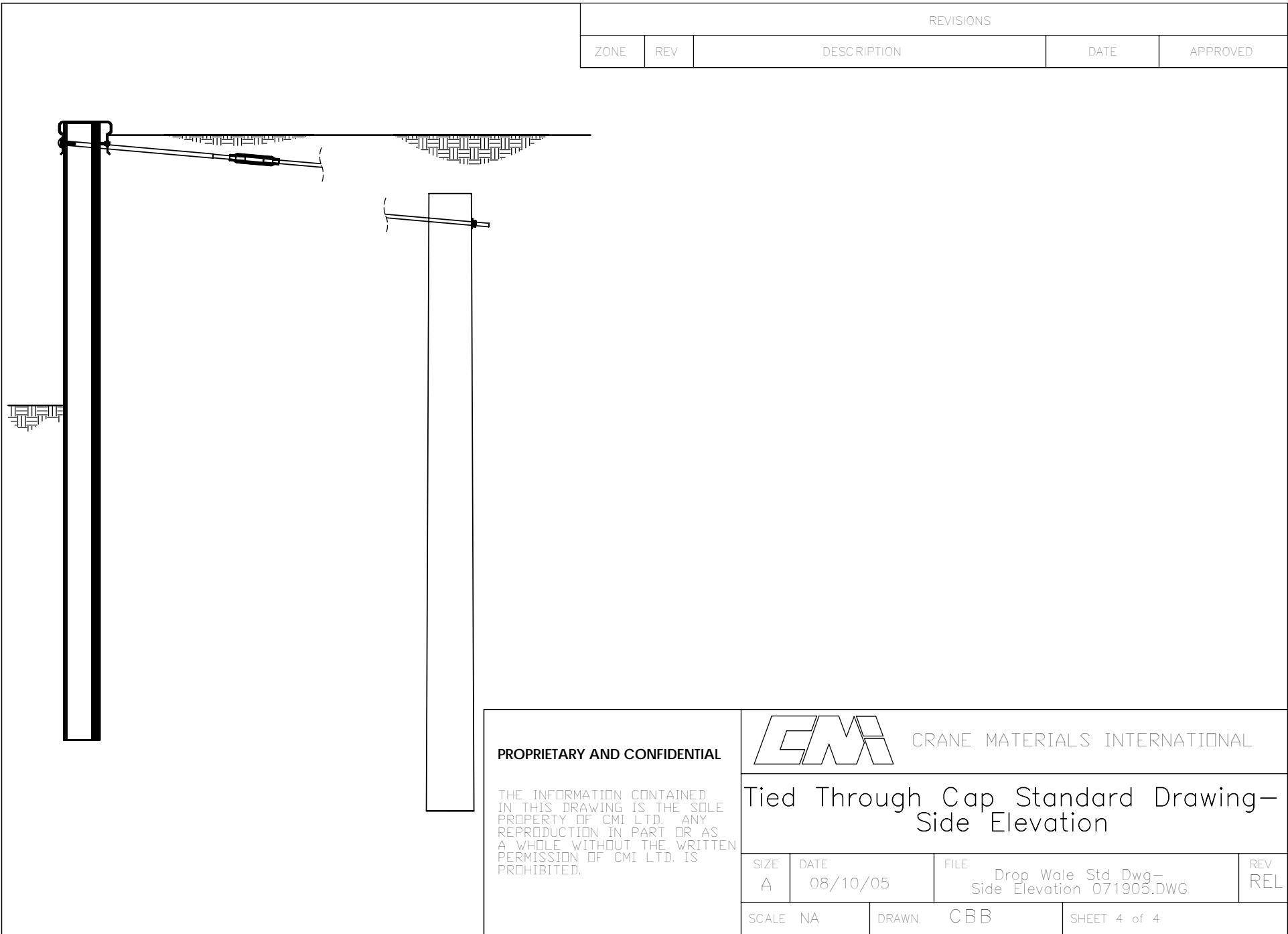
THE INFORMATION CONTAINED
IN THIS DRAWING IS THE SOLE
PROPERTY OF CMI LTD. ANY
REPRODUCTION IN PART OR AS
A WHOLE WITHOUT THE WRITTEN
PERMISSION OF CMI LTD. IS
PROHIBITED.



CRANE MATERIALS INTERNATIONAL

Tied Through Cap Standard Drawing—
Top Plan View

SIZE A	DATE 08/10/05	FILE Tied Through Cap Std Dwg— Top Plan View 071905.DWG	REV REL
SCALE NA	DRAWN CBB	SHEET 3 of 4	



REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CMI LTD. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CMI LTD. IS PROHIBITED.

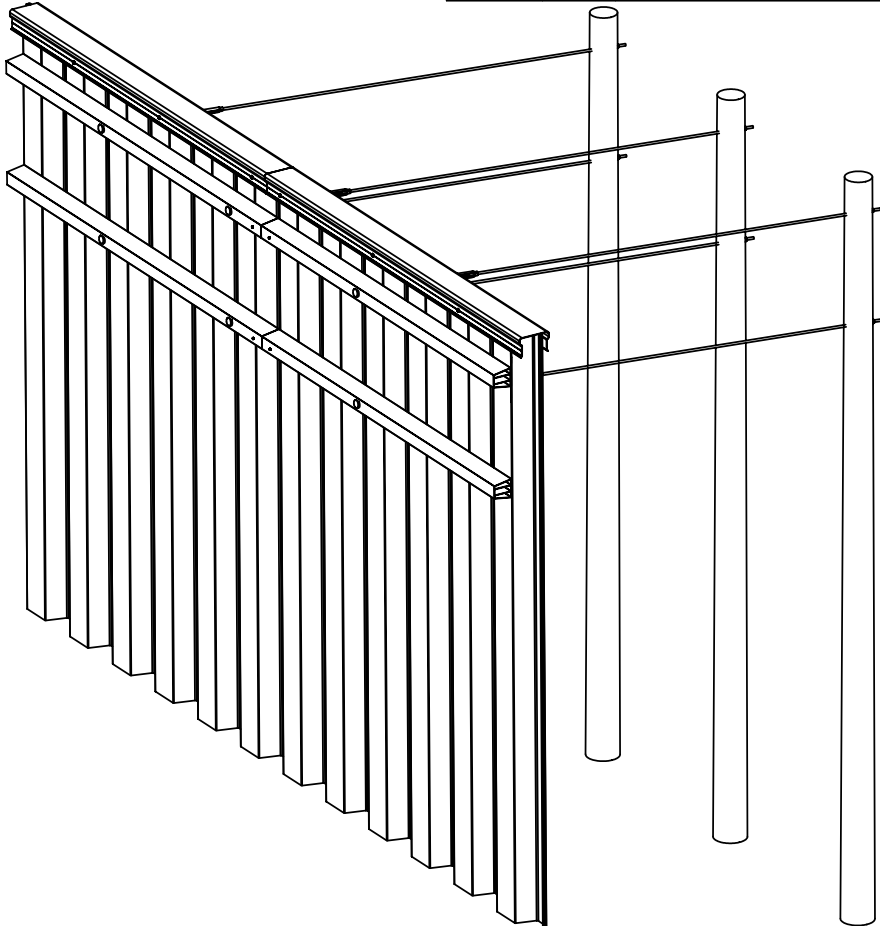


CRANE MATERIALS INTERNATIONAL

**Tied Through Cap Standard Drawing-
Side Elevation**

SIZE A	DATE 08/10/05	FILE Drop Wale Std Dwg- Side Elevation 071905.DWG	REV REL
SCALE NA	DRAWN CBB	SHEET 4 of 4	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CMI LTD. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CMI LTD. IS PROHIBITED.

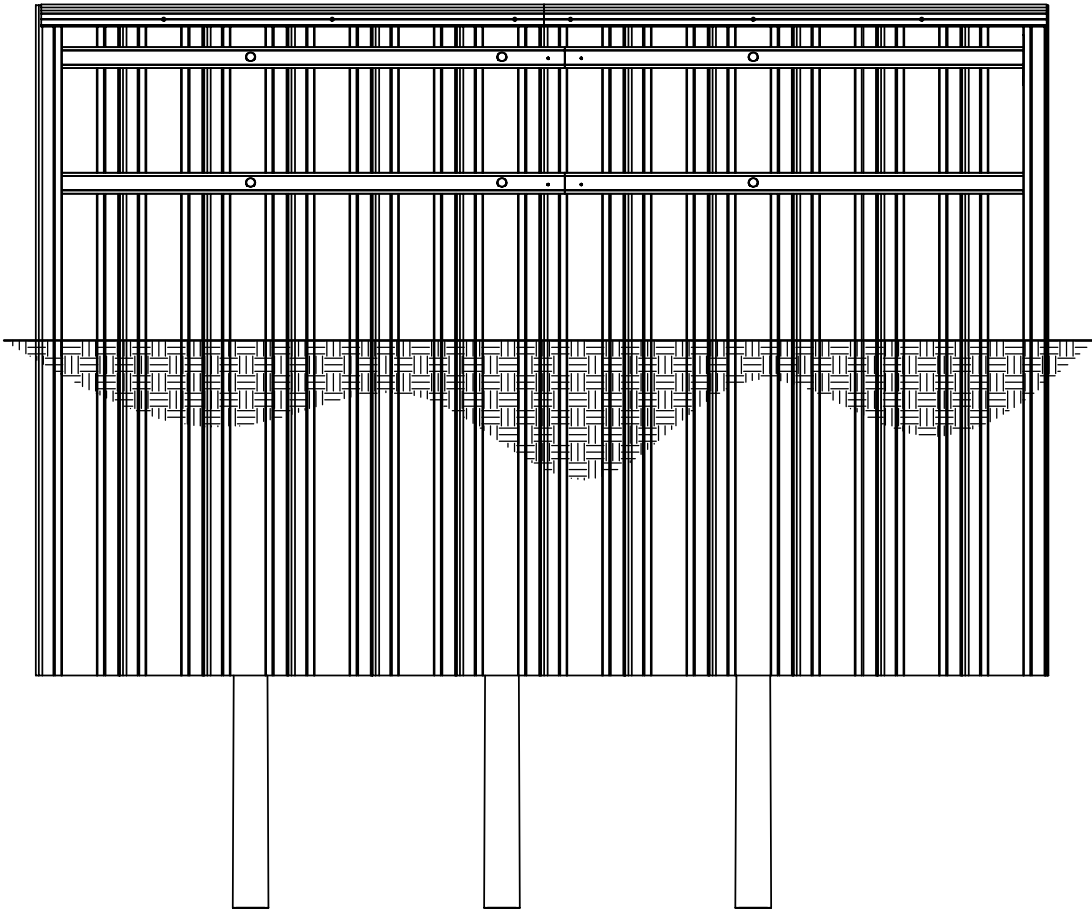


CRANE MATERIALS INTERNATIONAL

Double Wale Standard Drawing-ISO

SIZE A	DATE 08/05/05	FILE Double Wale Std Dwg-ISO 072105.DWG	REV REL
SCALE NA	DRAWN CBB	SHEET 1 of 4	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CMI LTD. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CMI LTD. IS PROHIBITED.

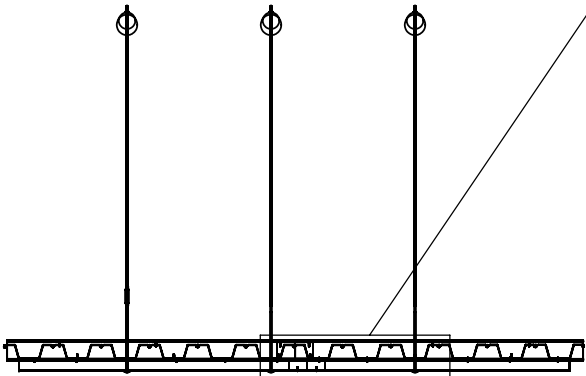
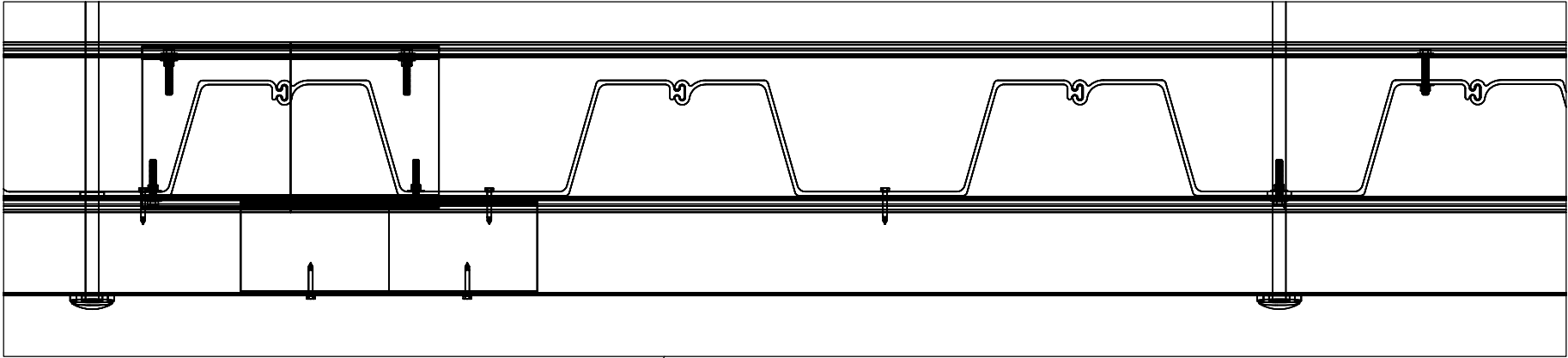


CRANE MATERIALS INTERNATIONAL

**Double Wale Standard Drawing—
Front Elevation**

SIZE A	DATE 08/05/05	FILE Double Wale Std Dwg -Front Elevation 072105.DWG	REV REL
SCALE NA	DRAWN CBB	SHEET 2 of 4	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED
IN THIS DRAWING IS THE SOLE
PROPERTY OF CMI LTD. ANY
REPRODUCTION IN PART OR AS
A WHOLE WITHOUT THE WRITTEN
PERMISSION OF CMI LTD. IS
PROHIBITED.

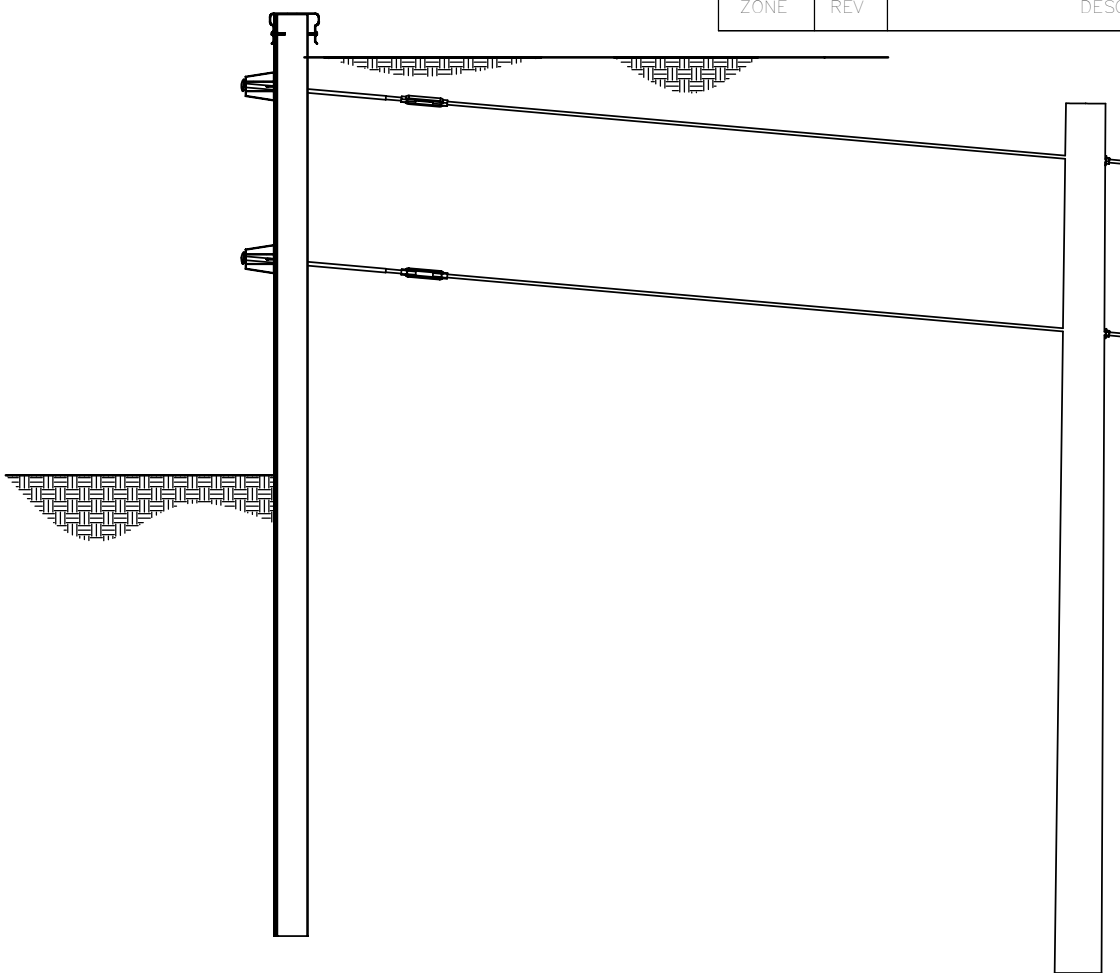


CRANE MATERIALS INTERNATIONAL

Double Wale Standard Drawing— Top Plan View

SIZE A	DATE 08/05/05	FILE Double Wale Std Dwg-Top Plan View 072105.DWG	REV REL
SCALE NA	DRAWN CBB	SHEET 3 of 4	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CMI LTD. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CMI LTD. IS PROHIBITED.



CRANE MATERIALS INTERNATIONAL

Double Wale Standard Drawing— Side Elevation

SIZE A	DATE 08/05/05	FILE Double Wale Std Dwg—Side Elevation 072105.DWG	REV REL
SCALE NA	DRAWN CBB	SHEET 4 of 4	