

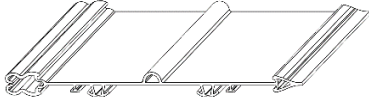

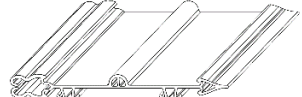

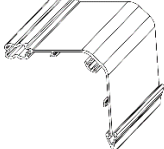

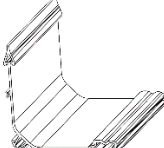

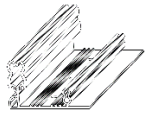



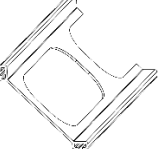

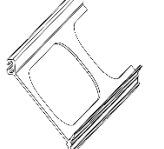



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ColumnArmour

ColumnArmour is a stay-in-place PVC jacket system designed for strengthening, restoration and seismic upgrade to columns and piles. Concurrently, it can also be used to build concrete structural elements such as columns and beams.

The system is easy to install, since it's finished when formed, it does not require any harsh coatings, extra finish or treatments of any kind. It is very versatile and simple in nature. Multiple sizes and shapes can be achieved using the same few basic parts, which makes it very easy to work with.

PARTS LIST

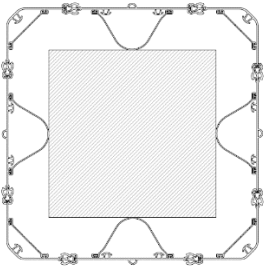
<p>PA6 6" arrowhead panel</p>		
<p>PA4 4" arrowhead panel</p>		
<p>PAR3 90° arrowhead outside corner</p>		
<p>PARI3 90° arrowhead inside corner</p>		
<p>PARF Female wall mount retainer</p>		
<p>PARM Male wall mount retainer</p>		
<p>B451 45° bracing</p>		
<p>B45-PLM Wall mount 45° bracing</p>		
<p>Standoff</p>		

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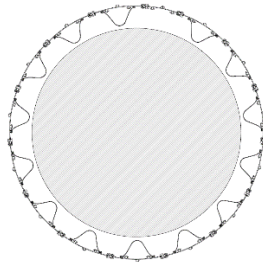
COLUMN SHAPES AND SIZES WITH COLUMNARMOUR

ColumnArmour can form virtually all common shapes and sizes of columns, beams and piles.

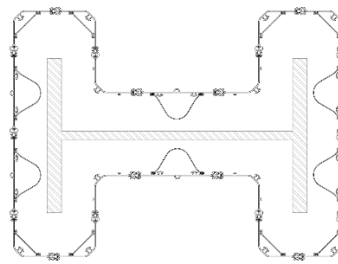
Square / Rectangular



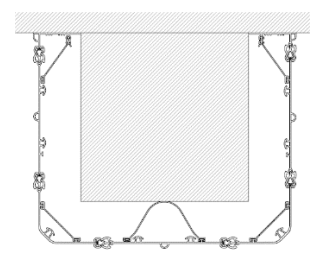
Circular



"I" Beam

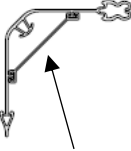


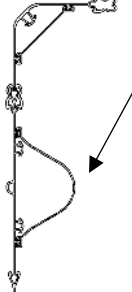
Pilaster

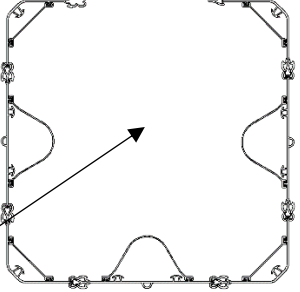


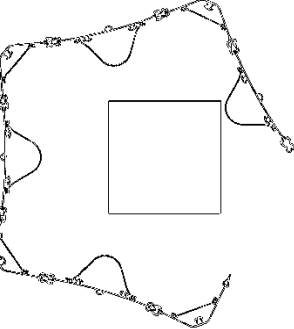
ASSEMBLY PROCESS

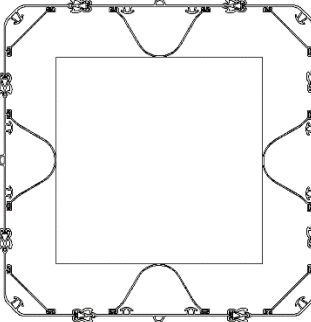
Square / Rectangular

1. 
Start with a corner and slide the 45° bracing into place.

2. 
Connect the next flat PA6 panel and slide the Standoffs into place, if required.

3. 
Continue connecting panels, corners and accessories until you have a semi-assembled set.

4. 
Wrap the semi-assembled set around the to-be-fixed column and connect the last joint.

5. 

Notes:
- Octaform's customized Zip Lock Tool must be used to connect panels and corners.

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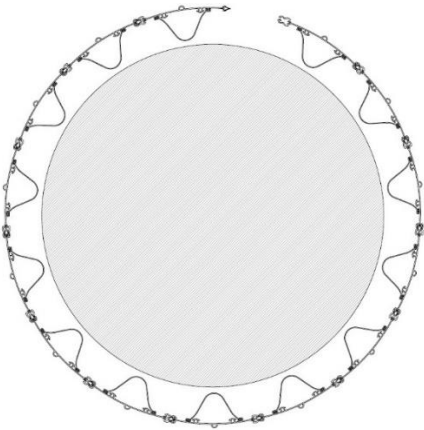
Circular

1.



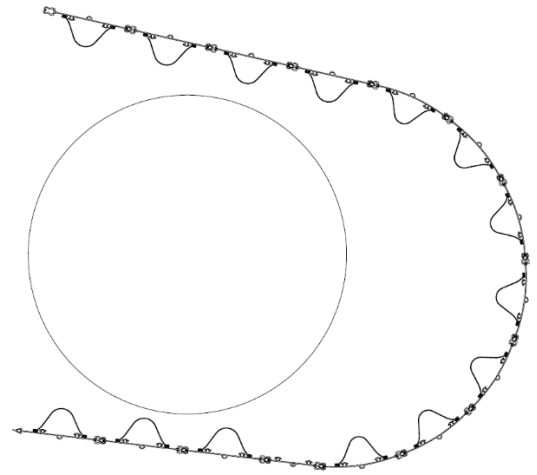
Connect as many flat panels as needed to achieve the desired diameter. (See table 1)

3.



Use Octaform's customized Zip Lock Tool to close and seal the remaining connection.

2.



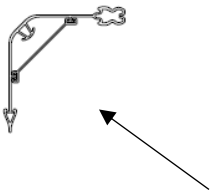
Slide the standoffs into place, if required, and wrap the semi-assembled set around the to-be-fixed column or pile.

Number of Panels	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Diameter (inches)	7 1/2	9 1/2	11 1/2	13 3/8	15 1/4	17 3/16	19	21	22 7/8	24 3/4	26 3/4	28 5/8	30 1/2	32 1/2	34 3/8	36 1/4

(Table 1)

I-Beam

1.



Start with a corner and slide the 45° bracing into place.

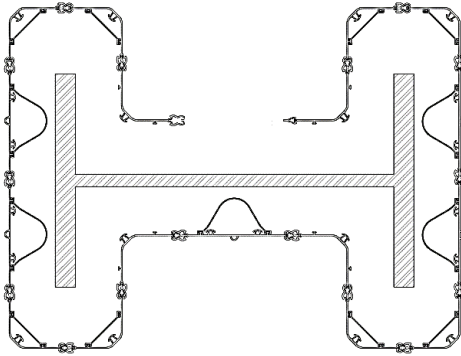
2.



Connect the next flat PA6 panel and slide the Standoffs into place, if required.

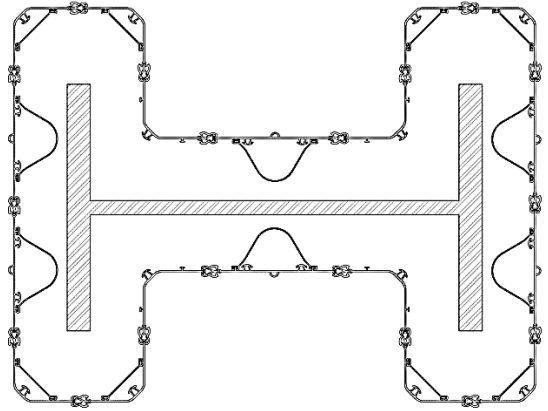
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3.



Follow the steps of a square column assembly, sliding B45's and standoffs into place as required.

4.



Wrap the semi-assembled set around the column / pile and close the last connection.

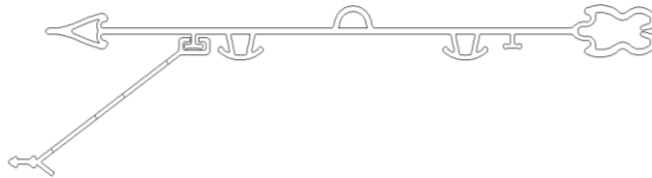
Pilaster

1.



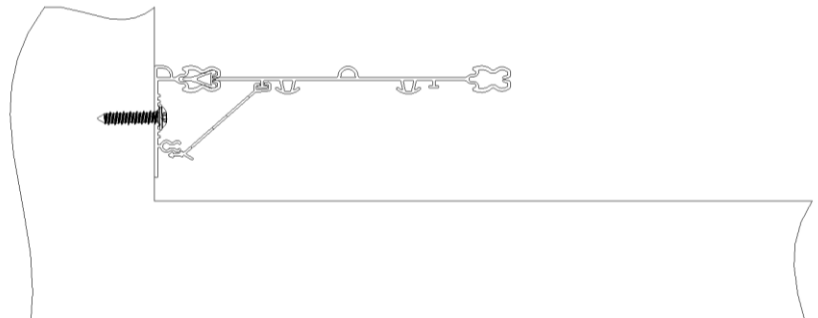
Step 1: Screw one retainer to the wall adjacent to the to-be-repaired pilaster.

2.



Step 2: Pre-assemble the B45 by sliding it down T-connector on ColumnArmour panel.

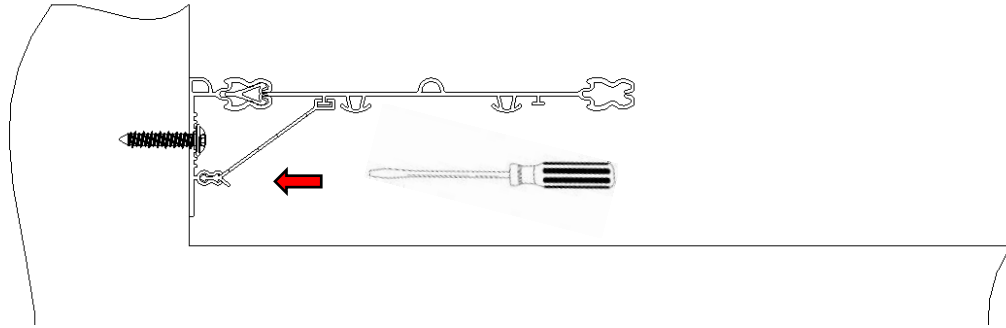
3.



Step 3: Use Octaform's customized Zip Tool to connect flat panel to retainer.

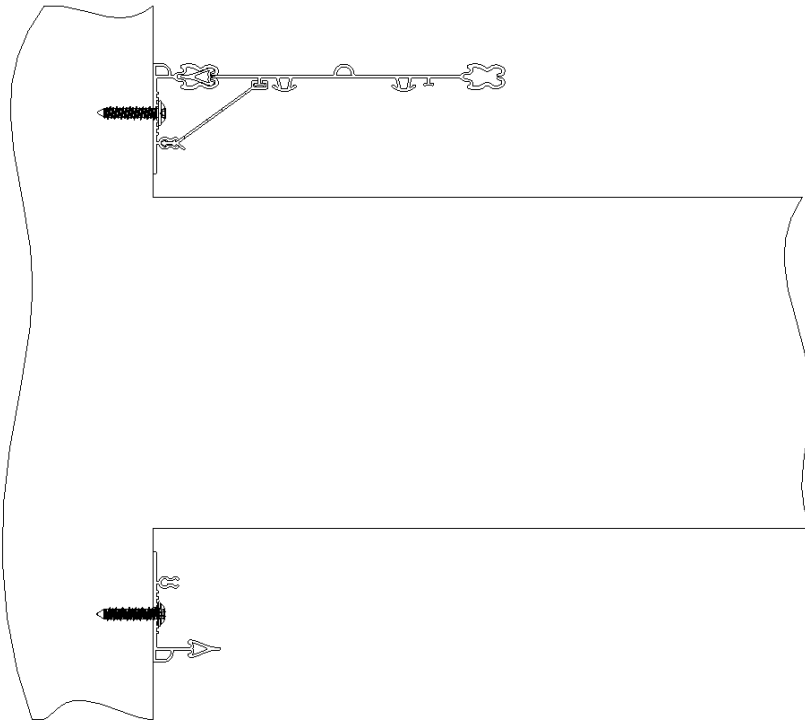
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4.



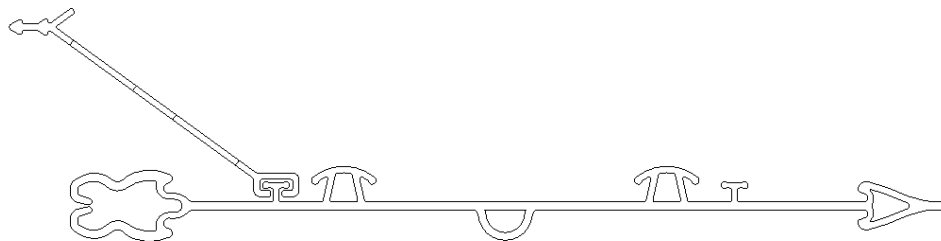
Step 4: Use a screwdriver to push B45 arrow joint into the retainer connection.

5.



Step 5: Fasten another retainer on other side of the column. Retainers must be different from each other (male/female)

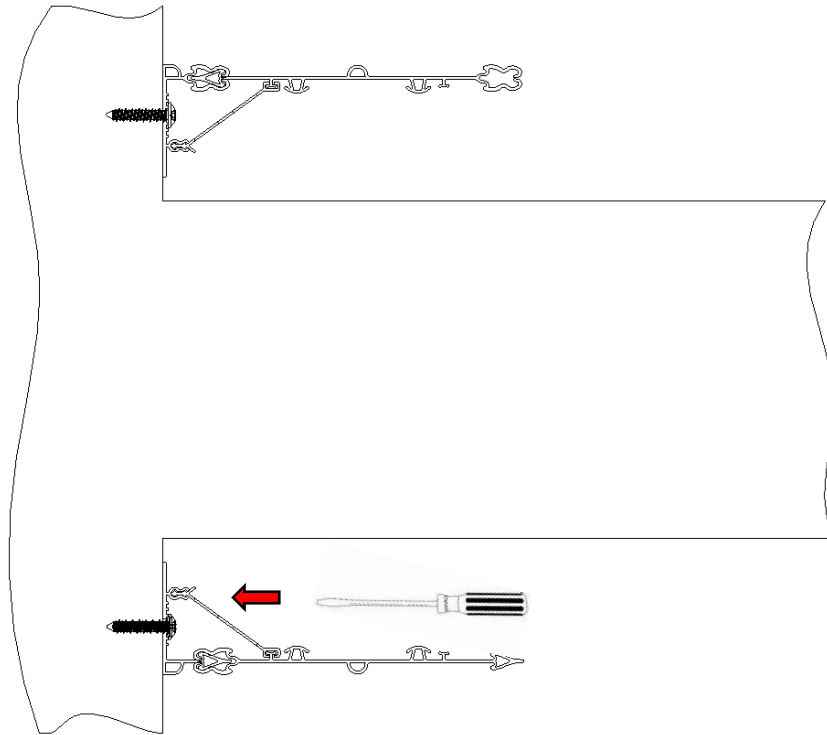
6.



Step 6: Preassemble the B45 by sliding it down through the T-connector on the flat panel

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7.



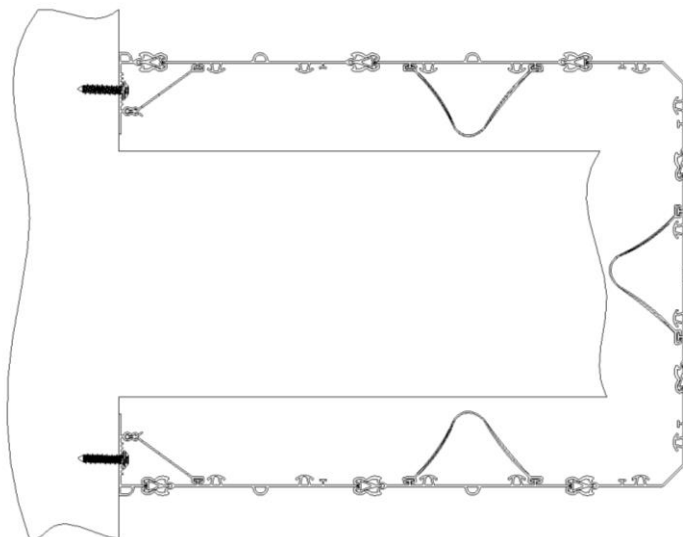
Step 7: Perform steps 3 & 4 to secure the flat panel to retainer.

8.



Step 8: If standoffs are used, press both ends together to bend it and make it fit the T-connections on the flat panels.

9.



Step 9: With both retainers in place, install remaining panels and corners until pilaster is complete.

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TECHNICAL DATA SHEET

PROPERTY	TEST METHOD	ARROWHEAD FEATURES
Tensile modulus	ASTM D638	4,100,000psi min.
Tensile strength	ASTM D638	6,010psi min.
Flexural Modulus	ASTM D790	403,000psi min.
Flexural Strength	ASTM D790	10,800 psi min.
Water absorption	ASTM D 570	No greater than 1.00
Hardness	ASTM S2240	Durometer hardness ShoreD-80
Barcol hardness	ASTM D2583	N/A
Izod impact (notched)	ASTM D256A	20 FT.LB/IN
Operating temp		65C--5C
Wall thickness		0.060 in
Color		WHITE*
UV resistance		YES

*Standard colours available on special orders.

SHIPPING

Crates

Octaform uses lightweight wooden crate packaging. To ensure the crate can be shipped internationally, they are manufactured from heat treated wood. In addition, the crates are inspected for damages prior to shipping and handled with care throughout the transportation process.

Working with your Octaform Sales Representative, a delivery date will be determined to fit your schedule. Once a date is agreed, shipping can either be handled by Octaform or be arranged by the client.

Due to ease of shipping flat, Octaform can be shipped by truck, train, ship and air. Octaform's sales team is happy to try and accommodate any special delivery requests.

Unloading

Before receiving the Octaform shipment, talk to your Octaform representative regarding the weight of the crates being shipped. The crate may contain up to 700 components and can weigh up to 1814 kg/pallet (4000 lbs/pallet). Once the weight is known, determine the size of equipment needed to unload the truck. When unloading a crate, ensure that the crate is completely lifted from the floor. Sliding the crate may cause damage and is prohibited.

The crate is built with an elevated bottom for easy lifting with forks or straps. When lifting, ensure the lifting points and weight are evenly positioned.

Material Storage

Make sure you have a predetermined location to position the crates, preferably a flat and levelled ground surface, located close to the install site and protected from the elements until the time of installation. This will help avoid ice or dirt build-up in connection points.

Crates can be stacked up to two crates high in situations where the material will not be installed right away.

The system consists of modular parts that are connected together and assembled in the job site, which means it ships flat and it requires very little storage space when compared to competing technologies.

Turning Crates into Work Tables

For your convenience, the crates that hold the ColumnArmour parts can be transformed into work benches by removing the ends off both sides and fastening them to the top of the crate.

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PANEL JOINTS

Depending on the panel length, a perfect connection can only be achieved with the use of Octaform's customized Zip Lock Tool, which is supplied by Octaform and returned at the end of the project when the tool is no longer needed.



DISCLAIMERS

This installation manual will provide contractors, engineers and end users with the knowledge required to specify or use the ColumnArmour System to its full capabilities. In some cases, the manual may be used to troubleshoot problem areas. It is the responsibility of the contractor and the engineer to comply with all local safety codes and local building codes.

Octaform has made every effort to ensure that the recommendations in this guide are consistent with the best practices of construction. However, Octaform does not assume any liability for errors resulting from the use of information in this document. It is the responsibility of the project's owner to provide authorized professional guidance for technical decision-making about the project.

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PREPARATION

Before construction of ColumnArmour, you must do a pre-job inspection. A pre-job inspection consists of logistics, and inspection of site, materials and tools.

Planning and Preparation of Site

To ensure that your project stays on schedule, the following areas should be pre-arranged:

- Determine concrete supplier.
- Determine availability of concrete placement equipment and sufficient staffing.
- Confirm delivery time of Octaform materials.
- Ensure equipment required to off-load Octaform crates is available.

Organize Tools, Materials and Equipment

Materials:

- ColumnArmour panels.
- Minimum 3 straps per column.
- Bracing planks.
- Reinforcement.

Tools:

- Rubber mallet.
- Octaform's Zip Tool.
- Plumb bob.
- Mason string line.

Equipment:

- Concrete mixer.
- Concrete pump.
- Concrete vibrator.
- Grout mixer.

NEW CONSTRUCTION

Before starting installation, read carefully this installation guide and all the structural drawings. Make sure you have all the parts required to achieve the desired shape and size for your structure. Check the job site's conditions and make sure that there is safe access to the area and all resources are available such as truck, equipment, personnel and material involved in the task. Check if all the material for the bracing and scaffolding is also available.

The ColumnArmour system can be installed on top of footings or any type of foundation. The foundation must be free of loose concrete and clean of any debris that may compromise the bonding of new concrete. Both the foundation, the column dimensions and rebar must be designed by the structural engineer. Check if the dowels are correctly placed and the rebar conforms to structural drawings.

Column Assembly

Proceed with the assembly process according to the steps required to achieve the desired shape. Depending on the shape of your structure, different parts must be required and a different sequence of steps must be followed.

With the use of a plumb bob or a total station, check the column's set out by comparing with the crossing point of the ranging lines stretching from the pegs or profiles. Then secure the forms in place with proper bracing. Before closing completely the ColumnArmour, make sure that the rebar was verified and all the standoffs and rebar spacers are in place as to guarantee proper cover of the rebar and the correct geometry of the structural element.

Column Bracing

When setting up the bracing make sure the braces are square and leveled as this will reflect in the column geometry. Different methods can be used including wood, steel frame and tube and clamp. To determine the best method for the job, verify the local safety code, consider the height of the columns and understand the local weather.

Tie minimum of three straps (at top, bottom and center) for added safety while pouring and vibrating the concrete. Install and secure additional bracing as required (by others).

Use 2x10 and/or 2x4 timbers and build T-braces with height equivalent to the height of the respective column. Stand the T-brace tight against the sides of the columns. Fasten top and bottom of the T-braces to kicker plates. When installing on soil, cut a wedge out of 2x4 and hammer it into the ground until it's solid. When installing on a slab, fasten a footlong 2x6 wood to the slab, preferably before the slab's concrete sets.

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Using a 2x4 timber, make a diagonal bracing connecting one end to the T-brace at an angle, and the other end to the 2x4 wedge that was hammered to the ground or the 2x6 that was fastened to the slab. See Figure 3 and Figure 4.



Figure 2: Typical wood bracing

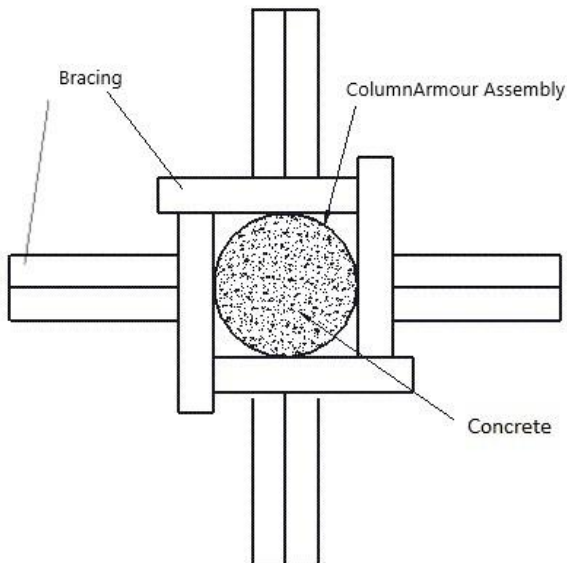


Figure 3: Typical bracing detail

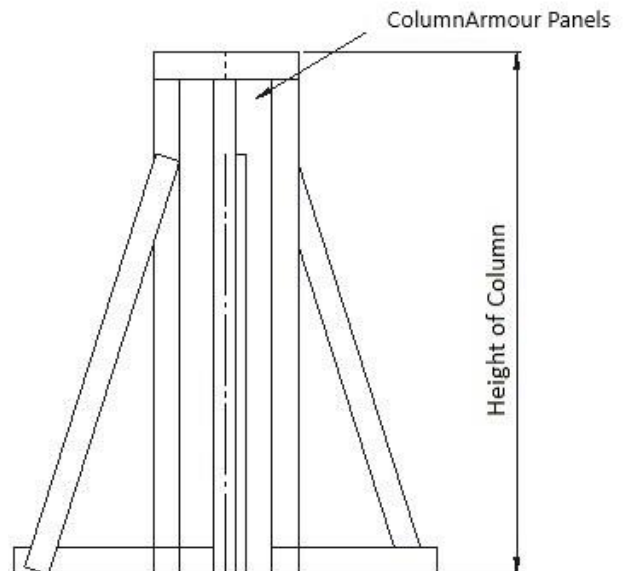


Figure 4: Typical bracing detail

Note: These drawings and specifications present possible methods of providing alignment support for the Column Armour system. They are intended to be used as a guide only and are not to scale. Proper support will vary depending upon site conditions, concrete pressures, column height, soil capacity and the overall building system being incorporated. Advise with on-site engineer or architect for precise bracing requirements.

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Concrete Placement

Use the concrete mix as per structural design and drawings (by others). The concrete mix design and selection of aggregates shall provide a mix that will flow easily through the standoffs and 45° braces with minimum vibration and will minimize the fluid pressure on the ColumnArmour panels.

If concrete mix is not specified by an engineer, a typical mix for Octaform has a minimum 28-day compressive strength of 20 MPa (3000psi); water to cement ratio of 0.55; maximum aggregate size 12mm (1/2"); superplasticized slump 125 mm (5") to 180mm (7") at the point of discharge plus or minus 12mm (1/2"). Air entrainment admixture is recommended when the concrete is to be submitted to freeze-thaw conditions.

Note: This is only the typical concrete mix design. Concrete should be specified by an on-site engineer.

Concrete can be placed by various methods including pumper truck, line pumper and hopper. Concrete pump with elephant trunk is recommended to prevent concrete segregation while pouring. It may be necessary to insert pump discharge hoses down into the ColumnArmour assembly to minimize freefall to less than 1.5 metres. Applications from heights greater than 1.5 metres must be discussed with the concrete supplier to determine the need for adjustments.

The pour rate must allow each successive lift to be vibrated into the previous lift for proper bonding. In ideal conditions, the placement should be a continuous operation until the element being constructed is complete.

If the columns, beams and slabs are to be poured all at once, it is recommended starting with the columns, moving forward to the beams up to the bottom level of the slabs and then completing the whole slab.

When planning the concrete pours, ensure that there is enough space available for equipment to maneuver when necessary. This may affect how much concrete is poured at one time and how fast the job can be finished. In addition, make sure to gather multiple columns together in the same pour as to optimize resource allocation and mobilization.

The size of the job will determine the size of the pumper trucks needed. Ordering the proper truck size will reduce the amount of times a pumper truck will need to be moved. Before the pumper truck arrives, have the chosen location cleared for the pumper truck to set up. The location should allow the pumper truck to access all or majority of the columns. In addition, the location should be easy to access by concrete trucks.

If there is the need to slow down the concrete coming out of the pumper truck, a 3" to 4" rubber hose can be installed at the end of the concrete line.

For medium builds or areas that don't fit a pumper truck, concrete line pumpers are used. When using a line pumper, make sure you have enough workers on hand and enough support to hold the line at the top of the bracing.

Hoppers are used for small builds or when there is no other concrete placing equipment. When using a hopper, make sure there is enough room to drive equipment around the build and all the columns can be reached by the hopper.

External vibration is not recommended. Continuously check for pillowing, bulging or blow out of panels while pouring the concrete. When pouring, always keep eye contact with the pumper truck's driver. Make sure there is a pour plan before starting to pour.

Concrete Pour Rates

Concrete being placed in the ColumnArmour System should be poured so that the maximum concrete pressure does not exceed a 1350 psf on the forms area. Field tests have revealed that a typical 8-foot high column can be filled in about 45 seconds with minimum bracing.

Bulging and Blow Out Repair

Octaform's ColumnArmour is a sturdy forming and jacket system that can take up to 1350 lbs per square foot of pressure from fresh concrete. When pouring the concrete, blow outs can occur due to multiple reasons, the most common ones being: Damaged parts, improper installation, connection failure, over vibration or too high pour rate.

If a bulge is noticed, stop the pouring into that section immediately. In most cases, if the bulge resulted in partial failure of the ColumnArmour connection between panels or accessories, the panels can be put back in place manually allowing the

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connection to be redone by using Octaform's customized Zip Tool. After putting the panels back into place, the bracing must be improved in the area of the bulge and an adequate pour rate must be maintained.

If the forms blew open and cannot be put back into place, the concrete will have to be released to allow the ColumnArmour to be reconnected and the bulge removed, in which case the concrete can be poured back into the forms as long as its initial setting time has not passed (this procedure must be approved by the concrete manufacturer).

To release the concrete, carefully use any tool such as a screwdriver to open the flawed connection. Ideally, the connection should be opened in such a way to allow the reuse of the same connection. It is highly recommended any sort of container be placed at the bottom of the column to collect and, possibly, reutilize the concrete released as well. Clean the connection with water and reengage the panels. Extra bracing might be required to prevent recurrence.

If there are damaged panels or accessories, the damaged pieces must be completely replaced, which usually takes a lot of time and will not allow for the reuse of the lost concrete in the same section. In this case, we recommend continuing to pour concrete in any other subsequent structural elements and returning after the repair is complete.

Recommended Cleaners for PVC

Stain Source	Cleaner
Pencil	Soft Scrub, Ajax, Pledge, Tide Powder,
Flair Pen	Fantastic, any water based cleaner
Paint	Ajax, Brillo Pad, Fantastic, Soft Scrub
DAP	Ajax, Brillo Pad
Oil Stain	Brillo Pad, Soft Scrub, Ajax
Top Soil	
Motor Oil	Fantastic, Windex, Endust, Tide Liquid, Ivory, Pine Powder, Lysol, Shout, Murphy's
Lithium Grease	Windex, Pine Powder, Grease Relief, Lysol, Pine Sol, Pledge, Clorox
Black Tar (crack filler)	Soft-Scrub, Endust
Red Crayon	Soft-Scrub
Rust Stain / Water Stain	Oxalic Acid (1 tbsp), Rust Out

STRUCTURAL STRENGTHENING / UPGRADE

The most popular method of strengthening building columns is jacketing, which consists of added concrete with longitudinal and transverse rebar around the existing column. Either for the purpose of building expansion or for seismic upgrade, this process can improve the axial and shear strength of columns while keeping the flexural strength of the column and the strength of the beam-column joints unchanged.

Planning and Preparation

Any structural intervention must be preceded by an assessment of the building and redesign of the structure. Every step of the job must be previously approved by the on-site engineer before moving on to the next step.

Beginning installation, carefully read this construction guide and all the structural drawings. Make sure you have all the parts required to achieve the desired shape and size for your structure. Check the job site's conditions and make sure that there is safe access to the area and all resources are available such as truck, equipment, personnel and material involved in the task. Check if all the material for the bracing and scaffolding is also available.

The ColumnArmour system can be installed in different configurations to adapt to virtually any column or beam, of any shape and size, with or without extra rebar. The structure to be repaired must be free of loose concrete and clean of any debris that may compromise the bonding of fill material.

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The concrete must be mechanically roughened to coarse aggregate exposure or concrete surface profile (CSP) 6 to 9 in order to maximize bond between fill material and substrate. A 15-lbd chipping hammer is recommended because hammers larger than a 15-lbs class might damage the existing substrate and/or rebar. Typically, the surface to be prepared includes the bottom of the superior beam/slab and the top of the inferior beam/slab.

Mark the position of the new rebar and drill anchoring holes as per structural design. With a blow out pump and round brushes, clean the drilled hole in dry state. Inject epoxy-based bond mixture into the holes up to half of its depth, insert the anchoring rebar and allow the epoxy adhesive to cure. Place the longitudinal and transverse rebar around the existing column.

Assembly

Proceed with the assembly process according to the steps required to achieve the desired shape. Depending on the shape of your structure, different parts must be required and a different sequence of steps must be followed.

Before closing completely the ColumnArmour, make sure that the rebar was verified and all standoffs and rebar spacers are in place to guarantee proper cover and the correct geometry of the structural element.

It is not uncommon to find restoration jobs where you cannot pour the fill material from the top of the forms due to the existence of a ceiling. In these cases, it will be necessary to use a cup saw to cut a hole close to the top of the ColumnArmour to form a port through which the fill material can be poured in.

Bracing

When setting up the bracing make sure the braces are square and leveled as this will reflect in the column geometry. In most cases, bracing is easier in restoration jobs rather than in new construction as the structural element is already in place. Different methods can be used including wood, steel frame and tube and clamp. To determine the best method for the job, verify the local safety code, consider the height of the columns and understand the local weather.

Tie minimum of three straps (at top, bottom and center) for added safety while pouring or pumping the fill material. Install and secure additional bracing as required.

Use 2x10 and/or 2x4 timbers to fasten top and bottom of the ColumnArmour to kicker plates.

Fill Material

The fill material, either concrete, grout or any other cementitious mixture, must be specified by a structural engineer. The fill material must be able to flow easily through the standoffs and 45° braces with little to no vibration and will minimize the fluid pressure on the ColumnArmour panels.

The most common fill materials used in concrete restoration is grout or self-consolidating concrete. All safety and technical recommendations of the grout manufacturer must be followed. Prior to pouring, concrete surfaces should be presoaked for 8-24 hours so it doesn't absorb water from the fill material, which can compromise its strength. The mortar mixer hopper and paddles should also be wetted prior to the beginning of a mix for the same reason.

If the top of the ColumnArmour is obstructed by a slab or any other structural element, not allowing the fill material to be poured from the top, it might require a mixing and pumping machine with pumping hose and nozzle. With a cup saw, make a hole on the bottom of the ColumnArmour and install a valve to which you will connect the pumping hose's nozzle. Drill a small hole on the top of the ColumnArmour to allow air to escape from inside and release the pressure. The top hole will also allow you to detect when the fill material has filled up the void in the jacket.

After the jacket is completely full, shut down the ventilation ports and the bottom valve. Allow the fill material to set. The bracing can be removed but the ColumnArmour will stay in place to protect the column from aggressive agents and provide seismic enhancement to the structure.

Concrete Pour Rates

Fill material should be pumped so that the maximum concrete pressure does not exceed a 1350 psf on the forms area.

The pour rate can be increased depending on the shoring and bracing solution adopted by the on-site crew.

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Bulging and Blow Out Repair

Octaform's ColumnArmour is a sturdy forming and jacket system that can take up to 1350 lbs per square foot of pressure from fresh concrete. This strength can increase significantly depending on the chosen bracing solution. When pumping the fill material, blow outs can occur due to multiple reasons.

If a bulge is noticed, stop the application into that section immediately. In most cases, if the bulge resulted in partial failure of the **arrowhead** connection between panels or accessories, the panels can be put back in place manually allowing the connection to be redone by using Octaform's customized Zip Tool. After putting the panels back into place, the bracing must be improved in the area of the bulge and an adequate pour rate must be maintained.

If the forms blew open and cannot be put back into place, the fill material will have to be released to allow the ColumnArmour to be reconnected and the bulge removed, in which case the fill material can be pumped back into the forms as long as its initial setting time has not passed (this procedure must be approved by the concrete supplier).

To release the fill material, carefully use any tool such as a screwdriver to open the flawed connection. Ideally, the connection should be opened in such a way to allow the reuse of the same connection. It is highly recommended any sort of container be placed at the bottom of the column to collect and, possibly, reuse the fill material released as well. Clean the connection with water and reengage the panels. Extra bracing might be required to prevent recurrence.

If there are damaged panels or accessories, the damaged pieces must be completely replaced, which usually takes a lot of time and will not allow for the reuse of the lost grout in the same section. In this case, we recommend continuing to pour concrete in any other subsequent structural elements and returning after the repair is complete.

INFRASTRUCTURE RESTORATION & MARINE REPAIRS

Jacketing is the most commonly used method of repair of highly degraded structures that show symptoms such as corrosion of rebar, spalling, cracking or deterioration due to tidal action. When it comes to marine structures, any variety of outside influences such as marine growth, vessels impact and salt water attack can result in reduced load allowances and usability and shorter lifespan. ColumnArmour can also be used for timber marine piles that have experienced reduction in cross section area due to "hour glassing" effect. The most common fill material is grout and the repair usually include some sort of reinforcing steel, carbon fiber rods, and carbon mesh for better performance of the repair system. The best results can be achieved with epoxy-based grout reinforced with steel rebar placed in the annulus between the existing pile and the interior surface of the jacket.

Planning and Preparation

Any structural intervention must be preceded by an assessment of the building and redesign of the structure. Every step of the job must be previously approved by the supervising engineer before moving on to the next step.

Beginning installation, read carefully this installation guide and all the structural drawings. Make sure you have all the parts required to achieve the desired shape and size for your structure. Check the job site's conditions and make sure that there is safe access to the area and all resources are available such as grout pump, hose, valves, nozzles, personnel and material.

The ColumnArmour system can be installed in different configurations to adapt to virtually any column or pile, of any shape and size, with or without extra rebar. Clean the pile using minimum 4,000 psi high-pressure washer or other mechanical means. Remove any loose, delaminated and weak concrete, oil, grease, marine growth and other contaminants.

The concrete must be mechanically roughened to coarse aggregate exposure or concrete surface profile (CSP) 6 to 9 in order to maximize bond between fill material and substrate. It is recommended a 15-lbd chipping hammer because hammers larger than a 15-lbs class might damage the existing substrate and/or rebar.

Any cracks must be brought to the attention of the engineer in charge, who will determine if the cracks are subject to movement. Prior to the installation of the ColumnArmour the cracks shall be repaired as directed.

For more detailed information, refer to "[Selecting and Specifying Concrete Surface Preparation for Coating Polymers and Concrete Repair, ICRI Technical Guideline 310.2R.](#)"

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If the existing rebar has lost bond with the concrete or has more than one-half of its circumference exposed shall be undercut by at least 3/4 inch (18 mm) or two times the maximum aggregate size. If the rebar has lost more than 20% of its diameter, it may require replacement or it will need to be spliced as directed by the engineer. All reinforcement must be rigidly secured and supported.

Rebar should be free of all loose scale, rust, oxidation and other contaminants. Exposed rebar may be sealed or primed if a delay occurs between surface preparation and epoxy grout placement.

If new rebar is to be placed, mark the position of the new rebar and drill anchoring holes as per structural design. Place the longitudinal and transverse rebar around the existing column. Place the sacrificial anodes, if required, properly spaced according to the manufacturer's recommendation.

Assembly

Proceed with the assembly process according to the steps required to achieve the desired shape. Depending on the shape of your structure, different parts must be required and a different sequence of steps must be followed.

Before closing completely the ColumnArmour, make sure that the rebar was verified and all standoffs and rebar spacers are in place to guarantee proper cover and the correct geometry of the structural element. Place straps to hold the jacket at every 24" of the jacket's length.

Use a cup saw to cut a hole in the ColumnArmour so to form a port through which the fill material can be pumped in. In marine repairs, it is very common that the grout is pumped from the bottom up. The recommendations of the fill material's manufacturer must be followed.

For pumping applications, secure suitable pump ports to ColumnArmour. Port should be about 12" from the bottom of the pile. Additional ports may be needed for jacket lengths over 5 feet. Where necessary, place an additional port about three feet above and 180° opposite the first port. If required, alternate the placement 180° from the previous port and three feet above.

Bracing

Wooden braces, battens or strong backs, should be placed on the outside of the jacket to prevent bulging during filling.

Sealing the Jacket

Use closed foam strips, PVC formwork sealing tape or epoxy packing sealants in order to keep the grout or concrete from leaking out through the bottom of the PVC jacket. Oakum, alone or with an expansive resin can also be used for this purpose. The sealant will be put in place before or after the positioning of the jacket around the pile, depending on the chosen sealant.

Foam strips must be placed around the interior bottom of the jacket before the jacket is wrapped around the pile. The ends of the strips must overlap to prevent leaks. Follow instructions of the manufacturer of the foam or PVC strips. The bottom of the seal should be secured with stainless steel or ratchet straps.

Oakum and resin solutions should be applied after the PVC jacket is in place and secure to the pile. The material must be packed up into the bottom annular space of the jacket. Upon contact with water, in about 5 minutes, the resin will expand and fill up all the bottom annular space of the PVC jacket.

Fill Material

The fill material, either concrete, grout or any other cementitious mixture, must be specified by a structural engineer. The fill material must be able to flow easily through the standoffs and 45° braces with little to no vibration and will minimize the fluid pressure on the ColumnArmour panels. The most common fill material used in marine repairs is underwater grout either pump grade or hand pack whatever the case is. All safety and technical recommendations of the grout manufacturer must be followed.

The ColumnArmour can be filled with a pressure pump from the bottom up through pumping ports evenly spaced, moving from one end to another as the jacket fills. As an alternative, the fill material can be poured from the top of the jacket starting at one side and moving to the other. Pouring from both sides at the same time can ensure even filling.

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If the pumping method is chosen, attach the pump hose to the bottom port and start pumping. For tremie pumping, insert hose into jacket to bottom and commence pumping. Keep pump hose submerged in epoxy grout and slowly raise pump hose as jacket fills with epoxy grout. When the grout in the jacket rises to the level of the next port stop the pump, remove the hose and close the port with a plug. Then attach the hose to the next higher port and continue pumping. Repeat this until the jacket is full of grout.

Fill the jacket up to 1" from the top of the jacket and then stop. Wait for the initial set of the fill material and fill the remaining 1" of the jacket with suitable marine mastic to seal the top of the ColumnArmour and prevent water from coming in. Finally, create a run-off at the top by creating a 45° bevel on the top of the jacket.

If the pouring method is chosen, use a headbox or ramp at top of jacket to facilitate pouring of fill material into jacket. The mixing and pouring of fill material should be a continuous process to minimize air entrapment. Headbox or ramp may be moved or alternated from side to side to also help reduce air entrapment. Continue pouring epoxy grout until jacket is full. Grout level may be topped off with additional material placed by hand or by a later placement of suitable marine mastic.