

Construction Guide for  
***Helicopter Revetment***  
*(Apache, Blackhawk, Kiowa Warrior, Cobra, Huey, Chinook, Super Stallion)*  
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Developed by:

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# *Bill of Materials*

Item Description	NSN	Apache/ Blackhawk	Kiowa Warrior	Cobra	UH-1 Huey
Concertainer – 4.5' high, 3.5' wide, 32' long	5680-99-001-9396 – Green 5680-99-835-7866 – Beige/Sand	16	11	14	14
Concertainer Infill Material, cubic yards	Not applicable	340	230	300	290

Item Description	NSN	Chinook	Super Stallion
Concertainer – 4.5' high, 3.5' wide, 32' long	5680-99-001-9396 – Green 5680-99-835-7866 – Beige/Sand	11	11
Concertainer – 7.25' high, 7' wide, 91' long	5680-99-126-3716 – Green 5680-99-169-0183 – Beige/Sand	4	4
Concertainer Infill Material, cubic yards	Not applicable	1000	1000

# Equipment, Personnel and Time Estimate

- To assist in planning, provided on the following pages are estimates of the necessary equipment, soldier assets and construction time required to construct each revetment. **In some cases multiple types of equipment are capable of performing the same task, and are listed as alternatives.** Consideration during planning should be given to such issues as equipment and operator availability, topographic and work area limitations, maneuverability, etc., and their impact on the construction effort. Note that based upon the foundation type and source of fill material, certain tasks – and their associated equipment – may be unnecessary. Only heavy equipment are listed below. Hand tools such as shovels, rakes, pliers, wire cutters, etc. will also be needed.

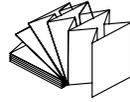
The indicated time required for construction includes the time associated with basic foundation preparation and construction of the position. **Factors such as threat based urgency, equipment and material availability, poor foundation soils, knowledge of construction techniques, etc. can greatly impact time requirements.** Therefore the time indicated is an estimate only, and should be utilized when actual performance data for similar positions under similar conditions is not available.

Aircraft	Task	Equipment Req'd.	Soldiers Req'd. (excluding operators)	Time Req'd.
AH-64 Apache UH-60 Blackhawk				
	Site preparation, foundation leveling	bulldozer, DEUCE, ACE	2	45 minutes
	Haul infill material to site	dump trucks	varies	varies
	Erect walls & place infill	front-end loader, HMEE	8	8 hours
OH-58 Kiowa Warrior				
	Site preparation & foundation leveling	bulldozer, DEUCE, ACE	2	30 minutes
	Haul infill material to site	dump trucks	varies	varies
	Erect walls & place infill	front-end loader, HMEE	6	8 hours

# *Equipment, Personnel and Time Estimate*

<b>Aircraft</b>	<b>Task</b>	<b>Equipment Req'd.</b>	<b>Soldiers Req'd.</b> (excluding operators)	<b>Time Req'd.</b>
<b>AH-1 Cobra</b>				
	Site preparation & foundation leveling	bulldozer, DEUCE, ACE	2	45 minutes
	Haul infill material to site	dump trucks	varies	varies
	Erect walls & place infill	front-end loader, HMEE	8	7 hours
<b>UH-1 Huey</b>				
	Site preparation & foundation leveling	bulldozer, DEUCE, ACE	2	45 minutes
	Haul infill material to site	dump trucks	varies	varies
	Erect walls & place infill	front-end loader, HMEE	8	7 hours
<b>Chinook</b>				
	Site preparation & foundation leveling	bulldozer, DEUCE, ACE	2	1 hour 30 minutes
	Haul infill material to site	dump trucks	varies	varies
	Erect walls & place infill	front-end loader w/ clamshell bucket, HYEX	10	16 hours
<b>CH-53 Super Stallion</b>				
	Site preparation & foundation leveling	bulldozer, DEUCE, ACE	2	1 hour 30 minutes
	Haul infill material to site	dump trucks	varies	varies
	Erect walls & place infill	front-end loader w/ clamshell bucket, HYEX	10	16 hours

# Hesco Bastion Concertainer Site Preparation & Infill Guidelines



## General

- Hesco Bastion Concertainer units are primarily utilized in the construction of protective positions in a wide array of environments. Concertainer units are transported in a compressed, “accordion” style, expanded on-site, and filled with infill material to create the desired structure. The Concertainer wire/fabric framework is utilized to create a confinement system for the infill material, which, when properly placed and compacted, will provide the global strength and stability for the structure. Considering that Concertainer structures transmit their loads through the “fill walls” and into the foundation below, proper foundation preparation and infill placement are critical to overall performance. **The following information provides essential guidelines to the proper foundation preparation and infill placement for these structures. Reference should be made to the Engineering Research and Development Center (ERDC) guide titled “Concertainer Construction Techniques” for requirements pertaining to proper layout, connection, modification and durability.**

Note that Concertainer units are manufactured in green, desert tan, and gray colors. The dyes used to pigment the fabrics impact the Concertainer’s resistance to UV degradation, and according to current data the gray color fabric exhibits the fastest deterioration. **Based upon this susceptibility to UV deterioration, the gray colored fabric is not recommended for use.**

## Site Preparation & Foundation Construction

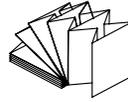
- The performance of Concertainer structures, as with any conventional structure, is highly dependent upon proper site selection and preparation. Concertainer structures strongly rely upon the strength of near-surface soil material for overall structural stability. The condition of these near surface materials can be deteriorated by elevated moisture levels, soil erosion, freeze/thaw cycles, decay of organic matter, compression of weak soils, etc. Therefore, the site evaluation process should include consideration of site drainage patterns and existing soil conditions for the purpose of identifying a **well drained, stable site**. Reference FM 5-34, Chapter 8 for procedures to assist in soil evaluation.
- Concertainer structures should be constructed on a relatively **flat, level foundation**. The foundation must exhibit sufficient **strength and stability** to support the structure over the intended life. If construction will not take place on an improved surface (such as concrete paving, asphalt paving, or stabilized soil), the foundation area must be prepared. At a minimum, preparation should consist of:
  - 1) Blade area to level foundation site and remove organic material and loose surface soils.
  - 2) Test exposed foundation material to ensure a stable foundation will be provided. FM 5-34, Figure 8-1 provides guidelines for procedures which can be utilized to test foundation soils.
  - 3) If exposed foundation material will not provide a stable foundation, or if the life of the structure is expected to be greater than 6 months, an improved foundation should be constructed to prevent future settlement and shifting.

To construct an improved foundation, excavate a trench 20” deep beneath all structure walls. The width of the trench should extend 20” beyond each edge of the wall.

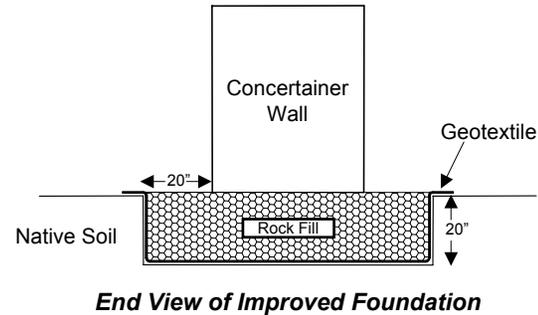
After excavation, line the trench with a geotextile cloth (minimum weight 200 g/m<sup>2</sup>) and backfill the trench with a **well compacted** layer of coarse graded fill material or crushed rock.

Prior to construction of structure, test improved foundation to ensure the desired level of foundation strength and stability has been achieved.

# Hesco Bastion Concertainer Site Preparation & Infill Guidelines

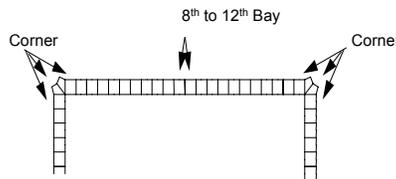


- Reference the following detail for a depiction of an improved foundation:



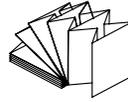
## Placement of Infill

- A basic principle behind the usage of Hesco Concertainers is the user's capability to easily create a lightweight wire/fabric "framework" for a given structure, and then fill the framework with infill material to impart structural strength and integrity. Considering that Concertainer structures therefore rely solely upon the "fill walls" for their global strength and stability, the proper placement of infill is critical to the performance of the structure. In all cases possible, the following guidelines to infill placement should be adhered to.
- Prior to filling, connect all units in a single layer together and adjust to the desired layout. Attaching empty units to filled units is difficult. In general, filling of a Concertainer layer should begin by first filling corner bays, and every 8<sup>th</sup> to 12<sup>th</sup> bay thereafter, with 1' of compacted material placed in two 6" lifts. This will allow the layer to be "anchored" during remaining filling activities.



After anchoring the wall, filling of the remaining bays should progress such that the infill material is uniformly placed throughout the Concertainer layer (e.g. Do not completely fill one bay while the adjacent bay is completely empty).

# Hesco Bastion Concertainer Site Preparation & Infill Guidelines

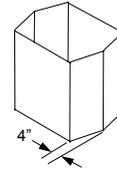


- Concertainer walls largely obtain their load carrying capacity and stability by “bulging” along the sides during the filling process and **allowing the wire/fabric structure to deform to its “maximum state”**. By allowing the bays to reach maximum deformation during filling, the infill material becomes confined within the widest, shortest volume of space available – **which significantly reduces the potential for future structure movement and failure**. “Bulging” also improves structure performance by increasing the width of the Concertainer walls, thereby creating a more stable structure.

Restraint mechanisms – such as wires and bracing – **must not** be used to prevent “bulging” of the Concertainer. As infill is placed within the bays, the fill material exerts lateral pressures on the walls in an attempt to “push” the walls outward. This outward pressure induces stress concentrations in restraint mechanisms which can lead to failure of the restraint. Upon failure of the restraint, the Concertainer walls move outward to reach the maximum deformed state described above, and the infill material moves outward with the wall. As the infill material moves outward to occupy the void space created by the moving wall, the fill material also moves downward. This outward/downward infill movement will induce wall settlement, wall and load shifting, and potentially an overall failure of the structure.

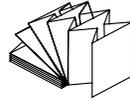
- To accommodate the deformation process previously described, the coil hinges on each side of every bay must be pulled out approximately 4” during initial filling. If coil hinges are not present, as with Mil 2 units, simply pull the sides of each bay outward to create a slightly curved side wall for each bay. This will assist the bay in deforming as necessary during the filling process.

Pull out center of each bay approximately 4” at base during initial fill placement

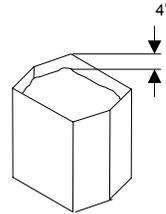


- After adjusting the base, fill the bay with infill material. **Unless otherwise specified, infill should be placed in lifts no greater than 9” in thickness and must be adequately compacted**. Adequate compactive effort can be obtained through foot compaction. During compaction, care must be taken to ensure that all infill material is compacted along the walls and in the corners. **Proper compaction of infill material is critical to prevent future settlement of Concertainer walls.**

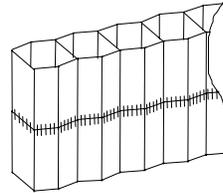
# Hesco Bastion Concertainer Site Preparation & Infill Guidelines



- If a 2<sup>nd</sup> level of units is to be placed on top of the first, halt filling of the first layer approximately 4" from the top of the unit.

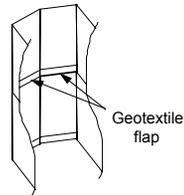


Place the 2<sup>nd</sup> layer on top of the 1<sup>st</sup>. **The 2<sup>nd</sup> layer must be positioned to ensure that it is correctly aligned with the 1<sup>st</sup> layer.** To achieve this alignment, place the second layer such that the bay corners of the 2<sup>nd</sup> layer are located directly above the corners of the 1<sup>st</sup>. This alignment will allow the walls of the 2<sup>nd</sup> layer to lay directly on top of the walls of the first, and thereby prevent infill leakage and enhance structural stability.

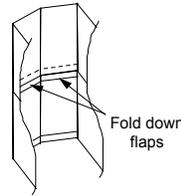


Ensure corners  
are properly aligned.

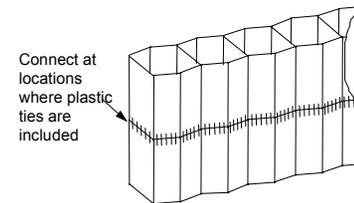
- After correctly positioning the second layer, seal the wall junctions with the geotextile flaps located at the bottom of the second layer, and connect the layers together with the pre-positioned plastic ties.



Geotextile  
flap



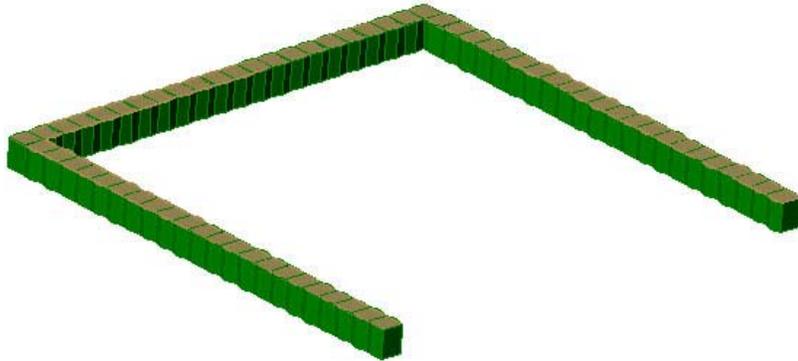
Fold down  
flaps



Connect at  
locations  
where plastic  
ties are  
included

- Continue to fill the second layer in the same manner as the first layer.

# Step 1 - First Layer



First layer placed and filled



Filling first layer



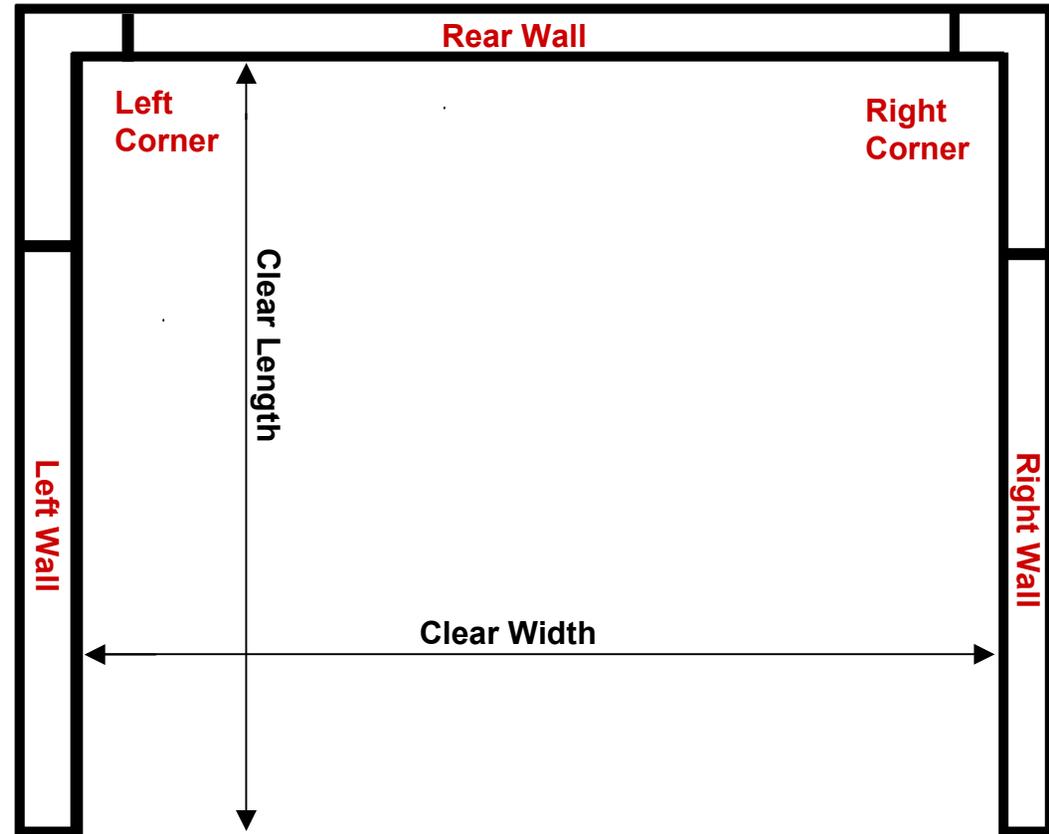
Compact fill in sides and corners

- After properly preparing the site, the first layer of Concertainer must be placed and filled. The aircraft currently in use by the Army constitute a broad range of sizes and configurations. Therefore, specific layout and material requirements for each type of aircraft differ, and are provided on the following pages. Regardless of the revetment under construction, the basic techniques associated with proper placing and filling of Concertainer units should be used in all cases.
- Refer to “Site Preparation & Infill Guidelines” and “Concertainer Construction Techniques” for detailed information on Concertainer construction.
- Begin by arranging the Concertainer as indicated on the appropriate page. Ensure that the fabric flaps at the bottom of the units are folded outward. This will assist with deformation of the sidewalls during filling.  

Note that for each position a minimum clear width and length is indicated. These represent the dimensions which are necessary to provide a minimum clearance of 10’-14’ between the walls and the rotors of the aircraft. **Prior to placing any fill, all Concertainer units should be placed and the clear dimensions should be checked.** Only after the dimensions are verified should filling proceed.
- Formation of the revetment corners will be by either the “single unit” or “end-to-side” method, depending upon the position being constructed. Reference “Concertainer Construction Techniques” for corner formation instructions.
- After arranging the Concertainer, fill the units with infill material
- **MAKE SURE FILL IS VERY WELL COMPACTED**

# *First Layer – Apache & Blackhawk*

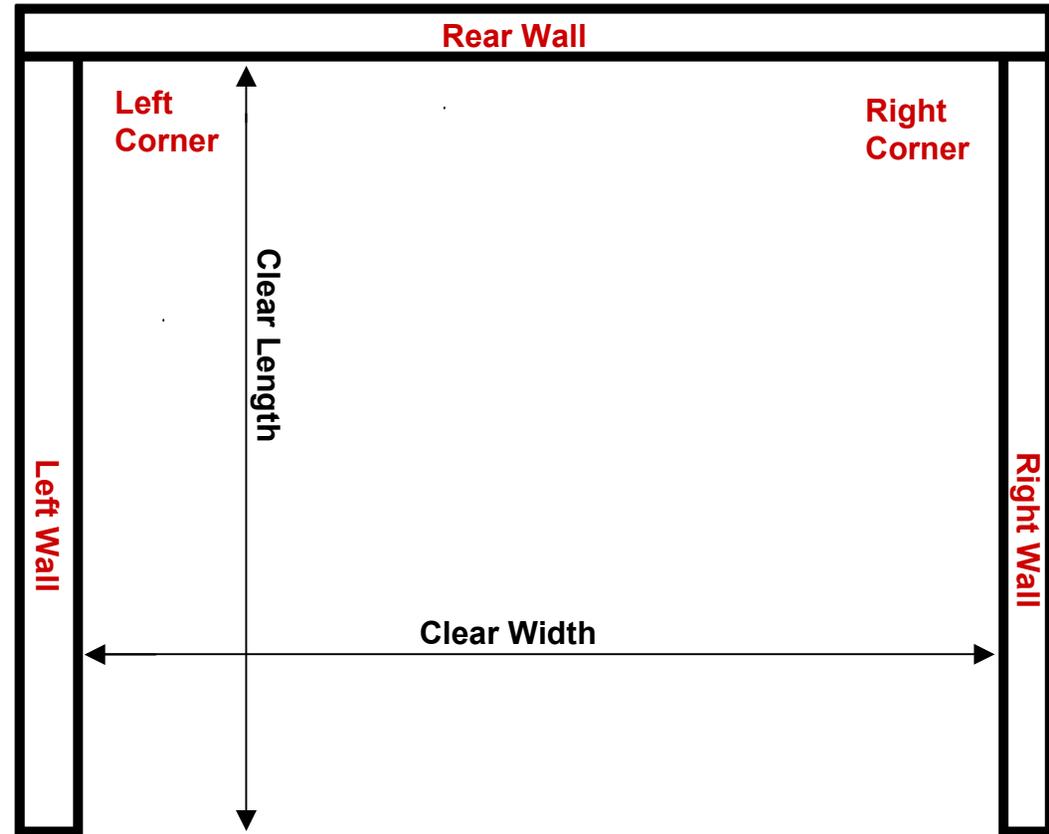
- Materials required: 8 sections of Concertainer – 4.5' high x 3.5' wide x 32' long
- Rear wall – form with 2 full sections
- Left corner – form by the “single unit” method; Utilize the 3<sup>rd</sup> and 4<sup>th</sup> bays from the end of the section to form the corner. Place the section such that the 1<sup>st</sup> and 2<sup>nd</sup> bays are attached to the rear wall and the 5<sup>th</sup>-9<sup>th</sup> bays are attached to the left wall.
- Right corner – form the same as the left corner
- Left wall – form with 2 full sections
- Right wall – form with 2 full sections
- Minimum clear width = 78'  
Minimum clear length = 82'



Position layout

# *First Layer – OH-58 Kiowa Warrior*

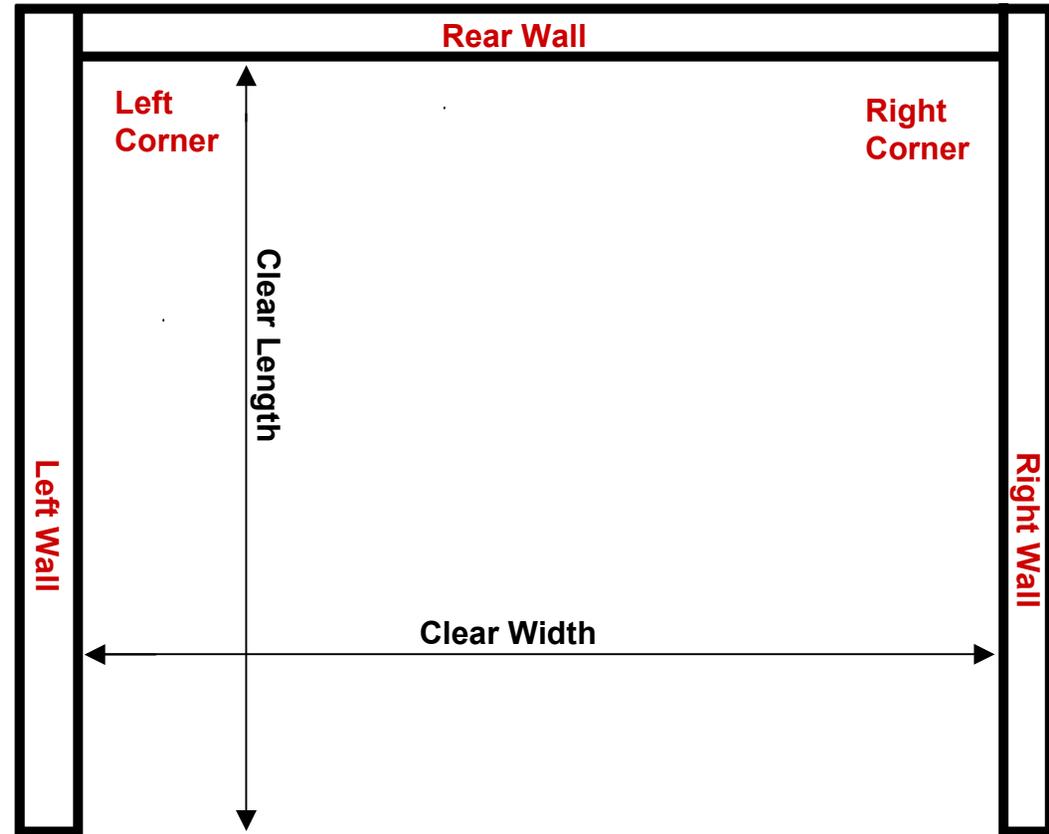
- Materials required: 6 sections of Concertainer – 4.5' high x 3.5' wide x 32' long
- Break two sections into one 6-bay unit and one 2-bay unit. Place the 2-bay units aside for use in Step 2.
- Rear wall – form with 2 full sections
- Left corner – form by the “end-to-side” method in the configuration shown
- Right corner – form the same as the left corner
- Left wall – form with 1 full section and one 6-bay unit
- Right wall – form with 1 full section and one 6-bay unit
- Minimum clear width = 57'  
Minimum clear length = 53'



Position layout

# First Layer – AH-1 Cobra

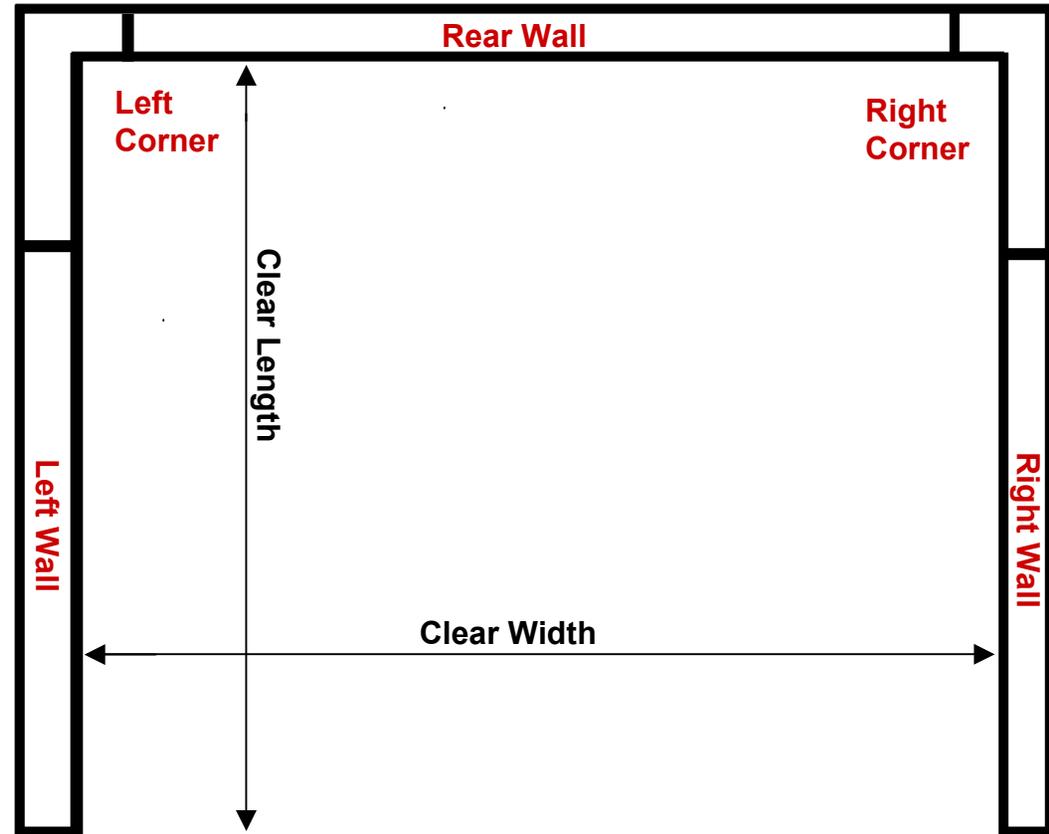
- Materials required: 8 sections of Concertainer – 4.5' high x 3.5' wide x 32' long
- Break two sections into one 4-bay unit and one 5-bay unit. Make break at pre-made disconnection point. Place the 5-bay units aside for use in Step 2.
- Rear wall – form with 2 full sections
- Left corner – form by the “end-to-side” method in the configuration shown
- Right corner – form the same as the left corner
- Left wall – form with 2 full sections and one 4-bay unit
- Right wall – form with 2 full sections and one 4-bay unit
- Minimum clear width = 64'  
Minimum clear length = 78'



Position layout

# *First Layer – UH-1 Huey*

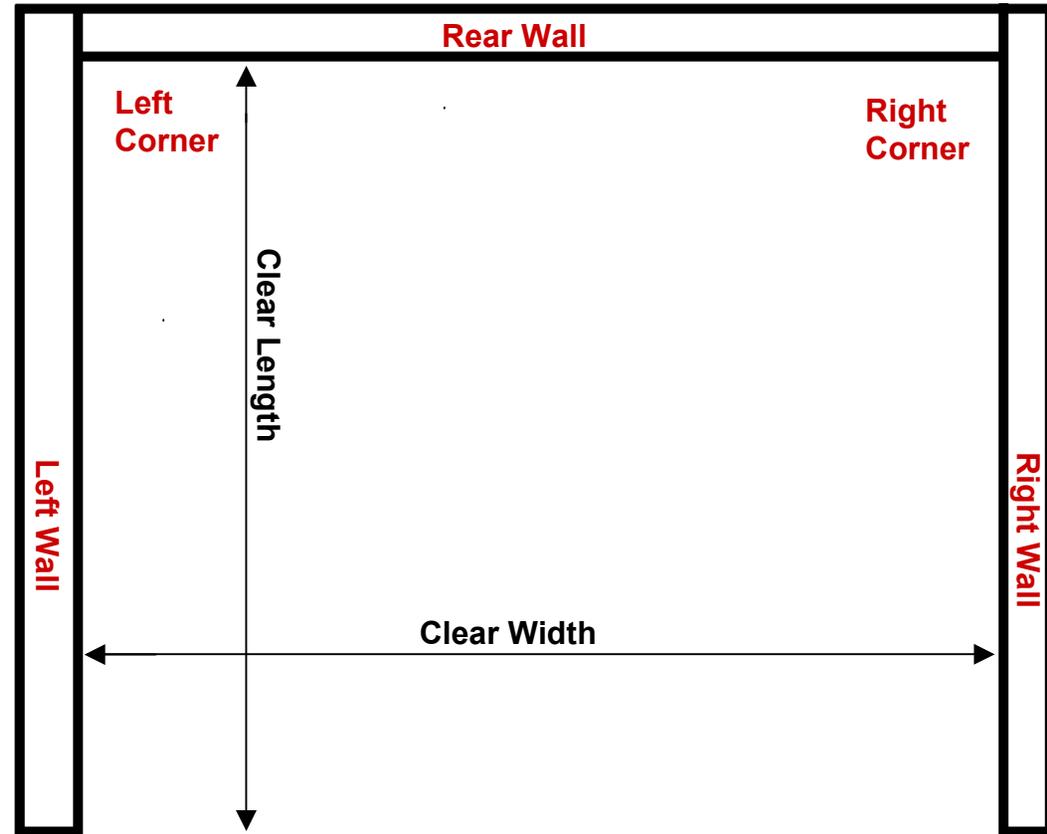
- Materials required: 8 sections of Concertainer – 4.5' high x 3.5' wide x 32' long
- Break two sections into one 4-bay unit and one 5-bay unit. Make break at pre-made disconnection point. Place the 5-bay units aside for use in Step 2.
- Rear wall – form with 2 full sections
- Left corner – form by the “single unit” method; Utilize the 2<sup>nd</sup> and 3<sup>rd</sup> bays from the end of the section to form the corner. Place the section such that the 1<sup>st</sup> bay is attached to the rear wall and the 4<sup>th</sup>-9<sup>th</sup> bays are attached to the left wall.
- Right corner – form the same as the left corner
- Left wall – form with 1 full section and one 4-bay unit
- Right wall – form with 1 full section and one 4-bay unit
- Minimum clear width = 71'  
Minimum clear length = 67'



Position layout

# *First Layer – Chinook*

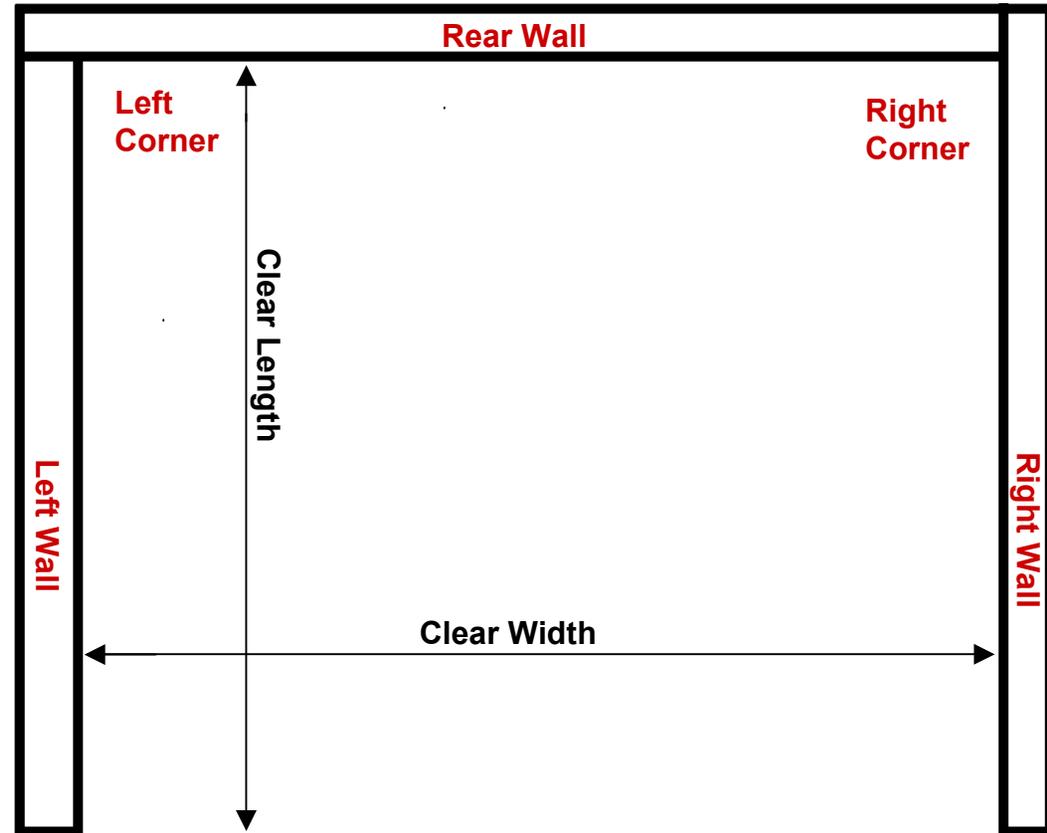
- Materials required: 4 sections of Concertainer – 7.25' high x 7' wide x 91' long
- Break one section into two 6-bay units.
- Rear wall – form with 1 full section
- Left corner – form by the “end-to-side” method in the configuration shown
- Right corner – form the same as the left corner
- Left wall – form with 1 full section and one 6-bay unit
- Right wall – form with 1 full section and one 6-bay unit
- Minimum clear width = 91'  
Minimum clear length = 126'



Position layout

# *First Layer – CH-53 Super Stallion*

- Materials required: 4 sections of Concertainer – 7.25' high x 7' wide x 91' long
- Break one section into one 3-bay unit and two 4-bay units.
- Rear wall – form with 1 full section and one 4-bay unit
- Left corner – form by the “end-to-side” method in the configuration shown
- Right corner – form by the “end-to-side” method in the configuration shown
- Left wall – form with 1 full section and one 3-bay unit
- Right wall – form with 1 full section and one 4-bay unit
- Minimum clear width = 112'
- Minimum clear length = 112'



Position layout

# Step 2 - Second Layer



Placing second layer



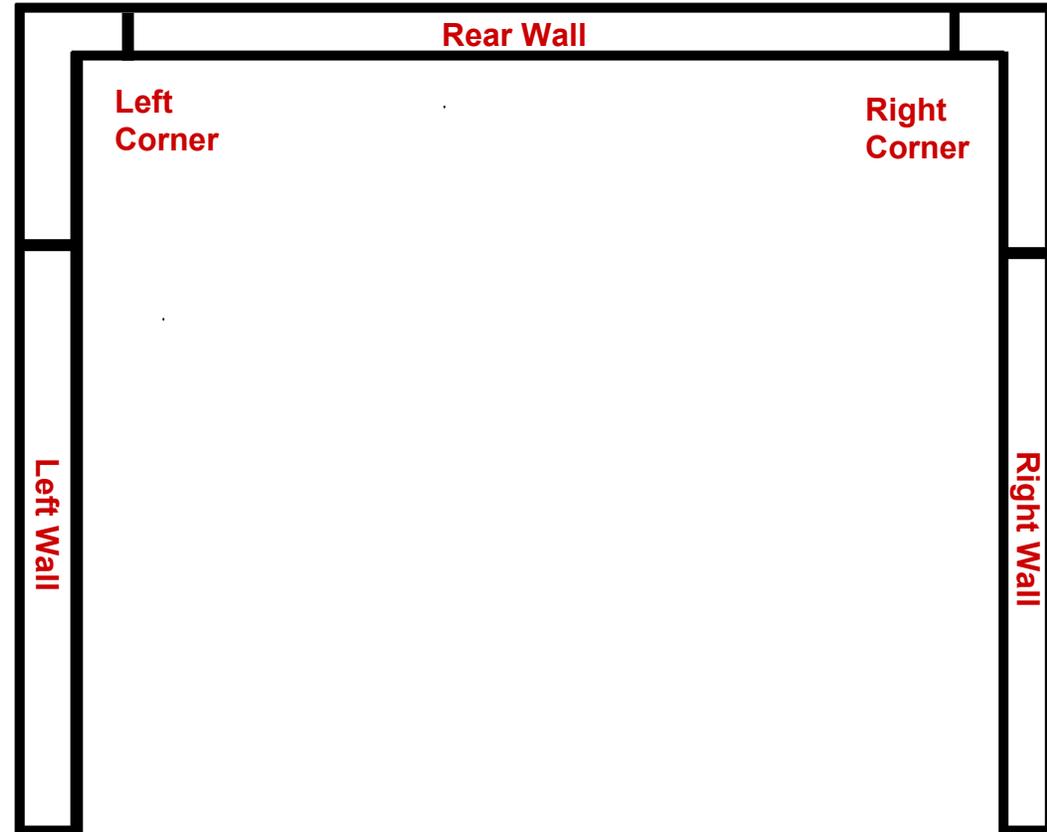
Connecting second layer to first using plastic wire ties

- As with the first layer, the configuration of the second layer will vary with each aircraft. Therefore, reference the following pages for layout and material requirements.
- With the exception of the Chinook and Super Stallion revetments, the second layer will be constructed with the same type of Concertainer used in the first. In these cases connect the second layer to the first with the included plastic wire ties as shown above. This will not be possible for the Chinook and Super Stallion revetments.
- After arranging the Concertainer, fill the units with infill material
- **MAKE SURE FILL IS VERY WELL COMPACTED**
- If necessary, the top of the wall can be capped to reduce the potential for Foreign Object Damage resulting from rotor wash. Several methods can be used to cap the wall including sandbags or chemical stabilizers. If a cap is utilized care must be taken to ensure that the cap itself will remain stationary when exposed to rotor wash.

# *Second Layer – Apache & Blackhawk*

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- **Materials required: 8 sections of Concertainer – 4.5' high x 3.5' wide x 32' long**
- **Rear wall – form with 2 full sections**
- **Left corner – form by the “single unit” method; Utilize the 3<sup>rd</sup> and 4<sup>th</sup> bays from the end of the section to form the corner. Place the section such that the 1<sup>st</sup> and 2<sup>nd</sup> bays are attached to the rear wall and the 5<sup>th</sup>-9<sup>th</sup> bays are attached to the left wall.**
- **Right corner – form the same as the left corner**
- **Left wall – form with 2 full sections**
- **Right wall – form with 2 full sections**

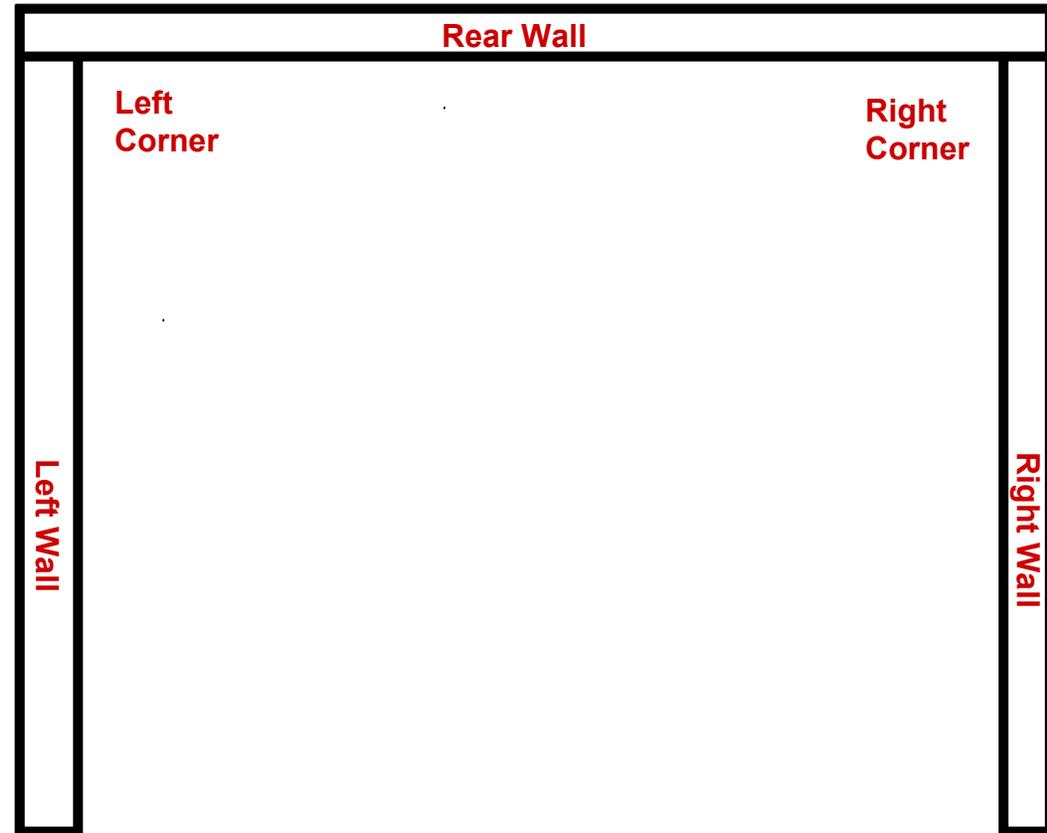


**Position layout**

# *Second Layer – OH-58 Kiowa Warrior*

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- **Materials required: 5 sections of Concertainer – 4.5' high x 3.5' wide x 32' long**  
Two 2-bay units produced in Step 1
- **Break one section into one 6-bay unit and one 2-bay unit.**
- **Rear wall – form with 2 full sections**
- **Left corner – form by the “end-to-side” method in the configuration shown**
- **Right corner – form the same as the left corner**
- **Left wall – form with 1 full section and one 6-bay unit**
- **Right wall – form with 1 full section and three 2-bay units**

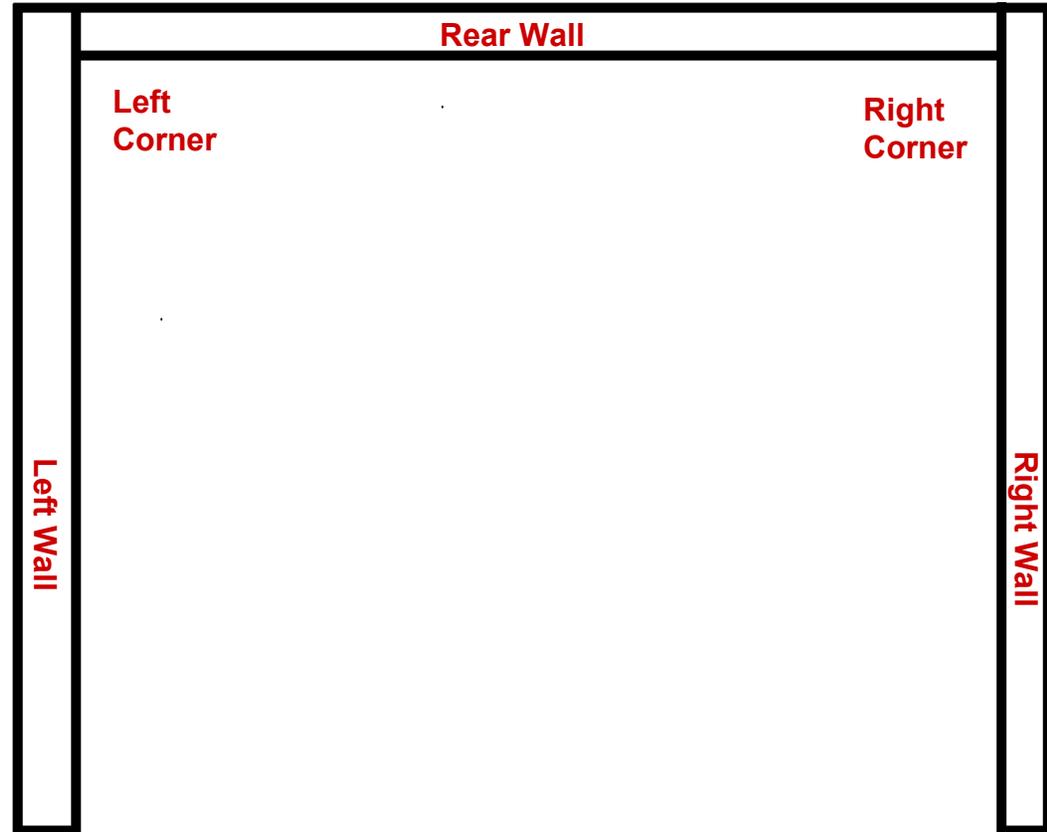


**Position layout**

# *Second Layer – AH-1 Cobra*

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- **Materials required: 6 sections of Concertainer – 4.5' high x 3.5' wide x 32' long**  
Two 5-bay units produced in Step 1
- **Collapse one bay on each 5-bay unit to produce two 4-bay units**
- **Rear wall – form with 2 full sections**
- **Left corner – form by the “end-to-side” method in the configuration shown**
- **Right corner – form the same as the left corner**
- **Left wall – form with 2 full sections and one 4-bay unit**
- **Right wall – form with 2 full sections and one 4-bay unit**

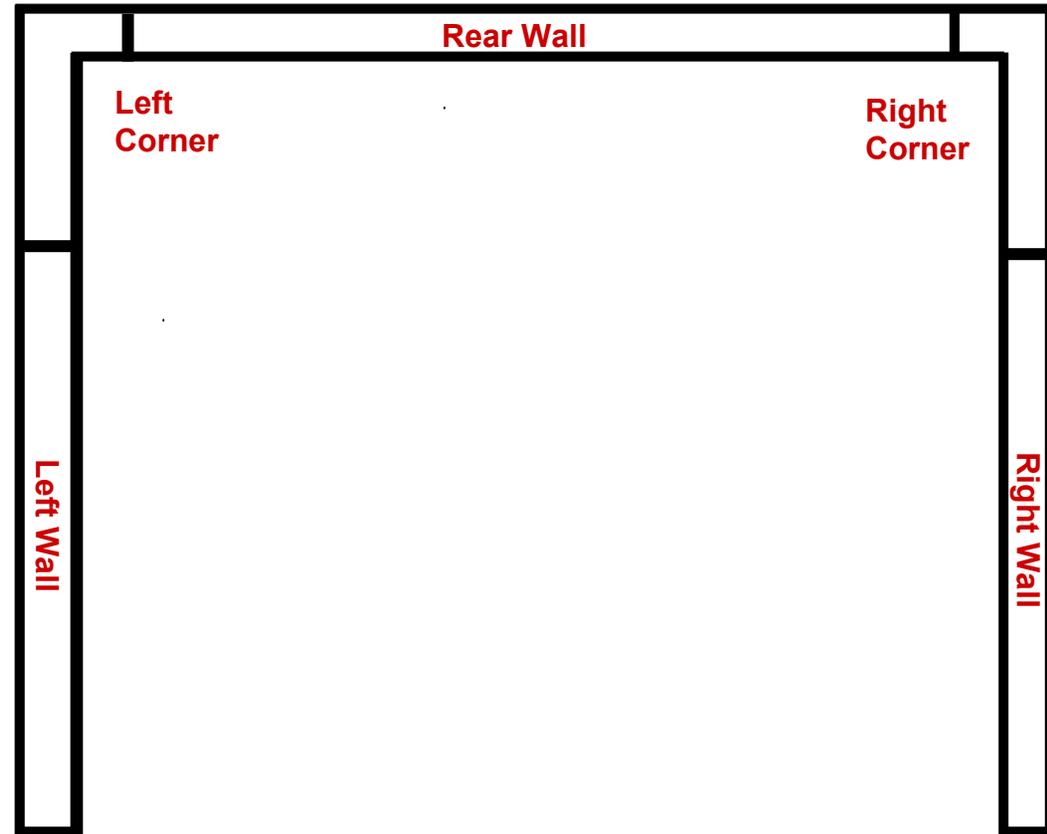


**Position layout**

# *Second Layer – UH-1 Huey*

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- **Materials required: 6 sections of Concertainer – 4.5' high x 3.5' wide x 32' long**  
**Two 5-bay units produced in Step 1**
- **Collapse one bay on each 5-bay unit to produce two 4-bay units**
- **Rear wall – form with 2 full sections**
- **Left corner – form by the “single unit” method; Utilize the 2<sup>nd</sup> and 3<sup>rd</sup> bays from the end of the section to form the corner. Place the section such that the 1<sup>st</sup> bay is attached to the rear wall and the 4<sup>th</sup>-9<sup>th</sup> bays are attached to the left wall.**
- **Right corner – form the same as the left corner**
- **Left wall – form with 1 full section and one 4-bay unit**
- **Right wall – form with 1 full section and one 4-bay unit**

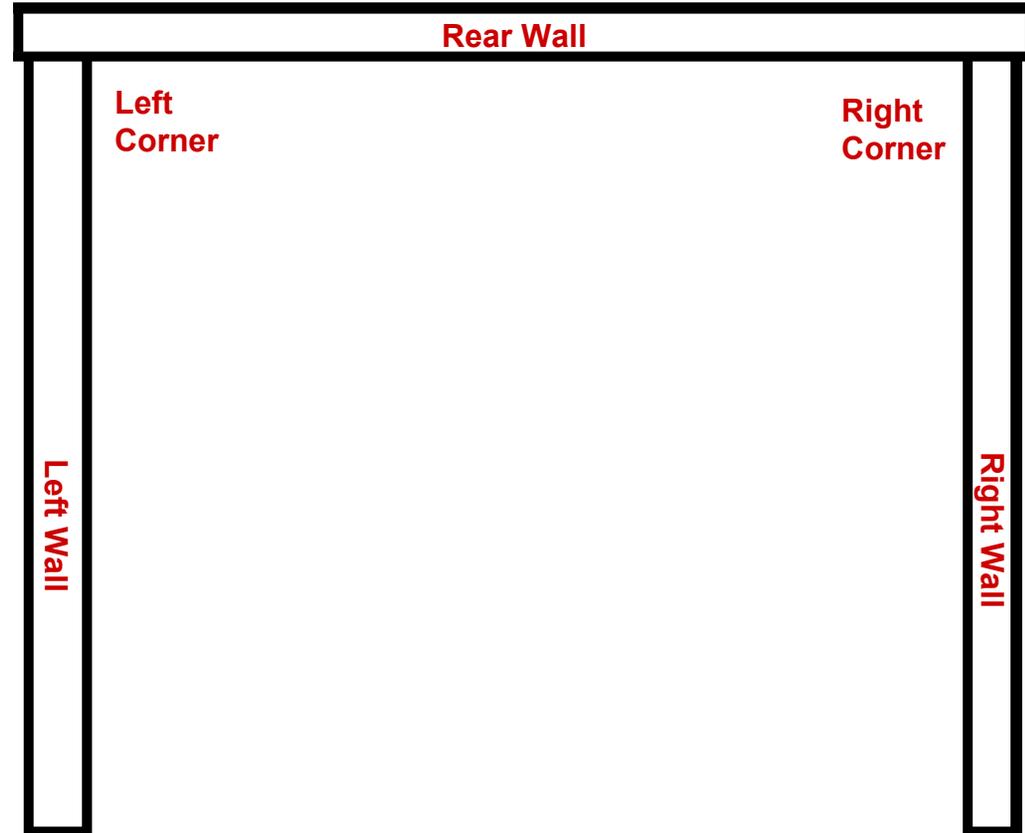


**Position layout**

# *Second Layer – Chinook*

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- Materials required: 11 sections of Concertainer – 4.5' high x 3.5' wide x 32' long
- Break two sections into one 7-bay unit and one 1-bay unit.
- Ensure that the second layer of Concertainer is centered on the first.
- Rear wall – form with 3 full sections and two 1-bay units. The ends of the second layer will be approximately 1' from the edge of the first.
- Left corner – form by the “end-to-side” method in the configuration shown, note that the connection will be made with the plastic ties only
- Right corner – form the same as the left corner
- Left wall – form with 3 full sections and one 7-bay unit
- Right wall – form with 3 full sections and one 7-bay unit

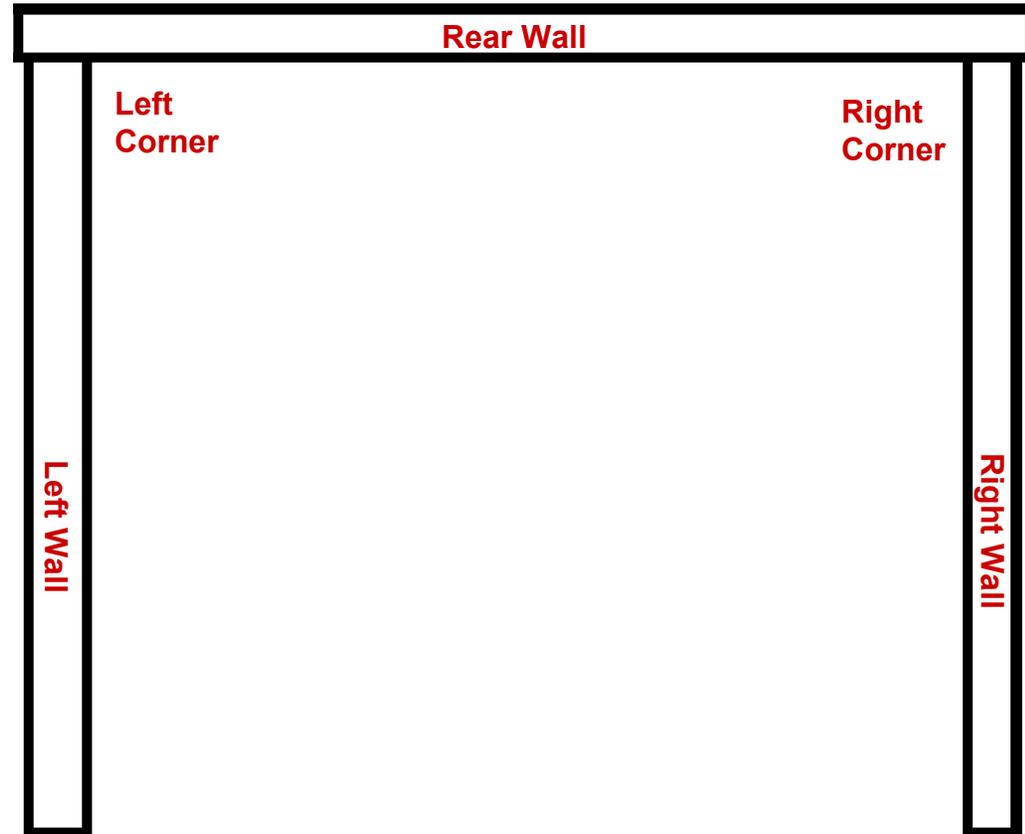


Position layout

# *Second Layer – CH-53 Super Stallion*

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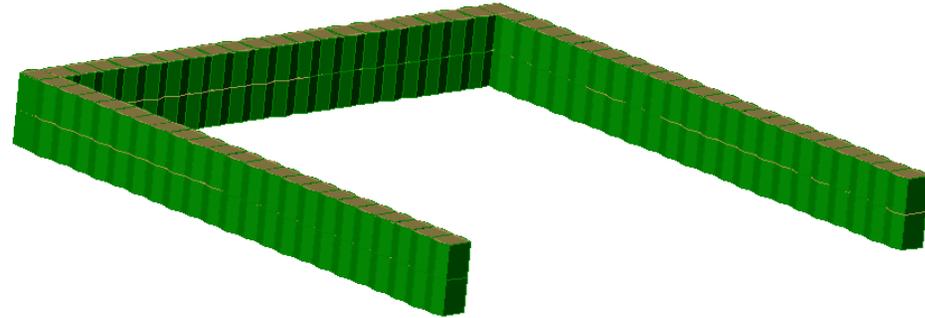
- **Materials required: 11 sections of Concertainer – 4.5' high x 3.5' wide x 32' long**
- **Break one section into two 4-bay units. Collapse a cell on one section to produce one 8-bay unit.**
- **Ensure that the second layer of Concertainer is centered on the first.**
- **Rear wall – form with 3 full sections and one 8-bay unit. The ends of the second layer will be approximately 10" from the edge of the first.**
- **Left corner – form by the “end-to-side” method in the configuration shown, note that the connection will be made with the plastic ties only**
- **Right corner – form the same as the left corner**
- **Left wall – form with 3 full sections and one 4-bay unit**
- **Right wall – form with 3 full sections and one 4-bay unit**



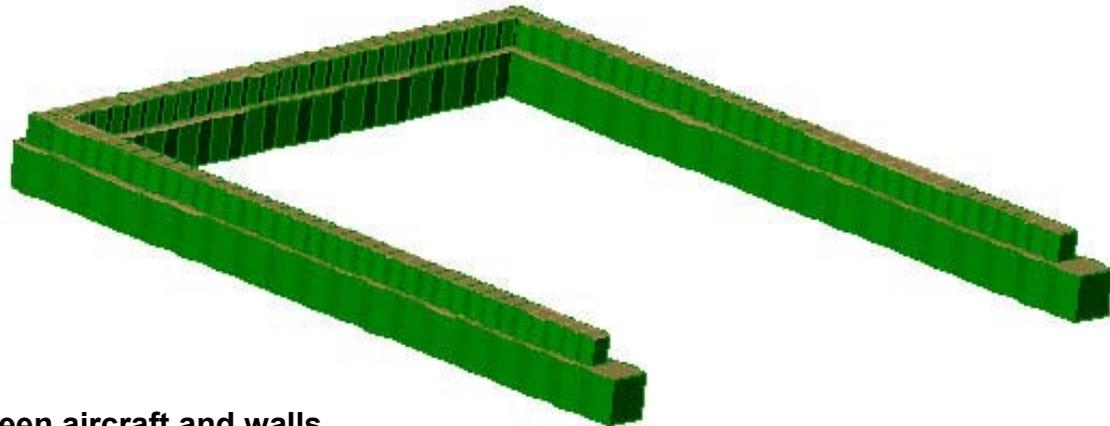
**Position layout**

# Step 3 - Revetment Checklist

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Typical layout – Apache, Blackhawk, Kiowa Warrior,  
Cobra, Huey



Typical layout – Chinook and Super Stallion

Check completed revetment to ensure:

- Walls straight
- No excessive settlement of walls
- Adequate clear distance is provided between aircraft and walls
- Wall caps, if applied, are adequately secured