Foundation Design
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Typically, there are three foundation types that a Sprung structure is erected upon. These are: concrete, direct to grade and asphalt.

Erecting a Sprung structure to Grade

Erecting the Sprung structure directly to grade requires very little surface preparation. The area should be graded and sloped to allow for positive drainage. The base should be graded with a slight crown. Underground utilities should be located and clearly marked. The structure is typically anchored with two @ 3/4” diameter X 5'-0” long steel pins per column base in conjunction with earth anchors. Depending on the structure size & wind loading in the area, one or two Manta Ray Earth Anchors are installed at each column base location. In average soil conditions these are typically driven to a depth of 7' to 10'.

Due to the flexible nature of the Sprung structure, the building system accommodates undulating grade, differential settlement, and frost heave. The Geotechnical Engineer can increase the bearing capacity based on the nature of this structural system. The arch base reactions, due to dead and roof loads, are lower than conventional building systems. Wind and seismic reactions typically govern. Design notes and base reactions prepared by our engineer are made available for each project on a site specific basis.

An “Earth Anchor Design and Installation Guide” is provided to the client. This guide explains the recommended procedures and tools required for the installation of the earth anchors. Also provided to the client are details, drawings, design notes and base reactions for the project from which the client’s engineer can determine the suitability and or depth for the earth anchoring method for the soil conditions on the site. The local engineer (the professional of record for the project) would be assuming responsibility for the soil capacity for this anchoring system and provide an appropriate letter to the Building Authority so that an occupancy permit can be obtained.

Compared with the time and cost associated with excavation, site preparation, cribbing, and pouring for a concrete pad or footing, earth anchors are a very desirable and cost effective alternative.

The steps to install earth anchors include: review of existing soil conditions, design loads, drawings, and earth anchor details by a local engineer to ensure that the existing grade will provide the necessary capacity for the anchor selected. After this review the earth anchors are prelocated, installed, proof loaded, and tested by the contractor.

Earth anchors must be installed very early in the erection sequence. It is recommended that the earth anchors be preinstalled prior to the start of general construction. If not, on site erection delays will occur after the technical consultant arrives on site, as the structure membrane cannot be installed until the earth anchors have been installed. Upon confirmation from the contractor that the anchors will be preinstalled, Sprung will ship the drive rod, load locker, and earth anchors to the site well ahead of the structure.
Earth anchors must be proof loaded. This loading is achieved during the anchor installation process. The pull value / design loads are supplied by Sprung’s consulting engineer and can be found in the design notes/base reactions as well on the earth anchor layout drawing. Copies of this information can be obtained from the client’s engineer or through the Sprung Sales Representative. The anchor pull test values at each column base location must be recorded so, if required, the client’s engineer can write the appropriate letters for occupancy to the local Building Authority. Fill in the Blank spaces have been provided on the “Column Base Layout” drawing adjacent to each earth anchor location to help with this process. If assistance is required from our consulting engineer for permitting, these pull values will be required. Pull out values are to be recorded on the drawing provided or other documentation by a responsible site authority, such as the local engineer, professional of record, or someone designated by him or her. Sprung’s Technical Consultant is not authorized to complete this documentation. The earth anchor installation manual will be provided by our Contracts Department if your project requires earth anchors.

Please review the drawings, pictures and sketches below. It is imperative that the contractor becomes familiar with this process.
A Typical Base Column /w Earth Anchor

NOTE:
SOIL CAPACITY FOR EARTH ANCHORING METHOD TO BE REVIEWED AND APPROVED BY LOCAL ENGINEER.

5/8"x8" J&J TURNBUCKLE

3/8" CABLE CLAMPS

5/8"x2 1/2" BOLT C/W NUT & WASHERS, 4 PLACES

5" x 10" ALUM. I BEAM

ALUM. BASE PLATE C/W INTEGRATED ANGLE

ASPHALT PAD OR GRADE

3/4" x 5'-0" STEEL ANCHOR PIN 2 PER COLUMN BASE

MANTA RAY MR3 EARTH ANCHOR 1 PER COLUMN BASE

5"x10" EARTH ANCHOR DETAIL (MR3) 1 1/2"=1'-0"

5"x10" ALUMINUM I BEAM MR3 EARTH ANCHOR DETAIL 30' THRU 60' STRUCTURES

DATE: 03/01/2008 SCALE: AS NOTED

DRAWING #: 5x10 EARTH ANCHOR
Base Column Layout
The architectural membrane can be finished to the ground by simply extending the 18" ground allowance flap and placing gravel, sand bags or fill from the area on top of the architectural membrane. In snow load areas, care must be taken with this finishing detail, for on occasion as the snow builds up along the perimeter of the structure, the snow will need to be removed so as not to interfere with the snow shedding capabilities of the structure. This flap can also be placed on the inside of the structure.

Additional information on earth anchors can be found at: [www.earthanchor.com/mantamain.html](http://www.earthanchor.com/mantamain.html)

**Erecting a Sprung structure on an Asphalt Foundation**

Erecting a Sprung structure on an existing or new asphalt pad is essentially the same as anchoring the structure directly to grade. (See above).

If a new asphalt pad is being laid for the structure, it is important to incorporate a slight crown in the center of the structure to allow for positive drainage.

If the Sprung structure is erected on an existing asphalt pad it will likely not be crowned to allow for drainage (most parking areas are sloped in one direction so that water does not pool). If migrating water is a potential problem for the structure application, a possible solution may involve the installation of a raised floor system in the interior. Alternatively a berm system can be installed around the inside perimeter by saw cutting the asphalt and installing a flat bar.

There is no guaranteed method of sealing the structure membrane to the asphalt pad and achieving a reliable, water proof seal. The architectural membrane can be finished to the asphalt in similar fashion as outlined above when anchoring to grade. Alternatively, the membrane can be finished to the asphalt with a flat bar finish which is attached to the asphalt using small anchors. The quality of the asphalt will determine the effectiveness of the procedure.
Erecting a Sprung structure on a Concrete Foundation

Most structures which are used for semi permanent or permanent applications are erected to a concrete foundation or footing. These typically consist of a slab on grade, ring beams, pony walls, piles and existing concrete slabs.

As with all building types, the grade around the concrete foundation will need to be lower than the foundation and should be sloped away from the structure to allow for positive drainage.

Sprung provides a column base layout along with design notes/base reactions and information on the concrete anchor bolts which Sprung provides. These details are provided to the client’s foundation engineer so that he or she can design an appropriate foundation. Sprung’s consulting engineer does not design foundation systems for they are not familiar with the soil conditions, local design codes and construction practices. The local foundation engineer is also able to inspect and approve the concrete foundation as it is being installed. This will allow for the appropriate letters to be written for the Building Authority.

It is imperative that the critical dimensions as outlined on the Sprung Column base layout are adhered to. Any deviation to these dimensions may result in site delays and an improper base finish for the architectural membrane. The continuous 1 1/2" recess or drop along the perimeter of the structure shown on our drawings is a recommended detail for it acts as a second line of defense against water infiltration at the base. If water happens to migrate into this area it would simply stop at the edge of the drop and may reduce the amount of damage to any of the interior floor finishes.

Note: A bump out from the pad is required at most, if not all, personnel and cargo door entrances to accommodate a hood over these doors. This is often overlooked.
One common error by contractors is setting the width of the concrete foundation or slab to the exact outside width of the structure. The structure is designed to allow the outside flange of the I beam to project 1” past the edge of the foundation for proper membrane finishing. i.e. A 50’ wide structure will require a pad or outside foundation width of 49’-10”, allowing for proper membrane finishing (see below).

**Proper 1 1/2” recess.**

Concrete slab on grade showing door hood bumpouts and 1 1/2” recess. Please refer to Sprung column base layout for critical dimensions.

The concrete slab should be segmented so that the Architectural Membrane can be finished to the side of the concrete. Please refer to the Sprung Column Base Layout.
All column bases, including those of the door hoods, connecting corridors, canopies and window hood projections must bear at the same elevation. It is imperative that this detail is adhered to for it may affect the finishing of the hoods at these locations.

When installing rebar, please ensure that the anchor bolt locations at each column base of the structure is reviewed. Rebar must not be installed in these areas for drilling through rebar to install anchor bolts is both onerous and time consuming and will cause site delays with the anchoring of the structure. Drilling through rebar requires specialty bits and, if provided by Sprung, additional cost will apply.

Due to the flexibility of the Sprung structure and the erection process, cast in place anchor bolts are not appropriate. Sprung specifies and provides the concrete ready anchors. Depending on the structure size, design loads, location, concrete type and the requirements as outlined by local Building Authority, either mechanical or epoxy anchors are specified by Sprung’s Design Engineer. All anchor bolts specified and provided by Sprung are from the Hilti Corporation. In most cases, all Building Authorities and Building Codes recognize these types of anchors.
The mechanical anchor bolts are typically Hilti HSL 3 red caps and depending on the structure size these consist of HLS 16/50 and HSL 20/30. The epoxy anchors typically consist of HAS threaded rods using the HVA/HVU adhesive system. The Hilti anchor bolts are provided by Sprung.

It is the responsibility of the foundation engineer to review the design loads, the Sprung provided details and the specifications from the Hilti Corporation to ensure that the anchor bolts are developed properly within the concrete foundation. It is critical that the recommended edge distances and concrete thicknesses as outlined by Hilti are adhered to. If not, on site delays can occur. Information on the Hilti anchor bolts can be obtained on their website www.hilti.com.

The architectural membrane is finished to the side of the concrete foundation. The outer flange of the I beam projects over the concrete by approximately 1". This allows the architectural membrane to leave the confines of the fabric rope chase of the outer flange. The membrane is fastened to the side of the concrete footing with aluminum flat bar trim using small concrete hit anchors. For insulated structures, the interior liner is finished to the concrete slab or foundation using a small continuous aluminum angle. If required, the 1 1/2" drop, which projects past the interior membrane, can be filled in using a low strength grout after the aluminum finishing angle is installed.

Architectural membrane finished to side of concrete footing using aluminum flat bar.

Concrete slab showing membrane finishing with aluminum flat bar.

Please note: all flat bars are powder coated to match Membrane color
Using a skeleton type of form is usually the easiest, most efficient, and cost effective method of creating the perimeter recess. This involves using a 2x4 (or similar) and bracing across the recess. In addition to saving a significant amount of lumber this method also allows the recessed area to be finished clean with a trowel.
Example of Ecology Blocks Foundation
Landscaping and Drainage

By design the Sprung structure has rounded eaves. As such, rain gutters are not required or incorporated along the roof line of the structure. It is imperative that the site be designed to allow for adequate positive drainage along the perimeter of the structure to divert water away from the structure. Similar to conventional buildings, the concrete foundation (top of concrete) should be placed a minimum of 6" above grade to help prevent water from entering the structure at the base due to hydrostatic pressure. As well, it will provide an area to adhere the architectural membrane to the side of the concrete slab or foundation. Remember to slope the grade away from the structure.
Incorporating crushed rock or mulch into the landscaping design aids in water drainage and pushes any sidewalks or paths out of potential snow shed areas.
Typical Concrete Pad Details for an Entryway

General landscaping design should allow for proper water diversion and drainage. The recommended design noted below, when used in conjunction with a site drainage plan, will prevent moisture from migrating into the structure.