

P-24 Delta Tie

The Dayton Superior P-24 Delta Tie is a unique insulated tilt-up concrete panel connector. It allows the contractor to fabricate a highly energy-efficient, insulated concrete sandwich wall panel using the insulating foam of his choice.

This versatile connector allows the foam insulation to be placed from panel edge to panel edge, eliminating thermal bridges and costly energy loss. The foam insulation is sandwiched between two concrete wythes, or layers, to form a long-lasting, energy-efficient concrete sandwich wall panel. The three wythes are tied together using P-24 Delta Ties. Spacing of the Delta Ties varies, based on the panel's required composite moment capacity.

The Delta Tie is produced using an engineered composite matrix. It consists of a geometrically configured, two-dimensional truss manufactured from continuous wound fiberglass embedded in an alkali resistant resin. The design of the Delta Tie produces a connector of remarkable strength and durability.

The non-metallic, non-corrosive design of the Delta Tie eliminates any thermal transfer through the panel, increasing the insulating efficiency of the panel.

Advantages

- Increased load bearing.
- Stiffer insulated panels, easier to handle.
- Design flexibility.
- Material, labor and transportation cost reduction.
- Quick and easy installation.
- Applicable to all brands of foam panel insulation.

P-24 Delta Tie

The standard Delta Tie dimensions are shown in the accompanying detail.

The connector is designed so that it can be oriented in the panel either on end or side, depending on the thickness of the insulation. For example, the 5" x 7" size can be used on its side in a 1" to 2" insulation or on end for 2" to 4" insulation. The Delta Tie can be used with any rigid insulation from 1" to 4" thick. This versatile, dual-use feature adds to the Delta Tie's effective application compatibility and, at the same time, reduces inventory and storage requirements.

In individual connector specimen and full size panel tests the Delta Tie has exhibited excellent loading behavior and load capacities.

Increased Load Bearing

Tests have verified the excellent tension and shear strength characteristics of the Delta Tie insulated panel connector.

The P-24 Delta Tie has the following ultimate capacities:

- 3,220 lbs. in shear.
- 3,100 lbs. in tension.

Stiffer Insulated Concrete Panels

The inherent capabilities of the truss design greatly increase the stiffness of the panel. The added stiffness makes the panel easier to lift, handle, store and/or transport.

Design Flexibility

Due to the composite action gained by using the Delta Tie, panels may be cast in longer lengths or with thinner concrete wythes. Contact Dayton Superior for design programs available for Engineers.

Cost Savings

The Delta Tie design provides a fast and easy installation to save labor. It produces stiffer panels to lessen handling. The connector's design flexibility allows the cost saving attributes to be designed into the panel. Delta Tie connectors are purchased as a separate item, allowing the contractor to provide the foam insulation of his choice.

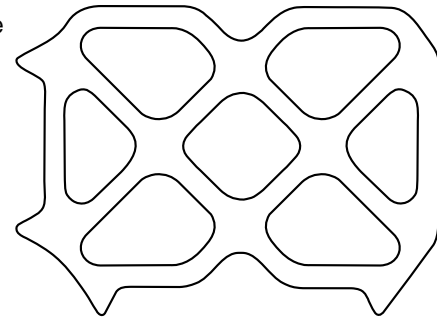
Quick and Easy Installation

The two-dimensional design of the Delta Tie lends itself to easy installation. No drilling or special tools required. Simply use the foam as a straight-edge template to quickly place the connectors.

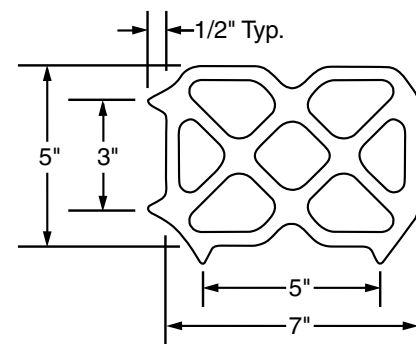
Maximum recommended spacing is 8 square feet of panel per panel connector.

For spacing other than 8 square feet of panel per connector, contact a Dayton Superior Technical Service Center.

Patent Pending



P-24 Delta Tie



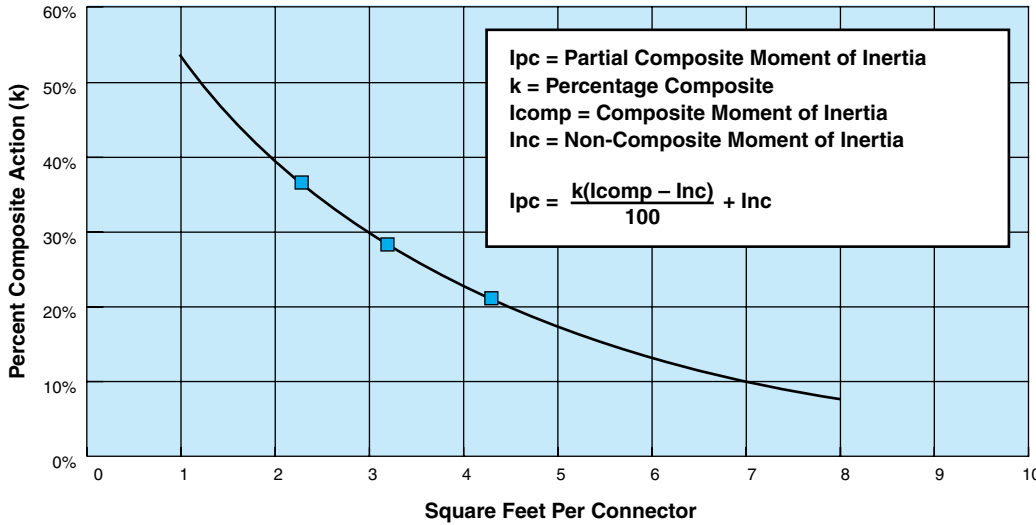
To Order:

Specify: (1) quantity, (2) name.

Example:

500, P-24 Delta Ties.

P-24 Delta Tie Design Chart



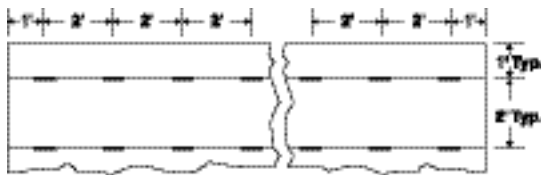
Notes:
Test reports are available on request.

I_{pc} = Partial Composite Moment of Inertia
 k = Percentage Composite
 I_{comp} = Composite Moment of Inertia
 I_{nc} = Non-Composite Moment of Inertia

$$I_{pc} = \frac{k(I_{comp} - I_{nc})}{100} + I_{nc}$$

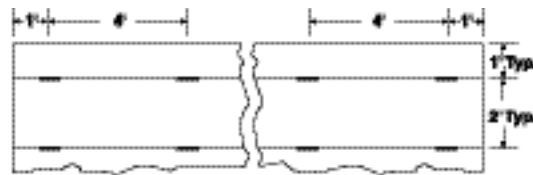
Typical Delta Tie Placement

25% Composite Action



4 sq. ft. per connector

No Composite Action



8 sq. ft. per connector

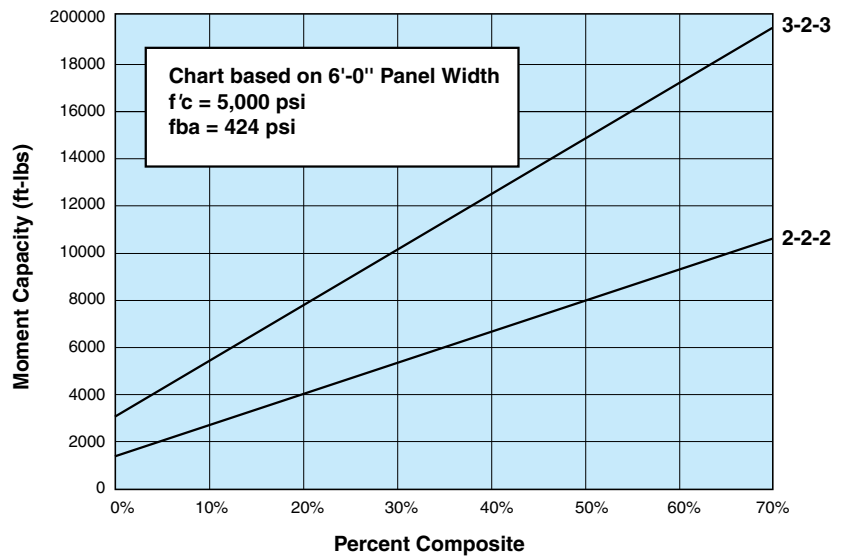
Composite Moment Capacity

For any given sandwich panel, the shear and moment diagrams define the required panel stiffness. The panel stiffness may be altered, as necessary, pending panel parameters, by adjusting the tie distribution as a function of the internal shear and moment forces. The two examples, below, illustrate the required stiffness (percent composite action) necessary to develop the shear and moment forces.

1. A panel measuring 37'-0" long by 6'-0" wide, with a 3-2-3 wythe pattern, must have a 5% composite action to achieve a flat lift with 4x2 rigging.
2. A 2-2-2 panel of same size requires a 10% composite action for the same rigging.

In order to employ the least amount of concrete to save weight, the percent of composite action must increase.

A small upward adjustment can be realized by a minimal addition of connectors strategically placed at the zones of maximum shear.



Delta Tie Installation Information

HOW IS SPACING ACHIEVED IN THE FIELD?

Dayton Superior recommends the use of 4'-0" wide x 8'-0" long sheets of extruded insulation foam when using the P-24 Delta Tie. This allows the contractor to space ties at 4'-0" centers across the width of the panel and then vary the vertical spacing depending on percentage of composite action desired. Sheets, 2'-0" x 8'-0", can be utilized for other spacing.

WHAT ARE THE INSTALLATION STEPS FOR THE DELTA TIE?

- 1) Install the required reinforcing, then place and screed the concrete for the outer wythe to its designed thickness.
- 2) Cut the first strip of foam to a width not exceeding 12" and place it tightly against the side of the form and on top of the just placed concrete while concrete is still in its wet or plastic state.
- 3) Insert the first row of Delta Ties tight against the edge of the foam, spaced vertically from top to bottom of panel. Minimum tie embedment into the fresh concrete is 1-1/2".
If the tie hits the reinforcing mesh prior to reaching its minimum embedment depth, move the tie slightly so that the reinforcing mesh sits in the depressed "V" section of the tie.
- 4) Place a full 4'-0" wide section of foam tight against the first row of P-24 ties, then insert the second row of Delta Ties from top to bottom of panel.
- 5) Repeat this process across the width of the panel until there is 12" or less left between the last full sheet of foam and the side form.
- 6) Install the last strip of foam cut to size in width, and force it between the last row of Delta Ties and the side form.
- 7) Once the concrete in the bottom wythe has stiffened, complete the balance of the panel by installing the required reinforcing steel, embeds and concrete. Finish and cure the backside of the panel per the project's specifications.

It is critical and required that Steps #1 through #6 above be completed immediately after the bottom wythe has been consolidated and leveled to required thickness. This is to ensure that the concrete mix is in a wet or plastic state and workable to be able to embed the Delta Tie properly. If the Delta Tie is not embedded into the concrete while the concrete is still plastic, the concrete will not properly flow through the openings in the tie, which "locks" and holds the tie into the concrete. This could result in failure of the panel.

IMPORTANT INSTALLATION NOTES:

- 1). The person that is installing the foam insulation and Delta Ties should lightly step several times on the foam immediately adjacent to and surrounding the tie to make certain concrete is consolidated around the tie and flows in and around the "anchoring" holes in the tie.
- 2) Set time of concrete varies as a function of many factors, including (but not limited to): mix design, concrete temperature, ambient temperature and mix time. The installer must ensure that the concrete has not reached initial set before ties are installed.
- 3) As the P-24 Delta Tie is a one-way shear connector, meaning it is stronger in one direction than it is in the other direction, care must be taken to make certain it is installed in its intended orientation in the panel.
- 4) With the Delta Tie visible above the foam, it is easy to verify if the Delta Tie is set at its proper depth. Utilize a tape measure to randomly check that the ties have a minimum of 1-1/2" above the foam.

WHAT CRITERIA SHOULD WE USE TO DETERMINE WHAT DIRECTION THE DELTA TIE SHOULD BE PLACED (5" OR 7" VERTICAL) WITH DIFFERENT FOAM THICKNESSES?

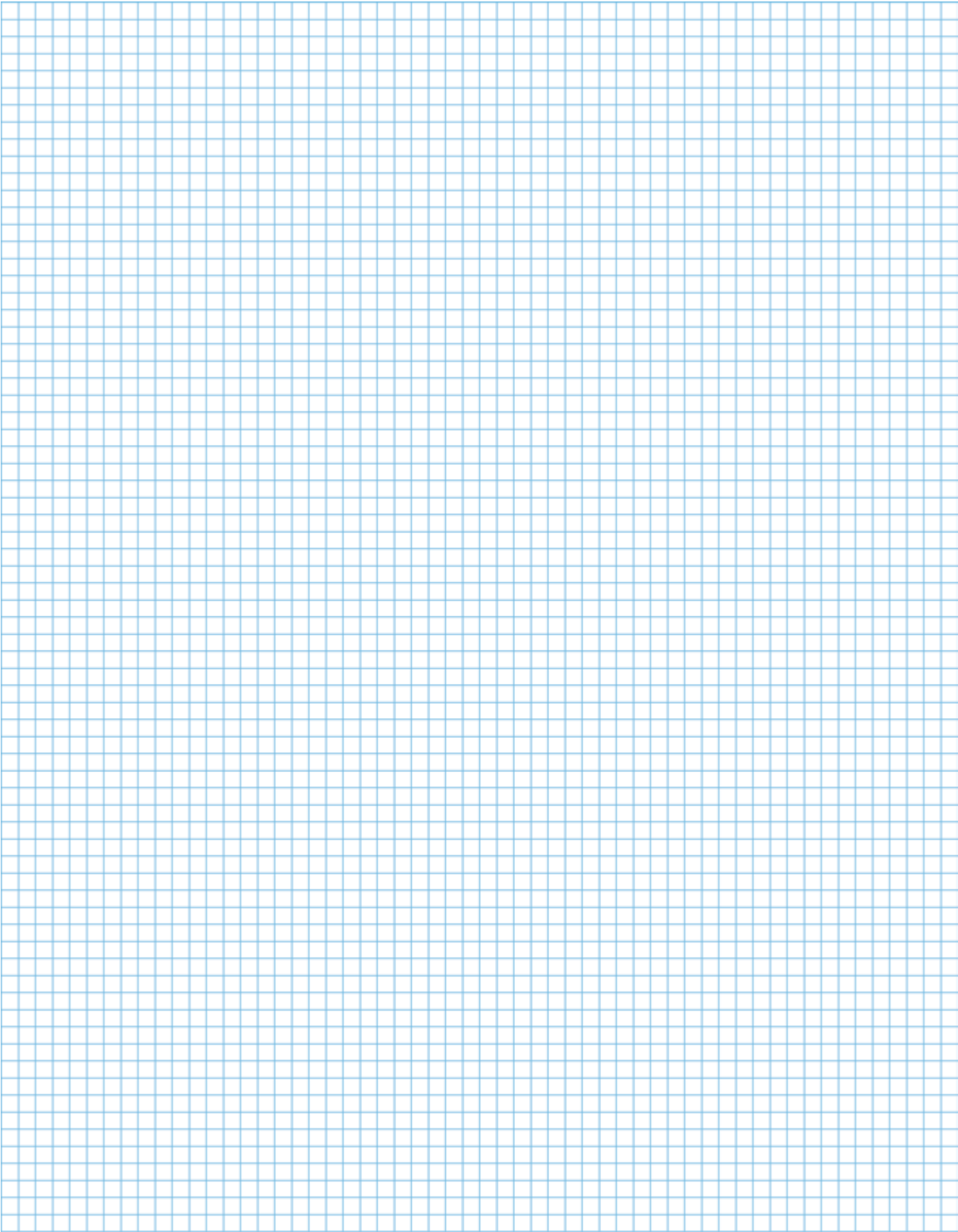
Delta Ties are installed to achieve a minimum of 1-1/2" in each concrete wythe. The tie is rotated using either the 5" or 7" dimension to achieve this minimum concrete depth. The chart below details the correct direction of the Delta Tie based on insulation thickness:

INSULATION THICKNESS	HORIZONTAL DIMENSION OF TIE TO PANEL FACE
1"	7"
1-1/2"	7"
2"	7"
2-1/2"	5"
3"	5"
3-1/2"	5"
4"	5"

WHAT IS THE LEARNING CURVE ON INSTALLING DELTA TIES?

Contractors have been able to learn quickly how to efficiently install the Delta Tie. In fact, at one jobsite, the crew was able to install the ties so quickly that it was estimated they had reduced the time to install the ties and insulation by almost 50% over the time it took to install the competitive system.

Sandwich Panel Connectors



Sandwich Panel
System