

FLANGED PIPE PILE (FPP)

as effective solution

for

Seismic and Lateral Loads



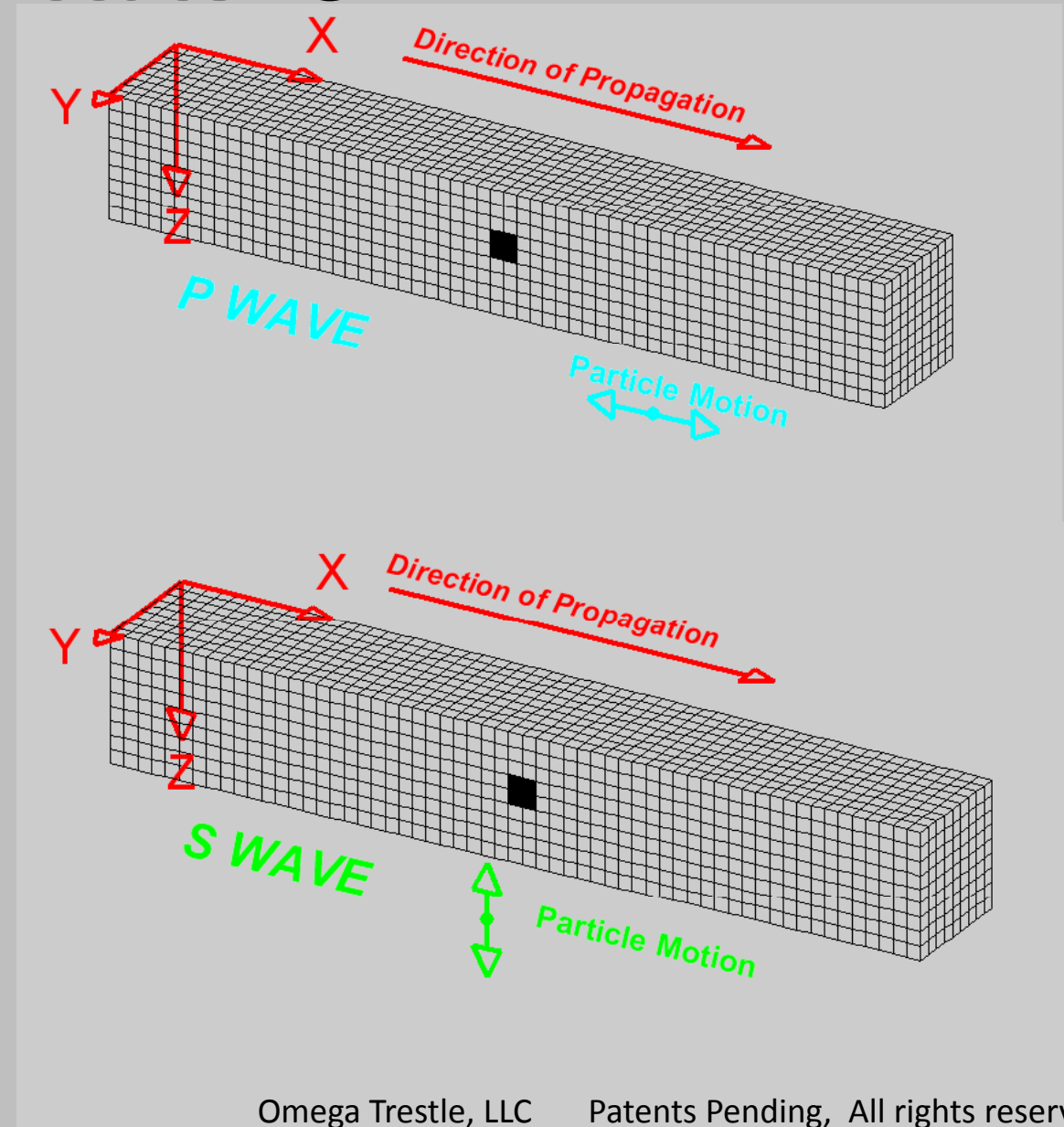
SEISMIC WAVES

BODY WAVES: The initial waves, from the earth's inner layers

P-waves (primary waves) are compression waves.

S-waves (secondary waves) are shearing waves.

Seismic Graphics courtesy of Dr. Lawrence Braile

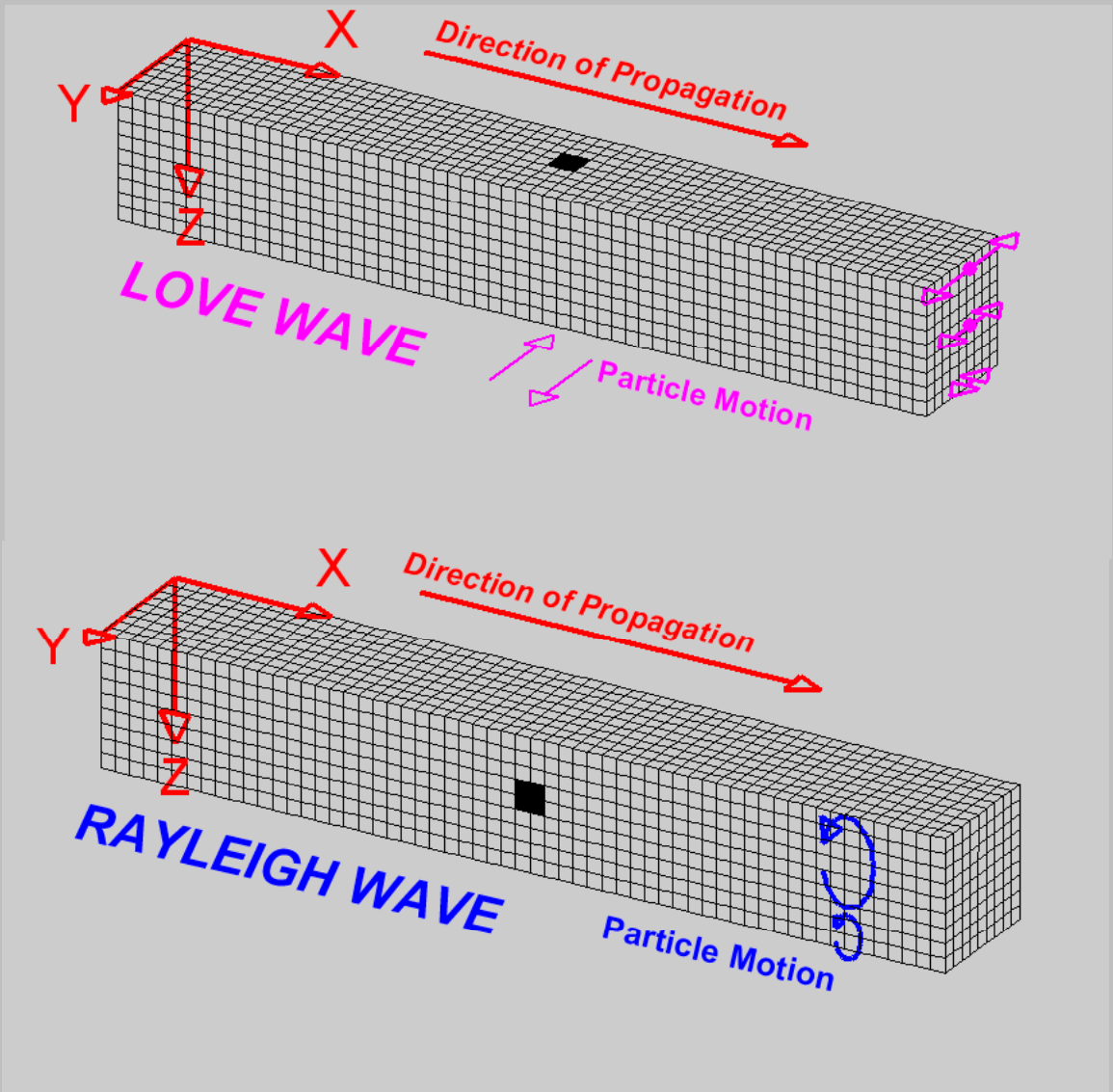


SEISMIC WAVES

SURFACE WAVES: only move along the surface of Earth

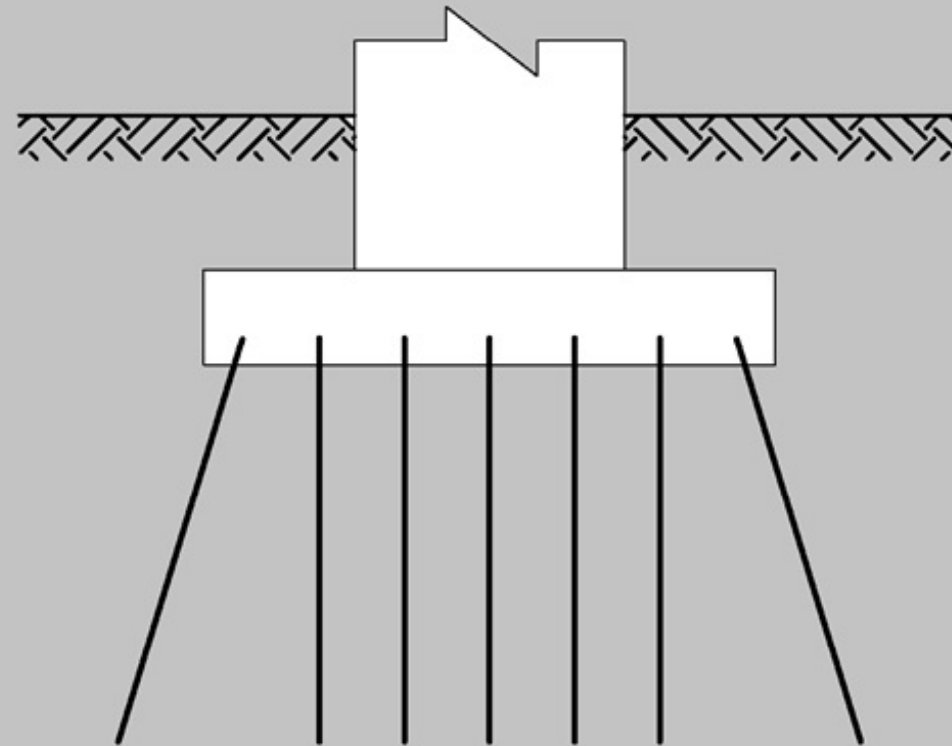
Love waves are shearing waves, similar to S-waves.

Rayleigh waves are waves in vertical plane.



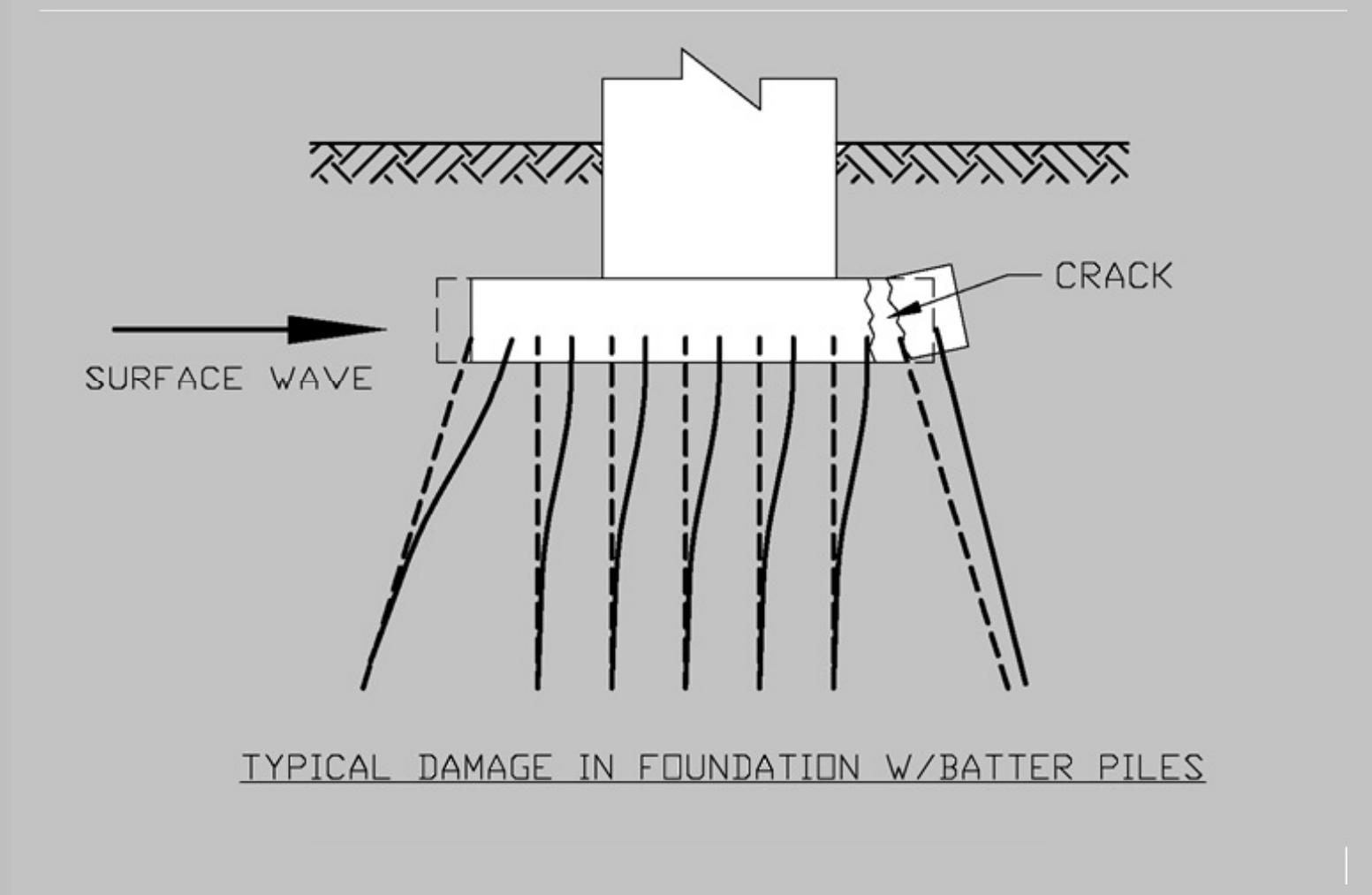
Seismic Graphics courtesy of Dr. Lawrence Braile

Batter piles are used for lateral load resistance

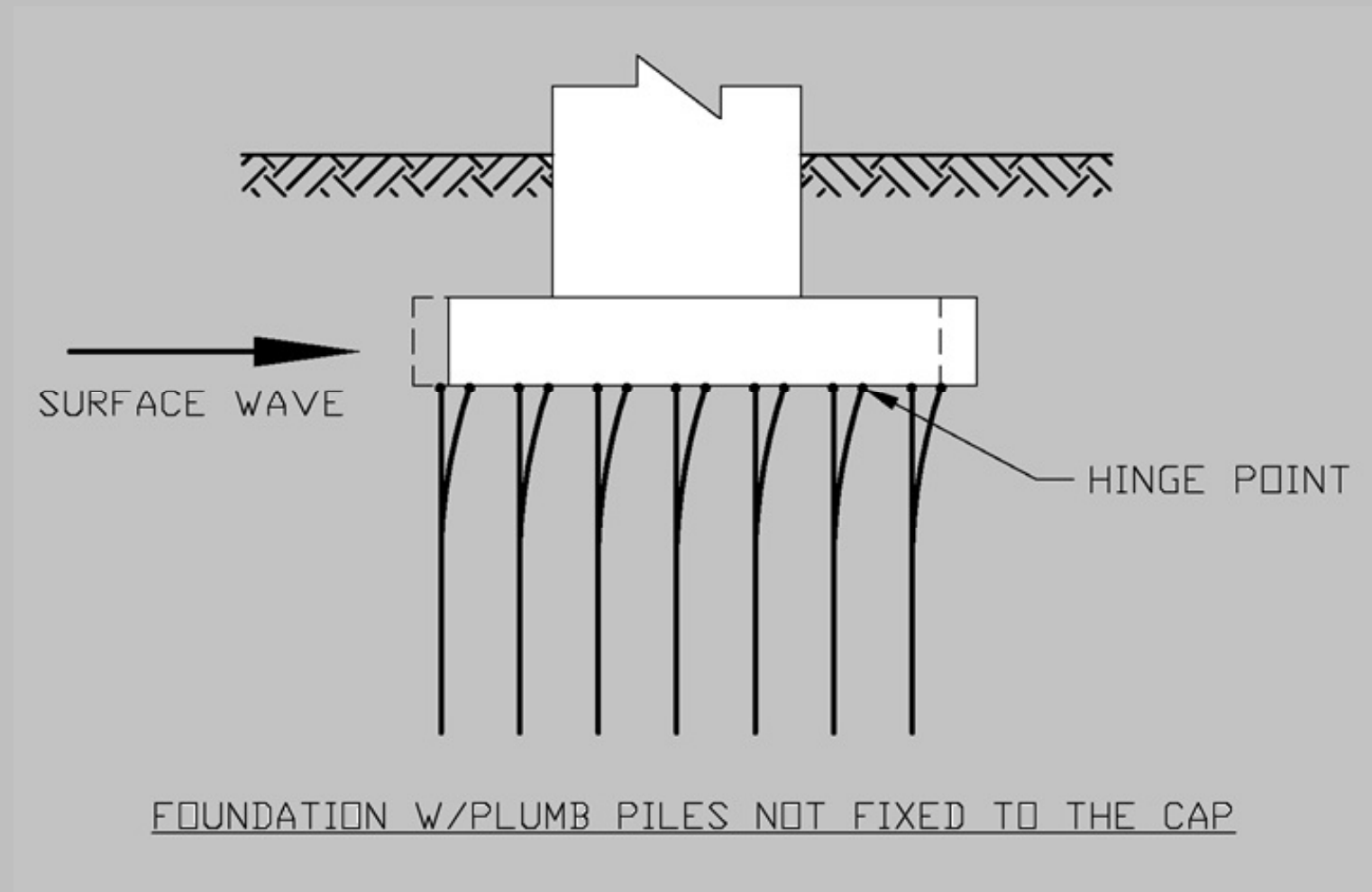


TYPICAL FOUNDATION W/BATTER PILES

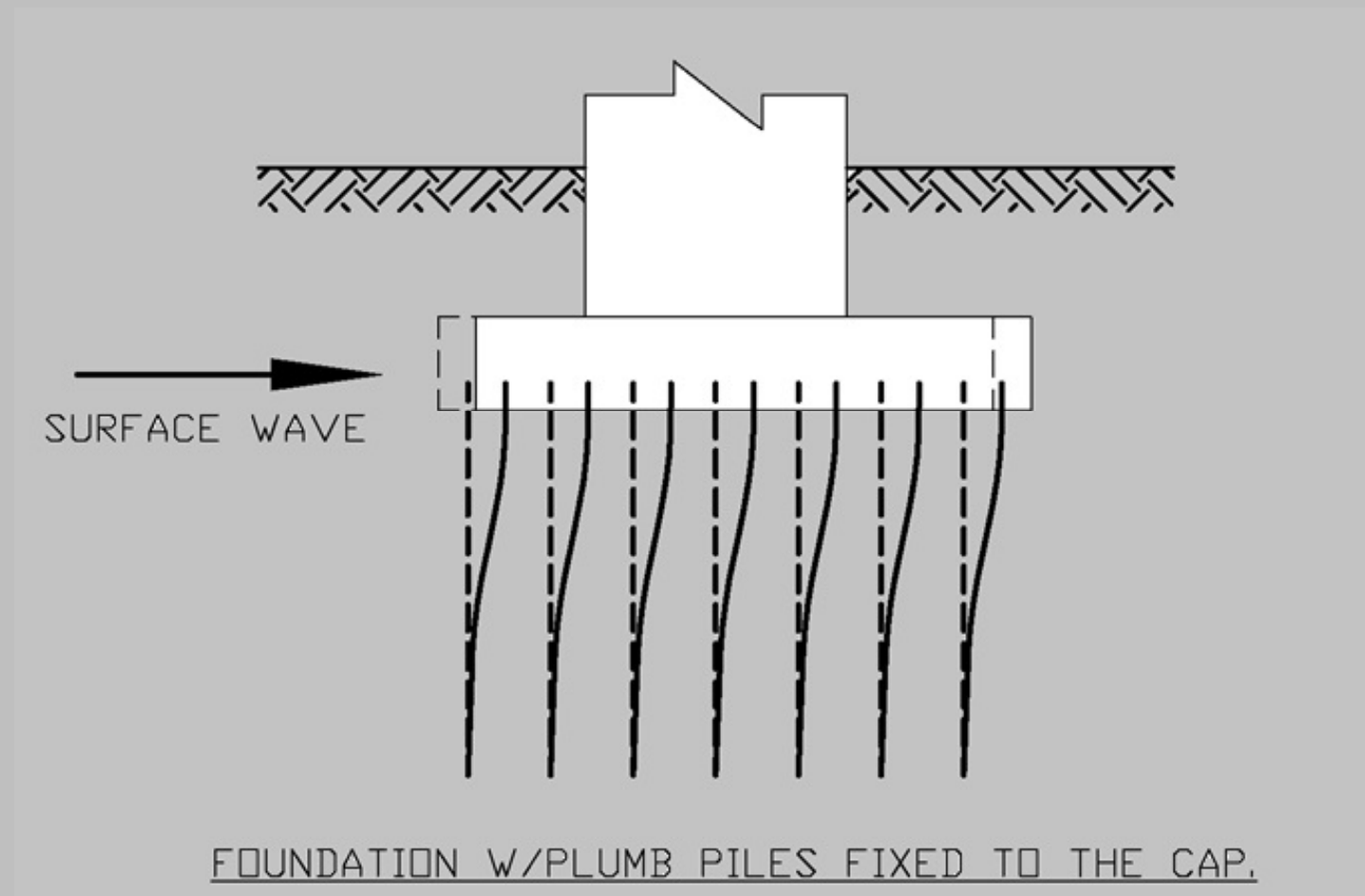
Batter pile foundations exhibit substantial damage when subjected to seismic loading due to lateral stiffness



Plumb pile foundations are not as stiff as the foundations with batter piles.
Such foundations absorb energy better during seismic events.



Example of plumb pile foundation with fixed connection to the pile cap.



Concrete piles are more likely to suffer damage during seismic events.

Steel and wooden piles are preferable, however those types of piles have disadvantages also:

Wooden piles have length and strength limitations;

Both have deterioration/corrosion problems;

Steel pile – currently two options : 1. pipe 2. H-pile

1. Pipe - optimized to resist compression and torsion.

$$S_y/S_x = 1$$

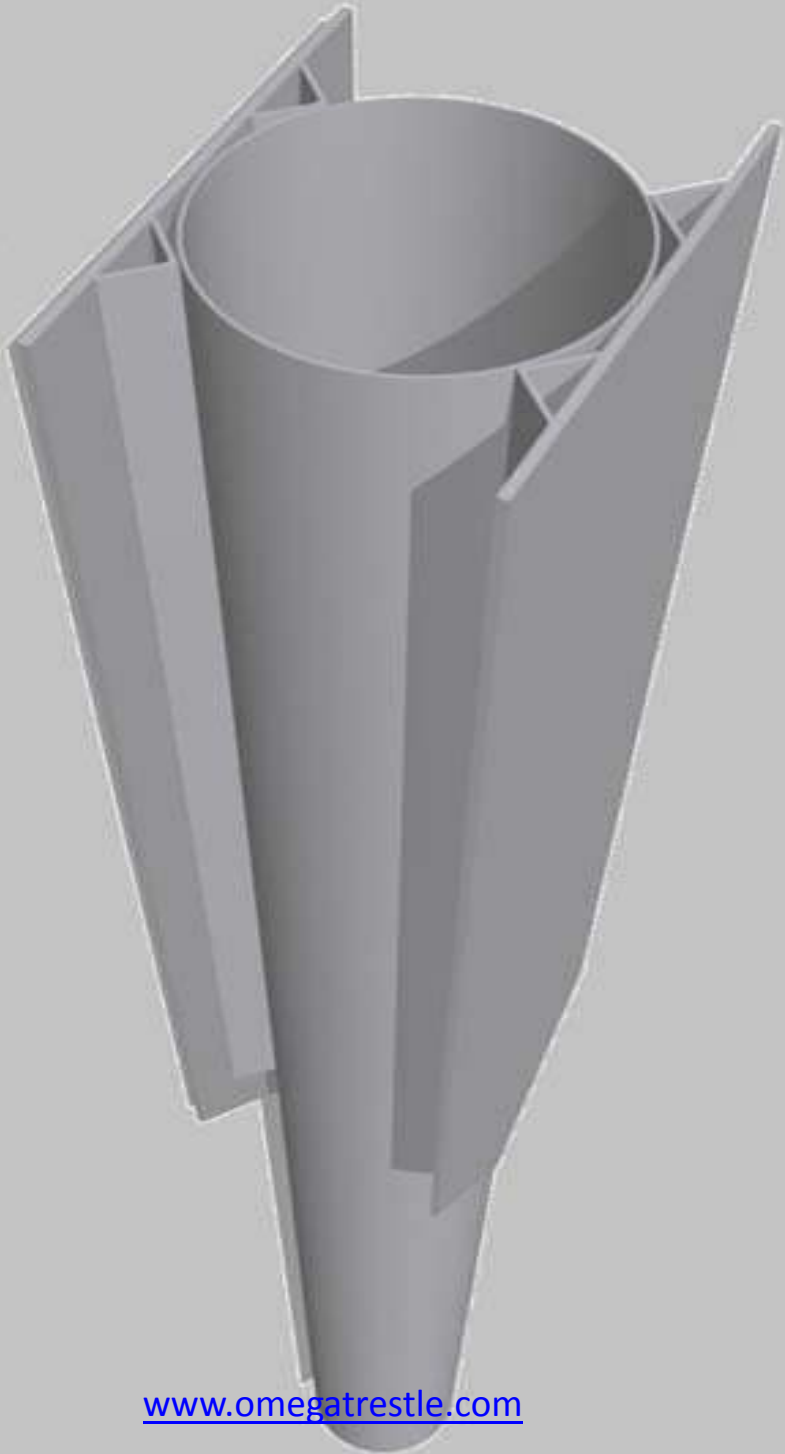
-often less economical when it comes to bending because it has extra material around neutral axis area.

2. H-pile - limited in size when hot rolled.
- much weaker in one direction than the other.

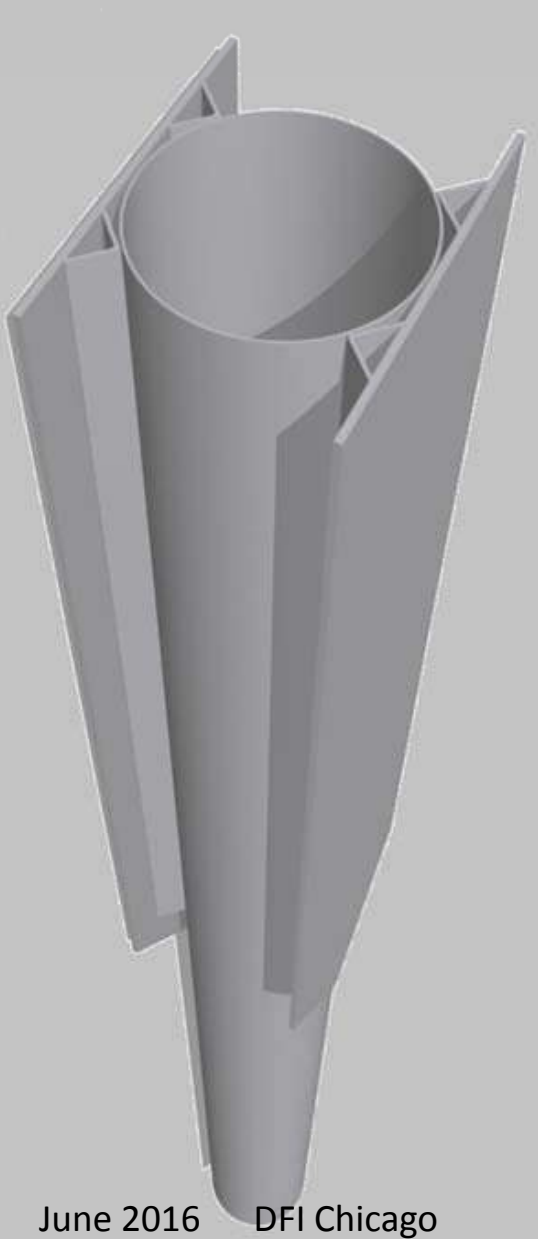
$$S_y/S_x = 0.30 \pm$$

Let us introduce you to a fundamentally new section and new piling option ...

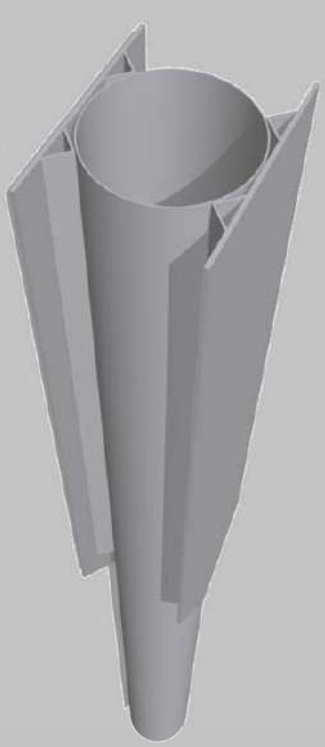
Flanged Pipe Pile (FPP)



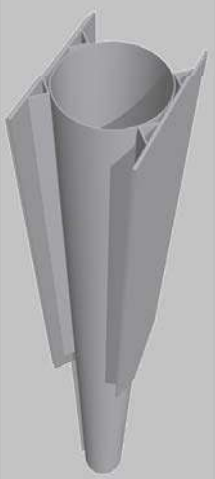
www.omegatrestle.com



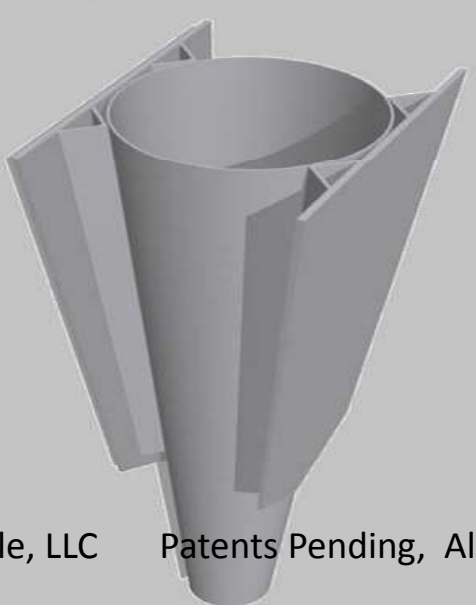
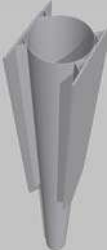
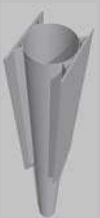
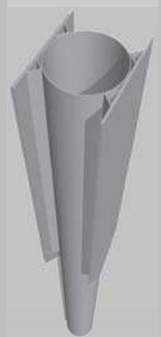
June 2016 DFI Chicago

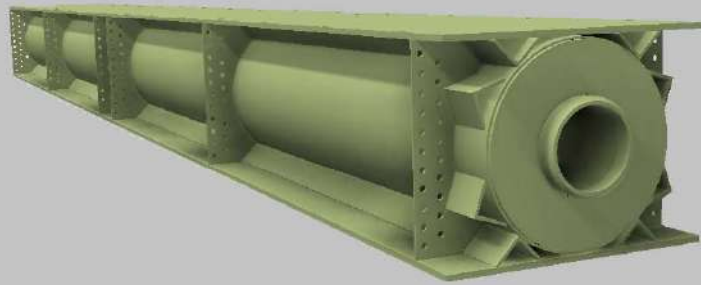


Omega Trestle, LLC

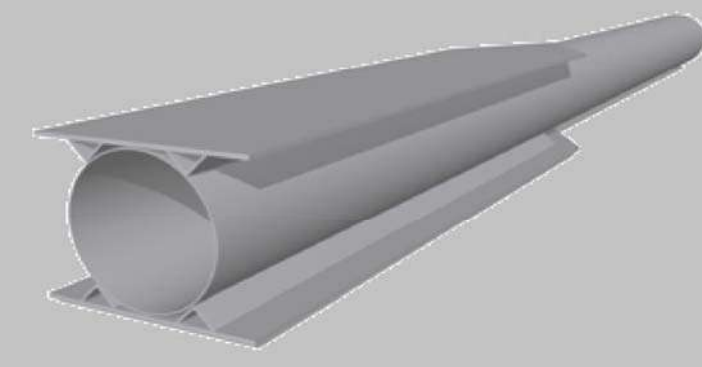


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New structural section The OMEGA Section



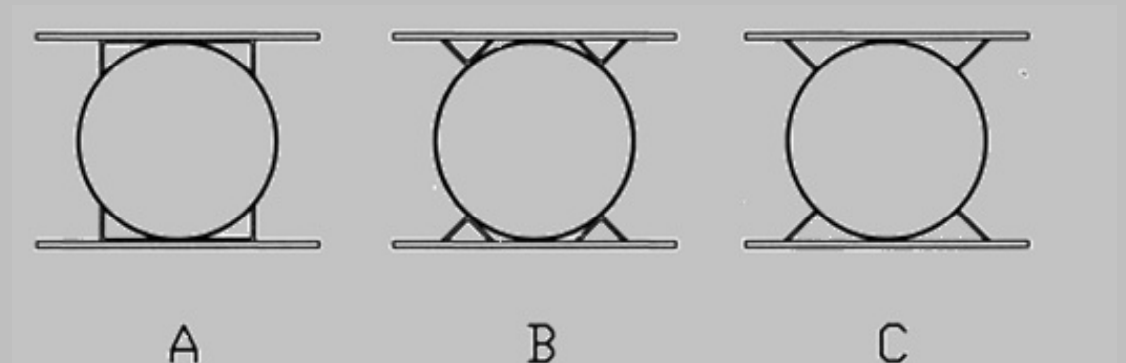
Also known as Flanged Pipe Pile (FPP)

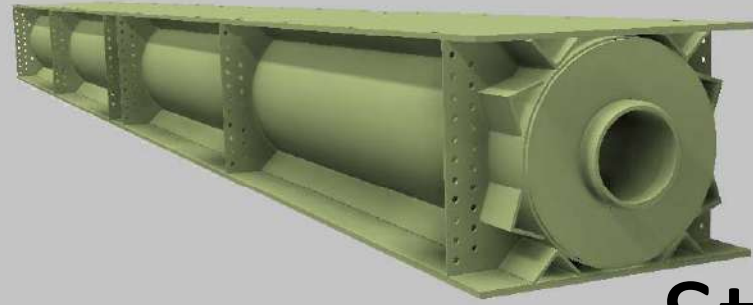
FPP section is built up from fundamental shapes

Advantages:

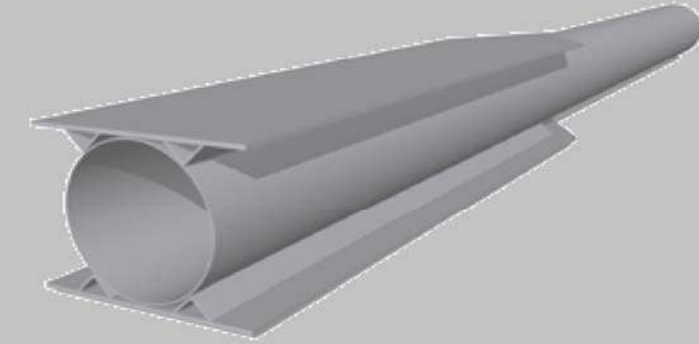
- Economical
- Scalable to any size
- Fabricated anywhere with readily available components
- Greater strength/smaller footprint than pipe
- High weak axis to strong axis ratio
- Significant increase in torsional, and asymmetrical loading

Pipe - Plates - Angles





The OMEGA Section



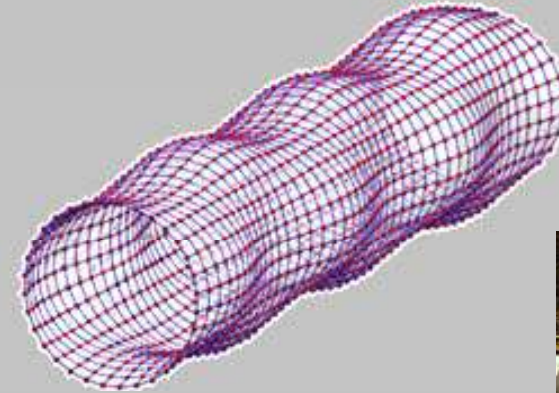
Structural Fundamentals

60-70 % Stronger than H-pile in weak direction:

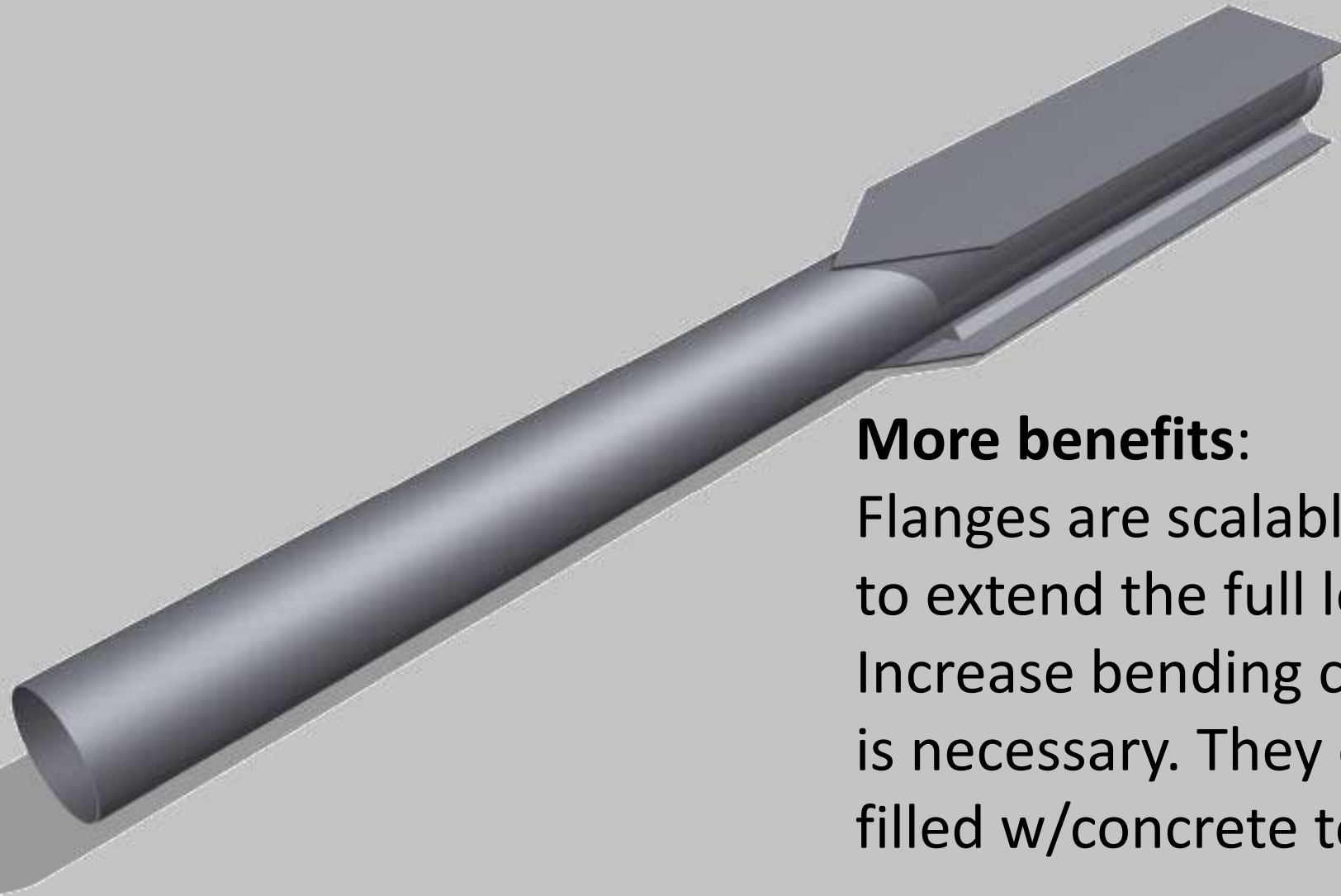
$$S_y/S_x=0.50 +/-$$

Greater crushing strength than pipe alone !

- Angles and plates reinforce pipe section.
- Pipe compression and bending capacity is improved significantly
- Addition of flanges can improve performance of any pipe section



Flanged Pipe Pile (FPP)



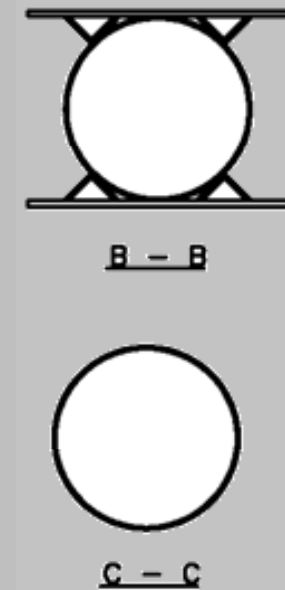
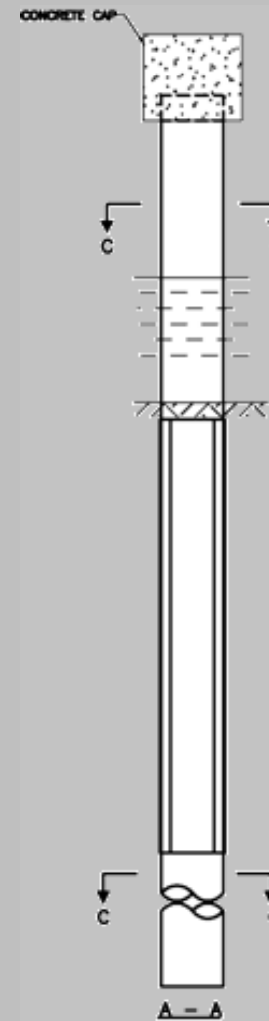
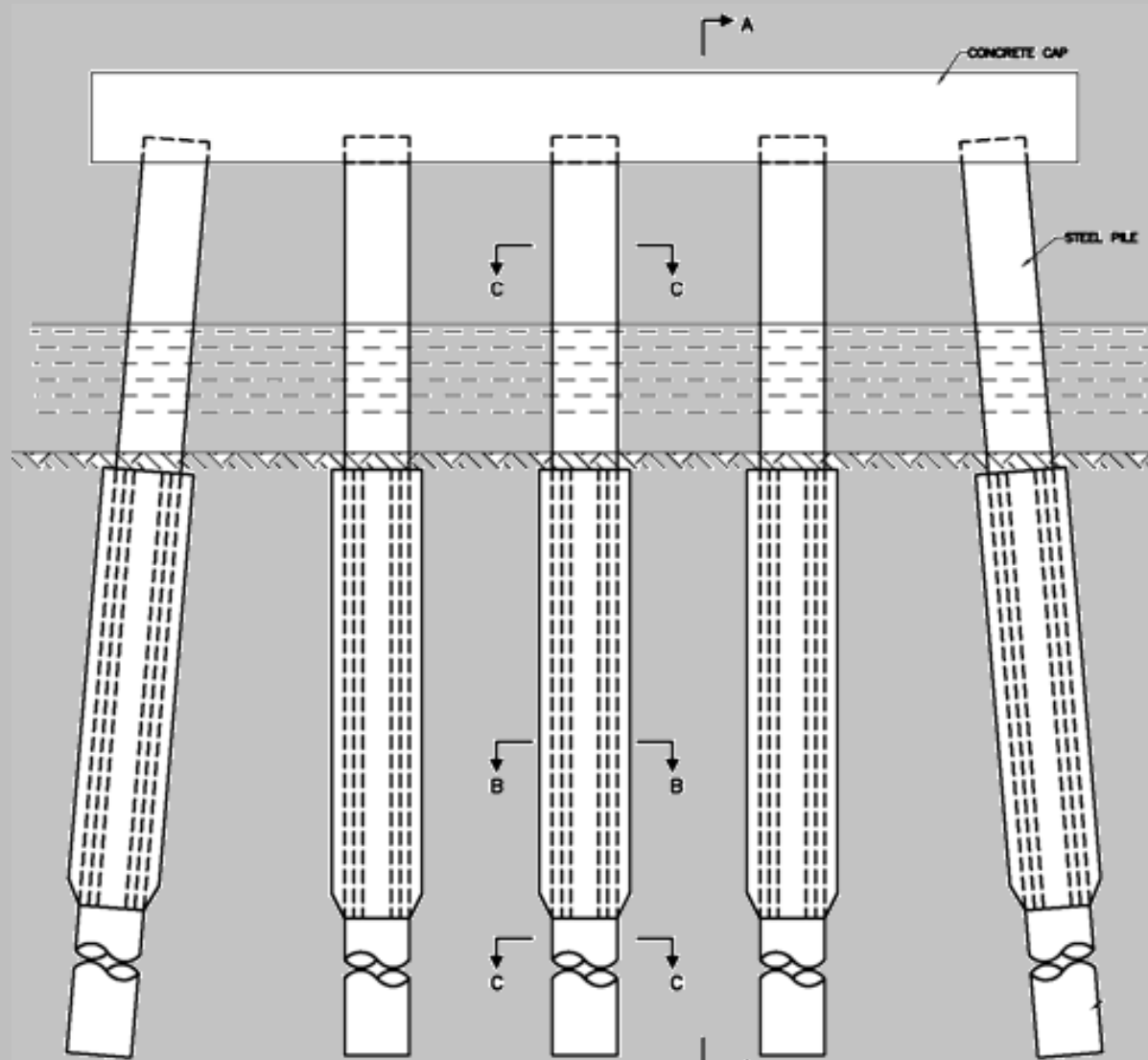
More benefits:

Flanges are scalable and DO NOT have to extend the full length of pile.

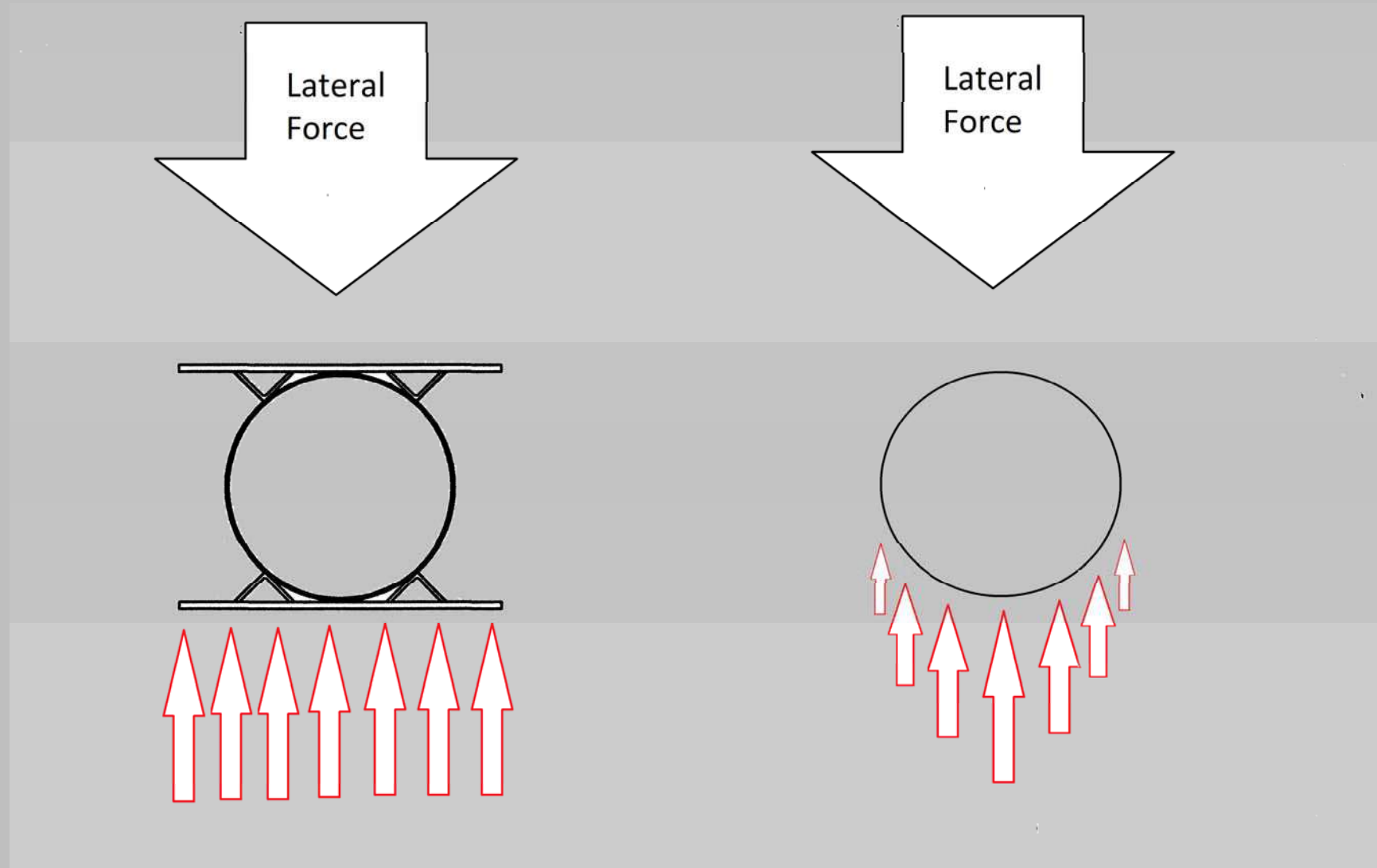
Increase bending capacity only where it is necessary. They can be left hollow, or filled w/concrete to increase capacity.

Example:

Improve performance in poor soils by increasing bending capacity, surface area and radius of gyration



Improved lateral geotechnical engagement



Geotechnical reactive forces shown in above schematics are approximated to highlight benefits of FPP geometry

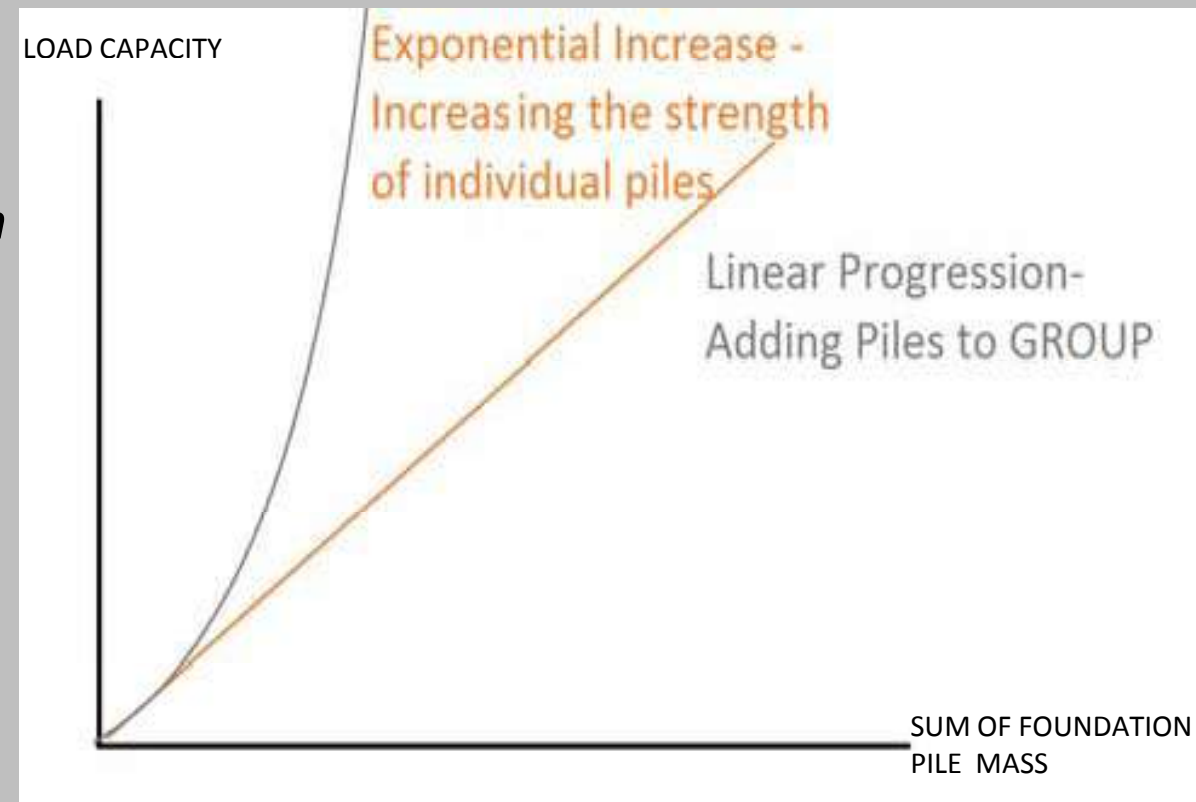
Individual Piles vs. Pile Group

GIVEN: Piles act as individual piles in granular soils if their spacing is greater than 7 times the pile diameter;

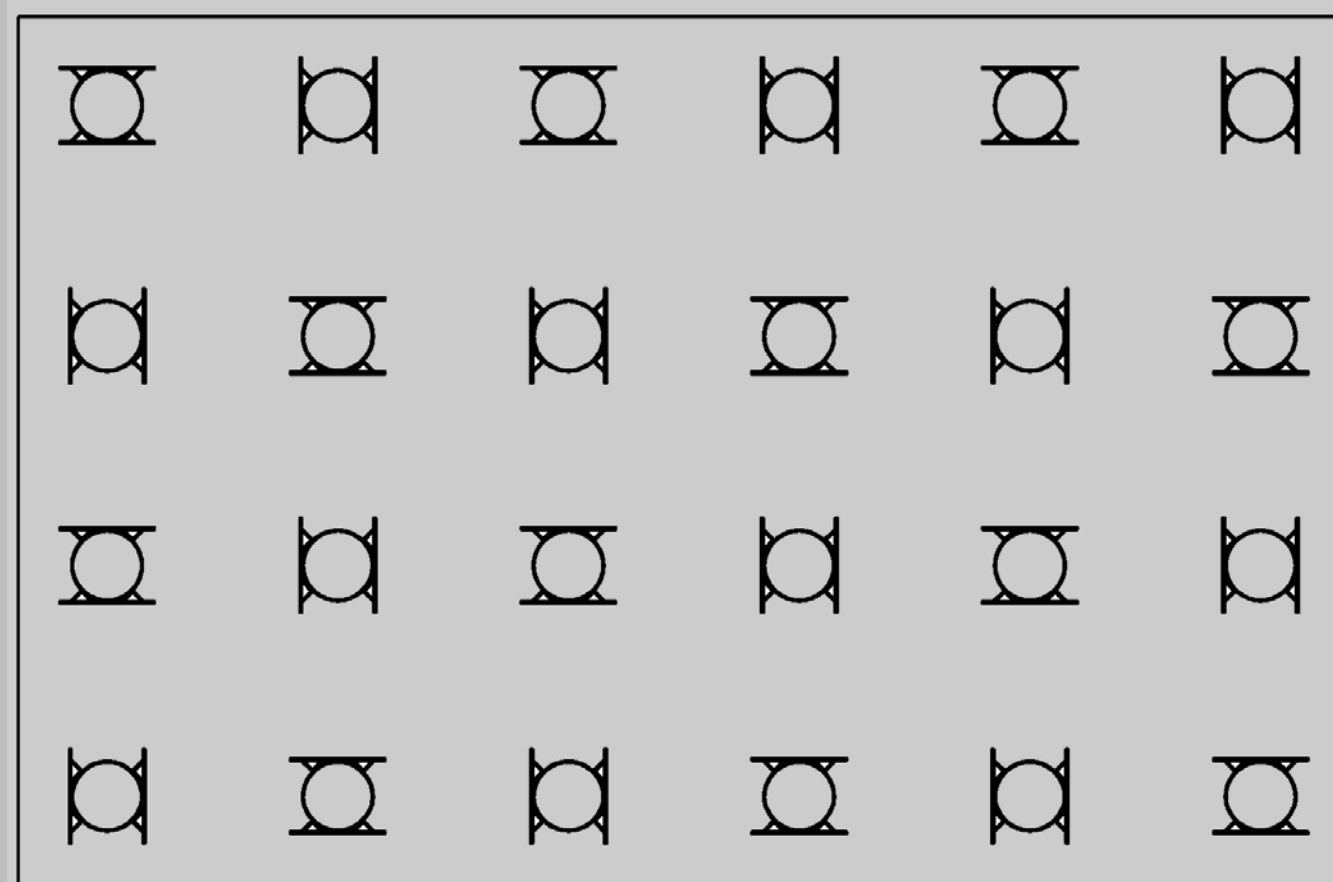
GIVEN: Bearing capacity of pile groups is generally less than the sum of individual piles.

THEN, in order to increase capacity of the foundation you need to increase strength of piles without significant increase of their dimensions.

SOLUTION: Consider utilizing a FLANGED PIPE PILE (FPP)
This is what it does !



Because of smaller dimensions more FPP's can fit within the same foundation footprint than pipe piles.



Greater S_y/S_x ratio allows to achieve greater resistance to horizontal loads than that of H-pile foundations.

Hollow tubular core provides opportunity to break up obstructions and to anchor piles to rock.

Was OMEGA Section ever tested? Sure!

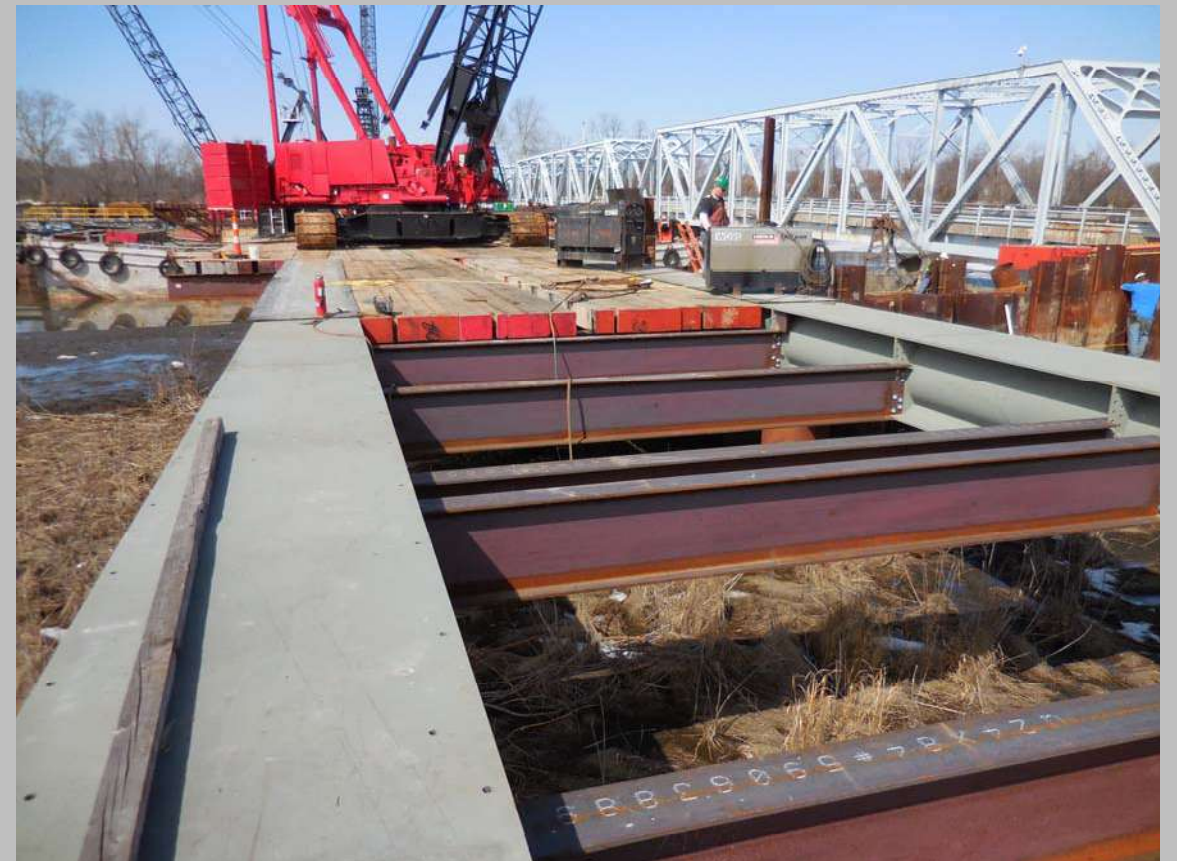


Compression “crush” Test

Two 800 Ton Capacity Jacks facilitated Bending and Shear Testing

Where the OMEGA section was used before?

- Heavy Trestle Application



- Heavy Trestle Application



- High Capacity Pier

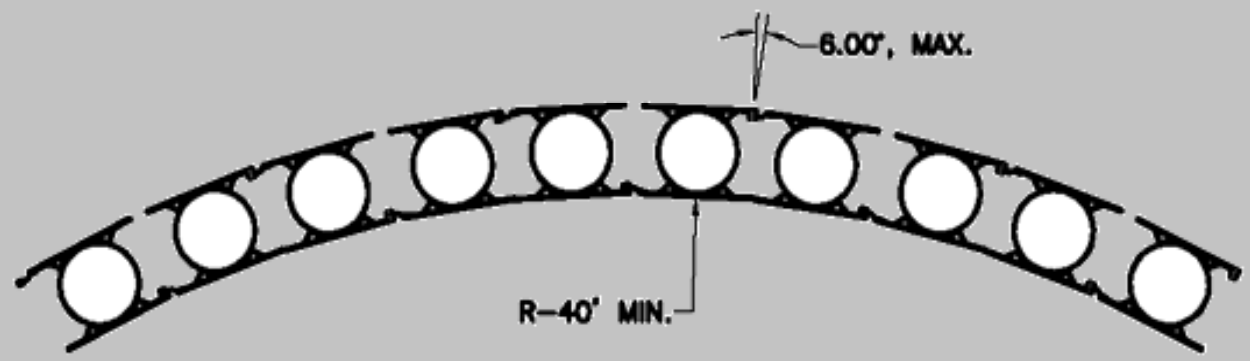
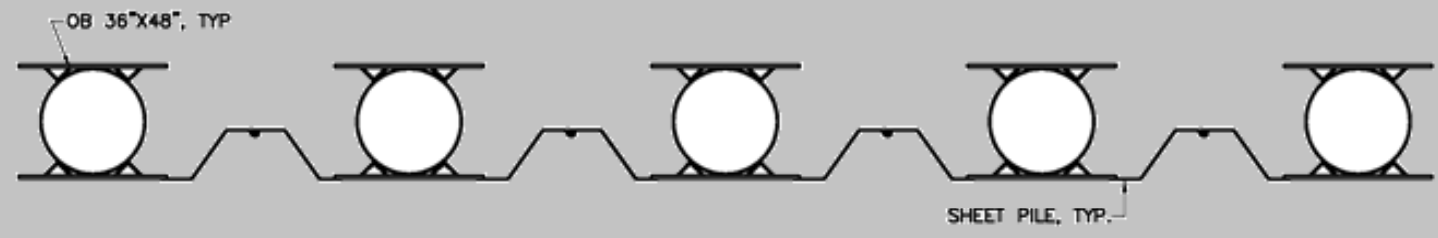
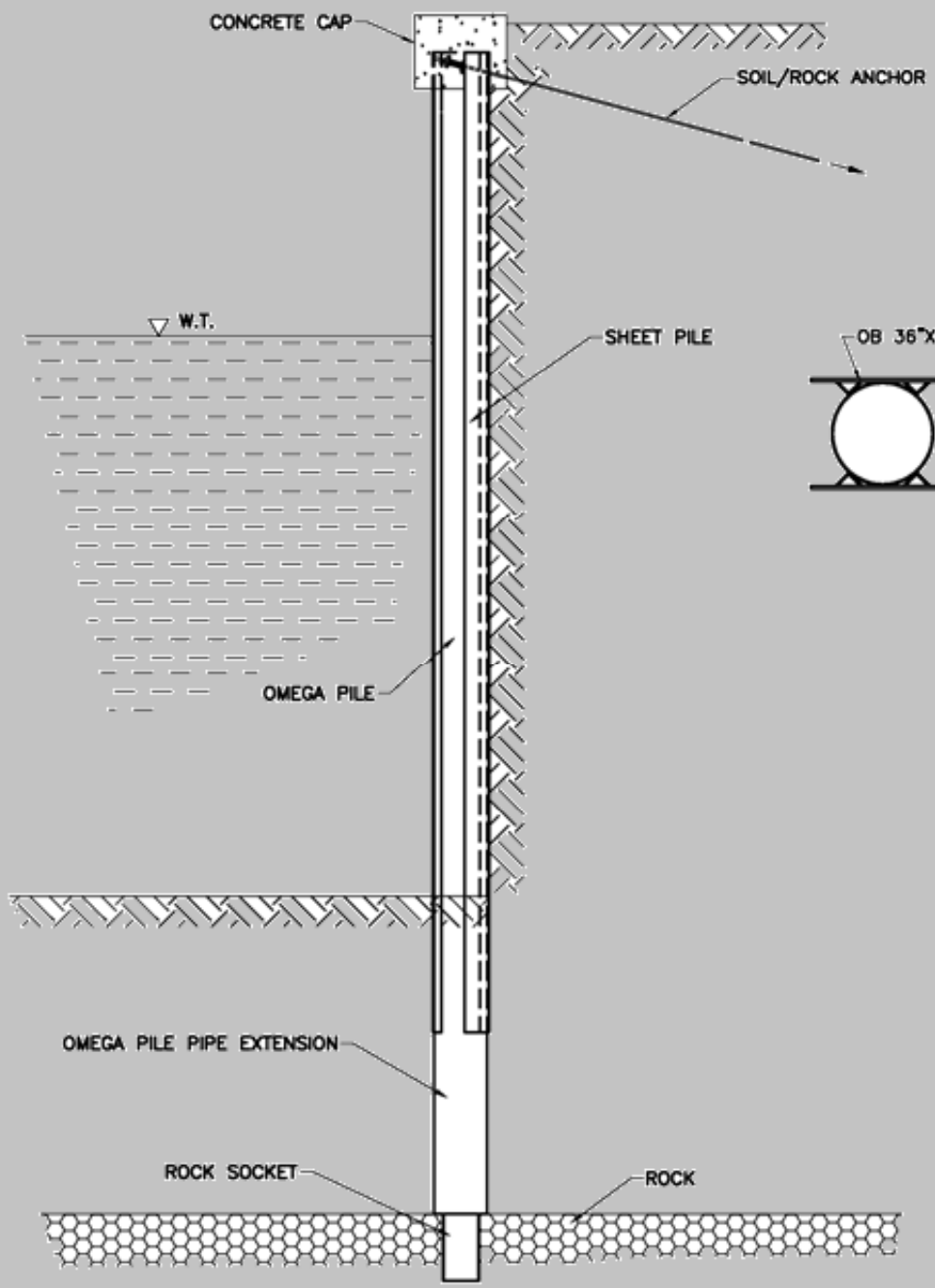


- High Capacity Pier

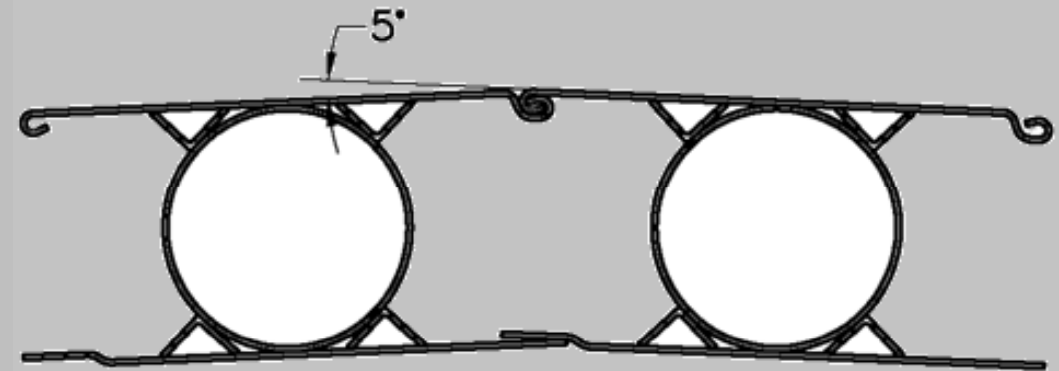
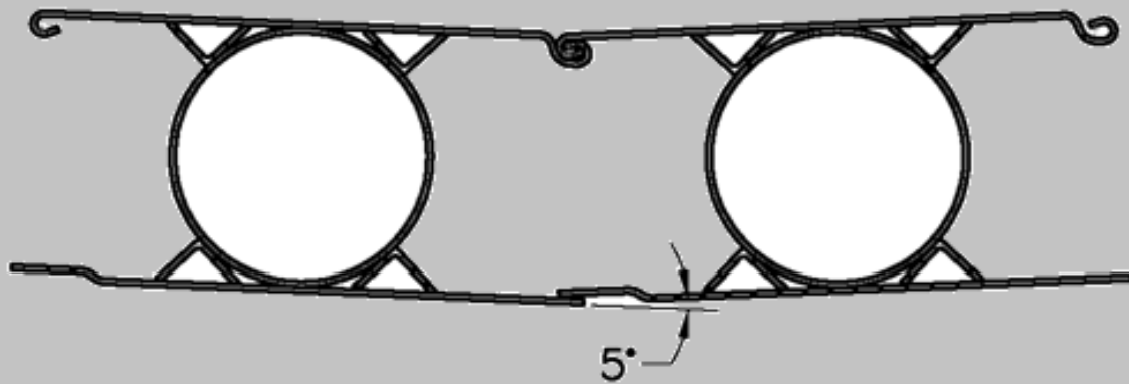
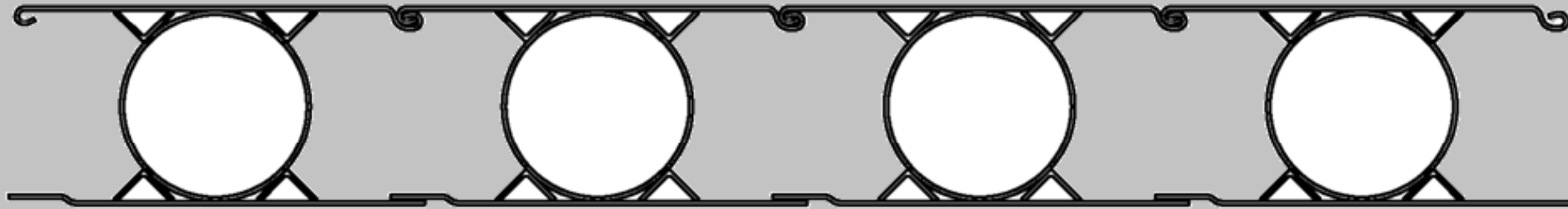
**NEW YORK WHEEL
LOAD TRANSFER PIER
1150 Ton Design Capacity**



Another application: **Connected Systems.**
smaller foot print = less environmental impact

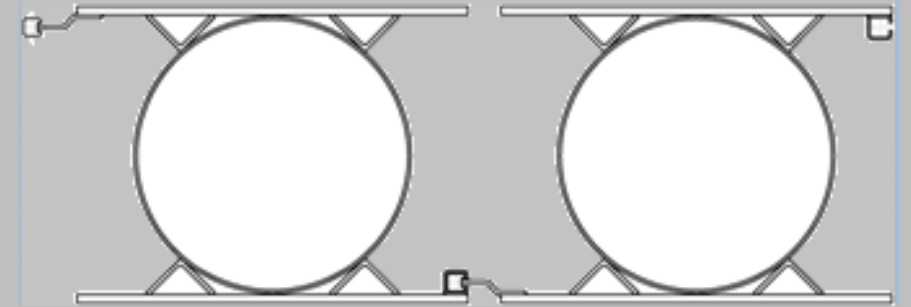
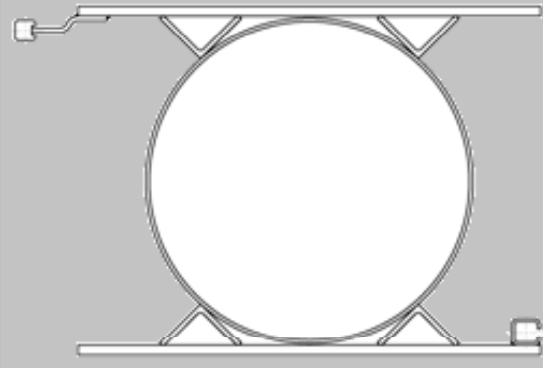


Cold rolled connected FPP



Connected systems

Smaller footprint = less environmental impact



Questions



The banner features the DFI logo on the left, which includes the text 'DEEP FOUNDATIONS INSTITUTE' in a semi-circle above 'DFI' in large red letters with a downward-pointing arrow. Below this is the text 'in partnership with' followed by the ADSC logo. The main title 'SuperPile '16' is in large, bold, brown letters. To the right of the title, it says 'piling design & construction conference' in black and 'Chicago, Illinois' in red. At the bottom, a dark brown bar contains the text 'June 7 - 9 ■ The Westin Michigan Avenue Chicago' in white.

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SuperPile '16

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