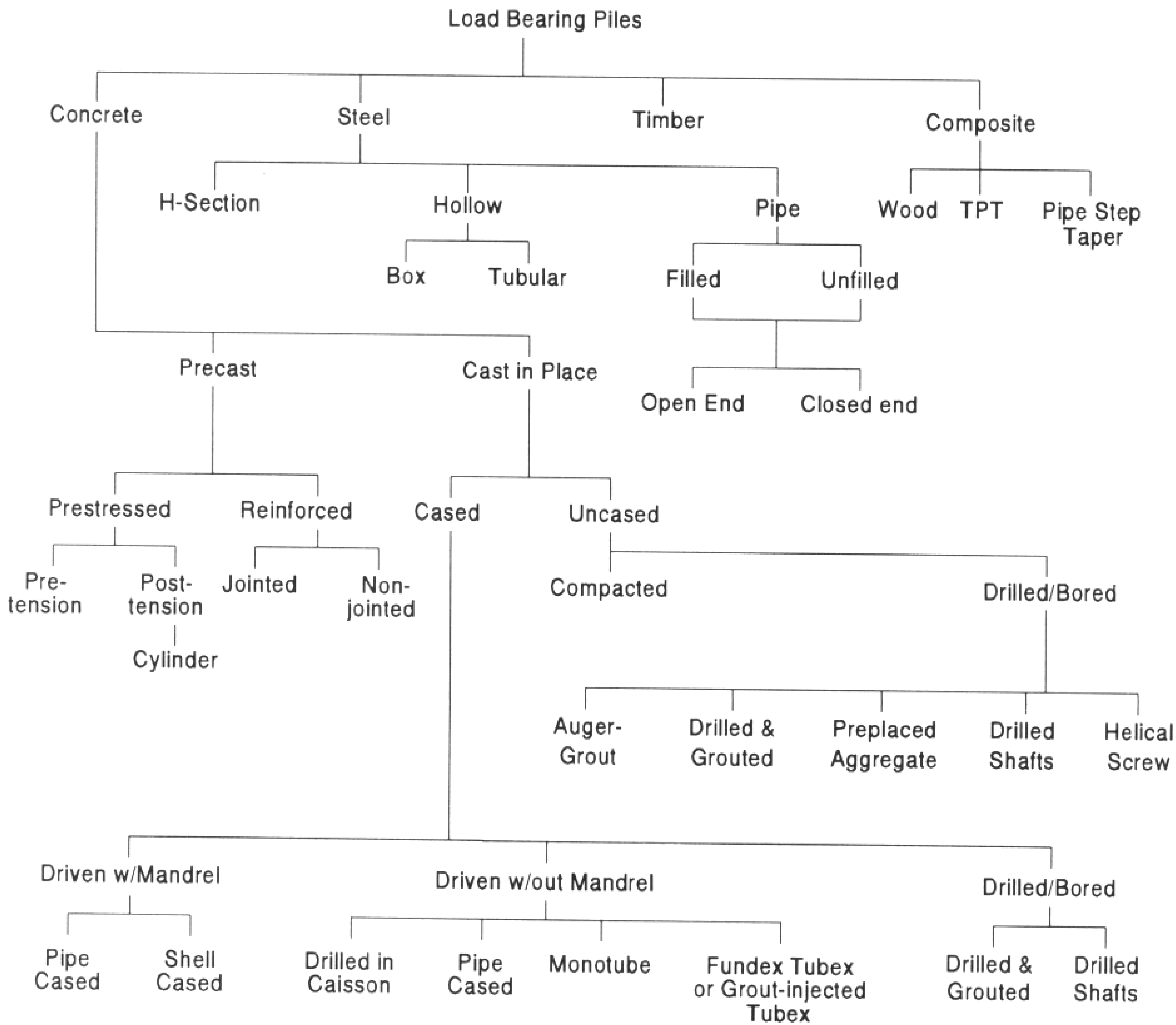
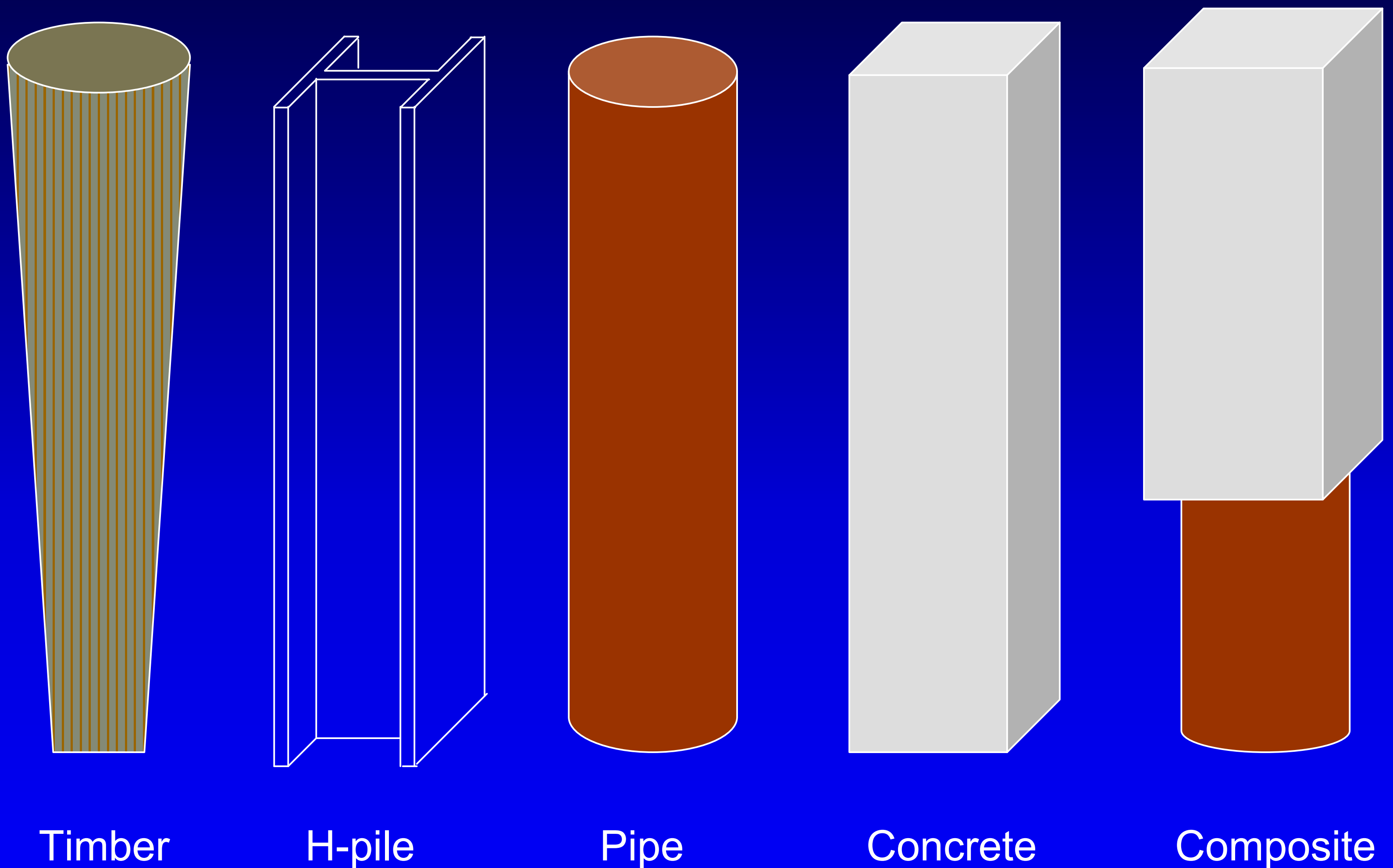
Pile Types


Load Bearing Piles
Concrete
Steel
Timber
Composite
H-Section
Hollow
Pipe
Wood
TPT
Pipe Step Taper
Box
Tubular
Filled
Unfilled
Precast
Cast in Place
Open End
Closed end
Prestressed
Reinforced
Cased
Uncased
Pre-tension
Post-tension
Jointed
Non-jointed
Compacted
Drilled/Bored
Cylinder
Auger-Grout
Drilled & Grouted
Preplaced Aggregate
Drilled Shafts
Helical Screw
Driven w/Mandrel
Driven w/out Mandrel
Drilled/Bored
Pipe Cased
Shell Cased
Drilled in Caisson
Pipe Cased
Monotube
Fundex Tubex or Grout-injected Tubex
Drilled & Grouted
Drilled Shafts

Common Driven Pile Types



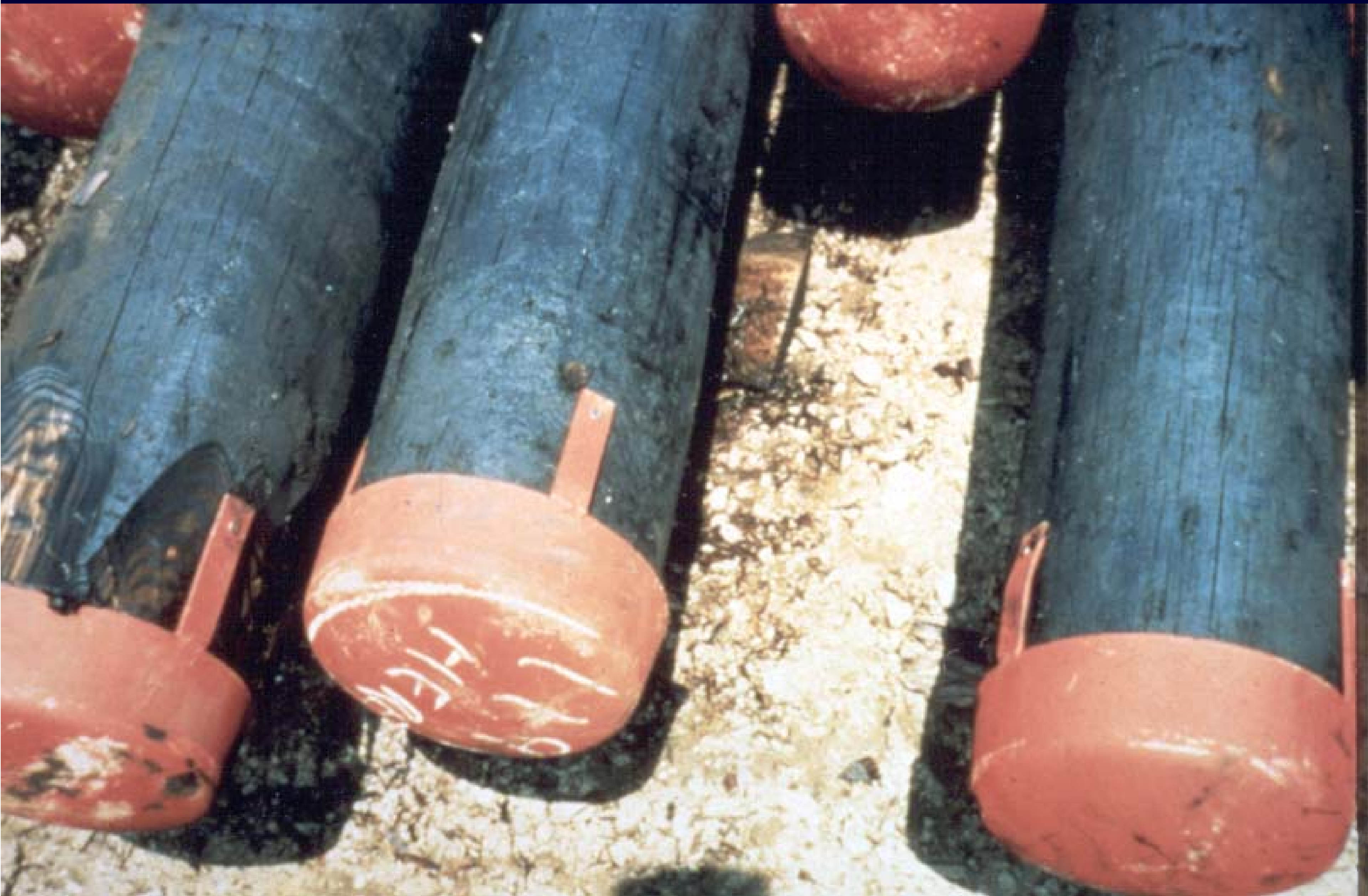
Timber Pile Overview

TYPICAL LENGTHS	15 to 65 feet.
MATERIAL SPECIFICATIONS	ASTM D25 AWPA-C3 (if used)
MAXIMUM STRESSES	Design Stress: 0.8 to 1.2 ksi (on pile toe area). Driving Stress: 3 x Design Stress.
TYPICAL DESIGN LOADS	10 to 55 tons.
DISADVANTAGES	Difficult to Splice. Vulnerable to Damage at Head and Toe in Hard Driving. Vulnerable to Decay (intermittently submerged) Unless Treated.
ADVANTAGES	Comparatively Low Initial Cost. Easy to Handle. Resistant to Decay (permanently submerged).
REMARKS	Best Suited for Friction Piles in Granular Soils.

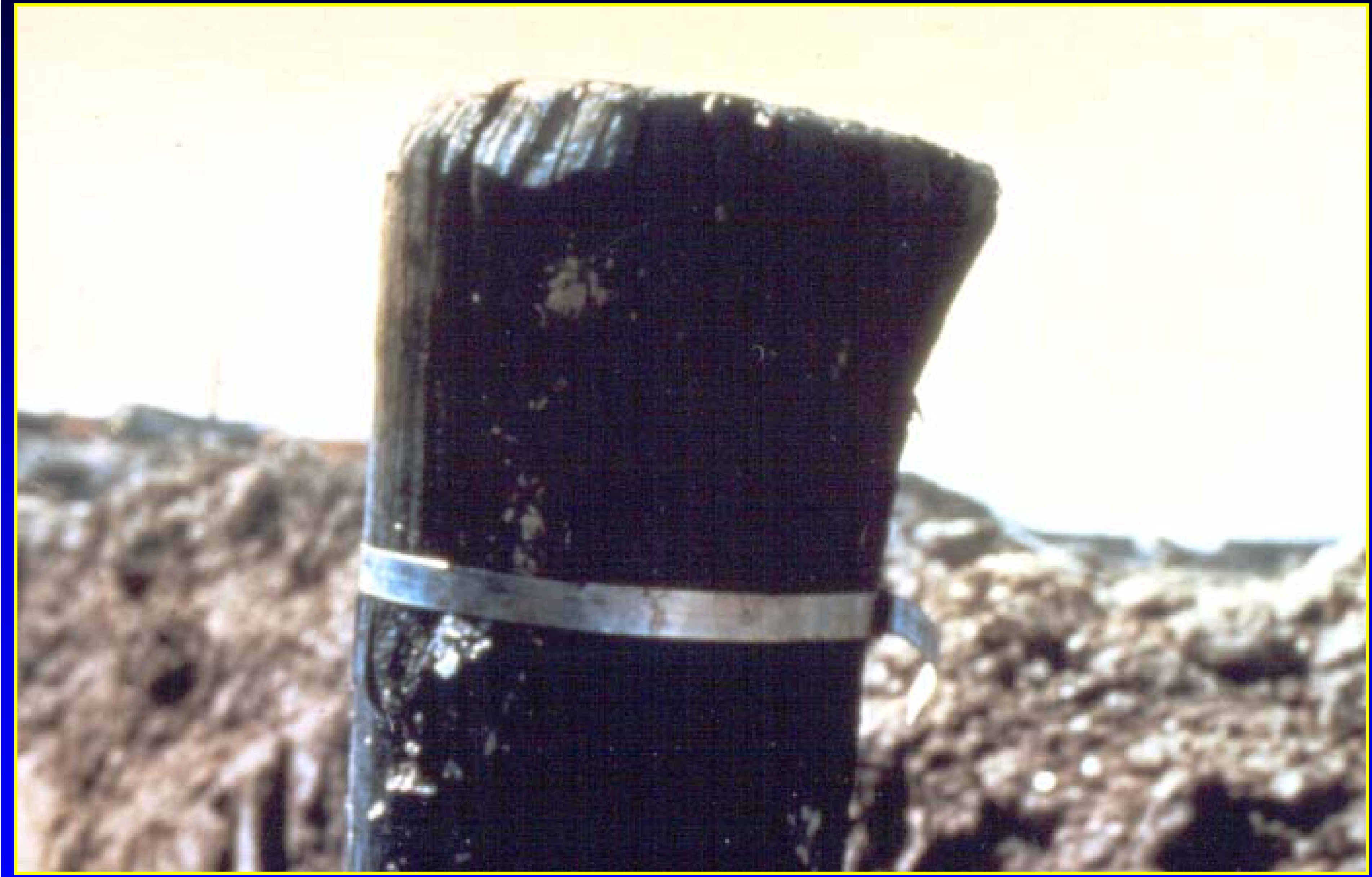
Timber Piles

Timber Piles

Timber Pile - Toe Protection



Timber Pile - Banding



H-Pile Overview

TYPICAL LENGTHS	15 to 120 feet.
MATERIAL SPECIFICATIONS	ASTM A-36 (F_y = 36 ksi) or ASTM A-572, A-588, or A-690 (F_y = 50 ksi)
MAXIMUM STRESSES	Design Stress: 0.25 to 0.33 F_y Driving Stress: 0.90 F_y
TYPICAL DESIGN LOADS	45 to 225 tons.
DISADVANTAGES	Vulnerable to Corrosion. Not Recommended as Friction Pile in Granular Soils.
ADVANTAGES	Available in Various Lengths and Sizes. Easy to Splice. High Capacity. Low Soil Displacements. May Penetrate Larger Obstructions with Driving Shoes.
REMARKS	Best Suited for Toe Bearing on Rock.

H-Piles

H-Pile - Toe Protection

Open End Pipe Pile Overview

TYPICAL LENGTHS	15 to 150 feet or greater.
MATERIAL SPECIFICATIONS	ASTM A-252, Grade 2 or 3 (F_y = 35 or 45 ksi) ACI 318 - for concrete (if filled) ASTM A-36 or A-572 - for core (if used)
MAXIMUM STRESSES	Design Stress: 0.25 F_y to 0.33 F_y (on steel) + 0.40 f'_c (on concrete, if filled) Driving Stress: 0.90 F_y
TYPICAL DESIGN LOADS	80 to 1500 tons.
DISADVANTAGES	Vulnerable to Corrosion.
ADVANTAGES	Available in Various Lengths, Diameters & Wall Thicknesses. Pile Can be Cleaned Out and Driven Deeper. High Capacity. Low Soil Displacements. Easy to Splice. High Bending Resistance on Unsupported Length.

Outside Cutting Shoe

Inside Cutting Shoe

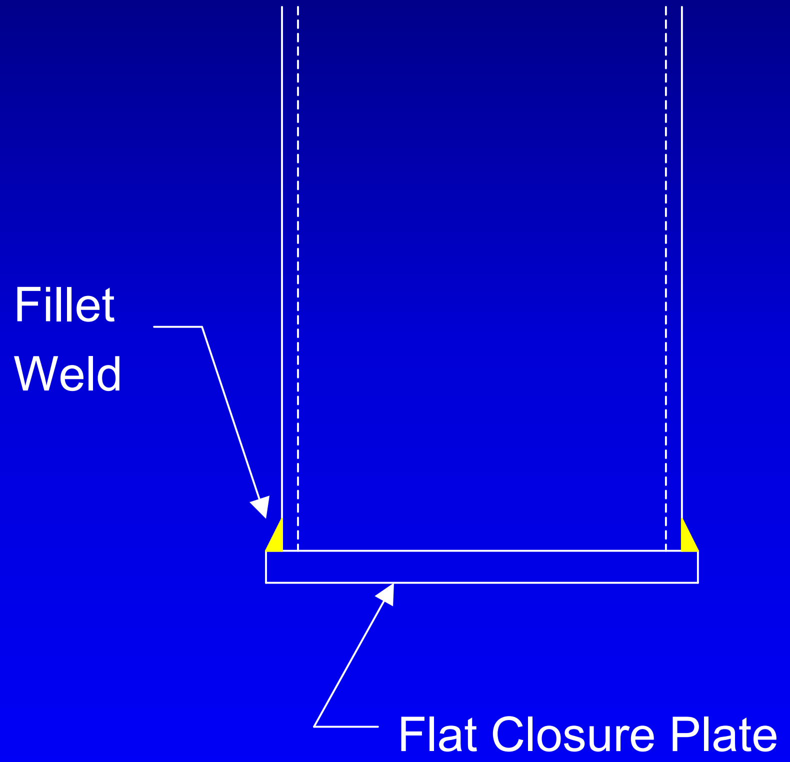
Large Diameter Open Ended Pipe

Spin Fin Pile

Closed End Pipe Pile Overview

TYPICAL LENGTHS	15 to 120 feet.
MATERIAL SPECIFICATIONS	ASTM A-252, Grade 1, 2, or 3 (F_y = 30, 35, or 45 ksi) ACI 318 - for concrete
MAXIMUM STRESSES	Design Stress: 0.25 F_y (on steel) + 0.40 f'_c (on concrete) Driving Stress: 0.90 F_y
TYPICAL DESIGN LOADS	40 to 300 tons.
DISADVANTAGES	Soil Displacement.
ADVANTAGES	Available in Various Lengths, Diameters & Wall Thicknesses. Easy to Splice. High Capacity Potential.
REMARKS	High Bending Resistance Where Unsupported Length is Loaded Laterally.

Typical Pipe Pile Closure Plate



Conical Pipe Pile Tip

Monotube Piles

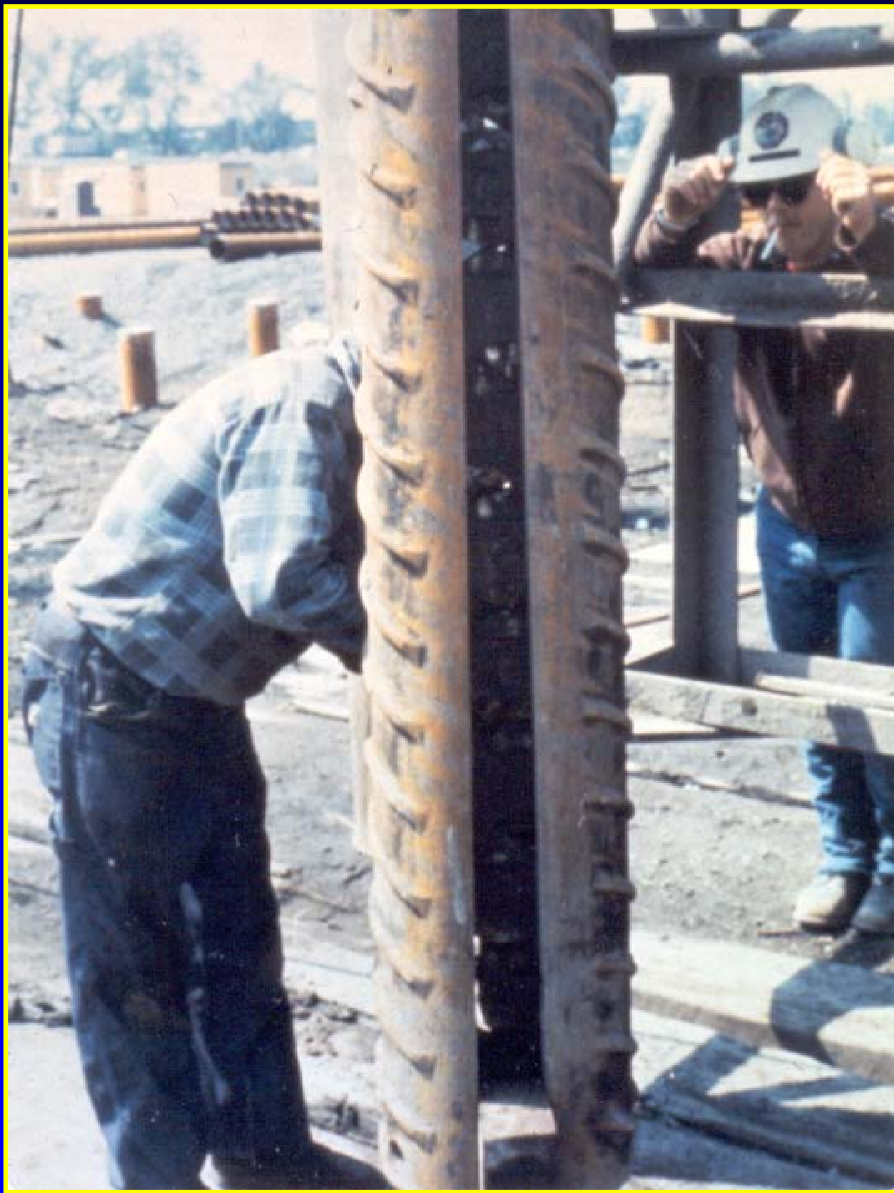
Tapertube Piles

Cast-In-Place (Mandrel Driven)

TYPICAL LENGTHS	50 to 80 feet (Shorter & Longer Lengths Possible.)
MATERIAL SPECIFICATIONS	ACI 318 - for concrete
MAXIMUM STRESSES	Design Stress: 0.33 f'_c (0.40 f'_c may be allowed) Driving Stress: Function of Mandrel & Shell
TYPICAL DESIGN LOADS	45 to 150 tons.
DISADVANTAGES	Thin Shell Vulnerable to Damage or Collapse. Redriving Not Recommended. May Be Difficult to Splice. Soil Displacement.
ADVANTAGES	Initial Economy. Can Be Inspected After Driving. Tapered Sections Provide High Resistance in Granular Soils.
REMARKS	Best Suited for Friction Pile in Granular Soils.

Cast-In-Place (Mandrel Driven)

Cast-In-Place (Mandrel Driven)

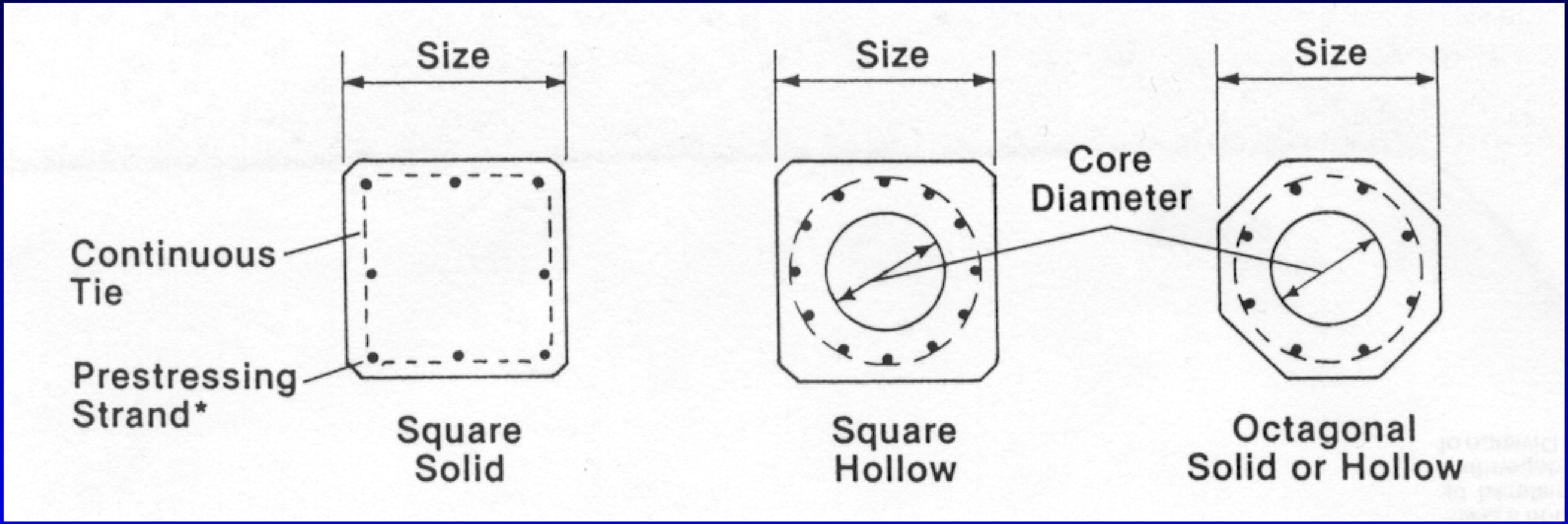


Prestressed Concrete Overview

TYPICAL LENGTHS	30 to 130 feet.
MATERIAL SPECIFICATIONS	ACI 318 - for concrete. ASTM A-82, A-615, A-722 & A-884 - for reinforcing steel. ASTM A-416, A-421, A-882 - for prestress.
MAXIMUM STRESSES	Design Stress: $0.33 f'_c - 0.27 f_{pe}$ (on gross concrete area) Driving Stress: $0.85 f'_c - f_{pe}$ (in compression) $3\sqrt{f'_c} + f_{pe}$ (in tension)
TYPICAL DESIGN LOADS	45 to 500 tons.
DISADVANTAGES	Relatively High Breakage Rate. Soil Displacement. Can be Difficult to Splice.
ADVANTAGES	High Load Capacity. Corrosion Resistance Obtainable. Hard Driving Possible. Cylinder Piles Well Suited for Bending Resistance.

Prestressed Concrete

Prestressed Concrete Details



Typical Sizes	10 – 20 inch	20 – 36 inch 11 – 18 inch void	10 – 24 inch 11 – 15 inch void

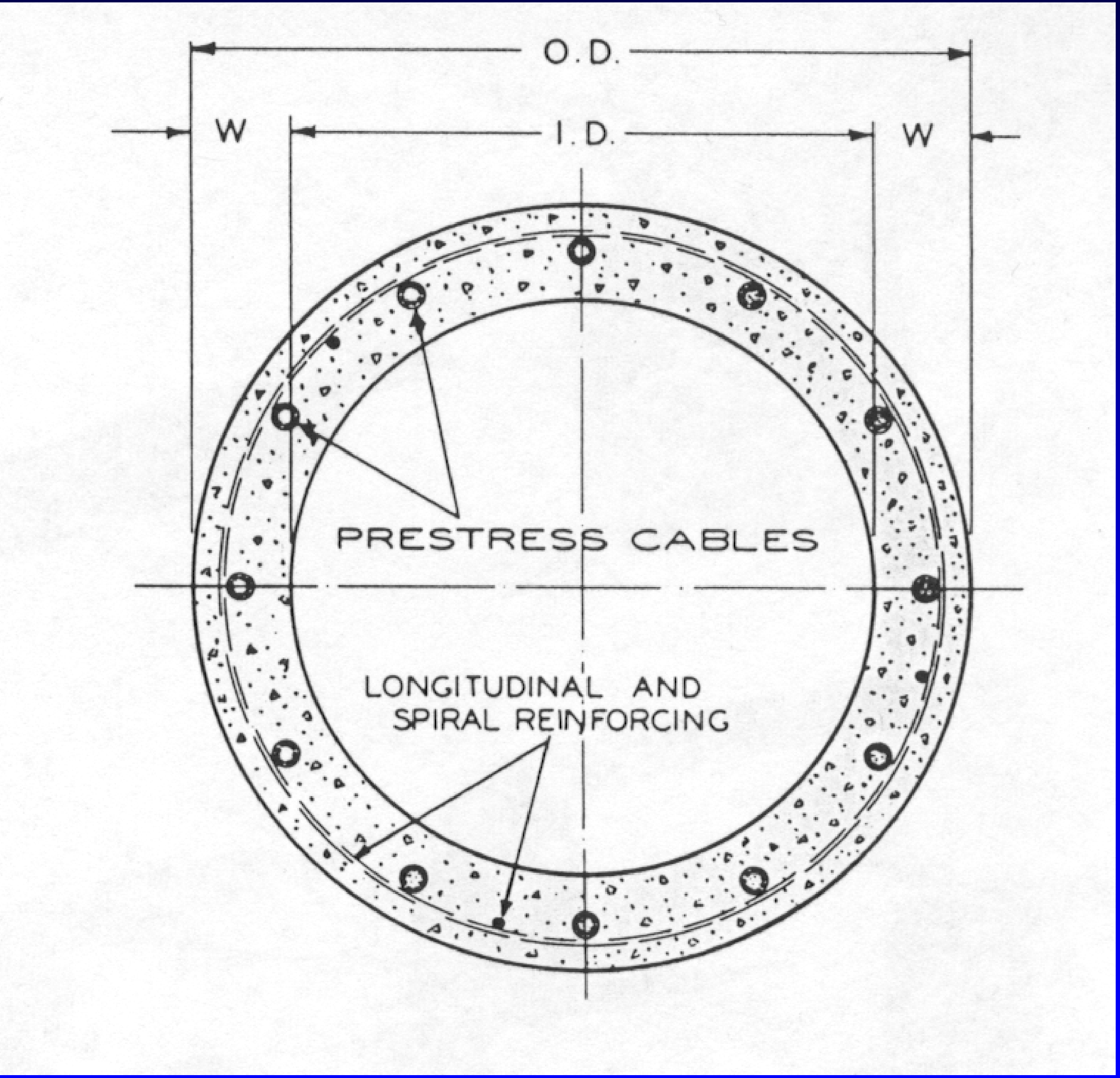
Cylinder Piles

Cylinder Pile Details

Typical Sizes

36, 42, 48, 54, & 66 inch O.D.

5 & 6 inch wall



Composite Piles

TYPICAL LENGTHS	50 to 200 feet.
MATERIAL SPECIFICATIONS	ASTM A-36 or A-572 for H-section. ASTM A-252 for pipe sections. ASTM D-25 for timber sections. ACI 318 for concrete sections.
MAXIMUM STRESSES	Design Stress: Dependent upon Pile Materials Used. Driving Stress: Dependent upon Pile Materials Used.
TYPICAL DESIGN LOADS	30 to 200 tons.
DISADVANTAGES	May be Difficult to Attain Good Joint Between Materials.
ADVANTAGES	May Solve Unusual Design or Installation Problems. High Capacity May be Possible Depending on Materials. May Reduce Foundation Cost.
REMARKS	Weakest Material Governs Allowable Stresses and Capacity.

Composite Piles

Concrete – H-pile

Pipe – H-pile

Composite Piles

Pipe - Concrete

Corrugated Shell - Timber

Site Considerations on Pile Selection

Driven Piles May Cause Vibration Damage.

Remote Areas May Restrict Equipment Size.

Local Availability of Pile Materials and Capabilities of Local Contractors.

Waterborne Operations May Dictate Use of Shorter Pile Sections.

Steep Terrain May Make Use of Certain Pile Equipment Costly or Impossible.

Subsurface Effects on Pile Selection

Typical Problem	Recommendation
Boulders over Bearing Stratum	Use Heavy Low Displacement Pile With Shoe. Include Contingent Predrilling Item in Contract.
Loose Cohesionless Soil	Use Tapered Pile to Develop Maximum Shaft Resistance.
Negative Shaft Resistance	Avoid Batter Piles. Use Smooth Steel Pile to Minimize Drag Load or Use Bitumen Coating or Plastic Wrap. Could Also Use Higher Design Stress.
Deep Soft Clay	Use Rough Concrete Piles to Increase Adhesion and Rate of Pore Water Dissipation.

Subsurface Effects on Pile Selection

Typical Problem	Recommendation
Artesian Pressure	Hydrostatic Pressure May Cause Collapse of Mandrel Driven Shell Piles and Thin Wall Pipe. Pile Heave Common on Closed End Pipe.
Scour	Adequate Pile Capacity Should be Developed Below Scour Depth (Design Load x SF). Tapered Pile Should Be Avoided Unless Taper Extends Below Scour Depth.
Coarse Gravel Deposits	Use Prestressed Concrete Piles Where Hard Driving is Expected.

Pile Shape Effects on Pile Selection

Shape Characteristic	Pile Types	Placement Effects
Displacement	Closed End Steel Pipe Prestressed Concrete	Increase Lateral Ground Stress. Densify Cohesionless Soils. Temporarily Remolds and Weakens Cohesive Soils. Setup Time for Large Pile Groups in Sensitive Clays May Be Up To Six Months.

Pile Shape Effects on Pile Selection

Shape Characteristic	Pile Types	Placement Effects
Low Displacement	Steel H-pile	Minimal Disturbance to Soil.
	Open End Steel Pipe	Not Recommended for Friction Piles in Coarse Granular Soils. Piles Often Have Low Driving Resistances in These Deposits Making Field Capacity Verification Difficult Resulting in Excessive Pile Lengths Installed.

Pile Shape Effects on Pile Selection

Shape Characteristic	Pile Types	Placement Effects
Tapered	Timber Monotube Tapertube Thin Wall Shells	Increased Densification of Soil. High Capacity for Short Penetration Depth in Granular Soils.

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