



Cost Estimation of Drilled Shafts

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Topics

- ➔ Identify Factors That Affect the Cost of Construction of Drilled Shafts
- ➔ Estimate Approximate Costs of Drilled Shafts

Why Care About Cost Estimation?

- ⇒ Economic Decisions About Feasible Foundation Types for Large Projects
- ⇒ Direct Cost Estimates for Smaller Projects
- ⇒ Evaluation of Alternate Strategies for Revision of Construction Methods Required by Subsurface Conditions

Big Projects

- ⇒ For large projects (> \$30,000,000) FHWA often requires alternate designs and costs are determined in the open marketplace from bids on alternate designs
- ⇒ The cost of the extra engineering required for alternate designs is generally offset by the resulting savings in cost

What Construction Methods Are Used ?

- ⇒ Drilling in the dry (cheapest)
- ⇒ Drilling with casing (requires casing and cranes)
- ⇒ Drilling with slurry (requires slurry tanks, desanding equipment, slurry supplies, etc)
- ⇒ Drilling with combinations of the above



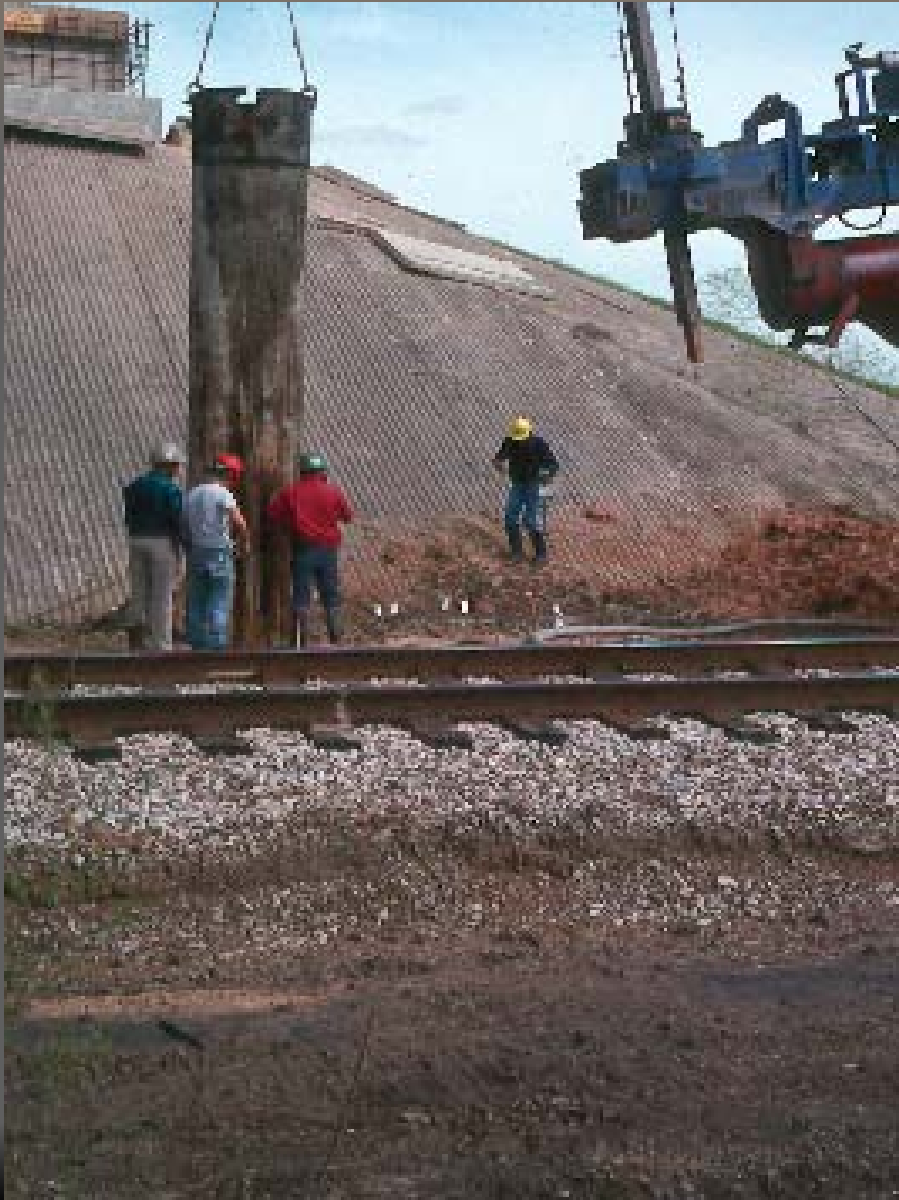
Carrier-Mounted Rig



Casing

- ⇒ Temporary
- ⇒ Permanent

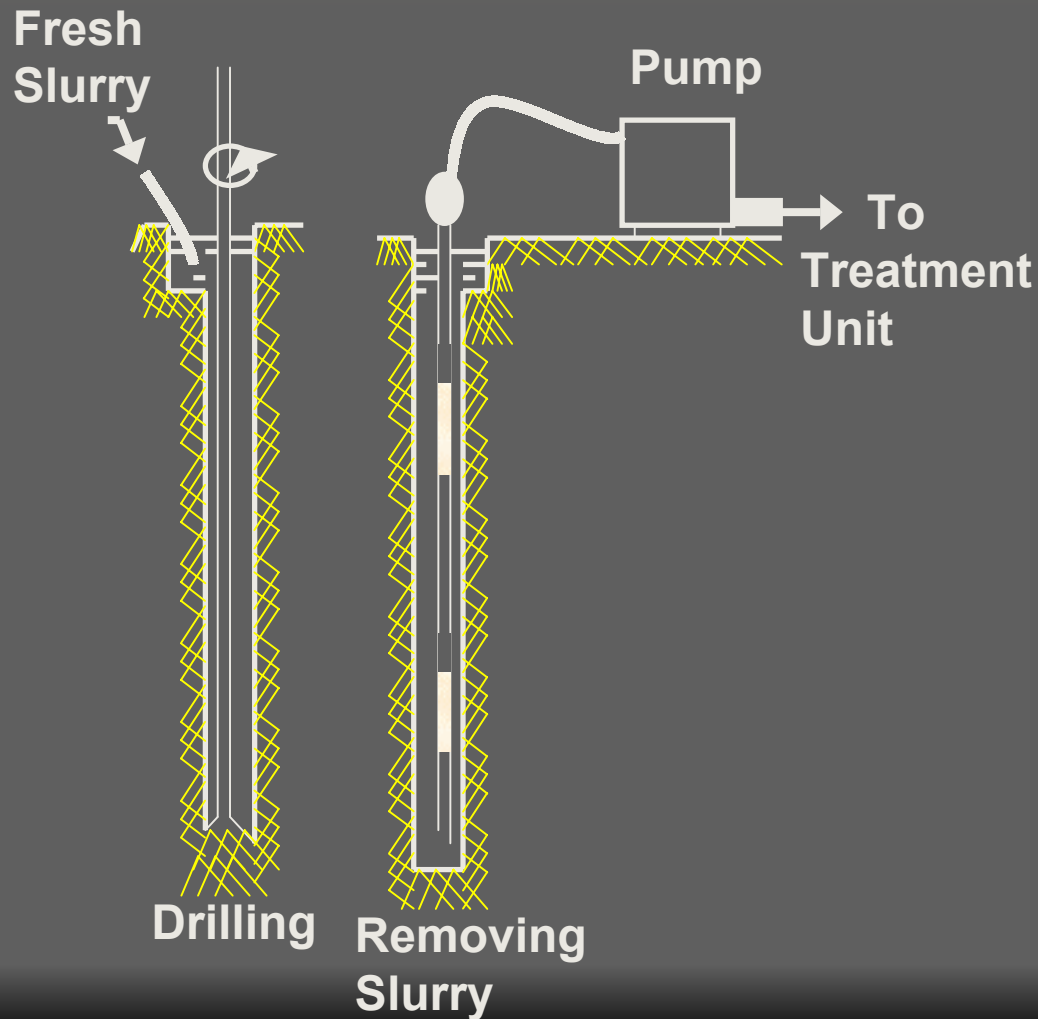
Casing Method



- ⇒ Near-surface Soils May Cave/deep Soils or Rock Are Stable and Dry
- ⇒ Otherwise, Full-depth Casing (or Wet Method) Is Considered

Drilling with Slurry

Clean and Condition the Slurry Between Uses



It is Usually the Contractor's Responsibility to Choose the Specific Construction Method to be Used

- ⇒ Workplace Safety Often Controls the Selection of the Construction Method
- ⇒ Occasionally, the Engineer May Want to Exclude a Particular Method Because It Might Do Harm

Factors That Influence the Cost of Construction of Drilled Shafts...

- ⇒ Subsurface Conditions
- ⇒ Shaft Geometry
- ⇒ Specifications and Inspection Procedures
- ⇒ Expected Weather Delays
- ⇒ Location of Project
- ⇒ Time Allocation and Penalty Clauses
- ⇒ Work Rules

Cost Factors ... Continued

- ⇒ Government Regulations
- ⇒ Equipment Availability
- ⇒ Experience and Ingenuity of Contractor
- ⇒ Current Economic Conditions
- ⇒ Insurance and Bonding
- ⇒ Cost of Borrowing Money
- ⇒ Assumption of Risk
- ⇒ General Contractor's Fees

Quality Is More Important Than Cost

- ⇒ Especially Since the Foundation Cost Is a Relatively Small Part of the Total Cost of the Entire Structure
- ⇒ Construction of Foundations Is Often On the Critical Path of the Project So Delays May Have a Major Impact



Examples of Cost Estimates

Extract From TxDOT On-line Data Base (Statewide Data)

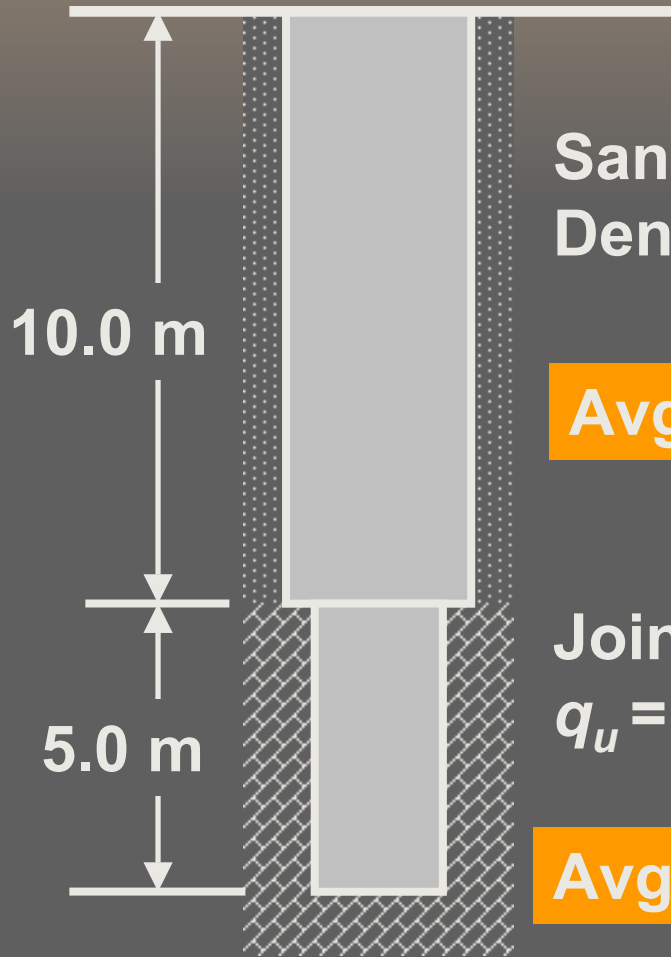
Description	Units	6 / 30 / 97		12-month moving	
		Quantity	Avg. Bid	Quantity	Avg. Bid
Drilled Shaft, 24"	LF	2,290	\$104.75	14 ,38	\$71.44
Drilled Shaft, 36"	LF	44,246	\$83.49	96,146	\$79.36
Drilled Shaft, 48"	LF	12,768	\$132.98	17,243	\$127.23
Drilled Shaft, 60"	LF	996	\$190.00	1,021	\$195.14
Drilled Shaft, 72"	LF	0	\$0.00	4,398	\$256.37
Drilled Shaft, 84"	LF	1,682	\$518.79	1,682	\$518.79
Drilled Shaft, 96"	LF	0	\$0.00	326	\$490.00

Prices Were About 10% Lower, on Average, in Houston
(No Rock, Mostly Slurry Drilling, Many Knowledgeable Contractors)



**Association of
Drilled Shaft Contractors
Member Cost Survey**

Scenario No. 1



Sand and Gravel –
Dense With No Boulders; Dry

Avg. Bid = \$560/LM = \$171/LF

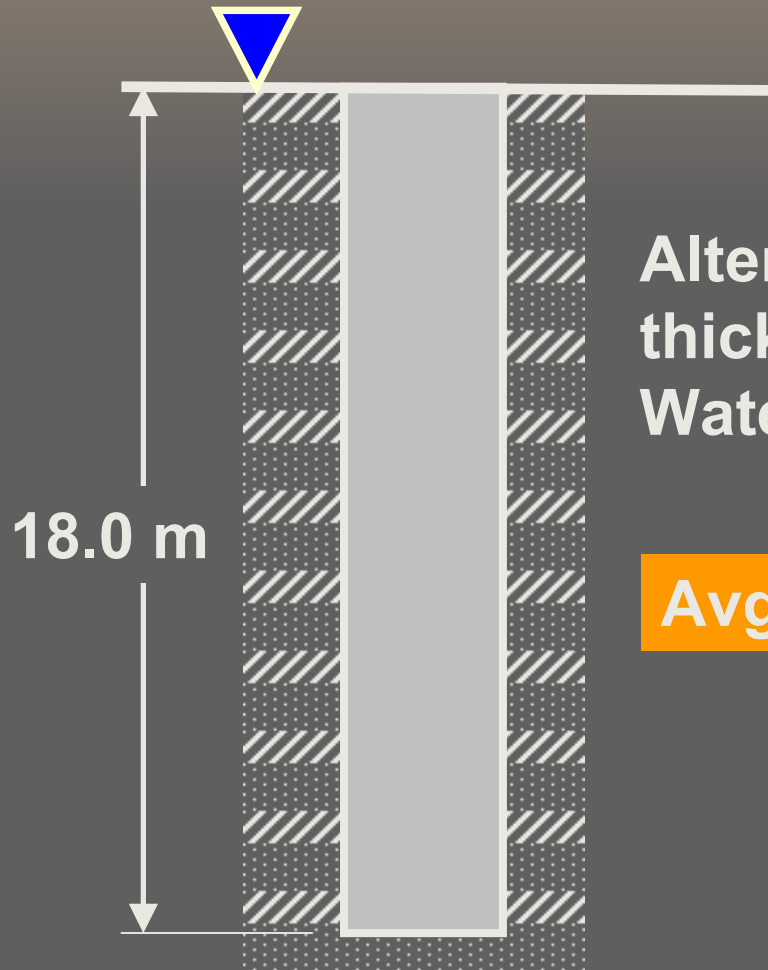
Jointed Limestone –
 $q_u = 68.9$ MPa (10,000 psi); RQD = 75%

Avg. Bid = \$1536/LM = \$468/LF

Socket Diameter = 1.22 M (48 in.)

Drilled Shaft Contractor Supplies Concrete; Not Steel

Scenario No. 2



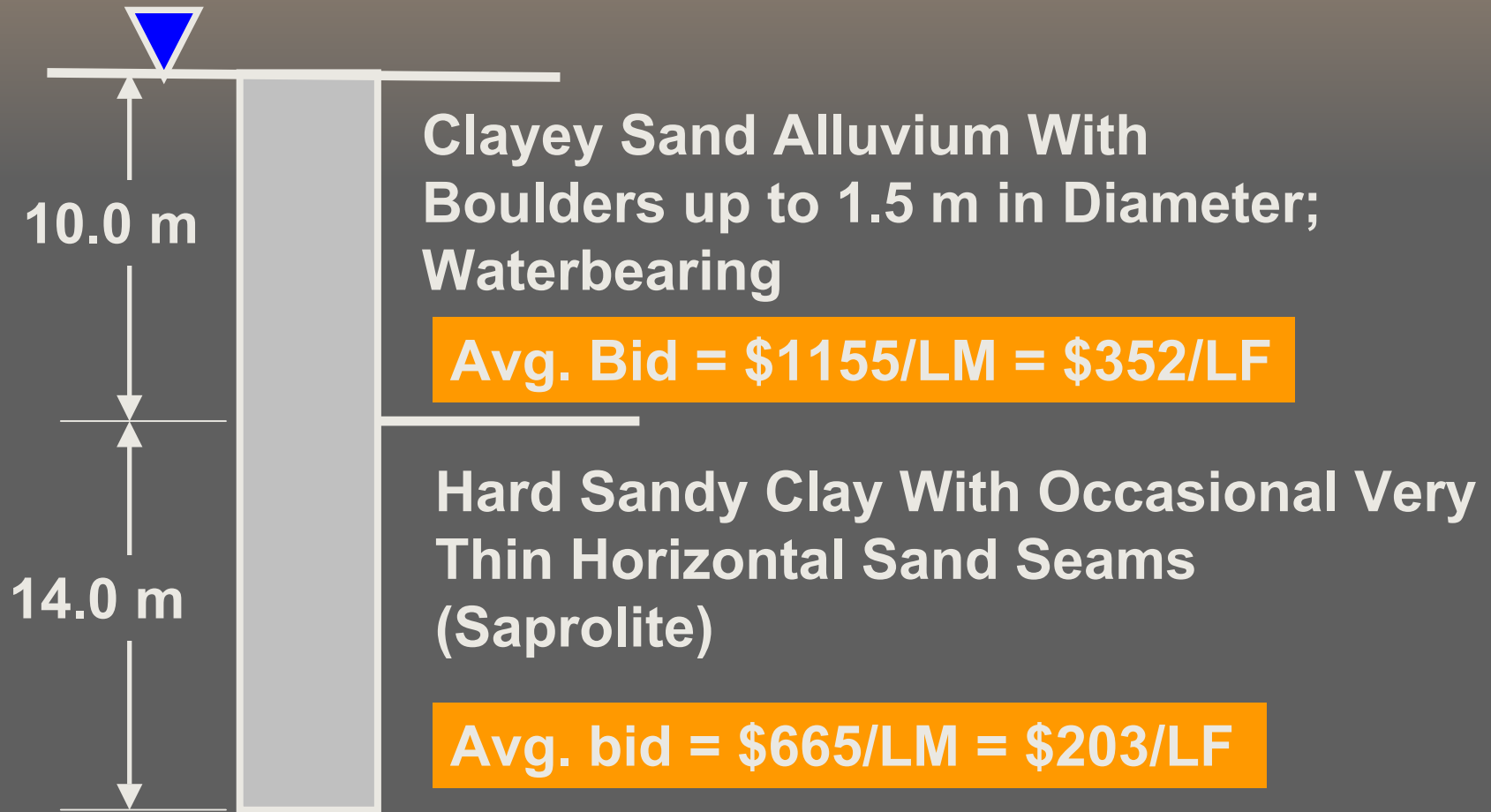
Alternating Thin Layers (< 1 m thick) of Stiff Clay and Dense Waterbearing Sand

Avg. Bid = \$741/LM = \$226/LF

Socket Diameter = 1.52 M (60 in.)

Drilled Shaft Contractor Supplies Concrete; Not Steel

Scenario No. 3



Socket Diameter = 1.52 M (60 in.)

Drilled Shaft Contractor Supplies Concrete; Not Steel

**It Is Obvious That You Need
Good Subsurface Data and
Knowledge of Construction Methods
in Order to**

1. Forecast the Construction Method



2. Estimate Costs

How Contractors Estimate Costs

- ⇒ Estimate Number of Rig-days to Complete Job Including Equipment, Labor, Weather Delays, Overhead, Other
- ⇒ Multiply Rig-days by Unit Cost Per Rig-day
- ⇒ Add Lump Sum Costs
- ⇒ Add Projected Profit

Real Example No. 1 from Texas, Mid-1980's

- ⇒ Shaft Diameters of 30 and 36 Inches
- ⇒ Lengths of 6.5 to 29 Feet
- ⇒ Numerous Moves (Several Small Bridges)
- ⇒ Total of 352 Shafts
- ⇒ 77% in Soil, 23% in Limestone (Some Hard)
- ⇒ Steel Furnished by General; Tied and Placed by Drilled Shaft Contractor
- ⇒ Avg. Price of \$66 / LF

Real Example No. 2 from Florida, Mid-1980's

- ⇒ Shaft Diameter of 60 Inches (All Shafts)
- ⇒ Lengths of 60 to 65 Feet
- ⇒ One Single Viaduct
- ⇒ 11 Test Holes and Technique Shafts
- ⇒ Total of 275 Shafts
- ⇒ About 75% in Sand; 25% in Limestone
- ⇒ Steel Furnished and Tied by General;
Placed by Drilled Shaft Contractor
- ⇒ Avg. Price of \$144 / LF

Summary

- ⇒ Most DOT's base their estimates on quantities only
- ⇒ Costs of drilled shafts are based on both the size of the project and the types of drilling methods needed to complete the drilled shafts as designed
- ⇒ Contractors base their estimates on production rates, operational costs, fixed costs, and projected profits