Building Contractor Market Share and Size by Raising the Bar

By Christopher Dumas, P.E.
Theory of Driven Pile Foundations: A Contractors Perspective?

- MATERIAL COST
- FIXED COSTS ON A DAILY BASIS
- HOW MANY CAN BE LIFTED AND PLACED PER DAY (AVERAGE)
ENGINEERED PRODUCT

• DESIGNED FOR STRUCTURAL CAPACITY

• DESIGNED FOR SOIL/ROCK RESISTANCE

• DESIGNED FOR CONSTRUCTABILITY
ENGINEERED PRODUCT

• DESIGNED FOR COST EFFECTIVENESS
ENGINEERED PRODUCT

• DESIGNED FOR STRUCTURAL CAPACITY (LOAD AND CAPACITY BY CODE)

• DESIGNED FOR SOIL/ROCK RESISTANCE (BY CODE)

• DESIGNED FOR CONSTRUCTABILITY (BY EXPERIENCE AND CODE)
HOW DO WE INCREASE MARKET SHARE?

• FOCUS ON PROVIDING A WAY TO ELIMINATE DISADVANTAGES OF OTHER METHODS.

• FOCUS ON PROVIDING THE SAME ADVANTAGES THAT OTHER METHODS PROVIDE
ENGINEERING MARKET
ADVANTAGES OF DRIVEN PILES

• GREATER SOIL RESISTANCE IN MANY SOIL TYPES. Engineering

• CAPACITY MEASUREMENT WITH EACH BLOW. Code

• PILE IS DRIVEN TO RESISTANCE—NOT AFFECTED BY SOIL STRATIGRAPHY CHANGE. Engineering, Code.
ENGINEERING MARKET
ADVANTAGES OF DRIVEN PILES

• TESTING FOR STRUCTURAL INTEGRITY AND BEARING CAPACITY IS FAST AND INEXPENSIVE.

• TESTING CAN BE DONE MORE FREQUENTLY—LOWER FACTOR OF SAFETY ACHIEVED AT LOW COST.

• PILE IS DRIVEN TO RESISTANCE—NOT AFFECTED BY SOIL STRATIGRAPHY CHANGE
IMPROVED MARKET OPPORTUNITIES THROUGH ENGINEERING DESIGN CODE

- Code Requirements for Structural Capacity
- Code Requirements for Soil/Rock Resistance
STRUCTURAL CAPACITY: CODE LIMITING ALLOWABLE STRESS

• ROUND ABOUT WAY TO ADDRESS DAMAGE FROM DRIVING

• ROUND ABOUT WAY TO LIMIT DESIGN SOIL CAPACITY.
MARKET OPPORTUNITY
STRUCTURAL CAPACITY: CODE LIMITING ALLOWABLE STRESS

• Currently 0.25fy TO 0.33 fy For Steel.

• Code Allows Higher 0.33 fy When a Higher Level of Field Testing QC is Employed-- Reduce Possibility for Damage From Driving.

• Result: Code Allows 32% Higher Stresses/Capacity with Improved Field QC.
MARKET OPPORTUNITY
STRUCTURAL CAPACITY: CODE LIMITING ALLOWABLE STRESS

• STEEL PILE: 0.25fy TO 0.33 fy FOR STEEL

• STEEL COLUMN IS 0.6 fy

• IMPLEMENTATION OF IMPROVED FIELD QC HAS THE POTENTIAL OF INCREASING ALLOWABLE DESIGN LOAD STRESS/CAPACITY BY UP TO 81%
SOIL/ROCK RESISTANCE: CODE LIMITING RESISTANCE VIA FACTOR OF SAFETY (FS)

• FS Reduces Estimated Ultimate Resistance to Account for Uncertainties (site soil, design parameters, analysis method, etc.)

• Round About Way to Limit Settlement.
MARKET OPPORTUNITY
SOIL RESISTANCE: CODE LIMITING FS

**LEVEL OF TESTING**

- **LEVEL 1**—DYNAMIC FORMULA, $FS = 3.0$
- **LEVEL 2**—WAVE EQUATION, $FS = 2.5$
- **LEVEL 3**—DYNAMIC TESTING, $FS = 2.25$
- **LEVEL 4**—STATIC TESTING, $FS = 1.8$ TO $2.0$
MARKET OPPORTUNITY
SOIL RESISTANCE: CODE LIMITING FS

LEVEL OF TESTING

• LEVEL 1/LEVEL 2—20% Higher Design Resistance

• LEVEL 1/LEVEL 3—30% Higher Design Resistance

• LEVEL 1/LEVEL 4—50% to 67% Higher Design Resistance
ARE YOU LEAVING MONEY ON THE TABLE

• IT'S NOT JUST ABOUT BID PRICES

• DIDN'T EXPLOIT POTENTIAL FOR INCREASED REVENUE VIA ENGINEERING.
MARKET OPPORTUNITY
FIELD TESTING

LEVEL OF TESTING

• DETERMINE THE SAVINGS POTENTIAL OF INCREASED ALLOWABLE STRESS, AND LOWERING THE FACTOR OF SAFETY VIA UPGRADE OF QUALITY CONTROL

• CONSIDER CAP SIZE REDUCTION AND ELIMINATION OF COFFERDAMS, TREMIE POURS, AND DEWATERING
3000 Ton Load Frame
WHAT IS YOUR POINT?

• POTENTIAL FOR 30% to 80% INCREASE IN DESIGN CAPACITY=$$$

• VE THE JOB, DESIGN BUILD, ETC.

• GETTING MORE DRIVEN PILE DESIGNS INTO THE PLANS VIA LOWER COST
INCREASE ENGINEERING MARKET ADVANTAGES

HOW CAN WE CONTINUE TO RAISE THE LIMITING STRESS AND LOWER THE FS?

• ELIMINATE POTENTIAL FOR STRUCTURAL DAMAGE

• DIRECTLY KNOW THE SOIL/ROCK RESISTANCE OF EVERY PILE
THAT’S NICE, BUT ITS ECONOMICALLY AND TECHNICALLY NOT POSSIBLE

- ELIMINATE POTENTIAL FOR STRUCTURAL DAMAGE

- DIRECTLY KNOW THE SOIL/ROCK RESISTANCE OF EVERY PILE
ECONOMICALLY

• TESTING PROVIDES VERY LARGE COST SAVINGS IN PILING AND CAP

• REDUCE THE COST OF TESTING
TECHNOLOGY WILL PROVIDE THE CAPABILITIES AND COST REDUCTION

• SIMPLICITY THROUGH SOPHISTICATION
INTELLIGENT PILE DRIVING

• THREE CRITICAL FEATURES:
  1. FULL TIME, REAL TIME, 100% MEASUREMENT OF ALL IMPORTANT PARAMETERS
  1. ABILITY TO CONTINUALLY VARY HAMMER TRANSFER ENERGY
  2. INTEGRATION OF 1&2 FOR 100% CONTROL AND DOCUMENTATION
INTELLIGENT PILE DRIVING
PIE IN THE SKY?
INTELLIGENT PILE DRIVING
PIE IN THE SKY?

• THE TECHNOLOGY ALREADY EXISTS.
ABILITY TO CONTINUALLY VARY HAMMER TRANSFER ENERGY
FULL TIME, REAL TIME, 100% MEASUREMENT OF ALL IMPORTANT PARAMETERS
HOW CAN WE CONTINUE TO RAISE THE LIMITING STRESS AND LOWER THE FS?

Example Kinetic Energy At Impact VS Throttle Pressure
B2005#9 (2000 lb Ram)
I DON’T WANT TO BUY A NEW HAMMER

YOU DON’T

• RETROFIT TECHNOLOGY ALREADY ON THE MARKET

• YOU MAY BE ABLE TO GET RID OF HAMMER
The E-Saximeter detects and counts blows by either

- impact sound or
- proximity switches

- Signals from 2 switches give impact velocity
- Signals transmitted by telemetry to E-Saximeter
E-Saximeter determines, displays and saves in memory:
Remote Dynamic Pile Testing

- Cost of testing reduced and predictable
- Equipment on site, operated at contractor’s convenience or when necessary
- Data sent to test engineer in office in real time
- Engineer analyzes and reports immediately
- Facilitates restrike testing
- Can bid “per test” or “per pile”
WIRELESS PILE TESTING
Receiver and Data Processing Unit

- Laptop
- Signal Receiver Unit
- DAQ Card
- Data Acquisition Software

**PCMCI A I/O Card**

- Digital
  - NI DAQCard 6533
  - 32-bit parallel interface
  - 76 Mbytes/sec (High)
  - 5 Volt/TLL Logic Level
Pile Instrumentation
INTELLIGENT PILE DRIVING IS THE FUTURE AND THE FUTURE IS NOW
THE FUTURE

• SOIL TO PILE TO HAMMER COMMUNICATION

• ADJUST REAL TIME TO CUSHION AND SOIL CHANGES

• CONTROLS DRIVING

• 100% DOCUMENTATION
THE FUTURE

• STOP DRIVING AT CAPACITY
• NO DAMAGE
• MAXIMUM DRIVING SPEED
• INCREASE ALLOWABLE STRESS ON PILE
THE FUTURE

“SILENCED HAMMERS”

• THEY EXIST TODAY
Junntan hydraulic piling hammer HHK-9AS (silenced)
THE FUTURE
NEW PRODUCTS

GROUND IMPROVEMENT

• PILE SUPPORTED EMBANKMENTS.
  • ITS HERE TODAY
  • VERY WIDE USE INTERNATIONALLY
  • STARTING TO TAKE OFF IN US—SCAN
  • HUGE QUANTITIES OF PILE REQUIRED
HOW DOES A DRIVEN PILE CONTRACTOR GET ECONOMIC ADVANTAGES

• COST ADVANTAGE. WITH FAST AND INEXPENSIVE TESTING, CAN LOWER THE FS. THIS WILL REDUCE THE NUMBER OF ELEMENTS, AND THE CAP SIZE. $$$.
HOW DOES A DRIVEN PILE CONTRACTOR GET ECONOMIC ADVANTAGES

• VALUE ENGINEERING. MANY BRIDGE FOUNDATIONS COULD BE DONE SIGNIFICANTLY CHEAPER—DS & DP.

• PROACTIVE APPROACH. SEEK JOBS BEFORE THE PRIME SEEKS YOU.
ENGINEERED PRODUCT

• DESIGNED FOR STRUCTURAL CAPACITY (LOAD AND CAPACITY BY CODE)
• DESIGNED FOR SOIL/ROCK RESISTANCE (BY CODE)
• DESIGNED FOR CONSTRUCTABILITY (BY CODE)
• COMMODITY SERVICE EQUALS COMMODITY PRICES

• TOTAL VALUE ADDED DICTATES PRICES

• NOT EVERYONE ON YOUR STAFF IS PAID THE SAME.
THANK YOU

• QUESTIONS?