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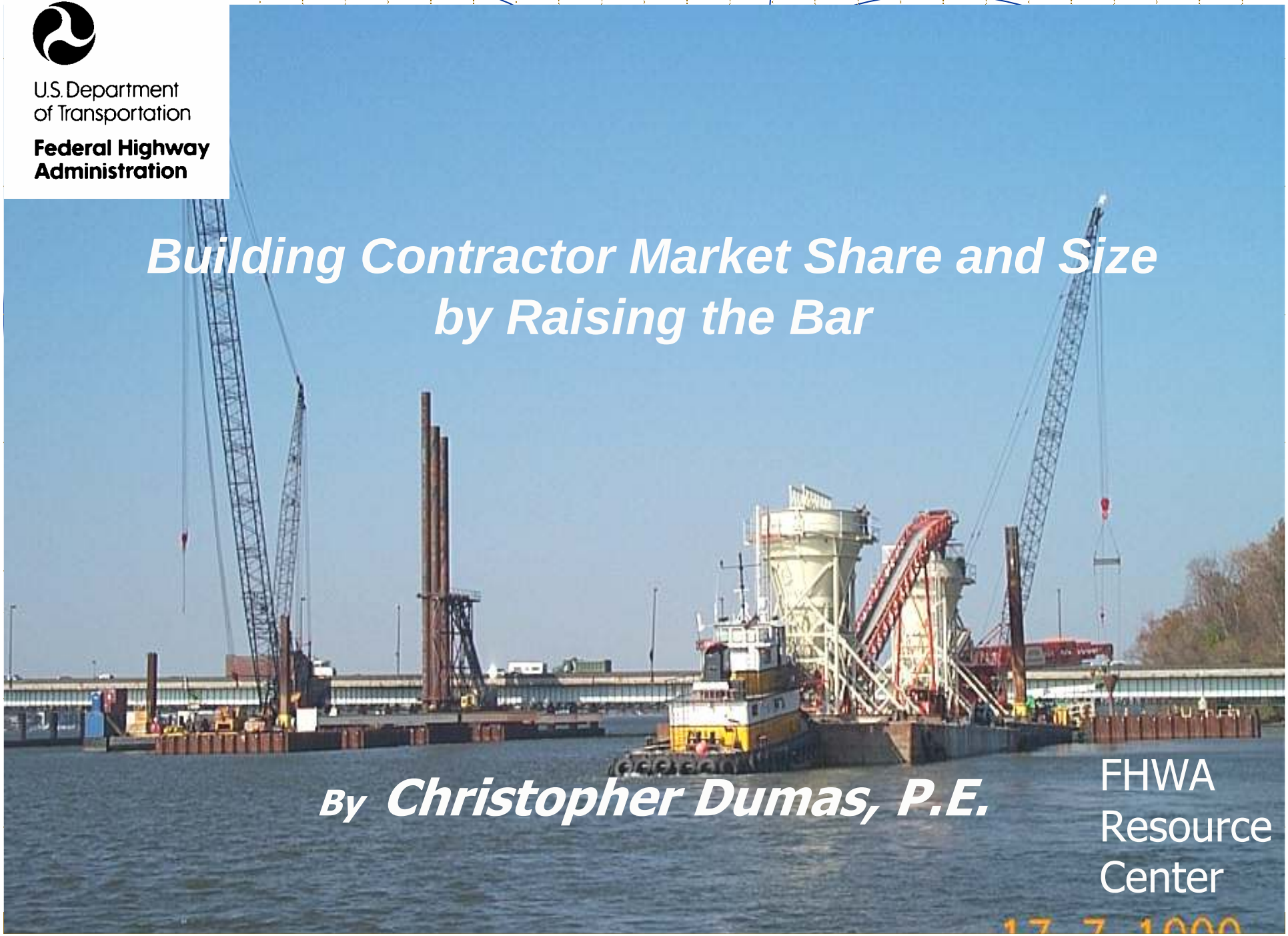
Building Contractor Market Share and Size by Raising the Bar



By ***Christopher Dumas, P.E.***

FHWA Resource Center

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

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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.

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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

ENGINEERING DESIGN CODE

- Code Requirements for Structural Capacity
- Code Requirements for Soil/Rock Resistance

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STRUCTURAL CAPAPACITY: CODE LIMITING ALLOWABLE STRESS

- ROUND ABOUT WAY TO ADDRESS DAMAGE FROM DRIVING
- ROUND ABOUT WAY TO LIMIT DESIGN SOIL CAPACITY.

MARKET OPPORTUNITY
STRUCTURAL CAPAPACITY: 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.

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MARKET OPPORTUNITY

STRUCTURAL CAPAPACITY: 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%

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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

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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

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ARE YOU LEAVING MONEY ON THE TABLE

- ITS NOT JUST ABOUT BID PRICES
- DIDN’T EXPLOIT POTENTIAL FOR INCREASED REVENUE VIA ENGINEERING.

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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

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3000 Ton Load Frame

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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

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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

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THAT'S NICE, BUT ITS ECONOMICALLY AND TECHNICHALLY 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

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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

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INTELLIGENT PILE DRIVING
PIE IN THE SKY?

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INTELLIGENT PILE DRIVING PIE IN THE SKY?

- THE TECHNOLOGY ALREADY EXISTS.

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ABILITY TO CONTINUALLY VARY HAMMER TRANSFER ENERGY

FULL TIME, REAL TIME, 100% MEASUREMENT OF ALL IMPORTANT PARAMETERS

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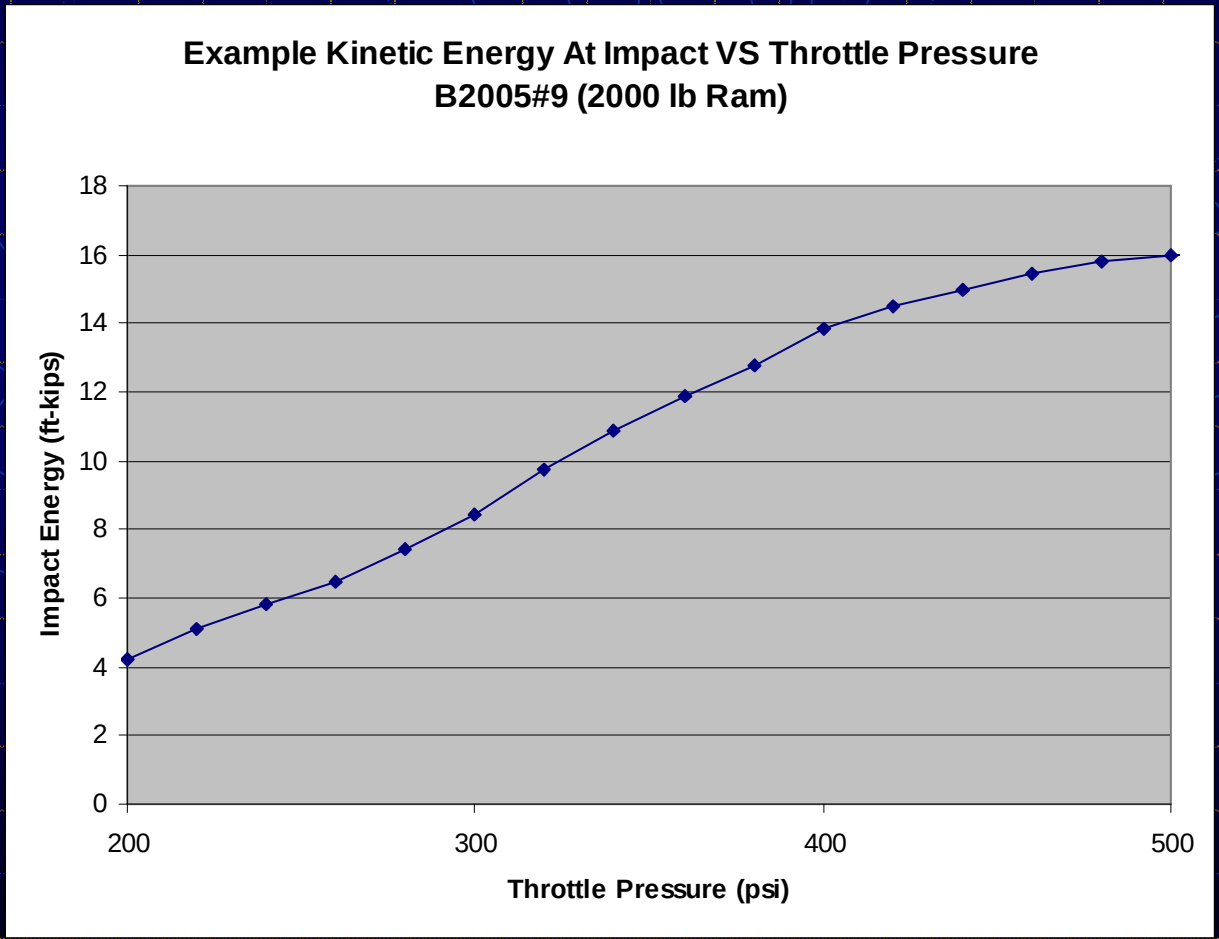
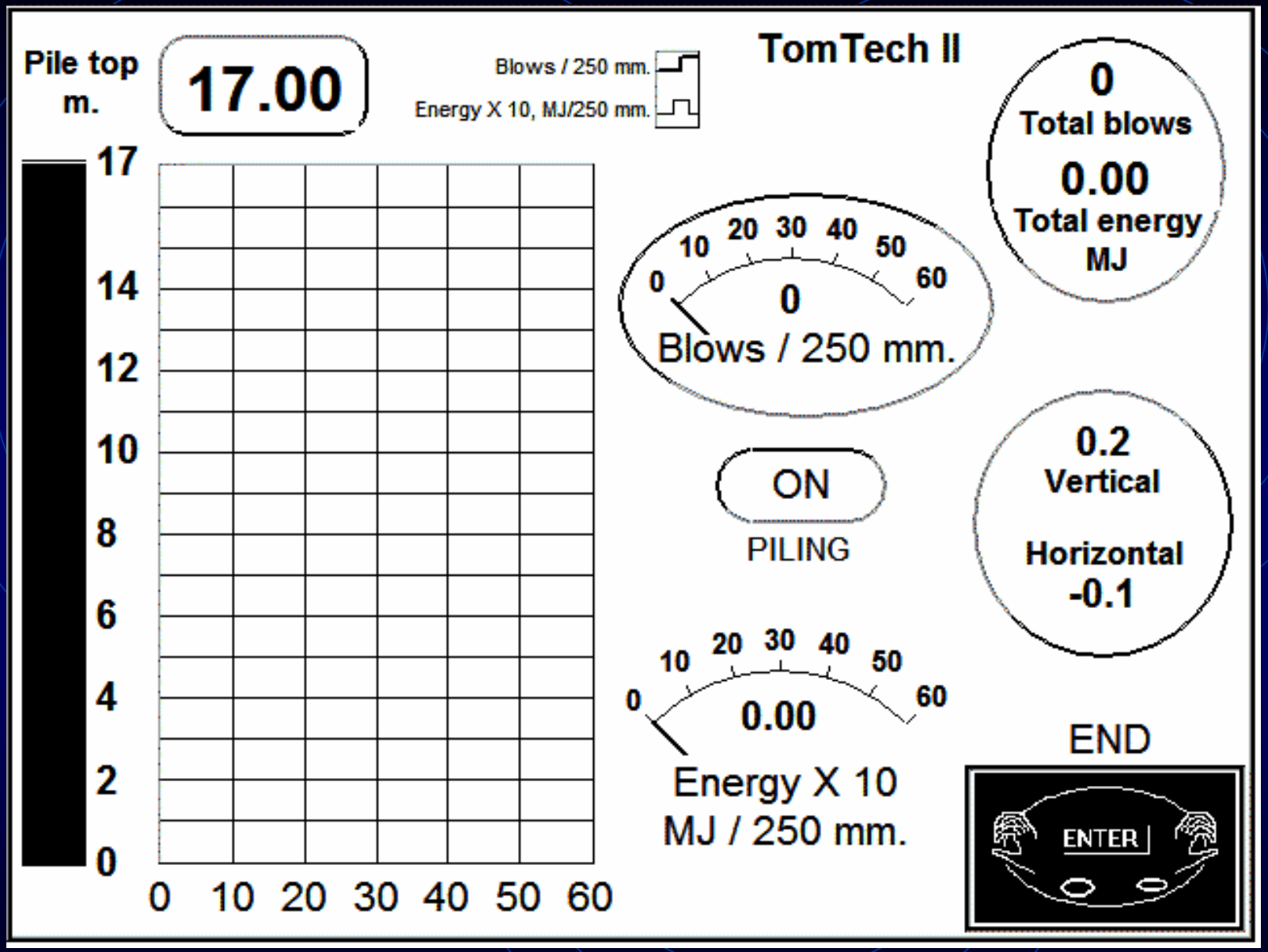
HOW CAN WE CONTINUE TO RAISE THE LIMITING STRESS AND LOWER THE FS?





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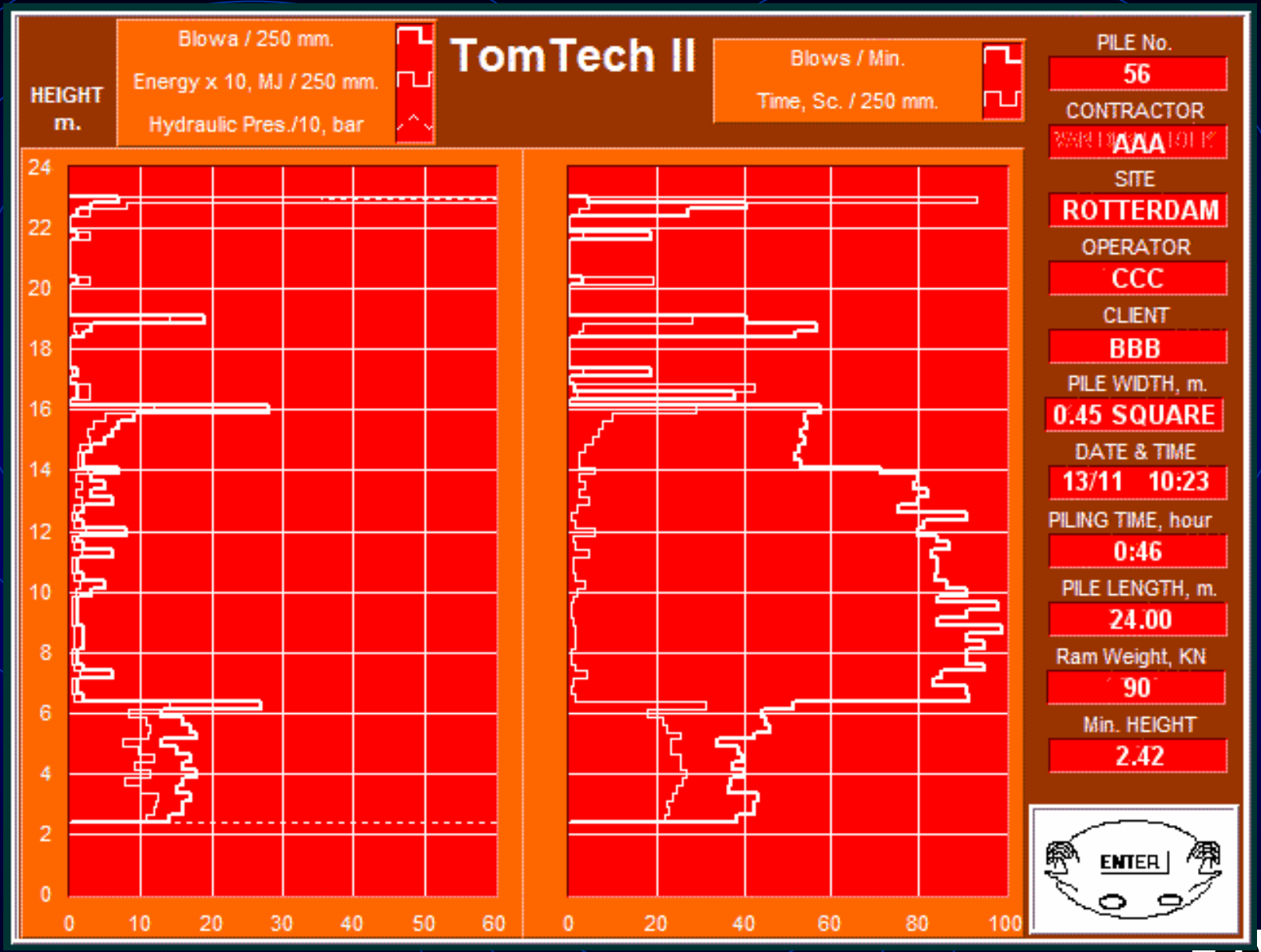

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I DON'T WANT TO BUY A NEW HAMMER

YOU DON'T

- RETROFIT TECHNOLOGY ALREADY ON THE MARKET
- YOU MAY BE ABLE TO GET RID OF HAMMER

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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

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E-Saximeter determines, displays and saves in memory:

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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".

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WIRELESS PILE TESTING

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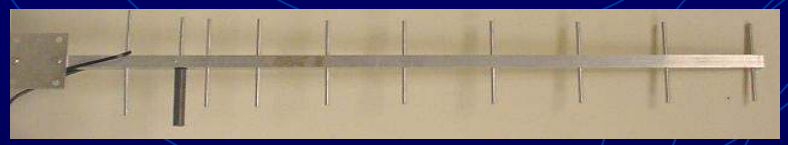
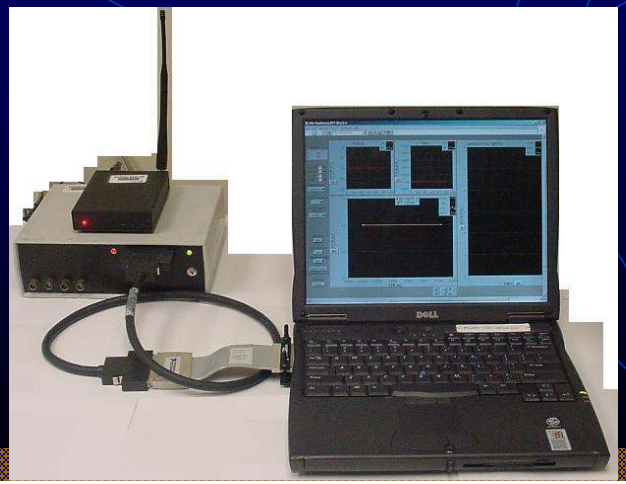
Receiver and Data Processing Unit

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





- <u>PCMCIA I/O Card</u>

- Digital
  - NI DAQCard 6533
  - 32-bit parallel interface
  - 76 Mbytes/sec (High)
  - 5 Volt/TLL Logic Level

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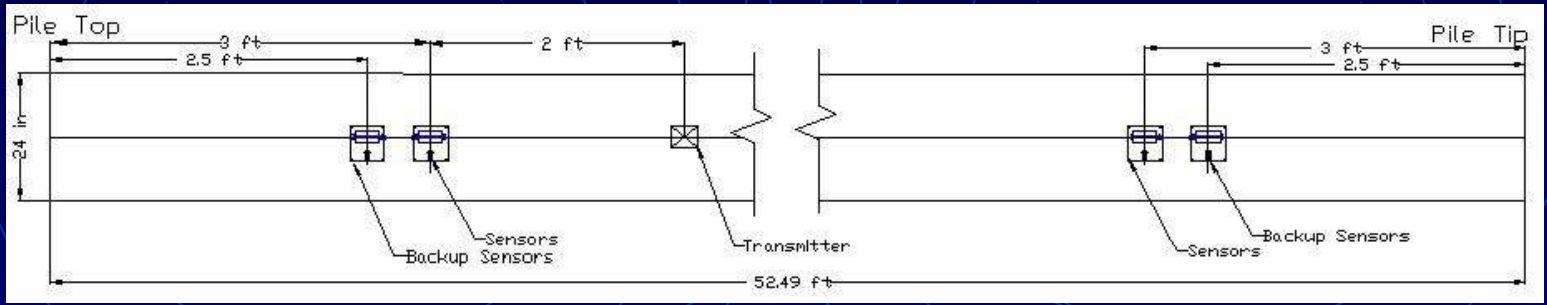
Pile Instrumentation



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INTELLIGENT PILE DRIVING IS THE FUTURE AND THE FUTURE IS NOW

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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

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Junttan 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

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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. $$$.

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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.

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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?

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