

SuperPile 2012 Portland, Oregon

A Driven Pile Is a Tested Pile – Not So Fast!

D. Michael Holloway

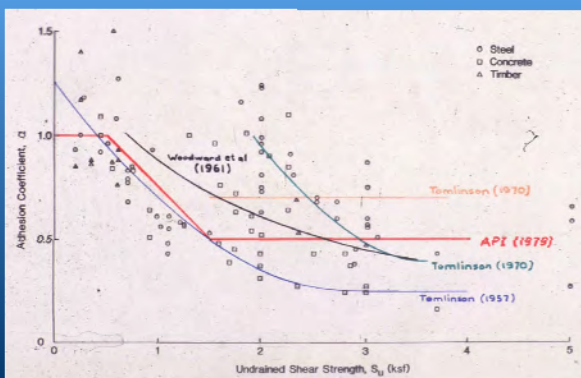
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Outline of Presentation

A Driven Pile is a Tested Pile – Not So Fast

- Prediction Methods
- Confidence
- Time
- Construction Issues
- Monitoring and Analyses
- Hammers
- Failure Modes

Correlation Methods?



IMPACT TESTING METHODS

“A DRIVEN PILE IS A TESTED PILE”

- Energy Formulae
- Wave Equation Analyses
- Dynamic Monitoring
- Signal Matching

Foundation Engineer's "DisComfort" Zone

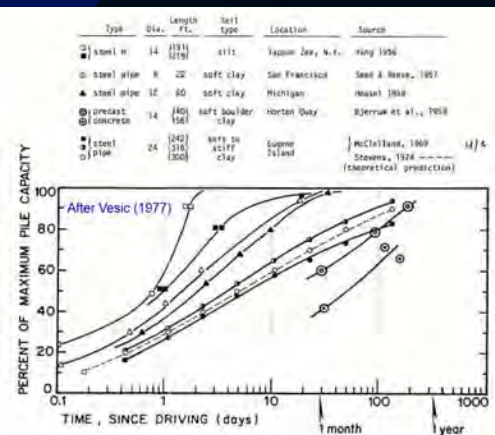
- Higher Capacity Piles
- Larger/Smaller Piles
- Different Pile Type
- Unfamiliar Geology
- Unusual Hammer/Technique
- Seismic Performance Issues

Good Old Days

Timber Piles Driven with a Vulcan 1



Capacity vs Time in Cohesive Soils



RELAXATION PROBLEMS
Shallow Bedrock Site – HP12X74 Piles – San Francisco

INSTALLATION Mid-September 2001							RESTRIKE 23 Oct 2001		
Pile No.	Pile Location	Date 2001	EOI Toe Penetr. ft	EOI Blount Blt	Estimated Capacity, kips Case (Rms) CAPWAP Method	BOR Blount Blt Equiv. Method	Estimated Capacity, kips Case (Rms)	Load - Capacity	
11	F-8	09/17	25	46	645	45	520	125	
12	E-1	09/17	12	30	625	40*	325	300	
13	C-1	09/17	15.7	8/8"	300	16**	265	35	
14	B-2	09/17		61	-	36**	470	1	
15	B-4	09/17	12.3	15/4"	1000	48**	650	350	
16	A-1	09/17	6	20	600	48**	500	400	
			9.7	64/8"	900				
17	E-3	09/17	13	27	650	40**	500	250	
			14.5	18/6"	750				
18	C-8	09/18	14.3	21/4"	700	36	495	205	
19	A-6	09/18	8.5	7/8"	355	16*	190	175	
110	F-5	09/18	11.5	5/8"	260	20*	175	85	
111	E-7	09/18	11.3	15/4"	900	36	495	405	

Notes: 1. EOI and BOR describe 'end of installation' and 'beginning of restrike,' respectively.
2. All HP 12 x 74 piles installed with a Delmag D30-32 diesel hammer using fuel setting 4 (FS4).
3. Restrikes were performed with FS4, FS2 (*) or FS3 (**).

Effective Stresses are Real!



High Strain Testing Methods

ISSUES FOR DISCUSSION

- What Kinds of Tests are Available?
- When Is Each Test Best Used?
- What Factors Affect Its Interpretation?
- When Are the Results Misleading?

High Strain Testing

Types of Tests

- Static Load
 - ▶ Conventional
 - ▶ Osterberg Cell(s)
- Impact Load
 - ▶ Pile Capacity
 - ▶ Pile Integrity
 - ▶ Hammer Performance

High Strain Testing

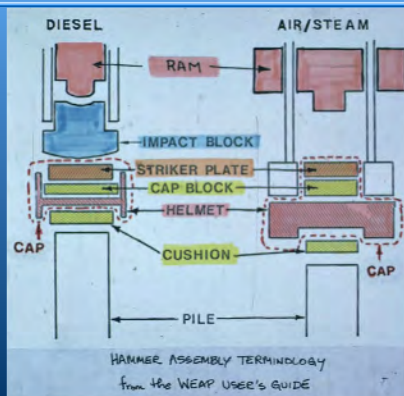
Types of Tests (continued)

- Pulse Load (Statnamic, RLT)
 - ▶ Capacity
 - ▶ Integrity

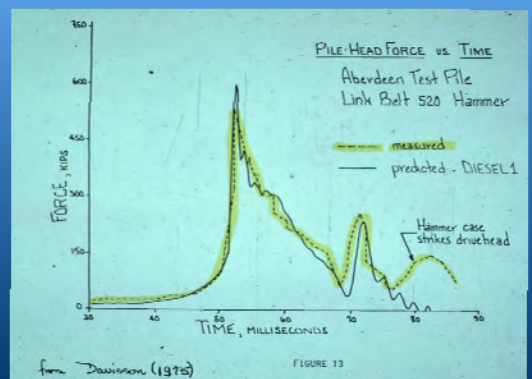
USAGE OF DYNAMIC METHODS

- Capacity
- Integrity
- Hammer Performance
- Resistance Distribution

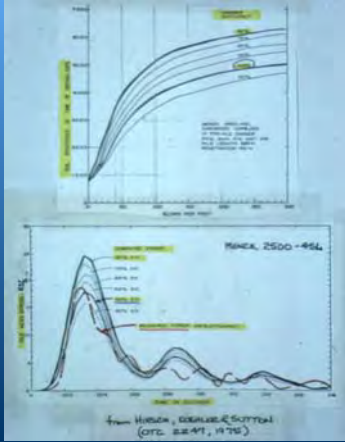
Conventional Impact Hammers



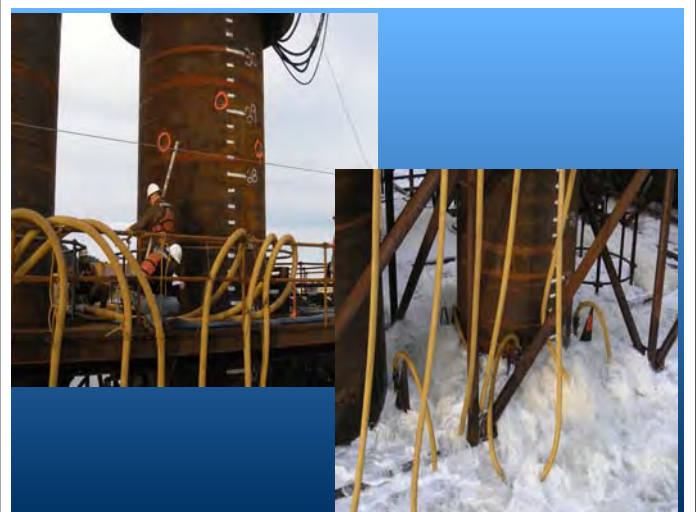
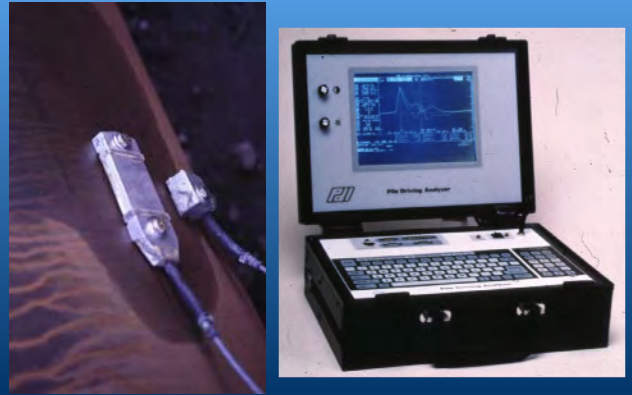
Diesel Hammer Thermodynamics

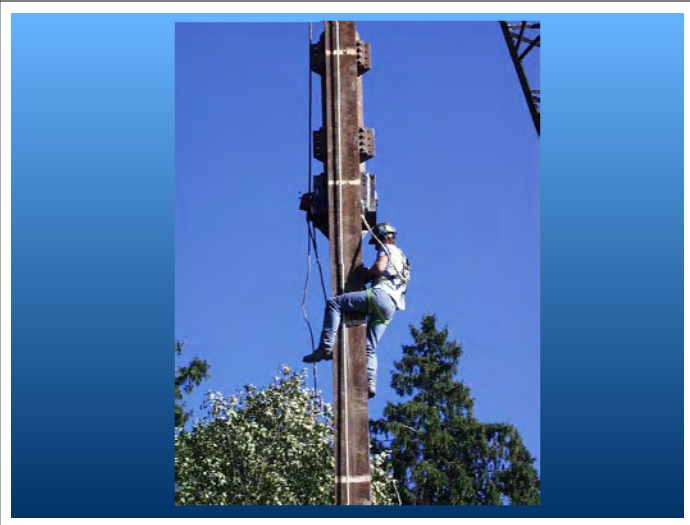
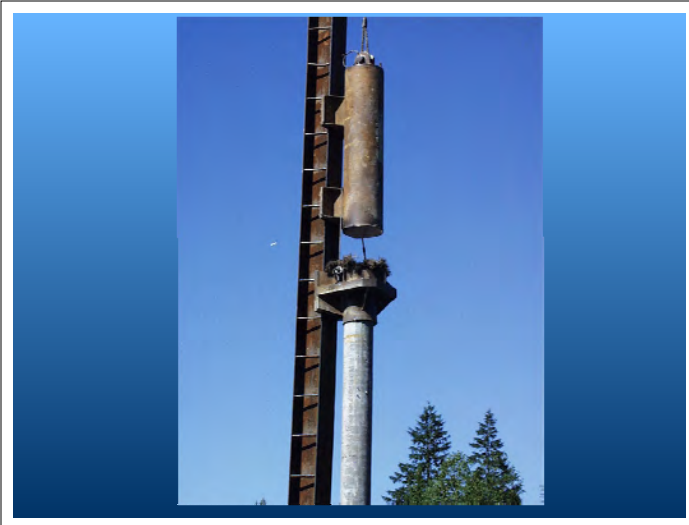


Offshore North Sea – first HS Testing



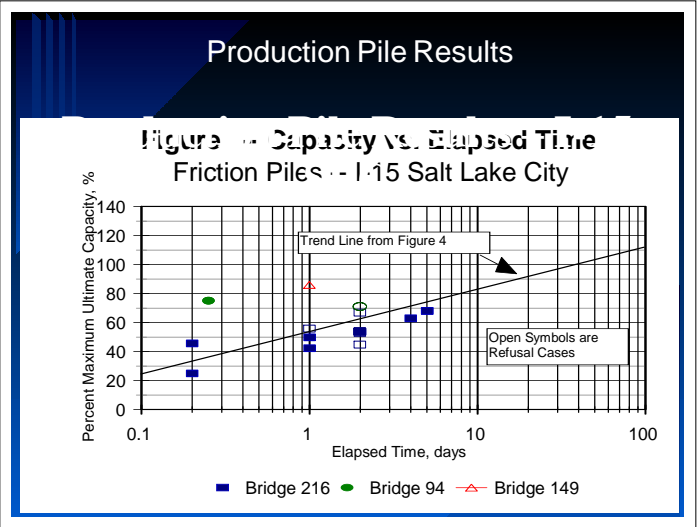
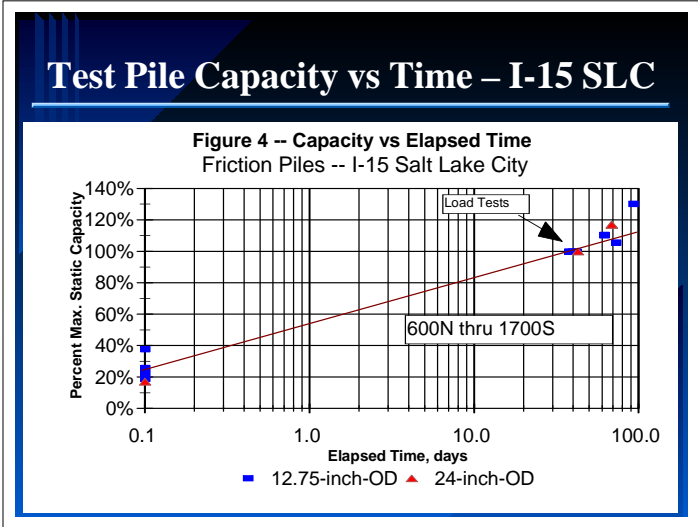
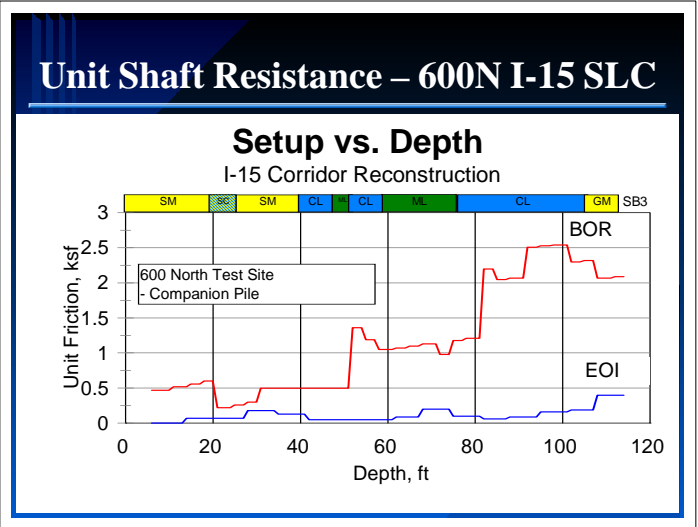
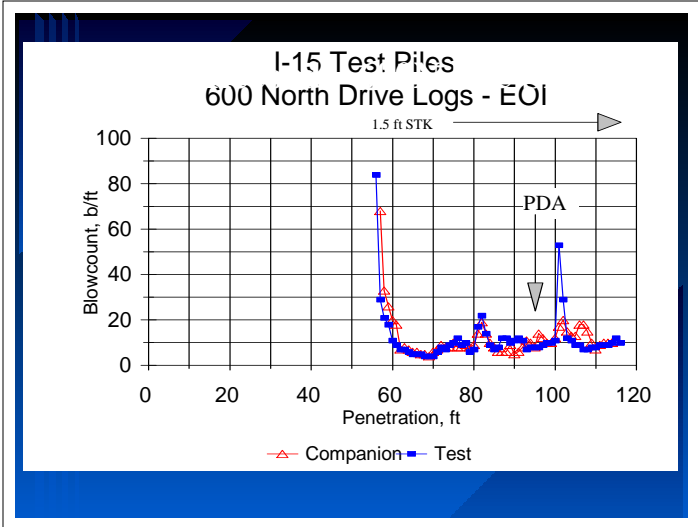
High Strain Testing

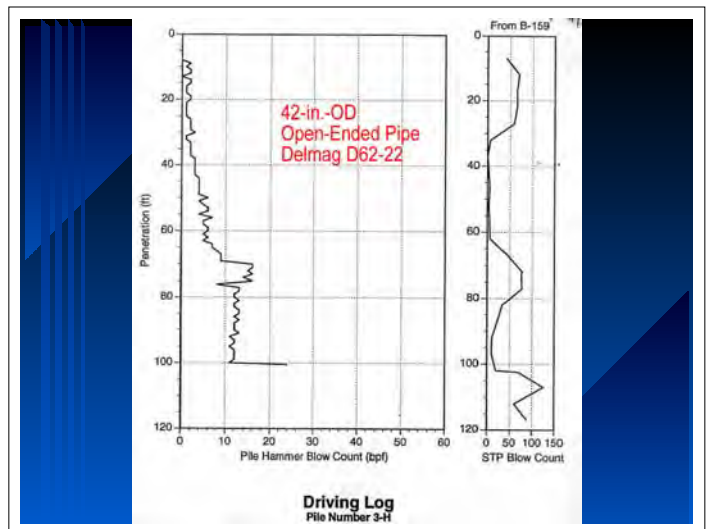
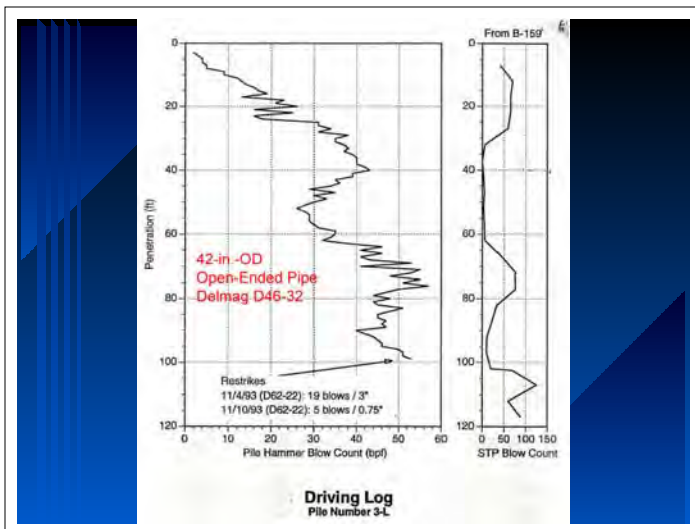




**1000 Kip Piles – 14-in.-sq PCPS
Concrete**







When Dynamic Testing Can Cause Problems

Pile Capacity Calculations

- Too Large a Hammer Blow!
Restrike Blowcount Too Low (<3b/inch)
- Too Small a Hammer Blow!
Restrike Blowcount Too High (>10 b/inch)
- Wrong Time to Restrike!
Pore Pressures Not Fully Dissipated
- Wrong Failure Mechanism!
Punching Plug in Low Displacement Piles

