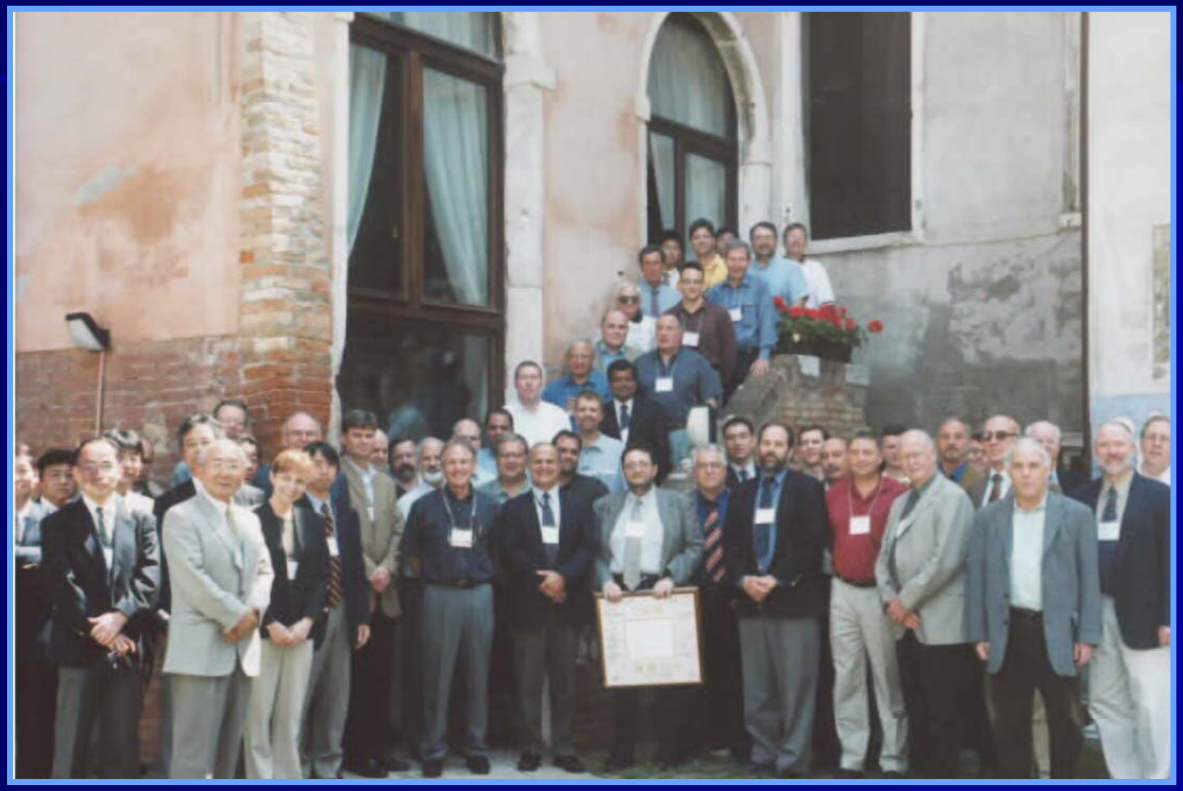
Micropiles in Middle Age: Triumphs, Failures and Challenges



Dr. Donald A. Bruce - Honorary Chairman, ISM

5th Lizzi Lecture, London, UK
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1. INTRODUCTION

- Passages of Life
  - Technology conceived in 1952
  - First major “growth spurt” 1960-1975
  - General “plateau:” 1975-1990
  - Second little “growth spurt:” 1990-1995
  - International cooperation begins 1994 (“mid-life crisis”)
  - Maturity combined with rapid growth: 1995 to present day

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1. INTRODUCTION

- Warnings
  - There have been “bumps in the road,” caused by both internal and external factors: these will doubtless happen again.
  - Current extreme global financial volatility has the potential to confound even our best plans and intentions.
- Time to Reevaluate
  - Fundamental reassessment of our life so far.
  - Provides basis for future plans and concepts.

2. TRIUMPHS AND POSITIVES

2.1 Project-Specific Progression (limited to U.S. examples only)

Year	Project	Notable Feature
1984	Boylston St. MA	40- to 50-ton micropiles!
1986-87	Coney Island, NY	Systematic use of "left-in" casing
1989	Union Station, DC	70-ton cased micropiles
1990	Pocomoke RB, MD	200-ton ultimate load, preloaded
1992	Vancouver, WA	300-ton ultimate load, structural failure
1997	Williamsburg Br., NY	Huge, high capacity project
1998	Mandalay Bay Hotel, NV	Emergency stabilization of failing structure
2001	Richmond SR Br., CA	700-ton micropiles in marine conditions

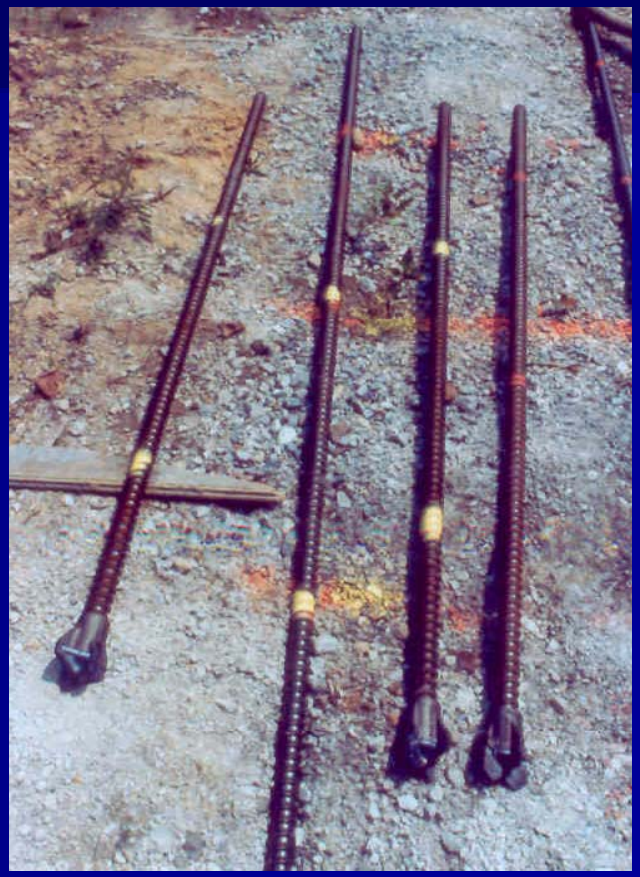
(continues)

2. TRIUMPHS AND POSITIVES

2.1 Project-Specific Progression (limited to U.S. examples only)

Year	Project	Notable Feature
2004	IBM Bldg., NY	High capacity, fast track project in karst
2004	Several	"Macropiles" to 1,400 tons
2005	Joplin, MO	Systematic pretreatment of karst
2006	Utah State Capital Bldg., UT	3,000 micropiles for seismic retrofit.
2007	Barbados, WI	Well…it's the Caribbean. (During the Cricket World Cup, coincidentally)

2. TRIUMPHS AND POSITIVES
2.2 Technology Development

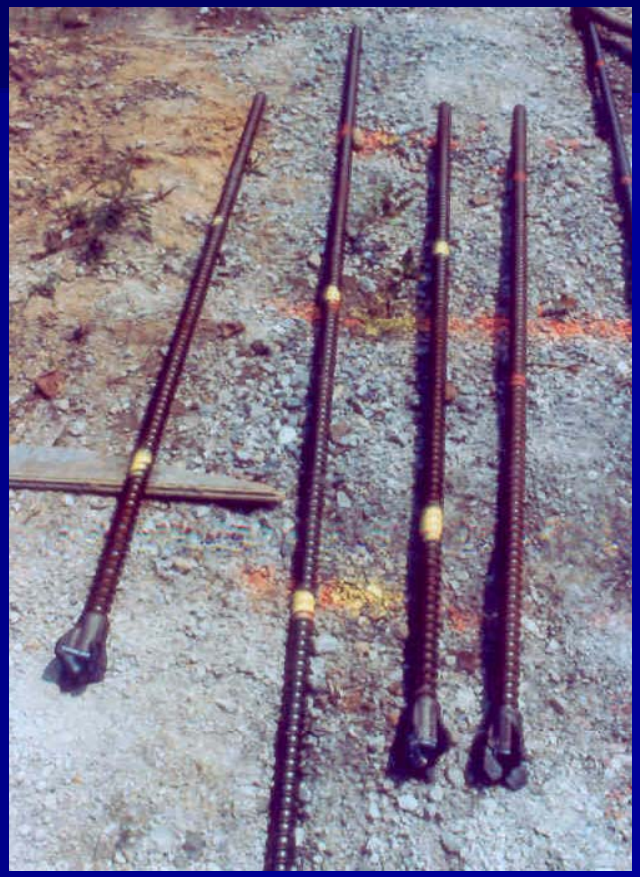


- Drilling
  - Power of rigs
  - Flexibility of rigs
  - Environmental compliance
  - Overburden drilling systems
  - MWD
  - Jacked systems
- Grouting
  - Mixing and pumping equipment
  - Multicomponent grouts
  - Real-time control of parameters
  - Pressure grouting (Types B, C and D)
  - Fluid property testing

(continues)

2. TRIUMPHS AND POSITIVES
2.2 Technology Development

- Reinforcement
  - Permanent casing
  - Hollow bars (underpinning, slope stability and embankment stabilization)
  - Composite sections (high capacity, lateral stiffness)
- Load Testing
  - Cycling
  - Preloading
  - Analytical capabilities



2. TRIUMPHS AND POSITIVES

2.3 Codes and Standards, etc.

- Mass Code (1984)
- U.K. Specifications (1987)
- FHWA State of Practice (1994-1997)
- FHWA Implementation Manual (2000) ("Referenceable Standard")
- DFI Specification Document (2000)
- ADSC/DFI Joint Committee on Micropiling
- ADSC Direct Support of ISM after FHWA
- Japanese Documents (especially on seismic design)
- Various European National Documents (especially from France and Germany, and Nordic Countries)
- More Recent Euronorm Documents

2. TRIUMPHS AND POSITIVES
2.4 Research, Development and Testing

- Systematic Field Testing (by Contractors) 1952-present
- FOREVER
- Japanese Research
- Turku University of Applied Sciences Research and Compilations (Dr. Lehtonen)
- ADSC-Sponsored Research (e.g., hollow bars, buckling, threads)
- Polytechnic University of Brooklyn (studies and translations)
- Reference Lists and Database (Dr. Herbst)
- University of Pittsburgh Research (John Kenny)

(continues)

2. TRIUMPHS AND POSITIVES
2.4 Research, Development and Testing

- University of Krakow Research
- University of Missouri Research (Erik Loehr)
- Cornell University Research (James Mason)
- Short Courses by
  - Trade Associations (ADSC, DFI)
  - ISM
  - NHI
  - Private Sponsors (e.g., 2006)
- ADSC GeoCubed 2005
- Miscellaneous ADSC “White Papers” (e.g., Cadden and Gomez)

3. FAILURES AND DISAPPOINTMENTS

3.1 Project Specific (U.S. only)

- Micropiles in karst (unfair distribution of contractual responsibility)
- Failures in sandy terrains (improper drilling and grouting techniques)
- Disappearance of Fondedile from U.S. market in late 1980's
- Ignorance, still, in certain market segments about micropiles
- Outcome of U.S. Army Marine Corps work in 2000 (Networks)
- Quiet/flat markets in Western Europe in general
- Poor specifications/no consistency
- Very few Case 2 structures

3. FAILURES AND DISAPPOINTMENTS

3.2 Codes and Standards

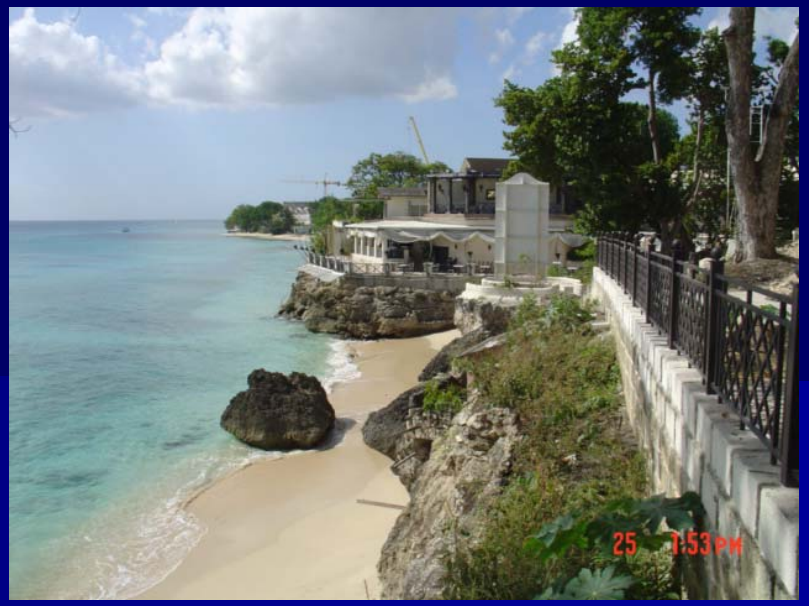
- No truly international agreement/unified document (but is one needed or indeed feasible?)
- No guidelines on Type 2 design
- Disconnect between Contractor and Engineer during the construction phase

3.3 Research/Development/Teaching

- Very little research or teaching at University level
- U.S. States Pooled Funds Project
- Generally poor links between practice and academia (notable exceptions)
- Little impact by Professional Societies, as opposed to Trade Associations

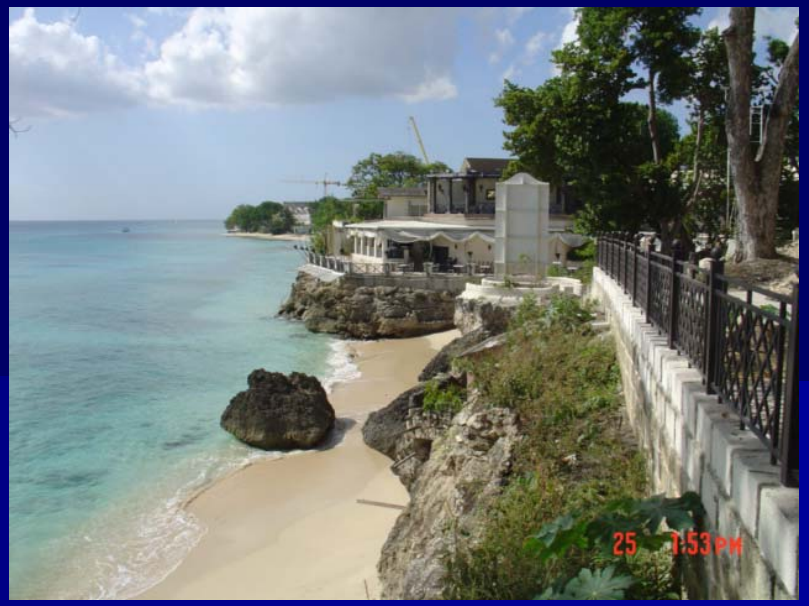
4. CHALLENGES

4.1 Commercial



- Expand activity levels in existing markets (marketing, new technical developments, education)
- Expand the geographic markets (Middle East, South Africa, etc.)
- Increase competitiveness relative to “traditional” alternatives (e.g., driven piles)
- Maintain quality standards (qualifications and experience of all parties)
- Enhance “green” image and capability
- Increase levels of automation
- Develop more appropriate and responsive contracting vehicles, including equable risk sharing

4. CHALLENGES



4.2 Technical

- Unravel “Networks” mystery (at last!)
- Sponsor multidisciplinary/ multinational research projects
- “Teach the teachers” (e.g., ADSC Faculty Workshop)
- Teach more teachers (the best friend of a specialty contractor is an educated owner)

4.3 ISM

- Increase membership levels
- Reassert relevance (and value for money)
- Maintain enthusiasm levels
- Assert industry leadership
- Keep increasing memberhip levels

5. DEDICATION

As always, we dedicate this conference to the vision of Dr. Fernando Lizzi, and the spirit he has left in all of us as we try to follow his footsteps in the world of micropiles.

Dr. Fernando Lizzi
(1914-2003)