

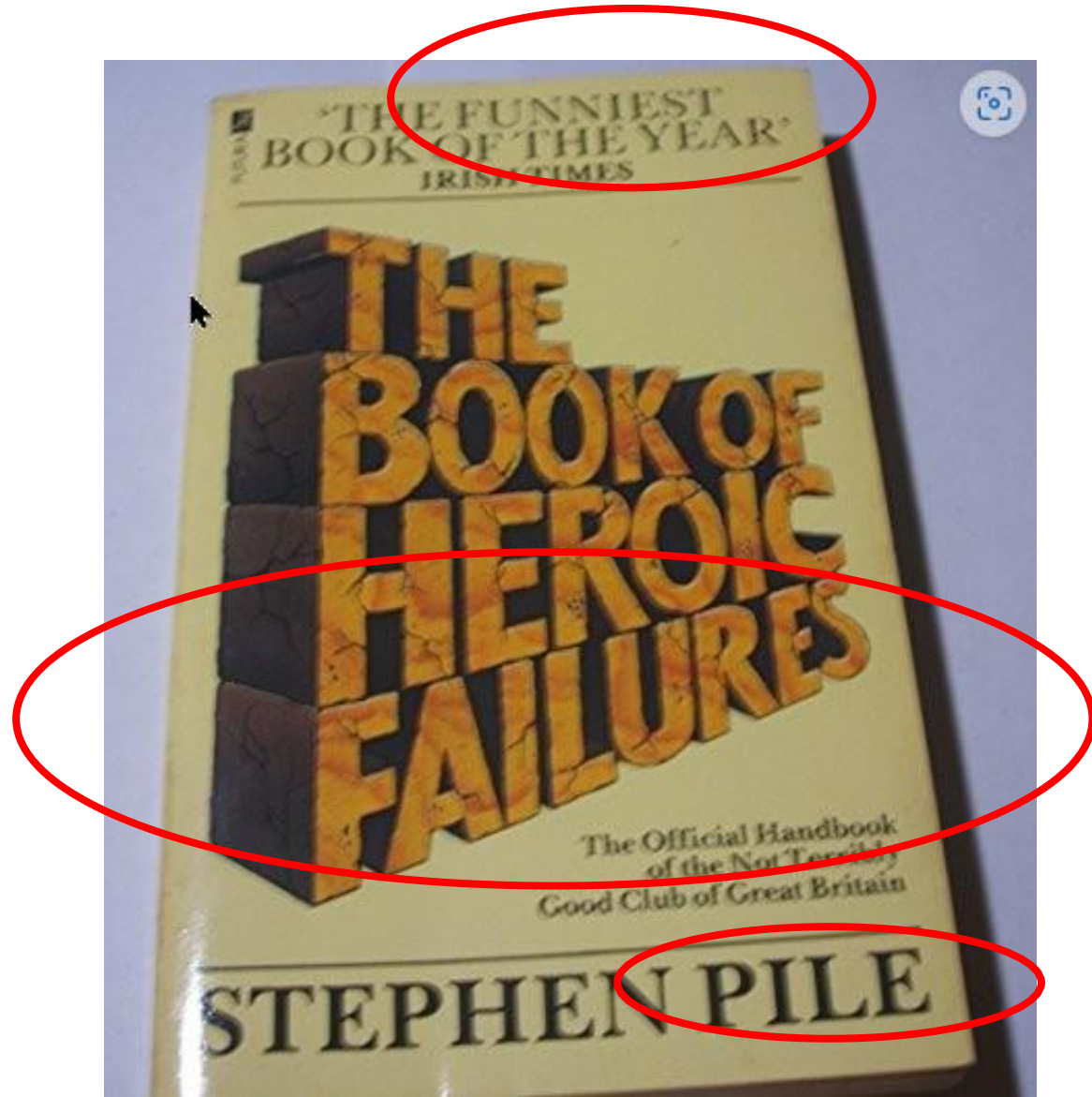
“Delegated design-build micropile foundations” (for buildings)

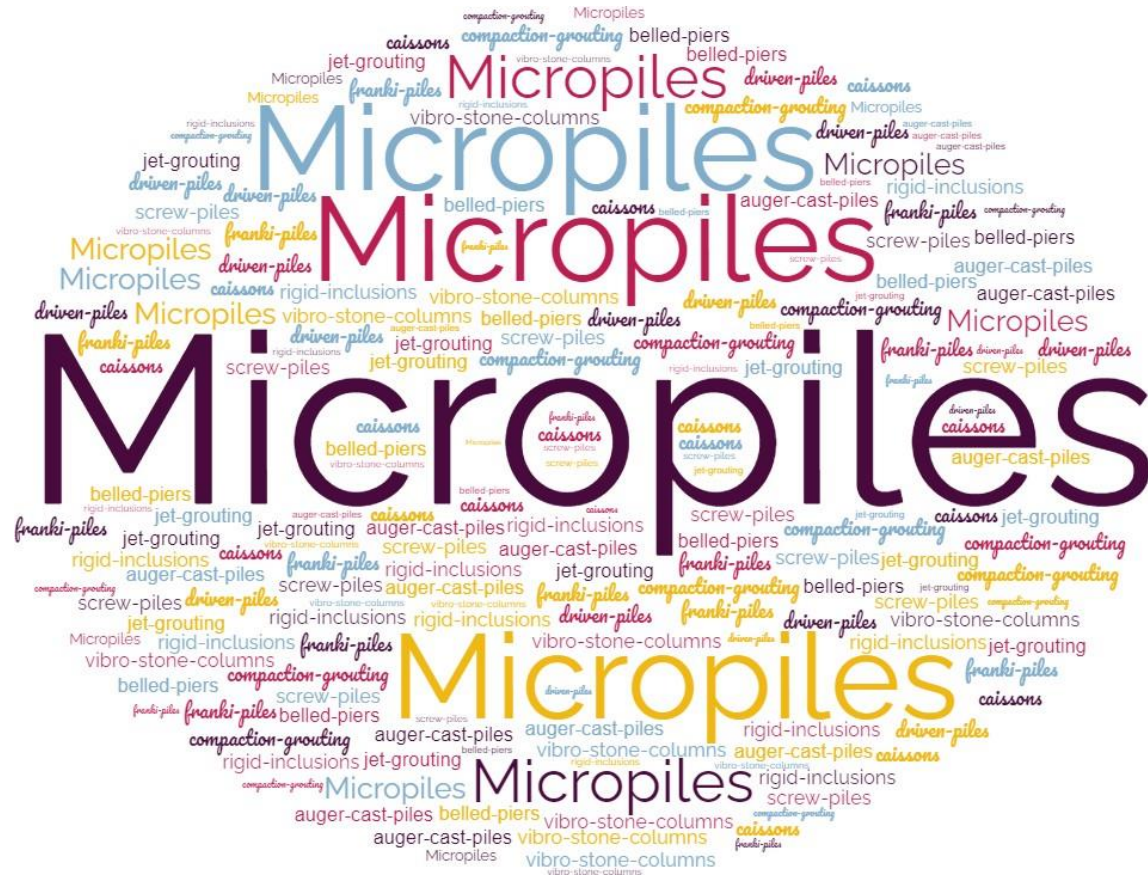
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A structural engineer of record's perspective...

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Martin/Martin Inc.

June 2, 2023





“Why do structural engineers and micropile engineers need **therapy**”?

Answer: Because when structural engineers have serious deep foundation issues and they try to talk the issues through with their micropile engineer, the micropile installer ends up.....

drilling a deeper and deeper hole!

Issues faced by the structural engineer for delegated design/build projects.

1. System selection and construction budget
2. Process to pick design/build contractor
3. Design collaboration process
4. Loading requirements and performance criteria
5. Design documents
6. Establish special inspection requirements (IBC 1704)
7. Building department deferred submittal (IBC 107.3.4.1)
8. Shop drawing submittal process (drawings and calculations)
9. Construction and construction observations (IBC 1704.6)

Structural engineers design foundations based on criteria from geotechnical engineer

Footings

Drilled piers

Piles and pile caps

Contractors build foundations

Based on structural engineer's design documents.

Structural engineers and contractors are less experienced in:

Soils improvement

Micropiles

Screw piles

Result: Structural Engineer (and contractor) select a traditional foundation

and that is why micropile contractors do not have a seat at the table from the beginning of design....

...Ok, lets start this over from the beginning...

1. Architectural design starts.....
2. Geotechnical report commissioned
3. Foundation design criteria established (loads and settlement)
4. Foundation design options are selected for report
5. Final Report (**deep foundations**)

Does the report include micropiles? why not?



Why not micropiles?

1. Geotechnical engineer may determine micropiles are not applicable?
2. Familiarity with micropiles?
3. Perceived cost?
3. Specialty/Design complexity?
4. Load testing cost?
5. Contractor input?
6. Engineer preference?

Other related questions:

Are you building the micropile sector as an industry... or are you working alone?

Do you have uniformly understood and fair procurement processes?

Suggestion to the lack of familiarity problem...

1. Give lunch and learn classes to your local structural engineers and take a local geotechnical engineer with you.
2. Educate your contractors.... take a structural engineer with you.

Suggestions for the cost problem....?

1. Provide all inclusive pricing upfront when the systems are being selected that does not change

Specialty Design complexity Problem..?

1. Geotechnical and structural engineers design the pile cap and micropile. Contractor and micropile sub-contractor build per contract documents (like drilled piers).

2. **Bring a micropile specialist onto the team.**

Geotechnical engineer provide borings, the structural engineer provides loads. Micro-pile contractor designs and builds the micro-piles (and the caps?).

Load test problem.....?

1. Design micropile using skin friction and end bearing capacities and safety factors. Are the industry micro-pile engineers comfortable with skipping the load testing?

2. Have Owner commission a pre-design load test that is designed by the Owners geotechnical engineer and load testing done by a micropile contractor and shared.

Contractor input problem.....?

1. Provide a GMP budget for the project and not just a unit cost per micropile..... precast design build contractors GMP the project

Engineer preference problem.....?

1. Educate us.....this comes back to familiarity
2. Build professional relationships with your structural engineers.. more on this later



Quiz #1

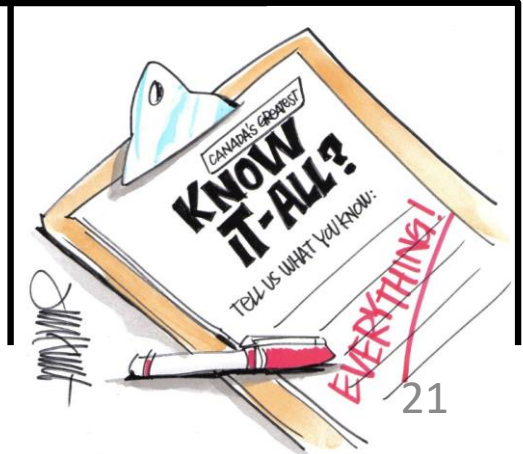
What do you and I have in common?



You and I we all have a lot in common

**We don't know it all about each others work
and likely never will !!**

What we have in common is the cap



Cap Interface

1. Pile spacing
2. Micropile bearing plates (Bearing)
3. Micropile bar embedment (tension)
4. Load transfer: Micropile/cap/structural element above cap.
5. Concrete materials strength
6. Congestion (rebar, bearing plates and dowels)
7. Special inspection criteria
8. Field observation

Collaboration

1. Micropile design build contractors engineer needs to be a part of the design no later than Design development phase. If not, design is done according to the geotechnical engineering requirements.
2. Design process is collaborative and timely to optimizes total cost and optimize constructibility of system.
3. Structural engineer needs to provide loading and performance criteria

Quiz # 2

Ghosts.....Who you gonna call.....?



Micropiles Who am I gonna call..... ?

Geotechnical Engineer?

Local drilling
contractor?

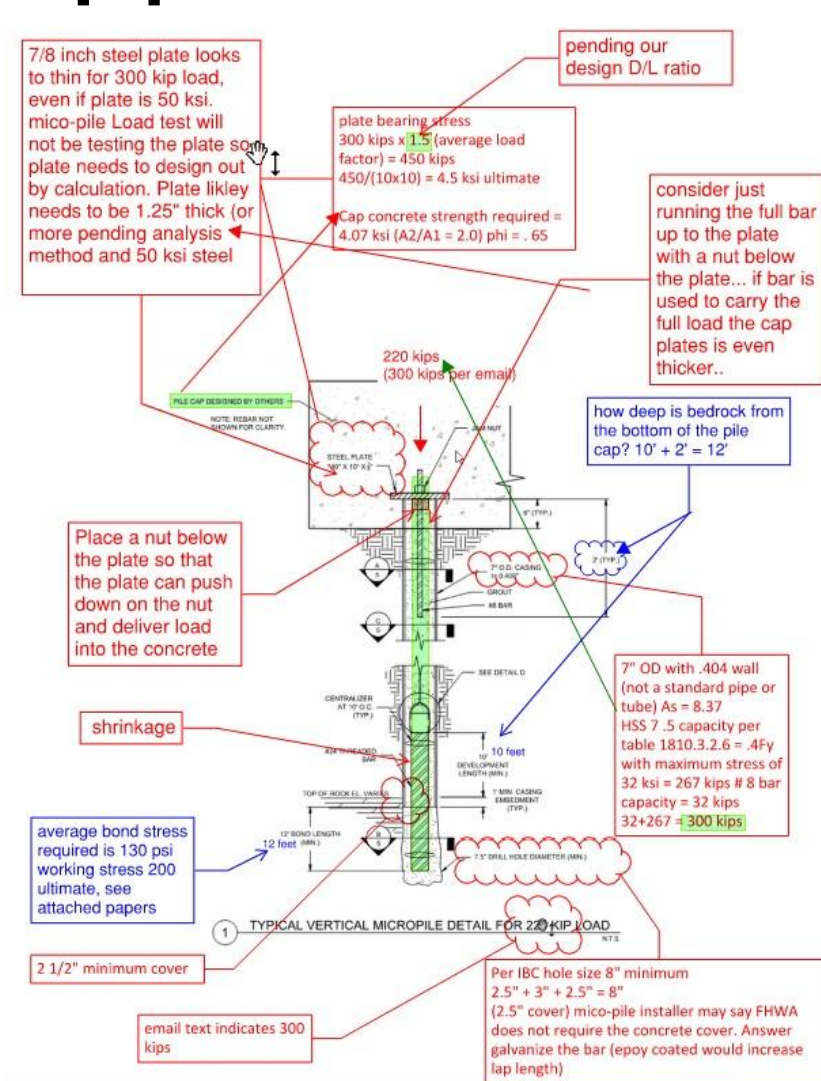
Micro-pile company?

ChatGPT?

Answer:

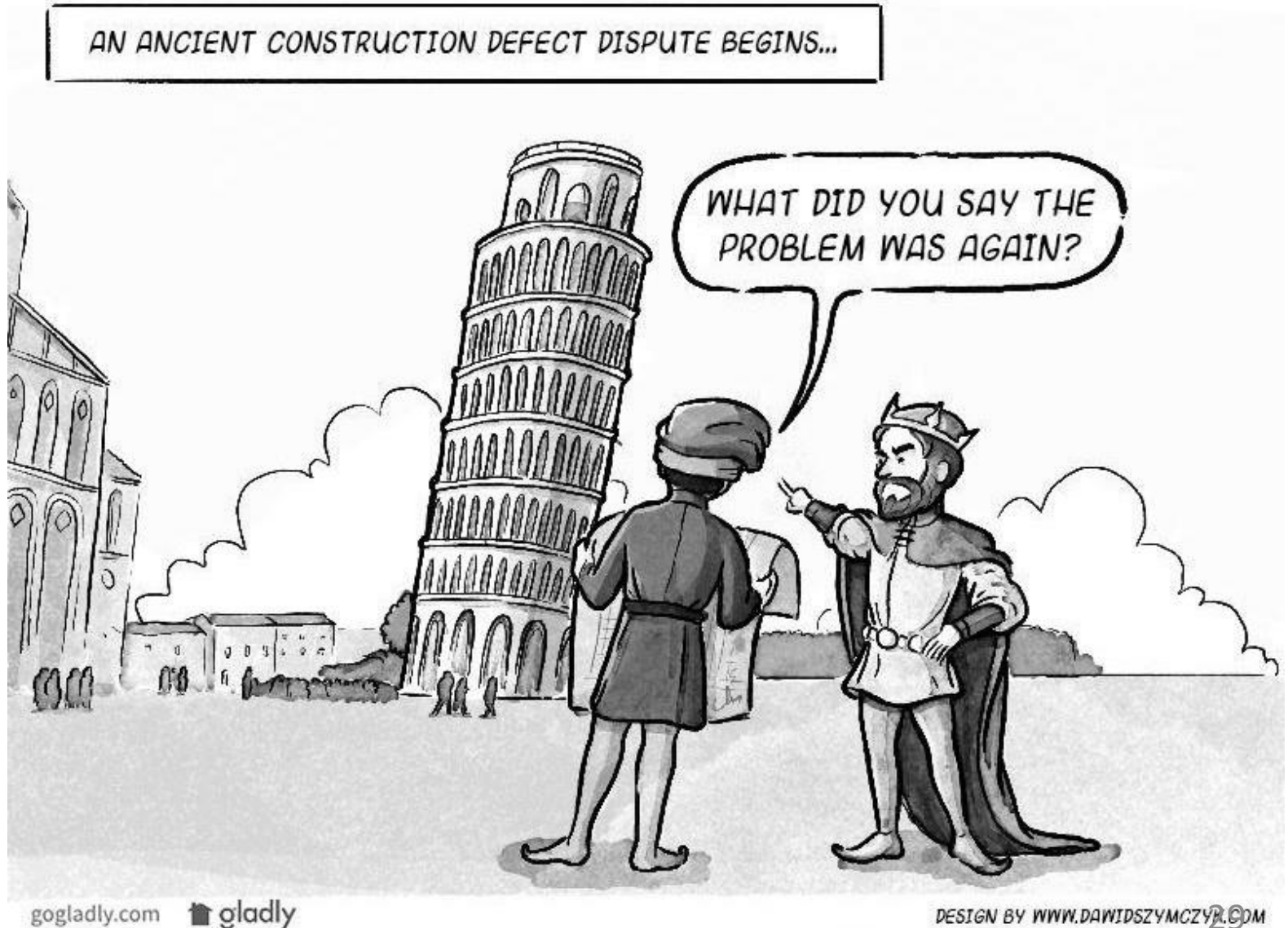
My trusted micropile engineer(s)
and
a qualified geotechnical engineer

But what happens when we disagree?



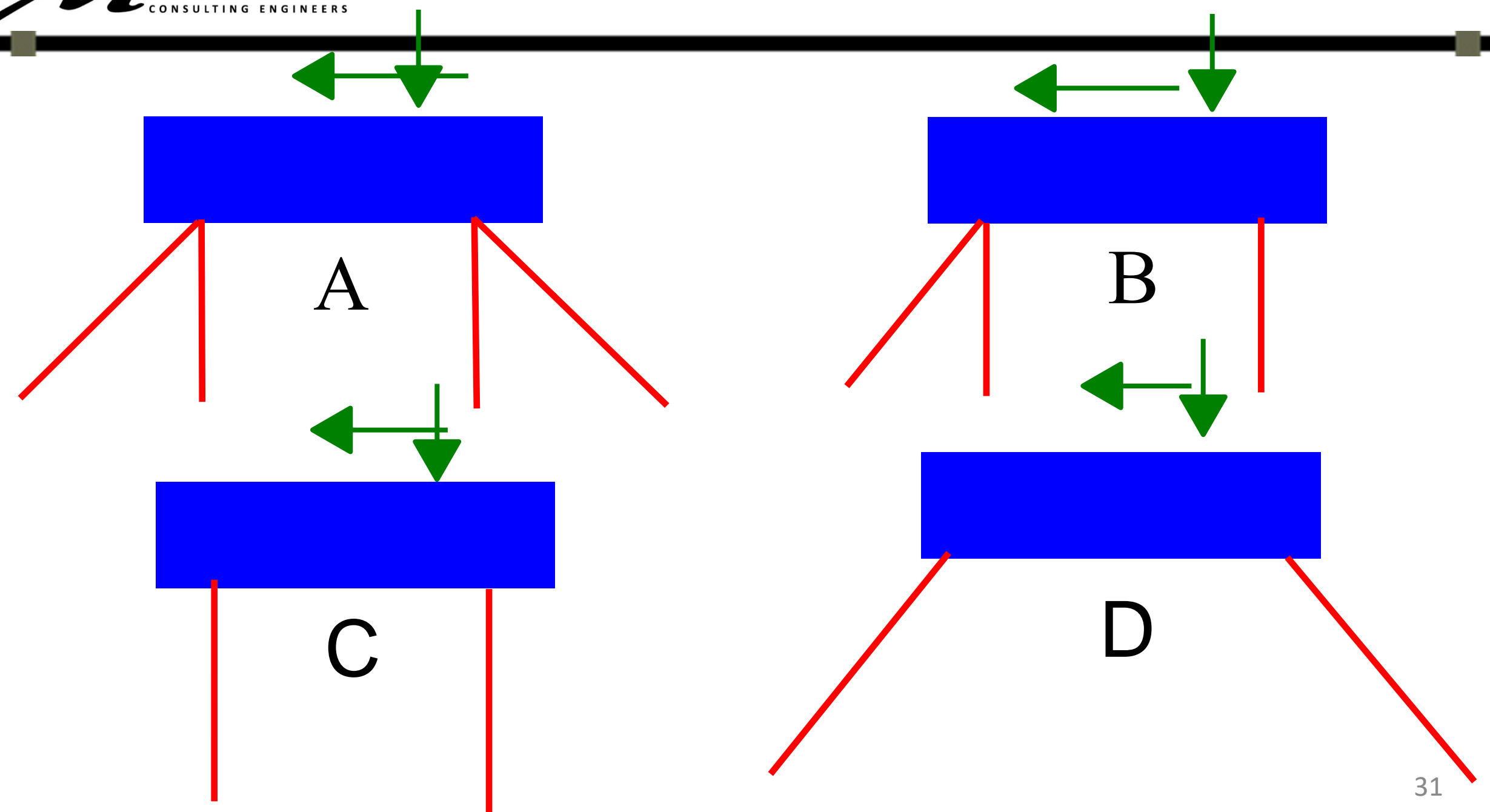
Who has the
final say?

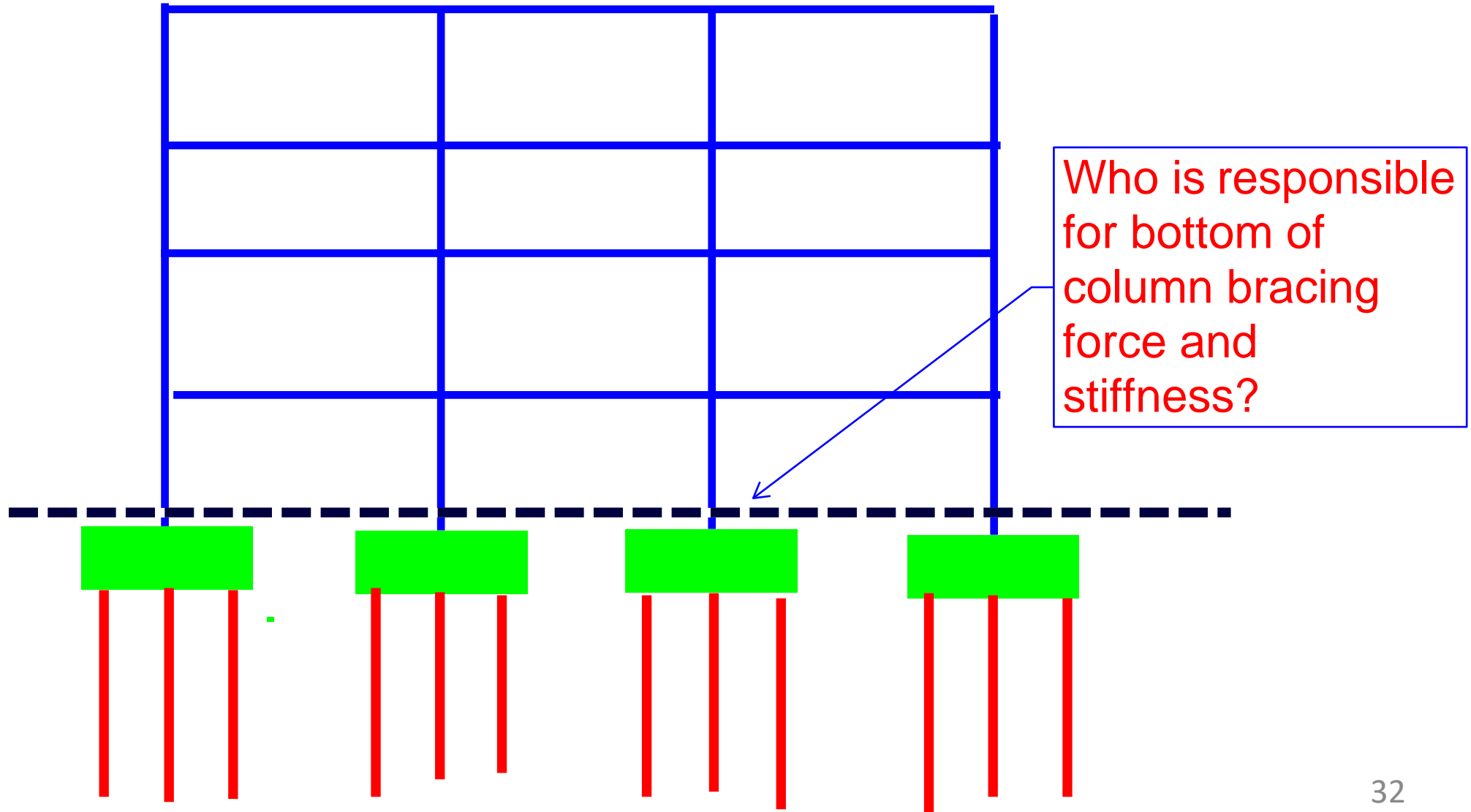
Who pays if we
disagree?



Quiz number 3

1. Axial- tension compression micropile (Micropile does not have shear capacity).
2. Pile cap is braced longitudinally.
3. Your company is competing for the project.
4. Which option do you propose for your companies solution? A, B, C or D?





Structural Engineers Role

1. Define design bases micropile capacities
2. Define micropile spacing used in cap design
3. Define battered pile locations and requirements
4. Locate pile caps
5. Coordinate piles with underground utilities
5. Define pile cap depth and bottom of pile cap
6. Define minimum embedment for tension pile bar
7. Define pile cap top plate size (thickness by micropile engineer?)

Structural Engineers Role

8. Define settlement criteria
9. Define construction tolerances
10. Define concrete strength
11. Define life expectancy requirements
12. Design the pile cap
13. Provide special inspection requirements on the design drawings (?)
15. Review micropiles submissions (discuss later)
16. Stamp micropile submission for delegated design submittal
17. Review field reports

Special inspections

Who writes the special inspections requirements for micropiles (IBC section 1704.2.3)?

1. Micropile design professional for the foundation?
2. Design professional for the structure?
3. Owners geotechnical design professional

Who decides the number of proof load tests during construction?

Who approves the special inspection requirements? (IBC section 1704.2.3)

Micropile construction administration

Role of delegated design-build engineer during construction:

1. Pre-construction verification load test
2. Design micropiles
3. Field observations (IBC 1704.6)
4. Review field reports
5. Field changes
6. Construction repairs

What is the role of EOR during construction?

Micropile construction administration

Role of structural engineer during construction:

1. Review pre-construction verification load test report results.
2. Review micropile fabrication and placing shop drawings
3. Review construction proof load testing reports

MARTIN/MARTIN, INC

DEFERRED SUBMITTAL REVIEW

REVIEWED

Date Received: 5/21/2023

Reviewer: rrempel

Date Returned: 5/21/2023

The deferred submittal documents have been reviewed and found to be in general conformance with the structural design intent of the building.

Reviewed to:

- 1) Verify the calculations and drawings have been stamped by a registered professional engineer who is in responsible charge of the deferred submittal including development of code-required design loads.
- 2) Verify design is based on correct codes and that additional minimum loads and details specified in the contract documents have been incorporated into the deferred submittal design and construction
- 3) Verify acceptability of connection details and loading imposed by the deferred submittal construction on the primary structural frame & foundations

Summary of issues

Traditional foundation design process often misses the opportunities for more technical foundation options such as micropiles, that for some applications are more cost effective, faster to construct with higher reliability.

Traditional design process puts foundation performance and design criteria in the hands of structural engineers who are often not experts in the fundamentals of micro-pile design which can result in:

1. Ambiguity and uncertainty for the contractor and micropile sub-contractor during procurement.
2. Changes/value engineering to the micropiles and/or structure supported by the micropiles after procurement of the micropile contractor.
3. Increased costs of the micropile foundations
4. Confusion during the design, submission and shop drawing process
5. Lack of clarity of design responsibility (control) between the structural engineer and the delegated design-build micropile contractor during the design and construction of micropiles

Summary of issues

Fragmented process with multiple stake holders

1. Geotechnical engineers
2. Structural engineers
3. Procurement
4. Micropile foundation engineer
5. Performance based design process

Summary of issues

Lack of unified Industry and codified standards for micropiles for building construction

Summary of issues

Special inspections

1. Establish who is responsible for the special inspection requirements
2. Lack of codified special inspection and testing requirements for micropiles
3. Qualifications of micropile inspectors

Summary of issues

The issues discussed in this presentation are also applicable to other performance-based foundations (soils improvement, aggregate piers, rigid inclusions)

Final thoughts

1. Micropile engineers need to develop a trusted partner and adviser relationship with structural engineers.
2. Structural engineers to release design control to the micropile specialists.
3. Micropile industry for buildings needs a codified design and construction standards.
4. Industry shift in micropile procurement delivery process to a collaborative design process.

Comments/disussion?

1. Does the micropile industry want engineers to just provide loads?
2. Does the micropile industry want to take on the full foundation design - pile cap and piles?
3. When should the micropile engineer be brought onto the project team?
3. What do you believe it takes to be a micropile trusted advisor for the engineer of record?
4. Does micropile industry want a certification process? (PCI, SJI, AISC)