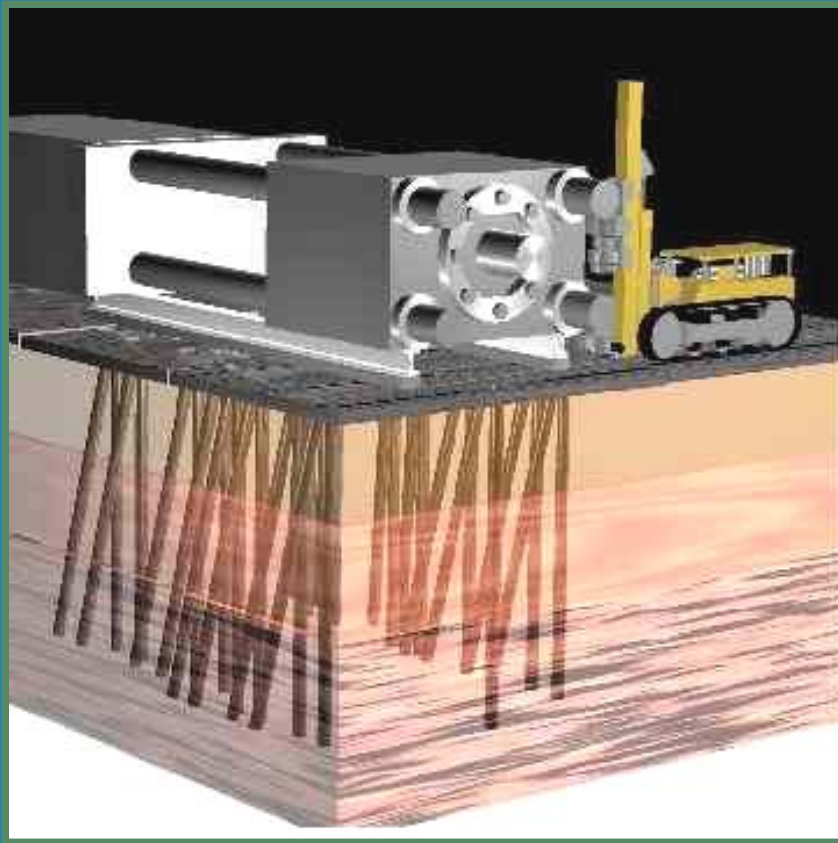


CONNECTION BETWEEN MICROPILES AND EXISTING FOOTINGS



Jesús Gómez, P.E., Ph.D.

Allen Cadden, P.E.

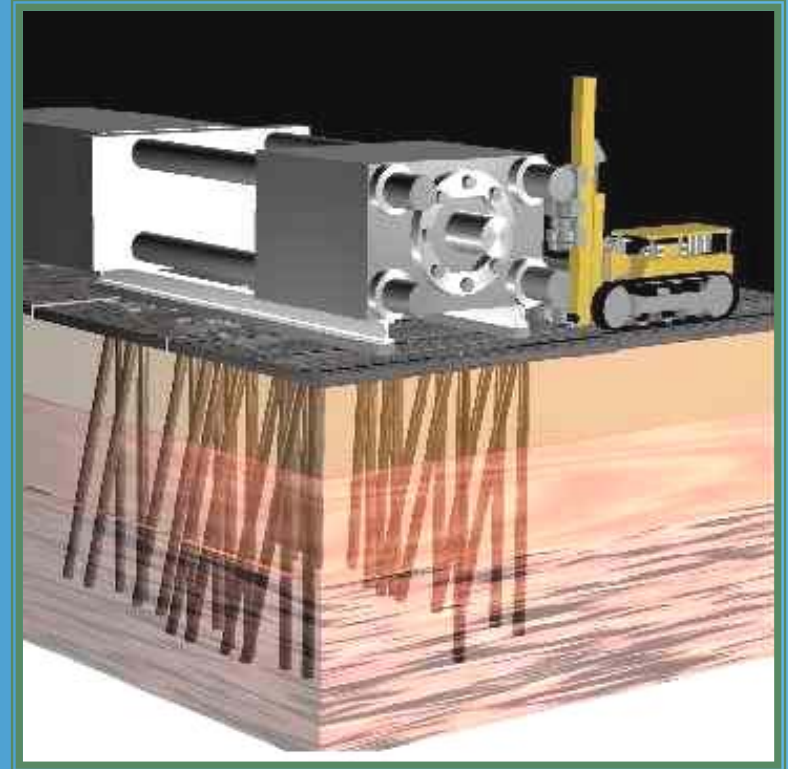


International Society for
Micropiles Conference
Schrobenhausen, Germany,
May 3-7, 2006

FOOTING UNDERPINNING



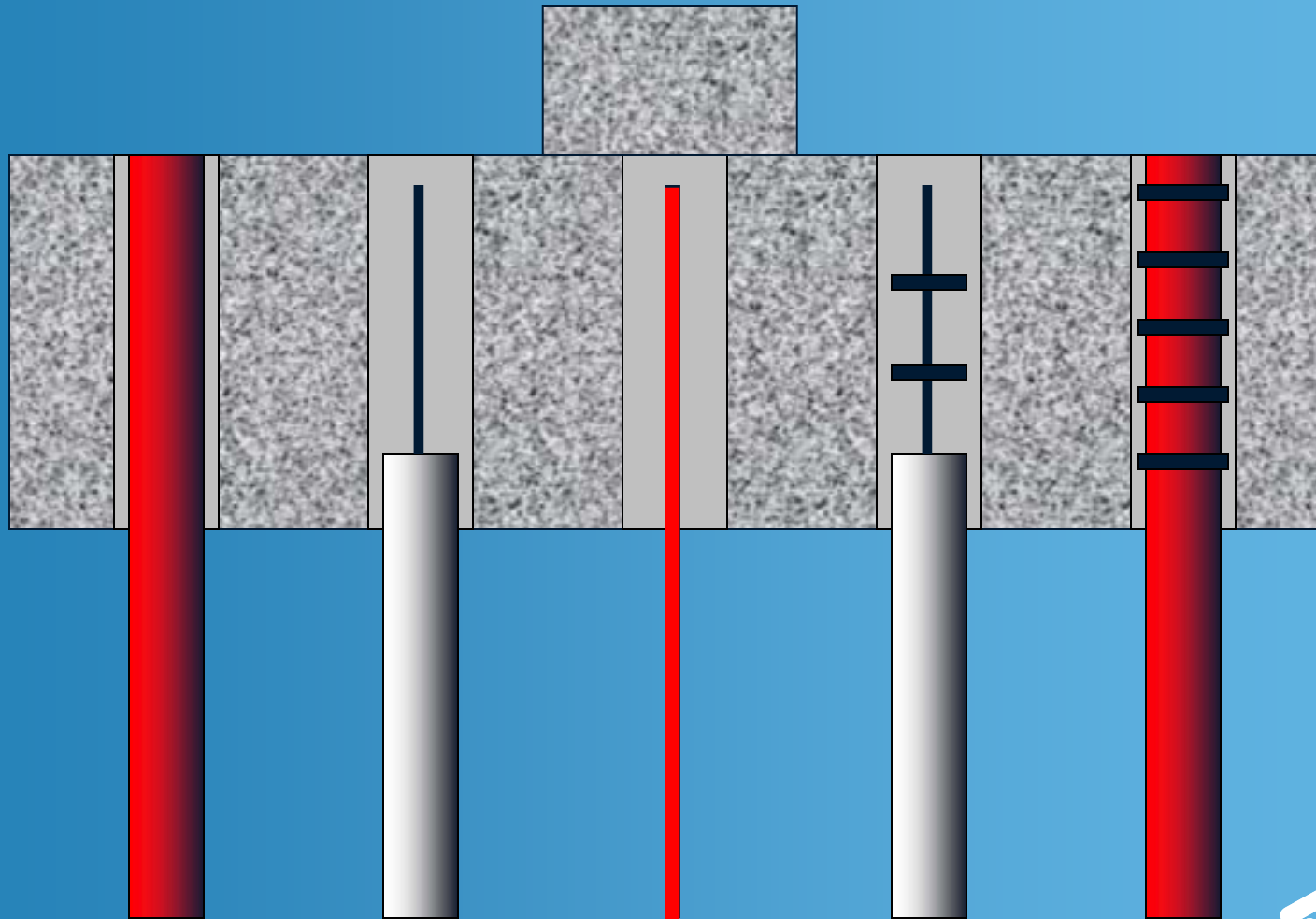
Courtesy: Structural Preservation Systems



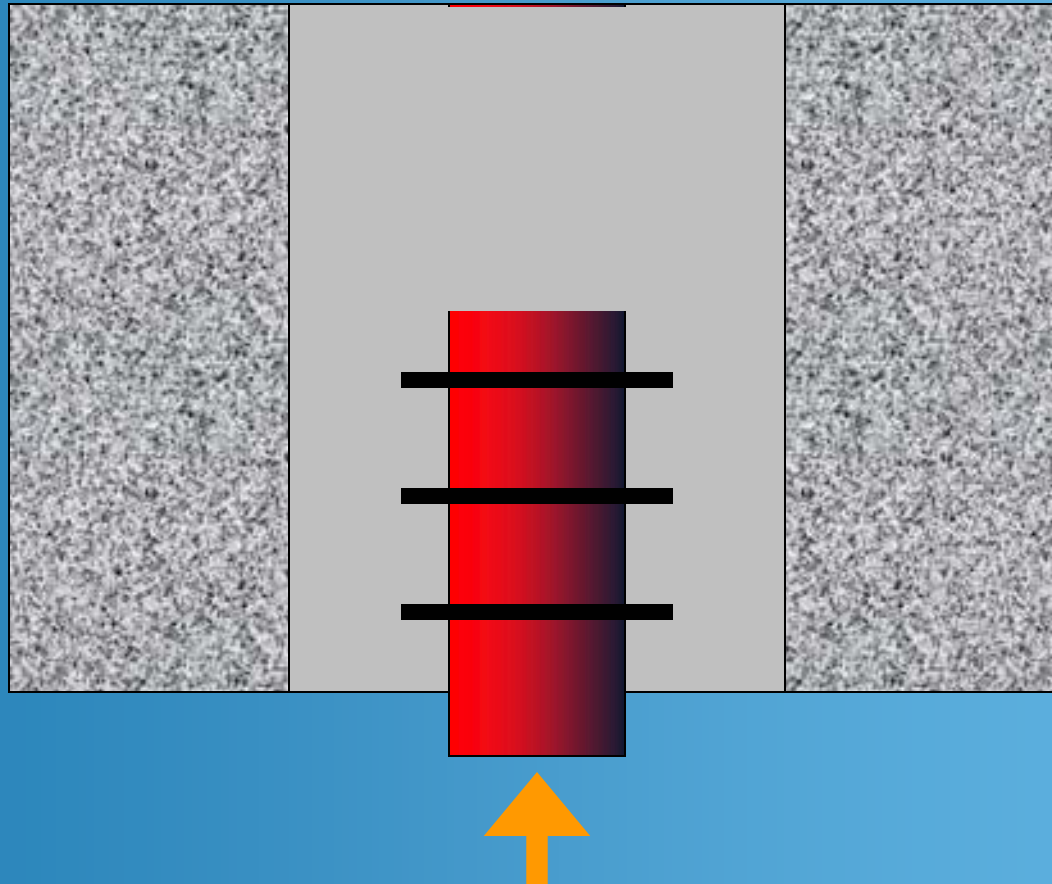
● DESIGN ISSUES

- **CONNECTION CAPACITY BETWEEN MICROPILE AND THE EXISTING CONCRETE**
- **HOW TO PREDICT IT?**
- **HOW TO IMPROVE IT?**
- **HOW TO ACCOUNT FOR IT?**

● CONNECTION TYPES



EXPERIMENTAL PROGRAM



TESTS



CONCRETE BLOCK REINFORCEMENT



- **LONGITUDINAL STEEL:**
4 – NO. 8 BARS **(25.4 mm)**
- **TRANVERSE STEEL:**
4 – NO. 8 BARS
- **$F_y = 60$ KSI **(414 MPa)****
- **1% BY VOLUME OF THE CONCRETE BLOCK**

SMOOTH INSERTS



- **4.5" OD (114.3 mm)**
CASING, API N80
- **0.531" WALL**
THICKNESS (13.5 mm)
- **1.75" OD (44.5 mm)**
REINFORCING BAR
GRADE 75 KSI (517 MPa)

SAS BAR INSERTS



➤ **1.75" OD (44.5 mm)**
REINFORCING BAR
GRADE 75 KSI (517 MPa)

TEXTURED INSERTS



● STRAIN GAUGES



● PREDRILLED HOLES



- **CAST IN BLOCK**
- **PREDRILLED HOLE DIAMETERS:
4.5 – 5 – 6 – 8 INCH
(114 - 203 mm)**
- **LENGTH:
17 – 24 – 35 INCH
(432 – 890 mm)**
- **STYROFOAM AT BOTTOM OF
HOLES TO AVOID END BEARING**

● **PREDRILLED HOLES**



- **NUMA CHAMPION 60HFE
DOWN HOLE HAMMER**
- **ROUGH HOLE WALLS**
- **TWO OR THREE HOLES PER
BLOCK**

● PREDRILLED HOLES



GROUTING OF ANNULUS

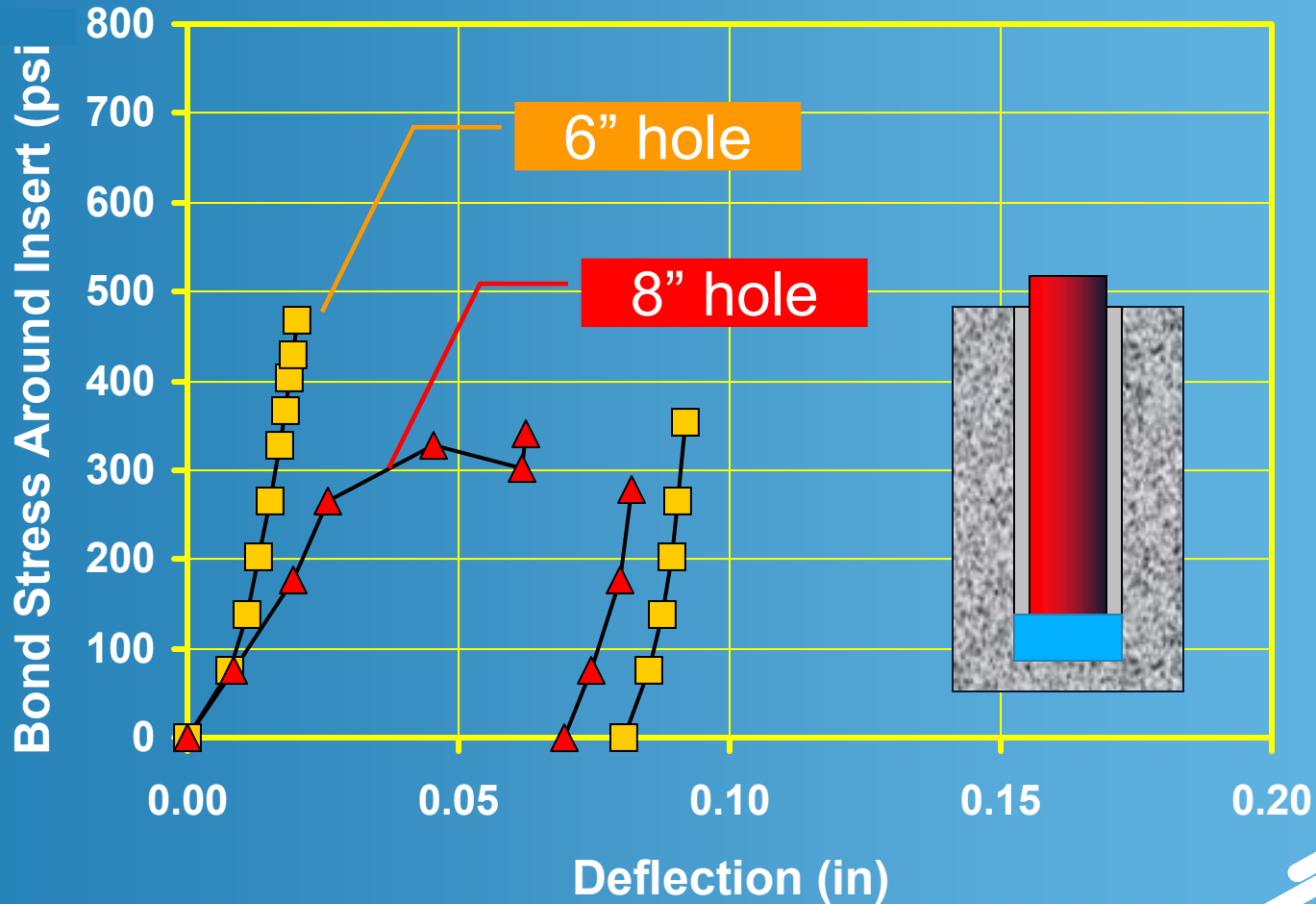


- **0.45 W/C RATIO**
- **$F'_c = 6,400$ PSI
AVERAGE AT 28
DAYS (44 MPa)**
- **$E = 900$ TO 1,200 KSI
(6200 TO 8300
MPa)**

TESTING

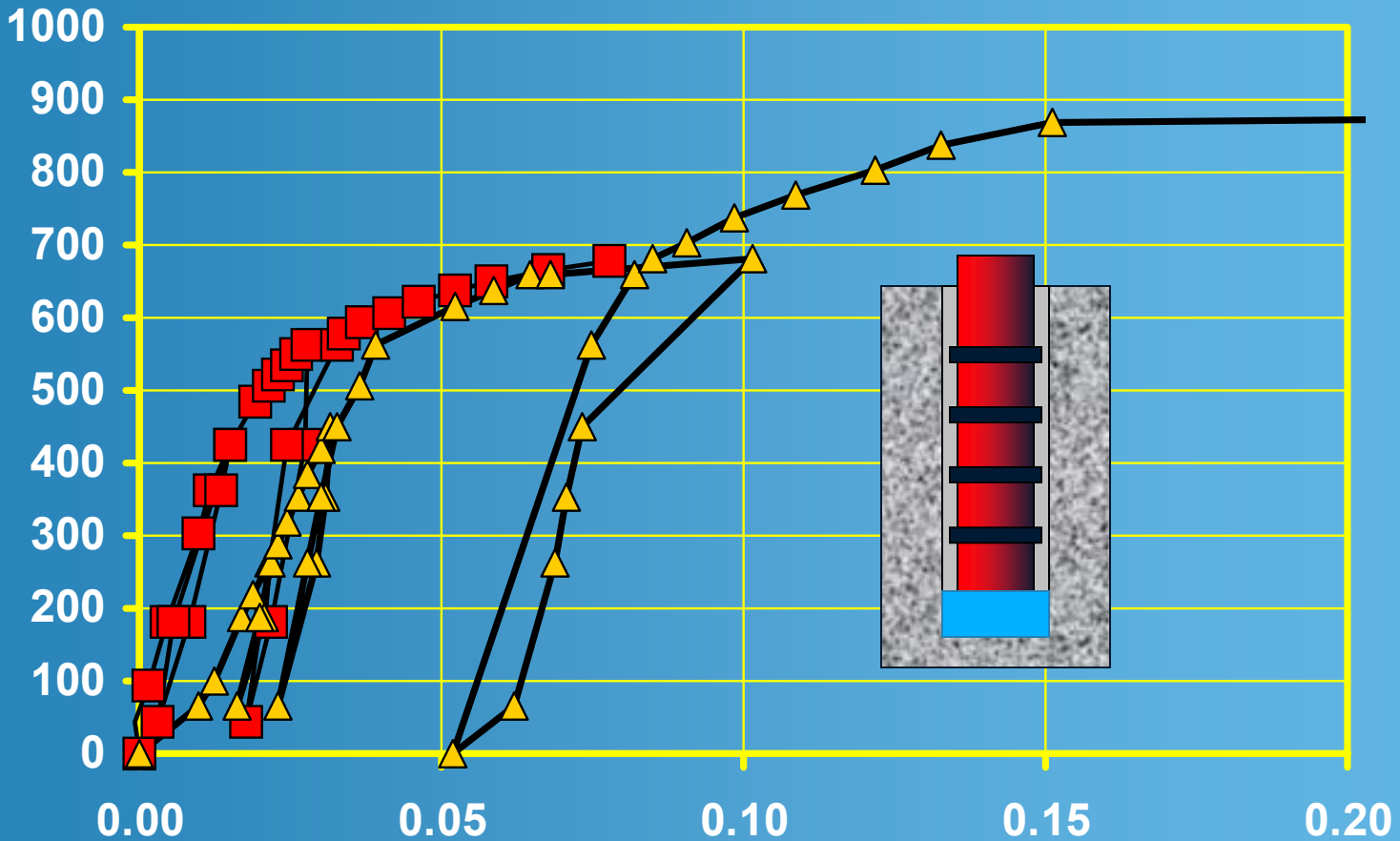


SMOOTH INSERTS



TEXTURED INSERTS

Bond Stress Around Insert (psi)

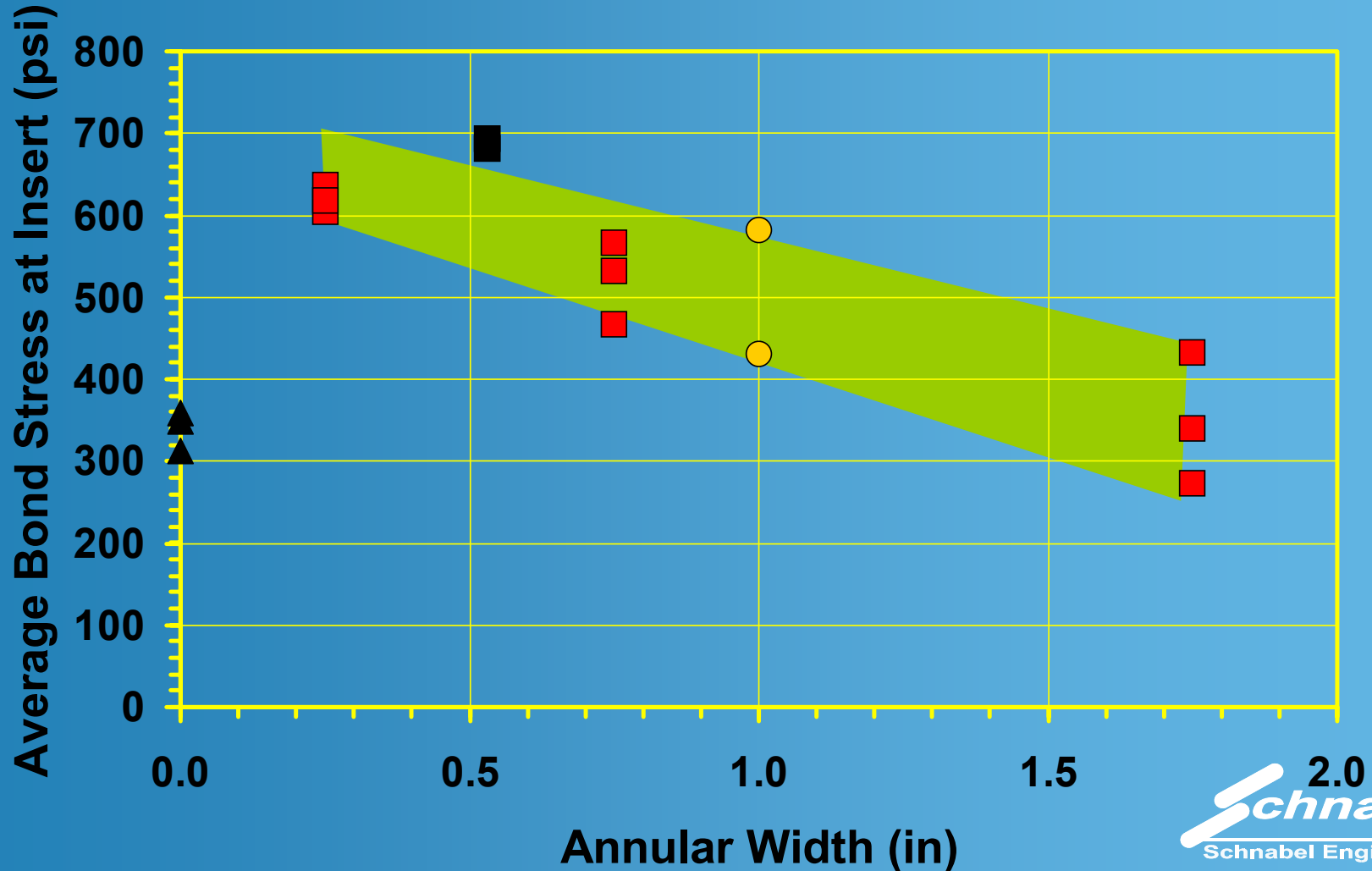


Deflection (in)

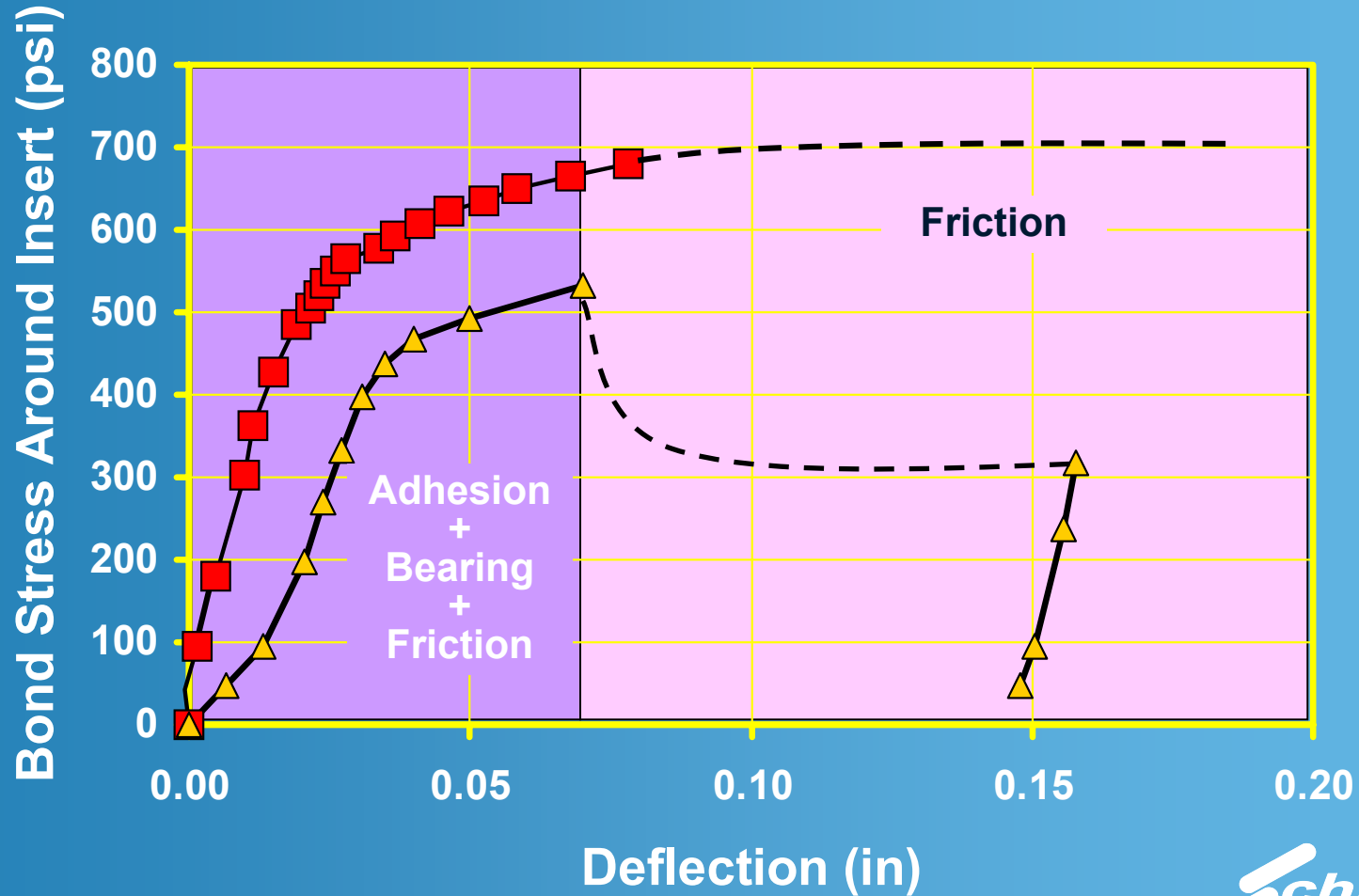
TEXTURED INSERTS



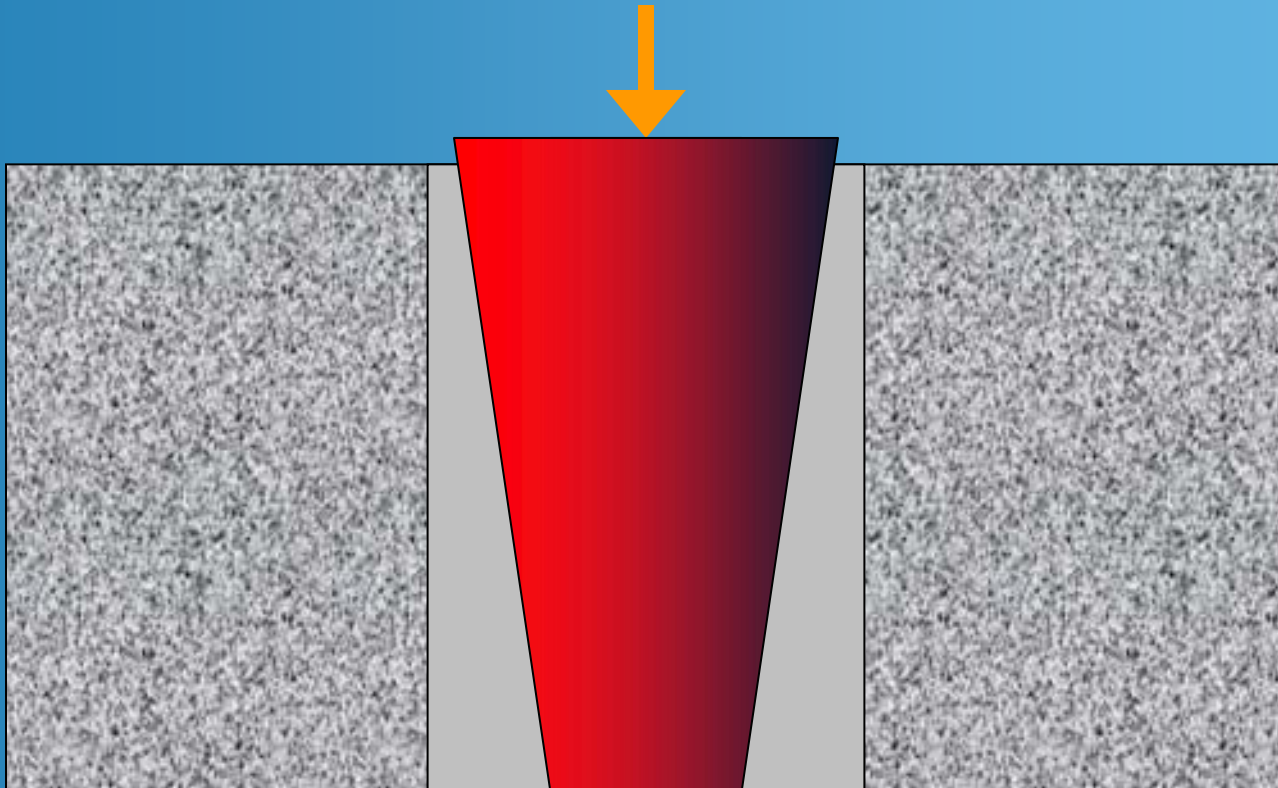
SUMMARY OF TEST RESULTS



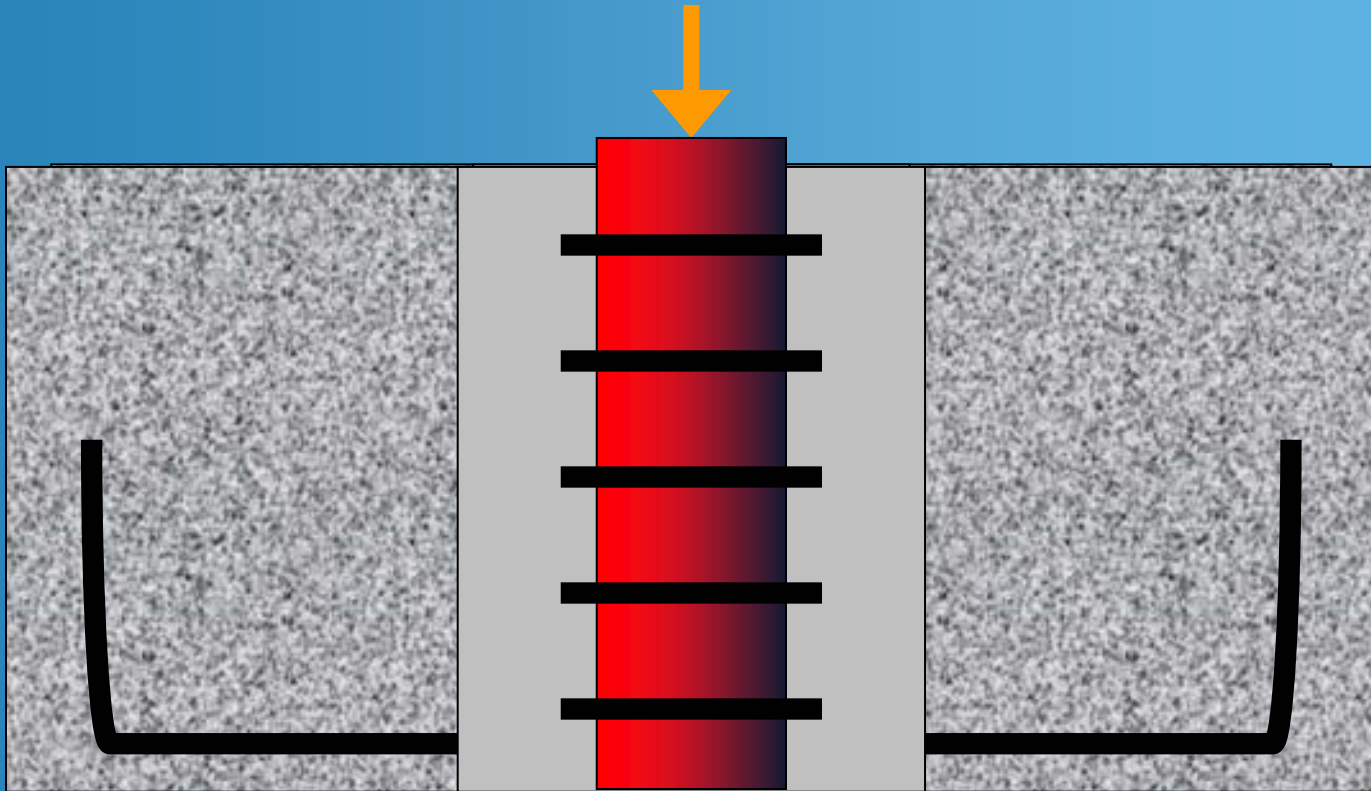
MECHANISM OF BOND STRENGTH



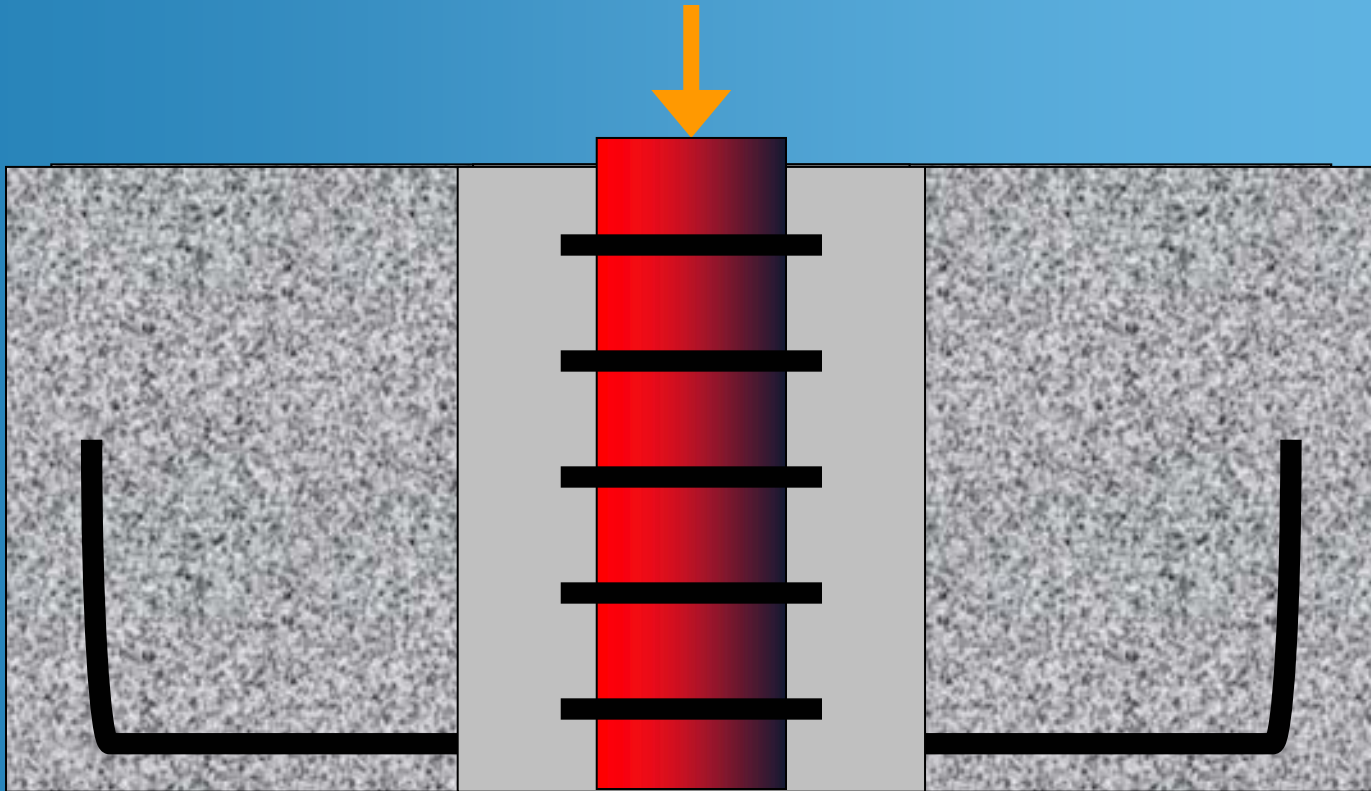
POISSON EFFECT



EFFECT OF SURFACE ROUGHNESS



EFFECT OF SURFACE ROUGHNESS



● FRICTION MECHANISM

- **LATERAL EXPANSION DUE TO POISSON EFFECT AND DILATION DUE TO SURFACE ROUGHNESS**
- **RADIAL NORMAL STRESSES AND TENSILE TANGENT STRESSES (HOOP STRESSES)**
- **FRICTION ALONG MICROPILE SURFACE**
- **IF BLOCK IS UNREINFORCED, NORMAL STRESS LIMITED BY CONCRETE TENSILE STRENGTH**
- **IF BLOCK REINFORCED, REBAR YIELD STRESS MAY CONTROL**
- **LOWER COMPRESSIVE STRESSES AND FRICTION FOR LARGER ANNULAR SPACE**

PREDICTION OF CAPACITY

- **ESTIMATION OF THE CAPACITY OF TEXTURED CONNECTIONS IS POSSIBLE BASED ON FOOTING REINFORCEMENT (SEE REPORT)**
- **NOT EASY FOR SMOOTH CONNECTIONS**
- **ALWAYS TEST FOR CRITICAL PROJECTS OR LARGE CONNECTION LOADS**

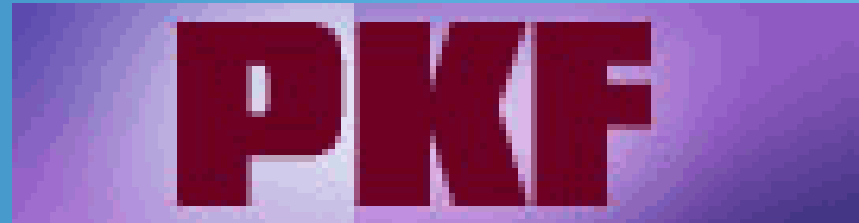
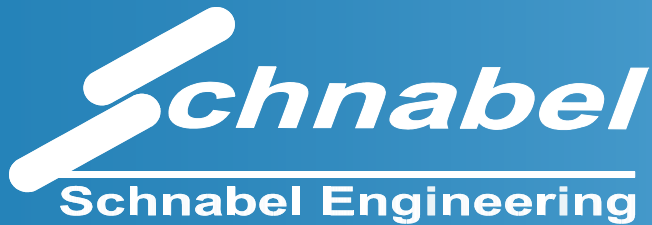
● CONCLUSIONS

- **NEAT CEMENT GROUT PROVIDES SIGNIFICANT BOND >200 PSI IN TESTS PERFORMED**
- **TEXTURING OF MICROPILE SURFACE MAY SIGNIFICANTLY INCREASE BOND**
- **REINFORCEMENT OF FOOTING IS CRUCIAL TO BOND STRENGTH, ESPECIALLY FOR TEXTURED MICROPILES**

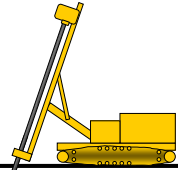
CONCLUSIONS

- **BOND STRENGTH DECREASES FOR INCREASING WIDTH OF ANNULAR SPACE AROUND MICROPILE**
- **MAY USE EXPERIMENTAL CHART FOR PRELIMINARY ESTIMATE OF BOND STRENGTH FOR DESIGN OF SMOOTH MICROPILES**
- **FOR SMOOTH MICROPILES, RECOMMEND TO PERFORM SPECIFIC TESTS IF DESIGN BOND > 250 PSI ULTIMATE**
- **WATCH FOR EXPERIMENTAL SCATTER**

Acknowledgement



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Specialty
Geotechnical
Construction



Foster
Piling

The logo for GEOKON features the word "GEOKON" in a bold, blue, sans-serif font. The letter "G" is significantly larger than the other letters. The text is set against a dark grey background with a subtle horizontal line above the letters.

The logo for SASstressteel features the word "SASstressteel" in a bold, blue, sans-serif font. The text is set against a background of a blue grid pattern with vertical bars of varying heights, suggesting a steel structure or rebar.