SELF CONSOLIDATING CONCRETE FOR CONCRETE REPAIR

ICRI Fall Convention

Nov 14 – 16, 2018

DEFINITION AND CHARACTERISTICS

- Concrete Mix
- Low yield stress
- Moderate viscosity
- Highly deformable when plastic
- Flows with its own weight without requiring external compaction or consolidation
- Properties approach self-leveling
- **Does not segregate or bleed**

HISTORY

- Compared to conventional concrete, it's really really new!
- Developed in 1986 in Japan by Prof. Okamura at Ouchi University
- Driving need was that it could be placed by less skilled labor
- First generation typified by high cement and admixture concentrations
- Viewed as a specialty material for repairs and congested areas

Prof.Dr.Hajime Okamu

Kochi University of Tec

ADVANTAGES

- Ease of placement
  - High flow
  - No vibrating
- Gets into congested and detailed areas
  - Reduced or no honeycombing
  - Faithfully reproduces complicated architectural formwork
  - Fills between rebar
- Faster placement
- Easier to mix and pump
- Economical
- Better bond strength (30% higher at 30 MPa 10% higher at 60 MPa)

ASTM C1621

Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring

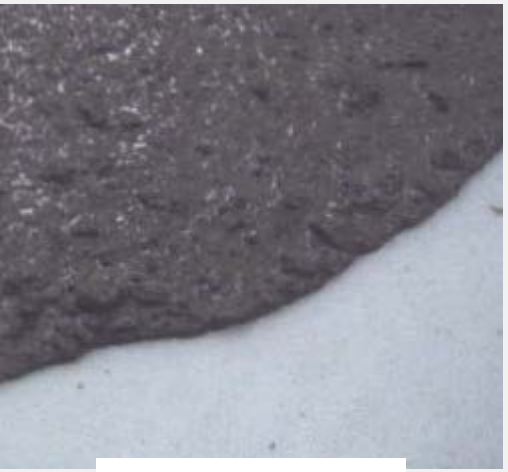
ASTM C1610

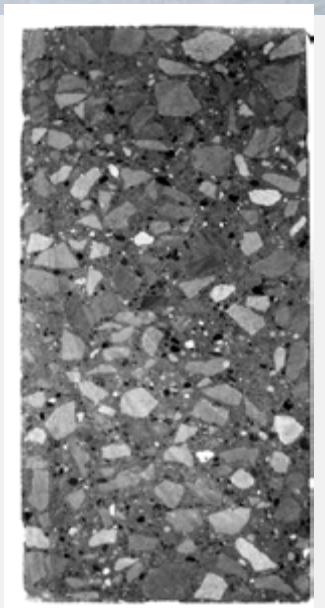
Test Method for Static Segregation of SCC Using Column Technique

Desirable: <15% Deviation

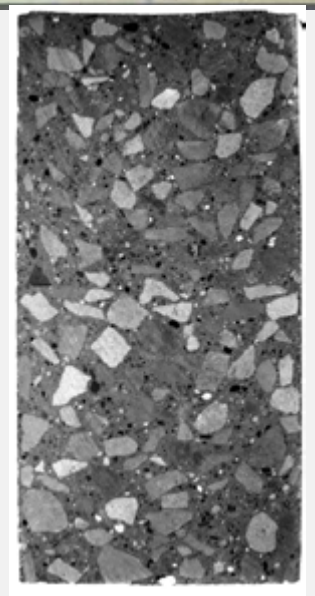
AASHTO 351, PP58 – Visual Stability Indices

Highly Stable

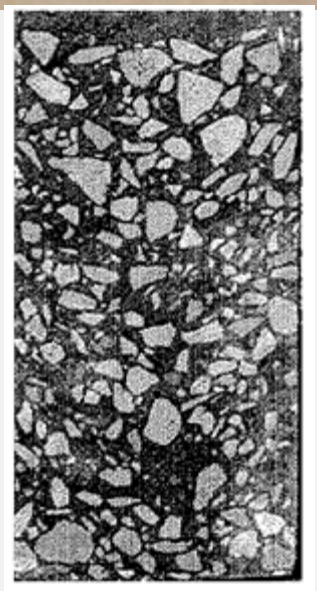




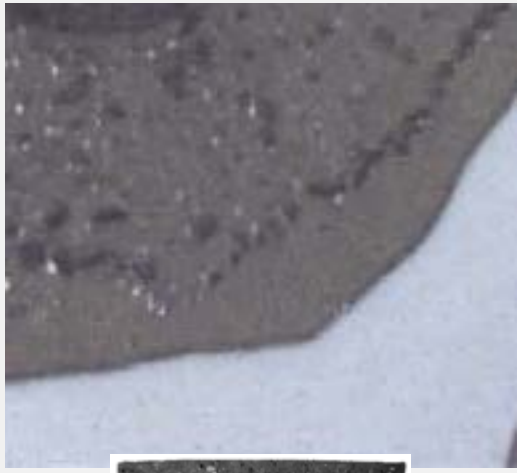
Stable

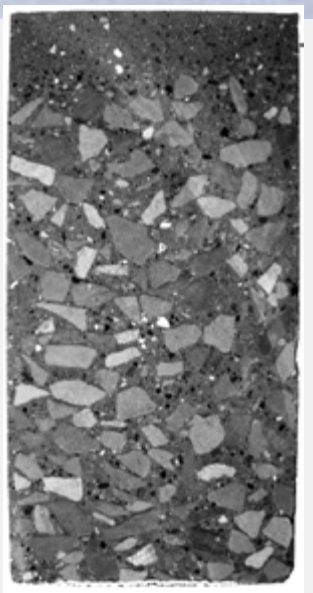


Unstable



Highly Unstable





GUIDELINES FOR SCC MIX DESIGN

- More portland cement than CVC (Conventionally Vibrated Concrete)
- Superplasticizer
  - Increased flow
- Rheology modifier
  - Resistance to segregation
  - Depending on which modifier is used, can increase longevity of the concrete
- Specific aggregate selection
  - Carefully controlled aggregate size and proportion
    - 50% of total solid volume - coarse aggregate

MATERIAL COST

The cost of the ingredients of SCC is marginally higher (than NVC) by about 10-15 percent. (Pai, 2004)

Pre-packaged SCC are approximately 15% higher in price than similar quality pre-packaged NVC

Depending on the market, some ready mix concrete suppliers will charge a premium of 30% for SCC vs NVC

Maybe just maybe, pre-packaged is a better value?? I'm just sayin'

LABOR AND PRODUCTION COST

- A case study for tracking the time required for placing double-tee beds in a precast plant reported a reduction of 20% compared to a conventional mixture, with a 32% reduction of labour involved in the process (Martin, 2002).
- Regardless of the applications, an average reduction in labour during the placing process is estimated to be about 30% using SCC (Schlagbaum, 2002).
- SCC may result in up to 40% faster construction than using NVC (Perssoiv, 1998; Nocher, 2001)

AGGREGATE SELECTION

- Out of the three ingredients (cement, fine agg, coarse agg) the shape and size of coarse aggregate has more influence on the properties of fresh and hardened concrete.
- The results of this study show that the flowability and strength of the high volume flyash SCC concrete mix with 10 mm to 16 mm MSA (3/8" to 5/8")is found to be better than low volume flyash SCC with 20 mm MSA (3/4").

(Pandurangan 2012)

[Please note American sizing is not a direct conversion, but the closest standard equivalent sizing]

THE ROLE OF AGGREGATE IN CONCRETE

BY GEORGE SEEGEBRECHT

From

concretenetwork.com

Quality Counts

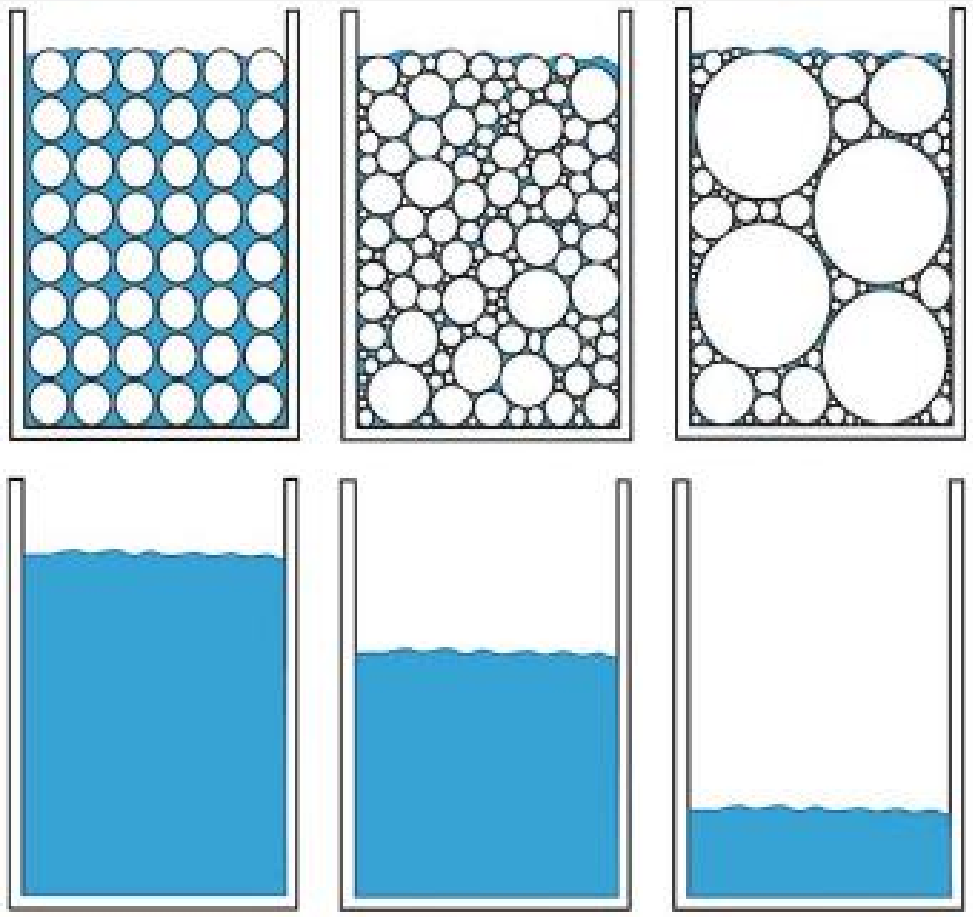
- Make sure that your concrete producer purchases good-quality aggregate as verified by regular aggregate test results in compliance with ASTM C 33, "Standard Specifications for Concrete Aggregates." A history of good performance of a local aggregate also provides an indication of how well the material performs in service.
- Good-quality aggregate must be clean, hard, strong, have durable particles, and be free of absorbed harmful chemicals, coatings of clay, or other contaminates that can affect hydration of cement or reduce the paste-aggregate bond.

IMPORTANCE OF AGGREGATE SIZE DISTRIBUTION

Water/Cement ratio is reduced by filling the gaps with properly graded aggregate

Flow of material is optimized without excessive water

Durability is increased, shrinkage is decreased



ASTM C33
3/8” AND CONCRETE SAND

Sieve (ASTM E11) Percentage Passing

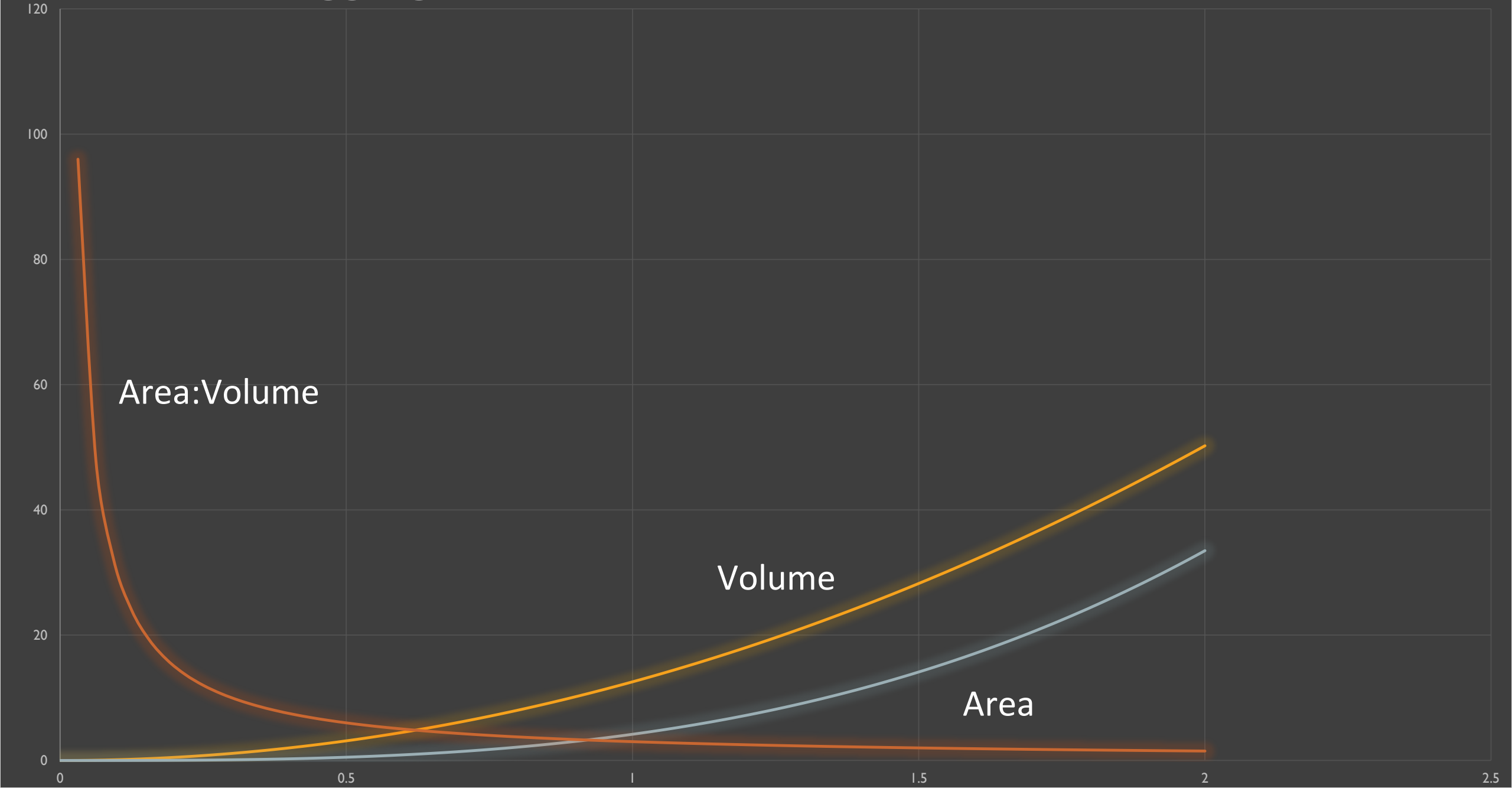
12.5-mm (1/2-in.) 100
9.5-mm (3/8-in.) 85-100
4.75-mm (No. 4) 10-30
2.36-mm (No. 8) 0-10
1.18-mm (No. 16) 0-5
600-µm (No. 30)
300-µm (No. 50)
150-µm (No. 100)

NOT ALL "GRADED" AGGREGATE IS ALIKE

Sieve (ASTM E11) Percentage Passing

9.5-mm (3/8-in.) 100
4.75-mm (No. 4) 100
2.36-mm (No. 8) 100
1.18-mm (No. 16) 50 to 85
600-µm (No. 30) 30 to 40
300-µm (No. 50) 0 to 10
150-µm (No. 100) 0

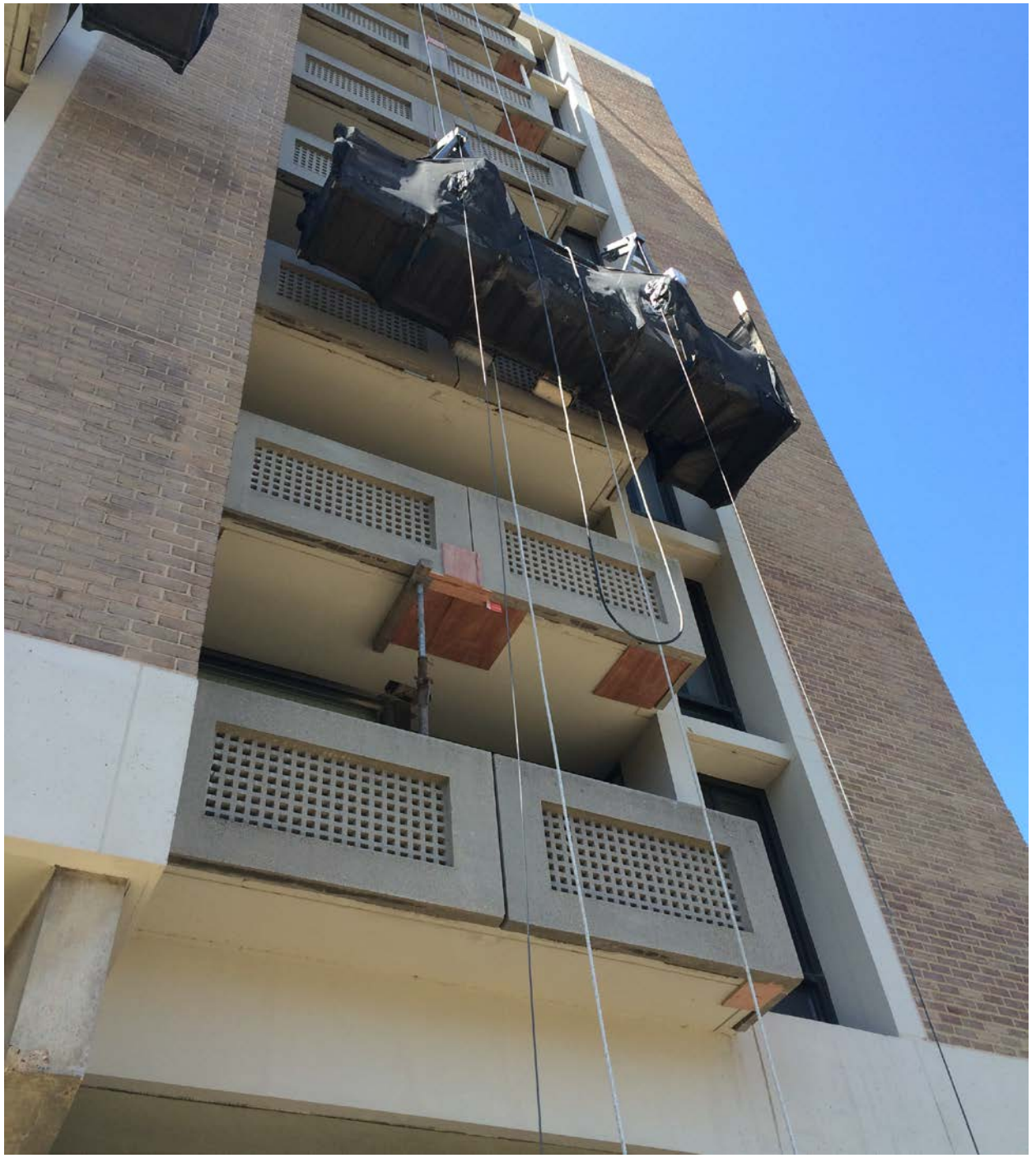
Aggregate Size vs. Area, Volume and A/V Ratio

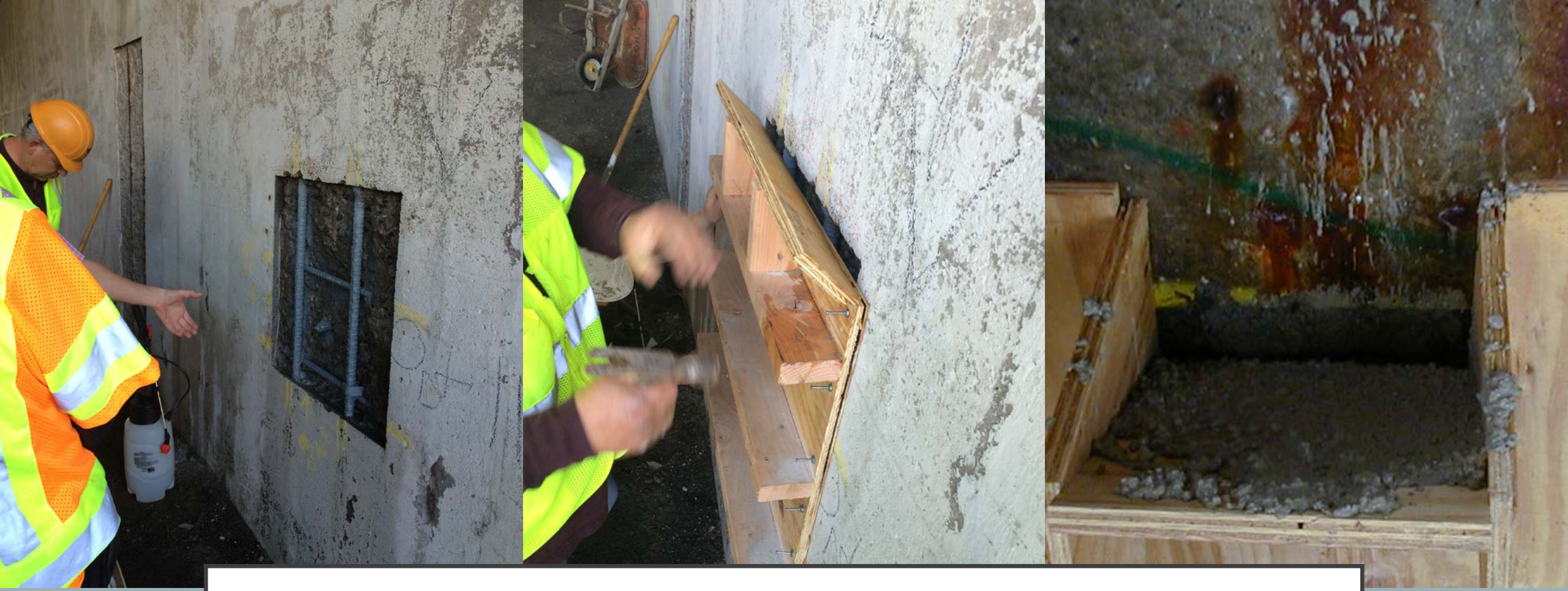


COLUMN CAPITAL

COLUMN EXPANSION

BALCONY REPAIR





HIGHWAY ABUTMENT WALLS

COMPLEX CORNER REPAIR

COMPLEX CORNER REPAIR