Repairing Concrete with Concrete

US CONCRETE PRODUCTS

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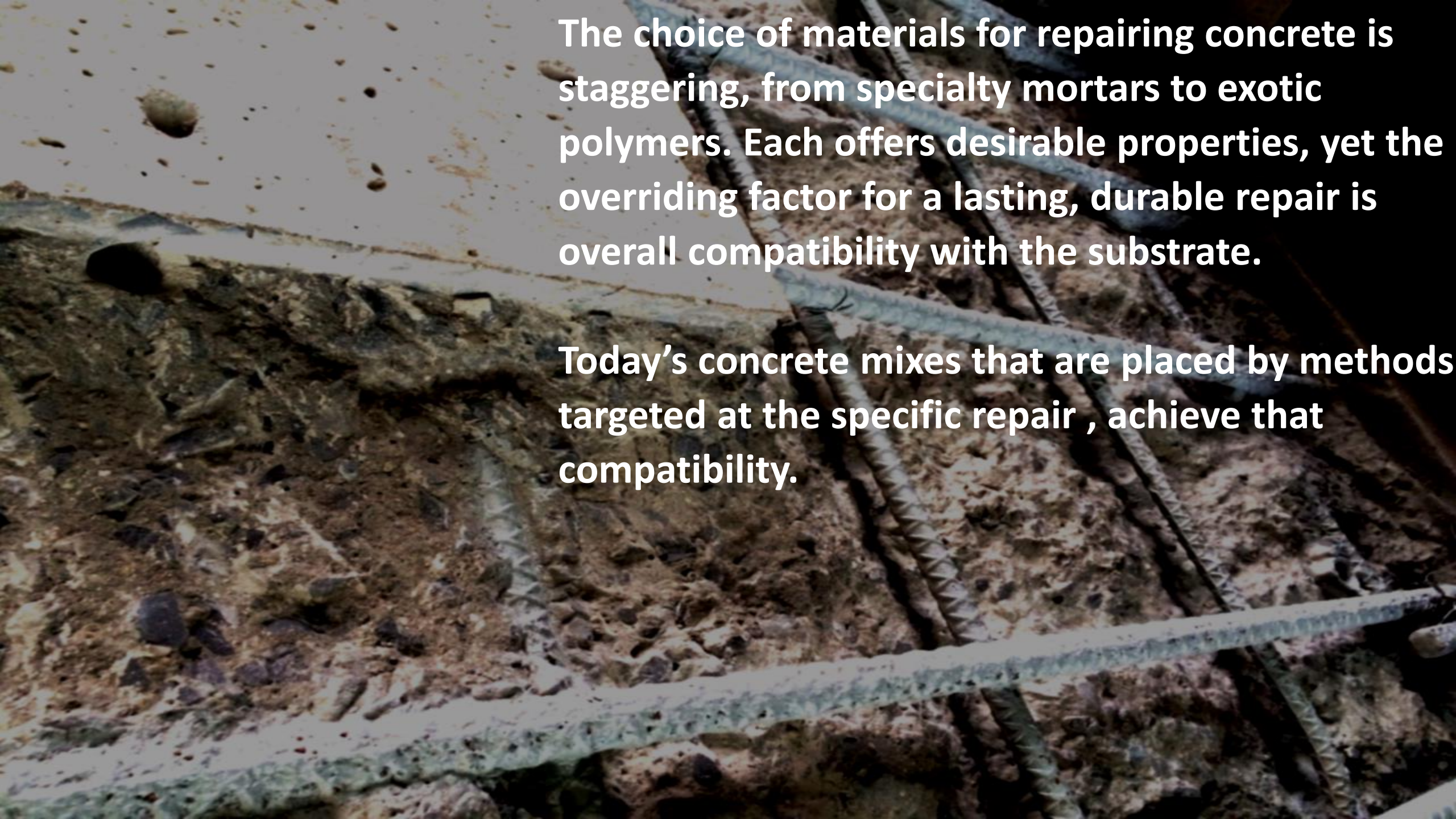
ICRI Fall Convention 10.16.2015



The choice of materials for repairing concrete is staggering, from specialty mortars to exotic polymers. Each offers desirable properties, yet the overriding factor for a lasting, durable repair is overall compatibility with the substrate.

Today’s concrete mixes that are placed by methods targeted at the specific repair , achieve that compatibility.

Objectives

Basic definitions: Concrete, mortar

Properties for a successful repair

When to use cement based mortars

When to use epoxies & other chemical repair systems

What is the role of coarse aggregate

Concrete design mixes for specific applications

Different ways to place concrete to achieve easy lasting repairs

Concrete:

Cement

Concrete sand and coarse aggregate

Quality Concrete:

Cement - ASTM C 150

Ensures the proper chemical make up for consistency in performance and long term durability

Concrete sand and coarse aggregate - ASTM C 33

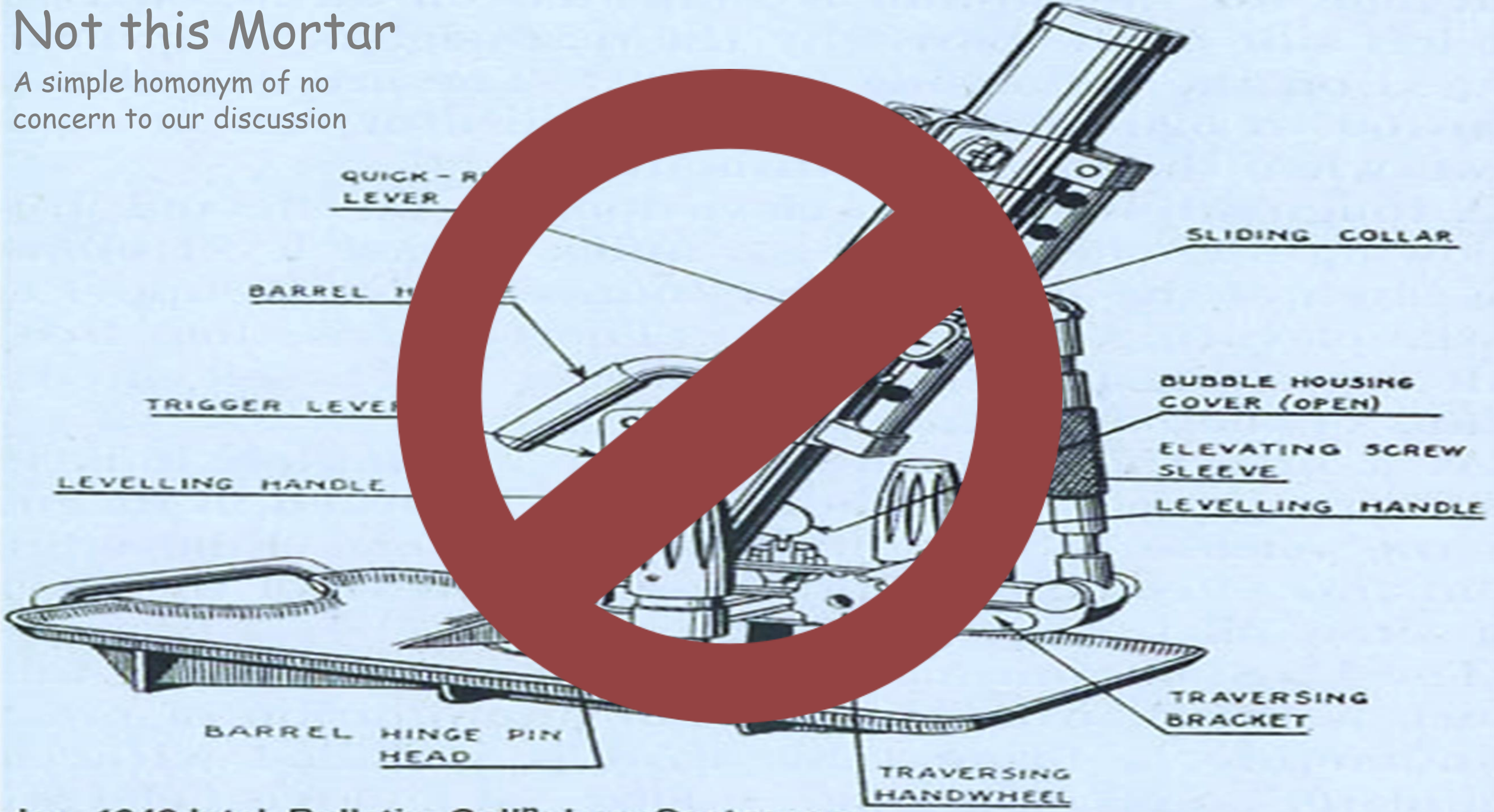
Specified gradation ensures proper aggregate distribution

Optional Admixtures – ASTM C494

Enhance specific performance

Not this Mortar

A simple homonym of no concern to our discussion



Jan. 1943 Intel. Bulletin, Coll^{n}: LoneSentry.com


This Mortar
A mixture of cement paste and fine aggregate. (ACI Definition)

Balanced Mix Designs Make Better Concrete

Παν μέτρον ἄριστον

Everything in excellent measure

Don’t sacrifice **performance** for excessive compressive **strength**

An excess of one property can diminish overall effectiveness

High Strength achieved by excessive cement

↓

Shrinkage, poor workability, cracking

Fast strength using too much rapid setting cement

↓

Thermal stress cracking, short working time

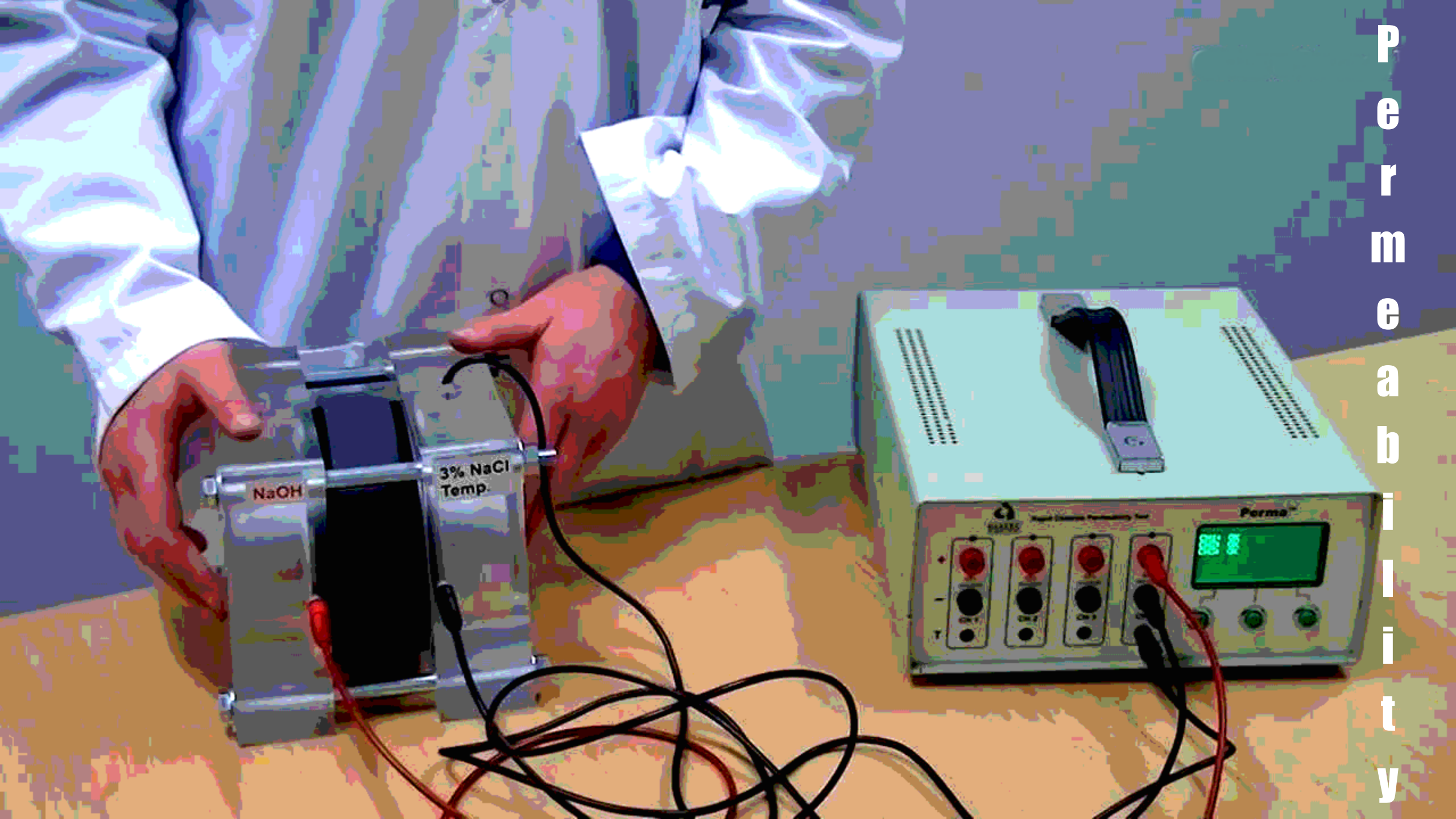

Placeability

Compressive Strength

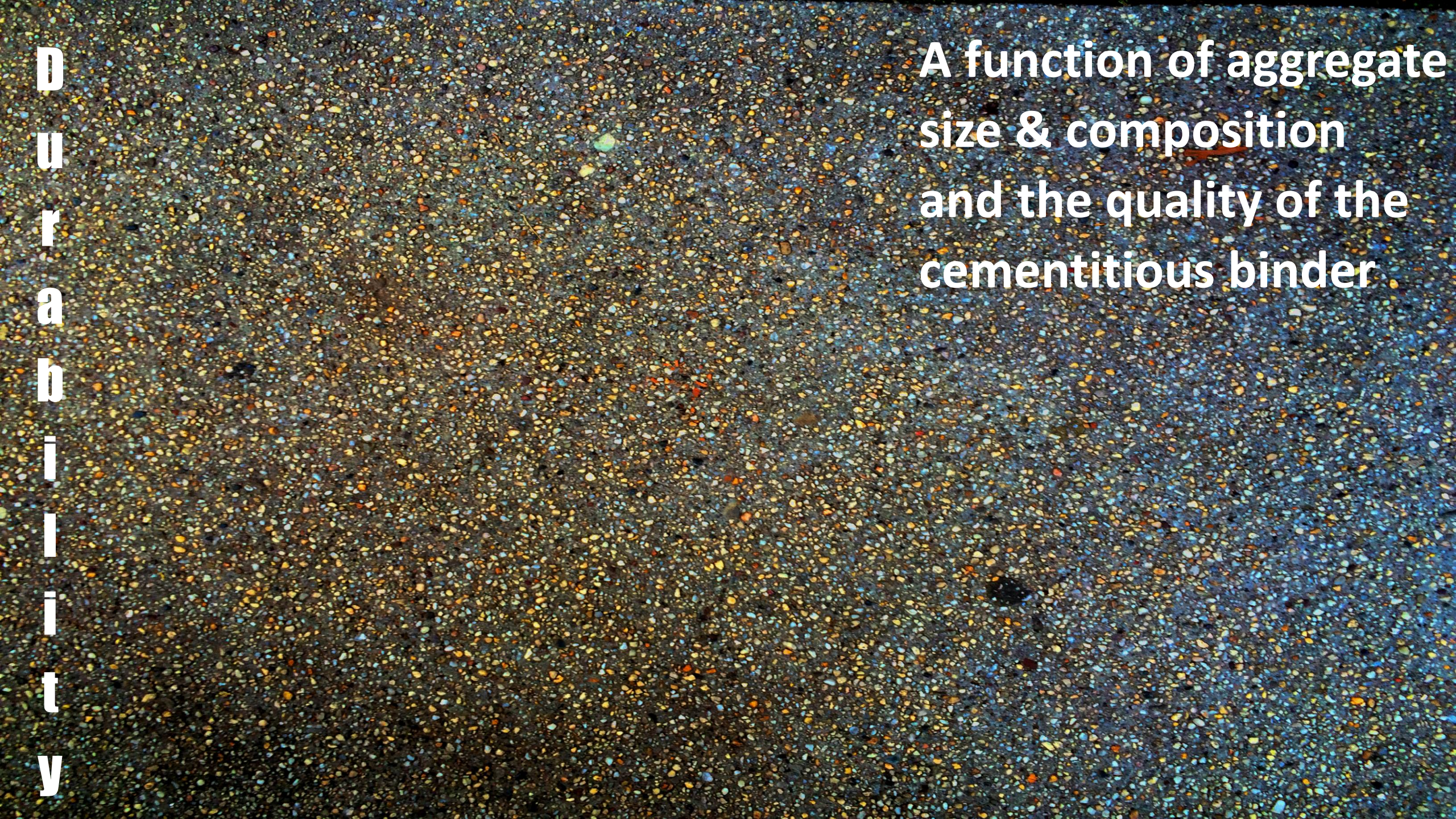
The FIRST thing we think of when we think concrete


Tensile & Bond


Flexural

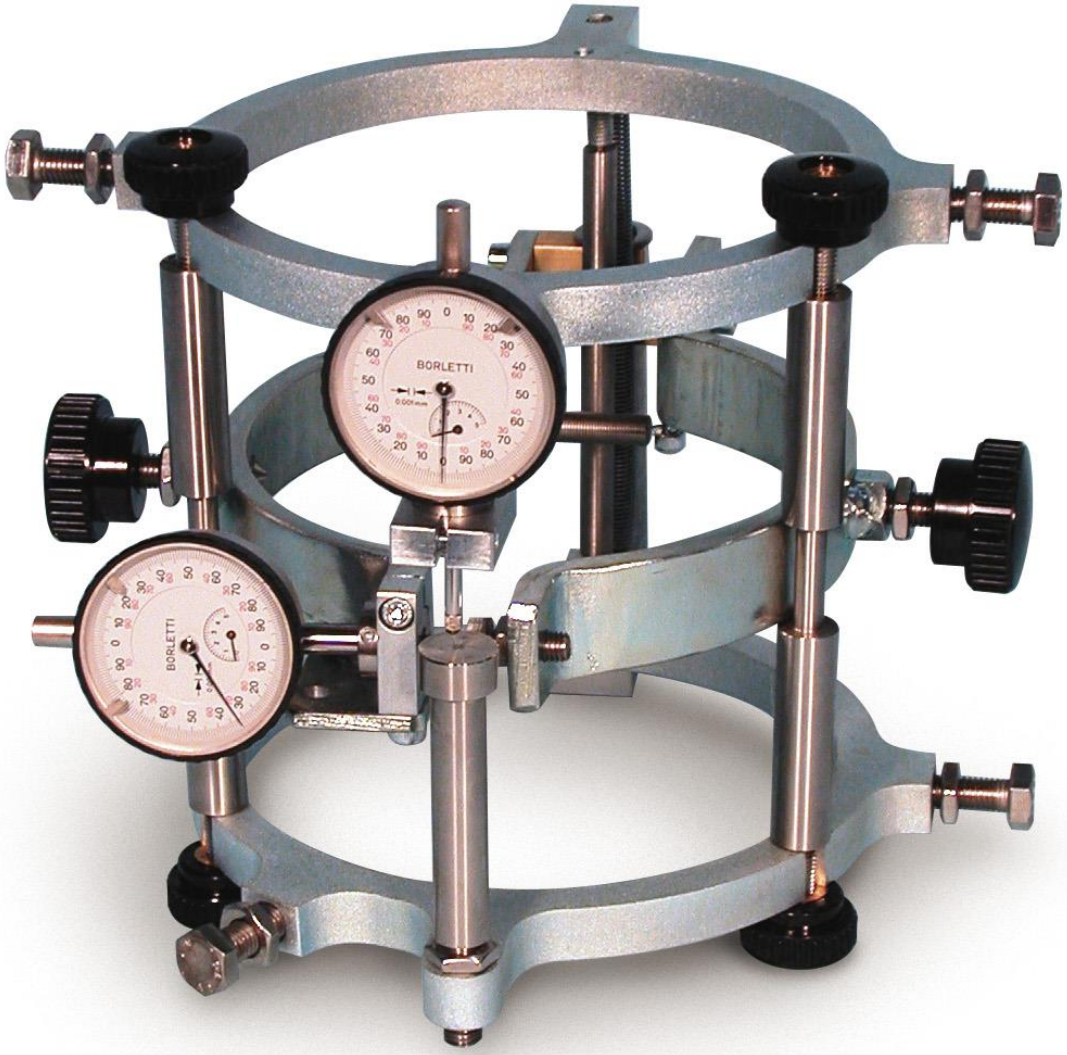


Permeability


Durability
A function of aggregate size & composition and the quality of the cementitious binder

Shrinkage

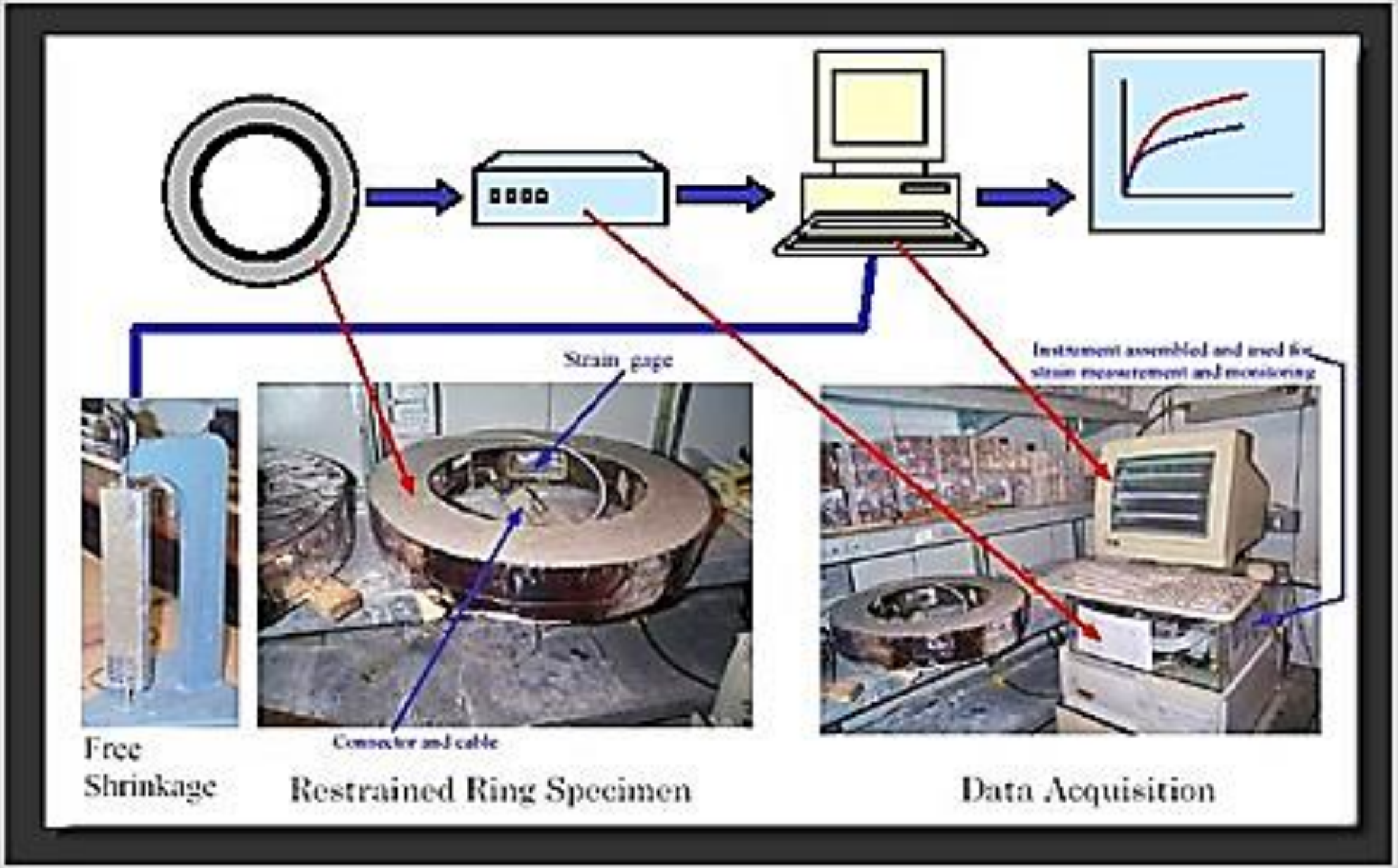
Modulus Elasticity



E= 33 w^1.5 *f^ 0.5

The Modulus = 33 * unit weight to the 1.5 power * the square root of the compressive strength

Crack Resistance




Freeze Thaw

Thermal Compatibility

Coefficient Thermal Expansion

Concrete

4 to 7 * 10^{-6}(in/in)/°F

Epoxy & Other Resins

25 to 36 * 10^{-6}(in/in)/°F

5 to 7 times!


corrosion
inhibition

The only mandatory reason to use mortar instead of concrete for a repair:

. The thickness of the repair cannot accommodate coarse aggregate.

ANY property that can be designed into a specialty mortar, can be designed into a specialty concrete

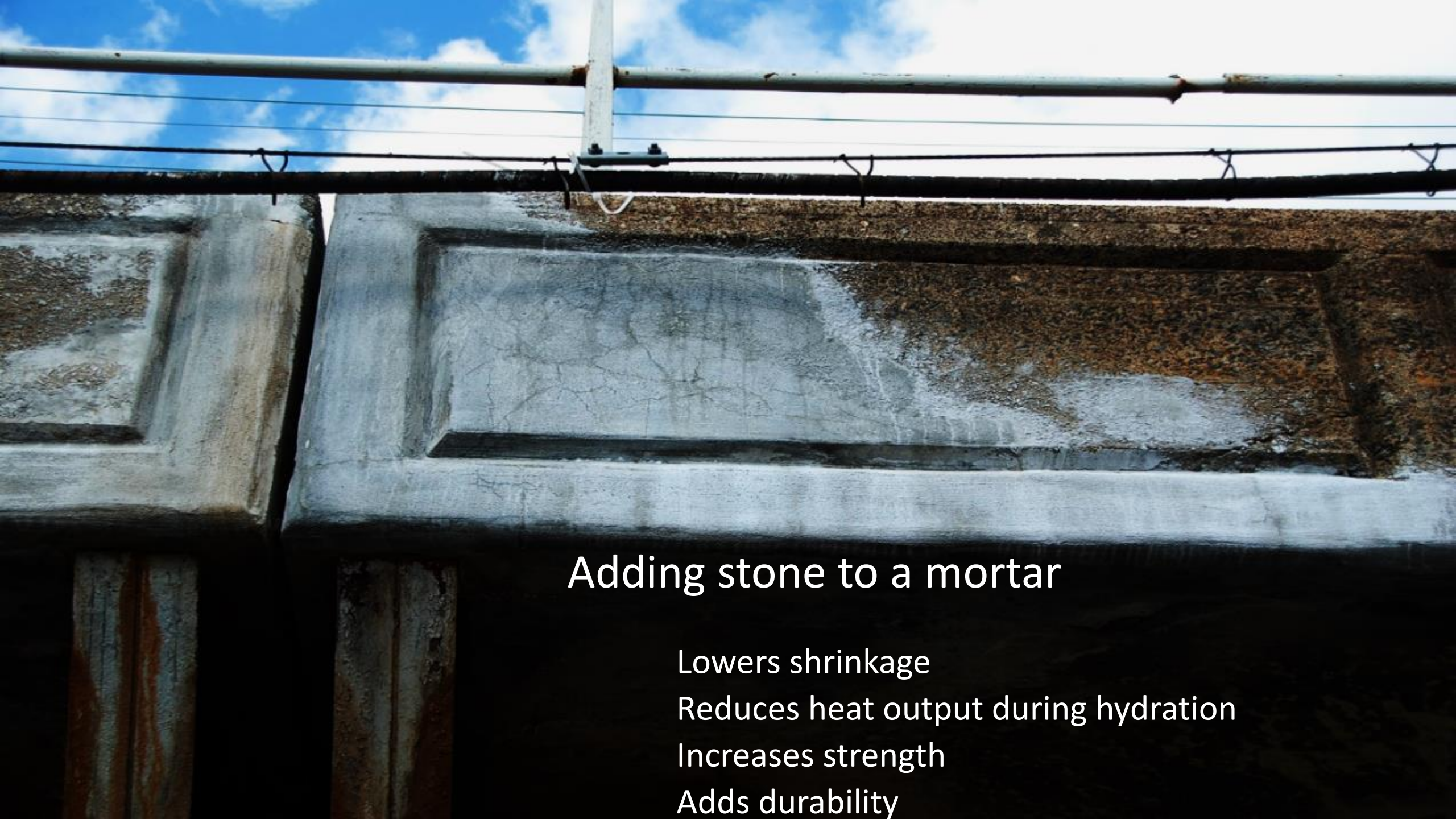
For deeper patches, a 55 lb (25 kg) bag of XXXXXXXXX may be extended by adding up to 30 lbs (13.6 kg) of thoroughly washed, SSD, sound, non (ASR) reactive ¼–½" (6–13 mm) rounded aggregate. When using angular aggregate, reduce the maximum amount added to 25 lbs (11.4 kg) to obtain the proper workability.

Addition of coarse aggregate, meeting ASTM C 33, should be used for pours greater than 2 inches (50 mm) in depth.

For repairs over 2 in. (5 cm) deep, the material should be extended 60% by weight with clean, SSD, pea gravel with an approximate size of 3/8 in (9.5 mm) and conforming to the requirements of ASTM C 33.

For repair areas 2 – 4" (51 – 102 mm) in depth, the minimum recommended addition is 15 – 25 lbs (6.8 – 11.4 kg) of 3/8" (10 mm) washed, graded, rounded, SSD, low-absorption, high-density aggregate per 50 lb (22.7 kg) bag.
2. For areas greater than 4" (102 mm) in depth, the minimum recommended addition is 25 – 50 lbs (11.4 to 22.7 kg) of 3/8" (10 mm) washed, graded, rounded, SSD, low-absorption, high-density aggregate per 50 lb bag.
3. The maximum aggregate extension is 50 lbs (22.7 kg) of pea gravel per bag.

Areas where the depth of the repair area
to sound concrete is greater than 1-1/2”
the repair shall be made in lifts of 1-1/2”



Adding stone to a mortar

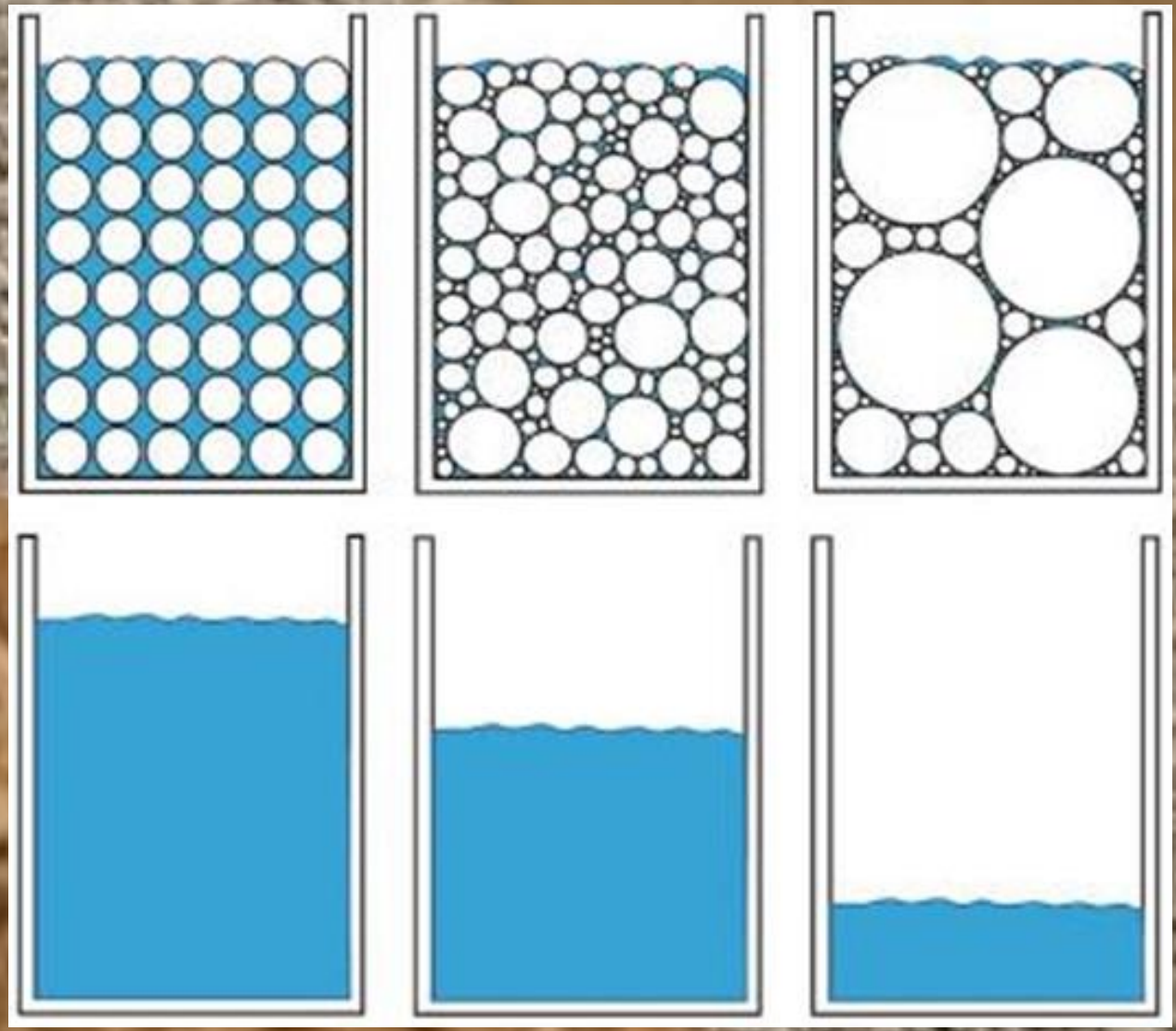
Lowers shrinkage
Reduces heat output during hydration
Increases strength
Adds durability

Gradation

More

is

Less



What about Epoxies?

High bond, flex, compressive strengths and chem resistance

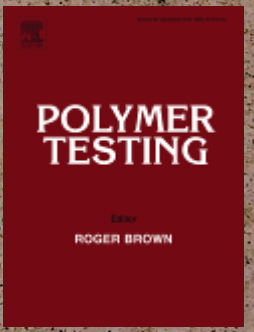
Move a lot more with temperature and are more elastic

With the addition of enough aggregate they can be made to approach some of the mechanical and thermal properties of concrete.
Of course at that point, they're chemical concretes.

Both formulations of plain polymer mortars present higher coefficients of thermal expansion at higher temperatures.

For both formulations … the variation of thermal expansion with temperature follows a polynomial law rather than a bilinear law. Therefore, it can be concluded that coefficients of thermal expansion of these materials vary continuously within the temperature range between 15°C and+60°C.

Thermal Expansion of Epoxy and Polyester Polymer Mortars
Polymer Testing Dec 2003



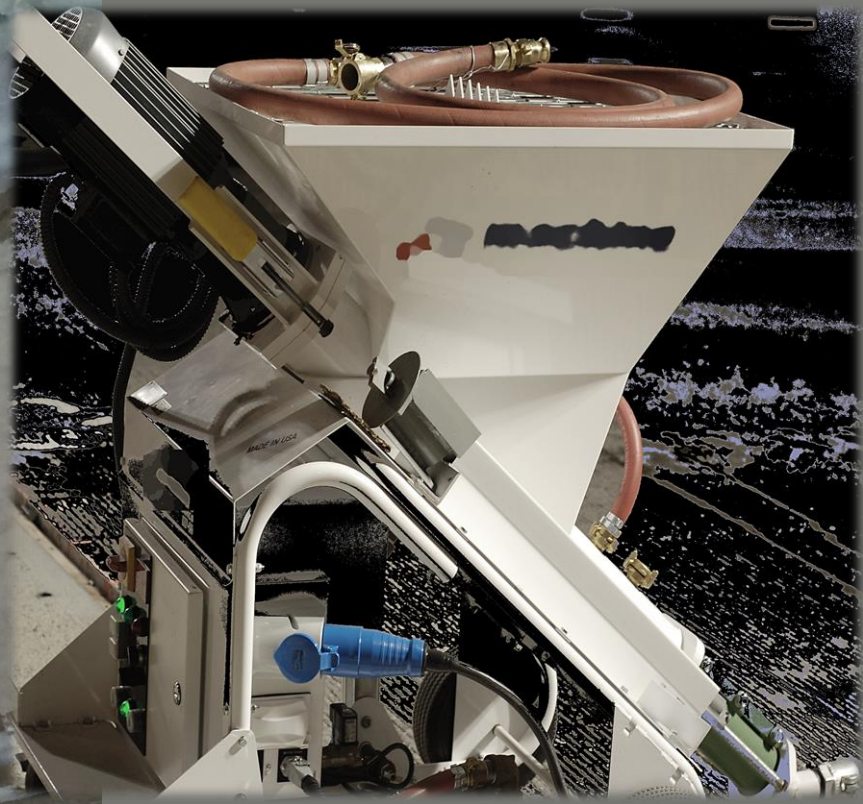

Horizontal Pour


Horizontal Pour – Fast Strength Required


Repair Using Precast Concrete


Form & Pour

Form & Pump




Wet Spray

Shotcrete

The vast majority of repairs can be made with a well-designed concrete that has the right amount and type of aggregates and admixtures.

The properties of the repair concrete should match those of the substrate.

The application method should be suitable for the size, orientation and environment in which the work is being performed.


Thank You!
EXIT 1A
We're Here!
Anything I can clarify or enhance?
EXIT
ONLY