

GFRC Learning Resources

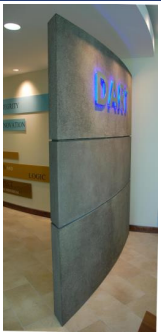
- **This seminar**
  - You will all receive the recording and PowerPoint slides
- **Free seminar "Understanding GFRC"**
  - Access from the Class Schedule page on the CCI website
- **Self-Study Comprehensive GFRC**
  - Includes 2 hours of hands-on videos, 54-page textbook, equipment list, mix calculator.
- **2-Day Hands-On Pro GFRC**
  - December 13-14, 2014 in Raleigh, NC

GFRC



GFRC







Furniture



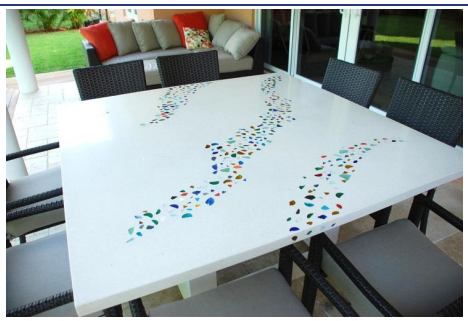




GFRC



GFRC



GFRC



GFRC





GFRC



GFRC



GFRC

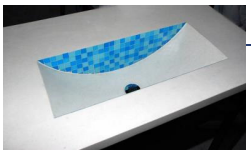


Fireplaces





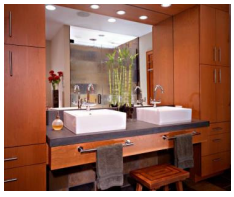

Sinks






Countertops



Possibilities are Endless

GFRC
- o Residential
- o Commercial
- o Interior
- o Exterior

Major steps in precast concrete countertop manufacturing:

ALL of these steps are important, not just the mix:

1. Templating
2. Forming
3. Reinforcing
4. Mixing, casting and curing
5. Processing
6. Sealing
7. Installation

Conventional Precast



Conventional Precast

Precise structural reinforcing
- o Reinforcing placed in tensile zone
- o Structural wire reinforcing:
  - o 9 gauge masonry block ladder wire
- o High performance concrete mix design
- o Thinner slabs 1.5" - 3"
- o Troweled, honed, polished or ground

2' x 8' x 4" countertop with dropped edges weighs about 400 lbs

Precast Methods

Hand packed





- Stiff, zero-slump concrete
- Variegated, hand-pressed or solid
- Often all-sand mix concrete

Precast Methods

Hand packed



- Single-sided molds (2D and 3D)

Precast Methods

Wet cast

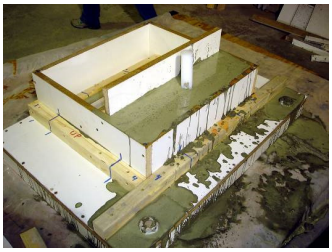




- Vibration
- Often aggregate based mix concrete

Precast Methods

Wet cast



- Single and double-sided molds (for 3D)

Precast Methods

GFRC





- Sprayed and hand placed
- Thin shells
- Single-sided molds (2D and 3D)
- Sand-based mix

Precast Methods

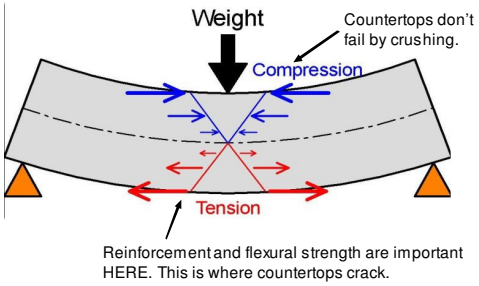
Choice of method depends upon:

- Skill
- Experience
- Speed
- Efficiency
- Design
- Look
- Ease
- Personal Choice

Beam Principles



How beams work:



Reinforcing controls flexing

- Countertops are beams
- Moving countertops is stressful
- Reinforcing controls flexing, provides strength

Steel Reinforced Concrete

- Block ladder wire

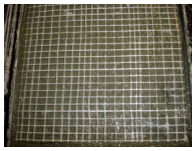


Glass Fiber Reinforced Concrete

GFRC uses AR Glass fibers

- Size
- Dosage
- Orientation
- AR Glass mesh (scrim)





Glass Fiber Reinforced Concrete

Scrim



GFRC: Origins

GFRC matured in 1970's

- Building façades
- Architectural details: columns, planters, etc.
- Artificial rock: zoos, pools, golf courses

- Las Vegas
- Disney
- Hotels
- Urban development

GFRC: Commercial Production



GFRC: Commercial Production



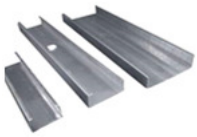
GFRC Structure

Structural shell

- Thin (3/4" to 1")
- Large pieces weigh less (8 to 12 lbs/sq ft)
- Structural AR glass fibers (1/2" to 1.5")
- High flexural strength – resists bending
- Capitalizes on shape, geometry for stiffness

GFRC Structure







GFRC: Strong



GFRC: Lightweight



GFRC Equipment





- GFRC is most often mixed by hand in small quantities.

GFRC Equipment





GFRC: Forming Benefits

Simplified Forming

- Complex, 3D shapes
- Single sided forms
- Little or no form pressure

GFRC Advantages

- Like hand packed, GFRC uses simple forming techniques.



GFRC Advantages

- Pieces can be stripped the next day and gain strength at a rate the same as high performance concrete.
- GFRC can be sprayed, hand packed or wet cast
  - Many different looks
  - Use all decorative concrete techniques
- Lighter weight
  - **2' x 8' x 4" countertop with dropped edges weighs about 200 lbs**

GFRC Disadvantages

- Cost
  - Specialized materials are 2/3rds material cost
  - Avg cost for ¾" GFRC = $3 per square foot
- Time
  - Hand packing backer takes longer than other precast methods
- Skill
  - Care and attention to detail are critical
  - Mix consistency
  - Rolling and compacting

GFRC Appearance

- GFRC can achieve very high casting detail.



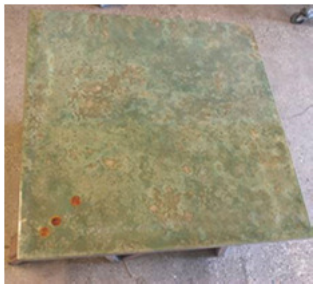
GFRC Appearance




- GFRC can achieve very uniform appearances.

GFRC Appearance

- GFRC can also be acid stained or have exposed aggregate.




GFRC: Casting Method

- Mist Coat – no aggregate, 1/16" thick
- or Face Coat – decorative agg. ¼" thick
- Backer – fibers, 3/8" to 1" thick




GFRC is cast in stages

Mist Coat: Sprayed



Face Coat: Hand-Packed



GFRC: Key Ingredients

- Polymer
  - Specialty polymers permit rapid stripping and quicker turnaround
- AR Glass Fibers
  - High volume of structural fibers gives high flexural strength

Polymer



Polymer

Polymer retains internal moisture

- Wet cure under plastic overnight
- Acts as an internal curing membrane
- GFRC can air cure and achieve 7 day wet cure strengths

GFRC Polymer reduces brittleness

- Concrete is more flexible
- Less prone to cracking

Glass Fibers



Glass Fibers

- Alkaline Resistant (AR)
- Fibers provide true tensile strength
- ½" (13mm) or ¾" (19mm) length
- Dosage based on total concrete weight
  - 3% = 3 lbs fibers in 100 lbs GFRC
  - GFRC fiber dosed up to 120x ordinary fibers

GFRC Mix Design

- 1 part fine sand
- 1 part cementitious material
- Water to cement ratios: 0.30 to 0.35
- 5% to 7% acrylic polymer (solids)
- 3% AR glass fiber content (3 lbs fiber / 100 lbs GFRC)

Cementitous material

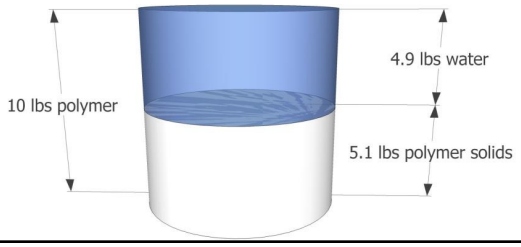
Portland cement + pozzolan

- Pozzolans: VCAS or metakaolin
  - Use 80% cement and 20% VCAS
    or
  - Use 90% cement and 10% metakaolin

Polymer: 5% to 7%

Water in polymer counts as mix water

- Polymer contains water + solids
- Forton VF-774 has 51% solids content



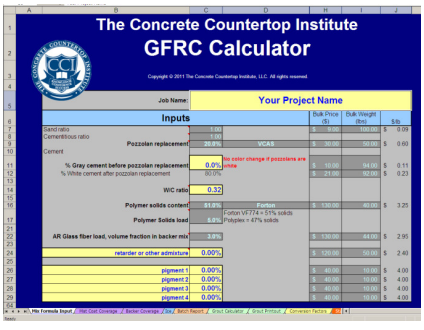
Fibers: 3%

Add fibers to the mist coat to create the backer coat.

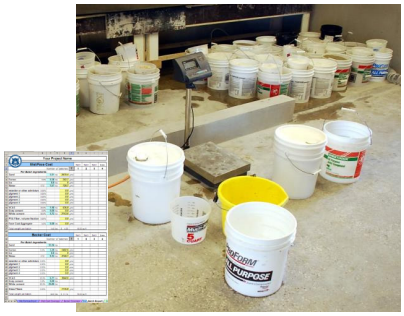
Fibers are **not** dosed the same way as pigments and admixtures.

- 3% *pigment* dose means you add 3 pounds of pigment to 100 pounds of cementitious material
- 3% *fiber* dose means you add 3 pounds of fibers to 97 pounds of mist coat for a total of 100 pounds of GFRC

GFRC Mix Calculator



Precision is essential for quality and consistency



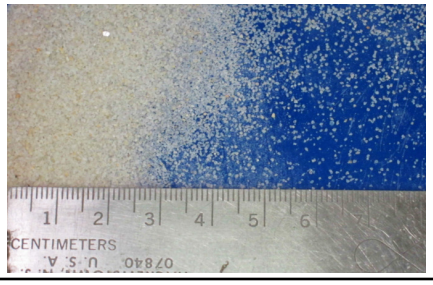
GFRC Mix

Sand

- Light or white in color
- Fine, uniform, clean and dry
- Silica blasting sand (#30, #20/#40)
- Coarser sands will work but have more blowback
- Finer sands are harder to spray (#50, #40/#70) and tend to trap more fine air bubbles (more pinholes)

GFRC Mix

#30 Silica Sand



GFRC Mix

Cement
- White Portland
- Gray Portland
- Calcium Sulfoaluminate (CSA)







GFRC Mix

Pozzolans (Portland cement only)
- VCAS – 20%
- Slag – 20%
- Metakaolin – 10-15%
- White silica fume – 10%

GFRC: Step by Step

- Mix Ingredients
  - Sand, pigment, pozzolan, water and polymer first.
  - Cement last.
  - AR fibers are added last to make the backer mix.



GFRC: Step by Step

- Check consistency



GFRC: Step by Step

- Adjust consistency



Superplasticizer
(increases fluidity)



Viscosity Modifier
(thickens mix)

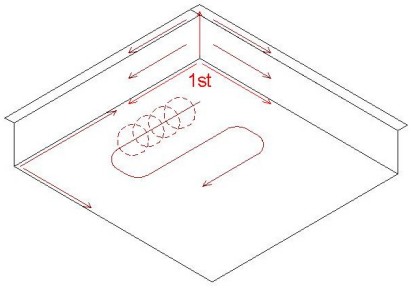
GFRC: Step by Step

- Spray mist coat



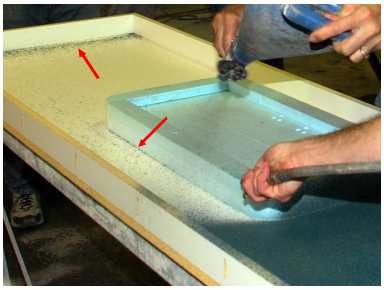
GFRC: Step by Step

- Spray mist coat



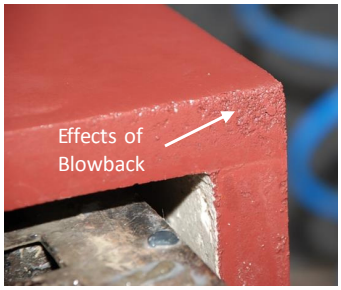
GFRC: Step by Step

- Manage blowback



GFRC: Step by Step

- Effects of blowback



GFRC: Step by Step

- Brush out voids



GFRC: Step by Step

- Apply tinted or untinted backer



GFRC: Step by Step

- First backer layer: ¼" thick



GFRC: Step by Step

- Roll to compact





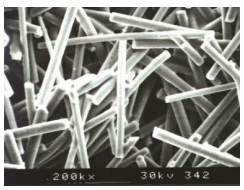
GFRC: Step by Step

- Compaction removes air
- Aligns fibers (flattens)
- Enhances interlayer bonding
- Makes stronger concrete



GFRC: Step by Step

- Compaction aligns fibers, removes air



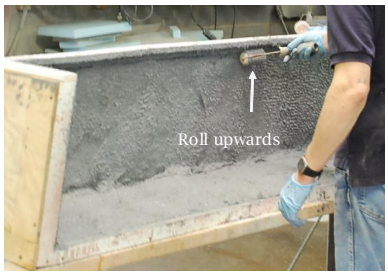


- 3D: 5%-10%

2D: 33%-45%

GFRC: Step by Step

- Rolling vertical surfaces



GFRC: Step by Step



Glass Fiber Reinforced Concrete

- Scrim: tensile reinforcement in cantilevers, thin panels and narrow sections



GFRC: Step by Step

- Scrim: stabilizes edges



GFRC: Step by Step

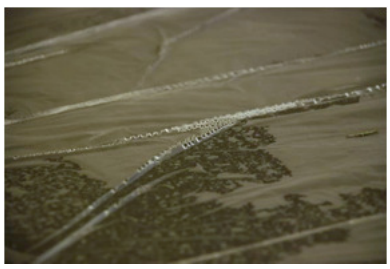
- Final thickness





GFRC: Step by Step

- Wet cure overnight



Curing Tips

- Cover with plastic overnight.
- Keep EVENLY moist, warm and out of direct sunlight.
- Minimum 55°F (13°C) for proper polymer coalescence.
- Once demolded, curing continues in the open air.

Polymer Allows for Air-Curing



Curing Tips

- Concrete cures faster when it's warm, slower when it's cold.
- Use blankets and insulation to trap the heat generated during curing when it's cold in your shop.
- Strength, density and hardness increase over time as GFRC continues to cure.

Curing Tips

- GFRC polymer retains internal moisture.
- GFRC needs only about 1-2 days in mold to cure before being safely demolded.
- Cure for additional time if you plan to polish the concrete.

GFRC Finishing

- Hand-sand, hone, grind and polish
- Acid stain, dye
- Seal
- Install

Remember: *it's still concrete*!

What You Learned

- Compare GFRC to other precast methods
- Structural behavior
- Specialty ingredients: polymer, fibers
- Mix design
- Casting technique
- Curing

Questions & Resources



2-day Pro GFRC Training
December 13-14, 2014
~~$995~~ **$895**



- Make a lounge chair and a fabric formed fire pit
- **Save $100 for 3 days only.** Ends Monday at 11:59pm Eastern.
- **Available to 3 people only.**

Type this into your browser: bit.ly/progfrcsale
(case sensitive, type exactly as shown)
Or check your inbox for a one-click link.

You will also receive a link in a later email to access the seminar recording.

Contact: info@concretecountertopinstitute.com or 888-386-7711

Copyright Materials

This presentation is protected by US and International copyright laws. Reproduction, distribution, display and use of the presentation without permission of the speaker is prohibited.

© The Concrete Countertop Institute, LLC 2013. All rights reserved.