

1. Does your State use Fiber Reinforced Polymers (FRP)? If no, survey is complete
  - a. Yes
    - i. 70.59% (12 responses)
  - b. No
    - i. 29.41% (5 responses)
2. Does your state have a policy or procedure indicating how to inspect FRP materials?
  - a. Yes
    - i. 35.71% (5 responses)
  - b. No
    - i. 64.29% (9 responses)
3. Does your state use FRP materials to strengthen members to increase ratings?
  - a. Yes
    - i. 53.85% (7 responses)
  - b. No
    - i. 46.15% (6 responses)
4. Does your state use FRP rebar?
  - a. Yes
    - i. 61.54% (8 responses)
  - b. No
    - i. 38.46% (5 responses)
5. Does your state use FRP bridge drains?
  - a. Yes
    - i. 30.77 (4 responses)
  - b. No
    - i. 69.23 (9 responses)
6. Does your state use FRP bridge members?
  - a. Yes
    - i. 23.08% (3 responses)
  - b. No
    - i. 76.92% (10 responses)
7. Does your state use FRP shells for concrete piles?
  - a. Yes
    - i. 38.46% (5 responses)
  - b. No
    - i. 61.54% (8 responses)
8. Has your state used carbon fiber strands?
  - a. Yes
    - i. 46.15% (6 responses)
  - b. No
    - i. 53.85% (7 responses)
9. How does your state inspect FRP products during fabrication?
  - a. according to AASHTO manuals
  - b. No state inspection during fabrication. Specify the use of certified materials fabricators.
  - c. Monitor plant's QC program. Sample materials for verification testing.

- d. We put a qualified inspector in the facility during manufacturing.
  - e. Sends consultant inspectors to the plant
  - f. Unfortunately, we don't know of any proven methods for inspecting FRP materials. Virginia would be very interested in finding out about methods for inspecting in-service structures.
  - g. Manufactured products are inspected by the fabricator according to ASTM D3917.
  - h. We don't use manufactured FRP products at this time, but we are looking to do that (see questions 5 through 7). We are having discussions on how to inspect them. We do inspect for strengthening systems.
  - i. Project special provisions which are based upon industry standards, best practices, manufacturer's recommendations, and our experiences.
  - j. Our specification contains the following language: We require that installers shall have a minimum of three years of experience performing FRP composite strengthening, and be trained and certified by the manufacturer of the supplied FRP composite/epoxy resin system being used. Between 24 and 48 hours after FRP placement, conduct a minimum of one tensile bond tests per member as specified in ACI 503R in the presence of the engineer and at location(s) specified by the engineer. Drill cores through the FRP and into the existing concrete a minimum of 1/4-inch but no more than 1/2-inch. A passing test will have a tensile strength greater than 250 psi, or a failure into the substrate where more than 50% of the core area has failed deeper than 1/4-inch. Immediately patch test core holes by blowing out with oil- and moisture-free compressed air and filling epoxy per manufacturer's instructions. In the presence of the engineer, the contractor will conduct a visual and acoustic sounding inspection to test for defects such as voids, delaminations, external cracks, chips, cuts, loose fibers, external abrasions, blemishes, foreign inclusions, depressible raised areas, or fabric wrinkles. Conduct this inspection after the FRP is cured but before the protective coating is applied. In the presences of the engineer, the contractor will conduct a visual inspection of the protective coating for damage including but not limited to cracking, crazing, blisters, peeling, or external abrasions. Conduct this inspection after the protective coating is cured.
  - k. Manufacturer certification of compliance.
10. Please describe any other composites that your state uses?
- a. fiber glass
  - b. Composite Pile Fender System
  - c. Wind Fairings, Decking, trench Plates, Concrete forms, bridge beams and concrete Arches.
  - d. Virginia has supported research using CFRP grids for shear reinforcement in beams, but has not adopted the material into policy. We are pushing CFCC in piles, particularly in high-salt marine environments. CFCC has also been approved for use in flexural members, but has not been widely adopted across the commonwealth. We have used FRP decks and beams, but only on a limited, experimental basis. For strengthening, we have used CFRP laminates, and are also looking into CFRP strand sheets as an alternative. Regarding FRP shells on piles, the more accurate response is that we've used CFRP wraps on pier columns and some concrete beam repairs. We do not use

jackets on piles in marine environments, because we have found that the jackets merely compound the corrosion issue for existing structures. Lastly, to clarify the response to Question #4, FRP rebar is allowed, but has not been widely adopted by VDOT engineers.

- e. CFRP prestressing strand, GFRP reinforcing, GFRP shells for pile jackets
- f. Typically use FRP wraps to repair concrete members such as prestress beam ends, columns, and pier caps.
- g. As noted in #9, we have a push to use more FRP products. So, we are looking at various opportunities. We currently use Carbon FRP for strand in some prestressed girders and wraps on concrete – mostly for confinement on prestressed girder concrete patching. We use Basalt FRP in curb and gutter. No current use of Glass FRP.
  - i. Please also note more details to the questions as follows: 1. Yes. 2. Yes (sort of). In general, most FRP have project specific SP but there are a couple FUSP and PASP that we use. 3. It has been used to address shear strength concerns in prestressed concrete I-beams. 4. Yes, in select applications. 5. No. 6. Depends on the definition of “bridge members” but typically FRP are used in conjunction with more conventional materials – concrete and steel when used in new members, or to augment existing members. 7. We don’t use FRP shells for concrete piles since we don’t drive concrete piles. 8. Yes. 9. Project SP which are based upon industry standards, best practices, manufacturer’s recommendations, and our experiences. 10. We currently use Carbon FRP for strand in some prestressed girders and wraps on concrete – mostly for confinement on prestressed girder concrete patching. We use Basalt FRP in curb and gutter. No current use of Glass FRP.
- h. FRP wrap has been used on many occasions. But use of GFRP rebar and concrete filled FRP tubes are currently only in the design phase.