

Glass Fiber Reinforced Polymer (GFRP) Dowel Bars - Aslan™ 600



Aslan 600
GFRP Dowels



Aslan FRP



Aslan™ 600 Glass FRP Dowel Bars are used as a “Load Transfer” device between joints in concrete slabs. They provide a mechanical connection between slabs but allow for horizontal contraction and expansion of the slab itself. This results in lower deflections at the joints and reduced slab stresses.

The Achilles heel of concrete pavement is the joint. Joint failure is often the result of corrosion of the steel dowel bar. Aslan 600 Dowels will not rust or corrode, locking a concrete joint together or causing spalling of the surrounding concrete. In addition, while providing the necessary shear capacity at the joint, the lower stiffness of the GFRP Dowels may reduce fatigue stresses in the concrete surrounding the dowel.

GFRP Dowels are also electromagnetically transparent and frequently used in high-speed toll collection areas near inductance sensors.

Since 1993, Hughes Brothers has been at the forefront of worldwide academic and industry efforts to define consensus FRP standards and methods.

GFRP Dowel Bars as a Load Transfer Device in:

- Contraction Joints
- Expansion Joints
- Isolation Joints
- Construction Joints
- Shear Dowels in MSE Walls



GFRP Dowel Bars are used in:

- Jointed Rigid Pavement
- Dowel Bar Retro Fits
- High Speed Tolling Areas with Electromagnetic Sensitivities
- Automatic & Wire Guided Vehicle Areas
- Canals and Desalination Input Channels
- Magnetometer Isolation Pads



Aslan 600 Dowels as shear connector in MSE Retaining Walls.



Aslan 100 GFRP Rebar is often used as “Tie Bars” in longitudinal joints.

Aslan 100 Tie Bars ~ Companion to Dowel Bars

- Restricts movement of the Concrete Slab
- Has a Surface Treatment to Bond With Concrete
- Often Used in Longitudinal Joints
- Considered a “Rebar” Rather Than a “Load Transfer Device” or Dowel Bar



Benefits of Aslan 600 Glass FRP Dowel Bars

- Impervious to Chloride Ion and Chemical Attack
- Transparent to Magnetic Fields
- 1/4th the Weight of Traditional Steel Dowels
- Easier Field Handling
- Less Potential for Injuries
- Stiffness or Modulus of Dowels Closer to Concrete than Steel Dowels
- Less Stress in Concrete around the Joint During Slab Curling
- No Need to Grease Dowels ~ Bond Strength to Dowels is Very Low

Aslan 600 Physical & Mechanical Properties

Dowel Diameter		Nominal Area		Longitudinal Shear Strength per ASTM D4475 Short Beam Shear		Transverse Shear Strength per ASTM D7617 Double Shear		Transverse Shear Strength	
mm	in	mm ²	in ²	MPa	psi	MPa	psi	kN	lbs
16	5/8	197.9	0.307	42.06	6100	151.7	22,000	30.04	6754
19	3/4	285.0	0.442	46.88	6800	151.7	22,000	43.25	9724
25	1	506.7	0.785	58.61	8500	151.7	22,000	76.82	17,270
32	1-1/4	791.7	1.227	58.61	8500	151.7	22,000	120.1	26,994
38	1-1/2	1160	1.800	59.98	8700	151.7	22,000	176.1	39,600

Hughes Brothers reserves the right to make improvements in the product and/or process which may result in benefits or changes to some physical-mechanical characteristics. The data contained herein is considered representative of current production and is believed to be reliable and to represent the best available characterization of the product as of July 2011. Transverse shear test is per ASTM D7617, which has superseded the ACI 440.3R method B.4.

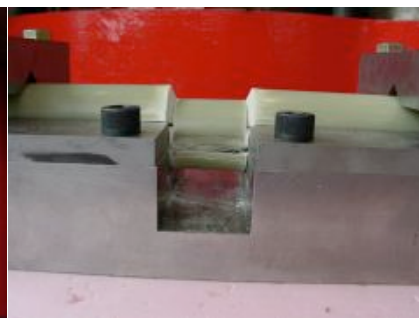
Material Properties

The “Shear Strength”, typically the “Transverse” or “Double Shear” strength of the Aslan 600 is determined using the ASTM D7617 method. Formerly, this method was described in ACI 440.3R method B.4. Nuances of the test fixture can have influences in the measured results.

A separate parameter, the “Longitudinal Shear” or “Short Beam Shear” subjects the Bar to a three point loading fixture and measures the shear strength along the axis of the bar. This testing is performed per ASTM D4475.



Transverse Shear or “Double Shear” testing



Longitudinal or “Short Beam Shear” testing



Fiber Content

Fiber content or fiber volume fraction is a key variable in the overall mechanical properties of the FRP Dowel.

Fiber Content by weight > 70% minimum by weight per ASTM D2584



Fiber Content measured by "burn off" of all inorganic constituents of the bar i.e. resin

Void Content

Each production run of Aslan 100 is sampled to screen for longitudinal thermal or mechanical cracks as well as continuous hollow fibers. No continuous voids are permitted after 15 minutes of capillary action. Testing performed per ASTM D5117.



Voids and hollow fibers in the bar appear in ASTM D5117 dye wick testing

Moisture Absorption

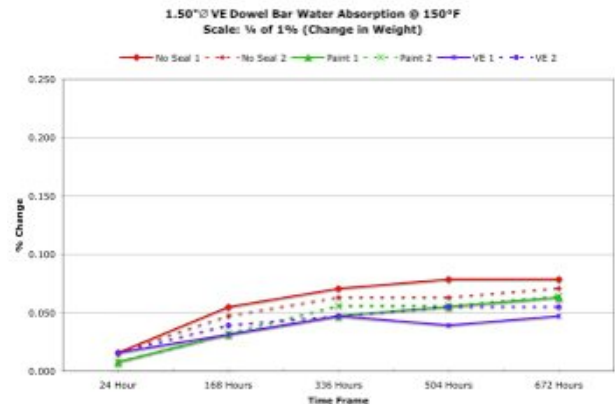
Susceptibility to moisture absorption is a key indicator of successful long-term durability. Testing per ASTM D570.

*24 hour absorption at 122°F (50°C) ≤ 0.25%
At saturation ≤ 0.75%*

Sealing of Ends ~ Not Necessary

Sealing of the ends of Aslan 600 Dowels to mitigate moisture uptake is NOT necessary.

Long-term moisture absorption tests at elevated temperatures reveal no significant effect of sealing the ends of the Aslan 600 Dowels with epoxy, paint or no sealing.



Transition Temperature of Resin - T_g

Known as the "glass transition temperature" or the temperature at which the resin changes from a "glassy state" and begins to soften. $T_g = 230°F (110°C)$

Density

GFRP Dowels are approximately one fourth the weight of steel rebar.

Diameter		Unit Weight / length	
mm	in	kg / m	lbs / ft
16	5/8	0.4465	0.30
19	3/4	0.5655	0.38
25	1	0.9674	0.65
32	1-1/4	2.4556	1.65
38	1-1/2	2.4556	1.65

Material Certs

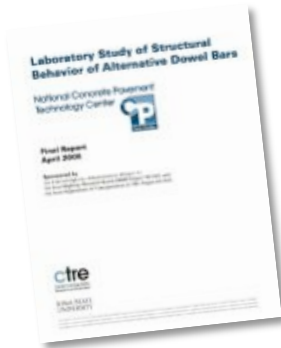
Material test certs are available for any production lot of Aslan 600 Dowels. Lab certs measure the Transverse Shear, Longitudinal Shear, Glass Content and Void Content.



Aslan FRP

Design Guidance & Field Trials

A number of field trials and research studies have been undertaken by various Universities and DOT's to access and measure the suitability of GFRP Dowels bars in Jointed Plain Concrete Pavement or JPCP. A couple of examples are described herewith.



From the FHWA Publication FHWA-HRT-06-106 ~ *Response of concrete pavement with FRP dowels is investigated through laboratory experiments and field implementation. This research showed that JPCP with FRP dowels provided very good load transfer efficiency (LTE). JPCP with FRP dowels provided sufficient LTE after 5 million cycles of fatigue tests under HS25 loading conducted in the Major Units Laboratory of West Virginia University.*

From Iowa State University, "Laboratory Study of Structural Behavior of Alternative Dowel Bars" ~ *The study concluded that all of the tested dowel bar shapes and materials were adequate with respect to performance under shear loading.*

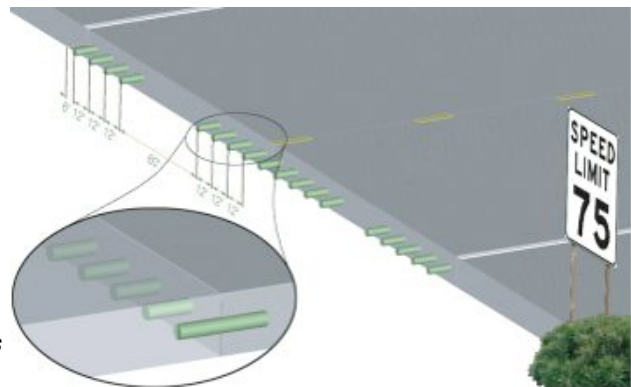


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The three design elements for dowels are spacing, length and diameter. Due to flexibility of the sub grade, the load is not transferred by a single dowel but by a group of dowels. Tests performed at the University of Manitoba in Winnipeg, Canada show the joint effectiveness of GFRP Dowels to be in the range of 86% to 100% effectiveness using a weak sub grade and 90% to 97% using a stiff sub grade. An ACPA criterion for successful joint load transfer is 75%. The research concludes, "GFRP dowels are a viable, corrosion free alternative to steel dowels." (*ACI Structural Journal Vol. 98 No. 2, March-April 2001, Glass Fiber Reinforced Polymer Dowels for Concrete Pavements, D. Eddie, A. Shalaby and S. Rizkalla.*)

In 1983, the Ohio Department of Transportation installed several alternative dowel bars for long-term durability performance studies in sections of Interstate 77 in Gueney County and Ohio State Route 7 in Belmont County. These dowel bars were produced from the same constituent materials as used in the Aslan 600 Dowels. In 1998, the Market Development Alliance (MDS) of the composites industry organized the extraction and testing of samples of these dowel bars to determine their durability performance after 15 years of in pavement service. ~ *These results show that the GFRP Dowel Bars were virtually unaffected by approximately 15 years of field service and exposure.*



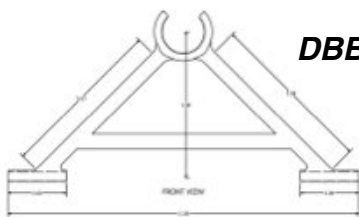
Aslan FRP

Aslan 600 Dowel Baskets

Hughes Brothers currently offers non-metallic dowel bar baskets for 10" (25.4cm) thick and 12" (30.48cm) thick segmental paving. These support chairs are well suited to segmental cast paving, but not appropriate for use with continuous paving as they are unable to resist the large forces associated with the advance of a large mass of low slump concrete.

When slip form paving is used, it is necessary to use a dowel bar insertion machine with the Aslan 600 dowels.

HB Part Number	Concrete Thickness		Dowel Height		Dowel Spacing	
	cm	in	cm	in	cm	in
DBB1500-12-5	25.40	10	12.70	5	30.48	12
DBB1500-10-6	30.48	12	15.24	6	25.40	10



DBB1500-12-5



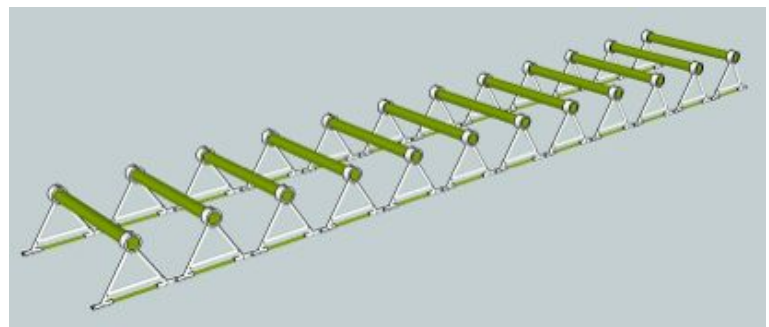
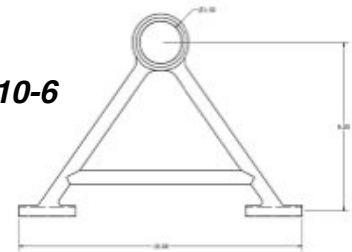
Each basket is used in conjunction with a #3 or 3/8" (10mm) diameter Aslan 100 GFRP Rebar "runner".

The runner ties multiple dowel bars together and allows for any variation of dowel bar spacing to be used. If the dowel spacing is narrower than the pre-set spacing of the basket, simply nest a pair of runners beside each other and overlap the baskets slightly at their base.

Minor adjustments in centerline height are also achieved by placing the runners on smaller "dobies" i.e. concrete support blocks or brick of appropriate thickness.



DBB1500-10-6



Handling and Placement

Field cutting of Aslan 600 Dowels is generally not necessary. However, if required use a fine blade saw, grinder, carborundum or diamond blade. Hughes Brothers uses a diamond blade in wet bath for cutting the dowels.

Sealing of Aslan 600 Dowel ends is NOT necessary

Greasing of Aslan 600 Dowels is NOT necessary (the bond strength to concrete is sufficiently low.)



When installing Dowels in the DBB1500-12-5 basket:

- Press fit the base of the basket onto the #3 (10mm) Aslan 100 GFRP Rebar runner
- Set the Dowel into position and stomp or rap on the dowel with a rubber mallet. The dowel will snap fit into place.



When installing Dowels in the DBB1500-10-6 basket:

- Press fit the Dowel into the opening.
- Tap the dowel into the basket from the end to secure the dowel into place.
- Attach the Dowels and baskets to the runners as required.



Aslan 600 Dowels in a Dowel Bar Insertion Machine



Drilled and Doweled GFRP Bars and Segmental Paving over Basket assemblies



Section of Continuous Paving completed with Dowel Bar Insertion Machine



Dowel Bar Retro-Fit - Marshalltown, IA



Bus Loop for Toronto Transit Authority



Hughes Brothers Factory



Packaged Dowels for shipment



Aslan 600 GFRP Dowels