



LARR 25736 P.1

PRODUCT BRIEF

C-Clad Carbon Fiber/ Epoxy Wet Lay-up Externally-bonded Reinforcement System

Physical description:

C-Clad is a fiber reinforced polymer composite system that is applied by wet lay-up process to the surface of concrete structural members for strengthening purposes. In its wet state, C-Clad consists of FC061 unidirectional carbon fiber fabric impregnated with RN075 epoxy system. As determined by the engineer of record, one or more layers of C-Clad may be applied to achieve the required strength. Upon curing, C-Clad forms a hardened laminate that binds permanently to the retrofitted structural member.

Material specifications:

Cured composite laminate specifications:

Single layer thickness:	0.04 in
Tensile strength:	149 Ksi
Tensile modulus:	10.1 Msi
Bond strength:	200 psi minimum
Rupture strain:	1.4 %

Constituent products:

Carbon fiber fabric:

Type:	Uniaxial in 0° direction
Density:	600 Grams/ Square Meter
Fiber properties:	
Fiber type:	12K Carbon
Tensile strength:	700 Ksi
Tensile modulus:	34 Msi

Epoxy system:

Type:	Two component, 100 % solids solvent-free system
Viscosity:	700 - 900 cps
Tensile strength (14 days):	6,000 psi
Compressive strength (7 days):	10,500 psi
Flexural strength (14 days):	7,600 psi

Typical uses:

- Shear and flexural strengthening of concrete beams, columns, slabs, walls and beam-column joints for structural and seismic retrofit, repair or upgrade **
- Confinement of columns, piles and other cylindrical structures
- Control of concrete cracking

Conditions of use:

- Design and calculations must be provided and certified by a licensed professional engineer.
- C-Clad System must be installed only by a specialty contractor who is trained and certified by FRP SOLUTIONS, INC.
- C-Clad System must be installed according to FRP SOLUTIONS installation manual titled "Installation Manual for C-Clad Carbon Fiber Reinforced Polymer Composite System" and in total compliance with all applicable health and safety codes and FRP SOLUTIONS quality control procedures.
- Minimum age of concrete must be 28 days.

Limitations:

- Design shall comply with the requirements and limitations of the ACI 440.2R-08 document, "Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures."
- This product is not appropriate for off-shore severe environment.

PRODUCT BRIEF

PS-C Pre-cured Carbon Fiber Composite Strip Externally-bonded Reinforcement System

Physical description:

PS-C System is a fiber reinforced polymer composite system that is bonded to the surface of concrete structural members for strengthening purposes. PS-C System consists of SC352 carbon fiber composite strip and GS100 gel/paste epoxy adhesive system. As determined by the engineer of record, one or more layers of PS-C System are applied to achieve the required strength. Upon curing of the bonding adhesive, PS-C System forms a hardened laminate that binds permanently to the retrofitted structure.

Material specifications:

Cured composite laminate specifications:

Tensile strength:	357 Ksi
Tensile modulus:	18.9 Msi
Bond strength:	200 psi minimum
Tensile strain:	1.9 %

Constituent products:

Pre-cured carbon fiber composite strip:

Type:	Uniaxial in 0° direction
Density:	0.28 lb / square foot
Thickness:	0.035 In.

Fiber properties:

Fiber type:	12K Carbon
Tensile strength:	700 Ksi
Tensile modulus:	34 Msi

Epoxy adhesive system:

Type: Two component,	100 % solids solvent-free system
Viscosity:	Gel/Paste
Tensile strength (14 days):	7,200 psi
Compressive strength (7 days):	10,500 psi
Flexural strength (14 days):	5,800 psi
Rupture strain:	0.85%

Typical uses:

- Shear and flexural strengthening of concrete beams and slabs for structural and seismic retrofit, repair or upgrade. **

Conditions of use:

- Design and calculations must be provided and certified by a licensed professional engineer.
- PS-C System must be installed only by a specialty contractor who is trained and certified by FRP SOLUTIONS, INC.
- PS-C System must be installed according to FRP SOLUTIONS installation manual titled "Installation Manual for PS-C Precured Carbon fiber/Epoxy System" and in total compliance with all applicable health and safety regulations and FRP SOLUTIONS quality control procedures.
- Minimum age of concrete must be 28 days.

Limitations:

- Design shall comply with the requirements and limitations of the ACI 440.2R-08 document, "Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures."
- This product is not appropriate for off-shore severe environment.



FRP SOLUTIONS, INC.

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PRODUCT BRIEF

E-Clad E-Glass Fiber/ Epoxy Wet Lay-up Externally-bonded Reinforcement System

Physical description;

E-Clad is a fiber reinforced polymer composite system that is applied by wet lay-up process to the surface of concrete structural members for strengthening purposes. In its wet state, E-Clad consists of FE261 unidirectional E-glass fiber fabric impregnated with RN075 epoxy system. As determined by the engineer of record, one or more layers of E-Clad may be applied to achieve the required strength. Upon curing, E-Clad forms a hardened laminate that binds permanently to the retrofitted structural member.

Material specifications:

Cured composite laminate specifications:

Single layer thickness:	0.042 In.
Tensile strength:	90.75 Ksi
Tensile modulus:	3.92 Msi
Bond strength:	200 psi minimum
Tensile strain:	2.3 %

Constituent products:

E-glass fiber fabric:

Type:	Uniaxial in 0° direction
Density:	880 Grams/ Square Meter
Fiber properties:	
Fiber type:	E-glass
Tensile strength:	499 Ksi
Tensile modulus:	10.25 Msi

Epoxy system:

Type:	Two component, 100 % solids solvent-free system
Viscosity:	700 - 900 cps
Tensile strength (14 days):	6,000 psi
Compressive strength (7 days):	10,500 psi
Flexural strength (14 days):	7,600 psi

Typical uses:

- Shear and flexural strengthening of concrete beams, columns, slabs, walls etc. for structural and seismic retrofit, repair or upgrade **

Conditions of use:

- Design and calculations must be provided and certified by a licensed professional engineer
- E-Clad must be installed only by a specialty contractor who is trained and certified by FRP SOLUTIONS, INC
- E-Clad must be installed according to FRP SOLUTIONS installation manual titled " Installation Manual for E-Clad E-Glass Fiber Reinforced Polymer Composite System" and in total compliance with all applicable health and safety codes and FRP SOLUTIONS quality control procedures.
- Minimum age of concrete must be 28 days.

Limitations:

- Design shall comply with the requirements and limitations of the ACI 440.2R-08 document, "Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures."
- This product is not appropriate for off-shore severe environments.



FC061 STRUCTURAL FABRIC

UNIDIRECTIONAL CARBON FIBER FABRIC

FOR INDUSTRIAL USE ONLY

DESCRIPTION

FC061 STRUCTURAL FABRIC is a standard modulus continuous-fiber unidirectional carbon fiber fabric with superior tensile strength. FC061 STRUCTURAL FABRIC can be impregnated with RN075 Fiber Impregnation Resin to achieve a super strong fiber reinforced polymer (FRP) composite laminate for structural strengthening applications.

ADVANTAGES

- ▶ Superior strength characteristics
- ▶ Excellent for shear, flexure or confinement applications
- ▶ Excellent strength-to-weight and strength-to-volume ratios
- ▶ Conforms to shape of most structural elements
- ▶ Externally applied –non-invasive reinforcement
- ▶ Cured system is non-corrosive and can accept most non-solvent-based architectural finishes.
- ▶ Quick installation requiring minimal downtime
- ▶ Neatly applied and non-bulky

APPROVALS AND CERTIFICATIONS

- ▶ ICC-ES ESR Number 2809
- ▶ City of Los Angeles Research Report Number 25736
- ▶ CA DOT (Caltrans) System 11
- ▶ IAPMO UES ER Numberer 295

TYPICAL DATA

IMPORTANT: Data subject to change without notice.

Physical Properties	
Color	Black
Weight, Oz / Yd ² [g / m ²]	17.7 [600]
Primary axis	0°

Fiber Properties	
Filament count	12k
Average tensile strength, KSI [MPa]	700 [4,826]
Average tensile Modulus, MSI [GPa]	34.0 [234.42]
Rupture strain	1.4 %

Cured Laminate Properties (Primary Axis) (When used with RN075 Fiber Impregnation Resin)	
Tensile strength, KSI [MPa] *	149 [1027.3]
Tensile modulus, MSI [GPa] *	10.1 [69.64]

* ASTM D-3039

PACKAGING

FC061 STRUCTURAL FABRIC is supplied in 24 inch (W) x 100 yard (L) rolls.

STORAGE

Store dry at 40°F (4°C) - 100°F (38°C).

TYPICAL USES

FC061 STRUCTURAL FABRIC is an excellent choice for repair and retrofit of candidate buildings and structures for the following purposes:

- ▶ Load capacity enhancement
 - o Vehicular load increase in parking structures and on bridges
 - o Equipment rooms subject to increased machinery weight and/or vibration
 - o Battery room expansion/ conversion in existing Telecommunication buildings
 - o Warehouse buildings subject to increase in live and dead load.
- ▶ Seismic enhancement
 - o Ductility improvement
 - o Confinement of columns and masonry structures
- ▶ Deficiency / damage compensation
 - o Aging structures
 - o Construction errors
 - o Building Code compliance
 - o Building modifications such as new openings and removal of structural components
 - o Non-destructive but weakening damages caused by impacts, fire or corrosion
- ▶ Safety Enhancements
 - o Protection from blasts
 - o Impact resistance

HOW TO USE

IMPORTANT NOTES:

- 1- FC061 STRUCTURAL FABRIC must be installed only by a specialty contractor who is trained and certified by FRP SOLUTIONS, INC.
- 2- Design and calculations must be provided and certified by a licensed professional engineer.

SURFACE PREPARATION:

All surfaces must be structurally sound, clean and free of laitance or other surface deposits, dirt, dust, oil, grease or any contaminant that would adversely affect the bond. Surfaces may be dry or damp, but free of standing water. Concrete surface must be prepared by mechanically removing laitance, coatings, grease, dust, and any surface contaminant and loose particles to achieve a sound concrete surface prior to installation of FRP. In general, a surface profile of **CSP 3**, per ICRI Guideline No. 310.2R: **Concrete Surface Profile Specifications**, should be a sufficient surface profile. However, due to variation in hardness, age and compressive strength of the existing concrete, the prepared concrete surface must be tested per ASTM D4541 for a minimum 200 psi bond strength before installation of FRP. As such, as long as the concrete surface is free of bond-inhibiting substances; does not include perturbations/irregularities in excess of 1/32 of an inch; and passes the minimum 200 psi bond strength



FC061

STRUCTURAL FABRIC
UNIDIRECTIONAL CARBON FIBER FABRIC
FOR INDUSTRIAL USE ONLY

test, the surface profile should qualify, and be accepted, as adequately prepared, regardless of preparation method.

Steel surfaces must be prepared by sandblasting to white metal finish with a minimum Surface Profile of 3 mils.

RESIN PREPARATION:

Refer to Instructions and information provided in RN075 Fiber Impregnation Resin product data sheet for proper resin preparation and mixing.

HANDLING AND CUTTING THE FABRIC:

Maintain a clean work area and keep the fabric free from dust, grease, dirt or other contaminants. For proper handling instructions refer to MSDS for FC061 STRUCTURAL FABRIC.

Use a sharp pair of heavy duty shears to cut FC061 STRUCTURAL FABRIC to desired length. Always keep the cutting edges sharp to prevent fibers from getting damaged, frayed, or misaligned.

IMPREGNATION:

Use an automatic or manually driven impregnating machine for large projects to impregnate FC061 STRUCTURAL FABRIC with RN075 Fiber Impregnation Resin. Manual impregnation with a roller or stiff brush is recommended only for small projects. For further information and detailed impregnation instructions consult FRP Guide Specifications.

APPLICATION:

Prepared substrate surface must be sealed and primed with RN075 Fiber Impregnation Resin prior to application of fabric. If necessary, prime vertical or overhead substrates with GS100 STRUCTURAL EPOXY GEL/PASTE ADHESIVE for better initial adhesion and hold. For further information and detailed instructions consult the applicable primer (GS100 or RN075) product data sheets.

Impregnated fabric should be positioned at the specified location and fiber orientation, pressed onto the surface, and secured in place by pressing further using a stiff brush or a hard roller. Any air entrapment must be removed within the resin working time. Properly applied Fabric should be in intimate contact with substrate, and fibers should be straightly oriented in the specified direction.

CAUTION - FOR INDUSTRIAL USE ONLY

Fine airborne carbon fiber particles may exist on the fabric or may be generated during the cutting process. To avoid inhalation, a properly filtered dust mask must be worn while handling dry fabric. Although carbon fiber is non-reactive, to avoid possible skin irritation, protective gloves must be worn when handling dry or impregnated fabric. Installers must wear protective clothing, goggles and barrier cream on all exposed skin during fabric installation. Provide adequate ventilation.

DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITY

FRP SOLUTIONS INC. ("Seller") warrants its products to be free of defects in material and workmanship for a period of ONE (1) YEAR from the date of purchase. Under this Warranty and limitation of liability, FRP SOLUTIONS will provide, at no charge, product and containers to replace any product. FRP SOLUTIONS' obligation hereunder, is limited solely to such replacement and is subject to receipt by FRP SOLUTIONS of a written notice of any alleged defects, promptly after discovery thereof, within the warranty period. Absence of such notice in writing during the warranty period constitutes a waiver of all claims with respect to such product. This Warranty excludes discoloration or change in visual appearance of the product due to the accumulation of or streaking of dirt or other airborne materials deposited on the surface from the atmosphere. FRP SOLUTIONS does not warrant the colorfastness of any product unless specifically stated otherwise. Before application, the Buyer shall determine the suitability of the product for the intended use and Buyer assumes all risks and liabilities whatsoever in connection therewith. THIS WARRANTY IS MADE IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED. IT IS UNDERSTOOD AND AGREED THAT BUYER'S SOLE REMEDY, AND THEREFORE SELLER'S LIABILITY, WHETHER IN CONTRACT, TORT, WARRANTY, IN NEGLIGENCE, OR OTHERWISE, SHALL BE LIMITED TO THE RETURN OF THE PURCHASE PRICE PAID BY PURCHASER OR REPLACEMENT OF ANY DEFECTIVE GOODS SOLD BY SELLER AND UNDER NO CIRCUMSTANCES SHALL SELLER BE LIABLE FOR SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES. THE PRICE STATED FOR THE GOODS IS A CONSIDERATION IN LIMITING SELLER'S LIABILITY. The terms of this paragraph may not be orally modified. THERE ARE NO WARRANTIES, WHICH EXTEND BEYOND THE FACE HEREOF.

MANUFACTURER INFORMATION

For more information about this product, please contact

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RN075 LPL TWO COMPONENT EPOXY SYSTEM

MOISTURE TOLERANT, HIGH MODULUS, HIGH STRENGTH STRUCTURAL EPOXY FOR INDUSTRIAL USE ONLY

DESCRIPTION

RN075 Fiber Impregnation Resin is a 100% solids, solvent-free, two-component moisture tolerant epoxy. RN075 is a low viscosity epoxy for wetting and use with carbon and glass fiber fabrics for structural strengthening.

ADVANTAGES

- ◆ User-friendly mix ratio: 2 Parts A to 1 Part B by Volume
- ◆ Long Pot Life with rapid strength development
- ◆ Provides high early strength and excellent adhesion to most structural materials
- ◆ Insensitive to moisture before, during and after cure
- ◆ Low temperature cure – As low as 40°F (4°C)
- ◆ Very low surface tension resulting in minimizes eliminating air entrapment that commonly occurs in other resin system.
- ◆ VOC compliant
- ◆ ANSI/NSF-61 compliant

APPROVALS AND CERTIFICATIONS

- ◆ ICC-ES ESR Number 2809
- ◆ City of Los Angeles Research Report Number 25736
- ◆ CA DOT (Caltrans) System 11
- ◆ IAPMO UES ER Numberer 295

TYPICAL DATA

IMPORTANT: Data subject to change without notice.

Physical Properties	
Colors	Part A (Resin): Clear amber Part B (Hardener): Black
Viscosity	700-900 cps (ASTM D-2393)
Working Time	55-64°F: 1.5 – 2.5 hrs. 65-74 °F: 1 – 1.5 hrs. 75-90 °F: 0.5 – 1 hr.
Gel Time	Approx. 100 minutes at 73°F (23°C)
Tack-Free Time	5 hours at 75°F (24°C) 4 ½ hours at 90°F (32°C)

Compressive Strength, psi [MPa]	(ASTM D-695)
After 7 days curing at 75°F (24°C)	10,500 [72]

Tensile Strength, psi [MPa]	(ASTM D-638)
After 14 days curing	6,000 [41]

Rupture Strain, %	(ASTM D-638)
2 – 4	

Flexural Strength, psi [MPa]	(ASTM D-790)
After 14 days curing	7,600 [52]

Bond Strength, psi, [MPa]	(ASTM C-882)
After 2 days curing	Min. 1200 [8.2]

Shore D Hardness (ASTM D-2240)

84

Water Absorption (ASTM D-570)

24 Hrs .08 % maximum

PACKAGING

RN075 is supplied as a 3-gallon unit. Component A, the resin, is packaged in a 2-gallon container, and Component B, hardener, is packaged in a 1-gallon container. As an option, the 2-gallon unit of Component A is available in a 3 ½ gallon container.

STORAGE

Store dry at 40°F (4°C) - 100°F (38°C).

SHELF LIFE

One year from the date of manufacture.

CAUTION

- ◆ Minimum surface application temperature is 40°F (4°C).
- ◆ Material is a vapor barrier after cure.
- ◆ Not for sealing cracks under hydrostatic pressure.
- ◆ Minimum age of concrete must be 21 – 28 days.
- ◆ Test for surface vapor transmission. Moisture passing through the substrate by pressure during the application and curing will cause bond failures.
- ◆ Due to many variables in bonding to damp or underwater surfaces, be certain to test application under the same conditions as full scale work.

THERMAL CONSIDERATIONS

RN075 cures at temperatures as low as 40°F (4°C), provided that the temperature is maintained above 40°F during the 72 hours following application. Pre-condition the product to 70°F (26°C) - 85°F (29°C) by storing at 80°F (26°C), or slightly higher, for at least 24 hours prior to mixing and use. Storing below 60°F (15°C), will cause the epoxy to thicken substantially, making it difficult to properly blend the two components and obtain a proper mating of resin and hardener. Protect from inclement weather and freezing. If product temperature falls below 50°F (10°C), it is recommended that a product temperature of 80°F (26°C) be obtained prior to using.

HOW TO USE

SURFACE PREPARATION:

All surfaces must be structurally sound, clean and free of laitance or other surface deposits, dirt, dust, oil, grease or any contaminant that would adversely affect the bond. Surfaces may be dry or damp, but free of standing water. Concrete surface must be



RN075 LPL TWO COMPONENT EPOXY SYSTEM

MOISTURE TOLERANT, HIGH MODULUS, HIGH STRENGTH STRUCTURAL EPOXY FOR INDUSTRIAL USE ONLY

prepared by mechanically removing laitance, coatings, grease, dust, and any surface contaminant and loose particles to achieve a sound concrete surface prior to installation of FRP. In general, a surface profile of **CSP 3**, per ICRI Guideline No. 310.2R: **Concrete Surface Profile Specifications**, should be a sufficient surface profile. However, due to variation in hardness, age and compressive strength of the existing concrete, the prepared concrete surface must be tested per ASTM D4541 for a minimum 200 psi bond strength before installation of FRP. As such, as long as the concrete surface is free of bond-inhibiting substances; does not include perturbations/irregularities in excess of 1/32 of an inch; and passes the minimum 200 psi bond strength test, the surface profile should qualify, and be accepted, as adequately prepared, regardless of preparation method.

Steel surfaces must be prepared by sandblasting to white metal finish with a minimum Surface Profile of 3 mils.

MIXING:

The mixing ratio is 2 parts Component A (Resin) to 1 part Component B (Hardener) by volume. Mix the components according to the following instructions:

DO NOT BATCH. Select a clean mixing container with a minimum capacity of 4 gallons and maximum capacity of 7 ½ gallons with a flat wall and flat bottom. Pre-mix each component separately with a clean stick. Pour the entire content of the 2-gallon unit (component **A**) into the mixing container, scraping the sides and the bottom of the 2-gallon unit to remove all resin. Then pour the entire content of the 1-gallon unit of the hardener (component **B**) into the mixing container or directly into the optional 3½ gallon container of Component A, scraping the sides and the bottom to remove all hardener. Use of a jiffy mixer attached to a low speed drill (400-600 rpm) is recommended. Mix for 3 minutes until all material is thoroughly blended. Improper mixing can result in soft or sticky spots. To minimize air entrapment and void content in the FRP, keep the mixer head deeply inside the container and well below the liquid surface, and minimize vortexing the liquid.

APPLICATION:

As a primer:

Using a brush, roller or airless sprayer, apply the mixed epoxy to the substrate that is prepared according to the above instructions. Apply RN075 at a rate sufficient to fully saturate the substrate without producing a surface film. Coverage rates depend on porosity of substrate.

As an impregnating resin:

To use as an impregnating resin for vertical and horizontal applications, apply RN075 to reinforcing fabric with an automatic impregnator or manually. For further information, consult installation guidelines.

CLEANUP:

Most tools can be cleaned up with water if the epoxy has not set. Warm water and soap is recommended. Cured material can only be removed mechanically.

CAUTION - FOR INDUSTRIAL USE ONLY

RN05 Resins contain alkaline amines which MAY CAUSE SKIN IRRITATION or allergic response ranging from a mild wheezing to a severe asthmatic type attack. Avoid contact with skin or eyes. IN CASE OF CONTACT immediately wash skin with soap and water. Flush eyes with water for at least 15 minutes and obtain medical attention. Wear protective clothing, goggles and barrier cream on all exposed skin. Provide adequate ventilation.

DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITY

FRP SOLUTIONS INC. ("Seller") warrants its products to be free of defects in material and workmanship for a period of ONE (1) YEAR from the date of purchase. Under this Warranty and limitation of liability, FRP SOLUTIONS will provide, at no charge, product and containers to replace any product. FRP SOLUTIONS's obligation hereunder, is limited solely to such replacement and is subject to receipt by FRP SOLUTIONS of a written notice of any alleged defects, promptly after discovery thereof, within the warranty period. Absence of such notice in writing during the warranty period constitutes a waiver of all claims with respect to such product. This Warranty excludes discoloration or change in visual appearance of the product due to the accumulation of or streaking of dirt or other airborne materials deposited on the surface from the atmosphere. FRP SOLUTIONS does not warrant the colorfastness of any product unless specifically stated otherwise. Before application, the Buyer shall determine the suitability of the product for the intended use and Buyer assumes all risks and liabilities whatsoever in connection therewith. THIS WARRANTY IS MADE IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED. IT IS UNDERSTOOD AND AGREED THAT BUYER'S SOLE REMEDY, AND THEREFORE SELLER'S LIABILITY, WHETHER IN CONTRACT, TORT, WARRANTY, IN NEGLIGENCE, OR OTHERWISE, SHALL BE LIMITED TO THE RETURN OF THE PURCHASE PRICE PAID BY PURCHASER OR REPLACEMENT OF ANY DEFECTIVE GOODS SOLD BY SELLER AND UNDER NO CIRCUMSTANCES SHALL SELLER BE LIABLE FOR SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES. THE PRICE STATED FOR THE GOODS IS A CONSIDERATION IN LIMITING SELLER'S LIABILITY. The terms of this paragraph may not be orally modified. THERE ARE NO WARRANTIES, WHICH EXTEND BEYOND THE FACE HEREOF.

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