



2022 Footprint Engineering Inc.

FeHDPlank RSS QA and CAD Details

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Section 1.0: FeHDPlank™ (M.H. Rating: 9/10 - Winner - 75-Year CSP Rehab)

A method and apparatus for repairing a damaged host pipe, such as a corrugated steel pipe or other conduit. A plurality of interlocking plastic planks are positioned within the invert of the host pipe forming a liner. Rebar is first installed and attached to the host pipe for supporting the planks. A cementitious grout non-shrink grout for concrete such as VELOSIT® NG 511 is installed in the spaces between the liner formed by the interlocking planks and the host pipe so that the rebar is encapsulated with the concrete and so that the planks are immovably secured.

Section 1.1: FeHDPlank™ RSS

This RS System provides large diameter CSP rehabilitation to extend life to 75 years by wall restoration, waterproofing, and abrasion resistance. See RSS QA Tools to this Installation Guide for details of the system implementation to see any QA inspection steps.

1-SURVEY SITE CONDITIONS

Prior to any work being initiated, the owner must survey the site conditions. The owner should look for any abnormalities or additional problems that may exist on site. The owner must also provide the bypass of water into the culvert.

Use Lidar survey to provide evidence of conditions to be compared with final results. Key survey points to resolve at 12 pm, 3 pm, 6 pm, 9 pm clock positions.

2-PREPARE AND CLEAN SUBSTRATE

Substrate where works are taking place must be prepared for the Rehabilicrete™ System. The substrate is prepared with high pressure water blasting to remove all bond breaking substances. Clean substrate with a pressure washer at 3000-5000 psi (5000 psi preferred). Remove all dust and debris from areas to be treated, anchored or supported.

3-CLOSED FOAM FILL CSP ID RIBS

Proceed in good weather with a one-day plan of 30 m / day. Pump foam into culvert corrugations. Do not fill entire corrugation. Leave a one-inch gap.

4-INSTALL SHEAR KEYS

Install shear keys at every sequential metre of the culvert. Shear keys are to be installed at the 1, 3, 5, 7, 9, and 11 o'clock positions. These will be used to tie in corrugations of the culvert and provide increased shear strength. Pucks will not be square shaped. Utilize Tek Screws as needed.

5-APPLY REPAIR MORTAR VELOSIT RM202

Apply to ¼ V max to level. Do not smooth. This will increase shear strength. Use legs of HDPE (Part B to have Part C) and struts HDPE or Basaltic bar.

Use rated 200 lb snap ties of plastic as needed Basaltic / Urethane (shop 10 m long mock ups before start in June 2021).

This QA RSS exact ID goal involves three key elements: 1) grout mixing method (pump type), 2) multiple stages of grouting result in lower risk, 3) QA oversight by Verdi.

6-APPLY WATERPROOFING VELOSIT WP120

Velosit WP 120 is a polymer modified cementitious waterproofing slurry with increased abrasion resistance. An excellent waterproofing solution for coating of trafficable flat roofs and parking structures. Helps against rising dampness and is a good barrier against carbon dioxide. Highly flexible, with a tensile elongation >100% and resists 50m (160 ft.) of water pressure. Achieves sufficient adhesive strength as a coating after 3 hours at 70°F, open to foot traffic after 3-4 hours.

Pour the B-component into a suitable bucket and mix in the A-component powder with a slow speed drill (300 – 600 rpm) until a lump free mix is achieved. Add up to 1 litre of water to adjust to desired consistency. Water addition extends the cure time and should be kept to a minimum. 2 mm coats of WP 120 can be applied 30-45 minutes apart. Coats are to be applied by roller, wet brush, or trowel. WP 120 has a pot life of 45-60 minutes. 1.7 kg of mixed Velosit WP 120 will typically cover 1 m² (3.5 lbs. per 10ft²) at 1 mm on smooth surface. Apply with a magic trowel (RSG) at 2 mm thick. Do not smooth. This will increase shear strength.

7-COMplete INSTALLATION OF 5 M BARS

Install %M spiral bars running along the inner surface of the culvert. The spiral bars should be installed with a right lay and a left lay beginning at the discharge end of the culvert. The two spiral bars will run in opposite directional rotations from one another so that they cross and overlap periodically. The rebar is to be run through the culvert at a 22.5 degree angle thus “spiraling”.

8- INSTALL FEHDPLANK™

The FeHDPlank™ is to be installed in a full circle on clock positions in a staggered overlap. This system is also to be installed into the correct positions while ‘dry’ before grouting.

The plastic extrusion Part A (HDPlank – pre camber) receives another extrusion shaped as an end female also with pre cambered H (Part B of the FeHDPlank™ End). This will be detailed per each CSP diameter to enable a seal of the grout at every 4 ft stagger joint. The first planks installed will connect to the bulkhead at the entrance of the culvert. Therefore, every second plank in the initial loop at the bulkhead will be half the length of a usual plank (2 ft instead of 4 ft) to ensure the planks remain staggered for the entirety of the pipe.

Each plank will be measuring 4 ft long to enable a man to reach with his arm to assemble both Part A and Part B. This will enable a systematic 360 degree coverage. The FeHDPlank™ can be installed at 20 m portions as each detail is ready.

9-INSTALL WEDGES TO SECURE FEHDPLANKS IN PLACE

Apply wedges so as to put equal pressure on all points around the complete plank structure and hold it in place. The wedge will be used only at joints in the middle of the basaltic bar hoop to help with pre-loading. The wedges will be applied outside of the hoops. The wedges will be utilized at every other position around the clock starting at 12 o'clock (12, 2, 4, 6, 8, 10).

10-ATTACH FEHDPLANK PART ‘C’ TO SPIRAL REBAR

Clip part 'C' of FeHDPlank to rebar as they align. The opening of part 'C' has been specially designed to fit perfectly with 5 m rebar ensuring a perfect and secure fit.

11-INSTALL INFLATABLE BULKHEAD AND GROUT

At the end of every work day grout will be installed to finish off the 30 metre section that was completed. 20 mm grout hoses are to be wrapped at 45-degree angles through the interior of the culvert. 2 hoses are to be used, one right lay and one left lay. Pumping is to be done through an inflatable bulkhead. The bulkhead will be installed at the 10 and 2 o'clock positions. Bulkhead will be inflated and attached. End points will be the 4 and 7 o'clock positions of the bulkhead. These will act as ports on grout. Valves will control a 'T' in the grout lines. Grouting will take 2 hours to complete. Grout tubes will not be pulled out after use.

Vent ports will be used at the 11 and 1 o'clock positions at the 30-metre point. Vent ports will show the progress of the grout.

Avoid voids, leaks and form movement during the placement of the grout.

Note: use transition solution to match survey OD and desired ID and these steps can include

A) A customized Basaltic System to match saddle CSP size specific as well as a Part C HDPE (column feet) on any T rib will be useful. Part 'C' Feet (HDPE .009) to match saddle CSP Size.

B) 10 M Basaltic bar to every Part B with 150 mm splice end at 22.5 degree mm spiral spacing.

C) A Wedge joint, HDPE

At each of 12, 2, 4, 6, 8 and 10 O'clock positions to each FeHDPlank End (Part B and Part C).

D) 75-year lifespan with Zero corrosion. Good factor of safety on grout and HDPE layer at .150 Thick HD (Std QW is .050 thick) but never one failure in that joint to date.

12-SURVEY FINAL RESULTS

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Owner to survey with Lidar to analyze before and after results.

Improve to 30 metres per week by training (Tension Ties and Wedges System to be made perfect through mock up phase and on first field trials). This is utilizing a good weather window.

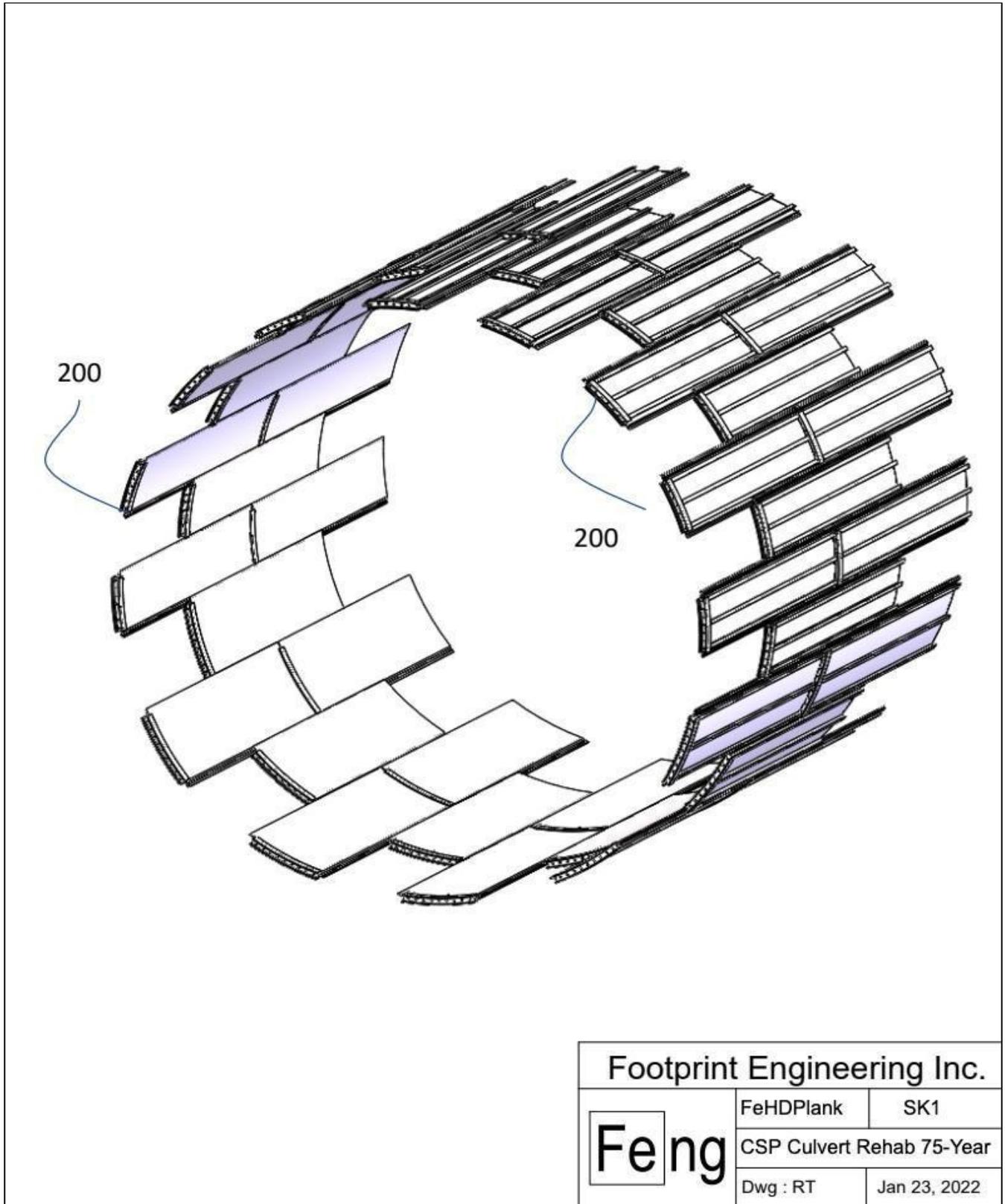
Supplement this with observational methods of precision survey to enhance accuracy.

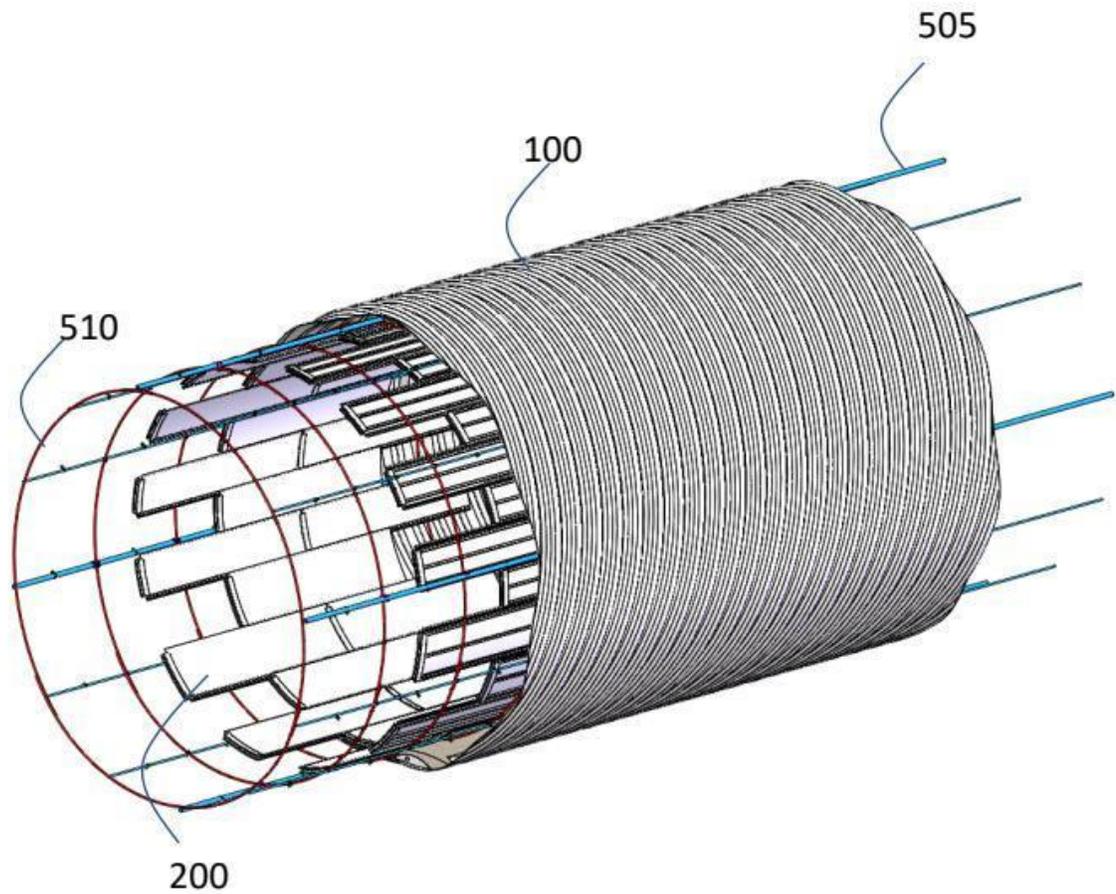
Full Time non working QA is recommended to be by Licensed Contractor as a non working field engineer who can assist Lidar or observational points while grouting.

Ensure FeHDPlank™ is installed correctly every step and in a slight compression ring manner with 100% as pre camber (.9 times 2400 mm is 90% of Plan 2150 mm). See actual HD Plank details in cross section(s) figures.

Section 1.2: FeHDPlank™ CAD Illustrations

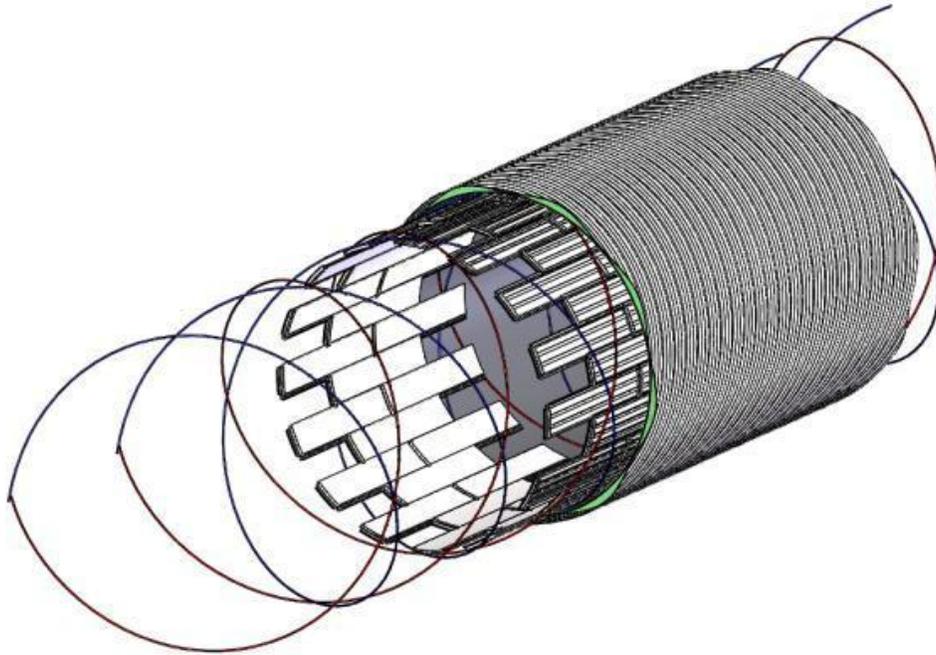
Several computer-aided design drawings depicting a typical FeHDPlank™ unit can be seen below.





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Feng	FeHDPlank	SK2
	CSP Culvert Rehab 75-Year	
	Dwg : RT	Jan 23, 2022

EXPLODED VIEW



Footprint Engineering Inc.		
Feng	FeHDPlank	SK3
	CSP Culvert Rehab 75-Year	
	Dwg : RT	Jan 23, 2022

