AERIAL GRAVITY PIPE REHABILITATION USING FIBER-REINFORCED CIPP

Presented By

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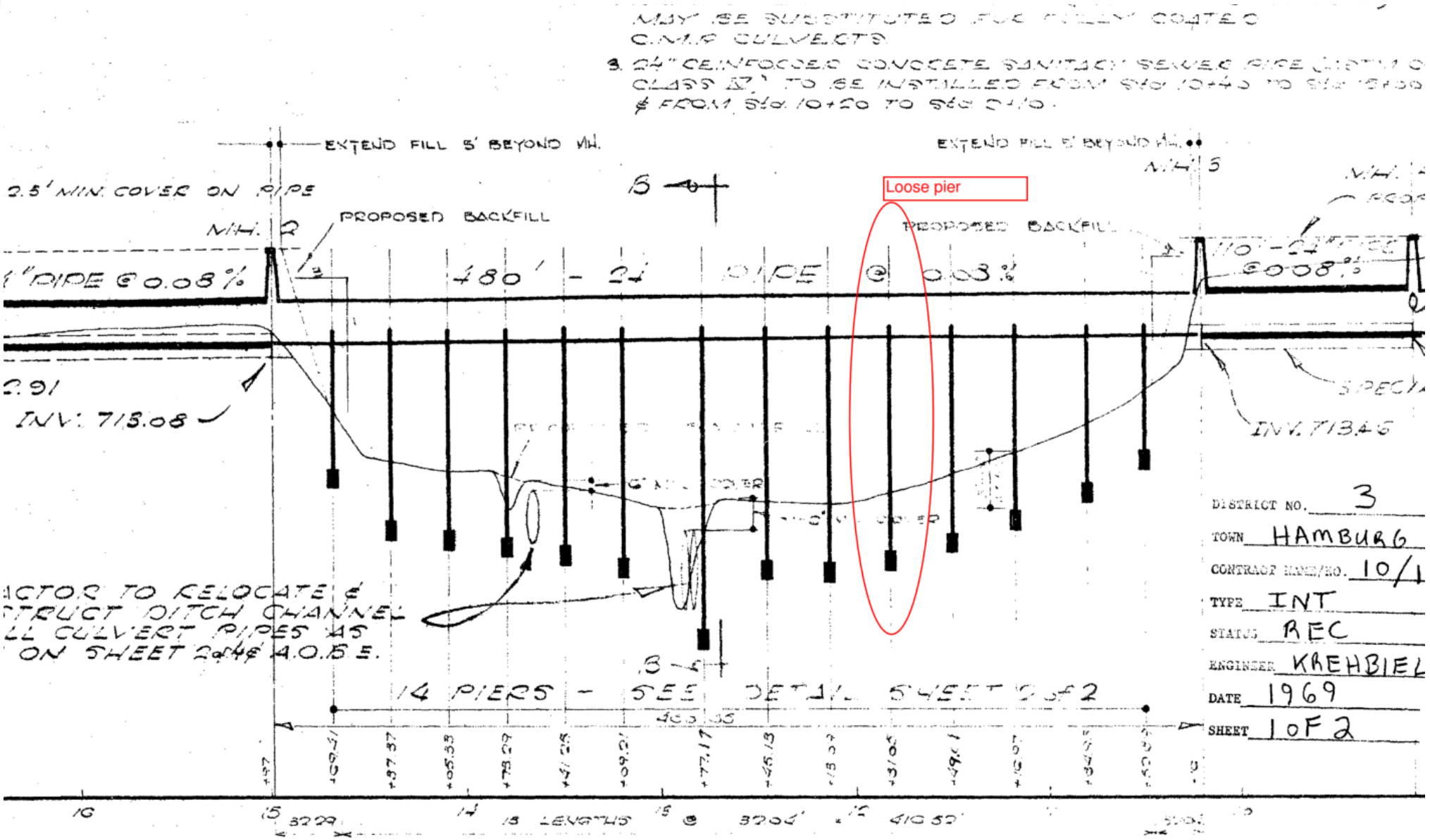
EXTEND FILL 5' BEYOND MH.
2.5' MIN. COVER ON PIPE
PROPOSED BACKFILL
480' - 24" PIPE @ 0.08%
Loose pier
2.91
INV: 715.08
INV. 713.46
14 PIERS - SEE DETAIL SHEET 2 OF 2
DISTRICT NO. 3
TOWN HAMBURG
TYPE INT
STATUS REC
ENGINEER KREHBIEL
DATE 1969
SHEET 1 OF 2

GIVEN: Host pipe is an existing 24-inch concrete cylinder pipe (AWWA C303) transporting wastewater on piers spaced at 32 feet on center. Project specifications required using a weight of 265 Lbs./LF for this pipe.

REQUIRED: Design a CIPP that will support the existing pipe carrying a 100% full wastewater flow.

DESIGN SOLUTION: For aerial applications the CIPP is designed to act as a cylindrical beam structure. Using AWWA MOP M9 (Chapter 10), we know that the existing piping has a max moment of approximately $0.0625wL^2$; but for the project specifications required using a simply supported beam design having a max moment of $0.125wL^2$.
The weight of the wastewater was estimated to be 196 Lbs./LF; making the design load for the liner 461 Lbs./LF.

Assuming a minimum finished thickness liner of 0.5709 inches (14.5 mm)…

$$I = \frac{\pi}{4}\left[\left(\frac{(24-(2\cdot 0.5709))}{2}+0.5709\right)^4-\left(\frac{(24-(2\cdot 0.5709))}{2}\right)^4\right] = 3673.88\ in^4$$

$$M_{max} = 0.125\cdot(265+196)\cdot(32)^2 = 59{,}008\ Lb-ft$$

$$\sigma_{max} = \frac{M_{max}\cdot c}{I} = \frac{(59{,}008\cdot 12)\left(12-\left(\frac{0.5709}{2}\right)\right)}{3673.88} = 2257.84\ psi$$

The liner material chosen had a flexural stress strength equal to 17,000 psi (in the longitudinal direction), and therefore the Factor of Safety in bending using the 0.5709 in thick liner is…

F.S. = ((17,000 x 0.55) / 2257.84 = **4.1**; which is well above 2.0 ✓

Given that this liner was a Glass-Reinforced CIPP, I needed to check the strain to confirm strain corrosion wouldn't be a problem…

$$\varepsilon_L = \frac{\sigma_{max}}{E_L} = \frac{2257.84}{1441000} = 0.0016$$

The breaking strain for the CIPP product the contractor was using was reported to be 0.027. Therefore, the strain at 50 years of continuous loading would be approximately 5.8% of the short-term breaking strain of the material. ✓

Project takeaways…

1. Glass Composite CIPP make for a reliable long-term solution to lining aerial piping

2. Strain corrosion testing needs to be added to the required product technical data

3. Using a light-cured CIPP assured that the cold, wintry conditions of the site would not negatively impact the field cured strength of the liner

Contact Info…

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