StrucRite
Architectural & Engineering Services

Thursday, September 24, 2026

RE: 194 Crooked Stick Pass - Cracks in Concrete Retaining Wall – Findings & Recommendations

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1. What's Causing the Cracks

- The wall contains steel form ties from the original concrete pour. The purpose of these ties is to hold the opposing concrete forms in place during the construction. After the concrete cures the concrete ties no longer have any purpose. The ties are located at the sides of the concrete forms that are typically 16 in. or 24 in. on center.
- Over time, water has reached these steel ties, causing them to rust and expand.
- As the steel expands, it pushes on the surrounding concrete and creates cracks that:
    - Run diagonally along the weakest path in the wall. In this case, ties on the adjacent form ties have also expanded. Stresses have found the weakest point between adjacent ties and the adjacent vertical and thus a diagonal crack developed.
    - Run vertically at where the ties were used to hold the sides of the forms in place;

2. Conditions Observed

- A primary diagonal crack running through the wall.
- Vertical cracks at or near the form ties and control joints.
- Areas of previous caulking that are now weathered and no longer sealing effectively.
- The concrete wall leans slightly backward towards south or towards the driveway. It is my opinion that this lean back into the retained earth may have been original and surprisingly intentional during the construction to minimize movement in the wrong direction.

3. Recommended Repair - Sections A and B below are a general direction for repair. Repair should be done in accordance with the manufacturer's specifications.

A. Diagonal Crack – Epoxy Injection - A polyurethane material is typically used in diagonal cracks to keep the water out; however, since this face of the wall would be in compression, it is better to use an epoxy material in this application.

- Clean and prepare the surface along the diagonal crack.
- Install injection ports and seal the surface of the crack where needed.
- Inject a two-part fluid epoxy under controlled pressure to:
    - Fill the internal crack,

- Displace water, and
- Create a water-tight, flexible seal within the wall.

- Remove ports and touch up surface areas after injection cures.

B. Vertical Cracks at Form Ties – Routing and Urethane Caulk

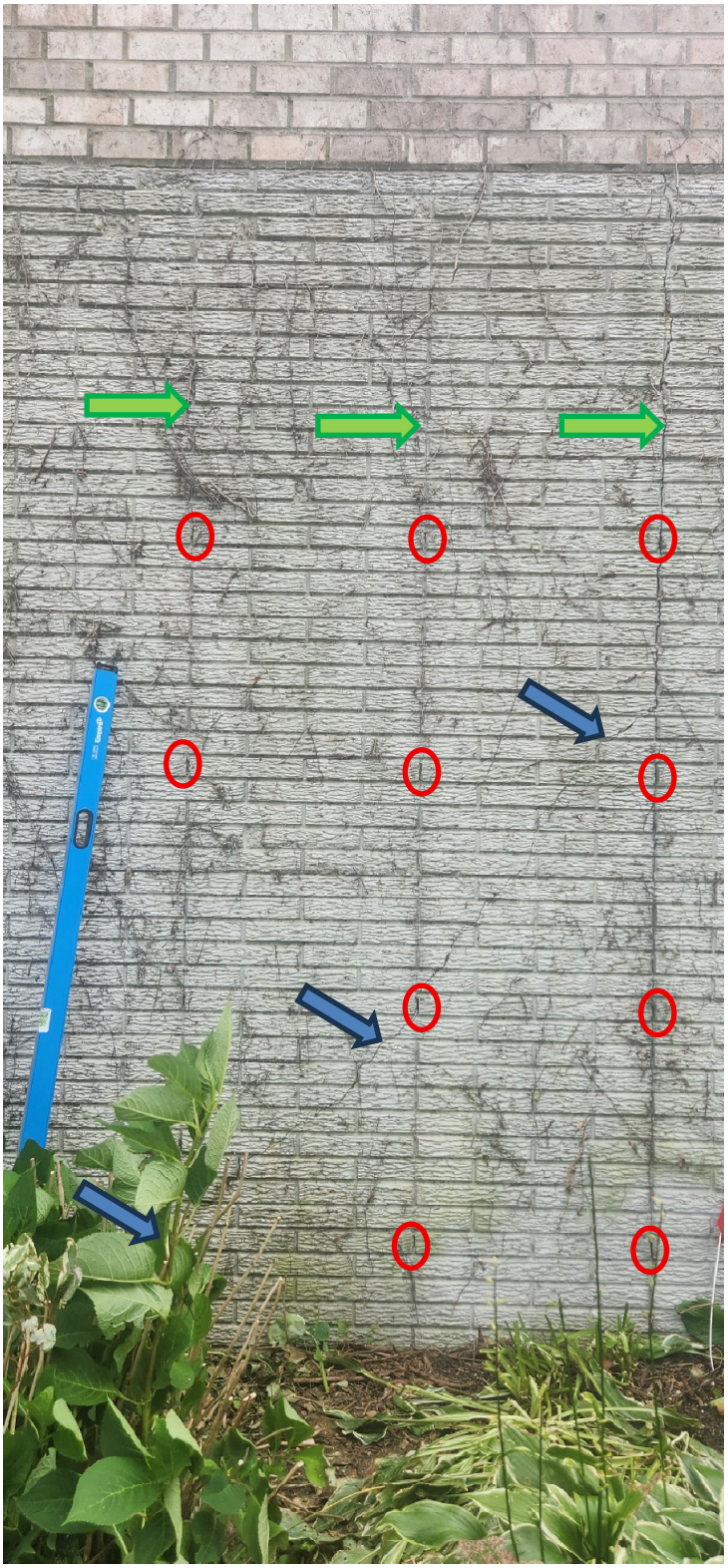
1. Remove any old materials
    - Cut out and remove all old/failed caulk and loose material from the vertical cracks and joints at the form ties.
2. Clean and shape ("route")
    - Slightly widen and shape these cracks and joints into a clean, consistent groove suitable for rod & sealant.
3. Address exposed tie locations where practical
    - Where steel tie ends are visible, clean loose rust and, where appropriate, treat or encapsulate before sealing.
4. Prepare and seal
    - Ensure cracks/joints are clean, dry, and dust-free; install backer rod and primer where required.
    - Seal with a high-quality flexible urethane caulk designed for exterior concrete and tool it for good adhesion and proper water shedding.

4. Expected Outcome

- Epoxy injection of the diagonal crack will help stop active water paths through the wall and provide material to transfer the structural forces.
- Routing and urethane caulking of the vertical cracks at form ties will reduce surface water intrusion and help manage movement at those joints.
- Together, these repairs are intended to slow further cracking and deterioration and extend the service life of the existing wall, with periodic visual monitoring recommended.



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Green arrows show where the sides of the forms were located, the red circles indicate the location of the form ties, and the blue arrow shows the location of the diagonal crack. A crack has developed full height at the far-right green arrow; the crack should be cleaned out full height, rodded, and sealed. If the joint has not developed at the location of other form ties, then I would recommend grinding the tie back into the wall and sealing the joint at the tie.



Image to left shows the finger pointing to the metal tie in the wall and the expansion of the tie create a vertical crack in the wall at the location of the vertical ties coming in. The diagonal crack can be seen coming in from the right.



The image above shows a concrete tie in the wall where a crack has not developed.



The image above shows where a construction joint was caulked incorrectly. This needs to be routed out, a rod installed and sealed properly.