

Why Continuous Steel Reinforcement is Not Used in Thin Concrete Panels or Concrete Siding

Production Process Analysis Thomas R. Beaudette, PE

Continuous steel reinforcement embedded in thin concrete panels and concrete siding requires a minimum concrete coverage for multiple reasons:

- Protect Against Corrosion: Corrosion is caused by combining oxygen and moisture. Minimum concrete coverages have been established to provide protection against corrosion. Corrosion results in the reduction or elimination of the bond between the concrete and steel which causes concrete to crack and spall.
- Protect Against Differential Temperature Expansion/Contraction: Because steel and concrete thermally expand and contract at different rates minimum coverages have been established to provide protection against seasonal temperature changes. Differential movement results in cracks in the concrete.
- Protect Against Fire/Heat Damage: Steel loses its strength at a relatively low temperature. Minimum coverages have been established to provide minimum protection of the steel from heat. Fire/heat damaged steel in concrete elements cannot be repaired.
- Protect Against Moisture Infiltration - Freeze/Thaw Damage: Any of the above issues will result in cracked concrete. Cracks allow for moisture infiltration through the concrete surface and into all adjacent voids. When water freezes, it expands approximately 9%. The trapped, frozen water causes pressures which ruptures the concrete from the inside out. Results being larger cracks, scaling and crumbled concrete.

Based on the above causes, concrete experts and code jurisdictions have established minimum coverages for steel in concrete. Typical governing bodies in the United States include:

- International Building Code (IBC)
- International Residential Code (IRC)
- The Precast Concrete Institute (PCI)
- American Concrete Institute (ACI)
- National Precast Concrete Association (NPCA).

These organizations are very clear about accepted uses of steel as reinforcement in concrete which includes siding or exterior cladding materials. The IBC and IRC reference the ACI and PCI for minimum standards. The ACI and PCI have identical coverage requirements for steel in concrete. The NPCA deviates from ACI/PCI but has similar minimums.

Relevant building codes references include:

- ACI Building Code (ACI 318) dictates minimum concrete cover for steel reinforcement in section 7.7.3. Minimum cover for precast concrete (manufactured under plant controlled conditions) is 3/4 in. Therefore, a minimum thickness for a thin concrete panel or siding would be $2 \times 3/4 \text{ in.} + \text{the thickness of steel}$. For pencil wire (approx. 1/8 in.), the minimum panel/siding thickness would be 1-5/8 in.
- NPCA – Quality Control Manual Section 4.3.3 states that “Concrete cover shall not be less than 1/2 in.” This minimum thickness is for deviation standards. Steel coverage should never be below 1/2 in.
- Thin concrete panel or siding sections cannot provide the minimum concrete coverage to meet industry standards and satisfy building codes.

Summary:

Thin concrete panels or siding using this type of steel reinforcement are in violation of building code standards and commonly accepted precast concrete practices. Steel reinforced thin concrete panels and siding should be avoided.

Specific areas of concern:

- Direct violation of building codes.
- Building jurisdictions should and will reject thin concrete panels and siding without extensive independent testing and certification per ASTM standards.
- Damage due to cracking, corrosion and internal freeze/thaw cycles is very likely.
- Potential for mid and long term damage is very likely.

About Beaudette Consulting Engineers (BCE)

Beaudette Consulting Engineers (BCE) is a nationally recognized structural engineering firm licensed in all 50 states and 2 Canadian provinces. BCE's national reputation extends across a diverse range of construction specialties including steel, masonry, cast-in-place concrete, precast concrete and log/timber frame. As a full-service firm BCE has experience in all phases of structural, seismic and construction services in all project categories including residential, commercial, industrial, historic renovation and research engineering. Projects of all sizes and material combinations have given BCE the expertise and knowledge to create aesthetically innovative and safe building environments.