Shop-primed steel for a bridge rehabilitation project was installed using galvanized bolts. The bolts were spot primed and two field coats were applied to the entire structure. After three years, white powdery deposits were visible on some, but not all of the fasteners.

Zinc oxide (zinc salts) naturally form on galvanizing. In fact, traces of the salts appear to have been present in the crevices of some of the bolts after installation and prior to the application of the coating.

An initial theory might be that the coating is defective, allowing the salts to form. But this is unlikely for a number of reasons. First, the coating performed well everywhere else. If it was defective, it is likely that some type of failure would be experienced elsewhere. Further, if the coating was defective, it is likely that the well-defined patterns of failure would not have occurred. The coating also did an excellent job in preventing the spread of the rust that was on present on the bolts prior to painting. The coating was well-adherent to the rusty edges and completely stopped the corrosion from progressing, preventing metal loss from occurring. The only way the presence of the underlying rust was revealed was by physically removing the coating. A defective coating would not have performed in this manner.

One important clue is that the salts emanated from crevice areas. Even though salts were visible across the surface of the coating, they started in the crevices. Crevices, threads, and irregular surfaces require special attention during coating application to assure that all surfaces are completely covered and sealed. Oftentimes, the coating does not penetrate into these areas by spray application alone. In addition, the coating must be applied from many directions to fully coat and seal these areas. To achieve optimum performance, spray application may need to be supplemented by brushing the crevices and edges, especially for the first coat.

The cause of the failure was the incomplete coverage of the coating system in the crevice areas and on some edges. For the crevices in particular, condensation was held in the crevices for lengthy periods of time, ultimately allowing the salts to form. Had the coating completely sealed the crevices, the salts would not have formed and any salts in the crevices that had been painted over would have been held in check (which was observed in some of the areas stripped).

Regarding the differences between amount of salts present between the west and east chords, the prevailing wind was west to east. This caused the westernmost chord to dry more quickly than the eastern chord, which was protected from the wind. The sun also caused the condensation on the upper sides and tops of both chords to dry more quickly, providing less time to retain the moisture. In time, though, all of the fasteners that are not completely sealed with the coating system can be expected to exhibit zinc salts if they are not touched up.