Safety Problem with FIXE Top Chain Anchors

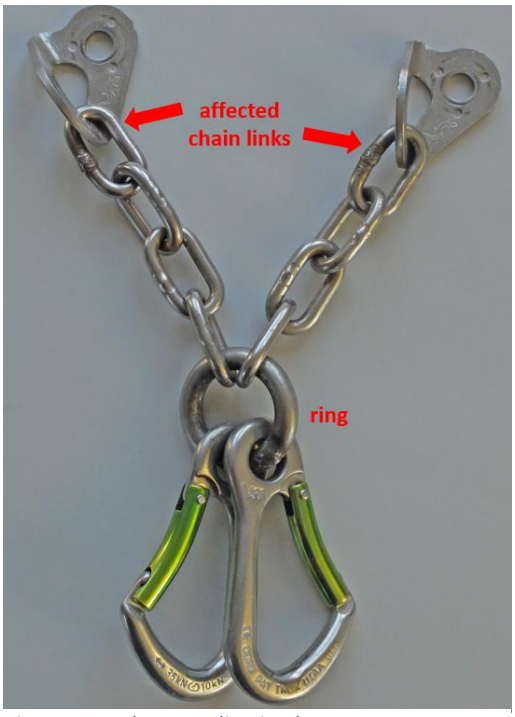

Figure 1: Anchor equalization by FIXE

This summer, a chain link of a FIXE top chain anchor made of stainless steel broke during lowering the climber at an outdoor wall of a climbing hall of the German Alpine Club (DAV). As the design of the top chain anchor equalizes the load between two attachment points (anchor equalization, Figure 1), the failure luckily had no consequences. In the subsequent examination of all top chain anchors at the outdoor wall of said climbing gym further chain links showing fissures were detected. It was always the last chain link which provides the connection to the bolt that was affected. Fissures occurred both in the area of the weld seam and at the leg opposite to the weld seam (Figures 2, 3). The affected top anchor chains had only been used for two years. After safety warnings had been released by the German Alpine Club on July 28 and by FIXE (TechRock) on July 29, top chain anchors that showed fissures in the chain link which is connected to the bolt were detected at outdoor walls of two further climbing gyms.

Reason

A Spanish laboratory commissioned by the manufacturer FIXE analyzed one of the top chain anchors and certified stress corrosion cracking, SCC, as cause for the fissures observed.

Figure 2: Chain link showing average traces of corrosion and an obvious fissure.

Stress corrosion cracking is the result of a combination of three factors: the material is susceptible to stress corrosion cracking, tensile stresses act upon the link (by internal thermal stresses within the link or external loads) and the environment promotes corrosion. An environment which promotes corrosion is almost always given in the outdoor area. Proneness of the material to stress corrosion cracking is created by the manual welding process of stainless steel, as far as we known. The chain link connected to the bolt which is affected by fissures is manually welded by the manufacturer FIXE and shows anomalies of structure in the metallographic

Figure 3: Chain link sowing a fine fissure opposite to the weld seam.

analysis. In contrast to that, the remaining chain links are machine-welded under controlled conditions and show no anomalies. Whether thermal stresses within the link or load during lowering finally cause stress corrosion cracking is not yet clear. Up to now, FIXE cannot limit the problem to one single production batch. Thus, all top chain anchors of the manufacturer made of stainless steel may be affected. Up to now, fissures were only detected at chains using anchor equalization in which both chain strands are under load. In strength tests conducted by the Safety Research Group of the German Alpine Club one chain stuck out at which only a very thin fissure was visible (Figure 3) but which only had a residual breaking strength of 5,6 kN! Visual control thus has to be executed very thoroughly. Stress corrosion cracking may occur at any point during the lifetime of a member. One single inspection is thus not sufficient to eliminate the problem.

Figure 4: Top chain anchor by FIXE in serial connection.

Two questions remain in connection with the issue. First: may also top chain anchors with a serial connection be affected (Figure 4)? Here, the chain is serially connected as a redundancy system and is not under load. Thermal stresses, generated by the welding process, would have to cause the corrosion without additional introduction of load. And second: may also the ring which connects both chains (in case of anchor equalization) or which connects the chain and the bolt (in case of serial connection) be affected by stress corrosion cracking? This ring is also welded manually but has a substantially larger cross section. Thus, there is basically a greater safety buffer and the tensile stresses within the material are lower. Up to now, no ring with fissures has been detected. In the analysis of the top chain anchors comprising fissured chain links the rings neither comprised fissures nor showed reduced strengths.

In general, the problem of stress corrosion cracking has already been known in the climbing scene. Up to now, however, this phenomenon predominantly occurred in maritime or tropical environments. The UIAA Safety Commission has been dealing with this problem for quite some time now. (See also http://www.theuiaa.org/news-865--Safety-Commission-issues-update-of-corrosion-notice-for-anchors-in-marine-locations-.html) Apart from stress corrosion cracking the usual corrosion problems still exist.

Conclusion

Figure 5: Redundancy using a quickdraw

Top chain anchors made by FIXE with anchor equalization (Figure 1) made of stainless steel are to be regarded cautiously. In the long run, they ought to be exchanged. At short notice or if you arrive at such an anchor as a climber, the anchors may be secured. In this respect, for example a quickdraw may be connected in parallel to a chain strand (Figure 5).

FIXE top chain anchors in serial connection made of stainless steel ought to be investigated with respect to traces of corrosion and fissures by operators of climbing gyms and persons in charge of climbing crags. In this investigation the focus has to be on the last link which provides the connection to the bolt and on the ring at the second bolt. The investigation has to be carried out thoroughly as the fissures may be relatively fine (Figure 3).

For further tests and inventory purpose we would be pleased to receive anchors that have been exchanged due to fissures or corrosion. Our postal address:

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