# Field Trials of Aerospace Fasteners in Mechanical and Structural Applications

G.N. Melhem[1,2], P.R Munroe[1], C.C. Sorrell[1] and A.C. Livingstone[2,3]

[1]School of Materials Science and Engineering
University of New South Wales
Sydney, NSW 2052
Australia

[2]Perfect Engineering Pty. Ltd.
14 Dick Street
Henley, NSW 2111
Australia

[3]School of Civil and Environmental Engineering
University of Technology Sydney
Ultimo, NSW 2007
Australia

Corresponding Author: g.melhem@unsw.edu.au or george@perfectengineering.com.au

***Abstract***

The present work reports findings for the application of specialised aerospace aluminium rivets, manufactured from Al 7075 (Al-Zn-Mg-Cu) T6 alloy stem/mandrel, with an Al 5056 (Al-Mg) shank or sleeve, which were used for construction rectification of an outdoor louvre façade on a high-rise building. These specialised rivets were used to replace failed conventional construction rivets, which consisted of sleeve and mandrel comprised of either all-steel, all-aluminium, or aluminium-steel. The building is in close vicinity to the ocean and exposed to extremely high wind loading, making the rivets susceptible to failure by corrosion and fatigue. The focus of the present work is to report the examination of the specialised replacement rivets following an in-service lifetime of 12 years. The examination revealed that the replacement rivets (mandrel and sleeve) remained intact and uncontaminated, essentially free of corrosion. It is likely that sunlight exposure and the composite nature of the rivets enhanced the performance through age-hardening. Analysis of the rivets included visual inspection, optical microscopy, Vickers microhardness testing, and transmission electron microscopy (TEM). The aim of the analysis was to correlate microstructures with microhardnesses, using these data to evaluate the ultimate tensile strength (UTS), yield strength (YS), and the potential for further age-hardening. The Vickers microhardnesses were observed to have increased by ~8% over the service lifetime of 12 years, which equates to increases in YS (34.8 MPa to 46.8 MPa) and UTS (23.8 MPa to 45.6 MPa). Whilst the results show that there is a large increase in the strength values when comparing the unused rivets to the 12 year old rivets, this increase in hardness may not necessarily be due purely to natural ageing kinetics such as exposure from the sun and or outdoor temperature. However, there appears to be some insignificant alteration of the microstructure and mechanical properties as a result of this exposure.