Dear Amini, M., Ekteraeae, H., Shariati, M.,

We appreciate your active participation in X-MECH 2016, also thank you for presenting your paper in this conference, entitled:

Experimental Study of the Ratcheting Effect on the Fatigue Life of Welded Aluminium 2024-T351

Conference Chair: M.M. Shahrieh
Professor: School of Mechanical Engineering, Iran University of Science and Technology, Tehran, Iran
Experimental study of the ratcheting effect on the fatigue life of welded aluminium 2024-T351

1 Amini, M., 2 Ekhteraee, H., 3 Shariati, M.
1 Undergraduate Student, Department of Mechanical Engineering, University of Mashhad, Mashhad, Ferdowsi, Iran
2 Associate Professor, Creep, Fatigue and Fracture Laboratory, Department of Mechanical Engineering, Ferdowsi University of Mashhad, Mashhad, Iran
3 Professor, Creep, Fatigue and Fracture Laboratory, Department of Mechanical Engineering, Ferdowsi University of Mashhad, Mashhad, Iran

Abstract - In this paper, the effects of pre-ratcheting deformations upon the fatigue life of aluminum 2024 welded specimen is studied. Ratcheting, as a characteristic of unbalanced cyclic plasticity, can accelerate fatigue damage or even acts as a failure mode by itself. In this study the combination of two levels of ratcheting loadings and their interactions are studied. In this regard, some tests are performed. The effects of such factors as mean stress, stress amplitude, stress frequency and the number of ratcheting cycles are investigated. The stress-controlled fatigue tests are carried out at ambient temperature. The results reveal how the mixed- ratcheting states can reduce the fatigue life expectancy of plain and welded specimens.

Keywords - Fatigue life, Ratcheting, Aluminum weldment, Experimental test, Taguchi analysis.

I. INTRODUCTION
Fatigue behavior is a complex phenomenon that is influenced by various factors such as ratcheting, mean stress, stress amplitude, microscopic structure and loading history. Ratcheting is the cyclic accumulation of inelastic strains. It is an important factor in the design and safety assessment of structural components subjected to asymmetrical stress-induced cyclic loadings. The existing results show that ratcheting level depends on different aspects of external loading conditions, e.g., loading level, rate, waveform, and history, as well as ambient temperature [1-7]. In a regime of unbalanced stretching, both the destructive effects of ratcheting phenomenon and hidden damage of fatigue loading can be combined in the low cycle fatigue condition. Other factors that may affect the fatigue life are the average stress and stress amplitudes. Low-weight alloys are frequently selected for many applications where low density and high strength-to-weight ratios are required. It is mainly supposed that ratcheting phenomenon does not have a significant rule on the behavior of aluminum alloys [8]. Accordingly, this study is focused on the experimental study of ratcheting effect upon the life expectancy of aluminum specimens in unbalanced high stress levels. In order to reduce the number of tests, one could use the method of design of experiments. In this regard the Taguchi’s method is used.

II. SPECIMENS AND TEST SETUP
As in Fig. 1, several fatigue test specimens are prepared as per E 606-92 standard of ASTM. The gage length is 15 mm. All tests are performed in stress-controlled condition and room temperature.
The importance and efficiency of different factors are evaluated by a statistical survey in outcomes. The analyses are performed by Taguchi Design Analysis in Minitab and the results are provided in Fig. 2. The figures show that, mean stress factor \( m \) deserves the most important effect on the fatigue life \( N \). The number of pre-ratcheting \( R \) cycles has the second position. The frequency \( f \) does not show an appreciable effect on the fatigue life of the weldments.

**REFERENCES**