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Experimental Analysis of Fatigue Life of Al7075

P. Saritha, A. Satyadevi, P. Ravikanth Raju

Abstract--- The modest aluminum density and its capacity to withstand corrosion through the passivation phenomenon are extraordinary. Aluminum and its compounds are vital to the aerospace industry, also for transportation and construction industries, such as façade construction and Construction to window panels. It has low density, non-toxic, elevated heat conductivity, great resistance to corrosion and casted, machined and shaped readily. It's non-magnetic as well as non-sparking. In this work, fatigue's life of AL7075 and pure Aluminum has been tested under high cyclic loads on fatigue assessment device. Analysis software ANSYS has been used to analyze fatigue's life of different series of Aluminum specimens. The obtained experimental results compared with ANSYS results and conclusions made from them.

Keywords: Fatigue, AL7075, fatigue assessment device and ANSYS.

I. INTRODUCTION

T. Iveland et al [1] Examine on aluminum alloy fatigue life assessment with casting defects.Shrinkage cavities (Interdendritic pores) in AlSi7 Mg (0.4) cast alloys parts have a major impact on lifetime and with pores current, the initiation period of the complete lifetime is very brief and is considered negligible. A typical fatigue crack begins at or near the surface of the specimen around the pores.One reason for this is a high stress connation due to the shrinkage pores. A model that requires into consideration the closure of the gap is used. The form and allocation of pore in actual samples is complicated. The comparatively easy model yielded adequate agreement with sample outcomes after creating some simplification based on observed crack development conduct of complicated faults. A easy alteration of the model, taking into consideration a tiny crack impact, resulted to conservative predictions. J Mar Sci Technol et al. [2] studied A state-of - the-art assessment of metal structures ' fatigue-life prediction methods. This paper conducted a review of metal fatigue, with particular emphasis on the latest developments in predictive methods for fatigue life. These are split into two classifications: the studies of total fatigue harm (CFD) and the models of fatigue crack spread (FCP).All variables that influence metal structures ' fatigue life are split into four types: material, composition, load, and environment. Also discussed were the impacts of these variables on fatigue activity. Finally, prospective issues in future job to be solved have been highlighted.T. Lagoda et al [3] conducted experiment on Fatigue life calculation under multiaxial and uniaxial random loading utilizing cycle counting and spectral methods.They used a spectral method to calculate fatigue life. Alexis Banvillet et al[4] are working on SG Cast Iron's Fatigue Life under Real Loading Spectra: Effect of the Bending-Torsion Correlation Factor. Comparison of fatigue information and simulations using five techniques of fatigue life calculation demonstrates that their projections are useful for equal loads, but there are large errors for non-proportional loadings, Probably because most of the techniques for ductile products have been suggested. Morel's proposal gives Best estimates for this SG cast iron and these experiments. It seems prudent to use a harm parameter below 1 to forecast crack initiation in the planning department, given that most projections are inaccurate.Future work also must be done to develop a life prediction method adapted to non-proportional loading case. E. Santecchia et al [5] studied and Review of fatigue life prediction methods for metals. A huge number of fatigue life prediction models have been proposed since the introduction of the linear damage rule, but none of these can be universally accepted. Authors in order to account for all factors that play critical functions during cyclic loading apps, attempts are being made worldwide to modify and extend current theories.The complexity of the fatigue problem makes this topic actual and interesting theories using new approaches arise continuously. Depending on the specific implementation and the variables of reliability regarded, scientists may choose to calculate multivariable models or methods that are simpler to manage leading to a "safe-life" system. The ideal model for fatigue life forecast should include the primary characteristics of those already developed and Simulation systems could be implemented to assist engineers and researchers in a number of products..

II. EXPERIMENTAL DETAILS

The sample is placed into the machine spindle's head and tail stock. Special weight (supplied with the device) is put on the loading mechanism's receiving panel to compensate for the rotating spindle unbalance. For the necessary stress, the pre-determined weights must apply.The machine's engine is started and the test is run, the engine revolution is 1480 rpm per minute during the test. The physical design of the fatigue assessment device is shown in Fig. 1 The proximity sensor signal is transferred to the machine-mounted digital counter. After fracturing, the machine is

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halted manually and the amount of cycles in the fracturing method is shown on the digital sensor of the device is displayed on the machine's digital sensor.The machine is started manually after fracturing and the amount of runs at fracturing is shown on the machine's digital sensor. The experiment is reiterated in distinct ways loads until adequate number of points can be plotted to obtain results.

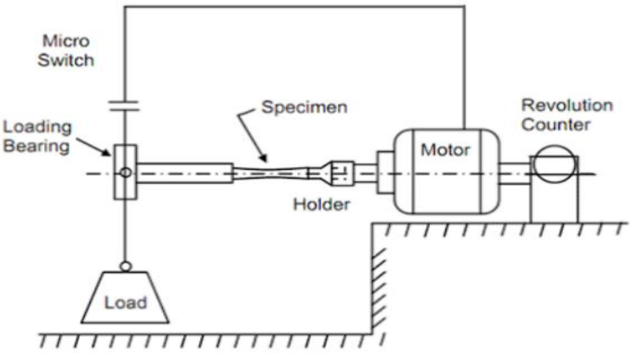

Fig.1: Physical Model of fatigue assessment device

III. MATERIAL SPECIFICATIONS:

The experiment carried out by taking materials with 100mm length, 20mm outer diameter of rods. This rods further used to turn out into required dimension of specimens by using CNC machine. The specimen detailed diagram is shown in Fig. 2. The mechanical properties of pure Aluminum and AL 7075 is shown in Table 1 and the Chemical composition of AL 7075 is given in Table 2.

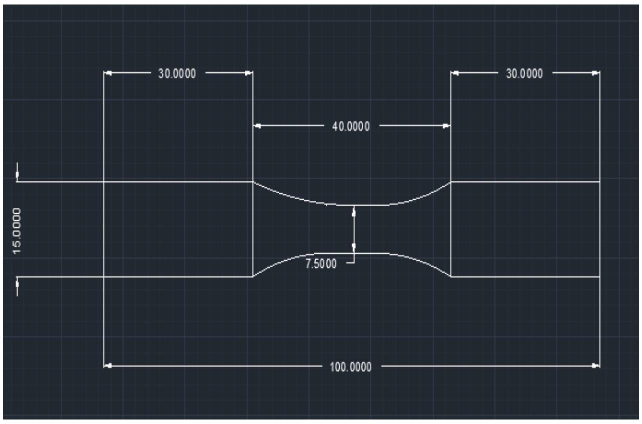

Fig.2: Specimen Diagram

Table 1: Mechanical PropertiesofPure Aluminum and AL7075

Property	Aluminum	AL 7075
Density	2.68 g/cm3	2.81 g/cm^3
Young's modulus	68.3 GPa	70 GPa
Fatigue strength	57 MPa	160 MPa
Poisson's ratio	0.33	0.32
Shear modulus	26 GPa	26 GPa
Shear strength	87 MPa	330 MPa
Ultimate tensile strength	150 MPa	560 MPa
Tensile strength	130 MPa	480 MPa

Table 2: Chemical Compositions of AL 7075

Elements%	Alloy 7075
Zn	5.10 – 6.10
Mg	2.10 - 2.90
Cu	1.20 - 2.00
Cr	0.18 - 0.28
Fe	0.50
Si	0.40
Mn	0.30
Ti	0.20
Others	0.15

IV. EXPERIMENTAL RESULTS AND DISCUSSIONS:

Experiments have been carried out for pure Aluminum and AL 7075 specimens on fatigue assessment device for getting the fatigue's life. The fatigue's life has been calculated for pure Aluminum and AL 7075 for three specimens each at different loads, and the average life has been obtained for the loads. The obtained experimental vales for pure Aluminum specimens are tabulated in Table 3. The same number of experiments has been carried out on AL 7075 specimens at same loads and the obtained experimental values are tabulated in Table 4. From Tables 3 and 4 it is observed that Al7075 is the one stand for high number of cycles. Comparing pure Aluminum and AL 7075 materials,fatigue's life is more in Al7075 because of its hardenability property.

Table 3: Fatigue Life for Pure Aluminum

Specimen No.	Load (N)	Number of cycles (N)	Average
1	80	372	372
2	80	346	
3	80	398	
4	100	10	10
5	100	9	
6	100	11	
7	120	2	2.33
8	120	3	
9	120	2	

Table 4: Fatigue Life for Al7075

Specimen No.	Load (N)	Number of cycles (N)	Average
1	80	15138	15389.66
2	80	15423	
3	80	15608	

4	100	7124	7158
5	100	7145	
6	100	7205	
7	120	925	936.66
8	120	933	
9	120	952	

V. FATIGUE ANALYSIS USING ANSYS:

The fatigue's life has been calculated in ANSYS for both pure Aluminum and AL 7075 specimens at different loads. The fatigue's life obtained for pure AL 7075 specimens in ANSYS at different loads is shown in Fig 3 (a), 3 (b) and 3 (c). Fig 4(a), 4 (b) and 4 (c) shows the fatigue life of Aluminum at 80 N, 100 N and 120 N respectively. Comparison of fatigue's life of experimental values with ANSYS values is shown in Table 5.

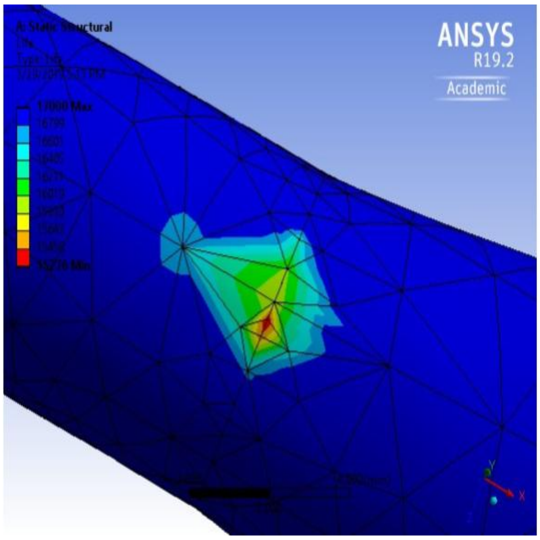

Fig. 3(a):Fatigue life for AL 7075 at 80NLoad

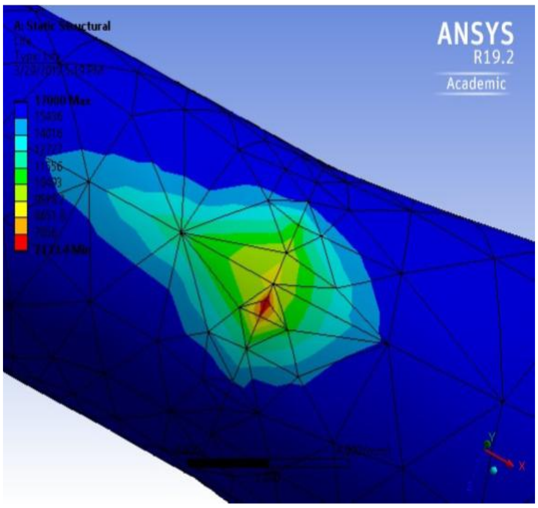

Fig. 3(b): Fatigue Life for AL 7075 at 100N Load

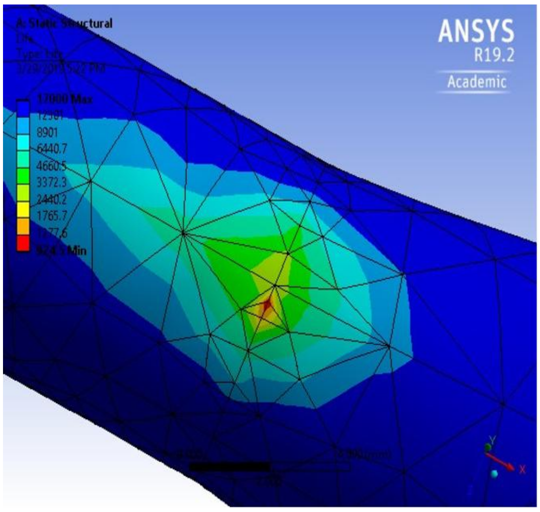

Fig. 3(c): Fatigue Life for AL 7075 at 120N Load

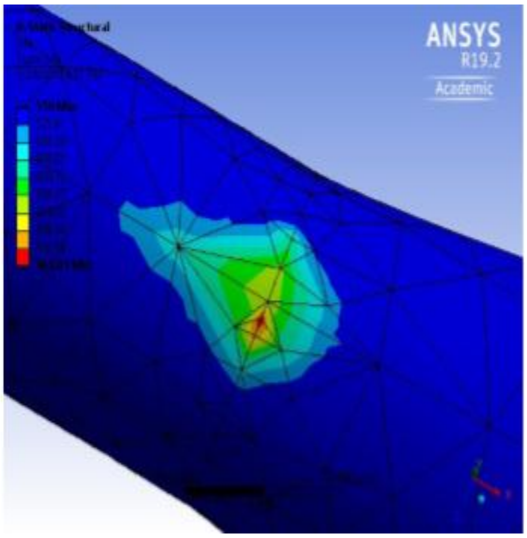

Fig. 4(a):Fatigue life for pure Aluminum at 80NLoad

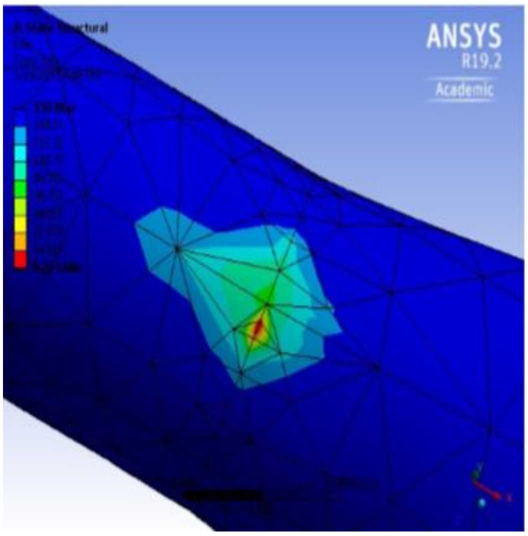

Fig. 4(b):Fatigue life for pure Aluminum at 100NLoad

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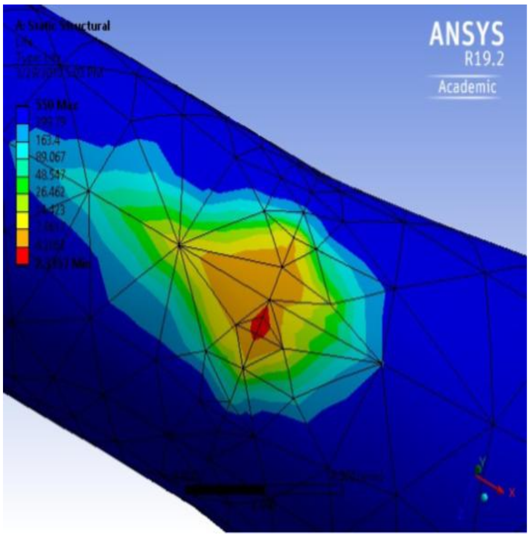

Fig. 4(c):Fatigue life for pure Aluminum at 120NLoad

Table 5: Comparison of Fatigue Life with Experimental and ANSYS Results

Material	Load (N)	Experimental value for life	ANSYS life value
Pure aluminum	80	372	365.61
	100	10	9.223
	120	2.33	2.3357
Al7075	80	15389.66	15276
	100	7158	7133.4
	120	936.66	924.5

VI. CONCLUSIONS:

The fatigue of pure Aluminum and AL 7075 has been examined both experimentally and using ANSYS software. From the results of Aluminum and AL 7075 the following conclusions are drawn.

- From the results it is found that AL 7075 has highest fatigue life and hardest than pure Aluminum.
- For pure Aluminum and AL 7075 as the load applied on the specimen increases the fatigue's life decreases.
- From the obtained results it may be concluded that AL 7075 material can be used rather than pure aluminum for better fatigue's life

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