FATIGUE LIFE ESTIMATION OF CYLINDER BLOCK USING STRAIN-LIFE METHOD

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion this thesis is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering with Automotive Engineering.

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted in candidate of any other degree.

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ABSTRACT

This project describes the fatigue life estimation of cylinder block using strain-life method. The main objectives of this project are to predict the fatigue life of the cylinder block using strain-life method and to identify the critical locations and to investigate the effect of loading. Aluminum alloys are selected as a cylinder block materials. The fatigue life predicted utilizing the finite element based fatigue analysis code. The structural model of the cylinder block was utilizing the solidworks. The finite element model and analysis were performed utilizing the finite element analysis code. In addition, the fatigue life was predicted using the strain-life approach subjected to variable amplitude loading. TET10 mesh and maximum principal stress were considered in the linear static stress analysis and the critical location was identifying at node (109730). From the fatigue analysis, Smith-Watson-Topper mean stress correction method was conservative life subjected to SAETRN loading. It is observed that the nitrided treatment and polished surface finish produce the longest life. Smith-Watson-Topper (SWT) mean stress correction is conservative method when subjected to SAETRN loading histories and the nitriding with polished combinations have been found the great influences on the fatigue life of cylinder block.

ABSTRAK

Projek ini menggambarkan kehidupan kelelahan anggaran blok silinder menggunakan kaedah ketegangan hayat. Objektif utama projek ini adalah untuk memprediksi hayat lesu blok silinder menggunakan kaedah kehidupan regangan dan mengenalpasti lokasi-lokasi penting dan untuk meneliti kesan daripada muat naik. Paduan Aluminium dipilih sebagai bahan blok silinder. Menjangkakan hayat lesu memanfaatkan elemen hingga berdasarkan analisis kelelahan kod. Model struktur blok silinder dibuat menggunakan SolidWorks. Model elemen hingga dan analisis dilakukan menggunakan analisis elemen hingga kod. Selain itu, kehidupan kelelahan dipercayai menggunakan pendekatan hayat lesu mengalami amplitud pembolehubah bebanan. Unsur TET10 dan maksimum voltan utama yang dipertimbangkan dalam analisis linear stres statik dan lokasi kritikal dianggap di simpul (109730). Dari analisis kelelahan, Smith-Watson-Topper pembetulan voltan rata-rata adalah kaedah konservatif sasaran bebanan SAETRN. Berdasarkan keputusan yang terhad, teramati bahawa penjagaan dan dicelup nitided permukaan terpanjang tamat menghasilkan kehidupan untuk semua kondisi beban. Sebagai kesimpulan, Smith-Watson-Topper (SWT) pembetulan voltan rata-rata adalah kaedah konservatif dan kombinasi nitriding dengan kombinasi dicelup telah dijumpai pengaruh besar dalam kehidupan kelelahan silinder blok.

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LIST OF SYMBOLS

$2Nt$	Transition fatigue life
ε_e	Elastic component of the cyclic strain amplitude
ε'_f	Fatigue ductility coefficient
σ'_f	Fatigue strength coefficient
σ_0	Positive for tensile stress and negative for compressive stress
σ_{max}	Local maximum stress
σ_{UTS}	Tensile strength
σ_{YS}	Yield strength
$\frac{\Delta}{2}$	Strain amplitude
b	Fatigue strength exponent
D	Cumulative damage
E	Modulus of elasticity
KIC	Fracture toughness
n_i	Number of load cycles
n	Strain hardening exponent
N_f	Number of cycles to failure
	Number of fatigue life
S–N	Stress verse cycles to failure
	Fatigue strength
	Load cycle with amplitude

LIST OF ABBREVIATIONS

Al	Aluminium
AA	Aluminum Alloy
CAD	Computer-aided design
CAE	Computer-aided engineering
FE	Finite element
FFM	Finite element modeling
LFC	Low fatigue cycle
MBD	Multibody dynamics
MPC	Multi-Point Constraints
SAE	Society of Automotive Engineers
SAETRN	Positive mean loading
SWT	Smith-Watson-Topper
TET	Tetrahedral