DETERMINATION OF STRESSES IN A SPUR GEAR BY PHOTOELASTIC AND NUMERICAL METHODS

By

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DECLARATION

I hereby declare that this thesis has been prepared by myself and it is a record of my own research work. It has not been accepted in any previous application for a higher degree. All sources and information are specifically acknowledged by means of references.



S. A. UGWU.

July, 1990.

CERTIFIED BY:



Dr. W. R. RYCHWALSKI,
Supervisor.

CERTIFICATION

This project report entitled, "Determination of Stresses in a Spur Gear by Means of Photoelastic and Numerical Methods", by Sylvester Ani Ugwu, meets the regulations governing the award of the degree of Master of Science (Production Engineering) of Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

W. R. Rychwalski Date: 30-JULY-1990
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Date: 1/8/90
Dr. E. J. Bala,
Member, Supervisory Committee.

Dare:
Professor C. O. Folayan,
Head of Department.

Date: 8-11-90
Dean, Postgraduate School.

DEDICATION

Dedicated To:

My Parents:

Mr. Ugwu Ngeeta

Mrs. Nogo-Arum Ugwu-Ngeeta;

My Brothers:

Jacob N. Ugwu

Moses C. Ugwu

Job N. Ugwu;

And My Sisters:

Miss Uchenwa Ugwu

Miss Calista Uruka Ugwu.

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ABSTRACT

The new developments in mechanical engineering in Nigeria (Low Cost Vehicle project, aviation projects - AIR BEETLE, etc.), require in-house practical calculation techniques in design generally and calculation of stresses in machine components, particularly.

The machine components (Spur Gears) under operation are subjected to stresses which differ at different locations. These stresses are hereby determined with the use of photoelastic and numerical methods and compared with classical design formulae.

Gear Models made of photoelastic material (Columbia Resin CR-39) were produced and loaded in a specially built gear loading system. The stresses in the model were analysed using the photoelastic principles giving the stress difference ($o - a$) at points. Next, numerical method (Finite Difference Method) was employed which gave ($a_1 + a_2$) values at the same points. The equations for ($a - a$) and ($a + o$) were solved for the individual stresses at the said points.

The stresses in the gear model were also determined using Finite Element Method, FEM. Later, the model stresses were applied to the steel prototype.

Finally, the results obtained using different methods and classical design formulae (Lewis, Modified Lewis and Sopwith Equations), were compared and inferences made. Some likely sources of error in the work were pinpointed.