REDESIGN AND OPTIMIZATION OF KEYSEAT

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REDESIGN, OPTIMIZATION AND VALIDATION OF KEYSEAT

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ABSTRACT

Function of keyseat is to lock between main component and sub component like shaft and gear in transmission. Keyseat as one part of moving machine's component need a precision calculation in design, as that reason this project studied about analysis and optimization of design from two dimension model to solid modeling model. Objectives of this project are to redesign a keyseat from the original design, optimize the parameter values and to validate the value using calculation and simulation concept. The original design was taken from anonymous design, and a new keyseat design was made under reflection from the literature reviews. This project have four phases; the first phase is redesigned the original design that add two keyseat into two location, second phase is analyzed the new design with mathematical analysis to identify the optimization of this new design, third phase is built solid modeling by using Computer-Aided Design (CAD) and then simulated by Computer-Aided Manufacturing (CAM), the last phase was made real manufacturing by using CNC machine that drive with G-code that generated from CAM program. Methodology that was used is analysis variable method; variables which affect the value of the objective function, in the manufacturing problem, the variables might include the amounts of different resources used or the time spent on each activity. As the conclusion, redesign and optimization of keyseat is usable in all of shaft in machining part to minimize the failure and minimize the decrease a torque.
ABSTRAK

Fungsi lurah kunci ialah pengunci antara komponen utama dan sub komponen seperti shaft dan roda bergigi pada transmisi. Lurah kunci adalah sebahagian komponen yang bergerak pada komponen mesin yang memerlukan pengiraan yang tepat dalam rekabentuk, oleh sebab itu projek ini mengkaji permasalahan analisa dan pengoptimuman pada rekabentuk daripada model dua dimensi kepada permodelan pejal. Matlamat projek ini adalah merebentuk semula lurah kunci dari bentuk asal, mengoptimumkan nilai parameter dan mengesahkan nilai dengan menggunakan pengiraan dan konsep simulasi. Bentuk asal diambil dari bentuk yang tidak diketahui, dan bentuk lurah kunci yang baru dihasilkan berdasarkan refleksi dari kajian literatur. Projek ini mempunyai empat fasa; fasa pertama ialah merebentuk semula daripada bentuk asal yang ditambah dengan dua buah lurah kunci kepada dua lokasi yang berbeza, fasa kedua pula ialah menganalisa bentuk baru dengan analisa pengiraan untuk mengenalpasti pengoptimuman pada bentuk baru ini, manakala fasa ketiga pula membina model pejal dengan menggunakan CAD dan kemudian ditiru semula oleh CAM, dan fasa terakhir ialah menghasilkan pembuatan yang sebenar dengan menggunakan CNC mesin yang dipandu dengan G-code yang dihasilkan dari program CAM. Metodologi yang digunakan ialah kaedah analisa pembolehubahan; dimana pembolehubah-pembolehubah ini mempengaruhi nilai pada fungsi objekti tersebut, pada permasalahan pembuatan, pembolehubah-pembolehubah ini mungkin termasuk penggunaan jumlah rujukan yang berbeza atau masa yang digunakan untuk setiap aktiviti. Sebagai kesimpulan, merebentuk semula dan pengoptimuman pada lurah kunci boleh digunakan pada semua shaft dalam bahagian mesin untuk mengurangkan kerosakan dan penurunan kuasa.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DECLARATION</td>
<td>ii</td>
</tr>
<tr>
<td></td>
<td>DEDICATION</td>
<td>iv</td>
</tr>
<tr>
<td></td>
<td>ACKNOWLEDGEMENTS</td>
<td>v</td>
</tr>
<tr>
<td></td>
<td>ABSTRACT</td>
<td>vi</td>
</tr>
<tr>
<td></td>
<td>ABSTRAK</td>
<td>vii</td>
</tr>
<tr>
<td></td>
<td>TABLE OF CONTENTS</td>
<td>vii</td>
</tr>
<tr>
<td></td>
<td>LIST OF TABLES</td>
<td>xi</td>
</tr>
<tr>
<td></td>
<td>LIST OF FIGURES</td>
<td>xii</td>
</tr>
<tr>
<td></td>
<td>LIST OF SYMBOLS</td>
<td>xiii</td>
</tr>
</tbody>
</table>

1 PROJECT OVERVIEW 1

1.1 Introduction 1
1.2 Background of Problem 3
1.3 Statement of the Problem 3
1.4 Project Objectives 4
1.5 Scope of Study 4
1.6 Organization of the Report 4

2 LITERATURE REVIEW 6

2.1 Keyseat 6

   2.1.1 Keyway 6

   2.1.2 Key 7
2.2 Mathematic Analysis
   2.2.1 Key Size
   2.2.2 Strength of Key
   2.2.3 Crushing Strength
   2.2.4 Stress in Key
   2.2.5 Material of Key
   2.2.6 Design of Key

2.3 Design Tool
   2.3.1 Computer-Aided Design (CAD)
   2.3.2 Computer-Aided Engineering (CAE)
   2.3.3 Computer-Aided Manufacturing (CAM)

2.4 Simulation

2.5 Real Manufacturing

2.6 G-Code

2.7 Optimization

2.8 Validation

3 METHODOLOGY

3.1 Problem Identification

3.2 Data Collection
   3.2.1 Design
   3.2.2 Mathematic Analysis
   3.2.3 Simulation
   3.2.4 Real Manufacturing

3.3 Step Taken

3.4 Test and Validation

3.5 Implementation
   3.5.1 Software
   3.5.2 Hardware

4 THE MODELING AND SIMULATION

4.1 Original Model

4.2 Redesign Model
4.3 Calculation
   4.3.1 Keyseat Size 43
   4.3.2 Lathe Calculation 44
   4.3.3 Milling Calculation 48
4.4 Design Tools Interface 50
4.5 Simulation 52
   4.5.1 Backplot Selected Operation 52
   4.5.2 Verify Selected Operation 53
   4.5.3 First Keyseat Simulation 54
4.6 G-Code 56
   4.6.1 Lathe G-Code 56
   4.6.2 First Keyseat G-Code 59
   4.6.3 Second Keyseat G-Code 60
4.7 Keyways Calculation Program 61
   4.7.1 Interface 61

5  VALIDATION AND RESULT ANALYSIS 64
5.1 Dimension 68
   5.1.1 First Keyseat 68
   5.1.2 Second Keyseat 69
5.2 Time 69
5.3 NC Code 71
   5.3.1 Lathe G Code 71
   5.3.2 Keyseat G Code 71

6  DISCUSSION AND CONCLUSION 73
6.1 Redesign 73
6.2 Optimization 73
6.3 Validation 74

REFERENCES
APPENDIXS
# LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE NO.</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>British Standard Metric Keyways for Square and Rectangular Taper Keys</td>
<td>11</td>
</tr>
<tr>
<td>2.2</td>
<td>British Standard Metric Keyways for Square and Rectangular Parallel Keys</td>
<td>12</td>
</tr>
<tr>
<td>2.3</td>
<td>ANSI Keyseat Dimension for Woodruff Key</td>
<td>13</td>
</tr>
<tr>
<td>2.4</td>
<td>British Standard Metric Square and Rectangular Tapper Keys</td>
<td>14</td>
</tr>
<tr>
<td>2.5</td>
<td>British Standard Metric Square and Rectangular Parallel Keys</td>
<td>15</td>
</tr>
<tr>
<td>2.6</td>
<td>British Standard Preferred Lengths of Metric Keys</td>
<td>16</td>
</tr>
<tr>
<td>4.1</td>
<td>Lathe cutting speed in meter per minute using high-speed toolbit</td>
<td>44</td>
</tr>
<tr>
<td>4.2</td>
<td>Feed for various materials (using high-speed toolbit)</td>
<td>45</td>
</tr>
<tr>
<td>4.3</td>
<td>Milling Machine Cutting Speeds</td>
<td>48</td>
</tr>
<tr>
<td>4.4</td>
<td>Recommended Feed per Tooth (high-speed steel cutters) Flow Process</td>
<td>48</td>
</tr>
<tr>
<td>5.1</td>
<td>First Keyseat Comparison</td>
<td>68</td>
</tr>
<tr>
<td>5.2</td>
<td>Second Keyseat Comparison</td>
<td>69</td>
</tr>
<tr>
<td>5.3</td>
<td>Workpiece Estimate Time</td>
<td>69</td>
</tr>
<tr>
<td>5.4</td>
<td>Lathe NC Code Comparison</td>
<td>71</td>
</tr>
<tr>
<td>5.5</td>
<td>First Keyseat NC Code Comparison</td>
<td>71</td>
</tr>
<tr>
<td>5.6</td>
<td>Second Keyseat NC Code Comparison</td>
<td>72</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

FIGURE NO.   TITLE                                             PAGE

1.1          Broken Keyway                                      2
2.1          Parallel Key                                       8
2.2          Gib Tapper Key                                     8
2.3          Plain Tapper Key                                   9
2.4          Woodruff Key                                       9
2.5          Round Key                                         10
2.6          Pressure Between Key and Keyseat                   17
2.7          Force Distributed in Key                          20
2.8          HAAS CNC turning / lathe machine                   27
2.9          CNC Jr. 3 Axis Milling Machine                     27
2.10         Design and Documentation Requirements for Full Life 31
            Cycle and Standard Validation                         31
2.11         Validation Documentation Relation and Sequence     32
3.1          Flow Chart of Research Methodology                 36
4.1          Original Design                                    40
4.2          Redesign with Solid Modelling                      41
4.3          First Keyseat                                      42
4.4          Second Keyseat                                     42
4.5          Lathe Cutting Step                                45
4.6          MasterCAM Interface                                50
4.7          SolidWork Interface                                51
4.8          Wireframe Backplot Selected Operations             52
4.9          Solid Backplot Selected Operations                  52
4.10         Solid Simulation                                   53
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.11</td>
<td>First Keyseat Simulation Process</td>
<td>54</td>
</tr>
<tr>
<td>4.12</td>
<td>Second Keyseat Simulation Process</td>
<td>55</td>
</tr>
<tr>
<td>4.13</td>
<td>Index Program Interface</td>
<td>61</td>
</tr>
<tr>
<td>4.14</td>
<td>Keyseat Calculation Program</td>
<td>62</td>
</tr>
<tr>
<td>4.15</td>
<td>Keyseat Calculation Program Result</td>
<td>62</td>
</tr>
<tr>
<td>4.16</td>
<td>Milling Calculation Program</td>
<td>63</td>
</tr>
<tr>
<td>4.17</td>
<td>Milling Calculation Program Result</td>
<td>63</td>
</tr>
<tr>
<td>5.1</td>
<td>Flow Process</td>
<td>64</td>
</tr>
<tr>
<td>5.2</td>
<td>Original Design</td>
<td>65</td>
</tr>
<tr>
<td>5.3</td>
<td>New Design in SolidWorks</td>
<td>65</td>
</tr>
<tr>
<td>5.4</td>
<td>New Design in MasterCAM</td>
<td>66</td>
</tr>
<tr>
<td>5.5</td>
<td>Real Manufacturing Product</td>
<td>66</td>
</tr>
<tr>
<td>5.6</td>
<td>Shaft and Keyslot</td>
<td>67</td>
</tr>
<tr>
<td>5.7</td>
<td>Pulley and Keyway</td>
<td>67</td>
</tr>
<tr>
<td>5.8</td>
<td>Key</td>
<td>68</td>
</tr>
<tr>
<td>5.9</td>
<td>Time Machine Estimate</td>
<td>70</td>
</tr>
</tbody>
</table>
LIST OF SYMBOLS

D / d  -  Diameter
L    -  Length of key
h    -  Thickness of key
b    -  Width of key
A_c  -  Area resisting crushing
A_s  -  Area resisting shear
F_c  -  Allowable average crushing stress
F_s  -  Allowable average shear stress
P    -  Tangential pressure
M_1  -  Torque
T_{xy}  -  Average stress
\sigma_s  -  Average bearing
CHAPTER 1

PROJECT OVERVIEW

1.1 Introduction

Function of keyseat is to lock between main component and sub component like shaft and gear in transmission. Keyseat as one part of moving machine’s component need a precision calculation in design, as the move machine component, keyseat is moving with a main component and distribute the torque, that is the reason why keyseat need precise design and accurate calculation to decrease wear, noise and deflation of torque. Without this condition keyseat can make main component failure and reduce the torque that distributed.

In this era, machine design is more complicated and more complex and detail, like sizing, scale, system drawing (America or Europe) and material contour for each detail design. Designer generally using three types of software design, such as: Computer-Aided Design (CAD), Computer-Aided Engineering (CAE), and Computer-Aided Manufacturing (CAM). Software design that usually used like AutoCAD and Mechanical Desktop are registered trademarks of Autodesk, SolidWork and CATIA are registered trademarks of Dassault Systemes, and MasterCAM are registered trademarks of CNC Software, Inc.

Machine design deals with the creation of machinery that works safely, reliably and well and designer have to know about mechanics, thermodynamics, heat transfers, material manufacturing processes, effects of vibration, etc. The ultimate
goal in machine design is to size and shape the parts and choose appropriate material and manufacturing processes so that the resulting machine can be expected to perform its intended function without failure.

**Figure 1.1: Broken Keyway**

Machining design also have simulation process to simulate a real manufacturing that refer to what happens when a digital computer runs a state transition table that describes the state transitions, inputs and outputs of a subject discrete-state machine. For simulation processes, designer using CAM software design.

The last process is machining process; machining operations can be divided into those that remove metal from an item, and those that form metal in an item. There is many machining operation like Drill, Lathe, Mill, etc, according to machining processes need. At this time, machining process already uses Computer Numerical Control (CNC)
1.2 Background of Problem

To design part of machine is complicated and have to considerate with concept generation, product planning, advance engineering, product engineering, process engineering and pilot running. US concept that usually used in Asia took 26 months to advance engineering schedule and for Europe and Japan concept used 14 and 15 months to advance engineering schedule.

If advance engineering schedule time can be reduce, the designing process can shorter and can concentrate to another process to increase the quality of product and decrease production cost.

Keyseat is a small thing in machine component however keyseat need precision design and correct calculation to design a keyseat because keyseat is moving part of machine and used to lock and to continue torque from main machine component to sub main component.

1.3 Problem Statement

Design a keyseat with accurate calculation and analysis is complicate and has many considerations, for this reason a program that use to make keyseat in machine design with mathematic calculation, solid modelling and Simulation is needed.

According for statement above, this thesis studying as title “Redesign, Optimization and Validation of Keyseat”, relate of anonymous design
1.4 **Project Objectives**

This study was undertaken to achieve the following objectives:
1. Redesign the keyseat
2. To optimize parameter values
3. To validate the value using mathematical calculation and simulation

1.5 **Scope of Study**

This study was undertaken to achieve the following scope:
1. The design took from anonymous design and keyseat design make under reflection from literature review.
2. Redesign, simulation and real manufacturing of the product
3. Software modeling is using SolidWork, simulation software is using MasterCAM and real manufacturing is using CNC machine.

1.6 **Paper Overview**

Chapter 1 illustrate an introduction and brief overview of the project including the problem background, problem statement, objectives, and scope.

Chapter 2 explain the literature review; explain about keyseat, formula for mathematic analysis, design and real machining process.

Chapter 3 covers the methodology of the process that will be use in redesign process in chapter four for optimization of keyseat.

Chapter 4 discusses the design and optimization result of keyseat design.
Chapter 5 discuss the validation and result for keyseat after redesign

Chapter 6 the conclusion of the project based on the five previous chapters that have been discussed.