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DESIGN OF MOTORCYCLE FRICTION PLATE COUPLING USING BORLAND DELPHI

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Borland Delphi 7,
Program,
Clutch Design

ABSTRACT

Information/ computer technology is currently experiencing rapid development. Jobs without using a computer will be difficult and require considerable time to complete. The use of information technology / computers increase productivity because various activities can be carried out quickly, and accurately. One of jobs that is quite difficult and takes a long time is designing of motorcycle friction plate clutch. The program was made by translating the plate coupling design procedure into the Delphi programming language. A design program was made by arranging interfaces according to clutch design requirements then giving orders (codes). Deviation or difference in results after cross-checking between manual calculations and program calculation is 0%. The friction plate clutch design program made by Borland Delphi 7 software can work well and calculation or design using the program is more effective than manual calculation because of the shorter time needed.

INTRODUCTION

One factor that needs to be developed is computer development [1]. Work without using a computer will be difficult and requires a long time in completion [2]. Along with technological developments, a mechanical engineer is required to be able to win the disconnection and power transfer system and transmission system [3]. The transmission system has an important role in the transmission vehicle [3]. The transmission system is a system that transfers power and rotation from the engine. Breaker and power transfer system in gear, chain and clutch vehicles. The clutch is part of the labor transfer system that is used to replace and disconnect the engine to the transmission [4]. The collaboration of computer technology with other fields of science needs to be done in this case is the design of machines, especially plate couplings. A Windows application program that can be used to create plate design applications in Borland Delphi. Borland Delphi is a database application based on Pascal objects from Borland [5]. Borland Delphi has provided components related to application development in standard units making it easier for users or programmers. Borland Delphi allows display forms to be designed by placing components using the mouse (without the command code) [6]. Delphi produces very efficient execution code, with no need to distribute the runtime of additional files with the application, it will not only speed up program execution in parallel, providing programmers an easy way to provide graphical information, but can also be used for debugging]. Previous studies that also carried out making programs using Borland Delphi are Temperature Measurement [8], Assessment of Radial Wave Function and Numerical Hydrogen Atomic Probability Meeting [9], Counter Structure of the Main House of 2 Floors [10]. The Design of Motorcycle Plate Couplings with the Delphi Programming Language uses the Borland Delphi program to create higher effectiveness and accuracy.

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RESEARCH METHODS
DESIGN OF MOTORCYCLE FRICTION PLATE COUPLING

The coupling connects the two shafts at both ends, which aims to transmit mechanical power. The function of the clutch is to transmit power from the driving shaft to the driven shaft, where the input speed will be the same as the output speed. The engine power transferred by the clutch to the transmission will then be changed according to the desired speed level. Transfer of power in the presence of clutch can be done regularly and as efficiently as possible.

A. Design of Axis

One of the most important parts of every engine is the shaft. The shaft plays a major role in transmission [11].

Table 1 Correction Factor Based on the Power to be Transmitted

Power to be Transmitted (P)	Correction Factor (fc)
Average power needed	1,2 – 2,0
Maximum power needed	0,8 – 1,2
Normal power	1,0 – 1,5

B. Design of Pegs

Pegs help as anchoring other engine elements such as pulleys, gear sprocket or coupling on the shaft.

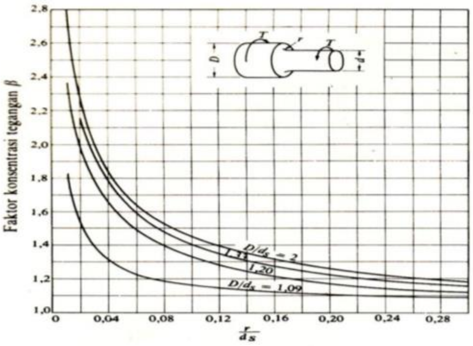

Figure 1: Voltage Concentration Chart on a Stabilized Shaft (β)

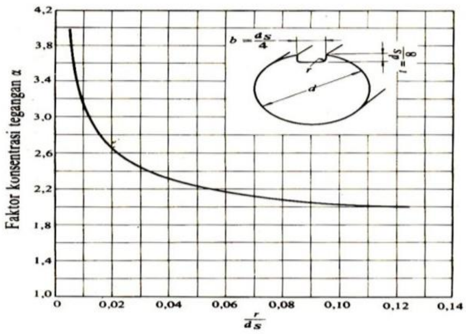

Figure 2: Voltage Concentration Graph on Shafts with Post Flow (α)

C. DESIGN OF SPLINE AND NAAF

Spline transmits power and rotation from the shaft to other components connected to it or vice versa. Naaf sometimes have the same size as the spline, but in actual conditions there is a very small size difference between the two.

Table 2 Spline and Naaf Specifications for Various Operating Conditions (SAE)

No.	Permanent Fit		To Slide When not		To Slide When		All
Splines	H	D	H	D	H	D	W
4	0,075D	0,850D	0,125D	0,750D	-	-	0,241D
6	0,050D	0,900D	0,075D	0,850D	0,100D	0,800D	0,250D
10	0,045D	0,910D	0,070D	0,860D	0,095D	0,810D	0,156D
16	0,045D	0,910D	0,070D	0,860D	0,095D	0,810D	0,098D

D. DESIGN OF SWIPE PLATE

The friction plate transfers power and rotation from the flywheel to the driven shaft.

Table 3 Contact Surface Material Specifications

Contact Surface Material	μ		P_a (kg/mm^2)
	Dried	Lubricated	

Cast iron and cast iron	0,10 - 0,20	0,08 - 0,12	0,09 - 0,17
Cast iron and bronze	0,10 - 0,20	0,10 - 0,20	0,05 - 0,08
Cast iron and asbestos	0,35 - 0,65	-	0,007 - 0,07
Cast iron and fiber	0,05 - 0,10	0,05 - 0,10	0,005 - 0,03
Cast iron and wood	-	0,10 - 0,35	0,02 - 0,03

E. BOLT DESIGN
Bolts are used to connect two different parts of a machine. The size of the bolt used will always be different, depending on the strength requirements to tighten a connection [13].

F. BEARING DESIGN
Pads are used to prevent friction between parts during relative motion. The main function of the bearing is to carry the load between the rotor and case with as little wear as possible [14].

G. DESIGN OF SPRING
The spring is used in the machine as an elastic element. The external force is deformed into the elastic force of the spring material created [15].

RESULTS AND DISCUSSION

BORLAND DELPHI

Delphi is classified as an object-based programming language whose reliability has been proven in the development of Windows applications. Delphi is a development of the Pascal program. The Graphical User Interface (GUI) concept is used to design the appearance or user interface of the application program that will be created. The concept of windows-based software that is visual will make it easier for program makers [16]. Delphi allows an application to communicate and share data worldwide through a communication network (Multiuser Distribution Application Service). The database that can be accessed by Delphi is not only Paradox, Xbase but also can access other databases such as Oracle, Sybase, Mysql, and others. Using Open Base Connectivity (ODBC), applications that have been completed to move and one type of database to another database do not need to change the application as a whole.

DEVELOPMENT AND RESULTS PROGRAM

The process of making the Motorcycle Friction Plate Coupling Design program begins with collecting the friction plate clutch design procedures manually. Make the relationship between input and output data so that it is easy to understand and translate in programming languages. After knowing the input and output data, the interface is designed and then followed by giving commands or code on each button or program component that is designed, so that it becomes a complete and workable program. Trials and cross-checks are carried out to find out whether there is a coding error, and to know whether there is a difference between manual calculations and program calculations. Programs that can run well and are calibrated are compiled to become their programs that can be run on Windows without the help of Borland Delphi. Following is the appearance of the program after compiling.

Figure 3: Main Display of Design Program (Login Page)

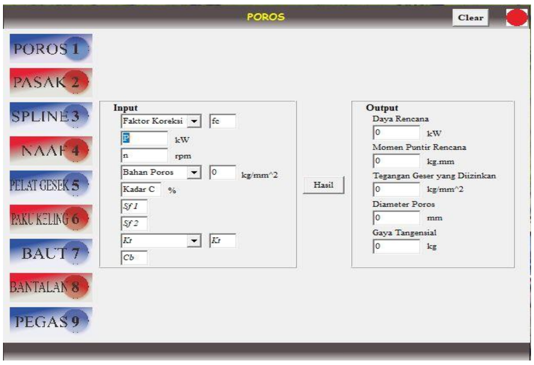

Figure 4: Display Calculate Shaft Form

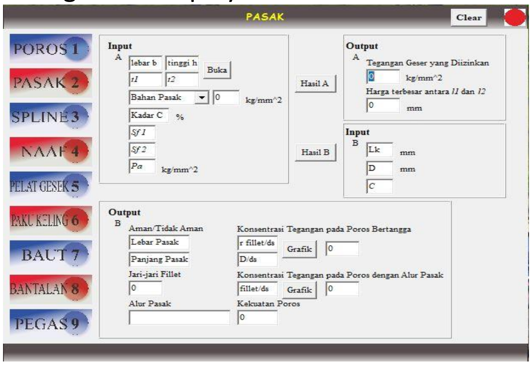

Figure 5: Display Stake Count Form

Figure 6: Display the Calculate Spline Form

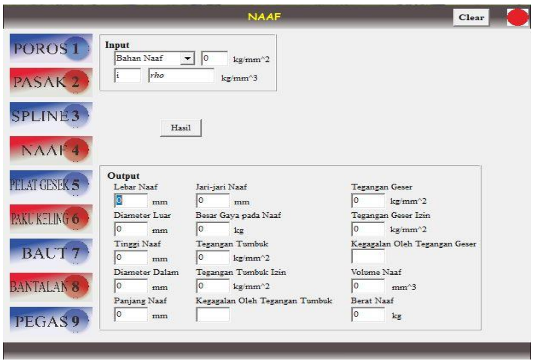

Figure 7: Display Form Calculate Naff

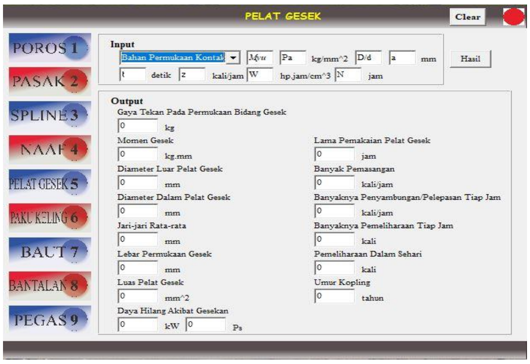

Figure 8: Display of the Swipe Plate Count Form

Figure 9: Display Form of Rivets

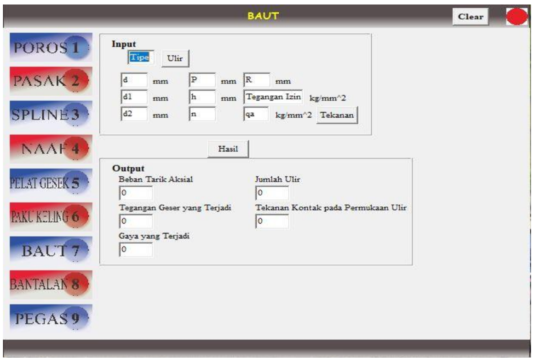

Figure 10: Display Calculate Bolt Form

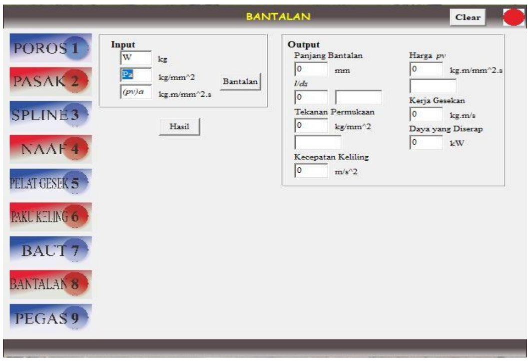

Figure 11: Display Form Calculate Pads

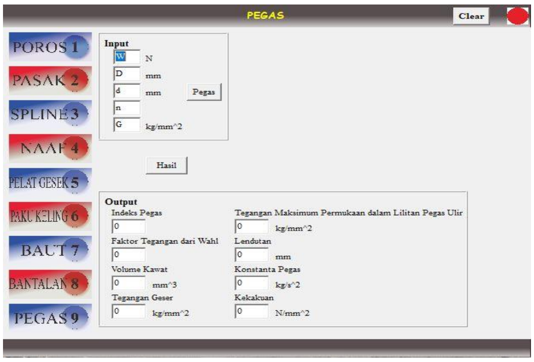

Figure 12: Display Spring Compute Form

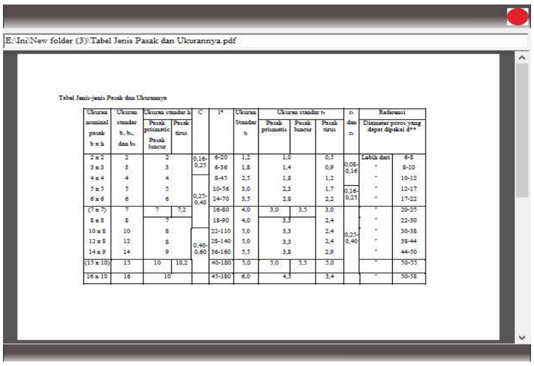

Figure 13: Open File Form Display

Table 4 Comparison of Manual and Program Counts

Part	Parametric	Result in manual	Result in Program	Different
Axis	Power plan	14,64 kW	14,64 kW	0,00
	Twisted Moment	1677,57 kg.mm	1677,57 kg.mm	0,00
	Tensile strength	110 kg/mm^2	110 kg/mm^2	0
	Permissible Sliding Voltage	6,1 kg/mm^2	6,1 kg/mm^2	0,0
	Shaft Diameter	18 mm	18 mm	0
Pegs	Tangential Force	186,4 kg	186,4 kg	0,0
	Permissible Sliding Voltage	6,1 kg/mm^2	6,1 kg/mm^2	0,0
	Highest Peg Length	8,32 mm	8,32 mm	0,00
	Wide Security	AMAN	AMAN	
	Long security	AMAN	AMAN	
	Fillet Radii	1 mm	1 mm	0
	Peg Flow	$6 \times 3{,}5 \times fillet\ 0{,}35$	$6 \times 3{,}5 \times fillet\ 0{,}35$	
Spline	(β)	1,22	1,22	0,00
	(α)	2,6	2,6	0,0
	Peg strenght	1,5 kg/mm^2	1,5 kg/mm^2	0,0
	Outer Diameter	20,93 mm	20,93 mm	0,00
	High	1,47 mm	1,47 mm	0,00
	Wide	2,05 mm	2,05 mm	0,00
	Long	28,30 mm	28,30 mm	0,00
Part	**Parametric**	**Result in manual**	**Result in Program**	**Different**
	Average radius	9,7 mm	9,7 mm	0,0
	Style that Works	172,9 kg	172,9 kg	0,0

	Security Against Mashed Voltage	AMAN	AMAN	
	Safety Against Shear Voltage	AMAN	AMAN	
Naaf	Wide	2,06 mm	2,06 mm	0,00
	Diameter	21,02 mm	21,02 mm	0,00
	High	1,47 mm	1,47 mm	0,00
	Inner Diameter	18,08 mm	18,08 mm	0,00
	Long	28,41 mm	28,41 mm	0,00
	Radius	9,8 mm	9,8 mm	0,0
	Force	171,18 kg	171,18 kg	0,00
	Security Against Mashed Voltage	Safety	Safety	
	Safety Against Shear Voltage	Safety	Safety	
Swipe Plates	Volume	2563,69 mm^3	2563,69 mm^3	0,00
	Weight	0,02 kg	0,02 kg	0,00
	Outer Diameter	124 mm	124 mm	0
	Inner Diameter	74 mm	74 mm	0
	Averange of radius	50 mm	50 mm	0
	Swipe Surface Width	25 mm	25 mm	0
	Large	7772 mm^2	7772 mm^2	0
	Power Lost Due To Friction	0,121 kW 0,165 Ps	0,121 kW 0,165 Ps	0,000
	Duration of Use	1168,16 jam	1168,16 jam	0,00
	Lots of Installation	7008960 kali /jam	7008960 kali /jam	0
	Number of Connections / Disconnections Every Hour	3504480 kali/jam	3504480 kali/ja m	0
Swipe Plates	Number of Maintenance Every Hour	584,080 kali	584,080 kali	0,000
	Maintenance in a Day	3504,48 kali	3504,48 kali	0,00
	Clutch Age	3,29 tahun	3,29 tahun	0,00
Bolt	Axial Tensile Load	72,53 kg	72,53 kg	0,00
	Shear Voltage	3,82 kg/mm^2	3,82 kg/mm^2	0,00
	Number of Threads	3	3	0
	Contact Pressure on the Surface of the Thread	2,66 kg/mm^2	2,66 kg/mm^2	0,00
The pads	long	28,91 mm	28,91 mm	0,00
	Choises in l/d	Accept	Accept	
	Surface Pressure	0,025 kg/mm^2 Acccept	0,025 kg/mm^2 Accept	0,000
	Traveling Speed	12,86 m/s	12,86 m/s	0,00
	pv	0,32 Accept	0,32 Accept	0,00
	Friction Work	4,16 kg.m/s	4,16 kg.m/s	0,00
	Power absorbed	0,041 kW	0,041 kW	0,000
Springs	Spring Index	4,5	4,5	0,0

The Voltage Factor of *Wahl*	1,2	1,2	0,0
Wire Volume	8518,69 mm^3	8518,69 mm^3	0,00
Shear Voltage	0,102 kg/mm^2	0,102 kg/mm^2	0,000
Surface Maximum Voltage in Threaded Spring Windings	11,18 kg/mm^2	11,18 kg/mm^2	0,00
Deflection	3,55 mm	3,55 mm	0,00
Spring Constant	3,66 kg/mm	3,66 kg/mm	0,00
Stiffness	3,66 kN/mm	3,66 kN/mm	0,00

Percentage of deviation or difference in results between manual calculations with program calculations is 0%. This shows that the level of correctness of the friction plate coupling design program that has been built is 100%.

CONCLUSION

Modeling / translating data about graphs and reference tables as well as the formula for the steps in the design of the friction plate coupling into the Delphi programming language resulted in a Friction Plate Coupling Design program that can make it easier to calculate the planning of each part of the friction plate coupling. After cross-checking there are no deviations or differences in the results between manual calculations and program calculations, this shows that there are no errors in the program. The friction plate clutch design uses a more effective program with higher accuracy.

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