1 # COMPUTERISED CALCULATIONS OF AUTOMOBILE

2 # CLUTCH ASSEMBLY

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4 ABSTRACT

The calculation process of automobile friction disc clutch assembly has been aided via the creation of a special computer program .

Input data to the program is different parameters of the vehicle and road . The program will determine the design dimensions according to materials used for the clutch assembly parts and design parameters values. It will perform all required calculations , checkings and modifications required for the complete design regarding the friction plate,pressure plate,clutch springs and clutch shaft.

Sutch a program beside helping the designer in his main job,it gives him also the possibility to study the influence of some design parameters on the assembly performance. As an example for the study of changing design parameters on the performance,a special routine is written to give the effect of changing the thickness of pressure plate on the increase of its temperature during the clutch slip . another routine is written to study the effect of road inclination angle on the clutch temperatur rise.

The presented program was applied to make the calculations and analysis of the Jeep car (GAZ-69) as a real example of applications.

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INTRODUCTION

The clutch is a device located between the engine and the gear box to transmit the torque of engine , to enable the take off run of a car and to enable a speed shifting .

The construction of the clutch can be very different , we can divide the types of clutches according to kind of connection between the driving and driven parts to: friction clutches and hydraulic clutches . According to shape of friction parts to : cone clutches and disc clutches .And according to kind of force to compress the friction parts together they can be divided to : clutches with peripheral pressure springs , clutches with one or two central springs , semi-centrifugal clutches , centrifugal clutches, and magnetic clutches .

Design of one type of these clutches for specific automobile and road parameters has long calculations . Many components are calculated , checked and recalculated perhaps several times . Different standards for friction plates , splines and springs are used . Are required also standards for materials and their properties .

By means of the program described , however , the problem of designing a friction disc clutch with peripheral springs can be solved by the user with minimum effort .

The computer facilities make the problem of studying very wide ranges of design parameters feasible while such a task needs a huge effort for hand calculations . As an example , the influence of both the thickness of pressure plate and the road inclination angle on the temperature rise of the pressure plate during clutch slipping is given .

CLUTCH ASSEMBLY DESIGN

Procedures for calculating different parts of automobile clutch assembly are given in various texts on machine design , some of which are [1] and [2] . To have a complete design of an automobile clutch assembly , the designer starts step by step calculating and checking of different parts of the clutch , mainly :

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-Friction plate ,

-Clutch shaft ,

-Pressure plate ,

-Clutch pressure springs ,

-Clutch damper springs .

Many parameters of the vehicle and road affect the design and checkings of the clutch assembly , mainly :

-Type of vehicle ,

-Vehicle weight ; G ,

-Maximum engine torque ; M_{emax} ,

-Engine revolutions at maximum torque ; n_M ,

-Final drive gear ratio ; i_o ,

-First speed gear ratio ; i_1 ,

-Wheel width ; B , rim diameter ; d_{rim}, coeff. of tyre deformation; λ ,

-Efficiency of mechanical transmission ; η ,

-Inertia moment of the engine ; I_e ,

-Coeff. of rolling resistance ; f ,

-Maximum road inclination ; α .

The standards for friction plates , splines , springs and materials are also used . They will be stored in the program and later used through the design process .

ALGORITHM FOR CALCULATION OF FRICTION PLATE

1.Determine the overloading coeff. β according to type of vehicle .

2.Calculate max. torque transmitted by the clutch :

$$M_{cl} = M_{emax} \cdot \beta$$

3.From the standard of friction plates determine the friction plate size : outer diameter D_o , inner diameter D_i and thickness t .

4.Calculate the average radius for the friction plate :

$$R_{av} = \tfrac{1}{4} (D_o + D_i) \text{ assuming equal pressure distribution}$$

$$= 2/3 (R_o^3 - R_i^3) / (R_o^2 - R_i^2) \text{ assuming that P.V=constant .}$$

5.Calculate pressure force of springs on pressure plate :

$P = M_{c1} / (i \cdot \mu \cdot R_{av})$;

where :

i = no of friction surfaces ,

μ = coeff. of friction between pressure and friction plates.

6.Calculate the effective area of friction plate :

$$F = \pi/4 \; (D_o^2 - D_i^2)$$

7.Calculate the specific pressure on friction and pressure plates ;

$$p = P / F$$

8.If p is less than max. limit STOP , otherwise GOTO 9 .

9.Choose the nearest bigger dimensions of the friction plate .

10.If there is no more dimensions , GOTO 11,otherwise GOTO 4.

11.Change the material of the pressure plate to another with greater μ , GOTO 5 .

ALGORITHM FOR CALCULATION OF THE CLUTCH SHAFT

1 .Choose the material of the shaft from the given standard .

2 .Calculate the approximate inner diameter of the shaft :

$$d= \sqrt[3]{\frac{5 \cdot M_{c1}}{\tau}}$$

3 .From the standard of splines (medium row) determine :

z=number of splines ,

a=width of splines ,

D=outer diameter of the shaft .

4 .Choose the length of splines 1 according to length of friction plate hub .

5 .Calculate the mean radius of splines :

$$R_{sp} = (D+d) / 4 .$$

6 .Calculate the tangential force :

$$T = M_{c1} / R_{sp} .$$

7 .Calculate the hight of splines: $h = (D - d) /2$.

8 .Calculate the total effective area of splines : $F = 0.75 \; z.1.h$.

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9 .Calculate the specific pressure : $p = T / F$.

10.If p is less than the maximum permissible STOP , otherwise GOTO 11 .

11.If heavy row dimensions was chosen GOTO 13 , otherwise GOTO 12 .

12.Choose heavy row dimensions of splines , GOTO 5 .

13.Choose the next bigger dimensions from the standard , GOTO 5 .

ALGORITHM FOR CALCULATION OF PRESSURE PLATE FOR HEATING

1 .Calculate the free tyre radius :

$$r = B + d_{rim} / 2$$

2 .Calculate the dynamic radius of wheel :

$$r_d = r \cdot \lambda$$

3 .Calculate the road resistance moment reduced to clutch shaft :

$$M_c = \frac{G (f \cos\alpha + \sin\alpha) \cdot r_d \cdot \eta}{i_o \cdot i_1}$$

4 .Calculate angular velocity $\omega = n_M / 30$.

5 .Calculate the inertia moment of the car reduced to clutch shaft :

$$I_c = \frac{G}{g} \cdot \frac{r_d^2}{i_o}$$

6 .Calculate the dissipated heat during clutch slipping :

$$L = 0.5 \frac{\omega^2 \cdot I_c \cdot I_e}{(1 - \frac{M_c}{M_{cl}}) I_e + (1 - \frac{M_e}{M_{cl}}) I_c}$$

where I_e = the inertia moment of the engine .

7 .Choose suitable dimension for the pressure plate according to dimnsions of the friction plate .

8 .Calculate the weight of the pressure plate :

$$G_{pp} = \frac{\pi}{4} (d_o^2 - d_i^2) \cdot h \cdot g \cdot \rho$$

where :

d_o = outer diameter ,

d_i = inner diameter ,

h = thickness of pressure plate ,

ρ = density of pressure plate material ,

g = gravitational acceleration .

9 .Calculate the temperature rise of the pressure plate due to slipping :

$$dt = \frac{\gamma \cdot L}{427 \cdot c \cdot G_{pp}}$$, where :

γ = coeff. of dividing heat energy between clutch plates and flywheel ,

c = specific heat for the pressure plate material .

10. If dt less than permissible increase in temperature, STOP , otherwise, GOTO 11 .

11. Increase dimensions of pressure plate , GOTO 8 .

ALGORITHM FOR CALCULATION OF PRESSURE SPRINGS

1.Choose number of springs ;z

(z = 6 , 8 , 10 , 12 or 14)

2.Choose wire diameter;d

(d =2 , 3 , 4.5 , 6 , 9.5 or 13 mm)

3. Choose the ratio D / d = 6 or 8 , where :

D = pitch diameter of the spring

4.Calculate force on one spring :

$P_s = P / z$, where :

P = total pressure force on friction plate .

5.Calculate the torsional stress :

$$T = (1.2 - 1.4)\, P_s \cdot \frac{D}{2} \cdot \frac{16}{\pi d^3}$$

6.Calculate actual torsional stress $T_a = T \cdot k$, where :

$$k = \frac{4C - 1}{4C - 4} + \frac{0.615}{C} , \quad C = \frac{D}{d}$$

7.If T_a is less than permissible value GOTO 9 , otherwise GOTO 8 .

8.If no. of springs < max. , increase this no., GOTO 4 ; otherwise , Choose smaller no. of springs , GOTO 2 to choose bigger diameter .

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9 .Calculate number of active turns of springs :

$$n_{act} = \frac{G \cdot d^4}{8 \cdot D^3 \cdot c} \quad , \text{ where :}$$

G = modulus of torsional rigidity ,

c = spring stiffness .

10.Calculate number of total turns :

$$n_{tot} = n_{act} + 2$$

11.Calculate spring deflection during clutch disengagement :

$y' = 2\delta$, where :

δ = clearance between pressure plate and friction plate .

12.Calculate deflection during assembly :

$$y = \frac{0.3 \cdot P_s}{c}$$

13.Calculate minimum length of springs :

$$l_{min} = 1.05\, d\, (z-1) +(0.5 - 1.5)\, n_{act} .$$

14.Calculate free length of spring :

$$l_{free} = l_{min} + y + y' .$$

15.Check the possible placing of springs :

$2\pi\left(\frac{R_o + R_i}{2}\right)$ should be greater than $z(D+d) + (z-1)L_{cl}$,where :

L_{cl} = minimum clearance between two springs ,

R_o , R_i = outer and inner radii of friction plate .

16.If placing is not possible , decrease no of springs , increase wire diameter , GOTO 2 .

ALGORITHM FOR CALCULATION OF DAMPER SPRINGS

Steps 1. ,2. and 3. as in the previous algorithm .

4.Choose R_s =radius of the circle touching the centre line of springs according to dimensions of both the clutch shaft and pressure plate .

5.Calculate force on one spring :

$$P_{s\ max} = \frac{1.6 \cdot M_{e\ max}}{R_s \cdot z}$$

6. Calculate torsional stress :

$$T = P_{s\ max} \cdot \frac{D}{2} \cdot \frac{16}{\pi \cdot d^3} \quad ,$$

$T_a = T \cdot k$, actual stress as before .

7 , 8, 9, and 10 as in the last algorithm .

11. Calculate deflection due to assembly :

$$y = \frac{0.35\ M_{e\ max}}{R_s \cdot z \cdot c}$$

12.Calculate additional deflection during transfer of torque :

$$y' = \frac{0.65\ M_{e\ max}}{R_s \cdot z \cdot c}$$

13. and 14. as in the last algorithm .

15 Check the possible placing of springs :

$2\ \pi\ R_s$ shoud be greater than $z \cdot (l_{free} + y) + (z-1) . L_{cl}$.

16. As in the algorithm for calculation of pressure springs .

SAMPLE PROBLEM

The technical data of the military passenger Jeep car (GAZ-69) is used as an example of application :

type of vehicle	Passenger car
max.engine torque	= 127 N.m
engine revolutions at max.torque	= 2000 rpm
weight of vehicle (loaded)	= 2275 kp
wheel width	= 6.5"
rim diameter	= 16"
max.road inclination	= 30°
final drive gear ratio	= 5.125
first speed gear ratio	= 3.115
inertia moment of engine(estimated)	= 0.06 kp.m.sec^2

The road rolling resistance coefficient is taken = 0.0175

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PROGRAM OUTPUT (Computer used : IBM-PC)

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          PROGRAMMABLE CALCULATION OF CLUTCH
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1. CALCULATION OF FRICTION PLATE
--------------------------------
Mcl =            139.7  N.m
CHOSEN DIMENSIONS ARE:
outer diameter  inner diam thickness (mm)
     180            124         3.5
CHECKING OF UNIT PRESSURE
DESIGN IS SAFE
Po =             22.66812  (N/cm2)

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2. CALCULATION OF CLUTCH SHAFT
------------------------------
CALCULATION OF SHAFT INNER DIAMETER
ACCORDING TO TORSIONAL STRESS......
inner diameter =  17.72659   (mm)
CHOSEN SHAFT DIMENSIONS:
CHOSEN LENGTH OF FRICTION PLATE HUB=  30   mm
inner  no of   outer spline's  effect.
diam.  splines diam. width      area
  18     6      22     5          6.3
CHECKING OF SPECIFIC PRESSURE ON CLUTCH SHAFT
CHOSEN MEDIUM ROW DIMENTIONS ARE NOT SAFE
SPECIFIC PRESSURE = 51.74074  N/mm2
HEAVY ROW DIMENTIONS WILL BE CHOSEN
inner  no of   outer spline's  effect.
diam.  splines diam. width      area
  18     10     23     3          13.5
dimensions of splines still not safe
NEW MEDIUM ROW DIMENSIONS ARE:
inner  no of   outer spline's  effect.
diam.  splines diam. width      area
  21     6      25     5          6.3
CHECKING OF SPECIFIC PRESSURE ON CLUTCH SHAFT
CHOSEN MEDIUM ROW DIMENTIONS ARE NOT SAFE
SPECIFIC PRESSURE = 44.99195  N/mm2
HEAVY ROW DIMENTIONS WILL BE CHOSEN
inner  no of   outer spline's  effect.
diam.  splines diam. width      area
  21     10     26     3          13.5
dimensions of splines still not safe
NEW MEDIUM ROW DIMENSIONS ARE:
inner  no of   outer spline's  effect.
diam.  splines diam. width      area
  23     6      28     6          7.9
CHECKING OF SPECIFIC PRESSURE ON CLUTCH SHAFT
CHOSEN MEDIUM ROW DIMENTIONS ARE NOT SAFE
SPECIFIC PRESSURE = 32.46478  N/mm2
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HEAVY ROW DIMENTIONS WILL BE CHOSEN
inner    no of     outer  spline's   effect.
diam.    splines  diam.  width      area
  23       10       29     4         16.5
dimensions of splines still not safe
NEW MEDIUM ROW DIMENSIONS ARE:
inner    no of     outer  spline's   effect.
diam.    splines  diam.  width      area
  26       6        32     6         9.899999
CHECKING OF SPECIFIC PRESSURE ON CLUTCH SHAFT
CHOSEN MEDIUM ROW DIMENTIONS ARE NOT SAFE
SPECIFIC PRESSURE = 23.78885  N/mm2
HEAVY ROW DIMENTIONS WILL BE CHOSEN
inner    no of     outer  spline's   effect.
diam.    splines  diam.  width      area
  26       10       32     4         18
Design is safe...
Specific pressure =            14.27331   N/mm2
------------------------------------------------------------------


3.CHECKING OF PRESSURE PLATE FOR HEATING
------------------------------------------------------
CHOSEN THICKNESS OF PRESSURE PLATE=  4 mm
TEMP. RISE = 9.250649    deg. c
CHOSEN THICKNESS OF PRESSURE PLATE=  5 mm
TEMP. RISE = 7.40052    deg. c
CHOSEN THICKNESS OF PRESSURE PLATE=  6 mm
TEMP. RISE = 6.1671    deg. c
CHOSEN THICKNESS OF PRESSURE PLATE=  7 mm
TEMP. RISE = 5.286086    deg. c
CHOSEN THICKNESS OF PRESSURE PLATE=  8 mm
TEMPERATURE RIZE IS  4.625325  deg. c
IT IS IN THE RANGE
------------------------------------------------------------
4. CALCULTION OF PRESSURE SPRINGS
-----------------------------------------
CIRCUMFERENTIAL SPRINGS ARE CHOSEN
 CHOSEN NUMBER OF SPRINGS= 6
 CHOSEN WIRE DIAMETER  3 (mm)
 CHOSEN RATIO  D/d =  6
 CHECKING OF TORSIONAL STRESS
design is not safe!!!!!!
 torsional stress = 1396.322  N/mm2
INCREASE NO. OF SPRINGS
 CHOSEN NUMBER OF SPRINGS= 8
 CHOSEN WIRE DIAMETER  3 (mm)
 CHOSEN RATIO  D/d =  6
 CHECKING OF TORSIONAL STRESS
design is not safe!!!!!!
 torsional stress = 1047.241  N/mm2
INCREASE NO. OF SPRINGS
 CHOSEN NUMBER OF SPRINGS= 10
 CHOSEN WIRE DIAMETER  3 (mm)
 CHOSEN RATIO  D/d =  6
```

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```
 CHECKING OF TORSIONAL STRESS
design is not safe!!!!!!
 torsional stress = 837.793  N/mm2
INCREASE NO. OF SPRINGS
 CHOSEN NUMBER OF SPRINGS= 12
 CHOSEN WIRE DIAMETER  3 (mm)
 CHOSEN RATIO  D/d =  6
 CHECKING OF TORSIONAL STRESS
design still not safe !!!
no of springs will be chosen as 6
CHOOSE BIGGER WIRE DIAMETER
 CHOSEN WIRE DIAMETER  4.5 (mm)
 CHOSEN RATIO  D/d =  6
 CHECKING OF TORSIONAL STRESS
design is safe.......
torsional stress= 310.2937 (N/mm2)
CALCULATION OF NUMBER OF ACTIVE TURNS
NO OF ACTIVE TURNS=  3
NO. OF TOTAL TURNS = 5
SPRING DEFLECTION DURING CLUTCH DISENGAGEMENT
 = 3 (mm)
SPRING DEFLECTION DURING ASSEMBLY
 = .9466659 (mm)
SPRING MINIMUM LENGTH
 = 21.9   mm
SPRING FREE LENGTH
 = 25.84667 mm
CHECKING DIMENSIONS FOR PLACING OF SPRINGS
PLACING OF SPRINGS IS POSSIBLE
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5. CALCULTION OF DAMPER SPRINGS
----------------------------------------

 CHOSEN WIRE DIAMETER  3 (mm)
 CHOSEN NUMBER OF SPRINGS= 4
 CHOSEN RATIO  D/d =  6
 CHECKING OF TORSIONAL STRESS
design is not safe!!!!!!
 torsional stress = 1080.713  N/mm2
INCREASE NO. OF SPRINGS
 CHOSEN NUMBER OF SPRINGS= 5
 CHOSEN RATIO  D/d =  6
 CHECKING OF TORSIONAL STRESS
design is not safe!!!!!!
 torsional stress = 864.5707  N/mm2
INCREASE NO. OF SPRINGS
 CHOSEN NUMBER OF SPRINGS= 6
 CHOSEN RATIO  D/d =  6
 CHECKING OF TORSIONAL STRESS
design is not safe!!!!!!
 torsional stress = 720.4756  N/mm2
INCREASE NO. OF SPRINGS
 CHOSEN NUMBER OF SPRINGS= 7
 CHOSEN RATIO  D/d =  6
 CHECKING OF TORSIONAL STRESS
design is safe.......
torsional stress= 617.5505 (N/mm2)
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CALCULATION OF NUMBER OF ACTIVE TURNS
NO OF ACTIVE TURNS= 2
NO. OF TOTAL TURNS = 4
SPRING DEFLECTION DURING ASSEMBLY
= .6803571 (mm)
SPRING DEFLECTION DURING TORQUE TRANSMISSION
= 2.267857 (mm)
SPRING MINIMUM LENGTH
= 11.45 mm
SPRING FREE LENGTH
= 13.71786 mm
CHECKING DIMENSIONS FOR PLACING OF SPRINGS
PLACING OF SPRINGS IS POSSIBLE

6.ANALYSIS OF PRESSURE PLATE TEMP. RISE

INCREASE IN TEMPERATURE OF PRESS. PLATE (deg.c)

thick.(mm)	single pl.	double plate intermed.	main
4.0	9.25	9.25	4.63
5.0	7.40	7.40	3.70
6.0	6.17	6.17	3.08
7.0	5.29	5.29	2.64
8.0	4.63	4.63	2.31
9.0	4.11	4.11	2.05
10.0	3.70	3.70	1.85
11.0	3.36	3.36	1.68
12.0	3.08	3.08	1.54
13.0	2.85	2.85	1.42
14.0	2.64	2.64	1.32
15.0	2.47	2.47	1.23

INCREASE IN TEMPERATURE OF PRESS. PLATE (deg.c)

thick.(mm)	single pl.	double plate intermed.	main
7.0	5.29	5.29	2.64
7.1	5.21	5.21	2.61
7.2	5.14	5.14	2.57
7.3	5.07	5.07	2.53
7.4	5.00	5.00	2.50
7.5	4.93	4.93	2.47
7.6	4.87	4.87	2.43
7.7	4.81	4.81	2.40
7.8	4.74	4.74	2.37
7.9	4.68	4.68	2.34
8.0	4.63	4.63	2.31

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INFLUENCE OF ROAD INCLINATION ON TEMP. RISE

road inclination(deg)	temp. rise(deg.c)
5	3.922161
10	4.051615
15	4.187502
20	4.329107
25	4.475466
30	4.625325

road inclination(deg)	temp. rise(deg.c)
25	4.475466
25.5	4.490318
26	4.505203
26.5	4.520121
27	4.53507
27.5	4.550049
28	4.565054
28.5	4.580087
29.00001	4.595144
29.5	4.610224
30	4.625325

CONCLUSION

The calculations process of automobile aggregates can be aided via a special tailored computer program . Input data to such a program is different parameters of the vehicle and road .

Such a program enhances the capability of microcomputers as a powerful computing facility on the designer's desktop . This program beside helping the designers calculating , checking and modification of parts , it also stores data of necessary standards for components and materials . The computer facilities give the designers the possibility to study the influence of changing some design parameters on the assembly performance .

In this paper is given a complete program for the calculation of all parts of the automobile clutch assembly . The program gives also the influence of changing some parameters on the clutch heating . This problem can be a work for further study to analyse the clutch heating up taking into consideration successive clutching and also the rate of cooling of different assembly parts .

REFERENCES

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2. "Mechanical engineering handbook",Revised by a staff of specialists , McGraw-Hill book company , Inc , New York , 1958 .
3. Harold ,C ,"Spring designer's hand book" , Marcel Dekker ,Inc., NewYork , 1978 .

APPENDIX

A PART FROM THE PROGRAM (language used : BASIC)

```
5 CLS
10 REM programmable calculation of clutch
11 PRINT TAB(10);"PROGRAMMABLE CALCULATION OF CLUTCH"
12 LPRINT TAB(10);"PROGRAMMABLE CALCULATION OF CLUTCH"
13 PRINT TAB(10);"--------------------------------------------------"
14 LPRINT TAB(10);"--------------------------------------------------"
15 LPRINT
20 REM input data
25 LOCATE 3,10 : PRINT "ENTER THE TYPE OF VEHICLE:"
31 LOCATE 4,15 : PRINT " 1   FOR PASSENGER CARS "
32 LOCATE 5,15 : PRINT " 2   FOR LORRIES "
33 LOCATE 6,15 : PRINT " 3   FOR BUSSES "
34 LOCATE 7,15 : PRINT " 4   FOR COMMERCIAL DRIVES "
36 LOCATE 8,15 : PRINT " 5   FOR LIGHT COMMERCIAL "
38 LOCATE 9,25 : INPUT T
39 CLS
40 INPUT "ENTER THE MAX ENGINE TORQUE (N.m)  ";M
41 INPUT"ENTER ENGINE REVOLUTIONS AT MAX. TORQUE(rpm)  ";NM
45 CLS
46 REM CALCULATION OF FRICTION PLATE
50 INPUT "ENTER NUMBER OF FRICTION PLATES  ";N
55 CLS
57 GOSUB 1000
58 LPRINT : LPRINT"------------------------------------------------------------"
59 REM CALCULATION OF CLUTCH SHAFT :CLS
60 PRINT"ENTER MATERIAL OF CLUTCH SHAFT:"
61 PRINT "    UNS       AISI      PROCESSING      YIELD      ULTIMIT"
62 PRINT "    NUMBER    NUMBER                       STRENGTH        "
63 PRINT "1.  G10500    3120    DRAWN 1000F      91        112  "
64 PRINT "2   G46200    4620    DRAWN 800F       94        130  "
65 PRINT "3   G10500    3130    DRAWN 1000F     120        137  "
66 PRINT "4   G61500    6150    DRAWN 1000F     132        155  "
67 PRINT "5   G10500    3120    DRAWN 600F      145        162  "
68 PRINT "6   G92550    9255    DRAWN 1000F     160        180  "
69 PRINT "7   G10500    3340    DRAWN 800F      183        221  "
70 PRINT "8   G92550    9840    DRAWN 800F      199        218  "
71 PRINT "9   G10500    3240    DRAWN 600F      211        237  "
72 PRINT "10  G43400    4340    DRAWN 600F      234        260  "
74 PRINT "MULTIPLY STRENGTH IN kpsi BY 6.89 TO GET IN  MPa"
75 INPUT"CHOOSE NUMBER BETWEEN 1 AND 10   ";M2
76 CLS
80 GOSUB 2000
85 LPRINT"------------------------------------------------------------"
90 REM CALCULATION OF PRESSURE PLATE
100 INPUT"ENTER VEHICLE WEIGHT WITH LOAD(kp):";G
110 GOSUB 3000
120 REM CALCULATION OF PRESSURE SPRINGS
130 GOSUB 4000
140 GOSUB 5000
150 GOSUB 6000
160 END
```