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Geneva mechanisms. Part 2: computer program

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VIEWpac 9611A

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The Mechanisms Committee, which first met in 1975, is continuing the work of the former Gearing and Mechanisms Committee, which first met in November 1964. Like the earlier Committee it has the cooperation of many engineers and scientists in industry, research establishments and universities from whom much assistance and information is being received.

GENEVA MECHANISMS. PART 2: COMPUTER PROGRAM

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GENEVA MECHANISMS. PART 2: COMPUTER PROGRAM

1. INTRODUCTION

ESDUpac A9611 provides a computer program for calculating the key dimensions, motion characteristics, forces, torques and power requirement for the operation of either external or internal Geneva mechanisms. Both constant and varying crank angular velocity definitions are permissible. Power is transmitted between the crank and wheel by either roller bearings or pins. Crowned or cylindrical profiles of these components are included. Two design strategies are provided. The designer may specify the Geneva wheel dimensions and the distance between crank and wheel shaft centres will then be calculated. Alternatively, the centre distance is specified and then the wheel diameter is evaluated.

The program determines the dependent dimensions, wheel motion, contact and bearing forces plus the crank torque and power required to drive the crank and produce the specified motion. Contact stresses and the dimensions of the contact area on the slot face and roller (or pin) are determined and compared with the specified limits. When a bearing is selected, its strength and life are calculated and compared with the published performance criteria. Similarly, the characteristics of a lubricant film are evaluated when oil lubrication is specified. If any of the applicable performance limits are exceeded, the program will issue an appropriate warning. If the crank angular velocity has been specified as constant, the limiting speed will be determined and a warning issued if this speed is exceeded.

In addition to a descriptive output file reproducing the input specifications and listing the results of the analysis, the program generates a series of data files in ASCII format. Separate files are provided which define the wheel motion, mechanism forces, contact stresses and deformations and lubrication data (when applicable). A DXF output file provides a graphical representation of the outline of the Geneva wheel, for the external Geneva only.

The analytical techniques implemented in the program are those described in ESDU 96002, entitled "Geneva mechanism. Part 1: Design" (Reference 2) and ESDU ME3, entitled "Analysis of Geneva mechanisms: derivation of kinematic and kinetostatic equations" (Reference 1). The applicable assumptions are stated in these documents and the program output must be considered in respect of the theoretical limitations and practical considerations of the design process.

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2. DESCRIPTIVE DETAILS OF COMPUTER PROGRAM

The computer program calculates the wheel motion, bearing forces, input torque, frame shaking force, contact stress, lubricant film thickness and roller life for a Geneva mechanism (external or internal). Limiting values of certain geometric parameters are also found. In the case of an external Geneva mechanism, a DXF file of the two-dimensional outline of the wheel is generated.

The computer program associated with this Data Item is supplied in two forms:

- (i) an executable VIEWpac[†] program, 9611Av##[‡]
- and (ii) a Fortran executable program, A9611v##.EXE[‡]

2.1 Executable VIEWpac Program

This version of the program, named 9611Av##, contains the Fortran executable code, A9611v##.EXE, wrapped within an interface called ESDUview and is for use on computers running Microsoft Windows 95, or later, operating systems. The main purpose of ESDUview is to allow:

- (i) input files to be created following descriptive screen prompts,
- (ii) embedded help to be available for every input quantity,
- (iii) program runs to be launched within the interface
- and (iv) automatic view of the main output file.

Other features of ESDUview include an editor that may be used to view all files, and a calculator. The ESDUview interface is included within the ESDU website, www.ihsesdu.com.

2.2 Executable ESDUpac Program

This version of the program, named A9611v##.EXE, is a 32-bit executable code compiled with Salford Fortran 77, Version 4.x, for use on a PC running MS-DOS (Microsoft[®] - Disk Operating System) Windows 95 (or later) operating system.

The program accepts the main input file as an “externally directed” file, *i.e.* its name is allocated at run time externally to the program (see Section 2.2.1). The input data are entered into the named input files with the use of a text editor as detailed in Section 2.2.2.

Running instructions for the program are given in Section 2.2.1.

[†] The term VIEWpac is here used to describe an interface program that runs within ESDUview (see ESDU 00009 and ESDU 04013, References 5 and 6)

[‡] The full name of an ESDUpac source file or executable file includes an encoded version of the program. Thus, for example, the full name of Version 1.0 of ESDUpac A9611 executable code will be A9611v10.EXE and must be used when accessing the file.

2.2.1 Running the ESDUpac

The program has been written to accept the name of the main input file as an “externally directed” file, *i.e.* its name is allocated external to the program. The four, five or six output files and, possibly, the extra one or two input files are named within the main input file (see Sections 2.2.2).

The program is run by simply entering the following command.

```
A9611v##.EXE<MAIN.IN
```

where MAIN.IN is an example name of a main input file. (The inclusion of the extension .EXE is optional.) If the main input file name is excluded from the command line (undirected), *i.e.* the following command is entered

```
A9611v##.EXE
```

then the program will prompt the user to enter the name of the input file from the keyboard. The data required for the two input files are described in Section 2.2.2.

2.2.2 Input Data

This section describes the data entry order for the main input file, the external torque data file and the crank motion data file and may be used to help create these files (using a text editor). Users of a PC/MS DOS operating system are recommended to use ESDUview (see ESDU 00009, Reference 5) which allows creation of the main input file (following screen prompts), then runs the program and views the output files.

(a) Main input file

The following table covers all possibilities of data entry.

Entry Number	Entry Instructions	Program Input Symbol(s)	Notation Symbol(s) Equivalent	Variable Type
1	Enter program identifier: A9611 (This identifier must be the only string other than spaces in the first 70 characters of the first line of the file)	PRNAME	–	CHARACTER
2	Enter file name for descriptive output file – 70 characters allowed	OUTFN1	–	CHARACTER
3	Enter file name for motion output file – 70 characters allowed	OUTFN2	–	CHARACTER
4	Enter file name for forces output file – 70 characters allowed	OUTFN3	–	CHARACTER
5	Enter file name for stress output file – 70 characters allowed	OUTFN4	–	CHARACTER
6	Enter run title – 1st line (50 characters allowed)	TITLE1	–	CHARACTER

Entry Number	Entry Instructions	Program Input Symbol(s)	Notation Symbol(s) Equivalent	Variable Type
7	Enter run title – 2nd line (50 characters allowed)	TITLE2	–	CHARACTER
8	Enter run title – 3rd line (50 characters allowed)	TITLE3	–	CHARACTER
9	Enter wheel type identifier 1. for external Geneva (lubricated) 2. for external Geneva (unlubricated) 3. for internal Geneva (lubricated) 4. for internal Geneva (unlubricated)	WHEEL	–	INTEGER
10	Enter the crank motion identifier 1. for constant angular velocity 2. for varying angular velocity	MOT		INTEGER
11	Enter the design mode identifier 1. for centre distance specified 2. for wheel diameter specified	MODE	–	INTEGER
12	Enter the number of slots	N	N	INTEGER
13	If MODE = 1 Enter the distance between the crankshaft axis and the wheel shaft axis (mm), or	G	G	REAL
	If MODE = 2 and (WHEEL = 1 or WHEEL = 2) Enter the external diameter of the wheel (mm), or	DOUT	D_{out}	REAL
	If MODE = 2 and (WHEEL = 3 or WHEEL = 4) Enter the internal diameter of the wheel (mm)	DIN	D_{in}	REAL
14	IF MOT = 1 Enter the angular velocity of the crank (rev/min)	WC	$\dot{\phi}$	REAL
	IF MOT = 2 Enter file name of crank motion data input file - 70 characters allowed	MOTNFN	–	CHARACTER
15	If WHEEL = 1 or WHEEL = 3 Enter file name for lubrication output file – 70 characters allowed	OUTFN5	–	CHARACTER

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Entry Number	Entry Instructions	Program Input Symbol(s)	Notation Symbol(s) Equivalent	Variable Type
16	If WHEEL = 1 or WHEEL = 2 Enter file name for DXF drawing output file – 70 Characters allowed	OUTFN6	–	CHARACTER
17	Enter pin/roller identifier 1. for cylindrical pin 2. for cylindrical roller 3. for crowned pin 4. for crowned roller	PIN	–	INTEGER
18	Enter mass of crank (kg)	M2	m_2	REAL
19	Enter mass moment of inertia of crank (kg m^2)	I2	I_2	REAL
20	Enter length defining centre of mass of crank (mm)	R2	r_2	REAL
21	Enter angle defining centre of mass of crank (degree)	G2	γ_2	REAL
22	Enter diameter of roller (or pin) (mm)	DP	$2R_r$	REAL
23	Enter width of roller (or pin) (mm)	LR	L_r	REAL
24	If PIN = 3 or PIN = 4 Enter crown radius of roller (or pin) (mm)	RRC	R_{rc}	REAL
25	If WHEEL = 1 or WHEEL = 3 Enter rms surface roughness of roller (or pin) (mm)	RQR	R_{qr}	REAL
26	Enter Young's modulus for roller (or pin) material (N/mm^2)	ER	E_r	REAL
27	Enter Poisson's ratio for roller (or pin) material	SIGR	σ_r	REAL
28	If PIN = 2 or PIN = 4 Enter name of roller manufacturer	MAKER	–	CHARACTER
29	If PIN = 2 or PIN = 4 Enter reference number of roller	CATNO	–	CHARACTER
30	If PIN = 2 or PIN = 4 Enter static load rating of roller (N)	CO	C_o	REAL

Entry Number	Entry Instructions	Program Input Symbol(s)	Notation Symbol(s) Equivalent	Variable Type
31	If PIN=2 or PIN = 4 Enter dynamic load rating of roller (N)	C	C	REAL
32	If PIN = 2 or PIN = 4 Enter maximum allowable load on stud or spindle (N)	PSTUD	—	REAL
33	If PIN = 2 or PIN = 4 Enter maximum allowable angular velocity of roller (rev/min)	WRRMAX	—	REAL
34	If PIN = 2 or PIN = 4 Enter minimum acceptable life of roller (hour)	RSPAN	—	REAL
35	If PIN = 2 or PIN = 4 Enter material correction factor	A2	a_2	REAL
36	If PIN = 2 or PIN = 4 Enter lubrication correction factor	A3	a_3	REAL
37	If PIN = 2 or PIN = 4 Enter static safety factor	SO	s_o	REAL
38	If PIN = 2 or PIN = 4 Enter service factor	SERV	f_w	REAL
39	If PIN = 2 or PIN = 4 Enter required reliability (per cent)	RELIAB	—	REAL
40	Enter slot face width (mm)	H	H	REAL
41	Enter locking radius of wheel (mm)	RL		REAL
42	If WHEEL = 1 or WHEEL = 2 Enter wheel hub diameter (mm)	DSHAFT	—	REAL
43	If WHEEL = 1 or WHEEL = 2 Enter slot length of wheel (mm)	SL	—	REAL
44	If WHEEL = 1 or WHEEL = 3 Enter rms surface roughness of slot (mm)	RQW	R_{qw}	REAL
45	Enter mass-moment of inertia of wheel	M4	m_4	REAL
46	Enter mass-moment of inertia of wheel (kg m ²)	I4	I_4	REAL
47	Enter length defining centre of mass of wheel (mm)	R4	r_4	REAL