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SOME ASPECTS REGARDING DESIGNING OF A NEW ELASTIC COUPLING WITH NONMETALLIC ELEMENTS USING THE PROGRAM FOR COMPUTER DESIGNING OF THIS PROTOTYPE

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Abstract: The paper presents a new elastic coupling with cylindrical bolts and nonmetallic intermediary elements and a computer program that allows the design of this prototype and the numerical solving of the analytical relations obtained for their functional modelling. The program may be of to engineers in their design activity a real use. The novelty of this coupling type consists in the existence of one disc between the two semi couplings (the disc does not presents centering thresholds), of eight metallic plates and nonmetallic elements of rubber that are mounted on the bolts.

1. Introduction

The paper presents original solution of an elastic coupling with intermediate nonmetallic elements (see fig. 3) in which the nonmetallic element has various shapes and is made of various qualities of rubber [2, 4, 6]. At choosing constructive dimensions, it is having in sight the following parameters of reference: axial clearance gauge, radial clearance gauge and value of torsion moment transmitted for a type dimensions to different revolutions of operation; supplementary, it is take consideration and another requisites: technical-economical and obligatory functionary requisites and technical-ergonomically requisites.

These nonmetallic elements may be mounted on the cylindrical bolts [3, 7, 8]. At this constructive variant of the prototype (see fig. 3,a), the torsion moment is transmitted from the driver semi coupling to the nonmetallic elements, of various shapes, through all the four cylindrical bolts, fixed rigidly on the driver semi coupling, and through the intermediary disc to the driven semi coupling [7]. The stresses which appear are compression in the sense of the motion, in the area in front of the bolts, crushing on the contact surface and traction in the area defined by section B-B.

2. Computer calculation programme

The program of calculus was elaborated using the library of Windows objects, for an agreeable/nice work interface and an efficient computer-user interaction [1, 4]. Thus, a calculus programme was conceived that would allow both the computer constructive design and the graphic visualization of some characteristic functional diagrams. When running the programme "Elastic couplings with bolts and nonmetallic elements" is displayed the principal menu of the programme, aimed at the calculi prototype, presented in fig. 1. The menu "Entry data"(see fig. 1) contains 4 submenus, the activation of which leads to the opening of 4 dialogue windows for the introduction of the entry data, as follows: *window „Design data. Technical Data",* fig. 2; *window „ Design data. Functioning conditions",* fig. 3; *window „ Design data. The choice of materials"*, fig. .4; *window Entry data. Results",* fig. 5. *The* window *„ Design data. Technical Data"* (fig. 2) includes the following principal data: the *power to be transmitted*, the *functioning speed* of the coupling, as well as calculus variants of *the entry shaft's diameter.* In case the shaft's diameter is known, then it is introduced in its value. If the *shaft's diameter* is not known, then the value of the *entry shaft's diameter* results after the calculation.

For exemplification the following entry data have been chosen: *the power of the engine P=3 kW*, *the engine speed n=1420 rot/min* and the *shaft's diameter*, d=38 mm – it is considered known on which the coupling is mounted.

The window *„ Design Data. The choice of materials"* (fig. 4) presents steel recommended for the driver and driven semi couplings, the intermediary disc, the plates, the wedge, the bolts (normal, cutered), as well as the materials recommended for the nonmetallic elements, the user having the possibility to choose the wished material for each element indicated in this window. The window *„Entry data. Results",*(see fig. 5) presents the following partial results: the values of the nominal M_{tn}, and the calculus M_{tc} torsion moment, respectively, the speed of the shaft on which the coupling is mounted, the entry shaft's diameter *d*, the standard length of the shaft's end – according to the shaft's series (long, short); the dimensions of the wedge (b_{pana}, h_{pana}) according to the shaft's diameter *d,* the actual length of the wedge and the length recommended by STAS (standard), the setting of the value of the diameter of bolt display, D_1; the diameter of the bolt, d_b; the exterior diameter of the coupling, D_e; the length of the hub, L_1; the length of the coupling *L.* The window *„Calculation elements"* (see fig. 6) presents the calculation schemes for the two constructive variants, forms of nonmetallic elements, so that the user may choose the data he/she wishes. After that the programme calculates and automatically lists the constructive dimensions of the selected form.

The window *„Results"* (see fig. 7) presents the final results obtained after the checking has been carried out inside the programme. In this window the following results are presented:

- the force which is loaded on bolt;
- the testing of the selected constructive form of the nonmetallic element to two stresses (traction, crushing) with the possibility of comparing the effective by traction/crushing stresses with the admissible tension corresponding to each stress;
- determination of the capable torsion moments from the condition of the resistance to traction, and to crushing, respectively;
- determination of the ratio of the capable torsion moments;
- testing the bending of the bolt, with the possibility of comparing the effective bending tension with the admissible tension corresponding to this stress;
- determination of the rotation angle between the semi couplings, the calculus torsion moment being known;
- determination of the static rigidities of the coupling.

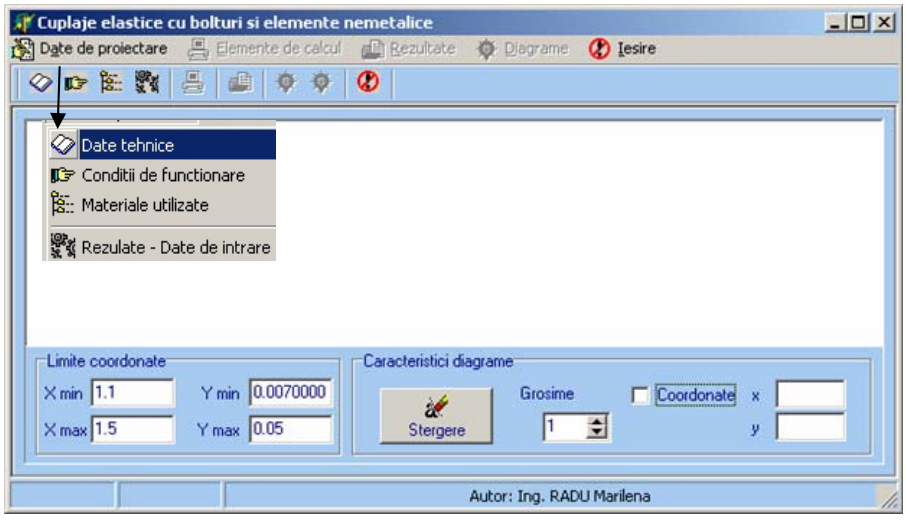
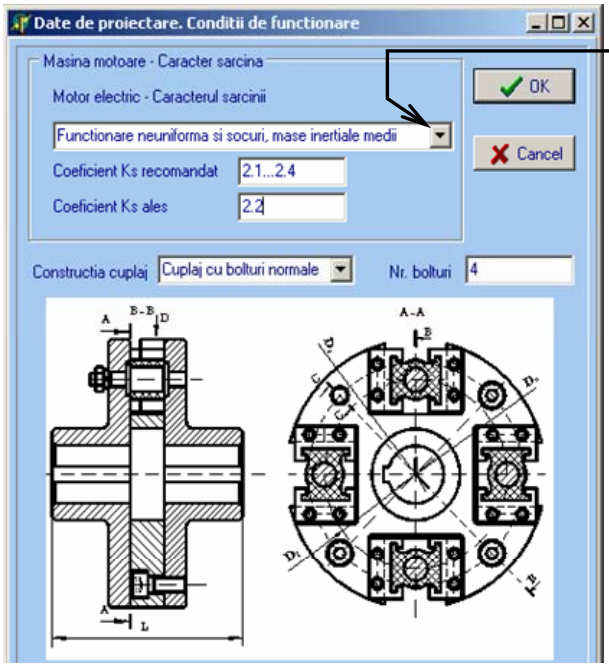


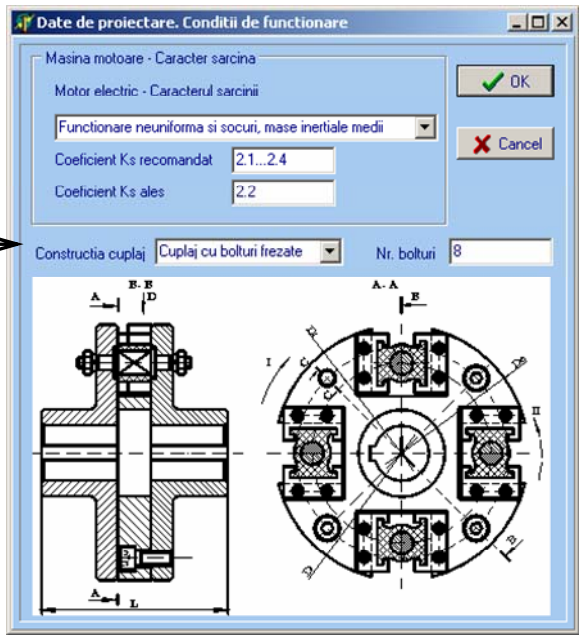
Fig. 1

Fig. 2

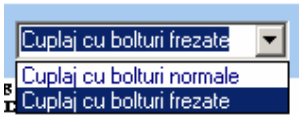


It allows choosing the safety coefficient K_s.

a



It allows the selection of the constructive variants selection of the coupling.



b

Fig. 3

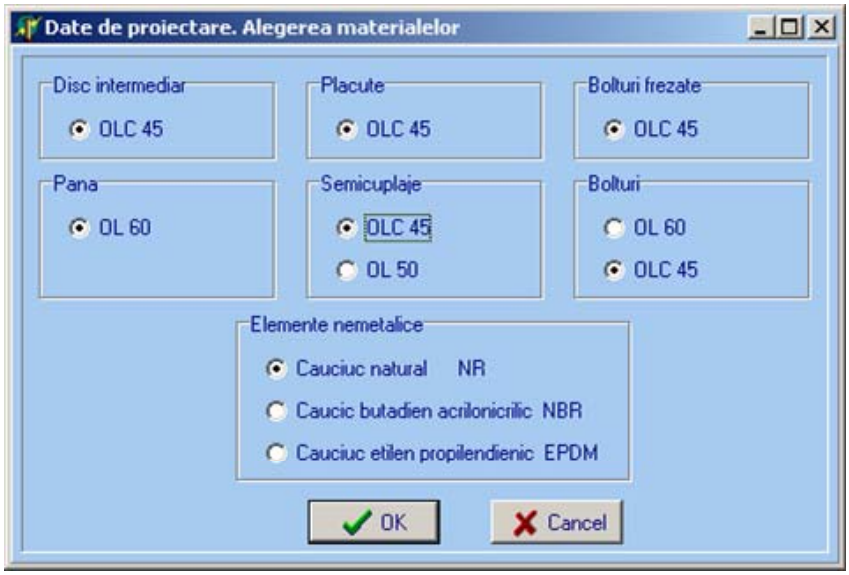

Date de proiectare. Alegerea materialelor
Disc intermediar
OLC 45
Placute
OLC 45
Bolturi frezate
OLC 45
Pana
OL 60
Semicuplaje
OLC 45
OL 50
Bolturi
OL 60
OLC 45
Elemente nemetalice
Cauciuc natural NR
Caucic butadien acrilonicrilic NBR
Cauciuc etilen propilendienic EPDM
OK
Cancel

Fig. 4

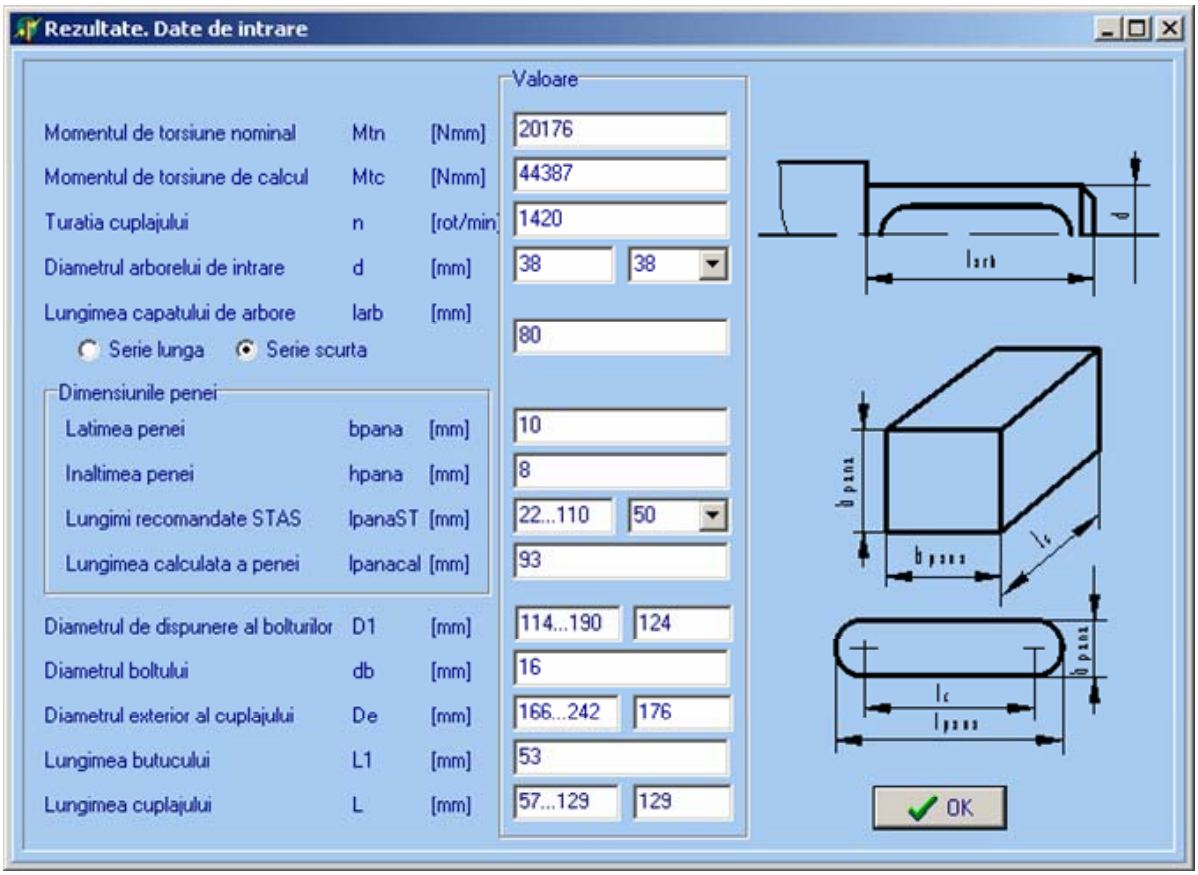

Rezultate. Date de intrare
Valoare
Momentul de torsiune nominal Mtn [Nmm] 20176
Momentul de torsiune de calcul Mtc [Nmm] 44387
Turatia cuplajului n [rot/min] 1420
Diametrul arborelui de intrare d [mm] 38 38
Lungimea capatului de arbore larb [mm] 80
Serie lunga
Serie scurta
Dimensiunile penei
Latimea penei bpana [mm] 10
Inaltimea penei hpana [mm] 8
Lungimi recomandate STAS lpanaST [mm] 22...110 50
Lungimea calculata a penei lpanacal [mm] 93
Diametrul de dispunere al bolturilor D1 [mm] 114...190 124
Diametrul boltului db [mm] 16
Diametrul exterior al cuplajului De [mm] 166...242 176
Lungimea butucului L1 [mm] 53
Lungimea cuplajului L [mm] 57...129 129
OK

Fig. 5

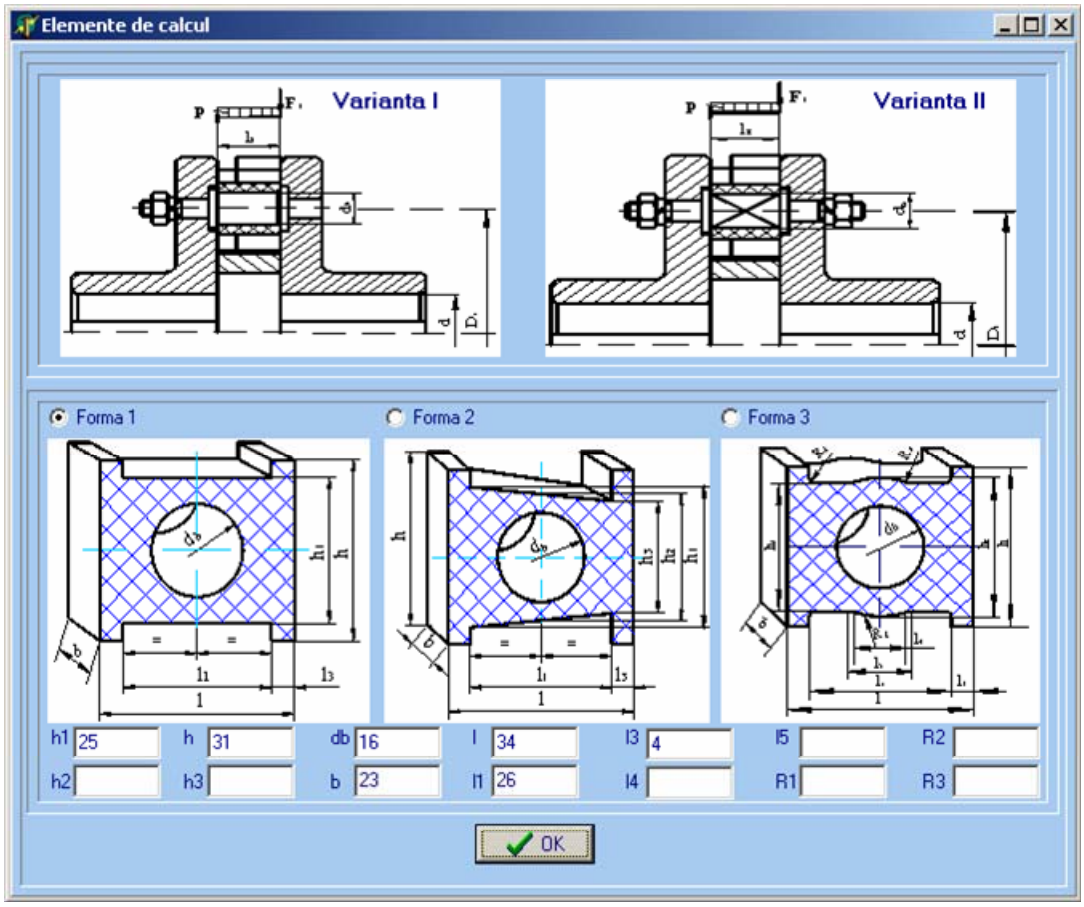

Elemente de calcul
Varianta I
Varianta II
Forma 1
Forma 2
Forma 3
h1 25
h 31
db 16
l 34
l3 4
l5
R2
h2
h3
b 23
l1 26
l4
R1
R3
OK

Fig. 6

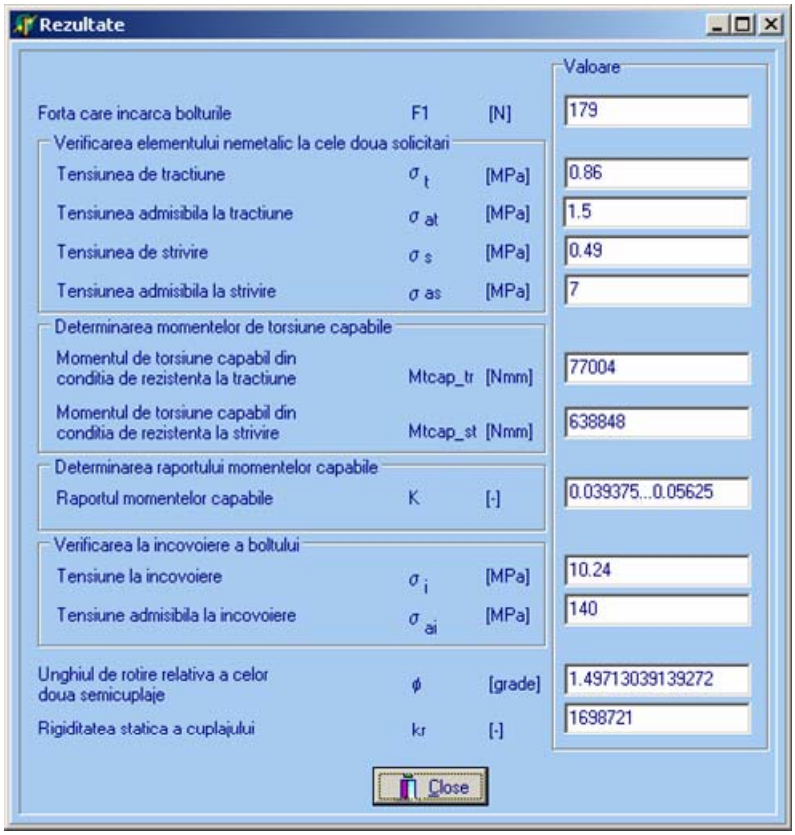

Rezultate
Valoare
Forta care incarca bolturile F1 [N] 179
Verificarea elementului nemetalic la cele doua solicitari
Tensiunea de tractiune σ t [MPa] 0.86
Tensiunea admisibila la tractiune σ at [MPa] 1.5
Tensiunea de strivire σ s [MPa] 0.49
Tensiunea admisibila la strivire σ as [MPa] 7
Determinarea momentelor de torsiune capabile
Momentul de torsiune capabil din conditia de rezistenta la tractiune Mtcap_tr [Nmm] 77004
Momentul de torsiune capabil din conditia de rezistenta la strivire Mtcap_st [Nmm] 638848
Determinarea raportului momentelor capabile
Raportul momentelor capabile K [-] 0.039375...0.05625
Verificarea la incovoiere a boltului
Tensiune la incovoiere σ i [MPa] 10.24
Tensiune admisibila la incovoiere σ ai [MPa] 140
Unghiul de rotire relativa a celor doua semicuplaje φ [grade] 1.49713039139272
Rigiditatea statica a cuplajului kr [-] 1698721
Close

Fig. 7

The window *„Diagrams"* allows the separate display of the graphs presented in fig. 8 and fig. 9. Figure 8 presents the setting out of the graphic's capable torsion moment ratio according to the selected constructive form of the nonmetallic element in function of (h_1/d_b or h_2/d_b), variation being linear. Figure 9 presents the graph of the torsion moment calculation in function of the rotation angle between the semi couplings corresponding to with the selected constructive form of the nonmetallic element.

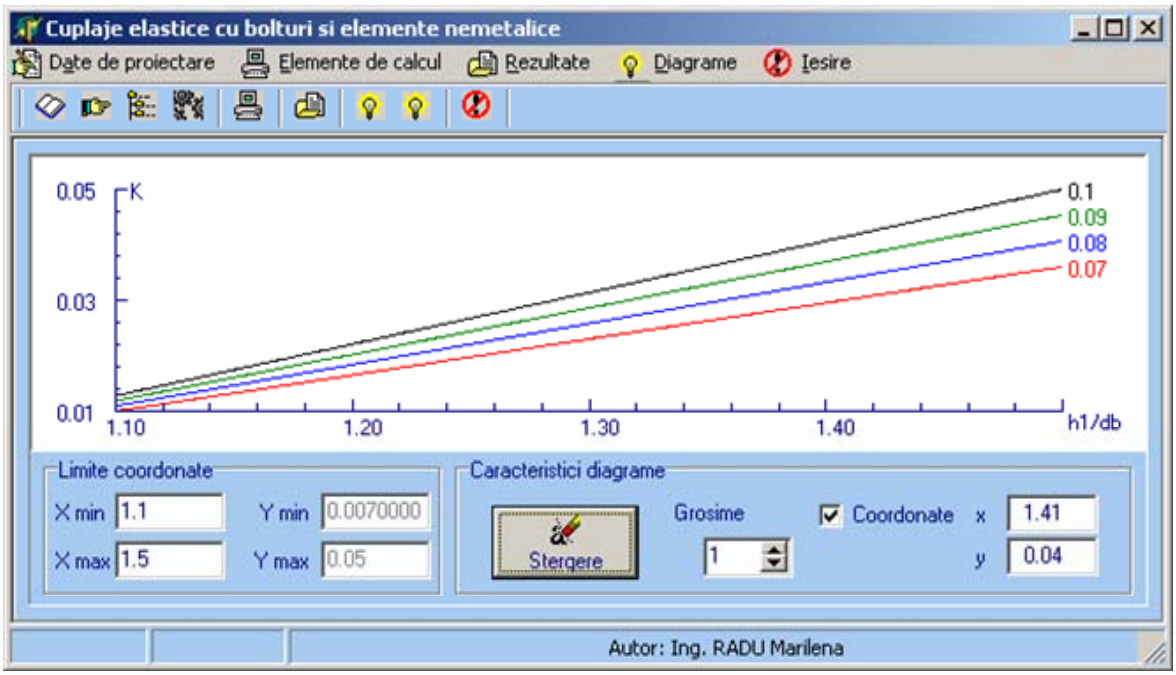


Fig. 8

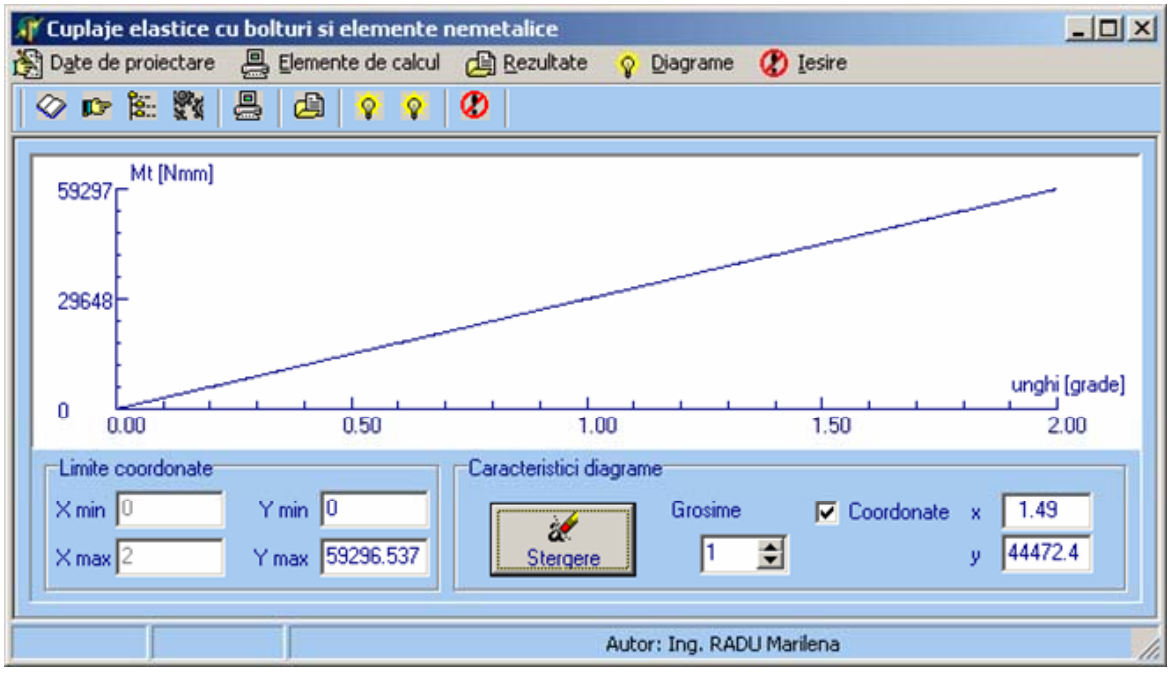


Fig. 9

3. Conclusions

The application of this calculation methodology of calculus requires advanced instruments and also the elaboration of the calculation programs for the design of new elastic coupling with cylindrical bolts and nonmetallic intermediary elements and the numerical solving of the analytical relations obtained from the functional modelling of these becomes a requirement.

The calculation programme presented in this paper may be of a real use to the engineers who design couplings.

References

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