ANNALS of the ORADEA UNIVERSITY.

Fascicle of Management and Technological Engineering, Volume VI (XVI), 2007

STRESSES AND DESIGNING METHODOLOGY FOR ELASTIC COUPLING WITH CURVED FLAT SPRING RADIAL-TANGENT CONNECTED

Bogdan-Ion VOICU
Mihai CIOBOTA
Transilvania Universitaty of Brasov, Dept. Product Design and Robotics, bogdan.voicu@unitbv.ro, ciobota.mihai@unitbv.ro

Keywords: coupling , curved flat spring, elastic characteristic, radial-tangent, bearing capacity.

Abstract: In the paper, starting from the adding relations which permit us to dispose the elastic feature of the elastic couplings with flat springs curved circular arc (fig.1), radial-tangent connected between the two half couplings it is established the analytic relations which permit the building of the coupling and depending on the main solicitations is caused the relations for the bearing capacity and the verification of the components of the coupling.

In work, it was established the geometric necessary relations of the building of elastic coupling with metallic curved flat springs, radial-tangent connected between half-couplings (Fig. 1). It is presented the adding relations for the settlement of elastic feature and the bearing capacity of the coupling of the as well as the verificatory relations.

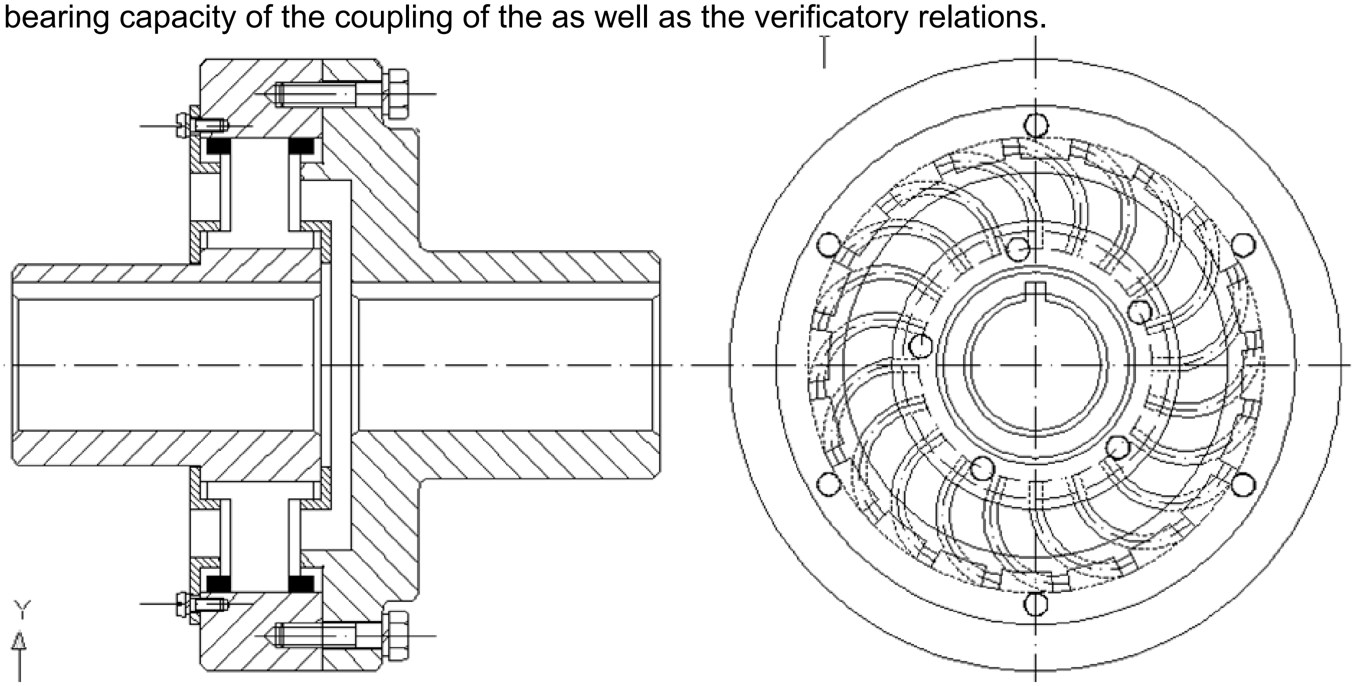

Fig.1 Elastic coupling with flat springs, radial-tangent connected

As for the figures 1 and 2, the relations that permit the settlement of theoretical feature of the coupling depending on the geometric and constructive features of this are next:

$$\alpha = \frac{\pi}{2} + arctg\frac{2R}{d_1}, \qquad (1)$$

$$D_0 = \sqrt{d_1^2 + 4R^2} + 2R, \qquad (2)$$

respective:

$$\varphi = \frac{4M_t R^3}{D_0^2 n_a z k_n E I_z}\left[\frac{3\pi}{4} + \frac{3}{2} arctg \frac{2R}{d_1} - 2\cos\left(arctg \frac{2R}{d_1}\right) - \frac{1}{4}\sin\left(2 arctg \frac{2R}{d_1}\right)\right], \qquad (3)$$

and by development drives to:

$$\varphi = \frac{4M_t R^3}{D_0 n_a z k_n E I_z}\left[\frac{3\pi}{4} + \frac{3}{2} arctg \frac{2R}{d_1} - \frac{d_1\left(R + \sqrt{d_1^2 + 4R^2}\right)}{d_1^2 + 4R^2}\right], \qquad (4)$$

In the relations (1) ÷ (4) α is the central angle of the active portion of the spring package (Fig. 1 and fig.2); R is average ray of a spring package; d_1- the diameter of embedment of the spring package; D_0 – the average diameter of support of spring package; φ – the angle of relative turnings of half couplings; n_a – the number of springs in the package; z – the number of spring packages; k_n=0,85÷0,95 - the factor of unsimultaneity; E – the module of elasticity of material the springs; I_z – the moment of inertia of the spring; b, h - the sizes in sectional of a spring.

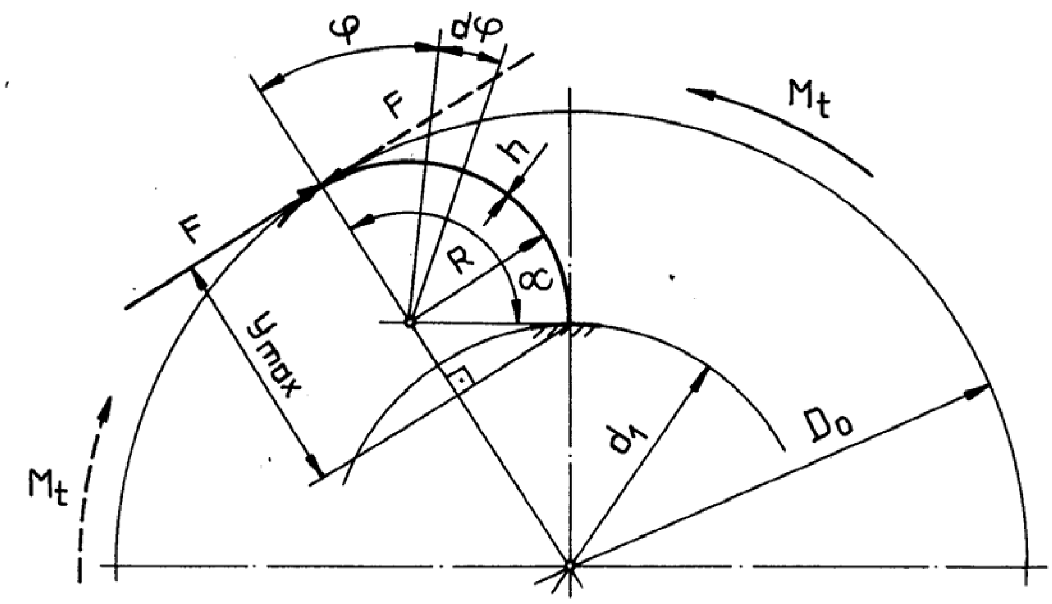

Fig.2 The bending of elastic elements under the torsional moment

The bearing capacity of the coupling is limited of moment-resisting of the flat springs (fig. 2), as for the relation:

$$M_{t\max} = \frac{n_a z k_n b h \sqrt{d_1^2 + 4R^2}}{12R} \cdot \tau_{ail}, \qquad (5)$$

in which, $\tau_{aie} = \tau_{02}/c$ with c=1,3÷1,5 is the material moment-resisting limit of the springs.

As for the notations from figure 2 and envisaging the main solicitations which appear to the heads of placement of the springs in the ring half coupling, respectively in interior half coupling, we can established the ultimate sizes of the couplings.

For the ring half coupling [1, 4, 5, 6] the main solicitations are calculated with the relations:

$$\sigma_{fe} = \frac{M_{t\max}}{D_0 z n_a k_n b_1 h} \le \sigma_{af1}, \tag{6}$$

$$\tau_{s1} = \frac{M_{t\max}}{D_0 z n_a k_n b_1 h} \le \tau_{as}, \tag{7}$$

and for the heads of catch from interior half couplings, the main solicitations are calculated with the relations:

$$\tau_{s2} = \frac{2M_{t\max}R}{D_0 z n_a k_n l h \sqrt{d_1^2 + 4R^2}} \le \tau_{as}, \tag{8}$$

$$\tau_{s3} = \frac{2M_{t\max}}{d_1 z k_n b_1 (b + 2l)} \le \tau_{as1}, \tag{9}$$

and

$$\sigma_{fc} = \frac{2M_{t\max}}{d_1 k_n [\pi(d_1 - 2b_1) - z n_a h](b + 2l)} \le \sigma_{af}, \tag{10}$$

In the relations (6) ÷(10), b_1 – is the width heads of placement ale the springs; l – the length of the placement heads the springs; $\sigma_{afe,}$ $\sigma_{afc}=(0,2÷0,3)\cdot\tau_{02}$ – the admissible stress to detrusion for springs material, respective the half couplings; $\tau_{as,}$ $\tau_{as1}=(0,3÷0,8)\cdot\tau_{02}$ – the admissible stress to crush for half couplings material, respective for the rings of shut [4, 5, 6].

According as is can consisted, the analytic relations for the determination of the bearing capacity , of the elastic feature and the relations for verification and sizing, contain dimensional elements which can be variable independence, what makes difficult the determination of size of the coupling using a simple calculus.

Bibliography:

1. Ciobota, M. – Contributii la studiul teoretic si experimental al cuplajelor elastice cu elemente metalice. Teza de doctorat, Universitatea din Brasov, 1989;
2. Ciobota, M. – Optimizarea parametrilor cuplajelor elastice de tip Elcard, cu arcuri multilamelare dispuse in pachete axiale.In Constructia de Masini, nr 1/1981;
3. Ciobota, M., Huidan, L., Dogaru, L., Barbu, E. - Proiectarea cuplajelor Elcard cu ajutorul electronic. In Buletinul M.T.M. vol II, Cluj, 1988;
4. Ciobota, M. – Transmisii cu reductoare armonice si cuplaje compensatoare, Ed. Aldus, Brasov, 1997;
5. Draghici, I., s.a. – Indrumar de proiectare in constructia de masini, Vol II, Ed. Tehnica, Bucuresti, 1983;
6. Gafitanu, M., s.a – Organe de masini, Vol II, Ed. Tehnica, Bucuresti, 2002.