elastically, the modular joint not only withdraws from the entire impact of the wheel, but it also causes a displacement of the brake force to other axles of the vehicle which do not touch the modular joint at the time. Thus, the elasticity in the steering of modular joints works not only as an isolation against the impact, but it also creates the effect of automatic load limitation. This is of great significance to the research in the area of operative fatigue strength of modular joints.

The same effect is to be expected when starting or accelerating a wheel, if the vehicle has more than one driving axle. More than one driving axle may well be the norm for heavy duty vehicles in the future, since such vehicles preserve the road much better.

In general, even though this study was geared specifically toward modular joints, the conclusions concerning the principle of elasticity for expansion joints are valid for all other joint constructions as well.

Finally, a remark for all those concerned with the construction and maintenance of bridges: it would be tremendously informative for all the busy bridge damage researchers to measure the vibration times or frequencies of expansion joints currently in use. The observed damages should then be studied in relation to the actual wheel loads applied to the construction.

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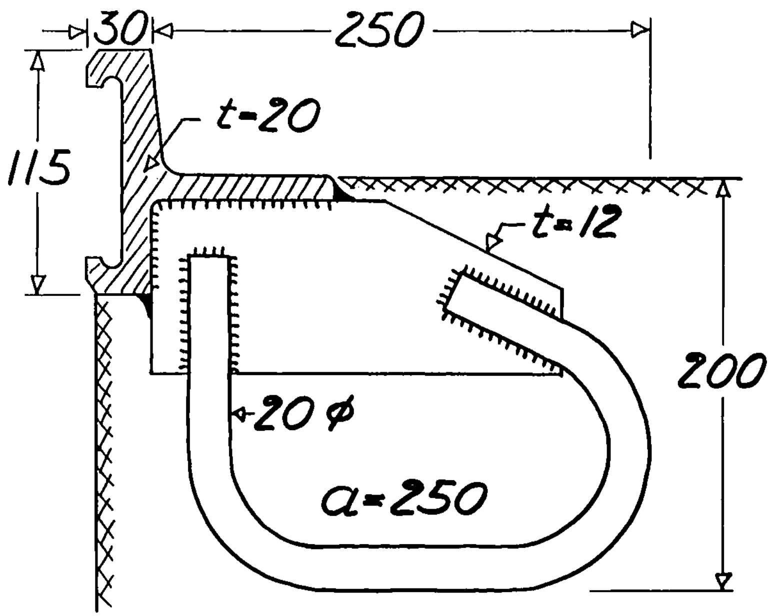



Fig. 1--Rigid edge beam

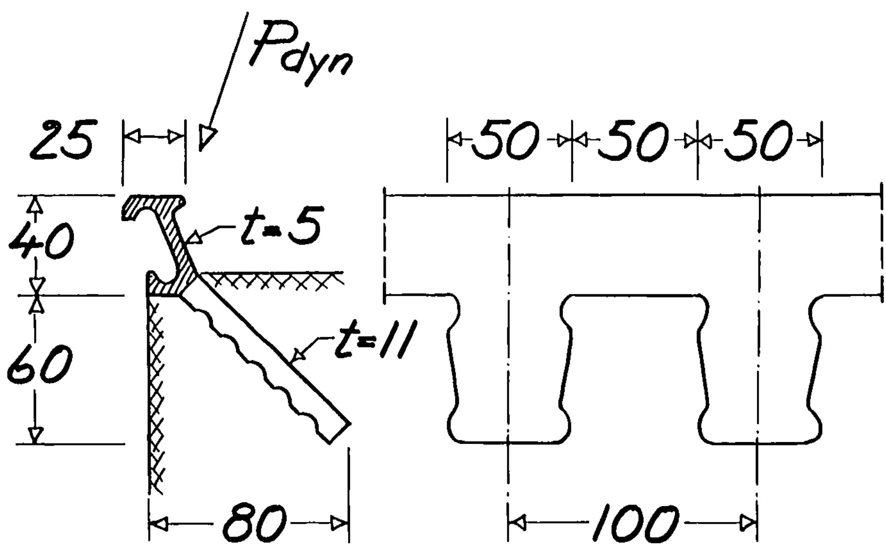



Fig. 2--Elastic edge beam

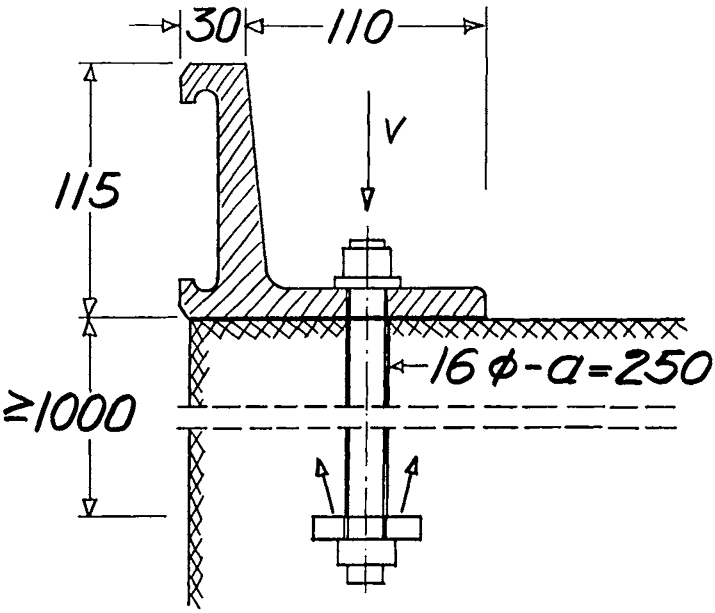



Fig. 3--Preloaded edge beam

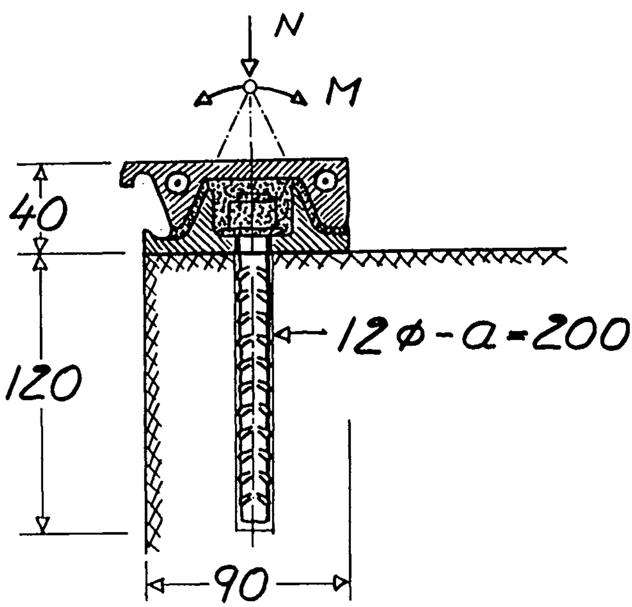



Fig. 4--Elastically supported edge beam

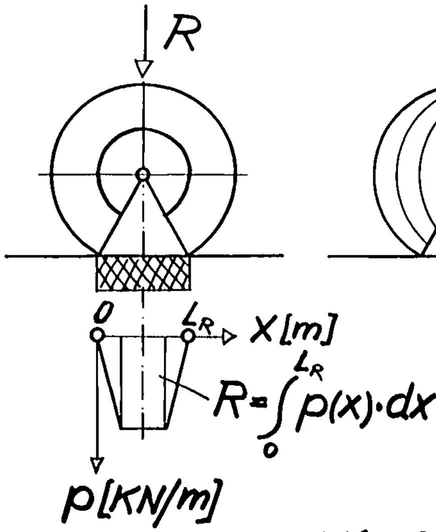



Fig. 5a--Static wheel load

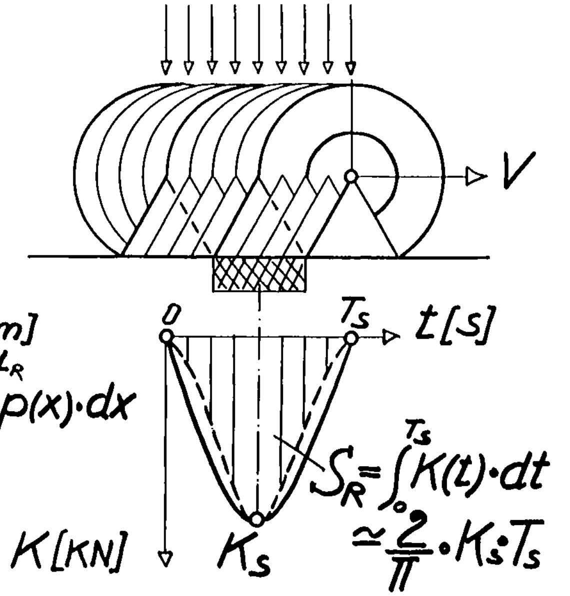



Fig. 5b--Dynamic wheel load

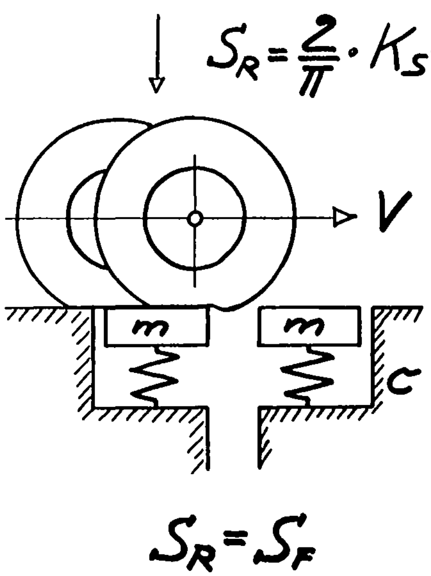



Fig. 6a--Wheel impact on edge beam

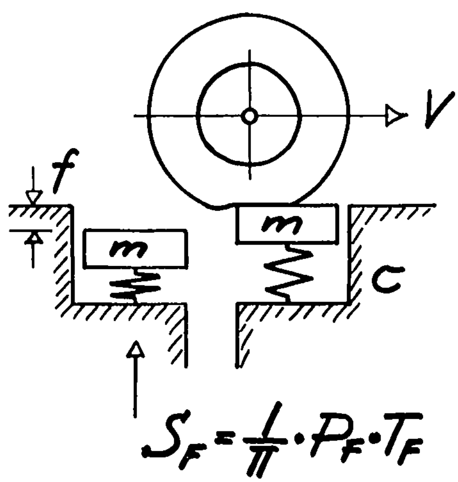



Fig. 6b--Reaction of edge beam

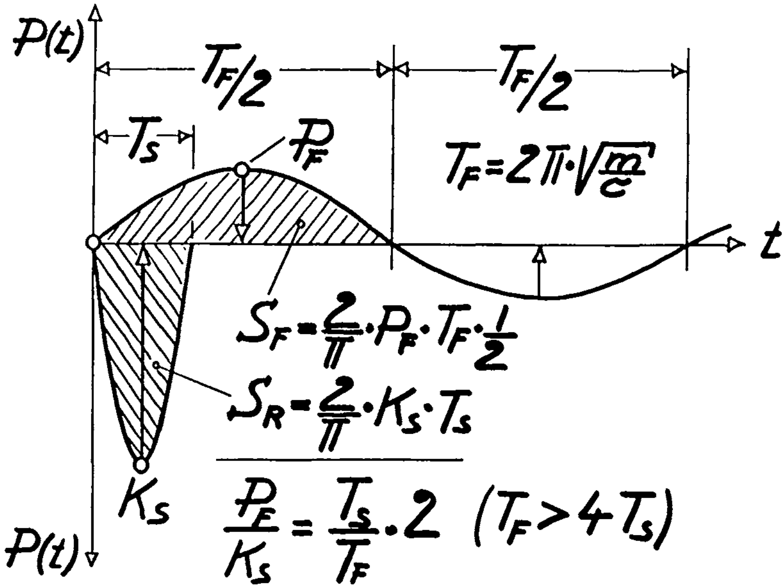
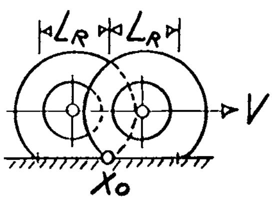



Fig. 7--Wheel impact and spring impact




$$L_R = 200\ \mathrm{mm}\ ;\ T_s = \frac{L_R}{V}\ ;\ n_s = \frac{1}{2T_s}$$

| | | | | $T_F$=80ms $n_F$=12,5 Hz | | $T_F$=100ms $n_F$=10 Hz | | $T_F$=120ms $n_F$=8,3 Hz | |
|---|---|---|---|---|---|---|---|---|---|
| V km/h | V m/s | $T_s$ ms | $n_s$ Hz | $\frac{n_s}{n_F}$ | $\frac{2T_s}{T_F}$ | $\frac{n_s}{n_F}$ | $\frac{2T_s}{T_F}$ | $\frac{n_s}{n_F}$ | $\frac{2T_s}{T_F}$ |
| 130 | 36,1 | 5,5 | 90 | 7,2 | 0,14 | 9,0 | 0,11 | 10,8 | 0,09 |
| 90 | 25,0 | 8 | 63 | 5,0 | 0,20 | 6,3 | 0,16 | 7,5 | 0,13 |
| 60 | 16,7 | 12 | 42 | 3,3 | 0,30 | 4,2 | 0,24 | 5,0 | 0,20 |
| 40 | 11,1 | 18 | 28 | 2,2 | 0,45 | 2,8 | 0,36 | 3,4 | 0,30 |
| 30 | 8,3 | 24 | 21 | 1,7 | 0,60 | 2,1 | 0,48 | 2,5 | 0,40 |

Fig. 8--Impact time and vibration time

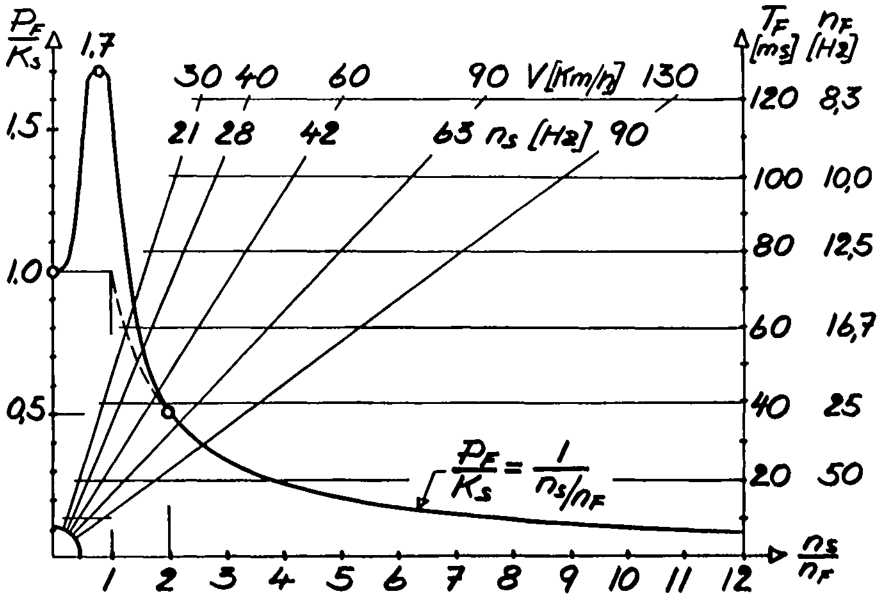



Fig. 9--Impact isolation, vibration time, and speed of traffic

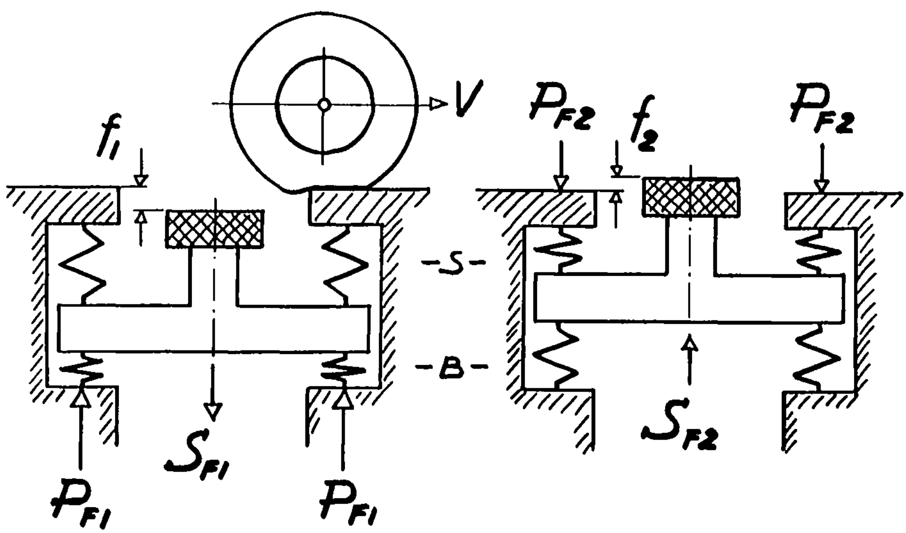



Fig. 10a--Wheel impact on Lamella Fig. 10b--Reaction of Lamella

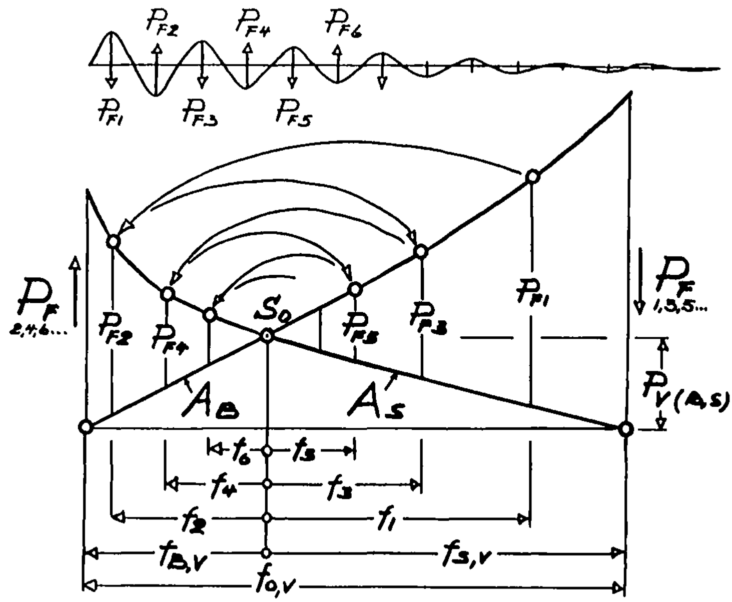



Fig. 11--Wave damping after the wheel impact

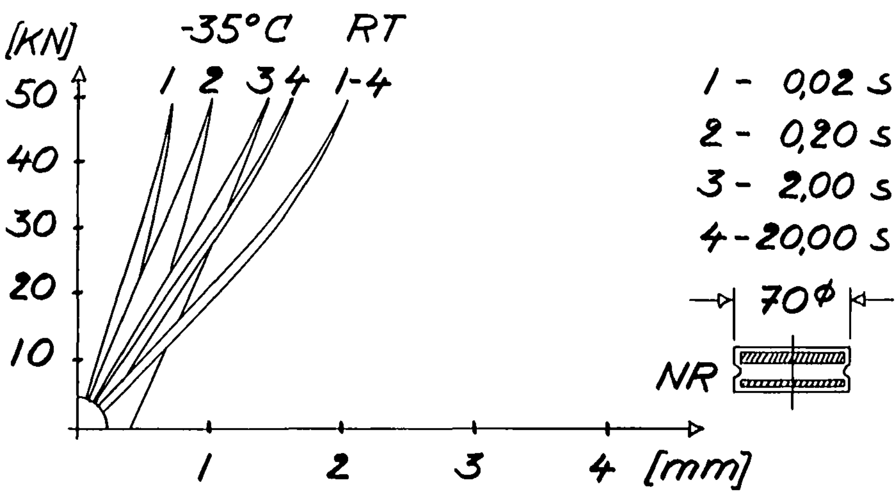



Fig. 12--Demarcation for bearings made from natural rubber

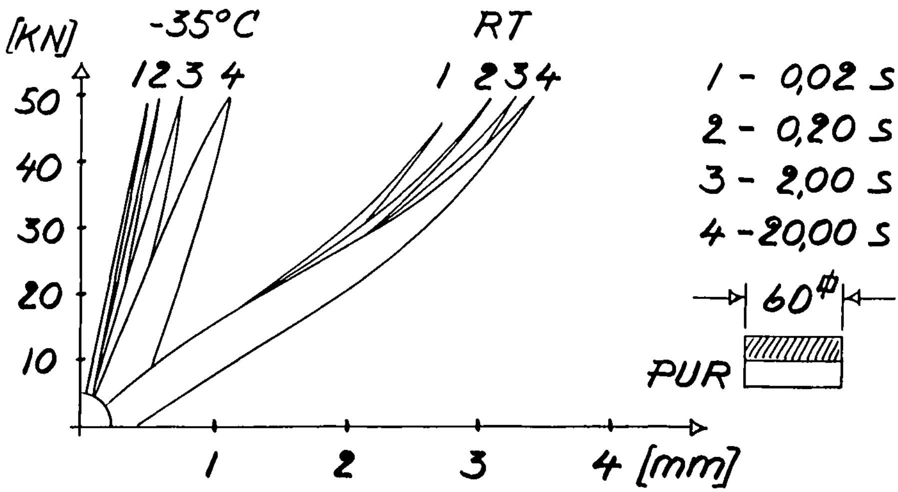



Fig. 13--Demarcation for bearings made from Polyurethane

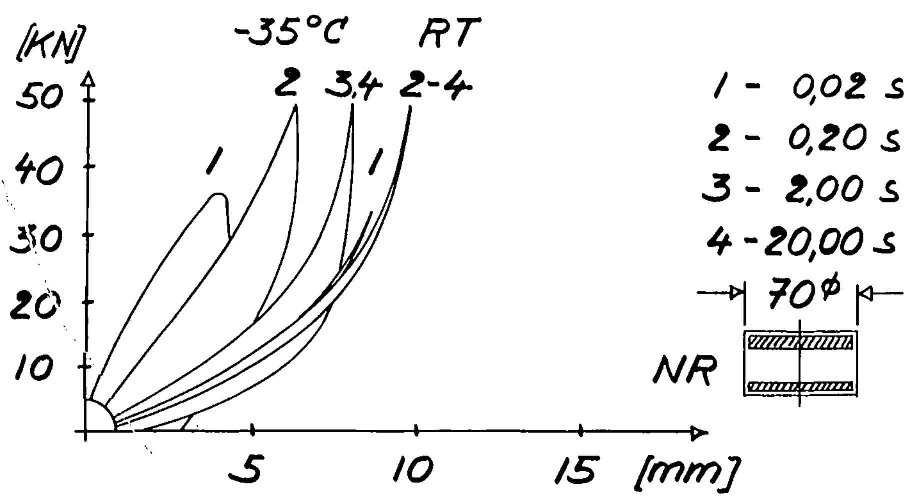



Fig. 14--Demarcation for springs made from natural rubber

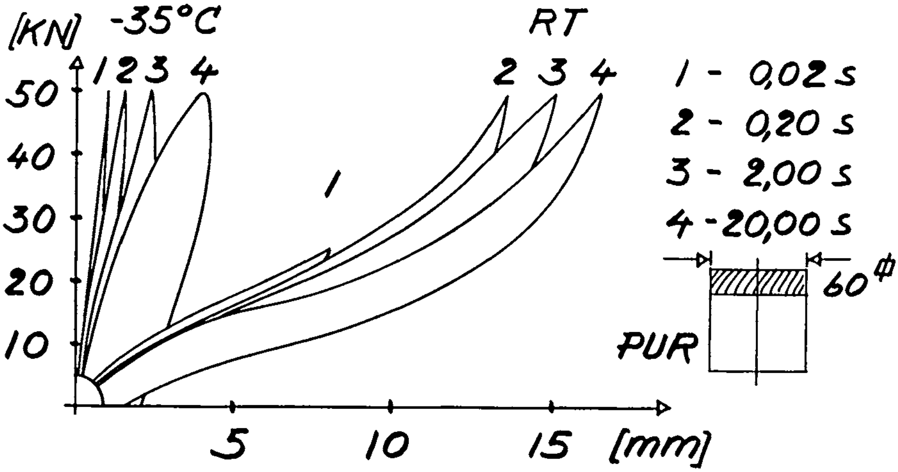
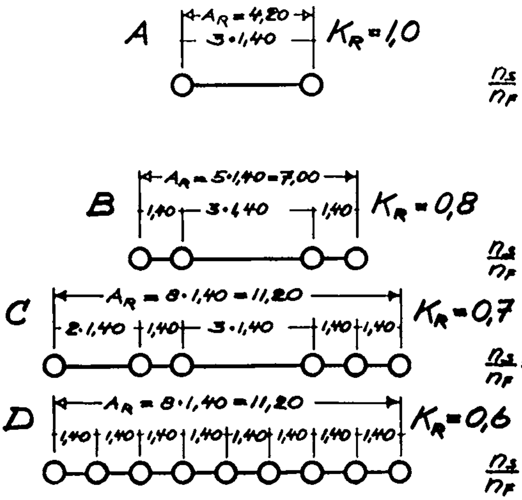



Fig. 15--Demarcation for springs made from Polyurethane




| | $K_T$ | $\frac{n_s}{n_F}$ | $K_E$ | $\frac{K_E}{n_s/n_F}$ |
|---|---|---|---|---|
| $\frac{n_s}{n_F} = \frac{10,5}{K_T}$ | 1 | 10,5 | 1,74 | 0,17 |
| | 2 | 5,25 | 1,55 | 0,29 |
| | 3 | 3,50 | 1,41 | 0,40 |
| | 4 | 2,63 | 1,30 | 0,49 |
| | 5 | 2,10 | 1,22 | 0,59 |
| | 6 | 1,75 | 1,17 | 0,67 |
| $\frac{n_s}{n_F} = \frac{17,5}{K_T}$ | 5 | 3,50 | 1,81 | 0,53 |
| | 10 | 1,75 | 1,35 | 0,77 |
| $\frac{n_s}{n_F} = \frac{28}{K_T}$ | 8 | 3,50 | 1,64 | 0,48 |
| | 16 | 1,75 | 1,06 | 0,30 |
| $\frac{n_s}{n_F} = \frac{28}{K_T}$ | 8 | 3,50 | 2,16 | 0,63 |
| | 16 | 1,75 | 1,32 | 0,75 |

Fig. 16--Load collectives and influence values