

For a car to ride comfortably the rear springs should have between 80 & 100 double vibrations per min. A 4" deflection gives about 32 per min. For the front spring a 2" to 3" deflection is quite sufficient.

Period for 1 complete oscillation

$$t = \frac{2\pi\sqrt{l}}{\sqrt{g}}$$

where t = time in secs.

l = spring deflection in feet

$$g = 32.2$$

$$\text{no. of oscillations} = \frac{60}{t} \text{ per min.}$$

If these do not come within the range specified the plates must then be adjusted to give correct results. If too many vibrations thinner plates are necessary. They can be obtained from table to give the same strength for greater deflection.

For laminated springs 1 lb. of spring for every 4 ft. lbs. of energy as minimum

Eq: Front Spring

$$N = \frac{15 W L}{f b t^2}$$

Centres - 2'-10"

Clips = 3"

$W = 700$ lbs

1 3/4" wide & assume 3/16" plates

$$N = \frac{15 \times 700 \times 34}{75,000 \times 1.75 \times (.187)^2} = 7.8 - \frac{7}{16} \text{ plates}$$

Say 6 3/16" and 1 1/4"

$$L = \frac{700 \times (3)^2}{2240 \times 42,000}$$

Eq. of Spring Steel (Fred Thompson)

Max Tensile	Elastic Limit
30 tons / □"	75 tons / □"
200,000 lbs / □"	170,000 lbs / □"
Elongation	Permissible Stress
5%	75,000 lbs / □"
	60,000 lbs / □"

- 1) Pleasure cars
- 2) Heavy commercial vehicles

The strength of plates considered as a beam is proportional to the square of the thickness
 The stiffness of plates is proportional to the cube of the thickness

Taking $\frac{1}{4}$ " as a unit

Thickness of plate	Strength	Stiffness
$\frac{3}{16}$.56	.423
$\frac{7}{32}$.767	.673
$\frac{1}{4}$	1.000	1.000
$\frac{9}{32}$	1.26	1.42
$\frac{5}{16}$	1.56	1.95
$\frac{3}{8}$	2.24	3.38
$\frac{7}{16}$	3.33	5.36
$\frac{1}{2}$	4.0	8.0
$\frac{9}{16}$	5.06	11.4
$\frac{5}{8}$	6.25	15.7

Resilience of metal

The amount of energy in ft.lbs which can be absorbed in one cubic in. of metal without causing permanent set is -

$$PE = \frac{W L}{2} \text{ ft.lbs}$$

L = Deflection in feet
 W = Weight in lbs.

$$B.H.P. = \frac{A^2 \times S \times R.P.M. \times M.E.P. \times N}{792,000}$$

$$M.E.P. = \frac{B.H.P. \times 792,000}{A^2 \times S \times R.P.M. \times N}$$

$$\text{Compression pressure} = P_1 \times (R)^c$$

where P_1 = atmospheric pressure
 R = compression ratio
 c = constant (about .13)

$$R = \frac{V_1}{V_2} = \frac{\text{Initial Volume}}{\text{Vol of compression space}}$$

$$P_2 = P_1 \left(\frac{V_1}{V_2} \right)^c$$

$$B.H.P. = \frac{P.A.S.N.E}{33,000 \times 4}$$

where P = MEP in lbs. per sq. in.
 A = area of piston in sq. in.
 S = piston speed in ft. per min.
 N = No. of cylinders
 E = mechanical efficiency

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = 2R.$$

$$a = c \cos B + b \cos C$$

$$c^2 = a^2 + b^2 - 2ab \cos C$$

$$\text{also } \cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

$$\sin A = \frac{2}{bc} \sqrt{s(s-a)(s-b)(s-c)}$$

$$\sin A = \frac{1}{\operatorname{cosec} A}; \quad \operatorname{cosec} A = \frac{1}{\sin A}$$

$$\cot. \times \tan = 1 \quad \frac{\sin}{\cos} = \tan.$$

$$\sin \times \operatorname{cosec} = 1 \quad \frac{\sin}{\sin} = 1$$

$$\cos \times \sec = 1 \quad \frac{\cos}{\sin} = \cot.$$

$$\sin^2 + \cos^2 = 1$$

$$\sec^2 = \tan^2 + 1$$

$$\operatorname{cosec}^2 = \cot^2 + 1$$

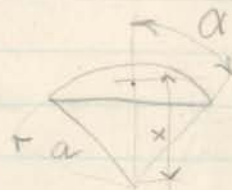
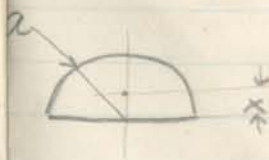
$$(\sin + \cos)^2 = 1 + 2 \sin \cdot \cos.$$

$$(\sin - \cos)^2 = 1 - 2 \sin \cdot \cos.$$

$$\frac{\cos^2}{\cot^2} = 1 - \cos^2$$

C.G. of semi circle

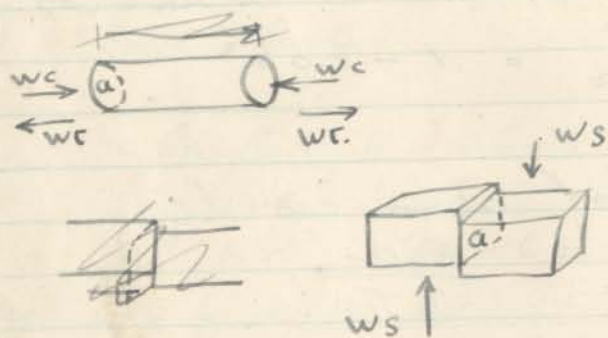
$$x = \frac{4a}{3\pi}$$



$$C.G. = \text{segment. } x = a = \frac{\sin \alpha}{\alpha}$$

$$(a+x)^n = a^n + na^{n-1}x + \frac{n(n-1)}{1.2} a^{n-2} x^2 + \frac{n(n-1)(n-2)}{1.2.3} a^{n-3} x^3 \text{ etc.}$$

$$(a-x)^n = a^n + na^{n-1}(-x) + \frac{n(n-1)}{1.2} a^{n-2} (-x)^2 + \frac{n(n-1)(n-2)}{1.2.3} a^{n-3} (-x)^3$$



3. Kinds of stress. viz.

Tension, compression, & shear. These are stated in lbs. per unit area.

Where \$W\$ equal load and \$a\$ the area of cross section

$$F_t = \frac{W}{a}, F_c = \frac{W}{a}, F_s = \frac{W}{a}$$

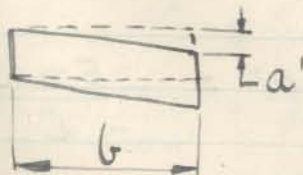
Tension and compression strains are measured by the increase or decrease of length divided by ~~the~~ the original length.

Where \$l\$ = original length and \$x\$ = increase^(t) or decrease^(c)

$$\text{strain} = \frac{x}{l}$$

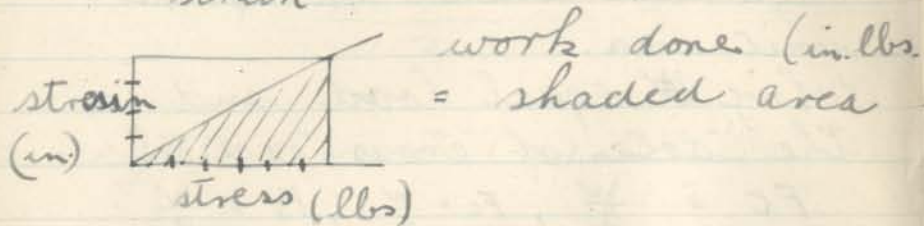


$$\text{shear strain} = \frac{a'}{b}$$



Hookes Law states that

$$\frac{\text{stress}}{\text{strain}} = \text{constant}$$



Elastic constants. (Youngs modulus)

$$\frac{\frac{w}{a}}{\frac{x}{l}} = \text{constant } (E)$$

\therefore if E is known
 we can find the stress which
 will produce a given strain

$$\frac{w}{a} = \frac{E x}{l}$$

and the strain that will
 be produced by a given stress

$$\frac{x}{l} = \frac{w}{a} \cdot \frac{1}{E}$$

$$x = \frac{w l}{a E}, \quad w = \frac{E x a}{l}$$

The coefficient of rigidity G ¹⁹⁹
 is the the same relation
 applied to shear strains

$$\frac{\frac{w}{a}}{\frac{\theta}{r}} = \text{constant } (G)$$

the coefficient of volume
 elasticity, K , is the ratio $\frac{\text{stress}}{\text{strain}}$

applied to a body subjected to
 a uniform pressure in all
 directions (such as a body
 immersed in a fluid)

$$\therefore \frac{\text{pressure}}{\text{change of vol.}} = K.$$

Poissons ratio.

When a bar is compressed
 longitudinally it expands
 laterally & the ~~the~~ ratio
 $\frac{\text{lat. strain}}{\text{long. strain}} = \frac{1}{4}$, for most materials.

the ratio is usually denoted by 'n'