The Hertz stress, σ_H (kgf/mm^2) is calculated from **Equation (17-40)**.

$$\sigma_H = \sqrt{\frac{\cos\delta_1 F_{tm}}{d_1 b}\,\frac{u^2+1}{u^2}\,\frac{R_e}{R_e - 0.5b}} \cdot \left[\frac{Z_H Z_M Z_\varepsilon Z_\beta}{K_{HL} Z_L Z_R Z_V Z_W K_{HX}}\sqrt{K_{H\beta} K_V K_O\ C_R}\right] \quad \textbf{(17-40)}$$

17.4.3 Determination of Factors In Surface Strength Equations

17.4.3.A Tooth Width, b (mm)

This term is defined as the tooth width on the pitch cone. For a meshed pair, the narrower gear's "b" is used for strength calculations.

17.4.3.B Zone Factor, Z_H

The zone factor is defined as:

$$Z_H = \sqrt{\frac{2\cos\beta_b}{\sin\alpha_t \cos\alpha_t}} \quad \textbf{(17-41)}$$

where: β_m = Central spiral angle

α_n = Normal pressure angle

α_t = Central radial pressure angle $\tan^{-1}\left(\frac{\tan\alpha_n}{\cos\beta_m}\right)$

$\beta_b = \tan^{-1}(\tan\beta_m \cos\alpha_t)$

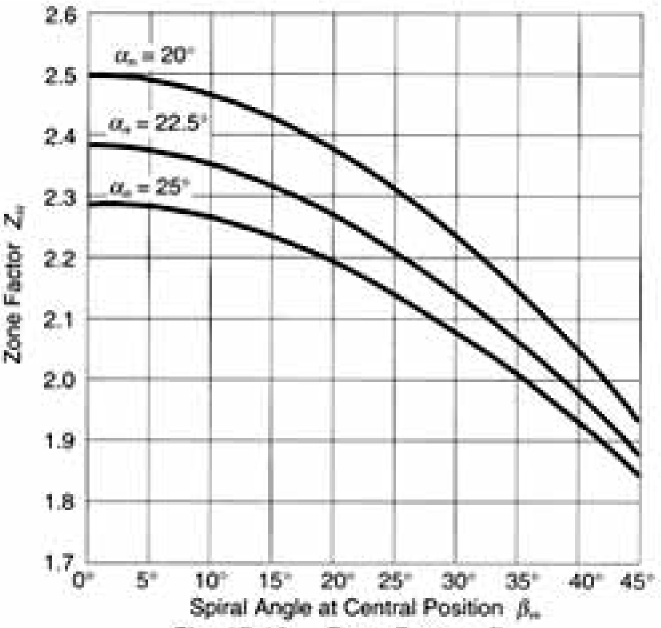

Fig. 17-10 Zone Factor, Z_H

If the normal pressure angle α_n is 20º, 22.5º or 25º, the zone factor can be obtained from **Figure 17-10**.

17.4.3.C Material Factor, Z_M

The material factor, Z_M, is obtainable from **Table 17-9**.

17.4.3.D Contact Ratio Factor, Z_ε

The contact ratio factor is calculated from the equations below.

Straight bevel gear: $Z_\varepsilon = 1.0$

Spiral bevel gear:

Straight bevel gear: $Z_\varepsilon = 1.0$

Spiral bevel gear:

$$\text{when } \varepsilon_\alpha \le 1,\ Z_\varepsilon = \sqrt{1 - \varepsilon_\beta + \frac{\varepsilon_\beta}{\varepsilon_\alpha}}$$

$$\text{when } \varepsilon_\beta > 1,\ Z_\varepsilon = \sqrt{\frac{1}{\varepsilon_\alpha}} \quad \textbf{(17-42)}$$

where: ε_α = Radial Contact Ratio

ε_β = Overlap Ratio

17.4.3.E Spiral Angle Factor, Z_β

Little is known about these factors, so usually it is assumed to be unity.

$Z_\beta = 1.0$ (17-43)

17.4.3.F Life Factor, K_{HL}

The life factor for surface strength is obtainable from **Table 17-10**.

17.4.3.G Lubricant Factor, Z_L

The lubricant factor, Z_L, is found in **Figure 17-3**.

17.4.3.H Surface Roughness Factor, Z_R

The surface roughness factor is obtainable from **Figure 17-11** on the basis of average roughness, R_{maxm}, in μm The average surface roughness is calculated by **Equation (17-44)** from surface roughnesses of the pinion and gear (R_{max1} and R_{max2}), and the center distance, a, in mm.

$$R_{maxm} = \frac{R_{max1} + R_{max2}}{2}\sqrt[3]{\frac{100}{a}}\ (\mu m) \quad \textbf{(17-44)}$$

where: $a = R_m(\sin\delta_1 + \cos\delta_1)$

$$R_m = R_e - \frac{b}{2}$$

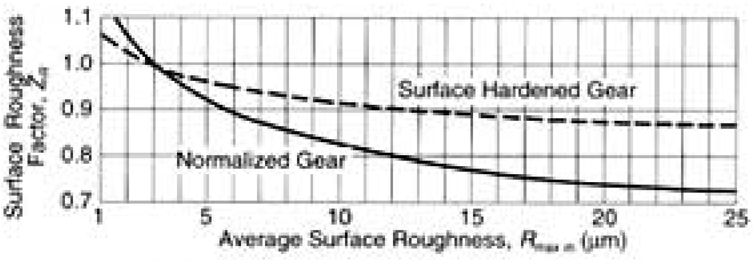

Fig. 17-11 Surface Roughness Factor, Z_R

17.4.3.I Sliding Speed Factor, Z_V

The sliding speed factor is obtained from **Figure 17-5** based on the pitch circle linear speed.

17.4.3.J Hardness Ratio Factor, Z_W

The hardness ratio factor applies only to the gear that is in mesh with a pinion which is quenched and ground. The ratio is calculated by **Equation (17-45)**.

$$Z_W = 1.2 - \frac{HB_2 - 130}{1700} \quad \textbf{(17-45)}$$

where Brinell hardness of the gear is: $130 \le HB_2 \le 470$

If the gear's hardness is outside of this range, Z_W is assumed to be unity.

$Z_W = 1.0$ (17-46)

17.4.3.K Dimension Factor, K_{HX}

Since, often, little is known about this factor, it is assumed to be unity.

$K_{HX} = 1.0$ (17-47)