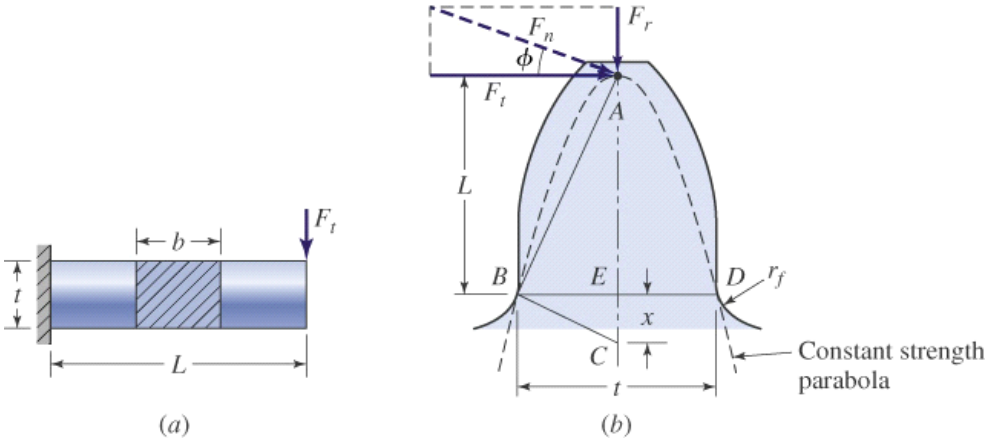
Rack Tooth Strength Calculation

Lewis Bending Equation:



$$\sigma = M/(I/c) = 6F^tl/(bt^2)$$

Also expressed as

$$\sigma = F^t/(bYm)$$

$$Y = 2x/(3*m)$$

$$x = t^2/4l$$

m= module

b= tooth face width

After adding velocity factor into the equation

$$\sigma = K'_vF^t/(bYm)$$

$$K'_v = (6.1+V)/6.1 \text{ (cut or milled profile)}$$

V= velocity in m/s

(Reference: Mechanical Engineering Design By Joseph E. Shigley, Charles R. Mischke)

Pinion Meshing Analysis shows that outer most engagement of Pinion with Rack happens at location D.

Therefore, equivalent max load at tip of the tooth

$F^t = F^T * l'/l$

F^T= 600 MT, l'= 145 mm, l= 180.12 mm

F^T	l'	l	F^t
MT	mm	mm	MT
600.00	145.00	180.12	483.01

m= 97.02 mm

b= 139.7

t	l	$x=t^2/(4*l)$	m	Y=(2*x)/(3*m)
mm	mm			
139.70	180.12	27.09	97.02	0.186130847

V	V	K'v= (6.1+V)/6.1
m/min	m/s	
0.45	0.0075	1.00

K'v	F^t	b	Y	m	$\sigma = K'_v F^t/(bYm)$
	MT	mm		mm	Mpa
1.00	483.01	139.70	0.63	97.02	562.34

Max Allowable stress for Rack Material (100 ksi)= 0.9x690 = 621 MPa