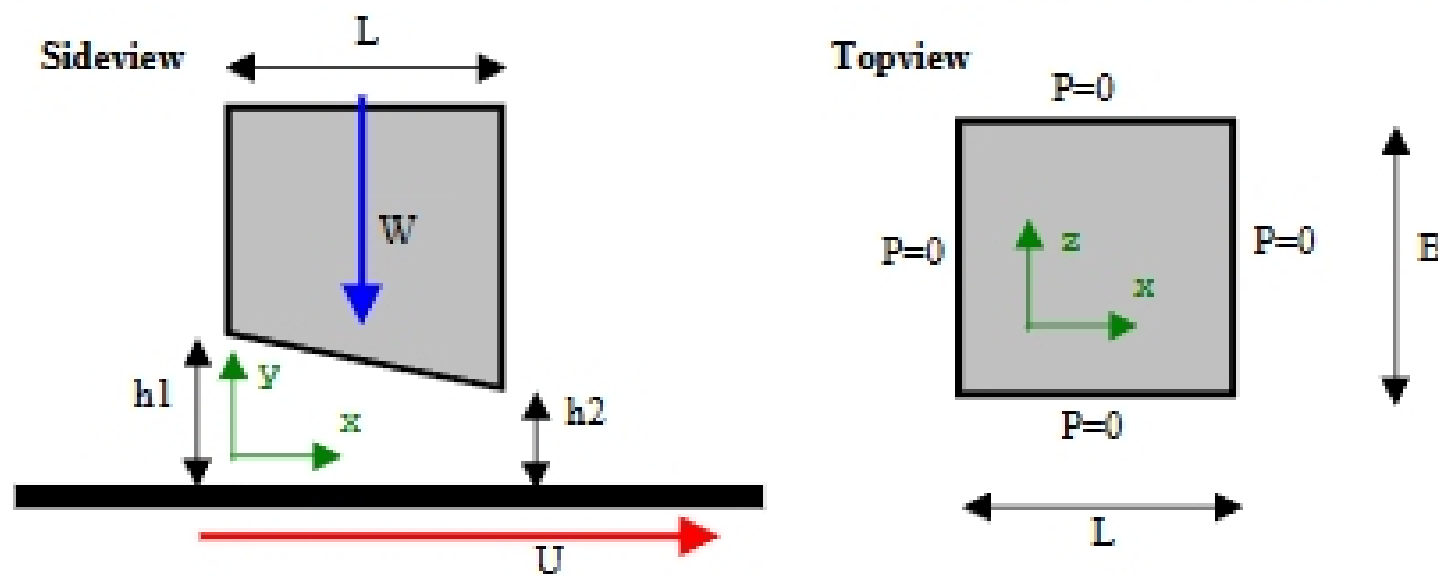


# Performance of 1D-Slider Bearing

Modern Lubrication  
Luis San Andres (c) 2009

ORIGIN :- 0



$$h(x) := h_2 \cdot \left[ \alpha + (1 - \alpha) \cdot \frac{x}{L} \right]^2 \quad \alpha := \frac{h_1}{h_2}$$

film thickness profile

(SI units)

U: surface speed - varies

Bearing geometry:

$L_{min} := 0.06$  m length and width of bearing

taper\_angle := 0.001 rads (machined)

$B := 0.180$

Fluid properties  $\mu_{in} := 0.0597$  Pa-sec  $\rho := 878$  kg/m<sup>3</sup>  $c_p := 1880$  J/kg-degC

$\alpha_v := 0.0414$  1/degC viscosity temperature coefficient

Operating conditions:

$T_{inlet} := 40$  degC - inlet temperature

$\kappa_T := 0.80$  thermal convection parameter

$W_{min} := 20000$  N external load

visc-Temperature relationship  $\mu(T) := \mu_{in} \cdot e^{-\alpha_v \cdot (T - T_{inlet})}$

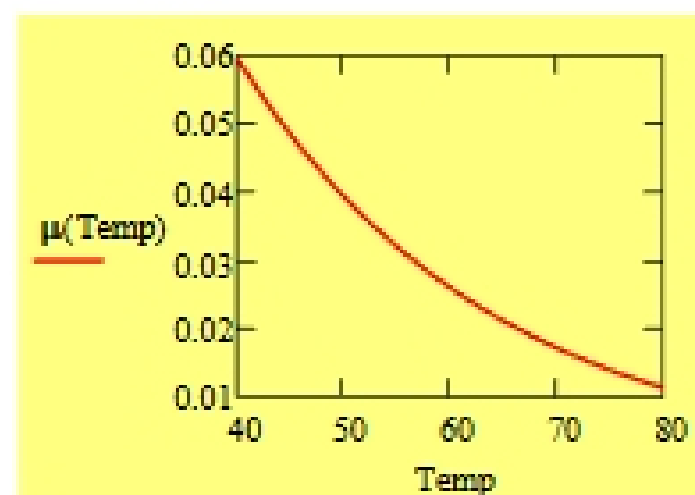
Calculated performance (Vary runner surface speed)

$U_{min} := 2$   $U_{max} := 20$  [m/s]

Number of cases:  $N_{cases} := 10$

Convergence params in load & temperature:

$W_{eps} := 0.001$   $T_{eps} := 0.05$



GUESS values:

$h_2 := 20 \cdot 10^{-6}$   $T_{out} := 55$  based on experience

Specific pressure (bars)

tapered height (h1-h2) taper := taper\_angle · L taper =  $6 \times 10^{-5}$  m

$$P_{spec} := \frac{W}{L \cdot B \cdot 10^5}$$

$P_{spec} = 18.519$

EXPAND regions below to display code

▣ slider bearing parameters

```

Find_pars(h2, U, Tout) :=
  Teff ← 0.5 · (Tinlet + Tout)
  μeff ← μ(Teff)
  α ←  $\frac{\text{taper}}{h_2} + 1$ 
  q ←  $\frac{\alpha}{1 + \alpha}$ 
  pmax ←  $\frac{1}{4} \cdot \frac{(\alpha - 1)}{\alpha(1 + \alpha)}$ 
  w ←  $\frac{1}{(1 - \alpha)^2} \cdot \left[ \ln(\alpha) + 2 \cdot \frac{(1 - \alpha)}{(1 + \alpha)} \right]$ 
  f ←  $-1 \cdot \left( \frac{6}{1 + \alpha} + 4 \cdot \frac{\ln(\alpha)}{1 - \alpha} \right)$ 
  t ←  $\frac{f}{q}$ 
  Cpre ← μeff · U ·  $\frac{L}{h_2^2}$ 
  Force ← 6 · Cpre · B · L · w
  Q ← q · U · h2 · B
  ShearF ← f · Cpre · B · h2
  ΔT ← t · κ1 ·  $\frac{C_{pre}}{(\rho \cdot c_p)}$ 
  Tout ← Tinlet + ΔT
  Pmax ← pmax · Cpre · 6
  (h2 Teff Force ShearF Q · 60000 Tout μeff Pmax)

```

▢ slider bearing parameters

imax := 24 Max number of steps for convergence

▢ Iterative loop

```

Find_filmT(h2, U, Tout, imax) :-
  i ← 0
  s ← Find_pars(h2, U, Tout)
  Force ← s0,2
  Tout ← s0,5
  Fratio ←  $\frac{\text{Force}}{W}$ 
  h2old ← h2
  Forceold ← Force
  h2 ←  $\begin{cases} (h_2 \cdot 1.05) & \text{if } F_{\text{ratio}} > 1.01 \\ (h_2 \cdot 0.95) & \text{if } F_{\text{ratio}} < 1.01 \end{cases}$ 
  Toutold ← s0,5 + 10
  while (i < imax) ∧ (|Fratio - 1| > Weps) ∧ (|Tout - Toutold| > Teps)
  |
    i ← i + 1
    Toutold ← Tout
    s ← Find_pars(h2, U, Tout)
    Force ← s0,2
    Δh ← h2 - h2old
    K ←  $\frac{-(\text{Force} - \text{Force}_{\text{old}})}{(\Delta h)}$ 
    h2old ← h2
    Forceold ← Force
    Fratio ←  $\frac{\text{Force}}{W}$ 
    h2 ← h2old +  $\frac{(\text{Force} - W)}{K}$ 
    Tout ← s0,5
  |
  dum ← 1
  (h2 Tout Force K i Fratio)

```

Newton-Raphson procedure to determine equilibrium film thickness at exit plane.

NOT a very accurate stiffness since changes in h<sub>2</sub> may

j := 0 .. N<sub>cases</sub>

$$U_j := U_{\min} + (U_{\max} - U_{\min}) \frac{j}{N_{\text{cases}}} \quad \text{vector of surface speeds}$$