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Temperature of a sliding contact between wire rope and friction lining

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Abstract

This paper studies the three-dimensional (3d) transient temperature field of a friction lining and a sliding wire rope. An efficient multigrid solver is developed. The multigrid code is validated by a comparison with a well-known analytical solution.

The influence of several parameters on the temperature rise is investigated. Sliding velocity has a great influence: the larger the velocity, the larger the average temperature rise and the temperature fluctuation at a certain time. Two approximate solutions characterized by simple heat flux forms are proposed, using only a limited computational effort. A comparison of the temperature rise by the original and the two simplified schemes is performed. It is found that the heat flux shape influence is limited to the surface temperature and the temperature rise far below the contact surface depends only on the total heat flow.

Keywords

temperature; multigrid; friction lining; wire rope

Notation

b	half-width of Hertzian line contact
b_p	radius of Hertzian point contact
f	right-hand side of the equation of a linear system
k_l	thermal conductivity of the friction lining
L	differential operator
L_g	length of the friction lining groove
p	contact pressure
p_h	maximum pressure of Hertzian line contact
p_{ph}	maximum pressure of Hertzian point contact
P	dimensionless contact pressure
Pe	Peclet number
q	heat flux
Q	dimensionless heat flux
R_g	groove radius
r_l	heat partition ratio
S_w	sliding distance of the wire rope
t	time
t_s	duration of the wire rope sliding
$\bar{t}$	dimensionless time
T	temperature
$\bar{T}$	dimensionless temperature rise
v	velocity of the wire rope
W	load
x	coordinate in direction of wire rope sliding
X	dimensionless coordinate in direction of wire rope sliding
y	coordinate perpendicular to direction of wire rope sliding
Y	dimensionless coordinate perpendicular to wire rope length
z	depth coordinate
Z	dimensionless depth coordinate
α_l	thermal diffusivity of the friction lining
τ	characteristic time

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