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”  
**ANALYSIS OF FORCES  
DUE TO ROLLING OF  
A LOADED TIRE OVER  
AN OBSTACLE”**



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NOTATION

$a_1, a_2, \dots, a_n$	Denominator coefficients of the transfer function.	
$b$	Obstacle width	mm
$b_1, b_2, \dots, b_m$	Numerator coefficients of the transfer function.	
$c$	Damping coefficient	N.S/m
$d$	Attack distance	mm
$D(w)$	Spectral content of the road irregularities (after reference 2)	
$E(w)$	Spectrum of the force response to a pulse of unit height (after reference 2)	
$f_1, f_2, \dots, f_n$	System of non-linear equations	
$f(x)$	Enveloping force (after ref. 1)	N
$F_i$	Tire preload calculated from the distribution curve.	N
$F(x)$	Vertical force.	N
$F^n(x)$	The $n^{\text{th}}$ derivative of $F(x)$	
$F(S)$	Laplace transform of the vertical force	
$G(h)$	Function depending on the obstacle height	$m^2$



$h$	Obstacle height	mm
$I$	Impulse communicated to the tested tire.	N.S
$J$	Impulse communicated to the proposed elastic wheel.	N.S
$K$	Tire stiffness.	N/m
$l$	Length of contact (after reference 1)	mm
	Distance between the obstacle and the dynamometer	mm
$L$	Length of contact	mm
$m$	Mass	Kg
$P_i$	Inflation pressure	N/m <sup>2</sup>
$R$	Wheel radius	mm
$V$	flywheel speed	m/s
$W$	Tire preload	N
$W(s)$	Transfer function	
$x$	Distance traveled by the obstacle	mm
$x_1, x_2 \dots x_n$	Variables of non-linear equations	
$y$	Deflection of the proposed wheel due to passing over the obstacle	mm
$\alpha_0$	Attack angle	radian
	Initial tire deflection	mm
$\phi(x)$	Road elevation (after reference 1)	
$\psi(x)$	Response to a step function	N
$\psi_c(w)$	Response to a step function computed	N

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A B S T R A C T

The present work was carried out to measure and analyse the vertical and tangential forces acting on the tire and arising due to its rolling over on obstacle under different working conditions. Also to determine the instantaneous force distribution at the contact zone in the case of the presence of an obstacle inside the contact zone. A test rig was built to accomplish the experimental work.

The enveloping forces acting on the tire are affected by the dimensions of the obstacle. They increase with the increase of the height and width of the obstacle, and the inflation pressure of the tire and with the decrease in the initial tire deflection. It was also found that the peak values of the enveloping forces are slightly affected by the change of the initial pre-load. The greatest part of the enveloping forces arises from the inflation pressure.

The enveloping capability of the tire " $\gamma$ " was defined. It relates the impulse energy communicated to the tested tire to that communicated to an elastic wheel having the same stiffness as the tested tire, under the different working conditions but without the