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ME486C-001

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To: Dr. David Alexander

From: Simeng Cai

Team: 20Su3 FMC Wheelchair

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Re: Individual Analytical Analysis II - Option 2 new

1: An introduction to the problem in question

The brake system in a wheelchair is very important for some patients. For example, some patients with leg injuries, their arms are normal. When turning the wheelchair, due to the larger total weight of the wheelchair and the patient, the inertia of the system is also larger, So the braking performance of the wheelchair can ensure that the user will not be injured twice

2: Assumptions that drive the calculations

o Define any and all variables used

Table 1: variables in project calculation

Physical term	unit
actuating force (F)	N
The moment of friction (M_f)	N*m
The moment of the normal forces by (M_N)	N*m
angle occupied by rim brake (θ1 and θ2)	rad
Friction coefficient (f)	Non-dimension
face width (b)	m
Forced equivalent length (a)	m
Pressure limitation (pa)	kPa
Radius of Wheel (r)	m
Diameter after removing the rim brake (c)	m

o Annotate (describe) equations used

$M_f = (f * pa * b * r / \sin(\theta a)) * (r - r * \cos(\theta_2) - a * \sin^2(\theta_2)/2)$

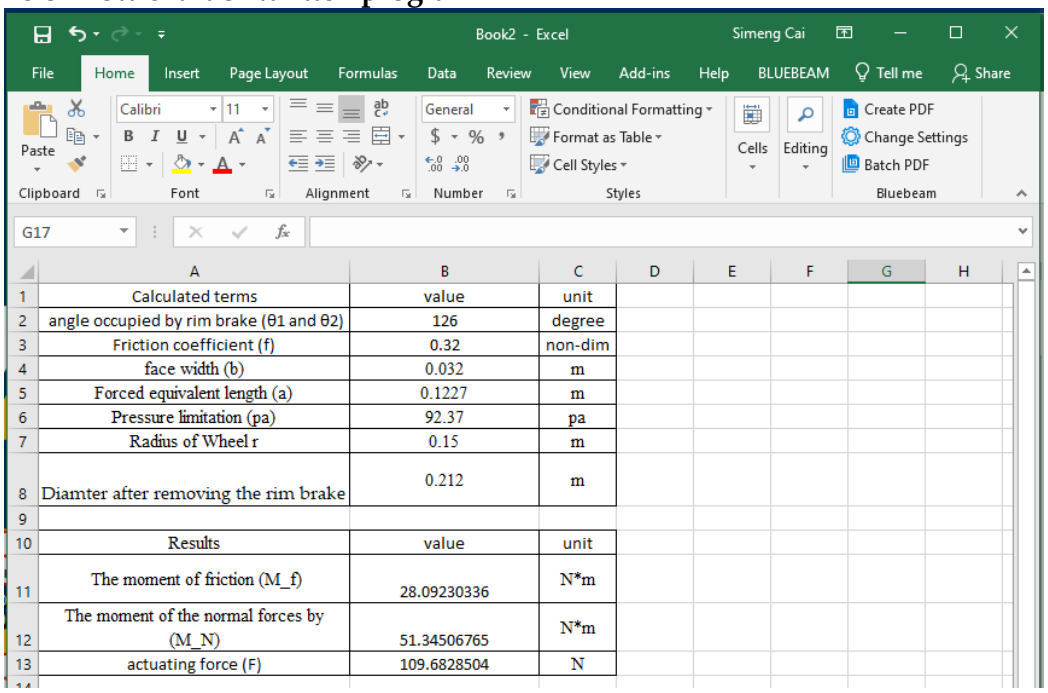
$M_N = (pa * b * r * a / \sin(\theta a)) * (\theta 2/2 - 0.25 \sin 2(\theta_2)$

$F = (M_N - M_f)/c$ [1]

Schematics and/or diagrams of the project/design

Figure 1: rim brake model

Equations or flow chart of written program



	A	B	C	D	E	F	G	H
1	Calculated terms	value	unit					
2	angle occupied by rim brake (θ1 and θ2)	126	degree					
3	Friction coefficient (f)	0.32	non-dim					
4	face width (b)	0.032	m					
5	Forced equivalent length (a)	0.1227	m					
6	Pressure limitation (pa)	92.37	pa					
7	Radius of Wheel r	0.15	m					
8	Diamter after removing the rim brake	0.212	m					
9								
10	Results	value	unit					
11	The moment of friction (M_f)	28.09230336	N*m					
12	The moment of the normal forces by (M_N)	51.34506765	N*m					
13	actuating force (F)	109.6828504	N					

Figure 2: Formula editing and results in excel

Referenced sources that equations came from (IEEE style)

The cited source will be shown at the end of the memo.

Models

Figure 3: CAD model

The result and how that influenced your project

Through calculation, the value of the actuating force (F) is 109. 68N, based on the team's previous analysis, the ideal acceleration during braking is -1.76m/s. According to Newton's second law F=ma [2], this can ensure that a passenger with a mass of 62Kg can safely use a wheelchair. But considering some obese patients, the team may have to ensure that the rim brake material is better in future work.

References

[1] R. G. Budynas, Shigley's Mechanical Engineering Design 8th Editon, New York: McGraw-Hill Education, 2015.

[2] "WIKIPEDIA," [Online]. Available: https://en.wikipedia.org/wiki/Newton%27s_laws_of_motion. [Accessed 9 October 2020].