P09009
20082-20083

National Science Foundation
WHERE DISCOVERIES BEGIN

One - Arm Manual Powered Wheelchair

Mission Statement: The purpose of this project is to develop a manual-powered wheelchair that can be operated by stroke patients or any other individual who has a reduced capacity to perform bilateral operation of a standard manual wheelchair.

Project Background: Typical wheelchairs are difficult to operate for individuals who lack full use of both upper extremities. The desired wheelchair will enable stroke patients to independently power and steer the manual chair. While there is a specific customer in mind for this project, it is expected that successful development of such a wheelchair will benefit a wide variety of patients with one arm function.

Key Customer Needs

-Must be useable by persons with one-arm function

-Must be foldable for transport

-Should be able to traverse common terrain (tile, carpet, concrete, etc.)

-Must be able to be maneuvered through a standard wheelchair accessible doorway

-Forces applied to propel wheelchair must be safe for users

-Must be able to handle a maximum of 250 lbs. weight limit (95th percentile male)

-Weight of wheelchair should be minimal.

-Must be able to remain stationary on a 1:12 ADA standard ramp grade

Force Analysis

The chart above displays the time required to achieve a speed of just under 2 mph for various inputs of force. Each peak denotes a power pulse or a round-trip movement of the lever. The chart shows that the lower the amount of force applied the longer it takes to achieve a desired speed.

Final Design & Stress Analysis

Lever Propulsion System

The wheelchair is propelled by a lever set at a height to accommodate a 5th percentile to 95th percentile male. Each brake lever controls one wheel. In order to turn, one brake must be applied while continuing to push.

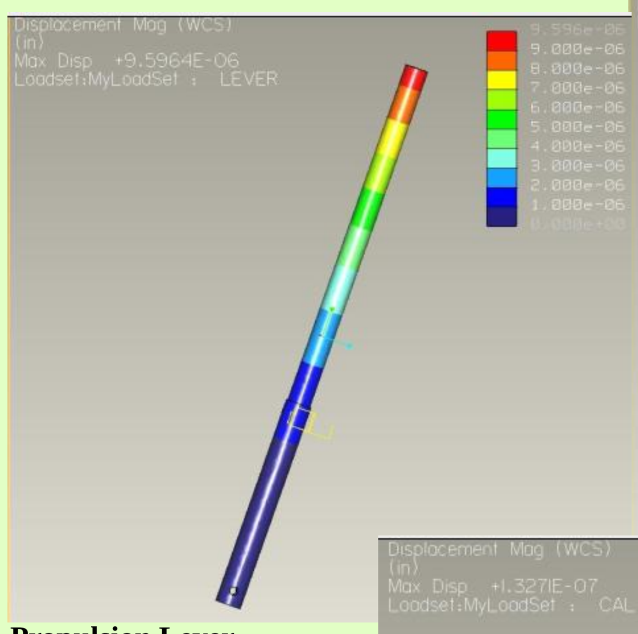
Differential Subsystem

The open differential transfers all power to the wheel that is not braking, thus completing a turn around the wheel that is stopped.

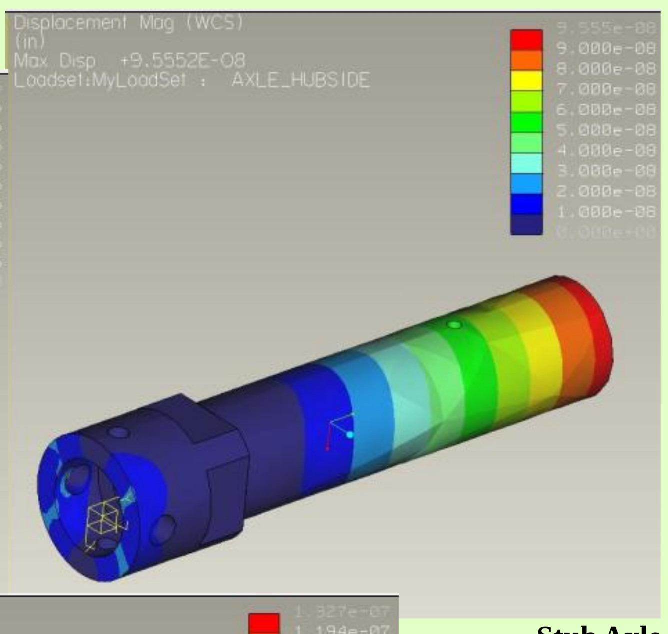
Hub Subsystem

Torque is transferred from the spline axle to the stub axle. Square keys connected to the wheel hub mate with the stub axle and transfer torque to the wheels.

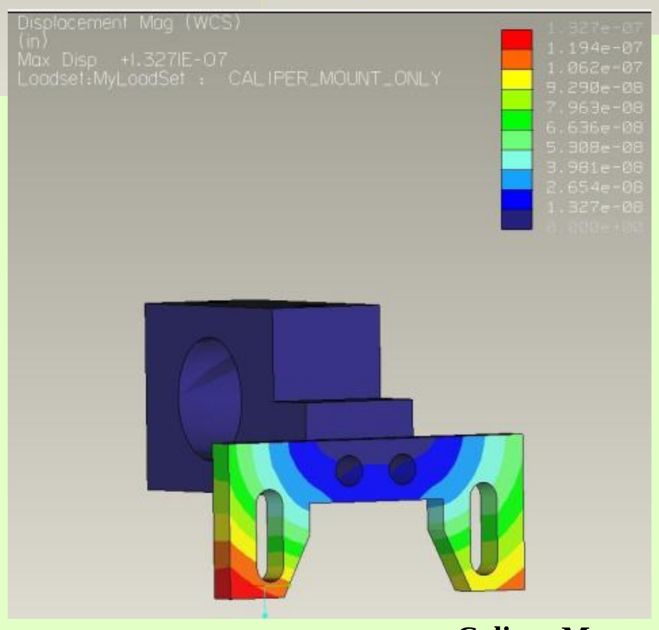
Wheelchair in Operation (Extended View)



Propulsion Lever



Stub Axle



Caliper Mount

Stress Analysis

Stress analysis was performed using finite element computational software on all custom built parts and modified parts from the wheelchair to ensure the structural stability during normal operation. Shown above is the propulsion lever, stub axle, and caliper mount.

NIOSH Lifting Analysis

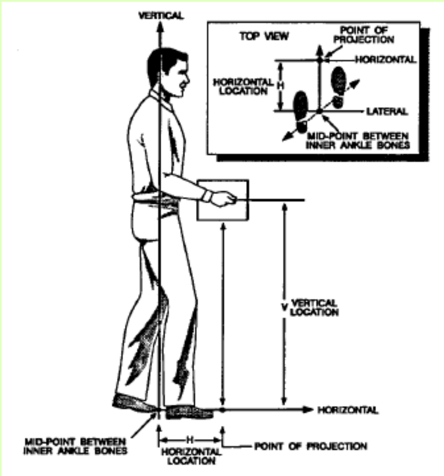


Figure 1 Graphic Representation of Hand Location

The task of lifting the wheelchair frame to place into a car trunk was analyzed. The NIOSH lifting index was calculated to be 1.11 and 1.57. A value over 1 poses an increased risk for some, but is still considered safe for a task that is not performed very often.

STEP 1. Measure and record task variables

Object Weight (lbs)		Hand Location				Vertical Distance	Asymmetric Angle (deg.)		Frequency Rate	Duration	Object Coupling
		Origin		Dest			Origin	Destination	lifts/min	Hrs	
L(AVG)	L(MAX)	H	V	H	V	D	A	A	F		C
36	45	12	15	18	38	23	0	30	<.2 (.004)	<1	Good

STEP 2. Determine the multipliers and compute the RWLs

		LC		HM		VM		DM		AM		FM		CM		
ORIGIN	RWL =	51	x	.83	x	.89	x	.9	x	1	x	1	x	1	-	32.37 lbs.
DEST.	RWL =	51	x	.56	x	.94	x	.9	x	.9	x	1	x	1	-	22.88 lbs.

STEP 3. Compute the LIFTING INDEX

ORIGIN	LIFT INDEX	OBJECT WEIGHT / RWL =	36 / 32.37 lbs.	= 1.11
DESTINATION	LIFT INDEX	OBJECT WEIGHT / RWL =	36 / 22.88 lbs.	= 1.57

LI>1: Task is increased risk for some.
LI>3: Task is high risk for most.

Team Members

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Acknowledgements:
Dr. Matthew Marshall (IE Dept.)
Dr. Elizabeth DeBartolo (ME Dept.)
Bob Brinkman (Customer)
Jack Allen (Customer)
ME Machine Shop Personnel

Contributions Made By:
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