The Engineering of the Walk'n'Chair

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The Walk'n'Chair Journal

Why does the Walk'n'Chair morph into so many configurations?

- Because people have different mobility limitations.
- Because people have different environments to contend with.

Outdoor and indoor environments require an adaptive mobility device.

And some serious engineering.

The (Adaptive) Outdoor Activity Extender

Walk`n´Chair™
by
BROOKEFIELD HUNTER INCORPORATED

The outdoor environment is not always conducive to mobility aids.

As the outdoor terrain becomes more irregular, it is second nature to take more care and go slowly.

Theoretically, increasing the rolling resistance of the wheels and increasing the turning radius as terrain gets more irregular mimics what people do when the going gets rough. They slow down and take wider turns.

The configurations of Walk'n' Chair.				
Purpose	**Rough Terrain Walker**	**Smooth Terrain Walker**	**Rough Terrain Wheel Chair**	**Smooth Terrain Wheel Chair with foot rest**
Turning	**Wide radius**	**0 radius**	**Wide radius**	**Narrow radius**
Rolling Resistance	**+++ Resistance**	**+ Resistance**	**+++ Resistance**	**+ Resistance**

Rolling Resistance

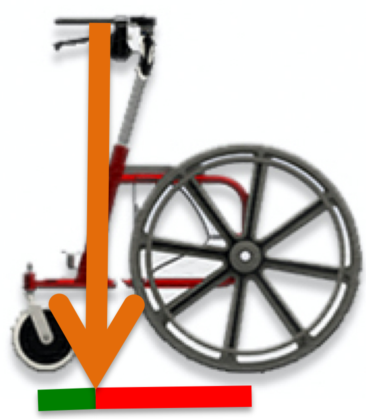
Rolling resistance is related to the tire material, wheel radius and load on the wheel base (Lin et al., 2015; Mediola et al., 2014; Sprigle and Huang 2015). Most of the resistance to rolling is due to "tire scrub" and "caster shimmy" not bearing resistance[2].

How Walk'n'Chair changes Rolling Resistance

Changing the configuration of the Walk'n'Chair alters the weight distribution of the load relative to the front and back wheels. The large wheels have much less rolling friction than to the smaller caster wheels (due to size, materials, caster shimmy).

When we change the Walk'n'Chair from a ***Smooth Terrain Walker*** to a ***Rough Terrain Walker***, the center of gravity moves from the large wheels (low resistance) to the casters (high resistance)

This increases the rolling resistance to match the caution one normally uses in rough terrain. Increased resistance for rough terrain gives the Walk'n'Chair a solid feel.

	
Rough Terrain Walker	***Smooth Terrain Walker***
Center of gravity is closest to high rolling resistance caster	Center of gravity is closest to low resistance larger wheel
Resistance **+++**	Resistance **+**

The Rough Terrain Walker increases the rolling resistance to match the slow and cautious strategy one assumes with rough ground.

Turning Radius (Maneuverability)
The Walk'n'Chair turning radius is increased for the ***Rough Terrain Walker*** configuration. This in combination with increased rolling resistance makes the ***Rough Terrain Walker*** configuration a sturdy match for irregular terrain.

Effects of Wheel Camber

The inclination of the large rear wheels (camber) is usually reserved for athletics and wheelchair sports (Tsai et al., 2012). Camber increases lateral stability; the effects are significant from 0-15^{o}. Camber allows increased turning velocities. Camber from 8 to 15^{o} increases rolling resistance (Tsai et al., 2012). A camber of 6^{o} was found to be optimal in terms of lateral stability on smooth terrain (Mediola et al., 2014).

The Walk'n'Chair large wheel camber is 12^{o}. This enhances stability especially when moving over lateral slopes.

The Walk'n'Chair was designed to traverse the obstacles in your way.

	
Rough Terrain Walker	***Smooth Terrain Walker***
Large wheel traverses a curb obstacle. Curb can be ½ of radius of wheel.	Small caster wheel traverses a curb obstacle.

Obstacle Traverse
The largest obstacle height safely traversed is related to the wheel radius. A curb half of the radius of the forward wheel is easily and safely crossed.

The ***Rough Terrain Walker*** and ***Rough Terrain Wheelchair*** configurations allow the traverse of rough terrain and curbs.

Conclusion
Several principles of wheel chair design were extracted from recent engineering literature[1-8]. These principles were applied to the Walk'n'Chair.

The Walk'n'Chair modifies the center of gravity to match rolling resistance to the terrrain. Turning radius is modified to optimize for smooth indoor or rough outdoor terrain. Stability is increased by reducing turning radius and adding camber to the rear wheels. Rough terrain features are traversed with larger wheels.

References
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