Toyota Assistive Lifting Exoskeleton (TALEX)

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TOYOTA BOSHOKU

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Background

Toyota Boshoku Canada, located in Elmira, ON, is responsible for the production of doors and seats for Toyota and Lexus vehicles, producing parts for up to 500 vehicles a day. While there are numerous processes that go into the creation of these parts, there are two stations in the plant which are ergonomically unfriendly. Stations one and two on the rear seat assembly line both involve picking up a 25lb seat frame from a lower rack and placing it on the assembly line. This section of the line causes such a strain on workers' lower backs that they are required to switch out every 2 hours, in order to prevent chronic injury. Not only this, but these stations were initially designed as one, and had to be split up to reduce muscle fatigue on line workers, resulting in both processes no longer completely filling the lines' takt time.

Objectives

Finding a solution to this problem will allow line workers to perform these stations for an extended period of time while lowering the risk of injury. This will not only possibly decrease the amount of stations required to complete this task, but will also allow line workers to return home after their shift without feeling worn-down, increasing employee morale.

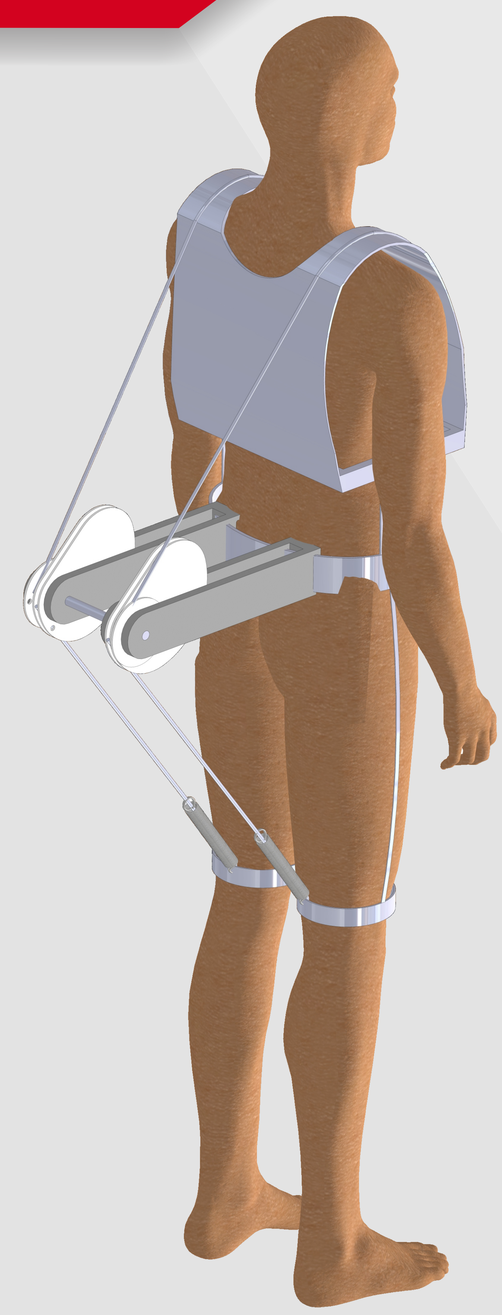
Modelling & Simulation

When a worker stoops down to pick up a heavy object, two main forces must be counteracted by the lower back muscles. The first force is the force of gravity acting on the body itself through its centre of mass. The second force is that of gravity acting on the object being lifted.

Figure 1 to the right displays:

- The moment felt when lifting up a 30 lb object from a stooped position.
- The level of moment which is safe for workers to experience.
- The moment felt when lifting a 30 lb object with TALEX assistance.

The results indicate that for the majority of the lifting process (20° - 80°), workers would be experiencing a safe level of moment in the lower back, and the highest assistive moment provided is approximately 35 N•m. This is equivalent to holding a 26 lb weight one foot away from your body.



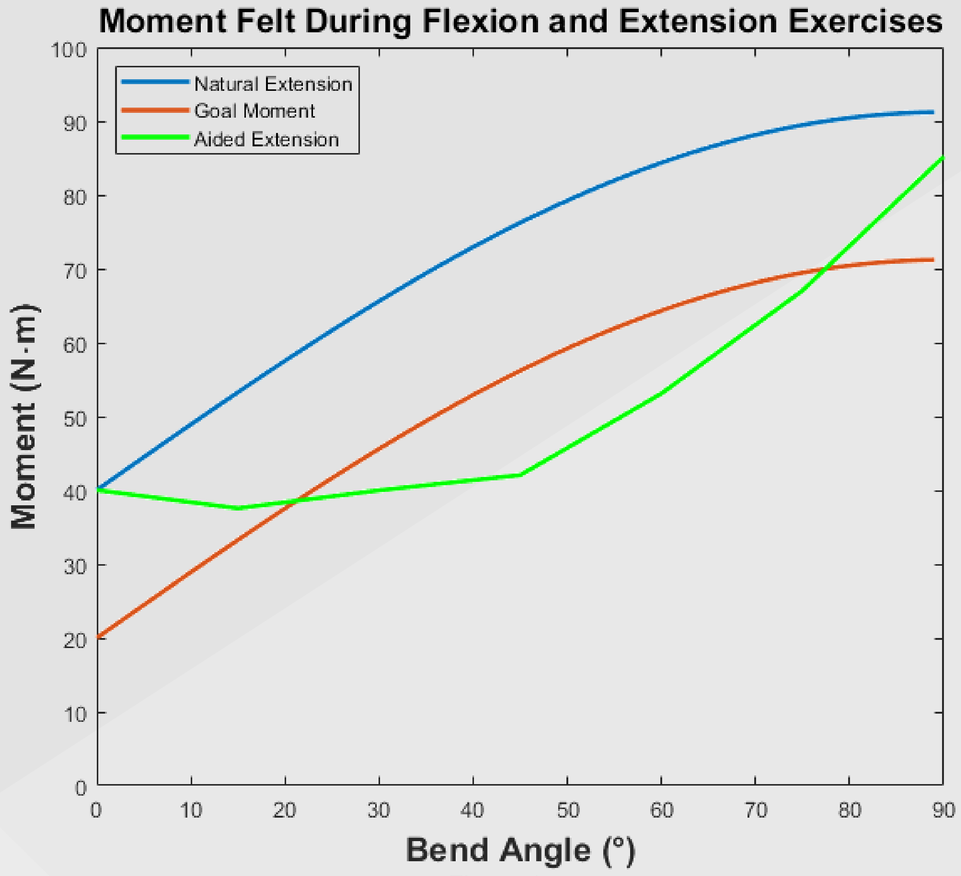


Figure 1

How it Works

- The nonlinear increase in moment as the upper body bends forward is countered with a pair of bell-cranks and springs. These springs have a stiffness of 1500N/m and are used to provide the force which pulls the upper body upright
- The bell-cranks are positioned 27cm away from the back and attach to the back of the thighs and to the shoulders with steel cables. Bending forwards changes the length from the shoulders to the bell-cranks, causing them to turn. This winds the lower cables around the bellcrank and the springs to which they are attached extend in response.
- An H-harness, belt, and webbing are used to attach this equipment to the body.

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Mechanical

Biomedical