

## BME 300/200 Design: Gait trainer with Treadmill

### *Product Design Specifications*

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### **Function**

Gait trainers are used to assist and support those who have issues with significant mobility impairments. In the winter, it is difficult to utilize the gait trainer outside. Due to the lack of access, users may suffer significant damage to physical and mental health. Utilizing a treadmill during the imperfect weather conditions would allow for increased mobility and less drastic damages to the overall health of the client. Creating a ramp and lock system will provide the fix needed for the client to use her gait trainer while on the treadmill. The ramp and lock system will be subjected to a large amount of force through the gait trainer. The overall system should work together smoothly to prevent the client from falling off the treadmill due to her gait trainer.

### **Client requirements**

- Develop a ramp system that will lock into place onto a treadmill to allow 5 to 15 minute walks at a pace of three miles per hour.
- The lock and ramp system should have an unlocking procedure for caretakers in case of a seizure, as well as follow the ADA ramp recommendations[1].

- The lock and ramp system needs to be detachable in order to store the treadmill.
- The system should be compatible with wood flooring without damaging the flooring.
- For the overall budget, the system should be within \$500.
- The lock and ramp system should be compatible with the Rifton Pacer Gait Trainer 2022[2].
- The project should last for a long period of time in order to allow the client to use the product in different seasons.

## Design requirements

### 1. Physical and Operational Characteristics

#### a. Performance requirements:

- The gait trainer with treadmill product should be compatible with the width, length, and height of the treadmill. The system should be able to withstand the force of a thirty-year-old woman during a seizure[3] while also having the capability to be easily unlocked during said seizure. The materials used for the ramp must not damage the flooring as well as hold a stagnant position during use. The locking mechanism must be easily adjustable and detachable in case of emergency. The gait trainer must be safely attached to the ramp and treadmill at all times of use. The system must be able to be deconstructed into parts in order to move the treadmill to different locations.

#### b. Safety

- The device must be able to safely support a large amount of force. The locking system must stay into place and support the force of a thirty-year-old woman during a seizure. Additionally, the locking system must remain locked into place until a caretaker is able to unlock the device. The ramp of the device must follow ADA recommended slope rate[1]. The material used in the ramp system must be compatible with wood flooring, as well as withstand the heat and force of the treadmill. All materials used in the device must be FDA approved and follow regulations. The materials must not contain exposed adhesive and latex due to client allergies.

#### c. Accuracy and Reliability

- The device must be able to seamlessly and securely lock into the treadmill every time the treadmill is used by the client. The ramp must be stable and capable of supporting the client's weight without bending or warping over repeated usages. The device is to be used every time the client uses the treadmill and needs to have reliable locks and supports that will not wear down with regular usage.

**d. Life in Service**

- i. This will be a multi-use device. The ramp and locking apparatus must remain completely functional for the entire duration of its usage by the client. As the device is to be used multiple times a week, especially in winter months, it will need to be very durable for repeated use. The device must also remain compatible with both the client's gait trainer, and treadmill model, and be capable of minor adjustments if needed in the future. It should also have an approximate life in service of 10-15 years.

**e. Shelf Life**

- i. The device should be kept indoors and at room temperature between 15 and 30°C. The device should not be exposed to hot temperatures (>48°C)[4] for long periods of time, and should be kept in humidity between 30-50% to prevent erosion or damage[5]. The device should also not be in freezing temperatures. If the device is not placed under any extreme stresses it will have a shelf life of 10-15 years[6].

**f. Operating Environment**

- i. This device is to be used day-to-day by the client. The operating environment will be in the clients home attached to her treadmill and gait trainer. The device should be relatively easy to carry and install in the clients home, as well as to remove from the treadmill and store compactly in the home. The client's floor is hardwood, so the device needs to be slip resistant and able to be installed and uninstalled without scratching or damaging the floors.

**g. Ergonomics**

- i. The device will not be based on the client's measurements but on the measurements of the treadmill. The width of the side of the treadmill, length, and height from the ground are all measurements that will have to be taken into account when designing the product.

**h. Size**

- i. The device should be compact and serve its function of attaching and securing the gait trainer to the treadmill. Any product designed will have to be stored away when not in use, and size limitations will be dependent on the dimensions of the storage space in which the device will be kept in when not in use.

**i. Weight**

- i. The device should not be extremely heavy as the product must be designed in such a way that it can be easily removed from the gait trainer and treadmill, and be able to be lifted by the family of the client so that it can be stored away. The device should also be able to hold the force of a

thirty-year-old woman. The average weight of a woman at 30 is 174.9 lbs[7].

**j. Materials**

- i. The client experiences adhesive and latex sensitivity. Apart from latex-based and materials with adhesive properties, there is no limitation in terms of the materials that can be used. Durability should be a driving factor when choosing materials. Any materials chosen should have a relatively high yield strength and be able to withstand a large amount of weight, approximately around 174.9lbs[7].

**k. Aesthetics, Appearance, and Finish**

- i. The Gait Trainer with treadmill device should be an easy to put together device with three main components that are easily compatible with the Horizon T101 treadmill [8] and the Rifton Pacer Gait Trainer[9]. The ramp should be made of durable material. The ramp should have a rubber bottom or other material that will be able to dampen impact and keep ramp stagnant while being used. The ramp should have a shallow incline[10] and lead onto tracks that start out wider and lead to a narrow secure fit to the wheels. These tracks lead to locking mechanisms that keep the gait trainer in one spot during walks on the treadmill. All of the components should be black to blend in with the treadmill, with the exception of the start of the tracks, which should be yellow for an easy guild onto the tracks. The ramp should have a rough face to ensure traction, and the tracks should have a smooth finish to let the wheels easily get to and from the locking device. Edges should be smoothed to prevent any possible hazardous sharp edges.

**2. Production Characteristics**

**a. Quantity**

- i. For the purposes of this design, one Gait Trainer with treadmill device will need to be constructed. This will include one ramp to the specific height of the Horizon T101 treadmill. Additionally we will need two tracks for the gate trainer wheels that lead into four locking devices for the wheels.

**b. Target Product Cost**

- i. The budget for the prototype is \$500 or less. The budget will be used for the ramp, tracks, locking devices, and any other materials needed for prototyping. It will also be applied to any modifications that the treadmill needs to undergo for the project.

**3. Miscellaneous**

**a. Standards and Specifications**

- i. The Americans with Disabilities Act requires that residential wheelchair ramps have a slope no more than 2:12 (in inches) [11]. The treadmill

should not exceed 3 mph when using it with a gait trainer [12]. The device must fit the current treadmill model used in home.

**b. Customer**

- i. Mrs. Amanda Pajerski, an occupational therapist works with a client affected by a seizure disorder. The client uses a gait trainer along with the support of two people when ambulating. The Wisconsin winters have made it difficult to access safe walking locations forcing the client to walk in circles around the kitchen island.

**c. Patient-related concerns**

- i. The device must be stable enough in the case of a seizure to stay secure to the treadmill. The gait trainer wheels must remain locked in place while the treadmill is in use but easily have access to an unlocking mechanism.

**d. Competition**

- i. Wheelchair ramp for treadmill [13].
  - Ramp enables a wheelchair to be pushed onto a treadmill. The ramp clamps on to the back of the treadmill and stays on during treadmill use.
  - The description states this ramp can be used for gait training.
  - This ramp does not allow for the gait trainer to be locked into place.
- ii. LiteGait 4 Home [14].
  - The base of the gait trainer itself is wide and long enough to fit around the base of the treadmill. The gait trainer is able to be used over ground or over a treadmill.
  - The gait trainer consists of an overhead harness design and is customized to the user's height.

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