Special Folding Bunk Beds

Design A New Product
034353/4

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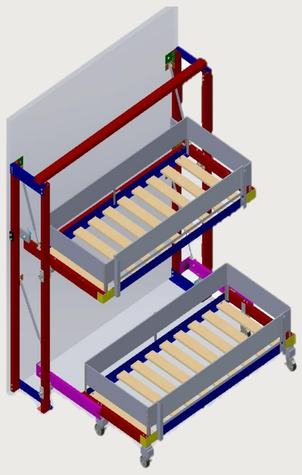
Customer
Beit Kessler

Mentor
Abraham Grinblat

Product Description



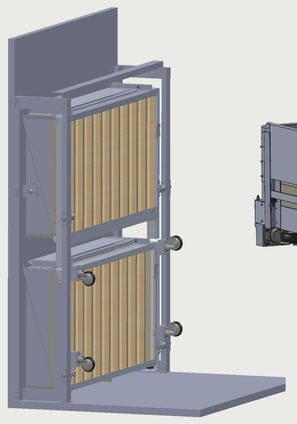
Bunk Beds with Lower Bed translated out

The bunk bed is customized for the needs of the Beit Kessler residents and is completely compatible with the ceiling lift.

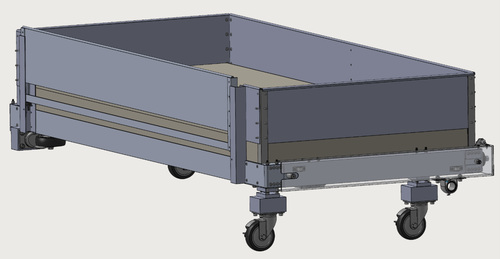
The upper and lower bed can be accessed independently of each other. This allows to be used without disturbing the user on either bed.

The lower bed can roll out from the structure with caster wheels and sliders, allowing access to the ceiling lift to the for the lower bed while the upper bed is in use.

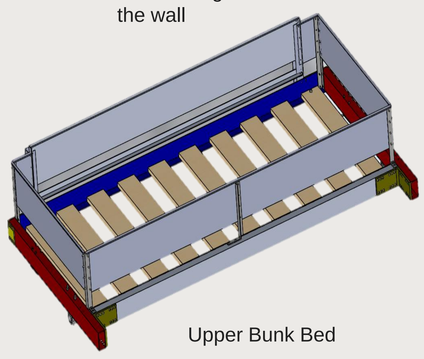
- The beds are made from aluminum profiles and wooden slats to keep it lightweight.
- There are guard rails surrounding the bed that secure safety of the resident. The front guard rail can slide in and out giving access to the bed.
- The beds can fold into the wall and can be opened by pulling on handles attached the left and right right-side bottoms of the bed.
- The opening and closing of the bed is supported by Gas springs that help the workers of Beit Kessler to pen and close the bed.



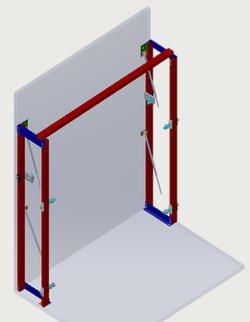
Bunk Beds folded against the wall



Lower Bed with one wheel folded and the Docking assembly transparent



Upper Bunk Bed



Structural Frame for the Bunk Beds

Summary

The purpose of this project is to build a special version of a folding bunk bed which will accommodate disabled residents by interfacing with a ceiling lift.

In time of emergency, bomb shelters in an assisted living for people with disabilities must be able to sleep all the residents while maintaining the room functionality.

To accommodate the maximum number of people in the smallest area, bunk beds are designed such that they fold against the wall. For the ceiling lift to place the resident in the lower bed, the bed will detach from the wall structure and roll out from underneath the upper bed.

Background

Beit Kessler is a residential home offering independent lives to physically handicapped residents.

The home is equipped with state-of-the-art technologies that improve the quality of life.

The multi-professional team provide various treatments and cooperatively assist in aspects of resident's life.

Beit Kessler House

The desires of Beit Kessler are to create a livable environment for as many of its handicapped residents in a particular bomb shelter during times of war or disasters.

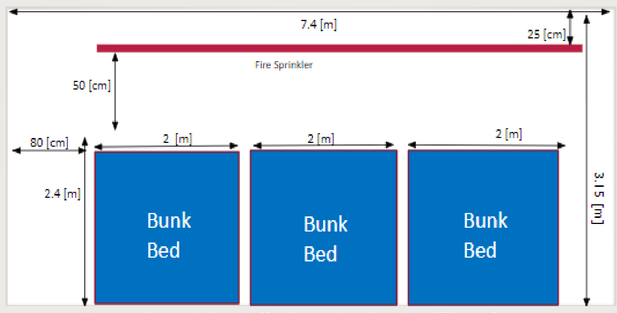
The problem is finding a way to Maximize the quantity of sleeping handicapped residents in an area (shelter) while Minimizing the used space during the daytime.

Customer Need

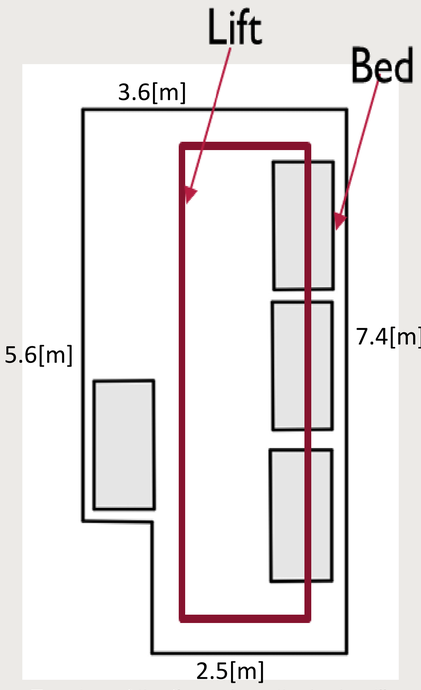
The desire for the foldable bunk beds (two beds) is to increase the number of handicapped residents that can sleep in the bomb shelter at any given time while maintaining the functionality of the room for other purposes when residents are not asleep.

This goal should not compromise the sleeping arrangements and requirements needed for the standard care provided to the residents which must include access to the ceiling lift from both beds.

Shelter room with the crane installed



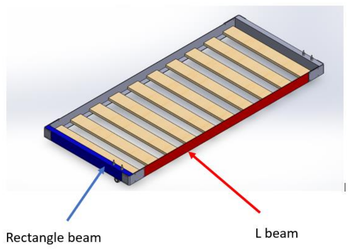
Front view of the wall where the beds will be places



Top view of the floor where the beds will go and the lift/crane access area

Calculations

Choosing of Profiles of the Bed



There will be 3 stresses

1. Bending stress
2. Shear stress
3. Shear stress due to Torsion

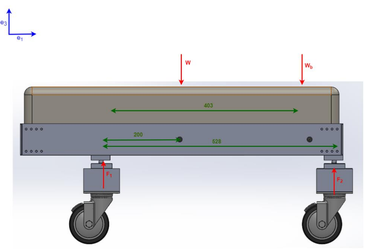
The equation for shear flow is:

$$q = \frac{(I_x V_x - I_{xy} V_Y)\sum X_A + (I_y V_y - I_{xy} V_x)\sum Y_A}{I_x I_y - I_{xy}^2}$$

$$\sigma_{11} = \frac{(M_y I_x - M_x I_{xy})x + (M_x I_y - M_y I_{xy})y}{I_x I_y - I_{xy}^2}$$

$$\tau_{torsion} = \frac{T}{2 * t * A}$$

Lower Bed



Givens:

- W = 451.3 N
- W_b = 1177 N

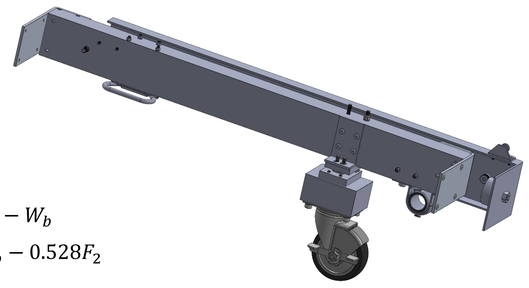
Equilibrium Equations:

$$\sum F = 0 = F_1 + F_2 - W - W_b$$

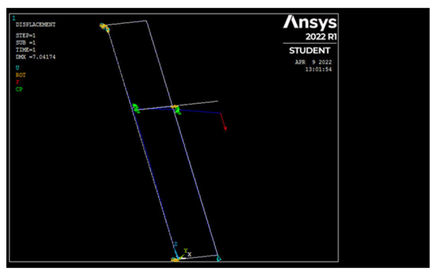
$$\sum M^{F_1} = 0 = 0.2W + 0.403W_b - 0.528F_2$$

F_2 = +1069.3 N

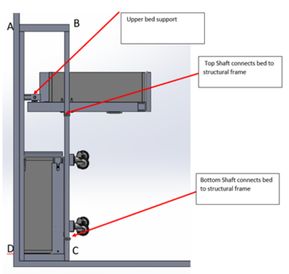
F_1 = +559 N



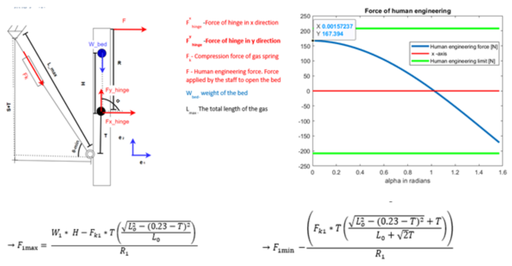
Structure



Credits to Yehuda for Ansys Analysis



Gas spring



$$\rightarrow F_{1max} = \frac{W_1 * H - F_{k1} * T\left(\frac{\sqrt{L_0^2 - (0.23 - T)^2}}{L_0}\right)}{R_1}$$

$$\rightarrow F_{1min} = \frac{\left(F_{k1} * T\left(\frac{\sqrt{L_0^2 - (0.23 - T)^2} + T}{L_0 + \sqrt{2}T}\right)\right)}{R_1}$$

Credits

We would like to thank everyone who was involved in the project.

Special thanks to:

- Abraham Grinblat - Mentor
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- Kfir Cohen
- Dr. Yehuda Rosenberg
- Moshe Dolev
- Orlee El-Bahar
- Charbel Bahouth
- Beit Kessler's residents

Challenges

1. The integration between many subs-systems and the geometric constraints on the system were hard to rectify.

2. Since the lower bed is removable, the upper bed forces have to be distributed to the structure without supporting connection to the lower bed. Large forces and stresses have to then be mitigated to ensure safety.

3. It was difficult to meet the safety standards for the guard rails while being compact and usable.

4. The channel mating in the lower bed docking mechanism was difficult to design to fit spatially and withstand the loads.

5. Achieving goals and staying in the time schedule as well as meeting the budget.