GNG2101

Design Project User and Product Manual

Portable Change Table

Submitted by:

TableCare - Team 1.4

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1 Introduction

This document was prepared to guide future GNG students on how to effectively design portable change table. This document will include information about the end product. All the way from the client problem statement, benchmarking, conceptual design, CAD models, prototype, assembly and finally end product. This user manual is intended to give a detailed description of the The portable change Table designed for Iram's sister.

2 Overview

Problems	Importance
The table could not be assembled and adjusted to the proper height within 2 minutes	The caregiver or user themselves would prefer a quick assembly especially when the user met physical problems
The tarp may not be comfortable enough for user while he is lying on it based on the low budget	Comfortability is an important criterion in product evaluation
The weight supportability is limited	Overweight would result in unbalance

Table1- Problem Analysis

Client statements/Observations	**Client needs**	**Priority**
-The portable change table should be sturdy -Be nice to be used in a public place like park or camping -Since his weight is mostly around the stomach, there needs to be extra support there	-Stable -Solid Material -Safe	High

-The fabric wasn't very comfortable - I would pay around 100, but I would also consider a more expensive option	-Soft and affordable surface/fabric	Medium
-Having suitable size that can be placed in a public area	-Do not occupy too much public area	Medium
-Easy to assemble -It would be nice if it were height adjustable to be at a comfortable height for different caregiver -It has to be low enough to transfer the user on the table	-Uncomplicated structure	Medium
-Easy to carry (like having a strap to carry it around)	-Light overall weight	Medium
-It doesn't need to fit in a backpack, but could have a strap to carry it around	-Not too large when being carried	Medium
-Materials that can be easily cleaned	-Easy to clean	Medium
-Having a curtain or a way of providing some kind of privacy would be a plus	-Privacy for the user	Low
-It would be nice if it were height adjustable to be at a comfortable height for different caregiver	-Adjustable height	High

-It has to be low enough to transfer the user on the table		
- I would pay around 100, but I would also consider a more expensive option	-Affordable	Medium
-It doesn't need to fit in a backpack, but could have a strap to carry it around	-Easy to carry	High
-It will be used multiple time a week	-Long lifespan and durability	Medium
-Easy to repair	-Use parts that are easily available and replaceable	Low
-The user is about 5 feet tall and still growing.	-Large changing surface	High
-Since user's weight is mostly around the stomach, there needs to be extra support there	-Can support a high weight	High

Table 2- customer fundamental needs

1. We used rope and hooks to reinforce the connection between tarp and frame
2. The aluminum lags are stretchable to adjust the slope of table surface

Table 3- key differences from others

Folded		

Unfolded		 

Table 4- final prototype

This product is customized for our user unlike any other bed can be bought from any other brand. This bed has been designed according to information we have collected from the client meets 1,2 and 3.

The main features of our product are foldable, height-adjustable, and surface slope-adjustable; where the features of foldable makes product easily carry with, height-adjustable feature would let user be more comfortable to move from wheelchair to the change table, and the surface slope-adjustable feature would be helpful for caregiver to assist

2.1 Conventions

If an action is required on the part of the user, please see the overall steps (4.1.1) to figure out which process you are in and what to do next.

2.2 Cautions & Warnings

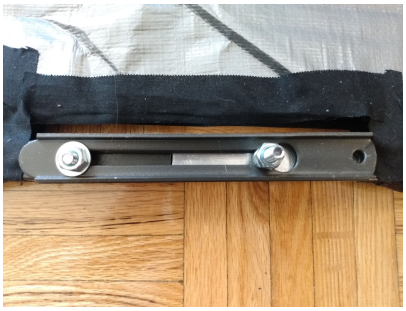
1. It is very important not to leave the user unattended meanwhile on the bed.
2. Be careful of the joints and safety pins while assembling, it is easy to get hurt.
3. Make sure the frame is locked before moving the user to the table.

3 Getting started

In this section, each component of the final prototype would be listed with its purpose. And the restrictions placed on the overall system would be explained for users.

3.1 Configuration Considerations

Equipment	Pictures	Explanation
Curtain		Curtain is used to protect the user's privacy while changing clothes.
Frame		Frame can be stretched to be like a table surface

Locker		Lock the frame to make sure it is supportable
Safety Pin		Make sure legs would not be apart from the frame
T-joint		Used to connect the frame and legs

Hook		Used to connect leg from leg
Rope		Used to reinforce the construction

Table 5- Configuration and Consideration

3.2 User Access Considerations

The users of our product could be divided into two groups: the disable people and their caregivers. For disable people, it might be difficult for them to complete the whale assembly process by themselves, especially like inserting legs and safety pins. But for caregivers, they can assemble those parts very quickly within 5 minutes.

3.3 Accessing/setting-up the System

The end product is not finalized yet. The upper frame of the body is not suitable for human use. For demonstration purposes this product would require approximately 2-4 minutes step-up time described in section 4.

3.4 System Organization & Navigation

The whole table consists of 3 main parts: frame, curtain, and legs. T-joints are used to connect the frame with legs.

3.5 Exiting the System

This system require folding the bed in three folds, full details of exiting the system has been desired in section 4.2

4 Using the System

The following subsections provide detailed, step-by-step instructions on how to use the various functions or features of the portable change table.

4.1 Unpacking the table

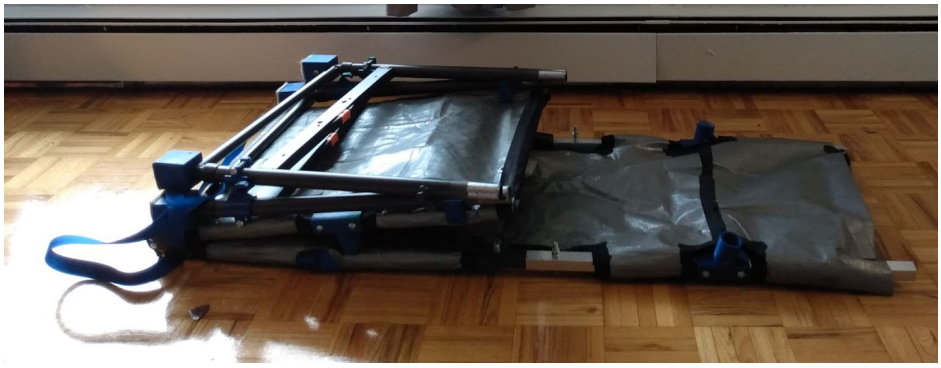
This section contains the overall steps to unpack the table and details to lock the frame.

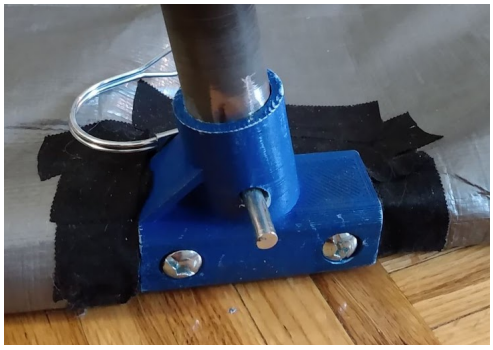
4.1.1 Overall Steps

The table **below** contains the steps to unpack the table:

Table 6- Unpacking the table

Steps	**Image**
Step 1: Position the table on the ground with the aluminum part of the frame on top	

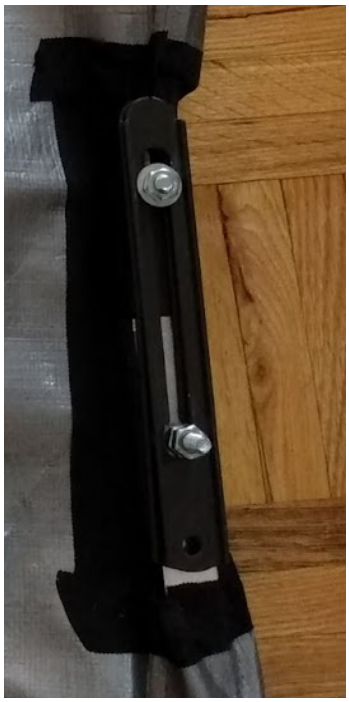
Step 2: Open the aluminum part of the frame	
Step 3: remove the accessories (rope and curtains) and flip the table	
Step 4: Detach the legs and put aside	
Step 5: Open the steel part of the frame and lock the frame (see 4.1.2 for more details)	

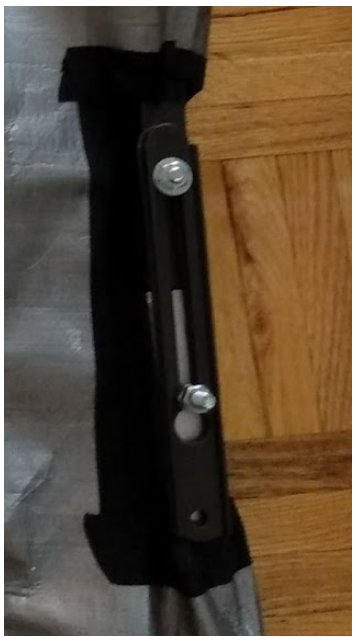
Step 6: Remove the safety pins from the T joints and insert the legs into the T joints (make sure the hooks on the legs are toward the center of the frame)	
Step 7: Insert and lock the pins into each legs	 
Step 8: Flip the table so the feet are on the ground and tend the ropes on the hooks	

4.1.2 Locking the frame

The frame only locks on the junctions between steel and aluminum of the table, which is also the part that would bend upward when using the table without the lock. The lock mechanism consists of 2 slide locks on each side of the frame, under the frame. The table below contains the detailed steps to lock the frame.

Table 7- Locking the frame

Steps	**Image**
Step 1: Insert the screws and bolt on the aluminum side into the hole of the slide lock by slightly bending the frame	

Step 2: Slide the lock downward	
Step 3: To make sure the lock is safe, lock the 2 bolts by hand	

4.2 Packing the table

This section contains the overall steps to pack the table as well as specific details to attach the legs onto the frame.

4.2.1 Overall steps

To pack the table, follow the following steps and use the visuals from 4.1.1 since the steps are similar, starting from the last one to the first one:

Step 1: Flip the table so the feet are toward the ceiling and remove the ropes

Step 2: Unlock the safety pins and remove them for each leg

Step 3: Remove the legs from the T joints and put the safety pins back in the T joints

Step 4: Unlock the frame (see 4.1.2 for more details) and fold the steel part of the frame

Step 5: Attach the legs onto the frame (see 4.2.2 for more details)

Step 6: Put the accessories and flip the table

Step 7: Fold the aluminum part of the frame

Step 8: Position the table on the ground, legs under the packed portable change table

4.2.2 Attaching the legs to the frame

Both pairs of legs attach to the frame using 3d printed clips, one of the pairs of legs attaches to the frame while the other attach the other pair, but it doesn't matter which set is attached first.

Step 1: Start by clipping the first pair to the frame using the square-rounded clips

Step 2: Turn the hooks of the first pair inward so they are not in the way

Step 3: Clip the second pair onto the first pair using the double rounded clips

4.3 Changing the User

This section covers how to safely use the portable change table when changing the user once the table is unpacked and ready to use.

4.3.1 Height Adjustment

The height adjustment is meant to facilitate the transfer of the user onto the portable change table (at the lower height) and to make it more comfortable for the caregiver when changing the user (at the highest height).

Table 8- Height Adjustment

Steps	Visual
Install the user onto the table and attach the user with the 2 lateral straps (1 is meant for the chest and the other one for the waist)	

Maintain the button pressed	
Lift the first set of legs (starting by elevating the users head for comfort)	

Lift the second set of legs (by maintaining the orange button and lifting again)	

4.3.2 Curtains

To install the desired number of curtains, simply insert the poles of the curtain into the holes at the corners of the frame and then put the curtains ring onto the hooks of the poles. The smaller curtains meant for the head and feet of the table are meant to stay on their respective set of poles, but can be removed if needed and put back later.

5 Troubleshooting & Support

In this section, troubleshooting and correction procedures will be included when using the change Table.

5.1 Error Messages or Behaviors

The caregiver should always make sure the bed is on a stable surface and would slowly help the user to relax his back on the bed. Just no screw will pop up and nothing will suddenly break. If the bed was making weird noise or if the caregiver anticipating something will go wrong the caregiver should take the user out of the bed immediately

5.2 Special Considerations

Given the bed was not tested extensively the caregiver should pay attention to the condition of the bed to make sure the user is safe all the time. If any part of the bed is about to break the caregiver should act immediately.

5.3 Maintenance

No maintenance is required for the bed. Nonetheless, the caregivers should always pay attention to the condition of the bed to make sure it looks good.

5.4 Support

In case the bed was broken, or any piece of the bed came out. Then the user should not be in the bed at all. The caregiver should come back to the designer of the bed to report the breakage.

6 Product Documentation

Because of the project's short budget and wide scope. The hardware and materials used have to make a lot of early sacrifices. The legs were designed with simplicity in mind, as well as the ability to 3D print and drill the majority of the components. Unfortunately, this decision resulted in 3D components requiring more friction work than expected.

6.1 Physical System

6.1.1 BOM (Bill of Materials)

Table 9- Bill of materials

Bill of Materials						
#	**Item Description**	**From**	**LINK**	**Quantity**	**Unit Price**	**Amount**
1	Lifetime 4 Ft. Fold-In-Half One Hand Adjustable Height Table[1]	Home Depot	https://www.homedepot.ca/product/lifetime-4-ft-fold-in-half-one-hand-adjustable-height-table/1001154278 (Please refer to receipts attachment)	1	$73.33	$73.33

2	Rope Ratchet, 1/8" Long Solid Braid Polypropylene Rope, Sold in 50 Foot Hanks (Lengths) - Black[2]	Amazon	https://www.amazon.ca/Rope-Ratchet-Solid-Polypropylene-Lengths/dp/B07YGG4Z52/?_encoding=UTF8&pd_rd_w=eUoTB&pf_rd_p=07ba691b-0556-46f1-afa7-1adb1aa83156&pf_rd_r=W6GY4Z4ASAYMBA6YF4BW&pd_rd_r=15da4cdc-28e3-4d84-9d38-1a94a9eeea4e&pd_rd_wg=MlndF&ref_=pd_gw_ci_mcx_mr_hp_d&th=1 (Please refer to figure 1)	1	$2.6(Assuming ⅕ of the rope per bed)	$12.99
3	MYCS Silver Tarp 6'x8' -	Amazon	https://www.amazon.ca/dp/B	1	$9.9(Assuming the tarp	$19.99

	Super Heavy Duty - Premium Quality - 14x14 Weave, 160 GSM, 5oz, 10mil, Ropes for Installation on Corners, Grommets Every 3 Feet, Double Stitching, Double Layered, Tarpaulin[3]		07N7LR8FS/ref=twister_B08CY79Z6S?_encoding=UTF8&th=1 (Please refer to figure 1)		will be divided into ½ to be used per one bed)	
5	Aluminum square tube(ALUMINUM SQUARE TUBE 6061T6(0.750X0.750X0.120) SHARP CORNER	METAL SUPERMARKETS	(Please refer to receipts attachment)	1	25.84	25.84
7	8 rounded	Dollarama	Bought in	1	$1.25	$1.25

	magnets		person from Dollarama			
8	Shower Curtain	Dollarama	Bought in person from Dollarama	2	$1.25	$2.50
9	Pack of 2 Straps[4]	Amazon	https://www.amazon.ca/Luggage-Adjustable-Suitcase-Release-GreyPink/dp/B09G6MKGWJ/ref=sr_1_4_sspa?crid=24NZO09IMB5I7&keywords=luggage%2Bstraps&qid=1644175914&sprefix=luggage%2Caps%2C72&sr=8-4-spons&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUExSThLMDFSNkg4RFg0JmVuY3J5cHRlZElkPU	1	$11.99	$11.99

			EwNTQ0NTYyM0JNTFNZVE1XUk44VSZlbmNyeXB0ZWRBZElkPUEwNzU2MDUyVV (Please refer to receipts attachment)			
10	Hinges(PR PB NARROW FLIP-TOP TABLE)[5]	LEE VALLEY'S TOOLS	(Please refer to receipts attachment)	1	17.18	17.18
11	woden(1/2X48 DOWEL ROD)	LOWE'S	(Please refer to receipts attachment)	1	15.77	15.77
12	T connection (with angle of 12 deg)*	Makerspace (3D print)		4	$0	$0
13	Feet of the legs*	Makerspace (3D print)		4	$0	$0
14	Curtain Hooks*	Makerspace (3D print)		16	$0	$0

15	Rope hook*	Makerspace (3D print)		4	$0	$0
16	Square round Link*	Makerspace (3D print)		2	$0	$0
17	Roun*d-Round Link	Makerspace (3D print)		2	$0	$0
					Total	**$180.84**

*See Appendice I for 3d print files

6.1.2 Equipment list

- 3D printer
- Drill press
- Screwdriver
- Utility knife
- Materials in BOM

6.1.3 Instructions

1. Print out all the 3D files that we need.
2. Sanding the 3D files inside until fit the frame
3. Drill holes for the hinges and screws
4. Mount the 3D component to the frame
5. Mount curtain poles to the table

6.2 Testing & Validation

The subsystem was tested two ways (unpack and pack) to ensure their function.

Unpack

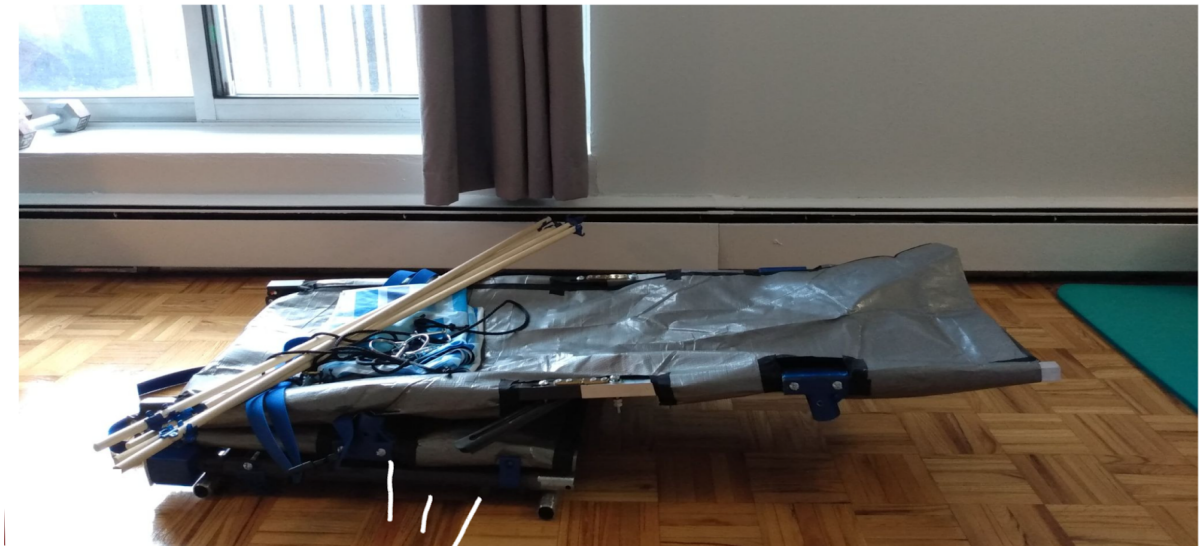


Figure 1: Open the Frame

Figure 2: Lock the frame

Figure 3: Insert the legs and safety pins

Figure 4: Return the Table and put the ropes

Figure 5: Install user and adjust the height to a comfortable height

To pack the table that inverse the unpacking steps

7. Conclusions and Recommendations for Future Work

Lessons taught include how to effectively manage time and money, how to empathize with customers during the interview process. In addition, we learned how to use some of the tools available at the University of Ottawa throughout the structural design period.

For future work, it’s better to use sturdier materials, have more budget, because we do not have time to do that. Especially to improve stability of the table and change the material of the frame. If more time and budget was available, we would have liked to have a solid material like (Carbon fiber) and changing the manual height adjustment to the eclectic lift.

8 Bibliography

[1] E. Gunn, Jcaz, VicP, HomeDepotCustomer, Jerry, dts1, and Katrinaevening, “Lifetime 4 ft. fold-in-half one hand adjustable height table,” *The Home Depot Canada*, 24-Mar-2022. [Online]. Available: https://www.homedepot.ca/product/lifetime-4-ft-fold-in-half-one-hand-adjustable-height-table/1001154278. [Accessed: 05-Apr-2022].

[2] “Rope ratchet, 1/8’ long solid braid polypropylene rope, sold in 50 foot Hanks (lengths) - black, ropes - Amazon Canada,” *, Ropes - Amazon Canada*. [Online]. Available: https://www.amazon.ca/Rope-Ratchet-Solid-Polypropylene-Lengths/dp/B07YGG4Z52/?_encoding=UTF8&pd_rd_w=eUoTB&pf_rd_p=07ba691b-0556-46f1-afa7-1adb1aa83156&pf_rd_r=W6GY4Z4ASAYMBA6YF4BW&pd_rd_r=15da4cdc-28e3-4d84-9d38-1a94a9eeea4e&pd_rd_wg=MlndF&ref_=pd_gw_ci_mcx_mr_hp_d&th=1. [Accessed: 05-Apr-2022].

[3] “MYCS Silver Tarp 6'x8' - super heavy duty - premium quality - 14X14 weave, 160 GSM, 5oz, 10mil, ropes for installation on corners, grommets every 3 feet, double stitching, double layered, tarpaulin, tarps - amazon Canada,” *MYCS Silver Tarp 6'x8' - Super Heavy Duty - Premium Quality - 14x14 Weave, 160 GSM, 5oz, 10mil, Ropes for Installation on Corners, Grommets Every 3 Feet, Double Stitching, Double Layered, Tarpaulin, Tarps - Amazon Canada*. [Online]. Available: https://www.amazon.ca/dp/B07N7LR8FS/ref=twister_B08CY79Z6S?_encoding=UTF8&th=1. [Accessed: 05-Apr-2022].

[4] “2 pack luggage straps, bright colors adjustable suitcase belts with quick release Buckle (greypink) : Amazon.ca: Clothing, Shoes & Accessories,” *2 Pack Luggage Straps, Bright Colors Adjustable Suitcase Belts with Quick Release Buckle (GreyPink) : Amazon.ca: Clothing, Shoes & Accessories*. [Online]. Available: https://www.amazon.ca/Luggage-Adjustable-Suitcase-Release-GreyPink/dp/B09G6MKGWJ/ref=sr_1_4_sspa?crid=24NZO09IMB5I7&keywords=luggage%2Bstraps&qid=1644175914&sprefix=luggage%2Caps%2C72&sr=8-4-spons&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUExSThLMDFSNkg4RFg0JmVuY3J5cHRlZElkPUEwNTQ0NTYyM0JNTFNZVE1XUk44VSZlbmNyeXB0ZWRBZElkPUEwNzU2MDUyVV. [Accessed: 05-Apr-2022].

[5] “Liberty.20PCs stainless steel folding hinge 1 inch cabinet box hinge is allocated with 80 stainless steel screws, hinges - Amazon Canada,” *, Hinges - Amazon Canada*. [Online]. Available: https://www.amazon.ca/Liberty-20Pcs-Stainless-Folding-Cabinet-allocated/dp/B08MXQ23G7. [Accessed: 05-Apr-2022].

APPENDICES

9 APPENDIX I: Design Files

Table 10 - Referenced Documents

Document Name	Document Location and/or URL
User Manual	https://makerepo.com/AhmedKashef/1119.gng2101-c14-caretable-team-
Video	https://makerepo.com/AhmedKashef/1119.gng2101-c14-caretable-team-

Table11- 3D Printing stl.Files

Document Name	Document Location and/or URL
3D_Print-T_Joints.stl	https://makerepo.com/AhmedKashef/1119.gng2101-c14-caretable-team-
3D_Print-Link_Square_Round.stl	https://makerepo.com/AhmedKashef/1119.gng2101-c14-caretable-team-
3D_Print-Link_Round_Round.stl	https://makerepo.com/AhmedKashef/1119.gng2101-c14-caretable-team-
3D_Print-Hooks.stl	https://makerepo.com/AhmedKashef/1119.gng2101-c14-caretable-team-
3D_Print-Hooks.stl	https://makerepo.com/AhmedKashef/1119.gng2101-c14-caretable-team-