Flap Stool Storage Furniture for Urban Nomads

Liu Yang
FLAP STOOL
STORAGE FURNITURE FOR URBAN NOMADS

Liu Yang
Master of Fine Arts in Industrial Design
School of Design | College of Imaging Arts and Sciences
Rochester Institute of Technology
October 24, 2013
FLAP STOOL: STORAGE FURNITURE FOR URBAN NOMADS

Chief Advisor:
Stan Rickel | Graduate Director Industrial Design, Associate Professor

_________________________________________________             Date_____________________

Associate Advisor:
Josh Owen | Program Chair Industrial Design, Associate Professor

_________________________________________________             Date_____________________

Associate Advisor:
Jon Schull | Associate Professor, School of Interactive Games and Media

_________________________________________________             Date_____________________
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The purpose of this project was to make moving from one location to another an easier process by developing a creative furniture piece that can be used for storage.

Research on the actual moving process and existing moving solutions was done to gather information to begin this project. At the beginning of ideation, light-weight materials and folding structures were studied, and several new furniture solutions were explored. Concepts such as a storage stool, a transformable shelf, and bamboo roll furniture were created and tested.

A storage stool was selected for further development, because it provided the best fit for the project objective and was elegant looking. Structure, material, joints, and some details were refined during a long process of prototyping and testing.

The final design turned out to be a folding storage stool made with polypropylene. It is a stool as well as a moving bag; light, strong, durable, and water-resistant to some extent. It also can be used as a laundry bag or a grocery shopping bag.
INTRODUCTION

Young people 20-29 years old move more frequently than any other age group. Most of them are college students or young professionals who move for a variety of reasons. However, moving is a time- and energy-consuming process.

After one year living in Rochester, NY, I moved to a new apartment that was much closer to school. It was the end of summer vacation, a moving rush time for college students. Some of my friends were moving too. We took a lot of time packing our things and cleaning up the apartments. Then came the most painful step—the actual moving. Two friends came to help me, loading up their SUVs and my sedan. The next day we helped another friend move. It was great that we helped each other.

These two particular moving experiences inspired me to design this Easy-Moving Furniture as my thesis. After unpacking my things, I thought about the whole process and believed I could do something creative to improve the process and make it less painful. I came up with some questions. First, how many people are needed to move large furniture, such as a full-size bed, a dining table, a bookshelf, or a couch? Can all of them be knocked down so that they are much easier to move? Second, what kinds of furniture do people take with them and what kinds of furniture are usually replaced? How durable should each piece of furniture be for young people who move frequently? Third, what do people do with their moving boxes after moving? Do they dispose of their cardboard moving boxes? Do they keep using plastic containers?

Then I decided to design a new type of furniture that helps people move more easily rather than hinder them with normal, often large, furniture. It needed to be lightweight but strong so that it was easy to carry and move. It was important to explore lightweight materials and strong structures. It should be a small size as well or have a knockdown design. Additionally, it should be inexpensive, because most of the target users are college students or people starting a new job.
MOVING PROCESS

Before Moving

Preparation and organization are important for a smooth move. The apartment should be inventoried and items that might be sold, donated, or discarded, as well as items to transport to the new apartment, need to be determined. All important documents, such as car registration, health insurance, diplomas, and precious or one-of-a-kind items such as jewelry and collections, should be organized. Then suitable moving and packing supplies, for example, cardboard boxes and packaging tape, should be purchased.

Classifying items is an important step before packing.

One way is to classify items by use, which is the most common and easiest. Food, seasonings, and cooking utensils are from kitchen, while shampoo, hand soap, and body wash are from the bathroom and should be put in two different piles.

Classifying items by weight and size is important too. Generally, furniture is large and heavy. It would be much easier to move those pieces if cabinets and drawers are emptied first. In addition, it would be even better if some large furniture pieces could be disassembled. Similarly, large electrical appliances, such as a television and refrigerator, are heavy and fragile, making them difficult to move. Another item that I would like to mention here is books. Books are heavy, especially when they are packed together. Hence, it would be wise to fit books into several small boxes, instead of one large box. In some cases, people donate, sell, or recycle books if they are moving to a faraway place.

Last but not least, items can be classified by material. Items are made out of different materials. For example, a blanket is soft because it is made from cotton or polyester, and a cup is fragile because it is made from ceramic or glass. Fragile items need to be wrapped with paper or bubble wrap and kept in a structured container to avoid damage during moving. Another option would be to wrap them in soft items already owned. Structured items like books need to be packed in a hard container, instead of a flexible plastic bag, for better protection. Items like bed sheets, clothes, and towels can
be put in waterproof containers or bags to protect them from water, rain, or other liquids.

Admittedly, it is extremely difficult to move without the aid of specific supplies. A variety of moving supplies are available in stores, such as cardboard boxes, plastic containers, envelopes, bubble wrap, and packaging tape. Just like shipping supplies, they are made to pack and protect items.

Based on my own experience, I would like to introduce several ways to make packing effective. First of all, items should be kept in certain containers so that they are easy to remember. I have my notebooks, important documents, and other paper goods in a certain medium-size plastic container. In this way, I won’t misplace these things or lose any of them during moving. I also have different boxes for items with different uses—one for cooking utensils, one for food and seasonings, one for skin care products, one for medicine, and one for odds and ends. Moreover, I mark the contents on each box.

Hollow areas can be filled with small items to save space, which also helps prevent loss and damage during moving. I usually put small things like phone chargers, a sewing kit, and beauty accessories into small plastic boxes. I also fill up pots with cooking utensils, spoons, and forks.

The right moving supplies provide better protection and make moving more financially efficient. Generally, heavy-duty moving boxes provide better protection, but they are more expensive than light-duty boxes. Heavy-duty boxes should be used for heavy and/or fragile items, while light- or medium-duty boxes should be used for light items, providing enough protection and saving money at the same time.
RESEARCH

Fig.01 Medium-size moving boxes

Fig.02 A bag filled with small items
MOVING PROCESS

During Moving

Moving furniture and other items from one place to another is a time- and energy-consuming process. Everything can be moved outside, loaded into a vehicle, and then moved inside upon arrival at the new location. Items might need to fit through a narrow doorway, which requires strength, patience, and even teamwork.

One problem may be preventing damage during the process. Preventing damage from water, rain, and snow is one possible problem. Cardboard boxes are not waterproof, but plastic containers are not affected by the weather. Additional measures need to be taken to protect any non-waterproof items.

I saw a post on the Internet from a college student who stated that he scratched a hallway floor while moving his refrigerator, and his landlord was asking $6,000 for the repair cost. Large items, such as couches and dining tables, could be scratched or damaged easily while being moved, and these items can easily scratch walls, floors, or door-frames, a loss to both the owner of the item and the landlord. Surfaces like leather couches could be scratched during moving. Therefore, covering those surfaces with a plastic sheet or canvas is important.

According to my survey, some of the respondents moved by themselves, and a larger group of respondents had one or two friends or family members help with their move. Few respondents had more than three people help them, but in fact, it is difficult for three people or less to handle large pieces of furniture like a dining table, a cabinet, a couch, and a full-size mattress. Unfortunately, a person may find it impossible to get help from others or may not have the budget to hire a mover. In this case, it would be nice to have more control over item sizes and weights or if break down large items.
MOVING PROCESS

After Moving

At the new place, a quick inventory should be done first to make sure everything has arrived and then boxes can be opened and unpacked. Next it is time to think about how to deal with moving supplies.

There are three common ways to dispose of carton moving boxes. One way is by recycling. The second way is to flatten them to save storage space and save them for future use, which is a definite advantage of carton boxes compared to other containers. The other way is to use them for storage; however, they are not as durable as plastic containers.

Plastic is definitely recyclable, but people usually keep the plastic containers as they are more durable and can be used for a long time. These plastic containers will continue to be used as containers in the new location, even though they cannot be folded like cardboard moving boxes to save storage space.

It takes awhile to get used to a new home and to feel comfortable. For most people, the first step to settling in is to arrange the furniture. People might use their old furniture moved from their former housing or purchase new furniture.

People might reassemble their old knockdown furniture. Knockdown furniture is a good idea, as it is relatively affordable and saves space during the move. However, some problems can occur with knockdown furniture, such as damaging it while disassembling and missing components. Tools and instructions are needed before reassembling, which brings up another problem: what if the instruction paper is lost?

Most people would like to purchase new or used furniture for their new home. New furniture brings a feeling of a fresh start and is important because it may be used for several years so time should be spent choosing the right piece. Sometimes it can be taken home the same day or it may have to be delivered or shipped.
PROBLEMS

Based on my own experience, observation, and research, people encounter several common problems during the moving process.

First is furniture size and weight. It is difficult, if not impossible, for one person to move a large furniture piece such as a bed or a sofa, up and down the stairs alone. Meanwhile, it is fairly easy to move or carry small items, but requires many trips back and forth. Breaking down large pieces and putting small items together in a box makes moving both easier and more effective. The situation of weight is similar with the situation of size.

The second common problem is the possibility of damage. Large furniture is more likely than smaller items to get scratched or to scratch walls or floors. Using a protective product such as bubble wrap is a frequently used method. Reducing the size of the piece also helps. Moving boxes and plastic containers protects the small items inside.

Third is cost. Young people generally have a tight budget for moving expenses. Moving supplies and transportation is usually expensive for them. Used corrugated boxes and re-usable plastic containers are good solutions to this problem.

Therefore, I intend to design a medium-size, light-weight furniture piece to solve these common problems. This new product also will function as a moving box and give its contents the necessary protection. Also, it will be affordable and easy to manufacture and use.
EXISTING SOLUTIONS

Cardboard Moving Box

Cardboard moving boxes are made from recycled corrugated cardboard and can be purchased at minimum cost. One cardboard moving box could cost $2-3, while the price of a plastic storage container could be ten times higher. Cardboard boxes are lightweight and easy to handle, but they are strong enough to hold items.

As we all know, corrugated cardboard is 100% recyclable, and the raw materials are organic. Hence, its disposal is not a problem. They could also be broken down to save space and be put into storage. However, corrugated cardboard has limited resistance to moisture. When wet from rain, it becomes soft and even pulpy, and because it is also highly absorbent, it will transfer moisture to its contents quickly.
EXISTING SOLUTIONS

Plastic Storage Container

As another common moving solution, plastic storage containers are more durable although more expensive than corrugated cardboard boxes. Unlike the corrugated boxes, however, plastic storage containers are waterproof with their lids on. Therefore, they can handle heavy contents better and provide protection from moisture or water. Another advantage is that they can be used for a long time. Moreover, these containers are made of plastic, which is recyclable, but they do have limitations. For example, they are not collapsible and can’t be folded flat to save space. As a result they are usually left somewhere, full of contents, after moving. They can only be stacked to save space.
Knockdown furniture is also known as ready-to-assemble furniture. It is generally easy to assemble, and most customers can assemble it themselves with the instructions enclosed with the furniture package. Assembly only requires simple tools such as screwdrivers.

Knockdown furniture is popular among people who wish to save money. Customers also save money on shipping because knockdown furniture comes in flat packs. Moreover, as a result of the knockdown feature, this kind of furniture is usually simple-looking, easy to assemble, and costs less to manufacture. However, knockdown furniture is not as durable as solid wood furniture, because of the material used in its manufacture. When users disassemble the knockdown furniture, the screw holes and the surface surrounding them might be damaged, making reassembly more difficult.
Portable furniture can be easily transported and carried by hand.

The most well-known portable furniture is outdoor camping furniture, such as folding chairs, pack-away tables, and hammocks. Some designers also work on portable furniture for indoor use. Most of these pieces are designed for a small living space or a portable office.

Another portable furniture example is a trunk, which is usually a large cuboid container used to store clothes and other personal belongings for long trips. Trunks are now used as either furniture, or storage, or both. Among the many styles of trunks are wardrobes and full dresser trunks. They are great examples of the combination of storage and furniture for traveling.
EXISTING SOLUTIONS

Basket and Carrying Stick

In mainland China and Taiwan, many people in suburban areas carrying items with a carrying stick made out of bamboo. A carrying stick is always used with two big baskets, one hanging on each end of the stick. It is interesting to note that some people also lay the stick on those two baskets and use the stick as a seat when they need to take a break and rest their legs.

Rope is a common way to join the baskets and the stick. It is lightweight and flexible. The rope is fastened on the edge of a basket and a groove on each end of the stick prevents the rope from slipping off. It takes only a few seconds to put two baskets and a carry stick together, but it is hard to stay balanced and it puts a lot of weight on the shoulder. The user needs to be somewhat skilled and strong to use this carrying tool.
NOMADIC PEOPLE

Mongolian and Yurts

Several nomadic tribes of the Near East and Central Asia, from Iran to Mongolia, for several thousand years have lived in a remarkable form of shelter: the yurt. It is a portable, bent-wood-framed dwelling covered with layers of fabric and sheep’s wool felt for insulation and weatherproofing. The frame consists of one or more expanding lattice wall sections, a door frame, bent roof poles, and a crown and is held together with one or more ropes or ribbons.

The whole shelter is carried on one or two camels. It can be erected by several men in a half hour. After the outside covering is tied on and door shut, it is astoundingly solid and sedentary looking.

Traditionally, Mongolians used to use camels to carry disassembled yurts and other belongings to their new place. With the improvement of living standards, Mongolians use vehicles to move yurts and other belongings nowadays.

Traditional Mongolian furniture is also designed for a nomadic lifestyle. Not many large furniture pieces are used in yurts. Cabinets and beds are not as big as those in a townhouse. Dining tables are small and low, and stools are more widely used than regular dining chairs. In some cases, small dining tables are put together for events such as a family party.
IDEATION

Based on research, problems can occur during moving, such as attempting to move large pieces of furniture alone and preventing damage. If large furniture pieces could be broken down, it would be easier to move them and protect them from scratches. Also, if furniture could be turned into moving supplies, it would be possible to cut expenses.

My idea is to make a product that is furniture as well as a moving box. It should be easy to move and will improve the moving experience as well. It will be made with a lightweight and durable material and have a strong structure.

Fig. 14 Size matters

Fig. 15 Collapsibility matters
Transformable Furniture

As the name implies, transformable furniture is a kind of furniture that can change structures and shapes for various purposes. It consists of several components and is designed for easy assembly. The idea is to make a piece of furniture that can be transformed into a moving box, making it easier to move. Users would not even need to move or reorganize items, and could leave them where they are and not to misplace anything.

Fig.16 Transformable furniture concepts
Modulear Furniture

Modular furniture is quite popular among urban nomads and people who live in small apartments because of its modern look and affordability. It allows users to customize their furniture and reinvent living space.

A bit more detail could be added to this kind of furniture, turning it into something that helps with a move. Several cubes can build a bed or a shelf, and handles can turn these cubes into moving boxes, or a shelf can be folded up and put on two wheels to move.

Fig. 17 Modular furniture concepts
**Storage Furniture**

Storage furniture, such as a cabinet or a dresser, have been widely used to keep rooms organized. We know that a cabinet can be tall, heavy, and very hard to move. In my case I pay more attention to small-size storage furniture, like a storage stool or storage ottoman.

An advantage to small storage furniture is that users do not have to reorganize the contents when they move. In addition, it is about the size of a moving box. It will be possible to carry a storage stool or a storage ottoman with only one hand if handles are added.

![Fig.18 Storage furniture concepts](image-url)
CONCEPTS

Storage Stool

This is a combination of furniture and storage, similar to those storage stools found in stores. The inspiration came from packaging design, which is generally a lightweight, strong container. Therefore, it is lighter than existing storage stools, and it folds flat to save space.

The transition from oval to square builds a strong structure. A welcoming curvy seating makes it a comfortable stool. It also has a proper volume, providing decent storage and a just-the-right-size moving box. It needs to be made with a lightweight yet rigid material, which might even be able to accommodate hinges.

Fig.19 Storage stool concept
Transformable Shelf

This is a shelf that hangs on the wall and provides a variety of surfaces and space for display and storage. It folds into a moving box when the user is ready to move. Hence, users don’t have to move things around or put them somewhere else when they pack.

Together the rigidness of material and 90° scoring cut build this structure without any extra support or bracket. Therefore, this shelf stays neat looking and provides more space for storage. Material choice is key to this design. This material needs to have a certain thickness to make sure the structure is strong enough and be lightweight as well.
Bamboo Roll Furniture

This bed has three parts—one bamboo roll and two boxes. Bamboo is a commonly used material in furniture and other products in most Asian countries. It is generally considered sustainable because it grows faster than wood. It is strong and relatively lightweight. A bamboo roll is used to roll up items such as blankets. Those boxes, which are used as box springs, can be assembled into moving boxes.

The idea is to break down large furniture pieces and use those components as moving supplies. These parts are usually strong yet heavy.

Fig. 21 Bamboo roll furniture concept
Admittedly, it is challenging to think “outside of the box” and come up with a completely new shape for a moving box. Both corrugated and plastic storage containers are in the shape of a box. This box shape works well for moving supplies, but it is somewhat limited as a furniture piece.

Hence, the storage stool concept is selected for further development. It fits my design purpose very well, and it has a simple and elegant shape that is different from a box.
Structure Exploration

During the earlier ideation process, I had the folding structure concept in mind, but I was not sure whether this structure would work best. Folding technology is another important part of this project. How could I make living hinges with stool material? Should I use additional living hinges? How could I keep the project strong while keeping its neat look?

I tried a bucket shape, which is similar to the storage stool concept I had earlier. It is a bit larger than a five-gallon bucket. The lid works as a seating surface and protects contents inside from water and dirt. The ropes are used to fasten the lid and work as a carrying handle. The folding issue is avoided, making it easier to manufacture. However, it does not fold flat like the initial stool concept, and the handles are somewhat cumbersome.

Fig.22 Structure concept 1
DEVELOPMENT

Fig. 23 Structure concept 2

Fig. 24 Structure concept 3
As a result I returned to the initial concept and began to refine its structural proportion. The ratio of length-to-width affects the curve of the seating surface, which affects comfort.

Fig.25 Testing structure
Material Exploration

Material is the key aspect of this project. It influences such components as the stool’s appearance, manufacturing process, the way it works, other components needed, and how these components work.

Coroplast was the first material I tried. It is a brand name of corrugated polypropylene. Because of its huge success, coroplast has become a generically used trade name, and many people in North America refer to all corrugated plastic as “coroplast.” It is tougher than corrugated cardboard and lighter than an extruded plastic sheet. It is also waterproof and stain resistant. It was fairly easy to make the stool with coroplast, because it did not take much effort to cut and score it, and the stool held an average-size adult male and was very light. However, folding action left random creases on the stool surface, making it look cheap.

Then I tried using mat. Mat, in the picture framing industry, is a flat, thin piece of paper-based material. It comes in different colors and sometimes with additional decoration. It is lightweight and affordable but not durable or moisture resistant. It is also easy to process, such as cutting and folding. Although naturally flexible, it is possible to fold it into a relatively strong structure. But it has two critical weaknesses—it is not moisture proof and it tears easily.
Since coroplast and mat did not work as well as I expected, I started another round of material research and I found polypropylene. Polypropylene, PP for short, is code 5 by the Society of the Plastics Industry, and it is recyclable. Although it is naturally translucent, it could be colored. It has high stiffness, high impact resistance, and good tensile and compressive strength and is used in a wide variety of applications including packaging, plastic parts, reusable containers, and stationery. The success of the polypropylene prototype was made with a 1/16” polypropylene final material.
Details Refining

I cut out handles on a coroplast full-size mockup and loaded it with books. The handles hurt my hand because the contact area was small. Therefore, instead of cutting out, I kept those two small pieces to build a handle, increasing contact area and hurting hands less.

After making my first polypropylene prototype, I changed the angle of the upper corners based on my advisor’s suggestion, making the corners less sharp.
Joint

The stool is made with a single piece of material. Two half-flat pieces need to be connected along the side folding line to hold the stool shape. I thought about heat sealing, but it might leave textures on the stool surface. In addition, I had difficulty finding heating sealing equipment. Then I tried plastic glue but that failed.

Then I drilled holes along the side folding line and joined two half pieces with metal screws and washers. They worked very well. However, as a designer friend pointed out, using metal parts means adding a different material to this plastic stool, affecting its simplicity. From this perspective, I discovered easy-to-install plastic snap shanks, which are made with nylon. I also added a foam ring between the male and female parts of each snap to increase flexibility of material in between for easier installation. Another function of these plastic snap shanks is to add great detail to the plain stool surface.

Fig.34 Plastic snap shank
Fig.35 Plastic snap shank installed
Further Development

I realized that a stool with curvy seating had some limitations as furniture. I tried to explore more of its potential, for example, turning it into a bench or a coffee table. A bench fits two or more people, and a coffee table provides a flat surface for things. In this way, several stools can make a furniture collection.

Fig.36 Bench concepts
Later, I gave up the bench idea, because a bench was similar to a stool and it was not necessary. However, a coffee table is different, and a flat surface is more useful in the case of building a furniture collection.

I started to focus on building a coffee table with a stool. After several attempts, I learned that the flexibility of the polypropylene sheet and the rigidness of bamboo made a great combination to add a flat surface on a curvy one. Eventually I came up with a simple solution that worked well and fit inside the stool. It is made with bamboo plywood, rope, and a polypropylene sheet.
**DEVELOPMENT**

Fig. 38 Refined coffee table top

Fig. 39 Table top installation
The final design came out great after months of testing and refining. I named it Flap stool.

The structure of the final design is similar with the initial concept. It is made with 1/16” polypropylene, and material is removed along folding lines to make living hinges. It is light, strong, durable, and water-resistant to some extent, just like the original design concept. It works as both a storage stool and a moving bag and folds flat to save space, and also has some other functions, such as laundry bag and grocery shopping bag. The coffee tabletop is an option for further development of this project. It is a removable part and fits inside the stool.
Fig. 41 Flap stool 2
Fig.42 The handle of Flap stool
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Fig. 46 Template

Fig. 47 Folding and assembly
CONCLUSION

Flap Stool: Storage Furniture for Urban Nomads

This project started from my own and my friends’ household moving experiences. I interviewed friends and studied different people’s moving processes in different locations. In this way, I had a clear idea about the common problems people have when they move. I also looked into the ways people carry things in different countries, different materials, and origami to find a creative nomadic furniture solution.

Based on my research, I intended to make a medium-size furniture piece that is lightweight and helps make moving easier. The final design, Flap stool, came out great, meeting my initial design intents.

Flap stool is a piece of storage furniture designed for urban nomads who move frequently. It is a stool as well as a bag, making it easier to carry and move things. It is lightweight, affordable, durable, simple to use, and easy to manufacture. Moreover, it can be used as a shopping bag or a laundry bag. There are several color options—natural translucent, white, and red. More color options will be available as this project further develops. The coffee tabletop is an additional part for the stool’s extended use.
“I would like to buy one of these,” said my friends and other people who saw this stool project.

I do believe that a design should go to market and let the market judge if it is a good product or not. I want to hear feedback from different people in the market.

After I presented my work at the Thought@Work Student Conference, I finished this project and had my thesis final presentation. With sponsorship from the School of Design and President Destler, I made a trip to the International Contemporary Furniture Fair (ICFF) in New York, May 2013, with nine studio mates. Exhibiting in ICFF was an unforgettable experience to all of us, and feedback from every visitor was precious.
I presented this stool project at fab.com’s disrupting design competition at ICFF and was luckily selected one of the winners. It was wonderful to get an email from Fab at midnight stating, the product concept you presented at the Fab Call for Design at ICFF has officially been shortlisted and is being considered for manufacturing and production to sell to our 13 million members on Fab.com. Now we are working on paperwork.
I give my deepest appreciation to my thesis committee members, Stan Rickel, Josh Owen, and Jon Schull. I wouldn’t have been able to reach this far without their help.

Stan’s ideas and suggestions have been very inspiring and helpful on this thesis project as well as my other projects. He gave me so many crazy and somewhat confusing thoughts, as if to say, “There are countless possibilities out there for you to explore.” In this way, he pushed me to explore new solutions and to try different things. His teaching was one of the most excellent parts of graduate study and helped me understand design better.

Josh’s design is always simple and iconic. His design philosophy influenced my stool design, and his suggestion was also crucial on some details of this project. Furthermore, I appreciate his support for my trip to ICFF in New York City, his effort with fundraising, and suggestion on booth arrangement.

Jon saw my design through a lens that was different from a designer’s, and his thoughts were fresh to me. He often showed me things that he felt might be inspiring and helpful to my project, such as sheet material folding technology and the book Collapsibility. He also helped me connect to other professors who specialize in composite material.

I would also like to thank Professor Kim Sherman, Alan Reddig, Alex Lobos, workshop Technician Rick Auburn, and Efe Kababulut for their help and advice on this project.

I am grateful that my family put a lot of effort into my education, especially graduate study. They made all these great things happen. I learned a lot, had a wonderful time, and met a group of great people in RIT. I would like to thank my friends, especially Andrew Daya and Yulong Bao. To my studio mates, I enjoyed working together, staying up late at night, and sharing ideas.

Surprisingly, I also received several emails from designers in New York and even in Italy, congratulating me, telling me they like this stool, and asking me if it is in the market yet.

Thanks again for this fantastic experience.
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Flap Stool: Storage Furniture for Urban Nomads

FIG. 05

FIG. 06

FIG. 07

FIG. 08

FIG. 09

FIG. 10

FIG. 11

FIG. 12

FIG. 13

FIG. 34
Fig. 49