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MAINTAINING FAMILIARITY THROUGH MOBILE DESIGN

by

Diana Nee

submitted to the Department of Architecture in partial fulfillment of the requirements to the degree of
Bachelor of Science in Art and Design – Architectural Design

at the

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ABSTRACT

This thesis aims to fulfill the needs for storage, portability, and comfort in the growing population of itinerant young professionals through generating a deployable device that provides a sense of familiarity and personalization. Prior to activation, the device acts as a secure and protective container for personal belongings. Once activated, it will provide a number of surfaces that allow for work, rest, display, and storage. Acting as both storage receptacle and deployable furniture, the device allows for one to move efficiently and, in doing so, still maintain a sense of identity at different locations.

Thesis Advisor - Jan Wampler
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to the members of my thesis committee for your invaluable advice and mentorship.

to daipan, ashlie, pam, mags, sim, swu, joey, dan, and friends for your support throughout this experience.

to my parents for your love and encouragement

thank you.



INTRODUCTION

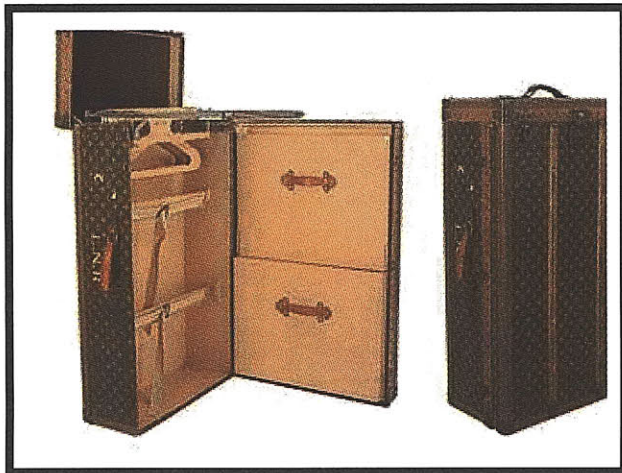
Mobility is in. One out of six Americans is a free agent, unattached to any traditional notion of job, constantly relocating to generate this modern nomadic culture.

When transience becomes the norm for scholars and professionals alike, how one maintains identity and comfort in the world becomes a critical question.

For young professionals and students, short-term housing often equals either high living expenses or discomfort and inconvenience from makeshift furnishing. A personal foray into full-scale construction and product design, this thesis aims to fulfill the needs of traveling young people through a device that is luggage, but deploys to make foreign spaces home.

By the definition given in *Collapsible: The Genius of Space-Saving Design*, a true collapsible is an object that can be deployed numerous times and possesses one active and one passive state. Therefore, this device will qualify as a “quasi-collapsible,” because it will be able to be deployed repeatedly, yet be “active” in both of its states. In one of its “active” state, the device will perform as a piece of luggage, allowing it to act as protector and transporter of personal belongings. After deployment, it will provide a personal environment that generates a sense of identity for the traveler in a foreign environment.

A similar example can be found in the steamer trunks designed for traditional sea travel. A large container of one’s personal belongings, this box also functioned as a wardrobe for the traveler during their long period at sea. However, as transportation technology advanced and air travel became the most common method of long distance travel, steamer trunks became an antiquated notion. The convenience of the steamer trunk was that, because it travels with its owner, it and its contents were always available for use to the traveler. Yet, because of the shorter trips in air, it is no longer necessary for one to have access to most personal belongings during travel. Therefore, this new device should be sized appropriately to be checked on an airplane, such that when the traveler arrives at his desired location, it is immediately available for use.



CRITERIA

Prior to deployment, this device acts as mobile storage that protects the traveler's personal belongings while being easily movable on wheels and sized appropriately as cargo on other forms of transportation.

After deployment, the device will generate a living environment which, because it remains constant through the traveler's constant travels, will provide a sense of home and identity. The physical pieces of furniture necessary to create an adequate living environment is demonstrated by the provisions of many hotels, college dorm rooms, and other locations that provide temporary stay.

LUGGAGE STATE

Meets the general airline requirements for oversized luggage:

length + width + height < 160 inches

weight < 70 pounds

Detachable wheels

DEPLOYED STATE

Functions to provide for the following:

Sleep

sleeping platform at least 12 inches off the ground

Work

30" high table surface large enough for desk work (24" x 36")

18" high seat surface to match table height

Display

20" high bedside table

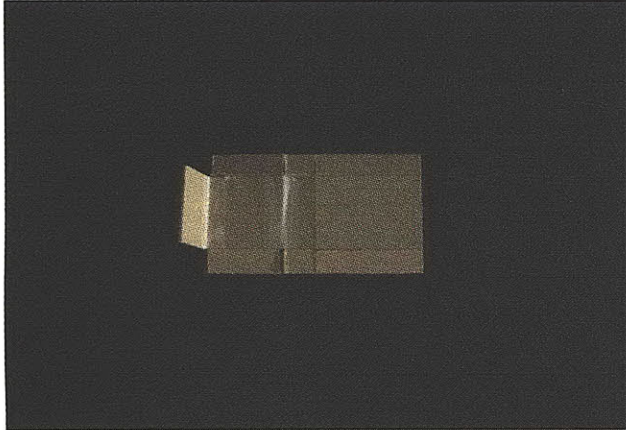
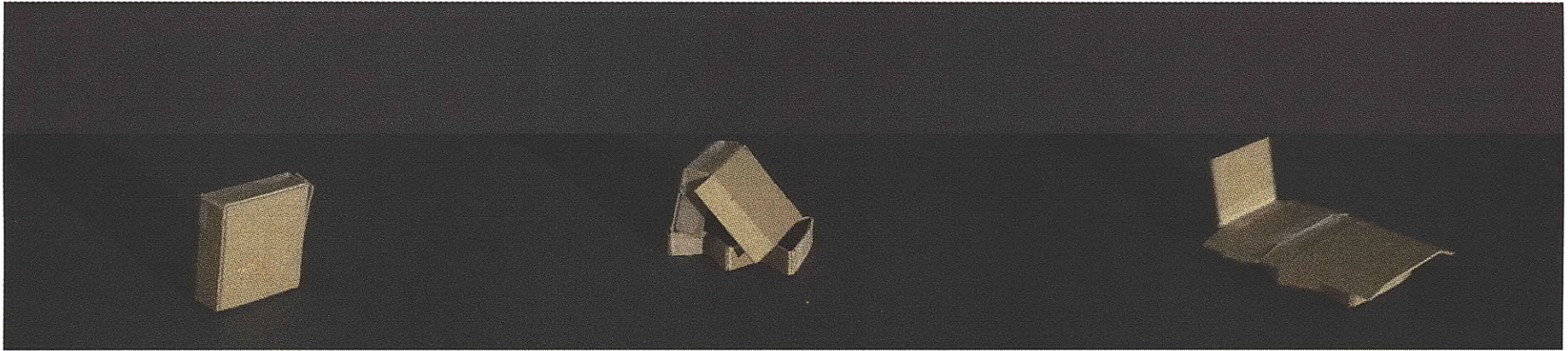
Storage

converts to shelving once deployed for easy access

may not be disturbed during deployment

20" high bedside table

Sized appropriately such that it fits inside a small apartment room 8' x 10'

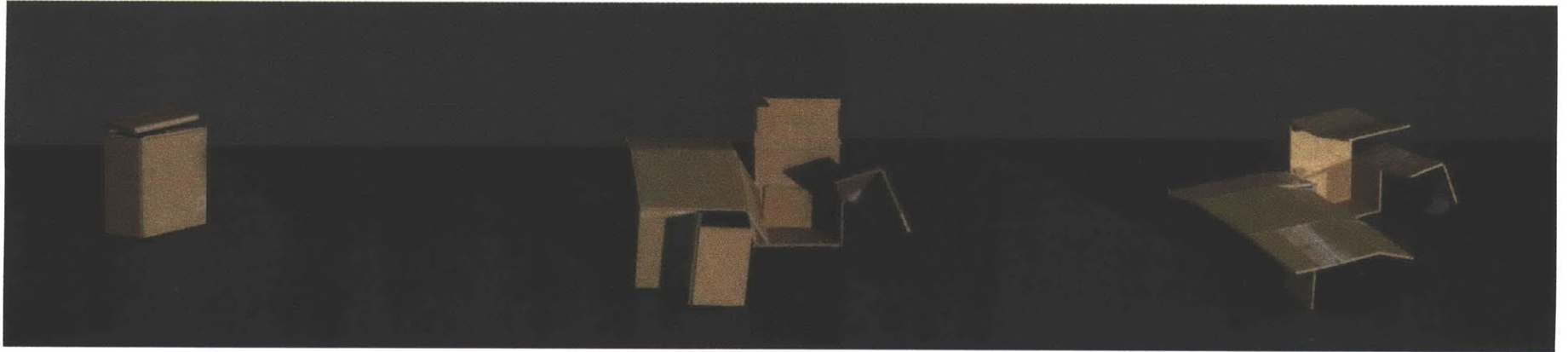


PROCESS

An iterative process of physical study models was used to explore and improve upon different basic design schemes. As the schemes became more elaborate and detailed, materials, scale, and production mechanisms were changed to accommodate the specific needs of each study.

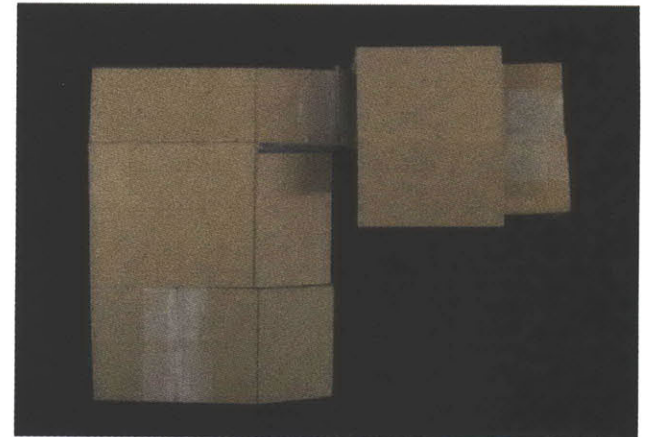
BOX 1

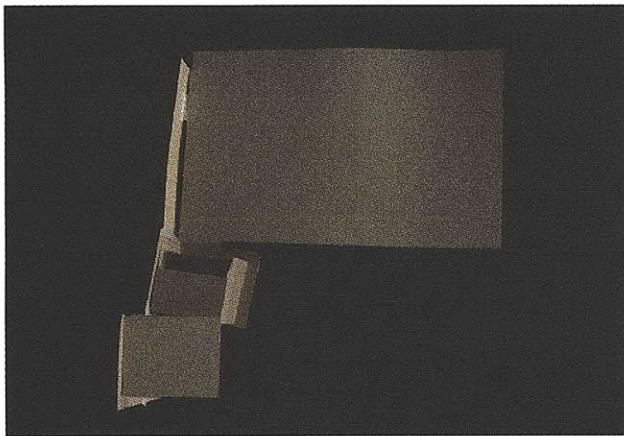
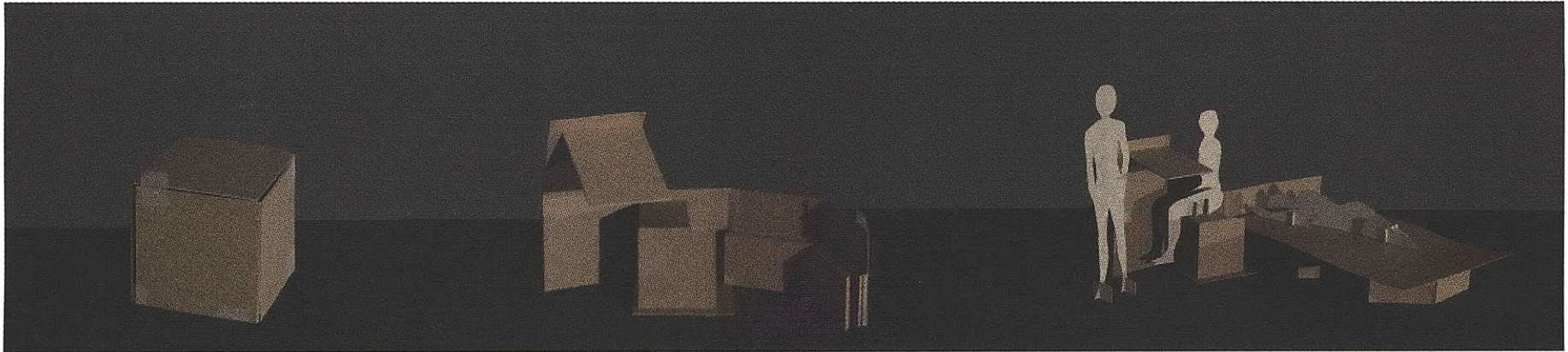
The first study explored methods to collapse bed, which is the largest singular surface in the collection of elements. This model displays a simple accordion mechanism that provides support for the bed and raises it, as stated in the previous criteria, to be one foot above ground. As the bed folds up, it doubles as a protective surface for the accordion, forming into a box.



BOX 2

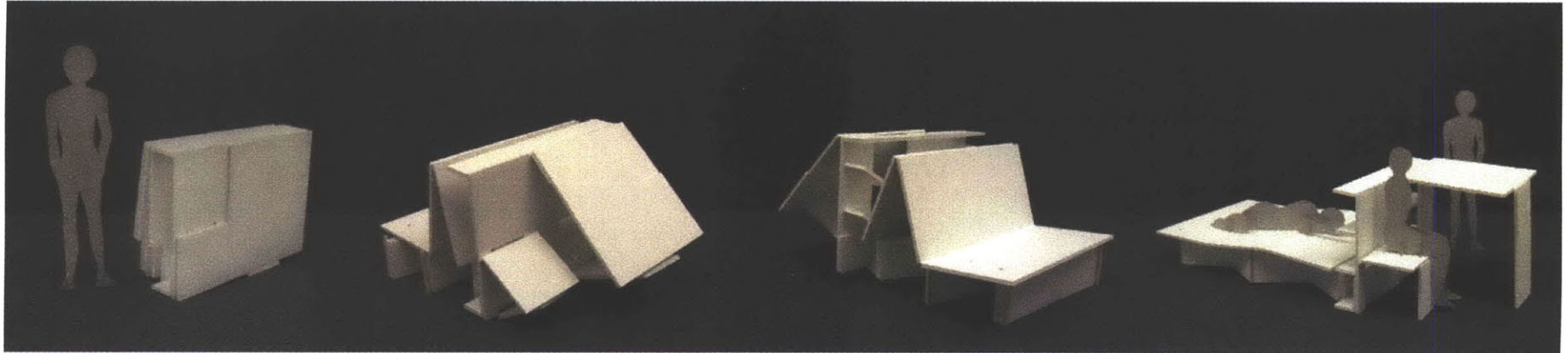
This study experimented with unfolding multiple surfaces from a box. An understanding and definition the relationships between the surfaces began here. With the table surface between the seating surface and the bed surface, the deployed setup created a single, central space. This arrangement also began to suggest inhabitation by more than one person in the potential for two or more people to sit across from each other on either sides of the table.





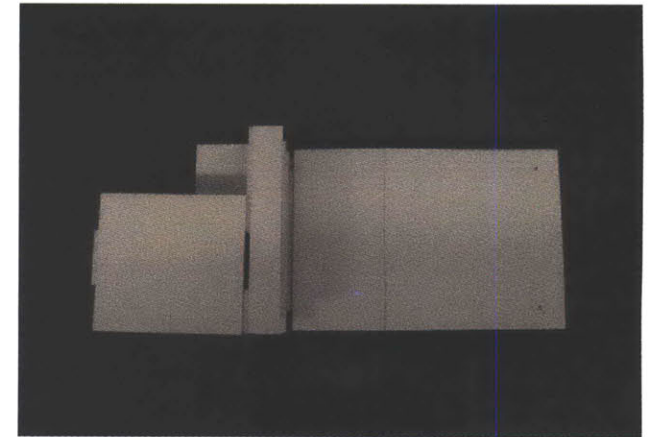
BOX 3

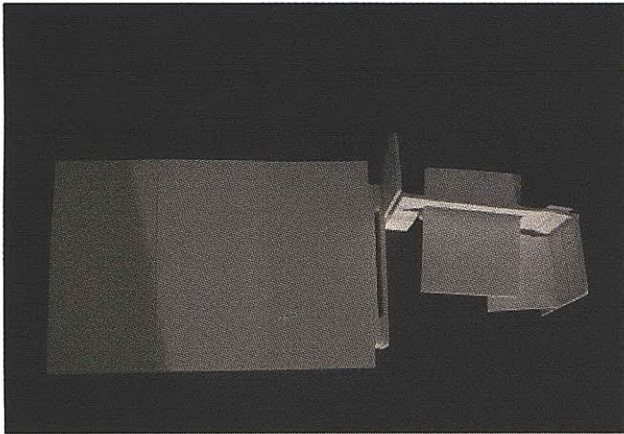
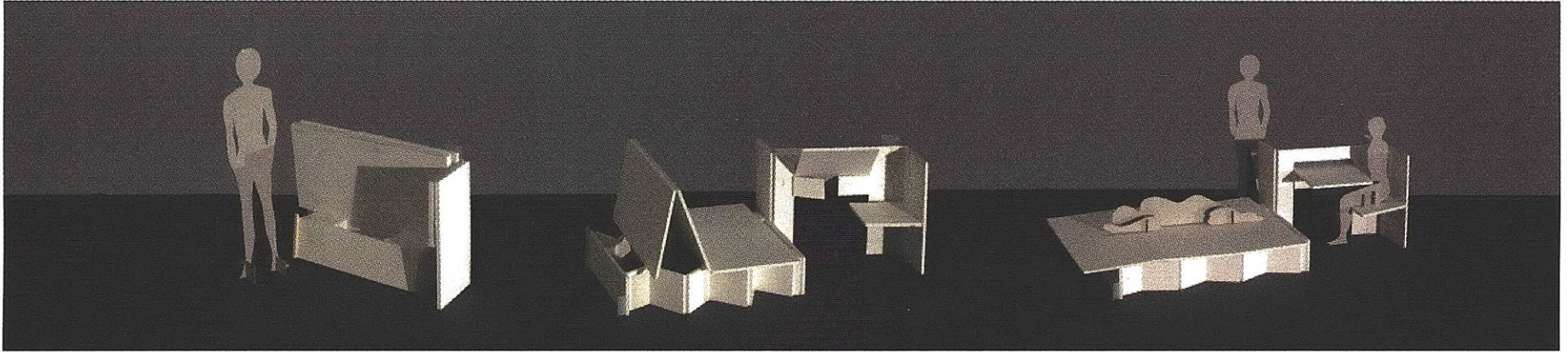
This third study combined the ideas from the previous two models and provided an arrangement with multiple surfaces that incorporates the accordion structure for the bed. In this iteration, transport was taken into consideration as the cube was sized at 21 inches for every side, such that it fulfills the checked luggage requirement. Also, this model displayed the first attempt at creating storage space that would not be affected as the mechanism unfolds. However, it was discovered in this model that chipboard does not maintain thickness and rigidity well, and that, after a number of deployments, the hinged edges, made by scoring the chipboard, quickly wore away.



BOX 4

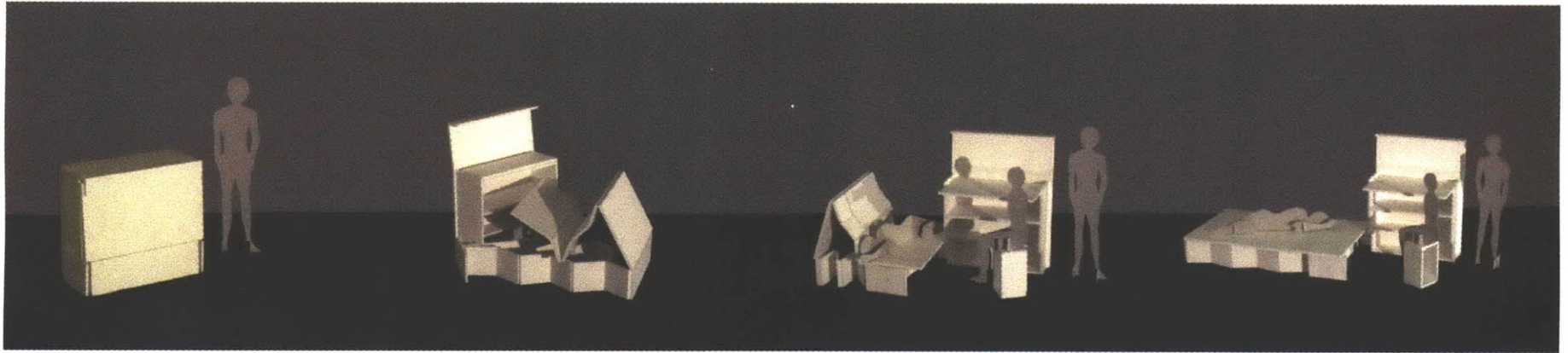
Foam-core boards were chosen as the new modeling material. Not only does foam-core maintain rigidity well, a simple score in the surface generated a quick, sturdy hinge. With this iteration, the bed began to take its final shape, with the accordion structure and a few simple folds. Registers were also placed on the accordions to keep the bed aligned with the accordions. The organization of this iteration was different from the previous models. The bed and the seating areas both utilized the largest dimensions of the box and unfold from the two opposing faces such that the resulting arrangement was very linear, with a clear delineation between the more private sleeping and the more public seating area. This arrangement yielded a length that would barely fit within 10 feet, the room size set in the criteria. Both of these characteristics reduce its flexibility and practicality.





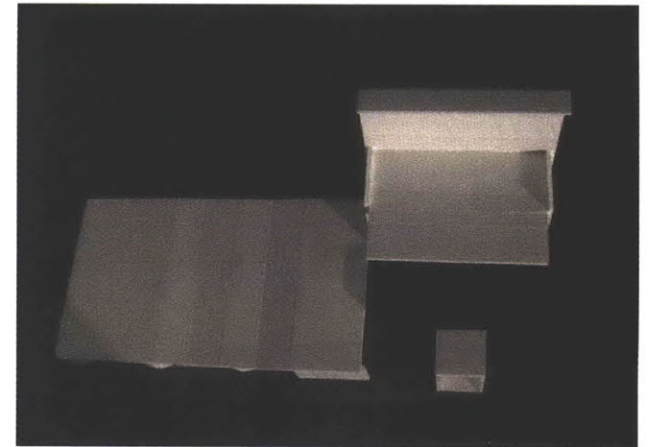
BOX 5

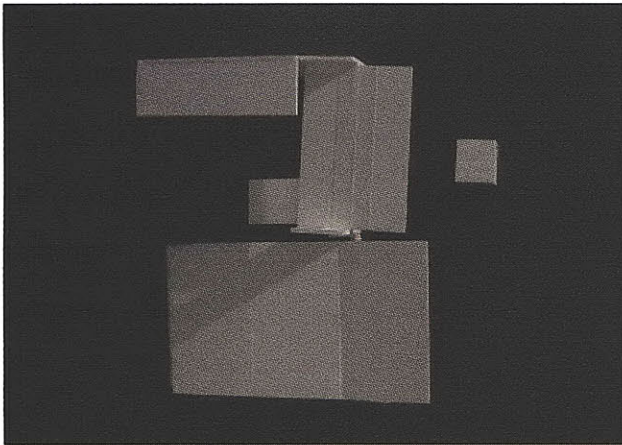
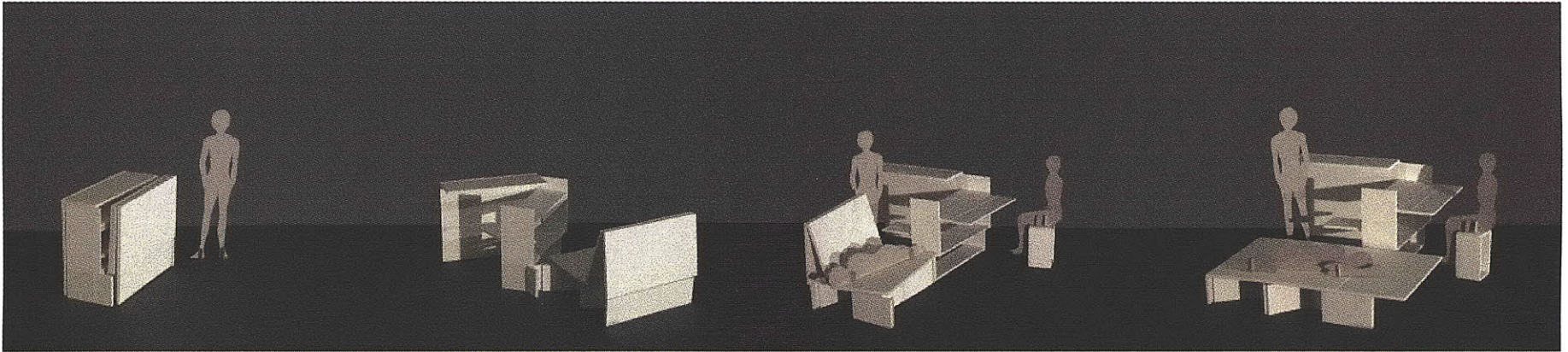
As a reaction to the previous study, this iteration focused on the arrangement of the pieces after deployment. The working surface and the seating surface both folded out of a single planar element, which provided good opportunities for structural support. This surface, hinged to the bed, also divides the more public zone into two, allowing for a public seating area as well as a small counter on the opposite side of the surface. However, the problem of one dimension being too long resurfaced and prevented that division to be possible in a 8' x 10' room, as there would be no way to access it. Other points for improvement include the lack of storage space, and the inconvenient shape of its luggage state.



BOX 6

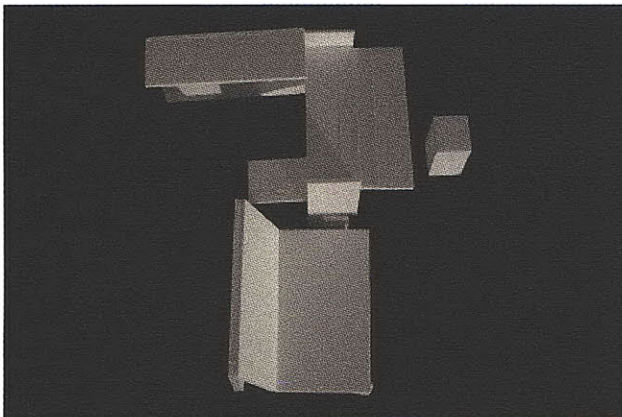
With the knowledge from the last two studies, this one combined elements of the two of them to solve the issues with each one. As a luggage piece, the dimensions of elements were aligned to form a protective box when compressed. Furthermore, an additional element of shelving was added as storage for personal belongings, and a small ledge at 50 inches high allowed for minimal display space. The shelves act as an anchor as the bed hinges out 90 degrees from it. The resulting arrangement still has one long dimension that nearly fills the 10' edge of the room, but because both the desk and the bed can be accessed from the side, it is no longer a problem.

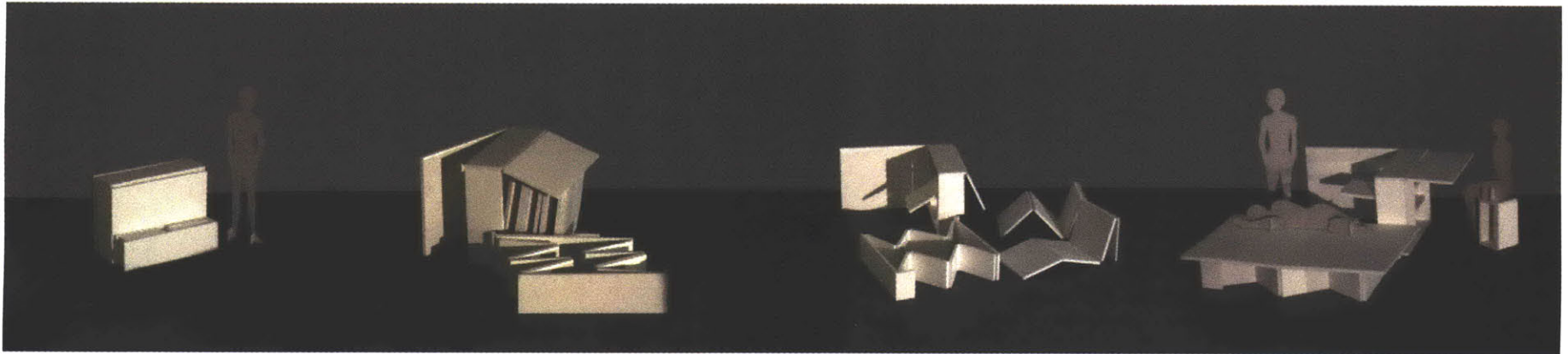




BOX 7

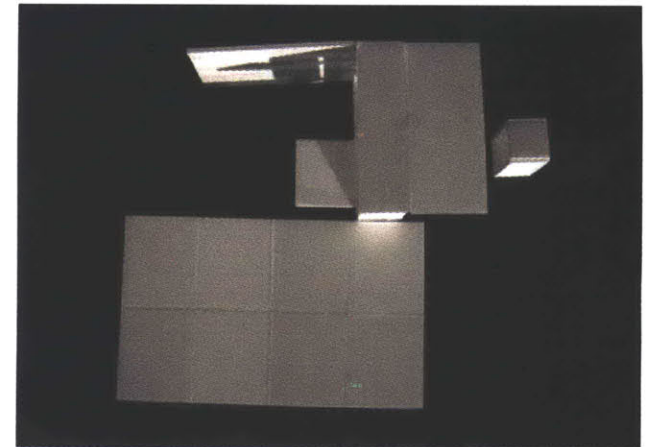
A further refinement of the previous models generated BOX 7. Rotating the bed 180 degrees delineated three zones of activity. The edges of the bed and the desk cater to a public seating area, where the bed can be converted to a couch at times. Together, the opposite edge of the desk, the storage shelving, the bedside table, and the bed form a private area for clothing and personal items. The arrangement of the elements were satisfactory in this iteration, however, its luggage state is much too big to be practically moved about. Thus, the next iterations work towards reducing dimensions to make the box more transportable.

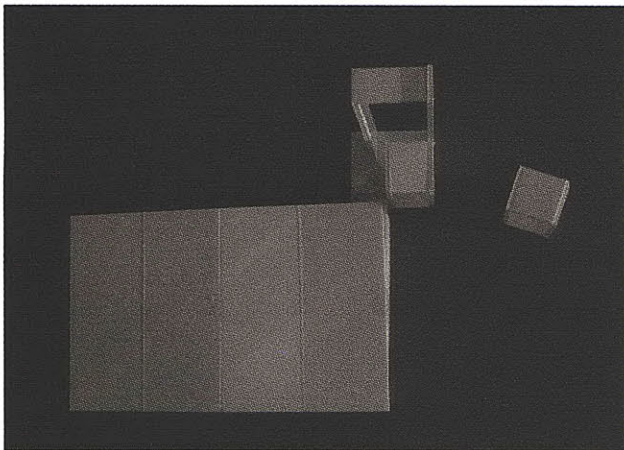
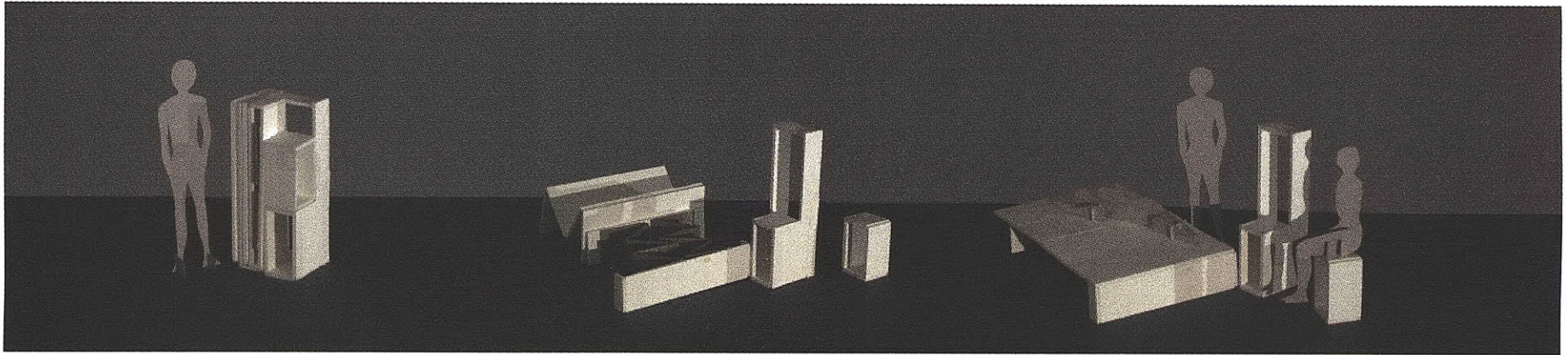




BOX 8

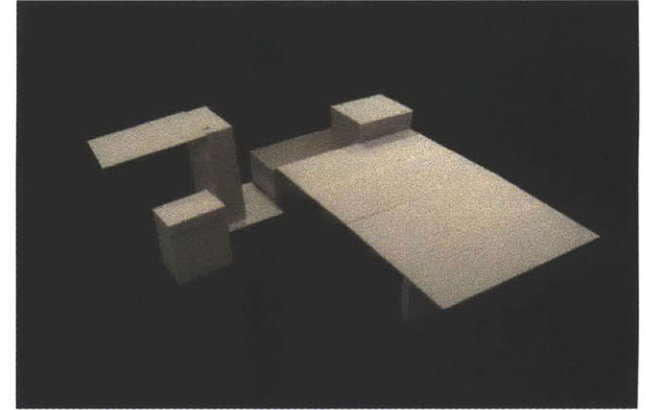
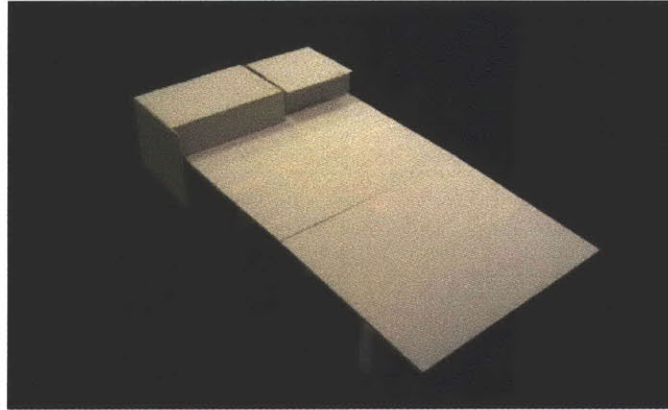
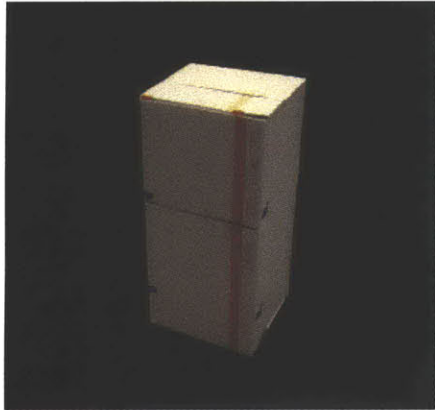
The eighth iteration was an attempt towards reducing the size of the box. Since its width is the same as the width of the box, the bed was the dominant factor in the sizing of the whole box. Therefore, BOX 8 experimented with different methods of collapsing the bed surface so that it is no longer part of the external box, thereby allowing the width of the box to be changed. However, the folded planes for the bed were difficult to deploy.





BOX 9

A further effort to reduce the size of the object and allow for more ease of movement, Box 9 tilted the accordion structures vertically. The changes in the connection between the bed and the accordion structure immediately reduced the width by half. As a collapsed box, the vertical rectangular shape can be more easily moved than the horizontal shapes before. While it was missing a table surface and the storage surfaces were not clearly defined, the move towards vertical was a positive one, and this was the model chosen to be further explored at a larger scale.

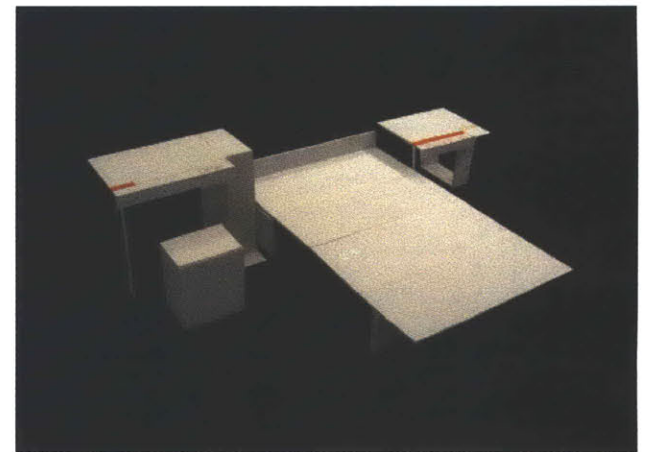


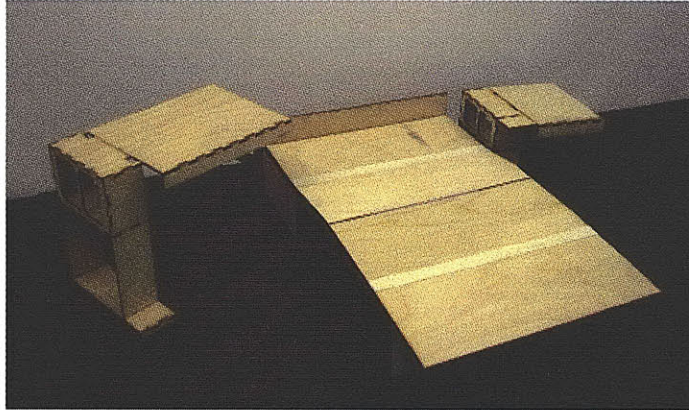
BIG BOX

When the basic orientation of the pieces was decided, a working model was built at half-scale to further explore various ways these pieces fit together. In this version, the material thicknesses were much more accurately modeled, testing the practicality of many details in the original design. Through assembling, disassembling, and changing this model numerous times, a number of practical mistakes were fixed and improved upon.

The underbed storage was developed in this stage. With the main storage compartment attached to the accordions, it was a natural development for the piece of the bed connected to the headboard to turn into a hinged lid for the storage, allowing for easy removal and storage of personal belongings.

A major design change also occurred in this phase of exploration. The furniture, all linked together, formed dimensions that lacked the flexibility to adapt to different rooms. Within the box itself, having everything be attached also accounted for a number of redundant surfaces. Thus, the final model became four separate pieces of furniture that could be arranged around freely.

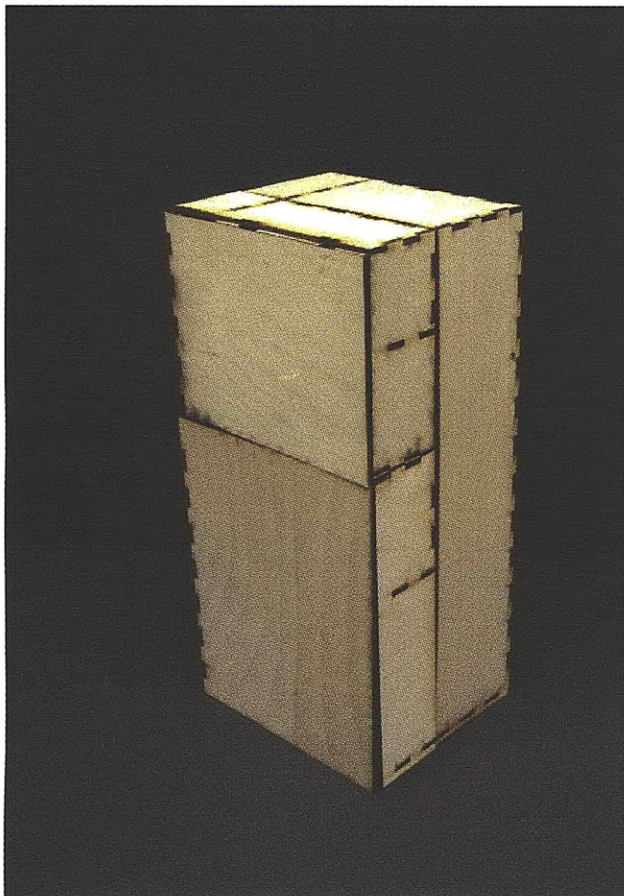


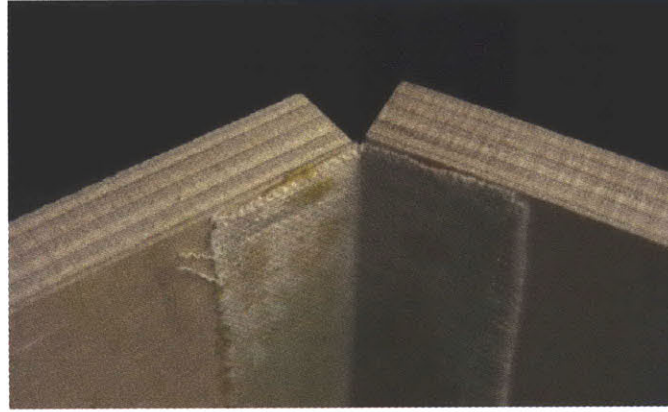
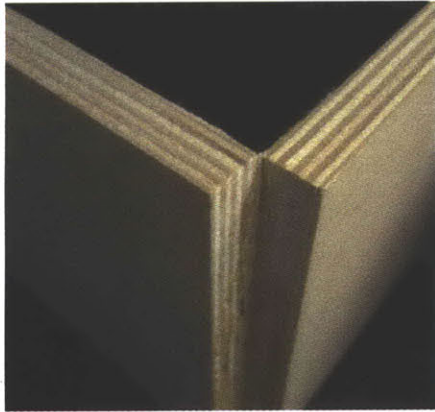


FULL-SIZE BOX

For precision, efficiency, and ease of construction, the TechnoCNC 3-axis LC Series 4896 Router was used to cut the pieces for the full-size prototype. The precision of the router allowed for easy creation of registers and box joints that assist with alignment, so that even someone with very limited woodshop experience can assemble the pieces with relative ease. A construction model exploring the assembly method and connections was made using the lasercutter.

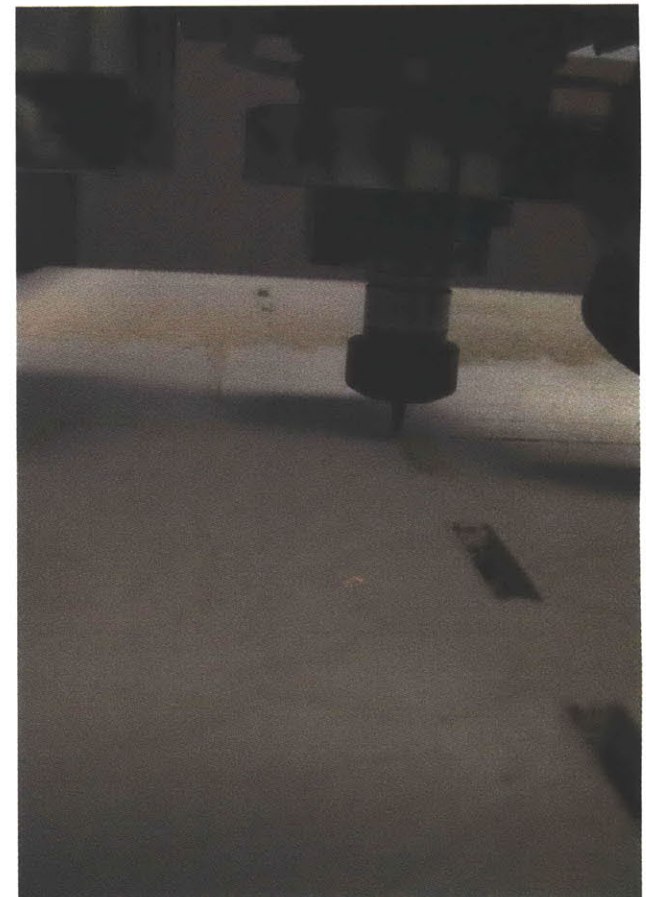
Canvas was chosen as the material for generating the hinges because of its properties as a lightweight, sturdy, and relatively dimensionless material. Also, because the furniture would only be deployed a few times a year, canvas hinges would perform adequately. Most of the hinges were not actually relying on the hinge to hold the weight of the hinged material, so the concern of the fabric ripping off of the wood from torsion was not a big concern.

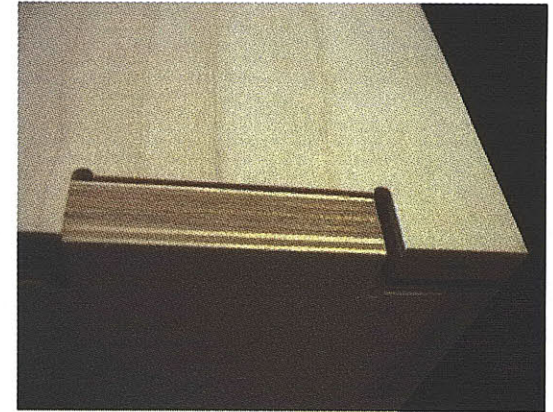
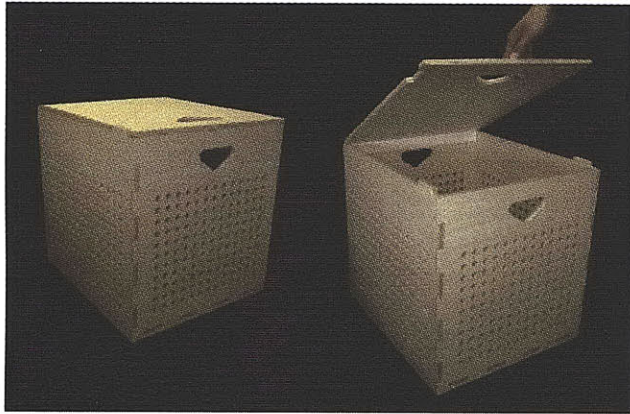




Prior to the creation of the actual full-scale prototype, these canvas hinges were utilized in the quarter-scale construction model. Full-scale small mock-ups were also made to experiment with the various glues and methods of gluing. The mock-ups with the canvas on the inner surface of the hinge rather than on the edges of the two pieces of material were the more successful hinges. Because the two pieces of material push against each other directly when opened, the hinge opens out to a completely flat plane. This orientation has less opportunities for torsion and, because the gluing area is larger, there is a stronger hold.

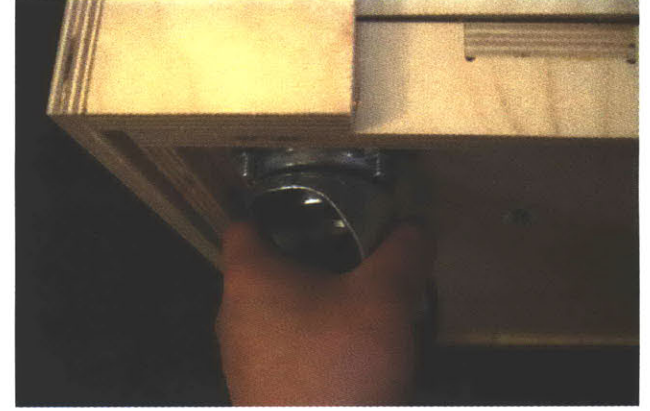
Previous experiences with the CNC router allowed for the tool to be used efficiently as a production tool. These past research projects and workshops dealt with issues such as how to generate traditional woodworking joinery on the router, and how to create registers for situations where a 90 degree angle is required of an inside corner. This prior knowledge enabled the quick generation of a construction model and cutsheets for the actual production.





The production of the full-size working prototype began with the stool, which was used as a test for many of the connections in the rest of the box. The four sides of the stool were joined with box joints, and the bottom was joined with dado joints into the sides. Because the stool also serves as a storage bin, the seating surface is hinged to one edge and also functions as a lid. Thus, the stool also served as a test for the canvas hinge. Also, to ensure that the surface remains on top of the sides, reducing the torsion on the hinge, registers were created on the lid, with holes that accommodated protrusions from the side panels. The same type of registers was also used to keep the bed surface rigid above the supports. The stool confirmed that these details were working, and the rest of the pieces were cut and assembled accordingly.

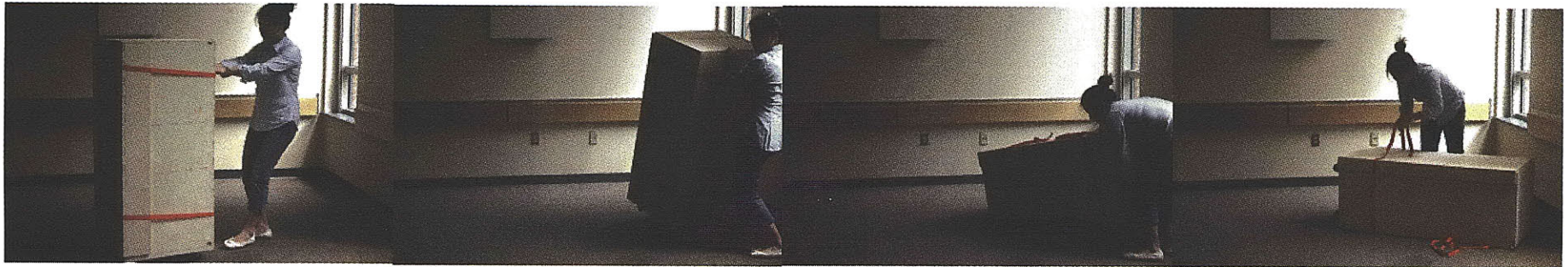
Along with almost all other surfaces, the stool is made of solid 1/2" Baltic birch plywood. In surfaces that do not have to be entirely solid, such as the stool walls, holes of various shapes were dug into them to reduce the weight of the final product. For the bed planes that would have to remain solid, a composite board of foam-core board and 1/8" thick plywood were created. Much like the way a door is made, a wooden frame, in this case filled with a piece of foam-core, is laminated on either side with sheets of 1/8" plywood. This significantly reduced the weight of those surfaces while maintaining adequate rigidity.



Because only the bed surfaces were made out of the composite boards, the entire box, when assembled, was still quite heavy. Therefore, for the prototype, it was decided that four wheels be used instead of two. These castors were mounted to a board that fits inside the bottom lip of the box. Separate from the rest of the box, this plate had holes that fit into bolts that extended from the bottom surface of the box and was secured with wingnuts, allowing it to be removed once deployed as furniture. With four castors, the box was able to rotate around easily and be dragged along with the straps that tie the box together.

The following pages illustrate the deployment process. With the furniture as separate pieces, the process can be divided into four parts: connection removal, bedside table deployment, desk and stool deployment, and bed deployment. A person of average strength can deploy the box in five to ten minutes without any tools.





bedside table deployment



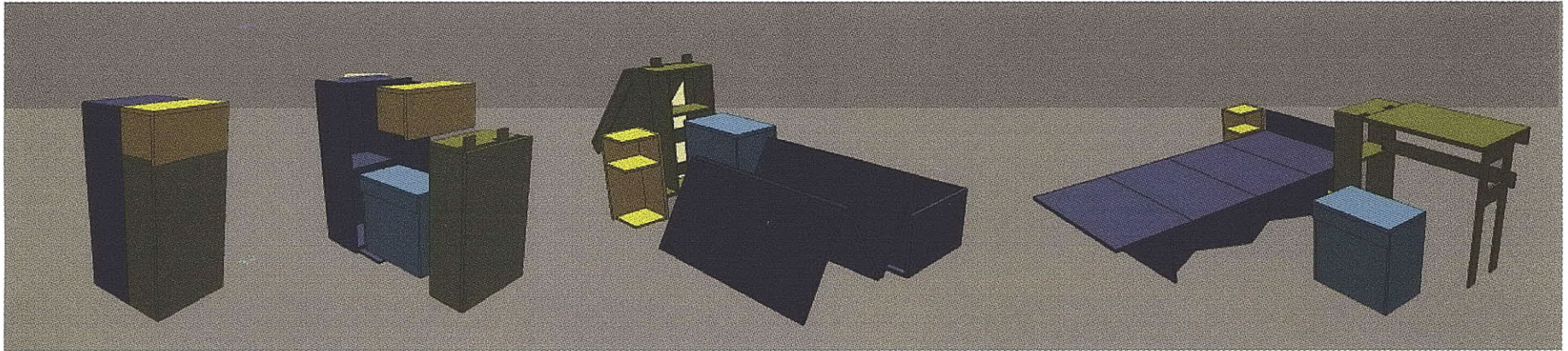
desk and stool deployment



bed deployment

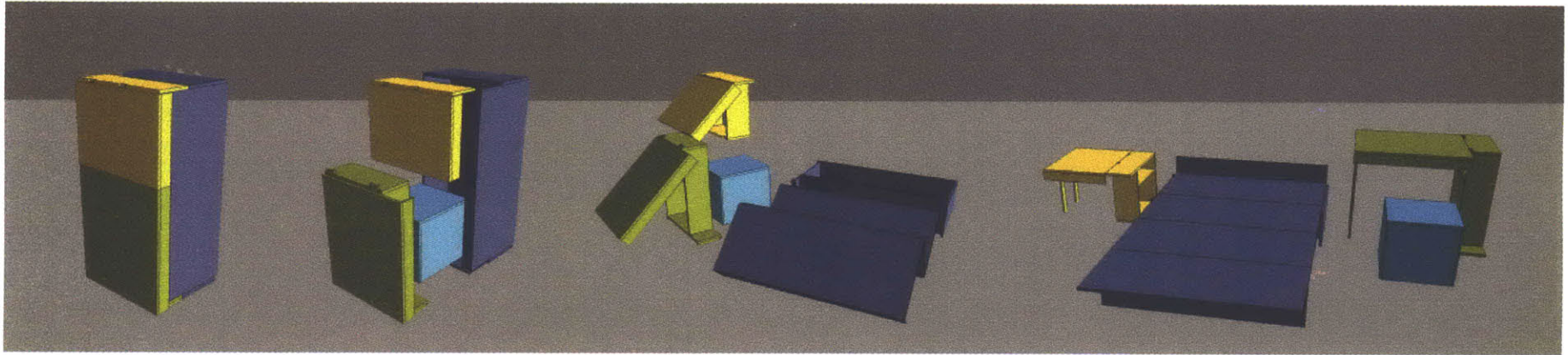






FURTHER DEVELOPMENT

In designing for young professionals from the ages of 20- 30, it was important that the furniture be designed to accommodate more than one person. Therefore, the bed dimensions were that of a double bed, and the desk was wide enough to allow two people to sit across from each other. The home as a location for social interaction is essential to the social life of a young professional. The ability to be able to entertain company at home while home is on the road assists in forming social networks in the local area, which will further assist the traveler in growing accustomed to the initially foreign environment and developing a sense of identity within it. Shown in the picture above is the iteration that was made into the full-size prototype, with the dimensions to accommodate this aspect of the young professional lifestyle.



However, for those who do not need to provide for others, it is possible to reduce the size of the device in exchange for smaller furniture dimensions. For example, in the case of a college student, because of the abundance of community spaces on typical college campuses and shared apartments, the room often becomes one's only space for solitude. Therefore, in providing for the college student, the sizes of the surfaces can be reduced to accommodate a single person. The bed can be reduced to an extra long twin sized bed, common to many college campuses in the U.S., and the desk width can be reduced to be around 18", enough for one person.

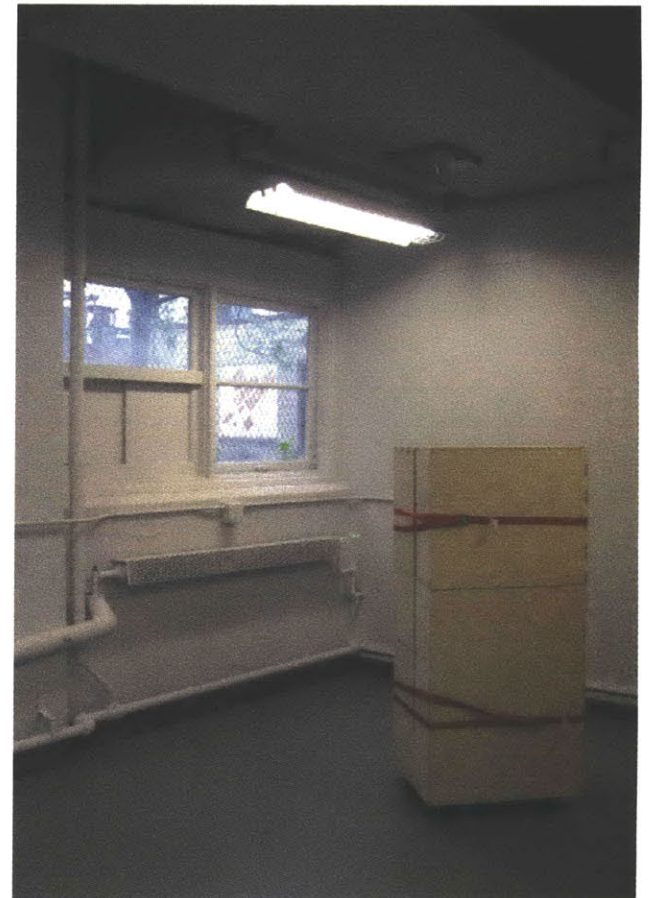
Other than variations with the actual layout of the pieces, further improvement can be made in the choice of material and detailing. In future variations, more of the surfaces would be made with the composite boards. Perhaps some of the supporting pieces can even be made out of Polygal or other forms of corrugated plastic. Upon the actual reduction of weight, the box could actually be moved on two wheels instead of four, thereby making it easier to move. These improvements would help the furniture pieces retain the familiarity of wooden furniture, and yet weigh little enough to be truly mobile.



CONCLUSION

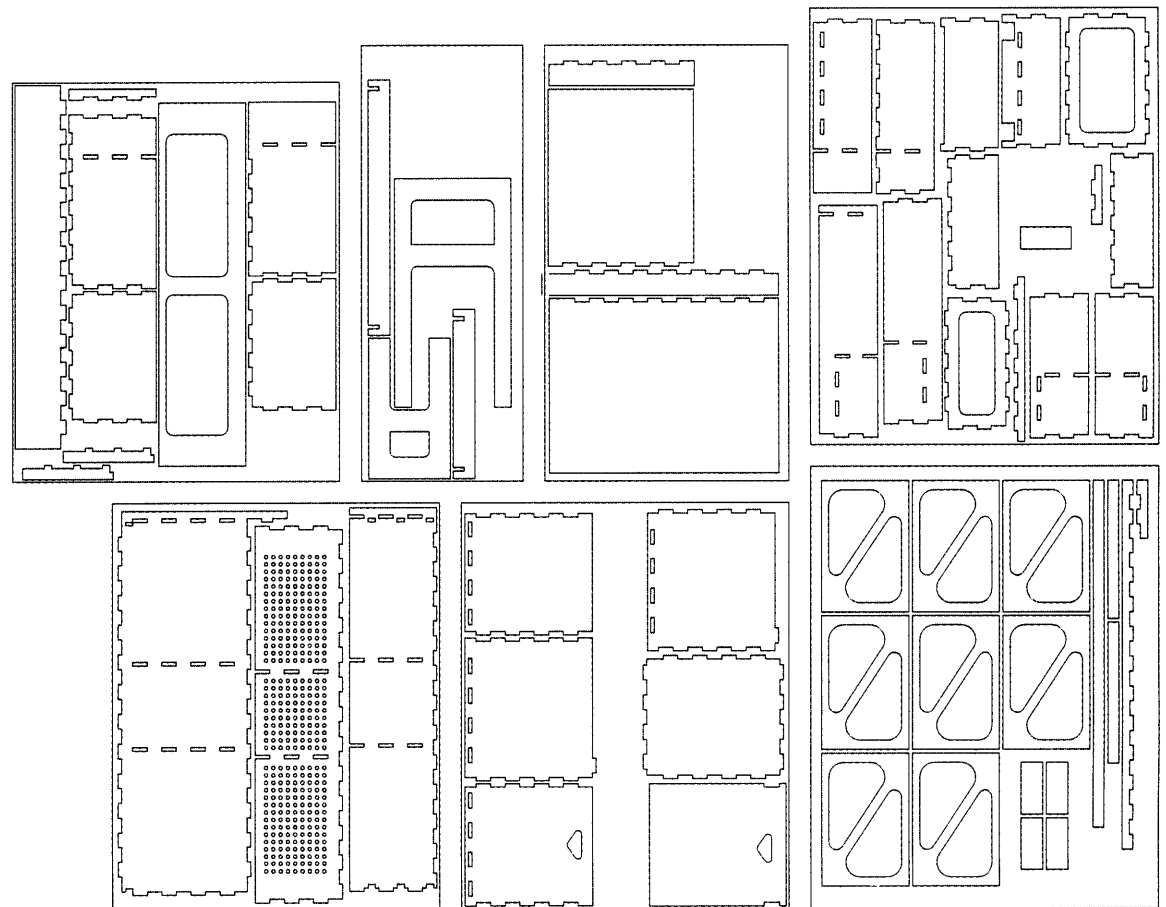
This process of exploration in various materials, scales, and production methods yielded a working prototype that enables a new lifestyle. An adaptation of the historical steamer trunk, four pieces of furniture emerge from this oversized suitcase, populating any unfamiliar apartment space to make it home. Connected with simple fabric hinges and joints, it is quick and simple in both construction and deployment. Further development and prototyping is necessary to give this current design robustness and real-world usability.

However, as a first foray into full-scale design and construction, this process has been an insightful experience. A new understanding of traditional woodworking was gained through the usage of new machinery. Physical prototyping in various scales yielded invaluable experience in properly designing joinery and alignment tools. Most important was the practical application of the progression from concepts and drawings to a full-scale product.



APPENDIX

Router cutsheets at $1/8" = 1'-0"$ scale.



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