# Homeless Transitional Living Center
## Department of Architecture - College of Architecture and Urban Studies

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|---|---|---|
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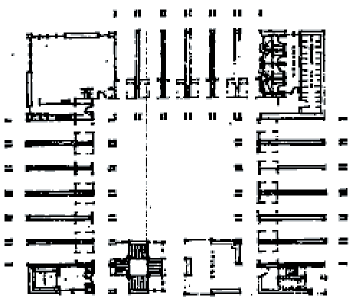
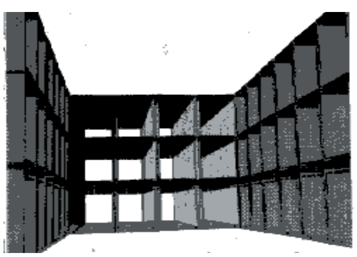
| Graduate Assistants: | Kevin Bullifant, cost estimating (1993) | |
| | Patricia Parola, prelim container evaluation (1993) | |
| | Tammy Felker, | revised container plan<br>sleeping / study furniture design<br>container assessment (1996)<br>floor construction team (1996) |
| | Shane Larkin | interior framing design (1997) |
| | David Connerly | partition construction team (1997) |
| | Tom Keeling | floor construction team (1996) |
| | Matthew Lutz | floor construction team (1996) |
| | Mark Gibson | partition construction team (1997) |
| Technical advisors | William Sevebeck | |
| | "Ducky" | |

The current iterations of single room occupancy apartments have developed from the "flop houses" and gender specific hotels which once made up a substantial percentage of low cost rental housing. (Hoben and Blankespoor, 1990.3) The contemporary SRO provides a private room for one person, a common entrance for all the rooms, and sometimes common kitchens, toilets, and baths. As a building type, the SRO almost disappeared as urban re-development demolished many core area housing zones but has begun a resurgence providing the working poor, special needs low income people and homeless people with affordable housing alternatives. (NAHB 1991.27) In SROs for the Homeless funded by HUD Section 8 moderate rehab. programs, the apartments themselves are fairly small, ranging from 80 to 360 square feet. The rooms have a bed, desk, clothes storage, and in some cases a sink and small refrigerator. Less common was private kitchens, toilets and baths. (Hoben and Blankespoor, 1990.15)



Proposed Courtyard plan for SRO

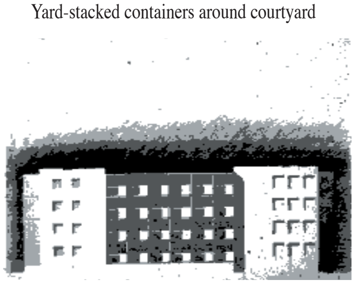
At the 1992 Virginia Governors conference on Affordable Housing, Ms. Barbara Barnes, manager of the New Clay House SRO for Virginia Mountain Housing presented the development and management issues for SRO type housing complexes for the homeless. The New Clay House SRO complex provides on site counseling for mental illness and substance abuse, classrooms for job training, common kitchens and dining spaces for communal dining, personal storage lockers, twenty four hour door attendants, on site facility managers, and a television lounge. This Richmond facility is an adaptive re-use, the building and land were donated to the project. This 46 unit facility was rehabbed for a total project cost of $42,000 per unit.



Yard-stacked containers around courtyard

With the New Clay house as a model of the range of services and spaces required of an SRO facility for the homeless, the following design program was developed.

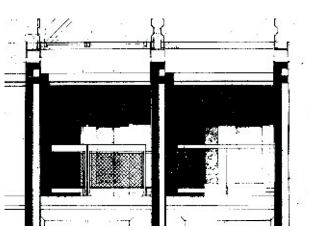
| | |
|---|---|
| 3 family units at 480 s.f. each | 1,440 |
| 60 single occupancy units at 240 s.f. each | 14,400 |
| 2 counseling offices and reception | 816 |
| Site Manager apartment | 240 |
| Site Manager office, Front desk and mail room | 480 |
| Tenant Storage | 2,912 |
| Classroom / Dining / Kitchen spaces | 3,072 |
| Informal lounge areas | 960 |
| Total area | 24,320 |



Proposed Courtyard elevation for SRO

**Design of complex**

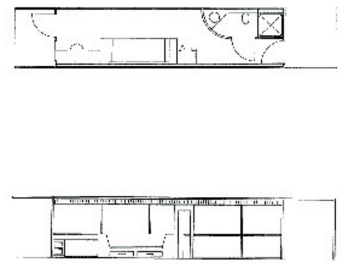
This project assumed a site of approx. 1 acre in an edge neighborhood between industrial / commercial land uses and urban residential uses. (NAHB 1991.7) Recognizing that the homeless population could include families, (Sauser 1991.6) and that the assumed site location may not provide for reasonable open space for children's recreation, we worked with a building form which would enclose a courtyard making a secure play space as well as a secure entrance to the complex. (Figure 1 idea sketch)



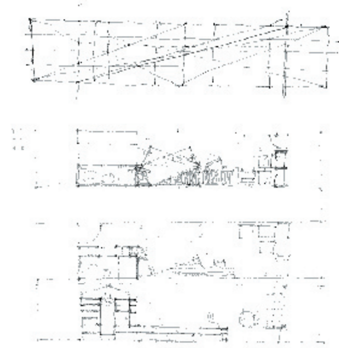
Container Elevation with doors removed

The containers are oriented with the doors facing out, and what is the closed end of the container facing the courtyard. This closed end becomes a six foot wide public corridor cut through the sides of the container, and a window cut in the closed end of the container to open the corridor to the courtyard. (Figure 2 Ground Plan) At the opposite end of the container, the doors are removed, and a new end wall is constructed with a glazed door and window set back four feet from the container edge to make a small balcony for each unit.

With the containers being purchased as surplus or scrap, the exterior condition of the container was assumed to be aesthetically challenged. Rust, dents, patches, mismatched paint were assumed to be a given condition. Even with the between-industry-and-residential site assumption this deterioration of the exterior could be a lightning rod for NIMBYs and may also contribute to a perception of less than acceptable treatment by the occupants. With these considerations in mind, the "U" shaped configuration and fire stairs / common spaces at the intersections of the "U' allows for minimal exposure of the sides of the containers except for the balconies and unit faces. (Figure 3 exterior elevation) This balcony face would be the where the containers doors have been removed and the edge framing clad with steel channels, welded to join the containers, close the gap between containers, and provide a smooth precise edge to the street face of the complex. (Figure 4 exterior unit elevation)



Sro unit plan (top), interior elevation (below)



Sro unit plan studies (top), interior elevations (below)

**Shipping Containers**

Shipping containers are off - loaded, repaired, and ultimately sold as surplus or scrap from freight, container leasing companies, and port areas. These containers are engineered to carry some 60,000 pounds, be picked up only at the upper corners, transfer this load across a forty foot span to only four corner points, and can be stacked up to four containers tall with no additional structure. (Figure 5 stacked containers) These containers are water tight, weigh only 8,000 pounds empty, and are made to withstand repeated use in ocean going ships, on trains, and as truck bodies for inter-city transit and delivery. These containers are relatively easy to move with either a light crane or heavy forklift. (Figure 6 forklift and container) A typical surplus cost is in the $1,000.00 range. This works out to $3.12 per square foot. Delivery cost can be as much as $500.00 for a 200 mile delivery and crane rental can add an additional $200 to $400 dollars per container depending on the number of containers to be unloaded, the unloading site conditions, and the experience of the handling crew.

Physical Characteristics of Shipping Containers

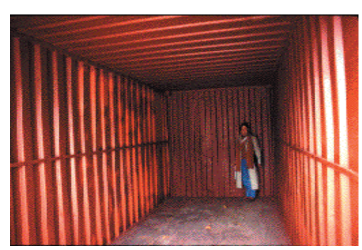
- Length outside 40 feet, length inside 39 feet 8 inches.
- Width outside 8 feet, width inside 7 feet 8 inches.
- Height outside 8 feet 6 inches, height inside 7 feet 10 inches.
- Weight empty 8,000 pounds
- Weight full 67,200 pounds
- Allowable stacking weight 432,280 pounds (4 containers without additional guy wires)

Container stacking, spanning

The containers are constructed on a steel chassis consisting of perimeter 6 inch deep steel wide flange channels with 4-1/2 inch deep cold rolled steel channels welded in between at 12 inches on center. A gooseneck tunnel which makes room for the fifth wheel mount when the container is in truck transit mode, extends from the closed back of the container towards the doors for a distance of twelve feet. This tunnel is framed with 4-1/2 "Z" cold rolled members at the tunnel periphery and 3-1/2 inch cold rolled channels spanning from the perimeter channel to the "Z". A wood floor, 1 inch thick made of treated T&G hardwood planks are screwed to the 4-1/2 inch channels to complete the floor. Walls are constructed on top of the six inch perimeter channels with a 2 inch wide, by 1 inch high steel plate welded to the channel. corrugated steel wall panels (overall dimension 1-3/4 inch) 1/4 inch thick are continuously welded to the plate at the bottom and to a similar plate at the top. Welded to this plate is a cold rolled channel which receives the corrugate steel roof.


Stacked containers at corner column

Inside each unit, new non-load - bearing partitions are constructed one and one half inches off the inside container walls to allow for wall damage, make room for electrical devices, and support a finished interior wall surface. Investigation of the possibilities for scraping, sandblasting or removing rust and damaged paint led to the finding that the paint in many first and second generation containers has a substantial lead content, with some having a cadmium content in excess of allowable maximums. The cost of environmental mitigation of the lead and cadmium ultimately stopped the project in late 1997. This meant that either



Container Interior

a special paint removal / priming / painting facility would have to be constructed on the job-site to contain and dispose of the paint fragments or the paint would have to be encapsulated with a partition and finish system. Any exterior exposed container walls would also have to be re-clad in order to avoid the environmental expenses involved in surface preparation and re-painting.

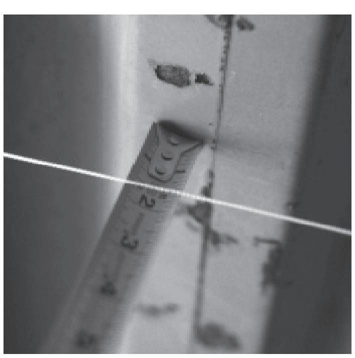
With the construction of new non-load - bearing interior partitions and ceiling a 3/4 bath is constructed. The bath has a lav, toilet and shower within the unit. (tub rooms are available at the corners on each floor of the complex) With the steel structure spanning the short dimension between the walls, there is no naturally occurring chase below the floor for plumbing. This meant the vertical stack for the plumbing has to occur within the same joist space as the outlet for the shower or toilet. As the plan developed, it became clear that the shower and stack would occupy the same space, and the toilet would be 3-6 from the main stack. With no subfloor space for the typical toilet discharge plumbing, an above-floor toilet was chosen to eliminate the need to re-frame the bathroom / corridor floor. The remainder of the bathroom is conventionally constructed with the exception of the curved partition between the lav area and rest of the unit. This partition is constructed with hollow cell translucent plastic to allow daylight from the balcony wall to penetrate and increase the perceived size of the interior of the unit.

Cost Estimating

After completing the design for the complex as a whole, a detailed cost estimate was developed as an interim check to verify that the container based superstructure / enclosure approach would offer a cost savings over the re-hab project where land and superstructure were donated. Graduating senior Kevin Bullifant, student in the Building Construction program and member of the nationally ranked cost estimating / project proposal team was retained to undertake a detailed construction estimate.

The cost estimating was structured according to the CSI standard format for specifications. Costs were based on published estimating values current during the time of the estimate (1993) Each of the specification divisions was broken down by material, labor, equipment, and regionally adjusted to arrive at an adjusted cost. Added to this subtotal was sales tax, payroll taxes and insurance, and overhead and profit.

Container Interior as-delivered



1 3/4 inch runout (bent) in containter length

Breakdown of cost estimate

| Division | Material | Labor | Equipment | Roanoke Adjustment | Adjusted Cost |
|---|---|---|---|---|---|
| General Conditions | $3,100 | $45,235 | $33,300 | 1.0 | $81,635 |
| Sitework | $19,969 | $11,515 | $332 | .924 | $29,399 |
| Concrete | $109,595 | $61,452 | $4,653 | .958 | $168,322 |
| Masonry | $58,617 | $64,302 | $0 | .854 | $104,973 |
| Metals | $146,836 | $82,707 | $3,275 | .667 | $155,290 |
| Wood & Plastics | $20,321 | $8,068 | $0 | .893 | $25,352 |
| Thermal/Moisture Prot. | $66,695 | $39,569 | $2,409 | .771 | $83,787 |
| Doors & Windows | $164,348 | $29,839 | $642 | .970 | $188,985 |
| Finishes | $116,194 | $86,350 | $0 | .929 | $188,164 |
| Specialties | $44,954 | $23,269 | $0 | 1.021 | $69,655 |
| Mechanical | $111,385 | $130,054 | $0 | 1.053 | $254,235 |
| Electrical | $41,371 | $51,712 | $0 | 1.019 | $94,852 |
| | Subtotal | | | | $1,444,656 |
| | Sales Tax | | | | $40,652 |
| | Payroll Taxes & Insurance | | | | $190,223 |
| | Overhead & Profit | | | | $435,638 |
| | Total Contract | | | | $2,111,170 |
| | Project Cost per unit ($2,111.170 / 63) | | | | $33,510 |
| Differential from New Clay House project ($8,489 per unit x 63 units) | | | | | $534,807 |

Current Status

The $8,489.00 per unit savings made the project seem competitive as an approach so a container was purchased for $1,000.00, transported to Blacksburg for $500.00, and set for $250.00. The process of assessing the container for square, plumb, rust through, floor damage, and structural damage began with Master of Architecture students Tammy Felker, Tom Keeling, Shane Larkin, and David Connerly. Ms. Felker began the second development of the living unit design, working to incorporate a shower, as well as closet, bed / couch, study center and integral storage.

Initial assessment stages included

- examination of the exterior for signs of structural damage and puncture, as well as mapping the locations of any rust - through points. This visual inspection is recorded on simple diagrams of the container for use in later patching stages.
- measuring opposing diagonals on the floor plate to check for square.
- mapping of floor damage for repair / replacement evaluation
- evaluation and measurement of any out of line or damaged floor framing elements.
- evaluation and measurement of out of line walls by spacing a string one and one-half inch out from the corner posts (assumed to be in line) and measuring from the inside of the stringline to the adjacent wall surface at four foot intervals horizontally, and two foot intervals vertically.

The initial assessment of this particular container showed two thirds of the flooring damaged beyond repair, a floor plate which was within one - quarter inch of being square, two badly damaged floor channels, two pinhole rust through locations, one door latch bent beyond operation, and exterior wall panels which projected into the container five - eigths of an inch on one side and projected out from the inside three - eights inch on the other side.

The door latch was cut away with a reciprocating saw and bi-metallic blade. This allowed for the free operation of the door, but latching and securing during the construction phase had to be accomplished with cable and padlock.

The first demolition stage involved removal of the damaged existing flooring. The broken segments were removed and cut into four foot long segments for disposal. The small areas of unbroken floor were removed with a pry bar and hand held sledge hammer. Remaining fasteners were ground off flush with the floor channel. With the floor framing exposed to view, the damaged channels were repaired using two different processes. The first was cut using a plasma cutter from the bottom of the channel to but not through the top flange of the channel. The channel was then levered down to the appropriate elevation and the cut was filled with weld. The second channel was cut from the bottom of the beam to but not through the top flange with a reciprocating saw and bi-metallic blade. The cut channel was levered down to the appropriate elevation and a splice plate was attached to the bottom of the web by drilling holes in the web and bolting.

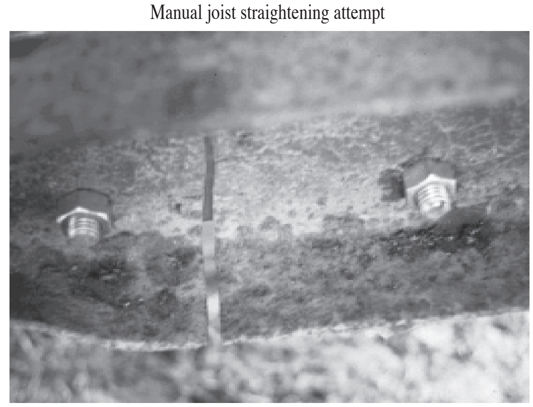
The flooring was replaced with 3/4 inch plywood sheets fastened to the floor channels with self drilling, self countersinking screws one foot on center along the perimeter and two feet on center in the panels interior.

Rust was initially planned to be removed, the metal re-primed and the container repainted inside and out. Laboratory testing revealed lead and cadmium contents high enough to require complete enclosure during paint removal, the disposal of the removed paint as a hazardous material, and worker protection including complete pressurized breathing apparatus. We re-considered the paint approach and decided to completely isolate the interior space from the walls and ceiling, and to begin design work on cladding systems for the exterior skin (required only to make this one - container demonstration visually acceptable.) The partition between the balcony and unit interior is tasked to provide a door for access to the balcony, windows extending to the ceiling to provide daylight, and controllable openings for ventilation. Three alternative designs were constructed by students from Prof. Hunter Pittman's environmental systems class in the test cell building at the Research and Demonstration Facility at Virginia Tech. The class is currently evaluating the thermal, ventilating, and lighting performance of each test wall.

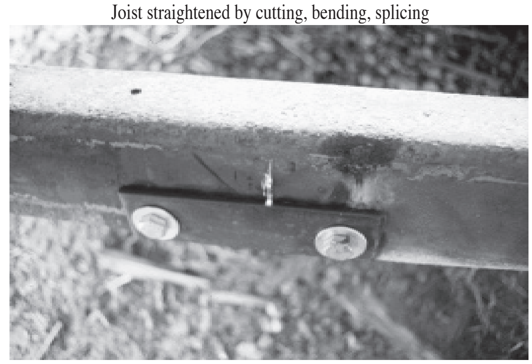
1 1/2" deflection in bent floor joist

Damaged floor joist as-delivered

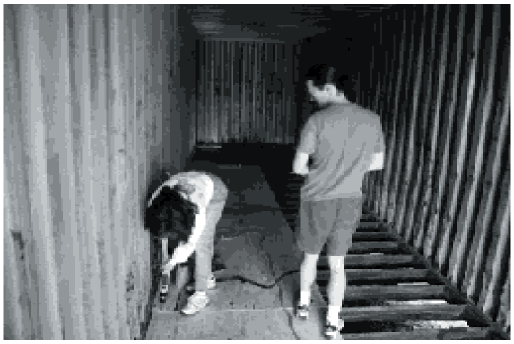
Manual joist straightening attempt



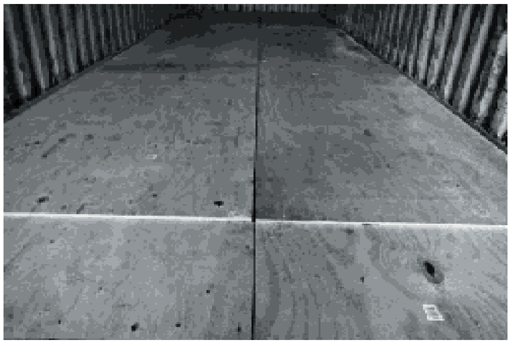
Joist straightened by cutting, bending, splicing



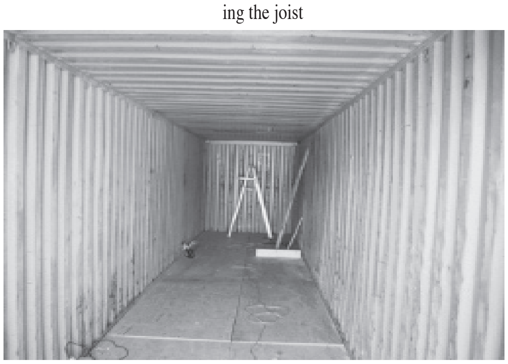
Splice plate after straightening



Master of Architecture students Tammy Felker and Tom Keeling install plywood subfloor



Joist deflection required removal, reinstallation of plywood after straightening the joist



Plywood subfloor installed, topping slab to follow

To effectively isolate the interior space from the deteriorated paint, and to make space for plumbing, and electrical systems, and compensate for the wall deformations, interior partitions will be constructed one and one - half inches away from the walls. These partitions, the ceiling they support, electrical systems, and plumbing systems are currently under construction.

Interim Conclusion:
In undertaking the stages of the work, we are attempting to evaluate the impact of knowledgeable trades people using state of the art tools, as compared to untrained volunteers using do-it-yourself tools. Each stage of assessment, demolition, repair and reconstruction is being photographically documented to provide illustrations for the true product of this study, a low - tech guide to renovation of shipping containers for single room occupancy housing units. (Figure 11 sample page) This guide will address safety and regulatory issues facing coordinators of volunteer laborers, tools required, materials required, prior preparations, time to complete the work, and step by step documentation of the work, and the volunteers thoughts about process improvements, appropriateness of skill level, and effectiveness of tools. Our goal is to facilitate the hands on development of the containers in a teaching / jobs training environment by a non-profit housing providers hopefully while licensed building professionals are constructing foundations, corner closures, fire stairs, elevators, parking and site work. The containers would be trucked to the jobsite, stacked up on the foundations, connected to the central mechanical / electrical systems for rapid project completion.

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