

Q-BRACE GUIDELINES

INTRODUCTION

These guidelines provide directions for proper restraint of common building contents in typical spaces on the UC Berkeley campus. The individual detail sheets are designed to cover common contents in each kind of space, and the materials called for are generic supplies available in most hardware and building supply stores. Some equipment is also available on campus at the Molecular and Cell Biology (MCB) storerooms. For more information call 3-8998 or see <http://mcb.berkeley.edu/main/storerooms/>.

In some cases, a unique design may be necessary. If you can't find directions here for the equipment you are bracing or the unique situation you confront, contact Patrick Kaulback in EH&S (2-3073, pkaulback@berkeley.edu). Because bracing is subject to review by the EH&S contract engineer, it's most cost-efficient when the person performing the work understands and follows all directions.

Although some of the bracing can be performed by staff in your department, craftspeople from Physical Plant, the Academic Facilities Office, or departmental shops will be needed to install the more complicated bracing.

GENERAL NOTES

I. Source of Material

- A. Information on "typical" contents of labs was collected by Professor Mary Comerio, of the Department of Architecture, and her research assistant, and was completed in late 2002.
- B. Typical seismic restraint details were developed by Rutherford & Chekene, Consulting Engineers, Oakland, CA.*

II. Intent of Basic Restraint - The details shown here are intended to prevent excessive movement of the various elements during strong earthquake motion. The restraint is expected to protect occupants from serious injury and to reduce significantly the incidence of functional damage to the component.

- A. Protection of functionality: Continued functionality of restrained components following an earthquake is dependent on both the basic restraint and the susceptibility of the component to shocks transmitted through the restraint, or - in the case of smaller bench top equipment - the susceptibility of the component to overturning. Functionality may also depend on continued utility services such as water, electricity, or gases, which are not addressed in these details.
- B. Protection of contents: Shelving, racks, refrigerator/freezers, incubators, etc. must be restrained, but in addition the contents must be protected from falling from the storage location.
 1. Shelving: Typical shelving is provided with perimeter lips approximately 1.5 inches high. For sensitive contents, or for contents with heights greater than 3 inches, lips of one-half the height of the contents should be installed. For further protection, racks or trays separating individual contents should be installed on shelves.
 2. Refrigerator/freezer: Positive door latches are necessary to protect the contents of each refrigerator/freezer. For further protection, racks or trays separating incompatible contents should be used.

III. Materials, Fabrication, and Installation

- A. Prefabricated restraint devices: When these details reference "Worksafe" devices, they are specifying Worksafe Industries™ products. Alternate manufacturers of similar products should be asked to certify equal quality with Worksafe Industries™ products.
- B. Slotted channels: When these details refer to "Unistrut" devices, they are specifying Unistruct Corporation™ products. Alternate manufacturers of similar products are available.

- C. Fabricated steel components: Fabrication should comply with the Code of Standard Practice for Steel Buildings and Bridges.
1. Materials
 - a. Steel plates, Shapes, and Bars: ASTM A 36
 - b. Steel tubing: ASTM A 500
 - c. Steel pipe: ASTM A 53
 2. Fabrication - All welders should have passed AWS (AWS D 1.1, Structural Welding Code) qualification tests for the welding processes involved and, if pertinent, undergone recertification.
- D. Fasteners:
1. Lag bolts: ASME B18.2.1
 2. Wood screws (flat head, carbon steel): ASME B18.22.1
 3. Expansion anchors to concrete: Anchors with current ICBO approval for use under specific conditions (diameter, embedment, through metal deck, etc.). Install in strict conformance with approval requirements and manufacturer's recommendations. A reasonable number (~25%) should be torque tested in accordance with approval requirements.
 4. Epoxy anchors: Anchors with current ICBO approval for use under specific conditions. Select to minimize chemical off-gassing. Before installing, confirm with occupants that use is acceptable. Do not use in overhead configuration. Install in strict conformance with approval requirements and manufacturer's recommendations.
 5. Adhesive tape/cloth: 3M VHB. Clean surfaces and install according to manufacturer's instructions. Apply pressure with 1-inch roller. Do not load for 72 hours. Do not use under conditions of constant loading.
- E. Exterior backing bars
1. Slotted channel members as called for in details, directly connected to the flanges of at least three metal studs. The end of the slotted channel should be extended 1 inch minimum and 6 inch maximum beyond the centerline of the outside stud.
 2. Exterior backing bars may be installed over four or more studs to provide a wall attachment for various pieces of equipment. Stud locations should be determined with a metal detector or by probing.
 3. Connection to gypsum board, plaster, or other wall surface material is not permitted without testing. Toggle bolts may be used for plaster walls with pencil studs or wire netting. Loads of greater than 50 pounds should be checked by an inspector or an engineer.

* Rutherford and Chekene understands that the Q-Brace seismic anchorage program is targeted at building contents, is voluntary (not required by code), and is intended to reduce damage and disruption to these items and the surrounding spaces from earthquakes, primarily by preventing excess movement. Most of the equipment and components are not, in themselves, designed for seismic forces nor are potential building support points (desks, benches, partitions, etc.) and it is generally not practical or cost-beneficial to remedy these potential deficiencies. Therefore, the anchorage recommended is generally intended to reduce movement, but not prevent all damage, particularly in large ground motions. To further minimize or prevent damage, to preserve data, or to increase the protection for valuable equipment, special non-Q-Brace details may be required, developed specifically for a specific performance objective and specific support conditions.

DETAILS

Securing Computers (C-1a and C-1b)

Computer equipment includes monitors, CPUs, printers, faxes, and other typical desktop office equipment. Such equipment can be secured to desk, table and counter tops with a variety of devices. Be sure the furniture is strong and stable, and the surface is clean so adhesives stick. Appropriate straps and fastening devices are available in hardware stores, building supply stores, laboratory supply stores, and the MCB storerooms (3-8998, <http://mcb.berkeley.edu/main/storerooms/>) Several manufacturers or suppliers are listed in the details. Follow specific manufacturer's directions. Computer bracing can be installed by department staff.

Door and Drawer Latches (no details)

There are a variety of ways to correctly latch doors and drawers. Positive latches or door locks made for seismic application can be found in hardware or home improvement stores. Other specialty latches—for refrigerator doors, for example—are available through the MCB Storerooms. (3-8998, <http://mcb.berkeley.edu/main/storerooms/>)

File Cabinets (F-1 and F-2)

File cabinets should be positioned against walls (F-1) for greatest stability. One or more can be fastened to the same wall (into the studs), as shown in F-1. File cabinets not positioned against a wall should be ganged (F-2) to increase their stability.

Shelving (S-1 to S-4)

Bookshelves over three feet tall should be positioned against walls for greatest stability, as shown in S-1. Each one should be fastened to the wall (into the studs), as shown. Bookshelves not positioned against a wall should be fastened to the floor, at a minimum (as shown in S-2). Better yet, they should be ganged back-to-back to increase their stability (S-3, B-4). Freestanding cabinets can be ganged side-by-side to increase their stability (S-4, B-4).

Library shelving systems require evaluation by the Library Architect or campus building inspector. Retrofit plans should be made in consultation with each system's manufacturer.

Shelf Restraints (S-5)

Shelves containing heavy hardbound books or artifacts should have shelf restraints to prevent the objects from becoming potentially deadly airborne missiles. Shelves containing chemicals or biological materials should have restraining lips to prevent containers from tumbling off and becoming potentially hazardous mixtures. It is very important to make the lips tall enough to keep the containers on the shelf: taller containers require higher lips. The minimum lip height is 2 inches. Large or particularly fragile containers should be restrained by individual straps, as shown in S-5.

Wall and Floor Anchors (B-1, B-2, B-3)

Detail B-1 shows typical wall anchors for file cabinets and shelves. Detail B-2 shows appropriate anchors for cabinets and shelves standing on wood floors. Detail B-3 shows an appropriate anchor for cabinets and shelves standing on concrete floors. Note that each detail specifies different fasteners depending on the wall or floor material. What is appropriate for wood studs and wood floors differs from what is appropriate for concrete floors or metal stud walls. Follow the directions carefully.

Warnings:

- 1) Toggle bolts mounted into gypsum board or plaster are not acceptable.
- 2) Nails are never allowed for any anchorage.
- 3) Dust generated when drilling into concrete may set off fire alarms if smoke detectors are located nearby. Use best management practices to control the dust (i.e., shop vac) or contact PP-CS (2-1032) to temporarily disable the fire alarms.

Gas Cylinders (T-1 to T-5)

Compressed gas containers cylinders and tanks should be protected against tipping, falling and rolling. The best way to do this is to chain or cable the top AND bottom of each container to a fixed object like the wall or a rack. Multiple containers can be chained or cabled into a rack. Details T-1 and T-2 show cylinders in racks. Detail T-3 shows the basic configuration for a cylinder at a wall. Detail T-4a is specific to metal stud walls, and Detail T-4b is specific to a concrete wall. Different types of walls require different fasteners. Detail T-5 shows a floor-mounted constraint for a short and fat tank.

Bench top Equipment (E-1 to E-4)

Bench top equipment requires different fastening systems depending largely on weight. Detail E-1 is for heavy (150-250 lbs) equipment. Detail E-2 is for moderately heavy (50-150 lbs) equipment. Details E-3 and E-4 are for various kinds of light (less than 50 lbs) equipment.

Refrigerators (R-1)

Detail A-1 specifies how to brace small (residential style) refrigerators against walls. After they are braced, the doors should also be latched for optimal security (see Door Latches in Part I).

Freezers

Ultra low temperature freezers are so heavy that they need custom bracing. The bracing must be designed to take into account the weight of the freezer, the center of gravity (top or bottom), and the structural wall next to which the freezer stands. For assistance with freezers, contact Patrick Kaulback (2-3073, pkaulback@berkeley.edu) for referral to a specialist in Facilities Services.

Non-Standard Equipment

Details for bracing all equipment not covered here may have to be designed by specialists at EH&S and installed by craftspeople in departmental shops, the Academic Facilities Office, or Facilities Services. Contact Patrick Kaulback (2-3073, pkaulback@berkeley.edu) with specifics about your equipment and setting. All details must conform to Title 24 of the California Administrative Code, and the bracing of all non-standard equipment will be inspected by an EH&S representative.

Warning:

Nothing that hangs on a wall or ceiling is considered generic. Contact Patrick Kaulback (2-3073, pkaulback@berkeley.edu) for assistance.

BRACING DETAIL ILLUSTRATIONS

Computer Bracing, Detail C-1a

Computer Bracing, Detail C-1b

Free Standing File Cabinets, Detail F-1

Free Standing File Cabinets, Detail F-2

Shelving at Wall, Detail S-1

Free Standing Shelving, Detail S-2

Free Standing Ganged Units, Detail S-3

Free Standing Cabinet Ganging Detail S-4

Ganging or Mending Plate, Detail B-4

Shelf Restraints, Detail S-5

Wall Anchor, Detail, B-1

Wood Floor Anchor, Detail B-2

Concrete Floor Anchor, Detail B-3

Nitrogen Cylinder Restraint, Detail T-1

Gas Cylinder Corral, Detail T-2

Individual Tanks at Wall, Detail T-3

Universal Tank Restraint (Metal Stud Wall), Detail T-4a

Universal Tank Restraint (Concrete Wall), Detail T-4b

Low Profile Tank Restraint (Freestanding), Detail T-5

Benchtop Light Equipment, Detail E-1

Benchtop Heavy Equipment, Detail E-2

Benchtop Heavy Equipment, Detail E-3

Benchtop Heavy Equipment, Detail E-4

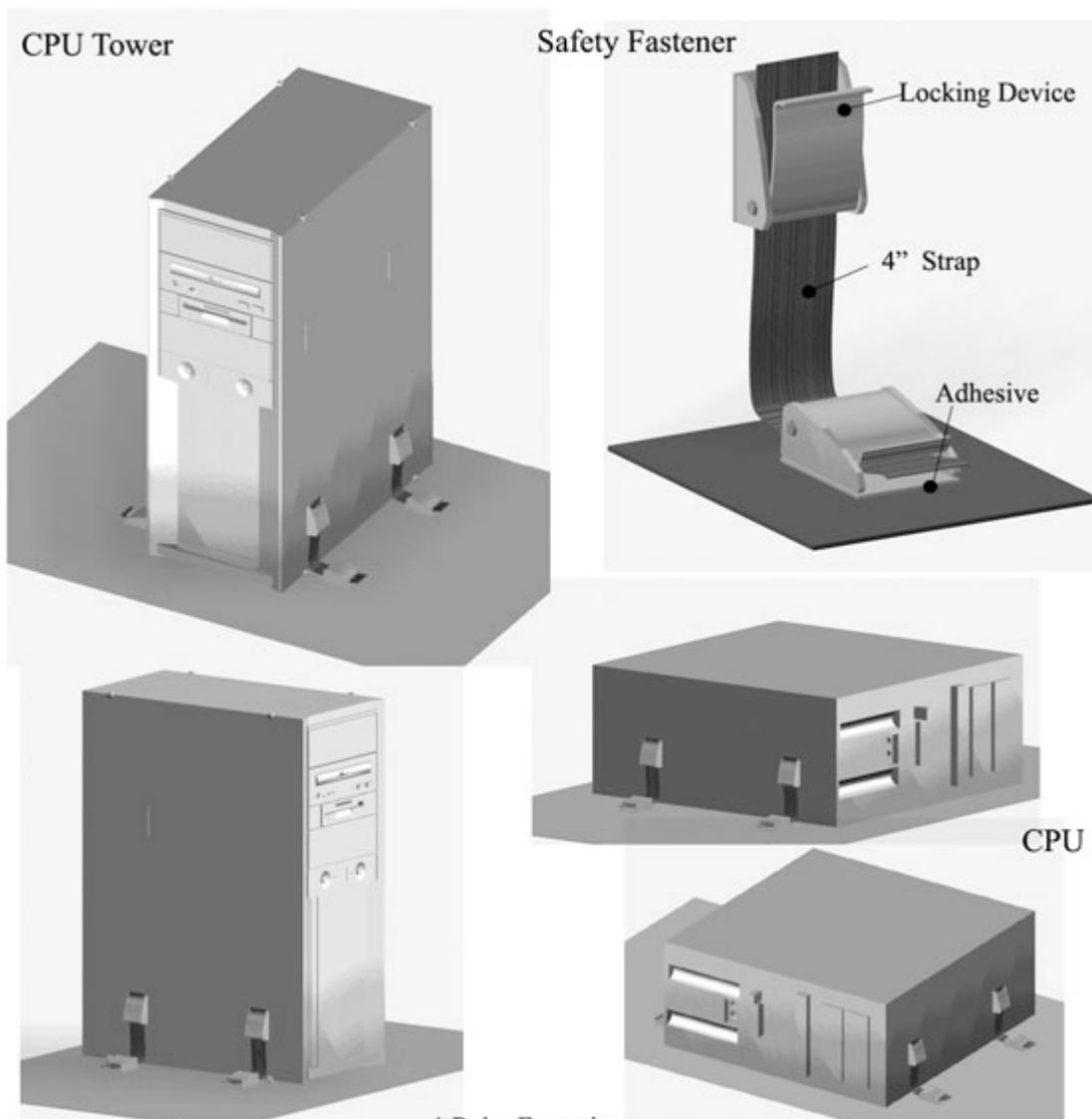
Residential Style Small Refrigerator, Detail A-1

Exterior Backing bar, Detail RT-1

Concrete Walls, Detail RT-2

Exterior Backing Bar, Existing Free Standing Cabinet Supports, Detail RT-3

<p>University of California, Berkeley Q-Brace Program</p>	<p>Computer Bracing Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: C-1a</p>



Common Brands:
 Worksafe: SeismaLoks SL4B
 Sciline
 Home Depot

4-Point Fastening
 - use for all CPUs

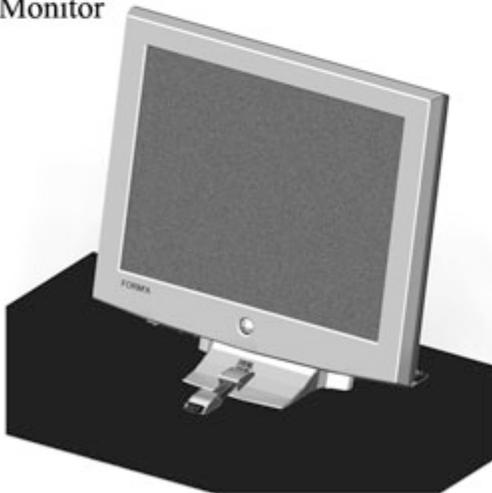
University of California, Berkeley Q-Brace Program	Computer Bracing Alternative Bracing May Be Approved. Contact EH&S at 642-3073	
	Date: September 2005	Detail: C-1b



Flat Monitor



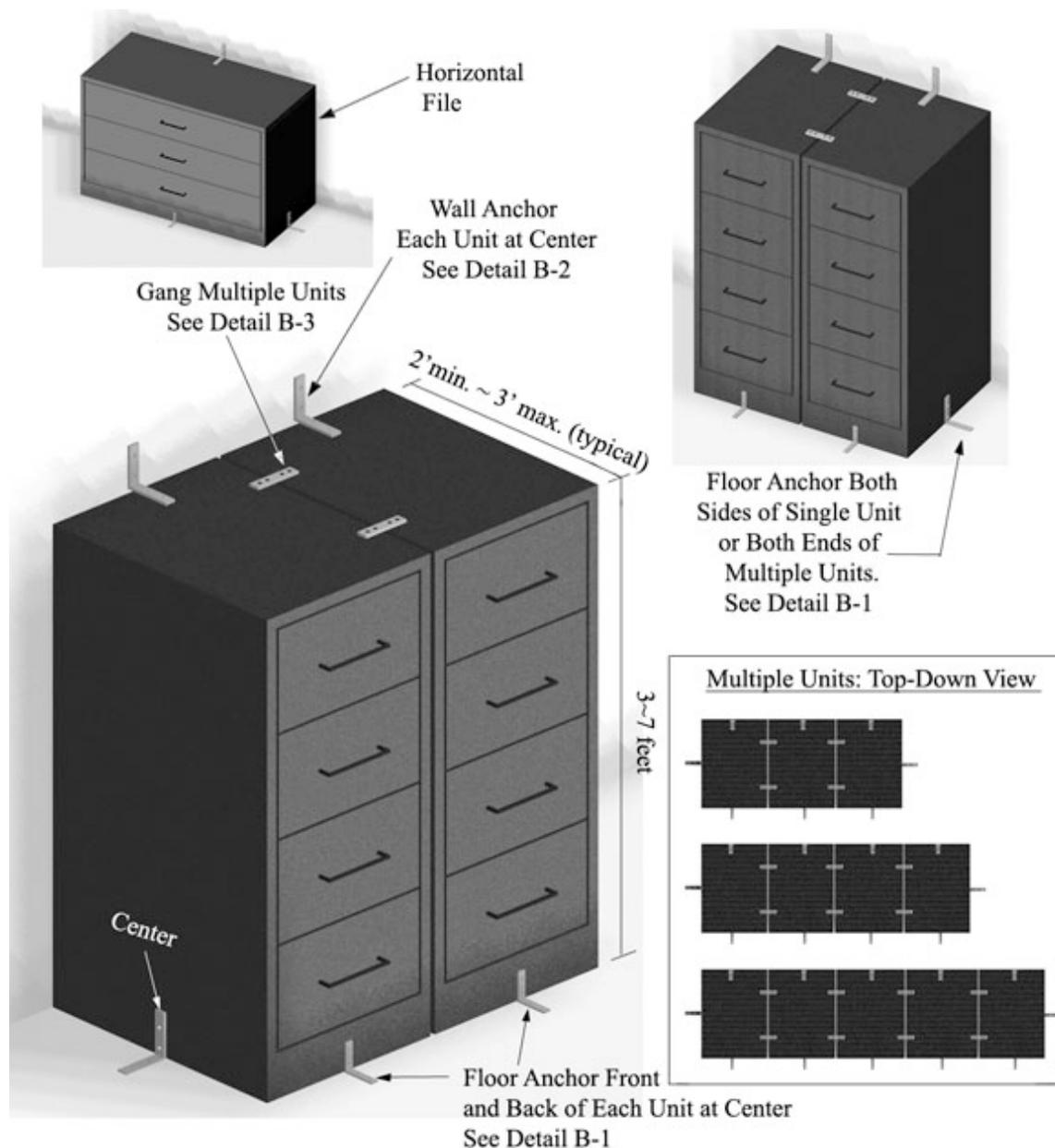
CRT Monitor



Common Brands:
Worksafe: SeismaLoks SL4B
Sciline
Home Depot

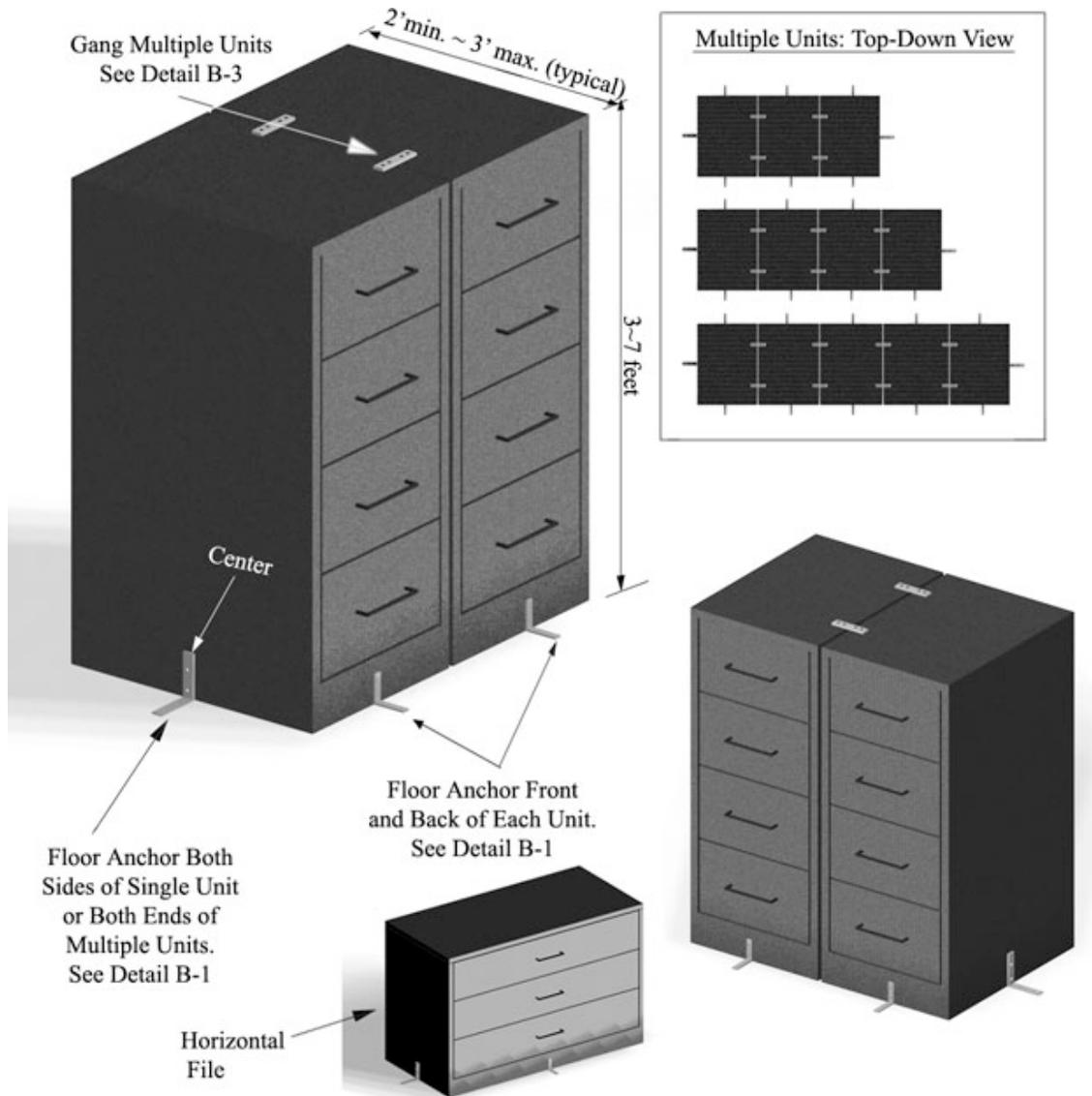
3-Point or 4-Point Fastening
- use for all monitors

<p>University of California, Berkeley Q-Brace Program</p>	<p>Free Standing File Cabinets Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: F-1</p>



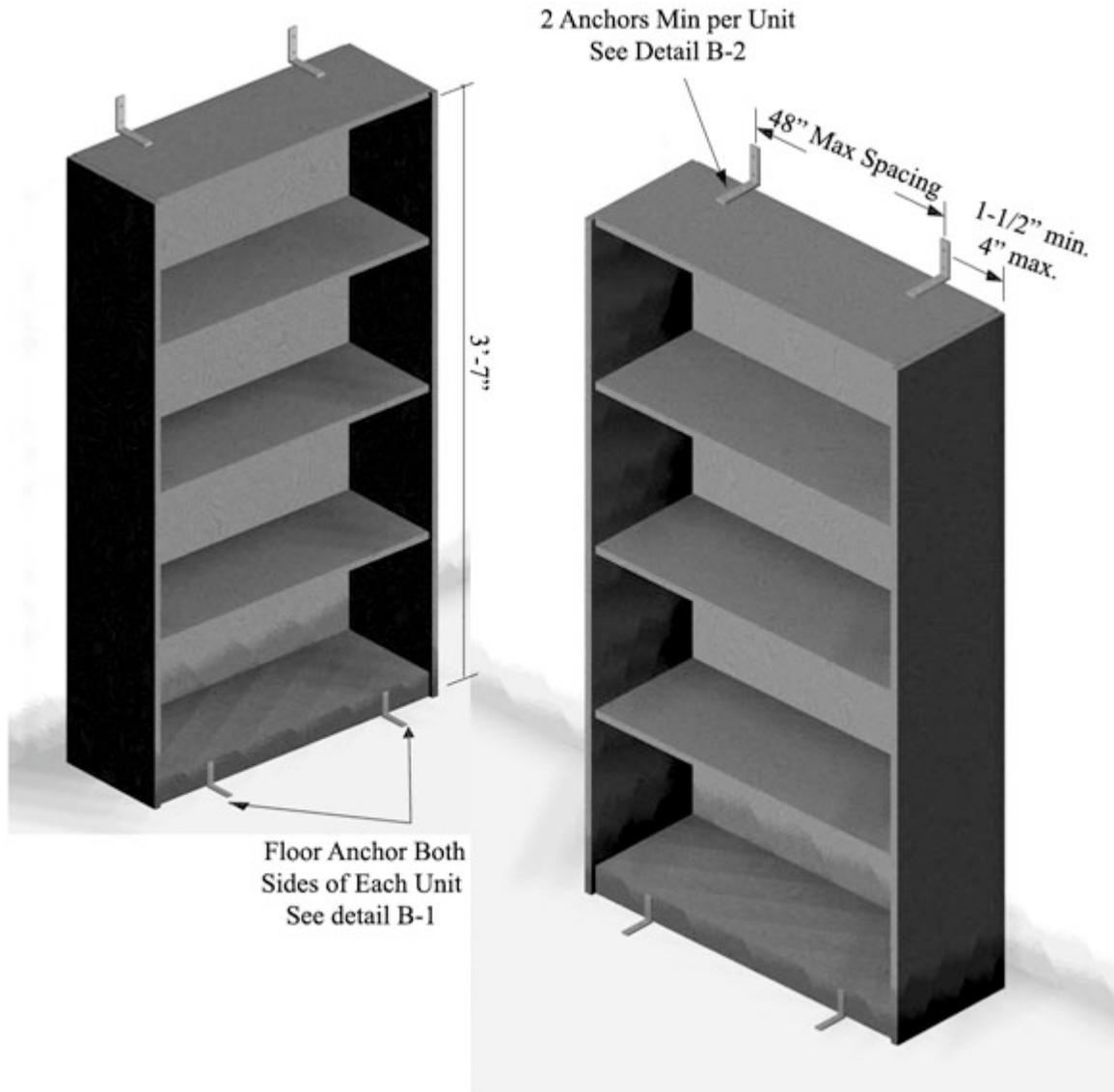
Free Standing File Cabinets
Detail F-1

<p>University of California, Berkeley Q-Brace Program</p>	<p>Free Standing File Cabinets Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: F-2</p>



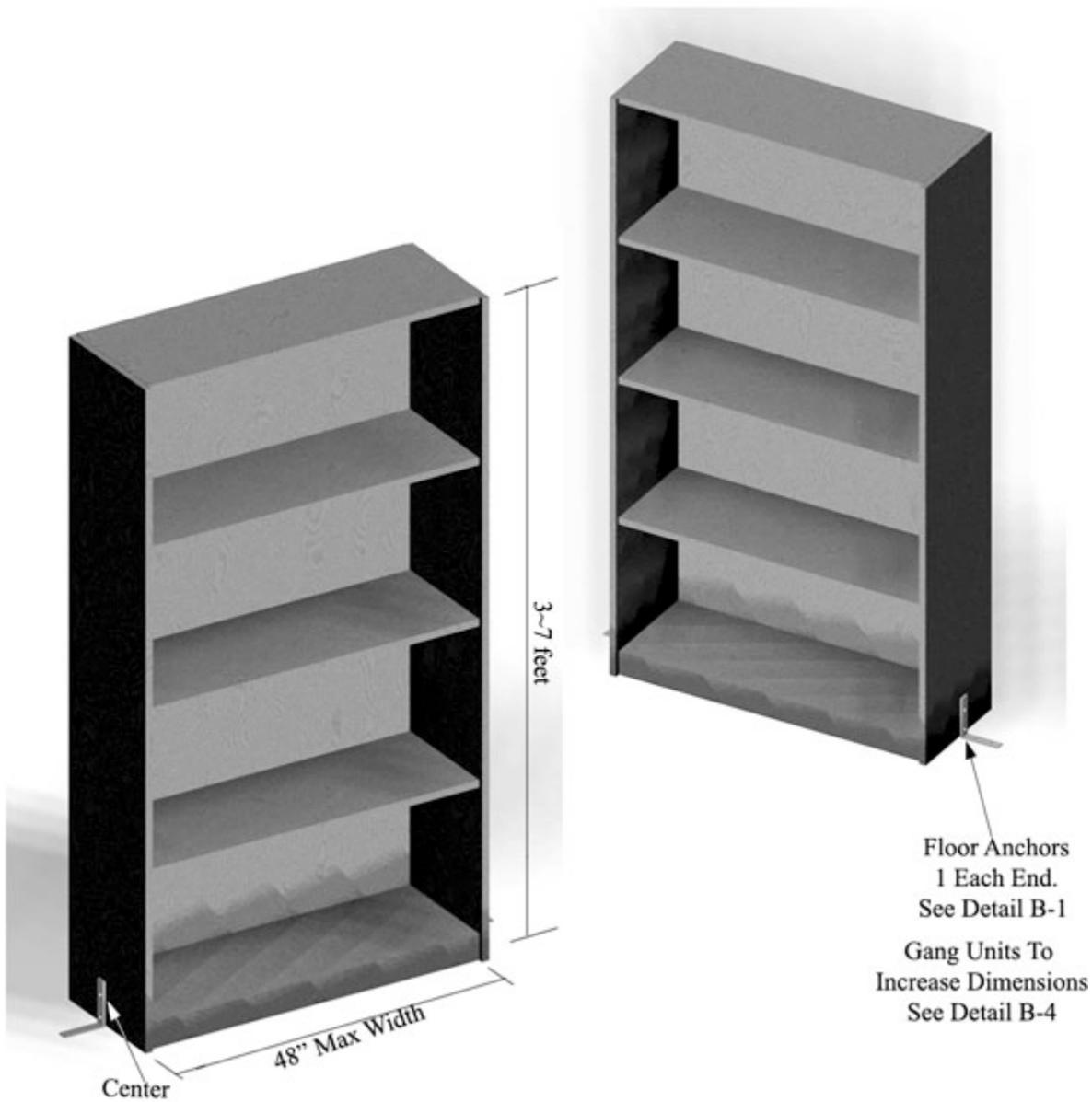
Free Standing File Cabinets
Detail F-2

University of California, Berkeley Q-Brace Program	Shelving at Wall Alternative Bracing May Be Approved. Contact EH&S at 642-3073	
	Date: September 2005	Detail: S-1



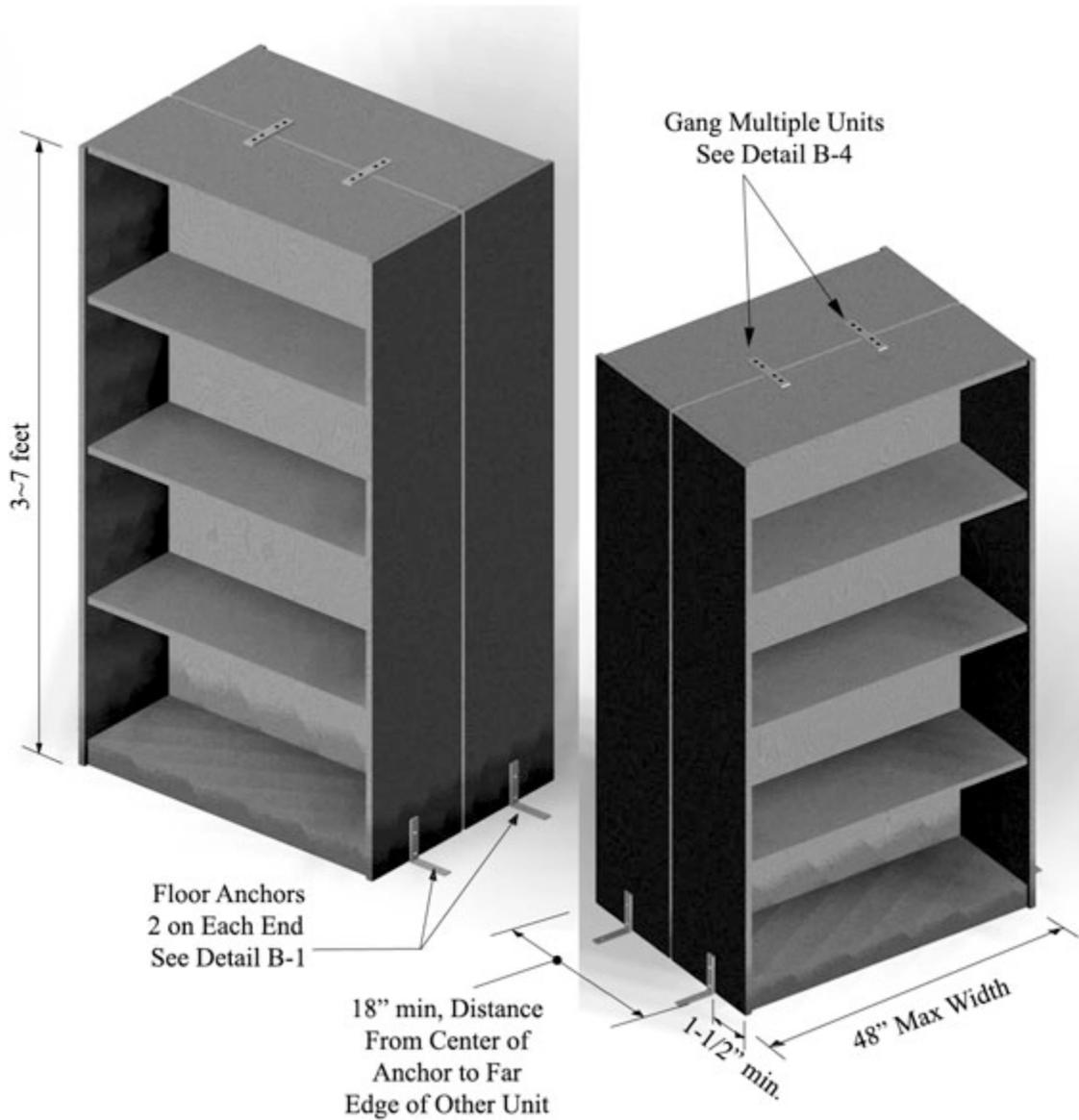
Shelving at Wall
Detail S-1

<p>University of California, Berkeley Q-Brace Program</p>	<p>Free Standing Shelving Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: S-2</p>



Free Standing Shelving
Detail S-2

University of California, Berkeley Q-Brace Program	Free Standing Ganged Units Alternative Bracing May Be Approved. Contact EH&S at 642-3073	
	Date: September 2005	Detail: S-3

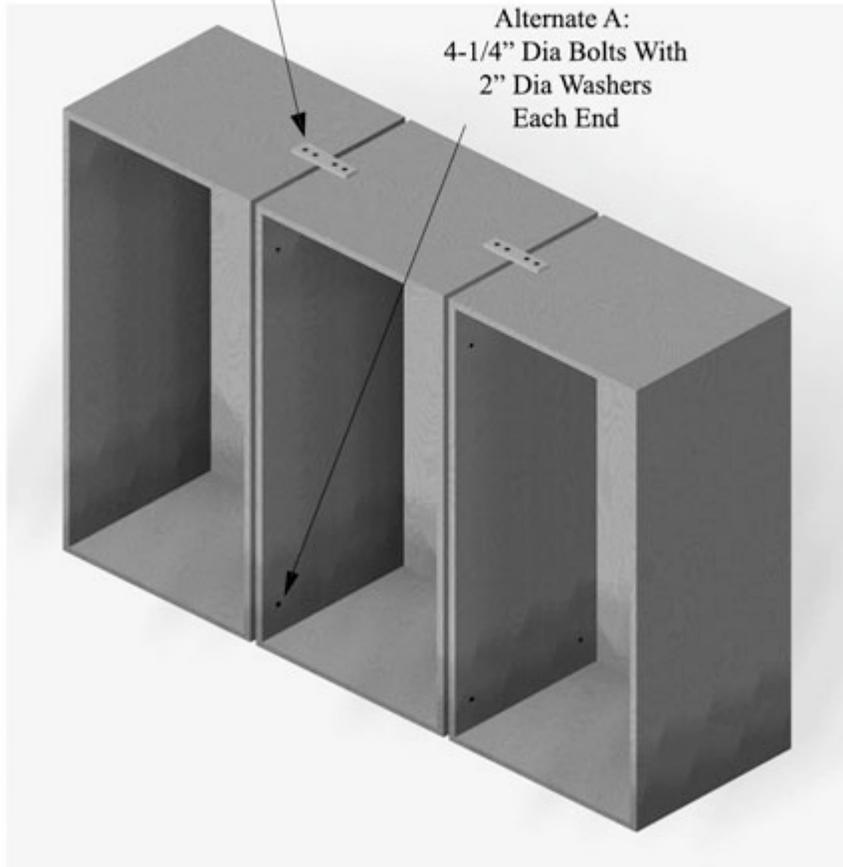


Free Standing Ganged Units
Detail S-3

<p>University of California, Berkeley Q-Brace Program</p>	<p>Free Standing Cabinet Ganging Detail Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: S-4</p>

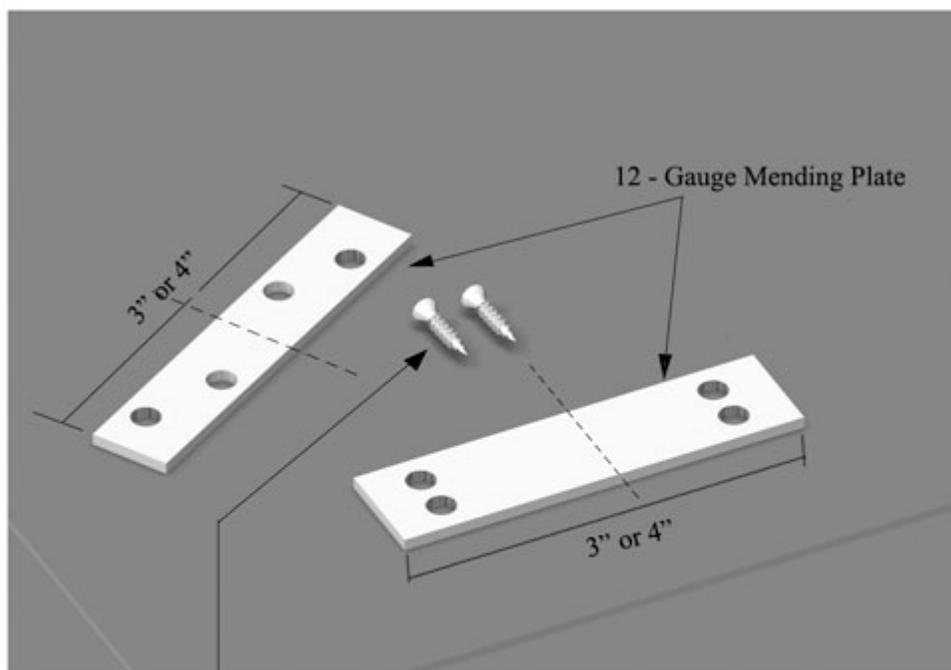
Alternate B:
Mending Plate: See Detail B-4
2-1/4" Dia Bolts
With 2" Dia Washers
Each Unit

Alternate A:
4-1/4" Dia Bolts With
2" Dia Washers
Each End



Free Standing Cabinet Ganging Detail
Detail S-4

University of California, Berkeley Q-Brace Program	Ganging or Mending Plate Alternative Bracing May Be Approved. Contact EH&S at 642-3073	
	Date: September 2005	Detail: B-4

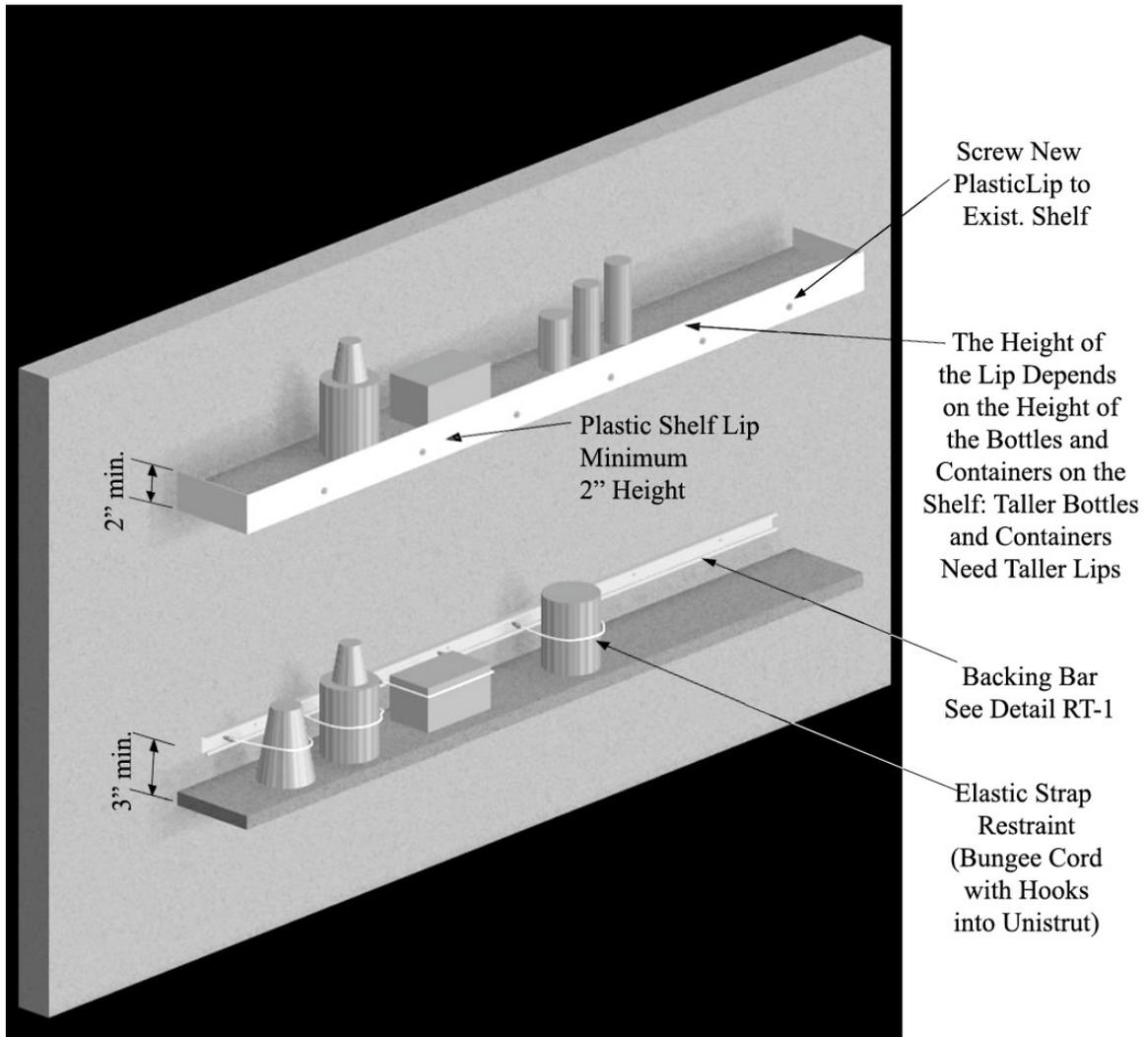


3/4" Long #12 Screw or 1/4" Dia Bolt with 2" Dia Washer and Bolt.

Wood screws go into wood shelves or cabinets
Sheet metal screws go into metal shelves or cabinets

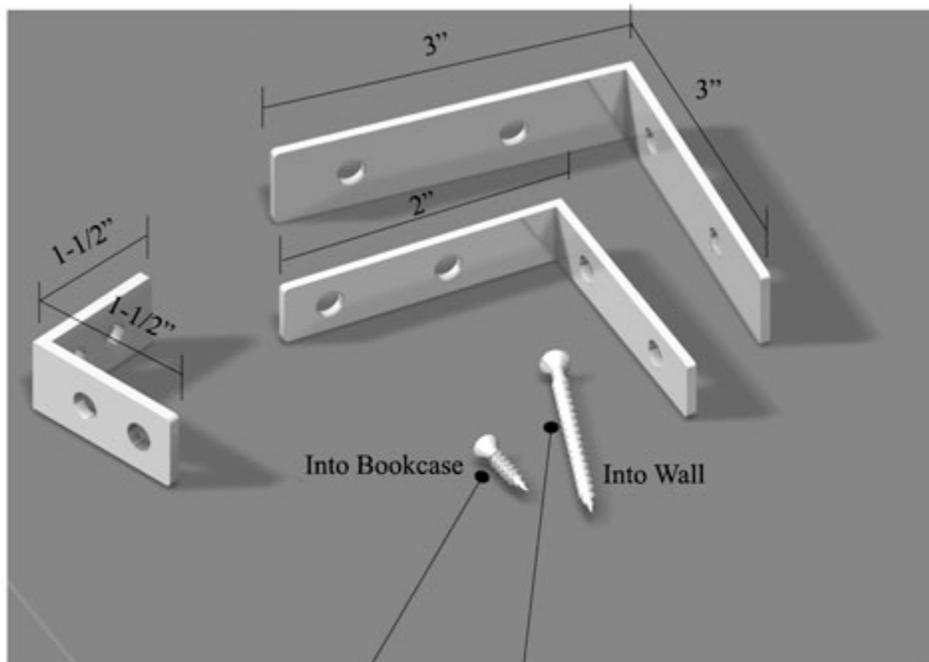
Ganging or Mending Plate
Detail B-4

University of California, Berkeley Q-Brace Program	Shelf Restraints Alternative Bracing May Be Approved. Contact EH&S at 642-3073	
	Date: September 2005	Detail: S-5



Shelf Restraints
Detail S-5

University of California, Berkeley Q-Brace Program	Wall Anchor Alternative Bracing May Be Approved. Contact EH&S at 642-3073	
	Date: September 2005	Detail: B-1



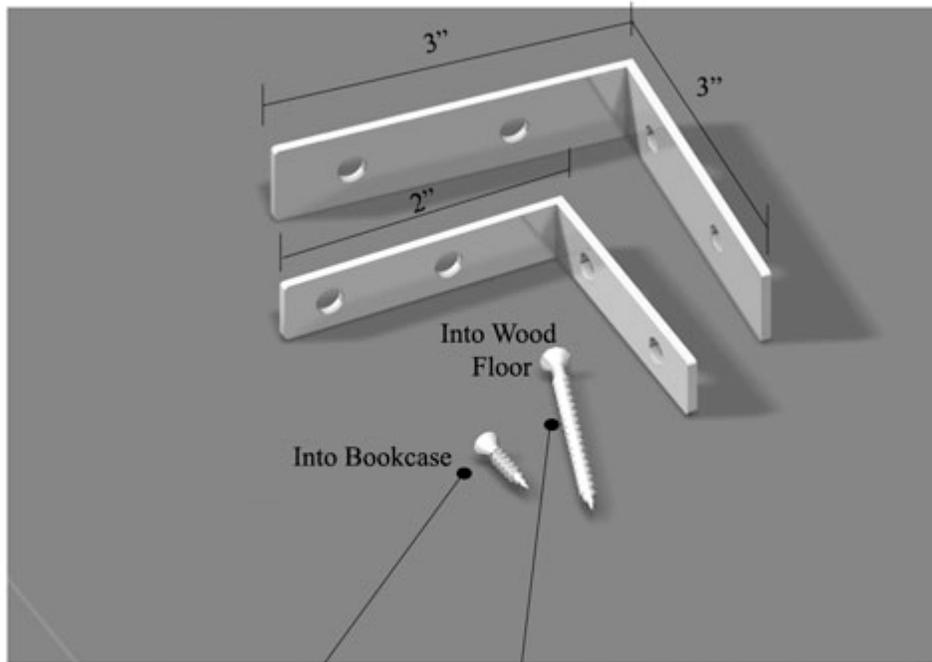
3/4" Long #12 Screw
or 1/4" Dia Bolt
with 2" Dia Washer and Bolt.

#12 Wood Screws (for Wood Studs):
2-1/4" long min.
#12 Sheet Metal Screws (for Metal Studs):
1-1/4" long min.

All screws must be embedded in studs.
- Wood screws go into wood studs.
- Sheet metal screws go into metal studs

Wall Anchor
Detail B-1

<p>University of California, Berkeley Q-Brace Program</p>	<p>Wood Floor Anchor Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: B-2</p>

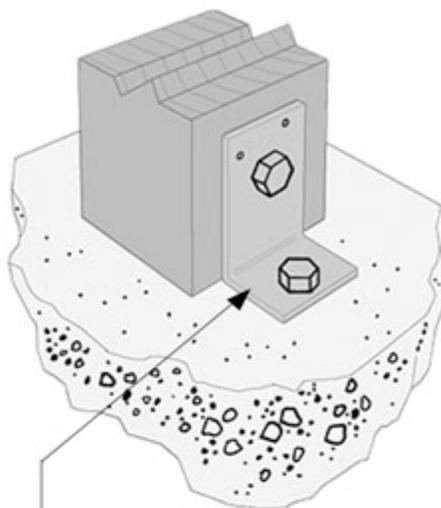


3/4" Long #12 Screw
or 1/4" Dia Bolt with
2" Dia Washer and Bolt.

#12 Wood Screws:
2-1/4" long min.

Wood Floor Anchor
Detail B-2

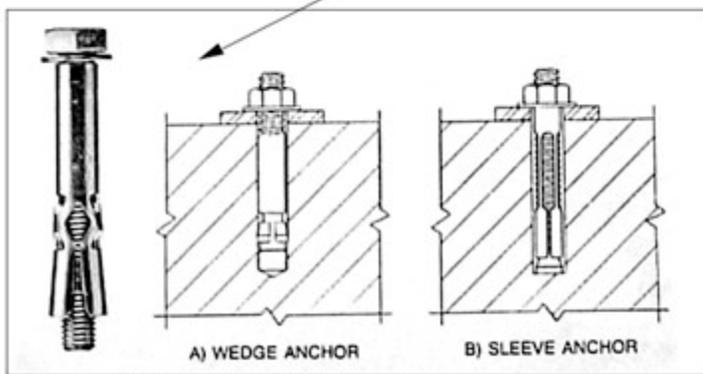
<p>University of California, Berkeley Q-Brace Program</p>	<p>Concrete Floor Anchor Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: B-3</p>



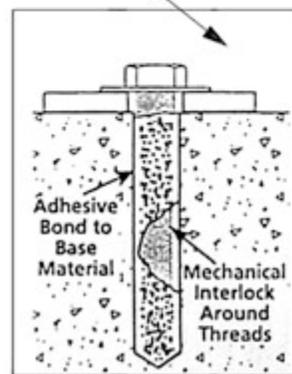
Angle
Simpson Strong Tie # A24
with 1/2" Bolts or Anchors

Use Expansion Anchors with 1-1/2" Embedment or

Epoxy Anchors
1/4" ~ 3/8" Diameters



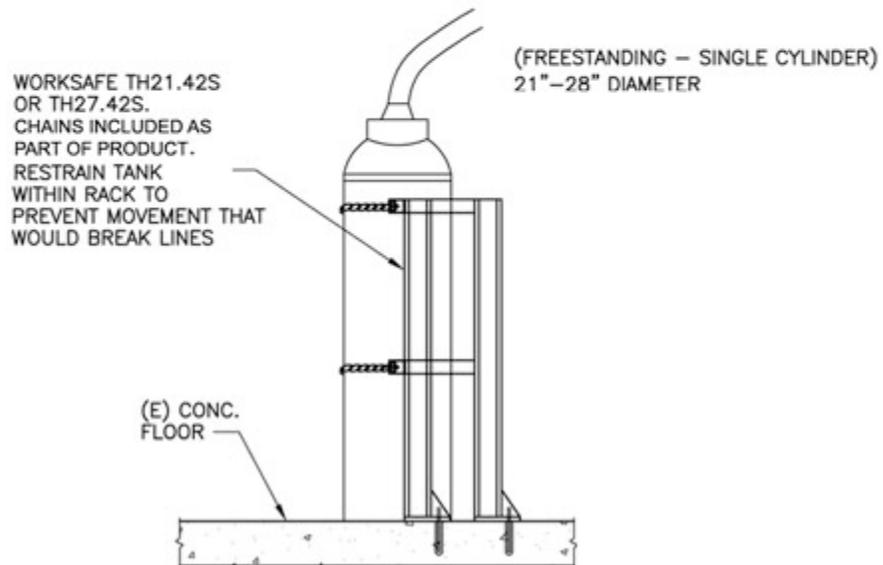
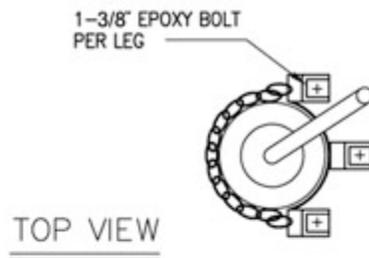
Typical Expansion Anchors



Typical Chemical Anchors

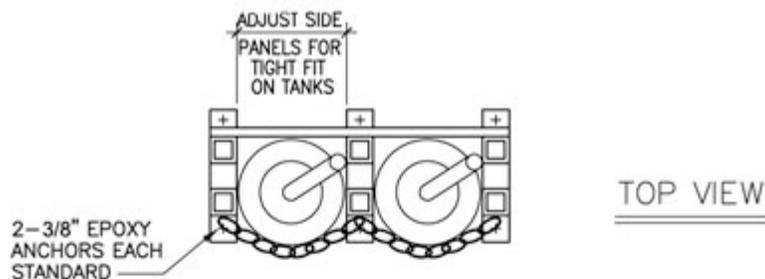
Concrete Floor Anchor
Detail B-3

University of California, Berkeley Q-Brace Program	Nitrogen Cylinder Restraint Alternative Bracing May Be Approved. Contact EH&S at 642-3073	
	Date: September 2005	Detail: T-1

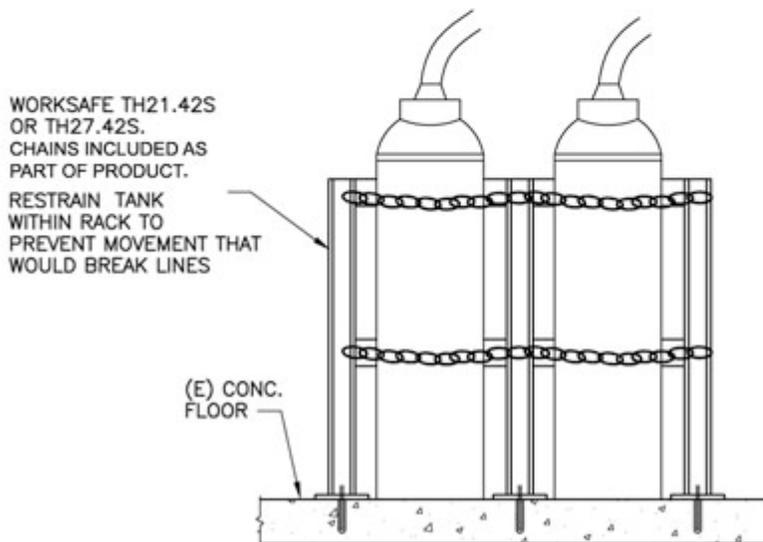


Nitrogen Cylinder Restraint
Detail T-1

<p>University of California, Berkeley Q-Brace Program</p>	<p>Gas Cylinder Corral Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: T-2</p>

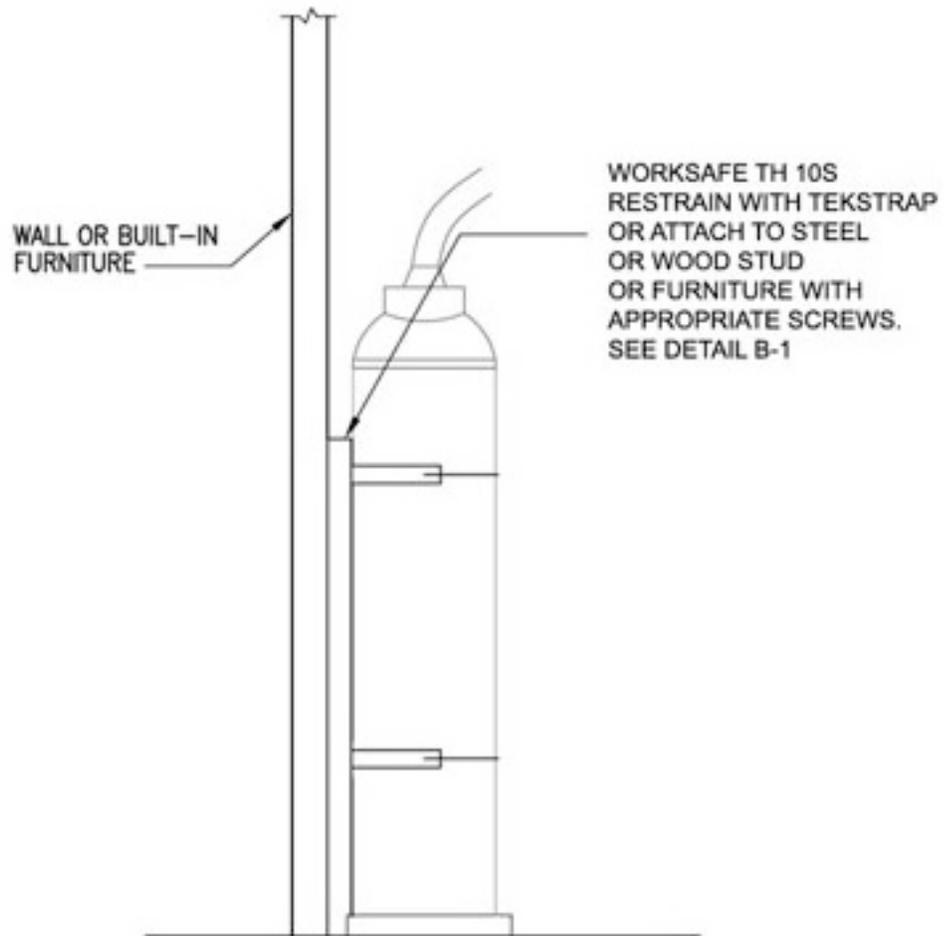


(FREESTANDING - MULTIPLE CYLINDERS)
10"-28" DIAMETER



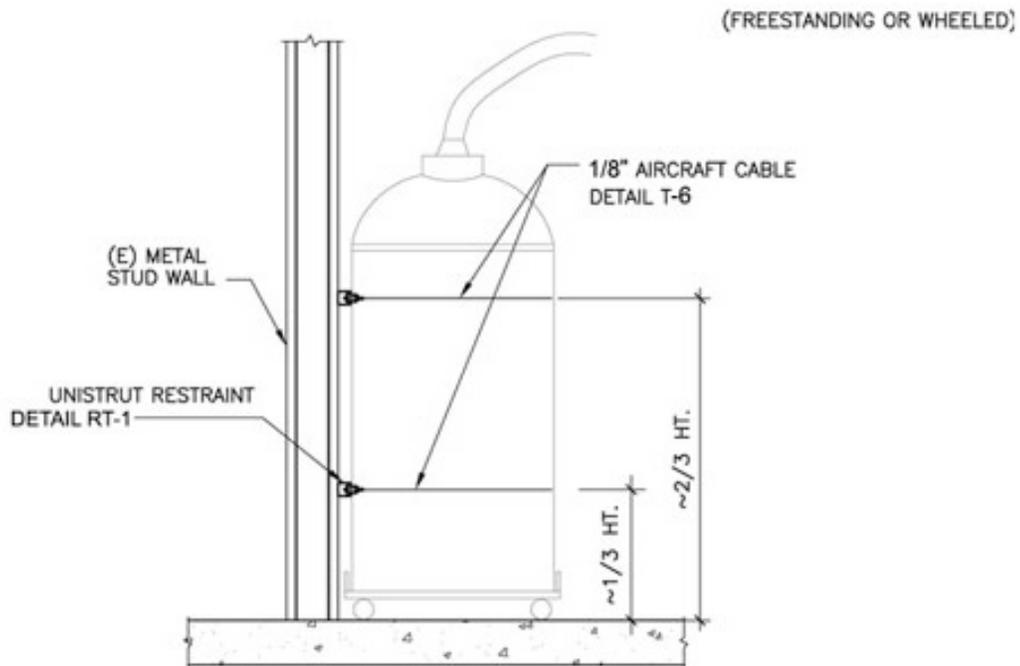
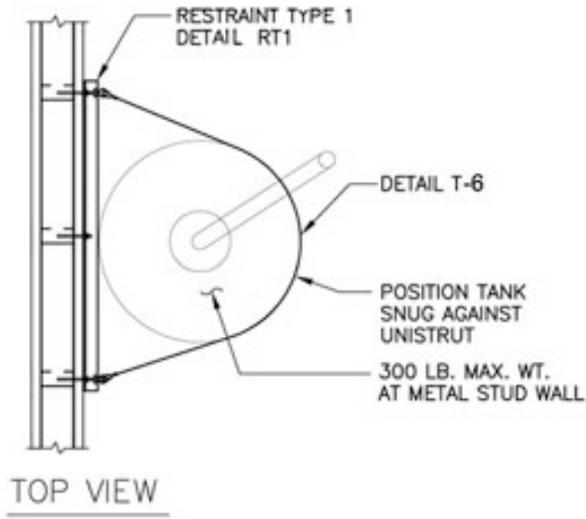
Gas Cylinder Corral
Detail T-2

University of California, Berkeley Q-Brace Program	Individual Tanks at Wall Alternative Bracing May Be Approved. Contact EH&S at 642-3073	
	Date: September 2005	Detail: T-3



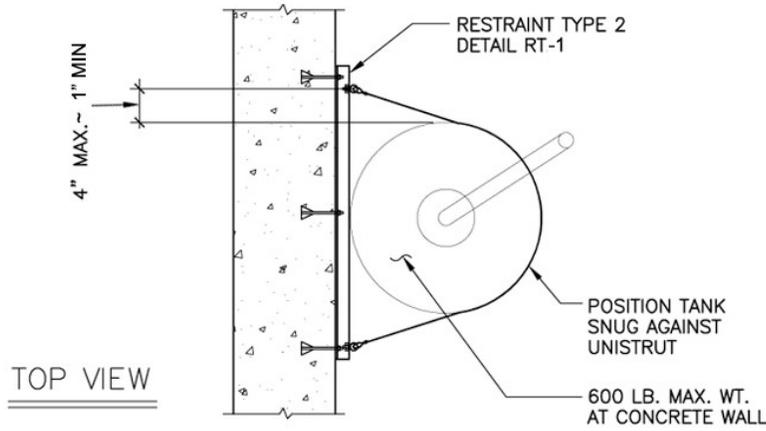
Individual Tanks at Wall
Detail T-3

<p>University of California, Berkeley Q-Brace Program</p>	<p align="center">Universal Tank Restraint (Metal Stud Wall) Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: T-4a</p>

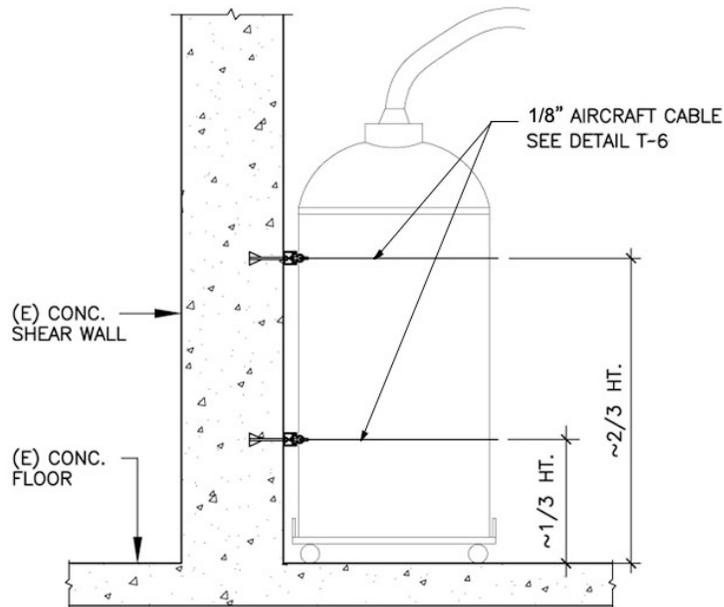


Universal Tank Restraint (Metal Stud Wall)
Detail T-4a

University of California, Berkeley Q-Brace Program	Universal Tank Restraint (Concrete Wall) Alternative Bracing May Be Approved. Contact EH&S at 642-3073	
	Date: September 2005	Detail: T-4b

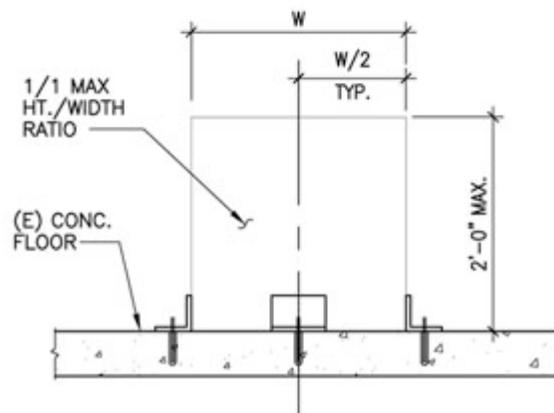
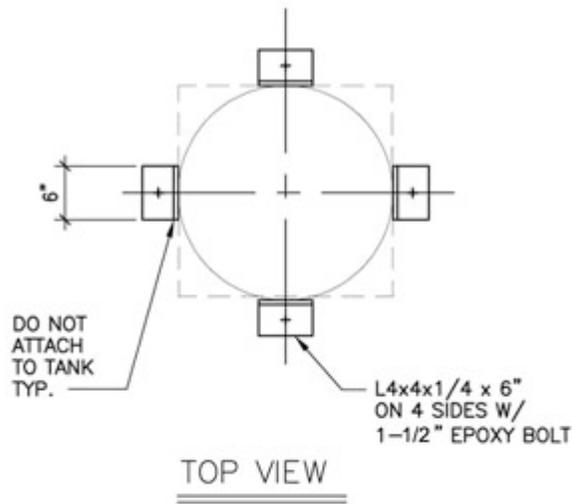


(FREESTANDING OR WHEELED)



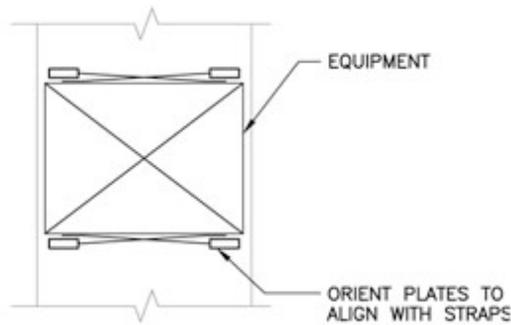
Universal Tank Restraint (Concrete Wall)
Detail T-4b

<p>University of California, Berkeley Q-Brace Program</p>	<p>Low Profile Tank Restraint (Freestanding) Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: T-5</p>

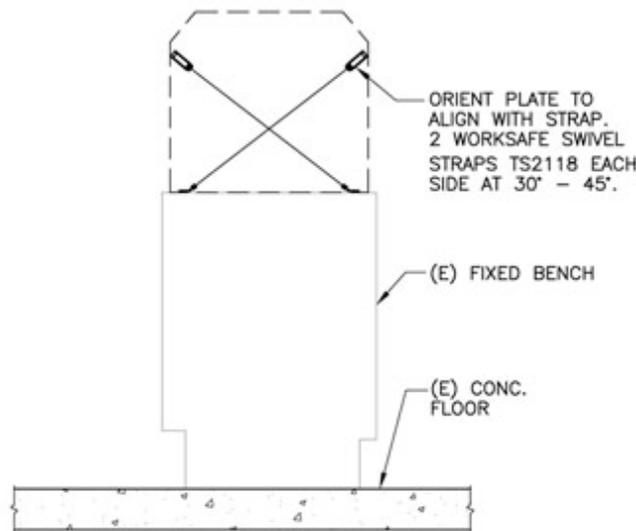


Low Profile Tank Restraint
(Freestanding)
Detail T-5

<p>University of California, Berkeley Q-Brace Program</p>	<p>Benchtop Heavy Equipment (150 – 250 lbs.) Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: E-1</p>

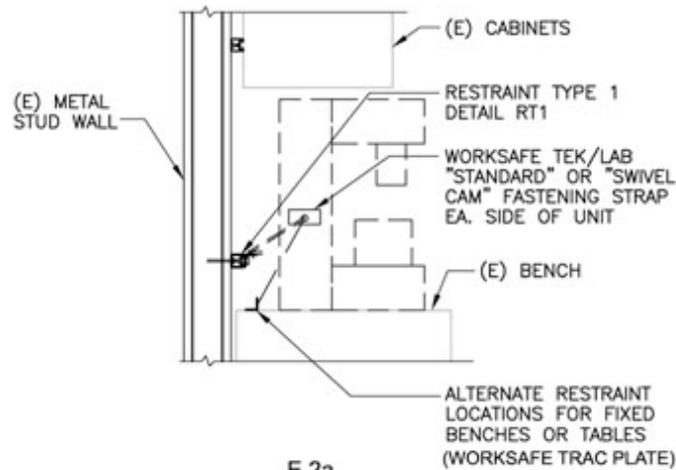


TOP VIEW

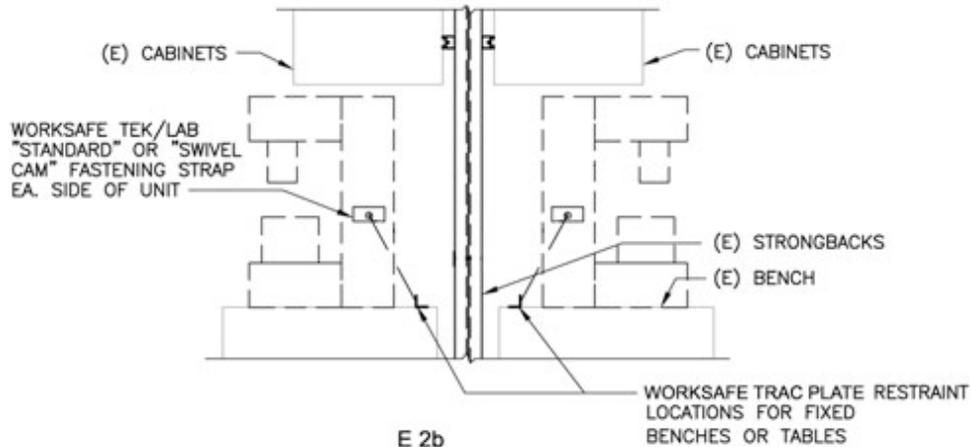


Benchtop Heavy Equipment
Detail E-1

<p>University of California, Berkeley Q-Brace Program</p>	<p>Benchtop Heavy Equipment (50 - 150 lbs.) Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: E-2</p>



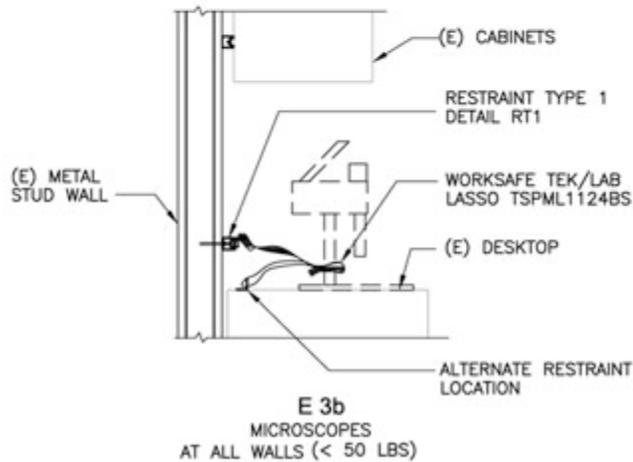
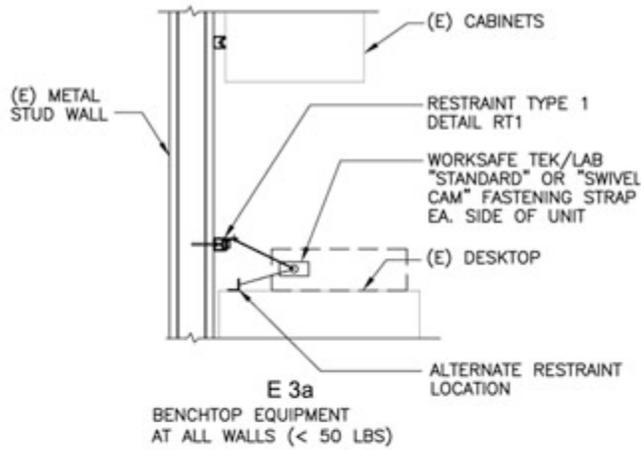
E 2a
AT ALL WALLS (50 LBS - 150 LBS.)



E 2b
AT ISLAND (50 LBS - 150 LBS.)

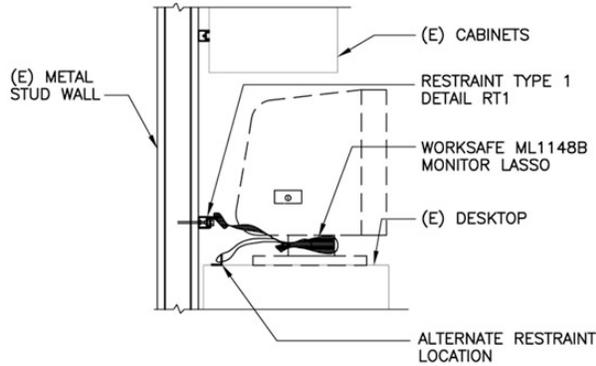
Benchtop Heavy Equipment
Detail E-2

University of California, Berkeley Q-Brace Program	Benchtop Light Equipment Alternative Bracing May Be Approved. Contact EH&S at 642-3073	
	Date: September 2005	Detail: E-3



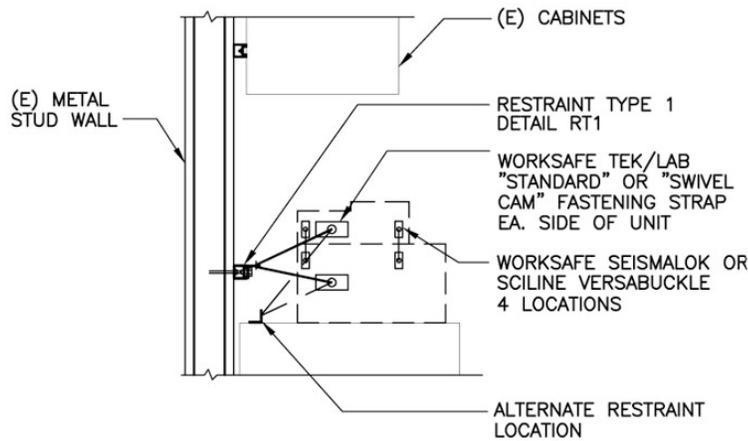
Benchtop Light Equipment
 Detail E-3

University of California, Berkeley Q-Brace Program	Benchtop Components Alternative Bracing May Be Approved. Contact EH&S at 642-3073	
	Date: September 2005	Detail: E-4



E 4a

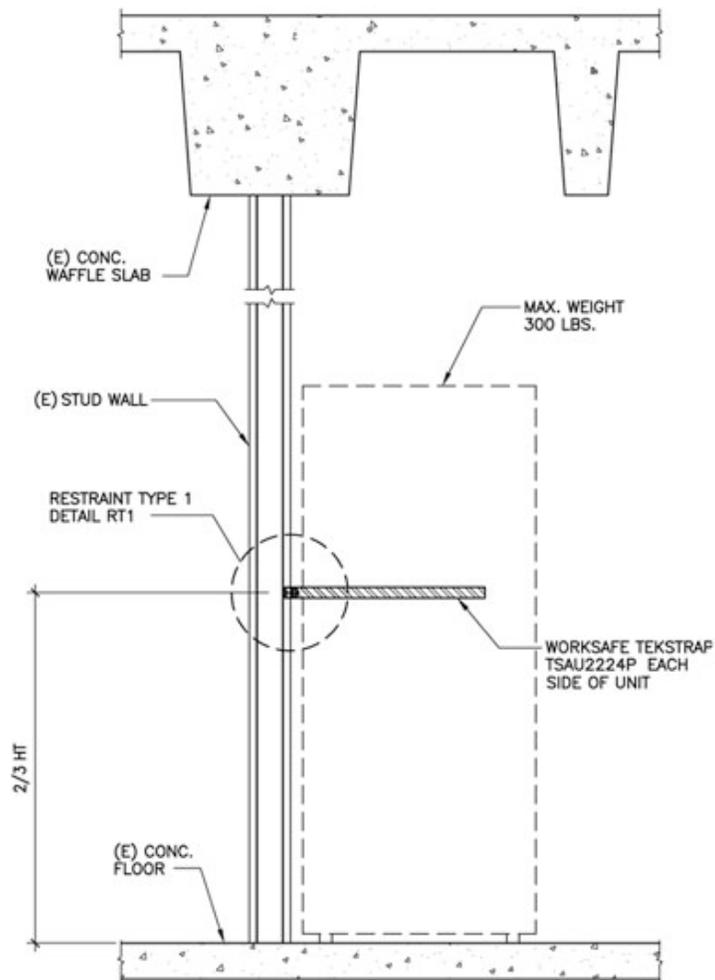
COMPUTER MONITORS
 AT ALL WALLS (< 50 LBS)



E 4 b

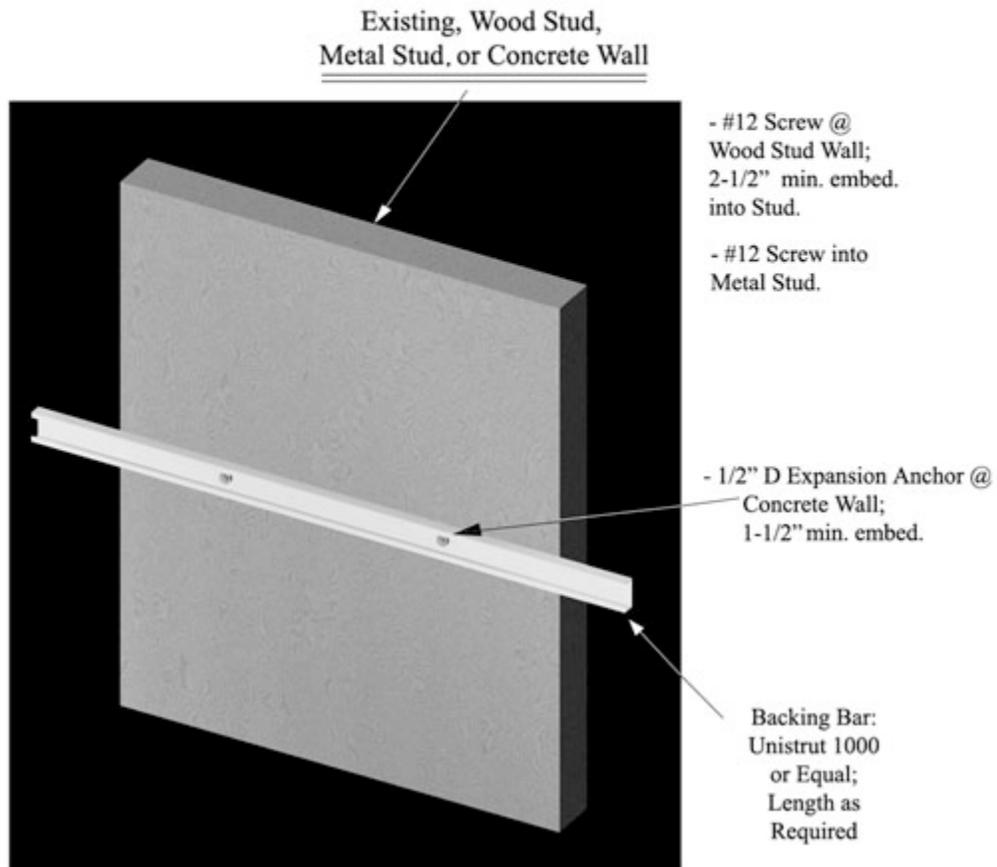
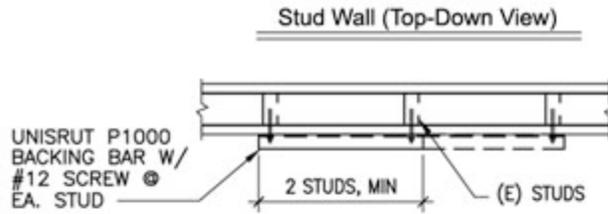
STACKED COMPONENTS
 (< 50 LBS)

<p>University of California, Berkeley Q-Brace Program</p>	<p>Residential Style Small Refrigerator Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: A-1</p>



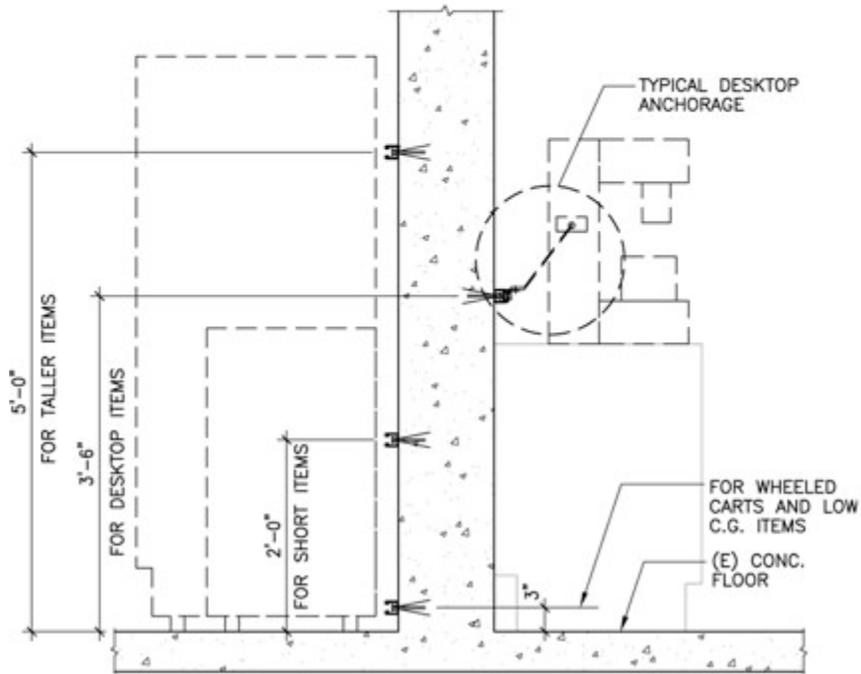
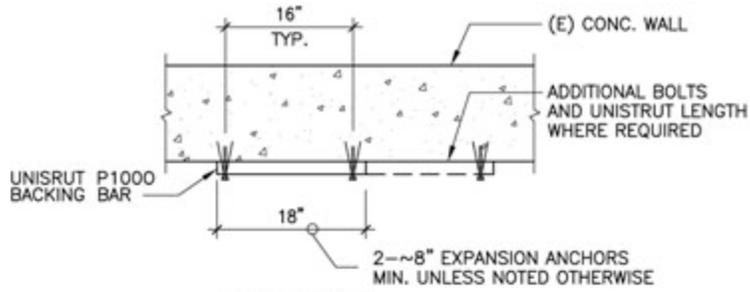
Residential Style Small Refrigerator
Detail A-1

<p>University of California, Berkeley Q-Brace Program</p>	<p>Exterior Backing Bar Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: RT-1</p>



Exterior Backing Bar
Detail RT-1

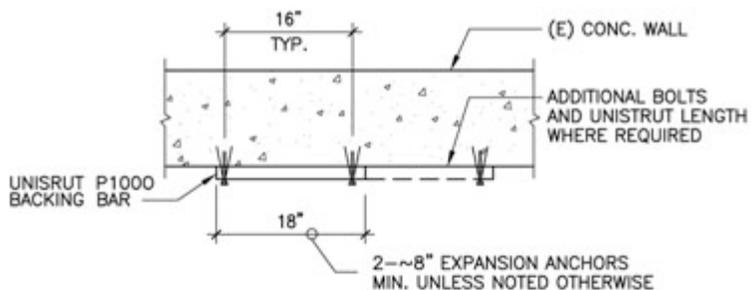
<p>University of California, Berkeley Q-Brace Program</p>	<p>Concrete Walls Alternative Bracing May Be Approved. Contact EH&S at 642-3073</p>	
	<p>Date: September 2005</p>	<p>Detail: RT-2</p>



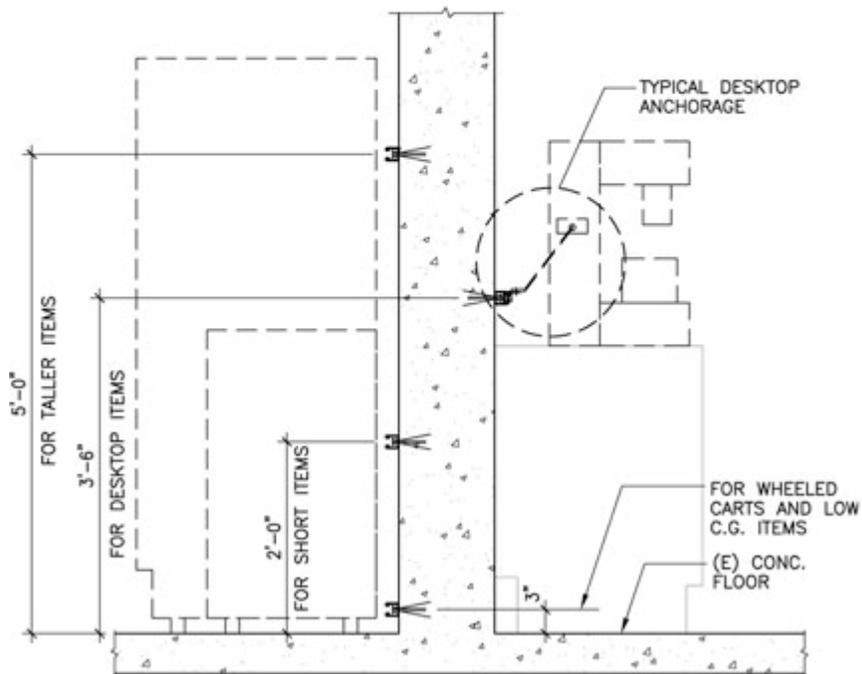
RESTRAINT TYPE 2

Concrete Walls
Detail RT-2

University of California, Berkeley Q-Brace Program	Exterior Backing Bar Existing Free Standing Cabinet Supports Alternative Bracing May Be Approved. Contact EH&S at 642-3073	
	Date: September 2005	Detail: RT-3



TOP VIEW



RESTRAINT TYPE 2

Exterior Backing Bar
Existing Free Standing Cabinet Supports
Detail RT-3