Construction Shop and BM&O Standards

Purpose

The following is a summary of guidelines and procedures for common plumbing, electrical and architectural installations. These include material selection, best practices for installation, and code adherence. These standards represent most installations. Special applications may differ from these guidelines.

Preparations

- Prior to beginning any work, a job number and phase shall be provided.
- Scope of work will be communicated and materials for the job will be procured.
- A print will often be required to assure full understanding. The lead mechanic is briefed on the job and should be consulted if there are any questions.
- Any interruption of utilities must be preapproved. Proper paperwork is completed by the project manager.
- Any work requiring torches, grinding, or significant creation of dust will require a hot work permit before starting.
- Special permits for live electrical work shall be obtained from the shop supervisor prior to start.
- Removal of hazardous waste will commence in accordance with the NCSU Hazardous Waste Program. Any concerns should be directed to the supervisor before any action is taken.

Safety

The Construction Shop is concerned with the safety of employees and others on every job site.

- The Facilities Operations Employee Safety Manual, available in the shop and on the NCSU site, is recommended reading for all employees.
- Safety facts are routinely made available in the shop and are to be read and signed when presented.
- Material Safety Data Sheets for commonly used materials are available in the shop.
- Mechanics shall be properly trained in the use of power tools and equipment.
- Any potential safety hazards or unsafe acts should immediately be reported to the supervisor.
- Immediately report any work related accidents involving injury or illness to the supervisor.
- Workers are encouraged to promote and maintain a safe work environment. Consider University faculty, staff, students, and visitors when scheduling and performing work.

Plumbing/HVAC Piping Standards

- General

  Piping shall be run straight, level, and plumb even if hidden in a wall or ceiling. It shall be properly insulated when carrying heated or chilled liquid. Hangers shall be installed to provide proper support and to prevent vibration and noise. All piping shall be tested prior to covering. Plumbing shall be installed compliant with North Carolina Plumbing Code and approved for use by NC State Construction Guidelines. Manufacturer installation instructions shall be followed. Add shut off valves whenever possible. When tapping into a main line consult BM&O before performing work.

- Piping Selection

  1. Piping conveying water shall be type 'L' copper. Press fittings are commonly used for connections up to 200 psi and temperature range -20°F to 250°F. Stainless braided hoses are the preferred choice for connections to fixtures where water temperatures are from 40 to 180 degrees. For applications exceeding these limits, soldering or brazing may be necessary.

  2. Piping for natural gas shall be steel pipe and malleable iron fittings. Soldered copper tubing should never be used. Connections within 30 inches may be soft copper tubing with mechanical fittings or stainless braided hose.

  3. Piping conveying compressed air shall be type 'L' copper or black malleable iron.

  4. Non-corrosive waste piping for major areas in public area shall be cast iron where temperatures will not exceed 212° F. No-hub type connections are preferred. Steel piping is discouraged whether or not it is galvanized. Heavy duty couplings will be used on wet, regular couplings can be used on vents.

  5. Piping for corrosive waste or temperatures above 212° F shall be lab certified CPVC or polypropylene.

  6. NO PVC PIPING ALLOWED ANYWHERE.

  7. No Pro-Press in mechanical rooms, ever.

  8. Condensate lines must be copper.

  9. Use of Pro-Press in installations outside of mechanical rooms and in branch lines, and is most often limited to compressed air lines and domestic cold/hot water installations. Anything 1 ½" and above in copper piping must be brazed. Pro-Press certification will be required of anyone using this system.

  10. Use of CPVC piping must be done by certified personnel.

	½"	¾"	1"	1 ¼"	1 ½"	2" and Greater
* Pro-Press	*	*	*	*		
Solder	* *	* *	* *	* *		
Braze					*	*

* Must be Qualified * Inside Mech. Room * Outside Mech. Room * All Locations

- Hangers

1. Hangers in contact with copper piping shall be copper coated. Others shall be aluminum, galvanized, or coated for corrosion protection.

2. Minimum spacing for pipe hangers shall be as follows :
    a) Copper, steel up to 1 in. - 7 feet
    b) Copper, steel 1 ¼ and up – 10 feet
    c) Lab Waste CPVC, poly – 5 feet

3. Split-ring type hangers are to be used for rigid vertical and horizontal support. 

4. Clevis type hangers are to be used primarily for insulated piping and drainage. 

5. Heavy insulated piping requires addition of pipe saddles. 

6. In typical piping installations, hangers shall be attached with 3/8 in. galvanized threaded rod.

Electrical Standards

- General

  Piping shall be run straight, level, and plumb even if hidden in a wall or ceiling. Hangers shall be installed to provide proper support and to prevent vibration and noise. Electrical shall be installed compliant with North Carolina Electrical Code and approved for use by NC State Construction Guidelines. Manufacturer installation instructions shall be followed.
  Whenever possible, conduit should be concealed from view within partitions, above ceilings, etc. Conduit should not be surfaced mounted unless approved by PM and lead mechanic.

- Piping Selection

  1. EMT shall be used for all general installations, including low voltage.
  2. Rigid must be used for outdoor applications and underground stub outs.
  3. Seal tight conduit shall be utilized for wet, non-plenum applications.
  4. Flexible metal conduit may be used for existing walls and equipment connections per code.
  5. Flexible conduit whips shall be limited to 6 feet in length.
  6. MC Cable for small jobs is acceptable.
  7. Use of ½" EMT is acceptable in limited locations.(When there is basically no chance it can be Utilized to carry multiple conductors for future reuse.)

- Electrical Identification

  The following color codes apply to each corresponding application:
  1. Blue – 120/208
  2. Black – 277/480
  3. Red – Fire Alarm
  4. Dark Red (Burgundy) - Security
  5. Green – Emergency Power
  6. Brown – Data
  7. Orange – Telephone
  8. Purple – TV
  9. Yellow – Control line VAV

  Boxes shall be identified with proper color on cover and sides.

- Hangers

  A large variety of options are available for hanging electrical conduit, and many types of hangers may be utilized in one run. Types include:

  Bolted conduit straps 

  Unistrut straps 

  One-hole and two-hole straps 

  Hammer-on flange clip 

  1. For conduit mounted on exterior walls, inside or outside surface, hangers shall be used providing a minimum ¼ in. spacing from finished wall.

2. Minimum spacing for pipe hangers shall be as follows :
    a) EMT – 3 ft. from box or fitting and every 10 feet afterwards.
    b) MC – 1 ft. from box or fitting and every 6 feet afterwards.
    c) EMT vertical drop – every 10 feet
    d) Rigid vertical drop – every 20 feet

Anchors – Typical for Plumbing, HVAC, and Electrical

Anchors shall be of approved type, rated for corresponding vertical or horizontal installation and meeting or exceeding AISI 1018-1022 requirements for hangers. Some examples include:

- Drywall, hollow block

  - Toggle bolt – horizontal or vertical

  - Screw-in type drywall anchors – horizontal only
    Use only metal type.
    For lightweight applications.

- Concrete, Solid Block

  - Strong-Tie/Sammy or equal - horizontal or vertical

  - Pipe spike - vertical only

  - Nail-in anchor - horizontal only

  - Tap-con anchor - horizontal or vertical

- Steel

  - Self drilling hex anchor - horizontal or vertical
    Typically Strong-Tie/Sammy or equal

- Wood

  - Screw type hex anchor - horizontal or vertical
    Typically Strong-Tie/Sammy or equal

- Plastic

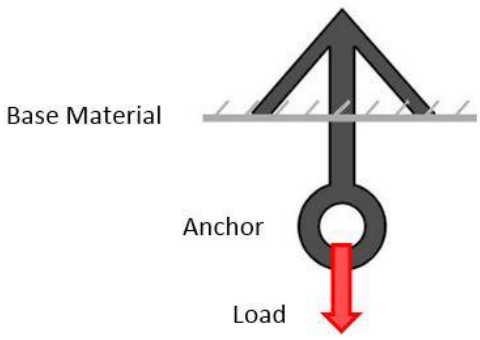
  - Plastic anchors can be used but not for any overhead installations

Use of other type fasteners must be approved by supervisor/PM.

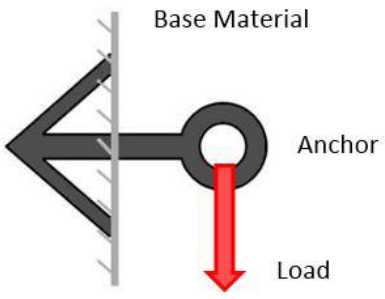
Anchor Allowable Load Table					
Base Material	Orientation (Base Material)	Allowable Load / Fastener (lb)	Anchor Type	Diameter (in)	Length (in)
Drywall - 5/8" Thick (Hollow Block)	Horizontal	50	Toggle Bolt	1/8"	2"
Drywall - 5/8" Thick (Hollow Block)	Horizontal	70	Toggle Bolt	5/16"	4"
Drywall - 5/8" Thick (Hollow Block)	Horizontal	100	Toggle Bolt	1/2"	6"
Drywall - 5/8" Thick (Hollow Block)	Vertical	45	Toggle Bolt	1/8"	2"
Drywall - 5/8" Thick (Hollow Block)	Vertical	75	Toggle Bolt	5/16"	4"
Drywall - 5/8" Thick (Hollow Block)	Vertical	95	Toggle Bolt	1/2"	6"
Drywall - 5/8" Thick (Hollow Block)	Horizontal	19	Screw-In type	3/4"	5/8"
Drywall - 5/8" Thick (Hollow Block)	Vertical	50	Screw-In type	3/4"	5/8"
Concrete - 3000psi (Soild Block)	Horizontal	600	Strong-Tie / Sammy or equal	5/16"	1_3/4"
Concrete - 3000psi (Soild Block)	Vertical	613	Strong-Tie / Sammy or equal	5/16"	1_3/4"
Concrete - 3000 psi (Soild Block)	Horizontal	315	Pipe Spike	1/4"	1_1/4"
Concrete - 3000 psi (Soild Block)	Horizontal	415	Pipe Spike	3/8"	1_3/4"
Concrete - 3000 psi (Soild Block)	Vertical	245	Pipe Spike	1/4"	1_1/4"
Concrete - 3000 psi (Soild Block)	Vertical	505	Pipe Spike	3/8"	1_3/4"
Concrete - 4000 psi (Soild Block)	Horizontal	100	Nail-In Anchor	3/16"	3/4"
Concrete - 4000 psi (Soild Block)	Horizontal	220	Nail-In Anchor	1/4"	1"
Concrete - 4000 psi (Soild Block)	Vertical	140	Nail-In Anchor	3/16"	3/4"
Concrete - 4000 psi (Soild Block)	Vertical	220	Nail-In Anchor	1/4"	1"
Concrete - 4000 psi (Soild Block)	Horizontal	273	Tap-Con Anchor	3/16"	1_1/2"
Concrete - 4000 psi (Soild Block)	Horizontal	455	Tap-Con Anchor	1/4"	1_1/2"
Concrete - 4000 psi (Soild Block)	Vertical	215	Tap-Con Anchor	3/16"	1_1/2"
Concrete - 4000 psi (Soild Block)	Vertical	345	Tap-Con Anchor	1/4"	1_1/2"
Steel - 1/2" Thick (22 gauge)	Horizontal	112	Self Drilling Hex Anchor	1/4" - 14	1"
Steel - 1/2" Thick (22 gauge)	Horizontal	378	Self Drilling Hex Anchor	1/4" - 20	1"
Steel - 1/2" Thick (22 gauge)	Horizontal	550	Self Drilling Hex Anchor	5/16"	1_1/4"
Steel - 1/2" Thick (22 gauge)	Vertical	369	Self Drilling Hex Anchor	1/4" - 14	1"
Steel - 1/2" Thick (22 gauge)	Vertical	475	Self Drilling Hex Anchor	1/4" - 20	1"
Steel - 1/2" Thick (22 gauge)	Vertical	620	Self Drilling Hex Anchor	5/16"	1_1/4"
Wood - Fir	Horizontal	440	Screw Type Hex Anchor	1/4"	2"
Wood - Fir	Horizontal	515	Screw Type Hex Anchor	1/4"	3"
Wood - Fir	Horizontal	528	Screw Type Hex Anchor	3/8"	2_1/2"
Wood - Fir	Vertical	431	Screw Type Hex Anchor	1/4"	2"
Wood - Fir	Vertical	471	Screw Type Hex Anchor	1/4"	3"
Wood - Fir	Vertical	562	Screw Type Hex Anchor	3/8"	2_1/2"

** See Reference Page for informational source.

Vertical Application



Horizontal Application



Architectural Standards

- General

  Walls shall be framed parallel and squared off existing walls. Framing shall comply with North Carolina Building Code and NC State Construction Guidelines. Manufacturer installation instructions shall be followed.

- Standards

  1. Pin track at least every two feet staggered.
  2. All studs shall be set at 16 in. on center.
  3. On newer concrete, power actuated fasteners should be used where applicable, minimum ½ in. depth. Older concrete will need to be drilled and pinned.
  4. When shooting support wires, test by pulling and replace if loose.
  5. Older buildings shall be drilled and pinned both for track and ceiling supports.
  6. All framing studs shall be installed so that holes line up.
  7. Frame door openings with two studs on each side on latch side of opening to ease lock clearance.
  8. Door openings shall be no closer than six inches from wall unless otherwise stated on plans.
  9. Where possible, brace all walls to top deck, spaced every ten feet.
  10. Ceilings shall be laid out to prevent tile cuts smaller than six inches.
  11. Ceiling mains shall be supported every four feet, starting twelve inches from wall angle.
  12. On larger ceilings over 500 square feet, joints should be staggered on mains.
  13. Each trade must clean up daily and at the end of the job. Remove all left over material.
  14. Access holes cut in walls shall be square to ensure proper patching.
  15. Sheet rock butt joints shall be staggered.
  16. Conduit should be run through top plate when possible.

Reference Page

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