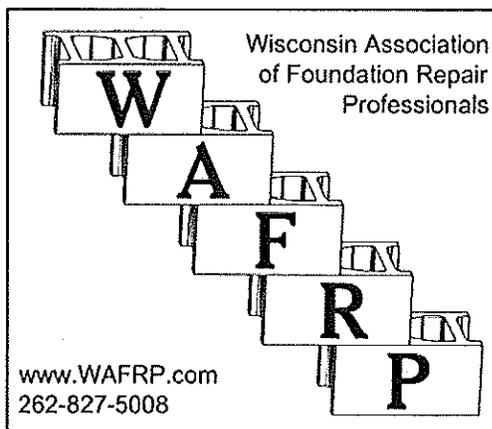


BEST MANAGEMENT STANDARDS FOR FOUNDATION REPAIR

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**Prepared in cooperation with the Building Inspectors
Association of Southeastern Wisconsin – www.biasew.net**



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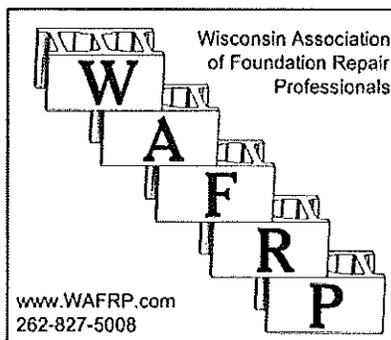
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These Standards were prepared by James F. Jendusa, PE, Jendusa Design & Engineering, Inc. exclusively for the Wisconsin Association of Foundation Repair Professionals (WAFRP) in cooperation with the Building Inspectors Association of Southeastern Wisconsin to establish foundation repair standards.



GLOSSARY OF TERMS

As-Built Condition – A basement wall with **NO DEFECTS** as constructed immediately following either installation of the concrete masonry or poured concrete wall before backfilling. The wall can be said to have no defects if the corners and/or the walls were constructed out of plumb with no cracks or movement. Additionally, the wall is not defective if repair has been done 10 years or more prior to the time of inspection and there are no cracks or movement. Shrinkage cracks with no movement of the wall are not considered a structural defect. Measurement of a wall is done by averaging the measurements of both corners compared to the measurement at the center of the wall.

Backfill – Material used to fill in an excavation.

Bleeders – Concrete or plastic pipe that is installed through the footing or foundation wall to allow transfer of water from the exterior drain tile to the interior drain tile.

Concrete Block – Concrete masonry unit used in basement wall construction. Concrete block is commonly used in nominal 8”, 10” or 12” widths and is typically 8” tall by 16” long with 2 open cells in the block. The concrete blocks are stacked with alternating vertical joints using mortar between the joints to hold the block together.

Downspout – Aluminum or galvanized steel pipe that directs water collected in the rain gutters down to the ground and away from the building

Drain Tile (Interior or Exterior) – Concrete or plastic perforated pipe used underground to collect water and direct it to the sump crock. Exterior drain tile is placed on the outside of the building at the elevation of, or on top of the footing, consistent with existing conditions. Interior drain tile is placed around the inside perimeter of the building just below the floor slab. Drain tile is encased in clear aggregate to allow for water drainage to the pipe.

Drain Tile Test – A test of the function of the interior drain tile. The drain tile test is performed by: cutting through the floor slab to access the drain tile, flushing water into the drain tile and observing the amount of water entering the sump crock. A diminished water flow indicates a plugged or crushed drain tile. (See Appendix C)

Efflorescence (Scale Stains) – White mineral deposits showing on face of masonry due to water leaching through the masonry to the dry surface.

Epoxy - Material used to repair cracks in concrete or masonry. Epoxy is a material that can be injected into wall cracks and when cured forms a very strong bond with the base material. Epoxy can be used for the structural repair of walls.

Expansive Clay Soils - Expansive soils contain minerals that are capable of absorbing water, which enables the soils to increase in volume. Expansions of ten percent or more are common. This change in volume can exert force on a building or other structure causing substantial damage.

Grade – Reference to the pitch of the exterior ground surface adjacent to the building.

Horizontal Cracks – Usually associated with bowing or displacement of masonry walls that are not plumb vertically and/or horizontally.

Laser Level – Instrument, which emits a beam of light on a certain horizontal or vertical plane. This plane can be used to measure deflection and/or movement of an adjacent plane.

Level – Instrument used for measuring the plane of a vertical or horizontal surface.

Palmer Valve – Stormwater discharge valve typically located in the side wall of the floor drain, designed to prevent backflow of sanitary sewer into stormwater system.

Pilaster – A projection of masonry or a filled cell area of masonry for the purpose of bearing concentrated loads or to stiffen the wall against lateral forces.

Plumb Line – Tool for measuring wall deflection consisting of a weight and string. The string is attached at the top of the wall and the weight is at the end of the string located near the floor providing a straight vertical reference line. Measurements are taken from the string to the wall to determine the amount of horizontal deflection in the wall.

Polyurethane – Material that can be injected into wall cracks to prevent water leakage. Polyurethane should not be used for the structural repair of walls.

Poured Walls – Solid concrete walls that are constructed by setting concrete wall forms, installing steel reinforcing bars and pouring concrete into the forms to create a wall.

Radon Gas – Odorless and colorless slightly radioactive gas that can seep into basements through floor or wall cracks. At certain concentrations Radon Gas is considered a health hazard. For more information on Radon Gas, refer to www.epa.gov/radon

Seepage – Water infiltration through masonry walls or floor slab. Seepage is evidenced by damp or wet masonry walls or concrete floor and is an indication that the basement drainage system is overloaded or not functioning correctly.

Spud Pipe – Steel pipe, 3/4” to 1” diameter that is driven into the soil around the perimeter of the building. Water is injected into the soil thru the pipe just above the elevation of the drain tile to test the function of the drain tile.

Steel Restraints – Wall reinforcing used to prevent further movement in basement walls. Steel restraints are typically composed of steel tubes placed vertically against the basement walls at a 32” or 48” spacing.

Step Cracks – Cracks in masonry walls that follow the vertical and horizontal joints in the masonry in a stepped fashion. Step cracks can be due to horizontal wall deflection, foundation settlement or shrinkage of concrete masonry.

Stone Backfill – Clear crushed aggregate 3/4” to 1” diameter used to backfill excavations. Stone backfill allows for water to migrate easily towards the drain tile located at the basement footing elevation. Additionally, stone backfill will have minimal settlement around the perimeter of the building after backfilling.

Sump Crock – Concrete, steel or plastic basin placed below the floor slab in the lowest area of the building for collecting water from drain tile. Top rim to extend minimum 1” above floor.

Sump Pump – Submersible or upright pump located in sump crock to pump water out and away from the building.

Tuckpoint – Term used for the repair of cracks that occur in the joints in masonry walls. Tuckpointing involves the removal and replacement of the mortar between masonry units where cracking along the joints has occurred.

Wall Drainage Board – One piece corrugated or ribbed plastic panel that is placed to form an angle on top of the wall footing and against the masonry wall. The panel extends a minimum of 1” above the floor slab elevation. The wall drainage board is used to drain water from the cores of concrete masonry walls to the interior drain tile. (See Appendix C for product listing)

Wall Deflection – The amount of horizontal movement in a basement wall at any given location with respect to its vertical plane.

Wall Irregularities – Masonry wall corners or areas in the wall that have thickened sections. Examples of wall irregularities include foundations for masonry fireplaces and wall pilasters.

Wall Slide (Base Shear) – Horizontal movement of basement wall, usually occurring at the bottom section of the wall.

1. CONDITION: Wet walls / No leakage on floor (NO DISPLACEMENT)

Characteristics:

Water spots on walls, wet walls, walls periodically dry up usually leaving scale stains, efflorescence, or mildew. Damp spots either high or low on wall. No major cracks or bowing. No significant block deterioration or displacement. No leaning of walls. No movement in footing.

Testing:

1. Check palmer valve or sump pump for correct operation. Check with local jurisdiction if repair of palmer valve is permitted (per local requirements).
2. Break open floor, test interior drain tile for correct flow to palmer valve, or sump pump. See Appendix C.
3. Use water spud pipe, inserted along outside wall to exterior drain tile, to introduce water to check exterior drain tile operation.
4. Check for proper grade away from exterior walls and adequate gutters & downspouts.

Standard Repairs:

1. Extend downspouts, improve grade by increasing pitch away from buildings to the greatest extent possible.
2. Install, replace, or repair sump pump. Sump pump must meet State and local Plumbing and Electrical Code.
3. Replace some or all of interior drain tile as necessary, drain first block into interior drain tile using an approved one-piece wall drainage board that provides water passage and lateral support to first course of block. Wall drainage board to be 1" minimum higher than floor. Use a wall drainage board that can be caulked for retarding radon migration. Install to manufactures specifications. See Appendix B & C.
4. In some cases it may be necessary to excavate to footing, seal wall, clean out bleeders, replace exterior drain tile, backfill to within 12-18" of grade with clear stone backfill. See Appendix A.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

2. **CONDITION: Water leakage at wall/floor joint**

Characteristics:

Signs of water leakage to a maximum of TWO courses high. Water puddles or streams during or after heavy rains. Walls often have wet or damp areas, presence of mildew or efflorescence. Walls show no cracking, bowing or displacement.

Testing:

1. Check palmer valve or sump pump for correct operation. Check with local jurisdiction if palmer valve is permitted (per local requirements).
2. Break open floor, test interior drain tile for correct flow. See Appendix C.
3. Use water spud pipe, inserted along outside wall to exterior drain tile, to introduce water to check exterior drain tile operation.
4. Check for proper grade away from exterior walls and adequate gutters & downspouts.

Standard Repairs:

1. Extend downspouts, improve grade by increasing pitch away from buildings to the greatest extent possible.
2. Install, replace, or repair sump pump. Sump pump must meet State and local Plumbing and Electrical Code.
3. Replace some or all of interior drain tile as necessary, drain first block into interior drain tile using an approved one-piece wall drainage board that provides water passage and lateral support to first course of block. Wall drainage board to be 1" minimum higher than floor. Use a wall drainage board that can be caulked for retarding radon migration. Install to manufactures specifications. See Appendix B & C.
4. In some cases, it may be necessary to excavate to footing, seal wall, clean out bleeders, replace exterior drain tile, backfill to within 12-18" of grade with clear stone backfill. See Appendix A.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

3. **CONDITION: Water leakage above wall base**

Characteristics:

Signs of water leakage appear in the middle to upper wall section. Water puddles or streams during or after heavy rains. Walls often have wet or damp areas, presence of mildew or efflorescence. Walls show no cracking, bowing or displacement.

Testing:

1. Check palmer valve or sump pump for correct operation. Check with local jurisdiction if palmer valve is permitted (per local requirements).
2. Break open floor, test interior drain tile for correct flow. See Appendix C.
3. Use water spud pipe, inserted along outside wall to exterior drain tile, to introduce water to check exterior drain tile operation.
4. Check for proper grade away from exterior walls and adequate gutters & downspouts.

Standard Repairs:

1. Extend downspouts, improve grade by increasing pitch away from buildings to the greatest extent possible.
2. Install, replace or repair sump pump. Sump pump must meet State and local Plumbing and Electrical Code.
3. Replace some or all of interior drain tile as necessary, drain first block into interior drain tile using an approved one-piece wall drainage board that provides water passage and lateral support to first course of block. Wall drainage board to be 1" minimum higher than floor. Use a wall drainage board that can be caulked for retarding radon migration. Install to manufactures specifications. See Appendix B & C.
4. Excavate, seal wall, clean out bleeders and test interior drain tile for correct flow, replace exterior drain tile, backfill to within 12-18" of grade with clear stone backfill. See Appendix A.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

4. **CONDITION: Water seepage through floor slab**

Characteristics:

Water seepage occurs through cracks in the floor slab, away from the basement walls, causing discoloration and dampness.

Testing:

1. Break open floor at site of leakage.
2. Check for defective sump pump or stuck palmer valve (if present). Check with local jurisdiction if palmer valve is permitted (per local requirements).
3. Check for interior drain tile presence and perform interior drain tile test. See Appendix C.
4. Check sewer system for proper drainage.

Standard Repairs:

1. Remove floor along leak areas.
IF NO DRAIN TILE: Dig out substrate. Install drain tile and approved drainage system, embed in filtering stone, install sump crock and pump (if required), replace floor removed. See Appendix B.
IF DRAIN TILE FOUND: Replace as needed, interior drain tile to provide correct drainage to sump or palmer valve. See appendix B.
IF LEAK NOT ALONG WALL: Install additional interior drain tile lateral for drainage and connect to interior wall perimeter drain tile.
2. Install, replace, or repair sump pump. Sump pump must meet State and local Plumbing and Electrical Code.
3. Replace some or all of interior drain tile as necessary, drain first block into interior drain tile using an approved one-piece wall drainage board that provides water passage and lateral support to first course of block. Wall drainage board to be 1" minimum higher than floor. Use a wall drainage board that can be caulked for retarding radon migration. Install to manufacturers specifications. See Appendix B & C.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

5. **CONDITION: High Water Table**

Characteristics:

Significant amounts of water continuously flows into the sump crock or seepage occurs thru cracks in the basement floor for extended periods of time, either seasonally or continuously throughout the year. This condition occurs during periods when there have been no recent major rain events or snow melts.

The following conditions may be indicative of a high water table:

- 1) Water enters a sump crock and overflows the crock while the pumps continue to operate normally due to lack of pump capacity.
- 2) There are ponds, streams, lakes or standing water in the vicinity of the house where the surface elevation of the water is higher than the drain tile elevation.
- 3) There is standing water in areas around the house during dry periods.
- 4) Water comes up through basement floor cracks even though sump pumps are operating properly.
- 5) The basement floor slab is deflected upward toward the center of the basement due to hydrostatic pressure.
- 6) An adjacent structure has been determined to have a high water table problem.

High water table determination is subjective based upon accurate history received from the home owner. Weather conditions at the time of inspection, particularly during dry periods, may conceal a high water table condition. It is possible that during periods of extreme rainfall or snow melt a basement may falsely appear to have a high water table problem.

Testing

Examples of testing for High Water Table may include:

- 1) Soil borings and installation of monitoring wells at the property to determine the soil types and water table elevations.
- 2) Test pit excavation and analysis by a soils engineer to examine the soil for evidence of a seasonal high water table elevation.
- 3) Survey of the elevations of nearby bodies of water to compare to the elevation of basement floor.
- 4) Research of municipal or other test wells in the vicinity that can be checked for water table levels.
- 5) Study of sources of storm water infiltration that may be affecting water table elevations.

Repairs

Site Specific Engineering is required when there is conclusive evidence of a high water table.

Typical repairs may include:

1. Installation of properly sized interior or exterior pumps and discharge piping with backup power and alarm systems
2. Repair or remove and replace floors damaged by bulging or cracking
3. Waterproof walls and floors
4. Establish proper grading for storm water control around property
5. Replacement or addition of drain tiles to allow for proper flow of water to sump pumps.
6. Raise the elevation of the basement floor or lift the house to move the drain tile system above the seasonal high water table elevation.

Maintenance After Repair:

1. Make sure sump pump discharges are free flowing.
2. Service backup battery and/or generator.
3. Rotate/replace sump pumps to prevent failure.

SITE SPECIFIC ENGINEERING REQUIRED

6. **CONDITION: Leaning or bowed walls / Wall deflection less than one inch (NO MOVEMENT)**

Characteristics:

One or more walls are bowed or leaning, with no signs of current or recent movement. The total amount of wall deflection is less than one inch from the original wall construction. Water seepage may be present at the floor line. Cracks have been patched or tuckpointed 10 years or more in the past*, with no sign of recent painting or patching. Owner indicates no observation of change in crack appearance or width. There may be evidence of prior wall repair/reinforcing or the walls could have been constructed out of plumb.

Testing:

Six foot level or plumb line and tape measure to check wall alignment.
Transit or laser level to check wall alignment.

Standard Repairs:

1. Do nothing; advise owner to monitor for further movement.

Optional Repairs:

1. Reinforce with recommended engineered steel support restraints every 36 to 50" on center, along bowed or leaning wall without excavating, grout behind supports. See Wall Reinforcement Design and Details. Appendix A & AA.
2. Excavate; straighten as best as possible. Reinforce with recommended engineered steel beam restraints. Reseal wall. Clean out bleeders and test interior drain tile for correct flow, replace exterior drain tile, backfill to within 12-18" of grade with clear stone backfill. See appendix A & AA.
3. Replace any defective interior drain tile to provide adequate drainage to sump or sewer system. See Appendix B & C.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

* Evidence of work performed 10 years or more prior to date of inspection include: past work orders, old paint – peeled or discolored, dated photographs, past inspection reports, other evidence of work performed prior to 10 years.

7. **CONDITION: Wall step cracks with no displacement**

Characteristics:

Appearance of cracks that follow the block joints in a diagonal fashion (step cracks). Many step cracks occur at the edge of windows or wall openings. There is no evidence of wall displacement, bowing or water leakage. Step cracks can be associated with minor foundation settlement or shrinkage of the concrete masonry wall. Under this condition there are no continuous horizontal wall cracks, water leakage or displacement.

Testing:

Six foot level or plumb line and tape measure to check wall alignment.
Transit or laser level to check wall alignment.

Standard Repairs:

1. Tuckpoint the visible cracks and recommend to owner to monitor for further movement.
2. If the crack exceeds 1/4" width, consult engineer for site-specific engineering.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

8. **CONDITION: Leaning or bowed walls / Wall deflection less than one inch (SOME MOVEMENT)**

Characteristics:

One or more walls are bowed or leaning, with signs of current or recent movement within the past 10 years. Wall cracks are less than 1/4" wide. The total amount of wall deflection is less than one inch from the as-built condition of the original wall construction. Water seepage may be present at the floor line. Previously repaired wall cracks show signs of continued cracking. Horizontal wall cracks are usually associated with bowing and may open and close with the seasons. Vertical or step wall cracks are usually associated with leaning walls or wall bowing adjacent to wall irregularities. There is no indication of settlement of the wall footings.

Testing:

Six foot level or plumb line and tape measure to check wall alignment.
Transit or laser level to check wall alignment.

Standard Repairs:

1. Reinforce with engineered steel support restraints every 36 to 50" on center along bowed or leaning wall without excavating, grout behind supports. See Wall Reinforcement and Design. Appendix AA.

Optional Repairs:

1. Excavate; straighten as best as possible. Reinforce with recommended engineered steel restraints. Reseal wall. Clean out bleeders and test interior drain tile for correct flow, replace exterior drain tile, backfill to within 12-18" of grade with clear stone backfill. See Appendix A & AA.
2. If bowing or leaning is in conjunction with wet walls or seepage, include previous repairs and testing. See Appendix B & C.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

9. **CONDITION: Leaning or bowed walls / Wall deflection one inch or more (SIGNIFICANT MOVEMENT)**

Characteristics:

One or more walls are bowed or leaning, with signs of current or recent movement. Wall cracks may be greater than 1/4" wide. The total amount of wall deflection is one inch or more from the as-built condition of the original wall construction. Water seepage may be present at the floor line. Previously repaired wall cracks show signs of continued cracking. Horizontal wall cracks are usually associated with bowing and may open and close with the seasons. Vertical or step wall cracks are usually associated with leaning walls or wall bowing adjacent to wall irregularities. There is no indication of settlement of the wall footings.

Testing:

Six foot level or plumb line and tape measure to check wall alignment.
Transit or laser level to check wall alignment.

Standard Repairs:

1. Excavate; straighten as best as possible. Reinforce with recommended engineered steel restraints. Reseal wall. Clean out bleeders and test interior drain tile for correct flow, replace exterior drain tile, backfill to within 12-18" of grade with clear stone backfill. See Appendix A & AA.

Optional Repairs:

1. Remove and replace wall with new concrete masonry constructed and reinforced per State of Wisconsin Uniform Dwelling Code requirements for construction of new basement walls.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

10. CONDITION: Walls sheared at base / Wall slide less than 1/2"

Characteristics:

Wall shearing or sliding usually occurs at the second course from the bottom block. The bottom block is anchored by the floor. Shearing, however, may occur at any level. This condition indicates one section of the wall is sliding off the remaining wall by less than 1/2". There is no evidence of block face failure.

Testing:

Six foot level or plumb line and tape measure to check wall alignment.
Transit or laser level to check wall alignment.

Standard Repairs:

1. Reinforce with engineered steel support restraints every 36 to 50" on center along bowed or leaning wall without excavating, grout behind supports. See Wall Reinforcement and Design, Appendix AA.

Optional Repairs:

1. Excavate; straighten as best as possible. Reinforce with recommended engineered steel restraints. Reseal wall. Clean out bleeders and test interior drain tile for correct flow, replace exterior drain tile, backfill to within 12-18" of grade with clear stone backfill. See Appendix A & AA.
2. If bowing or leaning is in conjunction with wet walls or seepage, include previous repairs and testing. See Appendix B & C.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

11. **CONDITION: Walls sheared at base / Wall slide 1/2" or more**

Characteristics:

Wall shearing or sliding usually occurs at the second course from the bottom block. The bottom block is anchored by the floor. Shearing, however, may occur at any level. This condition indicates one section of the wall is sliding off the remaining wall by 1/2" or more. Excessive wall slide can cause failure in the block face below and potential basement wall collapse.

Testing:

Six foot level or plumb line and tape measure to check wall alignment.
Transit or laser level to check wall alignment.

Standard Repairs:

1. Excavate along exterior building perimeter. Straighten block basement wall as best as possible. Replace or repair damaged concrete block. Reinforce with recommended engineered steel restraints. Reseal wall. Clean out bleeders and test interior drain tile for correct flow, replace exterior drain tile, and backfill to within 12-18" of grade with clear stone backfill. See Appendix A & AA.

Optional Repairs:

1. Remove and replace wall with new concrete masonry constructed and reinforced per State of Wisconsin Uniform Dwelling Code requirements for construction of new basement walls.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

12. CONDITION: Dropped, settled or rotated footing

Characteristics:

Foundation settlement is indicated by wide horizontal or step wall cracking and cracks in the floor slab, usually adjacent to the basement wall. The wall cracks are usually much wider than would be indicated by typical wall bowing. The wall may be tipped in the direction of foundation settlement, with horizontal wall joints being out of level. Door jams and windows in the building may be affected by foundation settlement.

Testing:

Six foot level or plumb line and tape measure to check wall alignment.
Transit or laser level to check wall and floor alignment.

Standard Repairs:

1. This repair **REQUIRES SITE SPECIFIC ENGINEERING.**
2. Repair usually accomplished with engineered helical pier anchors, hydraulically driven pipe piles, drilled caissons, support pads, etc. that are attached to the bottom of the footing.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

SITE SPECIFIC ENGINEERING REQUIRED

13. **CONDITION: Poured concrete, brick or stone walls with water leakage (NO WALL DISPLACEMENT)**

Characteristics:

Shrinkage of concrete or masonry often leads to cracks in basement walls. Poured concrete walls with little or no steel reinforcement are more susceptible to shrinkage cracking. During periods of heavy rains, water leakage can occur through cracks in the walls. Another cause of cracking in walls could be due to excessive pressure during backfilling or winter frost.

Testing:

1. Check palmer valve or sump pump for correct operation. Check with local jurisdiction if palmer valve is permitted (per local requirements).
2. Break open floor, test interior drain tile for correct flow. See Appendix C.
3. Use water spud pipe, inserted along outside wall to exterior drain tile, to introduce water to check exterior drain tile operation.
4. Check for proper grade away from exterior walls and adequate gutters & downspouts.

Standard Repairs:

1. Inject cracks from inside without excavating. Inject per manufacturing specifications.
 - a. **NON-STRUCTURAL** REPAIR - polyurethane injection for water stoppage only.
2. In some cases, it may be necessary to excavate to footing, inject cracks or fill cracks with hydraulic cement, seal wall, clean out bleeders, replace exterior drain tile, backfill to within 12-18" of grade with clear stone backfill. See Appendix A & B.
3. Refer to Condition #2 for additional standard repairs.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

14. **CONDITION: Poured concrete walls, leaning or bowed / wall deflection less than 1"**

Characteristics:

One or more walls are bowed or leaning, with signs of current or recent movement. Wall cracks are less than 1/4" wide. The total amount of wall deflection is less than one inch from the original wall construction. Water seepage may be present at the floor line. Previously repaired wall cracks show signs of continued cracking. Horizontal wall cracks are usually associated with bowing and may open and close with the seasons. Diagonal wall cracks or displacement at vertical cracks are usually associated with leaning walls or wall bowing adjacent to wall irregularities. Vertical cracks are usually associated with shrinkage of concrete. There is no indication of settlement of the wall footings.

Testing:

Six foot level or plumb line and tape measure to check wall alignment.
Transit or laser level to check wall alignment.

Standard Repairs:

1. Inject cracks from inside without excavating. Inject per manufacturing specifications.
 - a. **STRUCTURAL REPAIR** - epoxy injection for wall repair and water stoppage.
 - b. **NON-STRUCTURAL REPAIR** - polyurethane injection for water stoppage only.
2. If wall is leaning, secure top of wall to prevent further movement. Additional wall reinforcement is not required. See Appendix AA for detail.
3. If wall is bowed, reinforce with recommended engineered steel restraints. See Appendix AA.
4. If bowing or leaning is in conjunction with wet walls or seepage, refer to previous interior drain tile repairs and testing procedures. See Appendix B & C.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

15. **CONDITION: Poured concrete walls, leaning or bowed / wall deflection 1” or more**

Characteristics:

One or more walls are bowed or leaning, with signs of current or recent movement. Wall cracks may be greater than 1/4” wide. The total amount of wall deflection is one inch or more from the original wall construction. Water seepage may be present at the floor line. Previously repaired wall cracks show signs of continued cracking. Horizontal wall cracks are usually associated with bowing and may open and close with the seasons. Diagonal wall cracks or displacement at vertical cracks are usually associated with leaning walls or wall bowing adjacent to wall irregularities. Vertical cracks are usually associated with shrinkage of concrete. There is no indication of settlement of the wall footings.

Testing:

Six foot level or plumb line and tape measure to check wall alignment.
Transit or laser level to check wall alignment.

Standard Repairs:

1. Excavate, straighten as best as possible. Reinforce with recommended engineered steel restraints. Reseal wall. Clean out bleeders and test interior drain tile for correct flow, replace exterior drain tile, backfill trench to within 12-18” of grade with clear stone backfill. See Appendix A & AA.
2. Inject cracks or seal cracks with hydraulic cement in accordance with manufacturer specifications.
3. If bowing or leaning is in conjunction with floor seepage, refer to previous interior drain tile repairs and testing procedures. See Appendix B & C.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

16. **CONDITION: Brick walls leaning or bowed / wall deflection less than 1"**

Characteristics:

One or more walls are bowed or leaning, with signs of current or recent movement. Wall cracks are less than 1/4" wide. The total amount of wall deflection is less than one inch from the as-built condition of the the original wall construction. Water seepage may be present at the floor line. Previously repaired wall cracks show signs of continued cracking. Horizontal wall cracks are usually associated with bowing and may open and close with the seasons. Vertical wall cracks are usually associated with leaning walls or wall bowing adjacent to wall irregularities. Brick is in good structural condition with no sign of excessive deterioration. There is no indication of settlement of the wall footings.

Testing:

Six foot level or plumb line and tape measure to check wall alignment.
Transit or laser level to check wall alignment.

Standard Repairs:

1. Reinforce with engineered steel support restraints up to 36" max. on center spacing along bowed or leaning wall without excavating, grout behind supports. See Wall Reinforcement and Design. Appendix AA.

Optional Repairs:

2. Excavate; straighten as best as possible. Reinforce with engineered steel restraints up to 36" max. on center spacing. Reseal wall. Clean out bleeders and test interior drain tile for correct flow, replace exterior drain tile, backfill to within 12-18" of grade with clear stone backfill. See Appendix A & AA.
3. If bowing or leaning is in conjunction with wet walls or seepage, include previous repairs and testing. See Appendix B & C.
4. Remove and replace brick wall with new concrete masonry constructed and reinforced per State of Wisconsin Uniform Dwelling Code requirements for construction of new basement walls.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

17. CONDITION: Brick walls leaning or bowed / wall deflection 1" or more

Characteristics:

One or more walls are bowed or leaning, with signs of current or recent movement. Wall cracks may be greater than 1/4" wide. The total amount of wall deflection is one inch or more from the as-built condition of the original wall construction. Water seepage may be present at the floor line. Previously repaired wall cracks show signs of continued cracking. Horizontal wall cracks are usually associated with bowing and may open and close with the seasons. Vertical wall cracks are usually associated with leaning walls or wall bowing adjacent to wall irregularities. Brick may be in poor structural condition with signs of excessive deterioration. There is no indication of settlement of the wall footings.

Testing:

Six foot level or plumb line and tape measure to check wall alignment.
Transit or laser level to check wall alignment.

Standard Repairs:

1. Excavate, straighten as best as possible. Reinforce with recommended engineered steel restraints up to 36" max. on center spacing. Reseal wall. Clean out bleeders and test interior drain tile for correct flow, replace exterior drain tile, backfill trench to within 12-18" of grade with clear stone backfill. See Appendix A & AA.
2. Remove and replace brick wall with new concrete masonry constructed and reinforced per State of Wisconsin Uniform Dwelling Code requirements for construction of new basement walls.
3. If bowing or leaning is in conjunction with floor seepage, refer to previous interior drain tile repairs and testing procedures. See Appendix B & C.

Maintenance After Repair:

1. Keep downspouts extended.
2. Maintain positive pitch of grade away from house.

NO SITE SPECIFIC ENGINEERING REQUIRED

SITE SPECIFIC ENGINEERING IS REQUIRED FOR ANY REINFORCEMENT OF BASEMENT WALLS WHERE CONDITIONS DO NOT CONFORM TO THE STANDARDS OF THIS DOCUMENT

A SITE SPECIFIC ENGINEERING REPORT IS REQUIRED TO BE SUBMITTED AS PART OF THE PERMIT APPLICATION FOR FOUNDATION REPAIR (SEE APPENDIX E)

A list of alternative repair methods requiring Site Specific Engineering is as follows:

- Internal core filling with concrete and steel reinforcing bars
- Installation of an exterior grade beam
- Retention anchors installed outside the foundation wall with wall plates secured to the inside of the wall
- Construction of additional masonry pilasters on inside or outside of wall
- Installation of an carbon fiber and epoxy reinforcing on inside or outside of wall
- Any walls needing repair with height greater than 8'-2"
- Any walls needing repair where expansive clay soils are suspected (Soils Engineer required to verify soil conditions)
- Any wall repair using adjustable braces used to move basement walls without excavation.
- Any structural repair of stone foundation walls other than replacement with new walls constructed per State of Wisconsin Uniform Dwelling Code requirements for new construction.
- Any other methods or materials used for foundation repair not listed in the WAFRP Standards

SITE SPECIFIC ENGINEERING IS NOT REQUIRED FOR ANY FOUNDATION REPAIR PRODUCT OR METHOD THAT HAS A WISCONSIN BUILDING PRODUCT EVALUATION APPROVAL (PER THE CONDITIONS LISTED IN THE APPROVAL LETTER) ALONG WITH APPROVAL OF WAFRP AND THE BUILDING INSPECTORS ASSOCIATION OF SOUTHEAST WISCONSIN. (SEE APPENDIX C)

DISCLAIMER: Jendusa Design & Engineering, Inc., Wisconsin Association of Foundation Repair Professionals (WAFRP), Building Inspectors Association of Southeast Wisconsin and anyone associated with Jendusa Design & Engineering, Inc. and WAFRP assumes no liability, damages, or claims arising from any use of the engineering details and specifications, repair recommendations and procedures listed in this Best Management Standard for Basement Repair.

APPENDIX A

PROCEDURE FOR WALL REPAIR INCLUDING: EXCAVATION, WATERPROOFING & REINFORCEMENT

- Excavate a trench on the exterior wall from grade to the top of the footing.
- Haul all excavated clay to an approved landfill.
- Attempt to flush out all bleeders found on exterior footing to sump pump or palmer valve system. Check with local jurisdiction if palmer valve is permitted (per local requirements).
- Flush inside drain tile to sump pump or palmer valve, if applicable, on affected wall.
- Set jacks on the inside of the excavated walls and straighten the walls to the original position, or as close as possible.
- Identify structurally damaged concrete block (exterior and interior). Replace block, or repair with approved epoxy material, or fill block solid with concrete grout.
- Repair all mortar joint cracks on outside of wall with TYPE M masonry cement. Seal coat all excavated walls from the footing to grade with approved below-grade damp proofing material installed per manufacturer's specifications.
- Replace all removed drain tile on excavated wall with "ADS" polypropylene/PVC or UDC approved drain tile.
- Backfill trench with clear crushed aggregate per specification below to within 12 to 18 inches from finish grade at all grass/dirt areas.
 - 100% of the aggregate shall pass a 1-inch sieve.
 - 90-100% of the aggregate shall pass a ¾-inch sieve.
 - 0-55% of the aggregate shall pass a ⅜-inch sieve.
 - 0-5% of the aggregate shall pass a #8 sieve.
- Install a below grade geotextile filter fabric with minimum 6 oz. density on top of stone backfill at all grass/dirt areas to prevent dirt contamination of the clear stone due to water filtration to exterior drain tile.
- Finish backfilling trench areas with impervious fill sloped as best as possible away from the foundation to within 6" of ground surface, place topsoil or landscaping material to match existing finish grade height. Finished grade should be pitched at a minimum slope of ½" per foot away from building for a minimum distance of 10'-0". It is recommended to maintain grade 6" below wood framing if possible. If proper grading is not possible, inform owner of condition & recommend proper landscaping with appropriate water control measures.
- Reinforce all excavated walls with steel reinforcing columns. **(See Appendix AA regarding reinforcement for size, spacing, and attachment details)** Grout between steel columns and wall with a non-shrink grout to account for wall irregularities and displacement.
- Extend wall reinforcement beam 1 space in each direction beyond damaged section of wall.
- Tuckpoint all interior mortar joint cracks on all walls that are repaired.

APPENDIX B

PROCEDURE FOR INTERIOR DRAIN TILE REPAIR WITHOUT EXCAVATION (See also Appendix C regarding drain tile testing standards)

- Remove floor along wall area (12" to 18" wide) to be repaired to allow replacement of interior drain tile.
NOTE: Depending on the exterior ground pressure against the wall, bracing of the bottom 1/3 of the wall may be required to prevent the first course from moving after the floor has been removed.
- Remove existing drain tile and flush with water to sump crock or palmer valve. Check for correct drainage. Check with local jurisdiction if palmer valve is permitted (per local requirements).
- Replace drain tile at floor removal area with 3" min interior diameter perforated corrugated polypropylene/ PVC or UDC approved drain tile and encase new tile with clear 3/4" diameter filtering stone.
- Drill one (3/4 to 1 inch) drainage hole into the bottom of first course per core, under floor line, for block drainage. Holes shall be cleared for proper drainage.
- Wall drainage board shall be a one-piece unit. Wall drainage board to be installed at least 1" minimum higher than finish floor height and against first course to assure unrestricted passage of water flow. The wall drainage board MUST provide lateral support to first block and cannot have more than a 3/8" gap on vertical rise against block. Wall drainage board must be able to be sealed off to provide radon mitigation if necessary.
- Test wall drainage board: Drill holes at the third to fourth block above the footing and every 3 to 4 feet horizontally for the entire wall where possible. Flush wall with water by inserting hose into injection holes. Check for unobstructed flow to wall drainage board by observing water flow at the base of the wall.
- Replace floor where removed. Minimum thickness not to be less than 2" thick or at least as thick as what was originally in place.
- If floor is ramped, to obtain minimum floor thickness the original floor must be removed a distance of 24" from the basement wall.
- Site specific engineering is required for conditions that vary from these standards.

APPENDIX C

DRAIN TILE TEST STANDARDS

PURPOSE

The purpose of a drain tile test is to determine whether drain tile replacement is warranted and if so, how much drain tile needs replacing. These are the minimum standards for a drain tile test. A foundation repair contractor or foundation consultant can exceed these standards but never do less than the listed minimum standards.

CONDITIONS THAT MAY WARRANT A DRAIN TILE TEST

- Leakage/seepage on floor
- Wet/damp wall blocks near floor
- Staining/efflorescence on wall blocks near floor
- Iron ochre, tree roots, or mineral/calcium deposits in sump crock or at palmer valve.
- Wetness around floor cracks.
- Not all conditions shall warrant a drain tile test

LOCATION, SIZE AND NUMBER OF TEST HOLES

- The foundation repair contractor or foundation consultant should open a minimum of 3 holes to test interior tiles
- Each interior hole should be at least 12" x 12"
- The ideal location of interior test holes should be:
 - In or near corners
 - At sites where home owner noted leakage
 - Directly under windows (location of bleeders)
- The exterior drain tile test depth is recommended to be within 1-foot above the exterior drain tile. This test is also referred as an outside "spud test".
- An outside drain tile test is warranted if blockage of outside drain tile is suspected to be clogged due to signs of leakage.
- Test four feet from bleeder if location is known.
- At least two test spud sites are recommended per wall(s) in question.

TEST PROCEDURES

- Homeowner should remove personal property at all test site locations
- Open hole in floor, expose inside of drain tile
- Inspect drain tile to determine degree of obstruction if any
- Introduce water into hole to determine if it drains
- Insert running hose into drain tile in both directions if possible to point of blockage
- Clean out bleeders, if found
- Insert running hose in bleeders to determine disbursement to exterior tile
- Check functionality of palmer valve or sump crock

- Drill at least (1) hole in block, where floor is opened up at a wet area in question, on inside to check if wall is holding water.

EVALUATION OF NEED FOR REPAIR

Based upon test results foundation repair contractor or foundation consultant should consider:

- Degree of blockage (less than 30% marginal, more than 50% serious)
- Amount of water sitting in tile
- Condition of drain tile itself
- Actual water flow through inside tile
- Seasonal conditions
- Ground water levels at time
- Special situations (ochre, roots, mineral deposits)
- History and pattern of leakage from homeowner, if available
- Water leakage out of blocks
- Spacing and placement of cement drain tile
- Material around drain tile

Note: If a dry season prevails and/or there is at least 2 to 4 inches of clear gravel under the floor, the use of an air compressor is recommended to be used with water to get water to flow from test hole to test hole.

Due to the severity of the leak, an optional spud test may be recommended to test the outside tile.

REPORT TO HOMEOWNER:

- Drain tile evaluation requires rendering an opinion and reasonable minds may differ
- Foundation repair contractor or foundation consultant shall report areas of blockage and specify what sections of drain tile need repair in writing with a diagram
- Foundation repair contractor or foundation consultant shall not misrepresent condition of drain tile for purposes of persuading homeowners to purchase repairs
- Foundation repair contractor or foundation consultant may give homeowner option of replacing more drain tile than is necessary after explaining present conditions

REPAIR OF HOLE

- Remove debris, damaged tile and old stone
- Replace drain tile in hole with 3" interior diameter perforated corrugated polypropylene drain tile (or Wisconsin Uniform Dwelling Code compliant)
- Install approved drainage board on side of hole
- Encase new tile with ¾" diameter filtering stone
- Close hole with new cement unless homeowner elects to leave open for further inspection
- In the event homeowner elects to leave hole open, foundation repair contractor or foundation consultant shall warn homeowner of risk of injury and possible flooding

- Maximum of 3/8" open joint along top of wall board for placement of sealant for radon mitigation

PROHIBITED PRACTICES

- A foundation repair contractor or foundation consultant shall not create blockage in drain tile to cause test to fail
- A foundation repair contractor or foundation consultant shall not inform homeowner that open drain tile need replacement because they were placed too tight together or aren't perfectly sloped
- A foundation repair contractor or foundation consultant shall not make any material misrepresentations

Appendix D

Approved Drainage Board Products:

1. **Floor Edging**, Manufactured by Masonry Technology Incorporated.
2. **SHAD**, drainage product

Additional wall drainage board products may be used meeting the following specifications:

- Manufactured as 1 piece construction vertical and horizontal
- Minimum 8" horizontal leg with optional extension with no restriction of water flow
- Designed to provide proper lateral support of 1st course from solid material and concrete in contact with the exterior wall
- Minimum of 1" extension above finished floor
- Maximum of 3/8" open joint along top of wall board for placement of sealant for radon mitigation

Approved Structural Repair Products:

1. **EFP Foundation Repair Braces**, Manufactured by Engineered Foundation Products, Inc.

Use of any foundation repair product not specifically approved for use in the WAFRP Standards must obtain approval from WAFRP and the Building Inspectors Association of Southeastern Wisconsin.

Contact a WAFRP representative at (262) 827-5008 for information of how to submit a product for approval.

Appendix E
WAFRP - SITE SPECIFIC ENGINEERING REPORT

Residential Inspection Commercial Inspection

Visited Site Yes No Date _____ Time _____

Temperature _____ Weather Conditions _____ Dry Rain Snow

Site Conditions _____

Building Address _____

Building Description _____ Age _____

Areas Inspected _____

Proper Grading Yes No (Describe) _____

Foundation Type: Block Poured Concrete Brick Stone Wood

FOUNDATION CONDITIONS

Walls Out of Plumb Yes No Walls Settled Yes No Explain Below

Condition: (T) Tipped (D) Displaced (Bowed) (B) Base Shear (SC) Step Crack

(HC) Horizontal Crack (VC) Vertical Crack (DC) Diagonal Crack (S) Settled

<u>Wall</u>	<u>Condition & Measurement</u>
-------------	------------------------------------

North _____

South _____

East _____

West _____

Previous Repair Yes No Est. Age _____ Repair Adequate Yes No

Describe Prior Repair/Issues _____

Repairs Needed Yes No (Describe)

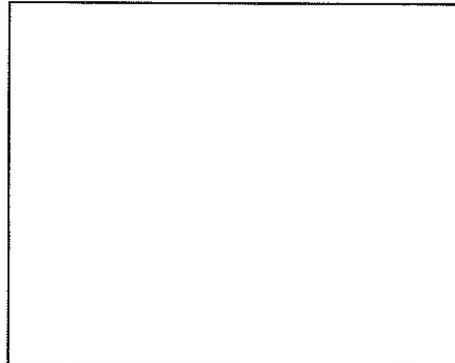
Are Recommended Repairs per WAFRP Standards Yes No If No: Assumed

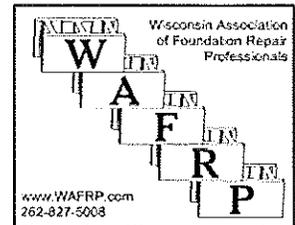
Soil Pressure 90 pcf Other _____ Attach Soil Information & Calculations

Supervising Repairs Yes No

Signature _____

Seal





BASEMENT WALL REINFORCEMENT DESIGN TABLES
(Tables based on a 90 PCF soil pressure)

WALL HEIGHT* - UP TO 6'-10"				
STEEL SIZE, SPACING and BLOCK SIZE	SINGLE JOIST SIDE MOUNT	DOUBLE JOIST Or 2x8 min. nailed to side of joist.	SINGLE JOIST With SADDLE	TJI JOIST
4" X 2" X 1/4" 36" Max. Spacing 8", 10" or 12"	(2) 1" Dia. Bolts See Details 2-5 on S2-A (4) 1/2" Dia. Bolts See Details 2-5 on S2-B	(2) 5/8" Dia. Bolts See Details 10-13 on S4-A	(2) 1/2" Dia. Bolts See Details 18-22 on S6	(2) 1" Dia. Bolts See Details 6-7 on S3-A
5" X 2" X 3/16" 50" Max. Spacing 10" or 12"	(4) 5/8" Dia. Bolts See Details 2-5 on S2-B	(2) 3/4" Dia. Bolts See Details 10-13 on S4-B (4) 1/2" Dia. Bolts See Details 10-13 on S4-B	(2) 5/8" Dia. Bolts See Details 18-22 on S6	(4) 5/8" Dia. Bolts See Details 6-7 on S3-B
WALL HEIGHT* > 6'-10" UP TO 7'-6"				
STEEL SIZE, SPACING and BLOCK SIZE	SINGLE JOIST SIDE MOUNT	DOUBLE JOIST Or 2x8 min. nailed to side of joist.	SINGLE JOIST With SADDLE	TJI JOIST
5" X 2" X 3/16" 36" Max. Spacing 8", 10", or 12"	(2) 1" Dia. Bolts See Details 2-5 on S2-A (4) 1/2" Dia. Bolts See Details 2-5 on S2-B	(2) 5/8" Dia. Bolts See Details 10-13 on S4-A	(2) 5/8" Dia. Bolts See Details 18-22 on S6	(2) 1" Dia. Bolts See Details 6-7 on S3-A
6" X 2" X 3/16" 50" Max. Spacing 10", or 12"	(4) 3/4" Dia. Bolts See Details 2-5 on S2-B	(2) 1" Dia. Bolts See Details 10-13 on S4-A (4) 1/2" Dia. Bolts See Details 10-13 on S4-B	(2) 3/4" Dia. Bolts See Details 18-22 on S6	(4) 3/4" Dia. Bolts See Details 6-7 on S3-B
WALL HEIGHT* > 7'-6" UP TO 8'-2"				
STEEL SIZE, SPACING and BLOCK SIZE	SINGLE JOIST SIDE MOUNT	DOUBLE JOIST Or 2x8 min. nailed to side of joist.	SINGLE JOIST With SADDLE	TJI JOIST
5" X 3" X 1/4" 36" Max. Spacing 8", 10", or 12"	(4) 5/8" Dia. Bolts See Details 2-5 on S2-A	(2) 3/4" Dia. Bolts See Details 10-13 on S4-B (4) 1/2" Dia. Bolts See Details 10-13 on S4-B	(2) 5/8" Dia. Bolts See Details 18-22 on S6	(4) 5/8" Dia. Bolts See Details 6-7 on S3-B
6" X 3" X 1/4" 50" Max. Spacing 10", or 12"	(4) 7/8" Dia. Bolts See Details 2-5 on S2-B	(2) 1" Dia. Bolts See Details 10-13 on S4-B (4) 5/8" Dia. Bolts See Details 10-13 on S4-B	(2) 1" Dia. Bolts See Details 18-22 on S6	(4) 7/8" Dia. Bolts See Details 6-7 on S3-B

*Wall Height is top of floor to bottom of joist (Field measurements can be rounded to the nearest 1/2") i.e: 9'-1/4" rounds to 9', 9'-1/2" rounds to 9'

**Bottom Anchors : Min. (2) 1/2" dia. x 7" long expansion bolts into footing
Or (2) 3/4" dia. x 4" long expansion bolts min. 3" into slab

See Pages S-5 thru S-12 for Additional Connection and Wall reinforcing Details

SPECIFICATIONS:

STEEL TUBE WALL REINFORCING @ MAX. 36" O.C. MAY BE USED FOR 8", 10", OR 12" BLOCK WALLS AND MAX. 50" O.C. FOR 10" OR 12" BLOCK WALLS.

REINFORCING SPACING CAN BE THE AVERAGE OF TWO ADJACENT SPACES WITH A MAXIMUM SPACING OF 50" (10" OR 12" BLOCK). FOR EXAMPLE $(4'-0" + 1'-4")/2 = 2'-8"$ AVERAGE SPACING

STEEL TUBE MUST HAVE MINIMUM 46KSI YIELD STRENGTH.
STEEL PLATE MUST HAVE 36KSI MINIMUM YIELD STRENGTH.

WELDING TO BE PER ASTM STANDARDS.

PRESTRESSING TUBES IS NOT ALLOWED WITHOUT PROPERLY ENGINEERED GUIDELINES.

REINFORCING GUIDELINES ALSO APPLY TO POURED CONCRETE, BRICK AND STONE WALLS OF EQUIVALENT HEIGHT AND THICKNESS.

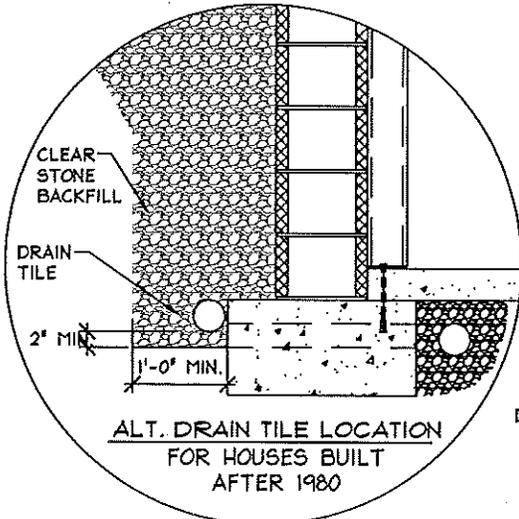
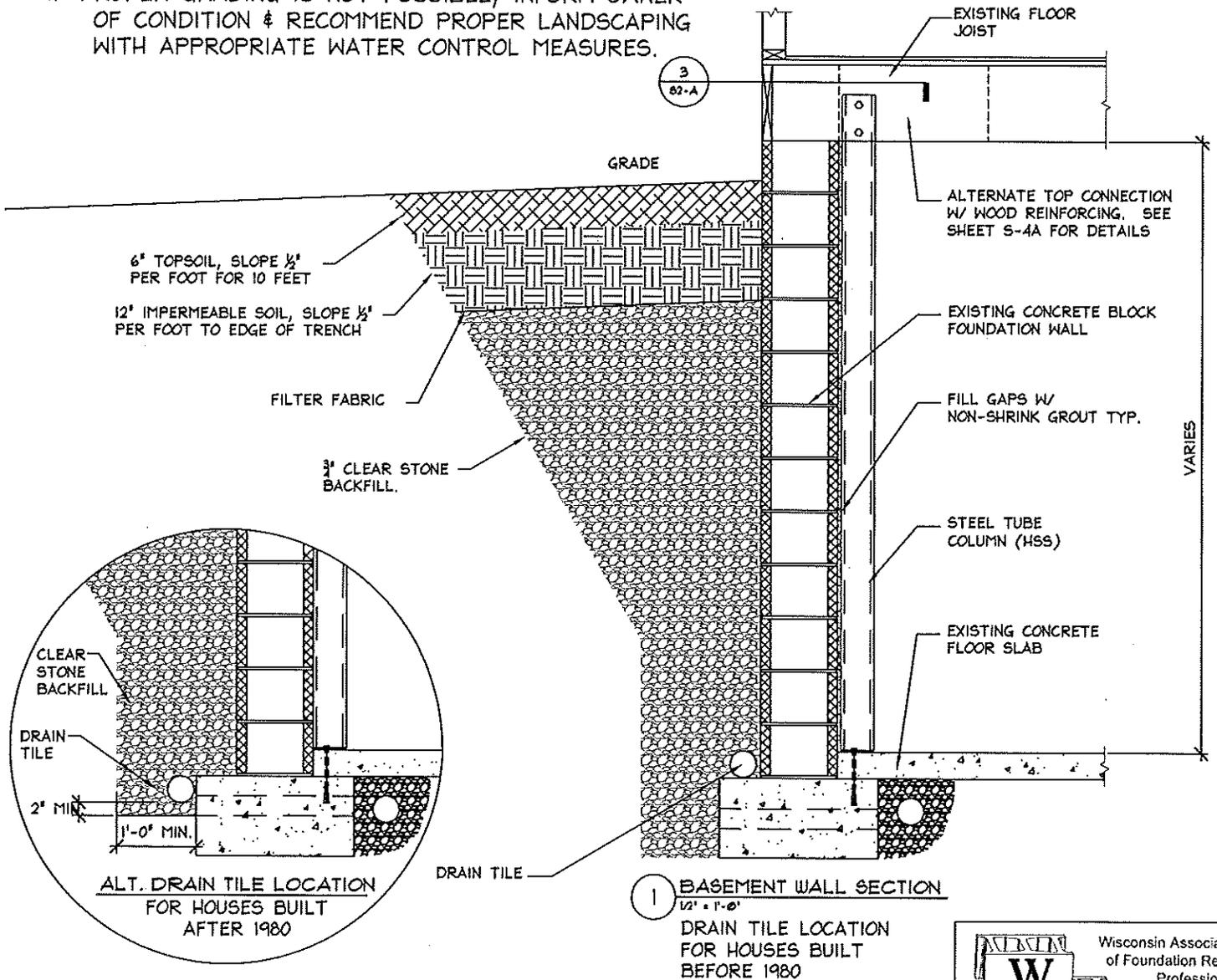
BOLTS AND SLEEVES TO BE ZINC PLATED CARBON STEEL OR BETTER.

NEW WOOD BLOCKING TO BE DOUG. FIR NO.2 OR BETTER.

SCREW TYPE ANCHORS CAN BE USED IN LIEU OF EXPANSION BOLTS IN ALL CASES.

ALL STRUCTURAL CALCULATIONS FOR WOOD MEMBERS PER 2009 NATIONAL DESIGN SPECIFICATIONS FOR WOOD CONSTRUCTION (NDS).

IF PROPER GRADING IS NOT POSSIBLE, INFORM OWNER OF CONDITION & RECOMMEND PROPER LANDSCAPING WITH APPROPRIATE WATER CONTROL MEASURES.



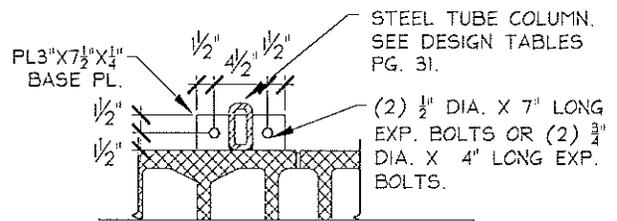
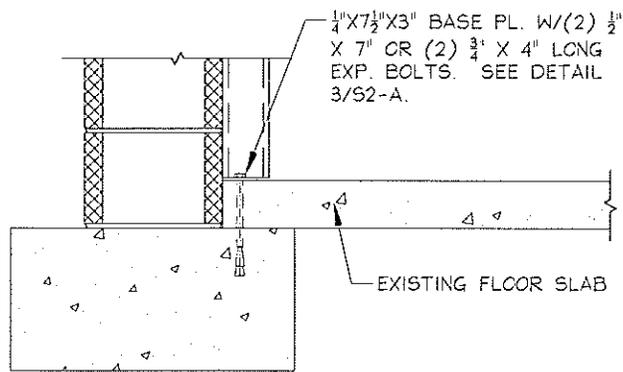
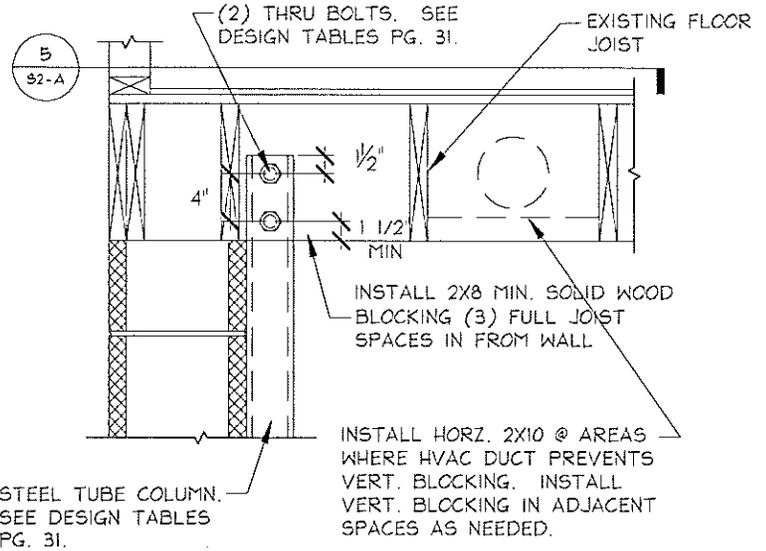
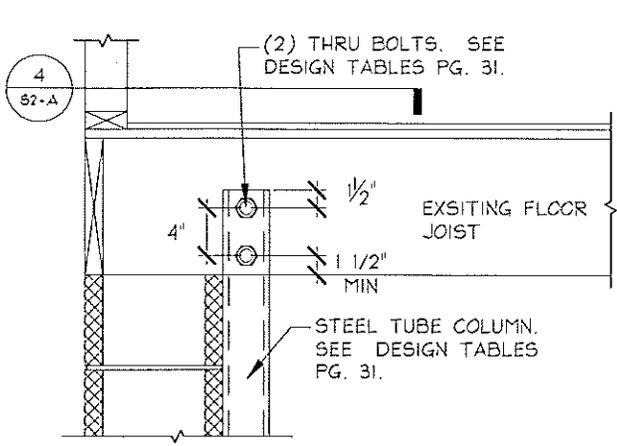
1 BASEMENT WALL SECTION
1/2" x 1'-0"
DRAIN TILE LOCATION
FOR HOUSES BUILT
BEFORE 1980

TITLE: 2 Bolt Basement Wall Reinforcing Details	
SHEET: S1-A, Appendix AA	DRAWN: Jim Jendusa
DATE: 3/26/03	REVISION: 06/13/12

Wisconsin Association
of Foundation Repair
Professionals

MEMBER
W A F R P

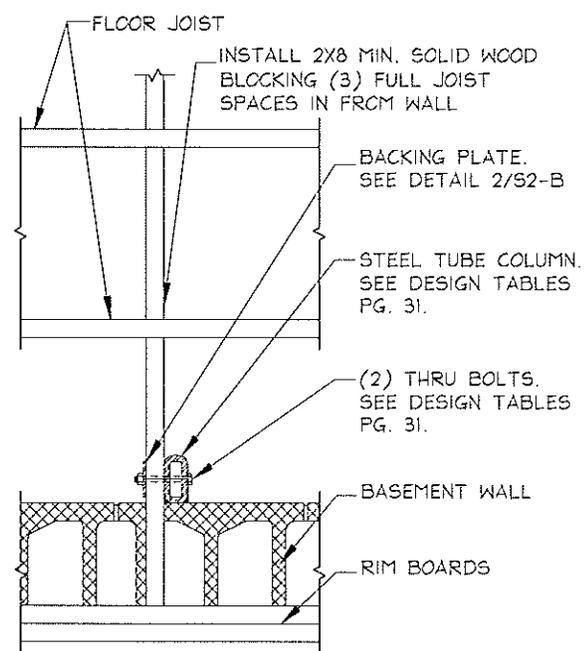
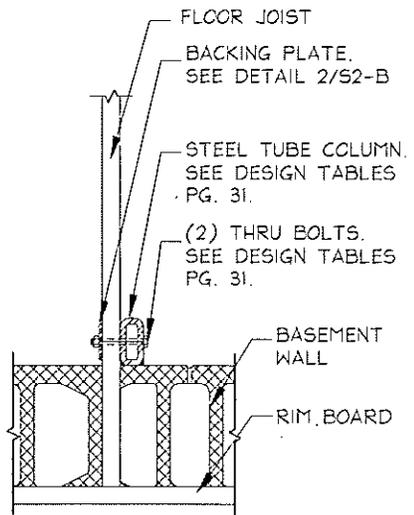
www.WAFRP.com
262-827-5008



NOTE: 1/2" DIA. BOLTS HAVE A FACTOR OF SAFETY OF 3 IN-SCME CASES.

2 CONNECTION DETAIL SIDE VIEW
3/4" = 1'-0"

3 BOTTOM CONN. DETAIL
3/4" = 1'-0"

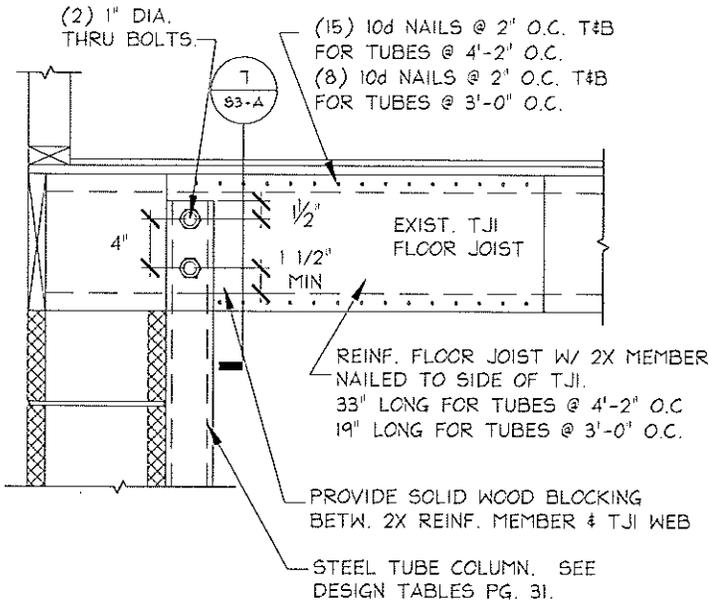


4 TOP CONNECTION DETAIL
3/4" = 1'-0"

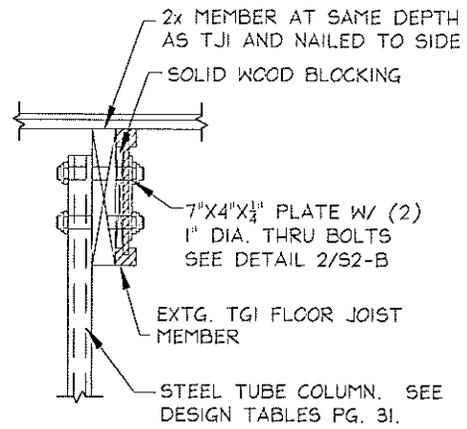
5 TOP CONNECTION DETAIL
3/4" = 1'-0"

TITLE: 2 Bolt Top & Bottom Connection Details	
SHEET: S2-A, Appendix AA	DRAWN: Jim Jendusa
DATE: 3/26/03	REVISION: 06/13/12

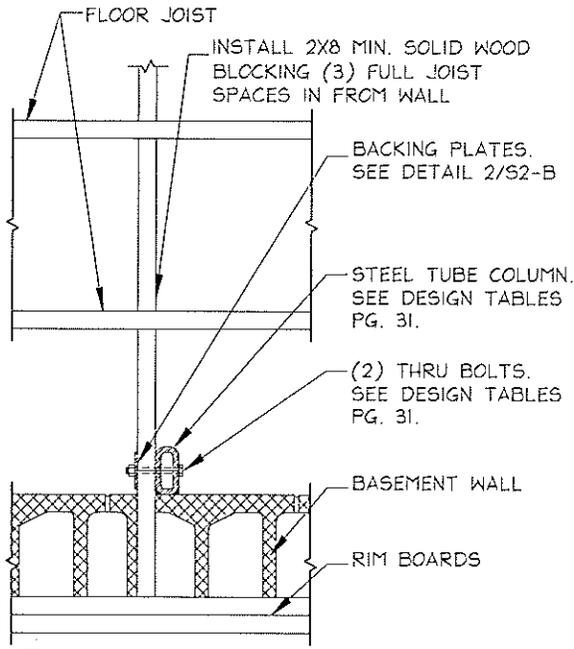




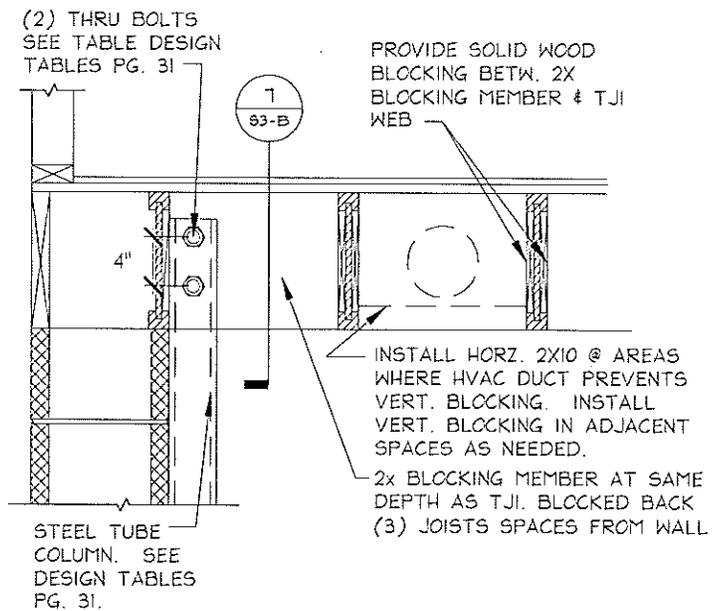
6 TJI CONNECTION DETAIL SIDE VIEW
3/4" = 1'-0"



7 TJI CONNECTION DETAIL SECTION
3/4" = 1'-0"

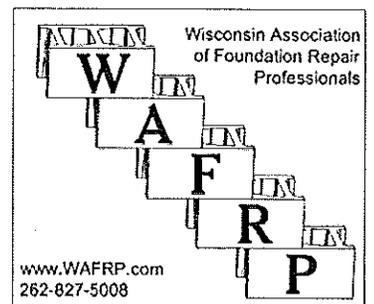


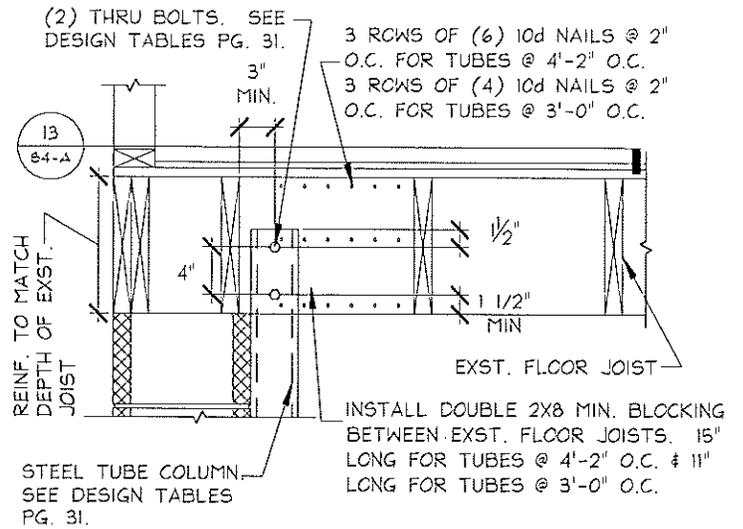
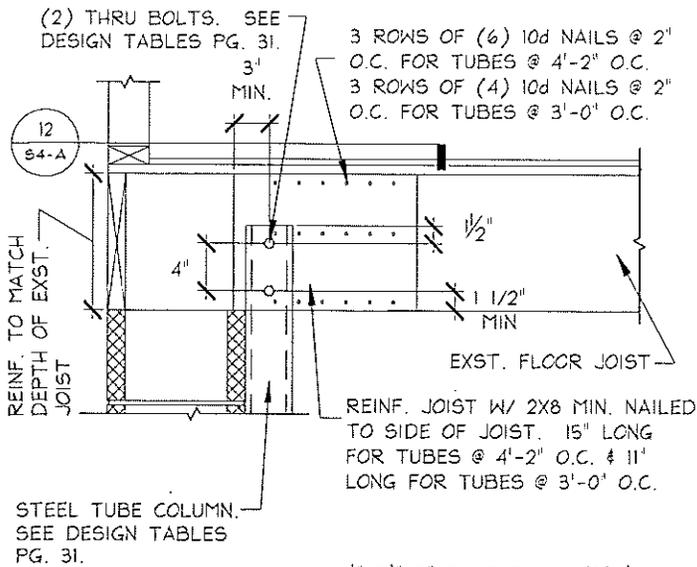
8 TOP CONNECTION DETAIL
3/4" = 1'-0"



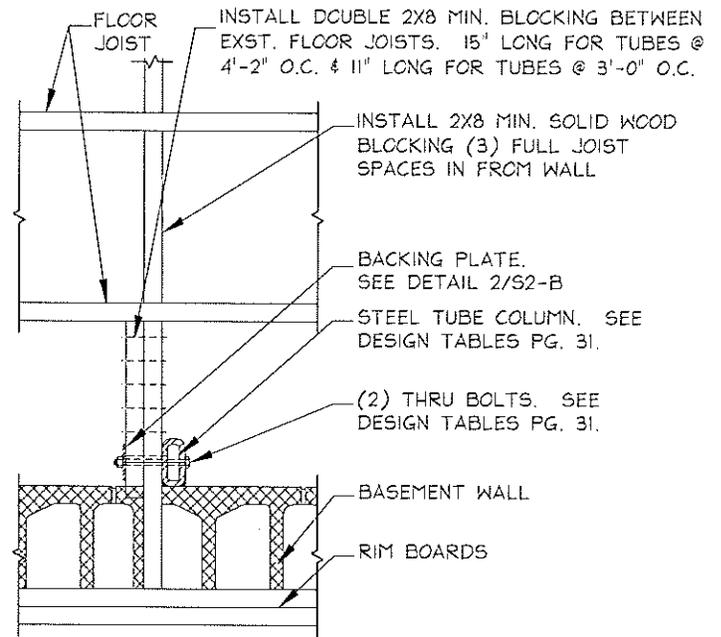
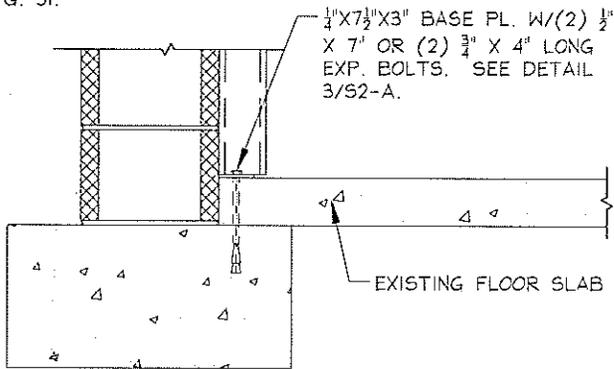
9 TOP CONNECTION DETAIL
3/4" = 1'-0"

TITLE: 2 Bolt Alt. TJI Top Connection	
SHEET: S3-A, Appendix AA	DRAWN: Jim Jendusa
DATE: 3/26/03	REVISION: 06/13/12



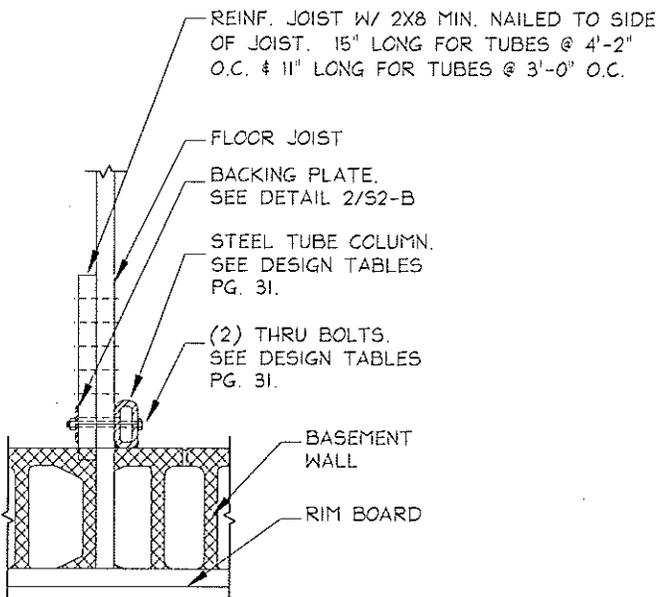


11 CONNECTION DETAIL SIDE VIEW
3/4" = 1'-0"



13 TOP CONNECTION DETAIL
3/4" = 1'-0"

10 CONNECTION DETAIL SIDE VIEW
3/4" = 1'-0"



12 TOP CONNECTION DETAIL
3/4" = 1'-0"

TITLE: 2 Bolt Alt. Top Connection W/ Double Floor Joist	
SHEET: S4-A, Appendix AA	DRAWN: Jim Jendusa
DATE: 3/26/03	REVISION: 06/13/12



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REINFORCING SPACING CAN BE THE AVERAGE OF TWO ADJACENT SPACES WITH A MAXIMUM SPACING OF 50" (10" OR 12" BLOCK). FOR EXAMPLE (4'-0" + 1'-4")/2 = 2'-8" AVERAGE SPACING

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STEEL PLATE MUST HAVE 36KSI MINIMUM YIELD STRENGTH.

WELDING TO BE PER ASTM STANDARDS.

PRESTRESSING TUBES REQUIRES SITE SPECIFIC ENGINEERING.

REINFORCING GUIDELINES ALSO APPLY TO POURED CONCRETE, BRICK AND STONE WALLS OF EQUIVALENT HEIGHT AND THICKNESS.

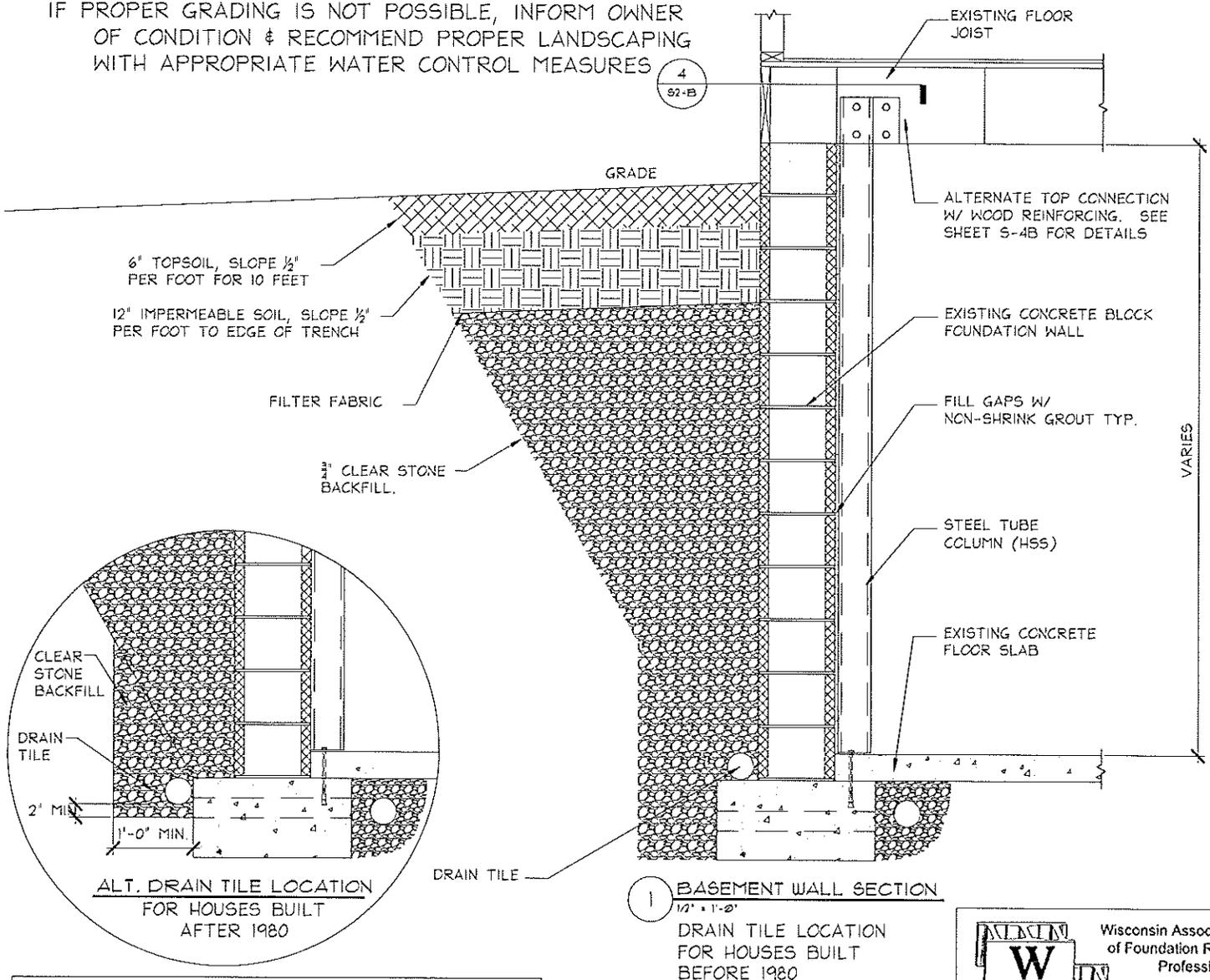
BOLTS AND SLEEVES TO BE ZINC PLATED CARBON STEEL OR BETTER.

NEW WOOD BLOCKING TO BE DOUG. FIR NO.2 OR BETTER.

SCREW TYPE ANCHORS CAN BE USED IN LIEU OF EXPANSION BOLTS IN ALL CASES.

ALL STRUCTURAL CALCULATIONS FOR WOOD MEMBERS PER 2009 NATIONAL DESIGN SPECIFICATIONS FOR WOOD CONSTRUCTION (NDS).

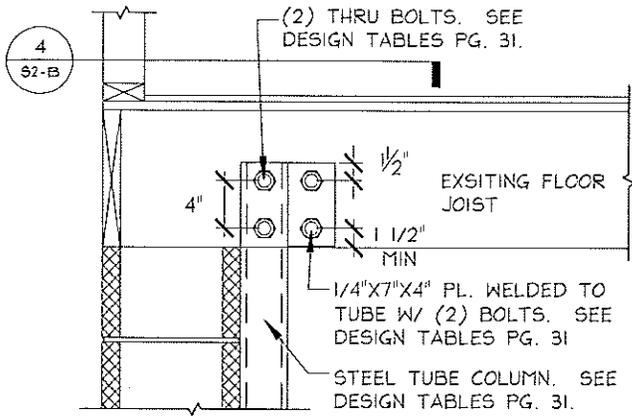
IF PROPER GRADING IS NOT POSSIBLE, INFORM OWNER OF CONDITION & RECOMMEND PROPER LANDSCAPING WITH APPROPRIATE WATER CONTROL MEASURES



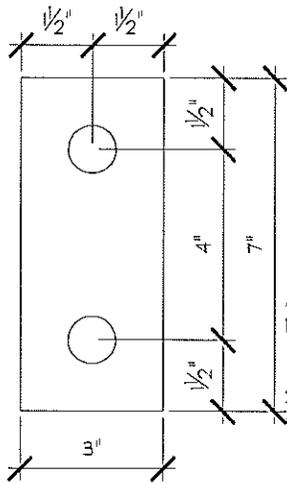
TITLE: 4 Bolt Basement Wall Reinforcing Details	
SHEET: S1-B, Appendix AA	DRAWN: Jim Jendusa
DATE: 3/26/03	REVISION: 06/13/12

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262-827-5008



1 CONNECTION DETAIL SIDE VIEW
3/4" = 1'-0"

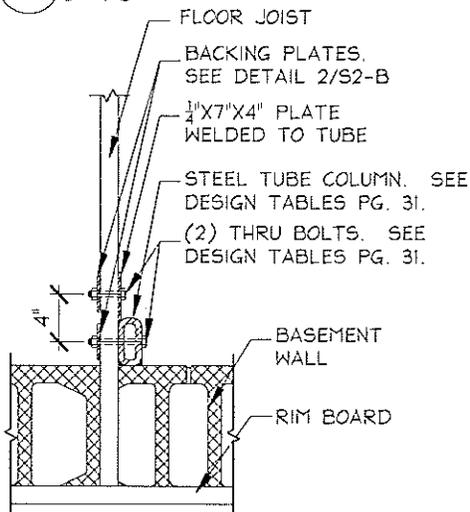


ALTERNATES :

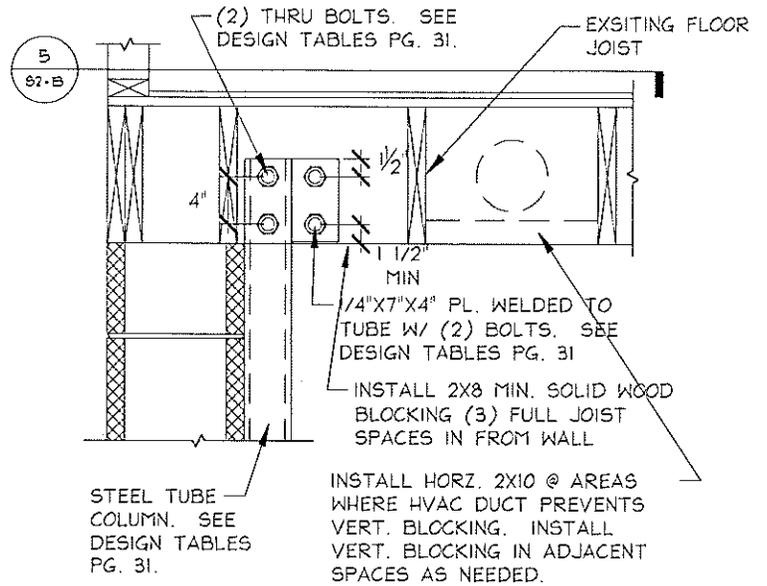
1 - (2) 1/8" THICK x 2" DIA. WASHERS CAN BE USED IN LIEU OF BACKING PLATE

2 - 2"X5"X1/4" PL. CRITICAL DIMENSION IS 4" BETWEEN BOLTS.

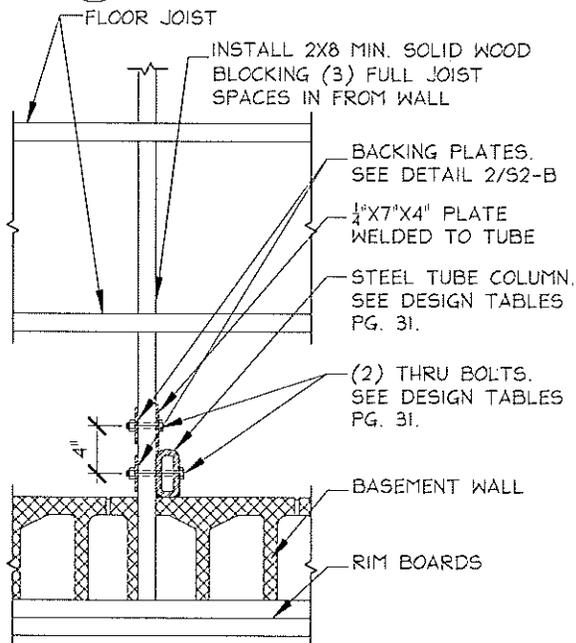
2 TOP PLATE DETAIL/BACKING PLATE
3" = 1'-0"



4 TOP CONNECTION DETAIL
3/4" = 1'-0"



3 CONNECTION DETAIL SIDE VIEW
3/4" = 1'-0"

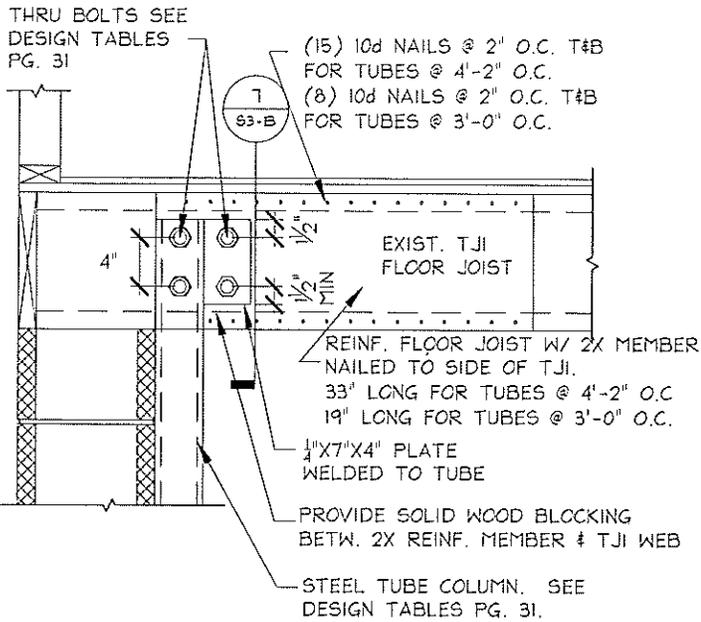


5 TOP CONNECTION DETAIL
3/4" = 1'-0"

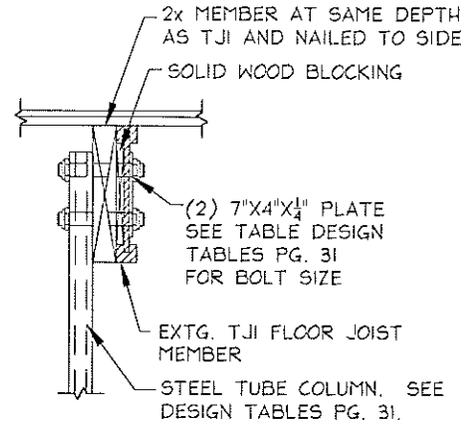
TITLE: 4 Bolt Top & Bottom Connection Details	
SHEET: S2-B, Appendix AA	DRAWN: Jim Jendusa
DATE: 3/26/03	REVISION: 06/13/12

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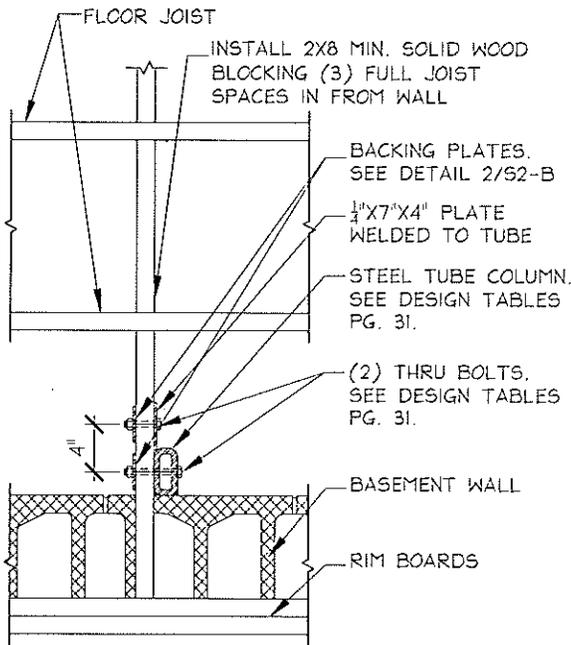
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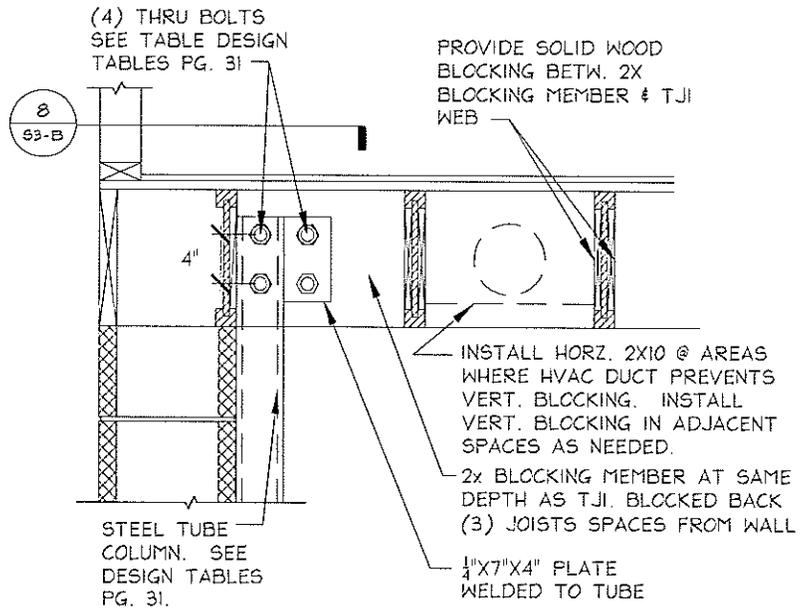
6 TJI CONNECTION DETAIL SIDE VIEW
3/4" x 1'-0"



7 TJI CONNECTION DETAIL SECTION
3/4" x 1'-0"



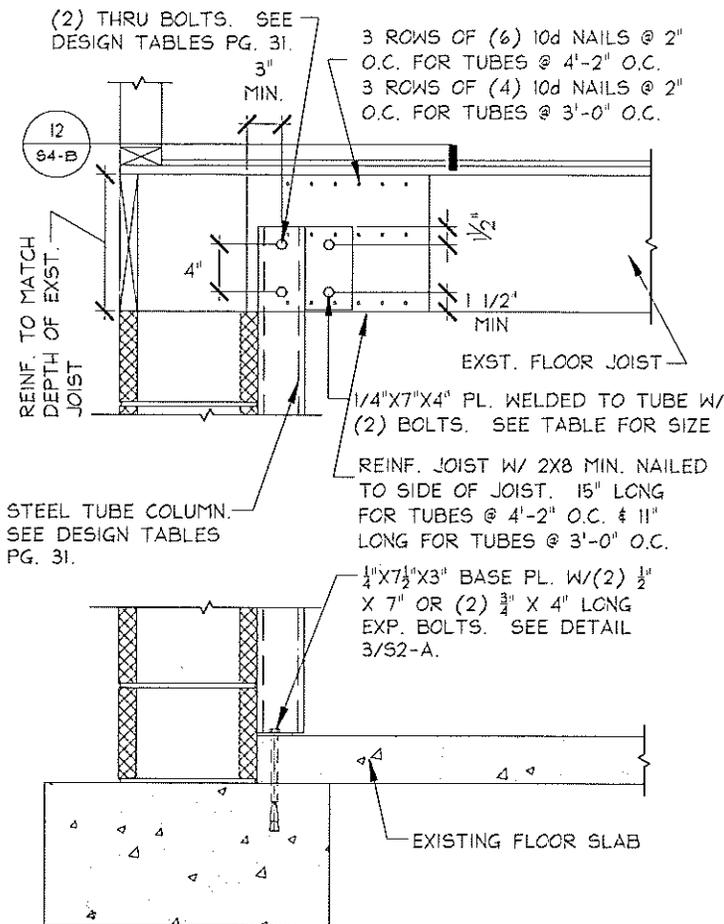
8 TOP CONNECTION DETAIL
3/4" x 1'-0"



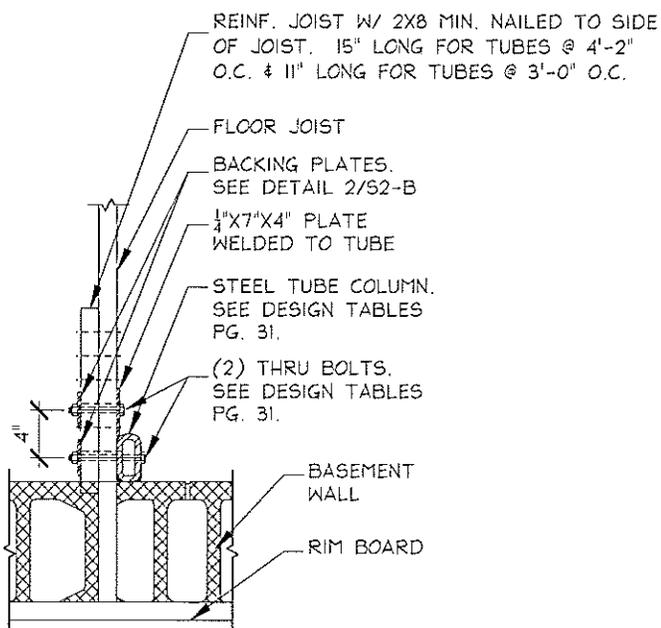
9 TOP CONNECTION DETAIL
3/4" x 1'-0"

TITLE: 4 Bolt Alt. TJI Top Connection	
SHEET: S3-B, Appendix AA	DRAWN: Jim Jendusa
DATE: 3/26/03	REVISION: 06/13/12

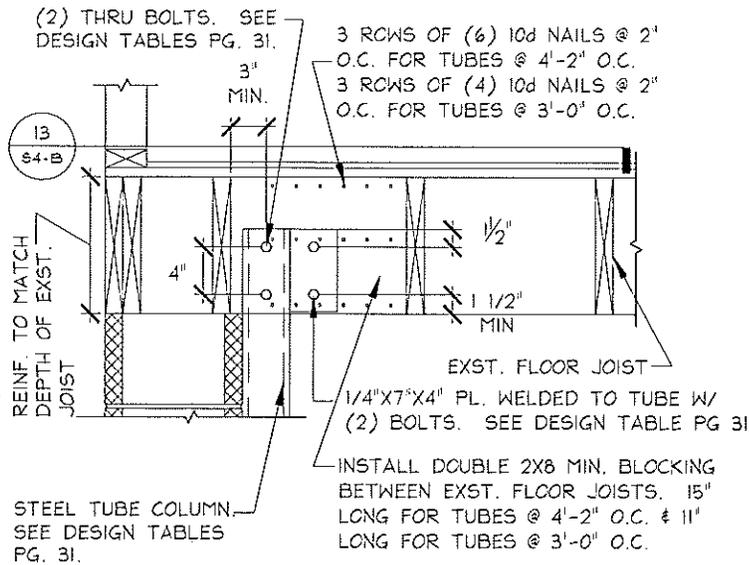




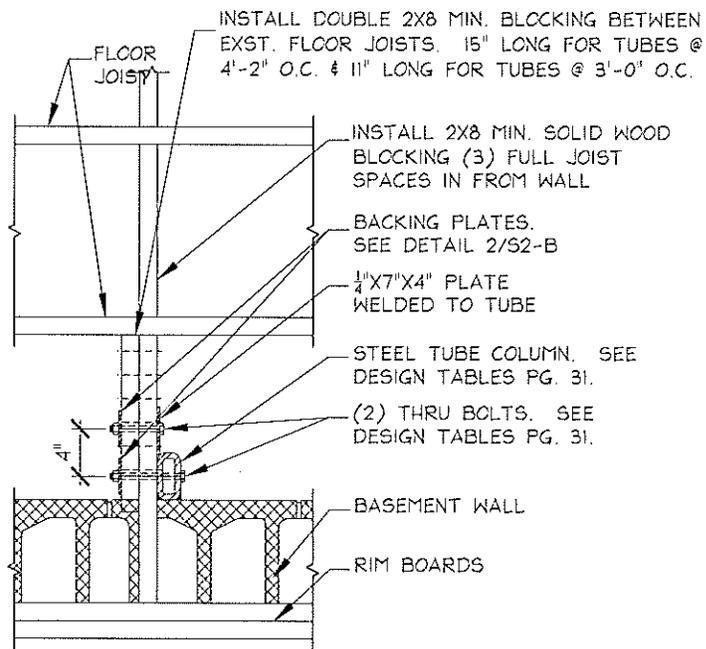
10 CONNECTION DETAIL SIDE VIEW
3/4" x 1'-0"



12 TOP CONNECTION DETAIL
3/4" x 1'-0"



11 CONNECTION DETAIL SIDE VIEW
3/4" x 1'-0"



13 TOP CONNECTION DETAIL
3/4" x 1'-0"

TITLE: 4 Bolt Alt. Top Connection W/ Double Floor Joist

SHEET: S4-B, Appendix AA

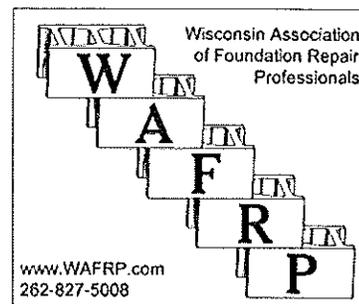
DRAWN: Jim Jendusa

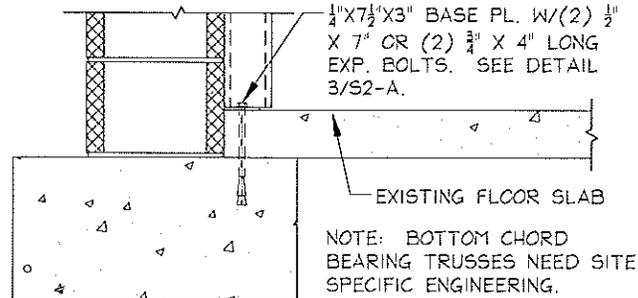
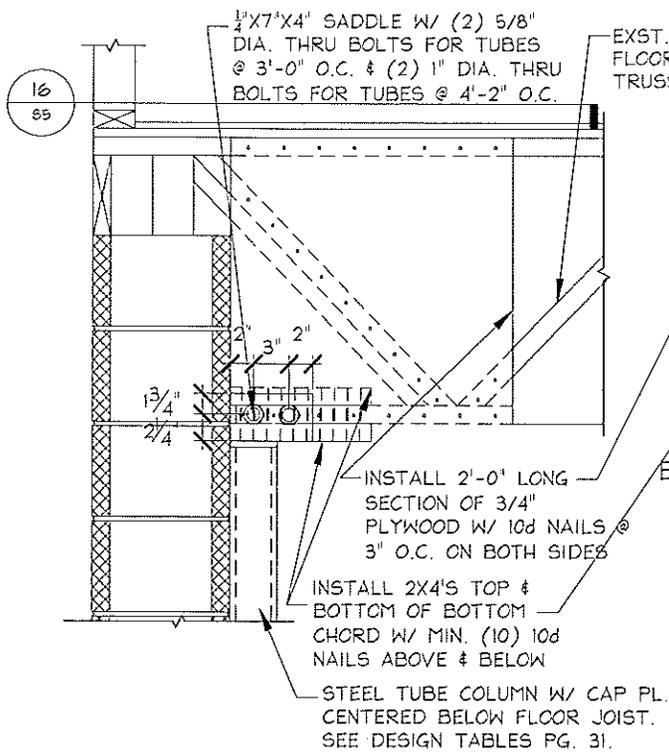
DATE: 3/26/03

REVISION: 06/13/12

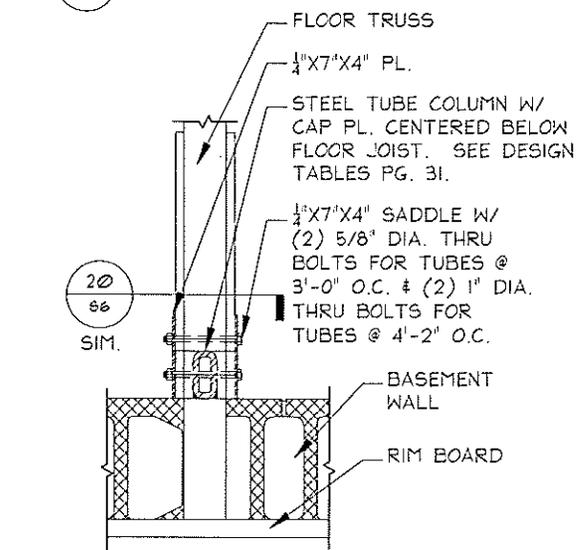
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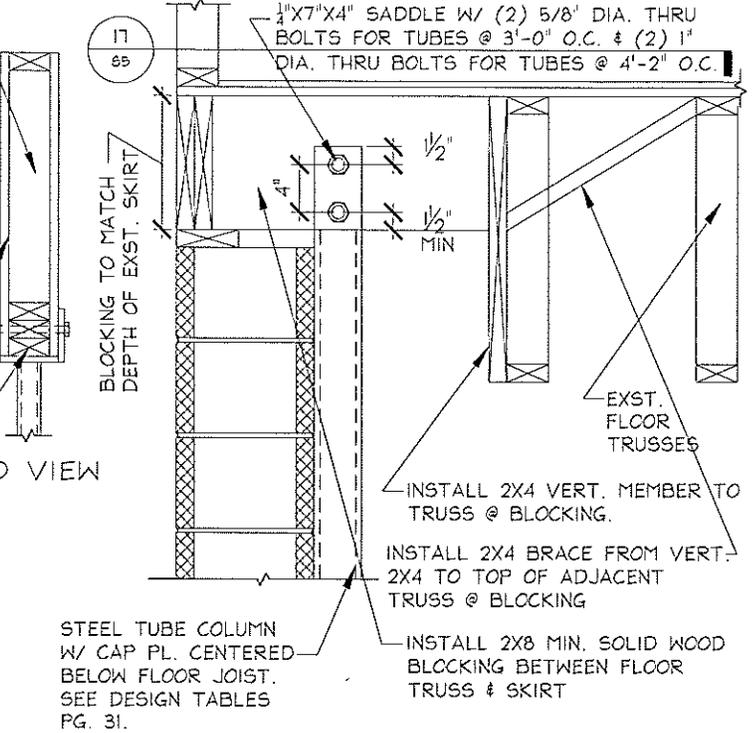


14 CONNECTION DETAIL SIDE VIEW

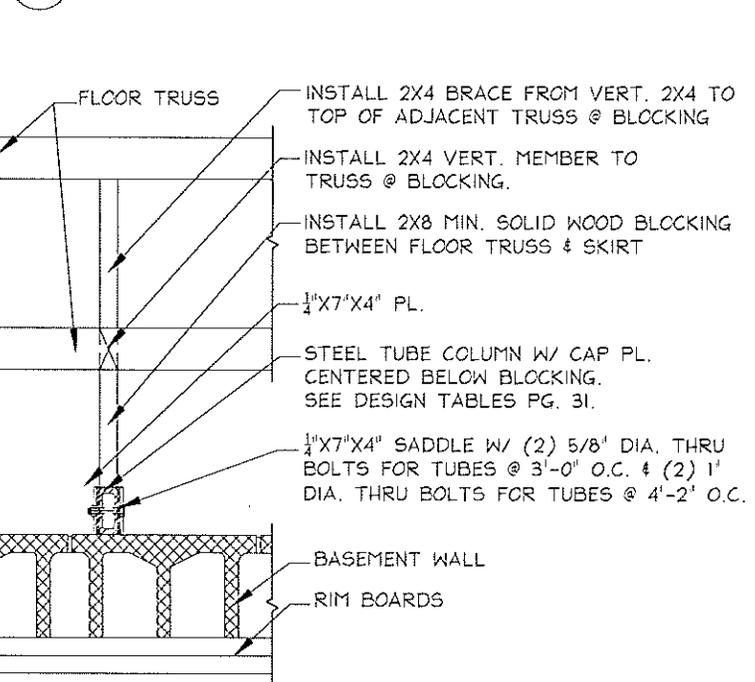


16 TOP CONNECTION DETAIL

TITLE: Alt. Top Connection W/ Floor Trusses	
SHEET: S5, Appendix AA	DRAWN: Jim Jendusa
DATE: 3/26/03	REVISION: 06/13/12

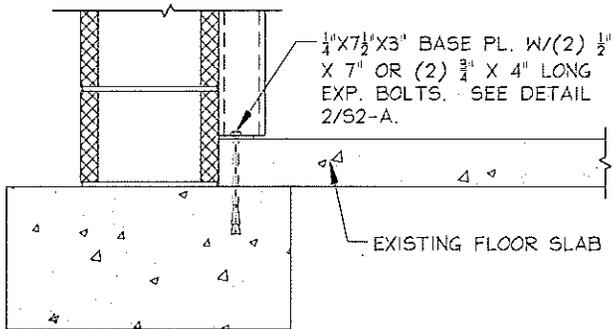
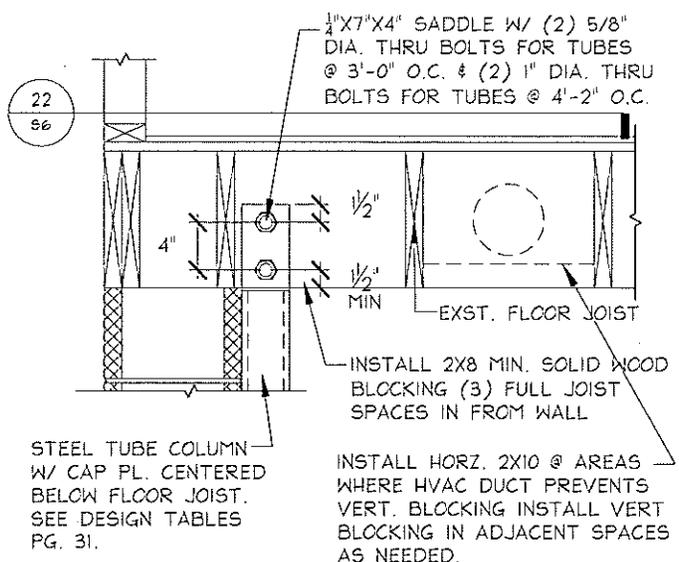
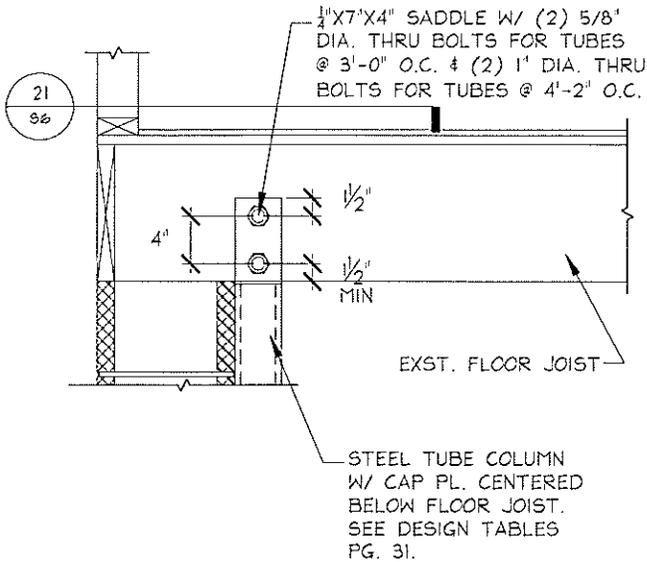


15 CONNECTION DETAIL SIDE VIEW



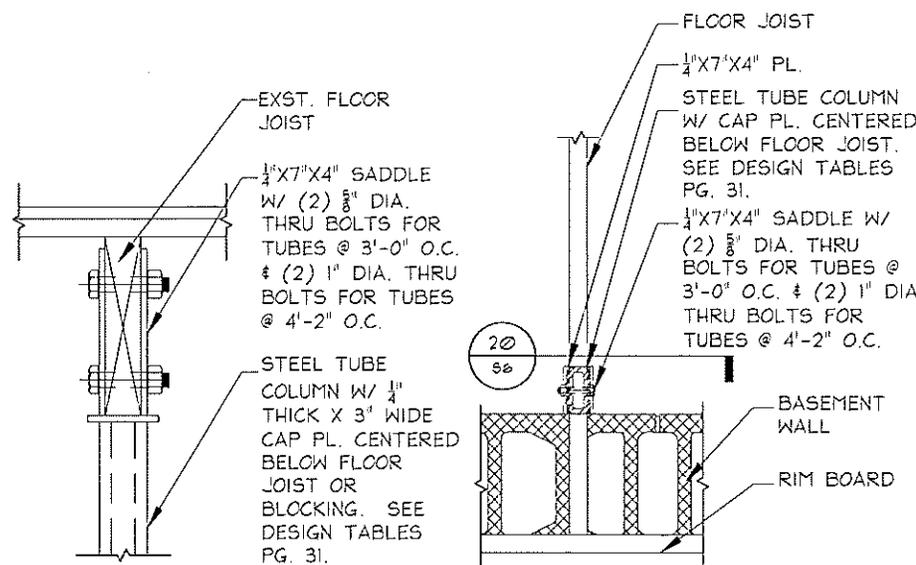
17 TOP CONNECTION DETAIL





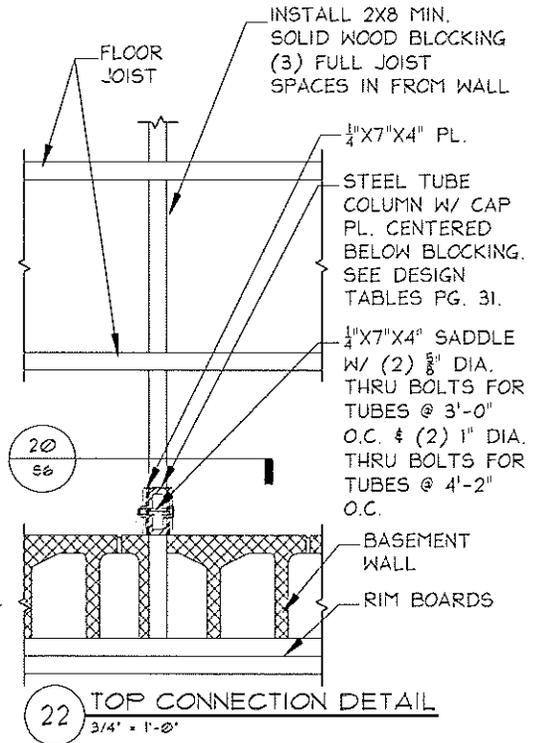
18 CONNECTION DETAIL SIDE VIEW
3/4" = 1'-0"

19 CONNECTION DETAIL SIDE VIEW
3/4" = 1'-0"



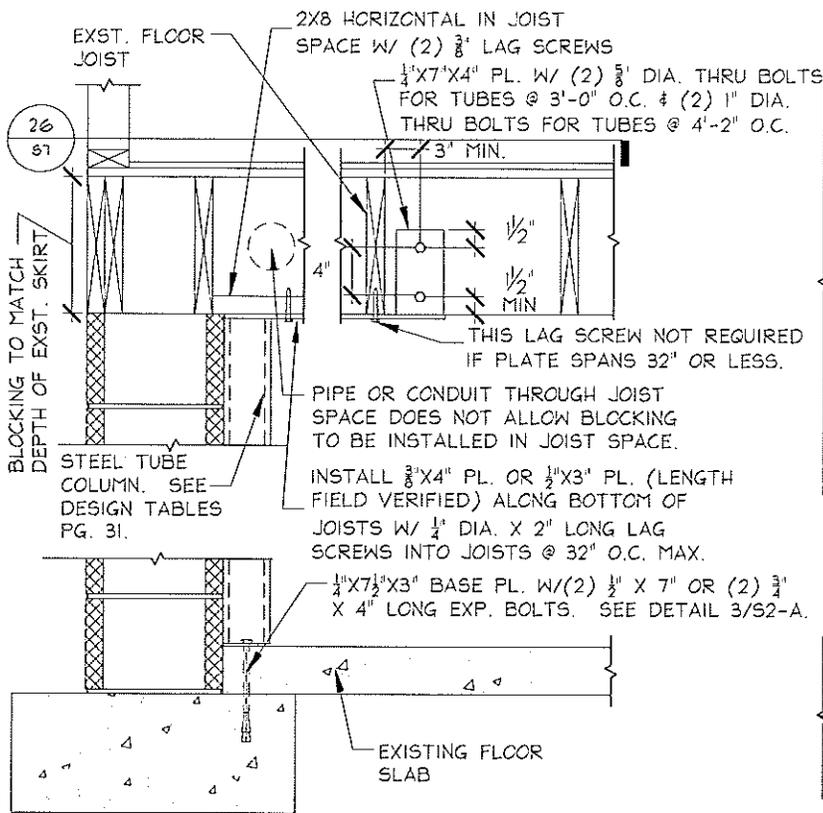
20 CONNECTION DETAIL SECTION
1/2" = 1'-0"

21 TOP CONNECTION DETAIL
3/4" = 1'-0"

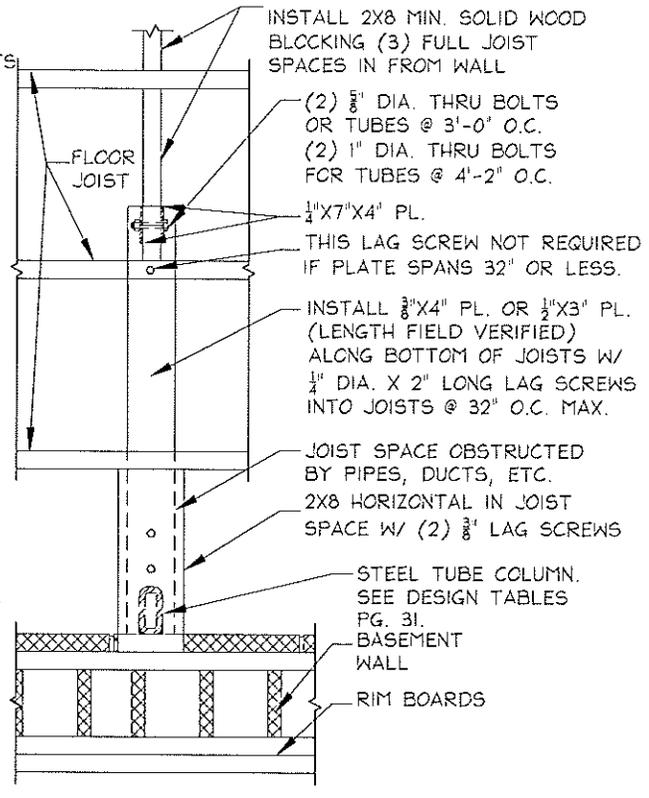


TITLE: Alt. Top Connection W/ Top Saddle	
SHEET: S6, Appendix AA	DRAWN: Jim Jendusa
DATE: 3/26/03	REVISION: 06/13/12

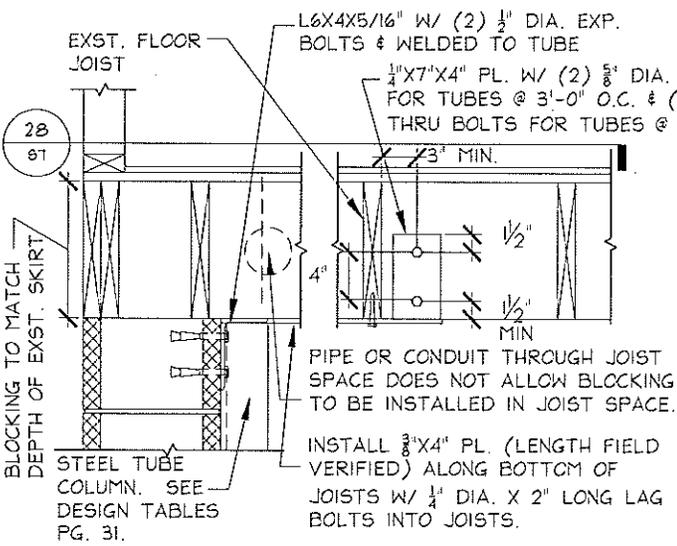




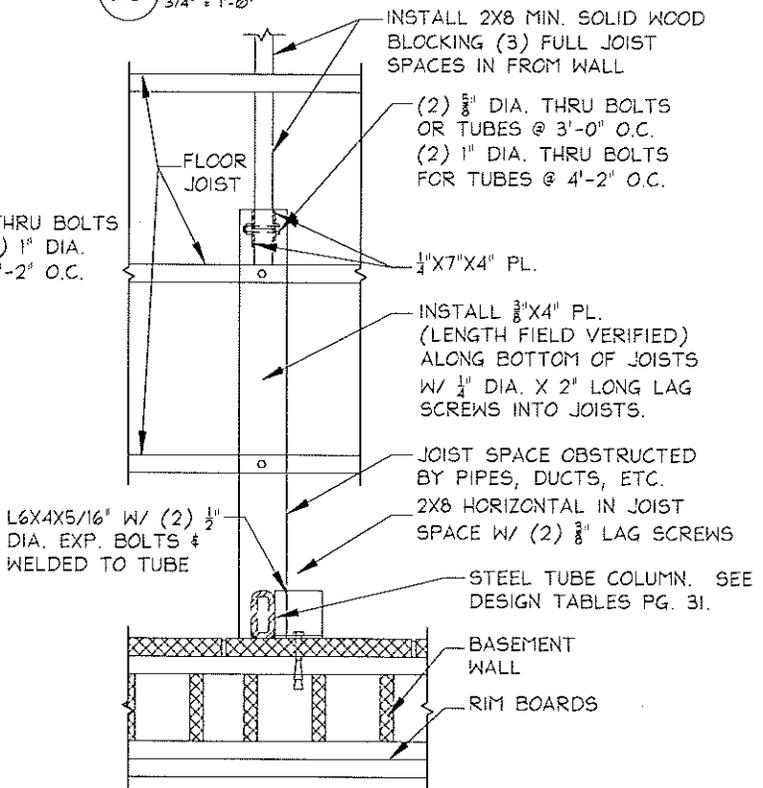
25 OFFSET CONN. DETAIL SIDE VIEW
3/4" x 1'-0"



26 OFFSET CONN. DETAIL TOP VIEW
3/4" x 1'-0"

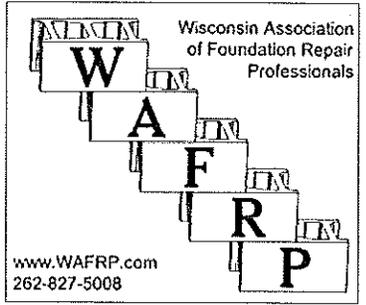


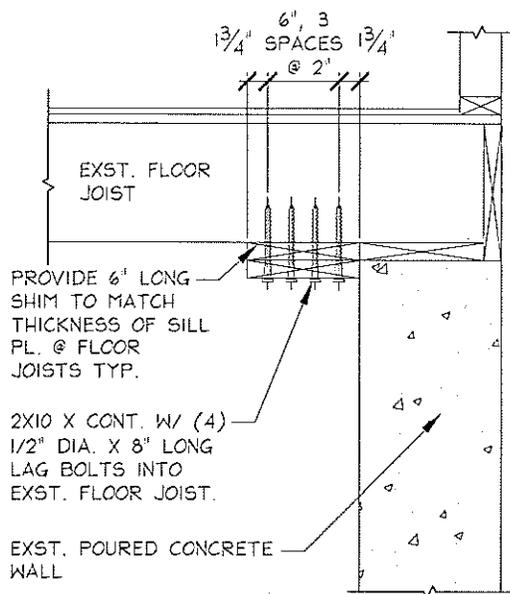
27 ALT. OFFSET CONN. DETAIL SIDE VIEW
3/4" x 1'-0"



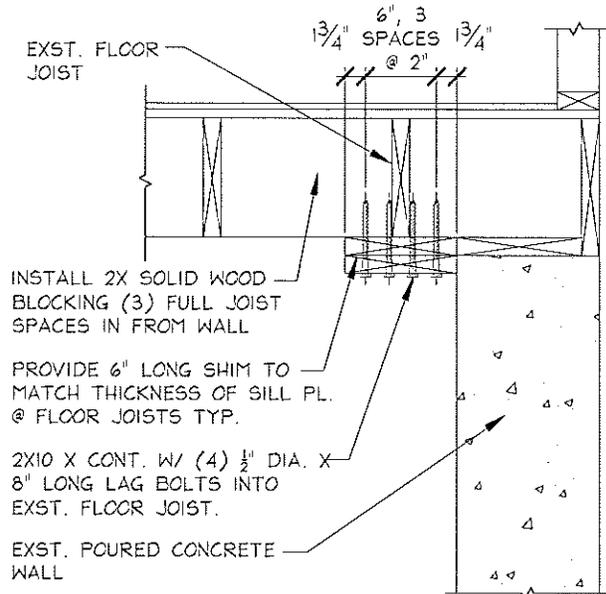
28 ALT. OFFSET CONN. DETAIL TOP VIEW
3/4" x 1'-0"

TITLE: Misc. Repair Details	
SHEET: S7, Appendix AA	DRAWN: Jim Jendusa
DATE: 3/26/03	REVISION: 06/13/12

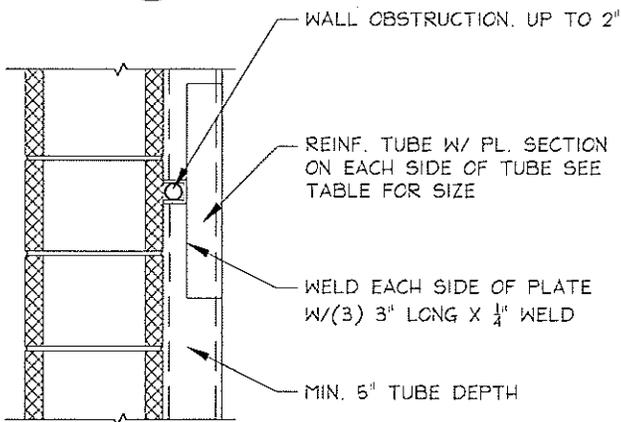




29 FLOOR JOIST CONNECTION DETAIL
3/4" = 1'-0"



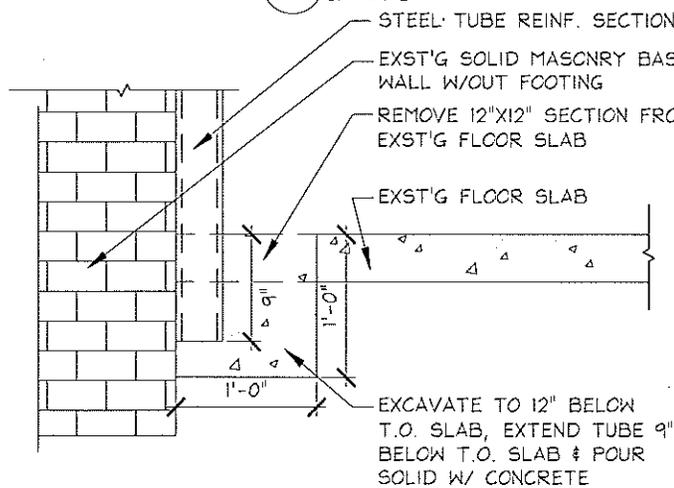
30 FLOOR JOIST CONNECTION DETAIL
3/4" = 1'-0"



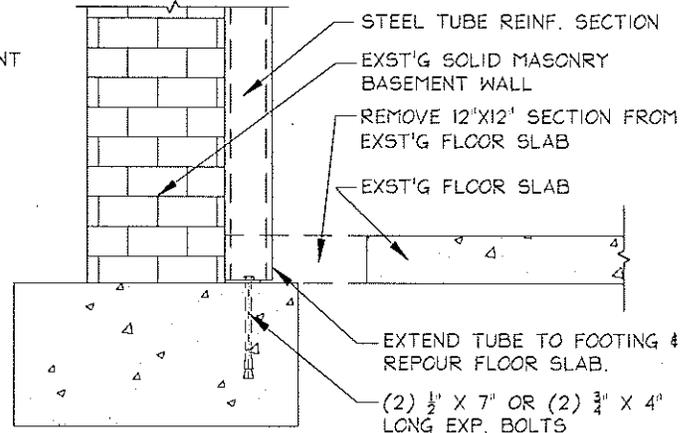
STEEL TUBE REINFORCING AROUND OBSTRUCTIONS			
WALL HT.	WALL REINF. #	SPACING	REINFORCING PLATES
10 COURSES (8'-10")	HSS 5"X2"X3/16"	3'-0"	(2) PL 1/4"X3"X18"
	HSS 5"X2"X3/16"	4'-2"	(2) PL 3/8"X3"X18"
11 COURSES (7'-6")	HSS 5"X2"X3/16"	3'-0"	(2) PL 3/8"X3"X18"
	HSS 6"X2"X3/16"	4'-2"	(2) PL 1/4"X4"X18"
12 COURSES (8'-2")	HSS 5"X3"X1/4"	3'-0"	(2) PL 1/4"X3"X18"
	HSS 6"X3"X1/4"	4'-2"	(2) PL 5/8"X4"X18"

* 2X4 TUBES CAN BE USED IF NOTCH IS LESS THAN OR EQUAL TO 1"

31 TUBE REINFORCEMENT AROUND OBSTRUCTIONS
3/4" = 1'-0"



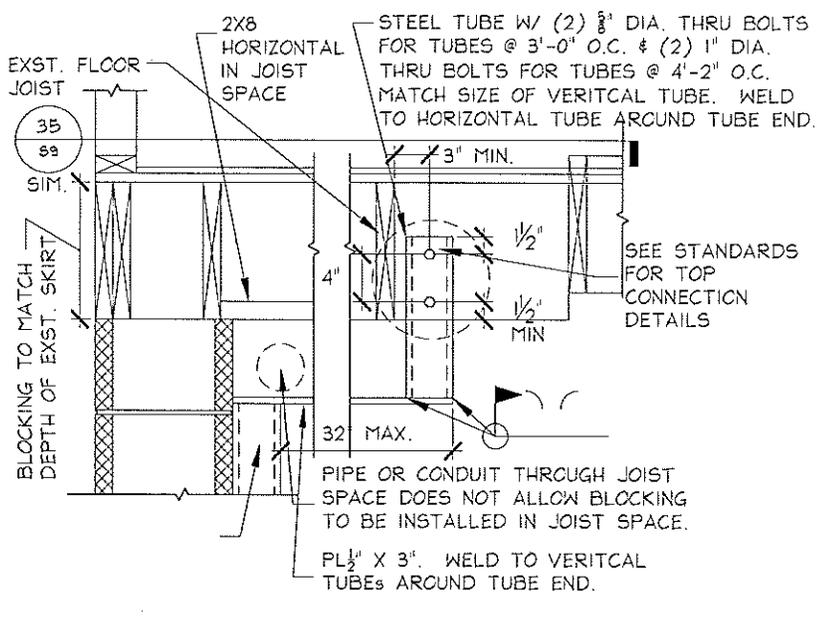
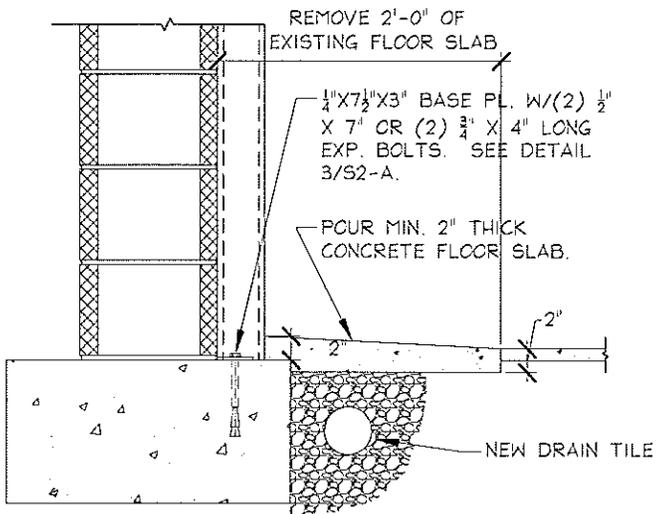
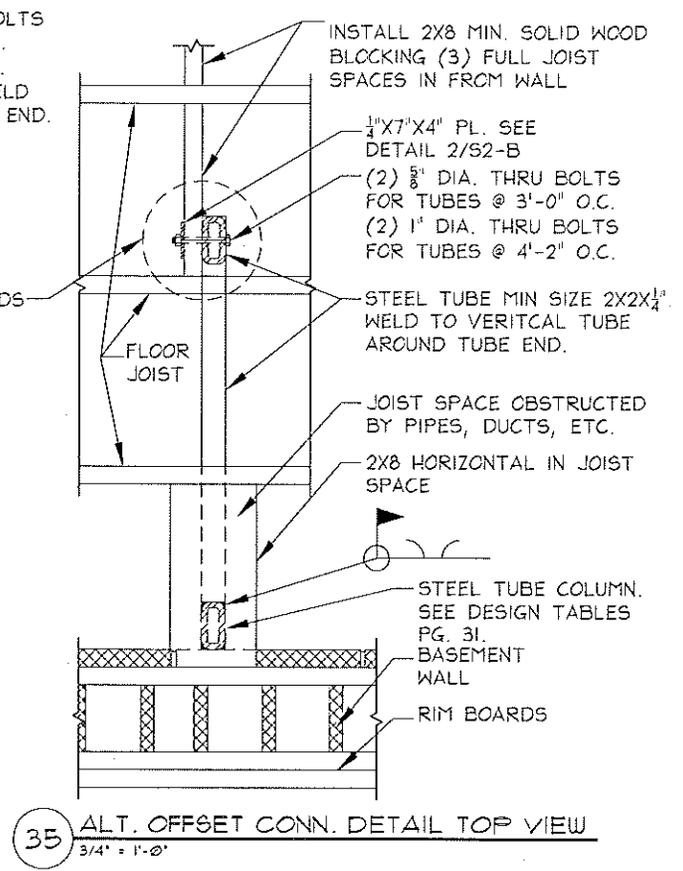
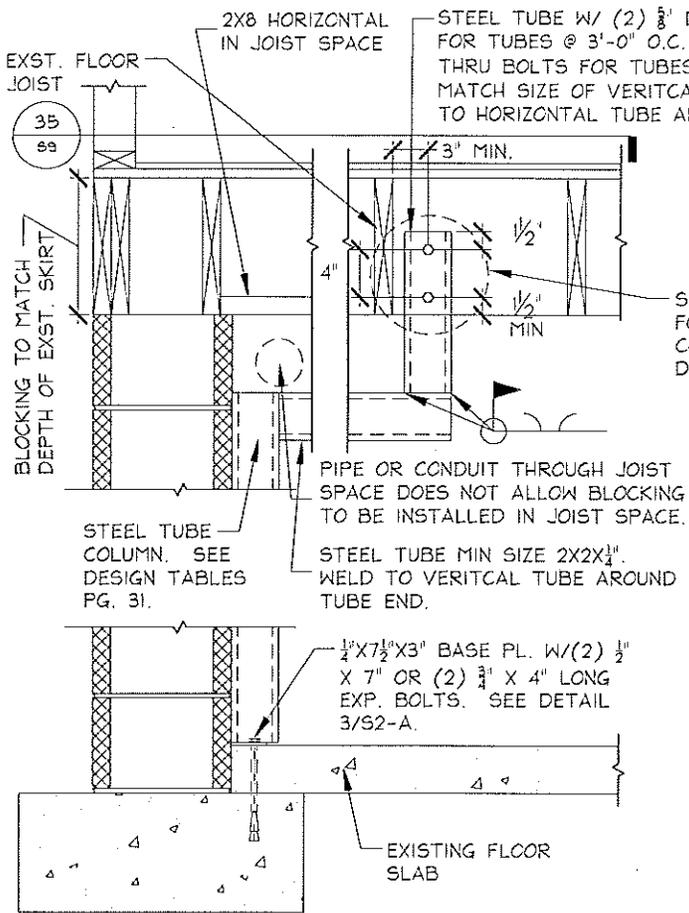
32 WALL REINF. BOTTOM CONNECTION W/O FTG
3/4" = 1'-0"



33 WALL REINF. BOTTOM CONNECTION TO FTG
3/4" = 1'-0"

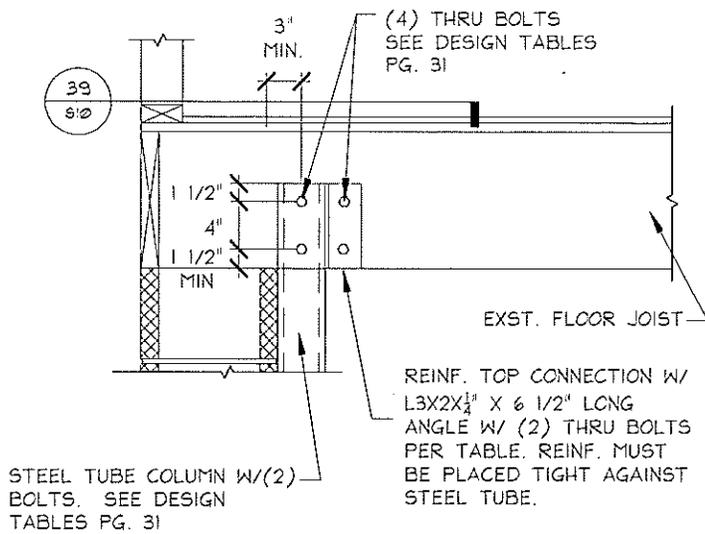
TITLE: Misc. Repair Details	
SHEET: S8, Appendix AA	DRAWN: Jim Jendusa
DATE: 3/26/03	REVISION: 06/13/12



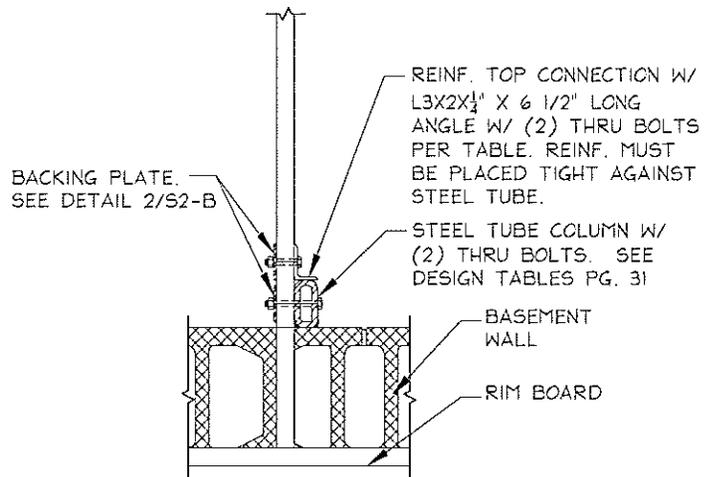


TITLE: Offset & Base Details	
SHEET: S9, Appendix AA	DRAWN: JFJ
DATE: 01/08/08	REVISION: 06/13/12

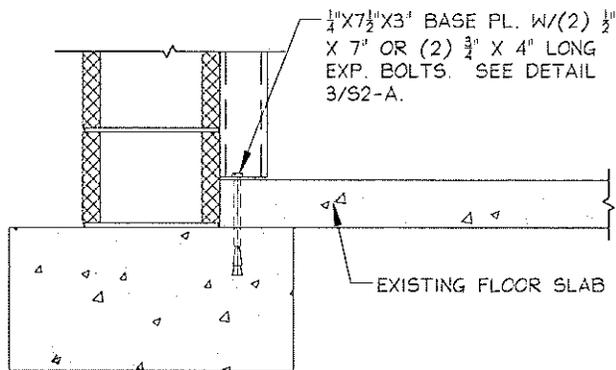




38 STEEL ANGLE SUPPORT DETAIL SIDE VIEW
3/4" = 1'-0"



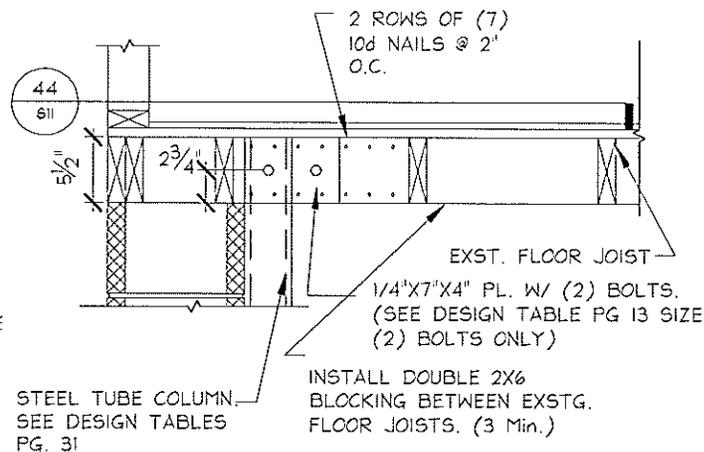
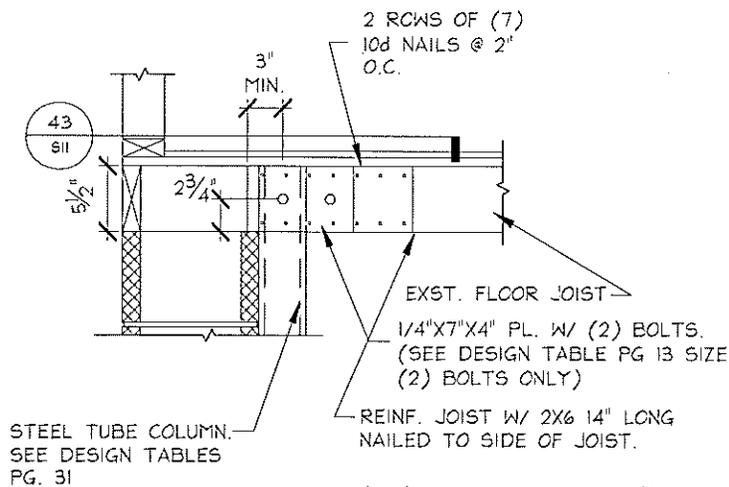
39 STEEL ANGLE SUPPORT DETAIL
3/4" = 1'-0"



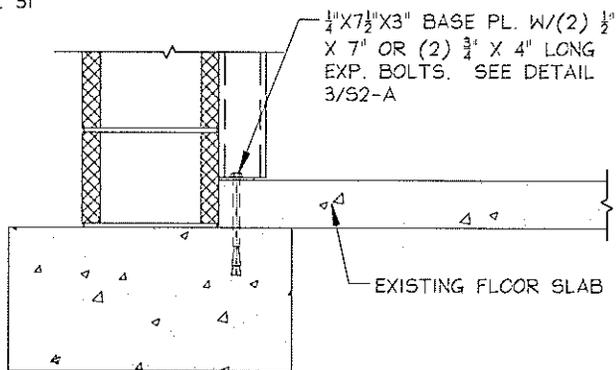
40 CONNECTION DETAIL SIDE VIEW
3/4" = 1'-0"

TITLE: Alternate Top Connection Details	
SHEET: S10, Appendix AA	DRAWN: JFJ
DATE: 6/15/10	REVISION: 06/13/12

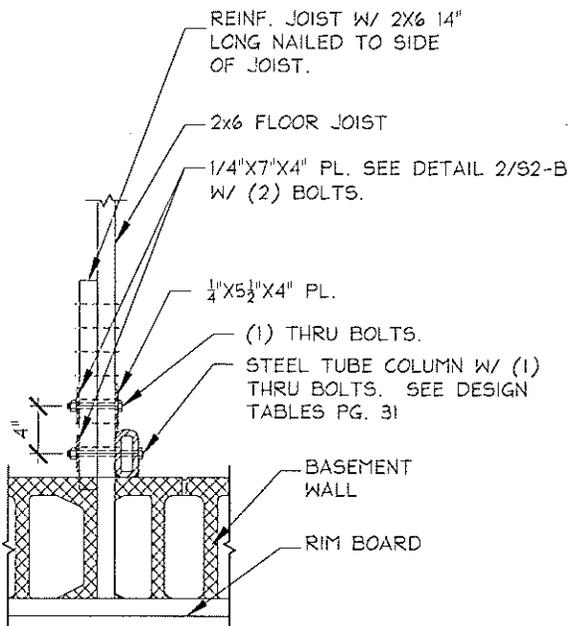




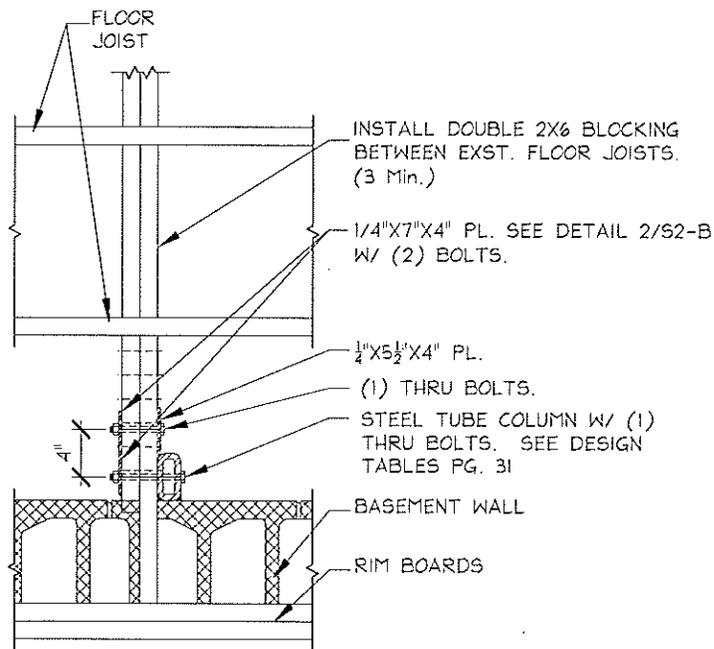
42 CONNECTION DETAIL SIDE VIEW
3/4" x 1'-0"



41 CONNECTION DETAIL SIDE VIEW
3/4" x 1'-0"

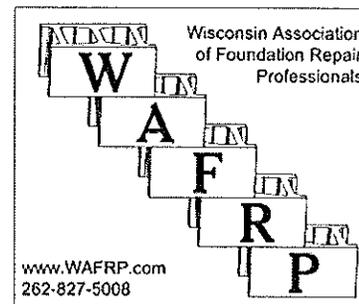


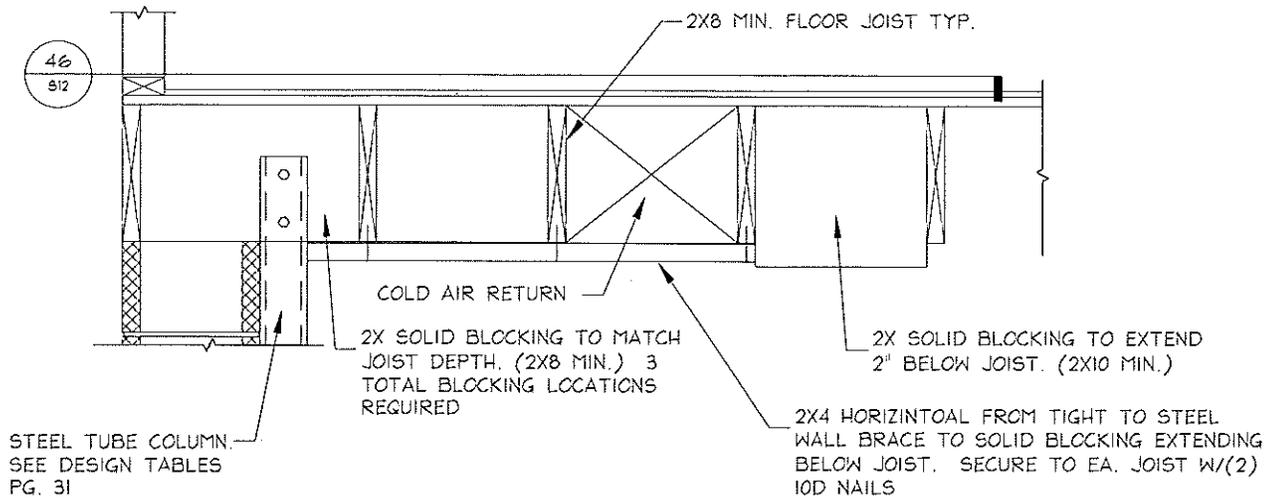
43 TOP CONNECTION DETAIL
3/4" x 1'-0"



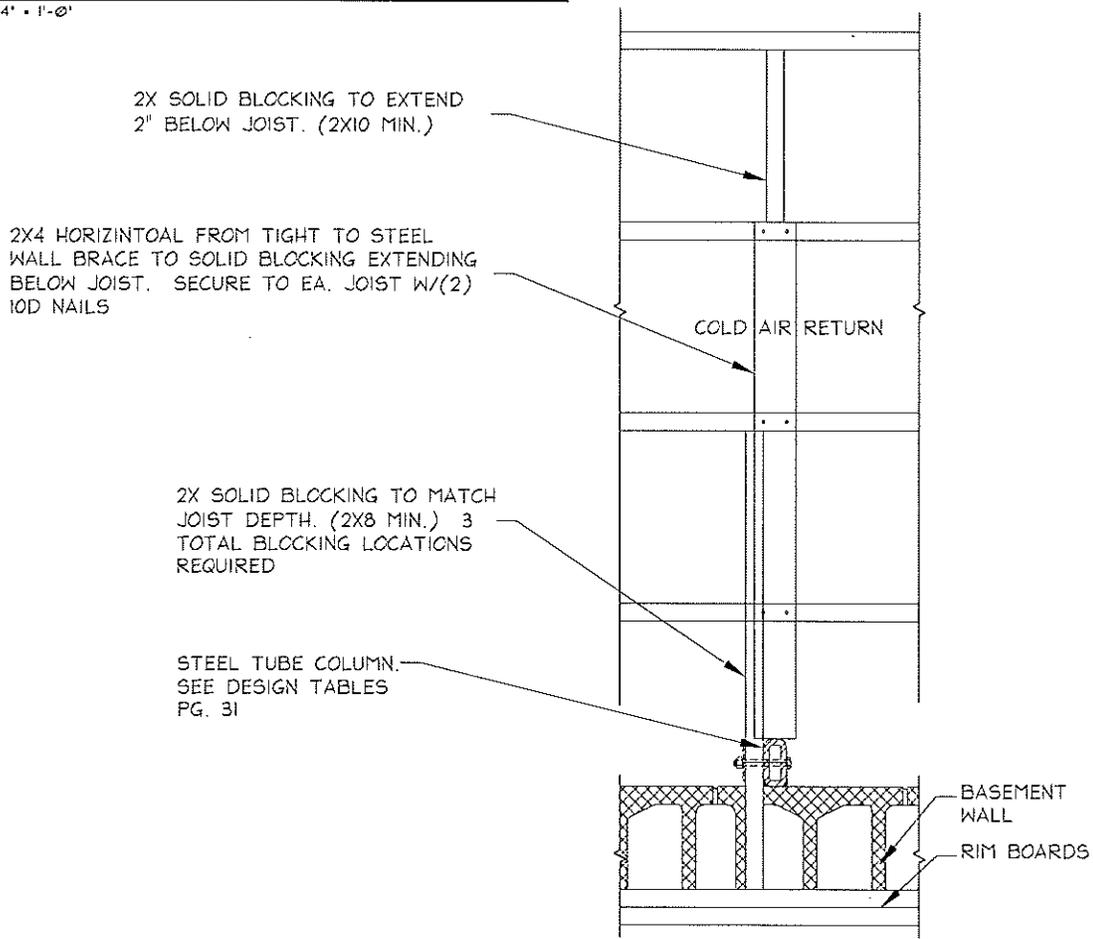
44 TOP CONNECTION DETAIL
3/4" x 1'-0"

TITLE: 2x6 Connection Details	
SHEET: S11, Appendix AA	DRAWN: JFJ
DATE: 06/15/10	REVISION: 06/13/12





46 WOOD BLOCK REPAIR DETAIL SIDE VIEW
3/4" x 1'-0"



45 WOOD BLOCK REPAIR DETAIL
3/4" x 1'-0"

TITLE: Blocking Detail With Obstruction	
SHEET: S12, Appendix AA	DRAWN: JFJ
DATE: 06/15/10	REVISION: 06/13/12

