

Seismic Bracing of No-Hub Cast Iron Soil Pipe in California Hospitals

for Plumbing Waste, Vent
and Storm Drains

Todd Noce, P.E.

Vice President, Mason West, Inc.

Experience

- 27 Years in Design of Mechanical, Electrical and Plumbing Equipment and Associated Distribution Systems in California Hospitals
- Co-Authored the Mason Industries, Inc. “Seismic Restraint Guidelines for Suspended Piping, Ductwork and Electrical Systems” – 1999 (OSHPD R-Number) and 2002 (OSHPD OPA-Number) Editions
- Co-Authored ASHRAE’s “A Practical Guide to Seismic Restraint”, 1999 Edition
- Co-Authored the Mason West, Inc. “Seismic Restraint Guidelines for Suspended Distribution Systems” – 2013 Edition (OSHPD OPM-Number)

History of Cast Iron Soil Pipe Seismic Bracing

- 1998 CBC – Section 1632A.6

“...Where possible, pipes and their connections shall be constructed of ductile materials (copper, ductile iron, steel or aluminum with brazed, welded or screwed connections). Pipes and their connections, constructed of nonductile materials (e.g. cast iron, no-hub pipe and plastic), shall have the brace spacing reduced to one-half of the spacing allowed for ductile material...”

- 2001 CBC – Section 1632A.6 And 2007 CBC Section 1614A.1.13 include the same language.
- Removed from 2010 and 2013 CBC.

Ductile vs. Nonductile Pipe Brace Spacings

1998 CBC to 2007 CBC

- Ductile:
 - Transverse (Perpendicular to Pipe) – 40 ft. Maximum (Typ.)
 - Longitudinal (Parallel to Pipe) – 80 ft. Maximum (Typ.)
- Nonductile @ $\frac{1}{2}$ Spacing for No-Hub Cast Iron Soil Pipe
 - Transverse – 20 ft. Maximum (Typ.)
 - Longitudinal – 40 ft. Maximum (Typ.)

2013 CBC - OSHPD OPM

- Brace Spacing Based on ASCE 7-10 Section 13.6.8 – Piping Systems
 - “..piping design... shall be based on the following allowable stresses
 - a. For piping constructed of ductile materials (e.g. steel, aluminum, or copper), 90 percent of the minimum specified yield strength.
 - b. For threaded connections in piping constructed with ductile materials, 70 percent of the minimum specified yield strength.
 - c. For piping constructed with nonductile materials (e.g. **cast iron** or ceramics), 10 percent of the material minimum specified tensile strength.
 - d. For threaded connections in piping constructed with nonductile materials, 8 percent of the material specified tensile strength.”

PIPE

CAST IRON SOIL PIPE
FILLED WITH WATER
MAXIMUM SEISMIC BRACE SPACINGS

VERTICAL FORCE
 $F_{pv} = 0.375g$ (ASD)

| NPS | MAX WEIGHT PER FOOT (LBS/FT) | MAX GRAVITY SUPPORT SPACING (FT) | MAX TRANSVERSE BRACE SPACING BASED ON PIPE SIZE AND g FORCE (FT) | | | | | | |
|-----|------------------------------|----------------------------------|--|-------|-----|------|----|-----|----|
| | | | g FORCE | | | | | | |
| | | | 0.25 | 0.375 | 0.5 | 0.75 | 1 | 1.5 | 2 |
| 2 | 5.1 | 8 | 16 | 13 | 12 | 9 | 8 | 7 | 6 |
| 3 | 8.4 | 8 | 22 | 18 | 16 | 13 | 11 | 9 | 8 |
| 4 | 13.0 | 8 | 25 | 21 | 18 | 15 | 13 | 10 | 9 |
| 5 | 18.0 | 8 | 28 | 23 | 20 | 16 | 14 | 11 | 10 |
| 6 | 23.4 | 8 | 30 | 24 | 21 | 17 | 15 | 12 | 11 |
| 8 | 40.2 | 8 | 35 | 38 | 25 | 20 | 17 | 14 | 12 |
| 10 | 60.8 | 8 | 41 | 34 | 29 | 24 | 21 | 17 | 15 |
| 12 | 82.1 | 8 | 43 | 35 | 30 | 25 | 21 | 18 | 15 |

PIPE

CAST IRON SOIL PIPE
FOR EMPTY SYSTEMS (NO WATER)
MAXIMUM SEISMIC BRACE SPACINGS

VERTICAL FORCE
 $F_{pv} = 0.375g$ (ASD)

| NPS | MAX WEIGHT PER FOOT (LBS/FT) | MAX GRAVITY SUPPORT SPACING (FT) | MAX TRANSVERSE BRACE SPACING BASED ON PIPE SIZE AND g FORCE (FT) | | | | | | |
|-----|------------------------------|----------------------------------|--|-------|-----|------|----|-----|----|
| | | | g FORCE | | | | | | |
| | | | 0.25 | 0.375 | 0.5 | 0.75 | 1 | 1.5 | 2 |
| 2 | 3.6 | 8 | 23 | 19 | 16 | 13 | 12 | 9 | 8 |
| 3 | 5.2 | 8 | 31 | 26 | 22 | 18 | 16 | 13 | 11 |
| 4 | 7.4 | 8 | 37 | 31 | 26 | 21 | 19 | 15 | 13 |
| 5 | 9.4 | 8 | 42 | 35 | 30 | 24 | 21 | 17 | 15 |
| 6 | 11.0 | 8 | 48 | 39 | 34 | 28 | 24 | 19 | 17 |
| 8 | 18.0 | 8 | 56 | 46 | 40 | 32 | 28 | 23 | 20 |
| 10 | 25.8 | 8 | 67 | 55 | 48 | 39 | 34 | 27 | 24 |
| 12 | 32.5 | 8 | 72 | 59 | 51 | 42 | 36 | 29 | 26 |

2013 CBC - OSHPD OPM

- 2013 CBC Brace Spacing: ASCE 7-10 Section 13.6.8 – Piping Systems
 - “..piping design... shall be based on the following allowable stresses
 - a. For piping constructed of ductile materials (e.g. steel, aluminum, or copper), 90 percent of the minimum specified yield strength.
 - b. For threaded connections in piping constructed with ductile materials, 70 percent of the minimum specified yield strength.
 - c. For piping constructed with nonductile materials (e.g. cast iron or ceramics), 10 percent of the material minimum specified tensile strength.
 - d. For threaded connections in piping constructed with nonductile materials, 8 percent of the material specified tensile strength.”
 - e. *For no-hub coupling connections in piping constructed with nonductile materials, ?? percent of the material specified tensile strength.*

OSHDP CAN 5-310.9

2013 California Plumbing Code CHAPTER 3

310.9 [OSHDP 1, 2, 3 & 4] *Drainage piping over operating and delivery rooms, nurseries, food preparation centers, food-serving facilities, food storage areas, and other sensitive areas shall be kept to a minimum and shall not be exposed. Special precautions shall be taken to protect these areas from possible leakage from necessary overhead drainage piping systems. Piping over switchboards, panel boards, and motor control centers are subject to restrictions of the California Electrical Code where applicable.*

PURPOSE

The code does not define what constitutes a "special precaution." FM Global is a nationally recognized testing laboratory. FM Approval Standard-Class Number 1680 is used to evaluate couplings used in drain, waste, vent, storm, and sanitary systems for "their intended application of long term connection to hubless cast iron soil pipe both above and below ground." The types of tests performed are: hydrostatic strength, blockage, bending moment, deflection angle, sealing sleeve, clamp strength, thrust test, and salt spray.

OSHPD CAN 5-310.9

INTERPRETATION

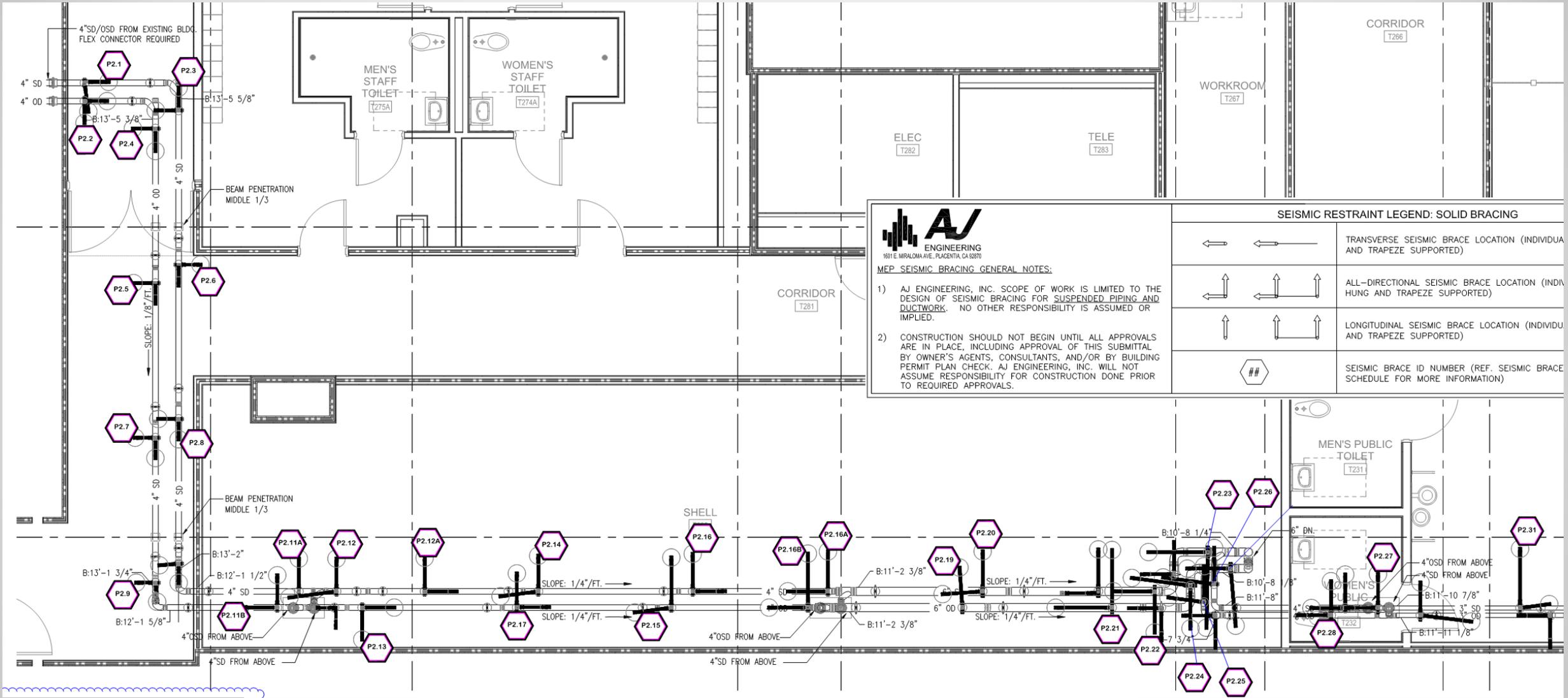
Sanitary and storm drainage piping over operating rooms, delivery rooms, cesarean rooms, recovery rooms, nurseries, intensive care units, food preparation centers, food serving facilities, food storage areas, shall be kept to a minimum and shall not be exposed. When it becomes necessary to route this piping above the ceiling of these rooms, special precautions shall be taken to protect these areas from possible leakage. This Code Application Notice is not intended to address piping over electrical rooms, which is regulated by California Electrical Code, Dedicated Equipment Space under Article 110.26 Spaces About Electrical Equipment.

1. Acceptable "special precautions" for hubless cast iron pipe include, but are not limited to, the following:
 - (a) The use of couplings that have been tested and certified to conform to the performance requirements of FM Approval Standard-Class Number 1680, Class I, by FM Global or by a nationally recognized independent testing agency. The coupling shall be installed in accordance with the manufacturer's recommendations.
 - (b) "Heavy Duty" (i.e. four-band type) couplings that have been listed by International Association of Plumbing and Mechanical Officials (IAPMO) for conformance to ASTM C 1540-11, but have not been tested to FM Approval Standard Class Number 1680, Class I, may be installed when restrained to prevent joint separation. Such restraint shall be by means of pipe clamps on each side of the joint with not less than two tie rods or plates across the joint installed similar to Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Seismic Restraint Manual, Guidelines for Mechanical Systems, Second Edition – February, 1998, Figure 9-10 or Cast Iron Soil Pipe (CISPI) Standard 310-11, Figure 4.
 - (c) Continuous sheet metal drain troughs under overhead hubless piping. Such troughs shall be sloped to drain with a properly identified air gap termination over an approved receptor.

2013 CBC - OSHPD OPM

- Mason West OPM-0043-13, December 2013 Edition
- 4) Cast iron pipe (no-hub pipe) brace spacings shall not exceed the spacings tabulated in Section S. Cast iron pipe sections joined with no-hub couplings must include an all-directional seismic brace at each pipe section unless approved otherwise by OSHPD.



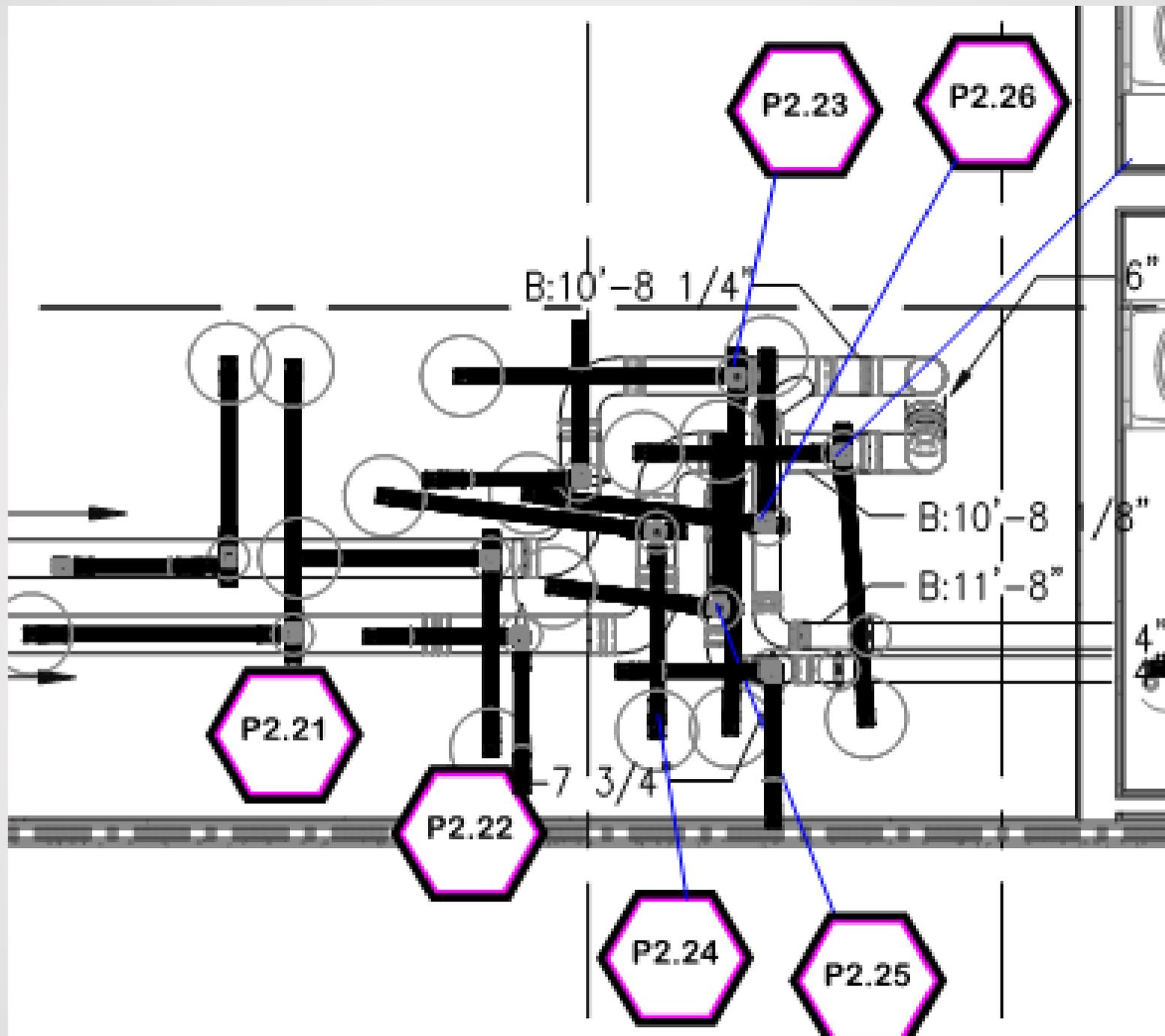


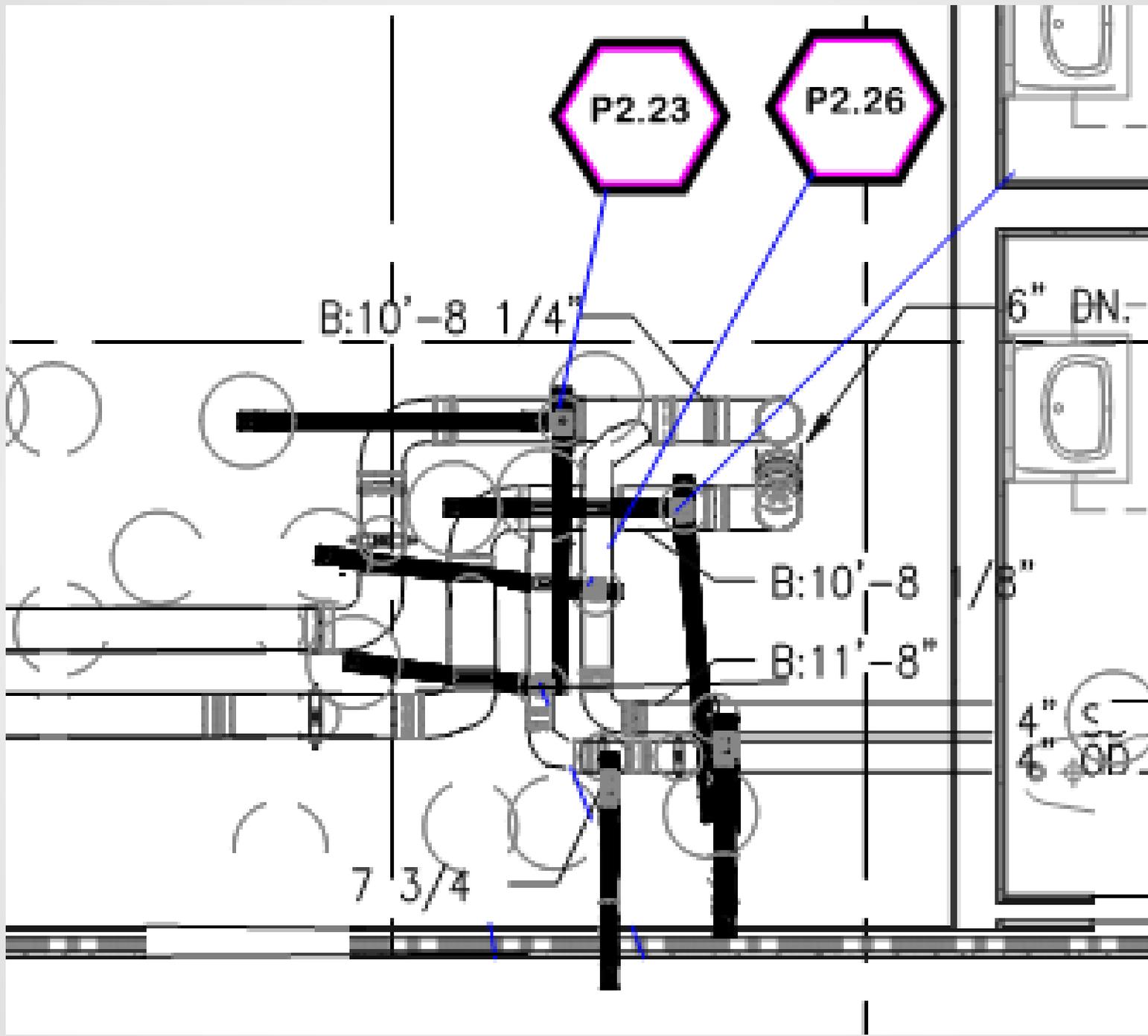
AJ ENGINEERING
 1601 E. MIRALOMA AVE., PLACENTIA, CA 92870

MEP SEISMIC BRACING GENERAL NOTES:

- 1) AJ ENGINEERING, INC. SCOPE OF WORK IS LIMITED TO THE DESIGN OF SEISMIC BRACING FOR SUSPENDED PIPING AND DUCTWORK. NO OTHER RESPONSIBILITY IS ASSUMED OR IMPLIED.
- 2) CONSTRUCTION SHOULD NOT BEGIN UNTIL ALL APPROVALS ARE IN PLACE, INCLUDING APPROVAL OF THIS SUBMITTAL BY OWNER'S AGENTS, CONSULTANTS, AND/OR BY BUILDING PERMIT PLAN CHECK. AJ ENGINEERING, INC. WILL NOT ASSUME RESPONSIBILITY FOR CONSTRUCTION DONE PRIOR TO REQUIRED APPROVALS.

| SEISMIC RESTRAINT LEGEND: SOLID BRACING | |
|---|--|
| | TRANSVERSE SEISMIC BRACE LOCATION (INDIVIDUAL AND TRAPEZE SUPPORTED) |
| | ALL-DIRECTIONAL SEISMIC BRACE LOCATION (INDIVIDUAL AND TRAPEZE SUPPORTED) |
| | LONGITUDINAL SEISMIC BRACE LOCATION (INDIVIDUAL AND TRAPEZE SUPPORTED) |
| | SEISMIC BRACE ID NUMBER (REF. SEISMIC BRACE SCHEDULE FOR MORE INFORMATION) |





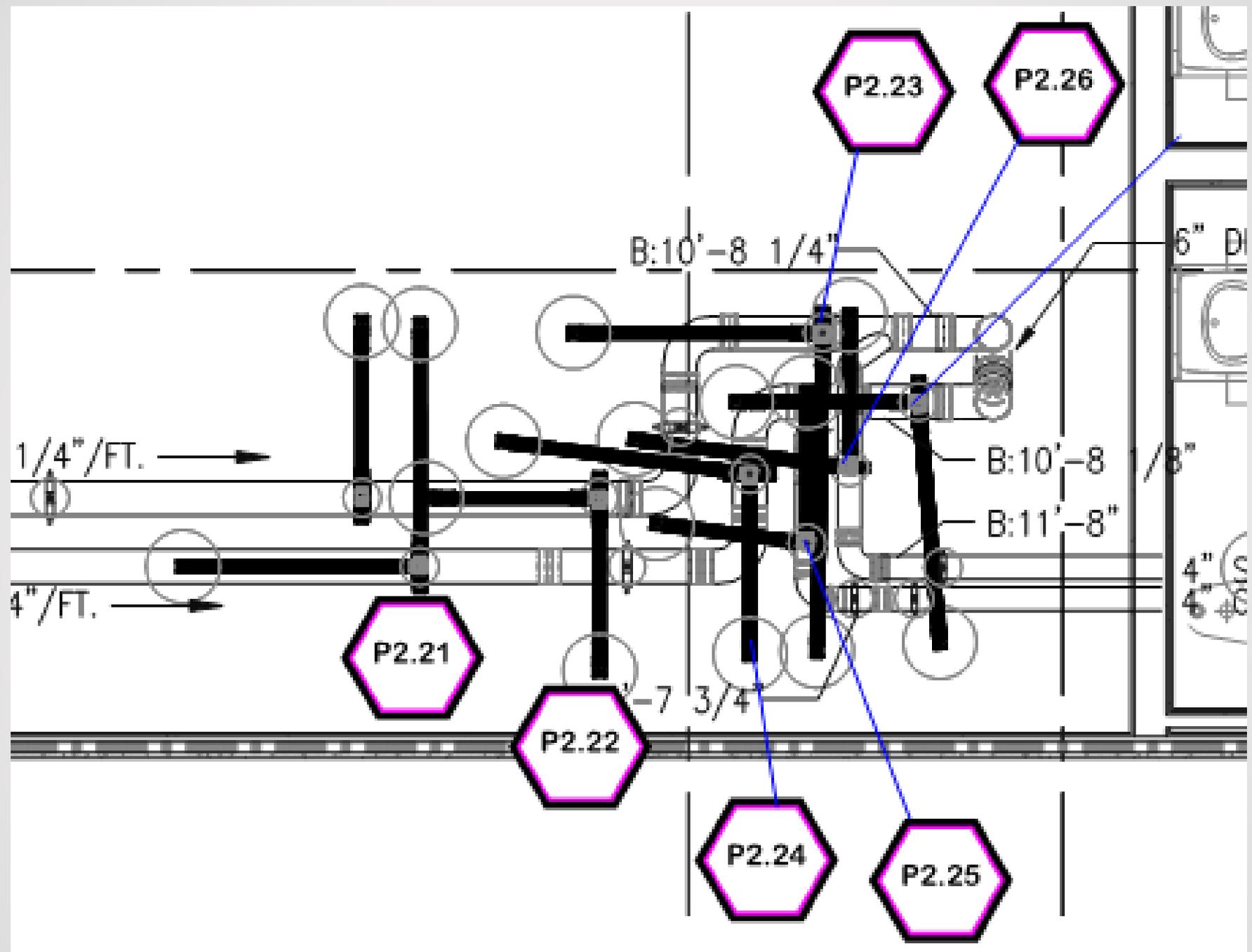
2013 CBC - OSHPD OPM

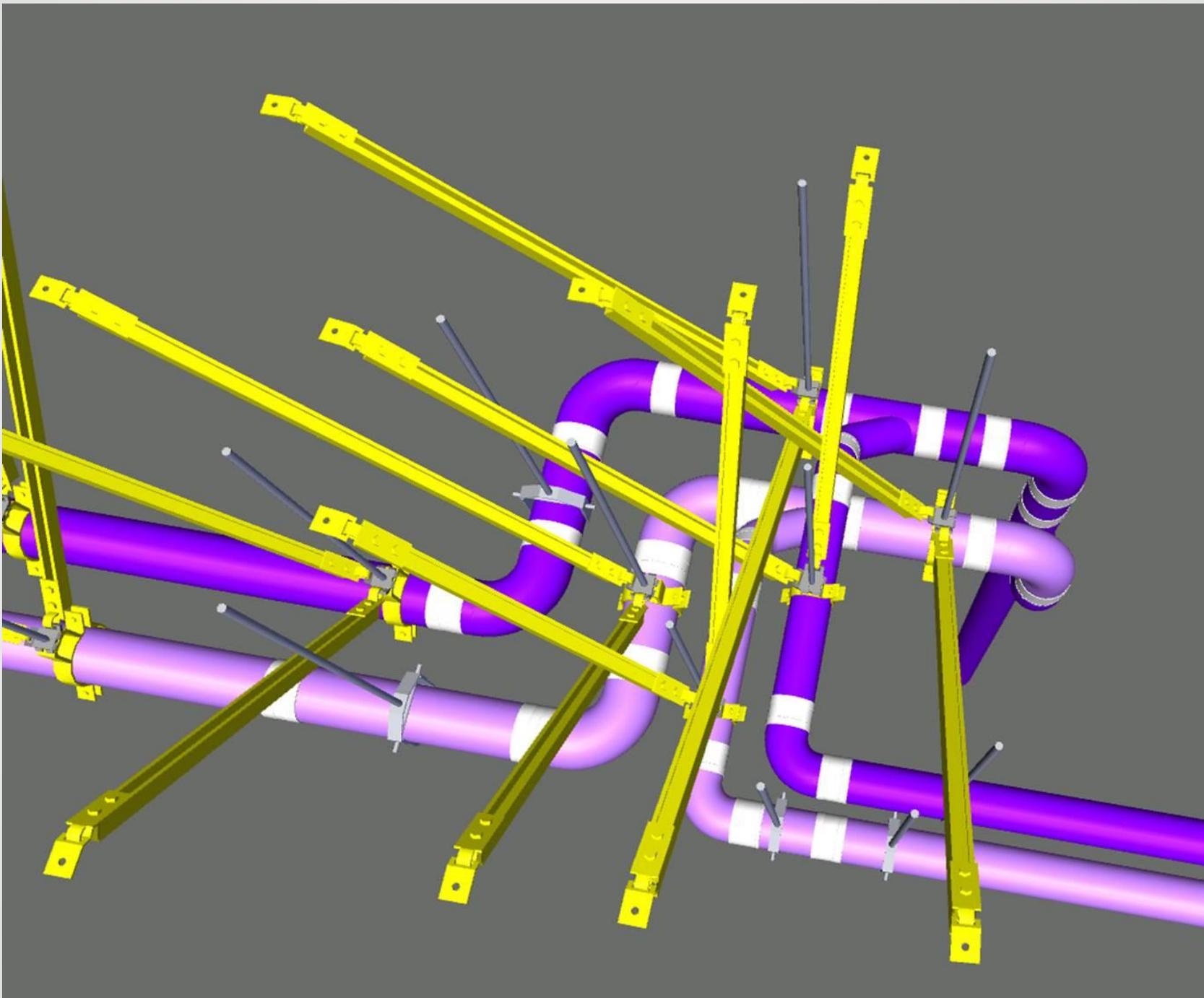
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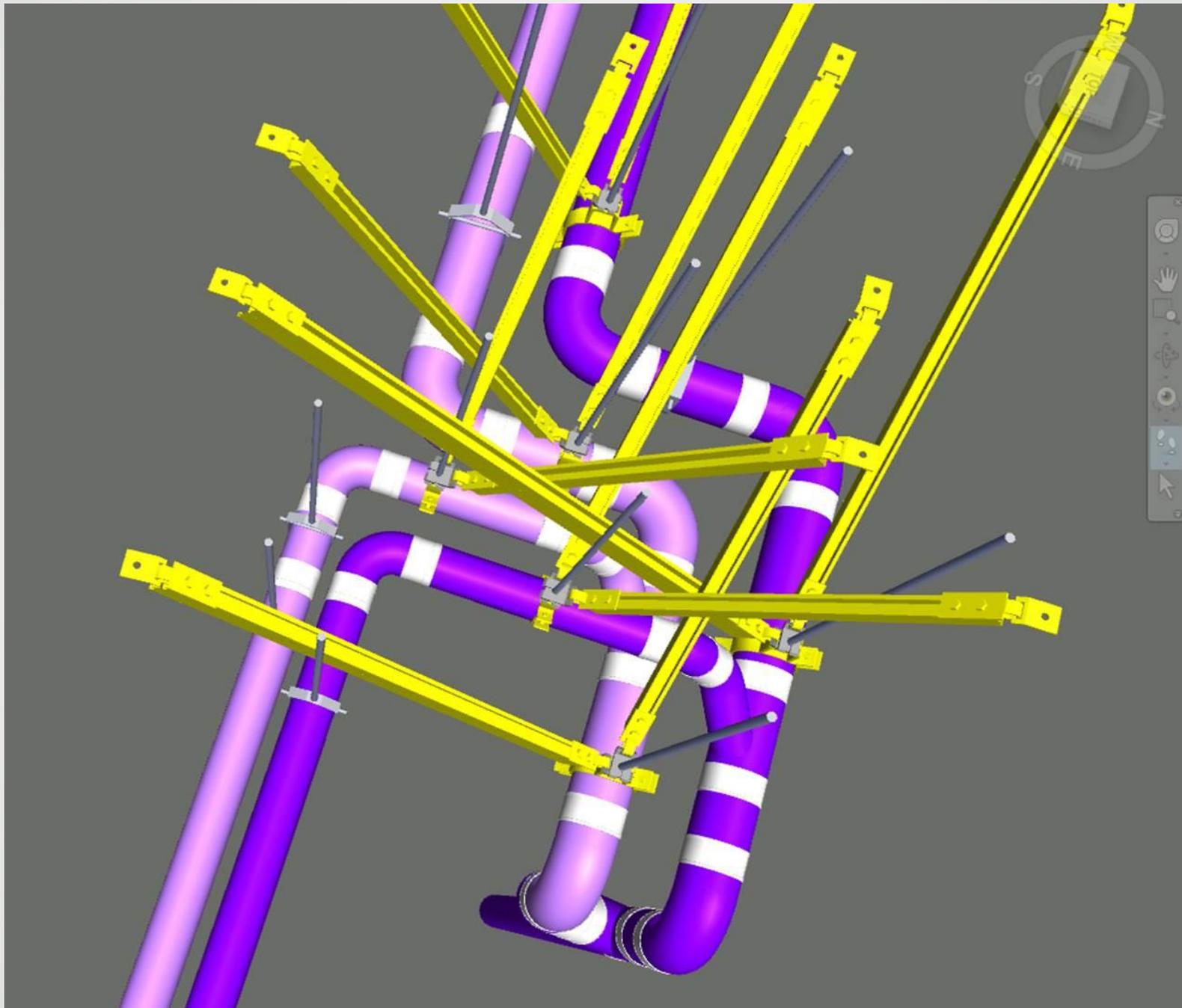
4) Cast iron pipe (no-hub pipe) brace spacings shall not exceed the spacings tabulated in Section S. Cast iron pipe sections joined with no-hub couplings must include an all-directional seismic brace at each pipe section unless approved otherwise by OSHPD.

- Mason West OPM-0043-13, March 2015 Edition

Exception: No-hub pipes with a transverse and longitudinal brace within 24 inches of every other coupling (including flexible couplings at groove fittings), using heavy duty couplings in accordance with ASTM C1540 that have been tested and certified in accordance with FM 1680 Class I, shall be considered an approved alternative where the transverse brace spacing does not exceed 10' and the longitudinal brace spacing does not exceed 20'. Refer to page A12.9 for a layout example applying this exception.







2013 CBC - OSHPD OPM

- Mason West OPM-0043-13, December 2013 Edition

- 4) Cast iron pipe (no-hub pipe) brace spacings shall not exceed the spacings tabulated in Section S. Cast iron pipe sections joined with no-hub couplings must include an all-directional seismic brace at each pipe section unless approved otherwise by OSHPD.

- Mason West OPM-0043-13, March 2015 Edition

Exception: No-hub pipes with a transverse and longitudinal brace within 24 inches of every other coupling (including flexible couplings at groove fittings), using heavy duty couplings in accordance with ASTM C1540 that have been tested and certified in accordance with FM 1680 Class I, shall be considered an approved alternative where the transverse brace spacing does not exceed 10' and the longitudinal brace spacing does not exceed 20'. Refer to page A12.9 for a layout example applying this exception.

- Mason West OPM-0043-13, ?? 2016 Edition

- Cast iron pipe (no-hub pipe) brace spacings shall not exceed the spacings tabulated in Section S provided the no-hub couplings are manufactured in accordance with ASTM C1540, have been tested and certified in accordance with FM 1680 Class 1 and a gravity hanger is located within 18" of both sides of each coupling or fitting (e.g. 45/90 degree elbows, wyes, reducers, etc.). Cast iron pipe joined with non-certified or rated couplings must include an all-directional brace at each pipe section unless approved otherwise by OSHPD.

PIPE

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 FILLED WITH WATER
 MAXIMUM SEISMIC BRACE SPACINGS

VERTICAL FORCE
 $F_{pv} = 0.375g$ (ASD)

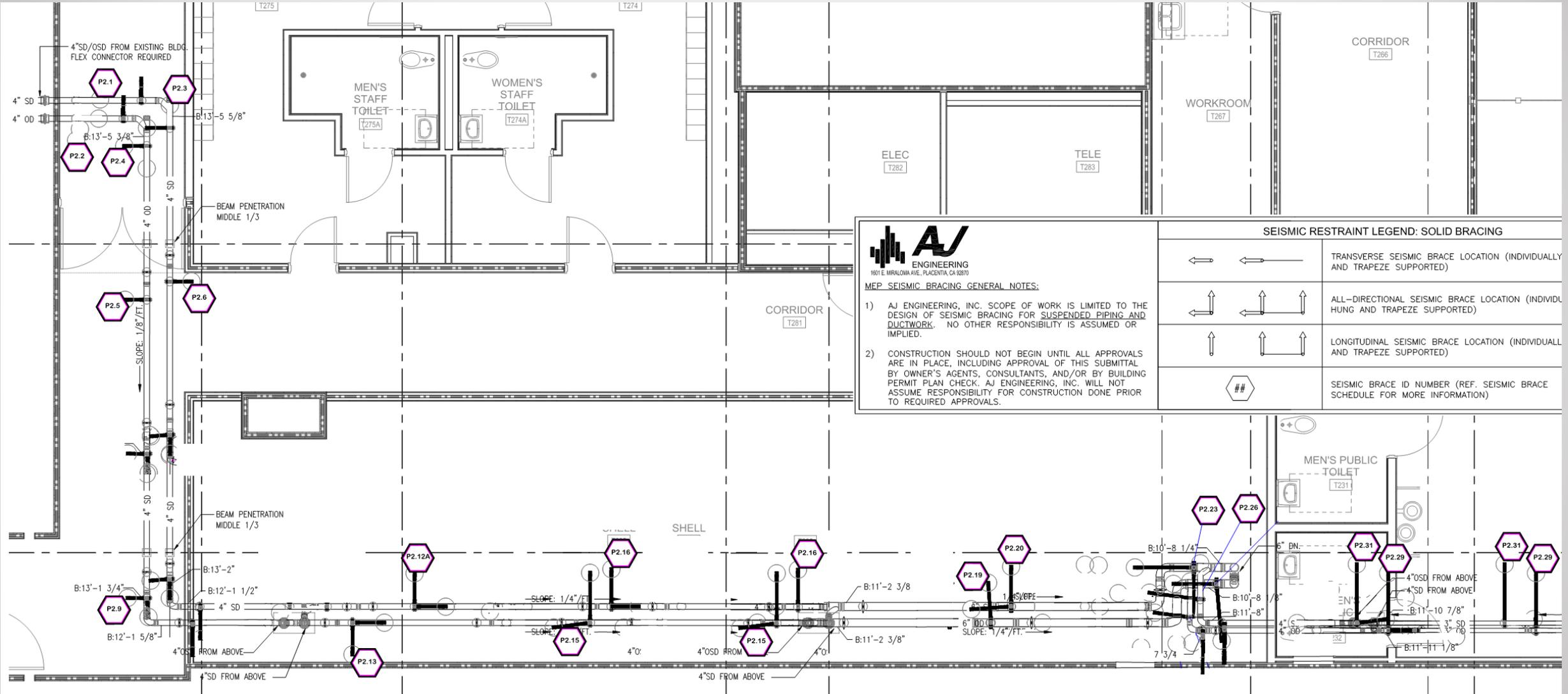
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| SEISMIC RESTRAINT LEGEND: SOLID BRACING | |
|---|--|
| ← ← | TRANSVERSE SEISMIC BRACE LOCATION (INDIVIDUALLY AND TRAPEZE SUPPORTED) |
| ↑ ↑ | ALL-DIRECTIONAL SEISMIC BRACE LOCATION (INDIVIDUALLY HUNG AND TRAPEZE SUPPORTED) |
| ↑ ↑ | LONGITUDINAL SEISMIC BRACE LOCATION (INDIVIDUALLY AND TRAPEZE SUPPORTED) |
| ## | SEISMIC BRACE ID NUMBER (REF. SEISMIC BRACE SCHEDULE FOR MORE INFORMATION) |

Recommendations

- Determine if the cost impact between the 2007 vs. 2013 requirements is warranted based on past performance, current standards/testing, etc.
- Consider equating cast iron soil pipe with no-hub couplings as equivalent to nonductile pipe with screwed connections in ASCE 7-10, Section 13.6.8.
- If necessary, determine specific requirements for systems that employ ASTM, FM, CISPI, etc. standards or approvals.
- Determine specific requirements for systems that employ no-hub couplings of unknown specifications (e.g. existing systems).
- Publish a new OSHPD CAN or some other official OSHPD document which summarizes the requirements so they are clearly understood and enforced on all new and existing projects, regardless of project size.
- Add a specific section in ASCE 7 or Chapter 16A of the CBC clearly defining the requirements for these non-pressurized plumbing systems.