ROOT VEGETABLE STORAGE WAREHOUSES

Designers, builders and owners of root vegetable storage warehouses know that there are two key objectives to good design and construction of root storage facilities:

1. A building that allows as much control of the indoor environment as possible;
2. And a building capable of withstanding large loads, such as loads from potato piles or other heavy root vegetables, in addition to wind and snow loads.

Almost any building can be constructed to accommodate root storage. The type of building used is mainly based on economics, type of root vegetable to be stored, size of storage needed, and building preference. The more common root storage facilities are built with heavy wood stud frame or steel arch structures, such as Quonset huts.

However, with rising energy costs and the inherent ability for LOGIX to provide strong, highly insulated and air-tight structures, LOGIX is becoming a preferred construction method for root vegetable storage warehouses.

This document explores the suitability of root vegetable storage warehouses built with LOGIX, and how it compares to stud frame buildings and Quonset Huts.

ROOT VEGETABLE STORAGE WAREHOUSES

INDOOR ENVIRONMENT

Healthy vegetables - free of rot and disease - depends heavily on the ability to control the interior climate during all phases of storage. This means the building must have a completely sealed and insulated building exterior, and proper ventilation.

An air tight structure with continuous insulation ensures the indoor temperature and humidity level is maintained, and reduces the risk of condensation. Depending on the geographic location R-values as high as R-35 may be required for the exterior walls of the root storage warehouse.

Wood Stud Frame Structures

In addition to the insulation between studs, framed structures require an additional layer of continuous insulation for the walls. The additional layer of insulation is needed to minimize thermal bridging effects where heat can enter or leave the building at stud locations. To minimize condensation on the insulation, a vapor barrier must also be added on the interior side of wall. On the exterior an air barrier is added to minimize moisture ingress.

Stud walls are basically hollow structures that offer places where leakage can occur, such as joints and insulation gaps. The R-value of batt insulation will decrease once air flow enters between the studs. Once air or moisture gets into the wall studs, condensation can occur making the studs more susceptible to rot, and the ability to control indoor temperatures will be harder to maintain.

ROOT VEGETABLE STORAGE WAREHOUSES

Quonset Huts

Spray applied foam insulation is typically applied to the interior of Quonset Huts. Some spray foam insulation can also act as the vapor and air barrier system. The shell of Quonset Huts is primarily metal sheeting. However, the metal sheeting, along with the arched shape structure of Quonset Huts makes it more susceptible to heat gains. As a result, a fair amount of insulation is required to offset any heat transfer - typically up to 6" of spray foam may be required. The exterior must also be weatherproofed and sealed.

LOGIX

A wide range of R-values are available with LOGIX to suit the high insulation required for root storage warehouses[1]. Once a LOGIX wall system is installed no additional labor or materials are required to create the necessary air and vapor barriers. The reinforced concrete core wall inside a LOGIX wall acts as a natural continuous air barrier. The concrete core along with the continuous layer of insulation provides a completely air tight building envelope.

Besides being air tight, the solid concrete wall prevents mice and other pests from breaching the wall structure.

In addition, LOGIX does not promote mold growth, does not rot, and the foam insulation panels do not absorb moisture.

The end result is a more durable, energy efficient building structure[2].

1. For a full list of R-values see Section 8 of the LOGIX Design Manual
2. For more information on the thermal performance of LOGIX see Technical Bulletin 23, Thermal Performance: The ICF Effect

ROOT VEGETABLE STORAGE WAREHOUSES

ROOT VEGETABLE STORAGE STRUCTURES

Root storage facilities must not only be designed to control the indoor environment. They must be strong and durable to resist the weather outside and the vegetable loads inside.

Wood Stud Frame Structures

Stud framed root storage structures can be designed to withstand large loads from vegetable piles, such as loads from potato piles, which can be high as 16 feet. Stud framed structures also offer flexibility in bin and plenum layout designs. However, if the root storage structure is intended to store heavy root vegetables, such as pototoes, then the design requires heavy stud construction of pressure treated 2x12 or even 4x12 studs. Because of the excessive lateral loading that some root vegetables, like potatoes, can exert on the walls, heavy anchors are needed at the stem/foundation and truss connections.

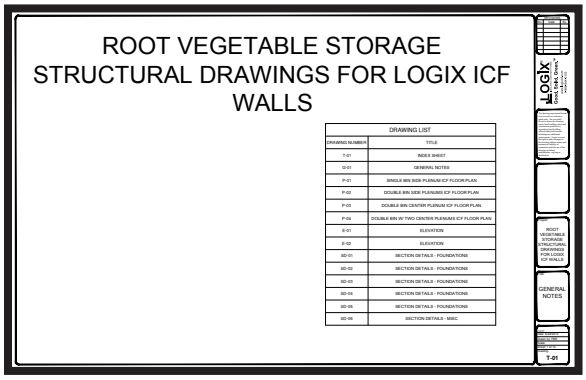
Quonset Huts

Quonset huts are relatively inexpensive and easy to erect. The arched shaped structure also provides good resistance to wind and snow loads. However, because Quonset Huts are prefabricated structures they are limited in building height, and storage layouts that some root vegetable farmers may need. Space is also limited for pallet bin storage next to the curved walls.

LOGIX

LOGIX forms are light weight, quick and easy to install. Once the forms are installed concrete is placed within the forms. The structural component of LOGIX is the reinforced concrete core within the forms. Reinforced concrete walls can be designed to take the same loads as heavy stud framed

ROOT VEGETABLE STORAGE WAREHOUSES


ROOT VEGETABLE STORAGE
STRUCTURAL DRAWINGS FOR LOGIX ICF WALLS

DRAWING LIST

DRAWING NUMBER	TITLE
T-01	INDEX SHEET
G-01	GENERAL NOTES
P-01	SINGLE BIN SIDE PLENUM ICF FLOOR PLAN
P-02	DOUBLE BIN SIDE PLENUMS ICF FLOOR PLAN
P-03	DOUBLE BIN CENTER PLENUM ICF FLOOR PLAN
P-04	DOUBLE BIN W/ TWO CENTER PLENUMS ICF FLOOR PLAN
E-01	ELEVATION
E-02	ELEVATION
SD-01	SECTION DETAILS - FOUNDATIONS
SD-02	SECTION DETAILS - FOUNDATIONS
SD-03	SECTION DETAILS - FOUNDATIONS
SD-04	SECTION DETAILS - FOUNDATIONS
SD-05	SECTION DETAILS - FOUNDATIONS
SD-06	SECTION DETAILS - MISC

ROOT VEGETABLE STORAGE STRUCTURAL DRAWINGS FOR LOGIX ICF WALLS

GENERAL NOTES

T-01

structures, and offers the same flexibility in bin and plenum layouts.

LOGIX can be used to build walls from footing to roof line, which eliminates the heavy reinforced anchors needed at the stem to stud wall connection for stud framed structures. The same interior and exterior finish applied to stud framed structures can also be applied to LOGIX.

As a reinforced concrete wall sandwiched between a minimum of 2.75 inch thick rigid foam insulation, LOGIX structures are naturally more durable, designed to last longer, and require less maintenance than wood stud framed structures and Quonset Huts.

As an aide to designers and builders LOGIX offers samples of typical wall and structural detail drawings for root storage warehouses of varying bin and plenum layouts, along with wall reinforcement. The drawings can be found at the end of this document or downloaded from the LOGIX Technical Library.

Ensuring the health of root vegetables is paramount in root storage management. Consequently, building structures that are naturally air tight with continuous high insulation values are equally vital to ensuring root vegetables are rot and disease free while in storage. These attributes are inherent in LOGIX walls with the added benefit of providing more durable, stronger, wall structures compared to stud frame structures and Quonset huts.

For further information contact your local LOGIX representative or e-mail info@logixicf.com.

Related Articles:

1. Technical Bulletin 13, R-value comparison - LOGIX ICF vs Stud Walls
2. Technical Bulletin 23, Thermal Performance: The ICF Effect
3. Technical Bulletin 30, Total R-value of LOGIX Wall Assemblies

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SD-05	SECTION DETAILS - FOUNDATIONS
SD-06	SECTION DETAILS - MISC

REVISIONS

No.	Date	By

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Project:
ROOT VEGETABLE STORAGE STRUCTURAL DRAWINGS FOR LOGIX ICF WALLS

Title:
GENERAL NOTES

11X17
Date: 8/22/2012
Drawn by: FBR
Scale:
Sheet: 1 of 14
Drawing:
T-01

GENERAL NOTES

1. Concrete
   - 1.1. Normal weight concrete minimum 28-day compressive strength (f'c) shall be 3,000 psi, or 25MPa in the US and Canada, respectively.
   - 1.2. Reinforcing bars shall have a minimum yield strength of 60 Ksi, or 400MPa in the US and Canada, respectively.
   - 1.3. Reinforcing bar protection:
     - 1.3.1. Concrete placed against earth = 3"
     - 1.3.2. Concrete placed in LOGIX shall be placed in center of wall
   - 1.4. Reinforcing bar placement tolerance is 0.5" in any direction.
   - 1.5. Bars should be lap spliced at all corners. Splice lengths as follows:
     - 1.5.1. #4 bars - 24"
     - 1.5.2. #5 bars - 30"
2. The construction drawings should not be scaled. Dimensions apply.
3. If there is a conflict among the General Notes, Specifications, and Plans, the order of precedence is Notes, then Specifications, then Plans.
4. The contractor is solely responsible for providing all measures necessary to ensure that the structure is protected during construction. These measures include (but not limited to) shoring and bracing for construction loads and worker safety purposes.
5. Follow manufacturer's recommendations for nailing requirements of uplift/shear resistance connectors.
6. It is the responsibility of the owner to consult with a local licensed engineer to ensure these drawings meet required design and building codes

DESIGN BASIS

1. Design is based on:
   - 1.1. ACI 318-05 & CSA A23.3
   - 1.2. Max roof clear span = 80 ft
   - 1.3. Max wall heights as shown in drawings
2. Live loads used in design:
   - 2.1. Factored wind pressure = 55 psf
   - 2.2. Potato lateral loading = 3.2 to 8 kip-ft/ft (depending on height of potato load and wall height, as shown in drawings). Governing load
   - 2.3. Roof = 70 psf
3. Dead loads used in design:
   - 3.1. Roof = 15 psf
4. Soil bearing capacity of 2,000 psf min. has been assumed.

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Title:

GENERAL NOTES

11X17
Date: 8/22/2012
Drawn by: FBR
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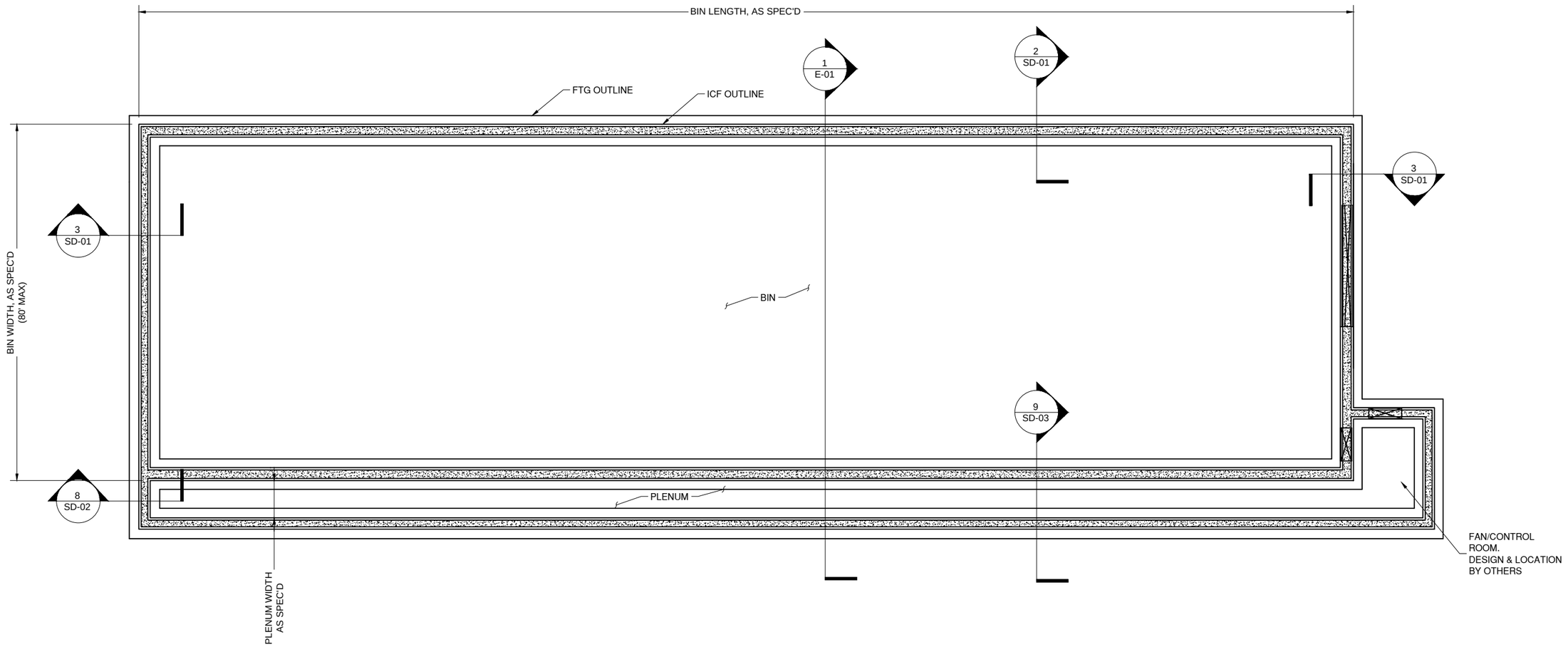
G-01



SINGLE BIN W/ SINGLE SIDE PLENUM OPTION

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Title:

SINGLE BIN SIDE PLENUM ICF FLOOR PLAN

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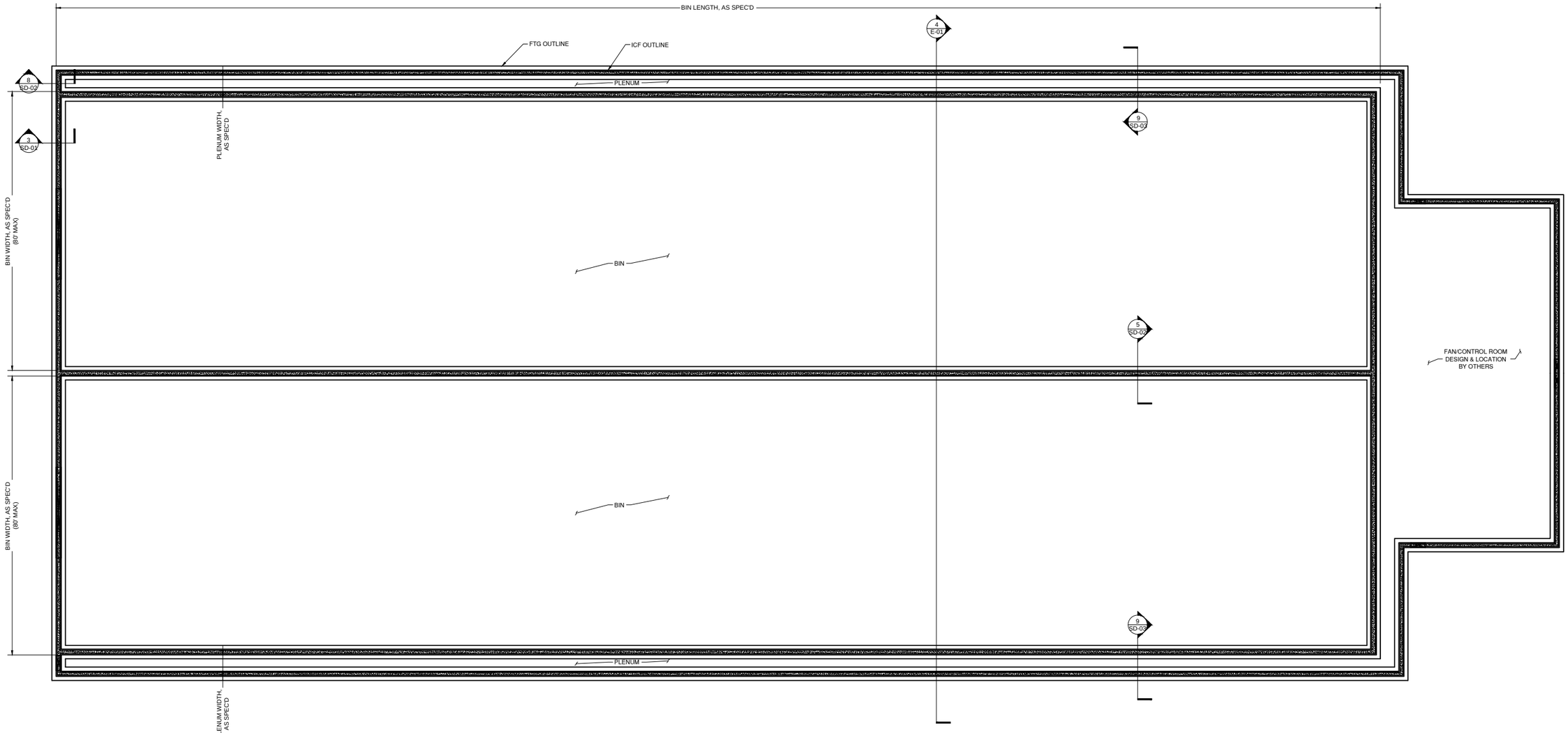

DOUBLE BIN W/ DOUBLE SIDE PLENUMS OPTION

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Title:

DOUBLE BIN SIDE PLENUMS ICF FLOOR PLAN

11X17
Date: 8/22/2012
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Scale:
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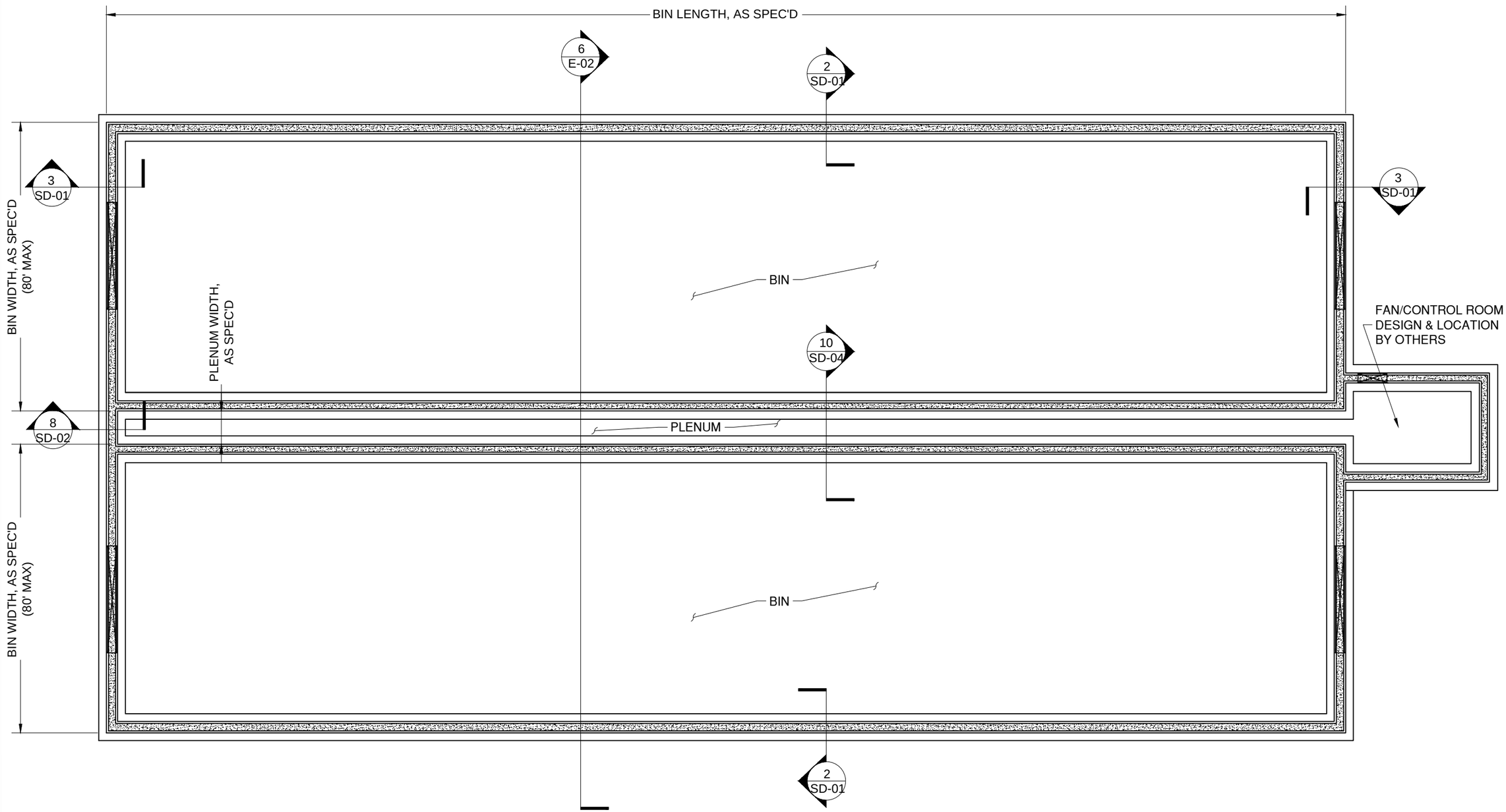
P-02



DOUBLE BIN W/ SINGLE CENTER PLENUM OPTION

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Title:

DOUBLE BIN CENTER PLENUM ICF FLOOR PLAN

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Date: 08/20/2012
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P-03

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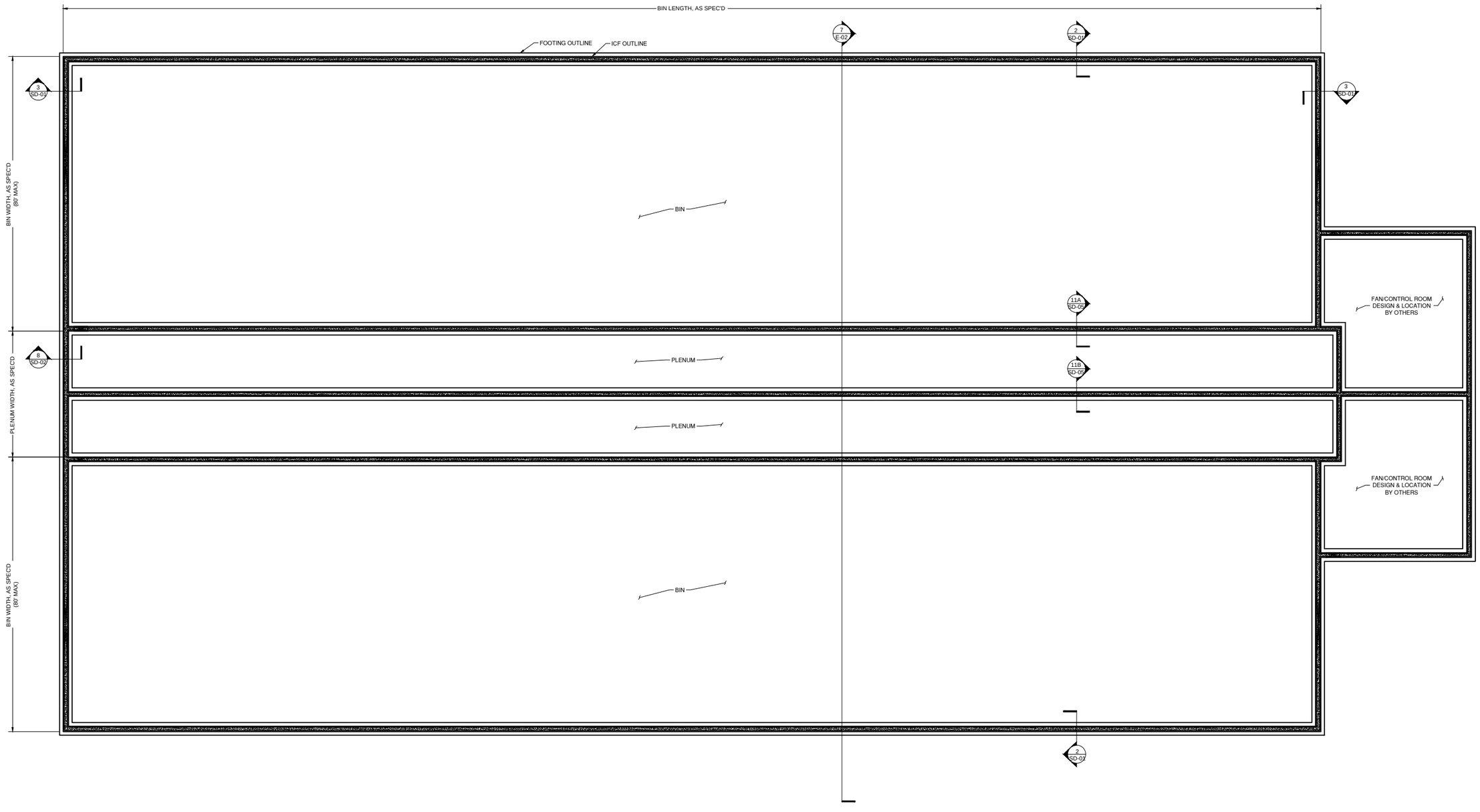

DOUBLE BIN W/ DOUBLE CENTER PLENUMS OPTION

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Title:

DOUBLE BIN 2 CENTER PLENUMS ICF FLOOR PLAN

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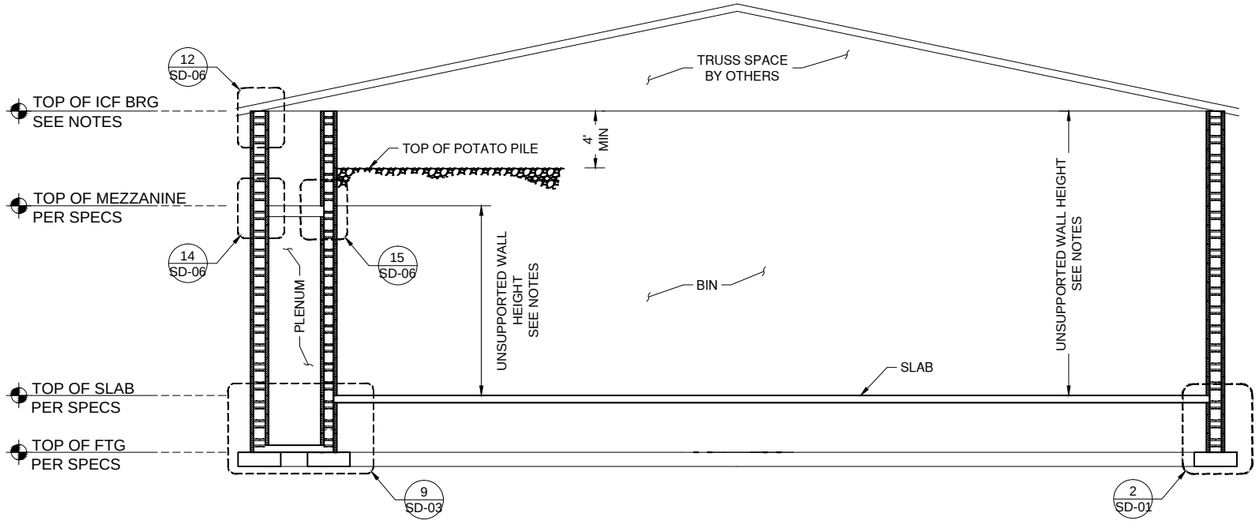
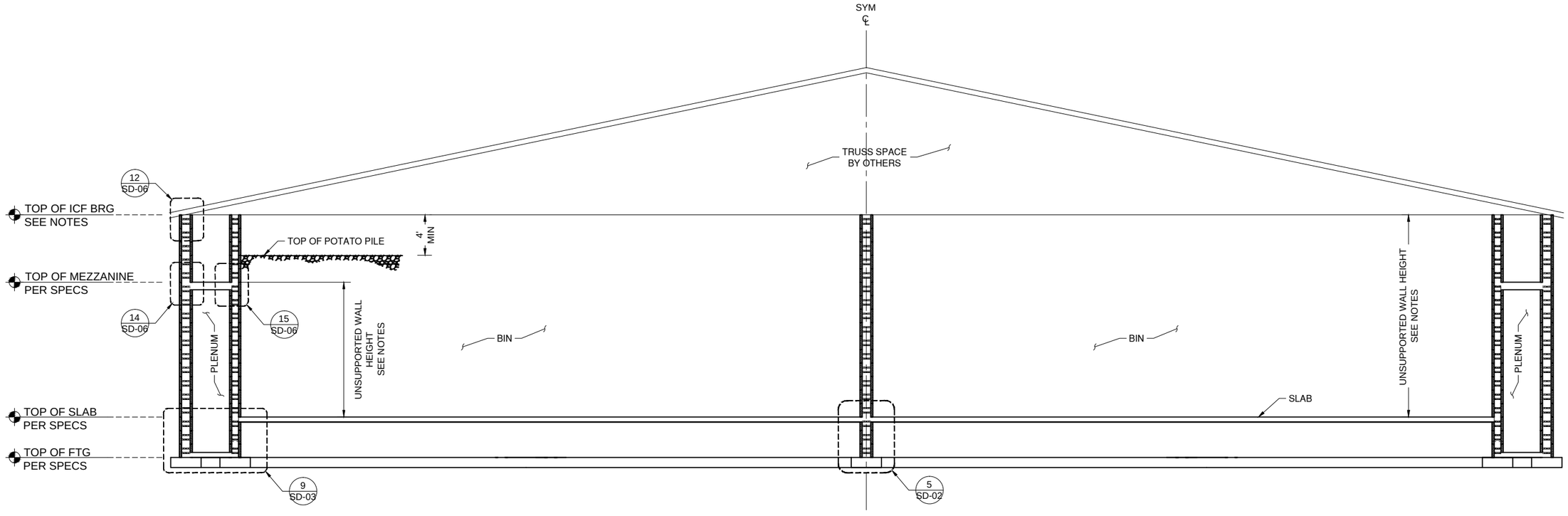
P-04



1 / E-01 **SINGLE BIN W/ SINGLE SIDE PLENUM OPTION**

SCALE: 3/32" = 1'-0"



4 / E-01 **DOUBLE BIN W/ DOUBLE SIDE PLENUMS OPTION**

SCALE: 3/32" = 1'-0"

NOTES:

Engineering is available for wall reinforcement with varying wall heights. Contact your local LOGIX representative, or email info@logixicf.com.

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ROOT VEGETABLE STORAGE STRUCTURAL DRAWINGS FOR LOGIX ICF WALLS

Title:

ELEVATION

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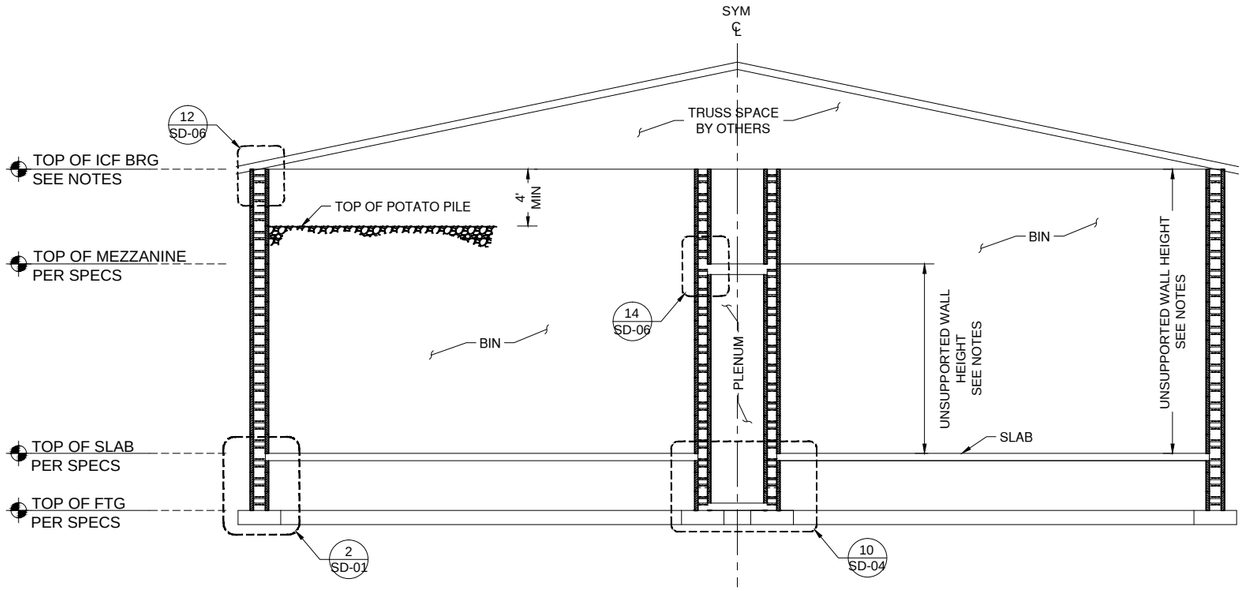

6 / E-02 DOUBLE BIN W/ SINGLE CENTER PLENUM OPTION

SCALE: 3/32" = 1'-0"

NOTES:

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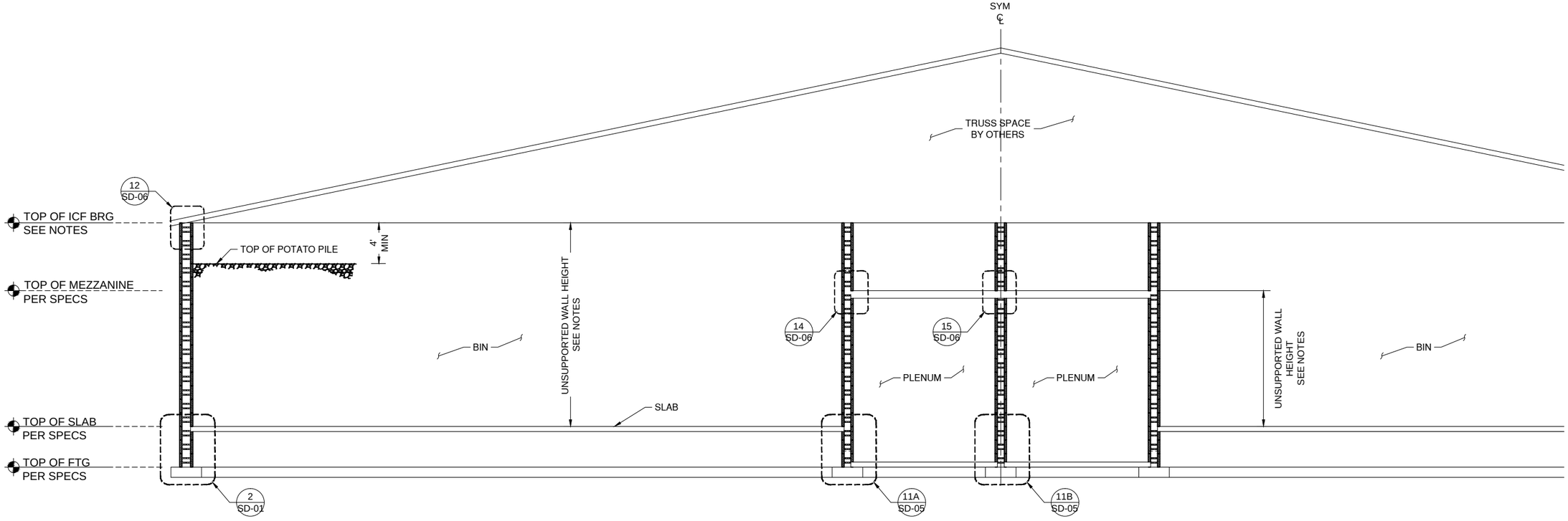

7 / E-02 DOUBLE BIN W/ DOUBLE CENTER PLENUMS OPTION

SCALE: 3/32" = 1'-0"

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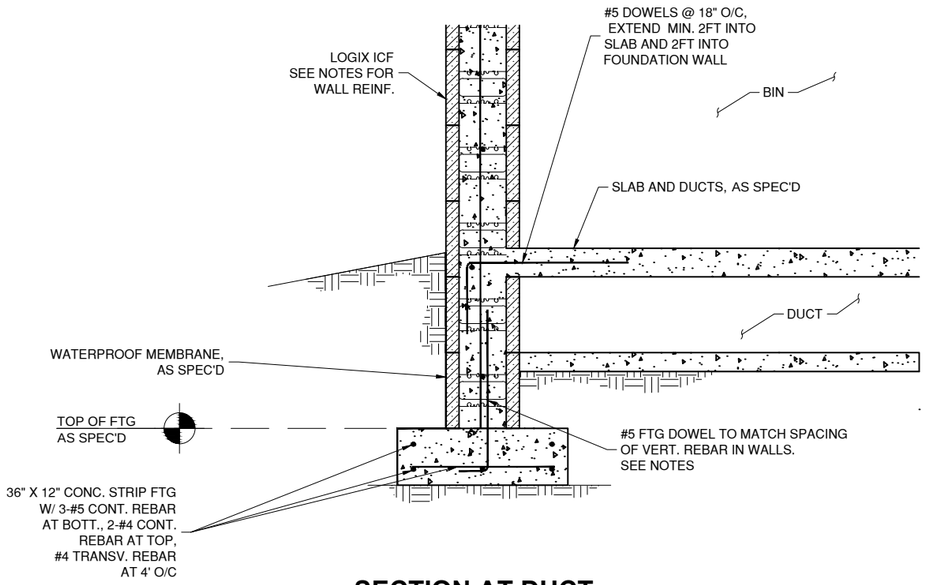

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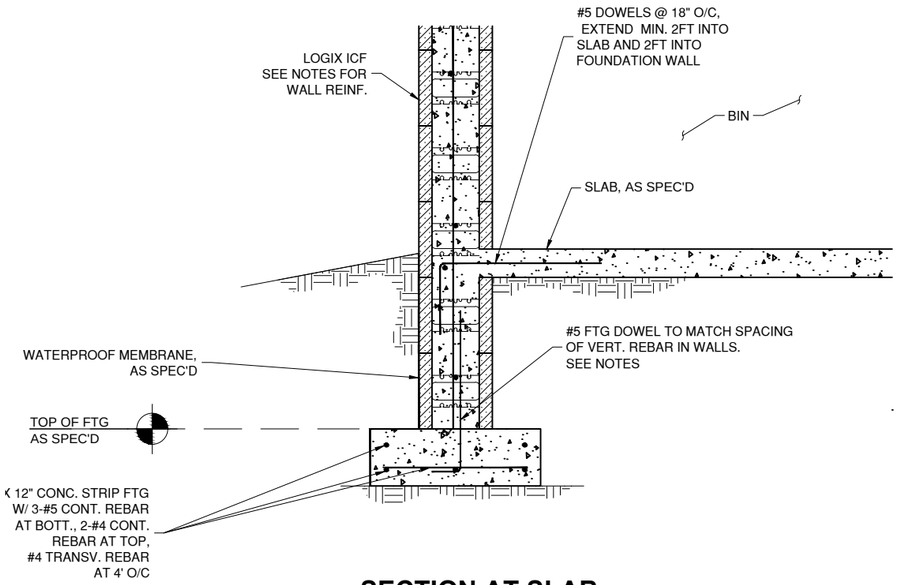
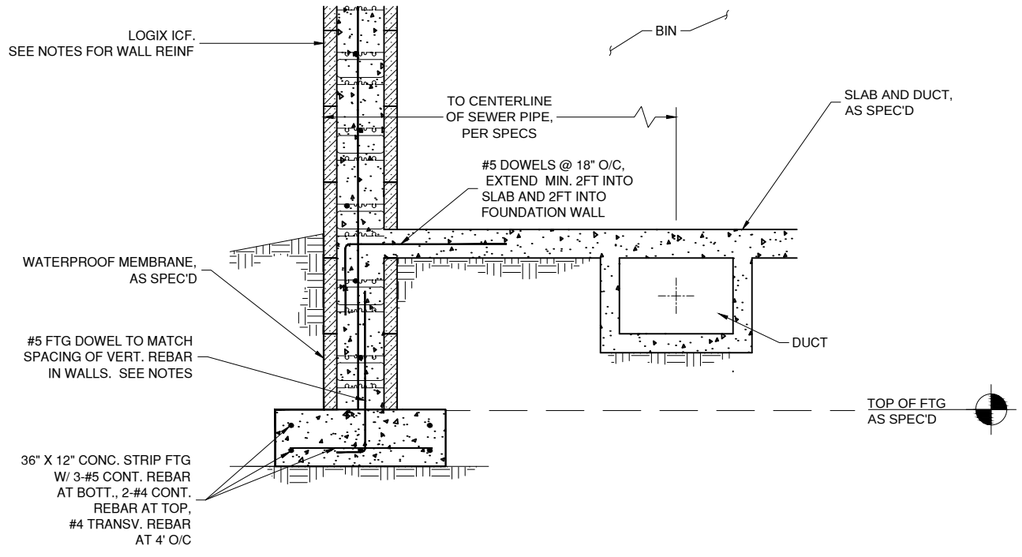


SECTION AT SLAB

2
SD-01

FOUNDATION WALL SECTION - DUCT BELOW SLAB OPTION

SCALE: 3/8" = 1'-0"



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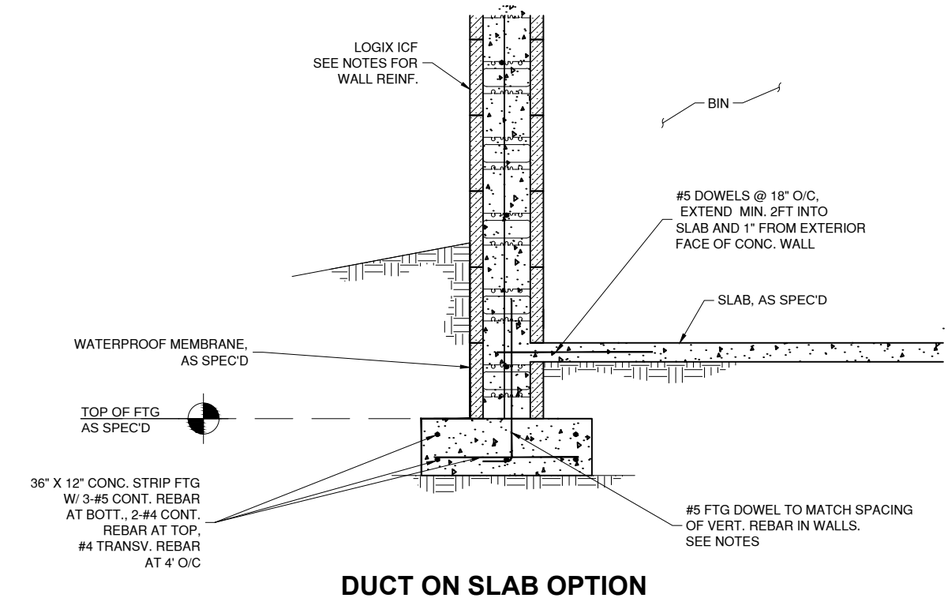

DUCT ON SLAB OPTION

3
SD-01

FOUNDATION WALL SECTION

SCALE: 3/8" = 1'-0"

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ROOT VEGETABLE STORAGE STRUCTURAL DRAWINGS FOR LOGIX ICF WALLS

Title:

SECTION DETAILS - FOUNDATIONS

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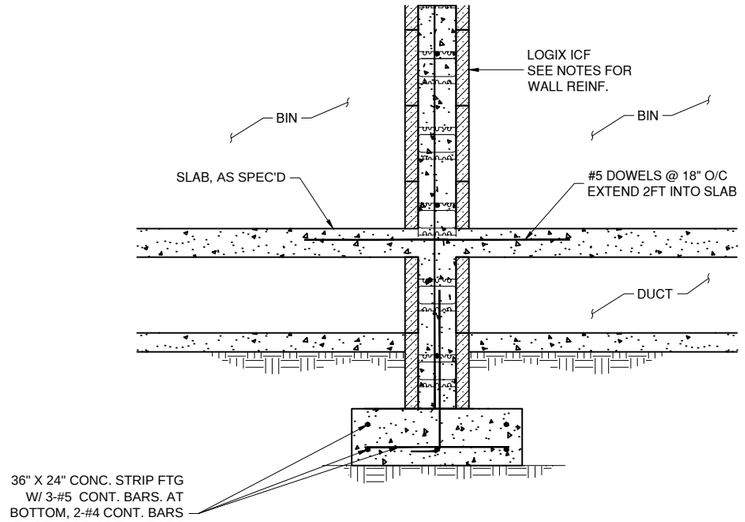

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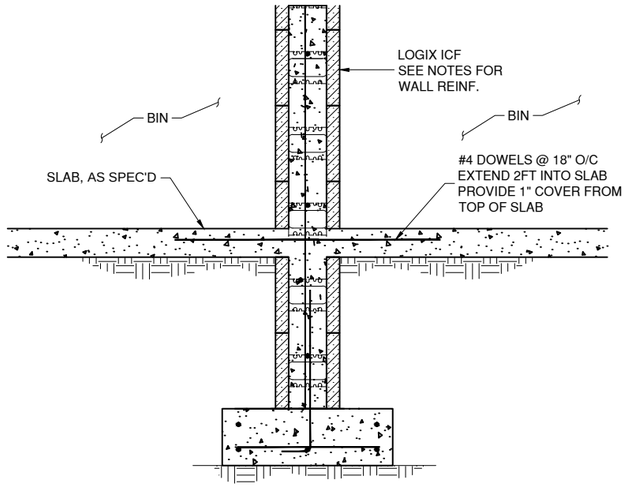

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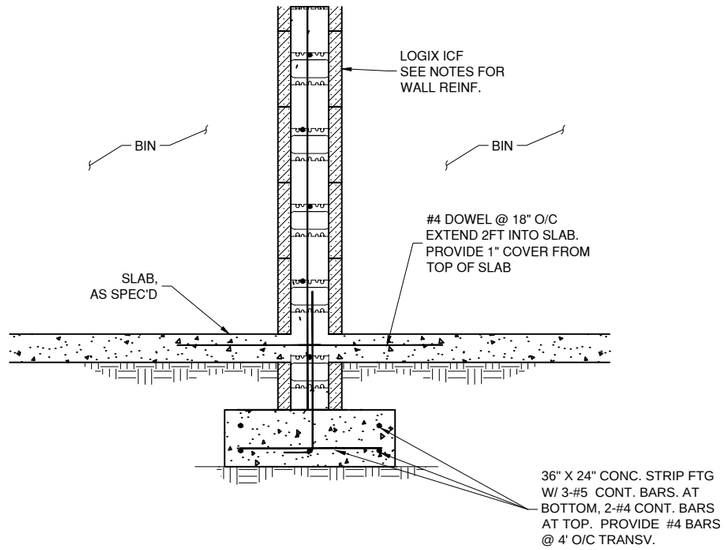

DUCT ON SLAB OPTION

5 SD-02 **FOUNDATION WALL SECTION**
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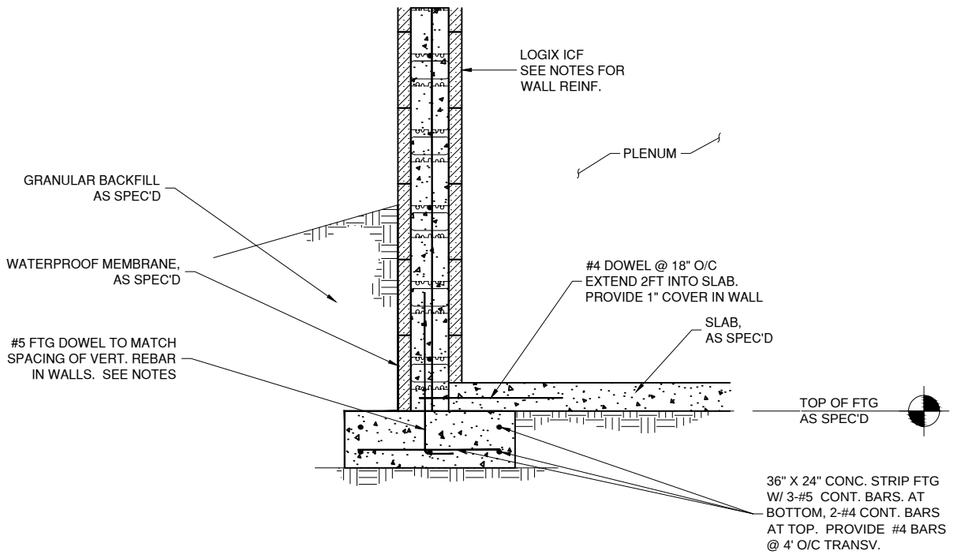

8 SD-02 **FOUNDATION WALL SECTION**
SCALE: 3/8" = 1'-0"

NOTES:
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Title:
SECTION DETAILS - FOUNDATIONS

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Drawn by: FBR
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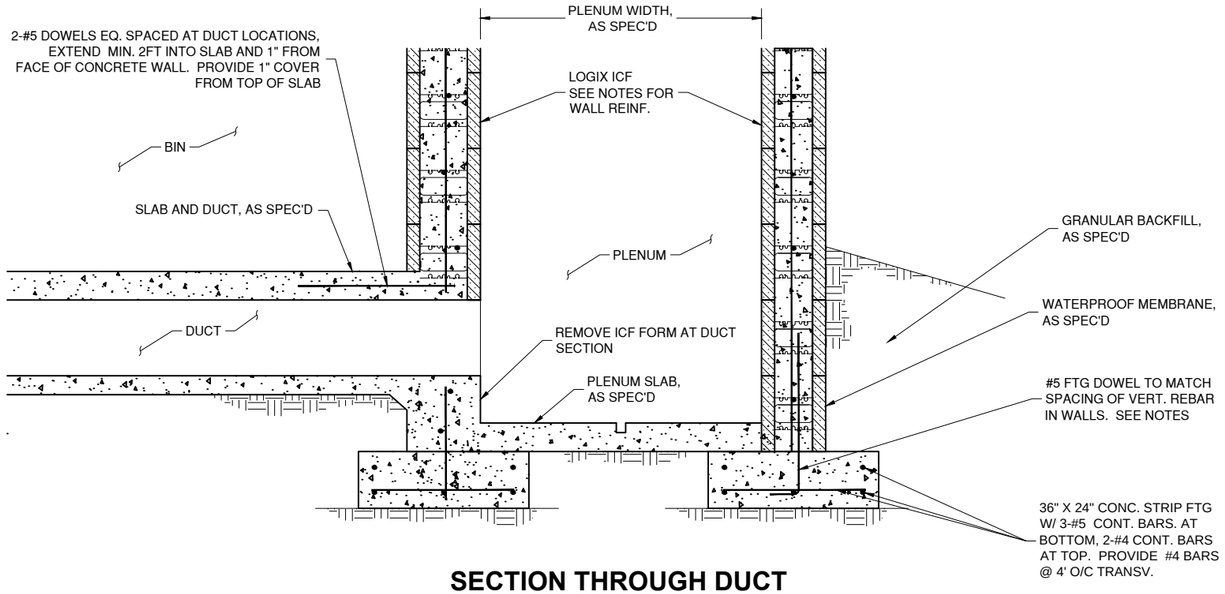

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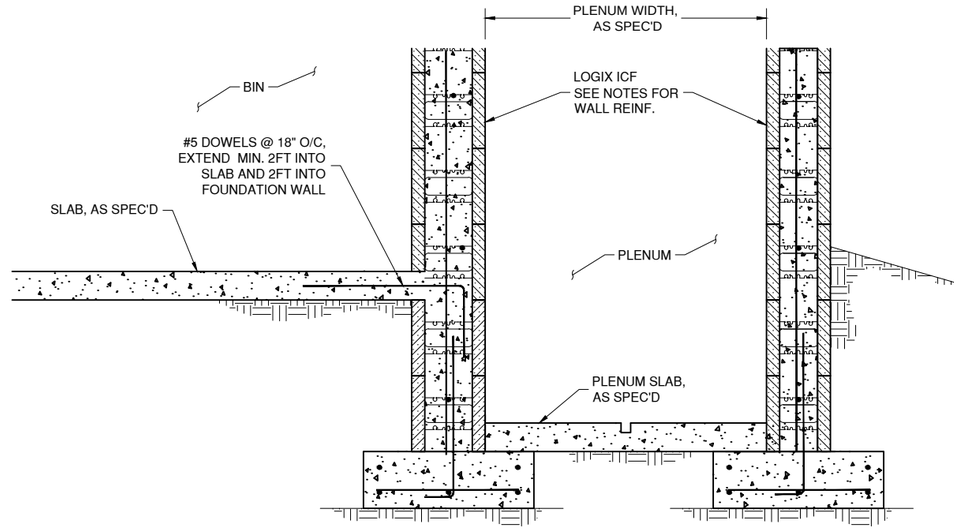

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9 / SD-03 FOUNDATION WALL SECTION - DUCT BELOW SLAB OPTION

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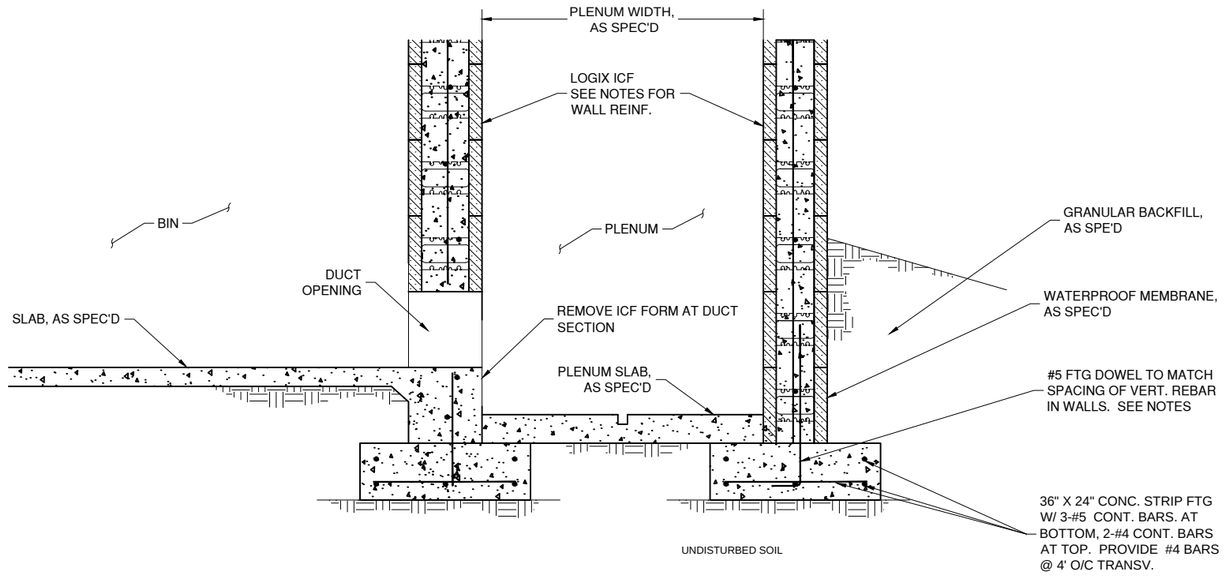

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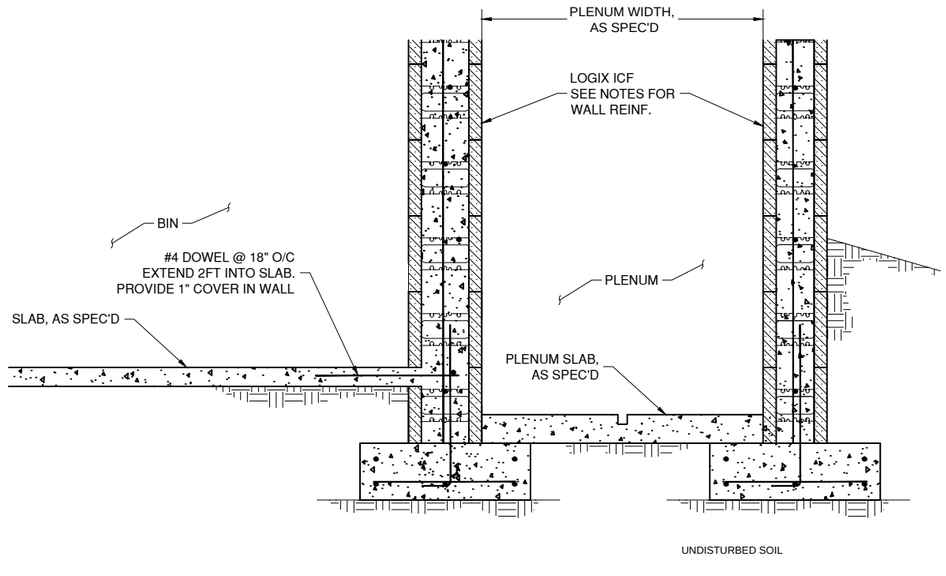

SECTION THROUGH SLAB

9 / SD-03 FOUNDATION WALL SECTION - DUCT ON SLAB OPTION

SCALE: 3/8" = 1'-0"

NOTES:

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Title:

SECTION DETAILS - FOUNDATIONS

11X17
Date: 8/22/2012
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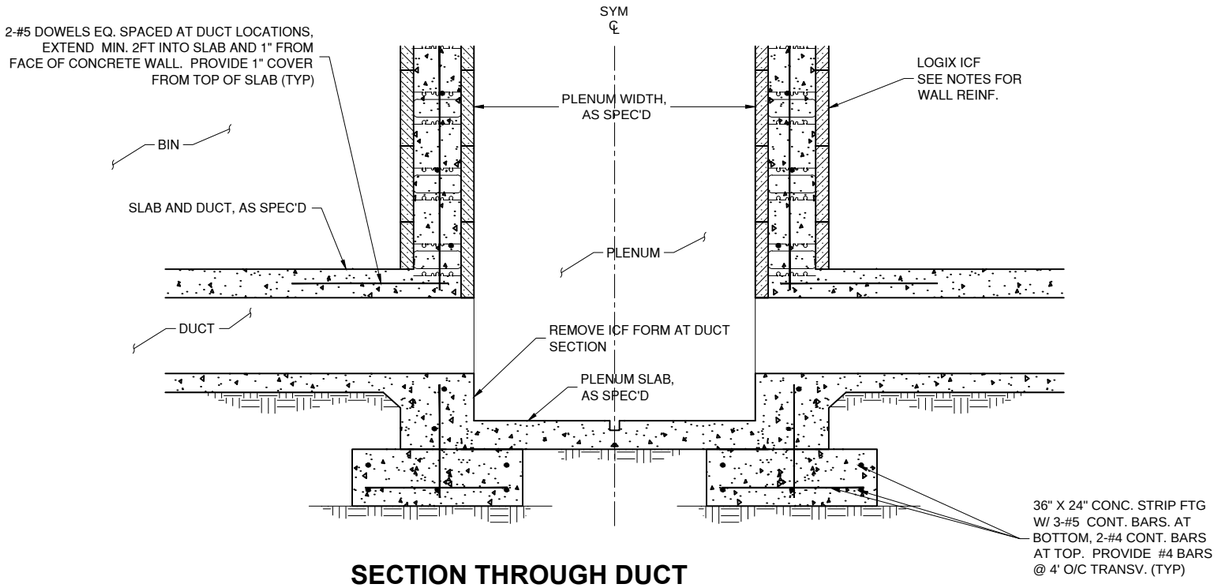

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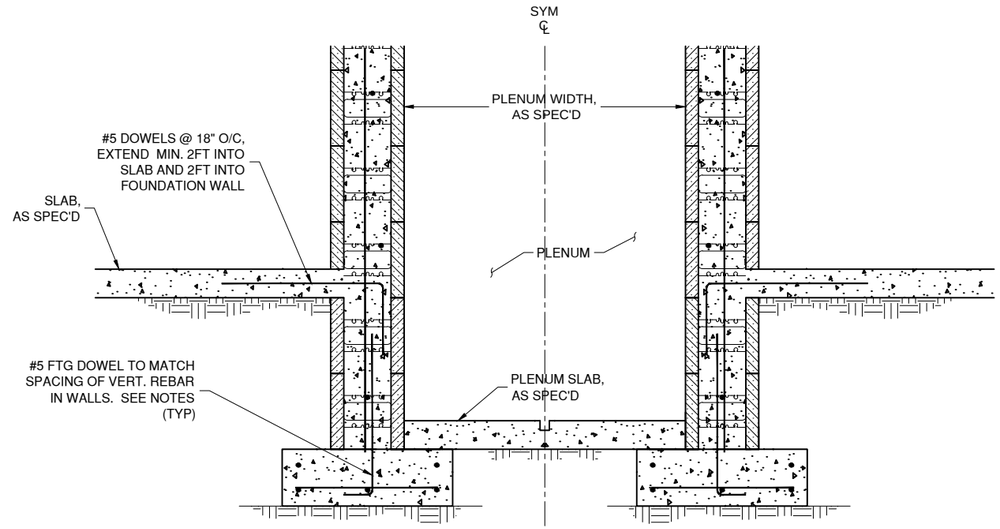

SECTION THROUGH SLAB

10
SD-04

FOUNDATION WALL SECTION - DUCT BELOW SLAB OPTION

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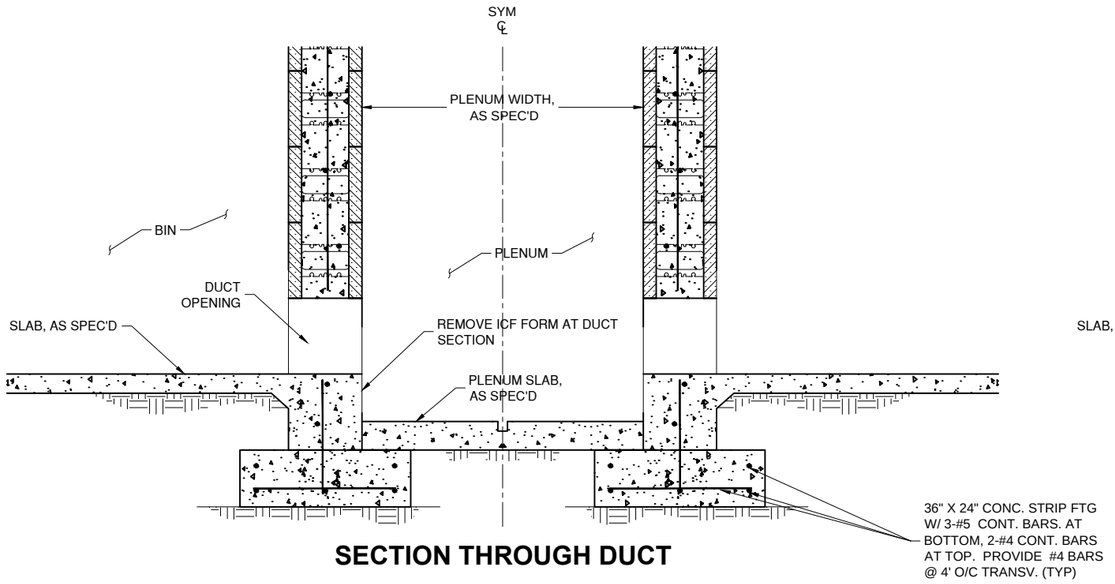
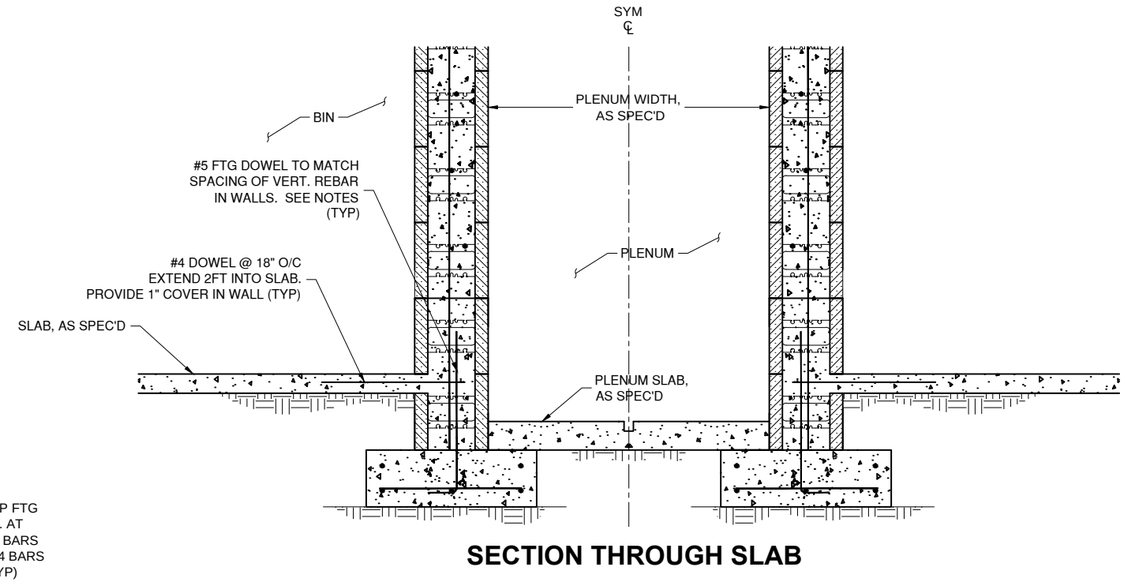


SECTION THROUGH DUCT



SECTION THROUGH SLAB

NOTES:

Engineering is available for wall reinforcement with varying wall heights. Contact your local LOGIX representative, or email info@logixicf.com.

10
SD-04

FOUNDATION WALL SECTION - DUCT ON SLAB OPTION

SCALE: 3/8" = 1'-0"

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Project:

ROOT VEGETABLE STORAGE STRUCTURAL DRAWINGS FOR LOGIX ICF WALLS

Title:

SECTION DETAILS - FOUNDATIONS

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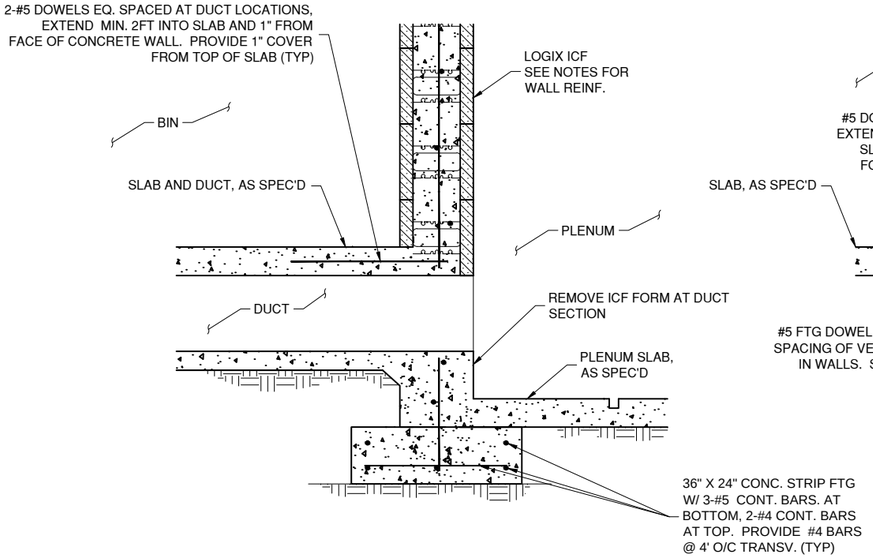
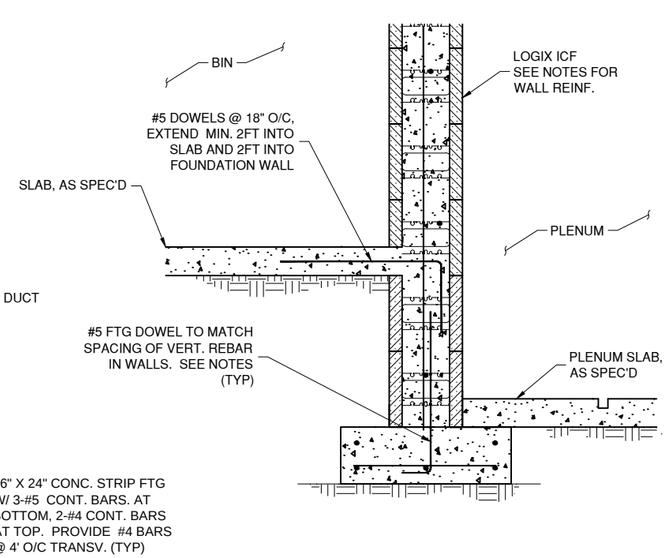


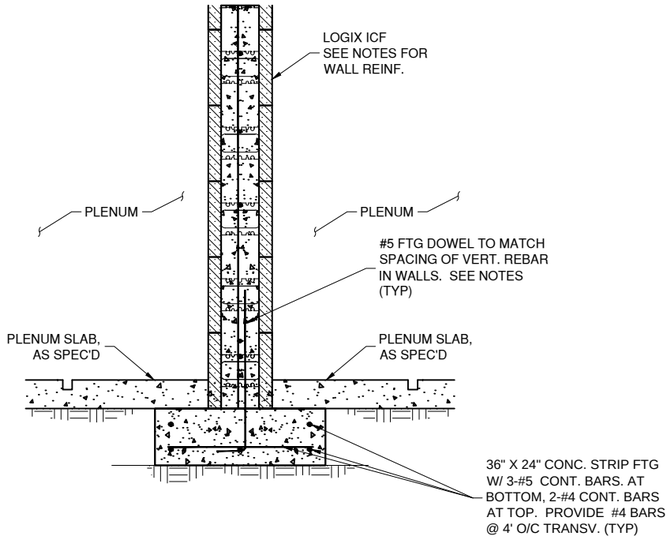
SECTION THROUGH DUCT



SECTION THROUGH SLAB

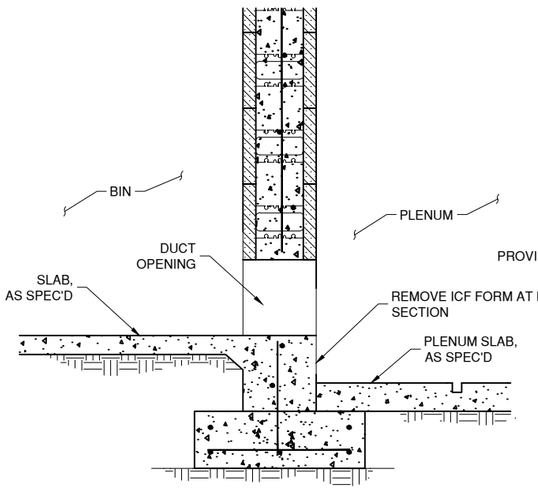
11A SD-05 FOUNDATION WALL SECTION - DUCT BELOW SLAB OPTION

SCALE: 3/8" = 1'-0"

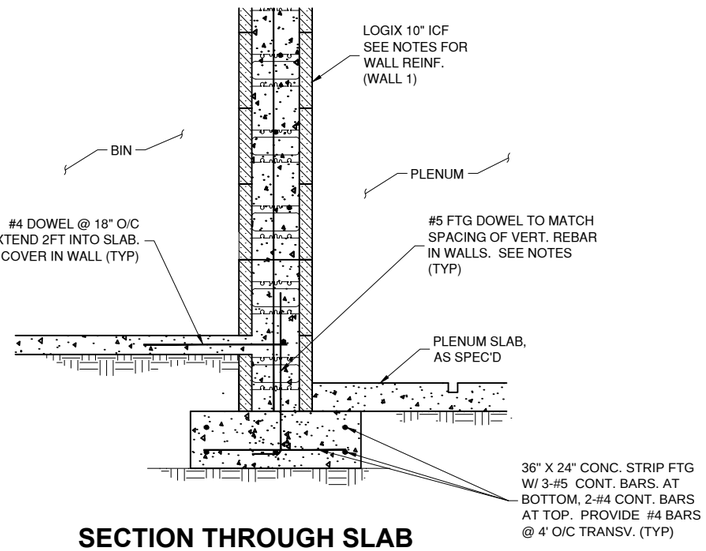


11B SD-05 FOUNDATION WALL SECTION

SCALE: 3/8" = 1'-0"



SECTION THROUGH DUCT



SECTION THROUGH SLAB

11A SD-05 FOUNDATION WALL SECTION - DUCT ON SLAB OPTION

SCALE: 3/8" = 1'-0"

NOTES:

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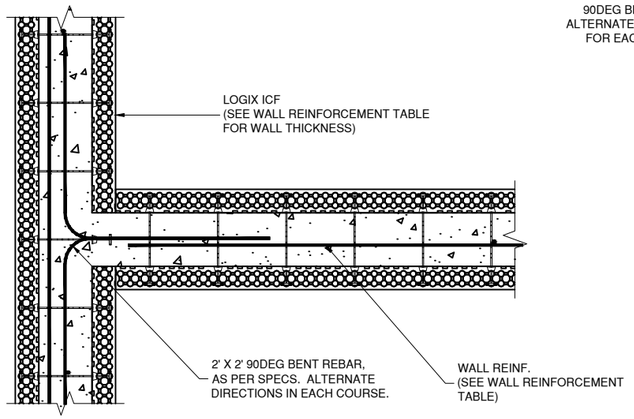
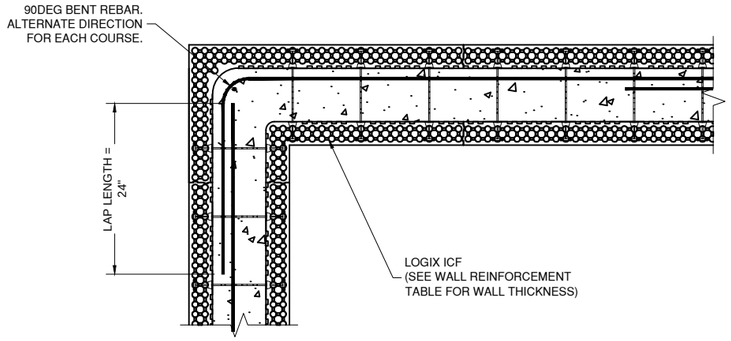
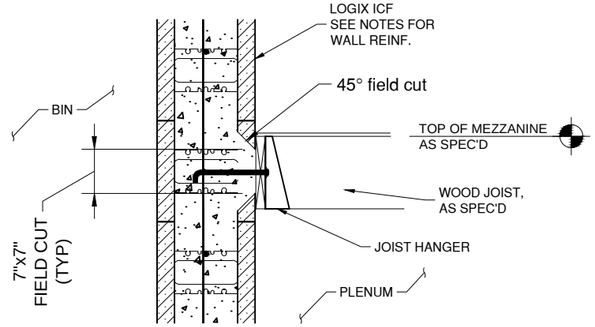




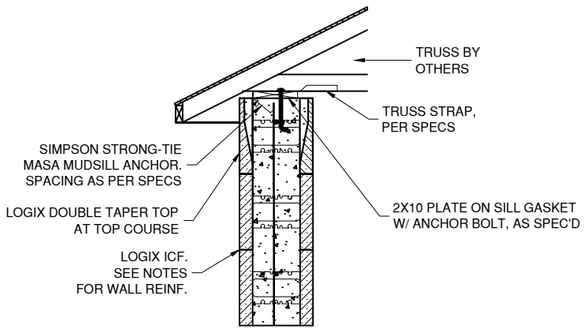
CORNER & T-WALL JUNCTION DETAILS

NTS



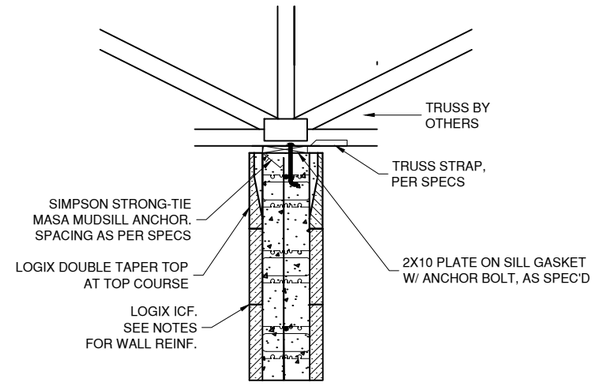
14 SD-06 **MEZZANINE LEVEL AT ICF (see Notes)**

SCALE: 1/2" = 1'-0"



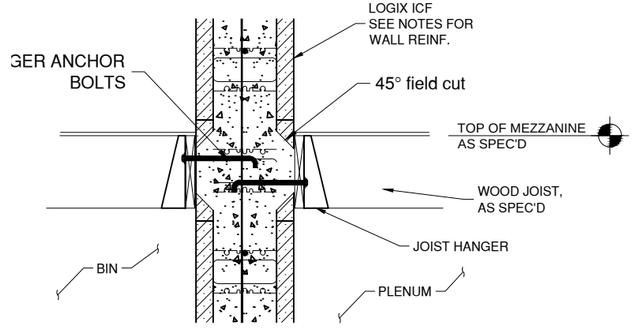
12 SD-06 **ROOF DETAIL AT EXERIOR WALLS**

SCALE: 3/8" = 1'-0"



13 SD-06 **ROOF DETAIL AT INTERIOR WALLS**

SCALE: 3/8" = 1'-0"



15 SD-06 **MEZZANINE LEVEL AT ICF (see Notes)**

SCALE: 1/2" = 1'-0"

NOTES:

1. Engineering is available for wall reinforcement with varying wall heights. Contact your local LOGIX representative, or email info@logixicf.com.
2. For alternative floor connections see Section 5.3 Commercial or 5.7 Residential CAD Drawings in the LOGIX Design Manual

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