PRIEST & ASSOCIATES CONSULTING, LLC

TEST PLAN

Fire Resistance Testing of a Loadbearing 2-hour MagMatrix Wood Stud Wall

Assembly Based on UL Design No. U301

Test Details

Project No. 11011A

Prepared for:

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Abstract

This Test Plan has been developed to describe the construction and testing details for a 2-hour loadbearing wood stud wall assembly utilizing a double layer of 12 mm MagMatrix MOS Structural sheathing board installed to wood framing using a wall configuration loosely based on UL U301. The intent of this testing is for recognition in an Intertek CCRR.

Submitted by,

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August 3, 2021

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President

August 3, 2021

INTRODUCTION

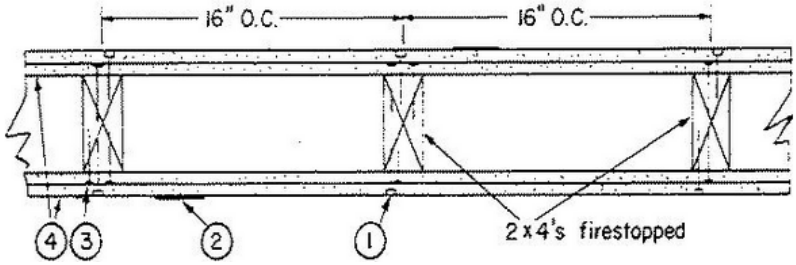
The following Test Plan has been devised to describe the elements of construction and assembly details for a 2-hour fire-resistance evaluation of the MagMatrix magnesium oxide oxysulfate (MOS) structural sheathing board product in a wood-framed assembly in accordance with ASTM E119/UL263. The client has requested that this test construction should be based on UL Design U301. This plan provides for testing the U301-type construction with two layers of 12 mm MagMatrix board installed on both sides of the wood framing in the wall construction as a substitute for double layers of 5/8 in. type X gypsum wallboard (GWB). This wall system is loosely based on the construction details described in the U301 2-hour configuration, except that mineral wool cavity insulation is recommended for use as stud cavity insulation.

UL Design No. U301 is summarized in the following.

Design No. U301
May 28, 2021

Bearing Wall Rating — 2 Hr.
Finish Rating — 66 Min.
This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



1. Framing – 2x4 wood studs spaced a maximum of 16 in. on center (OC)
2. Gypsum Board (GWB) – Two layers of ⅝ in. type X attached to studs. The base layer is attached with $1^{7}/_{8}$ in. long 6d nails spaced 6 in. OC. The face layer is attached with 2⅜ long 8d nails spaced 8 in. OC. Vertical joints are located over studs. All joints in face layers staggered with joints in base layers. Joints of each base layer offset with joints of base layer on the opposite side.
3. Insulation – Optional.

The client's objective for this testing is recognition in an Intertek CCRR. Therefore, Intertek's approval of this plan is necessary before testing can proceed.

The fire-resistance rating of assemblies is based on the performance of the construction when tested in accordance with ASTM E119/UL 263. The test performance is based on two criteria:

1. The ability of the assembly to support an applied load equivalent to the allowable strength design of the framing members for the duration of the fire classification period; and,
2. The ability of the assembly to resist excessive heat transfer to the unexposed surface of the construction.

The fire rating of a loadbearing wall assembly is dependent upon the degree of fire resistance protection provided by the protective membrane separating the wall framing from the fire exposure. This protection restricts heat transfer both to the framing and through to the unexposed side of the wall structure. However, the resistance to heat transfer of MgO-based panel products has been observed to be somewhat lower than that of GWB (personal test experience, see below).

Stud Cavity Insulation Considerations

Based on our review of competitive designs and our understanding of the MgO-type board's membrane protection (thermal resistance) characteristics, we recommend that mineral wool (MW) cavity insulation be used. As noted above, U301 includes two layers of ⅝ in. type X GWB on both sides of the wood framing. The membrane protection rating (termed the “Finish Rating”) in the UL listing indicates a rating of 66 minutes. This rating is a measure of the thermal protection afforded by membrane elements to the framing of the wall system. It is obtained by measuring the temperature rise of a set of thermocouples arrayed between the protective membrane and the framing elements. From testing experience, the Finish Rating for a 1 in. thickness of MgO-type board is estimated to be 30 minutes. Therefore, the use of mineral wool batt insulation is recommended to limit heat transfer both to the lateral sides of the wood studs (to assist in maintaining the applied load – Criteria No. 1) and the unexposed side of the assembly (Criteria No. 2). Typically, nom. 2.5 pcf (40 kg/m^3) MW batts filling the stud cavity have been used and recommended for this assembly. Rockwool Comfortbatt™ has been found suitable for this purpose. MW of greater density (nom. 6.2 pcf/100 kg/m^3) has been used in some MgO fire resistance designs. While this density of MW provides a greater degree of fire resistance protection, its use presents a more restrictive condition in terms of the assembly's versatility (and cost).

It should be noted that the use of MW insulation as part of the tested assembly will limit the design to MW at the tested density or greater, and insulation of types such as fiberglass or cellulosic may not be substituted.

Framing Considerations

This plan includes using nominal 2x4 wood studs at a spacing of 16 in. on center (OC) and is consistent with U301. Greater stud sizes (depths) than those tested are permitted. The indicated stud spacing is a maximum and allows for narrower spacing.

The framing for the test assembly includes two rows of wood blocking to provide backing for the horizontal joints of the 8 ft long MagMatrix panels.

Test Assembly Construction

The various elements of the assembly construction are described in the table and horizontal section provided below.

Construction Component	Description
Wood Studs, Bearing Plates, and	Nominal 2x4 studs spaced 16 in. on center (OC), with 2x4 blocking as shown in Figures 1 and 2. Lumber should be free of large knots and be as clear of knots and other imperfections as possible. Loading of the assembly is based on the grade and species of lumber. Cut studs to 9 ft 7½ in. lengths. Top

Construction Component	Description
Blocking/Joint Backing See Figures 1 & 2.	(double) and bottom plates cut to 10 ft in length. Each stud nailed at the top and bottom plates with 3¼ in. long 16d nails. The two end studs shall be spaced 12 in. from each end to accommodate the test frame dimensions. Top and bottom plates are fastened to the test frame following the laboratory's standard practice.
Insulation	Mineral wool batts (conforming to ASTM C665), 3½ in. thick by 15¼ in. wide, nom 2.5 lb/ft^3 (40 kg/m^3), friction fit within stud cavities.
MagMatrix Sheathing See Figures 3 – 6.	Two layers, 12 mm thick x 1220 mm (4 ft) wide x 2440 mm (8 ft) long, applied vertically (centered on studs). Joints of the base layer are staggered one stud cavity on opposite sides of the studs. Vertical joints in the face layer are staggered one stud cavity. Horizontal butt joints on opposite sides are staggered front to back. Horizontal joints are backed by framing (wood blocking, see Figs. 1 and 2). The base layer of board is attached to the framing with 1⅞ in. long 6d nails 8 in. on center (OC) at the perimeter and field. The face layer shall be attached with 2⅜ in. 8d nails spaced 8 in. OC (staggered 4 in. from base layer fasteners). Edge fasteners at the vertical joints shall be located precisely ⅜ in. from the board edge. Fasteners around the perimeter of the assembly are placed nominally ¾ in. from the outside board edges. Fasteners along the horizontal joints are located ⅜ in. from the board ends. Board joints are tightly fitted. Treatment of the joints and fastener heads shall be at the discretion of the client.

Instrumentation

Unexposed temperatures shall be recorded following standard test requirements with the number and location of the TCs to be determined by Intertek. For engineering purposes, five "Finish Rating" TCs shall be placed between the face of the studs and the MagMatrix board on the exposed side at the center and nominal quarter points of the framing.

Wall Loading

A superimposed axial load corresponding to the Allowable Strength Design (ASD) condition calculated for the species and grade of lumber used shall be applied. Intertek shall calculate the superimposed load.

Testing

Testing shall be conducted in accordance with ASTM E119 for 2 hours.

Hose Stream Test

The specimen shall be subjected to the hose stream test immediately after the fire endurance exposure. If the fire resistance test assembly fails the hose stream test after the 2-hour exposure, a "hose stream retest" shall be performed on a duplicate assembly after a fire exposure of 1 hour (½ the fire endurance period, as allowed in the E119 standard).

Test Report

The test laboratory shall provide a final report.

Construction drawings are contained in the following pages.

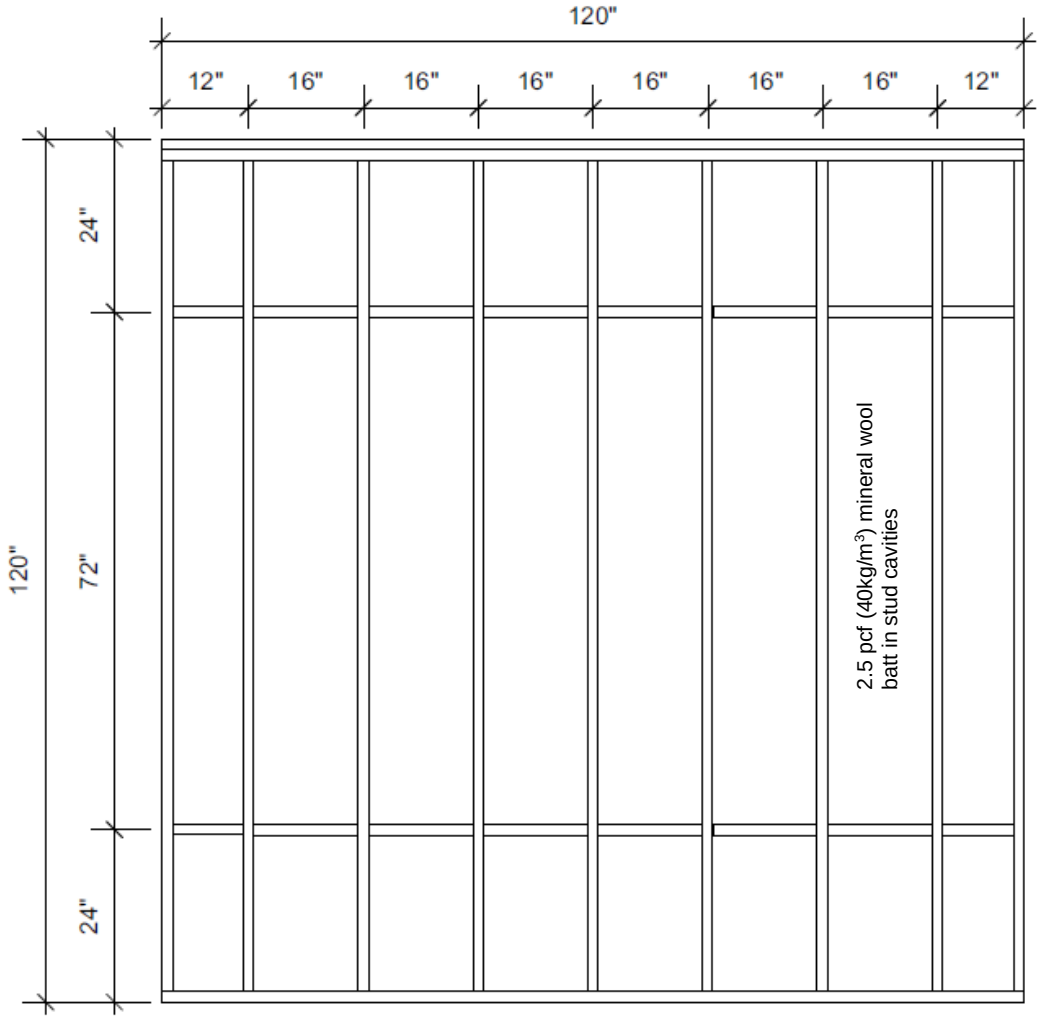


Figure 1
Wood Framing Details

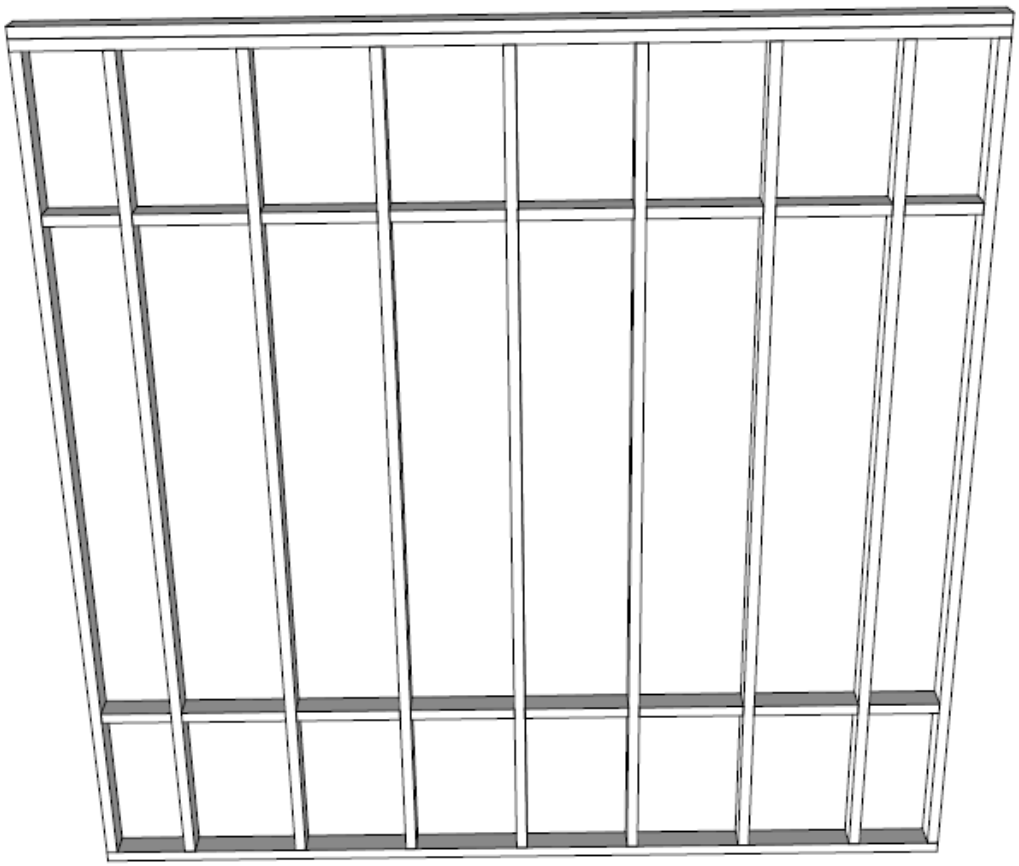


Figure 2
Isometric View of Framing

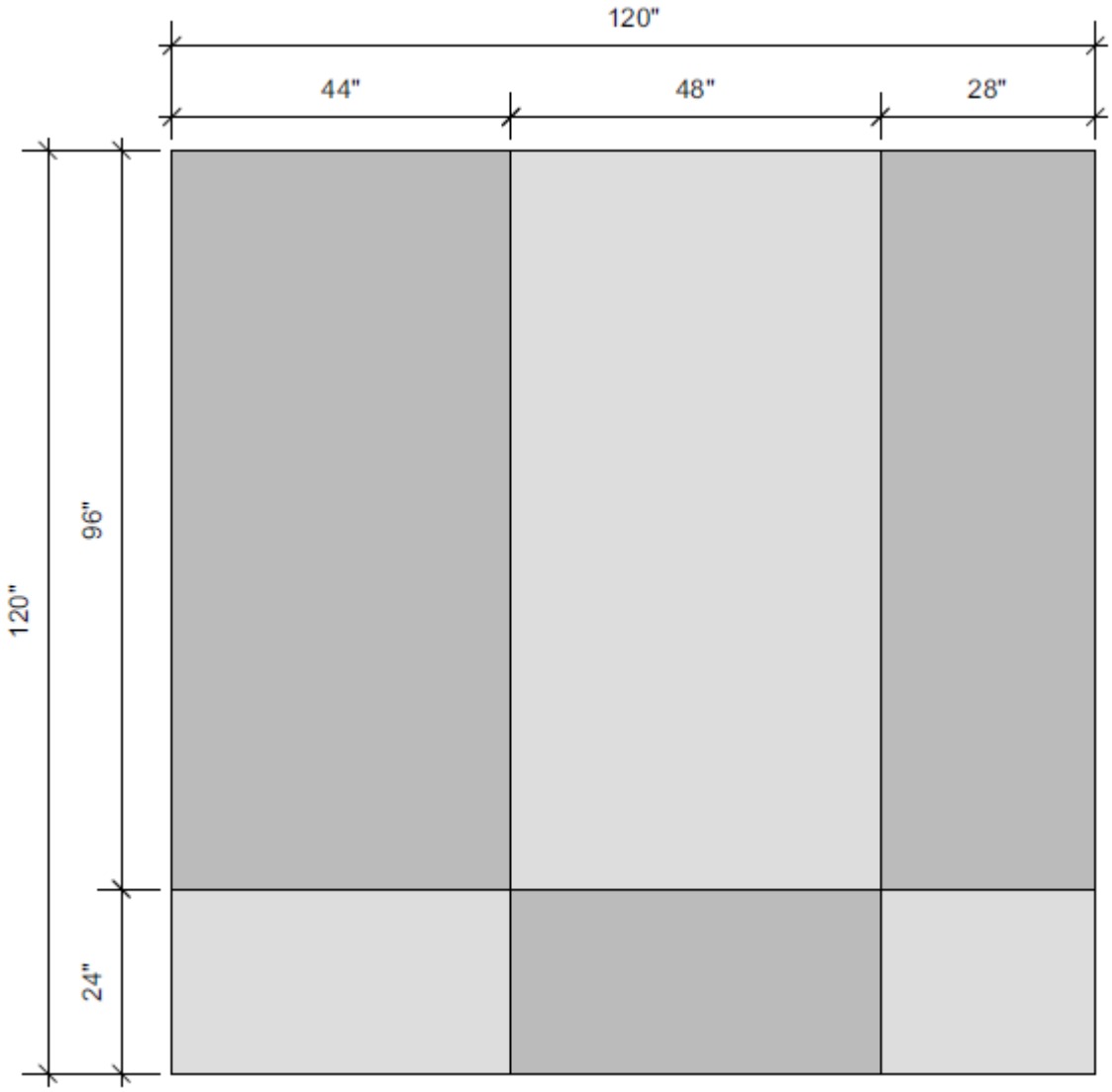


Figure 3
Base Layer 12 mm MagMatrix Board, Exposed Side

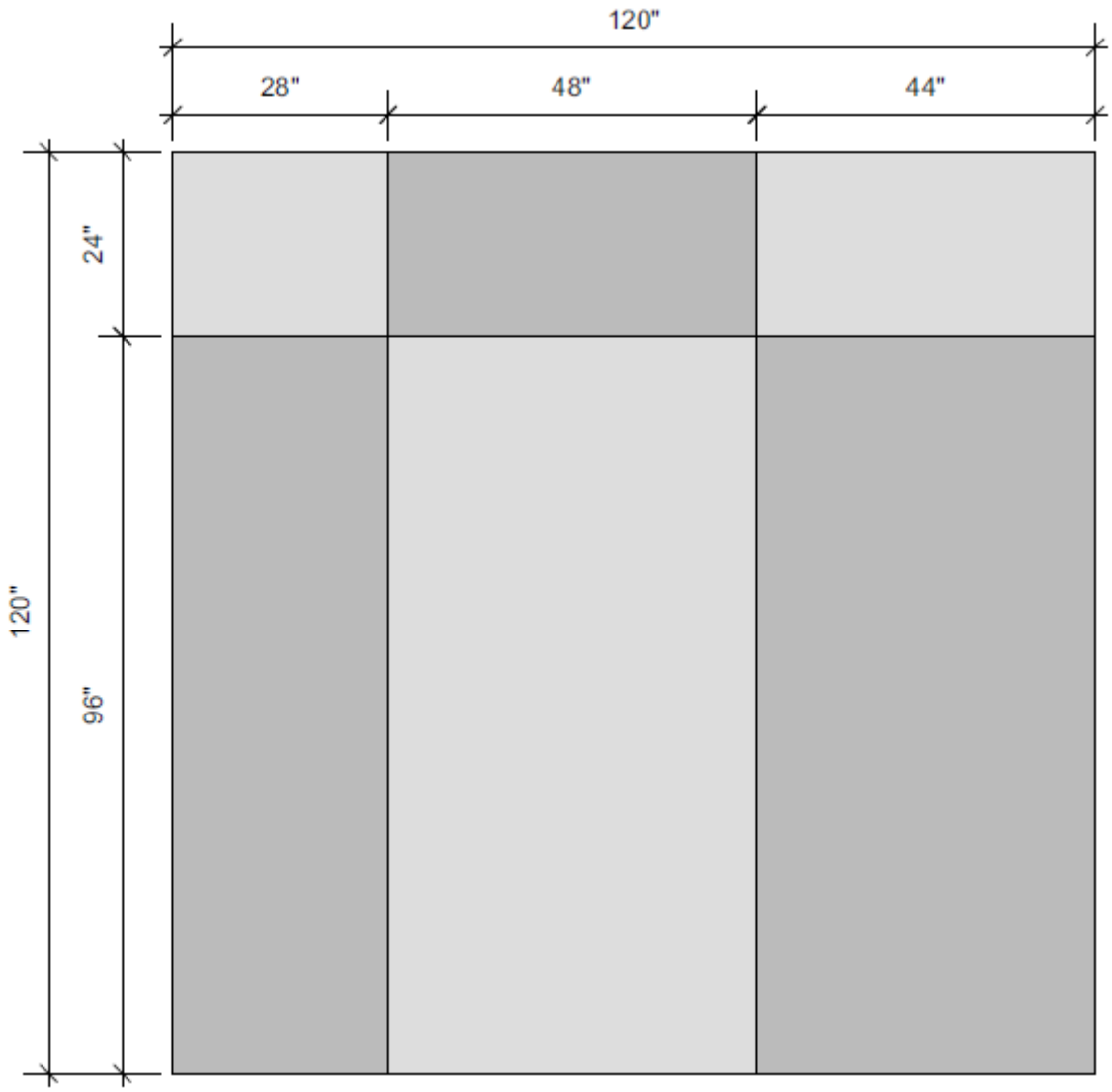


Figure 4
Face Layer 12 mm MagMatrix Board, Exposed Side

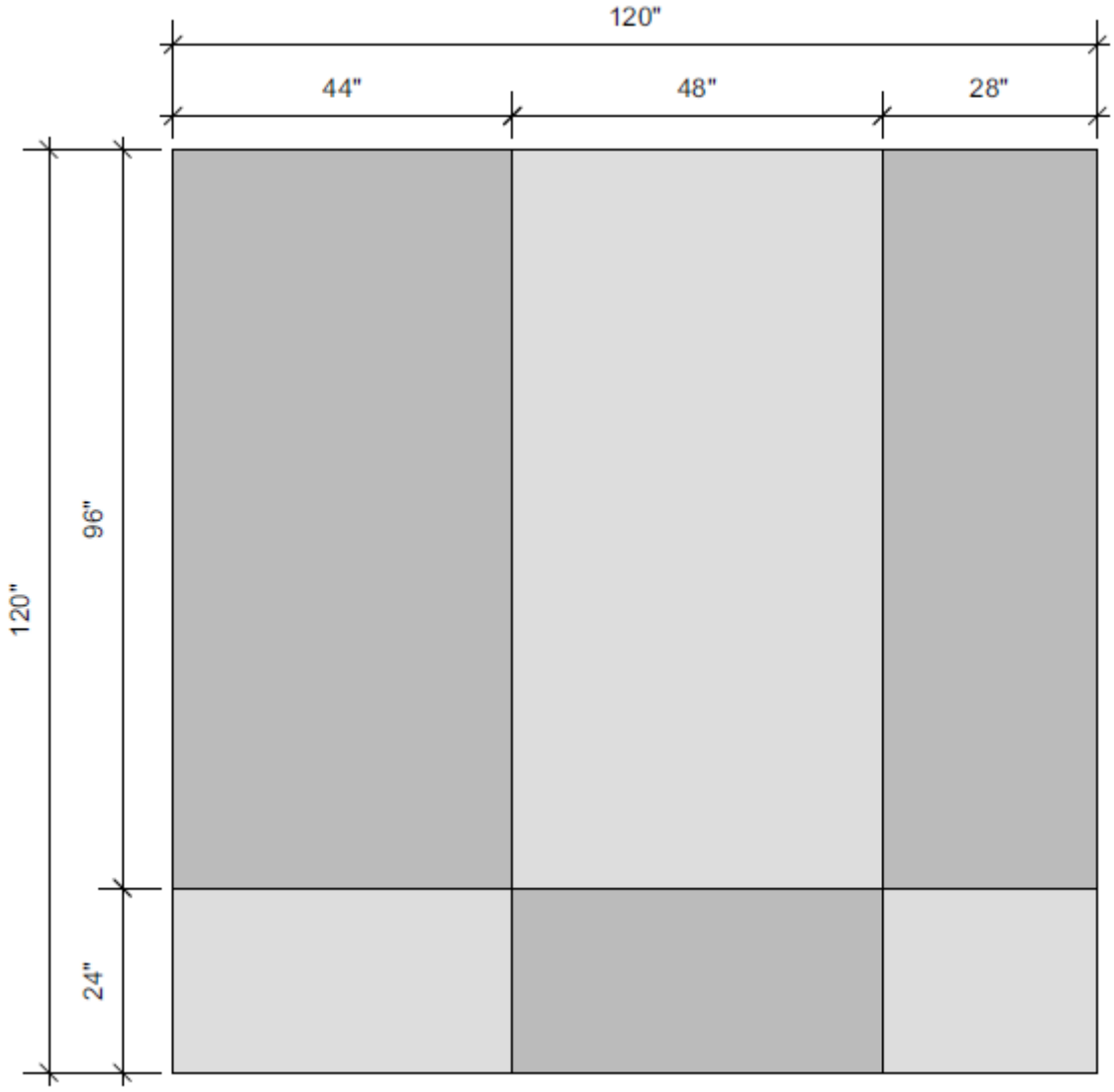


Figure 5
Base Layer 12 mm MagMatrix Board, Unexposed Side

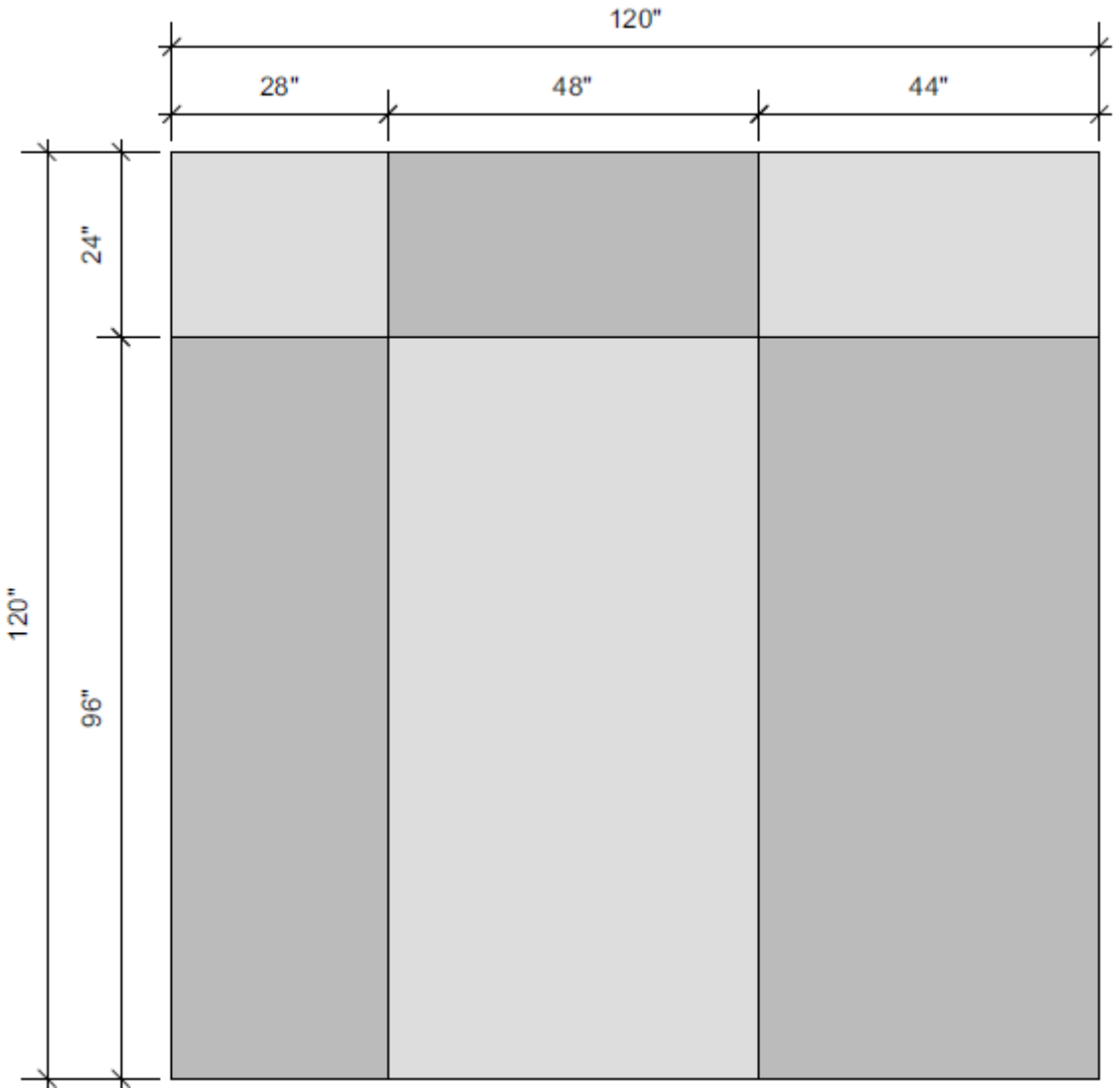


Figure 6
Face Layer 12 mm MagMatrix Board, Unexposed Side