ThermaSteel Corporation

ENGINEERING
&
ARCHITECTURAL
DESIGNING GUIDELINES
USING THE
THERMASTEEL PANEL
SYSTEM

The following information contains some of the many possible suggestions on calculations, methods of attachment, modifications, and designing assemblies. These suggestions are not to be considered necessarily the best possible solutions for your needs, but it will serve as one of many possible solutions. All attachment of connections, calculations, and designing must be reviewed by a certified architect or engineer for your particular application to insure that it meets with your individual requirement and/or structural application.

SUMMARY

I. THE SYSTEM

1. DESCRIPTION

The ThermaSteel System is panelized composite structure of modified expanded polystyrene (EPS), bonded to a light-gauge, galvanized steel frame. The panels are produced in a single step to provide a light-weight, energy efficient, load bearing construction system. The panels can be installed vertically as bearing walls and horizontally as floors and roofs in addition to the panels; top and bottom tracks, connectors, reinforcements, king and additional studs, lintels, columns, beams, channels, and blocking also conform to the system. Light gauge steel is an excellent alternative for these components to be built with.

2. MATERIAL PROPERTIES

The modified expanded polystyrene beads have a Class I flame-spread rating, and a smoke density ratio of less than 450. The steel is No.24 gauge, Grade B, complying with ASTM A 653 **(ref. 6)**, with G-90 galvanizing conforming to ASTM A 525 **(ref 7).**

The main physical properties of the components of the ThermaSteel System are:

A) Studs and 2" x 1" Top and Bottom Angles

24 gauge steel	
Design Thickness	0.0219 in.
Design Weight	1.0 PSF
Fy Strength	33.0 KSI.
Modulus of Elasticity	29,500 KSI.
Inside Bend Radius	3/32 in.

B) Expanded Polystyrene (EPS)

The following are strength properties of the modified expanded polystyrene:

	3 1/2" PANEL	**5 1/2" PANEL**
Density	1.5 PCF	1.0 PCF
NOVA Chemical Co. Compressive Strength at 10% Defl.	21-27 PSI	12-17 PSI
NOVA Chemical Co. Flexural Strength	55-70 PSI	28-35 PSI
Minimum Compressive Strength at yield or 10% Def *	18.3 PSI	11.2 PSI
Minimum Flexural Strength**	43.3 PSI	27.0 PSI

* Minimum, which ever occurs first, per ASTM C 578 ***(ref 8)***

** Minimum values per ASTM C 578 ***(ref 8)***

C) Glue

The glue bonds the steel with the EPS. It is applied to the steel before molding. The bond to the foam is formed in the press by heat activation combined with adequate pressure.

D) Light Gauge Steel Components:

GAUGE	FY (KSI)	DESIGN THICKNESS (in)	MINIMUM THICKNESS (in)
25	33	0.0188	0.0179
22	33	0.0283	0.0269
20	33	0.0346	0.0329
18	33	0.0451	0.0428
16	50	0.0566	0.0538
14	50	0.0713	0.0677
12	50	0.1017	0.0966

Note: - Thickness is for carbon sheet steel and uncoated steel.
- Minimum thickness represents 95% of the design thickness and is the minimum Acceptable thickness delivered to the job site based on Section A3.4 of ***Ref 2***.

3. PANEL DIMENSIONS

Typical panels are 4' wide. Other characteristics of the standard panels are ***(Ref 3):***

PANEL TYPE	THICKNESS	EPS DENSITY	STEEL STUDS	LENGTH
A-1	3 1/2"	1.5 PCF	AT 16" O.C.	8'1" TO 12'
B-1	3 1/2"	1.5 PCF	AT 24" O.C.	8'1" TO 12'
C-1	5 1/2"	1.0 PCF	AT 16" O.C.	8'1" TO 12'
D-1	5 1/2"	1.0 PCF	AT 24" O.C.	8'1" TO 12'

4. PANEL WEIGHT

Table No.1 illustrates the theoretical weight per panel (8' and 12') and dead load for the floor, roof and wall panels. Interpolate for other lengths. The weights shown in the table for the panel as delivered by the manufacturer. Consider adding dead weight for screws, channels, tracks, lintels, and any other additional components.

5. INSTALLATION

- Each panel has a steel overlap strip along the vertical edge at the outside face which overlaps the edge of the next panel approximately ¾" when set in place. This overlap strip serves as a point of attachment between panels using No. 8 x ½" self-tapping screws @ 12" O.C.
- The wall panels are placed in a No.18 gauge steel channel or per engineer design.
- After walls are erected, No.18 gauge steel channel (or per engineer design) are attached to the top tracks.
- The metal channels are attached to the foundation per legal code. Panels are secured in place by screwing through the channel and in to the panel.
- If necessary, typical X-bracing; metal columns and beams; lintels and headers; and any other metal reinforcement, can be added to the system.
- Roof panels are set and attached together to bear on roof beams, trusses or bearing wall plates.

II. THERMAL INSULATION

1. PANEL R-VALUE

The following list shows R-values (°f*ft*h/Btu) 75° F for 1" of the foam, for different densities and from different sources.

Density	**1.00 PFC**	**1.50 PFC**
NOVA Chemical Company (EPS manuf.)	3.92	4.13
Huntsman Chemical Corporation (EPS manuf.)	3.90	4.15
ASHRAE recommendations * ***(Ref 9)***	3.85	4.17
Minimum R-Values per ASTM C 578 ***(Ref 8)***	3.68	4.07

***** Technical Committee 4.4 selected the data from the ASTM standards as representative values.
Note: The R-value will increase for a condition with lower temperature.

For thermal calculation purposes the following are the R-values adopted for each type of wall

	R-value per inch	**Panel R-value:**
3.5" Wall – 1.50 PCF	4.10	14.35
5.5" Wall – 1.00 PCF	3.85	21.18

The above R-values are solely for the panels. Since there is no thermal bridge between the exterior and the interior studs, there is no other thermal loss on the panel. However, consider a 1-2% loss due to the additional components (top and bottom tracks)

2. ASSEMBLIES

TABLE No. 2 illustrates some R-values of common building materials, air spaces and films. Use only for general reference purposes only.
Example: 51/2" wall, with 5/8" gypsum wallboard interior and 7/8" stucco exterior.

	R-Value	
Outside Air film: winter value – 15 mph	0.170	0.75%
7/8" stucco exterior	0.175	0.77%
5 ½ "panel 1.00 PCF	21.180	93.04%
5/8" gypsum board	0.560	2.46%
Inside Air film: heat flow horizontal	0.680	2.99%

TOTAL R-Value for the assembly 22.77

The incidence of the panel insulation's value on the total R-value shows that ***ThermaSteel™*** Offers superior values compared to any other traditional construction system. **TABLE No. 3** shows R-values for other assemblies.

III. STRUCTURAL PERFORMANCE

1. GENERAL

The allowable ThermaSteel panel loads are shown in TABLE No.4 (reproduced from **Table No.1** from the ICBO report **(*Ref. 3*)**). The safety factor used on the table is 3.

The first two columns show the allowable axial uniform load. The panels were tested as columns having flat ends at the bottom. The compressive load was applied uniformly to the upper end of the panel and a ¾" steel rod used at the bottom to provide the required eccentricity.

The second two columns illustrate the axial center point loading. In this case, the load was applied through 6" long wood member with the same width as the panels. The allowable loads are shown in pounds per linear foot of panel.

For transverse load (applicable for roofs, floors, and walls resisting wind loads), the panels were tested by the vacuum method, attached to their resisting top and bottom plates.
As indicated in **Table No.4**, the racking shear values are for panels with ½" thick gypsum wallboard attached to one side of the panel with 1 ¼" long drywall screws at 12" O.C. along the perimeter and in the field.

For ICBO purposes, all the panels were tested under the ASTM E-72 Standards **(*Ref 5*).**

2. VERTICAL LOADS

A) Axial Uniform Loading
When dimensioning a wall to bear a uniform load, consider the following:

a. R-Value -This factor will set the thickness of the wall

b. Bearing Capacity - Table 1 for Axial Uniform Loading from ICBO **(*Ref 3)* (Table No. 4)**
- Interpolation for 9' and 10' spans is acceptable
- Safety factor used: 3 (failure/allowable)
- If the opening does not fit in one panel, a lintel must be calculated **(Table No. 6)**
- Check the top track for flexion **(Table No. 5 Top Track Verification)**

c. Stud Separation - Preferably match the stud separation with the truss separation, for example: @ 24" with @24" and @16" with @16". However track gauge and leg length can be increased to accommodate non conforming truss pattern. **(See Table No. 5)**

B) Axial Center Point Loading
When dimensioning a wall to bear a concentrated load, consider the following:

a. R-Value - This factor will set the thickness of the wall.

b. Bearing Capacity - Table 1 – for Axial Center Point Loading from ICBO ***(Ref 3)*** **TABLE No.4)**
- Interpolation for 9' and 10' is acceptable.
- Safety factor used: 3 (failure/allowable).
- If the opening does not fir in one panel, a lintel must be calculated **(Table No. 6)**
- Check the top track for flexion **(Table No. 5 Top Track Verification)**

c. Stud Separation - Preferably match the stud separation with the truss separation, for example: @ 24" with @24" and @16" with @16". However track gauge and leg length can be increased to accommodate non conforming truss pattern. **(See Table No. 5)**

3. TRANSVERSE LOADS

Transverse loads are applied in the plane of the panel. It could be wind for a wall or gravitational and/or uplift for roofs and/or floors. If the applicable load exceeds the allowable transverse load showed in **Table No.1** from **ICBO (Ref 3) (Table No.4),** a mid-length support could be the solution.

4. RACKING SHEAR

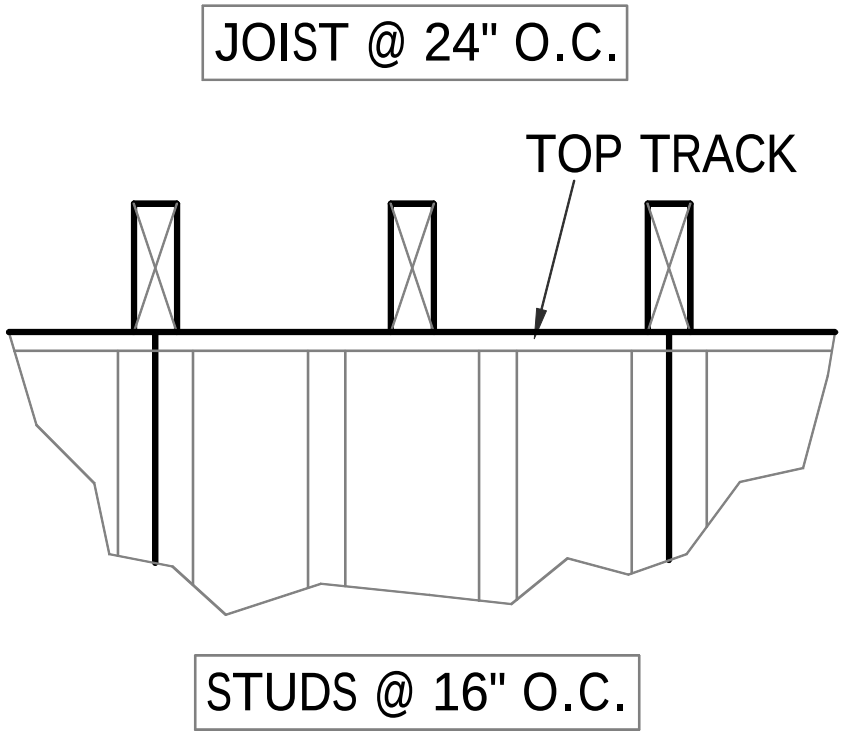
Table No.1 from ICBO **(Table No.4)** shows the maximum allowable racking shear load in PLF. As indicated in the ICBO report, those racking shear values are for panels with ½" thick gypsum wallboard attached to one side of the panel with 1 ¼" long drywall screws at 12" O.C. along the perimeter and in the field.
If those values are exceeded by the shear load, shear reinforcement can be installed **(sec 8. Shear Reinforcement).** Lateral load design including details for resistance to racking shear needs to be submitted to the building official for approval.

5. TOP TRACK VERIFICATION

If the distance between studs and the distance between trusses is the same (@ 24" O.C. or @16" O.C.) It is recommended to bear each truss on each stud. The allowable axial center point load from **Table No.1** from ICBO **(ref 3) (Table No.4)** must be checked. If the distance between studs and the distance between trusses does not match, it is very likely that one truss will land in the center of two studs. If trusses or joists @ 24" O.C. bear on panels with metal studs @ 16" O.C., one joist will land between the two studs. The top track must be checked for the following moments:

Ms = -P x 16" / (40/3) negative moment @ studs
Mj = P x 16" / (40/7) moment @ centered joist

Where P = joist (or truss) reaction. See figure:



The required section modulus will be Sreq = Ma * Ωf / Fy, where Ωf = 1.67 for Flexural Members, flexure only. **Table No. 5** shows allowable centered point loads (P allow) and uniform loads 55

(W allow) for different types of top track. The uniform load moments are based on wL ^ 2/12 for a continuous case loading.

6. LINTEL CALCULATION

Table No.6 shows the effective and full section modulus for angles b wide x d tall for different gauges.
If there is an opening (door or window) that does not fit in a panel, a lintel should be considered as a good solution. To size the lintel, the span and the load must be known. The span will be distance between two full studs next to either side of the opening. The moment (M^a) will be a function of the span and loads applied.
The required section modulus will be Sreq = M^a * Ωf/Fy, where Ωf = 1.67 for Flexrual Members, flexure only.

The reactions on the panels must be checked against the allowable axial center **point** load from **TABLE No.1** from **Ref 3 (TABLE No.4). If the reactions exceed the allowable load,** then either the lintel must be longer and bear on top of more studs, or a king stud can be installed.

7. ADDITIONAL COLUMN

If a concentrated load that applies to a panel exceeds its maximum capacity for point loads, then an additional stud is a good alternative. It consists of one or two (depending on the load) “C” channels connected back to back installed in between two panels (see **Figure 1** Load Bearing Wall).
The size of the web will be determined by the thickness of the panel (3 ½” or 5 ½”). Flanges and gauge will be determined by the loads applied, the length of the column and the end conditions.

8. SHEAR REINFORCEMENT

If the racking shear loads shown in **Table No. 1** from ICBO **(Ref 3) (TABLE No. 4)** are not sufficient then a shear reinforcement is required. One solution is an X-Bracing, on one or both sides of the wall. **Figure 2** – Shear Reinforcement shows all the components of an X-bracing, which needs to be engineered.

- Lateral Stability straps
- Multiple member at ends
- Top and bottom tracks
- Hold downs
- Anchors
- Gusset plates
- Screws

9. FENCE

ThermaSteel panels can also be used to build fences. The panels will be installed horizontally fastened to columns @ 8’ O.C. up to 12’ O.C. The columns (as in Section 7, ADDITIONAL STUD) consist of two “C” channels connected back to back installed in between two panels.

10. STAGGERING PANELS

In roof and floor applications, the most convenient way of connection is by staggering the panels half their length. Each panel will be connected to two others half their lap. Additional connection plates might be required to connect the studs of two contiguous panels. The same criteria can be followed for walls that exceed 12’ in height.

11. KING STUD

If the size and length of the lintel becomes insufficient, then a king stud on each side of the opening should be installed. King studs consist of “C” channels installed on each side of the opening. The

size of the web will be determined by the thickness of the panel (3 ½", 4", 5 ½", or 7 ½"). Flanges and gauge will be determined by the loads applied, the length of the stud, and the end conditions.

IV. FIRE RESISTANCE

1. GENERAL

Panels have been tested as a wall system with gypsum board thermal for 15 minutes, 1-hour and 2-hour ratings. Most codes require a 15 minute minimum thermal barrier.

	3 ½" - 1.5 PCF	5 ½" - 1.0 PCF
UL Flame Spread Rating	**5 – 10**	**5 - 20**
UL Smoke Developed Rating	**65 – 300**	**125 – 175**

Note: Rating ranges are from four manufacturers of the EPS beads and were determined while the material remained in the original test position.

2. 1-HOUR FIRE RESISTANCE RATED WALL ASSEMBLY

Where ThermaSteel panels are installed in fire resistance rated assembly, they shall be constructed in accordance with the details set forth in the manufacturer's instructions and the following:

1. One hour fire resistance rated wall assembly consists of a modified 5 ½" panel with metal 24" O.C. protected with one layer of 5/8" Type X gypsum wallboard on both faces, attached using 1-5/8", type S, bugle head, self tapping screws @ 12" O.C. All joints must be taped with joint tape and compound. Panels are attached to one another using No.8 x ½" self tapping screws placed 12" O.C.
The assembly was tested to ASTM E 119 with an applied uniform compressive load of 300 PLF (or 33% of allowable design load). The modification to the panel was to manufacture the panel with a recess along the exposed face's vertical joints which allows the insertion of 3" wide strips of 5/8" thick Type X gypsum board panels. The strips are secured using 1" long Type X, bugle head, self tapping screws @ 12" O.C.

2. Another one hour fire resistance rated wall assembly consists of a modified 5 ½" panel with metal @ 24" O.C. protected on each side with: 5/8" Type X gypsum panel, 1 – 3/8" thick fiberglass insulation, and a ½" thick regular gypsum panel. The 5/8" gypsum board is attached using 1 – ½" self tapping screws @ 12" O.C. Hat studs are attached to the metal channel of the panel through the 5/8" gypsum board using 1-1/2" long self tapping screws @ 12" O.C. The ½" gypsum board is then attached to the hat studs using 1" self-tapping screws @ 12" O.C. All joints must be taped with joint tape and compound. Panels are attached to one another using No.8 x ½ self-tapping screws placed 12" O.C. The assembly was tested to ASTM E 119 with an applied uniform compressive load of 1250 PLF (or 96% of allowable design load).

See attached tests report and the panel approval as one-hour for property line set back mitigation issued by the Big Bear City Fire Department.

V. EPS COMBUSTION TOXCITY

As currently written, model building codes have deleted references to toxicity because it is recognized there is no acceptable test protocol simulating actual fire conditions.

Nevertheless, we are called upon by specifiers, code officials, and fire marshals to establish relative toxicity levels of EPS versus other building materials. We have responded with a variety of test results from laboratories in Europe and the USA. To inform you, we reprinted below, a summary of results contained in DBR Paper #711, Division of Building Research, National Research Council of Canada.

MATERIAL	CO	CO2	HCl	HCN	OTHERS	MAXIMUM SUM OF TOXICITY FACTORS
Polystyrene	19	2				20
Polyethylene	21	1				20
Polyester Fabric	24	2				30
Phenolic Resin	5	1			22	30
Wood (White Pine)	47	3				50
Cotton	59	2				60
PVC	12	1	343			360
Wool		1		375		390
ABS	10	1		367		230
Urethane (Rigid)	14	1		273		290
Nylon-6	17	1		931		950
Polyacrylonitrile	7	1		1,201		1,201

VI. ARCHITECTURAL SPECIFICATIONS

1. GENERAL

These specifications are to be used in preparing details and documentation for projects using the ThermaSteel Building System, manufactured by ThermaSteel Corp. For further product description and usage, refer to:

ThermaSteel Assembly Manual

ThermaSteel Website www.thermasteelcorp.com

2. SYSTEM DESCRIPTION

The ThermaSteel Building System is customized to exact architectural drawings and specifications and can be used for below grade foundation wall systems as well as structural floor, wall, and roof systems.

Individual panel size and configuration is dependant upon project design requirements. Maximum overall size shall be no greater than 4' x 12'. Panel thickness shall be either 3 ½", 4", 5 ½", or 7½". Panel weight shall be no greater than 1.625 lb/sf.

Panels shall be composed of integral steel framework of 24, 20, 18, or 16 gauge.

Exterior sheathing materials provided by customer (brick, lap siding, stone, stucco, vinyl, wood, etc)

Polystyrene core insulation, Class 1 fire rated, is molded in to a steel frame to produce a structural composite panel.

Joinery and peripheral components shall be:

1. Footer track shall be 18ga galvanized steel attached per code directly to concrete slab-on-grade or other appropriate foundation. Panel is positioned over track and secured using self tapping sheet metal screws.

2. Shiplap joints on each panel will be joined using #8, ½" self tapping screws.

3. A header is designed in various configurations to accommodate truss systems for various roof slopes or for parapet on flat roofs.

4. Corner components shall be manufactured using the same materials as the specified wall panels.

5. Other components shall be custom designed as necessary to meet project design as well as structural requirements.

Performance requirements: As a minimum, the ThermaSteel 4' X 8' panels have been tested by an independent laboratory to meet the following criteria:

1. Load Criteria: See **Table No 4**

2. Fire Resistance: The panels have been tested for surface burning characteristics in accordance with UL 723 procedures (ASTM E84):

a. 3 ½" (8.9cm) thick EPS, 1 ½" PCF (24 kg/m3):

Flame Spread Rating:	5-10
Smoke Developed:	65-300

b. 5 ½" (13.9cm) thick EPS, 1.0 PCF (16kg/m3):

Flame Spread Rating	5-20
Smoke Developed	125-175

In addition, fire wall assemblies have been tested in accordance with ASTM E119 for the 1-hour and 2-hour ratings. Some are shown in the fire resistance table below:

WALL DESCRIPTION	RATING
3 1/2" ThermaSteel w/steel channels - 1/2" regular gypsum boards - attached with 1" screws 12" o.c.	**Minimum**
3 1/2 " ThermaSteel Panel w/ recessed steel channels on exposed side - 5/8" Type X FIRECODE gypsum panels, recessed layer 5/8" gypsum over recessed channels - recessed gypsum board attached with 1" Type S screws, 12" o.c., outer board attached with 1 5/9" Type S screws, 12" o.c., on exposed side, #6 5/8" self-tapping screws 12" o.c. on protected side	**1 Hour**
3 1/2" ThermaSteel panel w/steel channels - double layer 1/2" Type X FIRECODE gypsum boards - panels attached with 1" screws at 24" o.c. on exposed side, 1 5/8" screws at 12" o.c. on protected side	**2 Hour**
5 1/2" ThermaSteel panel w/steel channels - unfaced 2: fiberglass insulation sandwiched between 5/8" Type X FIRECODE gypsum board (protected) and 1/2" regular gypsum board (exposed) - gypsum boards and fiberglass attached with 1 3/8" x 1 1/2" Hat studs at 24" o.c.	**1 Hour Party Wall**

Sound Rating

The STC (Sound Transmission Class) is a single number rating determined by using ASTM E90 in combination with ASTM 413. The dB sound reduction through the sample is measured for the octave frequencies from 125Hz to 4000Hz. These noise reduction values measured in dB are compared to a subjective contour from which the single value of STC is determined. The STC values may be compared and the higher value would then represent the sample with the greatest amount of noise reduction.

ASTM E90 – Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

Use: Primary method for evaluating transmissions loss of materials and systems used in building construction, such as interior partitions, doors, windows, and floor/ceiling assemblies.
Result: Transmission Loss (TL)

ASTM E413 – Classification for Rating Sound Insulation

Use: Permits specifies to rank the transmission loss or noise reduction performance of similar materials or systems, using data from one of several test methods.
Results: Sound Transmission Class (STC), Field Sound Transmission Class (FSTC), Noise Isolation Class (NIC), Normalized Noise Isolation Class (NNIC)

Sound Transmission Class (STC) Ratings
The following word descriptions have been used to help express (somewhat qualitatively) the relative effectiveness of partitions having different STC ratings – in terms of speech privacy.

STC 25 – normal speech is transmitted audibly
STC 30 – loud speech made be heard fairly well
STC 35 – loud speech is blurred, but understandable
STC 42 – loud speech is heard only as a murmur

STC 45 – loud speech is heard only by straining
STC 48 – some speech is barley audible
STC 50 – loud speech is totally unheard

Decible (dB)

The term used to identify then times the common logarithm of the ratio of two like quantities proportional to the power or energy. Thus, one decible corresponds to a power ration of (10 to the 0.1 power) to the n power. Note: since the decibel expresses the ration of two like quantities, it has no dimensions. It is, however, a common practice to treat "decible" as a unit as, for example, in the sentence, "The average sound pressure level in the room is 45 decibels."

WALL DESCRIPTION	STC RATING
3 1/2" ThermaSteel partition panel with - 1/2" regular gypsum on either side	**36**
3 1/2" ThermaSteel panel with - 5/8" regular gypsum on either side	**37**
2 - 3 1/2" ThermaSteel panels with - 5/8" regular gypsum on either side	**40**
2 - 3 1/2" ThermaSteel panels with - 5/8" air space between and 5/8" gypsum on either side	**42**
2 - 3 1/2" ThermaSteel panels with ceiling tile	**48**
2 - 3 1/2" ThermaSteel panels w/ 3 1/2" air space on one side, from metal furring channels and with 5/8" gypsum on either side	**49**
ThermaSteel Party Wall: 5 1/2" panel with 5/8" gypsum on either side, 2" hat channel on either side of panel, infilled with 2" batt type FG insulation, covered with 1/2" gypsum **Total width** = 8 5/8" with load capacity of 1250/LF	**51**
2 - 1 3/4" ThermaSteel panels (3 1/2" split panel), 2" FG batt insulation between panels, 5/8" gypsum on each side. **Total width** = 7"	**53**
ThermaSteel Zublin Partition Wall: 2 - 3 1/2" ThermaSteel panels with 2" air space between and 1/2" & 5/8" gypsum on either side. **Total width** = 11 1/4"	**57**
WOOD COMPARISON: Wood studs w/ fiberglass insulation and 5/8" gypsum on each side. **Notes:** Wood studs are better at low frequency only. ThermaSteel is better than wood for approximately 90% of the frequency range. ThermaSteel is excellent in high frequency	**34**

*Improved sound rating values may be accomplished by the use of any of the following:
- ThermaSteel 5 ½ or 7 ½" panels
- Dynamat sound proofing films
- The use of lead foil on one or both interior surfaces
- Changing the density of the EPS
- Quiet Solutions sheet rock

Thermal Efficiency:

a. 3 ½" ThermaSteel Panel R-Value of 14*
b. 4" ThermaSteel Panel R-Value of 16*
c. 5 ½" ThermaSteel Panel R-Value of 22*
d. 7 ½" ThermaSteel Panel R-Value of 30*

* Effect of ship lap joints; the effective R Values may be 34% over theoretical. E.g. a 3 1/2" wall panel with no penetrating metal with exterior and interior finish is effective
R-19; 4" has an effective R-value of R-22. A 5 1/2" wall panel with no penetrating with exterior and interior finish is effective R-30. 7 ½" is effective R-40.

3. QUALITY ASSURANCE

Panel manufacturer shall be ThermaSteel Corp

Contractor/Installer shall be knowledgeable in the proper installation of the ThermaSteel Building System.

All supplied fasteners and other third party supplied components shall be certified by ThermaSteel Corp. as to quality and suitability for use.

Regulatory Requirements:

The ThermaSteel Building System and panel shall meet or exceed all code requirements for structure and fire safety.

The use of the ThermaSteel panel shall be in accordance with all applicable building codes.

The ThermaSteel Building System and panel shall be recognized for the intended use by applicable building codes.

Third Party Inspection

Manufacture of the building panel and components shall comply with quality assurance standards of a contracted independent third party quality assurance inspection agency.

4. DELIVERY, STORAGE, AND HANDLING

All ThermaSteel panels and components shall be delivered to the job site with labels intact. Questionable panels or parts shall not be used.

Store all panels in a clean and safe area.

Panels shall be handled so as not to damage corners, edges, or channels prior to installation.

5. PROJECT CONDITIONS

Application of sealants, primers, elastometric coatings, brick/stone facings, or other forms of exterior sidings or finishes shall be done under the conditions set forth by the manufacturers of those products.

6. SEQUENCING AND SCHEDULING

Installation of the ThermaSteel panels shall be coordinated with the other building trades. Foundations or slab-on-grade must be complete and properly cured, ready to accept the footer track prior to installation of the building panels when they are used as structural wall systems. Exterior finishing must be accomplished in a timely manner following the installation of the ThermaSteel building panels. Other building trades may be scheduled as required.

7. WARRANTY

ThermaSteel Corp. shall provide a warranty against defective material upon written request.

VII. PRODUCT

1. MANUFACTURER

The ThermaSteel panel and components are all proprietary products of ThermaSteel Corp. and manufactured under strict quality controls as monitored by a third party independent quality assurance agency.

2. MATERIALS

24, gauge galvanized G-90 roll formed steel shall comprise the integral framework of the panel. Expanded polystyrene incorporated into the design shall provide a sufficient thermal break to ensure non-conductivity of temperature between surfaces.

The exterior skins of the panel shall be at the discretion of the customer. Specifications for the non-propriety cladding shall be available upon request from ThermaSteel Corp.

The panel core shall be Class 1 fire-retardant foam with a minimum density of 1.0 lbs/cf to 1.5 lbs/cf injected in to the cavity to form a composite panel.

Footer tracks shall be at minimum (or per engineer design) 18ga galvanized roll formed steel on all load bearing walls.

Header and other required components shall be custom designed to meet structural requirements of the architectural or engineer design.

Mechanical fasteners and other third party components shall be available from authorized manufacturers and selected by the architect/owner.

Joint sealants, exterior finished, facings, or siding shall be recommended by ThermaSteel Corp. and selected by the architect/owner.

APPENDIX

A. REFRENCES

1. – UBC 1994

2. – AISI – "Specifications for the Design of Cold-Formed Structural Members" 1986, including the 1989 amendments

3. – *ICBO* Report No. PFC - 4216

4. – *BOCA* Report No. 91-40

5. – *ASTM E 72 –* "Standard Methods of Conducting Strength Tests of Panels for Building Construction"

6. – *ASTM A 446 –* "Standard Specification for Steel Sheet, Zinc-Coates (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality"

7. – *ASTM A 525 –* "Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized by the Hot-Dip Process"

8. – *ASTM C 578 –* "Standard Specification for Rigid, Cellular, Polystyrene Thermal Insulation

9. – *ASHRAE* (American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.) - Fundamentals

TABLES

TABLE No.1
PANEL WEIGHT

PANEL TYPE	STEEL		EPS		TOTAL PANEL WEIGHT (#)	DEAD LOAD		
	(Sq. Ft.)	(#)	(Cu. Ft.)	(#)		ROOF WEIGHT PSF	WALL WEIGHT (PLF)	(HEIGHT)
4 x 8 x 3.5 @ 24	20	23	10	13	36	1.2	10	8' Wall
4 x 8 x 3.5 @ 16	27	31	10	13	44	1.4	12	8' Wall
4 x 8 x 5.5 @ 24	20	23	15	15	38	1.2	10	8' Wall
4 x 8 x 5.5 @ 16	27	31	15	15	46	1.4	12	8' Wall
4 x 8 x 7.5 @ 24	20	23	20	20	43	1.4	17	8' Wall
4 x 8 x 7.5 @ 16	27	31	20	20	51	1.6	19	8' Wall
4 x 12 x 3.5 @ 24	30	35	14	19	54	1.2	15	12' Wall
4 x 12 x 3.5 @ 16	40	46	14	19	65	1.4	17	12' Wall
4 x 12 x 5.5 @ 24	30	35	22	22	57	1.2	15	12' Wall
4 x 12 x 5.5 @ 16	40	46	22	22	68	1.4	17	12' Wall
4 x 12 x 7.5 @ 24	30	35	30	30	65	1.4	17	12' Wall
4 x 12 x 7.5 @ 16	40	46	30	30	76	1.6	19	12' Wall

TABLE No. 2
RESISTANCE FACTOR (R) OF COMMON BUILDING MATERIALS, AIR SPACES, AND FILMS

BUILDING BOARD		R-VALUE
Gypsum Board	1/2"	0.45
Gypsum Board	5/8"	0.56
	1/4"	0.31
	3/4"	0.47
	1/2"	0.94
Insulating Board Sheathing	1"	1.32
	1/2"	1.32
	1/4"	2.63
		0.31
Hardboard Underlayment	1"	0.72
BUILDING PAPER		
Permeable Felt. 15lb		0.06
Plastic Film		Neg
MASONRY MATERIALS		
Concrete blocks, three oval cores		
Cinder Aggregate	4" thick	1.11
	12" thick	1.89
	8" thick	1.72
Sand and Gravel Aggregate	8" thick	1.11
Lightweight Aggregate	8" thick	2
	4" thick	1.5
Gypsum Mortar or Plaster	1/4"	0.05
	1/2"	0.1
	1"	0.2
Gypsum Plaster (Pertile)	1"	0.64
Gypsum Plaster (Vermiculite)	1"	0.59
Brick Per Inch		0.2
Fake Brick Per Inch		0.11
Stucco Per Inch		0.2
ROOFING MATERIAL		
Asbestos Cement Shingles		0.21
Asphalt Roll Roofing		0.15
Asphalt Shingles		0.44
Built Up Roofing	3/8"	0.33
Wood Shingles		0.94
SIDING MATERIAL		
Asbestos Cement thick lapped		0.21
Asphalt		0.15
Wood Shingle 16" x 7-1/2" Exposure		0.87
Double with 12" Exposure		1.19
Wood Drop Siding 1" x 8"		0.77
Wood Bevel Siding 1/2" x 8" (lapped)		0.81
Wood Bevel Siding 3/4" x 10" (lapped)		1.05
Wood Plywood 3/8" (lapped)		0.59
Structural Glass		0.10
INSULATION MATERIALS		
Insulation Board--		

Insulation Materials (contd)	R-VALUE
Perlite, Expanded Inch	2.7
Mineral Fiber Inch	2.2-2.9
Vermiculate Exfoliated Inch	2.1-2.3
AIR APCES (3/4")	
Heat Flow Up	
Non-Reflective	.75 (Summer)
	.87 (Winter)
Reflective, one surface	2.22 (Summer)
	2.21 (Winter)
Heat Flow Down--	
Non-Reflective	.85 (Summer)
	1.02 (Winter)
Reflective, one surface	3.29 (Summer)
	3.59 (Winter)
Heat Flow Horizontal	
Non-Reflective	.84 (Summer)
	1.01 (Winter)
Reflective, one surface	3.24 (Summer)
	3.46 (Winter)
SURFACE AIR FILMS, INSIDE (STILL AIR)	
Heat Flow Up (through a horizontal surface)	
Non-Reflective	0.61
Reflective	1.32
Heat Flow Down (through a horizontal surface)	
Non-Reflective	0.92
Reflective	4.55
Heat Flow Horizontal (through a horizontal surface)	
Non-Reflective	0.68
MOVING AIR SURFACE	
Any Position or Direction	
15 mph wind (Winter)	0.17
7.5 mph wind (Summer)	0.25

EXAMPLE

Determine EPS required for typical insulated steel desk. Under winter conditions when the U-value required is 0.05 MAX

Given--Substrate Components	R-Values
Outside Air Film (15mph)	0.17
BUR 1/8"	0.33
Fiberboard 1/2"	1.32
Molded EPS	2
Gypsum 5/8" Type X	0.56

Huntsman EPS @ 2.0 pcf 75°F	4.40	Metal Deck	0
Huntsman EPS @ 1.0 pcf 75°F	3.90	Inside Air Film (Heat Flow Up Non-Reflective)	0.61
Extruded EPS w/ skins 175°F Aged	5.00	Total R Without EPS	2.99
Polyurethane Polyisocyanates (I is 75°F)	5.60	Total R- Required =	20
Insulation Batts. Blankets		20.00-2.99 = 17.01 R EPS Required	
Mineral Wool Per Inch 75°F	3.66	Molded EPS at 1.0 pcf and 25°F = 4.4 R inch	
		Therefore 17.01 / 4.4 = 387 inches EPS required	
Insulation Loose Fill			
EPS	3.40	Quote 4 inches Type I molded EPS	
Celluslosic Inch	3.1-3.7		

The information contained herein is provided for general references purpose only.

TABLE No. 3
R-Value for Wall and Floor Assemblies

WALL	**Thickness**	**R per Sq. Inch**	**R**	
Outside Surface			0.17	15 mph (winter)
7/8" Stucco			0.18	
3 1/2" ThermaSteel Panel	3.5	4*	18.76	1.5 PCF
5/8" Gypsum			0.56	
Inside Surface			0.68	
		Total R=	20.35	
WALL	**Thickness**	**R per Sq. Inch**	**R**	
Outside Surface			0.17	15 mph (winter)
3/8" Stucco			0.08	
5 1/2" ThermaSteel Panel	5.5	4*	29.48	1.0 PCF
1/2" Gypsum			0.45	
Inside Surface			0.68	
		Total R=	30.86	
Roof	**Thickness**	**R per Sq. Inch**	**R**	
Outside Surface			0.17	15 mph (winter
Asphalt Shingles			0.4	70 lb/ft3
Plywood (Douglas Fir)			0.62	34 lb/ft3
5 1/2" ThermaSteel Panel	5.5	4*	29.48	1.5 PCF
1/2" Gypsum			0.45	
Inside Surface			0.61	
		Total R=	31.73	
Roof	**Thickness**	**R per Sq. Inch**	**R**	
Outside Surface			0.17	15 mph (winter)
Metal			0	
Plywood (Douglas Fir)			0.62	34 lb/ft3
5 1/2" ThermaSteel Panel	5.5	4*	29.48	1.5 PCF
1/2" Gypsum			0.45	
Inside Surface			0.61	
		Total R=	31.33	

***** Due to the following factors: Reduction of air infiltration; Elimination of thermal bridges; Effect of the interior and exterior cladding; Effect of ship lap joints; the effective R Values may be 34% over theoretical. E.g. a 3 1/2” wall panel with no penetrating metal with exterior and interior finish is effective R-19; 4” has an effective R-value of R-22. A 5 1/2” wall panel with no penetrating with exterior and interior finish is effective R-30. 7 ½” is effective R-40.

TABLE No. 4
LOAD CRITERIA

WALL PANELS (STANDARD-ASSUMES SAFETY FACTOR OF 2.5)									
	DIMENSIONS				AXIAL LOAD LBS/LF kg/m	LATERAL LOAD LBS/SF (L/360) kg/m2	LATERAL LOAD LBS/SF (L/240) kg/m2	RACKING SHEAR LBS/LF kg/m 1/8" defl. MAX	
PANEL TYPE	W	H	T	RIB					
W 8-3/24	4'	8'	3 1/2"	24"	1033 lbs/lf	13.6 lbs/sf	20.5 lbs/sf	107 lbs/lf	249 lbs/lf
	1.2m	2.4m	13.9cm	60cm	1537 kg/m	66.4 kg/m2	100.1 kg/m2	159.2 kg/m	370.5 kg/m
W 8-5/24	4'	8'	5 1/2"	24"	1067 lbs/lf	16.8 lbs/sf	21.8 lbs/sf	93 lbs/lf	243 lbs/lf
	1.2m	2.4m	13.9cm	60cm	1587.7 kg/m	82 kg/m2	106.4 kg/m2	138.4 kg/m	361.6 kg/m
W 8-3/16	4'	8'	3 1/2"	16"	1300 lbs/lf	20.5 lbs/sf	27.9 lbs/sf	162 lbs/lf	355 lbs/lf
	1.2m	2.4m	13.9cm	40cm	1934 kg/m	100.1 kg/m2	136.2 kg/m2	241.1 kg/m	525.2 kg/m
W 8-5/16	4'	8'	5 1/2"	16"	1869 lbs/lf	40.9 lbs/sf	42.3 lbs/sf	125 lbs/lf	312 lbs/lf
	1.2m	2.4m	13.9cm	40cm	2781 kg/m	199.7 kg/ m2	206.6 kg/m2	186 kg/m	464.3 kg/m
W 12-5/24	4'	12'	5 1/2"	24"	1104 lbs/lf	55.6 lbs/sf	> 55.6 lbs/sf		
	1.2m	3.6m	13.9cm	60cm	1642.8 kg/m	271.5 kg/m2	> 271.5 kg/m2		
W 12-5/16	4'	17'	5 1/2"	16"	1541 lbs/lf	53.7 lbs/sf	53.6 lbs/sf		
	1.2m	3.6m	13.9cm	40cm	2293 kg/m	262.2 kg/m2	310.6 kg/m2		

TABLE No.5
TOP TRACK CAPACITY

PANEL	Q ALLOW	P ALLOW	TOP TRACK						
	PANEL		GAUGE	Fy-1	SPAN	Web	Flange	TOP VALUE	
Length=8'	(PLF)	(PLF)	(#)	(KSI)	(IN)	(IN)	(IN)	(PLF)	(#)
3-1/2" @ 16"O.C.	1195	595	20	33	16.00	3.50	1.00	**217**	**138**
			20	33	16.00	3.50	1.00	**462**	**293**
			20	33	16.00	3.50	1.00	**783**	**497**
			20	33	16.00	3.50	1.00	**1173**	**745**
			18	33	16.00	3.50	1.00	**283**	**180**
			18	33	16.00	3.50	1.00	**615**	**391**
			18	33	16.00	3.50	1.00	**1051**	**667**
			18	33	16.00	3.50	1.00	**1195**	**1005**
			16	50	16.00	3.50	1.00	**532**	**338**
			16	50	16.00	3.50	1.00	**1163**	**738**
			16	50	16.00	3.50	1.00	**1195**	**1190**
			16	50	16.00	3.50	1.00	**1195**	**1190**
3-1/2" @ 24" O.C.	915	585	20	33	24.00	3.50	1.00	**96**	**n/a**
			20	33	24.00	3.50	1.50	**205**	**n/a**
			20	33	24.00	3.50	2.00	**348**	**n/a**
			20	33	24.00	3.50	2.50	**521**	**n/a**
			18	33	24.00	3.50	1.00	**126**	**n/a**
			18	33	24.00	3.50	1.50	**274**	**n/a**
			18	33	24.00	3.50	2.00	**467**	**n/a**
			18	33	24.00	3.50	2.50	**703**	**n/a**
			16	50	24.00	3.50	1.00	**249**	**n/a**
			16	50	24.00	3.50	1.50	**547**	**n/a**
			16	50	24.00	3.50	2.00	**915**	**n/a**
			16	50	24.00	3.50	2.50	**915**	**n/a**
5-1/2" @ 16" O.C.	1265	630	20	33	16.00	5.50	1.00	**220**	**140**
			20	33	16.00	5.50	1.50	**470**	**299**
			20	33	16.00	5.50	2.00	**796**	**505**
			20	33	16.00	5.50	2.50	**1192**	**757**
			18	33	16.00	5.50	1.00	**290**	**184**
			18	33	16.00	5.50	1.50	**630**	**400**
			18	33	16.00	5.50	2.00	**1077**	**684**
			18	33	16.00	5.50	2.50	**1265**	**1029**
			16	50	16.00	5.50	1.00	**546**	**347**
			16	50	16.00	5.50	1.50	**1192**	**757**
			16	50	16.00	5.50	2.00	**1265**	**1260**
			16	50	16.00	5.50	2.50	**1265**	**1260**
5-1/2" @ 24" O.C.	910	590	20	33	24.00	5.50	1.00	**98**	**n/a**
			20	33	24.00	5.50	1.50	**209**	**n/a**
			20	33	24.00	5.50	2.00	**354**	**n/a**
			20	33	24.00	5.50	2.50	**530**	**n/a**
			18	33	24.00	5.50	1.00	**129**	**n/a**
			18	33	24.00	5.50	1.50	**280**	**n/a**

			18	33	24.00	5.50	2.00	**478**	**n/a**
			18	33	24.00	5.50	2.50	**720**	**n/a**
			16	50	24.00	5.50	1.00	**243**	**n/a**
			16	50	24.00	5.50	1.50	**530**	**n/a**
			16	50	24.00	5.50	2.00	**907**	**n/a**
			16	50	24.00	5.50	2.50	**910**	**n/a**

TABELE No. 6
LINTELS

Fy 50 ksi 12,14, 16 gauge

Fy 33 ksi 18 gauge

E 29500 ksi

b	d	Gauge	FY	i	Corner R	ycg	Ie	Se
(in)	(in)	#	(ksi)	(in)	(in)	(in)	(in4)	(in3)
1.5	6.00	12	50	0.1017	0.1875	2.3636	2.661	0.732
1.5	7.00	12	50	0.1017	0.1875	2.8447	4.095	0.986
1.5	8.00	12	50	0.1017	0.1875	3.33	5.95	1.274
1.5	9.00	12	50	0.1017	0.1875	3.82	8.27	1.597
1.5	10.00	12	50	0.1017	0.1875	4.3135	11.103	1.952
1.5	11.00	12	50	0.1017	0.1875	4.8082	14.505	2.343
1.5	12.00	12	50	0.1017	0.1875	5.304	18.528	2.767
2.5	6.00	12	50	0.1017	0.1875	2.2486	2.859	0.762
2.5	7.00	12	50	0.1017	0.1875	2.7343	4.355	1.021
2.5	8.00	12	50	0.1017	0.1875	3.224	6.279	1.315
2.5	9.00	12	50	0.1017	0.1875	3.7162	8.68	1.643
2.5	10.00	12	50	0.1017	0.1875	4.2101	11.609	2.005
2.5	11.00	12	50	0.1017	0.1875	4.7052	15.117	2.401
2.5	12.00	12	50	0.1017	0.1875	5.2012	19.255	2.832
3.5	6.00	12	50	0.1017	0.1875	2.2081	2.928	0.772
3.5	7.00	12	50	0.1017	0.1875	2.6939	4.451	1.034
3.5	8.00	12	50	0.1017	0.1875	3.1837	6.404	1.33
3.5	9.00	12	50	0.1017	0.1875	3.6761	8.838	1.66
3.5	10.00	12	50	0.1017	0.1875	4.1702	11.804	2.025
3.5	11.00	12	50	0.1017	0.1875	4.6655	15.352	2.424
3.5	12.00	12	50	0.1017	0.1875	5.1617	19.535	2.857
1.5	6.00	14	50	0.0713	0.0938	2.4911	1.806	0.515
1.5	7.00	14	50	0.0713	0.0938	2.9854	2.764	0.688
1.5	8.00	14	50	0.0713	0.0938	3.4812	4.004	0.886
1.5	9.00	14	50	0.0713	0.0938	3.9781	5.563	1.108
1.5	10.00	14	50	0.0713	0.0938	4.4757	7.475	1.353
1.5	11.00	14	50	0.0713	0.0938	4.9737	9.776	1.622
1.5	12.00	14	50	0.0713	0.0938	5.4721	12.503	1.915
2.5	6.00	14	50	0.0713	0.0938	2.446	1.862	0.524
2.5	7.00	14	50	0.0713	0.0938	2.9406	2.84	0.7
2.5	8.00	14	50	0.0713	0.0938	3.4368	4.103	0.899
2.5	9.00	14	50	0.0713	0.0938	3.9339	5.687	1.123
2.5	10.00	14	50	0.0713	0.0938	4.4317	7.628	1.37
2.5	11.00	14	50	0.0713	0.0938	4.93	9.961	1.641
2.5	12.00	14	50	0.0713	0.0938	5.4286	12.722	1.936
3.5	6.00	14	50	0.0713	0.0938	2.4277	1.885	0.528
3.5	7.00	14	50	0.0713	0.0938	2.9224	2.87	0.704
3.5	8.00	14	50	0.0713	0.0938	3.4187	4.143	0.904
3.5	9.00	14	50	0.0713	0.0938	3.916	5.737	1.128
3.5	10.00	14	50	0.0713	0.0938	4.4139	7.69	1.377
3.5	11.00	14	50	0.0713	0.0938	4.9123	10.035	1.648
3.5	12.00	14	50	0.0713	0.0938	5.411	12.81	1.944

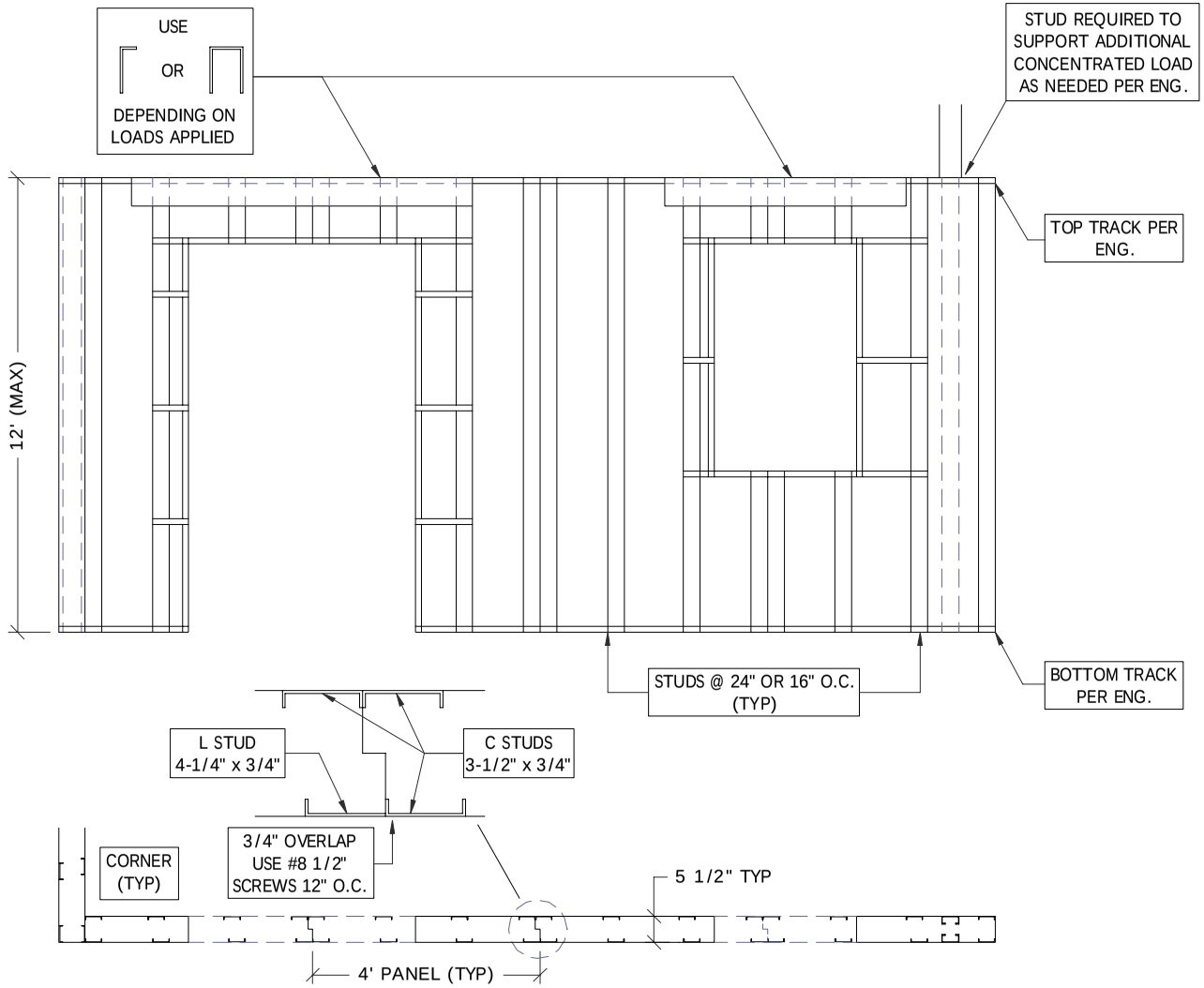
TABLE No. 6 (cont.)
LINTELS

Fy 50 ksi 12,14, 16 gauge

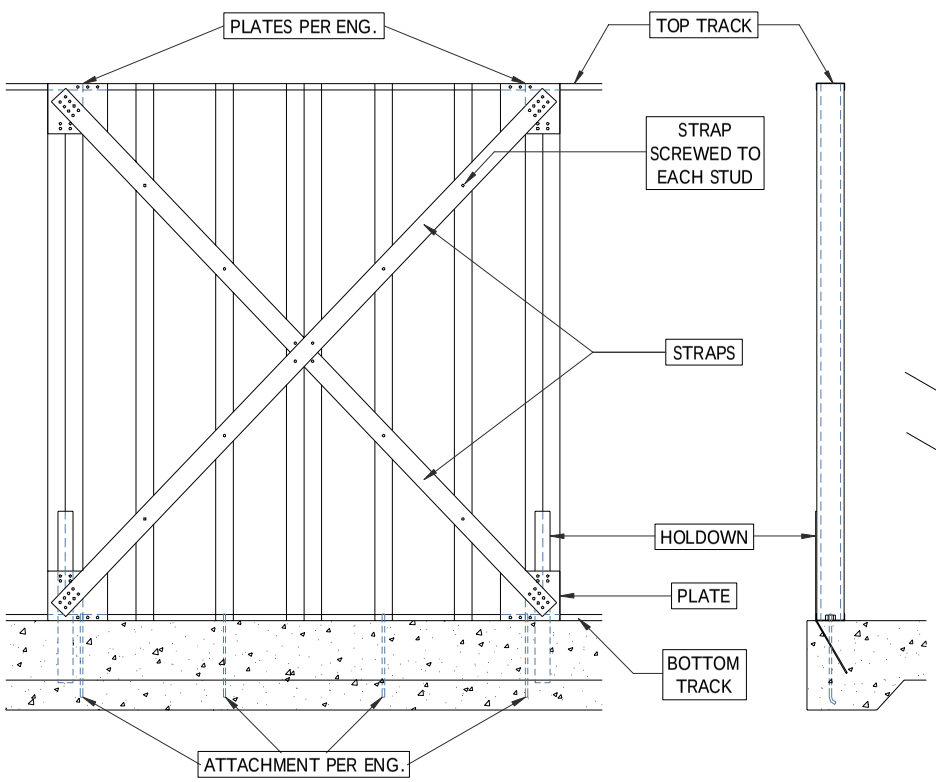
Fy 33 ksi 18 gauge

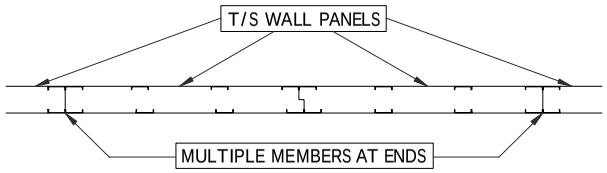
E 29500 ksi

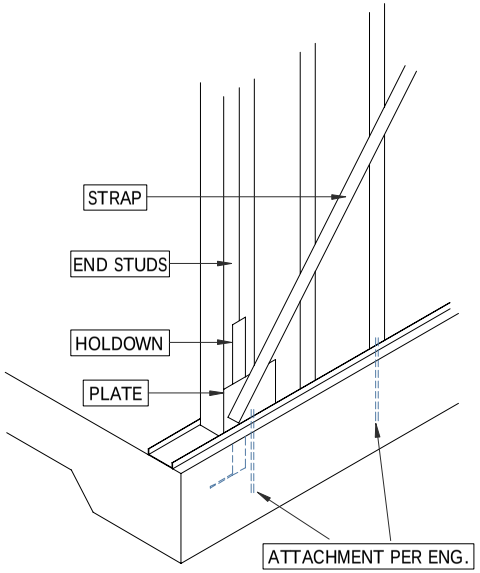
b	d	Gauge	FY	i	Corner R	ycg	Ie	Se
(in)	(in)	#	(ksi)	(in)	(in)	(in)	(in4)	(in3)
1.5	6.00	16	50	0.0566	0.0938	2.5585	1.377	0.4
1.5	7.00	16	50	0.0566	0.0938	3.0549	2.113	0.536
1.5	8.00	16	50	0.0566	0.0938	3.5523	3.07	0.69
1.5	9.00	16	50	0.0566	0.0938	4.0504	4.274	0.884
1.5	10.00	16	50	0.0566	0.0938	4.5489	5.755	1.056
1.5	11.00	16	50	0.0566	0.0938	5.0477	7.541	1.267
1.5	12.00	16	50	0.0566	0.0938	5.5467	9.661	1.497
2.5	6.00	16	50	0.0566	0.0938	2.5305	1.405	0.405
2.5	7.00	16	50	0.0566	0.0938	3.0272	2.151	0.541
2.5	8.00	16	50	0.0566	0.0938	3.5248	3.118	0.697
2.5	9.00	16	50	0.0566	0.0938	4.0231	4.335	0.871
2.5	10.00	16	50	0.0566	0.0938	4.5218	5.83	1.064
2.5	11.00	16	50	0.0566	0.0938	5.0207	7.632	1.276
2.5	12.00	16	50	0.0566	0.0938	5.5199	9.768	1.507
3.5	6.00	16	50	0.0566	0.0938	2.519	1.416	0.407
3.5	7.00	16	50	0.0566	0.0938	3.0158	2.166	0.544
3.5	8.00	16	50	0.0566	0.0938	3.5136	3.138	0.699
3.5	9.00	16	50	0.0566	0.0938	4.012	4.36	0.874
3.5	10.00	16	50	0.0566	0.0938	4.5107	5.861	1.068
3.5	11.00	16	50	0.0566	0.0938	5.0098	7.669	1.28
3.5	12.00	16	50	0.0566	0.0938	5.5089	9.812	1.512
1.5	6.00	18	33	0.0451	0.0938	2.5665	1.097	0.32
1.5	7.00	18	33	0.0451	0.0938	3.0632	1.683	0.427
1.5	8.00	18	33	0.0451	0.0938	3.5609	2.44	0.551
1.5	9.00	18	33	0.0451	0.0938	4.0591	3.402	0.689
2.5	6.00	18	33	0.0451	0.0938	2.5399	1.118	0.323
2.5	7.00	18	33	0.0451	0.0938	3.0369	1.711	0.432
2.5	8.00	18	33	0.0451	0.0938	3.5347	2.481	0.556
2.5	9.00	18	33	0.0451	0.0938	4.0332	3.449	0.694



1 INCREASE LINTEL CAPACITY AND CONCENTRATED LOADS





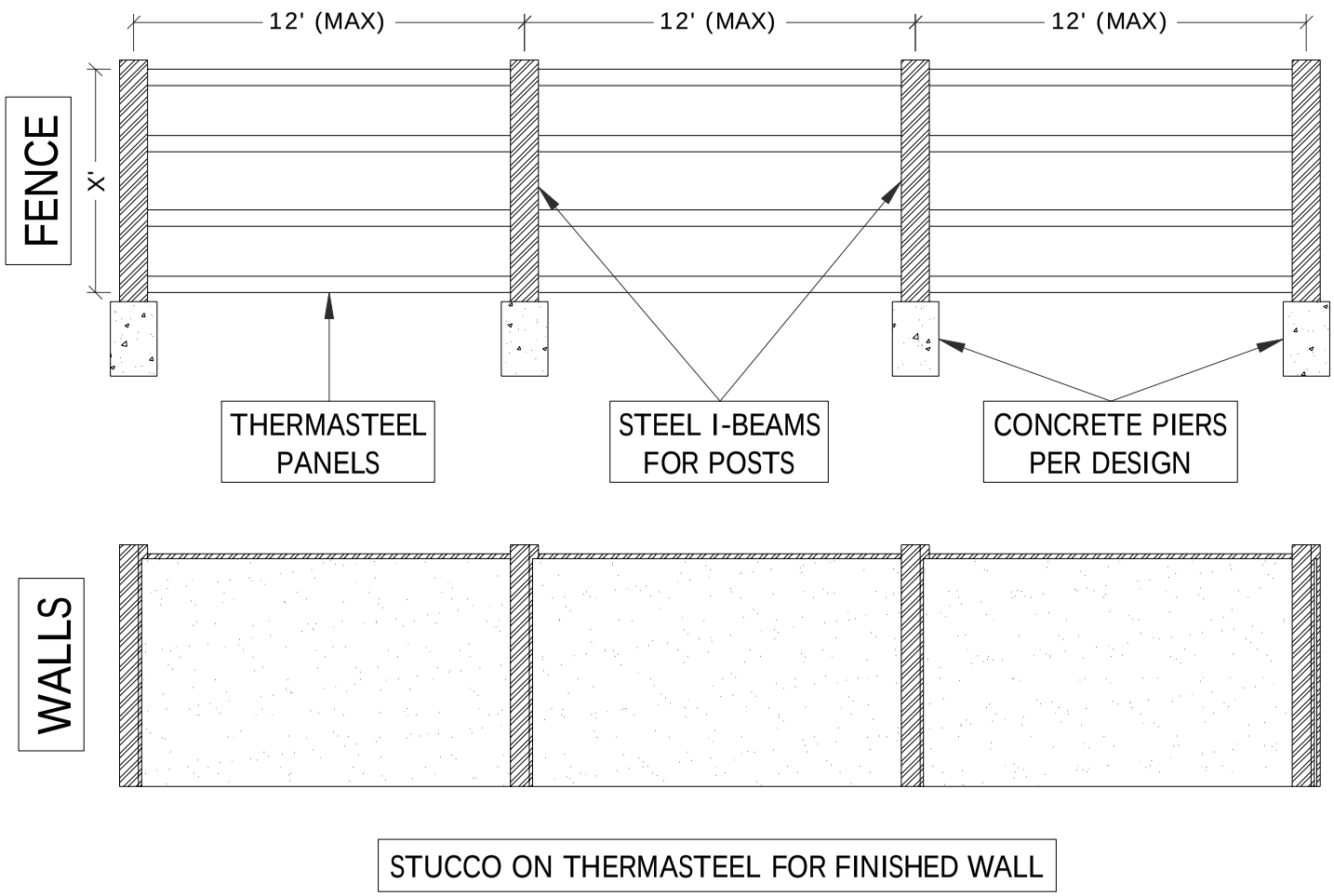


- LATERAL STABILITY STRAPS
- MULTIPLE MEMBERS AT ENDS
- TOP & BOTTOM TRACKS
- HOLDOWNS
- ANCHORS
- GUSSET PLATES
- SCREWS

AS REQUIRED BY DESIGN ON ONE OR BOTH SIDES

2

SHEAR REINFORCEMENT



3

THERMASTEEL SPECIAL APPLICATIONS