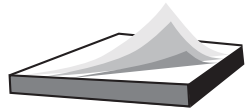




Sto Corp. | **Technical Paper**

Steel Cost Study



Cost Savings of StoTerm® Insulated Wall Claddings vs. Brick Veneer Over Non-Load Bearing Metal Stud Framing Systems

The purpose of this analysis is to provide building owners, contractors, and design professionals with basic information to understand the significant cost savings that can be realized with the use of StoTerm in lieu of brick veneer over nonload bearing metal stud framing systems. The cost savings are derived on the basis of allowable design deflection criteria for StoTerm versus brick veneer. StoTerm has a maximum allowable deflection of L/240, while brick veneer has a maximum allowable deflection criteria of L/600. The more stringent deflection criteria for brick translates

into a requirement for stiffer back-up construction. This means heavier, thicker steel studs, or deep section studs that cost more. Conversely, because StoTerm is a relatively flexible cladding, it does not require nearly the stud stiffness that brick does.

This means lighter, thinner steel studs, or thin-section studs that cost less. In fact, many designers impose more stringent deflection criteria than L/600 for brick, and will use L/720 or L/1200. In these cases the cost savings realized with StoTerm can be even greater.

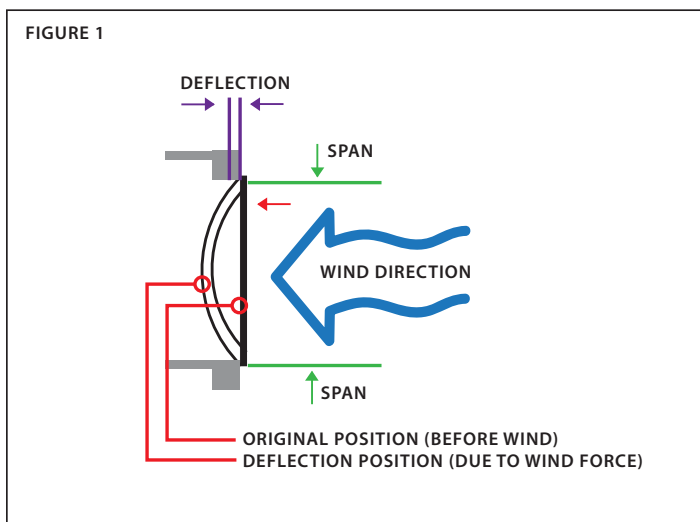


Figure 1: Assuming the span (L) in this case is 10 feet, the allowable *deflection* for StoTerm Insulated Wall Cladding is:

$$\frac{10\text{ft} \times 12\text{in}/\text{ft}}{240} = 0.5 \text{ inches}$$

$$\frac{10\text{ft} \times 12\text{in}/\text{ft}}{600} = 0.2 \text{ inches}$$

Although this may seem like a small difference (0.3 inches), significant cost savings can be realized because StoTerm has the greater allowance for deflection.

To demonstrate this point a prototypical 3 story commercial building (Figure 2) constructed with standard structural steel frame is used to establish a reference for applying either a brick veneer or a StoTerm Insulated Wall Cladding, and the cost savings in steel studs is compared. Cost savings are based on the option to select more economical stud framing systems, using the weight per linear foot of steel stud to define the % cost savings potential. The weight per foot of steel studs provides a uniform point of reference to make actual cost savings comparisons within different regions. Although additional cost savings can potentially be realized in sizing beams, girders, and footings, because of the light weight of StoTerm versus brick veneer (< 3 psf versus > 40 psf), this design comparison only addresses the impact of design wind loads normal to the face of the exterior wall. Other criteria such as roofs, type and size of windows, unique shapes on exterior of building etc. are not included in this comparison.

Figure 2



PROTOTYPICAL BUILDING

- Typical commercial office type building
- Footprint is 100'- 0" x 100'- 0" (10,000 SF / floor)
- Building height is 3 stories for a total of 30,000 SF
- Steel frame is conventional steel column and beam with steel joists
- Earthquake design is not included
- Floor construction is standard composite concrete and steel deck.
- No parapet / flat roof
- Exterior metal stud framing system is non-load bearing

For purposes of this evaluation the exterior windows are assumed to be 5' x 5' at 10' on center on the perimeter of all 3 floors. Wind loads are factored as simple uniform loads perpendicular to the exterior walls. Actual wind load calculations will require a design professional to evaluate all recognized wind load criteria for the specific building design and location.

As an example of cost savings that can be realized, refer to Table 1 which lists several design wind loads and the various studs that would be required for StoTherm Insulated Wall Cladding and brick veneer, respectively, based on their deflection criteria. Using a 10'-0" clear span at each floor level, and assuming a wind load of 86 MPH (25 PSF), the StoTherm Cladding requires a 3 5/8" x 1 5/8" x 20 gage metal stud at 16" on center @ 0.89 lbs per linear foot. The brick veneer requires one of 2 optional stud selections:

OPTION #1 3 5/8" x 2" x 14 gage stud @ 2.02 lbs per linear foot

OPTION #2 6" x 1 5/8" x 20 gage stud @ 1.17 lbs per linear foot

The StoTherm Cladding's potential savings related to the selection of metal studs is a minimum 0.28 lbs per linear foot to a maximum of 1.13 lbs per linear foot. Even though the 6" x 1 5/8" x 20 gage stud will comply with the deflection criteria, metal studs when used with brick veneer require a minimum 18 gage metal thickness for the required mechanical fasteners to secure the brick ties to the metal studs. This eliminates the 20 gage stud option and translates to a real savings of at least 50% on the purchase of the metal stud framing system for this project. This does not take into consideration any potential labor savings installing the lighter gage studs for the StoTherm Cladding. Additional comparisons for stud spans from 8 feet to 12 feet are shown in Table 2.

Table No. 1

StoTherm® Insulated Wall Cladding Comparison Chart of potential cost savings related to metal stud framing systems when StoTherm® is selected in lieu of a typical Brick Veneer cladding system

Wind Load Height of metal stud as a continuous span with a typical 16 inch on center stud spacing:
8 feet (1.28 / 0.1) Strength vs. Stiffness

MPH	PSF	WALL FRAMING SYSTEM	STUD WEIGHT IN LBS PER LINEAR FOOT	MAXIMUM SAVINGS IN LBS PER LF AND %
56	10	StoTherm® 3 5/8" x 1 5/8" (20 gage)	0.89	0.27 #/LF = 23%
		Brick 3 5/8" x 1 5/8" (20 gage) 1 or 3 5/8" x 1 5/8" (18 gage)	1.16	
68	15	StoTherm® 3 5/8" x 1 5/8" (20 gage)	0.89	0.55 #/LF = 38%
		Brick 6" x 1 5/8" (20 gage) or 3 5/8" x 1 5/8" (16 gage)	1.44	
79	20	StoTherm® 3 5/8" x 1 5/8" (20 gage)	0.89	0.74 #/LF = 45%
		Brick 6" x 1 5/8" (20 gage) or 3 5/8" x 2" (16 gage)	1.63	
86	25	StoTherm® 3 5/8" x 1 5/8" (20 gage)	0.89	1.13 #/LF = 56%
		Brick 6" x 1 5/8" (20 gage) or 3 5/8" x 2" (14 gage)	2.02	
96	30	StoTherm® 3 5/8" x 2" (20 gage)	1.01	1.8 #/LF = 64%
		Brick 6" x 1 5/8" (20 gage) or 3 5/8" x 2" (12 gage)	2.81	

¹ This 20 gage stud meets the wind load design but brick fasteners require a minimum 18 gage stud. This will increase the weight per linear foot by either using the indicated 3 5/8" stud or using a similar 6" stud @ a minimum 18 gage.

The specific cost savings addressed within this evaluation is directly associated with:

1. Code-mandated wind loads on the exterior wall systems
2. The maximum allowable StoTherm Insulated Wall Cladding or brick veneer deflection within the vertical clear span of the exterior wall system within each floor level.
3. A StoTherm Insulated Wall Cladding has a maximum allowable deflection of L/240 (floor to floor). This deflection of L /240 allows for a considerable reduction of the cross sectional area of metal studs used within the wall assembly when compared to the maximum allowable deflection of a brick veneer of L/600
4. A brick veneer assembly due to its brittleness has significantly more restrictive deflection criteria of L/600 to minimize movement of the brick veneer and consequential fracturing that may occur. The metal stud framing system requires significantly more cross sectional area to resist this movement and stay within the design requirement of an L/600 deflection.

TABLE NO. 2

GENERAL NOTES TYPICAL TO FOLLOWING STUD CHARTS AND PAPER

1. THE BASIC % SAVINGS SHOWN BELOW IS BASED ON THE METAL STUD MATERIAL COSTS ONLY. The labor cost will also increase as the gage of the stud increases making the labor cost an additional factor.

2. The deflection criteria used for this comparison is based on an L/240 for the StoTherm® Insulated Wall Cladding and an L/600 for the brick veneer. These are maximum allowable deflection requirements. It is noted that brick veneer is often subject to a deflection requirement limit of L/720 which will significantly improve the cost savings related to metal studs when StoTherm® is the cladding material. The metal studs reflected in this schedule are all constructed at 16 inches on center typical, 20 gage (minimum recommendation), 18 gage, 16 gage, and 14 gage either 3 5/8" or 6" with 1 5/8", 2", or 2 1/2" flanges as applicable to meet the wind load criteria for the vertical span noted based on the following proto-typical commercial type structure:

Commercial use group
Footprint 100' x 100' (10,000 SF floor area)
3 story height (see schedule for optional clear span heights per floor)
Conventional steel frame construction with steel joist floor and roof framing
Floors are composite concrete and steel deck
Flat roof / no parapet
Exterior metal stud framing system is non-load bearing

3. It is recommended to check the specifications when brick cladding is used. It is standard practice in the engineering trade to specify a minimum 18 gage stud for the brick ties to be mechanically fastened.

4. Reference Sto Corp ICC ES Legacy Report No. ER-3617 for the following Sto Exterior Insulation and Finish Systems (StoTherm Insulated Wall Cladding):

Sto Essence Insulated Wall Cladding
Sto Essence RainScreen Sto Insulated Wall Cladding
Sto Essence Insulated Wall Cladding with Sto Guard
Have been tested by certified independent testing laboratories to meet the following positive and negative wind loading criteria using a maximum 18 gage 3 5/8" metal studs @ 16 inches on center based on a deflection of L/240 of the span. These systems when applied in accordance with this report can resist the following uniform transverse positive and negative design wind pressures.

Over minimum 1/2" thick (12.7mm) gypsum sheathed steel framed walls:
35 lbs./SF (104 mph) Positive pressure 20 lbs./SF (79 mph) Negative pressure

Over minimum 5/8" thick (15.9mm) gypsum or minimum 3/8" thick (9.5mm) wood based sheathing on steel framed walls:
60 lbs./SF (136 mph) Positive pressure 38 lbs./SF (108 mph) Negative pressure

Sto Essence Insulated Wall Cladding can be custom designed by design professionals to meet higher individual project positive and negative transverse wind loads using different flange size metal studs and different fastening schedules to maintain the economies of using StoTherm Insulated Wall Cladding in lieu of brick veneer.

5. The primary benefit in using StoTherm vs. Brick cladding from a structural perspective is the moment of inertia calculation otherwise called "stiffness". A brick veneer requires a significantly stiffer metal stud as wind loads increase to stay within the deflection limitation of L/600 vs. L/240 for StoTherm. Another point; there are very few claddings within the commercial sector with a deflection requirement of L/240. Most all other claddings such as stucco do not go below L/360. This increased stiffness requires heavier studs to resist deflection. This factor will make metal stud framing systems in general offer cost savings when StoTherm is used as the cladding.

6. The method of wind load calculations are all based on ASCE 7-02 (2003) method 1 as calculated by a registered structural engineer

7. References and credits: The Guide to the Use of Wind Load Provisions of ASCE 7-02(2003); Minimum Design Loads for Buildings and Other Structures ASCE 7-02 (2003); The Brick Institute of America (BIA) / Technical Notes 28B (1999)

Notes:

1. Green highlight = a cost savings when Sto Insulated Wall Cladding is used in lieu of brick cladding at the designated wind loads

2. Brown highlight = 6 inch studs. The minimum IBIA" recommended stud gage for screws used to attach brick ties is 18 gage. All 6", 20 gage studs on this schedule are in compliance with structural criteria for proto-typical building, however the same stud dimensions with 18 gage is required for brick veneer wall assemblies with an increased weight in lbs. per linear foot to the noted 6" stud. This requirement reinforces the cost savings associated with the significantly more economical studs that can be used in a comparable wall assembly with a StoTherm Insulated Wall Cladding.

3. Black highlight = 3 5/8 inch studs

StoTherm® Insulated Wall Cladding Comparison Chart of potential cost savings related to metal stud framing systems when StoTherm® is selected in lieu of a typical Brick Veneer cladding system

Wind Load Height of metal stud as a continuous span with a typical 16 inch on center stud spacing:
8 feet (1.28 / 0.1) Strength vs. Stiffness

MPH	PSF	WALL FRAMING SYSTEM		STUD WEIGHT IN	MAXIMUM SAVINGS IN LBS PER LF AND %
				LBS PER LINEAR FOOT	
56	10	StoTherm®	3 5/8" x 1 5/8" (20 gage)	0.89	0.27 #/LF = 23%
		Brick	3 5/8" x 1 5/8" (20 gage) ¹ or 3 5/8" x 1 5/8" (18 gage)	0.89 1.16	
68	15	StoTherm®	3 5/8" x 1 5/8" (20 gage)	0.89	0.27 #/LF = 23%
		Brick	3 5/8" x 1 5/8" (20 gage) ¹ or 3 5/8" x 1 5/8" (18 gage)	0.89 1.16	
79	20	StoTherm®	3 5/8" x 1 5/8" (20 gage)	0.89	0.27 #/LF = 23%
		Brick	3 5/8" x 1 5/8" (20 gage) ¹ or 3 5/8" x 1 5/8" (18 gage)	0.89 1.16	
86	25	StoTherm®	3 5/8" x 1 5/8" (20 gage)	0.89	0.42 #/LF = 32%
		Brick	3 5/8" x 2" (20 gage) ¹ or 3 5/8" x 2" (18 gage)	1.17 1.31	
96	30	StoTherm®	3 5/8" x 2" (20 gage)	1.01	0.42 #/LF = 32%
		Brick	6" x 1 5/8" (20 gage) ¹ or 3 5/8" x 2" (18 gage)	1.17 1.31	

Wind Load Height of metal stud as a continuous span with a typical 16 inch on center stud spacing:
9 Feet (1.62 / 0.15) Strength vs. Stiffness

MPH	PSF	WALL FRAMING SYSTEM		STUD WEIGHT IN	MAXIMUM SAVINGS IN LBS PER LF AND %
				LBS PER LINEAR FOOT	
56	10	StoTherm®	3 5/8" x 1 5/8" (20 gage)	0.89	0.27 #/LF = 23%
		Brick	3 5/8" x 1 5/8" (20 gage) ¹ or 3 5/8" x 1 5/8" (18 gage)	0.89 1.16	
68	15	StoTherm®	3 5/8" x 1 5/8" (20 gage)	0.89	0.42 #/LF = 32%
		Brick	3 5/8" x 2" (20 gage) ¹ or 3 5/8" x 2" (18 gage)	1.01 1.31	
79	20	StoTherm®	3 5/8" x 1 5/8" (20 gage)	0.89	0.42 #/LF = 32%
		Brick	3 5/8" x 2" (18 gage) ¹	1.31	
86	25	StoTherm®	3 5/8" x 1 5/8" (20 gage)	0.89	0.74 #/LF = 45%
		Brick	6" x 1 5/8" (20 gage) ¹ or 3 5/8" x 2" (16 gage)	1.17 1.63	
96	30	StoTherm®	3 5/8" x 1 5/8" (20 gage)	1.01	0.93 #/LF = 51%
		Brick	6" x 1 5/8" (20 gage) ¹ or 3 5/8" x 2 1/2" (16 gage)	1.17 1.82	

Wind Load Height of metal stud as a continuous span with a typical 16 inch on center stud spacing:
10 feet (2.0 / 0.2) Strength vs. Stiffness

MPH	PSF	WALL FRAMING SYSTEM	STUD WEIGHT IN LBS PER LINEAR FOOT	MAXIMUM SAVINGS IN LBS PER LF AND %
56	10	StoTherm® 3 5/8" x 1 5/8" (20 gage)	0.89	0.27 #/LF = 23%
		Brick 3 5/8" x 1 5/8" (20 gage) ¹ or 3 5/8" x 1 5/8" (18 gage)	0.89 1.16	
68	15	StoTherm® 3 5/8" x 1 5/8" (20 gage)	0.89	0.55 #/LF = 38%
		Brick 6" x 1 5/8" (20 gage) ¹ or 3 5/8" x 1 5/8" (16 gage)	1.17 1.44	
79	20	StoTherm® 3 5/8" x 1 5/8" (20 gage)	0.89	0.74 #/LF = 45%
		Brick 6" x 1 5/8" (20 gage) ¹ or 3 5/8" x 2" (16 gage)	1.17 1.63	
86	25	StoTherm® 3 5/8" x 1 5/8" (20 gage)	0.89	1.13 #/LF = 56%
		Brick 6" x 1 5/8" (20 gage) ¹ or 3 5/8" x 2" (14 gage)	1.17 2.02	
96	30	StoTherm® 3 5/8" x 2" (20 gage)	1.01	1.8 #/LF = 64%
		Brick 6" x 1 5/8" (20 gage) ¹ or 3 5/8" x 2" (12 gage)	1.17 2.81	

Wind Load Height of metal stud as a continuous span with a typical 16 inch on center stud spacing:
11 Feet (2.42 / 0.27) Strength vs. Stiffness

MPH	PSF	WALL FRAMING SYSTEM	STUD WEIGHT IN LBS PER LINEAR FOOT	MAXIMUM SAVINGS IN LBS PER LF AND %
56	10	StoTherm® 3 5/8" x 1 5/8" (20 gage)	0.89	0.27 #/LF = 23%
		Brick 3 5/8" x 1 5/8" (18 gage)	1.16	
68	15	StoTherm® 3 5/8" x 1 5/8" (20 gage)	0.89	0.74 #/LF = 45%
		Brick 6" x 1 5/8" (20 gage) ¹ or 3 5/8" x 2" (16 gage)	1.17 1.63	
79	20	StoTherm® 3 5/8" x 1 5/8" (20 gage)	0.89	1.38 #/LF = 61%
		Brick 6" x 1 5/8" (20 gage) ¹ or 3 5/8" x 2 1/2" (14 gage)	1.17 2.27	
86	25	StoTherm® 3 5/8" x 1 5/8" (18 gage)	1.16	1.65 #/LF = 59%
		Brick 6" x 1 5/8" (20 gage) ¹ or 3 5/8" x 2" (12 gage)	1.17 2.81	
96	30	StoTherm® 3 5/8" x 1 5/8" (18 gage)	1.16	2.0 #/LF = 63%
		Brick 6" x 2" (20 gage) ¹ or 3 5/8" x 2 1/2" (12 gage)	1.29 3.16	

Wind Load	Height of metal stud as a continuous span with a typical 16 inch on center stud spacing: 12 feet (2.88 / 0.35) Strength vs. Stiffness
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MPH	PSF	WALL FRAMING SYSTEM	STUD WEIGHT IN LBS PER LINEAR FOOT	MAXIMUM SAVINGS IN LBS PER LF AND %
56	10	StoTherm® 3 5/8" x 1 5/8" (20 gage)	0.89	0.55 #/LF = 38%
		Brick 6" x 1 5/8" (20 gage) ¹ or 3 5/8" x 1 5/8" (16 gage)	1.17 1.44	
68	15	StoTherm® 3 5/8" x 1 5/8" (20 gage)	0.89	1.38 #/LF = 61%
		Brick 6" x 1 5/8" (20 gage) ¹ or 3 5/8" x 2 1/2" (14 gage)	1.17 2.27	
79	20	StoTherm® 3 5/8" x 1 5/8" (18 gage)	1.16	1.65 #/LF = 59%
		Brick 6" x 1 5/8" (20 gage) ¹ or 3 5/8" x 2" (12 gage)	1.17 2.81	
86	25	StoTherm® 3 5/8" x 1 5/8" (16 gage)	1.44	1.37 #/LF = 49%
		Brick 6" x 1 5/8" (18 gage) ¹ or 3 5/8" x 2" (12 gage)	1.52 2.81	
96	30	StoTherm® 3 5/8" x 2" (16 gage)	1.63	1.53 #/LF = 48%
		Brick 6" x 2" (18 gage) ¹ or 3 5/8" x 2 1/2" (12 gage)	1.67 3.16	

¹ This 20 gage stud meets the wind load design but brick fasteners require a minimum 18 gage stud. This will increase the weight per linear foot by either using the indicated 3 5/8" stud or using a similar 6" stud @ a minimum 18 gage.

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