U.S. Department of Housing and Urban Development
Office of Policy Development and Research

STEMWALL FOUNDATIONS FOR RESIDENTIAL CONSTRUCTION

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Prepared for:

U.S. Department of Housing and Urban Development
Office of Policy Development and Research

Prepared by:

NAHB Research Center
Upper Marlboro, MD

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Notice

The U.S. Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

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EXECUTIVE SUMMARY

This report addresses the design and demonstration of monolithic stemwall foundations for basement, split-level, and crawl space homes. The objectives of this study are:

1. To develop prescriptive design methods for stemwalls that will enable builders to use stemwall foundations without a special design.

2. To demonstrate the technology as well as the potential cost savings and practical problems associated with stemwall foundations.

3. To provide recommended design information for consideration by the U.S. model code bodies.

BACKGROUND

Stemwall foundations are foundations whose walls are supported directly on the soil without a separate spread footing. The base of the wall is constructed to distribute the dead and live design loads safely to the soil. Stemwall foundations save the material and labor costs associated with a footing, and can accelerate the construction schedule by up to two days.

As early as the 1970s, the Optimum Value Engineered home construction manual,[1] a product of HUD's Operation Breakthrough, suggested the use of stemwalls for basement and crawl space houses as a cost-saving construction method. However, for various reasons, the residential market has not adopted stemwall construction on a broad scale. Barriers to the use of stemwalls include the lack of prescriptive design methods for stemwalls in building codes, and a lack of data on the costs and benefits of the system.

DESIGN AND CONSTRUCTION

The initial designs produced under this project apply to single-story, split-level, one-and-one-half-story and two-story homes built over crawl space and basement foundations. Three loading configurations were considered for the one- and two-story designs: conventional stick-built construction on all floors and ceilings, conventional stick-built floor construction with a trussed (free-span) roof, and trussed construction for floors and roofs. All one-and-one-half-story homes were considered to be stick-built conventional construction with either an 8/12, 10/12, or 12/12 roof pitch.

The design tables in the Appendix provide the required allowable soil bearing capacity for a given house type and loading configuration for 8- and 10-inch foundation wall thicknesses. The building design loads per foot of wall reflect rounded values (e.g., 2151 = 2200). The designs do not account for differential settlement, which is rarely a problem with light-weight buildings. For similar reasons, the designs do not consider overturning due to high winds. (In high wind or seismic areas, a qualified professional should conduct further evaluation.)

The construction of a stemwall foundation is similar to that of a conventional wall built on a spread footing. Local experience or presumptive bearing capacity tables should be used to assess whether the soil condition is acceptable at a given site for stemwall construction. Currently, the design tables in this report are limited to cast-in-place or prefabricated concrete walls. Most concrete contractors should be fully capable of forming and building stemwalls without special labor skills or equipment.

DEMONSTRATIONS OF THE STEMWALL FOUNDATION

Two builders were recruited by the NAHB Research Center to construct demonstration homes with stemwall foundations. The homes completed included a duplex in Baltimore and one detached home in Eldersburg, Maryland. It was also discovered during the project that builders in certain areas of Massachusetts were using the stemwall technology because of its cost effectiveness.

DESIGN RECOMMENDATIONS

There are five possible approaches to gaining model code acceptance of stemwalls.

1. Incorporate all the design tables produced in this report either as direct text in the codes or as a reference document.

2. Distill the design tables into a single recommendation or series of recommendations that would apply to a wide variety of homes.

3. Introduce permissive language that recognizes stemwalls but does not include specific designs.

4. Develop a consensus standard.

5. Use a combination of approaches 2 and 3 above.

Each of the five approaches have problems associated with them. However, it appears that a combination of the second and third approaches could be successful. The permissive language could simply indicate that stemwalls are an acceptable construction method, while the design tables would provide the specific requirements for various conditions and house types.

CONCLUSIONS

A stemwall foundation consists of a foundation wall that transfers building design loads directly to the soil without a separate spread footing. Elimination of the footing is one less step which lowers costs by an amount equivalent to the materials and labor for the footing and can accelerate the construction schedule by up to two days. The cost differential to the builders of the demonstration homes varied from a loss of approximately $238 to a gain of $500 per unit when compared to conventional foundations. If building codes recognized stemwall foundations directly, then engineering costs could be eliminated or significantly reduced, resulting in additional savings of up to $500 per unit. To achieve wide acceptance of stemwalls, it will be necessary to introduce specific language into the model building codes.

INTRODUCTION

This project is part of a program sponsored by the U.S. Department of Housing and Urban Development (HUD) to research and evaluate cost-saving methods and materials for residential construction. The purpose is to investigate innovative methods and materials that preserve or improve on existing construction practices while lowering costs.

Specifically, this project focused on the development of design tables for monolithic stemwall foundations for basement, split-level, and crawl space homes (Figures 1, 2, and 3). Stemwall foundations rely on the base of the wall to transfer building loads directly to the soil without a separate footing. Stemwall foundations save the costs of forming or trenching the footing, eliminate the material and labor costs associated with casting the footing, and can cut one to two days from the construction cycle.

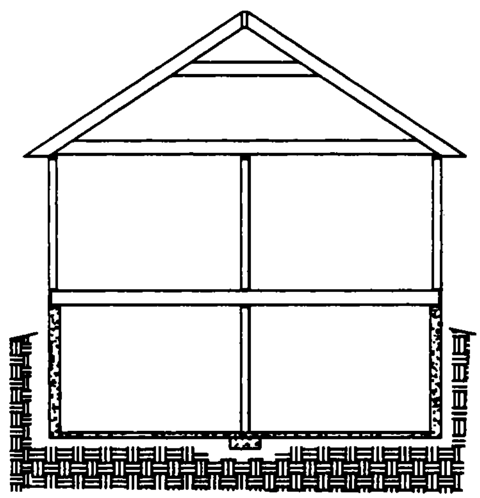

Figure 1. Basement

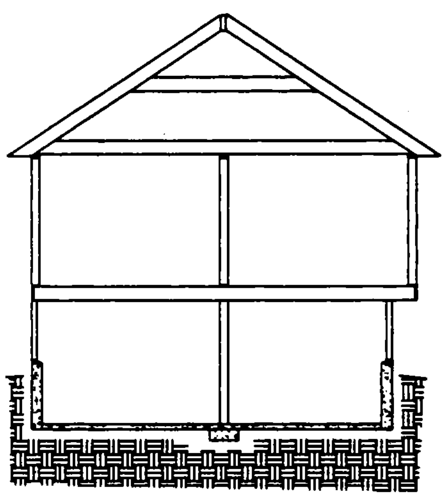

Figure 2. Split-Level

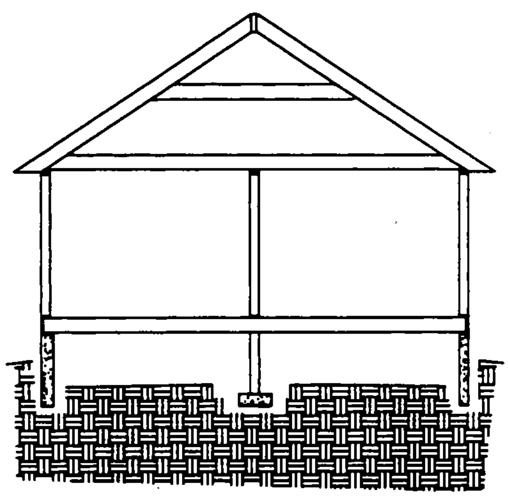

Figure 3. Crawl Space

The objectives of this study are:

1. To develop prescriptive design methods for stemwalls that will enable builders to use stemwall foundations without a special design.

2. To demonstrate the technology as well as the potential cost savings and practical problems associated with stemwall foundations.

3. To provide recommended design information for consideration by the U.S. model code bodies.

BACKGROUND

Stemwall foundations are foundations whose walls are supported directly on the soil without a separate spread footing (Figure 4). The base of the wall is constructed to distribute the dead and live design loads safely to the soil. The stemwall technique has been used extensively with slab-on-grade construction (Figure 5).

Figure 4. Eldersberg Demonstration House with Formwork Bearing Directly on the Ground.

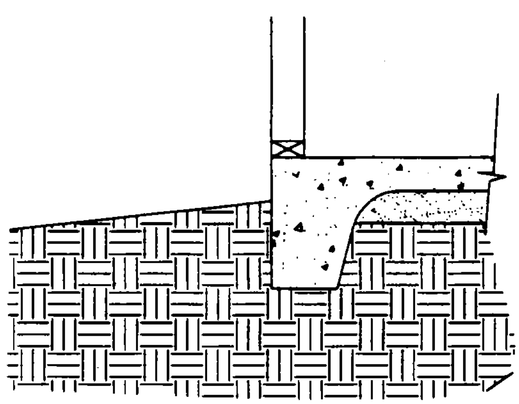

Figure 5. Slab-on-Grade Construction.

Using a stemwall foundation for other than slab-on-grade foundations is not new. For example, as early as the 1970s, the Optimum Value Engineered home construction manual,[1] a product of HUD's Operation Breakthrough, suggested the use of stemwalls for basement and crawl space houses as a cost-saving construction method. In addition this technique has been used in some areas of Massachusetts. The American Concrete Institute building code requirements also recognize that walls can be placed directly on soils that offer sufficient bearing capacity.[2] However, for various reasons, the residential market has not adopted stemwall construction on a broad scale. One barrier to the use of stemwalls is that prescriptive design methods for stemwalls do not appear in building codes. Given that building officials are often reluctant to approve new methods without specific code recognition, each house typically requires its own foundation design. Another barrier is the lack of data on the costs and benefits of the system versus a conventional spread footing. These data are necessary before a builder can decide whether the technology is appropriate for a given home.

TASKS

The following tasks were conducted under this project:

Task 1. Development of Design Tables and Construction Details;

Task 2. Demonstrations of the Stemwall Foundation; and

Task 3. Preparation of Design Recommendations.

RESULTS

TASK 1: DEVELOPMENT OF DESIGN TABLES AND CONSTRUCTION DETAILS

The development of design tables included a review of building design loads and soil properties; the determination of appropriate design configurations (e.g., number of stories, foundation wall height, etc.), and appropriate structural analysis to determine the wall dimensions that provide adequate bearing for common house configurations. The results are discussed below.

Design Configurations

The initial designs considered under this project apply primarily to single-story and one-and-one-half-story detached homes built over crawl space and basement foundations. Split-level homes may also be designed with stemwalls if certain assumptions, as described later, are made. After initial results showed that design loads for one- and one-and-one-half-story homes were lower than expected, the project was expanded to include two-story homes.

The following three loading configurations were considered for the one- and two-story designs: conventional stick-built construction on all floors and ceilings (Figure 6), conventional stick-built floor construction with a trussed (free-span) roof (Figure 7), and trussed construction for floors and roofs (Figure 8). All one-and-one-half-story homes were considered to be stick-built conventional construction with either an 8/12, 10/12, or 12/12 roof pitch. In all three house types, the project team examined a variety of building depths and basement wall heights.

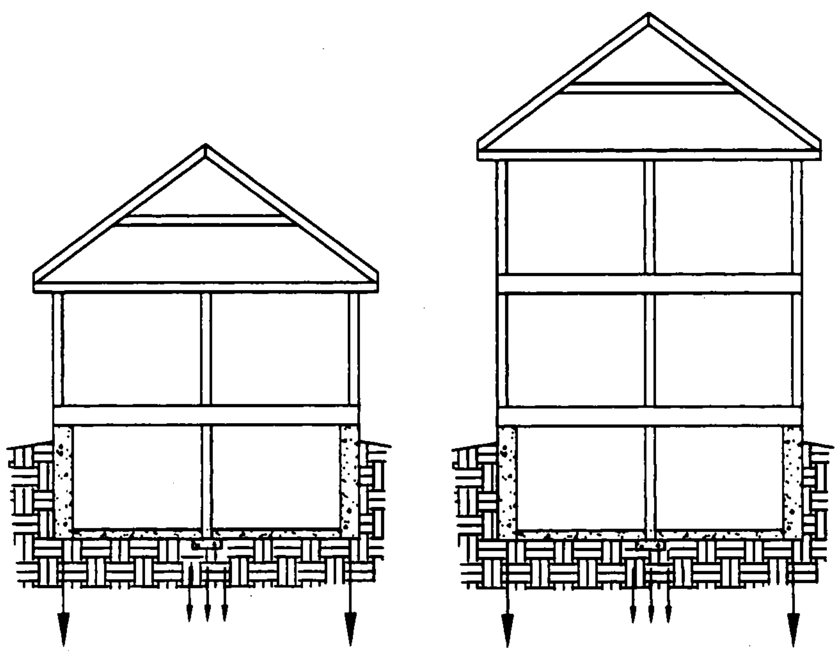

Figure 6. Typical House Sections: Stick-Built Floors & Roof

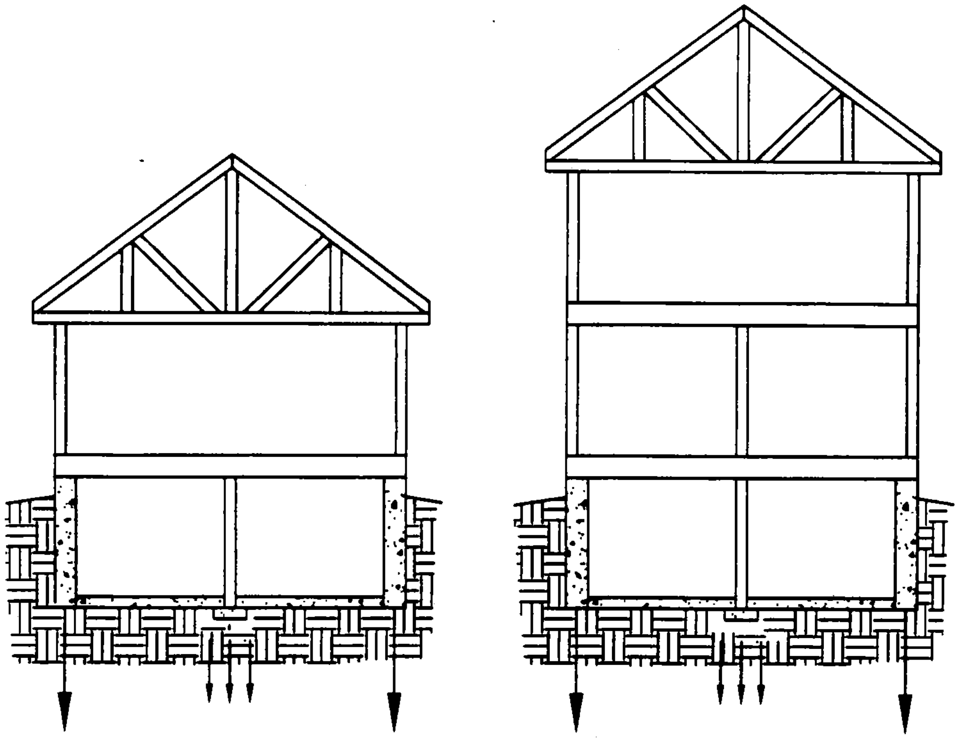

Figure 7. Typical House Sections: Stick-Built Floors with Trussed Roof.

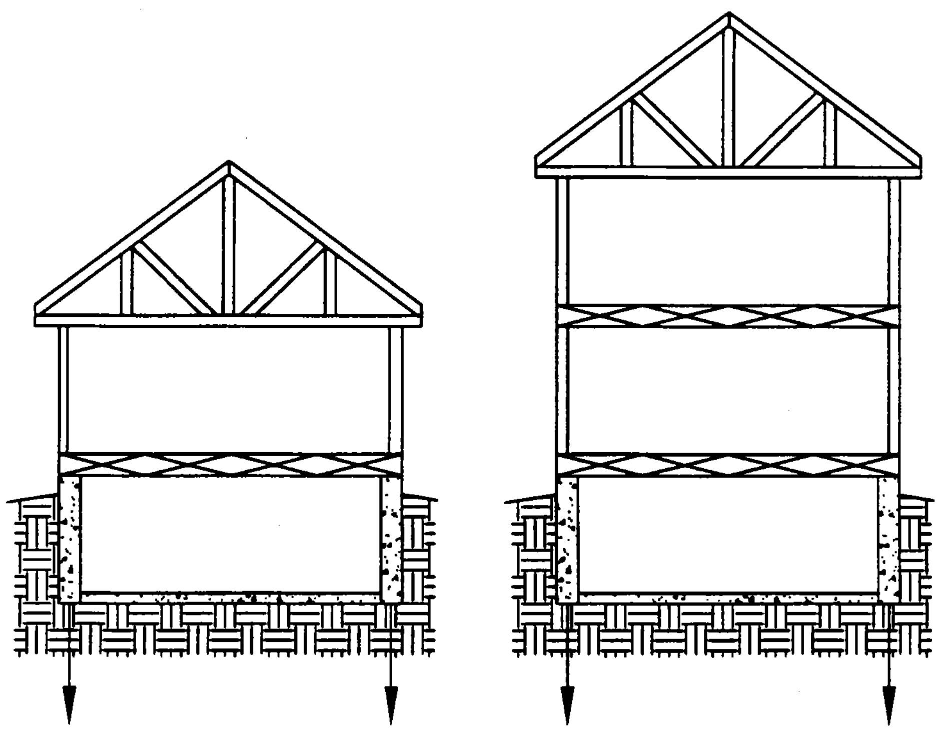

Figure 8. Typical House Sections: Trussed Floors and Roof.

Design Method

The design tables are based on the required allowable soil bearing capacity for a desired wall thickness. The designs did not account for differential settlement, which is rarely a problem with lightweight buildings. For similar reasons, the designs did not consider overturning due to high winds (in high wind or seismic areas, a qualified professional should conduet further evaluation). Additionally, it should be recognized that lateral loading on the wall due to hydrostatic or unbalanced fill is unaffected by the presence of a footing. Therefore, minimum wall width and reinforcing requirements for lateral loads can be determined in accordance with local codes.

The design table values demonstrate the required allowable soil bearing capacity for a given house type and loading configuration for 8- and 10-inch foundation wall thicknesses. The building design load per foot of wall was divided by the foundation wall width and rounded to the next highest increment of 50 (e.g., 2151 = 2200). The bearing capacities in the design tables reflect the allowable soil bearing capacity. In accordance with common engineering practice for determining the base area of a footing, unfactored forces were used.[2]

Design Assumptions

The design tables generated under this project are based on the assumption that all homes were symmetrical; that is, the joist spans on each half of the building were of equal length. The tables are also applicable to asymmetrical homes by multiplying the largest joist span supported by an exterior foundation wall by two and using the result as the house depth. Although specific tables were not developed for splitlevel homes, the tables can be applied conservatively by assuming that a split-level home is equivalent to a one-story home on a full basement. Examples that demonstrate how to use the design tables are provided later in this report.

The design dead and live load assumptions applicable to homes were obtained from both ASCE 7-88[3] and the NFPA Permanent Wood Foundation Design Manual[4] as shown in Table 1.

Table 1
DESIGN LOADS

Description	Loading Used	Reference
First-Floor Live Load	40 psf	ASCE 7-88
First-Floor Dead Load	10 psf	NFPA
Second-Floor Live Load	30 psf	ASCE 7-88
Second-Floor Dead Load	10 psf	NFPA
First-Floor Ceiling Dead Load	10 psf	NFPA
Second-Floor Ceiling Dead Load	10 psf	NFPA
First-Floor Wall Dead Load	88 lbs/ft	ASCE 7-88
Second-Floor Wall Dead Load	88 lbs/ft	ASCE 7-88
Attic Live Load	20 psf	ASCE 7-88
Roof Dead Load	10 psf	NFPA
Roof Live Load	Ground snow load	ASCE 7-88
Foundation Dead Load	150 lbs/cf	ASCE 7-88

Additional assumptions and design loads for each house type and loading configuration follow:

- A 2-foot overhang was assumed on roof surfaces.
- Attic live loads for low- and medium-sloped roofs (less than 8:12) were applied to one-half of the total span.
- Storage areas behind living areas in one-and-one-half-story homes were considered attic space.
- Ground snow loads were reduced per ASCE 7-88 as follows:

For one- and two-story homes,

$$Pf = 0.7\ Ce\ Ct\ I\ pg,$$

where

Pf = flat-roof snow load in pounds per square foot;
Ce = exposure factor (Ce = 1.1);
Ct = thermal factor (Ct = 1.0);
I = importance factor (I = 1.0); and
pg = ground snow load in pounds per square foot.

ASCE 7-88 provides a procedure for reducing snow loads on sloped roofs. However, the reductions were insignificant for roof slopes less than 30 degrees. Thus, the flat roof snow load was used for all one- and two-story homes. The sloped-roof snow load Ps was computed for one-and-one-half-story homes as follows:

$$Ps = Cs\ \ Pf \text{ (Note: } Ps \geq 20 \text{ PSF)},$$

where

Cs = roof slope factor (Cs = 1.0 - (slope - 30)/40); and
Pf = flat-roof snow load in pounds per square foot.

ASCE 7-88 also provides a procedure to reduce floor live loads when designing supporting members. However, the reduction is based on an influence area approach that is more appropriate for larger commercial buildings than for typically-sized homes. The floor live load reductions were insignificant and were not applied.

Soil Bearing Capacity

Local officials sometimes require a soils report to substantiate soil bearing capacities if the needed capacity is above an assumed minimum available capacity. For example, the prescriptive foundation details in one widely used one- and two-family dwelling code[5] are based on a soil bearing capacity of 2,000 pounds per square foot. Where the soil has less than 2,000 psf of bearing capacity, local officials sometimes require a special design, even though the code does not clearly specify the need for such a design.

For this project, the design tables that require less than 2,000 psf bearing capacity can be used without special study of most soils. Where local conditions are well documented, it is also possible to use the design tables directly for designs requiring more than 2,000 psf of bearing capacity. Local experience can often be relied on to determine the bearing capacity of a soil without engineering analysis. If the earth is firm, solid, well drained, and comprises a mixture of gravel, rock, sand, or clayey sands, it will likely support a stemwall foundation. In addition, tables published throughout the literature can be used to estimate bearing capacity to the level of accuracy needed for a one- or two-family structure. Table 2 provides presumptive bearing capacities from one widely used model building code.[6]

Table 2
PRESUMPTIVE BEARING VALUES OF FOUNDATION MATERIALS
Source: BOCA National Code

Class of Material	Bearing Pressure (psf)
1. Crystalline Bedrock	12,000
2. Sedimentary Rock	6,000
3. Sandy Gravel or Gravel	5,000
4. Sand, Silty Sand, Clayey Sand, Silty Gravel, and Clayey Gravel	3,000
5. Clay, Sandy Clay, Silty Clay and Clayey Silt	2,000

Design Tables

The appendix contains the design tables developed for this project from a computer program based on the design assumptions stated earlier. The examples below describe how to use the tables.

Example 1: A one-story crawl space house with symmetrical loads is stick-built with no engineered products (trusses). The house is 28-feet-wide x 32-feet-long with a 4-foot x 8-inch stemwall. A 30 psf local snow load is required. Floor spans run parallel to the 28-foot direction.

Solution: Using the table below (see also page A-7 of the Appendix) with a 28-foot width and a 30 psf ground snow load, a 2,250 psf allowable soil bearing capacity is required to support the structure. The foundation could be built on all soil types except those in Class 5 from Table 2.

Required Soil Bearing Capacity (psf) (Example 1) One-Story: Conventional Floor and Roof Construction Foundation Height 4 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1800	1850	2000	2100	2250
22	1900	1950	2100	2250	2400
24	1950	2050	2200	2350	2500
26	2050	2150	2300	2500	2650
28	2150	2250	2400	2600	2800
30	2250	2350	2550	2700	2900
32	2350	2450	2650	2850	3050

Example 2: A two-story house on a full basement with asymmetrical loads is stick-built. The house is 22- x 30-feet with the longest span equal to 12 feet. An 8-foot x 10-inch stemwall is desired, and a 40 psf local snow load is required.

Solution: Given that the home is asymmetrical, the span used in the design table should equal twice the longest span or, in this case, 24 feet. Using the table below (see also page A-40 of the Appendix), with a 24-foot width and 40 psf ground snow load, a 2,900 psf allowable soil bearing capacity is required.

Required Soil Bearing Capacity (psf) (Example 2) Two-Story: Conventional Floor and Roof Construction Foundation Height 8 Ft., Foundation Width 10 In.					
Building Width(ft)	Snow Load (psf)				
	20	30	40	50	60
20	2500	2550	2650	2750	2850
22	2600	2650	2750	2900	3000
24	2700	2750	2900	3000	3150
26	2800	2850	3000	3150	3250
28	2900	2950	3100	3250	3400
30	3000	3050	3200	3350	3550
32	3100	3150	3300	3500	3650

Construction Details

The construction of a stemwall foundation is similar to that of a conventional wall built on a spread footing (Figure 9). Currently, the design tables in this report are limited to cast-in-place or prefabricated concrete walls. Most concrete contractors should be fully capable of forming and building stemwalls without special labor skills or equipment. Local experience or presumptive bearing capacity tables can usually be used to assess whether a stemwall is acceptable at a given site.

Steel reinforcement similar to that typically used in footings is recommended for placement in the bottom of the stemwall to bridge weak or soft spots. The use of two No. 4 bars continuous at all perimeter walls allows the stemwall to act like a stiffer grade beam capable of bridging 3- to 4-foot distances. The steel should be placed a minimum of 3 inches from the bottom of the wall.

Stemwalls may be formed or trenched. The formed wall is set directly on the soil or on a gravel base. Formed walls offer the simplest construction method, but typically require the slight overexcavation of crawl space foundations to allow room for setting forms. Nonetheless, overexcavation is common practice for basement walls and for split-level homes to accommodate form-setting and installation of foundation drains, and therefore does not represent a departure from conventional construction. When foundation drains are required, it is recommended the system be located outside the foundation wall.

Trenched walls are what their name implies--walls that are trenched to the desired thickness and depth. However, additional work is required to obtain a clearance between final grade and the top of the foundation wall. One method, though probably not a practical approach in most situations, is to trench the wall and then lower the grade to expose the upper portion of the wall. The second and preferred alternative is to form a short section to extend the wall above the top of the trench. In any event, the trenched system may not be as practical or cost-effective as the formed system.

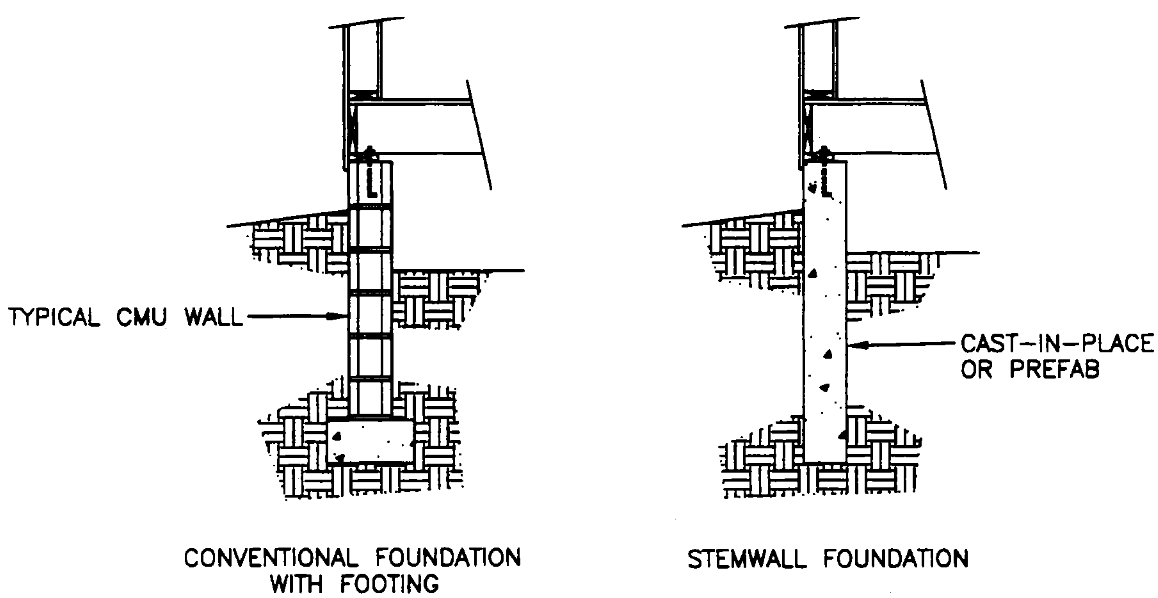

Figure 9. Foundation Types

Concrete quantity estimations are straightforward with the stemwall system. The volume of the forms and/or trench is equal to the required concrete quantity. It is usually cost-effective to cast interior pier footings at the same time as the walls.

TASK 2: DEMONSTRATION OF THE STEMWALL FOUNDATION

Two builders were recruited by the Research Center to construct demonstration homes with stemwall foundations (Figures 10, 11, and 12). The homes included a duplex in Baltimore and one detached home in Eldersburg, Maryland. It was also discovered during the project that builders in certain areas of Massachusetts were making extensive use of stemwalls. Information from the demonstration sites and from one Massachusetts builder is discussed below. The Research Center reviewed the builders' plans and conducted a preliminary soils test at each site. Construction was closely monitored at each site to record problems specific to the installation of the stemwalls and to note any additional costs incurred due to a lack of familiarity with the system. Cost estimates were obtained from the demonstration builders to determine the installed costs of the stemwall foundations. Builders also provided cost estimates for their standard foundation system for comparison with the stemwall foundations.

Neither of the jurisdictions' codes recognized stemwall construction as an acceptable method of foundation construction. Therefore, it was necessary to submit designs verified by a licensed professional engineer.

Figure 10. Formwork at the Eldersberg Site.

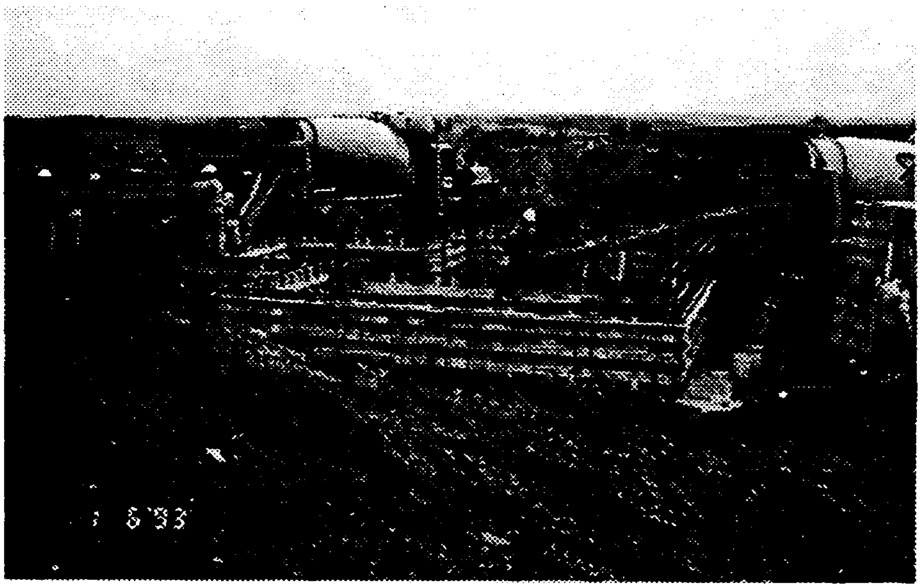

Figure 11. Foundation Walls Being Cast at the Eldersberg Site.

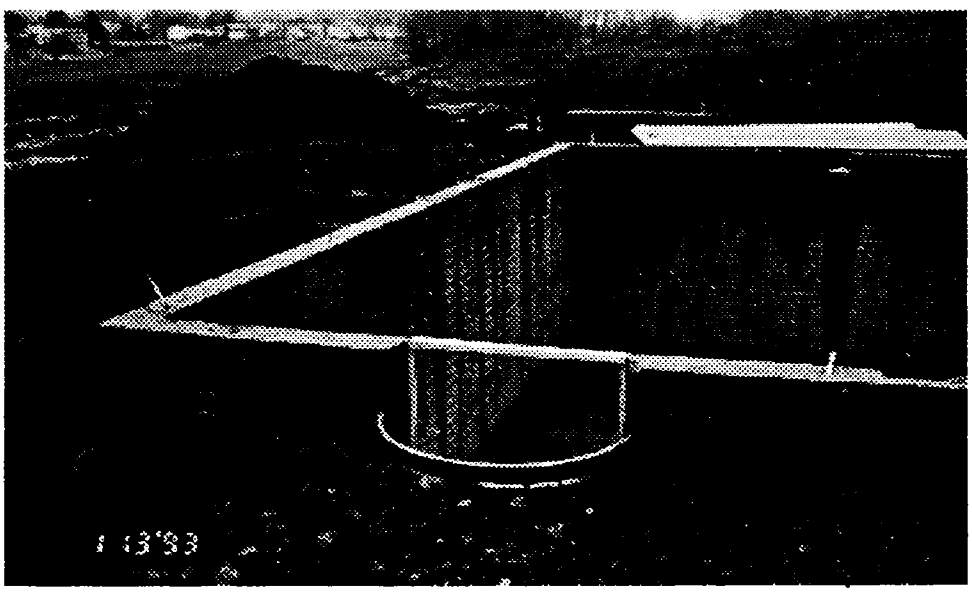

Figure 12. Completed Stemwall Foundation at the Eldersberg Site.

Baltimore, Maryland

Description and Design

The demonstration house in Baltimore is insured under the HUD EXTECH 233 program for experimental housing: The house is a modular duplex with exterior perimeter walls supported on a 10-inch-wide stemwall foundation. The party wall between the duplex units is supported on a conventional footing designed for the increased loading associated with the construction type. The building is symmetrical with a 14-foot clear joist span between the outside wall and an interior beam. Figure 13 shows the building's foundation plan.

The design load for the demonstration house is 2,391 lbs/ft. The required bearing capacity for the 10-inch stemwall is 2,900 psf. Site measurements showed that the soil's minimum bearing capacity was 3,200 psf.

Observations

The center party wall is supported by a spread footing that was formed on top of the grade rather than trenched into the ground. This resulted in an 8-inch difference in grade between the top of the party wall and the top of the stemwalls. The builder elected to raise the stemwalls by supporting them on an 8-inch gravel base. The building inspector voiced concern over the additional gravel and required a sealed letter certifying the gravel layer's bearing capacity.

Costs versus Conventional Spread Footing

Table 3 presents the cost breakdown for the demonstration house. Costs for the foundation construction of the demonstration home are compared to the costs for the foundation of an adjacent duplex constructed by the same builder on a traditional footing with block walls.

Table 3
COSTS AT BALTIMORE SITE

Demonstration Duplex				
Description	Quantity	Unit	Unit Price	Total
Excavation	---	---	Lump sum	$1,750
Foundation Wall	153	lf	Lump sum	$2,123
Foundation Wall Concrete	38	cy	$56.00	$2,128
Party Wall Footing Concrete	1.5	cy	$56.00	$84
Subtotal				$6,085
Soils Evaluation/Engineering	---	---	Lump sum	$986
Total				$7,071
Adjacent Duplex with Block Walls and Concrete Footings				
Excavation	---	---	Lump sum	$1,750
Foundation and Footings	153	lf	Lump sum	$6,277
Notes: lf = lineal feet cy = cubic yards			Total	$8,072

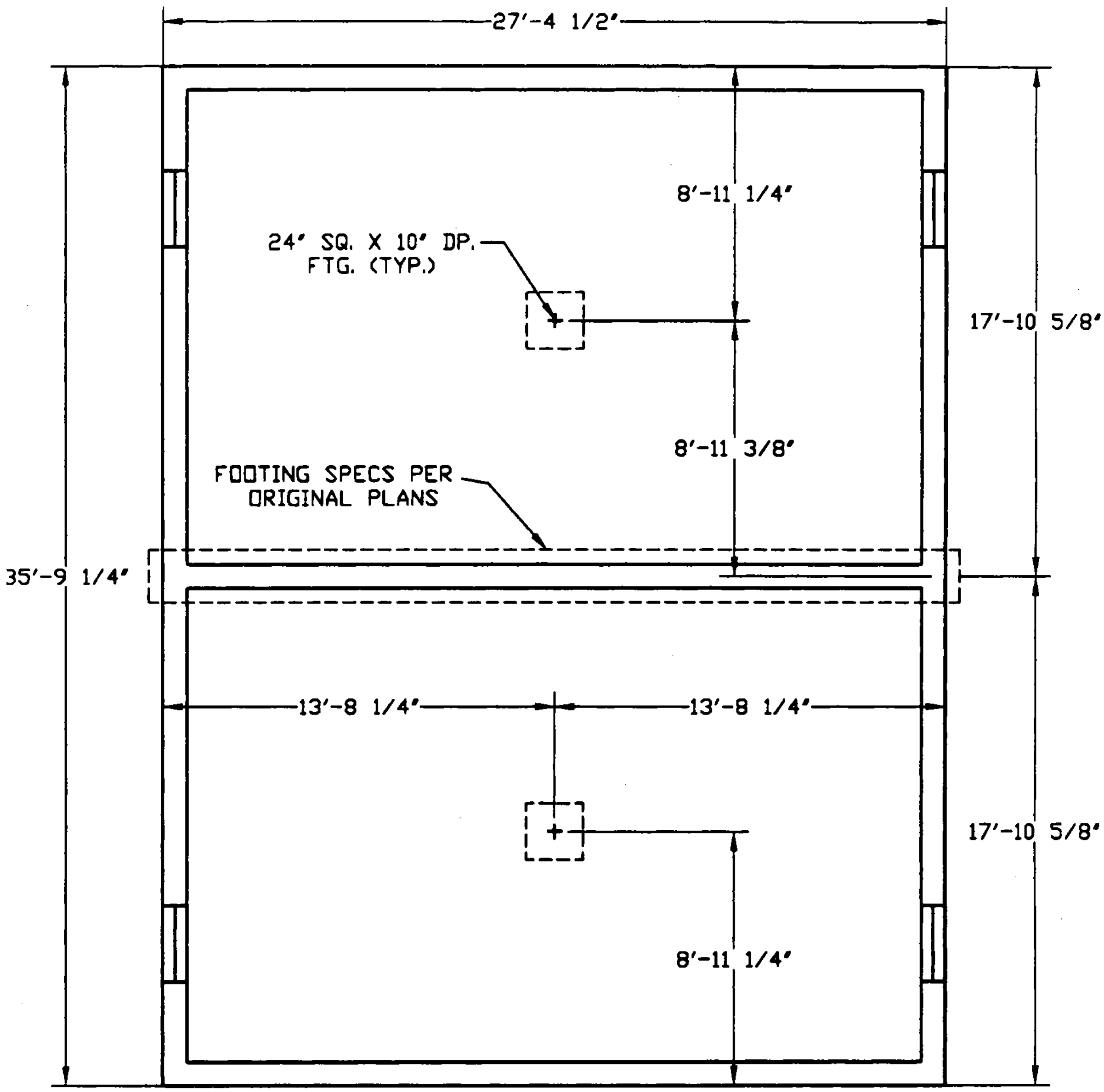

Figure 13. Foundation Plan: Baltimore Duplex.

The demonstration resulted in a savings of $1,001 to the builder or approximately $500 per unit. If the stemwall method were specifically recognized in the local building, code then engineering costs for the wall design could be eliminated and savings increased even further.

Eldersburg, Maryland

The demonstration house in Eldersburg is a two-story home with a full basement. A one-story family room is located off the back. The house is supported on an 8-inch nominal cast-in-place concrete stemwall. Figure 14 shows the home's floor plan.

Observations

A six-person crew set the forms and cast the wall in one nine-hour day; forms were stripped the next day. A day and a half is usually required for casting a separate footing and foundation wall. The start of construction was repeatedly delayed due to rain and a very clayey subgrade that retained water. The labor crews elected not to set forms on the wet soils. One possible method suggested for handling wet sites is to stabilize the ground with gravel and to set the forms on the gravel base. The contractor believed that the stemwall method may be more practical during drier periods when weather does not play a limiting role.

Costs versus a Conventional Spread Footing

Tables 4 and 5 present the cost breakdowns for the Eldersburg demonstration site. Costs for the demonstration home are compared to the costs for a similar home constructed earlier by the same builder.

Table 4
DEMONSTRATION HOME

Description	Quantity	Units	Unit Cost	Total Cost
Excavation	5.5	hours	$70.00	$385.00
Site Preparation	5	hours	$20.00	$100.00
Tamper Rental	1	day	---	$57.50
8-Foot Wall				
Foundation Wall	131	lf	$22.50	$2,947.50
Waterproofing	834	sf	$.12	$100.08
Backfill	6.0	hours	$70.00	$420.00
4-Foot Wall				
Excavation	1/2	hour	$70.00	$35.00
Foundation Wall	44	lf	$11.95	$525.00
Backfill	1.5	hours	$70.00	$105.00
Other				
Extra Stone	3	tons	$60.00	$180.00
Additional Reinforcing Steel	350	lf	$.35	$122.50
Basement Columns	5	---	Lump sum	$159.60
Basement Stairs	12	risers	Lump sum	$126.00
Engineering	---	---	Lump sum	$493.00
Notes: lf = lineal feet; sf = square feet			Total	$5,756.18

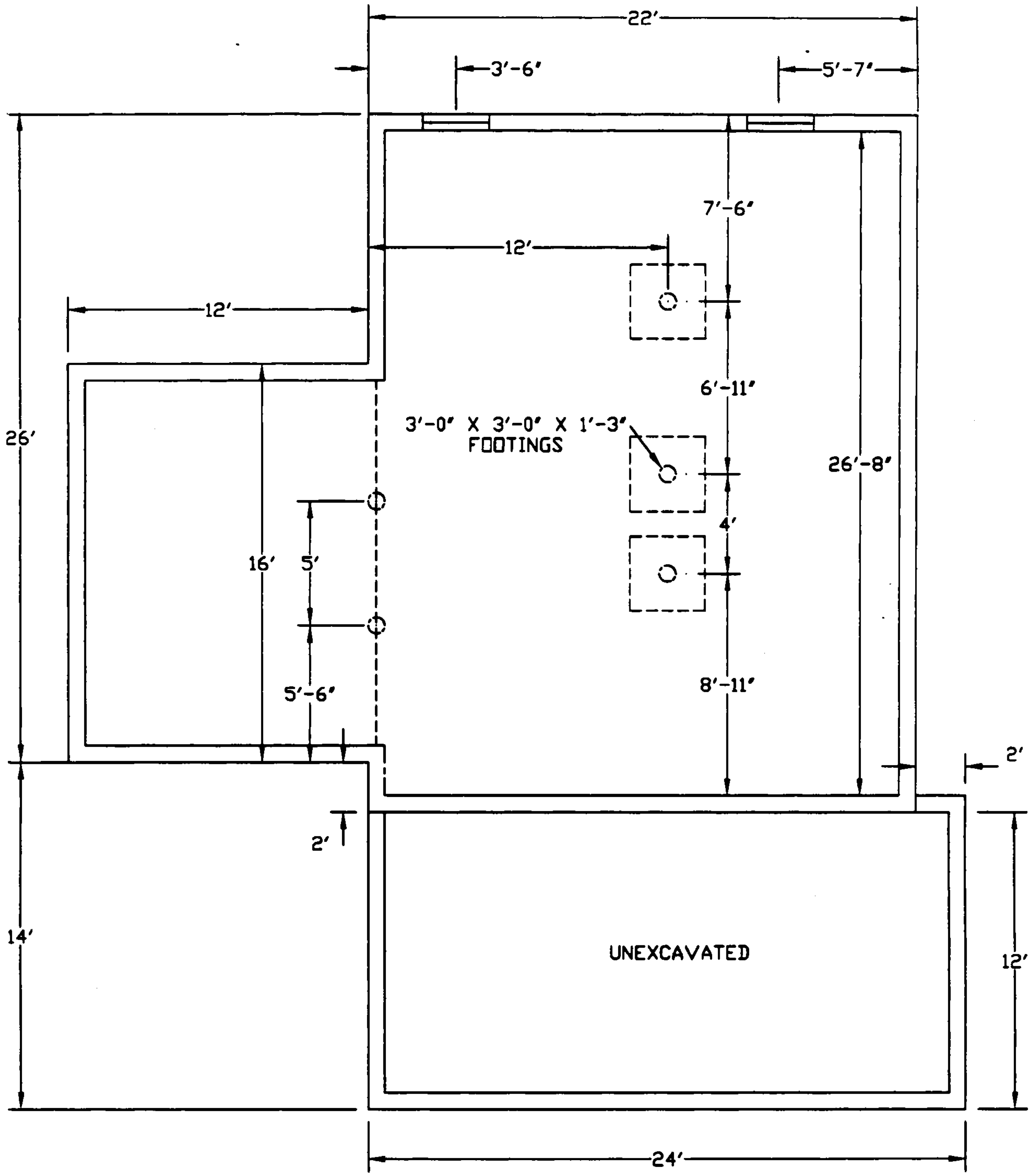

Figure 14. Eldersburg Foundation Plan.

Table 5
COMPARISON HOME WITH FOOTING

Description	Quantity	Units	Unit Cost	Total Cost
Excavation	5.5	Hours	$70.00	$385.00
8-Foot Wall				
Foundation Wall + Footing	131	lf	$26.50	$3,471.50
Waterproofing	834	sf	$0.12	$100.08
Backfill	6	hours	$70.00	$420.00
4-Foot Wall				
Excavation	1/2	hour	$70.00	$35.00
Foundation Wall	44	lf	$15.95	$701.80
Backfill	1.5	hours	$70.00	$105.00
Other				
Basement Columns	5	---	Lump sum	$163.01
Basement Stairs	13	risers	Lump sum	$136.50
Notes: lf = lineal feet; sf = square feet			Total	$5,517.89

The demonstration home cost approximately $240 more at this site than the comparison home. However, with time, the site preparation costs will come down as the builder becomes more experienced with the stemwall technique. Also, engineering costs of nearly $500 could be eliminated if stemwall construction were recognized by the local building code.

Plymouth, Massachusetts

Description and Design

The Massachusetts state building code permits foundation walls to be supported on virgin soil without footings. One builder in the Plymouth area has routinely used 10- and 12-inch cast-in-place concrete stemwalls. When spread footings are required due to poor local soil conditions, an 8-inch foundation wall is typically used. Although no new homes were built specifically for this project in Plymouth, information gathered on recently completed homes provided an assessment of the potential cost savings associated with the stemwall foundation from the perspective of a builder already familiar with the system. The experience in Plymouth also illustrates the impact of earlier code approval, which eliminates special engineering requirements.

The development in Plymouth contains 230 single-family homes built over the past six years. The builder used four model homes with the same 24- x 32-foot foundation plan (Figure 15). All homes were started at the beginning of the week to take advantage of Plymouth's inspection schedule. The builder was able to save up to two days by not using a separate footing.

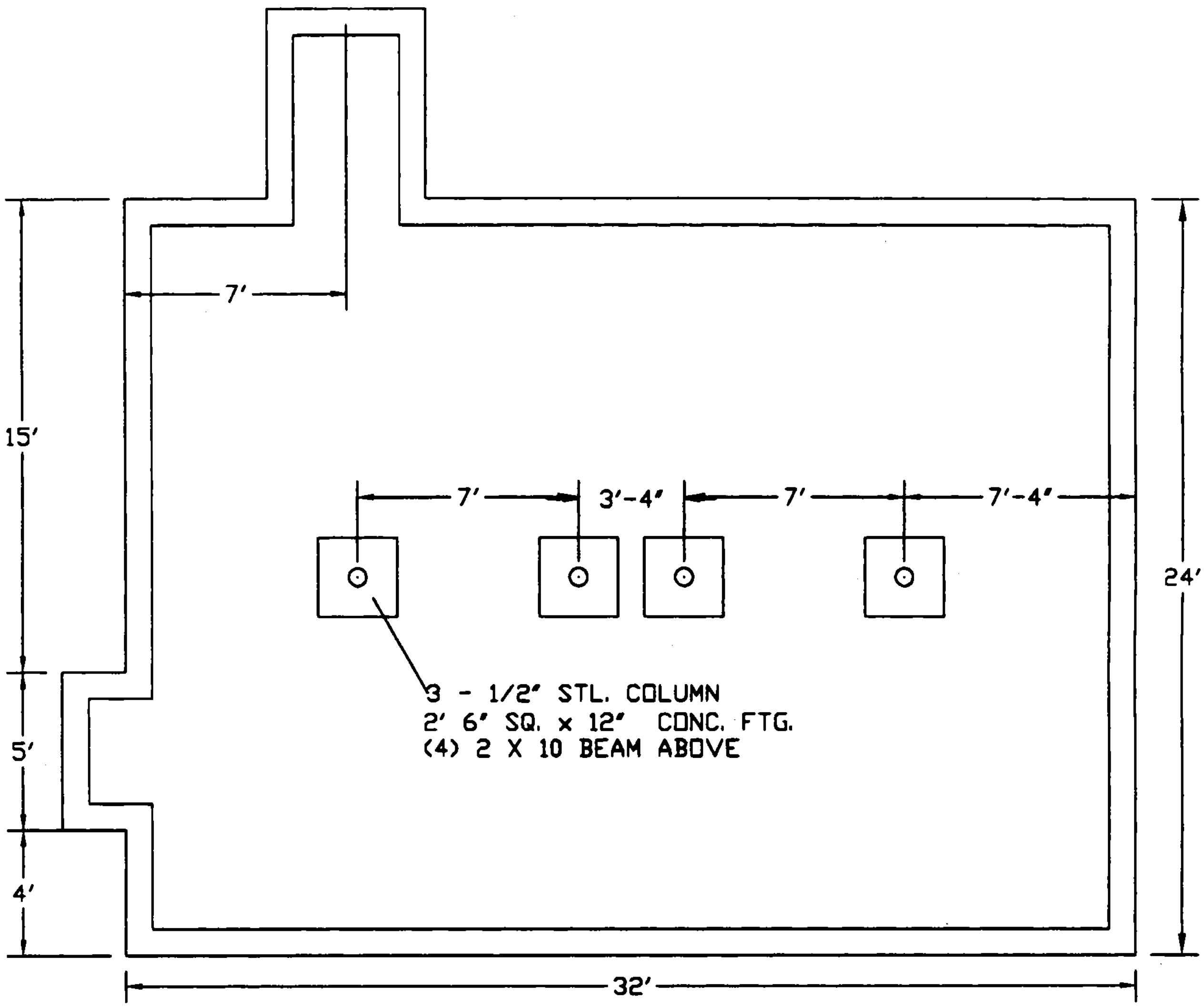

Figure 15. Massachusetts Foundation Plan

Construction specifications include:

- 10- or 12-inch-wide cast-in-place concrete walls;
- 2,500 psi concrete (wintertime 3,000 psi high early-strength concrete);
- no reinforcing steel;
- walls dampproofed with asphalt before backfill;
- all foundation or frost walls set on virgin soil; and
- basement windows flush with the tops of the foundation walls.

Costs versus Conventional Spread Footing

Costs for a 24- x 32-foot full basement two-story house are shown in Tables 6 and 7 for an 8-inch conventional wall and a 10-inch stemwall, respectively.

Table 6
8-INCH FOUNDATION WITH A FOOTING

Description	Quantity	Unit	Unit Price	Total Cost
CONCRETE FOUNDATION				
Running Feet	112	lf	$10.00	$1,120.00
Steps in Foundation	0	ea	$10.00	$0.00
Corners in Excess of 10	0	ea	$10.00	$0.00
Windows	2	ea	$60.00	$120.00
Yards of Concrete	22.5	cy	$56.00	$1,260.00
Yards of Concrete Placed	22.5	cy	$2.00	$45.00
Anchor Clips	20	ea	$0.75	$15.00
			Subtotal	$2,560.00
CONCRETE FOOTING				
Running Feet	112	lf	$1.00	$112.00
Yards of Concrete	5	cy	$56.00	$280.00
Yards of Concrete Placed	5	cy	$2.00	$10.00
Notes: lf = linear feet; cy = cubic yard of concrete; ea = each			Total	$2,962.00

Table 7
10-INCH FOUNDATION STEMWALL

Description	Quantity	Unit	Unit Price	Total Cost
CONCRETE FOUNDATION				
Running Feet	112	lf	$10.00	$1,120.00
Steps in Foundation	0	ea	$10.00	$0.00
Corners in Excess of 10	0	ea	$10.00	$0.00
Windows	2	ea	$60.00	$120.00
Yards of Concrete	28	cy	$56.00	$1,568.00
Yards of Concrete Placed	28	cy	$2.00	$56.00
Anchor Clips	20	ea	$0.75	$15.00
Notes: lf = linear foot of wall cy = cubic yard of concrete ea = each			Total	$2,879.00

Observations

An efficient form crew of four to five workers can set forms and cast the foundation walls in the 24- x 32-foot home in five hours. The forms are stripped the following day and the floor slab cast before backfilling the building. One interesting note is that the contractor felt it was more difficult to erect and straighten the wall forms on top of a footing than on soil. The erection time was not significantly different with either method.

TASK 3: PREPARATIONS OF DESIGN RECOMMENDATIONS

Recommendations for proposed code changes were prepared under this task. Since most codes do not directly recognize stemwalls, it is recommended that stemwalls be introduced into the model codes to enable builders to use them without an engineered design.

Recommendations

There are five possible approaches to gaining model code acceptance of stemwalls.

1. Incorporate all of the design tables from the Appendix either as direct text in the codes or as an Appendix.
2. Distill the tables in the Appendix into simplified recommendations that would apply to a wide variety of homes and incorporate as above.
3. Introduce enabling language that recognizes the concept of stemwalls but does not include specific designs.
4. Use a combination of approaches 2 and 3 above.
5. Develop a consensus standard that could be adopted by reference.

Any attempt to introduce the complete set of design tables would probably meet with limited success simply because the model code bodies are likely to resist the addition of a significant amount of text to their codes. Further, the trend among the major code groups is to consider for adoption by reference only those documents developed under the auspices of a recognized consensus organization.

A review of the tables in the Appendix generated by a computer program suggests that no clearly economical set of prescriptive requirements could be developed to cover stemwall construction for all housing types. Any distilled set of tables that could accommodate all relevant variables would be driven by two-story homes. Results would be too restrictive for one-story homes and would lead to high allowable bearing pressures that would, in turn, require expensive soils testing for verification.

The introduction of enabling language into the model codes would allow construction of most typical one- and two-story light-frame buildings with stemwall foundations. However, enabling language in itself would not give builders and code officials adequate information on the design and construction of stemwalls.

It appears that a combination of the above mentioned second and third approaches could be successful in gaining code adoption. The enabling language could simply indicate that stemwalls are an acceptable construction method, while the design tables would provide the specific requirements for various conditions and house types.

Incorporating a gravel layer to spread the building load across the subgrade greatly reduces the required soil bearing capacity. A 6-inch gravel layer would reduce the required bearing capacity to less than 2,000 psf for one-and-one-half- and two-story structures, which is acceptable with any of the soils shown previously in Table 2. The following detail with accompanying notes (Figure 16) is recommended for the design of one-and-one-half and two-story homes.

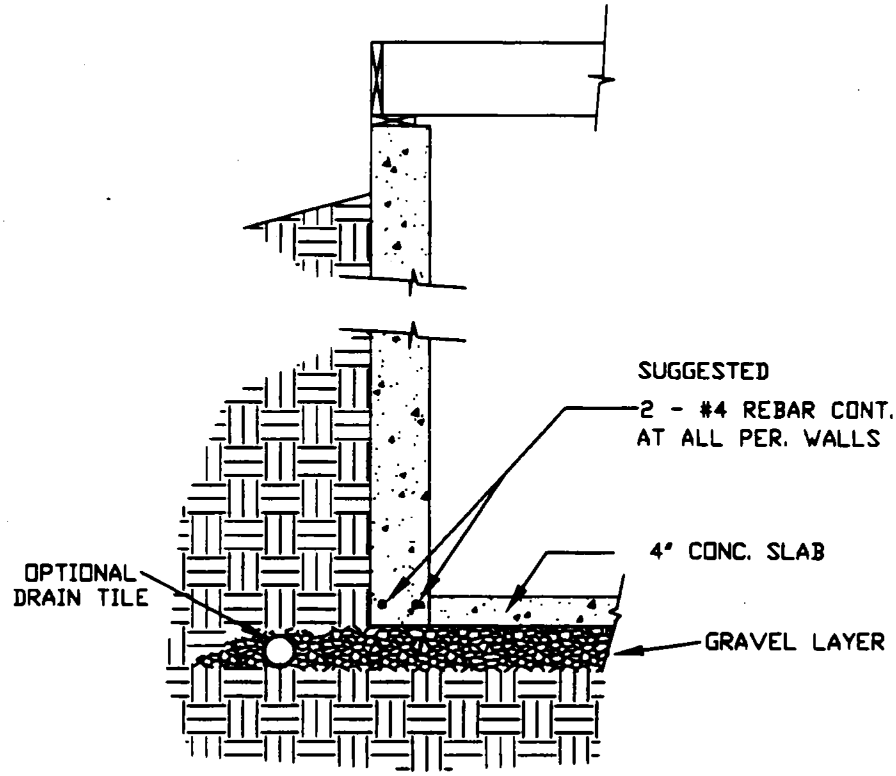

Figure 16. Two- and One-and-One-Half-Story Stemwall Recommendations

Notes:

- Gravel shall extend 12 inches minimum beyond the edge of each side of the wall and be confined at minimum by either a 4 inch concrete slab or 2 feet of fill.
- Unusual features or greater than 50 psf ground snow loads require a special design.
- Where local codes or conditions necessitate a foundation drainage system, the system shall be located outside the foundation wall.
- The gravel layer is assumed to have an allowable bearing capacity of 4,000 psf and shall be tamped in place.
- Design assumes that loads are distributed through the gravel at an angle of 33 degrees from the vertical.
- Walls may be cast-in-place or prefab concrete, 8 to 10 inches thick.
- Clear-span trusses on all floors and roofs require a special design for buildings greater than 24 feet or ground snow loads that exceed 30 psf.

Table 8 is recommended for use with one-story homes. It is distilled from the appropriate design tables in the Appendix. It is conservative for most cases since the values are based on the worst-case loading configurations and the longest spans in the tables.

Table 8
ONE-STORY STEMWALL RECOMMENDATIONS

Required Allowable Soil Bearing Capacity (psf) One-Story Houses					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1800	1900	2000	2150	2300
22	1900	2000	2150	2300	2450
24	2000	2100	2250	2400	2550
26	2100	2200	2350	2550	2700
28	2200	2300	2450	2650	2850
30	2300	2400	2600	2800	3000
32	2400	2500	2700	2900	3100

Notes: For foundation walls over 4 feet, add 150 psf for each additional foot of height.
For clear-span (truss) floors, add 600 psf.
Wall may be 8 or 10 inches.

Developing a consensus standard is another possible alternative. However, this is not a very practical approach in the short term given the time and effort typically required to develop such a standard. In addition, the consensus would probably eliminate the cost effectiveness of the stemwall technique.

CONCLUSIONS

A stemwall is defined as a foundation wall that transfers building design loads directly to the soil without a separate spread footing. Elimination of the footing is one less step which lowers costs by an amount equivalent to the materials and labor for the footing and can accelerate the construction schedule by up to two days. The cost differential to the builders of the demonstration homes varied from a loss of approximately $238 (including $493 engineering cost) to a gain of $500 per unit when compared to conventional foundations. If building codes recognized stemwall foundations directly, then engineering costs could be eliminated or significantly reduced, resulting in additional savings of up to $500 per unit. To achieve wide acceptance of stemwalls, it will be necessary to introduce specific language into the model building codes.

REFERENCES

1. NAHB Research Foundation, Inc. *Reducing Home Building Costs with OVE Design and Construction.* U.S. Department of Housing and Urban Development, Washington, DC (November 1977).

2. American Concrete Institute. *Building Code Requirements for Structural Plain Concrete. ACI 318.1-89* and *Commentary. ACI318.1R-89.* Detroit, MI (1989).

3. American Society of Civil Engineers. *Minimum Design Loads for Buildings and Other Structures. ANSI/ASCE 7-88.* New York, NY (1990).

4. National Forest Products Association. *Permanent Wood Foundation System, Design Fabrication, Installation Manual.* Washington, DC (1987).

5. Council of American Building Officials. *CABO One and Two Family Dwelling Code.* Falls Church, VA (1992).

6. Building Officials and Code Administrators International, Inc. BOCA National Building Code. Country Club Hills, IL (1990).

Appendix
DESIGN TABLES FOR STEMWALL FOUNDATIONS

This Appendix contains tables to simplify the design process for monolithic stemwall foundations. The tables were generated from a computer program based on the design assumptions given in the report. The tables are reference for cast-in-place or prefabricated concrete walls, and give the required allowable soil bearing capacity necessary at the site. Two examples of using the tables to design a stemwall foundation are given on pages 11 and 12 of the report.

The tables are organized to allow a designer to match the appropriate loading condition, foundation height, house type, and wall width of a proposed house to a required soil bearing capacity. Different loading conditions include conventional floor and roof, conventional floor and truss roof, and truss floor and truss roof construction. Conventional construction refers to stick-built while truss construction refers to the use of free span products (trusses or I-joists). A range of foundation heights, 3- to 8-feet, covers those most commonly encountered in design. House types are divided by one-story, two-story and one-and-one-half-story. The tables address 8- and 10-inch stemwalls with 8-inch walls providing more economical construction while, 10-inch walls lower the required allowable soil bearing capacity.

The Appendix is divided into two sections: Group A and Group B for stemwall widths of 8- and 10-inches, respectively.

APPENDIX CONTENTS

GROUP A: FOUNDATIONS WITH 8-INCH WIDTH STEMWALLS

Foundation Height

To find the allowable soil bearing capacity, follow these steps.

1. Select the desired foundation height from the pages listed above.

2. Choose from that page, or the following two pages, the appropriate house type: one-story, two-story, or one-and-one-half-story.

3. Choose the table which reflects the proposed type of construction for the floors and roof; either conventional, truss, or a combination.

4. Match the proposed building width row with the local ground snow load column to find the required allowable soil bearing capacity at your site.

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Roof Construction Foundation Height 3 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1650	1700	1850	1950	2100
22	1750	1800	1950	2100	2250
24	1800	1900	2050	2200	2350
26	1900	2000	2150	2350	2500
28	2000	2100	2250	2450	2650
30	2100	2200	2400	2550	2750
32	2200	2300	2500	2700	2900

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Truss Roof Construction Foundation Height 3 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1650	1750	1850	2000	2150
22	1750	1850	2000	2150	2300
24	1850	1950	2100	2250	2400
26	1950	2050	2200	2400	2550
28	2050	2150	2300	2500	2700
30	2150	2250	2450	2650	2850
32	2250	2350	2550	2750	2950

Required Allowable Soil Bearing Capacity (psf) One-Story: Truss Floor Construction Truss Roof Construction Foundation Height 3 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2050	2100	2250	2400	2500
22	2200	2250	2400	2550	2700
24	2300	2400	2550	2700	2850
26	2450	2500	2700	2850	3050
28	2600	2650	2850	3050	3200
30	2700	2800	3000	3200	3400
32	2850	2950	3150	3350	3550

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Conventional Construction
All Floors and Roof
Foundation Height 3 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2050	2100	2250	2400	2550
22	2200	2250	2400	2550	2700
24	2300	2400	2550	2700	2850
26	2450	2500	2700	2850	3050
28	2550	2650	2800	3000	3200
30	2700	2750	2950	3150	3350
32	2800	2900	3100	3300	3500

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Conventional Construction
All Floors with Truss Roof
Foundation Height 3 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2100	2150	2300	2450	2600
22	2250	2300	2450	2600	2750
24	2350	2400	2600	2750	2900
26	2500	2550	2750	2900	3100
28	2600	2700	2850	3050	3250
30	2750	2800	3000	3200	3400
32	2850	2950	3150	3350	3600

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Truss Construction
All Floors and Roof
Foundation Height 3 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2800	2850	2950	3100	3250
22	2950	3050	3200	3350	3500
24	3150	3250	3400	3550	3700
26	3350	3450	3600	3800	3950
28	3550	3650	3800	4000	4200
30	3750	3850	4050	4250	4400
32	3950	4050	4250	4450	4650

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 8 in 12 Roof Slope Foundation Height 3 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	1950	2000	2150	2300	2450
26	2100	2100	2300	2450	2600
28	2250	2250	2400	2600	2750
30	2350	2400	2550	2750	2900
32	2500	2500	2700	2900	3100

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 10 in 12 Roof Slope Foundation Height 3 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2050	2050	2100	2250	2350
26	2150	2150	2250	2350	2500
28	2300	2300	2400	2500	2650
30	2450	2450	2500	2650	2800
32	2550	2550	2650	2800	2950

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 12 in 12 Roof Slope Foundation Height 3 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2100	2100	2100	2200	2300
26	2200	2200	2200	2300	2400
28	2350	2350	2350	2450	2550
30	2500	2500	2500	2600	2700
32	2600	2600	2600	2750	2850

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Roof Construction Foundation Height 4 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1800	1850	2000	2100	2250
22	1900	1950	2100	2250	2400
24	1950	2050	2200	2350	2500
26	2050	2150	2300	2500	2650
28	2150	2250	2400	2600	2800
30	2250	2350	2550	2700	2900
32	2350	2450	2650	2850	3050

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Truss Roof Construction Foundation Height 4 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1800	1900	2000	2150	2300
22	1900	2000	2150	2300	2450
24	2000	2100	2250	2400	2550
26	2100	2200	2350	2550	2700
28	2200	2300	2450	2650	2850
30	2300	2400	2600	2800	3000
32	2400	2500	2700	2900	3100

Required Allowable Soil Bearing Capacity (psf) One-Story: Truss Floor Construction Truss Roof Construction Foundation Height 4 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2200	2250	2400	2550	2650
22	2350	2400	2550	2700	2850
24	2450	2550	2700	2850	3000
26	2600	2650	2850	3000	3200
28	2750	2800	3000	3200	3350
30	2850	2950	3150	3350	3550
32	3000	3100	3300	3500	3700

Required Allowable Soil Bearing Capacity (psf) Two-Story: Conventional Construction All Floors and Roof Foundation Height 4 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2200	2250	2400	2550	2700
22	2350	2400	2550	2700	2850
24	2450	2550	2700	2850	3000
26	2600	2650	2850	3000	3200
28	2700	2800	2950	3150	3350
30	2850	2900	3100	3300	3500
32	2950	3050	3250	3450	3650

Required Allowable Soil Bearing Capacity (psf) Two-Story: Conventional Construction All Floors with Truss Roof Foundation Height 4 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2250	2300	2450	2600	2750
22	2400	2450	2600	2750	2900
24	2500	2550	2750	2900	3050
26	2650	2700	2900	3050	3250
28	2750	2850	3000	3200	3400
30	2900	2950	3150	3350	3550
32	3000	3100	3300	3500	3750

Required Allowable Soil Bearing Capacity (psf) Two-Story: Truss Construction All Floors and Roof Foundation Height 4 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2950	3000	3100	3250	3400
22	3100	3200	3350	3500	3650
24	3300	3400	3550	3700	3850
26	3500	3600	3750	3950	4100
28	3700	3800	3950	4150	4350
30	3900	4000	4200	4400	4550
32	4100	4200	4400	4600	4800

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 8 in 12 Roof Slope Foundation Height 4 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2100	2150	2300	2450	2600
26	2250	2250	2450	2600	2750
28	2400	2400	2550	2750	2900
30	2500	2550	2700	2900	3050
32	2650	2650	2850	3050	3250

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 10 in 12 Roof Slope Foundation Height 4 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2200	2200	2250	2400	2500
26	2300	2300	2400	2500	2650
28	2450	2450	2550	2650	2800
30	2600	2600	2650	2800	2950
32	2700	2700	2800	2950	3100

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 12 in 12 Roof Slope Foundation Height 4 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2250	2250	2250	2350	2450
26	2350	2350	2350	2450	2550
28	2500	2500	2500	2600	2700
30	2650	2650	2650	2750	2850
32	2750	2750	2750	2900	3000

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Roof Construction Foundation Height 5 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1950	2000	2150	2250	2400
22	2050	2100	2250	2400	2550
24	2100	2200	2350	2500	2650
26	2200	2300	2450	2650	2800
28	2300	2400	2550	2750	2950
30	2400	2500	2700	2850	3050
32	2500	2600	2800	3000	3200

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Truss Roof Construction Foundation Height 5 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1950	2050	2150	2300	2450
22	2050	2150	2300	2450	2600
24	2150	2250	2400	2550	2700
26	2250	2350	2500	2700	2850
28	2350	2450	2600	2800	3000
30	2450	2550	2750	2950	3150
32	2550	2650	2850	3050	3250

Required Allowable Soil Bearing Capacity (psf) One-Story: Truss Floor Construction Truss Roof Construction Foundation Height 5 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2350	2400	2550	2700	2800
22	2500	2550	2700	2850	3000
24	2600	2700	2850	3000	3150
26	2750	2800	3000	3150	3350
28	2900	2950	3150	3350	3500
30	3000	3100	3300	3500	3700
32	3150	3250	3450	3650	3850

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Conventional Construction
All Floors and Roof
Foundation Height 5 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2350	2400	2550	2700	2850
22	2500	2550	2700	2850	3000
24	2600	2700	2850	3000	3150
26	2750	2800	3000	3150	3350
28	2850	2950	3100	3300	3500
30	3000	3050	3250	3450	3650
32	3100	3200	3400	3600	3800

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Conventional Construction
All Floors with Truss Roof
Foundation Height 5 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2400	2450	2600	2750	2900
22	2550	2600	2750	2900	3050
24	2650	2700	2900	3050	3200
26	2800	2850	3050	3200	3400
28	2900	3000	3150	3350	3550
30	3050	3100	3300	3500	3700
32	3150	3250	3450	3650	3900

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Truss Construction
All Floors and Roof
Foundation Height 5 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	3100	3150	3250	3400	3550
22	3250	3350	3500	3650	3800
24	3450	3550	3700	3850	4000
26	3650	3750	3900	4100	4250
28	3850	3950	4100	4300	4500
30	4050	4150	4350	4550	4700
32	4250	4350	4550	4750	4950

Required Allowable Soil Bearing Capacity (psf)
One-and-One-Half-Story
8 in 12 Roof Slope
Foundation Height 5 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2250	2300	2450	2600	2750
26	2400	2400	2600	2750	2900
28	2550	2550	2700	2900	3050
30	2650	2700	2850	3050	3200
32	2800	2800	3000	3200	3400

Required Allowable Soil Bearing Capacity (psf)
One-and-One-Half-Story
10 in 12 Roof Slope
Foundation Height 5 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2350	2350	2400	2550	2650
26	2450	2450	2550	2650	2800
28	2600	2600	2700	2800	2950
30	2750	2750	2800	2950	3100
32	2850	2850	2950	3100	3250

Required Allowable Soil Bearing Capacity (psf)
One-and-One-Half-Story
12 in 12 Roof Slope
Foundation Height 5 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2400	2400	2400	2500	2600
26	2500	2500	2500	2600	2700
28	2650	2650	2650	2750	2850
30	2800	2800	2800	2900	3000
32	2900	2900	2900	3050	3150

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Roof Construction Foundation Height 6 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2100	2150	2300	2400	2550
22	2200	2250	2400	2550	2700
24	2250	2350	2500	2650	2800
26	2350	2450	2600	2800	2950
28	2450	2550	2700	2900	3100
30	2550	2650	2850	3000	3200
32	2650	2750	2950	3150	3350

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Truss Roof Construction Foundation Height 6 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2100	2200	2300	2450	2600
22	2200	2300	2450	2600	2750
24	2300	2400	2550	2700	2850
26	2400	2500	2650	2850	3000
28	2500	2600	2750	2950	3150
30	2600	2700	2900	3100	3300
32	2700	2800	3000	3200	3400

Required Allowable Soil Bearing Capacity (psf) One-Story: Truss Floor Construction Truss Roof Construction Foundation Height 6 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2500	2550	2700	2850	2950
22	2650	2700	2850	3000	3150
24	2750	2850	3000	3150	3300
26	2900	2950	3150	3300	3500
28	3050	3100	3300	3500	3650
30	3150	3250	3450	3650	3850
32	3300	3400	3600	3800	4000

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Conventional Construction
All Floors and Roof
Foundation Height 6 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2500	2550	2700	2850	3000
22	2650	2700	2850	3000	3150
24	2750	2850	3000	3150	3300
26	2900	2950	3150	3300	3500
28	3000	3100	3250	3450	3650
30	3150	3200	3400	3600	3800
32	3250	3350	3550	3750	3950

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Conventional Construction
All Floors with Truss Roof
Foundation Height 6 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2550	2600	2750	2900	3050
22	2700	2750	2900	3050	3200
24	2800	2850	3050	3200	3350
26	2950	3000	3200	3350	3550
28	3050	3150	3300	3500	3700
30	3200	3250	3450	3650	3850
32	3300	3400	3600	3800	4050

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Truss Construction
All Floors and Roof
Foundation Height 6 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	3250	3300	3400	3550	3700
22	3400	3500	3650	3800	3950
24	3600	3700	3850	4000	4150
26	3800	3900	4050	4250	4400
28	4000	4100	4250	4450	4650
30	4200	4300	4500	4700	4850
32	4400	4500	4700	4900	5100

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 8 in 12 Roof Slope Foundation Height 6 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2400	2450	2600	2750	2900
26	2550	2550	2750	2900	3050
28	2700	2700	2850	3050	3200
30	2800	2850	3000	3200	3350
32	2950	2950	3150	3350	3550

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 10 in 12 Roof Slope Foundation Height 6 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2500	2500	2550	2700	2800
26	2600	2600	2700	2800	2950
28	2750	2750	2850	2950	3100
30	2900	2900	2950	3100	3250
32	3000	3000	3100	3250	3400

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 12 in 12 Roof Slope Foundation Height 6 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2550	2550	2550	2650	2750
26	2650	2650	2650	2750	2850
28	2800	2800	2800	2900	3000
30	2950	2950	2950	3050	3150
32	3050	3050	3050	3200	3300

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Roof Construction Foundation Height 7 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2250	2300	2450	2550	2700
22	2350	2400	2550	2700	2850
24	2400	2500	2650	2800	2950
26	2500	2600	2750	2950	3100
28	2600	2700	2850	3050	3250
30	2700	2800	3000	3150	3350
32	2800	2900	3100	3300	3500

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Truss Roof Construction Foundation Height 7 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2250	2350	2450	2600	2750
22	2350	2450	2600	2750	2900
24	2450	2550	2700	2850	3000
26	2550	2650	2800	3000	3150
28	2650	2750	2900	3100	3300
30	2750	2850	3050	3250	3450
32	2850	2950	3150	3350	3550

Required Allowable Soil Bearing Capacity (psf) One-Story: Truss Floor Construction Truss Roof Construction Foundation Height 7 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2650	2700	2850	3000	3100
22	2800	2850	3000	3150	3300
24	2900	3000	3150	3300	3450
26	3050	3100	3300	3450	3650
28	3200	3250	3450	3650	3800
30	3300	3400	3600	3800	4000
32	3450	3550	3750	3950	4150

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Conventional Construction
All Floors and Roof
Foundation Height 7 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2650	2700	2850	3000	3150
22	2800	2850	3000	3150	3300
24	2900	3000	3150	3300	3450
26	3050	3100	3300	3450	3650
28	3150	3250	3400	3600	3800
30	3300	3350	3550	3750	3950
32	3400	3500	3700	3900	4100

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Conventional Construction
All Floors with Truss Roof
Foundation Height 7 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2700	2750	2900	3050	3200
22	2850	2900	3050	3200	3350
24	2950	3000	3200	3350	3500
26	3100	3150	3350	3500	3700
28	3200	3300	3450	3650	3850
30	3350	3400	3600	3800	4000
32	3450	3550	3750	3950	4200

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Truss Construction
All Floors and Roof
Foundation Height 7 Ft., Foundation Width 8 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	3400	3450	3550	3700	3850
22	3550	3650	3800	3950	4100
24	3750	3850	4000	4150	4300
26	3950	4050	4200	4400	4550
28	4150	4250	4400	4600	4800
30	4350	4450	4650	4850	5000
32	4550	4650	4850	5050	5250

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 8 in 12 Roof Slope Foundation Height 7 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2550	2600	2750	2900	3050
26	2700	2700	2900	3050	3200
28	2850	2850	3000	3200	3350
30	2950	3000	3150	3350	3500
32	3100	3100	3300	3500	3700

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 10 in 12 Roof Slope Foundation Height 7 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2650	2650	2700	2850	2950
26	2750	2750	2850	2950	3100
28	2900	2900	3000	3100	3250
30	3050	3050	3100	3250	3400
32	3150	3150	3250	3400	3550

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 12 in 12 Roof Slope Foundation Height 7 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2700	2700	2700	2800	2900
26	2800	2800	2800	2900	3000
28	2950	2950	2950	3050	3150
30	3100	3100	3100	3200	3300
32	3200	3200	3200	3350	3450

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Roof Construction Foundation Height 8 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2400	2450	2600	2700	2850
22	2500	2550	2700	2850	3000
24	2550	2650	2800	2950	3100
26	2650	2750	2900	3100	3250
28	2750	2850	3000	3200	3400
30	2850	2950	3150	3300	3500
32	2950	3050	3250	3450	3650

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Truss Roof Construction Foundation Height 8 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2400	2500	2600	2750	2900
22	2500	2600	2750	2900	3050
24	2600	2700	2850	3000	3150
26	2700	2800	2950	3150	3300
28	2800	2900	3050	3250	3450
30	2900	3000	3200	3400	3600
32	3000	3100	3300	3500	3700

Required Allowable Soil Bearing Capacity (psf) One-Story: Truss Floor Construction Truss Roof Construction Foundation Height 8 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2800	2850	3000	3150	3250
22	2950	3000	3150	3300	3450
24	3050	3150	3300	3450	3600
26	3200	3250	3450	3600	3800
28	3350	3400	3600	3800	3950
30	3450	3550	3750	3950	4150
32	3600	3700	3900	4100	4300

Required Allowable Soil Bearing Capacity (psf) Two-Story: Conventional Construction All Floors and Roof Foundation Height 8 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2800	2850	3000	3150	3300
22	2950	3000	3150	3300	3450
24	3050	3150	3300	3450	3600
26	3200	3250	3450	3600	3800
28	3300	3400	3550	3750	3950
30	3450	3500	3700	3900	4100
32	3550	3650	3850	4050	4250

Required Allowable Soil Bearing Capacity (psf) Two-Story: Conventional Construction All Floors with Truss Roof Foundation Height 8 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2850	2900	3050	3200	3350
22	3000	3050	3200	3350	3500
24	3100	3150	3350	3500	3650
26	3250	3300	3500	3650	3850
28	3350	3450	3600	3800	4000
30	3500	3550	3750	3950	4150
32	3600	3700	3900	4100	4350

Required Allowable Soil Bearing Capacity (psf) Two-Story: Truss Construction All Floors and Roof Foundation Height 8 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	3550	3600	3700	3850	4000
22	3700	3800	3950	4100	4250
24	3900	4000	4150	4300	4450
26	4100	4200	4350	4550	4700
28	4300	4400	4550	4750	4950
30	4500	4600	4800	5000	5150
32	4700	4800	5000	5200	5400

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 8 in 12 Roof Slope Foundation Height 8 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2700	2750	2900	3050	3200
26	2850	2850	3050	3200	3350
28	3000	3000	3150	3350	3500
30	3100	3150	3300	3500	3650
32	3250	3250	3450	3650	3850

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 10 in 12 Roof Slope Foundation Height 8 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2800	2800	2850	3000	3100
26	2900	2900	3000	3100	3250
28	3050	3050	3150	3250	3400
30	3200	3200	3250	3400	3550
32	3300	3300	3400	3550	3700

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 12 in 12 Roof Slope Foundation Height 8 Ft., Foundation Width 8 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2850	2850	2850	2950	3050
26	2950	2950	2950	3050	3150
28	3100	3100	3100	3200	3300
30	3250	3250	3250	3350	3450
32	3350	3350	3350	3500	3600

GROUP B: FOUNDATIONS WITH 10-INCH WIDTH STEMWALLS

Foundation Height

To find the allowable soil bearing capacity, follow these steps.

1. Select the desired foundation height from the pages listed above.

2. Choose from that page, or the following two pages, the appropriate house type: one-story, two-story, or one-and-one-half-story.

3. Choose the table which reflects the proposed type of construction for the floors and roof; either conventional, truss, or a combination.

4. Match the proposed building width row with the local ground snow load column to find the required allowable soil bearing capacity at your site.

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Roof Construction Foundation Height 3 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1400	1450	1550	1650	1800
22	1500	1550	1650	1750	1900
24	1550	1600	1750	1850	2000
26	1650	1700	1800	1950	2100
28	1700	1750	1900	2050	2200
30	1800	1850	2000	2150	2300
32	1850	1900	2100	2250	2400

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Truss Roof Construction Foundation Height 3 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1450	1500	1600	1700	1800
22	1500	1550	1700	1800	1900
24	1600	1650	1750	1900	2050
26	1650	1700	1850	2000	2150
28	1750	1800	1950	2100	2250
30	1800	1900	2050	2200	2350
32	1900	1950	2150	2300	2450

Required Allowable Soil Bearing Capacity (psf) One-Story: Truss Floor Construction Truss Roof Construction Foundation Height 3 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1750	1800	1900	2000	2100
22	1850	1900	2000	2150	2250
24	1950	2000	2150	2250	2400
26	2050	2100	2250	2400	2550
28	2150	2200	2350	2500	2650
30	2250	2350	2500	2650	2800
32	2400	2450	2600	2800	2950

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Conventional Construction
All Floors and Roof
Foundation Height 3 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1750	1800	1900	2000	2100
22	1850	1900	2000	2150	2250
24	1950	2000	2150	2250	2400
26	2050	2100	2250	2400	2500
28	2150	2200	2350	2500	2650
30	2250	2300	2450	2600	2800
32	2350	2400	2550	2750	2900

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Conventional Construction
All Floors with Truss Roof
Foundation Height 3 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1800	1800	1950	2050	2150
22	1900	1950	2050	2150	2300
24	2000	2050	2150	2300	2400
26	2100	2150	2300	2400	2550
28	2200	2250	2400	2550	2700
30	2300	2350	2500	2650	2800
32	2400	2450	2600	2800	2950

Required Allowable Soil Bearing Capacity (psf)
Two-Story: Truss Construction
All Floors and Roof
Foundation Height 3 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2300	2350	2450	2600	2700
22	2450	2500	2650	2750	2900
24	2650	2700	2800	2950	3050
26	2800	2850	3000	3100	3250
28	2950	3000	3150	3300	3450
30	3100	3150	3300	3500	3650
32	3250	3300	3500	3650	3800

Required Allowable Soil Bearing Capacity (psf)
One-and-One-Half-Story
8 in 12 Roof Slope
Foundation Height 3 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	1650	1700	1800	1950	2050
26	1800	1800	1900	2050	2150
28	1900	1900	2050	2150	2300
30	2000	2000	2150	2300	2450
32	2100	2100	2250	2400	2550

Required Allowable Soil Bearing Capacity (psf)
One-and-One-Half-Story
10 in 12 Roof Slope
Foundation Height 3 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	1750	1750	1800	1900	1950
26	1850	1850	1900	2000	2100
28	1950	1950	2000	2100	2200
30	2050	2050	2100	2200	2350
32	2150	2150	2200	2350	2450

Required Allowable Soil Bearing Capacity (psf)
One-and-One-Half-Story
12 in 12 Roof Slope
Foundation Height 3 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	1750	1750	1750	1850	1900
26	1850	1850	1850	1950	2050
28	2000	2000	2000	2050	2150
30	2100	2100	2100	2150	2250
32	2200	2200	2200	2300	2400

Required Allowable Soil Bearing Capacity (psf)
One-Story: Conventional Floor and
Roof Construction
Foundation Height 4 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1550	1600	1700	1800	1950
22	1650	1700	1800	1900	2050
24	1700	1750	1900	2000	2150
26	1800	1850	1950	2100	2250
28	1850	1900	2050	2200	2350
30	1950	2000	2150	2300	2450
32	2000	2050	2250	2400	2550

Required Allowable Soil Bearing Capacity (psf)
One-Story: Conventional Floor and
Truss Roof Construction
Foundation Height 4 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1600	1650	1750	1850	1950
22	1650	1700	1850	1950	2050
24	1750	1800	1900	2050	2200
26	1800	1850	2000	2150	2300
28	1900	1950	2100	2250	2400
30	1950	2050	2200	2350	2500
32	2050	2100	2300	2450	2600

Required Allowable Soil Bearing Capacity (psf)
One-Story: Truss Floor Construction
Truss Roof Construction
Foundation Height 4 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1900	1950	2050	2150	2250
22	2000	2050	2150	2300	2400
24	2100	2150	2300	2400	2550
26	2200	2250	2400	2550	2700
28	2300	2350	2500	2650	2800
30	2400	2500	2650	2800	2950
32	2550	2600	2750	2950	3100

Required Allowable Soil Bearing Capacity (psf) Two-Story: Conventional Construction All Floors and Roof Foundation Height 4 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1900	1950	2050	2150	2250
22	2000	2050	2150	2300	2400
24	2100	2150	2300	2400	2550
26	2200	2250	2400	2550	2650
28	2300	2350	2500	2650	2800
30	2400	2450	2600	2750	2950
32	2500	2550	2700	2900	3050

Required Allowable Soil Bearing Capacity (psf) Two-Story: Conventional Construction All Floors with Truss Roof Foundation Height 4 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1950	1950	2100	2200	2300
22	2050	2100	2200	2300	2450
24	2150	2200	2300	2450	2550
26	2250	2300	2450	2550	2700
28	2350	2400	2550	2700	2850
30	2450	2500	2650	2800	2950
32	2550	2600	2750	2950	3100

Required Allowable Soil Bearing Capacity (psf) Two-Story: Truss Construction All Floors and Roof Foundation Height 4 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2450	2500	2600	2750	2850
22	2600	2650	2800	2900	3050
24	2800	2850	2950	3100	3200
26	2950	3000	3150	3250	3400
28	3100	3150	3300	3450	3600
30	3250	3300	3450	3650	3800
32	3400	3450	3650	3800	3950

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 8 in 12 Roof Slope Foundation Height 4 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	1800	1850	1950	2100	2200
26	1950	1950	2050	2200	2300
28	2050	2050	2200	2300	2450
30	2150	2150	2300	2450	2600
32	2250	2250	2400	2550	2700

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 10 in 12 Roof Slope Foundation Height 4 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	1900	1900	1950	2050	2100
26	2000	2000	2050	2150	2250
28	2100	2100	2150	2250	2350
30	2200	2200	2250	2350	2500
32	2300	2300	2350	2500	2600

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 12 in 12 Roof Slope Foundation Height 4 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	1900	1900	1900	2000	2050
26	2000	2000	2000	2100	2200
28	2150	2150	2150	2200	2300
30	2250	2250	2250	2300	2400
32	2350	2350	2350	2450	2550

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Roof Construction Foundation Height 5 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1700	1750	1850	1950	2100
22	1800	1850	1950	2050	2200
24	1850	1900	2050	2150	2300
26	1950	2000	2100	2250	2400
28	2000	2050	2200	2350	2500
30	2100	2150	2300	2450	2600
32	2150	2200	2400	2550	2700

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Truss Roof Construction Foundation Height 5 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1750	1800	1900	2000	2100
22	1800	1850	2000	2100	2200
24	1900	1950	2050	2200	2350
26	1950	2000	2150	2300	2450
28	2050	2100	2250	2400	2550
30	2100	2200	2350	2500	2650
32	2200	2250	2450	2600	2750

Required Allowable Soil Bearing Capacity (psf) One-Story: Truss Floor Construction Truss Roof Construction Foundation Height 5 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2050	2100	2200	2300	2400
22	2150	2200	2300	2450	2550
24	2250	2300	2450	2550	2700
26	2350	2400	2550	2700	2850
28	2450	2500	2650	2800	2950
30	2550	2650	2800	2950	3100
32	2700	2750	2900	3100	3250

Required Allowable Soil Bearing Capacity (psf) Two-Story: Conventional Construction All Floors and Roof Foundation Height 5 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2050	2100	2200	2300	2400
22	2150	2200	2300	2450	2550
24	2250	2300	2450	2550	2700
26	2350	2400	2550	2700	2800
28	2450	2500	2650	2800	2950
30	2550	2600	2750	2900	3100
32	2650	2700	2850	3050	3200

Required Allowable Soil Bearing Capacity (psf) Two-Story: Conventional Construction All Floors with Truss Roof Foundation Height 5 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2100	2100	2250	2350	2450
22	2200	2250	2350	2450	2600
24	2300	2350	2450	2600	2700
26	2400	2450	2600	2700	2850
28	2500	2550	2700	2850	3000
30	2600	2650	2800	2950	3100
32	2700	2750	2900	3100	3250

Required Allowable Soil Bearing Capacity (psf) Two-Story: Truss Construction All Floors and Roof Foundation Height 5 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2600	2650	2750	2900	3000
22	2750	2800	2950	3050	3200
24	2950	3000	3100	3250	3350
26	3100	3150	3300	3400	3550
28	3250	3300	3450	3600	3750
30	3400	3450	3600	3800	3950
32	3550	3600	3800	3950	4100

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 8 in 12 Roof Slope Foundation Height 5 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	1950	2000	2100	2250	2350
26	2100	2100	2200	2350	2450
28	2200	2200	2350	2450	2600
30	2300	2300	2450	2600	2750
32	2400	2400	2550	2700	2850

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 10 in 12 Roof Slope Foundation Height 5 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2050	2050	2100	2200	2250
26	2150	2150	2200	2300	2400
28	2250	2250	2300	2400	2500
30	2350	2350	2400	2500	2650
32	2450	2450	2500	2650	2750

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 12 in 12 Roof Slope Foundation Height 5 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2050	2050	2050	2150	2200
26	2150	2150	2150	2250	2350
28	2300	2300	2300	2350	2450
30	2400	2400	2400	2450	2550
32	2500	2500	2500	2600	2700

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Roof Construction Foundation Height 6 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1850	1900	2000	2100	2250
22	1950	2000	2100	2200	2350
24	2000	2050	2200	2300	2450
26	2100	2150	2250	2400	2550
28	2150	2200	2350	2500	2650
30	2250	2300	2450	2600	2750
32	2300	2350	2550	2700	2850

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Truss Roof Construction Foundation Height 6 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	1900	1950	2050	2150	2250
22	1950	2000	2150	2250	2350
24	2050	2100	2200	2350	2500
26	2100	2150	2300	2450	2600
28	2200	2250	2400	2550	2700
30	2250	2350	2500	2650	2800
32	2350	2400	2600	2750	2900

Required Allowable Soil Bearing Capacity (psf) One-Story: Truss Floor Construction Truss Roof Construction Foundation Height 6 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2200	2250	2350	2450	2550
22	2300	2350	2450	2600	2700
24	2400	2450	2600	2700	2850
26	2500	2550	2700	2850	3000
28	2600	2650	2800	2950	3100
30	2700	2800	2950	3100	3250
32	2850	2900	3050	3250	3400

Required Allowable Soil Bearing Capacity (psf) Two-Story: Conventional Construction All Floors and Roof Foundation Height 6 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2200	2250	2350	2450	2550
22	2300	2350	2450	2600	2700
24	2400	2450	2600	2700	2850
26	2500	2550	2700	2850	2950
28	2600	2650	2800	2950	3100
30	2700	2750	2900	3050	3250
32	2800	2850	3000	3200	3350

Required Allowable Soil Bearing Capacity (psf) Two-Story: Conventional Construction All Floors with Truss Roof Foundation Height 6 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2250	2250	2400	2500	2600
22	2350	2400	2500	2600	2750
24	2450	2500	2600	2750	2850
26	2550	2600	2750	2850	3000
28	2650	2700	2850	3000	3150
30	2750	2800	2950	3100	3250
32	2850	2900	3050	3250	3400

Required Allowable Soil Bearing Capacity (psf) Two-Story: Truss Construction All Floors and Roof Foundation Height 6 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2750	2800	2900	3050	3150
22	2900	2950	3100	3200	3350
24	3100	3150	3250	3400	3500
26	3250	3300	3450	3550	3700
28	3400	3450	3600	3750	3900
30	3550	3600	3750	3950	4100
32	3700	3750	3950	4100	4250

Required Allowable Soil Bearing Capacity (psf)
One-and-One-Half-Story
8 in 12 Roof Slope
Foundation Height 6 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2100	2150	2250	2400	2500
26	2250	2250	2350	2500	2600
28	2350	2350	2500	2600	2750
30	2450	2450	2600	2750	2900
32	2550	2550	2700	2850	3000

Required Allowable Soil Bearing Capacity (psf)
One-and-One-Half-Story
10 in 12 Roof Slope
Foundation Height 6 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2200	2200	2250	2350	2400
26	2300	2300	2350	2450	2550
28	2400	2400	2450	2550	2650
30	2500	2500	2550	2650	2800
32	2600	2600	2650	2800	2900

Required Allowable Soil Bearing Capacity (psf)
One-and-One-Half-Story
12 in 12 Roof Slope
Foundation Height 6 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2200	2200	2200	2300	2350
26	2300	2300	2300	2400	2500
28	2450	2450	2450	2500	2600
30	2550	2550	2550	2600	2700
32	2650	2650	2650	2750	2850

Required Allowable Soil Bearing Capacity (psf)
One-Story: Conventional Floor and
Roof Construction
Foundation Height 7 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2000	2050	2150	2250	2400
22	2100	2150	2250	2350	2500
24	2150	2200	2350	2450	2600
26	2250	2300	2400	2550	2700
28	2300	2350	2500	2650	2800
30	2400	2450	2600	2750	2900
32	2450	2500	2700	2850	3000

Required Allowable Soil Bearing Capacity (psf)
One-Story: Conventional Floor and
Truss Roof Construction
Foundation Height 7 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2050	2100	2200	2300	2400
22	2100	2150	2300	2400	2500
24	2200	2250	2350	2500	2650
26	2250	2300	2450	2600	2750
28	2350	2400	2550	2700	2850
30	2400	2500	2650	2800	2950
32	2500	2550	2750	2900	3050

Required Allowable Soil Bearing Capacity (psf)
One-Story: Truss Floor Construction
Truss Roof Construction
Foundation Height 7 Ft., Foundation Width 10 In.

Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2350	2400	2500	2600	2700
22	2450	2500	2600	2750	2850
24	2550	2600	2750	2850	3000
26	2650	2700	2850	3000	3150
28	2750	2800	2950	3100	3250
30	2850	2950	3100	3250	3400
32	3000	3050	3200	3400	3550

Required Allowable Soil Bearing Capacity (psf) Two-Story: Conventional Construction All Floors and Roof Foundation Height 7 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2350	2400	2500	2600	2700
22	2450	2500	2600	2750	2850
24	2550	2600	2750	2850	3000
26	2650	2700	2850	3000	3100
28	2750	2800	2950	3100	3250
30	2850	2900	3050	3200	3400
32	2950	3000	3150	3350	3500

Required Allowable Soil Bearing Capacity (psf) Two-Story: Conventional Construction All Floors with Truss Roof Foundation Height 7 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2400	2400	2550	2650	2750
22	2500	2550	2650	2750	2900
24	2600	2650	2750	2900	3000
26	2700	2750	2900	3000	3150
28	2800	2850	3000	3150	3300
30	2900	2950	3100	3250	3400
32	3000	3050	3200	3400	3550

Required Allowable Soil Bearing Capacity (psf) Two-Story: Truss Construction All Floors and Roof Foundation Height 7 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2900	2950	3050	3200	3300
22	3050	3100	3250	3350	3500
24	3250	3300	3400	3550	3650
26	3400	3450	3600	3700	3850
28	3550	3600	3750	3900	4050
30	3700	3750	3900	4100	4250
32	3850	3900	4100	4250	4400

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 8 in 12 Roof Slope Foundation Height 7 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2250	2300	2400	2550	2650
26	2400	2400	2500	2650	2750
28	2500	2500	2650	2750	2900
30	2600	2600	2750	2900	3050
32	2700	2700	2850	3000	3150

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 10 in 12 Roof Slope Foundation Height 7 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2350	2350	2400	2500	2550
26	2450	2450	2500	2600	2700
28	2550	2550	2600	2700	2800
30	2650	2650	2700	2800	2950
32	2750	2750	2800	2950	3050

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 12 in 12 Roof Slope Foundation Height 7 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2350	2350	2350	2450	2500
26	2450	2450	2450	2550	2650
28	2600	2600	2600	2650	2750
30	2700	2700	2700	2750	2850
32	2800	2800	2800	2900	3000

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Roof Construction Foundation Height 8 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2150	2200	2300	2400	2550
22	2250	2300	2400	2500	2650
24	2300	2350	2500	2600	2750
26	2400	2450	2550	2700	2850
28	2450	2500	2650	2800	2950
30	2550	2600	2750	2900	3050
32	2600	2650	2850	3000	3150

Required Allowable Soil Bearing Capacity (psf) One-Story: Conventional Floor and Truss Roof Construction Foundation Height 8 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2200	2250	2350	2450	2550
22	2250	2300	2450	2550	2650
24	2350	2400	2500	2650	2800
26	2400	2450	2600	2750	2900
28	2500	2550	2700	2850	3000
30	2550	2650	2800	2950	3100
32	2650	2700	2900	3050	3200

Required Allowable Soil Bearing Capacity (psf) One-Story: Truss Floor Construction Truss Roof Construction Foundation Height 8 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2500	2550	2650	2750	2850
22	2600	2650	2750	2900	3000
24	2700	2750	2900	3000	3150
26	2800	2850	3000	3150	3300
28	2900	2950	3100	3250	3400
30	3000	3100	3250	3400	3550
32	3150	3200	3350	3550	3700

Required Allowable Soil Bearing Capacity (psf) Two-Story: Conventional Construction All Floors and Roof Foundation Height 8 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2500	2550	2650	2750	2850
22	2600	2650	2750	2900	3000
24	2700	2750	2900	3000	3150
26	2800	2850	3000	3150	3250
28	2900	2950	3100	3250	3400
30	3000	3050	3200	3350	3550
32	3100	3150	3300	3500	3650

Required Allowable Soil Bearing Capacity (psf) Two-Story: Conventional Construction All Floors with Truss Roof Foundation Height 8 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	2550	2550	2700	2800	2900
22	2650	2700	2800	2900	3050
24	2750	2800	2900	3050	3150
26	2850	2900	3050	3150	3300
28	2950	3000	3150	3300	3450
30	3050	3100	3250	3400	3550
32	3150	3200	3350	3550	3700

Required Allowable Soil Bearing Capacity (psf) Two-Story: Truss Construction All Floors and Roof Foundation Height 8 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	3050	3100	3200	3350	3450
22	3200	3250	3400	3500	3650
24	3400	3450	3550	3700	3800
26	3550	3600	3750	3850	4000
28	3700	3750	3900	4050	4200
30	3850	3900	4050	4250	4400
32	4000	4050	4250	4400	4550

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 8 in 12 Roof Slope Foundation Height 8 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2400	2450	2550	2700	2800
26	2550	2550	2650	2800	2900
28	2650	2650	2800	2900	3050
30	2750	2750	2900	3050	3200
32	2850	2850	3000	3150	3300

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 10 in 12 Roof Slope Foundation Height 8 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2500	2500	2550	2650	2700
26	2600	2600	2650	2750	2850
28	2700	2700	2750	2850	2950
30	2800	2800	2850	2950	3100
32	2900	2900	2950	3100	3200

Required Allowable Soil Bearing Capacity (psf) One-and-One-Half-Story 12 in 12 Roof Slope Foundation Height 8 Ft., Foundation Width 10 In.					
Building Width (ft)	Snow Load (psf)				
	20	30	40	50	60
20	---	---	---	---	---
22	---	---	---	---	---
24	2500	2500	2500	2600	2650
26	2600	2600	2600	2700	2800
28	2750	2750	2750	2800	2900
30	2850	2850	2850	2900	3000
32	2950	2950	2950	3050	3150