A Methodology for Seismic Design and Construction of Single-Family Dwellings

Cost Impact
Analysis

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COST IMPACT ANALYSIS

For The Construction Recommendations in The Report Titled

"A METHODOLOGY FOR SEISMIC DESIGN AND CONSTRUCTION OF SINGLE FAMILY DWELLINGS"

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by

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NOTICE

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I

SUMMARY OF THE ANALYSIS

This report presents the results of a detailed analysis of the increased costs imposed by the earthquake resistive construction recommendations specified in the report titled " A Methodology for Seismic Design and Construction of Single Family Dwellings", hereafter referred to as the Report.

The methods used for the preparation of the cost impact analysis as well as the conclusions drawn are fully explained in the succeeding chapters. A brief synopsis of these items is contained in the remainder of this chapter.

Five basic designs consisting of four wood-frame and one exterior masonry walled house were studied. The wood-frame Houses are of one-story, two-story, split-level and split-entry configurations. A variety of exterior finish materials was assumed, with one exterior finish material assigned to each model. The split-entry home, Model F, was designed using the heaviest roofing, exterior and interior wall finish materials. The fifth model studied was a one-story house with exterior masonry walls similar in floor plan to the one-story wood-frame house. In addition the large windows and sliding doors of the one-and two-story houses were reduced in size in alternate designs, for a total of seven houses studied. Each house was designed for Seismic Zones 2 and 3 and for 15 psf, 25 psf, and 40 psf wind load. The impact of the Report on the cost of construction was determined for each design, using the Los Angeles region as a base area for incremental cost determinations and assuming the differential in cost to be the difference between the requirements of the Report and the requirements of the Conventional Construction Provisions and other applicable sections of the Uniform Building Code, 1973 edition.

Tables 1 and 2 of Chapter 6 summarize the results of the cost impact analysis by model and type of horizontal load. Table 1 specifies the impact in terms of dollars, while Table 2 converts this information to the percentage increase in construction costs. As shown in the latter tabulation, impact upon construction costs in seismic regions is very nominal, ranging from approximately 0.2 per cent to a maximum of 1.4 per cent. The impact on cost for high wind load designs was somewhat more uniform but greater than that for the requirements for seismic design.

Major conclusions reached include the following:

- Reasonable seismic protection similar to that offered other construction in Seismic Zones 2 and 3 can be provided in residential structures for relatively minimal cost. Certain configurations of homes which presently utilize construction details especially prone to damage in seismic disturbances are subject to a somewhat higher cost impact than more standardized designs.

- The Report was intended primarily to deal with the damage caused by earthquakes. Although it is flexible enough to be useful in designing for high wind loads as well, the methodology presented for the determination of wind loads to lines of shear resistance is not as sophisticated as it should be to allow for optimum economy in design.

- The assignment of the same shear values for exterior and interior wall finish materials for both wind and seismic loads is questioned. It is suggested that a higher value (and therefore a lower factor of safety) might be acceptable for these materials in conjunction with wind load designs.

- Testing to determine the uniformity and validity of the results upon which present shear resisting values are based is suggested. In addition, it is concluded that testing to determine allowable values for combinations of exterior and interior finish materials would reduce the cost impact of the methodology and provide more realistic and economical designs for both types of lateral loads.

- In designing these homes the Report was "tested" and found practical for use in seismic areas. As mentioned above, some revisions to the methodology would be necessary to obtain the same effectiveness in high wind areas.

II

DESIGN OF THE COST ANALYSIS

HOUSE SELECTION

Five basic floor plans and variations on two of these plans were selected for the homes to be used for this study. The four dwellings with wood frame exterior walls are intended to be representative of the four basic floor plans currently used for home design in many parts of the country. These are the simple one-story home, a two-story house, a split-level house and a split-entry house. In addition, a one-story residence incorporating exterior masonry walls is provided to represent that type of construction. The last home is similar in floor plan to the wood-frame one-story house. Floor plans, elevations, foundation plans and material specifications for each of these Model homes is included in Appendix A.

The one-story, two-story and split-level homes, as well as the house with exterior masonry walls, are as they appear as Example Homes in the Report with revisions as noted below and are designated Models A, B, C and E respectively. Since Model D as presented in the Report is not used for this analysis, no such model designation is used herein. The split-entry home is therefore designated Model F.

Models B and C are essentially identical to homes actually damaged in the 1971 San Fernando Earthquake. Model A, while not a reproduction of any particular house, is representative of typical one-story home design and construction in the area affected by that earthquake. These three models therefore represent typical Southern California designs utilizing relatively large window openings, sliding glass doors, etc. Because of energy requirements, as well as normal design practices in colder climates, Models A and B were modified to represent designs with smaller exterior wall openings and are presented as Models A-1 and B-1. In order to more nearly balance the length of shear walls on the various sides of Model B-1, the fireplace was relocated from the rear to the left side. When presented in the Report, the rear wall of Model B was also a modification of the actual home design as it existed in the earthquake area. The rear wall of the actual house contained slightly more shear wall. This was reduced to the minimum allowed by Section 2518 (f) 5 of the Uniform Building Code.

In making the initial selection of Models A, B and C for inclusion in the Report as Example Homes, consideration was given to both the type of damage sustained and the representation the particular model afforded as being generally typical for houses of the type represented. Models B and C were contained in tract type developments and were included in the survey of damaged homes reported in "Performance of Single Family Dwellings in the San Fernando Earthquake of 1971", May 1973, as reviewed as Reference 1 of Task 1 of damage data reviewed in developing the Report. Variation in damage to individual houses of both Models B and C was extreme. Despite the fact that the referenced report studied only the more severely damaged homes, damage ratings for Model B varied from slight to total. At least two of these homes had to subsequently be torn down.

The two story portion of two of the homes depicted as Model C totally collapsed, while other homes of this type (not included in the reference) received only slight damage. This model was also slightly modified in plan in order to provide shear wall at the front of the garage as well as to avoid knowingly depicting actual existing homes in their entirety.

The plans, Calc Forms and cost data pertaining to the designs studied may be found in the Appendices.

MATERIAL SELECTION

Framing methods indicated and finish materials selected in no way relate to a specific existing residence but were selected to provide the widest possible variety of structurally acceptable finish materials. The reader should recognize that the selection of exterior finish in particular has an effect upon the cost impact of the Report. A house finished with exterior plywood siding, for instance, can be designed to develop shear resistances of up to 410 pounds per foot by simply decreasing nail spacing; while the same house, if finished in fiberboard, is limited to 175 pounds per foot and must use plywood beneath the finish material when shears exceed this amount. Therefore, to give the most realistic appraisal of maximum cost impact, plywood siding was assigned to Model A, the one-story residence developing the least shears in the various walls.

Since stucco and nailbase fiberboard develop very nearly the same allowable shears, and when gypsum board is used as an exterior finish material it is also used as the interior finish material with the result that allowable shear per foot may be doubled, virtually all exterior finishes other than plywood have an allowable shear of from 175 to 200 pounds per foot. Hardboard is the lone exception and falls midway between the other finishes and plywood with its allowable shears of 230 and 300 pounds per foot for ship-lap and butt-joint hardboard, respectively.

The heaviest of wall finish materials (and a heavy roofing material) was assigned to Model F. It was anticipated that this would provide a reasonably good comparison between this two-story house and the basic two-story design provided in Model B.

VENEER

A four inch thick brick veneer is provided at Model A, and the entire front of the house at the first story is four inch stone veneer on Model B. The effect of these materials upon the overall design of each residence is commented upon in the next chapter.

FOUNDATION CONDITIONS

The provision of basements under houses virtually eliminates the need for grade beams when unstable walls requiring hold-down anchors are encountered. Since Model A-1 is single story construction and is provided with the maximum in shear walls, it was anticipated that the cost impact of the recommended methodology would be the least for this home. It was also assumed that a further reduction would be achieved by providing a basement under this model.

Since all design calculations extend to the first floor only (except in a few unusual designs), a single set of calculations was necessary for the three Model C configurations. The mid-level was considered as having a basement beneath it in Model C, as being slab on grade in Model C-1, and with crawl space and wood floor construction in Model C-2. The only other variable introduced into these three designs is the location of grade at the rear of the two-story portion. Variations in cost for these three models are therefore caused by the variables due to these two items and can easily be discerned.

FIREPLACES

Although fireplaces are shown for each model, Models A, B, and C were designed as if no fireplace were present. The cost take-offs also reflect the omission of the fireplace for these models. Since the models in the Report were designed with a fireplace, it was anticipated that a comparison of the effect of the fireplace upon shear walls could be reasonably made. Although the cost impact of constructing masonry fireplaces in accordance with the Report's recommendations is discussed herein, it was recognized that the effect of a masonry fireplace on shear walls is much too variable to make any definitive comments with regard to additional costs which might be incurred in construction of shear walls when fireplaces are added.

UNUSUAL CONFIGURATIONS

The term "unusual configurations" was first used in conjunction with single-family dwellings by McClure in his report on dwelling damage in the San Fernando Earthquake referenced above. It is virtually impossible to provide an all-inclusive definition for this term. In brief, it refers to those elements of modern home design that cause these structures to become more prone to damage in earthquakes than the more box-like dwellings constructed a number of years ago. Included in this definition would be cathedral ceilings, cripple stud walls extending from the foundation to the wood first floor, vertical breaks in roof diaphragms, use of large amounts of glass (and therefore smaller amounts of shear wall), use of lightweight concrete fill on second floors and other similar conditions causing either an increase in seismic load, a decrease in the load resistance of the structure, or the development of an inherent weakness within the structure. The most common unusual configuration is the split-level home. The methodology and details are designed to automatically consider virtually all such conditions when they occur.

Without question, the Report's design and construction recommendations for these unusual configurations will increase the cost impact upon that design. The combinations and permutations of all such special conditions would be too complex to include in this analysis, however. In addition, the subtleties of the influence on cost would be very difficult to evaluate since in some designs little if any impact would be made, while exactly the same combination of conditions in a different design would create a more substantial increase in cost. The two most common unusual configurations have been considered in this analysis. Model C is a split-level house and Models A, B and C contain relatively large amounts of glass.

WIND

Methods used in making wind load designs vary considerably by locale. It was not intended that the Report be jointly directed to wind loads as well as seismic disturbances. A system for figuring wind load on the structure was included only because most local building agencies in Seismic Zone 3 require that wind loads be checked against seismic loads and that each individual shear wall be designed for the load which governs at that location. The method shown is in general use on the West Coast which includes most of Seismic Zone 3. The Report, therefore, includes wind load determination only to make the Report more practical by providing the home designer with guidelines for determining wind as well as earthquake loads to shear walls. The wind methodology of the Report does not entirely reflect the procedures set forth in the Hud Manual of Acceptable Practices, nor was it intended that the Report cover all considerations which are given to wind loads in high wind areas.

The designs for 15, 25 and 40 pound per square foot wind load used herein are intended to reflect only the impact on cost of the development of shear walls capable of resisting racking, overturning and sliding. Development of hurricane anchors or other devices used to resist roof uplift, as well as other conditions peculiar to wind load alone, are not reflected in the wind designs presented. In many areas where such devices are required, local codes already require their installation and no additional cost impact would therefore be implied. The same remarks are equally applicable to increased sizes of wood studs or roof members which could result in high wind areas.

One additional complication is created by the consideration of wind loads. The Uniform Building Code states that 1.5 times the load determined should be used in establishing the stability of shear walls for overturning. This presumably counters the decreased weight of the structure created by the uplift forces of the wind. This consideration is not required by other publications. It was therefore decided to design Model A with and without this requirement so that a comparison could be made. Since this consideration is not stated in the HUD Manual of Acceptable Practices, all other designs have been made without consideration of this provision. The existence of this complication is mentioned in the Report as a warning to the designer. The Report provides guidelines for overturning designs with variable loads and therefore local requirements will determine the necessity of incorporating this method of figuring overturning in the design.

III

DESIGN AND DETAILING

DESIGN METHODS AND ASSUMPTIONS

Insofar as possible, all designs were made utilizing the charts, tables, formulae and recommendations presented in the Report. In the preparation of the Calc Forms and the subsequent selection of details, the method or detail considered to be most economical was selected in virtually all cases. Where a choice of details was possible and the same detail occurred in more than one model, variations were presented in order to indicate the price variation created by the selection of method or detail. Shear wall plans, tributary area plans and completed Calc Forms for each model and loading condition are given in Appendix B.

When it was found necessary to require the application of plywood sheathing beneath the finish material, Structural II plywood was utilized in all cases. It was felt that too large a variation in cost would be reflected between models by changing plywood grade from model to model. Structural II plywood is the designation used in the Report to describe all grade-stamped plywood other than Structural I or Siding, and should not be interpreted as implying that the plywood itself must be grade-stamped Structural II.

Wind Load Designs

The Report discusses the fact that interior nondesigned walls parallel with the direction of movement resist small portions of the seismic load. A downward adjustment of interior wall loads to designed shear walls has been made in the Wall Load tables to account for this circumstance. When wind loads are applied no such allowance is made for nondesigned walls, although even 15 psf wind frequently governs shear wall design in Seismic Zone 3. It is believed this contradiction in assumptions has never before been noted. When preparing the two-story house designs for the higher wind loads, this anomaly quickly became apparent. For Model B-40 psf wind, for example, plywood is required at the second floor on Lines A and B of this relatively small structure. At Model F, Line A, the wind load is actually greater at the second floor than it is at the first floor when the methods set forth in the Report are utilized. Had interior second floor walls at Model F been used as shear walls, no plywood would have been required at the second floor. It was concluded that if the Report is to be used for high wind load designs, a somewhat more sophisticated methodology for dealing with these loads should be added.

Models A and A-1 (pp 112-132)

As mentioned previously, the existence of plywood siding for Model A precludes the necessity of providing plywood sheathing under the finish material. Inspection of shear per foot (pps 118-124)indicates that no special sheathing would need to be added for Seismic Zones 2 or 3 or 15 psf wind load (and 25 psf for A-1) if lesser shear resisting materials were used. Only wall C of Model A would require plywood sheathing at 25 psf wind load (p 122), but Walls B, C, E, F and G could require plywood sheathing if fiberboard were used for 40 psf wind (pps 125-126), and only Wall D would be eliminated from this list if ship-lap hardboard were used. If stucco were the exterior finish material, loads would be heavier and new calculations would be needed in order to make an exact determination, but the shear per foot would be approximately double. Assuming a doubling of the shear, Walls C and E of Model A would require the application of plywood sheathing in Seismic Zone 3 with no effect in Seismic Zone 2. For all materials other than stucco, hold-down anchors, sill bolting, etc., would not be affected. Wall B would apparently require additional hold-downs if stucco were used in Seismic Zone 3.

Models B and B-1 (pp 133-157)

The minimum shear wall (per UBC requirements) provided at the rear of Model B did not require the application of plywood until 40 pound wind loads were applied (Wall I, p 151). This was primarily due to the existence of the interior shear wall which does require plywood sheathing for both 25 and 40 pound wind loads (p 148). The left side wall (Line A on the tributary area plan, p 137) also required the application of plywood for 25 and 40 pound wind loads. Model B has 18'-0" of effective shear wall length at its front and only 9'-0" at the rear. The Rigidity Analysis supplied as a part of the Supplementary Engineering Analysis indicates that this model would be subject to considerable diaphragm rotation due to the imbalance of shear walls.

At Model B-1, the effective shear wall lengths have been adjusted to achieve a greater degree of balance. Twenty feet of effective shear wall length occurs at both the front and rear of the house, with fifteen feet at the left side and 26'-4" at the right-hand side of the two-story portion. Although the difference in lengths at each side is considerable, the length of side walls appeared to be adequate. The design of Model B-1 (pps 153-157) indicated that it would ultimately prove to be more expensive since plywood is required at the left side wall in Seismic Zone 3 and for all wind loads. Plywood is still required at the interior wall for 25 and 40 pound wind loads and at the front and rear wall for 40 pound wind. These considerations made it clear that the most economical design could be achieved by decreasing the size of the openings as was done in Model B-1, but leaving the fireplace located in the rear wall as is indicated for Model B.

Model C (pp 158-181)

The short wall adjacent to the garage door requires the use of hold-down anchors and plywood sheathing for all loads. When 25 and 40 pound wind loads are applied, the design of this wall is not possible using the Report and an engineered design must be provided. For 25 pound wind load the engineered design requires the use of 2 X 8 studs such that two hold-down anchors can be applied side by side to a 4 X 8 post at each end of the wall. Since no tables are supplied for grade beams using such a design, this also was done by engineering. For 40 pound wind load it became necessary to supply a wide flange column in line with the wall, since neither shear nor overturning could be effectively dealt with using the wall itself. The wide flange column would be installed by first pouring a small footing to which the column could be attached. The grade beam would then be poured around the column to provide proper embedment for transfer of moment.

Model E (pp 182-193)

Due to the short length of wall at the rear of the living room, it was necessary to provide a grade beam at Line F. All other walls proved to be stable for all loads other than 40 pound wind. For this latter load, it was assumed that it would be less expensive to grout the wall solid than to provide grade beams at the various locations. Since this was not possible at Line F, a grade beam is provided at this location for all models and solid grouted walls are provided at other locations for the 40 pound design.

Model F (pp 194-212)

As stated in the previous chapter the heaviest of all loads was applied to this model. The exterior stucco and interior lath and plaster are the most common wall finish materials used in the Southern California area. Although concrete roof tile is not often used for residential structures, Spanish tile is occasionally used. Split-entry homes are rarely, if ever, constructed in Southern California, however, but are constructed in other parts of Zone 3, usually with lighter weight finishes. Despite its heavy loads, the shear requirements for Seismic Zone 3 appear to be unusually severe. This is primarily caused by the upper story having a diaphragm ratio of nearly 2 to 1 and the almost 1 to 1 ratios between shear walls at the first floor.

An example of the adjustment a designer might make through knowledge developed by the use of the Report is shown in this model. The fireplace was originally shown as adjacent to the entry stairway. When it was determined that more shear wall was required at this location, the fireplace was shifted to the right to allow the wood-stud wall to extend behind it. The adjusted location is shown on the foundation plans for the various loads. This solution is not entirely desirable because it requires that the wall be constructed and shear resisting material applied before the fireplace is built. A more desirable solution might be to enclose the room shown by the dashed lines on the first floor plan (p 97), so that the shear wall provided adjacent to the front entry and this wall could be considered as acting together. The methodology would not require that the wall adjacent to the fireplace be used at all. Judgment would indicate that shear wall should be developed at this location. This type of decision will become apparent to users of the Report through experience.

Due to the configuration of this model it was assumed that the roof was framed from front to rear while the floor framing extended from side to side. This appears to be the most practical method of framing this house and has a secondary result of supplying considerable vertical load to all shear walls. As a result, relatively few hold-down anchors and grade beams are required. This slightly offsets the cost of the application of a large amount of plywood sheathing in Seismic Zone 3 and the 40 pound wind zone. The need for an adjustment in wind requirements is again emphasized when considering the 25 pound wind load design. Plywood is required at both end walls at the second floor while no plywood is required at these locations at the first floor.

Veneer

Because all shear resisting materials for Model A-Seismic Zone 3 prove to be sufficient, the veneer added at the front of the house had no affect upon cost. At Model B, veneer load represents less than 10% of the total load to Walls A and B. The shear resisting materials supplied would therefore still be required if a 10% reduction were effected. Since the affected walls are also stable, the only increase in cost in Seismic Zone 3 would be the addition of, at most, three anchor bolts.

DETAILING

Because the Report is intended for use in Seismic Zones 2 and 3, no particular problems were encountered in specifying the details to be used for earthquake loads. Several assumptions were necessary, however, in order to properly detail the various models for wind loads. The Report does not specify which Nailing Table should be used in various wind zones. A study of the table for Zone 2 indicated that roof nailing and all one-story construction is good for 15 pound wind zones, while two-story construction, in the worst case, is adequate for about 11 psf (assuming a 4 in 12 roof pitch). One story "heavyweight" construction in Zone 3 is capable or resisting a minimum of about 18 psf, while " lightweight" nailing can take only 15 psf in the worst case. These figures are predicated upon a maximum 2 to 1 diaphragm ratio for one-story construction and 1 -1/2 to 1 for two-story. Most homes do not approach this diaphragm ratio, particularly if interior second floor walls are considered to be resisting wind loads. The closest the homes studied come to the diaphragm ratios mentioned is the 1.29 ratio of Model B. If interior second-floor walls are not assumed to resist wind (as they are not presently in the Report), the ratio for the roof of Model C is 2.29, however. In accordance with these findings, Zone 2 nailing was used for 15 psf wind designs and Zone 3 nailing for 25 and 40 psf wind.

Since the wind analysis presented in the Report is intended to be supplemental to the seismic applications, it was assumed that the arbitrary details such as water heater ties and cabinet fastenings, framing anchors at sole plates of two-story construction, and corner connections were applicable. The first two details mentioned would most probably not be required in zones having low seismic activity but high wind. The framing anchor fastenings at the sole plates would be at least as desirable in wind zones exceeding 15 psf as they are in Seismic Zones 2 and 3, but the necessity of the provision of the special corner details is questionable.

IV

DETERMINATION OF COSTS

The basis for all costs set forth herein are the prices in Los Angeles for September-October 1975. The conditions in the construction market during this time period will affect these cost estimates by an undetermined amount. When interviews with contractors were undertaken for the purpose of determining unit costs and other pertinent data, it was discovered that although most contractors were quite willing to discuss their costs and methods of estimating, there was virtual unanimity in declining to reduce such statements to writing. At first it was assumed that particular contractors did not wish to be associated by name with their costs or methods because of the competitive nature of their business. As more interviews were obtained, it became clear that the principal reason for this reluctance was the depressed state of the market in the Los Angeles area which had produced extreme competition. Dry-wall contractors, for example, were uniform in their statement that the cost for "structural nailing" (5d at 4) should have been more than the 3/8 to 1/2 cent per square foot being charged, but in view of the market, they could not obtain a higher figure.

Since no firm commitments could be obtained from any single contractor, a method was devised whereby two contractors were approached to provide estimates of installed costs and/or unit cost for particular items. If the prices quoted were essentially in agreement, the cost was noted and used. Where prices varied, at least one more contractor was approached. In all but one case this yielded an agreement between at least two contractors for the prices used.

One of the largest home builders in Southern California was furnished with a copy of the Design Methodology and Details and originally agreed to furnish unit costs. In conference with the contractor's architect, structural engineer and framing contractor, they determined the impact of the Report to be 75 to 90 dollars per house for one-story construction, 105 to 125 dollars for two-story construction and, using less accurate methods, approximately 260 dollars for split-level construction. The first two prices were based on a 1320 square foot, one-story house selling for $47,500 and an 1830 square foot, two-story house selling for $53,000. Having determined and transmitted this information verbally, they were unwilling to provide unit costs or write any letters verifying their findings. The information did tend to add credence to the cost analysis made, however.

Where slight variations in costs quoted were found, the highest price was used in an attempt to somewhat offset the market conditions discussed above. The one exception to this rule involved Detail 15, Continuous Footings. Each contractor approached indicated that he would achieve the detail in an entirely different way or, if using the same method, quoted considerably different costs. One contractor felt that placing dowels would be the least expensive and intended to place the pre-bent dowels along with the anchor bolts near the edge of the footings. Another indicated that he would insert the dowels into the concrete while it was still wet and bend them after the concrete cured. The first contractor mentioned stated that if the key detail were used it would be necessary to use milled 2 X 4's which he estimated could be reused five times. A third contractor stated he would use framing lumber and remove it as soon as the concrete had set enough to be self-supporting. He then planned to use the framing lumber in the structure so that there would be no material cost. The latter contractor estimated his method at six cents per foot, while still another agreed that the last method would indeed be the cheapest, but that it would be necessary for a laborer to remain to remove the 2 X 4's before they became locked in the concrete, with the result that the cost would be somewhat higher. Ultimately a cost of 25 cents per foot was used for dowels and 15 cents per foot was used for the 2 X 4 key. It is considered that these prices are the most questionable in the cost analysis, however.

Another complicating factor was the apparent widespread use of piece-work payments being used in the Los Angeles area. The local HUD cost estimator indicated that the split-level tie details would probably be priced uniformally as piece work, despite the fact that Detail 11 is considerably more complicated that Details 9 or 12. This method was not used in the analysis. In all cases, it was attempted to obtain an accurate cost foreach detail by either obtaining the costs themselves from contractors, or by obtaining both the cost of material and an estimate of time to install the detail. The unit and detail costs used are shown in Appendix C

Model Home Cost Analysis

To obtain the cost impact of each type of load on each model, the base cost of those details other than shear resisting materials, nailing, sill bolting, hold-down anchors and grade beams was first established for Seismic Zone 3. To account for the difference in nailing requirements for Seismic Zone 2, the base cost was subsequently reduced for Zone 2 and for 15 pound wind loads by subtracting the difference in unit cost between the zones and multiplying it by the quantity effected. In most cases the unit cost impact in Zone 2 was zero and the entire cost of the item could be deducted. These calculations were not shown in detail since they have relatively little effect on the base cost in most instances.

Cost impact was assumed to be the difference between the cost of items required by the Report and the cost of those items already required by the Conventional

Construction Provisions, Section 2518 of the 1973 edition of the Uniform Building Code. For the masonry House (Model E) in Zone 2, the base cost was assumed to be a house with partially reinforced masonry walls, per Section 2419 (a) of the Uniform Building Code. It should be pointed out that many localities in Zone 2 do not now require that masonry in residential construction be as heavily reinforced as required by this Section of the Uniform Building Code. In those localities the increase in cost will be greater than indicated by this study, but it was not deemed reasonable to attribute those increased costs to the impact of the Report.

Where Section 2518 does not specify a procedure to be used, current practice in the Los Angeles area was considered to be the norm, since this practice usually reflects other requirements of the code. As an example, dry-wall must be attached in some manner to all wood stud walls. Section 2518 does not specify the required attachment for dry-wall for walls other than exterior walls and main cross stud partitions. It would not appear to be practical to attach some dry-wall in one fashion and the remainder in a different manner. General practice in the Los Angeles area is to attach all dry-wall with 5d nails at 7 inches on center, although occasionally other methods are used for interior non-structural partitions. The Report specified that all dry-wall be nailed with 5 d nails at 7 inches on center as a minimum. Since this nailing was taken as the norm for the Los Angeles area, no cost impact was associated to the nailing for dry-wall in the cost analysis. It was recognized that other methods are used in other parts of the country, and that the MPS refers to double nailing. The quantity of interior wall finish and other similar items which might have a cost impact elsewhere are therefore listed in the take-off, even though no unit cost is assigned to the item.

The structural requirements shown on the plans prepared for each individual loading were next itemized and then added to the base cost to obtain the cost impact for each model with each loading specified.

It was attempted to reflect field procedures in establishing the cost for all items. Since box nails are preferred for toe-nailing for instance, this type of nailing was assumed with a resultant increase in toe-nailing costs of 50%. Many costs, such as toe-nailing, nailing of dry-wall, etc. are usually figured in larger quantities with the result that it was necessary to list unit costs to the nearest mil in order to obtain some degree of accuracy. This procedure has been extended to other items where that degree of accuracy may not be justified.

In establishing areas for plywood, gypsum board and solid-grouted masonry wall, the following rules were used:

Masonry Walls: Use actual wall area deducting all openings.

Plywood: Consider all normal windows and single man-doors as solid wall. Take one-half of area for double-doors, floor-to-ceiling glass and other large openings wider than 3'-0". Consider area to be zero for 6'-8" high openings wider than 8'-0".

Dry-Wall: Take all area as solid and deduct one-half of door and full-height glass openings more than 3'-0" wide. Reduce total area obtained by 7 to 10 per cent depending upon number and size of openings. Use 9 per cent deduction for normal Southern California house.

V

COST OF OTHER CONSIDERATIONS

For various reasons, three major items of concern are not reflected in the analysis of the homes studied. These are snow, masonry fireplaces, and the special garage front wall detail. The cost impact and the reasons for their exclusion from the basic analysis are set forth below.

SNOW

The report does not require that snow loads be considered until they exceed 32 psf. This virtually excludes snow load consideration for all but mountainous regions in Seismic Zones 2 and 3. Where snow is to be considered, the Report requires that one-fourth of the vertical design load be included with roof load in obtaining the equivalent seismic forces. Since this condition will be relatively rare for FHA-financed homes, no design was prepared to consider the effects of snow load.

First-story walls of two-story construction are subjected to considerably larger loads than those in one-story houses. The one-story house will therefore be most affected by the inclusion of snow loads. Walls B and F of Model A were selected as representing the worst case for load in each direction in this particular home. It was assumed the worst case would be developed at those locations where the tributary width was the largest dimension. The forces applied by the various wind loads were then converted into equivalent horizontal Zone 3 force created by snow load in order to allow a comparison between the requirements of designs already made and the forces generated with snow load. For transverse loading it was found that the 15 pound wind design on Wall B would support a vertical design snow load of 66 psf and that the 25 pound design would support a load of 151 psf. In the longitudinal direction, 15 pound wind load on Wall F is virtually identical to the Seismic Zone 3 load, and no increase for snow would therefore be acceptable. The 25 pound load is equivalent to a 43 pound snow load and 40 pound wind is equivalent to 105 psf. In both cases the shear walls at the particular lines studied are quite long. Framing anchor hold-downs are required for the wind loads equivalent to the seismic force created by snow loads of 70 pounds or less, with the heavier angle hold-downs required for a capacity equivalent to 100 psf or greater snow load. Plywood sheathing is not required for lighter snow loads when other finishes are used, but it is required for heavier loads.

MASONRY FIREPLACES

The reinforcing and tying of masonry fireplaces as detailed in the Report is already required in California. Although masonry fireplaces were omitted from the designs for Models A, B and C, the cost impact of the fireplace construction using Los Angeles as a base area would therefore be zero. In addition, the one-and two-family dwelling code endorsed by BOCA, Southern Building Code Congress, ICBO, the National Building Code, and American Insurance Association requires that masonry fireplaces in Seismic Zone 3 be strapped and tied in a similar manner. These requirements are presently not met in most parts of the country and there will therefore be a cost impact in meeting these requirements. In view of the requirements already stated in both the Uniform Building Code and the one and two-family dwelling code, it is questionable whether this impact should be assigned directly to the Report. In utilizing the unit costs developed for other items it would appear that the additional cost for the reinforcing and ties as shown on Detail 47/4 in the Report would be approximately $50. This requirement was instituted in the Salt Lake City area during the year previous to the study. The cost analyst in the Salt Lake City HUD office stated that his figures indicated impact of cost to be more nearly $150.

In addition to the cost of reinforcing and tying the fireplace itself, the affect upon shear walls must be considered. It is impossible to make any generalized conclusions in this matter. Many shear walls are loaded to only a small portion of their shear and overturning capacity with the result that the additional load generated by the reaction of the chimney upon the structure has no impact at all. When special shear resistance must be developed it will be found in many cases that the addition of the fireplace load again has little effect since the additional shear per foot will frequently fall within the range of that material. It is only when the additional load requires a change in shear resisting material or the addition of hold-down anchors that costs are affected. When such is the case, the additional cost can quickly approach $50 to $100 or even more.

SPECIAL GARAGE FRONT WALL

It is estimated that the Special Garage Front Wall Details will cost approximately $40 for one-story construction and $51 for two-story construction. A 4'-0" minimum length shear wall would be required if the detail is not used, however. The grade beam cost alone for the 4'-0" long shear wall at the front of Model C, Zone 3, is $111.11. The savings achieved through the use of the front wall detail are offset by the requirement that 100% of the load must be taken by the rear wall of the garage but a net savings should result. In addition, this detail allows the use of slightly narrower garages than would be required if a shear panel were provided.

VI

COST IMPACT AND CONCLUSIONS

GENERAL

Table 1 summarizes the cost impact of the Report on each house studied for each of the various loads. No incremental increases in cost are listed in Table 1 for 25 and 40 psf wind loads on Model C and its variations because these designs could not be achieved through the use of the Report's methodology alone. Engineering is required at the front of the garage on these models as discussed in Chapter III (Model C). The detailed supporting data may be found in Appendix C.

Table 2 states the range of percentage impact upon the builder's cost of construction. The cost of construction itself varies considerably, depending upon the size and purchasing power of the developer plus the size of the tract. Based upon the square foot area of the house itself (excluding garage) costs without contractors' overhead or markup range from about \$18 to \$23 per square foot, and up. \$18 and \$23 were multiplied by the square footage of each model studied to establish the range of construction cost. The lower percentage indicated in Table 2 is based upon the higher costs for the small builder, while the higher percentage assumes no cost savings by the large builder and results in a percentage increase which is almost certainly conservative. In assessing the accuracy of these tabulations, a number of factors must be weighed. Of major concern are:

1. Accuracy of the estimates themselves.
2. Present economic conditions.
3. Relationship to future cost.
4. Inflation.

Accuracy of the Estimates Themselves

Considerable effort was expended in the cross-checking of unit prices. It is therefore believed that the prices used in the estimates reflect, with reasonable accuracy, the current unit costs in the Los Angeles base area. Because of various systems used to determine costs, such as piece work, it cannot be assumed that the total cost of several of the new details introduced in the Report are as equally accurate. The costs assigned do, however, reflect the best estimates of material and labor required to construct the detail.

TABLE 1

ADDITIONAL COST IN DOLLARS FOR THE CONSTRUCTION OF MODEL DWELLINGS INCORPORATING SEISMIC OR WIND DESIGN RECOMMENDATIONS *

SEISMIC OR WIND LOADING	DWELLING BY MODEL DESIGNATION										
	'A'	'A' 1.5 x O. T.	'A-1' Sliding door	'A-1' Window	'B'	'B-1'	'C'	'C-1'	'C-2'	E	F
Zone 3	69.77	—	85.87	85.87	152.59	162.74	330.82	300.93	304.24	133.60	560.10
Zone 2	65.54	—	83.72	83.72	105.90	105.46	126.49	112.79	108.30	133.60	94.23
15 psf. wind	72.98	132.93	93.95	90.83	158.16	219.77	512.91	470.23	494.72	133.60	97.36
25 psf. wind	137.24	252.52	139.99	136.87	333.86	365.28	—	—	—	133.60	282.26
40 psf. wind	464.64	503.28	365.40	335.33	787.50	706.03	—	—	—	357.20	758.09

* Design recommendations as given in the report titled " A Methodology for Seismic Design and Construction of Single-Family Dwellings". Costs for September-October , 1975.

Present Economic Conditions

The depressed but highly competitive nature of the construction industry in the Los Angeles area at the time of the study apparently depressed the costs assigned to performing some types of work. It cannot be foreseen that this condition will markedly change in the foreseeable future.

Relationship to Future Cost

Table 2 was prepared to allow the reader to place the cost impact of the Report in perspective by relating it to the cost of construction of the dwelling. Although costs might vary for individual items due to the competitiveness of the market, increases in wage rates for one trade but not for another, etc., the impact of the Report on the base area should not affect the overall percentage impact as greatly as cost itself.

Inflation

In a recent 12-month period the cost of new housing increased by approximately 20 per cent in the Los Angeles area. This far outstripped the concurrent high inflation rate of the economy as a whole. It is not the function of this analysis to predict future inflationary spirals or the impact of this phenomenon on the construction industry. As discussed above, the use of Table 2 approximates the cost impact of the Report regardless of inflation.

IMPACT ON OTHER LOCALES

To obtain a broader view of pricing and construction methods, a telephone survey of HUD cost analysts was conducted. The selection of cities surveyed was based on either the seismic zone location, the presence of a high wind area or simply to fill out geographical representation. With the exception of dry-wall application, the prices obtained were uniformally lower than those considered in the analysis. A summary of the information obtained is contained in Table 3. Although no firm conclusion can be drawn from this brief survey, it seems reasonable to assume that although some recommendations of the Report would create a larger cost impact in areas not utilizing present UBC requirements (such as reinforced masonry, for instance), for most items the cost impact in terms of dollars would be less in other locales because of a lower labor rate. It is also interesting to note that where wind load designs are required by local building authorities, the requirements are never greater than those required by the MAP and are sometimes less. In Coral Gables, Florida, for example, the MAP tables imply that the wind load in flat open country

TABLE 2

PERCENTAGE INCREASE * IN CONSTRUCTION COST FOR MODEL DWELLINGS INCORPORATING SEISMIC OR WIND DESIGN RECOMMENDATIONS **

SEISMIC OR WIND LOADING	DWELLING BY MODEL DESIGNATION										
	'A'	'A' 1.5 x O. T.	'A-1' Sliding door	'A-1' Window	'B'	'B-1'	'C'	'C-1'	'C-2'	E	F
Zone 3	0.3 0.24		0.37 0.29	0.37 0.29	0.42 0.33	0.45 0.35	0.81 0.63	0.74 0.58	0.74 0.58	0.48 0.38	1.4 1.1
Zone 2	0.28 0.22		0.36 0.28	0.36 0.28	0.29 0.23	0.29 0.23	0.31 0.24	0.28 0.22	0.27 0.21	0.48 0.38	0.24 0.18
15 psf wind	0.31 0.25	0.57 0.45	0.41 0.32	0.39 0.31	0.44 0.34	0.61 0.47	1.3 0.98	1.2 0.90	1.2 0.95	0.48 0.38	0.24 0.19
25 psf wind	0.59 0.46	1.1 0.85	0.60 0.47	0.59 0.46	0.92 0.72	1.0 0.79				0.48 0.38	0.71 0.55
40 psf wind	2.00 1.57	2.2 1.7	1.6 1.2	1.4 1.1	2.2 1.7	1.9 1.5				1.3 1.0	1.9 1.5

* Estimated upper and lower bounds given

**Design recommendations as given in the report titled " A Methodology for Seismic Design and Construction of Single-Family Dwellings".

TABLE 3

MISCELLANEOUS CONSTRUCTION COST AND CONSTRUCTION PRACTICE INFORMATION FROM VARIOUS CITIES IN THE UNITED STATES *

ITEM	ESTIMATED PRICE	LOS ANGELES	SALT LAKE	OMAHA
Building Department Wind Load		15 psf	30 psf	
Carpenter Labor ($/hr): Base With Mark-up	$16.50	$9.03 + $3.00 $22.00	$6.50 (1) $7.50	$11.00 (1)
Frmg. Lumber: Grade Stud Grade Stud/Frmg. Cost	#164/200-225	D. F. D. F. $165/199	D. F. #1 D. F. std. up $189/199-239	So. Pine Hem-Fir $228/247
Fiber Board Attach. Cost/sq. ft.			4" E. N.-8"F. N. 18¢	6"-8"o. c. 14¢
Gyp. Board Attach. Cost/sq. ft.	26¢	5d @7" 22¢	Dbl. Nail 28¢	Dbl. Nail 21¢
Masonry: Cost/sq. ft. Reinforced Masonry Fireplaces Reinforced	$2.55	 Yes Yes Yes	$1.18 #4@30 Vert. Yes Yes	Brick: $2.76 Yes Yes No
Remarks			(1) Non-Union Union: 7.61 +1.28= $8.89	(1) $5.50 Non-Union Most Common

* Costs as of September-October, 1975

** Prices obtained from Hud Estimator do not necessarily match prices used for L. A. Base area

TABLE 3 (Cont.)

MISCELLANEOUS CONSTRUCTION COST AND CONSTRUCTION PRACTICE INFORMATION FROM VARIOUS CITIES IN THE UNITED STATES *

ITEM	CHICAGO	NEW ORLEANS	BOSTON	CORAL GABLES
Building Department Wind Load		25 psf.	10 psf	27 psf
Carpenter Labor ($/hr) Base With Mark-up	$9.65 + 1.24 $12.60	$5.00	$9.45 + 1.17 $12.85	$9.50
Frmg. Lumber: Grade Stud Grade Stud/Frmg. Cost	Yel. Pine Wes. Fir 170/180	So. Pine & D. F. Yel. Pine 170/220	D. F. Hemlock 185-200/210-230	Hemlock 190
Fiber Board Attach. Cost/sq. ft.		Nail Base 13¢		
Gyp. Board Attach. Cost/sq. ft.		8" E. N. 12"F. N. 16¢	5d @ 6"-8" 31¢	Dbl. Nail 25¢
Masonry: Cost/sq. ft. Reinforced Masonry Fireplaces Reinforced	$2.40 (1) No Yes No	 Very few 	$1.75 No Yes No	$0.78 Partial Very few Yes
Remarks	(1) Brick and block Combination			Mostly masonry exterior walls

* Costs as of September-October, 1975

should be 42 psf. The local building department requires that designs be provided for 22 psf up to 5 feet in height, 27 psf up to 15 feet and 33 psf up to 25 feet, with a 0.8 shape factor for rectangular prismatic structures. This wind load is not too unlike the MAP requirement for surburban areas and towns.

A minor effect of the Report will be to more nearly standardize construction techniques in the areas affected by it. Individual problems for a given locale will, of course, require adaptation of the details provided, rather than the direct use of those details. Despite this trend towards standardization, it is impossible to foresee or to be knowledgeable of all problems in all areas and the methods used to achieve solutions. It therefore cannot be predicted what unusual effects might occur through implementation of the Report in a particular locale. Over 90% of all homes built in the U. S. today are wood-frame with framing procedures that do not vary significantly from area to area. It is therefore concluded that the impact on construction costs in areas other than the one studied will not greatly exceed the estimates shown herein, despite the fact that some of these geographical areas do not presently use all of the methods required by the UBC, much less those encompassed in the Report.

WIND LOAD DESIGNS

The primary conclusion drawn from the 25 and 40 pound wind load designs is: if houses were designed and constructed as rigorously in high wind areas as is generally required in California for seismic loads, the resulting construction requirements would be more severe that those required for earthquake. Comments in previous tasks relating to the Report imply that this situation seems somewhat incongruous. Many areas with wind loadings exceeding those encountered in most parts of California require very little in the way of shear wall design or shear transfer for wind load resistance and yet rarely encounter severe problems from winds other than tornadoes. It is suspected that these problems are alleviated for one of two reasons: (1) either the wind load on the entire structure for which racking, overturning and sliding designs are made is less than the design requirements imply or (2) the shear resisting material has greater strength than that attributed to it. It is felt that the latter is primarily responsible in both a direct and indirect manner. Shear resisting materials are required by ICBO standards to have a minimum factor of safety of 3 to 1. In zones of high seismic activity this factor of safety is desirable because the ground motion frequently exceeds the design seismic loads by large amounts.

Collapse or severe damage is occasioned when total load exceeds the assigned factor of safety of the material or system. In wind zones, it is presumed that the wind load assigned approximates the maximum encountered. If this be the case it is questionable that a safety factor of 3 is necessary. It can be argued that the material would exceed the 1/8" deflection allowed for lesser shear resisting materials, but 3/8" and 1/2" plywood, especially when nailed with the closer nail spacings, also exceeds this value at design loads as would most other shear resisting materials when actual seismic force exceeds design force. It therefore appears that greater economy could be achieved, and still meet the intent of the Report, if higher shear resisting values were assigned when designing for wind loads.

Two other factors should enter into the further development of wind load criteria. As mentioned in Chapter III, interior walls assist the designed shear walls in resisting these loads. In addition, the mode of failure of homes in wind storms is considerably different than that encountered in earthquakes. There is little point in applying a safety factor of 3 for shear resisting materials if hold-down fastenings at roofs and design of individual members does not have a safety factor at least as great. The structure will not act in racking, overturning and sliding unless it first holds together. It is concluded that a further and more thorough analysis of wind load design is needed in order to make the most practical use of the Report when designing shear walls subjected to these conditions. It is also concluded that the Report's methodology for dealing with wind loads should be developed in a more sophisticated manner if cost impact is to be reduced.

SHEAR RESISTING MATERIALS

Regardless of whether the structure is subjected to wind or seismic load, additional economy could be achieved if more were known about the action of combinations of materials. At present it is not acceptable by building code standards (or in the Report) to combine exterior and interior finishes applied to the same wall when they are different materials. The very few tests made with combinations of materials imply that their values are additive or nearly additive. Exterior walls are therefore stronger than the designs indicate, while interior walls, with the same finish applied to both sides, may be developed to their full value. It would appear there is little impetus for the manufacturers of the various materials to conduct such tests.

The testing of the various shear resisting materials upon which present code values are based has taken place over the past 20 years. The values assigned by the ICBO were determined at the time the tests were submitted and it is presumed that different people sat on the committee making these determinations over the 20 year period. It is therefore not surprising that the assigned shear values seem inconsistent. It is concluded that a uniform review of all existing tests by a single panel would be useful.

It is believed that most of the recommendations made in this chapter would serve to reduce the cost of home construction and still allow the implementation of the Report in its entirety. At the very least, determination of the items mentioned above would assure greater and more uniform safety to the home owner.

APPENDIX A

FLOOR PLANS

ELEVATIONS

FOUNDATION PLANS

and

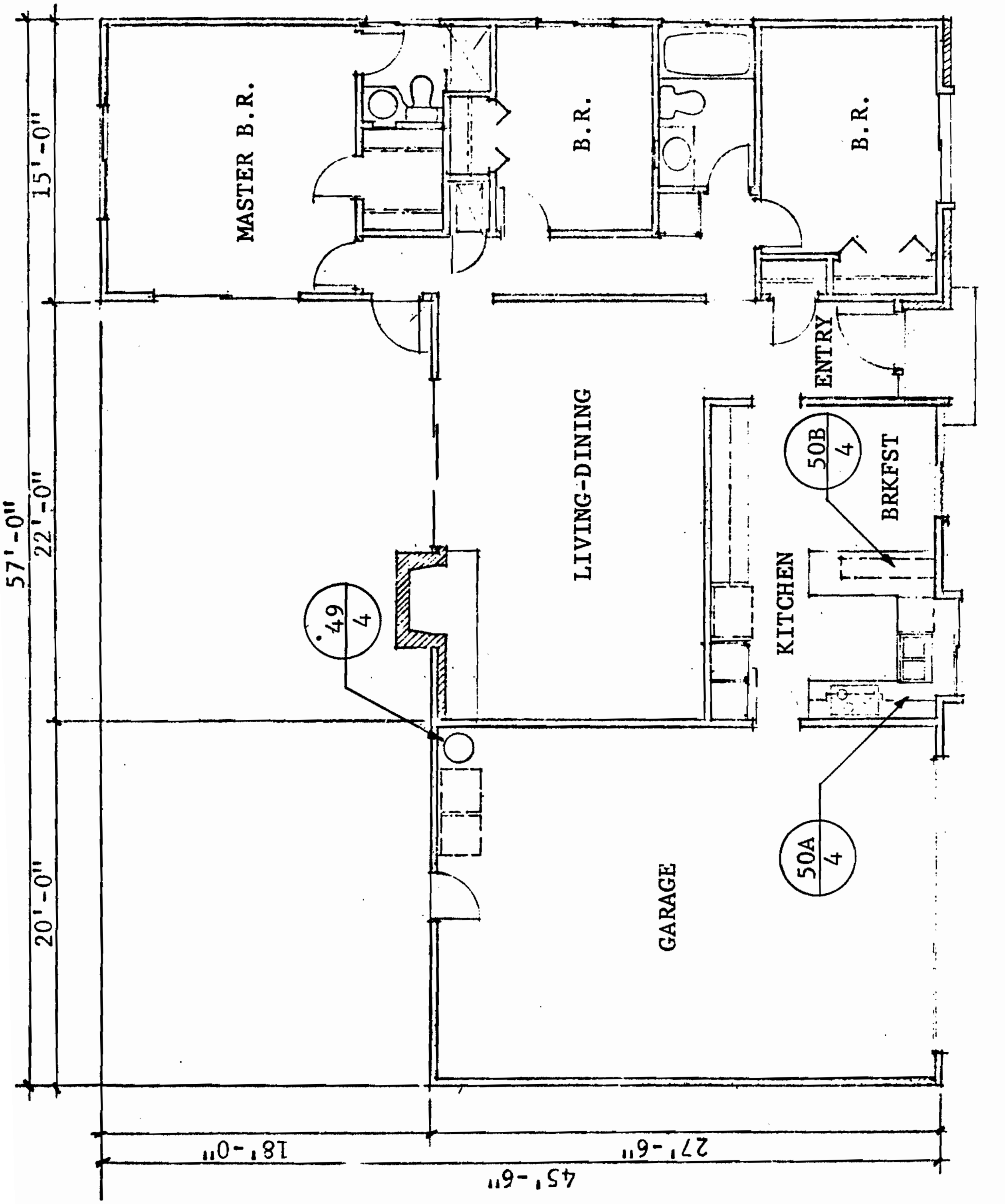
MATERIAL SPECIFICATIONS

FRAMING AND FINISH MATERIALS
FOR EXAMPLE HOMES

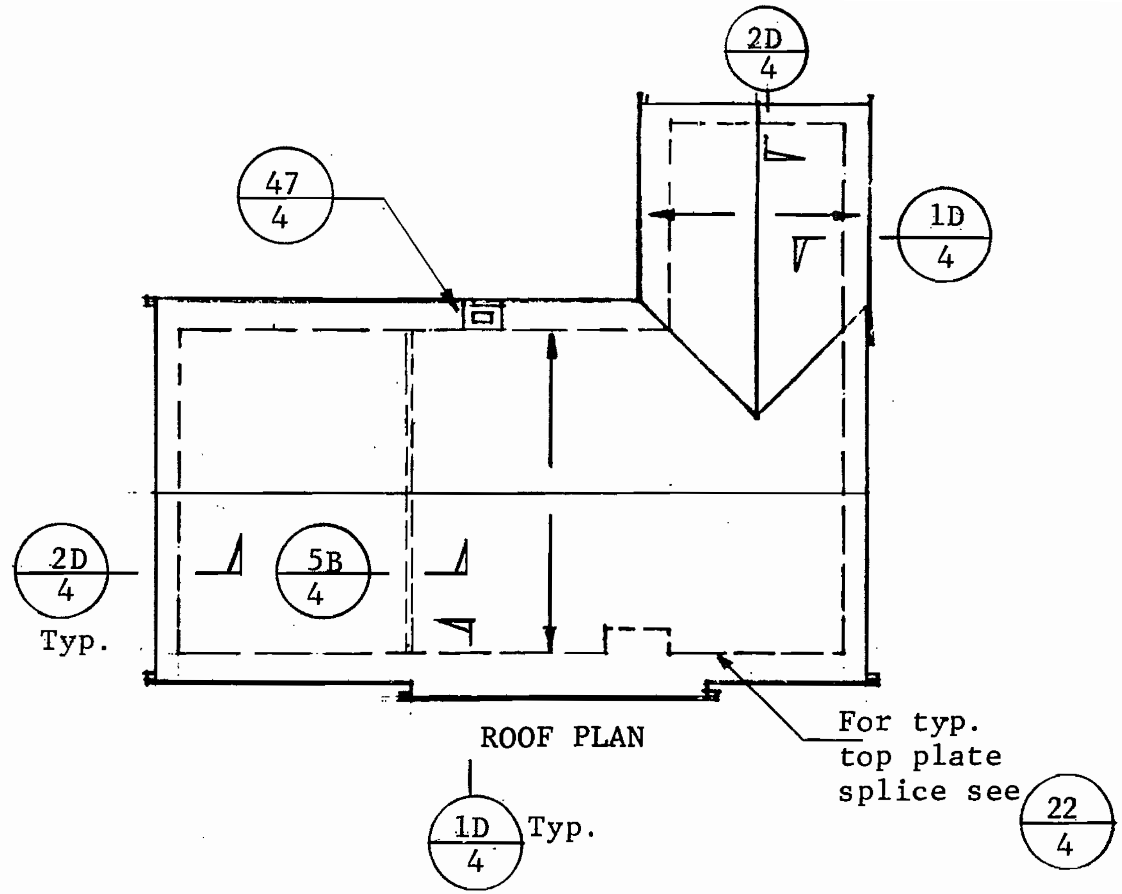
ROOF	Model 'A'	Model 'B'	Model 'C'
Roofing	Wood shake	Asphalt shingle	Asphalt shingle
Sheathing	Spaced	3/8" plywood	1/2" plywood
Roof Framing	Prefab. wood trusses	Standard wood framing	Prefab. wood trusses
Ceiling	Gypsum board with acoustic finish	Gypsum board	Gypsum board
SECOND FLOOR			
Flooring		Carpet	Carpet
Underlayment		None	5/16" particle-board
Sheathing		5/8" plywood	1/2" plywood
Framing		Wood	Wood
Ceiling		Gypsum board	Gypsum board
EXTERIOR WALL FINISH	Plywood Brick veneer	Hardboard Veneer	Fiberboard Wood siding
INTERIOR WALL FINISH	Gypsum board	Gypsum board	Gypsum board 5/16" plywood in family room

FRAMING AND FINISH MATERIALS
FOR EXAMPLE HOMES

	Model 'E'	Model 'F'
<u>ROOF</u>		
Roofing	Dec. rock	Concrete tile
Sheathing	1/2" plywood	1/2" plywood
Roof Framing	Prefab. wood trusses	Prefab. wood trusses
Ceiling	Gypsum board with acoustic finish	Gypsum lath and plaster
<u>SECOND FLOOR</u>		
Flooring		Carpet
Underlayment		
Sheathing		5/8" plywood
Framing		Wood
Ceiling		Gypsum lath and plaster
<u>EXTERIOR WALL FINISH</u>	Concrete block with int. furring and gyp. board	Stucco (Wood siding at front-2nd floor)
<u>INTERIOR WALL FINISH</u>	Gypsum board	Gypsum lath and plaster

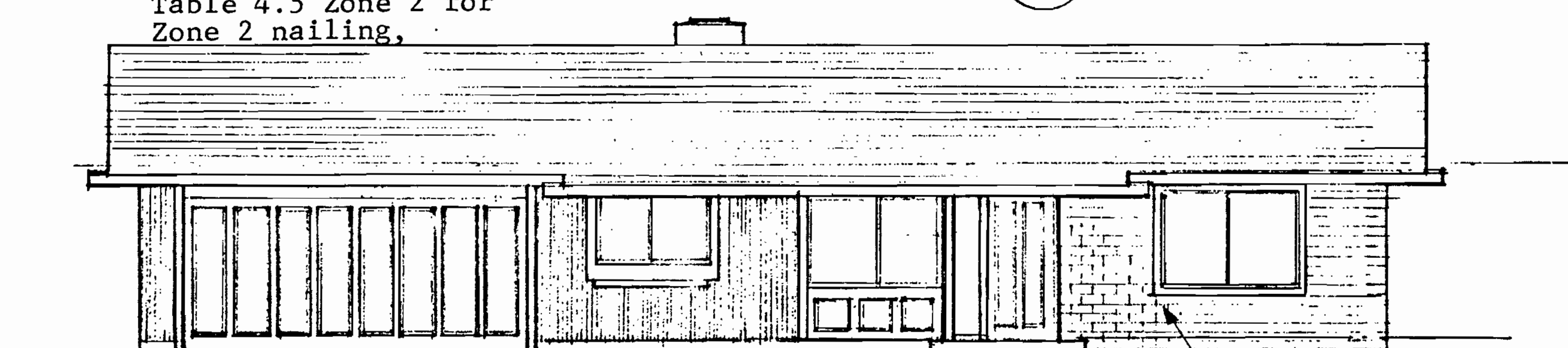


FLOOR PLAN - MODEL 'A'

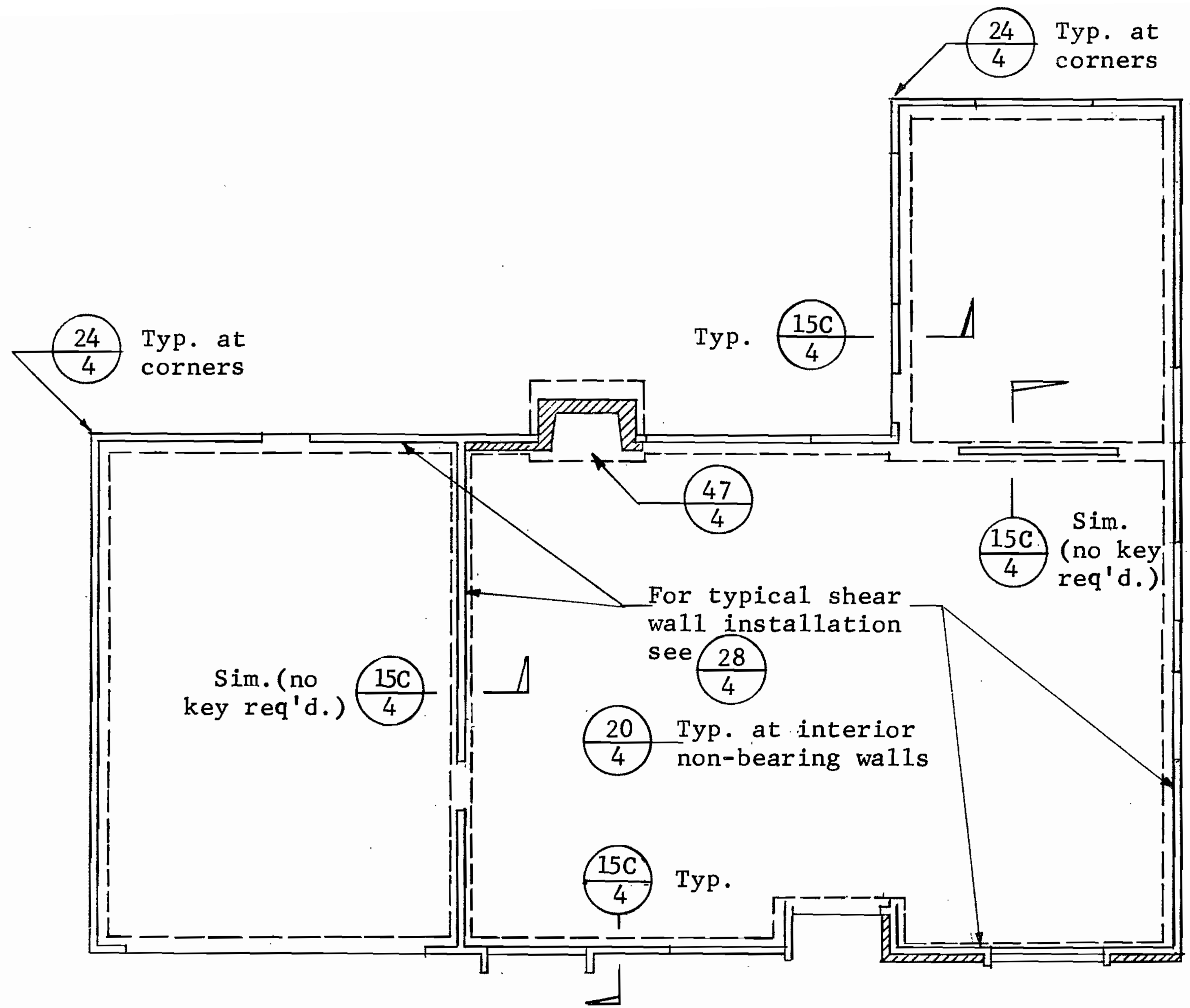


ROOF PLAN

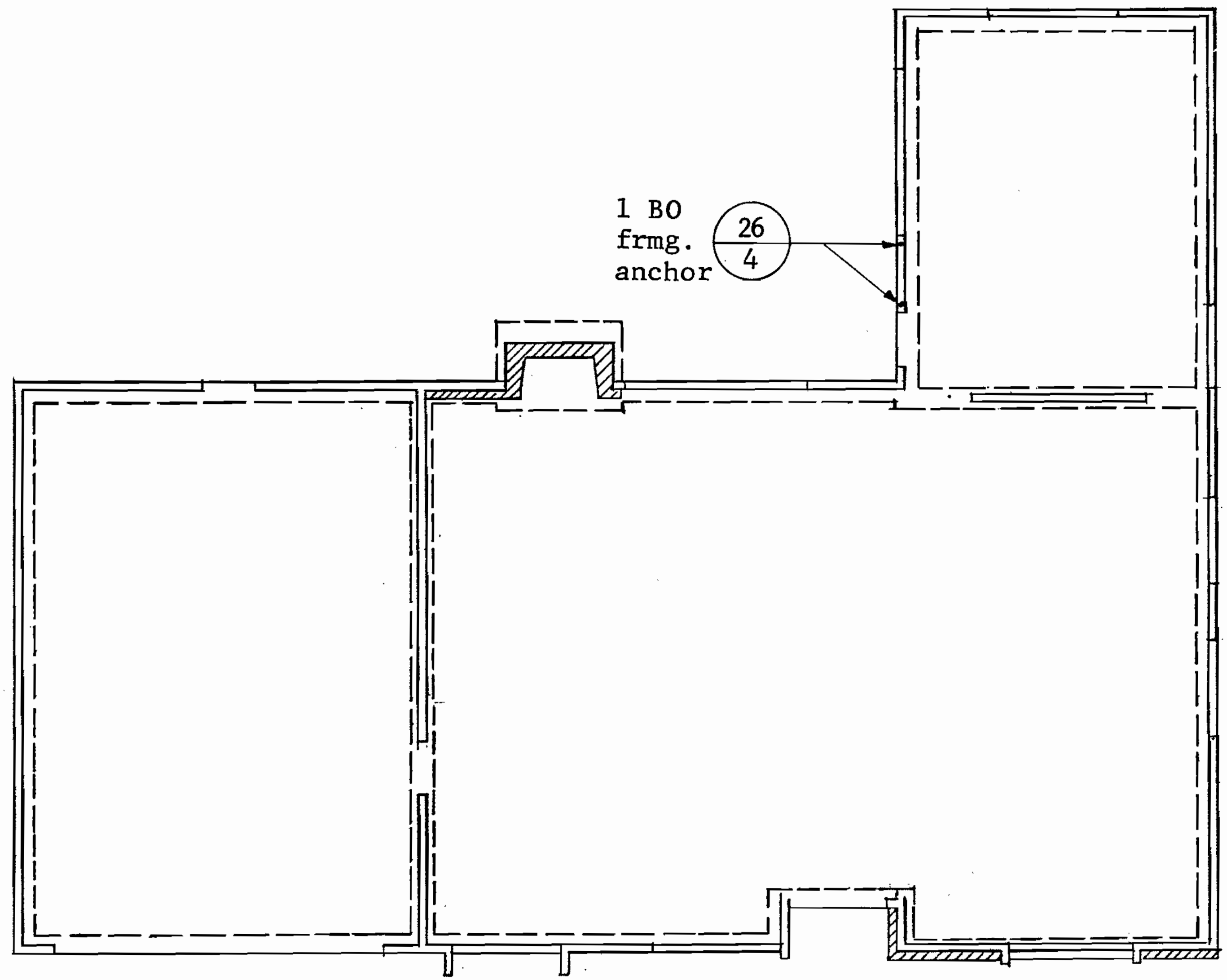
Note: Table 4.5-Zone 3 Nailing Schedule applicable to all designs other than Seismic Zone 2. See Table 4.5 Zone 2 for Zone 2 nailing,



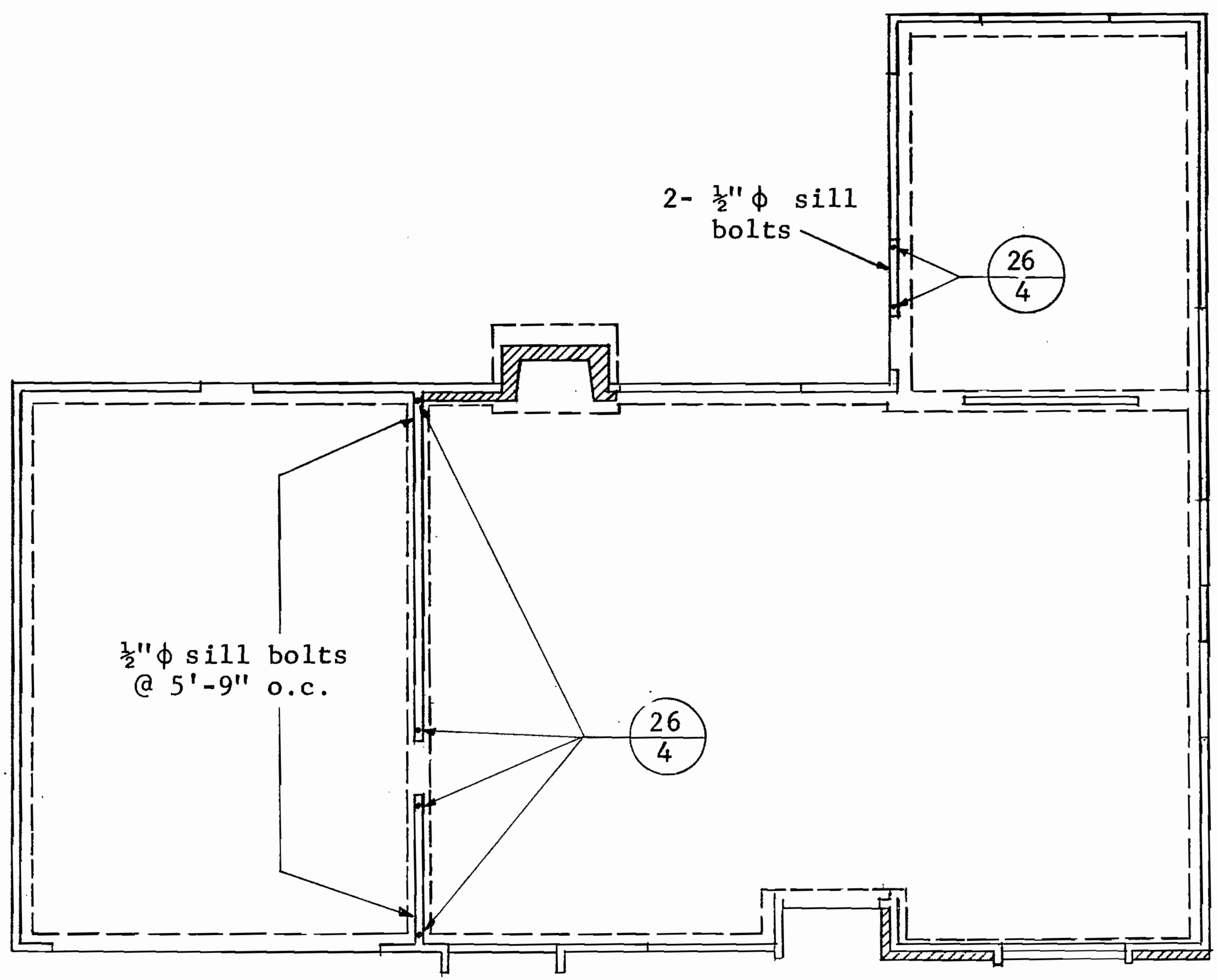
FRONT ELEVATION - MODEL 'A'



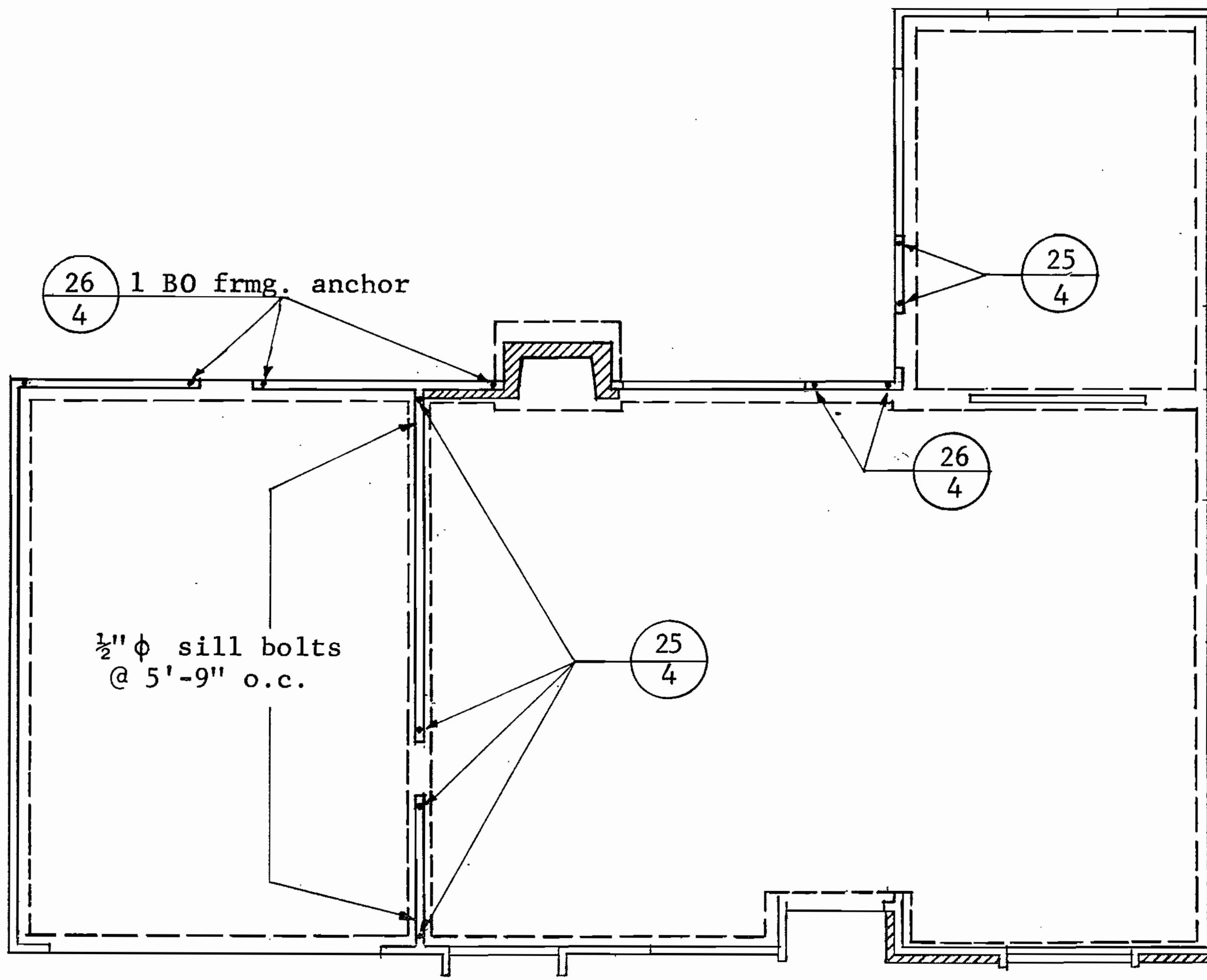
TYPICAL FOUNDATION PLAN - MODEL 'A' - ALL LOADS



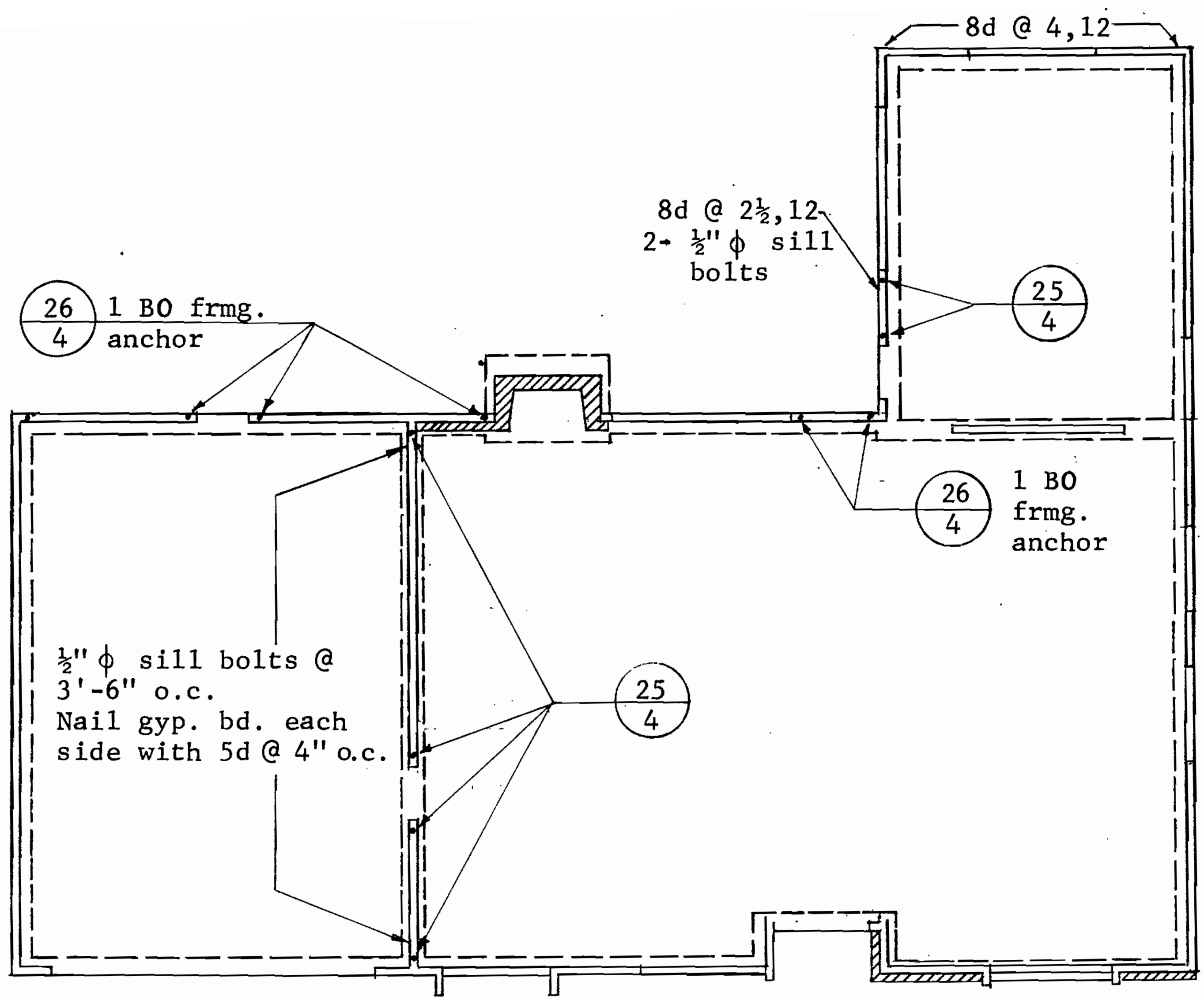
FOUNDATION PLAN - MODEL 'A' - SEISMIC ZONE 3



FOUNDATION PLAN - MODEL 'A' - 15 psf WIND

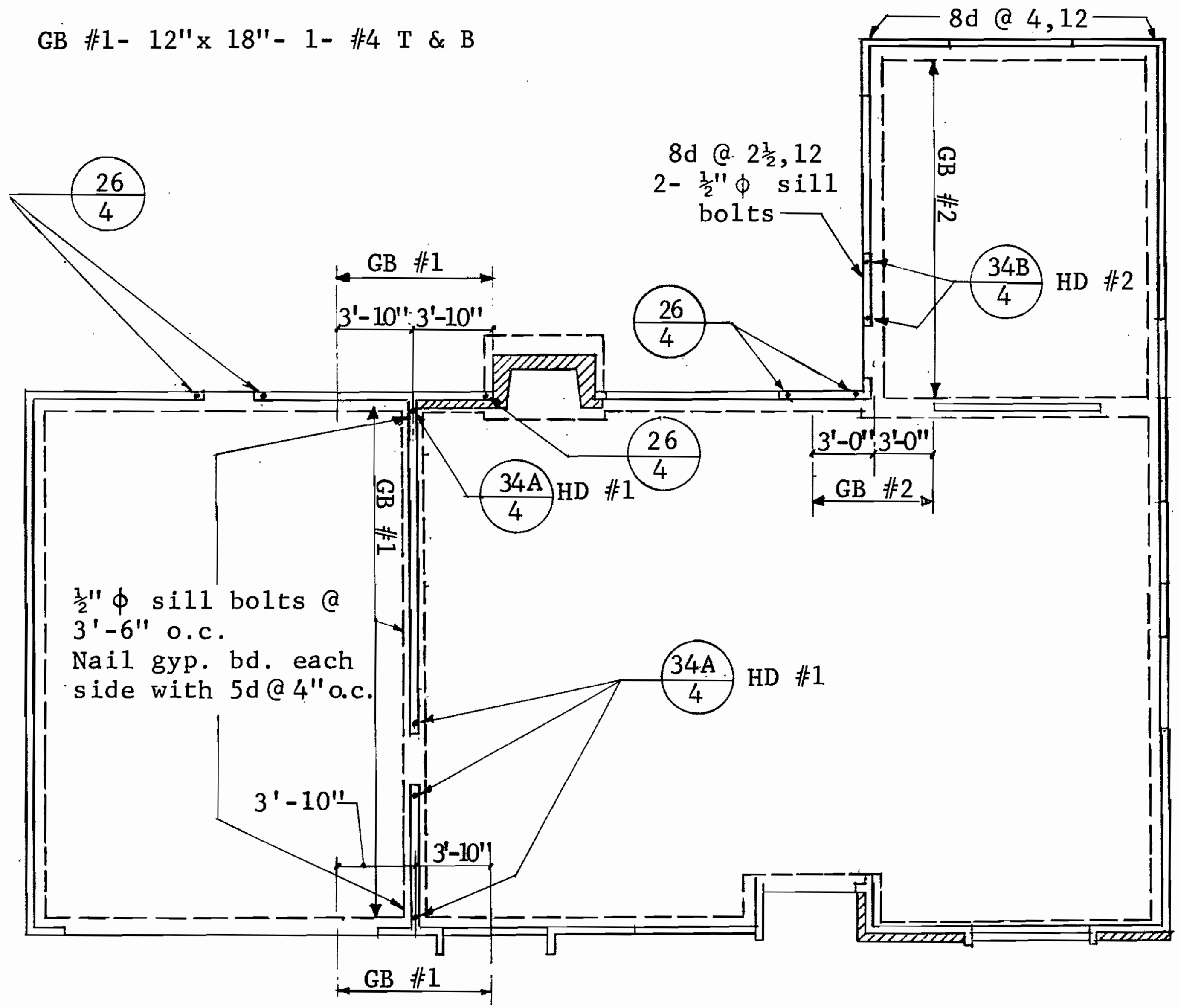


FOUNDATION PLAN - MODEL 'A' - 15 psf WIND - 1.5 x OVERTURNING

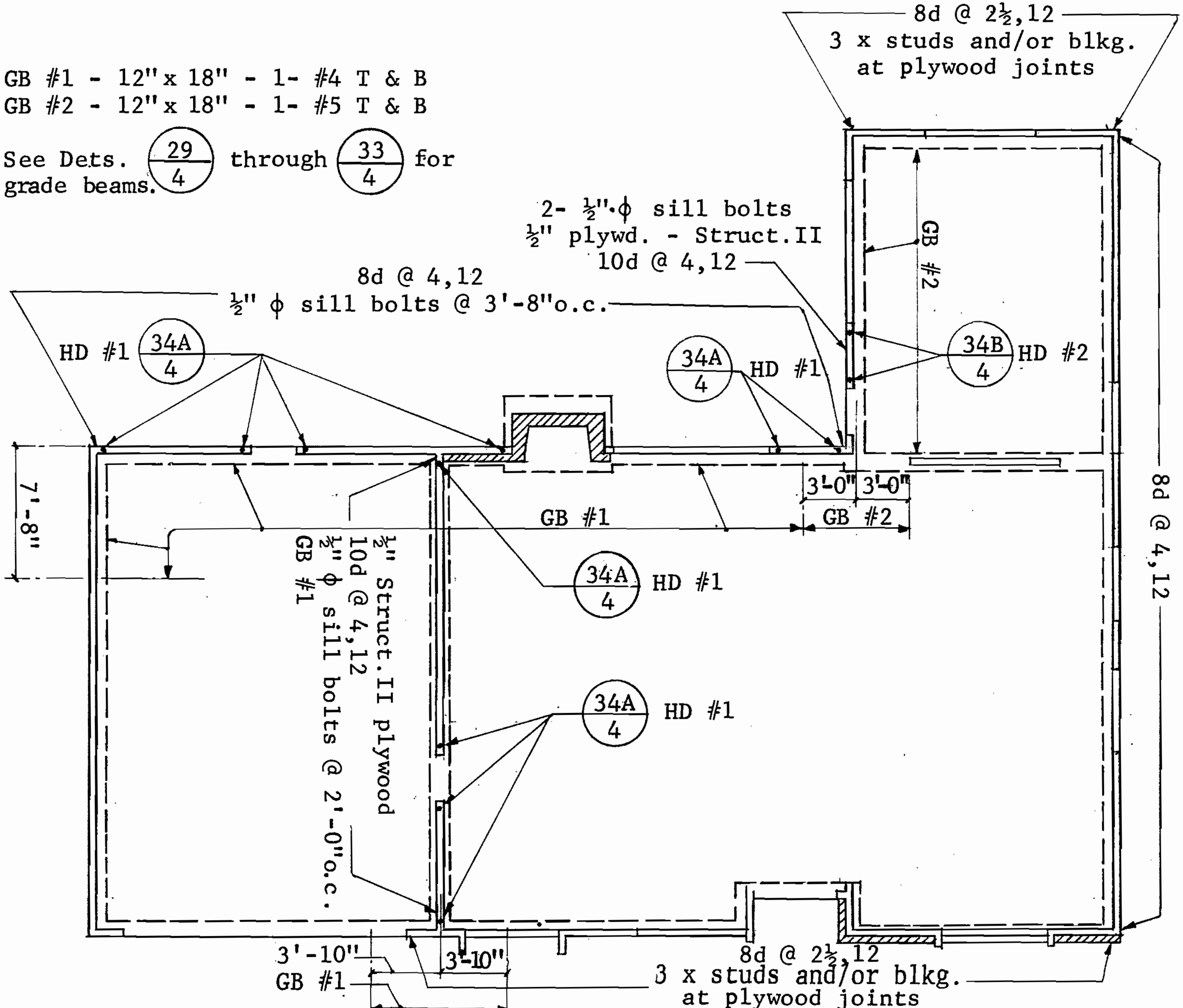


FOUNDATION PLAN - MODEL 'A' - 25 psf WIND

GB #1- 12"x 18"- 1- #4 T & B



FOUNDATION PLAN - MODEL 'A' - 25 psf WIND - 1.5 x OVERTURNING

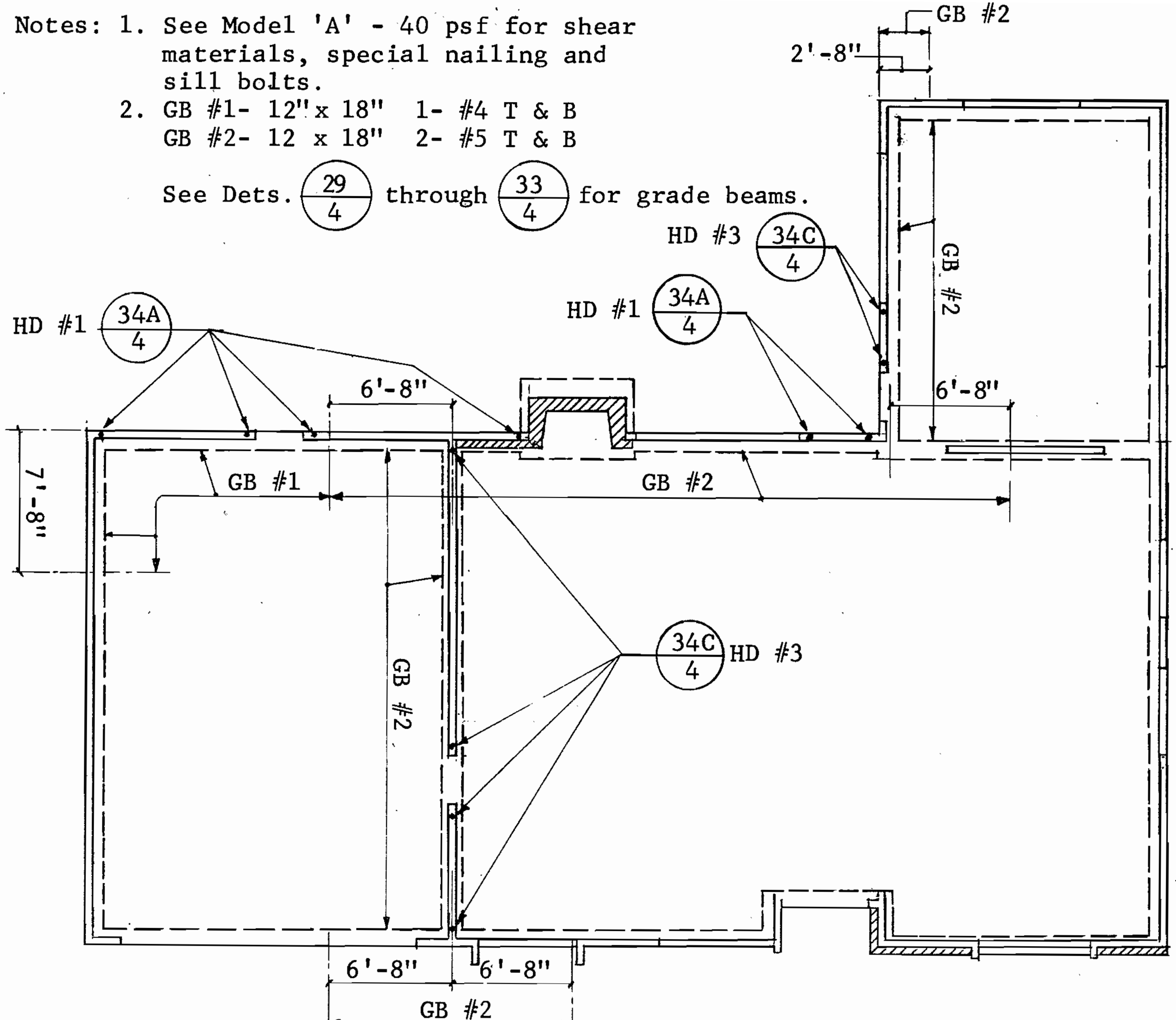


FOUNDATION PLAN - MODEL 'A' - 40 psf WIND

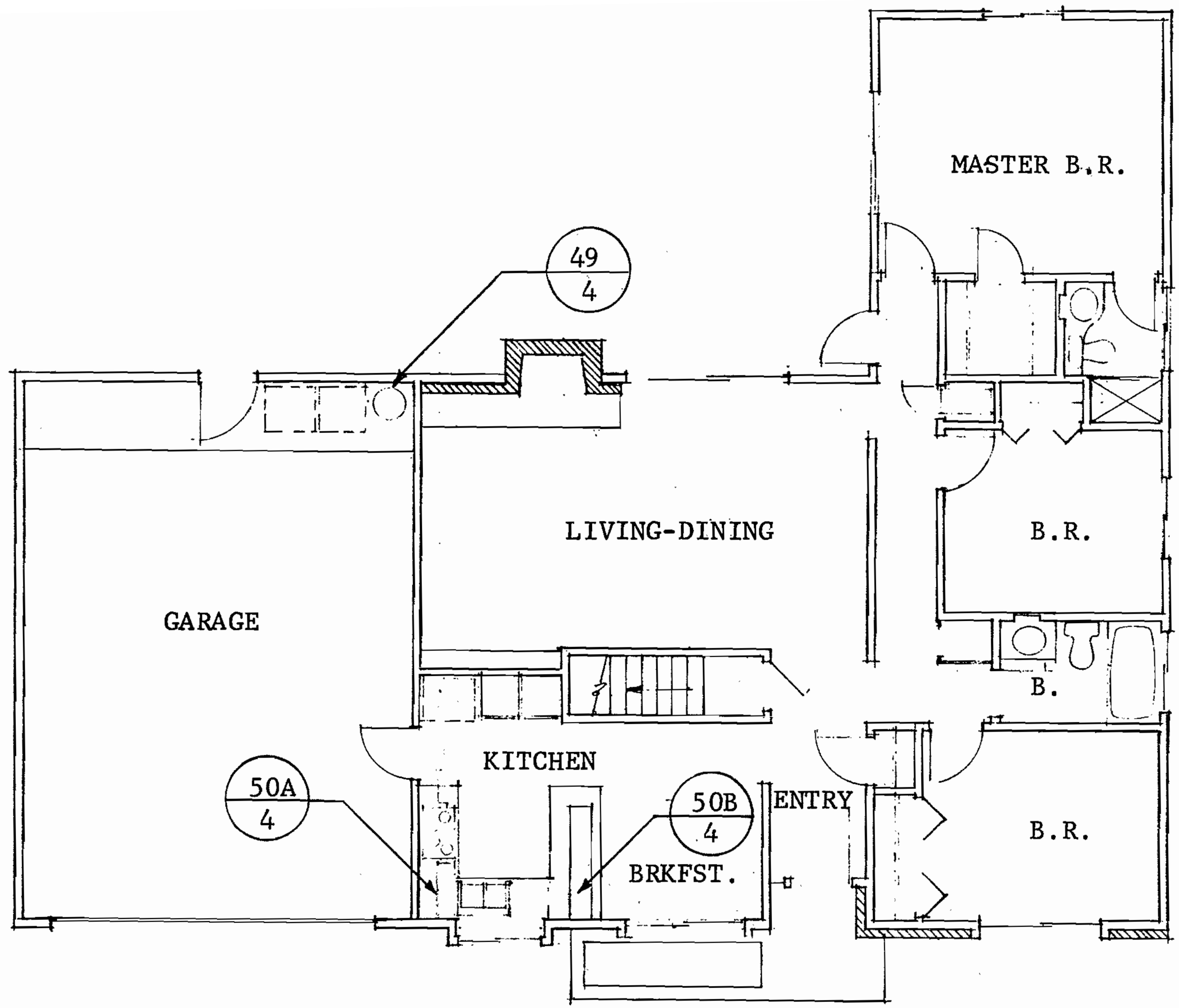
Notes: 1. See Model 'A' - 40 psf for shear materials, special nailing and sill bolts.

2. GB #1- 12" x 18"   1- #4 T & B
GB #2- 12 x 18"   2- #5 T & B

See Dets. 29/4 through 33/4 for grade beams.

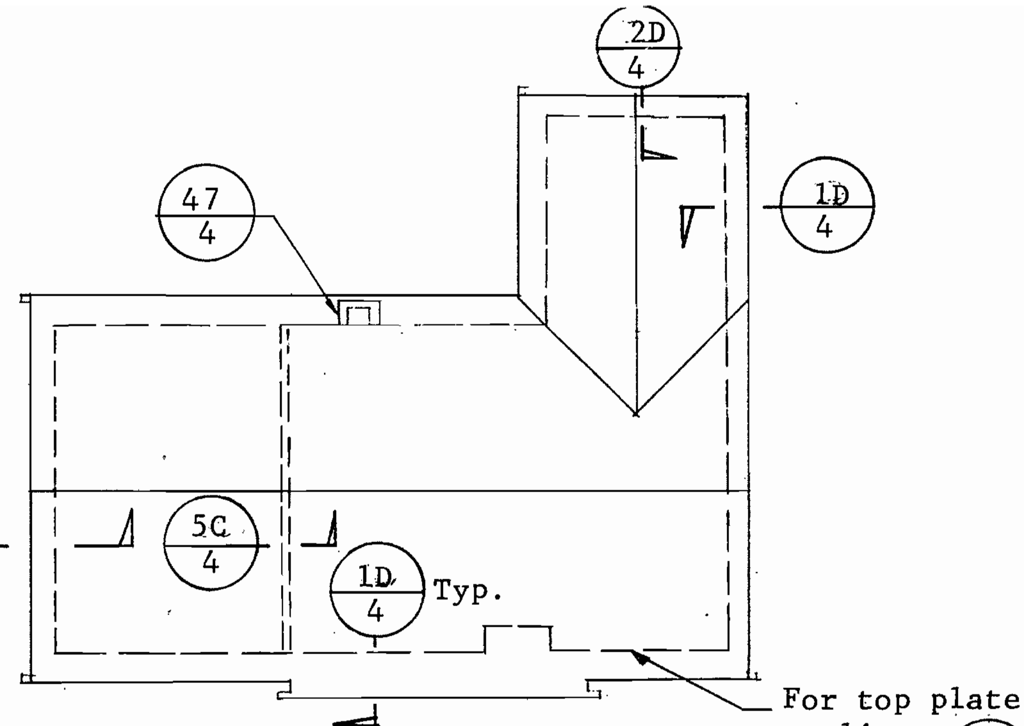


FOUNDATION PLAN - MODEL 'A' - 40 psf WIND - 1.5 x OVERTURNING

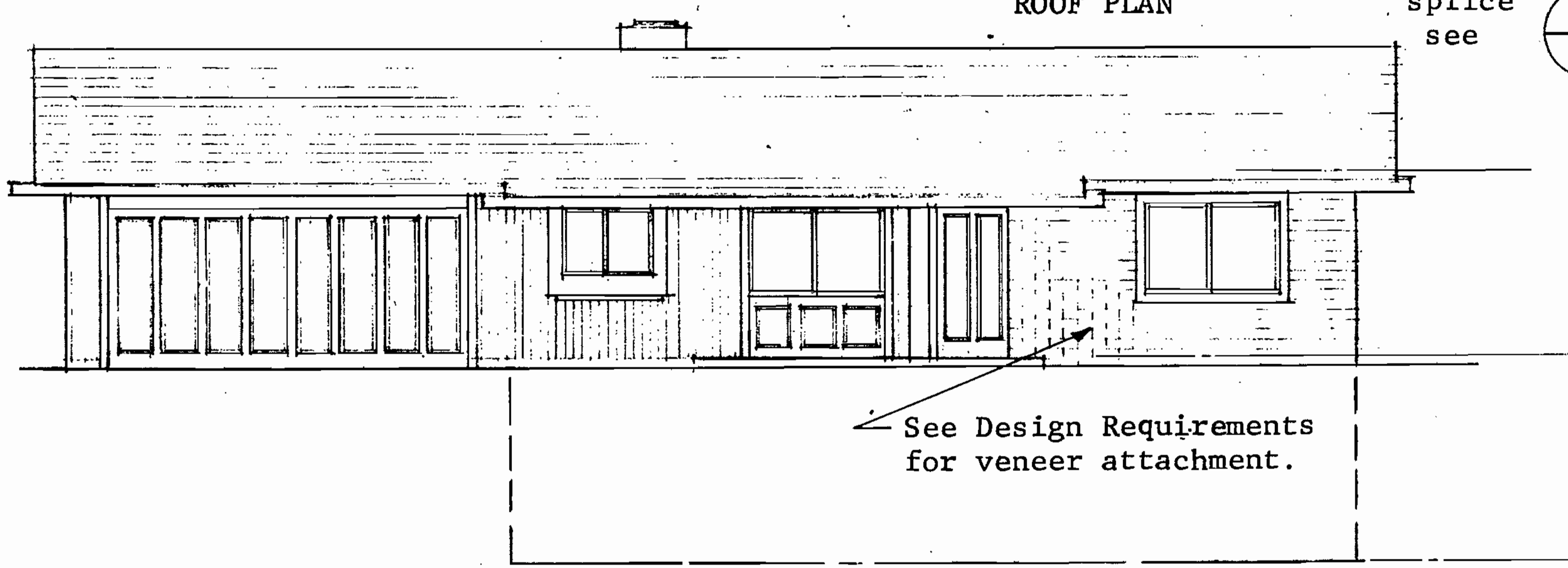


FIRST FLOOR PLAN - MODEL 'A-1'

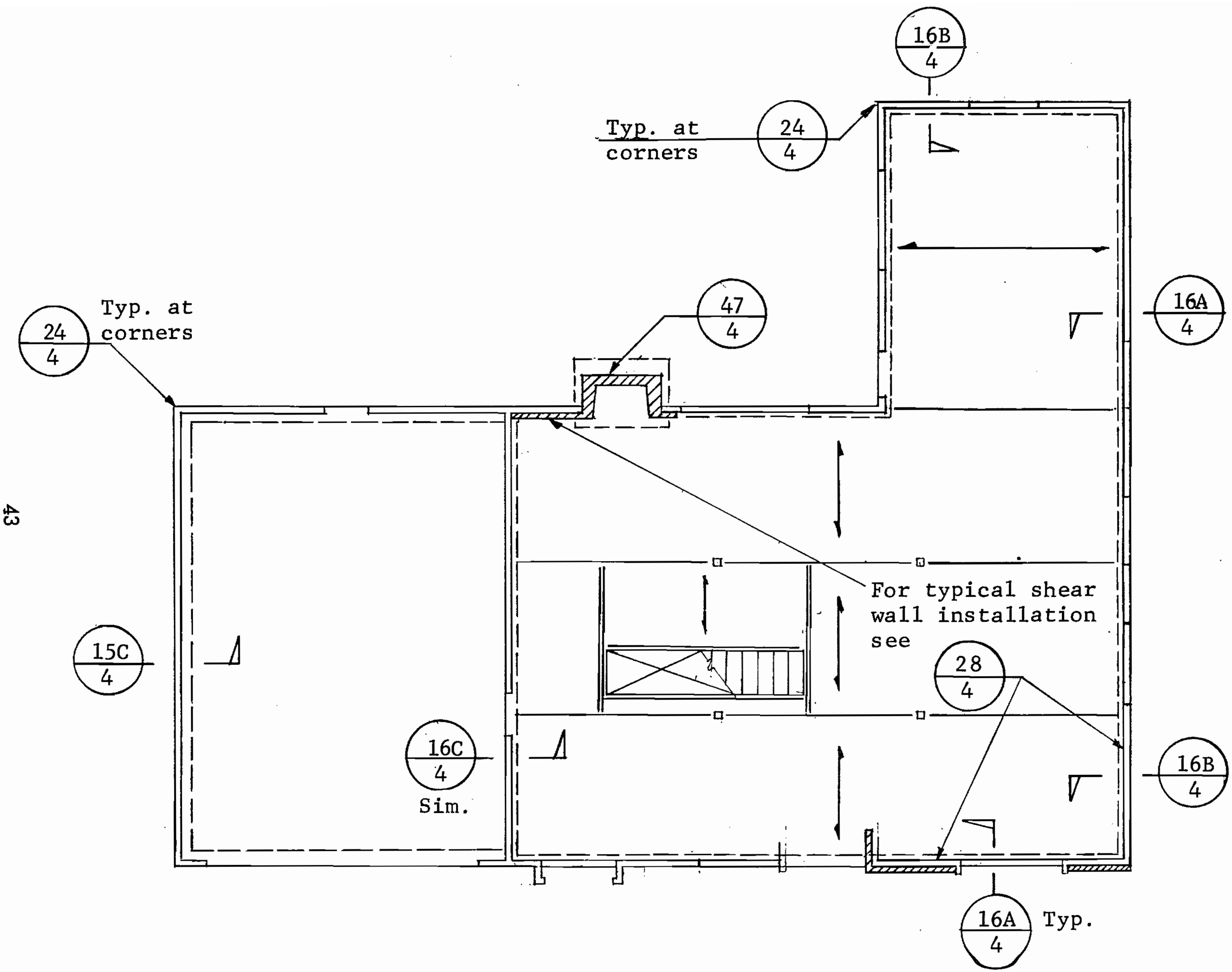
Note: Table 4.5 -Zone 3 Nailing Schedule applicable to all designs other than Seismic Zone 2. See Table 4.5 - Zone 2 for Zone 2 nailing.



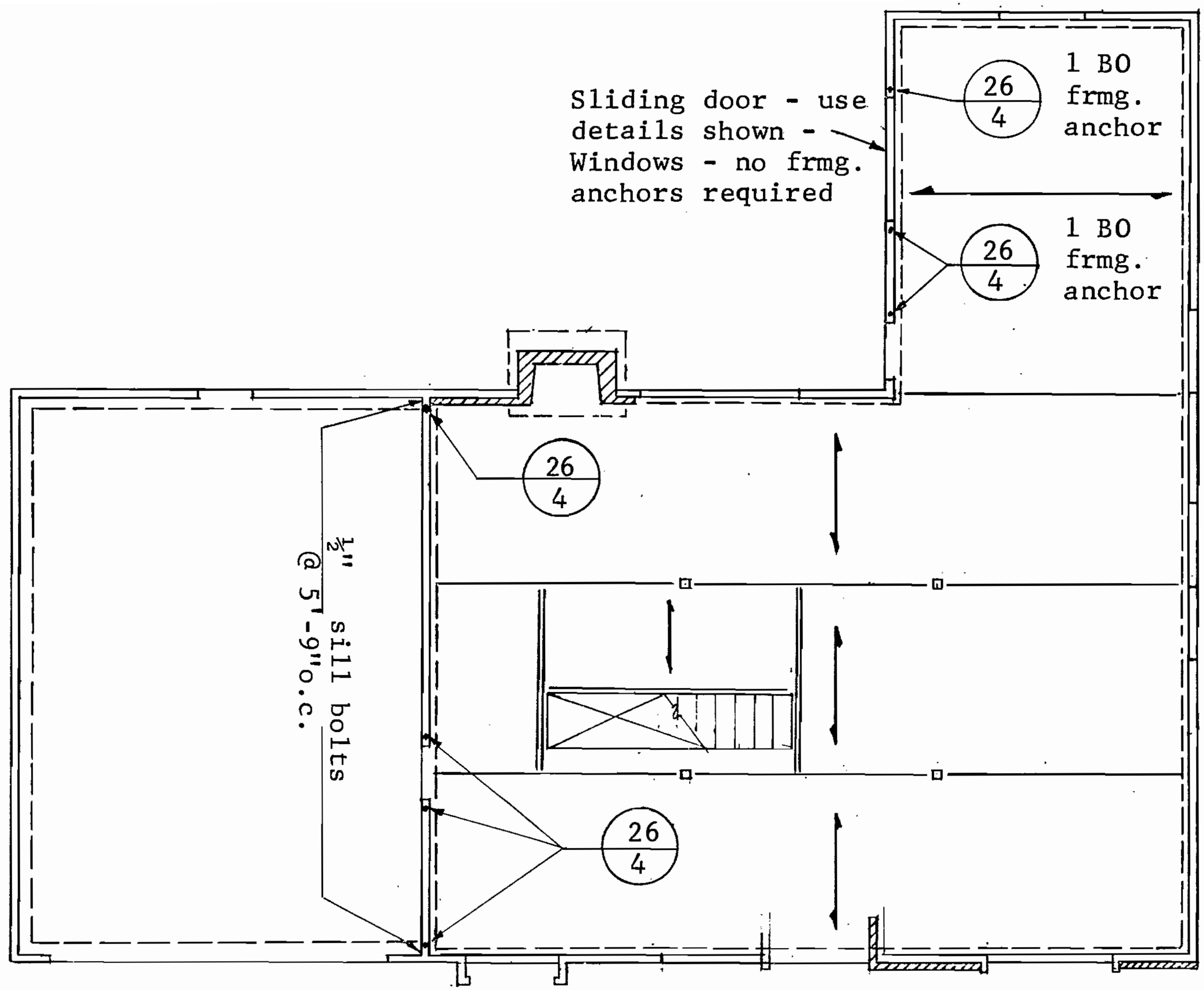
ROOF PLAN



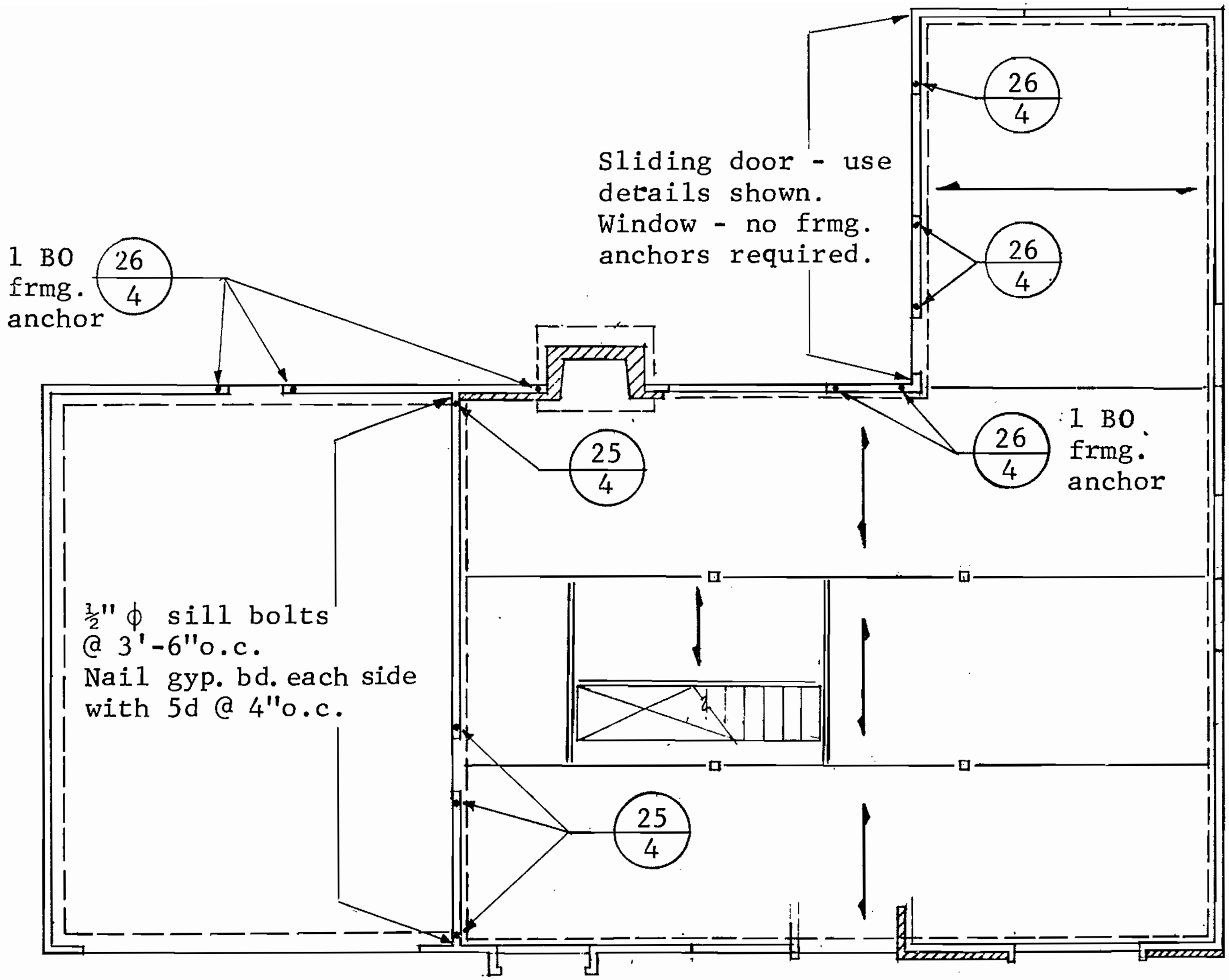
FRONT ELEVATION - MODEL 'A-1'



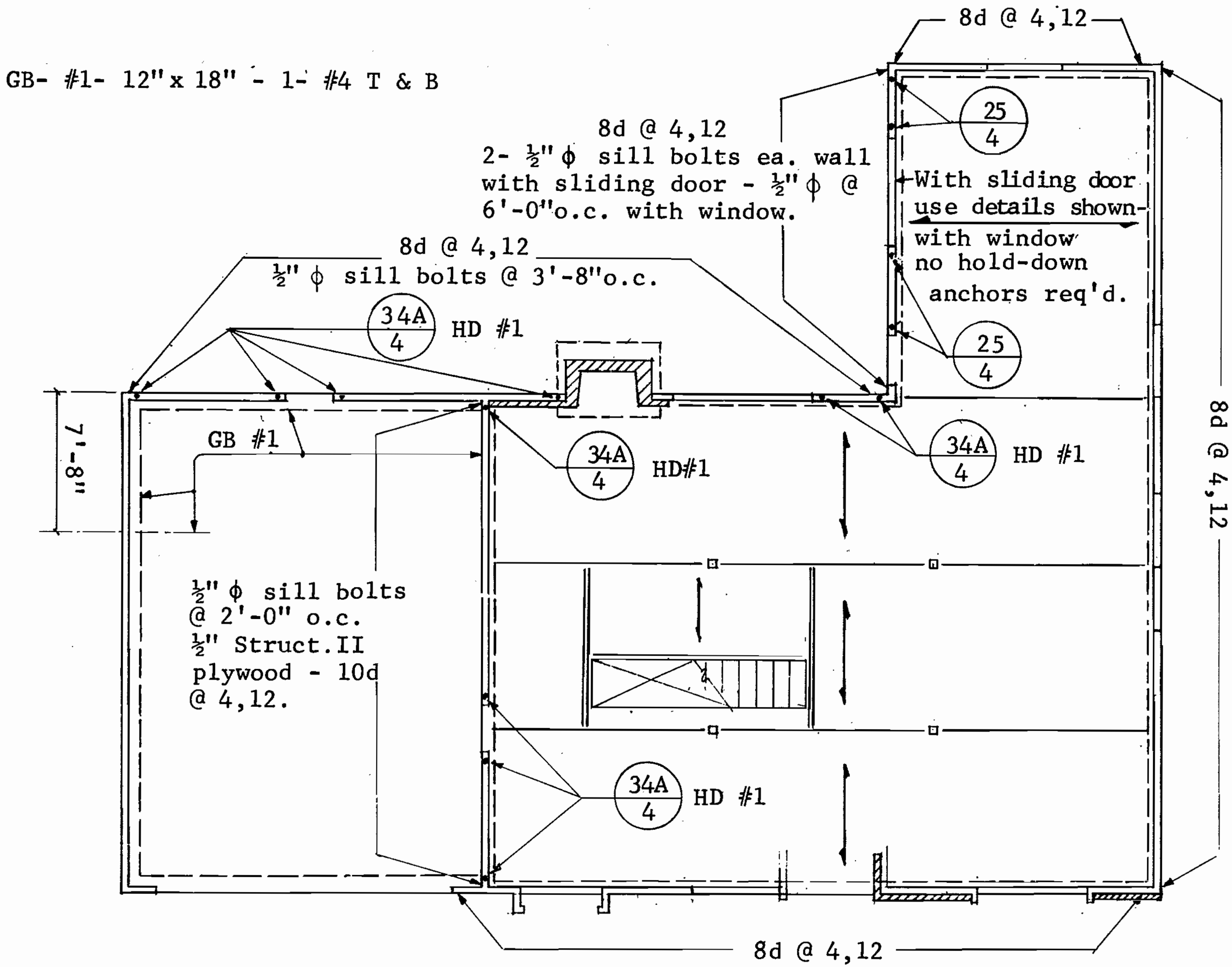
TYPICAL FOUNDATION PLAN - MODEL 'A-1' - ALL LOADS



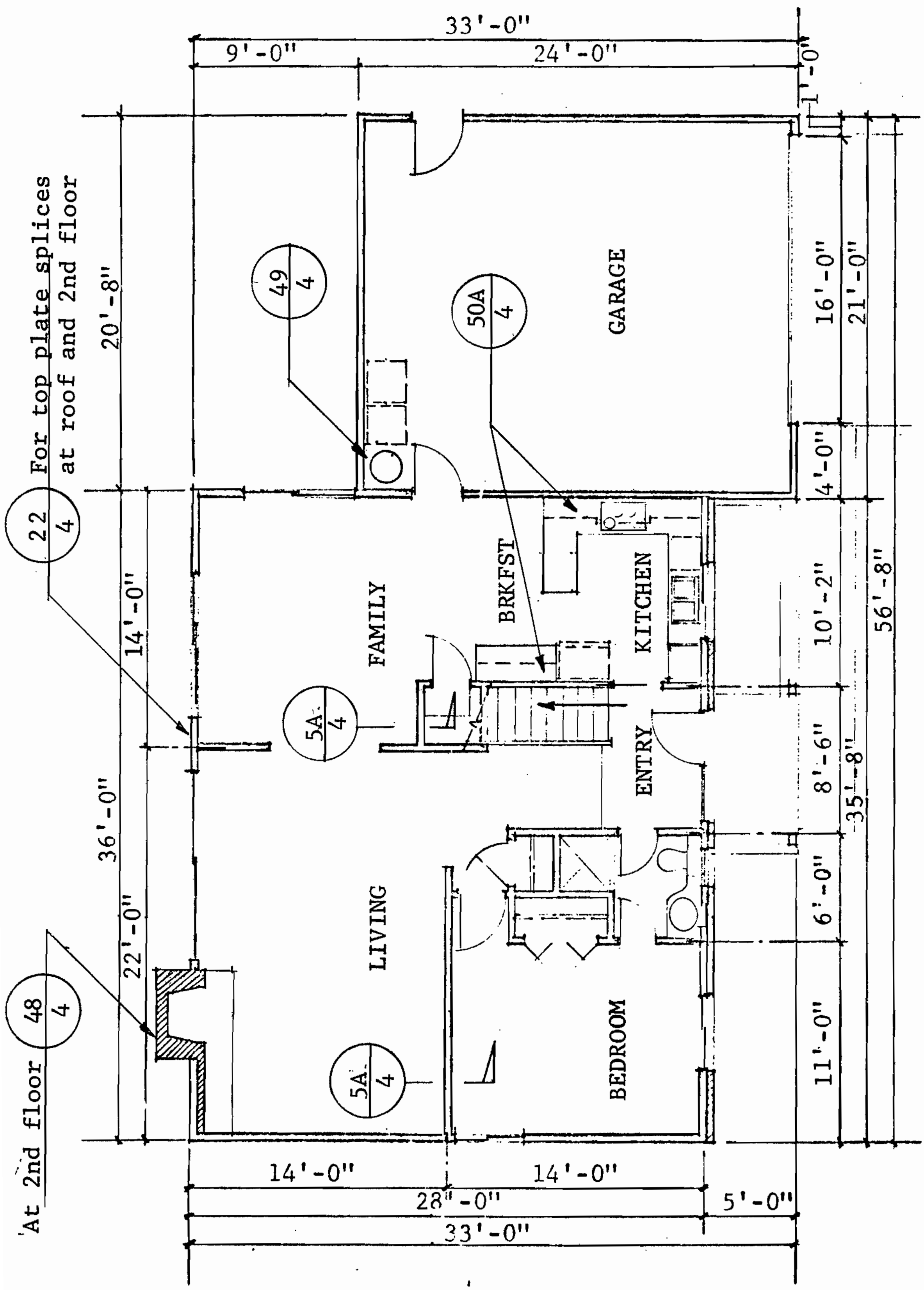
FOUNDATION PLAN - MODEL 'A-1' - 15 psf WIND



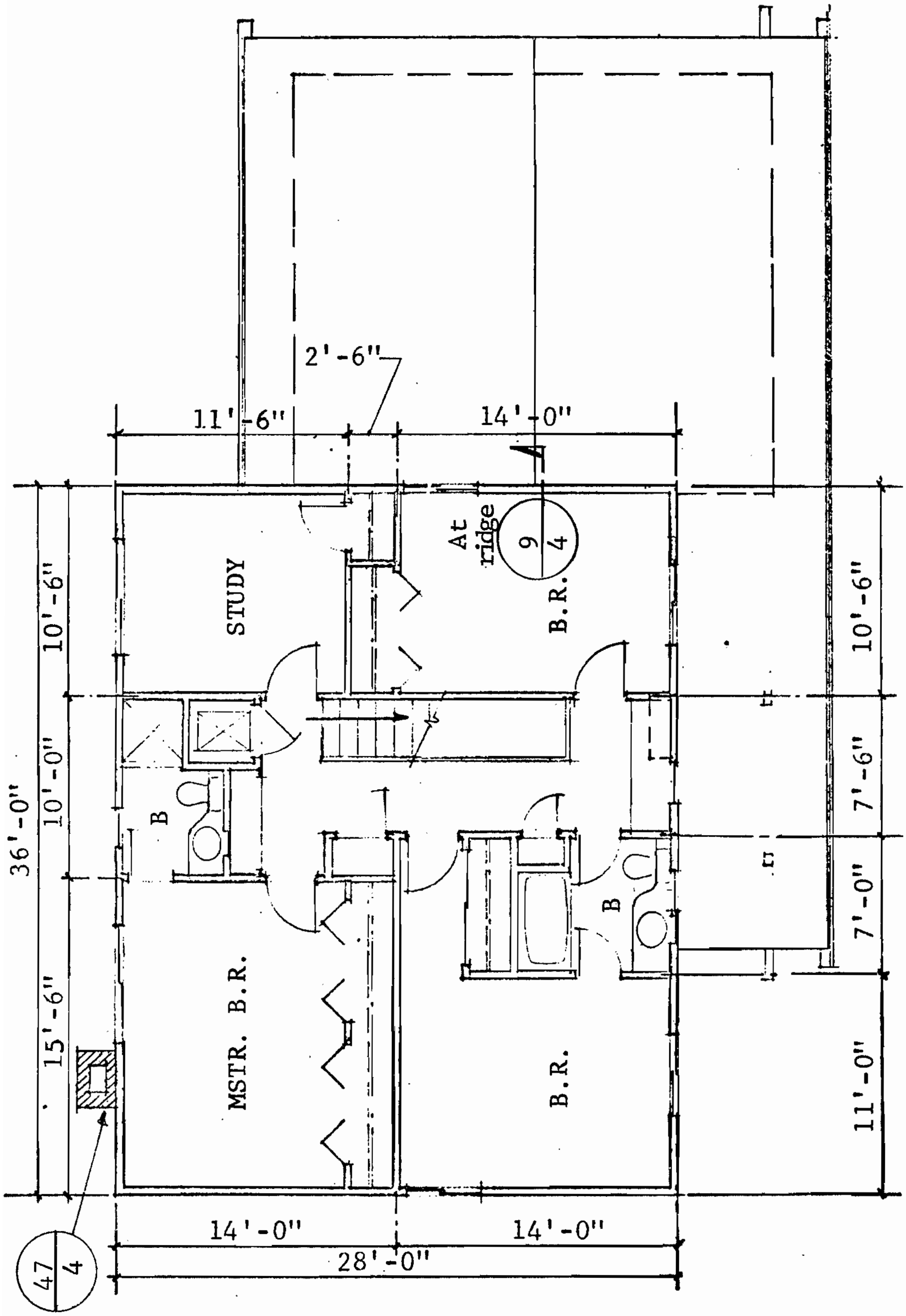
FOUNDATION PLAN - MODEL 'A-1' - 25 psf WIND



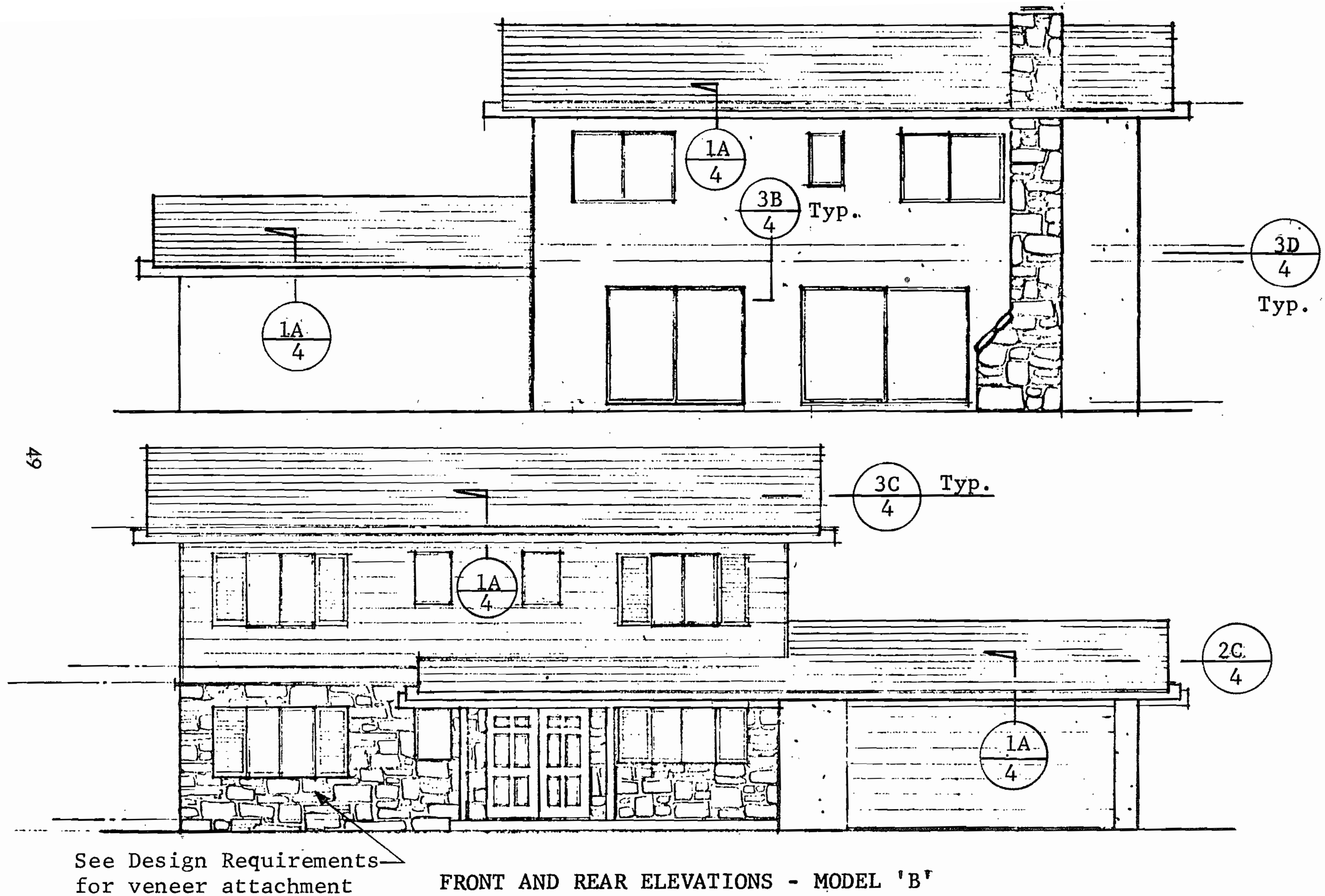
FOUNDATION PLAN - MODEL 'A-1' - 40 psf WIND



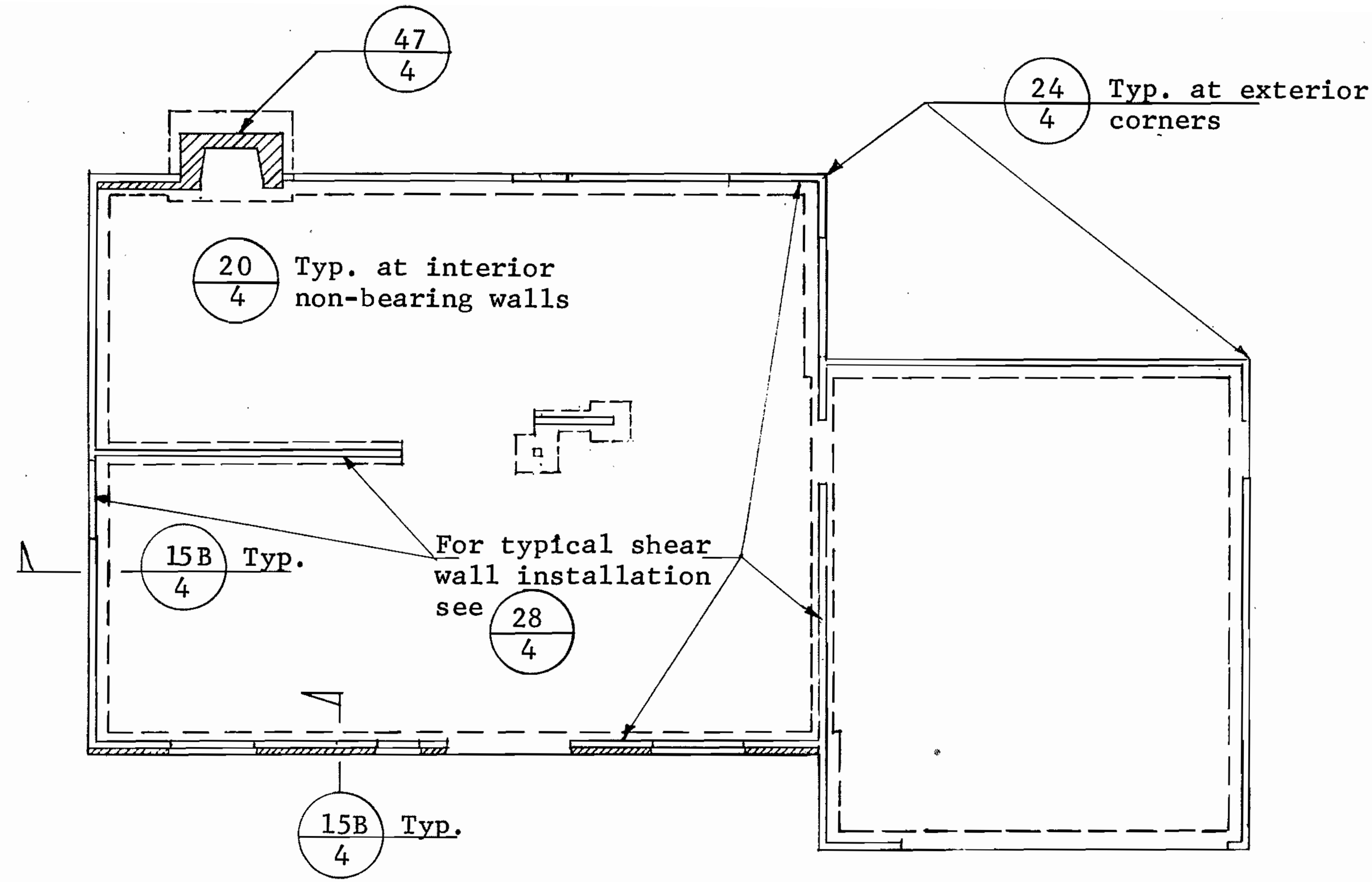
FIRST FLOOR PLAN - MODEL 'B'



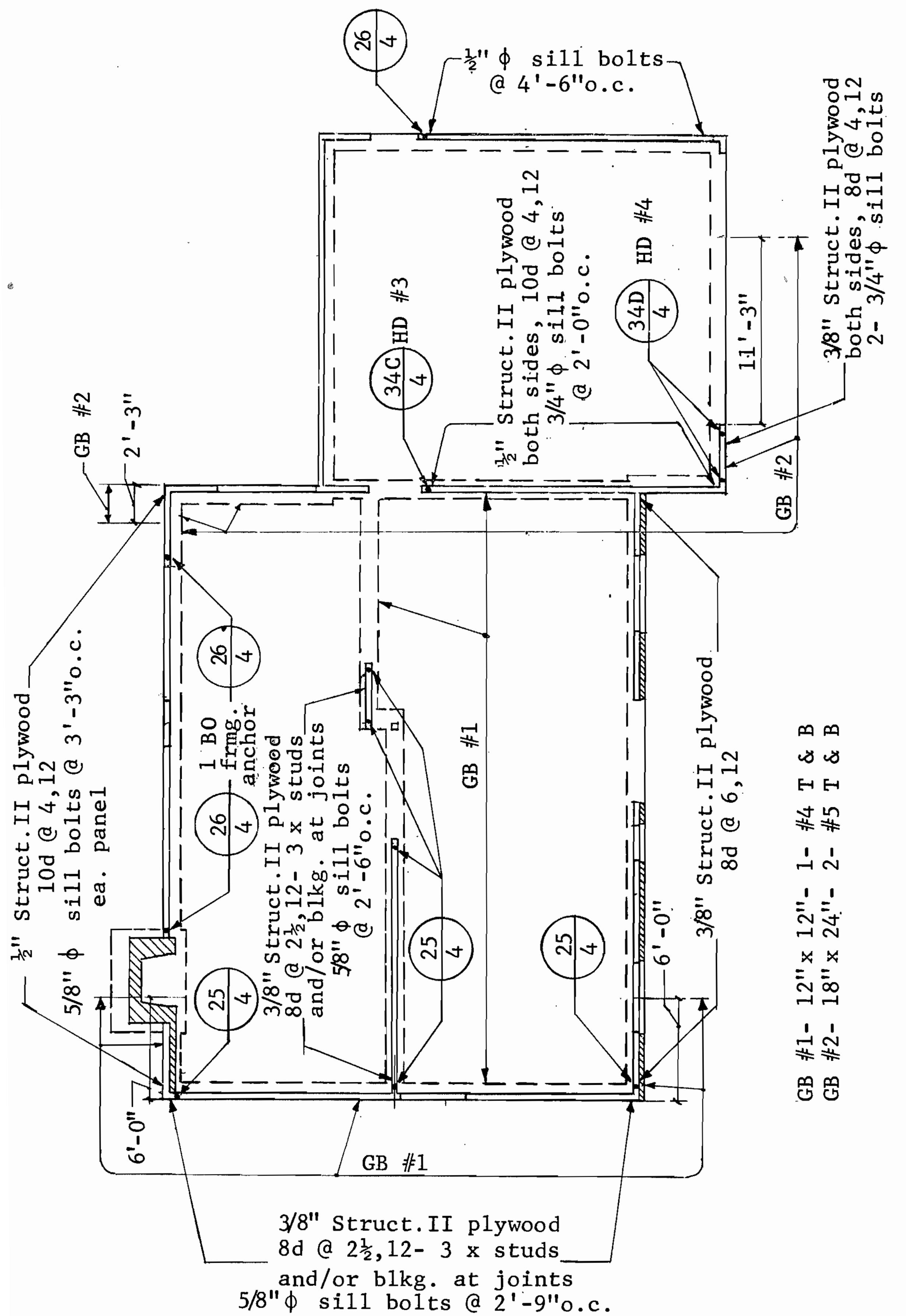
SECOND FLOOR PLAN - MODEL 'B'



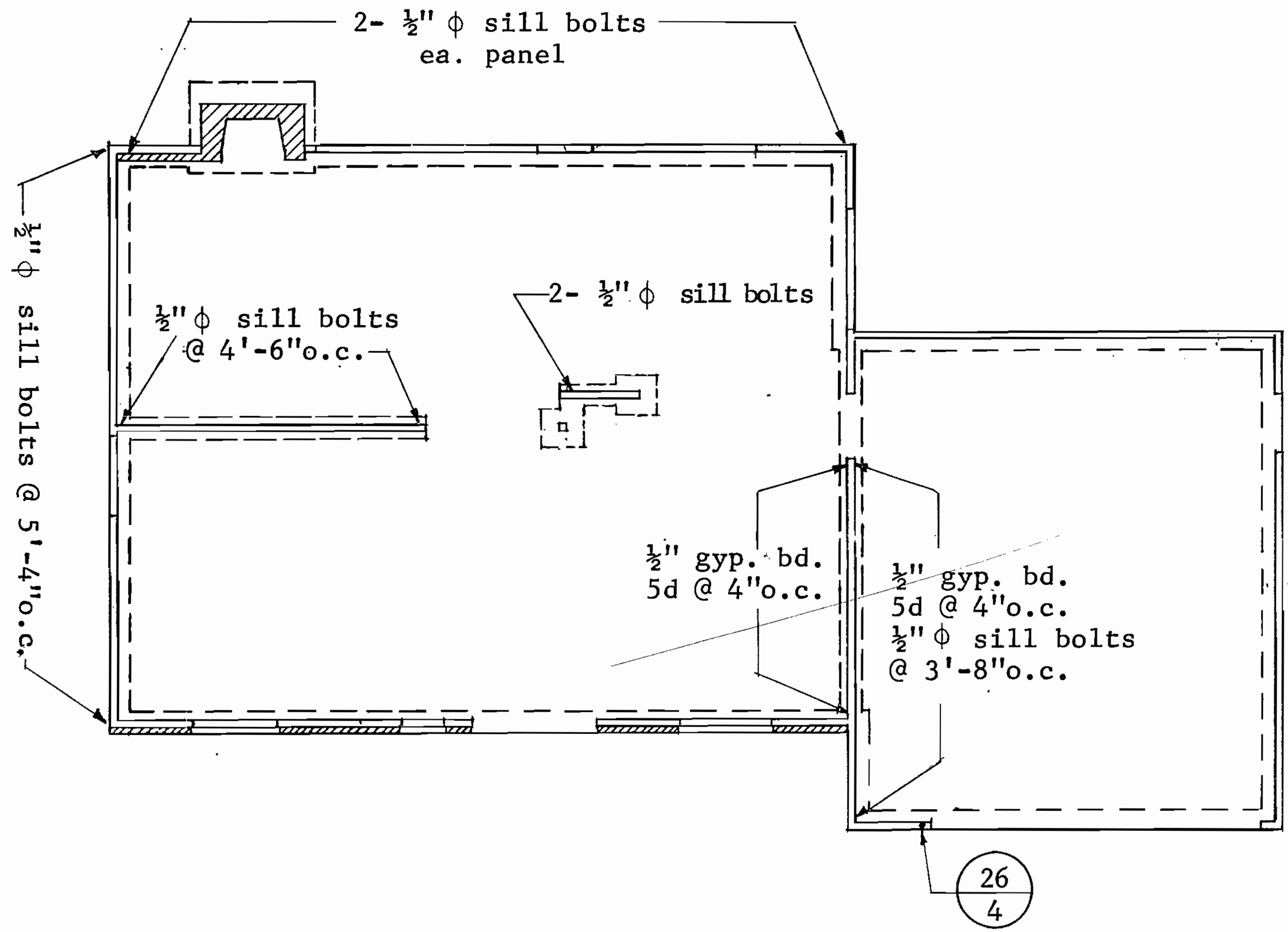
FRONT AND REAR ELEVATIONS - MODEL 'B'



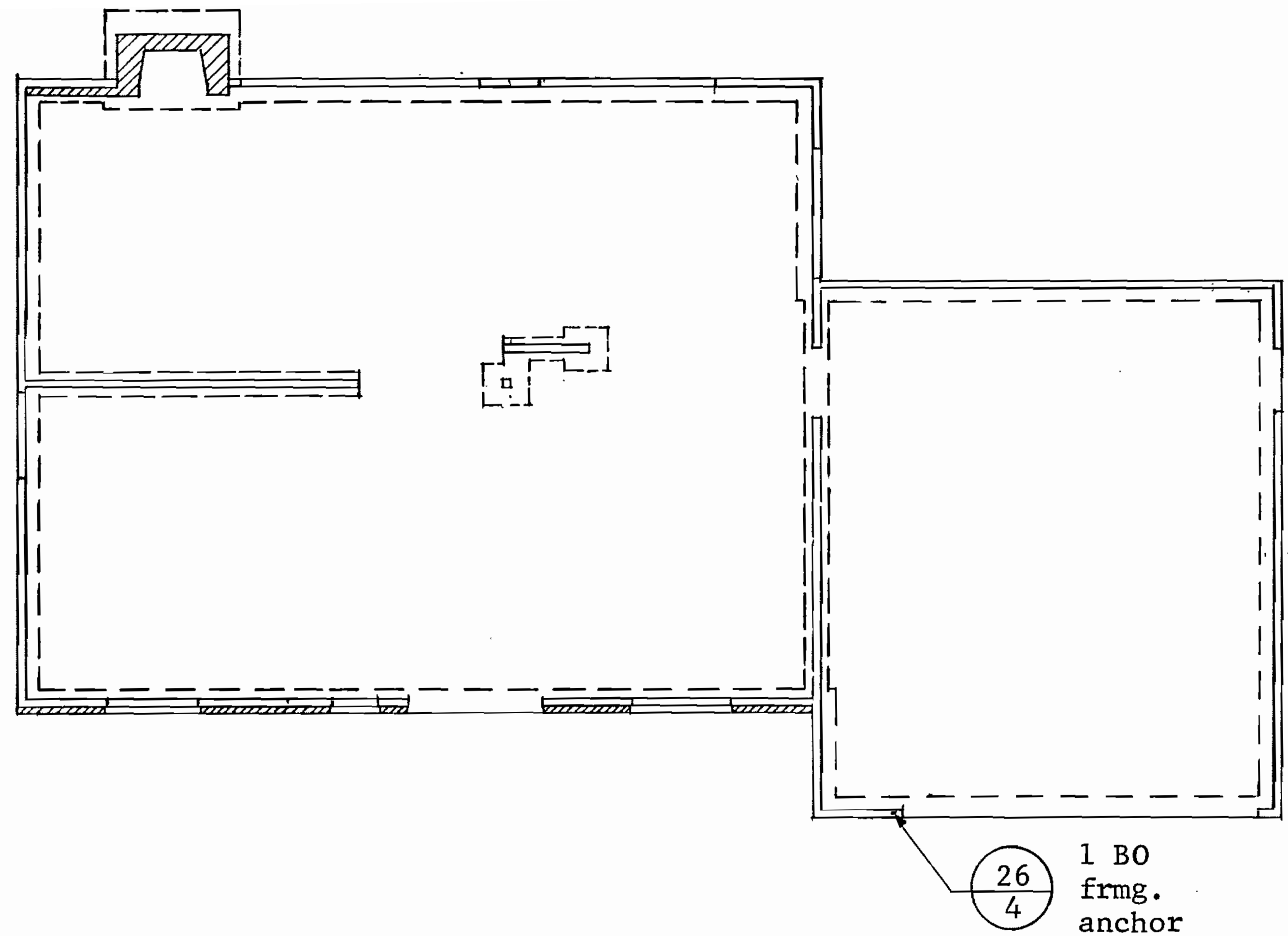
TYPICAL FOUNDATION PLAN - MODEL 'B' - ALL LOADS



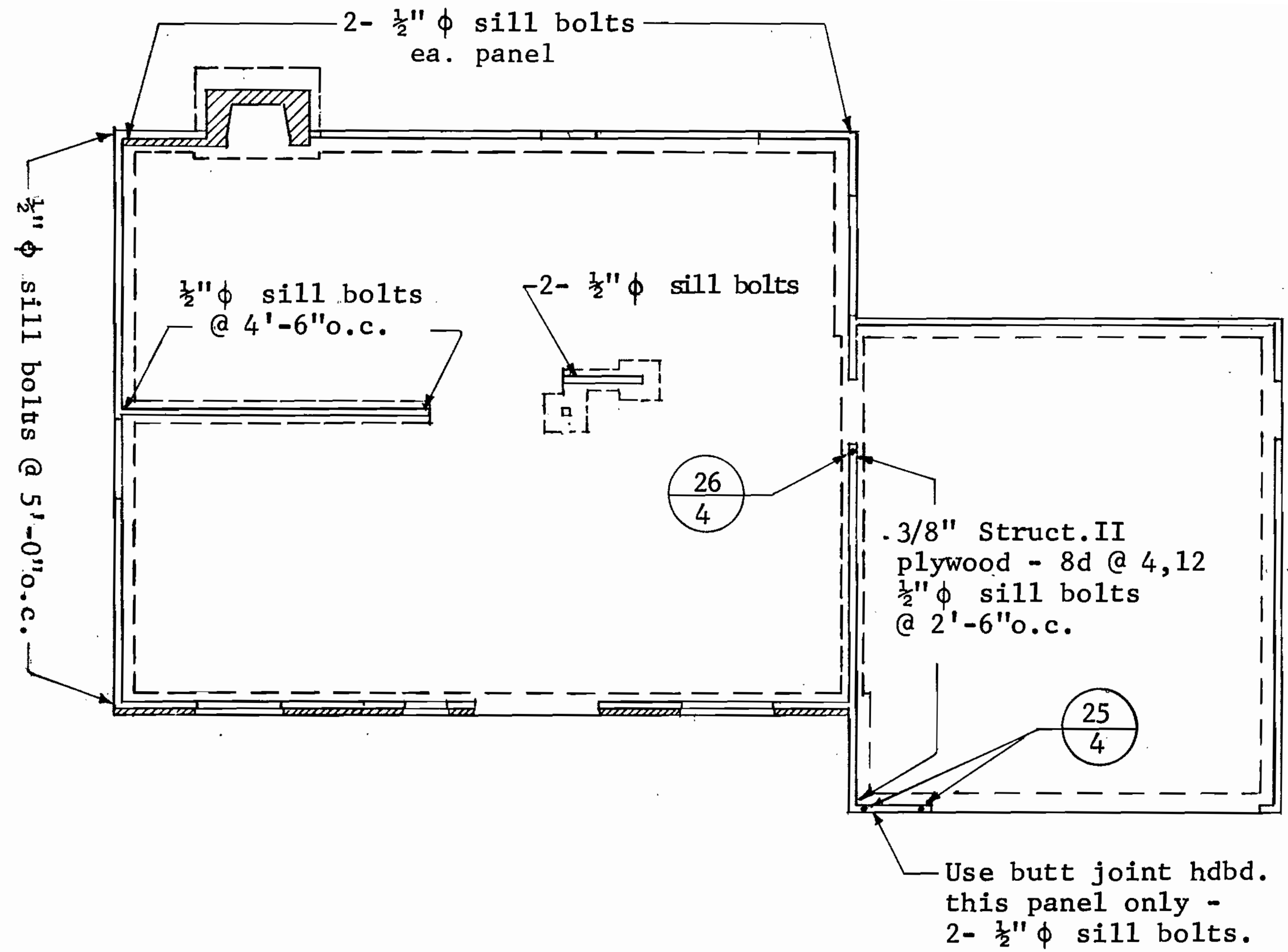
FOUNDATION PLAN - MODEL - 'B' - 40 psf WIND



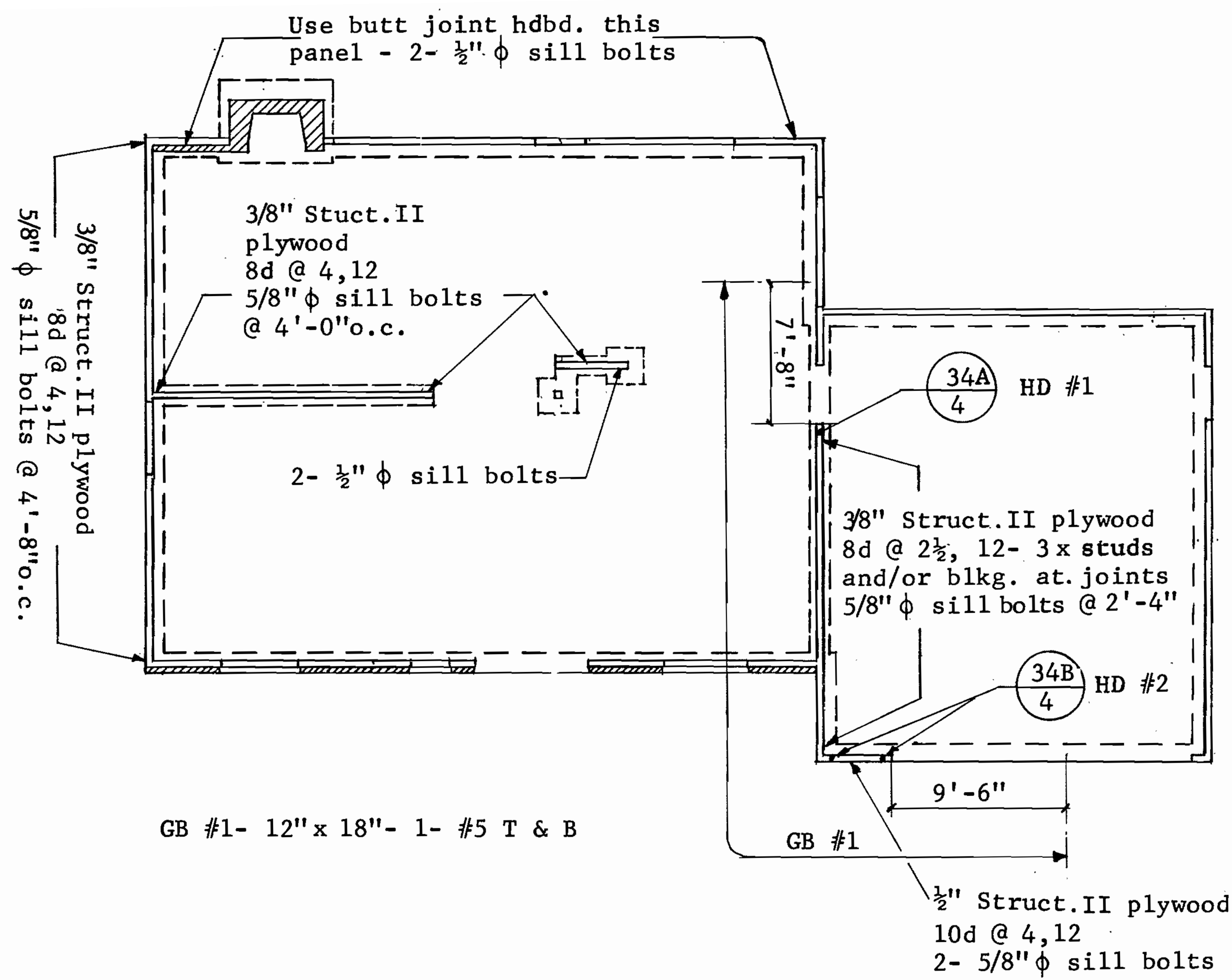
FOUNDATION PLAN - MODEL 'B' - SEISMIC ZONE 3



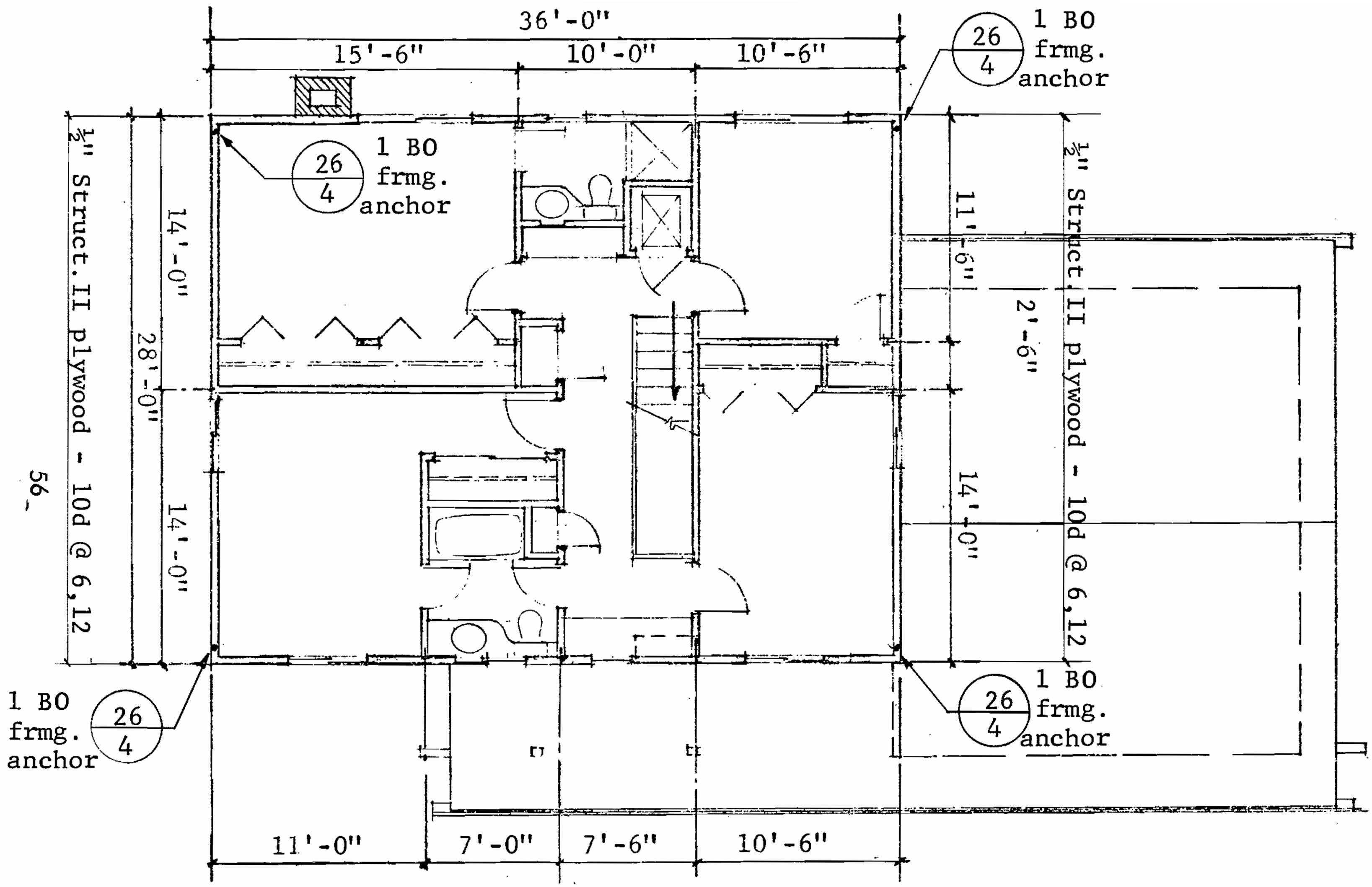
FOUNDATION PLAN - MODEL 'B' - SEISMIC ZONE 2



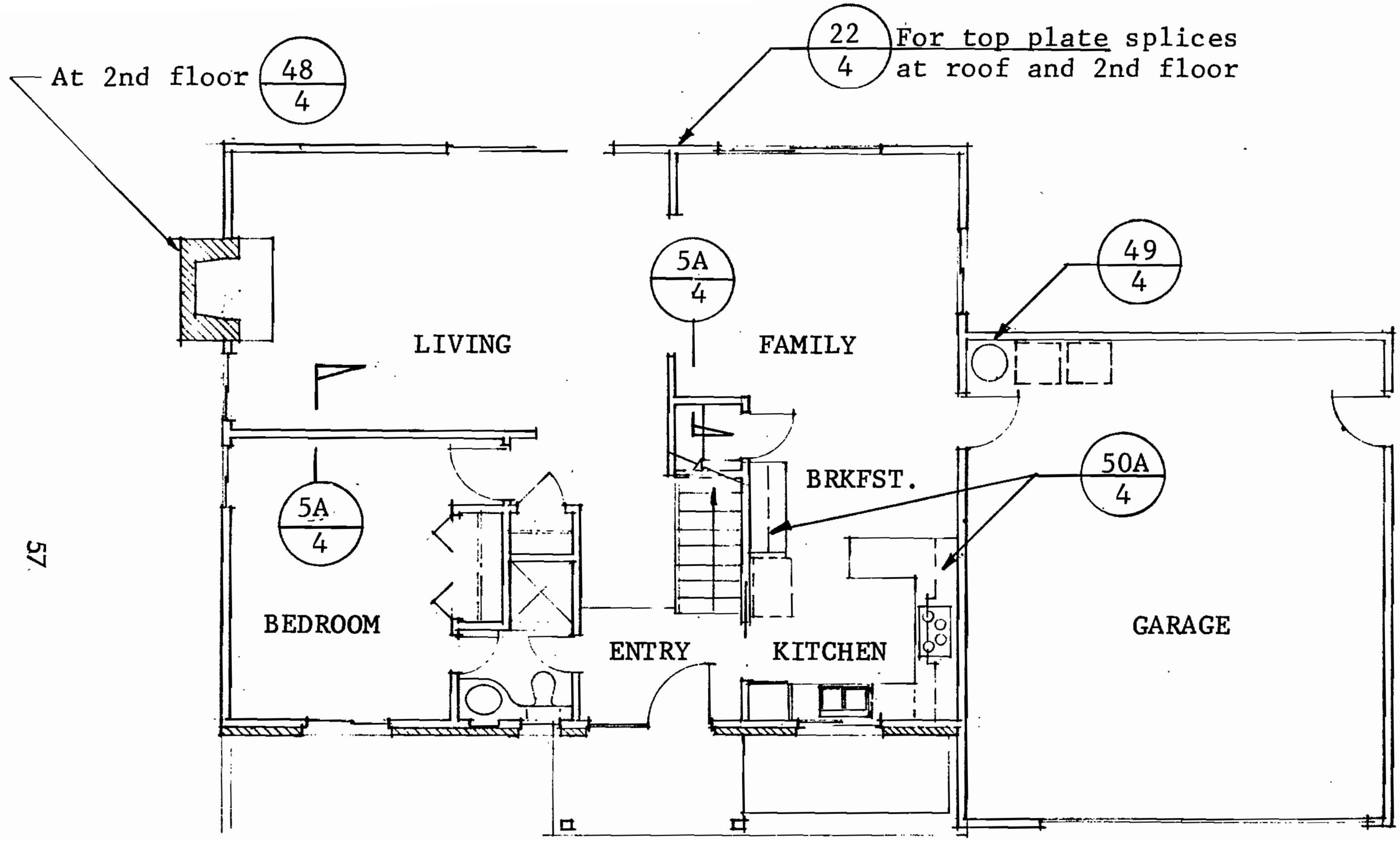
FOUNDATION PLAN - MODEL 'B' - 15 psf WIND



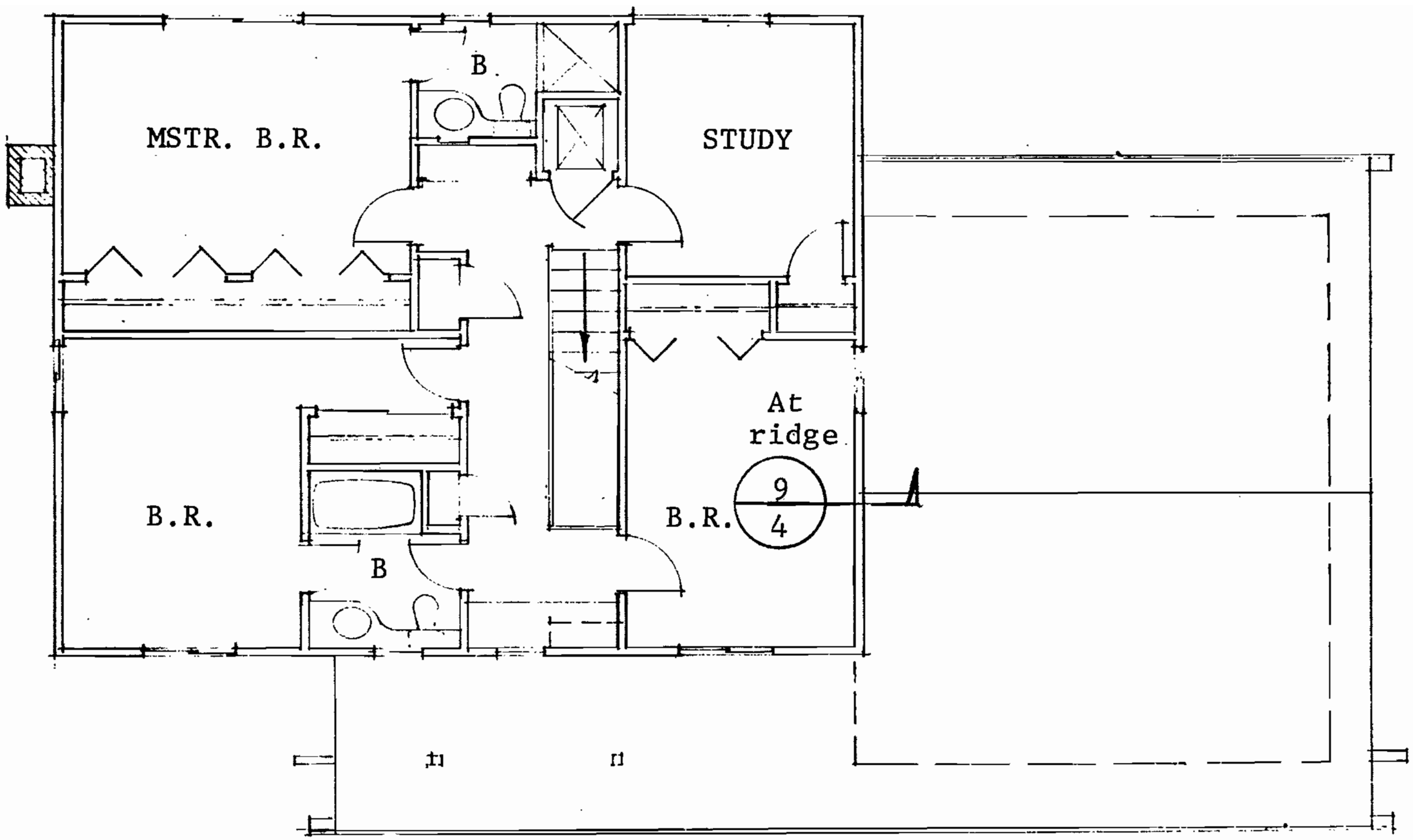
FOUNDATION PLAN - MODEL 'B' - 25 psf WIND



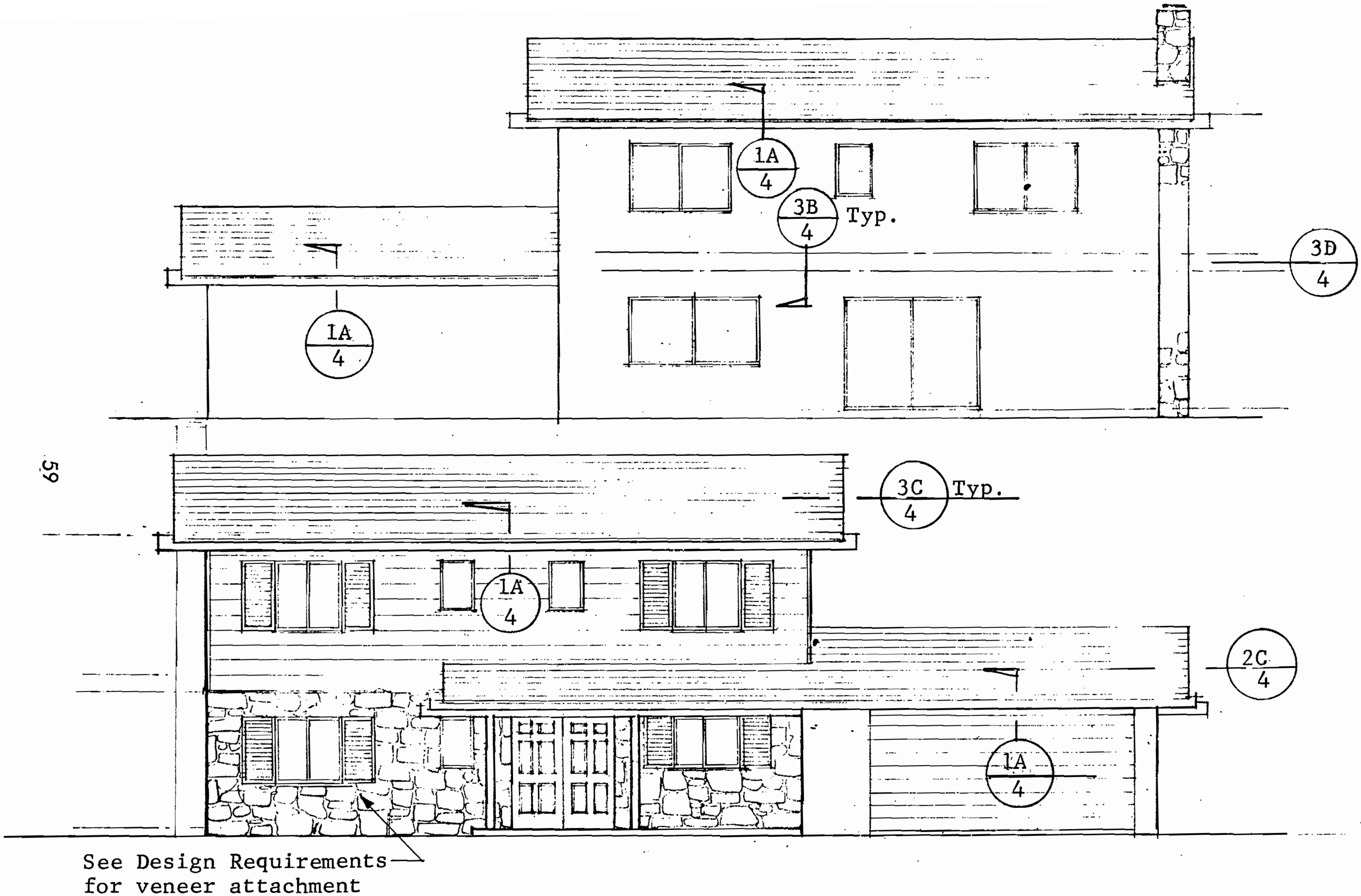
SECOND FLOOR PLAN - MODEL 'B' - 40 psf WIND



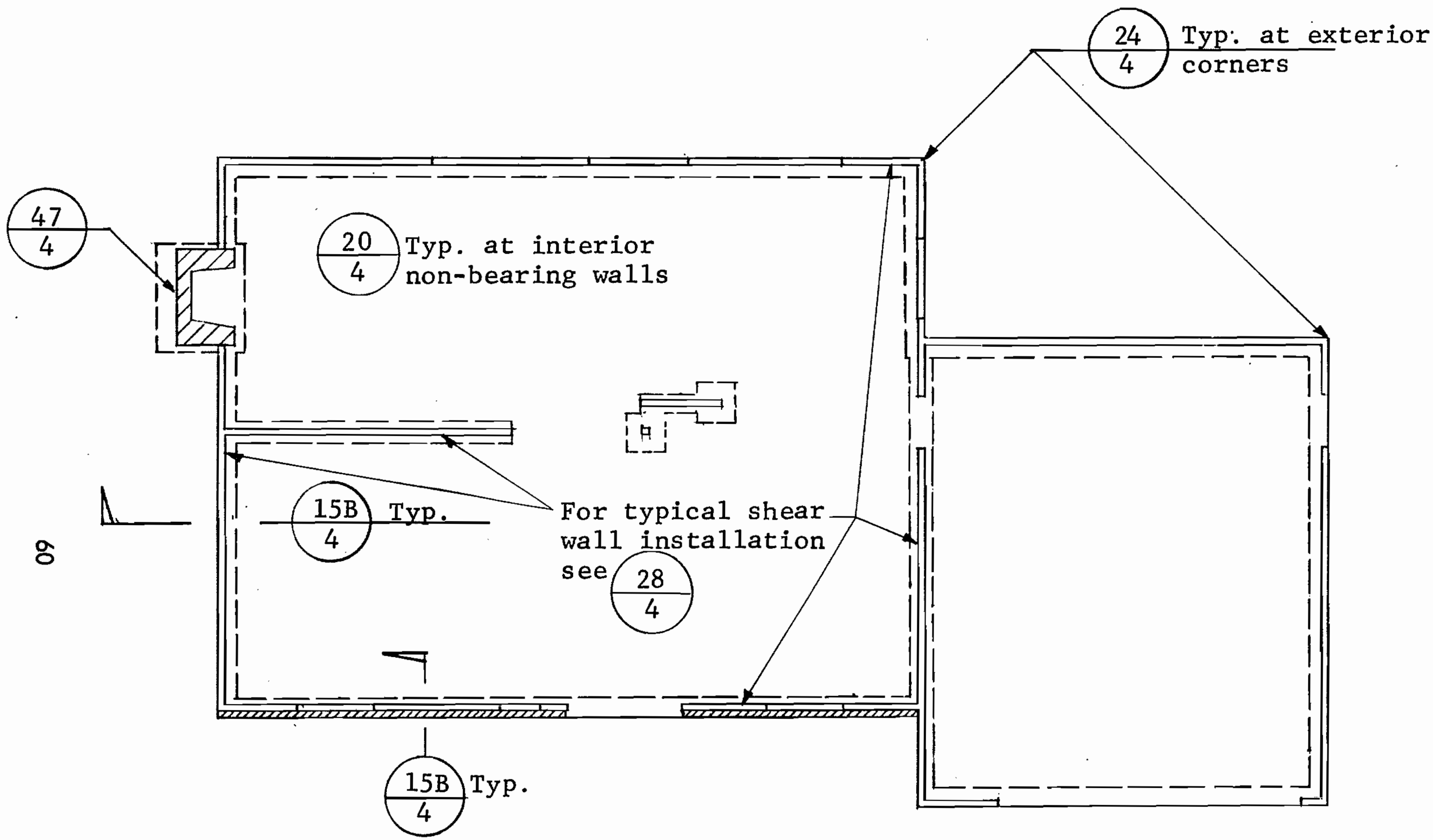
FIRST FLOOR PLAN - MODEL 'B-1'



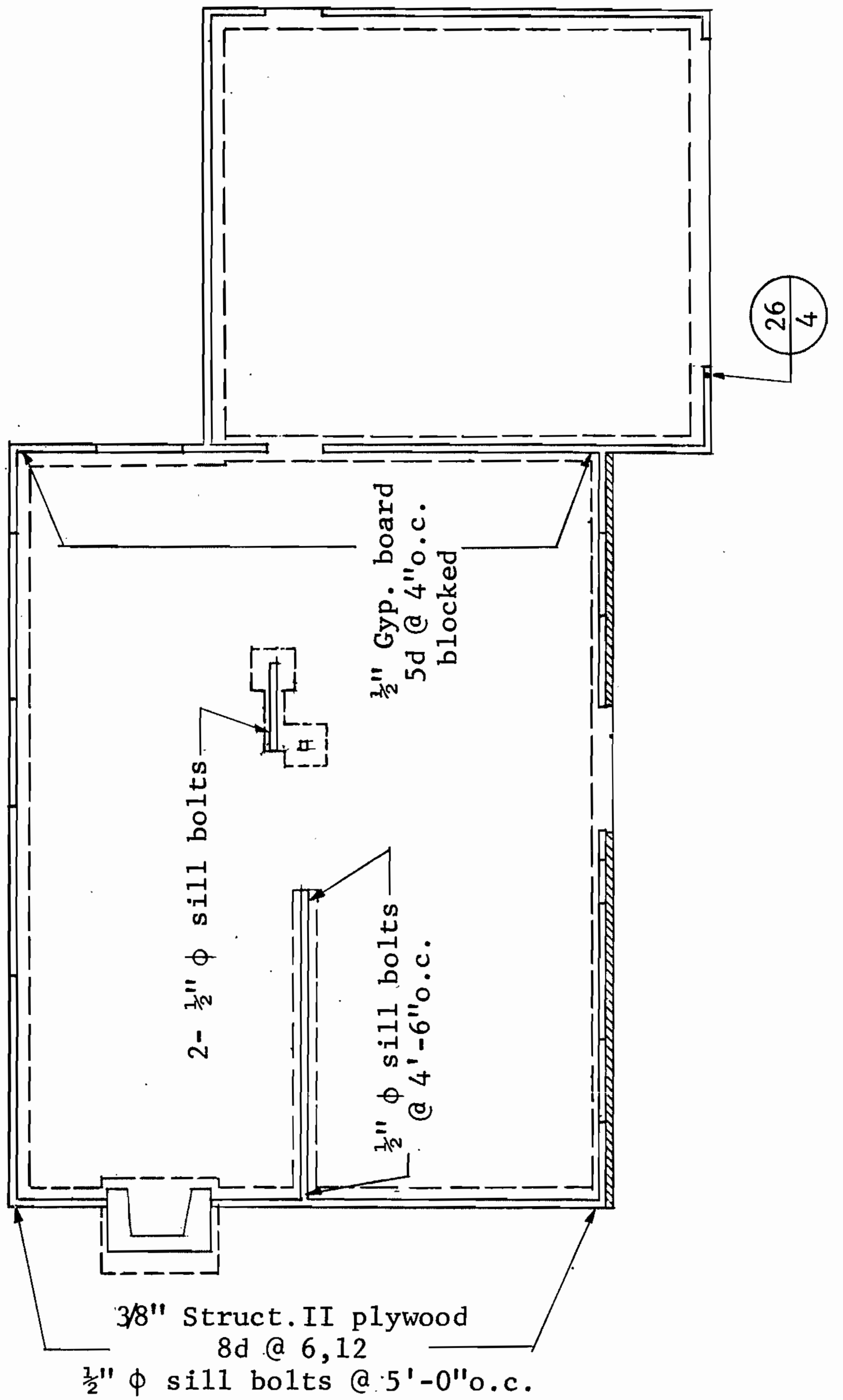
SECOND FLOOR PLAN - MODEL 'B-1'



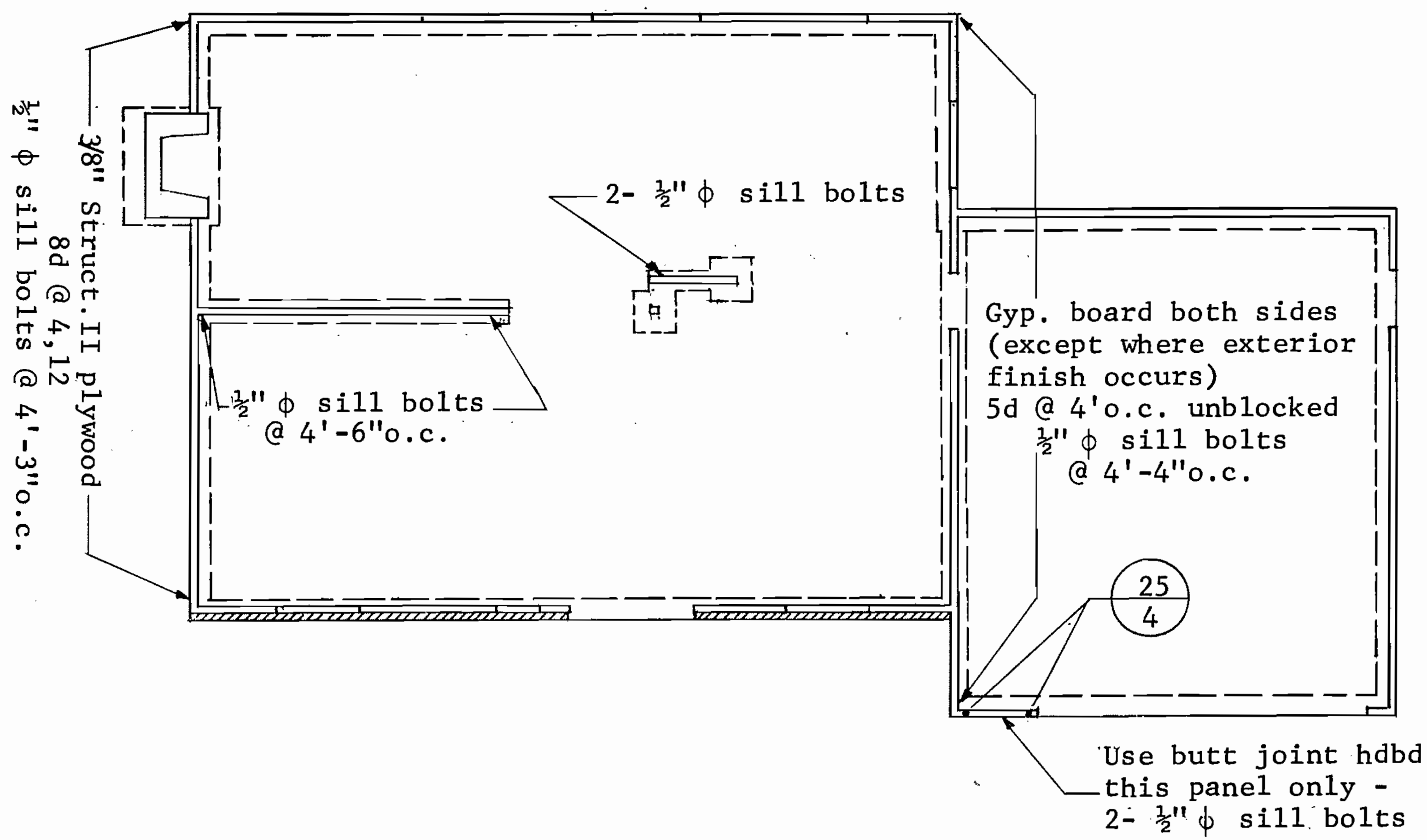
FRONT AND REAR ELEVATIONS - MODEL 'B-1'



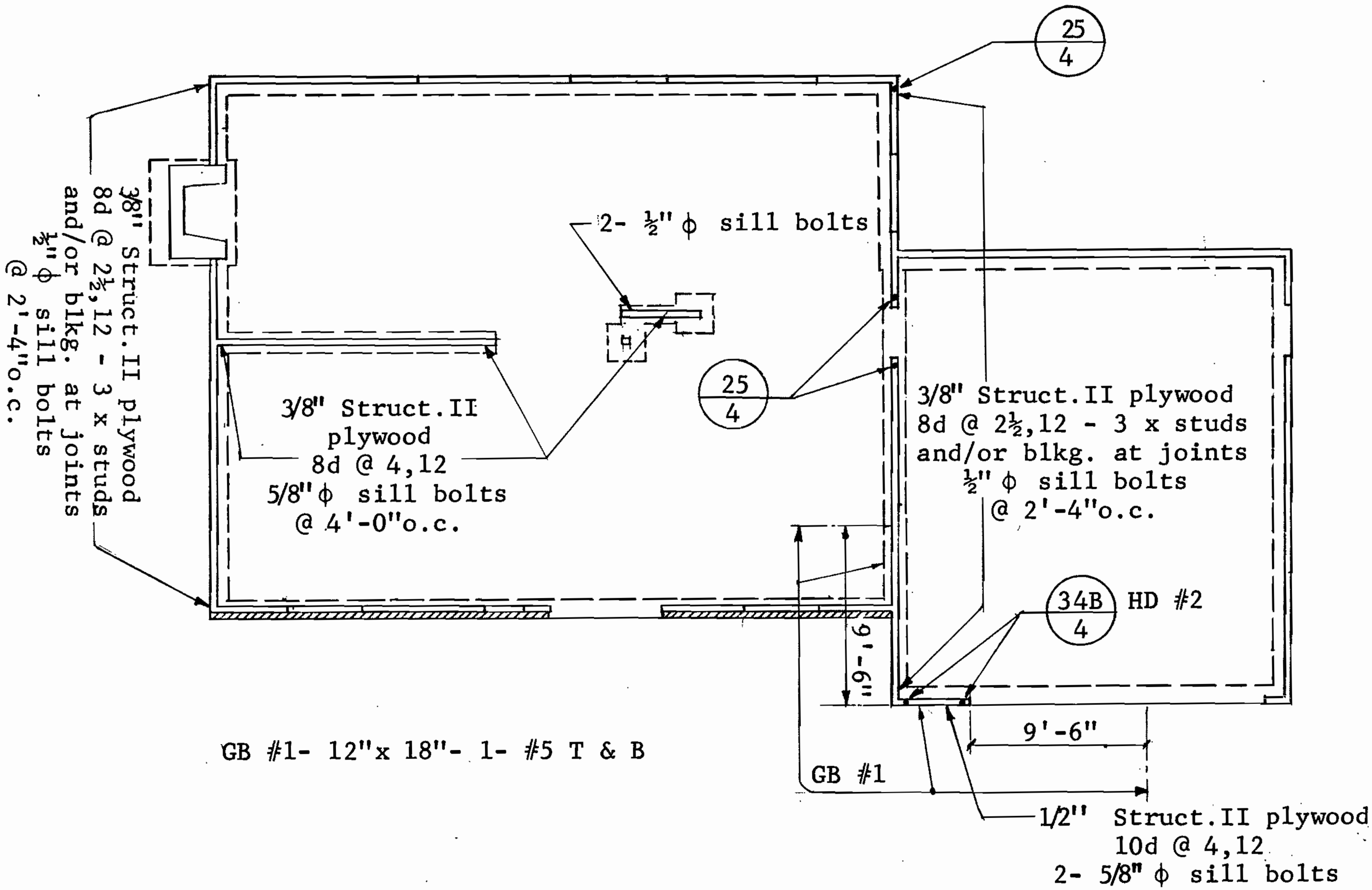
TYPICAL FOUNDATION PLAN - MODEL 'B-1' - ALL LOADS



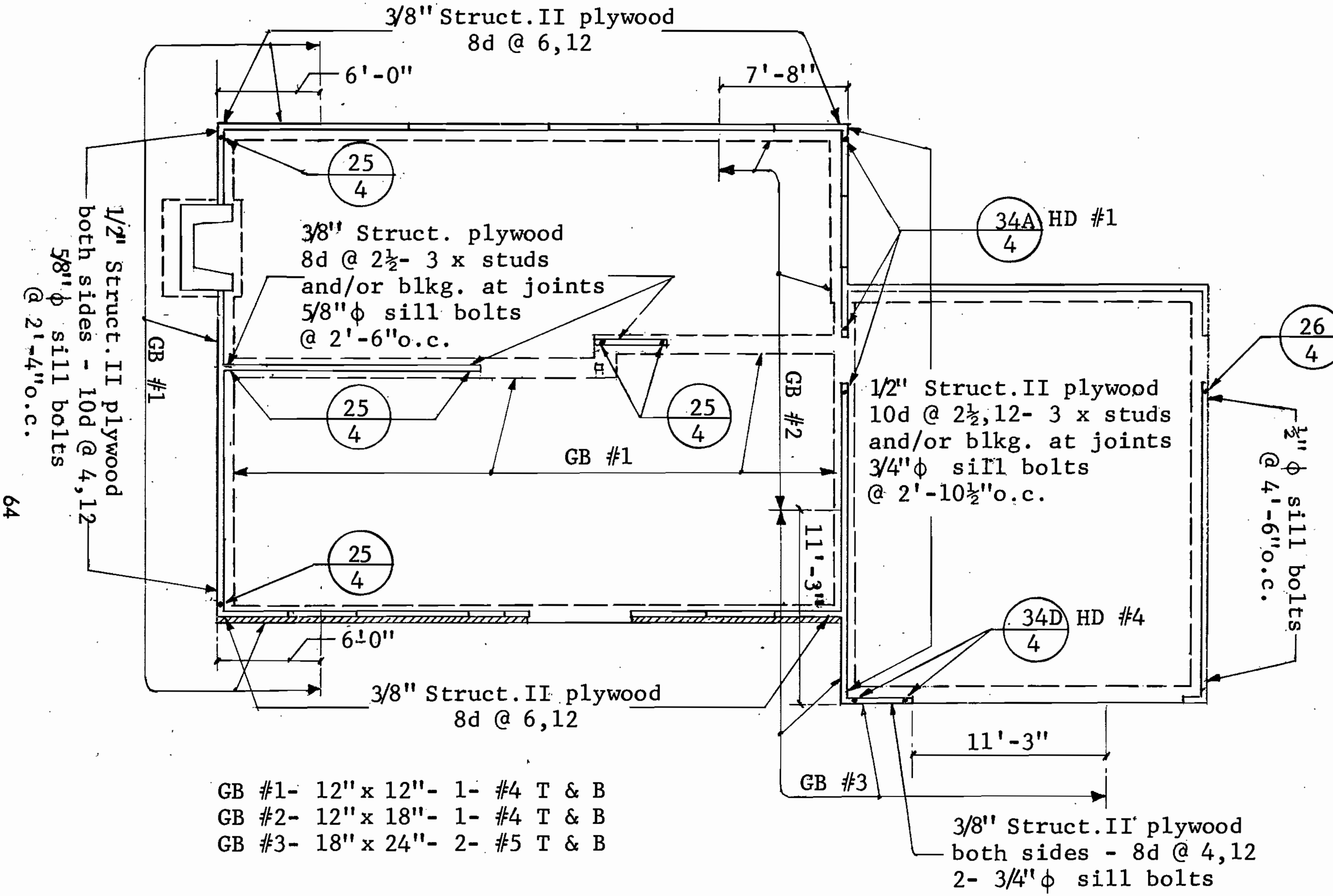
FOUNDATION PLAN - MODEL 'B-1' - SEISMIC ZONE 3



FOUNDATION PLAN - MODEL 'B-1' - 15 psf WIND

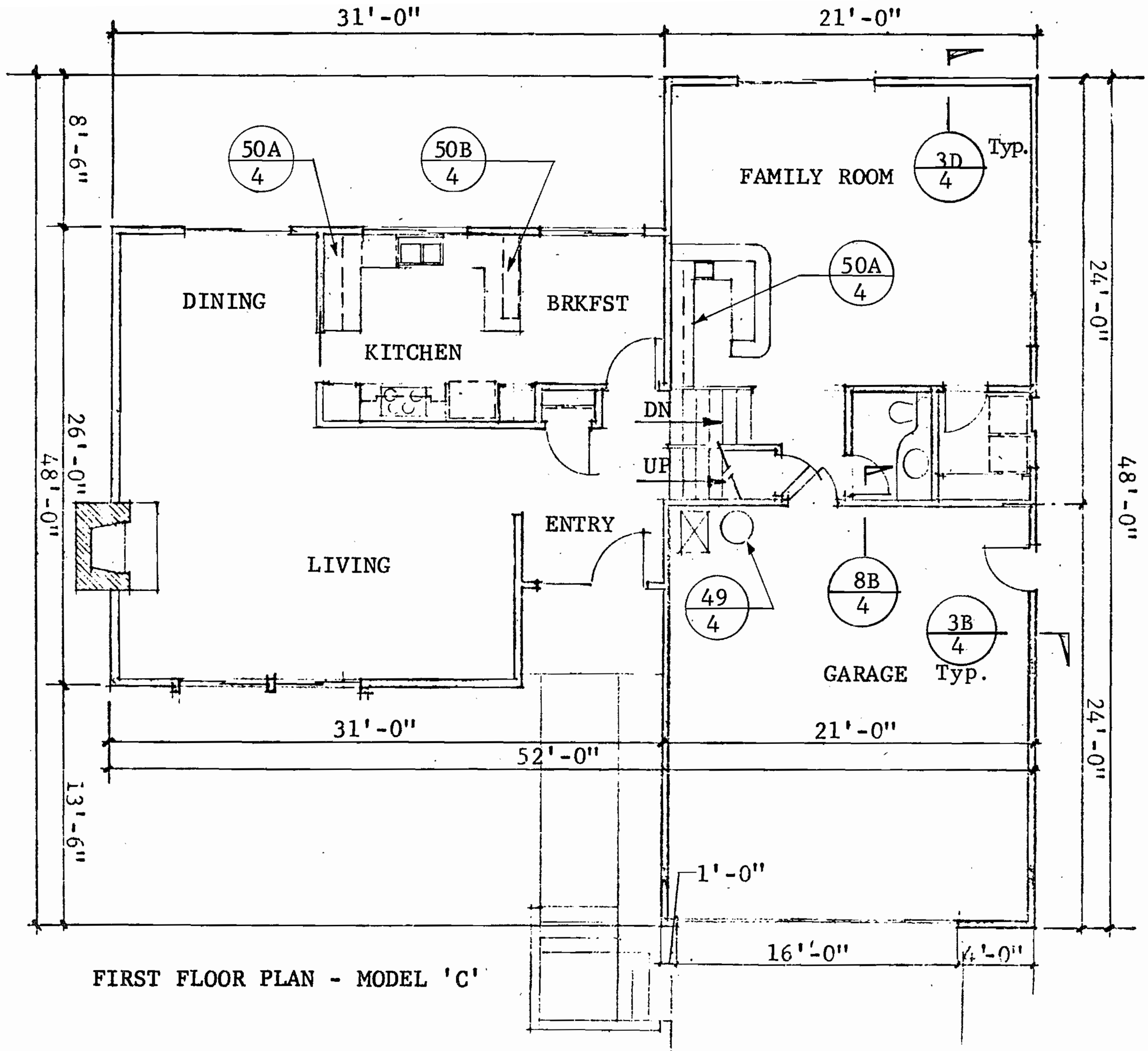


FOUNDATION PLAN - MODEL 'B-1' - 25 psf WIND

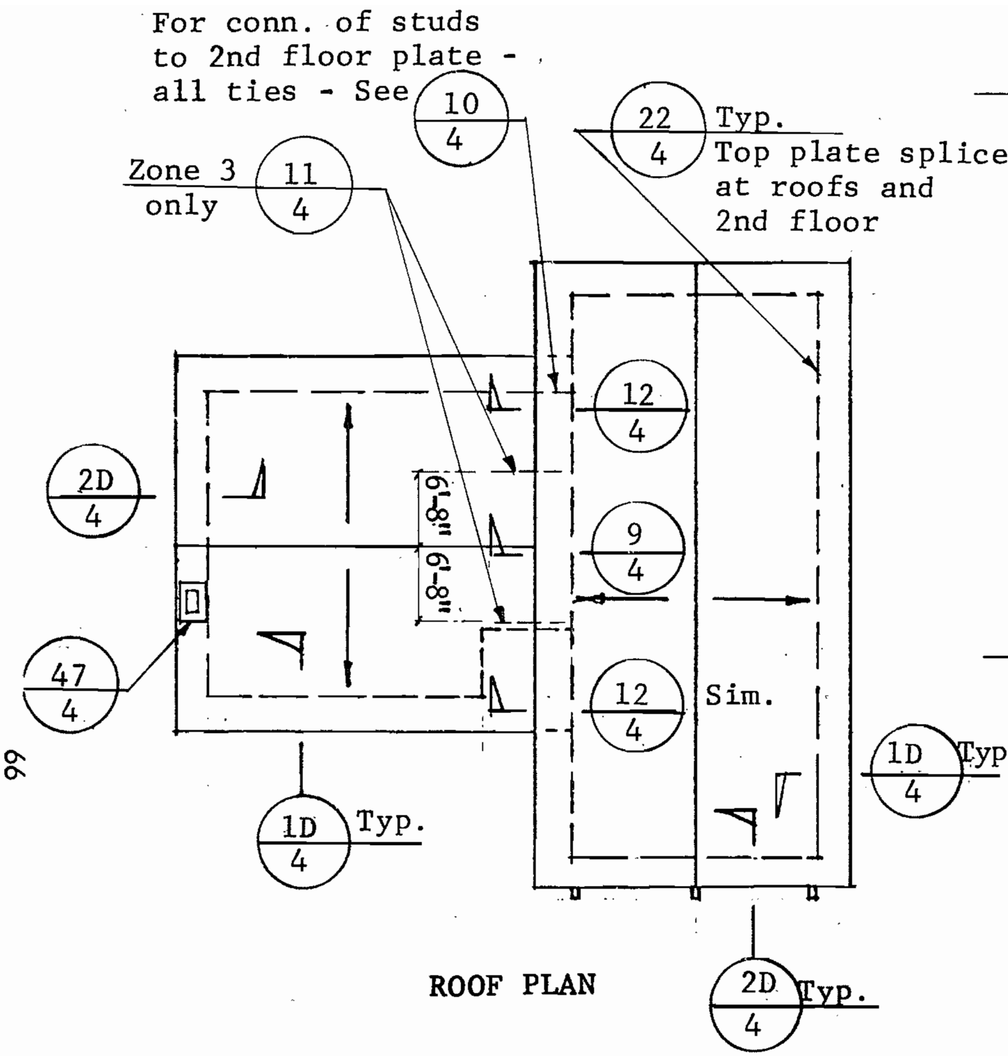


GB #1- 12"x 12"- 1- #4 T & B
GB #2- 12"x 18"- 1- #4 T & B
GB #3- 18"x 24"- 2- #5 T & B

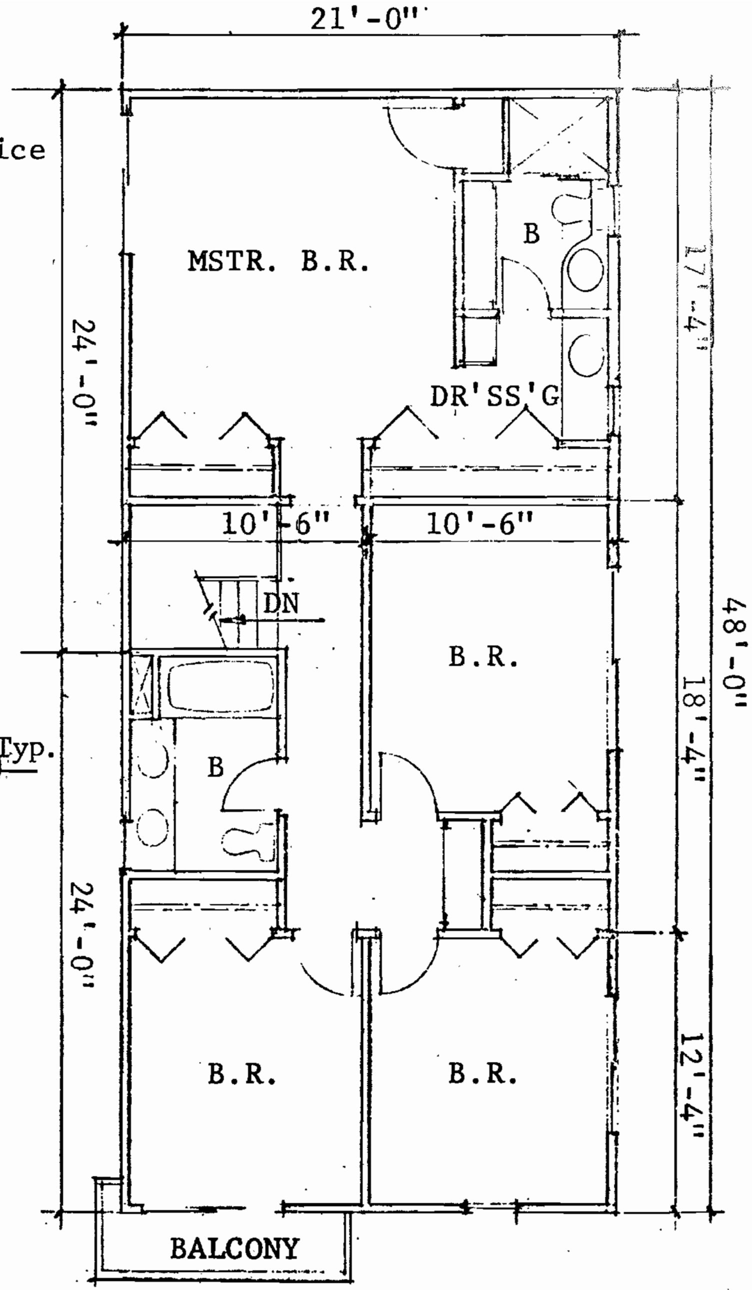
FOUNDATION PLAN - MODEL 'B-1' - 40 psf WIND



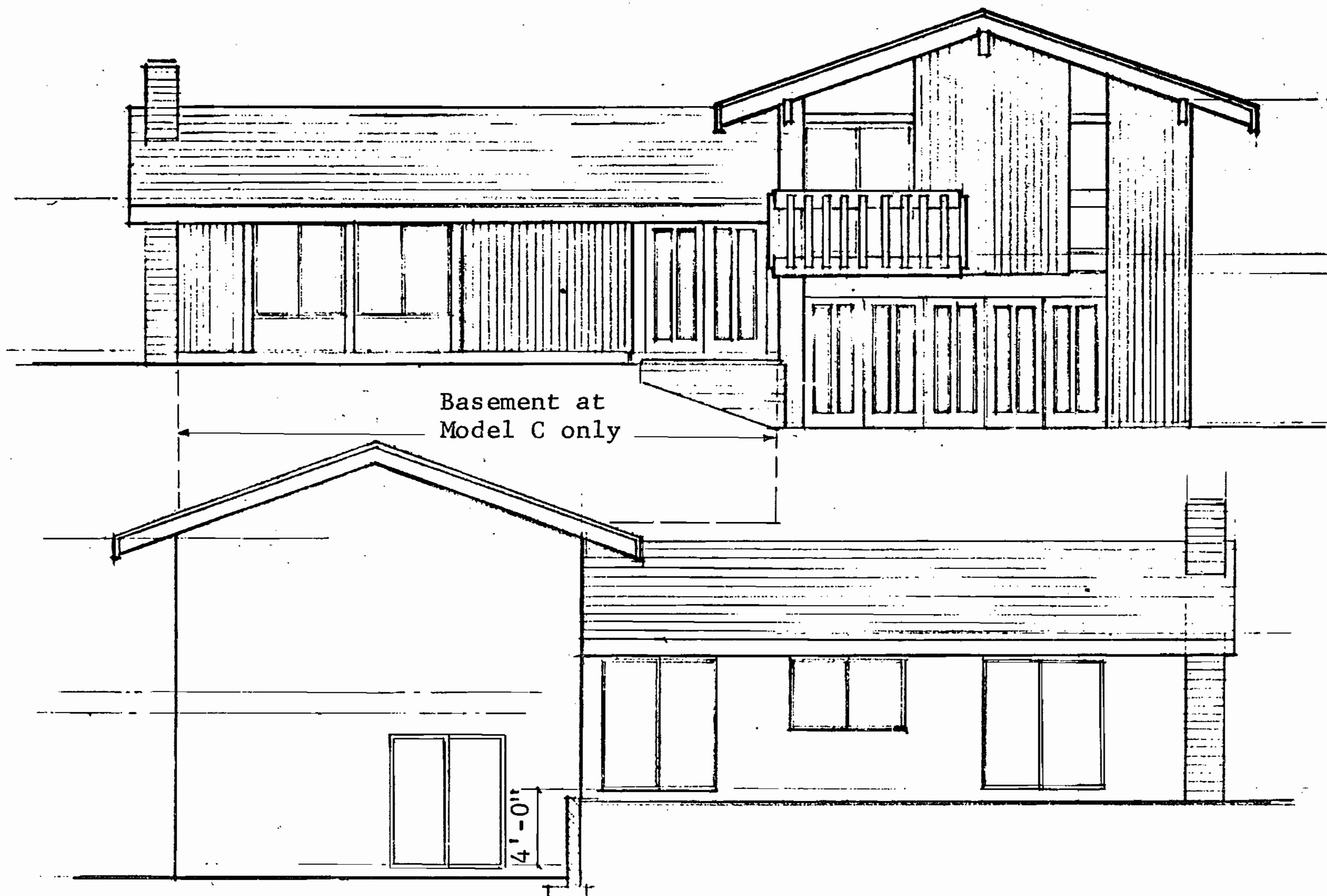
FIRST FLOOR PLAN - MODEL 'C'



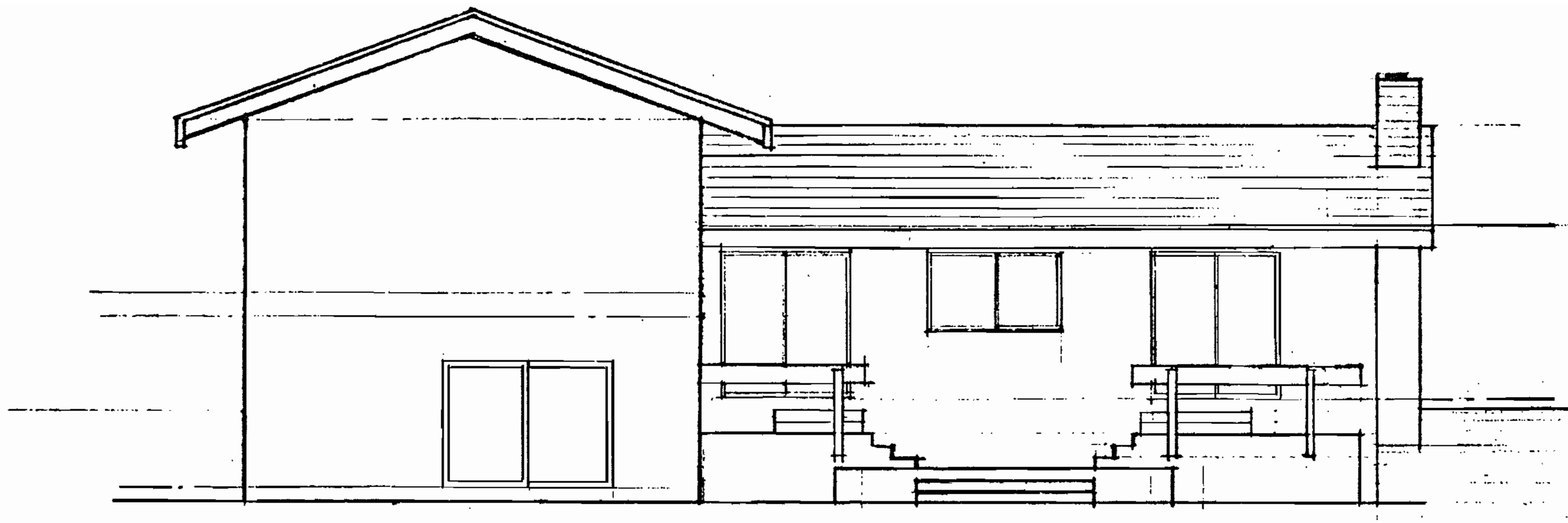
ROOF PLAN



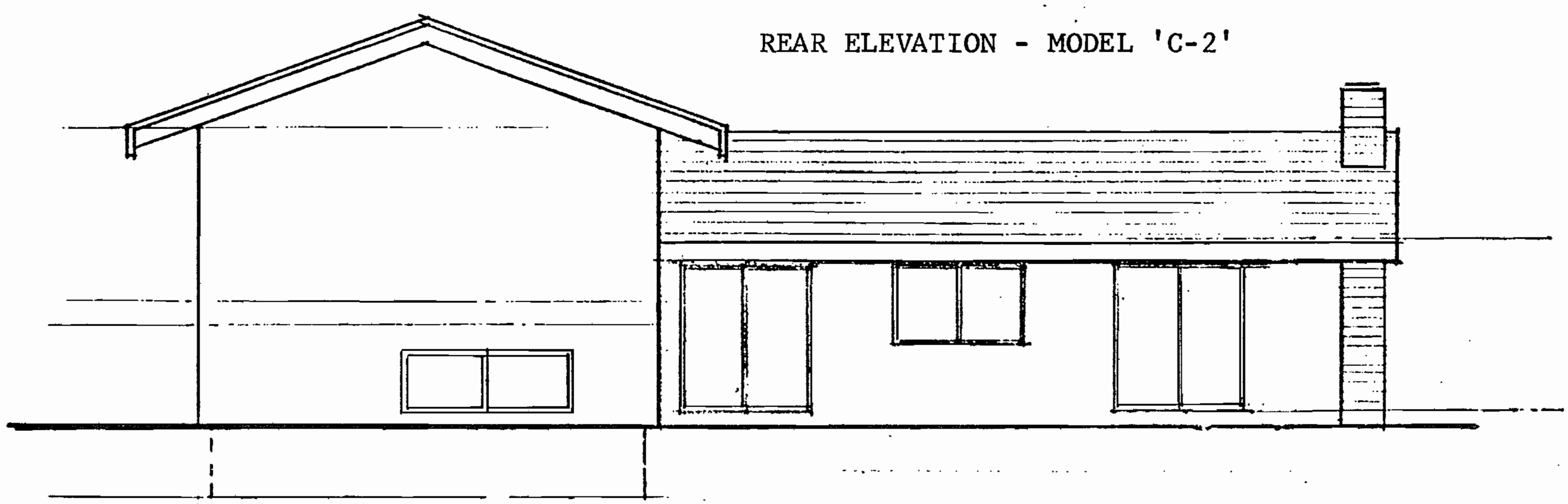
SECOND FLOOR PLAN - MODEL 'C'



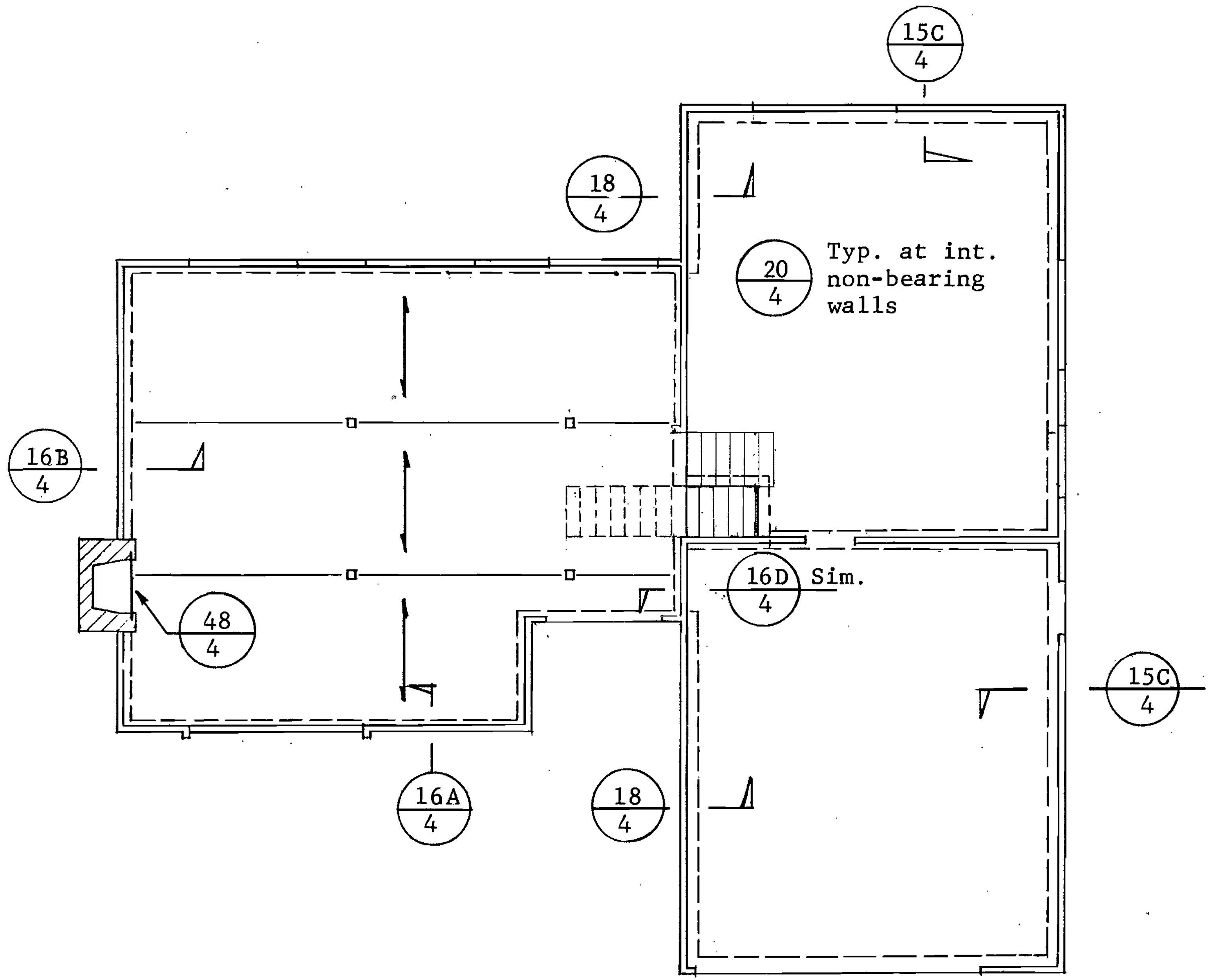
FRONT AND REAR ELEVATIONS - MODEL 'C'



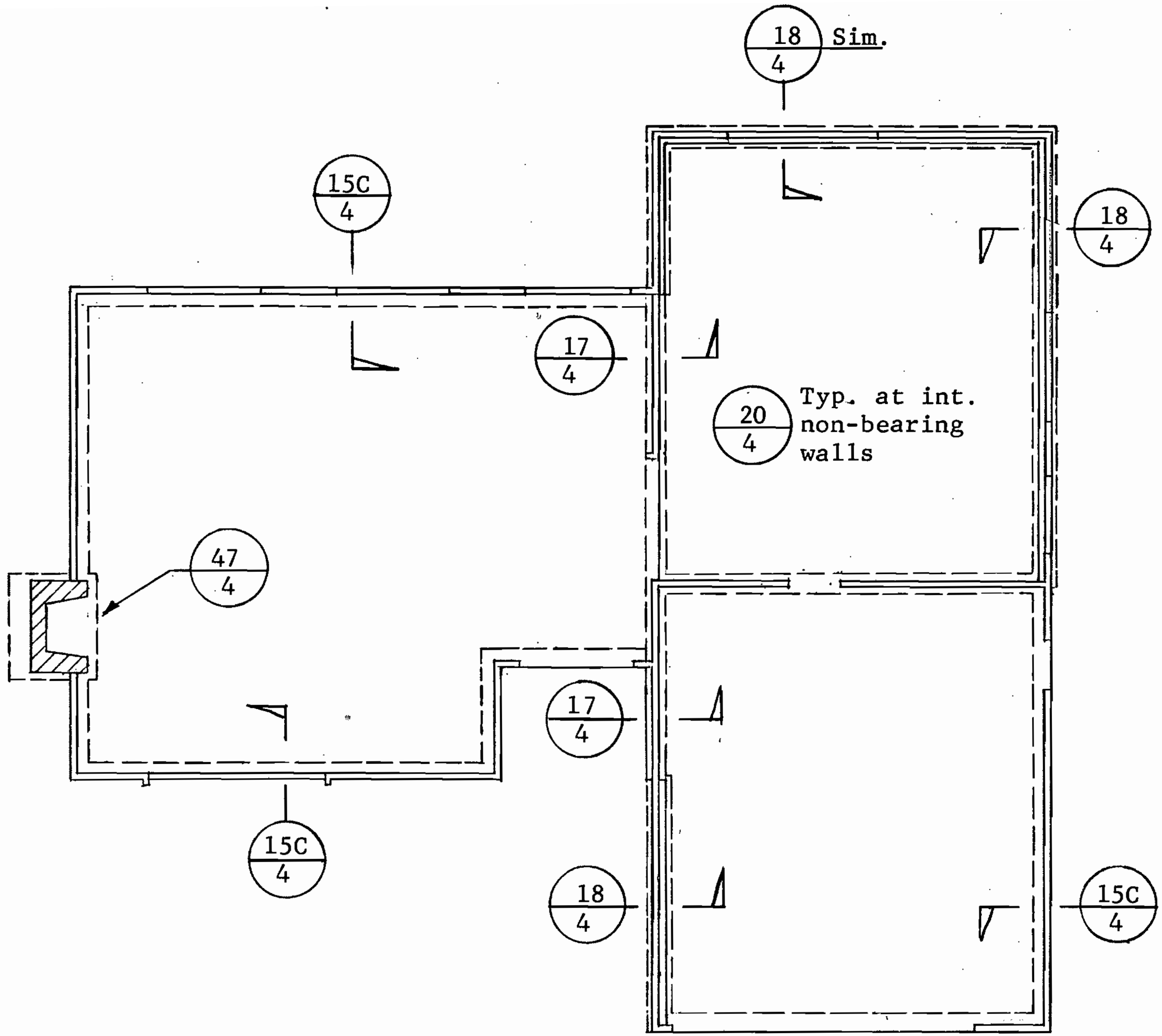
REAR ELEVATION - MODEL 'C-2'



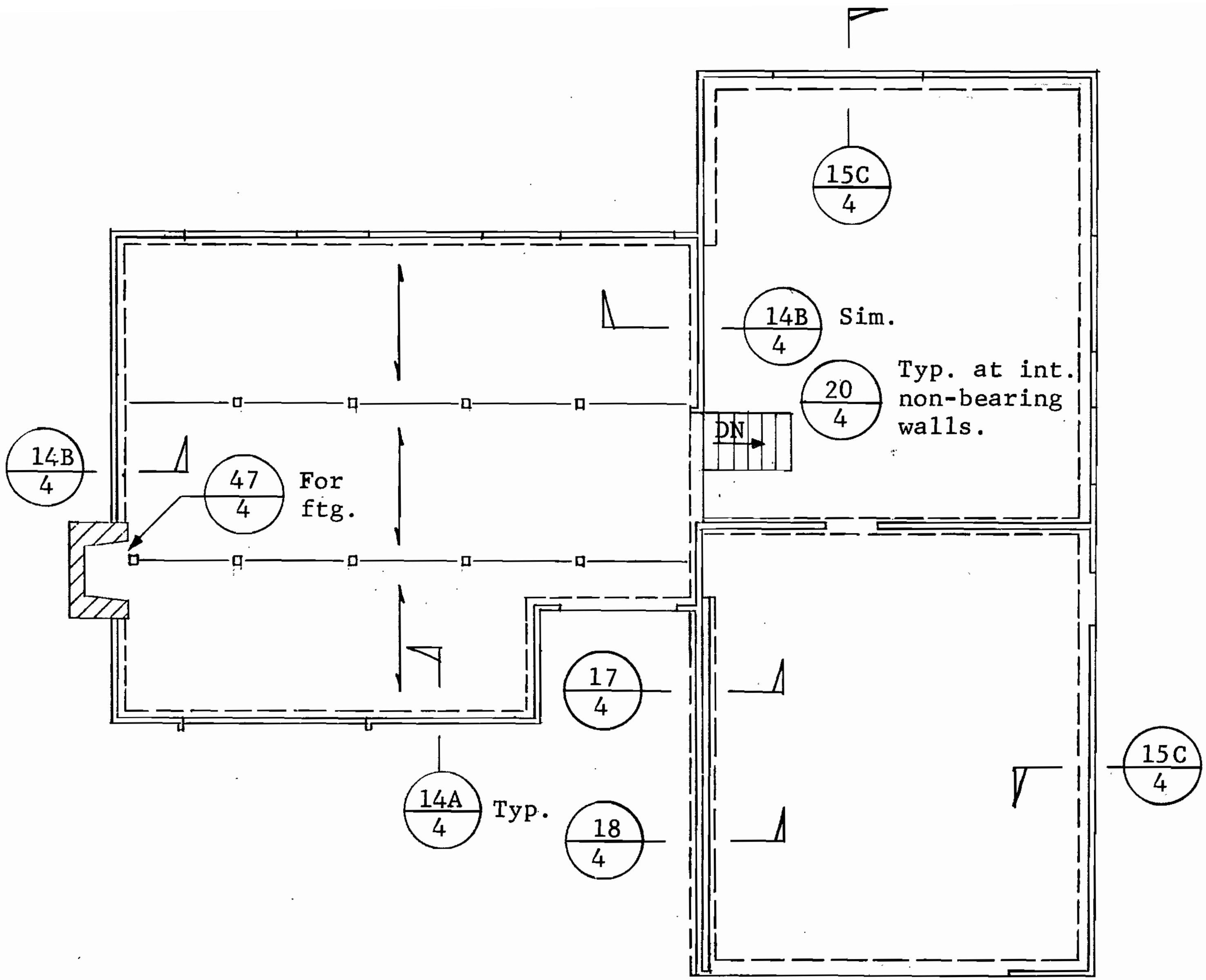
REAR ELEVATION - MODEL 'C-1'



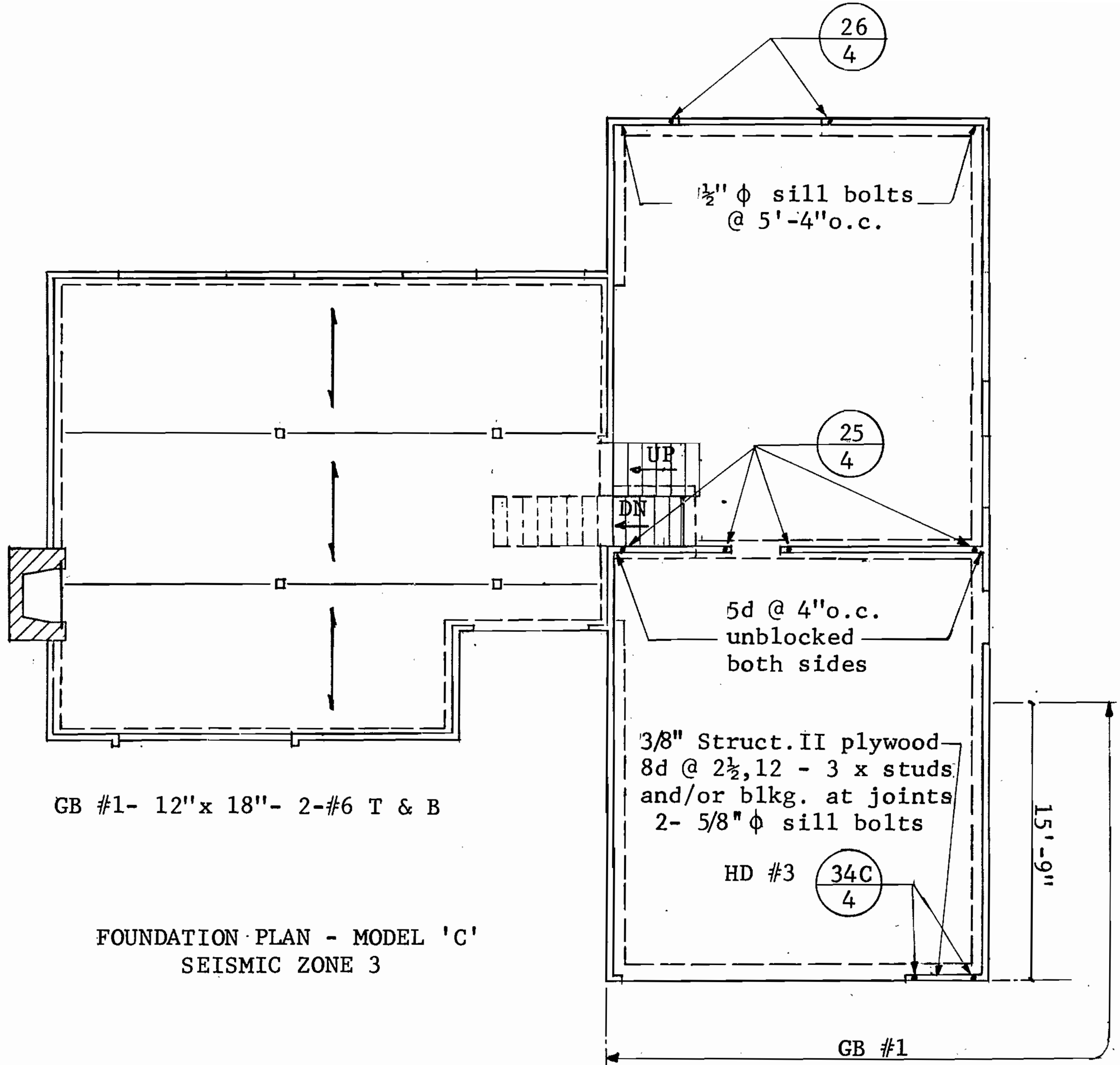
TYPICAL FOUNDATION PLAN - MODEL 'C'



TYPICAL FOUNDATION PLAN - MODEL 'C-1'

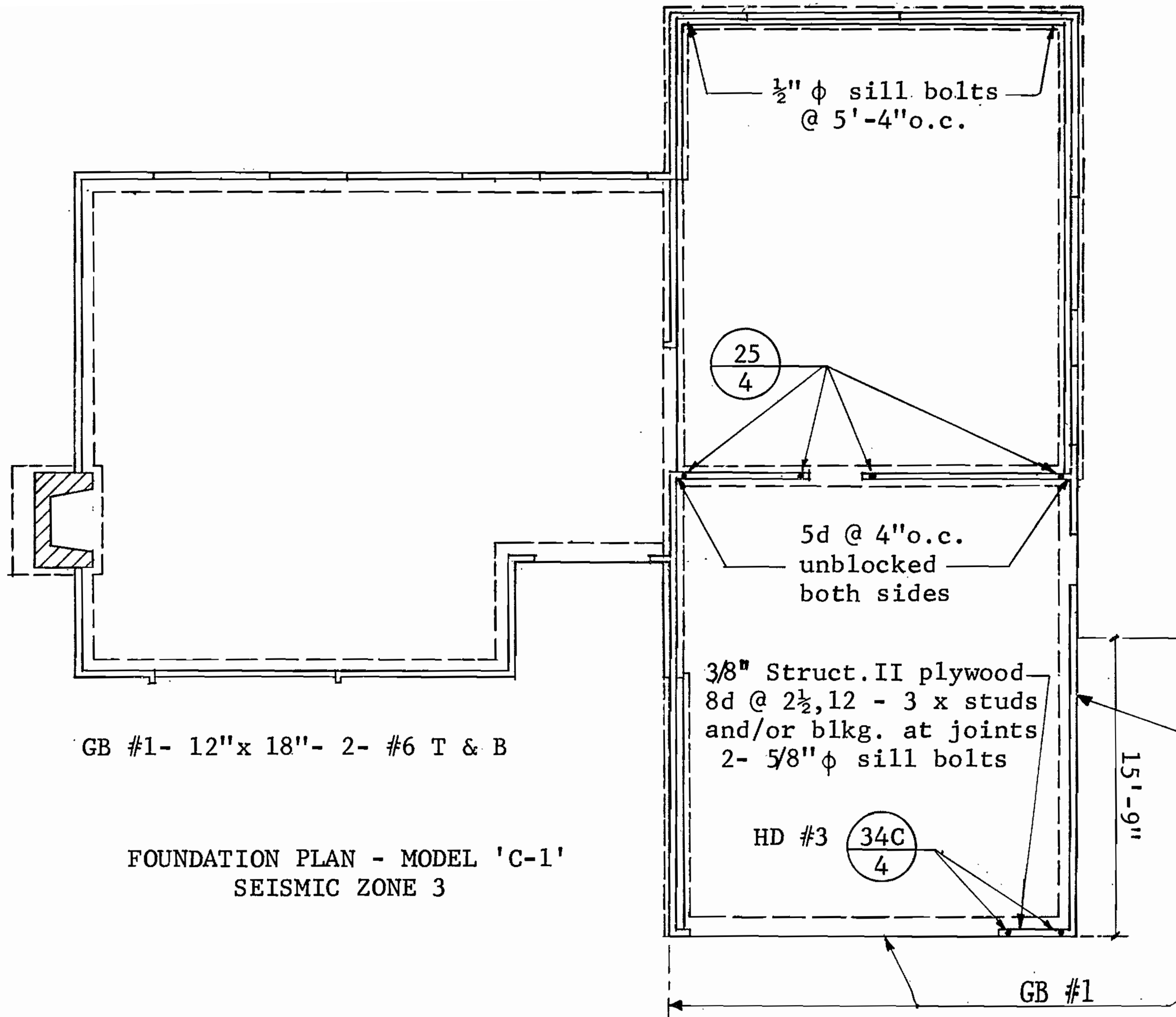


TYPICAL FOUNDATION PLAN - MODEL 'C-2'



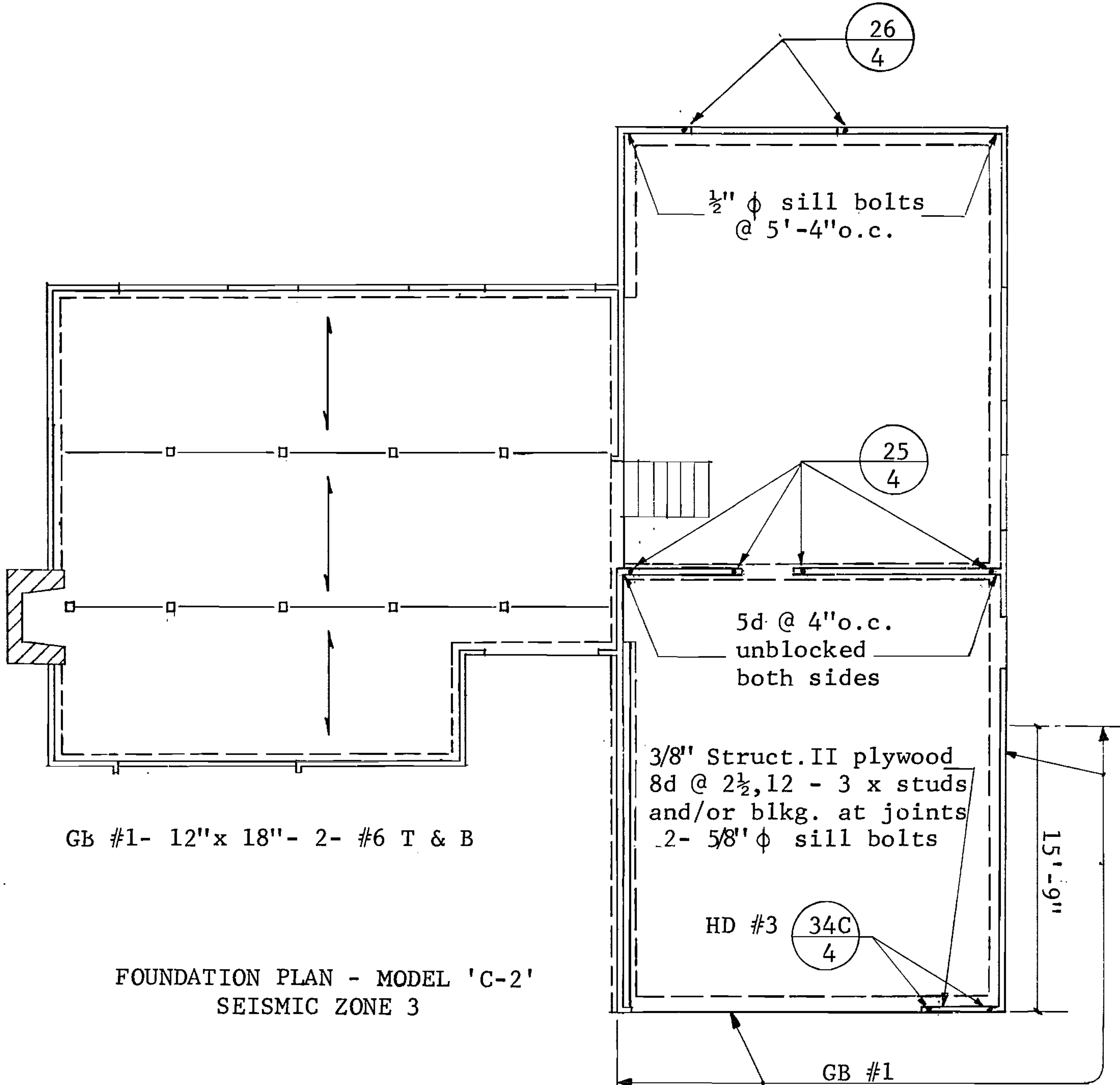
GB #1- 12"x 18"- 2-#6 T & B

FOUNDATION PLAN - MODEL 'C'
SEISMIC ZONE 3

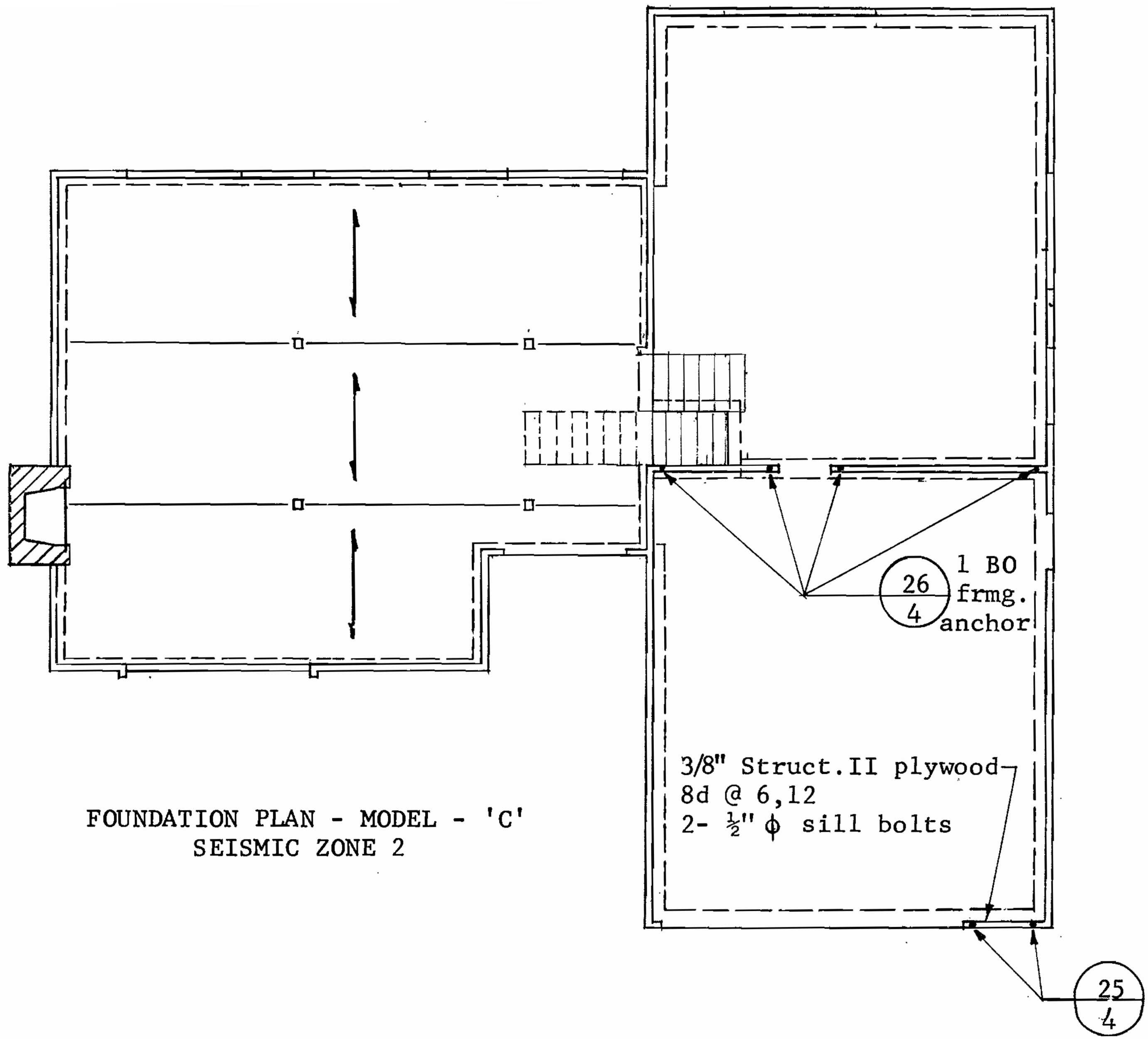


GB #1- 12"x 18"- 2- #6 T & B

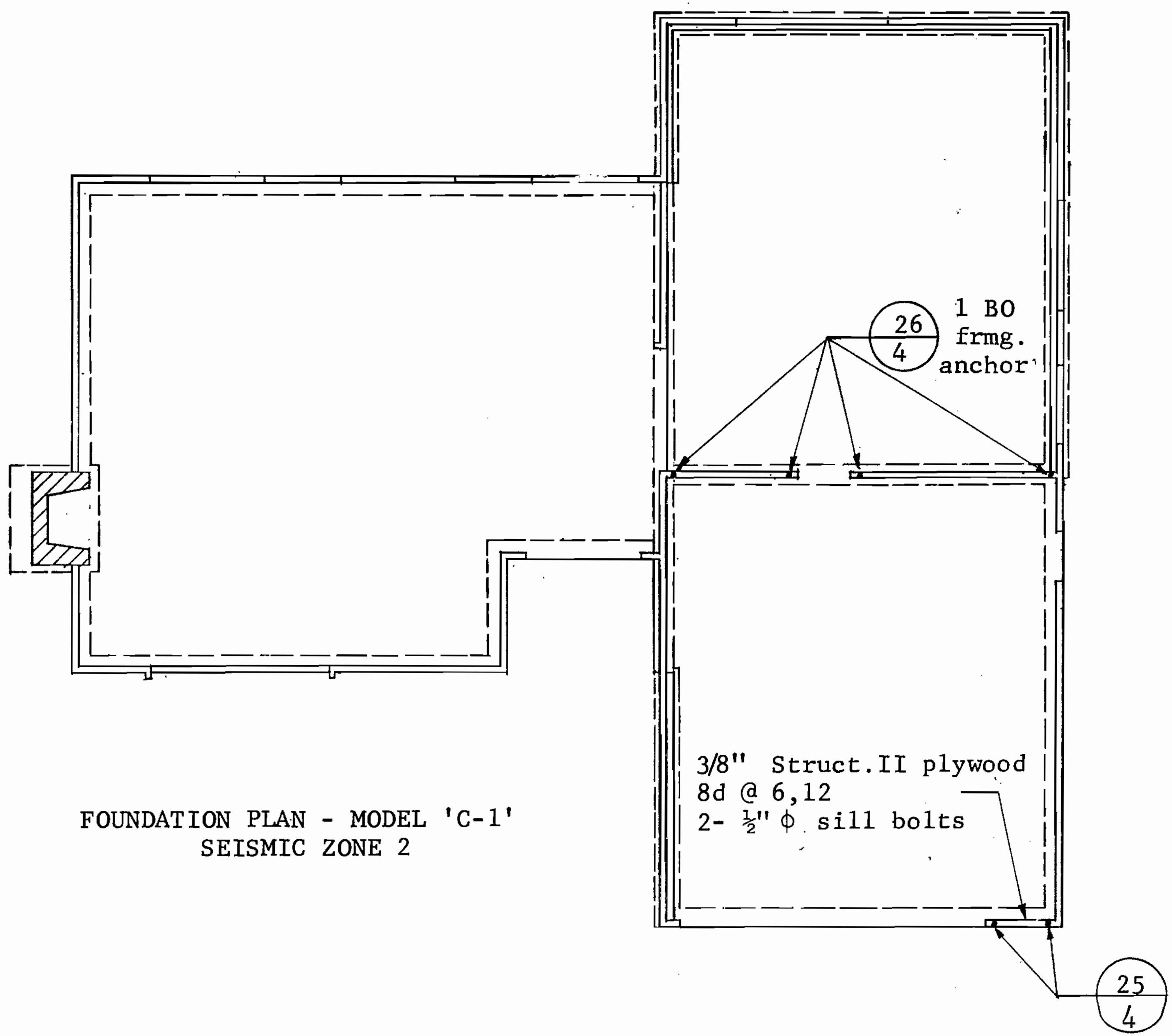
FOUNDATION PLAN - MODEL 'C-1'
SEISMIC ZONE 3



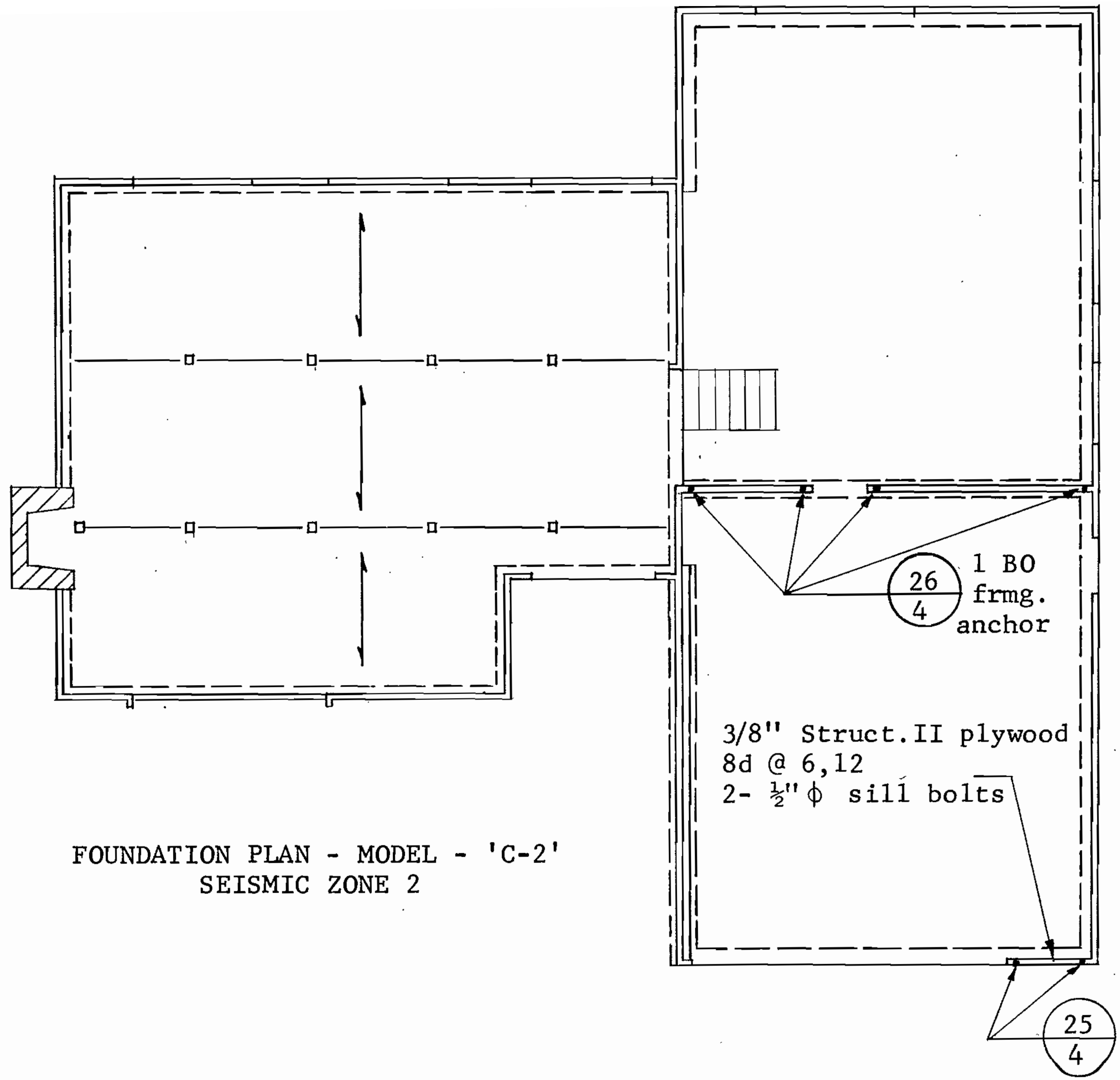
FOUNDATION PLAN - MODEL 'C-2'
SEISMIC ZONE 3



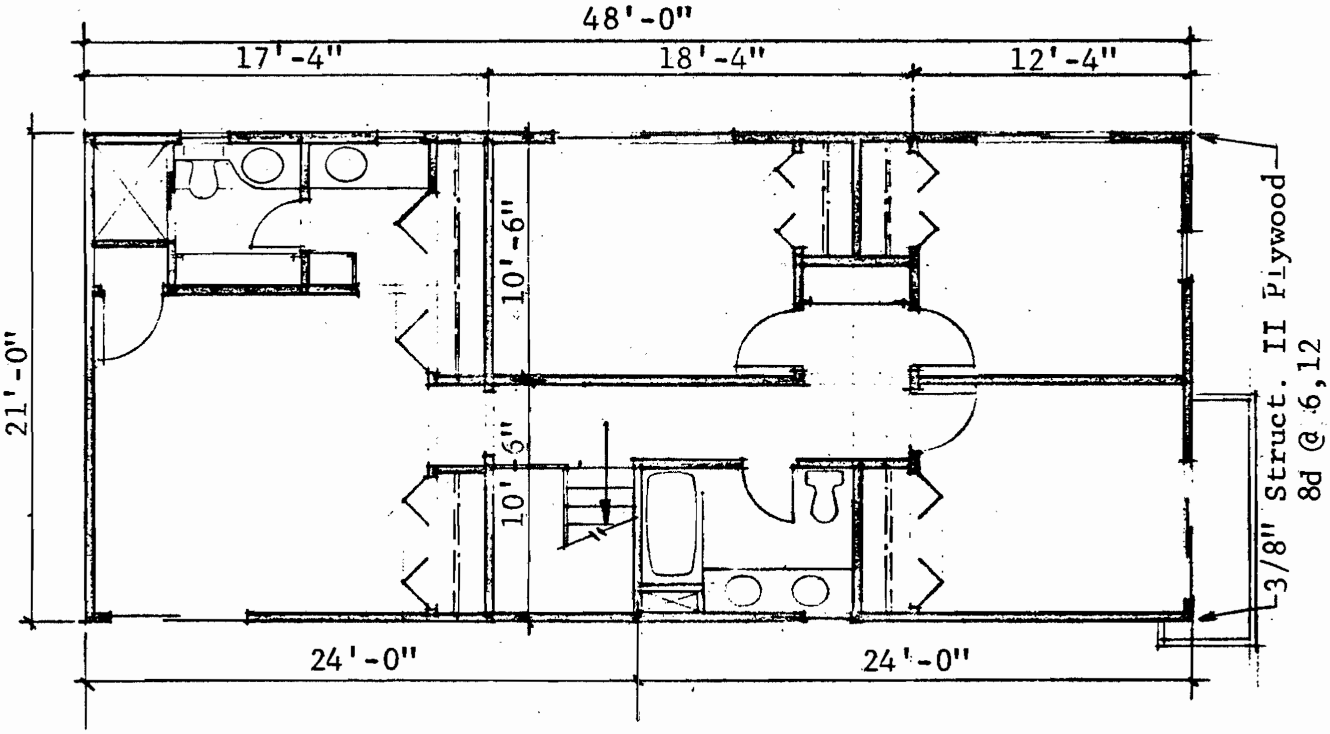
FOUNDATION PLAN - MODEL - 'C'
SEISMIC ZONE 2

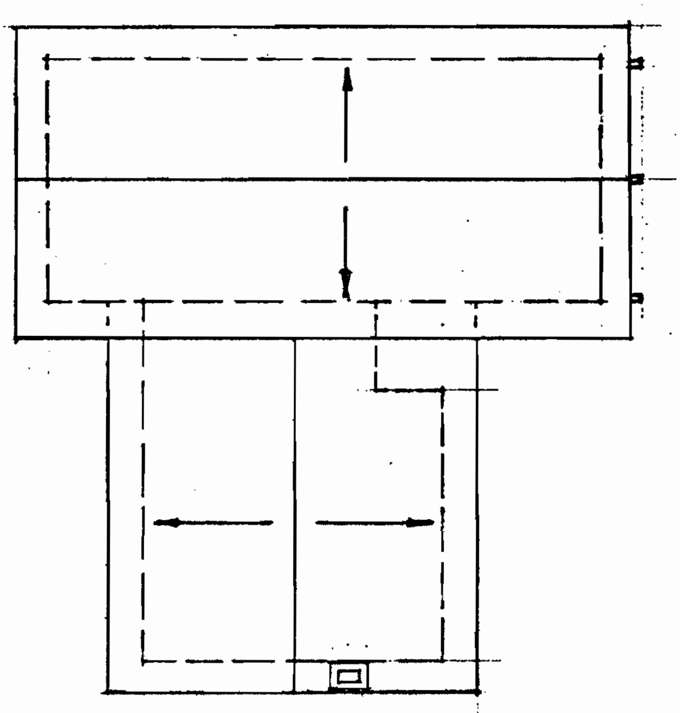


FOUNDATION PLAN - MODEL 'C-1'
SEISMIC ZONE 2

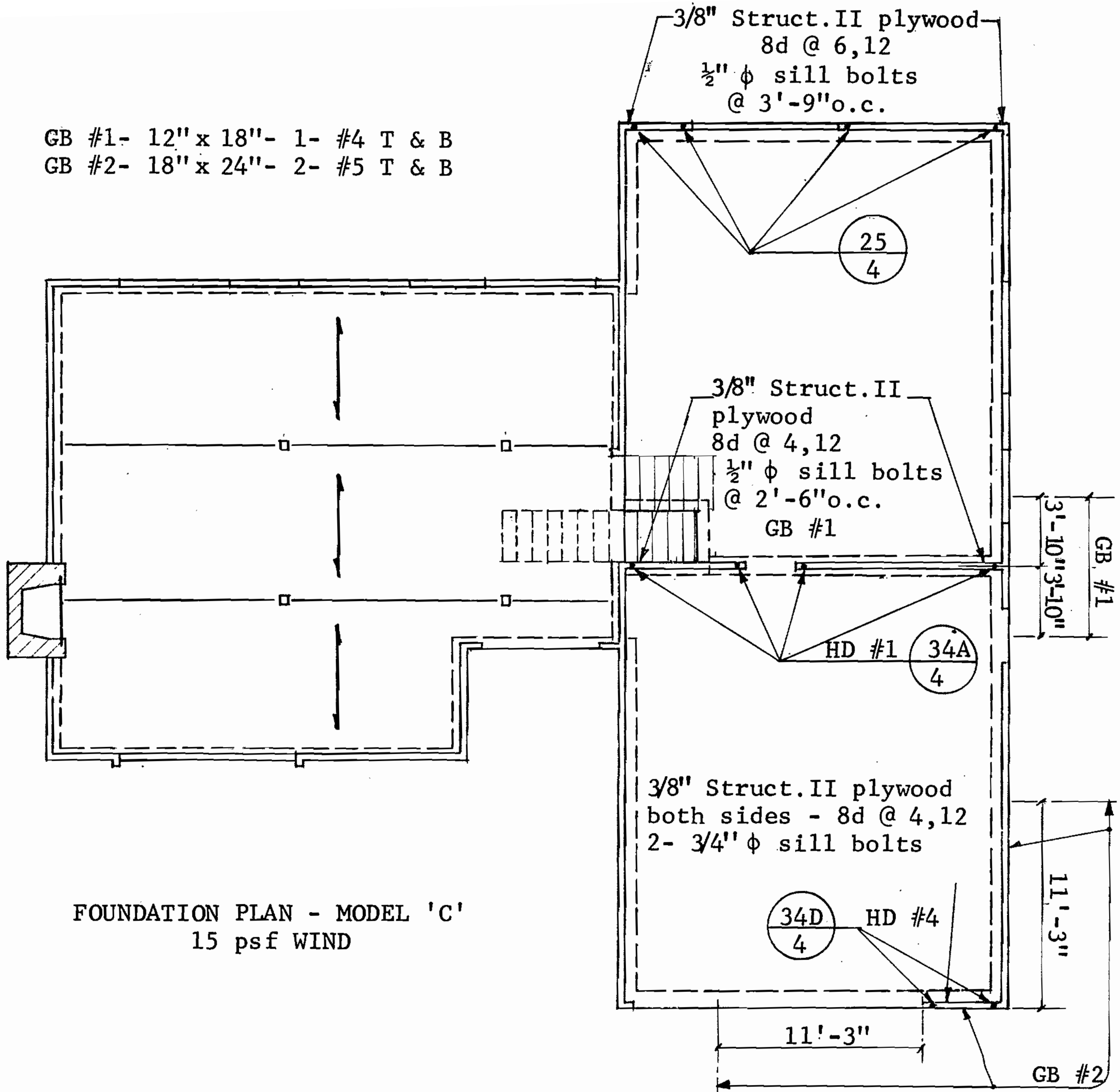


FOUNDATION PLAN - MODEL - 'C-2'
SEISMIC ZONE 2



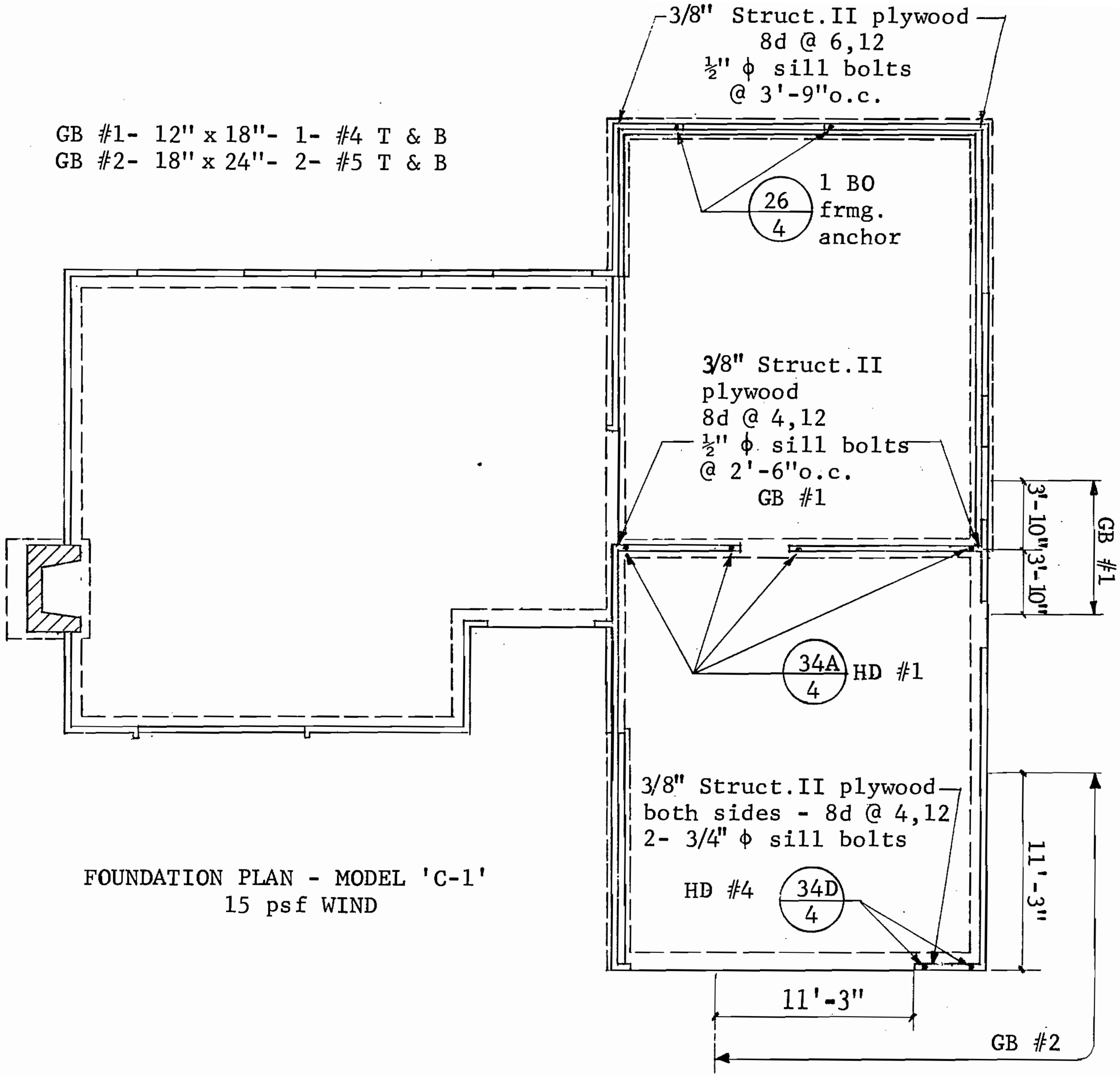


SECOND FLOOR PLAN-MODEL'C'
15 psf WIND



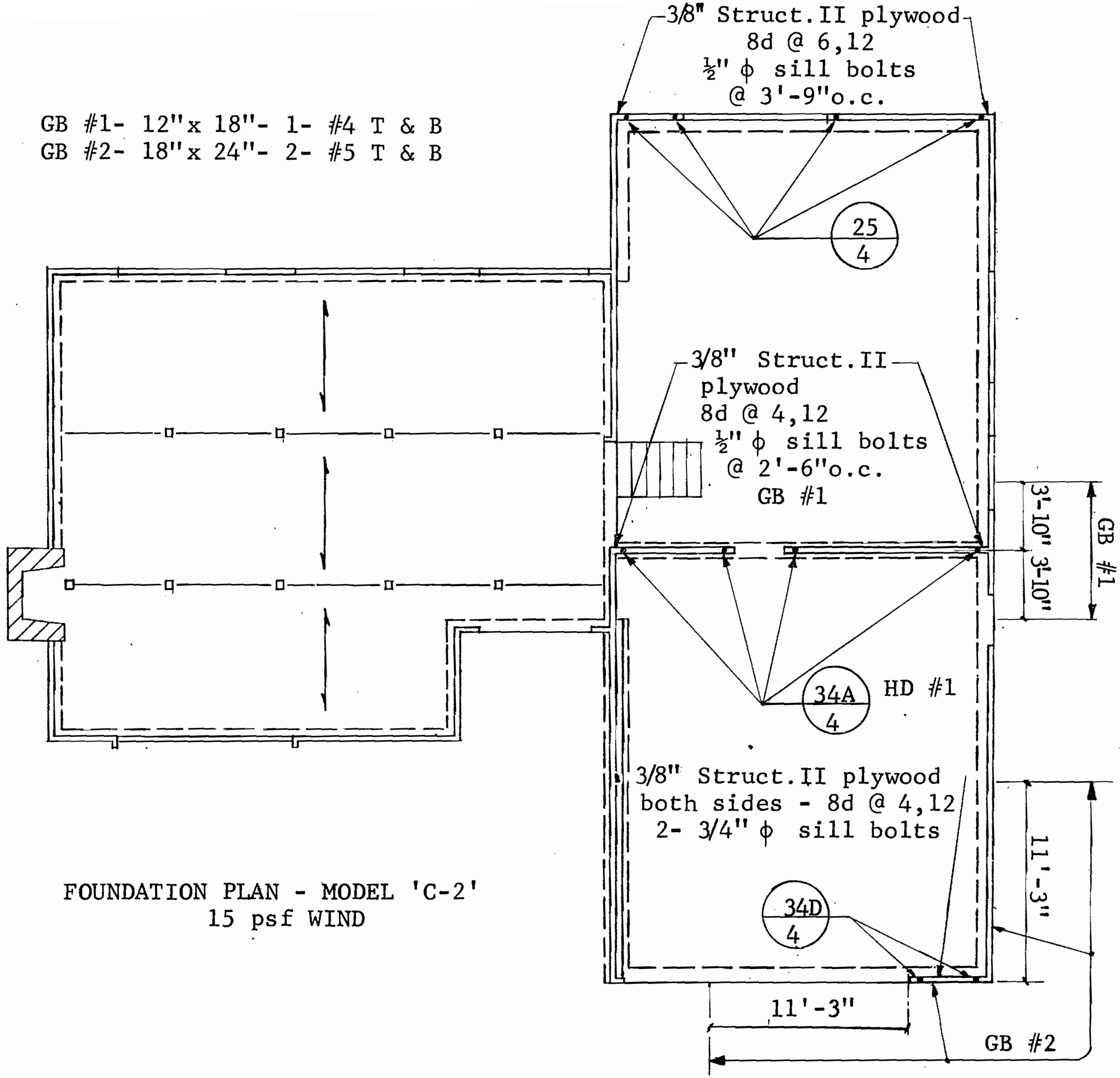
FOUNDATION PLAN - MODEL 'C'
15 psf WIND

GB #1- 12" x 18"- 1- #4 T & B
GB #2- 18" x 24"- 2- #5 T & B

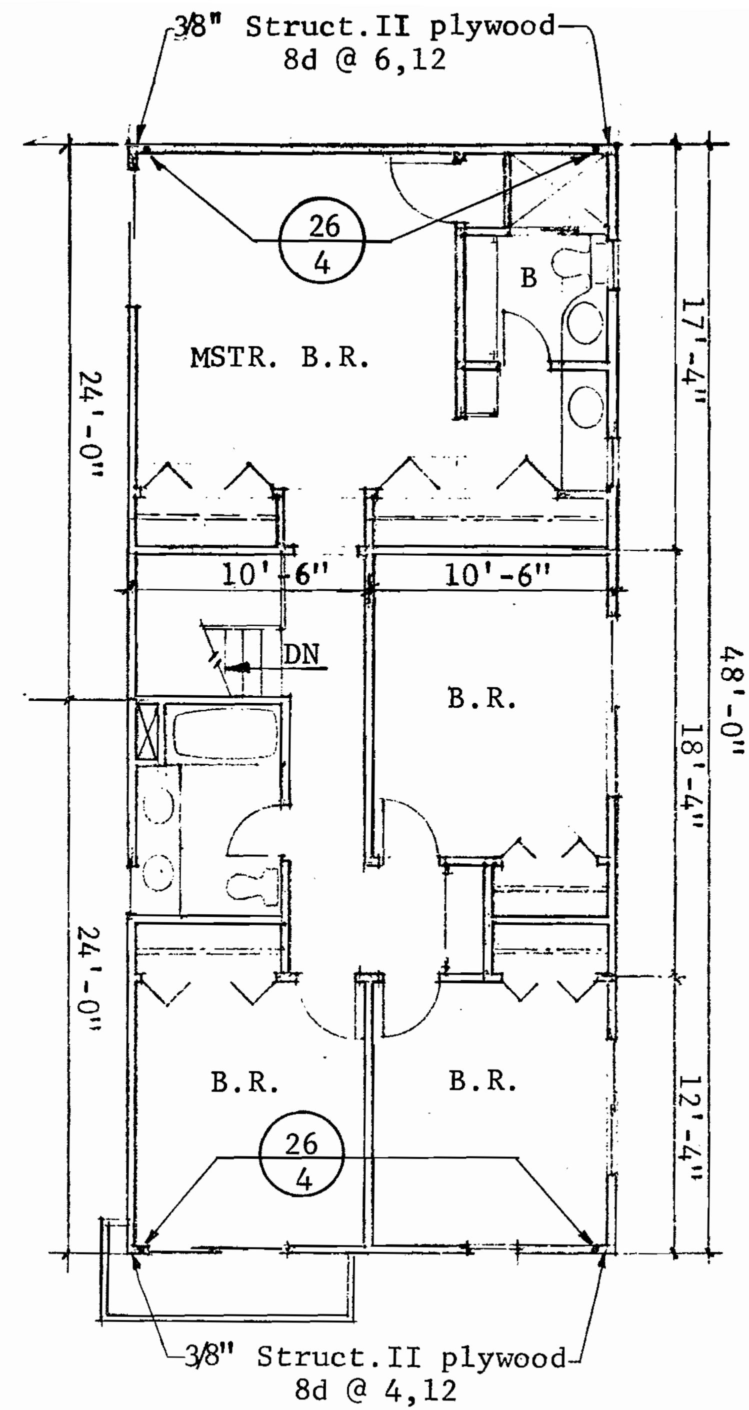


FOUNDATION PLAN - MODEL 'C-1'
15 psf WIND

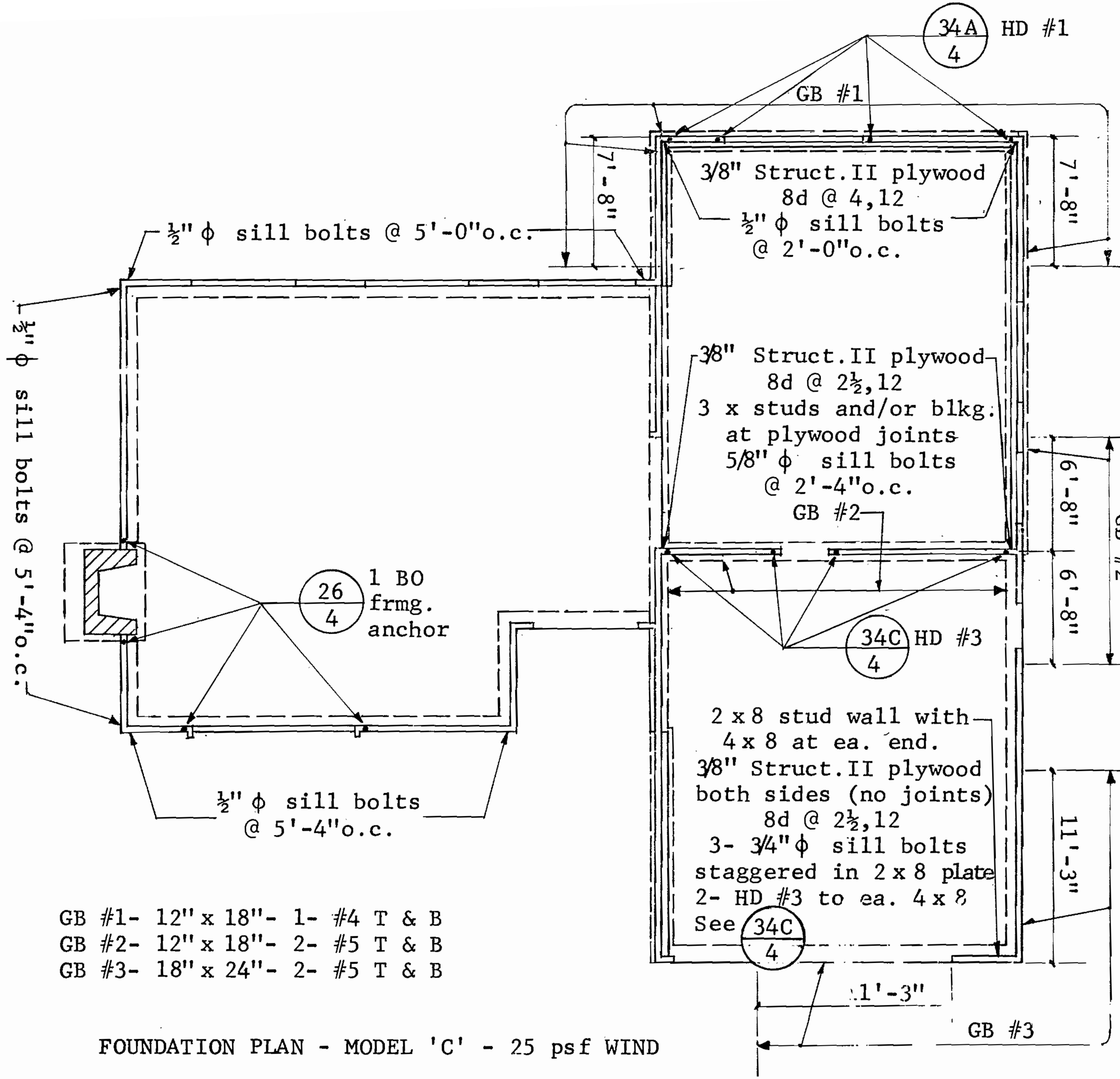
GB #1- 12"x 18"- 1- #4 T & B
GB #2- 18"x 24"- 2- #5 T & B



FOUNDATION PLAN - MODEL 'C-2'
15 psf WIND

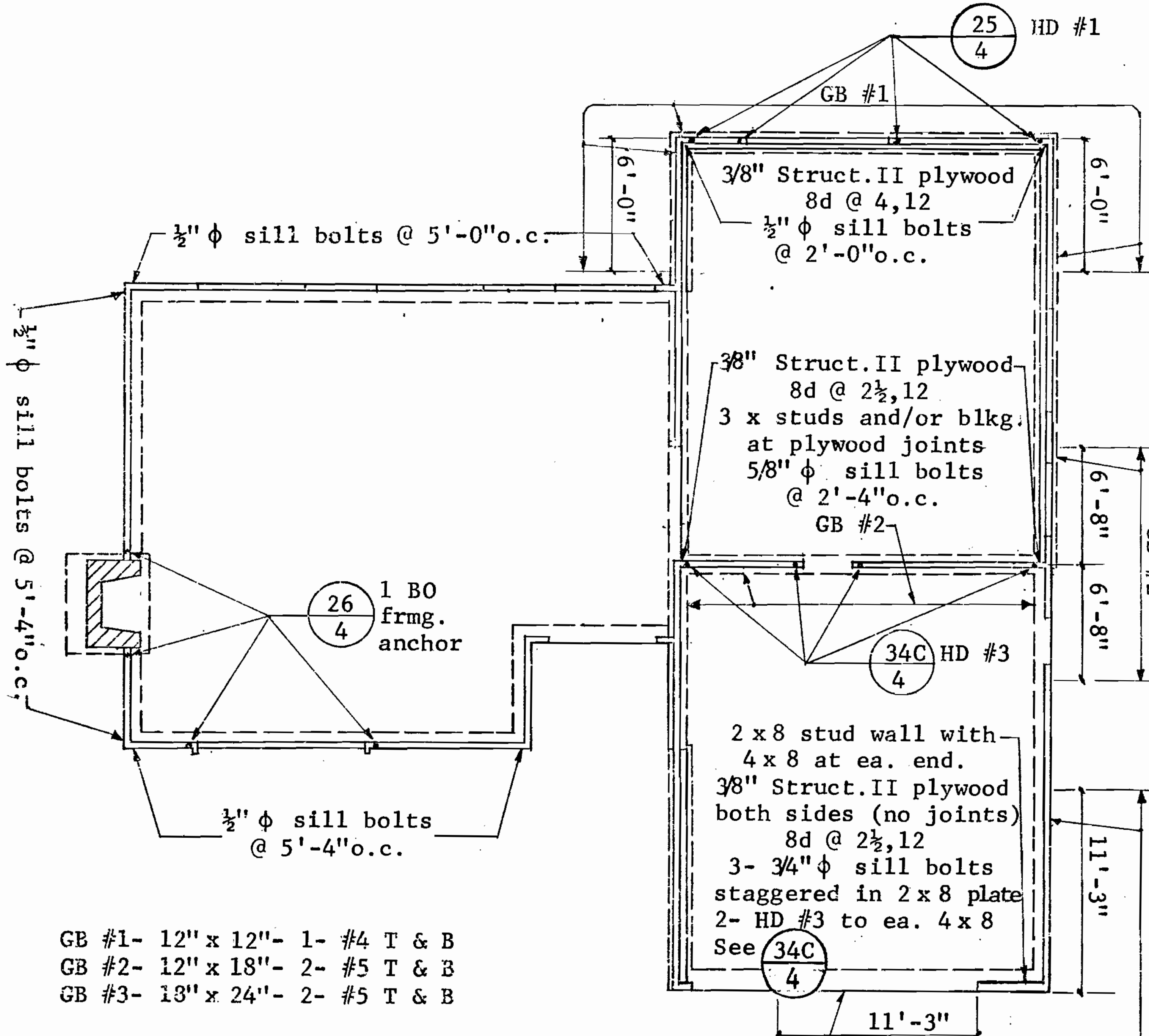


SECOND FLOOR PLAN - MODEL 'C' - 25 psf WIND



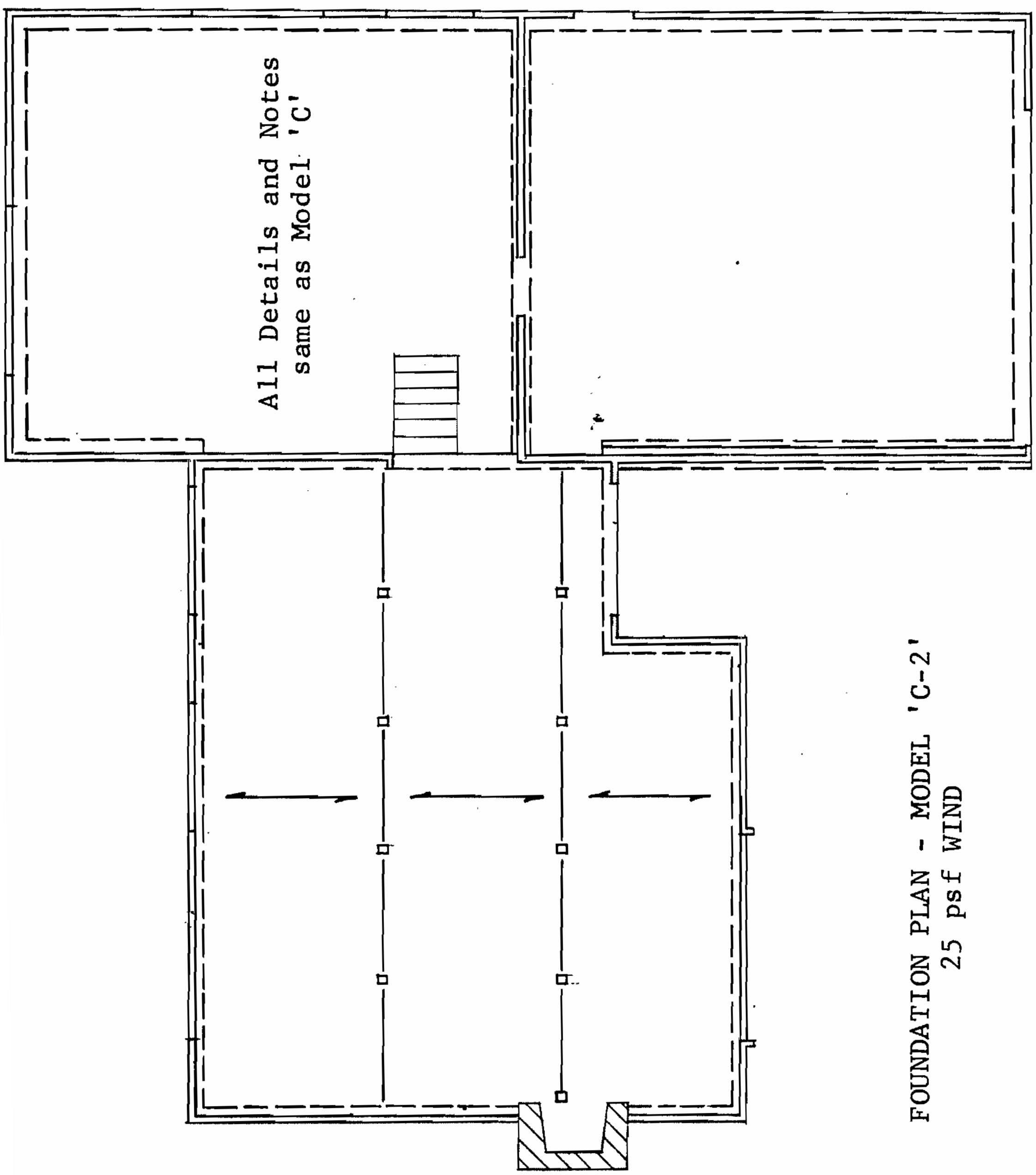
GB #1- 12" x 18"- 1- #4 T & B
GB #2- 12" x 18"- 2- #5 T & B
GB #3- 18" x 24"- 2- #5 T & B

FOUNDATION PLAN - MODEL 'C' - 25 psf WIND

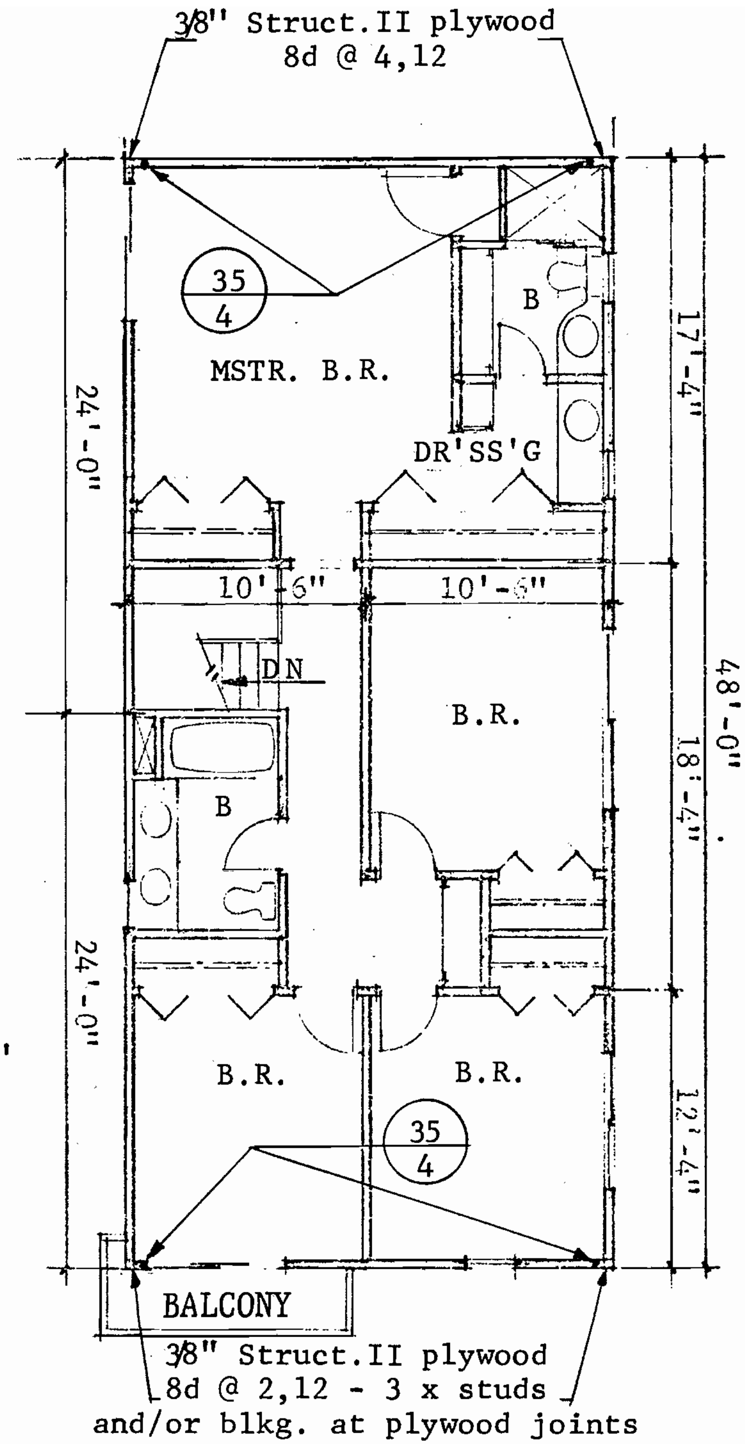


GB #1- 12" x 12"- 1- #4 T & B
GB #2- 12" x 18"- 2- #5 T & B
GB #3- 13" x 24"- 2- #5 T & B

FOUNDATION PLAN - MODEL 'C-1' - 25 psf WIND

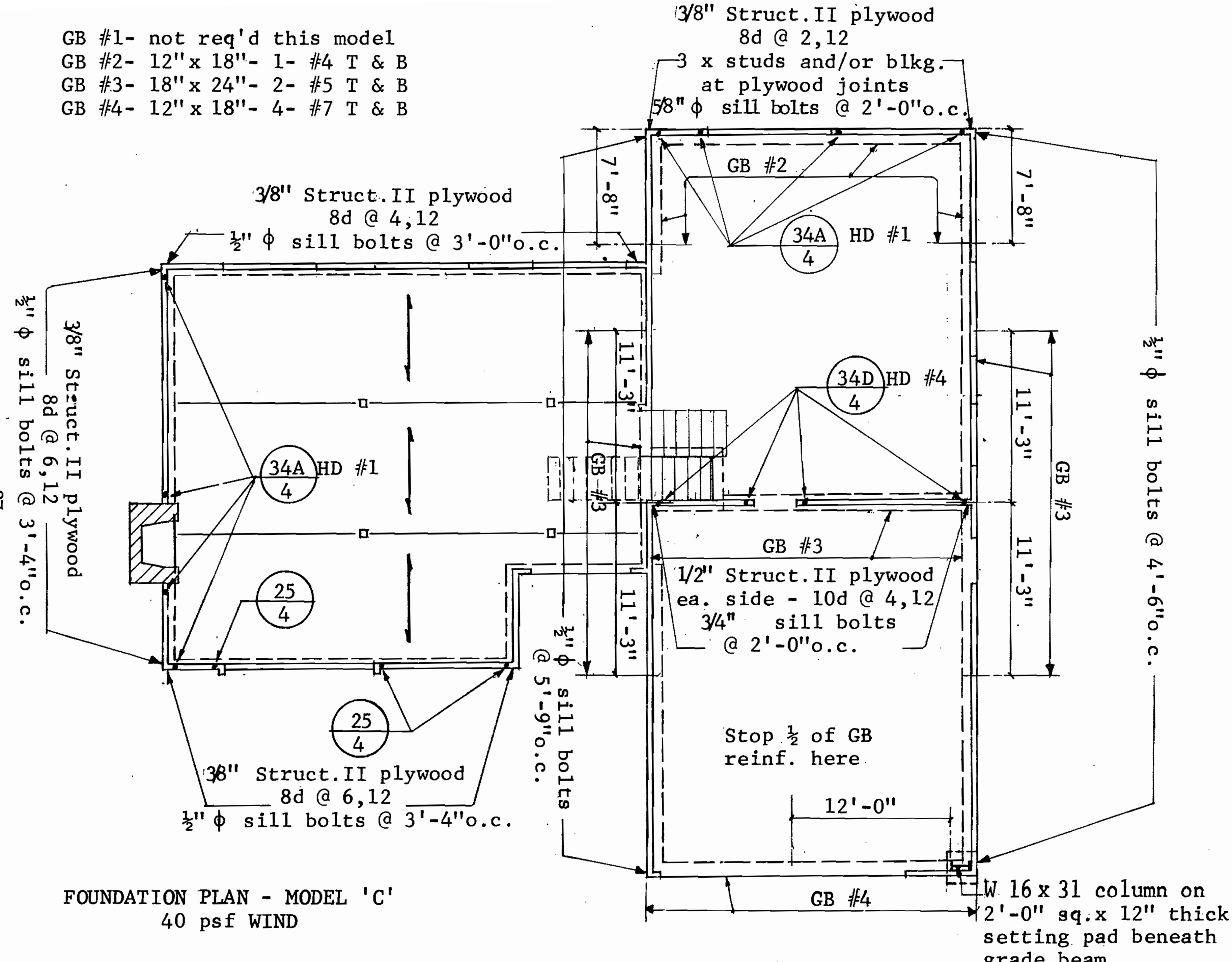


FOUNDATION PLAN - MODEL 'C-2'
25 psf WIND

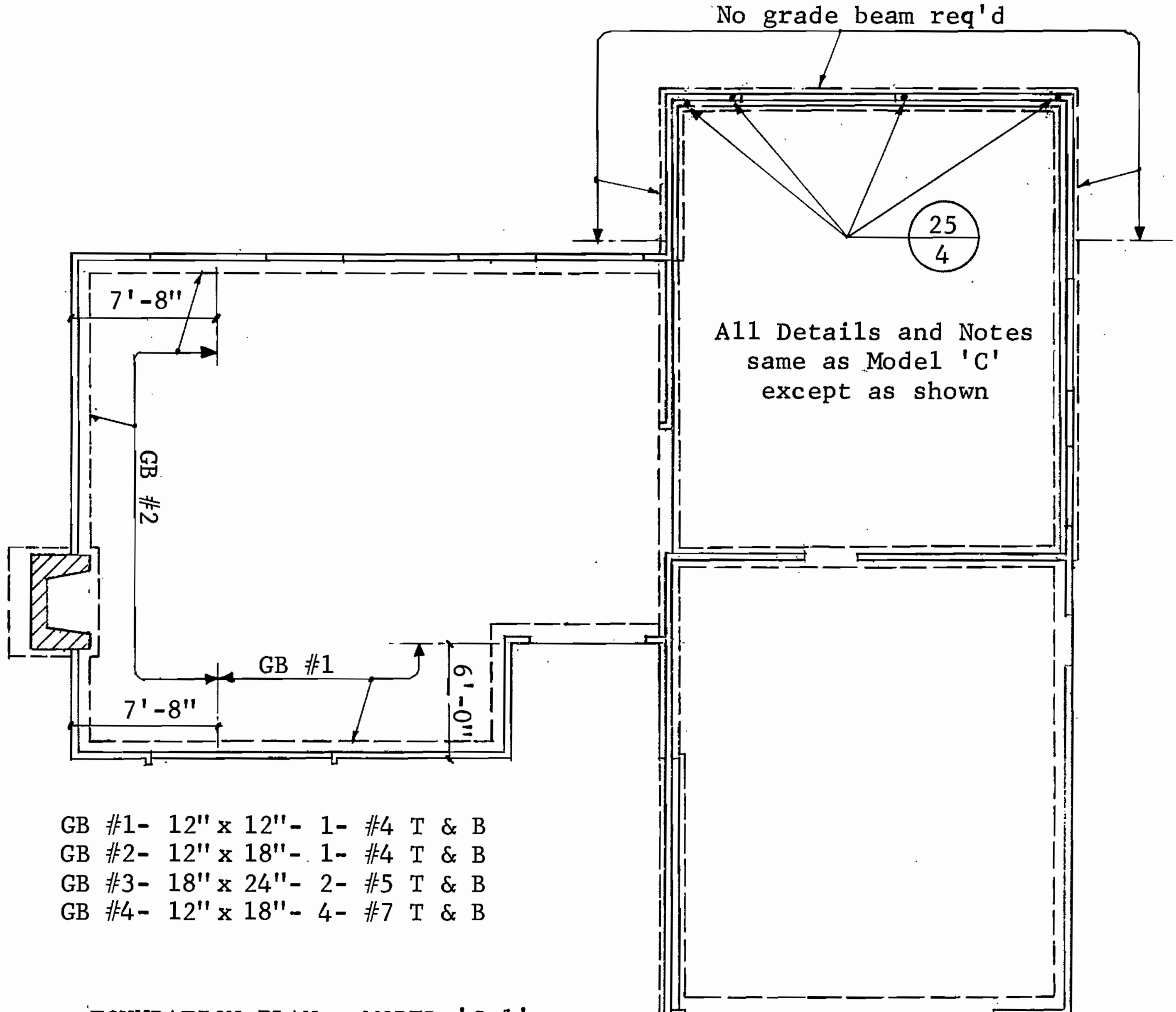


SECOND FLOOR PLAN - MODELS 'C', 'C-1' and 'C-2'
40 psf WIND

GB #1- not req'd this model
GB #2- 12"x 18"- 1- #4 T & B
GB #3- 18"x 24"- 2- #5 T & B
GB #4- 12"x 18"- 4- #7 T & B

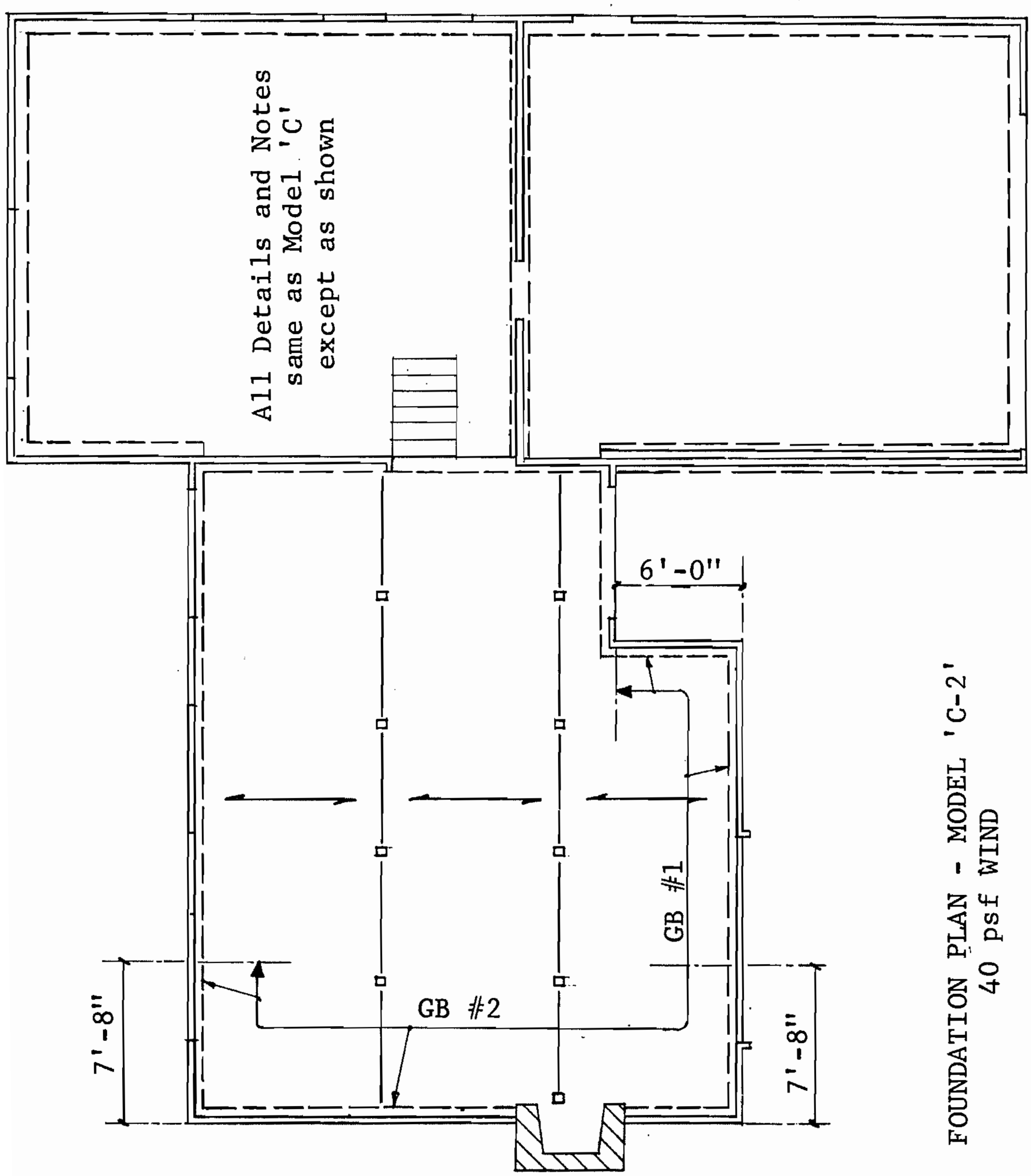


FOUNDATION PLAN - MODEL 'C'
40 psf WIND

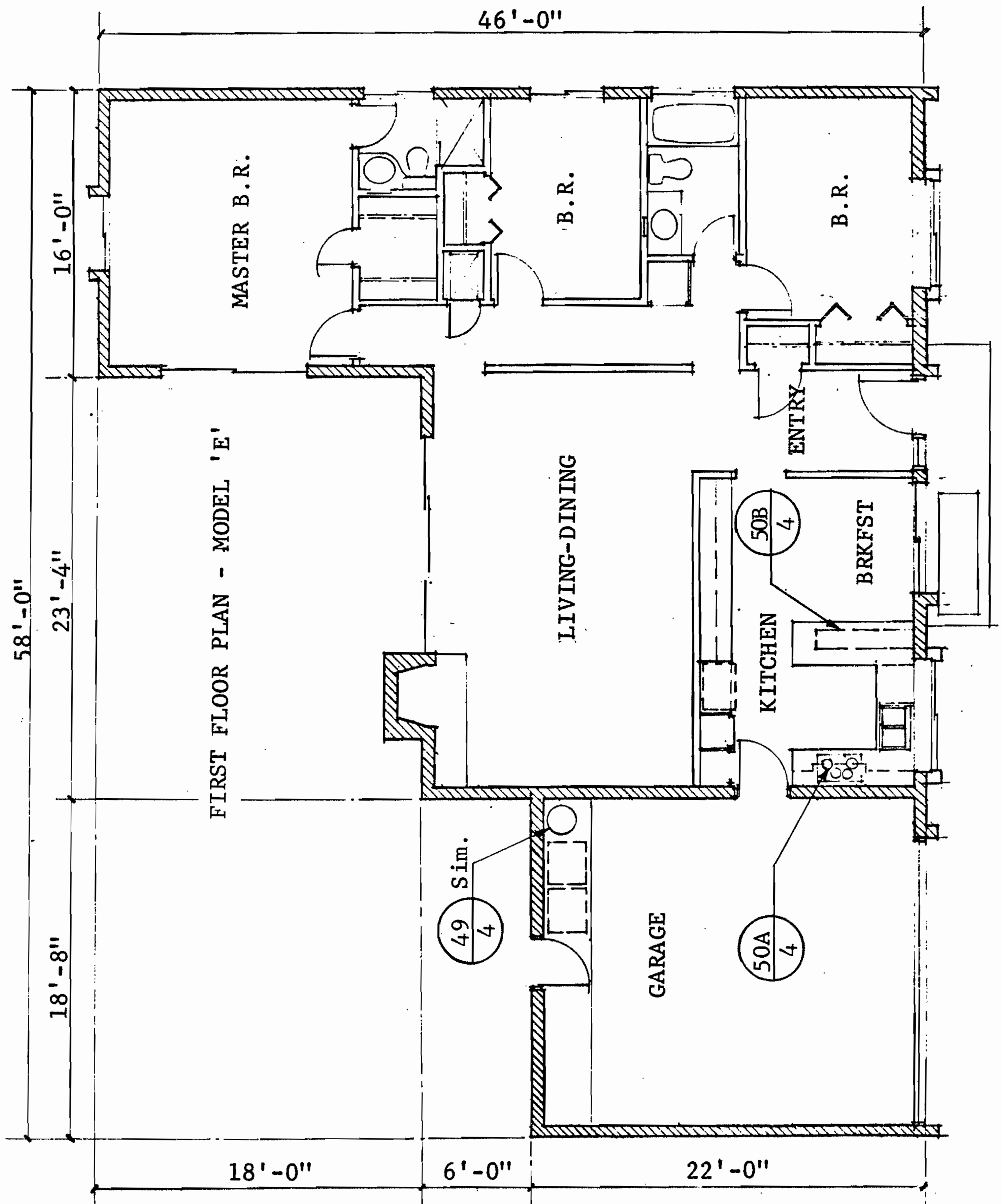


GB #1- 12" x 12"- 1- #4 T & B
GB #2- 12" x 18"- 1- #4 T & B
GB #3- 18" x 24"- 2- #5 T & B
GB #4- 12" x 18"- 4- #7 T & B

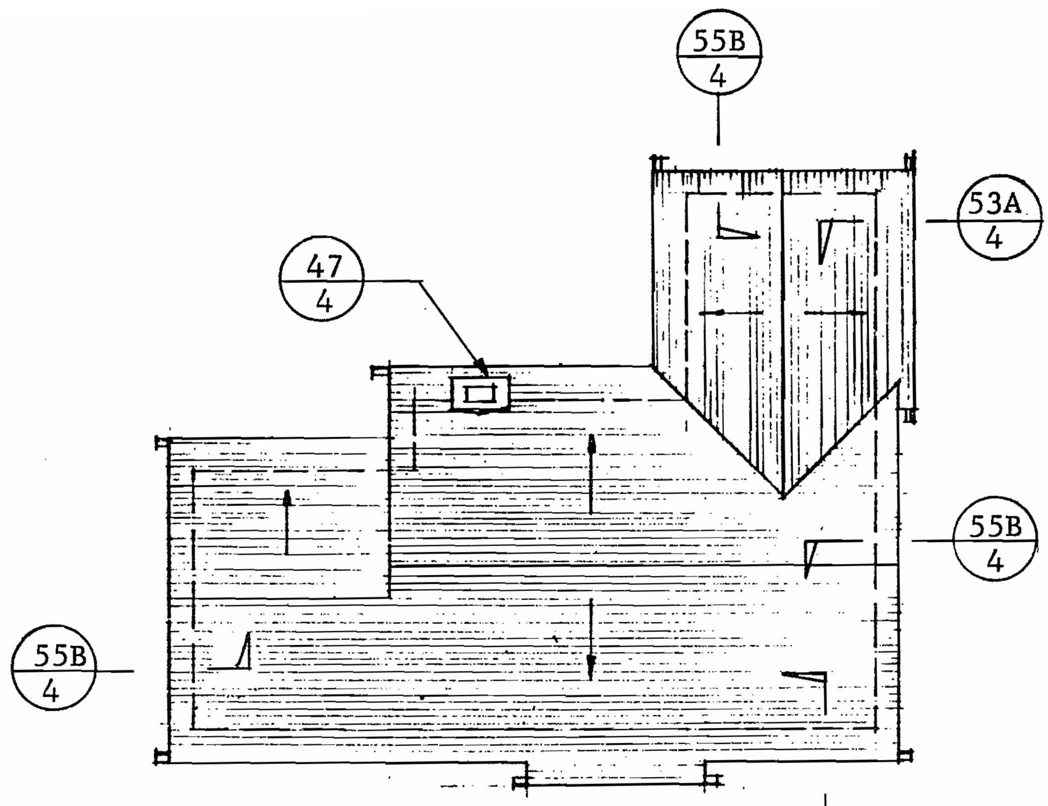
FOUNDATION PLAN - MODEL 'C-1'
40 psf WIND



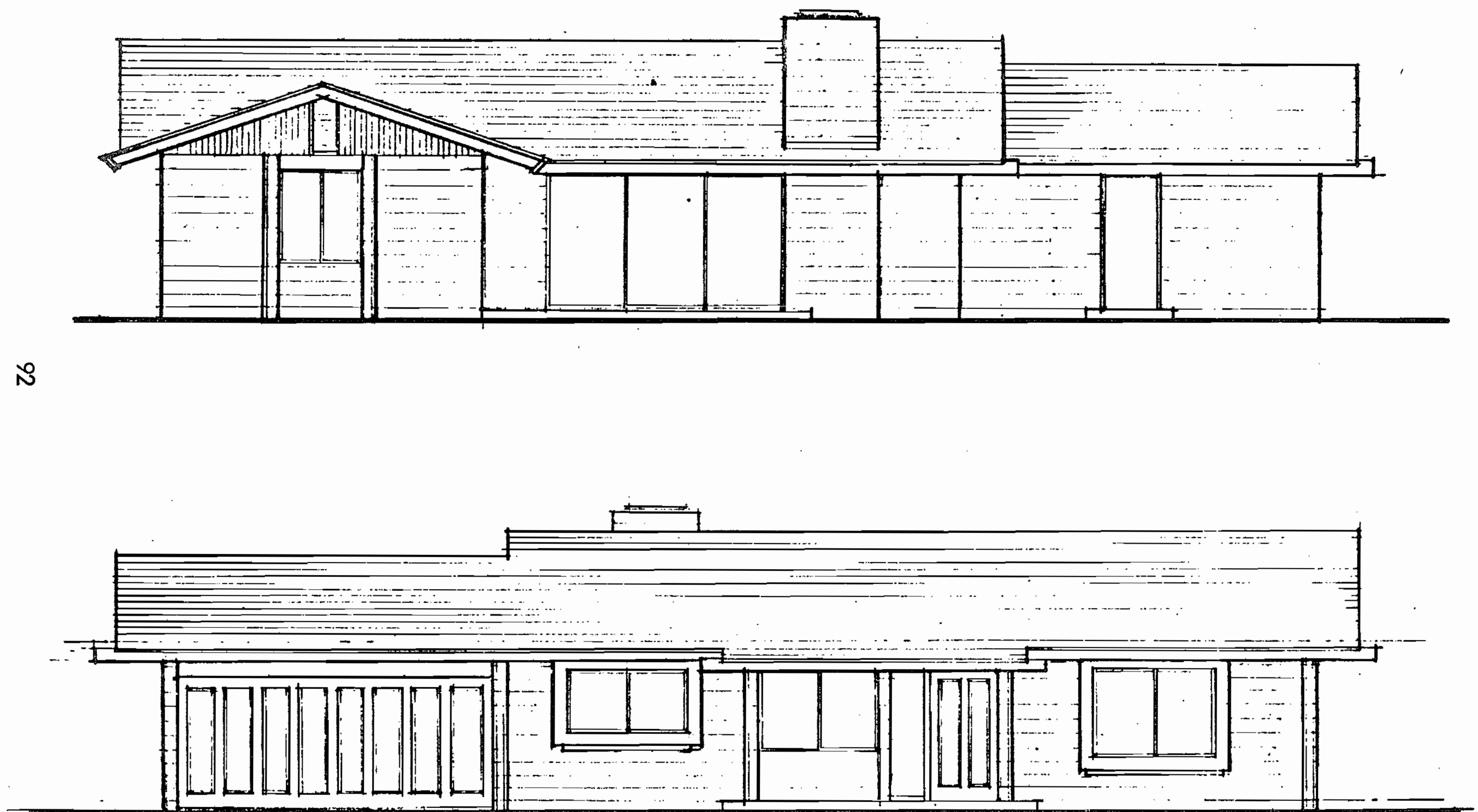
FOUNDATION PLAN - MODEL 'C-2'
40 psf WIND



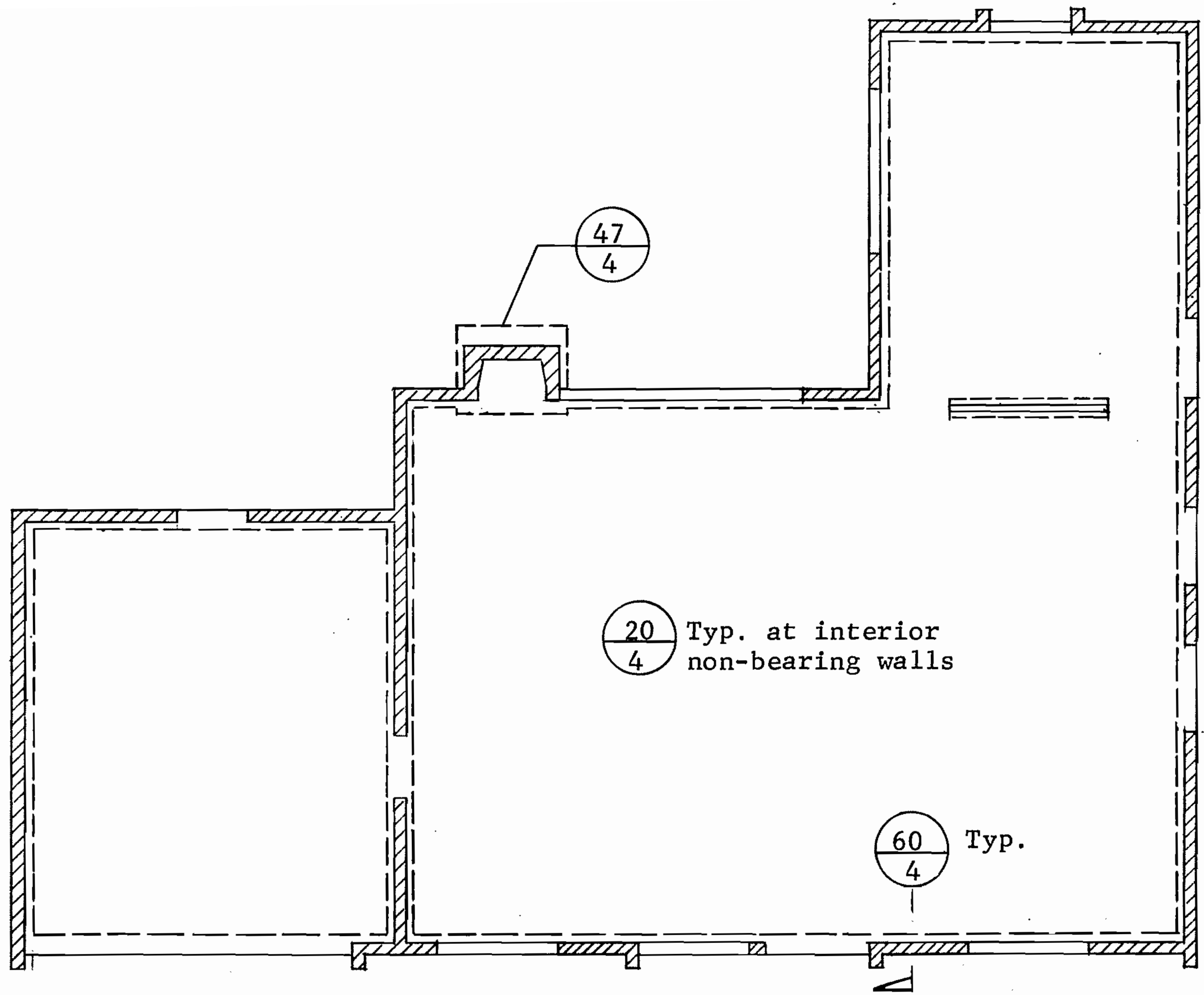
FIRST FLOOR PLAN - MODEL 'E'



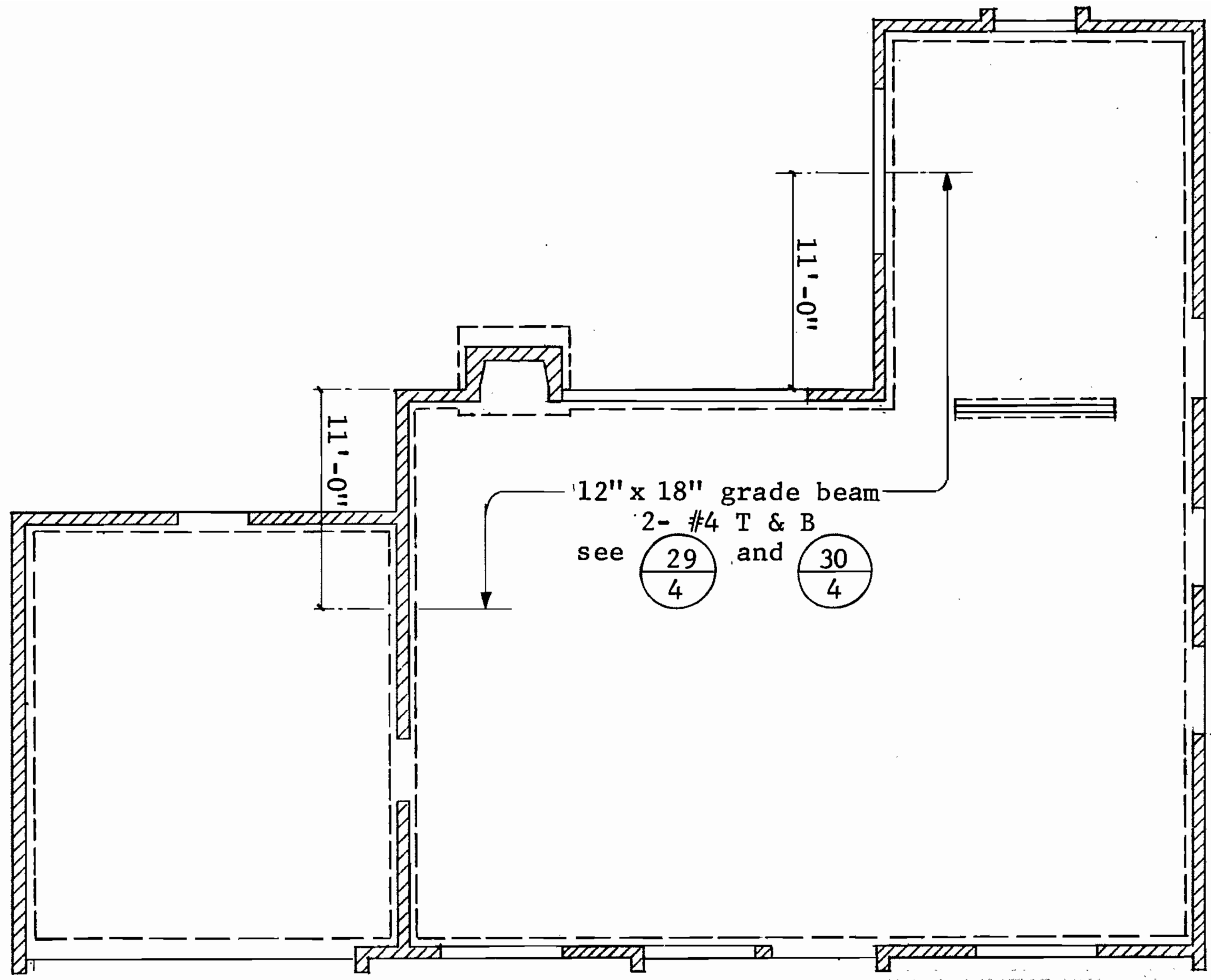
ROOF PLAN - MODEL 'E'



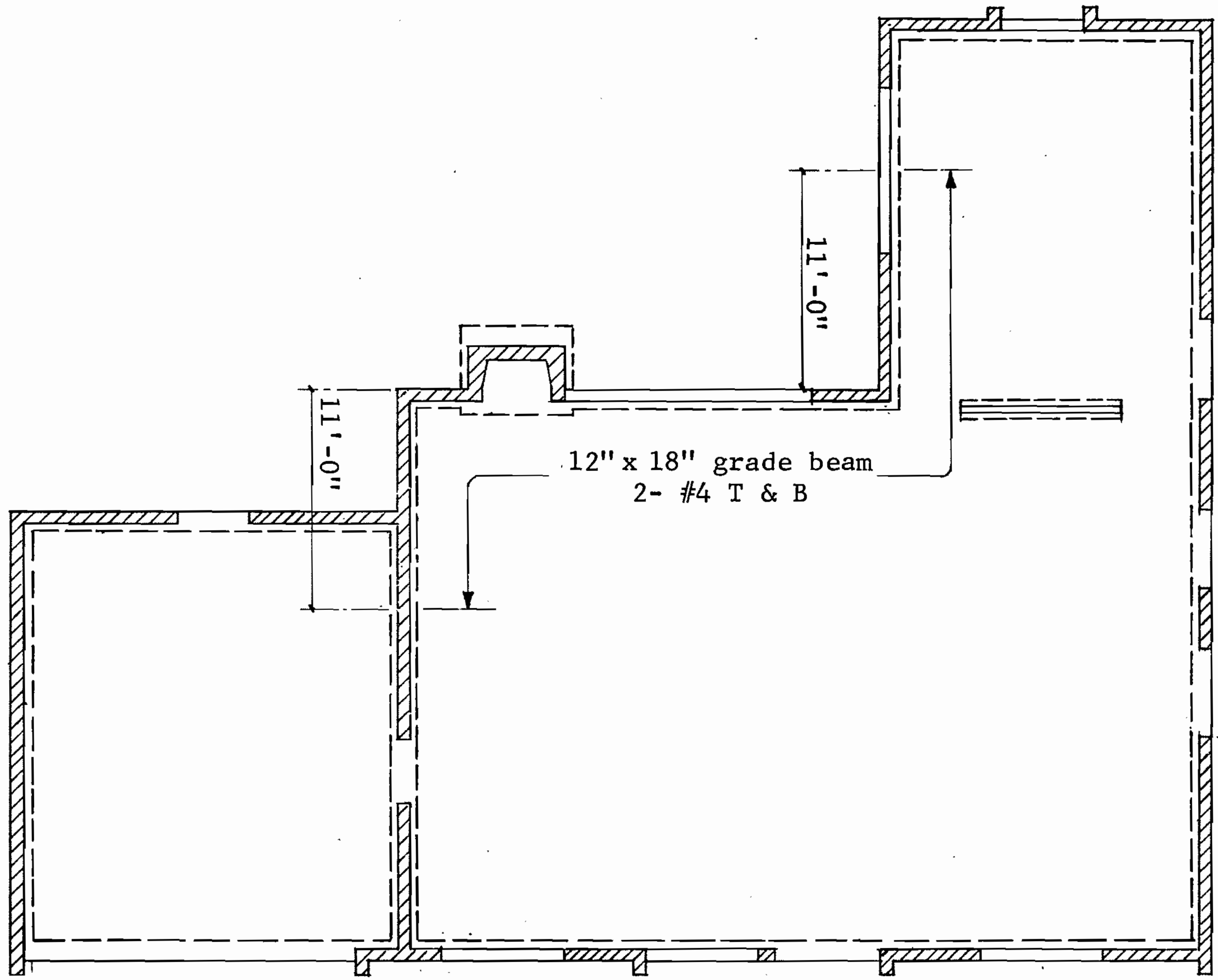
FRONT AND REAR ELEVATION - MODEL 'E'



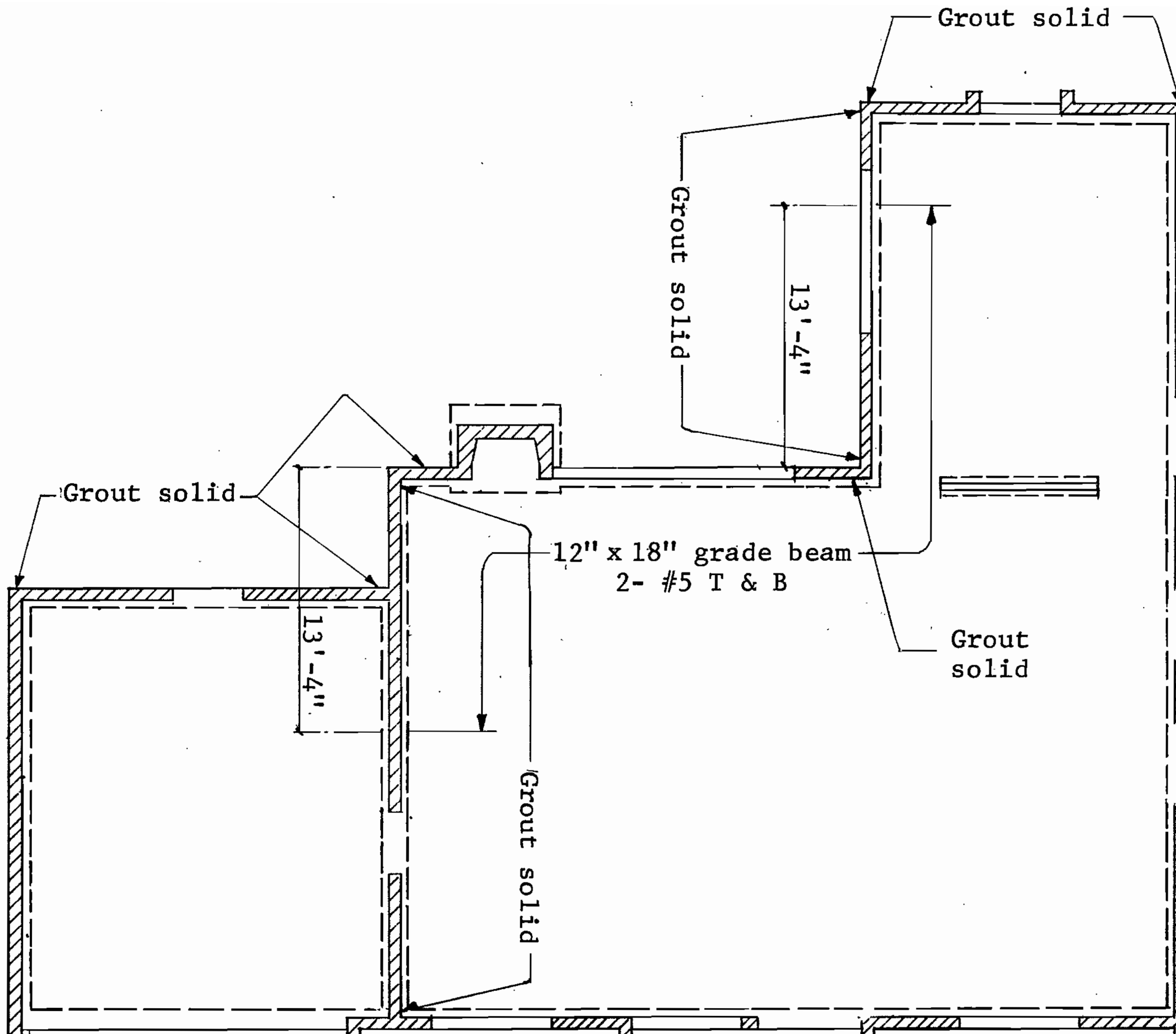
TYPICAL FOUNDATION PLAN - MODEL 'E'



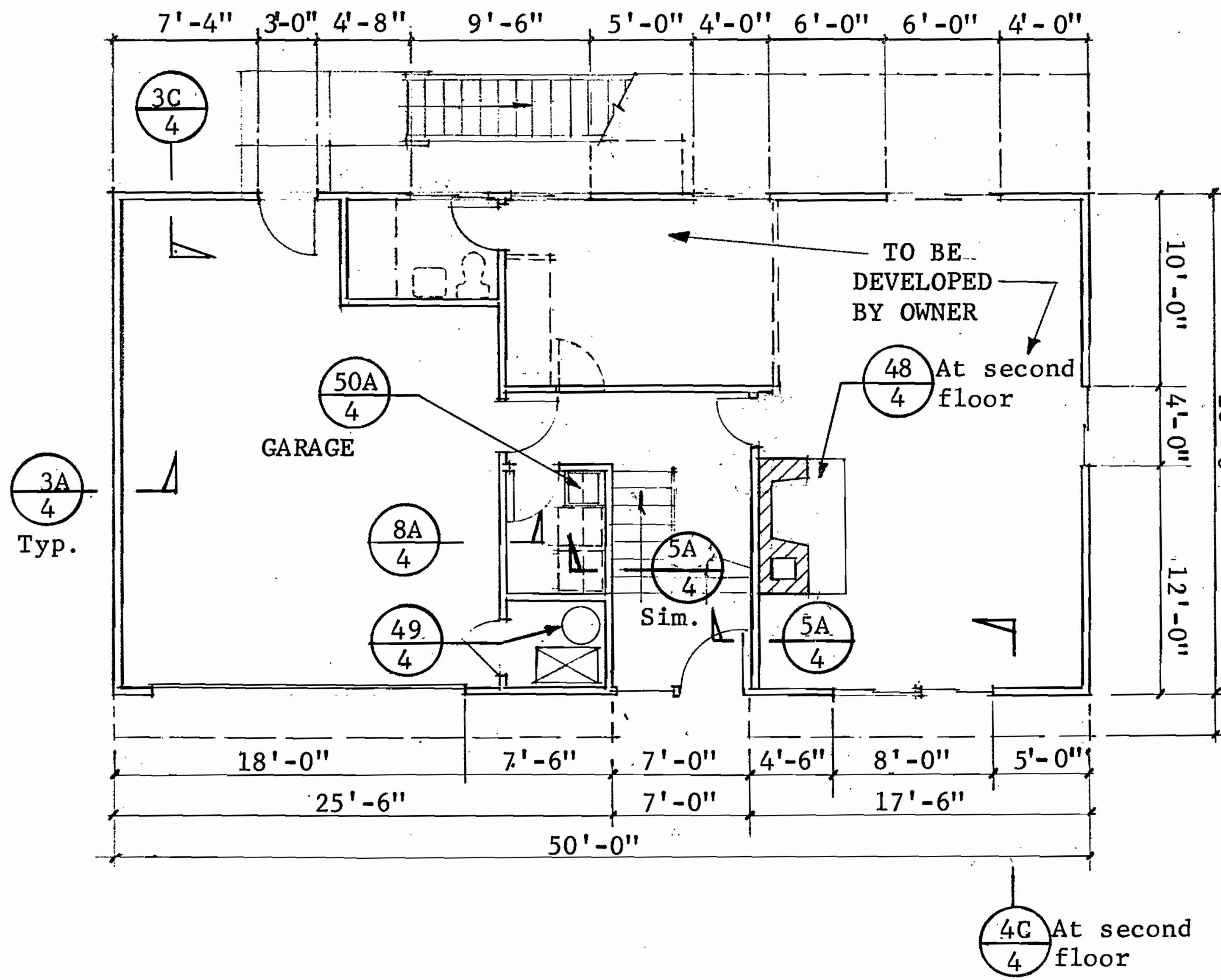
FOUNDATION PLAN - MODEL 'E' - 15 psf WIND
and SEISMIC ZONES 2 and 3



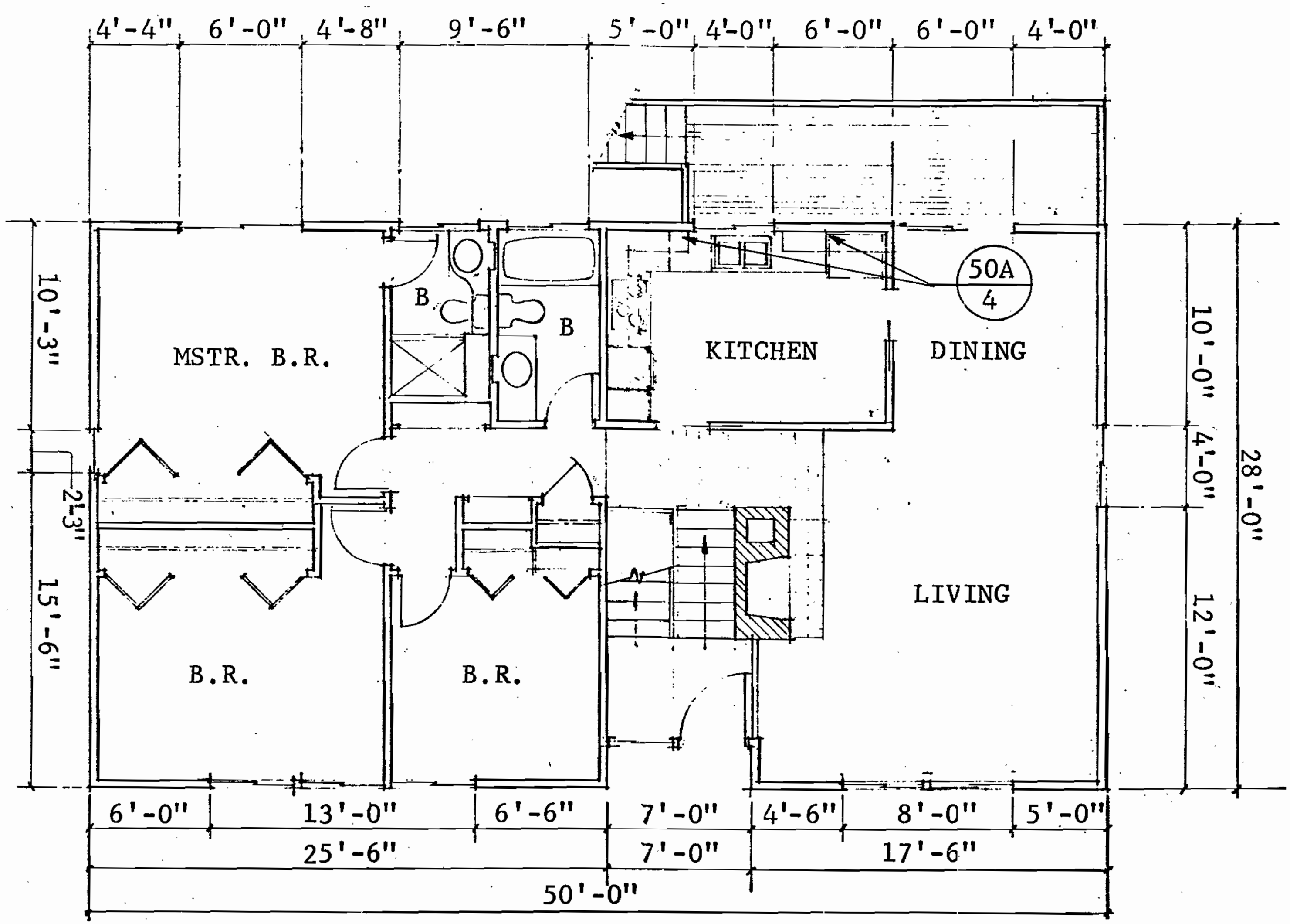
FOUNDATION PLAN - MODEL 'E' - 25 psf WIND



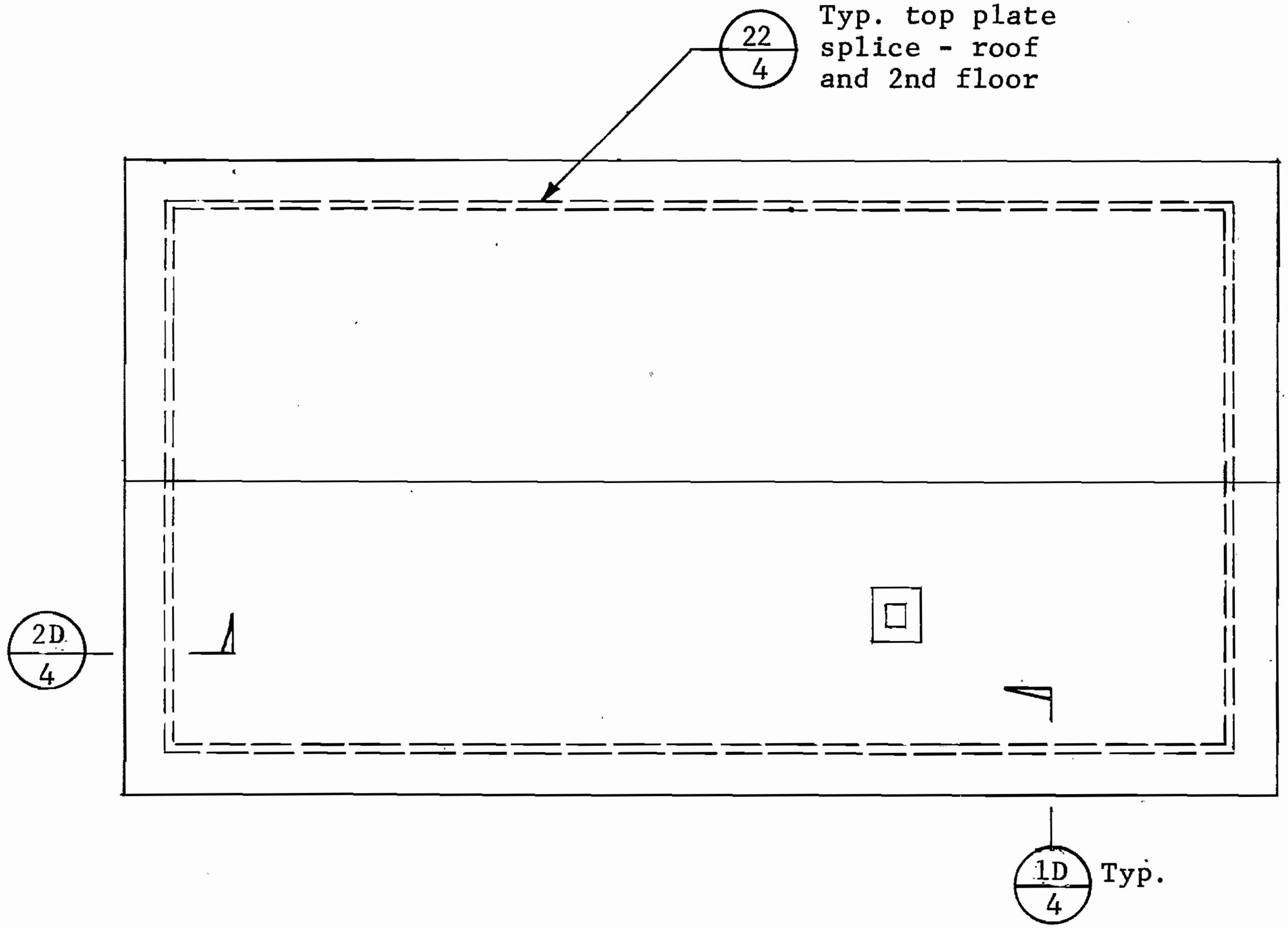
FOUNDATION PLAN - MODEL 'E' - 40 psf WIND



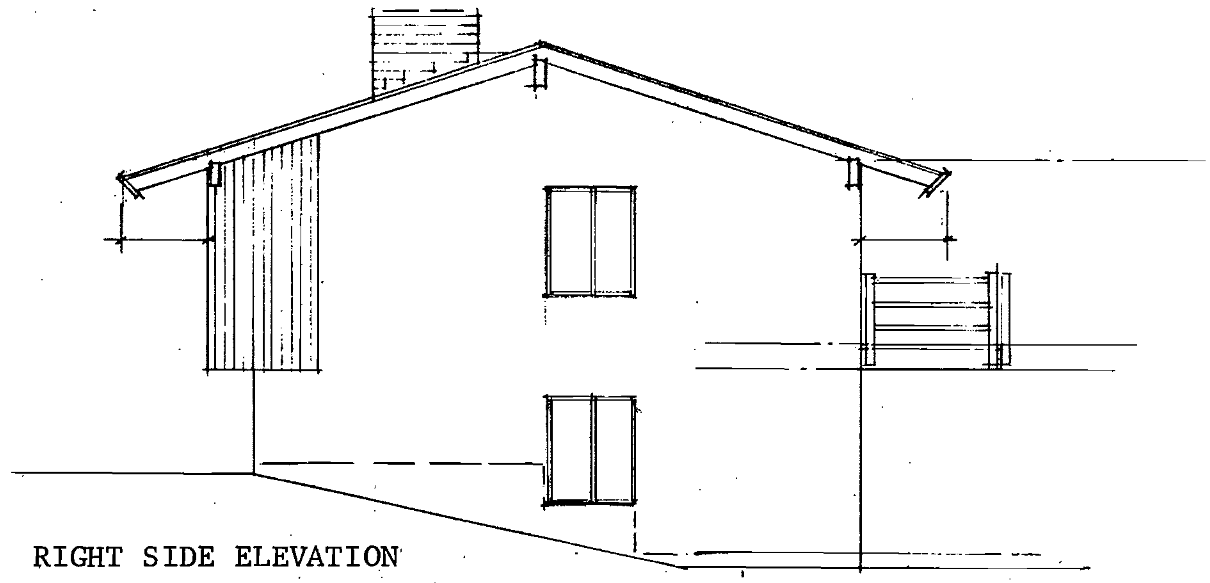
FIRST FLOOR PLAN - MODEL 'F'



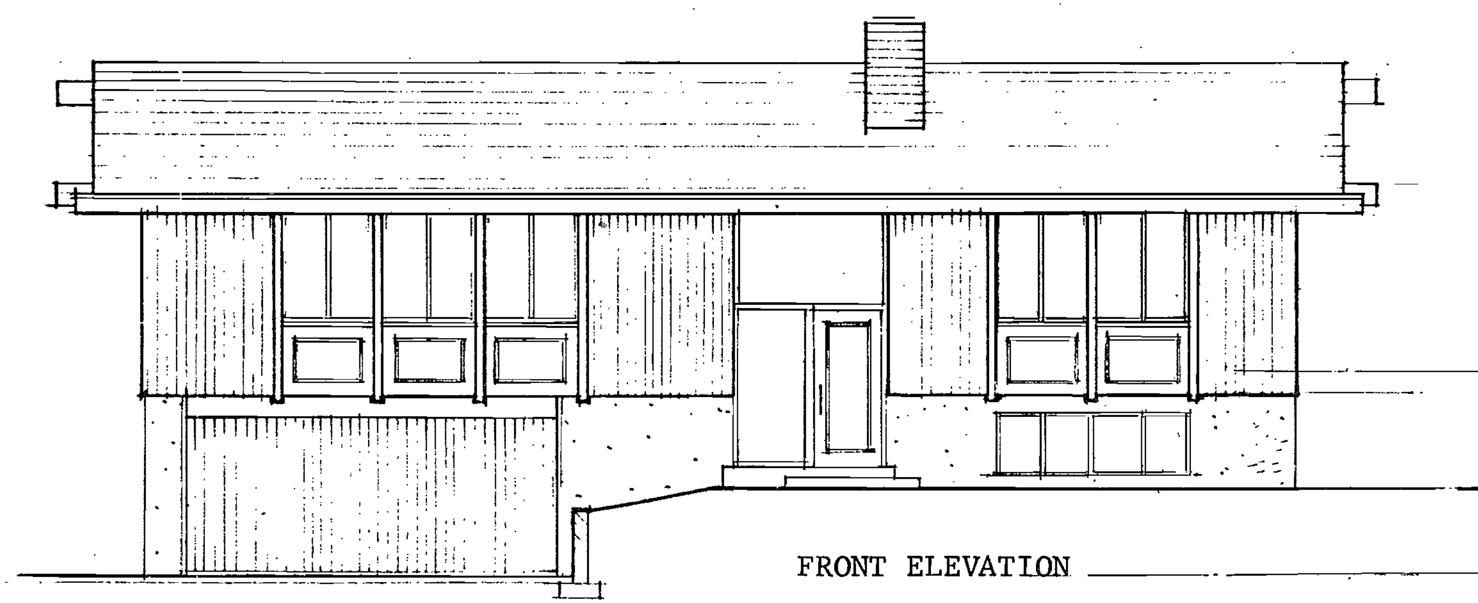
SECOND FLOOR PLAN - MODEL 'F'



ROOF PLAN - MODEL 'F'

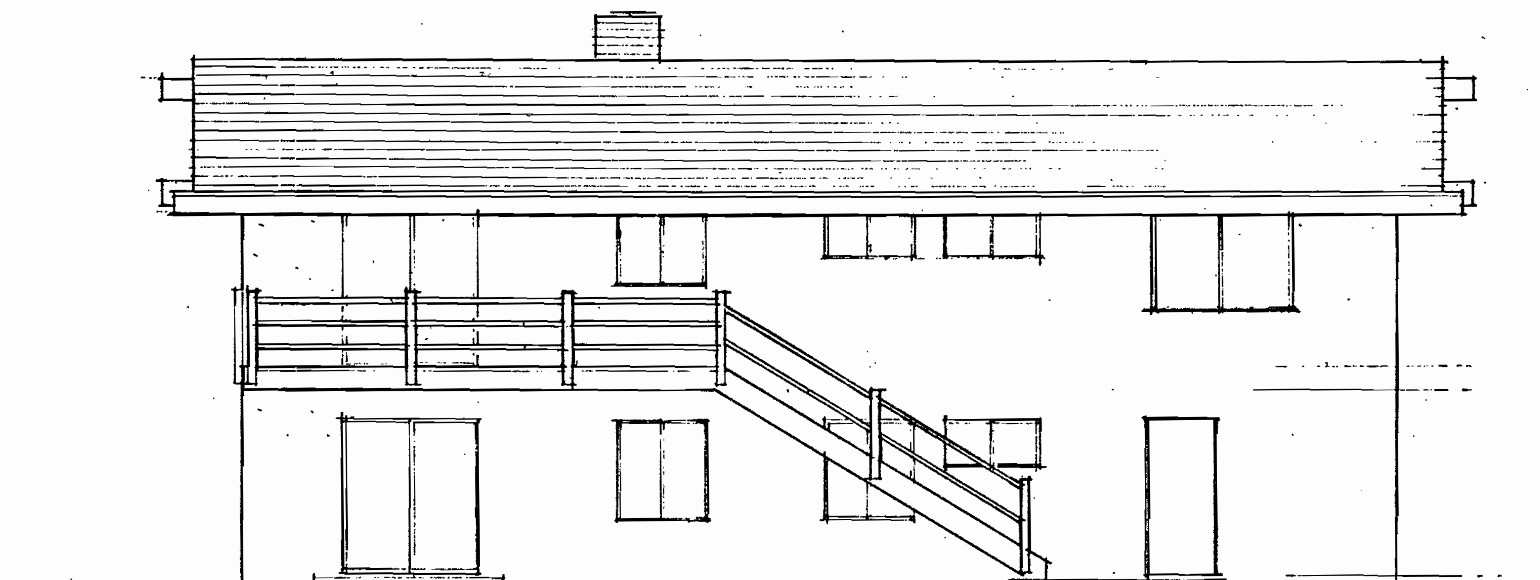


RIGHT SIDE ELEVATION

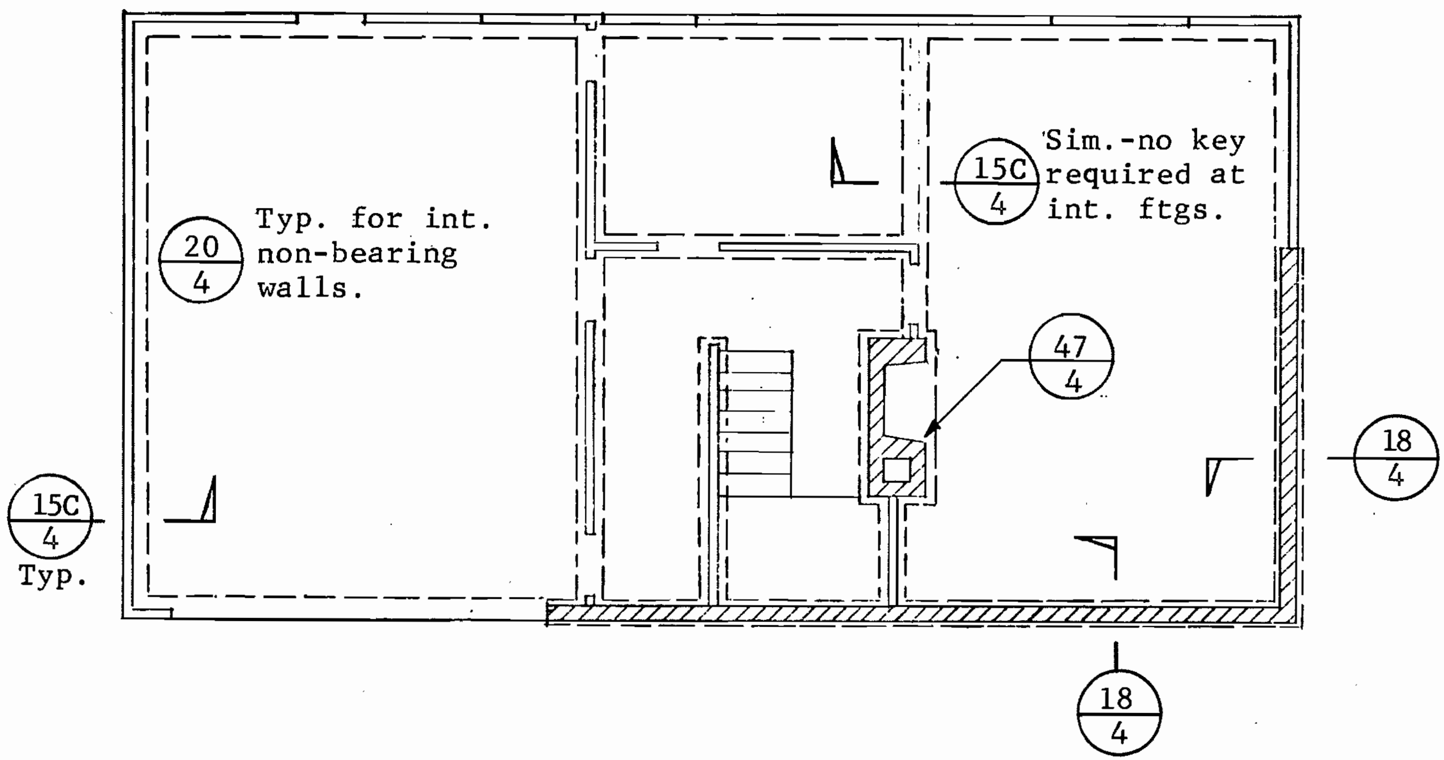


FRONT ELEVATION

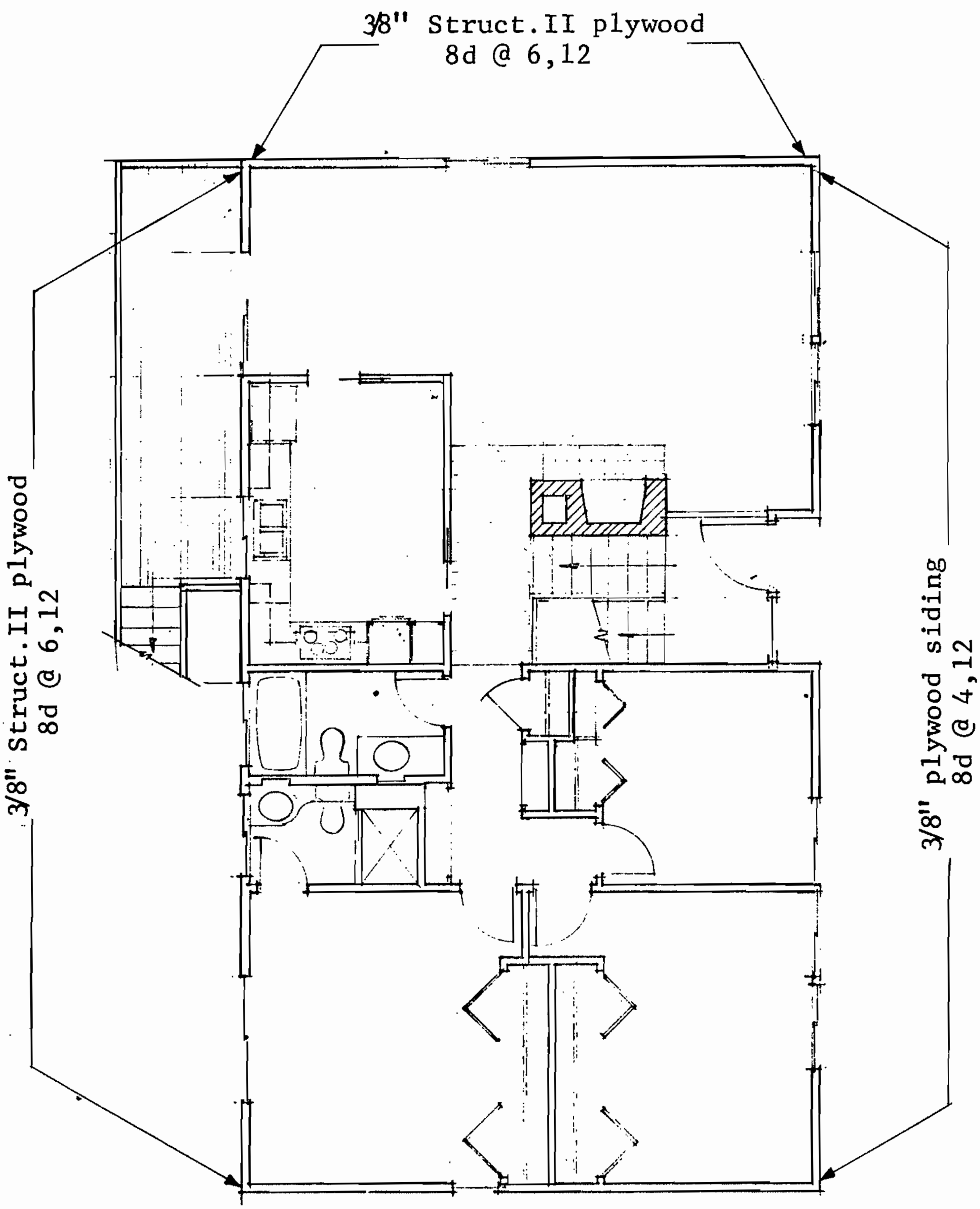
ELEVATIONS - MODEL 'F'



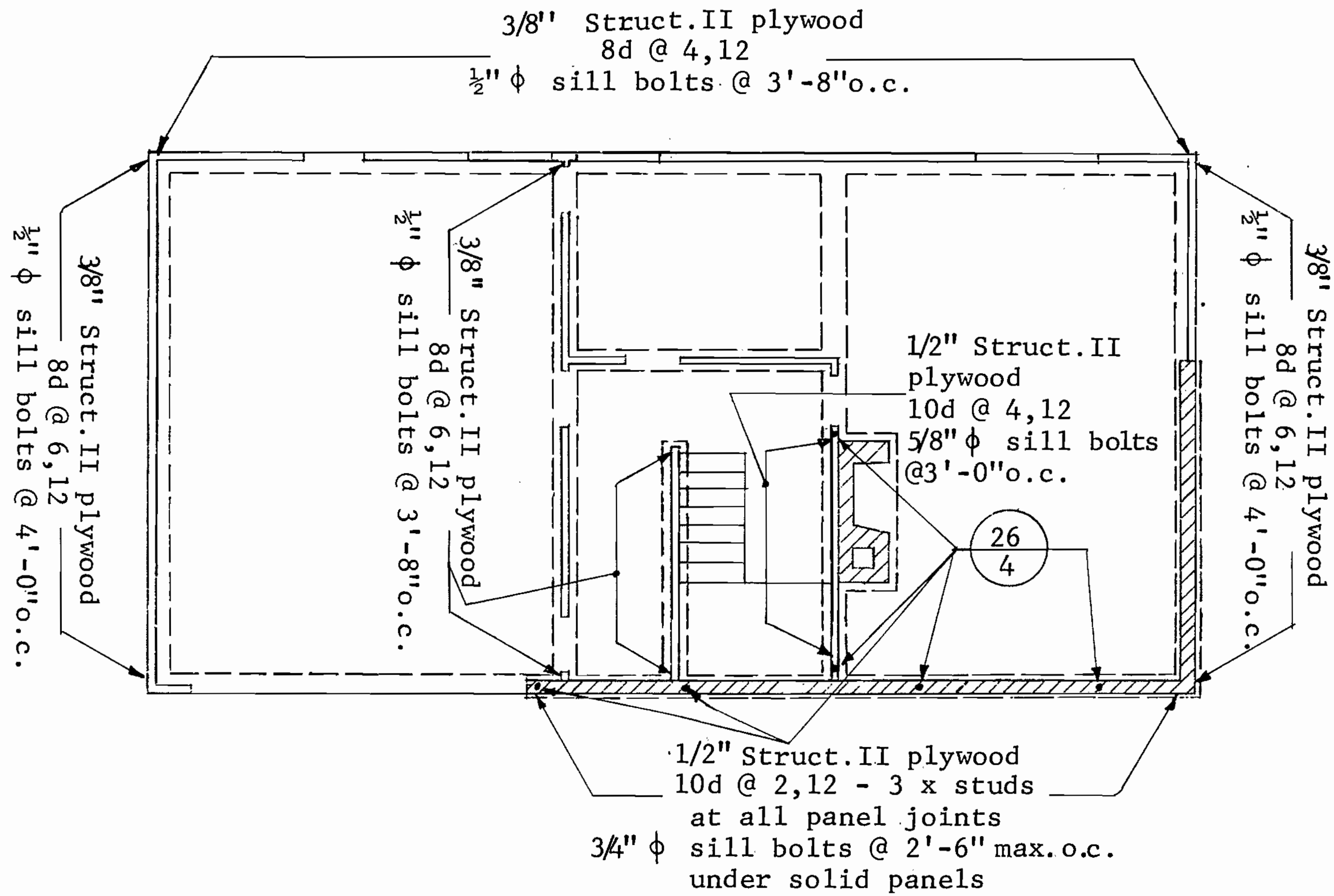
REAR ELEVATION - MODEL 'F'



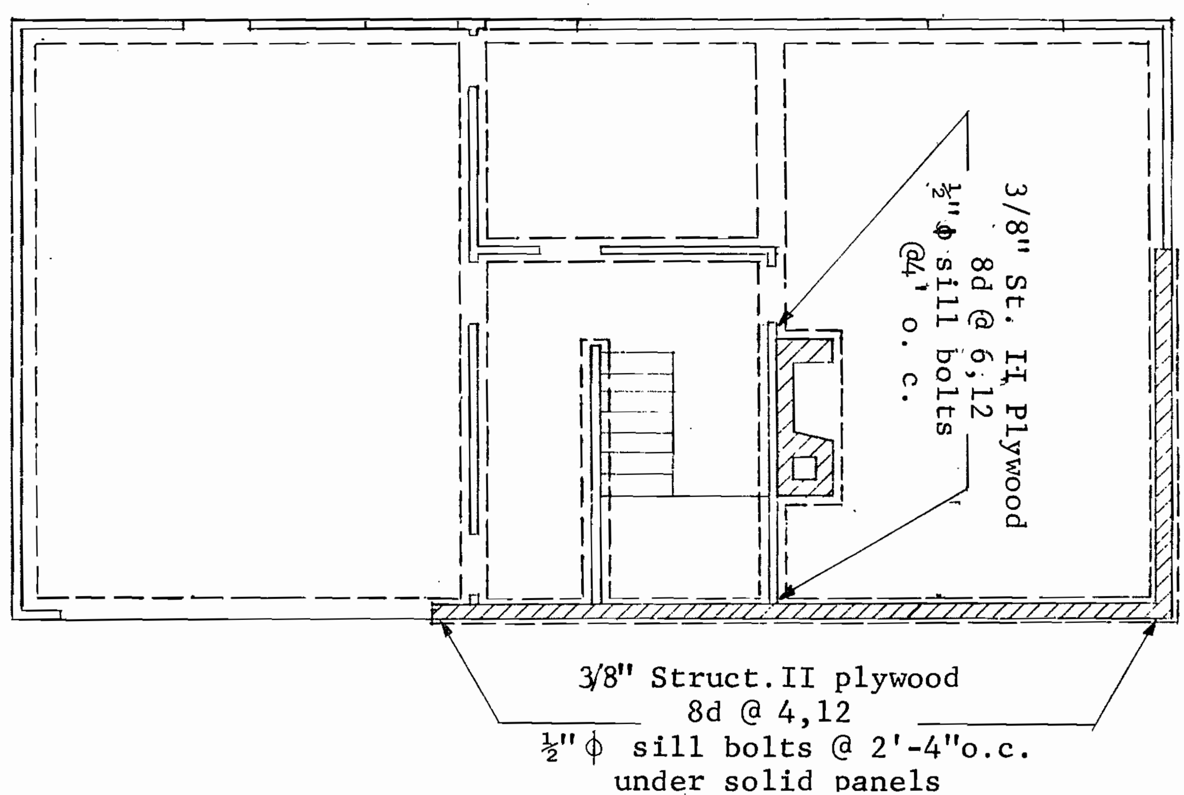
TYPICAL FOUNDATION PLAN - MODEL 'F'



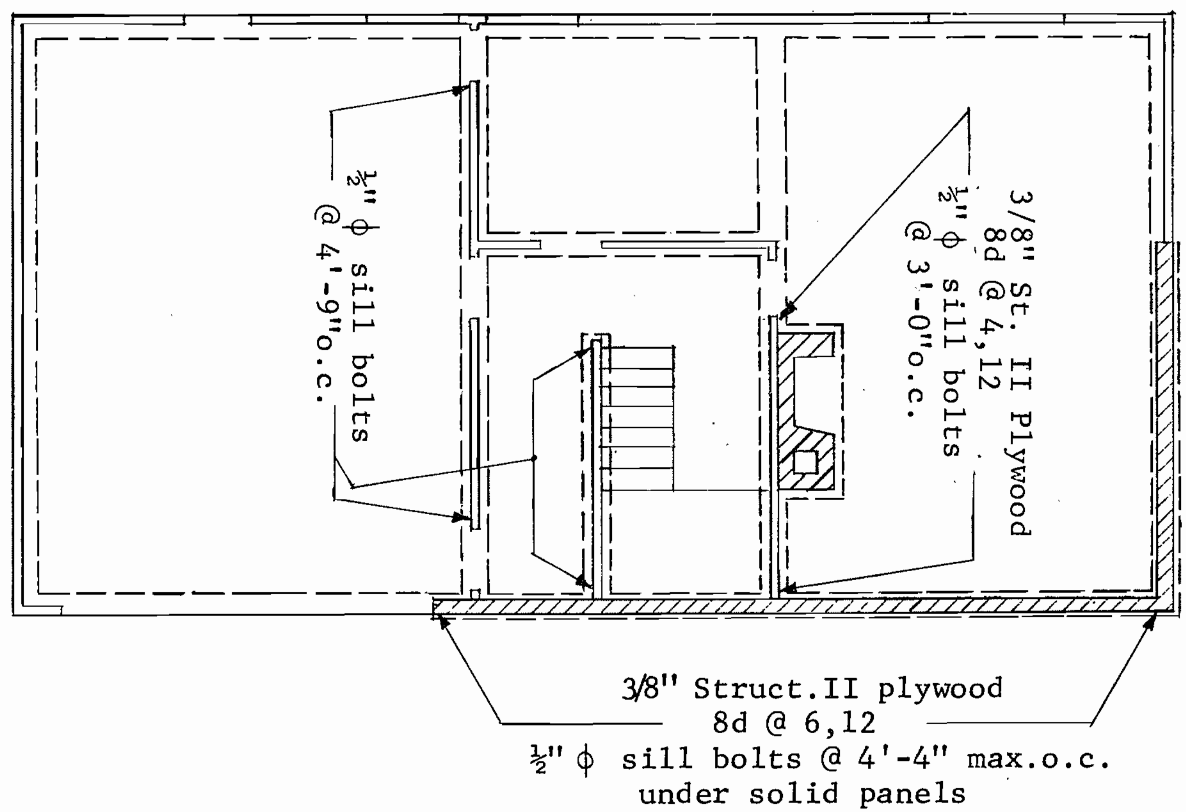
SECOND FLOOR PLAN - MODEL 'F' - SEISMIC ZONE 3



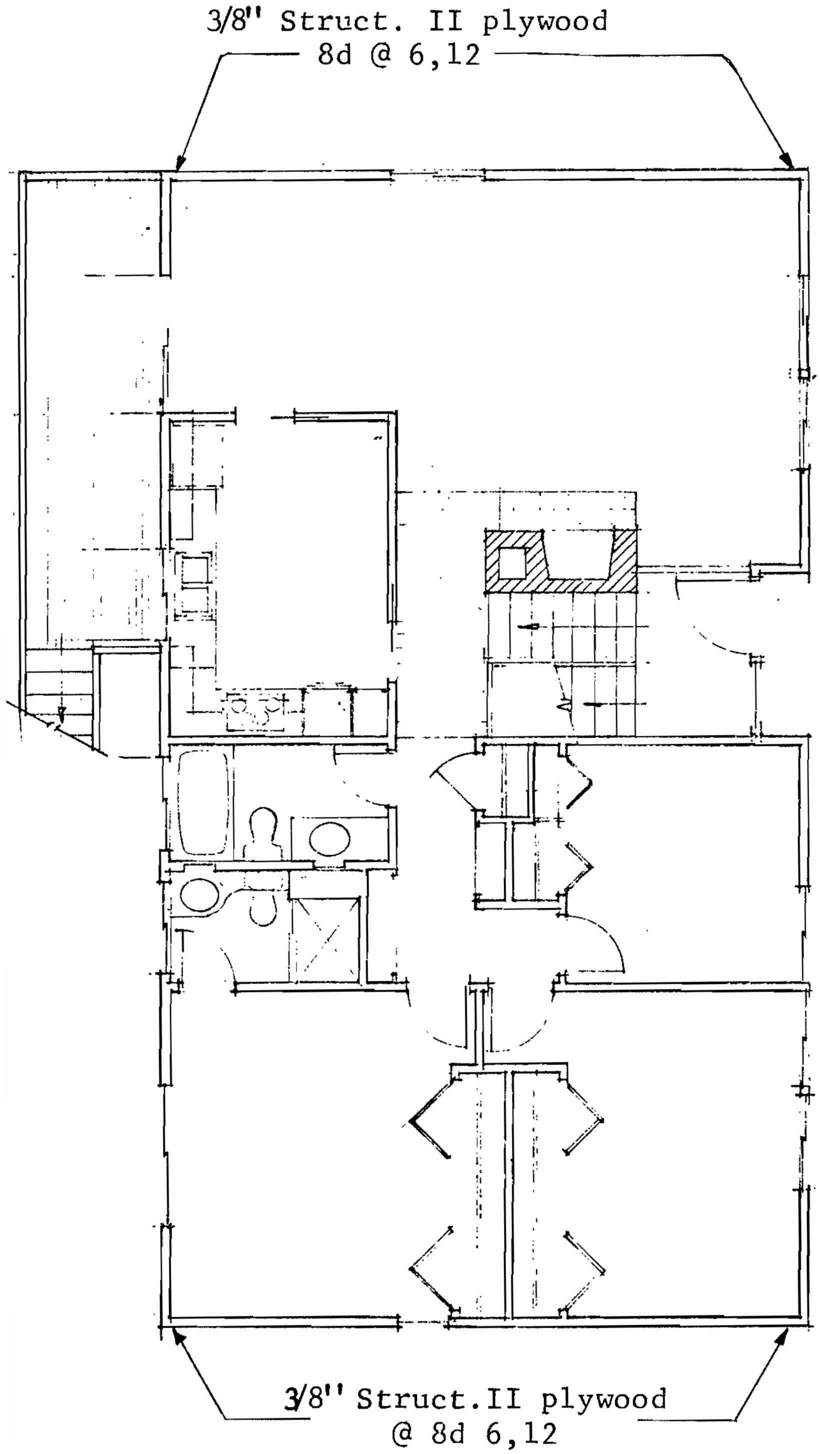
FOUNDATION PLAN - MODEL 'F' - SEISMIC ZONE 3



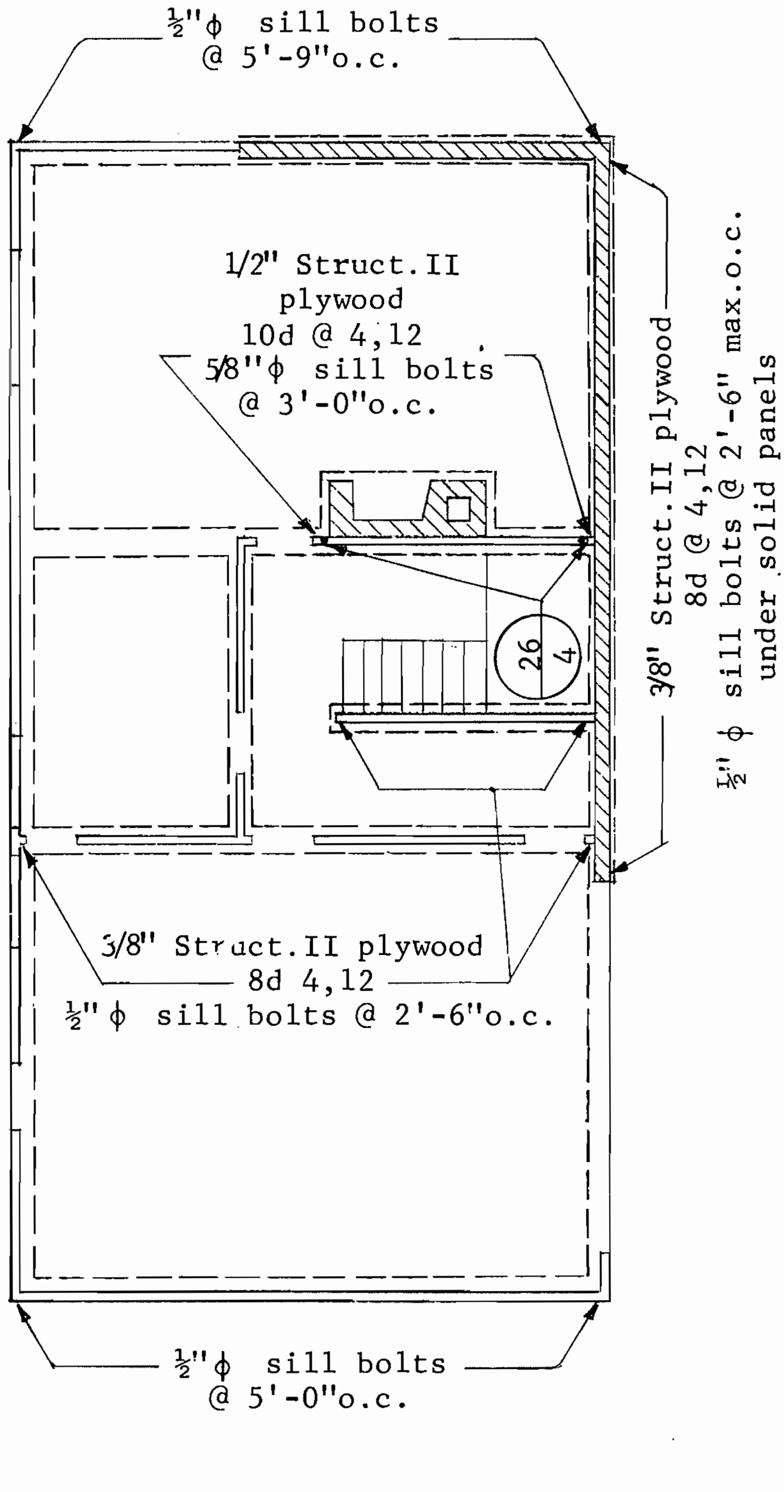
FOUNDATION PLAN - MODEL 'F' - SEISMIC ZONE 2



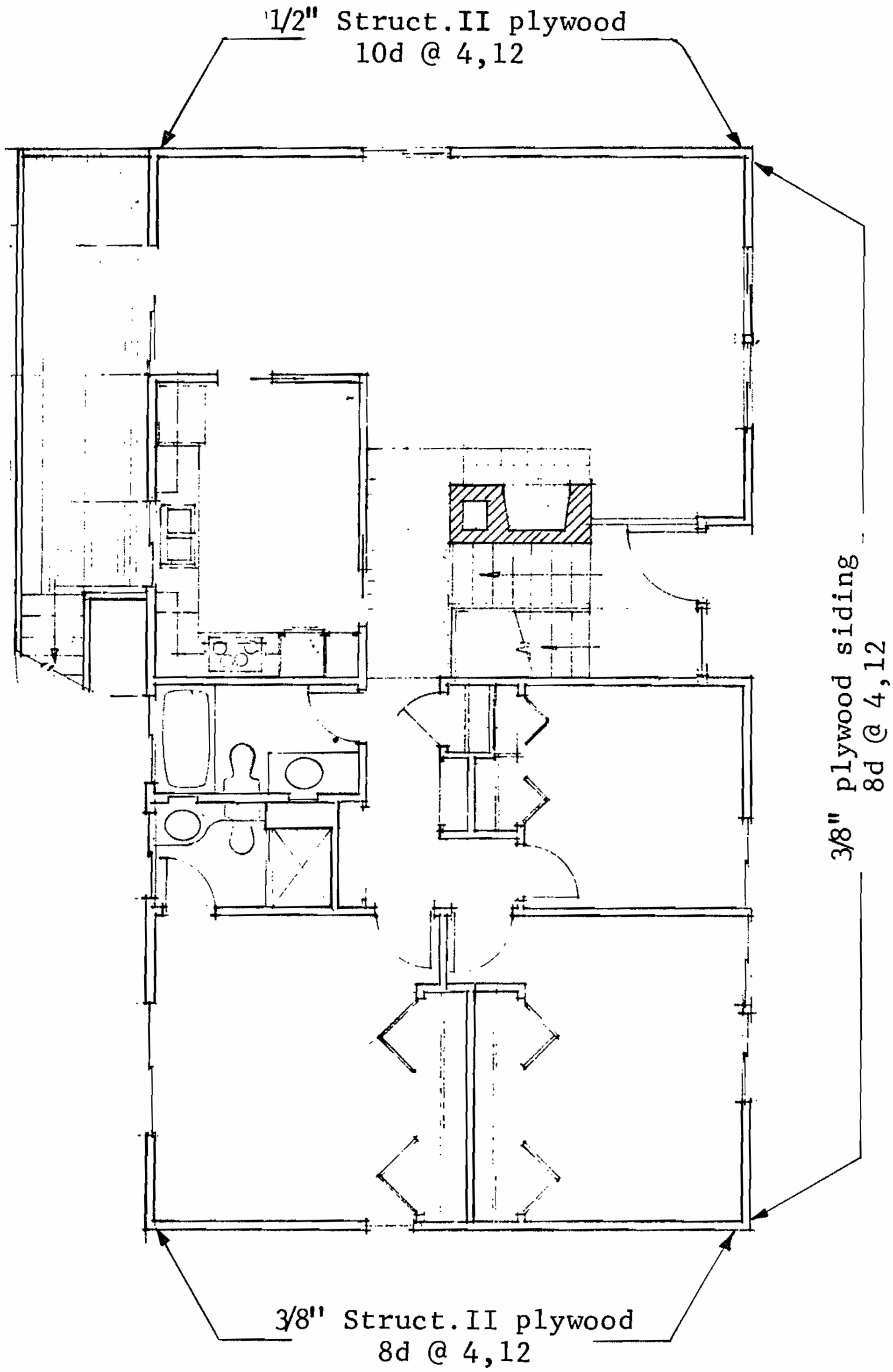
FOUNDATION PLAN - MODEL 'F' - 15 psf WIND



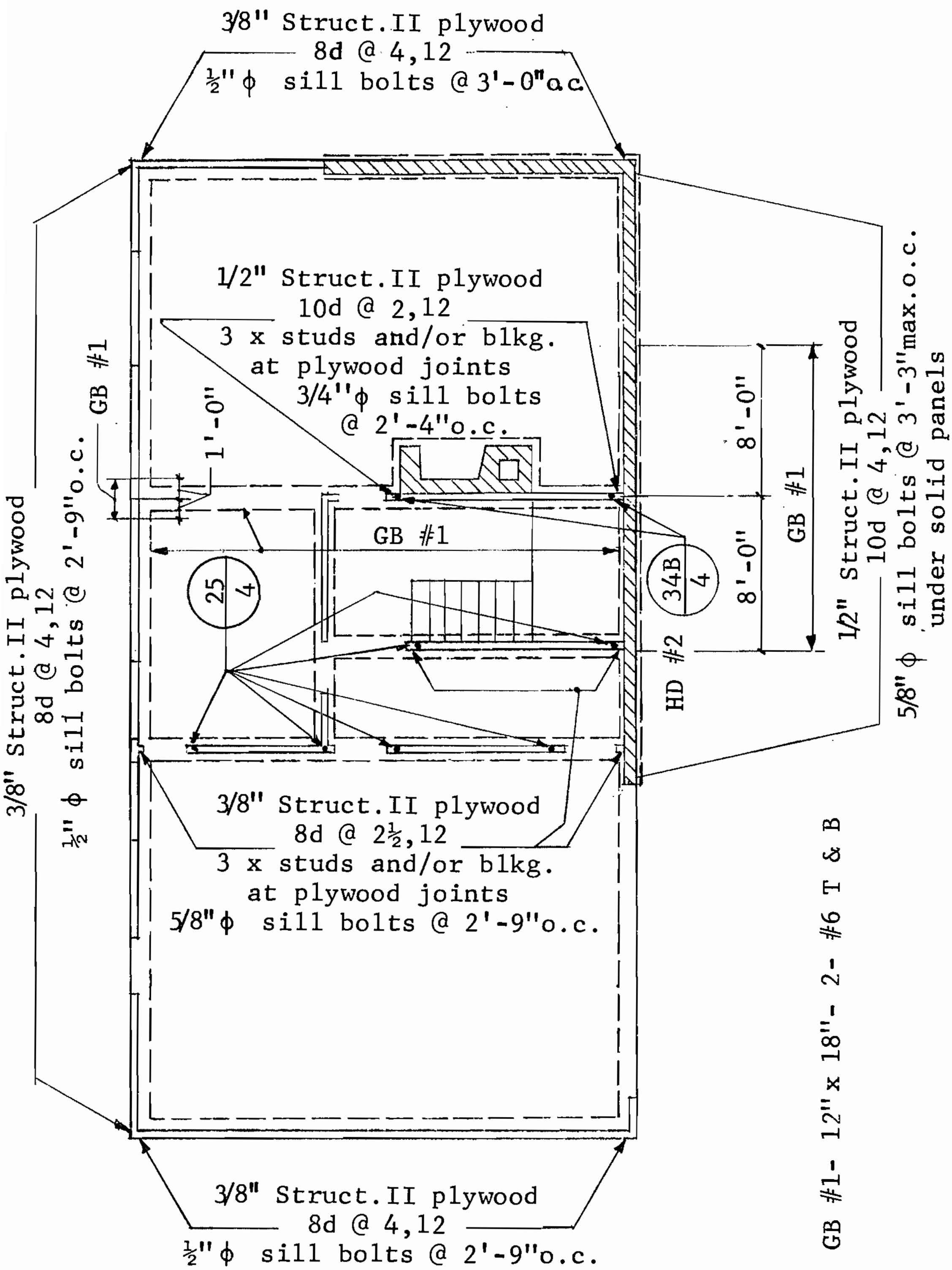
SECOND FLOOR PLAN - MODEL 'F' - 25 psf WIND



FOUNDATION PLAN - MODEL 'F' - 25 psf WIND



SECOND FLOOR PLAN - MODEL 'F' - 40 psf WIND



FOUNDATION PLAN - MODEL 'F' - 40 psf WIND

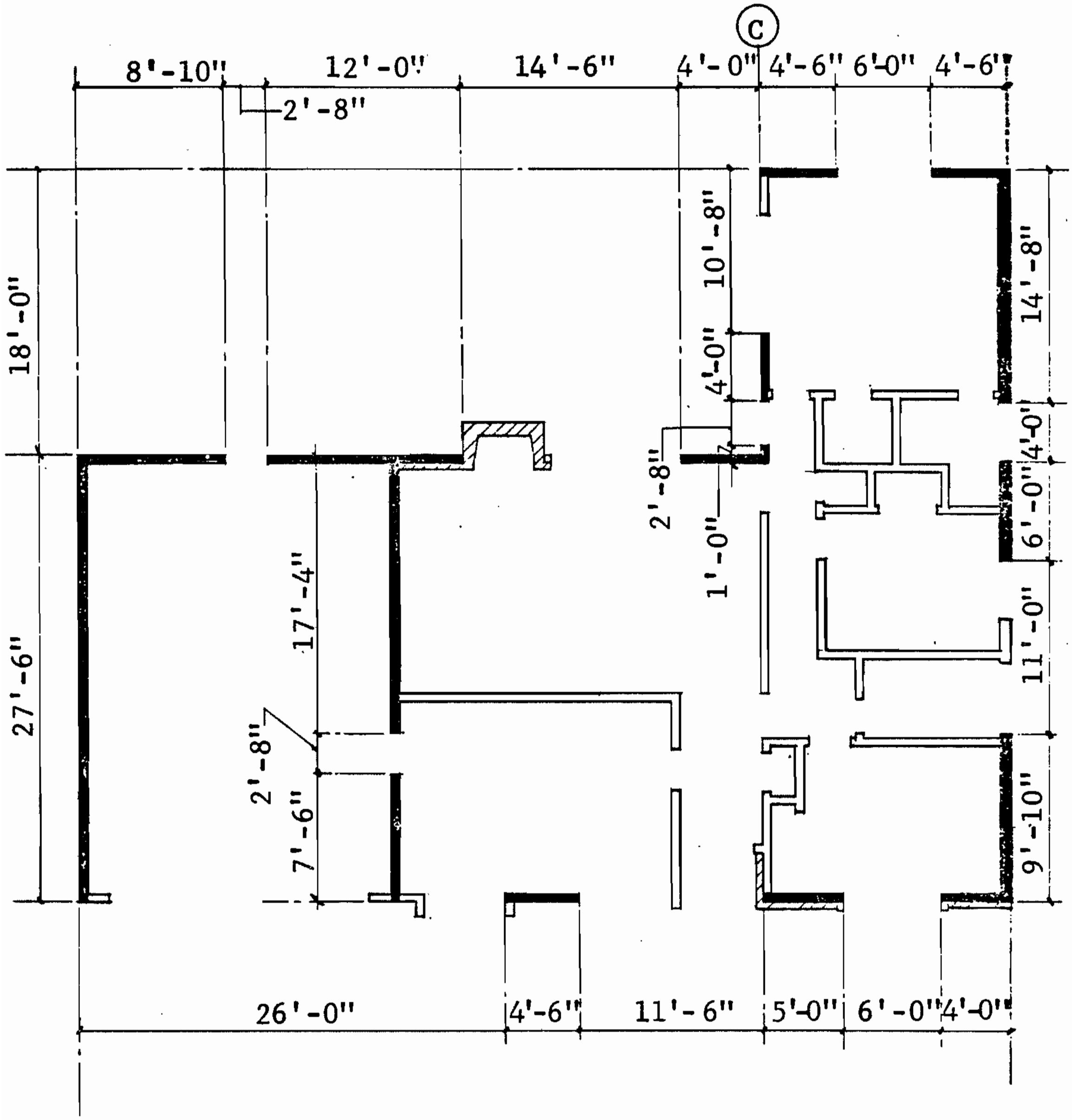
APPENDIX B

SHEAR WALL PLANS

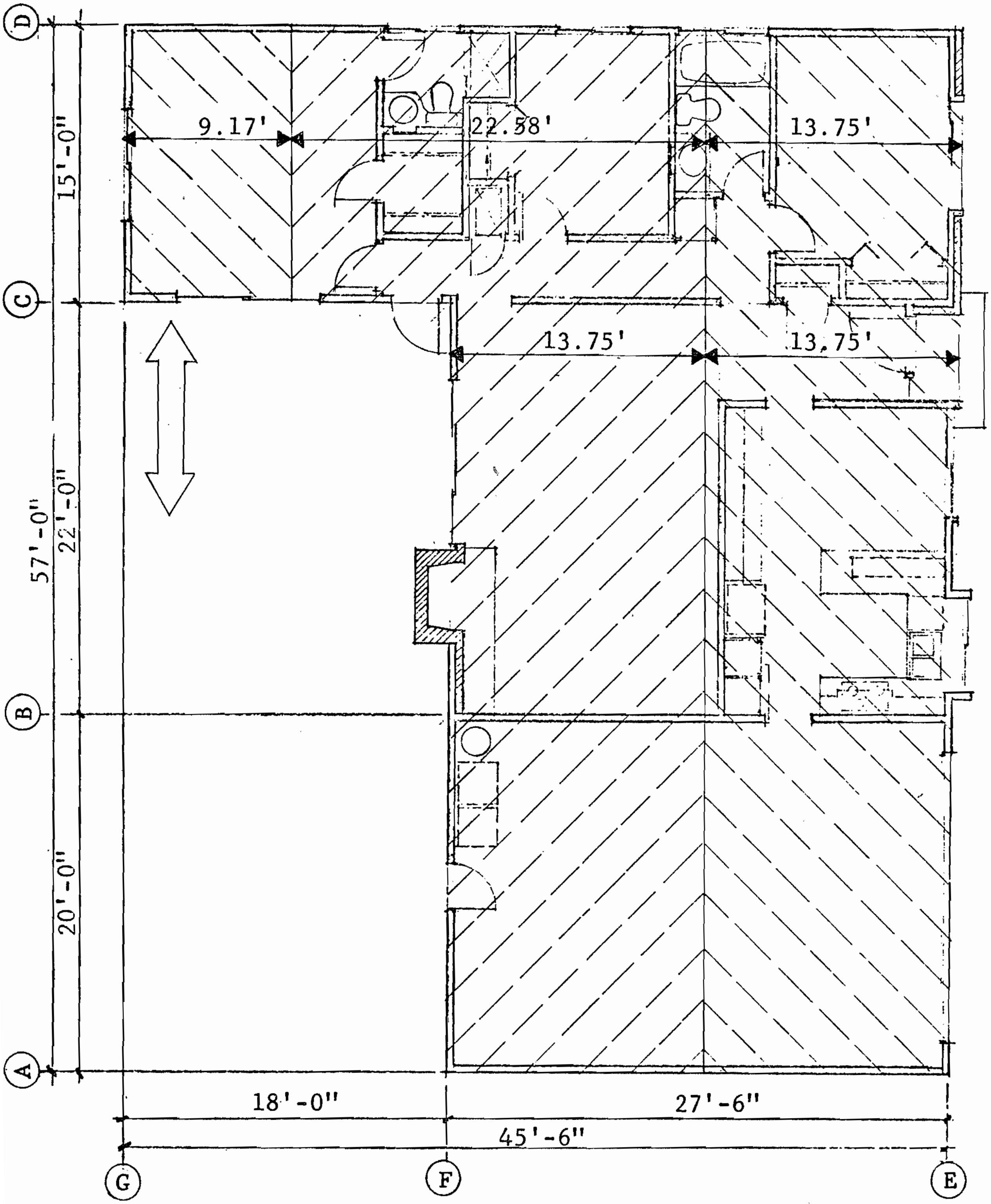
TRIBUTARY AREA PLANS

and

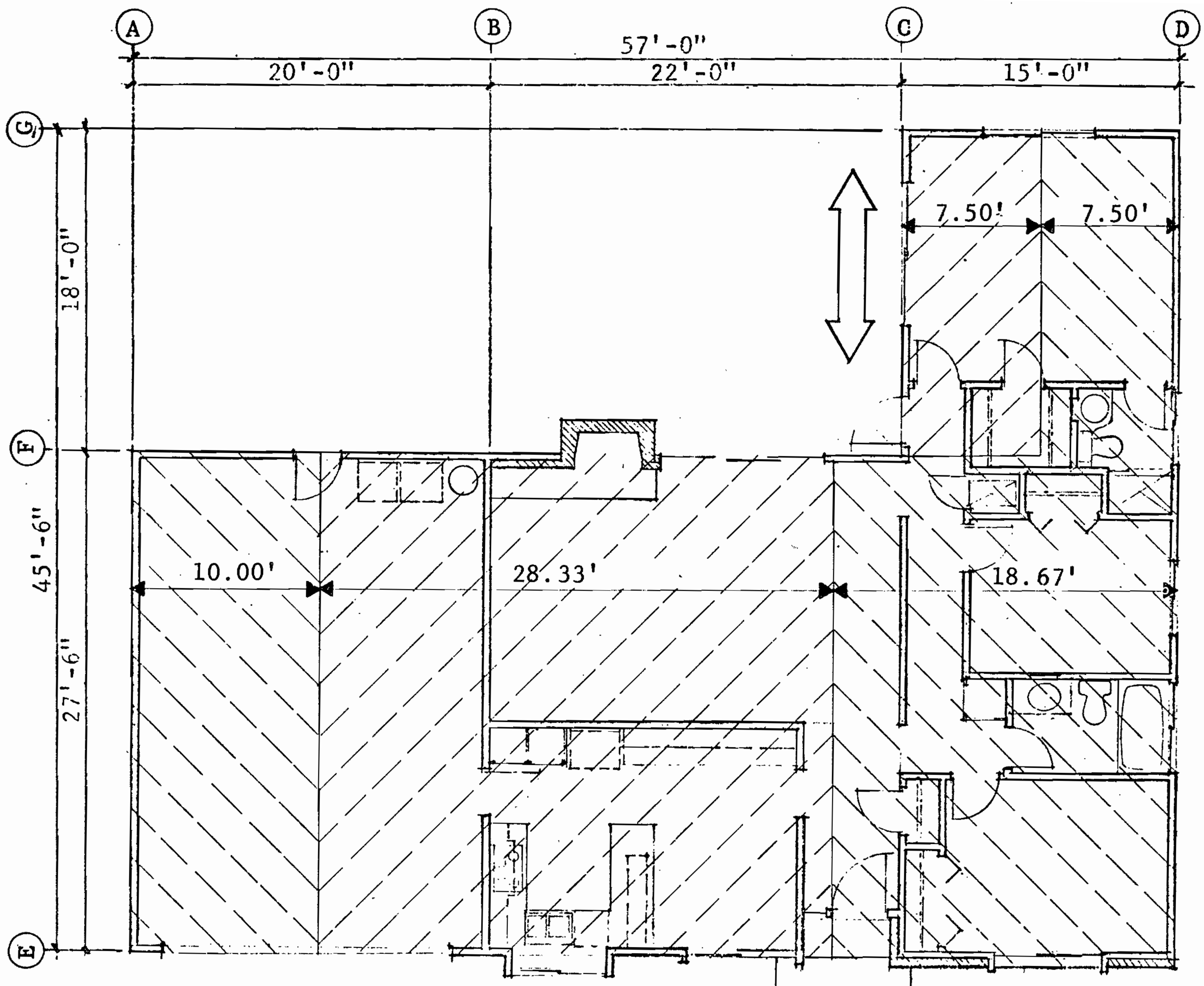
CALC FORMS



SHEAR WALL PLAN
MODEL 'A'



TRIBUTARY AREA - MODELS 'A' and 'A-1'



TRIBUTARY AREA - MODELS 'A' and 'A-1'

Job: COST ANALYSIS Model: 'A'

ONE STORY RESIDENCE - ROOF AND WALL LOADS

Calc Form 1

ROOF	Material	Act.	Seis.	CLG.	Material	Act.	Seis.
Rfg.	WOOD SHAKE	3.0	0.400	Frmg.		2.0	0.267
Shtg.	SPACED	1.5	0.200	Fin.		3.0	0.400
Frmg.	TRUSSES	2.0	0.267				
TOTAL		6.5	0.867	TOTAL		5.0	0.667

	EXTERIOR WALLS				INTERIOR WALLS	
	Mat.	Actual	Mat.	Actual	Mat.	Actual
Framing		4.0				4.0
Finish	PLYWD	2.0			GYP. BD.	2.0
Finish	GYP. BD.	2.0			" "	2.0
TOTAL		8.0				8.0

Roof load: 0.867

Veneer load: 21.33

"Ceiling" load: Clg- 0.667
Ext- 0.750
Int- 0.250

TOTAL 1.667

Job: COST ANALYSIS ·Model: 'A' SEISMIC

TRIBUTARY AREAS

Calc Form 6

	ROOF AREA		CEILING AREA	
LINE	Height x Width	Area	Height x Width	Area
A	12x31.5	378	10x275	275
B	28.33x31.5	892	HSE 18.33x27.5	504
			GAR 10x27.5	275
C	9.5x20	190	7.5x18	135
D	20.67x29.5	610	18.67x27.5	513
	+9.5x20	190	+7.5x18	135
		800		648
E	15.75x61	961	HSE 13.75x37	509
			GAR 13.75x20	275
F	15.75x61	961	HSE 13.75x37	509
	+6.83x19	130	+8.83x15	132
		1091		641
			GAR 13.75x20	275
G	11.17x19	212	9.17x15	138

Job: COST ANALYSIS Model: 'A' SEISMIC

SEISMIC LOADS

Calc Form 7

LINE	ROOF AREA	ROOF LOAD	OTHER LOAD	TOTAL RF. LD.	CLG. AREA	CLG. LOAD	TOTAL LOAD
A	378	0.867			275	0.750	328 206 534
B	892	"			275 504	0.750 1.667	773 206 840 1819
C	190	"			135	1.667	165 225 390
D VNR	800	"	15x21.33	694 320 1014	648	"	1014 1080 2094
E	961	"			509 275	1.667 0.750	833 848 206 1887
F	1091	"			641 275	1.667 0.750	946 1068 206 2220
G	212	"			138	1.667	184 230 414
				______			______

Job: COST ANALYSIS Model: 'A' SEISMIC - 2.3

SHEAR WALL DESIGN

Calc Form 8

LINE	LOAD	WALL LENGTH	SHEAR PER FT.	SILL BOLTS	SHEAR MAT.	OVERTURNING
A	534	27.5	19.4	½@6	OK	L=27.5 PALL=4720
B	1819	24.83	73.3	½@6	OK	L=17.4 PALL=1860
C	390	4.0	97.5	½@6	OK	180 Fermco Anch
	w= 180#/		PALL= 180+100=280#			
	U= 8/4(390-280)=220#					
D	2094	30.5	68.7	½@6	OK	L=45.5' OK
E	1887	13.5	139.8	½@6	OK	L=15' PALL=2800+
F	2220	25.17	88.2	½@6	OK	OK
	68-10	w=182	490+	.82×495= 896		
	12-0	182	900+	.82×850=1597		
					2493	
G	414	9.0	46.0	½@6	OK	L=15' PALL=1400#

Job: COST ANALYSIS Model: 'A'-Z.2 & 'A-1' Z.'s 2&3

SHEAR WALL DESIGN

Calc Form 8

LINE	LOAD	WALL LENGTH	SHEAR PER FT.	SILL BOLTS	SHEAR MAT.	OVERTURNING
ALL WALLS EXCEPT LINE C OK FOR MODEL 'A',						
ZONE 3, THEREFORE OK FOR A-1 & ZONE 2 BY						
COMPARISON - CHECK WALL C ONLY.						
'A-1' - ZONE 3						
C	390	8.83	44.2	1/2@6	OK	OK
		4-10	145+	.8x145=	116	
		4-0			180	
			2x100		200	
					496	
'A' - ZONE 2						
C	195	4.0	48.8	1/2@6	OK	L=4' 180+100=280

Job: COST ANALYSIS Model: 'A' 15 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 160	OVERTURNING
A	8.92	10.0	15	1338		27.5	48.7	1/2@6	OK	L=27.5' P_{ALL}=4720
									200	
B	8.92	28.33	15	3791		24.83	152.7	1/2@59	OK	2-B0 Frmg Ankrs
	ω=	100#/'		17-4	1860					
				7-6	350	$\frac{8}{24.83}$(3791-2410) =			444.9	1.5x-Strap H.D.
				2x100	200					
					2410	$\frac{8}{24.83}$(3791x1.5-2410)=			1056	
									160	
C	5.58	7.50	15	628		4.0	156.9	2-1/2"φ	OK	2 B0 Frmg Ankrs
	ω=	180#/';	P_{ALL}	=180+	100=280#;	U=$\frac{8}{4}$(628-280)=			696#	
					$U_{1.5}$=	$\frac{8}{4}$(628x1.5-280)=			1324#	1.5x Strap H.D.
D	8.92	18.67	15	2498		30.5	81.9	1/2@6	OK	L=45.5' OK
E	6.62	13.75	15	1365		13.5	101.1	1/2@6	OK	L=15' P_{ALL}=2800
	ω=	251#/'								1.5x - OK

Job: COST ANALYSIS   Model: 'A' 15 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 1600	OVERTURNING
E	6.62	13.75	15	1365		25.17	90.2	1/2@6	OK	OK
	6.83	8.83	15	905						
				2270	L=8-10	W=182#/1	490+.82×495		= 896	1.5x-180 [illegible]
					12-0	182#/1	900+.83×850		= 1597	Anch.
					4-4	251#/1	225+.51×125		= 299	
							3×100		= 300	
									3092	
			$U_{1.5}=\frac{8}{25.17}(2270\times1.5-3092)=99.5$							
G	6.83	9.17	15	939		9.0	104.4	1/2@6	OK	L=15' P_{ALL}=1400
										1.5x~ OK

Job: COST ANALYSIS Model: 'A' 25 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 1600	OVERTURNING
A	8.92	10.0	25	2230		27.50	81.1	1/2@6	OK	L=27.5' P_{ALL}=4720
									200	
B	8.92	28.33	25	6318		24.83	254.5	1/2@3-6	5d@4"	STRAP HD
	W=100#/'			17-4	1860					
				7-6	350	8/24.83	(6318-2410)	=	1259#	
				2x100	200					
					2410					
	1=	1.5 TIMES -		6318x	1.5=9477	HD#1-	8150			At 1.5x:
							2570			HD-#1 12x18 6B
							200			1-#4 T&B
							10920			
C	5.58	7.50	25	1046		4-0	261.5	2-1/2"ϕ	3/8" sdng 8d@2½,12	STRAP HD
	W=	180#/' ;	P_{ALL}	=180	+100=	280; U=	8/4 (1046-	280)=	1532	
	1.5	x1046=1569		HD#2 -	P_{ALL}=1670#	+100=		1770		At 1.5x:
										HD#2-12x18 6B
										1-#5 T&B

Job: COST ANALYSIS   Model: 'A' - 25 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 160	OVERTURNING
D	8.92	18.67	25	4163		30.50	136.5	1/2@6	OK	L=45.5 OK
E	6.62	13.75	25	2276		13.50	168.6	L=27-6 1/2@6	OK 5% OVER	OK
	w=251#/'			15-0	2800+					1.5x - OK
				12-6	1850+					
					4650+					
F	6.62	13.75	25	2276		25.17	150.3	1/2@6	OK	180 FRMCO ANCH
	6.83	8.83	25	1508	L-8-10	w=182#/'	490+.82x495=		896	
				3784	12-0	182#/'	900+.82x850=		1597	1.5x - 2130
					4-4	251#/'	235+.51x125		= 299	FRMCO ANCHS
							3x100		= 300	(2.7% OVER)
									3092	
			$U = \frac{8}{25.17} \times (3784 - 3092) = 220$#							
			$U_{1.5} = \frac{8}{25.17} (3784 * 1.5 - 3092) = 821$#							

Job: COST ANALYSIS Model: 'A' 25 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 1600	OVERTURNING
G	6.83	9.17	25	1566		9.0	174.0	2-1/2"ØCL 1/2@6	8d@4,12	OK
	w =	104.5#/'	L = 15'	P_{ALL} =	1400 +	.045 × 13	70 = 14	62		
							1	00		45x−280 FRMG
							15	62		ANCHS
			$\frac{8}{15}$(	1566 × 1.5 −	15	62) = 4	20			

Job: COST ANALYSIS Model: 'A' 40 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

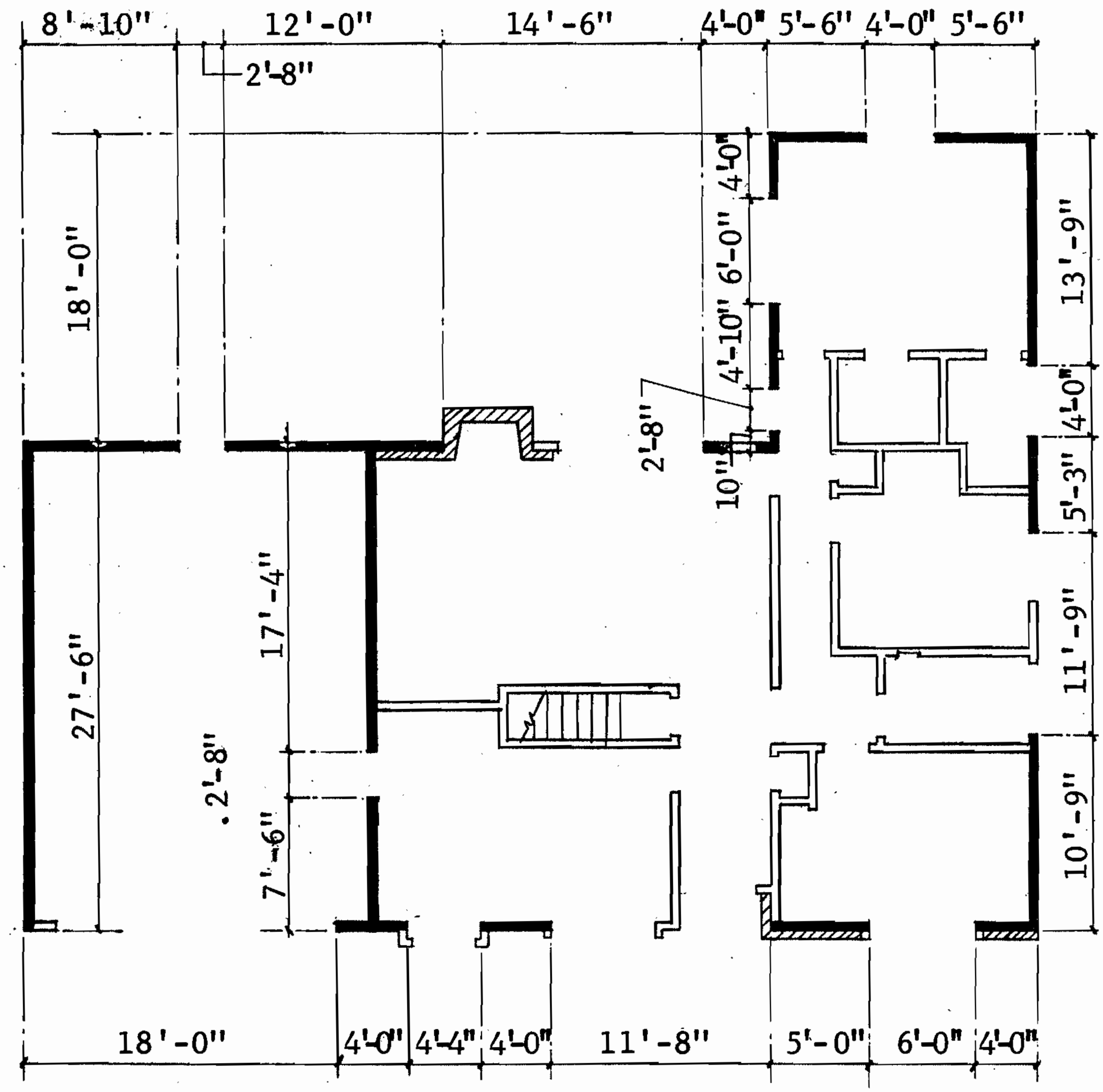
LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 1600	OVERTURNING
A	8.92	10.0	40	3568		27.50	129.7	1/2@6'0"	OK	L=27.5' P_{ALL}=4720
									200	
B	8.92	28.33	40	10,108		24.83	407.1	1/2@2'-0"	1/2" ST II 10d@4,12	
	W=100#/1				17-4	1800	HD#1	8150		HD#1-12x18GB
					7-6	350		2570		1-#4T&B
					2x100	200		200		
						2410		10920		
	1F	1.5 TIMES-		10,108x1.5=15,162			HD#3	13300		IF 1.5xO.T. USED;
								5000		HD#3 12x18GB
								200		2-#5T&B
								18500		
									1600	
C	5.58	7.50	40	1674		4.0	418.5	2-1/2"ϕ	1/2" ST II 10d@4,12	HD#2-12x18GB
	W=180#/1			HD#2 - P_{ALL}=1670+100=1770+						1-#5T&B
	1.5x1674=2511			HD#3 - P_{ALL}=2480+100=2580+						1.5xO.T.-HD#3
										12x18GB-2-#5T&B

Job: COST ANALYSIS Model: 'A' 40 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 1600	OVERTURNING
D	8.92	16.67	40	6661		30.50	216.3	L=45.5 W=146.4	3/8" 5 PLY 8d@4,12	L=45.5' OK
								1/2@6		
E	6.62	13.75	40	3641		13.50	269.7	L=27.6 W=132.4	3/8" 5 PLY 8d@2 1/2,12	OK
	W=	251#/'		15-0	2800+.51(4100	-2800)	=	1/2@6 3463		1.5xOK
				12-6	1850+.51(2850	-1850)	=	2360		
								5823		
I	6.62	13.75	40	3641		25.17	240.5	1/2@38	3/8" 5 PLY 8d@4,12	HD#1 - 12x18 GB
	6.83	8.83	40	2412	L=8'-10"	W=182#	HD#1	3515		1-#4 T&B
				6053	12'-0"	182#		5206		
					4'-4"	251#/'		1511		1.5x - SAME
								10,232		
G	6.83	9.17	40	2505		9.0	278.3	3-1/2" 400K 1/2@6	3/8" 5 PLY 8d@2 1/2,12	L=15' 2-HD
	W=104.5		L=15'	P_{ALL}=	1400+	.045x1370	=1462			EXIST ANCHS.
			8/15(2505-		1462)=	556#				15x-STRAP HD.
			8/15(2505x1.5-		1462)=	1224#				



SHEAR WALL PLAN

MODEL 'A-1'

Job: COST ESTIMATE Model: 'A-1' 15 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 160	OVERTURNING
A&B	SEE MODEL 'A'									
C	5.58	7.50	15	628		8.83	71.1	1/2@6	OK	180 FRMG ANCH
	W=	180#/1	SEE MODEL 'A'-496							AS 'SOLID' WALL,
			U= 8/8.83 (628-496) = 120#							OK PER 'A'
D	8.92	18.67	15	2498		29.75	84.0	1/2@6	OK	L=45.5' OK
E	6.62	13.75	15	1365		17.0	80.3	1/2@6	OK	L=15' PALL=2800+
F	SEE MODEL 'A'									
G	6.83	9.17	15	939		11.0	85.4	1/2@6	OK	L=15' PALL=1400
										1.5x OK

Job: COST ANALYSIS   Model: 'A-1' 25 PSF WIND

Calc Form 9

WIND LOAD AND SHEAR WALL DESIGN

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 160	OVERTURNING
A & B	SEE MODEL 'A'									
C	5.58	7.50	25	1046		8.83	118.5	½@6	OK	As 2 WALLS-
	w=	180#/1		4-10 +	145+0	.8x145	= 116			2 BOLTING [illegible]
				4-0			= 180			
					2x100		= 200			As 'SOLID' WALL-OK
							496			
			U = 8/8.83	(1046-	496) =	498#	WITH DOOR			
			IF OPG	WERE A	WINDOW:	L = 14'-	10"; P_{ALL}	= 2434		
D	8.92	18.67	25	4163		29.75	139.9	½@6	OK	L=45.5 OK
E	6.62	13.75	25	2276		17.0	133.9	½@6	OK	OK
	w=	251#/1		15-0	2800#					
				12-4						

Job: COST ANALYSIS   Model: 'A-1' 25 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 1600	OVERTURNING
F	6.62	13.75	25	2276		25.17	150.3	1/2@6	OK	SEE MODEL 'A'
	6.83	8.83	25	1508						1800 FRMG ANCH
				3784						
G	6.83	9.17	25	1566		11.0	142.4	1/2@6	OK	SEE MODEL 'A' - OK

Job: COST ANALYSIS   Model: 'A-1' 40 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

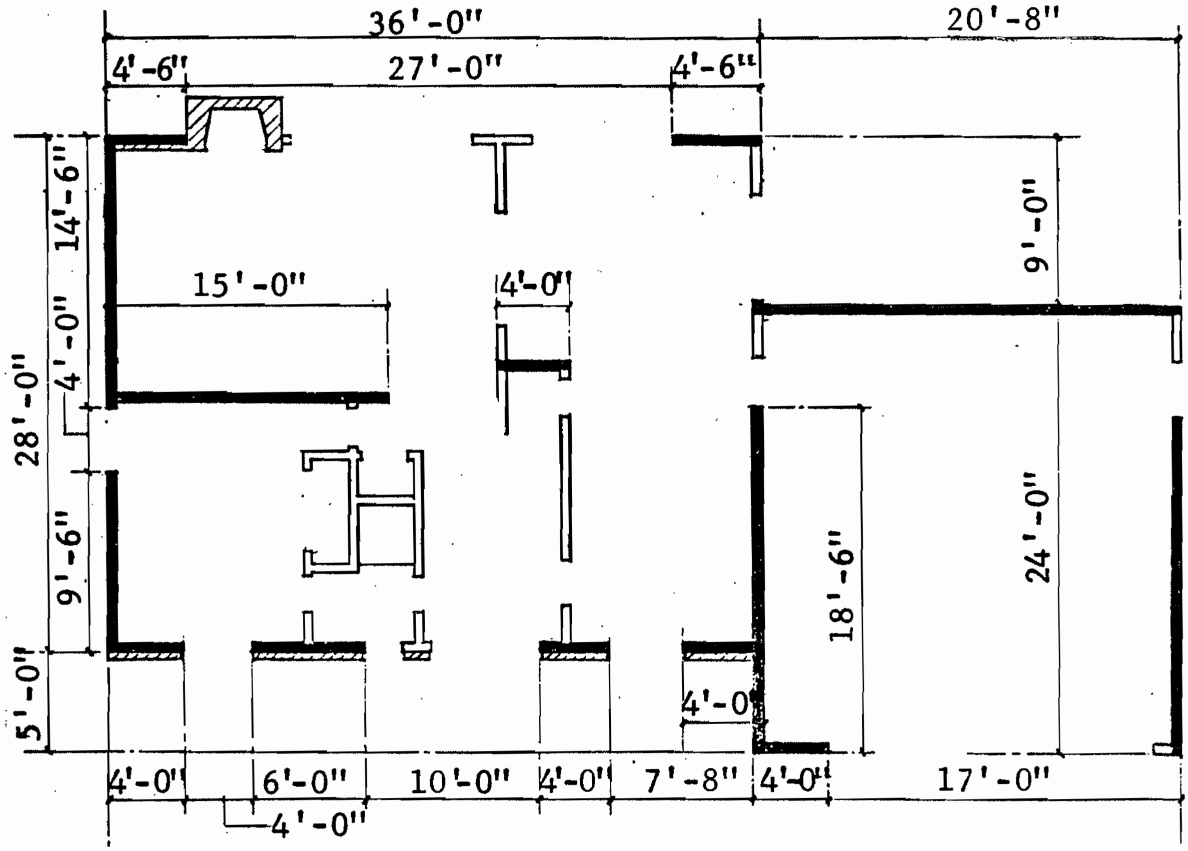
LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 1600	OVERTURNING
A&B	SEE MODEL 'A'									
C	5.58	7.50	40	1674		8.83	189.5	2-1/2"φ EA SECT.	3/8" 5DWG 8d@4,12	AS TWO WALLS-
	W=180#/'			4-10	145+0	.8x145=	116			STRAP H.D.
				4-0		=	100			
				2x100		=	200			AS 'SOLID' WALL
							496			OK
		U = 8/8.83(1674-496) = 1067#					WITH DOOR			
	IF 8'6" WERE A WINDOW:					L = 14'-6"	P_{ALL}=1370+.8x1330=2434			
D	8.92	18.67	40	6661		29.75	223.9	L=45.5 U=1464 1/2@6	3DWG 8d@4,12	L=45.5' OK
E	6.62	13.75	40	3641		17.0	214.2	L=27.4 U=1332 1/2@6	8d@4,12	OK
	W=251#/'			15-0	2800+.51(4100-2800)			=	3463	
				12-4	1850+.51(2800-1850)			=	2335	
									5798	

Job: COST ANALYSIS　　　　Model: 'A-1' 40 PSF WIND

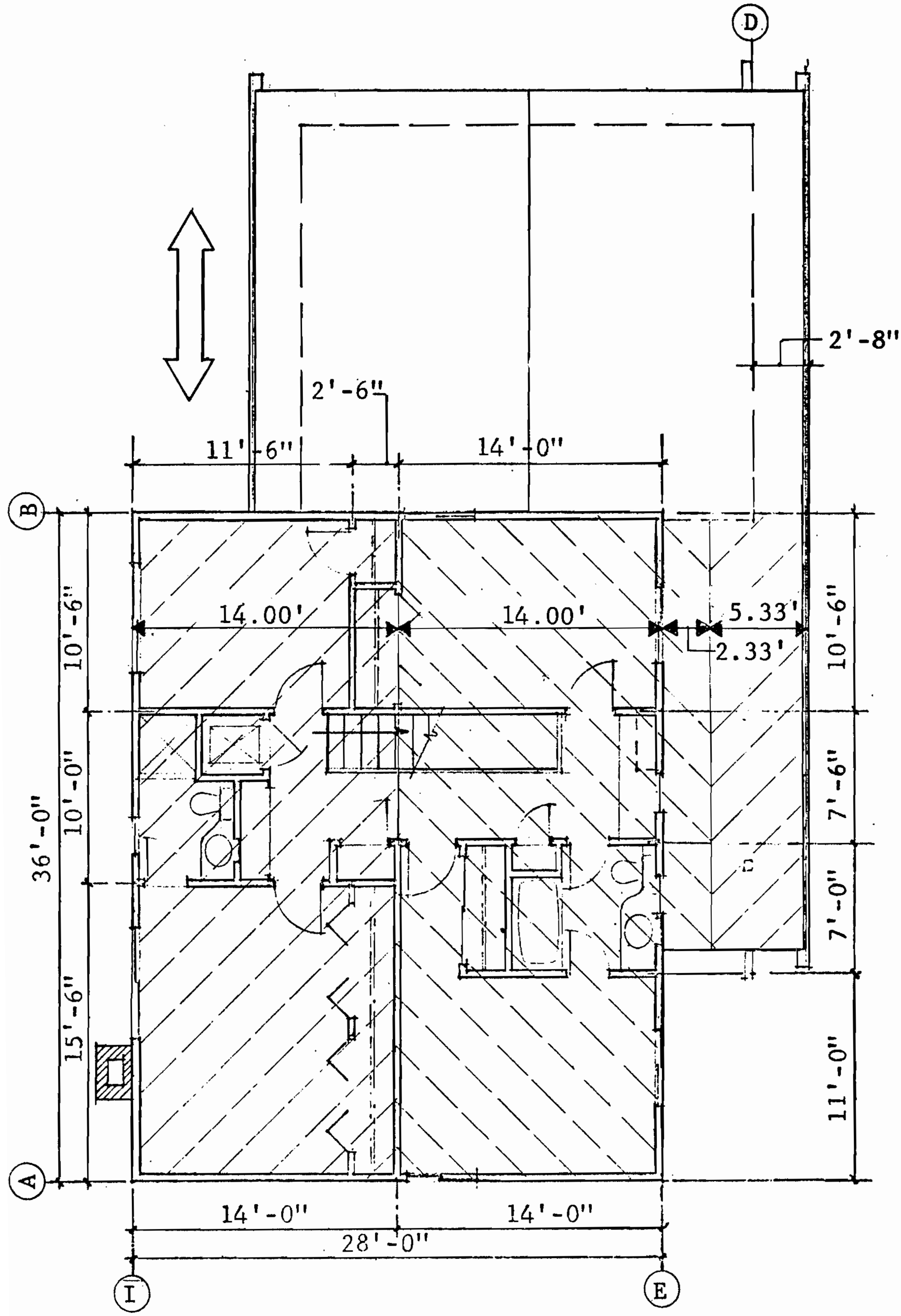
WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

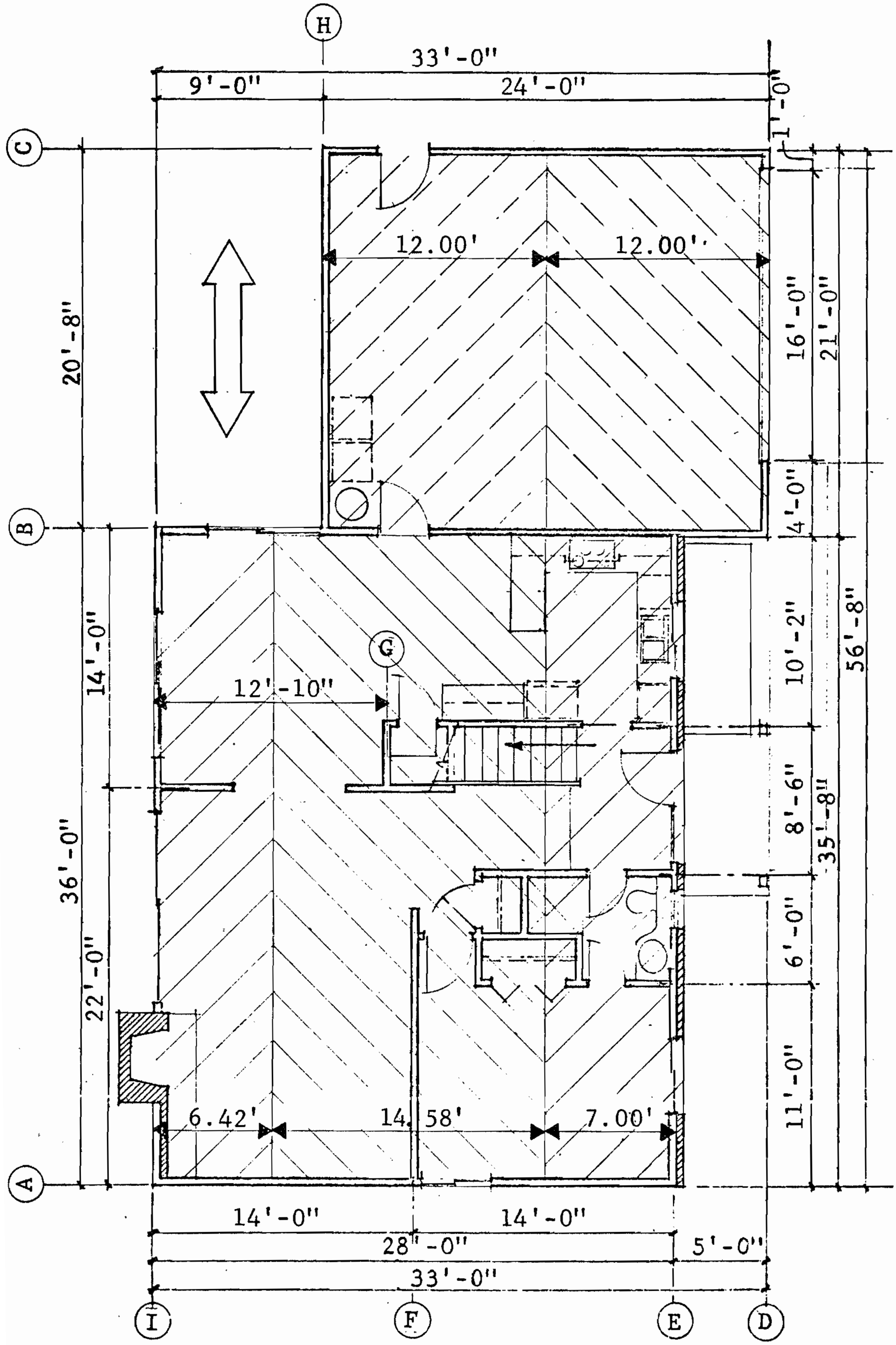
LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT.	OVERTURNING
F	SEE MODEL 'A'.									
	IF SLIDING DOOR WERE WINDOW:							L=34.4 v=176.3 ½@5.0		HD#1
		WINDOW TOO WIDE - O.T. SAME								
G	6.83	9.17	40	2505		11.0	227.7	3-½" OK ½@6	3@4,12	SEE MODEL 'A'
										2-B0 FRMCO ANCHS



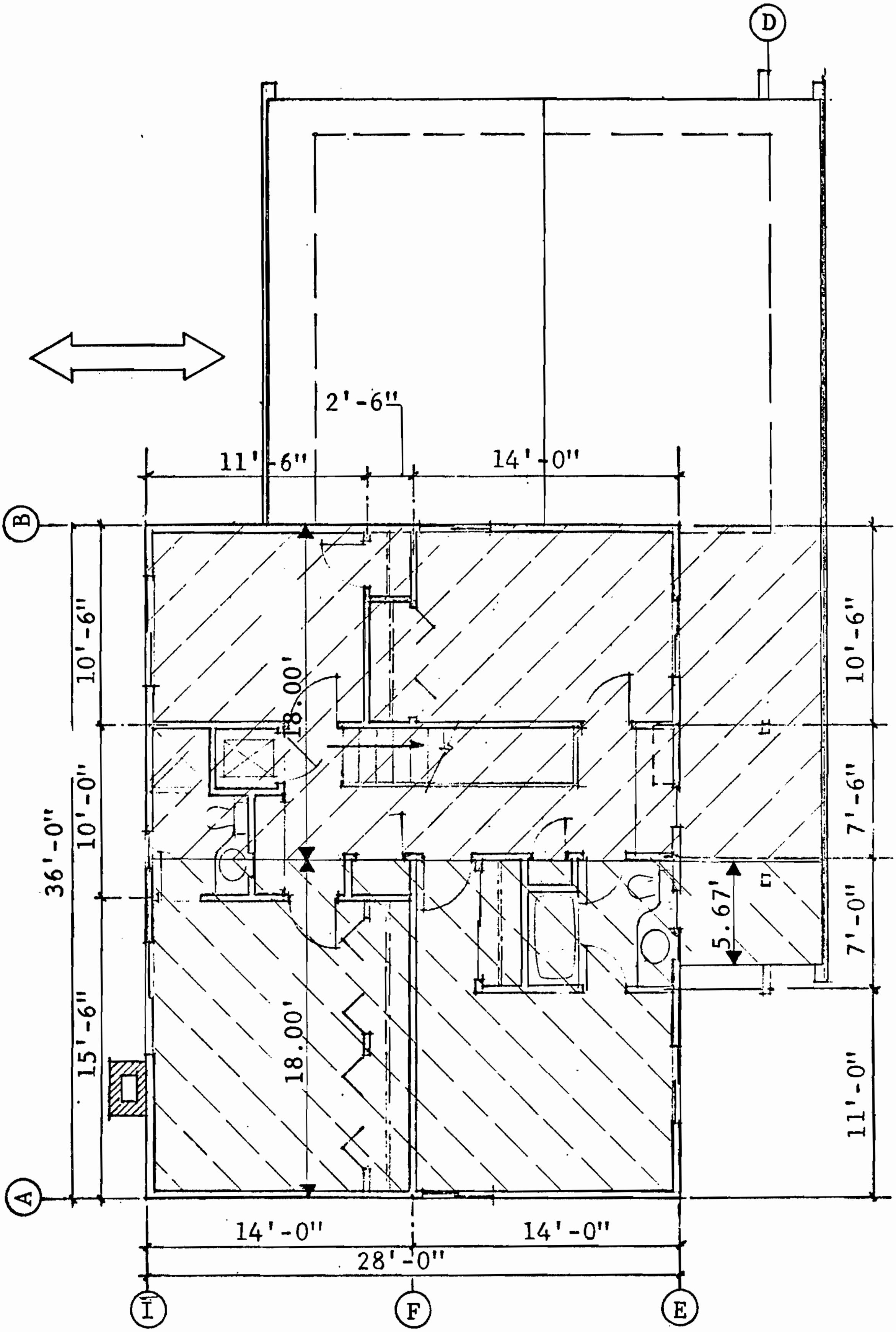
SHEAR WALL PLAN - MODEL 'B'



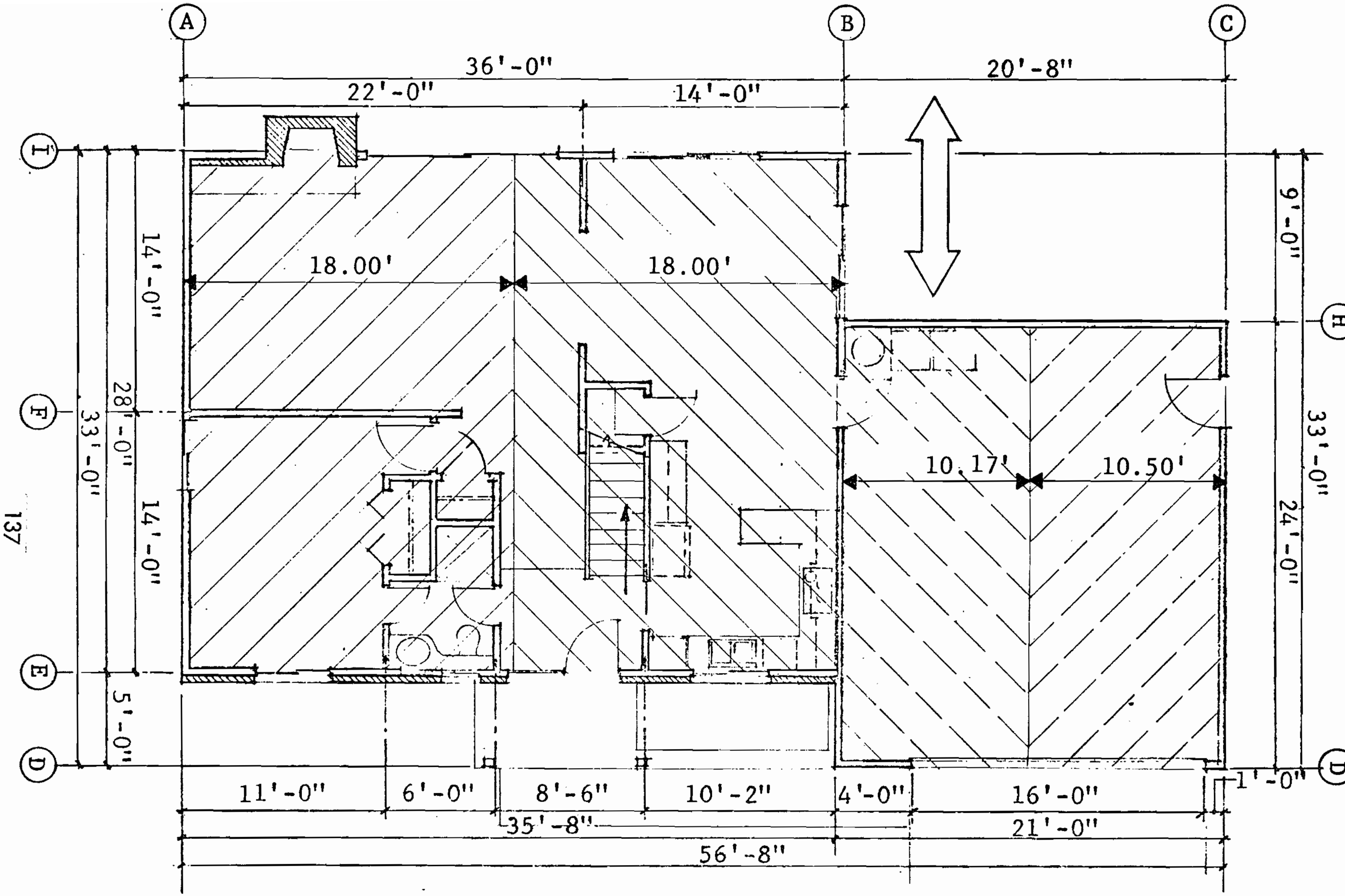
TRIBUTARY AREA - SECOND FLOOR - MODEL 'B'



TRIBUTARY AREA - FIRST FLOOR - MODEL 'B'



SECOND FLOOR - MODEL 'B'
TRIBUTARY AREA



FIRST FLOOR - MODEL 'B'
TRIBUTARY AREA

Job: EXAMPLE HOMES Model: 'B'

LOADS

Calc Form 2

	Material	Actual	Seismic	Actual	Seismic
ROOF					
Roofing	ASPHALT SHINGLE	3.0	0.400		
Shtg.	5/8" PLYWD.	2.0	0.267		
Framing	STD. FRMG.	2.0	0.267		
TOTAL		7.0	0.934		
CEILING					
Framing		2.0	0.267		
Finish	GYP. BD.	2.0	0.267		
TOTAL		4.0	0.534		
2nd FLOOR					
Flooring	CARPET	1.0	0.133		
Shtg.	5/8" PLYWD	2.0	0.267		
Framing	2x10@16	4.0	0.533		
Ceiling	GYP. BD.	2.0	0.267		
TOTAL		9.0	1.200		

Job: EXAMPLE HOMES Model: 'B'

WALL LOADS

Calc Form 3

EXTERIOR	Mat.	Actual	Mat.	Actual	Mat.	Actual
Framing		4.0				
Ext. Fin.	Hdbd.	2.0				
Int. Fin.	Gyp. Bd.	2.0				
TOTAL		8.0				
INTERIOR						
Framing		4.0				
Int. Fin.	Gyp. Bd.	2.0				
Int. Fin.	" "	2.0				
TOTAL		8.0				

Veneer Load: 21.33#/'

TOTAL LD.	Roof	2nd Clg.	2nd		Gar.	
Ceiling	/	0.534	1.200			
Ext. Walls	/	0.750	1.500		0.750	
Int. Walls	/	0.250	1.500			
TOTAL	0.934	1.534+	4.200=	5.734	0.750	

Job: EXAMPLE HOMES Model: 'B'

TRIBUTARY AREAS

Calc Form 6

	ROOF AREA		CEILING AREA	
LINE	Height x Width	Area	Height x Width	Area
HIGH ROOF				
A	20x32	640	18x28	504
B	20x32	640	18x28	504
		1280		1008
E	16x40	640	14x36	504
I	16x40	640	14x36	504
		1280		1008
GARAGE ROOF				
B	10.17x28.67	292	10.17x24	244
C	12.5x28.67	358	10.5x24	252
		650		496
D	14.67x22.67	333	12x20.67	248
H	14x22.67	317	12x20.67	248
		650		496
PORCH ROOF				
A	5.67x7.67	43		
B	18x7.67	138		
		181		
D	5.33x23.67	126		
E	2.33x23.67	55		
		181		
2ND FLOOR				
A			18x28	504
B			18x28	504
E			7.00x36	252
F			14.58x36x1.25	656
I			6.42x36	231

Job: COST ANALYSIS   Model: 'B' SEISMIC Z.3

SEISMIC LOADS

Calc Form 7

LINE	ROOF AREA	ROOF LOAD	OTHER LOAD	TOTAL RF. LD.	CLG. AREA	CLG. LOAD	TOTAL LOAD
HIGH ROOF A	640	0.934		___	504	1.534	598 773 1371
B	640	"		___	504	"	1371
E	640	"		___	504	"	1371
I	640	"		___	504	"	1371
LOW ROOF D GAR	333	"		___	248	0.750	311 186
PORCH D	126	"		___			118 615
C	358	"		___	252	0750	334 189 523
H	317	"		___	248	"	296 186 482

Job: COST ANALYSIS Model: 'B' SEISMIC 2,3

SEISMIC LOADS

Calc Form 7

LINE	ROOF AREA	ROOF LOAD	OTHER LOAD	TOTAL RF. LD.	CLG. AREA	CLG. LOAD	TOTAL LOAD
2ND FLOOR A PORCH	43	0.934		598 40 638	504	5.734	638 2890
VNR. A			18x21.33	384			384 3912
B GAR	292	"		598 273 871	244	0.750	871 183
PORCH VNR B	138	"	18x21.33	129 384 513	504	5.734	513 2890 4457
E PORCH	55	"		598 51 649	252	"	649 1445 2094
F&G					656	"	3762 3762
I					231	"	598 1325 1923

Job: COST ANALYSIS Model: 'B' SEIS. ZONE 3

SHEAR WALL DESIGN

Calc Form 8

LINE	LOAD	WALL LENGTH	SHEAR PER FT.	SILL BOLTS	SHEAR MAT.	OVERTURNING
HIGH ROOF					230	
A&B	1371	24.0	57.1	—	OK	L=28' OK
E	1371	18.5	74.1	—	OK	L=36' OK
I	1371	20.0	68.6	—	OK	L=36' OK
LOW ROOF						
C	523	18.0	29.1	1/2@6	OK	L=15' OK
D	615	4.0	153.8	2-1/2"⌀	OK	2 BOTTOM FRAME ANCHS
	W=	178#/1 ;	178+100=		278#	
		U= 8/4 (615-278) =			674#	
H	482	21.0	23.0	1/2@6	OK	L=21' OK
1ST STORY WALLS						
A	3912	24.0	163.0	1/2@5.4	OK	L=28' OK
B	4457	18.5	240.9	1/2@3.6	PLYWD 2 SIDES 4	4 OK
		(4457-5×220)/13.5	= 245#/'			
	L=18'-6" - PALL: 4250+1.08×2125+1000 = 4520					
					180	
E	2094	18.0	116.3	1/2@6	OK	L=18' OK
					200	
F&G	3762	19.0	198.0	1/2@4.6	OK	L=15' PALL=6950
					220	
I	1923	9.0	213.7	2-1/2"⌀ EA WALL	OK	L=10' PALL=1850+

Job: COST ANALYSIS Model: 'B' SEIS. ZONE 2

SHEAR WALL DESIGN

Calc Form 8

LINE	LOAD	WALL LENGTH	SHEAR PER FT.	SILL BOLTS	SHEAR MAT.	OVERTURNING
ALL WALLS OK BY COMPARISON WITH ZONE 3 EXCEPT						
	AS CHECKED					
LOW ROOF					230	
D	308	4.0	77.0	2-½"φ	OK	1800 FRMCO ANCH
		$U = \frac{8}{4}(308 - 278) = 600$				
1ST STORY WALLS						
A	1956	24.0	81.5	½@6	OK	L=28' OK
					100 MIN	
B	2229	18.5	120.5	½@6	OK	L=18'-6" OK
		$\frac{2229 - 5 \times 230}{13.5} = 79.9$				
					200	
F&G	1881	19.0	99.0	½@6	OK	L=15' OK

Job: COST ANALYSIS Model: 'B' 15 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 230	OVERTURNING
HIGH ROOF										
A&B	9.0	18.0	15	2430		24.0	101.3	—	OK	L=28' OK
E&I	6.67	14.0	15	1400		18.5 AVW	75.7	—	OK	L=36' OK
LOW ROOF										
C	8.33	10.5	15	1312		18.0	72.9	1/2@6	OK	L=18' P_{ALL}=2000
D	6.33	12	15	1140		4.0	285	2-1/2"ϕ	BUTT JNTS	STRAP HD
	W=	178#/'	178+100=278,		U= 8/4 (1140-278)	= 1724				
4	6.33	12	15	1140		21.0	54.3	1/2@6	OK	L=21' P_{ALL}=2730+
1ST STORY WALLS										
A	18.0	18.0	15	4860		24.0	202.5	L=22.0 w=173.6 1/2@5.0	OK	L=28' OK

Job: COST ANALYSIS   Model: 'B' 15 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 100	OVERTURNING
1ST STORY WALLS										
B	18.0	18.0	15	4860		18.5	331.4	1/2@2-6	3/8 ST II 8d@4,12	280 Frame Anchor
	8.33	10.17	15	1271						
	w=	208#/'		6131	L=18'6"	-4250+.08x2175+100=			4520	
						v= 8/18.5 (6131-4520)			= 697	
									180	
E	14.5	7.0	15	1523		18.0	84.6	1/2@6	OK	L=18' OK
									200	
F&G	16.75	14.58	15	3663		19.0	192.8	1/2@4-6	OK	L=15' OK
									230	
I	14.42	6.42	15	1389		9.0	154.3	2-1/2" 4/E	OK	L=10' P_{ALL}=1850±

Job: COST ANALYSIS Model: 'B' 25 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 230	OVERTURNING
HIGH ROOF										
A&B	9.0	18.0	25	4050		24.0	168.8	—	OK	L=28' P_{ALL}=4900+
E&I	6.67	14.0	25	2335		18.5 MIN	126.2	—	OK	L=36' OK
LOW ROOF										
C	8.33	10.5	25	2187		18.0	121.5	1/2@6	OK	OK
	W=	101#/'	P_{ALL}=	2000+	2000/100	+100=	2120	3% OVER		
D	6.33	12	25	1899		4.0	474.8	2-5/8"Φ	1/2" STD II 10d@4,12	HD #2
	W=	178#/'	HD#2	-1670	+.78×120	+100=	1864	2% OVER		
H	6.33	12	25	1899		21.0	90.4	1/2@6	OK	L=21' P_{ALL}=2730+
1ST STORY WALLS										
A	18.0	18.0	25	8100		24.0	337.5	L=28.0 L'=289.3	5/8" STD II 8d@4,12	OK
	W=	201#/'	P_{ALL}=	9750+	100=	9850		5/8@4-8		

Job: COST ANALYSIS Model: 'B' 25psf WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 230	OVERTURNING
1ST STORY WALLS										
B	18.0	18.0	25	8100		18.5	552.3	5/8@2-4	3/8" ST II Ed@2½,12	HD#1
	8.33	10.17	25	2118	HD#1 -	9900+	.08×2200	+100	=10176	
	w =	208#/1		10218						
									180	
E	14.5	7.0	25	2538		18.0	141.0	½@6	OK	L=18' OK
									200	
F&G	16.75	14.58	25	6105		19.0	321.3	5/8@4-0	3/8" ST II Ed@4,12	L=15' PALL=6950
									230	
I	14.42	6.42	25	2314		9.0	257.1	2-½"φ EA WALL	BUTT JNTS	OK
	w=	394#/1		L=10-0	-1850	+.094×650	=	2461		

Job: COST ANALYSIS   Model: 'B' 40 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 230	OVERTURNING
HIGH ROOF										
A	9.0	18.0	40	6480		24.0	2700	—	1/2" STR II 10d@6,12	1-BO FRMG ANCH
	W = 105#/'; P_{ALL} = 4900 + .05 x 4850 + 100 = 5242#									
	U = 8/28 (6480 − 5242) = 354#									
B	SAME AS LINE A									
E	6.67	14.0	40	3735		18.5	2019	—	OK	L = 36' OK
I	6.67	14.0	40	3735		20.0	1868	—	OK	L = 36' OK
LOW ROOF										
C	8.33	10.5	40	3499		18.0	194.4	1/2 @ 4-6	OK	2 BO FRMG ANCH
	W = 101#/'; P_{ALL} = 2000 + 100 = 2100#									
	U = 8/18 (3499 − 2100) = 622#									

Job: COST ANALYSIS Model: 'B' 40 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

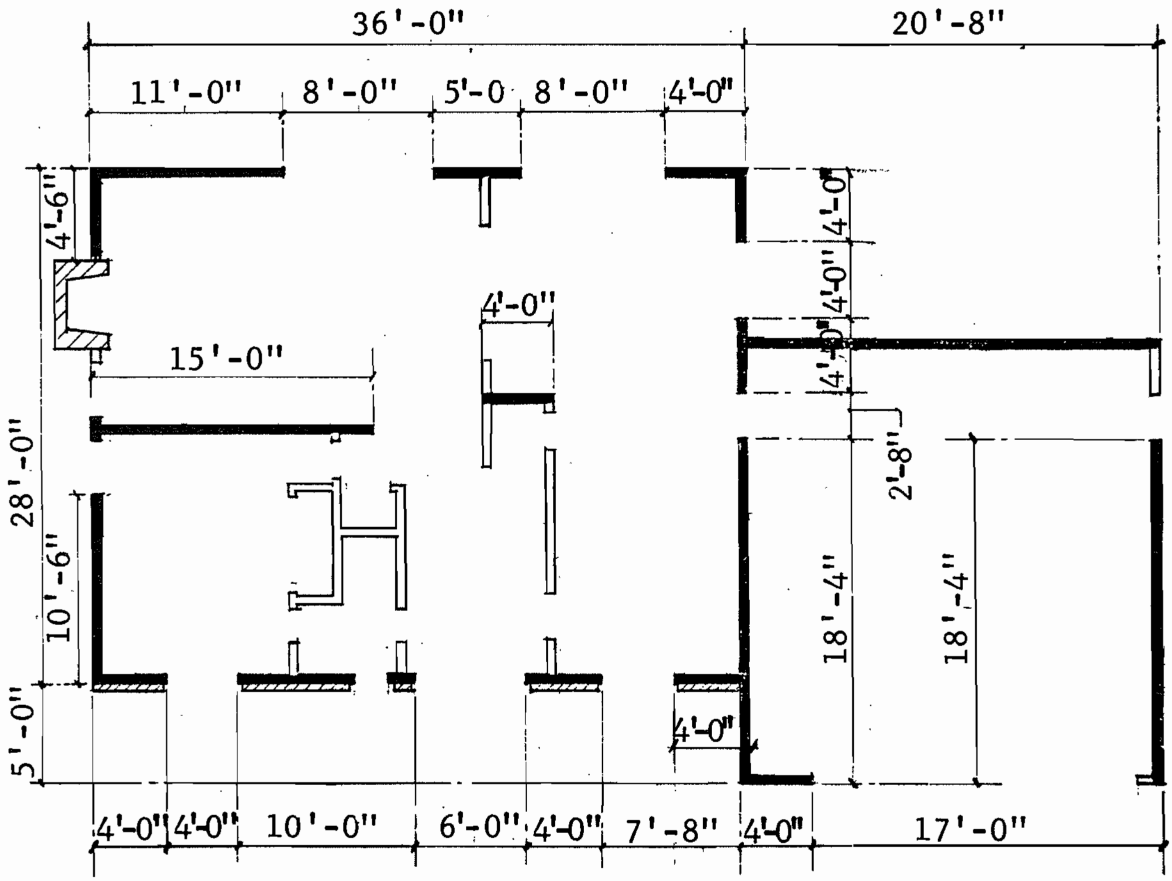
Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 230	OVERTURNING
LOW ROOF										
D	6.33	12	40	3038		4.0	759.5	2-3/4"ϕ	3/8" ST II 2 SIDES 8d @ 4,12	HD #4
	w=	178#/1	, HD#4 - 3300+							
H	6.33	12	40	3038		21.0	144.7	1/2 @ 6	OK	OK
	w=	178#/1	P_{ALL} = 2730 + 0.78 x 3520 + 100 = 5576							
1ST STORY WALLS										
A	18.0	18.0	40	12960		24.0	540.0	L = 28-0 O = 4@2.9 5/8 @ 2.9	3/8" ST II 8d @ 2 1/2, 12	STRAP HD
	w=	201#/1	L = 28'	P_{ALL} = 9750 + 100 = 9850						
				U = 8/28 (12960 - 9850) = 889#						
B	18.0	18.0	40	12960		18.5	883.7	3/4 @ 2'-0"	1/2" ST II 2 SIDES 10d @ 4,12	HD #3 - 12" x 18" DB
	8.33	10.17	40	3389						2 - #6 T & B
				16349						HD #4 NG FOR 6.5
	w=	208#/1		HD#2 -	208 x 18.5² / 2 / 8	+ 540 x 18	= 35594 + 97380 / 8 = 16622			

Job: COST ANALYSIS Model: '8' 40 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 180	OVERTURNING
1ST STORY WALLS										
E	14.5	7.0	40	4060		18.0	225.6	L=30 U=135.3 1/2@6	3/8" ST II 8d@6,12	L=18' P_ALL=8100
									200	
E&G	16.75	14.58	40	9769		19.0	514.2	5/8@26	3/8" ST II 8d@2½,12	STRAP HD
	w=	500#/'		L=15.0"	6950					
				4-0	505	U= 8/19	(9769-7655)=		890#	
				2x100	200					
					7655					
									230	
I	14.42	6.42	40	3703		9.0	411.4	5/8@3.3	1/2" ST II 10d@4,12	180 FRMLO ANCH
	w=	394#/'		L=10-0	-1850	+0.94x	650 =	2461		
				4-6	- 380	+0.94x	130 =	502		
					2x100		=	200		
								3163		
			U= 8/14.5	(3703-	3163)	= 298#				



SHEAR WALL PLAN - MODEL 'B-1'

Job: COST ANALYSIS Model: 'B-1' SEIS. ZONE 3

SHEAR WALL DESIGN

Calc Form 8

LINE	LOAD	WALL LENGTH	SHEAR PER FT.	SILL BOLTS	SHEAR MAT.	OVERTURNING
HIGH DESIGN, LOW ROOF AND 1ST STORY WALLS F & G						
	SEE	MODEL 'B'				
1ST STORY	WALLS				230	
A	3912	15.0	260.8	L=23.0 v=170.1	3/8" STR II 8d@6,12	L=28' OK
				1/2@5-0	100 lbs	
B	4457	26.33	169.3	L=30.33 v=147.0	1/2" GYP B 5d@4 B	OK
				1/2@6		
		4457 - 9x230 / 17.33		=137.7		
		L=18.4	4150±			
		12-0	1750±			
					180	
E	2094	20.0	104.7	1/2@6	OK	L=18' OK
					230	
I	1923	20.0	96.2	1/2@6	OK	L=11' P_{ALL}=2200±

Job: COST ANALYSIS   Model: 'B-1' 15 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT.	OVERTURNING
									230	
HIGH & LOW ROOFS - 1ST STORY WALLS F & G										
	SEE MODEL 'B'									
1ST STORY WALLS										
								L=23.0	3/8" STII	
A	18.0	18.0	15	4860		15.0	324.0	U=211.3	8d@4,12	L=28' OK
								1/2@4.3	1000 ALW	
								L=30.33	PLY 2 SIDES	
D	18.0	18.0	15	4860		26.33	232.9	U=202.1	5d@4U	OK
	8.33	10.17	15	1271				1/2@4-4		
					6131-9x230 / 17.33		=234	3#/1		
				6131						
				L=18-4	-4150	4.08x2150	=	4322		
				12-0	-1750	4.08x925	=	1824		
					2x100		=	200		
								6346		
									1800	
E	14.5	7.0	15	1523		20.0	76.2	1/2@6	OK	L=18' OK
									230	
I	14.42	6.42	15	1389		20.0	69.5	1/2@6	OK	L=11-0 P ALL=2200±

Job: COST ANALYSIS Model: 'B-1' 25 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 230	OVERTURNING
HIGH & LOW ROOFS - 1ST STORY WALLS F & G										
	SEE MODEL 'B'									
1ST STORY WALLS										
A	18.0	18.0	25	8100		15.0	540.0	L=27-0 U=2522	3/8" STII 8d@2½,12	L=28' P_{ALL}=9750
								1/2@2-4		
B	18.0	18.0	25	8100		26.33	328.1	L=30.33 U=3318	3/8" STII 8d@4,12	STRAP HD
	8.33	10.17	25	2118	L=18-4	4150+.08x2150		1/2@2-6 =4322		
	w=	208#/'		10218	12-0	1750+.08x925		=1824		
						2x100		200		
								6346		
		U=8/30.33(10,218-6346)=1021								
									180	
E	14.5	7.0	25	2538		20.0	126.9	1/2@6	OK	L=18' OK
									230	
I	14.42	6.42	25	2314		20.0	115.7	1/2@6	OK	L=11'-0" P_{ALL}=2200±

Job: COST ANALYSIS

Model: 'B-1' 40 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

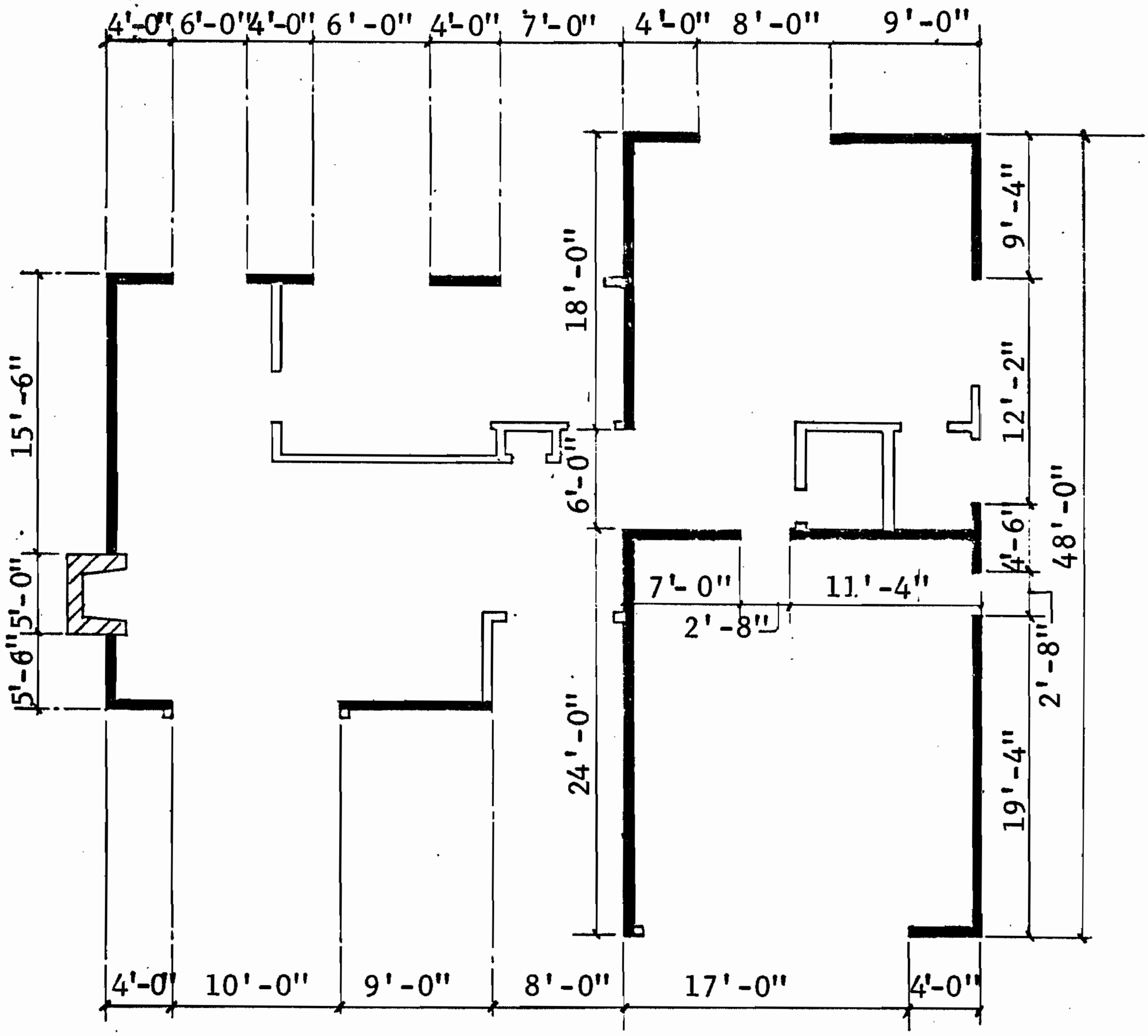
LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT.	OVERTURNING
									230	
HIGH & LOW ROOFS										
	SEE MODEL 'B'									
1ST STORY WALLS										
A	18.0	18.0	40	12960		15.0	864.0	L=23-0 v=563.5 5/8@24	1/2" ST II 2 SIDES 10d@4,12	STRAP HD
	W=	201#/1	L=28' - SEE MODEL 'B'							
B	18.0	18.0	40	12960		26.33	620.9	3/4@2'-10 1/2	1/2" ST II 10d@2 1/2,12	
	8.33	10.17	40	3389						
				16349	HD#1	L=18-4	9800+.08×2150		=9972	HD#1 4.8% OVER
	W=	208#/1				12-0	5350+.08×900		=5422	
							2×100		= 200	
									15594	
									180	
E	14.5	7.0	40	4060		20.0	203.0	L=30 v=135.3 1/2@6	3/8" ST II 8d@6,12	L=18' P_{ALL}=8100

Job: COST ANALYSIS   Model: 'B-1' 40PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

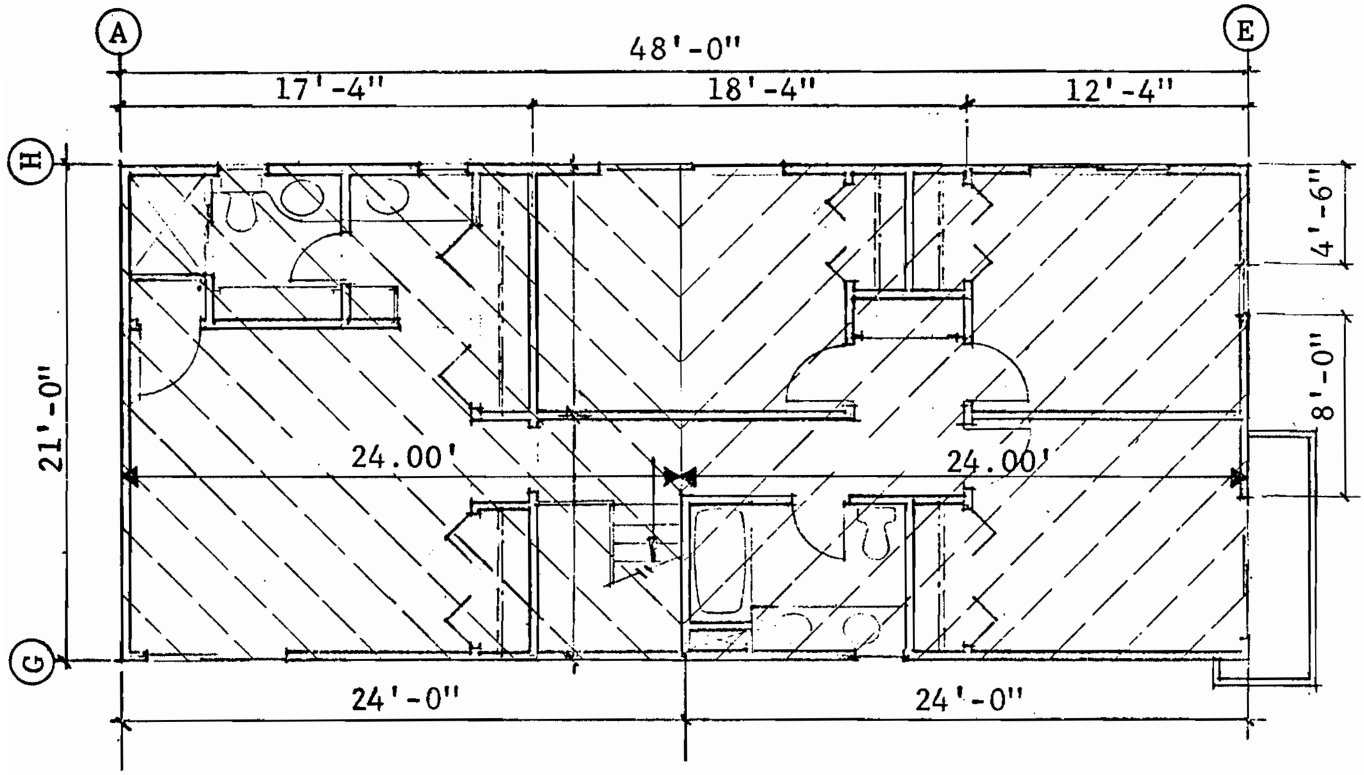
Calc Form 9

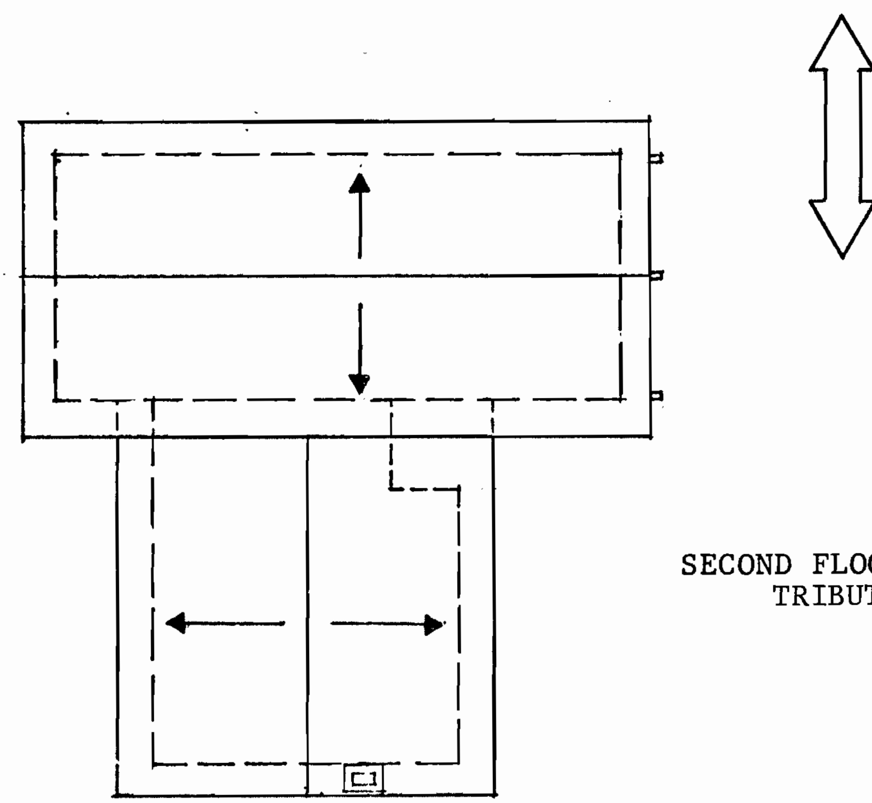
LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 230	OVERTURNING
1ST STORY WALLS										
E&G	SEE MODEL 'B'									
I	14.42	6.42	40	3703		20.0	185.2	½@4.9	OK	OK
	W=	394#/l		L=11-0	2200	+.94x850	=	2999		
				5-0	470	+.94x155	=	616		
				4-0	300	+.94x105	=	399		
					3x100			300		
								4314		



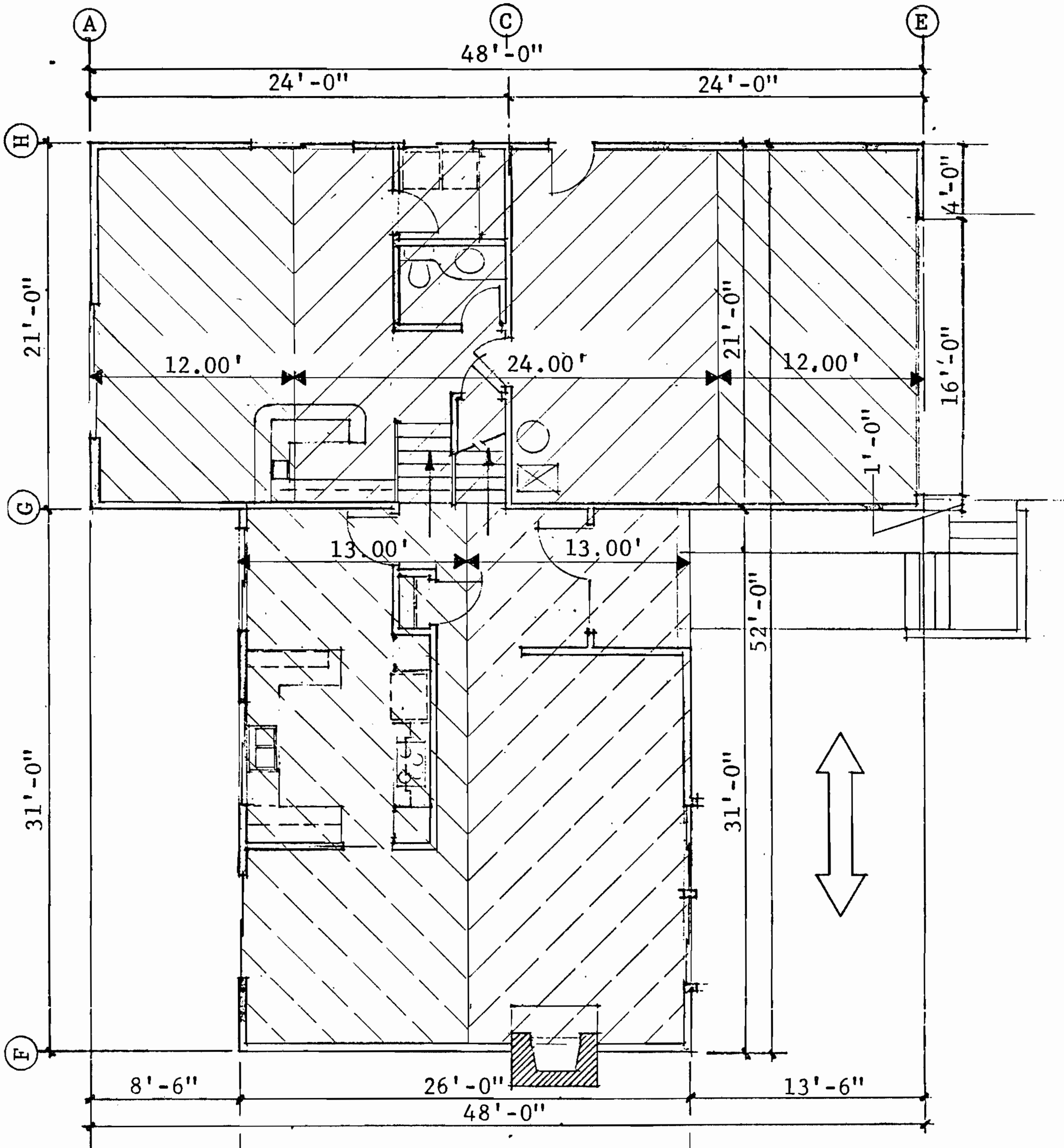
SHEAR WALL PLAN

MODEL 'C'

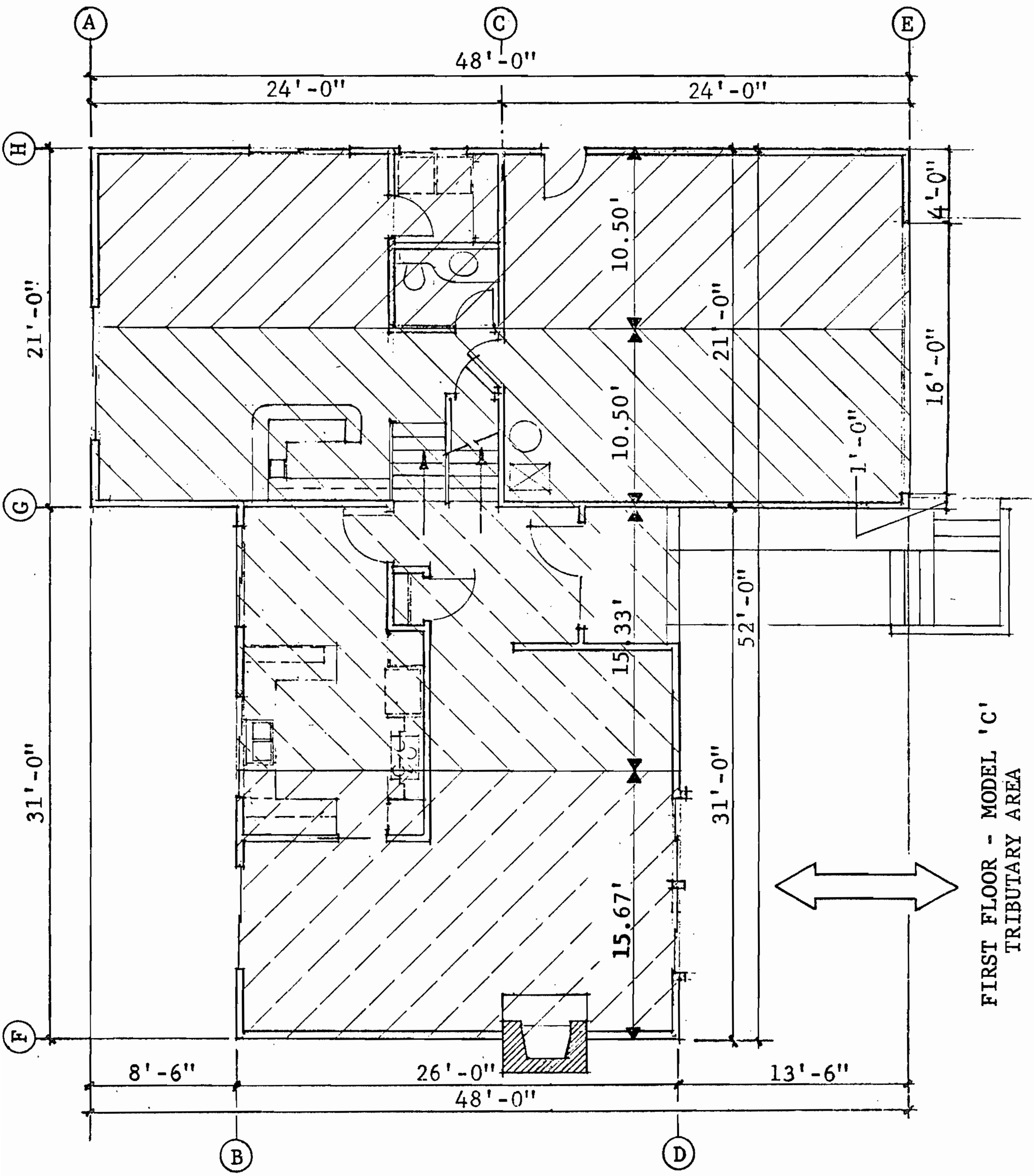




SECOND FLOOR - MODEL 'C'
TRIBUTARY AREA



FIRST FLOOR - MODEL 'C"
TRIBUTARY AREA



FIRST FLOOR - MODEL 'C'
TRIBUTARY AREA

Job: EXAMPLE HOMES Model: 'C'

LOADS

Calc Form 2

	Material	Actual	Seismic	Actual	Seismic
ROOF					
Roofing	ASPHALT SHINGLE	3.0	0.400		
Shtg.	½" PLYWD	2.0	0.267		
Framing	TRUSSES	2.0	0.267		
TOTAL		7.0	0.934		
CEILING					
Framing		2.0	0.267		
Finish	GYP. BD.	2.0	0.267		
TOTAL		4.0	0.534		
2nd FLOOR					
Flooring	CARPET	1.0	0.133		
Shtg.	½" PLYWD	2.0	0.267		
Framing	2x14@16	5.0	0.667		
Ceiling	GYP. BD.	2.0	0.267		
UNDERLAYMENT	5/16 PTCLEBD	1.5	0.200		
		11.5	1.524		
TOTAL					

Job: EXAMPLE HOMES Model: 'C'

WALL LOADS

Calc Form 3

EXTERIOR	Mat.	Actual	Mat.	Actual	Mat.	Actual
Framing		4.0				
Ext. Fin.	FIBER BD	4.0				
Int. Fin.	GYP. BD.	2.0				
TOTAL		10.0				
INTERIOR						
Framing		4.0				
Int. Fin.	GYP. BD.	2.0				
Int. Fin.	" "	2.0				
TOTAL		8.0				

Veneer Load: ________

TOTAL LD.	BOTH ROOFS	MID & 2ND CLG	2ND			
Ceiling		0.534	1.524			
Ext. Walls		0.750	1.500			
Int. Walls		0.250	1.500			
TOTAL	0.934	1.534 +	4.524 =	6.058		

Job: EXAMPLE HOMES Model: 'C'

TRIBUTARY AREAS

Calc Form 6

	ROOF AREA		CEILING AREA	
LINE	Height x Width	Area	Height x Width	Area
MID-LEVEL ROOF				
B	15x33	495	13x31	403
D	15x33	495	13x31	403
		990		806
F	17.75x30	533	15.75x26	410
G	15.25x30	458	15.25x26	397
		991		807
2 STORY ROOF				
A	26x25	650	24x21	504
E	26x25	650	24x21	504
		1300		1008
G	12.5x52	650	10.5x48	504
H	12.5x52	650	10.5x48	504
		1300		1008
2ND FLOOR				
A			12.00x21	252
C			24.00x21x1.39	701
E			12.00x21	252
G			10.5x48	504
H			10.5x48	504

Job: COST ANALYSIS Model: 'C' SEIS. ZONE 3

SEISMIC LOADS

Calc Form 7

LINE	ROOF AREA	ROOF LOAD	OTHER LOAD	TOTAL RF. LD.	CLG. AREA	CLG. LOAD	TOTAL LOAD
MID-LEVEL							
B	495	0.934			403	1.534	462 618 1080
D	495	"			403	"	1080
F	533	"			410	"	498 629 1127
2ND STORY ROOF							
A	650	"			504	"	607 773 1380
E	650	"			504	"	1380
G	650	"			504	"	1380
H	650	"			504	"	1380

Job: COST ANALYSIS Model: 'C' SEIS. ZONE 3

SEISMIC LOADS

Calc Form 7

LINE	ROOF AREA	ROOF LOAD	OTHER LOAD	TOTAL RF. LD.	CLG. AREA	CLG. LOAD	TOTAL LOAD
2ND FLOOR A				____	252	6.058	607 1527 2134
C				____	701	"	4247 4247
E				____	252	"	607 1527 2134
G				____	504	"	607 3053
MID-LEVEL G	458	0.934		____	397	1.534	42[illegible] 609 4697
H				____	504	6.058	607 3053 3660
				____			____
				____			____

Job: COST ANALYSIS Model: 8' SEIS ZONE 2

SHEAR WALL DESIGN

Calc Form 8

LINE	LOAD	WALL LENGTH	SHEAR PER FT.	SILL BOLTS	SHEAR MAT.	OVERTURNING
MID-LEVEL					175	
B	1080	12.0	90.0	½@6	OK	L=14' OK
D	1080	13.0	83.1	½@6	OK	OK
	w=	237#/'	L=9.0	1020+.37(480)=1198		
			4.0			237
				2x100		200
						1635
F	1127	21.0	53.7	½@6	OK	L=15.6 Pall=1500#
HIGH ROOF						
A	1380	21.0	65.7	——	OK	L=21' OK
E	1380	12.5	110.4	——	OK	L=21' OK
G	1380	40.0	34.5	——	OK	L=48' OK
H	1380	27.25	50.6	——	OK	L=20.33' MAX OK
1ST STORY WALLS						
A	2134	13.0	164.2	½@5.4	OK	2-80 FRMG ANCHS
	w=	201#/'	L=9.0	1000		
			4.0	200		
			2x100	200		
				1400		
	U=	8/13(2134-1400) = 452#				

Job: COST ESTIMATE Model: 'C' SEIS. ZONE 3

SHEAR WALL DESIGN

Calc Form 8

LINE	LOAD	WALL LENGTH	SHEAR PER FT.	SILL BOLTS	SHEAR MAT.	OVERTURNING
1ST STORY WALLS					200	
C	4247	18.33	231.7	1/2@39	5d@4U	STRAP HD
	w=	95#/1	L=11.33	- 762		
			7.0	- 291		
			2x100	200		
				1253		
	U=	8/18.33 (4	247-12	53) = 1	307	
					175	
E	2134	4.0	533.5	2-5/8"Φ	3/8" 1ST II 5d@2 1/2,12	HD#3
	w=	201#/1	HD#3	Pall=25	20+100	=2620
G	4697	42.0	111.8	1/2@6	L=28' v=107.8 OK	L=24' H=4' OK
H	3660	33.17	110.3	1/2@6	OK	L=26.33 MAX. OK

Job: COST ANALYSIS Model: 'C' SEIS ZONE 2

SHEAR WALL DESIGN

Calc Form 8

LINE	LOAD	WALL LENGTH	SHEAR PER FT.	SILL BOLTS	SHEAR MAT.	OVERTURNING
MID-LEVEL & HIGH ROOF					175	
	ALL WALLS MIN - SEE SEIS, ZONE 3					
1ST STORY WALLS						
A	1067	13.0	82.1	1/2@6	OK	OK P ALL = 1400
C	2124	18.33	115.9	1/2@6	OK	1 ESO FERRO ANCH
	SEE 2.3		U = 8/18.33 (2124 - 1253) = 380			
E	1067	4.0	266.8	2-1/2"4	3/8" ST II 8d@6,12	STRAP HD
	U = 8/4 (1067 - 301) = 1532#					
G & H	MIN. - SEE SEIS ZONE 3					

Job: COST ANALYSIS   Model: 'C' 15 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 175	OVERTURNING
MID-LEVEL										
B	6.5	13.0	15	1268		12.0	105.7	1/2@6	OK	L=14' P_{ALL}=2400
D	6.5	13.0	15	1268		13.0	97.5	1/2@6	OK	P_{ALL}=1635(2.3)
F	8.67	15.67	15	2038		21.0	97.0	1/2@6	OK	OK 3.3% OVER
	W=	105#/'	L=15-6 —	1500 +	.05x	1450 =		1573		
			5-6 —	190 +	.05x	185 =		199		
			2x100 =	200				200		
								1972		
HIGH ROOF										
A	7.83	24	15	2819		21.0	134.2	—	OK	L=21' P_{ALL}=2745#
E	7.83	24	15	2819		12.5	225.5	—	3/8" STII 8d@6,12	L=21' OK
G	6.08	10.5	15	958		40.0	24.0	—	OK	L=48' OK

Job: COST ANALYSIS Model: 'C' 15 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 175	OVERTURNING
HIGH ROOF										
H	6.08	10.5	15	958		27.25	35.2	—	OK	L=20.33 max OK
1ST STORY WALLS										
A	17.0	12.0	15	3060		13.0	235.4	1/2@3-9	3/8" STII 8d@6,12	STRAP HD
		SEE Z.3.	P_{ALL} =	1400;	U = 8/13	(3060-	1400)	= 1022		
C	17.0	24.0	15	6120		18.33	333.9	1/2@2-6	3/8" STII 8d@4,12	HD #1
	w =	95#/	HD#1	L=11-4	-3850	+.875×	350 =	4156		
				7-0	-2210	+.875×	130 =	2324		
					2×100		=	200		
								6680		
E	17.0	12.0	15	3060		4.0	765.0	2-3/4"Φ	3/8" STII 2 SIDES 8d@4,12	HD #4
	w =	201#/		HD#4	- P_{ALL} =	3400+	100 =	3500#		

Job: COST ANALYSIS Model: 'C' 15 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 100 MIN	OVERTURNING
1ST STORY WALLS										
G	15.25	10.5	15	2402		42.0	57.2	1/2@6	OK	L=24' H=4' OK
4	15.25	10.5	15	2402		33.17	72.4	1/2@6	OK	L=19.33 OK

Job: COST ANALYSIS Model: 'C' 25 psf WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 175	OVERTURNING
MID-LEVEL										
B	6.5	13.0	25	2113		12.0	176.1	1/2@5.0	OK	L=14' P_ALL=2400
D	6.5	13.0	25	2113		13.0	162.5	1/2@5.4	OK	1800 FENCO ANCH
	w=	237#/'	L=90-	1020+.37(480)		=	1198			
			40.			=	237			
				2x100		=	200			
							1635			
		V=	8/13 (2113-	1635)		=294#				
E	8.67	5.67	25	3396		21.0	161.7	1/2@5.4	OK	2-800 FENCO ANCHS
	w=	105#/'	L=15.6	-1500+.05x		1450=	1573			
			5-6-	190+.05x		185 =	199			
				2x100		=	200			
							1972			
		V=	8/21 (3396-	1972)		=542				

Job: COST ANALYSIS Model: 'C' 25 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 175	OVERTURNING
HIGH ROOF										
A	7.83	24	25	4698		21.0	223.7	—	3/8" ST II 8d@6,12	2 BOT FRMG ANCHS
	W=	105#/	L=21.0	PALL=	2740+.05×2760+200=3078					
		U=	8/21(4698 –	3078)	=617#					
E	7.83	24	25	4698		12.5	375.8	—	3/8" ST II 8d@4,12	L=21' 2-BOT FRMG ANCH
G	6.08	10.5	25	1596		40.0	39.9	—	OK	L=48' OK
H	6.08	10.5	25	1596		27.25	58.6	—	OK	L=20.33 MAX OK
1ST STORY WALLS										
A	17.0	12.0	25	5100		13.0	392.3	1/2@2-0	3/8" ST II 8d@4,12	HD#1-12"x18" GB
	W=	201#/1	HD#1	L=9-0	4200					1-#4 T&B
				4-0	1300					
				2×100	200					
					5700#					

Job: COST ANALYSIS Model: 'C' 25 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 200	OVERTURNING
1ST STORY WALLS										
C	17.0	24.0	25	10,200		18.33	556.5	5/8"@2-4	3/8" STII 8d@2 1/2,12	HD#3 12"x18"@B
	W=	95#/1	HD#3	L=11-4	-8100					2-#5 T&B
				7.0	-4690					
				2x100=	200					
					12990					
									175	
E	17.0	12.0	25	5100		4.0	1275.0	3-3/4"φ	3/8" STII 8d@2,12 2 SIDES	CANNOT BE DES.
	W=	201#/1								BY MANUAL - SEE
			5100x8-201x4 2/2		=	40800-1608				CALCS HERE
		E=		4.0-0.5			3.5	= 11,197#		USE 2-HD#4
										W 2x6 STUD WALL
	ITLC.	M=40,800#		$Z=\frac{450l^2}{2}+201\times4(l-2)+W(l-\frac{1.5}{2})$						USE 4x8@ENDS
				$=225l^2+804l-1608+Wl-0.75W$						
				$Y=201\times4+450l+W=804+450l+W$						
				$40800=Z-\frac{Y^2}{3000}$				W=	450l	

Job: COST ANALYSIS Model: 12' - 25 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 175	OVERTURNING
E	FTG (CONT.)			$\omega_1 = 201^{\#}/'$		$\omega_2 = 450^{\#}/'$		$V = 450\,l$		
	TRY l = 10.3'									
		Z = ½ × 450 × 10.3² + 201 × 4 (10.3 − 2) + 450 × 10.3 (10.3 − .75)								
		= 23870.3 + 6673.2 + 44264.3 = 74807.8								
		Y = 201 × 4 + 450 × 10.3 × 2 = 804 + 9270 = 10,074								
		M = 5100 × 8 = 40,800#								
		Z − Y²/2000K = 74,807.8 − 10074²/3000 = 74807.8 − 33828.5 = 40,979.3								
							l = 10.3' USE:			18" × 24" G.B.
										2-#5 T&B
G	15.25	10.5	25	4003		42.0	95.3	½@6	OK	L=24' H=4' OK
H	15.25	10.5	25	4003		33.17	120.7	½@6	OK	L=19.33' OK

Job: COST ANALYSIS   Model: 8' 40 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT.	OVERTURNING
MID-LEVEL										
B	6.5	13.0	40	3380		12.0	281.7	1/2@30	3/8" STII 8d@4,12	OK (3.59/6 OVER)
	w=	237#/	L=	14-0	2400	+0.37x1	150 =	2826		
				4-0	200	+0.37x1	05 =	239		
					2x100		=	200		
								3265		
D	6.5	13.0	40	3380		13.0	260.0	1/2@3-4	3/8" STII 8d@6,12	STRAP HD
	w=	237#/	L=9-0	1020	+.37x4	80 =	1198			
			4-0			=	237			
				2x100		=	200			
							1635			
		v = 8/13	(3380-	1635)	=1074					

Job: COST ANALYSIS   Model: C' 40 psf WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 175	OVERTURNING
MID-LEVEL										
F	8.67	15.67	40	5434		21.0	258.8	1/243.4	5/16" STI B d6,12	HD#1 12"x18" G.B.
	W=	105#/1	HD#1	L=15.6	6200#					1-#4 T&B
HIGH ROOF										
A	7.83	24	40	7517		21.0	358.0	—	3/8" STI B d4,12	STRAP HD
	W=	105#/1	L=21.0	P_{ALL}=2740	+.05×2	760+200=3078				
			U= 8/21	(7517-3078)=	1691#					
E	7.83	24	40	7517		12.5	601.3	—	3/8" STI B d2,12	L=21.0 STRAP HD
G	6.08	10.5	40	2554		40.0	63.9	—	OK	L=48'
H	6.08	10.5	40	2554		27.25	93.7	—	OK	L=20.33' MAX OK

Job: COST ANALYSIS Model: 'C' 40 PSF WIND

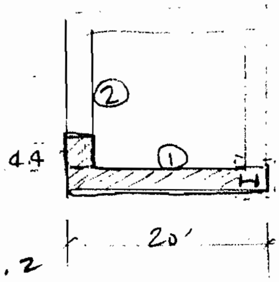
WIND LOAD AND SHEAR WALL DESIGN

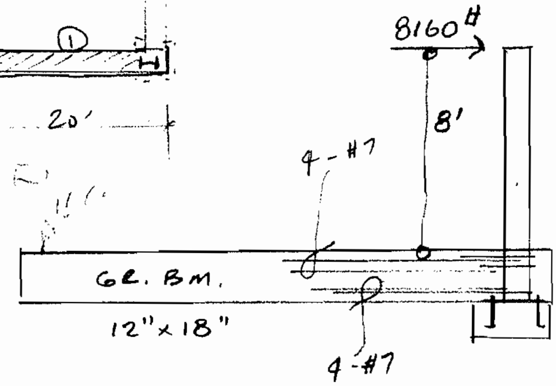
Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 175	OVERTURNING
1ST STORY WALLS										
A	17.0	12.0	40	8160		13.0	627.7	5/8 @ 2-0	7/8 #STII 8d @ 2,12	HD#1 - 12"x18" GB
	W=	105#/1	L=21.0	HD#1	PALL = 9250#					1-#4 T&B
C	17.0	24.0	40	16320		18.33	890.3	3/4 @ 2-0	1/2" ST II EA SIDE 10d @ 4,12	HD#4 - 18"x24" GB
	W=	95#/1	HD#4	L=11.4	10,500 + 7/8(1200) =	11550				2-#5 T&B
				7.0	6150 + 7/8(200) =	6325				
							200			
							18075			
E	17.0	12.0	40	8160		4.0	2040			
		SHEAR WALL NG - SEE ATTACHED CALCULATIONS								
G	15.25	10.5	40	6405		42.0	152.5	1/2 @ 5.9	OK	L=24' H=4' OK
H	15.25	10.5	40	6405		33.17	193.1	1/2 @ 4-6	7/8 #STII 8d @ 6,12	L=19.33' PALL=11750#

STEEL SEISMIC COL. – C – 40 PSF WIND

$P_u = 8160^{\#}$ $H = 8.0'$ STL.





COL.

$M = 8'(8.16^k) = 65.28^{k'}$

$S = \dfrac{65.28 \times 12}{19 \times 1.33} = 31.0 < 47.2$

$\dfrac{Ld}{bt} = \dfrac{96 \times 16}{5.53 \times .44} = 631$ $F_B = \dfrac{12 \times 10^3}{631} = 19$

$\Delta = L/360 = 96/360 = .267''$

I REQ'D $= \dfrac{8.16 \times 96^3}{3 \times 29 \times 10^3 \times .267} = 310.8 < 374$ 16WF 31

GR. BM.

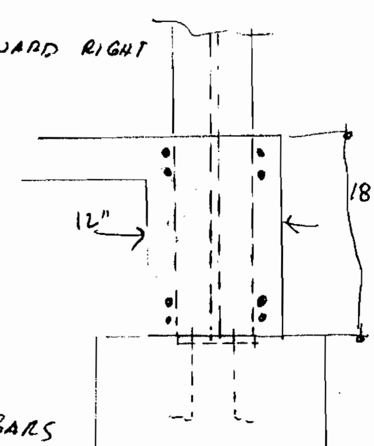
$M = 65{,}280^{\#'}$ $d = 18''$

CONC. BEARING STRESS

$f = \dfrac{6 \times 65{,}280}{5.53 \times 18^2} = 219.0 \text{ psi} < .25 \times 2000 \times 1.33 = 665$ O.K.

$A_s = \dfrac{65.28}{1.92 \times 14.7} = 2.3^{\square''} < 4 \times .6 = 2.4$

OVERTURNING OF GR. BM. – LOAD ACTING TOWARD RIGHT



$O_t M = 65.28^{k'}$

RESIST. M. OF G.B ① $= 10'(20' \times 225^{\#}/_{1}) = 45.0^{k'}$

" " G.B ② $= 20'(4.44' \times 225) = 20.28$

65.28

AT 8' LT. OF COL.

$M = 12'(1.0^k) + 12 \times 6 \times .225 = 12 + 16.2 = 28.2$

$A_s = \dfrac{28.2}{1.92 \times 19.8} = 1.0 < 1.2$

STOP HALF OF BARS 12'-0 LEFT OF COL.

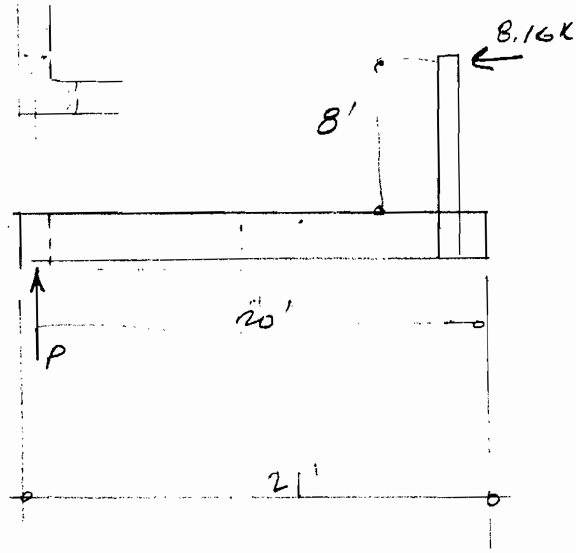
O.T. – LOAD ACTING TOWARD LEFT

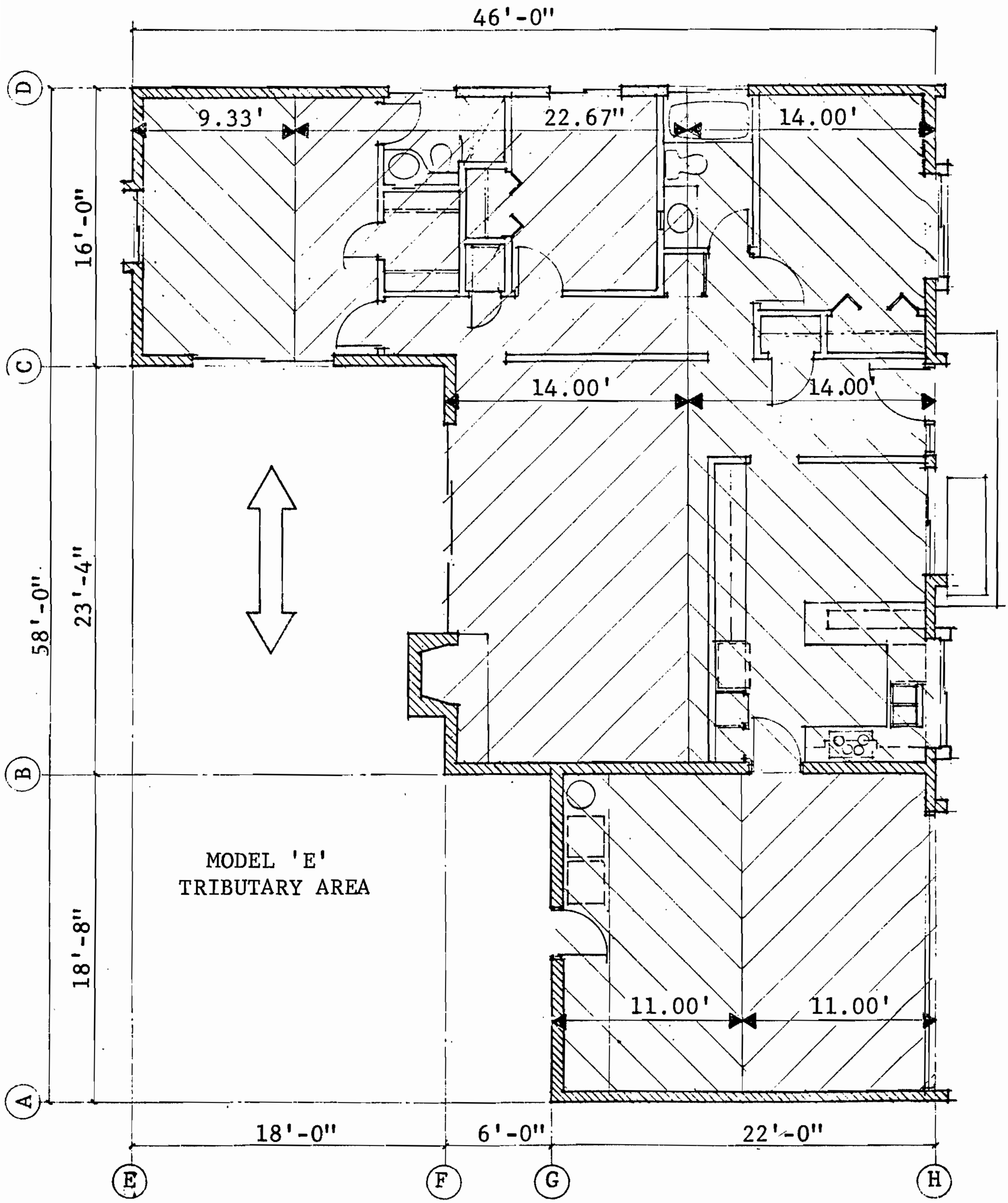
$P = 8(8.16/20) = 3.25^K$

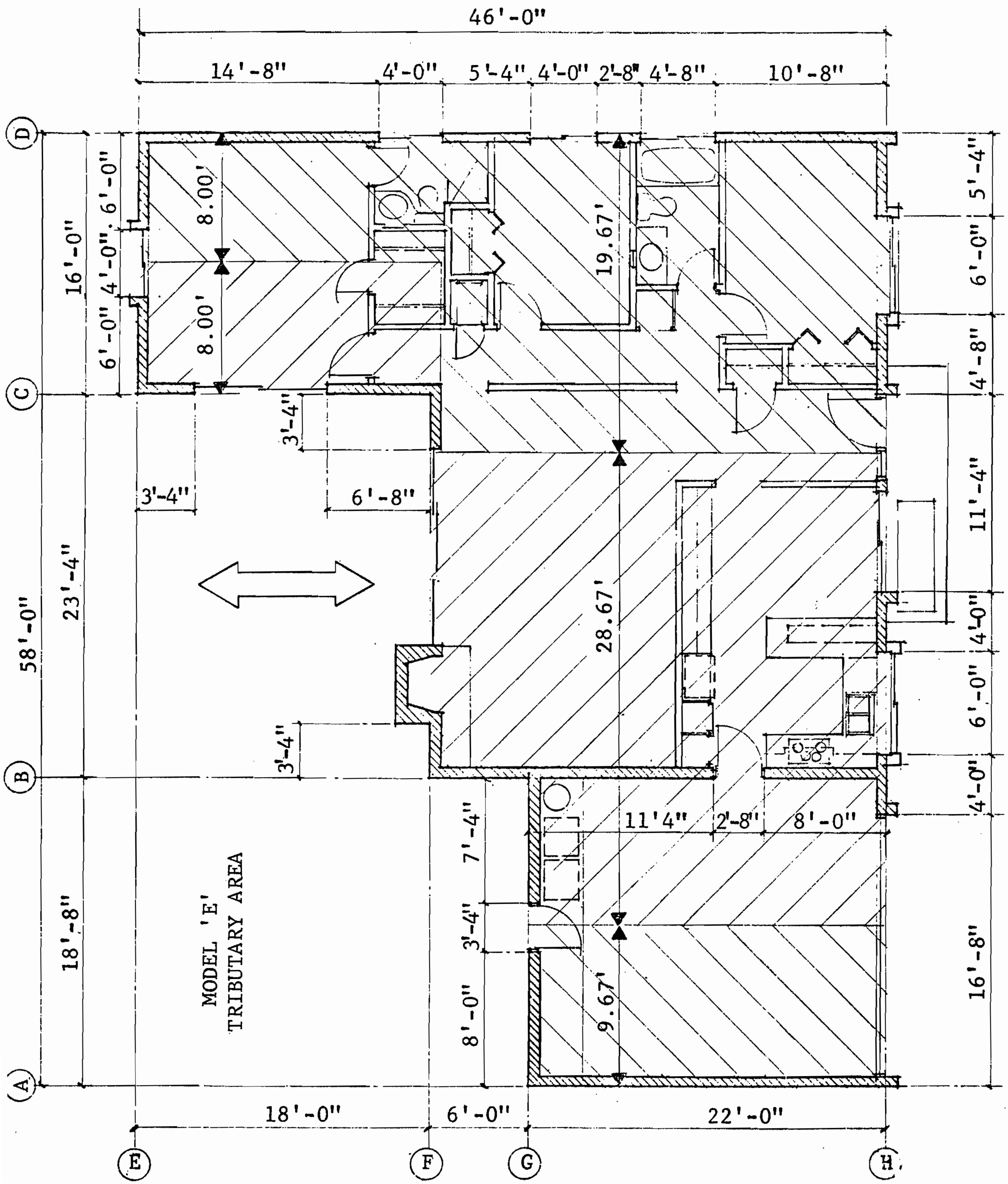
$A = \frac{3250}{1330 - 225} = 3.0'$

(1105)

12" × 3'-0"




46'-0"
9.33'
22.67"
14.00'
14.00'
14.00'
11.00'
11.00'
16'-0"
23'-4"
18'-8"
58'-0"
18'-0"
6'-0"
22'-0"
D
C
B
A
E
F
G
H
MODEL 'E'
TRIBUTARY AREA


MODEL 'E'
TRIBUTARY AREA
46'-0"
14'-8"
4'-0"
5'-4"
4'-0"
2'-8"
4'-8"
10'-8"
16'-0"
6'-0"
4'-0"
6'-0"
58'-0"
23'-4"
18'-8"
5'-4"
6'-0"
4'-8"
11'-4"
4'-0"
6'-0"
4'-0"
16'-8"
8.00'
8.00'
19.67'
28.67'
9.67'
3'-4"
3'-4"
6'-8"
3'-4"
11'4"
2'-8"
8'-0"
7'-4"
3'-4"
8'-0"
18'-0"
6'-0"
22'-0"
A
B
C
D
E
F
G
H

Job: EXAMPLE HOMES Model: 'E'

ONE STORY RESIDENCE - ROOF AND WALL LOADS

Calc Form 1

ROOF	Material	Act.	Seis.	CLG.	Material	Act.	Seis.
Rfg.	DECORATIVE ROCK	6.0	0.800	Frmg.		2.0	0.267
Shtg.	1/2" PLYWOOD SHEATHING	2.0	0.267	Fin.	GYP BD/ ACOUST, FIN	3.0	0.400
Frmg.	TRUSSES	2.0	0.267				
TOTAL		10.0	1.334	TOTAL		5.0	0.667

	EXTERIOR WALLS				INTERIOR WALLS	
	Mat.	Actual	Mat.	Actual	Mat.	Actual
Framing	FURRING	1.0				4.0
Finish	GYP. BD	2.0			GYP. BD	2.0
Finish					" "	2.0
CONC. BLK		46.0				
TOTAL		49.0				8.0

Roof load: 1.334

Veneer load: ______

"Ceiling" load: Clg- 0.667
Ext- 3.675
Int- 0.250

TOTAL 4.592

Job: EXAMPLE HOMES Model: 'E'

TRIBUTARY AREAS

Calc Form 6

	ROOF AREA		CEILING AREA	
LINE	Height x Width	Area	Height x Width	Area
A	26.0 x 11.67	303	22.0 x 9.67	213
B	26.0 x 9.0 +	234	22.0 x 9.0 +	
	32.0 x 14.0	448	28.0 x 12.0	
		682		534
C	20.0 x 10.0	200	18.0 x 8.0	144
D	30.0 x 29.33 +	880	28.0 x 27.33 +	
	20.0 x 10.0	200	18.0 x 8.0	
		1080		909
		2265		1800
E	20.67 x 13.0 +		18.67 x 11.0 +	
	43.33 x 16.0		39.33 x 14.0	
		962		756
F	20.67 x 13.0	269	18.67 x 11.0	205
G	43.33 x 16.0 +		39.33 x 14.0 +	
	20.0 x 6.67		16.0 x 8.67	
		827		689
H	20.0 x 11.33	227	16.0 x 9.33	149
		2285		1799

Job: EXAMPLE HOMES Model: 'E'

SEISMIC LOADS

Calc Form 7

LINE	ROOF AREA	ROOF LOAD	OTHER LOAD	TOTAL RF. LD.	CLG. AREA	CLG. LOAD	TOTAL LOAD
A	303	1.334		____	213	3.675	404 783 1187
B F.P.	682	1.334		910 600 1510	198 336	3.675 4.592	1510 728 1543 3781
C	200	"		____	144	4.592	267 661 928
D	1080	"		____	909	"	1441 4174 5615
E	962	"		____	205 551	3.675 4.592	1283 753 2530 4566
F	269	"		____	205	3.675	359 753 1112
G F.P.	827	"		1103 600 1703	689	4.592	1703 3164 4867
H	227	"		____	149	4.592	303 684 987

Job: EXAMPLE HOMES Model: 'E'

SHEAR WALL DESIGN

Calc Form 8

LINE	LOAD	WALL LENGTH	SHEAR PER FT.	SILL BOLTS	SHEAR MAT.	OVERTURNING
A	1187	22'-8"	52.4			L=22.67' OK
B	3781	25'-4"	149.3			L=17.33' P_{ALL}=5130
C	928	10'-8"	87.0			L=7.33 - 900
						3.33 - 180
						1080 OK
D	5615	34'-0"	165.1			L=46.0' OK
E	4566	18'-0"	253.7			L=16.0 - 4380
						14.0 - 3320
						OK → 7700
F	1112	16'-0"	69.5			L=8.0'
						2x1080=2160 OK
G	4867	7'-4"	663.7			L=4.0'
						2x540 - NG
						2x2600=5200
						12x18 GB - 2-#4
						T&B "d"=11'-0"
H	987	12'-0"	82.3			L=16.0' P_{ALL}=4380

Job: COST ANALYSIS Model: 'E' 15 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT.	OVERTURNING
A	8.0	9.67	15	1160		22.67	OK			OK
B	8.0	9.0	15	1080		17.33	OK			P_{ALL}=5260+ OK
	9.0	19.67	15	2655		8.0				
				3735						
C	5.67	8.0	15	680		7.33	OK			P_{ALL}=900+ OK
						3.33				
D	9.0	19.67	15	2655		14.67 MAX	OK			L=46' OK
E	7.0	9.33	15	980		2@6.0	OK			L=16' OK
F	6.67	14.0	15	1400		2@4-0	OK			2x270=540 NG
	7.0	8.67	15	910						2x2600-OK
				2310						12"x18" LB-2-#4T&B

Job: COST ANALYSIS Model: 'E' 15 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT.	OVERTURNING
G	6.17	11.0	15	1018		2@8.0	OK			2x1080=2160 OK
H	6.67	14.0	15	1400		5-4 MAX	OK			L=16.0' OK

Job: COST ANALYSIS Model: 'E' 25 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT.	OVERTURNING
A	8.0	9.67	25	1934		22.67	OK			OK
B	8.0	9.0	25	1800		17.33	OK			5150
	9.0	19.67	25	4426		8.0				+1080
				6226						6230 OK
C	5.67	8.0	25	1134		7.33	OK			900
						3.33				180
									2x100	1200
										1280 OK
D	9.0	19.67	25	4425		14.67 MAX	OK			L=46' OK
E	7.0	9.33	25	1633		2@6.0	OK			L=6' OK

Job: COST ANALYSIS   Model: 'E' 25 psf WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT.	OVERTURNING
F	6.67	14.0	25	2333		264.0	OK			2x270=540 NG
	7.0	8.67	25	1517						2x2600-OK
				3850						12"x18" GB-2-#4 T&B
G	6.17	11.0	25	1696		268.0	OK			2x1080=2160 OK
H	6.67	14.0	25	2333		533 MAX	OK			L=16.0' OK

Job: COST ANALYSIS Model: 'E' 40 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

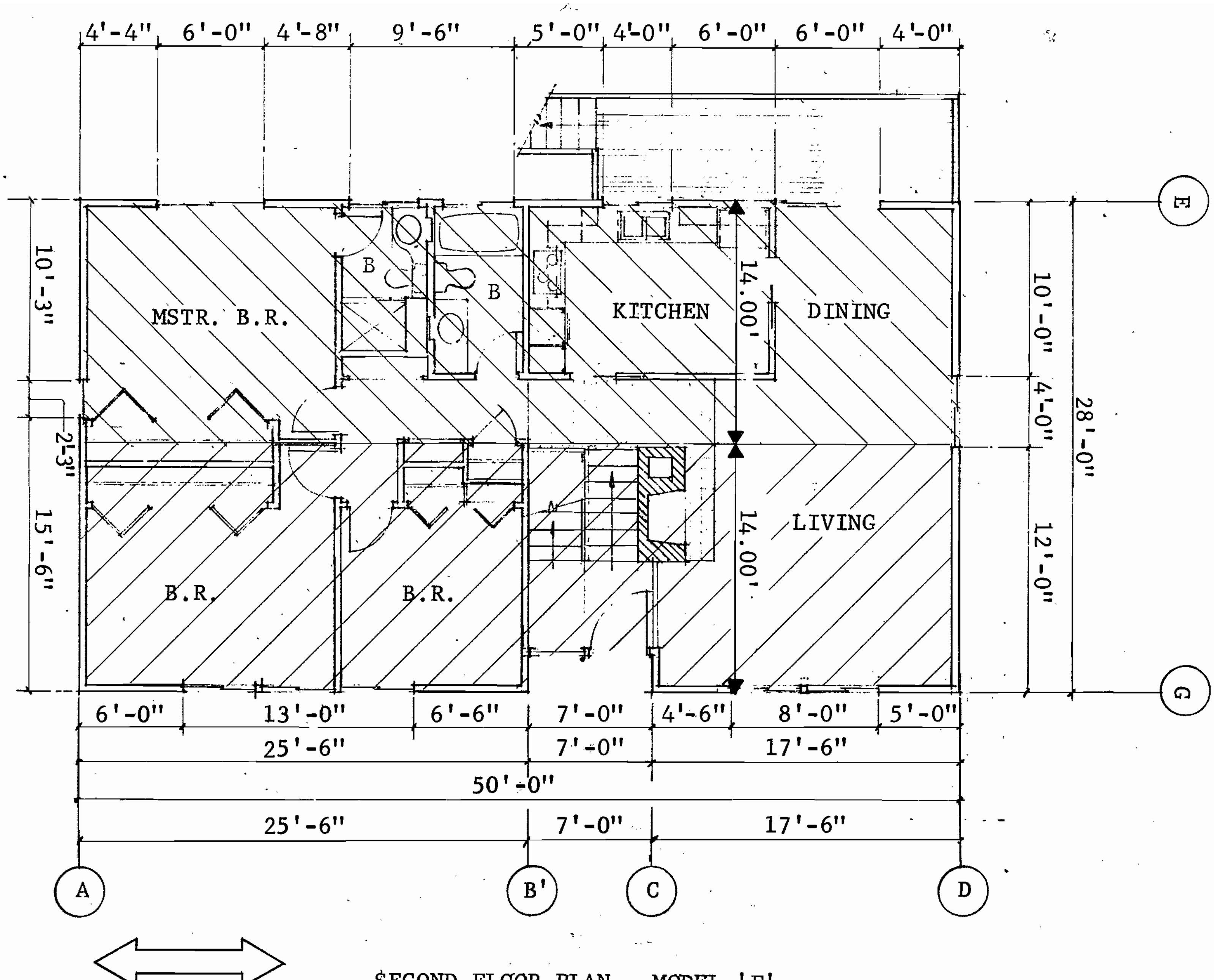
LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT.	OVERTURNING
A	8.0	9.67	40	3093		22.67	OK			OK
B	8.0	9.0	40	2880		17.33	OK			5150
	9.0	19.67	40	7080		8.0				1080
				9960						200
										6430 NG
										GROUT SOLID - OK
C	5.67	8.0	40	1813		7.33	OK			GROUT SOLID OK
						3.33				
D	9.0	19.67	40	7080		14.67 MAX	OK			L=46' OK
E	6.67	14.0	40	3733		2@6.0	OK			L=16' PALL=4400
	7.0	8.67	40	2427						GROUT SOLID. OK
				6160						

Job: COST ANALYSIS Model: 'E' 40 PSF WIND

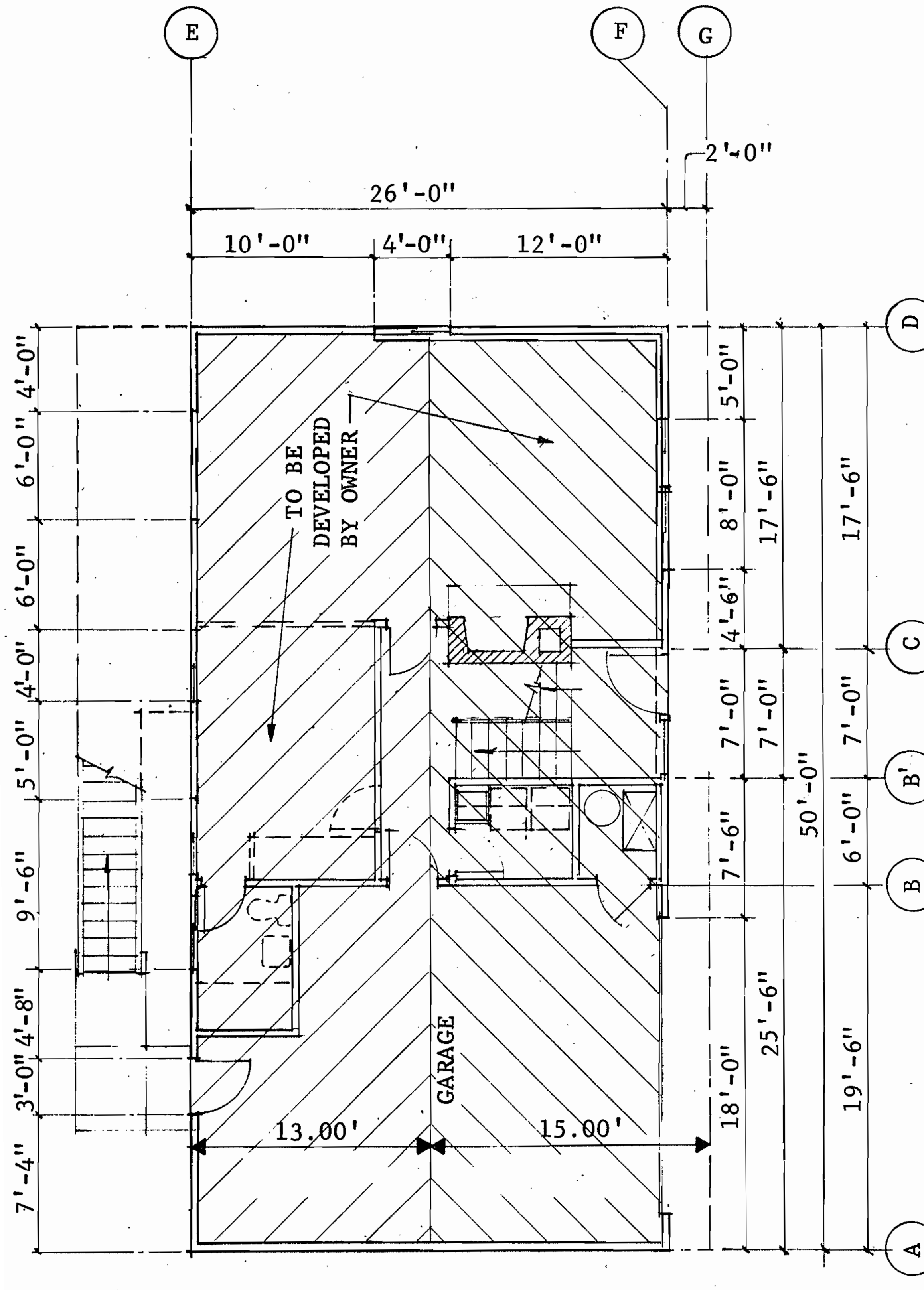
WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9.

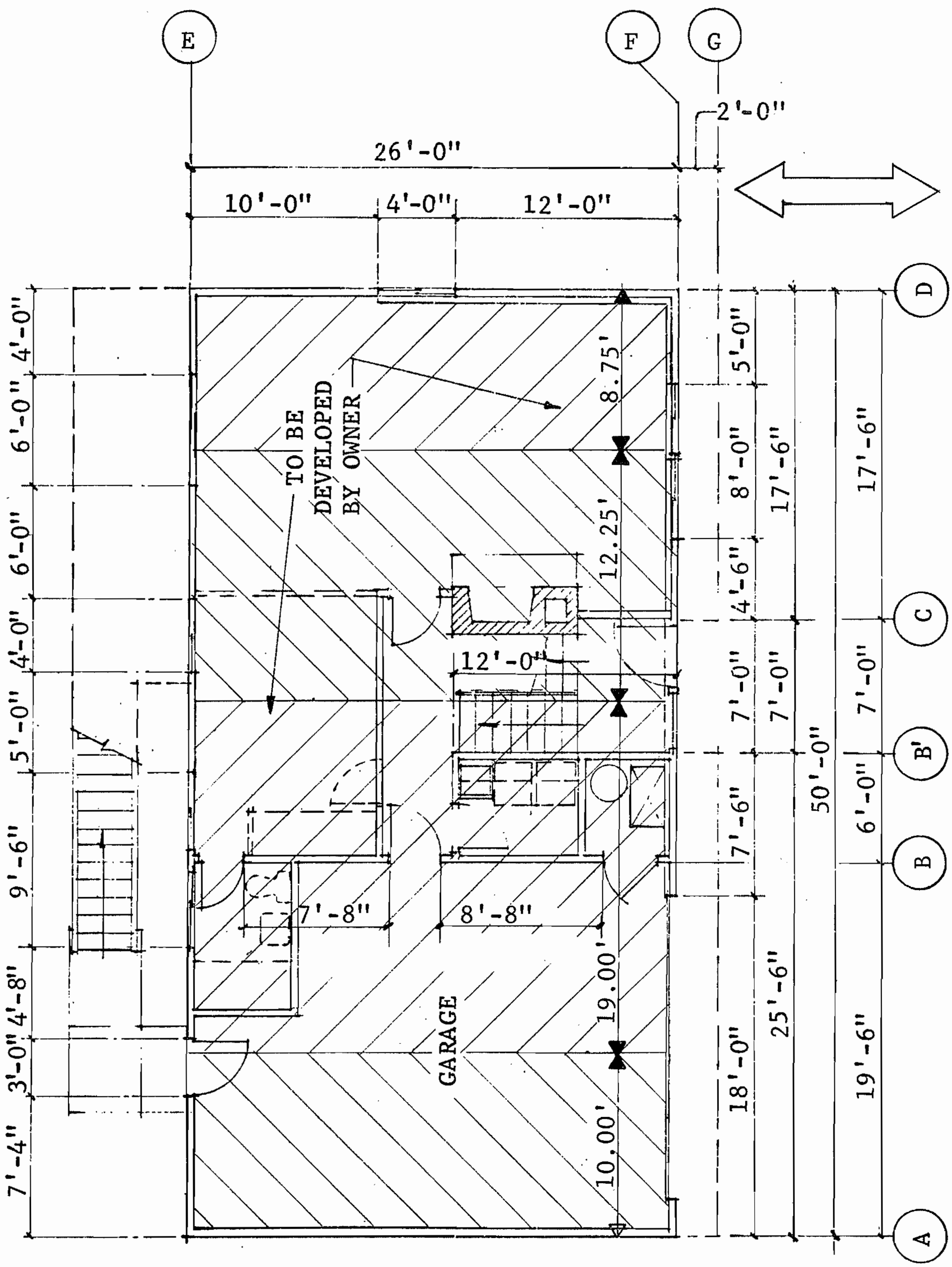
LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT.	OVERTURNING
F	6.67	14.0	40	3733		2@4.0	NG			12"x18" G.B.
	7.0	8.67	40	2427		USE 4.0 #4-B	SOLID GROUT			2-#5 T&B
				6160						
G	6.17	11.0	40	2713		2@8.0	OK			2x1080+200 NG
										2x2340+200 OK
										SOLID GROUT
H	6.67	14.0	40	3733		5.33 MAX	OK			L=16.0' OK



SECOND FLOOR PLAN - MODEL 'F'
TRIBUTARY AREA



FIRST FLOOR PLAN - MODEL 'F'
TRIBUTARY AREA



FIRST FLOOR PLAN - MODEL 'F'
TRIBUTARY AREA

Job: COST ANALYSIS Model: 'E' SEIS ZONE 3

LOADS

Calc Form 2

	Material	Actual	Seismic	Actual	Seismic
ROOF					
Roofing	CONC TILE	16.0	2.133		
Shtg.	1/2" PLYWD	2.0	0.267		
Framing	TRUSSES	2.0	0.267		
TOTAL		20.0	2.667		
CEILING					
Framing	TRUSSES	2.0	0.267		
Finish	LATH & PLASTER	8.0	1.067		
TOTAL		10.0	1.333		
2nd FLOOR		INTERIOR		DECK	
Flooring	CARPET	1.0	0.133	9KLO 3.0	0.400
Shtg.	5/8" PLYWD	2.0	0.267	2.0	0.267
Framing	2x14@	5.0	0.667	4.0	0.533
Ceiling	LATH & PLASTER	8.0	1.067		
TOTAL		16.0	2.133	9.0	1.200

Job: COST ANALYSIS Model: 'F' SEIS. ZONE 3

WALL LOADS

Calc Form 3

EXTERIOR	Mat.	Actual	Mat.	Actual	Mat.	Actual
Framing	WOOD	4.0	WOOD	4.0		
Ext. Fin.	STUCCO	8.0	WOOD SIDING	2.0		
Int. Fin.	LATH & PLASTER	8.0	LATH & PLASTER	8.0		
TOTAL		20.0		14.0		
INTERIOR						
Framing	WOOD	4.0				
Int. Fin.	LATH & PLASTER	8.0				
Int. Fin.	"	8.0				
TOTAL		20.0				

Veneer Load: ____________

TOTAL LD.	ROOF	2ND FLR CLG	2ND		DECK	
Ceiling		1,333	2,133		1,200	
Ext. Walls		1,500	3,000			
Int. Walls		0.500	3.000			
TOTAL	2.667	3.333+	8.133=	11.467	1.200	

Job: COST ANALYSIS Model: 'F' SEIS. ZONE 3

TRIBUTARY AREAS

Calc Form 6

	ROOF AREA		CEILING AREA	
LINE	Height x Width	Area	Height x Width	Area
ROOF:				
A	32x27	864	28x25	700
D	32x27	864	28x25	700
E	16x54	864	14x50	700
G	16x54	864	14x50	700
2ND FLOOR:				
A			10x28	280
B			9.5x28x1.25 + 9.5x28	598.5
C			8.75x28x1.25 + 3.5x28	404
D			8.75x28	245
E			13x50	650
F			15x50	750
PORCH				
C			12.25x6	73.5
D			8.75x6	52.5
E			6x21	126

Job: COST ANALYSIS Model: 'F' SEIS. ZONE 3

SEISMIC LOADS

Calc Form 7

LINE	ROOF AREA	ROOF LOAD	OTHER LOAD	TOTAL RF. LD.	CLG. AREA	CLG. LOAD	TOTAL LOAD
ROOF: A	864	2,667		___	700	3,333	2304 2333 4637
D F.P.	864	"		2304 600 2904	700	"	2904 2333 5237
E	864	"		___	700	"	2304 2333 4637
G F.P.	864	"		2304 600 2904	700	"	2904 2333 5237
2ND FLOOR A				___	280	11.467	2304 3211 5515
B				___	598,5	"	6863 6863
C F.P. PORCH				600 600	404 73,5	" 1,200	600 4633 88 5321
D PORCH				___	245 52,5	11.467 1,200	2904 2809 63 5776

Job: COST ANALYSIS Model: 'F' SEIS ZONE 3

SEISMIC LOADS

Calc Form 7

LINE	ROOF AREA	ROOF LOAD	OTHER LOAD	TOTAL RF. LD.	CLG. AREA	CLG. LOAD	TOTAL LOAD
2ND FLOOR E PORCH					650 126	11.467 1.200	2304 7454 151 9909
F F.P.				2904 600 3504	750	11.467	3504 8600 12104

MODEL 'F'

ROOF:

LINES A & D

$$w = \text{ROOF} - 3 \times 20 = 60$$
$$\text{CLG} - 1 \times 10 = 10$$
$$\text{WALL} - 8 \times 20 = \underline{160}$$
$$230 \#/'$$

LINES E & G

$$w = \text{ROOF} - 16 \times 20 = 320$$
$$\text{CLG} - 14 \times 10 = 140$$
$$\text{WALL} - 8 \times 20 = \underline{160}$$
$$620 \#/'$$

2ND FLOOR

LINE A

$$w = \text{RF LD} - = 230$$
$$\text{2ND} - 10 \times 36 = 360$$
$$\text{WALL} - 8 \times 20 = \underline{160}$$
$$750 \#/'$$

LINE B

$$w_1 = \text{2ND} - 12.5 \times 36 = 450 \qquad w_2 = 17 \times 36 = 612$$
$$\text{WALL} - 8 \times 20 = \underline{160} \qquad \underline{160}$$
$$610 \#/' \qquad 772 \#/'$$

LINE B'

$$w = \text{2ND} - 3 \times 36 = 108$$
$$\text{WALL} - 8 \times 20 = \underline{160}$$
$$268 \#/'$$

MODEL 'F'

2ND FLOOR

LINE C

W=2ND – 8.75×36 = 315
WALL – 8×20 = 160
475#/1

LINE D

W=2ND – 8.25×36 = 297
WALL – 8×20 = 160
457#/1

LINES E & F

W=RF LD – = 620
WALL – 8×20 = 160
780#/1

Job: COST ANALYSIS Model: 'F' SEIS ZONE 3

SHEAR WALL DESIGN

Calc Form 8

LINE	LOAD	WALL LENGTH	SHEAR PER FT.	SILL BOLTS	SHEAR MAT.	OVERTURNING
ROOF					180	
A	4637	25.75	180.1	—	OK	L=28' OK
D	5237	22.0	238.0	—	3/8" ST II 8d@6,12	L=28' OK
E	4637	24.0	193.2	—	3/8" ST II 8d@6,12	L=40' OK
G	5237	22.0	238.0	—	3/8" 5 PLY 8d@4,12	L=25.5' OK
2ND FLOOR						
A	5515	26.0	212.1	1/2@4-0	3/8" ST II 8d@6,12	L=26' OK
					200	
B+B'	6863	28.33	242.3	1/2@3-8	3/8" ST II 8d@6,12	OK
	L=12-0	W=268	268×12² / 2×8	= 2412		
	8.4	610		2864		
	7.8	772		2836		
		3×1000		300		
				8412		
C	5321	12.0	443.4	5/8@3-0	1/2" ST II 10d@4,12	2-BOLT FRMG ANCHS
	w=	475#/'	PALL: 3625+.75	×875=4281		
		U=8/12	(5321-	4281)=	693	
					180	
D	5776	22.0	262.5	L=26 U=222.1 1/2@4-0	3/8" ST II 8d@6,12	L=26' OK
E	9909	27.0	367.0	L=41-0 U=2417 1/2@3-8	3/8" ST II 8d@4,12	L=29' OK
F	12104	17.0	712.0	3/4@2-6	1/2" ST II 10d@2,12	2-BOLT FRMG ANCHS.

Job: COST ANALYSIS Model: 'F' SEIS, ZONE 3

SHEAR WALL DESIGN

Calc Form 8

LINE	LOAD	WALL LENGTH	SHEAR PER FT.	SILL BOLTS	SHEAR MAT.	OVERTURNING
2ND FLOOR						
F(cont)		L=7-6	$\frac{780L^2}{2\times4}$	=5484		
		5-0		2438		
		4-6		1974		
			3×100	300		
				10196		
		$\frac{4}{17}(12104-10196)=448.9$				

Job: COST ANALYSIS . Model: 'F' SEIS ZONE 2

SHEAR WALL DESIGN

Calc Form 8

LINE	LOAD	WALL LENGTH	SHEAR PER FT.	SILL BOLTS	SHEAR MAT.	OVERTURNING
ROOF					180	
A	2319	25.75	90.1	—	OK	L=28' OK
D	2619	22.0	119.0	—	OK	L=28' OK
E	2319	24.0	96.6	—	OK	L=40' OK
G	2619	22.0	119.0	—	OK	L=25.5' OK
2ND FLOOR						
A	2758	26.0	106.1	½@6	OK	L=26' OK
					200	
B&B'	3432	28.33	121.1	½@6	OK	OK - SEE ZONE 3
C	2661	12.0	221.8	½@4.0	3/8" ST II 8d@6,12	OK
	W=	475#/',	PALL=3/	6254.75	x875=	4281
					180	
D	2882	22.0	131.3	½@6	OK	L=26' OK
E	4955	27.0	183.5	L=41.0 W=1209 ½@6	OK	L=29' OK
F	6052	17.0	356.0	½@2-4	3/8" ST II 8d@4,12	OK - SEE ZONE 3

Job: COST ANALYSIS Model: 'E' 15 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 1800	OVERTURNING
ROOF										
A	9.0	25	15	3375		25.75	131.1	—	OK	L=28' OK
D	9.0	25	15	3375		22.0	153.4	—	OK	L=28' OK
E	6.67	14	15	1400		24.0	58.3	—	OK	L=40' OK
									1600	
G	6.67	14	15	1400		22.0	63.6	—	OK	L=25'-6" OK
2ND FLOOR									1800	
A	18.0	10.0	15	2700		26.0	103.8	½@6	OK	L=26' OK
									2100	
B&B'	18.0	19.0	15	5130		28.33	181.1	½@4.9	OK	OK
		SEE	SEIS.	ZONE	3-	PALL=84	12			

Job: COST ANALYSIS Model: 'F' 15 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 200	OVERTURNING
2ND FLOOR										
C	18.0	12.25	15	3308		12.0	275.7	1/2 @ 3-0	3/8" ST II 8d @ 4,12	OK
	W =	475#/'	; P_{ALL} =	8625	+ 0.75 ×	875	= 4281			
									180	
D	18.0	8.75	15	2363		22.0	107.4	1/2 @ 6	OK	L = 26' OK
E	15.67	13.0	15	3055		27.0	113.1	1/2 @ 6	OK	L = 29' OK
F	11.67	15.0	15	2625		17.0	200.3	1/2 @ 4-4	3/8" ST II 8d @ 4,12	OK
	4.0	13.0	15	780						
				3405						
		SEE	SEIS.	ZONE	3 –	P_{ALL} = 10,196				

Job: COST ANALYSIS Model: 'E' 25 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 180	OVERTURNING
ROOF										
A	9.0	25	25	5625		25.75	218.4	—	3/8" ST II 8d@6,12	L=28' P_{ALL}=9750+
D	9.0	25	25	5625		22.0	255.7	—	3/8" ST II 8d@6,12	L=28' OK
E	6.67	14	25	2335		24.0	97.3	—	OK	L=40' OK
									160	
G	6.67	14	25	2335		22.0	106.1	—	OK	L=25.5' OK
2ND FLOOR									180	
A	18.0	10.0	25	4500		26.0	173.1	½@50	OK	L=26' OK
									200	
B & B'	18.0	19.0	25	8550		28.33	301.8	½@26	3/8" ST II 8d@4,12	OK
	SEE SHT. 2	3. P_{ALL}=8412	– 1.6% OVER							

Job: COST ANALYSIS Model: 'F' 25 psf WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 200	OVERTURNING
2ND FLOOR										
C	18.0	12.75	25	5513		12.0	459.4	5/8"@3 [illegible]	1/2" STII [illegible] 4,12	2-DD [illegible]
	w=	475#/1	P_{ALL}= 3625+.075×875=4281							
		U= 8/12 (5513-4281)= 821.33								
									180	
D	18.0	6.75	25	2938		22.0	179.0	L=26' v=151.5 1/2@5.9	OK	L=26' OK
E	15.67	13.0	25	5093		27.0	188.6	L=41.0 v=124.2 1/2@6	OK 4.8 [illegible]	L=29' OK
F	11.67	15.0	25	4376		17.0	333.9	1/2@2-6	5/8" STII [illegible] 4,12	OK-SEE [illegible] 2,3
	4.0	13.0	25	1300						
				5676						

Job: COST ANALYSIS Model: 'F' 40 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 180	OVERTURNING
ROOF										
A	9.0	25	40	9000		25.75	349.5	—	3/8" ST I 8d@4,12	L=28' PALL=9750±
D	9.0	25	40	9000		22.0	409.1	—	1/2" ST II 10d@4,12	L=28' OK
E	6.67	14	40	3733		24.0	155.5	—	OK	L=40' OK
									160	
G	6.67	14	40	3733		22.0	169.7	—	8d@4,12	L=25.5' OK
2ND FLOOR									180	
A	18.0	10.0	40	7200		26.0	276.9	1/2@3.0	3/8" ST II 8d@4,12	L=26' OK
									200	
B&B'	18.0	19.0	40	13680		28.33	482.9	5/8@2.9	3/8" ST II 8d@2½,12	STRAP HD
	SEE	SEIS	2.3 -	P ALL = 8412;	U = 8/28.33	(13680 -	8412) =		148[illegible]	
C	18.0	12.25	40	8820		12.0	735.0	3/4@2'-4"	1/2" ST II 10d@2,12	HD #2
	W =	475#/'	HD#2	8750+0.75	x755 =	[illegible]13160				

Job: COST ANALYSIS Model: 'F' 40 PSF WIND

WIND LOAD AND SHEAR WALL DESIGN

Calc Form 9

LINE	TRIB. HT. (FT.)	TRIB. WDTH. (FT.)	WIND LOAD (PSF)	TOTAL WIND LOAD	TOTAL SEIS. LOAD	WALL LENGTH	SHEAR PER FOOT	SILL BOLTS	SHEAR MAT. 180	OVERTURNING
2ND FLOOR										
D	18.0	8.75	40	6300		22.0	286A	1/2@3.0	3/8" ST II 8d@4,12	L=26' OK
E	15.67	13.0	40	8148		27.0	301.8	1/2@2-9	3/8" ST II 8d@4,12	L=29' OK
F	11.67	15.0	40	7002		17.0	411.8	5/8@3.3	1/2" ST II 10d@4,12	OK-SEE SEIS. 23
	4.0	13.0	40							

APPENDIX C

COST IMPACT ANALYSIS

BASE COSTS

EXCAVATION (FOR CONTINUOUS FTGS. OR GRADE BEAMS)

HAND - \$8.00/YD.

TRENCHER - \$0.50/FT. (12"x12")

CONCRETE (FOR FOOTINGS)

\$30.00/YD. IN PLACE

REINFORCING STEEL

\$0.40/LB IN PLACE

#4 - 0.668 x 0.40 = 0.267/FT

#5 - 1.043 x 0.40 = 0.417/FT

#6 - 1.502 x 0.40 = 0.601/FT

CONCRETE BLOCK

8" UNGROUTED - \$2.17/□'

8" GROUTED AT REINF. - \$2.55/□'

8" SOLID GROUTED - \$2.80/□'

FRAMING LUMBER

2x6 TO 2x12 - \$200 - \$225/1000 BD. FT.

2x4 STUDS - \$164/1000 BD. FT.

3x4 STUDS - \$180/1000 BD. FT.

PLYWOOD

3/8" - \$1.15/1000□'

1/2" - \$144/1000□'

NAILING - ANY SPACING - \$3.50/SHEET

3/8" - $\frac{115}{1000} + \frac{3.50}{32}$ = 0.115 + 0.109 = \$0.224/□'

1/2" - $\frac{144}{1000}$ + 0.109 = 0.144 + 0.109 = \$0.253/□'

BLOCKING

\$0.20/FT - INSTALLED

CARPENTER LABOR (SUB'S COST)

\$16.50/HR.

BASE COSTS

DRYWALL

5d@7 - INSTALLED — $0.26/#1
5d@4 - ADD - $0.005/#1
TACKED AND GLUED - ADD - $0.0025/#1
BLOCKED - ADD - 0.20/8 = $0.025/#1

NAILING

16d - FACE OR TOE - $2.12/100

GUN-BOLTS

$0.225/EA, INSTALLED

FRAMING ANCHORS

$0.075 MAT. + 0.125 LABOR = $0.20/EA

HOLD-DOWN ANCHORS

HD #1 — $12 - $14 EA.
HD #2 — $14 - $16 EA.
HD #3 — $14 - $16 EA.
HD #4 — $16 - $18 EA
STRAP — $5 EA

ANCHOR BOLTS

½"φ x 10" — 0.20 + 0.53 = $0.73
½"φ x 12" — 0.31 + 0.53 = 0.84
5/8"φ x 10" — 0.40 + 0.53 = 0.93
3/4"φ x 10" — 0.58 + 0.53 = 1.11

SCREWING OF KITCHEN CABINETS

SMALL — $3.00/HOUSE
AVERAGE - $4.00/HOUSE
LARGE — $6.00/HOUSE

3x STUDS

8 x 0.180 - 8 x 2/3 x 0.164 = 1.44 - 0.87 = $0.57 EA.

DETAIL COSTS

1A, 1B & 1D

ZONE 3 - 'HEAVY' OR 'LIGHT'

24" O.C. - 1-16d COM = 3-16d BOX/4'

$\frac{3 \times 0.0212}{4} = \$0.0159/\text{FT.}$

ZONE 2 - \$0

2D

ZONES 2 & 3 - HVY OR LTWT.

16d COM @ 16 = 16d BOX @ 10½

$\frac{12}{10.5} \times 0.0212 = \$0.0242/\text{FT.}$

3A AND 3B - 16" O.C. JOISTS

ZONE 3 - 'HEAVY' - SOLE PLATE NLG. $\frac{.0212}{4} = 0.0053$

TOE-NLG. $\frac{3 \times .0212}{1.33} = 0.0477$

\$0.053/FT

ZONE 3 - 'LTWT' - SOLE PLATE NLG. $= 0.0053$

TOE-NLG. $\frac{3 \times .0212}{2.67} = 0.0238$

\$0.0291/FT.

ZONE 2 - \$0

3C, 3D, 4C AND 4D - 16" O.C. JOISTS

ZONE 3 - 'HEAVY' - SOLE PLATE NLG. - $= 0.0053$

FRMG ANCH. - $\frac{0.20}{2} = 0.1000$

\$0.1053/FT.

ZONE 3 - 'LTWT' - SOLE PLATE NLG $= 0.0053$

FRMG. ANCH. - $\frac{0.20}{2.5} = 0.0800$

\$0.0853/FT.

ZONE 2 - FRMG ANCH. - $\frac{0.20}{4} = \$0.050/\text{FT}$

DETAIL COSTS

5A AND 5B - JOISTS @ 16" O.C. (2ND FLR)

ZONE 3 - HVYWT - $\frac{3 \times .0212}{1.33}$ = \$0.0477/FT.

LTWT - $\frac{3 \times .0212}{2.67}$ = \$0.0238/FT.

ZONE 2 - \$0

9 AND 12

2 STUDS - 2 x 0.875 + 0.04 = 1.79

2 BLOCKS - 2 x 0.16 + 2 x 0.25 = 0.82

10 FRMNG ANCHS. - 10 x 0.20 = 2.00

ADD'L LABOR = 0.30

\$4.91 - SAY \$5.00

11

2 STUDS - 2 x 0.875 + 0.04 = 1.79

BLOCK - 0.16 + 0.25 = 0.41

10 FRMNG. ANCHS - 10 x 0.20 = 2.00

2-2' BLOCKS & 1' STRAP - 0.875 + 2.75 = 3.63

\$7.83 - SAY \$8.00

14A - JOISTS @ 16" O.C.

ZONE 3 - HVY WT - SOLE PLATE - $\frac{.0212}{4}$ = 0.0053

TOE-NLG. - $\frac{9 \times .0212}{4}$ = 0.0477

FRMNG. ANCH. - $\frac{.20}{8}$ = 0.0250

\$0.0780/FT.

ZONE 3 - LTWT. - SOLE PLATE = 0.0053

TOE-NLG. $\frac{9 \times .0212}{8}$ = 0.0239

FRMNG ANCH. = 0.0250

\$0.0542/FT.

ZONE 2 - \$0

DETAIL COSTS

14B

ZONE 3 HVYWT- SOLE PLATE = 0.0053

FRMNG ANCH. - .20/2 = 0.1000

$0.1053/FT

ZONE 3 LTWT- SOLE PLATE = 0.0053

FRMNG ANCH. .20/2.5 = 0.0800

$0.0853/FT.

ZONE 2- TOE-NLG. -.0212 x 12/8 x 1.5 = $0.0477/FT.

15A AND 15B

DOWELS - 0.267 x 1.67 = 0.446

LABOR - 16.50/30 = 0.55

8)0.996

$0.125/FT

ALTERNATE- $374/1500 = $0.25/FT

15C

MILLED KEY- $943/1500' = $0.629/FT

2x4 FRMNG LUMBER - LABOR- $0.15/FT

16A - JOISTS @ 16" o.c.

ZONE 2 - ADD'L TOE-NAILS - 2x.0212/1.33 = 0.0318

3/4" Φ A BOLTS @ 4' - 1.11/4 = 0.2775

0.3093

-1/2" Φ A BOLTS @ 6' - .73/6 = 0.1217

$0.188/FT

ZONE 3-LTWT- SOLE PLATE .0212/4 = 0.0053

TOE-NAILS 3x.0212/2.67 = 0.0238

$0.217/FT

DETAIL COSTS

16B - JOISTS @ 16" O.C.

2x BLKG (2x12) - 2x0.225x2x1.33 = 1.20

LADDER - 8x.0212 = 0.1696

BOLT = 0.38

2 FRMG ANCHS. - 2x0.20 = 0.40

4) 2.15

ZONE 2 ——— 0.5375/FT

0.0053

ZONE 3 ——— 0.5428/FT.

16C AND 16D

3x SILL $\frac{8}{12}$ x 0.200 = 0.1333

BOLT. 0.2775-0.1217 = 0.1558

16C AND ZONE 2-16D #0.2891

0.0053

16D-ZONE 3 - #0.2944 /FT

24 - CORNER CONN ONLY

2-½"⌀x12" A BOLTS - 2x0.84 = 1.68

FRMG ANCHS. - 8x0.20 = 1.60

#3.28/EA.

26

1 BO H.D. - ½"x12" A BOLT - 0.84

1 FRMG ANCH - 0.20

1.04 /EA.

2 BO H.D. - ADD'L FRMG ANCH. - 0.20

1.24/EA

DETAIL COSTS

28

12x18 GRADE BEAM

EXCAVATION - $\frac{0.5}{27}$ x 8.00 = 0.148

CONCRETE - $\frac{0.5}{27}$ x 30.00 = 0.556

\#0.704/FT.

\#4 - 2x0.267 + 0.704 = \#1.238/FT.

2-\#4 - 4x0.267 + " = 1.772/FT.

\#5 - 2x0.417 + " = 1.538/FT.

2-\#5 - 4x0.417 + " = 2.372/FT.

2-\#6 - 4x0.601 + " = 3.108/FT.

18x24 GRADE BEAM

EXCAVATION - $\frac{2.0}{27}$ x 8.00 = 0.593

CONCRETE - $\frac{2.0}{27}$ x 30.00 = 2.222

\# 2.815/FT.

2-\#5 - 4x0.417 + 2.815 = \#4.483/FT.

2-\#6 - 4x0.601 + " = 5.219/FT.

2-\#8 - 4x2.67x.40 + " = 7.087/FT.

53A AND 53C

ZONE 3 - TOE-NAILS $\frac{3 \times 0.0212}{4}$ = \#0.0159/FT.

ZONE 2 - \#0

55B

ZONE 3 - BLOCKING - 6x0.20 = 1.20

STRAP = 0.44

NAILING - 8x0.0212 = 0.17

LABOR $\frac{5}{60}$ x 16.50 = 1.38

GYP. NLG. = 0.21

ENG. ARCH. = 0.20

4) 3.60

0.90

TOE-NLG - $\frac{0.0212}{1.33}$ = 0.0159

\#0.916/FT

ZONE 2 - $\frac{0.90}{2}$ + 0.0159 = \#0.466/FT

CALC SHEETS

IMPACT OF REINFORCING

SPECIAL GARAGE DETAILS etc.

MODEL 'A'	DET.	QUANT.	UNIT COST		COST	
FLOOR PLAN						
WATER HEATER	49	1	9	50	9	50
CABINETS	50	1	3	00	3	00
INTERIOR WALLS	—	3813 □'		—	—	—
FRONT ELEV. & ROOF						
ROOF FRAMING	.10	135'	0	0159	2	15
	20	70'	0	0242	1	69
	56	27'		—	—	—
CHORD SPLICE	22	205'		—	—	—
VENEER	—	92 □'		—	—	—
FOUNDATION PLAN						
CONT. FTG.	158	209'	0	15	31	35
INT WALL CONN.	20	NO ADD'L	0	225	3	60
CORNER CONN'S	24	5	3	28	16	40
BASE COST					67	69
ZONE 3						
BASE COST					67	69
1800 H.D.	26	2	1	04	2	08
TOTAL					69	77
15 PSF WIND						
BASE COST					67	69
2800 H.D.	26	6	1	24	7	44
ADD'L SILL BOLTS	—	0			—	—
					75	13
LESS: ROOF FRAMING	.10				2	15
TOTAL					72	98

MODEL 'A'	DET.	QUANT.	UNIT COST		COST	
15 PSF WIND-1.5xO.T.						
BASE COST					67	69
STRAP H.D.	25	6	5	00	30	00
#4 REINF.	25	111'	0	267	29	64
280 H.D.	26	2	1	24	2	48
180 H.D.	26	3	1	04	3	12
TOTAL					132	93
25 PSF WIND						
BASE COST					67	69
STRAP H.D.	25	6	5	00	30	00
#4 REINF.	25	111'	0	267	29	64
180 H.D.	26	5	1	04	5	20
SPECIAL NLG.-PLYWD	—	152 LF		—	—	—
SPECIAL NLG.-GYP. BD.	—	503 LF	0	005	2	52
ADD'L SILL BOLTS	—	3	0	73	2	19
TOTAL					137	24
25 PSF WIND-1.5xO.T.						
BASE COST					67	69
H.D. #2	34B	2	16	00	32	00
H.D. #1	34A	4	14	00	56	00
280 H.D.	26	5	1	24	6	20
12x18GB-1-#4T&B	28	40.83'	1	238	50	55
12x18GB-1-#5T&B	28	23.0'	1	538	35	37
SPECIAL NLG.-PLYWD	—	152 LF		—	—	—
SUB-TOTAL					247	81

MODEL 'A'	DET.	QUANT.	UNIT COST		COST	
25 PSF WIND-1.5xO.T.						
SUB-TOTAL					247	81
SPECIAL NLG-CMP. BD	—	503□'	0	005	2	52
ADD'L SILL BOLTS	—	3	0	73	2	19
TOTAL					252	52
40 PSF WIND						
BASE COST					67	69
H.D. #2	34B	2	16	00	32	00
H.D. #1	34A	10	14	00	140	00
12x18GB-1-#4T&B	28	79.33'	1	238	98	21
12x18GB-1-#5T&B	28	23'	1	538	35	37
SPECIAL NLG-PLYWD	—	1014□'	—		—	–
ADD'L ½" PLYWD-10d@4	—	324□'	0	253	81	97
ADD'L SILL BOLTS	—	8	0	73	5	84
3x STUDS	—	12	0	57	6	84
					467	92
LESS-CORNER COLUMN	24	1	3	28	3	28
					464	64
40 PSF WIND-1.5xO.T						
BASE COST					67	69
H.D. #3	34C	6	16	00	96	00
H.D. #1	34A	6	14	00	84	00
12x18GB-1-#4T&B	28	94.33'	1	238	116	78
12x18GB-2-#5T&B	28	20.0'	2	372	47	44
SUB-TOTAL					411	91

MODEL 'A'	DET.	QUANT.	UNIT COST		COST	
40 PSF WIND - 1.5×O.T						
SUB-TOTAL					411	91
SPECIAL NLG. - PLYWD	—	1014□'		—	—	—
ADD'L ½" PLYWD - 10d@4	—	324□'	0	253	81	97
ADD'L SILL BOLTS	—	8	0	72	5	84
3x STUDS	—	12	0	57	6	84
					506	56
LESS - CORNER CONN.	24	1	3	28	3	28
					503	28

MODEL 'A-1'	DET.	QUANT.	UNIT COST		COST	
FLOOR & ROOF PLANS - ELEV.						
SEE MODEL 'A'	—				16	34
INTERIOR WALLS	—	4075□'		—	—	—
FOUNDATION PLAN						
CONT. FTG.	15B	65.5'	0	15	9	83
CORNER CONNS.	24	5	3	28	16	40
BASEMENT WALL	16A	95'	0	188	17	86
	16B	42'	0	42	17	64
	16C	27'	0	289	7	80
					85	87
ZONES 2 & 3						
NO ADD'L DETAILS					85	87

MODEL 'A-1'	DET	QUANT.	UNIT COST		COST	
15 PSF WIND						
BASE COST					85	87
WITH WINDOW-LINE C						
2 BO H.D.	26	4	1	24	4	96
ADD'L SILL BOLTS	—	0				
TOTAL					90	83
WITH SLIDING DOOR						
1 BO H.D.	26	3	1	04	3	12
TOTAL					93	95
25 PSF WIND						
BASE COST					85	87
STRAP H.D.	25	4	5	00	20	00
ADD'L SILL BOLTS	—	3	0	73	2	19
1 BO H.D.	26	5	1	04	5	20
SPECIAL NLG-GYP. BD.	—	503#'	0	005	2	52
#4 REINF.	25	79'	0	267	21	09
W/WINDOW - TOTAL					136	87
1 BO H.D.	26	3	1	04	3	12
W/DOOR - TOTAL					139	99
40 PSF WIND						
BASE COST					85	87
H.D. #1	34A	10	14	00	140	00
12x18 GB-1-#4T&B	28	26.67'	1	238	33	02
SPECIAL NLG-PLYWD	—	1138#'		—	—	—
SUB-TOTAL					258	89

MODEL 'A-1'	DET.	QUANT.	UNIT COST		COST	
40 psf WIND						
Sub-Total					258	89
Add'l 1/2" Plywd	—	292□'	0	253	73	88
Add'l Sill Bolts	—	8	0	73	5	84
					338	61
Less-Corner Coun.	24	1	3	28	3	28
W/ Window- TOTAL					335	33
Strap H.D.	25	4	5	00	20	00
#4 Reinf.	25	50'	0	267	13	35
					368	68
Less-Corner Coun	24	1	3	28	3	28
W/Door- TOTAL					365	40

MODEL 'B'	DET	QUANT.	UNIT COST		COST	
FLOOR PLANS						
WATER HTR.	49	1	9	50	9	50
CABINETS	50A	1	4	00	4	00
CHORD SPLICES	22	322'		—	—	—
INT. SHEAR WALL	15A	19'	0	0238	0	45
RIDGE TIE	9	1	5	00	5	00
INT. WALLS	—	5066#'		—	—	—
ELEVATIONS						
ROOF FRAMING	1A	114'	0	0159	1	81
	2C	80'		—	—	—
2ND FLR. FRMG.	13B	72'	0	0291	2	10
	13D	56'	0	0853	4	78
VENEER	—	232#'		—	—	—
FOUNDATION						
CONT. FTG.	15B	209.67'	0	250	52	42
INT. WALL CONN.	20	4 ADD'L	0	225	—	90
CORNER CONNS.	24	8	3	28	26	24
FRMG. ANCHS. @ SILL	24	20	0	20	4	00
BASE COST					111	20
ZONE 3						
BASE COST					111	20
2 BO H.D.'s	26	1	1	24	1	24
1/2" GYP. BD.-5d@4	—	144#'	0	26	37	44
SPECIAL NLG.-GYP. BD.	—	104#'	0	005	0	52
ADD'L SILL BOLTS	—	3	0	73	2	19
TOTAL					152	59

MODEL 'B'	DET.	QUANT.	UNIT COST	COST
ZONE 2				
BASE COST	111.20-0.45-1.81-2.10-1.98			104 86
1800 H.D.	26	1	1 04	1 04
TOTAL				105 90
15 PSF WIND				
BASE COST				104 86
STRAP H.D.	25	2	5 00	10 00
#4 REINF.	25	32'	0 267	8 54
2800 H.D.	26	1	1 24	1 24
3/8" PLYWD.-8d@4,12	—	148□'	0 224	33 15
ADD'L SILL BOLTS	—	5	0 73	3 65
				161 44
LESS CORNER COLS	24	1	3 28	3 28
TOTAL				158 16
25 PSF WIND				
BASE COST				111 20
H.D. #2	34B	2	16 00	32 00
H.D. #1	34A	1	14 00	14 00
12x18GA.-1-#5T&B	28	38.67'	1 538	59 47
3/8" PLYWD.-8d@2½,12	—	148□'	0 224	33 15
3x STUDS	—	4	0 57	2 28
½" PLYWD.-10d@4,12	—	32□'	0 253	8 10
3/8" PLYWD.-8d@4,12	—	376□'	0 224	84 22
5/8" SILL BOLTS	—	22	0 20	4 40
				348 82

MODEL 'B'	DET.	QUANT.	UNIT COST		COST	
25 PSF WIND						
SUB-TOTAL					348	82
LESS-1/2" SILL BOLTS	—	16	0	73	11	68
-CORNER COLU	24	1	3	28	3	28
TOTAL					333	86
40 PSF WIND						
2ND FLOOR					111	20
1/2" PLYWD-10d@6,12	—	588□'	0	253	148	76
1 BO H.D.	26	4	1	04	4	16
1ST FLOOR						
H.D. #4	34D	2	18	00	36	00
H.D. #8	34C	1	16	00	16	00
STRAP H.D.	25	6	5	00	30	00
#4 REINF.	25	146'	0	267	38	98
2 BO H.D.	26	1	1	24	1	24
1 BO H.D.	26	2	1	04	2	08
18x24 GB-2-#5T&B	28	43.5'	2	372	103	18
3/8" PLYWD.-8d@2½,12	—	423□'	0	224	94	75
3x STUDS	—	10	0	57	5	70
3/8" PLYWD-8d@6,12	—	270□'	0	224	60	48
3/8" PLYWD.-8d@4,12	—	64□'	0	224	14	34
1/2" PLYWD-10d@4,12	—	422.5□'	0	253	106	89
SILL BOLTS-5/8"	—	12	0	93	11	16
-3/4"	—	25	1	11	27	75
SUB-TOTAL					812	67

MODEL 'B'	DET.	QUANT.	UNIT COST		COST	
40 PSF WIND						
SUB-TOTAL					812	67
LESS-½" SILL BOLTS	—	21	0	73	15	33
-CORNER CONNS.	24	3	3	28	9	84
TOTAL					787	50

MODEL 'B-1'	DET.	QUANT.	UNIT COST		COST	
FLOOR PLANS						
WATER HTR	49	1	9	50	9	50
CABINETS	50A	1	4	00	4	00
CHORD SPLICES	22	322'		—	—	—
INT. SHEAR WALL	5A	19'	0	0238	0	45
RIDGE TIE	9	1	5	00	5	00
INTERIOR WALLS	—	5072□'		—	—	—
ELEVATIONS						
ROOF FRAMING	1A	114'	0	0159	1	81
	2C	80'		—	—	—
2ND FLR. FRAMING	3B	72'	0	0291	2	10
	3D	56'	0	0853	4	78
VENEER	—	232□'		—	—	—
FOUNDATION						
CONT. FTGS.	15B	209.67'	0	250	52	42
INT. WALL CONN.	20	4 ADD'L	0	225	0	90
CORNER CONNS.	24	8	3	28	26	24
FRMG ANCHS & SILL	24	23	0	20	4	60
BASE COST					111	80

MODEL 'B-1'	DET.	QUANT.	UNIT COST		COST	
ZONE 3						
Base Cost					111	80
280 H.D.	26	1	1	24	1	24
5/8" Plywd-Bd@6,12	—	214□'	0	224	47	94
Spec. Nlg.-Gyp. Bd.	—	205□'	0	005	1	03
Add'l Sill Bolts	—	1	0	73	0	73
TOTAL					162	74
ZONE 2 —	111.80-0.45-1.81-2.10-1.98				105	46
15 psf WIND						
Base Cost					105	46
Strap H.D.	25	2	5	00	10	00
#4 Reinf.	25	32'	0	267	8	54
5/8" Plywd-Bd@4,12	—	214□'	0	224	47	94
Gyp Bd-5d@4	—	187□'	0	26	48	62
Spec. Nlg. Gyp. Bd.	—	205□'	0	005	1	03
Add'l Sill Bolts	—	2	0	73	1	46
					223	05
Less: Corner Conn	24	1	3	28	3	28
TOTAL					219	77
25 psf WIND						
Base Cost					111	80
H.D. #2	34B	2	16	00	32	00
Strap H.D.	25	3	5	00	15	00
#4 Reinf.	—	59'	0	267	15	75
					174	55

MODEL 'B-1'	DET.	QUANT.	UNIT COST		COST	
25 PSF WIND						
SUB-TOTAL					174	55
12x18 G.B.-1-#5T&B	28	23'	1	538	35	37
1/2" PLYWD.-10d@4,12	—	32 □'	0	253	8	10
3/8" PLYWD-8d@2 1/2,12	—	465 □'	0	224	104	16
3x STUDS	—	7	0	57	3	99
3/8" PLYWD-8d@4,12	—	152 □'	0	224	34	05
ADD'L SILL BOLTS	—	13	0	73	9	49
5/8" SILL BOLTS	—	7	0	93	6	51
					376	22
LESS: 1/2" SILL BOLTS	—	6	0	73	4	38
CORNER CONNS.	24	2	3	28	6	56
TOTAL					365	28
40 PSF WIND						
BASE COST					111	80
HD#4	34D	2	18	00	36	00
HD#1	34A	3	14	00	42	00
STRAP H.D.	25	6	5	00	30	00
#4 REINF.	25	146'	0	267	38	98
280 H.D.	26	1	1	24	1	24
18x24 G.B.2-#5T&B	28	26'	4	483	116	56
12x18 G.B.-1-#4T&B	28	28.42'	1	238	35	18
3/8" PLYWD.-8d@6,12	—	503	0	224	112	67
3/8" PLYWD-8d4,12	—	64	0	224	14	34
SUB-TOTAL					538	77

MODEL 'B-1'	DET.	QUANT.	UNIT COST		COST.	
40 PSF WIND						
SUB-TOTAL					538	77
3/8" PLYWD-8d@2½,12	—	152	0	224	34	05
½" PLYWD-10d@4,12	—	214	0	253	54	14
½" PLYWD-10d@2½,12	—	264	0	253	66	79
3x STUDS	—	9	0	57	5	13
SILL BOLTS-5/8"	—	20	0	93	18	60
3/4"	—	14	1	11	15	54
SUB-TOTAL					733	02
LESS-½" SILL BOLTS	—	19	0	73	13	87
-CORNER COLUMNS	—	4	3	28	13	12
					706	03

MODELS 'C', 'C-1' & 'C-2'	DET.	QUANT.	UNIT COST		COST	
FLOOR PLANS						
WATER HEATER	49	1	9	50	9	50
CABINETS	50	1	6	00	6	00
INT. SHEAR WALL	5B	21'	0	0238	0	50
INT. WALLS	—	586.5'		—	—	—
2ND FLR. FRMG.	3B	96'	0	0291	2	79
	3D	42'	0	0853	3	58
ROOF PLAN						
ROOF FRAMING	1D	158'	0	0159	2	51
	2D	68'	0	0242	1	65
CHORD SPLICES	22	364'		—	—	—
SPLIT-LEVEL TIES	9	1	5	00	5	00
	11	2	8	00	16	00
	12	2	5	00	10	00
FOUNDATION						
CORNER CONNS.	24	9	.3	28	29	52
FRMG. ANCH. @ SILL	24	24	0	20	4	80
SUB-TOTAL					91	85
'C'						
CONT. FTGS.	16A	62'	0	217	13	45
	16B	32'	0	538	17	21
	15C	90'	0	15	13	50
	16D	20'	0	25	5	00
	18	28'		—	—	—
INT WALL CONNS.	20	3 ADD'L	0	225	0	68
BASE COST 'C'					141	69

MODELS 'C', 'C-1' & 'C-2'	DET.	QUANT.	UNIT COST	COST
C-1				
CONT. FTGS.	15C	139'	0.15	20.85
	17	26'	—	—
	18	67'	—	—
INT. WALL CONNS	20	7 ADD'L	0.225	1.58
BASE COST-'C-1'				114.28
C-2				
CONT. FTGS.	14A	62'	0.0542	3.36
	14B	52'	0.0853	4.44
	15C	98.5'	0.15	14.78
	17	6'	—	—
	18	13.5'	—	—
INT WALL CONNS.	20	3 ADD'L	0.225	0.68
BASE COST-'C-2'				115.11
ZONE 3-'C'				
HD#3	34C	2	16.00	32.00
STRAP H.D.	25	4	5.00	20.00
#4 REINF.	25	66'	0.267	17.62
2 BO H.D.	26	2	1.24	2.48
12x18GB-2-#6T&B	28	35.75'	3.108	111.11
3/8" PLYWD-8d@2½,12	—	32□'	0.224	7.17
SPEC. NLG-GYP BD.	—	325□'	0.005	1.63
5/8" SILL BOLTS	—	2	0.93	1.86
SUB-TOTAL				193.87

MODELS 'C', 'C-1' & 'C-2'	DET	QUANT.	UNIT COST		COST	
ZONE 3 - 'C'						
SUB-TOTAL					193	87
LESS - 1/2" SILL BOLTS	—	2	0	73	1	46
- CORNER CONNS	24	1	3	28	3	28
SUB-TOTAL					189	13
BASE COST - 'C'					141	69
TOTAL - 'C'					330	82
ZONE 3 - 'C-1'						
BASE COST					114	28
SUB-TOTAL - 'C'					189	13
					303	41
LESS - 2 BO H.D.	26	2	1	24	2	48
TOTAL - 'C-1'					300	93
ZONE 3 - 'C-2'						
BASE COST					115	11
SUB-TOTAL - 'C'					189	13
TOTAL - 'C-2'					304	24
ZONE 2 - 'C'						
STRAP H.D.	25	2	5	00	10	00
#4 REINF.	25	32'	0	267	8	54
1BO H.D.	26	4	1	04	4	16
5/8" PLYWD. Edg@12	—	32 LF	0	224	7	17
					29	87
LESS - CORNER CONN	24	1	3	28	3	28
SUB-TOTAL					26	59

MODELS 'C','C-1' & 'C-2'	DET	QUANT.	UNIT COST		COST	
ZONE 2 - 'C'						
BASE COST	141.69-0.50-2.79-1.48-2.51				99	90
SUB-TOTAL	-16.00-4.80-13.45-0.16 -0.10				26	59
TOTAL-'C'					126	49
ZONE 2-'C-1'						
BASE COST	114.28-0.50-2.79-1.48-2.51				86	20
SUB-TOTAL	-12.00-4.80				26	59
TOTAL-'C-1'					112	79
ZONE 2 - 'C-2'						
BASE COST	115.11-0.50-2.79-1.48-2.51				81	71
SUB-TOTAL	-16.00-4.80-3.36-1.96				26	59
TOTAL-'C-2'					108	30
15 PSF WIND- 'C'						
2ND FLOOR						
3/8" PLYWD-Edge 6,12	—	168□'	0	224	37	63
1ST FLOOR						
H.D. #4	34D	2	18	00	36	00
H.D. #1	34A	4	14	00	56	00
STRAP H.D.	25	4	5	00	20	00
#4 REINF.	25	66'	0	267	17	62
12x18GB-1-#4T&B	28	27.67'	1	238	34	26
18x24GB-2-#5T&B	28	26.5'	4	483	118	80
3/8" PLYWD-Edge 6,12	—	141□'	0	267	37	65
3/8" PLYWD-Edge 4,12	—	232□'	0	267	61	94
SUB-TOTAL					419	90

MODELS 'C', 'C-1' & 'C-2'	DET.	QUANT.	UNIT COST		COST	
15 PSF WIND - 'C'						
SUB-TOTAL					419	90
3/4"φ SILL BOLTS	—	2	1	11	2	22
ADD'L SILL BOLTS	—	3	0	73	2	19
					424	31
LESS - 1/2" SILL BOLTS	—	2	0	73	1	46
- CORNER CONNS	24	3	3	28	9	84
TOTAL LESS BASE					413	01
BASE COST					99	90
TOTAL - 'C'					512	91
15 PSF WIND - 'C-1'						
TOTAL LESS BASE 'C'					413	01
1800 H.D.	26	2	1	04	2	08
CORNER CONNS	24	2	3	28	6	56
					421	65
LESS - STRAP H.D	25	4	5	00	20	00
- #4 REINF	25	66'	0	267	17	62
					384	03
BASE COST					86	20
TOTAL - 'C-1'					470	23
15 PSF WIND - 'C-2'						
TOTAL LESS BASE - 'C'					413	01
BASE COST					81	71
TOTAL - 'C-2'					494	72

MODEL 'E'	DET.	QUANT.	UNIT COST		COST	
FLOOR PLAN						
WATER HEATER	49	1	9	50	9	50
CABINETS	50	1	3	00	3	00
INTERIOR WALLS	—	2108[01]		—	—	—
ROOF PLAN						
ROOF FRAMING	53A	136'	0	0159	2	16
	55B	66'	0	9166	60	46
FOUNDATION						
CONT FTG.	60	202'		—	—	—
INT WALL CONN.	20	16 ADD'L	0	225	3	60
BASE COST					78	72
15 & 25 PSF WIND-S.2½ 2 & 3						
12x16 G.B.-2-#4 T & B	29 & 30	44.33'	1	238	54	88
BASE COST					78	72
TOTAL					133	60
40 PSF WIND						
12x16 G B. 2-#5 T & B	29 & 30	49'	2	372	116	23
GROUT WALL SOLID		649[01]	0	25	162	25
BASE COST					78	72
TOTAL					357	20

MODEL 'F'	DET.	QUANT.	UNIT COST		COST	
FLOOR PLANS						
WATER HEATER	49	1	9	50	9	50
CABINETS	50	1	4	00	4	00
INT. SHEAR WALLS	3A	53'	0	0477	2	53
FLOOR FRAMING	3A	56'	0	0530	2	97
	3C	57'	0	1053	6	00
	4C	43'	0	1053	4	53
INTERIOR WALLS	—	5639□'		—	—	—
ROOF PLAN						
ROOF FRAMING	1D	100'	0	0159	1	59
	2D	56'	0	0242	1	36
CHORD SPLICE	22	312'		—	—	—
FOUNDATION						
CONT. FTG.	15C	104'		15	15	60
	18	48'		—	—	—
INT. WALL CONN.	20	7 ADD'L	0	225	1	58
CORNER CONNS.	24	4	3	28	13	12
BASE COST					62	78
ZONE 3						
2ND FLOOR						
3/8" PLYWD-8d@6,12	—	604□'	0	224	135	30
3/8" PLYWD-8d@4,12	—	292□'	0	224	65	41
1ST FLOOR						
2BD H.D.	26	6	1	24	7	44
1/2" PLYWD-10d@2,12	—	68□'	0	253	17	20
SUB-TOTAL					225	35

MODEL 'F'	DET.	QUANT.	UNIT COST		COST	
ZONE 3						
SUB-TOTAL					225	35
3x STUDS	—	3	0	57	1	71
1/2" PLYWD - 10d @ 4, 12	—	96 □'	0	253	24	29
3/8" PLYWD. 8d @ 6, 12	—	656 □'	0	224	146	94
3/8" PLYWD. 8d @ 4, 12	—	380 □'	0	224	85	12
3/4" SILL BOLTS	—	9	1	11	9	99
5/8" SILL BOLTS	—	5	0	93	4	65
ADD'L SILL BOLTS	—	8	0	73	5	84
					503	89
LESS - 1/2" SILL BOLTS	—	9	0	73	6	57
BASE COST					62	78
TOTAL					560	10
ZONE 2						
BASE COST	62.78 - 2.53 - 2.97 - 5.53 - 1.59				50	16
GYP. BD. - 5d @ 4 U	—	96 □'	0	265	25	44
ADD'L NLG. - GYP. BD.	—	96 □'	0	005	0	48
3/8" PLYWD - 8d @ 4, 12	—	68 □'	0	224	15	23
ADD'L SILL BOLTS	—	4	0	73	2	92
TOTAL					94	23
15 PSF WIND						
BASE COST					50	16
GYP. BD. - 5d @ 4 B	—	96 □'	0	29	27	84
ADD'L NLG. - GYP. BD.	—	96 □'	0	005	0	48
SUB-TOTAL					78	48

MODEL 'E'	DET.	QUANT.	UNIT COST		COST	
15 PSF WIND						
SUB-TOTAL					78	48
3/8" PLYWD-8d@6,12	—	68□'	0	224	15	23
ADD'L SILL BOLTS	—	5	0	73	3	65
TOTAL					97	36
25 PSF WIND						
2ND FLOOR						
3/8" PLYWD-8d@6,12	—	448□'	0	224	100	35
1ST FLOOR						
2BO H.D.	26	2	1	24	2	48
1/2" PLYWD-10d@4,12	—	96□'	0	253	24	29
3/8" PLYWD-8d@4,12	—	372□'	0	224	83	33
5/8 SILL BOLTS	—	5	0	93	4	65
ADD'L SILL BOLTS	—	6	0	73	4	38
BASE COST					62	78
TOTAL					282	26
40 PSF WIND						
BASE COST					62	78
2ND FLOOR						
1/2" PLYWD-10d@4,12	—	224□'	0	253	56	67
3/8" PLYWD-8d@4,12	—	516□'	0	224	115	58
1ST FLOOR						
H.D. #2	348	2	16	00	32	00
STRAP H.D.	25	6	5	00	30	00
SUB-TOTAL					297	03

MODEL 'F'	DET.	QUANT.	UNIT COST	COST
40 PSF WIND				
SUB-TOTAL				297.03
#4 REINF	—	94'	0.267	25.10
ADD'L 12"x12" FTG	—	3.0#	1.41	4.23
12"x18" G.B., 2-#6 T&B	28	42'	3.108	130.54
1/2" PLYWD-10d@2,12	—	96□'	0.253	24.29
1/2" PLYWD-10d@4,12	—	68□'	0.253	17.20
3/8" PLYWD-8d@2½,12	—	304□'	0.224	68.10
3x STUDS	—	8	0.57	4.56
3/8" PLYWD-8d@4,12	—	732□'	0.224	163.97
3/4" SILL BOLTS	—	6	1.11	6.66
5/8" SILL BOLTS	—	20	0.93	18.60
ADD'L SILL BOLTS	—	14	0.73	10.22
				770.50
LESS-1/2" SILL BOLTS	—	17	0.73	12.41
TOTAL				758.09

IMPACT OF REINFORCING MASONRY FIREPLACES

H_T = 8'-4" + 5'-0" = 13'-4"

REINFORCING

#4 - 4 x 16.5 = 66.0
2 x 7.0 = 14.0
80.0 FT x 0.668 #/' = 53.4

#3 - 6 x 6.0 = 36.0
2 x 12.0 = 24.0
60.0 FT. x 0.167 #/' = 10.0
63.4#

EXCAVATION - $\frac{5 \times 0.5}{27}$ x 8.00 = 0.74
CONCRETE - $\frac{2.5}{27}$ x 30.00 = 2.78
REINFORCING - 63.4 x 0.40 = 25.36
STRAP TIES - 2 x 12.20 = 24.40
$53.48

SPECIAL GARAGE FRONT WALL DETAILS

ONE STORY

PLYWD - 16#' x 0.253 = 4.05
3/16" STRAPS - 2 x 2.45 = 4.90
3/4"ϕ M.B.'s - 9 x 0.66 = 5.94
LABOR - 20 MIN - 16.50/3 = 5.50
20.39 x 2 SIDES = $40.78

TWO STORY

PLYWD - 32#' x 0.270 = 8.64
5/8"ϕ A BOLTS - 2(0.93 - 0.73) = 0.40
3/16" Π STRAP - = 7.00
3/4"ϕ M.B.'s - 6 x 0.66 = 3.96
LABOR - 20 MIN - 16.50/3 = 5.50
25.50 x 2 = $51.00

INTERIOR WALL FINISHES — SURFACE AREA

MODEL 'A'

LINE B –	26.83 (8.0 + 10.67)	= 501
C –	18 × 8 + 27 × 2 × 8 – 8 × 6.67 × $\frac{1}{2}$	= 549
D –	45 × 8	= 360
E –	(37 – 5/2) 8	= 276
F –	22.33 × 8 – 1/2 × 14.5 × 6.67	= 406
G –	14.5 × 8	= 116
KITCHEN –	(17 + 12) 8 × 2	= 464
B.R. & BATHS –	(60 (E-W) + 39) × 8 × 2 – (4+5) 6.67 × 2/2	= 1524
		4190

4190 × .91 = 3813 □'

MODEL 'A-1'

B –		= 501
C –		= 556
D + E + G –		= 752
F –		= 406
KITCHEN –	43.5 × 8 × 2	= 696
B.R.S & BATHS –	(60 + 40) 8 × 2 – (4 + 6) 6.67 × 1/2	= 1567
		4478

4478 × .91 = 4075 □'

INTERIOR WALL FINISHES - SURFACE AREA

MODEL 'B'

2^{ND} FLR.

EXT - 125.33 × 8 = 1003
E-W - (78 × 8 - 24 × 6.67 × ½) 2 = 1088
N-S - 75 × 8 × 2 = 1200

3291

1^{ST} FLR.

EXT - 125.33 × 8 - 24 × 6.67 × ½ - 5 × 4 × ½ = 913
E-W - 32 × 8 × 2 = 512
N-S - 54 × 8 × 2 - 4 × 6.67 × ½ = 851

5567

5567 × .91 = 5066 □'

MODEL 'B-1'

2^{ND} FLR. = 3291

1^{ST}. FLR.

EXT - 125.33 × 8 - 22 × 6.67 × ½ - 5 × 4½ × ½ = 920
E-W - = 512
N-S = 851

5574

5574 × .91 = 5072 □'

INTERIOR WALL FINISHES SURFACE AREA

MODEL 'C'

2ND FLR.

EXT	135.33 x 8	= 1083
N-S	61 x 8 x 2	= 976
E-W	94 x 8 x 2 − 27.33 x 6.67 x 2/2	= 1322
		3381

1ST FLR.

A	20.33 x 8 − 8 x 6.67 x 1/2	= 136
C	20.33 x 8 x 2	= 325
E	4 x 8	= 32
G	42 x 8 + 13.5 x 8	= 444
H	47 x 8	= 376
INT	30 x 8 x 2	= 480
		1793

MID - LEVEL

EXT	86.33 x 8 − 18 x 6.67 x 1/2 − 5 x 4 x 1/2	= 621
INT	36.5 x 8 x 2	= 584
		1205

3381 + 1793 + 1205 = 6379

6379 x .91 = 5805 □'

MODEL 'E' - 40 psf WIND
AREA OF SOLID GROUTED WALL

LINE	B	10.667 × 27.33 − 2.67 × 6.67 = 291.56 − 17.78	= 273.78
	C	9.33 × 8	= 74.67
	E	16 × 8 − 4 × 4.67 = 128 − 18.67	= 109.33
	F	8 × 8	= 64.00
	G	18.67 × 8 − 3.33 × 6.67 = 149.33 − 22.22	= 127.11
			648.89

INTERIOR WALL FINISHES – SURFACE AREA

MODEL 'E'

N-S

E-W – 77 × 8 × 2 – 5 × 6.67 × 2/2 = 1199

N-S 71.5 × 8 × 2 – 4 × 6.67 × 2/2 = 1117

2316

2316 × .91 = 2108□'

MODEL 'F'

2ND FLR.

EXT – 153.33 × 8 – 13 × 6.67 × 1/2 = 1183

N-S – 84 × 8 × 2 = 1344

E-W 86 × 8 × 2 – 26 × 6.67 × 1/2 = 1289

3816

1ST FLR

EXT – 106 × 8 + 36.33 × 4 – 6 × 6.67 × 1/2 = 973

N-S 57.5 × 8 × 2 = 920

E-W 30.5 × 8 × 2 = 488

2381

3816 + 2381 = 6197

6197 × .91 = 5639□'

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