

FOUNDATION CONSTRUCTION DRAWING NOTES FOR RESIDENTIAL AND OTHER LOW-RISE STRUCTURES

by
The Structural Committee
of
The Foundation Performance Association
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PREFACE

This document was written by the Structural Committee and has been peer reviewed by the Foundation Performance Association (FPA). This document is published as FPA-SC-15 Revision 0 and is made available to the public at www.foundationperformance.org. To ensure this document remains as current as possible, it may be periodically updated under the same document number but with higher revision numbers such as 1, 2, etc.

The Structural Committee is a permanent committee of the Foundation Performance Association. At the time of writing this document, Ron Kelm chaired the Structural Committee and during this period approximately 25 to 35 members were active on the committee. In September 2005, the committee sanctioned this paper and formed a subcommittee to write the document. The subcommittee chair and members are listed on the cover sheet of this document. The scope of the subcommittee evolved the following year such that in October 2006 a second subcommittee (FPA-SC-09) was sanctioned by the committee to address the design contract portion of this subcommittee's original scope.

Suggestions for improvement of this document shall be directed to the current chair of the Structural Committee. If sufficient comments are received to generate interest in a new revision, the committee will form a new subcommittee to revise this document. If the revised document successfully passes FPA peer review, it will be published on the FPA website and supersede the previous revision.

The intended audiences for the use of this document are engineers and others that may be involved in foundation engineering services in the State of Texas.

This document was created with generously donated time in an effort to assist engineers in providing foundation construction drawing notes for residential and other low-rise structures. In addition to the committee member companies, the committee wishes to acknowledge the generous contribution of the following companies: C&C Engineering, Inc., TSG Consultants, and Clark Engineers, Inc.

The Foundation Performance Association and its members make no warranty regarding the accuracy of the information contained herein and will not be liable for any damages, including consequential damages, resulting from the use of this document. Each project should be investigated for its individual characteristics to permit appropriate application of the material contained herein. Please refer to the website at www.foundationperformance.org for other information pertaining to this publication and other FPA publications.

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1.0 INTRODUCTION

The purpose of this document is to provide guidelines that an engineer may use in preparation of construction drawing notes and specifications for foundations of residential and other low-rise building projects. This document includes suggested notes related to foundation design and is separated into sections.

Section 2 is titled “General Notes” general notes and provides drawing notes that this committee believes are applicable to various aspects related to foundation design such as codes and ordinances, geotechnical report, design loads, foundation maintenance, etc. Section 3 is titled “Foundation Notes” foundation notes and is separated into subsections for foundation design assumptions, site notes, concrete notes, conventional reinforcement notes, drilled piers, structurally isolated concrete foundations, helical pilings, post tensioning, basements, and Harris County flood plain notes. Within these sections are highlighted areas that the design engineer is required to complete or remove for project specific details such as design loads, geotechnical report number, reinforcing size, etc. The design engineer is responsible to review the applicability of the notes contained herein for each specific project.

2.0 GENERAL NOTES

1. **Codes and Ordinances:** Construction shall conform to the latest edition of the International Code Council documents, including, but not limited to, the International Building Code and the International Residential Code (if applicable), all applicable codes and ordinances, drawings, and manufacturers' recommended installation and other specifications. In the event of a discrepancy between the plans / specifications and applicable codes and ordinances the more stringent provision shall apply. All referenced standards, manuals and publications referenced herein shall be the latest edition.
2. **Design Codes:** This foundation is designed in accordance with, but not limited to, the latest editions of the International Building Code and the International Residential Code (if applicable) and other applicable codes and standards.
3. **Geotechnical Report:** The contractor shall be familiar with the geotechnical report. If a conflict occurs between these notes / specifications and the geotechnical engineer's recommendations, then the more stringent shall apply.
4. **Permits:** Owner or owner's designated representative shall obtain all required permits.
5. **Drawings Scope:** These drawings are intended to show only structural foundation plans and details. See appropriate drawings from other disciplines such as architectural, mechanical, plumbing, electrical and civil for the design, location and size of drops, openings, sleeves, driveways, patios, pools, etc.

6. **Verify Dimensions:** Contractor shall verify all dimensions, drops, slopes, and details of these drawings with those of the architectural design plans, and contractor shall report discrepancies to engineer in writing and architect/designer prior to the start of construction.
7. **Grade Beam Depths:** Grade beam depths shown in the plans, sections, details or schedules are the minimum depths required for the design structural integrity for this foundation. The actual constructed depth may be more in order to satisfy the geometry of the site and foundation as well as other standards, details, notes and specifications. The grade beam depth is defined as the vertical dimension from the top of the slab to the bottom of beam trench unless otherwise noted.
8. **Contractor Field Verification:** During construction the contractor may encounter existing conditions that were unknown during design and vary from the plans. The contractor shall notify the engineer in writing prior to proceeding with the work of all discoveries that interfere with proper execution of the work and/or jeopardize the structural integrity of the structure.
9. **Additional Details:** If contractor requires additional details or information not found on the drawings or in the specifications, contractor shall request this information from engineer in writing **prior** to the start of construction.
10. **Requested Change:** Any requested modification to these drawings and/or specifications shall be submitted to engineer in writing. Contractor shall not proceed with requested modifications unless engineer approves requested modifications in writing.
11. **Revised Information:** These drawings are based on certain assumptions and the engineer reserves the right to revise these documents if other information becomes available.
12. **Design Loads:** Select design loads are noted below:

Wind speed 3 second gust (MPH): _____			
Exposure: _____			
Live loads (PSF):		Dead Loads (PSF):	
Attic	_____	Roof (Tile, Composition, etc.)	_____
Stair	_____	Ceiling	_____
Floor	_____	Floor	_____
Garage Floor	_____		
Balcony	_____		
Roof	_____		

13. **Construction Review:** Construction review services by the engineer of record are available prior to concrete placement, during the concrete placement and during and subsequent to the stressing of the post-tensioning strands, if applicable. If the engineer of record does not perform these construction reviews, then the engineer of record accepts no responsibility for improper implementation of the plans and specifications.

14. **Roof drainage:** Dwellings shall have a controlled method of water disposal from roofs that will collect and discharge roof drainage to the ground surface at least 5 feet from foundation walls or to a subsurface drainage system.
15. **Final Grade Survey:** In order to assure positive drainage away from the foundation, a licensed land surveyor shall perform a final grade survey prior to occupancy. Drainage elevations and direction should be noted on the document.
16. **Structural Stability During Construction:** The drawings illustrate the completed structure with all elements in their final positions, properly supported and braced. The contractor shall be responsible for all construction means and methods. The contractor, in the proper sequence, shall provide proper shoring and bracing as necessary during construction to achieve the final completed structure.
17. **Limitations:** The client will inform owner of the limitations and stipulations placed herein. The client will inform owner to advise subsequent owners of the limitations and stipulations placed herein.

3.0 FOUNDATION NOTES

3.1 FOUNDATION DESIGN ASSUMPTIONS

1. **Geotechnical Report:** This foundation design is based on the recommendations in geotechnical report no. [REDACTED] by [REDACTED] dated [REDACTED]. In designing the foundation for the proposed structure, the foundation design engineer does not assume responsibility for the accuracy of the geotechnical engineer's report or any information contained therein. Information contained in the above referenced geotechnical report(s) reflects conditions as found at the location of the borings. Actual conditions at locations between and surrounding the borings may differ from the soil stratigraphy depicted by the borings. If there are any conditions differing from those described in the geotechnical report, or if any changes have been imposed on the soils in question since the report was written, then the design engineer of record should be notified in writing prior to construction of the foundation in order to review the effects on the performance of the designed foundation.
2. **Geotechnical Engineer Review:** The contractor will provide the foundation plans to the geotechnical engineer for review to ensure compliance with the geotechnical report.
3. **Abnormal Conditions:** If the foundation is installed during a dry or wet period, which is considered extreme or abnormal, then builder shall notify the engineer prior to construction for a possible re-design.
4. **Brick Veneer:** The builder will locate expansion joints in brick veneer at [REDACTED] feet maximum. Expansion joint fillers will be compressible so the anticipated movement of the masonry can occur without imposing stress.
5. **Foundation Movement:** The foundation has been designed with the assumption that movement can be tolerated within the allowables of the latest revision of document

No. FPA-SC-13, “Guidelines for the Evaluation of Foundation Movement for Residential and Other Low-Rise Buildings”, available on the Foundation Performance Association's website: www.foundationperformance.org.

6. **Grading:** Grading is completed as outlined in the site notes section.
7. **Site Slope:** This site slopes less than 1 vertical to 4 horizontal prior to or after construction.
8. **Soil Moisture Level:** A reasonably uniform soil moisture level is maintained around the foundation for the life of the structure.
9. **Foundation Maintenance:** Positive drainage away from the structure is maintained for the life of the structure and the contractor shall convey this requirement to the owner. The initial and all subsequent owners maintain the foundation in accordance with the latest revision of document no. FPA-SC-07, “Foundation Maintenance and Inspection Guide for Residential and Other Low-Rise Buildings”, available on the Foundation Performance Association's website: www.foundationperformance.org. Contractor shall provide this document to owner.
10. **Expiration:** Plans are valid for one year from the date the plans are issued or revised by the engineer. Contact engineer for review if plans have expired or if construction of the foundation has not commenced within this time frame.

3.2 SITE NOTES

1. **Site Preparation:**
 - a) Site preparation and foundation support are to be provided as specified in the soils investigation report or as noted herein, whichever is more stringent.
 - b) Site grading and drainage around the foundation shall be maintained at all times during construction in such a manner that surface or ground water will not collect around or within the footprint of the foundation. This is critical during the period immediately after concrete placement and prior to tendon stressing (if applicable). If unusual amounts of water continue to appear on the site, the geotechnical engineer should be contacted for corrective action.
2. **Fill**
 - a) Existing fill shall be replaced in accordance with the geotechnical report.
 - b) The geotechnical engineer shall approve any fill consisting of onsite soils.
 - c) Select fill (also called “structural fill”) shall be in accordance with the geotechnical report.
 - d) Field density tests are required for the subgrade below the fill and each lift including, but not limited to, flatwork areas such as driveways and patios.
 - e) Fill required adjacent to the footprint of the foundation or any flatwork shall be compacted to the same specifications required within the footprint of the foundation and for a horizontal distance of 3 feet for every foot that the finished floor concrete elevation is above existing grade.

- f) Fill required elsewhere on the lot shall be in accordance with the geotechnical report.
 - g) There shall be a minimum of 6" clearance between the top of the foundation and/or brick ledge and final grading, including landscaping.
 - h) Soil removed from grade beam trenches may not be used as part of the pad fill in the foundation area. Dispose of grade beam excavated soil by compacting it outside the forms or remove it from the site.
3. **Contractor Familiar with Geotechnical Report:** Prior to start of construction, contractor shall be familiar with the site and the geotechnical engineering report. During construction, contractor shall have in contractor's possession a final copy of the geotechnical engineering report and shall conform to all applicable requirements in the geotechnical engineering report. Should the contractor become aware of site conditions that are inconsistent with the geotechnical report, the geotechnical engineer should be consulted before work proceeds, such as but not be limited to, an inconsistent pocket of soil, unexpected source of ground water, abandoned septic tank, old garbage pit, etc.
 4. **Contractor Notification of Engineer Cut / Fill:** Unless otherwise noted on the drawings or in the geotechnical report, contractor shall notify the engineer if more than 2 feet of cut or fill is required within the footprint of the foundation.
 5. **Trees:** The soils at this site could be expansive. Remove existing tree trunks/roots and replace with compacted fill having the same properties as surrounding soils. If trees or high density brush are removed, contractor shall follow guidelines for pad preparation outlined by the soils engineer. **The soils at this site are expansive. Trees should not be planted closer than 20 feet to the foundation. If trees are located within 20 feet of the foundation, a root barrier shall be installed.**
 6. **Site Drainage Plan:** A site drainage plan showing positive drainage away from the foundation and lot shall be provided and contractor shall install drainage in accordance with the site drainage plan.
 7. **Site Grading:** Surface water shall be directed away from the foundation at a minimum slope of 5% within 10 feet of foundation. No ponding of surface water shall be allowed within 10 feet of the foundation before, during, or after construction.
 8. **Perimeter Grade Beams:** Perimeter grade beams shall be embedded the minimum depth shown in the geotechnical report or the foundation plans, whichever is greater, but in no case shall perimeter grade beams be embedded less than 12" below the final grade. Unless otherwise addressed in the plans, the engineer shall be notified prior to construction of the foundation if the site topography is such that any perimeter grade beams will have more than 24" exposure above final grade.
 9. **Solid Rock:** If solid rock is encountered during trenching operation, grade beam depth may be reduced to 12" minimum. Bottom of beams must be founded minimum 1" into solid rock. Weathered and fractured shale is not considered solid rock and must be penetrated to full beam depth or to solid rock below.
 10. **Leveling Sand:** A maximum of 2" of sand for leveling may be placed directly beneath the slab and vapor retarder, where applicable.

11. **Grade Beam Drainage:** During construction a drainage trench shall be formed such that any water that intrudes into the foundation make up will drain out of the bottom of the beams.
12. **Utility Service Lines:** Underground utility services that run parallel to the foundation shall not be located closer than 5 feet from the foundation.

3.3 CONCRETE NOTES

1. **Compressive Strength:** All concrete shall have a minimum 28-day compressive strength of [REDACTED] psi and be tested per ASTM C-39 specification with a [REDACTED]" to [REDACTED]" slump for the slab and a [REDACTED]" to [REDACTED]" slump for the piers. Compressive strength for basement walls shall have a minimum 28-day compressive strength of [REDACTED] psi and be tested per ASTM C-39 specification with a [REDACTED]" to [REDACTED]" slump.
2. **Aggregate Size:** Maximum aggregate size shall be 1 ½".
3. **Concrete Placement:** All mixing, transportation, placing, and curing of concrete shall comply with ACI-318, current edition. Do not place concrete less than two days prior to a freeze unless protective measures are taken. Concrete shall be placed when temperatures are at a minimum of forty degrees Fahrenheit (40°F) and rising unless protective measures are taken as specified by the concrete supplier. If ambient temperatures will reach above sixty degrees Fahrenheit (60°F), the entire slab surface shall be additionally cured by keeping it wet for a minimum of 72 hours, commencing the morning after concrete placement.
4. **Concrete Temperature:** In no case will the placement of concrete having a temperature in excess of ninety degrees Fahrenheit (90°F) be permitted.
5. **Calcium Chloride and Fly Ash:** Calcium chloride or admixtures containing calcium chloride shall not be used as additives. Where fly ash is used, only type C fly ash shall be accepted.
6. **Air Entrainment:** In areas subject to freezing conditions, concrete shall be designed accordingly using air entrainment or other appropriate methods.
7. **Vibration:** Concrete shall be mechanically vibrated in exterior and interior grade beams, particularly around tendon anchorages and in deep excavations. A minimum of two operable mechanical vibrators shall be onsite prior to pour.
8. **Vapor Retarder:** A minimum 6-mil thick polyethylene vapor retarder sheeting shall be placed directly below the concrete; lap joints a minimum of 6" and seal with duct tape or other tape approved for such use by its manufacturer. Vapor retarder shall extend to the perimeter formwork and preferably extend 2 feet beyond the perimeter of the foundation. Clear or translucent sheeting is preferred over opaque material.
9. **Continuous Pour:** Concrete shall be placed in a continuous pour, unless otherwise approved by engineer in writing. In no case shall adjacent concrete be placed more than 30 minutes apart in order to prevent the formation of a cold joint. If an unplanned delay and possible cold joint occurs for any reason, vibrate the fresh concrete and contact the engineer promptly for instructions on how to proceed.

10. **Adding Water:** Maximum water added to concrete at the jobsite, without written permission from the concrete supplier, is 1½ gallons per cubic yard of concrete. Concrete tickets showing time of mix, time of delivery, yards delivered and total water added shall be collected from each driver and retained by contractor.
11. **Pre-Fabricated Fireplaces:** Slab shall be thickened to [redacted]" below pre-fabricated fireplaces and provide # [redacted] reinforcement at [redacted]" on center each way extending a minimum of 50 bar diameters into adjacent slab area.
12. **Foundation Drops:** Foundation drops (locations and elevation changes) shown on the plans have been determined by others such as the architect, designer, contractor or owner (*not* by the foundation engineer) and shall be confirmed by the contractor.
13. **Penetrations:** Piping and electrical shall be under the slab and all penetrations through grade beams shall be sleeved. For slab on grade foundations, trenches for plumbing shall not be located both directly under and parallel to grade beams. Under slab plumbing shall be located between grade beams and cross under or through grade beams. Where plumbing penetrates from under the foundation into the adjacent grade, the area around the plumbing shall be sealed with a clay plug (or equal) that will prevent moisture from migrating under the foundation. In the event of trench sloughing or other events that cause a beam to exceed the planned width, the sleeve must be lengthened so that it will perform as intended during the actual pour to prevent concrete from entering the ends of the sleeve or coming into contact with the sleeved component.
14. **Anchor Bolts:** Anchor bolts shall be a minimum of [redacted]" diameter x [redacted]" long J-bolt or approved equal, minimum two J-bolts per sole (bottom) plate per ASTM F-1554 Grade 55 with [redacted] washers with nuts and shall be embedded a minimum of [redacted]" into concrete. Anchor bolts shall be spaced a maximum of 4'-0" o.c. and located within 12" from the ends of each plate section. Anchor bolts shall not be placed in doorways. **Anchor bolts shall be coated in accordance with the pressure treated wood manufacturer's recommendations.**
15. **Hold-Down and Other Anchorages:** In post-tensioned foundations, all hold-downs and other anchorages shall be cast-in-place. Contractor shall ensure that hold-downs and other anchorages shall not interfere with concrete reinforcement.
16. **Shrinkage Cracks:** This foundation may sustain normal temperature and shrinkage cracks as a result of the concrete curing process.
17. **Control Joints:** Contact engineer in writing prior to placement of concrete for a revised foundation design if crack control joints are desired.
18. **Non-Shrink Grout:** Non-shrink grout shall be Medco "Metal Grout" or equal. The grout shall be according to the Army Corps of Engineers' CRD-621 and ASTM C-109 with a 28-day compressive strength of 7200 psi (fluid) to 10,500 psi (plastic).

3.4 CONVENTIONAL REINFORCEMENT NOTES

1. **Grade:** #3 rebar and smaller shall conform to ASTM A615 Grade 40 or higher, and #4 rebar and larger shall conform to ASTM A615 Grade 60 or higher and shall be detailed and installed per ACI-318 latest edition.

2. **Coverage:** The following shall be the minimum reinforcement concrete coverage (including tendons):
 - a) Concrete cast against and permanently exposed to earth 3"
 - b) Concrete exposed to earth or weather:
 - No. 6 through No. 18 bars 2"
 - No. 5 bar, W31 or D31 wire, and smaller 1½"
 - c) Concrete not exposed to weather or in contact with ground ¾"
3. **Chairs:** Bottom rebar in grade beams shall be supported on rebar chairs at a maximum of 6'-0" spacing. Rebar chairs for the slab shall be spaced a maximum of [redacted]" on center each way such that the reinforcing steel is located 1/3 the distance from the top of the slab.
4. **Lap:** Continuous reinforcing shall be lapped a minimum of [redacted] bar diameters. Splices shall be tied at the both ends of the splice.
5. **Welded Wire Fabric:** Welded wire fabric (WWF) shall be per ASTM A185. Where shown on plans WWF shall be supplied in sheets.
6. **Corners:** The exterior face of grade beam corners shall have four # [redacted] (2 top / 2 bottom) 2 feet x 2 feet "L" shaped reinforcing bars. Four # [redacted] reinforcing (2 top / 2 bottom) 2 feet x 2 feet "L" shaped reinforcing bars shall be used where interior grade beams end at another grade beam.
7. **Grade Beams Greater Than 30" in Depth:** When grade beams exceed 30" in depth then 2 # [redacted] continuous horizontal # [redacted] reinforcing bars shall be spaced a maximum of 12" vertically between the grade beam reinforcement layers.
8. **Stirrups:** Depths of stirrups for rebar cages shall be beam depth less 7" to allow for minimum reinforcement concrete coverage (unless noted otherwise). Unless otherwise noted, stirrups shall be #3 rebar spaced at 24" on center.
9. **Reentrant Corners:** At all reentrant (inside) corners provide 2 # [redacted] x [redacted] feet long rebar 6" apart at 45 degrees to the corner in the slab, approximately 2 feet from the corner.
10. **Dowels at Foundation Additions:** In cases where foundation additions are added to existing foundations, deformed reinforcing steel dowels shall be provided and embedded a minimum of 6" into the existing foundation and secured using an epoxy anchorage adhesive such as the adhesives manufactured by Simpson Strong Tie SET or equal and installed per the manufacturer's recommendations. The reinforcing dowels shall be lapped a minimum of 36 bar diameters with the reinforcing for the new foundation. See plans for dowel sizes and locations.
11. **Flatwork:** Flatwork such as, but not limited to, driveways, patios, porches and sidewalks shall not be doweled into and shall be isolated from the foundation to allow for independent movement.

3.5 DRILLED PIERS

1. **Depth:** The bottom of the drilled piers shall be located at a depth of [redacted] feet below natural grade. The bearing capacity at this depth is [redacted] psf for sustained loads and [redacted] psf for total loads and is based upon the geotechnical report.
2. **Test Piers:** Due to the potential variability of the on-site soils and potential groundwater fluctuations, if recommended in the geotechnical report, drill test piers before drilling production piers. Once the information is verified, production piers should be constructed accordingly.
3. **Bell Caving:** Should caving of the bell occur, incrementally increase the diameter of the shaft to the next standard size until caving of the bell no longer occurs.
4. **Excavations:** The drilled footing excavations shall be free of loose materials and water prior to concrete placement.
5. **Concrete Placement:** Concrete shall be placed the same day the piers are drilled and shall occur within the time frame specified in the geotechnical report.
6. **Casing:** Casing may have to be provided to facilitate the installation of the drilled piers if sloughing occurs.
7. **Deep Pier Reinforcement Installation:** Provide slide roller assemblies rollers a maximum of 48" on center vertically in order to center the steel cage in the drilled shaft. A slide roller assembly consists of a minimum of four slide rollers and shall be provided spaced equally spaced around the circumference of the reinforcement cage.

3.6 STRUCTURALLY ISOLATED CONCRETE FOUNDATIONS

1. **Fill:** The existing grade and any fill provided to elevate the foundation shall be compacted to support the concrete during setup.
2. **Void Spaces:**
 - a) Provide [redacted]" deep carton forms under the entire slab.
 - b) Provide a [redacted]" deep void space system under the grade beams.
 - c) Do not provide polyethylene sheathing below the degradable carton forms.
 - d) Fully wax impregnated carton forms may be used under the grade beams, but must not be used under the slab areas.
3. **Void Space Specifications:** Design, specification and use of void space systems shall be in accordance with the latest revision of Document No. FPA-SC-11, "Specification and Application of Void Spaces Below Concrete Foundations", available at www.foundationperformance.org.

3.7 HELICAL PILINGS

1. **Depth:** The bottom of the helical pilings shall be located at a minimum depth of [redacted] feet below natural grade. The bearing capacity at this depth is [redacted] psf for sustained loads and [redacted] psf for total loads and is based upon the geotechnical report.

2. **Authorized Contractor:** Piles shall be installed by a contractor authorized to install the applicable helical pile system used.
3. **Loads:** Each pile shall be able to support a [REDACTED] pound allowable load or a [REDACTED] pound ultimate load.
4. **Corrosion Protection:** Piles shall be corrosion protected for a minimum 50-year design life.
5. **Torque:** Installation units shall be capable of developing the minimum torque as required. Installation torque shall be monitored and recorded throughout the installation process.
6. **Indicator Device:** The contractor shall utilize a shear pin indicator device during installation of the first pile to verify torque and allow for correlation between shear pin indicator and pressure gage readings.
7. **Pile Angle:** The angle of the pile may vary within 5 degrees of vertical or the specified battered angle on the drawings.
8. **Lead Section:** The helical lead section shall be in accordance with manufacturer's specifications.
9. **Connection:** The connection of the pile to the foundation shall be per manufacturer's approved method.

3.8 POST TENSIONING

1. **General:** This post-tensioned foundation has been designed using the current edition of the Post Tension Institute (PTI) publication "Design of Post-Tensioned Slabs-on-Ground". Construction of the post-tensioned foundation shall follow the "Construction and Maintenance Procedures Manual for Post-Tensioned Slab-on-Ground Construction", current edition by Post Tension Institute (PTI).
2. **Design:**
 - a) The bottom of the grade beams shall be located at a minimum depth of [REDACTED]" below final grade. The bearing capacity at this depth is [REDACTED] psf for sustained loads and [REDACTED] psf for total loads and is based upon the geotechnical report. The Design Plasticity Index is [REDACTED] %.
 - b) Designed beam sizes, beam spacing, strand quantities, and spacing shown are minimum requirements to allow the structural system to perform as intended based on the design loads and information from the above referenced PTI publication. The intent is not to eliminate soil movement, but to limit detrimental differential foundation movement.
3. **Tendons:**
 - a) Pre-stressing steel shall be 1/2" diameter 270 KSI, seven wire strand, greased within plastic sheathing.
 - b) Strand shall comply with ASTM A416 and shall be stressed to 33 kips to achieve a target average tendon force of 28.9 kips.

- c) Concrete coverage shall be in accordance with coverage shown under Reinforcement Notes.
- d) Contractor is solely responsible to confirm required tendon lengths.
4. **Materials:** All materials used shall meet the test criteria established by PTI.
5. **Tendon Sheathing:** Plastic sheathing shall have a minimum thickness of 25 mils. Tendons shall be coated with a rust preventative lubricant within the plastic sheathing.
6. **Concrete:** Concrete shall be well consolidated around cable end anchors to mitigate failures at time of stressing. Concrete shall not contain any admixtures that could have a detrimental effect on the steel strands, sheathing, and hardware.
7. **Superstructure:** Construction of the superstructure shall not begin until tendon stressing has been completed.
8. **Makeup:**
 - a) Every effort shall be made to not allow to water intrusion into the grade beams prior to concrete placement. If water is present just prior to concrete placement, the grade beams shall be de-watered or deepened to dry soils and/or dried out to ensure proper bearing capacity.
 - b) Anchors shall be installed a minimum of 4" below final elevation of concrete at edge of foundation and a minimum of 6" from corners.
 - c) Anchors shall be securely fastened with pocket formers to prevent cement from entering wedge.
 - d) Dead end shall have a minimum of ¾" clearance from the concrete form.
 - e) Tendon intersections and chairs shall be tied in such a manner to remove slack starting at the fixed end and moving towards the live end to mitigate excessive displacement during the concrete placement.
 - f) Tendons and rebar shall be supported on chairs at a maximum spacing of 4 feet on center. Supports for reinforcing bars or tendons shall not penetrate the membrane.
 - g) Provide #3 bars at 15" O.C.E.W. with rebar chairs at 45" O.C.E.W. in all areas with cable spans less than 20 feet. Turn down slab rebar ends 15" into grade beams.
 - h) Add 2#5 continuous rebar to bottom of all grade beams for which no draped bottom tendon or other conventional reinforcing is detailed in the plans, and provide 2#5 continuous rebar to the top of all grade beams for which no slab tendon is located directly above the grade beam and for which no other conventional reinforcing is detailed on the plans.
 - i) Acceptable tolerances for the tendon placement shall be as follows:
 - Beam tendons ± 1" vertical, ± 1" horizontal
 - Slab tendons ± ½" vertical for 4" to 5" slabs (± 10% of slab thickness for slabs more than 5" thick), ± 12" horizontal
 - Slab tendons shall have a maximum horizontal deviation of 1:6 if needed in order to miss obstructions.

- j) Draped cables shall be [redacted]" from the bottom of the beams.
 - k) Use two 20d nails to attach the dead end anchor to the forms.
 - l) Live ends stripped of sheathing more than 1" and dead ends striped of sheathing more than 12" shall be taped so that concrete will not bond to the tendon. Tape breaks, tears and holes in sheathing.
 - m) Tendons shall be initially pulled taut and shall be supported on chairs at 4 feet each way. All chairs shall be tied and all S-hooks shall be crimped.
 - n) Tendons must be sprayed with white or fluorescent paint prior to stressing to facilitate the measurement of the elongation.
 - o) Looping of tendons to form dead end anchorages is not allowed.
 - p) Tendons shall be cut or burned a minimum of 1" from wedges.
9. **Stressing:**
- a) Tendons shall be initially stressed 72 hours after concrete is placed to [redacted] kips.
 - b) Tendons shall be final stressed at 33.0 kips per tendon no earlier than when concrete has attained a minimum compressive strength of 75% of its 28 day design strength or 2000 psi. Final pressure gauge readings for each tendon during stressing shall be recorded. Contractor shall ensure that pressure gauges are calibrated in accordance with manufacturer's recommendations.
 - c) Theoretical elongation to be 0.079" per foot for ½" diameter tendon. Actual tendon elongations shall measure within 10 percent of theoretical elongations.
 - d) Exterior brick veneer work shall not begin before stressing is completed.
10. **Grouting:** Stressing pockets shall be filled with non-shrink grout within 7 days of the final stressing operation to mitigate corrosion of the anchor and wedge assembly.

3.9 BASEMENT

Some of the information contained in the following basement foundation guidelines is from the policy published by the Planning and Development Services Department, Building Safety for the City of Overland Park, Kansas. This committee urges the designer to check with the specific county or municipality where the structure is located to determine if notes specific to that particular area should be included.

1. **Reinforcement:** Reinforcement shall be continuous around openings for windows, doors and other openings. Vertical reinforcement and top horizontal bar to extend to within 3" of the top of the wall.
2. **Reentrant Corners:** At all reentrant (inside) corners such as openings for doors, windows, and wall elevation transitions, provide a minimum 6 feet long #5 rebar on a 45-degree angle at interior corners.
3. **Lap:** Continuous reinforcing shall be lapped a minimum of [redacted] bar diameters.

4. **Moisture Retarder:** A moisture retarder, such as two layers of 15# felt or one layer of 30# felt, and hot-mopped or approved equivalent foundation membrane shall be applied to exterior wall surfaces below grade. Seal tie holes, voids and honeycombed areas with sealant before damp proofing.
5. **French Drain:** Install continuous French drain around the perimeter of the bottom of basement foundations located below grade, unless noted otherwise on the drawings. French drains shall be a minimum 4" in diameter. Cover French drain with at least 12" of coarse, clean rock or gravel and slope to drain. Either connect the French drain to a minimum 20-gallon sump pit with sufficient depth for proper sump pump operation or drain by gravity to an outlet a minimum of 10 feet away from the foundation. Sump system should include an appropriate check valve on the outlet line, located within 12" of the pump, to prevent backflow of water into the sump.
6. **Backfill:** The foundation wall shall be braced prior to placing backfill against the wall. If cracking or bowing of the foundation wall occurs the contractor shall notify the engineer for possible corrective action. Contractor shall not backfill an unsupported straight run of wall over 20 feet in length between corners and cross wall unless adequate bracing is provided or the floor framing has been set and nailed in place and anchor bolts tightened. Contractor shall not backfill any wall before 7 days after concrete placement to allow the wall to gain sufficient strength to support the imposed loads. Backfill with loose, non-cohesive fill, preferably slightly damp. The top 12" of backfill shall be non-porous and shall have a minimum slope of 5% within 10 feet to allow for drainage away from the foundation.
7. **Foundation Anchorage:** Basement foundation sill plates shall be bolted to the foundation with minimum 5/8" diameter anchor bolts embedded at least 7" into the concrete and spaced not more than [redacted]" on center and within 12" of the end of each piece. A properly sized nut and washer shall be tightened on each bolt to the plate. Walls which do not have more than 4 feet of unbalanced fill on either side of the wall may have anchor bolts at a minimum [redacted]" on center and at least 12" from the end of each piece. A minimum 2" x 6" sill plate shall be used to ensure sufficient strength is provided to transfer loads from the anchor bolts to the floor system.
8. **Top of Wall Support Connections:** Connect joists and blocking to plates using Simpson Strong-Tie [redacted] or equal. Where joists run parallel to foundation walls, solid blocking for a minimum of two joist spaces shall be provided at a maximum of [redacted]" centers to transfer lateral loads on the wall to the floor diaphragm. The blocking shall be securely anchored to the joists and flooring.

3.10 HARRIS COUNTY FLOOD PLAIN NOTES

The following notes are copied from the Harris County, Texas website at the time of publication. Harris County, Texas requires these notes to appear on the foundation drawings when the structure is located in a flood plain. This committee urges the designer to check with the specific county or municipality where the structure is located to determine if notes specific to that particular area should be included.

Harris County, Texas Flood Plain Notes

FOUNDATION NOTES:

“All foundation drawings in a flood plain where the difference between the natural grade and the 100 year flood elevation is greater than three (3) feet should be shown as pier and beam. Slab on grade foundations can be allowed as long as a separate permit is issued for fill material. Other types of foundations must be reviewed on a case-by-case basis.

1. This property lies within the designated 100 year flood plain or below the base flood elevation according to the Flood Insurance Rate Map Panel No. _____, dated _____.
2. All water heaters, furnaces, air conditioning units, electrical distribution panels and any other mechanical or electrical equipment must be elevated eighteen (18) inches above the base (100 year) flood elevation.
3. Any electrical circuit serving a light switch or outlet located below the base (100 year) flood elevation shall be dropped from the above and be on a separate breaker.
4. The minimum finished floor elevation is clearly shown on the drawings. The minimum is eighteen (18) inches above the base (100 year) flood elevation.
5. A Federal Emergency Management Agency (FEMA) Reference Mark (benchmark) is fully described on survey drawings. Along the coastal area Harris-Galveston Coastal Subsidence District (HGCSA) benchmark is used. Temporary benchmarks (TBM's) may be used as long as they tie into a FEMA or HGCSA benchmark.
6. All materials used below the (100 year) base flood elevation are on approved FEMA Technical Bulletin 2-93 as Class 5 water resistant.
7. Any storage areas below the (100 year) base flood elevation are less than one hundred fifty (150) square feet in size.

INSPECTION REQUIREMENTS:

1. 2- Completed * elevation certificates must be submitted at permitting and after the slab is poured or sub-floor is installed and before the framing starts. * (PER CURRENT FIRM PANEL & PER TSARP MAP) to the
2. Harris County Engineer's Office, Permit Division, 10000 Northwest Freeway, Suite 102, Houston, Texas 77092-8620
3. A completed as-built certificate must be submitted after the structure is complete and before it is occupied.
4. The County Engineer's Office will post a final inspection notice on the structure once all requirements have been met.”