SoCal STRUCTURAL

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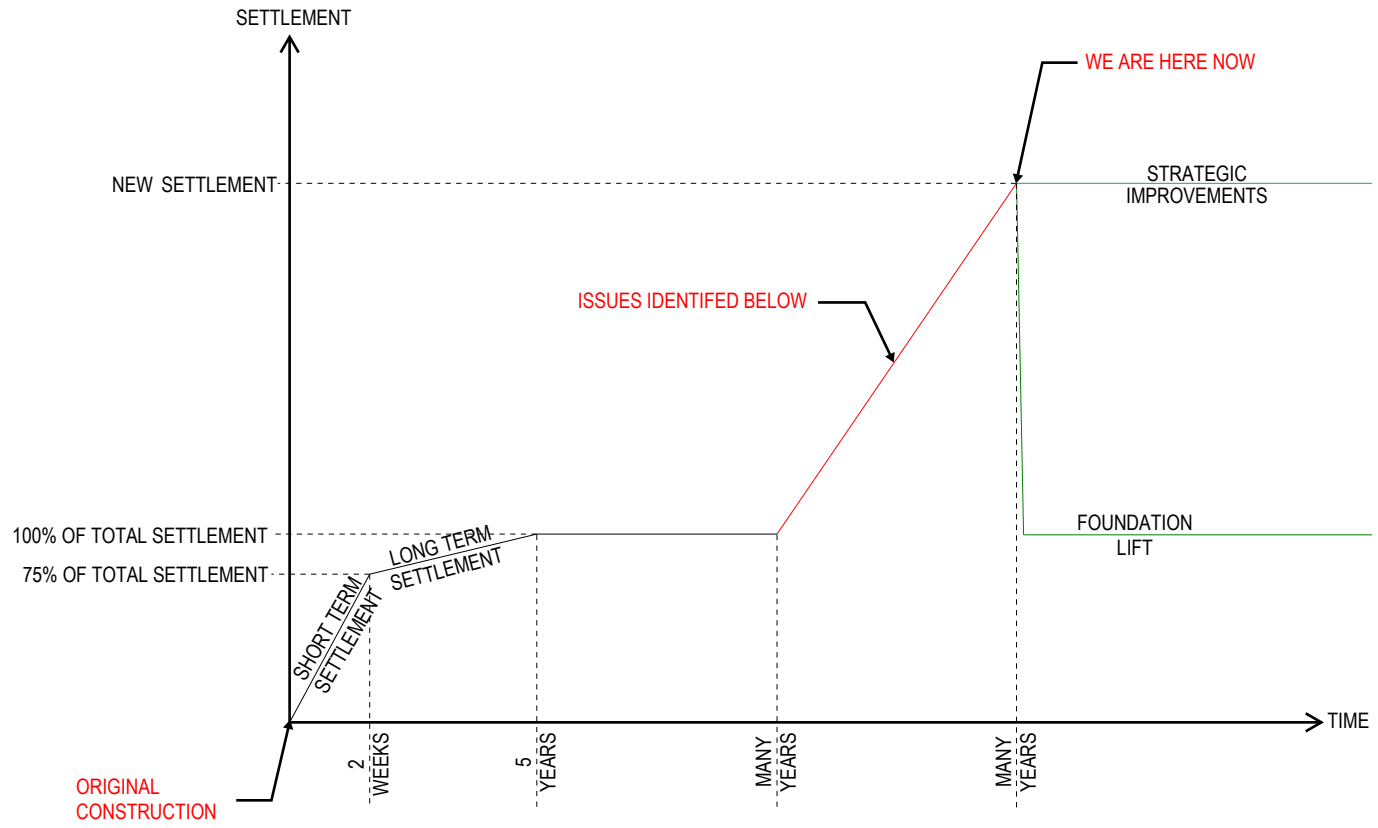
(Developed after 700 houses assessed)

SETTLEMENT OVER TIME



Differential settlement occurs when soil under a footing compresses, consolidates, or moves. The cause of soil compression or consolidation could be either:

a) moistening of the subgrade soil by water infiltration. Water infiltration of the subgrade soil may have occurred from pipe leaks, inadequate drainage of ground surface water away from the home, or other sources of water. Inadequate drainage occurs when the topography is flat, topography slopes downward toward the house, irrigation volume is unnecessarily high, torrential rains create ponding conditions, water has no escape route (bathtub scenario), or drains are blocked. The planter areas may also be flat or drain towards the house. Proper drainage is important to keep water away from the subgrade soil under perimeter foundations. Regardless of the source of the water, when water percolates through the top soil to saturate the subgrade soil under the foundation, the soil under the foundation becomes more compressible, and gravity forces the foundation downward.

b) drying of clay-like soils

c) crumbling of decomposing organics in a subterranean layer. <== hard to detect

d) inadequate or non-uniform compaction of the soil prior to construction of the foundation

e) additional loading applied to an existing foundation through structural additions/expansions/modifications

f) hillside slope creep due to an adjacent slope slowly shifting

g) soil erosion under footings

h) tree roots lifting or drawing out water from slay soils causing drying/shrinking of clay soils

i) vibrations due to nearby construction or seismic activity causing consolidation

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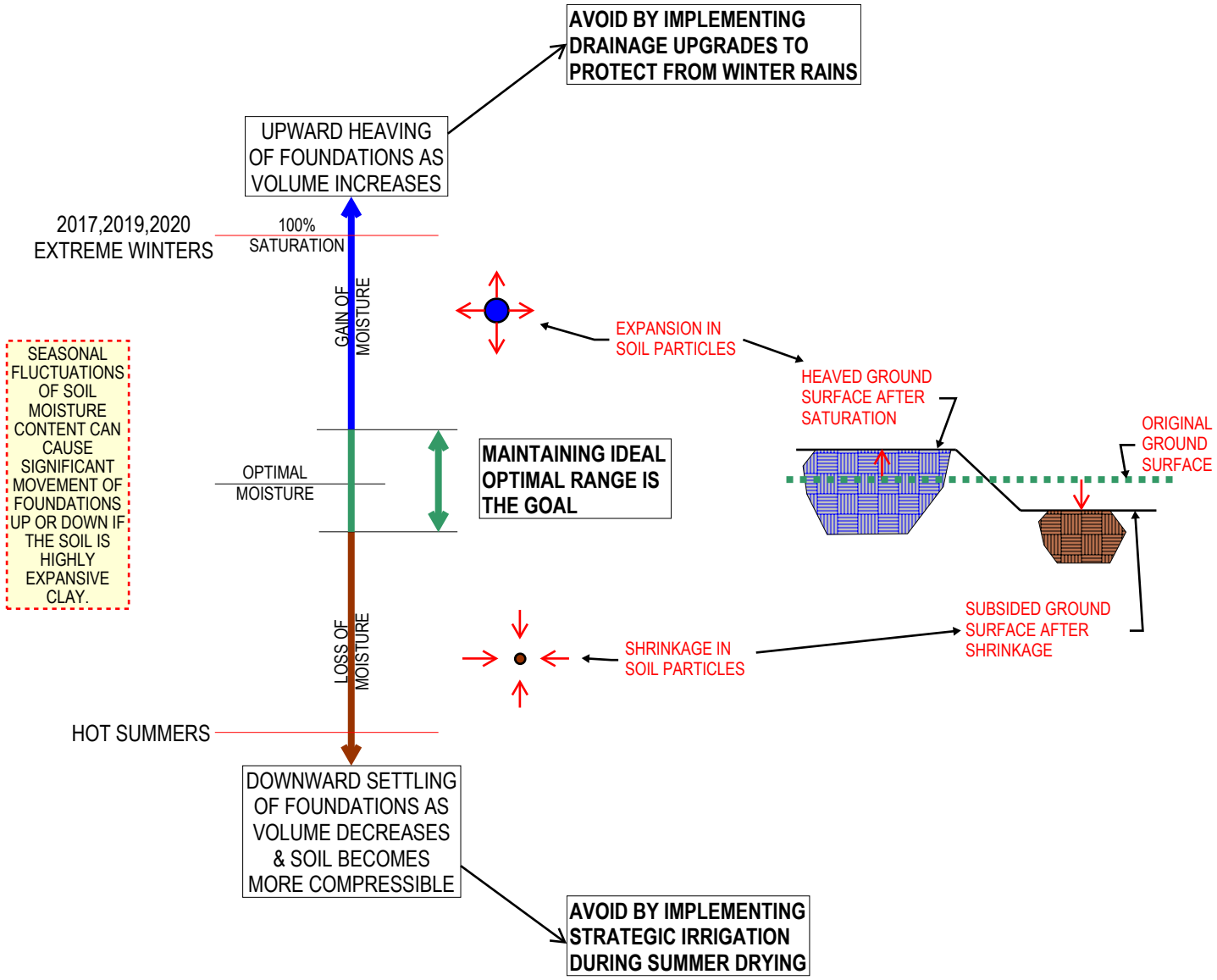
CLAY SOIL EXPANSION-CONTRACTION SPECTRUM



b) Clayey soils have a high expansion and contraction rate. Upon moistening, these soils expand. This diagram if for soil not loaded from the top with gravity forces such as the weight of the house. See next diagram for that.

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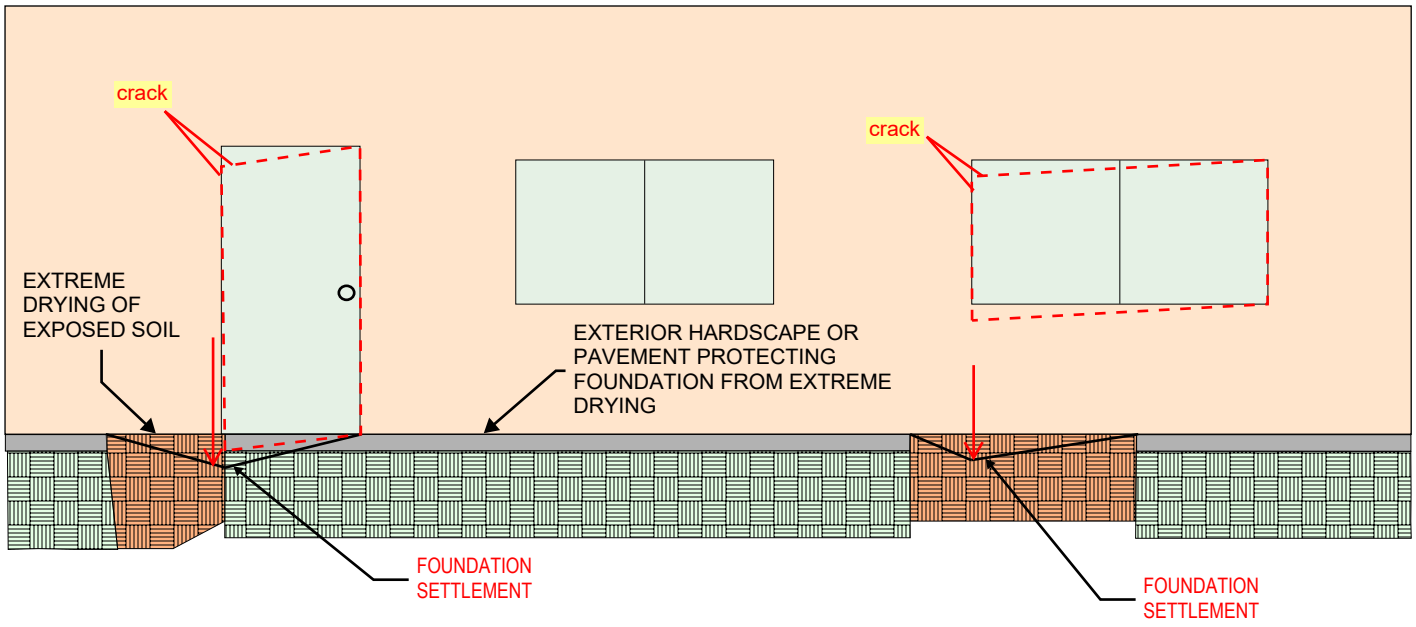
PERMANENT CONSOLIDATION OF AFFECTED SOIL WHEN LOADED WITH WEIGHT OF HOUSE



Gravity forces push the mass of the house down. The previously over-saturated soil consolidates (and shrinks if clay) is permanent and irrecoverable as the air voids between particles are eliminated. The foundation is permanently displaced downward and never recovers even if clay soil is saturated again.

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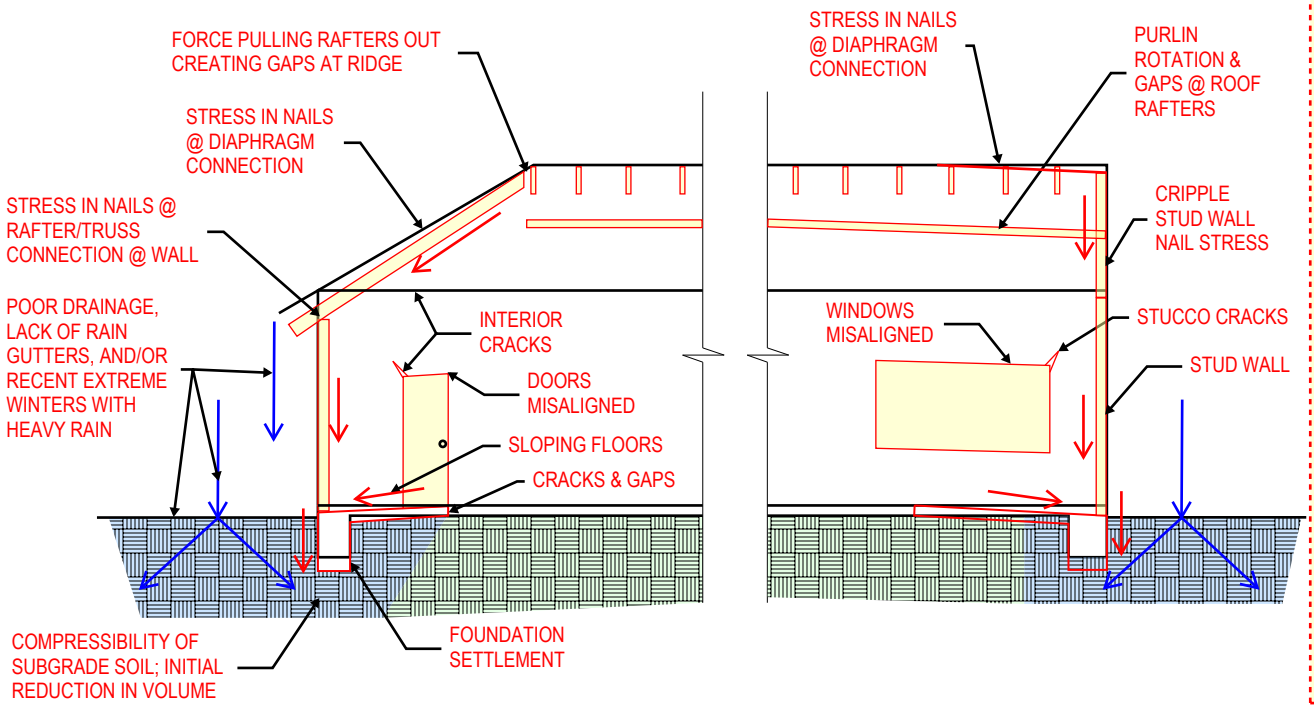
CAUSE #1: LOCAL SATURATION OF SUBGRADE & DRYING

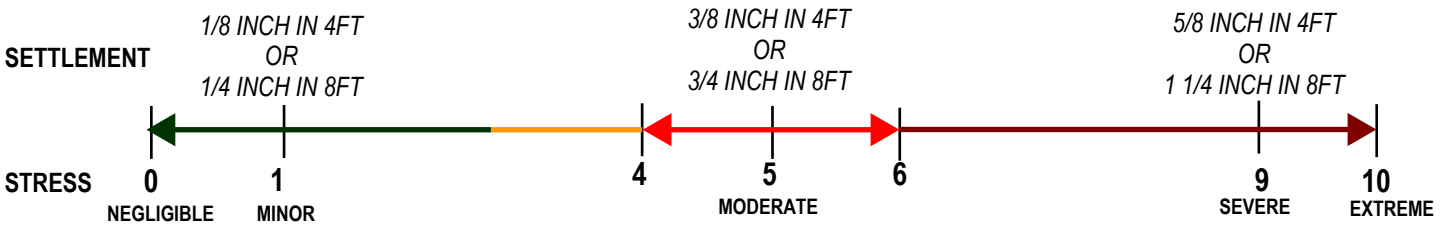


WHEN THE FOUNDATION SETTLEMENT EXCEEDS THE MODERATE THRESHOLD, THE STRUCTURAL SYSTEM (RAFTERS, NAILS, CONNECTIONS, ETC) IS STRESSED OUT. THE HOUSE IS SLOWLY BEING **TORN APART** BY GRAVITY PUSHING THE FOUNDATION DOWN WHICH PULLS ON THE STUDS WHICH PULLS ON THE RAFTERS. PAST THE MODERATE THRESHOLD, MAJOR LOCALIZED STRUCTURAL DAMAGE WILL ENSUE IN A LARGE ENOUGH EARTHQUAKE. LOCAL FRAMING MAY BE SUDDENLY DISCONNECTED.

The level of stress in the connections and members of the structural framing system depends on the induced displacement caused by settlement.

With moderate to severe level of stress, the structure is vulnerable to major structural damage due to gravity forces, seismic forces, and/or continued settlement.

SETTLEMENT - STRESS SPECTRUM



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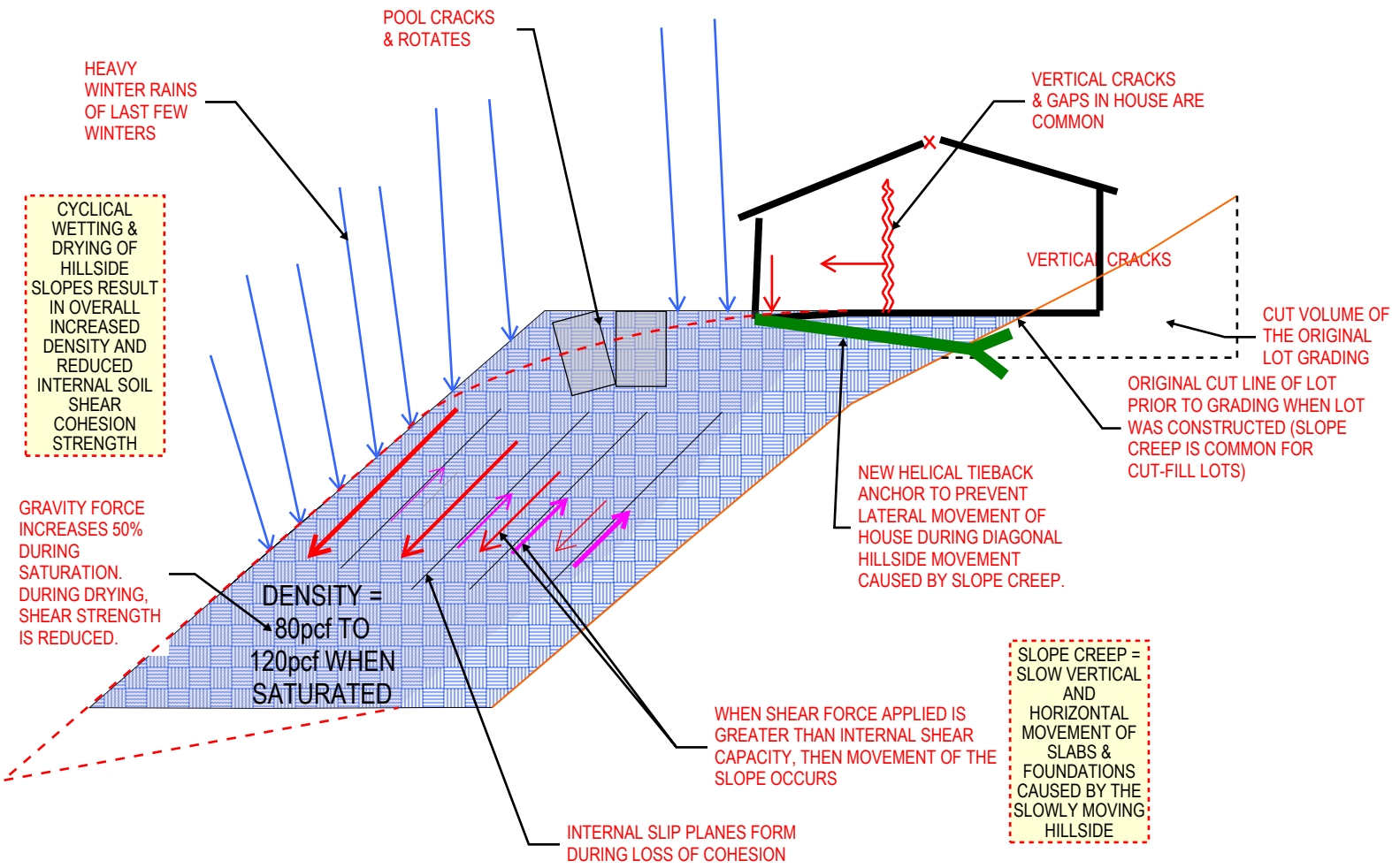
CAUSE #2: SLOPE CREEP OF HILLSIDE



The homeowner should guard against slope creep by considering the probable explanations of causes of slope creep from a geologist or geotechnical engineer, which may include:

a) Drying of expansive clayey soils (during the severe drought years) under the slope leading to a reduction in volume (shrinkage). Past rainfall and irrigation have likely been insufficient to maintain moisture equilibrium. In such cases, moisture would be depleted causing the shrinkage deformation of the clay filled slope.
b) Over-saturation of soils increases the overall weight. Eventually, as the weight of the soil increases beyond the shear strength of the soil, a slip plane develops as described above.
c) Inadequate grading compaction of the cut-fill layers under the house during the original construction of the home.
d) Earthquake induced movement of the slope.

The homeowner is advised to consult with a geologist or geotechnical engineer for further evaluation.

It is important to note that the potential for slope creep on the hillside is different from the potential for a landslide. General planar or translational long-term slope creep is the steady downward seepage (millimeters per year) of the hillside soil caused by the gradual decrease in the internal shear cohesive strength of soils. This strength reduction occurs along a failing “slip” plane (or series of failure planes) parallel to the hillside ground surface. Such continuous movement is caused by gravitational forces acting on a wedge of soil below the ground surface and may be associated with the seasonal variations of top soils (seasonal creep may also have occurred in the top soil along the hillside and is caused by local shallow temperature and moisture variations near the surface for clayey or silty soils). All drying and saturating cyclical changes (either in shallow or deep soil) exacerbates the reduction in frictional shear capacity along the slip plane leading to long-term downward movement.

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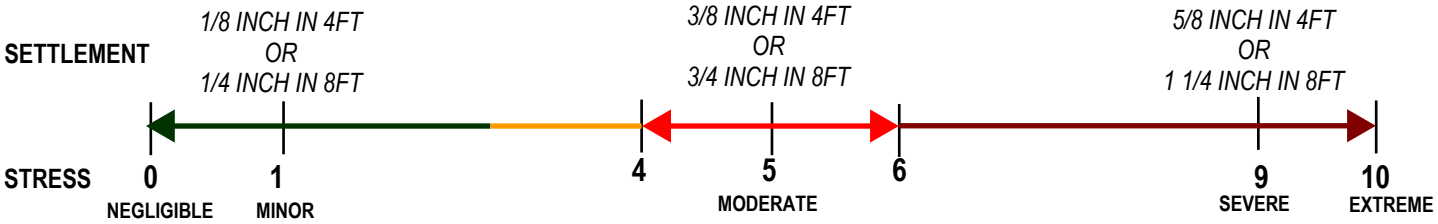
GUIDELINE FOR HOW AN ENGINEER DETERMINES IF FOUNDATION SETTLEMENT WARRANTS A RETROFIT

SETTLEMENT - STRESS SPECTRUM



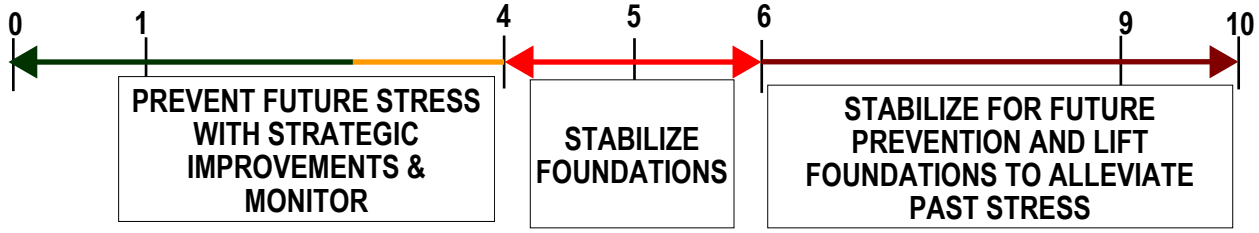
VULNERABILITIES CREATING FUTURE STRESS

MULTIPLY STRESS SCORE ABOVE BY FACTORS BELOW WHERE CONDITIONS APPLY

IF LIQUIFIABLE ZONE	1.15
IF CONVENTIONALLY FRAMED	1.15
IF PREFABRICATED TRUSSES	0.85
IF HILLSIDE EXISTS NEAR REGION ASSESSED	1.15
IF INADEQUATE DRAINAGE EXISTS NEAR REGION ASSESSED	1.15
FOR INTERIOR REGIONS	0.75
FOR PERIMETER REGIONS	1.00
FOR FLAT ROOF REGIONS	0.75

IF EXTREMELY HIGH SEISMIC ZONE, 1.50 < Sds < 2.00	1.25
IF VERY HIGH SEISMIC ZONE, 1.00 < Sds < 1.50	1.10
IF HIGH SEISMIC ZONE, 0.60 < Sds < 1.00	1.00
IF MODERATE SEISMIC ZONE, Sds < 0.60	0.90

FINAL SCORE FROM PAST MOVEMENT INDUCING STRESS & FUTURE VULNERABILITIES CREATING MORE STRESS



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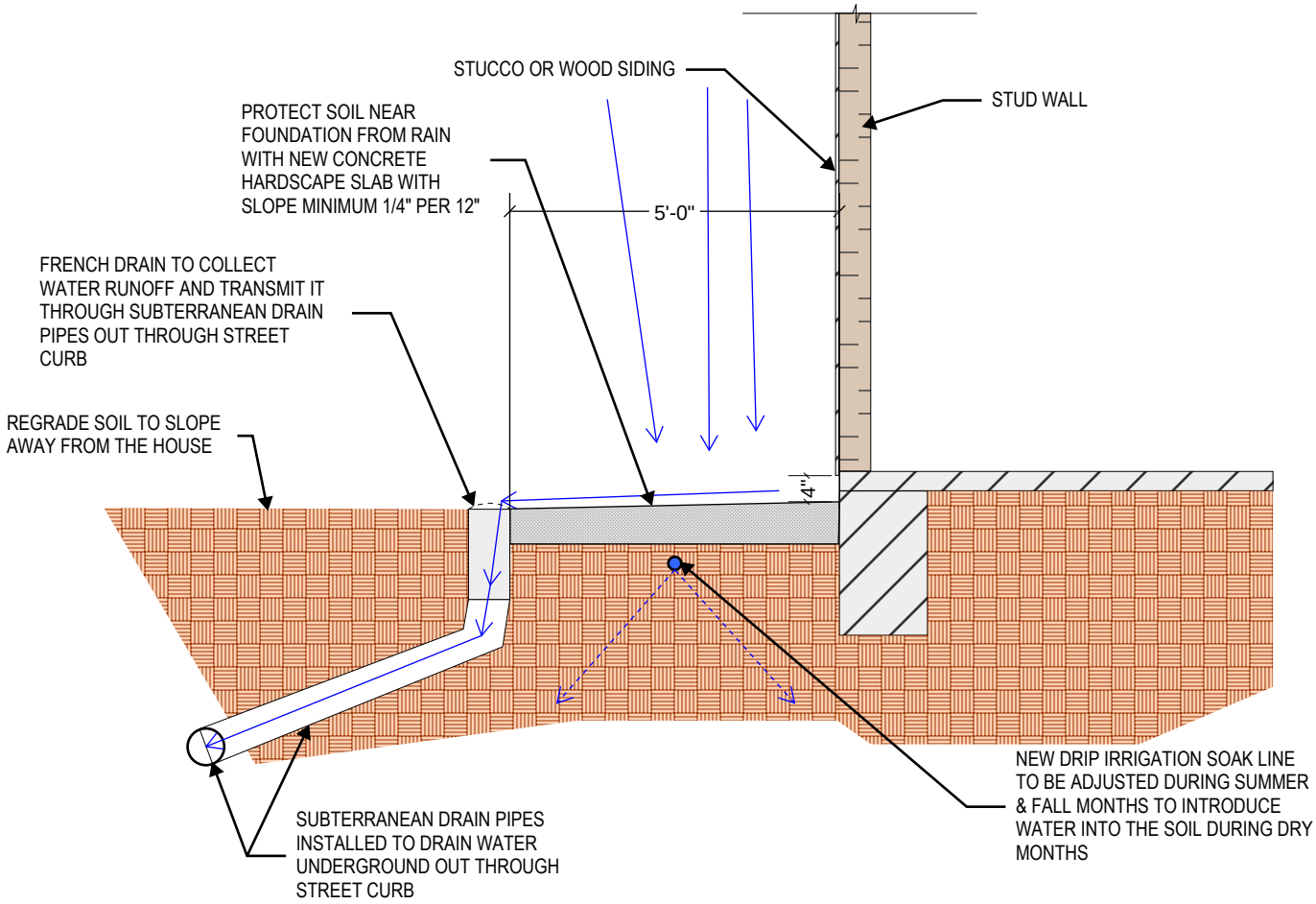
STANDARD DRAINAGE CORRECTIONS & IMPROVEMENTS



Special care should be taken to address any drainage issues along the exterior of the home that do not have hardscape or where hardscape is not draining properly. New concrete slabs should be installed within 5ft of the structure around the entire structure's perimeter. The new concrete slab to house interface should be properly sealed to prevent water seeping through. New slabs should be sloped away from the structure at 3/8 inch per 12 inch. Drain lines should be installed at the new slab to soil interface to move collected water off the new slab into the drain. A licensed landscape contractor or licensed landscape architect may be consulted for final design recommendations. Additional roof gutter installation, roof gutter assessment/maintenance, and downspout subterranean drain lines assessment/maintenance, around the perimeter is necessary to avoid large sheet flow water off the roof in proximity of the foundation. Surface topography should be re-graded so as to ensure surface runoff flows away from each side of the house. A new drip irrigation line should be installed under the slab to keep the current moisture content in the soil consistent throughout the seasons.

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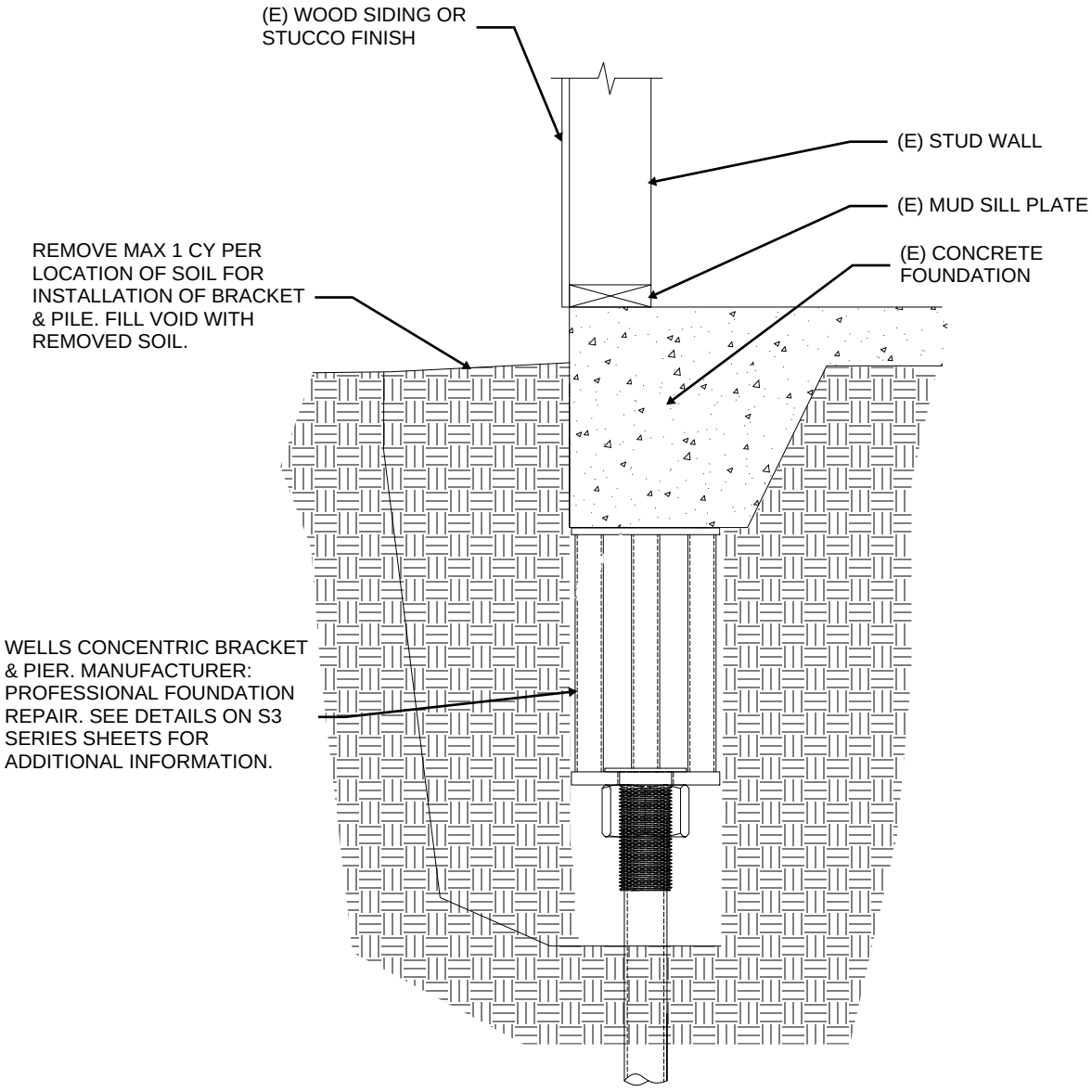
VERTICAL SETTLEMENT SOLUTIONS: CONCENTRIC BRACKET PUSH PIER



1 WELLS CONCENTRIC BRACKET
BY PROFESSIONAL FOUNDATION REPAIR

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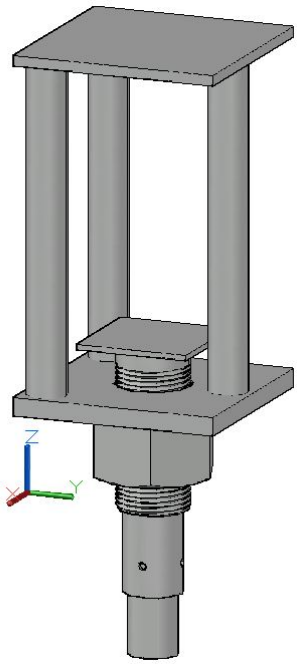
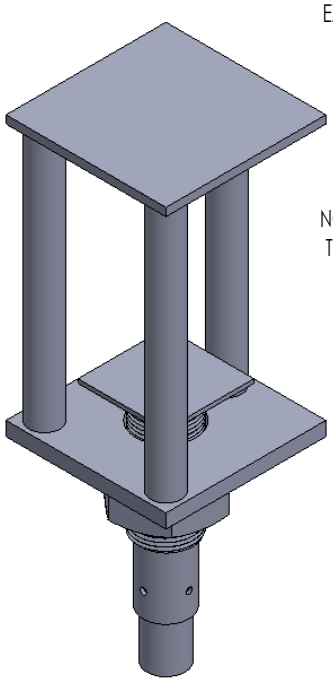
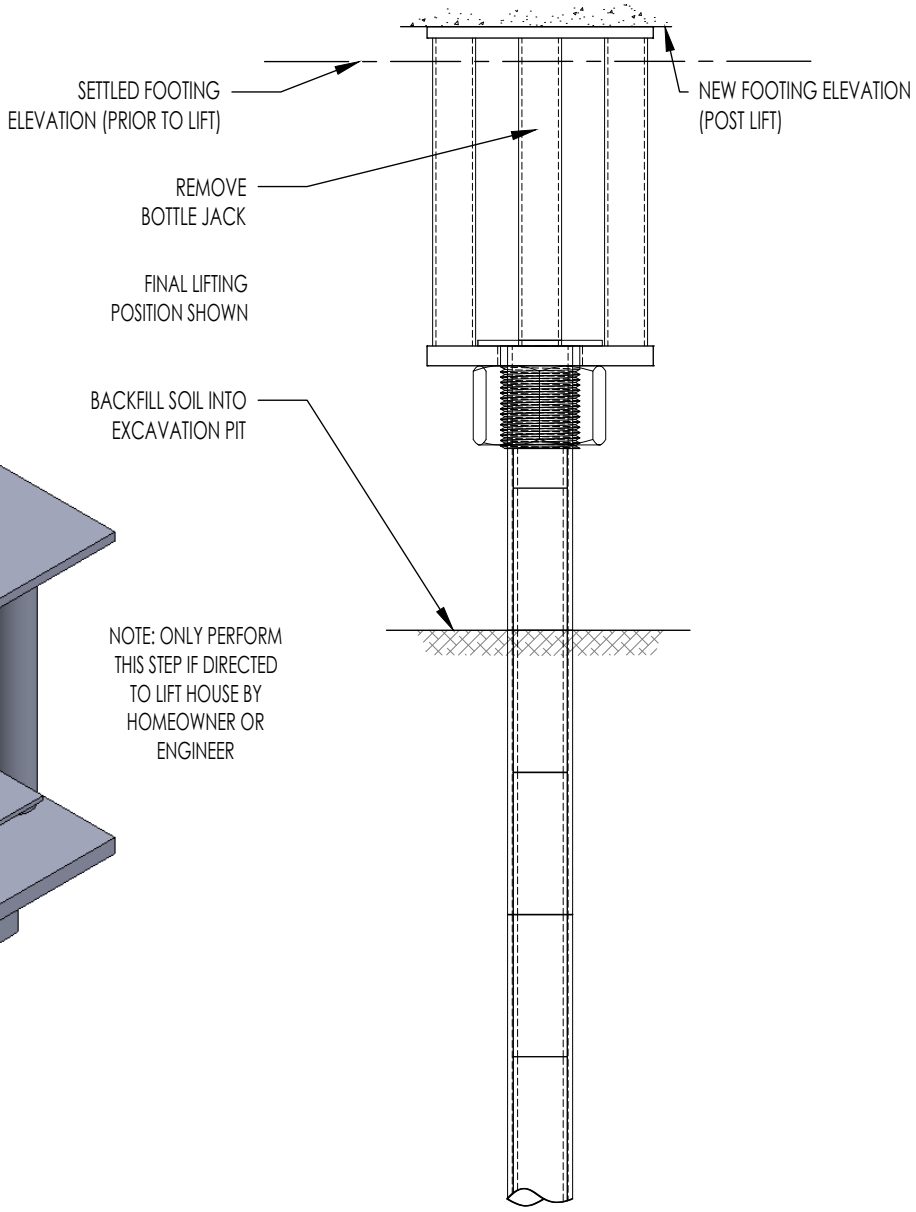
VERTICAL SETTLEMENT SOLUTIONS: CONCENTRIC BRACKET PUSH PIER







1 WELLS CONCENTRIC BRACKET

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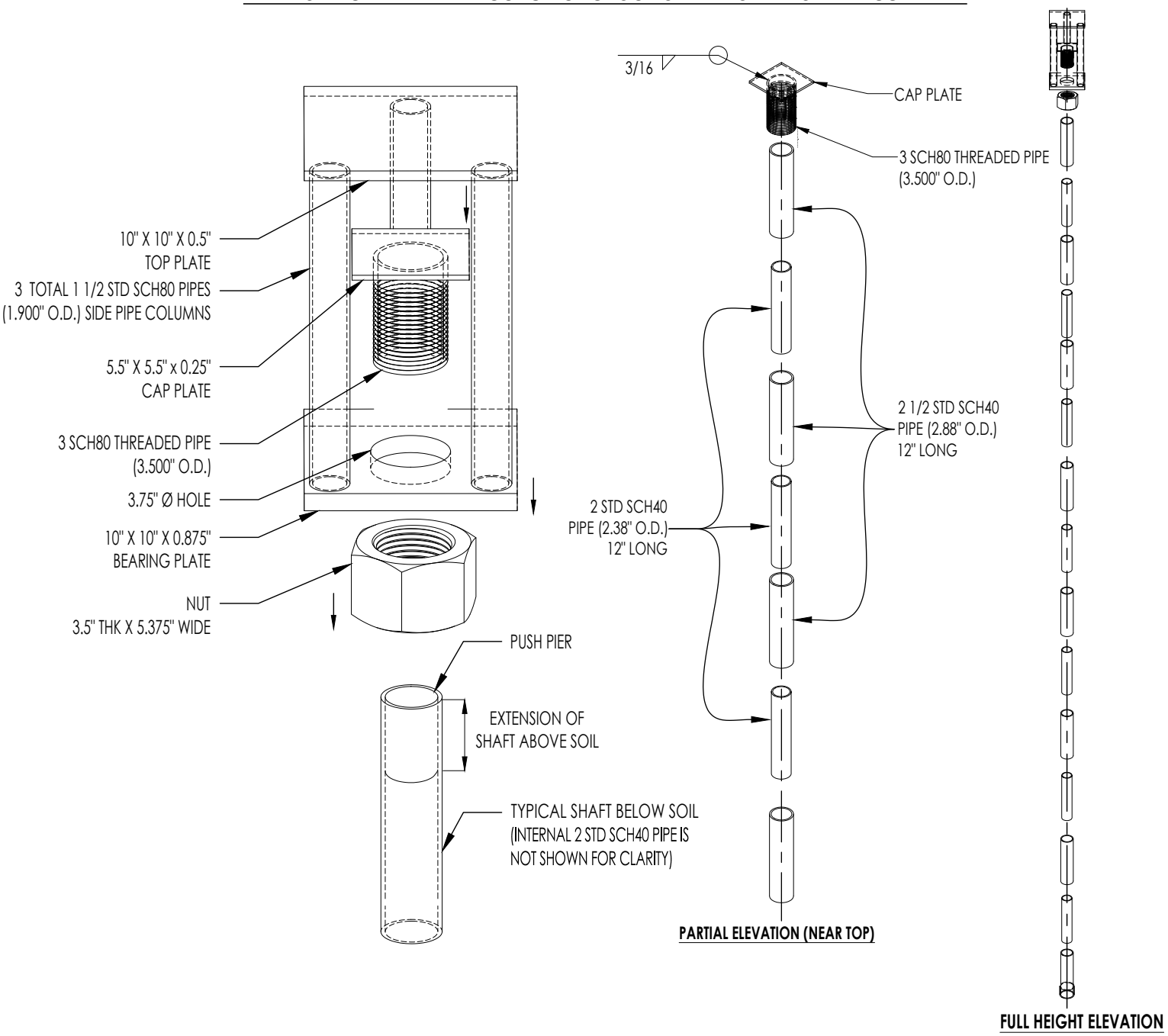

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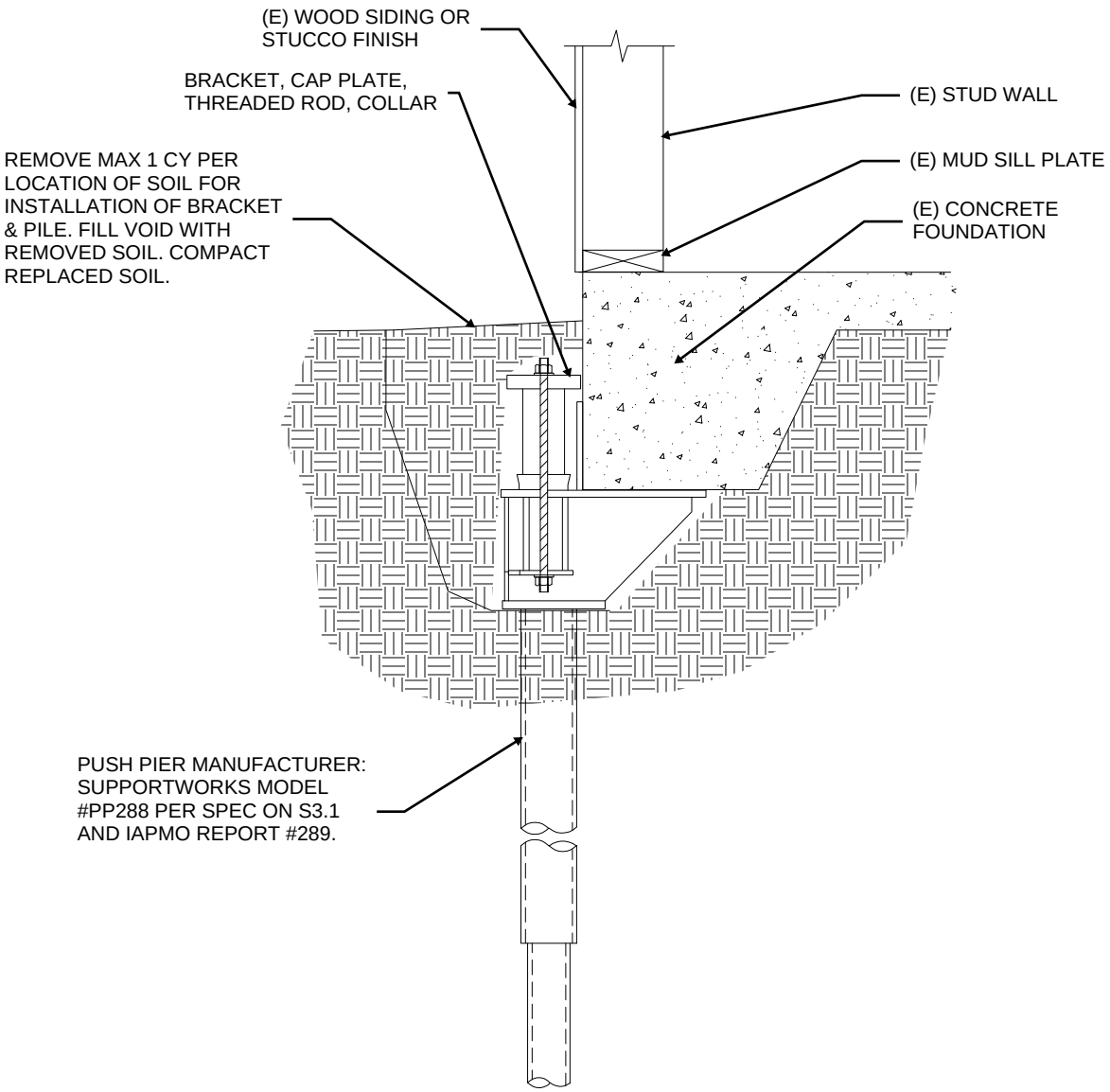
VERTICAL SETTLEMENT SOLUTIONS: ECCENTRIC BRACKET PUSH PIER



ALL STEEL SHALL BE HOT-DIPPED GALVANIZED.

1 VERTICAL PUSH PIER (TYP)

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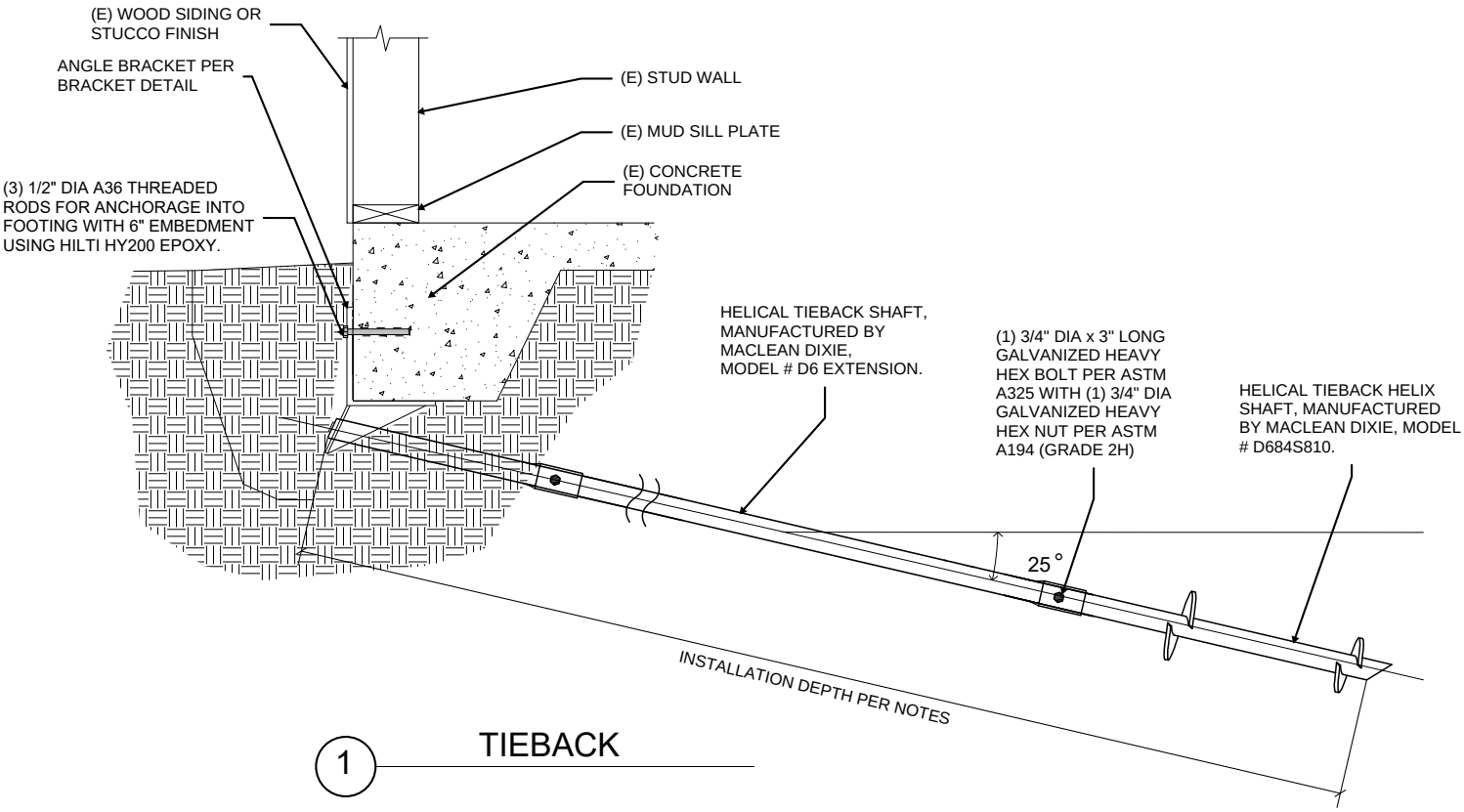
SLOPE CREEP SOLUTIONS: DIAGONAL TIEBACK



1 TIEBACK

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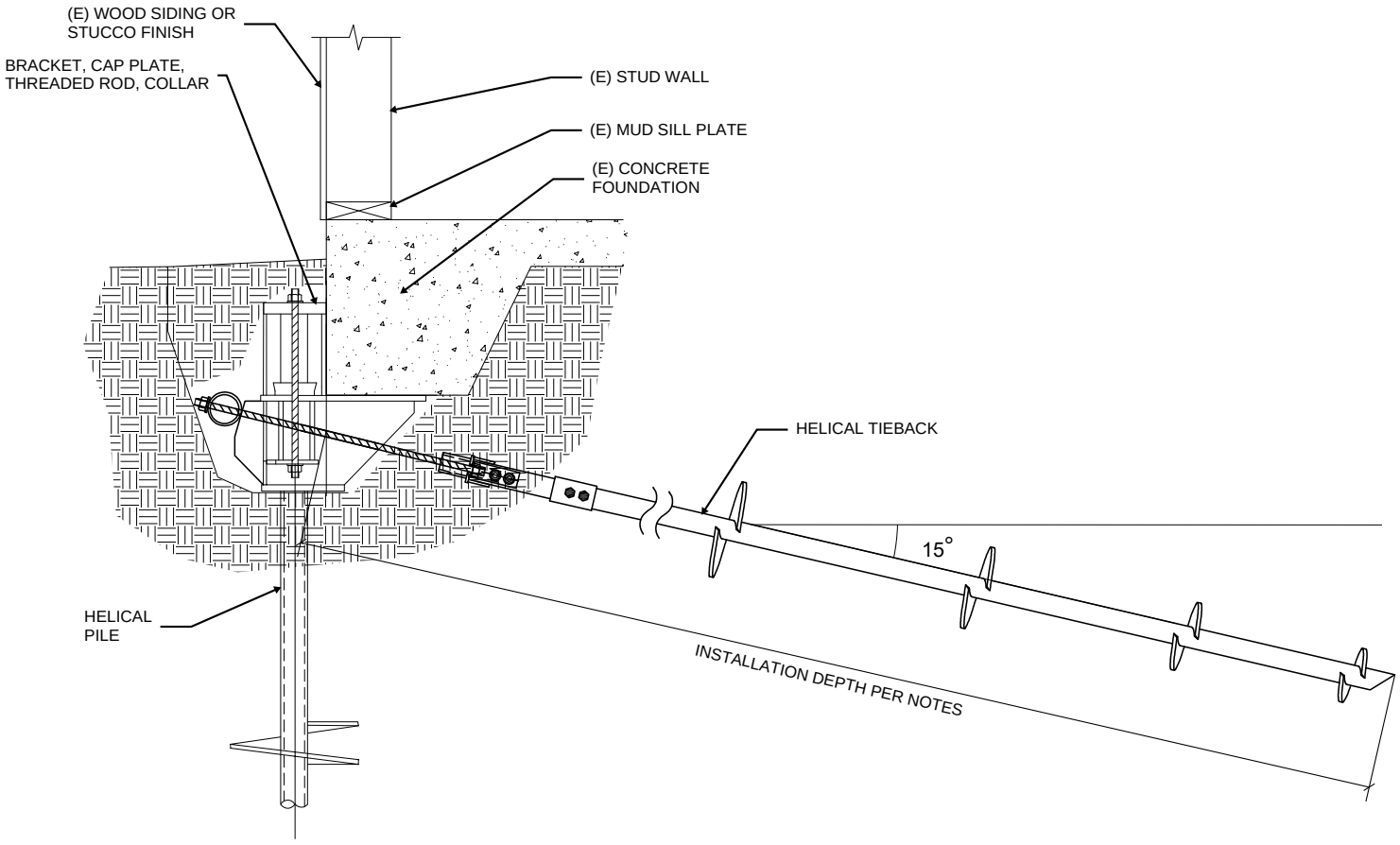
SLOPE CREEP SOLUTIONS: DIAGONAL TIEBACK



1 VERTICAL PILE @ TIEBACK

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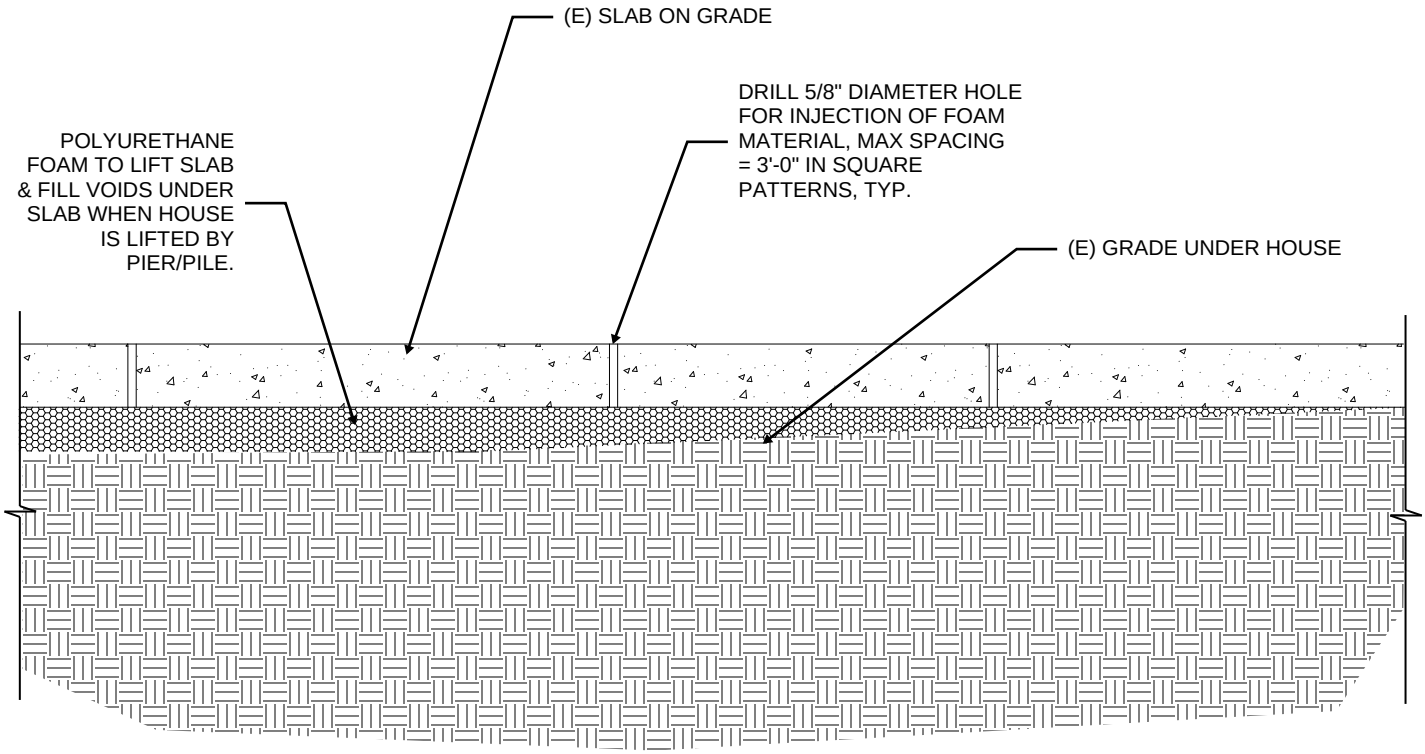

1 FOAM INJECTION DETAIL