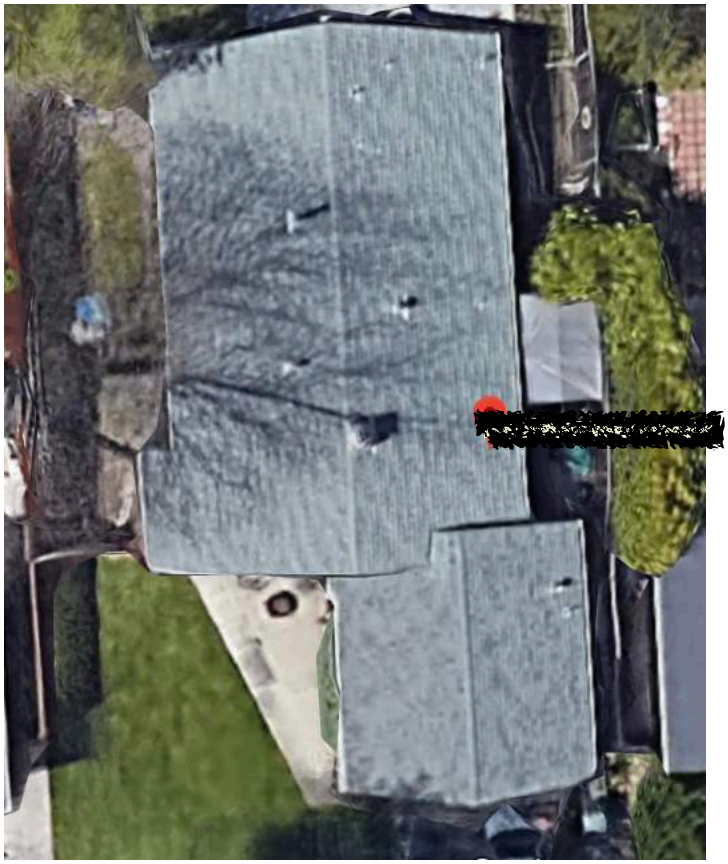
FOUNDATION INSPECTION REPORT

[redacted]

2/13/19



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Report Date: 2-13-19

Address: [redacted]

Client: Xu Yuan

Subject: Foundation Inspection

References: (1) Home Inspection Report

Attachments: (1) Glossary of Terms
(2) Drainage Illustrations
(3) Matrix of Possible Causes of Foundation Movement

Dear [redacted]

Background

On 2/13/19, we inspected the interior and exterior of the property listed above as part of a real estate transaction and the observation by the client of some sloping in the kitchen and the goal is to understand the overall condition of the foundation from the standpoint of a foundation specialist. The observations/findings are included with the corresponding pictures along with recommendations for improvement.

Note 1: The words left, right, front, rear, and center are used throughout this report to describe locations within or around the structure/property. These directions are all made relative to standing facing the structure/property from the front entry door and/or street.

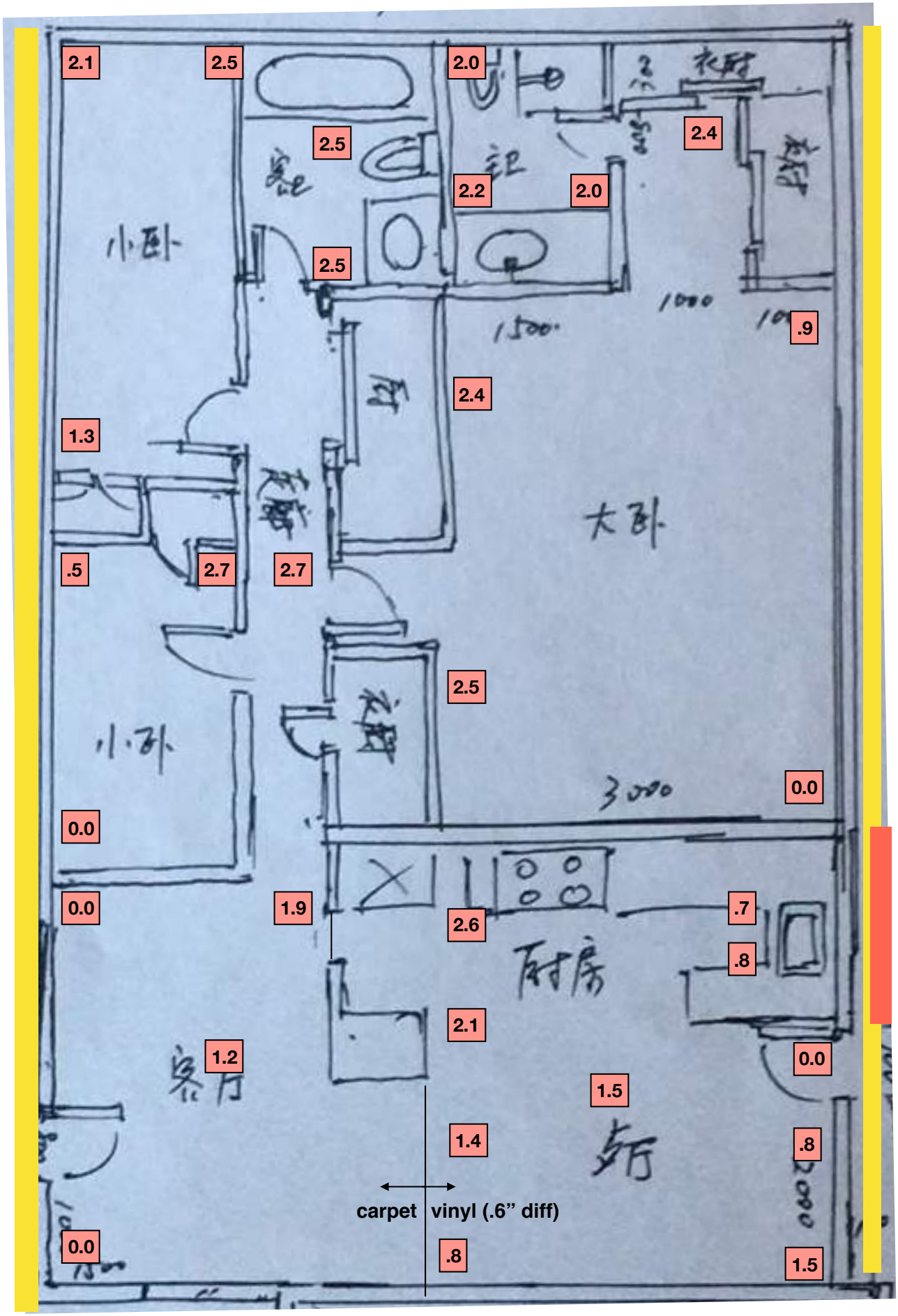
Note 2: The comments made herein are limited only to the exposed and visible portions of the foundations. Comments cannot be made on the foundation where the foundation is hidden from view. The exact design of the foundations is not known especially the portions of the foundation which are hidden from view such as below ground embedment depth and dimensions or existence and/or size, placement and amount of steel reinforcing bars within the foundation.

Description

The structure was originally built in 1958 and the structure appears to have been built using conventional building practices consistent with the age of the structure. The house is a single story structure and rests on a relatively flat level building lot. The house is a wood framed structure supported by a slab-on-grade foundation. This type of foundation typically has a relatively shallow embedment depth into the ground.

Floor Elevation Spot Check Results

BACK



FRONT

Stabilization

Option A

Option B

Condition #1 - Sloping Slab / Foundation

Figure 1

Figure 2

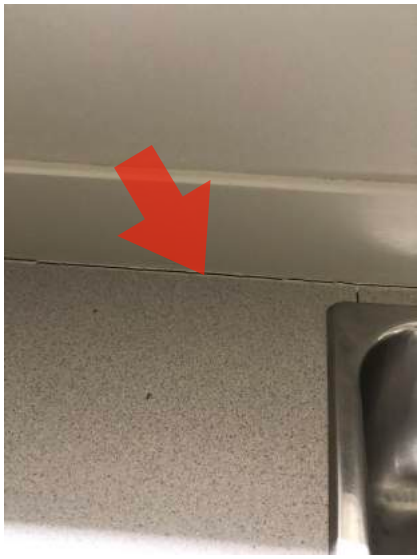


Figure 3

Figure 4

Figure 5

Figure 6

- We took representative floor elevations readings with a Ziplevel manometer and the key results are shown in the preceding page. Overall there is a high point along the center of the house with a slope towards the outer edges along with a slope from the back of the house towards the front.
- This degree and direction of movement is not uncommon and relates to the expansive nature of the soils in this area and seasonal water fluctuations (See Appendix 3 for a further discussion of possible causes of movement). These conditions are likely present, to some degree, in other houses of similar design in the area.
- Most of the movement the house will experience has likely happened, i.e. it's unlikely to drop another 2" on the ends and the movement measured has likely been in the past because we do not see any sizable cracks in the house. We do however see some small cracks that have opened up since the last painting and it is possible some of them will change with seasonal fluctuations so the movement is active to some degree - a full soils report would be necessary to analyze further.
- The most feasible way to fully stop any future movement would be the underpinning of the foundation to support the foundation on deeper and more stable soils (or rock) below but drainage improvements will also assist and sometimes those are undertaken first and then monitor for future movement, in the case of the kitchen the drainage in that area is already good.
    - Option A: The kitchen area is of higher priority so if this area were stabilized the cost may be in the $8K range (+/- 20%) - Area A (see illustration on preceding page). The kitchen is the most noticeable because of the cabinetry and the other rooms are less noticeable - this would be of higher priority for stabilization given the nature of how a kitchen is used.
    - Option B: If it were the whole house, going along the long sides of the house where the greatest movement is occurring, it would be in the $60K range (rough budgetary pricing for local foundation underpinning companies is roughly in the $750-$900/linear ft range and that includes permitting and engineering but they must look at each job case by case to provide a detailed quote with economies of scale for larger areas).

Condition #2 - Drainage Improvement Opportunities

Figure 7

Figure 8

Figure 9

- As with most structures of this age and area, the structure was not designed and built with exterior drainage upgrades. We recommend a proactive approach to the drainage conditions noted and in general it is recommend collecting and diverting excess water at the exterior of the structure before the excess water can affect the foundation and supporting soils of the foundation
- In some areas, there is a slight negative grade where the slope is flat or slightly back towards the house and the exterior grounds should be re-graded so that surface water flows more efficiently downward and away from the structured ideally, the areas shown above should have a concrete walkway poured to slope away from the structure to further the distance from where water is absorbing next to the foundation (see Attachment 2).
- All gutter downspouts should extend at least 5' from the house and discharge to a point that will flow away from the house.

Condition #3 - Typical cracking of concrete garage & exterior concrete slabs

Figure 10

Figure 11

- For the garage, this is typical and relatively minor concrete cracking especially when expansion/control joints are not present, not of a structural concern and not related to the house foundation
- For the exterior patio, there may not have been adequate reinforcing steel installed and/or poor compaction/subsurface preparation but it is not of structural concern for the house and could be patched for the time being and eventually replaced or resurfaced as desired.

It was a pleasure working with you on this inspection, please let me know if you have any additional questions or concerns.

Sincerely,

Nathan M. Toothman
Owner

Disclaimer

This inspection report should not be considered a warranty or guarantee, implied or expressed, of the structure in general, including but not limited to the building superstructure, slabs, foundations, repairs recommended or repairs performed. Structures including but not limited to their foundations and slabs may be affected severely by changes in climate, land use, drainage, soil moisture conditions, soil characteristics, and other factors too numerous to list. The conclusions presented in this letter are based on the conditions visually observed during our visit. It is performed without the benefit of formal soils investigation, slope stability analysis, drainage analysis or similar studies. This letter is for use by the above named individual and is not to be used by any other individuals and is not transferable. Our opinions and recommendations are subject to change based on new information as it becomes available to this office.

Attachment 1 - Glossary of Terms (Page 1 of 2)

ANCHOR BOLT: A steel bolt anchoring a wood frame structure to the foundation. Current UBC Code requires anchor bolts at 6" centers and within 4" to 12" of the end of each sill board.

BEARING PILE: A shaft or column drilled or driven into the ground to act as a foundation by transferring the load that it supports to the very firm soil or bedrock on which it rests.

BEDROCK: The solid crust of the earth, which may be exposed at the surface or located several hundred feet below the surface.

CAP: A concrete pad that ties the top end of a pile group together either in a cluster or row, which in turn supports a column or wall.

CATCH BASIN: Surface drain inlet with grate (also "drop inlet").

COSMETIC: Minor distress that does not impact structural integrity, i.e. drywall cracks, door offsets.

CREEP: The slow down slope movement of near surface soils usually related to annual wetting and drying cycles of expansive clay soils or poorly consolidated fill.

CRIPPLE WALL: The wall in the crawl space of a home between the foundation and home's first floor.

CUT: The ground surface remaining after the removal of soil by excavation.

EARTH TO WOOD SEPARATION: Current UBC Code and good construction practice requires a 6" separation between soil and the wood elements of a home to minimize pest infestation and rot problems.

EFFLORESCENCE: An indication of excessive moisture resulting in a white salt deposit remaining on a concrete surface after repeated drying cycles (also calcium deposit).

END BEARING PIER: A drilled or driven shaft, extended to bedrock, providing foundation support.

EXCAVATION: The digging out and removal of soil from a site.

EXPANSIVE SOIL: A type of clay soil which expands when moisture is added and shrinks during drying cycles.

FILL: The material used to fill & level, or adjust the grade of, a sloping site or to rebuild the base of an excavation to the required height (imported, not native soil).

FINGER DRAIN: A finger drain is constructed much like a sub-drain, but is typically positioned in the sub-area, just inside the perimeter foundation. A finger drain is typically 8" wide and varies in depth from 6" to 15" and often outlets to an 18" diameter, 30" deep, cased sump that is provided with a float-switch activated pump.

FLOATING FOUNDATION: A continuous spread footing foundation that extends under an entire building replacing many separate footings (also "mat").

FLOOR JOISTS: any of the small timbers or metal beams ranged parallel from wall to wall in a structure to support a floor or ceiling.

FOOTING: The portion of the foundation that bears on the supporting soil.

FORM WORK: The temporary mold into which liquid concrete is poured to create a specific shape and the associated structure.

FOUNDATIONS: The structural system constructed below a building that transfers the vertical weight and lateral loads of the building to the ground on which it stands.

FOUNDATION WALL: A wall (usually poured concrete or concrete block) built below ground level to transfer the weight of the exposed wall it supports to the footing on which it rests (also stem wall).

FRICTION PIER: A drilled or driven shaft extended into the ground normally filled with reinforced concrete which provide support through friction between the piers surface and the soil.

FRICTION PILE: A shaft or column that is drilled or hammered into the ground until the pressure or friction developed between the pile surface and the soil into which it is forced (driven) enables it to become a firm foundation support on which, when combined or grouped with other piles, to build heavy structures.

GRADE: Soil surface or the inclination of a pipe or the property (also site slope). Grade is often expressed as a ratio of the horizontal to the vertical components of slope i.e. 2:1.

GRADE BEAM: A reinforced concrete foundation element used to distribute building loads to foundations piers and to interconnect the piers.

HONEYCOMB: Voids in concrete typically resulting from inadequate vibration during placement (also "popcorn concrete").

INVERT: The lowest point on the inside surface of a pipe or channel.

Attachment 1 - Glossary of Terms (Page 2 of 2)

LANDSLIDE: A slope failure resulting in the downward movement of a section of a hillside.

LATERAL LOAD: A horizontally applied force typically resulting from seismic loads on foundations and wind loads on walls.

PIER: A column or shaft (also caisson) in the ground that serves as a foundation constructed by drilling a hole and filling it with concrete and reinforcing steel.

PIPE PILES: A type of underpinning in which steel pipes are driven into the ground below an existing foundation to provide stable support (also mini-pile).

PONY WALL: A less than standard height stud wall (also known as a cripple wall). It is usually employed to provide support between the foundation and the floor on a sloping site.

REINFORCING: The deformed steel rods or mesh embedded in concrete to strengthen it.

RETAINING WALL: A wall built to retain soil or support a foundation on sloping ground. The Uniform Building Code requires walls over 4 feet to be designed by a licensed Civil or Structural Engineer.

SEISMIC STRAP: A steel strap used to restrain the structure or an element of the structure from the lateral forces developed during earthquakes by connecting the frame to the foundation (also "tie-down). The term used to describe the exact location of a building.

SHEARPLY: Plywood reinforcement used to improve the strength of stud walls to resist lateral loads (earthquake forces).

SHEAR TRANSFER TIE: A metal brace nailed into both the shear wall and the floor joists that allows the shear wall to support the house during the shaking of an earthquake.

SHEAR WALL: Sheets of plywood nailed to the studs of an exterior wall, such as a cripple wall, to provide bracing against the shaking forces of an earthquake.

SILL: The first wood element above the foundation (also mudsill).

SIMPSON: A manufacturer of steel connectors for wood frame construction.

SLAB: A flat, thin, horizontal concrete element.

SLIPOUT: A small slope failure that moves (also "mud flow").

SLOPE: The degree to which a surface tends upward or downward – see definition for GRADE

SOFT STORY: An open area, commonly a garage, at ground level with a room directly above it. Because of the garage door, one wall of the house can't be secured with shear wall.

SOIL PROFILE: A vertical cross-section drawing of the ground showing the type and depth of each layer of material between the surface and bedrock.

SPOT FOOTER: A spot or pad footing is used to support a single point of contact, such as under a pier or post.

SPREAD FOOTING FOUNDATION: A very common type of foundation that involves placing a wide flat concrete footing under the perimeter building walls distributing the weight over a greater area.

STANDING WATER: Water within the crawl space that has not evaporated or percolated away.

STEM WALL: The portion of the foundation above the footing that supports the wood frame by connection to the sill plate.

SUBDRAIN: A subsurface moisture collection system normally designed to cut off underground water flow (also "back drain", "curtain drain" or "french drain").

SWALE: Linear depression which forms a drainage channel.

UBC: Uniform Building Code; the code that each building permit authority uses as a basis for review and acceptance at residential design and construction (the code is updated periodically).

UNDERPINNING: Added foundation support placed under an existing building foundation.

WATERPROOF MEMBRANE: An impermeable barrier placed to prevent moisture intrusion.

WATER TABLE: The distance below the surface at which the soil is completely saturated with water. A perched water table can develop above the actual water table when a clay lens or other impermeable layer prevents or delays vertical percolation.

Attachment 2 - Drainage Illustrations

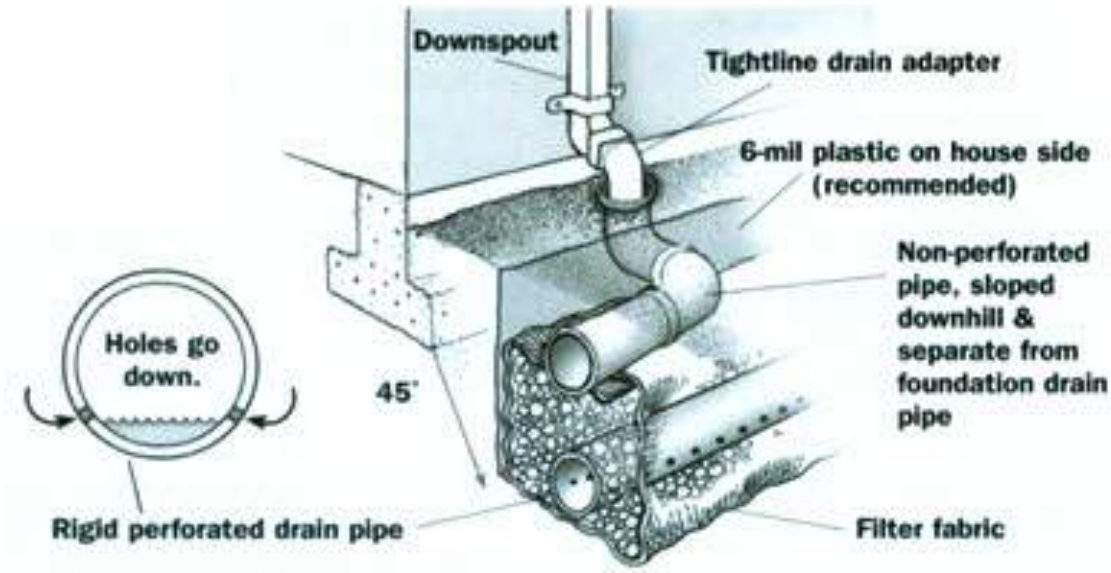


Fig 1 - Subsurface & Surface Drain Overview

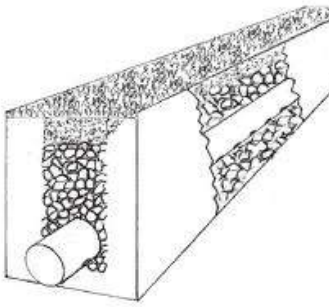


Fig 2 - French Drain

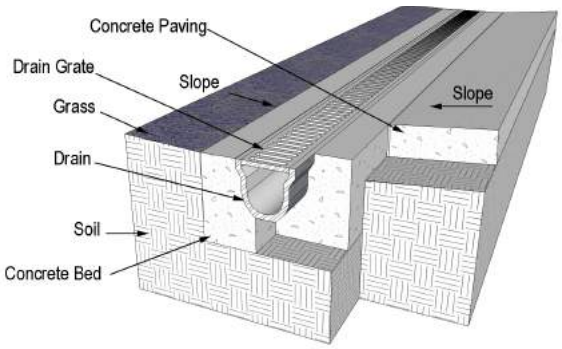


Fig 3 - Trench Drain

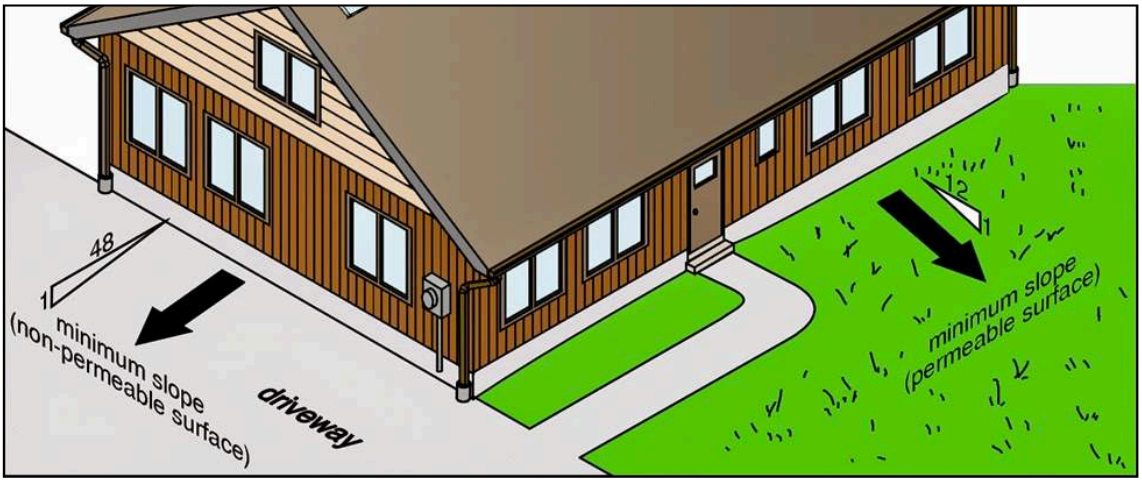


Fig 4 - Drainage Slope Relative To The Structure

Attachment 3 - Matrix of Possible Causes of Foundation Movement

Low Bearing Capacity Soils Some soils are not capable of supporting the weight or bearing pressure exerted by a building's foundation.	✗
Poor Fill Compaction In some cases lots are created by adding soils brought in from off-site locations or cutting one area of the hillside and filling another to create a more level lot and when fill soils are not adequately compacted, they can compress under a foundation load.	✗
Excessive Moisture Content Excess moisture can saturate foundation soils, which often leads to softening or weakening of clays and silts. The reduced ability of the soil to support the load results in foundation movement and/or cracking. The moisture is often a consequence of poor surface drainage around the structure, leaks in water lines or plumbing, or a raised groundwater table.	✓
Expansive Soils Expansive soils will swell when wet and contract when dry.	✓
Lateral Sliding/Soil Creep Soil creep is caused by slow downward movement of expansive soils under the influence of gravity and the effect of moisture changes. The depth to which this occurs varies depends on moisture amounts and soil types but can often times extend down below the depth of most shallow foundations.	✗
Insufficient Footers Sometimes footers are either nonexistent, designed too small for the current loads or not built to the design at the time and hence have inadequate bearing capacity.	✗
Soil Consolidation Consolidation occurs when the weight of a structure or newly-placed fill soils compress lower, weak clay based soils. Consolidation results in downward movement or settlement of overlying structures. Settlement caused by consolidation of foundation soils may take weeks, months, or years to be considered "complete."	▬
Soil Compaction Vibration from heavy equipment or vehicular traffic.	✗
Seismic Activity Vibration from seismic activity.	▬
Impact from Trees As trees mature, their demand for water also grows and the root systems continually expand and can draw moisture from the soil beneath the foundation. Clay-rich soils shrink as they lose moisture, resulting in settlement of overlying structures. Foundations closer to the surface are more often affected by soil dehydration due to tree roots than are deep, basement level foundations.	✗
Soil Erosion Most likely causes include poor surface drainage, faulty drains, leaking water mains or other underground water movements.	✗
Apparent Settlement Due to Construction This is where the area in question was built with a slope to it, greater than normal such that it looks as if it has settled when in fact it may not have moved.	✗

✗ Unlikely to be contributing based on data available at the time of the inspection

✓ Likely contributing

▬ Possibly contributing but further data, analysis (soils report) or history would be needed to say for sure