OWNER'S GUIDE TO A BETTER FOUNDATION

by
The Structural Committee

of
The Foundation Performance Association

Houston, Texas

www.foundationperformance.org

Document # FPA-SC-20-0

ISSUE HISTORY (Some internal committee issues omitted)

Rev #	Date	Description	Subcommittee Chair	Subcommittee Members
A	1 Oct 13	For Committee Review	Gary Beck	Adam Bakir Gerard Duhon Jim Dutton Dan Jaggers Ron Kelm Michael Skoller
Q	8 Sep 15	Issued for FPA Peer Review		
T	20 Nov 15	Issued for 2nd FPA Peer Review		
U	11 Dec 15	For FPA Peer Reviewers Meeting		
V	22 Dec 15	For FPA Peer Reviewers Meeting		
W	2 Feb 16	For FPA Peer Reviewers Meeting		
0	25 Feb 16	Issued for Website Publishing		

PREFACE

This document was created by the Structural Committee and has been peer reviewed and accepted by the Foundation Performance Association (FPA). This document is published as FPA-SC-20 Revision 0 (i.e., FPA-SC-20-0) and is made freely available to the public at http://www.foundationperformance.org/committee_papers.cfm so all may have access to the information. 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 at 1, 2, etc.

Portions of the text in the main body of this document have been rearranged into two other document types the subcommittee decided could be more useful to certain users. These other document types are a two-page trifold flyer (PDF) and a slide presentation (available both as a PDF and as an online presentation). Both PDF documents are included in the appendix and considered to be part of this peer review. The trifold flyer in Appendix A is a checklist and the presentation graphics in Appendix B were slides from an animated online presentation produced by the subcommittee. While the presentation snapshots contain graphics that may help the reader of this document understand its contents, the actual online presentation may be different than the Appendix B snapshots as it can be revised by the Structural Committee from time to time without revising this peer reviewed document.

The Structural Committee is a standing committee of the FPA. At the time of writing this document, the Structural Committee was chaired by Ron Kelm with 50 to 60 members being active on the committee. The Structural Committee sanctioned this project on 24 April 2013, formed an ad hoc subcommittee to write this document with Gary Beck as chair, and provided oversight of the subcommittee throughout this document's development and publication. The subcommittee's chair(s) and members are listed on the cover sheet of this document and are considered this document's co-authors.

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

This subcommittee's goal was to create a simple language trifold flyer with an online presentation about the care of foundations that can be understood by the non-engineering public. This work is supported in this more detailed document. The intended audiences for the use of these documents are the owners and tenants of residences and other low-rise buildings located in areas of shrink-swell soils. The documents may also be helpful to architects, builders, contractors, designers and engineers. An effort was made to reference the 2015 International Residential Code (IRC) guidelines, some of which have significantly changed when compared to the 2009 and earlier IRC versions. Online searches could lead to the online presentation, trifold flyer, and this document located on the FPA website.

These documents were created with generously donated time in an effort to advance the knowledge, performance, design, engineering, construction, and repairs related to

foundations, soil, and structures. Notably, this subcommittee held many meetings online through use of virtual meeting software. The text in this document represents the opinions of a majority of the subcommittee members and may not necessarily reflect the opinion of every subcommittee member or FPA member at the time of, or since this document's publication. The FPA 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 or the online presentation. Each project should be investigated for its individual characteristics to permit appropriate application of the material contained herein.

Please refer to the FPA's website at
http://www.foundationperformance.org/committee_papers.cfm
for other information pertaining to this publication and other FPA publications.

TABLE OF CONTENTS

GLOSSARY

The following glossary terms were developed for this document. Some items were taken from FPA-SC-17-0 (see http://www.foundationperformance.org/committee_papers.cfm), an FPA paper called "Drainage Guidelines" created for the construction industry, plus added or modified glossary terms provided by the subcommittee.

Basin, Detention Basin – A natural or excavated depression in the surface of the land used for temporary or permanent water storage.

Cistern – A waterproof receptacle designed or constructed to catch and store rainwater, generally for non-potable water used for Landscaping.

Daylight – Terminating a drainage pipe to the open air for the purpose of disposal. An example would be a storm water pipe Discharging though a curb into the street gutter.

Detention – A storm water Mitigation requirement designed volume such as a Basin, pond, or Swale that receives and temporarily holds a specific volume of storm water before releasing the water at a controlled rate into a Drainage System.

Discharge – Exiting of water flow from a drainage device such as a drainage pipe.

Disposal, dispose, disposal point – The Discharge of water flow to a storm water Drainage System such as a Drainage Ditch, storm sewer Inlet, Detention Basin, Dry Well, remote area, or other drainage components.

Ditch – A Graded and sloped drainage depression, often along a street, designed to detain or carry storm water to a storm water system.

Drainage Components

> **Area Drain (Surface Drain, Field Drain)** – A protected Inlet connected to underground piping for collecting surface water used to convey water away for purposes of drainage. Can be located in a grass or paved area.
>
> **Catch Basin** – An accessible storm water collection and junction box or cylinder that can capture and hold debris, soil, and silt in order to help reduce clogging of a Drainage System.
>
> **French Drain** – An underground system designed to collect and convey subsurface water.
>
> **Drain, Trench** – A sloped channel with near vertical sides, often filled with bull-rock or smooth gravel. Trench Drain centerlines are typically sloped 2% if less than 10' from foundation, otherwise as low as 0.25%. A higher slope will carry more storm water.
>
> **Drainage Ditch** – Typically a county-managed storm water drainage channel located at the side of a street designed to hold storm water until it can flow to a downstream storm sewer Inlet, channel, bayou or river. Drainage Ditches may have very low slopes such as 0.1% (6 inches per 500 feet) or less.

Drainage System (Drainage Infrastructure) – A system that accepts storm water runoffs from many properties. Drainage Infrastructure components may include street side storm

sewer Inlet grates, street side curb and Gutter, Ditches, Detention Basin, and Retention Basins.

Drip Line – An imaginary line at the edge of a tree's leaf canopy that for some situations can provide an approximation of the extent of that tree's roots.

Drip Irrigation – An irrigation method that saves water by providing small amounts of water directly to Landscaping.

Drop – Elevation difference from a water collection point to the water Discharge point.

Expansive Soil, Shrink-Swell– Typically a high clay content soil that is prone to significant volume changes (swelling and shrinking) with moisture changes. Expansive Soil can expand with enough force to lift a house. If moisture is concentrated in one area, that area may lift a foundation unevenly, possibly causing distress.

Flatwork – A common term for concrete surfaces used for driveways, patios, and sidewalks.

Foundation – The lowest load bearing part of a building.

Grade (Noun) The drainage surface of the ground (soil or sod, but not mulch or gravel, etc.)

(Verb, also Grading) To Landscape or modify the slope of soil or sod surface.

Gutter

Gutter, Roof or Rain – A near horizontal roof edge rainwater collector.

Gutter, Street – A drainage area formed by the street edge and the curb that normally carries water to a storm sewer street Inlet.

Hardscaping – Impervious site design elements including pavers, flagstone, Flatwork, masonry, rocks, gravel, fountains, pools, and pool patios, etc.

Inlet – A water entry or inflow point for a Drainage System.

Landscape, Landscaping – Alteration of ground surface by adding or removing material including soil, rock, pavement, Flatwork, and/or plants.

Mitigation – A design and planning practice to help resolve storm water run-off and drainage issues with the goal of preventing flooding. Mitigation calculations are normally prepared by an engineer.

Outflow (Outfall) – The location where a drainage pipe or Ditch Discharges into a storm water system.

Pervious/Impervious, Permeable/Impermeable – Characteristic of a surfacing material, product, or soil. Impervious surfaces will not allow water to pass through. Pervious surfaces will allow water to pass through.

Root Barrier – A physical or chemical deterrent installed to restrict tree root growth in a specific direction. Root Barriers may be set adjacent to the structure being protected, or may be placed in a half moon shape or a linear shape between Foundations and the tree roots they are intended to limit.

> **Root Barrier, Chemical** – A Permeable barrier combined with a long-lasting chemical deterrent designed to inhibit the growth of roots. Typically applied between 24" to 36" into the ground.
>
> **Root Barrier, Physical** – An Impermeable (solid) barrier that is usually 15 to 60 mil thick plastic, corrosion resistant metal, or reinforced concrete. Typically set between 24" to 36" into the ground. Solid Root Barriers will limit groundwater movement across the barrier.

Root Range – The extent of roots from the tree trunk. Without site investigation, a tree's Root Range may be expected to be at minimum to the canopy Drip Line and could extend well beyond this point, depending on the species.

Swale – An open sloped channel. A residential Swale is typically an open sloped "V" shaped channel constructed to ensure drainage away from the Foundation. Swales can be grass or gravel lined.

Topographic Data – General or relative site elevation data collected onsite or online recording differences in the elevations (Topography) between site grades, structures, street curbs, or Gutters. Topographic data is used to create drainage plans, grading plans, and landscaping plans.

Topographic Survey – A Surveyor-sealed survey document that includes a site's elevation data presented as points placed on a grid, typically 25' x 25', often with references to the elevations of structures, build-lines, street curbs, Gutters, and street crowns. Additional Topographic Data may include contour lines, location and types of trees, and infrastructure items like the elevation of a sanitary manhole rim within 100' of the site borders.

Topography – A description of the surface elevation features of land.

Trees and Foliage

> **Tree, Large** –Trees (ash, oak, pecan, pine, sycamore, etc.) forming high tree crowns or canopies can spread 30' to 50' in diameter with heights typically to 50'+.
>
> **Tree, Small (Understory)** – Includes ornamentals, (e.g. crepe myrtles, palm) and fruit trees. Small trees typically have a ball root shape spreading out from the base of the trunk that does not migrate far from the trunk. Branches are generally located below the elevations of Large Trees. Mature crowns can spread 10' to 20' in diameter with heights typically 10' to 20'.
>
> **Bushes and Shrubs** – Smaller ornamentals (e.g. holly, hedges, flowering Bushes) may have a root system spreading out from the base of the trunk. These woody plants can have many stems arising at or near the base that can create dense foliage due to leafy branches growing close together.

1.0 INTRODUCTION

Homeowners and owners of other low-rise buildings regularly make Landscaping and Hardscaping changes to their property. Often these changes alter the drainage patterns around the Foundation. If the soil type is sensitive to moisture changes, the soil can expand or contract, and/or lose bearing capacity. Any of these can adversely affect the performance of the Foundation.

This document was written to assist owners in making decisions affecting their lot, Foundations, and structures. This document is separated into the following sections:

A link to a page containing a link to the original FPA-SC-20 animated slide presentation, which may change, is: http://www.foundationperformance.org/committee_papers.cfm

2.0 DRAINAGE AND SITE PLANNING BULLET POINTS

2.1 THINGS THAT CAN DAMAGE FOUNDATIONS AND STRUCTURES

2.1.1 Drainage

Drainage of surface water away from the Foundation is critical to good long-term performance. For new projects, roof and site drainage needs to be designed and coordinated with other underground utilities and with the locations of Foundations and Flatwork. Typical methods include sloping the Grade and Flatwork away from the Foundation, adding an underground Drainage System, or creating Swales to carry storm water away from the Foundation. For additional methods of site drainage refer to FPA-SC-17 (see http://www.foundationperformance.org), an FPA paper called "Drainage Guidelines".

Water remaining near Foundations for an extended period can be harmful to Foundations. Examples are:

- Water draining towards or ponding at or near the Foundation edge.
- Leaking water near or under the Foundation.
- Sprinkler system leaks near the Foundation.
- HVAC condensation lines Discharging at the Foundation edge.
- Excessive or uneven watering by any means.
- Leaking sewer line or water line under the Foundation or crawl space.
- A pool or pool piping leaking near the Foundation.
- Roof drainage collecting near the Foundation.
- Gravel or bull rock beds adjacent to or near the Foundation.
- Use of slotted drain pipe as downspout extenders instead of solid pipe.

Examples of possible solutions include:

- Consulting with a Professional Engineer.
- Control of roof rainwater flow such as by dispersion or by design.
- Adjusting Gutter downspout Discharge to flow away from Foundation edges.
- Adding rainwater harvesting system(s).

2.1.2 Poorly performing Landscape irrigation systems

Do not allow irrigation systems to overwater soil near the Foundation. Eliminate irrigation systems or sprinkler patterns that apply water to areas such as Flatwork and gravel beds. For new projects, sprinkler pipe routing needs to be designed and coordinated with the locations of Flatwork.

Examples of possible solutions include:

- Pointing sprinkler spray heads out and away from Foundations.
- Use of properly designed and located Drip Irrigation systems to limit water usage and overwatering.
- Limit overwatering through monitoring.

- Install a properly programmed system that utilizes soil moisture sensors and or a rain sensor.
- Minimize leaks through use of higher quality piping systems such as Schedule 40 PVC instead of thinner or more flexible piping.
- Check valve box connections for leaks.
- Consider a maintenance contract with your sprinkler contractor to check for leakage and sprinkler orientation.
- Pressure test lines every two years.

2.1.3 Water from Flatwork (driveways, sidewalks, patios)

All paving and Flatwork should drain away from the Foundation. If less than 10’ from a Foundation, and especially for sites located in Expansive Soil, the Subcommittee recommends using a slope of 2% away from Foundation (2" Drop per 8'). Typical design considerations would include a stable and compacted base material (not sand) to help limit future vertical movement causing slope changes. If 2% is impractical, lower slopes such as 1% or lower may be used, or a side slope can be used to drain to the adjacent grade.

2.1.4 Seal between Foundation and Flatwork

Paving and Flatwork joints next to your Foundation should be sealed. Sealing can prevent water penetration between the Flatwork (patios, pool decks, walkways, and driveways) and the Foundation edge.

2.2 TREES, FOLIAGE, AND LANDSCAPING

Planting trees and plants too close to your Foundation may become harmful due to removal of increasing amounts of soil moisture by the tree as it matures. A larger tree can be expected to have a larger Root Range. Large roots can also directly lift and even break portions of Foundations. Improper removal of trees may later cause soil to heave. New pier & beam crawl space structures may be less damaging to existing nearby trees. It is the owner’s responsibility to manage the effects of trees and Landscaping on the Foundation. The following is provided for guidance:

2.2.1 Large or Canopy Trees

Ideally locate Large/Canopy Trees (20’ to 50’+ ash, oak, pecan, pine, sycamore, etc.) 12’ minimum from your Foundation's edge. In Expansive Soil, the owner may consider the installation of a Root Barrier to help minimize future Foundation movement.

2.2.2 Small or Understory Trees

Ideally locate Small Trees (10’ to 20’ tall ornamentals, fruit trees, etc.) 8’ minimum from Foundations. If Small Trees exist or are desired closer on lots with Expansive Soil, the owner may consider the installation of a Root Barrier to help minimize future Foundation movement.

2.2.3 Bushes and Shrubs

Smaller ornamental Shrubs and Bushes (4' to 10' tall crepe myrtles, holly, hedges, flowering Bushes etc.) may have a migrating root spreading out from the base of the trunk. If kept small, these plants usually do not affect Foundation performance but should be kept 2' minimum from Foundations for ease of maintenance access for Landscaping and pest control.

2.2.4 Tree, Foliage, and Landscaping Distance Summary Table

Mature Heights	Suggested Planting Distances from Structure
Large/Canopy Trees 20' to 50'+ tall	12' Minimum
Small/Understory Trees 10' to 20' tall	8' Minimum
Shrubs/Bushes 4' to 10' tall	2' Minimum

2.2.5 Root Barriers

1. Solid (Physical) Root Barriers are usually made of 15 to 60 mil thick plastic, corrosion resistant metal, or reinforced concrete. Joints should be sealed. Note that solid Root Barriers will also limit water movement across the barrier.
2. Chemical Root Barriers are normally a grid or net material with herbicide to limit root growth without otherwise harming the tree or limiting natural groundwater movement.
3. Root Barriers are installed beginning at or just below Grade and typically extend 24" to 36" into the ground, but can be shallower or deeper. Roots can go deeper than Root Barriers, but most Roots will typically will stay closer to Grade to gather water and nutrients.
4. Root Barriers may be set adjacent the structure being protected, or may be placed in a half moon shape or a linear shape adjacent to the tree roots they are intended to limit.

2.3 ROOFS, POOLS, AND LANDSCAPING

2.3.1 Roof Drainage

1. Roofs on Expansive Soil sites should use a controlled method of water disposal to the ground surface not less than 5' from the Foundation edge. (from 2015 IRC R801.3)
2. Control roof rainwater flow by dispersion or by collection and piping.
3. Locate Gutter downspouts to allow for Outflow away from Foundations.
4. Use Gutter downspout extenders that drain to Daylight at least 5 feet from the Foundation edge, or connect downspouts to underground drainage piping.

5. Downspouts can directly Outflow onto properly sloped Flatwork, or can be dispersed by splash blocks that Outflow to a point of positive drainage away from the Foundation.
6. Roof rainwater can be harvested and stored in Cisterns with overflow piping that Outflows at least 5 feet from the Foundation.

2.3.2 Pool Designs

1. Pool patios and similar Flatwork are to be designed to drain away from the house. If located within 10' of a Foundation, and especially for sites located in Expansive Soil, the recommended Flatwork slope is a 2-inch Drop per each 8 feet (a 2% slope). If 2% is impractical, lower slopes such as 1% or lower may be used, or a side slope can be used to drain to the adjacent grade.
2. Flatwork should Discharge into a Swale or other drainage element, or should Discharge greater than 5' from the Foundation, where the water should then continue to drain away.
3. Typical design considerations for flatwork should include a stable and compacted base material (not sand) to help limit future vertical movement causing slope changes.
4. Surface or slotted patio drains should be installed between the pool and the structure, but not immediately next to the Foundation. If used, these should be piped to Discharge 5' or more from the Foundation, where the water should then continue to drain away.
5. Pool drain pipes must be glued or gasketed (not dry fit) and should drain away from the Foundation.
6. Pool Landscaping soil should have a drainage path away from Foundations. If not, water can become trapped between the pool and the Foundation. Avoid saturating the soil and trapping water between the pool and the Foundation.

2.3.3 Landscaping and Grading

1. The top of the finished Landscaping surface (mulch, turf, soil) is recommended to be at least 6" below the top of a Foundation. The 2015 International Residential Code (R401.3) recommends that the Grade shall fall a minimum of 6" within the first 10 feet. If a 6" fall within 10' (a 5% slope) is not possible (e.g., the property line is only 5' from the Foundation), the available Landscaping should fall 6" in the available distance, or should drain away from the Foundation at 5% slope, to a Swale that ideally drains away at a 1% slope (1' Drop per each 100' of length) until it is 10' away from a Foundation. Swales can otherwise drain at slopes as low of 0.25% (1.5" Drop per each 50'). Properly designed drains or Flatwork may also be used for drainage away from the Foundation.
2. Before adding mulch, Grade and compact the natural ground at the Foundation so water easily flows away from the Foundation. Then place mulch no higher than 6" below the top of Foundation.
3. Bull-rock or gravel beds next to Foundations in Expansive Soil should be avoided because they will hold water next to the Foundation possibly causing clay soils to expand and unevenly lift Foundations.

4. Landscape drain piping located closer than 10' from a Foundation should be solid pipe. Slotted or perforated drain pipe should never be used closer than 10' from the Foundation, unless designed by an engineer.
5. In flood prone areas, for elevated structural floors, the Grade under the first floor requires a method to drain. This can be accomplished by raising the crawl space Grade 4" above the final exterior Landscaping surface (mulch, turf, soil). Flood openings can then drain flood water from within the crawl space areas.
6. In flood prone areas, the bottoms of crawl space flood vent openings cannot be higher than 12" above the highest adjacent Grade. (Refer to 2015 International Residential Code paragraphs R321 and R322).

2.3.4 Storm Water Drainage

1. Excess storm water typically drains off of a site into a Drainage System that is part of a larger Drainage Infrastructure. All storm water run-off will eventually flow to a river, estuary, bay, or ocean. Care should be taken to avoid clogging or contaminating Drainage Ditches and storm sewers with trash, leaves, oil, or chemicals.
2. An engineered drainage plan may be required for sites in a 100-year flood plain. The engineer may need to develop Topographic Data or may require use of a Topographic Survey.
3. Water should not pond or create erosion near the Foundation.
4. Rainwater Discharged by Gutter downspouts should easily drain along the Grade away from Foundations or connect to non-perforated drain pipes that are located either above or below Grade.
5. Downspout drains and French drains should not share a common pipe that would allow roof water to backup into French drains and saturate the soil.
6. Underground drainage piping should have positive slopes. This is especially important for drainage piping located in Expansive Soil. If practical, the subcommittee recommends that 3 to 6-inch drainage pipe slope at a minimum of 1/8" per foot (~1% slope). If impractical, drainage pipe may be sloped less than this, if design considerations include clean-out openings and/or catch basins for owner maintenance to prevent clogging by leaves, debris, soil, or silt. Engineers can make recommendations for specific pipe size, type, and slope based on project requirements.
7. Grading and Landscaping should drain away from Foundations. See Landscaping and Drainage Section 2.3.3.
8. A combination of Swale slopes may be used along the Swale. An example is a lower slope (0.25%) Grade in a rear yard, Outflowing to a higher slope (1%) Swale or Trench Drain within 10' of Foundations, Outflowing to a low slope (0.25 to 0.5%) for front yards draining towards a Ditch or street Gutter.
9. FPA-SC-20 provides general information and the subcommittee's interpretations of building codes and best-practices. The subcommittee recommends to always consult with a professional engineer for resolution of Foundation issues, drainage issues, or for the design of a specific drainage system.

3.0 TRIFOLD CHECKLIST ITEMS

Included in this section is a concise checklist of items, described in more detail in Section 2, that an owner can check in order to help improve the performance of the Foundation. The below checklist items have been compiled into a 2-page printable trifold flyer and included in Appendix A. (Checklist items copied from page 1 of the trifold flyer)

---------- (Page 1) ----------

Owner's Guide Check List

REVIEW 'GENERAL CHECK & REPAIR', THEN VISIT OTHER SECTIONS FOR MORE DETAIL

☺*Great!* 😐 *Good* ☹*Fix It!* ⓘ *Info*

---

1. GENERAL CHECK & REPAIR

☐ ☹ Does water drain towards or pond at the foundation edge?

☐ ☹ Is rain water from the roof or from a gutter downspout causing erosion?

☐ ☹ Does an air conditioner drain adjacent to the foundation?

☐ ☹ Is there a leaking sewer or water line near or under foundation?

☐ ☹ Is there a pool or pool piping leak?

2. IRRIGATION SYSTEMS

☐ ☹ Are drip irrigation lines too close to foundations, or do sprinkler heads spray on foundations?

☐ ☹ Are irrigation systems or sprinkler systems ponding near the foundation? (Check valve boxes)

☐ ☺ Is a soil moisture or rain sensor installed? ☐☹ No (ⓘ Overwatering?)

☐ ☺ Is the controller properly programmed

☐ ☹ Under-watering or Over-watering?

3. PAVING AND FLATWORK

☐ ☺ Does all paving and flatwork drain away from the foundation? ☐☹ No

☐ ☺ Are paving and flatwork joints sealed next to your foundation? ☐☹ No

---

☐ *All* ☹ *items have been fixed =* ☺

---------- (Page 2) ----------

Owner's Guide Check List

4. POOLS & POOL PATIOS

☐ ☺ Pool patios <10' from foundations should slope away at 1" to 2" per 8' (1% to 2%) and then discharge 5' away.

☐ ☺ Surface or slotted drains, if used, discharge 5' or more from the foundation.

☐ ☺ Pool piping is glued or gasketed, not dry fit, and pressure tested before completion of installation.

☐ 😐 Pool landscaping soil has a drainage path away from foundation. ⓘ If not, the soil can become saturated between pool and foundation. ☹

5. TREES & VEGETATION

☐ Large trees (Mature height 20' or taller)

😐 Plant 12' to ☺ 20'+ from foundation.

☐ Small trees (Mature height 10' to 20')

😐 Plant 8' to ☺ 12'+ from foundation.

☐ Shrubs & bushes (Mature height 4' to 10')

😐 Plant 2' to ☺ 8' + from foundation.

☐ Flowering plants & herbs - can plant ☺ close to foundations (ⓘ allows better maintenance access).

☐ Also use grass, mulch, and annuals for < 2'. ☺

ⓘ New pier & beam crawl space structures may be less damaging to existing nearby trees.

6. ROOT BARRIERS

☐ Are solid root barriers planned by the owner?

☐ Are chemical root barriers planned by the owner?

☐ Are root barriers to be installed by the owner at the time of planting? __24" __30" __36" deep.

☐ ☹ Are large trees planted closer than 12' from foundations without root barriers?

☐ *All ☹ items have been fixed =* ☺

---------- (Page 3) ----------

Owner's Guide Check List

7. LANDSCAPING & GRADING

ⓘ The lowest floor should be 6" or more above the adjacent landscaping soil or mulch. This can be 12"+ above the foundation supporting grade.

ⓘ For a crawl space foundation, landscaping soils / mulch should be 6" or more below flood vents.

ⓘ In flood prone areas, the first floor level should be at least 12" higher than the base flood elevation.

ⓘ Water < 10' from a foundation should flow away using: (a) a minimum protective slope of a 6" fall within the first 10' (a 5% slope); or (b) a 1% to 2% slope for impervious surfaces; or (c) 3" to 6" drainage piping slopes at 1/8" per foot (a 1% slope).

ⓘ Compacted clay soil used under landscaping beds should drain away as described above.

☐ ☺ Landscaping drains away from foundation.

☐ ☺ Rock / Gravel beds are not next to foundation. ☐ ☹ Landscaping does not drain correctly.

8. STORM WATER DRAINAGE

ⓘ Is an engineer stamped drainage plan required ?

☐ Does rainfall either pond or create erosion near the foundation? ☐☹ Yes ☐☺ No

☐ Do downspouts connect to pipes or swales?

☐ ☹ No. ☐😐 No, splash blocks are used.

☐ ☺ The drainage plan is engineer sealed.

☐ Does the roof's storm water drain 5' away ?

☐ ☹ No. ☐☺ The site drains away from the foundation. The grade falls 6" within 10' (a 5% slope), or all flatwork slopes 1" to 2" per 8' (1% to 2% slope). Drainage piping slopes at 1/8" per ft (1%), or it has catch basins and clean-outs for owner maintenance.

All ☹ items have been fixed = ☺

APPENDIX A – TRIFOLD FLYER

The following two pages in this appendix are intended to be printed in color on the front and back sides of a standard letter-size sheet of paper, that can be folded into a trifold flyer. This trifold flyer is a stand-alone checklist that can be used or applied separately from this document.

A guide of common items and practices that need to be done properly to avoid damaging a foundation.

Learn about what should be fixed right away. Read best practices for sprinklers, paving, pools, and patios. Understand preferred tree locations and how to use root barriers. Become more knowledgeable on grading and storm water drainage.

Use this checklist for discussions with:

- Designers
- Engineers
- Builders
- Pool Contactors
- Landscaping Contractors
- Foundation Contractors

For more information and details, read the FPA-SC-20-0 *"OWNER'S GUIDE TO A BETTER FOUNDATION"* paper and presentation at foundationperformance.org published 25 February 2016

Surface water management and soil moisture changes are at the core of many foundation issues.

Whether dealing with an existing foundation or planning for foundation, use this checklist to help better manage these issues.

This FPA-SC-20 Tri-Fold provides check list information as the subcommittee's interpretations of building codes and best-practices.

We recommend to always consult with a professional engineer for foundation issues, drainage issues, or for the design of a specific drainage system.

This **OWNER'S GUIDE TO A BETTER FOUNDATION** Checklist is associated with the FPA-SC-20 Presentation and Paper developed by The Structural Committee of the Foundation Performance Association of Houston, Texas
foundationperformance.org
View the FPA-SC-20 Presentation
www.foundationperformance.org

OWNER'S GUIDE TO A BETTER FOUNDATION

☑ CHECK LIST FLYER

The Structural Committee of The Foundation Performance Association of Houston, Texas

Owner's Guide Check List

REVIEW 'GENERAL CHECK & REPAIR', THEN VISIT OTHER SECTIONS FOR MORE DETAIL

☺Great! 😐Good ☹Fix It! ⓘInfo

1. GENERAL CHECK & REPAIR

☐ ☹ Does water drain towards or pond at the foundation edge?

☐ ☹ Is rain water from the roof or from a gutter downspout causing erosion?

☐ ☹ Does an air conditioner drain adjacent to the foundation?

☐ ☹ Is there a leaking sewer or water line near or under foundation?

☐ ☹ Is there a pool or pool piping leak?

2. IRRIGATION SYSTEMS

☐ ☹ Are drip irrigation lines too close to foundations, or do sprinkler heads spray on foundations?

☐ ☹ Are irrigation systems or sprinkler systems ponding near the foundation? (Check valve boxes)

☐ ☺ Is a soil moisture or rain sensor installed? ☐☹ No (ⓘ Overwatering?)

☐ ☺ Is the controller properly programmed

☐ ☹ Under-watering or Over-watering?

3. PAVING AND FLATWORK

☐ ☺ Does all paving and flatwork drain away from the foundation? ☐☹ No

☐ ☺ Are paving and flatwork joints sealed next to your foundation? ☐☹ No

☐ *All ☹ items have been fixed =* ☺

Owner's Guide Check List

4. POOLS & POOL PATIOS

☐ ☺ Pool patios <10' from foundations should slope away at 1" to 2" per 8' (1% to 2%) and then discharge 5' away.

☐ ☺ Surface or slotted drains, if used, discharge 5' or more from the foundation.

☐ ☺ Pool piping is glued or gasketed, not dry fit, and pressure tested before completion of installation.

☐ 😐 Pool landscaping soil has a drainage path away from foundation. ⓘ If not, the soil can become saturated between pool and foundation. ☹

5. TREES & VEGETATION

☐ Large trees (Mature height 20' or taller)

😐 Plant 12' to ☺ 20'+ from foundation.

☐ Small trees (Mature height 10' to 20')

😐 Plant 8' to ☺ 12'+ from foundation.

☐ Shrubs & bushes (Mature height 4' to 10')

😐 Plant 2' to ☺ 8' + from foundation.

☐ Flowering plants & herbs - can plant ☺ close to foundations (ⓘ allows better maintenance access).

☐ Also use grass, mulch, and annuals for < 2'. ☺

ⓘ New pier & beam crawl space structures may be less damaging to existing nearby trees.

6. ROOT BARRIERS

☐ Are solid root barriers planned by the owner?

☐ Are chemical root barriers planned by the owner?

☐ Are root barriers to be installed by the owner at the time of planting? __24" __30" __36" deep.

☐ ☹ Are large trees planted closer than 12' from foundations without root barriers?

☐ *All ☹ items have been fixed =* ☺

Owner's Guide Check List

7. LANDSCAPING & GRADING

ⓘ The lowest floor should be 6" or more above the adjacent landscaping soil or mulch. This can be 12"+ above the foundation supporting grade.

ⓘ For a crawl space foundation, landscaping soils / mulch should be 6" or more below flood vents.

ⓘ In flood prone areas, the first floor level should be at least 12" higher than the base flood elevation.

ⓘ Water < 10' from a foundation should flow away using: (a) a minimum protective slope of a 6" fall within the first 10' (a 5% slope); or (b) a 1% to 2% slope for impervious surfaces; or (c) 3" to 6" drainage piping slopes at 1/8" per foot (a 1% slope).

ⓘ Compacted clay soil used under landscaping beds should drain away as described above.

☐ ☺ Landscaping drains away from foundation.

☐ ☺ Rock / Gravel beds are not next to foundation

☐ ☹ Landscaping does not drain correctly.

8. STORM WATER DRAINAGE

ⓘ Is an engineer stamped drainage plan required ?

☐ Does rainfall either pond or create erosion near the foundation? ☐☹ Yes ☐☺ No

☐ Do downspouts connect to pipes or swales?

☐☹ No. ☐😐 No, splash blocks are used.

☐☺ The drainage plan is engineer sealed.

☐ Does the roof's storm water drain 5' away ?

☐☹ No. ☐☺ The site drains away from the foundation. The grade falls 6" within 10' (a 5% slope), or all flatwork slopes 1" to 2" per 8' (1% to 2% slope). Drainage piping slopes at 1/8" per ft (1%), or it has catch basins and clean-outs for owner maintenance.

All ☹ items have been fixed = ☺

APPENDIX B – PRESENTATION SLIDES

The latest FPA-SC-20 animated presentation can be viewed via a link that can be found on the FPA website (http://www.foundationperformance.org/committee_papers.cfm).

This online presentation is also accessible remotely by any smartphone, tablet, or PC.

The slide copies that follow were created from the FPA-SC-20 online presentation are only provided as a record and graphical aid for this document, but the static slides will not be as clear or informative as the sequenced animated slide presentation.

While these graphics were taken from the subcommittee's online presentation at the time of this document's publication, these graphics may not exactly match the slides contained in the online presentation, which is an online learning tool that can be revised from time to time.

The Foundation Performance Association presents...

OWNER'S GUIDE TO A BETTER FOUNDATION

To view press your L or R keyboard cursor keys

or download the Prezi Phone App

Prezi

First, some words about the FPA...

FOUNDATION PERFORMANCE ASSOCIATION

The FPA advances knowledge, engineering, construction, and repair of foundations and low-rise structures.

FPA Members are involved in design, construction, inspection, repair, and forensic investigation.

The FPA hosts events, seminars, and sponsors technical papers like this presentation and supporting documents.

www.foundationperformance.org

Next, an FPA-SC-20 disclaimer...

FOUNDATION PERFORMANCE ASSOCIATION

This FPA-SC-20 presentation provides very general information and the subcommittee's interpretations of building codes and best-practices.

We recommend to always consult with a professional engineer for specific foundation issues, drainage issues, or for detailed design of a drainage system.

www.foundationperformance.org

Key Foundation Concepts

1. Foundations are soil supported.
2. Moisture changes shrink/swell soil.
3. Water management is important!

SOIL MOISTURE CHANGES CAN CAUSE SOIL SHRINK-SWELL MOVEMENT WHICH CAN CAUSE FOUNDATION MOVEMENT

Introduction

Whether dealing with an existing foundation, or planning for a new foundation, you should understand what can effect its performance.

Use this information for discussions with:

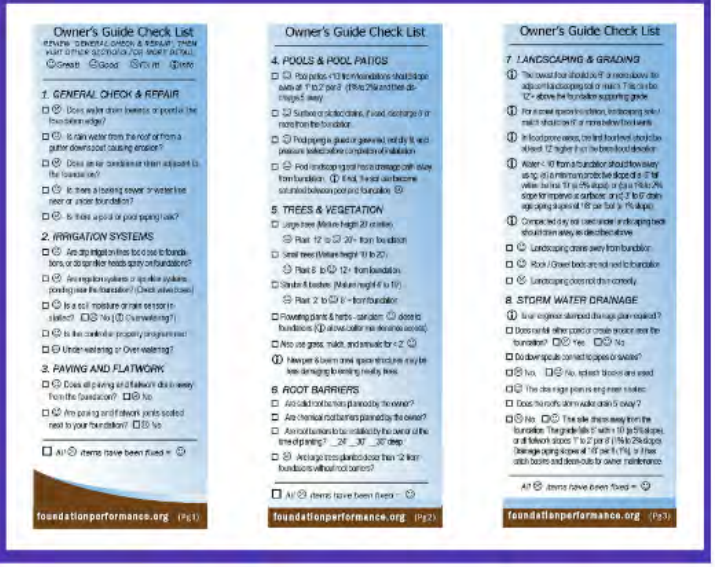
Designers,
Engineers,
Builders,
Foundation Contractors,
Pool and Landscape Contractors

Print and Use Our Checklist!

Here's a tri-fold flyer checklist to help you maintain long-term foundation performance.

Download it from the FPA website* or look at it now.

*www.foundationperformance.org



A guide of common items and practices that need to be done properly to avoid damaging a foundation.

Learn about what should be fixed right away. Read best practices for sprinklers, paving, pools, and patios. Understand preferred tree locations and how to use root barriers. Become more knowledgeable on grading and storm water drainage.

Use this checklist for discussions with:

- Designers
- Engineers
- Builders
- Pool Contactors
- Landscaping Contractors
- Foundation Contractors

For more information and details, read the FPA-SC-20 *"OWNER'S GUIDE TO A BETTER FOUNDATION"* paper and presentation at foundationperformance.org

Surface water management and soil moisture changes are at the core of many foundation issues.

Whether dealing with an existing foundation or planning for foundation, use this checklist to help better manage these issues.

This FPA-SC-20 Tri-Fold provides check list information as the subcommittee's interpretations of building codes and best-practices.

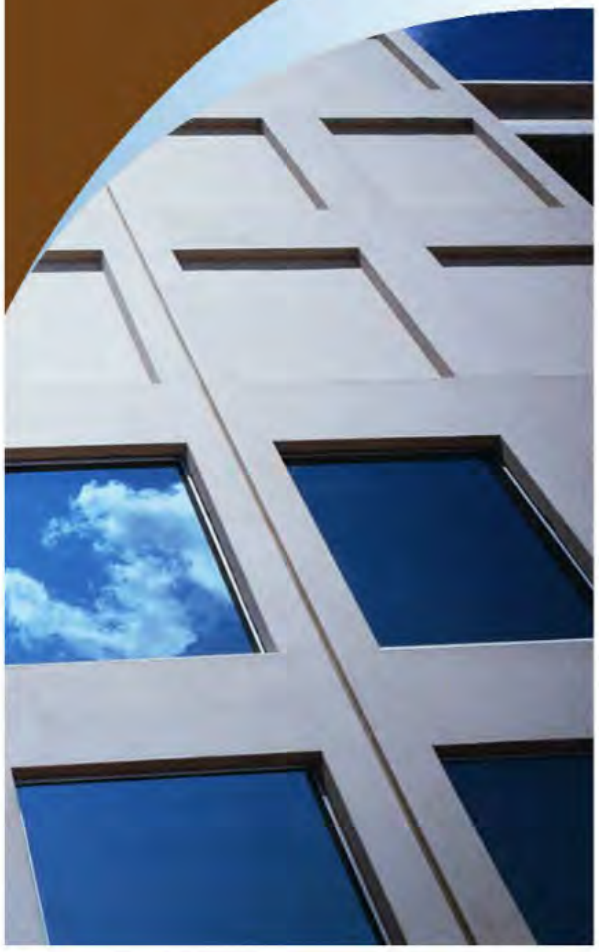
We recommend to always consult with a professional engineer for foundation issues, drainage issues, or for the design of a specific drainage system.

This **OWNER'S GUIDE TO A BETTER FOUNDATION** Checklist is associated with the FPA-SC-20 Presentation and Paper developed by The Structural Committee of the Foundation Performance Association of Houston, Texas
foundationperformance.org
View the FPA-SC-20 Presentation
www.foundationperformance.org

OWNER'S GUIDE TO A BETTER FOUNDATION

☑ CHECK LIST FLYER

The Structural Committee of The Foundation Performance Association of Houston, Texas



Owner's Guide Check List

REVIEW 'GENERAL CHECK & REPAIR', THEN VISIT OTHER SECTIONS FOR MORE DETAIL

☺ *Great!* 😐 *Good* ☹ *Fix It!* ⓘ *Info*

1. GENERAL CHECK & REPAIR

- ☐ ☹ Does water drain towards or pond at the foundation edge?
- ☐ ☹ Is rain water from the roof or from a gutter downspout causing erosion?
- ☐ ☹ Does an air conditioner drain adjacent to the foundation?
- ☐ ☹ Is there a leaking sewer or water line near or under foundation?
- ☐ ☹ Is there a pool or pool piping leak?

2. IRRIGATION SYSTEMS

- ☐ ☹ Are drip irrigation lines too close to foundations, or do sprinkler heads spray on foundations?
- ☐ ☹ Are irrigation systems or sprinkler systems ponding near the foundation? (Check valve boxes)
- ☐ ☺ Is a soil moisture or rain sensor installed? ☐☹ No (ⓘ Overwatering?)
- ☐ ☺ Is the controller properly programmed
- ☐ ☹ Under-watering or Over-watering?

3. PAVING AND FLATWORK

- ☐ ☺ Does all paving and flatwork drain away from the foundation? ☐☹ No
- ☐ ☺ Are paving and flatwork joints sealed next to your foundation? ☐☹ No

☐ *All ☹ items have been fixed = ☺*

Owner's Guide Check List

4. POOLS & POOL PATIOS

- ☐ ☺ Pool patios <10' from foundations should slope away at 1" to 2" per 8' (1% to 2%) and then discharge 5' away.
- ☐ ☺ Surface or slotted drains, if used, discharge 5' or more from the foundation.
- ☐ ☺ Pool piping is glued or gasketed, not dry fit, and pressure tested before completion of installation.
- ☐ 😐 Pool landscaping soil has a drainage path away from foundation. ⓘ If not, the soil can become saturated between pool and foundation. ☹

5. TREES & VEGETATION

- ☐ Large trees (Mature height 20' or taller)
  - 😐 Plant 12' to ☺ 20'+ from foundation.
- ☐ Small trees (Mature height 10' to 20')
  - 😐 Plant 8' to ☺ 12'+ from foundation.
- ☐ Shrubs & bushes (Mature height 4' to 10')
  - 😐 Plant 2' to ☺ 8'+ from foundation.
- ☐ Flowering plants & herbs - can plant ☺ close to foundations (ⓘ allows better maintenance access).
- ☐ Also use grass, mulch, and annuals for < 2'. ☺
- ⓘ New pier & beam crawl space structures may be less damaging to existing nearby trees.

6. ROOT BARRIERS

- ☐ Are solid root barriers planned by the owner?
- ☐ Are chemical root barriers planned by the owner?
- ☐ Are root barriers to be installed by the owner at the time of planting? __24" __30" __36" deep.
- ☐ ☹ Are large trees planted closer than 12' from foundations without root barriers?

☐ *All ☹ items have been fixed = ☺*

Owner's Guide Check List

7. LANDSCAPING & GRADING

- ⓘ The lowest floor should be 6" or more above the adjacent landscaping soil or mulch. This can be 12"+ above the foundation supporting grade.
- ⓘ For a crawl space foundation, landscaping soils / mulch should be 6" or more below flood vents.
- ⓘ In flood prone areas, the first floor level should be at least 12" higher than the base flood elevation.
- ⓘ Water < 10' from a foundation should flow away using: (a) a minimum protective slope of a 6" fall within the first 10' (a 5% slope); or (b) a 1% to 2% slope for impervious surfaces; or (c) 3" to 6" drainage piping slopes at 1/8" per foot (a 1% slope).
- ⓘ Compacted clay soil used under landscaping beds should drain away as described above.
- ☐ ☺ Landscaping drains away from foundation.
- ☐ ☺ Rock / Gravel beds are not next to foundation
- ☐ ☹ Landscaping does not drain correctly.

8. STORM WATER DRAINAGE

- ⓘ Is an engineer stamped drainage plan required?
- ☐ Does rainfall either pond or create erosion near the foundation? ☐☹ Yes ☐☺ No
- ☐ Do downspouts connect to pipes or swales?
- ☐☹ No. ☐😐 No, splash blocks are used.
- ☐☺ The drainage plan is engineer sealed.
- ☐ Does the roof's storm water drain 5' away?
- ☐☹ No. ☐☺ The site drains away from the foundation. The grade falls 6" within 10' (a 5% slope), or all flatwork slopes 1" to 2" per 8' (1% to 2% slope). Drainage piping slopes at 1/8" per ft (1%), or it has catch basins and clean-outs for owner maintenance.

All ☹ items have been fixed = ☺

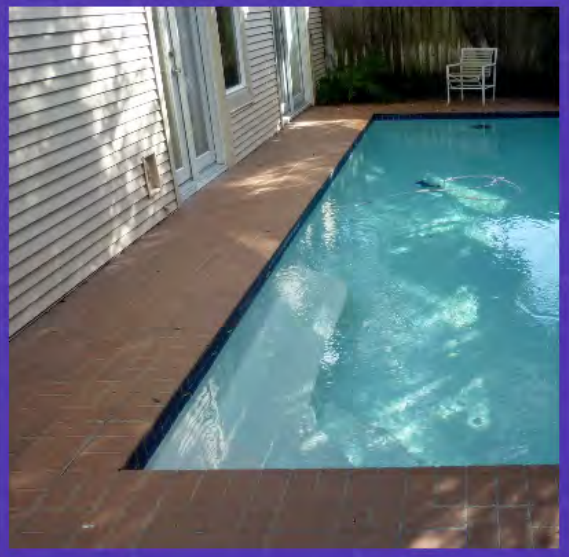
Presentation Overview

First, we'll address items to promptly fix.

Then we will cover irrigation and sprinkler systems.

Overview (Continued)

Next we'll cover paving, pools, and patios.



Then trees, and when to use root barriers.

Overview (End)

Lastly we'll cover landscaping, grading, and storm water drainage.

Let's get started...

Typical Residence Overview

Water management is at the core of many foundation issues.

#1 GENERAL CHECK & REPAIR

Do downspouts erode soil?

Does water pond near the foundation?

Both must be fixed!

Roof water should drain 5' from foundations. (Code portion from 2015 IRC R801.3)

Use sloped grade, flatwork, swales or underground piping.

Splash Blocks can help disperse surface water

Surface drainage swale

Add a 6" fall within 10' of foundations

Does your AC drain next to the house?

An HVAC contractor or a plumber can correct this, or...

Capture HVAC water and rainwater for watering plants.

This simple system captured over 200 gallons of HVAC-produced water in each summer month.

#2 IRRIGATION SYSTEMS

Do sprinklers spray towards the foundation?
They should not.

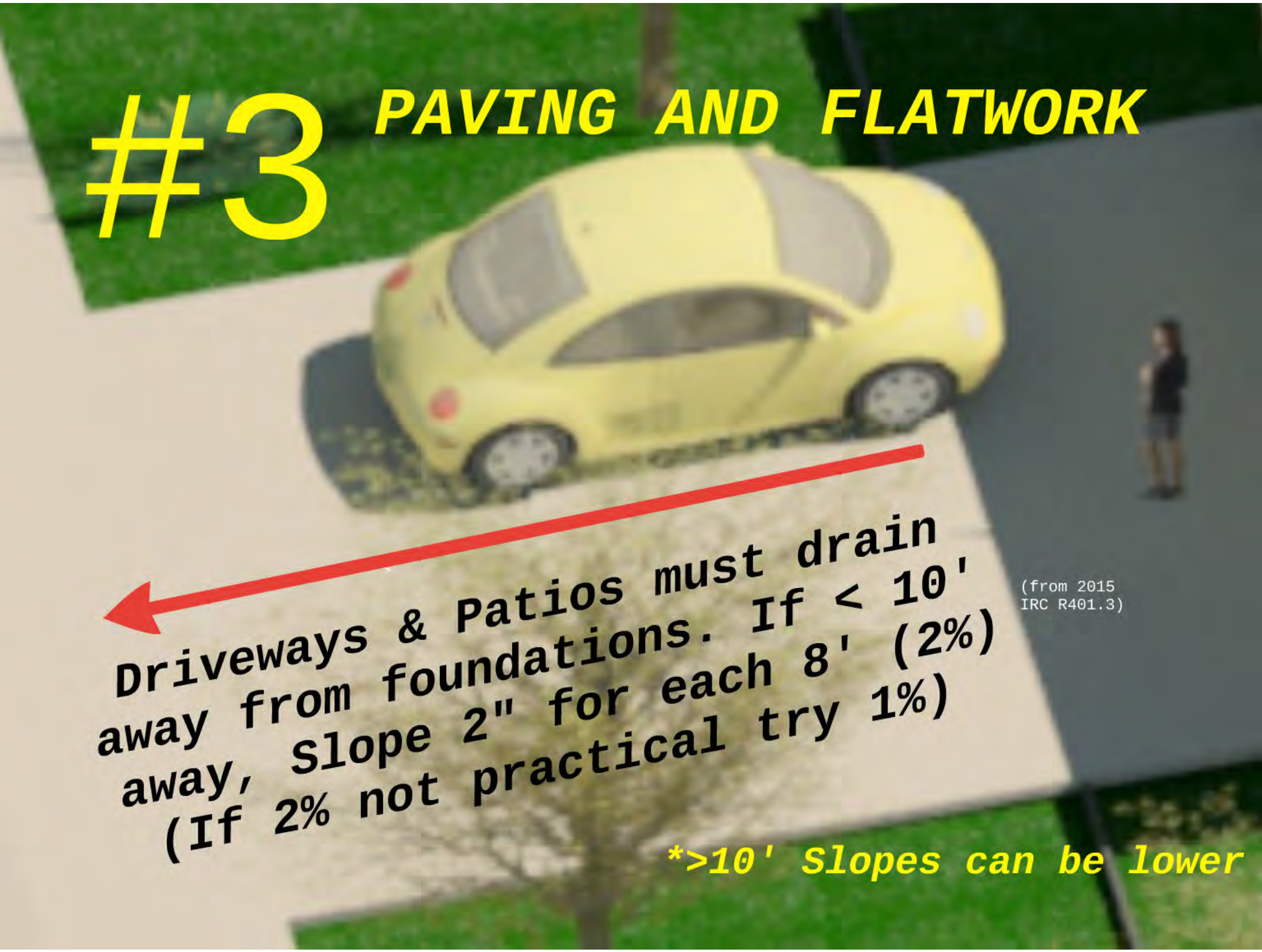
Adjust them to spray away from foundations like this.

See the Check List for more advice!

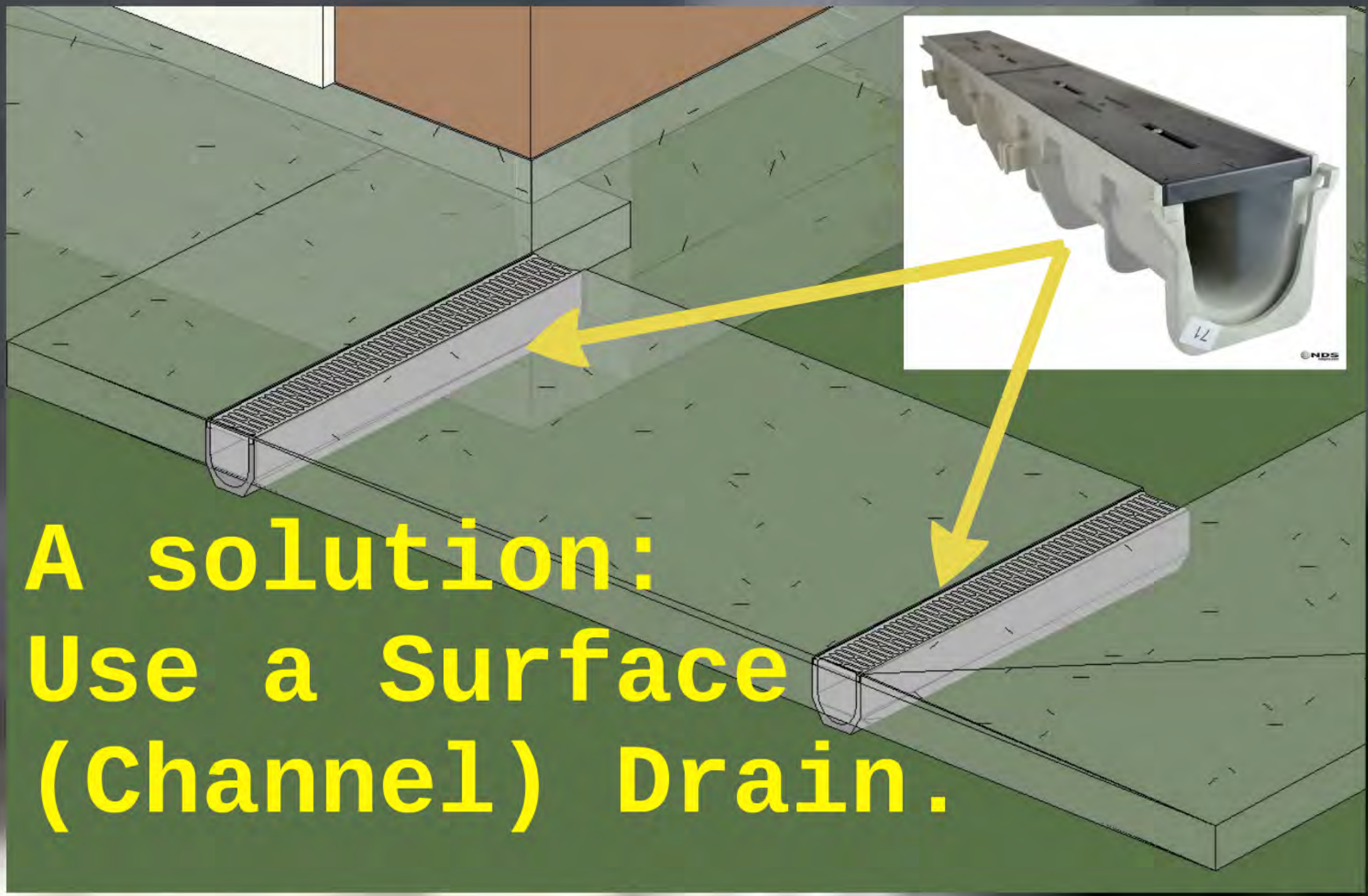
IRRIGATION SYSTEMS

Drip irrigation systems can directly water plants, gardens, and landscaping.

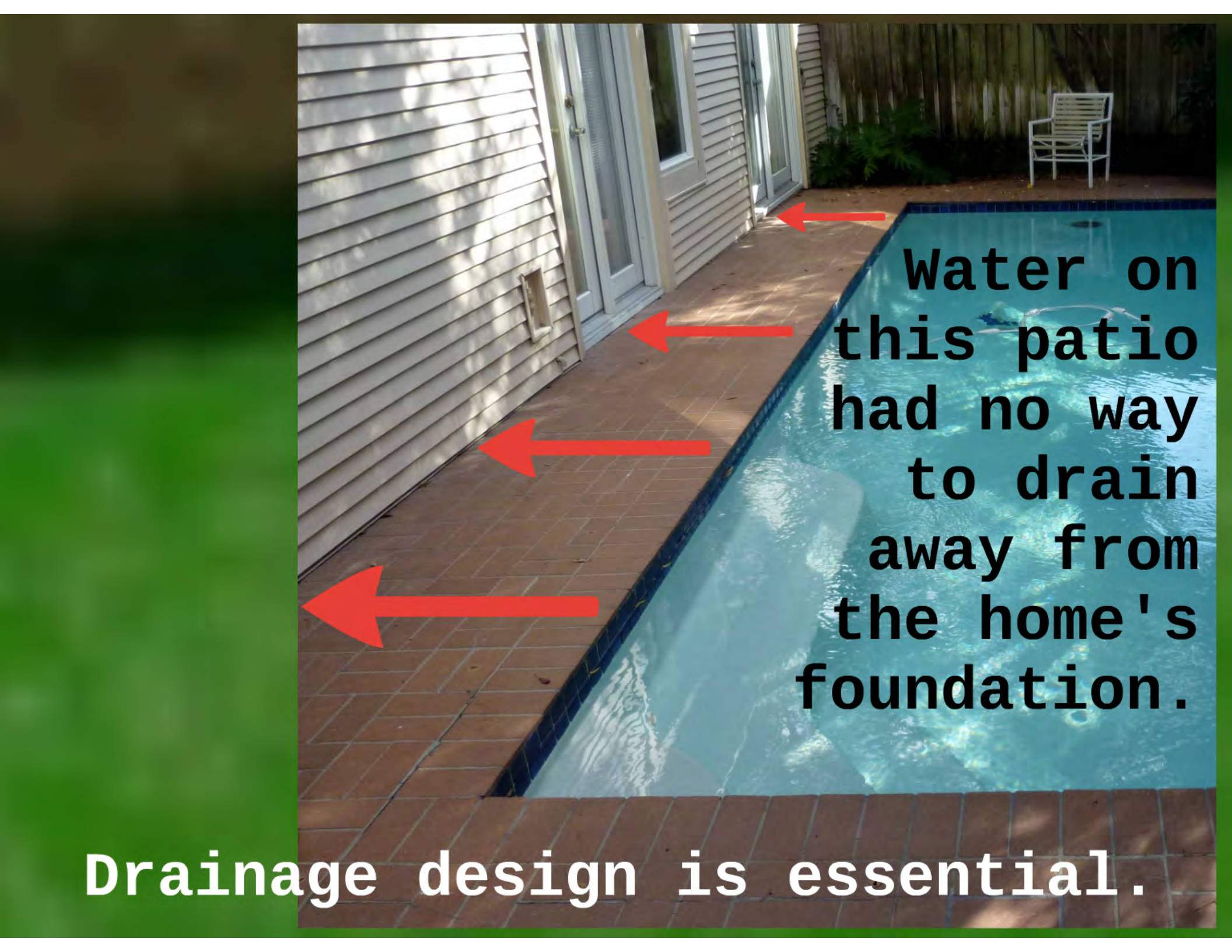
Just be sure to check them to prevent ponding at foundations


3 PAVING AND FLATWORK
Driveways & Patios must drain away from foundations. If < 10' away, slope 2" for each 8' (2%) (If 2% not practical try 1%)
(from 2015 IRC R401.3)
*>10' Slopes can be lower


Sidewalks should not trap
water next to a foundation.


A solution:
Use a Surface
(Channel) Drain.

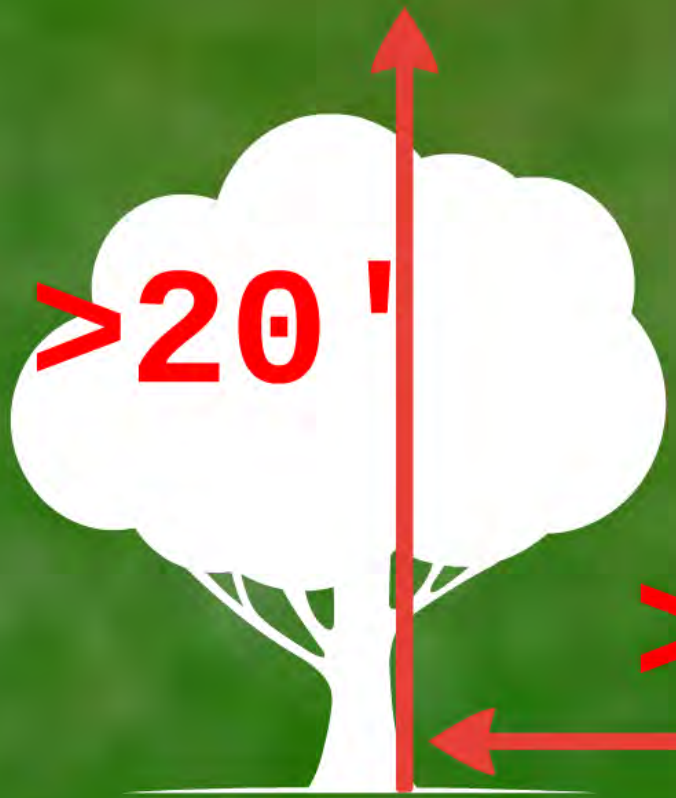

#4 POOLS & POOL PATIOS
Patios < 10' from foundation to drain away at 1% to 2%.
The patio should also drain >5' away from the foundation.
(from 2015 IRC R401.3)

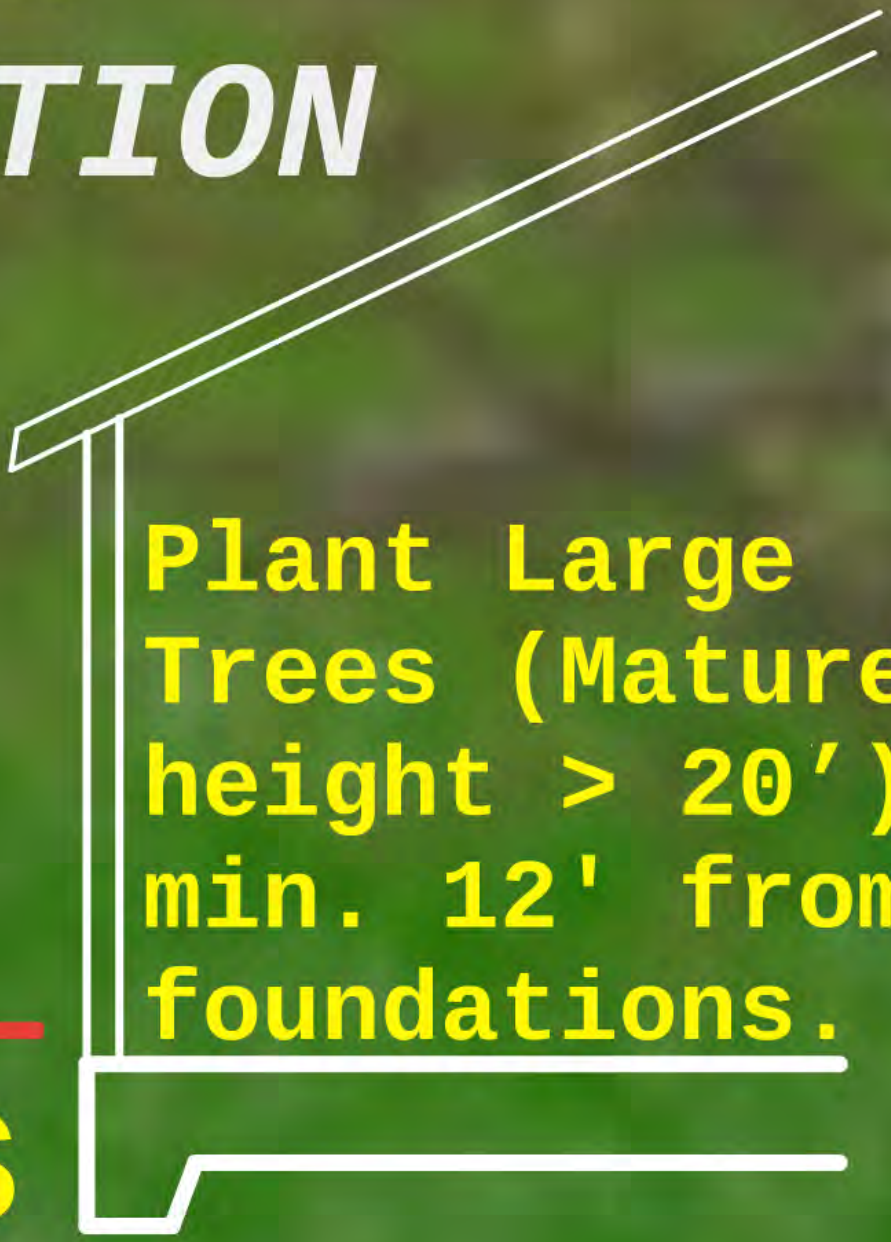

Water on this patio had no way to drain away from the home's foundation.
Drainage design is essential.

Solution: Patios are a good place to use surface drains.

Images from NDSpro.com and Troublefreepool.com

#5 TREES & VEGETATION





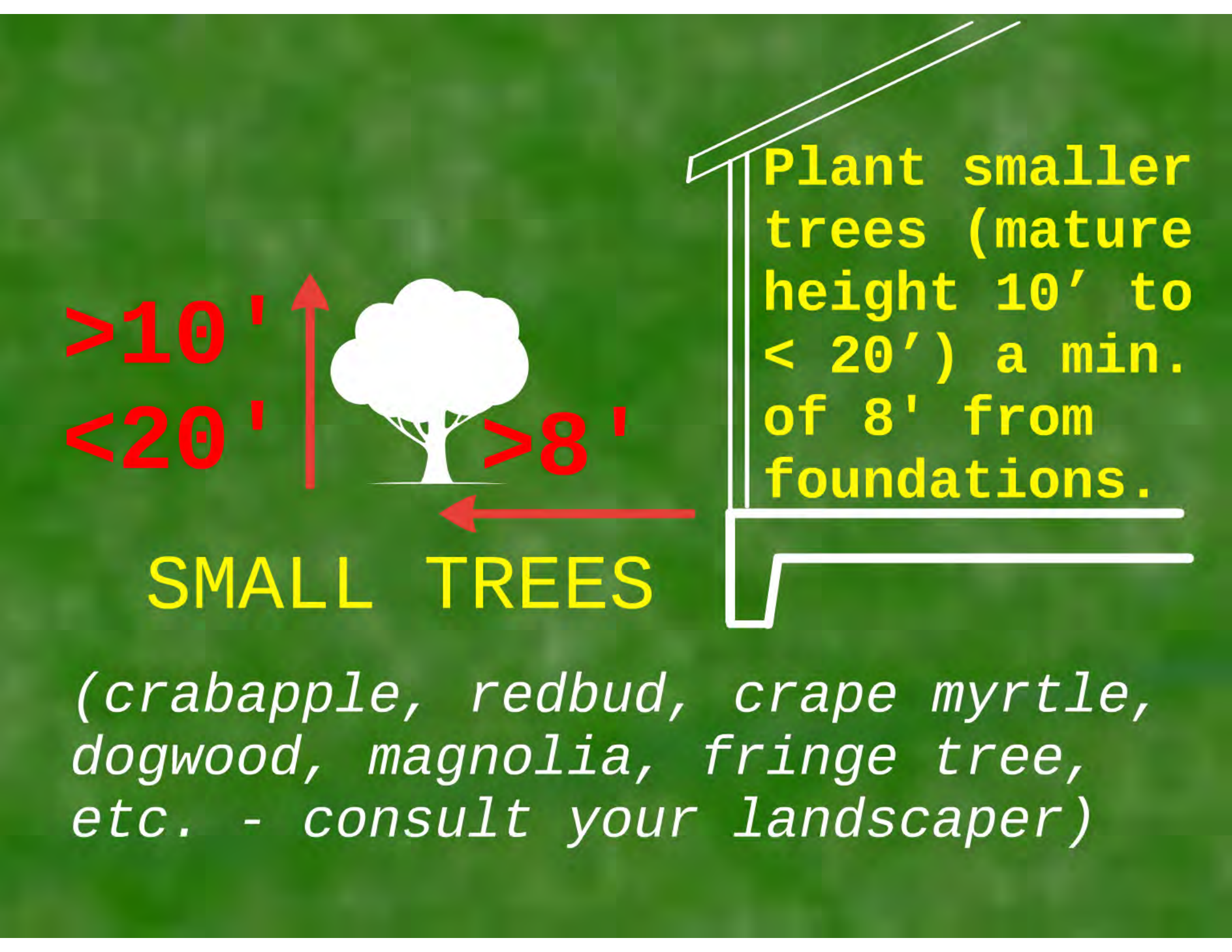
>12'

Plant Large Trees (Mature height > 20') min. 12' from foundations.

LARGE TREES

Trees Grow!

Large trees (ash, oak, pecan, pine, sycamore, etc.) planted too close will likely cause problems.


>10'
<20'
>8'
Plant smaller trees (mature height 10’ to < 20’) a min. of 8' from foundations.
SMALL TREES
(crabapple, redbud, crape myrtle, dogwood, magnolia, fringe tree, etc. - consult your landscaper)

Small Trees Also Grow!

Small trees planted too close to a foundation can also cause problems.

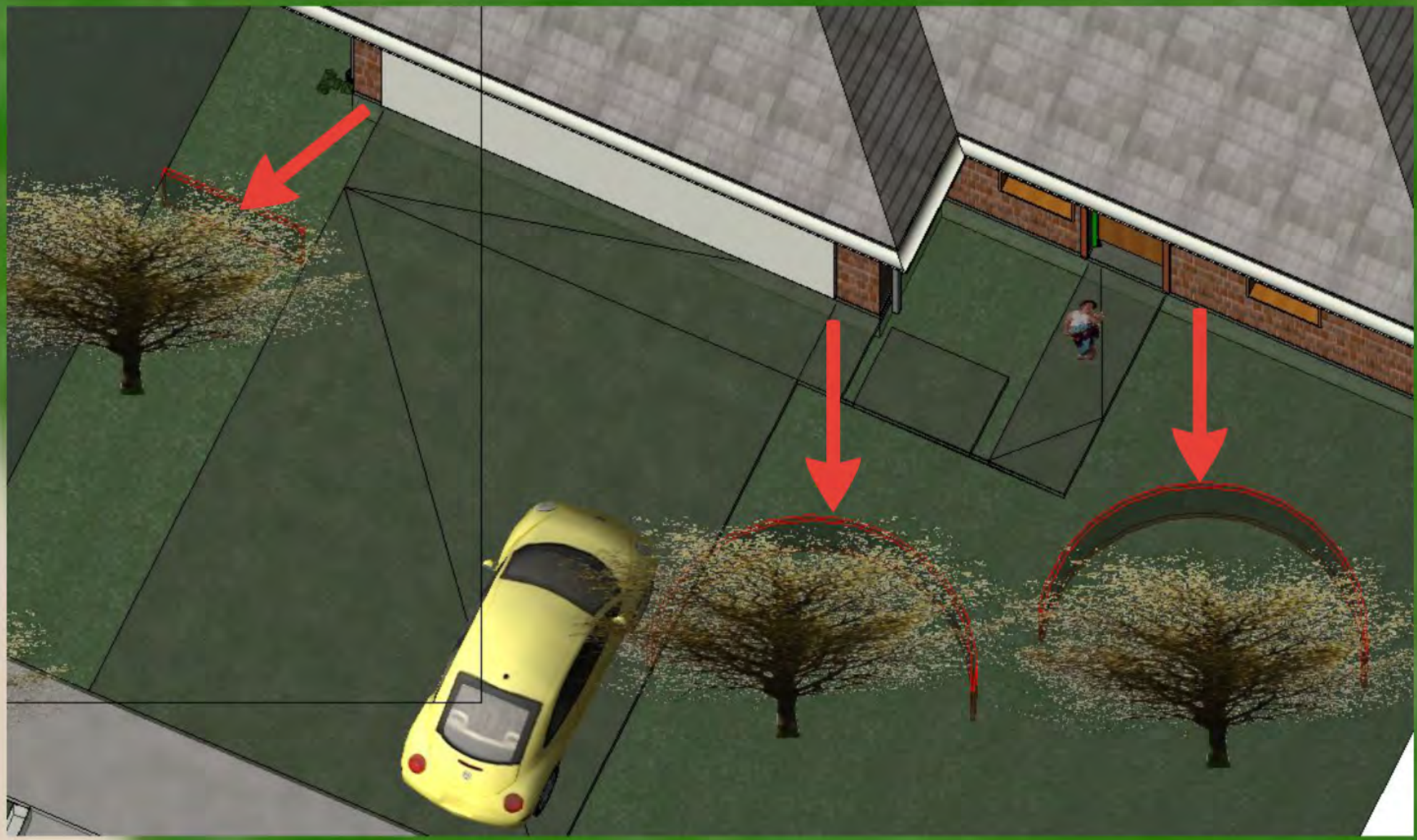
Other Recommendations

- Plant Shrubs, bushes, and flowering plants 2′ to 8′+ from foundations.
- Use only grass, mulch & annuals for < 2′.

Try to locate new trees in or near easements - far from foundations.

#6

Owners can install Root Barriers for trees planted close to foundations.



New 'Large Trees' planted next to a new foundation.

If not installed already, this owner should consider installing root barriers.

Photo of a chemical root control fabric. *(photo from Biobarrier®)*

Photo of a physical or solid root barrier *(photo from Deeproot®)*

#7 LANDSCAPING & GRADING

Lots should drain away from foundations - Use a 6” fall within 10’ (from 2015 IRC R401.3) **(a 5% slope), then manage by swales or piping systems.**

Image from FPA-SC-17 Drainage Paper

LANDSCAPING & GRADING

(*But per 2015 IRC R404.1.6, masonry veneer can be just 4")

6" Min *

Design to be 6"(min)* above FINAL landscape.

12” to 18" above ORIGINAL grade is worth it!

SWALES

Slope as low as 1.5" over 50' (0.25%)
A higher slope like 2" over 8' (2%)
can carry much more water.
How Much more? Ask an engineer!

Slope sides @ 1:3 max (4" drop per 12")

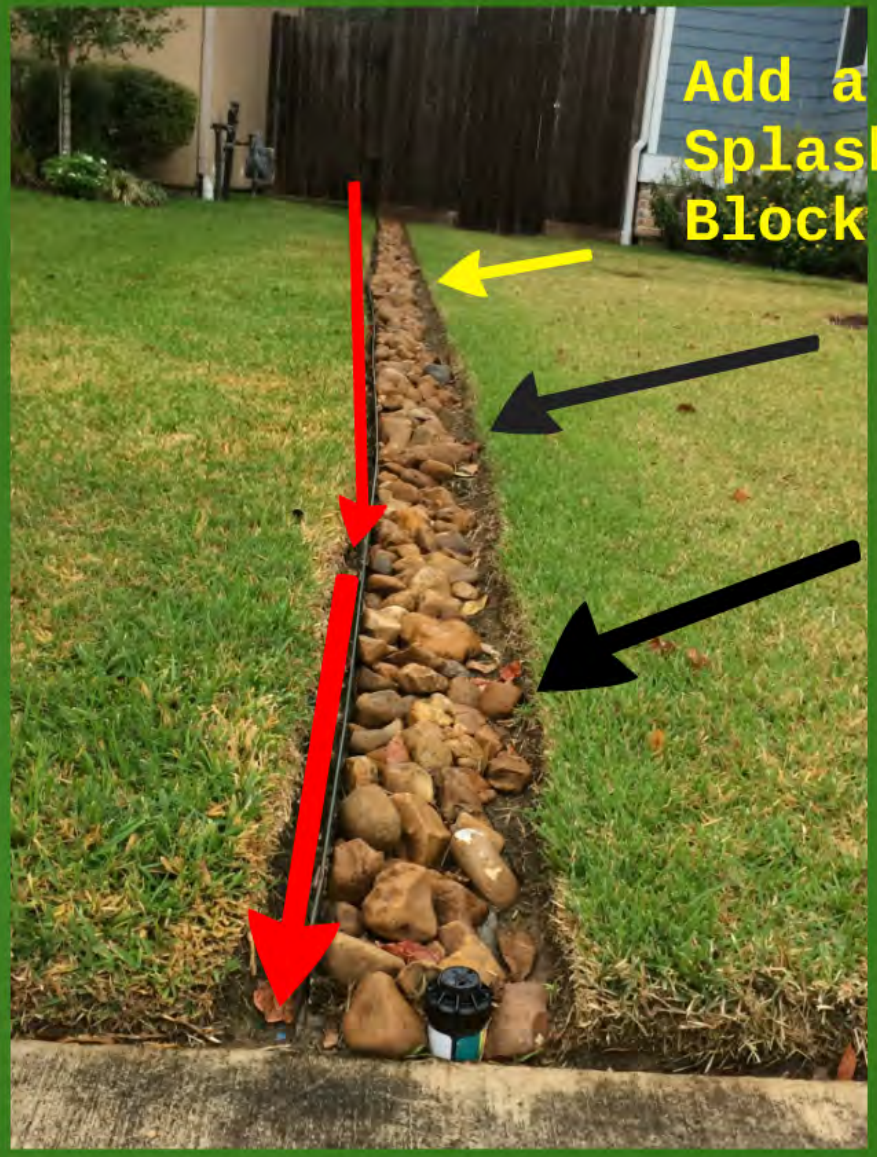
Cover with grass, gravel, or perrenials.

TRENCH DRAINS

A gravel trench drain or a gravel swale over poly or geo-cloth also works.

Slope the same as a swale (0.25% to 2%)

Can provide a small detention volume & and NO curb cuts!



#8 STORM WATER DRAINAGE

Stormwater drainage requires planning.

Can be done by an informed homeowner, builder or contractor.

Architects & engineers create more detailed plans for permitting.

Storm Water Mitigation

In a 100 year flood plain, drainage should be designed by an engineer.

Engineered underground detention

THE END !

REMEMBER THE KEY CONCEPTS...

1. Foundations are soil supported.
2. Moisture changes shrink/swell soil.
3. Water management is important !

Have specific questions?...

Contact an FPA member!

We have dedicated Engineers, Experts, and Contractors that can help with these and many other areas.

FOUNDATION PERFORMANCE ASSOCIATION

http://www.foundationperformance.org/

OWNER'S GUIDE TO A BETTER FOUNDATION

FPA-SC-20 Paper and Presentation

Thanks to our FPA-SC-20 team!

Subcommittee Chair

Gary Beck

Subcommittee Members

Adam Bakir

Dan Jaggers

Ron Kelm

Jim Dutton

Gerard Duhon

Michael Skoller

FOUNDATION PERFORMANCE ASSOCIATION