DISTRESS PHENOMENA
OFTEN MISTAKENLY ATTRIBUTED TO
FOUNDATION MOVEMENT

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INTRODUCTION

Architectural and structural distress in residential and light commercial buildings in Texas is indeed a common occurrence and is usually the result of differential foundation movement. However not all observed distress can be attributed to movement in the foundation. The purpose of this document is to provide the user with a list of phenomena that are sometimes wrongly associated with foundation movement. An attempt is given to provide more probable causes of these certain phenomena in the structures and foundations. Possible reasons for the causes of distress are provided along with repair recommendations.

This document is based on experience gathered by engineers in Houston, working primarily in the southeast Texas area. It is intended to be used in southeast Texas by homeowners, building owners, builders, foundation repair contractors, inspectors, engineers, architects, and others involved with the structural inspection of, the forensic assessment of, or simply the monitoring of residential and light commercial structures. The information contained herein is provided as a guide only and its use should be exercised with caution when applied for other types of structures or when used outside the geographical area for which it was written.

This document is made freely available to the public through the Foundation Performance Association at www.foundationperformance.org so all engineers designing foundations for residential and other low-rise buildings may have access to the information. To ensure the document remains as current as possible, it will be periodically updated under the same document number but with new revision numbers.

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DISTRESS PHENOMENON	PROBABLE CAUSE OF DISTRESS	POSSIBLE REASON FOR CAUSE	REPAIR RECOMMENDATION
1. Masonry cracks above garage door and other long lintels. Crack in first brick of soldier course on either side of garage. *a. Cracks at center span* *b. Cracks at ends* *c. Racks at soldier course*	a. Lintel beam may be under designed. b. Either the lintel beam is under designed or there is insufficient bearing. c. Lack of brick bonding.	a. Gravity load is causing the lintel to deflect excessively. b. Excessive lintel deflection or the masonry is crushing. c. Thermal stresses can cause the initial bond to break.	a. Reinforce or replace lintel. b. Reinforce or replace lintel. c. Patch crack with non-shrink grout.
2. Vertical cracks in masonry full height of wall, uniform crack width from top to bottom of wall and usually at center of wall or openings.	Thermal contraction and expansion of the masonry wall.	Insufficient expansion joints provided when masonry was constructed.	Saw cut vertical expansion joints into the brick as required.
3. Surface cracks in post-tensioned slabs prior to tendon stressing, which are typically perpendicular to the long dimension.	Concrete shrinkage during curing process.	When the water evaporates out of the slab voids are left causing shrinkage cracks.	Cracks will typically close up after stressing. Use water or chemical cure.
4. Cracks or buckling at top of walls supporting sloping roofs.	Inadequate collar ties, causing walls to bow outwards as ridge settles.	This spreading deflection causes drywall to separate. No horizontal restraint is provided to resist gravity load reactions from sloping roof members.	Add collar ties or reinforce ridge.
5. Spalled concrete at corner of foundations supporting brick walls.	Caused by brick bonding to grade beam when it thermally expands and contracts.	The lack of bond breaker between brick and brick ledge.	Spalled area can be cosmetically patched with a bonding agent and non-shrink grout.
6. Cracks along gambrel and other vaulted ceilings, usually on exterior walls	Ceiling joists are supported by rafters that are subject to more extreme temperatures than ceiling joists.	The ceiling joists and rafters may not be adequately nailed together or supported.	Provide some type of flexible material, such as caulking at the intersection of rafters and ceiling joists.
7. Sags and cracks in drywall ceiling	Excessive deflection of beams and plates, causing drywall to crack.	Undersized wood beams, improper support of the wood beams, or overloaded attic roof members.	Analyze wood support beams and reinforce as required. Investigate whether there is adequate

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			support for beams.
8. Cracks in first story brick when second floor is wood framed.	Inadequate support of the second floor walls.	The wall may be supported by brick, which may not have been designed to be load-bearing.	Adequately supporting second floor walls.
9. Ground floors are 1 inch or more out of level, but there is no evidence of distress in the structures.	The slab may have been originally constructed out of level.	Slabs-on-grade can be out-of-level per ACI 117-90 4.3.1 up to 1 inch (+ or – 0.5"), but contractors could have exceeded this limit.	Begin slab elevation monitoring program on a quarterly basis.
10. Nails popping out of walls and ceilings in structures.	Shrinkage of wood members. Could also be infiltration of moisture into the wall.	Wood members may have gotten wet during construction or there may be a roof or plumbing leak.	Repair leak if found. Otherwise, wait two (2) years for shrinkage to subside and repair.
11. Crown molding separation in newly constructed structures.	Shrinkage of wood members.	Wood members may have gotten wet during construction and have shrunk while drying.	Wait two (2) years for the shrinkage to subside and repair.
12. Drywall separation around tape seals and corner beads in newly constructed residences.	Shrinkage of wood members.	Wood members may have gotten wet during construction and shrunk while drying.	Wait two (2) years for the shrinkage to subside and repair.
13. Miscellaneous cracking in concrete foundation members with no distress in the structures.	a. Concrete may have impurities in aggregate. b. Evaporation of water causes placement caused shrinkage cracks. c. Water flowed to the surface and b. occurs. d. Rebar corrosion close to slab edge causing spalling	a. Deleterious chemical reactions may cause cracking of concrete. b. High water/cement ratios c. Over vibration.	Wait until cracking appears dormant, and then repair if needed.
14. Short Horizontal brick cracks at window lintels	Lintel corrosion expanding and lifting brick	Inadequate lintel seat	Clean and seal lintel ends

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15. Doors that bind at the bottom, but are easy to open or close if lifted by knob	a. Door hinge is loose b. Door hinge too small	a. Screws are too small or too short for weight of door b. Hinge is too weak (or not enough hinges)	a. Tighten or replace with longer screws b. Replace or add additional hinges
16. Masonry cracks adjacent to garage doorjamb 1' to 2' above slab, frequently with outward displacement of brick at crack, frequently with misaligned garage doorjamb.	Veneer or jamb was hit by a passing auto bumper		Repair brickwork and wooden jamb