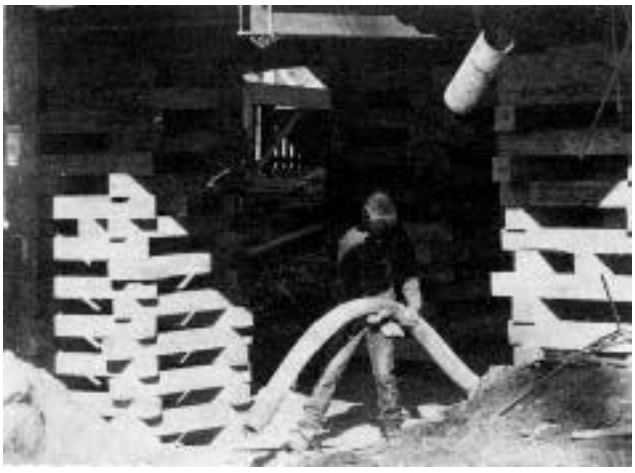
FOUNDATION CATASTROPHES:

CAUSES & CURES



After this house was jacked up and supported with cribbing, a worker pumps in concrete for new footings. Repairing a failed foundation can cost a hundred times what it would have cost to do it right the first time.

Skimping on the foundation can expose the homeowner –and yourself– to a whopping repair bill

by Thomas Florence
and
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According to a survey by NAHB, about 20 percent of all new homes have foundation problems. For most Americans, 90 percent of their net worth is their home, so failed foundations pose major financial problems for homeowners.

Generally, there are two causes of foundation problems. One is that the builder lacked basic design and construction knowledge and had little understanding of proper soil conditions. Two, poor supervision, poor inspections, and sometimes simple greed compound the problem of construction and design flaws.

Our company, On The Level (OTL), has been repairing foundations for four generations, and we see more failed foundations in a month than most builders see in a lifetime. From our perspective, most failed foundations could have been done right the first time for an average of under $500 more. A minor repair, after the fact, can cost ten times that, and a major repair, more than a hundred times that.

Homeowners can sue almost anyone remotely liable, from the sub who dug the hole to the broker who sold the home. (In Massachusetts, suits can be filed under the tough consumer-protection law, Chapter 93 A, with triple damages to the unsuccessful contractor.) It is impossible to overemphasize the importance of limiting and sharing liability, full disclosure of all risks, and proper documentation of each step in the foundation repair process. These jobs put the contractor squarely in the middle of a buzzing hornets nest, and he must ensure he is not stung. OTL stresses teamwork with responsible structural, geotechnical, and soil engineers. All parties should work together to find an acceptable renovation plan, and all should share the liability if Murphy's Law proves true.

Case Number One: Foundation Problems the First Year

When the owner moved into a one-year-old, elegant Federal reproduction overlooking the bay in historic Cape Cod Village, there were 4 inches of water in the basement. Three months later, when he couldn't open an upstairs door, he contacted a local carpenter to plane it. But the homeowner soon recognized the extent of the problem and called OTL.

Upon inspection, we found a cracked foundation and extensive reflected damage throughout the house: cracked plaster, sticking doors, and trim separation (see Figure 1). From experience we knew these symptoms meant that the foundation and center supports were settling at different rates, probably as a result of bad soil conditions, cracked footings, and clay backfill around the foundation. OTL established a benchmark that later confirmed the house was settling under the Lally columns at about 1/8 inch per month — or 1 inch per year. Since the

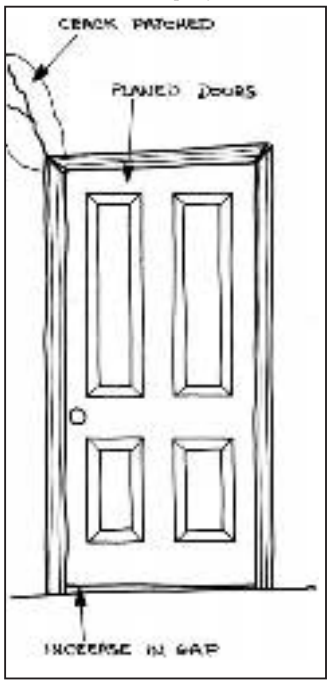

Figure 1. *A failed foundation radiates reflected damage throughout the house - such as separated trim, gaps in the threshold and sticking door.*

Lally-column pads supported 50 percent of the load of this structure, their failure was causing most of the damage.

Meanwhile, the engineer who originally designed the perimeter drainage system was called onto the site. He said the settling was acceptable and would subside. Nonetheless, he recommended regrading to redirect rainwater, and he redesigned the perimeter drainage system, which involved some excavation. Regrading turned up indigenous clay, an open invitation to trouble.

The owner agreed to the engineer's plan, and the new drainage system was installed. We thought that this was like giving chicken soup to a dead man — it couldn't hurt, but the dam-

age was already done.

By this point, the homeowner retained an attorney experienced in structural matters, and the attorney recommended three steps. First, a soils engineer should do an analysis. Second, the structure should be immediately stabilized to minimize ongoing damage. Third, the owner should seek an attachment against the builder to guarantee the replacement cost of the foundation and the repair of damage to plaster, paint and wood.

The certified soils engineer retained by the owner noted the same differential settlement OTL had noticed, between the outside of the foundation and the center row of Lally columns supporting the main house beam. His test pits, at opposite ends of the cellar, found silty sand with pockets of clay. This soil combination is unsuitable for foundation support and should have been removed prior to construction. OTL calculated design loads and, after an engineer's review, recommended installing a new ground beam that would support the Lally columns (see Figure 2). The ground beam would stabilize the structure and provide adequate foundation support to stop future settlement, even if the owner decided not to renovate the perimeter foundation.

We made an extensive photographic survey before work started. A photographic record is invaluable in disputes and limits potential liability of the contractor.

Phase one: jacking and supporting the superstructure. Once a plan was agreed on with the homeowner and certified by the engineer, OTL began shoring up the superstructure so we could attempt to jack it back to square. First, we had to crib the house for jacking. Through calculations we found that the existing cellar floor could serve as a cribbing base. By using the floor, we didn't risk accelerating the settling by making holes elsewhere before the structure was supported.

We installed the cribbing by running two 44-foot temporary steel beams parallel to the existing basement center beam. Other steel beams were placed at 90 degrees to the temporary timbers to support the center carrying timber (see Figure 3). Once the building was shored, jacking started. The owner was thrilled to find that doors worked, cracked closed, and the house felt solid as a rock.

Phase two: excavation for the ground beam. One the house was cribbed and jacked, we removed the Lally columns and cut the floor under them with a 10-inch concrete saw. The cut-out area was broken up with an electric Bosch demolition hammer, to minimize vibrations. Using shovels and a conveyor system, we removed the concrete pieces, about 16 inches of the fine silty soil, and pockets of clay. We raked, tamped, and hydraulically compacted the area. A bed of 3/4-inch stone was laid; forms for the new ground beam were installed, stacked, and backfilled. Rebar was put in place within the forms — about 6 inches above the base — and wired and tack welded.

Phase three: the first pour. The ground beam was ready to be poured. We pumped in seven yards of 4,000 psi, 2-percent calcium-chloride hot-mix concrete. It was screeded and allowed to set up.

Phase four: excavation and discovery. During setup for pouring the new floor, the crews discovered that round the perimeter the thickness of the existing floor varied from 4 inches to less than 1 1/4 inches. Also, extensive vertical and horizontal cracks were found in the foundation wall below the floor. These cracks were caused by the settling footings and wall. Water and clay had washed through.

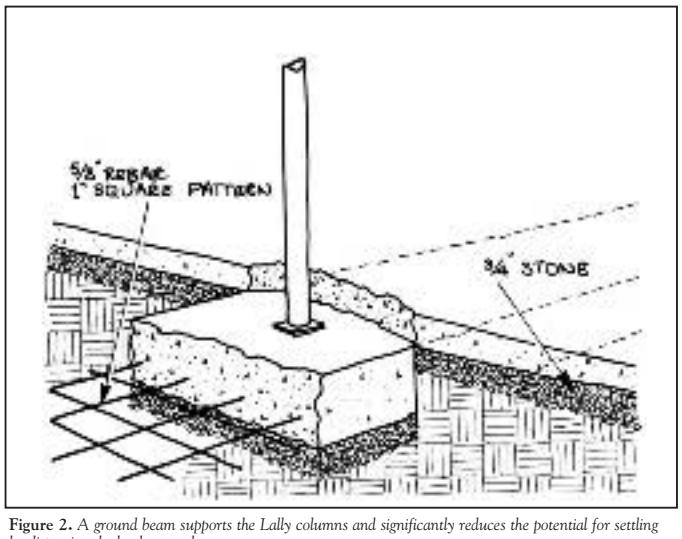

Figure 2. *A ground beam supports the Lally columns and significantly reduces the potential for settling by dispersing the load over a large area.*

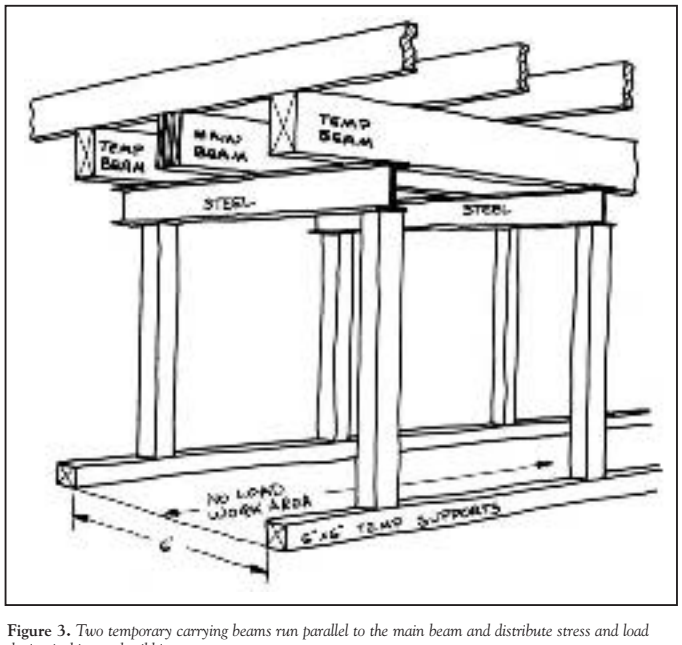

Figure 3. *Two temporary carrying beams run parallel to the main beam and distribute stress and load during jacking and cribbing.*

Have the client release you from liability in writing. Don't leave significant issues to a handshake. As a catastrophe unfolds, memories become selective.

The original builder and his attorney viewed the exposed footings. Clearly, they had a problem. The builder claimed he advised the owner not to build on the lot, but he failed to educate his client on the full impact of building on unstable soil. He didn't get a specific waiver of liability in writing for settling consequent damages, nor did he take reasonable precautions against the expected settling. All of these are essential elements in limiting liability.

OTL's policy — a sensible practice for any contractor — is to completely explain the situation, so there are no "hidden killers" that can escalate to dispute and litigation. Should the client wish to proceed contrary to your recommendations get your alternatives, objections, and recommendations — both generally and specifically — in writing. Have the client release you from liability in writing. Don't leave significant issues to a handshake. As a catastrophe unfolds, memories become selective.

Phase five: Lallys and floor. After the concrete from the first pour had cured, the six 3 1/2-inch Lally columns were cut to fit snugly into place under the carrying timber and placed on plates on the new ground beam. The structure was jacked slightly to release the load from the cribbing, which was carefully removed, section by section, and the ground beam was loaded. Now that the house rested on the Lally columns and new ground beam, work could begin on the floor. First, the oil tank, the furnace, and the remainder of the floor were removed. Trenches were dug for 8-inch furnace and oil tank pads (this meant excavating 12 inches — 4 inches for stone and 8 inches for concrete). Soil was excavated to uniform depth of inches and raked smooth. A 4-inch bed of 3/4-inch stone was laid.

The concrete truck pumped in 15 yards of 4,000 psi, 2-percent hot-mix concrete. The pads for the mechanicals were poured first, then the rest of the 4-inch floor was poured. The new floor was screeded, bull-floated, and trowelled. Plates were lagged into the timbers, the oil tank and furnace were reinstalled, and the site cleaned. This phase of renovation was complete. (The owner at this writing is still undecided about replacing the perimeter foundation).

Case Two: Foundation Problems After Thirty Years

The Cape ranch with an add-a-level addition is about 30 years old. It sits on a sloping lot on the edge of a wetland, the lowest lot in the low-lying area of Cape Cod, Massachusetts. The current owners had lived there since 1963, and they'd been aware of problems since they moved in. The back corner of the house had settled over 12 inches. So, they'd adjusted in an extreme way. They'd cut of the legs of furniture to achieve level surfaces. Chairs were altered similarly; they'd installed 6x6 blocks under tables, and continually replaced pipes and wires. They'd even grown accustomed to half filled glasses, and deep pots instead of frying pans!

In 1986 when the town installed a catch basin in front of the house to correct a rainwater run-off problem, the owners soon complained that the town should pay for accelerated settling caused by the catch basin. But the soils engineer they retained disagreed. He said the settling was caused by an 8-inch-thick layer of decomposing logs and stumps 2 feet below the surface, dumped near the house and filled over prior to the construction (see Figure 4).

Because the real estate market was strong and they had a good equity position, the owners decided to act. But they were repeatedly turned down for refinancing. The bank wouldn't accept the house with a failed foundation as collateral for a loan to repair that foundation. Their net worth was worthless. They couldn't sell, they couldn't remortgage, and they couldn't pay for the work out of their pockets. Since the situation with the house could only get worse, they risked a high-interest, short-term mortgage loan with a non-bank source, hoping to mortgage conventionally after their home was intact. Then they called OTL.

We concluded that the foundation had to be removed and replaced. We gave a price for the entire job, which the owners needed to get out of the clutches of the high-interest mortgagor.

Our planners designed a single-pour steel reinforced footing, 3-feet wide by 10 inches deep. On this continuous footing, we installed a cored, reinforced-block foundation wall. We also recommended a lighter stud wall in the sensitive area to provide added strength and decreased load on the unstable soil. The engineers and the town approved the plan, but the lender declined to release the funds to OTL on the draw-down agreement. When the distraught owners approached OTL, we helped them find a legitimate convertible construction mortgage based on the value of their property. Things got under way.

Phase one: site preparation. The

interior was stripped, and electrical service and supply pipes were disconnected. The oil tank and furnace were removed.

We hoped to save the chimney. This involved disconnecting it from its footing and supporting it with a steel plate. It would be lifted up with the superstructure by a steel cable suspended from the center carrying timber and floor joists.

Phase two: cribbing and jacking. The cellar floor, which was extensively cracked, was demolished by a Uniloader. The Lally columns and pads were left intact. We temporarily put up 8-inch steel beams parallel to the permanent timber. Four cribbing stations with 20-ton jacks were used. We lifted the structure with two 44-foot, 12x8 inch beams under the other steel and timber.

We first leveled the structure, then raised it a uniform 2 inches above the foundation. The tricky lift was completed and the jacks removed.

Phase three: excavation and demolition of the foundation. When we excavated we found partially decomposed squarely sawn 3-foot logs 8 inches under the lower half of the structure. The builder apparently stuck them in for fill and took no precautions against settling. The foundation literally fell apart of its own accord. We easily toppled 20-foot sections of the wall, and broke them up with a jack hammer.

Phase four: installing the footings and foundation walls. We hauled away the debris and prepped the area for footings. The footings and 3-foot square, 12-inch deep Lally column pads were formed. Even wider, doubly reinforced footings were formed where the most settling had occurred. Rebar was installed in one-foot grids, with vertical rods placed every 3 feet. 4,000-psi mix was poured. A concrete-cored, reinforced-block wall was built with Durawell-steel lattice every other course for lateral reinforcement (see Figures 5&6). Corresponding to the rebar in the footings, we placed #4 rebar every 3 feet and wired it.

The structure was ready to be lowered when the third payment - for the footing - was returned. Then, the job came to a halt while we investigated the bounced check. The owners tearfully claimed they "gave away" the money to friends and family after the closing!

Phase five: working out the problem. Resolving this new problem would take skills beyond those of OTL. The lending institution had realized their error in giving the homeowner the money in one lump sum, and they tried to get the money back. They wanted to release it on performance, as the mortgage stated. But that was going to be impossible. The bewildered banker told a friend, "All I could see was 'The Miracle of 34th Street,' with Santa Claus giving the bank's money away by the handful to passers by. I've never seen anything like this in 30 years of banking."

Using the remodeler's traditional thirds would have hurt here. If you do foundation work in thirds, and the homeowner decided not to pay the second payment, you'd have little leverage against him, because most of the major work is done. Say you leave the job; it doesn't take much for the homeowner to lower the house onto the new foundation himself. On larger jobs, OTL uses at a minimum, a five-payment schedule. We get a healthy "start" payment and a token "final" payment, because the final payment is traditionally the most difficult to collect. This leaves the company in a good position, and the client pays on progress.

In this situation, OTL offered to finish the job for a secured note.

Phase six: lesson learned. This case illustrates the need for the contractor to ensure finances are secure, as unfinished projects hurt both the company and the client. It also shows the devastating effect a failed foundation can have on the homeowner and family as well as the contractor who tries to help them. On large jobs, it's a good idea to have payment escrowed. Thoroughly investigate the expertise, credentials and insurance of subcontractors. In addition to the usual Worker's Comp, personal injury, and property damage coverage, insist on completed operations coverage. This makes the insurance company your partner in guaranteeing the longevity of the project. ■

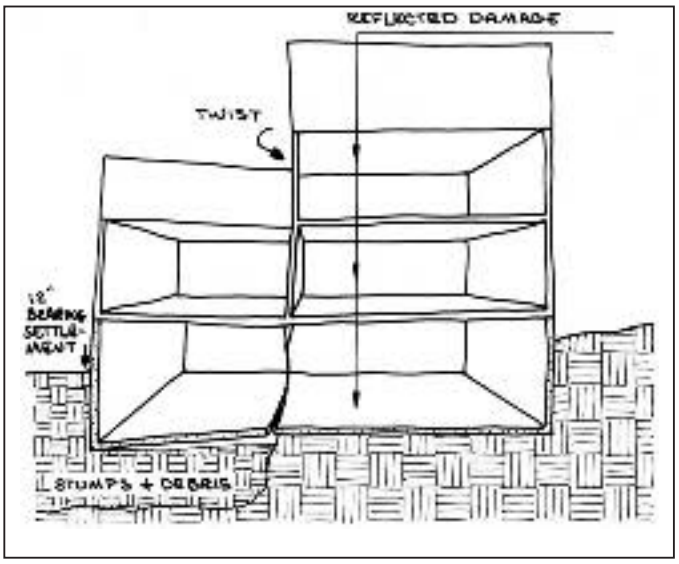

Figure 4. *Excavation revealed 3-foot sawn logs under the part of the house that dropped 12 inches. The owners adjusted the settling by sawing the legs of furniture and cooking in deeper pots.*

Figure 5. *After jacking, the house was cribbed and continuous footing poured. The vertical #4 rebar will be wired to corresponding rebar in the block wall.*

Figure 6. *A concrete-cored reinforced block wall was built with Darawell-steel lattice every other course for lateral reinforcement. After the wall was in place, the house was lowered; cribbing and jacks were removed.*

Thomas Florence is president of On the Level, Inc. His grandfather started his boys doing structural work in the early 1900's, and eight family members are now in Tom's company. He has worked in the construction business for 30 years.