FORCON INTERNATIONAL

THE CONSULTANTS PERSPECTIVE

A SUGAR PUBLICATION

SPRING 1995

FORCON INTERNATIONAL

Providing Forensic Consulting and Technical Services

SETTLEMENT - CAUSE AND EVALUATION

Cracking or movement of a building structure or foundation is a common cause of insurance claims. On such claims, the primary determination that must be made to resolve coverage is the cause of this structural damage. Settlement is often the cause. In many cases, the cracking pattern in a concrete or masonry structure can tell the experienced investigator whether the damage has resulted from settlement of the underlying soils. (See Identification of Cracks in Concrete and Masonry Walls by James H. Robinson, Jr., P.E. in FORCON Newsletter for Fall, 1992). There are occasions, however, where the apparent soil settlement may need further evaluation to determine if there was something other than the natural consolidation of the soil that may have contributed to the settlement.

The purpose of this article is to provide information on the various causes for settlement of soils, both natural and unnatural, and on what can be done to determine if the settlement was caused or accelerated by some other condition.

Causes of Settlement

Settlement of a structure supported on soil may be caused by two primary mechanisms.

1. Load-induced compression of the soil mass into a denser state by water being pushed out of the skeletal voids, or by the solid particles shifting into a tighter configuration, or
2. Non-load-dependent loss of solid particles by ravelling (erosion into openings, cavities), biochemical or chemical deterioration (organic decay), mass collapse (well, mine, cave, sewer), structural collapse (loss of bonding by thawing, saturation), or reorientation of solid particles by shock or vibration (blasting, machines).

Almost all structures supported by soil will settle somewhat because of the increased loads felt by the soil mass. Typically, a large percentage of the settlement due to a given increased loading will take place during or shortly after the application of that loading. Settlement may continue at a much reduced rate for several years. It is often this continuing settlement that ultimately reflects itself in the form of noticeable cracking of slabs or plaster, or jamming of doors or windows.

An un-insulated water line at an exterior wall of a residence may split from a freeze-thaw cycle and discharge considerable water into the subsurface. This water may cause erosion (carry soil away) and/or apply saturation loading to the soil mass, with resultant settlement. If a garage or interior slab was constructed on several feet of fill, settlement may have occurred prior to the broken water line event; voids may have existed below the slab, and the slab may have already exhibited cracking. The water line break may likely result in increased settlement and distress. Distinguishing between original progressive settlement of the fill and water line-break caused settlement may be very difficult.

In This Issue

A common cause of ground settlement in residential settings is from the burial of organic debris (stumps, tree limbs, etc.) in yard areas or below driveways. Two primary mechanisms will be at work, often causing large surface depressions. One is the movement of soil particles into the large open voids within the underlying buried debris. The other is the biochemical decay of the organics, leaving voids or much softer solids which collapse or compress from overburden loadings.

Settlement may also be caused by variations in subsurface soil moisture and changes in the water table. During extreme dry periods, soils may shrink; structural elements supported on such soil will settle. Alternating drying and wetting cycles may accentuate such settlement. Lowering of a water table below a building by natural or unnatural causes may cause settlement. Stresses of the soils below the original highest water table are increased because of the change from a buoyant state to a saturated state of loading. A lowering of the water table of 10 feet could be equivalent to the new loading produced by a 3 or 4 story building. Dewatering of a construction site of a new building may have dire consequences on an adjacent existing building.

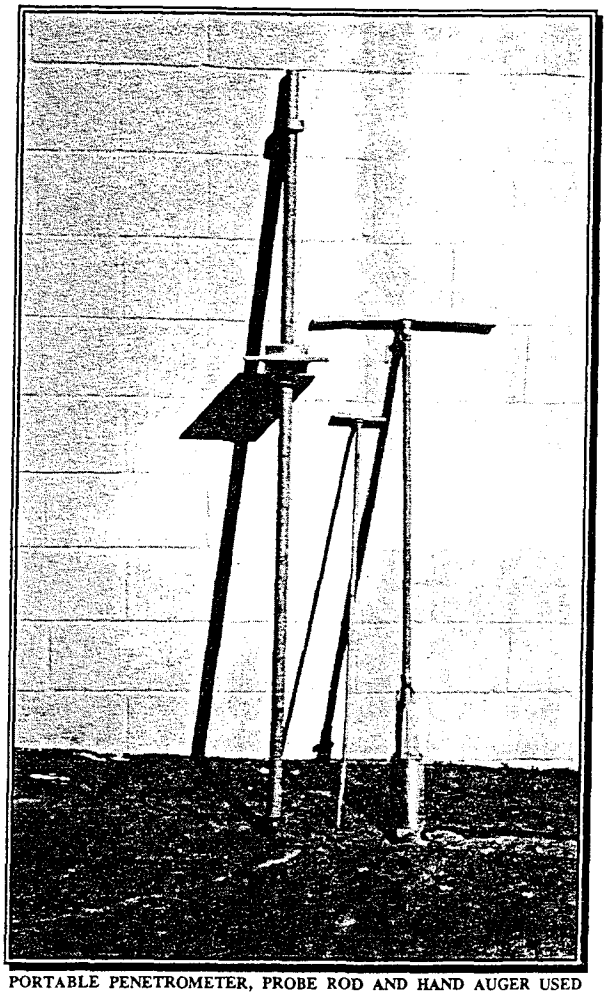
Evaluation of Settlement

Investigation and evaluation of residential or commercial/ industrial property damage claims, where settlement is one of the possible causes, have many things in common, but some differences. In common is the need for the investigator to determine if the problem condition relates to prior placement of fill. How was the site graded and what was and is the drainage condition? Evaluation of the cause of building distress and apparent settlement requires an understanding of the history of the site, the building, and of all prior and present indications of the problem condition.

For a residence, the additional investigation is often limited by access constraints. Landscaping, fences, steep grades, etc., often preclude using a drill rig or backhoe to investigate the subsurface. Primary investigative tools are a probe rod, a hand auger and a portable penetrometer. With such tools, a geotechnical (soils) engineer will attempt to define subsurface conditions and to evaluate the cause of the problem. Settlement may be determined to be causing the distress to the house. It may be difficult, however, to determine how much of the settlement took place because of one recent event and how much has been on-going due to other natural causes.

For a commercial or industrial building, the investigative approaches generally have more options available than for the residence. Many questions can be answered by knowledgeable personnel familiar with the site, design, construction, operation, and history of the problem. Drawings of various types and prior, and possibly new, subsurface data are often available. A key factor is whether the structure is supported by natural or fill soils. The type information helpful in determining this include:

1. An old typographic map showing the contour elevations at the site prior to construction of the present building. A "site civil" plan is part of most development-construction contracts and shows both the topo and proposed new grades. If not available, a U.S. Geological or air-photo topo plan may be secured and may be helpful.



PORTABLE PENETROMETER, PROBE ROD AND HAND AUGER USED TO INVESTIGATE SHALLOW SOIL CONDITIONS

2. Borings or back-hoe dug test pits may be made to explore the subsurface. A geotechnical engineer may use various tools and techniques to quantify the engineering characteristics of the subsurface. Laboratory tests and detailed calculations may be warranted.

3. The physical signs of distress should be inspected, and detailed measurements made and recorded, as appropriate. An experienced engineer may reach significant conclusions from the location, size, orientation and other appearance and relationships of the cracks, depressions, etc.

From evaluation of the above, the geotechnical engineer determines if the cause of surface settlement is due to settlement of fill due primarily to its own weight, or to the loading of the building, or to both. If neither seems the likely cause, other possibilities are postulated and evaluated.

Evaluation of specific claimed causes, such as blasting, water line break, high winds, etc., require detailed questioning to determine the conditions existing before and after the specific event. Often, a new "fresh" crack can be identified. The evaluation can then be tailored to confirm the greater likelihood of the cause of the fresh crack being the claimed event, rather than from other possible unrelated mechanisms.

Closing Comments

Most structures settle from a variety of predictable, well known mechanisms. Others may settle from unusual difficult to anticipate mechanisms.

When damage results from settlement which may have been caused by one of these unusual mechanisms, a qualified geotechnical engineer may be able to determine the specific cause. The success in doing so will depend upon the timeliness of the investigation following the claimed "event", and upon the ability to acquire data on the site/soils in question.

Stanley A. Schwartz, P.E.

ABOUT THE AUTHOR

FORCON consultant Stan Schwartz is a geotechnical engineer who has been involved in the design and construction of hundreds of projects during an engineering career which included having been Chief Geotechnical Engineer for Law Engineering Testing Company and Chief Geotechnical Engineer for Westinghouse Environmental and Geotechnical Services. Stan is a Registered Professional Engineer in six (6) states and is a member of numerous technical organizations including the Association of Drilled Shaft Contractors, Association of Soil and Foundation Engineers, and the Deep Foundation Institute. His expertise includes settlement, slope instability, wall distress, water retention structures, erosion problems, excavation related issues, pavement distress, and all aspects of fill problems. He can be contacted through our Atlanta office.

FORCON International Offices Providing Forensic Consulting and Technical Services:

Atlanta, GA	(404) 390-0980
Dallas, TX	(214) 436-3046
Gaithersburg, MD	(301) 670-1262
Houston, TX	(713) 820-7846
Morristown, NJ	(201) 326-8822
Nashville, IN	(812) 988-9850
Richmond, VA	(804) 285-7870
San Antonio, TX	(512) 366-8725
Tampa, FL	(813) 684-7686

If you have any change of address, please mail corrections to:

FORCON International Corporation

1216 Oakfield Drive
Brandon, FL 33511

ACCIDENT RECONSTRUCTION SEMINAR DRAWS HUGE RESPONSE

FORCON is sponsoring a half-day training course entitled "Accident Reconstruction - A Primer for the Insurance Claims Professional". As the title suggests, the course provides vehicular accident claims professionals with a broad introduction to the use of accident reconstruction in resolving claims or litigation associated with serious traffic accidents. Instructors for the course are FORCON accident reconstructionist Steve Chewning and attorney Ray Persons of the Arrington & Hollowell law firm in Atlanta. The Georgia Insurance Department has approved the course for 4.0 Continuing Education Credit Hours.

The original plan was to conduct the program as an afternoon session from 1:00 p.m. until 5:00 p.m. Advance registration for this session quickly consumed the 110 spaces available and a morning session has also been scheduled to accommodate the overflow crowd. Over 190 claims professionals have registered for the two sessions which are scheduled for Monday, March 20, 1995 at the Ramada Hotel, Dunwoody, Georgia.

New FORCON Office
Morristown, New Jersey

FORCON International is pleased to announce the opening of our New Jersey office. Located in Morristown, this new office will enable us to better serve the needs of our clients with claims in the New Jersey area.

The manager of FORCON's New Jersey office is Paul Sowa. Paul is a graduate of Dartmouth College where he received a B.A. in Engineering Sciences and a Bachelor of Mechanical Engineering from the Thayer School of Engineering at Dartmouth. He brings to FORCON over 28 years experience in consulting and business management which includes the project management, planning and scheduling of many major construction projects. Paul's consulting work also includes extensive contractual litigation support work for a variety of prominent law firms.

The New Jersey office has already been heavily involved in several assignments for FORCON surety clients in the Northeast. They have also assisted with the investigation of wind damage to amusement park rides in Atlantic City, and with the determination of the cause of damage to an underwater sewage outfall line during installation. You can reach our New Jersey office at (201) 326-8822.

" 1995 "
LIGHTNING SEASON BEGINS

The 1995 lightning season will soon be upon us. FORCON experts are available to assist with lightning claims involving the following:

1. Computer Hardware and Software Systems
2. Telephone Systems
3. Alarm and Security Systems
4. Satellite Receivers and Equipment
5. Commercial, Industrial and Residential HVAC Systems.
6. Underground Cable Systems
7. Electric Motor Equipment and Control Panels
8. Transformers, Switchgear and Other Heavy Electrical Equipment
9. Radio and T.V. Stations including Transmission and Reception Towers.

Once the Claim has been verified and documented as being the result of a lightning strike, FORCON is also capable of estimating the damage and assisting you with one or all of the following:

1. Inspecting, documenting and establishing an itemized cost of repair and/or replacement.
2. Reviewing service and repair invoices associated with the claim to determine if service, repair or replacement procedures and associated costs were justified and if replacement equipment was of like kind and quality.
3. Determining if repair or replacement costs were competitive with current market pricing.
4. Determining the value of salvage possibilities.

Let FORCON assist you by taking the uncertainty out of your lightning claims.

FORCON INTERNATIONAL CORP.

PRESENTS

THE CONSULTANTS PERSPECTIVE

IN THIS ISSUE ! - AN ARTICLE ON

SETTLEMENT - CAUSES AND EVALUATION

PLUS

A New FORCON Office - Morristown, New Jersey

PLUS

Accident Reconstruction Seminar

AND MORE !

FORCON INTERNATIONAL CORPORATION
1216 Oakfield Drive
Brandon, Florida 33511

BULK RATE
US POSTAGE
PAID
PERMIT No. 116
BRANDON, FL