THE MAGAZINE OF THE DEEP FOUNDATIONS INSTITUTE MAR/APR 2020

# DEEP FOUNDATIONS

## Active Soil Nail Wall Shores Up Historical Building

Bolivian Cable Car Micropiles

Reducing Excavation-Adjacent Risks

Micropiles Stabilize Factory Machines

Helical Pile-Foundation Load Tests

**Executive Director**
Theresa Engler
tengler@dfi.org

**Executive Editor**
Barbra Rodriguez
mageditor@dfi.org

**Managing Editor and Advertising Manager**
Karol Paltsios
magads@dfi.org

**Graphic Design**
Faye Klein

**Staff Photographer**
Herb Engler



COVER STORY





## Departments



**COVID-19 (Coronavirus) Update**
DFI is monitoring recommendations from the World Health Organization (WHO), the US Centers for Disease Control and Prevention (CDC), and health authorities of those countries where we have scheduled conferences and other activities. Check **www.dfi.org** and event-specific web pages for updates.

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326 Lafayette Avenue
Hawthorne, NJ 07506, USA
T: +1 (973) 423-4030 | F: +1 (973) 423-4031
Email: staff@dfi.org

## 87 Adjacent Structure Technical and Legal Risks

*Scott J. DiFiore, P.E., Gregory R. Meeder, James P. Chivilo and Matthew H. Johnson, P.E.*

Heavy civil construction in urban environments can damage existing, adjacent structures through ground movement and vibration. Owners of new construction projects and their team must be aware of legal and technical risks posed by excavation, dewatering and demolition to navigate and allocate those risks. This article discusses approaches to early and frequent communication among project participants that are necessary to manage risks, regardless of local regulations that may or may not exist to drive risk-related processes.

## 95 Micropiles to Improve Stability of Factory Machining Centers

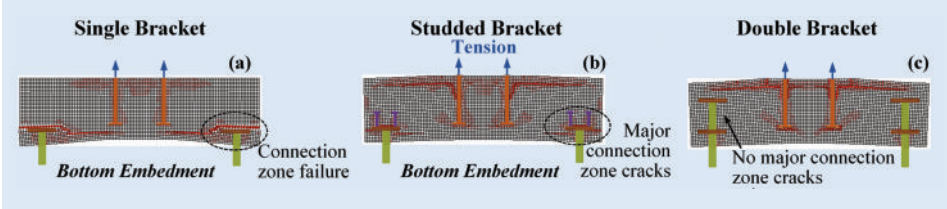
*Glenn Patterson*

Modern manufacturing facilities employ a quick production pace and precision machines that work with few interruptions. The large machining centers involved require an independent foundation that is free from vibrations of all other shop machinery and equipment. As a result, micropiles can improve installation of machinery due to their minimal impact on factory schedules, speed of installation, small footprint of installation equipment, and ability to create lasting, competent foundations for machinery.

## 103 Improving Helical Pile-to-Foundation Connections

*Serhan Guner, Ph.D., P.Eng., and Sundar Chiluwal*

Many structures are subjected to sequential applications of compression and tension loads due to events such as windstorms. Tall and light structures that are particularly vulnerable to the tensile components of cyclic loads can be developed with helical pile foundations as part of addressing this. DFI's Helical Pile and Tiebacks Committee funded a research study to help evaluate current helical pile designs and inform the development of more robust helical pile-to-foundation connections.



# Adjacent Structure Technical and Legal Risks

A tight urban excavation site

Excavation and heavy civil construction in urban environments directly impact abutters and existing adjacent structures. Noise and dust create nuisance concerns, while demolition, excavation and dewatering can cause earth movement and structural damage. Many jurisdictions have their own regulations that dictate requirements, roles and responsibilities for varying parties during construction. Illinois and Chicago, as an example, provide a legal framework for the owner of the new construction project to provide adequate protections for adjacent structures. This article covers legal and technical risks posed to adjacent structures that owners of new construction projects and their team must be aware of, such that the team is knowledgeable to navigate and allocate those risks. Early and frequent communication among project participants is necessary to manage risks, regardless of local regulations that may or may not exist to drive the process of developing a project.

## Threats to Adjacent Structures

There are many threats from new construction that can damage adjacent structures. Excavations and vibrations can be significant contributors to ground movement, resulting in structural damage to adjacent properties. Excavation and vibration-induced ground movements have received considerable attention in industry literature; as structural engineers and attorneys, we briefly re-introduce both areas of concern below.

Excavations can lead to a wide range of problems associated with abutters' property, particularly due to horizontal or vertical movement of the ground that is supporting existing foundations. Movements can result from a support of excavation with insufficient strength and stiffness, dewatering that lowers the water table, and/or direct undermining of adjacent structures. A zone of influence of excavation-induced ground movements can be large.

Vibrations can be caused by a wide range of construction activities including, but not limited to, heavy construction traffic, demolition, blasting, driven excavation-support elements or foundations, excavation or bored tunnels. Vibrations can cause soils to densify or liquefy, which in turn can damage fragile structures that bear upon these soils. Impacts of vibrations are most pronounced closest to the source and diminish with distance.

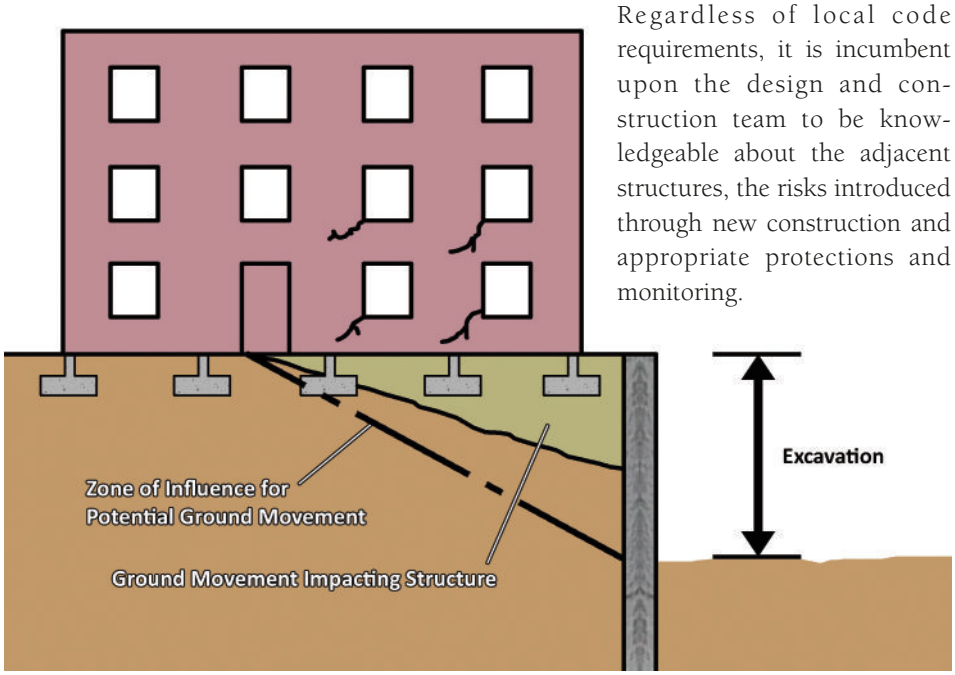
## Proper Project Set Up

The success of a new construction project is based upon a project team's proactive planning and communication. Leaving responsibility to a single party leads to a reactive response to issues, impacts schedules, adds costs and frequently results in claims.

The owner and design team are best positioned to identify excavation extents and anticipated vibrations and ground deformations based on construction

AUTHORS *Scott J. DiFiore, P.E., Simpson Gumpertz & Heger, Gregory R. Meeder, Holland & Knight, James P. Chivilo, Holland & Knight, and Matthew H. Johnson, P.E., Simpson Gumpertz & Heger*

approaches. Evaluations are commonly performed during the design phase to document the existing structural systems and conditions of the adjacent structure. This information can be shared with the abutters and the construction teams bidding the project. Communication during the design phase allows all parties to be educated on important issues, and appropriate limitations can be addressed in the project specifications to establish roles and responsibilities.




**Typical abutter excavation influence zone**

While the construction team may ultimately be responsible for the means, methods and sequences of construction, the owner/design team needs to provide guidance through either performance or prescriptive specifications. Geotechnical reports are typically issued before developing bid/construction documents, and well-crafted ones will identify construction considerations associated with vibration-inducing activities or support-of-excavation systems. The design team can use the information to develop an instrumentation program that defines acceptable thresholds for various parameters, including groundwater levels, ground vibrations, movement of existing structures and movement of the support-of-excavation system. The design team can also establish limitations on construction means, methods and sequences, and provide processes for addressing construction-phase modifications upon reaching threshold values of instrumentation. With little effort, the design team can utilize common empirical relationships to predict ground movements of excavation-support systems and understand associated risks to adjacent structures.

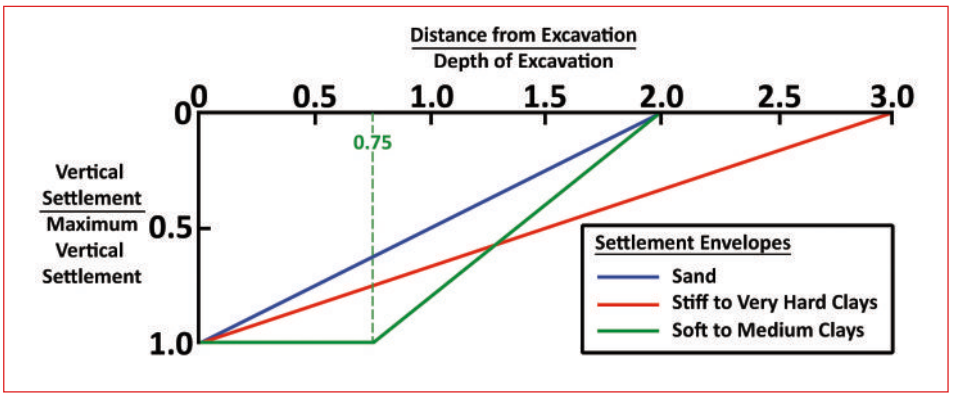
Not all jurisdictions have established requirements for considering adjacent construction projects, and the risk for damage to adjacent structures can be highest in the absence of such guidance. Regardless of local code requirements, it is incumbent upon the design and construction team to be knowledgeable about the adjacent structures, the risks introduced through new construction and appropriate protections and monitoring.

## Understanding Risk Allocation

There are significant risks associated with urban excavations under state or city code requirements and due to risk allocation clauses contained in procurement contracts for design professionals and contractors.

Excavations carry design and construction obligations under the law and under contract clauses. Different cities, states or jurisdictions manage property damage risk allocation differently for new construction owners and abutters. It is necessary to examine excavation risks under the law in the project's jurisdiction before performing design and construction in dense metropolitan areas. The following questions require attention to identify risk, while the answers help reduce risk:

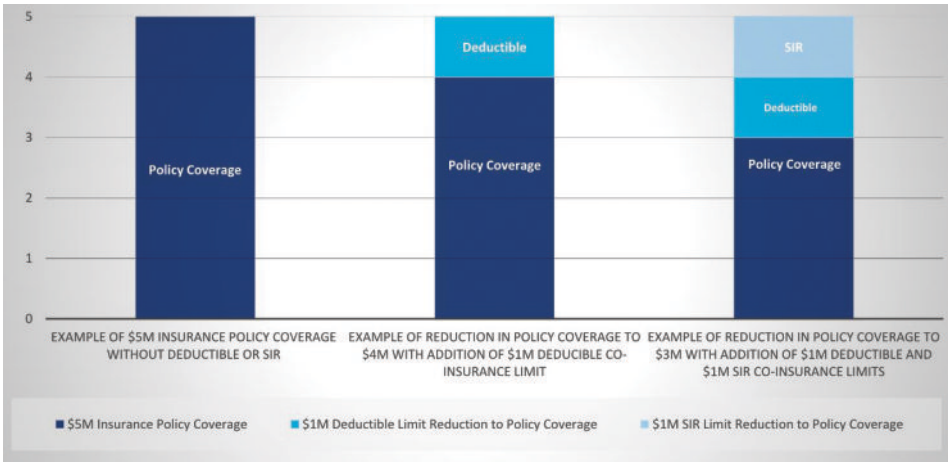
- Does the state or local government unit have a statute or ordinance for risk allocation for new construction and property damage to abutters?
- Has the new construction owner assigned the risk of protection to the design professional, the contractor or no one?
- What are the contractual or statutory deliverables required from design professionals and contractors with respect to the protection of abutters' property?
- Is a contractor aware of what the design professional has done, and what deliverables might be available, with respect to protecting adjacent structures?
- What indemnifications have the design professional and/or contractor given to the new construction owner or third parties with respect to damage?
- Is the new construction owner's, professional engineer's or contractor's deductibles or self-insured retention under applicable insurance policies so large that it renders insurance coverage meaningless?




**Soil empirical ground settlement envelopes** *(adapted from G.W. Clough and T. D. O'Rourke, June 1990 conference proceedings)*

- What notice to abutters needs to be provided (and by whom) for new construction projects, so that the abutters can review the intended design or construction?
- How is a defect determined to be a design defect or a construction defect when multiple tiers of contractors and design consultants are involved in executing large metropolitan projects?

Excavations in dense metropolitan areas carry significant legal and monetary risks. Given the nature of high-density construction and excavations in metropolitan areas, these risks can result in high-profile and newsworthy events.




**Coverage reduction with deductible and coinsurance**

## Illinois Example Laws

***Adjacent Landowner Excavation Protection Act (ALEPA).*** In 1957, Illinois joined several other states in providing abutters to construction projects with legally protected lateral and subjacent support from adjoining land. Through this law, contractors and design professionals can be liable for failure to meet (1) published legal regulations and (2) related provisions in their procurement contracts.

Under the Adjacent Landowner Excavation Protection Act (ALEPA), Chapter 765 of the Illinois Compiled Statutes (ILCS) Section 140, rights are conferred upon abutters to adjacent construction projects, and duties are placed upon owners of new construction projects to make proper excavations. In nearly all cases, new construction owners do their best in contract procurement documents to pass this obligation to their contractors, subcontractors, architects, engineers and service providers. This usually includes standard contractual indemnification clauses that require the contractor and design professionals of the new construction to defend and indemnify the owner for claims, which would include any legal liability under ALEPA.

ALEPA requires new construction owners or possessors of land intending to excavate to give "due and reasonable notice in writing to abutters stating: (1) the depth to which the excavation is intended to be made and (2) when the excavation will begin." (See 765 ILCS 140/1(1)).

If the excavation is at a depth greater than 8 ft (2.4 m) below the established grade of the street (or, if there is no established grade, below the surface of the abutters' land), and if it appears that the excavation is to be of a greater depth than the walls or foundations of any abutters' building or other structure and is to be so close as to endanger the abutters' building or structure, then abutter shall be allowed a reasonable time (not less than 30 days) to take measures to protect the abutters' land, building and structures from damage or to extend the foundations, and for that purpose, the abutter must be given a license to enter onto the land on which the excavation is to be or is being made. (See 765 ILCS 140/1(1), (4)).

If provided a license by the abutter, the new construction owner shall protect the abutter's land and any building or other structure from damage by reason of the excavation without cost to the abutter, by furnishing lateral and subjacent support.

| | Risk Spectrum → | | | |
|---|---|---|---|---|
| | **High** Ignorance and No Communication | | | **Low** Strong Project Understanding and Communication |
| **Communication with Neighbors - Methods** | None | Letters | Meetings | Description and Quantification of Anticipated Behavior |
| **Building Construction - Source of Knowledge** | None | Visual Walk-Throughs | Openings through Finishes or Test Pits | As-Built Drawings |
| **Subsurface Conditions - Source of Knowledge** | None | Conditions at Nearby Properties | Historical Records | Site Subsurface Explorations |
| **Pre-Construction Conditions of Adjacent Building - Documentation** | None | Photos of Obvious Visible Exterior Distress | | Photos of Exterior and Interior within Zone of Influence - and Quantification of Distress |
| **Predicting Impacts to Adjacent Structures - Methods** | None | Empirical Correlations | | Finite Element Analyses |
| **Instrumentation and Monitoring - Extent** | None | Survey, Vibration, and/or Groundwater Data, at Both Construction Site and Adjacent Property | Data Comparison with Response Values that Allow Work to Respond to Issues as They Develop | Share Data with Neighbor for Awareness |

**Range of project risk management approaches**

This law provides that the new construction owner shall be liable to the abutter for any damage to the land, buildings or any other structures, including liability to occupants and tenants. (See765 ILCS 140/1 (2), (5), (6)).

The language of this statute expands damages to more than just repairs for abutters' property damages, but also to business losses and economic-related expenses of adjoining building occupants and tenants.

***Chicago Regulations.*** The City of Chicago (the City) has its own excavation regulations that create additional requirements. These regulations contain further requirements for notice, bracing and liability when compared to the state law of ALEPA. (See Chicago Municipal Code §13-124-380 and the following).

The City regulations include requirements for 30 day's advance notice of excavation to "neighboring properties" and local government officials, §13-124-390; bracing of neighboring structures within 5 ft (1.5 m) of the excavation, §13-124-400; fencing in certain circumstances, §13-124-411; and in addition, there are provisions dictating that certain insurance coverage is required to be procured by contractors and new construction owners, §13-124-420.

Unlike ALEPA, the City regulations allow declaration of liability upon not only new construction owners but their contractors as well. As a result, both owners and contractors can be declared jointly liable for "any damage, death, or injury caused by sagging, settling, cracking or collapsing of the public way or of the foundation or walls of a structure located within 5 ft (1.5 m) of the excavation, due to absent or insufficient reinforcement or bracing or due to any other act or omission in the performance of such excavation." (See §13-124-410). This would include costs of salvage, relocation, temporary housing and costs incurred by the City. Additionally, violators are subject to penalties, fines and potentially criminal liability. (See §13-124-440).

## Insurance Protections

Understanding insurance requirements and available insurance programs is important before engaging in an excavation project. A self-insured retention (SIR) is an amount that must be paid by an insured before the insurance company will allow its

**Recording steps of adjacent structure distress**

*Recording step crack at bottom of masonry veneer*

*Crack width measurement at stone masonry retaining wall*

*Sloping floor measurement*

policy coverage to satisfy third-party claims. An SIR is a form of coinsurance commonly used in the construction industry to offset premium costs. A policy deductible further offsets the stated limit of insurance. These offsets transfer indemnity directly to an insured and reduce insurance coverage limits. In such cases, the insured must pay for claims, legal fees and damages before insurance takes effect under the policy. Contractors should be aware of these coinsurance limits because they can apply per claim. For example, in the case of a large deductible and/or SIR limit, combined with an event involving multiple parties and claims, these financial insurance risk-transferring terms could eliminate insurance coverage and pass all financial risk directly to the design team.

One should also be aware of the insurance policy provisions. Standard insurance policy terms are typically changed by *endorsements* that may eliminate coverage one might expect is usually available through insurance. For example, some insurers endorse general liability policies to eliminate coverage for property damage caused by earth subsidence or movement. When a contractor plans to perform underground or foundation work, it is particularly important to specify that coverage for earth subsidence and movement is included in the policy terms.

Attention should also be made to Explosion, Collapse or Underground (XCU) coverage. This coverage is usually modified by insurance carriers. Many carriers eliminate this coverage through endorsements, resulting in the exclusion of insurance coverage for explosion, collapse or underground risks (known as *XCU risks*). If those risks are implicated in a project, it is good practice to specify with insurers, through contractual terms and with the design team, that XCU endorsements eliminating coverage will not be allowed.

## Promoting Project Success

There is a spectrum of approaches to protecting abutters' structures and mitigating the potential for damage and delay. The project team for the new construction is in the best position to establish criteria and expectations for the work. Indifference and ignorance create the potential for high risk. Conversely, knowledge and communication enhance awareness, and allow for proactive protections for existing adjacent structures.

Even small steps can help improve knowledge, awareness and the ability to navigate risks. For example, simple photos or measurements to document preconstruction conditions create an inexpensive baseline to understand whether changes have occurred during the construction process. This puts the project team in a much stronger position if the abutter claims that its structure was damaged due to construction activity.

Staying on the low-risk side of the risk spectrum puts all parties in a better position to understand and mitigate risks, identify problems and collaborate to make corrections as the work proceeds. This collaborative and informed approach can effectively mitigate damage, associated costs and delays, and potential litigation.

## Conclusion

Construction professionals and risk managers need to be aware of the threats associated with construction projects, particularly with excavation projects adjacent to existing structures in urban environments. In Chicago, for example, liability for owners, contractors and engineers exists based upon state and local city laws, ordinances and regulations. These risks are passed on by new construction owners to contractors and construction professionals through procurement documents. Lack of understanding by the project/construction team and lack of communication with abutters can result in third-party damages, increases in project costs and costly repairs that also cause delays. In certain cases, these costs can become extravagant if they cannot be passed on to insurers. Best practices for a successful project include understanding and planning for the technical, legal and insurance risks, engaging and educating abutters prior to and during construction, and monitoring construction to allow for appropriate course correction as issues arise.

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*Scott J. DiFiore, P.E., a principal at Simpson Gumpertz & Heger, has 25 years of experience in structural and geotechnical engineering. DiFiore evaluates complex problems related to below-grade construction and soil-structure interaction, including underpinning systems, excavation-support systems, deep and shallow foundations, buried utilities and other underground structures.*

*Gregory R. Meeder, a partner of Holland & Knight, is a nationally recognized construction attorney who handles civil trial matters in state and federal courts on a local and national basis, proceedings before governmental and administrative agencies, and arbitration and mediation proceedings. Meeder is also the firm's Midwest regional construction practice group leader.*

*James P. Chivilo, a partner at Holland & Knight, concentrates his practice on construction law, mechanic lien law, premise liability, general tort defense, insurance law and general commercial litigation matters. Chivilo represents many client types, including owners, developers, contractors, suppliers, and governmental entities involving claim administration, project management, complex litigation and dispute resolution.*

*Matthew H. Johnson, P.E., a principal at Simpson Gumpertz & Heger, is the structural engineering division head for its Chicago office, leading a diverse team that designs, investigates and rehabilitates buildings and infrastructure, structurally complex building enclosures and non-traditional structures. These include complex concrete formwork, structural steel construction and temporary structures.*

**Deep Foundations Institute**
326 Lafayette Avenue
Hawthorne, NJ 07506 USA
Phone: +1 (973) 423-4030
Fax: +1 (973) 423-4031

*Berm prepared for novel soil nail wall installation at historical Stevens Institute of Technology building in New Jersey*