ENR New York

How Safe Is Your Sidewalk Vault?

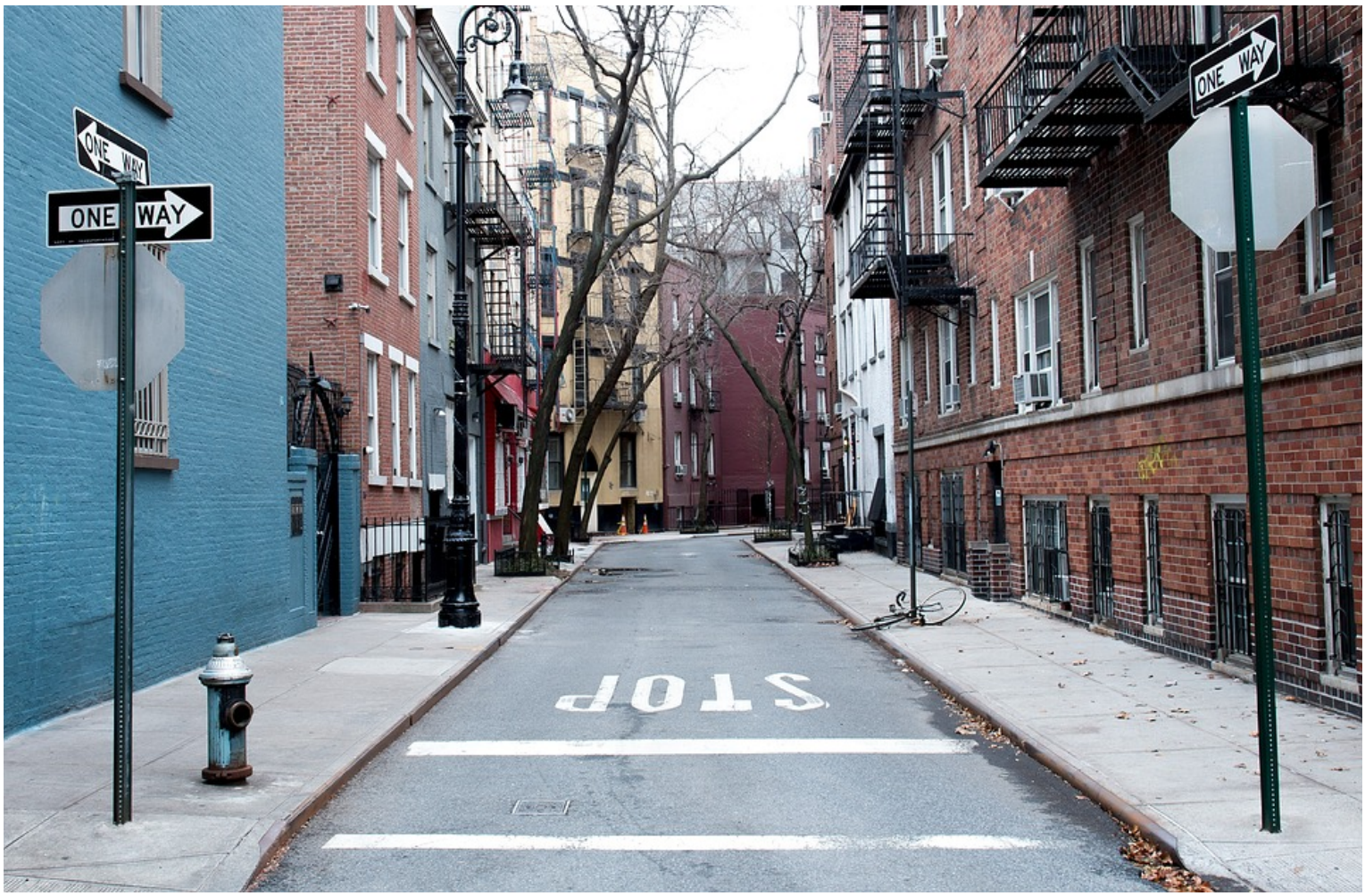

Photo Courtesy of Pixabay.

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Most people ambling along city sidewalks don't realize that what they're walking on is not solid ground, but likely the roof of an underground vault. Like all building components, below-grade spaces require periodic maintenance to resist the ravages of time and the elements. Sidewalk vaults tend to be used as mechanical rooms or storage space, so they garner less attention than those parts of the building people actually see. Moreover, much of the deterioration may

not be visually evident, since it is often concealed behind masonry or fireproofing that appears intact. Neglecting the space below city sidewalks can spell disaster for building owners and the public should the structure collapse. In overcrowded cities, sidewalk vaults are also valuable real estate that is often overlooked.

Why Do Vaults Exist?

Extending the building basement beneath the city-owned sidewalk, creating a "vault," was common in many metropolitan areas during the late 19th century and the first half of the 20th century. Vaults permitted delivery, particularly of coal, and access to utilities without disturbing building operations. As the use of coal phased out, many building owners elected to stop using the vaults, and the maintenance of vaults was forgotten.

Common Problems with Sidewalk Vaults

Heavily salted in winter and exposed to weather, sidewalk vaults tend to exhibit extensive water infiltration, which often results in significant damage to the vault's structural framing. The resulting corrosion of structural steel and deterioration of masonry arches compromises the vault's bearing capacity, which can result in the types of sudden collapses that have recently made headlines.

In historic areas where streets are narrow, such as SoHo in New York City, delivery vehicles commonly park on the sidewalk, placing excessive loading onto vaults. Even intact vaults as originally constructed may not meet today's load requirements.

Invisible Damage

With steel beams and columns concealed within masonry, concrete, or fireproofing, it can be easy to miss even advanced deterioration of vault structural framing. Until the surface material is removed, it may be difficult to distinguish between a stable structure and one that has been compromised.

As deicing compounds migrate from the sidewalk surface into the vault, degradation of steel beams and girders diminishes the structural integrity of the system, priming the structure for potential collapse. Since much of the damage may be invisible from the surface, periodic evaluation and maintenance may entail isolated removals to expose embedded structural elements.

Sidewalk Violations

Most cities require property owners to maintain sidewalks adjacent to their buildings, at their own expense. Building owners can be held liable for personal injuries that result from sidewalk failures. If a property owner receives a violation for a defective sidewalk and does not remedy the problem, the Department of Transportation or other local authority may perform the work and then bill the property owner later.

Investigation of Sidewalk Vault Conditions

An architect or engineer typically begins an investigation with an initial visual observation, above and below street level, to evaluate general conditions and identify sites for further testing. Photographs of problem areas document existing materials and can be helpful in locating sources of water infiltration. The design professional will also review existing building drawings, if available.

Since most structural elements are concealed within masonry or concrete, invasive probes are essential to uncover concealed deterioration, particularly of structural steel, and to determine whether a waterproofing membrane is present and, if so, its condition.

To determine the load capacity of the vault and evaluate structural integrity, the design professional performs tests and analysis that assess the ability of the structure to provide the requisite support. Often, evaluation of severe deterioration finds that corrosion of beams is so advanced that the vault can scarcely support itself, let alone the applied load of pedestrian or, worse, vehicular traffic. In such cases, the risk of imminent collapse demands prompt remedial action.

Codes, Standards, and Review Boards

Before determining a sidewalk vault rehabilitation strategy, the design team must consider applicable codes for street/sidewalk loads. Sidewalk vaults are subject to an overlapping tangle of regulatory authorities, including the Department of Buildings, the Department of Transportation (not only are these city sidewalks, but their rehabilitation often requires street lane closures), and, if the property is a landmark or part of a historic district, the local authority having jurisdiction over historic buildings. For cities with subways, the transit authority may impose additional requirements.

Rehabilitation Solutions for Sidewalk Vaults

Severely compromised structural elements must be replaced, and those building materials that are salvageable usually need some degree of restoration and repair. The exterior envelope, including the sidewalk and foundation walls, demands integration of water infiltration protection to promote the longevity of below-grade elements.

Finishes and Waterproofing

Remediation of water-related vault deterioration typically involves removal and replacement of sidewalk finishes and waterproofing. For newer sidewalks, the wearing surface, usually concrete, may be replaced, but historic construction often demands the temporary removal and reinstallation of existing stone pavement. In some historic districts, notably SoHo in New York, massive granite sidewalk slabs typically bear directly on the structural steel of the vault, a structurally deficient condition that makes rehabilitation a challenge. Other historic construction includes cinder concrete slabs with draped wire mesh, or concrete slabs with glass inserts (vault lights).

Waterproofing should extend beyond the sidewalk to the face of the building foundation wall to a reasonable depth (depending on existing conditions) on the street side. A typical waterproofing assembly might consist of multi-ply modified bitumen membrane on a new concrete structural slab, with a drainage

mat and wearing surface.

If the vault is intended to be habitable, insulation must be incorporated in the assembly. Considering that modern sidewalks are subject to occasional vehicular traffic from delivery trucks and emergency vehicles, insulation installed directly below the wearing surface must be designed with an appropriate compressive strength.

Typically, a small section of the roadway must be removed for proper installation of waterproofing and potential replacement of structural framing. Deteriorated setting beds, pavers, and curbs must be replaced. For concrete wearing surfaces, control joints and expansion joints are required to allow for shrinkage and thermal movement, and to prevent cracking and heaving of the sidewalk. For granite pavers, a watertight expansion joint system is likewise required.

Within the vault, portions of walls, ceilings, and floors damaged by water must be repaired. If the investigation traced the source of water infiltration to the foundation wall, crack injection or negative side waterproofing may be recommended, considering that access on the positive side (outside the vault) can be problematic. Where spray fireproofing has been used, asbestos-containing materials may be present, requiring remediation.

Structural Rehabilitation

Deterioration that has not compromised the structural integrity of beams, columns, and building piers may be addressed through repair of the original materials. Depending on the existing construction and the load capacity requirements dictated by code, supplemental structural support may be necessary.

Many city sidewalk vaults dating from the turn of the last century were constructed of masonry arches and vaults, often of clay brick. Over time, as structural steel embedded in the masonry began to corrode in the presence of moisture, the oxidized steel expanded, exerting pressure on the surrounding brick and causing it to crack and spall. To treat the damage, masonry must be removed to access and treat corroded steel. The expansive force of the rusting structural steel may have damaged some areas of masonry beyond repair, necessitating replacement.

Replacement of Compromised Structural Systems

In addition to the deterioration of structural framing, the structural deck may have sustained enough damage to merit replacement. Even if intact, the deck may need to be reinforced to meet current codes. In some cases, installation of a new structural deck may be required to provide adequate support, given the rigors of modern traffic loads. Rehabilitation affords the opportunity to assess anticipated loads and augment load-bearing elements in accordance with code requirements.

Usage Considerations

Continuous operation and access to the building are key considerations. For both weather protection and security, a temporary sidewalk enclosure typically is erected, with access to building entrances, elevators, emergency exits, and building standpipes.

Sidewalk vault repairs often require both footpath and traffic lane closures, and the owner must provide a five-foot pedestrian walkway throughout the construction period. Maintaining continuous operation can be a challenge in the tight quarters of narrow historic streets, where traffic may already be limited.

Your Vault, Your Responsibility

While sidewalk vault rehabilitation is not glamorous, having your property wind up on the front page under a sensational headline about collapse and injury could be devastating. While there may be no obvious outward signs of deterioration, even a seemingly intact vault could be in jeopardy. Years of persistent water infiltration can lead to hazardous deterioration of structural members and pose a danger to public safety. Sidewalk vault collapses make headlines in part because many people are shocked to discover that the solid ground they traverse every day is in fact not solid at all.

AUTHORS

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