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Concrete Slab Penetration Infill

Introduction

Concrete slab penetration infill is the process of restoring and repairing penetrations in concrete slabs that were initially made to accommodate mechanical, electrical, plumbing (MEP), or structural systems. These penetrations may be left unused after layout changes, system removal, or design revisions. Once they are no longer needed, it is essential to properly infill these penetrations to restore structural integrity, ensure safety, and maintain the appearance and functionality of the floor. Poorly executed or neglected infills can result in uneven surfaces, shrinkage zones, or depressions that create tripping hazards. A professional, code-compliant infill ensures a flush, durable surface that meets design standards and building code requirements.

Benefits of Proper Infill

Proper infill offers several key advantages. Structurally, it restores the slab's original load-bearing capacity. Open or poorly filled penetrations can become points of stress concentration, leading to cracking, deflection, or long-term degradation. For this reason, ACI 318 Section 7.2.1 requires designers to evaluate the effect of slab penetrations on flexural and shear strength. When penetrations are present, they create potential new critical sections. The presence of concentrated loads near penetrations can also cause a one-way slab to behave like a two-way slab. A well-executed infill prevents these issues and ensures floor durability.

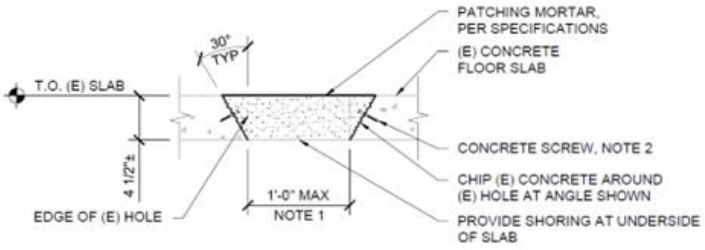
Fire safety is another critical consideration. In many buildings, concrete slabs serve as fire-rated horizontal assemblies. Unsealed or improperly filled penetrations compromise this fire separation, allowing smoke and flames to spread between floors during a fire event. For this reason, NFPA 101 Section 8.3.5.1 mandates that penetrations through fire-rated barriers be properly protected by tested firestop systems. ASTM E814 provides a standardized test method to evaluate such firestop systems.

Adequate infill improves thermal and acoustic performance. In multi-story or mixed-use buildings, unsealed penetrations can become pathways for heat transfer and noise transmission. Using appropriate infill materials enhances energy efficiency and occupant comfort.

Adequate infill also prevents water infiltration through the slab, which can otherwise lead to corrosion of embedded reinforcement and mold formation. Both conditions accelerate structural deterioration and pose potential health risks.

Infill Strategies

One common effective method for infill involves chipping the concrete around the penetration to form a reverse cone shape, where the top diameter is greater than the bottom. This geometry prevents the hardened infill from being pushed out under load. Additionally, installing at least four concrete screws with 1-1/4" embedment into the existing slab and a 1/2" projection into the infill area improves mechanical bonding. Screws shall be placed opposite each other along two perpendicular directions for optimal anchoring. The infill material shall consist of a non-shrink grout with a minimum compressive strength at least 1.5 times greater than that of the surrounding concrete to be repaired (see Figure A for reference).



NOTES:
1. DETAIL IS APPLICABLE FOR A MAXIMUM EXISTING OPENING SIZE OF 12" SQUARE OR 12" Ø ROUND.
2. (4) 3/16" Ø CONCRETE SCREWS WITH 1-1/4" EMBEDMENT, AND 1/2" PROTRUSION, LOCATED OPPOSITE EACH OTHER IN THE TWO PERPENDICULAR DIRECTIONS.

Figure A: Common infill construction detail

Conclusion

Concrete slab penetration infill is a critical process for maintaining structural strength, life safety, and the functional quality of building floors. Selecting the right materials and methods based on slab type, penetration size, load requirements, and fire-rating ensures long-term success. The Division of Technical Resources at NIH has developed several reliable infill details that can be referenced by design professionals at their discretion. Early coordination with design professionals helps ensure penetrations are properly restored, reducing future risks and ensuring a safe, code-compliant, and durable building environment.

Additional Reading

1. ACI 318 Section 7.2.1- Building Code Requirements for Structural Concrete
2. NFPA 101 Section 8.3.5.1 - Life Safety Code (for firestop requirements)
3. ASTM E814 - Standard for Firestopping