WHAT ARE THOSE OTHER 31 CHAPTERS OF THE BUILDING CODE FOR?

BY DAVID JACOBY AND BRIAN KUHN

There are many different types and conditions of concrete repairs in the industry and lots of guidance on the topic by various organizations. When designing a repair, the engineer will likely consult with Chapter 16 of some edition of the International Building Code (IBC), which provides the structural requirements (including loads) for a building in which the repair is occurring. The engineer may also peruse Chapters 17, 19, and 21 to identify whether there are any special inspection requirements and specific material requirements for concrete and masonry. So what are those other chapters of the building code for?

You may think that other requirements are someone else's problem; and your issue is only the concrete repair. However, there are many repair projects that are led by structural engineers or contractors that do not have an architect or a complete design team to address the rest of the building code. Without an architect, it is incumbent on the party submitting for a permit to ensure that all local codes and requirements are met related to the scope of work. In this article, we provide a brief overview of the other chapters in the IBC and the International Existing Building Code (IEBC) so that you can be more informed on other requirements that may be triggered by concrete repair work.

THE BUILDING CODE

Some form of the IBC is enforced in most jurisdictions within the United States. By way of a very brief history lesson, the right to regulate construction is a state power, not a federal power, and therefore the United States does not have a national building code like some of our neighbors around the globe. As such, each state is responsible for developing and enforcing regulations for the built environment. Over time, larger cities also developed their own building codes mostly to address the fact that when there is a fire, it tends to burn down large swaths of the city at once (such as the Great London fire, the New York fire of 1835, the Chicago fire of 1871, and the post-earthquake fire of San Francisco in 1906). Over time, these requirements were expanded to address issues that were revealed by other deadly events. Today, the International Code Council (ICC), promulgator of the IBC, and the National Fire Protection Association (NFPA) regularly update their model codes and standards (generally on a 3-year cycle) to keep the codes current with the state-of-the-art and newer building practices.

For a model code to become legally enforceable, it must be adopted by a jurisdiction. Just because there is a newer edition of the IBC published does not necessarily mean that this edition is legally enforceable in a jurisdiction. Different jurisdictions enforce different versions of the IBC. Because different versions of the IBC have different requirements, it is very important that when you are trying to determine what impact your repair project may have on a building, you look at the locally adopted code and not necessarily the "most recent edition."

Key Point: *The most current edition of a code is not necessarily the correct code!*

So what does this have to do with your concrete repair? Well, concrete repairs may trigger other compliance issues within the building code, especially items related to fire and life safety (remember, fire and life safety drove the development of the building codes and standards, and therefore are central to the documents).

THOSE OTHER CHAPTERS

The IBC is broken down into 35 chapters, which is generally consistent across the country. Even in areas that amend the code, the format allows you to identify where the information you are looking for is located (for example, Chapter 16 is always structural requirements). What are the other chapters that someone who is doing a concrete repair should be concerned with?

Chapter 1 is the administration chapter of the code, and it tends to be heavily modified in all jurisdictions. Items of particular importance in Chapter 1 for a concrete repair are requirements for when a repair may require a permit to be filed.

Different jurisdictions use different trigger points, but as a general rule of thumb, if your repair is affecting the ability of the structure to support its intended load, you are likely going to need to file a permit. The New York City Building Code (NYCBC) requires a permit for any cutting, removal, or change to the fire rating or load-bearing components of the structure. The NYCBC makes a fairly broad statement that anything that affects the health, structural or fire safety of the building, or safe operation of equipment requires a permit. In the Rules of the City of New York, 1-RCNY 101-14 provides more clarity in a table that identifies specific "minor works" and whether they will require a permit. Among them is concrete crack repair with injection of repair cement, which would not require a permit. However, repair of reinforcing bars, post-tensioning tendons, curtain wall panels, and precast concrete will require a permit. Similarly, repair of cracked or spalled concrete on exterior spandrel beams, concrete fascia, or balconies will also require a permit (refer to Fig. 1).

Key Point: *Not all repairs require permits, but verify the permit requirements in Chapter 1 of the applicable code.*

Chapter 2 contains definitions for keywords, or at least a reference to where in the code the definition can be found (as of the 2012 edition of the IBC, all definitions are found in Chapter 2 and are no longer found in individual chapters). As an example, the definition of Repair ("the reconstruction or renewal of any part of an existing building for the purpose of its maintenance") is found in Chapter 2. Although not directly applicable to a concrete repair, Chapter 3 provides occupancy classifications. It may be important to know the occupancy of the building in which you are performing repairs due to some of the unintended consequences of the repair (discussed later). Permits may also have a field where the occupancy classification of the building is required to be input. Chapter 4 contains special occupancy requirements. In particular, this Chapter has requirements for high-rise buildings, areas that have hazardous materials, parking garages, and hospitals that may be affected by your repair. As an example, hazardous areas with liquids may require a liquid-tight repair to be performed to contain the materials in the space.

Chapters 5, 6, and 7 provide the requirements for where and how much fire rating is required for structure and fire separation assemblies (walls and floors). For a concrete repair, these requirements may very well come into play. Although many engineers use "repair to match existing," it is important to understand what was required at the time of construction to properly match existing. Especially with older building stock, the materials

Table 3
Façade Work that may be Exempt from Permit in All Buildings

	Exterior Facade Restoration Item (all buildings)	Permit required?
I. Masonry (not including Terra Cotta and Stone)	**1.** Brick re-pointing (or other unit masonry).	NO
	2. Removal and replacement of individual bricks - single outside wythe up to 10 sf., not to exceed 4 ft. horizontally, in any 100 sf. of wall area, and the cumulative area of all brick replacement on all facades does not exceed 150 sq. ft.	NO
	3. Mechanical anchorage (pinning) of brick masonry to underlying structure.	YES
	4. Parapet demolition and reconstruction.	YES
	5. Increasing height of an existing parapet.	YES
	6. Installation of new parapet coping (masonry).	NO
	7. Installation of new parapet guardrail.	YES
	8. Replacement of existing guardrail or parapet to the same height (for masonry parapets, replacement of existing parapet limited to 10 sq. ft. in any 100 sq. ft. of continuous parapet vertical surface area.	NO
	9. Installation of expansion or control joints in existing masonry construction (entailing saw-cutting of masonry).	YES
	10. Installation of flashing and weeps, repair or replacement of relieving angles (or lintels), installation of new brickwork, exceeding limits noted in #2 above.	YES
	11. Flashing: cutting in reglet, removing one or two courses of brick from a single wythe on inside face of parapets, exceeding limits noted in #2 above.	YES
	12. Masonry crack repair with injection of repair mortar.	NO
	13. Masonry cladding of existing exterior building walls.	YES
	14. Replacement of masonry sills.	NO

Fig. 1: Permit requirements for exterior façade restoration (Table attributed to the NYC Building Code)

used may no longer be readily available and engineers must ask themselves if there are other solutions that can be used to maintain the fire rating of the structure or floor. For example, one popular current repair option is fiber-reinforced wraps. These products generally consist of fiber (carbon fiber or other) and a resin to adhere the fibers together and to the concrete to strengthen the element being repaired/reinforced. While the fiber material may indeed be noncombustible, the resins that hold it together are not and may start to soften or lose adhesion at elevated temperatures. Several studies investigating the fire-related performance of fiber reinforcement have concluded that while the wraps can enhance the performance of the concrete, the strength of the substrate material alone must be sufficient to carry the loads under fire-related loadings. Additional studies are being conducted to determine if fire-resistant material (insulation) can protect the wraps for the duration required by the code.

If your concrete repair is within a fire-rated separation or fire-rated exterior wall, the repair may affect other fire rating-related requirements. In addition to maintaining the fire rating of the wall in question, the joints and penetrations of the wall may need to be addressed (refer to Fig. 2).

Fig. 2: Repairs must maintain required fire ratings

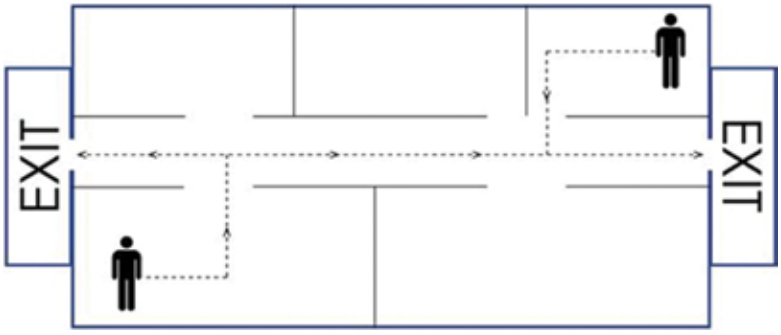

Fig. 3: Can two means of egress be maintained during a repair? If not, the work may require a phased approach

Where walls have joints or meet with floor slabs, fire-rated joint assemblies need to be provided. This is especially important where differential movement of the wall section or wall to floor joint is expected. Joint assemblies need to be specified that not only maintain the fire rating but also address any movement expected in the joint and are compatible with the materials used to make the wall.

Key Point: *Many repairs require the maintenance of a fire-rated assembly and need to consider the effects of fire on the repair material.*

Chapter 8 addresses interior finish and, generally, a concrete repair is not going to be affected by this chapter, except if you are tasked with replacing a finish over the repaired area. This chapter provides classifications for materials and where different classes are allowed in a building. Chapter 9 contains requirements for fire protection systems, including sprinkler systems, standpipes, fire alarm systems, and smoke control. Some issues with concrete repairs related to these requirements involve embedding conduit, pipes, or wires. Generally, unless the fire-rated assembly was tested with such items embedded within, then they should not be embedded.

Chapter 10 provides requirements for egress, occupant loading, egress width, size of doors, stairs, and arrangement of exits leading through to the outside. A typical floor repair could impact egress paths while the repair is underway. If the facility is occupied while the repairs are occurring (which is common), access to the exits has to be maintained or other appropriate means need to be taken. What could seem like a "simple" floor repair may end up requiring a multi-phase egress plan being developed and implemented to keep the facility operational (refer to Fig. 3). Repairs must also maintain any slopes or flat surfaces required. A flat landing is required on both sides of doors, except at exterior doors where a 0.25 unit vertical in 12 units horizontal (2% slope) is allowed. Ramps should not exceed a slope of 1 in 8 (12%) or have a cross slope greater than 1 in 48 (2%).

Chapter 11 provides accessibility requirements. Repairs need to maintain accessibility across surfaces. Joints between a repair and the original material cannot create tripping hazards, and any elevation change greater than 0.25 in. (6 mm) should be beveled and cannot be greater than 0.5 in. (13 mm). Repair of large floor areas have to maintain slopes and cross slopes required by this chapter and as detailed in Chapter 10. Chapter 11 also provides requirements for accessible parking spots. A large garage repair could result in restriping of the garage. This could

trigger the need to provide additional or alternate accessible parking, including van-accessible spots. A repair to steps in front of a government building (refer to Fig. 4) exceeded trigger points based on the value of the building. This concrete repair resulted in accessible upgrades being triggered throughout the building, including upgrades to the fire alarm system, elevators, and accessible entrances.

Key Point: *Concrete repairs can have impacts on requirements for accessibility upgrades.*

Chapter 12 addresses the interior environment. Repairs to courts need to maintain drainage from the area. Conversely, repairs to bathing and shower rooms must be smooth, hard, and nonabsorbent. Chapter 13 addresses energy efficiency, Chapter 14 addresses exterior walls, and Chapter 15 addresses rooftop assemblies and structures. Repairs to exterior walls may invoke compliance with NFPA 285, a fire testing requirement for exterior walls with flammable components (such as claddings and insulation). Repairs on rooftop structures may need to address additional wind loads and may cause re-roofing, which could result in upgrades to the roof to address energy requirements (that is, additional insulation, which could affect the height of parapets and guards).

Key Point: *Roof and exterior wall repairs may require additional work and testing.*

Chapter 16 provides the base structural requirements that a repair must provide and Chapter 17 specifies structural tests and special inspections. These two chapters are generally familiar to engineers. Chapters 18 to 26 address specific materials that may be used in construction including masonry, as identified at the beginning of this article. Chapters 27 to 30 address electrical, mechanical, plumbing, and elevators/conveyors, respectively. These chapters generally refer you to an appropriate code or standard addressing those specific topics. Chapter 31 addresses special construction including membrane structures, temporary structures, pedestrian walkways, awnings/canopies, signs, swimming pools, and solar photovoltaic panels. Repairs to pool decks can result in requirements for providing new gates or barriers (refer to Fig. 5).

Chapter 32 addresses encroachments beyond property lines above and below grade. Pay attention to this chapter if your repair is near the property line.

Key Point: *Pay attention to repairs near the property line*.

Chapter 33 covers safety during construction and certainly needs to be addressed during concrete repairs. Construction barriers may be needed to separate the repair from the occupied area depending on the amount of work being done. Protection of pedestrians (sidewalk sheds) may be necessary as well protection of adjacent properties. As discussed in Chapter 10, this chapter requires egress to be maintained during construction.

Chapter 34 addresses existing buildings. It is important to note, as of the 2015 edition of the IBC, this chapter has been removed and reference is made to the IEBC. Many jurisdictions that have adopted the IEBC have also removed Chapter 34 and make direct reference to the IEBC. The NYCBC also removed Chapter 34 but does not adopt the IEBC. The NYCBC, through the administrative code (referenced in Chapter 1), allows

Fig. 4: Step repair at government building

Fig. 5: Repair to pool decks can result in requirements for providing new gates or barriers (Photo attributed to A-Comfence Pty Ltd)

repairs to buildings built under a prior code to use the requirements of the previous code.

The last chapter of the IBC, Chapter 35, provides the other standards and guidelines referenced throughout all chapters and include the American Concrete Institute (ACI), American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Fire Protection Association (NFPA), and others.

SUMMARY

Often, you may be called upon to provide a "simple" concrete repair. Having a basic understanding of the building code can help you identify when other requirements may be triggered or how various approaches to the repair may prevent unintended consequences. Including an architect or code consultant on your team can also go a long way toward ensuring code compliance.

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