The Code Corner

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Applying the Building Code during Design

A Step-by-Step Process

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"Quality is never an accident; it is always the result of intelligent effort."

John Ruskin, author and critic of art and architecture

Nobody likes to redo work that he or she has already completed. However, time and again, some design professionals seem satisfied to let the building department review their designs and then make any corrections that are noted. This may work well for very small projects, where the impact of a correction has minimal effect on the overall design. Large, complex projects, on the other hand, will likely suffer delays and significant changes if code compliance errors are left for the building department to find. For example, if the design professional for a multistory building miscalculated the occupant load on the low side for a restaurant on the top story, the error might require widening of stairs, or worse, the addition of another stair.

Checking or inspecting work after completion is referred to as *quality control*, or QC. For construction, the Construction Specifications Institute (CSI) defines *quality control* as the "procedures for evaluating completed activities and elements of the design for conformance with the requirements." Although some design firms use the local building department to perform the QC review, other design firms may have internal reviews conducted at the end of document production either by in-house staff or third-party peer reviewers to perform the QC review. However, relying only on QC to ensure a quality project is neither efficient nor cost effective—regardless of who performs the review.

To minimize errors at the completion of construction documents, design firms need to implement *quality assurance*, or QA, in their design process. CSI defines *quality assurance* as the "procedures for guarding against defects and deficiencies before and during the execution of the work." In other words, it involves taking measures along the way to ensure that errors are eliminated, or at least minimized, by the time construction documents are completed. Reviewing the building code and understanding how it will apply to a project is a step that must be taken as early as possible in the design process.

The application of the building code in a design QA process is different than the application of the building code in a plan review QC process. The plan review QC process compares the completed design documents to the requirements of the building code—any inconsistency will result in a comment back to the design professional. As a QA process, however, there is no design to compare with the building code. Therefore, the building code becomes a "road map" to compliance, and as such, there are various paths to get from point A to point B. The best path selected becomes the design team's *code compliance strategy*. Like the use of a road map for travel, the planned path for code compliance is not always the path actually taken—changes may be necessary as the design develops and more detail is added.

The Step-by-Step Process

The step-by-step process described below provides the designer with a logical sequence and timing for implementing code compliance during the design of the project. The process is divided into the three phases that the American Institute of Architects (AIA) has established for typical design projects:

schematic design, design development, and construction documents. If under contract to provide programming services, some of the early steps for the schematic design may be accomplished at the programming stage. This process is only a suggestion, and some steps may start earlier if the design team elects to do so.

Please note that each step described below is not comprehensive; each step may include multiple sub-steps, which requires a basic understanding of the applicable code requirements. Where available, a link is provided to another *Code Corner* article that will provide some detailed information on all or a portion of the step's topic.*

Schematic Design

Step 1: *DETERMINE THE APPLICABLE BUILDING CODE*. Many jurisdictions do not adopt the building code that is currently published, and many also publish amendments to the adopted code to cover local conditions and policies. Using the actual building code that will be used for plan review during the design process is critical.

Step 2: *OBTAIN ESSENTIAL BUILDING DATA*. Gathering basic information about the project, such as building area and height, will affect the application of the building code. Also, making basic decisions early in the process, such as whether a sprinkler system will be provided and the type of structural materials proposed, will factor in later steps. (See *The Code Corner* No. 18)

Step 3: *DETERMINE BUILDING'S OCCUPANCY GROUP OR GROUPS*. Based on the owner's programming requirements, a determination of the building's primary occupancy group can be made. If individual spaces are listed in the program, it could be established if the building will be a mixed occupancy. (See *The Code Corner* No. 14)

Step 4: *DETERMINE CONSTRUCTION TYPE BASED ON ANTICIPATED CONSTRUCTION MATERIALS*. If the building is constructed on wood-framed bearing walls, then the only option is Type V construction. However, if the construction is noncombustible, then the design team has several alternatives for construction type, depending on the level of fire-resistance the team is willing to incorporate into the design. (See *The Code Corner* No. 15)

Step 5: *DETERMINE HOW MIXED USES AND OCCUPANCIES WILL BE HANDLED*. If multiple occupancy groups are identified in Step 3, then an initial decision needs to be made whether they will be treated as accessory, separated, or nonseparated occupancies, or a combination of these three. (See *The Code Corner* No. 14)

Step 6: *DETERMINE IF ANY SPECIAL USE AND OCCUPANCY REQUIREMENTS WILL APPLY*. Some projects may have features or uses that are not covered by the general requirements of the building code. In the *International Building Code* (IBC), Chapter 4 covers these unique circumstances, such as stages and platforms, atria, high rises, parking garages, etc. The design team should review this chapter to determine if any of these requirements apply to the project. (See *The Code Corner* Nos. 13 and 30)

Step 7: *DETERMINE ALLOWABLE AREA AND HEIGHT*. Based on construction type (Step 4), occupancy group or groups (Step 3), and the method selected for mixed occupancies, if applicable, (Step 5), determine the allowable area. Apply any increases for sprinkler system and frontage (if the

building has not been situated on the site, determine what the expected increase could be; this can be adjusted later if necessary). If actual area exceeds allowable, a change in construction type, the use of a sprinkler system (if not already considered), or the introduction of a fire wall into the design should be considered. (See *The Code Corner* Nos. 16 and 17)

Step 8: *CALCULATE OCCUPANT LOAD*. Based on preliminary floor areas, determine occupant loads for each floor level using occupant load factors in IBC Chapter 10. (See *The Code Corner* No. 22)

Step 9: *ESTABLISH POINTS OF EXIT*. Using the occupant loads calculated in Step 8, determine the number of required exits for each floor level according to IBC Table 1021.1. Only one exit may be required if conditions comply with Section 1021.2. If more than one exit is required, ensure that at least two of the exits are separated in accordance with Section 1015.2. (See *The Code Corner* No. 22)

Step 10: *CHECK EGRESS PATHWAYS FOR TRAVEL DISTANCE, COMMON PATH OF EGRESS TRAVEL, DEAD-END CORRIDORS, AND ACCESSIBLE ROUTES AND EGRESS*. Look at every pathway from each space to each exit to see if at least one path is less than the maximum travel distance required by IBC Section 1016. Verify that every path does not have a common path that exceeds the maximum distances in IBC Section 1014.3. If corridors are provided, verify that none have dead ends that are longer than the maximums in IBC Section 1018.4. (See *The Code Corner* No. 29)

Step 11: *DETERMINE FIXTURE COUNTS*. Using the occupant load calculated in Step 8, determine the number of plumbing fixtures according to the requirements of IBC Chapter 29. (See *The Code Corner* No. 33)

Step 12: *IDENTIFY FIRE DEPARTMENT ACCESS ROADS*. During this phase of design, the project should have a preliminary site plan to determine if sufficient access is provided for the fire department. Fire access roads complying with Section 503 of the *International Fire Code* (IFC) may be necessary to ensure all sides of a building are within reach of firefighting capabilities.

Design Development

Step 13: *CONFIRM STEPS 2 THROUGH 12*. During the review of schematic design documents, changes may have been suggested that require reevaluation before design development proceeds.

Step 14: *IDENTIFY LOCATIONS OF FIRE-RESISTIVE ASSEMBLIES AND OPENINGS*. Based on construction type, allowable area, separation of occupancies, means of egress components, and other special code requirements, determine where fire-resistive construction is required and which openings require protection complying with IBC Chapter 7. (See *The Code Corner* Nos. 2, 19, 34, and 35)

Step 15: *DEVELOP EXTERIOR WALL ASSEMBLIES*. During this design phase, exterior wall assemblies are designed and evaluated, including the selection of materials. Based on construction type and fire separation distance, exterior walls and openings may require some level of fire-resistive protection in accordance with IBC Chapter 7. Additionally, energy efficiency in accordance with the *International Energy Conservation Code* (IECC) and water resistance of exterior walls per IBC Chapter 14 are also a concern. (See *The Code Corner* No. 26)

Step 16: *DEVELOP ROOF ASSEMBLIES*. Similar to exterior walls, roof assemblies are also designed and evaluated during the design development phase to comply with IBC Chapter 15. Roofing materials are analyzed for applicability and performance, and like other building materials, roofing needs to comply with the requirements of the building code. (See *The Code Corner* No. 6)

Step 17: *SELECT FINISHES*. Interior finishes for floors, walls, and ceilings need to comply with several requirements, including fire and smoke performance characteristics of IBC Chapter 8 and sanitation requirements of IBC Chapter 12. Floor finishes also need to address slip resistance as required by ANSI A117.1 and ADA Standards. Although specific materials and colors may not be selected at this stage, minimum performance requirements should be at least identified at this point based on the use of each space. (See *The Code Corner* No. 4)

Step 18: *CHECK EGRESS WIDTHS*. Using occupant loads calculated in Step 8, exit points determined in Step 9, and means of egress paths determined in Step 10, establish the minimum widths of egress components. (See *The Code Corner* No. 22)

Step 19: *CHECK ACCESSIBILITY REQUIREMENTS*. There are many factors associated with accessibility in the building code, and many of these directly affect building layout and floor area. IBC Chapter 10 needs to be reviewed for accessible means of egress, and ANSI A117.1 and the ADA standards need to be reviewed for accessible routes and clearances, among many other requirements.

Step 20: *INTEGRATE SPECIAL REQUIREMENTS*. As identified in Step 6, requirements associated with the unique elements of the project need to be considered in greater detail. Such requirements include seating layouts for assembly occupancies, construction related to stages and platforms, smoke control for atria, sound transmission for residential occupancies, energy efficiency for exterior envelope components, flood-resistant elements for projects in flood plains, and provisions specific for high rise buildings. (See *The Code Corner* Nos. 11, 12, 13, and 30)

Construction Documents

Step 21: *CONFIRM STEPS 2 THROUGH 20*. During the review of design development documents, changes may have been suggested that require reevaluation before starting the construction documents phase.

Step 22: *INTEGRATE EGRESS DETAILS*. Since means of egress is important, drawings and specifications need to address specific requirements of the egress system, such as door swings, door hardware, riser and tread dimensions, luminous markings, and design of handrails and guards.

Step 23: *IDENTIFY LOCATIONS OF SAFETY GLAZING*. This is an area where there is some difference of opinion. Some think that the glazing installer should know where safety glazing is required as long as the specifications indicate that safety glazing be provided where required by code. Others believe that the drawings should explicitly show where safety glazing is required, which is required by some jurisdictions. See IBC Section 2406 for safety glazing requirements.

Step 24: *DETAIL FIRESTOPPING AND FIRE-RESISTANT JOINTS*. If fire-resistive construction and assemblies are used on the project, the construction documents need to address how joints and penetrations

in these building elements are handled per IBC Sections 713 and 714. Policy varies between jurisdictions, but some jurisdictions only require approved systems be identified on the documents, while others require the full content of approved systems be shown on the drawings. (See *The Code Corner* No. 23)

Step 25: *LOCATE PORTABLE FIRE EXTINGUISHERS AND CABINETS*. Fire extinguishers are often overlooked until either the last minute or during construction. Unless a sprinkler system with quick response sprinklers is installed, fire extinguishers are required in most occupancy groups per IBC Section 906. (See *The Code Corner* No. 32)

Step 26: *DETAIL CONSTRUCTION BASED ON SPECIFIC BUILDING MATERIALS AND EQUIPMENT*. This is a broad step that covers a multitude of sub-steps—each with a varying degree of applicability depending on project requirements. Drawings and specifications need to address specific material and construction requirements in the code, such as those for concrete, masonry, steel, wood, plaster, gypsum board, plastics, and elevators.

Step 27: *PREPARE CODE INFORMATION SHEETS*. This step may be started at any time that information is available; however, this is the last step that needs to be performed in order to have a complete set of submittal documents for the building department. The code information sheets provide all the essential code-related information in a single location in the set of drawings. It allows the plans examiner to confirm compliance without having to conduct an extensive and time consuming review of the drawings.

As John Ruskin's quote emphasizes, achieving quality in a building project is a deliberate process that must be implemented by the design team at the earliest possible phase of the project. Although quality in building design implies more than just complying with building code requirements, it is the safeguarding of "public health, safety and general welfare"—the intent of building codes—that is directly tied to the design professional's license to practice. Therefore, design professionals should incorporate into office practice a quality assurance process that covers building code-related issues.

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* References to the *International Codes* used in this article are for the 2009 editions. However, *The Code Corner* articles referenced may be based on older editions of the *International Codes*. It is suggested that the reader compare information in past articles to the current code editions used in this article.