HE 2016

[1] AISC (2016). *Specification for Structural Steel Buildings*, ANSI/AISC 360-16, American Institute of Steel Construction, Chicago, Illinois.

[2] American Society of Civil Engineers (2010). *Minimum Design Loads for Buildings and Other Structures*, ASCE 7-10, American Society of Civil Engineers, Reston, Virginia.

[3] Fisher, J.W. and Pugh, C.W. (2007). "Technical Digest 3: Structural Design of Steel Joist Roofs to Resist Ponding Loads," Steel Joist Institute, Myrtle Beach, South Carolina.

[4] Leyendecker, E. V. and Ellingwood, B. R. (1977). "Design

Providing minimum tensile strength for connections and splices improves the continuity and ductility in the structure and reduces the chance of its failure when subjected to unanticipated tension loads caused by extraordinary events such as failure of an adjacent structural member, impact loads on columns, etc.

There is signi cant ongoing research, and as the results become available, future editions of the *Speci cation* may incorporate the newer ndings. Currently, there is an effort to con rm what type of connections can carry the tie forces while undergoing rotations of 0.2 rad (11.3°) and the UFC 4-023-03 now requires that tie forces go through the oor and roof system.

The Section B3.9 provisions are in addition to the general structural integrity design requirements for re conditions that were stated in the 2010 AISC *Speci cation*, Appendix 4, Section 4.2.4.1, and now appear in the 2016 AISC *Speci cation* Appendix 4, Section 4a. These provisions include requirements: to provide adequate strength and deformation capacity when subjected to re within the prescribed limits of deformation; for the structural system to sustain local damage and remain stable as a whole; and for providing a continuous load path to transfer all forces to the nal point of resistance.

E

Presently, different codes contain provisions that relate to steel construction and address structural integrity. The AISC *Speci cation* was developed with knowledge of this prior work. Following is a summary of some of the integrity provisions found in two prominent building codes:

A 7. 10. Section 1.4 in ASCE 7-10 provides general structural integrity provisions including continuous load path, load combinations with notional loads for integrity checks, minimum lateral forces and connections to supports. Section 2.5 provides load combinations to be used for checking the structure for extraordinary events.

B (B). New York's code has similar, but in some cases more stringent, structural integrity provisions for steel structures compared to the new provisions in the 2016 AISC *Speci cation*. These provisions are stated in Section BC 2212:

a) Required minimum nominal tensile strength for column splice is equal to the largest design gravity load reaction applied to the column at any oor level located within four oors below the splice (Section 28.2-2212.2.1).

b) Required minimum nominal tensile strength for beam and girder end connections is the available vertical shear strength of the connection at either end, but not less than 10 kips. Shear force and axial tensile force need not act simultaneously for the connection design (Section 28.2-2212.2).
c) Required minimum nominal tensile strength for elements bracing compression members is 2% of the required compressive strength of the member being braced, but not less than 10 kips. Shear force and axial tensile force need not act simultaneously for the connection design. Where more than one element braces a compression member at a point in one direction, each element and connection should have a minimum available tensile strength equal to 1% of the required compressive strength of the member being braced, but not less than 10 kips (Section 28.2-2212.2).

According to NYCBC Section BC 2212, the only exemption from providing the abovementioned tie-force capacity requirements are one-story structures less than 5,000 sq. ft and not exceeding 15 ft in height, and structures in occupancy group category $R = 3$ (which are one- and two-family dwellings, as de ned in Section 28.2-310.1.3) not more than three stories in height.

In addition, some minimum requirements for bolted connections and composite slab construction are provided in the same section.

NYCBC also provides additional structural integrity provisions including prescriptive requirements for speci c cases of vehicular impact and gas explosions in Section BC 1615 as well as key element analysis for the buildings that qualify for this analysis as stated in Section BC 1616.

AC F

Section B3 of the *Speci cation* has been reorganized to provide a consistent framework for introducing charging language and design requirements for the *Speci cation*. If water is impounded on a roof, design for ponding must be considered regardless of the roof slope. Also, additional provisions related to structural integrity have been included as a result of recent efforts by AISC to take steps towards reducing the possibility of disproportionate collapse with minimal additional cost to the project. As more research results become available, these structural integrity provisions may be developed further to more effectively control the risks associated with disproportionate