

## 6.9 Recommendations

It is difficult to draw conclusions and more detailed study is required to understand how the collapse was halted. As better descriptions of the structural details become available, the observed patterns of damage may provide useful information in the calibration of numerical simulation tools. Some issues requiring further study are:

1. Whether the observed damage in the column flange, and not at the beam flange, of the moment frames top connection plates is due to high restraint in the welds.
2. Why the bottom flange welded connection has typically failed at the fillet weld to beam interface and not at the fillet weld to seat plate interface.
3. The impact response of various moment-connected details.
4. Whether composite construction would reduce local collapse zones. (There were no shear connectors to provide composite action between the floor beams and slab. Composite construction would have increased the capacity of the members and may have dissipated more of the impact energy; however, it may have also pulled a greater extent of the adjoining regions into the collapse zone.)
5. Whether perimeter rebar in the slabs could improve the structural response by providing catenary action and tensile force resistance in the slabs to reduce local collapse zones.
6. Whether the partial-strength connections permitted members to break away from the structure, thereby limiting the extent of damage. (If the moment connections had been designed for the capacity of the sections [as opposed to fully rigid partial strength based on design load and stiffness requirements], the building performance is likely to have been different.)
7. Whether the collapse zone would have been limited if the spandrels on the 16th, 17th, and 18th floors had not been so grossly distorted through twisting.

## 6.10 References

Guy Nordenson and Associates and Simpson, Gumpertz, and Heger, Inc. 2001. *Draft Structural Engineering Evaluation for the New York Department of Design and Construction (DDC)*. Prepared for LZA Technology. October.

Rudderman, James, Office of. 1971–1975. “Bankers Trust Plaza.” Structural Drawings. New York, NY.

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