



*Figure 4-17
Buckled beam flange and column on the 8th floor
of WTC 5 that was weakened by fire.*

beam stub cantilevers that formed diagonal tension field mechanisms in the cantilever webs and plastic moments at the column, as seen in Figure 4-18.

It is apparent that fire weakened the steel, contributing to the large shear-induced deformations observed in several of the cantilever beams. The shear failures observed at connection ends in several of the beam web samples shown in Figure 4-18 are indicative of the tensile forces that developed. The end bearing resistance of the beam web was found to be less than the double shear strength of the high-strength bolts, based on the analysis presented in Appendix B.

Steel framing connection samples were recovered from floors 6, 7, and 8 of WTC 5 with the aid of the New York Department of Design and Construction (DDC) and are described in Figure 4-22. These samples have not been analyzed and are being preserved for future study. The photographs of connection samples in Figure 4-22 indicate that the deformed structure subjected the bolted shear connection to a large tensile force. At 550 °C (1,022 °F), the ultimate resistance of the three bolts is about 45 kips. The capacity increases to approximately 90 kips at room temperature. Connection failure likely occurred between these bounds.