



*Figure 4-19*  
*Internal collapsed area in WTC 5.*

The structural redundancy provided by the exterior wall pipe columns helped to support the cantilevered floors. This was important because it kept the cantilevers from buckling near the columns as might be expected.

The limited structural collapse in WTC 5 due to fire impact as described in Section 4.3.2 appeared to be caused by a combination of excessive shear loads and tensile forces acting on the simple shear connections of the infill beams. The existence of high shear loads was evident in many of the column tree beam stub cantilevers that formed diagonal tension field failure mechanisms in the cantilever webs, as seen in Figure 4-19.

The end bearing resistance of the beam web was less than the double shear strength of the high-strength bolts. An increased edge distance might have prevented this collapse by increasing the connections' tensile strength. The failure most likely began on the 8th floor and progressed downward, because the 9th floor did not collapse. The 4th floor and those below remained intact.

The 7th floor framing was shop-coated. In some locations, the paint appeared to be in good condition and not discolored by the fire. Paint usually blisters and chars when heated to temperatures of about 100 °C (212 °F). This indicates that the fire protection material remained on the steel during the early phase of the fire and may have fallen off relatively later in the fire as the beams twisted, deflected, and buckled. Additional measures for proper adhesion may be required when applying spray-on fire protection to painted steel.