

plane stiffness of the adjoining slab that was not included in the model. The west edge of the slab in the model was parallel to the W33x130 girder and was extended approximately 8 in. beyond the edge of the girder flange, to allow for contact between the girder and the slab to be maintained even if the girder were pushed laterally due to thermal expansion of the beams.

To avoid dynamic effects, the gravity loading was ramped up smoothly over a period of 1 s, as shown in Figure 8–24. Ramping of the temperatures for the beams and the girder then commenced at 1.1 s, as shown in Figure 8–25, leveling off at temperatures of 600 °C for the beams and 500 °C for the girder at 2.6 s. These temperature histories were prescribed uniformly for all nodes of the beams and the girder, respectively. The material model for the steel beams and girders incorporated temperature dependence in the stress-strain behavior and accounted for thermal expansion. No thermal expansion or material degradation was considered for the slab, as the slab was not heated in this analysis.

The predicted response of the system is summarized in Table 8–2. The first failures observed were of the shear studs, which were produced by axial expansion of the floor beams, and which began to occur at fairly low beam temperature of 103 °C. Axial expansion of the girder then led to shear failure of the bolts at the connection to Column 79; and, at a girder temperature of 164 °C, all four erection bolts had failed, leaving that end of the girder essentially unrestrained against rotation. Continued axial expansion of the floor beams pushed the girder laterally at Column 79, as shown in Figure 8–26, in which failed shear studs and bolts were evident. When the beam temperatures had reached 300 °C, all but three shear studs in the model had failed due to axial expansion of the beams, leaving the top flanges of the beams essentially unrestrained laterally. Continued axial expansion of the girder caused it to bear against the face of Column 79, generating large axial forces that led to failure of the bolts connecting the girder to Column 44. When the girder temperature had reached 398 °C, all four erection bolts at Column 44 had

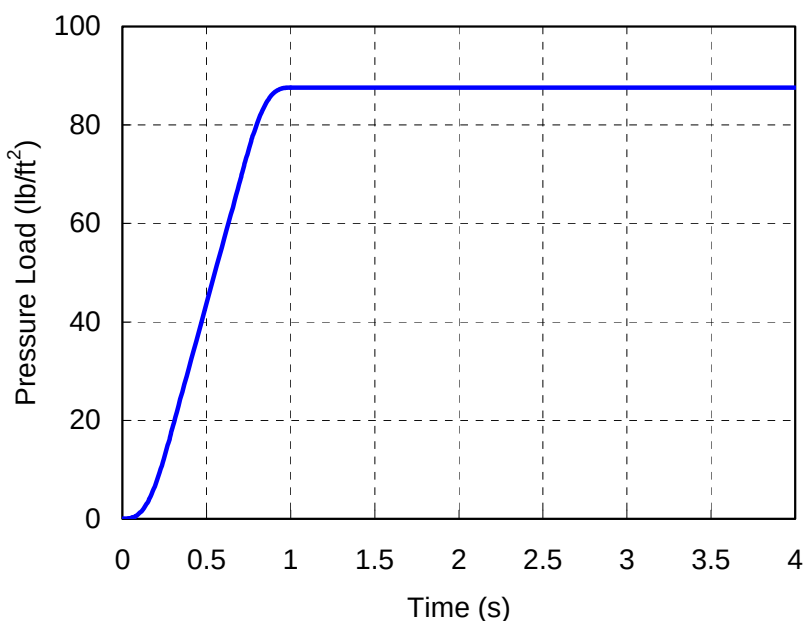


Figure 8–24. Time history of gravity loading, applied as a downward pressure on the concrete slab and metal deck.