Tsunamis pose a significant threat to coastal communities and infrastructure throughout the world. In many cases horizontal evacuation is not possible due to the potential local source of the tsunami or the number of people to be evacuated. It is essential that selected existing buildings, or new emergency centers, be evaluated or designed for vertical evacuation. However, there has been a lack of research on the effect of tsunami waves on coastal infrastructure such as buildings, bridges, and harbor facilities. Furthermore, design guidelines are lacking. To overcome this deficiency, this research has developed the methodology and tools for implementation of site-specific Performance Based Tsunami Engineering (PBTE) for use in the analysis, evaluation, design and retrofit of coastal structures. The technical focus of the work is the simulation of tsunami inundation of coastal communities, development of structural loading for application in design of constructed facilities, and simulation of the effects of sediment transport and scour. Significant outcomes include: PBTE methodology; refined and validated simulation tools; and building code compatible guidelines for tsunami-resistant structural design, including performance level specifications.